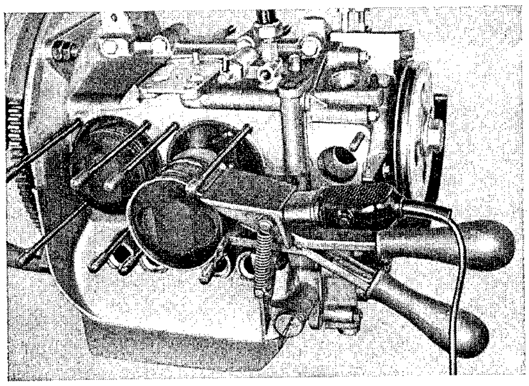
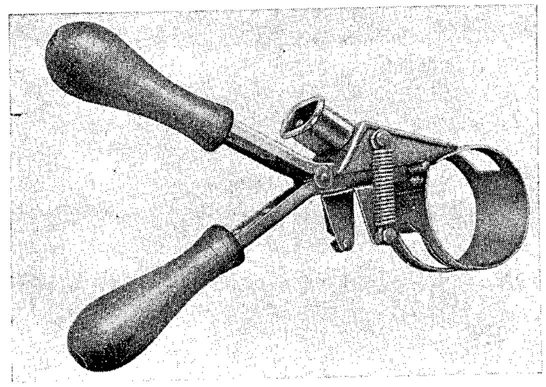
SPECIAL TOOLS

FOR

SECTION E

Electric Piston Heater	P 1a


Example of use

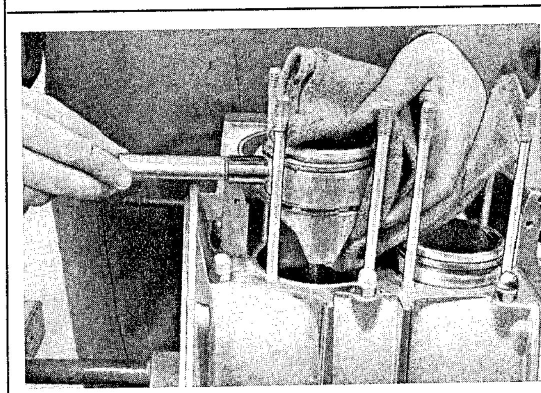

Tool

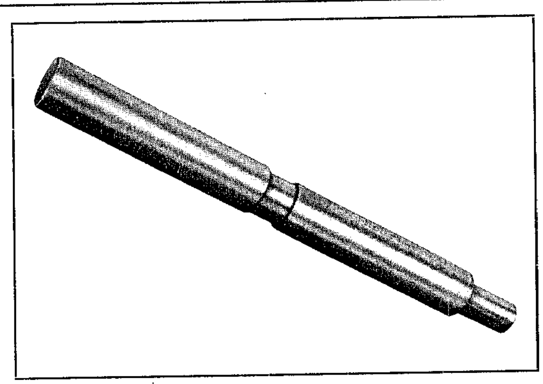
Use: To heat pistons to remove and install piston pins

See operation 2 EN

Subject to change

Piston Pin Mandrel	P 2


Example of use

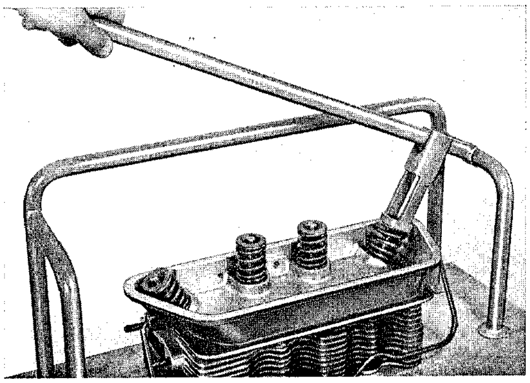

Tool

Use: To remove and install piston pins

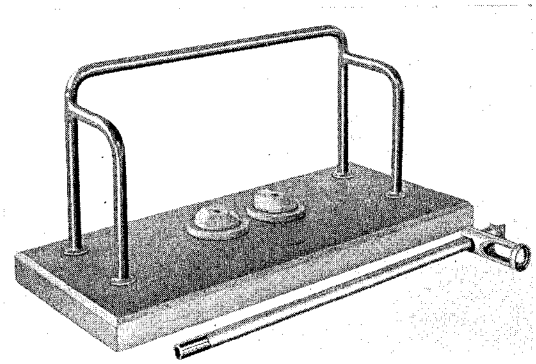
See operation 2 EN

Subject to change

Valve spring compressor set	P 7



Example of use



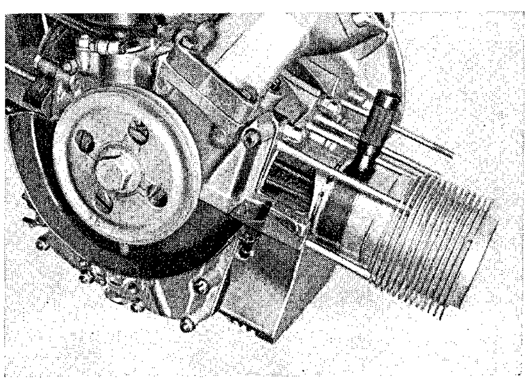
Tool

Use: To remove and install valve springs and valves

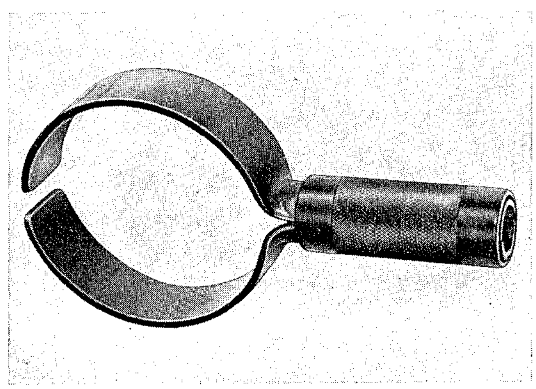
See operation 24 EN

Subject to change

Piston ring compressor 82,5 mm dia.	P 8a



Example of use



Tool

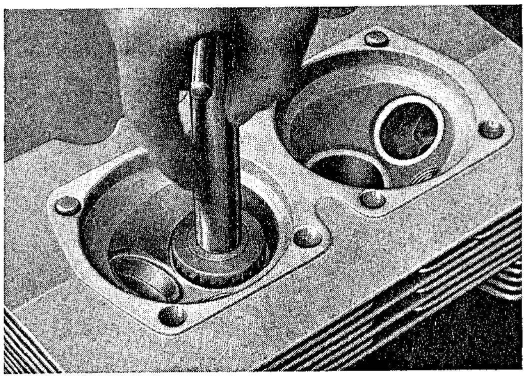
Use: To compress piston rings when installing cylinders

See operation 2 EN

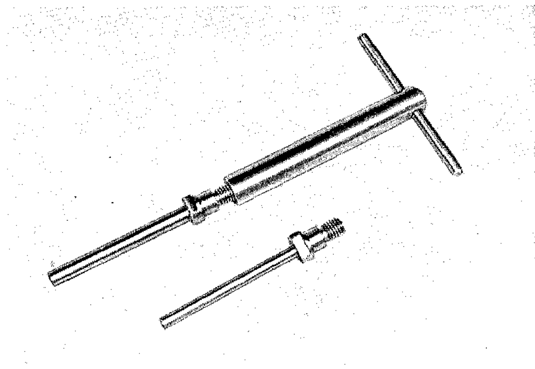
Subject to change

Valve seat cutter handle and shaft

P 11



Example of use



Tool

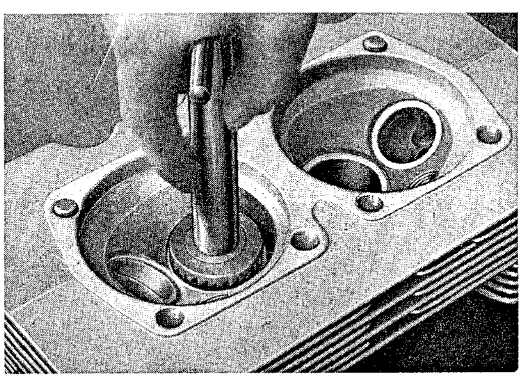
Use: To cut valve seats using cutter set P 12

See operation 26 EN

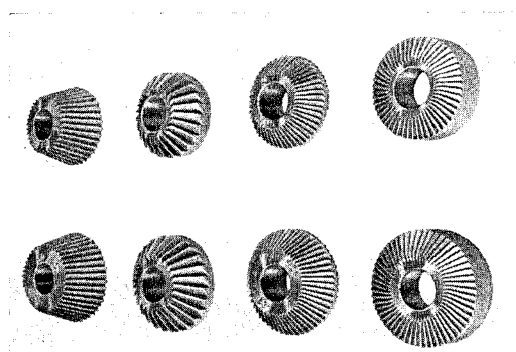
Subject to change

Valve seat cutter set

P 12



Example of use



Tool

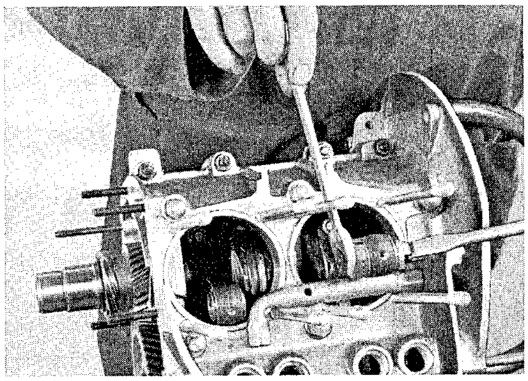
Use: To cut valve seats using handle and shaft P 11

See operation 26 EN

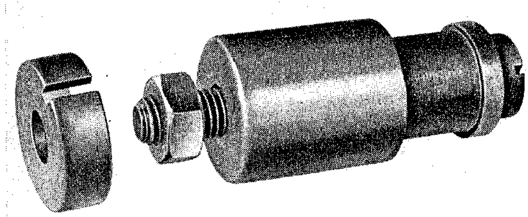
Subject to change

Piston pin bushing extractor and press

P 15



Example of use



Tool

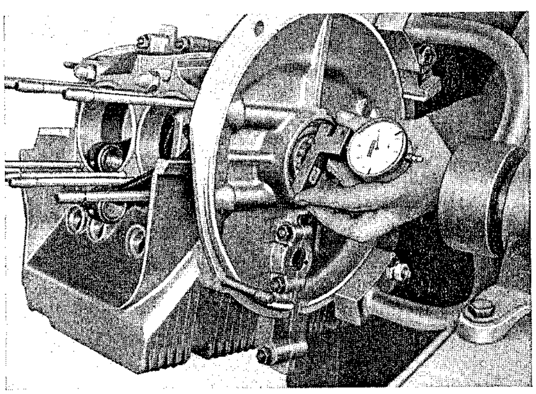
Use: To extract and install piston pin bushings

See operation 47 EN

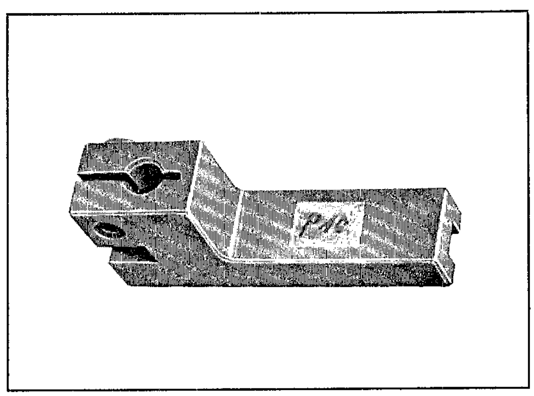
Subject to change

Dial gauge holder

P 16



Example of use



Tool

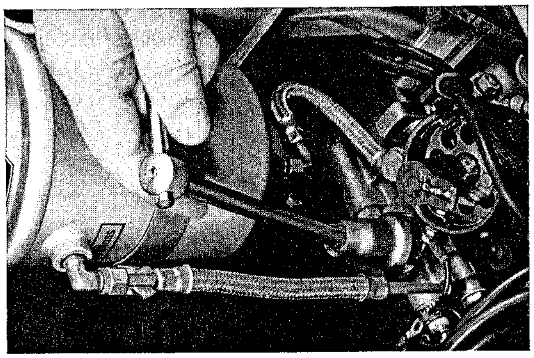
Use: To measure shim thickness for correct crankshaft end play

See operation 50 EN

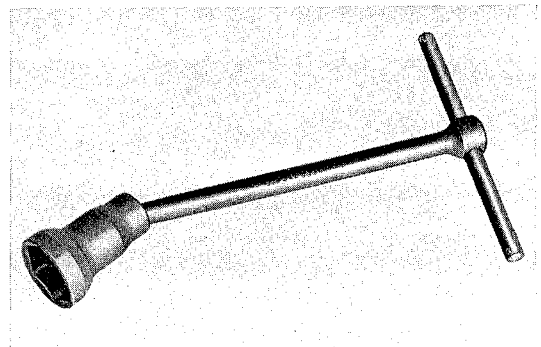
Subject to change

T-handled socket wrench 24 mm

P 19a



Example of use



Tool

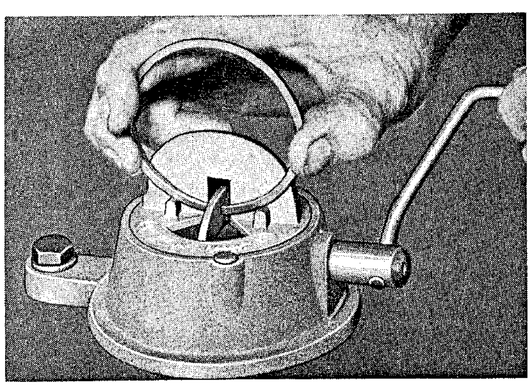
Use: To remove and install oil pressure indicator switch

See operation 2 EN

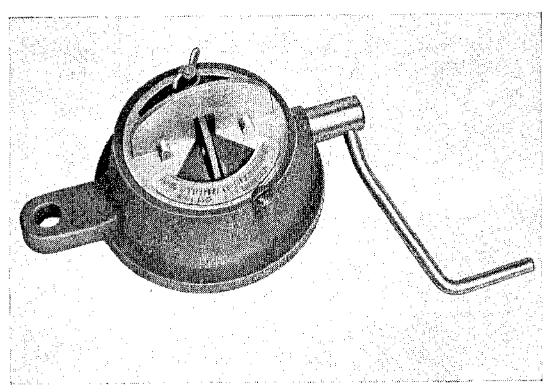
Subject to change

Piston ring gap grinder

P 20



Example of use



Tool

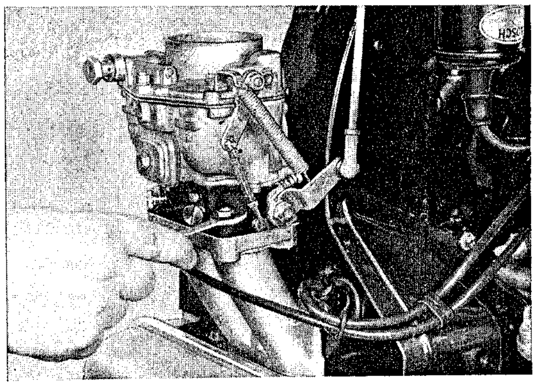
Use: To adjust piston ring gap

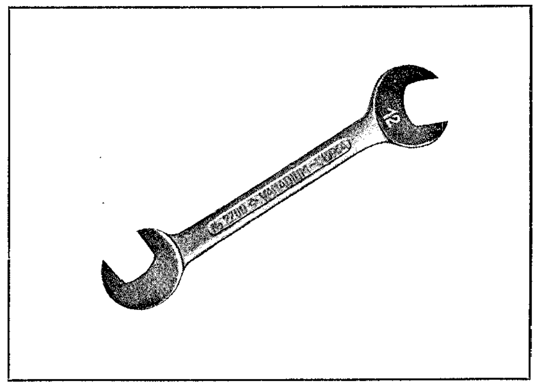
See operation 34 EN

Subject to change

Carburetor wrench 12 mm

P 23


Example of use


Tool

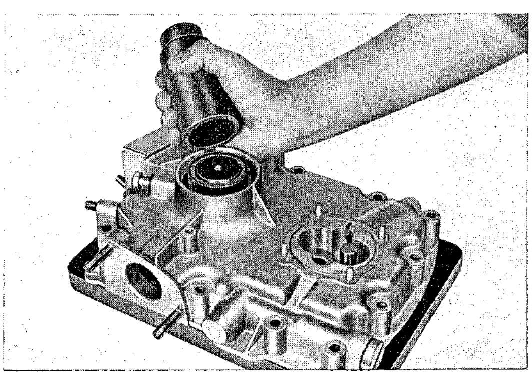
Use: To remove and install carburetors

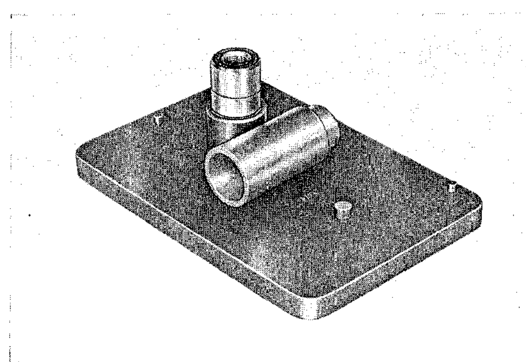
See operation 23 EN

Subject to change

Assembly plate

P 27a


Example of use


Tool

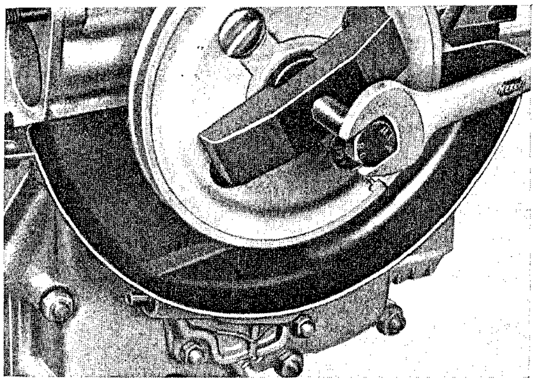
Use: To remove and install main bearing No. 4 in the timing case cover and to install the crankshaft oil seal using tool P 73

See operation 39 EN

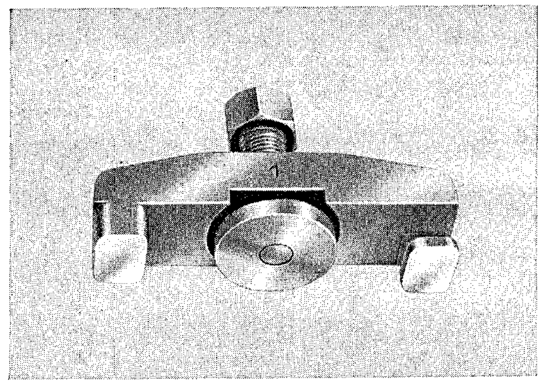
Subject to change

Puller for V-belt pulley

P 43



Example of use



Tool

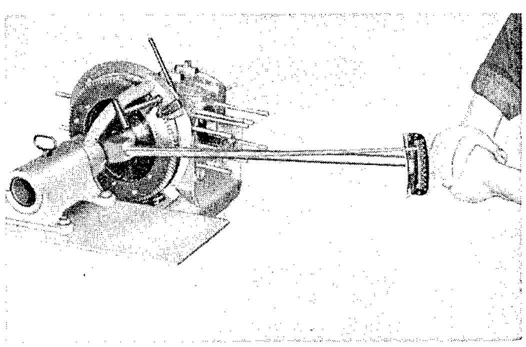
Use: To remove the V-belt pulley from the crankshaft

See operation 42 EN

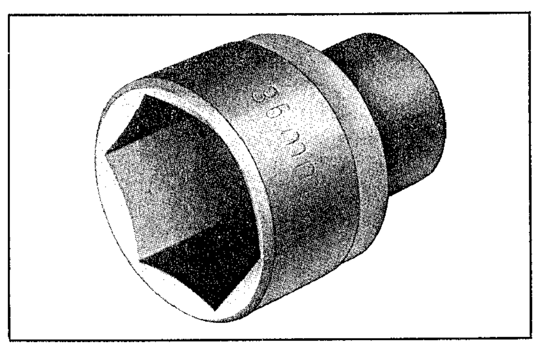
Subject to change

Socket 36 mm

P 44



Example of use



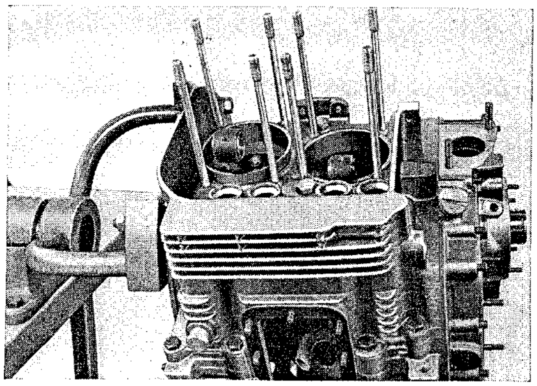
Tool

Use: To remove and tighten the flywheel gland nut

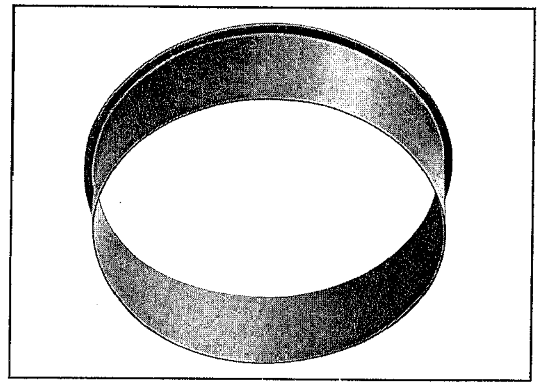
See operation 41 EN

Subject to change

Sleeve (4) — P 51



Example of use



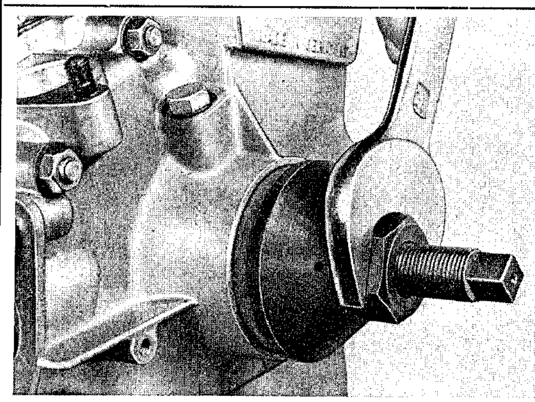
Tool

Use: To protect the crankcase bores while rotating the crankshaft with the cylinders removed

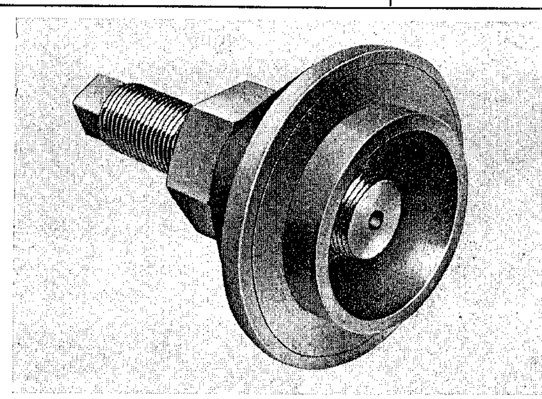
See operation 36 EN

Subject to change

Press for installing oil seal — P 73



Example of use



Tool

Use: To install crankshaft oil seal in the timing case cover

See operation 38 EN

Subject to change

SECTION INDEX

Group F: Fuel System

DESCRIPTION OF THE FUEL SYSTEM

The fuel system consists of:

1. Fuel tank with fuel cock and fuel filter
2. Fuel lines
3. Mechanically operated fuel pump with additional filter
4. Dual downdraft carburetors with air filter

The fuel tank has a capacity of appr. 13²/₃ US gals., appr. 1¹/₃ of these are reserve (52 ltrs., 5 reserve) and is under the front hood.

The fuel cock, located on the lowest part of the tank, is accessible from the front seat. The fuel cock is directly connected to a filter which prevents dirt, dust and other abrasive particles from entering the fuel lines.

The fuel line is connected with the fuel cock by a short flexible tube and leads through the frame tunnel to the fuel pump.

The fuel pump is mechanically operated by an eccentric on the distributor shaft over a push rod.

Carburetors. Two cylinders each have one common dual downdraft carburetor with accelerating pump.

The air filters or intake silencers resp. clean the intake air from dust and dirt.

DESCRIPTION OF THE DUAL DOWNDRAFT CARBURETOR ZENITH 32 NDIX

General

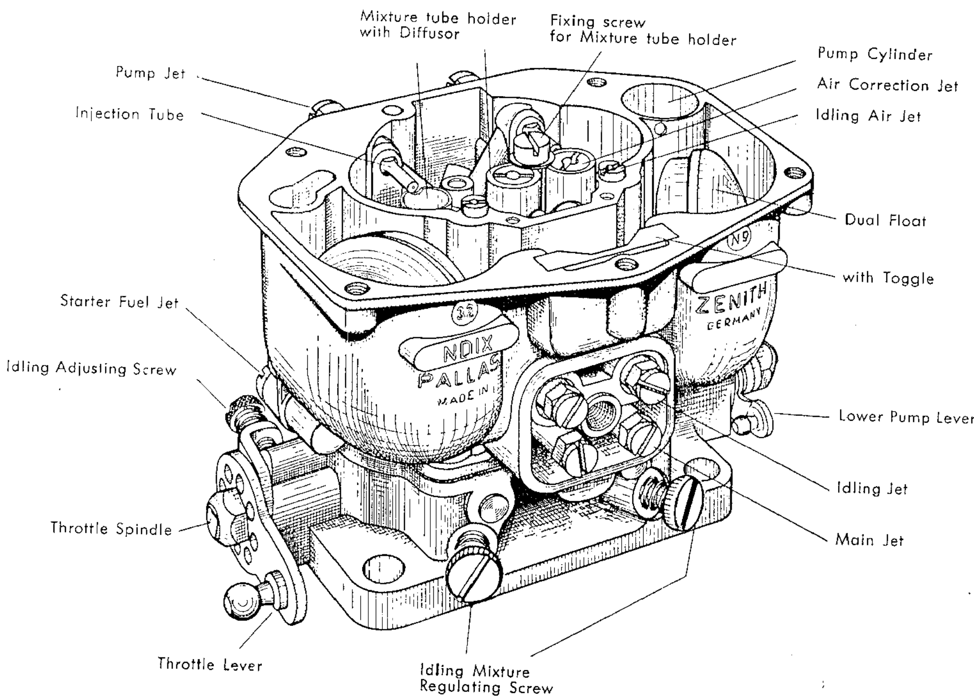
The Dual Downdraft Carburetor Zenith 32 NDIX has two barrels with a 32 mm (1.17") intake. It is provided with a central air intake and encased to make it dust- and water-proof.

Description

The carburetor consists of three main components: Throttle butterfly valve assembly, float chamber and carburetor cover.

The cast iron **throttle valve assembly** is attached with its flange to the intake manifold of the engine. Above the flange across the two barrels is the **throttle shaft** with the two **throttle butterfly valves.** Attached to the ends of the throttle shaft are the throttle lever, a throttle stop and the lower pump lever. The **throttle lever** allows to control the position of the butterfly valves and thus the quantity of the sucked-in fuel air mixture. The idling **adjusting screw** is mounted on the **throttle stop.** The lower **pump lever** actuates the **pump rod** for the accelereator pump. On the throttle assembly there are also two **idling mixture regulating screws.**

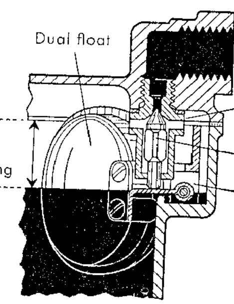
The die-cast **float housing** combines the two mixing chambers and the dual float chamber. It contains all parts necessary for the preparation of the fuel air mixture for normal operation and idling, the float assembly and the accelerator pump. The main body and the throttle body are bolted on to the carburetor housing with the aid of a gasket and need normally not be removed.



Zenith Carburetor Type NDIX – Cover removed

Fig. 1

The **carburetor cover** – also made of die-cast – is mounted on the float chamber with the aid of a gasket and may be removed after loosening five retaining screws to give access to the inside of the carburetor. It is connected to the fuel pipe. The **float needle valve** controlling the fuel supply is screwed to the inside of the carburetor cover. Inside the air intake nipple of the carburetor cover, the vent pipe for the float chamber is situated. The air intake nipple serves to mount the air filter.



Float system

Fig. 2

The **float system** consists of a **dual plastic float** which is mounted in the float housing by means of a float toggle. The float system maintains a constant fuel level in the carburetor. When the fuel has reached the required level, the rising float forces the needle valve on to its seat and shuts off the fuel supply. The dual float chamber and two floats provide the correct quantity of fuel even while the car is inclined („cross-country" type carburetor).

The **central air intake** serves to clean the air for the mixture preparation for all operational conditions of the engine (starting, idling, normal operation) and at the same time ventilates the float chamber. Internal ventilation of the float chamber not only prevents particles of dirt from getting into the carburetor, but it also enables the carburetor to deliver a constant fuel air mixture even if the air filter is clogged, with the result that the fuel consumption is not affected no matter how badly the filter may be clogged.

Idling Circuit

Each barrel of the carburetor is provided with an idling circuit (see fig. 3 and 4) which also acts as a small auxiliary carburetor. The idling mixture is determined by:

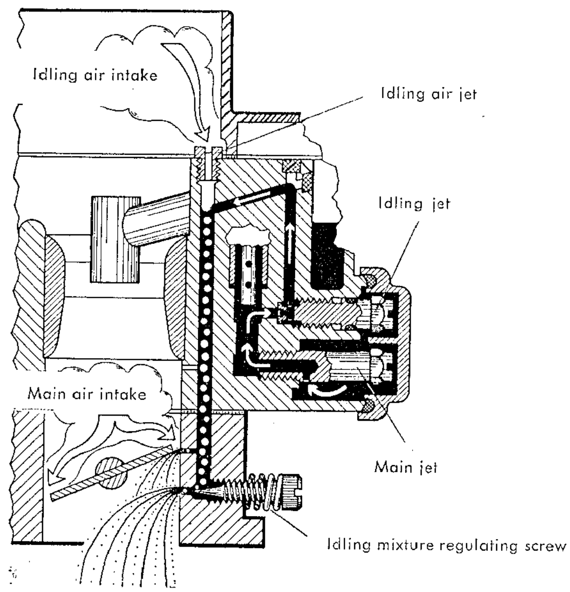
the **idling jet** which meters the quantity of fuel, and

the **idling air jet** which regulates the proportion of air for the preparation of the idling mixture, and

the **idling mixture regulation screw** which reduces or increases the quantity of idling mixture drawn in.

The fuel required for idling is taken from the mixture tube holder after having passed the main jet. It is drawn to a point above the fuel level by the idling jet and mixed with the air entering through the idling air jet to form a mixture.

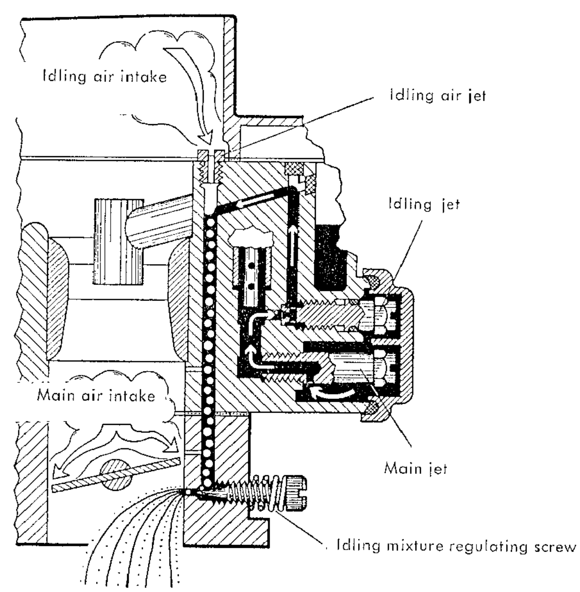
The idling mixture flows downwards to an orifice leading into the mixing chamber somewhat below the throttle valve. This bore can be modified by the mixture regulating screw. At idling speed of the engine the idling mixture is discharged through this orifice into the mixing chamber and then mixed with air entering through the throttle butterfly opening.



Operation at Idling Speed

Fig. 3

Just above the throttle valve there are in addition two further orifices subjected to the depression. When the throttle valve is opened they also deliver idling mixture, thereby ensuring a flawless transition from idling to main jet circuit.



Operation during Transit

Fig. 4

With the aid of the **idling mixture regulating screw** the quantity of fuel in the idling mixture can be increased or reduced. Adjustment of this screw reduces or increases the quantity of the idling mixture dran in. Screwing it in provides an idling mixture a low fuel content, unscrewing it gives a richer fuel air mixture.
The **idling adjustment screw** which is attached to a stop on the throttle shaft can be used to regulate the idling speed of the engine by increasing or reducing the throttle valve opening. The idling speed is increased by screwing it in and is reduced by unscrewing it.

Main carburation takes place in the two mixing chambers (fig. 5).

Each mixing chamber is provided with a **venturi** and in front of it is a **diffusor** which is combined with the **mixture tube holder.** The two mixture tube holders are secured by one common fixing screw in the float chamber. In each mixture tube holder there is a **mixture tube** which is clamped by the screwed-on air **correction jet.**

The two **main jets** and the two idling jets are situated under a cover plate at the side of the carburetor. The cover is mounted with the aid of a gasket as the chamber covered by it is in connection with the float chamber and filled with fuel.

For normal operation the fuel air mixture in the main carburetor is determined by:

the **main jet** which meters the quantity of fuel,

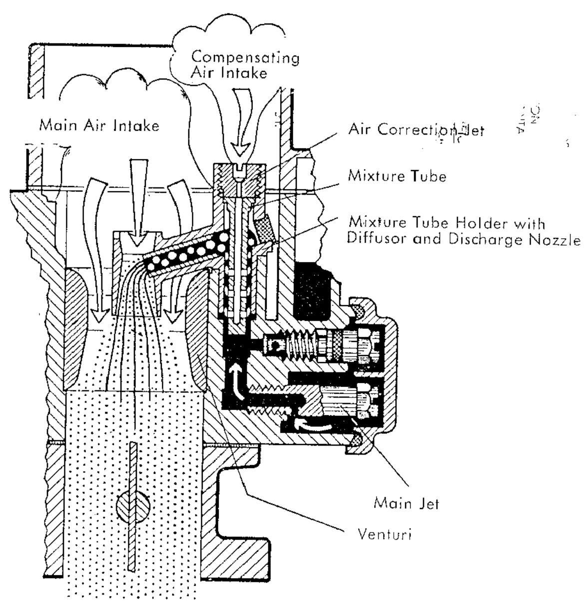
the **air correction jet** which meters correctional air as the engine speed increases, and

the **venturi** which controls the air volume.

The fuel flows from the float chamber into the space under the cover. From here it flows through the calibrated orifice of the two main jets into the main jet holders filling them to the general level of the fuel.

As the throttle valves are opened a vacuum is formed in the mixing chambers, which is greatest in the venturi. This vacuum acts on the main jet system and draws fuel from the outlet orifices of the main jet assembly. First the fuel is mixed in the small diffusors with the incoming air and then in the large venturis with the air entering there, and thus the fuel air mixture ist formed.

As the vacuum increases, the fuel level in the mixture tube holder decreases and compensating air enters through the air correction jets which mixes via the small orifices in the mixture tubes



Operation at Full Throttle

Fig. 5

with the fuel from the main jets. With increasing speed more compensating air is drawn in, preventing the otherwise occuring enrichening of the fuel-air mixture and ensuring its approximately equal composition throughout the entire range of engine operation.

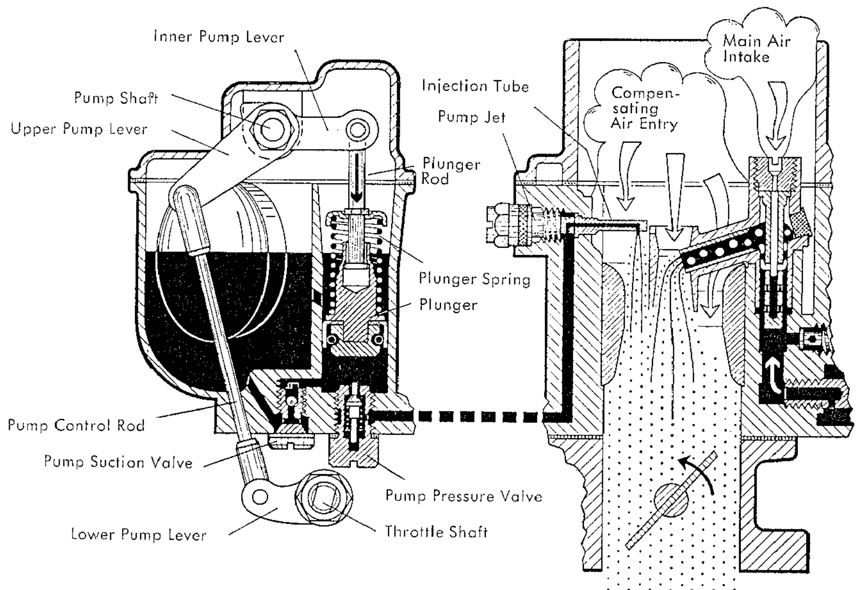
Accelerator Pump

The **accelerator pump** of the carburetor (fig. 6) is of the plunger type. A partioned space of the float chamber forms the pump cylinder in which the **plunger** moves up and down. The plunger is attached to the **pump lever** seated on the **pump shaft** in the carburetor cover. The throttle valve shaft and the pump shaft are connected through a linkage — consisting of lower and upper **pump lever** and the **pump rod.**

As the throttle valves are closed, the pump plunger moves in an upward direction and fuel is drawn through the **pump suction valve** into the **pump cylinder.** The foregoing is termed the suction stroke of the accelerator pump.

When the throttle valves are opened, the plunger moves downward and the pressure stroke of the pump is effected. The fuel is forced into mixing chambers of the carburetor through the **pump pressure valve** and two pump jets with injection tubes.

The plunger is provided with a damping device which enters into operation when a sudden actuation takes place. Then the pressure of the plunger is built up as a resilient force and according to the fuel flow the plunger moves downward.



Operation of accelerator pump Fig. 6

Efficient acceleration is thus obtained by supplementing the main fuel air mixture. An alteration of the pump jet only alters the duration of the injection, because the calibration of these jets determines the rate of flow in relation to a unit of time. The quantity of fuel injected can only be controlled by the pump stroke, i. e. by abjusting the pump linkage.

Dual Downdraft Carburetor Zenith 32 NDIX

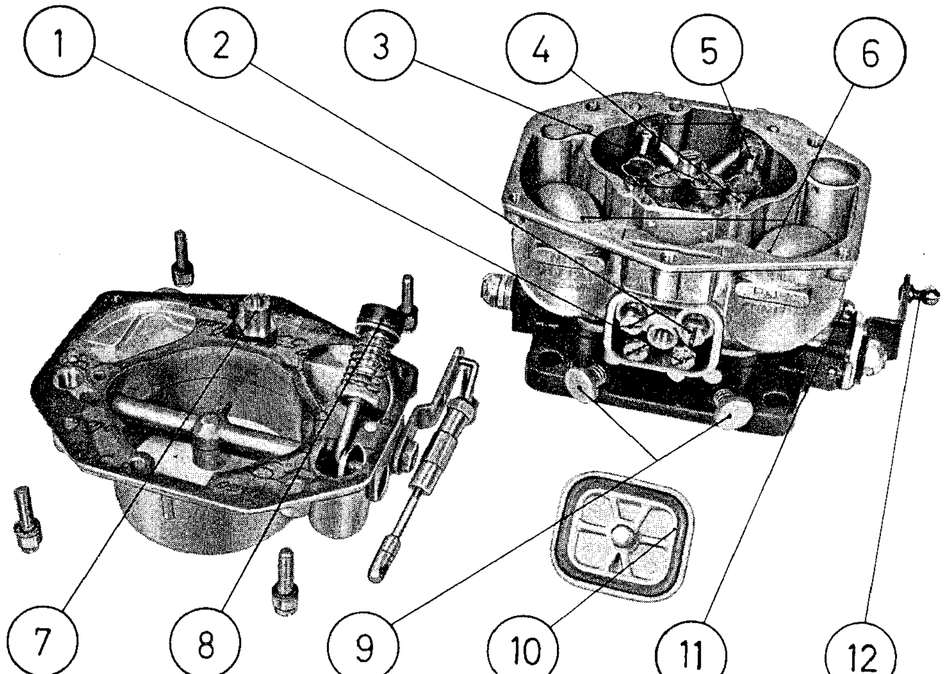


Fig. 7

① Main jets
② Idling jets
③ Air correction jets
④ Idling air jets
⑤ Injection tube pump jets
⑥ Dual float

⑦ Float needle valve
⑧ Pump plunger (accelerator pump)
⑨ Idling mixture regulating screw
⑩ Jet chamber cover
⑪ Idling adjustment screw
⑫ Carburetor lever

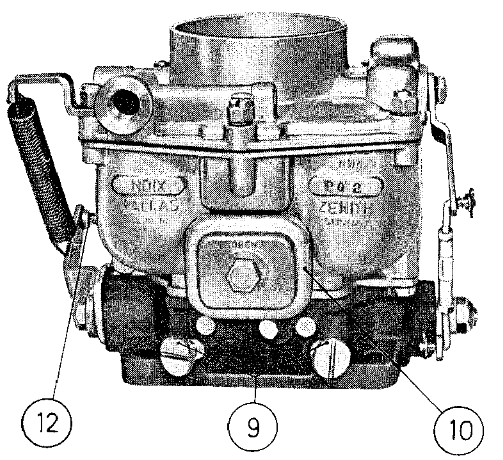


Fig. 8

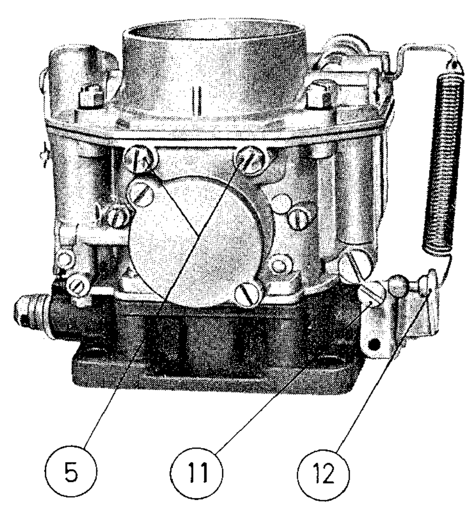


Fig. 9

CARBURETOR ADJUSTMENT DATA

Engine Type	1600 (616/1)	1600 S (616/2)	Notes
Carburetor Zenith	32 NDIX	32 NDIX	2 per engine
Characteristics	dependent idling	dependent idling	——
Venturi K	24	28	2 per carburetor
Main Jet Gg	0115	0130	2 per carburetor
Air correction jet a	230	220	2 per carburetor
Idling jet g	50	50	2 per carburetor
Idling air jet u	120	140	2 per carburetor
Pump jet Gp	50	40	2 per carburetor
Injection tube	No. 8 short	No. 8 short	2 per carburetor
Float needle valve (sprung)	125	125	1 per carburetor
Float weight	per float 5.2 g	per float 5.2 g	2 per carburetor
Mixture tube	No. 1 S	No. 1 S	2 per carburetor
By-pass bore	1,4/1,4	1,4/1,4	——
Injection quantity	0,2 – 0,3 c. c. at 2 strokes per tube	0,2 – 0,3 c. c. at 2 strokes per tube	2 tubes per carb.
Float level	18,5 ± 1,0 mm .728″ ± .04″	18,5 ± 1,0 mm .728″ ± .04″	measured with cover closed and a test pressure of 1,8 m WC

The main jet is of particular importance with regard to differences in altitude. A good rule to go by is: for every 3300 ft (1000 metres) of difference in altitude, change the cross section of the main jet by approx. 6%. (Example: Normal adjustment at 1310 ft (400 metres) above sea level is 0110; adjustment at 4590 ft (1400 metres) above sea level is 0105).

Removing and Installing Carburetor

1 Fu

Special tools
P 75 Carburetor synchronizing unit
P 23 Carburetor wrench 12 mm

Removal

1. Close fuel cock
2. Remove air filter
3. Disconnect fuel line between fuel pump and carburetor

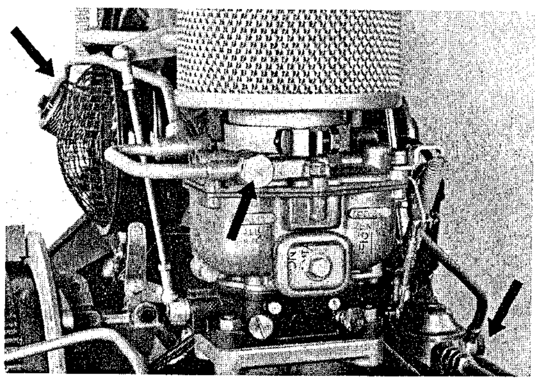


Fig. 10

4. Loosen and remove carburetor throttle lever at carburetor linkage

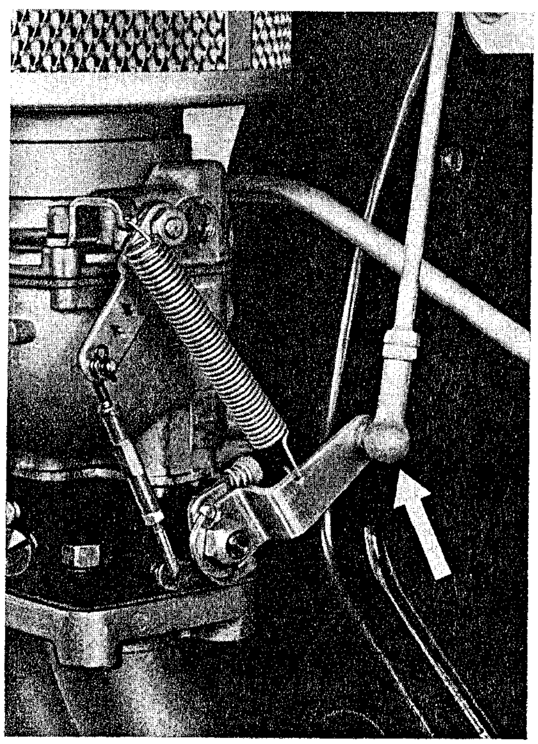


Fig. 11

5. Loosen carburetor flange nuts (special wrench P 23)

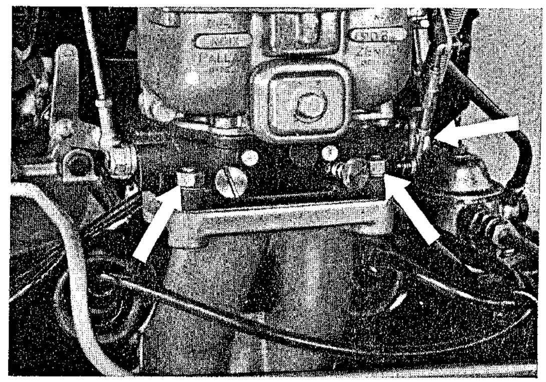


Fig. 12

6. Take off carburetor
7. Cover intake manifold

Installation:

When installing, proceed in reverse order, observing the following points:

1. Replace gasket at intake manifold flange.
2. Tighten carburetor flange nuts.
3. Adjust throttle valve position by actuating accelerator linkage, so that at full throttle opening both carburetors are in the same open position. (Must be corrected later on while engine is running).
4. Check gasket for fuel line nipple, replace if necessary.
5. If necessary, clean and oil filter.
6. Adjust idling speed. Synchronize carburetors using P 75 unit (see 4 Fu).

2 Fu

Cleaning Carburetor

Cleaning

1. Remove carburetor
2. Wash carburetor with clean gasoline.
3. Unhook pump linkage.
4. Loosen retaining screws on carburetor cover.
5. Take off carburetor cover.
6. Remove dual float.
7. Remove cover (jet chamber cover), unscrew main jets and idling jets.
8. Unscrew retaining screw for mixture tube holder, loosen air correction jets, take off both mixture tube holders, remove air correction jets, remove and clean mixture tubes.
9. Remove and clean idling air jet.
10. Remove and clean float needle valve and pump jets.
11. Carefully clean all jets and ports.
12. Re-insert jets.

It is recommended to clean the carburetor in clean gasoline. Blow compressed air through jets and lines. When cleaning the jets, do not use a needle or wire, since this will damage or widen the calibrated bores.

3 Fu

Disassembling and Assembling Carburetor

1. Remove carburetor.
2. Remove spring clip and pressure spring at pump linkage and unhook linkage.

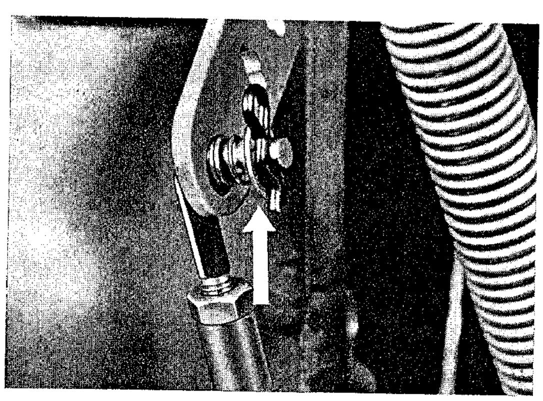


Fig. 13

3. Loosen retaining screws and carefully take off carburetor.
4. Remove float toggle lever and take off dual float.

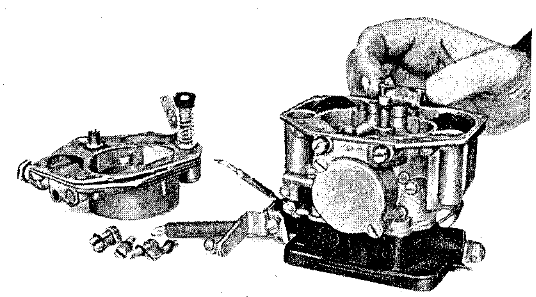


Fig. 14

5. Remove retaining screw on mixture tube holder.

6. Loosen air correction jets.
7. Pull out mixture tube holder.
8. Unscrew air correction jets and remove both mixture tubes.

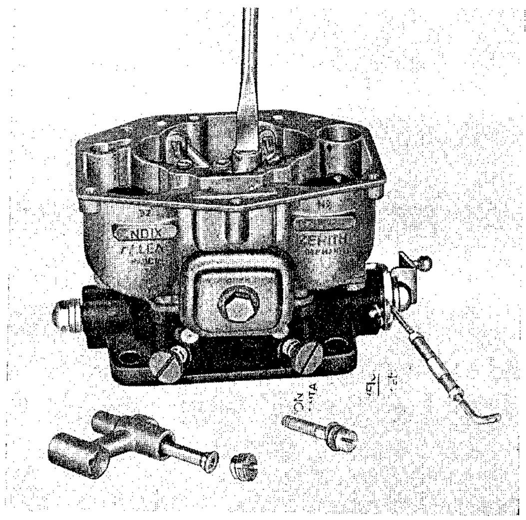


Fig. 15

9. Screw out idling air jets.
10. Screw out pump jets.
11. Remove injection tubes, if necessary by using a screw driver which should be protected by means of a protection tube to avoid damage to the injection tubes. Protect venturi by a piece of wood as illustrated below (fig. 16).

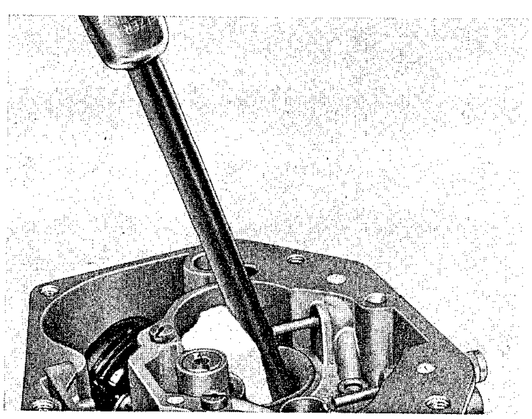


Fig. 16

12. Release venturi clamping screw and lift out venturi.

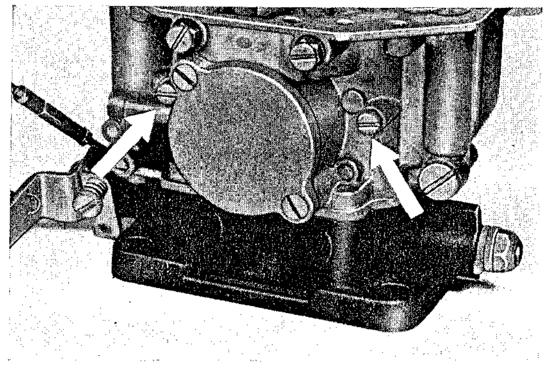


Fig. 17

13. Remove jet chamber cover.
14. Remove main jets and idling jets.
15. Remove idling mixture regulating screws.

Cleaning

1. Clean all components in fuel.
2. Blow compressed air through jets, valves, and ports. When cleaning, do not use a needle or wire, since this will damage or widen the calibrated bores.

Inspection and Assembly

When assembling, proceed in reverse order of disassembling. To check the components, the following points should be observed:

Carburetor Cover

1. Check float needle valve for leaks.
2. The sealing surface of the float needle valve must be perfectly smooth and clean.
3. Check float needle valve gasket for perfect condition and make sure that it is properly installed to prevent leakage.
4. The thread for the hollow bolt must be intact.
5. Check sealing surfaces of carburetor cover.
6. Replace gasket.

The carburetor cover gasket is held by two rivets. When replacing the gasket, the rivets may be removed by using a sturdy knife. The new gasket must be secured by two rivets.

Carburetor Bowl

1. Check pump plunger for perfect condition, if necessary replace.

2. Check float for perfect condition, replace if leaking. For float weight see „Carburetor Adjustment Data" table, page F 9.

3. Check all jets for correct size given in the „Carburetor Adjustment Data" table.

When replacing jets or valves, only genuine ZENITH parts should be used, which are available as spare parts. These parts are accurately calibrated and thus ensure proper adjustment and low fuel consumption.

4. Install venturi. Be sure that the restriction (rated diameter of venturi) faces upwards, i. e. that designations can be read from above. Do not overtighten clamping screw (fig. 17) (hold venturi).

5. Check clearance of throttle valve shaft. Excessive radial clearance allows secondary air to enter which has a detrimental effect on the starting and idling conditions.

6. Check tip of idling mixture regulating screw for perfect condition. Replace screw, if tip is bent or broken off

4 Fu

Idling Adjustment

Special Tool:
P 75 Carburetor Synchronizing Unit

1. Remove air filter while engine is at operating temperature.

2. Loosen pressure rods for actuating carburetor levers from bell cranks.

3. Tighten idling adjustment screw uniformly on both carburetors, until engine reaches approx. 1000 r.p.m.

4. Fully close idling mixture regulating screws on both carburetors (do not tighten too firmly, in order to avoid damaging the cone), then re-open by approx. $1^1/_2$ turns. Now adjust by screwing in or out and leave it in the position which gives the highest r.p.m. and at which the engine runs smoothly. The regulating screws must never remain in fully closed position.

5. Loosen idling adjustment screws until an idling speed of 650 – 750 r. p. m. is reached.

6. Mount carburetor synchronizing unit P 75 on one carburetor and adjust by turning adjusting screw (varying venturi) so that the plunger in the inspection glass rises to about half-way position between two marks.

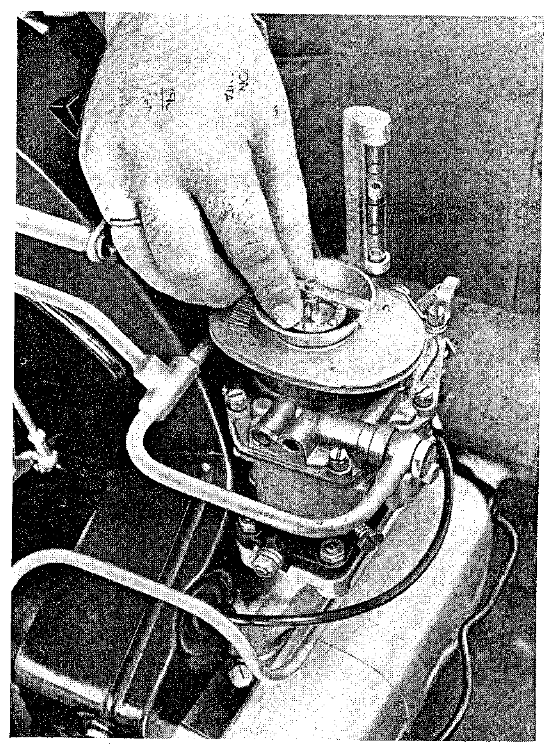


Fig. 18

7. Mount carburetor synchronizing unit on second carburetor (varying venturi) without making any alteration at the adjusting screw, until the plunger in the inspection glass is in the same position as described in point 7.

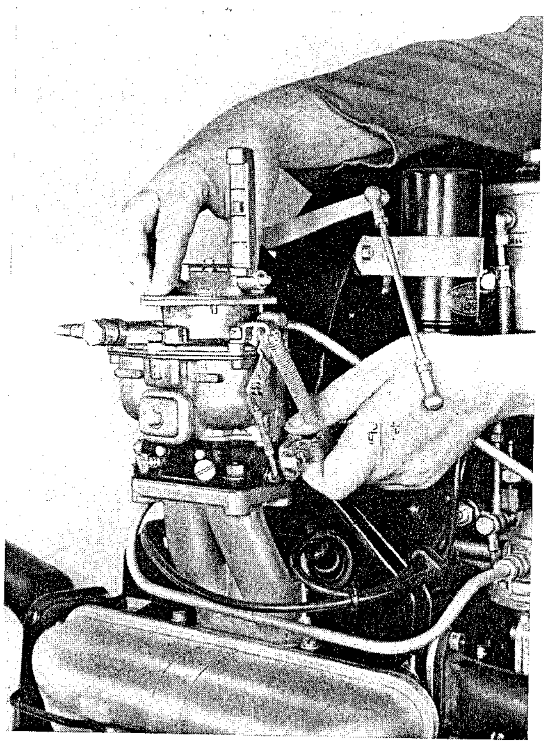


Fig. 19

8. Adjust idling mixture regulating screws of both carburetors, so that the plunger in the inspection glass shows hardly any discrepancies.

9. Attach pressure rods to bell cranks.

Note: Adjust pressure rods so that at idling position the pressure rods may be attached without tension.

10. Adjust engine speed to 1200 — 1300 r. p. m. by means of the hand gas knob and check uniform throttle butterfly valve position using synchronizing unit P 75 (see point 7 and 8). If the carburetor synchronizing unit does not give the same value for both carburetors, the throttle valve position must be adjusted by adjusting the pressure rods.

11. Re-check idling speed.

12. Check injection quantity (0.2—0.3 c.c with 2 strokes at one tube)

13. Check and, if necessary, adjust stop screw at accelerator pedal. When the accelerator pedal is fully depressed, there must be a clearance of approx. .04" (1 mm) between stop point of throttle valve shaft and stop point at carburetor housing.

14. Mount air filter or intake silencer resp.

Note: If a correct idling cannot be obtained, the throttle valve part must be checked as described in section 8 Fu. For checking, the carburetors must be removed.

Adjusting Injection Ratio

5 Fu

Special Tools

P 76 Carburetor wrench 5.5 mm

P 25 a Gauge glass

1. Adjust idling speed.
2. Fill float housing with fuel (while the engine is running)
3. Stop engine and remove air filter from carburetor.
4. Actuate throttle lever, until bubbles on the injection tube disappear.
5. Hold gauge glass (P 25 a) toward injection tube opening and press throttle lever twice from stop to stop.
6. Check fuel quantity, fully empty gauge glass and repeat measuring process.

7. Injection ratio should be 0.2 — 0.3 c.c. per injection tube at two strokes.

8. Repeat measuring process on second carburetor.

9. If necessary, adjust the injection quantity by adjusting the pump pressure rods with carburetor wrench.

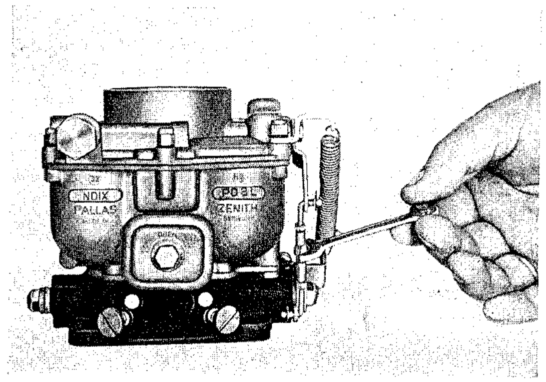


Fig. 20

Note:

The pump jet has no influence on the injection ratio. Injection time and ratio must be uniform for both carburetors.

6 Fu

Checking Fuel Level in Float Housing

Special Tool:
P 77 Fuel Level Measuring Glass

1. Place carburetor horizontally.

2. Connect level measuring glass P 77 to fuel outlet at float housing.

3. Pour fuel into float housing in the normal manner. Use a 2.3 m high fuel column (corresponding to approx. 1.8 m WC) to obtain the correct pressure.

4. Close fuel supply and read fuel level. The correct level should be 18.5 ± 1.0 mm (.728" ± .04") measured from the edge of the carburetor housing to the fuel surface.

Note:

Usually it is not necessary to adjust the fuel level, provided the correct method of checking has been applied. In case an incorrect fuel level is obtained, the float and float needle valve should be checked for perfect condition. Only then the fuel level may be adjusted by using a thicker or thinner gasket.

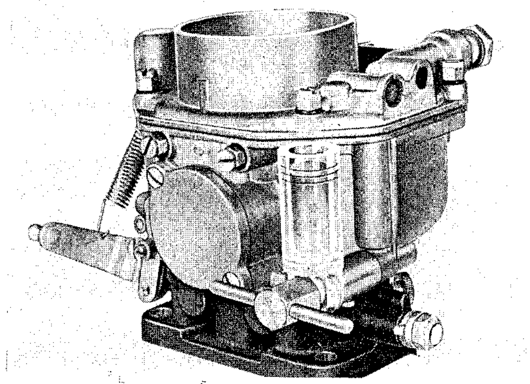


Fig. 21

Checking Float

7 Fu

General Information

Flowing over of the carburetor or excessive fuel consumption and poor engine performance may be a result of incorrectly adjusted floats or floats touching the float housing.

Checking

1. Remove float.
2. As shown in fig. 22, place floats on a plane plate and check to see whether both floats and the float brackets touch. If necessary, rebend floats carefully.

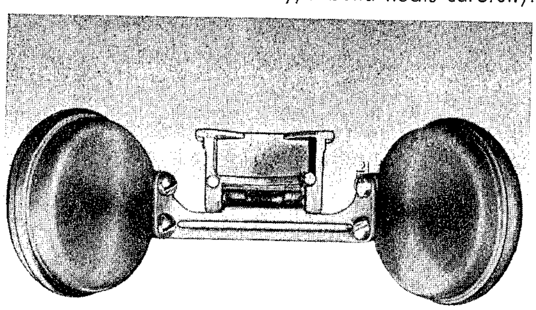


Fig. 22

3. Insert float into float housing. Allow float to oscillate (see fig. 23), then check whether floats touch float housing. If necessary, rebend floats carefully.

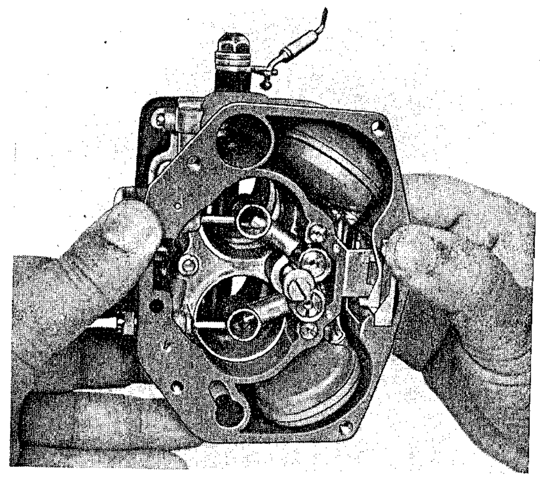


Fig. 23

4. Reinstall floats.
5. Check fuel level in float housing (6 Fu).

Checking Throttle Valve Assembly

8 Fu

General

Poor idling and flat spots are not always caused by clogged idling jets, but may be attributed to the throttle valve assembly.

Checking:

1. Unscrew mixture regulating screws and check whether cone is intact, i.e. make sure that no dents nor pressure points can be found. Cone should neither be bent (see fig. 24). In case of doubt, use new mixture regulating screws.

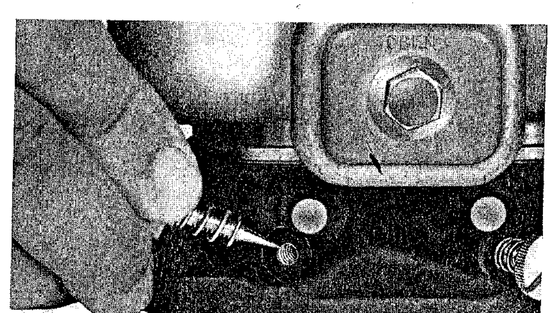


Fig. 24

2. Subject throttle valves to a light scanning test. Both throttle valves must close uniformly (see fig. 25). Should this not be the case, turn throttle valve shaft carefully until both throttle valves close uniformly.

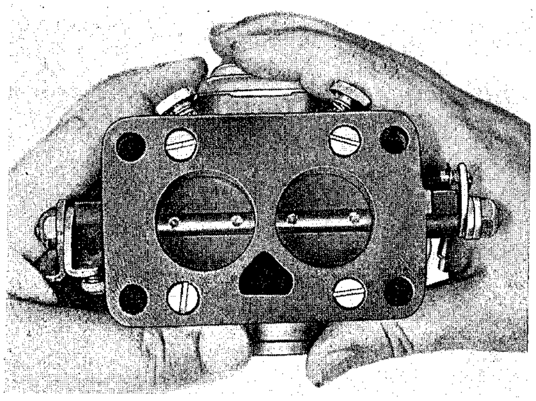


Fig. 25

3. Remove throttle valve assembly by loosening 4 fastening screws, check to see whether gasket between float housing and throttle valve assembly covers idling bores correctly or whether a foreign body has entered. It is hardly possible to remove foreign bodies at this point of the carburetor without removing the throttle valve assembly.

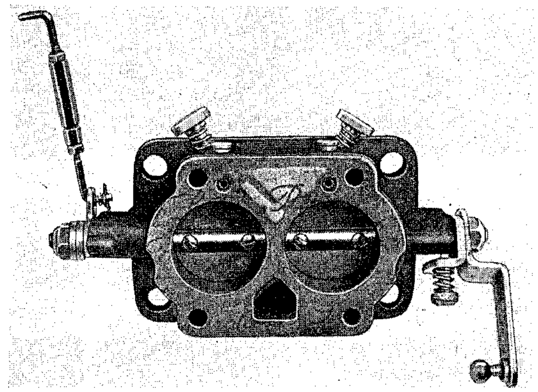


Fig. 26

4. Remount throttle valve assembly.

9 Fu

Cleaning Air Filter

The metal air filter, moistened with oil, serves to clean the intake air from entering dirt and dust. Frequency of cleaning the oil filter depends more or less on the local conditions prevailing.

1. Loosen clamp screws on fastening clips.
2. Remove air filter.
3. Clean air filter in clean washing gasoline.
4. Blow through with compressed air.
5. Slightly oil air filter.
6. Mount air filter.

10 Fu

Replacing Micronic Elements

The engines of type 1600 S are equipped with two intake silencers. They contain micronic elements, which should be replaced by new ones whenever they are dirty, at the latest, however, after 20 000 km (12 000 miles). (Fig. 27).

The micronic elements must not be washed nor oiled! If necessary, they may be slightly beaten or blown through with compressed air.

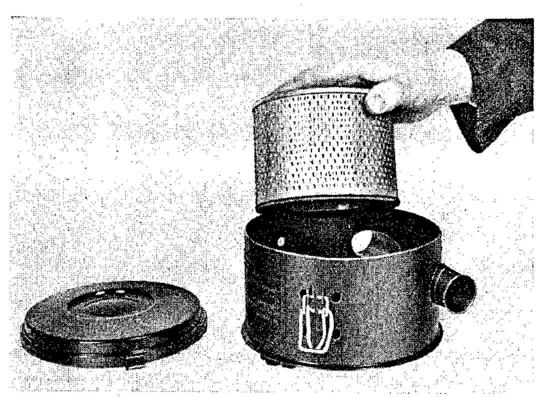


Fig. 27

Removing and Installing Intake Manifold

11 Fu

Removal

1. Remove carburetor.
2. Take off spark plug connectors.
3. Remove vertical side duct plate.
4. Loosen intake manifold nuts and screws and take off intake manifold.
5. Cover suction port of cylinder head.

Installation

Follow reverse order, observing the following details:

1. Replace intake manifold gasket. Care should be taken that the punched gasket holes correspond to the size of the cylinder head suction ports.
2. Install graphite-treated side of gasket toward cylinder head.
3. Check intake manifold for cracks.
4. Tighten intake manifold nuts and screws carefully and uniformly.
5. Replace carburetor gasket.

Removing and Installing Accelerator Linkage

12 Fu

Removal

1. Unhook ball pan on accelerator pedal.
2. Remove accelerator pedal.
3. Remove left half of floor board.
4. Loosen ball pan of long accelerator rod from ball joint on bell crank.
5. Unscrew ball pan and lock nut from accelerator rod, as otherwise the accelerator rod cannot be pulled backward.
6. Open rear hood.
7. Detach ball pan of short accelerator rod from bell crank at blower housing.
8. Jack up rear end of car.
9. Loosen long accelerator rod from bell crank on transmission and pull out of the frame, moving backward.

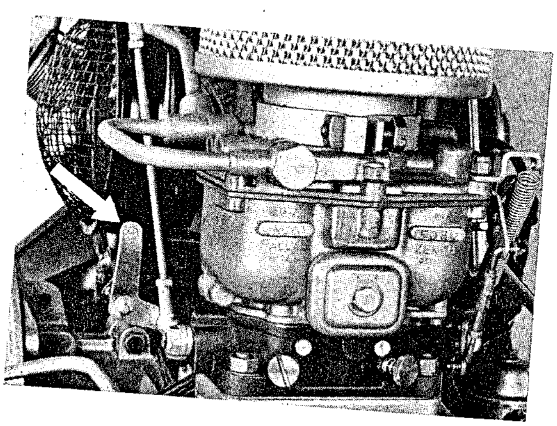


Fig. 28

Pull out short accelerator rod from engine compartment and unhook it on bell crank.

Installation

When installing proceed in reverse order. Carefully grease the ball pans and all bell crank axles. Tighten lock nuts of ball pans.

13 Fu

Adjusting Carburetor Linkage

The carburetor linkage must be adjusted so that all throttle valves are operated uniformly. Care must be taken that the full travel of the throttle valves from idling position to full throttle opening is not obstructed by incorrect adjustment of the pressure rod at the front bell crank. Final adjustment is effected by using the carburetor synchronizing unit P 75, see page F 14.

Caution!

Correct and uniform closing of the throttle valves is only obtained, if all ball joints of the acellerator linkage are moving smoothly. If necessary apply some grease to ball pans.

Carburetor Troubles and their Cure

The carburetor troubles as mentioned below presuppose the specified carburetor settings (see table on page F 9).

Trouble	Cause	Remedy
1. Engine will not start (with fuel in tank and ignition in order	a) No fuel in system b) Carburetor flows over	a) Clean main jet. Check fuel supply. Detach line to fuel pump and actuate starter without ignition. If fuel escapes pump, float needle valve is clogged. If no fuel comes out, pump valves may stick, pump mechanism may be damaged, or fuel cock is dirty b) Check and clean float needle valve. Check gasket. Check float, if nec. replace
2. Flat spot at idling speed	a) Idling adjustment incorrect b) Idling jet or idling air jet clogged c) Intake manifold leaking d) Idling mixture regulating screw damaged	a) Readjust idling speed b) Clean idling jet or idling air jet c) Check intake manifold, flanges, gaskets and compensation line d) Replace idling mixture regulating screw
3. Poor acceleration	a) Idling mixture too lean b) Fuel level incorrect c) Incorrect injection ratio d) Intake manifold leaking	a) Readjust idling speed (check jet) b) Adjust fuel level c) Check injection ratio d) Check intake manifold, flanges and gaskets and compensation line
4. Engine stalls when accelerator pedal is suddenly released	Incorrect idling adjustment	Readjust idling speed
5. Engine runs uneven, misfires and cuts out	a) Fuel surplus b) Lack of fuel c) Intake manifold leaking	a) Check pump pressure. Check float needle valve. Check float. Check fuel level. b) Clean main jet Check fuel lines Check fuel level c) Check intake manifold, flanges, gaskets and compensation line
6. Fuel consumption too high	a) Float needle valve flooded b) Float leaking c) Float needle valve does not close	a) Check pump pressure b) Replace float c) Check float needle valve

FUEL PUMP

General

Fuel is fed to the carburetors by a diaphragm pump which is flange-mounted to the crankcase. It is operated mechanically from a cam on the distributor drive shaft over an actuating rod. The quantity of fuel delivered by the pump is automatically controlled as the fuel is consumed by the float bowls.

The fuel pump consists of the pump cover, containig suction valve, delivery valve and a fuel strainer, and a fuel pump housing, incorperating the rocker mechanism. The diaphragm and spring are situated between the cover and the housing. The diaphragm consists of several layers of special flexible, clothlike material which is not affected by the fuel and two protecting discs which are riveted to the diaphragm actuating rod.

Operation

As the distributor drive shaft revolves, the cam causes the actuating rod to move against the rocker arm which pushes the diaphragm downward against the diaphragm spring. This movement creates a vacuum above the diaphragm which lifts the suction valve off its seat so that fuel can be drawn in. When the actuating rod moves backward, the loaded diaphragm spring pushes the diaphragm upward, forcing the fuel in the pump through the delivery valve and into the carburetors. This process is repeated at every turn of the cam (once every two revolutions of the engine).

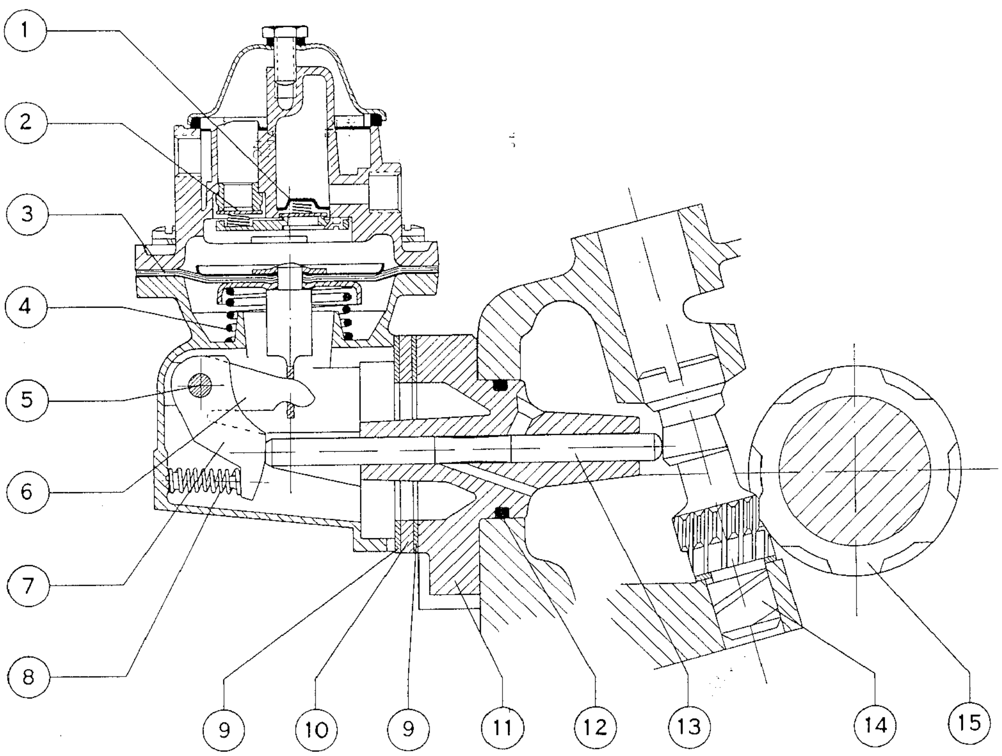


Fig. 29

Fuel Pump (Cutaway)

① Delivery valve
② Suction valve
③ Diaphragm
④ Diaphragm spring
⑤ Rocker arm pin
⑥ Rocker arm link
⑦ Rocker arm
⑧ Rocker arm spring
⑨ Gasket
⑩ Fibre flange
⑪ Intermediate flange (light alloy)
⑫ O-ring
⑬ Actuating rod
⑭ Distributor drive shaft
⑮ Distributor drive gear

Fuel Pump Components

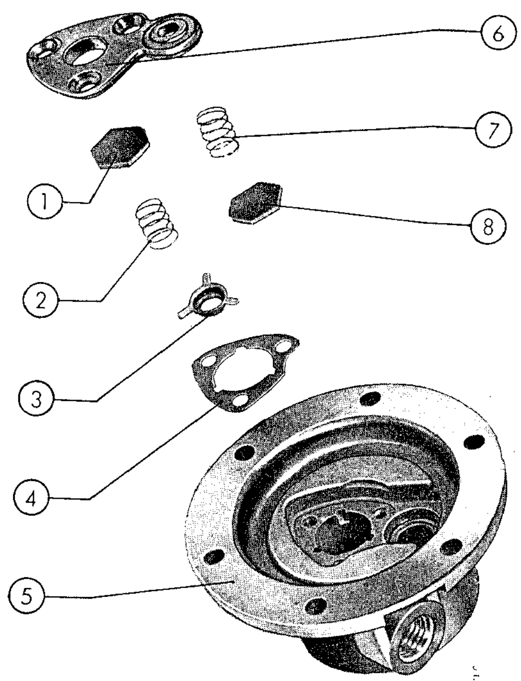


Fig. 30

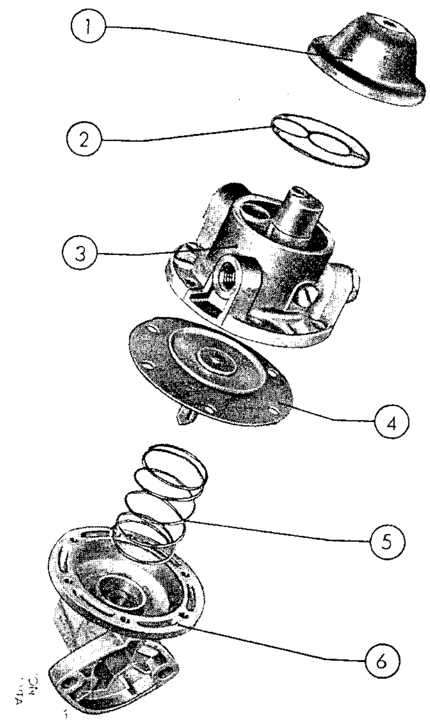


Fig. 31

① Valve plate for exhaust valve
② Valve spring for exhaust valve
③ Spring seat for exhaust valve
④ Gasket for valve retainer plate
⑤ Pump Cover
⑥ Valve retainer plate
⑦ Valve spring for intake valve
⑧ Valve plate for intake valve

① Housing cover top
② Filter
③ Housing cover
④ Diaphragm
⑤ Diaphragm spring
⑥ Pump housing

Checking Pump Pressure

14 Fu

General

The pump pressure depends on how much the spring is compressed during the pump suction stroke. The spring is so balanced that fuel is forced to the carburetor via the pressure valve only if the float needle valve is open. In case the float needle valve closes with rising float, the pressure in the fuel line and pump housing increases while the pump working stroke decreases. Under normal conditions the diaphragm is moved only some fractions of an inch (approx. 2/100").

A hole is provided for venting the chamber below the diaphragm. This hole also permits draining of fuel which might have entered the lower chamber.

Checking

The pump pressure should amount to .13 to .18 atü with the float needle valve closed and the engine running at 1000 to 3000 r.p.m. The minimum amount of fuel delivery is 18 ltrs/h = 300 c.c. per minute at 4500 r.p.m.

To check the pump pressure use a pressure gauge which is connected to a fuel line between the pump and the carburetor by means of a T-fitting. The fuel line is fitted with a fuel shut-off cock behind the pressure gauge. The specified pump pressure ist determined by the correct adjustment of the actuating rod stroke and the diaphragm spring tension.

Adjustment of the pump stroke is effected by fitting corresponding flange gaskets.

If the stroke adjustment does not give the desired result, replace the diaphragm spring. If the pump pressure is too low, the intermediate coils of the spring may be stretched apart, should this be necessary.

Too high a pump pressure will result in overflow of the carburetor and, consequently, in dilution of the engine oil. If it is too low, insufficient fuel will be delivered and an uneven running and missing of the engine at high speed as well as a decrease in performance will be the result.

Removing and Installing Fuel Pump

15 Fu

Special Tools:
VW 126 a Fuel Pump Wrench
VW 328 a Fuel Pump Push Rod Gauge

Removal

1. Disconnect fuel lines from carburetors and fuel pump.
2. Remove retaining screws on pump flange (using fuel pump wrench VW 126 a).
3. Take off pump.

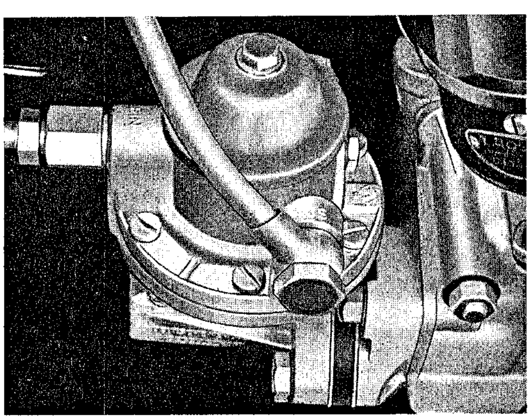


Fig. 32

4. Remove actuating rod, fibre flange and gaskets.

Adjusting Stroke of Fuel Pump

1. Place intermediate flange, actuating rod, and a gasket, which should be in perfect condition, on crankcase. The oil hole in the intermediate flange must face upwards. The convex end of the actuating rod must face toward the cam of the distributor drive shaft.
2. Attach gauge VW 328 a to the flange and tighten it to the same torque as for the fuel pump in order to compress the gaskets to their usual thickness. The actuating rod stroke of about .16" (4 mm) is determined by the cam on the distributor drive shaft. The stroke should move within a range of 2" (5 mm) which is marked on the gauge. The marks correspond to a length of 1.14" (29 mm) and 1.34" (34 mm) measured from the fuel pump contact flange (including gaskets) to the projecting actuating rod end. Crank the engine to check the pump stroke. The specified stroke can be adjusted by fitting an appro-

priate number of gaskets to the intermediate flange. Do not fit less gaskets than required, as this would have a detrimental effect on the diaphragm and the drive mechanism.

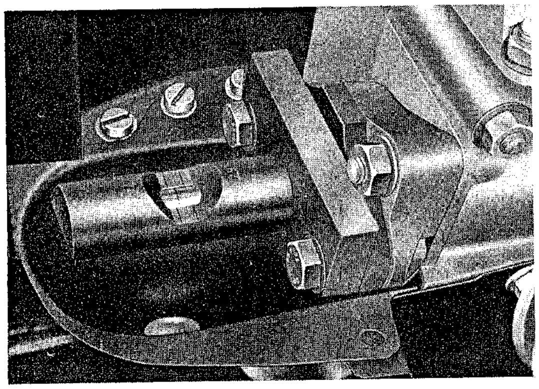


Fig. 33

Installation

1. Fill fuel pump housing with special grease before installing it.
2. Fit fuel pump.
3. Connect fuel lines.
   See to it that the fuel line rubber grommet is correctly seated in the engine front cover plate!

16 Fu

Reconditioning Fuel Pump

Special Tool: VW 328 b Fuel pump diaphragm gauge

Disassembly

1. Remove hex. hd. retaining screws on pump cover.
2. Take off pump cover and fuel strainer.
3. Unscrew the six slotted screws and take off pump cover.

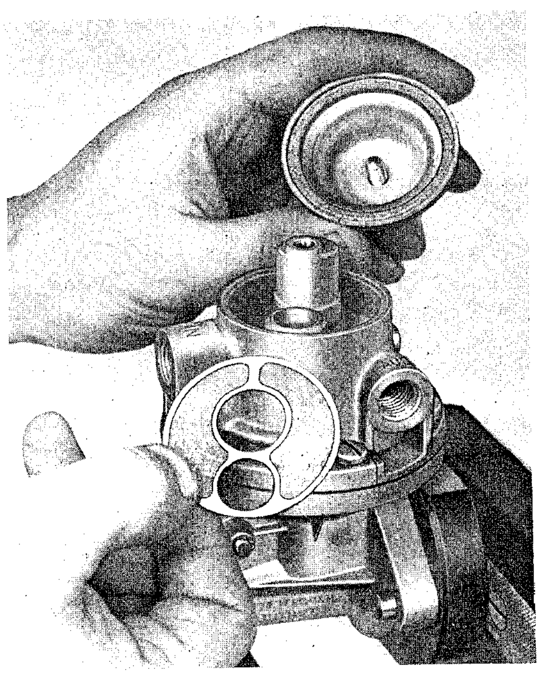


Fig. 34

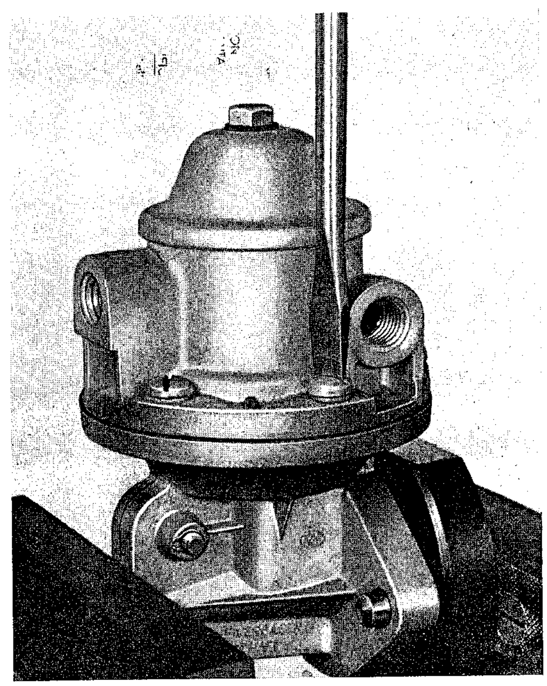


Fig. 35

4. Press down diaphragm and disconnect it from the pump rocker arm link. Remove diaphragm with spring.

5. Force out rocker arm link pin. Remove rocker arm link, rocker arm and spring.

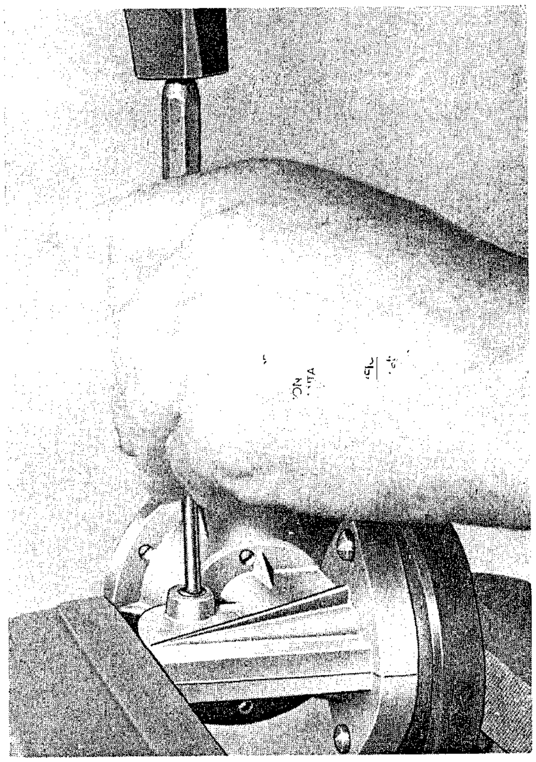


Fig. 36

6. Unscrew valve retainer plate from pump cover by pressing down valve retainer plate until the three screws have been screwed out. Carefully take off the plate to avoid the components jumping off.

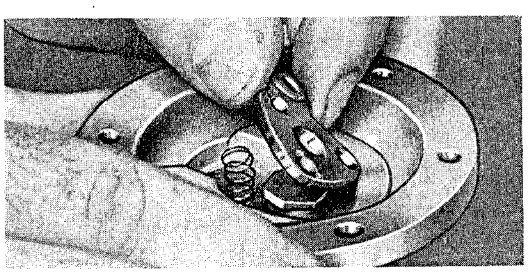


Fig. 37

7. Thoroughly clean all pump components in fuel.

Assembly

1. Check valve seat in pump cover for perfect condition.

2. Check valve seat at valve retainer plate.

3. Replace valve plates, valve springs and valve retainer plate gasket. Place valve plates in position taking care that their sides with red coated face contact with the valve seat.

4. Place and hold valve retainer plate in position until the screws are tightened uniformly.

5. After installation of the valves check to see whether opening and closing is perfect.

6. Install rocker arm link, rocker arm and spring in pump housing. Check rocker arm pin for wear. Install pin and secure.

7. Place spring and diaphragm in position. Engage the diaphragm actuating rod in the rocker arm link. Replace diaphragm if it shows traces of hardening or wear.

8. Place fuel pump housing in a vice with the gauge VW 328 b inserted. Thus the rocker arm is pressed 1.4" (35 mm) inwards (measured from flange joining face), bringing the diaphragm to the required assembling position.

9. Fit pump cover, taking care that the diaphragm is perfectly even. Securely tighten cover screws diagonally and uniformly.

10. Check pump cover gasket, if necessary replace.

11. Place fuel filter in position and tighten cover screws.

12. Fill fuel pump housing with special grease (anti-freeze). At operating temperature the grease assumes a liquid condition, thus lubricating all moving parts. Lubrication is improved by engine oil which is fed into the pump housing through the bore in the light alloy flange. Another grease packing is therefore not necessary. Rocker arms and actuating rods which are lacking grease indicate a leaking diaphragm.

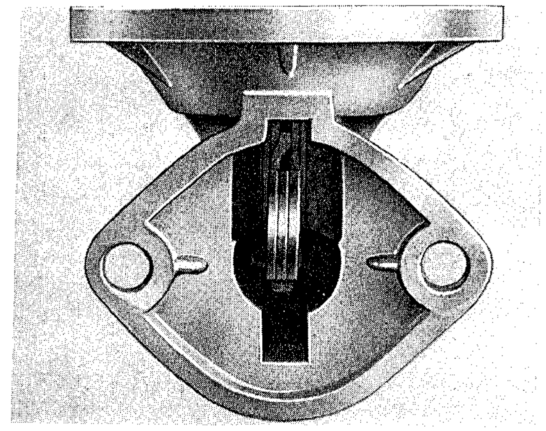


Fig. 38

Fuel Pump Troubles and Their Cure

Trouble	Cause	Remedy
1. Pump leaking between housing and cover: loss of fuel	a) Slotted screws loose b) Diaphragm cracked	a) Tighten screws b) Replace diaphragm
2. Diaphragm leaks at rivets; loss of fuel	Diaphragm damaged by inexpert installation	Replace diaphragm acc. to specification
3. Diaphragm material leaking; loss of fuel	Diaphragm material damaged by solvent ingredients in fuel	Replace diaphragm
4. Excessive pump stroke: overstraining of the diaphragm	Pump incorrectly installed, gasket too thin	Install pump correctly, if necessary check diaphragm
5. Pump pressure too low	a) Pump incorrectly installed, gasket too thick b) Spring tension too low	a) Install pump correctly b) Replace spring, or if necessary stretch it apart
6. Pump pressure too high; float needle valve forced down	a) Pump incorrectly installed, gasket too thin b) Spring tension too high	a) Install pump correctly b) Replace pring, or if necessary bring intermediate coils closer together
7. Fuel pump inoperative or insufficient fuel delivery	Valves leaking or sticking	Check valves, if necessary replace valve plates and valve seats

Removing and Installing Fuel Tank

17 Fu

General

The fuel tank, holding 13⅔ US gals, 1⅓ being reserve (52 ltrs., 5 ltrs. reserve) is located under the front hood and accessible after opening the hood.

Removal

1. Close fuel cock and disconnect fuel hose from fuel line.
2. Remove cotter pin between operating linkage and fuel cock and pull operating linkage slightly backwards.
3. Remove fuel tank bleeder hose.
4. Remove gasoline gauge connection.
5. Remove screws on the two fastening straps.

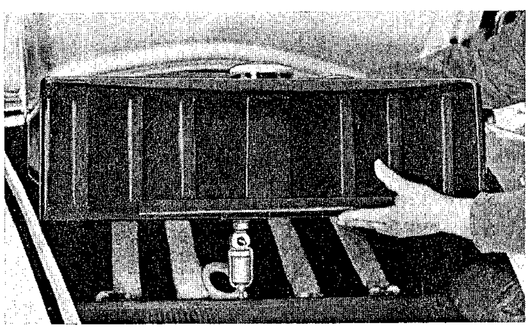


Fig. 39

6. Take off and completely empty fuel tank.
7. Remove fuel cock.
8. Remove fuel gauge indicator mechanism.
9. Flush fuel tank with fuel.
10. Clean fuel cock.

Installation

When installing, proceed in reverse order, observing the following points:

1. If necessary, replace felt and rubber ring on the opening of the fuel cock.

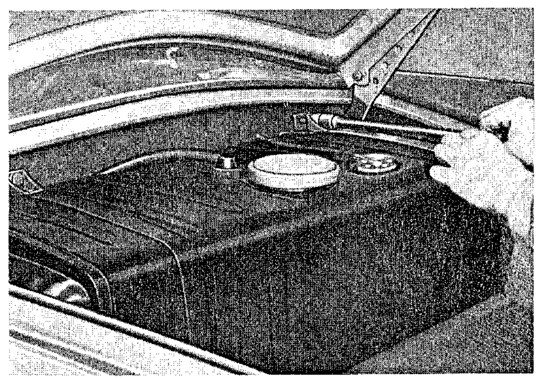


Fig. 40

2. Fuel tank bleeder hose must be in perfect condition; Blow compressed air through bleeder hose.
3. Detach fuel line from fuel pump and blow compressed air through it, refasten fuel line.
4. Make sure that seat of rubber grommet for the operating linkage is in perfect condition.

Fuel Cock

Fuel passes through a strainer via the fuel cock and filter into the fuel line. The fuel cock is operated by a linkage from the front seat of the car. Its three positions are: "Auf" (open), "Zu" (closed), and "Reserve" (reserve).

Cleaning

The fuel cock filter can be removed after unscrewing the wing nut and the water separator (close fuel cock). With the fuel tank installed, the cock is accessible from the inside of the car. Rinse the filter in clean gasoline and blow compressed air through it. After reinstallation check fuel cock for leaks and perfect operation.

Fuel Cock

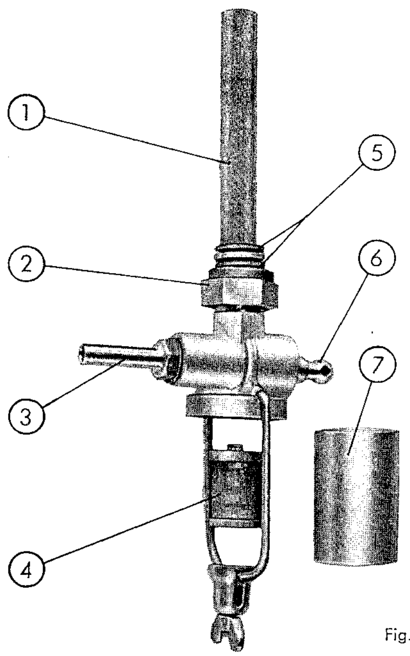


Fig. 41

① Strainer

② Union nut

③ Connection for fuel hose

④ Filter

⑤ Gaskets

⑥ Connection for operating linkage

⑦ Filter housing

18 Fu

Removing and Installing Fuel Cock

To clean the fuel tank and the strainer in front of the fuel shut-off cock, the fuel cock must be removed.

Removal

1. Remove and fully empty fuel tank (see 17 Fu).

2. Unscrew union nut and take off fuel cock.

3. Clean strainer with compressed air.

Installation

Install in reverse order, observing the following points:

1. Thoroughly clean fuel tank.

2. Use new gaskets (one each above and below the strainer edge).

3. Make sure that connection at fuel cock correctly aligns with operating linkage. If necessary, loosen union nut and slightly offset fuel cock.

3. After installation check connections for leaks.

Inspection of Fuel System

19 Fu

Procedures:

1. Check quantity of fuel in tank. Air vent hole in the fuel filler cap must be perfectly clean.

2. Check position of fuel cock.

3. Disconnect fuel line on carburetor. For a moment press the starter button without switching on ignition and check if fuel is delivered:

   a) Fuel is delivered: check pump pressure; check if float needle valve and jets in the carburetor are perfectly clean.

   b) No fuel is delivered:

4. Disconnect fuel line to fuel pump.

   a) Fuel is coming out: check fuel pump for leaks. If necessary, retighten pump housing screws and connection. If necessary, remove and check fuel pump.

   b) No fuel is coming out:

5. Remove fuel tank, check cock, check gaskets.

6. Blow compressed air through fuel line.

Fuel Mileage Test

20 Fu

Mileage Test while the Car is driving

(average consumption)

It is recommended to measure the fuel consumption of a car under normal driving conditions over a great distance. An approximate measurement can be made by fastening a fuel-mileage tester on the fuel pump and replenishing or weighing the fuel consumed for a certain distance. Do not allow the carburetors to become empty while driving, unless they were empty at the beginning of the test. To carry out the test, the following points should be observed:

1. Adustment of fuel pump, carburetor and ignition should correspond to factory specification.

2. Before carrying out the test, the engine must have obtained the normal operationg temperature.

3. The car must be normally loaded.

4. If possible, conduct the test under normal road and driving conditions. City driving, continous driving in the lower gears on a level ground or in the mountains, rapid acceleration and high speeds, consequently lead to higher fuel consumption.

5. Only high-grade commercial fuel should be used. Consumption may be determined as follows:

$$\frac{\text{Fuel consumed (gals.)}}{\text{Length of the course (miles)}} \times 100$$

Apart from the above mentioned test there is also the possibility to measure the fuel consumption on the test bench with the engine removed.

In this connection we should like to refer to the information for determination of the fuel consumption according to DIN 70030.

SPECIAL TOOLS

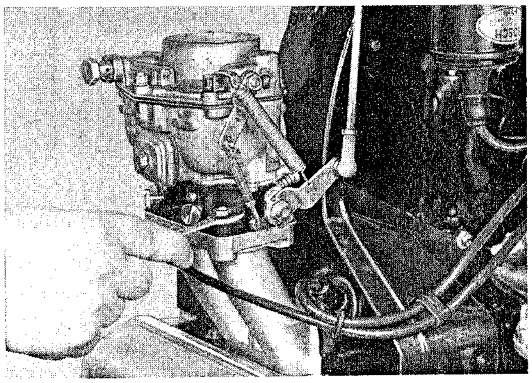
TO

GROUP F

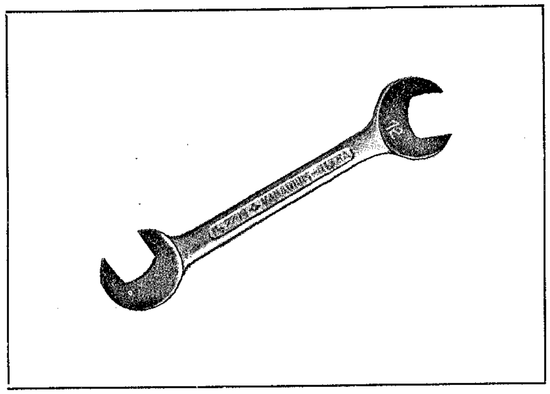
FUEL SYSTEM

Carburetor Wrench

P 23



Application



Tool

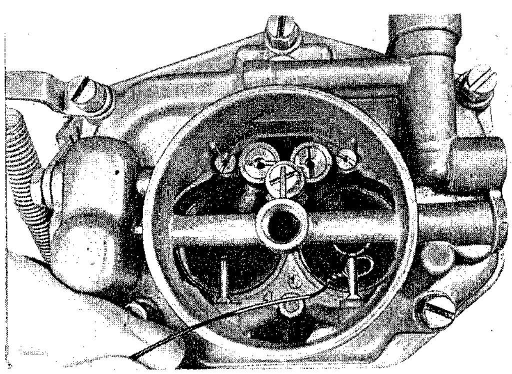
Use: To tighten and loosen carburetor retaining nuts
Engine Type 1600, 1600 S

See Supplements to Workshop Manual, Group F; Procedure: Fu 11

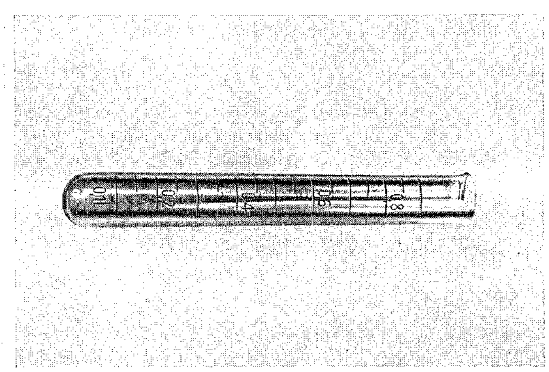
Subject to Modification

Measuring Glass

P 25a



Application



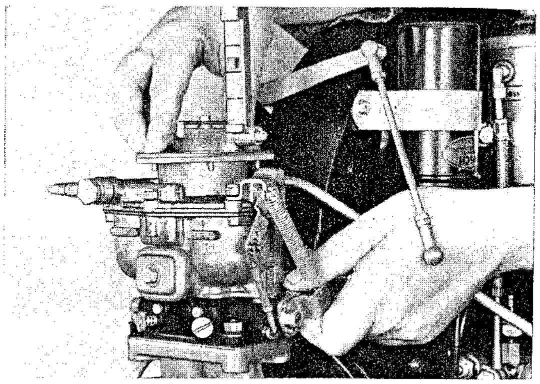
Tool

Use: To measure injection ratio

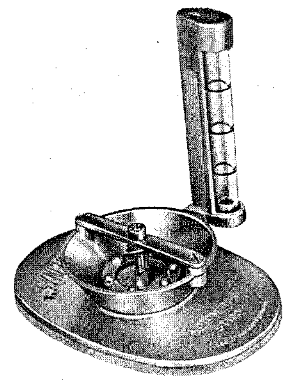
See Supplements to Workshop Manual, Group F; Procedure: Fu 15

Subject to Modification

Carburetor Synchronizing Unit — P 75



Application



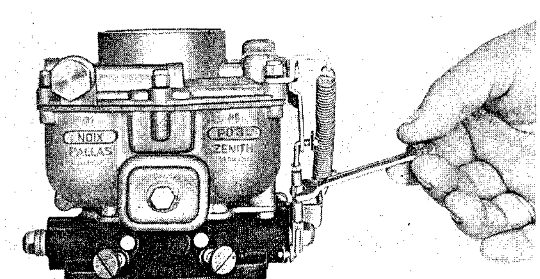
Tool

Use: To synchronize both carburetors

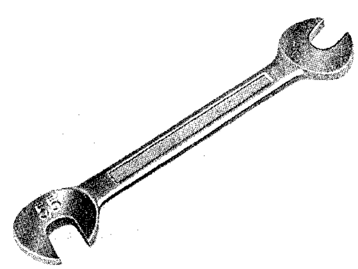
See Supplements to Workshop Manual, Group F; Procedure: Fu 16

Subject to Modification

Carburetor Wrench 5,5 mm — P 76



Application



Tool

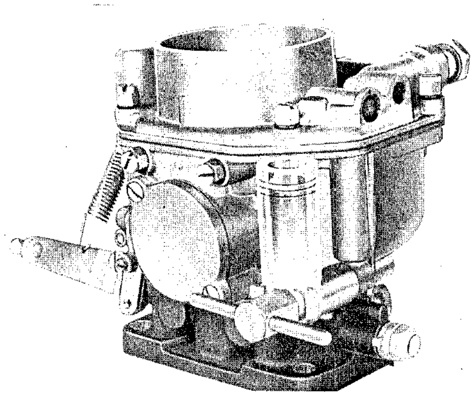
Use: To readjust pump linkage when adjusting injection ratio
Carburetor Zenith 32 NDIX

See Supplements to Workshop Manual, Group F; Procedure: Fu 16

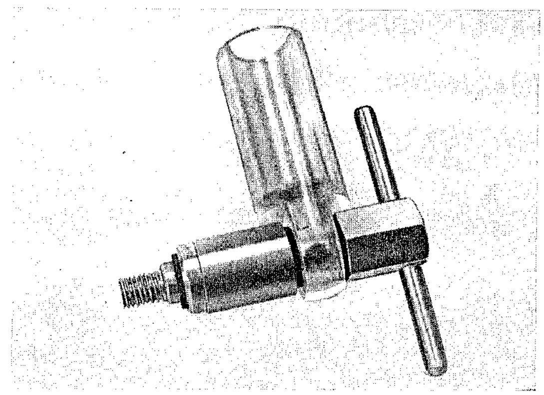
Subject to Modification

Fuel Level Measuring Glass

P 77



Application



Tool

Use: To check fuel level with closed carburetor cover.
Carburetor Zenith 32 NDIX

See Supplements to Workshop Manual, Group F; Procedure: Fu 14

Subject to Modification

SECTIONAL INDEX

Section S: Steering Gear and Front Axle

Sectional View

of

Front Axle

DESCRIPTION OF FRONT AXLE

General

The front axle consists of two rigidly joined tubes which are welded to the frame. The axle tube ends carry the four supension arms which are free to pivot in one fiber bushing at the inside and one bearing at the outer end each. One torsion bar in each tube, adjustably anchored in the center counteracts twisting and lateral movement. The suspension arm ends are connected to the suspension arm links by adjustable pins, which are free to pivot. The stub axle swivels on king pins which pass through bushings in the suspension arm link. A thrust washer is fitted between the upper end and a rubber ring between the lower end of the stub axle and the suspension arm link, in order to prevent dirt from entering. Front axle tubes, suspension arms and suspension arm links have approximately the form of a parallelogram. Hydraulic, double-acting telescopic shock absorbers lessen road shocks and prevent rebound. Stops with rubber bumpers prevent bottoming of the suspension.

Lubrication

Under normal driving conditions the front axle should be lubricated at regular intervals as set out in the lubrication chart. If, however, the car is mainly used on bad roads or if it is driven no more than 7500 to 10 000 miles (12 000 to 15 000 km) in a year, that is a monthly average of less than 600 miles (1000 km), it is recommended to effect additional lubrication, say every 800 miles (1250 km) particularly at the lubricating points of the suspension arm link and the outer tie rod joints. The front wheel bearings should be thoroughly cleaned and repacked with the specified amount of grease once a year.

Important!

Perfect lubrication of the front axle bearing points is only ensured with the front axle raised off its wheels (unloaded condition). Grease should be applied to the nipples until the excess grease begins to emerge at the edges of the lubrication points. The service life of the front axle depends on proper lubrication with the recommended brand of lubricants. Before lubricating, the grease guns should be perfectly clean.

Maintenance

To maintain the good riding qualities of the car with regard to roadholding and perfect safety of operation, regular inspections and maintenance of the front axle and steering are absolutely necessary.

Proceed as set out below:

1. Check and adjust front wheel bearings
2. Check and adjust suspension arm link pins
3. Check and re-set toe-in of front wheels
4. Check shock absorbers for proper fit and effectiveness
5. Check wheel nuts or knock-off wheel nuts for tightness
6. Check and correct tire pressure

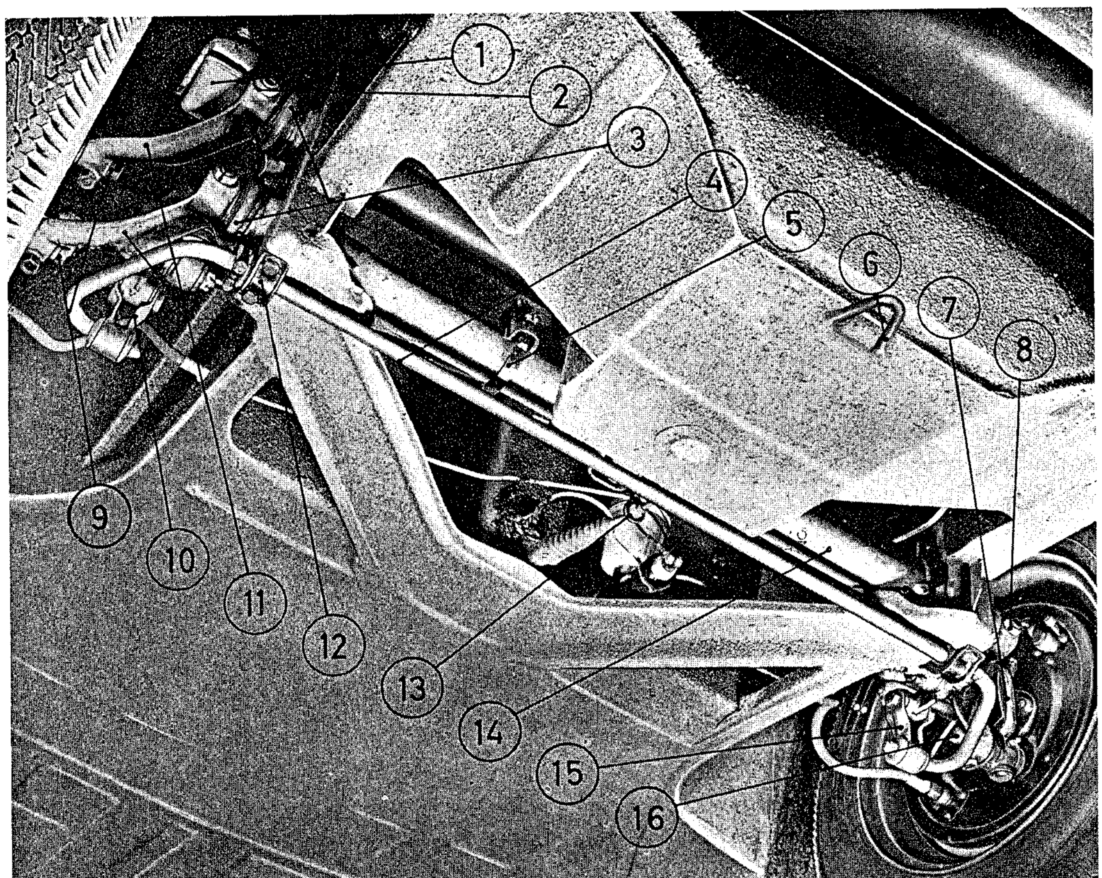


Fig. 1

① Rubber stop
② Retaining screw for suspension arm
③ Suspension arm oil seal
④ Anti-roll bar
⑤ Retaining clip for steering damper
⑥ Towing hook
⑦ Suspension arm link for stub axle
⑧ Retaining screw for suspension arm
⑨ Suspension arm link pin
⑩ Shackle for anti-roll bar, right
⑪ Suspension arm
⑫ Bearing cap for anti-roll bar, right
⑬ Connecting eye for parking brake cable
⑭ Lower torsion bar housing tube
⑮ Shackle for anti-roll bar, left
⑯ Lower suspension arm link pin, left

Illustration (right) gives a perspective detail view of the encircled section of both axle tubes.
Clearly visible are: Torsion bar mounting, threaded readjusting pin and carrier plate (contact plate) (see also fig. 56).

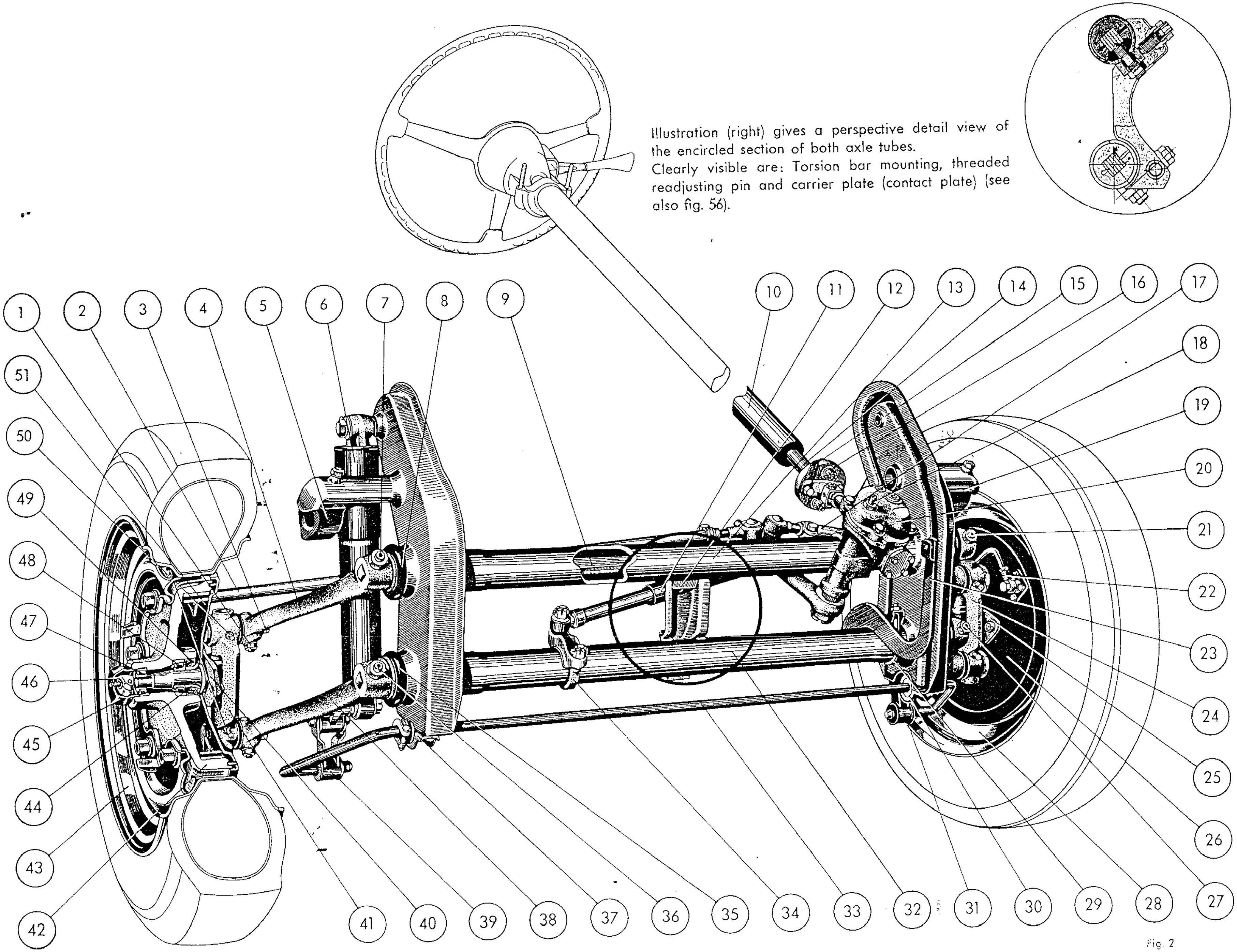


Fig. 2

① Hex. hd. clamping screw
② Tie rod, right
③ Suspension arm link pin
④ Upper suspension arm, right
⑤ Rubber stop, right
⑥ Shock absorber
⑦ Retaining screw for upper suspension arm, right
⑧ Upper suspension arm seal, right
⑨ Torsion bar
⑩ Tubular jacket
⑪ Steering damper
⑫ Carrier plate (stop)
⑬ Upper axle tube
⑭ Drag link tube
⑮ Earthing strap
⑯ Joint disc

⑱ Steering gear adjusting screw
⑲ Rubber stop, left
⑳ Steering gear
㉑ Retainig screw for upper suspension arm, left
㉒ Connection for brake line
㉓ Parking brake bell crank
㉔ Suspension arm link, left
㉕ Stub axle
㉖ Brake anchor plate, left
㉗ Retaining screw for lower suspension arm, left
㉘ Rim
㉙ Retaining clip for parking brake lever shaft
㉚ Anti-roll bar bearing
㉛ Mounting shackle for anti-roll bar, left
㉜ Lower axle tube
㉝ Anti-roll bar

㉟ Lower suspension arm seal, right
㊱ Retaining screw for lower suspension arm, right
㊲ Bearing cap for anti-roll bar, right
㊳ Lower suspension arm, right
㊴ Mounting shackle anti-roll bar, right
㊵ Stub axle
㊶ Suspension arm link, right
㊷ Brake drum
㊸ Rim
㊹ Spacer
㊺ Hub cap
㊻ Clamping nut
㊼ Front wheel bearing, outer
㊽ Front wheel bearing, inner
㊾ Front wheel bearing, seal
㊿ Grease nipple

DISASSEMBLY AND ASSEMBLY OF FRONT AXLE

Special tools:

P 30	Brake drum puller
P 63	Puller for annular taperd bearing
VW 266 f	Tie rod end remover
VW 156	Key 8 mm for tightening and loosening suspension arm center lock

1 ST

Disassembly

1. Remove drums (2 St)

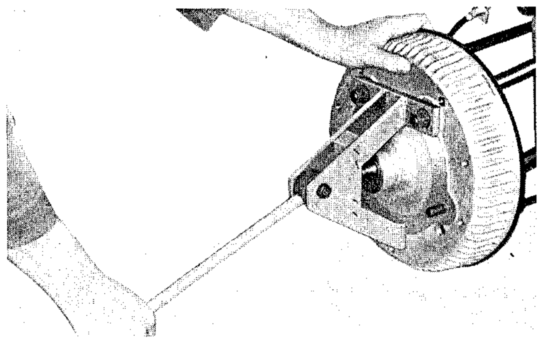


Fig. 3

2. Remove brake anchor plates

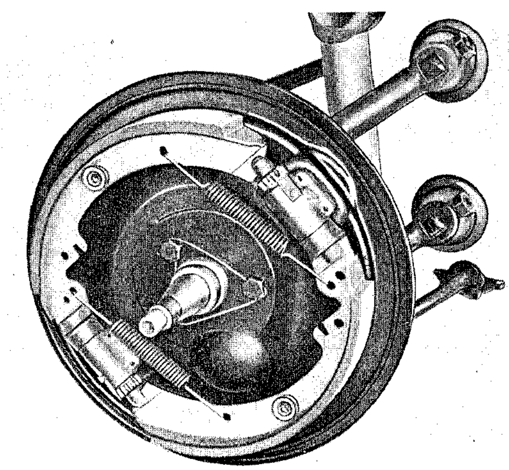


Fig. 4

3. Remove tie rods (19 St)

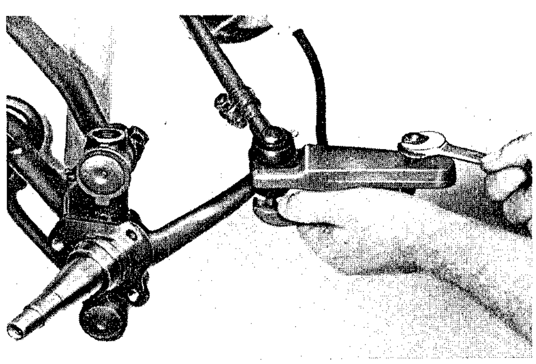


Fig. 5

4. Remove suspension arm link and stub axle (6 St)

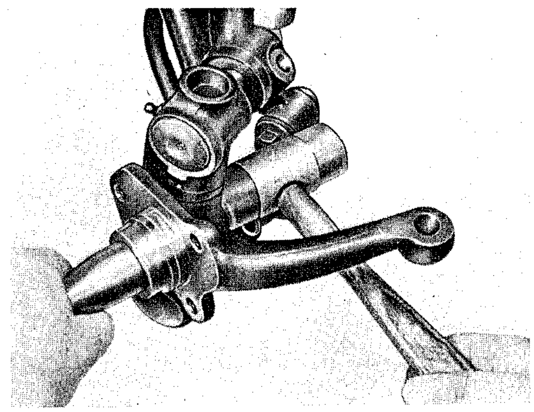


Fig. 6

5. Remove shock absorbers (16 St)

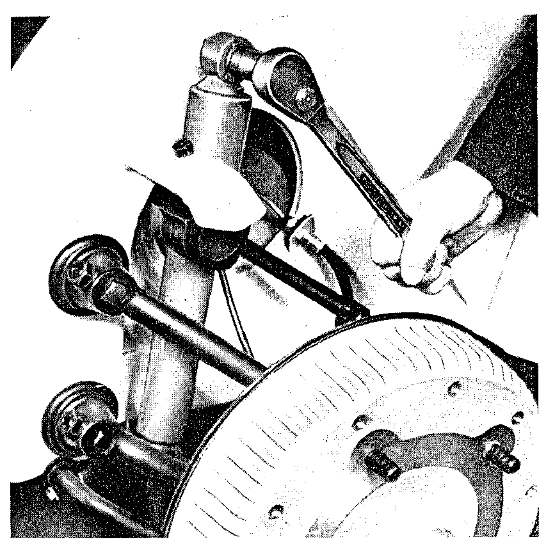


Fig. 7

6. Remove anti-roll bar (18 St)

7. Remove suspension arm (10 St)

8. Remove torsion bars (12 St)

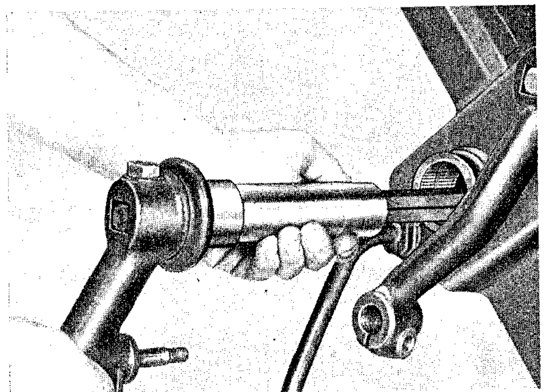


Fig. 8

Assembly

The front axle is assembled in reverse order, attention being paid to the instructions given in the following chapters.

2 ST

Removal and Installation of Front Wheel Brake Drum

Special tools:

P 30 Brake drum puller
P 63 Puller for annular tapered bearing

Removal

1. Take off wheel hub cap

2. Loosen wheel nuts

3. Jack up car

4. Take off wheel nuts and wheel

5. Remove speedometer drive shaft cotter pin on left front wheel.

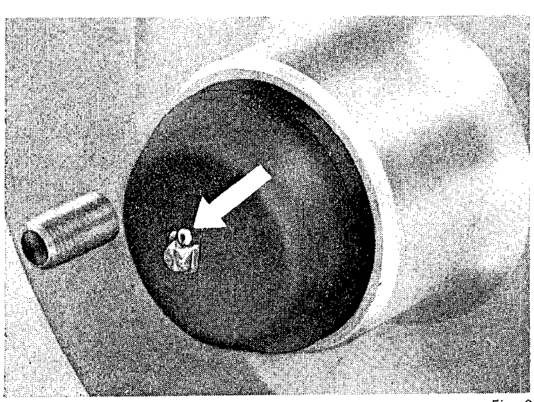


Fig. 9

6. Take off axle cover

7. Loosen cyl. screw in clamping nut and remove nut (right-hand thread on left and right stub axle). Loosening and tightening of cyl. screw is done with a commercial 6 mm hex. socket wrench.

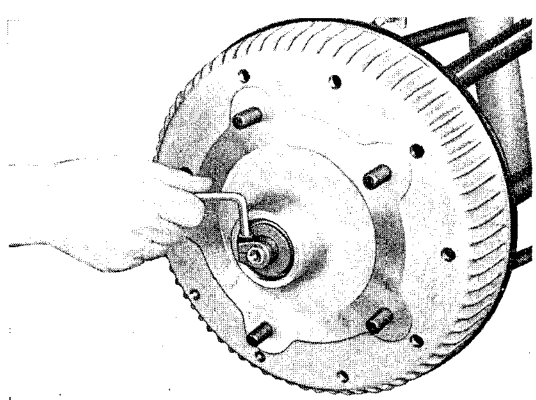


Fig. 10

8. Take out thrust washer

9. Remove brake drum with special tool P 30.

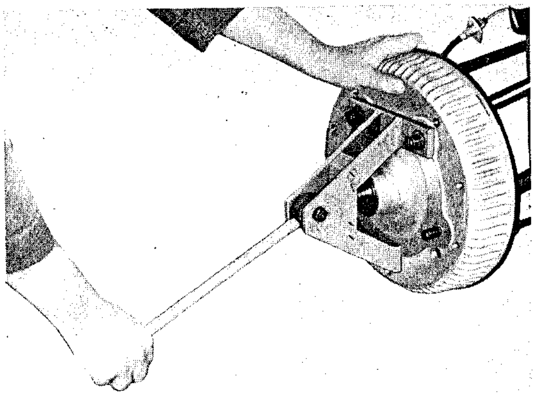


Fig. 11

Note: If an inner bearing should remain on the stub axle it can be pulled off by means of special tool P 63 (fig. 12).

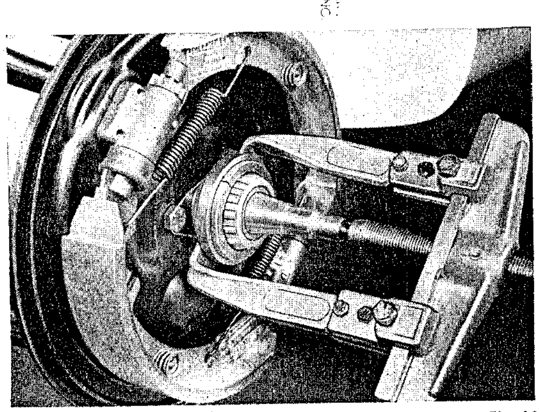


Fig. 12

Installation

Install brake drum in reverse order, observing the following points:

1. Brake surface of brake drum must be perfectly clean and should not show grooves. If necessary recondition brake drum as outlined in Group T of workshop manual.

2. Clean braking surface carefully, using fine-grained emery paper.

3. Clean hub in brake drum, front wheel bearing and seal

4. Check proper condition o front wheel bearing and seal

5. Grease and insert bearing with multi-purpose lithium-base grease. Take care that filling of one hub does not exceed approx. 1½ ozs. (or 50 c. c. = 45 grams).

6. Mount seal and make sure that washer is correctly seated.

7. Place brake drum in position and insert by means of clamping nut on stub axle.

8. Adjust front wheel bearings (4 St).

9. Mount axle cover

FRONT WHEEL BEARING

Removing and Installing Front Wheel Bearings

3 ST

Special tools:

P 30 Brake drum puller

P 63 Puller for annular tapered bearing

Arrangement of Front Wheel Bearings
(Sectional view)

① Brake drum

② Brake anchor plate

③ Seal

④ Washer (slotted)

⑤ Spacer

⑥ Outer race of bearing

⑦ Inner race of bearing

⑧ Speedometer drive shaft

⑨ Axle cover

⑩ Clamping nut
(Wheel bearing adjusting nut)

⑪ Thrust washer

⑫ Inner race of outer bearing

⑬ Outer race of outer bearing

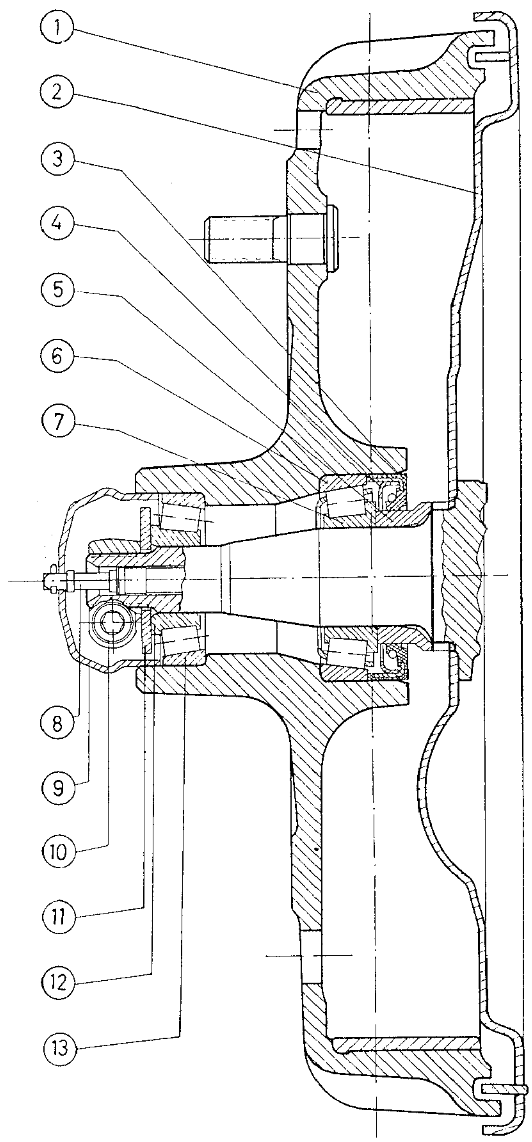


Fig. 13

Removal

1. Remove brake drum (2 St)

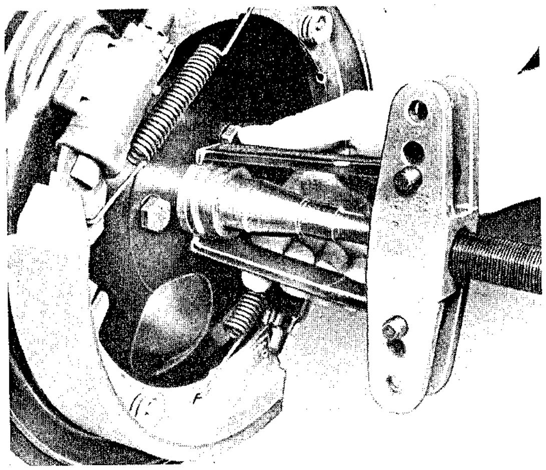


Fig. 14

2. If necessary, pull off spacer with sturdy commercial double-claw puller. Take care of cutout recess at stub axle.

3. Drive out both outer races of bearing of brake drum, proceeding carefully and evenly with a punch.

Installation

The front wheel bearings are installed in reverse order, observing the following points:

1. Prior to installing brake drum, clean it thoroughly. Remove all traces of old grease between the bearing seats. If the outer bearing races do not fit firmly, replace brake drum.

2. Wash annular tapered bearings carefully in clean gasoline and check them for perfect condition. If necessary replace bearings.

Important!

Ball races, cages or balls must never be replaced separately!

3. Check spacer for signs of cracks and wear; if necessary replace, using a suitable sleeve.

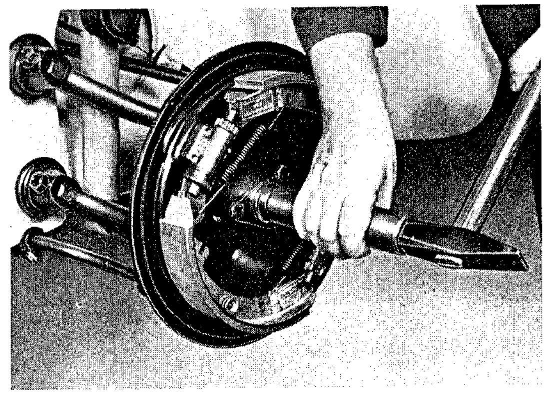


Fig. 15

4. Effective sealing of the brake drum oil seal is only guaranted if the surface of the spacer is absolutely clean and smooth

Seat A for inner bearing = 30,000 mm dia. (1.181) to 29,984 mm dia. (1.180)

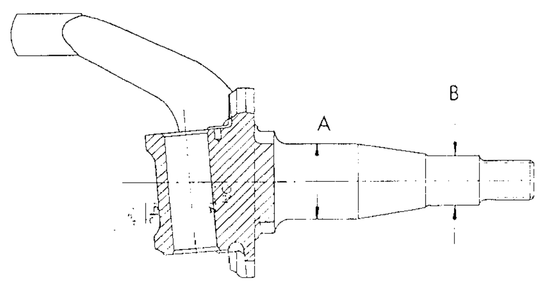


Fig. 16

Seat B for outer bearing = 19,993 mm dia. (.787") to 19,980 mm dia. (.780")

5. For installation of the outer bearing races for the inner and outer bearing the brake drum should be heated up to about 80° C (176° F). Install bearing, using a suitable arbor.

6. Install both bearings with approx 1½ ozs. (50 c. c. or 45 grams) of multi-purpose lithium-base grease, as specified in the lubrication chart.

7. Insert seal, make sure that washer is correctly seated.

8. Place brake drum in position and insert on stub axle by means of clamping nut. Take care that outer bearing is correctly seated. (see fig. 13).

Adjusting Front Wheel Bearings

4 ST

When adjusting the front wheel bearings the following points should be observed in order to prevent premature wear and damage.

Inspection

1. Take off axle cover from brake drum and remove excessive grease

2. Adjustment is correct, if the thrust washer on the outer bearing can be easily moved laterally, using a screw driver, and if no bearing clearance is felt when rocking the brake drum. The brake drum should rotate easily.

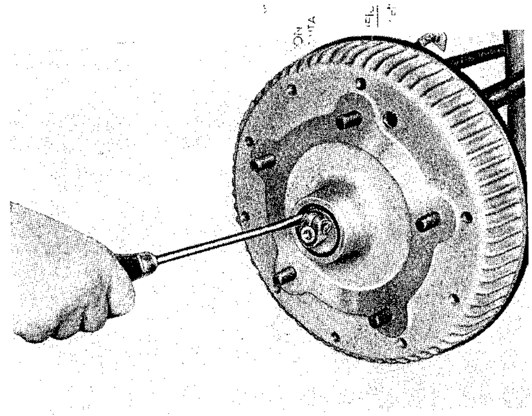


Fig. 17

Adjustment

1. Pry off clamping nut by loosening cyl. screw

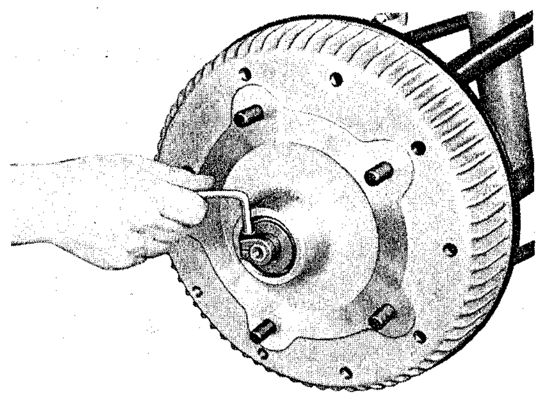


Fig. 18

2. Tighten or loosen clamping nut until thrust washer can be easily moved laterally when using a screw driver and no clearance can be felt when brake drum is moved. Lock clamping nut without twisting by tightening cyl. screw.

Important!

In order to be able to tighten or loosen the locking screw of the clamping nut in vehicles with Knock-off wheels, a .5512" (14 mm) dia. hole should be drilled into the threaded part of the hub. The distance from centre of bore to outer edge of hub should be .7480" (19 mm). As an emergency, an offset 6 mm hexagon socket wrench can be shortened correspondingly.

Adjusting Suspension Arm Link Pins

5 ST

General

The suspension arm link pins should be checked at regular intervals, as set out in the maintenance plan. If necessary they should be adjusted.

Inspection

1. Jack car up
2. Rock the wheel by hand to check clearance between the suspension arm link and suspension arm. If excessive play is present, adjust suspension arm link pins

Fig. 19

Adjustment

1. Loosen hex. hd. clamping screws on suspension arm eyes

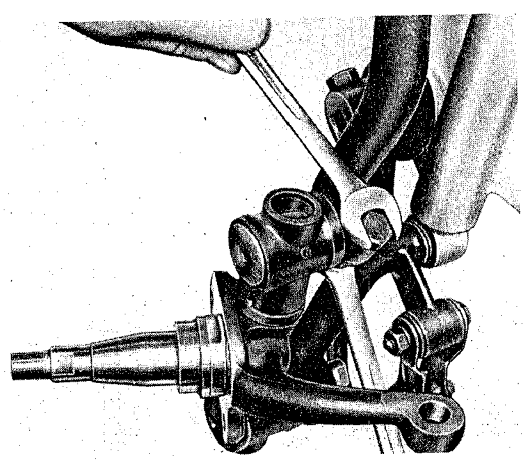


Fig. 20

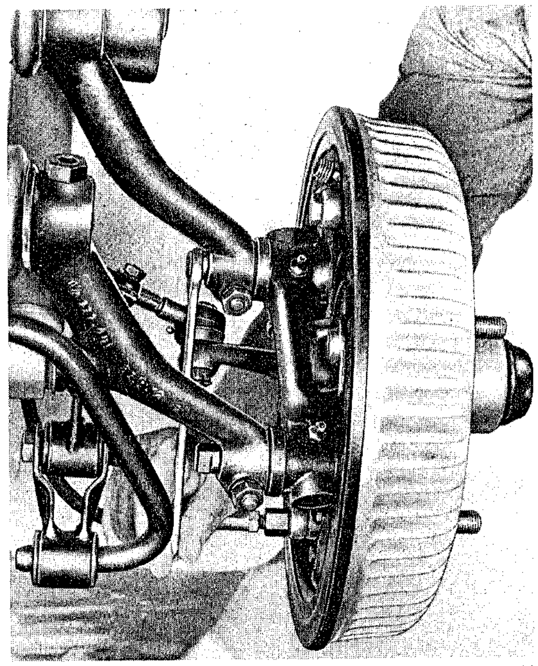


Fig. 21

2. Tighten suspension arm link pins to a degree which will still allow a free movement between the suspension arms and the suspension arm link pins. For this purpose tighten first the suspension arm link pins fully and then untighten slightly — at the most by approx. 1/8 turn. If no correct adjustment can be effected, the shims are worn and should be replaced by new ones. See procedure 6 St.

3. Tighten clamping screws.

Attention!

After every adjustment of the suspension arm link pins, check toe-in and if necessary re-adjust

Correct offset with shims of .0197" (0,5 mm) thickness

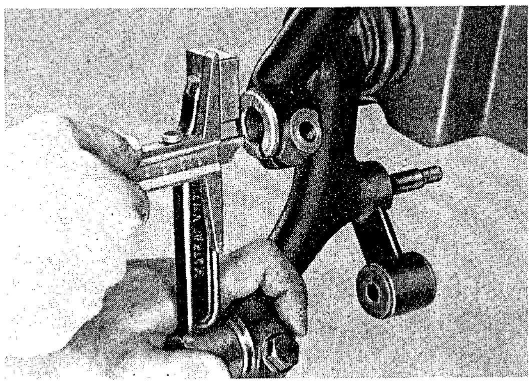


Fig. 26

Arrangement of shims on Suspension arm link pins

Offset in (mm)	Number of shims on			
	Upper suspension arm		lower suspension arm	
	inner (A)	outer (B)	inner (C)	outer (D)
.200 (5)	3	7	7	3
.217 (5,5)	4	6	7	3
.236 (6)	4	6	6	4
.246 (6,5)	5	5	6	4
.276 (7)	5	5	5	5
.295 (7,5)	6	4	5	5
.315 (8)	6	4	4	6
.335 (8,5)	7	3	4	6
.354 (9)	7	3	3	7

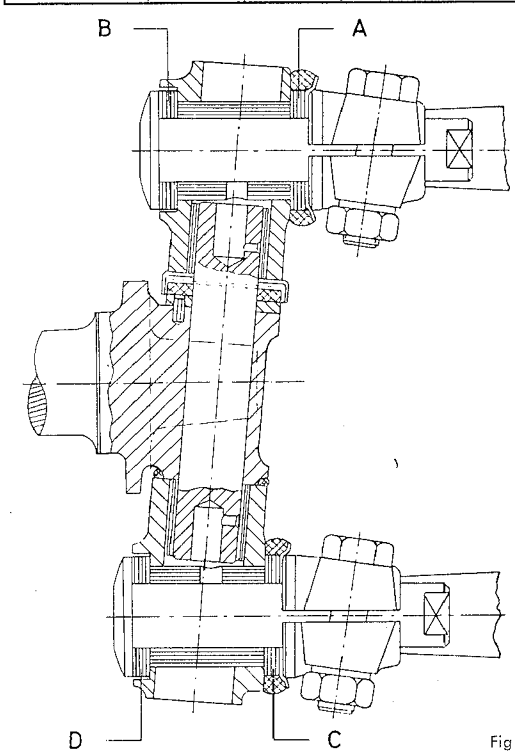


Fig. 27

Note:

a) Always 10 shims must be fitted to **one suspension arm link;** this includes also the sectional shim for the suspension arm eye. Make sure that the lug of the sectional shim is fitted in the clamping slot of the suspension arm eye.

b) If the offset amounts to .276" (7 mm) the same number of inner und outer shims (5 required) should be added

c) If the offset exceeds .276" (7 mm) add shims to A and remove from C

d) If the offset is less than .276" (7 mm) take off shims from A and add to C

e) The total number of shims at B and D should always be added up to 10

Example:

a) Offset measured was .327" (8,3 mm). The value measured is to be rounded out to the nearest value indicated in the table, in this case to .335" (8,5 mm)

b) The difference from the correct value .276" (7 mm) is .335" — .276" = .059" (8,5 — 7 = 1,5 mm)
This value corresponds to the thickness of 3 shims of .020" each

c) The shims must be arranged as follows:

Upper Suspension Arm		Lower Suspension Arm	
Inner (A)	Outer (B)	Inner (C)	Outer (D)
7	3	4	6

If the discrepancy from the required value exceeds ± .78" (2 mm) it is not permissible to correct by adding more shims. Misalignment can be determined by removing the suspension arms and checking them on test plate P 70. The front axle should be checked for alignment by means of the front axle tube alignment gauge VW 256 a.

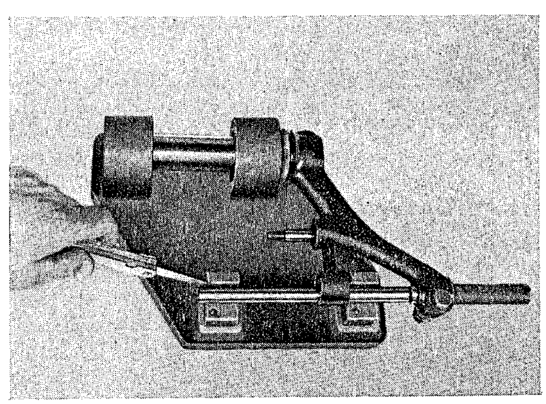


Fig. 28

4. Twisted suspension arms must be in any case repla-

ced. For safety reasons no attempt should be made to straighten them.

5. Grease suspension arm link pin and shims with multipurpose grease and install. If the offset has been corrected as outlined above, the suspension arm link pins can easily be pushed into the suspension arm eyes and the faces of the upper and lower suspension arms simultaneously make perfect contact

6. Adjust suspension arm link pins

7. After installation of the brake anchor plate, secure retaining screws with wire (fig. 29)

8. Check camber and toe-in of front wheels

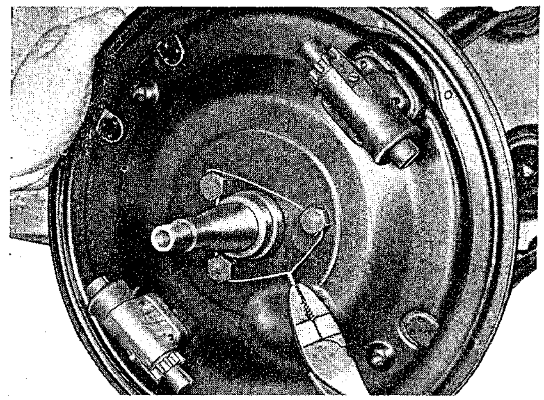


Fig. 29

7 ST

Removing and Installing Suspension Arm Link Pin Bushings

Special tools:

VW 133 Suspension arm link pin pilot drift, or
VW 400 Repair press with
VW 434 Arbor
VW 408 Punch and
VW 401 Thrust plate
VW 418 Tube or installing suspension arm link pin bushing in connecting with aforementioned tools
VW 259 Suspension arm link gauge

Removal

1. Remove suspension arm link and stub axle (6 St)
2. Press out suspension arm link pin bushings (with pilot drift VW 133 or VW repair press with arbor VW 434 in connection with VW 408 and VW 401)

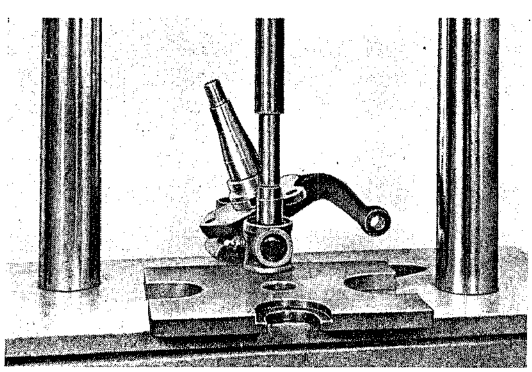


Fig. 30

Installation

When installing suspension arm link pin bushings, attention should be paid to the following points:

1. Check suspension arm link for correct offset, using gauge VW 259

2. Check depth of bores for suspension arm link pin bushings by means of gauge VW 259

3. Check clearance of king pin in bushings. If necessary, replace king pin and bushings (9 St)

4. Install suspension arm link pin bushings on

VW repair press with punch VW 408 in connection with VW 401 and VW 418. The bushings must be a press fit in the suspension arm link.

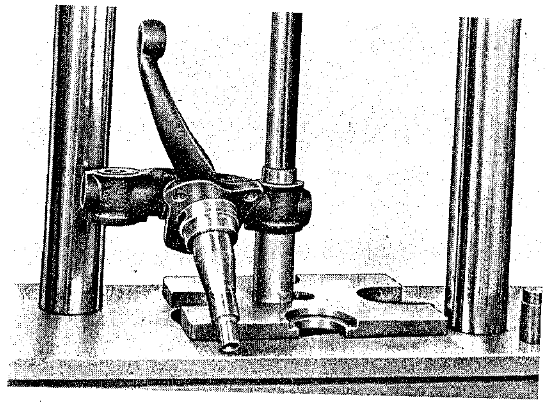


Fig. 31

Note:
When installing the suspension arm link pin bushings, make sure that the radial bore of the bushing is in line with the grease hole in the suspension arm link.

Removing and Installing Stub Axle

8 ST

Special tools:

VW 400	Repair press
VW 401	Thrust plate with
VW 411	Punch and
VW 418	Tube for removing king pin
P 69	Stub axle gauge
VW 259	Suspension arm link gauge
VW 434	Arbor in connection with VW 401, 411 for installation of king pin

Removal

1. Press out suspension arm link pin bushings from suspension arm link (7 St)

2. Drive out king pin on VW repair press with punch 411 in connection with VW 401 and VW 418. In order to prevent damage, the stub axle should be heated to 176—194° F (80—90° C) in an oil bath

3. Take out stub axle, thrust washer, cover (thrust bearing) and rubber seal from suspension arm link

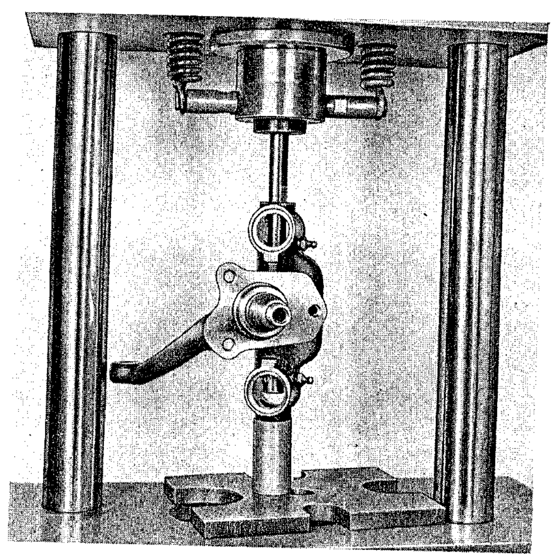


Fig. 32

Checking Stub Axle

1. Check stub axle for bends and twisting on alignment gauge P 69. Place stub axle in gauge and check position of seating surface on bore for the tie rod end. The bore in the steering arm of the stub axle should align with the hole in the gauge. No attempt should be made to straighten bent stub axles, they must always be replaced.

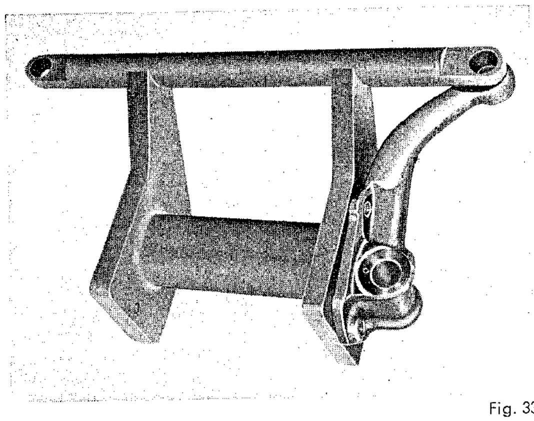


Fig. 33

2. Check thrust washer contact surface of the stub axle for smoothness and remove any burrs

3. Check front wheel bearing surfaces of stub axle.

4. Check bore for king pin (press fit); in case of wear due to seizure of the king pin, replace stub axle

Checking Suspenion Arm Link

1. Check suspension arm link for correct offset, using gauge VW 259

Correct value	.276" (7 mm)
Tolerance limit	.00787" (0,2 mm)

Place gauge and suspension arm link in a vise and measure offset, using a depth gauge resting against the back of the gauge plate; a dimension of .787" (20 mm) up to the recessed face in the torsion arm link corresponds to an offset of .276" (7 mm). Discrepancies from the correct value should be taken into account when determining the suspension arm offset

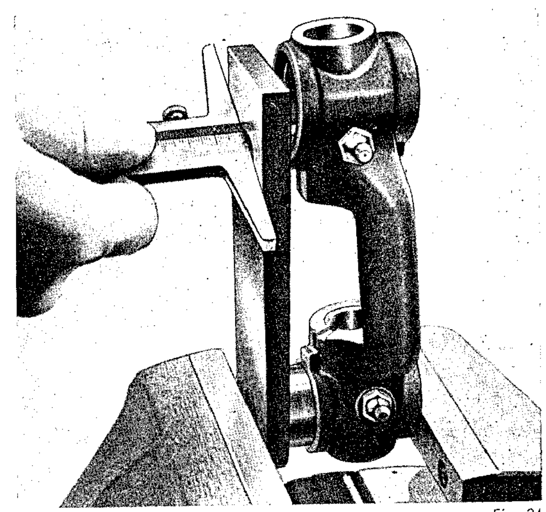


Fig. 34

3. Check depth of bores for suspension arm link pin bushings, using gauge VW 259. Replace suspension arm links, if the depth of the bores is below tolerance limit.

Installation

When installing stub axle, proceed in reverse order, observing the following points:

1. Check king pins for wear. If necessary, replace together with suspension arm link pin bushings

2. Check fit of thrust washer dowel pin in stub axle

3. Replace rubber seal

4. Fit suspension arm link together with stub axle and thrust bearing (thrust washer, friction washer and cover) so that no end play is felt. Existing play should be eliminated by inserting a thicker washer. For this purpose steel thrust washers 3,65, 3,75, 3,85, 3,95 through 4,5 mm in thickness are available. The thrust washer dowel pin is located in the stub axle and the cover is secured in position by grooves in the suspension arm. The rubber seal is on the opposite side.

5. Heat stub axle in oil bath to approx. 176° F (80° C) and press in king pin on VW repair press with arbor 434 in connection with thrust plate VW 401 and punch VW 411.

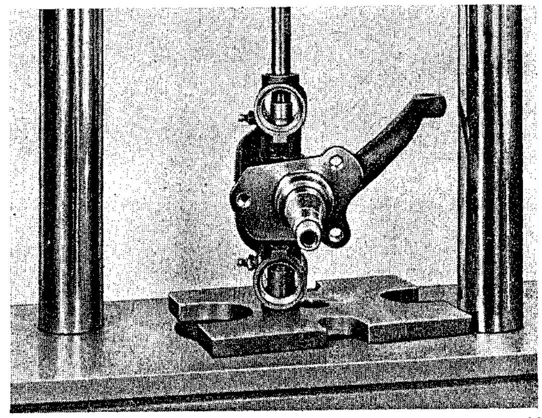


Fig. 35

Suspension arm link and stub axle must swivel freely when being moved by hand. If movement is stiff, tap slightly with an aluminium hammer

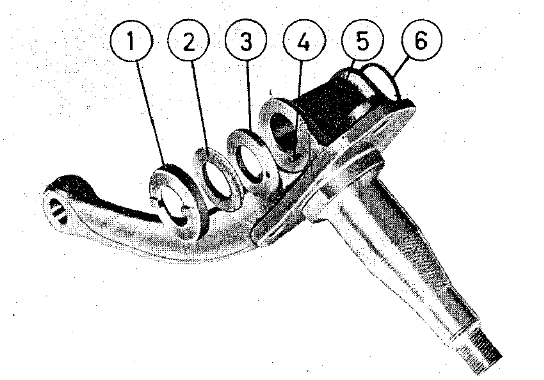


Fig. 36

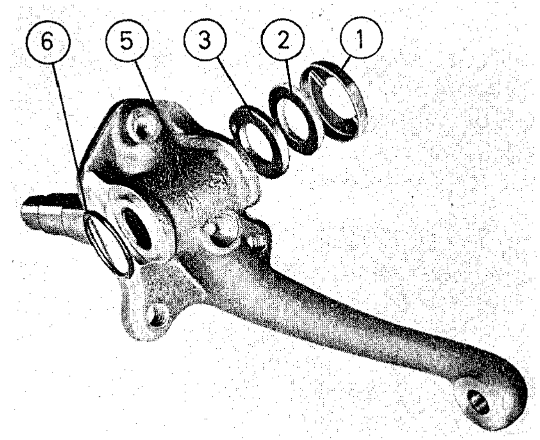


Fig. 37

① Bearing cap
② Friction washer
③ Thrust washer
④ Dowel pin
⑤ Stub axle
⑥ Rubber seal

Removing and Installing King Pin Bushings

9 St

Special tools:

VW 131	**King pin bushing pilot drift**
VW 400	**Repair press**
VW 401	**Thrust plate**
VW 411	**Punch with**
VW 422	**Tube and**
VW 423	**Tube for removing king pin bushing**
VW 224	**King pin bushing reamer**
VW 431	**Thrust pad with**
VW 432	**Thrust pad in connection with VW 401, 411, for installation of king pin bushings**

Removal

1. Remove stub axle (8 St)

2. Press king pin bushings out of suspension arm link, using pilot drift VW 131, or on repair press with punch VW 411 in connection with VW 422 and VW 423

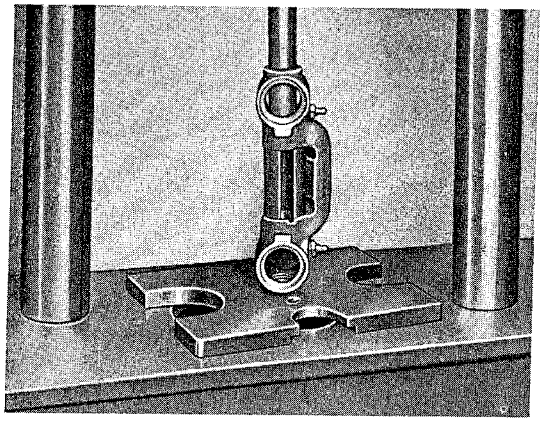


Fig. 38

Installation

When installing king pin bushings, attention should be paid to the following points:

1. Press in new bushings from inside of suspension arm link on VW repair press with punch VW 411 in connection with VW 431, VW 432 and VW 401

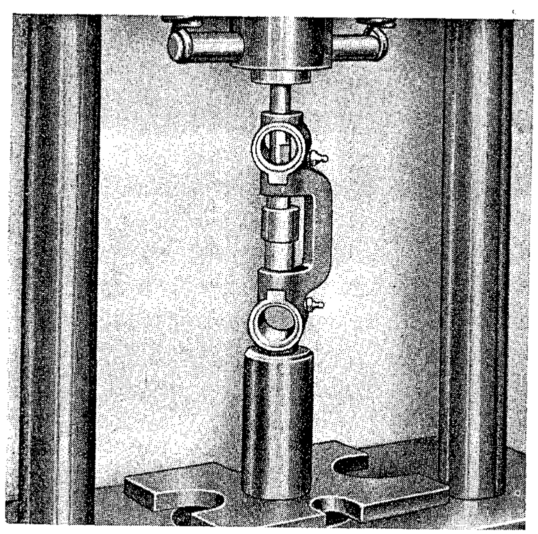


Fig. 39

2. When fitting upper bushing, take care that the groove in the bushing is in line with the groove in the suspension arm link. If not provided, file groove into the bushing after installation

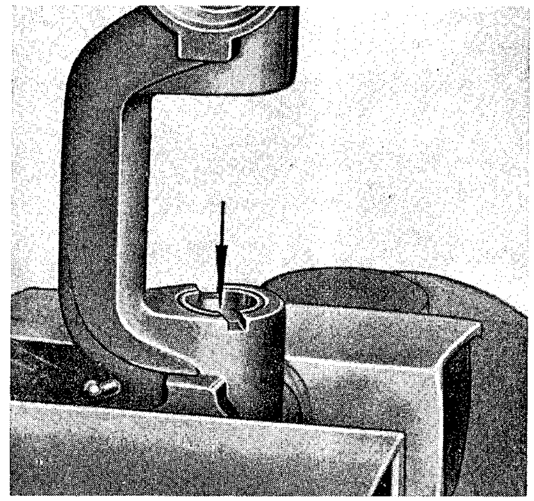


Fig. 40

3. Ream out bushings with reamer VW 224 (18 to 21 mm dia.). The tapered bushing of the reamer serves as a guide

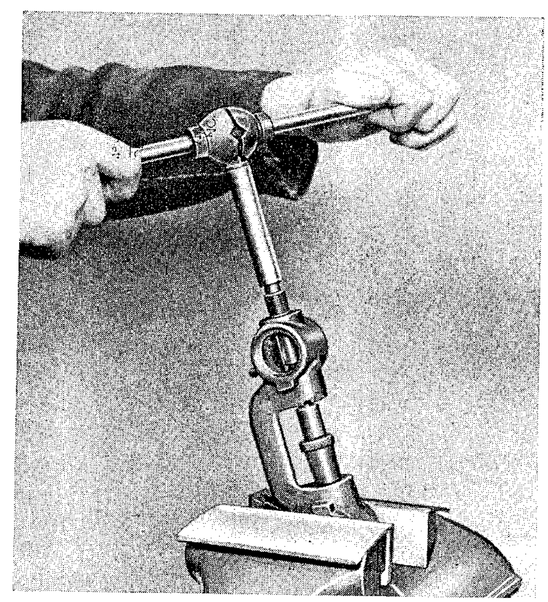


Fig. 41

Final size: 18.034 mm dia. to 18.016 mm dia.

The bushings are correctly reamed, if they are not scored and free from chatter marks, the king pin can be turned by hand and no clearance is felt in the bushings.

Removing and Installing Suspension Arms

10 ST

Special tools:

P 70	Suspenion arm gauge
VW 150	Offset handle with
VW 156	Key 8 mm for loosening suspension arm retaining screws
VW 127	Facing cutter for refacing suspension arm eyes

Removal

1. Remove suspension arm link and stub axle (6 St)

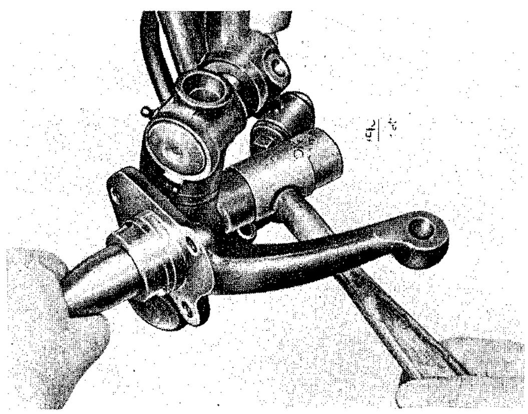


Fig. 42

2. Remove shock absorber (16 St)

3. Loosen shackle for anti-roll bar on lower suspension arm

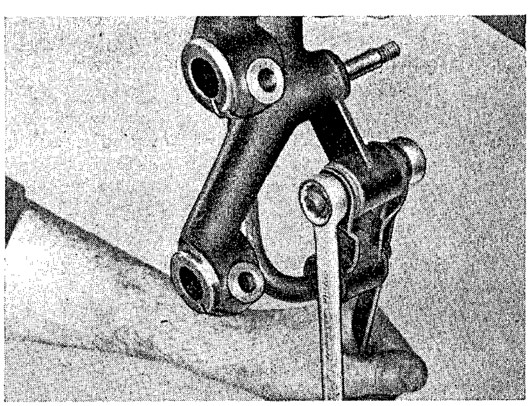


Fig. 43

4. Loosen lock nuts and threaded set pins on suspension arms with offset handle VW 150 or ratchet in connection with key VW 156

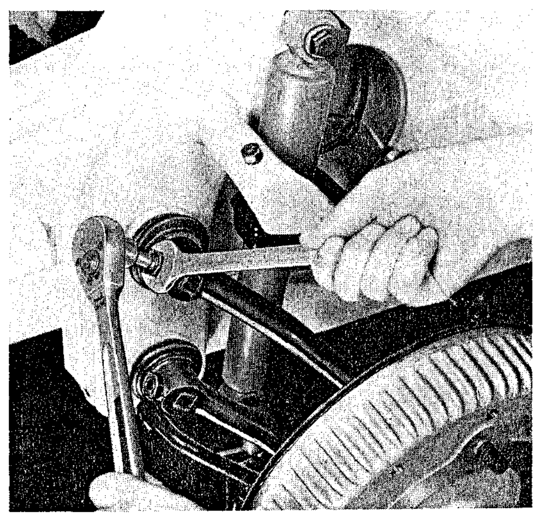


Fig. 44

5. Pull off suspension arm and rubber seal

6. Mark suspension arm needle bearings to avoid getting them mixed up when reinstalling

Checking Suspension Arms

1. Check suspension arms for parallelism and twist by placing suspension arms in test plate P 70.

   Prior to checking, remove rubber bearing for anti-roll bar on lower suspension arm

   Insert mandrel in suspension arm eye and tighten with clamping screw. Discrepancies from the test plate values can be determined by means of a feeler gauge. Permissible out-of-parallel is .00787" (0,2 mm)

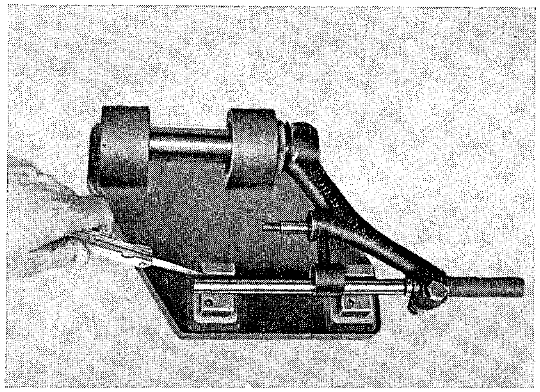


Fig. 45

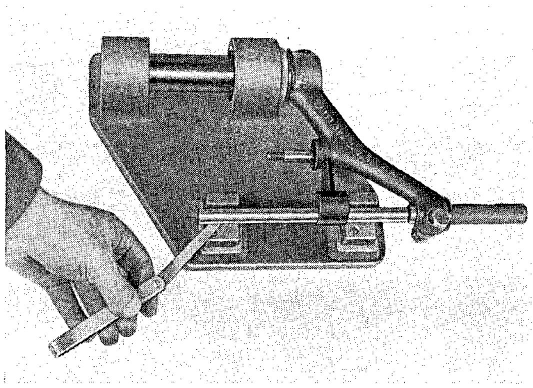


Fig. 46

No attempt should be made to straighten bent suspension arms, they must always be replaced

2. Check contact faces of suspension arm eyes for wear. If neccesary reface with cutter VW 217

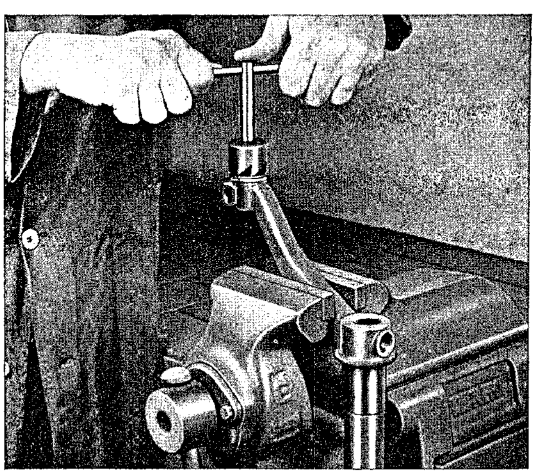


Fig. 47

3. Check suspension arm bearing points for wear. If heavy signs of wear or seizure are found, the suspension arm must be replaced

Installation

Installation is done in reverse order, observing the following points:

1. Check torsion bar adjustment. Make gauge according to sketch on page S 25

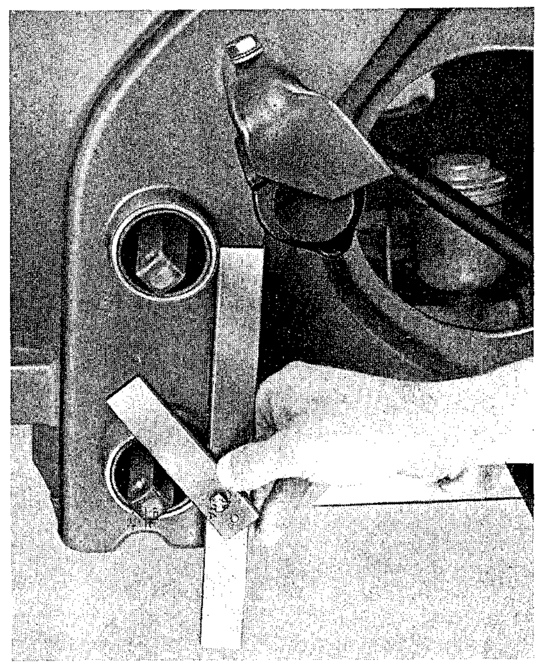


Fig. 48

2. Check suspension arm bearing bushings and needle bearings in front of axle tube for wear, replace if necessary.

3. If required, replace suspension arm rubber seal

4. Grease suspension arm with lithium-base grease and insert torsion bar until the countersink is in line with the recess in the suspension arm. Tighten threaded set pin and lock with counternut.

5. Re-install shock absorbers and firmly tighten retaining screws and nuts, using new lock plates or cotter pins resp.

Replacing Shock Absorber Mounting Stud on Suspension Arm

11 ST

General

When replacing the shock absorber mounting stud on suspension arm, in any case a .0197" (0,5 mm) oversize stud must be used. By pressing in the original stud, the hole in the suspension arm has been enlarged, so that a new stud of the same size would be a loose fit. Therefore replace standard studs of 11.989 mm dia. to 12,00 mm dia. by oversize studs of 12.489 mm dia. to 12,500 mm dia.

Removal

1. Remove suspension arm

2. Drive out retaining pin

3. Pull out stud. In case the stud is broken, center the piece remaining in the suspension arm by means of a center punch and drill a center hole of 1/8" (3 mm) dia.

Then drill out the remaining piece using a 27/64" (10,75 mm) drill. The thin shell remaining around the drilled hole will come out during the final drilling revolutions.

Installation

1. Drill the hole in the suspension arm out with 31/64" (12,3 mm) dia; drill and ream with reamer 12,5 P 8 = 12,455 to 12,482 mm dia. If a reamer 12,5 P 8 is not available, make the stud to fit the hole by grinding it to the required size. A press fit of .0004" — .0020" (0,01 — 0,5 mm) must in any case be ensured.

2. Press oversize stud in place, ensuring that the free end has a length of 1.770" — 1.790" (45,0 to 45,5 mm).

3. Drill hole .1575" (4,00 — 4,08 mm) dia. in stud for retaining pin

4. Drive in retaining pin

Removing and Installing Torsion Bars

12 ST

Special tools:

VW 150 Offset handle with
VW 156 Key 8 mm for loosening suspension arm retaining screws

General

The front axle torsion bars consist of 8 steel leaves, welded together at both ends. The torsion bars are mounted in the center of the front axle tubes and secured in an adjustable clamping piece by means of retainings screws and counternuts.

The clamping piece is split and as the retaining screws are tightened, it is forced open and pressed against the axle tube. The clamping piece is further prevented from turning by an adjustment stop which is pressed from outside against the axle tube by the retaining screw nut.
A threaded set pin presses on the adjustment stop from the top and serves to readjust the torsion bars and prevents the adjustment stop at the same time from turning under heavy load.

Removal

1. Remove suspension arm of one side (10 St)

2. Loosen retaining screws and lock nuts of torsion bars in axle tube

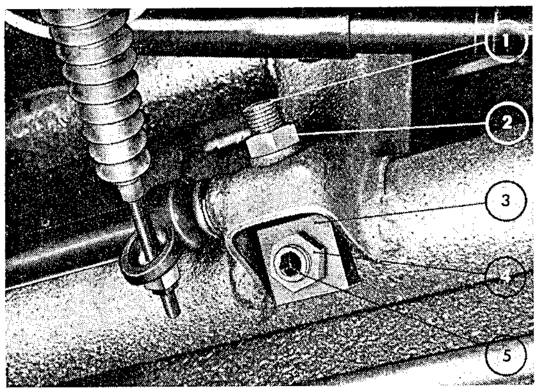


Fig. 49

① Threaded set pin
② Lock nut
③ Adjustment stop
④ Lock nut
⑤ Retaining screw

3. Pull out suspension arm of the opposite side together with the torsion bar

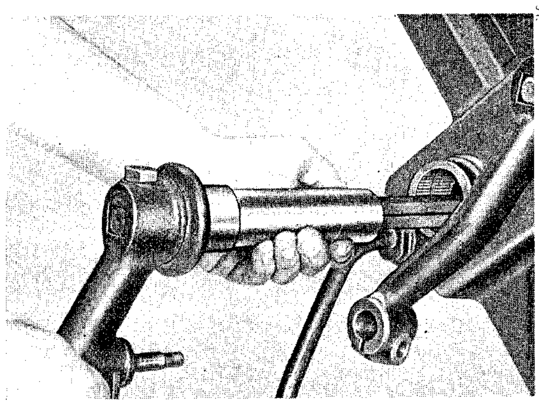


Fig. 50

Inspection

1. Clean torsion bars and check them for cracks and fractures. If necessary, replace
2. Loose torsion bar leaf ends must always be arc-welded

Installation

Install torsion bars in reverse order, observing the following points:

1. Check suspension arms, plastic bushings and needle bearings for wear, if necessary replace

2. Coat torsion bars with grease and place in position

3. Bring the countersink in the center of the torsion bar in line with the hole for the retaining screw. Tighten retaining screw slightly and press upward until the adjustment stop makes contact with the threaded set pin. Tighten retaining screw and check position of torsion bars

4. a) If the position of the torsion bar is correct, press adjustment stop against axle tube by tightening lock nut

   b) If the position of the torsion bars is incorrect, adjust them as outlined in page S 25

Important!

Offset of suspension arms and toe-in must be checked after every removal and reinstallation of torsion bars.

Checking and Adjusting Angular Position of Torsion Bars

Checking

1. Remove left suspension arm

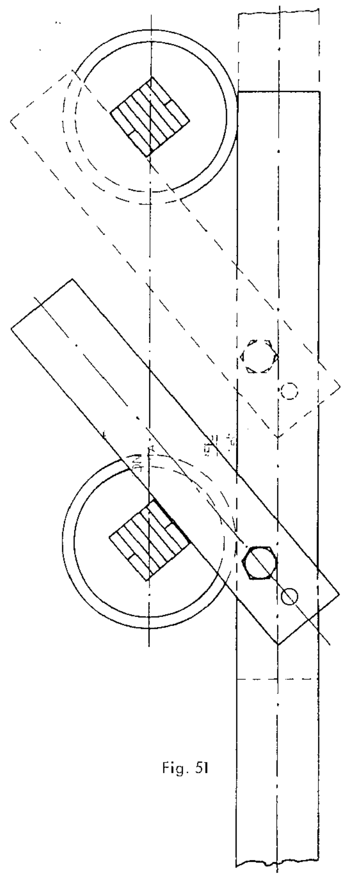


Fig. 51

Sketsch how to make gauge for checking torsion bar adjustment

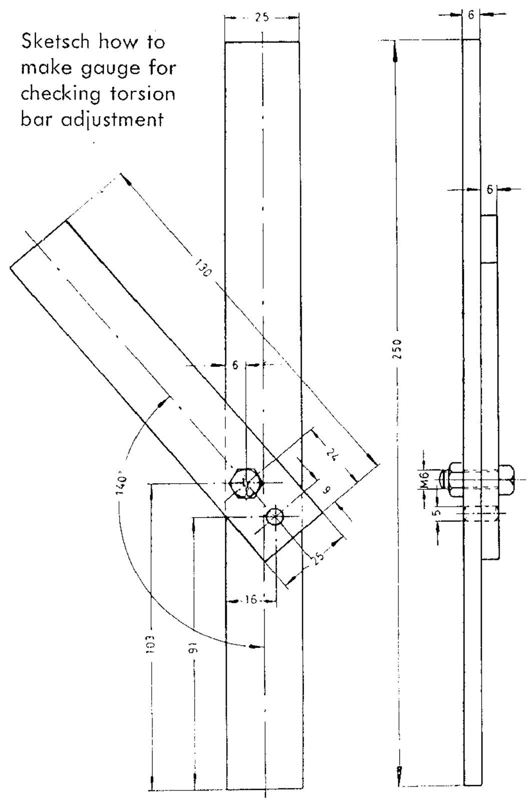


Fig. 53

2. Check angular position using homemade gauge (see fig. 52)

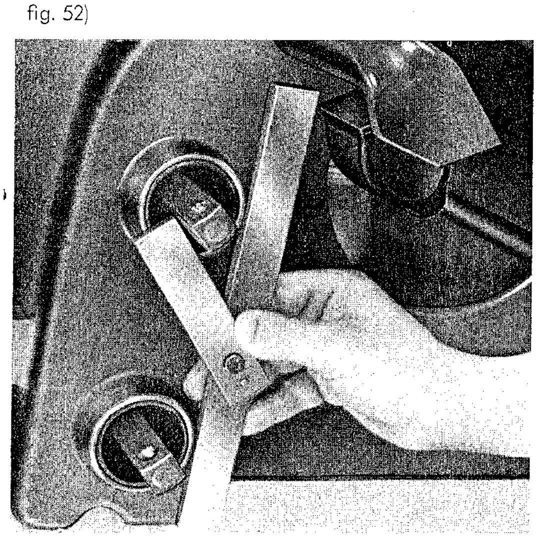


Fig. 52

Adjustment

1. Remove left suspension arm

2. Remove right stub axle

3. Loosen lock nut of retaining screw for torsion bar in the center of the axle tube

4. Loosen retaining screw with allen wrench (8 mm)

5. Loosen lock nut on threaded set pin

6. Correct torsion bar adjustment by turning threaded set pin, using allen wrench (8 mm)
   One full turn corresponds to an approximate angular correction on the torsion bar of 2° 50'

7. Check angular position, make sure that the adjustment stop makes contact with the threaded set pin

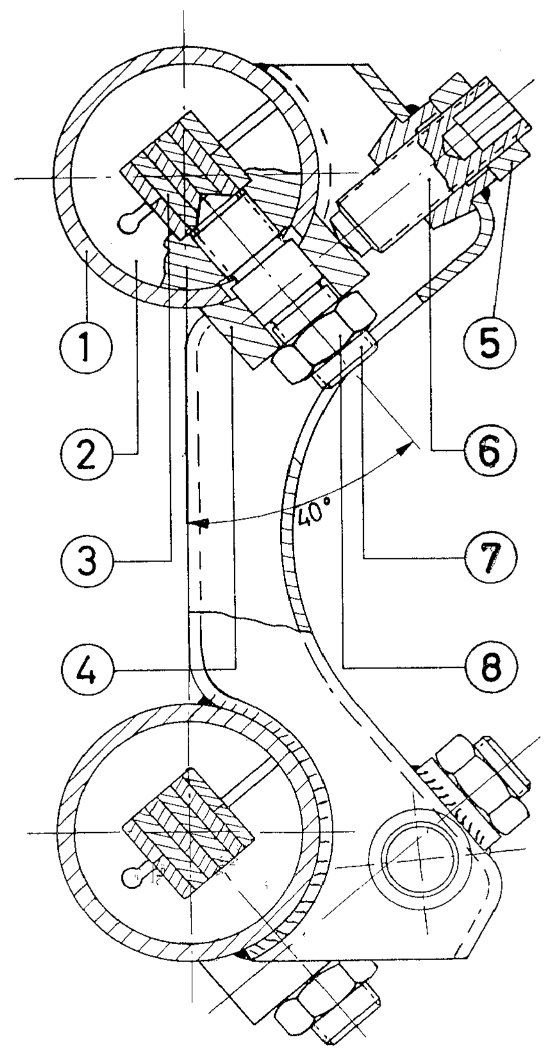
8. Tighten retaining screw and press adjustment stop against lock nut

9. Secure threaded set pin by tightening lock nut

10. Recheck torsion bar adjustment

Note:

If the adjustment range in the slot of the axle tube is not sufficient to correct the angular position of the torsion bar, the torsion bar to be adjusted must be removed and the slot refinished. Care should be taken that the slot is refinished .0394" (1 mm) longer than required, in order to make adjustment after setting of the torsion bars possible



① Front axle tube
② Clamping piece
③ Torsion bar
④ Adjustment stop
⑤ Lock nut
⑥ Threaded set pin
⑦ Retaining screw
⑧ Lock nut

Fig. 54

Removing and Installing Plastic Bushing and Bushing for Needle Bearing

14 ST

Special tools:

P 54	Puller for needle bearing bushing in axle tube
P 71	Sleeve
VW 272	Puller for plastic bushings
VW 273 a	Suspension arm bushing drift
VW 274 a	Suspension arm bushing reamer

Removal

1. Remove torsion bars (12 St)
2. Remove grease nipples on front axle tube
3. Extract bushing for needle bearing, using puller P 54

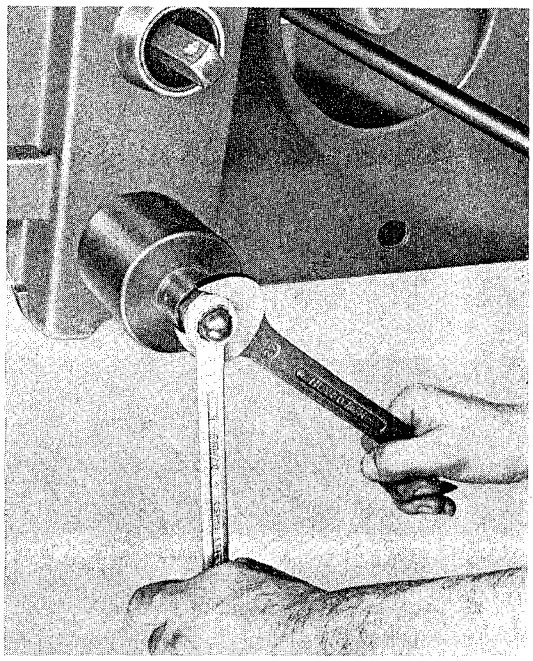


Fig. 55

4. Extract plastic bushing using tool VW 272

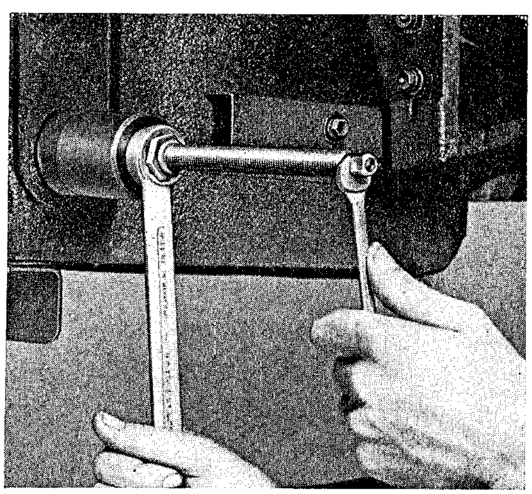


Fig. 56

Installation

1. Clean front axle tube housing, especially seating of bushings prior to fitting new bushings

2. Install plastic bushing in such a manner that the open side of the grease grooves point towards outside. Drive in bushing with tool VW 273 a until the shoulder at the arbor touches the torsion bar tube

3. If neccessary, ream inner bearing bushing. For this purpose insert sleeve P 71 in axle tube (see fig. 57)

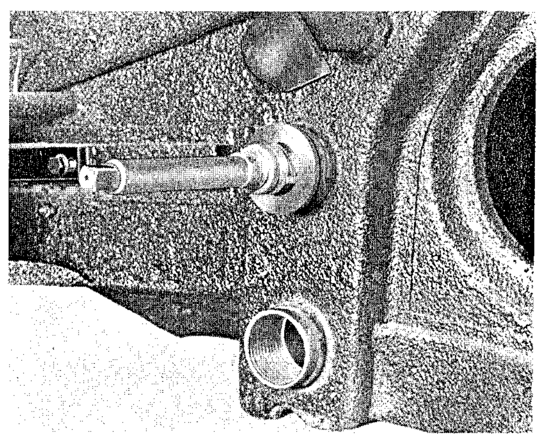


Fig. 57

The reamer is guided into the sleeve P 71 by means of a bearing bushing (fig. 59)

The bearing bushings should be reamed to the following dimensions:

Suspension arm	Reaming dimension of plastic bushing
(36,93 – 36,95 mm) dia. 1.453" – 1.454"	(37,10 – 37,15 mm) dia. 1.4606" – 1.4646"

Installation clearance of suspension arm-bushing:
(0,15 – 0,22 mm) .00591 – .00865"

4. Clean axle tube with compressed air. Care should be taken that no chips remain in the axle tube
5. Insert needle bearing in axle tube and drive in with short section of drift VW 273 a
6. Screw grease nipples into axle tubes, replace defective nipples

15 ST

Checking Front Axle Tube

Special tools:

(2) **P 71**	**Sleeve to be inserted in axle tube when measuring with tool VW 256 a**
P 54	**Puller for needle bearing bushing in axle tube**
VW 256 a	**Front axle tube alignment gauge**

General

Front axle tubes which are suspected to be twisted or out of alignment due to an accident should be checked by means of the front axle tube alignment gauge VW 256 a.

Checking

1. Check inner supension arm bearing bushings for wear. If neccessary, install new bushings and ream them. Severely worn bushings do not allow accurate checking of the tube alignment
2. Pull out needle bearing bushings, using tool P 54 (14 St)
3. Insert 2 sleeves P 71 in place of the needle bearings
4. Insert the two mandrels of the VW gauge 256 a in the front axle tube as far as they will go

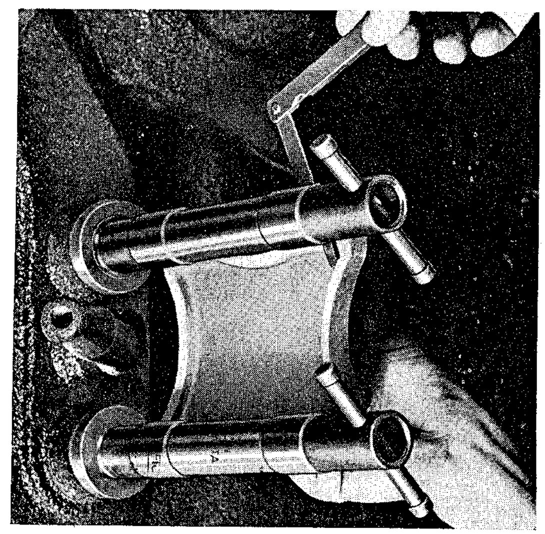


Fig. 58

5. Apply test plate against the four test diameters of the mandrels and check for twist by means of a feeler gauge. Permissible out-of-parallel is .031" (0,8 mm)

SHOCK ABSORBER AND ANTI-ROLL BAR

General

The front axle of the Porsche car is equipped with double-acting hydraulic telescopic shock absorbers which lessen road shocks and prevent rebound of the car. These shock absorbers have a progressive effect, i. e. the shock absorbing forces increase with increased wheel movement, whereas they are relatively small with minor wheel movement.
As both the compression and rebound rate of the shock absorbers correspond to the spring characteristics of the car, no attempt should be made to alter the adjustment of the shock absorbers or to install shock absorbers of different characteristics. This would result in inferior roadholding of the car. KONI shock absorbers allow a certain adjustment limitted by the spring characteristics.

Inspection and Maintenance

For checking effectiveness of the shock absorbers, bounce car at front and rear end, or still better, test the car on a very uneven road. Accurate checking necessitates special test installations, which generally are not available in workshops.
A simple check of the removed shock absorber can be carried out by holding it vertically and compressing it by hand. However, this method only indicates whether the shock absorbers are working. The degree of effectiveness cannot be determined in this way.
If the effectiveness of the shock absorber is found to be insufficient, it should be replaced – if possible by one of the same manufacture. Leaking shock absorbers must also be replaced. However, if only a slight loss of fluid is noticed and the effectiveness of the shock absorber is not impaired, it is not necessary to make immediate replacement, as an adequate fluid reservoir compensates smaller losses. Refilling the shock absorbers is not possible. This explains why they require no maintenance in this respect! Maintenance is limited to checking the effectiveness of the shock absorbers, and to a periodic examination of the shock absorber mounts on the front axle tube and the suspension arm.

Removing and Installing Shock Absorber

16 ST

Removal

1. Jack up car and remove front wheel

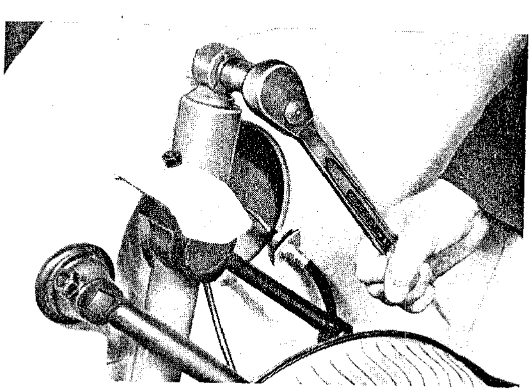


Fig. 59

2. Unlock and unscrew hex. nut on lower suspension arm link pin and retaining screw on front axle tube.
3. Take off shock absorber

Installation

When intalling, proceed in reverse order, observing the following points:

1. Check shock absorber, if necessary replace – using only parts of identical manufacture –
2. Check shock absorber rubber bushings for wear, if necessary replace.
3. Check retaining screw and pin of suspension arm for wear, if nec. replace.
4. Use new lock plates.
5. Tighten nut and screw until they fit tightly against the rubber bushing sleeves, otherwise premature wear and rattling will be experienced.

Adjusting KONI Shock Absorbers

For initial assembly, the shock absorber is installed in its softest position. If after some time a readjustment will be required, proceed according to the following instructions:

1. Remove shock absorber and fix in a vise in vertical position at lower eye – with the plunger rod pointing upward – (see fig. 60).

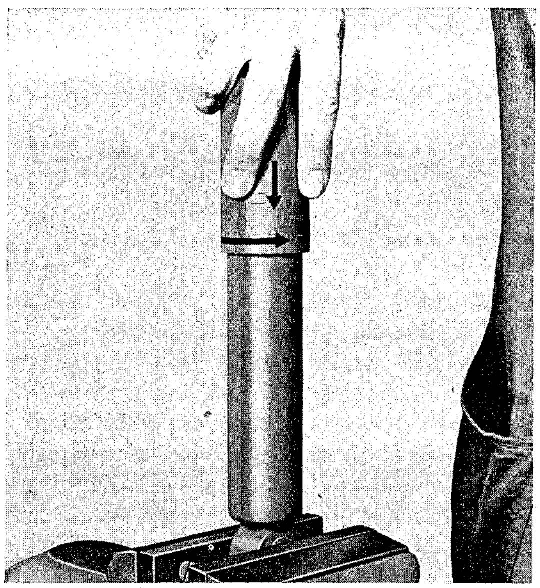


Fig. 60

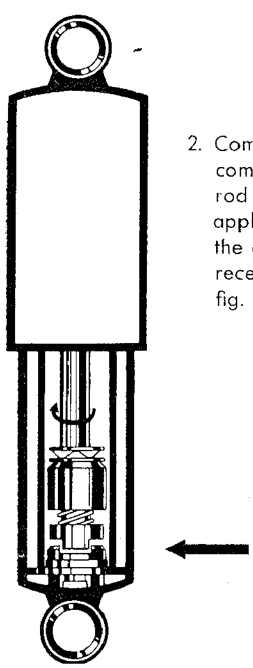


Fig. 61

2. Compress shock absorber completely and turn plunger rod counterclockwise without applying force, until the lug of the adjusting cam engages the recess of the bottom valve (see fig. 61).

3. Turn carefully further counterclockwise in order to find out whether the shock absorber has already been readjusted and to what extent (whether a harder position has been adjusted).

4. Starting from the original position, turn $1/2$ or more revolutions clockwise – depending on the extent of the shock absorbing force to be checked – then stretch the shock absorber somewhat apart in order to be able to disengage the adjusting device (see fig. 62) (Max. readjustment 4 revolution halves).

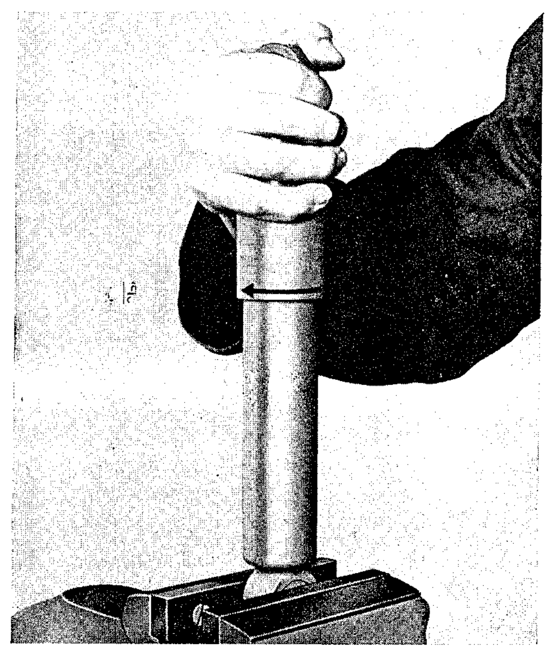


Fig. 62

5. By spreading and compressing with some intuition it will be easy to ascertain whether 2 shock absorbers have identical adjustment.

Removing and Installing Rubber Bushing for Shock Absorber

18 ST

Special tools:

VW 438 Guide pin in connection with
VW 401 Thrust plate
VW 410 Punch and
VW 421 Tube for removing shock absorber rubber bushing sleeve
VW 436 Guide pin (tapered) in connection with VW 401, VW 410 and VW 421 for installation of the shock absorber rubber bushing sleeve

Removal

1. Remove shock absorber (16 St)
2. Press out rubber bushing sleeve on VW repair press with cylindrical guide pin VW 438 in connection with VW 401, VW 410 and VW 421

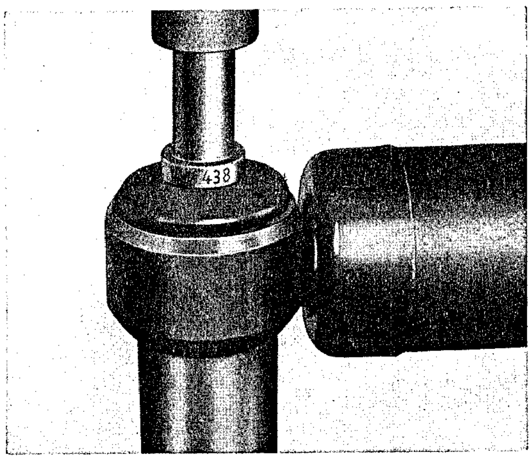


Fig. 63

3. Press out rubber bushing from shock absorber mounting eye

Installation

1. Install rubber bushing in shock absorber mounting eye
2. Install ruber bushing sleeve on VW repair press with the tapered guide pin VW 436 in connection with VW 401, VW 410 and VW 421

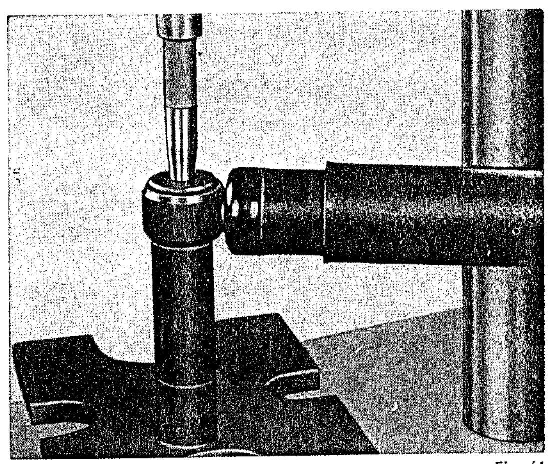


Fig. 64

3. Fit shock absorber

Removing and Installing Anti-Roll Bar

19 ST

Removal

1. Jack up car
2. Loosen bearing cover on bottom end of front axle tube
3. Loosen anti-roll bar shackle screws on lower suspension arm
4. Take off anti-roll bar, loosen retaining clips and remove rubber bushings. Check all parts for damages, if necessary replace

Installation

1. Attach anti-roll bar to lower suspension arm shackles
2. Press anti-roll bar upwards and bolt on bearing cover
3. Attach retaining clips and tighten screws
4. Tighten screws at suspension arms
5. Lower car

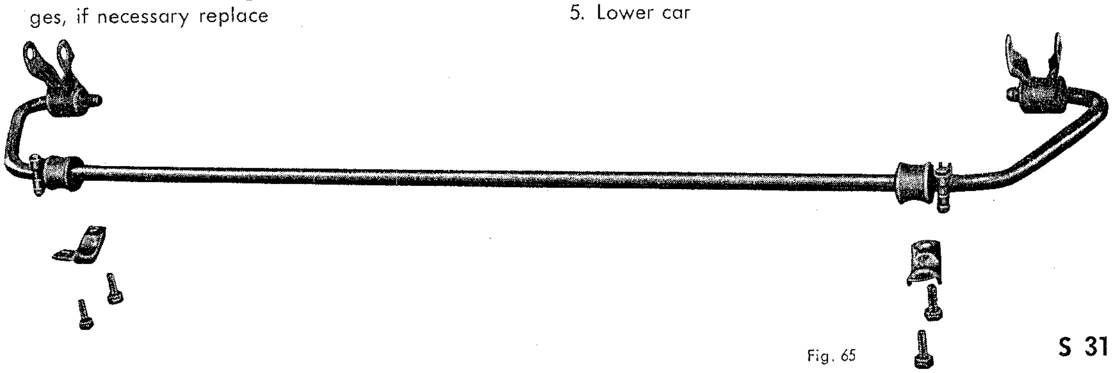


Fig. 65

STEERING GEAR

Description of the ZF single-peg steering mechanism

General

The movements of the steering wheel are transmitted through the steering column and the flexible joint to the steering worm, which is mounted in adjustable taper ball bearings in the steering box. The steering peg, which is mounted in roller bearings on the drop arm shaft (rocker shaft), rolls along the flanks of the worm. It transmits the movement of the worm to the drop arm, and hence through the two tie rods to the steering arms on the stub axles and in this way to the front wheels.

Lubrication

High-grade SAE 90 gear oil should be used for the lubrication of the steering gear. The steering box has a capacity of about 1/4 US/quarts (0.25 liters). The oil level should be checked at regular intervals as specified in the Lubrication Chart.

Maintenance

Only in its central position, with the wheels in straight-ahead position, there is no play in the steering gear. If the steering gear is correctly adjusted and the vehicle is jacked up, this position will be indicated by a slight resistance at the steering wheel – known as the "pressure point". When adjustments are made to the steering peg, it is essential that the steering gear should be at this pressure point, as described in the following sections. A certain amount of play in the steering when the vehicle is stationary and the front wheels are turned from the straight-ahead position is quite normal. When the vehicle is on the road and is rounding a curve, this play is compensated for by caster action of the front wheels, acting through the tie rods and the drop arm, which forces the steering peg against one flank of the steering worm.
The toe-in must be checked with great care at regular intervals. It is prerequisite that the instructions given in the section **"adjusting toe-in"** are complied with when this is done.
Axial play of the steering worm can be reduced by removing some of the shims located between the steering box and the end plate.

Please note:

New steering boxes, and also those that have been overhauled by the manufacturers, are sealed to prevent tampering by a third party. Since the manufacturers will not accept any claims under the guarantee in respect of steering boxes with a damaged seal, we recommend that a few factory-reconditioned steering boxes should be kept in stock for exchange purposes, and that repairs be as far as possible entrusted to the manufacturers.

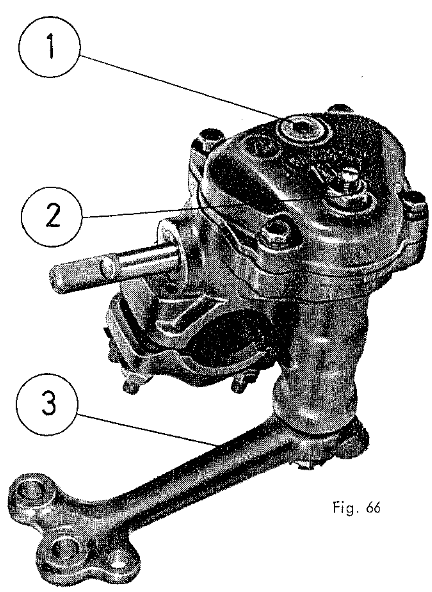


Fig. 66

Steering Gear

① Oil filler plug
② Adjusting screw and lock nut
③ Steering drop arm

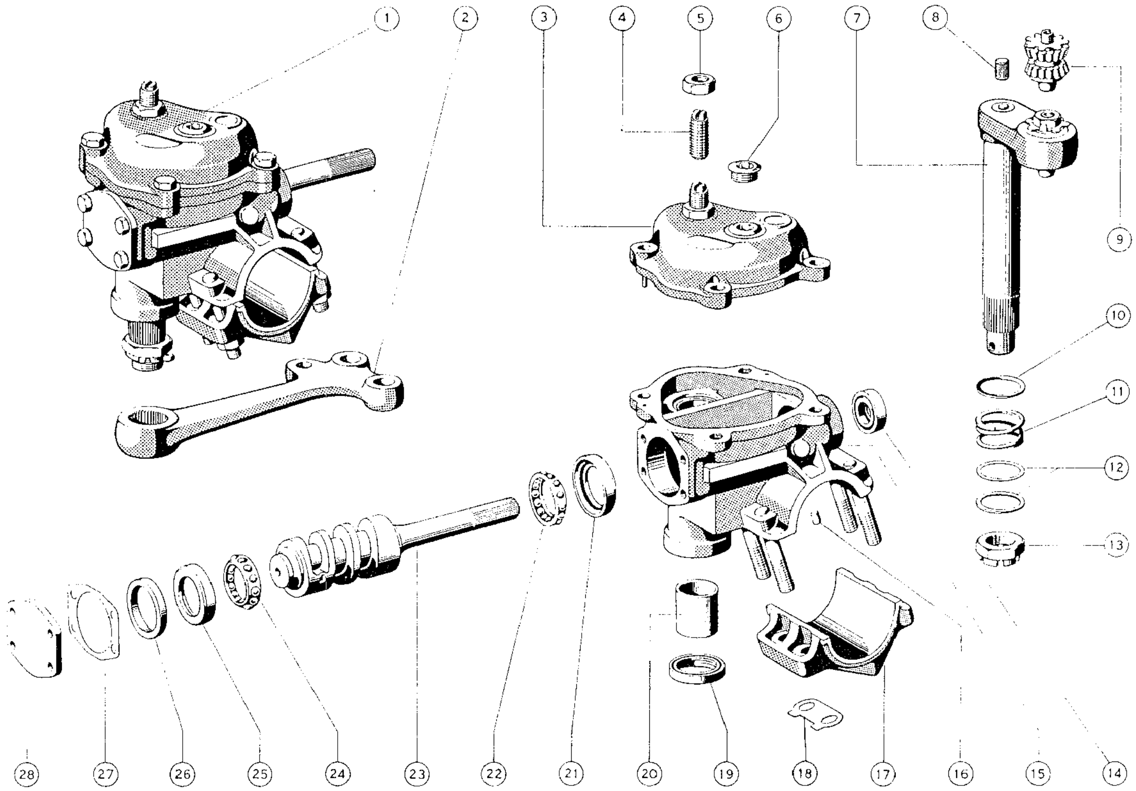


Fig. 67

① Steering box, complete	⑮ Steering box
② Steering drop arm	⑯ Dowel pin
③ Steering box cover	⑰ Clamp
④ Adjusting screw	⑱ Lock plate
⑤ Lock nut for adjusting screw	⑲ Seal
⑥ Oil filler plug	⑳ Bearing bushing
⑦ Rocker shaft	㉑ Ball race, top
⑧ Thrust pin	㉒ Ball cage
⑨ Steering peg roller bearing	㉓ Steering worm
⑩ Thrust washer	㉔ Ball cage
⑪ Compression spring	㉕ Ball race, bottom
⑫ Thrust washers	㉖ Spacer
⑬ Castle nut	㉗ Adjusting washer
⑭ Radial oil seal	㉘ End plate

Removing and Installing Tie Rods

Special tool: VW 266 f Tie rod end remover

20 ST

Removal

1. Jack up car and remove front wheels
2. Unlock and unscrew tie-rod end nuts
3. Press out tie rod ends with remover VW 266 f

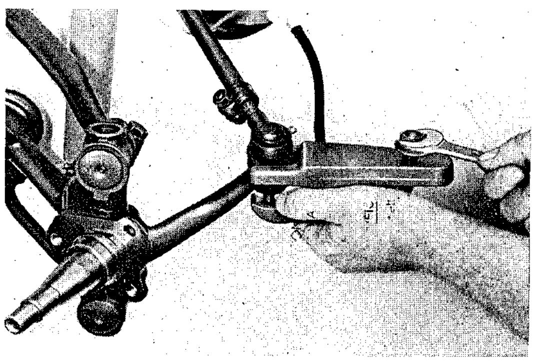


Fig. 68

4. Take off tie rods

Installation

When installing, proceed in reverse order, observing the following points:

1. Check tie rods for damage and deformation. Bent or damaged tie rods must always be replaced
2. Check tie rod ends for wear and, if necessary, replace separate tie rod ends or complete new tie rods. Only tie rod ends with undamaged ball stud threads should be re-used
3. Damaged, clogged or missing grease nipples should be replaced. Angle grease nipples should be fitted to the inner tie rod ends
4. Install short tie rod. Make sure that the bend contacts the drop arm of the steering gear
5. Tighten and lock tie rod end castle nuts and check toe-in
6. Grease tie rod ends

Removing and Installing Steering Damper

21 ST

Removal

1. Jack up car and remove front wheels
2. Unlock and unscrew castle nut on drop arm and on retaining clip
3. Lift out steering damper

Installation

When installing, proceed in reverse order, observing the following points.

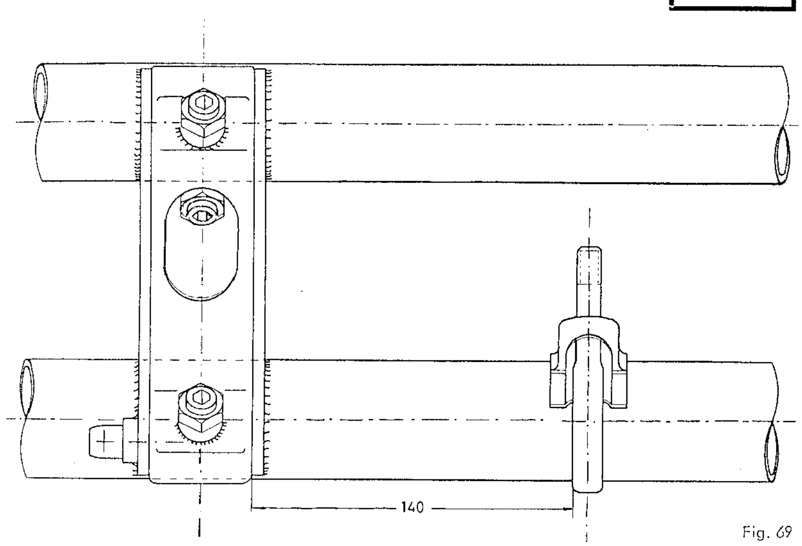


Fig. 69

1. Check steering damper, if necessary replace

2. Check rubber bushing on steering damper for wear, if necessary replace

3. Check retaining clips and nuts

4. Make sure that the dimension shown in fig. 69 is adhered to when assembling the retaining clip.
5. Tighten castle nuts until they rest on the rubber bushings, otherwise premature wear and rattling will result
6. Lock castle nuts

22 ST

Removing and Installing Steering Wheel

Removal
1. Disconnect battery
2. Remove horn button. Turn at outer ring with three lugs counterclockwise, applying some force, and remove horn button (see fig. 70)

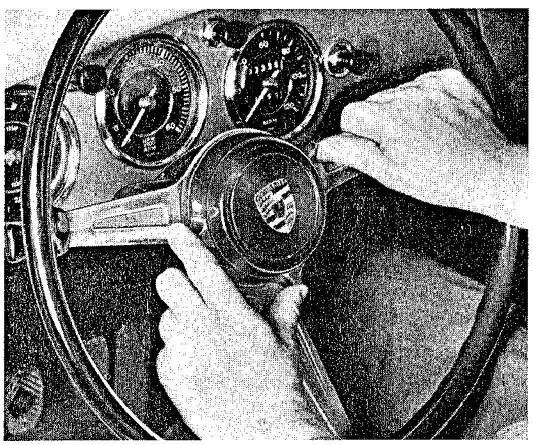


Fig. 70

3. Remove contact pin
4. Remove nut on steering wheel with socket wrench (27 mm opening) and remove steering wheel. When doing this, take care of pressure spring and retaining ring for steering shaft bearing.

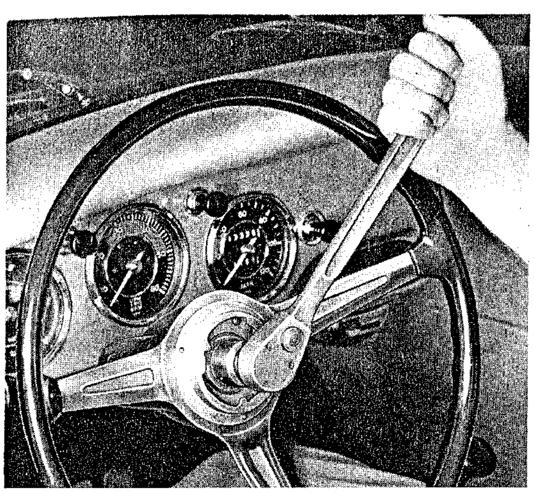


Fig. 71

Installation
Install by proceeding in reverse order, paying attention to the following points:

1. Attach pressure spring and retaining ring to steering wheel hub. (see fig. 72). Fit steering wheel with the wheels in straight-ahead position, and make sure that central spoke points downward. Lock steering wheel nut by a lock washer.

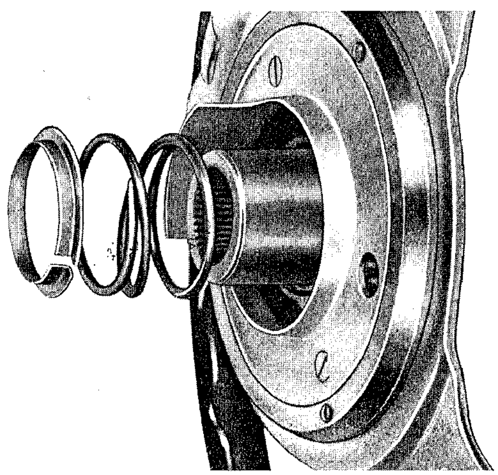


Fig. 72

2. Check whether return mechanism of flashlight switch is working correctly.

3. Insert contact pin and turn horn button clockwise until it engages.

Removing and Installing Steering Column

Removal

1. Disconnect battery
2. Remove cover to steering box (fig. 73)

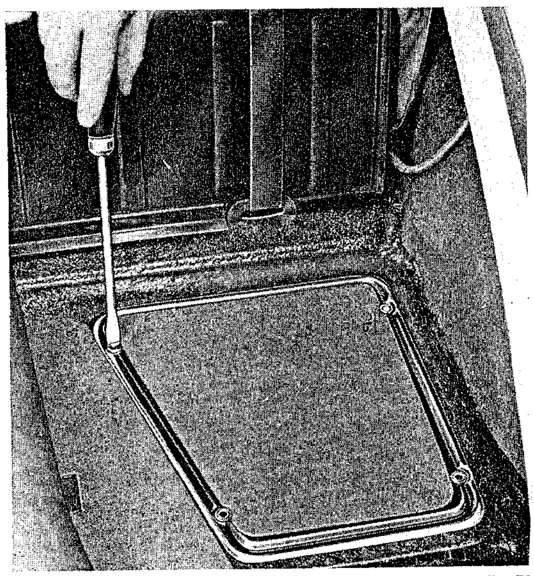


Fig. 73

3. Disconnect steering column at steering coupling (Unlock hex. hd. screw, unscrew and detach clamp from steering column (see fig. 74)

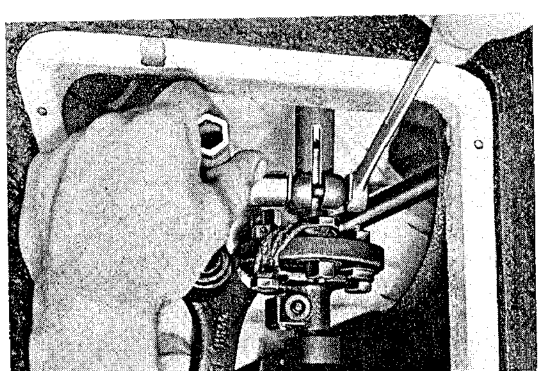


Fig. 74

4. Loosen steering wheel nut (21 St)
5. Pull out steering column with steering wheel of tubular jacket; to do this, turn steering wheel until steering column has disengaged from steering coupling, then remove steering wheel.

Installation

When installing, proceed in reverse order, observing the following points:

1. Check steering column for out-of true. Permissible out-of-true .0787" (2 mm)
2. Check whether steering shaft bearing in tubular jacket moves easily.

Note:

The steering shaft bearing is filled with special grease and therefore free of maintenance. If a replacement should become necessary, it can be pushed out of the lower end of the tubular jacket towards top.

3. Install clamp on steering column with a new lock plate, tighten hex. hd. screw and lock.

24 ST

Removing and Installing Steering Column Tube

Removal

1. Remove steering wheel (21 St)

2. Disconnect cables from sockets

3. Unscrew nuts at mounting studs below instrument panel

4. Turn steering column tube slightly to remove it from the rubber cushion in the dashboard

Installation

Installation is done in reverse order, observing the following points:

1. Check ease of movement of steering shaft bearing in tube.

Note:

The steering shaft bearing is filled with special grease and therefore free of maintenance. If a replacement should become necessary, it can be pushed out from the lower end of the tube towards top.

2. Check rubber cushion in dashboard, if necessary replace.

3. Insert tube until the steering column projects .925" + .0197" (23,5 + 0,5 mm) beyond the upper edge of the steering shaft bearing installed in the tube (see fig. 75)

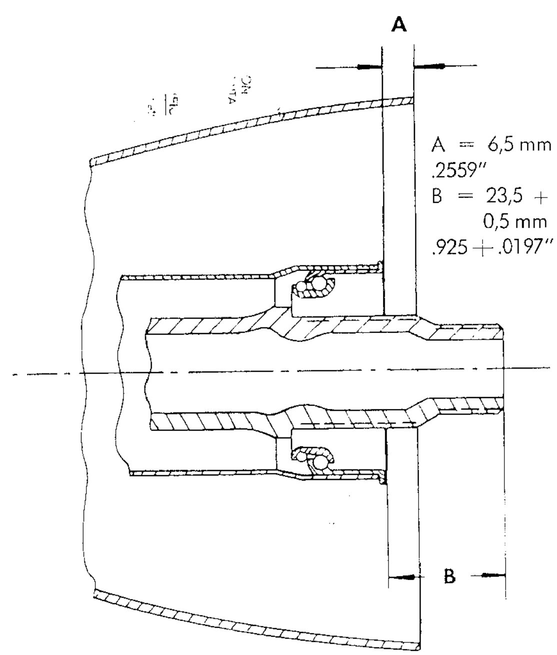


Fig. 75

4. When connecting the cables, take care to join only cables of matching colour.

Removing and Installing Steering Gear

Special tool: VW 266 f Tie rod end remover

25 ST

Removal

1. Jack up car, remove left front wheel
2. Open front hood and remove steering box cover and front cover. Disconnect battery.
3. Loosen steering damper at drop arm
4. Push out tie rod ends on drop arm, using tool VW 266 f (19 St) or some other commercial drift.
5. Remove horn button (21 St) and take out contact pin
6. Turn steering towards right or turn drop arm completely counterclockwise. Loosen steering column from steering coupling (22 St)
7. Remove clamp on steering gear after unlocking and removing hexagon nuts.
8. Remove steering gear from front axle and pull out towards front.

Installation

Installation is done in reverse order, observing the following points:

1. Check and adjust steering gear. If necessary, disassemble and replace damaged or worn out parts, or install a steering gear which has been reconditioned by factory experts.
2. Attach steering gear to axle tube, remember dowel pin.
3. Lock retaining nuts on clamp with new lock plates. Tightening torque 22 ft lb (3 mkg).
4. Check oil level, if required, top up to lower rim of oil filler opening with gear oil of the prescribed specification (capacity 1/4 US/quarts, 0,25 l).
5. Check and if necessary readjust toe-in.

Important!

After every removal and reinstallation of the steering gear check and if necessary adjust toe-in. The instructions on "adjusting toe-in" in section "W: Alignment of Wheels" must be strictly observed.

Disassembly and Assembly of Steering Gear

26 ST

Disassembly:

1. Pull off steering coupling (Unlock screw and unscrew)
2. Unlock and unscrew retaining nut for drop arm
3. Pull off drop arm with special tool P 72

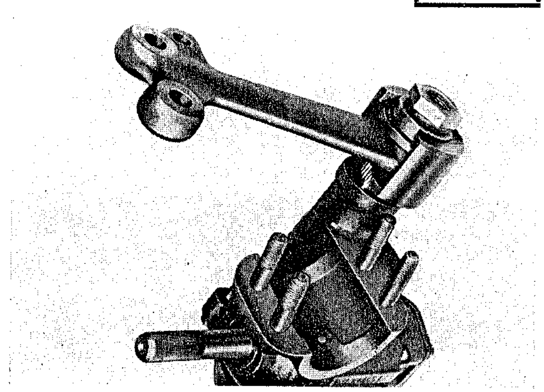


Fig. 76

4. Loosen the 4 retaining screws on steering box cover and take off cover
5. Pull out rocker shaft

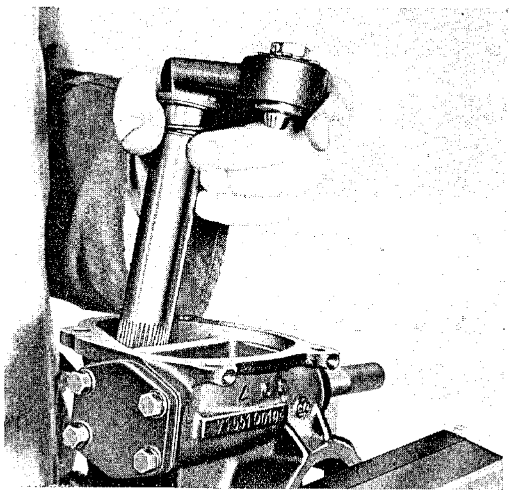


Fig. 77

6. Pull washers and compression spring from rocker shaft
7. Unscrew retaining screws on end plate, remove end plate

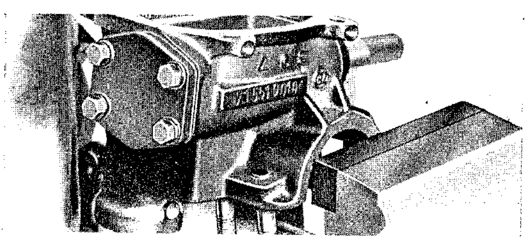


Fig. 78

8. Take out shims and collect at a safe place
9. Take out spacer ring

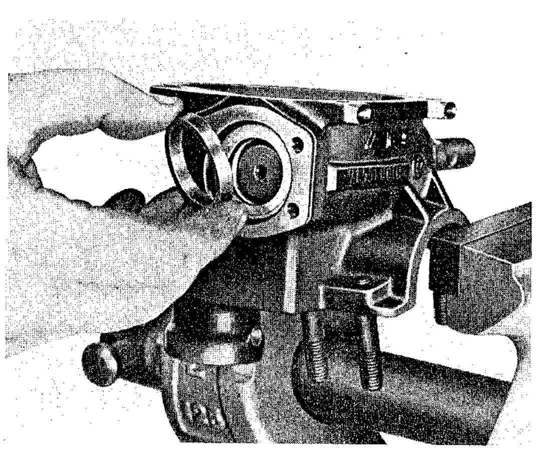


Fig. 79

10. Pull out steering worm downward, if necessary by using a composition hammer.

Important!

Do not mix up bearing cage und bearing race, all parts of the taper roller bearing must be refitted to the same side of the steering worm.

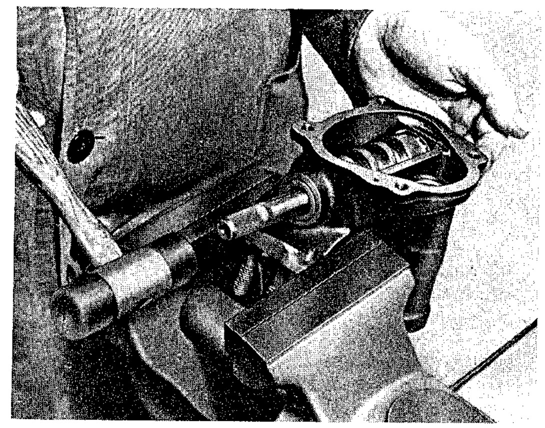


Fig. 80

11. Remove oil seal for rocker shaft and steering worm

Assembly

The steering gear is re-assembled in reverse order, observing the following points:

1. Thoroughly clean the steering box and all components
2. Check the worm and the peg for wear, renewing them, if necessary. When doing this, the following points should be kept in mind:
   a) if the worm is renewed, both taper bearings must also be replaced
   b) if the peg is renewed, a new locking plate must also be fitted. See procedures (28 St)
3. Fit new oil seals
4. Insert worm, together with upper bearing, which should be packed with grease, through the lower opening

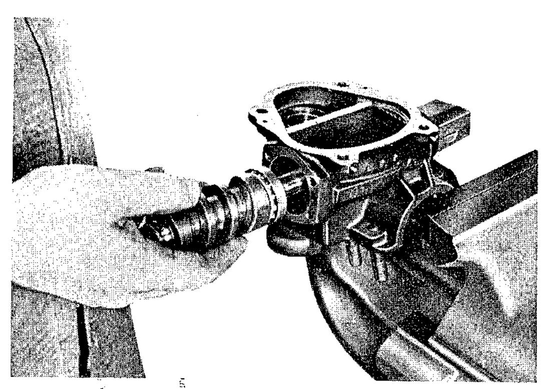


Fig. 81

5. Pack the lower bearing with grease and fit in place. Then fit outer race.

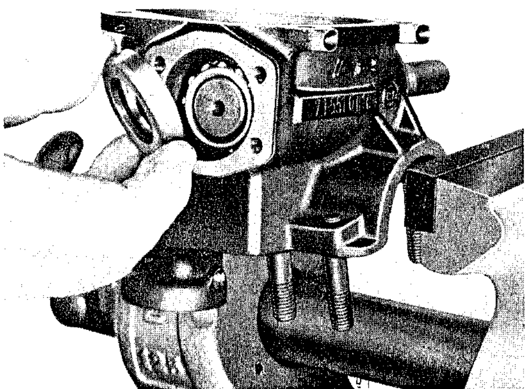


Fig. 82

6. If a new steering worm is fitted, place sufficient shims between the steering gear and the end plate to ensure that the worm turns freely but has no play. Do not use any paper gaskets for making this adjustment.

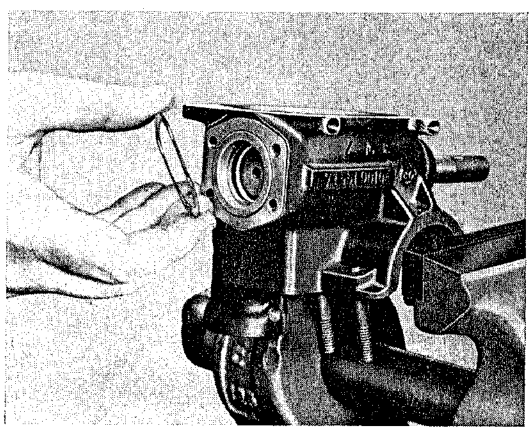


Fig. 83

7. For adjustment, turn steering so that it is at "Pressure Point". (Lines marked on worm and steering box must coincide).

8. Fill steering box with 0.25 liters of SAE 90 hypoid gear oil.

9. Make sure that the marks on the drop arm and the rocker shaft coincide (see fig. 84).

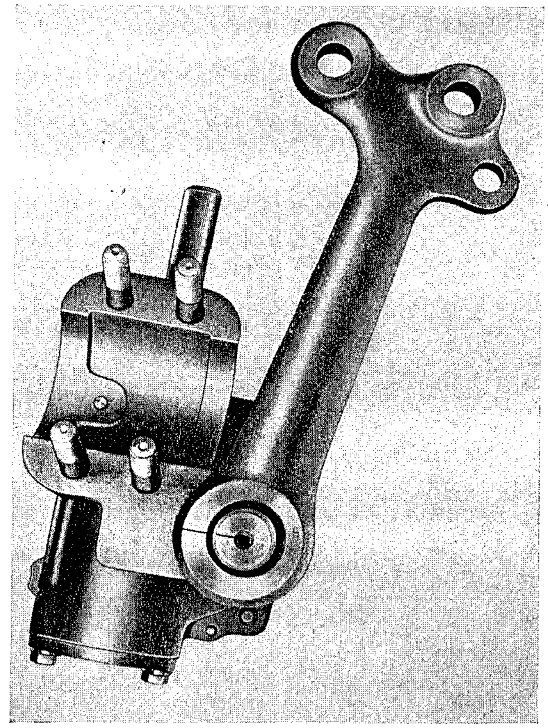


Fig. 84

10. Screw up castle nut and insert cotter pin. Tightening torque 112 ft lb. (15 mkg).

Please note:

It is advisable not to disassemble the steering gear except in an emergency, since the manufacturers refuse any claims under the guarantee, if the seal on the bolts securing the cover plate is broken. See also note in section on "Maintenance" on page S 33.

Adjustment

The pressure point is adjusted by the manufacturers. Only in exceptional cases any attempt should be made to correct this adjustment. In general, it is advisable to have the pressure point a little loose rather than too tight. Maximum play of the steering wheel in the central position should be .3937" (10 mm).

The play can be adjusted by means of the adjusting screw and lock nut.

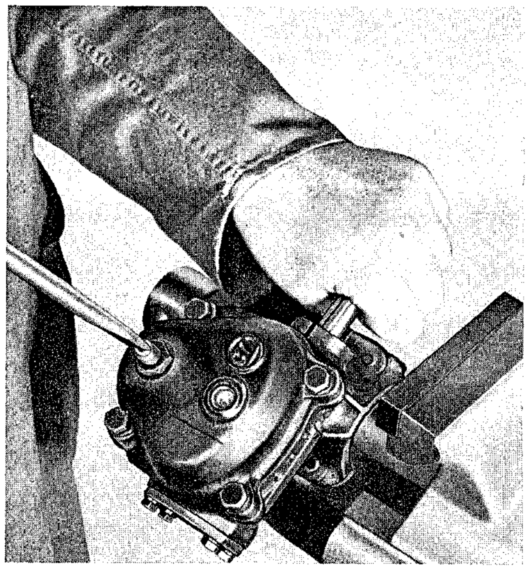


Fig. 85

Take care: Unlike the worm steering gear formerly employed, the single-peg gear is designed in such a way that only in the centre of its range, with front wheel deflections between ± 2°, there is no play. If the wheels are turned more than 3° in either direction there must be play in the steering mechanism.

This design makes it possible to adjust the steering gear accurately and to take up any wear without any danger of the peg binding at some other point on its travel. When checking the play in the steering, the front wheels must be placed accurately in the straight-ahead position. The central position of the steering gear is indicated by notches on the steering box.

27 ST

Position of Pressure Point

The pressure point is located midway between full left and full right lock, and is indicated by a line on the spindle of the steering worm and a notch on the steering box (fig. 85). It is possible to bring these two marks into alignment at points other than the pressure point. To avoid this error, turn the steering wheel to full lock (in either direction). Then turn the wheel back approx. one full revolution and align the marks.

The accurate adjustment of the pressure point is effected by means of a torque measuring device. This can be supplied on special order.

28 ST

Adjustment of Pressure Point

1. Disconnect tie rods and steering damper from drop arm.
2. Unscrew lock nut on steering gear
3. Tighten adjusting screw (right hand thread) until a slight resistance is felt when turning the steering wheel through its central position.
4. Tighten lock nut
5. Fasten tie rod and steering damper.

The pressure point should not be noticeable when the car is being driven. Under no circumstances try to eliminate steering shocks by increasing the pressure point. (If measuring device is available, set the pressure point to 4.34–6.08 in. lbs. (5–7 cmkg).

Note: It is essential that the instructions regarding the adjustment of the toe-in given in the group "Alignment of wheels" are observed.

Removing and Installing Steering Peg (mounted in roller bearings)

29 ST

Removal

1. Fix the cylindrical shoulder on the steering peg adjacent to the tapered portion in a vise (use jaw protectors).

2. Straighten the bent-up lug on the locking plate and unscrew the nut.

3. Take the rocker shaft out of the vise, and strike the threaded end of the peg with a composition hammer until the peg and rollers fall out and the adjusting cone can be removed.

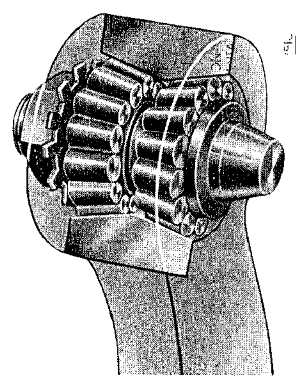


Fig. 86

Installation

The steering peg is fitted in reverse order, attention being paid to the following points:

1. Wash all components and check for wear. The normal play between the rocker shaft and the bore (bushing) is .00078" to .00197" (0.017 to 0.05 mm). Wear tolerance is .00236" (0.06 mm).

2. Coat tapered section of peg and adjusting cone with a .0591" (1.5 mm) thick layer of ball bearing grease or vaseline.

3. Place rollers on peg and on adjusting cone. Take care that the larger diameter ends of the rollers are placed on the larger diameters of the tapered bearing surface, so that both tapers increase together.

4. Carefully place adjusting cone with its rollers in the appropriate taper bore on the rocker shaft.

5. Push the peg with its rollers in its bore in the rocker shaft and carefully press in, using a pair of pliers, if necessary.

6. Fit a new locking plate.

Important!

Where possible, the rollers should be fitted to the same taper as that on which they were originally. It is absolutely essential that the full number of rollers is fitted in each of the two roller bearings. If a roller is missing, destruction of the bearing cannot be avoided.

Adjusting steering peg

1. Fix the cylindrical shoulder of the peg in a vise with the threaded end facing upward.

2. Slightly bend up lugs of the locking plate.

3. Tighten the nut gently until a slight resistance is felt when the peg is turned. This resistance should be slightly greater when a new bearing is fitted than when the bearing has been in use previously.

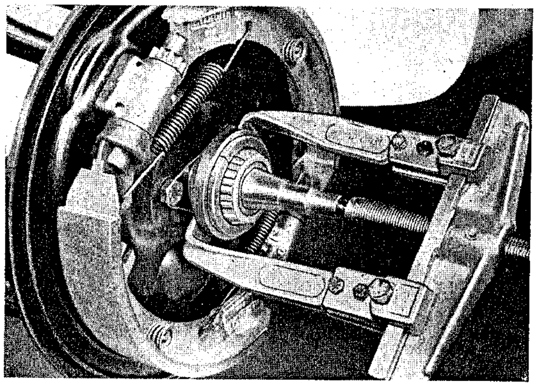
4. Check the adjustment once more and then bend up two diametrically opposed lugs on the locking plate that are at right angles to one of the plates on the nut.

Note: When locking plate is taken off, remove the lugs which had been bent up; they must never be used a second time for locking the nut. Take in any case a new locking plate.

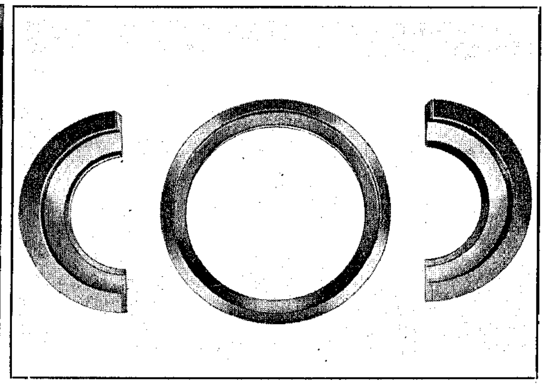
Steering Troubles and Their Cure

Trouble	Cause	Cure
Steering hard in operation. Steering is equally hard at all locks, and does not return automatically to the straightahead position after rounding bends	a) Front axle insufficiently greased. b) King pins do not turn freely and may be binding. c) Steering gear incorrectly adjusted.	a) Jack car up to remove load from front axle and grease thoroughly. b) Check by jacking up car and disconnecting tie rod. If king pin does not turn freely, try to free it by through greasing. If necessary remove king pin and replace defective parts. c) Check adjustment of steering gear. Pay special attention to adjustment of pressure point.
Steering hard in operation, cannot move evenly. Although steering is quite free to move, it does not automatically return to straightahead position after rounding bends.	Faulty steering damper a) Front wheels are not aligned as specified. b) Steering arms on stub axles are distorted.	Remove and check steering damper and fit new damper, if required. a) Correct alignment of front wheels (caster, camber, and toe-in). b) Remove stub axles and check for distortion with aid of gauge P 69. Replace distorted stub axle.
Play in steering gear	a) Faulty adjustment of steering gear. b) Steering gear components worn	a) Adjust steering gear as specified. b) Fit new set of steering gear components (rocker shaft, nut and steering worm).
Play in tie rod ends	a) Worn tie rod ends	a) Fit new tie rod ends
Play in front wheel suspension	a) Wear at bearings (suspension arms, suspension arm links, stub axles, and front wheel bearings).	a) Check adjustment of pivot pins and front wheel bearings. Replace any parts showing excessive wear.

Puller for wheel bearing	P 63



Example of application



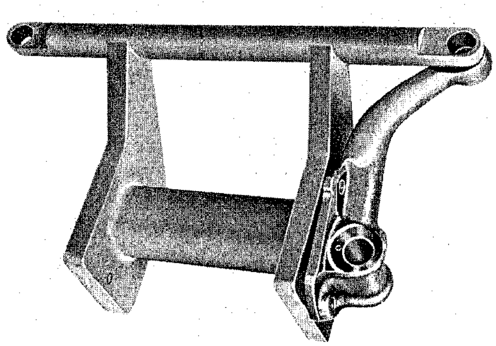
Tool

Application: To pull off inner bearing from stub axle

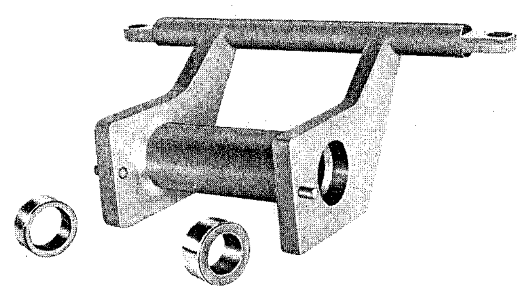
See Workshop Manual, group S, procedure No. 8 ST

Subject to modification

Stub axle gauge	P 69



Example of application



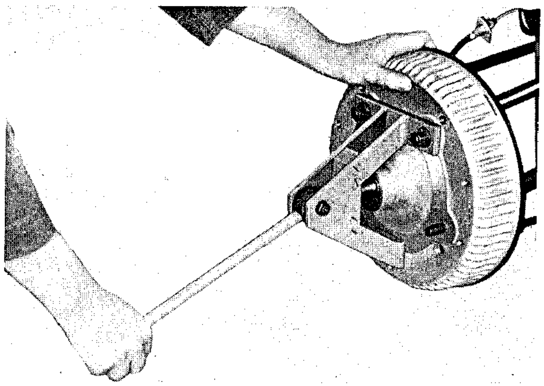
Tool

Application: To check straightness of stub axle

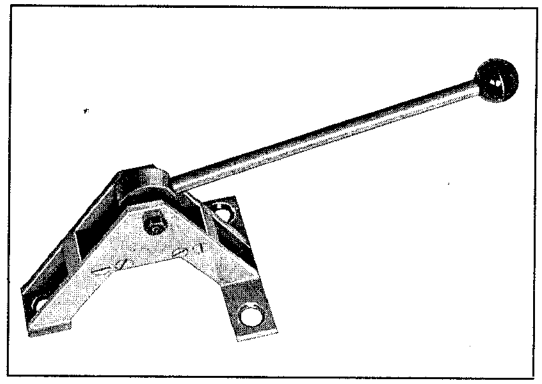
See Workshop Manual, group S, procedures No. 1 ST, 2 ST

Subject to modification

Brake drum puller	P 30



Example of application



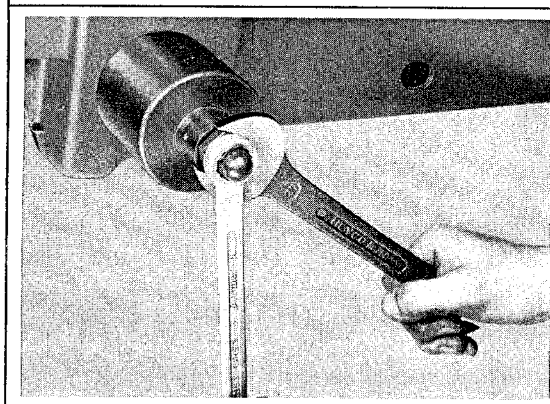
Tool

Application: To pull off brake drums

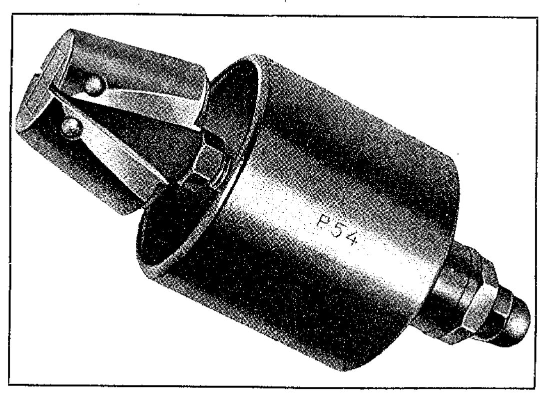
See Workshop Manual, group S, procedure No. 2 ST

Subject to modification

Puller	P 54



Example of application



Tool

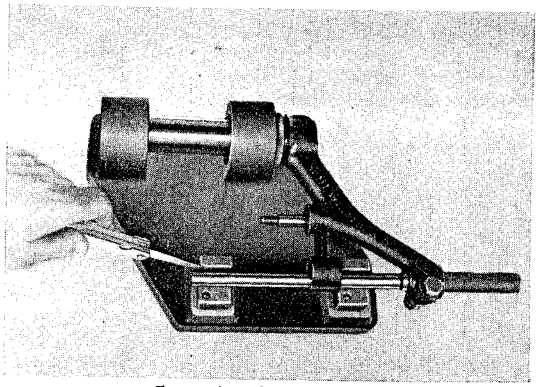
Application: To pull off needle bearing bushing in axle tube

See Workshop Manual, group S, procedure lo. 14 ST

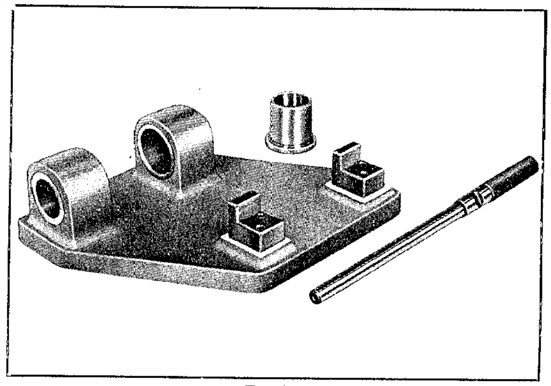
Subject to modification

Suspension arm gauge

P 70



Example of application



Tool

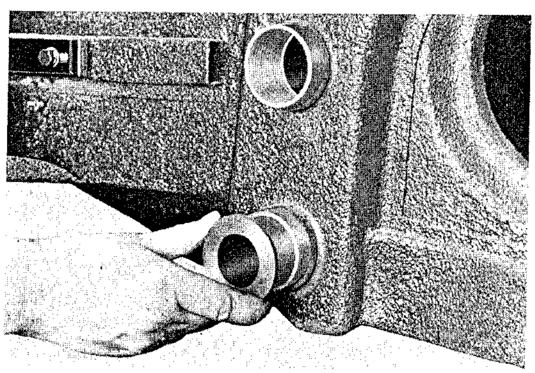
Application: To check suspension arms for out-of-parallel and twist

See Workshop Manual, group S, procedure No. 10 ST

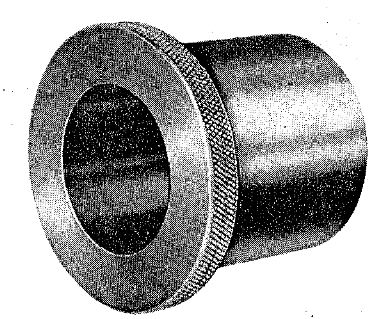
Subject to modification

Sleeve

P 71



Example of application



Tool

Application: Serves – when inserted in the axle tube – as a guide or the reamer VW 274 a when reaming the inner bearing bushing

Use two units: Serves – each one inserted into the upper and lower axle tube – as spacer bushing when checking twist of both tubes in connection with VW 256 a

See Workshop Manual, group S, procedures No. 14 ST, 15 ST

Subject to modification

SUMMARY OF TOLERANCES

TO

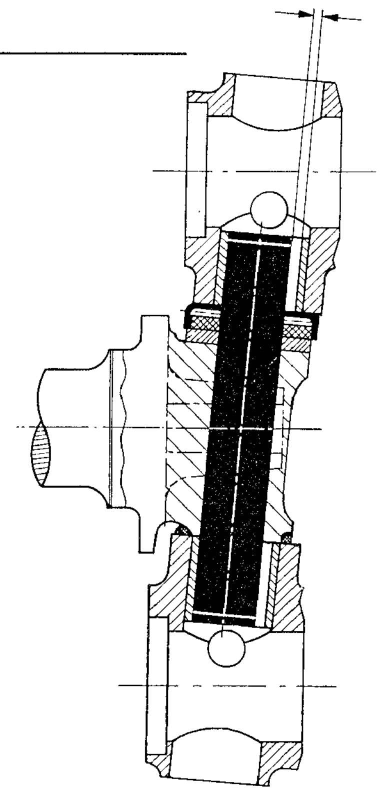
GROUP S

SPECIAL TOOLS

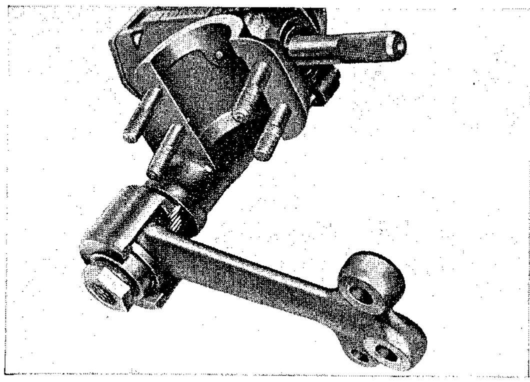
TO

GROUP S

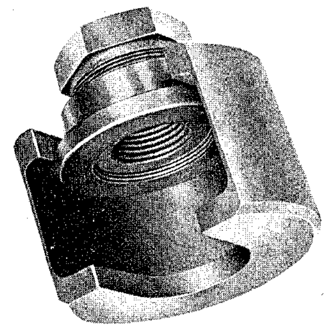
Measuring point		Tolerance (new) mm	Wear limits mm
5. King pin / Bushing	Radial play	0,016 – 0,045	0,1
Stub axle / suspension arm link	end play	free of play	—



Puller for steering drop arm (pitman arm) | P 72



Example of application



Tool

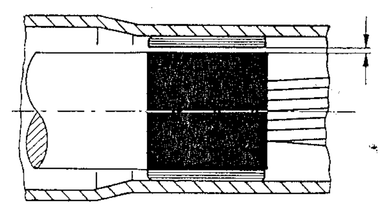
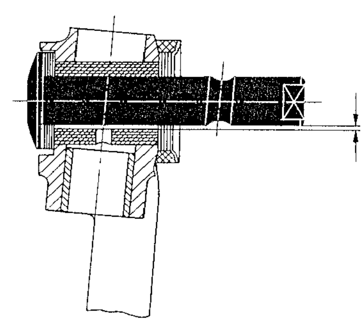
Application: To pull off steering drop arm

See Workshop Manual, group S, procedure No. 25 ST

Subject to modification

Summary of Tolerances and Wear Limits

Front Axle and Steering

Measuring point		Tolerance (new) mm	Wear limits mm	
1. Suspension arm	twist	max. 0,2	—	———
2. Suspension arm / plastic bushing (try to reach max. limit, bushing tending to swell)	Radial play	0,15 – 0,22	0,30	
3. Suspension arm link pin / bushing	Play	0,042 – 0,087	0,20	
4. Suspension arm link pin	dia.	17,940 – 17,913	17,800	———

SECTION INDEX

Group R: Rear Axle and Transmission

Operations:

Rear Wheel Suspension

DESCRIPTION OF REAR AXLE AND TRANSMISSION (TYPE 741)

General

The transmission and rear axle, together with the rear mounted engine forms the operating unit of the car. The rear wheels are independently suspended on ball jointed half axles. The transmission housing is suspended in the front and rear on rubber mounts and contains the transmission and differential.

Transmission Housing

The tunnel type transmission housing is made of cast light alloy.

Transmission

The transmission has four forward speeds and one reverse. The forward speeds are fully synchronized and employ a lock-type synchronization. The forward speeds are constantly in mesh and are silent running due to the employment of helical gears.

Gear Ratios

To insure good acceleration and top speed various gear ratios for the different types of engines are used. For special purposes (competition driving etc.) it is possible to exchange individual gear pairs to obtain suitable transmission ratios.

The various gear ratios are shown in diagrams on pages R 9 to R 19. These diagrams enable one to determine the relationship between rpm and speed for the various ratios.

Example:

The engine is turning at 4000 rpm (left, vertical scale). The transmission is in third gear with a ratio of B 23:26. This will give an effective speed of 58.2 mph (intersection of the horizontal rpm line with the gear line 3 B). Similar examples may be read from the various diagrams.

Function of the Synchronized Transmission During Gearchanges

Gears are selected by a shift lever mounted on the floor tunnel within close reach of the steering wheel. A selector rod in the floor tunnel connects the shift lever to the gearbox. The reverse gear is engaged by a non synchronized sliding gear while the forward speeds are angaged through a self-servo lock synchronization which adjusts to the synchronizing load of engaging a forward gear. This variable synchronization enables quick shifting with a minimum effort.

The operations that take place when changing gears will be understood more easily if one first considers what occurs when the gears are stationary.

When a gear is engaged with all gears stationary, the sliding sleeve moves from its central position until it engages with the toothed ring on the gear. As the sliding sleeve moves toward the gear, it compresses the synchronizing ring until the external diameter of the ring corresponds to the internal diameter of the sleeve. As the sleeve passes over it, the ring expands again into the shallow V-groove in the sleeve.

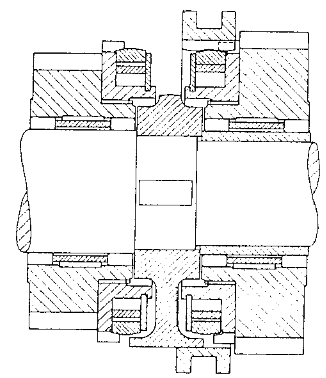


Fig. 1

When the sliding sleeve is moved in this way it must be pushed over the expanded synchronizing ring. The only resistance encountered is the pressure required to compress the ring and of course the sliding friction of the sliding sleeve over the ring. The brake bands, slider, and stop are not involved in such an engagement.

A considerably different process occurs when a gear is engaged while the car is in motion. In this case the synchronizing mechanism must match the speed of the floating gear on the pinion shaft to the speed of the shaft. This is done by employing a friction clutch effect to reduce the difference in speed between the two rotating members to be engaged, while at the same time preventing the sliding sleeve from engaging the gear until their speeds are equal.

During this process the clutch must be completely disengaged, since the torque exerted by the synchronizing clutch will cause the gearbox main shaft, and hence the clutch plate, to increase or decrease speed.

When a gear is changed with the car in motion the selector fork pulls the sliding sleeve away from the synchronizing ring of the previously engaged gear and continues toward the ring of the adjacent gear. As the sliding sleeve (rotating at the speed of the pinion shaft) engages the synchronizing ring of the next gear; the friction between the rotating ring and the sleeve exerts a torque on the ring which is transmitted by the brake band to the stop. The brake band is thus expanded preventing the synchronizing ring from contracting to allow the sliding sleeve to pass over it.

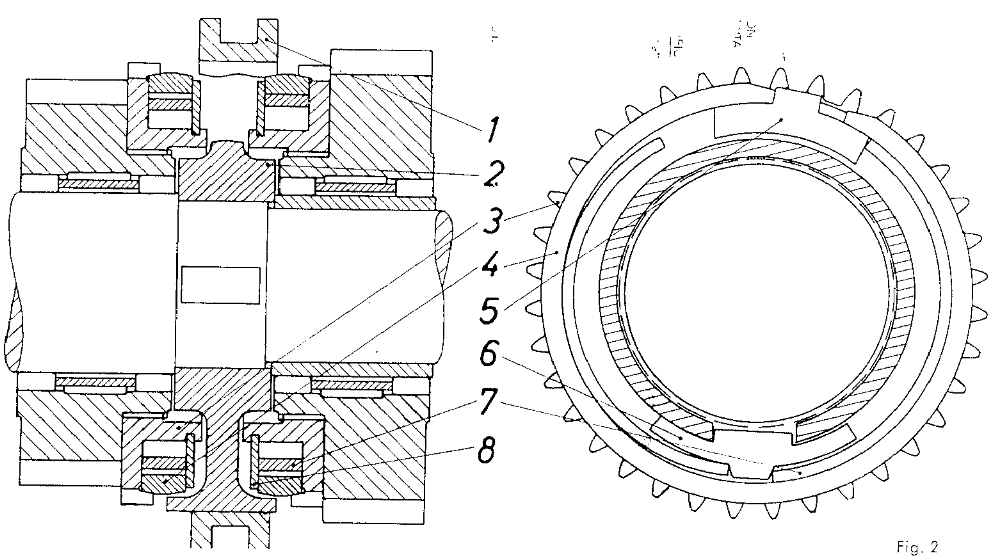


Fig. 2

1 **Sliding sleeve**
2 **Spider**
3 **Toothed ring on gear**
4 **Synchronizing ring**
5 **Slider**
6 **Stop**
7 **Brake band**
8 **Lock ring**

The gear to be engaged is forced to assume the same speed as the pinion shaft by the sliding sleeve. As long as there is a difference in speed between the sliding sleeve and the synchronizing ring, which is constrained to rotate with the gear, the radial force exerted by the brake band prevents the synchronizing ring from being compressed. It is thus impossible for the teeth on the sliding sleeve to engage with the teeth on the ring attached to the gear until their speeds are equal.

As the difference in speed between the sliding sleeve and the gear decreases, the friction force between the synchronizing surfaces is reduced. When the two speeds are equal the slider no longer transmits a force to the brake band which in turn no longer expands the synchronizing ring, allowing it to be compressed by the sliding sleeve. The sliding sleeve passes over the synchronizing ring and engages the toothed ring of the gear, thereby firmly engaging it with the pinion shaft. The synchronizing ring expands in the shallow V-groove in the sliding sleeve, holding the sleeve in engagement. A locking device to hold the selector shaft when a gear is engaged is therefore unnecessary.

The same synchronizing and locking components are used for all gears of the gearbox with the exception of the first gear. Since this gear is often engaged from a standstill, care has been taken to insure that it can be engaged easely witout interference from a locking mechanism.

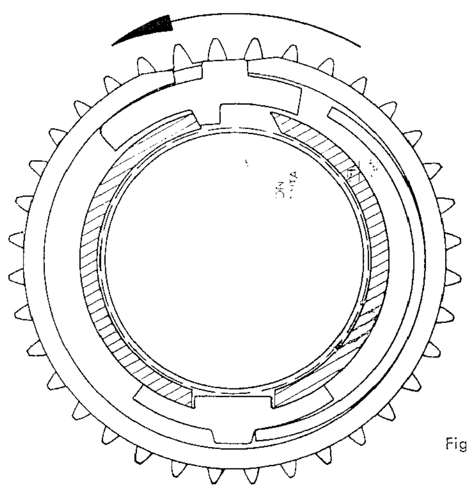


Fig. 3

As shown in Fig. 3 the slider used in this case is equipped with a lug which engages directly in a recess in the hub of the toothed ring attached to the gear. Also, one brake band has been omitted. Compared with driving speeds, the idling speed of an automobile engine is very low. If the clutch is disengaged in order to engage first gear, the main shaft will quickly come to rest. To reduce this time still further, and thereby enable the driver to engage first gear quickly without grinding, a synchronizing mechanism is required (to act as a brake).

When braking the gear, the force exerted by the friction between the sliding sleeve and synchronizing ring acts on the slider, and through its lug, directly on the gear. The lug is sloped so that the slider is forced outward while its longer end bears against the inside of the synchronizing ring. This small force is sufficient to enable first gear to be easily engaged while providing sufficient synchronization to prevent gear clash.

If a change from second to first gear is made while the vehicle is in motion, the first gear must be accelerated. There is a normal brake band on the side that comes into operation in this event, giving the same servo action as in all the other gears (Fig. 4).

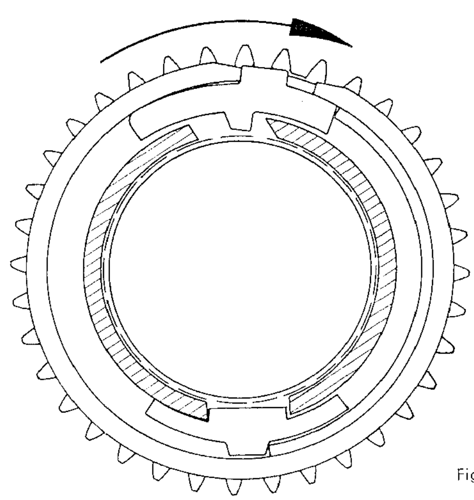


Fig. 4

Rear Axle Drive

The power is transmitted by a spiral bevel gear differential with bevel spider gears through the axle shafts to the rear wheels. Accurate adjustment is essential for the life and silent operation of the ring and pinion gears.

The ring and pinion gear ratio is 1:4.428 (7:31).

The differential divides the drive to the rear wheels to equal the different paths traveled in curves.

Rear Wheel Suspension

The rear wheels are independently suspended. Road shocks are transmitted from the wheels by the radius arms to the left or right torsion bar. The torsion bars are anchored in a splined socket which is welded into the middle of the torsion bar tube.

The different number of splines on the ends of the torsion bar permits an exact adjustment of the rear wheel suspension on both sides. Hydraulic, double-acting, telescopic, shock absorbers absorb road shock and prevent the vehicle from recoiling.

Vehicles of the type 356 B/1600 GS and 356 B/1600 S-90 have a compensating spring as standard equipment. The compensating spring, a single transverse leaf, is attached at both ends to the axle tube suspension brackets and is pivoted against the transmission housing under the differential at its center. The compensating spring acts as an anti-stablizer.

Oil Capacity

The capacity of the transmission is 3.5 liters (approx. 3.75 quarts). Oil changes should be made according to the lubrication chart using only approved lubricants. An oil change requires approximately 3.5 quarts (3.2 liters).

Components of Synchronizing Mechanism

1. Sliding sleeve

The tapered inner circumference of the sliding sleeve makes the friction contact with the synchronizing ring. In addition, when the gear is fully engaged, the internal teeth on the sliding sleeve engage with corresponding teeth on the gear, and thereby form a positive coupling.

The sides of the inner circumference of the sliding sleeve are tapered with a shallow V groove in the center which the synchronizing ring engages to retain the sliding sleeve when the gear is engaged (no locking device is therefore needed to hold the selector shaft when gears are engaged) (Fig. 5).

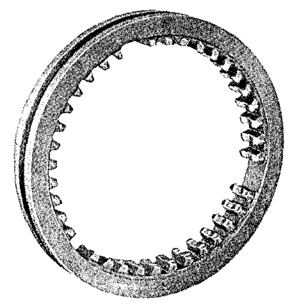


Fig. 5

2. Spider

The spider has three arms that carry the sliding sleeve which is free to slide exially. In addition to guiding the sliding sleeve, the spider transmits the drive torque (Fig. 6).

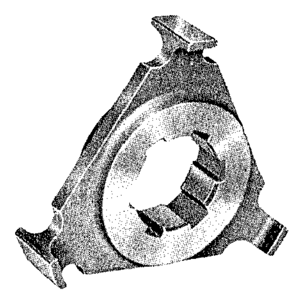


Fig. 6

3. Toothed synchronizing drive ring

The toothed ring forms the coupling between the gear and the sliding sleeve. It carries the synchronizing ring and the brake bands (Fig. 7).

The toothed ring of the first gear has two diametrically opposed recesses. The recess with the chamfered edge is for the lug on the inner side of the slider. The lug on the lock ring must never be inserted in the recess with the chamfered edge, but always in the recess that locates the stop.

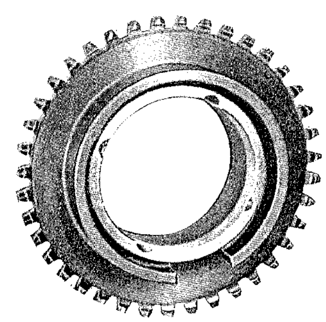


Fig. 7

4. Synchronizing ring

The synchronizing ring is a split elastic ring. The V shaped ridge on the outer surface serves both as a synchronizing surface, and a retainer for the ring in the sliding sleeve.

One side of the ring has a groove which, when assembled, must face the lock ring (Fig. 8).

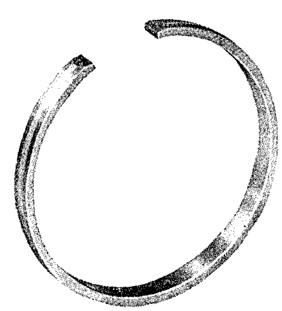


Fig. 8

5. Slider

One end of the synchronizing ring bears against the lug on the slider which transmits the synchronizing torque to the brake band (Fig. 9).

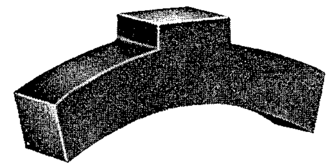


Fig. 9

The slider employed with the first or low gear is modified in that it also has an inner lug (Fig. 10).

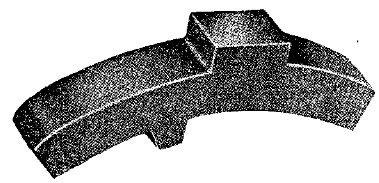


Fig. 10

6. Stop

The stop is located in the recess of the toothed ring which is attached to the gear. It transmits torque (frictional torque) from the synchronizing elements to the toothed ring which is attached to the gear (Fig. 11).

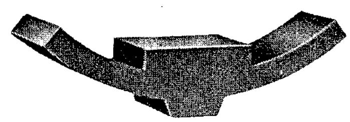


Fig. 11

7. Brake band

The brake band is bowed outward between the slider and stop by the force from the synchronizing ring, thereby expanding the ring against the inside of the slider (Fig. 12).

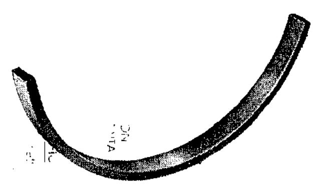


Fig. 12

8. Lock ring

The lock ring retains the synchronizing ring and the lock system elements on the drive ring (Fig. 13).

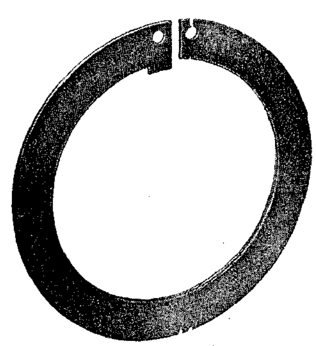


Fig. 13

TRANSMISSION 741

Section View

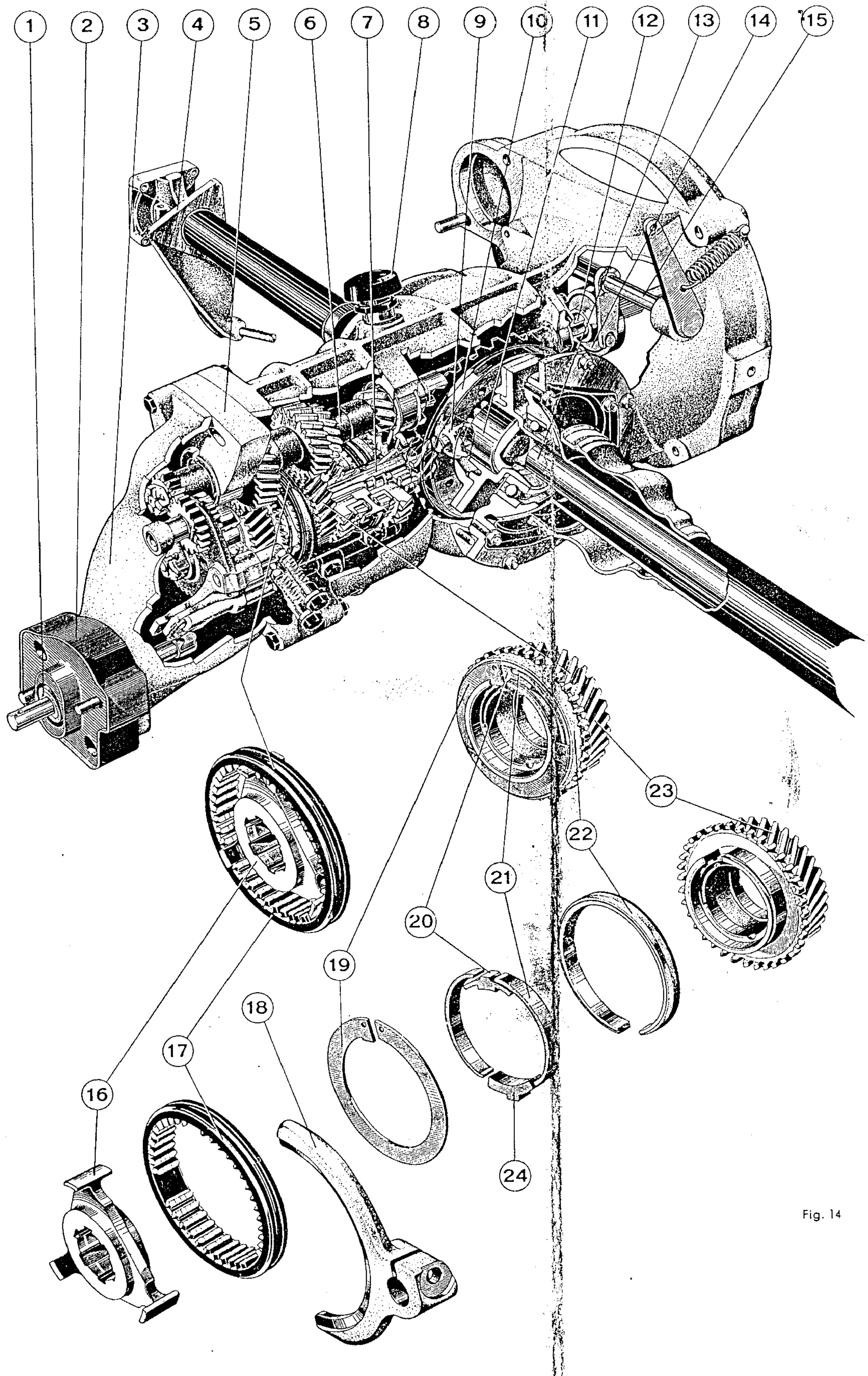


Fig. 14

Porsche Rear Axle and Lock Synchronized Gearbox, Type 741

(Section View)

1. Oil Seal
2. Front transmission mounting
3. Gearbox cover
4. Axle tube end flange with shock absorber extension
5. Intermediate plate
6. Main shaft
7. Pinion shaft and pinion
8. Breather
9. Differential pinion
10. Ring gear
11. Differential side gear
12. Clutch release bearing guide
13. Rear axle shaft
14. Clutch release bearing
15. Clutch release pivot shaft
16. Spider
17. Sliding sleeve
18. Selector fork
19. Lock ring
20. Brake band stop
21. Brake band
22. Synchronizing ring
23. Third gear on pinion shaft with synchronizing element
24. Slider

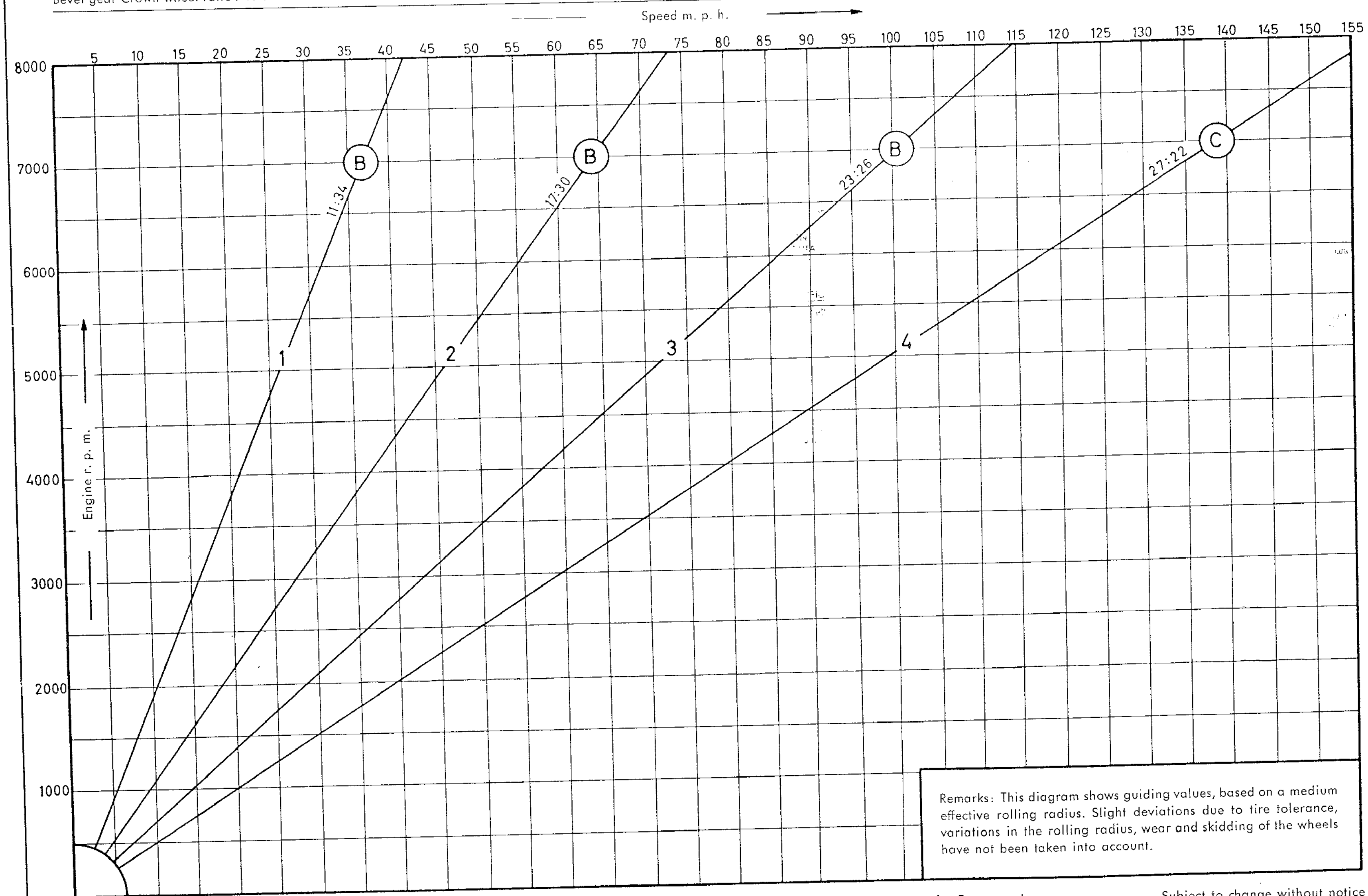
Transmission Diagram

PORSCHE

Type 356 B/1600, Coupé, Cabriolet/Hardtop, Roadster*)

Tires: 5.60—15

Bevel gear Crown wheel ratio 7 to 31



Remarks: This diagram shows guiding values, based on a medium effective rolling radius. Slight deviations due to tire tolerance, variations in the rolling radius, wear and skidding of the wheels have not been taken into account.

*) All gears as given in this diagram are standard equipment for USA and Europe, except with Roadster being equipped with these gears for Europe only.

Subject to change without notice

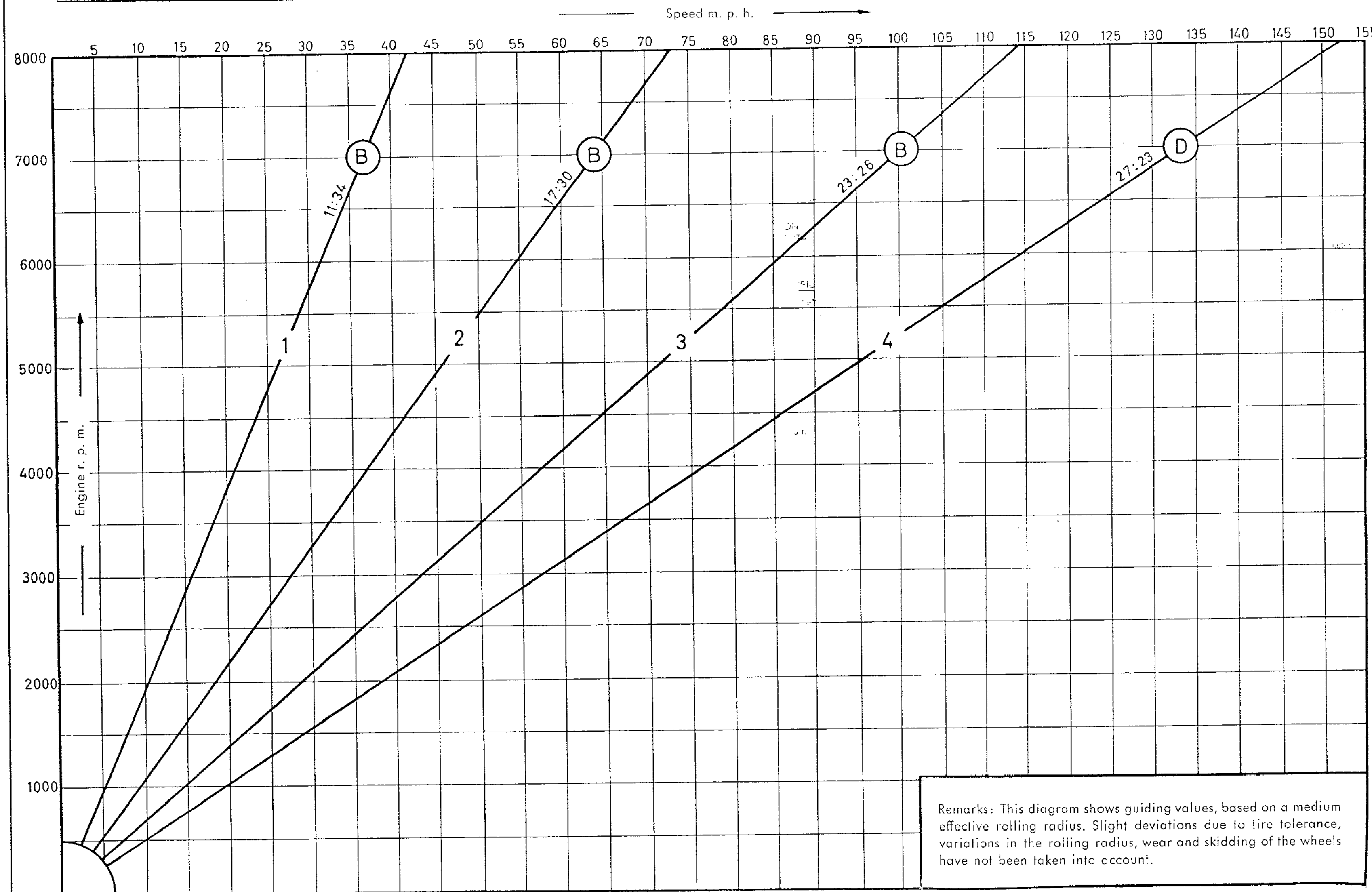
PORSCHE

Type 356 B/1600 S Coupe, Cabriolet/Hardtop, Roadster
Type 356 B/1600 Roadster, Equipment for USA

Transmission Diagram

Bevel gear Crown wheel ratio 7 to 31

Tires: 5.60—15



Remarks: This diagram shows guiding values, based on a medium effective rolling radius. Slight deviations due to tire tolerance, variations in the rolling radius, wear and skidding of the wheels have not been taken into account.

Subject to change without notice

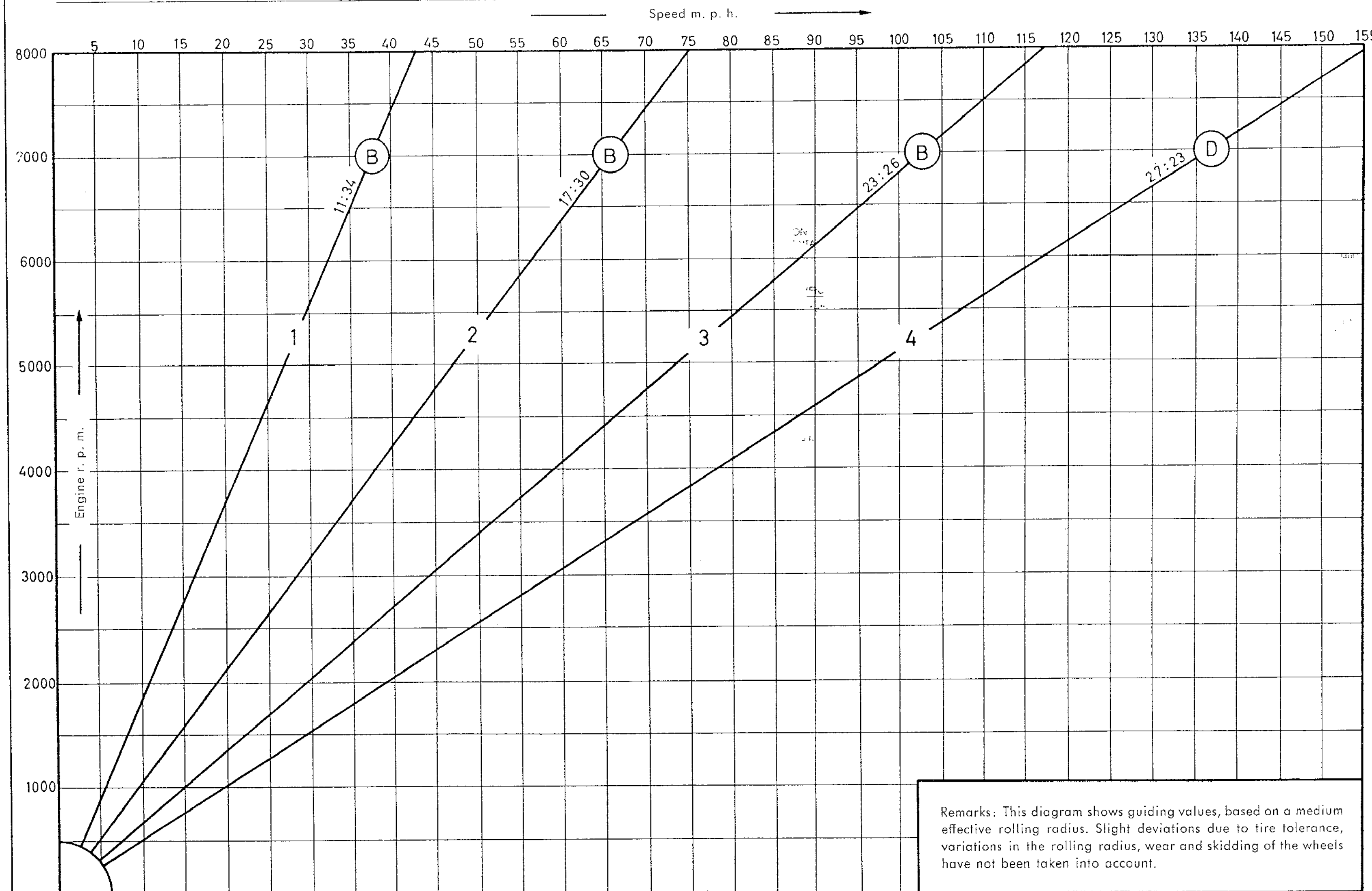
PORSCHE

Transmission Diagram

Type 356 B/1600 S-90 Coupe, Cabriolet/Hardtop, Roadster

Bevel gear Crown wheel ratio 7 to 31

Tires: 5.90—15



Remarks: This diagram shows guiding values, based on a medium effective rolling radius. Slight deviations due to tire tolerance, variations in the rolling radius, wear and skidding of the wheels have not been taken into account.

Subject to change without notice

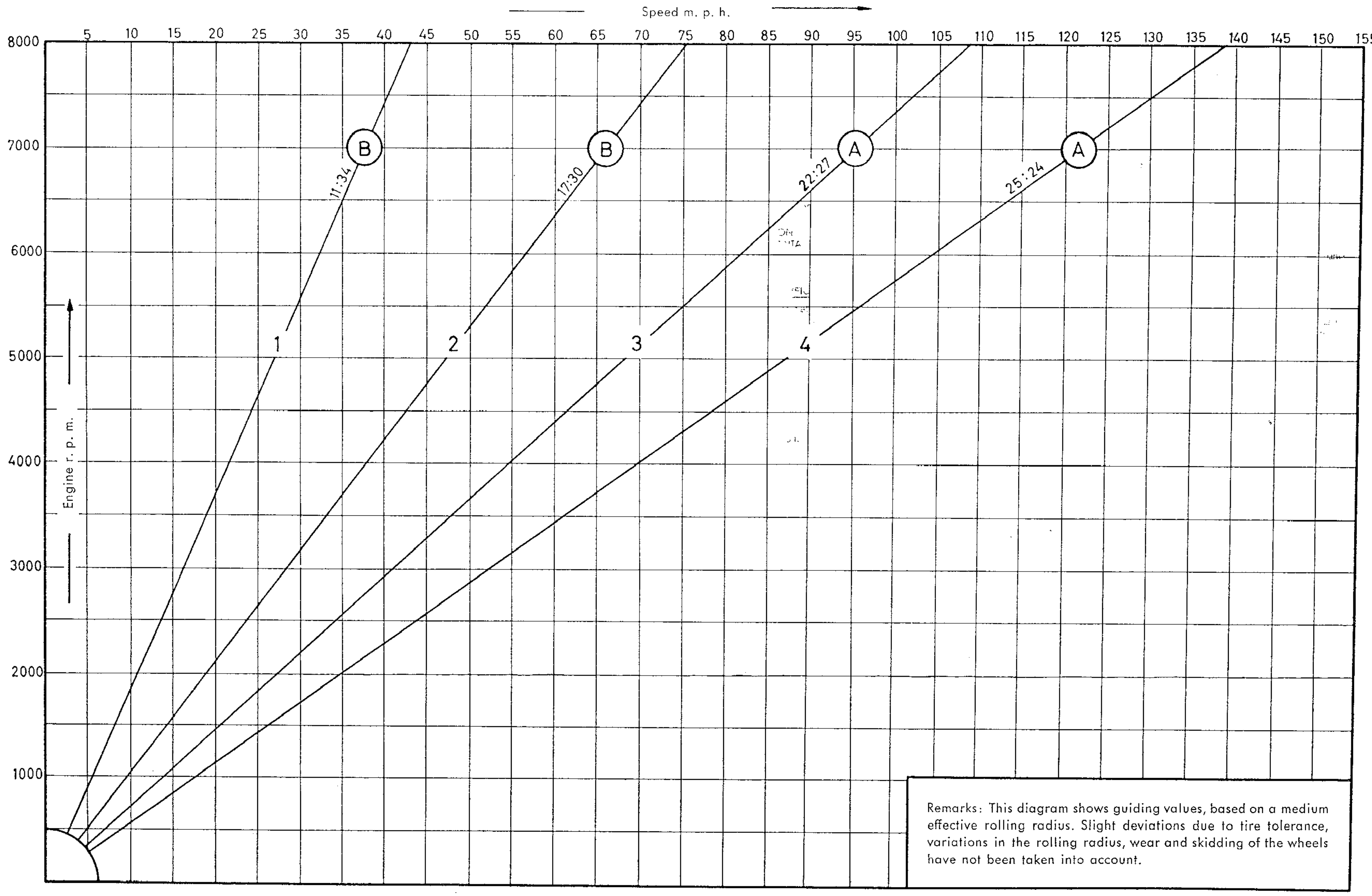
PORSCHE

Transmission Diagram

Type 356 B/1600 GS — Carrera GT (Gran Turismo) Equipment for Europe

Bevel gear Crown wheel ratio 7 to 31

Tires: 5.90—15



Remarks: This diagram shows guiding values, based on a medium effective rolling radius. Slight deviations due to tire tolerance, variations in the rolling radius, wear and skidding of the wheels have not been taken into account.

Subject to change without notice

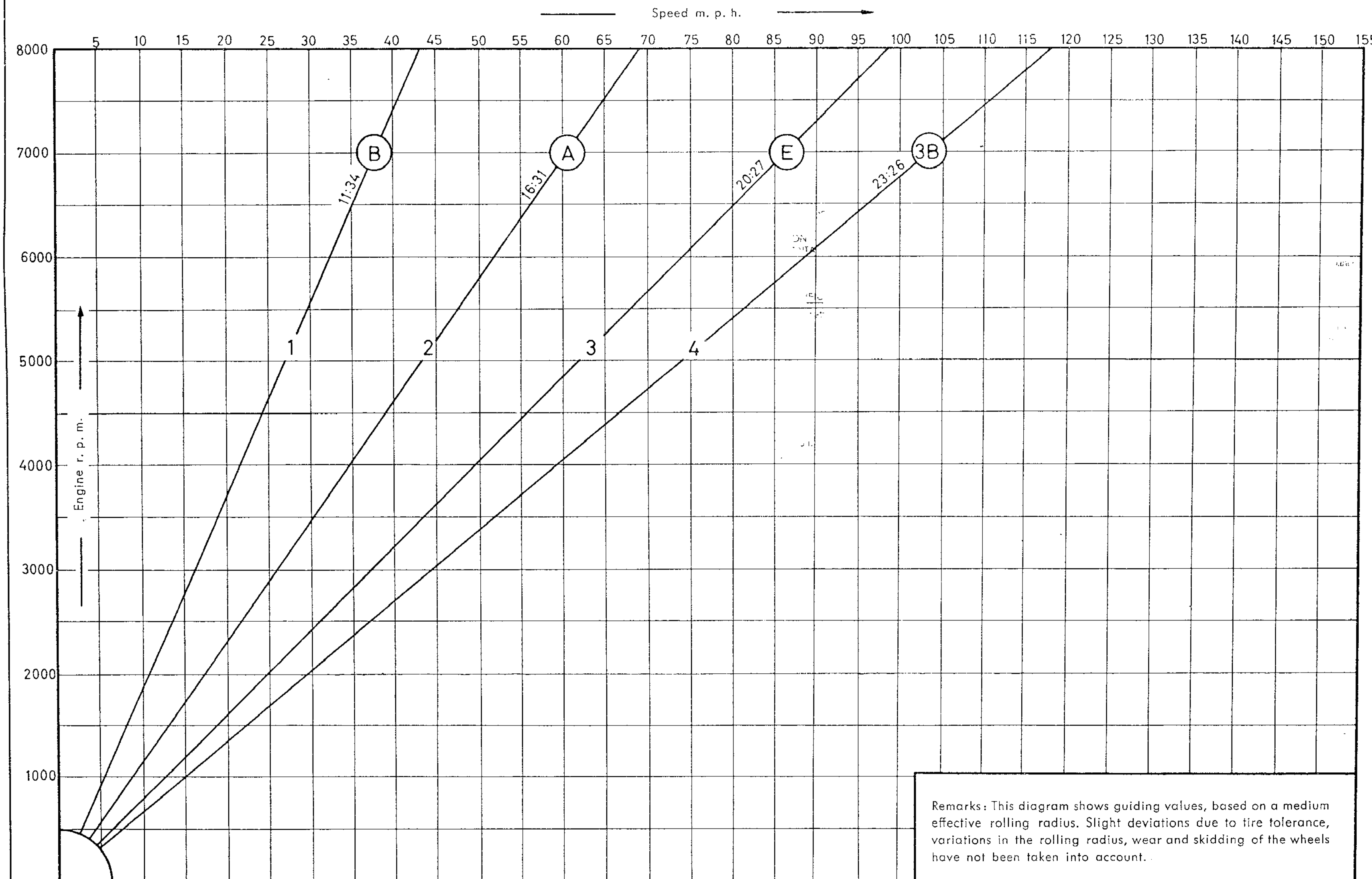
PORSCHE

Transmission Diagram

Type 356 B/1600 GS — Carrera GT (Gran Turismo) Special Equipment for Air Port Racing

Bevel gear Crown wheel ratio 7 to 31

Tires: 5.90 – 15



Remarks: This diagram shows guiding values, based on a medium effective rolling radius. Slight deviations due to tire tolerance, variations in the rolling radius, wear and skidding of the wheels have not been taken into account.

Subject to change without notice

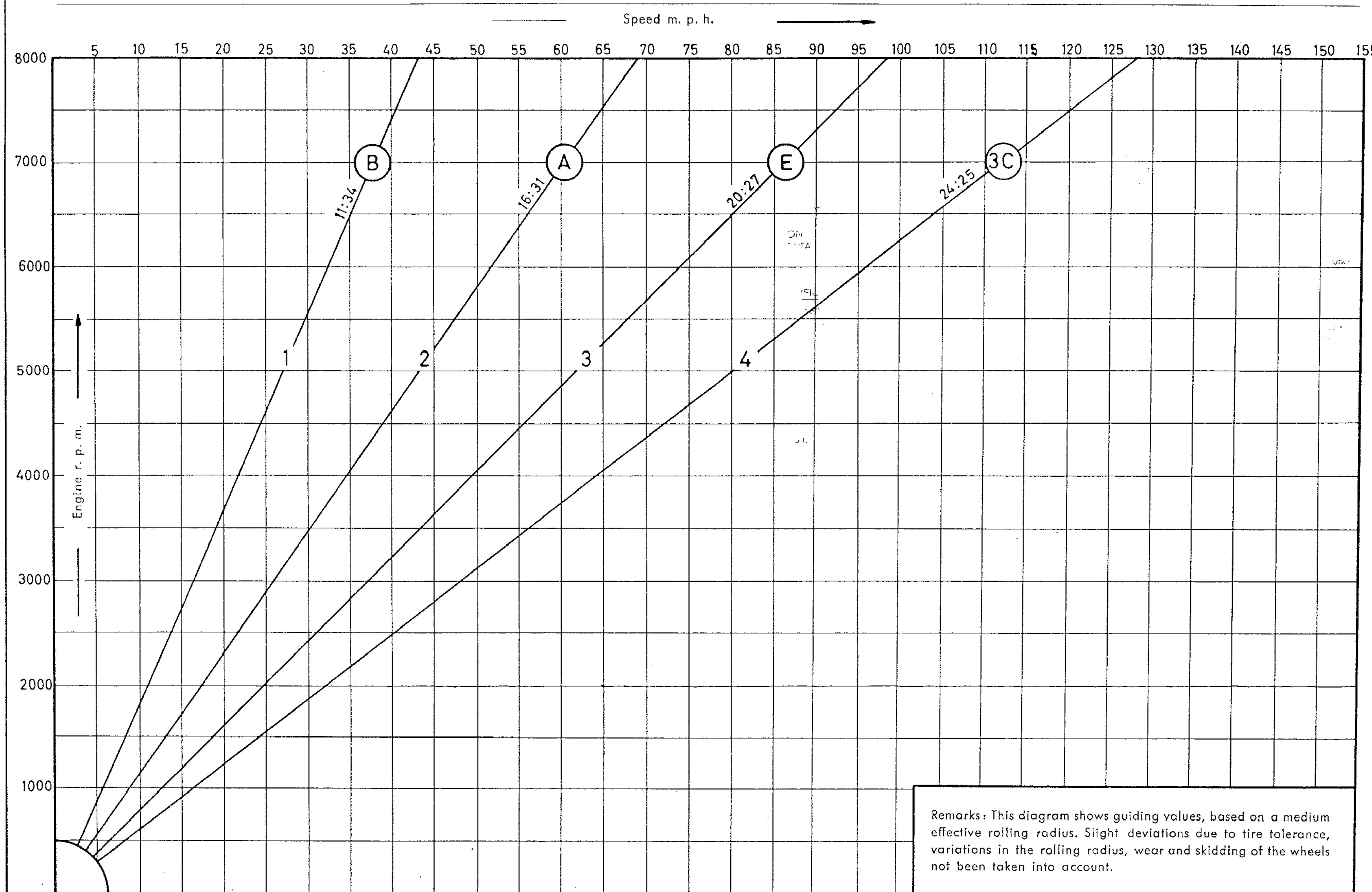
PORSCHE

Transmission Diagram

Type 356 B/1600 GS — Carrera GT (Gran Turismo) Equipment for USA

Bevel gear Crown wheel ratio 7 to 31

Tires: 5.90—15



Remarks: This diagram shows guiding values, based on a medium effective rolling radius. Slight deviations due to tire tolerance, variations in the rolling radius, wear and skidding of the wheels not been taken into account.

Subject to change without notice

TRANSMISSION WITH REAR AXLE AND REAR SUSPENSION

Coupe, Cabriolet, Hardtop and Roadster with 1600 and 1600 Super Engines.

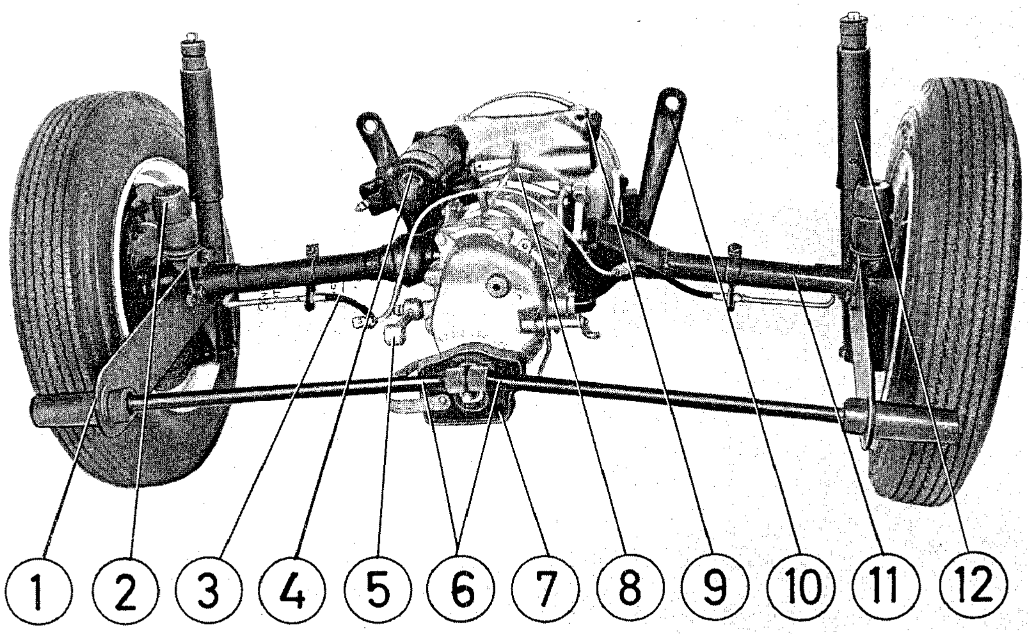


Fig. 15

① Radius arm, right

② Buffer

③ Brake hose, right

④ Starter

⑤ Adjustable torque rod

⑥ Rear torsion bars

⑦ Forward transmission support

⑧ Transmission

⑨ Clutch pivot shaft

⑩ Transmission mount

⑪ Axle tube, left

⑫ Telescopic shock absorber, left

Bottom view (without compensating spring).

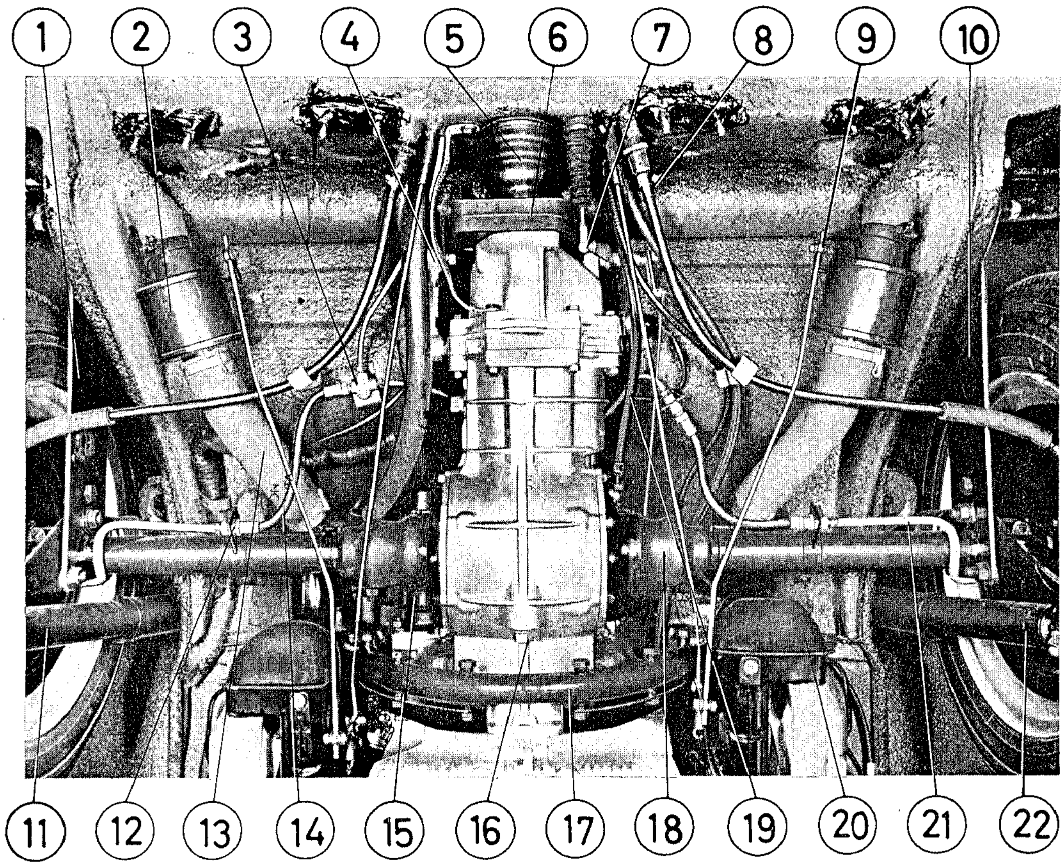


Fig. 17

1. Radius arm, right
2. Heater flap, right
3. Brake hose connector
4. Adjustable torque rod
5. Bellows for shift linkage
6. Forward transmission support
7. Bell crank for throttle linkage
8. Hand brake cable, left
9. Control rod for heater flap, left
10. Radius arm, left
11. Telescopic shock absorber, right
12. Connection for brake hose and brake line, right
13. Flexible heater connector, right
14. Brake hose, right
15. Starter
16. Oil drain plug for transmission
17. Transmission mount
18. Axle boot, left
19. Clutch cable housing
20. Heater box, left
21. Brake hose, left
22. Telescopic shock absorber, left

TRANSMISSION WITH REAR AXLE AND REAR SUSPENSION

Coupe, Cabriolet, Hardtop and Roadster with 1600 S-90 and Carrera Engines.

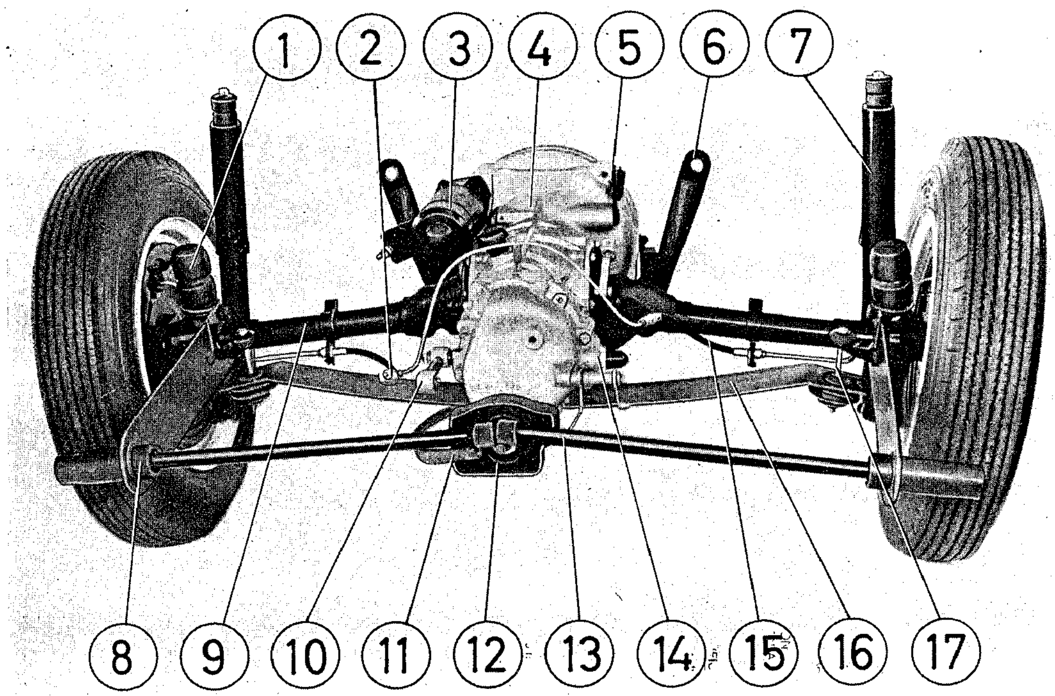


Fig. 16

1. Buffer
2. Brake hose connector
3. Starter
4. Transmission
5. Clutch pivot shaft
6. Transmission mount
7. Telescopic shock absorber, left
8. Radius arm, right
9. Axle tube, right
10. Adjustable torque rod
11. Ground strap (Transmission to chassis)
12. Forward transmission support
13. Torsion bar, left
14. Back-up light switch
15. Brake hose, left
16. Compensating spring
17. Adjustable mounting for compensating spring

1 RA

Removing and Installing Rear Axle and Transmission

Special Tools:

P 30	Puller for brake drum
P 35a	Gauge for adjusting clutch release bearing
P 36	Brake drum holder and wrench guide for P 42, P 44, P 44a and P 36a
P 36a	Special tool for brake drums with knock-off wheels
P 42	Torque wrench 360 ft. lb. (50 mkg)
P 44	36 mm socket
P 44a	Extension for P 44
P 53	Radius arm compressor

Removal

1. Jack up automobile.
2. Disconnect battery lead, close fuel tap.
3. Loosen rear wheel nuts, remove rear wheels.
4. Remove Engine (1 EN).
5. Remove floor tunnel cover in rear of driver compartment.

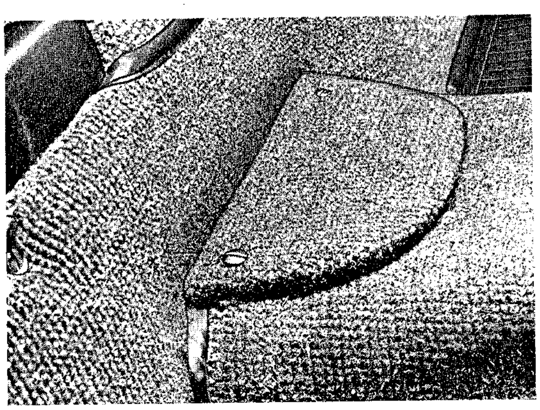


Fig. 18

6. Push rubber bellows in tunnel forward. Loosen locking bolt on shift rod and remove shift rod from flexible connector (RA 21).

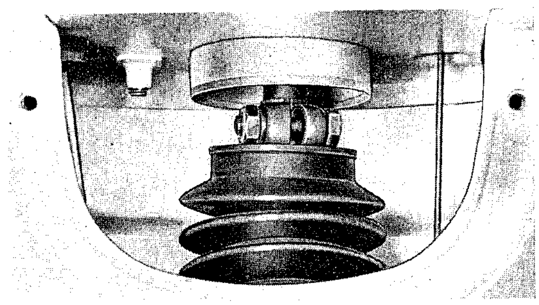


Fig. 19

7. Remove cotter key from rear axle nut and remove rear axle nut using P 36, P 36a, P 42 and P 44a.

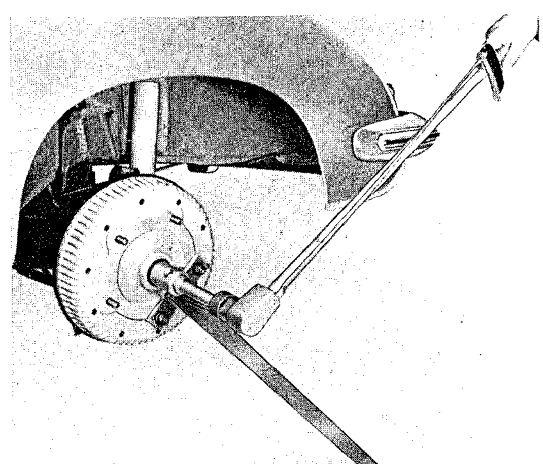


Fig. 20

8. Remove brake drums using puller P 30.

9. Remove brake shoes, springs, and push rod (8 TI).

10. Remove brake line on brake cylinder and cover with bleeder cap.

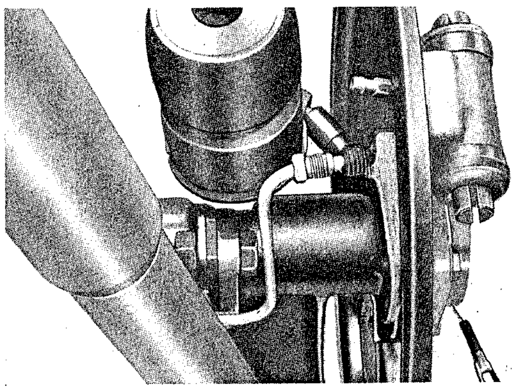


Fig. 21

11. Remove brake hose clamp on axle tube.

12. Loosen bracket for hand brake cable and remove hand brake cable.

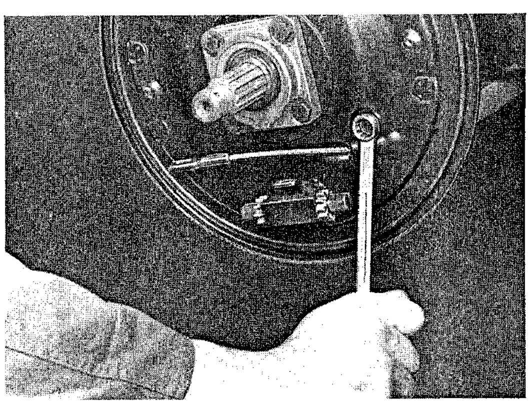


Fig. 22

13. Remove bolts from rear wheel bearing cap. Caution! Transmission oil will run out.

Remove brake backing plate and replace bearing cap and spacer temporarily.

14. Lift radius arms with tool P 53 and remove shock absorbers.

15. Remove mounting bolts from axle tube suspension flange. The front bolt is an adjustable stop and should not be disturbed. Remove angle bracket and rubber buffer.

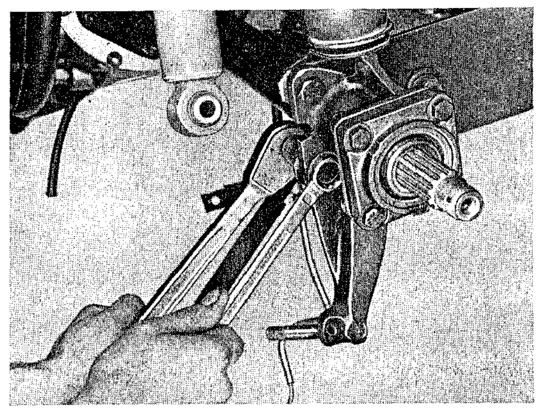


Fig. 23

16. Remove nuts from front transmission mount.

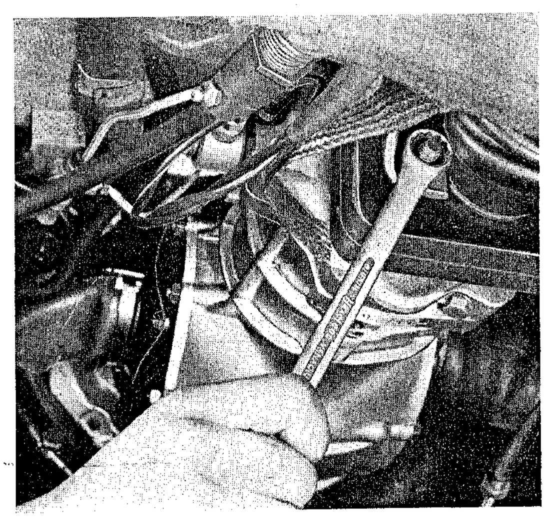


Fig. 24

17. Remove ground strap.

18. Disconnect throttle linkage.

19. Remove torque rod.

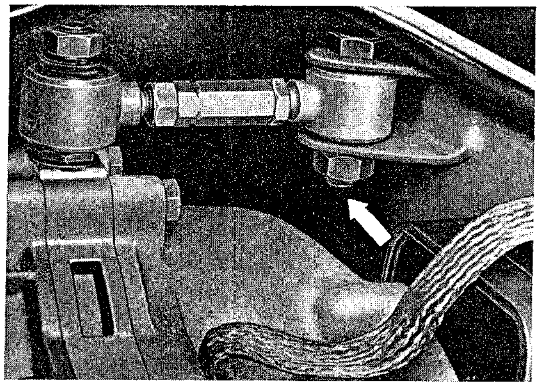


Fig. 25

20. Disconnect starter cable. Remove plug for back-up light switch.
21. Remove clevis from clutch release lever by removing clevis pin.

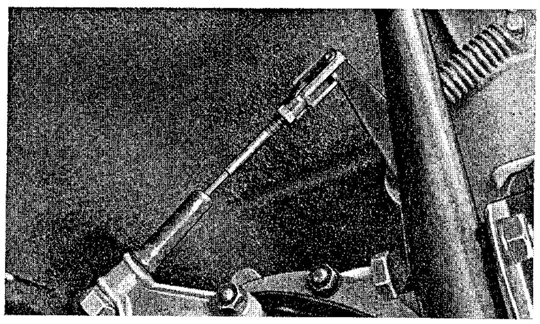


Fig. 26

22. Remove both cover plates from transmission mount bolts. Remove mounting bolts, then remove rear axle and transmission.

If the cable bracket is not slotted, the clevis end of the clutch cable must be unscrewed so that the cable can be pulled through the cable bracket.

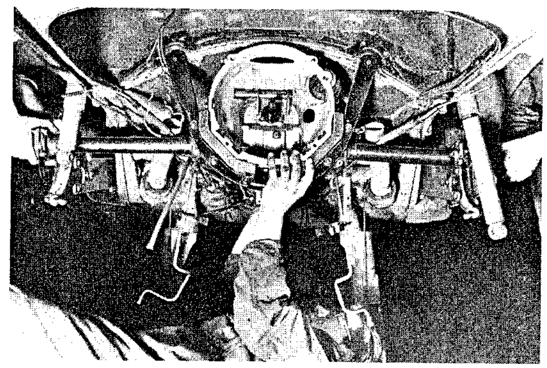


Fig. 27

23. Remove starter.

24. Remove shift rod connector and bellows from selector shaft.

Removed Rear Axle with Transmission

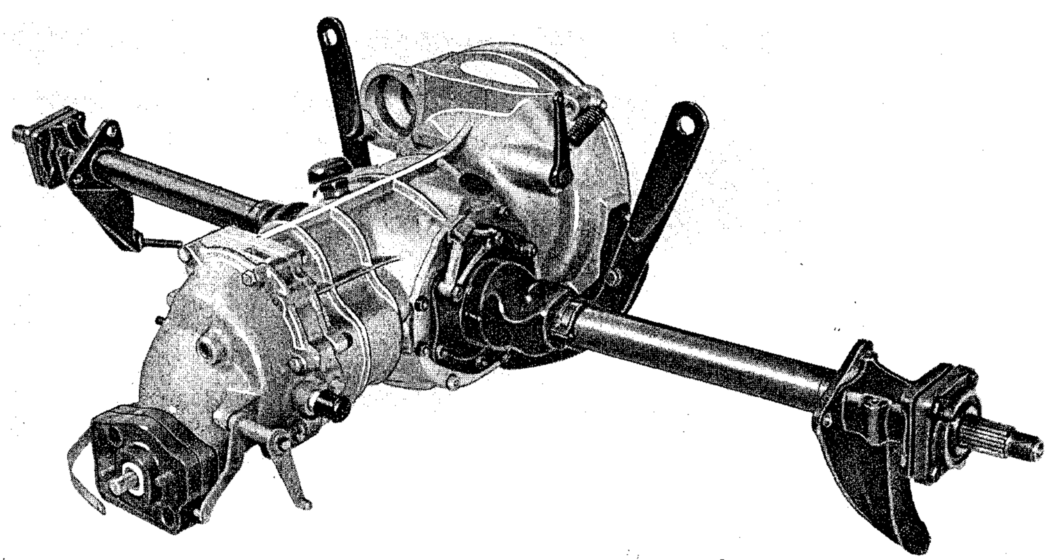


Fig. 28

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. To prevent damaging the axle boots during installation of the rear axle assembly, the axle tubes should not be turned, in their sockets.

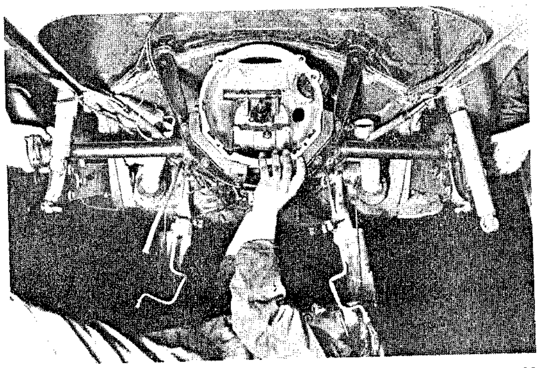


Fig. 29

2. Connect starter and generator cable to starter solenoid. To avoid loosening terminal studs from the insulators, do not tighten terminal nuts more than necessary.

3. The torque rod should be adjusted so that there is no force between the transmission and mount. Adjust if necessary.

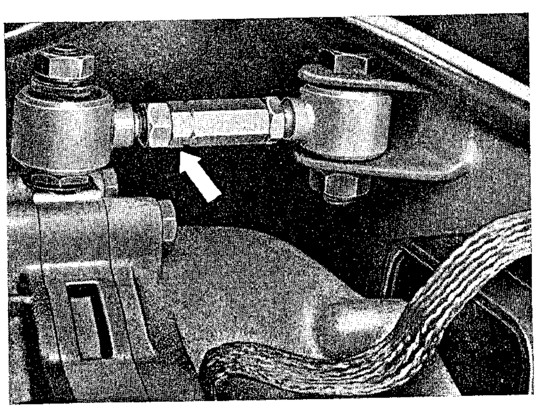


Fig. 30

4. Adjust gear shift linkage as follows: Place shift lever in second gear position. Engage second gear in the gearbox and connect shifting rod to selector shaft without preload. Tighten clamp nuts and test shifting (21 RA).

5. The clutch cable housing should be bowed between the chassis and cable bracket on the transmission (preload approx. 15 to 20 mm, $^5/_8$ to $^3/_4$ in.).

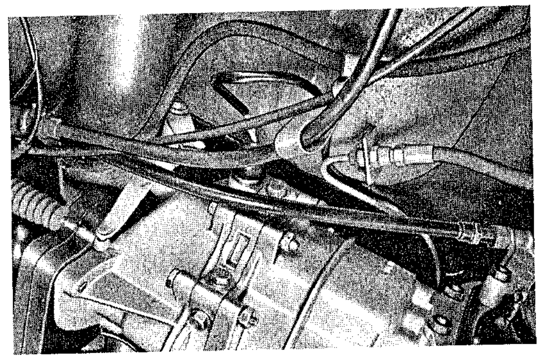


Fig. 31

6. After installing engine adjust clutch play (64 EN).

7. Adjust service and hand brake. Bleed brakes (13 and 16 TI).

8. Tighten rear axle nuts to 55 mkg (400 ft. lb.) torque and insert cotter key.

9. Tighten rear wheel nuts to 13 mkg (95 ft. lb.).

10. Fill transmission with 3.5 l (7.5 pts.) gear oil.

11. After road test, adjust rear axle on optical measuring device (3 WA).

Remarks:

Exchange transmission-rear axle assemblies are supplied without brake backing plates and brake drums.

To prevent damage to the main shaft, a removed transmission should not be placed on its flange.

After the road test make sure that there is no tension on the torque rod. If necessary adjust. This should be done with the rear wheels on the ground.

2 RA

Disassembling and Assembling Transmission

Special Tools:

P 31a	Guide ring used with tool P 31 to tighten castle nut of pinion shaft.
P 36	Holder for brake drum and guide for axle nut wrench.
P 37	Holder for main shaft for tightening castle nuts of main and pinion shafts.
P 42	Torque wrench 50 mkg (360 ft. lb.) for rear axle nuts (used with P 44).
P 44	Socket 36 mm with extension (used with P 42).
P 46	Socket 32 mm for castle nut of pinion shaft.
P 55	Stand, to press main and pinion shafts into intermediate plate.
P 56	Stand, to press main and pinion shaft out of intermediate plate.
P 57	Short guide pin for installing selector rod lock bushing (1st, 2nd and reverse gear).
P 58	Long guide pin for installing selector rod lock bushing (3rd and 4th gear).
P 59	Puller to remove roller bearing races from transmission housing.
P 60	Mandrel for installing roller bearing race in transmission housing (pinion shaft).
P 61	Mandrel for installing roller bearing race in transmission housing (main shaft).
P 62	Drift for clutch pivot shaft bushing.
P 63	Puller for inner bushing of clutch pivot shaft.
P 64	Mandrel for installing outer bushing of clutch pivot shaft.
P 65	Plate for removing inner roller bearing race from main shaft.
P 66	Puller for selector rod lock bushings.
P 67	Press guide for removing roller bearing from pinion shaft.
P 68	Selector rod guide for adjusting shift forks.
VW 118	Torque wrench (6 mkg, 44 ft. lb.) general application.
VW 222	Drift for starter shaft bushing.
VW 228	Puller for removing starter bushing with engine installed.
VW 246	Limit gauge for starter shaft bushing.
VW 291 b	Press stand for installing oil seal.
VW 308	Assembly stand for transmission.
VW 400	Hydraulic press.
VW 401	Frame for various press operations.
VW 407	Arbor, general application.
VW 408	Arbor, general application.
VW 409	Arbor, general application.
VW 415	Tube, 57 mm dia. for general application and differential ball bearings in transmission side covers.
VW 433	Press accessory, general application.
VW 438	Guide (cylindrical) general application.

General

Due to high precision machining of transmissions all cast parts are interchangeable. If it becomes necessary to replace the transmission housing; the ring and pinion clearance must be computed as well as the preload on the ball bearings (11 RA). Should the intermediate plate or the double ball bearing of the pinion be exchanged; computations and new adjustments are necessary (10 RA).

Disassembly

1. Mount transmission with rear axle on special tool VW 308.
2. Remove transmission drain plug and drain oil.
3. Remove starter.
4. Remove clutch release bearing and clutch pivot shaft if necessary (20 RA).

5. Remove transmission mount.

6. Remove axle tubes (17 RA).

7. Remove transmission housing end cover with selector rod.

8. Remove reverse idler II from reverse gear shift fork.

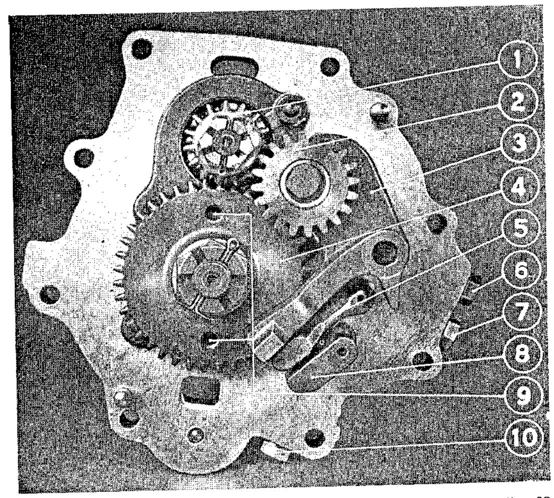


Fig. 33

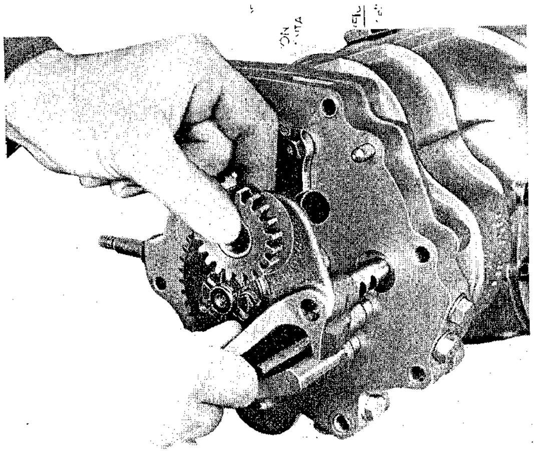


Fig. 32

① Reverse gear I (on main shaft).

② Reverse gear II (held by selector fork).

③ Selector rod for reverse gear.

④ Reverse gear III (mounted on pinion shaft).

⑤ Selector rod, 1st and 2nd gear.

⑥ Plug for selector rod lock, reverse gear.

⑦ Plug for selector rod lock, 1st and 2nd gear.

⑧ Selector rod 3rd and 4th gear.

⑨ Tapped holes to extract gear.

⑩ Plug for selector rod lock, 3rd and 4th gear.

9. Install main shaft holder P 37 (Fig. 47).

10. Engage 4th gear. Remove cotter key from pinion shaft castle nut. Loosen nut on pinion shaft using P 42 and P 46, and remove reverse gear III and key from main shaft.
Should the gear be excessively tight on the pinion shaft, insert bolts in the two holes in the gear and pull off evenly.

11. After removing cotter key and nut from main shaft, remove reverse gear I and key.

12. Remove intermediate plate with main and pinion shafts from transmission housing. For reassembly note thickness of gaskets used. The two dowel pins should remain in the intermediate plate.

13. Hold intermediate plate in vise using soft jaws.

14. Remove three plugs from selector rod locks (Fig. 45, ⑥, ⑦, and ⑩).

Note

One ball and spring fits into each of the shift lock bores of the first and second gears and the reverse gear. A ball and spring followed by a spacer tube fits into the shift lock bore of the 3rd and 4th gears (Fig. 45).

15. Remove bolts holding shift forks and pull shift rods out of intermediate plate.

Note

As seen in Fig. 45 interlock pins are located in the connecting passage between the shift rods for reverse and 1st and 2nd gear and between the shift rods for 1st and 2nd gear and 3rd and 4th gear.
Upon disassembly all locks should be removed from the bores so that the correct installation procedure may be followed at assembly.

16. Using tools P 56 and VW 407 remove pinion and main shaft simultaneously from intermediate plate. The dowel pins must be pushed to one side so that the plate will lie flat on the press.

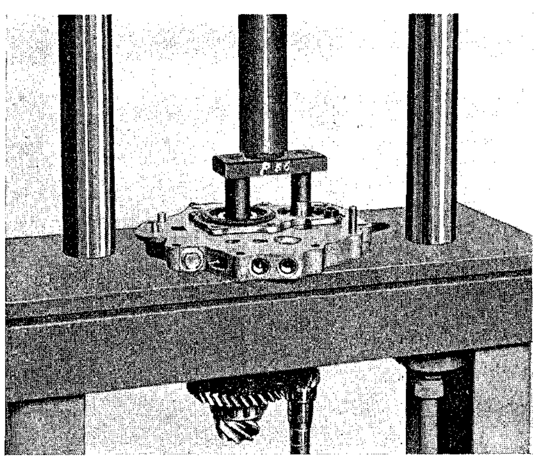


Fig. 34

17. Disassemble intermediate plate (9 RA).

Note

Should it become necessary to install a new intermediate plate, the adjustment of the ring and pinion as well as the preload on the double row ball bearing must be redetermined (12 and 13 RA).

18. Remove rear axle drive assembly (8 RA).

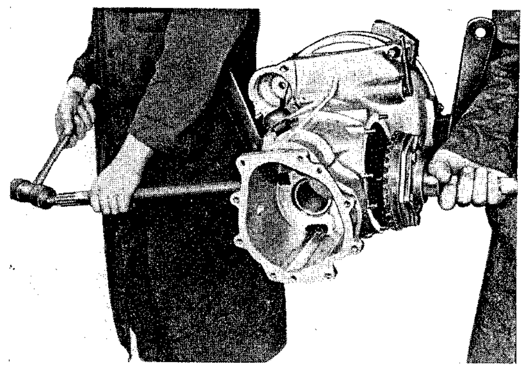


Fig. 35

19. Remove both lock rings from the bearing race of the main shaft and the lock ring inside the gear box from the bearing race of the pinion shaft (Fig. 38 and 39).

20. Remove main shaft bearing from transmission housing using tool P 59 (complete with rollers and cage).

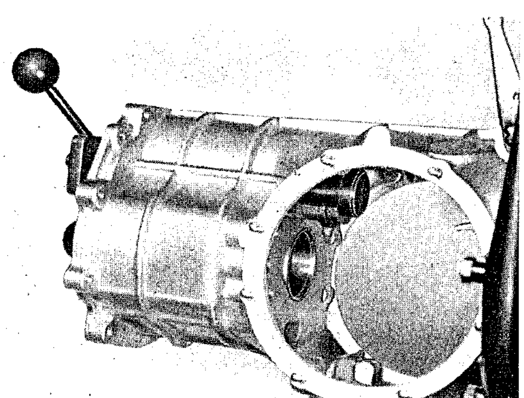


Fig. 36

21. Remove bearing race from pinion shaft using tool P 59.

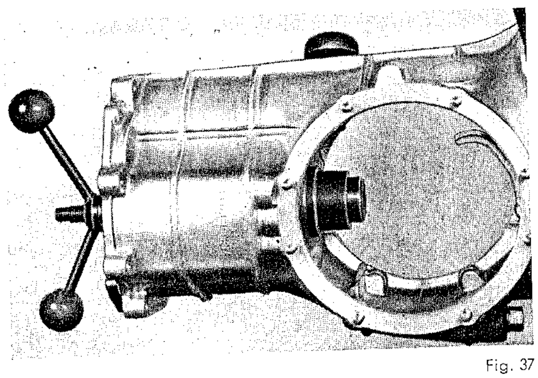


Fig. 37

Note

For easier removal of the races, the housing may be heated to 212° to 240° F (100 to 120° C).

22. Remove oil deflector plate from differential housing.

23. If necessary remove main shaft oil seal (19 RA).

Assembly

The assembly is accomplished in the reverse order of disassembly observing the following points:

1. Clean transmission housing and inspect for wear, external damage, or cracks. In case of severe damage (e. g. ring or pinion fracture) check whether the bearing seats have also been damaged. If necessary replace transmission housing.

2. Inspect wear of starter bushing using tool VW 246. Install new bushing using tool VW 222 if required.

3. Inspect clutch pivot shaft bushings for wear. Replace if necessary (20 RA).

4. Check roller bearings of main and pinion shafts for wear or damage. Replace if necessary.

5. Check main shaft for runout (7 RA).

6. Install outer lock ring of pinion shaft bearing.

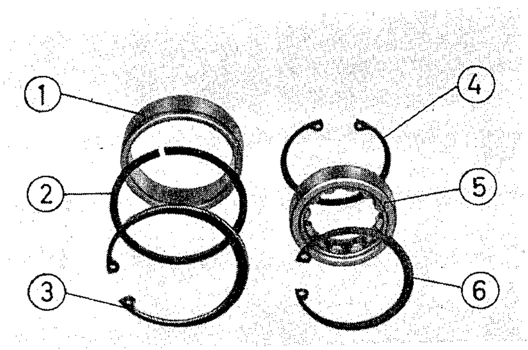


Fig. 38

① Roller bearing outer race for pinion shaft
② Lock ring (installed on bearing race)
③ Lock ring
④ Lock ring
⑤ Roller bearing outer race with cage and rollers for main shaft
⑥ Lock ring

7. Install rear lock ring for main shaft bearing using special pliers.

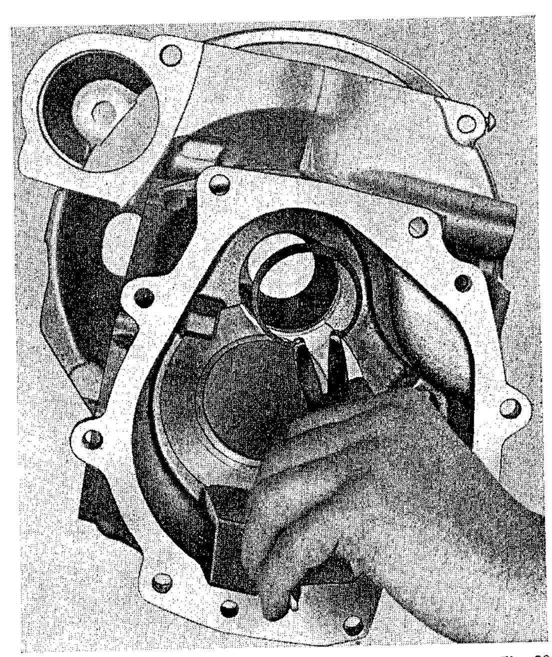


Fig. 39

8. Heat transmission housing to 212 to 230° F (100 to 110° C) and install bearing races using tool P 60 and P 61.
   For main shaft: Outer race with cage and rollers.

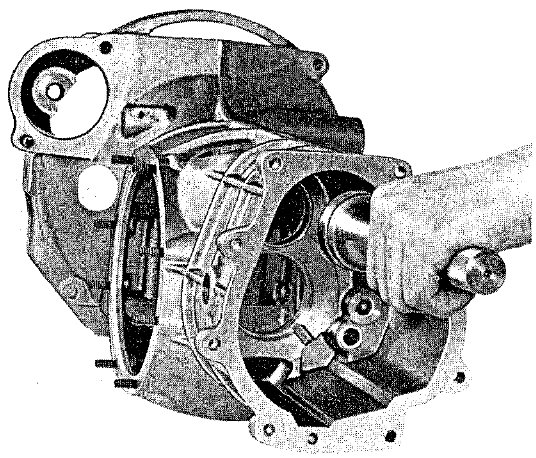


Fig. 40

For pinion shaft: Outer race with mounted lock ring.

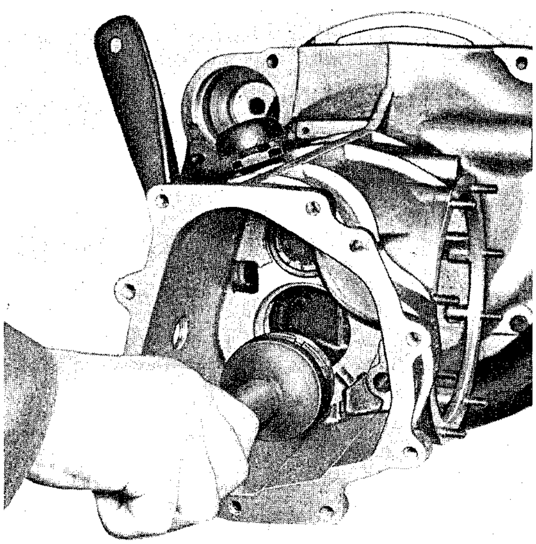


Fig. 41

9. Install lock rings on both bearings (Fig. 38 and 39).

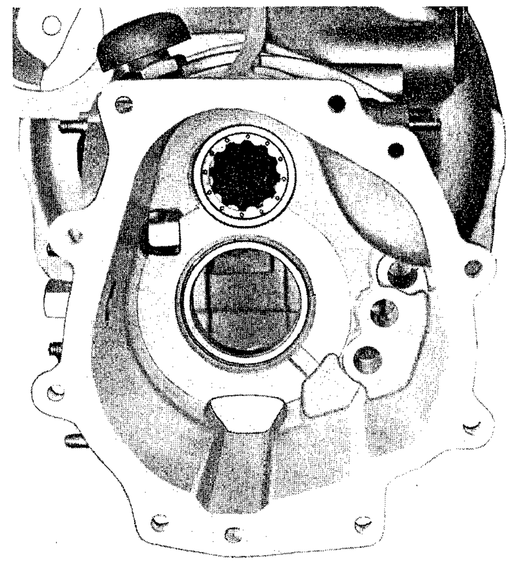


Fig. 42

10. Install oil deflector plate and secure with copper lock washer.

11. Install main shaft seal.

12. Insert main and pinion shafts in special tool P 55 and adjust height with adjusting screw until the faces of the fourth gears of both shafts are flush.

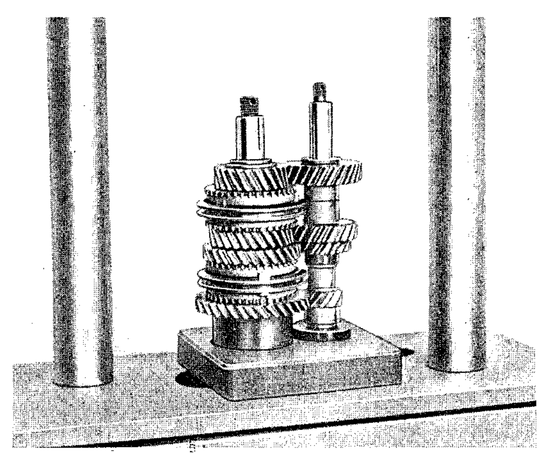


Fig. 43

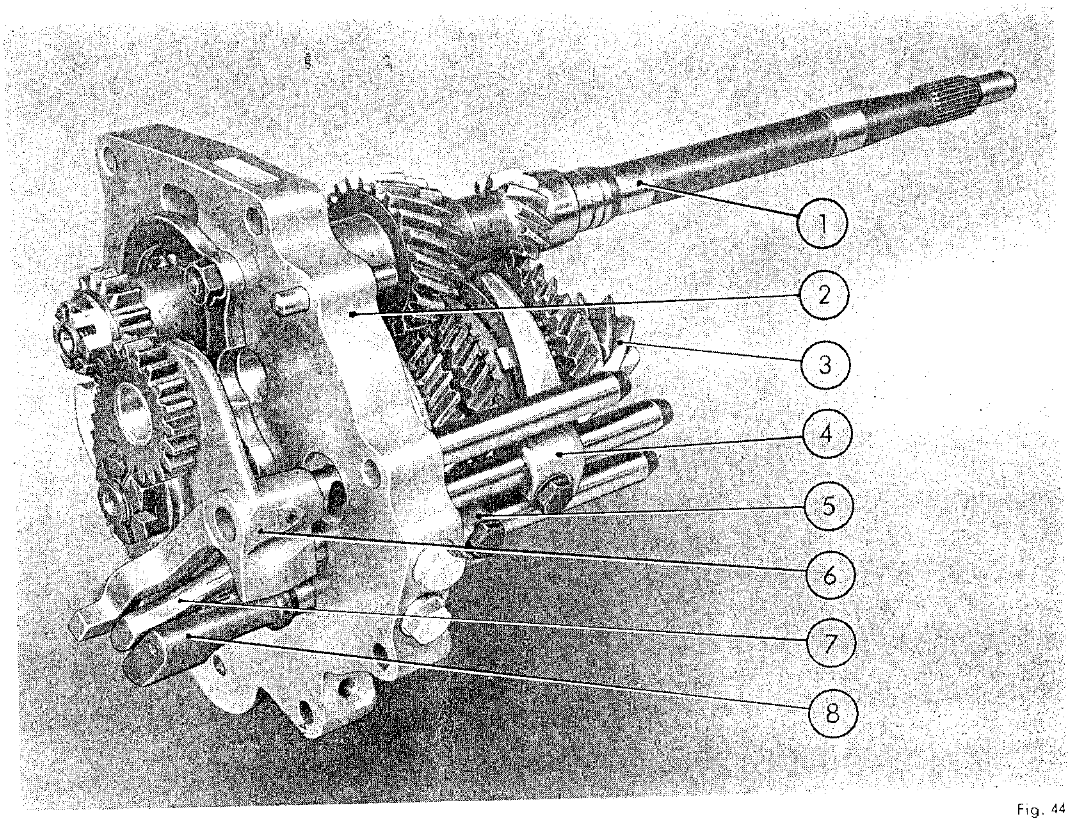


Fig. 44

① Main shaft
② Intermediate plate
③ Pinion gear
④ Selector fork 1st and 2nd gear
⑤ Selector fork 3rd and 4th gear
⑥ Shift rod with fork for reverse gear
⑦ Shift rod for 1st and 2nd gear
⑧ Shift rod for 3rd and 4th gear

Arrangement of Selector Interlocks

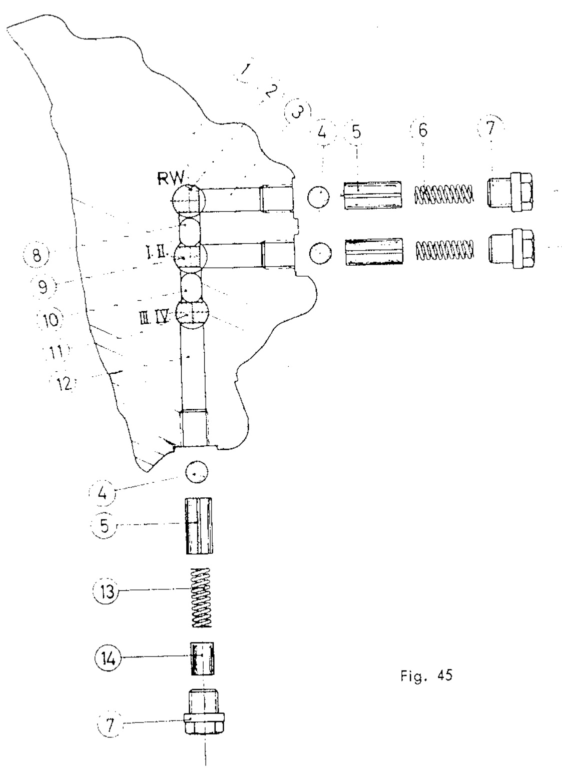


Fig. 45

① Intermediate plate
② Shift rod for reverse gear
③ Bore for reverse gear interlock (seat for part 5)
④ Locking ball
⑤ Guide bushing
⑥ Reverse gear lock spring (free length 25.7 mm, 1.012 in.)
⑦ Retaining plug
⑧ Interlock pin
⑨ Shift rod for 1st and 2nd gear
⑩ Interlock pin
⑪ Shift rod for 3rd and 4th gear
⑫ Bore for 3rd and 4th gear interlock
⑬ Lock spring for 3rd and 4th gear (free length 23.2 mm, .913 in.)
⑭ Spacer plug

13. Using tool P 55 press main and pinion shafts into intermediate plate simultaneously. There should be at least 0.2 mm (.079 in.) clearance between the upper faces of the 4th gears of both shafts and the surface of the intermediate plate.

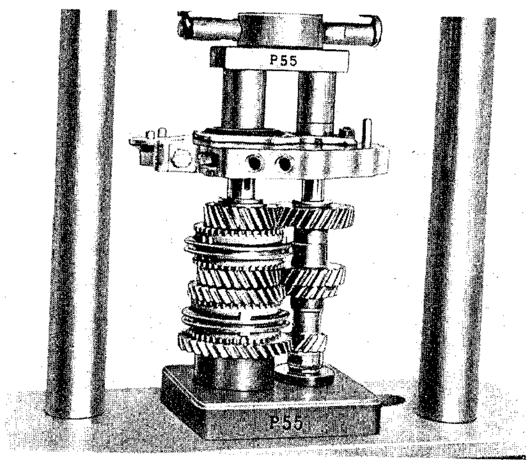


Fig. 46

14. Hold intermediate plate with main and pinion shafts in a vise using soft jaws.

15. Install shift rods and selector forks in the following order:

a) Reverse gear selector rod.

b) Insert first interlock pin.

c) 1st and 2nd gear selector rod and fork.

d) Insert second interlock pin.

e) 3rd and 4th gear selector rod and fork.

16. If the bushings for the selector rod locks have been removed (using tool P 66) or if a new intermediate plate is used, the bushings must be installed in the three bores using tools P 57 and P 58.

17. Inspect springs of gear shift locks. Replace damaged springs. The correct free length for reverse gear is 25.7 mm (1.012 in.), minimum 25.2 mm (.992 in.). Free length for forward gear springs is 23.2 mm (.915 in.), minimum 22.7 mm (.895 in.).

18. Install a locking ball and spring in each of the three gear lock bores using the correct spring for reverse gear (Fig. 45).

19. Install spacer plug in the 3rd and 4th gear lock bore.

20. Install three retaining plugs.

21. Install intermediate plate with main and pinion shafts in gear box. The dowel pins must fit tight in the intermediate plate.

22. Install tool P 37 to hold main shaft.

23. Secure intermediate plate to transmission housing.

24. Engage 1st gear using a screwdriver.

25. Install gear I of reverse gear on main shaft and tighten castle nut to 2.5 mkg (18 ft. lb.) torque.

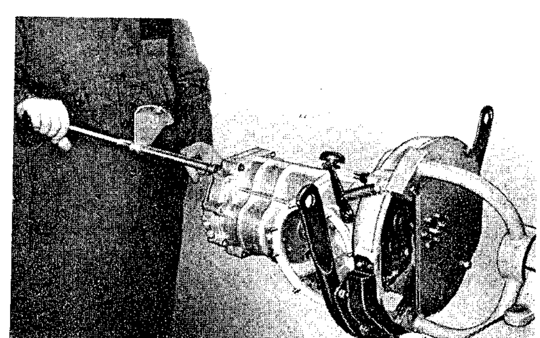


Fig. 47

26. Install reverse gear III on pinion shaft and tighten castle nut using torque wrench P 42 and socket P 46 to 20 mkg (145 ft. lb.) torque.

27. Loosen castle nut and re-tighten to 10 mkg (70 ft. lb.) torque.

28. With selector forks free on shafts check locking of selector rods. As soon as a gear is engaged, the other rods must be locked in position, i. e. after selecting 1st or 2nd gear the other selector rods must be locked in position.

29. In cases where the intermediate plate, the transmission housing or pinion have been exchanged, the ring and pinion adjustment must be performed (10 and 11 RA).

30. Remove intermediate plate with main and pinion shafts from transmission housing and secure in vise using soft jaws.

31. Install gear II of reverse gear in selector fork.

32. Insert shaft for reverse idler through reverse idler into intermediate plate. This will provide a proper guide for the reverse gear selector rod and assure the proper position for adjusting selector forks for forward speeds (Fig. 48).

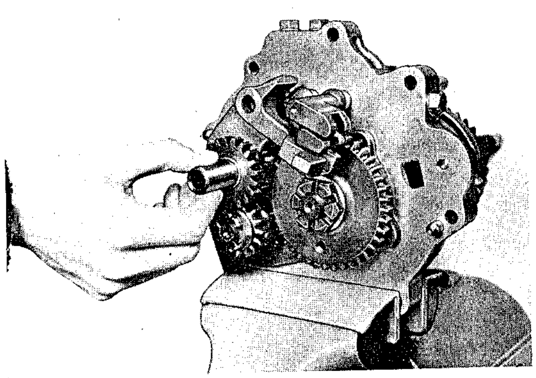


Fig. 48

33. Install selector rod guide P 68.

34. The selector forks should be so adjusted that the sliding sleeve in a neutral position is exactly centered between the synchronizing rings. This adjustment must be exact to insure proper gear synchronization.

35. After completion of fork adjustment, tighten clamping bolts to 2.5 mkg (18 ft. lb.) torque. Insure that the selector rod heads are in the proper position, i. e. parallel to each other.

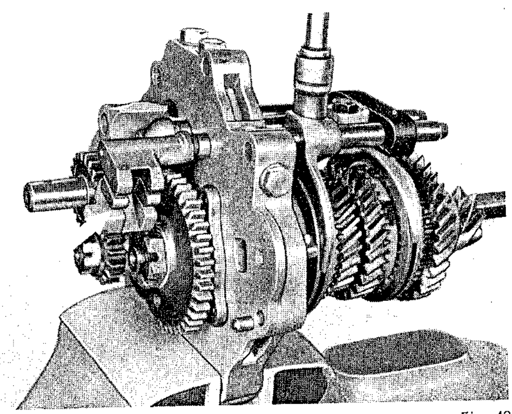


Fig. 49

36. After the proper shims for ring and pinion clearance have been determined, install intermediate plate in transmission housing.

37. Secure pinion and drive shaft castle nuts with cotter keys.

RECONDITIONING PINION SHAFT

3 RA

Disassembling Pinion Shaft

Special Tools:

P 31	Holder for pinion shaft while tightening castle nut
P 31a	Guide ring used with tool P 31 to tighten castle nut of pinion shaft
P 39	Pinion shaft collar
P 41	Assembly ring for roller bearings on pinion shaft
P 42	Torque wrench
P 46	Socket used with P 42 to tighten castle nut on pinion shaft
P 67	Press guide for removing roller bearing from pinion shaft
VW 400	Hydraulic press
VW 401	Plate for various press operations
VW 409	Arbor, general application
VW 410	Arbor, general application
VW 412	Arbor, general application
VW 421	Tube, 28 mm dia. 100 mm long, general application

Disassembly

1. Disassemble transmission (2 RA).

2. Press pinion shaft out of complete gear train using tools VW 400, VW 401 and VW 410.

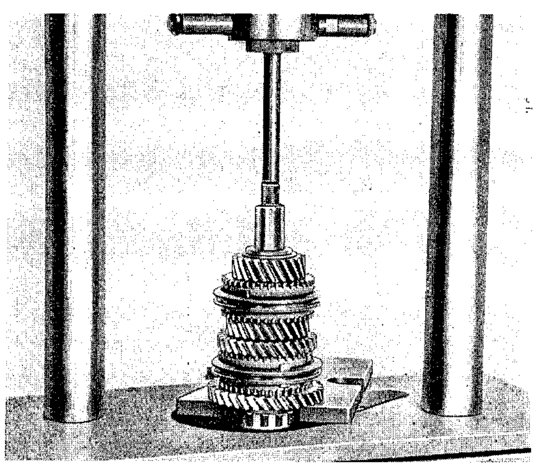


Fig. 50

3. Remove spacer 4 mm and washer 2 mm from 4th gear with needle bearing and bushing.

4. Remove sliding sleeve and spider.

5. Remove third gear with needle bearing and bearing sleeve.

6. Remove washer between 2nd and 3rd gear.

7. Remove 2nd gear, rollers, cage and bearing sleeve.

8. Remove sliding sleeve and spider.

9. Remove 1st gear, rollers, and cage.

10. Press bearing sleeve, thrust washer, and roller bearing from pinion shaft using tools P 67, VW 400, VW 401, and VW 402.

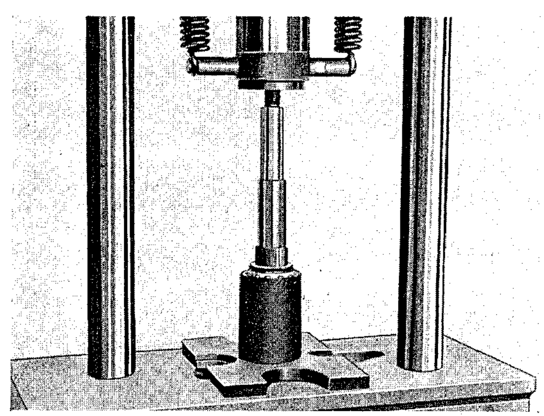


Fig. 51

11. Note the number and thickness of spacers between roller bearing and thrust washer.

Inspection

1. Inspect pinion (especially teeth) for wear and damage. Make sure that both parts have the same set number.
2. Inspect roller bearing and double-row ball bearing. Replace if necessary.
3. Inspect gears for wear and damage. If necessary replace (2nd, 3rd and 4th gear in pairs only).
4. Inspect all synchronizing parts for wear.

Determining Shims

4 RA

Provisional determination of shims between roller bearing and thrust washer for 1st gear on pinion shaft.

For differential ring and pinion ratio 7:31 the **setting dimension** is etched either into the face of the pinion or the outside of the ring gear. This dimension gives the correct distance R between the centerline of the differential drive and the face of the pinion when assembled (Fig. 52).

The basic size for the dimension R, before fitting shims, is given as 59.80 mm (2.354 in.) for the gear ratio 7:31.

The difference between this basic size and the setting dimension marked on the gears has to be made up with shims. The shims are available in thicknesses of 0.10 mm, 0.15 mm, 0.30 mm. These shims are placed between the roller bearing inner race and the thrust washer for the 1st gear.

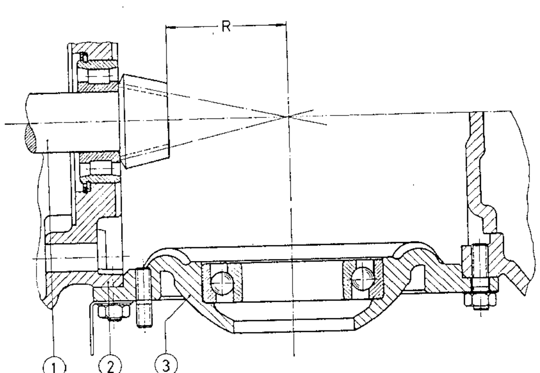


Fig. 52

Example (gear ratio 7:31)

Basic dimension	59.80 mm
Setting dimension	59.25 mm
Difference	0.55 mm
Shims required:	1 shim 0.30 mm
	1 shim 0.10 mm
	1 shim 0.15 mm

Use the next larger size for shim values above 0.05 mm.
Use the next lower size for shim values below 0.05 mm.

The shim combination is best chosen in such a manner that it is possible, in case additional adjustment is required, to add or substract the smallest possible value of 0.05 mm by a change of one shim.

Note

For the foregoing determination of the required shims, it is advisable to assume the basic dimension too high rather than too low, i. e. to fit too thick a shim pack rather than too thin, since an error on the plus side can be corrected by installing gaskets at the intermediate plate. Removal from the intermediate plate and dismantling of the pinion subassembly can thus be avoided.

R = Distance between centerline of differential and face of pinion

① Pinion and shaft

② Transmission housing

③ Differential cover plate, left side

5 RA

Assembling Synchronizing Mechanism

Disassembly

1. Remove lock ring using lock ring pliers.

2. Clean all parts thoroughly.

3. Check all parts for wear and damage. If synchronization no longer functions properly, install new synchronizing ring.

4. Remove sharp edges from the long ends of the stops with an oil stone. Replace brake bands in which a ridge (approx. 18 mm, 11/16 in. from one end) has formed where the end of the stop contacts the inside of the brake band.

Assembly

1. Place synchronizing ring on toothed ring with the grooved side out.

2. Install slider, stop, and brake bands.

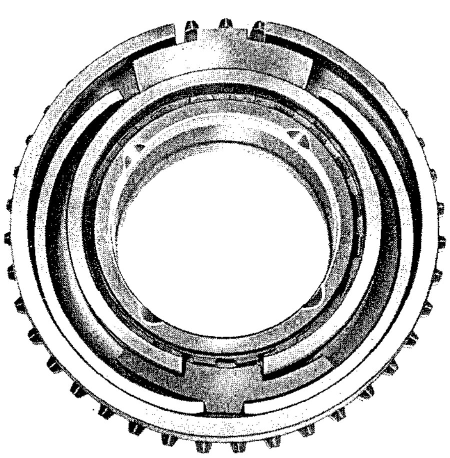


Fig. 53

3. When assembling the synchronizing mechanism of the 1st gear, note that only one brake band is installed as shown in Fig. 54.

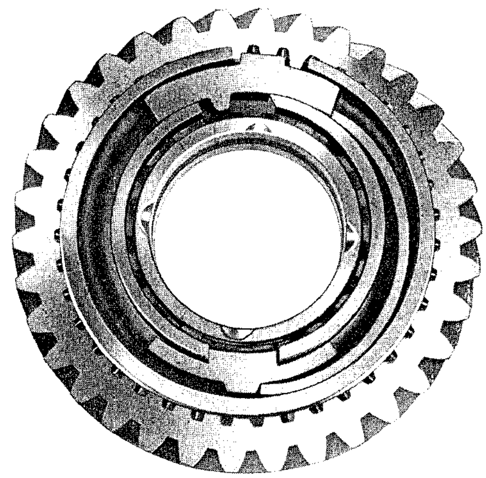


Fig. 54

4. Install lock ring using lock ring pliers.

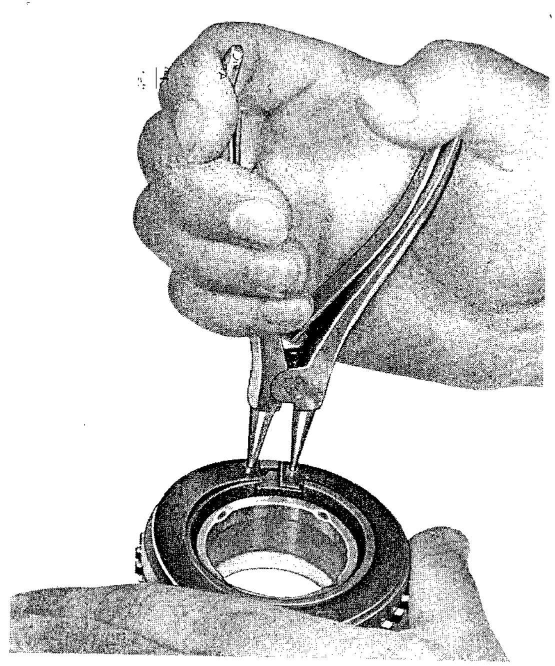


Fig. 55

5. Check installed synchronizing ring with micrometer for correct diameter (76.44 ± 0.20 mm).

Section View of Pinion Shaft

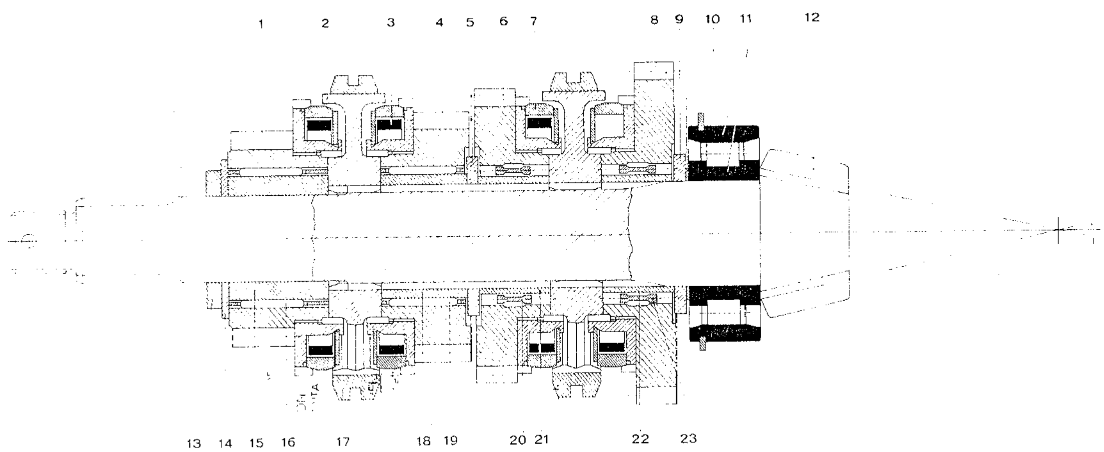


Fig. 56

(1) 4th gear
(2) Spider
(3) Brake band
(4) 3rd gear
(5) Thrust washer
(6) 2nd gear
(7) Synchronizing ring
(8) 1st gear
(9) Thrust washer
(10) Shim
(11) Roller bearing
(12) Pinion gear
(13) Spacer
(14) Thrust washer
(15) Needle bearing sleeve 4th gear
(16) Needle bearing
(17) Sliding sleeve
(18) Needle bearing sleeve 3rd gear
(19) Needle bearing
(20) Roller cage, 2nd gear
(21) Roller bearing sleeve 2nd gear
(22) Roller bearing sleeve 1st gear
(23) Roller cage, 1st gear

Exploded View of Pinion Shaft

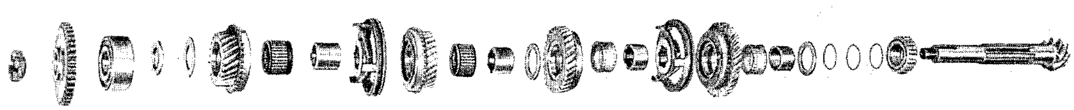


Fig. 57

5. Install 1st gear.

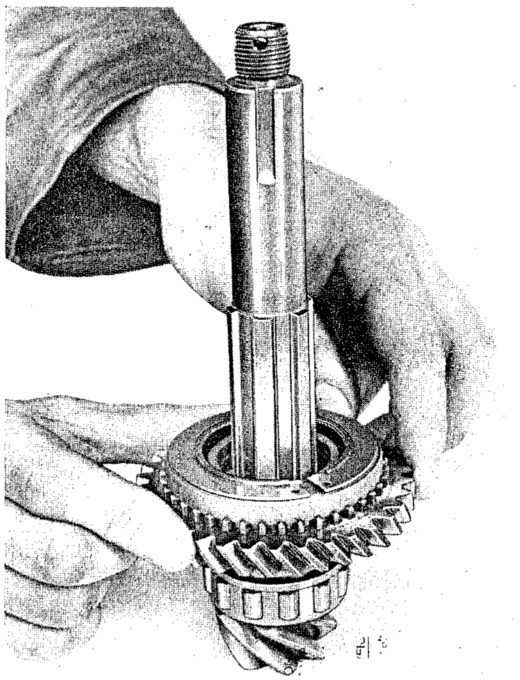


Fig. 62

6. Install shorter splined roller bearing sleeve and roller cage with rollers.

7. Install sliding sleeve.

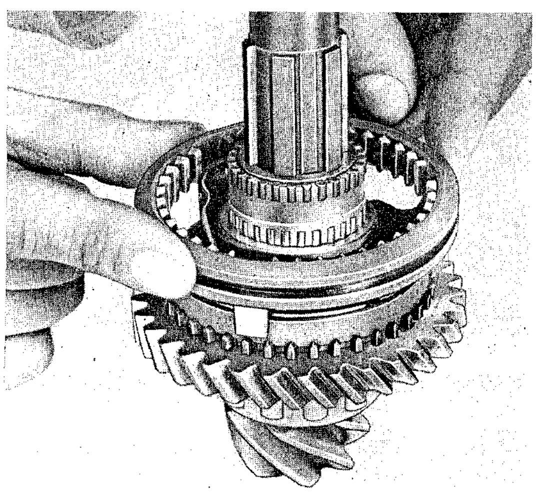


Fig. 63

8. Install 2nd gear.

9. Install thrust washer (Fig. 64).

10. Install splined needle bearing sleeve for 3rd gear (24 mm, .945 in. wide) (Fig. 64).

11. Install needle bearing for 3rd gear.

12. Install 3rd gear.

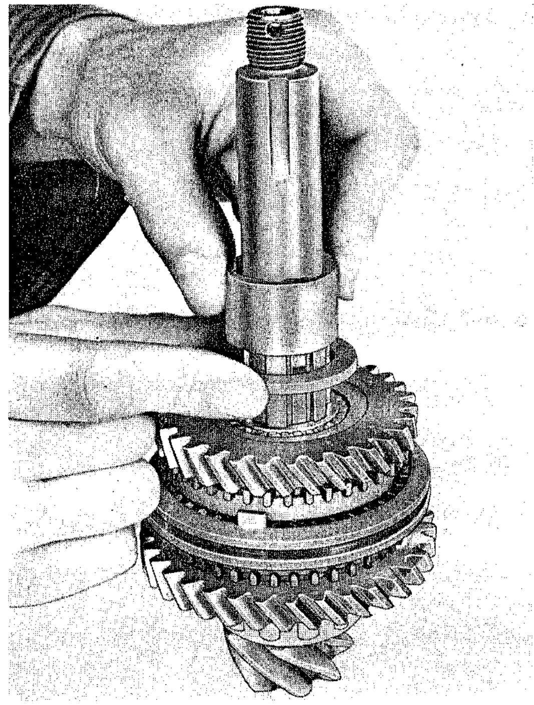


Fig. 64

13. Install spider.
14. Install needle bearing sleeve for 4th gear (28 mm, 1.102 in. wide).
15. Install needle bearing so that needles lie under center of gear teeth (Fig. 65).

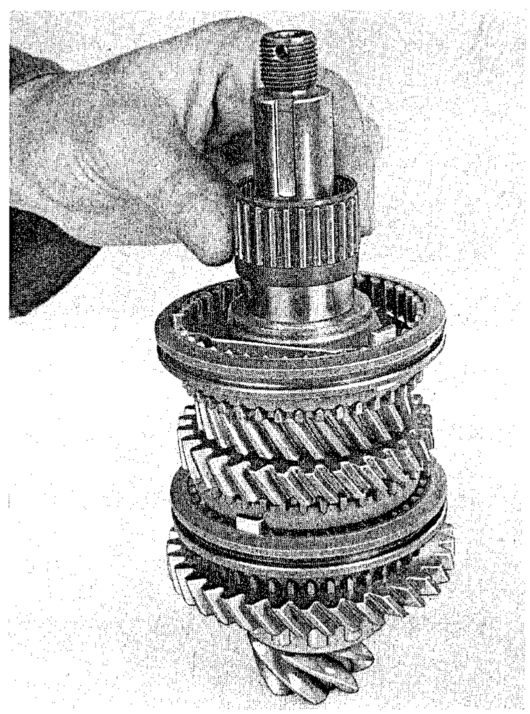


Fig. 65

16. Install 4th gear.
17. Install thrust washer 2 mm.
18. Install spacer 4 mm.

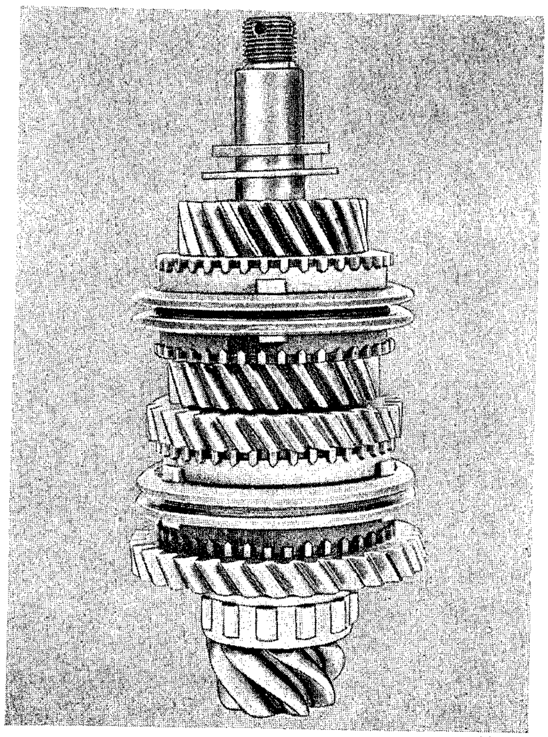


Fig. 66

19. Place assembled pinion shaft in stand P 31, using P 31a and P 40 tighten castle nut to 16 mkg (115 ft. lb.) torque. Loosen nut.

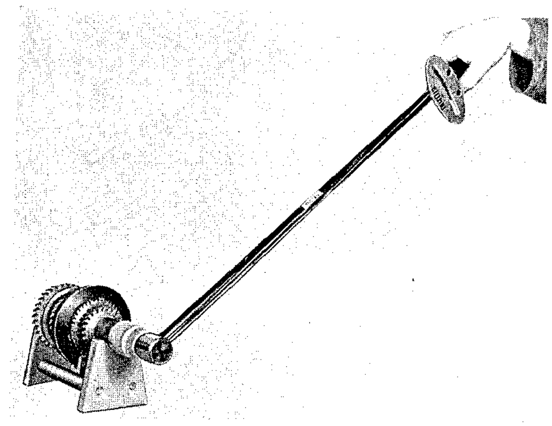


Fig. 67

20. Install sliding sleeve for 3rd and 4th gear.

Note

1st and 2nd gears each have double row caged roller bearings. The 3rd and 4th gears employ single row needle bearings. The 4th gear needle bearing is offset so that the needles are centered under the gear teeth while the 3rd gear needle bearing is symmetrical. Correct end play:

1st gear 0.25 to 0.35 mm (.0098 to .0138 in.). 2nd, 3rd, 4th gear 0.20 to 0.30 mm (.0079 to .0118 in.).

Arrangement of Reverse Gears

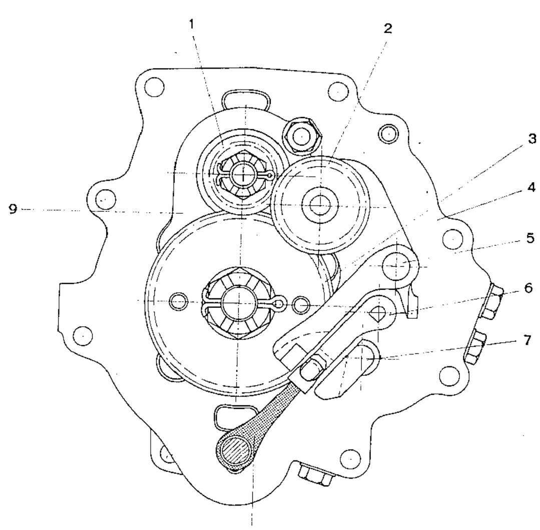


Fig. 68

① Gear I with 15 teeth, on the main shaft (one key)
② Gear II double gear with 10 and 20 teeth is on a seperate shaft
③ Gear III 40 teeth on the pinion shaft has two keys
Ratio of reverse gear: 1:3.56
④ Intermediate plate
⑤ Selector rod for reverse gear
⑥ Selector rod for 1st and 2nd gear
⑦ Selector rod for 3rd and 4th gear
⑧ Selector finger
⑨ Bearing cover plate

Reconditioning Main Shaft

Special Tools:

P 45	Tube to press gears on main shaft
P 65	Press plate for removing inner roller bearing race from main shaft
VW 400	Hydraulic press
VW 401	Plate for various press operations
VW 405	V-block arbor
VW 406	V-block (two)
VW 408	Arbor, general use
VW 409	Arbor, general use
VW 412	Arbor, general use

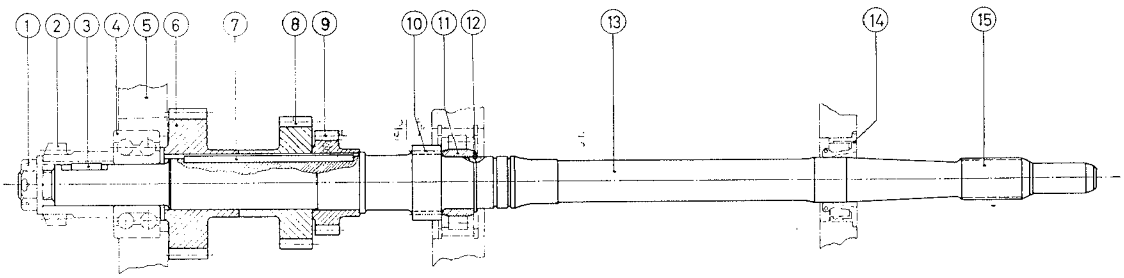


Fig. 69

1. Castle nut
2. Reverse gear
3. Key
4. Double-row ball bearing
5. Intermediate plate
6. 4th gear
7. Key
8. 3rd gear
9. 2nd gear
10. 1st gear
11. Inner bearing race
12. Lock ring
13. Main shaft
14. Oil seal
15. Splines for clutch plate

To remove the main shaft the transmission must be partially disassembled but the differential may remain undisturbed.

Removal

1. Remove front cover and intermediate plate with main and pinion shafts (2 RA).

Caution

Note size and number of gaskets between transmission housing and intermediate plate.

2. Remove main shaft and pinion from intermediate plate (2 RA, Fig. 34).
3. Remove spacer between 4th gear and double-row ball bearing.
4. Clean main shaft.

Inspecting

To inspect the main shaft it is necessary to remove the double-row ball bearing from the intermediate plate and the outer roller bearing race from the transmission housing. The check can also be made with other available bearings of the same type.

The double-row ball bearing should be pressed on the shaft lightly to insure easy removal after examination with tool VW 401.

1. Inspect main shaft for wear and damage.

   a) Inspect pilot bearing surface for wear.

   b) Inspect splines for clutch disc for wear (loose fit in clutch disc).

   c) Inspect oil seal surface for wear.

   d) Check gears for wear and damage. Excessive wear or damage require replacement of the main shaft. Badly worn 2nd, 3rd, or 4th gears must be replaced in matched pairs.

2. Check main shaft for alignment (place shaft with installed bearing on V-blocks and check shaft on gears using a dial indicator). Permissible run-out: Maximum 0.03 mm (.0012 in.). Excessive run-out up to 0.2 mm (.0079 in.) may be corrected using tools VW 400, VW 405, and VW 406.

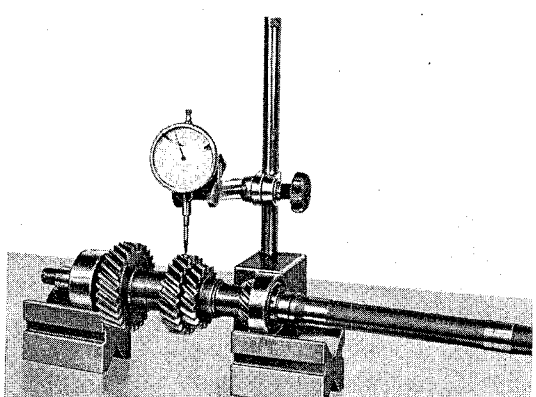


Fig. 70

Note

Check run-out of main shaft in fully assembled condition on pilot bearing surface. Maximum permissible run-out: 0.1 mm (.004 in.).

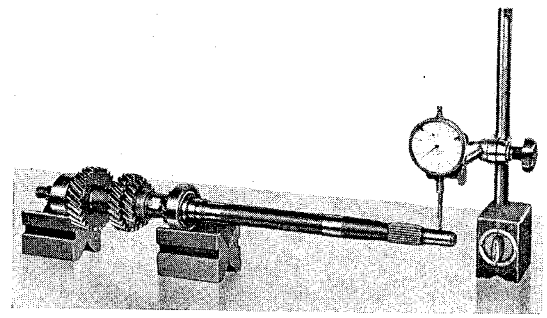


Fig. 71

3. Check double-row bearing and roller bearing for wear. Replace if necessary.

Disassembly

1. Remove lock ring for inner bearing race.

2. Remove inner bearing race using press VW 400 and VW 412.

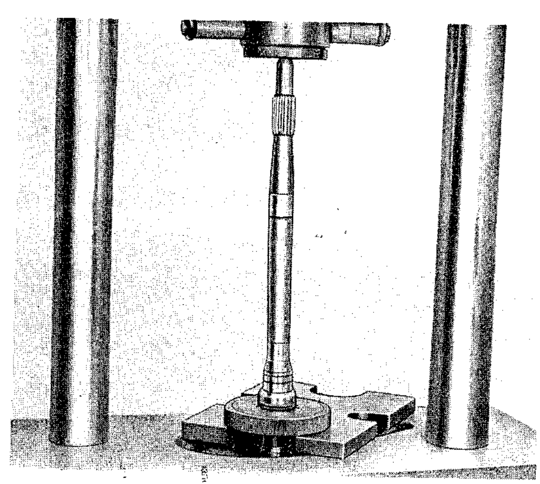


Fig. 72

3. Remove 4th gear using press VW 400 with VW 401 and tools P 65, VW 401, and VW 412.

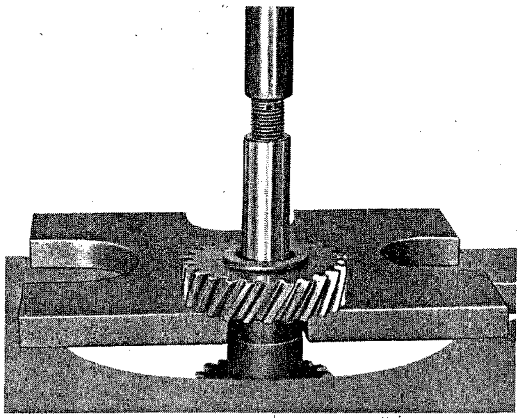


Fig. 73

4. Remove 2nd and 3rd gear.

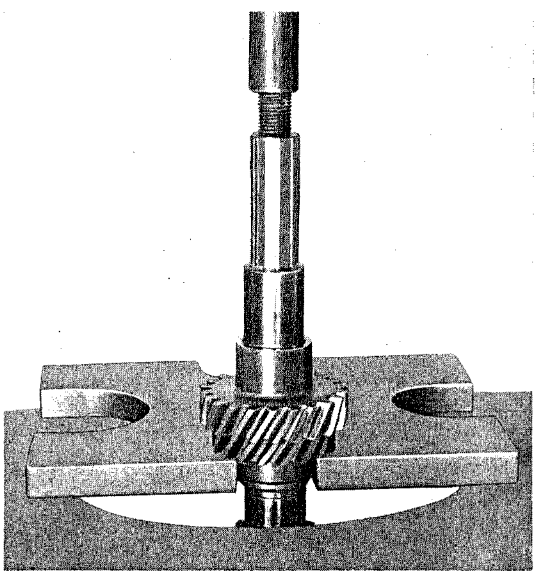


Fig. 74

Note

Gears for 2nd, 3rd, and 4th speed can only be exchanged in pairs.

Assembly

The assembly is accomplished in the reverse order of disassembly observing the following points:

Note

Heat gears in oil bath to 150° C (300° F). Ball bearings and gears must have a press fit.

1. Install key for gears.

2. Install heated gears in the following order: 2nd, 3rd, and 4th, and press tight using P 45 and VW 400.

3. Install inner ball bearing race using press VW 400 with VW 401 and VW 409.

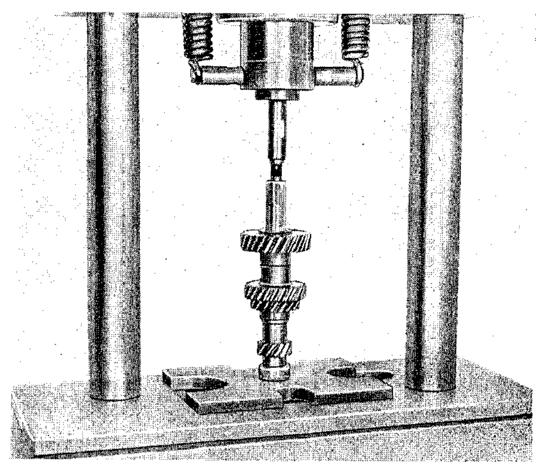


Fig. 75

4. Install lock ring.

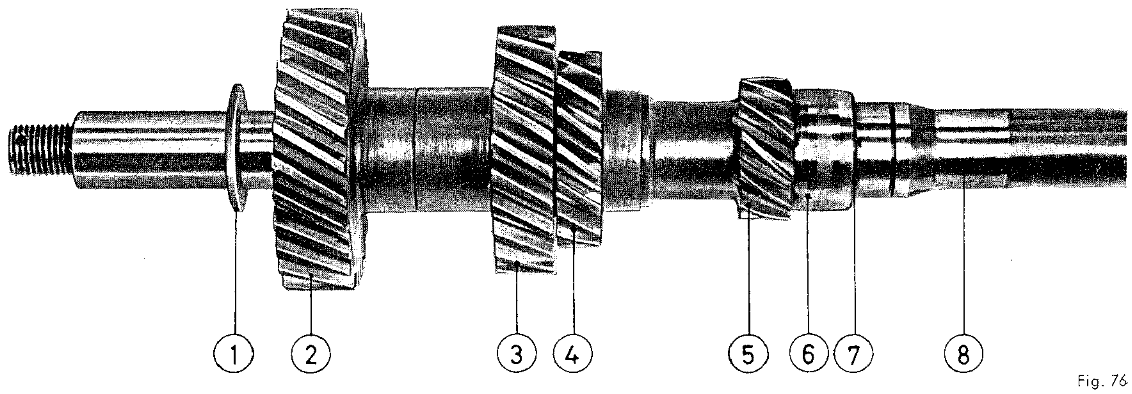


Fig. 76

① Spacer
② 4th gear
③ 3rd gear
④ 2nd gear
⑤ 1st gear
⑥ Inner race of roller bearing
⑦ Lock ring
⑧ Main shaft

Reconditioning Differential

8 RA

Special Tools:

VW 400 Hydraulic press
VW 405 V-block arbor
VW 406 V-blocks (two)

Transmission in assembled condition. The two side transmission covers as well as the axle tube flanges are held in position by studs and nuts.

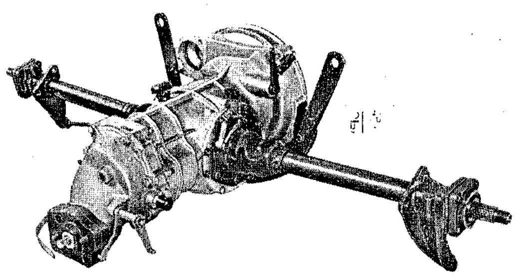


Fig. 77

If work is limited to the differential, (bent axles, defective pinion gears etc.) the differential may be disassembled in the following order.

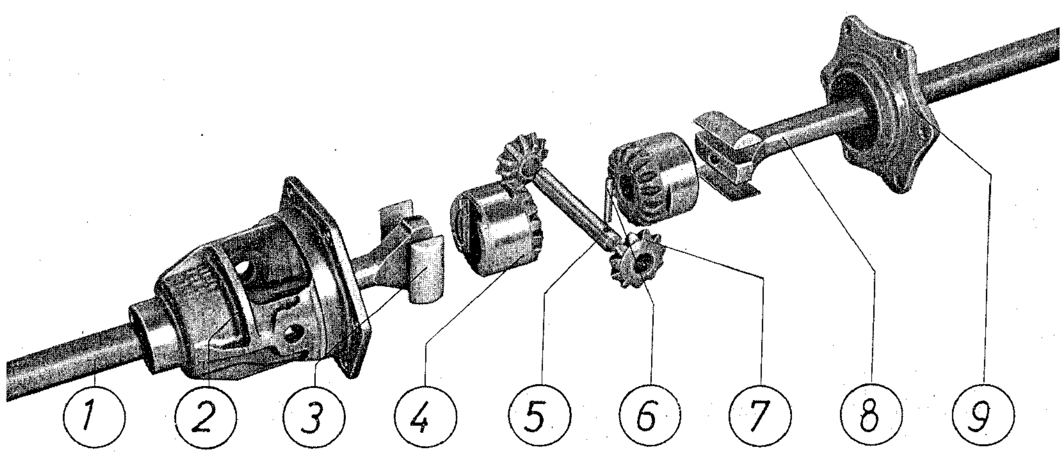


Fig. 78

1. Half-axle, right
2. Differential carrier
3. Fulcrum plate
4. Differential side gear
5. Differential pinion shaft
6. Pin
7. Differential pinion gear
8. Half-axle, left
9. Cover

Disassembly

1. Remove brake backing plates and axle tubes (16 RA).

2. Remove left transmission side cover.

3. Remove entire differential with axles from the left opening of transmission housing.

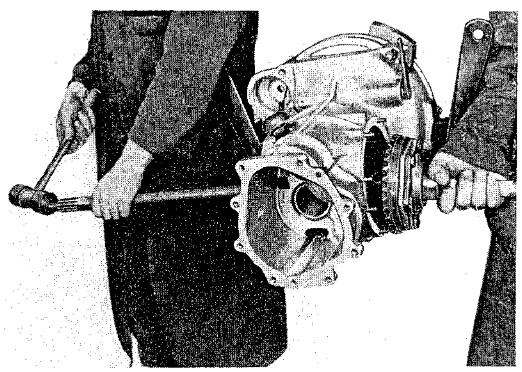


Fig. 79

4. Hold differential in a vise and remove bolts from ring gear.

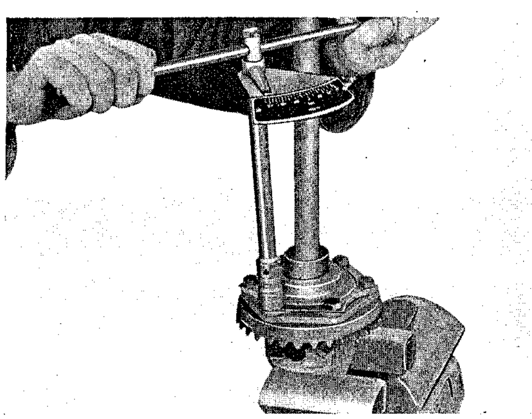


Fig. 80

5. Remove differential carrier cover and rear axle with gear and fulcrum plates.

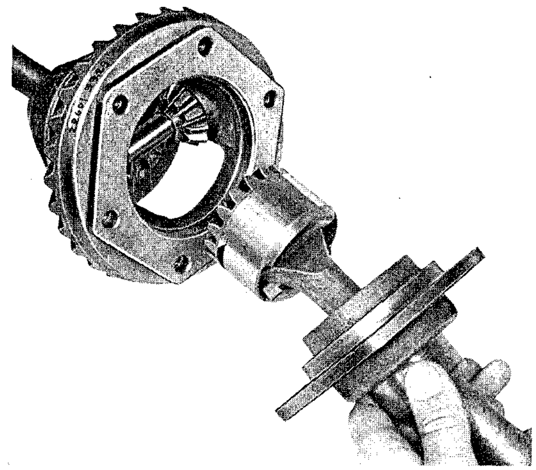


Fig. 81

6. Remove ring gear.

7. Remove lock pin from differential pinion shaft.

8. Drive out pinion shaft using a drift pin.

9. Remove rear axle with gear and fulcrum plates from differential carrier.

10. If necessary remove ball bearings from transmission side cover plates using VW 400, VW 409, VW 415, and VW 433.

Inspection

1. Inspect the differential carrier for wear on the bearing surfaces of the pinions and side gears. Replace if necessary.

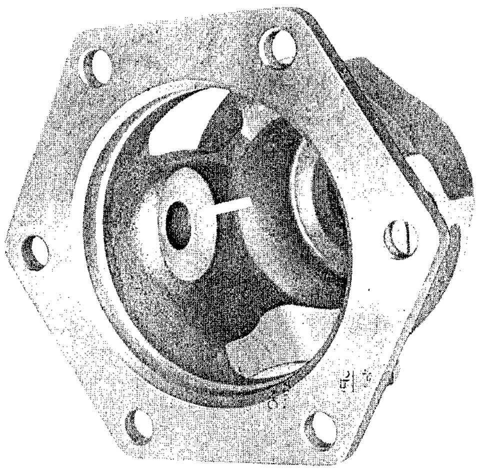


Fig. 82

2. Check rear axles and differential gears for wear and damage. Replace if necessary.

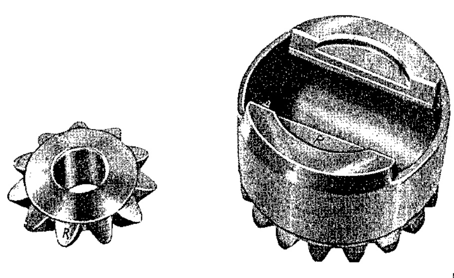


Fig. 83

Note

The number of teeth on the differential gears are as follows:

Side gear .... 17 teeth
Pinion .... 11 teeth

3. Inspect rear axle alignment. Small deviations may be corrected using press VW 400 with VW 405 and VW 406. Permissible run-out measured on ball bearing seat: 0.03 mm (.0012 in.).

4. Inspect ring gear for wear and damage. If necessary replace together with the pinion.

Note

The differential gears are supplied in pairs and may only be exchanged as such. The rear axle shafts and differential gears must have the same color markings.

Rear axle shafts and differential gears are divided into 3 groups:

Color marking	Differential side Gear Int. dia.	Half-axle Ext. dia.
Blue	59.97 – 60.00 mm (2.3610 – 2.3621 in.)	59.90 – 59.94 mm (2.3586 – 2.3598 in.)
Pink	60.01 – 60.04 mm (2.3626 – 2.3638 in.)	59.95 – 59.97 mm (2.3602 – 2.3610 in.)
Green	60.05 – 60.07 mm (2.3642 – 2.3650 in.)	59.98 – 60.00 mm (2.3614 – 2.3622 in.)

The marking on the differential side gear is a dot in the recess of the bearing surface, while the marking on the axle shaft is a complete ring around the axle, approximately 6 inches from the flat end.

The assembly tolerance of the rear axle (measured on the large diameter of the flat end) is 0.03 to 0.10 mm (.0012 to .0039 in.).

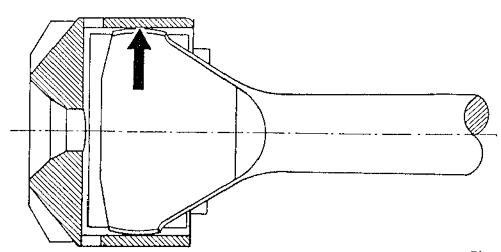


Fig. 84

Excessive clearance may cause objectionable rear axle noises.

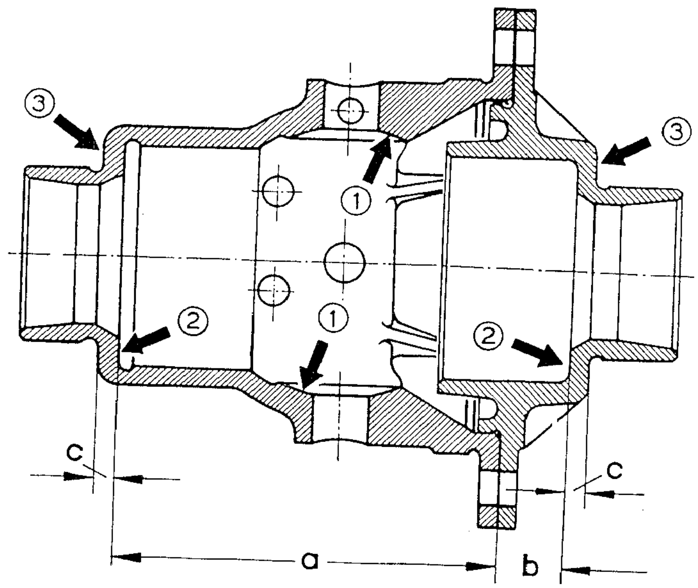


Fig. 85

① **Bearing surface for differential pinion**
② **Bearing surface for side gear**
③ **Surface for spacer ring**

a) **Depth of differential carrier 109 mm (4.290 in.)**
b) **Depth of differential carrier cover 19 mm (.750 in.)**
c) **Minimum wall thickness 4.0 mm (.157 in.)**

Assembly

The assembly is accomplished in the reverse order of disassembly observing the following points:

1. Lubricate and assemble cleaned parts.
2. Check rear axle clearance, fulcrum plates and rear axle gear. Should excessive play exist, use oversize fulcrum plates. Permissible clearance: 0.05 mm (.002 in.).

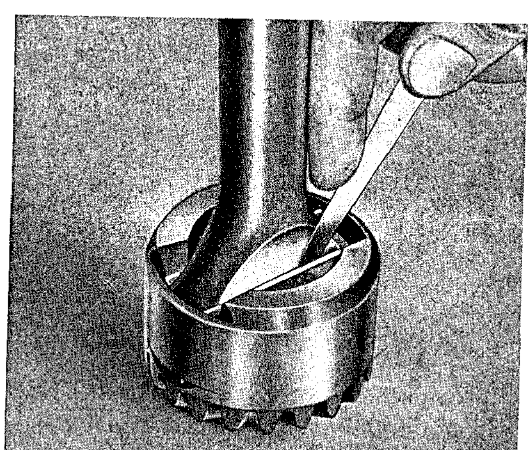


Fig. 86

3. Secure differential pinion shaft by peening locking pin.

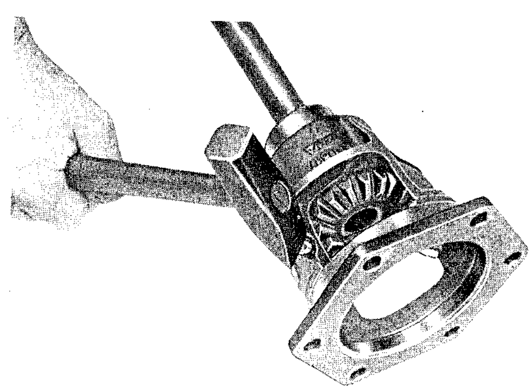


Fig. 87

4. Clean surfaces on differential carrier and ring gear before installing.
5. Install bolts with locking plates (use safety wire after gearbox no. 39645).
6. Tighten bolts to 6 mkg (43.5 ft. lb.) torque and bend over locking plates. Secure safety wire for gearboxes after no. 39645 in such a way that wire tends to tighten bolts.

Disassembling and Assembling Intermediate Plate

9 RA

Special Tools:

P 57 Guide pin (short) for selector lock bushings R, 1st and 2nd gears
P 58 Guide pin (long) for selector lock bushings 3rd and 4 th gears
P 66 Puller for selector lock bushing

Note

In the event that the intermediate plate, the bearing retaining plate, or the ball bearings show any sign of damage, the intermediate plate assembly must be completely dismantled in order to replace the defective parts.

Disassembly

1. Remove screws securing bearing retaining plate after removing lock tabs.

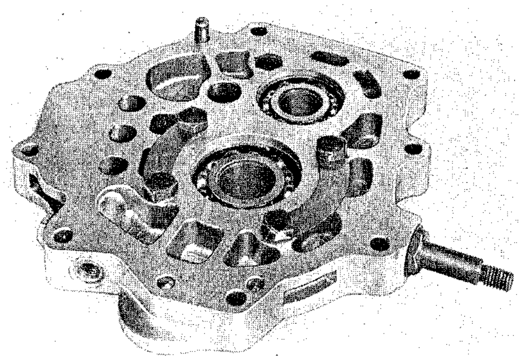


Fig. 88

2. Remove double-row bearing for pinion and main shafts using suitable arbors.
   Should the bearings be excessively tight, heat intermediate plate to approx. 212 to 230° F (100 to 110° C) and remove.

3. Remove dowel pin from intermediate plate.

4. If necessary remove bushing for selector rod locks using P 66.

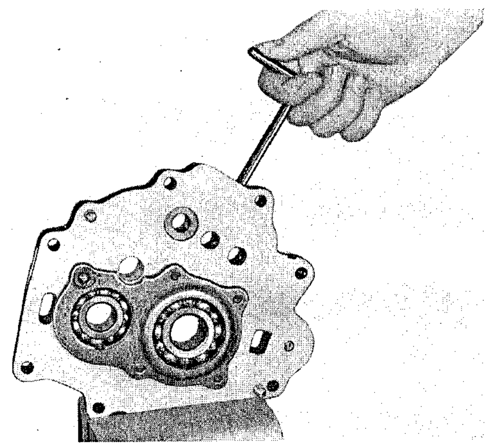


Fig. 89

Assembly

1. Clean all parts thoroughly and check for wear.
2. Heat intermediate plate to approx. 212 to 230° F (100 to 110° C).
3. Insert double-row bearings for pinion and main shafts in their respective bores.

Note

The two double-row bearings must be installed in such a manner that the cutouts in the outer bearing races face the bearing retaining plate (preferably positioned nearest each other).

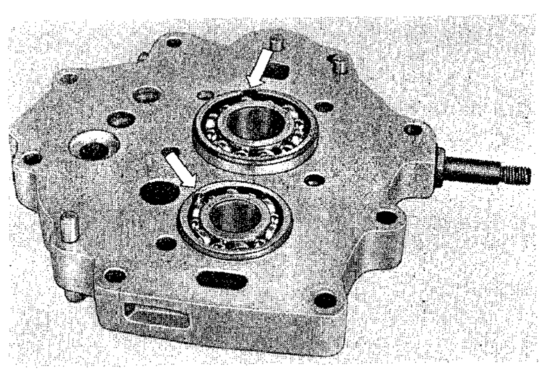


Fig. 90

Insure that bearings are fully seated. The insertion of the double-row bearings can be made using press VW 400.

4. Determine preload between retaining plate and intermediate plate.

The measurements should be made with a depth micrometer (or depth gauge).

Measurement A: Measure depth of recess in bearing retaining plate and record.

Fig. 91

Measurement B: Measure height of bearing above intermediate plate and record.

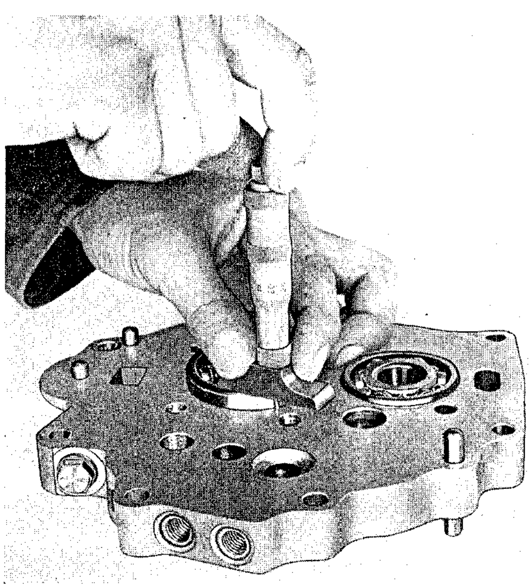


Fig. 92

The difference A – B should be adjusted with shims so that the required preload of 0.03 to 0.13 mm (.0012 to .0051 in.) on the double-row bearing of the pinion shaft is obtained.

Example

Measurement B		8.445 mm
Measurement A		– 8.245 mm
Difference		0.20 mm
Preload 0.03 to 0.13		
or 0.08 ± 0.05		– 0.08 mm
Thickness of gasket		0.12 mm
	practically	0.10 mm

Since a gasket of 0.12 mm is not available, the next lower one of 0.10 mm will be used. The effective preload is therefore 0.10 mm, which is within the tolerance.

A — Depth of seat for the double-row bearing in the bearing retaining plate

B — Height of double-row bearing for pinion above intermediate plate

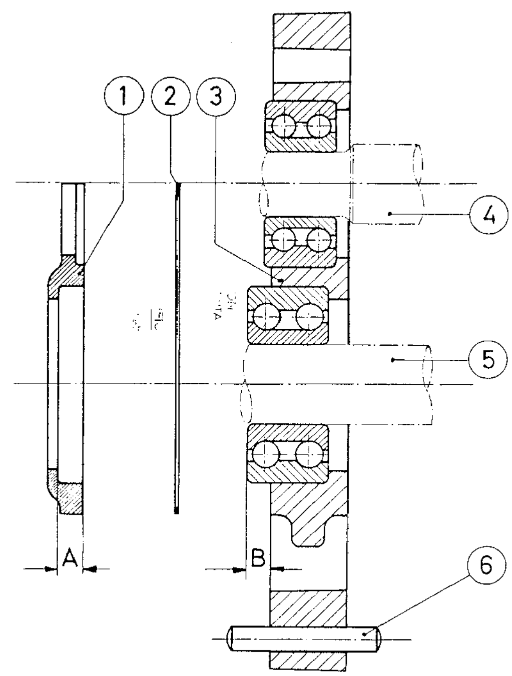


Fig. 93

① Bearing retaining plate
② Gasket
③ Intermediate plate
④ Main shaft
⑤ Pinion shaft
⑥ Dowel pin

Note

The bearing retaining plate is installed with a preload of 0.03 to 0.13 mm (.0012 to .0051 in.). By selecting the proper amount of paper gaskets the correct preload can be obtained. The paper gaskets have a thickness of 0.10 mm (.0039 in.).

5. Install bearing retaining plate with gaskets required for correct preload.

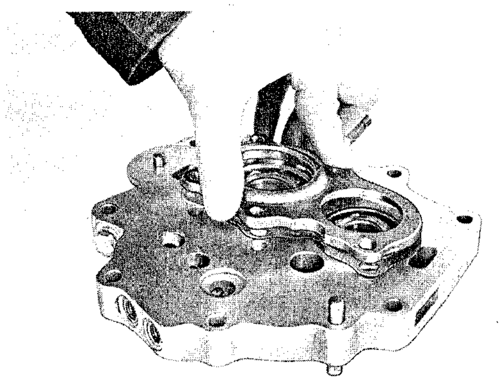


Fig. 94

6. Bolt down cap screws of retaining plate and tighten to 2 mkg (14.5 ft. lb.) torque and lock.

7. Install dowel pins.

8. Insert three bushings for selector rod lock using tools P 57 and P 58.

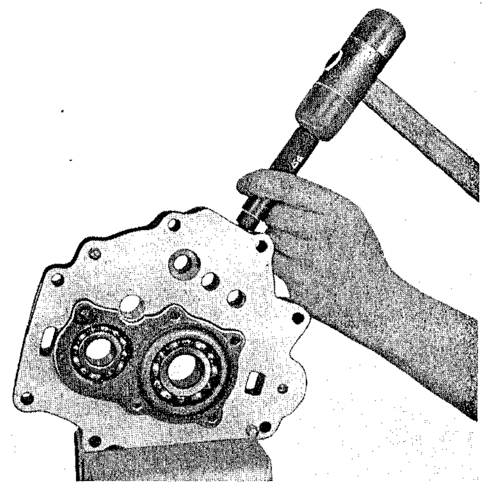


Fig. 95

9. Install selector rod locks (2 RA, Fig. 45).

10 RA

Adjusting Ring and Pinion Gears

General

The accurate adjustment of the ring and pinion gears is the decisive factor affecting the life and silent running of the rear axle. The ring and pinion gears are therefore matched during their manufacture and are tested on special machines to insure proper tooth contact and silent operation. The position where the least noise is generated is determined by varying the position of the two gears with respect to each other. The variation from the theoretical normal position and the optimum tooth contact is measured and the adjustment is then marked on both gears. Each ring and pinion set is marked with a pair number and must be replaced only as a complete unit.

The object of adjusting the ring and pinion gears is to reproduce the setting which generates the least noise according to the factory tests. This can be accomplished by accurately obtaining the setting which is marked on the gears.

When this adjustment is correctly carried out, the distance of the ring gear from the axis of the pinion gear and the distance of the pinion gear from the center of the ring gear will correspond to the predetermined settings. Instructions for these adjustments are given in the following section.

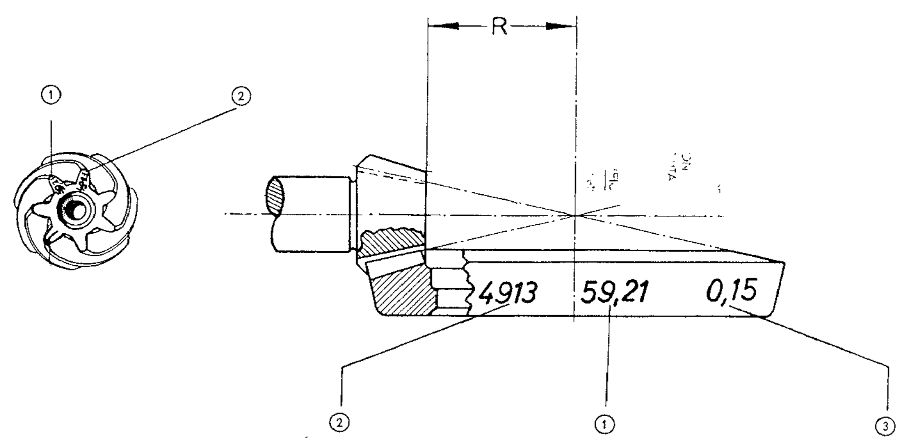


Fig. 96

① **Setting dimension "R" for ring and pinion gears**
② **Matching set number**
③ **Backlash for the ring pinion gears at setting "R"**
R **Distance between ring gear centerline and face of pinion**

Method of Ring Gear Adjustment

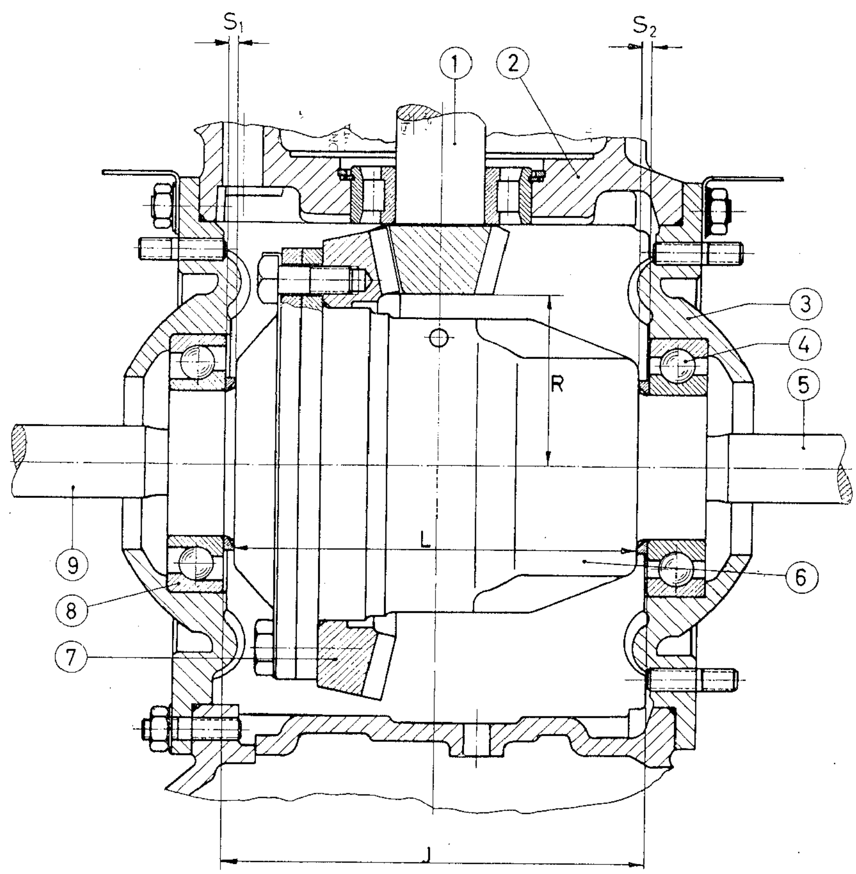
The ring gear is bolted to the differential carrier and is positioned in the housing by spacer rings placed on either side of the differential carrier. The amount of spacers required is determined from the measurement made on the assembled housing and re-checked by measuring the backlash of the assembled unit after the pinion gear has been adjusted.

To determine the thickness of the spacer rings "S_1" and "S_2" the following dimensions must be measured:

Example	Nominal
"J" Total depth of housing	145.21 mm
"L" Length of differential carrier	138.00 mm

All dimensions should be measured with an accuracy of 0.01 mm (.0004 in.).

The preload on the differential carrier bearings should be 0.13 to 0.17 mm.



S_1 Spacer (ring gear side)

S_2 Spacer (opposite ring gear)

R Distance between differential bearing centerline and face of pinion gear

L Length of differential carrier

J Total depth of housing

① **Half-axle, right**
② **Pinion shaft**
③ **Bearing wall in transmission housing**
④ **Transmission side cover, right**
⑤ **Ball bearing 6210**
⑥ **Differential carrier**
⑦ **Ring gear**
⑧ **Thrust bearing 7210 behind ring gear (Install on correct side)**
⑨ **Half-axle, left**

Adjusting Ring Gear

Special Tools:

P 33 Gauge for adjusting ring and pinion gears

General

To insure that the measurements are made accurately it is essential that the bearing surfaces for the measuring instruments are absolutely clean and undamaged. The ball bearings for the differential must be parallel and properly seated.

Measuring

1. Install left transmission housing cover with paper gasket 0.20 mm (.008 in.) thick.
2. Install dial gauge on measuring device P 33 and zero dial gauge using ring master.
3. Insert gauge P 33 in the inner race of the ball bearing in the left half of the housing.
4. Install right transmission housing cover with paper gasket 0.20 mm (.008 in.) thick.
5. Secure dial gauge with holder to one of the studs for axle tube bearing cover and set to zero.
6. Turn the transmission housing so that the gauge moves axially and rests with its own weight on the inner race of the ball bearing in the right half of the housing. The value shown on the dial gauge must be added to the length of gauge P 33 (marked on gauge body) to give the total depth "J" of the housing (Fig. 98).

Note

As mentioned above the exact length "F" is marked on gauge P 33.

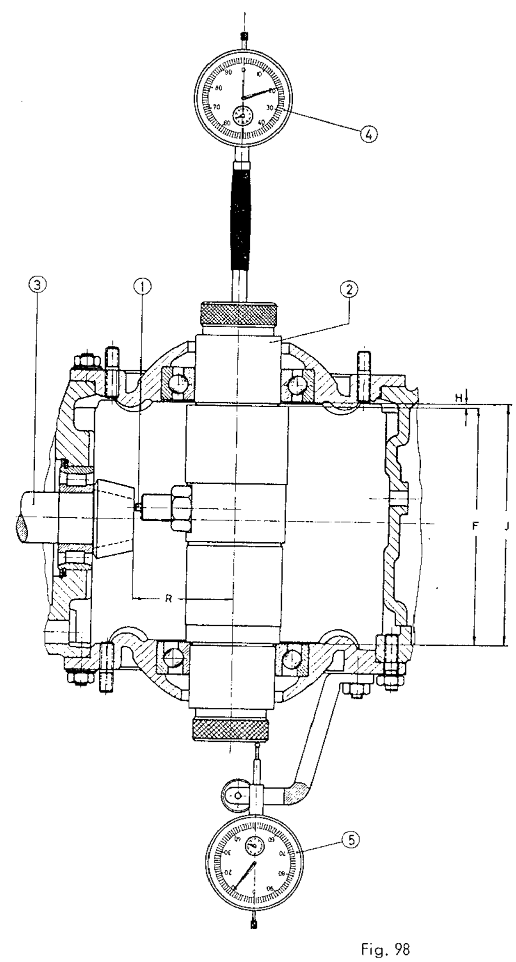


Fig. 98

① Feeler

② Gauge

③ Pinion

④ Dial gauge measures R

⑤ Dial gauge measures H

R Distance between differential bearings centerline and face of pinion

H Free end play of gauge in differential bearings

F Length of gauge

J Total depth of housing

Computing Thickness for Differential Spacers

Special Tools:

VW 287 Gauge for differential carrier

Determine distance between differential carrier bearings using tool P 33 (see Fig. 98 and the following example) and record.

Example:

F =	143.50 mm
+ H =	1.71 mm
J =	145.21 mm

Measuring the differential carrier length "L".

1. Adjust gauge VW 287 on master gauge.

2. Measure differential carrier and add or substract from measurement on master gauge.

Nominal dimension for L	=	138.00 mm
Reading	= –	0.15 mm
Length of differential carrier L	=	137.85 mm

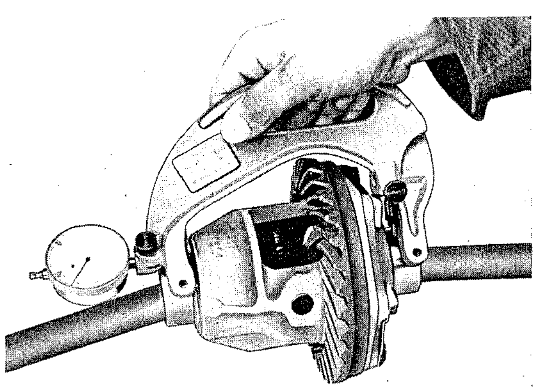


Fig. 99

To obtain the proper clearance between ring and pinion, spacer "S_1" will be 0.10 mm thinner than spacer "S_2" (Fig. 97).

Example

J Total depth of housing		145.21
L Length of differential carrier		–137.85
	Difference	7.36
	Preload	+ 0.15
Necessary thickness of spacers $S_1 + S_2$		7.51

Thickness of spacer $S_2 = \frac{7.51\ \text{mm}}{2} = 3.755$
– 0.10
3.655

Thickness of spacer $S_1 = \frac{7.51\ \text{mm}}{2} = 3.755$
+ 0.10
3.855

General

The spacers are available in thicknesses from 2.90 mm to 4.50 mm in 0.10 mm increments.
A shim 0.25 mm thick makes it possible to vary spacers within 0.05 mm. The calculated measurements for spacers should be selected so that shims "S_1" and "S_2" and the preload on the ball bearings for the differential are within the tolerance of 0.13 to 0.17 mm.

Example:

Calculated thicknesses
$S_1 + S_2 = 3.655 + 3.855 = 7.510$ mm

Selected thicknesses
$S_1 + S_2 = 3.65 + 3.85 = 7.50$ mm

Measure spacers with micrometer at four different places around the circumference. Permissible deviation: 0.02 mm. Make sure before measuring that burrs have been removed.

Transmission Side Covers

The transmission side covers should be heated to approx. 212 to 230° F (100 to 110° C) for insertion of the ball bearings. Due to the thrust loads different ball bearings are employed. Thrust bearing No. 7210 DIN 628 is installed in the left cover (**ring gear side**).

Make sure that the ball bearing is correctly installed, i.e. the outer race should be so inserted as to transmit the thrust towards the outside (Fig. 100).
Bearing No. 6210 DIN 625 is installed in the right side. Insure that the proper gasket 0.20 mm is installed between transmission housing and transmission side covers prior to assembly.

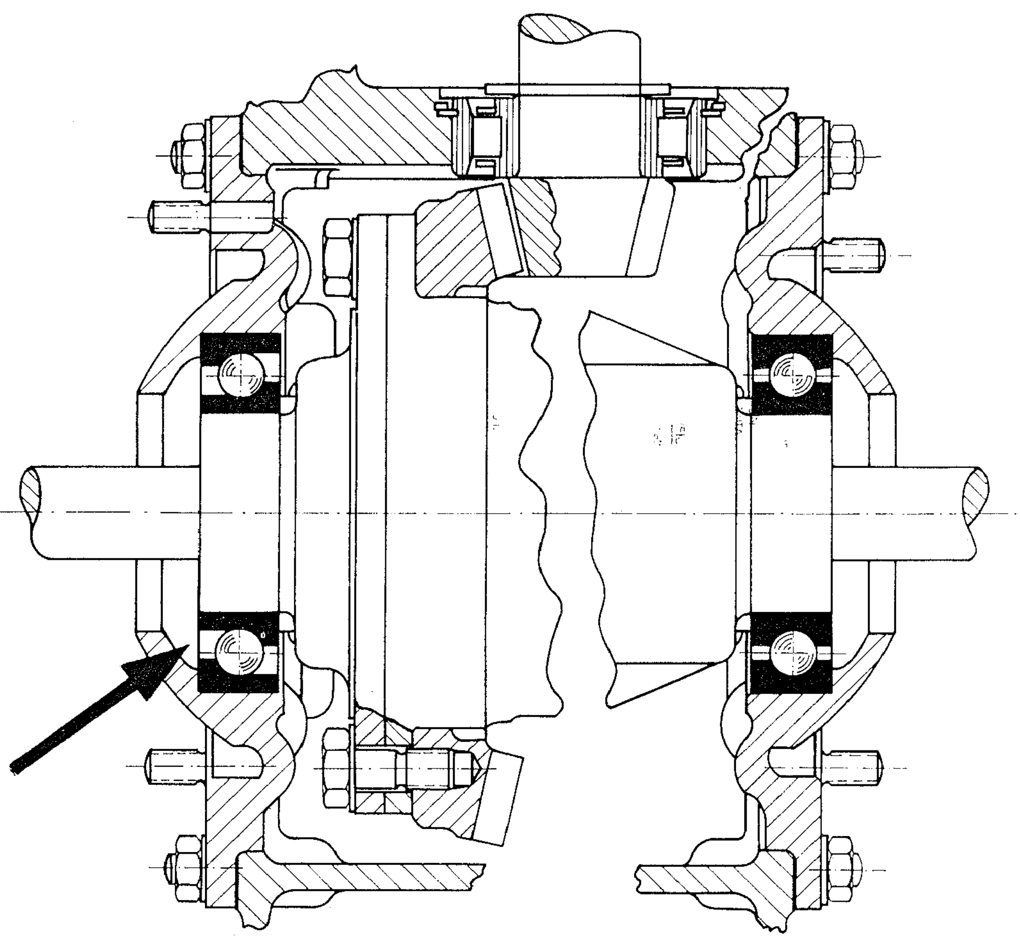


Fig. 100

Adjusting Pinion Gear

13 RA

Special Tools:

P 33 Gauge for adjusting ring and pinion
VW 400 Hydraulic Press with accessories

General

The provisional adjustment of the pinion has been made prior to assembly (see section 4 RA reconditioning pinion).

Measure distance "R" after measuring distance "J" using tool P 33 (11 RA).

Preparation

Install assembled intermediate plate (without paper gasket) in transmission housing and secure.

Zero the dial gauge in P 33 using adjusting ring. The inscribed diameter of the adjusting ring should be divided and recorded, i.e. 118 mm gives 59.00 mm.

Measuring

1. Install P 33.
2. Turn until feeler contacts face of pinion gear.
3. Turn gauge shaft left and right and record the observed minimum reading.

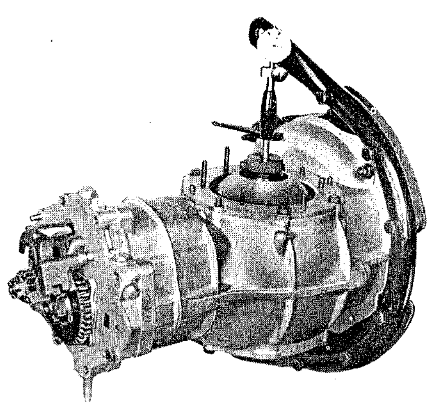


Fig. 101

First Example

Dial gauge adjustment	59.00 mm
Reading	59.06 mm
Required dimension R	59.24 mm
Difference	– 0.18 mm

i.e. the pinion has to be moved away from ring gear center axis 0.18 mm. This is possible by inserting a paper gasket of 0.2 mm between the intermediate plate and the transmission housing. (Adjust differences to the nearest gasket thickness available.)

Second Example

Dial gauge adjustment	59.00 mm
Reading	59.45 mm
Required dimension R	59.31 mm
Difference	+ 0.14 mm

i.e. the pinion has to be moved 0.14 mm towards the center axis of the ring gear. Disassemble pinion and insert required shims on pinion shaft (Fig. 96, 97, 98).

Note

In order to move the pinion gear away from the ring gear center, paper gaskets available in sizes 0.10 mm, 0.15 mm, and 0.20 mm may be installed between the intermediate plate and the transmission housing.

In order to move the pinion gear closer to the ring gear center it is necessary to disassemble the pinion shaft and install shims which are available in sizes 0.10 mm, 0.15 mm, and 0.30 mm.

14 RA

Verifying Adjustment of Ring Gear

Special Tools:

P 34a	**Pinion shaft holding clamp**
VW 288b	**Backlash gauge**

General

The correct adjustment of the ring gear is checked by measuring the backlash.

Preparation

Install assembled intermediate plate with previously determined paper gaskets into transmission housing.

1. Secure intermediate plate with two bolts.

2. Install right transmission cover with 0.20 mm paper gasket and secure.

3. Install assembled differential with previously determined spacers.

Measuring backlash

1. Remove standard 8 mm feeler from VW 288b and replace with a longer feeler 20 mm of the same shape.

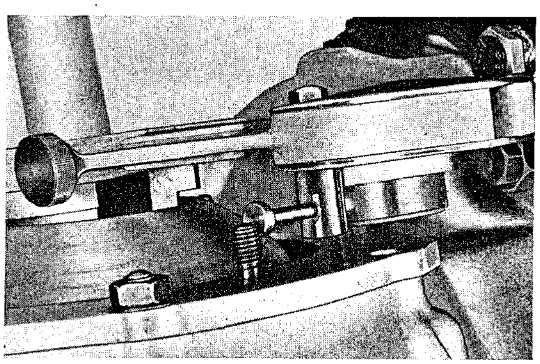


Fig. 102

2. Insert and clamp the backlash gauge VW 288b into the axle opening in such a manner that the long indicator point contacts one of the axle flange studs in the side plate.

3. Clamp castle nut of the pinion shaft with special tool P 34a.

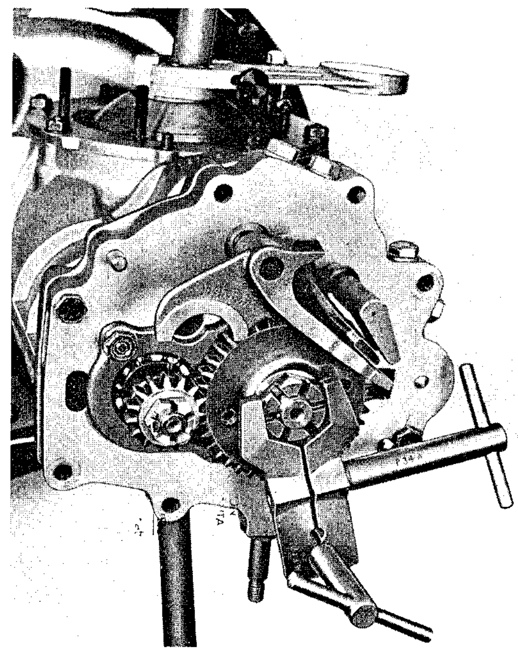


Fig. 103

4. Move the gauge lightly in both directions until it stops and read the indicator movement.

5. Turning the ring gear each time through approx. 90°, repeat the measurement. The indicated values of the four measurements must not differ by more than 0.05 mm. Compare the mean value with that marked on the gears (Fig. 96).

6. If the backlash is not within the tolerance, rearrange spacers S_1 and S_2 until the correct adjustment is obtained.

Removing and Installing Transmission Cover

Removal

1. Remove front transmission mount by removing two allen screws.

2. Remove transmission cover bolts and remove cover. Use plastic hammer to free tight cover.

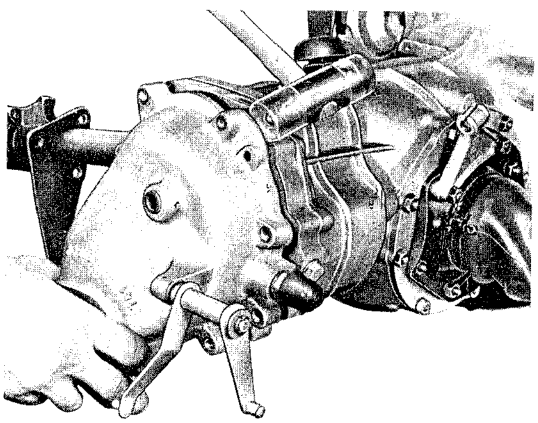


Fig. 104

3. Remove paper gasket.

4. The reverse idler shaft in the transmission cover must be secured with a roll pin. The hollow shaft must be closed with an aluminum plug and installed as in Fig. 105.

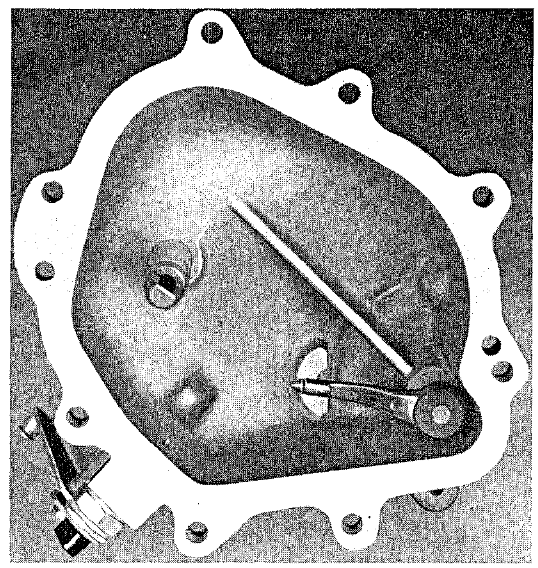


Fig. 105

Note

Before removing selector rod from cover, remove burrs on selector rod to prevent damaging its bore in the transmission cover.

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Clean sealing surfaces of intermediate plate and cover.

2. Renew gasket (thickness 0.20 mm).

3. Inspect selector rod bore in cover as well as reverse idler and shaft for wear and renew worn parts.

5. Inspect oil seal for selector rod in cover and renew if necessary.

6. Before installing the cover, lubricate selector rod forks and reverse idler shaft with graphite grease.

7. Insure that selector finger is engaged in selector rods. The reverse idler shaft must be inserted into the hole of reverse idler and properly guided into opening of intermediate plate. Check proper seat of gasket.

8. Tighten cover bolts to 2 mkg (14.5 ft. lb.) torque.

9. Check for proper engagement of each gear.

REAR WHEEL BEARINGS AND AXLE TUBES

16 RA

Replacing Rear Wheel Bearings and Seals

Special Tools:

VW 241a	Puller for rear wheel bearing
VW 230	Mandrel for replacing rear axle seal
VW 400	Hydraulic press
VW 401	Plate for various press operations
VW 441	Arbor for pressing in rear axle seal
VW 442	Arbor for pressing in rear axle seal

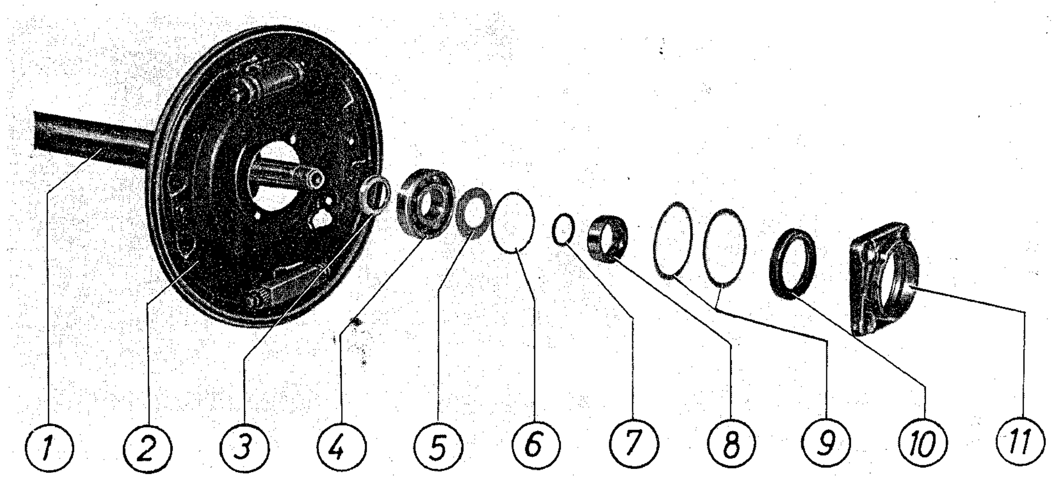


Fig. 106

① Axle tube
② Brake backing plate
③ Spacer ring, inner
④ Ball bearing
⑤ Washer
⑥ Seal
⑦ Seal
⑧ Spacer ring, outer
⑨ Shims
⑩ Oil seal
⑪ Bearing cover

Disassembly

1. Remove brake drums and brake shoes (1 RA).
2. Remove bearing cover and oil seal.
3. Remove brake backing plate.
4. Remove outer spacer ring, both oil rings and washer from axle.
5. Remove rear wheel bearing and inner spacer using puller VW 241a.

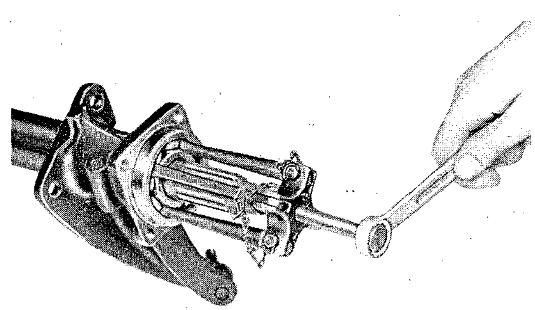


Fig. 107

Removing and Installing Seal in Bearing Cover

1. Remove damaged seal from bearing cover using VW 230 or hydraulic press with VW 401, VW 408, VW 441, and VW 442.
2. Lubricate wheel bearing seal and install in bearing cover using VW 230 or hydraulic press with VW 401, 408, 441 and 442.
   The seal ring should be inserted so that the outer surface is flush with the bearing cover plate.
3. Check parallel seat of seal with straight edge.

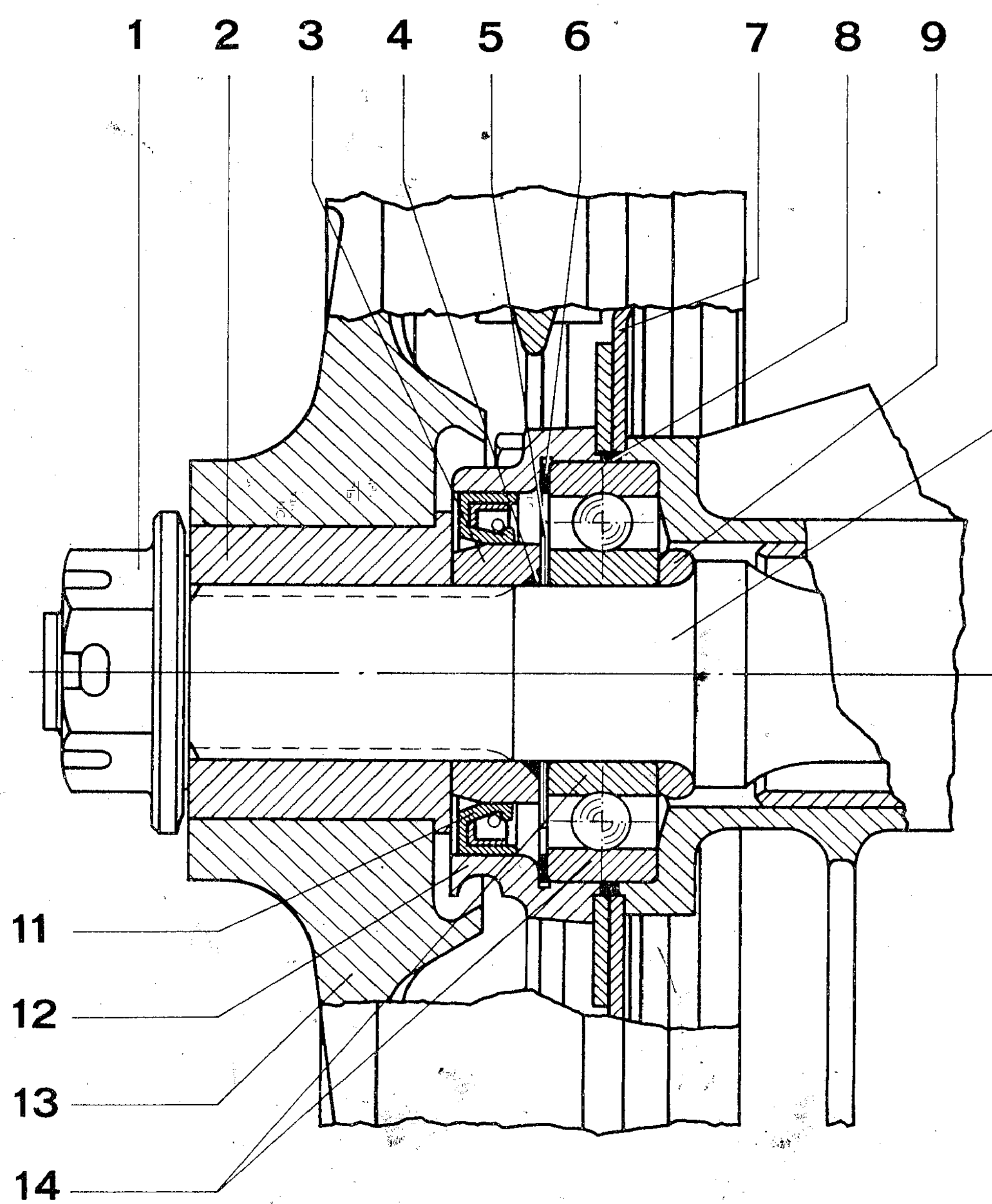


Fig. 108

① Castle nut for rear axle shaft
② Internally splined sleeve
③ Spacer ring
④ Rubber seal ring
⑤ Washer
⑥ Shims (as required)
⑦ Brake backing plate
⑧ Rubber seal ring
⑨ Spacer ring
⑩ Rear axle shaft
⑪ Oil seal
⑫ Bearing cover
⑬ Brake drum
⑭ Ball bearing

Installation

1. Inspect ball bearing and replace if necessary.
2. Renew seal ring between spacer and ball bearing as well as seal for rear axle bearing cover.
3. Adjust end play or rear axle bearing as follows:

Note

The ball bearing on the axle shaft is partially recessed into the bearing flange of the axle tube. The brake backing plate is installed over the ball bearing followed by a rubber sealing ring and is held by the bearing cover. To prevent excessive movement of the rear axle bearing and to insure proper preload as well as securing the brake backing plate, shims (0.1 mm thick) are installed. The determination of these shims is as follows.

Measurement "s"

Determine thickness of brake backing plate. Burrs should first be removed. Measure the thickness at several points.

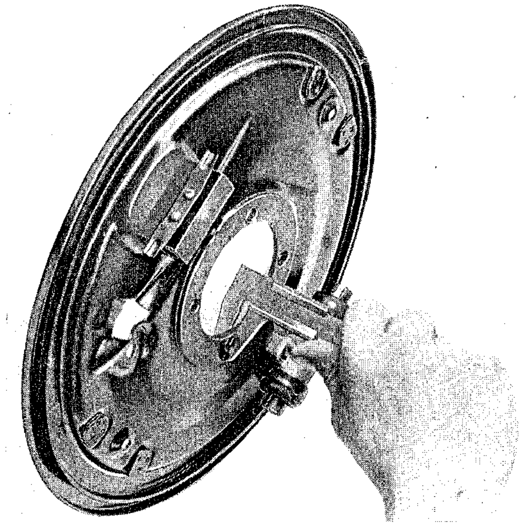


Fig. 109

Install bearing cover with seal ring and tighten.

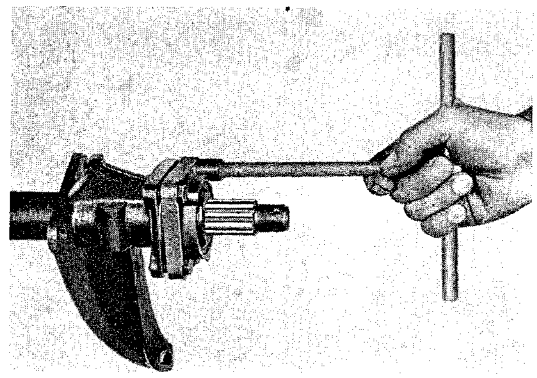


Fig. 110

Measurement "r"

Determine distance between rear axle bearing flange and rear axle bearing cover.
To avoid incorrect measurements all components should be installed with the exception of spacers.

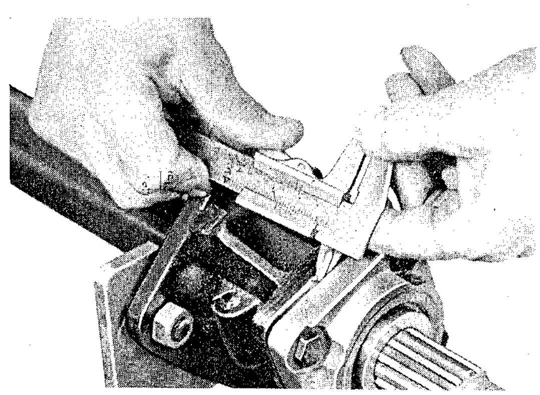


Fig. 111

Example

Measurement "s"	5.0 mm (.197 in.)
Measurement "r"	4.5 mm (.177 in.)
Difference	0.5 mm (.020 in.)
Preload	0.1 mm (.004 in.)
Thickness of spacers	0.4 mm (.016 in.)

To obtain the correct bearing play four spacers of 0.1 mm (.004 in.) each must be installed.

4. Install bearing cover with the oil drain hole facing downward.
5. The spacer should not show any sign of wear, cracks, or rust and should be lubricated prior to installation to prevent damaging the oil seal. Cleanliness is essential for this operation.

Removing and Installing Rear Axle Tubes

17 RA

Special Tools:

VW 202	Puller used with VW 202b and 202h
VW 202b	Extractor hooks
VW 202h	Spacer
VW 240a	Arbor for bearing flange
VW 400	Hydraulic press
VW 401	Plate for various press operations
VW 407	Arbor, general use
VW 433	Press accessory, general use

Removal

1. Remove brake drums and brake backing plates (1 RA).
2. Loosen nuts on bearing cover of axle tube.

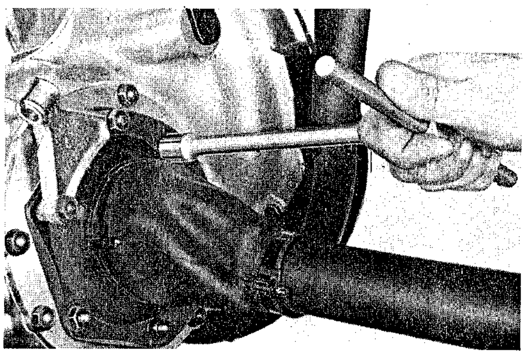


Fig. 112

3. Remove axle tube with bearing cover and gasket (16 RA).
4. Drive dowel pin out of bearing flange.

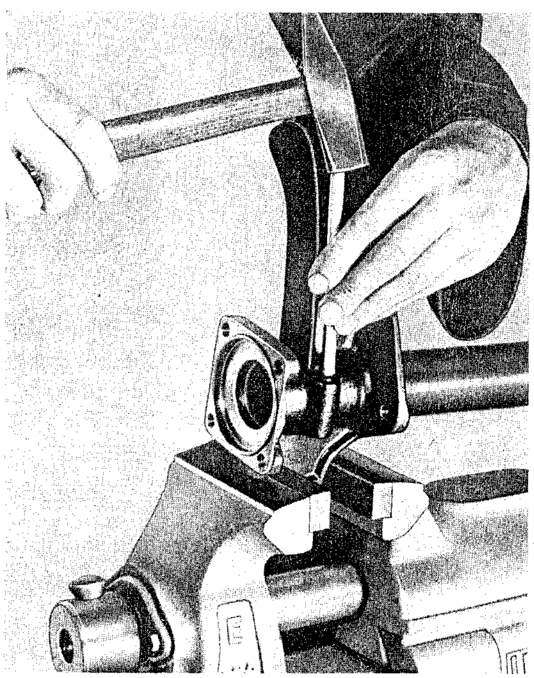


Fig. 113

5. Remove bearing flange from axle tube using extractor VW 202, with VW 202b and VW 202h, or press VW 400 with VW 407 and VW 401.
6. Loosen clamps and remove boot and bearing cover from axle tube.

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Inspect spherical surface on rear axle tube and transmission side cover for wear. Remove roughness.
2. Inspect axle boot and replace if necessary.
3. Inspect bearing flange and replace if necessary. Before installation the mating surfaces should be thoroughly cleaned and the flange and axle tube covered with a light coat of grease. Install the flange using hydraulic press VW 400 with VW 407 and VW 433.

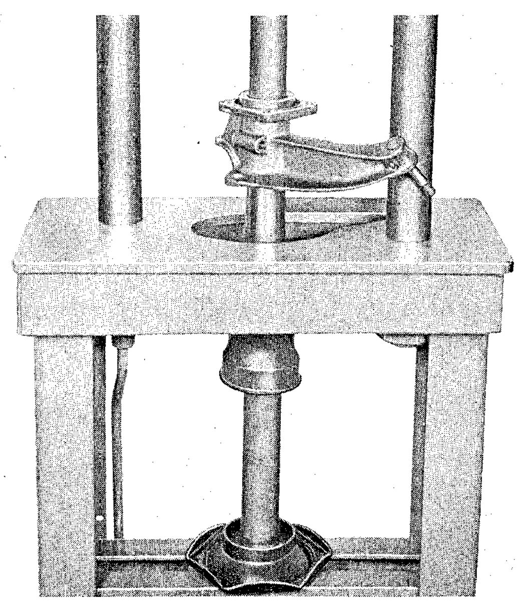


Fig. 114

4. Install new flange gaskets 0.1 to 0.3 mm (.004 to .012 in.) as required.

5. After installation the axle tube must move freely in all directions without any noticeable play. If necessary remove or add gaskets.
   Should corrections not be possible by inserting a 0.1 mm (.004 in.) gasket, the axle tube and side cover should be replaced or an oversize cover installed.

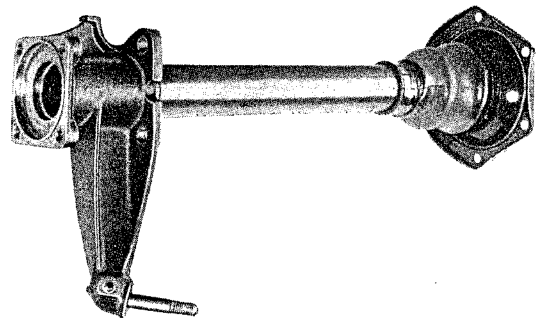


Fig. 115

18 RA Removing and Installing Transmission Carrier and Rubber Mounts

Removal

1. Remove six bolts that hold the transmission rubber mounts to the transmission carrier.

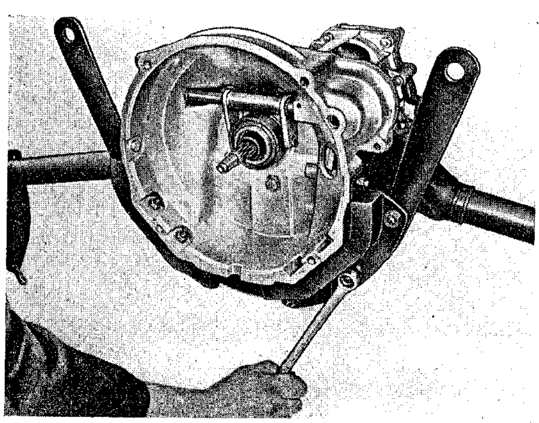


Fig. 116

2. Remove transmission carrier.
3. Remove rubber mounts from transmission housing (2 nuts and 1 bolt on each mount).

Removal of the rubber mounts is only necessary if these have been damaged or the rear axle is to be completely disassembled.

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Inspect rubber mounts and replace if necessary.
2. Inspect transmission carrier for alignment. Straighten or replace as necessary.
3. Install transmission carrier. The flat side of the carrier must be toward the rubber flange.
4. Tighten mounting bolts uniformly.

Installing Main Shaft Seal (Rear axle installed)

19 RA

Special Tools:

VW 291b Press Sleeve for Installing Oil Seal

General

The main shaft seal can be renewed without removing or disassembling the transmission.

Removal

1. Remove engine (1 EN).
2. Remove clutch release bearing.

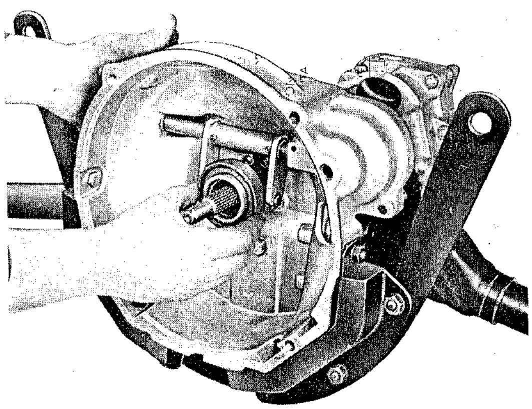


Fig. 117

3. Remove clutch release bearing guide.

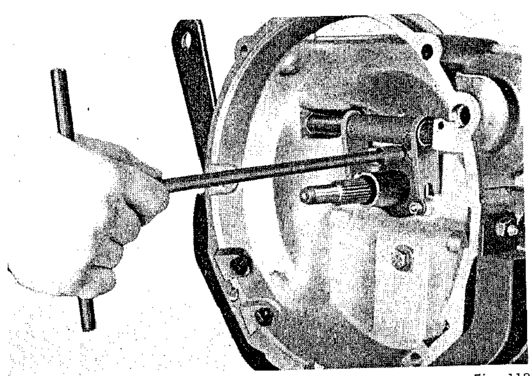


Fig. 118

4. Remove old seal (with screwdriver). Note: Do not damage seal seat in the transmission housing.

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Apply sealing compound to outside of new oil seal so that no compound touches the sealing lip. Lubricate main shaft and sealing lip.
2. Push seal on main shaft and drive home using VW 291b.

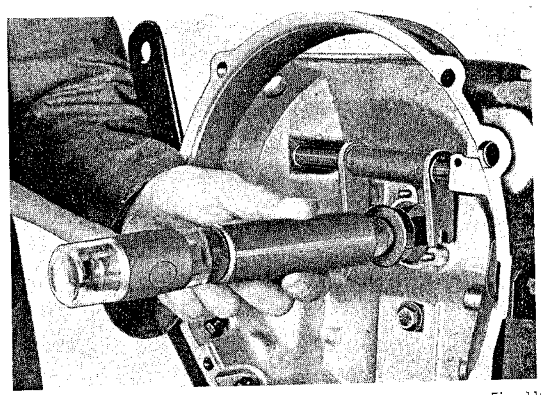


Fig. 119

Warning

Care should be exercised to prevent the spring from being dislocated.

Note

The seal is exchanged in the same manner, on a disassembled transmission. The removal of the old seal may be simplified by driving it out from the inside.

20 RA

Removing and Installing Clutch Pivot Shaft

Special Tools:

P 62 Drift to remove or install clutch pivot shaft bushing
P 64 Mandrel to install outer bushing of clutch pivot shaft

Removal

1. Remove return spring for clutch pivot shaft.

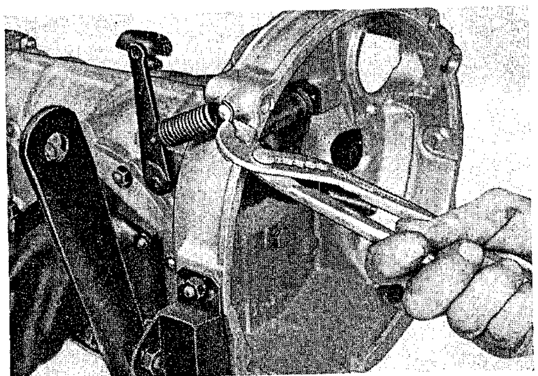


Fig. 120

2. Remove clutch release bearing.

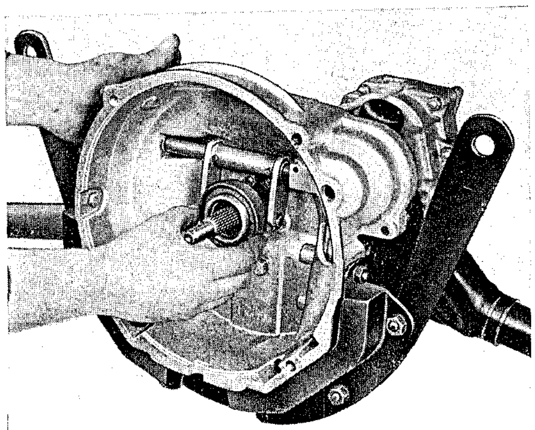


Fig. 121

3. Drive out roll pins.

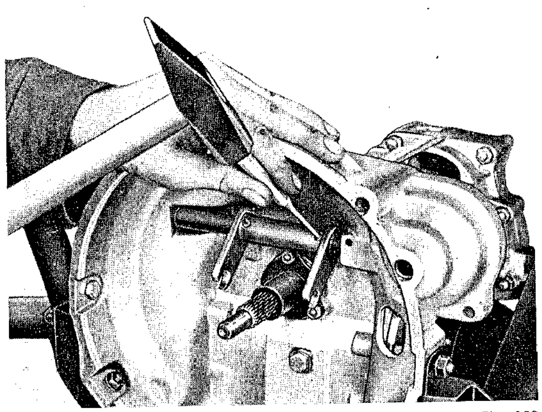


Fig. 122

4. Remove clutch pivot shaft.

Inspection

Inspect the bushings of the clutch pivot shaft. If necessary renew using tools P 62 and P 64.

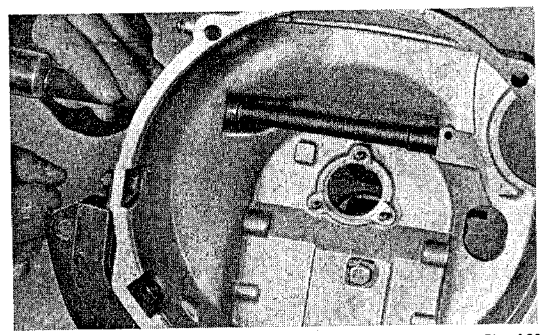


Fig. 123

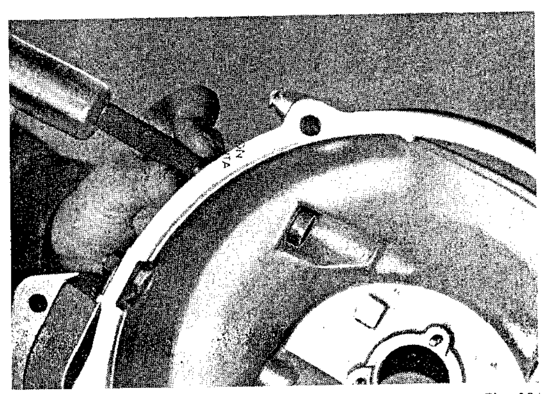
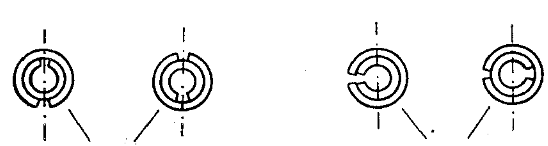


Fig. 124

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. The clutch release fork is fastened to the pivot shaft by two roll pins inserted into each other.
2. The openings of the roll pins should be offset 180° vertically (see sketch).



right wrong

Removing and Installing Gear Shift Linkage

Removal

1. Remove both front seats and rubber floor mats.
2. Remove floor tunnel cover mat.
3. Disconnect heater cables from heater flaps.
4. Mark position of gear shift lever bracket to avoid unnecessary adjustments when installing.

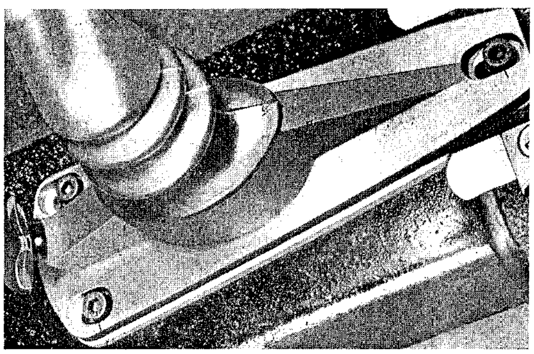


Fig. 125

5. Remove three allen screws.
6. Lift gear shift lever bracket and move to one side.
7. Remove lock ring from spindle for heater control screw and turn control knob till nut is free.

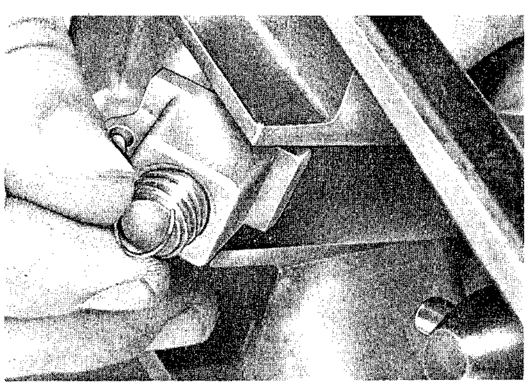


Fig. 126

8. Remove gear shift lever bracket.
9. Slide rubber boot forward on shift rod.
10. Loosen clamping screw and push shift rod forward from flexible connector.

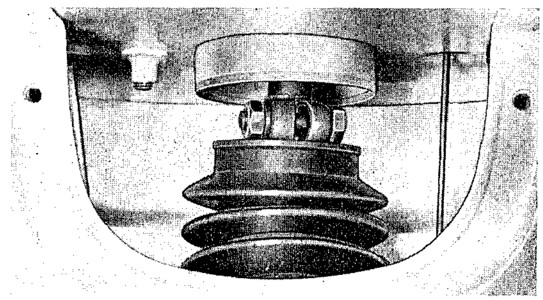


Fig. 127

11. Pull shift rod toward the front until the back end of the shift rod can be pushed back under the separating plate in the tunnel.

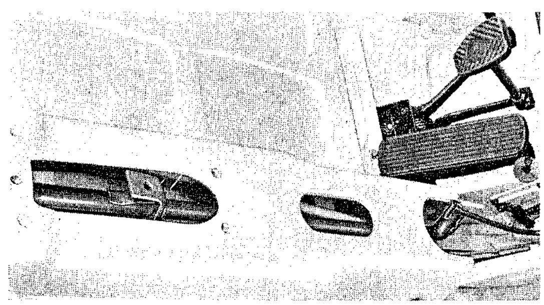


Fig. 128

12. Push shift rod back to shift bracket opening and remove pulling forward.

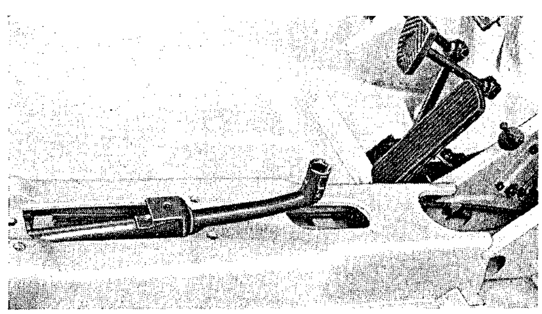


Fig. 129

SUMMARY OF TOLERANCES

FOR

GROUP R

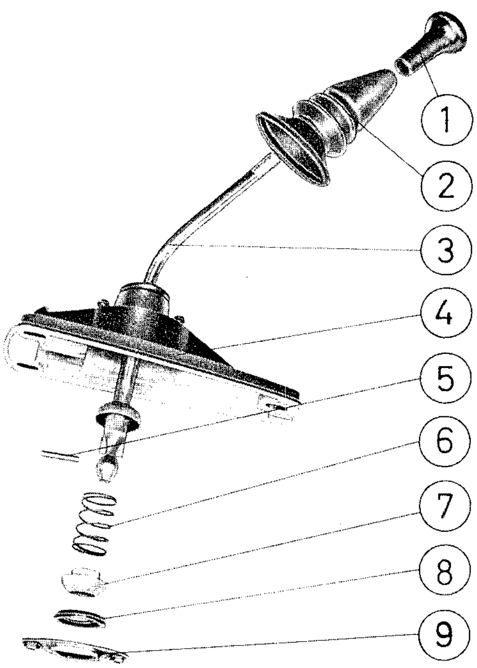


Fig. 130

① Gear shift knob
② Rubber boot
③ Gear shift lever
④ Gear shift bracket
⑤ Roll pin
⑥ Spring
⑦ Ball
⑧ Socket
⑨ Retaining plate

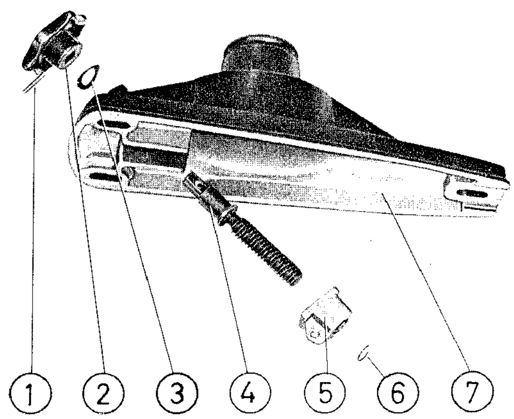


Fig. 132

① Roll pin
② Heater control knob
③ Spring washer
④ Spindle for heater control
⑤ Nut for heater control
⑥ Lock ring
⑦ Gear shift bracket

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Install nut for heater cable with the eye to the front (front of car).

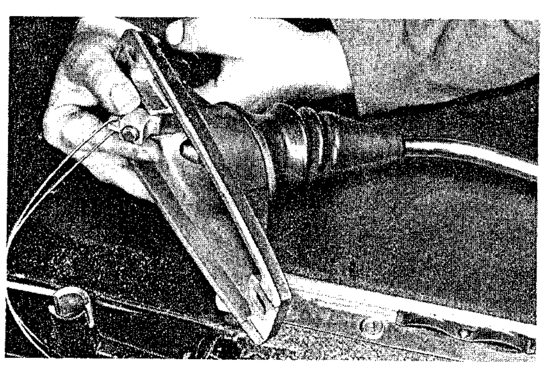


Fig. 131

2. Check whether the shift rod guide is centered over the rear threads of the bracket.

3. Install gear shift bracket and secure with three allen screws aligning the markings previously inscribed on the bracket.

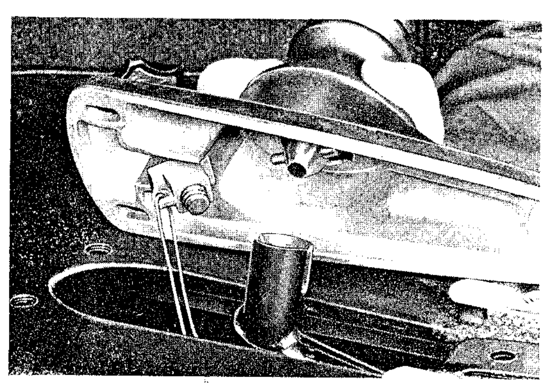


Fig. 133

Testing and Adjusting Gear Shift Mechanism

The gear shift mechanism is designed so that the travel of the selector is greater than the movement of the selector finger in the transmission. The difference is absorbed by the rubber coupling between selector rod and gear shift rod. To insure equal preload the shifting mechanism should be adjusted as follows:

1. Engage 1st or 2nd gear.
2. Loosen connection between coupling and selector rod so that preload is released.
3. Tighten clamp and test shifting mechanism in all gears.

REAR WHEEL SUSPENSION

General

The rear wheels are independently suspended. The splined ends of the torsion bars fit into a splined socket which is welded to the central chassis tube. The rubber mounted trailing radius arms are connected to the splined outer ends of the torsion bars. The axle tube flanges are bolted to the trailing ends of the radius arms. Suspension adjustment is accomplished by engaging the desired splines of the torsion bars. The suspension is controlled by double acting adjustable shock absorbers.

22 RA

Removing and Installing Torsion Bars

(See also group W, Wheel Alignment)

Special Tools:

P 53 Radius arm compressor

Removal

1. Hoist car and support on level dolly. Remove rear wheels.
2. Lift radius arm with tool P 53 until the shock absorber is free.
3. Remove shock absorbers and release holding clamps for brake hoses from axle tubes.
4. Remove three bolts from bearing flange on axle tube. The buffer bracket is fastened to the two upper bolts.
5. Move axle tube rearward out of radius arm.
6. Remove special tool P 53.

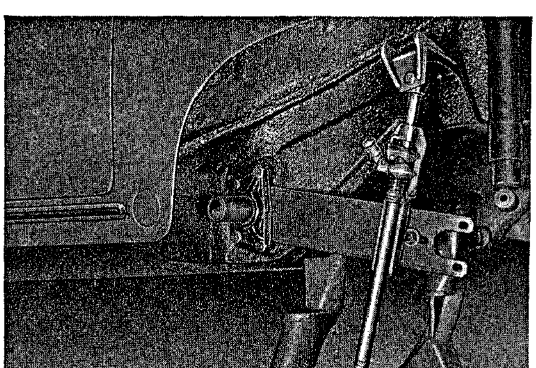


Fig. 134

7. Remove bolts from radius arm cover and remove cover.

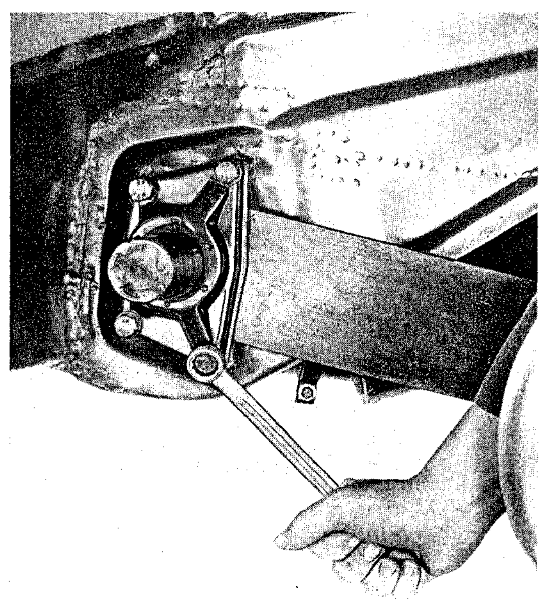


Fig. 135

8. Remove rubber bearing.
9. Remove radius arm and inner rubber bearing.

10. Remove torsion bar through the hole provided in the body.

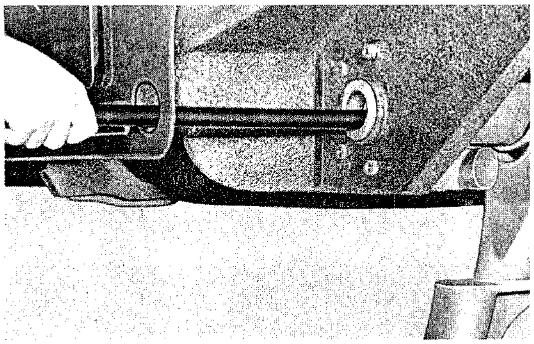


Fig. 136

Note

If the torsion bar has fractured, the broken end can be driven out of the internally splined central tube by a steel rod after the opposite torsion bar has been removed.

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Inspect torsion bars for damaged splines and condition of paint, especially for traces of rust. Replace if necessary.
2. Grease the splines of the torsion bar.
3. Install torsion bar and engage radius arm splines enough to hold without fouling stop stud. Adjust correct angle (23 RA).
4. Dust rubber mount with graphite powder and install.
5. Raise radius arm and push in together with torsion bar until the radius arm rests against lower stop stud.
6. Install outer rubber mount and bolt on cover of radius arm.
7. Clean surfaces on radius arm and axle tube flange (remove traces of paint, rust etc.). Tighten bolts on axle tube flange 9 to 10 mkg (65 to 72 ft. lb.) torque.

Note

Torsion bars with 23 mm (.91 in.) and 24 mm (.94 in.) diameter are installed. Cars without compensating spring use 24 mm (.94 in.) bars and cars with compensating spring 23 mm (.91 in.) bars. If a compensating spring is installed later on, the 24 mm (.94 in.) must be exchanged for 23 mm (.91 in.) bars.
When removing torsion bars it is not necessary to mark them left or right, since this will not affect their elastic quality or shorten their life.

Adjusting Rear Wheel Suspension

Special Tools:

VW 245a Protractor

The correct adjustment of the torsion bar may be obtained by measuring the angle of the radius arm with respect to the horizontal position of the automobile. The radius arm must be unloaded.

Make sure the chassis is level by placing the protractor VW 245a on the floor tunnel. The unloaded radius arm should give the following reading:

Vehicle type 356 B 1600, 1600 S (without compensating spring)

Coupe, Cabriolet/Hardtop
16° 30'

Roadster
14° 30'

Vehicle type 356 B 1600 S-90 (with compensating spring)

Coupe, Cabriolet/Hardtop
15° 30'

Roadster
13° 30'

These values are valid for cars with compensating springs which where not orignial equipment.

Vehicle type 356 B 1600 GS (with compensating spring)

12° to 13°
Camber: – 0.5° to – 1.5°

To insure proper radius arm travel as well as roadholding qualities of the automobile, the adjustment of both radius arms should be identical. When adjusting one side, always check the other and correct if necessary.

The adjustment is made as follows:

1. Install torsion bar so that its splines engage the socket in the frame.
2. Install radius arm on outer end of torsion bar.
3. Place protractor VW 245a on unloaded radius arm.
4. Adjust pendulum on protractor so that the level is horizontal.

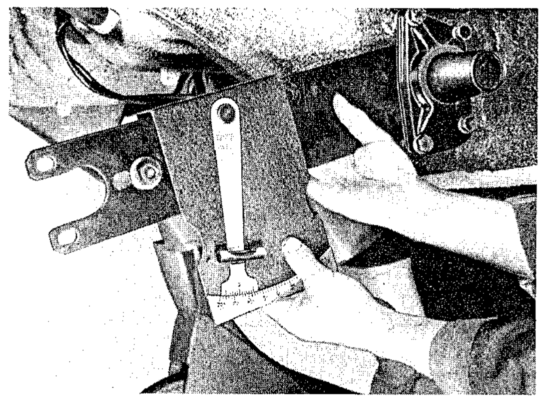


Fig. 137

If the protractor shows a noticeable variation between the actual angle of radius arm and the specified angle, the position of the radius arm should be corrected. The different number of splines on either end of the torsion bar permits such an adjustment. The number of splines are:

Inner end: 40 splines
Outer end: 44 splines

When the inner end of the torsion bar is advanced one spline it turns 9°. When the radius arm is moved one spline it gives a change of 8° 10'. As a result the minimum adjustment of the radius arm is 0° 50'. If this procedure does not result in the same radius arms inclination on both sides of the vehicle, the adjustment must be repeated with a different radius arm.

The adjustment of the right and left radius arms may vary up to ± 30'. Depending on right-hand or left-hand drive, the greater angle should be on the driver side.

Note

Correct adjustment of the rear wheels can be obtained only on an optical alignment device. (See Group W — Wheel Alignment.)

Removing and Installing Shock Absorbers

24 RA

Special Tools:

P 53 Radius arm compressor

General

For proper suspension and road holding, shock absorber adjustment is next in importance to the radius arm adjustment.

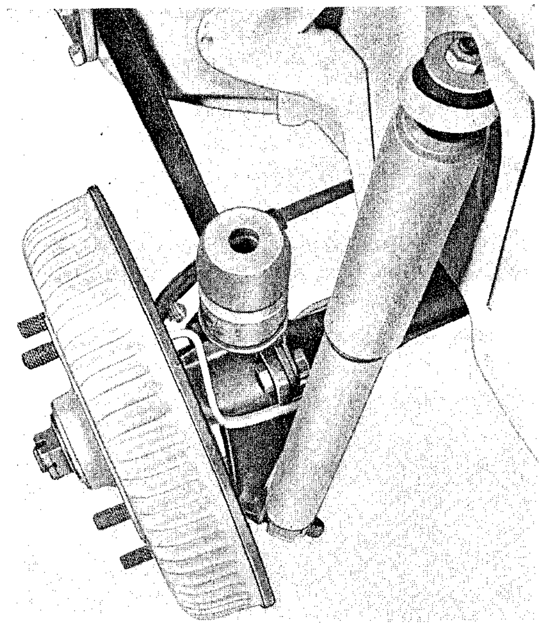


Fig. 138

Maintenance

Shock absorbers require no maintenance. A slight loss of fluid does not necessitate replacement of the shock absorber since small losses are replenished from an internal oil reservoir.

Testing

The shock absorbers are double acting and are designed to match the suspension characteristics of the car. Therefore changes in adjustment are not recommended. An operational check can be made by manually bouncing the car up and down. The car should return to the neutral position without passing it. A road test is also effective. Exact testing requires special testing machines. Hand operation can merely indicate whether a shock absorber is working and gives no indication of its effectiveness.

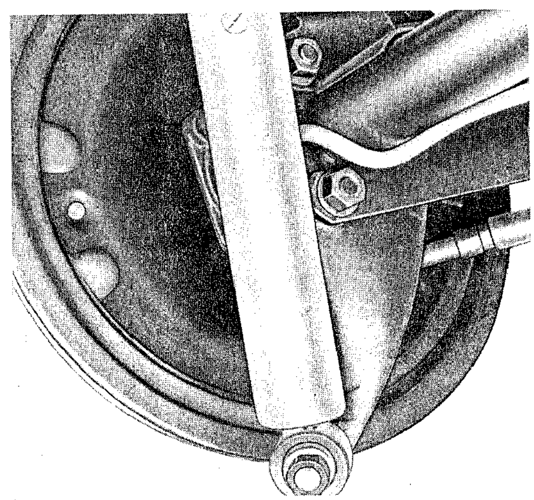


Fig. 139

Removal

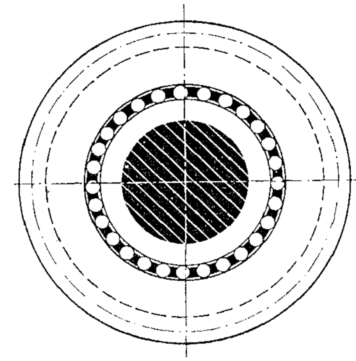
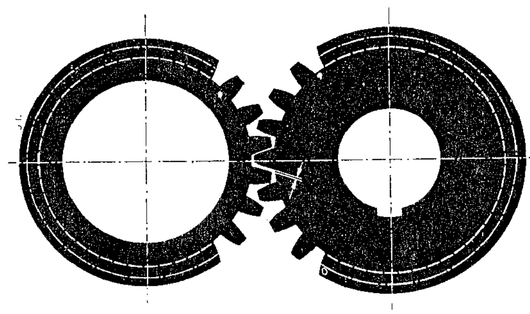
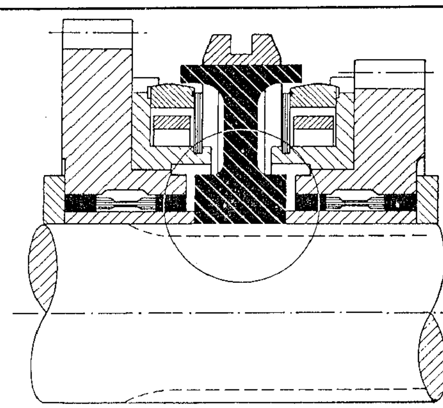
1. Jack up car.
2. Raise radius arm using tool P 53 until shock absorber is free.
3. Remove shock absorber mounting nuts.
4. Remove shock absorber.

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Check shock absorber for proper operation. If necessary replace, observing the instructions given in paragraph (17 ST).
2. Check bushings and rubber mounts for wear. Replace if necessary (18 ST).

Table of Tolerances for Transmission 741

Measuring Point	Tolerance (new) mm	Wear limit mm	
1. Clearance between sleeve, rollers or needles, and inner surface of gear 1st and 2nd gear rollers 3×5 DIN 5402 available in standard and + 0.004 mm 3rd and 4th gear needle bearings 2.5×19.8 mm are available in standard and + 0.004 mm	By installing oversize roller or needle bearings, practically no clearance but turning freely.	By installing oversize roller or needle bearings, practically no clearance but turning freely.	
2. Backlash between gears 1st gear 2nd gear 3rd gear 4th gear	0.06—0.20	0,30	
3. Backlash ring and pinion gears	Between 0.12 and 0.18 as marked on ring gear. Measure at four different positions 90° apart.	Up to 0.05 mm in excess of clearance marked on gears	—
4. Gears on pinion shaft 1st gear 2nd gear lateral 3rd gear clearance 4th gear	 0.25—0.35 0.20—0.30 0.20—0.30 0.20—0.30	 0.40 0.40 0.40 0.40	

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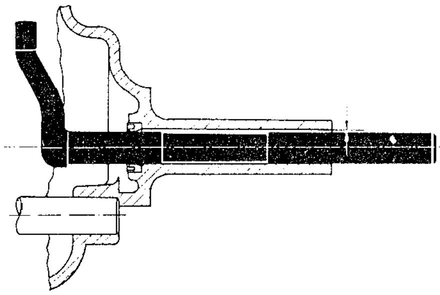
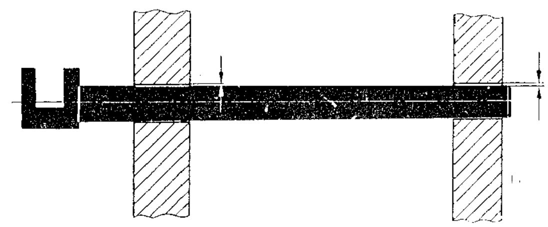
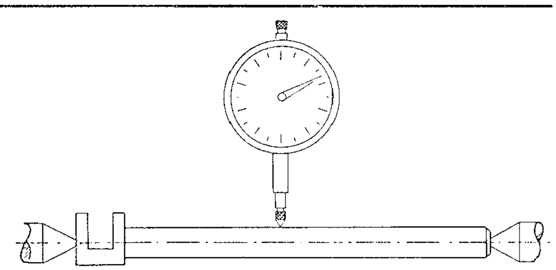
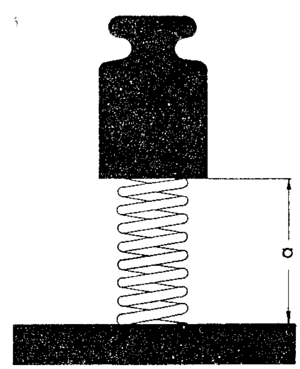
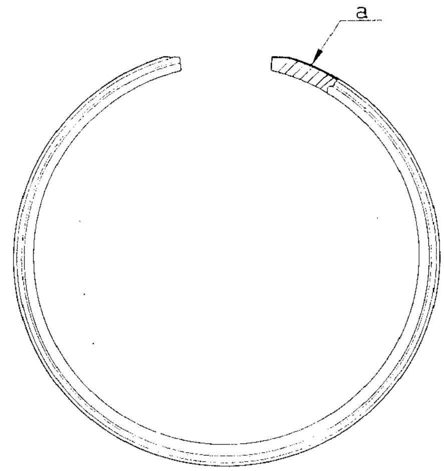
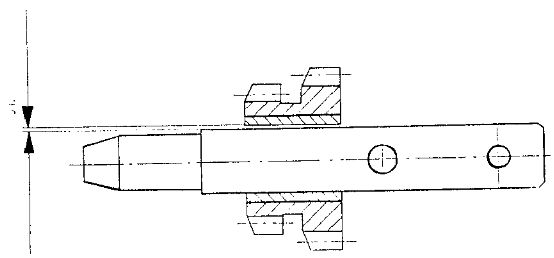
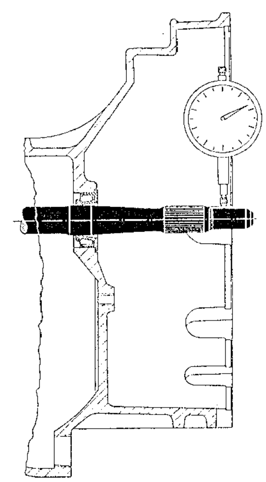
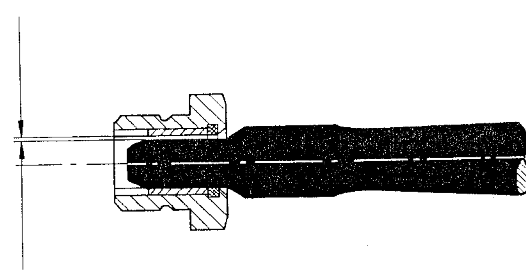
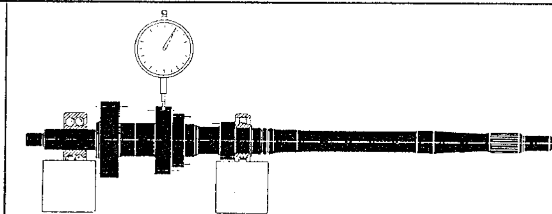
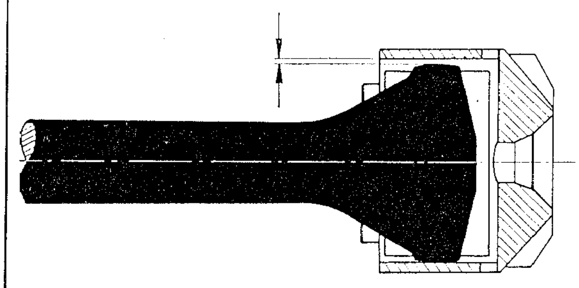
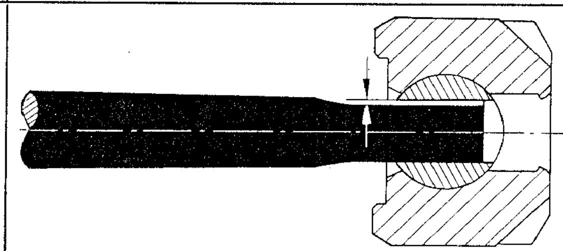
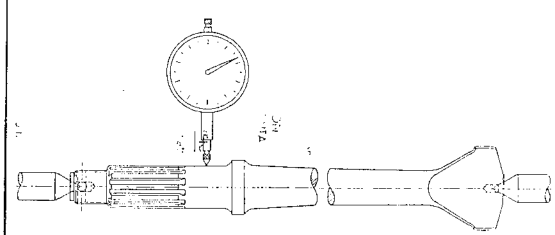
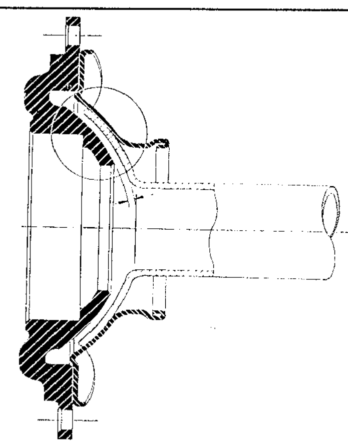
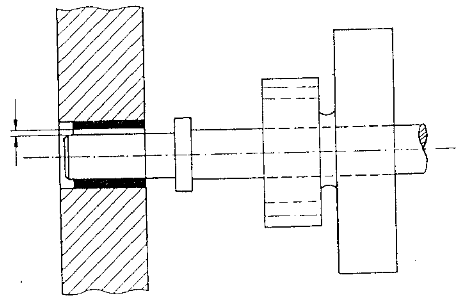
Measuring Point	Tolerance (new) mm	Wear limit mm	
5. Selector rod in transmission cover, end play	0.095—0.140	0.3	
6. a) Selector rod clearance in guide bores of intermediate plate and gearbox housing for 1st and 2nd gear, 3rd and 4th gear, and reverse gear	0.095—0.156	0.4	
b) Selector rods for 1st and 2nd gear, 3rd and 4th gear, and reverse gear run-out	—	0.10	
7. Selector rod lock spring 1st and 2nd gear 3rd and 4th gear load at 21.5 mm free length reverse gear load at 21.9 mm free length	 3.3 kg 23.2 mm 6.5 kg 25.7 mm		
8. Selector fork lateral clearance in sliding sleeve 1st and 2nd gear 3rd and 4th gear	0.10—0.30	0.5	

Measuring Point	Tolerance (new) mm	Wear limit mm	
9. Synchronizing rings 1st gear 2nd gear 3rd gear 4th gear Outside diameter Removed Installed	 76.56—76.84 76.3 —76.7	When molyb-denum coating has worn off (a)	
10. Reverse idler II on idler shaft clearance	0.032—0.068	0.25	
11. Main shaft a) Run out on pilot bearing surface	0.1 max.	0.2	
b) Shaft clearance in pilot bushing	0.082—0.168	0.2	

Measuring Point	Tolerance (new) mm	Wear limit mm	
c) Run out between bearings	0.03 max.	0.04 *)	
12. Rear axle shaft a) Clearance on large diameter clearance	0.03–0.10	0.15	
b) Clearance between fulcrum plates	0.05—0.15	0.25	
c) Run out on outer bearing surface, shaft on centers	0.00—0.02	0.03 **)	
13. Transmission side cover/rear axle tube/rear axle tube retainer clearance	0.1—0.2	0.3 ***) (After reconditioning adjust to new tolerance using at least one 0.1 mm paper gasket)	

*) **) Excessive run out of rear axle or main shaft may be corrected without heat. However, the value to be corrected should not exceed 0.25 mm on the main shaft and 0.2 mm on the rear axle shaft. To correct use hydraulic press VW 400.

***) If the wear limit is exceeded, a thinner gasket may be used for adjustment.

Measuring Point	Tolerance (new) mm	Wear limit mm	
14. Starter shaft / starter bushing clearance	0.018—0.055	0.25	

Preloads

Measuring Point	Tolerance (new) mm	—	
1. Bearing retaining plate / intermediate plate with bearings installed	0.03—0.13 **Preload**	—	———
2. Transmission side cover left and right with bearings / 2 spacers / differential carrier	0.13—0.17 **Preload**	—	———
3. Outer bearing cover left or right / brake backing plate / inner bearing flange with ball bearing Brake backing plate	0.05—0.15 **Preload**	—	———

Torque Values for Transmission 741

	mkg	ft.lb.
Castle nut on main shaft	2.5	18.0
Castle nut on pinion shaft	10.0	72.5
Bolts for differential ring gear	6.0	43.5
Bolts for bearing retaining plate on intermediate plate	2.0	14.5
Bolts on selector forks	2.5	18.0
M 8 bolts on transmission housing	2.0	14.5
Rear axle nuts	55.0	400

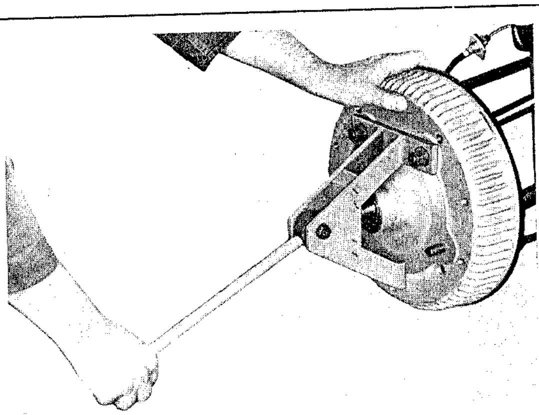
SPECIAL TOOLS

FOR

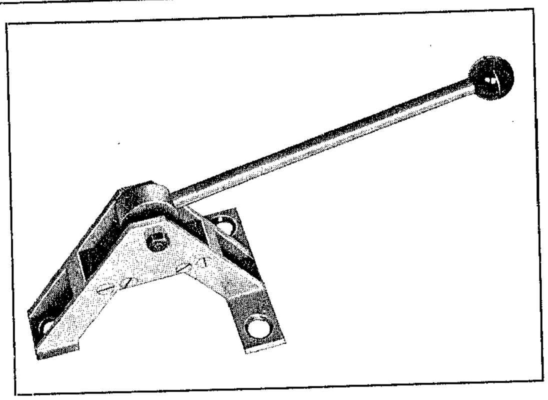
GROUP **R**

Puller for Brake Drums

P 30



Application



Tool

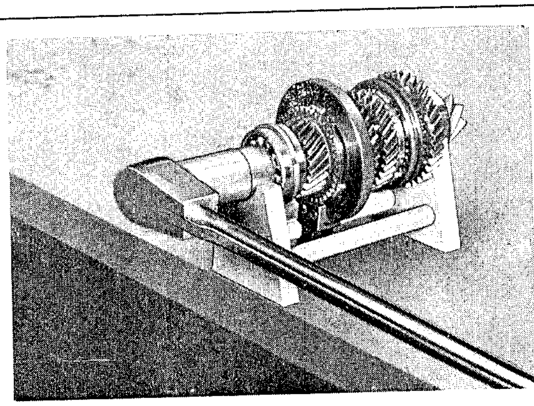
Use: To remove brake drums

See: Workshop Manual, group R, operation 1 RA

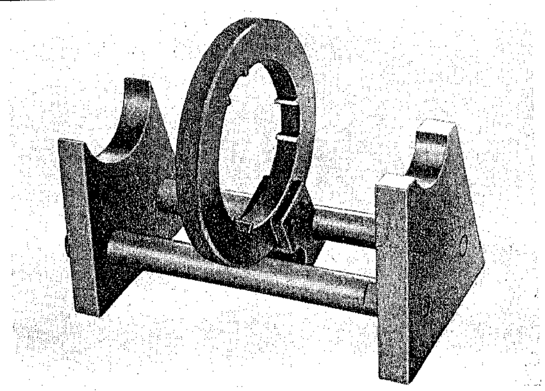
Subject to change

Holder for Pinion Shaft

P 31



Application



Tool

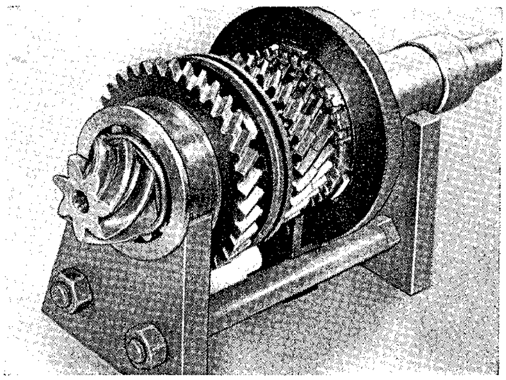
Use: To loosen or tighten pinion shaft castle nut

See: Workshop Manual, group R, operation 6 RA

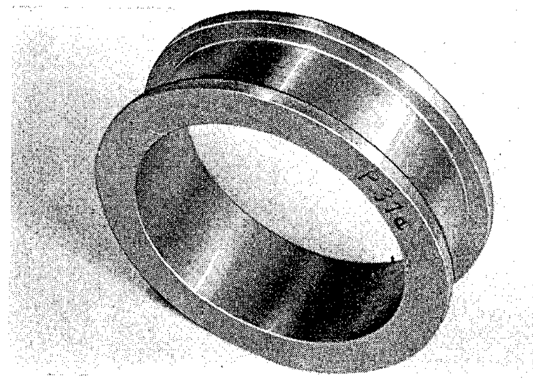
Subject to change

Guide Pinion Shaft

P 31a



Application



Tool

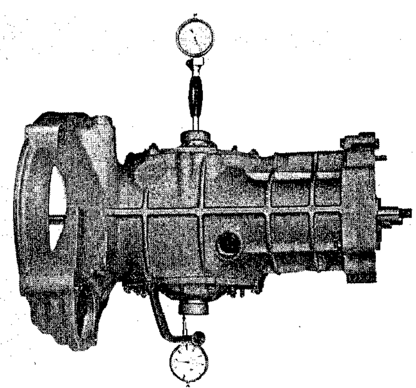
Use: Used with P 31 to loosen or tighten pinion shaft castel nut

See: Workshop Manual, group R, operation 6 RA

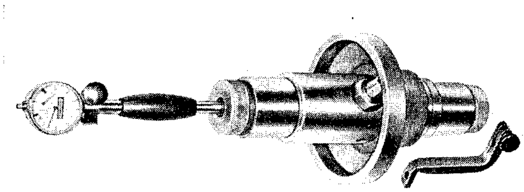
Subject to change

Gauge

P 33



Application



Tool

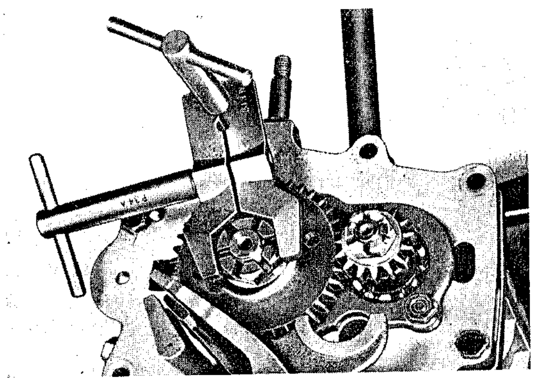
Use: To measure housing depth and to determine spacers for differential and final adjustment of ring and pinion

See: Workshop Manual, group R, operation 11 RA

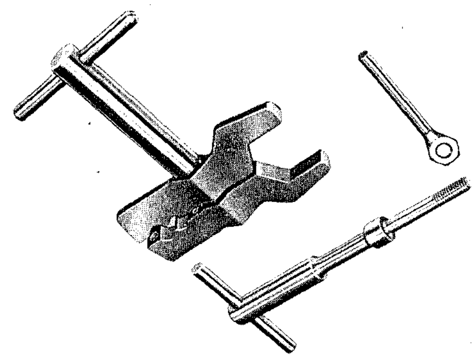
Subject to change

Pinion Shaft Holding Clamp

P 34a



Application



Tool

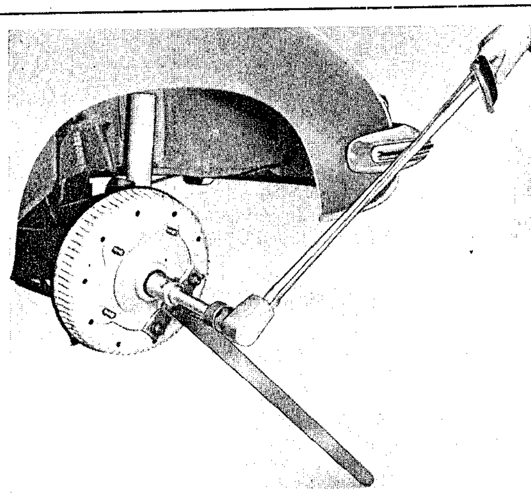
Use: To hold pinion shaft while measuring the backlash of the ring and pinion gear

See: Workshop Manual, group R, operation 14 RA

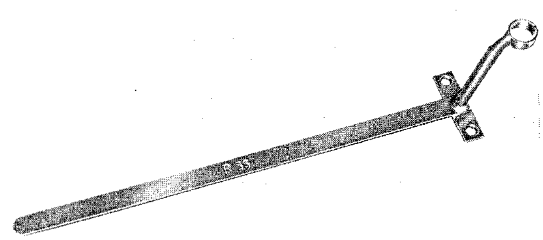
Subject to change

Wrench Guide and Holder

P 36



Application



Tool

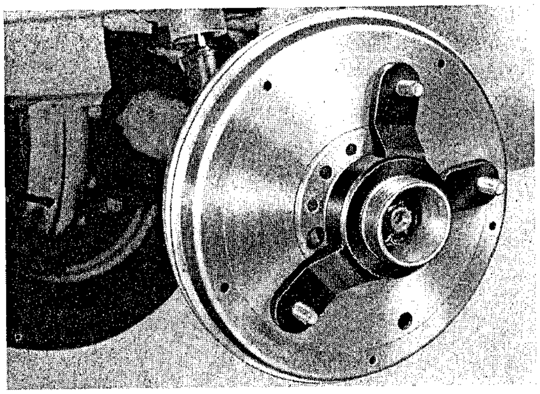
Use: To loosen and tighten rear axle nuts (used with P 42, P 44, and P 44a)

See: Workshop Manual, group R ,operation 1 RA

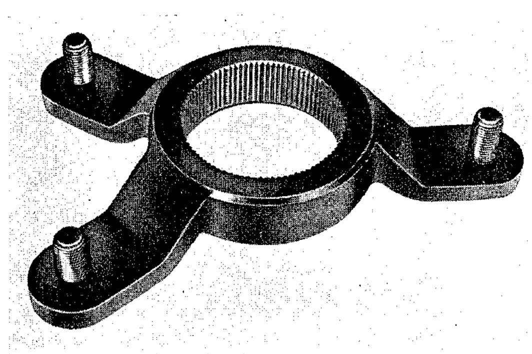
Subject to change

Holder

P 36a



Application



Tool

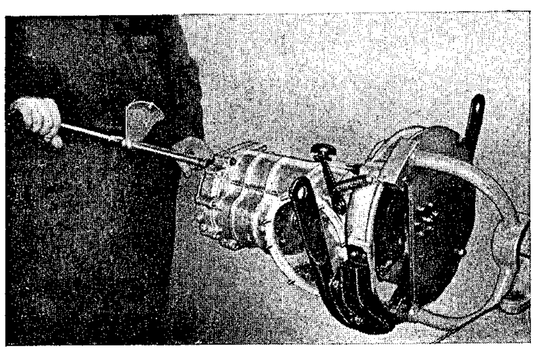
Use: To loosen and tighten rear axle nuts on cars with knock-off wheels, used with P 36, P 42, P 44, and P 44a

See: Workshop Manual, group R, operation 1 RA

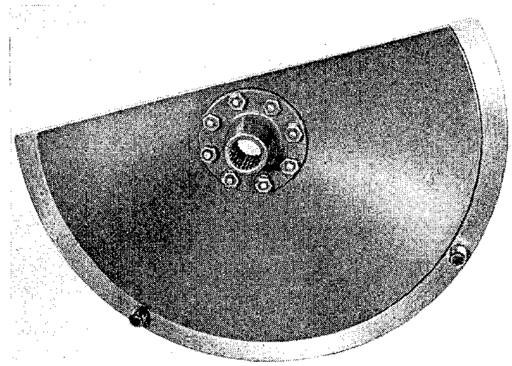
Subject to change

Holder for Main Shaft

P 37



Application



Tool

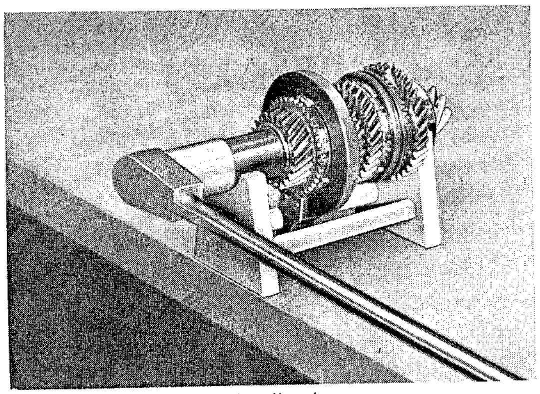
Use: To hold the main shaft while loosening and tightening castle nuts of the main and pinion shafts

See: Workshop Manual, group R, operation 2 RA

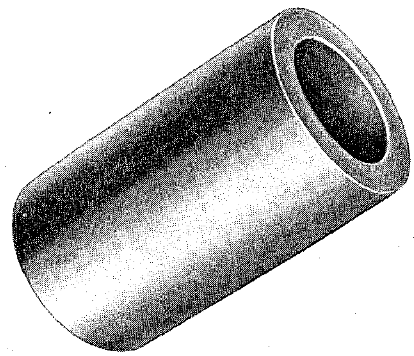
Subject to change

Collar (long)

P 39



Application



Tool

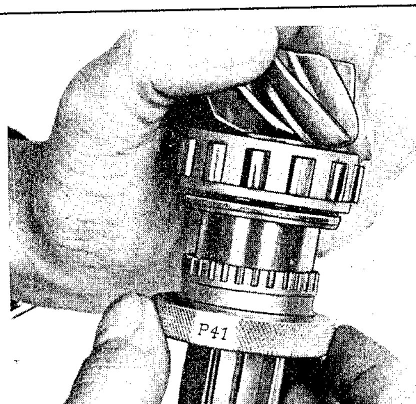
Use: To tighten gears and sleeves on pinion shaft

See: Workshop Manual, group R, operation 6 RA

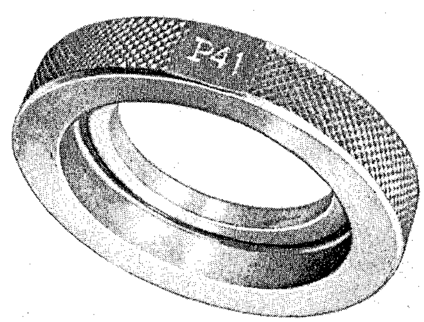
Subject to change

Assembly Ring

P 41



Application



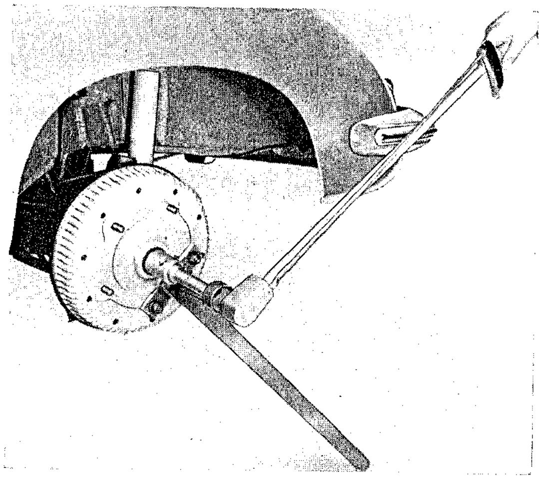
Tool

Use: To install roller bearing cage and rollers on pinion shaft

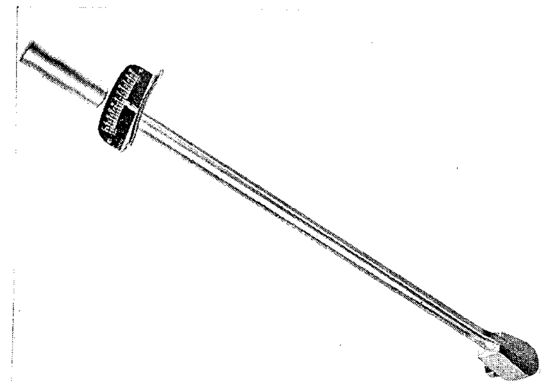
See: Workshop Manual, group R, operation 6 RA

Subject to change

Torque Wrench (50 mkg. 360 ft. lb. cap.) — P 42



Application



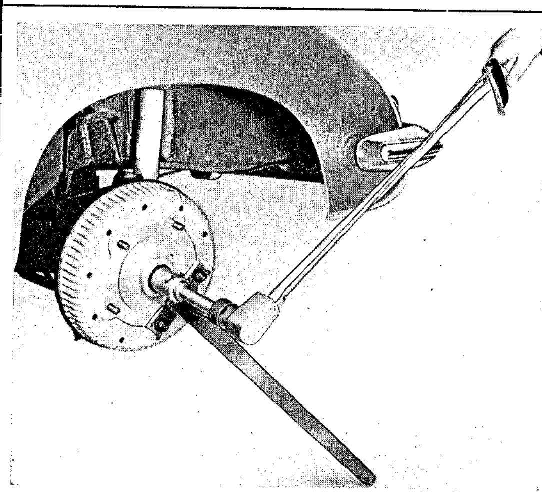
Tool

Use: To loosen and tighten rear axle nuts, used with P 44, P 44a, and P 36

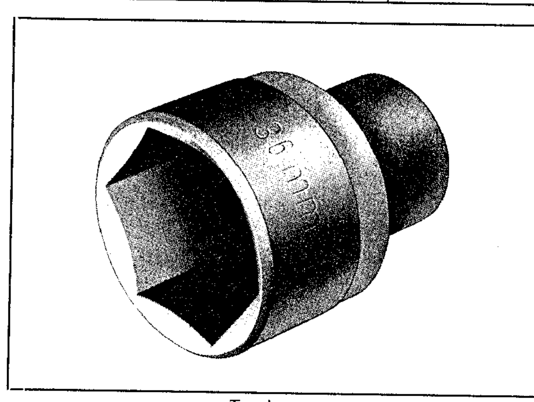
See: Workshop Manual, group R, operation 1 RA

Subject to change

Socket 36 mm — P 44



Application



Tool

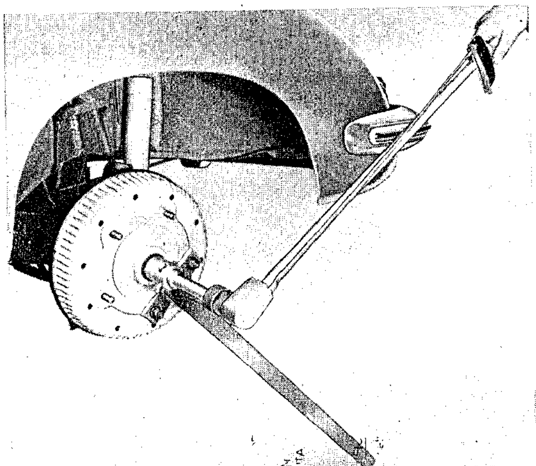
Use: To loosen and tighten rear axle nuts, used with P 36, P 42, and P44a

See: Workshop Manual, group R, operation 1 RA

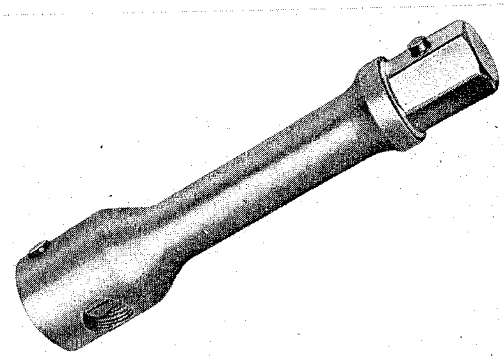
Subject to change

Socket Extension

P 44a



Application



Tool

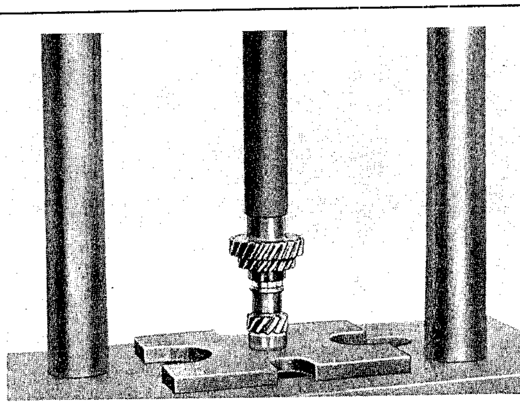
Use: To loosen and tighten rear axle nuts, used with P 36, P 42, and P 44

See: Workshop Manual, group R, operation 1 RA

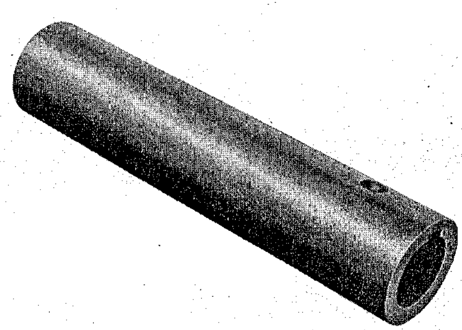
Subject to change

Tube

P 45



Application



Tool

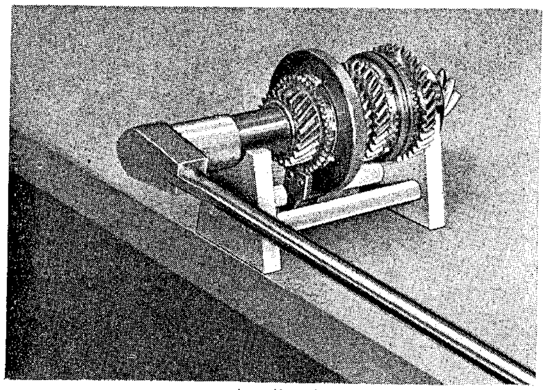
Use: To press gears onto main shaft

See: Workshop Manual, group R, operation 7 RA

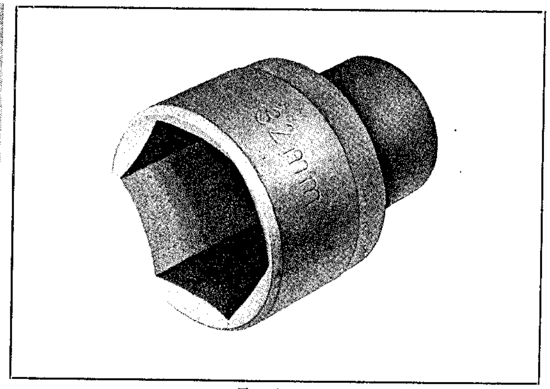
Subject to change

Socket 32 mm

P 46



Application



Tool

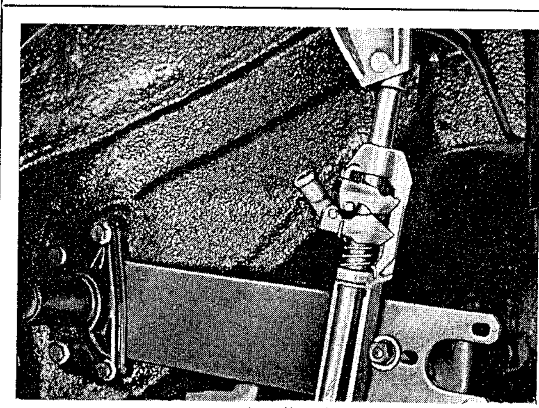
Use: To loosen and tighten castle nut on pinion shaft

See: Workshop Manual, group R, operation 6 RA

Subject to change

Radius Arm Jack

P 53



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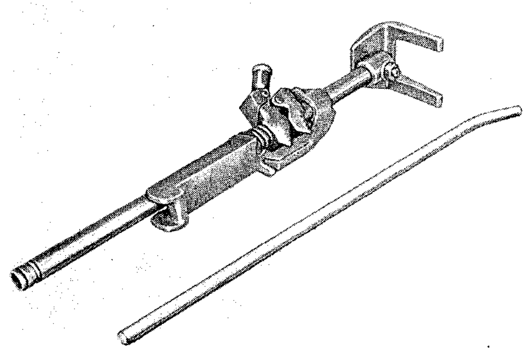


Tool

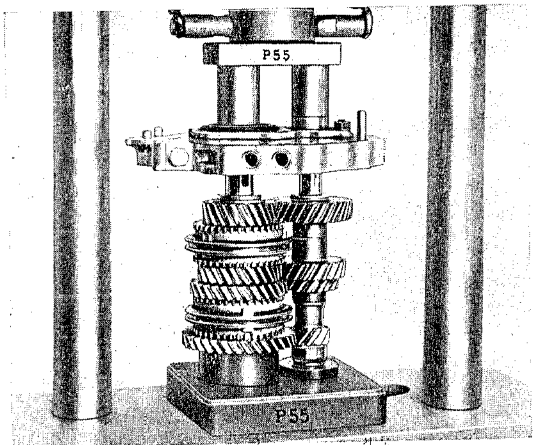
Use: To raise radius arm for tansmission and shock absorber installation

See: Workshop Manual, group R, operation 24 RA

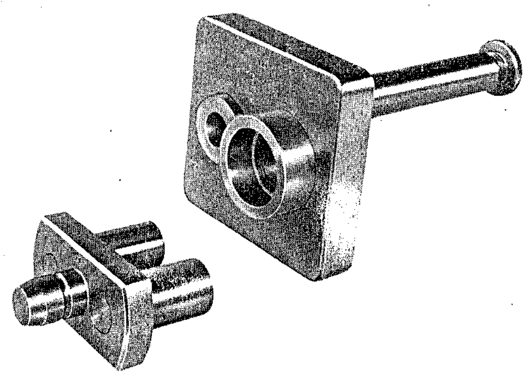
Subject to change

Press Stand

P 55



Application



Tool

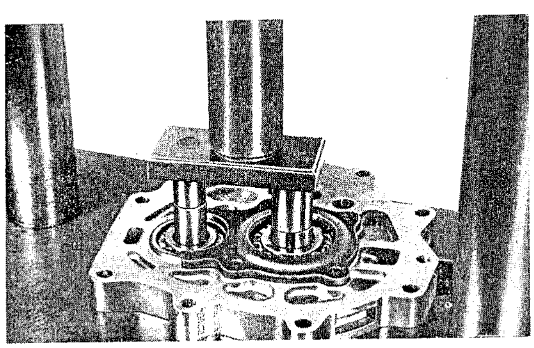
Use: To press intermediate plate onto main and pinion shafts

See: Workshop Manual, group R, operation 2 RA

Subject to change

Press block

P 56



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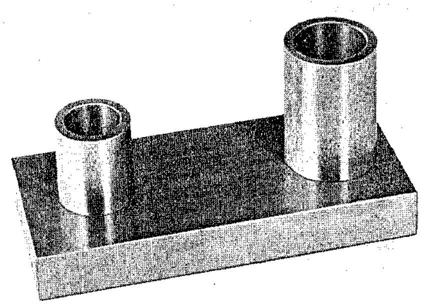


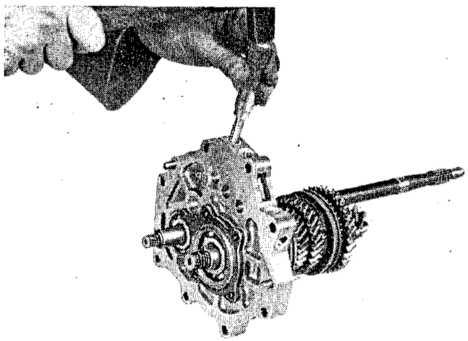
Tool

Use: To press main and pinion shafts out of intermediate plate

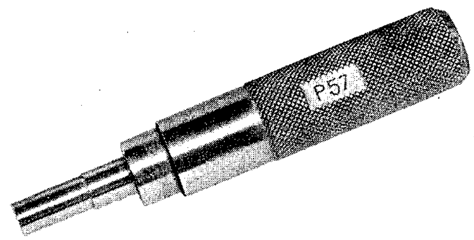
See: Workshop Manual, group R, operation 2 RA

Subject to change

Guide Pin (short)	P 57



Application



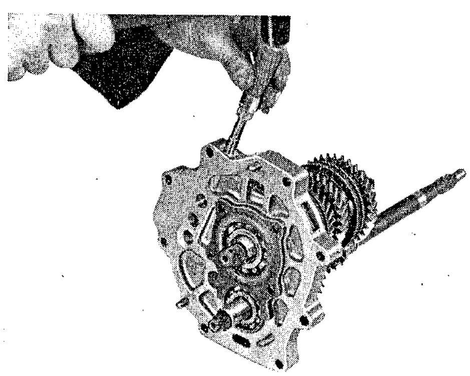
Tool

Use: To install selector rod lock bushing (1st, 2nd, and reverse gear)

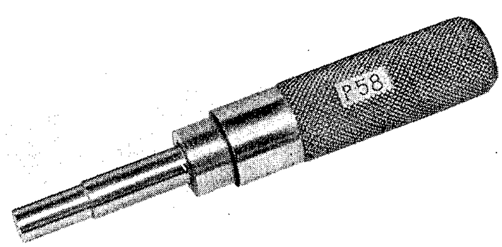
See: Workshop Manual, group R, operation 9 RA

Subject to change

Guide Pin (long)	P 58



Application



Tool

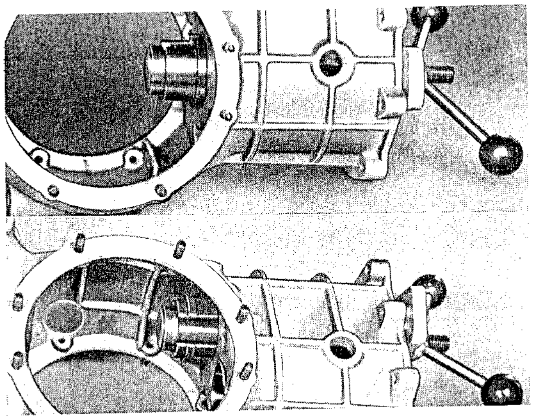
Use: To install selector rod lock bushing (3rd and 4th gear)

See: Workshop Manual, group R, operation 9 RA

Subject to change

Puller

P 59



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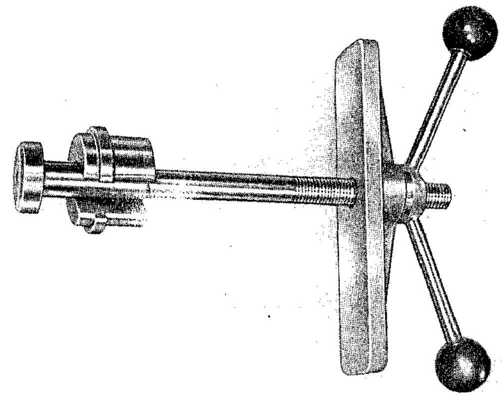


Tool

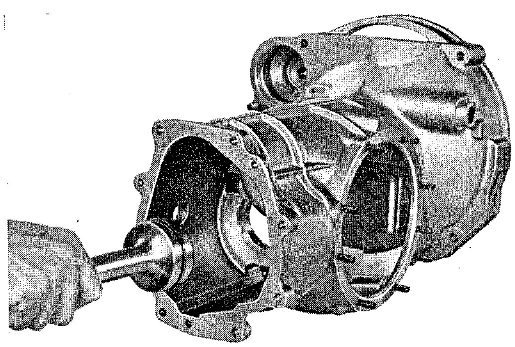
Use: To remove outer race of main and pinion shafts from transmission housing

See: Workshop Manual, group R, operation 2 RA

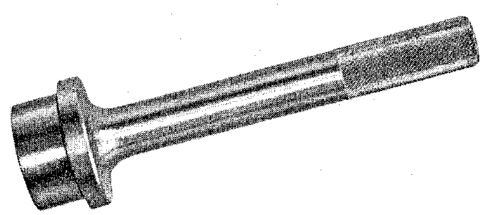
Subject to change

Mandrel

P 60



Application



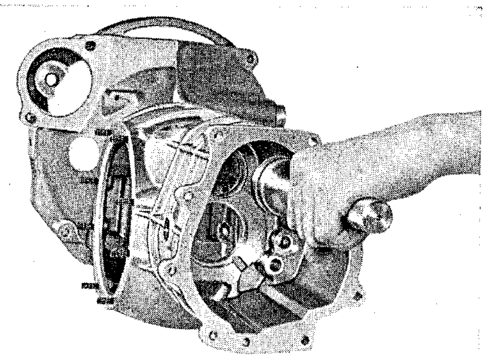
Tool

Use: To install roller bearing race in transmission housing (pinion shaft)

See: Workshop Manual, group R, operation 2 RA

Subject to change

Mandrel	P 61



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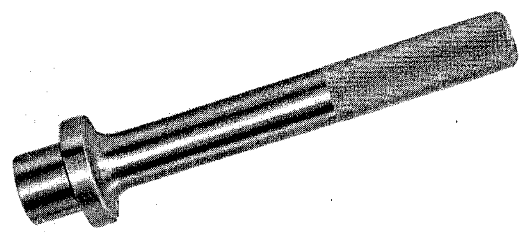


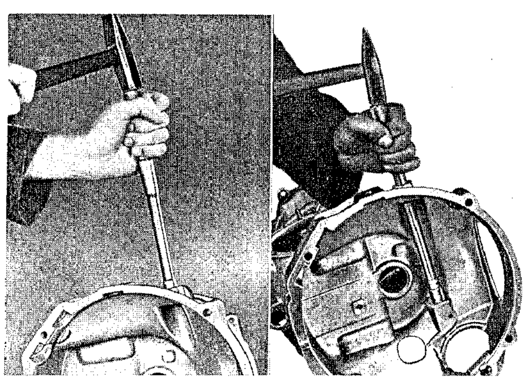
Tool

Use: To install roller bearing race in transmission housing (main shaft)

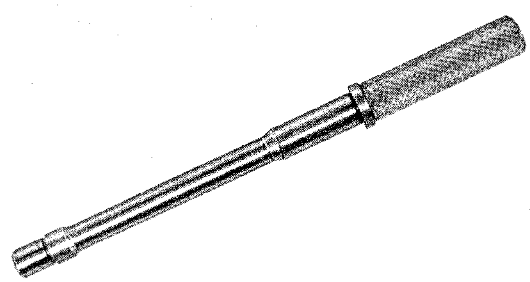
See: Workshop Manual, group R, operation 2 RA

Subject to change

Drift	P 62



Application



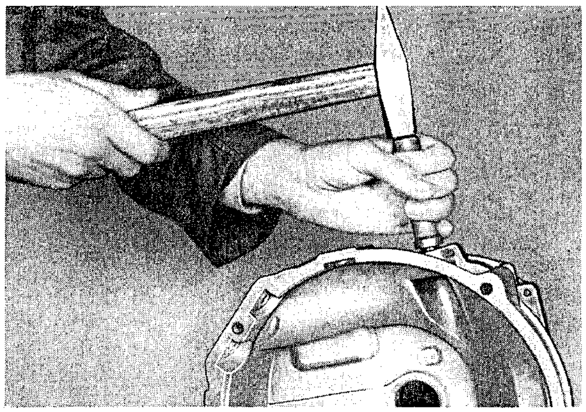
Tool

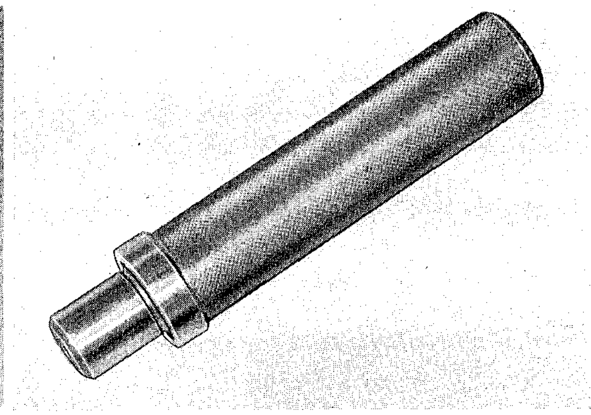
Use: To remove or install clutch pivot shaft bushing

See: Workshop Manual, group R, operation 20 RA

Subject to change

Mandrel	P 64


Application

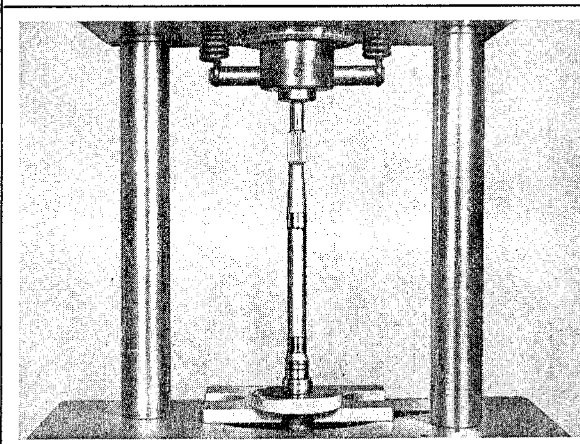

Tool

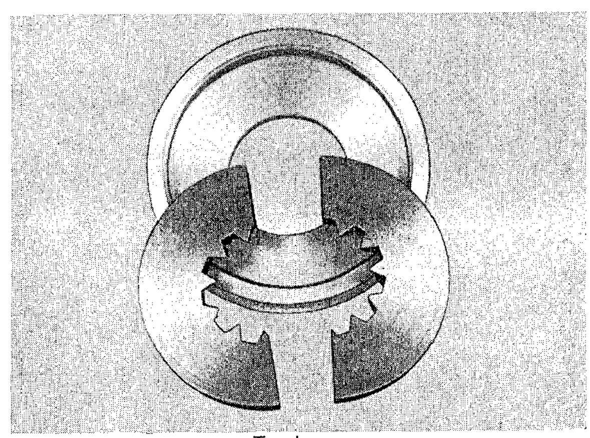
Use: To install outer bushing for clutch pivot shaft

See: Workshop Manual, group R, operation 20 RA

Subject to change

Plate	P 65


Application


Tool

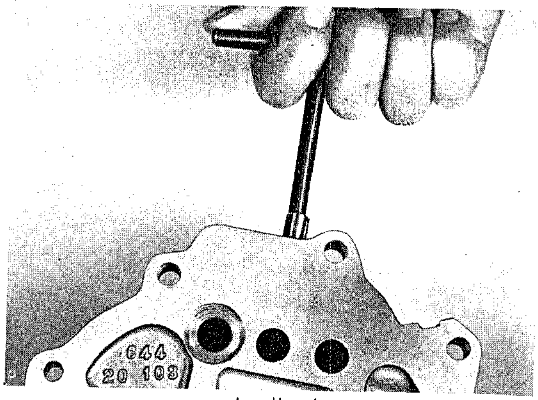
Use: To remove inner roller bearing race from main shaft

See: Workshop Manual, group R, operation 9 RA

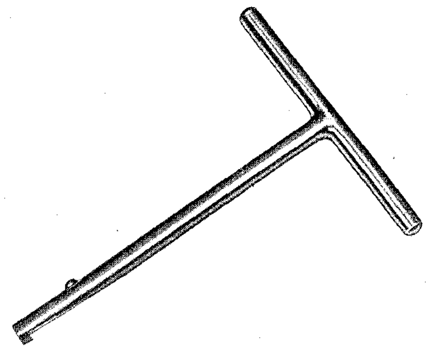
Subject to change

Puller

P 66



Application


Tool

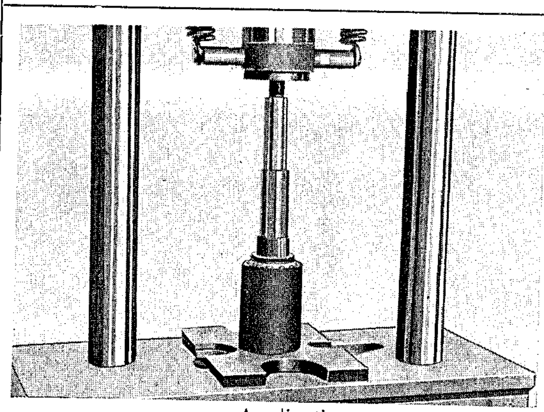
Use: To remove selector rod lock bushings from intermediate plate

See: Workshop Manual, group R, operation 9 RA

Subject to change

Press Guide

P 67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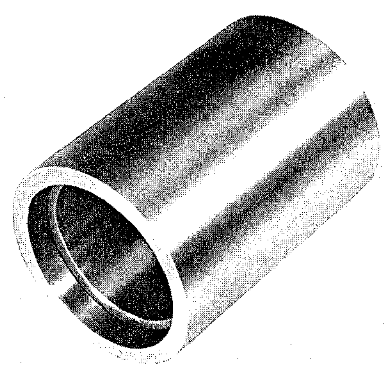

Tool

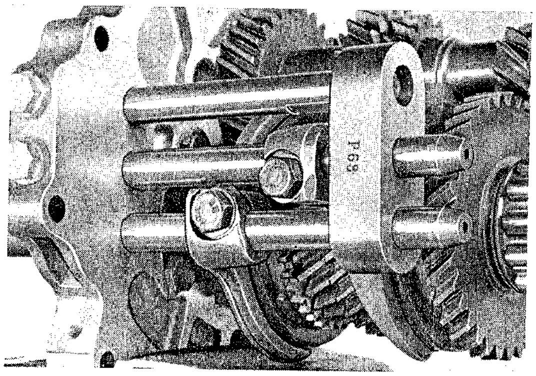
Use: To remove roller bearing from pinion shaft

See: Workshop Manual, group R, operation 6 RA

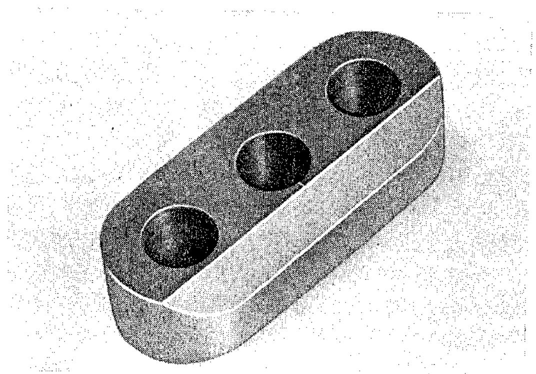
Subject to change

Selector Rod Guide

P 68



Application



Tool

Use: To guide selector rods while adjusting forks

See: Workshop Manual, group R, operation 2 RA

Subject to change

SECTION INDEX

Group W: Wheel Alignment

WHEEL ALIGNMENT

General:

The following section gives instructions on aligning front and rear wheels of the vehicle.

A correct alignment of the wheel is, however, not the only factor which is responsible for a perfect road-holding ability of the vehicle. Some practical hints and recommendations are given in the following:

1. All moving parts of the steering and wheel assembly must have the correct amount of play.
2. The suspension system must be in proper condition and correctly adjusted (radius arms).
3. The individual wheels must turn freely. Check for grazing brake linings and so on.
4. The wheels must be properly balanced, the rims should have no unpermissible vertical out-of-true.
5. The tires must be inflated to the specified pressure, their treads should show no uneven amount of wear.
6. Effectiveness of shock absorbers must be perfect.

Basic Information

Camber and Inclination

The camber of the front wheels is determined by the angle of the wheel bearing pivot (stub axle) towards horizontal. The inclination is determined by the angle of the king pin in relation to a level which is parallel and vertical to the longitudinal axis of the vehicle. Camber and inclination ensure that the distance between the point of contact of the tire and the point of intersection of a line projected through the king pin is in a favourable size relative to the road plane. Thus, road shock is lessened and the wheel turns in steering movement with considerably reduced tire friction. The inclination of the king pin contributes to an increased stability of the front wheels by lifting the car somewhat during steering movement. The resistance counteracting this movement forces the wheels back into the straight-ahead position.

Angle α = Camber angle

Angle β = King pin inclination

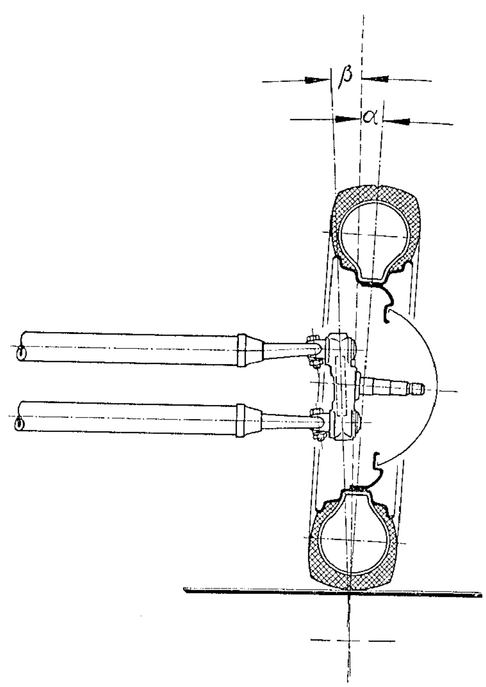


Fig. 1

MEASURING VEHICLE

General

Most wheel alignment devices give only a partial measurement. We recommend, therefore, to use the optical wheel alignment device "Exacta" of Messrs. Müller, Heilbronn, for measuring our vehicles.

With its help one can in a short time detect and correct any errors of wheel alignment.

If the measurements are found to be within tolerance limits, the given complaints are not due to incorrect wheel alignment, but to other causes which are mentioned in the beginning of this section.

Misalignment frequently causes unequal tire wear.

If wheel alignment is correct and if the car is not loaded unevenly or often driven on high crowned roads, then tires of the same manufacture and age should wear evenly. The rear tires wear out faster than the front tires.

In addition to periodic inspections, wheel alignment should be checked if tires show uneven wear, or if poor roadability is experienced; also after removing and installing axles.

Since our service stations feature standard measuring frames and stationary facilities, both types of aligning methods will be described. This description will be of no use to a person who is not familiar with this work, it shall only help to guide the expert.

Attention

Prior to checking the wheel alignment of a car, check and, if necessary, correct the tire pressure and the clearance of the axle components.

Measuring Frame

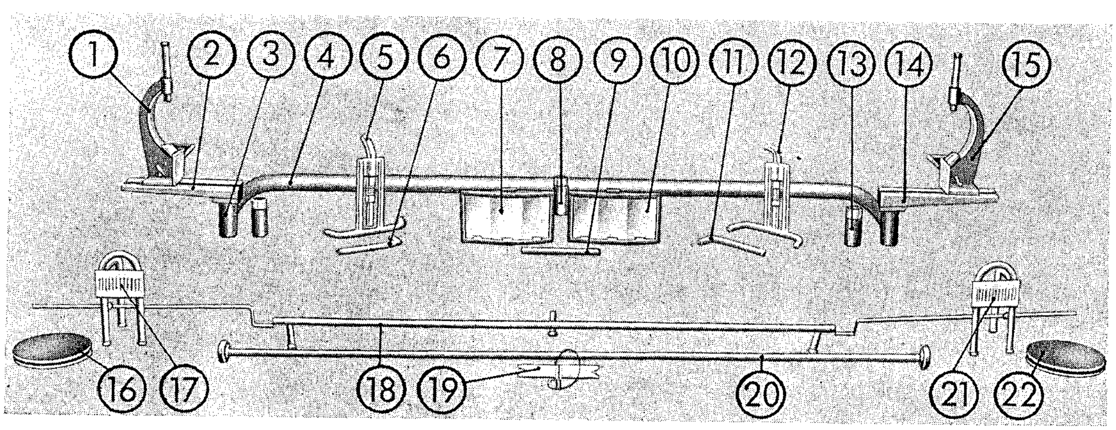


Fig. 5

① Microscope
② Prismatic guide
③ Extension base
④ Rack
⑤ Wheel mirror bracket
⑥ Centre part for 13" rim
⑦ Wheel mirror
⑧ Extension base
⑨ Distance rod
⑩ Wheel mirror
⑪ Centre part for 13" rim
⑫ Wheel mirror bracket
⑬ Extension base
⑭ Prismatic guide
⑮ Microscope
⑯ Wheel support plates
⑰ Scale trestle
⑱ Tripod adjusting rod
⑲ Supporting angle with adjusting wire
⑳ Mirror adjusting bar
㉑ Scale trestle
㉒ Wheel supporting plates

1 Wh

Adjusting Measuring Gauge

1. Attach supporting angle for mirror adjusting bar.
2. Place mirror adjusting bar in position.
3. Adjust measuring distance with distance rod.

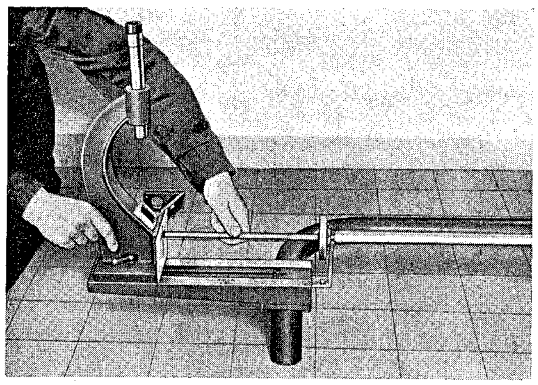


Fig. 6

4. First side:
   Turn mirror adjusting bar, align mirror at the three setscrews until the cross wire on the measuring scale does no longer move.
5. Turn mirror round its axis and observe cross wire (max. deviation: Toe-in 5', camber 10').
6. Align cross wire by turning microscope mirror until the vertical hairline passes through 0 and the horizontal hairline indicates —10'.
7. Proceed in similar way when adjusting second side.
8. If cross wire is not right-angled, loosen setscrews at the elbow sight bracket and correct position of microscope.
9. Set tripod adjusting rod to centre, adjust scale trestles (attach stop angle to measuring scale).

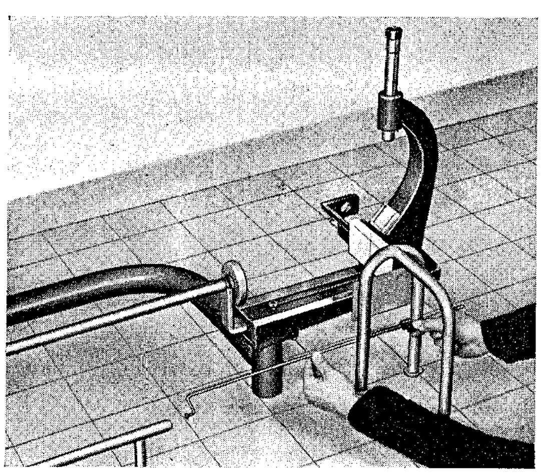


Fig. 7

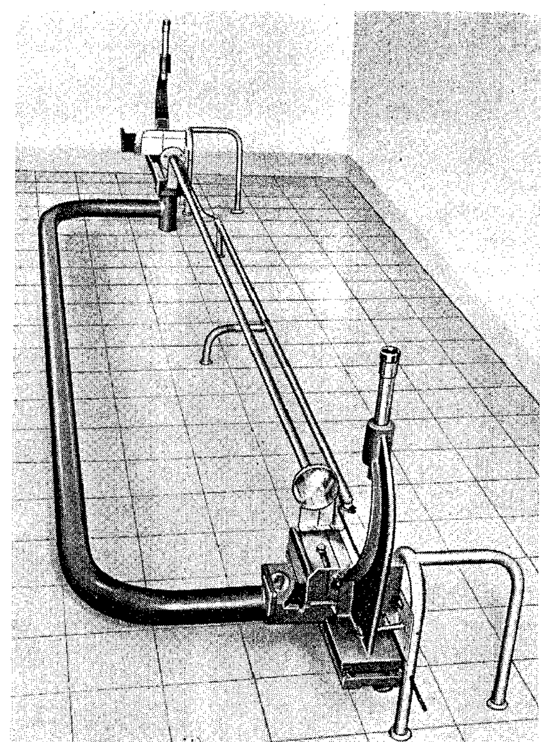


Fig. 8

10. Move tripod adjusting rod at a distance from the rack until both adjusting wires are fully stretched.
11. Place scale trestles left and right in position (with exact alignment).
12. Place elbow sight forward and adjust to zero line on scale trestle. Horizontal line must be somewhat below scanner.

Measuring Front Wheels

2 Wh

1. Secure wheel mirror to front wheels.

2. Position tubular frame so that microscopes are set as close to the centre of the wheel axis as possible.

3. Jack up car until the wheel to be aligned turns freely.

4. Set measuring distance, turn wheel, change position of mirror by means of the three screws, until cross wire does no longer move.

5. Turn mirror round its axis and observe cross wire (max. deviation: Toe-in 5', camber 10').

6. Align second front wheel, proceeding similarly.

7. Lower car, at the same time placing rotating plates underneath both wheels.

8. Rock car and move it to and fro several times.

9. Set measuring distance, attach scale trestles with stop angle to measuring scale and adjust scanners at distance to rim flange.

10. Place scale trestles in position to the rear wheels (attach scanner to the rim flange concerned).

11. Put elbow sight forward and move frame on one side in parallel direction to the longitudinal axis of the vehicle until the same figure appears in the same field of the scale (of the scale trestle) when reading both microscopes.

12. Check measuring distance and correct distance and position of tubular frame, if required.

13. Remove elbow sight, attach tension spring to the wheels (load approx. 20 kg).

14. Set left front wheel to zero, read camber and enter this figure in measuring chart.

15. Read toe-in of right wheel, set wheel to zero, read camber and enter result.

16. Turn wheel towards left until left wheel is exactly on 20° (correct measuring distance). Read camber of left wheel and enter result (observe clinometer).

17. Read difference angle through right microscope and enter result (correct measuring distance).

18. Set right cross wire to zero (toe-in), read camber and enter result (observe clinometer).

19. Turn wheels towards right until the right wheel is exactly on 20°, read camber of right wheel, read difference angle left, set to zero (toe-in), read camber and enter result (observe measuring distance and clinometer).

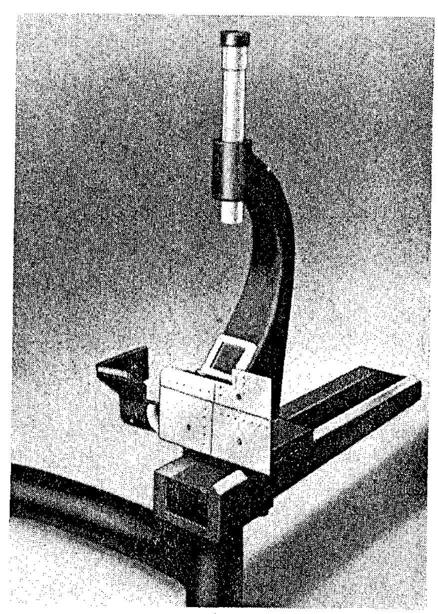


Fig. 9

3 Wh

Measuring Rear Wheels

1. Attach wheel mirror.

2. Position tubular frame so that microscopes are approximately set to centre of wheel axis.

3. Jack up car until the wheel to be aligned can turn freely.

4. Set measuring distance, turn wheel, modify position of mirror by means of the three screws until cross wire does no loger move.

5. Align second rear wheel, proceeding similarly.

6. Lower car, rock and move it to and fro several times.

7. Adjust measuring distance, attach scale trestles with stop angle to measuring scale and set scanners at distance to rim flange.

8. Put scale trestles to front wheels turned in straight-ahead position.

9. Put elbow sight forward and move tubular frame on one side in parallel direction to the longitudinal axis of the car until the same figure appears in the same field of the scale (of the scale trestle) when looking through both microscopes.

10. Check measuring distance and correct distance and position of tubular frame, if necessary.

11. Remove elbow sight, read camber and wheel alignment on both sides, enter results.

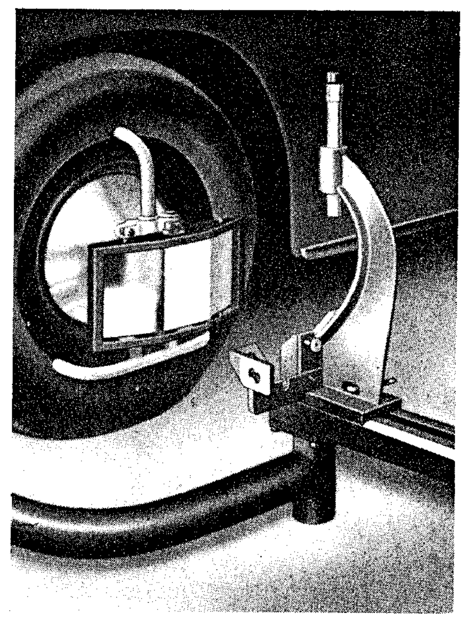


Fig. 10

Stationary Measuring Gauge

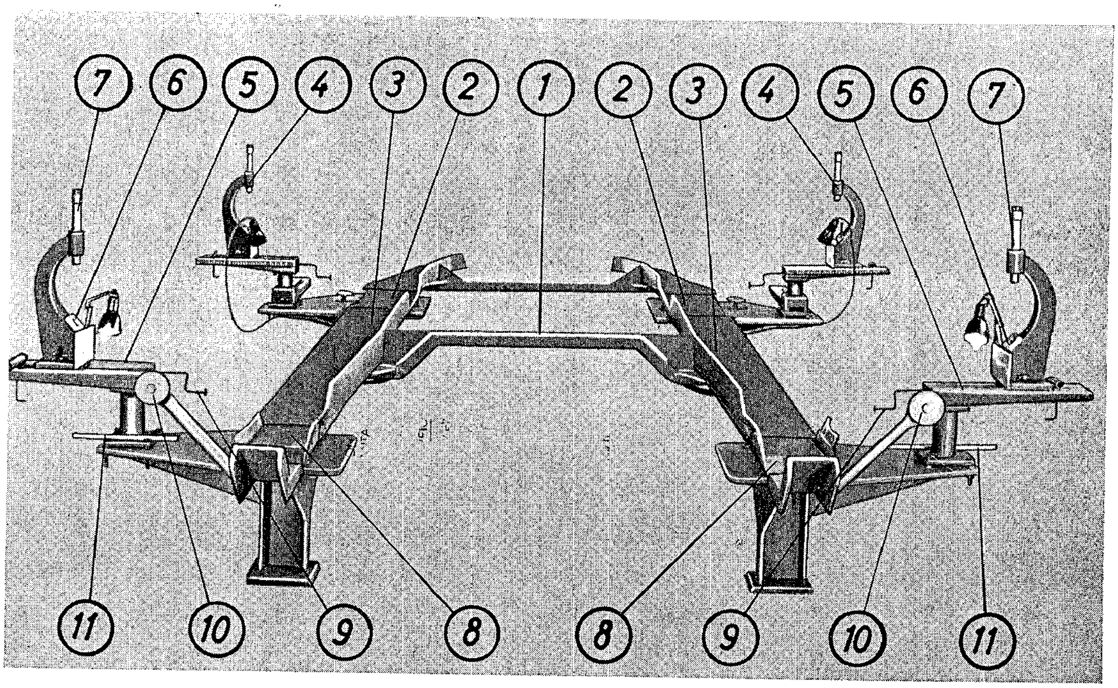


Fig. 11

① Transverse strut
② Rear plate
③ Platform
④ Sliding rear microscope
⑤ Prismatic guide
⑥ Microscope mirror
⑦ Microscope
⑧ Front wheel base
⑨ Scanner
⑩ Reel for weight
⑪ Distance rod

Adjusting Measuring Gauge

4 Wh

1. Check prismatic guide for parallelism and distance.
2. Attach supporting angle for mirror adjusting rod.
3. Place mirror adjusting rod into position.
4. First microscope:
   Set measuring distance, turn mirror adjusting rod, align mirror by means of the three setscrews until the cross wire on the measuring scale does no longer move.

5. Turn wheel mirror round its axis and observe cross wire (max. deviation: Toe-in 5', camber 10').

6. Align cross wire by turning setscrews of the microscope mirror until the vertical hairline points to 0 and the horizontal hairline indicates —10'.

7. Adjust remaining microscopes by proceeding in a similar manner.

Attention:

Take care with adjustable prismatic guides to maintain equal distance on both sides to the fixed prismatic guide.

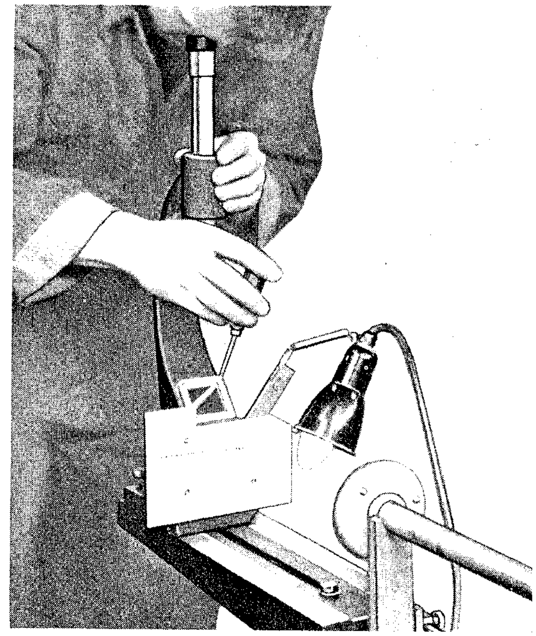


Fig. 12

5 Wh

Measuring Vehicle

1. Set front wheel bases and rear plates to initial position and arrest.

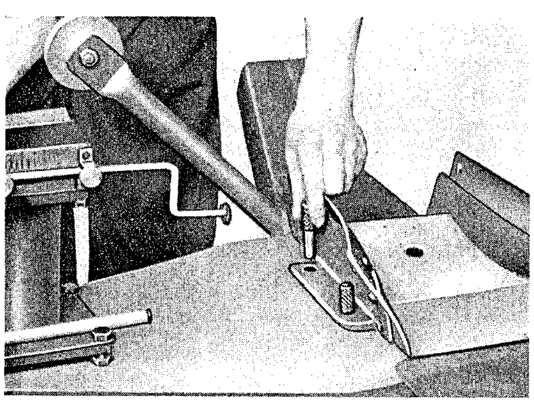


Fig. 13

2. Position vehicle so that front wheels left and right are placed at equal distance to the microscopes.

3. Remove wheel hub cap and attach wheel mirror.

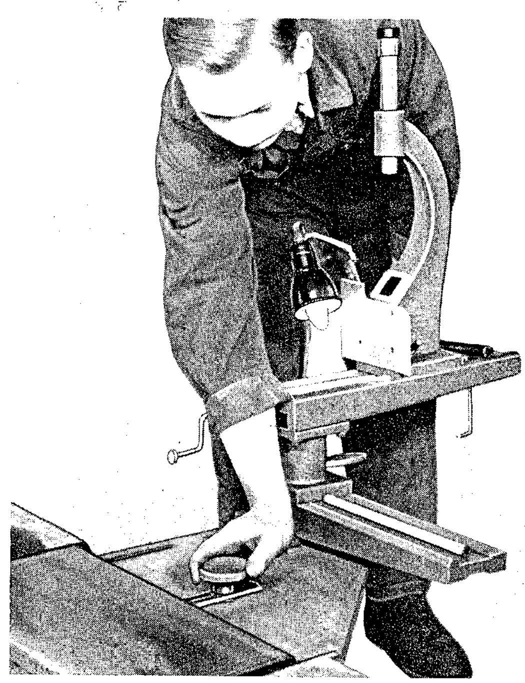


Fig. 14

4. Loosen pin at wheel bases and screws at rear plates, attach tension spring or weights resp. to the front wheels.

5. Move car at the rear to the side until indicators of scanners give the same figure left and right.

6. Adjust measuring distance at the rear wheels with distance rod and read camber and toe-in for each wheel. Enter result into measuring chart.

7. Adjust measuring distance at left front wheel, align wheel to zero, read camber. Enter result.

8. Read toe-in of right front wheel. Enter result. Align wheel to zero, read camber and enter result.

9. Turn wheels to left until left wheel is exactly on 20° (Correct measuring distance). Read camber of left wheel and enter result (Observe clinometer).

10. Read difference angle on right microscope. Enter result (Correct measuring distance).

11. Turn right wheel until vertical line passes through zero, read camber and enter result (Observe clinometer).

12. Turn wheels to right until right wheel is exactly on 20° and read camber right, read difference angle left, set vertical line to zero (20°), read camber and enter all data obtained.

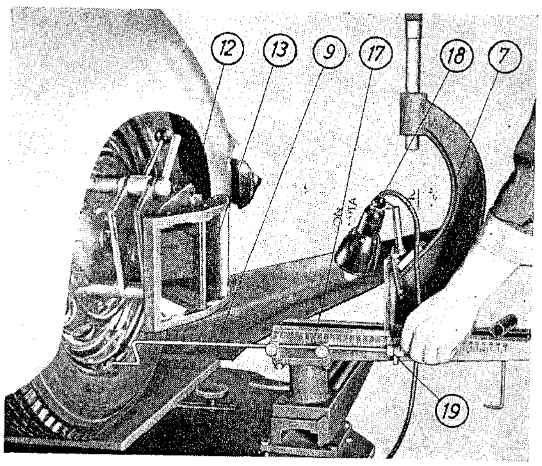


Fig. 15

▲

⑦ Microscope
⑨ Scanner
⑩ Reel for weight
⑪ Distance rod
⑫ Clinometer
⑬ Wheel mirror
⑭ Excentric lever
⑮ Weight
⑯ Yoke
⑰ Scale for scanner
⑱ Scale light
⑲ Indicator for scanner

▶

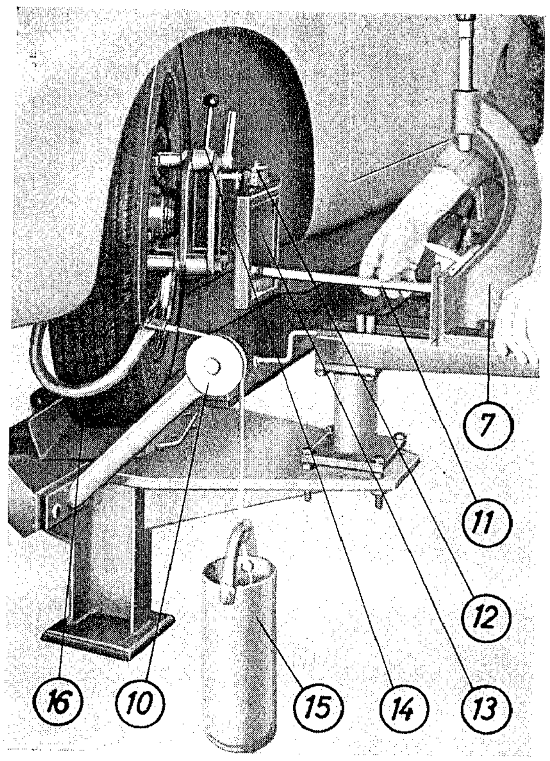


Fig. 16

Measuring Toe-In Variation of Front Wheel During Spring Action

6 Wh

1. Set vertical line to zero on left wheel (with vehicle unloaded), read toe-in right and enter result.

2. Press front part of car downward until stop, set left wheel exactly to zero, read toe-in right and enter result.

7 Wh

Alignment of Toe-In

1. Align vehicle.
2. Adjust steering to pressure point (Mark).
3. Adjust short tie-rod so that left wheel shows + 10' toe-in (pressed).
4. Adjust long tie-rod so that right wheel shows + 10' toe-in (pressed).
5. Check difference angle.

Attention! Misalignment of the difference angle cannot be corrected by adjusting the tie-rods. Errors which do not exceed the tolerance limits as specified in the measuring chart have to be put up with. If difference angle errors are severe, this will be caused by deformations on the steering arm at the stub axle, tie rods, stub axles or frame.

Alignment Data

(For Porsche Type 356 B, unloaded, weight empty)

	1600/1600 S	1600 S–90	
Tire Dimensions	5,60–15 Sport (165–15 upon request)	165–15	5.90–15 Super Sport (upon special request only)
Tire Pressure, (Approx. data) front:	normal driving (country roads) (1,3 atü) 18,46 psi	normal driving (country roads) (1,6 atü) 22,8 psi	normal driving (country roads) (1,2 atü) 17,3 psi
	high-speed (Highway) (1,5 atü) 21,3 psi	high-speed (Highway) (1,8 atü) 25,6 psi	high-speed (Highway) (1,4 atü) 19,9 psi
rear:	normal driving (country roads) (1,6 atü) 22,8 psi	normal driving (country roads) (1,8 atü) 25,6 psi	normal driving (country roads) (1,5 atü) 21,3 psi
	high-speed (Highway) (1,8 atü) 25,6 psi	high-speed (Highway) (2,0 atü) 28,4 psi	high-speed (Highway) (1,7 atü) 24,2 psi

Difference angle, each side 3° 10' ± 20'

(Based on an angle of 20° for wheel on the inside of the curve).
The amount of toe-in must be added to the measured angle to arrive at the nominal difference angle value.

Toe-in of Front Wheels (pressed)

.0394" to .118", 1 to 3 mm (5' to 25') for each wheel pressed approx. + 10'

Camber of Front Wheels

(in straight-ahead position) 0° 40' ± 30'
Values should be equal for both sides

Caster

Values should be equal on both sides 5° ± 30'

Camber of Rear Wheels

Values must be equal for both sides + 10' to + 1° 30'

Toe-in of Rear Wheels .00 to .059" (0 to 1,5 mm) (0° ± 10')

SUMMARY OF TOLERANCES

TO

GROUP W

SAMPLE MEASURING CHART

General

In order to ensure a reliable analysis of the records obtained, the measuring chart specifies tolerance limits which should not be exceeded. Thus it will be possible to ascertain at a glance where modifications are required. The new measuring chart will in addition include columns where corrections should be entered.

Name:

Car: PORSCHE TYPE 356, 356A, 356B, Empty weight:

Chassis No.:

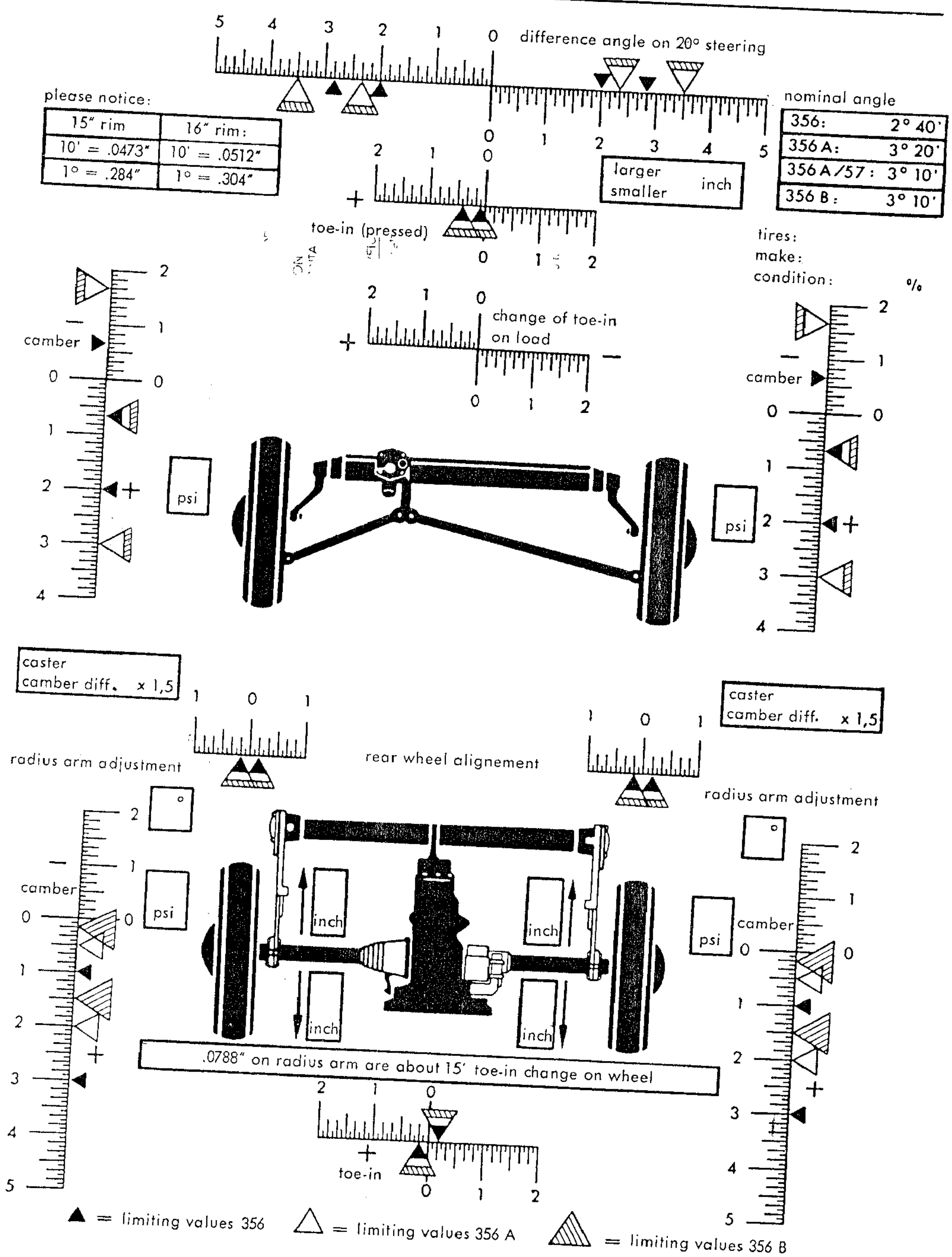
Number plate:

miles:

Date:

measured by:

EXACTA-MEASURING CHART



Determining Difference Angle

The location of the steering gear of the Type 356 B is determined by a dowel pin. It is not possible to correct the difference angle. In case of severe faults, all parts of the front axle must be checked.

Rear Wheel Alignment

General

The toe-in of the rear wheels varies during spring action.

To ensure minimum tire-wear, the total toe-in of the rear wheels during driving should be approximately zero (0).

Minimum toe-in increases driving stability. The alignment value of the rear wheel may be corrected by adjusting the wheel.

Offsetting the radium arm towards front by .0433" (1,1 mm) will result in a toe-in variation of .0394" (1 mm).

9 Wh

Aligning Rear Wheels on Measuring Gauge

1. Loosen screws on bearing flange of axle tube and stop screw (See fig. 17).
2. Move axle tube until aligning data is reached (observe with microscope).
3. Tighten stop screw, tighten screws on bearing flange.

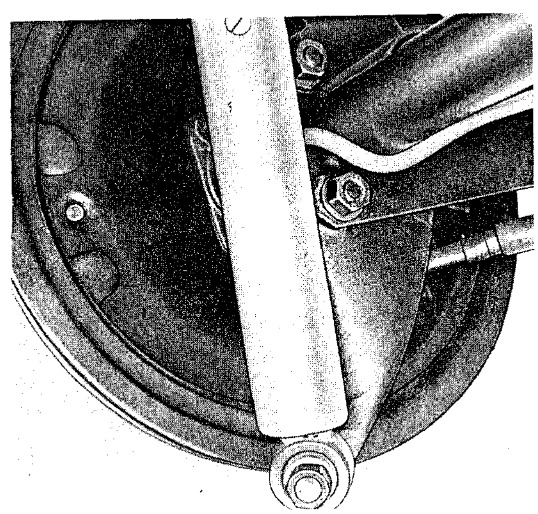


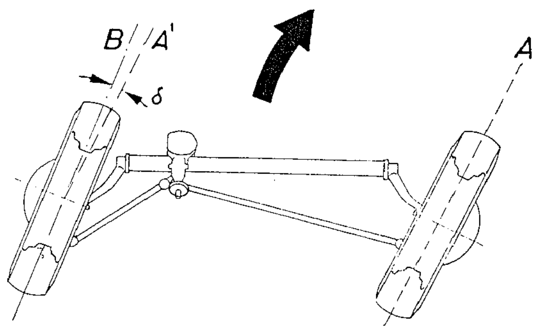
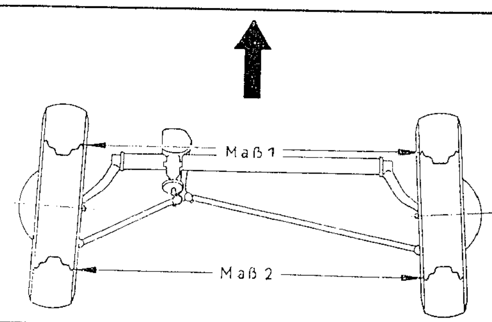
Fig. 17

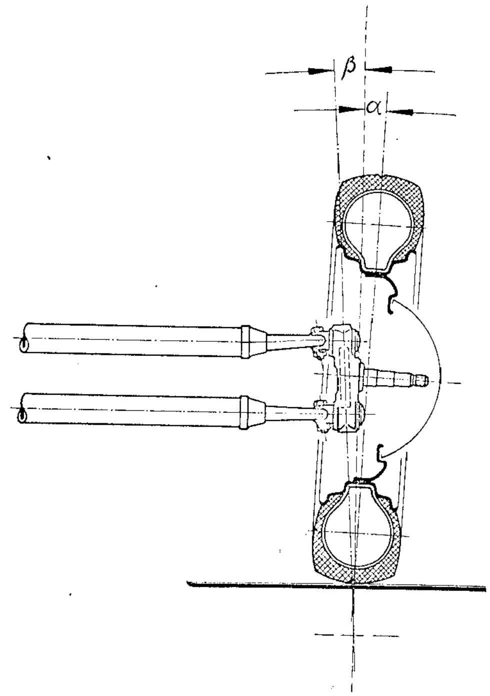
Camber of Rear Wheels

The camber adjustment of an unloaded car depends on the setting of the radius arms. Care should be taken that equal adjustment on both sides is obtained.

Alignment Data and Tolerances

(Type 356 B, Vehicle unloaded, Weight empty)

Description	Nominal Alignment Value	Alignment	
Difference angle, each side Wheel on inside of curve set to 20° A' parallel to A δ Difference angle	3° 10'	± 20'	
Toe-in of front wheels Dimension 2 > dimension 1	2 mm .0788"	± 1 mm ± .0394"	
Toe-in of rear wheels	.00" 0 mm (0°)	± .059" ± 1,5 mm (± 10')	
Caster Caster displacement is constant. Caster angle will be obtained from the camber difference of the front wheels between steering movement to the left and right.	5°	± 30'	

Description	Nominal Alignment Value	Tolerance	
Camber of front wheels (straight-ahead position) Angle α = camber angle Inclination Angle β = inclination angle	$0^\circ\ 40'$ $4^\circ\ 30'$	$\pm 30'$ —	
Camber of rear wheels	$+ 45'$	$\pm 35'$	—

SECTION INDEX

Group T: Brakes, Wheels and Tires

DESCRIPTION OF HYDRAULIC BRAKES

General

The function of the hydraulic brake is based on Pascal's law, which says: Pressure applied to a given area of a fluid enclosed in a vessel is transmitted undiminished to every equal area of the vessel.

In order to make use of the displacement of weight occuring during braking action, the front wheels of the car are equipped with Duplex brakes, while the rear wheels feature Simplex brakes.

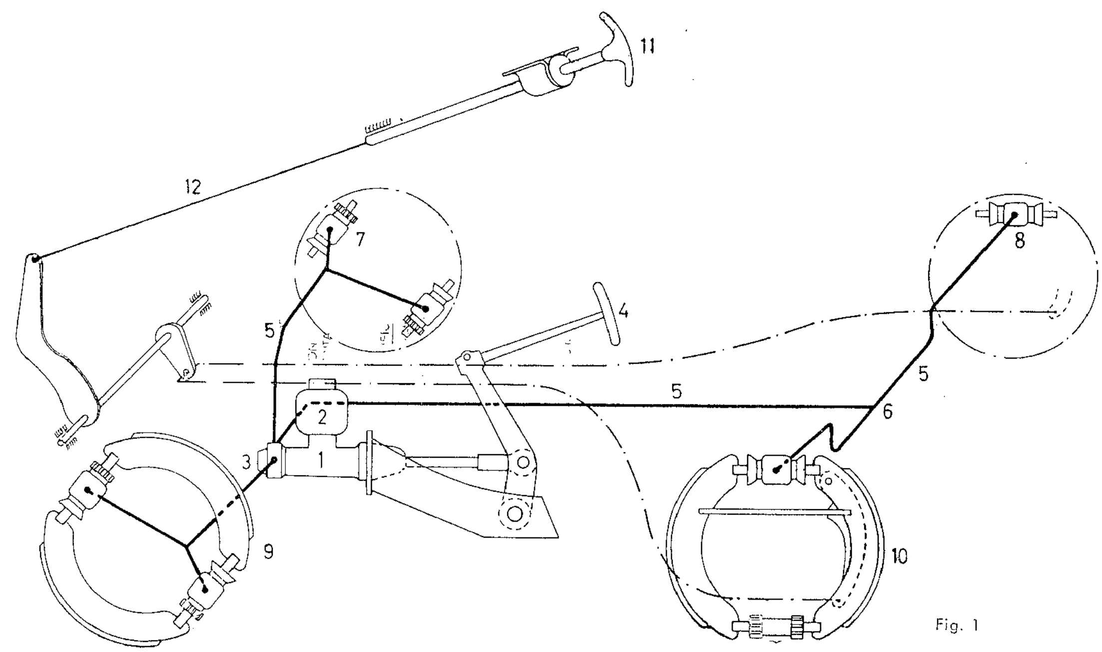


Fig. 1

Schematic Drawing of Brake System

1 Master cylinder
2 Fluid reservoir
3 Stop light switch
4 Brake pedal
5 Brake line
6 Distributor
7 Single-action front wheel brake cylinder
8 Double-action rear wheel brake cylinder
9 Front wheel brake
10 Rear wheel brake
11 Parking brake handle
12 Parking brake cable

The brake system consists of:

Master cylinder where hydraulic pressure is produced.

Wheel brake cylinder acts directly against the brake shoes, forcing them against the drums.

Fluid reservoir maintains constant volume of brake fluid.

Hydraulic lines distribute fluid from master cylinder to wheel brake cylinders. Flexible hoses are employed from brake lines to moving parts.

The master cylinder and each of the 4 front wheel brake cylinders are equipped with one operating piston and the rear wheel brake cylinders with two opposed pistons. All pistons are protected against pressure and fluid loss by rubber pressure seals, rubber caps are provided to keep out dirt.

Operation

When the brake pedal is depressed, the brake push rod activates the piston in the master cylinder. The movement of the piston introduces equal pressure into all brake lines and subsequently activates pistons in the wheel brake cylinders, moving them outward, whereupon the piston rod forces the brake shoes against the brake drum.

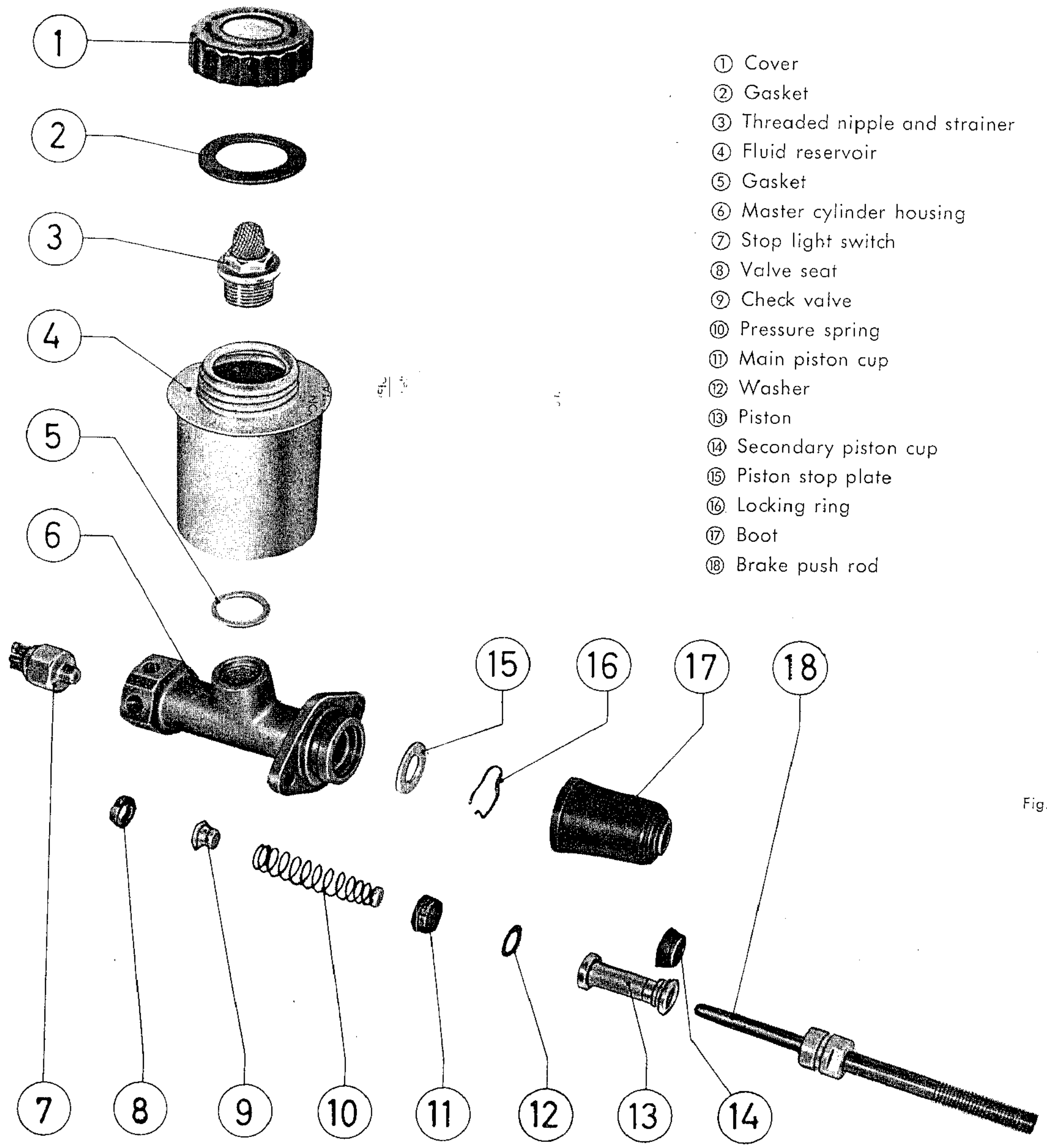
The contact pressure of the brake shoes onto the brake drums is increased by the action of the advancing brake shoes. The transverse support of the brake shoes at the readjusting screws ensures an even wear of the brake linings.

As the pressure on the brake pedal is increased, the contact pressure of the brake shoes exerted onto the brake drums rises. Returning of the brake shoes to their initial position is effected by the return springs which are attached at an oblique angle, at the same time forcing the pistons of the wheel brake cylinders to return to their initial position.

MASTER CYLINDER

General

The piston in the master cylinder is connected to the brake pedal by the actuating rod. When depressing the brake pedal, the pressure applied to the brake fluid through the piston is equally transmitted to the pistons of the wheel brake cylinders.



① Cover
② Gasket
③ Threaded nipple and strainer
④ Fluid reservoir
⑤ Gasket
⑥ Master cylinder housing
⑦ Stop light switch
⑧ Valve seat
⑨ Check valve
⑩ Pressure spring
⑪ Main piston cup
⑫ Washer
⑬ Piston
⑭ Secondary piston cup
⑮ Piston stop plate
⑯ Locking ring
⑰ Boot
⑱ Brake push rod

Fig. 2

Fluid reservoir

Make sure the vent hole in the cover is always clear to allow the brake fluid to flow into the master cylinder (be careful when painting).
When filling the reservoir, take care that the cover is absolutely clean to avoid dirt entering the brake system. There must always be sufficient fluid in the reservoir. Replenish brake fluid to $^5/_8$" to $^3/_4$" (15–20 mm) below upper edge of the fluid reservoir.

Attention!

Only use genuine Ate brake fluid or Pentosin-Superfluid for refilling, on no account should mineral oils be used for this purpose.
When bleeding the brake system or when replenishing, be careful to prevent brake fluid from getting into contact with the body finish. Even the tiniest drops of brake fluid will damage the paintwork (decomposing effect!).

Brake Fluid Compensation

The brake fluid in the master cylinder, the brake lines, and the wheel brake cylinders is subjected to external and internal influences which may cause variations in the amount of fluid. Temperature changes cause contraction or expansion of the liquid in the system. This has the effect of either increasing or decreasing the amount of volume in the brake system, which must then be compensated for correspondingly.

Bypass port

For brake fluid compensation, the master cylinder is provided with an automatic fluid control. Directly in front of the main piston cup is a by-pass port in the cylinder wall which compensates for expansion and contraction by allowing the excess fluid to flow into or out of the reservoir, thus maintaining a constant fluid volume in the system at all times. As it is the task of the by-pass port to maintain the balance in the fluid system, troublefree operation of the brake therefore depends perfect working of the port.

Attention!

The by-pass port must be free when the system is at rest.

The piston push rod must be carefully adjusted at the brake pedal to assure that there is free movement (S) of approx. .04" (1 mm) between the push rod and the piston. Otherwise the main piston cup will not clear the by-pass port.

The required clearance will be obtained by adjusting the actuating rod (see fig. 3).

Obstruction of the by-pass port by foreign matter or by the main piston cup, due to incorrect pedal adjustment, results in pressure built up in the system, causing all brakes to drag (stop light does not go out).

a = approx. 5.2" (130 mm)

s = .04" (1 mm)

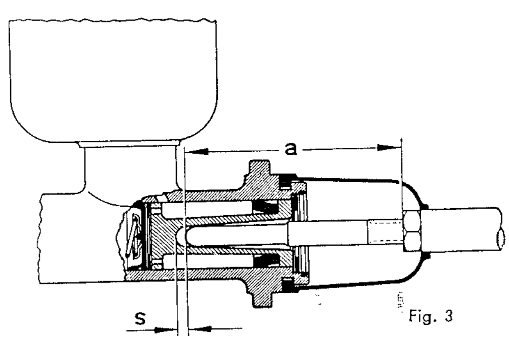


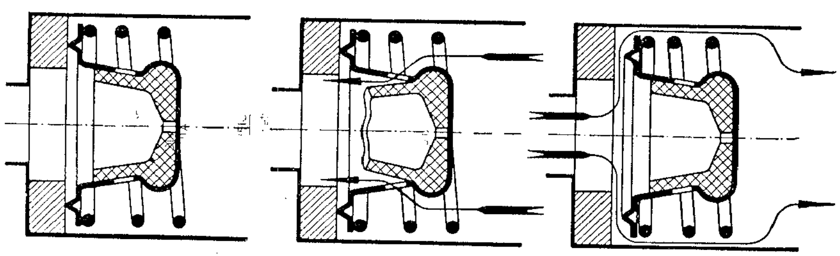
Fig. 3

Check Valve

A further part of the automatically balancing master cylinder is the double-action check valve, which serves to control the fluid and pressure balance as specified. If there is a vacuum in the system, the small inner valve (valve cap) responds even to very small variations and allows the required amount of fluid to flow from the fluid reservoir via the by-pass port and the cylinder pressure chamber into the system (see fig. 4 b).

Vice versa, if the pressure in the brake system is too high, the check valve is lifted from its seat, so that the excessive fluid may flow into the reservoir (see fig. 4 c).

If the brake pedal is depressed, the fluid reaches the lines by movement of the master cylinder piston via the check valve, when the brake pedal is released, the fluid returns. The check valve is loaded by a pressure spring, which gives the fluid system some preload. This ensures that the system remains completely filled and that the pressure applied to the brake pedal is transmitted to the braking elements without lost motion.



a) Position at rest b) Position with brake pedal depressed c) Position with brake pedal released

Fig. 4

Main Piston Cup

In order to prevent air from being aspirated when releasing the brake pedal, there is an annular space behind the main piston cup at the piston skirt, so that fluid can additionally flow into the system through the bores in the piston via the washer and the main piston cup provided with grooves, if the piston rapidly returns. If therefore a rapid return of the piston causes a vacuum in the master cylinder, this will never permit air to be drawn in, but additional brake fluid will always be supplied from the rear piston space.

Secondary Piston Cup

Sealing of the annular reservoir towards outside is effected by the secondary piston cup. The combined action of by-pass port, doubleaction check valve, and main piston cup will ensure a completely automatic charge control, compensate for any variations and prevent air from entering, which would jeopardize the effectiveness of the brakes.

Attention!

Assembled master and wheel brake cylinders, as well as rubber mouldings (cups, dust boots, check valves, etc.) and brake hoses must be stored cool and dry and should be protected from dust. If brake parts of rubber are stored for too long a period, they may get unserviceable. Make sure, therefore, that assembled master and wheel brake cylinders, which have been in storage for more than 6 months, are disassembled, cleaned and checkd prior to installation. Rubber mouldings should not be stored for more than 12 months, brake hoses are limited to 18 months' storage time.

Important!

When exchanging a master cylinder, care should be taken to ensure that the inner cyl. master is .75" (19.05 mm).

1 Ti

Removing and Installing Master Cylinder

Removal

1. Jack up car.

2. Open front hood, take out spare wheel an tools.

3. Fold rubber mat (except in Roadster) sideways and unscrew cover to steering gear.

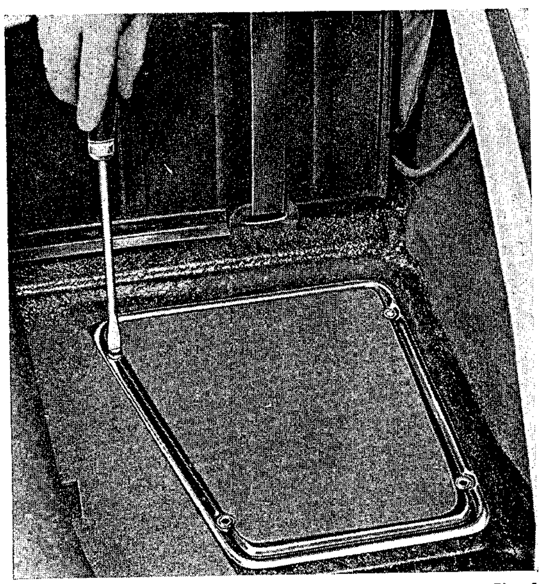


Fig. 5

4. Disconnect cable on stop light switch.

5. Unscrew brake lines from master cylinder and plug openings (with bleeder dust caps).

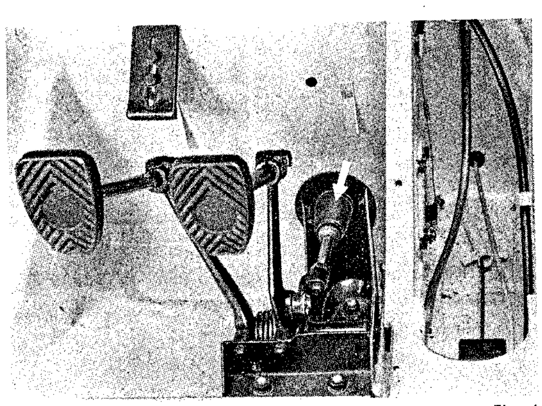


Fig. 6

6. Take rubber mat out of car remove floor board at pedal side.

7. Pull protective cap from master cylinder. (see fig. 6)

8. Undo retaining screws of master cylinder and remove master cylinder.

Installation

The master cylinder is installed in reverse order, observing the following points:

1. When placing the master cylinder into position, the brake push rod must be inserted correctly right from the beginning. Moreover, the master cylinder flange should be sealed with sealing compound, in order to avoid water entering the car inside.

2. Adjust clearance between brake push rod and piston in master cylinder, after loosening the locknut on the brake push rod. Clearance approx. .04" (1 mm).

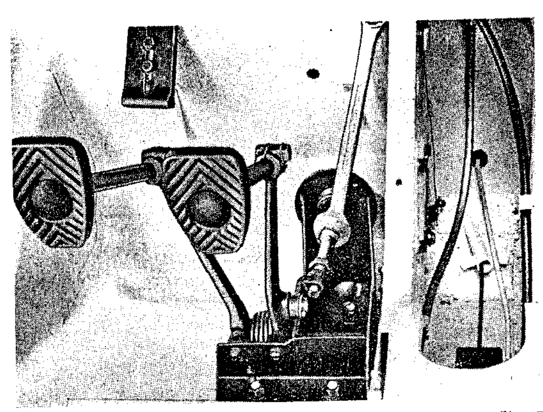


Fig. 7

3. Adjust and bleed brakes (13 Ti). Do not forget bleeder dust caps.

Reconditioning Master Cylinder

① Cover
② Fluid reservoir
③ Strainer
④ Threaded nipple
⑤ Stop light switch
⑥ Master cylinder housing
⑦ Check valve seat
⑧ Check valve
⑨ Piston return spring
⑩ By-pass port
⑪ Main piston cup
⑫ Piston washer
⑬ Intake port
⑭ Piston
⑮ Secondary piston cup
⑯ Piston stop plate
⑰ Lock ring
⑱ Boot
⑲ Push rod

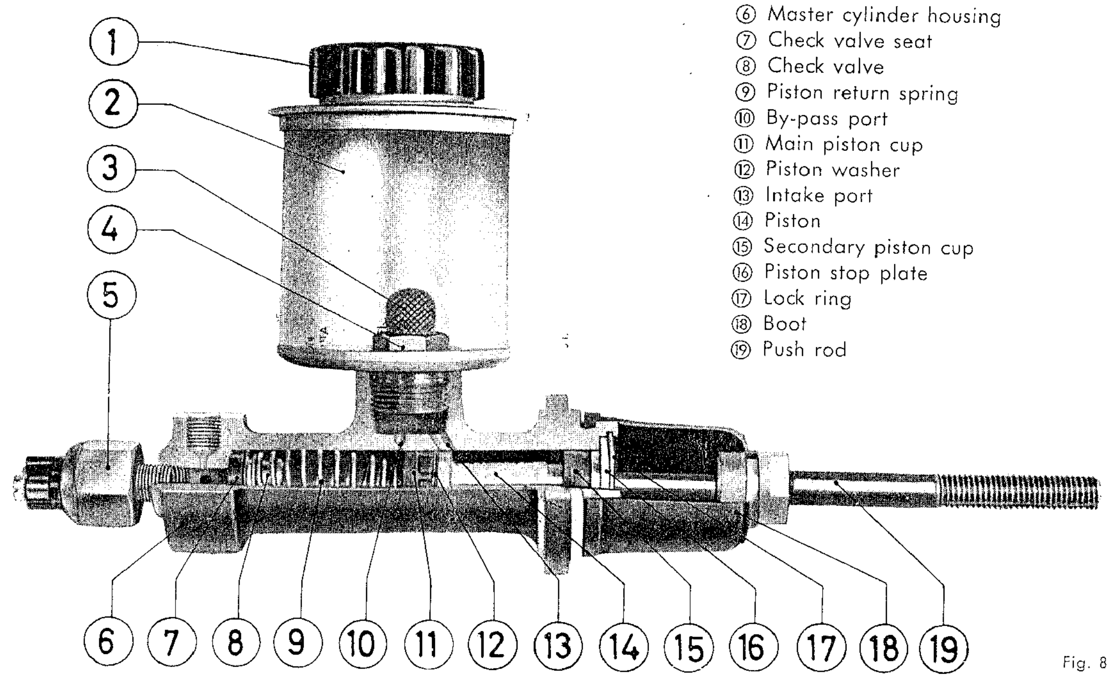


Fig. 8

Master cylinder (sectional view)

Disassembly

1. Empty and remove fluid reservoir.
2. Unscrew stop light switch.
3. Remove spring for stop plate (see fig. 9).
4. Take out stop plate, piston with secondary piston cup.
5. Remove washer, main piston cup, return spring with spring retainer, check valve and valve seat.

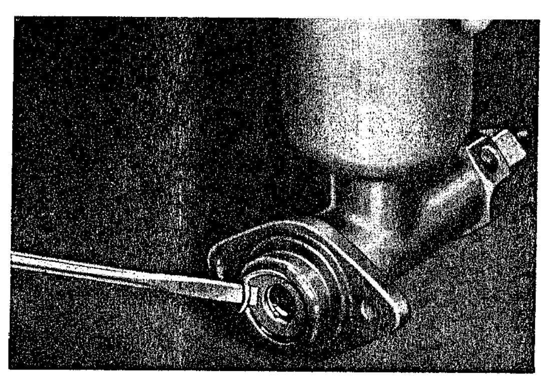


Fig. 9

Assembly

To assemble, proceed in reverse order, observing the following points:

1. Clean all parts, using exclusively spirit or geniune Ate brake fluid. Gasoline (petrol), benzol, glycerin etc. detroy rubber parts.

2. Check all parts for wear and damage. Make sure that the intake and by-pass ports are open and free from burrs. The cleaned and dried piston must move with suction in both directions in the cylinder.

3. It is necessary to replace the two piston cups whenever rebuilding a master cylinder (Note specified diameter of master cylinder, .75" = 19.05 mm).

4. Apply a thin film of genuine Ate brake cylinder paste on piston, cylinder wall and rubber parts.

5. Make sure the lock ring is properly seated.

6. When tightening the reservoir in place, make sure that the mark at the bottom of the reservoir points towards the stop light switch and is in line with the center line of the master cylinder housing.

7. Check for obstructions in the ventilation hole of the fluid reservoir cover.

WHEEL BRAKE CYLINDER

General

The wheel brake cylinders on the brake back plates serve to transmit pressure produced by the master cylinder equally to the brake shoes.

While the front wheel brake features two single-action wheel brake cylinders per wheel (Duplex), the brake pressure in the rear wheel brake is transmitted by a double-action wheel brake cylinder per wheel. Inner diameter of the wheel brake cylinder front and rear ¾" or 19.05 mm.

One end of the front wheel brake cylinder bore is closed. The cylinder body contains a piston, a rubber cup, a return spring and spring seat. In the rear wheel brake cylinder body (which is open on both ends) there are two pistons, two rubber caps and one stop spring with two spring seats. The stop spring (return spring) in conjunction with the spring seat serves to press the piston cups belonging to the respective piston against the cylinder wall. During braking action, the fluid from the master cylinder is pressed into the wheel brake cylinders, thus forcing the rubber cups and pistons outward, each piston bringing the brake shoe connected with it by a plunger to contact the brake drum.

Rubber caps over the plungers and wheel brake cylinder housings prevent dirt and moisture from entering.

When the brakes are released, the spring seats press the return spring together in the cylinder so that no space remains. Thereby the wheel brake cylinder can be perfectly ventilated.

Each wheel brake cylinder has a bleeder valve bore. The bleeder valve opening is situated so that it cannot be blocked by the cups. The function of the bleeder valve is to release air which may have entered the system. When replacing a wheel brake cylinder note the diameter of the cylinder bore (front and rear ¾" or 19.05 mm).

Front Wheel Brake Cylinder

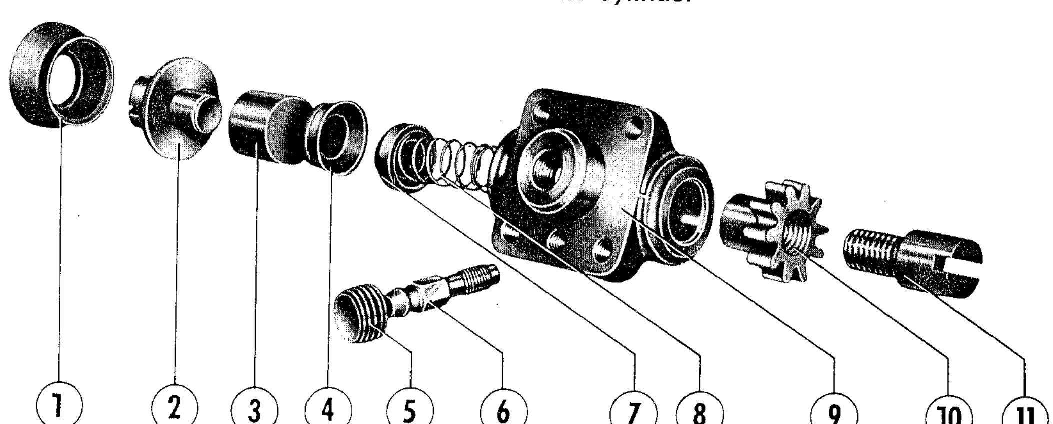


Fig. 10

① Boot
② Plunger
③ Piston
④ Rubber cup
⑤ Dust cap
⑥ Bleeder valve
⑦ Spring seat
⑧ Stop spring
⑨ Wheel brake cylinder housing
⑩ Adjusting nut
⑪ Adjusting screw

Brake Hoses

General

All hydraulic lines are installed directly on the frame. Flexible hoses connect the hydraulic lines with the wheel brake cylinders (see fig. 17 and 18).
When mounting hydraulic lines and hoses, care must be taken to avoid twisting; sharp bends at the connecting points must be avoided. All hoses must be installed so that no wear or damage can occur during springing action and steering movement. The hoses should be of sufficient length to avoid being stretched during normal movement of the wheels. The hoses must on no account chafe on the chassis or body parts. They must not be painted or come into contact with gasoline, kerosene or mineral oils. Chafed, cracked or swollen brake hoses must be replaced by new ones.

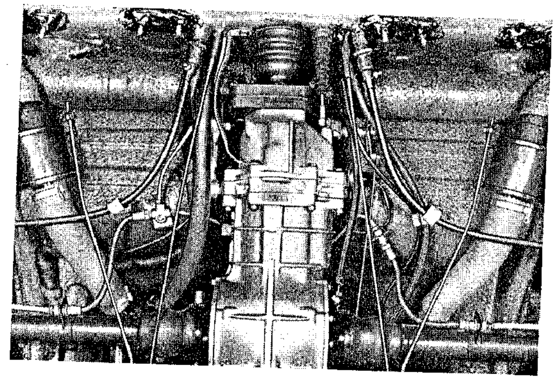


Fig. 17

Attention!

After any work on the hydraulic system involving replacement of brake hoses and pipe lines, the brake system must be bled and checked for leaks. If necessary, replenish Ate brake fluid.

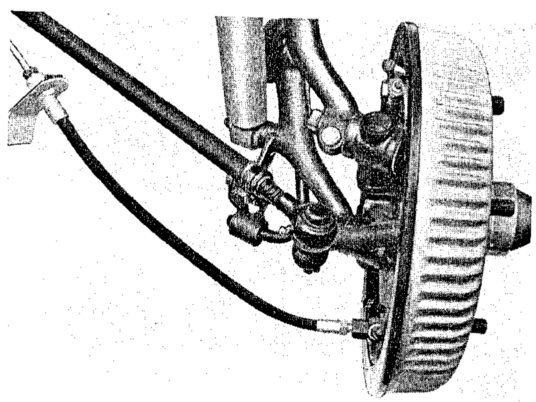


Fig. 18

Replacing Brake Hose

6 Ti

1. Separate brake line from hose by loosening union nut.
2. Remove clamp spring of hose bracket and pull out brake hose.
3. Unscrew brake hose at the other end.
   Replace brake hose at the wheel brake cylinder, front, and at the distributor, rear, or union respectively.

Installation

Installation is done in reverse order, observing the following details:

1. Install brake hose correctly, avoid twisting.
2. Check for correct position of hose at all wheel positions.
3. Bleed brake. Remember dust cap at bleeder valves! (13 Ti).

Rear Wheel Brake Cylinder

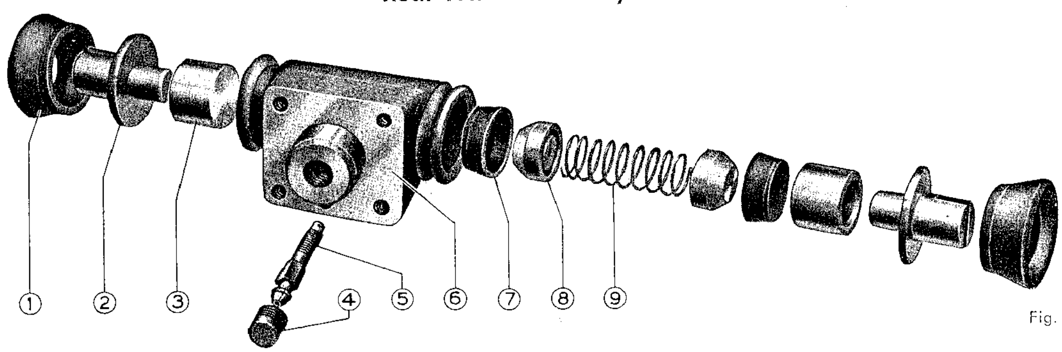


Fig. 11

① Boot
② Plunger
③ Piston
④ Dust cap
⑤ Bleeder valve
⑥ Wheel brake cyl. housing
⑦ Rubber cup
⑧ Spring seat
⑨ Stop spring

3 Ti

Removing and Installing Front Wheel Brake Cylinder

Special tools: P 30, P 47

Removal

1. Jack up car, remove front wheel.
2. Remove brake drum (2 St).
3. Remove return springs, spring retainers, dowel pins and springs of brake shoes, remove brake shoes.
4. Clamp tool P 47 over plunger and adjusting screw of the wheel brake cylinder which is not exchanged.

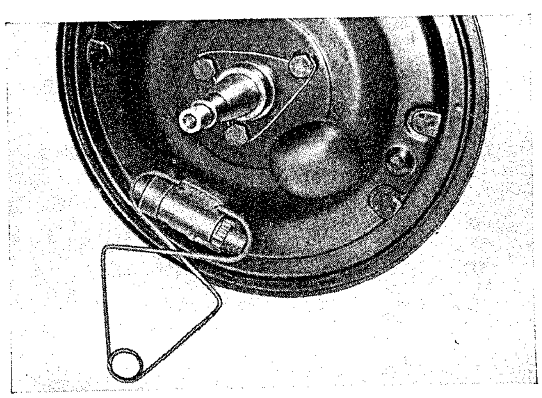


Fig. 12

5. Remove brake hose (6 Ti). Can be omitted for removal of upper wheel brake cylinder.
6. Loosen screwed connection of connecting line. Unscrew wheel brake cylinder.

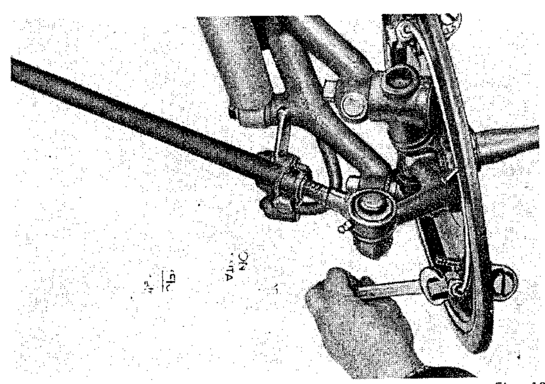


Fig. 13

Installation

The wheel brake cylinder is installed in reverse order, observing the following details:

1. Care must be taken to install the wheel brake cylinders in correct position, which means that the piston side must show in direction of the wheels driving forward. (When replacing, take care to use the correct size.)
2. The brake shoe must be installed so that the notch in the web faces the piston side of the wheel brake cylinder.
3. Refer to special instructions on repair work at the brake system (Page T 17).
4. Before installing brake drum, check oil seal and conical roller bearing for perefect condition.
5. Clean brake drum hub and bearing and pack with multi-purpose grease (approx. 1¾ ozs., see Lubrication Chart, Group S).
6. Adjust front wheel bearing as prescribed (4 St).
7. Adjust and bleed brakes (13 Ti). Remember dust cap on bleeder valve.

Removing and Installing Rear Wheel Brake Cylinder

Special tools: P 30, P 36, if nec. P 36 a, P 42, P 44 and 44 a

4 Ti

Removal

1. Jack up car, take off rear wheel.

2. Undo castle nut, pull off brake drum.

3. Remove both lower return springs, pressure springs with spring retainers and dowel pins of brake shoes.

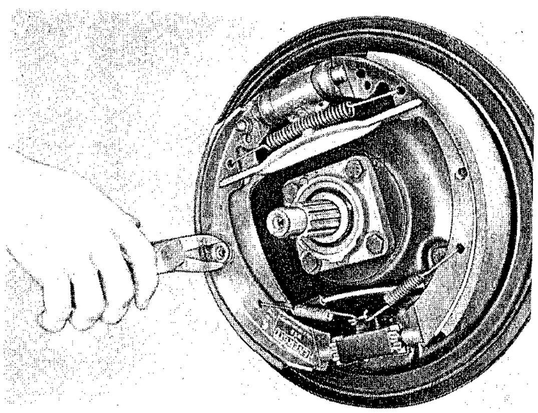


Fig. 14

4. Remove brake shoes with parking brake actuating lever, push rod and upper return spring and unhook parking brake cable.

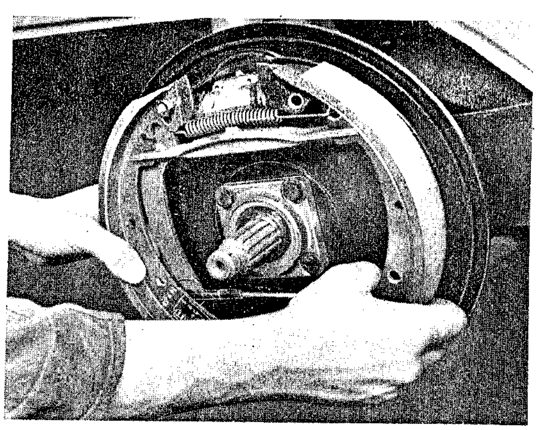


Fig. 15

5. Unscrew brake line and plug with bleeder dust cap.

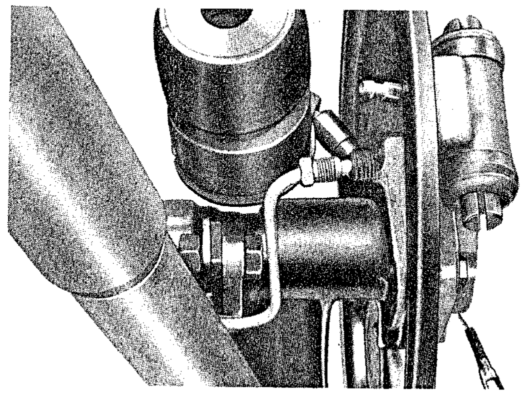


Fig. 16

6. Remove retaining screws of wheel brake cylinder and remove wheel brake cylinder.

Installation

The wheel brake cylinder is installed in reverse order, observing the following points:

1. When replacing a wheel brake cylinder by a new one, take care to use the required size.

2. The notch in the web of each brake shoe points towards the wheel brake cylinder.

3. Refer to special instructions when doing repair work on the brake system (page T 17).

4. Install parking brake actuating lever and pressure rod in correct position.

5. Tighten castle nut for axle shaft with 50–55 mkg (360–370 lbs. ft.).

6. Adjust foot and parking brake. Bleed brake (13 Ti). Remember dust cap on bleeder valve.

5 Ti

Reconditioning Wheel Brake Cylinder

Disassembly

1. Remove boots.

2. Take out plungers, pistons, piston cups, spring seats and stop spring.

3. Unscrew bleeder valve.

Assembly

The wheel brake cylinder is installed in reverse order, observing the following points:

1. Use only spirit or brake fluid to clean all parts.

2. Check all parts for wear and damage. Replace worn parts.

3. The cleaned and dried pistons must move easily in the wheel brake cylinder in both directions. (Clearance between cylinder bore and piston max. .0102" = 0.26 mm.)

4. Prior to assembly, the pistons, cylinder wall and piston cup should be coated with a very thin film of genuine Ate brake cylinder paste.

WHEEL BRAKES

General

The front and rear wheel brake assemblies are shown in the following illustrations.

The rear wheel brake differs from the front wheel brake in that a parking brake actuating lever and cable are connected to the secondary brake shoe. A pressure rod is installed between the two brake shoes and the shoes are activated by one double acting cylinder, whereas on both front wheels a single acting cylinder activates each brake shoe.

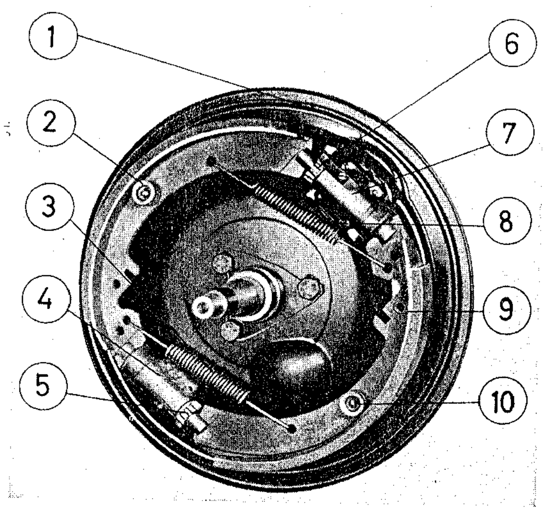
The brake shoes rest freely in the slots of the plungers and adjusting screws.

Constant contact of the shoes with the back plate is assured by two pressure springs which are anchored by dowel pins and collars. When the brake is released, the shoes are free from contact with the drums by return springs.

Adjusting screws and nuts allow adjustment of the brake shoes.

Front Wheel Brake

1. Brake back plate
2. Pressure spring with collar
3. Return spring
4. Lower brake cylinder
5. Lower adjusting nut
6. Upper adjusting nut
7. Upper brake cylinder
8. Return spring
9. Brake shoe with lining
10. Pressure spring with collar

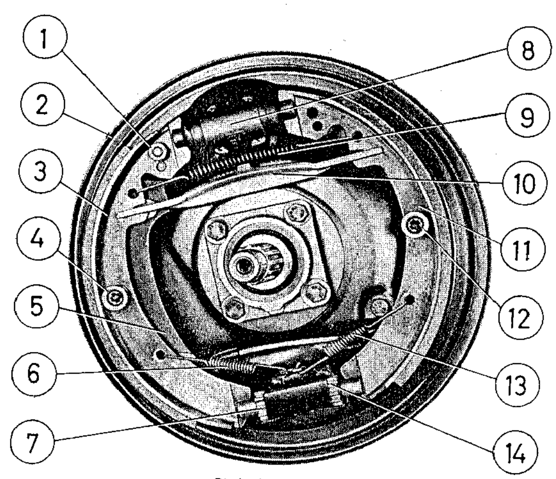


Right-hand side

Fig. 22

Rear Wheel Brake

1. Pivot bolt for parking brake actuating lever
2. Brake back plate
3. Secondary brake shoe
4. Pressure spring with collar
5. Parking brake cable
6. Return spring
7. Adjusting nut
8. Brake cylinder
9. Return spring
10. Pressure rod
11. Primary brake shoe
12. Pressure spring with collar
13. Return spring
14. Adjusting nut



Right-hand side

Fig. 23

7 Ti

Replacing Front Brake Shoes

Special tools: P 30, P 47

Removal

1. Jack up car, remove front wheel.
2. Remove brake drum (2 St).
3. Remove return springs, pressure springs with collars and dowel pins of brake shoes.
4. Remove brake shoes.

If dismounting takes some time, push clamp (P 47) over plungers of wheel brake cylinder, in order to prevent and piston cup from jumping out (see fig. 12).

Installation

The brake shoes are installed in reverse order, observing the following points:

1. Refer to special instructions on repair work on the brake system (page T 17).
2. Install brake shoes in correct position. The notch in the web points towards the piston side of the wheel brake cylinder.
3. Correctly attach return springs (see fig. 22).
4. Prior to assembly of brake drum check oil seal and conical roller bearing for proper condition.
5. Clean hub in brake drum and conical roller bearing and fill with approx. 3,05 cu. in. (50 c.c.) of multipurpose grease (see Lubrication Chart, Group S).
6. Adjust front wheel bearings acc. to instructions (4 St).
7. Adjust brake and check effectiveness of entire brake system.

8 Ti

Replacing Rear Brake Shoes

Special tools: P 30, P 36, if nec. P 36 a, P 42, P 44 and 44 a, P 47

Removal

1. Jack up car, remove rear wheel.
2. Loosen castle nut, pull off brake drum.
3. Remove both lower return springs, pressure springs with collars and dowel pins of brake shoes.
4. Remove brake shoes with parking brake actuating lever, pressure rod and upper return spring, detach parking brake cable.

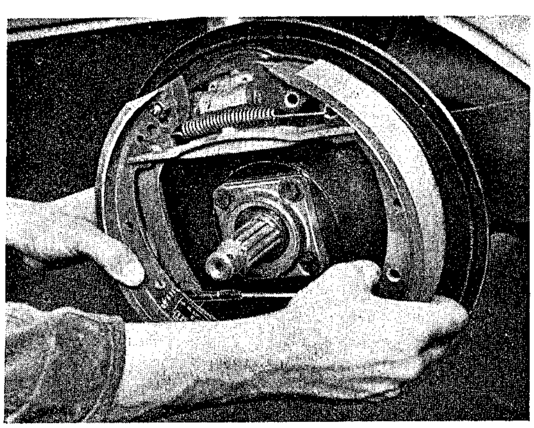


Fig. 24

5. Unhook upper return spring on brake shoes and remove parking brake actuating lever by loosening pivot bolt from brake shoe.

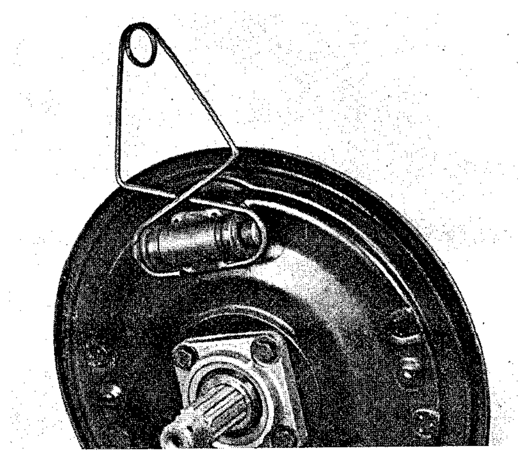


Fig. 25

If dismounting of the brake system takes some time, push clamp (P 47) over plungers of wheel brake cylinder, in order to prevent piston and piston cup from jumping out (see fig. 25).

Installation

The brake shoes are installed in reverse order, observing the following points:

1. Refer to special instructions on repair work on the brake system (page T 17).
2. Install brake shoes with parking brake actuating lever and pressure rod in correct position.
3. Correctly attach return springs (see fig. 23).
4. Tighten rear axle nut with 360–370 lbs.ft. (50–55 mkg) and secure with cotter pins.
5. Adjust foot and parking brake. Check entire brake system for perfect effectiveness.

Special Notes on Repair Work on the Brake System

1. Brake shoes cannot be relined with the commercial means available in service stations, since the brake linings are bonded acc. to a special method. When replacing brake shoes, use only complete brake shoes and linings.
   Replacement brake shoes are available: With normal linings of .28" (7 mm) thickness, for a brake drum inner diameter of 11.024" to 11.062" (280 to 281 mm); with oversize brake linings of .30" (7,5 mm) thickness, for a brake drum inner diameter of 11.062" 281 to 282 mm).
2. Care should be taken to ensure that one vehicle is equipped with 8 brake shoes and brake linings of identical design and material and that they meet the factory specifications.
3. A temporary deviation is only permitted, if there is a difference between both front wheel brakes and both rear wheel brakes. Discrepancies regarding the right and left front wheel brake or the right and left rear wheel brake are not allowed.
4. The brake drums of two opposing wheels should have equal inner diameters. Differences are limitted to 0.2 mm.
5. When doing work on the brake system avoid the brake linings and the braking surfaces in the brake drums getting into contact with oil or grease.
6. In order to obtain optimum effectiveness of new brake shoes, it is recommended to mark the lining surface with dry chalk (no oil chalk) and to refinish the brake lining according to the surface appearance obtained. When doing this, be careful not to remove more than 0.3 mm from the surface of the new brake lining.

Removing and Installing Front Brake Back Plate

9 Ti

Special tool: P 30

Removal

1. Jack up car, remove front wheel.
2. Remove brake drum (2 St).
3. Remove brake shoes and return springs, pressure springs, collars and dowel pins.
4. Loosen brake hose on wheel brake cylinder.
5. Remove securing wire on retaining bolts and unscrew brake back plate.
6. Remove brake back plate and separate it entirely from the brake hose by turning it.
7. Unscrew wheel brake cylinder and connecting line from brake back plate.

Installation

The brake back plate is installed in reverse order, observing the following points:

1. Tighten wheel brake cylinder in correct position, the piston side points towards sense of wheel rotation when driving forward.
2. Clean contact surfaces of stub axle and brake back plate.
3. Check brake back plate for proper condition (deformation and collision).

4. Tighten retaining bolts for brake back plate, using a torque wrench:
   Bolts of grade 8 G with 29 to 32,5 ft.lb. (4 to 4,5 mkg)
   Bolts of grade 10 G with 40 to 43,5 ft.lb. (5,5 to 6 mkg)

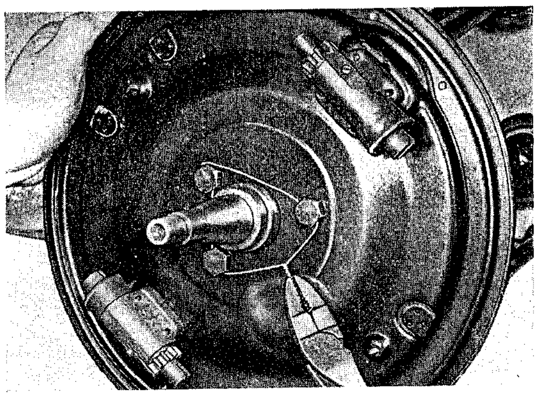


Fig. 26

5. Secure retaining bolts with wire so as to prevent back plate bolts from getting loose (see fig. 26).

6. Install brake shoes and return spring in correct position (see fig. 22).

7. Prior to installing brake drum, check conical roller bearing and oil seal for proper condition.

8. Clean hub in brake drum and conical roller bearing and pack with approx. 3,05 cu.in. (50 c.c.) multi-purpose grease (see Lubrication Chart, group S).

9. Adjust front wheel bearing acc. to instructions (4 St).

10. Adjust and bleed brake (13 Ti). Remember dust caps on bleeder valves.

10 Ti

Removing and Installing Rear Brake Back Plate

Special Tools: P 30, P 36, if nec. P 36a, P 42, P 44 and 44a

Removal

1. Jack up car, remove rear wheel.
2. Loosen castle nut and pull off brake drum.
3. Remove spring collar, pressure springs and dowel pins, return springs, brake shoes with parking brake actuating lever and pressure rod.
4. Unscrew bracket for brake cable on brake back plate.

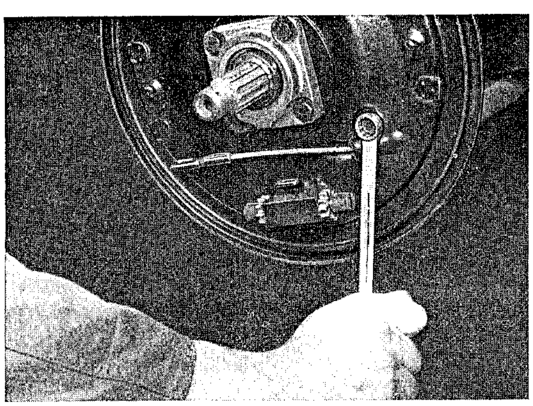


Fig. 27

5. Unscrew brake line from wheel brake cylinder.
6. Loosen brake back plate retaining bolts and take off brake back plate. Remount bearing cap provisionally, so that gear oil cannot escape.
7. Remove wheel brake cylinder and adjusting screws.

Installation

The brake back plate is installed in reverse order, observing the following points:

1. Clean contact surfaces between brake back plate, bearing flange and cover and check for damage.

2. Tighten wheel brake cylinder. Check easy movement of adjusting screws and grease.
   Check whether leaf springs for adjusting nut have sufficient load and insert adjusting nuts with screws. Replace weak leaf springs.

3. Prior to placing the bearing cap for the rear wheel bearing into position, check the appertaining oil seal for exact seat and proper condition.
   The rubber seals for the rear axle bearing should be replaced by new ones whenever effecting disassemblies. Check spacer and cover plate for proper conditions, if necessary replace.

4. Install brake back plate. Make sure that rubber seals are correctly seated and are not jammed. Tighten retaining bolts of brake back plate by means of torque wrench:
   Bolts of grade 8 G with 29 to 32,5 ft. lb. (4 to 4,5 mkg),
   Bolts of grade 10 G with 40 to 43,5 ft. lb. (5,5 to 6 mkg).

5. Install brake shoes with parking brake actuating lever and pressure rod in correct position.

6. Correctly attach return springs (see fig. 23).

7. Tighten rear axle nut with 360–370 lbs. ft. (50 to 55 mkg) and secure with cotter pins.

8. Adjust foot and parking brake. Bleed brake system (13 Ti). Do not forget dust cap on bleeder valve.

Removing and Installing Parking Brake Cables

11 Ti

Special tools: P 30, P 36, if nec. P 36a, P 42, P44 and 44a, P 47

General

The parking brake acts mechanically on the rear wheels. The power applied to the parking brake is transmitted via the front hand brake cable on to a bell crank, from there via the central hand brake cable, which is connected with 2 additional brake cables by a cable coupling, which act on the actuating levers of the rear wheels.

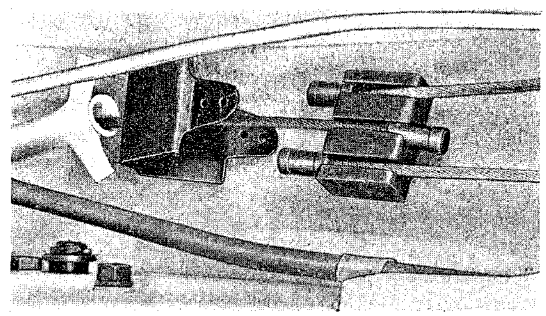


Fig. 29

Removal

1. Jack up car, remove rear wheels.

2. Remove both rear brake drums.

3. Remove brake shoes, left and right (8 Ti).

4. Unscrew bracket of parking brake cables at brake back plates.

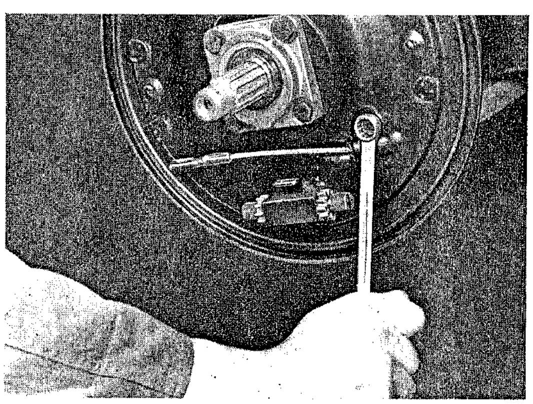


Fig. 28

5. Remove floor board at pedal assembly side and front tunnel covering.

6. Detach spring on cable coupling, unhook parking brake cables.

7. Pull out rear parking brake cables backwards.

8. Unscrew adjusting nuts from central parking brake cable and pull out cable towards front.

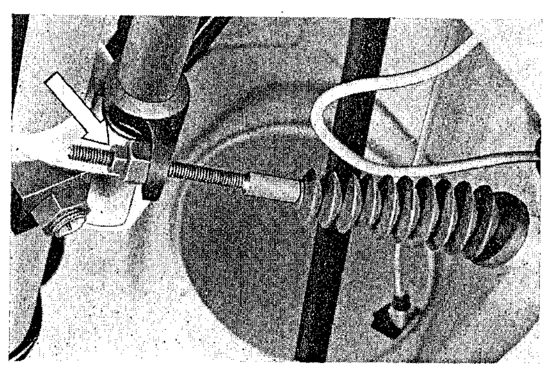


Fig. 30

9. Open front hood, remove cover to steering gear (see fig. 5).

10. Unhook front parking brake cable on bell crank.

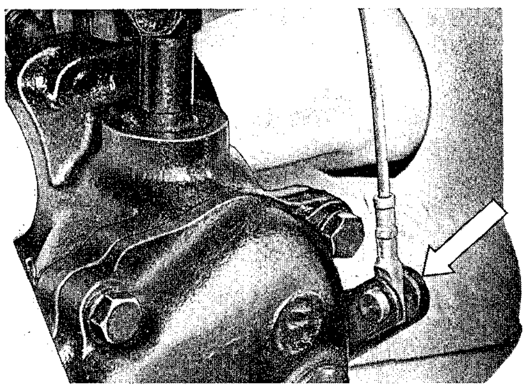


Fig. 31

11. Upon loosening the two retaining nuts, remove parking brake assembly.

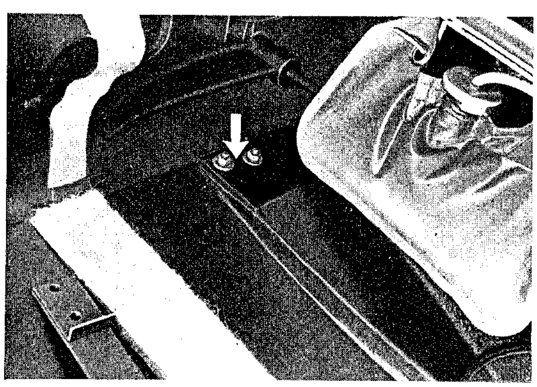


Fig. 32

12. For removal of front hand brake cable dissassemble parking brake actuating system.

Installation

The parking brake cables are installed in reverse order, proceeding acc. to the following points:

1. Correctly assemble parking brake actuating system.

   a) The arresting part side, marked by a "L", must face towards the handle (vice versa with right-hand drive cars).

   b) The hollow of the locking part must point towards the handle.

   The correct succession of the parts to be installed is as follows: (from handle downward) arresting part, spring, locking part, and shim.

   When inserting the parking brake assembly, the handle should be in vertical position, the "L" (or "R" respectively) on the arresting part and the notch mark on the locking part should be visible in the hole.

2. Remember sealing rubbers for parking brake actuating system.

3. Preload brake cable before attaching by approx. half a turn, so that the handle returns automatically from the release position to the horizontal initial position.

4. See to it that adjusting sleeves and nuts move easily.

5. Clean brake cables, fill cable guides with grease.

6. When replacing a brake cable by a new one, make sure to use the correct length.

7. Adjust foot and parking brake (16 Ti and 18 Ti). Check whether brake system functions properly.

Overhauling Brake Drum

Special tools: P 38, VW 400, VW 401, VW 411, VW 418

12 Ti

General

If the inner diameter of brake drums, which are unevenly worn, scored or oval, has not yet reached the wear limit of 11.1023" (282 mm) they may be made serviceable by machining.

Prior to machining a brake drum, it should be checked whether the ovalty which is felt by a intensively vibrating brake pedal, is not caused by incorrectly balanced wheels, a wobbling rear axle shaft or unevenly worn tires. Wobbling rear axle shafts must be replaced. Checking foot and parking brake separately will indicate whether the ovalty is caused by the front axle or the rear axle. It may,however, occur that inspite of a correctly machined brake drum and true running axle shaft the mounted brake drum does not run unobjectively. This may be traced back to a small difference between the serration of the axle shaft and that on the mandrel P 38. This can be remedied by offsetting the brake drum on the serration.

After every machining of the brake drums check carefully whether the inner diameter does not exceed the permissible wear limit of 11.1023" (282 mm). To ensure proper reconditioning of the brake drums, an accurate lathe must be available. Not only machining on brake drums, but also most of the inspection jobs on shafts, rods etc. are carried out on the lathe.

It is very important that the contact surfaces and bearing seats of the drums are cleaned carefully prior to mounting the brake drums on the lathe. Dirt will make perfect eccentricity of the drums impossible, or cause run-out.

If the brake drums have already reached their wear limit or are near it, or if their bearing seats are worn beyond possibility of press fit of the bearing, they have to be replaced by new ones. The same applies if the rear wheel brake drum rivets are insecure.

To avoid unequal braking action, make certain that brake drums opposite each other do not differ as to their inside diameter more than .008" (0.2 mm).

Machining

1. Remove front brake drum, conical roller bearing and oil seal.
2. Clean brake drum.
3. Mount brake drum on mandrel (P 38).
4. Place brake drum and mandrel between head and tail stock of lathe and check for run-out.
5. Machine drum surface by means of carbide lathe tool at low cutting speed, adhering to the max. permissible tolerance of 11.10" (282.0 mm). Make sure that surface is perfectly smooth, do not polish.

Inspection

1. Care must be taken to avoid a tapering cut of the braking surface (Max. permissible taper .04" = 0.1 mm).
2. Reverse mandrel P 38 and drum in lathe and check drum for run-out. Check at point where wheel contacts drum (at wheel studs on the side away from center of drum). Permissible run-out .004" (0.1 mm). If necessary press out wheel bolts and reface wheel contact surface.
3. The braking surfaces of two opposite drums should be of one series (of equal make).

Characteristics for identification:

Version a) without mark

Version b) small bore or punch
at 1.6" (4 mm) wide face of brake surface.

Replacing Wheel Bolts

Wheel bolts may be removed and refitted using VW repair press 400 in connection with VW 401, VW 411, and VW 418. Damaged wheel bolts should be replaced by new ones.

If wheel bolts fit loosely, they must be replaced by oversize bolts.

FILLING, BLEEDING AND ADJUSTING BRAKES

General

The hydraulic system must be refilled and bled whenever one or the other section of a line has been temporarily disconnected or a master brake cylinder or wheel brake cylinder has been removed during repairs on the car. The necessity to bleed the brakes is given whenever the brake pedal can be depressed to the floor board or must be "pumped" to get braking action which very soon diminishes again.

Caution! Brake fluid destroys body finish.

Brake fluid

Only best quality genuine Ate brake fluid or Pentosin Superfluid should be used for the hydraulic brake. They ensure a correct and reliable operation of the brake independent from climatic influences. It is composed of ingredients which will not alter or deform the structure or surface of the brake components. The use of brake fluids (for operation of hydraulic brakes) other than those recommended by the factory will not guarantee perfect and safe operation of the brakes.

Brake Cylinder Lubricant

The sealing components of the hydraulic system must not be lubricated with mineral oil or grease. To ensure a perfect lubrication of the pistons or cylinders resp., the genuine Ate brake cylinder paste has been introduced. This lubricant does not affect the sealing material of the brake system and greatly improves action of the pistons and cups.

The cylinders are taken apart and carefully cleaned in spirit. After they have been allowed to perfectly dry, a thin film of brake cylinder paste is applied onto the pistons and cylinder walls. Then the components are re-assembled. Cylinder paste should be used whenever the cylinders have been disassembled.

13 Ti

Bleeding Brakes using Filling and Bleeding Device

Bleeding Brakes

Two persons are required for bleeding the brakes. Work is always started at the most remote point from the master brake cylinder. The following order should be observed: (Sequence for left-hand drive types)

1. Left rear wheel
2. Right rear wheel
3. Right front wheel, upper wheel brake cylinder
4. Right front wheel, lower wheel brake cylinder
5. Left front wheel, upper wheel brake cylinder
6. Left front wheel, lower wheel brake cylinder

Bleeding

1. Remove dust cap of bleeder valve at wheel brake cylinder.
2. Push bleeder hose over nipple of bleeder valve.
3. Place free end of bleeder hose in a glass jar which is partially filled with brake fluid.

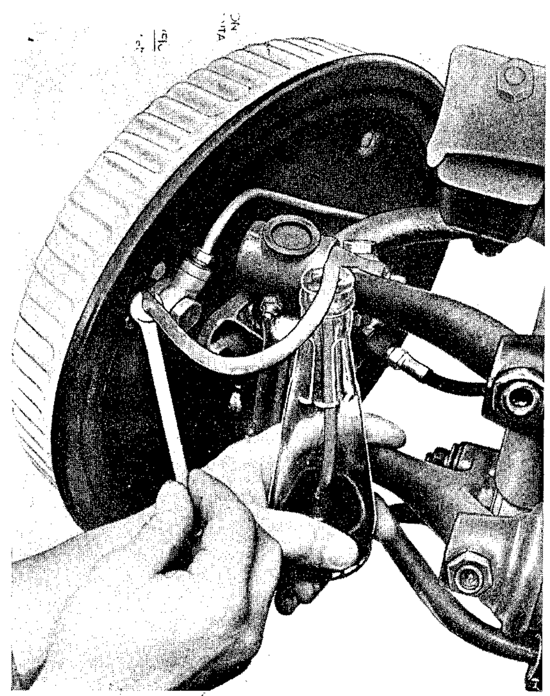


Fig. 33

4. Loosen bleeder valve by approx. one turn, using 7 mm wrench.
5. Strongly depress brake pedal several times and release slowly, repeating until no more bubbles escape from the hose orifice. Whenever releasing the brake pedal close bleeder valve for a short space of time. When doing this, make sure that in any case sufficient brake fluid is available in the reservoir, as otherwise air will be sucked in.
6. When pushing the brake pedal down for the last time, hold it in its lowest position, until bleeder valve is closed.

Brake fluid which is coming out during the bleeding process must on no account be reused.

7. Remove bleeder hose and re-place dust cap.
8. Repeat process on the remaining wheel or wheel brake cylinders respectively in sequence. If necessary, replenish brake fluid in reservoir.
9. Check proper result of bleeding process by depressing brake pedal.

Bleeding Brakes without Bleeding and Refilling Device

14 Ti

General

Bleeding and filling may be accomplished by one mechanic as described below.

For this purpose a filling and bleeding service is required, which on principle operates according to the same method although it may be manufactured by different suppliers.

Before starting work, check whether the device is sufficiently filled with brake fluid. Then the tank is filled with compressed air until the pressure gauge indicates (2,5 atü).

Bleeding

1. Remove dust caps on all bleeder valves.
2. Connect filler hose of bleeder device to upper wheel brake cylinder of left front wheel. Open bleeder valve by approx. one turn.
3. If the reservoir of the master brake cylinder is empty, the shut-off cock at the filler hose of the bleeder device is opened, until the reservoir is filled approx. one third with brake fluid. Close shut-off cock on filler hose.
   (If the reservoir is filled with a sufficient amount of brake fluid, point 3 may be omitted.)
4. Keep brake pedal in braking position by clamping it with pedal support.
5. Open shut-off cock on filler hose.
6. Connect bleeder hose to rear left wheel brake cylinder, submerge free end of bleeder hose in a glass container filled partially with brake fluid. Allow the air existing in the brake system to escape by opening the bleeder valve.
   Repeat the bleeding process until the brake fluid flows out clear and without any bubbles.
7. Close shut-off cock.

Do not re-use brake fluid which has been employed for bleeding!

8. Repeat procedures 5 through 7, at the right rear wheel, right front wheel upper and lower wheel brake cylinder and left front wheel lower wheel brake cylinder.
9. Release brake pedal. Do not forget dust caps on bleeder valves.
10. Check brake fluid level in reservoir, if necessary replenish.
11. Check whether system is properly bled by depressing brake pedal.

For all other procedures refer to the instruction manual which is supplied along with each device by the respective manufacturers.

For bleeding the brakes, Messrs. Teves recommend to use their device ARC 50.

15 Ti

Flushing the Brake System

When flushing and cleaning the brake system use only best quality brake fluid. Do not use gasoline and other solvents or mineral oil. To use spirit is only allowed if provisions have been made that it is completely removed and no remainders are still in the system.
For flushing the brake system Messrs. Teves recommend to use their device ARC 50.

16 Ti

Adjusting Brakes

General

Due to the loss of brake lining material through normal wear, periodic brake adjustments are necessary.
Wear is indicated when excess free play of the brake pedal is noticed, and the brake shoes require individual adjustment at all four wheels.

Before adjusting brakes, check front wheel bearing play.

Since all of the brake adjusting nuts and screws have a right-hand thread, attention should be paid to the following information:

Brake location	Adjusting nut	Direction of screwdriver handle for tightening
Right rear wheel	Front nut	turn downward
	Rear nut	turn upward
Left rear wheel	Front nut	turn upward
	Rear nut	turn downward
Right front wheel	Upper nut	turn upward
	Lower nut	turn downward
Left front wheel	Upper nut	turn downward
	Lower nut	turn upward

Adjusting

1. Jack up car and release parking brakes, pull off wheel hub cap.
2. Prior to adjusting, completely depress the brake pedal several times to allow the brake shoes to centralize in the brake drums.
3. Rotate brake drum forward until the adjusting hole in the drum is in line with one of the adjusting nuts.
4. Insert a screwdriver through the hole and turn the adjusting nut, using the screwdriver as a lever, until the brake lining contacts the brake drum tightly. Back off adjusting nut by 7 or 8 notches to allow the brake drum to rotate freely.
5. Repeat with other adjusting nut.

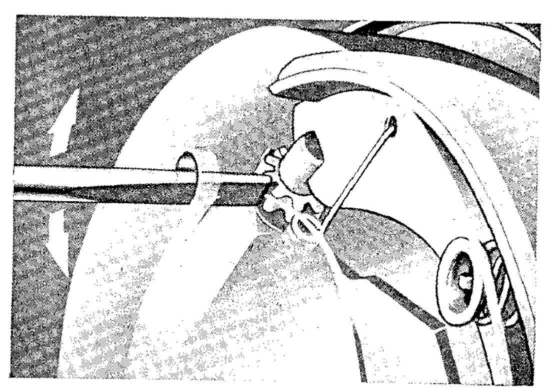


Fig. 34

6. Adjust remaining wheels in similar way.
7. Check brake pedal travel and subject car to a road test.

Readjusting Parking Brake

17 Ti

General

Normal wear of the rear wheel brake linings results in excessive play in the parking brake linkage. Therefore, periodic adjustments to the parking brake are necessary.

To obtain the full braking effect of the parking brake and to eliminate unnecessary adjustment work on the parking brake cables, it is important that the foot brakes be adjusted properly first.

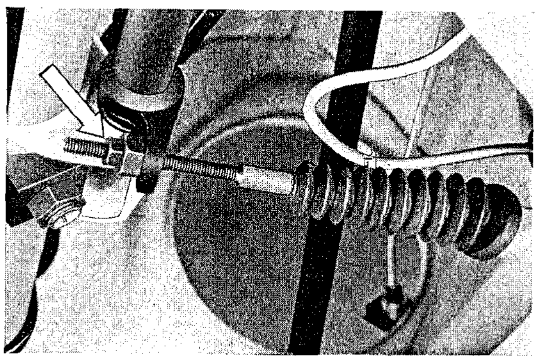


Fig. 35

If the braking effect on both rear wheels is equal during application of the parking brake, adjustment of the nut and center brake cable (see fig. 35) is usually sufficient. If the braking effect is unequal, the parking brake must be readjusted.

Readjusting

1. Jack up car.
2. Pull parking brake and check to see whether brake effect of both rear wheels is equal.
3. Tighten parking brake lever by approx. .275" to .315" (7 to 8 cm).
4. Loosen lock nut of adjusting nut (see fig. 35), tighten adjusting nut until the rear wheels drag, tighten lock nut.

This procedure requires that the rear parking brake cables and adjusting nuts of the brake shoes are properly adjusted, i.e. that the rear wheels show equal braking effect.

Adjusting Parking Brake

18 Ti

Adjusting

1. Jack up car ,remove wheel hub caps.
2. Release parking brake, loosen adjusting nut (spherical nut) on the center parking brake cable by some turns.
3. Adjust foot brake (16 Ti).
4. Pull parking brake until rear wheels turn freely.
5. Adapt parking brake effect on rear wheels by adjusting sleeves on rear parking brake cables. Secure adjusting sleeves by lock nuts.
6. Tighten adjusting nut on center parking brake cable until the rear wheels drag, the parking brake lever should then be tightened to .275"–.315" (7–8 cm).
7. After adjustment has been made, check again whether both rear wheels rotate freely.
8. Secure adjusting nuts by means of lock nuts.

Hydraulic Brake Troubles and Their Cure

Trouble	Cause	Cure
Excessive brake pedal travel	a) Worn brake linings b) Worn brake drums c) Inside dia. exceeding 10.10" (282 mm)	a) Adjust brakes a) Replace brake shoes b) Install oversize shoes c) Replace brake drums
Excessive brake pedal play	a) Missing or worn rubber stop b) Incorrect play of foot brake pressure rod	a) Replace rubber stop b) Correct play between foot brake pressure rod and piston in master brake cylinder
No resistance to brake pedal action or brake pedal can be pushed down to floor board Braking effect only after fully depressing pedal several times	a) Air in brake system b) Fluid amount insufficient in reservoir	a) Bleed brake system b) Replenish brake fluid, then bleed
Brake pedal can be easily depressed, no resistance	a) Torn, burst, chafed or loose-fitting brake line or hose b) Damaged master or wheel brake cylinder cup	a) Replace or tighten brake line or hose b) Replace defective cup
Brake gets hot during driving without being actuated	a) Adjustment of the foot brake too tight b) Broken or weak return spring of brake shoes c) No or insufficient play between brake pedal and piston in master brake cylinder d) Bypass port in master brake cyl. clogged e) Swollen rubber parts caused by unsuitable brake fluid	a) Adjust foot brake correctly b) Replace return spring c) Correct play (Bypass port is covered) d) Debur port and clean master brake cylinder e) Disassemble and clean master and wheel brake cylinders, replace rubber parts. Flush hydraulic system
Rear wheels get hot during driving	a) Parking brake pulled b) Rear wheels do not rotate freely although parking brake is released	a) Release parking brake b) Correct parking brake adjustment

Trouble	Cause	Cure
Poor braking effect despite depressing brake pedal properly	a) Brake linings and drums oiled or greasy b) Brake linings or drum surfaces burnt c) Front wheel brake cyl. incorrectly mounted	a) Replace defective oil seals, clean drums and replace shoes b) Replace shoes, machine or replace drums c) Mount cylinder correctly
Brake blocking when pedal is slightly depressed	a) Burnt or cracked brake linings or drums b) Brake shoes are jamming or sticking in plungers or adjusting screws resp.	a) Replace shoes, machine or replace drums b) Remove burr or rust film on shoes, adjusting screws and plungers to allow easy moving of brake shoes
Brakes do not operate equally	a) One wheel brake oiled up or greasy b) Seizing piston in wheel brake cylinder c) Different wheel brake cylinders mounted on one axle d) Faulty attached or weak return springs e) Different brake linings mounted on one axle f) Different brake shoes mounted on one axle g) Different brake drum inside diameter on one axle h) Unequal adjustment of foot brake i) Wear of tires varying or different makes j) Loose brake back plate k) Different brake surfaces on one axle	a) Replace defective oil seal, Clean brake drum and replace brake shoes b) Overhaul or replace wheel brake cylinder c) Install only wheel brake cylinders with equal inside dia. 19.05 mm d) Correct position of return springs or replace e) Install only brake linings of equal make f) Install only shoes of equal make g) Machine drums to equal inside diameter h) Adjust foot brake equally i) Use only equally worn tires or equal make j) Tighten brake back plate k) Mount only brake drums with equal surfaces on one axle

Trouble	Cause	Cure
Brakes are squealing	a) Brake surfaces oxidized or very dirty (brake dust) b) Brake shoe surface burnt	a) Clean brake linings and drum b) Replace brake shoes
Brakes are rattling	a) Brake surface has uneven contact, only contact on outer ends b) Brake shoes are not parallel to brake surface. Brake back plate bent c) Poor tires, tend to rattling noises d) Brake drums out-of-true e) Excessive play in wheel suspension or back plate, or loose	a) Adapt brake shoe radius to brake drum radius. Check whether surface appearance print is correct b) Replace brake back plate c) Replace poor tires by new ones d) Machine brake drums or replace e) Adjust bearing play or collar pin play. Replace worn parts. Tighten loose bolts
Stop light does not go out	a) No play at foot brake pedal, brake system	a) Bypass port covered, adjust play on brake pedal

WHEELS

General

Wheels are slotted disc wheels with drop center rims.

Rims size is: $4\frac{1}{2}$ J x 15 for all types.

Tire size is, for vehicles with engine:

356 B/1600 Normal 356 B/1600 Super	5.60 – 15 Sport
356 B/1600 Super 90 356 B/1600 GS Carrera	165 – 15 Braced - tread tire

For increased driving safety and economy of operation proper care of tires and wheels is essential.

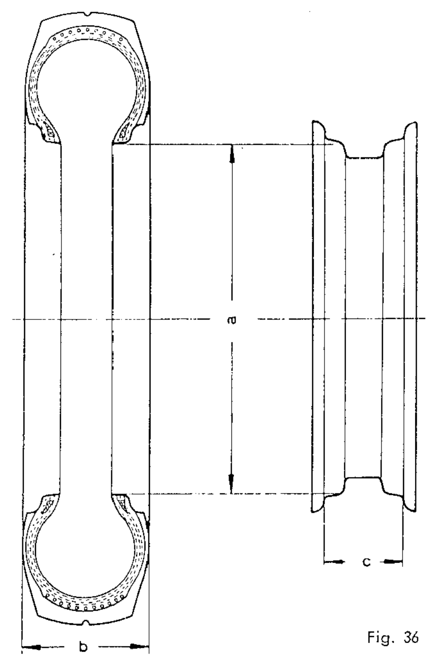


Fig. 36

a) Nominal diameter of rim	15"	= 378,8 mm
b) Tire width	5.60" or 165 mm	
c) Rim width	114,3 mm	

Hints

1. Bolt disc wheel to brake drum properly.
2. Adhere to the specified tire pressure.
3. Check tires for damage and signs of wear.
4. Balancing of wheels.
5. Check alignment periodically (See Group R).

Changing the Wheels

19 Ti

Removing the Wheels

1. Pull parking brake.
2. Remove hub cap on disc wheel.
3. Loosen 5 retaining nuts for disc wheel using wheel nut spanner.
4. Insert jack lifting arm in opening on the side at the bottom of the car. Base of jack should rest on level ground.
5. Jack up car.
6. Loosen wheel nuts and remove wheel.

Mounting the Wheels

Proceed in reverse order, observing the following points:

1. Tighten nuts lightly. Care must be taken that the nuts fit properly and that their hemispherical end fits centrally in the socket formed in the wheel.
2. Lower car to ground.
3. Tighten nuts diagonally, always skipping one, to 13 mkg (105 ft. lb.).

20 Ti

Renewing Broken Spring Clamps

1. Remove wheel (19 Ti).
2. Chisel off remainder of spring clamp and rivet head and remove remaining part.

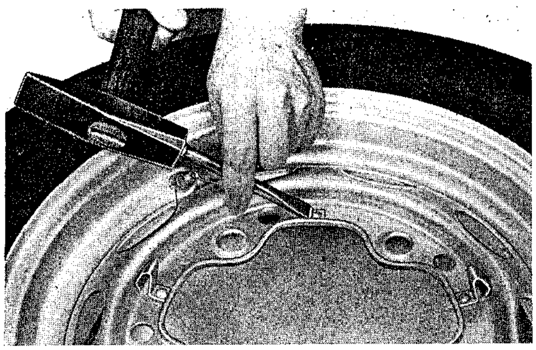


Fig. 37

3. Place mandrel and rivet seat (4.5 x 7 DIN 660) in vice and slip on half round rivet and spring clamp.

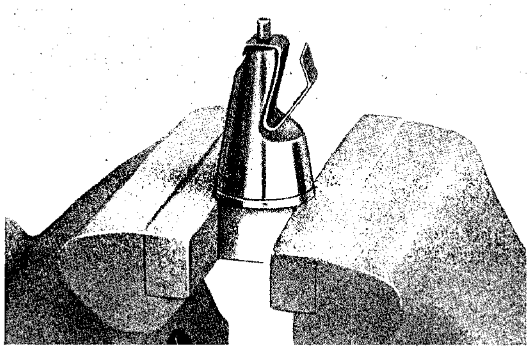


Fig. 38

4. Place wheel in horizontal position – its outer side facing downward – so that rivet aligns with respective wheel hole.

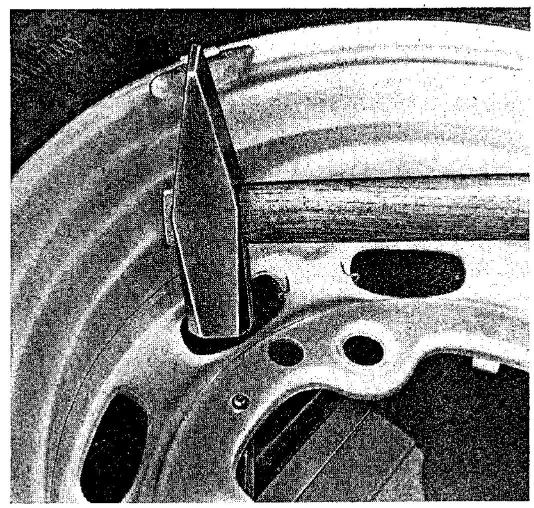


Fig. 39

5. Rivet spring clamp to wheel.
6. Paint spring clamp and rivet on both sides of wheel.
7. Fit wheel and tighten bolts.

Damaged Rims

Slight damages to rims, in particular to rim edges, can usually be remedied without causing difficulties. Heavy damage – e.g. caused by an accident – necessitates replacement of the rim. In any case where damages to the rims are encountered, the rim must by subjected to a thorough check-up for vertical and lateral out-of-true,

(Max. permissible tolerance: Damage to top edges .0691" (1.5 mm); Damage to side .07874" (2 mm). Check at edge of rim.

In every case of wheel repair where repaired rims are reused, check for correct static and dynamic balance.

Repair of twisted rims is not permitted and should not be attempted.

General

Good tire condition not only improves driving qualities but also increases safety. It depends greatly on perfectly balanced wheels and tires. Therefore it is of importance that special care and maintenance of tires and wheels be practised.

Due attention to tire care will lengthen tire life and reduce wear to a minimum.

Abnormal wear may be due to improper tire pressure, bad driving habits or poor road conditions.

The car should not be overloaded. Tires must be protected from undue solar radiation, fuel and oil.

Size of tires: For vehicles

356 B/1600 356 B/1600 Super (75 PS)	5.60–15 Sport (upon special request only 165–15 Belt)
356 B/1600 Super-90 356 B/1600 GS (Carrera)	165 –15 Braced tread tire (upon special request only 5.90–15 Supersport)

Dimensions of Tires

	5.60–15 Sport approx. mm	165–15 Braced-tread approx. mm	5.90–15 Supersport approx. mm
Outer diameter	652	654	665
Tire width	152	163	152
Effective static radius	304	301	312
Effective dynamic radius	309	313	318

Tire pressures (recommended)

	High-speed roads				Country roads			
	front		rear		front		rear	
Tires	atü	psi	atü	psi	atü	psi	atü	psi
5.60–15 Sport	1,5	21.5	1,8	25.5	1,3	18.5	1,6	23
165 –15 Braced-tread	1,8	25.5	2,0		1,6	23	1,8	25.5
5.90–15 Supersport	1,4	20	1,7	24	1,2	17	1,5	21.5

Mounting and Dismounting Tires and Tubes

21 Ti

General

Every repair or assembly of tire and tube should be carried out very carefully. Damages occur when tube is pinched by tire tool or when it is improperly seated in the casing, and can result in early breakdown. Correct positioning of tube in casing is extremely important.

Dismounting

1. Unscrew valve cap and screw out valve. Detach retaining spring for tube valve.
2. Place wheel flat on ground with the inner side downward and loosen tire bead from rim.
3. The side opposite the valve should be pressed into the drop center of the rim, and the other side pryed (without force) over the rim edge. Proceed around rim.

4. Pull out tube.

5. Check valve and tube for leaks. Damaged spots or hole should be marked and entire tube checked for signs of chafing. Check inside of casing for fabric breaks and damages; check outside of casing for cuts, foreign bodies and signs of wear.

Mounting

Assemble and mount in reverse order, observing the following points:

1. Dust inside of tire lightly and evenly with talcum.

2. Be careful not to damage bead by prying forcibly.

3. Before inserting tube in casing make certain that it is dry and that no dirt particles cling to it. Tube should be inserted in casing so that the valve lines up with the red dot painted on the casing. On tires with two dots valve should be centred between them.

4. Tube should be semi-inflated after insertion in casing so that it will remain in proper position during assembly.

5. Before insclating tire, make sure that the tire beads are positioned properly against the rims.

6. Inflate tire to prescribed pressure.

7. Remember valve cap with rubber gasket.

22 Ti

Mounting Retaining Spring for Tube Valve

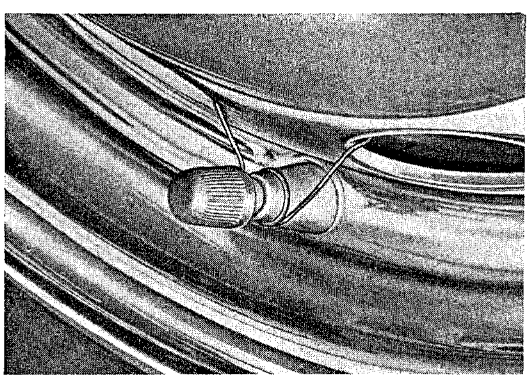


Fig. 40

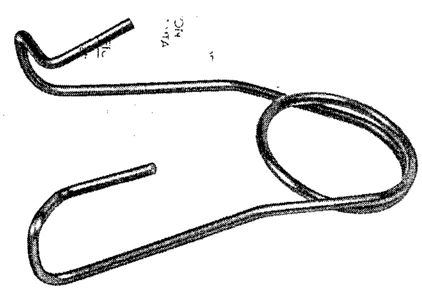


Fig. 41

General

The retaining spring serves to keep the rubber valve in its normal position against centrifugal force even at high speed. A subsequent mounting of the retaining spring is possible with all standard rims 4,5 J x 15.

Removal

1. Unscrew valve cap.
2. Detach retaining spring on both ends, stretch somewhat apart and remove from rubber valve.

Installation

1. Grip retaining spring on both free ends, stretch somewhat apart and push over rubber valve.

2. Attach free ends of retaining spring in the slotted disc rim.

3. Screw on valve cap.

Checking Tires

General

Tires should be checked for correct pressure, wear, cuts, grease deposits, fabric breaks and foreign bodies frequently, in any case during maintenance inspections and before starting on longer trips.

Tire Pressure

To increase the life of tires and to insure the best riding qualities of Porsche sports cars, it is important that the prescribed tire pressure be maintained at all times. The tire pressure should therefore be checked regularly, at least, however, once a weak and above all before starting on a long trip, use an accurate pressure gauge for this purpose. A gradual loss of air is normal and is due to the presence of acids in the air which attack the walls of the tube and allow air to seep through the walls of the tube. Pressure should be checked when the tire is cool. If the tire is checked after the tire pressure has increased due to heating up after a speed run, it must on no account be decreased, as otherwise the pressure will be too low after the tire has cooled down.

Note

Tire pressure gauges should be checked after they have been used for a longer period to make sure that they indicate correctly. Worn out gauges (varying $^1/_{10}$ in accuracy) cause over- od under-pressure which results in abnormal tire wear and life span. It is therefore important that the gauge is checked periodically for accurate indication of the pressure.

The effectiveness of the valve can easily be checked by moistening the finger and placing it lightly over the valve opening. The appearance of small bobbles indicate that the valve is not seating properly. If necessary, replace the valve.

Abnormal Wear

Some causes for abnormal wear are:

Tire pressure too low or too high
Bad driving habits
Overloading vehicle
Bad roads
Improper wheel alignment

Pressure too low

Heavy wear occurs on the side of the tread due to increased friction of the soft tire against the road. The resultant overheating affects the fabric structure of the tire. Damage to the fabric will appear first as two black parallel lines inside the casing (at an angle to the direction of rotation). This means that the cords of the fabric are beginning to separate from each other. Continuing to drive under this condition will eventually cause rupture of the fabric and render the tire completely unserviceable.

If the tire pressure is too low, the entire load is placed on the shoulders of the tread and extreme friction then results in rapid wear of the center of the tread.

Pressure too high

This results not only in hard riding qualities, but also in excessive spring action, and rapid wear on the center of the tread.

Driving habits

Average driving speeds have greatly increased during recent years, and tire damage and wear have increased proportionally. Such damage and wear are caused by higher tire temperature due to friction and to violent variations of load due to road shock and by taking curves at high speed, as well as by the heavier braking actions. Heavy brake application increases tire wear, due to the grinding action of the tire against the road surface. This is particularly true if the brakes are applied hard enough to skid the wheels. Wear and damage are also increased if braking action is uneven due to faulty or defective brake shoes, linings and drums.

Overloading the car

The weight of the car is supported by the air in the tires. The compressability of the air gives a cushioning effect to small bumps and absorbs road shocks. Tire pressure, air volume and weight are directly related.

Each tire size is designed to support a given normal load and is constructed to sustain that load according to a specified air pressure and to sustain overload for short periods of time. Heavy overloading over a longer period may result in serious damage of the tire. This

Dynamic balance depends on even distribution of weight through the center line of the wheel. Stagger or wobble of a wheel indicate a lack of dynamic balance.

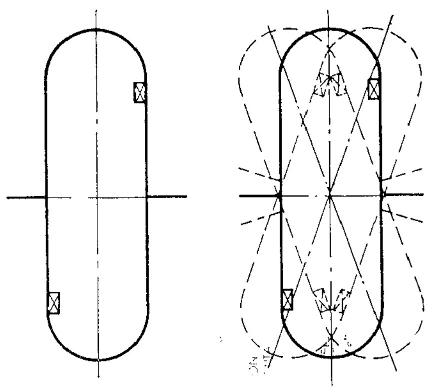


Fig. 43

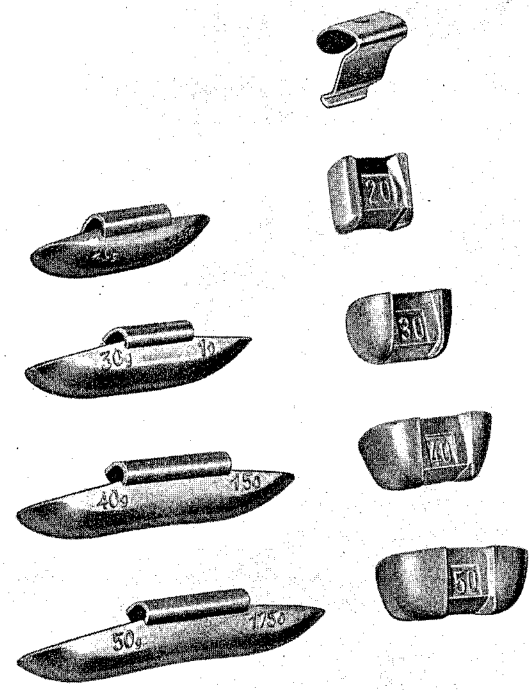


Fig. 44

The static balance can be checked by improvised methods. For checking dynamic balance one must use a balancing machine. Such machines are made by several manufacturers. Balancing is done in several ways, depending upon the design of the machine, and different sizes of lead weights are used. The location of the places on a wheel where weights should be fastened can be learned by reading the instructions supplied with the machine.

Note:

The lightest spot of the tires is marked by the manufacturer with one or two coloured dots, which should align with the valve when assembling tires.

This will already bring about a certain balance.

Balancing weights required for balancing wheels are made of lead and supplied in various sizes.

Version a) (see fig. 44 on the left)

is only used for painted steel rims. The weight is positioned at the rim flange and secured by tapping it with a hammer. The tire need not be compressed for this purpose.

Version b) (see fig. 44 on the right)

can be used for all commercial rims, is however mainly installed in chromium-plated and light-alloy rims. When mounting this type of weight, the tire must be compressed at the respective place with a clamp, so that the balancing weight can be secured in position.
Prior to balancing, the rims must be checked for permissible vertical and lateral out-of-true.

Vertical out-of-true	**max. .0591″ (1.5 mm)**
Lateral out-of-true	**max. .0787″ (2 mm)**

Balancing dynamically

1. Fasten complete inflated wheel with all five wheel nuts to the hub of the balancing machine.

2. Rotate wheel rapidly.

3. Determine size and point of location of balancing weight.

4. Stop rotation of wheel, compress tire at the place where the weight shall be mounted to the outer rim flange, usine a clamp. Insert balancing weight in rim flange and clamp with spring. Make clamping spring to contact by tapping with a hammer.

5. Remove clamp.

6. Rotate wheel again rapidly and check whether dynamic out-of-balance is corrected.

   Max. permissible dynamic lack of balance 10 g.

Note:

If the balancing weight is found to be placed incorrectly, it may be moved in either direction on the rim flange without being removed after the tire has been compressed.

For removing the balancing weights of both types special commercial pliers should be used.

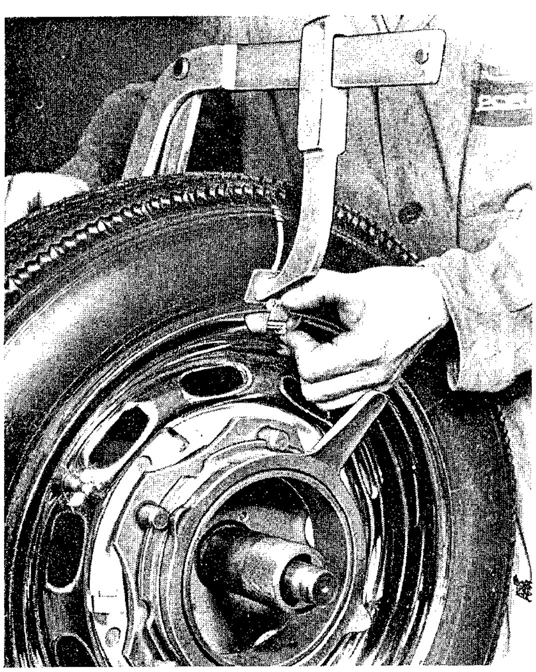


Fig. 45

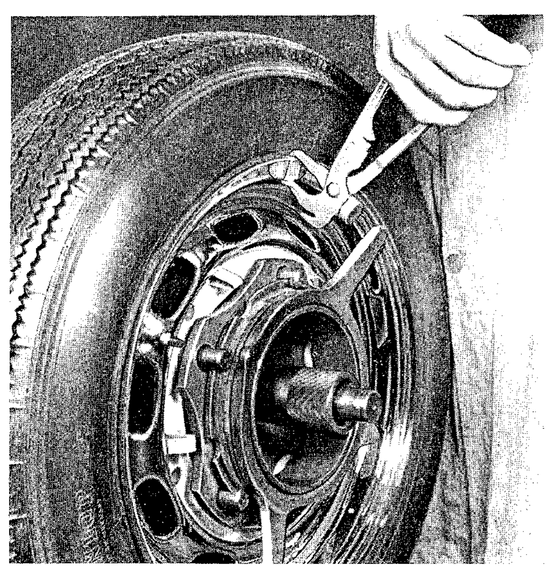


Fig. 46

Balancing statically

1. The dynamically balanced wheel which is still clamped on the balancing machine should then be rotated and allowed to stop gradually. (Axis of rotation of balancing machine must allow free movement.)

2. Mark the lightest weight point of the wheel at the rim edge with chalk, i.e. directly above the center of rotation while the wheel is at standstill.

   Fit selected magnetic weight to the determined point on the rim flange and turn the wheel by 90 °. If the wheel comes to rest, the size and weight is correct.

   If the wheel is revolving downward, the weight selected is too heavy. If the wheel revolves upward, the weight must be increased.

Fig. 47

If no magnetic weights are available or if wheels with light-alloy rims have to be balanced, the size of the balancing weights has to be determined by fitting various weights.

3. Fit balancing weight of equal size as magnetic weight to the inner rim flange.

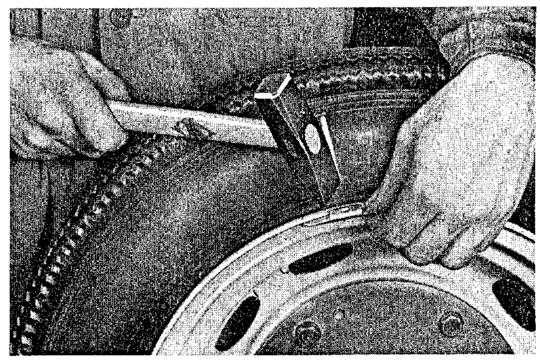


Fig. 48

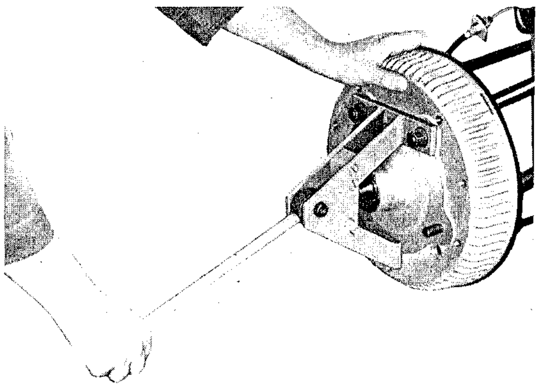
Static balance of the wheel is correct if the wheel stops in any position.

SPECIAL TOOLS

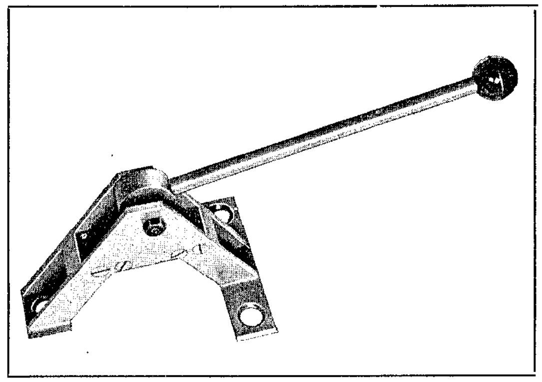
TO

GROUP T

Puller for Brake Drums — P 30



Application



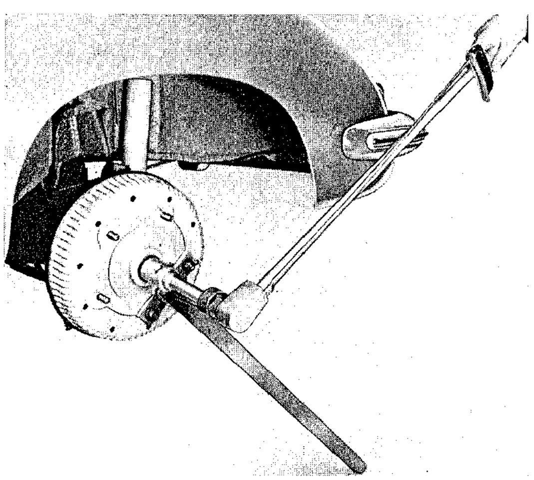
Tool

Purpose: To hold the brake drum and to guide the wrench when tightening and loosening the rear axle nut. (In conjunction with P 42, P 44, and P 44 a, if necessary P 36 a.)

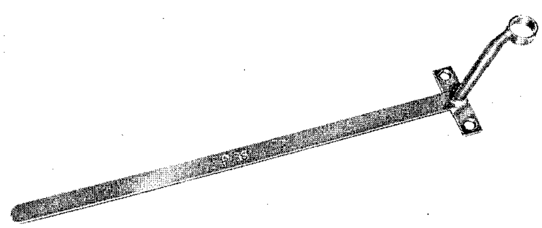
See Workshop Manual, Group T Procedures: 4 Ti, 8 Ti, 10 Ti. 11 Ti.

Subject to Modification

Brake Drum Holder and Wrench Guide — P 36



Application



Tool

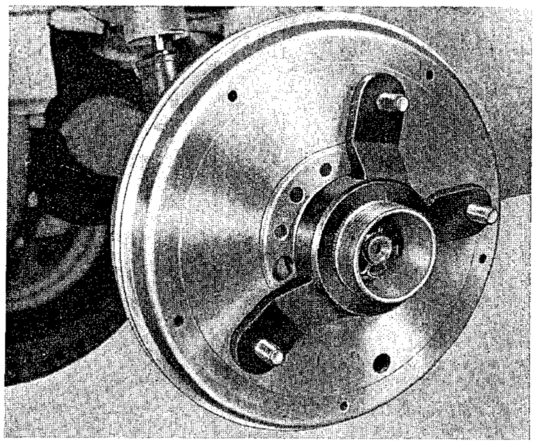
Purpose: To pull off brake drums, front and rear.

See Workshop Manual, Group T Procedures: 3 Ti, 4 Ti, 7 Ti, 8 Ti, 9 Ti, 10 Ti, 11 Ti.

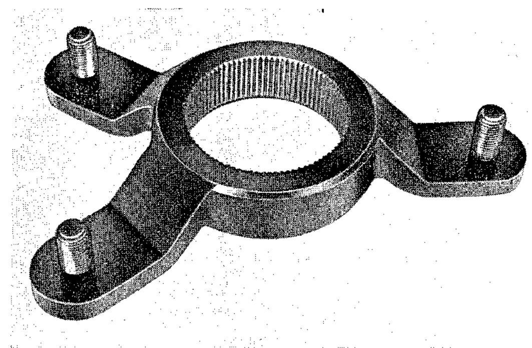
Subject to Modification

Holder

P 36a



Application



Tool

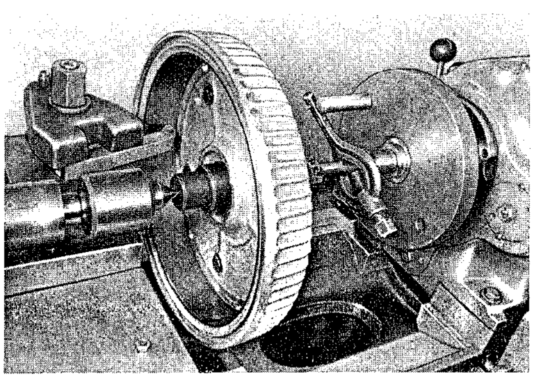
Purpose: To loosen and tighten rear axle nuts of vehicles with Rudge wheel lock. (In conjunction with P 36, P 42, P 44, P 44 a.)

See Workshop Manual, Group T Procedures: 4 Ti, 8 Ti, 10 Ti, 11 Ti.

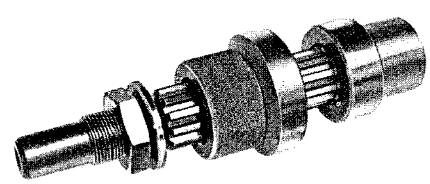
Subject to Modification

Madrel for Brake Drums

P 38



Application



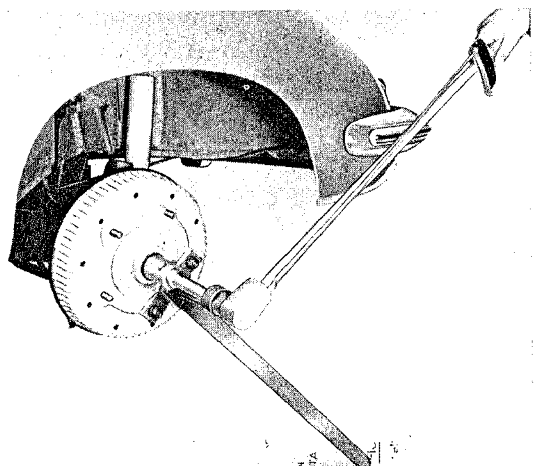
Tool

Purpose: For machining brake drums.

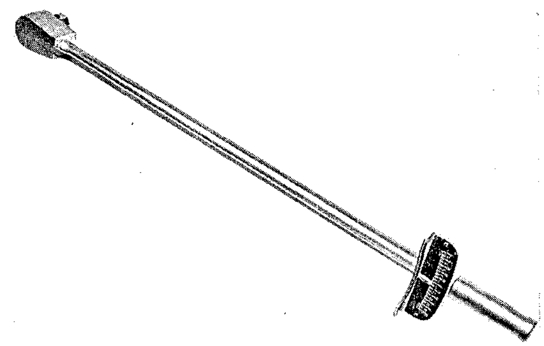
See Workshop Manual, Group T Procedure: 12 Ti.

Subject to Modification

Troque Wrench (up to 50 mkg = 360 lbs. ft.) — P 42



Application



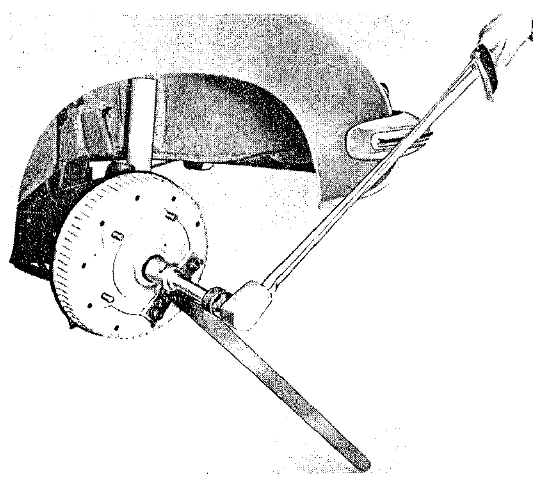
Tool

Purpose: Used in conjunction with P 36, if nec. P 36 a, P 44 and P 44 a for tightening and loosening rear axle nuts.

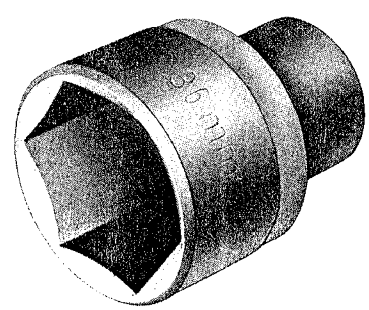
See Workshop Manual Group T   Procedures: 4 Ti, 8 Ti, 10 Ti, 11 Ti.

Subject to Modification

36 mm Socket — P 44



Application



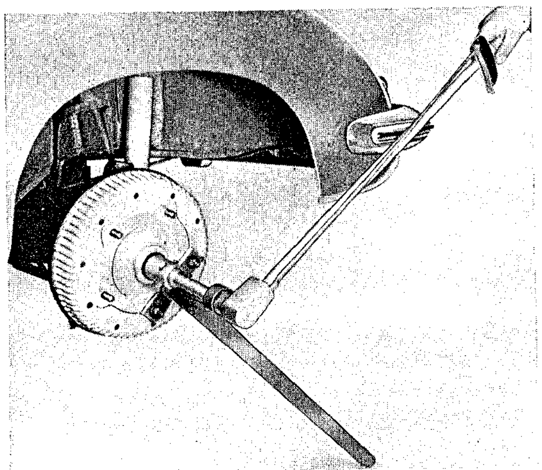
Tool

Purpose: Used in conjunction with P 36, if nec. P 36 a, P 42 and P 44 a for tightening and loosening rear axle nuts.

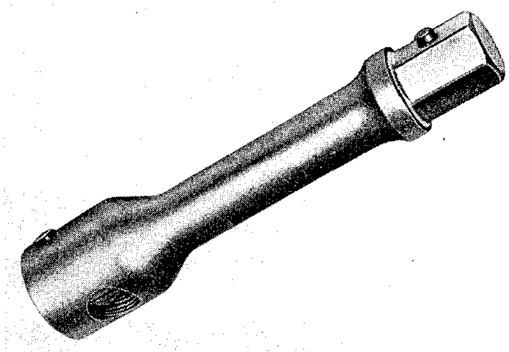
See Workshop Manual Group T   Procedures: 4 Ti, 8 Ti, 10 Ti, 11 Ti.

Subject to Modification

Extension for Socket P 44	P 44a



Application



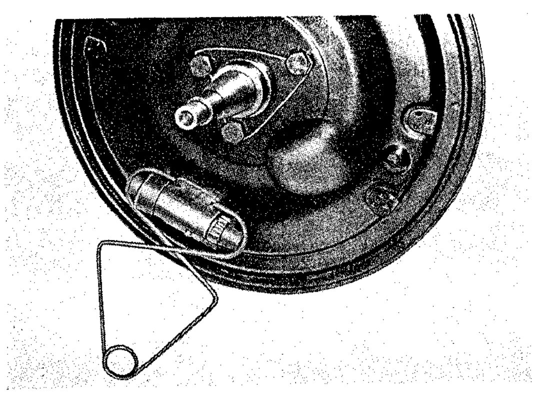
Tool

Purpose: Used in conjunction with P 36, if nec. P 36 a, P 42 and P 44 for tightening and loosening rear axle nuts.

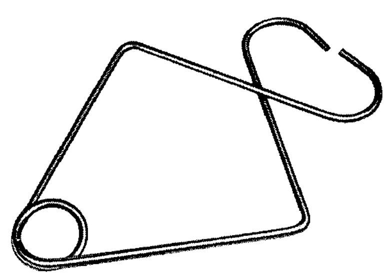
See Workshop Manual Group T   Procedures: 4 Ti, 8 Ti, 10 Ti, 11 Ti.

Subject to Modification

Piston clamp for Wheel Brake Cylinder	P 47



Application



Tool

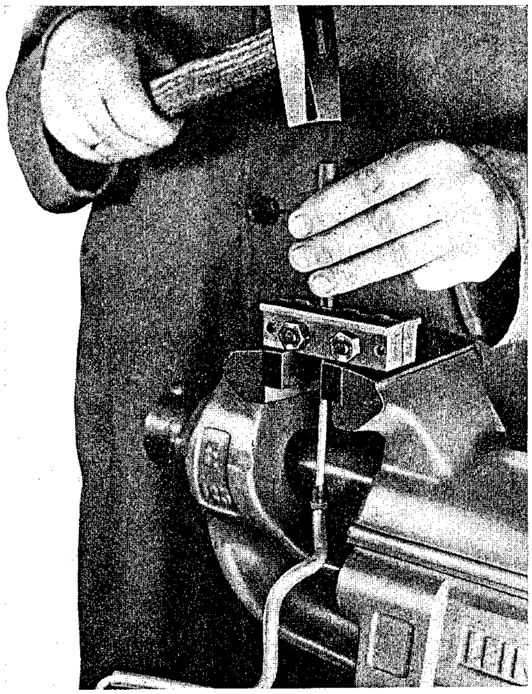
Purpose: To hold the pistons in wheel brake cylinder while brake shoes are removed.

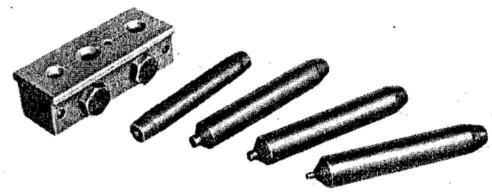
See Workshop Manual Group T   Procedures: 3 Ti, 7 Ti, 8 Ti, 11 Ti.

Subject to Modification

Flanging Tool for Brake Lines

P 48





Tool

Purpose: To flange brake lines.

See Workshop Manual Group T   Procedure: Tubing.

Application

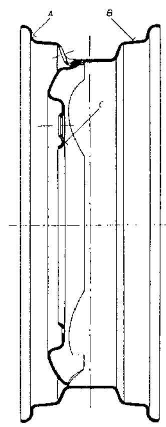
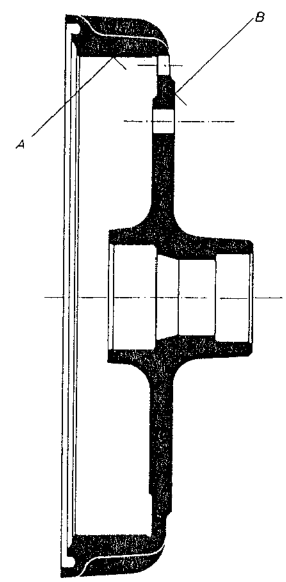
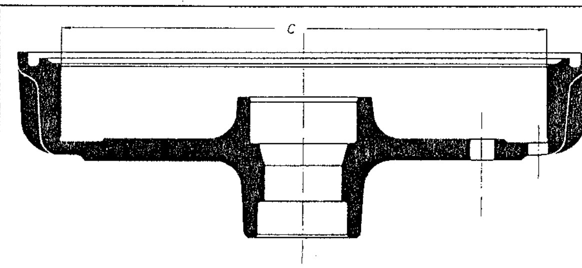
Subject to Modification

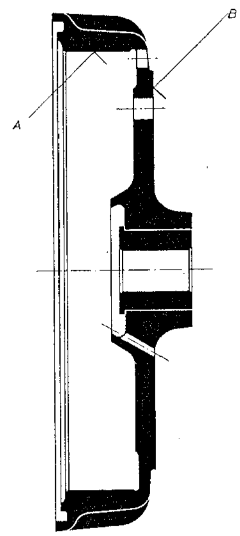
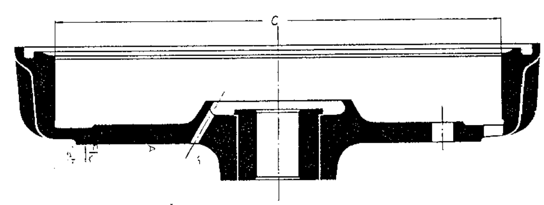
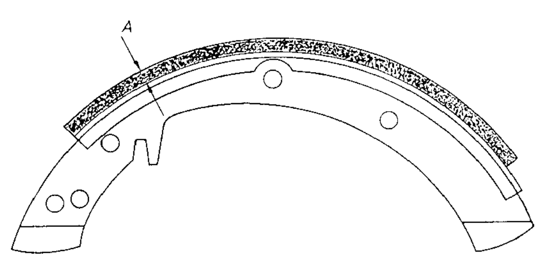
SUMMARY OF TOLERANCES

TO

GROUP T

Summary of Tolerances including Wear Limits, Brakes, Wheels, Tires

Point of measurement	Tolerance (new) mm	Wear Limit mm	
1. **Slotted disc wheel**			
A Lateral out-of-true	max. 1,5	2,0	
B Vertical out-of-true	max. 1,5	1,5	
C The outer section of the contact surface must be plane. It should only be possible to insert a feeler gauge of a max. thickness of 0,3 mm between wheel seating surface and a surface-ground base of 250 mm diameter.	—	—	
2. **Front Brake Drum**			
A Vertical out-of-true (with true reception in hub).	max. 0,1	—	
B Lateral out-of-true	max. 0,1	—	
C Inside diameter, normal size	280,0 ± 0,1	281,0	
C Inside diameter, oversize. (In this case oversize brake shoes have to be used.) (See 4.)	281,0 ± 0,1	282,0	
Conicity	max. 0,1	—	

Point of measurement	Tolerance (new) mm	Wear Limit mm	
3. **Rear Brake Drum**			
A Vertical out-of-true, for reception in serration and axial tension of hub against true faces.	max. 0,1	—	
B Lateral out-of-true	max. 0,1	—	
C Inside diameter, normal size	280,0 ± 0,1	281,0	
C Inside diameter, oversize. In this case oversize brake shoes have to be used. (See 4.)	281,0 ± 0,1	282,0	
Conicity	max. 0,1	—	
4. **Brake Shoes**			
A Brake Lining, standard	7,0	—	
A Brake lining, oversize	7,5	—	

SECTION INDEX

Section B: Body

Interior

Pedal Assembly

Cabriolet Convertible Top

Roadster Top

Repairs and Inspection

Paint

Interior

The floor in front and behind the seats, as well as the forward half of the floor tunnel and pedal wall, are covered with rubber mats which are durable and easily cleaned. The lower portion of the walls and door sills are covered with durable, coarse, woven fabric.

Insulation and Sound Proofing

The underside of the car is protected with two coats of underseal while the forward luggage space and engine compartment have only one coat. The walls and body panels nearest the engine are completely covered with sound proof sheeting.

Heater and Ventilation

The warm air from the engine cooling system is brought forward through the left and right chassis members to the passenger compartment where the warm air is blown against the windshield for defrosting. Sliding flaps at either side of the front seats can be opened to allow part of the warm air to enter the passenger compartment near the floor.

Bumpers and Trim

The bumpers are suspended on spring steel supports and have a protector strip of elastic material mounted in a light alloy trim.

All the trim on the car is either chrome plated or highly polished light alloy.

Removing and Installing Front Hood

1 BO

Removal

1. Open front hood and engage the catch mechanism so that the hood remains open.

2. Carefully mark the position of the hood on both hinges with a line along the edge of the entire flange and one across the flange to the hinge.

3. With one person holding each side of the hood remove the bolts which hold the hood.

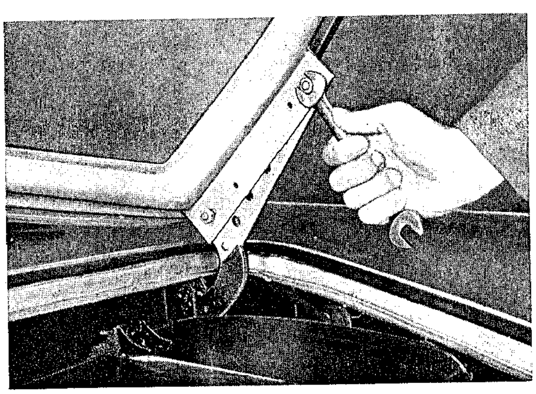


Fig. 1

4. Remove the hood being careful not to bend the hinge brackets and catch shaft.

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Inspect the rubber weather strip around the opening. The strip is glued to the body and held in place with screws. The two upper corners have mouldings to hold the rubber. Install a new weather strip if necessary.

Fig. 2

2. Install the hood lightly tightening the four screws so that the lid may be adjusted to the previously inscribed marks. Tighten all screws and carefully close the hood to test the fit. Adjust where necessary.

2 BO

Removing and Installing Hinges for Front Hood

The hinges are held by two M8 screws in a half round channel located behind the instrument panel.

One screw is located under the hood and is removed as in Fig. 3. The second screw is found under the instrument panel as in Fig. 4.

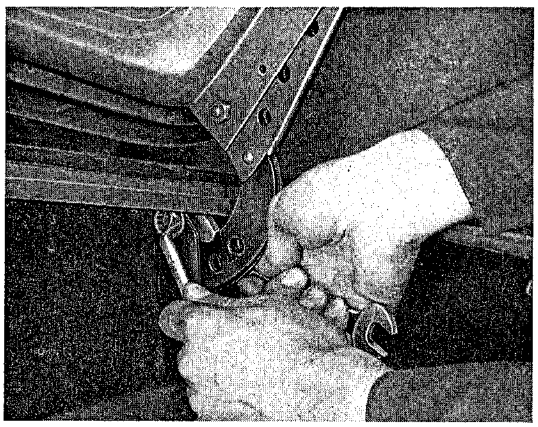


Fig. 3

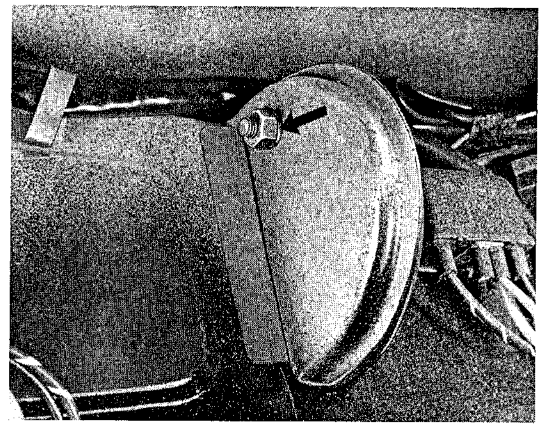


Fig. 4

Function of the Hood Latch

(For front and rear hood)

As described in 2 BO, the hinges and the latch mechanism are mounted in half round recesses under the instrument panel. The latch consists of a rotating three cornered ratchet (Fig. 5 part 5) which is brought into a blocking position when the hood is fully raised. When the hood is once more raised fully the ratchet is advanced slightly and is disengaged. The hood can then be closed.

Sequence of operation

When opening the hood, the ratchet (1) engages the inside of the forward catch (2) which holds the ratchet (Fig. 6) in a position where it will lock the hinge when it is lowered (Fig. 7).

When closing the hood, the catch is disengaged by the rear catch when the hood is fully raised (Fig. 8). The hood can then be lowered.

(1) **Ratchet arm**
(2) **Front catch of ratchet arm**
(3) **Rear catch of ratchet arm**
(4) **Hinge arm**
(5) **Ratchet**

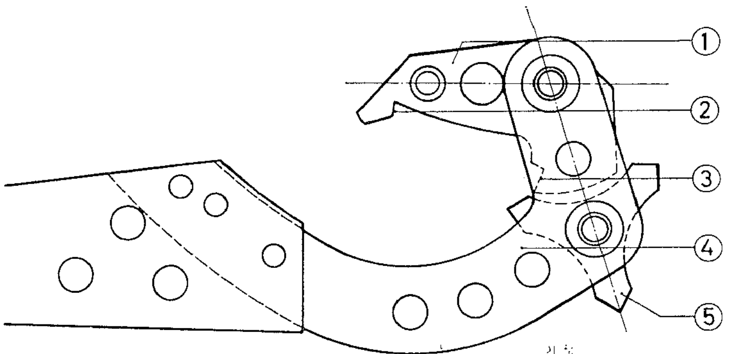
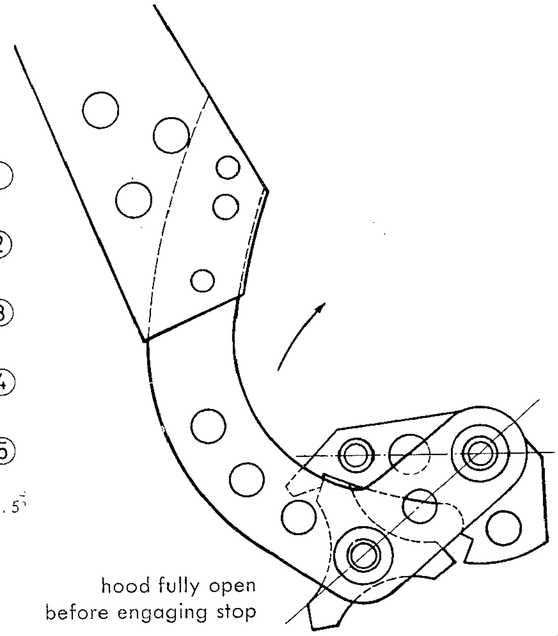


Fig. 5

hood closed



hood fully open
before engaging stop

Fig. 6

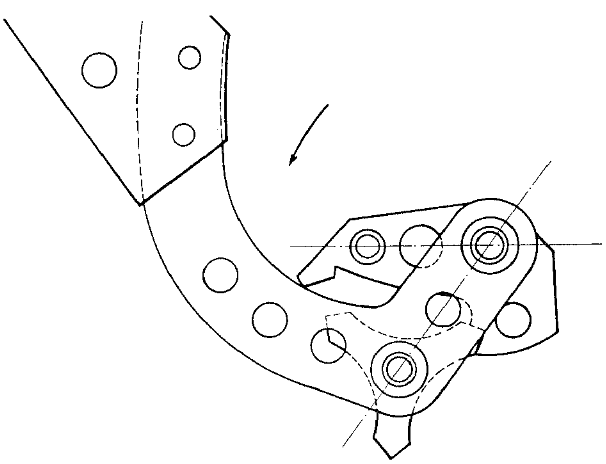


Fig. 7

hood held open by ratchet

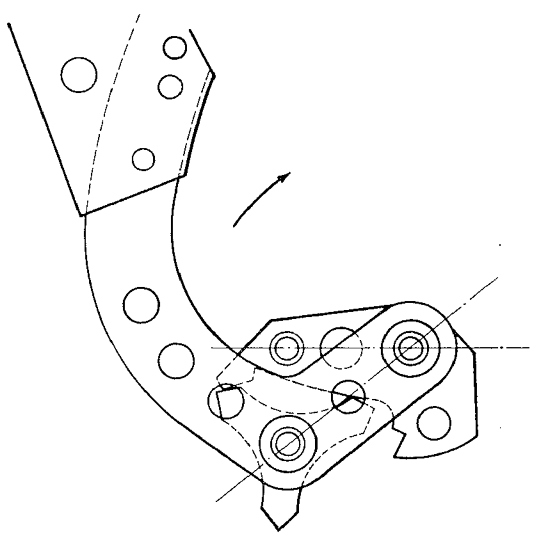


Fig. 8

hood fully open before closing

3 BO

Removing and Installing Front Hood Lock

Removal

1. Open hood and secure in raised position.
2. Remove the two cap screws which hold the hood latch and remove the latch and release spring assembly. The nuts are welded to the inside of the hood frame.

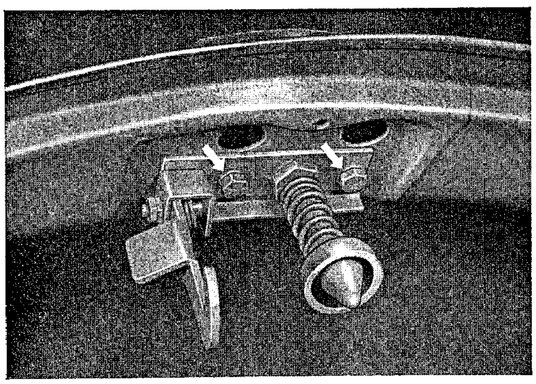


Fig. 9

3. Remove the two cap screws which hold the lock in place (note the position of the lock).

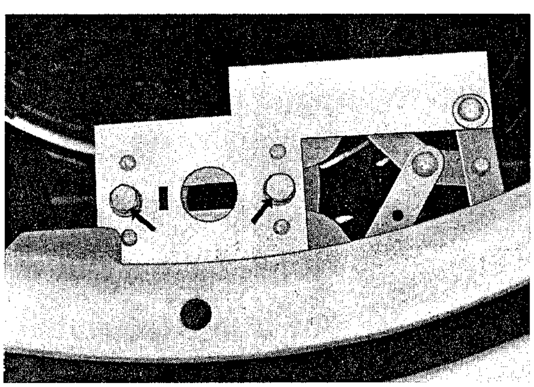


Fig. 10

4. Disconnect the return spring and remove the lock assembly.
5. Loosen the clamping screw and remove the release cable from the lock assembly.

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Grease the lock assembly.
2. Connect the release cable and return spring and position the lock.
3. Install the lock assembly loosely with the two cap screws and tighten release cable clamp.

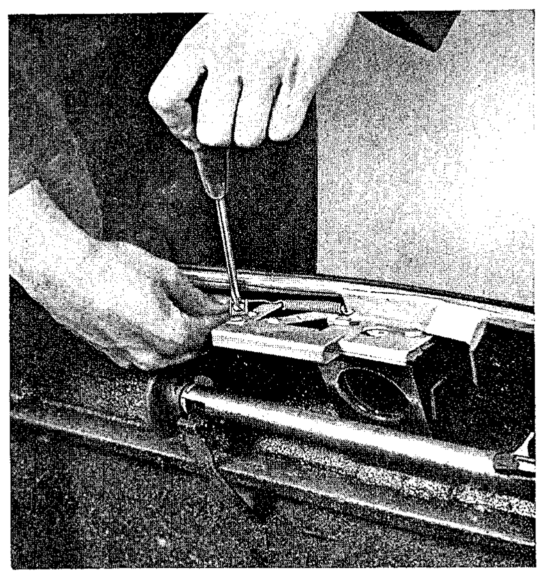


Fig. 11

4. Install latch assembly in the hood and tighten screws.
5. Apply a coat of grease to the surface of the lock plate and carefully close the hood. By observing the contact of the hood release striker, adjust the lock assembly.
6. Tighten the lock assembly screws.
7. Adjust the depth of the hood lock pin in the hood so that the hood closes to match the contours of the car.
8. Grease the springs and moving parts of the hood latch mechanism.

Emergency Access to Front Hood

General

The emergency access to the hood lock is located under the left front fender above the horn as shown in Fig. 12.

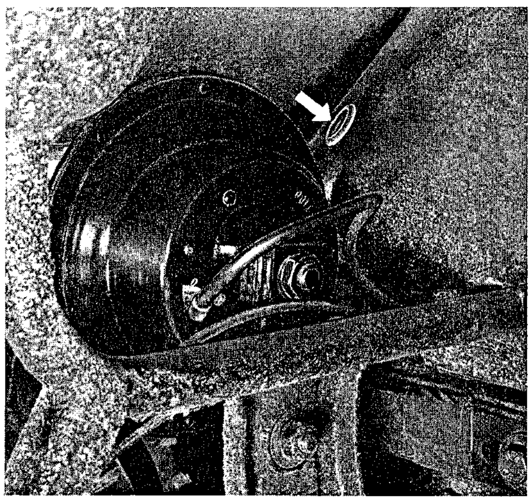


Fig. 12

In the event that the hood release cable becomes inoperative the hood may be opened in the following manner:

1. Turn front wheels fully to the right.
2. Remove the horn if necessary.
3. Remove rubber cap (at arrow Fig. 12).
4. Using a 3 mm dia. (wire clothes hanger) wire with its end bent in a small hook, reach into the hood lock and pull the release lever arm.

Note

It is important that the jack is always placed correctly in the holders. The lifting head must be to the right (driving direction). In the opposite position it will block the emergency access.

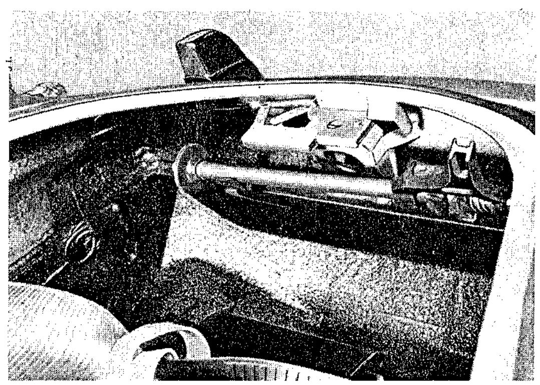


Fig. 13

Removing and Installing Rear Hood

4 BO

Removal

1. Pull hood release next to the left rear seat and raise hood into latched position. Mark position of hood on hinge.

2. Loosen two bolts on each hinge (Fig. 14).

3. While holding the hood remove the two screws farthest from the hinge first; then remove remaining screws removing the hood.

4. If necessary remove hinges by removing the mounting screws (5 BO).

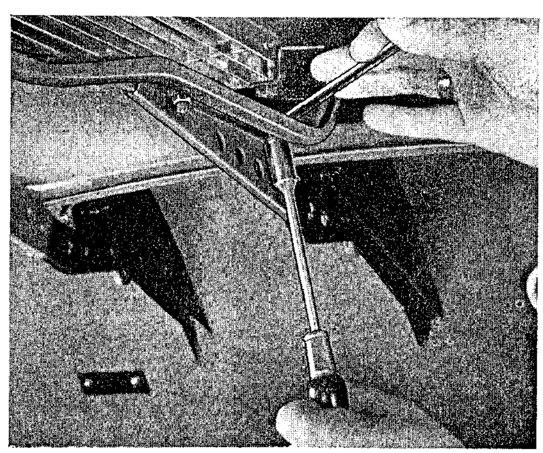


Fig. 14

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Inspect the rubber buffer pads at the four corners of the hood. Install new buffers where necessary.
2. Lightly fasten the four mounting screws and align the hood on the hinges.
3. Carefully close the hood to check its position with respect to the body. Adjust where necessary.

5 BO

Removing and Installing Hinges for Rear Hood

The hinges of the rear hood are held in place by two M 8 screws which can be reached from the engine compartment. The hinge latching device must operate freely so that the ratchet can turn easily.

For function of the latch mechanism see pages B 4 and B 5.

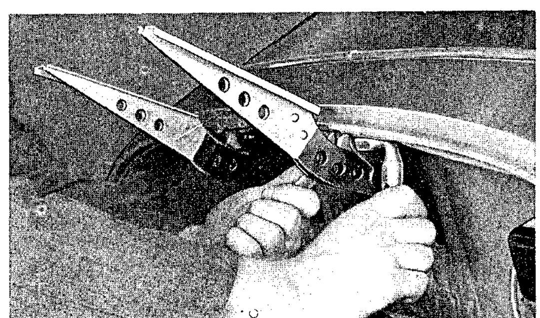


Fig. 15

6 BO

Removing and Installing Rear Hood Lock

Removal

1. Open rear hood and latch in raised position.
2. Remove two M 6 mounting screws in the hood and remove latch from hood.
3. Remove four M 6 mounting screws from the lock assembly and remove the lock.
4. Disconnect release cable.

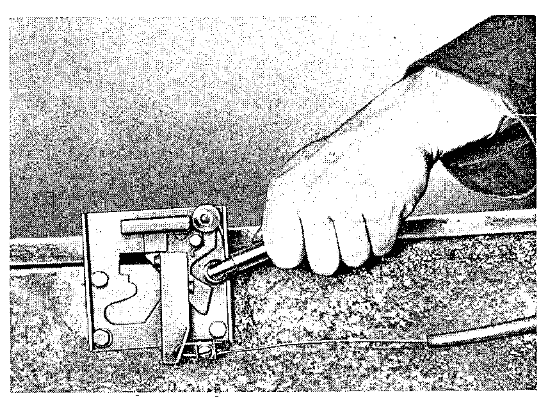


Fig. 16

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Grease lock assembly.

2. Install upper lock portion in the hood.

3. Install lock assembly in the body lightly tightening the four screws.

4. Check the position of the lock by closing the hood.

5. Tighten the four mounting screws.

6. Grease release cable (if cable is removed) and connect to lock assembly. Fasten cable clamp.

Emergency Access to Rear Hood

General

The emergency access to the rear lock is located in the engine compartment floor and can be reached from beneath the car.

1. Remove the rubber plug from below (Fig. 17).

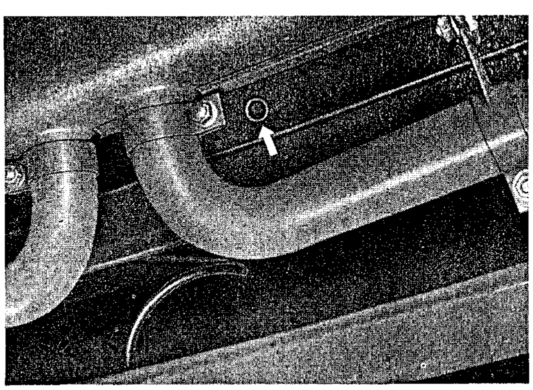


Fig. 17

2. Using a rigid steel rod, release the catch as shown in Fig. 18. (Fig. 18 shows the operation as seen from the engine compartment, engine removed.)

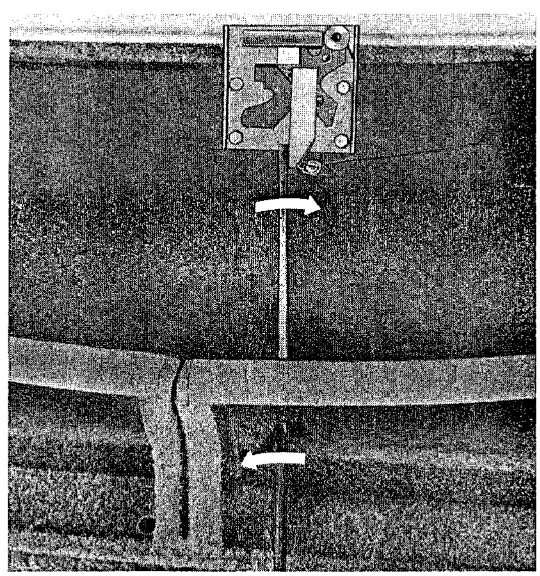


Fig. 18

7 BO

Removing and Installing Front Bumper

Removal

1. Remove the two bolts holding the bumper braces to the body and pull the bumper free from the car.

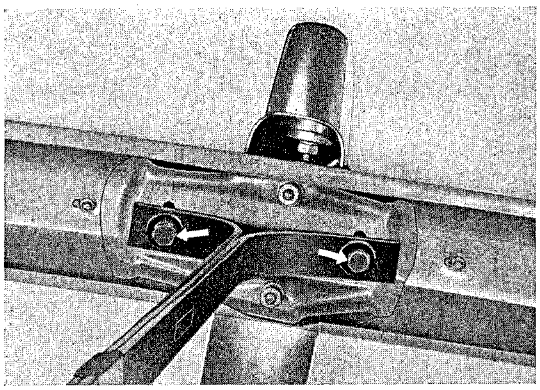


Fig. 19

2. Remove the two bolts holding the bumper braces to the bumper.

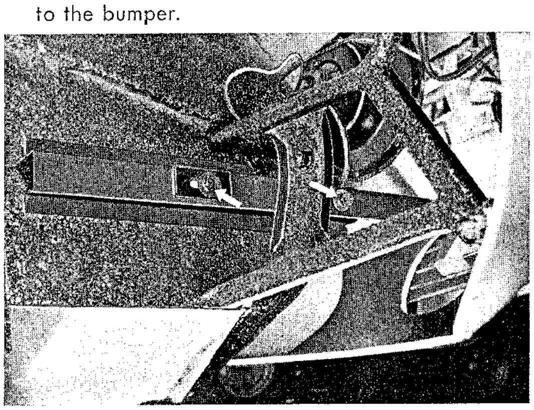


Fig. 20

3. Remove two M 8 nuts to remove the bumper guards.

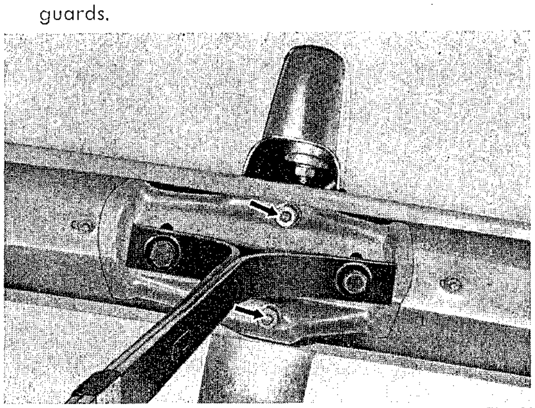


Fig. 21

4. To remove the moulding from the bumper, remove the nuts from the inside of the bumper. In the event that the screws turn, pull out the plastic center strip and hold the heads.

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. If a new moulding is installed it is necessary to trim the plastic edging so that it will fit around the curve at each end. Cut "V" shaped sections into the flat portion covered by the moulding to allow bending.

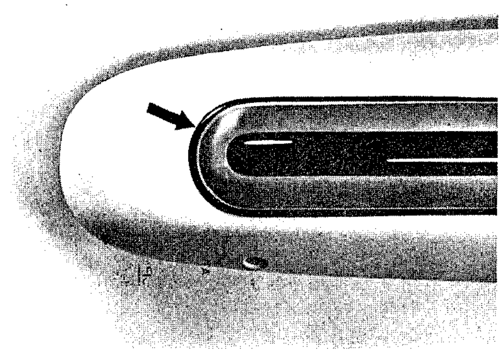


Fig. 22

2. Fit the correct plastic strips under the bumper guards.

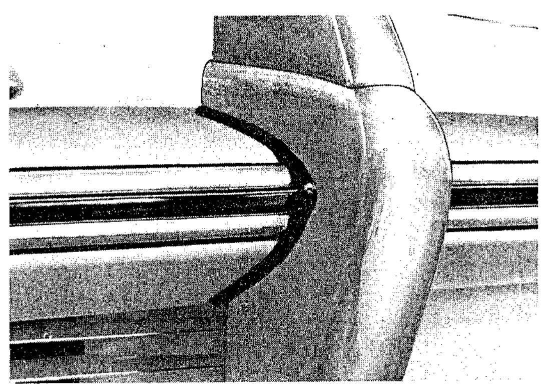


Fig. 23

3. Mount the bumper guards before installing the bumper.

Removal

1. Disconnect plug connectors to the licence plate lights.

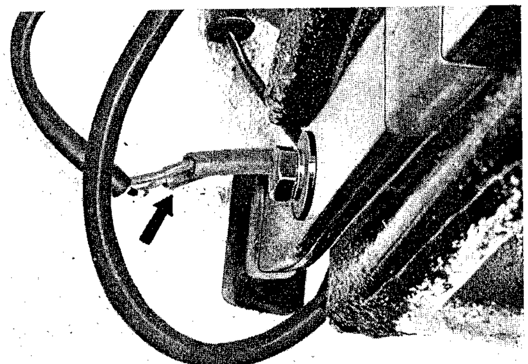


Fig. 24

2. Remove the bolts which hold the ends of the bumper from the inside of the fenders.

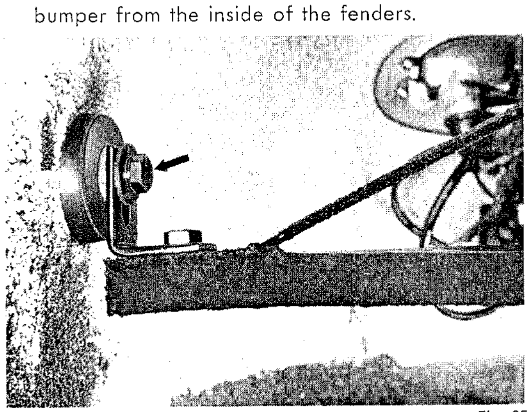


Fig. 25

3. Remove two bolts from each bumper brace under the fender and remove the bumper.

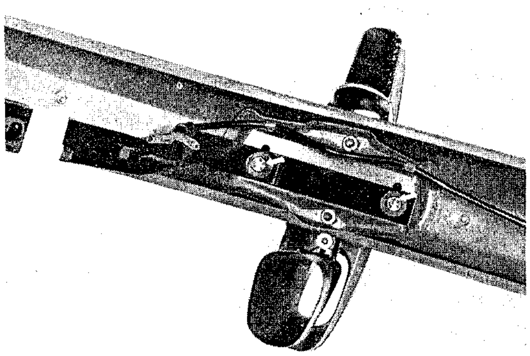


Fig. 26

4. Remove two bolts from the bumper brace at the bumper and remove the brace being careful not to damage the wires of the licence plate lights.

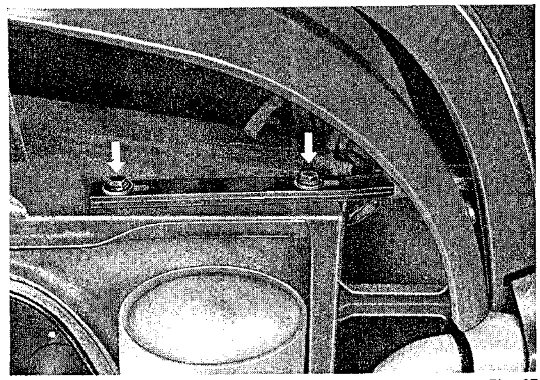


Fig. 27

5. Remove two bolts holding the bumper guard and remove bumper guard.

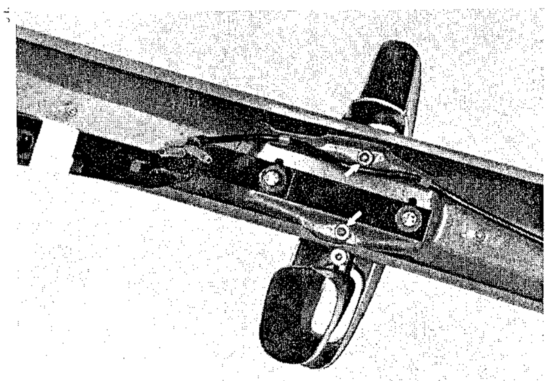


Fig. 28

6. Remove the nut holding the bumper guard exhaust funnel and remove the funnel.

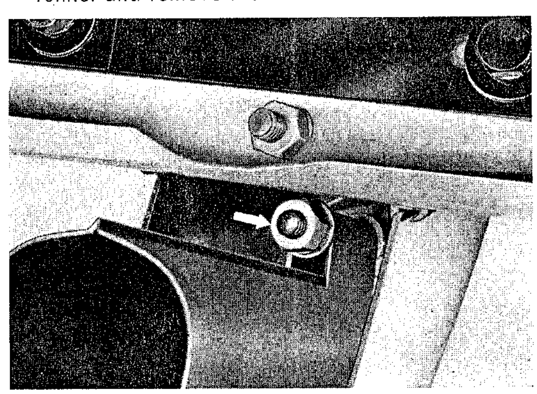


Fig. 29

7. If the moulding is to be removed, remove the nuts from the inside of the bumper. If the screws begin to turn, the plastic center piece can be pulled out to gain access to the screw heads.

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Check the plastic strip under the moulding. If replacement is necessary, proceed as in 7 BO and cut excess material from the inside of the curved portion at either end of the bumper.
2. Install the plastic strips correctly under the bumper guards.
3. Install the bumper guards and braces before securing the braces to the car.
4. Loosely install all bumper mounting screws before tightening.

Removing and Installing Doors

9 BO

Removal

1. Remove sheet metal covering the hinges.
2. Remove cotter keys from hinge pins.
3. Drive the upper hinge pin down with a hammer and drift.

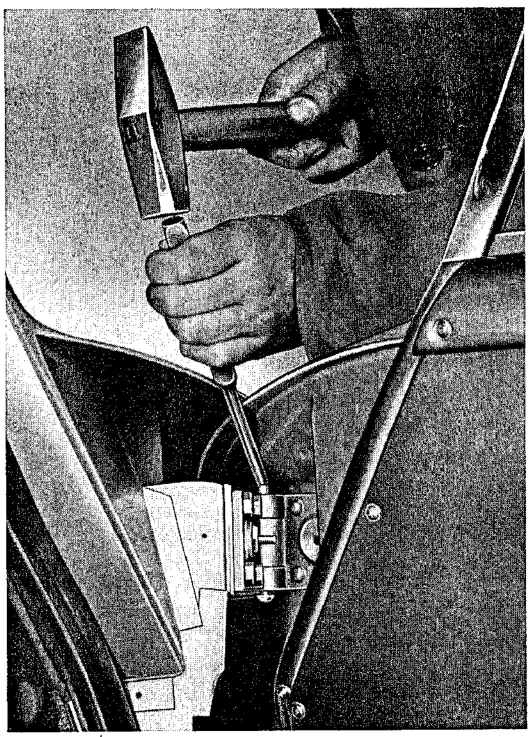


Fig. 30

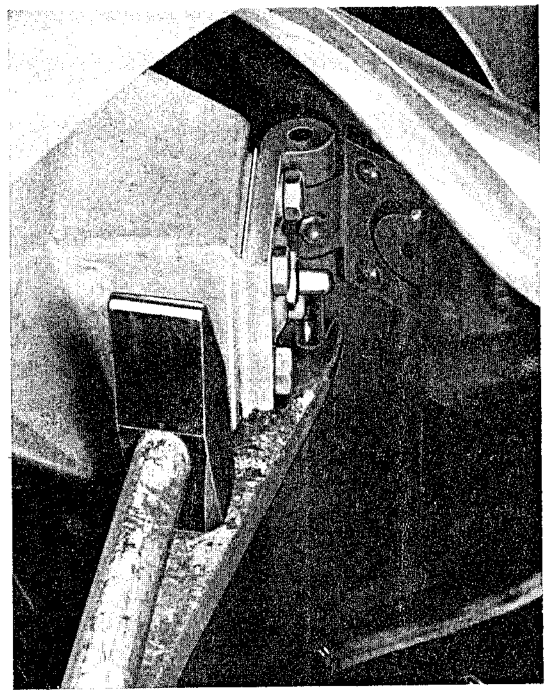


Fig. 31

To extract the hinge pin a piece of flat iron with an 8.5 mm dia. hole cut open with a hack saw can be used to advantage. While extracting the hinge pins, an assistant should hold the door.

4. Remove the rubber cap from the panel below the lower hinge and drive the lower hinge pin out from below using a hammer and drift.
5. Remove the door.

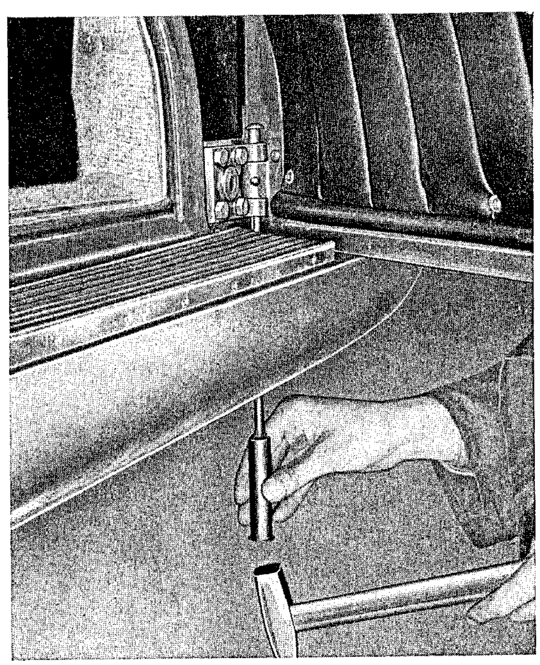


Fig. 32

Weather Strip

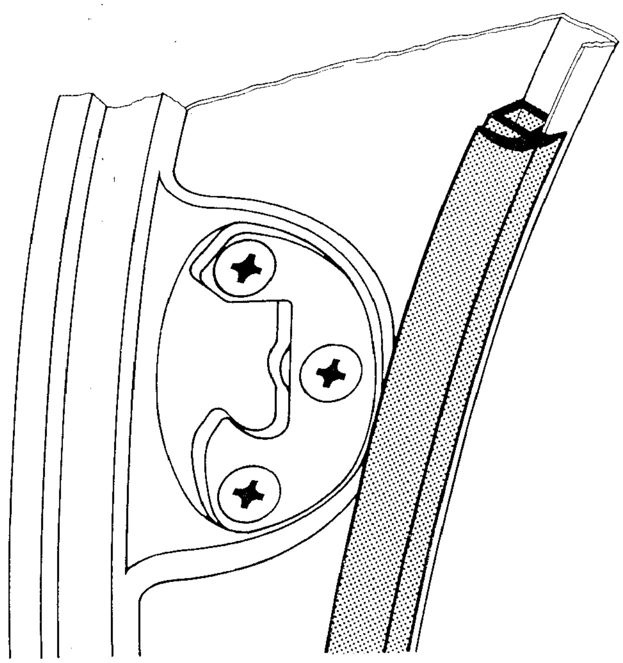


Fig. 33

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Inspect weather stripping and install new weather strip where necessary.

2. After installing the door, check whether the door fits flush with the body on all sides. The adjustment can be made by removing or installing shims at the door hinges. Remove the four cap screws shown in Fig. 34 and adjust as required.

3. Test the weather strip around the doors by inserting a piece of paper and closing the door. If the paper can be pulled out easily, it is necessary to install sponge rubber stripping under the weather strip to obtain the required contact.

4. Grease the hinges cleaning nipples before connecting the grease gun.

5. Check the door lock to see if the door closes sufficiently and is properly closed. The lock plate can be moved vertically and horizontally by loosening the three philips screws.

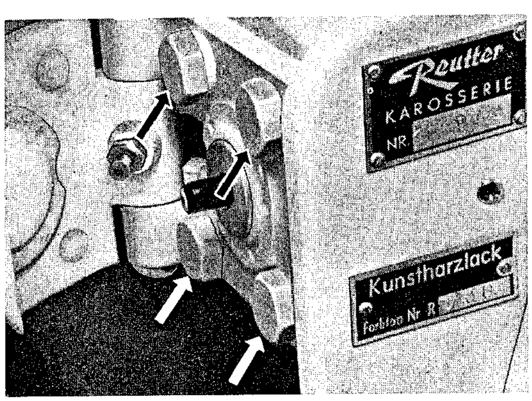


Fig. 34

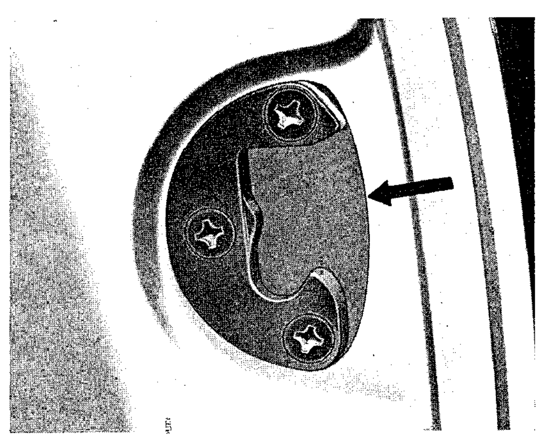


Fig. 35

Note

a. The rubber parts and weather strips may cause squeaking noises where they contact metal parts. This can be corrected by dusting the parts in question with tire talcum powder.

b. If a door rattles while closed, the position of the door with respect to the body should be checked. If the door is not flush with the body, the lock plate must be moved inward. The enlarged holes in the body may be widened if necessary.

It is, however, important, that the holes are covered in the installed position so that water and dirt cannot enter into the car from the car underside.

c. The three screws of the lock plate thread into a common plate inside the door post.

Removing and Installing Door Panels

10 BO

Removal

1. Remove door handle and window crank. The retaining pins are removed by pushing back the handle boss and pressing the pins out with a punch.
2. Remove the top moulding by removing two philips screws.
3. Remove the screws from the door panel observing the screw inside the glove compartment. The "D" handle must not be removed since it is part of the panel. Remove the panel.

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Check the rubber strips and replace where necessary before installing the door panel.
2. Do not forget to install the springs for the window and door handles before installing the door panel.
3. Check for loose objects (tools) lying inside the door which may rattle after assembly.

11 BO

Removing and Installing Door Window

Coupe

Removal

1. Roll down window.

2. Remove door panel (10 BO).

3. Remove sponge rubber pad from window crank shaft.

4. Disconnect window rails from the bottom of the door frame.

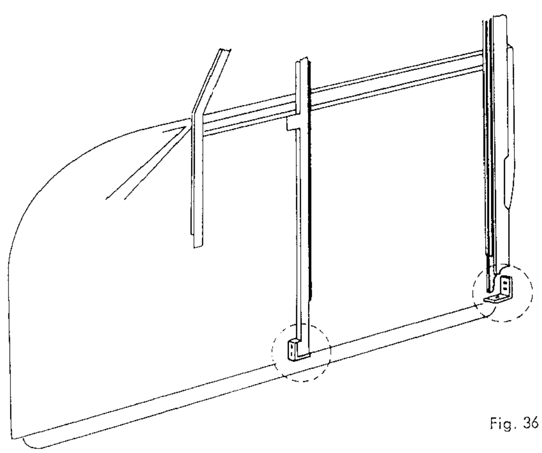


Fig. 36

5. Bend open the window elevating track at the arrow Fig. 37, and spread the window rails so that the window can be brought out of the frame toward the inside.

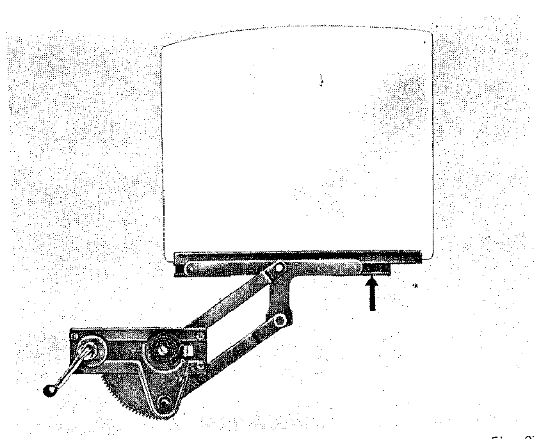


Fig. 37

6. Lift the window so that the forward roller leaves the end of the elevating track and tilt the assembly forward lifting it from the door edgewise.

7. Remove the screws which hold the elevating mechanism and remove the assembly.

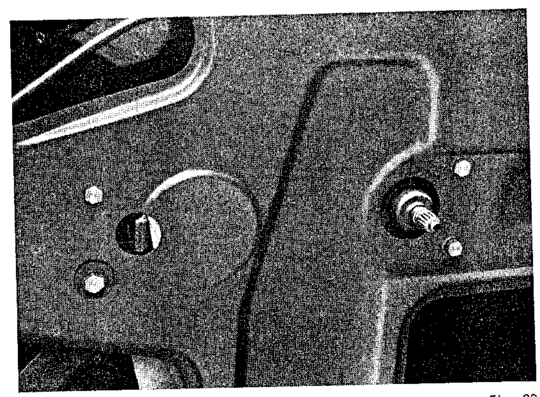


Fig. 38

8. Remove the window frame rails only if necessary.

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Install the elevating mechanism loosely at first.

2. Install the window standing it on edge and lowering it into the door channel so that the elevating track engages the rollers of the elevating mechanism. Bend track back into shape.

3. Fasten window rails to the bottom of the door frame.

4. Adjust the window rails so that the window is secured but free to move. Adjust the level position of the window by adjusting the position of the elevating mechanism (thin arrow Fig. 39).

5. Tighten the mounting screws of the elevating mechanism.

6. The bottom of the window travel is regulated by a stop on the window carrier (large arrow Fig. 39).

7. Grease moving joints of the elevating mechanism.

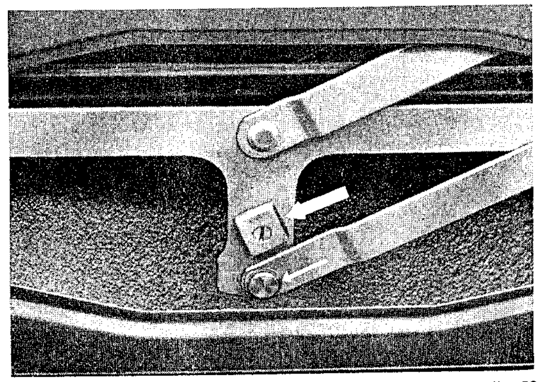


Fig. 39

Cabriolet-Hardtop

Removal

1. Roll down window.
2. Remove door panel (10 BO).
3. Remove sponge rubber pads from the mounting screws.
4. Remove felt moulding at the upper edge of the window channel.
5. Disconnect window rails from the bottom of the door frame.

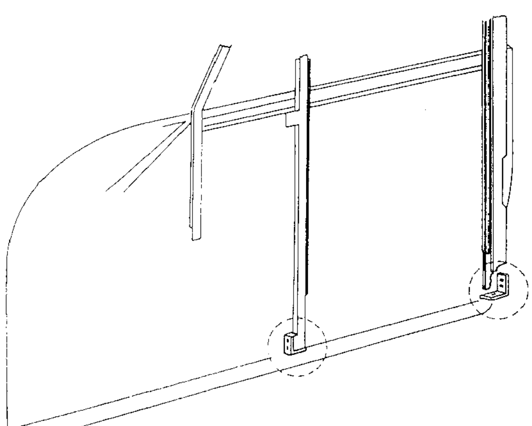


Fig. 40

6. Remove the nut (14 mm) from the inside of the elevating arm pin (on the other end of the pin shown by the arrow Fig. 41).

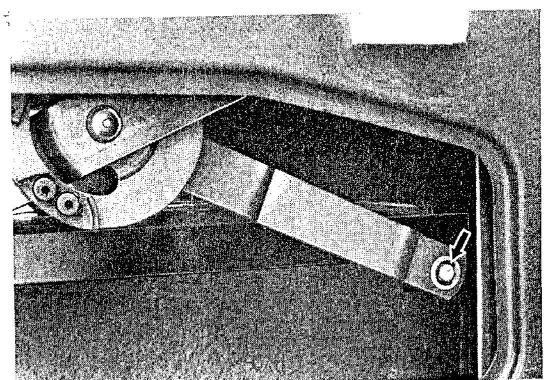


Fig. 41

7. Roll the other elevating arm out of the track, move the window out of the frame and lift it out tilting it up edgewise.
8. Remove screws holding the elevating mechanism and remove the entire assembly.

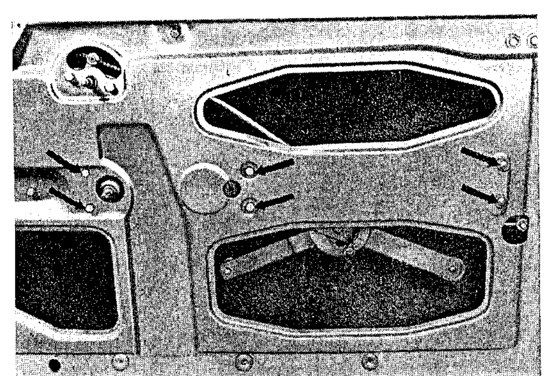


Fig. 42

9. Remove the window rails only if necessary.

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Install the elevating mechanism loosely at first.
2. Install the window edgewise so that the elevating roller is engaged and the window fits into the rails.
3. Fasten the window rails to the bottom of the door frame.
4. Install the nut on the back of the elevating arm pin (Fig. 41) and raise the window fully to determine whether the window is parallel to the frame. Adjust the mounting screws of the elevating assembly.
5. Tighten the mounting screws of the elevating assembly.
6. Install felt moulding at the upper edge of the window slot.
7. The fully raised windshield should extend a slight amount higher than the top of the wind wing rim (approx. 1 mm, 1/32 in.).
8. The end stops for the windshield travel are adjustable for downward and upward travel in Fig. 43 and Fig. 44 respectively.

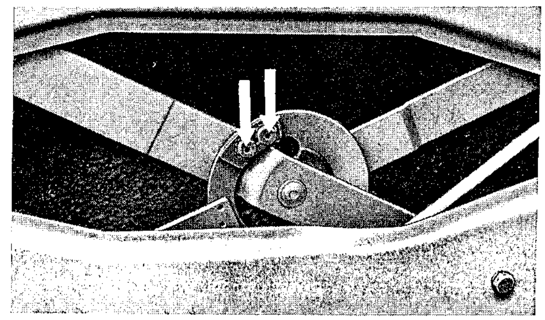


Fig. 43

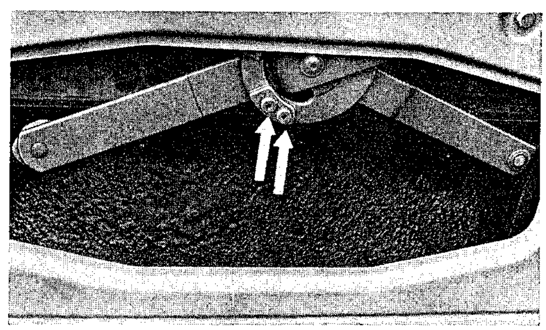


Fig. 44

Roadster

Removal

1. Roll down window.
2. Remove door panel (10 BO).
3. Remove felt moulding from the top edge of the window slot.
4. Remove the nut on the end of the elevating arm.

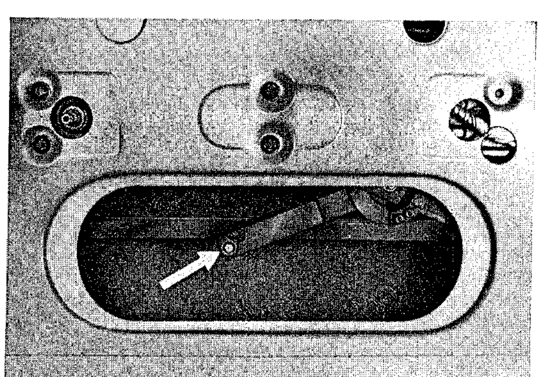


Fig. 45

5. Remove the screws which hold the elevating mechanism.

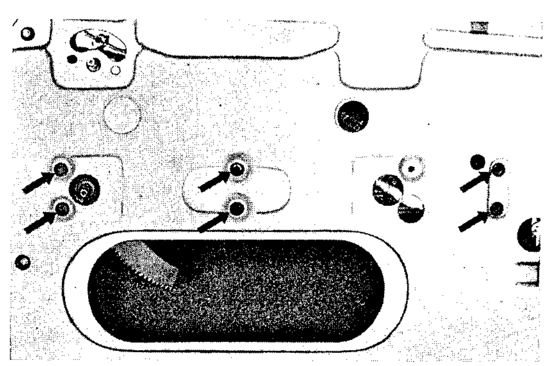


Fig. 46

6. Move the elevating arm roller from the window track and raise the window by lifting it out edgewise.
7. Remove the complete elevating assembly.

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Roll down the elevating mechanism as flat as possible so that it will fit through the opening in the door.

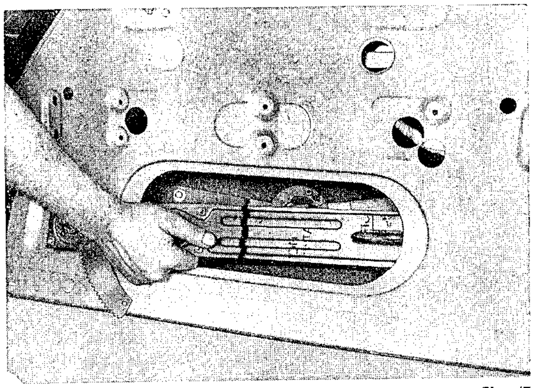


Fig. 47

2. Loosely fasten the elevating mechanism to the door so that it can be adjusted to fit the window.

3. Disconnect the window rails from the bottom of the door frame so that the window may be adjusted to fit the elevating mechanism and install the window.

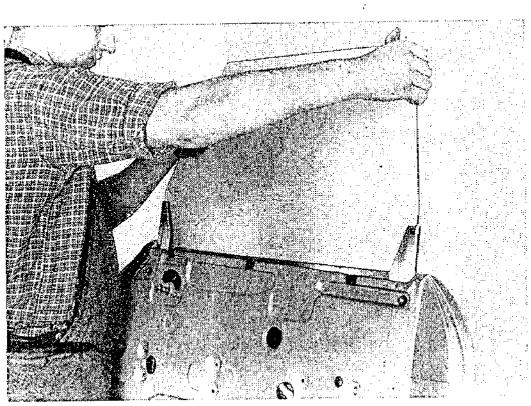


Fig. 48

4. Engage the rollers of the elevating arm in the elevating track of the window. Tighten the elevating mechanism mounts when the correct position is obtained.

5. Fasten the window rails to the bottom of the door frame.

6. Roll up the window and check whether it is parallel to the windshield post and roof. If not, adjust by re-locating the elevating mechanism.

7. The window must be tilted inward so that it seals against the roof and windshield post when the door is closed. The slope can be adjusted by moving the window rails.

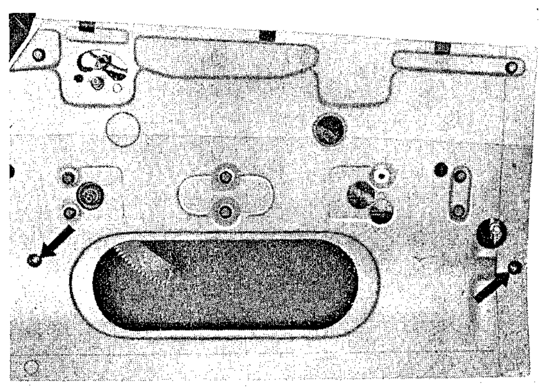


Fig. 49

8. The travel of the window can be adjusted by two limiting stops on the elevating mechanism (see item 8 page R 18).

9. Grease all moving joints of the elevating mechanism.

4. Using a 10 mm socket, remove two cap screws from front edge of window frame.

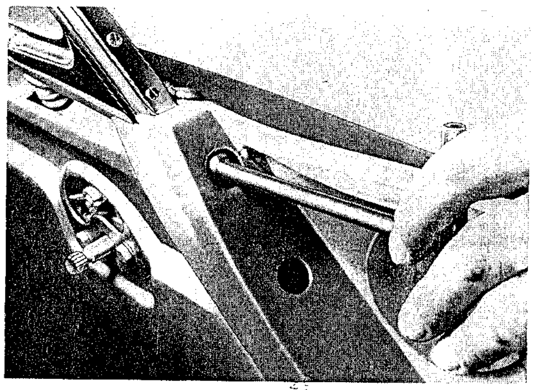


Fig. 53

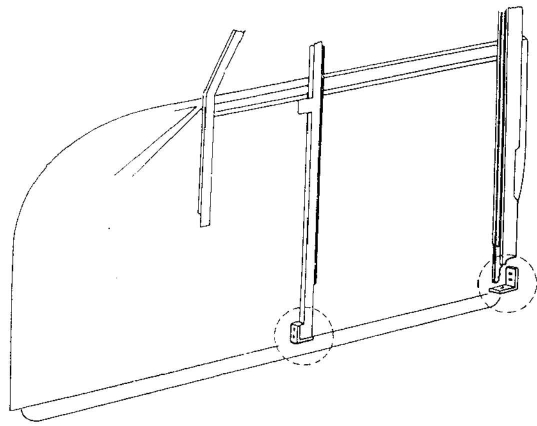


Fig. 55

7. Remove window frame and rails from the door.

5. Remove two cap screws from the inside of the door indicated by arrows in Fig. 54.

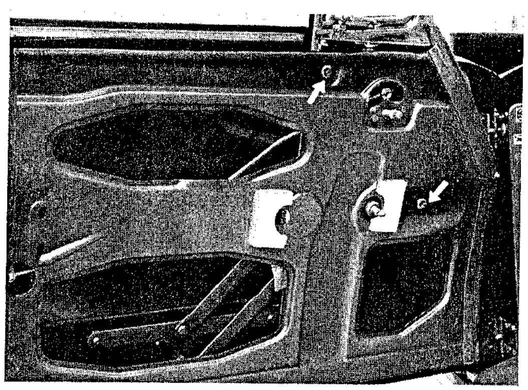


Fig. 54

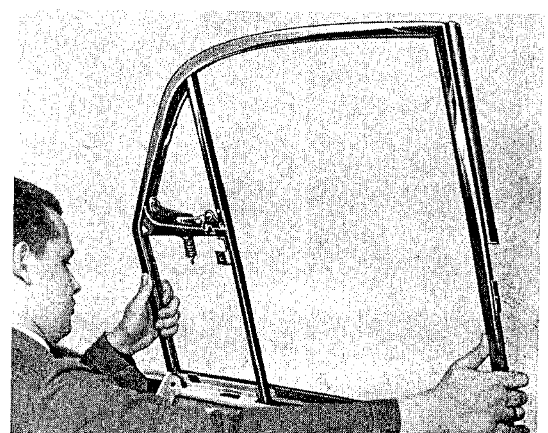


Fig. 56

6. Remove the screws from the window rail in the bottom of the door frame if they have not already been disconnected.

Installation

The installation is accomplished in the reverse order of removal observing the condition of the weather strip and felt linings in the window rails replacing where necessary.

Cabriolet-Hardtop

Removal

1. Remove door panel (10 BO).
2. Remove window (11 BO).
3. Remove the mounting screws from the vent window frame and window rail as shown in Fig. 57.

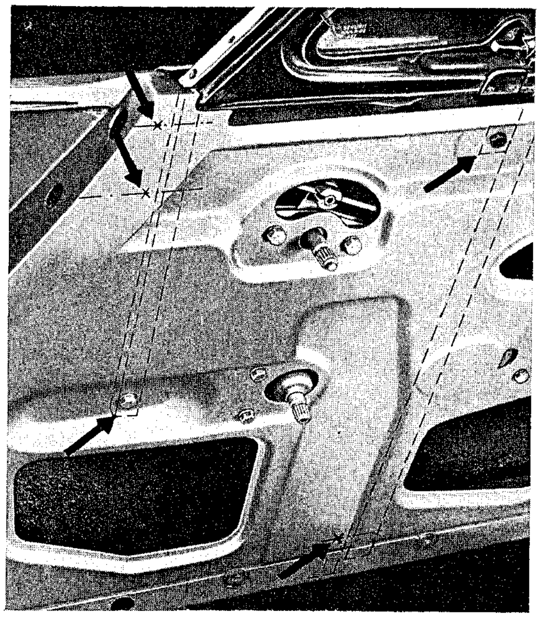


Fig. 57

4. Remove the vent window, frame, and window rail.

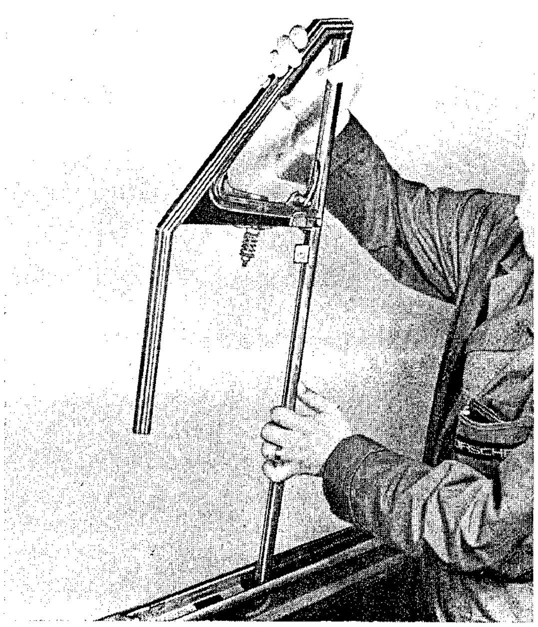


Fig. 58

5. Remove the two screws from the rear window rail.

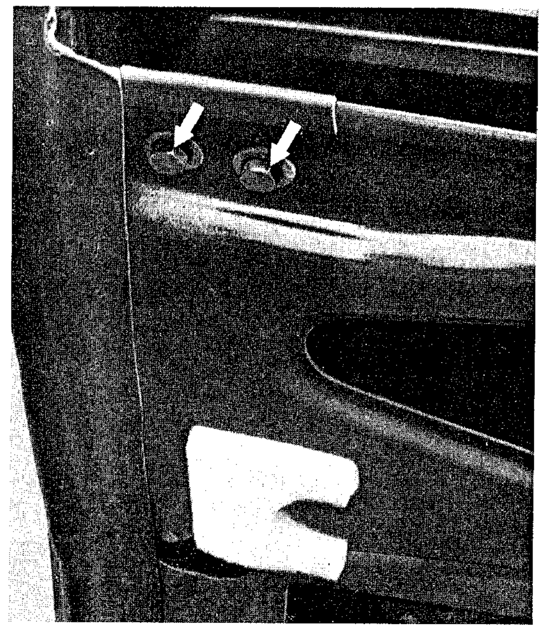


Fig. 59

6. Remove screws from lower end of the window rail.
7. Remove the window rail.

Installation

The installation is accomplished in the reverse order of removal observing the condition of the weather strip and felt linings in the window rails replacing where necessary.

Roadster

Removal

1. Remove door panel (10 BO).
2. Remove window (11 BO).
3. Remove the window rail screws as shown in Fig. 60.
4. Remove window rail.

The installation is accomplished in the reverse order of removal observing the condition of the weather strip and felt lining of the window rails replacing where necessary.

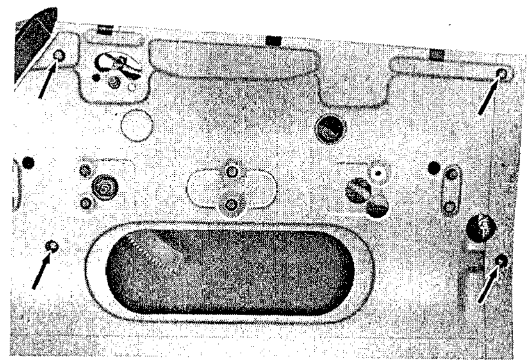


Fig. 60

Function of the Door Lock

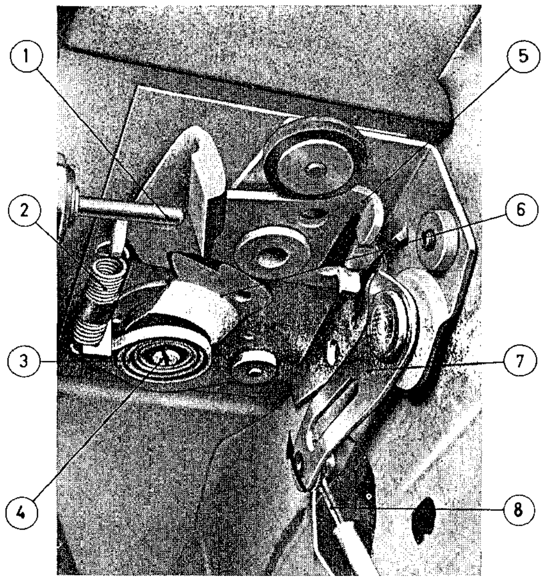


Fig. 61

Door closed. The arrows indicate the position in which the door is locked from the inside.

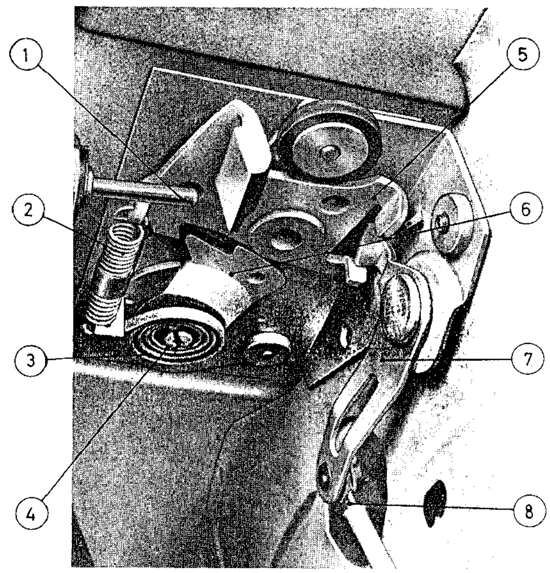


Fig. 62

Door being opened from the inside.

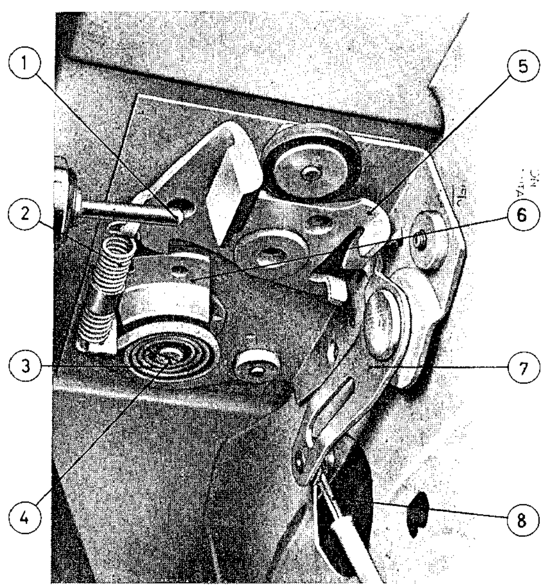


Fig. 63

Door latch released (door open).

① Push button plunger
② Catch return spring
③ Spiral spring of the latch
④ Spiral spring mount
⑤ Catch
⑥ Latch
⑦ Catch release and lock
⑧ Catch release cable

Removing and Installing Door Lock

14 BO

Removal

1. Remove door panel (10 BO).
2. Remove window (11 BO).
3. Remove window frame. Only the one window rail on the Roadster (13 BO).
4. Remove set screw from door lever and pull out release cable.
5. Remove door lever mounting screws and remove lever assembly.

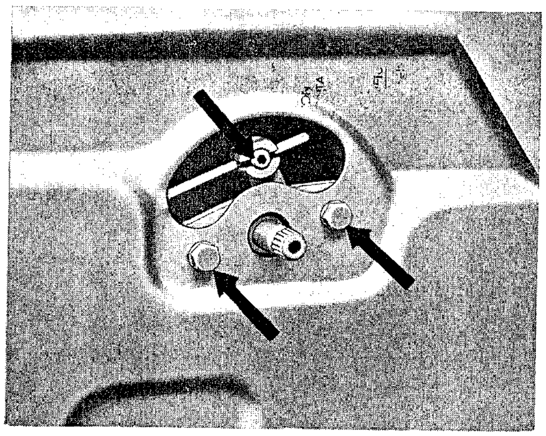


Fig. 64

6. Remove the four mounting screws from the door lock.

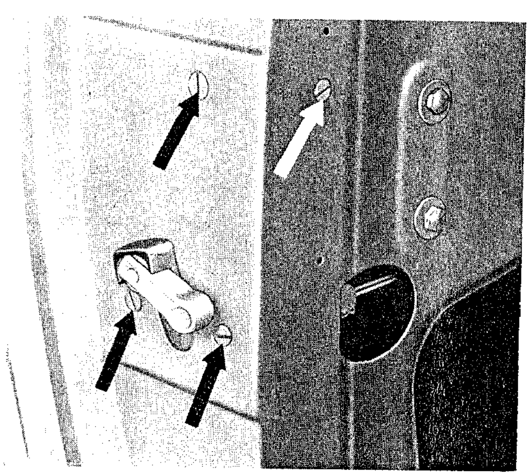


Fig. 65

7. Remove the door lock from the door.

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Inspect the lock for worn parts and weak springs replacing parts as necessary.
2. Clean all parts and grease the moving parts.
3. Adjust the door striker so that the door surface fits flush with the car body.

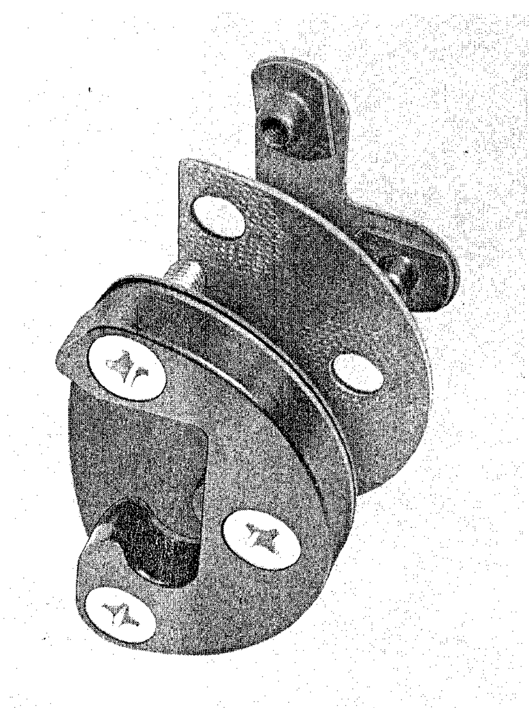


Fig. 66

Removing and Installing Windshield

Coupe, Cabriolet-Hardtop

Removal

1. Remove windshield wiper arms.
2. Using a sharp knife or linoleum knife, cut rubber around entire window being careful to cut close to but not touching the aluminum trim. Remove cut rubber and slide trim strip connections to one side.

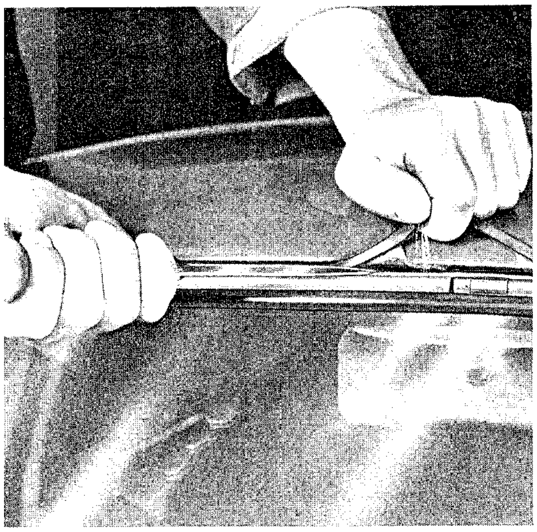


Fig. 67

3. Insert a putty knife or screw driver completely under trim strip and draw evenly around the window. Remove trim strip.

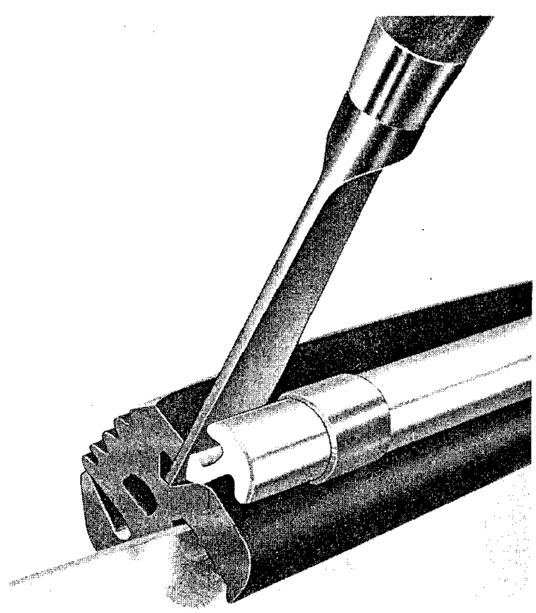


Fig. 68

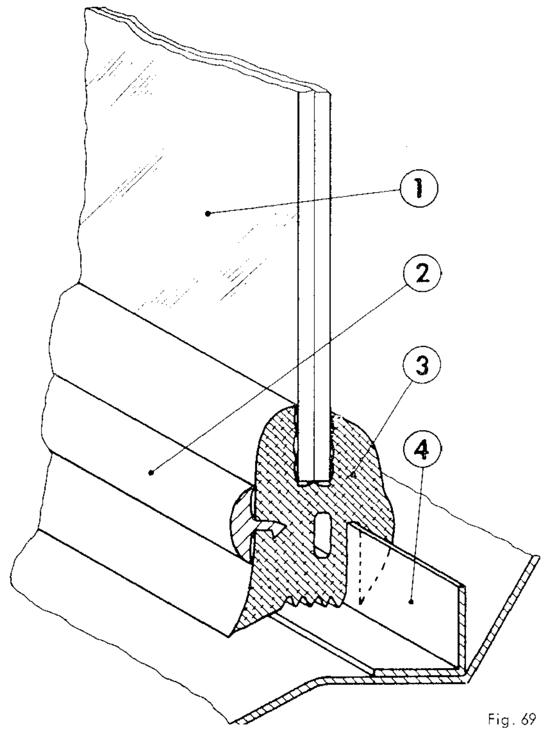


Fig. 69

① Windshield
② Trim strip
③ Rubber strip
④ Body section

4. Loosen rubber around glass with a putty knife, then cut parallel to the surface of the glass through the weather strip being careful not to chip or scratch the edge of the glass.

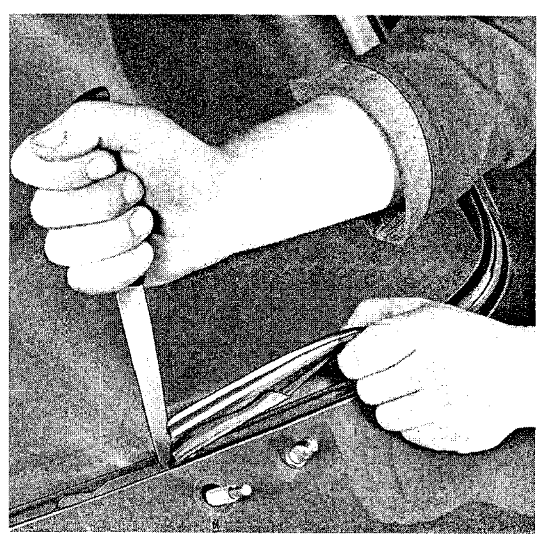


Fig. 70

5. Using the palm of the hand, gently strike the upper part of the windshield from the inside and remove the windshield.

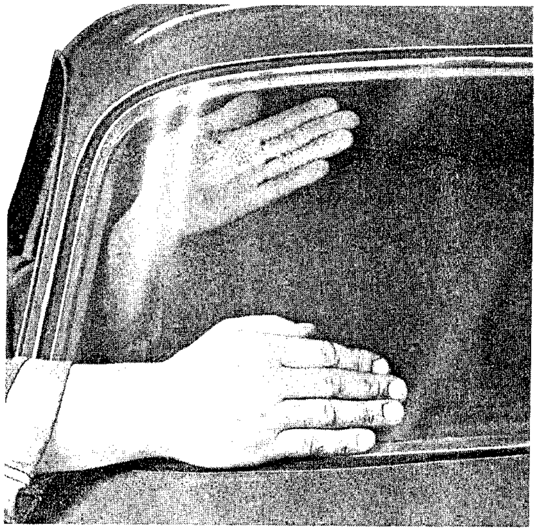


Fig. 71

6. Clean the recess for the windshield weather strip of rubber and rubber cement.

Note

If the entire car is to be spray painted, the windshield should be left in after performing step 3 removal. The windshield can easily be removed and cleaned after spraying.

Installation

1. Clean windshield and inspect defroster vents for obstructions.

2. Place new rubber strip on clean windshield so that the connected seam is exactly in the bottom center of the windshield.

3. Using rubber lubricant or soapy water, moisten the slot for the aluminum trim and press trim strip in place. Slide center connectors in place.

4. Insert a thick cord into the bottom of the slot (item 4 in Fig. 69) so that the cord overlaps at the top.

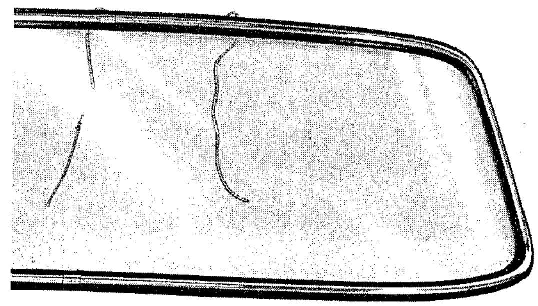


Fig. 72

5. Set complete windshield with rubber strip and trim into the windshield frame engaging the lower edge first. Press windshield into the frame as far as possible and pull out the cord parallel to the glass.

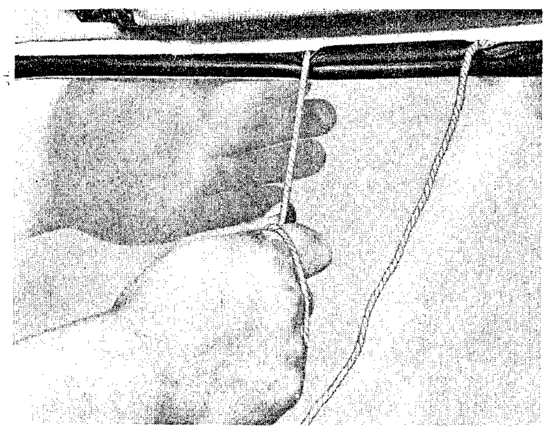


Fig. 73

6. Using a wooden block and hammer, seat the windshield firmly in place.

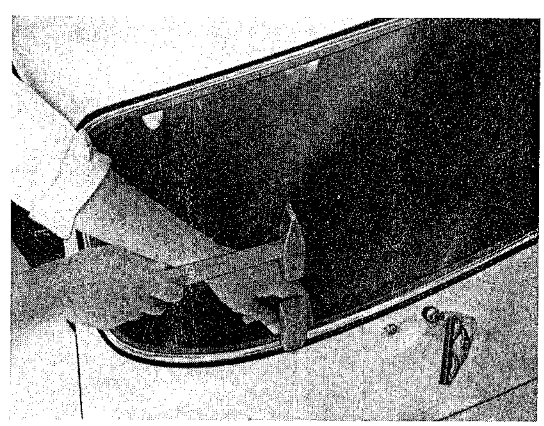


Fig. 74

7. Apply special rubber cement between the rubber strip and body, using a putty knife to pry up the edge of the strip. The same procedure is used to apply rubber cement between the outside of the windshield and the rubber strip.

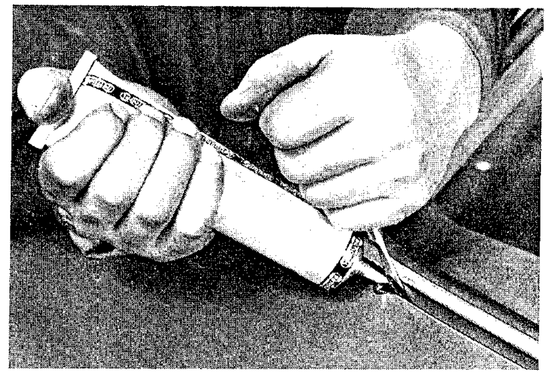


Fig. 75

Note

This step is essential to insure a waterproof seal between the windshield and body.

Roadster

Removal

1. Lower convertible top.
2. Remove wiper arms.
3. Remove windshield holding clamps from wiper shafts by removing the nut and rubber pad.
4. Remove trim strip lifting upward and out.
5. Remove windshield frame tensioner by removing the two screws at the top and releasing the tension from beneath the instrument panel.

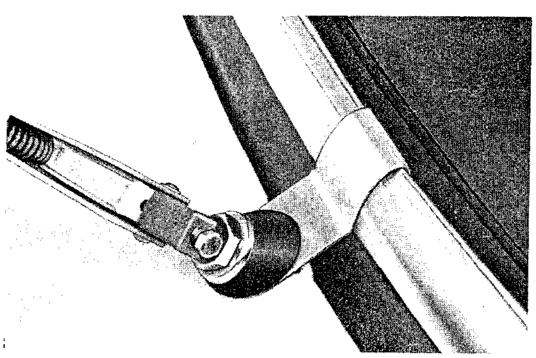


Fig. 76

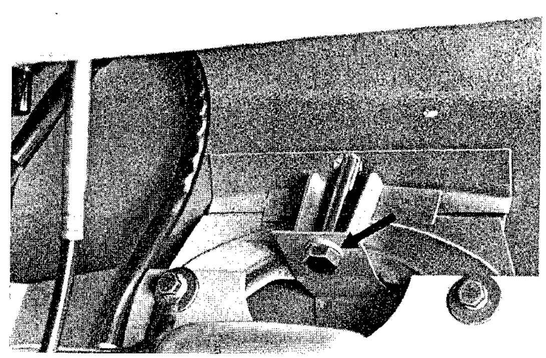


Fig. 77

6. Remove the two allen head screws located at the extreme left and right lower edges of the instrument panel. These screws thread directly into the windshield posts.

7. Lift out windshield with frame.

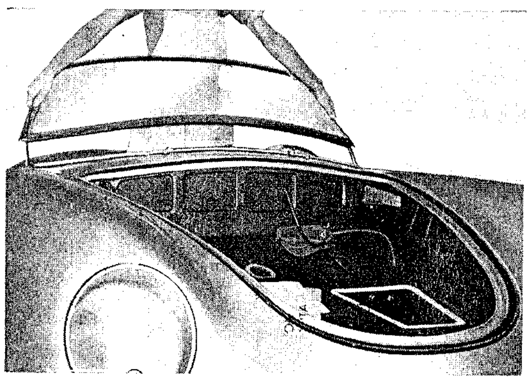


Fig. 78

8. Remove lower rubber strip.

9. Remove windshield from frame.

Installation

1. In the case of a new windshield, compare the shape of the glass and the frame. If there are differences, the glass must be reworked to match the frame.

2. Fit rubber strip to the windshield.

a. Slot for glass.

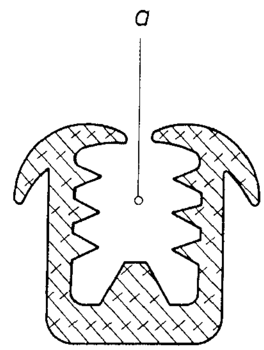


Fig. 79

3. Install windshield in frame and secure with two cords.

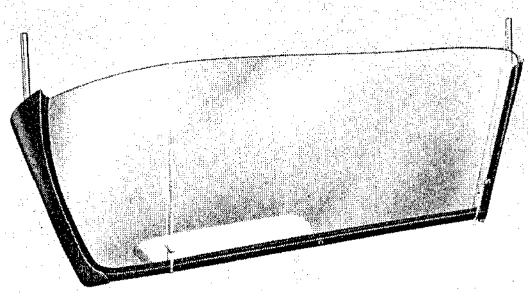


Fig. 80

4. Seal rubber with special rubber cement around edges.

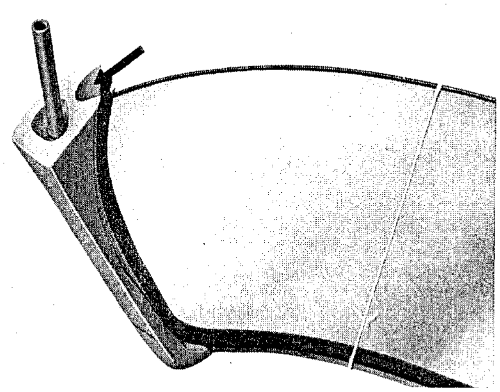


Fig. 81

5. Install lower rubber strip.

Bottom rubber strip

a. Windshield slot

b. Trim strip slot

c. Slot for body sections

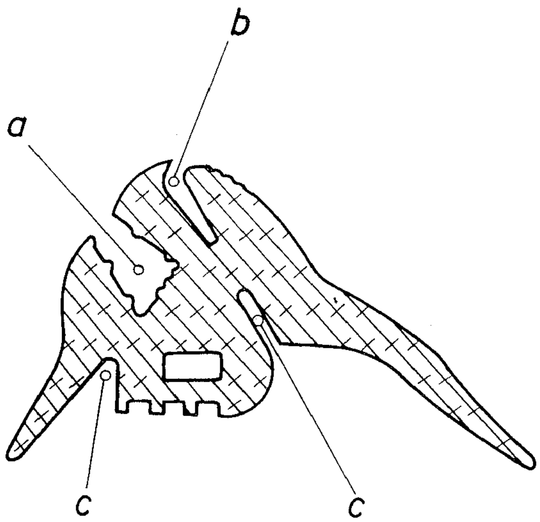


Fig. 82

6. Install windshield complete with frame.

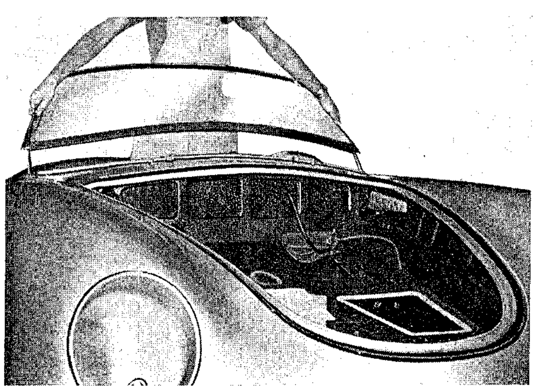


Fig. 83

7. Install and tighten allen screws for windshield posts.

8. Check the angle of the windshield post with respect to the door window and the top as shown in Fig. 84. The correct space is approx. 15 cm ($^5/_8$ in.) which can be adjusted by placing shims under the windshield post as required.

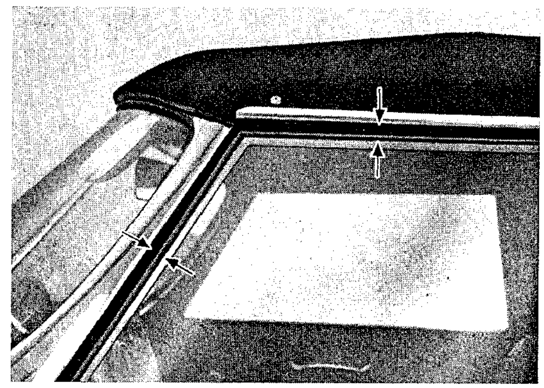


Fig. 84

9. Install tension rod in center of windshield.

10. By raising the forward edge of the lower rubber strip, check whether the body section is properly engaged.

11. Press down rubber strip so that the body section seats fully.

12. Place a cord in the slot ("b" Fig. 82) and insert trim strip. Pull out cord downward and press trim strip in place.

13. Install windshield holding clamps on wiper shafts.

14. Install wiper arms.

15. Test the windshield with water. Where leaks are found, dry with compressed air and seal with special rubber cement.

16. Clean windshield with alcohol.

Removing and Installing Rear Window

16 BO

The removal and installations is accomplished in a manner similar to that of the windshield.

Removing and Installing Side Windows

17 BO

Removal

1. Open the window and remove the three screws which hold the window linkage.

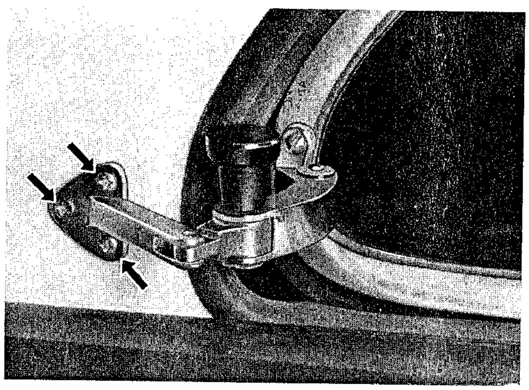


Fig. 85

2. Remove two screws from each hinge and remove the window.

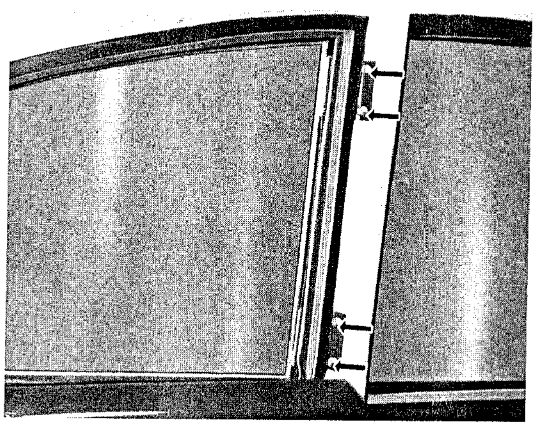


Fig. 86

3. If necessary, remove the screws from the hinges and remove the hinges.

Disassembling

1. Pull weather strip from the outer edge of the window frame.

2. Remove end piece from the frame as in Fig. 87.

3. Remove the straight section of the window frame and remove the pane from the frame.

4. Remove the rubber strip from the frame.

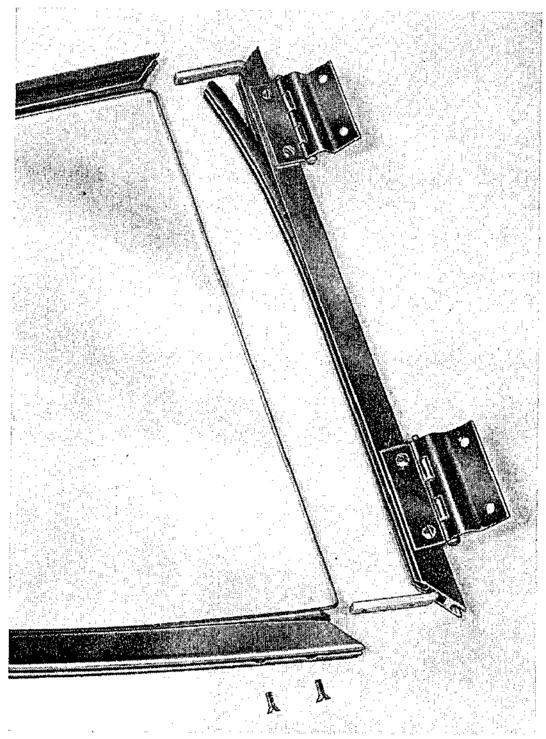


Fig. 87

Assembly and Installation

The assembly and installation are accomplished in the reverse order of disassembly and removal respectively, observing the following points:

1. Inspect all rubber gaskets and weather strips replacing them where necessary.

2. Check seating of the rubber parts and that the window opens and closes properly.

3. Dust rubber parts with talcum powder.

Removing and Installing Front Seats

18 BO

Removal

1. Remove rubber floor mat in front of the seat.

2. Press seat catch lever and move seat fully forward.

3. Remove seat.

Installation

Before installing the seat, grease the rails and inspect the surfaces of the sliding parts.

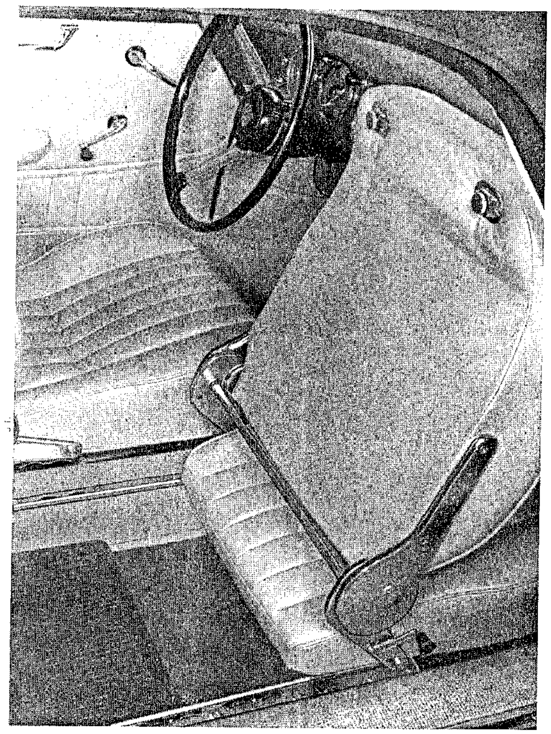


Fig. 88

19 BO

Removing and Installing Folding Back Rests

Removal

1. Remove the two screws at the rear of the mat covering the back of the seat.

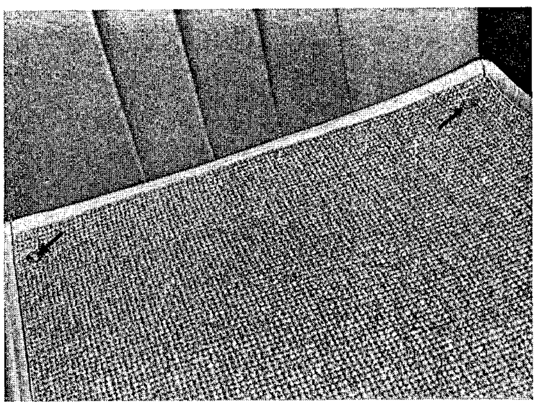


Fig. 89

2. Raise the back rest.

3. Remove both hinge screws noting the position of the washers.

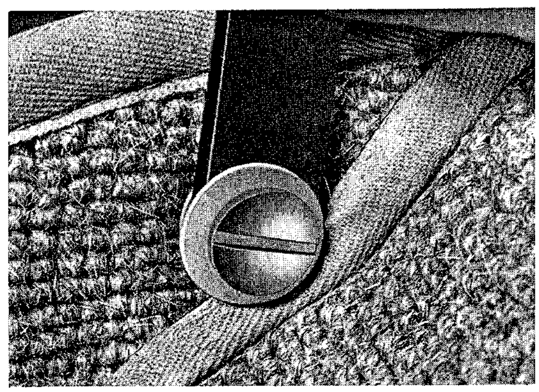


Fig. 90

4. Remove back rest.

Installation

The installation is accomplished in the reverse order of removal.

Removing and Installing Door Handles

20 BO

Removal

1. Remove door panels (10 BO).

2. Remove the screw from the front of the handle.

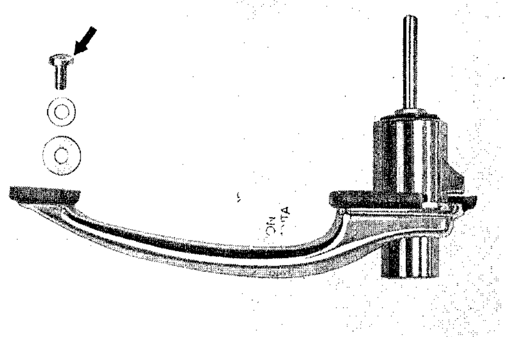


Fig. 91

3. Remove the door handle and locking assembly pulling forward and out so that the tang at the base of the lock becomes free from the door.

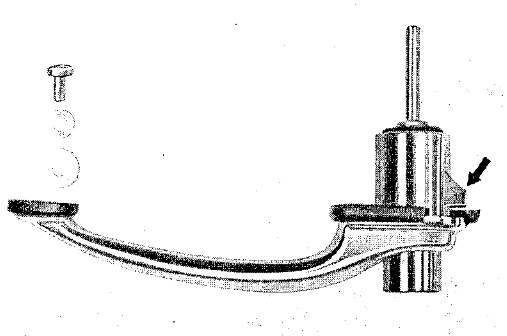


Fig. 92

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Install new rubber pads under the door handle if necessary.

2. Test the length of the push rod before replacing the door panel. If necessary, file off the end of the push rod or adjust by bending so that the lock functions properly.

21 BO

Removing and Installing Mouldings

Removal

1. Push back the rubber strip at the door jamb and remove the screw holding the window moulding.

2. Remove the moulding unhooking it from the slot in the rear wall.

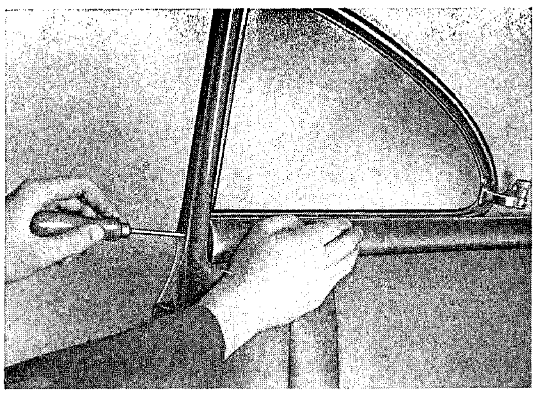


Fig. 93

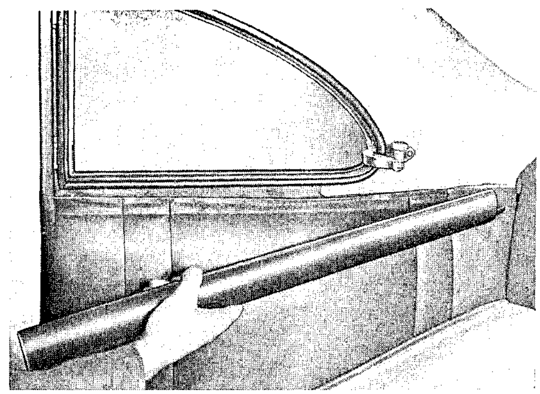


Fig. 94

Installation

The installation is accomplished in the reverse order of removal.

22 BO

Removing and Installing Grills, Hood Ornament, and Porsche Name Plate

The grills are easily removed by removing the screws which support them.

When installing the grills it is important that the rubber is properly located.

Name Plate

The name plate and model designation (1600, 1600 Super, 1600 Super 90) are held by spring clips which are spot welded to the inside of the rear body sheeting. The name plate has pins which protrude through the body sheeting, and are held by the spring clips.

The spring clip has smaller openings in it than the size of the pins and is therefore expanded by the pins as they are pushed into place. The locking jaws of the spring clip hold the name plate firmly against the car body.

To remove the embleme, pry evenly near the pins shown in Fig. 95 until the entire piece is free.

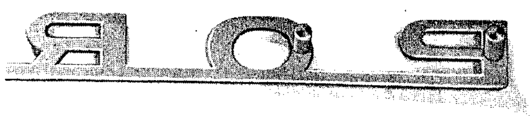


Fig. 95

Fig. 96 shows the spring clip which is spot welded to the inside of the body panel.

It is advisable to use a new plate when repainting the car since it is practically impossible to remove the old one in perfect condition. This small item is usually the only evidence of an otherwise perfect repair job.

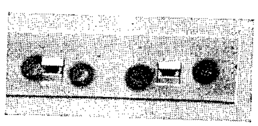


Fig. 96

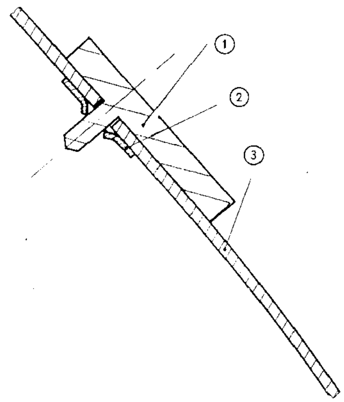


Fig. 97

① **Name plate**

② **Spring clip**

③ **Body panel**

Interior

General

The ceiling in the Coupe and Hardtop are lined with sound absorbant perforated leatherette. The rear and inside walls of the Coupe are padded with sound proofing and covered with leatherette as are the side walls of the Cabriolet/Hardtop. The rear wall of the Cabriolet/Hardtop is covered with coarse weave matting as is the entire rear section of the Roadster. The ceiling liner is fastened to bows in the roof and is attached to the wall at the front, rear and side windows. The dash board is padded with rubber cushioned material and covered with leatherette.

23 BO

Installing Side Liner

1. Glue sound proofing felt to the rear and side walls and glue a fastener strip (white strip in Fig. 98) wherever the liner is to be attached.

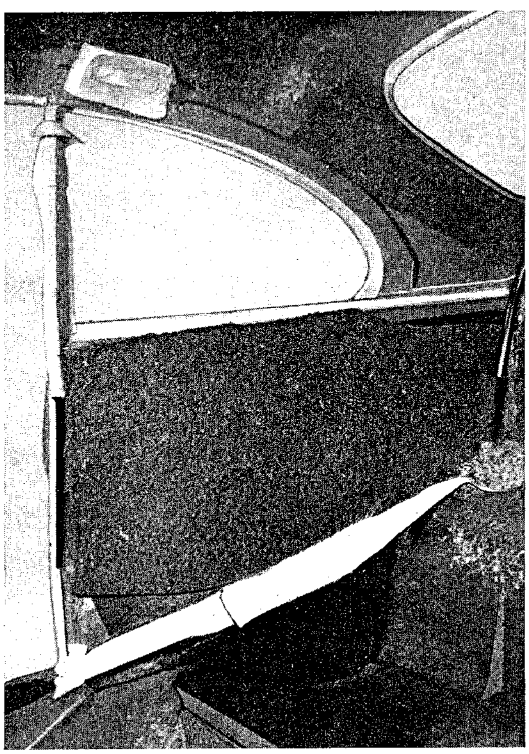


Fig. 98

2. Fasten the bottom of the panel with a washer and sheet metal nail.

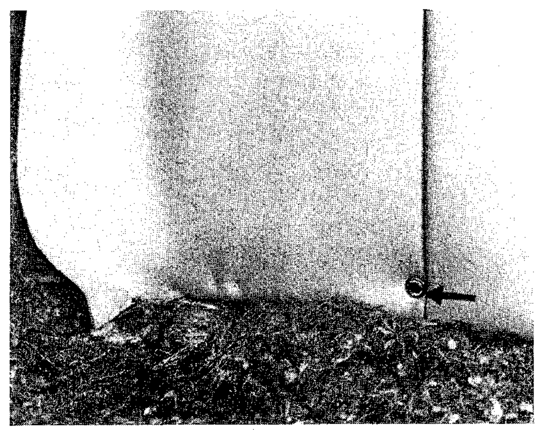


Fig. 99

3. Fasten the upper edge of the panel to the wall with clamps.

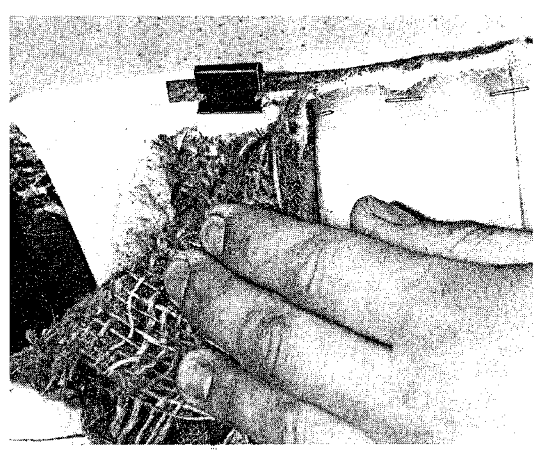


Fig. 100

4. Fit the press board into the slot behind the edge of the door post.

5. Glue the leatherette material to the fastener strip at the edge of the door post.

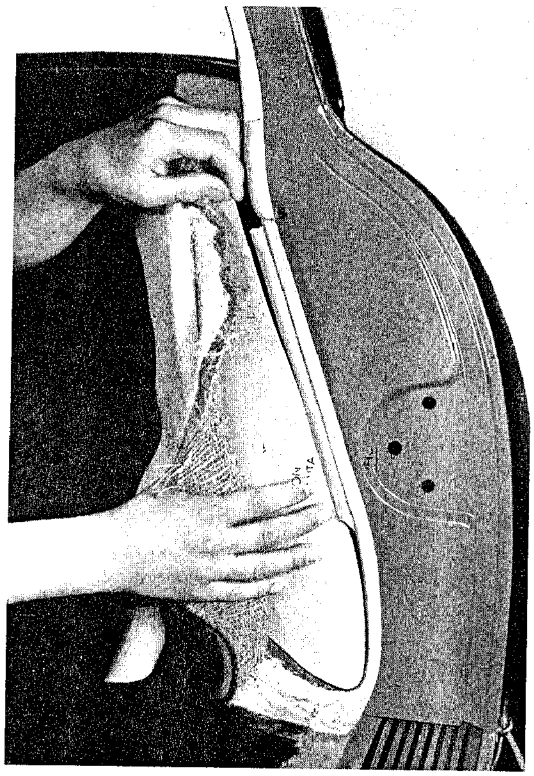


Fig. 101

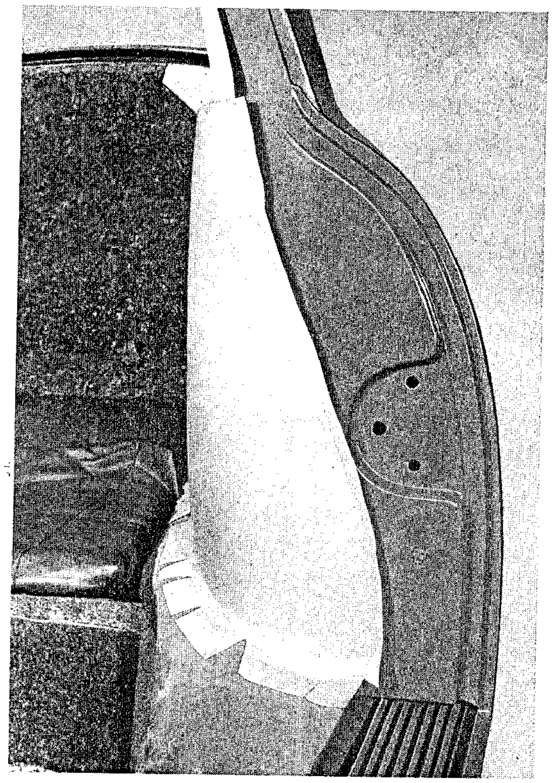


Fig. 102

Installing Head Liner

24 BO

1. Glue sound proofing to the inside of the roof and glue fastener strip to the places where the liner is to be glued to the body.

2. Install the bows for the headliner in the roof with the liner.

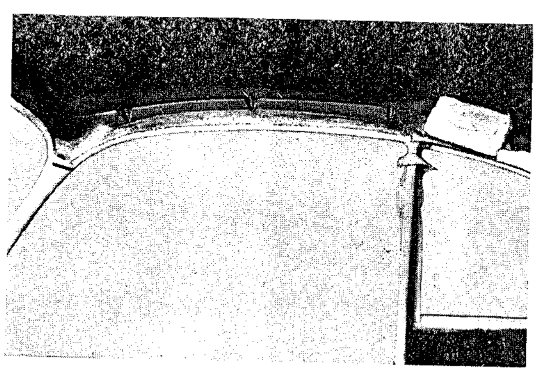


Fig. 103

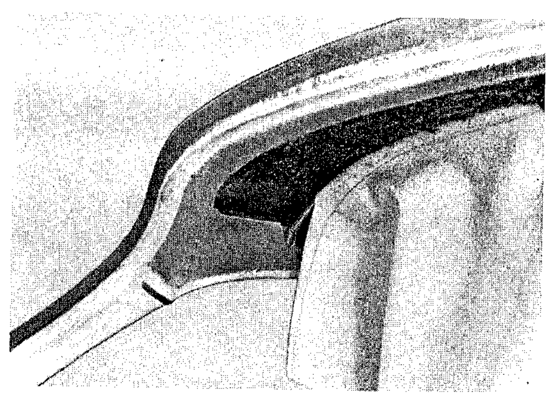


Fig. 104

3. Stretch the liner to the front and glue to the fastener strip previously glued to the windshield opening.

Fig. 105

4. Stretch the liner to the side and glue to the fastener strips at the sides.

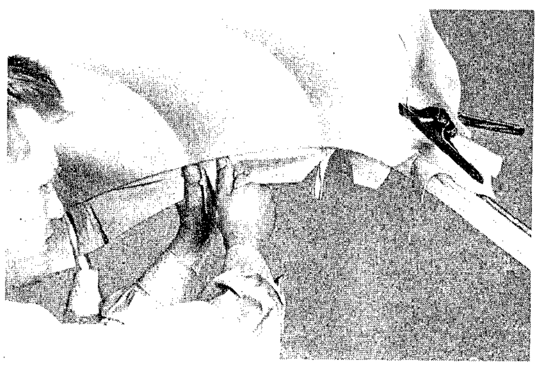


Fig. 106

5. Stretch the liner to the rear and glue to the fastener strip while holding the liner with clamps.

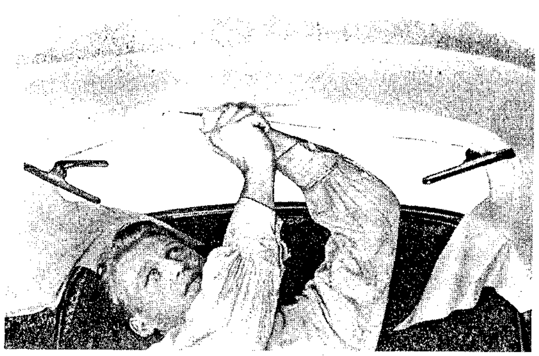


Fig. 107

6. Press the liner firmly against the fastener strip so that a good bond is obtained at all glued joints.

7. Secure the liner with clips at the rear window.

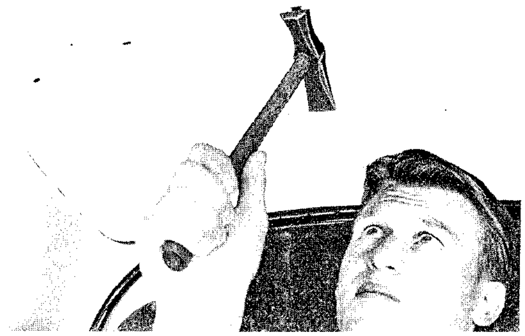


Fig. 108

8. Cover the windshield posts with fastener stripping to glue the liner to the window post.

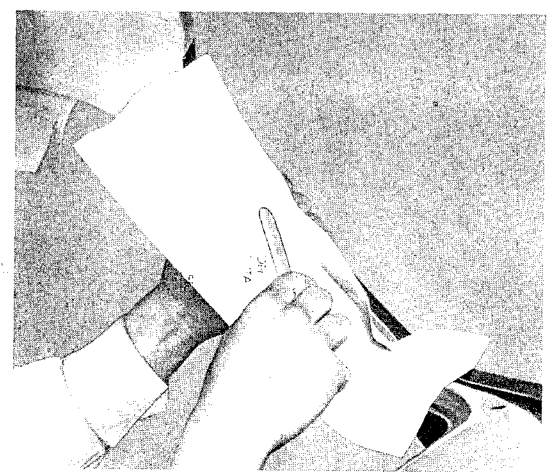


Fig. 109

9. Trim edges and glue ends of liner firmly around dome light openings.

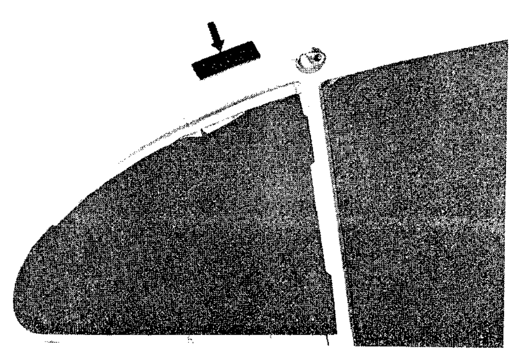


Fig. 110

Installing Front and Rear Fiber Matting

1. Glue front fiber mat with pocket to the front side wall.

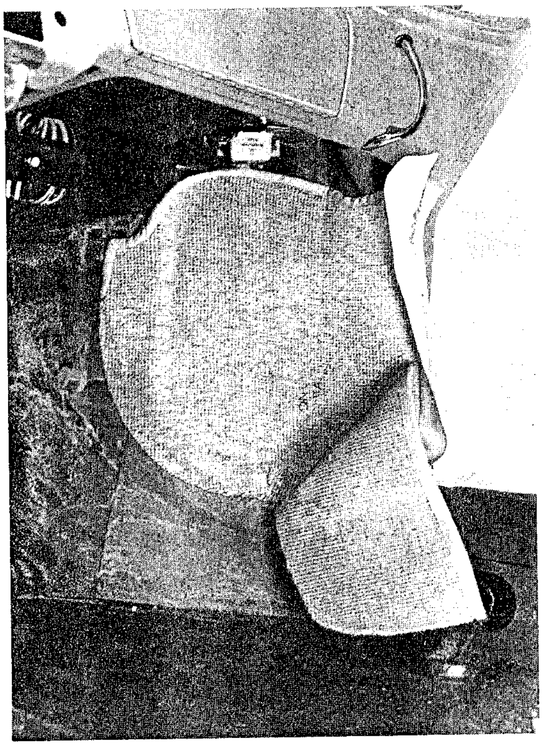


Fig. 111

2. Fasten pocket section to the wall with nails.

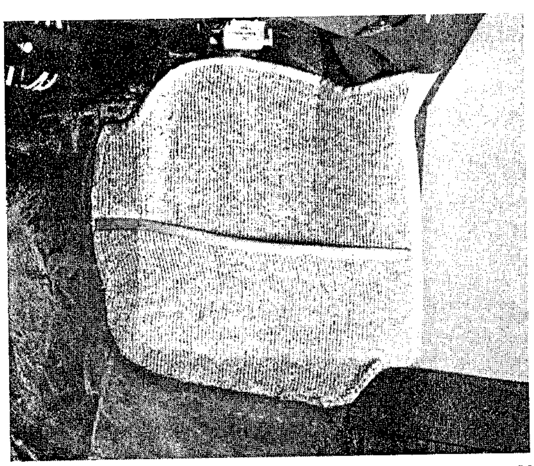


Fig. 112

3. Glue the remaining mat to the wall so that it matches the other mat.

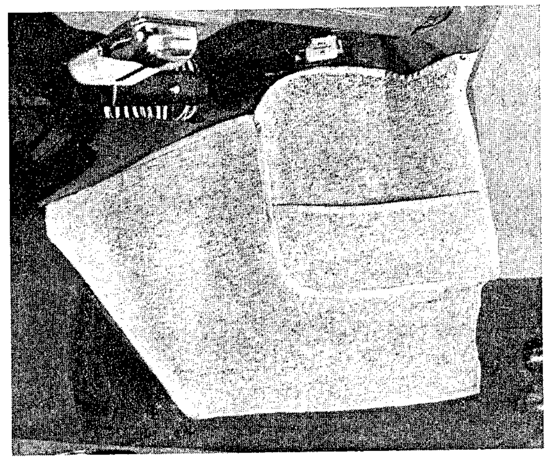


Fig. 113

4. Glue felt lining into the rear seat recesses.

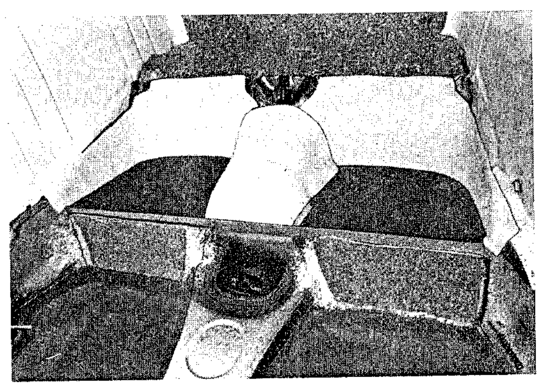


Fig. 114

5. Glue floor tunnel mat in place.

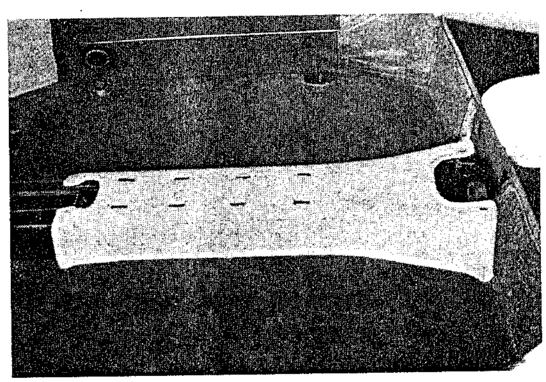


Fig. 115

6. Fit mat for rear side panel.

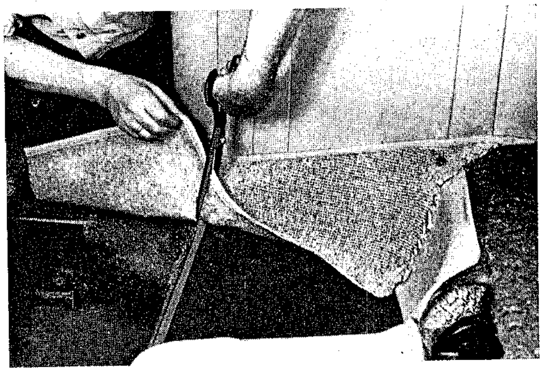


Fig. 116

7. Glue mat for side panel in place.

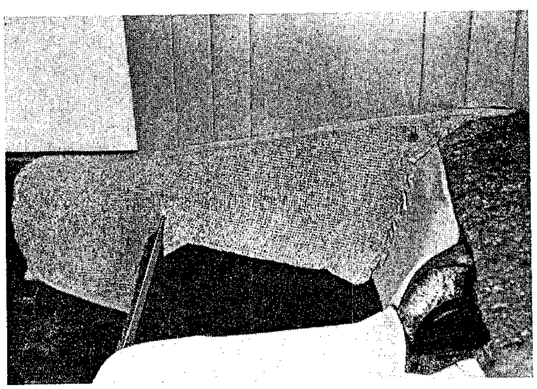


Fig. 117

8. Glue mat over gear box cover between seats.

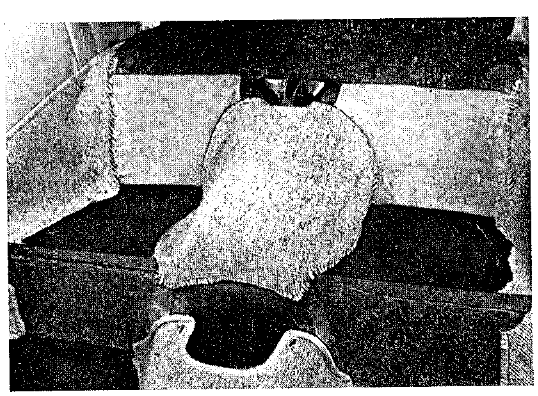


Fig. 118

9. Glue mat onto rear floor section and back of seats.

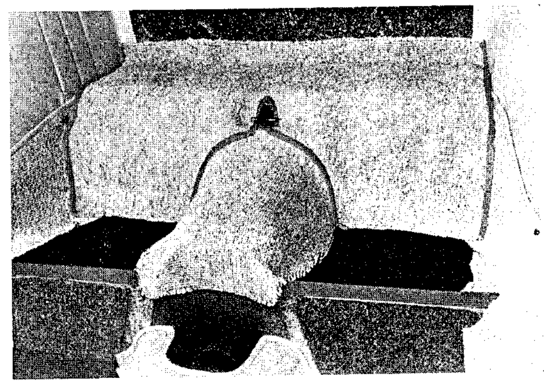


Fig. 119

10. Glue mat on kick board and install luggage strap holders.

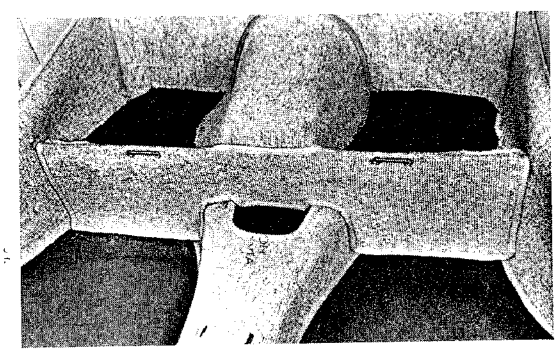


Fig. 120

11. Glue mat on door sill.

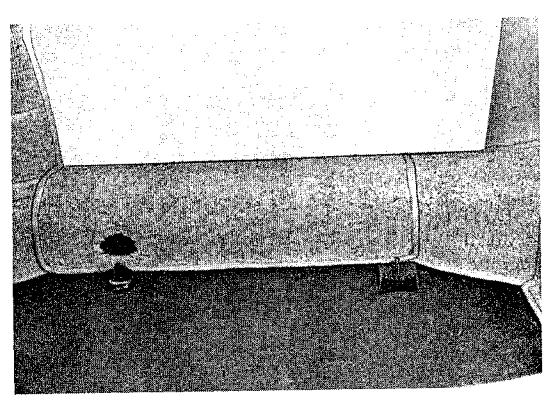


Fig. 121

12. Cut out opening for heater flap.

13. Install seat pads.

14. Install rear wall press board with luggage strap holders.

15. Cut protruding screws and nails from fire wall in the engine compartment using end cutters.

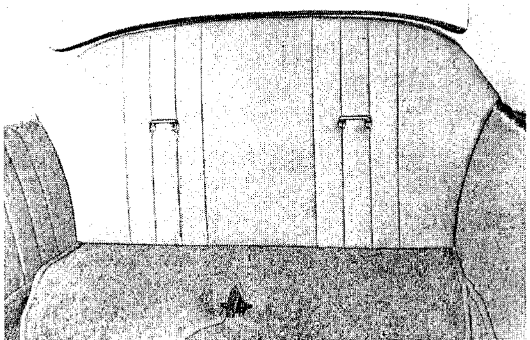


Fig. 122

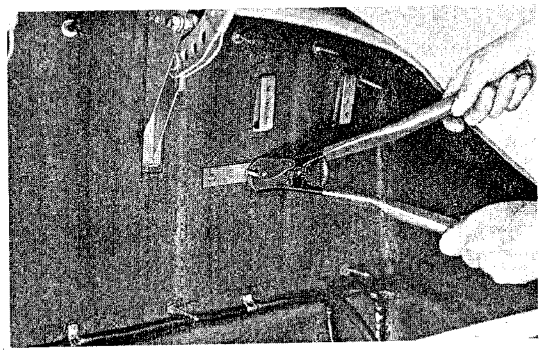


Fig. 123

Pedal Assembly

General

The clutch and brake pedals are mounted on a common shaft while the accelerator pedal is mounted on a separate bracket. The brake pedal operates a hydraulic master cylinder directly through a short push rod while the clutch and throttle are connected to the pedals by cables.

26 BO

Removing and Installing Pedal Assembly

Removal

1. Remove rubber floor mat.
2. Disconnect the throttle linkage at the pedal.

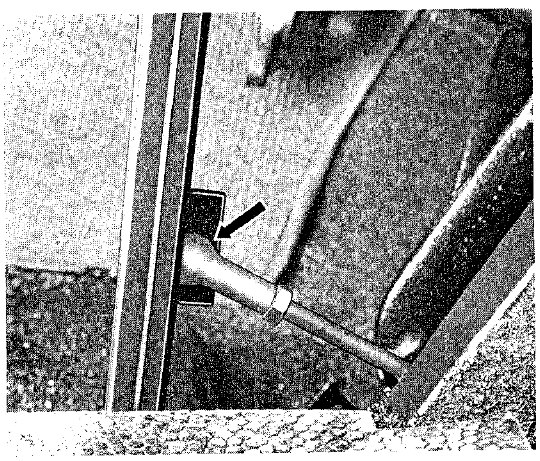


Fig. 124

3. Remove two screws at the accelerator pedal bracket and remove pedal.

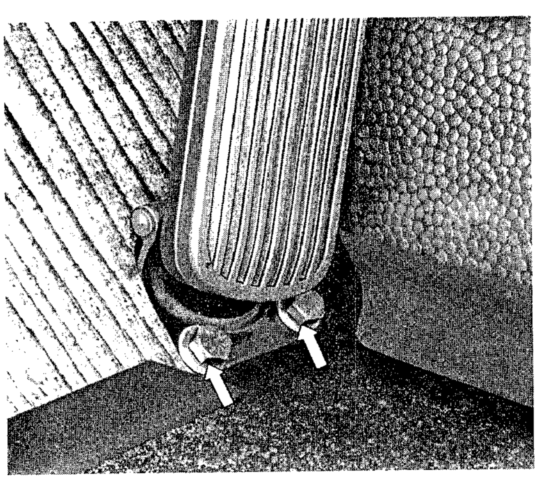


Fig. 125

4. Remove pedal board.
5. Disconnect clutch cable from pedal shaft. It may be necessary to hold the cable from twisting with pliers.

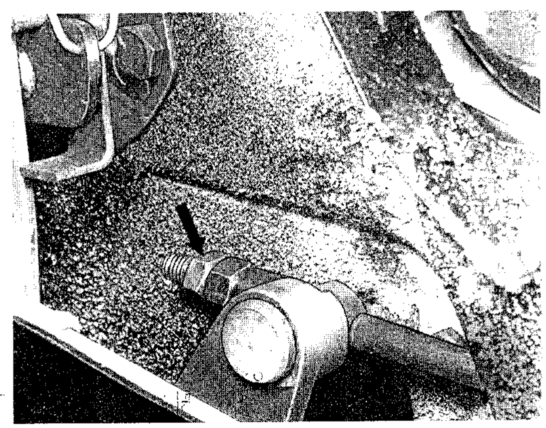


Fig. 126

6. Disconnect brake cylinder push rod from pedal.

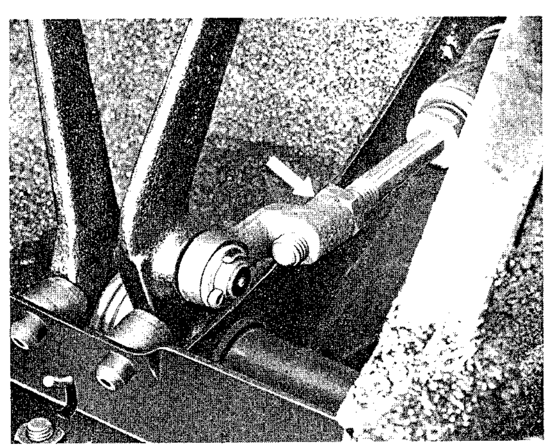


Fig. 127

7. Remove three screws from base of pedal bracket.

8. Release brake pedal return spring.

9. Remove clutch pedal roll pin.

10. Remove pedals from the shaft observing the arrangment of parts.

11. Remove pedal shaft from the pedal bracket.

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Clean all parts and inspect for wear. Install new parts where necessary.

2. Install new bushings.

3. Grease all bearing points.

4. Before installing pedals, note the correct arrangement of the return spring and thrust washer.

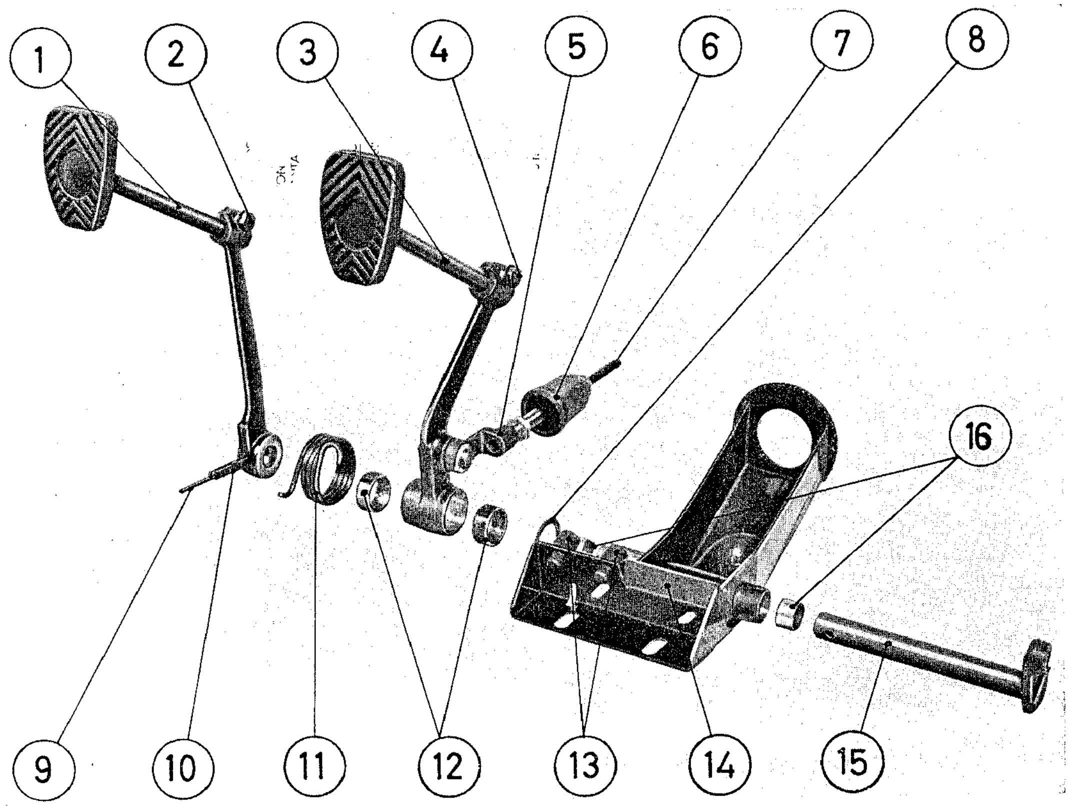


Fig. 128

Pedal Assembly

① Clutch pedal	⑨ Roll pin
② Clamp screw	⑩ Heavy roll pin
③ Brake pedal	⑪ Return spring
④ Clamp screw	⑫ Bushings
⑤ Connecting link	⑬ Rubber buffer pads
⑥ Rubber boot (inverted after installing)	⑭ Pedal bracket
⑦ Push rod	⑮ Clutch pedal shaft
⑧ Washer	⑯ Pedal shaft bushings

Cabriolet Convertible Top

Convertible Top

General

The cloth top is fastened to wooden bows at the front and top rear. A steel pipe bow is used as main support and is connected to the body by a hinge at the door post.

The remaining metal bows are connected to the main bow through hinges. A trim strip is nailed to the wooden rear bow above the window.

27 BO

Raising and Lowering Cloth Top

Lowering

1. Roll down windows or open both doors.

2. Release the three top latches above the windshield.

3. Raise top at front and push toward rear. The cloth must lie between the bows in smooth folds. The rear window should be positioned so that it is as smooth as possible.

Fig. 129

4. After the top is completely folded down, a boot is buttoned down over it to prevent dirt and moisture from collecting in the top.

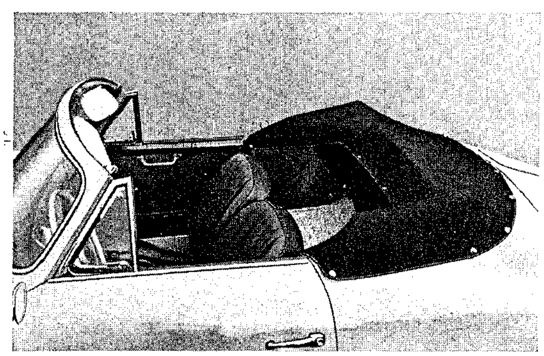


Fig. 130

Note

Clean the cloth and rear window before lowering in order to avoid scratching the plastic window. Brush off cloth and clean the window with a soft wet rag or sponge. Never fold down a wet top.

The top is raised in the reverse order of lowering.

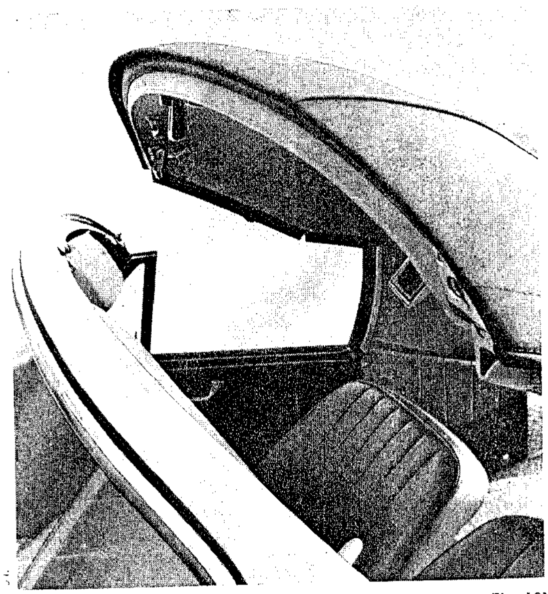


Fig. 131

Note

When installing a new top, fasten the top securely in the raised position and wet it down with clean water. The top should remain in the closed position for two to three days to allow the canvas to adjust itself to the form of the roof.

Raising

Raise the top carefully watching the plastic window so that no wrinkles which may crease the plastic will form. It as advisable to lower the windows. Make certain that the three fasteners are properly secured before driving the car.

Note

Never fold down the top when it is wet. In a closed garage it is advisable to open the windows of the car for better ventilation.

To replace the plastic window, it is necessary to remove the canvas portion of the roof so that the new plastic may be sewn to the top with a machine. After replacing the canvas the seam must be waterproofed with rubber cement.

Care of the Cloth Top

The appearance and life of the top depends upon the care it receives. A wet top must always be dried in the stretched position or it will become distorted and cracked.

A dusty top should be cleaned by brushing in line with the grain of the cloth. Dust can cause damage to the canvas through abrasive action and should therefore be removed before folding the top.

To remove oil or other spots, never use cleaning fluid, gasoline or similar fluids. Use only cleaning agents specificially designed for cleaning auto tops.

Wash the top only when absolutely necessary using clear water.

Before wetting the top, brush the canvas clean with a brush. Thoroughly soak the top and apply a special canvas top soap as prescribed by the manufacturer. Work up a lather on the roof and rinse away the dirt with clear water.

After cleaning the top, wash the remainder of the car and dry the surface with a chamois.

28 BO

Converting from Soft to Hardtop

Removing soft top:

1. Remove front seats (18 BO).
2. Release the three top fasteners over the windshield and slightly raise the top in order to release the tension of the canvas.
3. Remove the side panels by removing the philips screw at the black arrow Fig. 132.

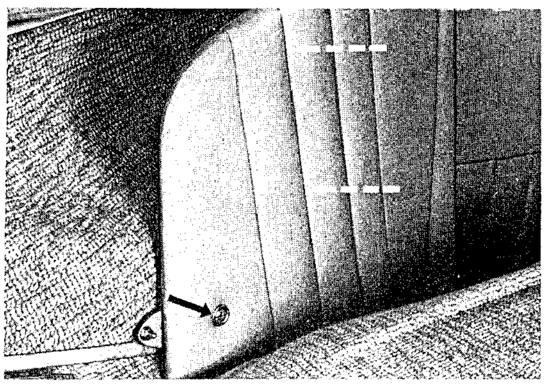


Fig. 132

4. Loosen the head liner from the side walls by removing the retaining screws.
5. Disconnect the turn buckle links from the top and body by loosening the tensioner and prying off the ball joints.

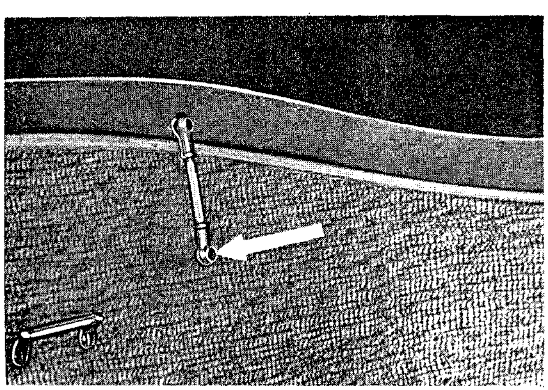


Fig. 133

6. Remove the screws at the two top fasteners.

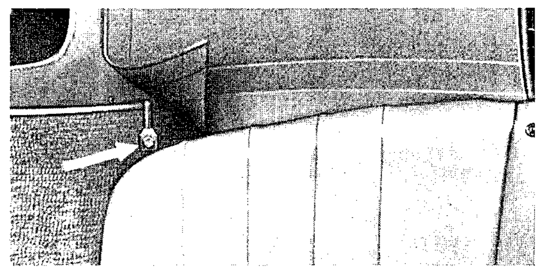


Fig. 134

7. Remove the nuts holding the hinge brackets in the door posts.

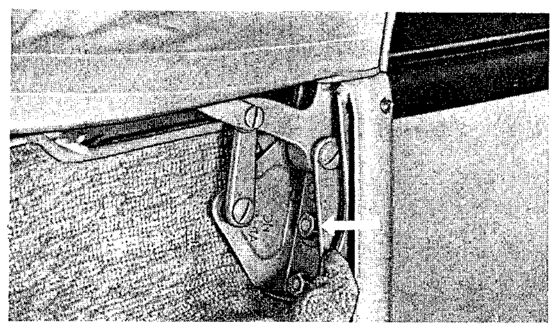


Fig. 135

8. Lift entire top assembly out and to the rear.

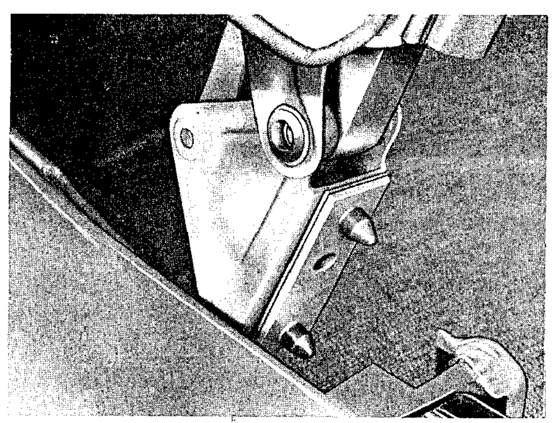


Fig. 136

Installing the Hardtop

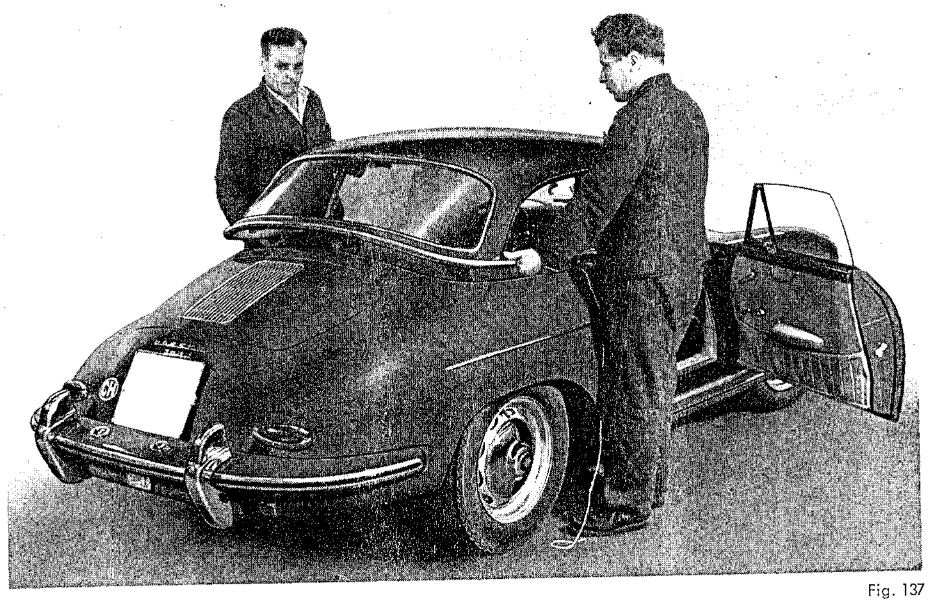


Fig. 137

1. Install a strong thin cord in the groove of the rear weather strip, let extend 30 to 40 cm beyond each end for a good grip.
2. Hook the two turnbuckles to the ball studs on the roof.
3. Lift hardtop in place engaging the lugs in the door post.
4. Place a flat washer and nut on each retaining bolt and tighten the two bolts evenly. Check the position of the roof against the windshield. If the two do not match, the roof may be adjusted forward by shims at the lugs on the door posts.
5. Connect and tighten the two turnbuckles lightly.
6. Pull the cord to the inside so that the weather strip lies smoothly on the inside of the rear panel.

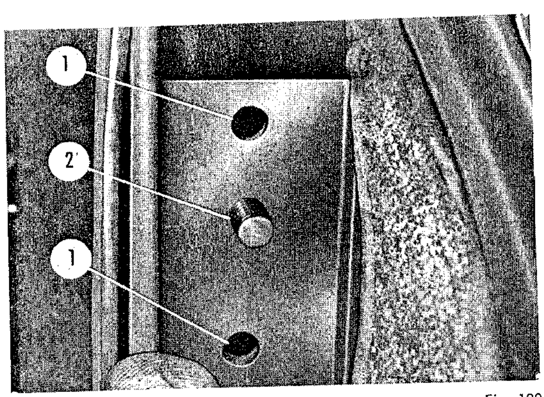


Fig. 138

① Sockets for guide pins.

② Retaining bolt for hardtop or convertible.

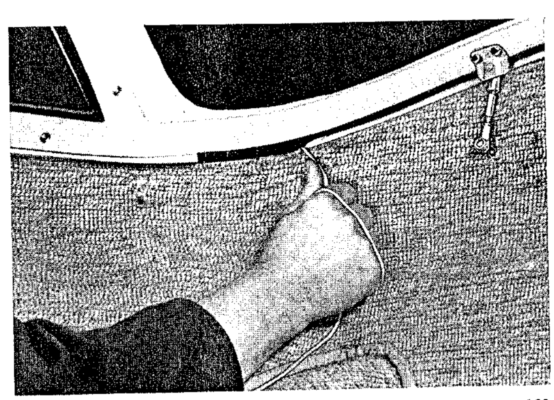


Fig. 139

7. In the event that the outer weather strip does not lie properly, adjust the rubber using a plastic spatula being careful not to damage the finish.

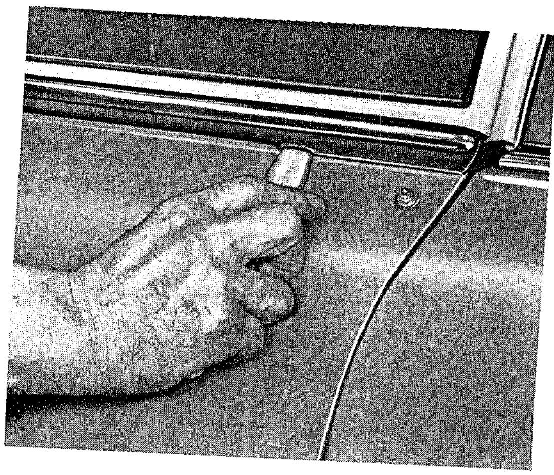


Fig. 140

8. Tighten the mounting bolts and turnbuckles in sequence a turn at a time.

9. Install turnbuckle caps and secure with two punch marks.

   ① **Turnbuckle**
   ② **Cover**
   ③ **Punch here**
   ④ **Ball pin bracket**

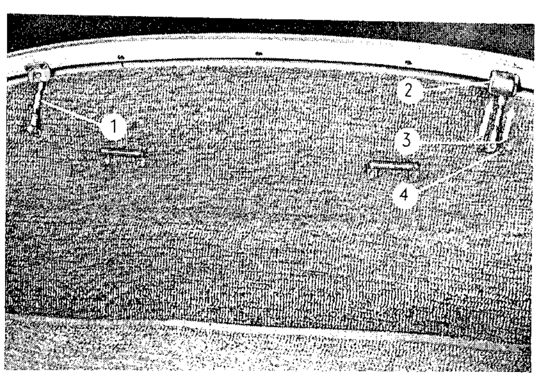


Fig. 141

10. Fasten the three hold down clamps at the windshield.

11. Install side wall panels.
    If this is the first time a hardtop is installed it is possible that the screw hole is covered.
    The hole can be located as follows:

a) Engage the two tabs of the panel into the door post.

b) Mark the position of the wall panel with chalk.

c) Remove the panel and locate the hole with a punch. The hole is located approx. "a" = 3.5 cm ($1\frac{3}{8}$ in.) and "b" = 6 cm ($2\frac{3}{8}$ in.) as in Fig. 142.

d) Insert the screw and apply chalk to the cross slot. Install side panel first in front hooks and then press against screw so that a white mark is made. Punch a hole through the panel at the mark.

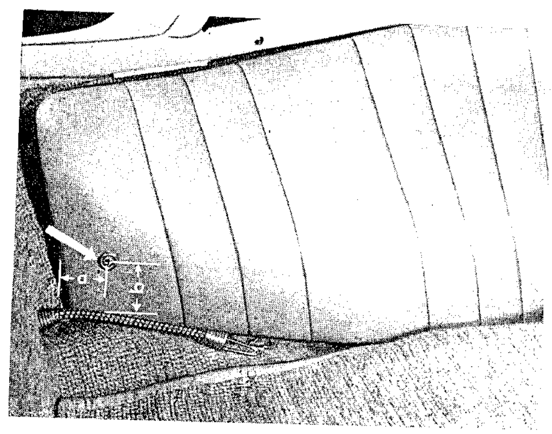


Fig. 142

12. Install side panel.

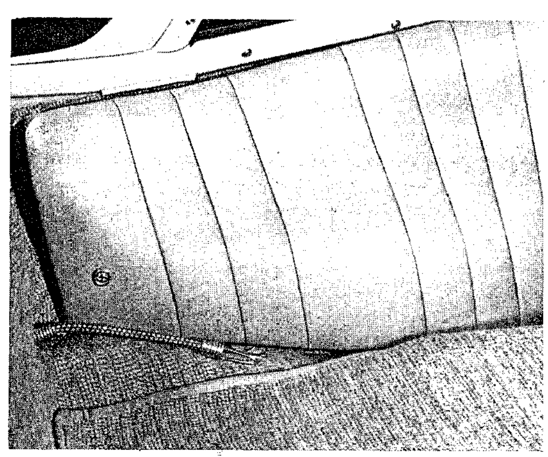


Fig. 143

Removing Hardtop to Install Soft Top

The installation of the soft top is similar to the operation involved in installing the hardtop with the addition of the following points:

1. The convertible top has two connections where an additional bow is mounted to the body. These must be adjusted after installation for proper length before tightening the clamps.

2. The cloth top does not require the cord in the weather strip since it has a different seal with the body. When the top is fully connected to the windshield and body, it must be properly tensioned and without folds.

In the event that no convertible top was previously installed, the holes for the side panels must be made as in step "11" previous page, with the exception that the hole must be located "a" 4.5 cm and "b" 4.5 cm (1$^3/_4$ in.).

Note

For new convertible tops it is advisable to install the roof in the raised position and tighten the bolts after the roof has been loosely fitted.

Roadster Top

General

The top is attached in the front to the window frame and in the rear to the body. The main hinge is located just behind the door post on the side wall. The top is supported by two forward bows and one over the rear window besides the front and rear fastening frames.

29 BO

Removing and Installing Convertible Top

Removal

1. Roll down windows or open both doors.

2. Release the two hold down latches at the windshield.

3. Remove the hold down brackets in the rear.

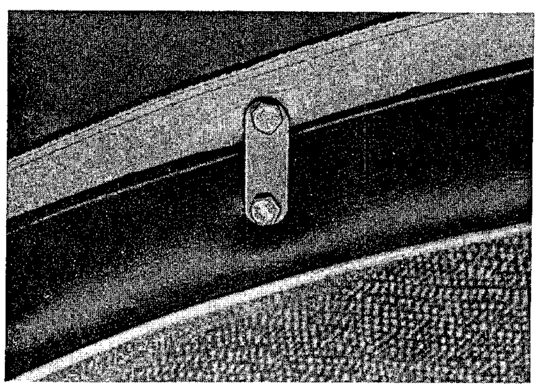


Fig. 144

4. Remove the hinge cover by removing the philips screw in its center.

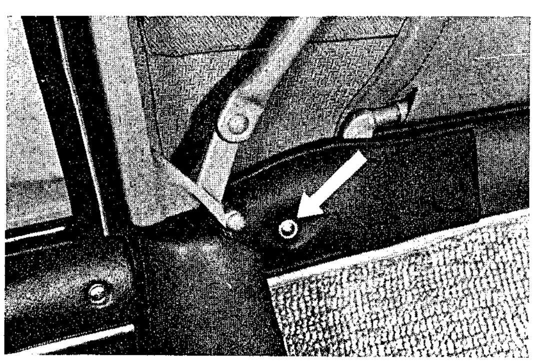


Fig. 145

5. Remove the two mounting bolts from the side brackets.

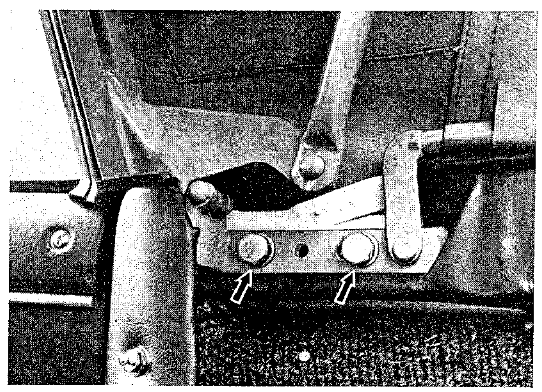


Fig. 146

6. Lift off top.

Installation

The installation is accomplished in the reverse order of removal, observing the following points:

1. Carefully adjust the hinge so that the guide pins in the front frame fit into the sockets on the windshield frame.

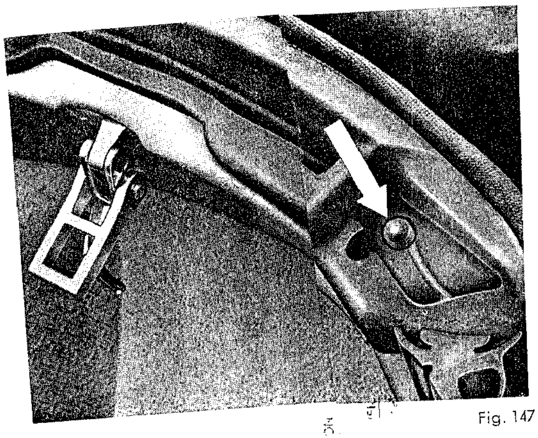


Fig. 147

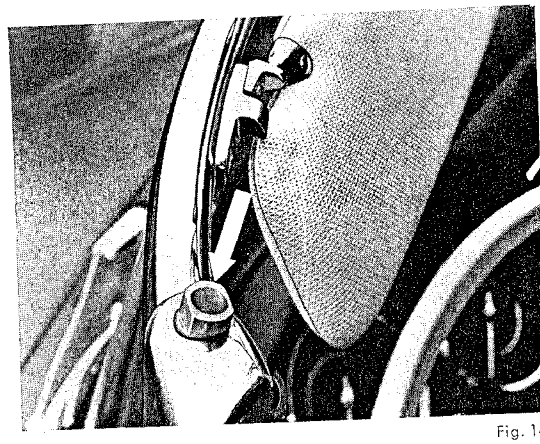


Fig. 148

2. The top must seal against the windshield frame and door windows.

ising and Lowering Convertible Top

30 BO

Lowering

1. Roll down windows or open d.
2. Release front hold down latch

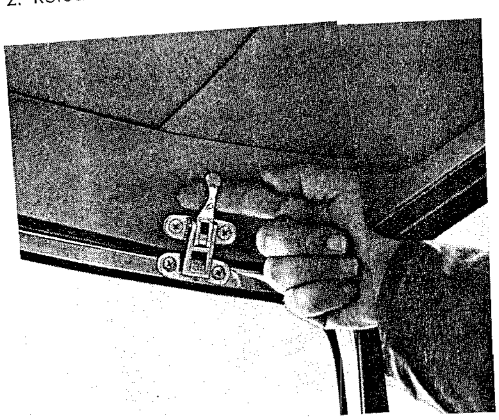


Fig. 149

3. Raise front portion of top and bo fold the top back.

Fig. 150

4. Raise the canvas between the first and second bow so that the two can come together. The canvas should hang smoothly between the front frame and first bow.

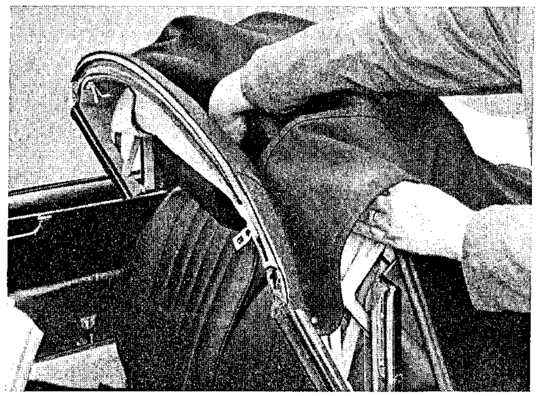


Fig. 151

5. Push first two bows close together, moving front frame rearward.

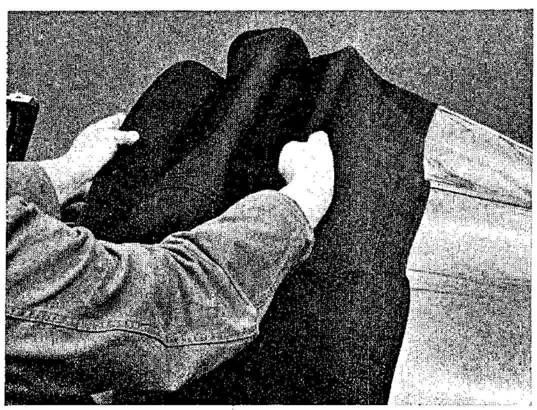


Fig. 152

6. Press the rear section and window inward, smoothing wrinkles which tend to form.

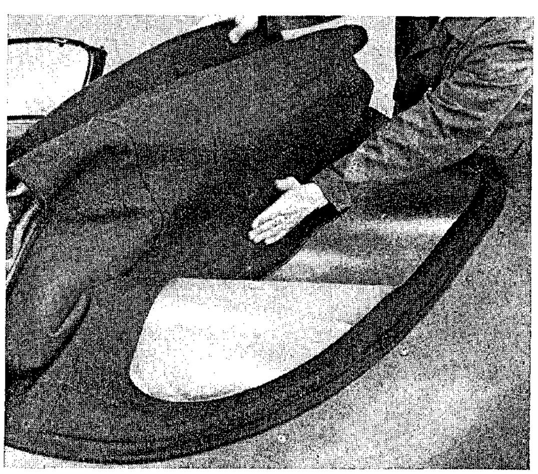


Fig. 153

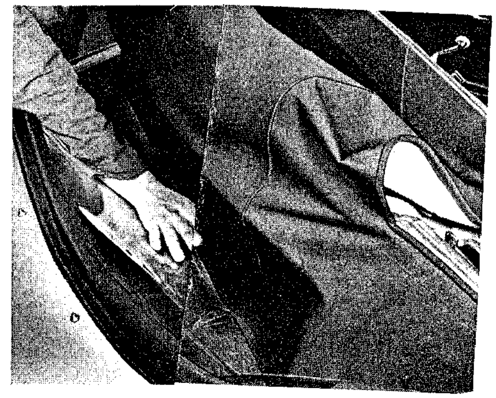


Fig. 154

7. Push the folded p down into the rear compartment.

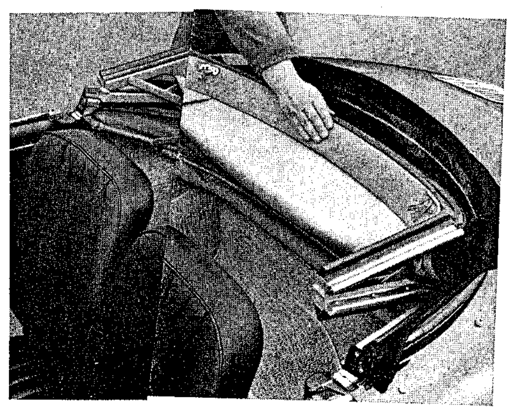


Fig. 155

8. Cover the ed top with the top boot, fastening it tightly the ball snaps furnished for this purpose.

Note:

Before l g the convertible top, it should be cleaned a stiff brush. The plastic window should be cleaning a soft wet rag or sponge. A convertible hich is lowered in a dirty condition will soon led have a scratched rear window.
The top never be lowered when wet. When the car is p in a closed garage with a wet top the window e car should be opened to allow better ventila

Raising Convertible Top

The top is raised in the reverse order of lowering, observing the following points:

1. Raise the front frame section until the cloth begins to become tight. Move the third bow back toward the rear window until it is between the seam and the window.

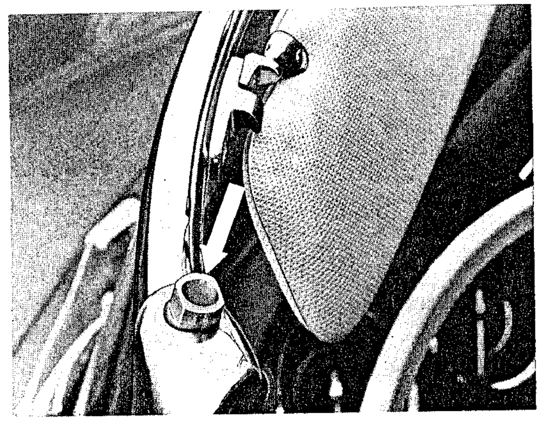


Fig. 157

2. Close the top so that the guide pins fit into the sockets on the windshield frame.

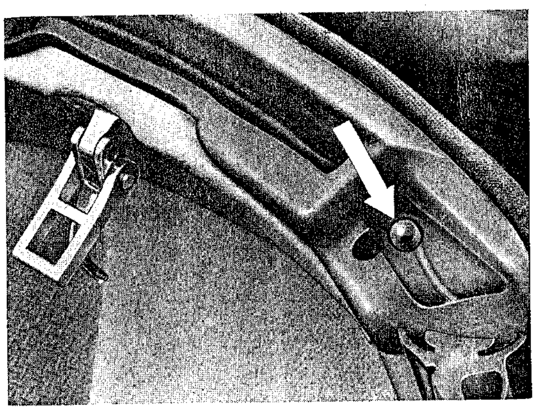


Fig. 156

3. Push down on the front frame and fasten the hold down latch.

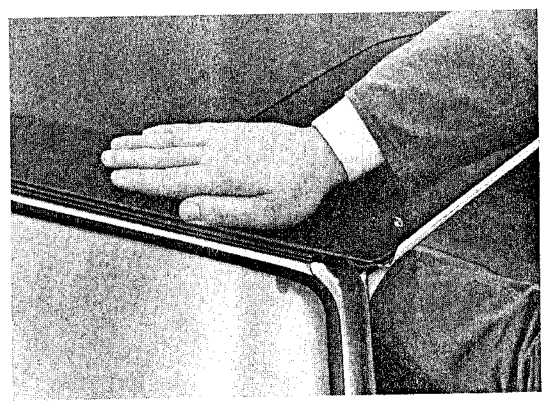


Fig. 158

Repairs and Inspection

General

Repairs

Repairs and measurements of the chassis and frame can only be made by Porsche shops which are specially equipped with the necessary measuring devices and chassis repair jigs. In the event of serious damage it is necessary to make measurements without which repairs are merely superficial and result in improper alignment.

The chassis jig serves as an accurate chassis measuring and alignment device. All structural parts of the chassis and frame must be in proper alignment and lateral location within the prescribed tolerances. The jig must seat firmly on a level surface. To insure that all four legs rest squarely on the floor, one of the legs has an adjustable foot. With only minor alterations, the Porsche chassis jig can be used for 356, 356 A and 356 B cars with either single or dual front suspension of the transmission.

Measurement

In order to measure the critical chassis dimensions, the entire under frame must be stripped including the transmission, front and rear suspension and various accessory linkage. The set screws of the chassis jig must be screwed apart to receive the car. For 356 and 356 B cars with single front suspension of the transmission, the locating blocks must be screwed apart, while for 356 A and 356 B cars with dual suspension of the transmission they must be screwed together. After placing the car on the jig, the chassis is secured in sequence starting at the rear suspension tube, then the jaws of the transmission mounts and then the front suspension tubes. Do not use force to fit the measuring bolts into the sockets in question. When the chassis is properly positioned, the screws of the gearbox-suspension jaws can be screwed into place. The depth of the front measuring bolts is shown in the form of graduated lines. The bolts are to be inserted by hand until they stop against the contact in question.

Permissible deviations are marked on the base plates of the measuring points. From these marks it can easily be determined how badly the chassis has been deformed. Small deformations can be corrected by carefully applying force to the correct places. If greater damage has occured, it is necessary to cut out and replace entire frame sections. The chassis jig should be used only to spot weld the parts in place. Heavy welding and alignment work must not be performed on the measuring jig. As previously mentioned, the jig is not to be used with force and is principally a measuring device. The most critical dimensions are the front and rear suspension tubes, which should always be replaced as units.

Chassis Jig

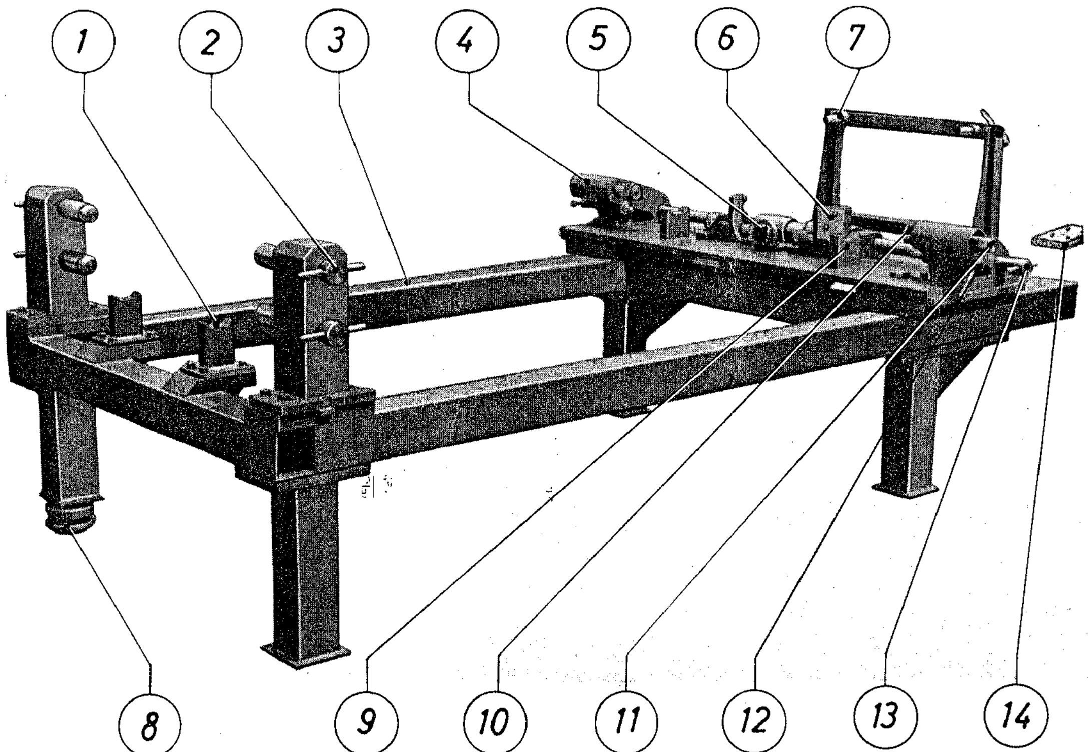


Fig. 159

	Required for 356	356 A	356 B* Type I	356 B* Type II
1. Support for front suspension tube, left and right	×	×	×	×
2. Measuring pin for front suspension tube, left and right upper and lower				
using markings for 356	×	O	O	O
using markings for 644	O	×	×	×
3. Chassis jig frame	×	×	×	×
4. Measuring pin bearing bracket for rear suspension tube	×	×	×	×
5. Centering device	O	O	×	O
6. Angle block for front gearbox suspension, left and right	O	×	O	×
7. Measuring pin for rear gearbox suspension, left and right	×	×	×	×
8. Levelling screw	×	×	×	×
9. Rear chassis support, left and right	×	×	×	×
10. Measuring pin for rear suspension tube, left and right	O	×	×	×
11. Shaft extension with 32 mm hex. head for item 10	O	×	×	×
12. Measuring pin for bumper mounting hole	×	O	O	O
13. Hand lever for operating item 6	O	×	×	×
14. Adapter plate	×	×	O	O

× = required
O = not required

* Type 1: central transmission suspension
Type 2: dual transmission suspension

31 BO

Measuring Chassis on Jig

1. Remove all front and rear suspension members.

2. Place chassis on the jig so that the measuring pins are opposite the suspension tubes.

3. Insert the measuring pins in the suspension point which appears to be the least damaged.

4. Adjust the frame so that the connected points indicate zero on the calibrated marks.

5. Move the base of the measuring pins which do not fit until a fit or approximate fit is obtained.

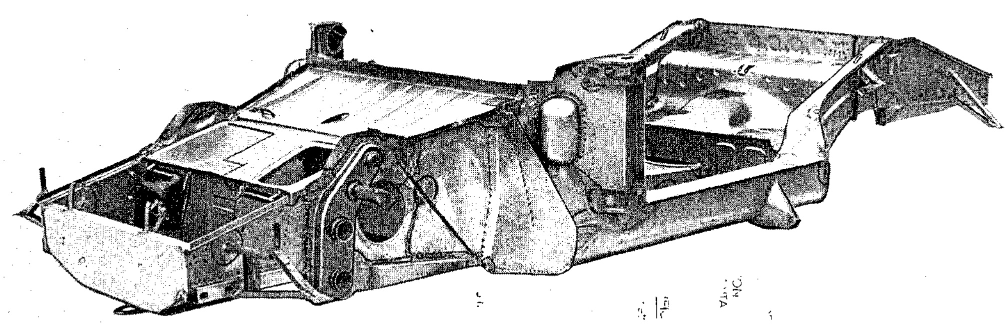


Fig. 160

Chassis, seen from left front

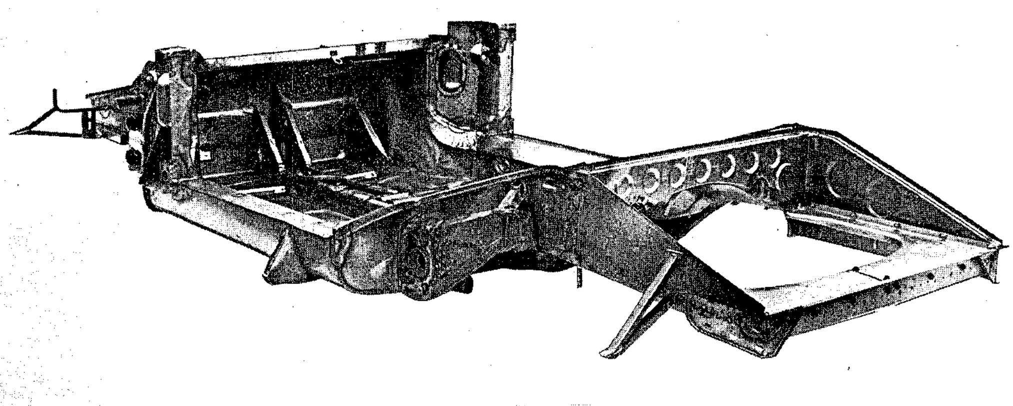


Fig. 161

Chassis, seen from left rear

6. Adjust measuring pins to zero.

8. The measuring pins on the damaged side will now show how great the deformation is and whether new sections are necessary or whether adjustments will suffice.

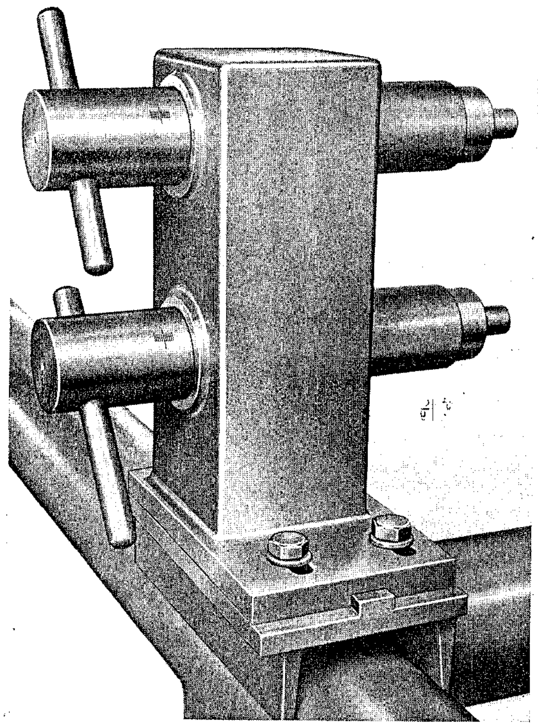


Fig. 162

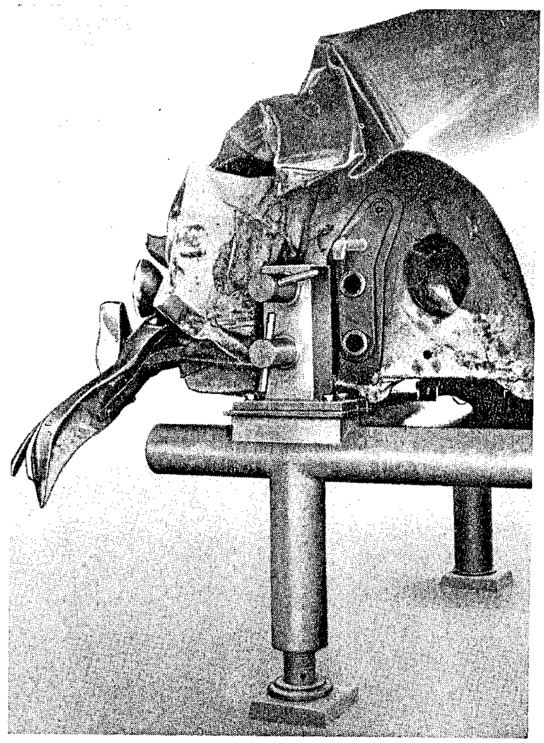


Fig. 163

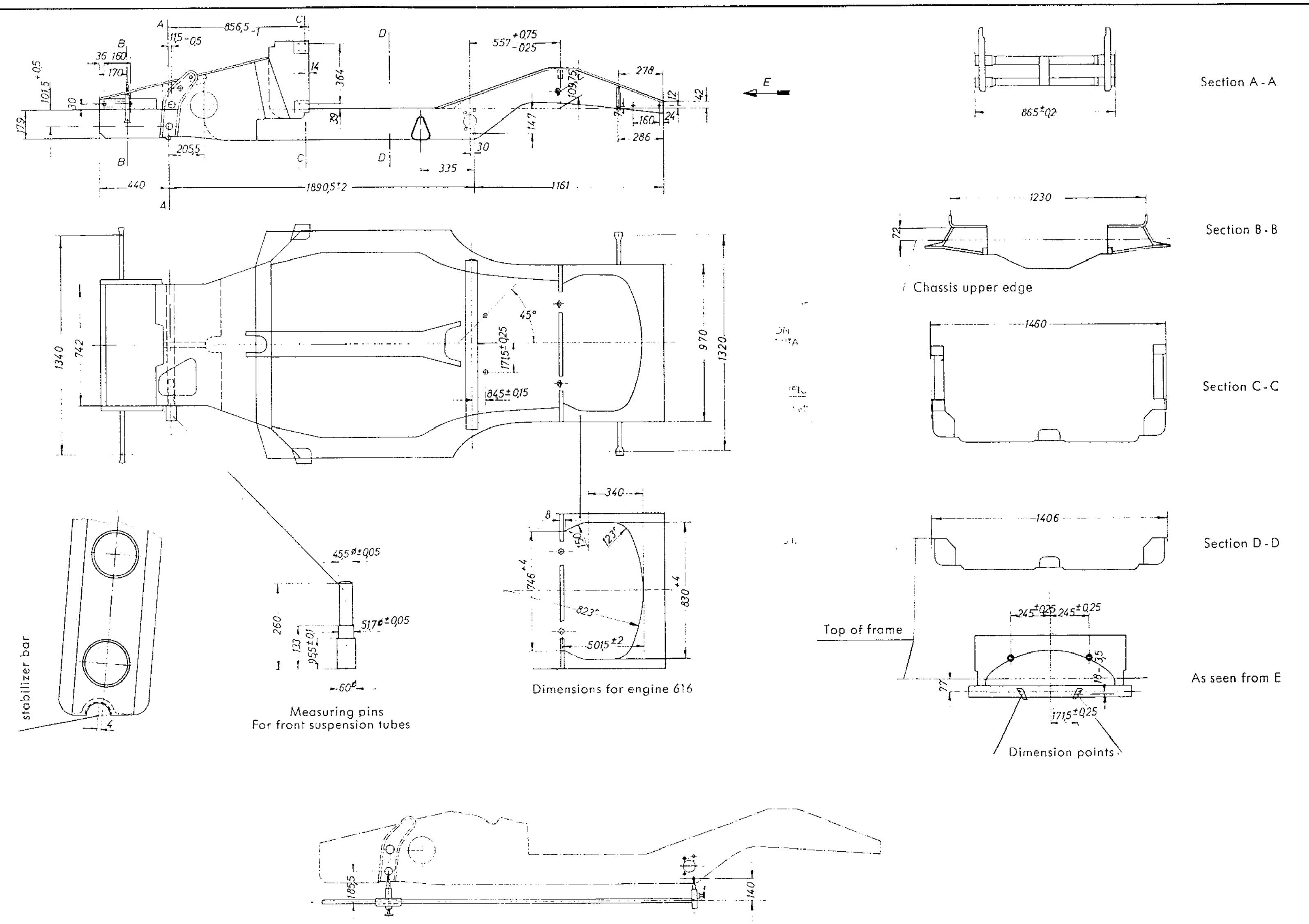
7. The undamaged side of the chassis and thereby the centerline of the car can be centered latterally by setting the pins to zero.

Tolerances

32 BO

The drawing on page B 61 gives all necessary dimensions and tolerances in millimeters. Chassis measurements which are not within the tolerances but not greater than 4 mm may be corrected.

Beyond 4 mm new sections should be installed.



Chassis Dimensions

Dimensions in mm

Fig. 164

Damage to Chassis and Body

General

Since the body, frame and chassis are welded together into a self supporting unit construction, it is always possible that body damage can result in chassis distortion. A car which has been involved in a serious collision should be measured accurately at the chassis suspension points for distortion.

Straightening Front Axle Tubes

33 BO

To be performed only for distortions which lie within ± 4 mm of the required dimensions.

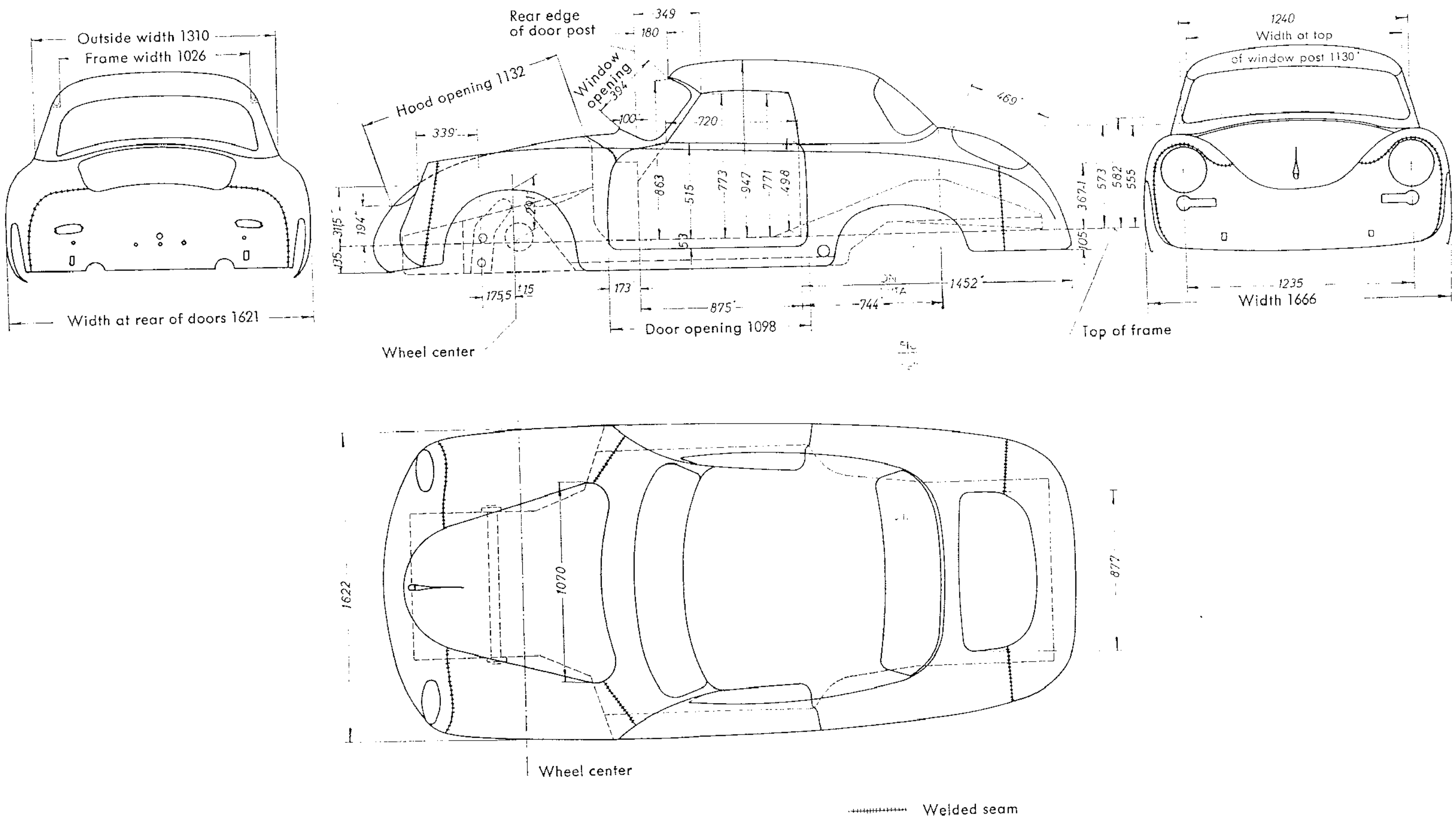
1. Cut the flange of the front torsion bar tubes free on both sides with a cutting torch.
2. Using a hydraulic press, adjust the position of the suspension members until the required dimension is obtained. The two central reinforcing brackets must be heated simultaneously so that the tubes can be moved without being bent.
3. Tack the flanges to the suspension tubes and flame weld in place, working evenly on all sides to avoid distortion. Readjust if necessary before the joints cool.

Note

1. In cases where damage is small it may be possible to straighten the parts by heating the area in question and adjusting with a hydraulic press.
2. Besides specially designed hydraulic presses, car jacks having sufficient lift and a sturdy shaft can be used.
3. All welding, cutting and forming work should be done on a special working jig in order to protect the measuring jig from becoming inaccurate.

General

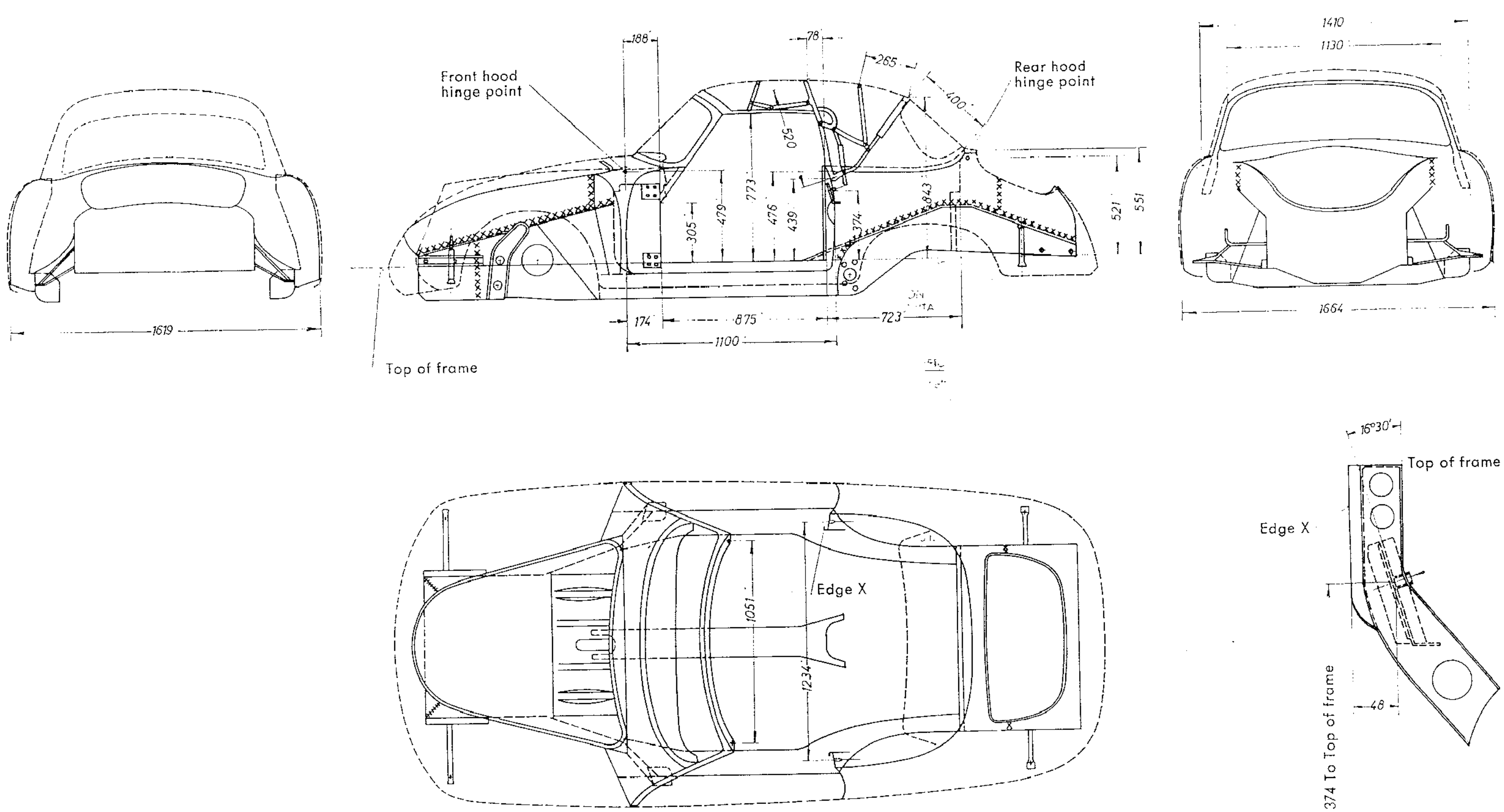
In the event that new chassis or body parts are required, it is important that the parts are properly cut from the body in accordance with the size and shape of the replacement parts. For correct dimensions see the spare parts catalog sections five through nine. For additional dimensions and cutting lines, a series of drawings for the Coupe, Cabriolet/Hardtop and Roadster are shown on the following pages.



Body Work Dimensions for Cabriolet/Hardtop

Dimensions in mm

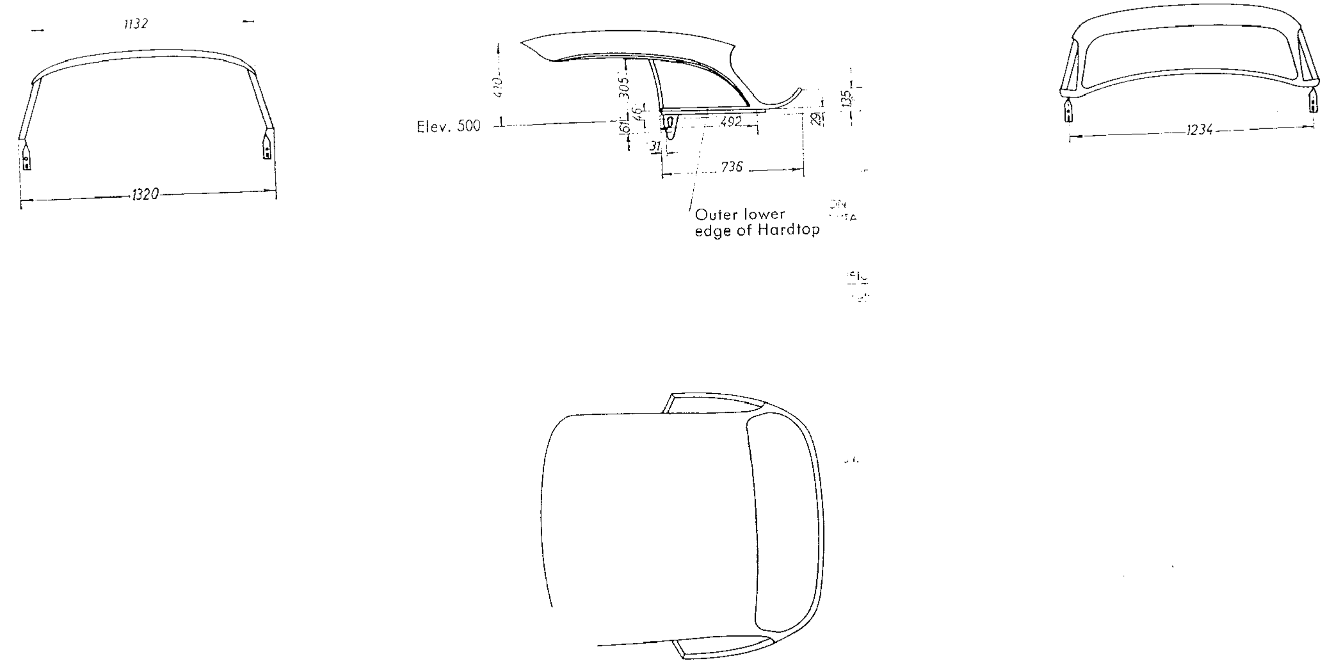
Fig. 167



Body Work Dimensions for Interior of Cabriolet/Hardtop

Dimensions in mm

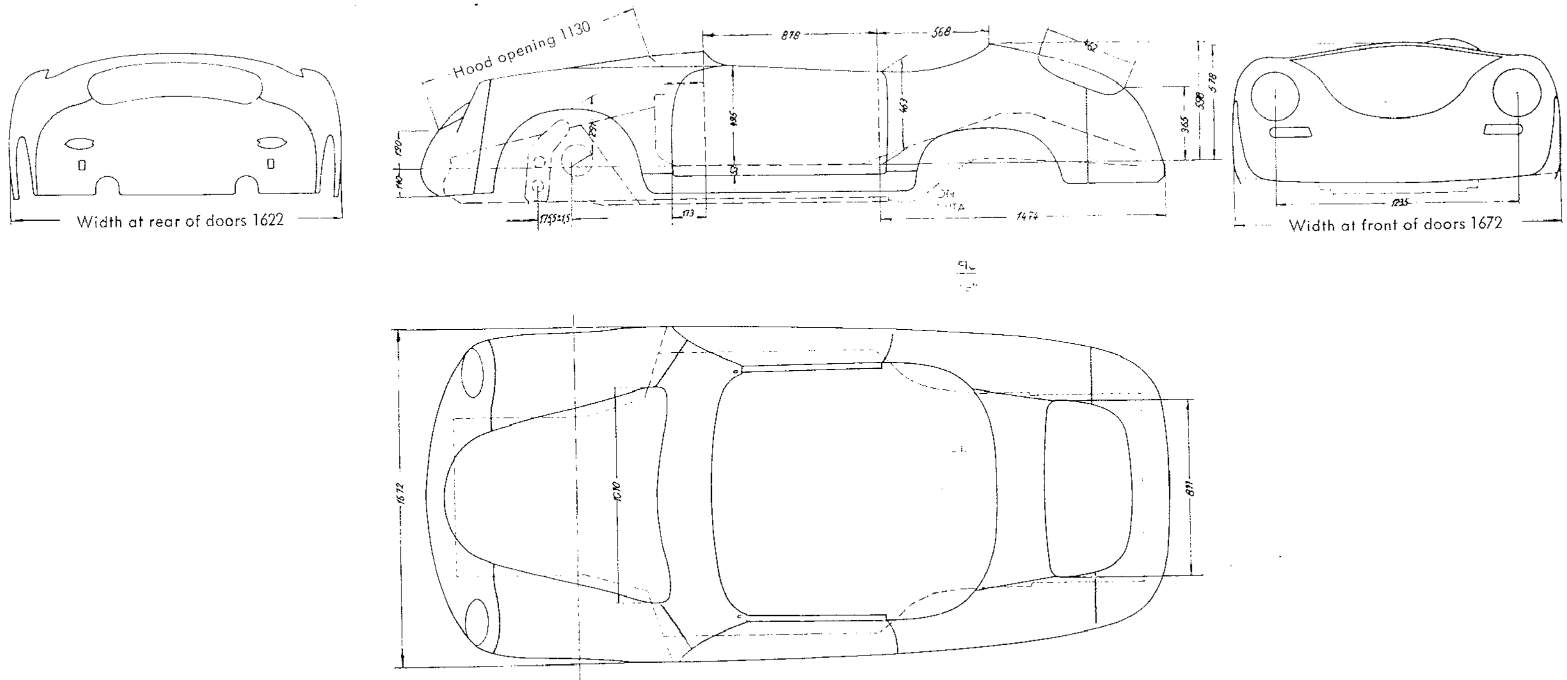
Fig. 168



Dimensions of Hardtop

Dimensions in mm

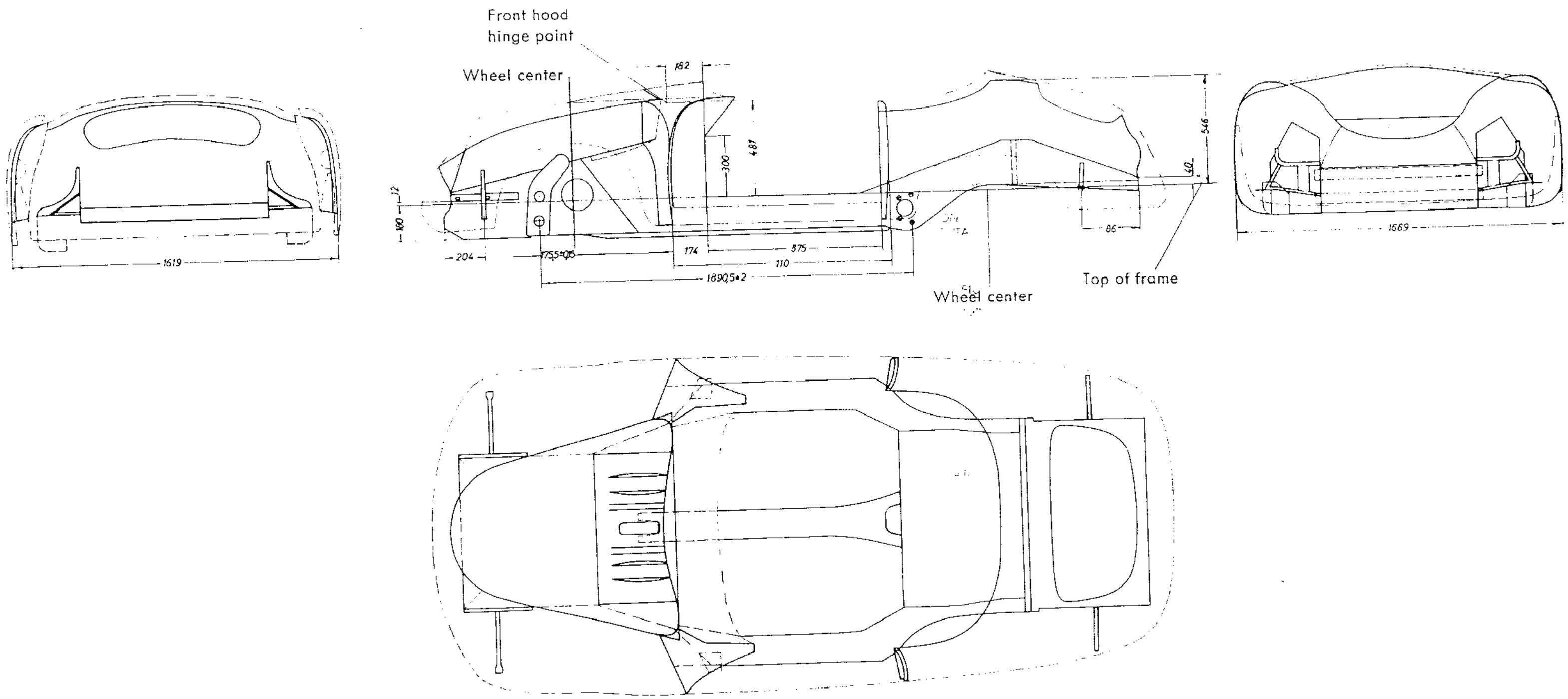
Fig. 169



Body Work Dimensions for Roadster

Dimensions in mm

Fig. 170



Body Work Dimensions for Interior of Roadster

Dimensions in mm

Fig. 171

Attaching New Chassis Members

34 BO

It is, of course, impossible to enumerate the separate operations that are required at the various stages of body and chassis repair work. The repairs must be carried out by an experienced body repair man who is familiar with the problems involved in such an operation and can foresee the work required to meet with various situations. For this reason, only general instructions are given which serve to pass on to the body shop those things which have been learned through experience.

When removing damaged frame sections, particular care should be taken to leave sufficient material to furnish a surface to which the new section may be lap welded. This method is required to give a strong weld using a gas welding set. See pages 80 to 82 for location of weld seams.

Attaching Interior Panels

35 BO

Damage to the interior panels is usually not apparent from the outside. In the event of body damage, the interior panels must be checked to determine the extent of distrotion and which panels have been affected. The interior panels are of great importance and must be brought to the original shape so that the body will retain its rigidity. The interior panels form the connection between chassis and body and contribute largely to the stability of the car.

The interior sections are installed similarly to the chassis members. New sections are flame welded with lapped seams inside and out. The remaining edges are spot welded to the chassis and are waterproofed with calking compound.

Attaching Body Panels

36 BO

When replacing or straightening front or rear body sections, the hood in question is used as the pattern for the shape of the hood opening. The slots for the bumper braces in the body panels can be used as alignment points by mounting a 30 × 5 × approx. 300 mm ($^3/_{16}$ × 1$^3/_{16}$ × 12 in.) iron bar in each bumper brace socket. Particular care should be taken to see that the headlight openings are horizontal and equidistant from the center of the car. The gap between the hood and body, when closed, should be adjusted to 3 mm ($^1/_8$ in.) by filing or building up with lead.

When replacing roof sections, the top should be cut off carefully at the pillars and door posts so that they will give a starting point for mounting the new roof. It is important that an overlap is retained between the undamaged portion and new parts.

To build up the body and interior panels to the roof frame, wooden or metal templates in the shape of the doors and windows should be used to assist in the correct reconstruction of the upper body. The door posts must also be braced if they are not secure in place. All welded seams on the body skin are smoothed over with lead after being hammered smooth.

Paint

General

The use of lacquers, synthetic enemals and combination finishes has made auto painting a highly developed specialized operation. Up to the spring of 1954, Porsche cars were finished in lacquer paints.

Through the development of synthetic enamels and their many advantages, a change over was made to these finishes.

In the springs of 1955 all colors, with the exception of the metallics, were synthetic enamels. Beginning 1956 all finishes were synthetic enamel. Laquer finishes are now available only on special order and of course at additional cost.

The type and color of the finish is found on a plate attached to the hinge post of each car. This plate shows the type of paint and identification code number.

The instructions contained in this section are primarily intended to assist in the spray painting of Porsche cars and are to be considered only as a guide. The instructions given by paint manufacturers for their product should be followed. The amount of thinner, nozzle size, air pressure, paint pressure and similar instructions should be in compliance with the manufacturer's specifications.

Shop Practice

The following are basic requirements for an auto paint shop:

- Spray paint chamber and dryer room must be kept dust free.
- The floor should be a grating under which a flow of water circulates to catch any falling dirt, dust, or overspray. In any case the floor must be wet.
- The paint sprayer must wear lint free overalls sprayed with tack spray so that dust will remain on the surface.
- Parts which must be masked should be covered with smooth non porous paper. Newspaper is not acceptable.
- Only masking tape which is heat resistant can be used when the paint is to be baked.
- Windows must not absolutely be covered with paper. Liquid masking material which can easily be peeled off can be used.
- Cars which have been on the road for some time must be cleaned so that no silicon or wax remain

Repair Procedure for Body Damage

Body repairs are individual cases and cannot be outlined in exact details. The descriptions which follow are merely suggestions to be used as a guide.

The individual shop must consider the examples, shown as typical cases.

37 BO

Front End Repair

A damaged Cabriolet

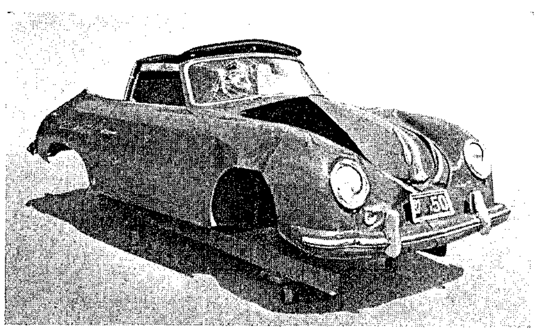


Fig. 172

The measurement of the frame (31 BO) disclosed that the distortion of the front suspension section was beyond the tolerances. This repair could only be performed by replacing the front chassis and body section.

Chassis and body section removed.

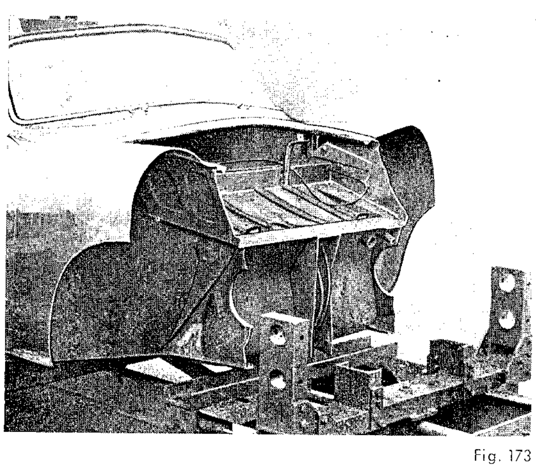


Fig. 173

The undamaged pedal wall and chassis sections were not removed while the section in front was entirely removed.

Front chassis section tacked in place in assembly jig.

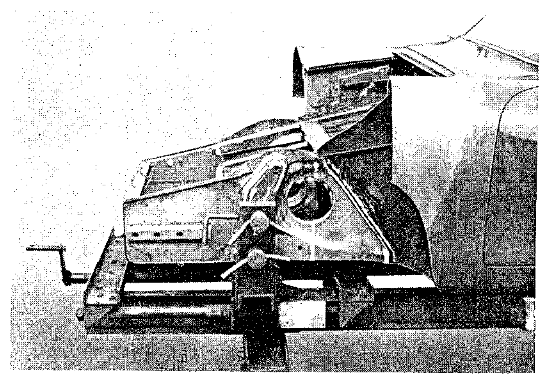


Fig. 174

The stubs of the cut off chassis section were bent inward sligthly to allow the new section to overlap. The front chassis and inner panel sections are then flame welded along the seams shown in white. After these seams are secure the body must be removed from the jig so that the bottom seams as well as the diagonal braces can be welded.
Front interior section tacked in place.

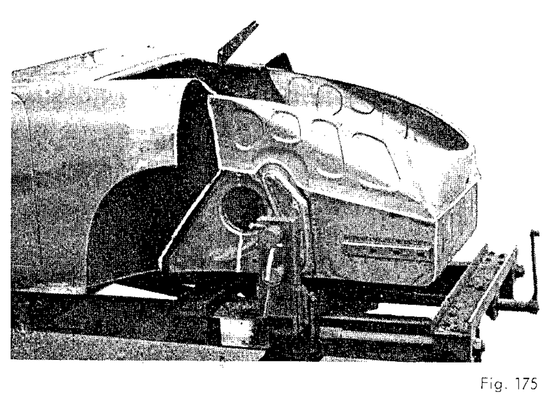


Fig. 175

The interior section is tacked in place and spot welded with calking compound in the seam around the lower edge. The vertical seam is flame welded.

Body with new front section.

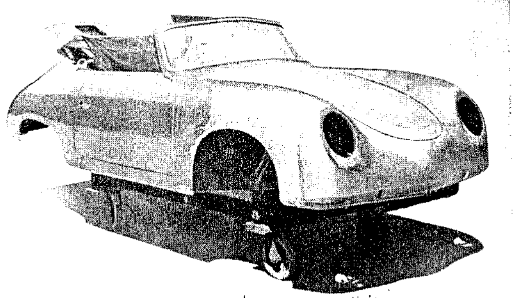


Fig. 176

After the body is removed from the alignment jig, the fitting of the skin section is performed with the aid of a new front hood and the two bumper brace holes. The hood serves as a pattern for the hood opening and the two bumper brace slots are used as levelling references. Two 30 x 5 x approx. 300 mm ($^3/_{16}$ x 1$^3/_{16}$ x 12 in.) rods are to be inserted into the bumper brace sockets to serve as reference markers. The headlight sockets must be horizontally on the same level and equidistant from the car center.

The paint near the weld seams must be removed so that the joints can be covered with lead in order to smooth them into the body contours. The hood must then be aligned with the opening so that there is a uniform 3 mm ($^1/_8$ in.) gap around the entire hood.

Rear End Repair

38 BO

These two illustrations show the damage to the rear end, the roof and rear fenders. What cannot be seen, is the damage to the interior panels and possible chassis damage.

Fig. 177

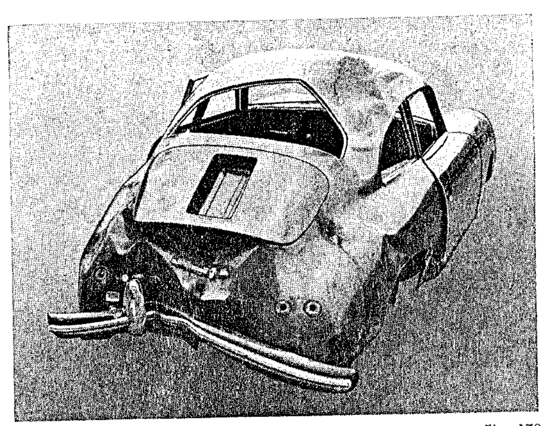


Fig. 178

The body after removal of the damaged parts.

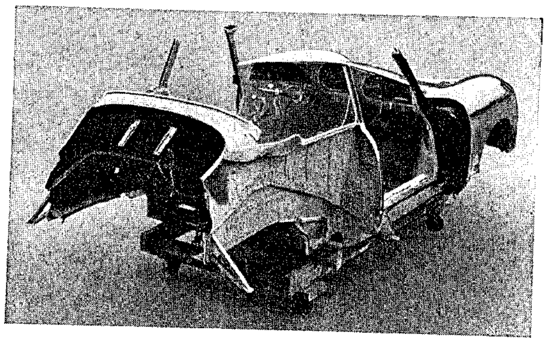


Fig. 179

The fenders were completely removed up to the door posts, first with thin shears along the door post and then by heating the metal red hot and removing the spot welded portion from the post, a spot at a time. The inner and outer rear sections were removed similarly. The top is removed best by cutting at the existing weld seams so that the posts are retained.

Installed interior rear section.

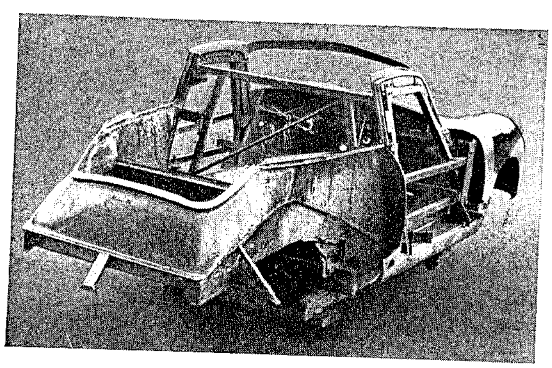


Fig. 180

The rear cross member has been installed and the rear interior panel spot welded to the body and cross member. The left and right roof frames were rebuilt with the aid of door templates specifically constructed for this purpose. The door post must be held firmly in place as shown in Fig. 180. The roof frame and interior sections are to be installed, spot welded together, and finally welded in place.

Reconstructed body.

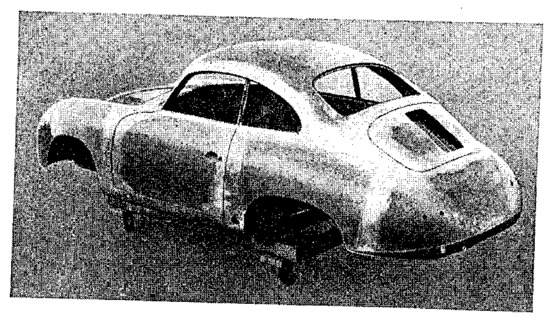


Fig. 181

After completing the welding of the frame sections the top, rear, and fender sections are spot welded in place. The rear hood opening is aligned to match the new hood so that a uniform gap of 3 mm (1/8 in.) extends around the entire hood. The skin sections are then welded in place and the seams hammered flat. All skin seams are tinned and filled with lead so that a smooth contour is obtained. These seams are clearly visible in Fig. 181.

on the old paint. Car polishes and waxes produce a surface film to which new paint will not adhere. A silicon remover or good car wash solution must be used to remove such coatings.

- If oven dried synthetic enamel is to be used and temperatures in excess of 90° C (195° F) will be reached in the drying oven, all rubber, fabric and interior parts as well as the radio and instruments must be removed.

Warning

Overspray dust of synthetic enamel together with overspray dust from lacquer paints will ignite by spontaneous combustion. For this reason it is not permitted that lacquer and synthetic enamel paints be sprayed in the same spray room.

Spraying Synthetic Enamel

There are three principal types of synthetic enamels:

Air drying

Due to its relatively poor durability, this type is used mainly for small touch-up work.

Oven dried at 80° C (175° F)

This type is considerably more durable but does not have the hardness of the 120° C type.

Oven dried at 120° C (250° F)

This type is generally used at automobil factories and larger repair shops. The finish after hardening is extremely durable and hard and in the case of repairs, cannot be distinguished from the original.

For this type of paint it is important that all temperature sensitive parts are removed from the body.

Lacquer and Enamel Primer

Both air drying and oven drying synthetic enamels can be applied over lacquer and synthetic enamel primer paint.

A — Synthetic Enamel Primer

— Remove old paint using paint remover.

— Thoroughly clean paint rests, paint remover, and rust traces from the body surface. Use only solvents designed for metal preparation to remove grease and paint rests. Do not use gasoline or other fuels.

Spraying Primer

— Using thinned primer, spray one uniform coat of 3 to 4 passes with the spray gun.
Air drying: 4 to 5 hours.
Oven drying: approx. 40 min. at 70 to 80° C (160 to 175° F).
(Allow primer to set 15 min. before placing in oven.)

— Smooth putty work using No. 240 wet sand paper.

— Spray two passes of spray filler over the entire body. Apply two to three coats as required.
Air drying: 6 to 8 hours.
Oven drying: approx. 60 min. at 70 to 80° C (160 to 175° F).
(Allow filler to set 15 min. before placing in oven.)

Sanding

— Wet sand the entire surface after the filler dried using No. 320 and finishing with No. 400.

— Wash primer dust from the surface and dry until all moisture is evaporated.

Spraying Paint

Prepare the car for spraying by draining all water from the seams and spaces and remove all dust using a tack cloth.

— Apply two coats of thinned synthetic enamel of the desired color using the type of paint best suited for the facilities and extent of spraying.

Do not apply too thick a coat of paint (max. 40 μ = .0016 in.).

Note

Metallic colors require an additional coat. The spray gun must be held at a slightly greater distance from the surface being sprayed to produce a dryer spray, preventing floatation of the metallic particles.

Air drying: 12 hours.

Oven drying: 1 to 1½ hours (allow paint to set 15 min. before placing in oven).

Note

Complete hardening of the paint surface occurs after several days. It is therefore important that the above mentioned drying time be extended as much as practical. The car should then be polished with a protective material which will prevent damage through moisture or abrasive dust. This polish should be applied with clean pure cotton and then polished with a new piece of cotton.

Do not use a buffer or polishing rags.

B — Lacquer Primer

When lacquer primers are used the drying temperature must not exceed 50° C (120° F).

Preparation

1. Remove old paint using paint remover.
2. Thoroughly clean the surface of paint rests, paint remover and rust traces.

   Use only solvents designed for metal preparation to remove grease and paint rests. Do not use gasoline or other fuels.

Spraying Primer

— Using thinned primer, spray one uniform coat of 3 to 4 passes with the spray gun.

Air drying: 2 to 3 hours.

Oven drying: approx. 30 minutes at 40 to 50° C (105 to 120° F).

— Apply body putty in thin coats where necessary. Air drying: approx. 4 hours.

Oven drying: approx. 1 hour at 40 to 50° C (105 to 120° F).

— Spray one coat of thinned filler primer.

Air drying: 6 to 8 hours.

Oven drying: 1 hour at 40 to 50° C (105 to 120° F).

Sanding

— Wet sand complete car.

First with No. 320 grade wet paper.

Finish with No. 400 grade wet paper.

— Clean and dry body until all moisture is removed.

— Areas which were sanded through should be re-sprayed with filler primer.

Air drying: 1 hour.

— Dry sand to a finish using No. 360 grade wet-or-dry paper.

Spraying Paint

Prepare car for spraying by draining all water from the seams and spaces where it may gather and remove all dust using a tack cloth.

Apply two coats of thinned synthetic enamel of the desired color using the type of paint best suited for the facilities and extent of spraying.

Do not apply too thick a coat of paint (max. 40 μ = .0016 in.).

Note

Metallic colors require an additional coat. The spray gun must be held at a slightly greater distance from the surface being sprayed to produce a dryer spray, preventing floatation of the metallic particles.

Air drying: 12 hours.

Oven drying: 1 to 1¹/₁ hours (allow paint to set 15 min. before placing in oven).

Note

Complete hardening of the paint surface occurs after several days. It is therefore important that the above mentioned drying time be extended as much as practical. The car should then be polished with a protective material which will prevent damage through moisture or abrasive dust. This polish should be applied with clean pure cotton and then polished with a new piece of cotton.

Do not use a buffer or polishing rags.

Repainting

When repainting an entire car over the original paint, proceed as follows:

Preparing Surface

— Inspect old paint carefully for surface condition and hardness. Watch for cracks and areas which might peel off. Remove all paint in areas where the paint is not entirely in order.

— Clean the entire car using a cleaning agent to remove wax and silicon.

Spraying Primer

— In areas where old paint was removed, prepare the surface as described on page B 85.

— Wet sand the entire car using No. 320 grade paper and finish with No. 400 paper. Be careful that no unsanded areas remain appearing as glossy surfaces of old paint. The quality of the new paint is largely dependent on the cleanliness and preparation of the old surface. The surface should be cleaned using generous amounts of water. To prevent the formation of water marks, the surface must not be allowed to dry by itself but must be dried with a chamois carefully removing all traces of water. Remove water from all seams and crevasses with compressed air.

— Smooth out irregularities in the surface with filler as required

Air drying: 2 to 2½ hours.

Oven drying: 1 hour at 40 to 50° C (105—120° F).

— Wet sand refinished area with No. 360 paper and re-spray lightly with primer.

Air drying: 1 hour.

Oven drying: 30 min. at 40 to 50° C (105—120° F).

Spraying Paint

— Apply one uniform coat of the desired color. Do not exceed 40 μ = .0016 in. thickness.

Note

Metallic colors require an additional coat. The spray gun must be held at a slightly greater distance from the surface being sprayed to produce a dryer spray, preventing floatation of the metallic particles.

Air drying: 12 hours.

Oven drying: 1 to 1½ hours (allow paint to set 15 min. before placing in oven).

Note

Complete hardening of the paint surface occurs after several days. It is therefore important that the above mentioned drying time be extended as much as practical. The car should then be polished with a protective material which will prevent damage through moisture or abrasive dust. This polish should be applied with clean pure cotton and then polished with a fresh piece of cotton.

Do not use a buffer or polishing rags.

Air and Oven Drying Lacquer Paints

Preparation

— Remove old paint using paint remover.

— Thoroughly clean paint rests, paint remover and rust traces from the body surface.
Use only solvents designed for metal preparation to remove grease and paint rests. Do not use gasoline or other fuels.

Spraying primer

— Using thinned primer, spray one uniform coat of 3 to 4 passes with the spray gun.

Air drying: 2 to 3 hours.

Oven drying: approx. 30 minutes at 40 to 50° C (105 to 120° F).

— Apply body putty in thin coats where necessary.

Air drying: approx. 4 hours.

Oven drying: approx. 1 hour at 40 to 50° C (105 to 120° F).

— Spray one coat of thinned filler primer.

Air drying: 6 to 8 hours.

Oven drying: 1 hour at 40 to 50° C (105 to 120° F).

Sanding

— Wet sand complete car.

First with No. 320 grade wet paper.

Finish with No. 400 grade wet paper.

— Clean and dry body until all moisture is removed.

— Areas which were sanded through should be re-sprayed with filler primer.

Air drying: 1 hour.

— Dry sand to a finish using No. 360 grade paper and spray a light coat of primer.

Spraying paint

Spray a uniform coat of the desired color.

Air drying: approx. 6 to 8 hours.

Oven drying: 1 hour at 40 to 50° C (105 to 120° F).

Wet buff with electric buffer and wet polishing paste. Remove polishing paste and polish to high luster. Apply protective polish and finish by hand.

Lighting System

Accessories

Instruments

Description of the Electrical System

Generator

The generator of the 365 B delivers a 6 volt current at a nominal power of 200 watts at 2600 generators r.p.m. The generators supplies power to charge the battery and operate the electrical system. A generator indicator light (red) is located in the combination instrument on the instrument panel.

Starter

The 1/2 hp starter is actuated by a solenoid which also engages the overrunning clutch mounted pinion. The solenoid is operated by a contact in the ignition switch.

Battery

The six volt 84 ampere hour battery has three cells and is located under the front hood behind the spare tire. The negative terminal is grounded.

Ignition

Power supplied by the battery is converted to high voltage current by the ignition coil. The distributor incorporates a centrifugal spark advance mechanism. The ignition switch is located on the instrument panel.

Lights

A headlight with standard high and low beam is located in each fender. The parking lights are located in the headlight housing except in the case of "sealed beam" lights, in which case the parking lights are located in the turn signal lamps. The parking and driving lights are controlled by a three position pull switch which also contains a rheostat for the instrument lights. The tail lights are also controlled by this switch.

The low and high beams are selected by the dimmer switch which is contained in the turn-light signal-dimmer switch (BAL switch). A blue high beam indicator light and a red turn signal indicator light are located in the face of the tachometer.

The brake light is controlled by an hydraulic switch on the master brake cylinder. The back-up light is automatically controlled by a switch on the gear box and lights only when the ignition is turned on and reverse gear is engaged (in earlier models only when the low headlight beam is on).

The interior light of the Cabriolet/Hardtop is located in the center of the instrument panel while the Coupe has two lights located over the center posts. The interior lights have integral three position switches permitting the lights to be either on, off, or door controlled. The door control is effected by a pressure release switch in the upper hinge of each door which operates when the door is opened. The Roadster is not equipped with interior lights.

A socket for a handy lamp or other accesories is located under the left side of the instrument panel.

Accessories

The horns are actuated by the horn button in the center of the steering wheel through a contact in the BAL-switch.

The turn signals are operated by the lever of the BAL-switch on the steering column, as are the high and low beams and the light signal. When the turn signal is in operation a red light in the tachometer face flashes accompanied by a clicking sound. The signal lever is returned to the neutral position by a cam on the steering wheel hub. When, for instance, the left signal and the brakes are operated at the same time, the left signal light flashes while only the right brake light operates normally.

The windshield wipers are driven by an electric one speed motor, which is controlled by a pull switch on the left side of the instrument panel. All fuses are located in a single box under the instrument panel.

Instruments

The speedometer and tachometer are driven by flexible shafts. The speedometer is driven by the left front wheel while the tachometer is driven by a gear on the end of the oil pump shaft. The fuel gauge registers the fuel level measured by a float and lever type sending unit on the fuel tank.

The oil temperature is measured in the main oil line ahead of the cooler by a sending unit and is shown on the instrument panel temperature gauge.

The combination instrument on the dash board contains the fuel gauge, oil temperature gauge, oil pressure light, and generator light. The oil pressure light (green) registers when the pressure at the sending unit in the main flow falls below normal.

Note

Electrical system repairs are generally limited to the replacement of defective or worn components and reconditioning of the wiring. When replacing wires it is important to use wire of the same size, and, if possible, the same color code.

Important

To avoid short circuits the negative (ground) strap should be removed from the battery when work is done on the electrical system. When replacing battery cables, first connect the positive, then the negative strap.

Instruments and Controls

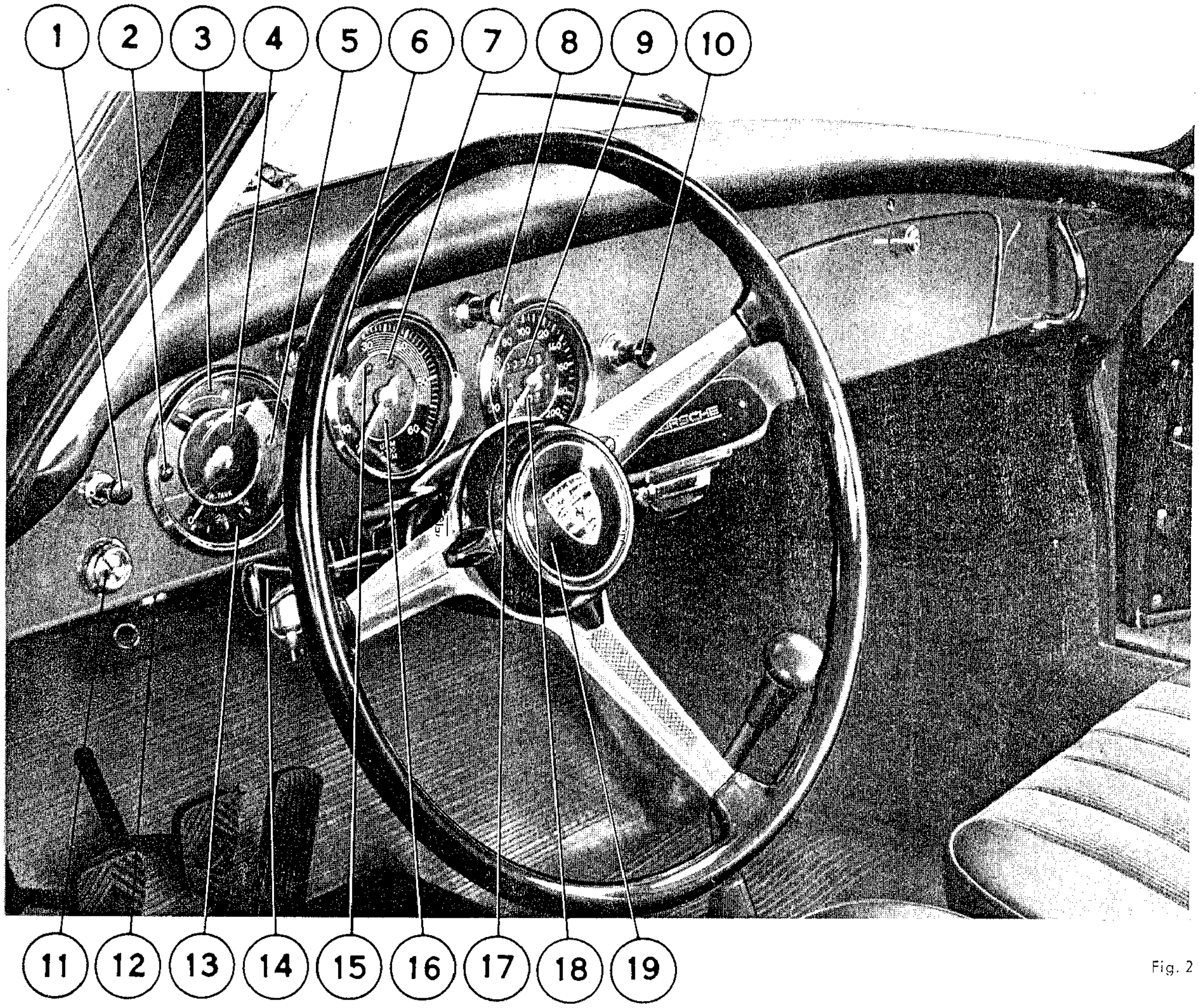


Fig. 2

① Pull switch for windshield wiper
② Generator warning lamp
③ Oil temperature indicator
④ Combination instrument
⑤ Oil pressure warning lamp
⑥ Hand throttle
⑦ High beam indicator
⑧ Light switch
⑨ Odometer
⑩ Cigarette lighter
⑪ Ignition-starter switch
⑫ Socket for auxiliary light
⑬ Fuel gauge
⑭ Turn signal, dimmer, light signal switch
⑮ Turn signal monitor lamp
⑯ Tachometer
⑰ Speedometer
⑱ Trip odometer
⑲ Horn button

Fuses and Light Bulbs

Fuses

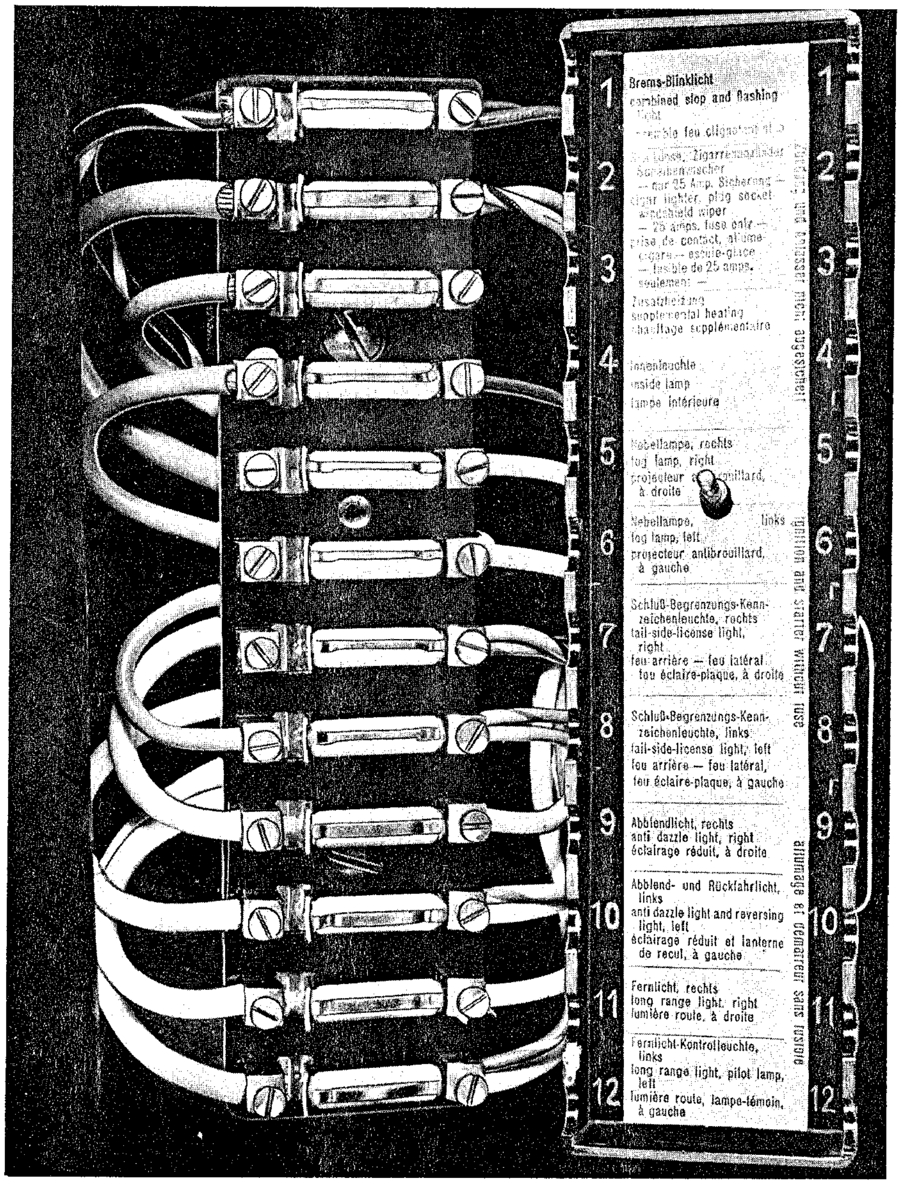


Fig. 3

Light Bulbs

High and low beam (Europe)	6 V—45/40 W
Sealed-beam (USA)	6 V—50/40 W
Front parking light (Europe in headlight)	6 V— 4 W
Front parking light (USA in turn signal)	6 V— 4 W
Turn signal front	6 V—15 W
Turn signal brake light	6 V—15 W
Tail light	6 V— 5 W
Licence plate light	6 V— 5 W
Back up light	6 V—25 W
Interior light	6 V—15 W
Tachometer light	6 V— 0,6 W
Speedometer light	6 V— 0,6 W
High beam indicator light	6 V— 0,6 W
Turn signal indicator light	6 V— 1,2 W
Combination instrument light	6 V— 1,2 W
Generator indicator light	6 V— 1,2 W
Oil Pressure light	6 V— 1,2 W

Generator

General

The generator supplies power to the electrical system and keeps the battery charged. It is driven by a V-belt from the crankshaft. Its output which varies with load and change in speed is governed by a voltage and current regulator.

Generator construction

The main assemblies are:

housing, pole shoes, field coil,

armature winding and commutator,

brushes and brush holders,

armature bearing and end frames,

and the regulator.

Operation

The voltage of the DC shunt wound generator is held nearly constant despite changes in engine speed and electrical load by an electro-magnetic vibrating regulator which also prevents overcharging the battery. A cut-out relay automatically prevents the back flow of current and subsequent discharge of the battery when the engine is stopped.

In order to prevent generator damage from overload when the battery is discharged and accessories are in use, a system of regulators is used.

The housing is a magnetically permeable steel walled cylinder inside which the pole shoes and field coils are attached with counter sunk screws.

The field coils, consisting of many turns of insulated copper wire, are wound around the two pole shoes and are connected in series.

The armature, an iron core in which the armature windings are imbedded and on which the commutator is located, turns between the two pole shoes. The current induced in the armature windings is taken from the commutator by the brushes.

Regulator

The regulator system is composed of a voltage and current regulator which protects the generator from excessive current while keeping the voltage nearly constant up to the maximum load, at which point the voltage drops sharply. This system employs the generator more efficiently and charges the battery more quickly.

The iron core is made of numerous stamped sheet metal laminations whose surfaces are insulated to reduce eddy currents. The armature coils, consisting of insulated copper wire, are placed in the grooves of the armature and are secured against centrifugal forces. This system of coils is called the armature winding and consists of as many coils as there are commutator sections. The end of each coil is soldered to a commutator section to provide a path to the brushes where the generator power is collected.

The commutator consists of copper sections which are insulated from each other and from the armature shaft. To prevent the carbon brushes from coming into contact with the insulation between sections after prolonged use, the insulation is trimmed back below the commutator surface.

The carbon brushes are held by spring pressure against the commutator from which they collect the current induced in the armature coils. The brushes are laterally secured by box channels in which they can move up and down.

The armature is supported by ball bearings which are held in the end frames that cover both ends of the generator. A band around one end of the generator housing covers openings through which the commutator and brushes can be inspected.

Bearings are only lubricated in conjunction with a general overhaul. Never use chassis grease.

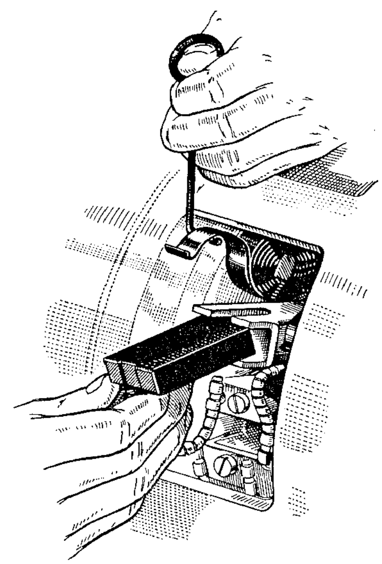


Fig. 4

Maintenance

The ball bearings of the generator are lubricated with heat resistant grease and require no attention under normal conditions.

The brushes should be inspected every 6000 miles (10,000 km). Worn brushes should be replaced to prevent commutator damage.

Never oil brushes.

Bosch Generator

Principles of Operation

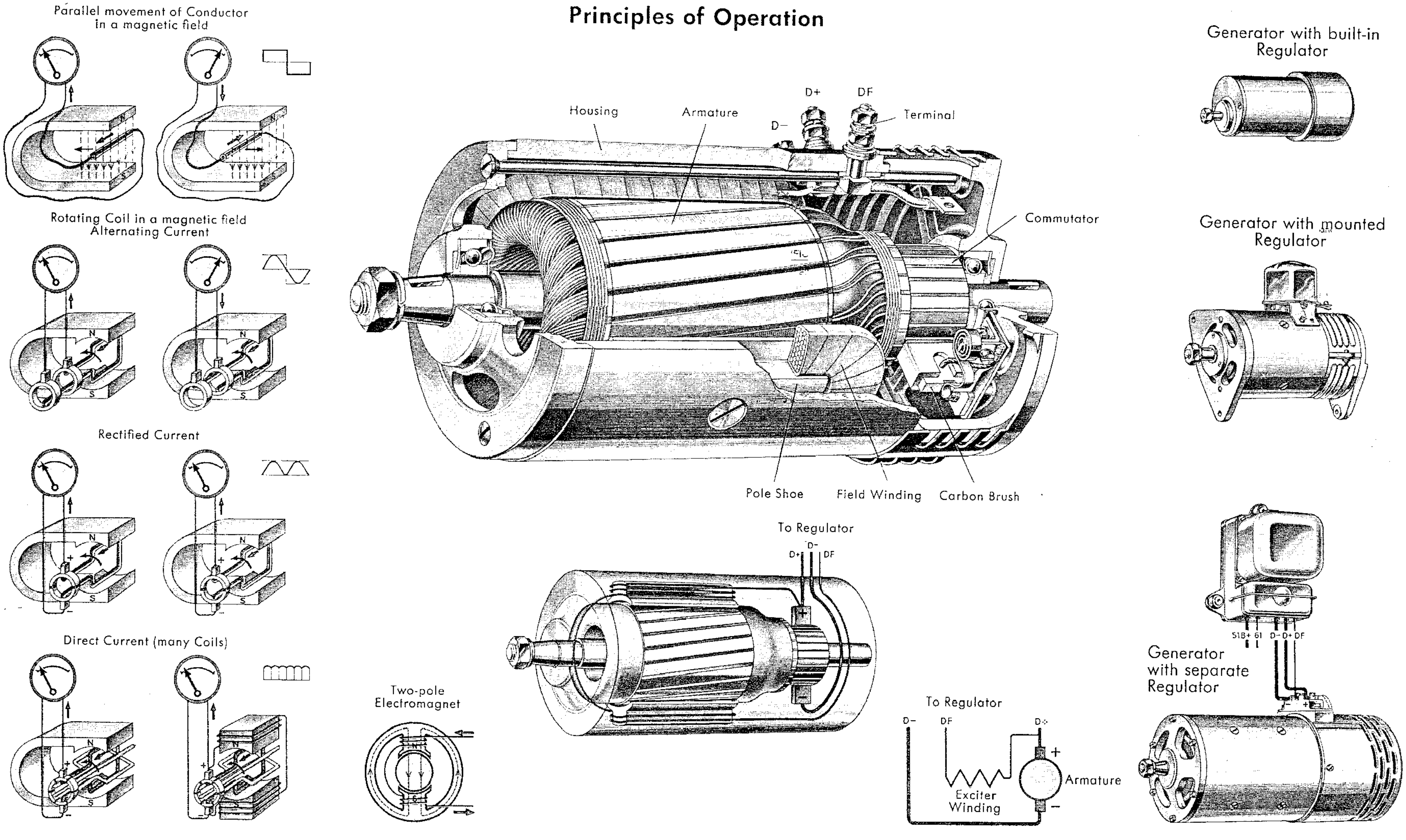
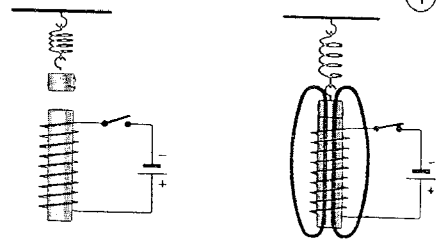


Fig. 5

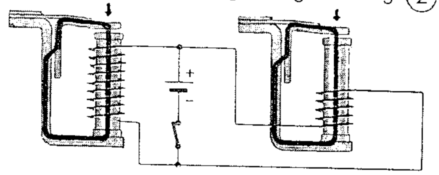
Bosch Regulator

Type RS/UA (with separate Current Regulator)

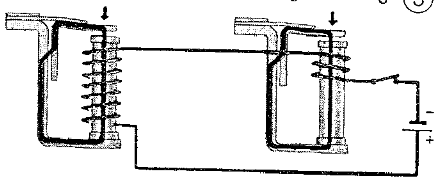
Action of Electromagnet ①

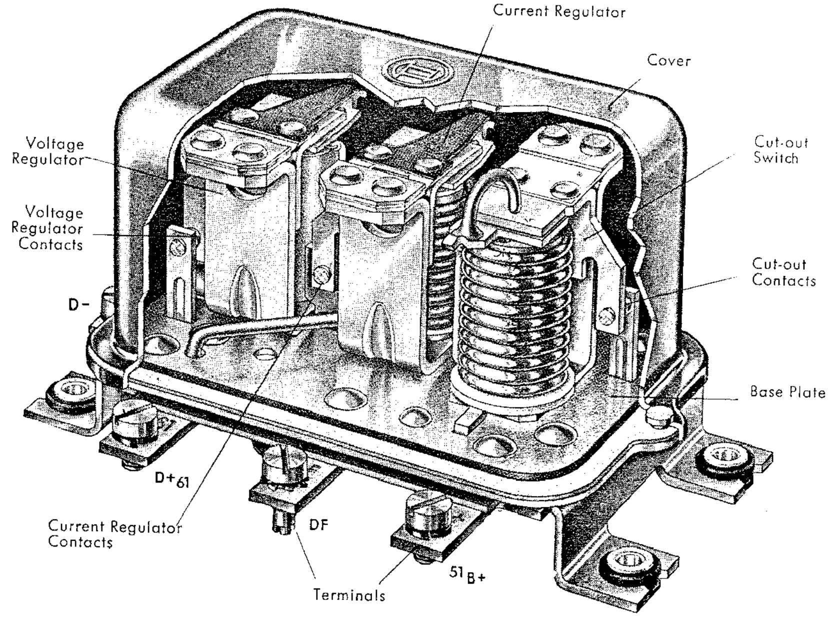


Action of the Voltage Regulating Windings ②

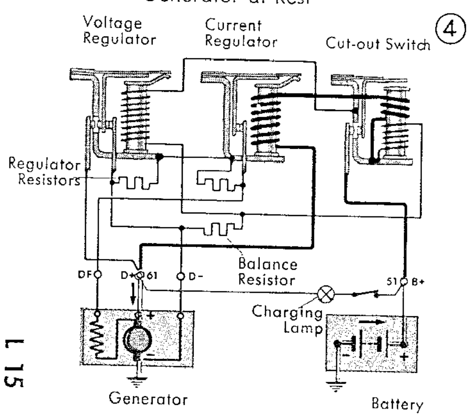


Action of the Current Regulating Windings ③

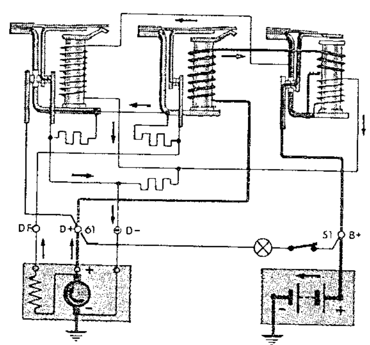




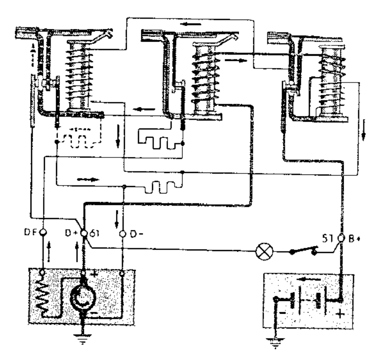
Generator at Rest ④



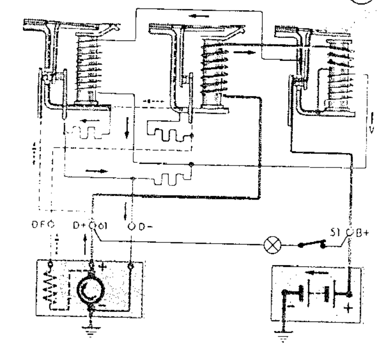
Close Cut-out Contacts ⑤



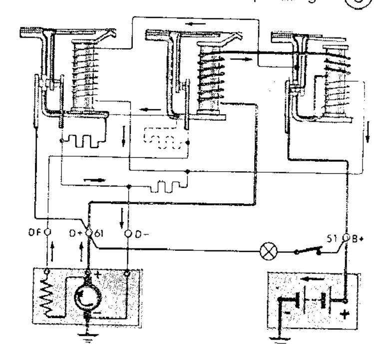
Voltage Regulation: Lower Contacts operating ⑥



Voltage Regulation: Upper Contacts Operating ⑦



Current Regulation: Current Regulator Contacts Operating ⑧



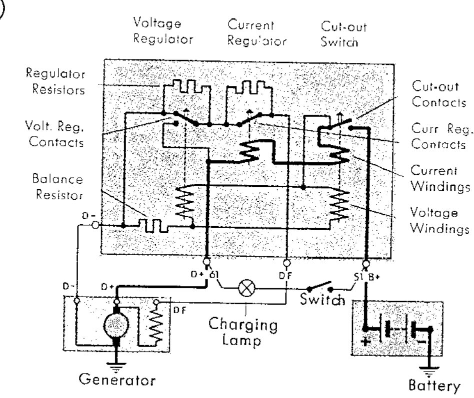


Fig. 6

Replacing Generator Indicator Bulb

1 LI

General

A generator voltage light (red) connected through the ignition switch to terminals 51 and 61 of the regulator, lights when the ignition is on. It remains lit as long as the engine is running slowly and goes out when the generator voltage exceeds the battery voltage. The lamp also provides a warning signal in case of V-belt failure and consequent stopping of the generator and cooling blower.

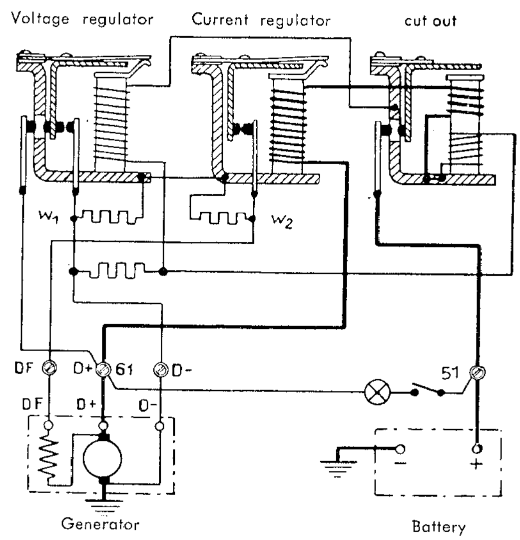


Fig. 7

Bulb Replacement

1. Pull out socket and bulb.
2. Push in, turn to the left, and pull the bulb from the socket.
3. Install new bulb in reverse manner.

Note:

For testing electrical circuits a tester with the following instruments is required:

1. Voltmeter 0 to 15 volt range.
2. Ammeter 10 to 0 to 60 amp. range and 100 to 600 range (shunt).
3. Variable resistor 0 to 5 Ohm, 300 watt rating.

Testing Current

2 LI

Warning

When performing this test do not start the engine until the ammeter is set on the 600 amp. capacity and properly connected with heavy leads.

1. Disconnect the ground strap from the battery terminal, connect the negative lead of the ammeter to the battery and the positive lead to the ground strap (series connection).
2. With all accessories switched off the ammeter should read zero. Any current reading indicates leakage in the circuit of the car to ground which must be found and repaired.
3. Switch on ignition. Ammeter should show not more than 3 amp. (with breaker points closed), going through the coil, generator and oil pressure light. A greater reading indicates faulty ignition or ignition switch.

Note:

All accessories can be tested similarly by switching them on individually. Their permissible currents are given by dividing their wattage by the circuit voltage (6 V). The total current through all accessories should not exceed the generator current rating.

3 LI

Testing Generator and No-Load Voltage

Note:

Although the generator indicator lamp may go out with increased engine speed, it is not certain that the battery is being charged adequately. If the wiring is in good condition (see 2 LI) indications of improper charging may be: weak starting effort, dim headlights when starting, or frequent battery water loss caused by excessive charging rates. The cause may be found through simple preliminary tests without removing the generator or regulator cover.

Before making any tests check the condition and tension of the V-belt.

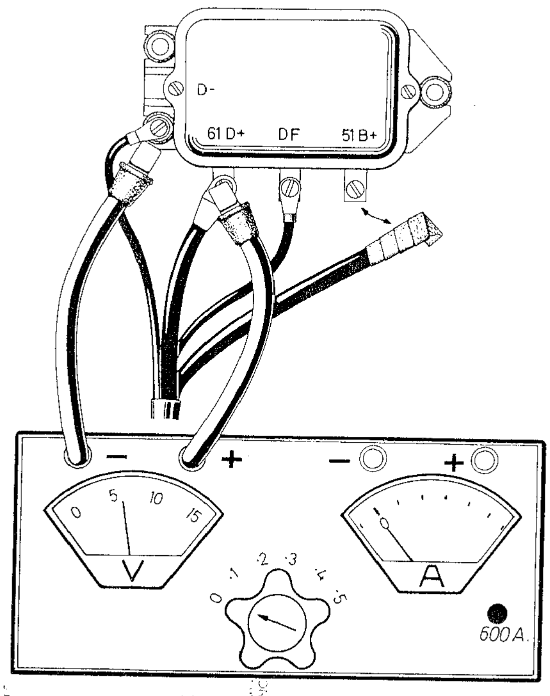


Fig. 8

Test:

1. Switch on ignition. Generator indicator lamp on the instrument panel must light. Disconnect generator lead from terminal "61 D+" at regulator. Lamp should go out. If the lamp does not go out the generator lead is grounded and must be repaired. Reconnect generator lead to terminal "61 D+".

2. Disconnect battery lead from terminal "51 B+" at the regulator and insulate end with tape. Connect the positive lead of the voltmeter to terminal "61 D+" and the negative lead to ground on the regulator base plate (Fig. 8).

3. Start the engine and increase speed gradually to the nominal voltage rpm (see page L 85). The voltmeter should indicate 6 V. If no reading is obtained the generator is not charging and must be overhauled.

If a replacement regulator is to be used for a quick check, it is important to check the field winding of the generator first to prevent damaging the regulator.

To test field windings (regulator fully connected) connect an ammeter to terminals "51 B+" and "DF" of the regulator. A reading considerably greater than 5 amp. indicates a short in the field windings or a short to ground.

Testing Voltage

Note:

The regulator cover must remain on during the tests since the regulator elements are temperature sensitive.

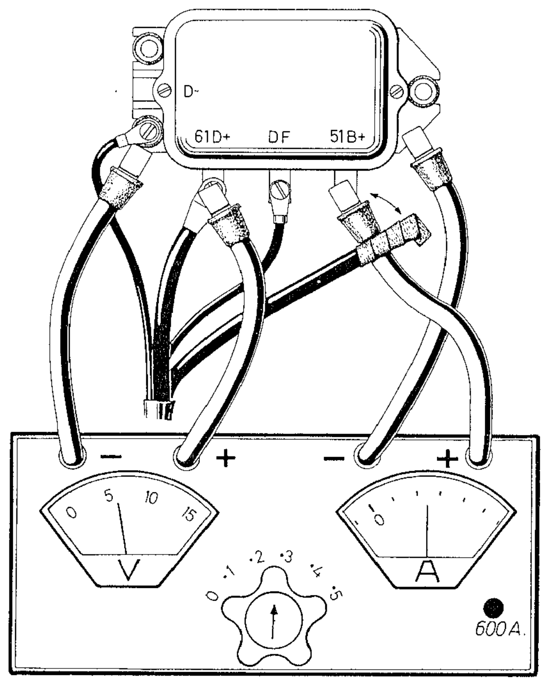


Fig. 9

a) **Regulator voltage under no load**

1. Connect leads as in Fig. 8.

2. Start engine and increase generator speed to 3500–4000 rpm, at which time the voltmeter should register the correct no-load voltage.

b) **Regulator voltage under load**

1. Connect leads as in Fig. 8 and connect ammeter to terminal "51 B+" and ground as in Fig. 9.

2. Start engine and increase speed to generator test rpm and hold constant. Increase resistance load until the ammeter indicates the correct test current. At this setting the voltmeter must indicate at least 6 volts for a generator in good working order. If the generator has become warm during the test an increase of 100 rpm is permissible to obtain rated output.

3. If the generator fails to produce current during this test the generator must be removed and checked for internal shorts in the armature and field windings. If the current does not reach the required values the regulator is at fault and must be adjusted by an auto electric shop or be replaced.

c) **Current Regulator Test**

1. Connection as in Fig. 9, generator running at test rpm.

2. Gradually reduce the circuit resistance at the variable resistance, the reading on the ammeter will increase correspondingly until the current regulator starts to operate. Further reduction in the resistance will cause the voltage to fall sharply without affecting the current reading. For maximum permissible current values see page L 85.

3. If the current does not remain within the prescribed limits the regulator must be adjusted by an auto electric shop or be replaced.

5 LI

Testing Regulator Cut-Out Switch

Note:

Before making this test the battery must be in good condition and at least half-charged (Specific gravity 1.230).

a) **Cut-Out Closing**

1. Connections as for previous test. If necessary reset variable resistor to nominal output and check setting with ammeter as in 4 LI, Fig. 9.
2. Start engine and slowly increase speed. Voltage should increase but no current should flow, indicating that the cut-out switch is open. When the cut-out switch closes, the indicated voltage drops slightly and the ammeter begins to register. Leave the engine running at idle speed. The maximum voltmeter reading before the hand jumps back indicates the closing voltage. The value should be within the limits shown on page L 85. If it does not, the cut-out switch should be adjusted.

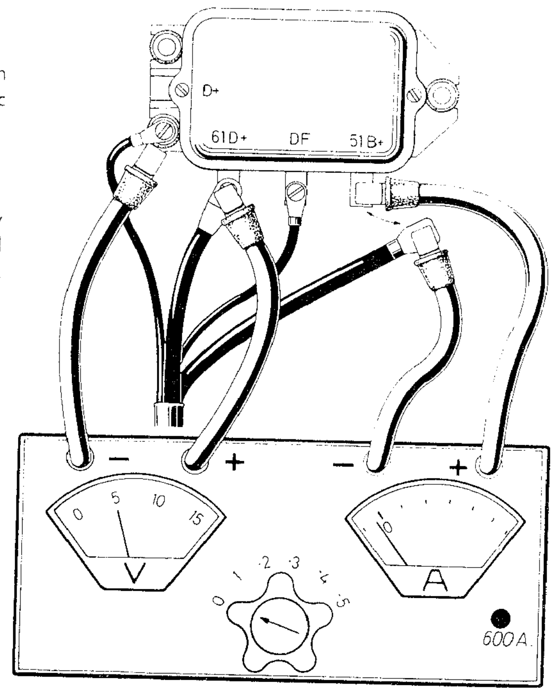


Fig. 10

b) **Cut-Out Opening**

1. Set regulator to zero. Connect battery lead "51 B+" (insulated until now) to negative lead of ammeter. Connect positive lead of ammeter to terminal "B 51+" of the regulator (Fig. 10).
2. Increase engine speed until ammeter shows a charging current. Gradually reduce engine speed; the ammeter will pass the zero mark and indicate a negative reading before finally returning to zero. The maximum reading of the ammeter shows the opening current required to disconnect the battery from the generator. This value should lie in the range specified on page L 85. If the contacts open while ammeter shows a positive reading, the relay windings are shorted and the regulator must be replaced. The engine idle speed should preferably be set so that the ammeter rests on zero at normal engine temperatures. The ammeter must in any event indicate zero before the engine finally stops. If this does not occur the cut out switch must be adjusted by an auto electric shop or be replaced (sticking contacts).

6 LI

Removing and Installing Regulator

Removal

1. Disconnect all cables from regulator.
2. Remove mounting screws and remove regulator.

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. When replacing a regulator, first check that the field coils of the generator are not grounded.
2. Connect cables according to wiring diagram on regulator box.
3. Polarize generator (see 8 LI Note).
4. If incorrect readings are again obtained after installing a new regulator, the generator or the wiring may be at fault and an auto electric specialist should be consulted.

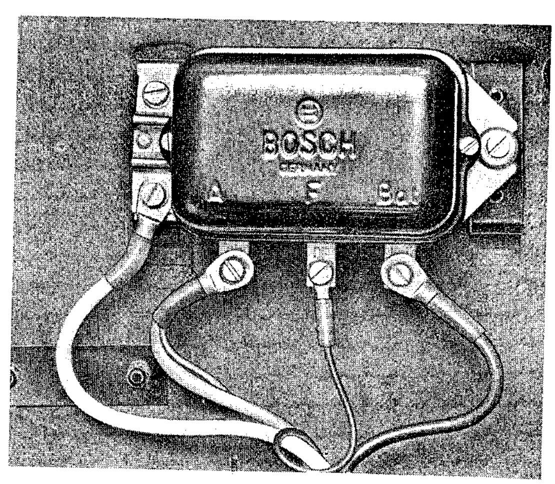
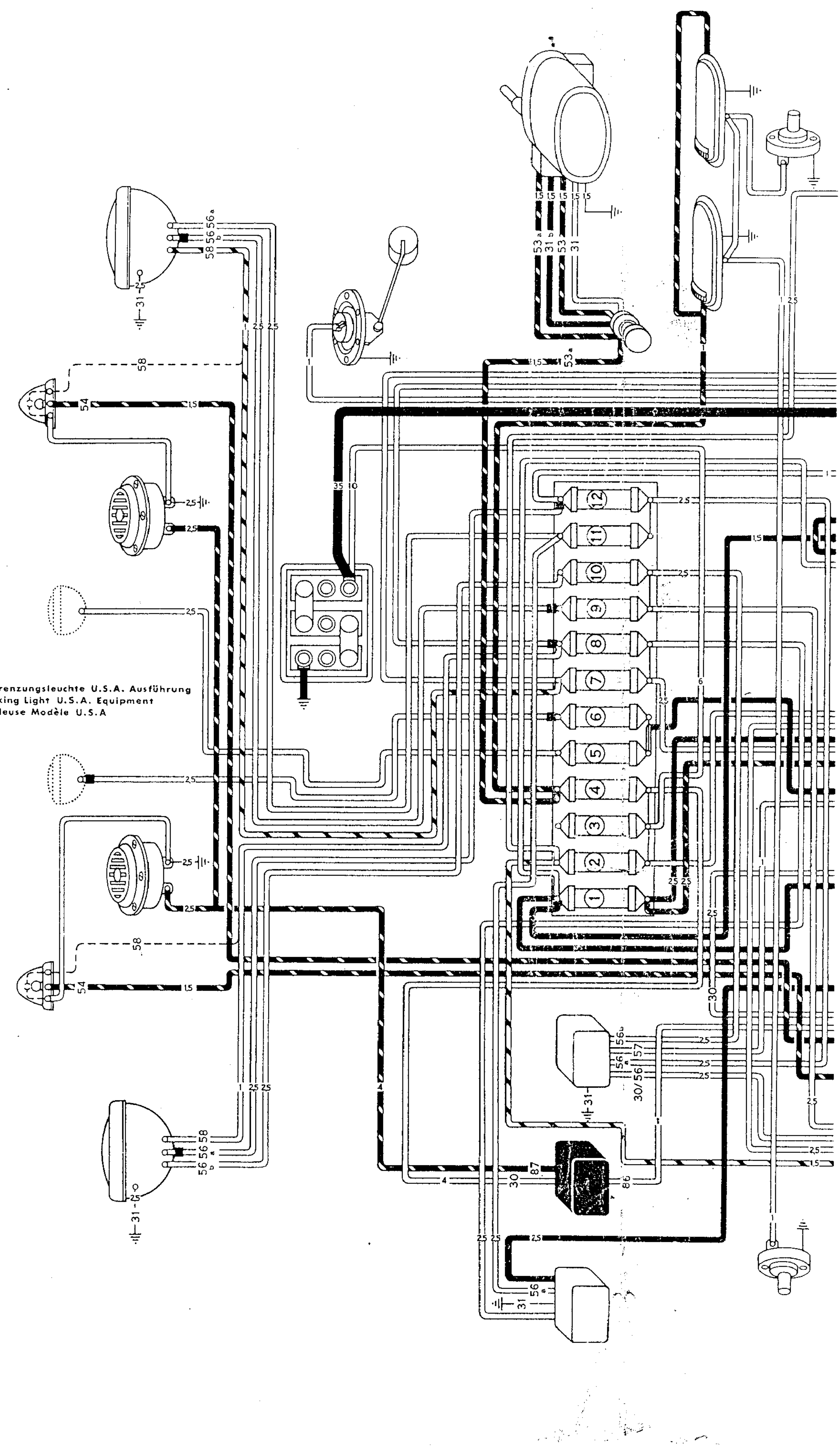


Fig. 11

WIRING DIAG



----- : Begrenzungsleuchte U.S.A. Ausführung
Parking Light U.S.A. Equipment
Veilleuse Modèle U.S.A

WIRING DIAGRAM 356 B

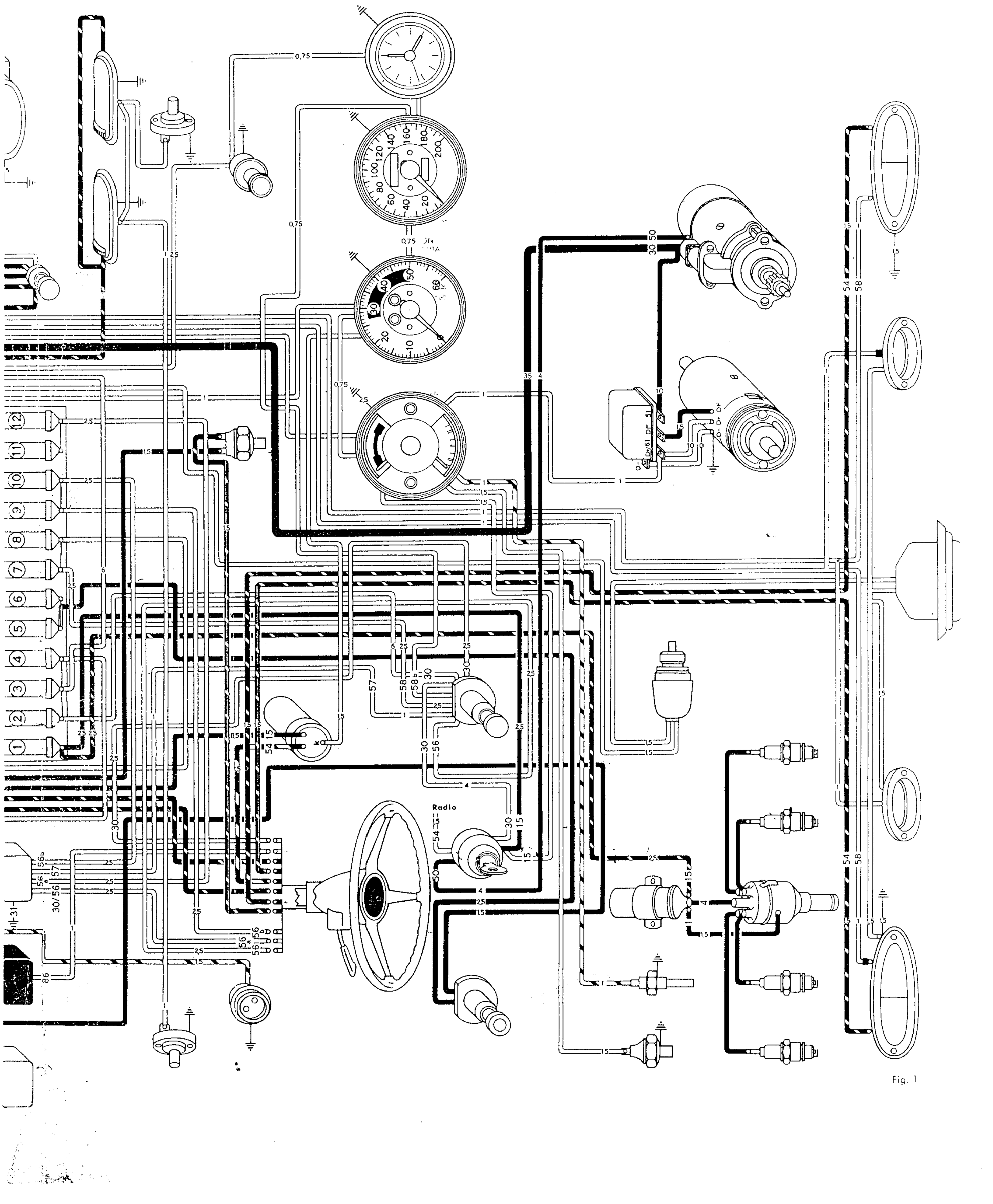


Fig. 1

9 LI

Disassembling and Assembling Generator

Disassembly

1. Remove V-belt pulley and blower.
2. Disconnect field coil terminal from brush holder of positive brush.
3. Remove nuts from generator through bolts.
4. Disassemble generator and remove armature.
5. Remove ball bearing. After disassembling the generator thoroughly wash all components with clean solvent and dry with compressed air.

Assembly

The assembly is accomplished in the reverse order of disassembly observing the following points:

1. Test armature, field coils, cable connections and brushes.
2. Examine ball bearings for wear and damage. Replace if necessary. Rinse bearings in clean solvent and lubricate with high temperature grease.
3. Check end play: Too little play may cause bearing damage while too much play will permit the armature to touch the field coils.
4. Insure that cables are correctly connected to brush holders.

10 LI

Testing Armature

Armature failures cannot be found through visual inspection in most cases. The armature must therefore be tested for open circuits, short circuits, and internal ground.

Testing:

1. Open circuits in the armature usually cause arcing between segments and are therefore easily visible. Open circuits may also be found by using a potentiometer which, however, is not always available.
2. A short in the armature windings can only be tested using a growler (A.C.-Test magnet). Place the armature on the growler and turn the armature slowly, holding a thin steel strip or hacksaw blade over the core segments. Short circuits in the armature cause the hacksaw blade to vibrate against the core when held above the slot containing the short. A similar device uses a feeler containing a coil instead of a hacksaw blade. The feeler coil is connected to ear phones which make a growling noise due to the alternating current induced in the feeler coil by the short circuit (Fig. 15).

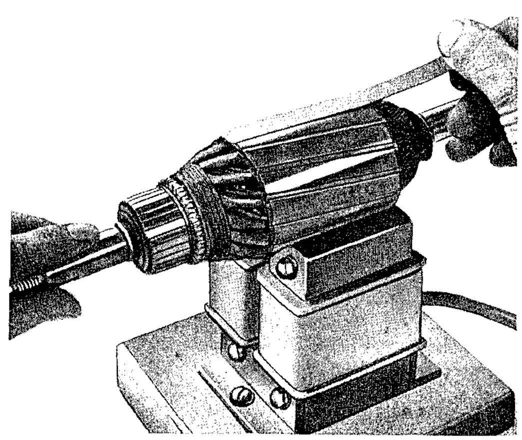


Fig. 14

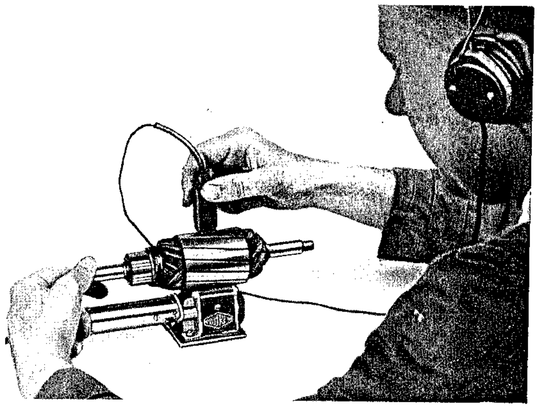


Fig. 15

3. An internal ground occurs when the armature core makes contact with the windings or when carbon dust enters the windings. The test is made using a 40 volt source and 40 volt test lamp holding the test prods on the commutator and armature core. The test lamp should not light.

4. If the commutator is out of round, burned, or scored, it should be turned and reconditioned. Such damage can only be properly corrected by turning and polishing.

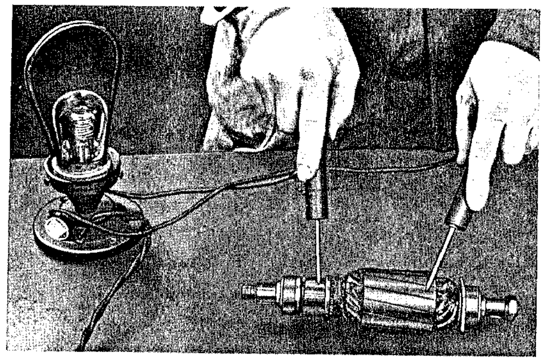


Fig. 16

The insulation between the segments should be cut down 0.3 to 0.5 mm (.012 to .020 in.) below commutator surface using a commutator saw.

Testing Field Coils

11 LI

Test field coils for open circuits, short circuits, and grounds.

1. Test each field coil separately for open circuits by connecting the coil in series with a 6 volt test lamp and a 6 volt battery. If the test lamp does not light the field coil is faulty.

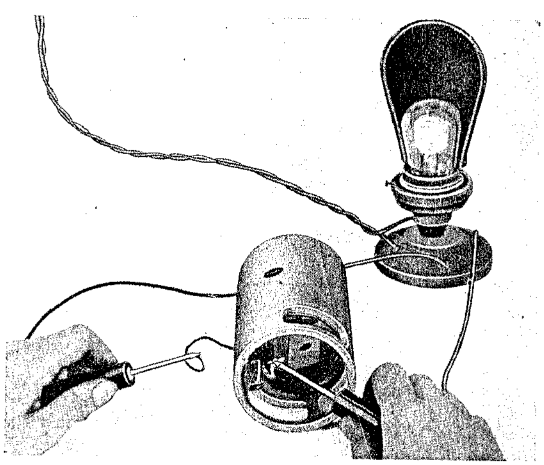


Fig. 17

2. Test each field coil for short circuity by connecting an ohmmeter to the ends of the coil and comparing the readings to the standard values (page 85). If an ohmmeter is not available, an ammeter and 6 volt battery may be connected in series to each coil to compare the current flow. If the current flow of the coils differs by more than 5 amp. the coil with the higher reading is faulty.
3. Test for grounds while field coils are installed in the generator housing by connecting a 40 volt test lamp (using 40 volt source) connecting one prod to the field winding connector and the other to the generator housing. The lamp should not light.

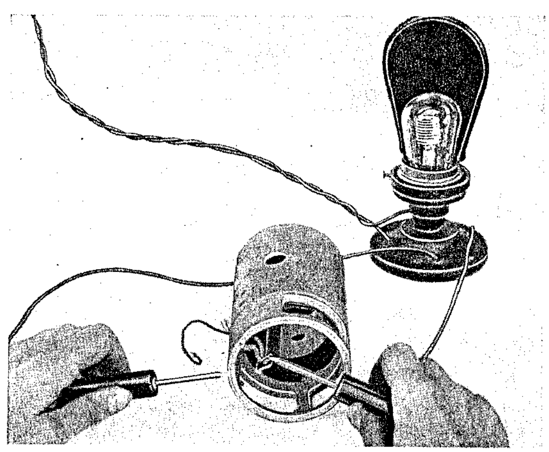


Fig. 18

4. Test the assembled field coils for continuity and solid connections in the housing (use 6 volt test lamp).

Service Diagnosis

The red generator indicator lamp lights when the ignition is switched on and should go out when the engine has been started and the speed increases.

Trouble	Cause	Repair
Generator indicator lamp does not light with ignition switched on	a. Battery discharged b. Battery defective c. Bulb burned out d. Corroded or loose battery terminals e. Loose connections or broken cables f. Ignition switch defective g. Generator brushes do not make contact with commutator	a. Charge battery b. Replace battery c. Replace bulb d. Clean or tighten terminals e. Tighten or replace cables f. Replace ignition switch g. Reseat brushes, or replace, or replace tension springs Do not oil brushes!
Generator lamp does not go out with increased engine speed or flashes intermittently	a. V-belt loose or faulty b. Regulator defective c. Charging cables loose or broken (open circuit) d. Generator defective	a. Adjust belt tension or replace belt b. Replace regulator c. Check cables and connections d. Check generator
Generator lamp goes out only at high r.p.m.	a. Generator defective b. Regulator defective (improperly set)	a. Check generator b. Reset or replace regulator
Generator lamp continues to light with the ignition switched off	a. Regulator contact points sticking (burned)	a. Replace regulator

Starter

General

The starter, which is used to crank the engine, must overcome the combined resistance of the compression, piston friction, and bearing friction. In order to be able to provide the considerably large torque required for this purpose, the starter draws a very high current.

Construction and Function

The design of the starter is similar to that of the generator. The main difference lies in the fact that the starter is a current consumer and the generator a current producer.

The overrunning clutch coupling, mounted on the starter drive, breaks the connection between engine and starter as soon as the peripheral speed of the flywheel exceeds that of the starter pinion.

The driver, coupled with the pinion by the overrunning clutch, is mounted on the long helical spline of the armature shaft. The rotation of the armature and spline pushes the pinion forward to engage the flywheel ring gear. The forked end of the solenoid lever is held between two spring loaded washers in the middle of the driver sleeve on which the starter gear is mounted. The forked end of the actuating lever engages between the two actuating rings to advance the pinion. The pinion is also advanced by the inertia action of the helical spline. The commutator end of the starter is closed by an end cap. The starter is actuated electromagnetically by a solenoid switch mounted on the starter and in turn actuated by the ignition/starter switch mounted on the instrument panel.

Engaging

After the starter has been switched on, the actuating lever is first moved against spring pressure without the field and armature windings switched on. The actuating lever pushes the driver and pinion toward the ring gear by the actuating ring on the pinion side and against the coil spring; the driver and pinion thereby turn on the helical spline. Should the pinion be in line with a tooth space in the process, it meshes instantly.

Shortly before the pinion meshes fully, the switch mounted on the starter is closed so that the starter armature begins to rotate. As the starter shaft accelerates the starter pinion is fully engaged with the ring gear by the worm action of the helical spline shaft. When the pinion gear reaches the end stop on the starter shaft it is firmly seated and the starter begins to drive the flywheel through the overrunning clutch. When the solenoid switch closes the actuating lever stops but the driver continues forward tensioning the coil spring nearest the armature.

Should the advancing pinion come against a tooth, the actuating lever compresses the coil spring at the pinion end, until the switch closes. The pinion being turned passes the tooth face and engages the succeeding tooth space under pressure exerted by the coil spring. Because of the long helix no axial pressure that would jam the mechanism occurs. The solenoid switch mounted on the starter contains one actuating and one holding coil. Both coils are in action while actuating the plunger. When the starter current is switched on, the actuating coil is short-circuited, and the holding coil alone remains energized.

Disengaging

The overrunning clutch used to protect the armature from damage is connected to the pinion gear. When the pinion gear speed exceeds the armature speed it is free to rotate on the roller and ramp type overrunning clutch. As shown in Fig. 19 the rollers become jammed against the shaft and couple the pinion gear to the armature when driving. The rollers are pushed back into the larger gap when driven by the engine. When the gear is stationary, springs push the rollers into the engaged position so that the pinion gear will be driven as soon as the starter is actuated. The pinion gear remains engaged with the flywheel ring gear as long as the starter is running and the solenoid is activated. The pinion gear is withdrawn from the starter ring gear only when the solenoid is released. The pinion gear is returned to the neutral position by the coil spring on the shaft and the solenoid return spring.

This spring holds the pinion gear in the neutral position even during engine vibration and vehicle acceleration until the starter is again used.

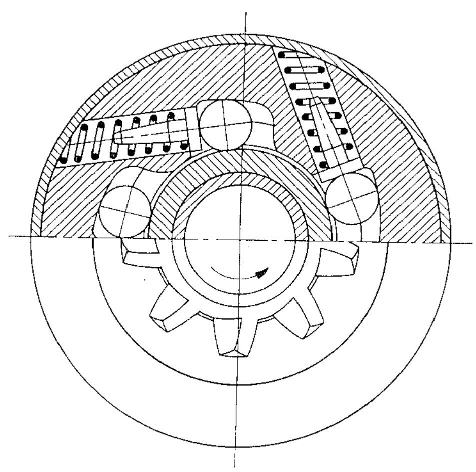


Fig. 19

5-Roller Overrunning Clutch

Maintenance

The armature bearing requires no lubrication during normal operation but should be serviced when the engine is overhauled. The starter bushing in the transmission housing should be inspected for wear when the starter is removed and lubricated with high temperature grease before installing the starter. The starter end cap should be removed every 6000 miles (10,000 km) to inspect the condition of the brushes. Replace worn brushes or weak springs (page L 85).

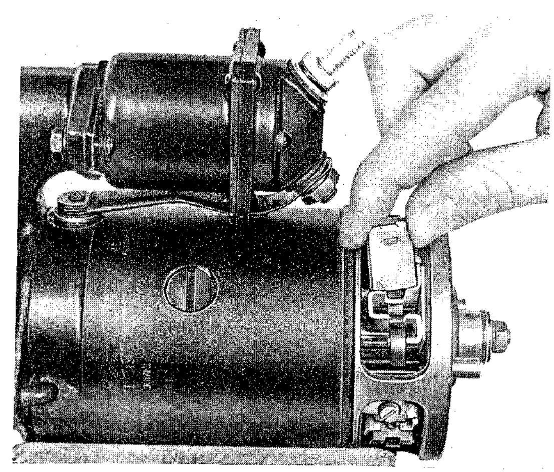
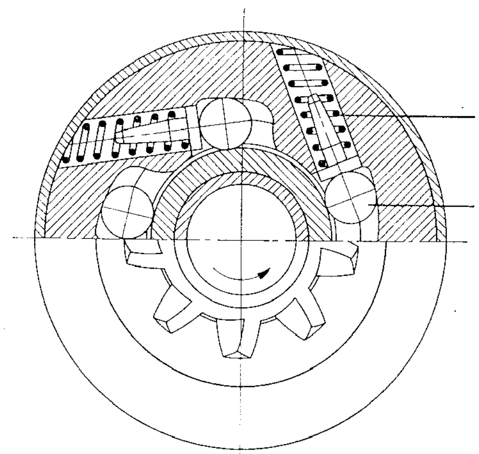


Fig. 20

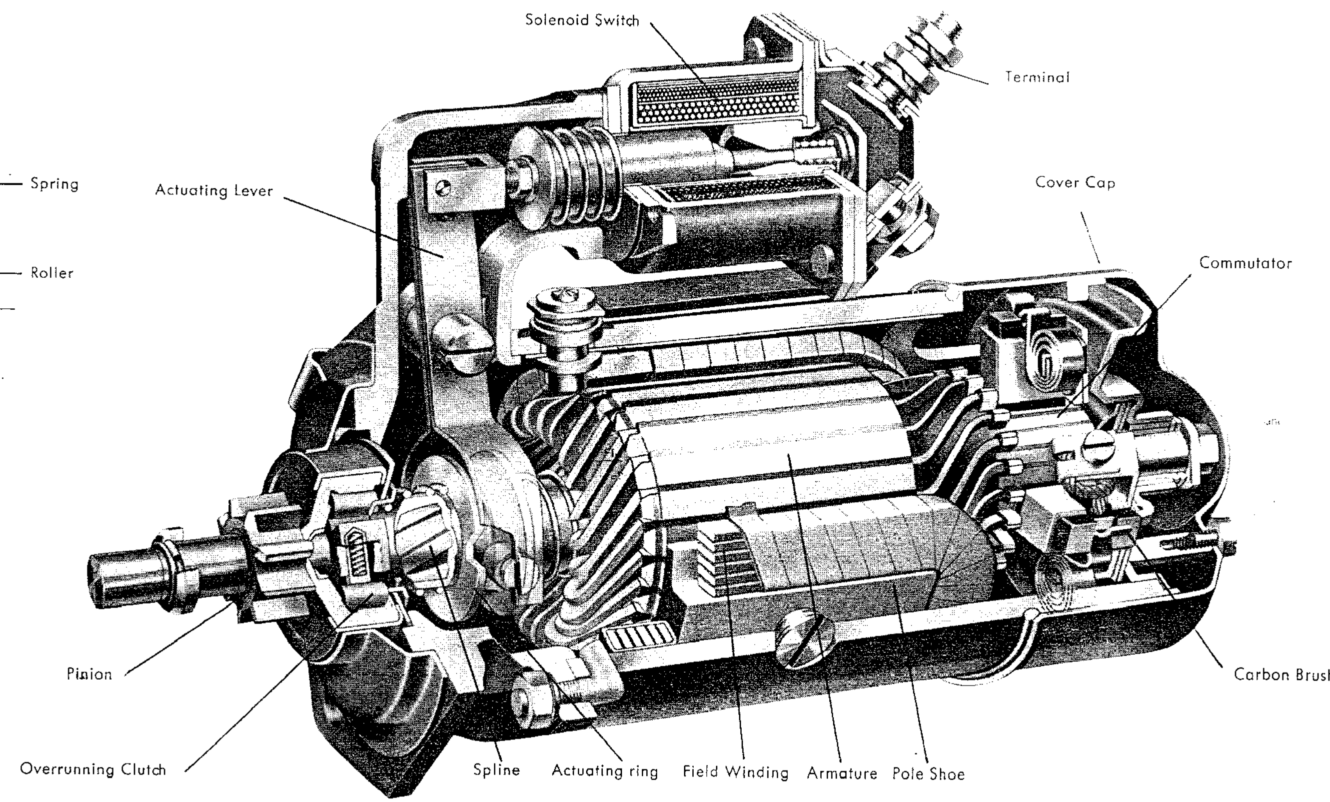
Armature Brake

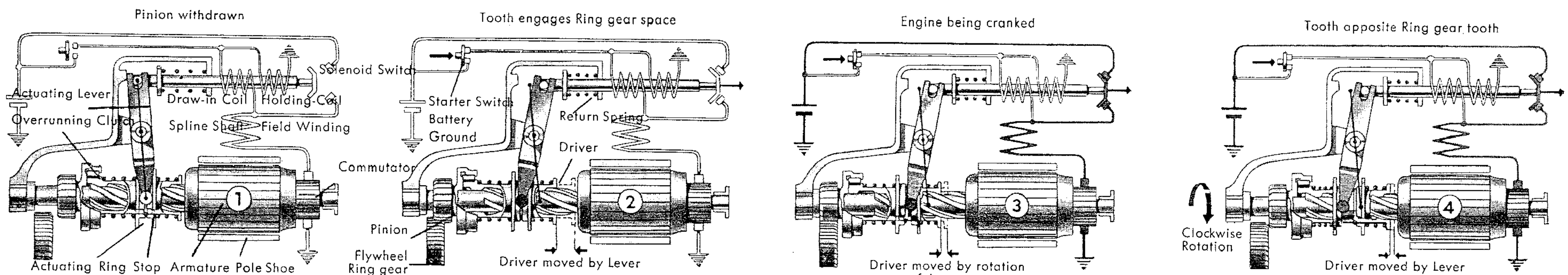
A brake is mounted at the commutator end of the starter in order to stop the armature as soon as possible after cutting off the current so that a fresh start may be made quickly if necessary. The brake consists of a spring washer, a holding washer, and a friction washer (Fig. 27). The braking torque is designed so that it does not impede the generator during operation yet is sufficient to arrest the armature quickly when it is switched off. The friction torque should be from 2.5 to 5 cm.kg. (2.2 to 4.4 in.lb.). The commutator must be clean and free of oil. A dirty commutator may be cleaned using a clean rag soaked in solvent or carbon tetrachloride. If the commutator is badly worn or shows signs of arcing, the starter should be overhauled. When replacing the end cap insure that the rubber seal ring is in good condition or is replaced if necessary.

Bosch Solenoid Starter



Overrunning Clutch





Rest position / no current flowing

Draw-in and holding coils energised
Pinion meshes instantly
Just before main circuit is switched-in

Engaging lever in end position / Draw-in coil dead / Main circuit closed / Pinion fully meshed / Engine being cranked

Fig. 21

Engaging lever in end position / Draw-in coil dead / Main circuit closed / Armature rotates / Pinion seeks tooth space and meshes fully / Engine being cranked

Removing and Installing Starter

12 LI

Removal

1. Disconnect ground strap at battery.
2. Disconnect battery cable and cable to generator and ignition switch from terminal 30 of the starter.
3. Disconnect control cable (to starter/ignition switch) from terminal 50 of the starter.
4. Remove starter by removing the flange screws.

Installation

The installation is accomplished in the reverse order of removal observing the following points:
1. Lubricate starter shaft bushing with high temperature grease.
2. Apply sealing compound to face of intermediate bracket flange and transmission case.
3. Make sure that terminals and cables are clean and properly connected.

Note

If the flywheel gear is excessively worn, the gear teeth may be refaced a maximum of 2 mm ($^1/_{16}$ in.). They must be accurately and evenly rechamfered to assure proper operation of the starter and balance of the flywheel. Do not alter the solenoid switch setting.

Connections

1. Generator and battery cables to upper solenoid terminal.
2. Solenoid actuating cable to small terminal.
3. Ground strap to battery.

Removing and Installing Solenoid Switch

13 LI

Removal

1. Remove connector strap from solenoid switch.

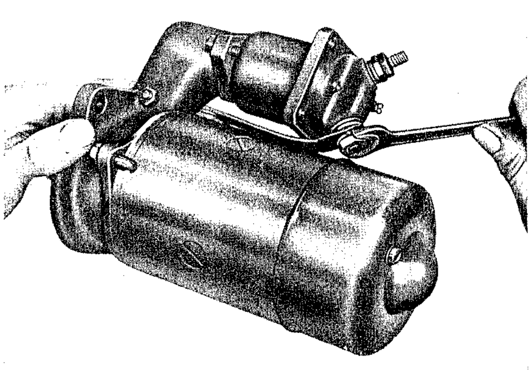


Fig. 22

2. Remove bolts that attach solenoid switch to intermediate bracket.
3. Pull out starter pinion and remove solenoid switch. A defective solenoid switch must be replaced. At a general engine overhaul it is advisable to replace the switch. Never alter the setting of the switch.

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Hold cable ends from twisting while tightening terminal nuts; do not use excessive force.

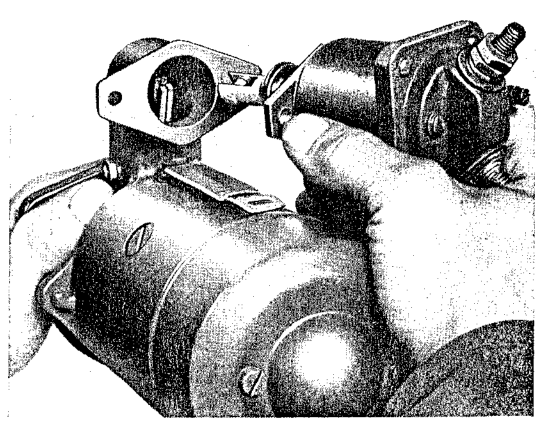


Fig. 23

2. To facilitate connecting the solenoid switch with the actuating lever, slightly pull out the starter pinion.

3. When installing a new switch, adjust the plunger so that the centerline of the pivot pin in the yoke is 32.4 ± 0.1 mm (1.275 ± .004 in.) from the solenoid flange.

Note: Testing solenoid switch

1. Total armature travel should be 10 ± 0.2 mm (.394 ± .008 in.). Of this, 3 mm (.118 in.) is contact reserve.

2. To check, connect a 6 V lamp between the main terminals and push in the armature. Measure the travel remaining after the test lamp lights.

3. When installed in the starter the solenoid switch must pull the armature in when 4 volts are applied between terminal 30 and ground. If it does not, check for proper starter brush seating.

14 LI

Testing Brushes and Commutator

1. Remove starter end cap.

2. Inspect brushes for wear and free movement in the guides of the brush holders. If the brushes are worn so that they will not bear on the commutator they must be replaced by new ones of the same type. Replace brushes which are oil saturated or have loose flexible connectors.
When installing brushes the flexible connectors should be positioned so that they will not hinder brush movement during operation and subsequent wear. Always install a complete set even if only one brush requires replacement.

3. Test tension of brush springs. Replace weak springs.

4. If the commutator is oily or gummed, it may be cleaned with a cloth dampened with solvent or carbon tetrachloride wrapped around a piece of wood.
Dirt or solvent should not enter the bearing.

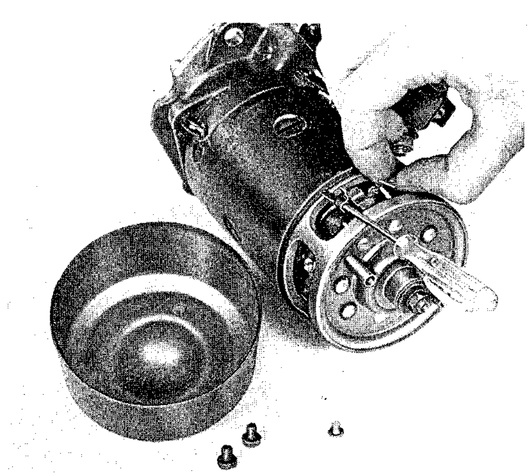


Fig. 24

5. If the commutator surface is scored or shows burned spots, the starter must be overhauled.

Dissasembling and Assembling Starter

Exploded view of complete starter

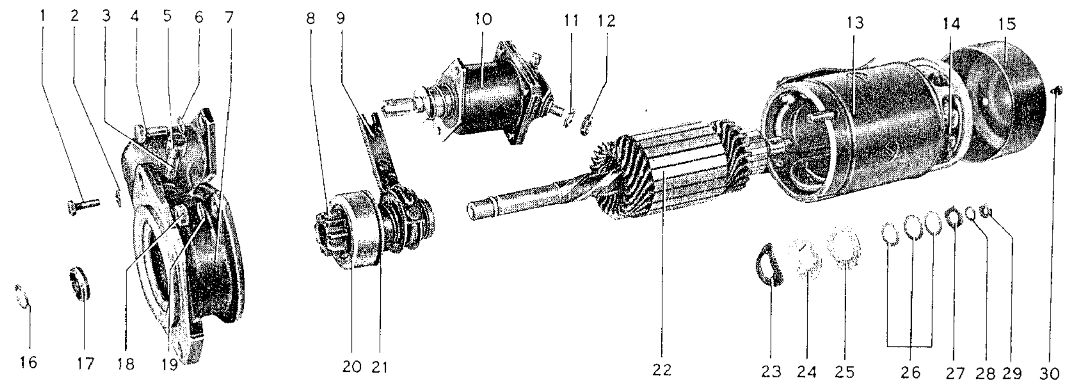


Fig. 25

① Bolt
② Lock ring
③ Pivot pin
④ Bolt
⑤ Pivot pin screw head
⑥ Lock washer
⑦ Intermediate flange
⑧ Pinion gear
⑨ Actuating lever
⑩ Solenoid
⑪ Lock washer
⑫ Nut
⑬ Housing
⑭ Brush
⑮ Cover
⑯ Lock ring
⑰ Pinion stop
⑱ Nut
⑲ Lock washer
⑳ Overrunning clutch
㉑ Thrust washer
㉒ Armature
㉓ Spring washer
㉔ Holding washer
㉕ Thrust washer
㉖ Shims
㉗ Drive washer
㉘ Lock washer
㉙ Nut
㉚ Cover screw

Exploded view of starter housing with armature and armature brake

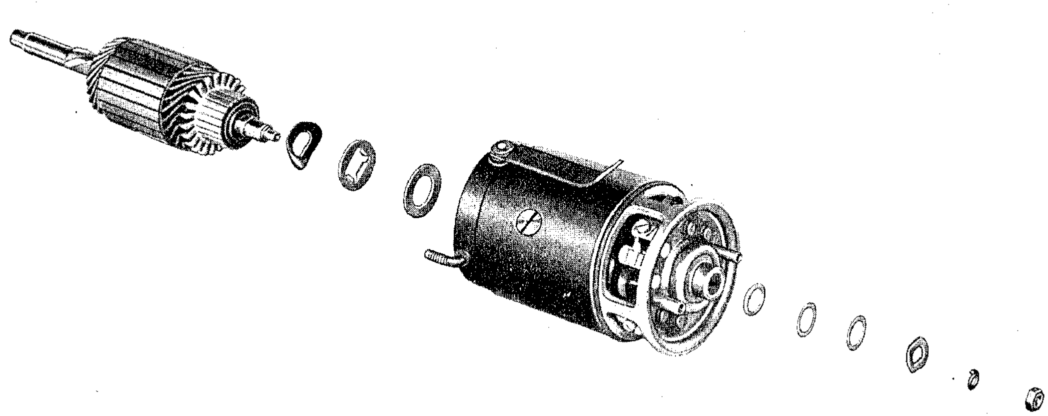


Fig. 26

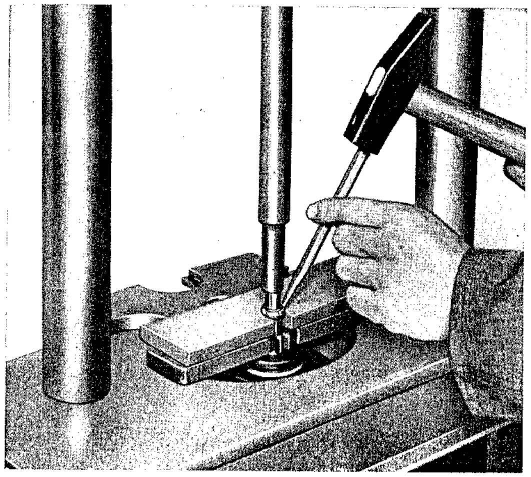


Fig. 30

5. Do not forget end cap gasket.

6. To avoid starting trouble caused by water entering the starter, the following points should be sealed with sealing compound:

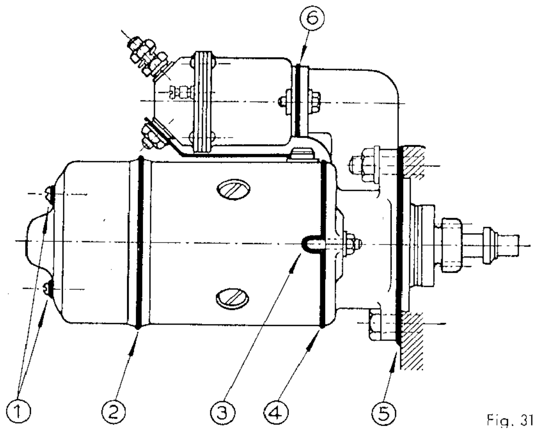


Fig. 31

① **Holes for slotted screws in end cap**
② **Rubber seal between housing and end cap**
③ **Holes in housing for hook studs of intermediate bracket**
④ **Joint faces between housing and intermediate bracket**
⑤ **Joint faces between transmission housing and intermediate bracket**
⑥ **Joint faces between solenoid switch and intermediate bracket**

Testing Armature

16 LI

In many cases the armature does not show visible evidence of damage. The armature is tested for open circuits, short circuits and internal ground.

Test

1. Open circuits in the armature are usually readily apparent, since this condition causes burned spots between adjacent commutator segments due to the brush deposits which bridge the insulation between segments. Check soldered commutator connections.

2. The armature is tested for short circuits on the growler. Place the armature on the growler and slowly revolve it while holding a thin steel strip or hack saw blade on the armature core. Short circuits in the armature cause the steel strip or hack saw blade to vibrate against the core when the blade is held above the slot containing the shorted winding.

3. The armature is grounded when the armature core comes into contact with the winding or when carbon dust has entered the windings (direct and indirect ground). The armature ist tested electrically for ground placing one lead of a 40 volt test lamp from a 40 volt source on the armature core and the other on the commutator. The test lamp should not light.

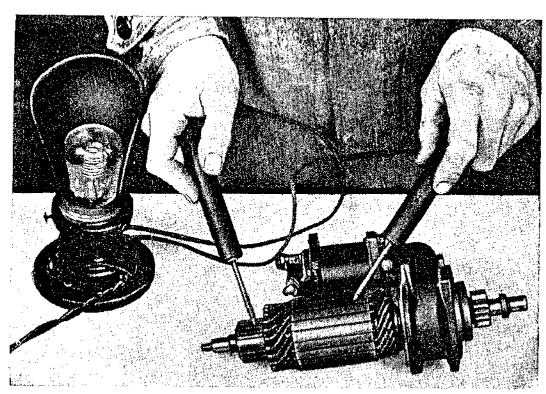


Fig. 32

4. The commutator consists of copper segments separated by mica plates. If the commutator is out of round and scored or burned it should be turned on a lathe to obtain a true surface. Maximum permissible run-out 0.05 mm (.002 in.). Do not remove more metal than is necessary. The mica should then be undercut 0.3 to 0.5 mm (.012 to 0.20 in.). This operation should be performed with a motor driven undercutter which will provide a small chamfer on each segment, or in an emergency very carefully with a thin hacksaw blade.

   No metal chips should remain between the segments since these will lead to short circuits. Remove all burrs from the undercut slots to provide a smooth running surface for the brushes.

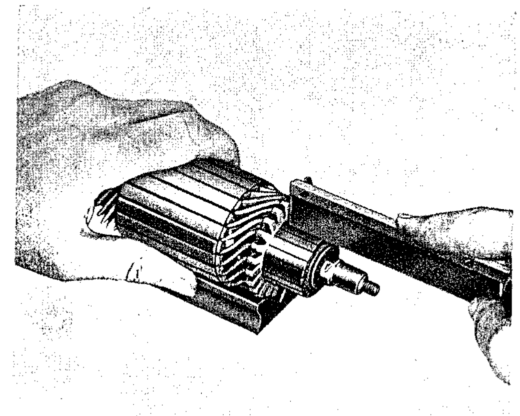


Fig. 33

17 Ll

Testing Field Coils

The two field coils are tested for open circuits, short circuits and ground.

Test

1. Test each field coil individually for open circuits with a 6 volt test lamp in series with the battery.

2. If the outer insulation of the field coils is found to be in order there is rarely a short circuit in the windings. Finding short circuits is generally beyond the scope of workshops as this requires a very sensitive ohmmeter or resistance bridge.

   However, if they have been disassembled, the field coils may also be tested on the growler by hanging them on an iron bar over the growler. If the coil becomes warm, a short must be present.

3. Test for a grounded field coil (coils installed) by connecting a 40 volt test light and 40 volt source between one coil connection and the starter housing. The lamp should not light.

4. Also check the electrical connection between the two field coils for continuity with a 6 volt test lamp.

Service Diagnosis

Trouble	Cause	Repair
Starter does not operate when the starter switch is turned	Switch on lights for this test: a. If lights do not burn: Loose cables or poor ground connections. Battery is run down b. If lights go out when turning starter switch: Insufficient current due to loose connections or corroded terminals c. If lights suddenly go dim when turning the starter switch: Battery run down or old d. If lights stay bright when turning starter switch: Connect jumper lead between terminals 30 and 50 at starter. If the starter operates, there is an open circuit in the cable to the starter switch, or to the battery or the switch is defective e. If lights stay bright and the plunger in the solenoid switch is pulled when pressing starter button: Disconnect the battery cable from terminal 30 at the starter and connect it to the terminal stud of the connector strap. If the starter operates, the contacts of the solenoid switch are worn or dirty	a. Check battery cables and connections. Test voltage of battery and charge if necessary b. Clean battery terminals and cable clamps, clean and tighten connections between battery, starter and ground c. Charge battery, or replace d. Eliminate open circuits, replace defective parts e. Replace solenoid switch
Starter does not operate when battery cable is directly connected with terminal stud of connector strap Sluggish or slow action of the starter	a. Brushes sticking b. Brushes worn c. Weak spring tension Brushes do not make contact d. Commutator dirty e. Commutator rough, pitted or burned f. Armature or field coils defective	a. Clean brushes and guides of brush holders b. Replace brushes c. Replace springs d. Clean commutator e. Overhaul starter f. Overhaul starter
Starter can be heard operating, but cranks engine erratically or not at all Drive pinion does not disengage	a. Battery run down b. Insufficient current flow due to loose or corroded connections c. brushes sticking d. Brushes worn e. Commutator dirty f. Commutator rough, pitted or burned g. Armature or field coils defective	a. Charge battery b. Clean battery terminals and cable clamps, tighten connections c. Clean brushes and guides of brush holders d. Replace brushes e. Clean commutator f. Overhaul starter g. Overhaul starter
Starter can be heard operating, but cranks engine erratically or not at all	a. Drive pinion defective b. Flywheel ring gear defective	a. Replace drive pinion b. Rework ring gear or replace flywheel
Drive pinion does not disengage	a. Drive pinion or spline shaft dirty b. Solenoid switch defective	a. Immediately shut off engine to prevent further damage to starter Overhaul starter b. Replace solenoid switch

Battery

General

The battery serves as a power supply for the electric accessories when the engine is not running and to supply power to the starter for cranking the engine. When the engine is running the generator supplies part of its output to charge battery. The energy thus stored can be drawn from the battery at any time.

Construction and Function

The 6 volt battery consists of 3 cells, each of which contains positive lead dioxide (PbO_2) plates and negative lead (Pb) plates. There is one more negative plate than positive plate so that there is a negative plate at each end of the cell. The plates are held apart from each other by separators made of acid resistant porous material. There is a complete set of negative and positive plates in each of the three cells of the battery case which are sealed with plastic material.

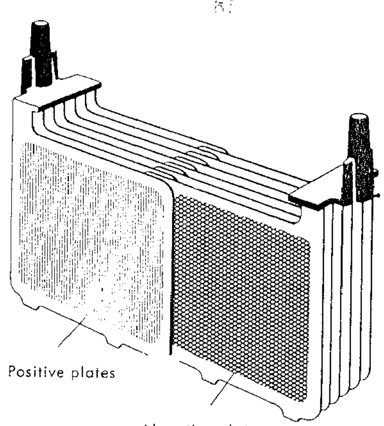


Fig. 34

The bottom of the battery housing has fins which support the plates. The space between the fins serves as a mud space where the small particles which break off the plates can accumulate without causing short circuits between the plates. The detachable battery cell caps also function as ventilators.

Each cell when fully charged has a voltage of approx. 2 volts. By connecting the three cells in series a combined battery voltage of 6 volts is obtained.

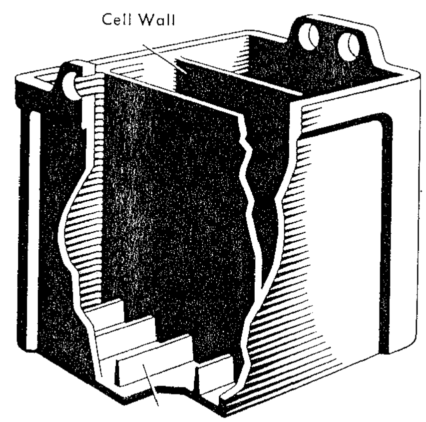


Fig. 35

For clear identification the positive and negative poles are provided with a plus (+) and a minus (—) sign respectively. They are also of different size (positive pole is larger in diameter).

The electrolyte consists of dillute sulphuric acid ($H_2SO_4 + H_2O$) which has a specific gravity of 1.285 or 32° Bé (Baumé).

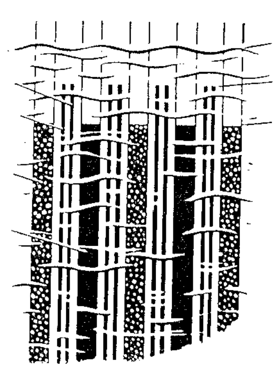


Fig. 36

Cell voltage

The average test voltage of each cell is 2 volts. It increases to about 2.5 to 2.7 volts while the battery is being charged and decreases to between 2.1 and 2.0 volts soon after the charging current has been cut off. The battery is discharged when the cell voltage has dropped to approx. to 1.8 volts under no-load test conditions.

Battery Rating

The capacity of the battery is 84 ampere-hours. This rating gives the amount of current the battery can deliver for 20 hours at an electrolyte temperature of 27° C (80° F). Formerly 10 hours delivery at 20° C (68° F). The capacity of a fully charged battery is determined by the discharging current which can be drawn so that the voltage drops to 1.75 volts in 20 hours. Thus a battery of 84 ampere-hours can deliver a current of 4.2 amperes for 20 hours while the cell voltage does not drop below 1.75 volts. The temperature is a very important factor since the capacity increases with rising electrolyte temperature due to lower internal resistance and the lower viscosity. The capacity drops at decreasing electrolyte temperature.

Charging the Battery

The battery can only be charged with direct current (from the generator). It is important that the proper polarity is obtained. In other words the positive pole of the power supply must be connected to the positive pole of the battery, and the negative pole of the power supply to the negative pole of the battery.

Battery charging process

Under the action of the d.c. charging current the grey-white lead sulphate ($PbSO_4$) at the negative plate is converted to lead sponge (Pb), and that of the positive plate to lead dioxide (PbO_2). Additional sulphuric acid is formed in the process. As a result the acid concentration in the cell increases.

Battery gas

During gassing the acid concentration of the battery increases further, owing to dissociation of the H_2O molecules yielding combustible gases.

As the charging proceeds, the voltage at the terminals of each cell increases to a maximum of 2.8 volts at full charge. This value is not exceeded even if the cell gasses for a longer time. Normally the battery is allowed to gas a certain amount to insure that at all points, especially in the active material, the lead sulphate has been converted to lead or lead dioxyde. Hydrogen and oxygen escape in a highly explosive mixture called oxy-hydrogen gas. Extreme care must be taken to avoid bringing open flames, lighted matches etc. near a battery which is or has been gassing. Likewise care must be taken to avoid causing sparks near a battery, since this can also ignite the gases. No smoking or open flames should be allowed near a charger.

Battery discharging process

The brown lead dioxide of the positive plate and the light grey colored lead of the negative plate combine with sulphuric acid (H_2SO_4) to yield lead sulphate ($PbSO_4$), water (H_2O) and electric current. The density of the battery acid is reduced by the water produced by discharging.

Battery Maintenance

A battery in good working order is required to properly start the engine. The battery should therefore be given proper care and inspections at regular intervals.

Hydrometer Test

The state of the battery can be checked my means of a battery hydrometer. The specific gravity of the battery acid increases with the charging of the battery. Tested with the hydrometer, the gravity can be read from the scale on the float.

Recharging the Battery

It is a good practice to remove the battery at intervals of three or four months and discharge it to a cell voltage of 1.8 volts before recharging it at a rate not to exceed 5 amp.

Batteries are subject to a self discharge of 1 per cent per day with the battery in good condition. If the car is not used for a longer period, the battery must be recharged at 6 to 8 week intervals. The charging rate of the battery depends on the capacity of the battery and should, with a battery of 84 amp.-hours, not exceed a rate of 8.4 amperes. Thus, the charging requires about 10 hours, and longer at a lower charging rate.

The fully charged condition is reached when the cell voltage has increased to approx. 2.5 to 2.7 volts, the battery is gassing freely and there is no further rise in voltage in one hour. Heavy gassing occurs at this time. During the charging process the cell plugs should be removed to prevent acid from being forced through the vents.

Winter operation

The conductivity and viscosity of the electrolyte is greatly affected by temperature changes. At low temperatures the battery capacity is severely reduced. At an electrolyte temperature of —15° C (5° F), the output of the battery is only one half of the output at 20° C (70° F).

The higher the specific gravity of the electrolyte, the lower the freezing point. The battery must, therefore, be kept in a sufficiently charged condition to prevent freezing. If freezing has not ruined the battery it can be restored by slow thawing and recharging. While frozen, a battery cannot furnish current.

Specific Gravity	Electrolyte Freezing Point
1.285	— 65° C (— 85°F)
1.18	— 25.5° C (— 13°F)
1.14	— 13° C (+ 9°F)

The increased load imposed on the battery at low temperatures by the starter which has to crank the sluggish engine, necessitates more frequent inspection of the battery. In severe cold it is recommended to remove the battery at 4-weeks intervals for recharging and checking specific gravity and electrolyte level.

Warning

Do not smoke or use open flames in a room where batteries ar charged. It is advisable not to keep precision tools and instruments in such rooms because of the corrosive gases which are generated.

Charging New Batteries

New batteries are generally shipped dry. If no instructions are supplied by the manufacturer, proceed as follows:

1. Remove vent plugs and fill cells with chemically pure battery acid diluted with distilled water to a specific gravity of 1.285 at 20° C (68° F). The level should be approx. 15 mm ($^5/_8$ in.) above the plates.

2. Let the battery soak for 5 or 6 hours in order to saturate the plates with electrolyte. The electrolyte level will drop slightly during this period.

3. Add electrolyte to restore the correct level. Insure that the small vent holes in all plugs are open. Loosely replace caps to prevent acid "spitting".

4. Charge battery at a rate of 5 amperes or less until the voltage of each cell is between 2.5 and 2.7 volts, and the cells gas freely.

5. Check the temperature of the battery electrolyte from time to time. If the permissible temperature of 40° C (105° F) has been exceeded, reduce the charging current.

6. After charging, check specific gravity (1.285 or 32° Bé) and adjust if necessary. If acid or distilled water are added, the battery should be connected to the charger again for a short time to insure good mixing.

7. Replace vent plugs not earlier than two hours, if possible later, after the charging process has been completed (to allow gas to escape). Wash off electrolyte and dry the battery.

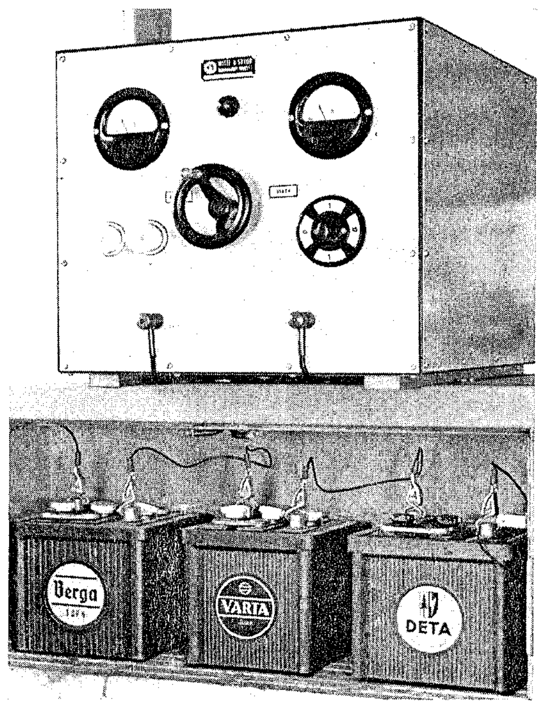


Fig. 39

Note

Never quick-charge a new battery.

Ignition System

General

The ignition system consists of a battery, switch, coil, distributor with centrifugal advance mechanism, spark plugs and wiring. The 6 Volt current supplied by the batterie is converted to high voltage ignition current by the coil. The ignition system is interference suppressed.

Function

The ignition coil is a transformer. The current in the primary winding of the ignition coil is interrupted by the contact breaker points in the distributor. The magnetic flux in the iron core thereby collapses suddenly causing a high voltage impulse in the secondary winding which causes the spark at the spark plugs.

The condenser connected in parallel with the contact breaker points suppresses the arc at the points when they open thereby preserving the contact points and promptly cutting the primary current.

Construction of the coil

The secondary winding consisting of many turns of thin wire is wound on the laminated iron core of the coil. The primary winding consisting of a few turns of heavy wire is wound around the secondary windings. The inner end of the secondary coil is connected to the iron core to the end of which the high voltage output socket is attached. The other end of the secondary winding is attached to the beginning of the primary winding at terminal 15 on the top of the coil. The end of the primary winding is connected to terminal one at the top of the coil and to ground by way of the breaker contacts.
The iron core is supported by a ceramic insulator at the bottom and by the coil cap at the top. The coil is enclosed in a soft iron shell which acts as a magnetic conductor. The plastic coil cap which contains the HT socket and terminals 1 and 15, are secured to the metal housing. The windings of the coil are impregnated with insulating compound which also fills the cavities and empty spaces. The compound insures good heat dissipation from the coil windings to the metal casing and thereby to the surrounding air.

Testing

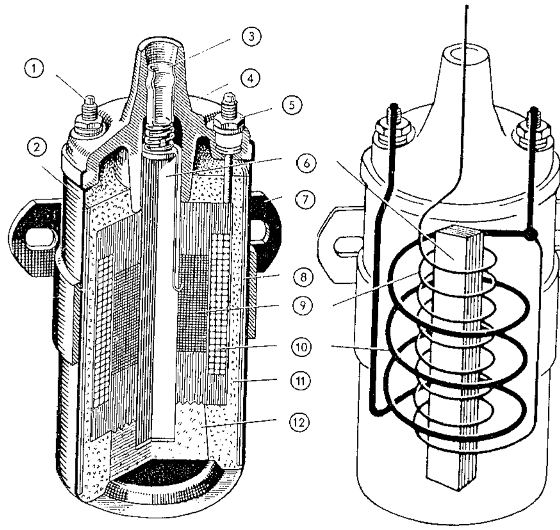
To test the performance of the ignition coil, the length of the spark it produces is measured. This can be done on a test bench or on the engine.

After first testing the braker points and 6 volt connections, disconnect the center lead from the distributor cap and hold it approx. 7 mm ($^9/_{32}$ in.) from the crankcase. A strong spark should occur.

When the engine is turned by the starter a good spark should jump from the wire to ground.

Maintenance

The ignition coil insulating cap must be kept clean and dry to prevent high voltage leaks.



Section view Schematic

Fig. 40

Ignition coil

① Housing
② Terminal 1
③ Terminal 4
④ Cap
⑤ Terminal 15
⑥ Laminated iron core
⑦ Mounting bracket
⑧ Soft iron shell
⑨ Secondary winding
⑩ Primary winding
⑪ Insulating material
⑫ Ceramic insulator

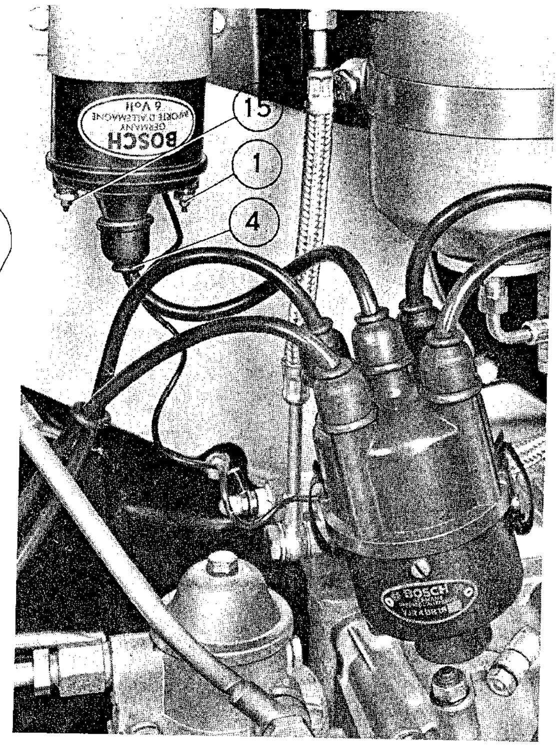


Fig. 41

Connections:

Terminal 15 to ingnition switch
Terminal 1 to distributor (contact breaker points)
Terminal 4 to distributor cap (high-tension lead)

Distributor

General

The distributor, with its rotor, distributes the high voltage current to the correct spark plug wire while on the same shaft a cam opens breaker points which interrupt the power supply to the coil, thereby producing the high voltage current. A centrifugal mechanism advances the spark timing as engine speed increases.

Construction

The cast iron, cup shaped, distributor housing contains the breaker contacts, breaker cam, centrifugal advance mechanism, and distributor rotor. The extension of the distributor housing provides the plain bearing for the distributor shaft as well as being the mount for the distributor. The housing is held to the crankcase by a clamp which also serves as an adjustment for the timing angle. A slotted coupling connects the distributor to the pinion shaft which is driven by worm drive on the crankshaft. The cam which operates the tungsten tip contacts has four lobes and carries the rotor on its extended end. The contacts are opened by the cam at regular intervals to a gap of 0.4 mm (.016 in.) which can be adjusted by an eccentric screw.

The distributing mechanism consists of contact points, one of which is pivoted and driven by the four lobe distributor cam; an insulated rotor which is mounted on the top of the cam so that its electrode points to the stationary electrode of the correct spark plug wire at the instant the breaker points open; and a cap of high grade insulating material which contains the sockets and electrodes for the four spark plug wires the high voltage wire from the ignition coil and covers the distributor housing. The impulse initiated by the breaker points causes a high voltage current to flow from the coil to the center terminal on the distributor cap and through a spring loaded carbon brush to the rotor from which it jumps over an air gap of approx. 0.3 to 0.7 mm (.118 to .276 in.) to the electrode at the edge of the distributor cap and finally to the spark plugs.

The distributor is ventilated by holes in the bottom of the housing so that the ozone generated by the spark from the rotor to the wire terminals may escape. The harmful effects of the ozone are thereby reduced. The condenser, connected in parallel to the contact points, is located on the outside of distributor housing.

Maintenance

Dirty or slightly burned breaker points should be cleaned with a contact file, which is designed especially for this purpose. Emery cloth should never be used. The contact surfaces must be flat and smooth to insure a parallel contact when closed. This is accomplished by filing with light pressure against the stationary contact while the movable contact presses against the file. It is important to file parallel to the contact surface. Clean the filings from the distributor with compressed air. The cam lobes should be slightly greased to reduce wear of the fiber block to a minimum.

A few drops of engine oil should be applied to the distributor shaft through the contact-breaker plate when carrying out the first service inspection of the car. Care should be taken that no oil gets on the contacts of the breaker points.

The rotor finger and the four electrodes of the distributor cap are subjected to a certain amount of erosion from continuous sparking during operation. Misfiring may occur, if the insulating material of the distributor cap or the rotor is cracked. The cap must be kept clean and dry inside and outside to prevent high voltage leaks. When mounting the cap, insure that the spring loaded brush for the rotor has not been left out and is in good working order. The rotor must be fully seated to insure proper operation.

19 LI

Ignition System Failure

If engine trouble indicates poor ignition performance, the following easy checks may be made to determine the cause. It should be understood that this is not a substitute for a thorough inspection which should be carried out at an auto electric shop.

Starter operates but engine will not start

1. Check HT lead for good contact at the coil terminal. Pull ignition coil HT lead from the distributor cap and hold the wire end about 7 mm ($^9/_{32}$ in.) from a clean ground point on the engine. If a good spark occurs when the engine is being cranked, primary and secondary circuits are good to this point; proceed with test 5. If there is no spark:

2. Connect a 6-volt test lamp between the distributor primary terminal 1 and ground. If the light goes on and off as the engine is being cranked, the primary circuit is probably good. Disconnect the test light.

3. If the test light remains on as the engine is cranked, the contact points are not closing. Check point opening and ground connections in the distributor. Clean contacts.

4. If the test light remains off while the engine is cranked, the primary circuit is open or the points are not opening correctly. Check for loose connections, broken leads, grounded distributor terminal, and condition of points (severe pitting). Also check the ignition switch and primary winding of the coil. These tests are best performed with a test lamp or voltmeter. A new coil may be installed.

5. Remove distributor cap and check for moisture, severe corrosion, and internal arc paths (burned tracer lines). Check spark plug sockets for moisture and that the contact pins penetrate to the center of the leads.

   Remove and inspect spark plugs; reset gap if necessary 0.5 to 0.6 mm (.020 to .024 in.).

6. If the cause has not been found, check the ignition timing. If this is found to be correct, the fault probably does not lie in the ignition system but in the fuel or carburetor system.

Engine runs poorly

1. Misfiring, loss of power, or hard starting are not necessarely caused by faulty ignition but may be due to various causes. A complete check should be made by a qualified repair shop.

   Spark plugs must be in good condition and relatively new. The coil and condenser can be checked by using replacement units. All leads should be checked for good clean connections. Spark plug wires should be checked in the dark to determine high voltage leaks while the engine is running. In cases of high speed misfiring, check the breaker arm spring tension. Check the distributor on a testing unit if possible.

2. Backfiring and carburetor spitting can be caused by improper timing or a loose or bent distributor shaft. A wobbling shaft will cause continuously changing spark timing. Spark plugs of the wrong heat range may also be the cause along with excessive carbon formation or poor fuel. A faulty breaker point condenser should not be overlooked.

Adjusting Breaker Points

The breaker contacts are adjusted in the following manner:

1. Remove distributor cap and rotor.

2. Turn the crankshaft until the fiber block on the breaker arm rests on the highest point of the cam lobe (Fig. 42).

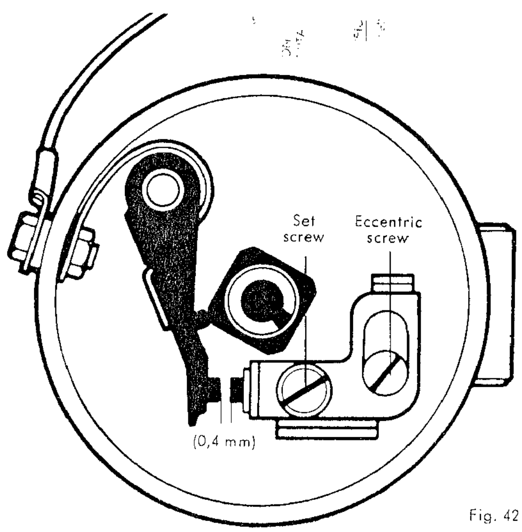


Fig. 42

Distributor, plan view

3. Measure point gap with a feeler gauge (0.4 mm, .016 in.).

4. If the point gap is other than specified, loosen the set screw of the fixed breaker point.

5. Turn the eccentric adjusting screw until the correct gap of 0.4 mm (.016 in.) is obtained. Check with a feeler gauge (make sure gauge is clean).

6. Tighten clamping screw.

7. Recheck the gap on four lobes.

Important

After the contact points have been adjusted, it is absolutely necessary to check the ignition timing, since a 0.1 mm (.004 in.) gap difference alters the ignition timing by approx. 3° crankshaft angle.

The correct opening and closing of the breaker points is obtained only if there is no perceptible clearance between the distributor shaft and bearing.

Installing Breaker Points

The breaker points erode during normal service by burning. If the points have reached a stage where an adjustment is no longer possible, or if the breaker points are badly burned, a new set should be installed.

Replacement

1. Remove distributor cap and rotor.
2. Disconnect low voltage wire from terminal 1 at distributor.
3. Loosen nut of terminal screw and remove breaker arm.
   Note proper position of insulator to avoid short circuit at this point when fitting the new breaker arm. Lightly lubricate pivot pin with special grease.
4. Install new breaker arm.
5. Connect low voltage wire.
6. Remove fixed contact by removing clamping screw. Do not let screw fall into distributor housing.
7. Install new contact and install securing screw.
8. Adjust breaker point gap.
9. Adjust ignition timing if necessary.
10. Install distributor cap and check HT wires.

① Primary contact (terminal 2)
② Condenser
③ Breaker point spring
④ Insulation
⑤ Insulator washer
⑥ Insulator block
⑦ Clamp plate
⑧ Terminal screw
⑨ Breaker arm
⑩ Clamp screw
⑪ Breaker point
⑫ Eccentric screw

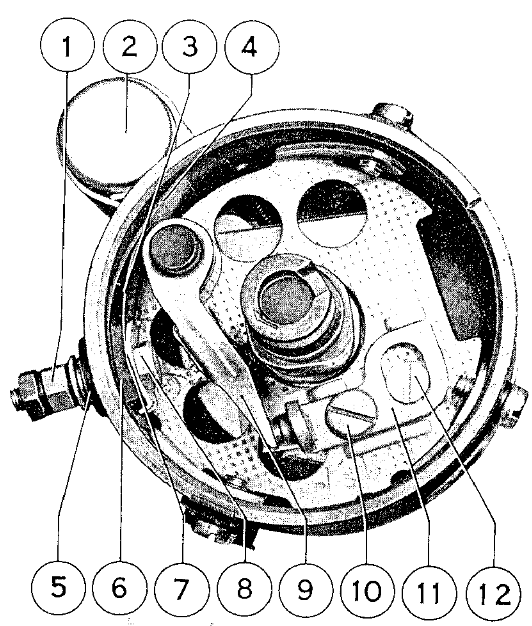


Fig. 43

Adjusting Ignition Timing

Note

Before beginning the adjustment, adjust the breaker point gap as outlined in section 20 LI. The timing mark must be marked on the V-belt pully 5° or 6.3 mm (.248 in.) before TDC for 1600 and 1600 S engines.

Adjustment

1. Mark timing point 5° before TDC.

2. Remove distributor cap.

3. Align the timing mark (5° BTDC) with the line on the crankcase so that the distributor rotor is in line with the cylinder I mark on the distributor housing.

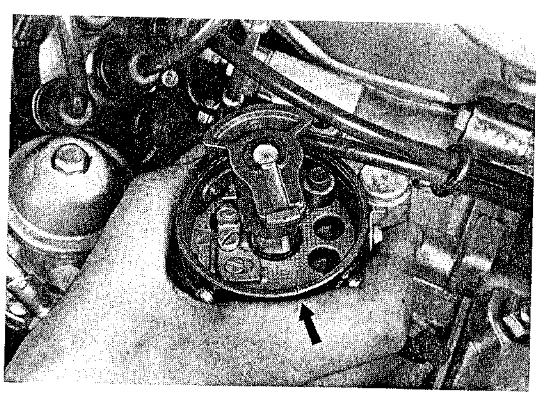


Fig. 44

4. Loosen distributor clamping screw.

5. Connect a 6 volt test lamp to terminal 1 on the distributor and ground.

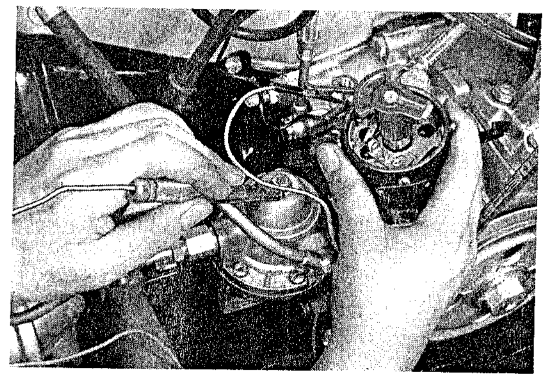


Fig. 45

6. Switch on ignition and rotate the distributor clockwise until the breaker points close. Then rotate the distributor counter-clockwise very slowly until the test lamp lights.

7. Carefully tighten distributor clamp without moving the distributor.

8. Re-check adjustment and install distributor cap.

The ignition timing of all four cylinders is correct if, when the crankshaft is turned in the normal direction of rotation, the test lamp lights each time when the timing mark comes in alignment with the mark on the crankcase and when it is straight downward.

Automatic Ignition Advance

The ignition is advanced automatically by a centrifugal mechanism located in the distributor housing under the breaker point plate. Its basic parts include a carrier frame, flyweights, and return springs.
The flyweights are mounted on pivots attached to the drive plate and cause the driven plate to advance by their outward movement. With increasing speed of the drive plate, the flyweights move outward against the force of the return springs and advance the driven plate to which the distributor cam and rotor are attached. The breaker points are thereby opened earlier and effect the required ignition advance. The correct automatic advance is 30° of crankshaft rotation not including the 5° basic advance. As the engine speed decreases the flyweights are pulled back to their original position by the return springs whereby the basic timing point is obtained.

23 LI

Testing Automatic Advance Mechanism

A simple test to determine whether the advance mechanism is functioning can be made by removing the distributor cap and turning the rotor clockwise until it stops. When the rotor is released it should return to its original position freely by itself. If it does not return, the springs are faulty or the bearing surfaces are gummed. An unexplained "pinging" noise in the engine can be caused by a defective advance mechanism. The exact operation of the advance mechanism can be tested with an ignition test set.

To test the movement of the advance mechanism while the engine is running, a timing light and degree markings on the pulley are necessary. The degree markings are best made by making a sheet metal pattern as described in Fig. 46. Carefully mark degree markings on the rim of the pulley and connect the timing light. If available, a degree wheel with a 23 mm (.905 in.) dia. center bore may be used by mounting it between the spring washer and bolt head of the V-belt pulley. Mount the degree wheel so that the 0° marking is in line with the OT slot on the pulley.

Incorrect timing or faulty advance mechanism operation can easily be detected and corrected by testing at various engine speeds. The correct timing adjustment can be adjusted very accurately in this manner.

A pattern for marking degree markings on the V-belt pulley can be fabricated in the following manner:

1. Select a piece of sheet metal 80 x 50 mm ($3\,^1/_8 \times 1\,^{31}/_{32}$ in.).

2. Mark degree lines and radii and cut slots using a saw or tin shears. The slots should be approx. 10 mm (½ in.) deep and just wide enough to allow a pencil to enter.

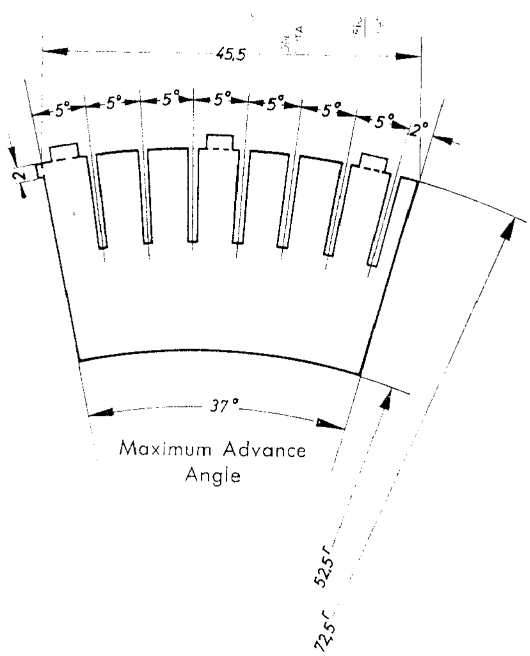


Fig. 46

3. The three tabs at the upper rim are to be bent back to act as guides. The small tab at the left edge, when bent back, fits into the OT slot on the pulley and acts as an index. The index tab should be not more than 0.5 mm (.197 in.) high when bent over.

The timing can now be tested with a stroboscopic test light as follows:

Testing

1. Turn the crankshaft so that the timing (OT) mark is upward.

2. Using the fabricated pattern, mark the timing degrees on the pulley with a pencil.

3. Using a quick drying lacquer, paint black segments as shown in Fig. 47.

4. Connect a strob-light in series with the spark plug wire of No. I cylinder.

5. Darken the marking on the generator base with black paint.

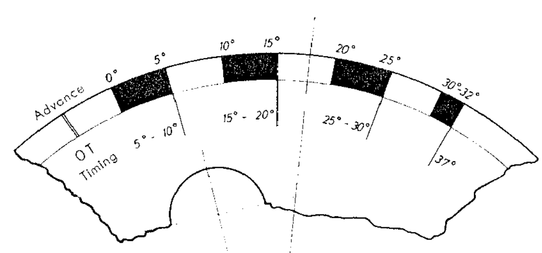


Fig. 47

6. Start the engine and test the automatic advance at various speeds.

As the engine speed increases the timing point should move slowly and evenly to a greater advance while remaining within the range specified in Fig. 48. The maximum permissible advance is 37° total or 35 ± 2°.

If only a general test is required, a black mark from 5° or 6.3 mm (1/4 in.) from OT mark, to 35° or 47.3 mm (1/8 in.) should be painted on the pulley. At idling speed the timing should be at the left end of the mark and at speeds above 3100 rpm at the right end of the mark.

Automatic Advance Curve

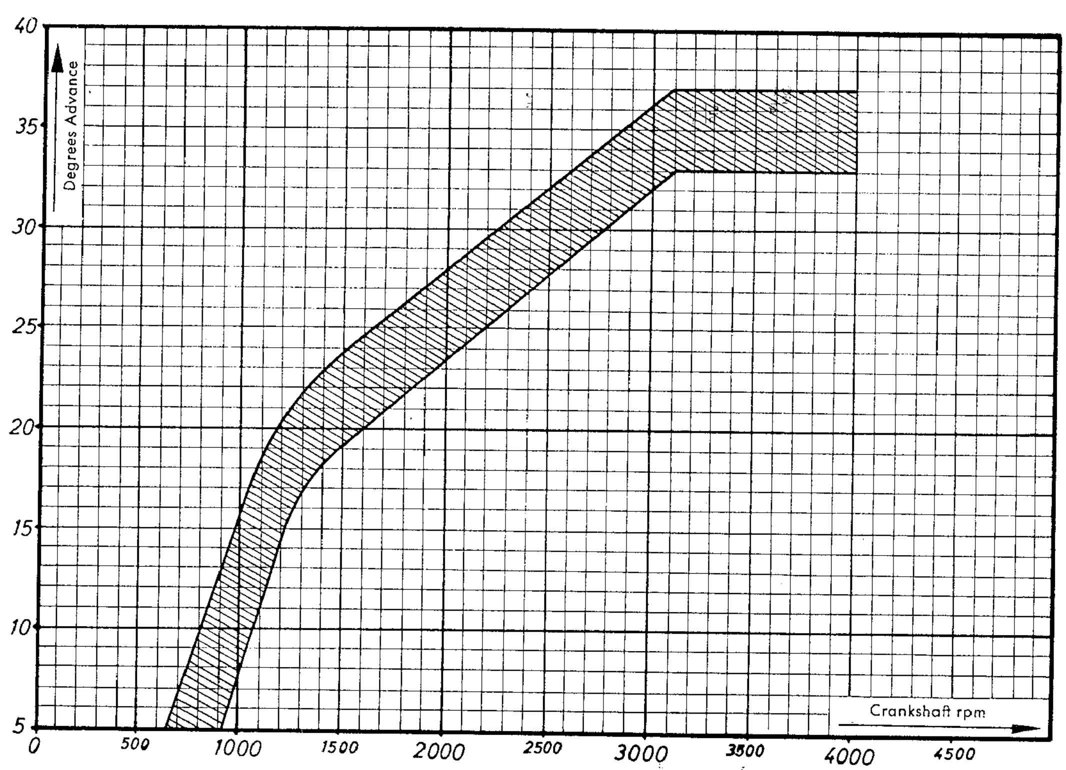


Fig. 48

Testing Condenser

The condenser is essential in producing the required high voltage for the ignition. It suppresses the spark which occurs when the points separate, reducing contact wear.

A defective condenser is indicated by burned breaker points and a weak spark as well as difficult starting. Also when no spark, even across a short gap from a plug lead, can be obtained the condenser can be at fault.

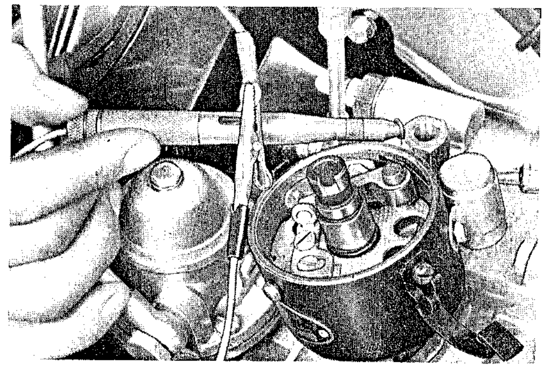


Fig. 49

Testing

It is possible to check a condenser for high resistance, insulation leakage, and capacity on a testing device. If a condenser tester is not available, proceed as follows:

1. Disconnect cable 1 from terminal of breaker arm.
2. Connect one lead of a 6 volt test lamp to cable 1 at the ignition coil and the other to the condenser cable (Fig. 49).
3. Switch on ignition. If the lamp lights, the condenser is grounded and should be replaced. If it does not light proceed as follows:
4. Remove test light and reconnect coil and condenser leads.
5. Disconnect high tension lead from coil at distributor cap and hold it approx. 7 mm ($^{9}/_{32}$ in.) from the crankcase.
6. Crank engine with ignition switched on. If no spark occurs at the prescribed distance, the inspection should be repeated with a new condenser. If still no spark occurs the fault is elsewhere.

For replacement, use only condensers of the prescribed type, since condensers of incorrect capacities will seriously affect breaker point life.

25 LI

Removing and Installing Distributor

Removal

1. Disconnect lead from terminal 1 at distributor (breaker point terminal).

2. Remove distributor cap.

3. Remove retaining screw of distributor holder at the crankcase.

4. Remove distributor.

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Rotate the crankshaft until No. I cylinder is at TDC with both valves closed. The slot of the distributor drive pinion must then be offset toward and parallel to the V-belt pulley, while the pulley mark is in line with the mark on the generator support.

2. Make sure the spacer spring is properly seated in the distributor drive head.
Warning. Do not allow the spring to fall into timing case.

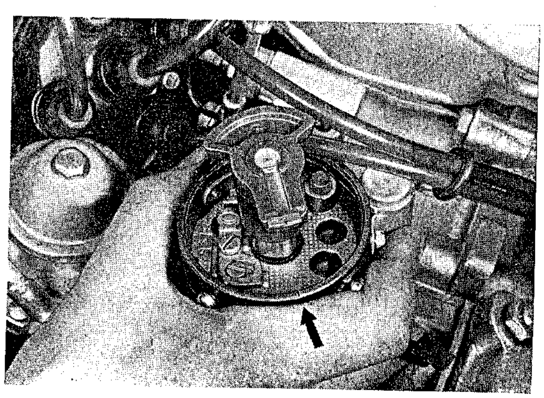


Fig. 50

3. When installing the distributor, turn the shaft until the rotor points to the mark for cylinder No. I on the rim of the distributor body. Install the distributor turning the rotor back and forth until the coupling engages.

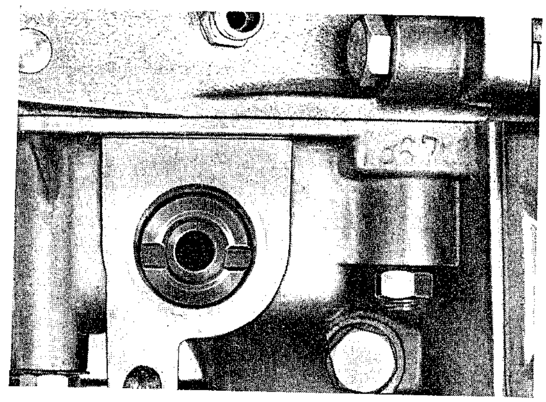


Fig. 51

4. Secure distributor mounting plate and check ignition timing.

Spark Plugs

General

The spark plugs bring the ignition current into the combustion chamber. The current flows through the insulated body to the electrodes in the combustion mixture where the current spans an air gap in the form of the ignition spark.

Construction

The basic parts of a spark plug are:

Center electrode

Insulator

Spark plug body.

The center electrode conducts the high voltage current through the insulator to the combustion chamber. The upper end is usually steel and is threaded to carry the ignition cable contact. A shoulder below the top threads seats against the insulator. Below the shoulder a set of threads holds the electrode in the ceramic. The end of the electrode which enters the combustion chamber is made of a special alloy section bonded to the upper shaft of the electrode. This alloy tip is designed to operate under high temperatures and is corrosion resistant. The metal is not easily affected by the lead content of the fuel or the sulphur compounds of the burned gases.

The insulator is made of a high grade ceramic material which retains its good insulating qualities even at high temperatures. The ceramic is very hard and is a good thermal conductor. For these reasons a spark plug of the correct heat range will not foul or oil up, nor will it pre-ignite the mixture by glow ignition. The thermal coefficient of expansion of the ceramic is very close to that of steel and can therefore operate through a large temperature range. Small differences in expansion are absorbed by the bonding cement in the spark plug base. The upper portion of the insulator is glazed to protect the ceramic from moisture and dirt.

The spark plug base contains the ceramic insulator, holds the spark plug in the cylinder head, and has the side electrode attached to its lower rim. The insulator is secured with spacers and washers by crimping the upper rim of the housing under high pressure. The side electrode is made of a special alloy and is attached to the rim of the housing by welding or by being forced into a bore in the side of the bottom edge.

Function

The high voltage current flows through the center electrode into the combustion chamber where it spans the air gap to the side electrode in the form of a spark. The resulting spark ignites the combustible mixture.

Service

Spark plugs should be checked every 3000 mi. (5000 km) for appearance, spark gap, and proper operation. The appearance indicates whether they are of the correct heat range, whether the engine is using too much oil, and whether the carburetors are correctly adjusted. The color of the spark plug insulator around the electrode indicates the following:

Light Brown
: correct carburetor adjustment, heat range, and combustion.

Black
: mixture too rich, spark plug too cold.

Light Grey
: mixture too lean, spark plug too hot.

Oil coated
: excess oil in cylinder, bad piston rings or worn intake valve guides.

Fuels with lead compounds cause a grey-brown tone in contrast to other fuels. This should be taken into account when inspecting the spark plugs.

During operation the electrode gap will become larger from the burning of electrode metal. Since this action does not burn the material away uniformly, it is best to measure the gap with a wire type gap gauge. The proper electrode gap can be obtained by bending the side electrode until a gap of 0.5 to 0.6 mm (.020 to .024 in.).

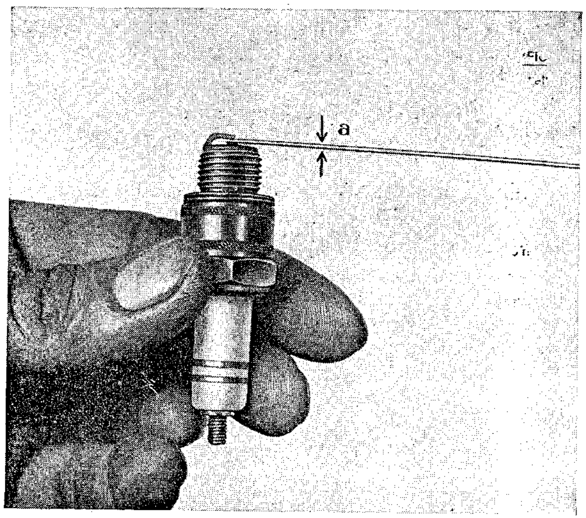


Fig. 52

The proper operation of the spark plugs may be tested on a spark plug tester. The spark should be observed under a pressure of 6 to 8 kg/cm^2 (85 to 114 psi.). Spark plug gaskets must be used when installing the spark plugs in the tester in order to obtain correct results.

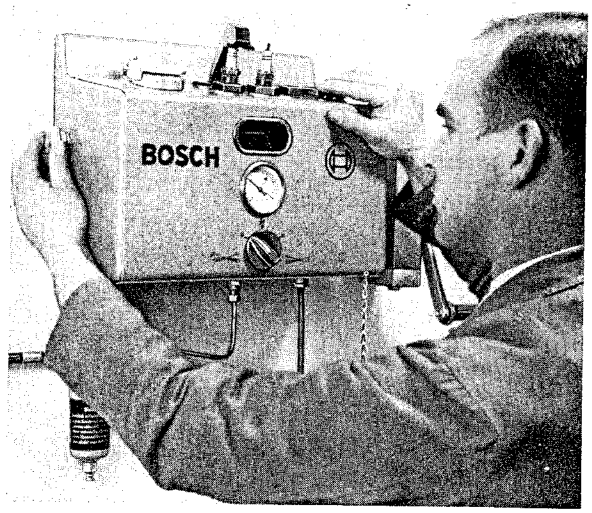


Fig. 53

It is advisable to install new spark plugs every 15 000 km (10 000 mi.). Spark plugs may be cleaned with a spark plug sand blasting device.

Oiled spark plugs should be first cleaned with solvent and dried with a blast of compressed air before cleaning in a sand blasting device. It is important that no sand particles remain in the spark plug. Clogged sand will become free during operation and damage the engine. The glazed portion of the insulator should be clean and dry for proper ignition.

Headlights

Description

The headlights are mounted in recesses in the front of the car and have a high and low beam. The european model has asymmetrical beams which contain a bulb, reflector, and diffusion lens, and are equipped with a parking light inside the headlight housing behind the diffusion lens. The headlights have two elements, 45—40 watt while the parking lights have single element 4 watt bulbs. The two element bulbs are centered in the reflectors and are held by a flanged socket connected to a three-pin plug which can also be used for sealed beam lights.

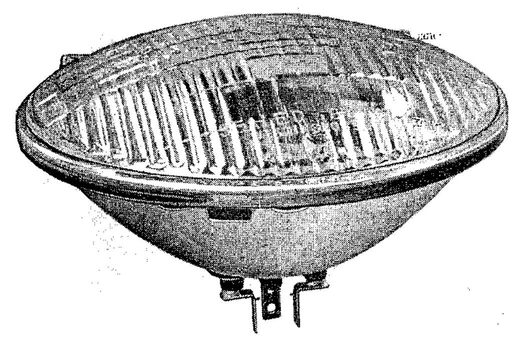


Fig. 54

The sealed beam lamp requires a special adaptor set with holder, adjustment, device, and clear protector lens, available as spare parts No. 644.631.101.31.

Sealed beam headlights are used on vehicles for the USA to meet the requirements of the Department of Motor Vehicles of the various states. These headlights are, however, at the present time not authorized in the following european countries:

France

Germany

Holland

Italy

Sweden

The sealed beam unit (Fig. 54) fits the standard three pin socket which is also used for the european headlights. When one of the elements burns out, the entire unit must be replaced.

The parking lights for USA vehicles are located in the turn signal lamps. These are 4 watt bulbs located directly above the turn signal bulbs.

When a vehicle equipped with sealed beam lights is to be driven in a country where such lights are not permitted, the lights can be easily converted to the required type by the so called sealed beam "Ersatz" set, spare part No. 644.631.106.31.

This light has the same dimensions as the sealed beam lamp and fits into the holder. The set consists of a reflector lens unit and a bulb socket (Fig. 55).
The use of this unit enables temporary conversion of sealed beam lamps to the specifications of the countries concerned without requiring a completely new headlight assembly. The standard three pin socket can be used for all Porsche headlights.

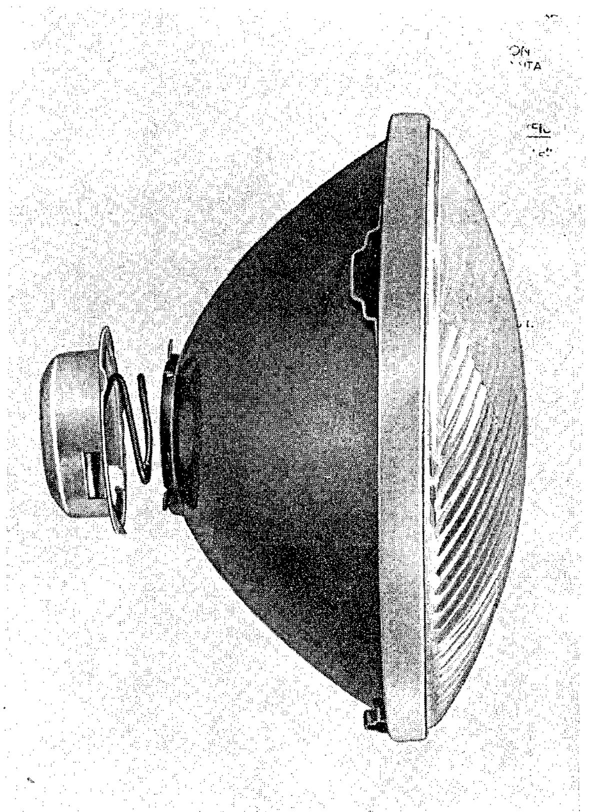


Fig. 55

Description

The dimensions of the high and low beam conform with the requirements of the German Motor Vehicle Code (StVZO). The lights have 45—40 watt dual filament bulbs. The low beam has a greater range than symmetrical lamps in that it deflects to the side of the road while remaining relatively high. The oncoming motorist is not blended by the low beam because of its low position straight ahead and a high, nearly horizontal position on the side which is 15° above the downward portion of the beam. This is accomplished by providing a notch in one side of the shield below the low beam filament, together with a special set of prisms in the diffusion lens which produce the asymmetrical pattern. The sealed-beam "Ersatz" lamps are identical in operation and adjustment to the sealed-beam lamps.

Service

When performing maintenance on the european type headlights it is very important that the reflector is not touched or soiled in any way. The reflector cannot be cleaned without damaging the extremely thin silvered layer. Soiled or oxidized reflectors must be replaced.

The asymmetrical effect of the european type headlights can be prevented by covering the wedge shaped section on the diffusion lens. In this way these headlights become acceptable for travel in countries with left hand traffic. This measure will prevent the high portion of the asymmetrical beam from blinding oncoming motorists.

Replacing Headlights

26 LI

General

Headlight sealed beam units should be replaced when either filament is burned out or when the globe becomes blackened from vaporization of the element.

Removal

1. Remove the headlight unit by removing the large screw under the headlight frame.
2. Disconnect the three pin plug from the headlight unit.
3. Place the headlight unit on a paddel surface and remove the six spring clips from the inner ring (Fig. 56.).

   Warning: Eyes may be endangered if spring clips are not carefully removed.

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Clean the protector lens of the headlight set and place the locating ring on the sealed beam globe so that it engages the three lugs.

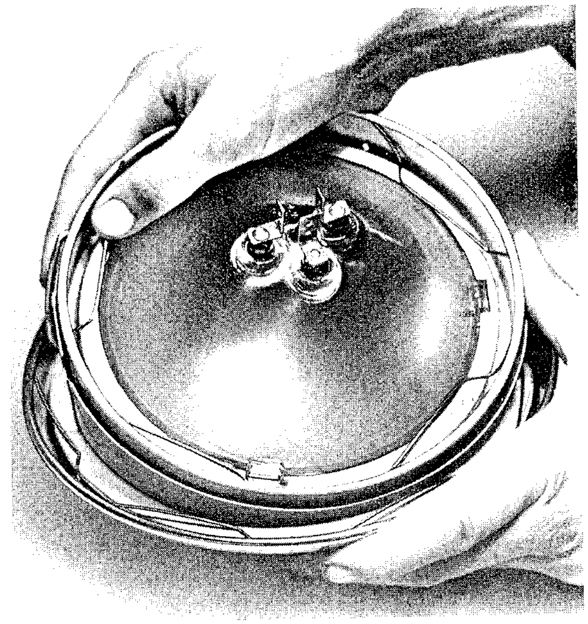


Fig. 56

2. Place the globe together with the locating ring in the headlight assembly so that the three tabs fit into the slots in the frame.
3. Install the six retaining clips evenly spaced around the globe so that they press against the ring but do not rest against the glass (Fig. 56).
4. Install headlight unit taking care that the three pin plug is firmly seated and the rubber gasket is properly mounted around the headlight rim.

Replacing Headlight Glass

27 LI

1. Remove headlight assembly by removing the large screw under the headlight frame.
2. Disconnect the three pin plug from the headlight unit.
3. Remove both adjusting screws from the frame.
4. Place the headlight on a paddel surface and remove the spring clips from the outer frame.

   Warning: Eyes may be endangered if spring clips are not carefully removed.

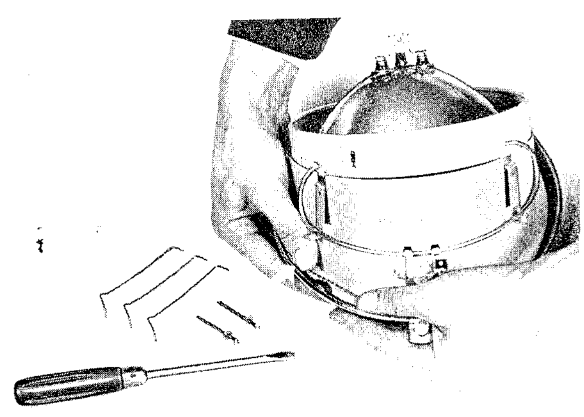


Fig. 57

5. Install the rubber gasket on the new glass and install the glass so that the shaded portion is at the top of the frame.

6. Position the rubber gasket so that it will furnish a waterproof seal.

7. Install spring clips, carefully spacing them around the circumference of the frame.

8. Install and aim the headlight (28 LI).

When installing headlight lenses it is important that the glass makes a waterproof seal with the rim and that the retaining clips are uniformly spaced around the rim as in Fig. 57.

28 LI

Aiming Headlights

Note

The adjustment is best performed with an optical headlight aiming device following the instructions furnished by the manufacturer.

In the event that such a device is not available, the lights may be aimed using a test screen.

Adjustment

1. Align the car perpendicular to the test screen or testing device.

2. The tire pressure must be correct and the car must be normally loaded. The normal load is considered to be equivalent to either a full fuel tank and no passenger or an empty tank and the driver. The loaded car must be rolled back and forth so that the rear suspension can adjust itself.

3. The aiming can now be carried out in accordance with the local regulations.

Sealed Beam

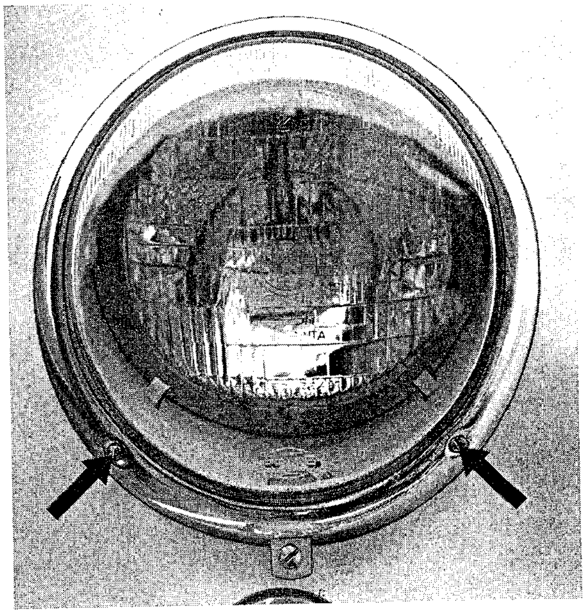


Fig. 58

Symmetrical Bosch

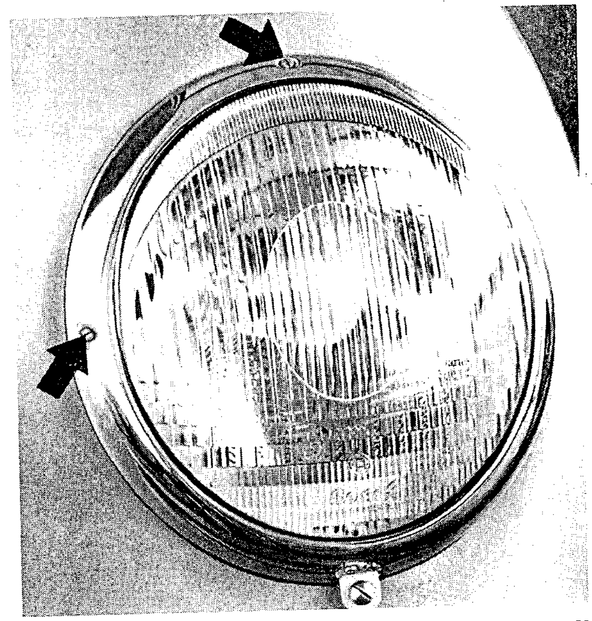


Fig. 59

Adjustment

Vertical

Left screw clockwise: higher
Left screw counter-clockwise: lower

Horizontal

Right screw clockwise: left
Right screw counter-clockwise: right

Vertical

Upper screw clockwise: lower
Upper screw counter-clockwise: higher

Horizontal

Right screw clockwise: left
Right screw counter-clockwise: right

Left and right directions are with respect to the driving direction. Clockwise and counter-clockwise are with respect to screws as seen in the frame.

29 LI

Testing Headlight Voltage

The voltage reaching the headlight from the battery or generator may drop for various reasons. Several tests can be made to locate such voltage drops.

1. Remove headlight unit by removing the large screw under the headlight frame.

2. Connect a voltmeter to the low beam terminals of the headlight. When seen from the back of the sealed beam globe, terminals are: left ground, top low beam, right high beam.

3. Switch on headlights (low beam) and run the engine at approx. 2000 rpm. When the headlights are on, the voltage at the terminals should be from 6 to 6.3 volts.

4. If the voltage is considerably lower than 6 volts the following tests should be performed:

   a. Check the battery terminal connections for clean and tight fit.

   b. Check cable connections at the voltage regulator.

   c. Check plug connections at the light switch.

   d. Check terminals and fuses at the fuse box for oxidation.

   e. Check the connectors in the three pin plug at the headlight.

5. If the trouble is not located by the preceding tests the trouble must be in the generator, regulator, or battery.

Signal System and Dimmer Switch

General

The turn signal lights in the front are located in separate lamps under the headlights and in the rear of the car in the combined tail and brake light. One bulb serves as both brake and turn signal light. The turn signal is activated by the hand lever of the combination (BAL) switch on the steering column. An automatic return brings the lever back to the neutral position after completion of the turn. A red indicator lamp is located in the face of the tachometer. The signal relay is thermally operated and is located on the wall behind the left of the instrument panel above the foot pedals (left hand drive). The relay is a plug type which may be removed by simply pulling it out. The bi-metal element with heater coil serves to interrupt the current at regular intervals during operation.

In the event that one of the signal bulbs is burned out, a relay interrupts the current to the indicator lamp so that such failures are immediately detectable from the drivers position. It is, however, important that the indicator bulb is in working order. When replacing a burned out signal bulb it is necessary that a bulb of the specified power be installed to insure proper functioning of this system.

The combination BAL switch located on the steering column serves as left and right turn signal switch, low and high beam switch, and headlight signal switch, whereby the turn signal positions do not preclude selection of any desired headlight setting.

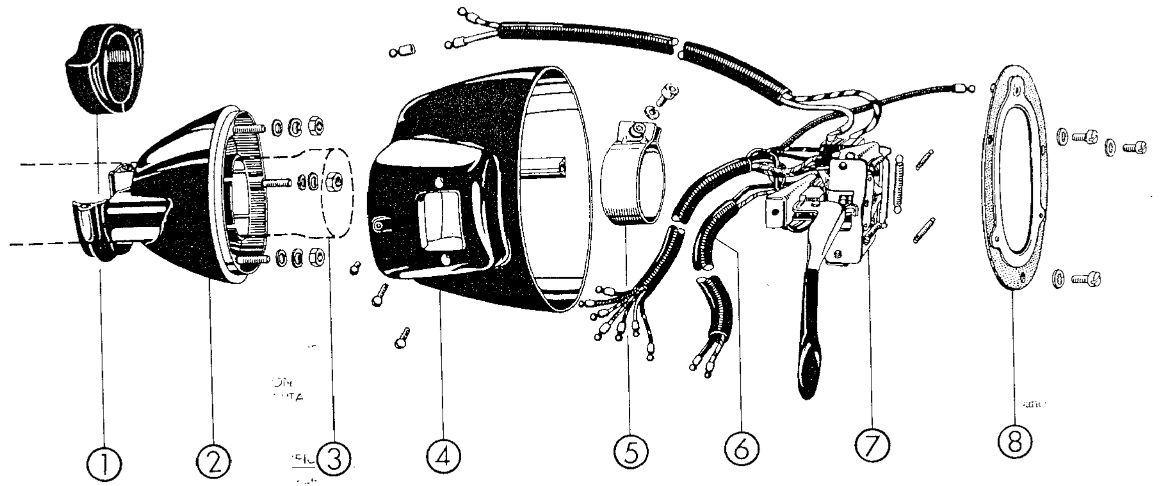


Fig. 60

BAL Switch

① Rubber mount
② Base
③ Steering column
④ Housing
⑤ Clamp
⑥ Wire set
⑦ Switch
⑧ Horn contact ring

Removing and Installing BAL Switch

30 LI

Removal

1. Remove steering wheel (22 ST).

2. Disconnect all plug connectors.

3. Remove screws from the horn contact ring and remove the ring.

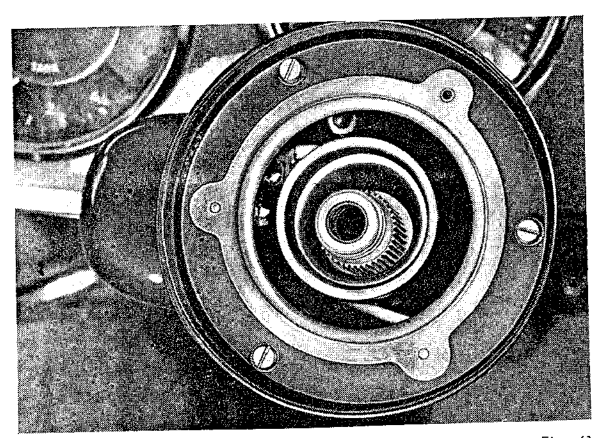


Fig. 61

4. Remove the three 9 mm nuts and remove the switch, housing and cables from the steering column.

5. Remove the three screws from the side of the switch housing and pull out the switch and cables from the inside.

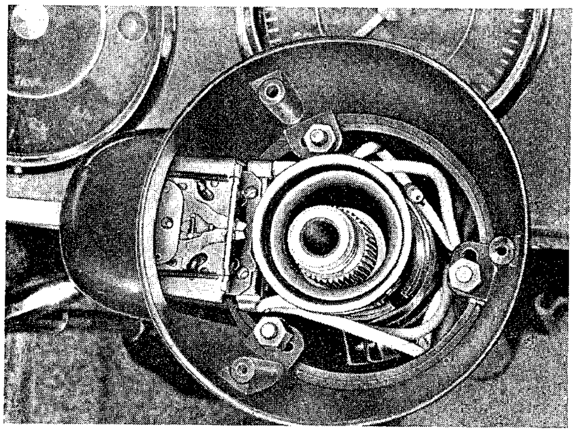


Fig. 62

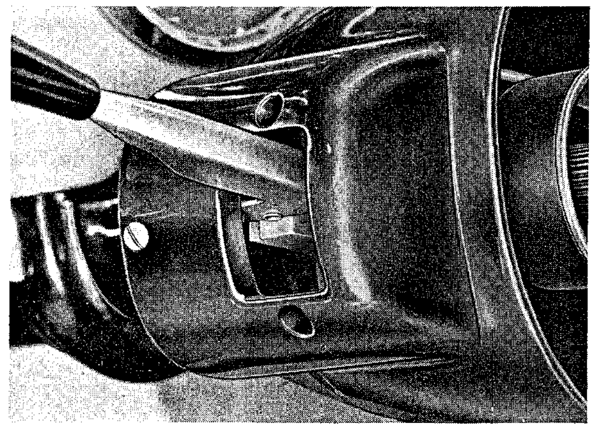


Fig. 63

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Before installing the horn contact ring, connect the horn wire to the back of the ring.
2. Fasten the cables to the steering column with plastic electrical type.
3. Connect the cables in the correct manner always connecting cables of the same color code.

31 LI

Replacing Parking and Turn Signal Bulbs

General

The bulbs for the parking lights are located in the turn signal lamp below the headlights. The parking lights remain on when the headlights are on but may be switched on separately. In european cars the parking lights are located in the headlight reflector but operate in the same manner as those of the USA model.

Replacement

1. Grasp the turn signal lamp cover, press in and turn counter-clockwise to remove.
2. Remove burned out light bulb.
3. Install a new bulb of the same power.
4. Clean and install plastic cover and insure a waterproof seat against the gasket.

Replacing Brake, Turn Signal, and Tail Light Bulbs

32 LI

General

The combined brake, turn signal, and tail lights are located at the rear of the car on the left and right sides. The tail light is located toward the center of the vehicle while the brake and turn signals are on the outside. A common bulb serves both brake and turn signal. When signalling for a turn while braking, the brake light does not function on the side in question and begins to function in a normal turn signal manner. The brake light on the other side functions normally.

Replacement

1. Remove phillips screws from the tail light frame and remove the lense.
2. Press in and turn the burned out bulb counter-clockwise to remove.
3. Clean contacts.
4. Install a new bulb of the same size.
5. Install tail light glass insuring a waterproof seal on the rubber gasket.

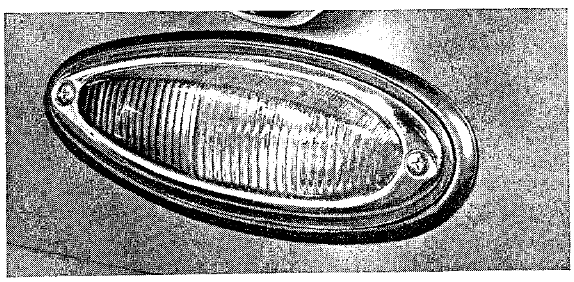


Fig. 64

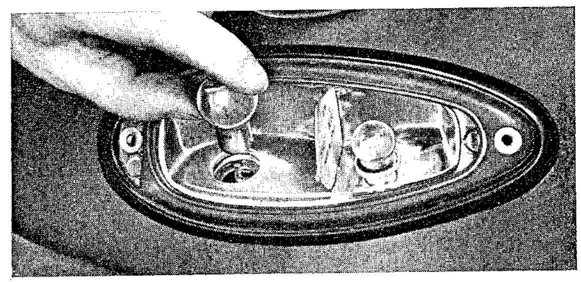


Fig. 65

Replacing Back-up and Licence Plate Light Bulbs

33 LI

General

The licence plate lights are located in the upper part of the rear bumper and have one 5 watt bulb each. The back-up light is located below the bumper in the center of the car and has a 25 watt bulb.

The licence plate lights go on with the parking lights which also light when the headlights are on. The back-up light lights automatically when the reverse

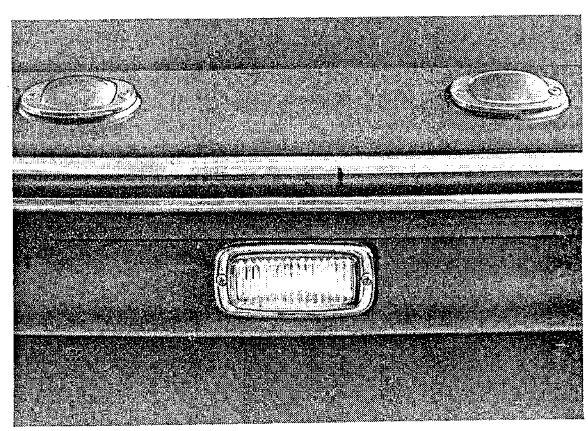


Fig. 66

gear is engaged but only when the ignition is turned on. Earlier models had the back-up light connected to the low headlight beam. A small swich connected to a plunger on the gearbox cover makes the necessary contact.

Replacement

1. Remove the two retaining screws and remove the lid.
2. Press in and turn counter-clockwise to remove bulb.
3. Clean the contact spring and adjust the tension as required.
4. Clean the lens and gasket.
5. Install a new bulb of the same size.
6. Install the cover carefully to obtain a waterproof seal.

34 LI

Replacing Interior Light Bulbs

General

The interior light of the Cabriolet/Hardtop is located in the center of the instrument panel while in the Coupe there are two lights, one over each window post. The interior lights are switched on by contacts located in both door posts, so that the lights go on when either door is opened. The lights may, however, be controlled by a switch contained in the lamp itself. This switch has three positions which are, on, off, and door controlled. In the on position the lights remain on regardless of the door contacts, while in the off position the lights do not go on at all. The door operated position allows the lights to be operated by the door contacts. The lights in the Coupe are identical so that the two light switches in the lamps operate mirror reversed. The Roadster has no interior light as standard equipment.

Replacement

1. Carefully pull out the entire lamp.
2. Remove the tube bulb without damaging the holder.
3. Install new tube bulb and check the tension of the holding clamp.
4. Install the lamp cover being careful not to damage the retaining clips.
5. Check the three position switch for proper operation.

Replacing Instrument Light Bulbs

35 LI

General

The oil pressure and generator indicator lights are located in the face of the combination instrument. The high beam and turn signal indicator lights are located in the face of the tachometer. There are two lights per instrument for illumination in the combination instrument, the tachometer, and the speedometer.

The light sockets are removable from the rear of the instruments and can be pulled out in order to replace a burned out bulb.

Replacement

1. Pull the socket of the burned out lamp from the rear of the instrument.
2. Press the bulb into the socket and rotate counterclockwise to remove.
3. Install a new bulb of the same size and install the socket.

Replacing Back-up Light Switch

36 LI

The back-up light switch is located on the left side of the transmission cover. A small push rod operates the switch when the reverse shift fork is moved into engagement.

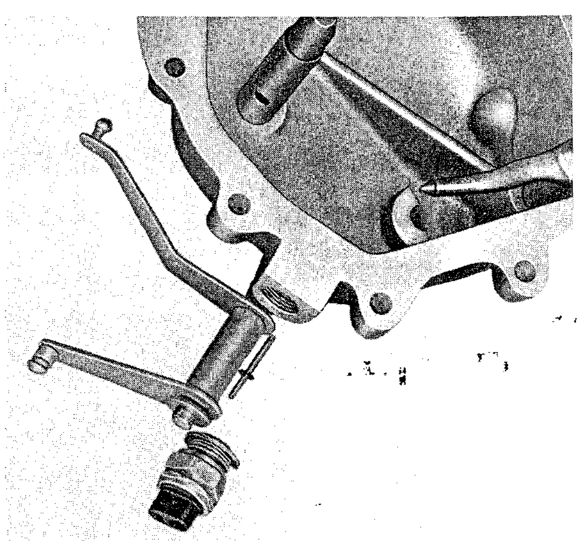


Fig. 67

Removal

1. Remove rubber cap.
2. Remove contact plugs.
3. Remove the switch using a 22 mm wrench.

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. The lock ring on the push rod must be secured in order to keep it from falling into the gearbox.
2. Install the push rod with the rounded end inward.
3. After connecting the plug pins, position the rubber cap so that it furnishes a waterproof seal.

37 LI

Replacing Door Contact Switches

The door contact switches for the interior lights are located in the center of the inner hinge plate. The switches are pressure release actuated and operate when the doors are opened. The switch merely supplies the ground for the interior light and therefore has only one wire.

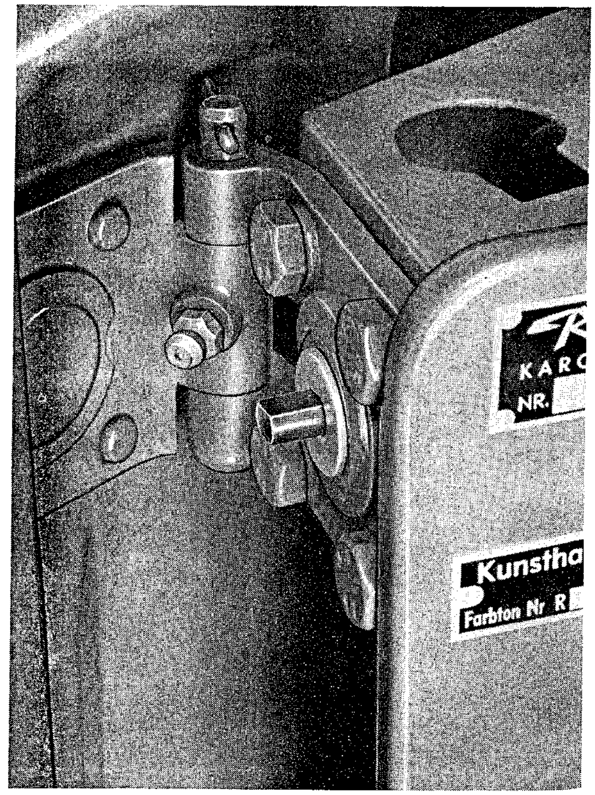


Fig. 68

Replacement

1. Pull out switch and disconnect cable.
2. Connect cable to new switch and push switch into place.

Windshield Wipers

General

The wiper motor, located under the instrument panel on the frame, drives the wiper arms by way of connecting rods which link the central crankshaft to the wiper arm cranks. The motor is controlled by a pull switch located above the ignition switch and is turned on in the pulled position.

Maintenance

The connecting rod sockets on BOSCH wipers require no service. The connecting rods and wiper cranks on SWF wipers must be oiled at regular intervals. The wiper blades should be adjusted so that they both sweep the same pattern and turn freely.

Removing and Installing Wiper Motor

38 LI

Removal

1. Remove connecting rods from the motor crank.
2. Loosen the set screw on the crank and remove the crank.
3. Disconnect cables.
4. Remove three mounting screws and remove the motor.

Installation

The installation is accomplished in the reverse order of removal observing the correct cable connections.

Horn

General

The horns are located under the front fenders behind the upper grill slots. The horns are two tone with a high tone horn on the left and the low tone horn on the right.
The horns are the standard diaphragm, magnet, and contact type known as the "Wagnerian Hammer". The electromagnet attracts the diaphragm which in turn opens contacts that interrupt the current to the electromagnet. The resulting vibration gives the frequency of the horn. A condenser connected in parallel with the contacts suppresses the arc which would normally occur and cause rapid damage. The horns are operated by the horn button in the center of the steering wheel. The contact is transmitted through a carbon brush and collector ring to ground on the steering column. This ground connection activates the horn relay which makes the connection to the horns. The relay is located on the right wall under the instrument panel and can be identified by its black cover.

Maintenance

The spring leaf mounts of the individual horns should be carefully installed so that the horns are supported free to vibrate. The usual horn failures are electrode wear, rust clogged diphragms, moisture entering the housing, or condenser failure.

39 LI

Removing and Installing Horns

1. Remove bolt from the spring mount under the fender.
2. Remove the cables from the two screw contacts on the horn and remove the horn.

When installing the horn it is important that the horn does not contact the body work but is supported freely on the spring mount.

40 LI

Tuning Horns

General

The horns may become weak or irregular from contact wear or diaphragm distortion. A screw on the back of each horn for tuning has therefore been designed to correct such changes.

Adjustment

1. Remove the horn in question (39 LI).
2. Secure the base of the spring mount in a vise (Fig. 69).
3. Connect the horn to a 6 V battery through a control switch or simple door bell button.
4. Adjust the tuning screw in or out until a clear loud tone is obtained which has no irregular sounds or overtones.

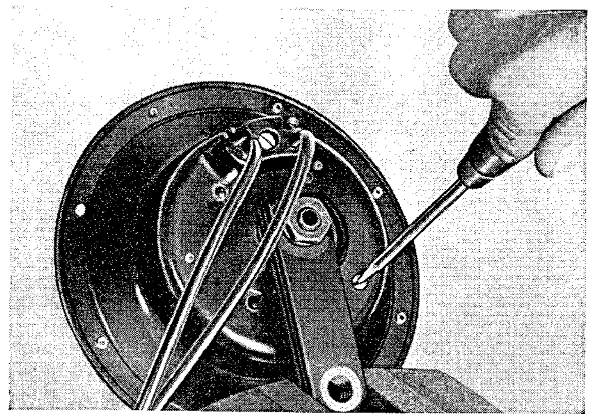


Fig. 69

If a clear loud signal cannot be obtained by this adjustment, a new horn must be installed.

Horn Button

The horn button section in the center of the steering wheel can be removed by unscrewing or turning it counter-clockwise by grasping the knobs on its outer circumference. It is advisable to disconnect the ground cable from the battery before-hand to avoid excessive noise.

Headlight Signal

The headlight signal is operated by the lever of the BAL switch on the steering column. The headlight relay is located near the horn relay on the right-hand wall under the instrument panel and can be identified by its grey cover. The relay provides a quick and efficient contact to prevent the BAL switch contacts from being burned. For repair of this switch, refer to page L 64.

Replacing Fuses

The fuse box is centrally located under the instrument panel and contains all the fuses for the electrical equipment.
Fuses may be removed by pushing downward and pulling out.
In the event that a fuse burns out it is of primary importance to locate the cause before installing a new fuse. The fuses serve to prevent serious damage to the wiring and accessories and can therefore indicate possibly dangerous damage which must be corrected before replacing the fuse. Never use fuses of greater capacity, pieces of metal foil, or wires. It is advisable to carry a few spare 8/15 ampere and 25/40 ampere fuses.

Service Diagnosis for Windshield Wiper Motor

Failure	Cause	Repair
Wipers operate very slowly, jerkey, or stop.	a. Dirty or worn brushes. b. Brush pressure too weak. c. Brush holders have tight hinges. d. Dirty commutator.	a. Install new brushes. b. Install new springs. c. Free brush holder hinges. d. Clean commutator.
Squeaking noises.	a. Crank pin and linkage dry. b. Armature dragging on field core.	a. Lubricate crank pin and linkage with high temperature grease. b. Adjust field core and test armature movement.
Wipers do not start.	a. Poor cable connection or burned fuse. b. Field core displaced or fouling armature. c. Burned out armature due to an internal short or internal ground; may be traced to field core fouling the armature.	a. Test for current supply with meter or replace fuse. b. Test movement of armature and adjust field core if necessary. c. Install new motor or armature.

Speedometer

General

The speedometer indicates the speed of the vehicle, the total mileage, and trip mileage. A flexible shaft from the left front wheel brings the drive to the speedometer. The dial of the instrument is driven by a magnetic system. The magnet rotates at the speed of the wheels and drives the needle of the dial. The magnet rotates inside an aluminum shell which is attached to the dial needle but does not contact the magnet.

The speedometer drive is a flexible woven wire shaft in a flexible steel housing which connects the left front wheel to the speedometer. The shaft is driven from the wheel hub through the hollow stub axle.

The rotation of the magnet induces eddy currents in the aluminum shell and advances the speedometer needle against a spring. With increasing speed, the torque becomes greater moving the needle proportionally farther around the speed scale. The spring on the dial shaft is matched to the magnetic drive characteristics. This enables the speedometer to show the speed by means of the magnetic coupling whose transmitted torque increases with speed. The needle advances around the speed scale until the magnetic torque and the spring torque are equal.

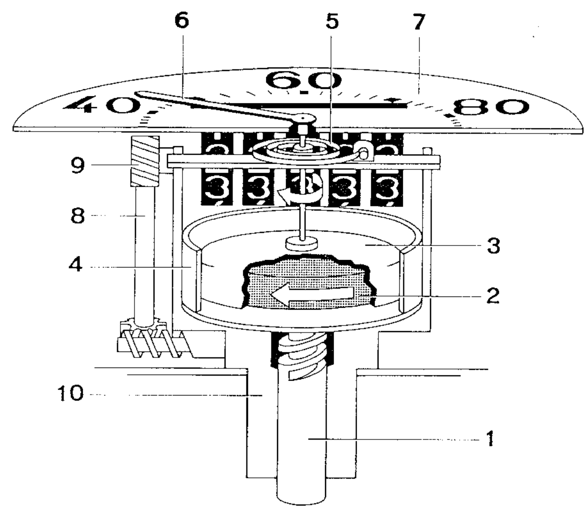


Fig. 70

1. Input shaft
2. Magnet
3. Aluminum shell
4. Magnetic shield
5. Spiral spring
6. Speedometer hand
7. Dial
8. Worm drive shaft
9. Worm gear with counter
10. Bearing block

The odometer is driven by a worm gear drive train and has five reels which record the total mileage. A four reel trip mileage odometer is located in the lower half of the speedometer face. The first reel on the right indicates tenths of miles giving a total capacity of up to one thousand miles for the four reels. The trip mileage may be turned to zero by means of a knob on the back of the speedometer.

42 LI

Removing and Installing Speedometer

Removal

1. Remove instrument lights from the sockets.
2. Remove speedometer cable nut and pull cable from instrument.
3. Remove clamp screws from the back of the speedometer.
4. Remove the clamp bracket and remove the speedometer from the instrument panel.

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Inspect sockets of the instrument lamps for a tight fit.
2. Before tightening the clamp screws on the back of the speedometer, adjust the position of the instrument so that the numbers are vertical.

Note:

Turning the odometer back or other such operations are not permitted. When exchanging a speedometer for repair, the original mileage is to be left on the dials. When exchanging a speedometer at the factory, the correct mileage is to be given so that this may be registered on the dials of the new instrument.

Repairs and service covered by the guarantee are performed only by the manufacturers or their representatives.

43 LI

Removing and Installing Speedometer Drive Shaft

Removal

1. Disconnect drive shaft from the speedometer.
2. Remove left front hub cap.
3. Remove the cotter key from the end of the speedometer shaft on the bearing cap and remove the cap.
4. Remove the flexible shaft and housing by pulling it out of the back of the stub axle.
5. Remove speedometer shaft assembly from the car.

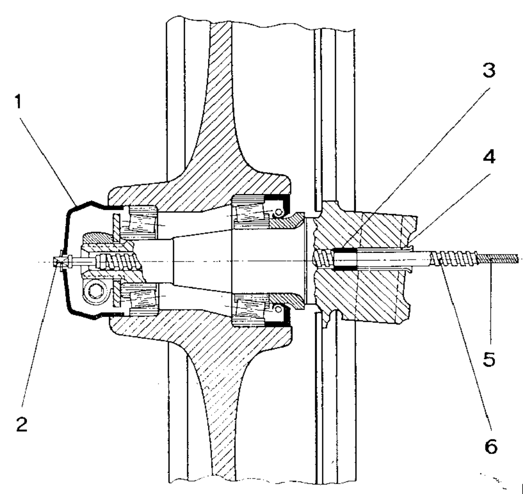


Fig. 71

① **Bearing cap with square hole.**
② **Drive extension with cotter key.**
③ **Rubber protector.**
④ **Steel shell.**
⑤ **Flexible shaft.**
⑥ **Flexible housing.**

Installation:

The installation is accomplished in the reverse order of removal observing the following points:

1. Do not kink or stretch the new shaft.
2. The flange of the shaft housing must mate flush with the speedometer.
3. The square end of the shaft must fit easily into the speedometer without force.
4. Install a new rubber collar where the shaft enters the stub axle.
5. Use a new cotter key for the drive shaft in the wheel bearing cap.

Note:

Special care should be taken in placing the flexible shaft in a good position.

The shaft must operate smoothly without noise or vibrations and must therefore be positioned so that it has no bends with a radius of less than 150 mm (6 in.). When the wheels are aligned straight ahead, the flexible shaft should lie in a smooth curve from the wheel to the entrance in the chassis. The flexible shaft must not become kinked or stretched in any wheel position. If the housing becomes damaged and binds the shaft, a pulsation will occur and make the speedometer needle oscillate. Sharp bends hinder the motion of the shaft and cause the shaft to break permaturely. The rubber seal at the entrance to the axle prevents the entry of water which could cause bearing damage or, in winter, freeze the shaft solid in the housing. This seal must therefore be carefully installed so that a proper seat is obtained.

Oil or water resistant grease are to be used to lubricate the speedometer drive.

Removing and Installing Tachometer Drive Shaft

44 LI

General

Since the construction and operation of the tachometer drive shaft is, in principle, identical to the speedometer drive shaft, the same care and installation cautions apply as in section 43 LI.

Removal

1. Remove foot pedal floor board.
2. Disconnect the flexible shaft from the tachometer.
3. Remove the flexible shaft from the oil pump at the engine.
4. Remove clamps at the instrument panel and engine compartment.
5. Remove hose clamps in the floor tunnel.
6. Remove the flexible shaft from the car.

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Install a new rubber boot at the rear panel.
2. Waterproof the flexible shaft and rubber boot with sealing compound.
3. Inspect the rubber strap above the rear axle and replace if necessary.
4. Properly connect clamps and fasteners.

45 LI

Removing and Installing Combination Instrument

General

The combination instrument, located on the left side of the instrument cluster, contains the oil thermometer, fuel gauge, oil pressure indicator light, and generator warning light. The oil thermometer and pressure units are remote controlled by electric sending units on the engine.

Removal

1. Disconnect cables.
2. Remove clamp nuts.
3. Pull out instrument lights.
4. Remove complete instrument.

Installation

The installation is accomplished in the reverse order of removal observing particularly the correct cable connections.

46 LI

Removing and Installing Fuel Gauge

Removal

1. Open front hood.
2. Disconnect green sending cable from fuel gauge.
3. Remove five mounting screws from fuel gauge.
4. Carefully remove fuel gauge sending unit and float.

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Install a new cork gasket.
2. Tighten the mounting screws uniformly to the same torque.

47 LI

Removing and Installing Oil Pressure Switch

General

The oil pressure switch is located on top of the crankcase in the main oil flow to the oil cooler. When the engine is not running a contact attached to a diaphragm is held in the closed position by a spring. When the ignition is turned on, current flows from terminal 15 of the ignition switch through the oil pressure warning lamp and the oil pressure switch to ground. Therefore, when there is no oil pressure the green warning lamp lights.

When the engine is running, the oil pressure in the main oil line presses against the diaphragm and opens the contacts, whereby the green warning lamp goes out.

Removal

1. Disconnect cable from oil pressure switch.
2. Remove oil pressure switch using tool P 19 a or a 24 mm open end wrench.

Installation

The pressure seal at the pressure switch is obtained by the use of a tapered thread. For this reason it is important to tighten the switch no more than is necessary for a tight seal since the thread will otherwise become damaged.

After installing the switch, test its operation by running the engine and observing the green warning lamp.

Note

The oil pressure switch used in 356 B cars, in contrast to previous models, cannot be adjusted and must be replaced with a new unit in the event of improper function or failure. The operating range of the switch is from 0.3 to 0.6 kg/cm² (4.3 to 8.5 psi).

Oil Pressure Warning Light

If the green warning light goes on while the engine is operating, the main oil supply line and bearings are receiving insufficient pressure and are therefore not being properly lubricated. During winter driving the warning light may go on only while the engine is idling or possibly not at all. In contrast, in the summer when the engine is quite warm the light may go on while changing gears due to the low viscosity of the warm oil.

Present day engine oils are relatively light in viscosity which, besides aiding in engine starting, assures a good oil flow at lower oil pressures The increased flow gives better lubrication and cooling to the friction surfaces.

Windshield Washer System

General

The fluid for the washer system is held in a plastic bag next to the fuel tank. A rubber hose system feeds the water to a rubber ball foot pump and from the pump to the two jets. By depressing or flattening the rubber ball pump water is sprayed on the windshield through a jet located near each windshield wiper arm. As the foot pressure is released, the ball expands and by way of valves refills itself from the reservoir. When dismantling the washer system note the correct position of the "T" pipe sections so that they may be correctly installed.

For winter driving it is advisable to fill the fluid reservoir with one part alcohol to three parts water to keep the system from freezing.

General

The car radio operates under relatively unfavorable conditions with its small antenna signal and correspondingly large static and noise reception from the auto electrical system. The ignition, generator, and windshield wiper motor as well as the surrounding vehicles are a constant source of interference. For this reason it is of great importance that the electrical system is thoroughly noise suppressed especially in the case of FM reception. Loose ground connections (varying resistance) are a common cause of static noises. When installing a radio it is advisable to test the ground connections with an ohmmeter. The choice of suppressor items is generally prescribed by the radio manufacturer and can be found in the radio accessory lists.

In the event that the radio receives interference from other sources than those which are normally suppressed, the entire system should first be tested for ground connections. If this does not locate the cause of the interference an auto electric shop which is specially equipped for such work should be consulted.

Note

The maximum capacity for the suppressor condenser at generator terminals D + and regulator terminal D + is 0.45 μF. A greater capacity will burn the regulator contacts.

Electrical Data and Specifications

Generator

Note: Generator rpm are related to engine rpm by the V-belt ratio of 1:1.8

1. Type	Bosch shunt
2. Designation	LJ/GEG/200/6/2600 L 19
3. Load and speed for performance test	200 watt 2500 rpm (36 amp)
4. Nominal voltage speed	1750 rpm
5. Field coil resistance	1.0 to 1.1 ohm
6. Carbon brush spring tension	450 to 600 g (16 to 21 oz.)

Regulator

1. Type	Bosch RS/UA 200/6/23
2. Cut-out closes	6.3 to 6.7 V
3. Cut-out opens	4 to 9 amp
4. Cut-out contact gap	0.4 mm (.016 in.) main contact 0.5 to 1.2 mm (.020 to .047 in.)
5. Regulator voltage (no load)	7.0 to 7.5 V
6. Armature gap for voltage regulator	closed 0.2 mm min. (.008 in.) open 0.8 to 1.3 mm (.032 to .051 in.)
7. Contact gap for voltage regulator	0.25 to 0.4 mm (.010 to .016 in.)
8. Current regulator cuts in	cold 50 to 54 amp warm 47 to 51 amp

Starter

1. Type	Bosch, Solenoid worm, EED 0.5/6 L 35
2. No load test	5.5 V 60 to 80 amp at 5300 to 7300 rpm
3. Load test	4.5 V at 260 amp 1000 to 1300 rpm 0.4 mkg (2.9 ft.lb.) torque
4. Torque stalled	3.5 V 450 to 520 amp 0.9 to 0.95 mkg (6.5 to 6.9 ft.lb.)
5. Carbon brush spring tension	800 to 900 g (28 to 32 oz.)

Distributor	
1. Type	Bosch VJR 4 BR 18 mk
2. Breaker point gap	0.4 to 0.5 mm (.016 to .020 in.)
3. Centrifugal advance degrees at engine rpm	0° 600 to 900 rpm 10° 1000 to 1200 rpm 20° 1600 to 2200 rpm 33° 2900 to 5300 rpm
4. Dwell angle	47° to 53°
5. Spring tension	400 to 500 g (14 to 17.6 oz.)
6. Condenser	0.27 to 0.32 μF
Ignition Coil	
1. Type	Bosch TK 6 A 3
2. Spark on Bosch tester EFMZ 1 with ionized spark gap	14 mm (.551 in.) with 1.8 ohm test resistor at 2.8 amp primary current
Spark plugs	Bosch W 225 T1 gap 0.5 to 0.6 mm (.020 to .024 in.)
Battery	6 V 84 amp hour negative ground

MAINTENANCE PLAN

Break in Period 300 m 500 km	1500 m 2500 km	3000 m 5000 km	Maintenance		Every
			Clean air filter		3000 miles (5000 km)
			Check V-belt tension		
			Clean fuel system, check carburetor adjustment		
			Check contact breaker points and ignition timing		
			Check valve clearance		
			Check compression		
			Check spark plugs		
			Check battery		
			Check cables and connections of electrical system and generator		
			Check front wheel bearings, torsion arm link pins, steering and toe-in		
			Check tire pressure, check wheel nuts for tight fit		
			Check foot and parking brake, check all tube and hose connections for leaks, check brake fluid level		
			Check correct fit and effectiveness of shock absorbers		
			Check clutch pedal travel		
			Check rear axle and engine for leaks		
			Exhaust, intake manifold, carburetor and fuel pump	Check bolts and nuts for tight fit	6000 miles (10 000 km)
			Engine, transmission, rear axle and front axle, steering		
			Remove brake drums and check brake linings		

Engine Type	1600	1600 S	1600 S-90
Permissible total weight, ... kg (lbs.)	1250 (2760)		
Permissible axle load			
front .... kg (lbs.)	550 (1213)		
rear .... kg (lbs.)	700 (1544)		
Capacities			
Fuel tank .... ltr. (gals)	approx. 52 (13.8 US gals; 11.5 Imp. gals) 5 (1.33 US gals; 1.1 Imp. gals of which are reserve		
Crankcase .... ltr.	approx. 4 (4.23 US quarts); with bypass oil filter approx. 5 (5.28 US quarts)		
Transmission and differential .... ltr.	approx. 3,5 (3.5 US quarts)		
Steering gear .... ltr.	approx. 0,25 (0.264 US quarts)		
Brake fluid container .... ltr.	approx. 0,25 (0.264 US quarts)		
Performance			
Output .... SAE HP	70	88	102
DIN HP	60	75	90
at engine speed .... (rpm)	4500	5000	5500
Max. torque .... mkg (lbs/ft)	11,2 (81.0)	11,9 (86.0)	12,3 (89.0)
at engine speed .... U/min. (rpm)	2800	3700	4300
Mean piston speed at max. n. p. m/sec. (ft/sec)	11,1 (36.4)	12,3 (40.3)	13,6 (44.6)
Mean working pressure at max n. p. .... kg/cm² (psi)	7,6 (108.1)	8,5 (120.9)	9,3 (132.2)
Min. Fuel consumption .... g/PSh	240	245	220
at engine speed .... U/min (rpm)	3300	3700	3500
Max. speed .... km/h (mph)	160 (100)	175 (109)	180 (112)
Specific power output .... PS/ltr.	38	47,5	57
Power/weigth ratio (in service conditions) kg/PS (lbs/hp)			
Coupé, Convertible/Hardtop	15 (27.5)	12 (21.8)	10 (18.8)
Roadster	14,5 (26.4)	11,6 (21.0)	9,7 (18.1)
Road speeds	see Transmission Diagram, section R		
Fuel consumption			
Standard fuel consumption			
(DIN 70030) ltr/100 km	7,6	8,2	8,5
mpg (US)	31.5	29.5	27.7
Fuel	86 octane	88 octane	92 octane

Engine Type	1600	1600 S	1600 S-90	
Total reduction ratio	1 : 16 (average)			
Steering damper	double-acting hydraulic shock absorber			
Steering wheel revolutions from lock to lock	approx. 2,25			
Minimum turning circle dia., m (St.)	approx. 11 (36.1)			
Toe-in, front	+ 5' to + 25' (per wheel pressed approx. + 10'), steering gear on pressure point			
Toe-in, rear	0° ± 10'			
Camber, front	+ 40' ± 30'			
Camber, rear	+ 10' to + 1° 30'			
King pin inclination	4° 30'			
Caster	5° ± 30'			
Difference angle per side	3° 10' ± 20' inside wheel (curve) set to 20°			
Wheels	perforated steel disc			
Rims	4,5 J x 15 well-base			
Tires	5.60–15 Sport (upon request 165–15)	5.60–15 Sport (upon request 165–15)	165–15 braced tread tire	5.90-15 Super Sport (upon special request
Tire pressures, front, atm (nominal values) (psi)	Normal driving (country road) 1,3 (18.48) high-speed driving (Speedway) 1,5 (21.33)	Normal driving (country road) 1,3 (18.48) high-speed driving (Speedway) 1,5 (21.33)	Normaldriving (country road) 1,6 (22.75) high-speed driving (Speedway) 1,8 (25.59)	Normaldriving (country road) 1,2 (17.06) high-speed driving (Speedway) 1,4 (19.9)
Tire pressures, rear, atm (nominal values) (psi)	Normal driving (country road) 1,6 (22.75) high-speed driving (Speedway) 1,8 (25.59)	Normal driving (country road) 1,6 (22.75) high-speed driving (Speedway) 1,8 (25.59)	Normaldriving (country road) 1,8 (25.59) high-speed driving (Speedway) 2,0 (28.44)	Normaldriving (country road) 1,5 (21.33) high-speed driving (Speedway) 1,7 (24.17)
Driving brake	Ate hydraulic brake, front-Duplex, rear Simplex			
Parking brake	mechanical, acting on both rear wheels			
Braking area, front, cm² (sq. in).	390 (60.5)			
Braking area, rear, cm² (sq. in.)	390 (60.5)			
Lubrication points	individually lubricated			
Body				
Type	All-steel body welded to frame, sloping front hood, stepless rear with Coupé			
Doors	2 doors hinged to the front door pillars			
Width, mm (in.)	1090 (42,9)			
Opening angle	approx. 55°			
Windows				
Windshield	one piece, curved			
Door windows	fitted with crank-operated lowering mechanism; Coupé, Convertible/Hardtop with deflector panes			
Quarter panes	hinged, with locking device			
Rear window	one piece, curved			
Glass	safety glass			
Windshield wipers	electrically operated, two parallel wiper arms			
Hoods				
Front	hinged at rear, held open by catch engaging and disengaging automatically. Thief-proof, opened from inside car. Fitted with lock and safety catch.			

The special tools listed in the various sections of the Service Manual should be available at every Porsche Service Station.

The following tools are essential for a Porsche mechanic, i. e. 1 tool kit, containing:

Porsche Special Tools

P-19a	Oil pressure switch wrench	P-115	Set of feeler gauges
P-23	Carburetor wrench 12 mm	P-117	Spark plug wrench with ratchet
P-24	Carburetor wrench 14 mm	P-118	Allen wrench for valve adjustment
P-101	Flywheel bolt wrench	P-119	Allen wrench for cylinder head nuts
P-113	Degree wheel		

VW-Special Tools

VW-118	Torque wrench 6 mkg max.	VW-156	Allen wrench hexagon socket 10 mm
VW-126	Fuel pump wrench	VW-157	Allen wrench hexagon socket 8 mm

Commercial Tools

Screw driver 2,3 mm
Screw driver 3,5 mm
Screw driver 5,5 mm
Screw driver 9,0 mm
Screw driver 10 mm
Philips-head screw driver 6 mm dia.
Ratchet ½"
Socket wrench adaptor 10, 12, 14, 15, 17, 19, 21, 27, 30, 32, mm
Box wrench 6, 7, 8, 9, 10, 11, 12, 13, 14, 17, 19, 21, 22, 24 mm
Open end wrench 10 x 14
Open end wrench 11 x 12
Open end wrench 17 x 19
Box wrench 27/36 mm
Hammer 500 g
Plastik hammer No. 40
Combination pliers 160 mm
Flat pliers 160 mm
Circlip pliers, straight
Circlip pliers, bent
Water pump pliers
Retaining ring pliers
Side cutter, 140 mm long
Flat chisel 150 mm
Cross cut chisel 150 mm
Triangular scraper 80 mm
Punch 2 mm
Punch 3 mm
Punch 4 mm
Punch 5 mm
Center punch
Scriber
Flat file 250 mm
Round file 150 mm
Inspection lamp
Tapemeasure 2 m
Allen wrench 6 mm
Wheel nut wrench

We recommend further for every Porsche Service Station to have our assembly car 842 E available. The drawing for self-production of this assembly car may be requested from the factory.

Second Edition of this page , September 1961

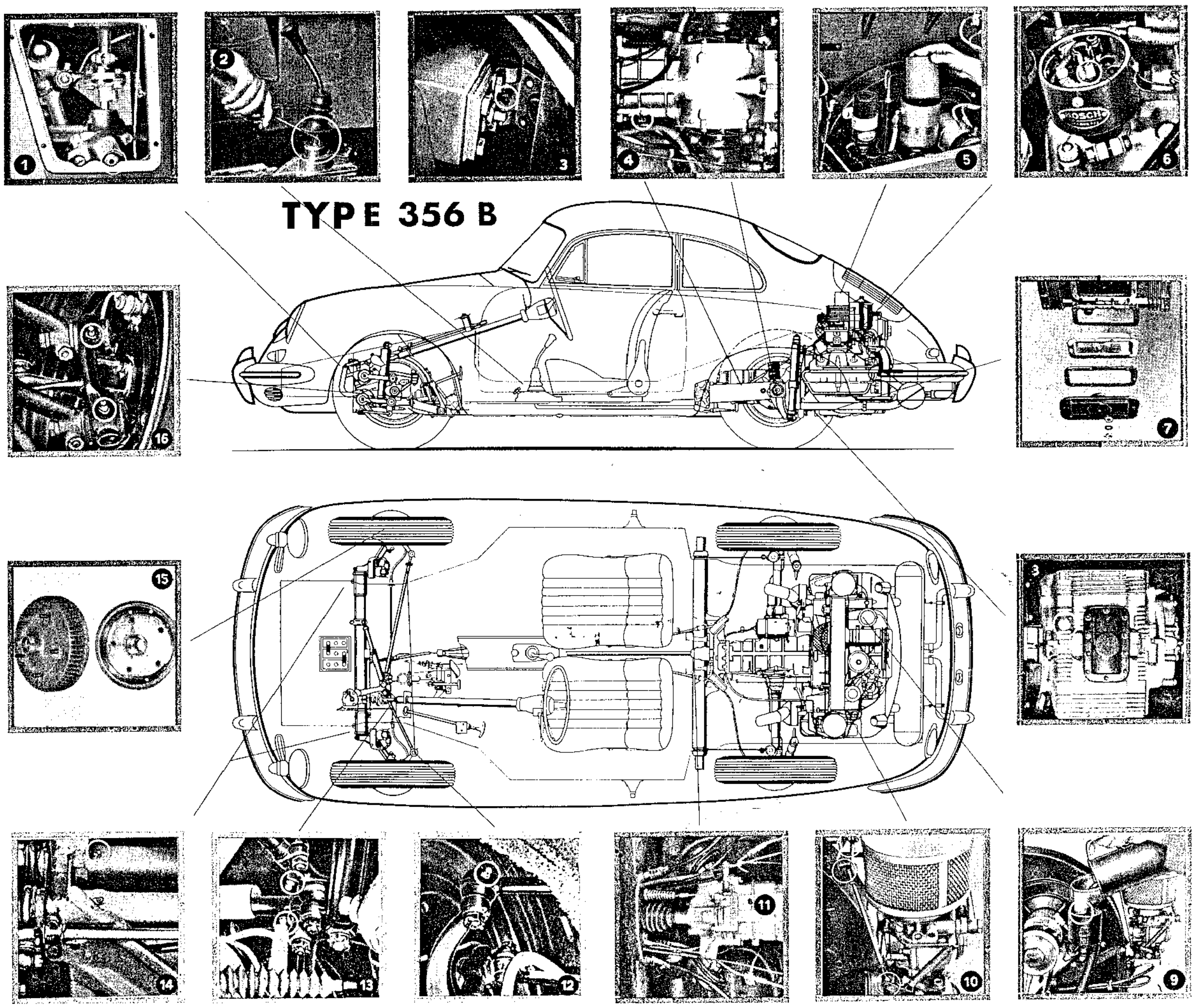
LUBRICATION CHART

During breaking in period after every 300 miles / 500 Kilometers	900 miles / 1500 Kilometers	1500 miles / 2500 Kilometers	3000 miles / 5000 Kilometers	Lubrication point	Picture No.	Lubricant	Remarks Required characteristics of lubricants	After breaking-in period, every
				Front axle: lubricate torsion bar tubes	14	Universal grease	low-temperature grease	1500 miles 2500 km
				Lubricate king pins	16		water-repellent	
				Lubricate tie rod joints	12,13			
				Engine: change oil *	7-9	good quality HD-oil **		3000 miles 5000 km
				Transmission / Differential: check oil level	4	Transmission oil	Hypoid SAE 90	
				Check oil level in steering gear	1			
				Lubricate parking brake cables	11	Universal grease	low-temperature grease	
				Lubricate distributor cam	6		water-repellent	
				Lubricate door and hood-locks and hinges	3			
				Lubricate carburetor linkage joints	10	Engine oil		
				Engine: Clean oil strainer and magnetic filter	7		together with an oil change	6000 miles 10000 km
				Engine: Replace oil refining filterinsert	5			
				Transmission / Differential: change oil	4	Transmission oil	In warm season: Hypoid SAE 90 ***	
				Repack front wheel bearings	15	Multi-purpose grease Lithium base	Drop point above 180° C (356° F) Max. 1 3/4 oz. per Wheel hub — ASTM penetration: - Worked: approx. 290	
				Lubricate shift lever	2	Engine oil		
				Lubricate parking brake cable tubes, carburetor linkage, clutch, heater and windshield wiper mechanism		Universal grease	low-temperature grease water-repellent	At the beginning of the cold season

* **Note:** In cold outside air temperature, for city driving and short distances, change engine oil every 1500 miles (2500 km).

** **Important!** For engines of the type 1600 Super **good quality HD-oil for Diesel engines** should be used. For engines of the type 1600 for normal use, **good quality HD-oil** should be used. If the 1600 engine is used for competition driving, **good quality HD-oil for Diesel engines** should be used.

*** In countries with prevalently cold climate Hypoid SAE 80 may also be used.



Lubricant and Grease Brands for Units

Engine

HD oil approved brand ** (see Lubrication Chart)
Summer: SAE 30
Winter: SAE 20
Capacity:

Initial filling with bypass oil filter	approx. 5 ltrs.
for oil change incl. cleaning of oil strainer	approx. 4 ltrs.
for normal oil change	approx. 3 ltrs.

Fill in oil up to upper mark on oil dipstick

Transmission and differential gear

Gear oil
Summer: Hypoid SAE 90
Winter: Hypoid SAE 90
(in countries with cold climate Hypoid SAE 80)
Capacity: approx. 3,5 ltrs.

Steering Gear

Gear oil
Independent from season SAE 90 or
Hypoid SAE 90
Capacity: approx. 0,25 ltrs.

Front axle

Axle tubes
King pins
Tie rod joints
Front wheel bearings, capacity: for each wheel hub 50 c. c.
(approx. 45 g)
Lithium-base gréase (multi-purpose grease) e. g. Retinax A

Parking Brake Cables

Lithium-base (multi-purpose grease)

Gear-shift lever

Engine lube oil or multi-purpose grease

Ignition distributor cam

Bosch special grease Ft 1 v 8

Carburetor joints

Engine lube oil

Door, hood locks and hinges

Lithium-base grease (multi-purpose grease)

**Cables for carburetor, clutch, heater,
windshield wiper linkage**

Lithium-base grease (multi-purpose grease)

DATA AND SPECIFICATIONS

Porsche Types 356 B/1600, 1600 S, 1600 S-90

Engine Type	1600	1600 S	1600 S-90
Engine			
Type	air-cooled four-stroke gasoline engine, integral unit with clutch, transmission and rear axle, and fitted at rear of vehicle		
No. of cylinders	4		
Cylinder arrangement	in pairs, horizontally opposed (flat four)		
Bore, mm (in.)	82,5 (3.25)	82,5 (3.25)	82,5 (3.25)
Stroke, mm (in.)	74,0 (2.91)	74,0 (2.91)	74,0 (2.91)
Displacement, c. c. (cu. in.)	1582 (96.5)	1582 (96.5)	1582 (96.5)
Compression ratio	7,5 : 1	8,5 : 1	9 : 1
Total weight (dry), kg, (lbs) approx.	110 (242,5)	110 (242,5)	110 (242,5)
Crankcase	light alloy, three-part		
Cylinders	Separate cylinders		
Cylinder material	grey cast	light alloy	light alloy
Cylinder liner	—	hard-chromed	Ferral liner
Cylinder head	one to each pair of cylinders, light alloy cylinder head		
Valve seat	shrunk in place		
Valve guide	shrunk in place, special bronze		
Spark plug seat	Heli-Coil insert		
Crankshaft	forged		
Crankshaft bearings	4 plain bearings		
No. 1, 3, and 4 main bearings	one-piece bearing bushings, light alloy		
No. 2 main bearing	light alloy shells		
No. 1, 2, and 3 main bearings			split, threelayer bearings
No. 4 main bearing			one-piece, light-alloy bearing bushing, lead-coated
Connecting rods	forged-steel H-section shank		
Big-end bearings	three-layer bearings		
Small-end bearings	pressed-in bronze bushings		
Pistons	light alloy		
Piston rings	3 compression rings, 1 oil scraper ring	2 compression rings, 1 oil scraper ring	3 compression rings, 1 oil scraper ring
Valve timing	1 camshaft mounted underneath crankshaft, operation trough push rods and rocker arms cast, 3 plain bearings directly in crankcase		
Camshaft			
Camshaft drive	2 helical spur gears		
Valve arrangement	OHV		
Valve springs	1 coil spring for each valve		
Valve clearance, adjuste while engine is cold			
intakte mm (in.)	0,10 (.00394)	0,15 (.0059)	0,15 (.0059)
exhaust mm (in.)	0,15 (.0059)	0,10 (.00394)	0,10 (.00394)
Valve timing **with 1mm (0.040 in.) valve clearance**			
Intake opens before TDC	7°	17°	17°
Intake closes after BDC	45°	53°	53°
Exhaust opens before BDC	44°	50°	50°
Exhaust closes after TDC	6°	14°	14°

Engine Type	1600	1600 S	1600 S-90
2 clearence lights for all countries other than USA fitted in headlights; for USA fitted in front direction indicator lights ... Watt	4 each		
2 tail lights in combined flashing direction indicator and stop lights ... Watt	5 each		
2 flashing direction indicator lights, front Watt	18 each		
2 combined flashing direction indicator and stop lights ... Watt	18 each		
2 licence plate lights ... Watt	5 each		
1 back-up light ... Watt	25		
Interior lighting			
2 lights for Coupé ... Watt	10 each		
1 for Convertible/Hardtop ... Watt	10		
Tachometer illumination ... Watt	0,6		
High beam headlight pilot lamp ... Watt	0,6		
Direction indicator pilot lamp ... Watt	1,2		
Combination instrument illumination . Watt	1,2		
Generator indicator lamp ... Watt	1,2		
Oil pressure warning lamp ... Watt	1,2		
Speedometer illumination ... Watt	0,6		

Transmission and Rear Axle

Type ...	Four-speed transmission and differential gear mounted in common housing
Transmission ...	4 forward speeds with Porsche baulked synchromesh system
Gear ratios 1st to 4th speeds see Transmission Diagram, section Reduction ratio of reverse gear ...	i = 3,56
Gearchange mechanism ...	rod mechanism, ball and socket lever arranged in centre of car
Axle drive ...	spiral bevel gears, bevel differential gear, swinging half axles
Reduction ratio ...	i = 4,428

Chassis

Frame ...	welded pressed-steel box frame welded to body	
Front wheel suspension ...	independent suspension, 2 trailing arms	
Rear wheel suspension ...	swinging half axles, radius arms forming spring mountings	
Front wheel springing ...	2 transverse continous square torsion bars laminated	
Rear wheel springing ...	1 transverse round torsion bar on either side	
Adjustment of rear radius arms (Inclination)	Coupé, Convertible/Hardtop 16° 30′ Roadster 14° 30′	with compensating spring: Coupé, Convertible/Hardtop 15° 30′ Roadster 13° 30′
Shock absorbers, front and rear ...	double-acting telescopic shock absorbers	double-acting adjustable telescopic shock absorbers
Stabilizer ...	transverse anti-roll bar at front	
Steering ...	ZF single-peg steering with divided tie rod and hydraulic steering damper	

Engine Types	1600	1600 S	1600 S-90
Rear	Engine hood is hinged at front. Held open by catch engaging and disengaging automatically. Opened from inside car.		
Seats			
Number	2/2		
Front	2 adjustable individual seats, backs can be lowered for reclining		
Rear	two occasional seats. The back rest hinges forward to serve as luggage rack.		
Instrument panel	Speedometer with total mileage recorder and trip mileage recorder, illuminated Tachometer fitted with high beam indicator light and direction indicator pilot light, illuminated Combination instrument comprising remote-reading oil thermometer, fuel gauge, generator indicator light, and oil pressure warning light, illuminated Windshield wiper knob, ignition/starting switch, light, hand throttle knob, socket for inspection lamp, cigar lighter, ash tray, glove compartment with lock, grab handle Direction indicator and low beam headlight switch on steering column. Steering wheel with horn and button for headlight signalling		
Internal trimming and fittings			
Floor	covered with rubber mat		
Tunnel	front covered with rubber, rear with carpeting		
Front side panels	covered with carpeting		
Doors and side walls	padded		
Dome	fitted with plastic lining		
Heating	hotair heating with remote control, 2 defroster nozzles for the windshield and 2 outlets for hot air in the side members under the doors		
Sliding top			
Make	Golde		
Length of opening, mm (in.)	approx. 260 (10.23)		
Width of opening, mm (in.)	approx. 780 (30.7)		
Miscellaneous			
Bumpers	at front and rear, each with two overriders		
Spare wheel	in thief-proof location under the front hood		
Fuel tank	under the front hood		
Tools and Accessories	under the front hood		
Dimensions and Weights			
Wheelbase, mm (in.)	2100 (82.7)		
Track, front, mm (in.)	1306 (51.4)		
Track, rear, mm (in.)	1272 (50.1)		
Length, mm (in.)	4010 (157.7)		
Width, mm (in.)	1670 (65.7)		
Height (empty), mm (in.)	Coupé, Convertible 1330 (52.4); Hardtop 1315 (51.7); Roadster 1310 (51.5)		
Overhang, front, mm (in.)	865 (34.05)		
Overhang, rear, mm (in.)	1055 (41.5)		
Ground clearance, mm (in.)	150 (5.9)		
Bulk clearance, mm (in.)	140 (5.51)		
Weight, empty, acc. to DIN, ...kg (lbs.)	Coupé, Convertible/Hardtop 900 (1985); Roadster (1918)		

Compensating Spring

A compensating spring can be installed in any 356 B 1600 or 1600 S car. For such a conversion the following parts are required.

① 2 ea. Torsion bar	695.333.102.00	⑨ 2 ea. Tie bolt	695.333.241.01
② 1 ea. Compensating Spring	695.333.021.00	⑩ 2 ea. Support bracket	695.333.231.00
③ 1 ea. Spring support	695.333.025.00	⑪ 2 ea. Lock pin	5 x 8 1473
④ 1 ea. Rubber mount	695.333.221.00	⑫ 2 ea. Lock washer	B 12 DIN 127
⑤ 2 ea. Elastic support	695.333.207.00	⑬ 2 ea. Cap screw	M 12 x 1.5 x 30 DIN 960
⑥ 2 ea. Centering plate	695.333.205.00	⑭ 2 ea. Castle nut	M 10 DIN 937
⑦ 2 ea. Rubber joint plate	695.333.233.00	⑮ 2 ea. Cotter key	2 x 22 DIN 94
⑧ 2 ea. Rubber joint	695.333.235.00		

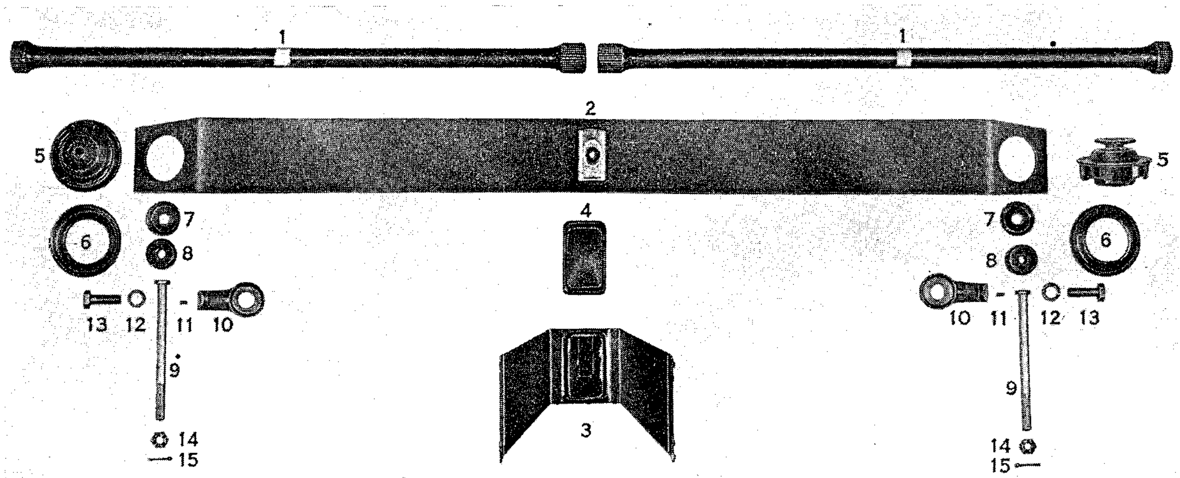


Fig. 1

In order to retain the proper suspension characteristics with the compensating spring, a softer torsion bar is required. Two 23 mm dia. torsion bars, which can be identified by a white marking (Fig. 1), replace the standard 24 mm dia. bars.

Exchanging Torsion Bars

1. Remove torsion bars (22 HA).

2. Install new 23 mm dia. torsion bars and adjust proper setting.

   The correct angle is:

Model 356 B	Coupe, Cabriolet/Hardtop	Roadster
1600, 1600 S	15° 30'	13° 30'

A difference between left and right torsion bars of not more than one degree is permissible in the event that the greater angle is on the driver's side (left or right depending on left or right hand drive).

Installing the Compensating Spring

1. Install the spring support fastening it to the two bottom studs of the transmission side covers.

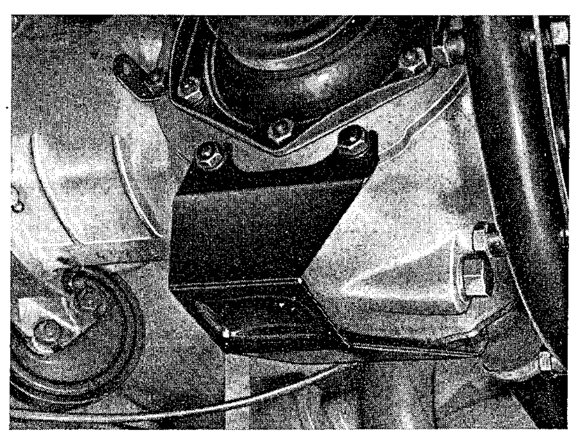


Fig. 2

2. Install lock pin in support bracket.

3. Remove nut, lock washer, and bolt. Place lock washer on bolt, insert bolt through the suspension arm and mount support bracket.

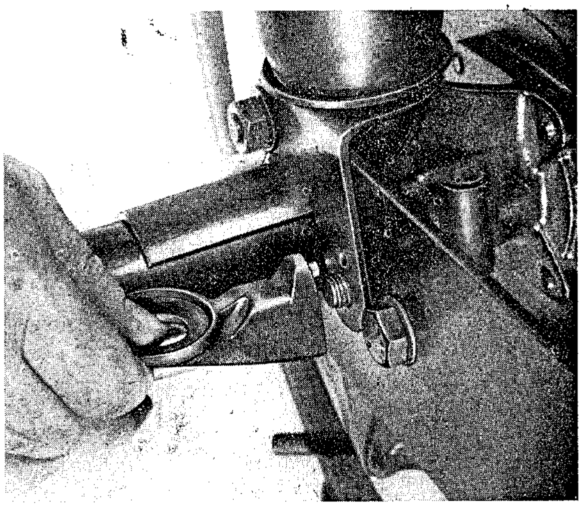


Fig. 3

In the event that there is no hole provided for the lock pin, a hole must be bored as shown in the following sketch.

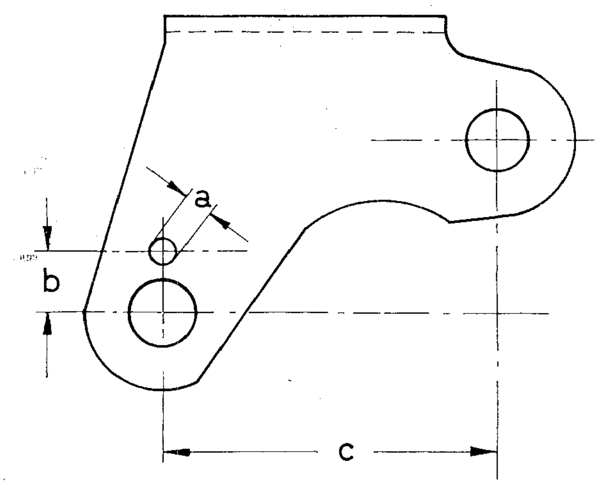


Fig. 4

a = 5.1 mm dia.

b = 12 ± 0.1 mm

c = 66 ± 0.2 mm

4. Install tie bolts with rubber joints and rubber joint plates in the support brackets.

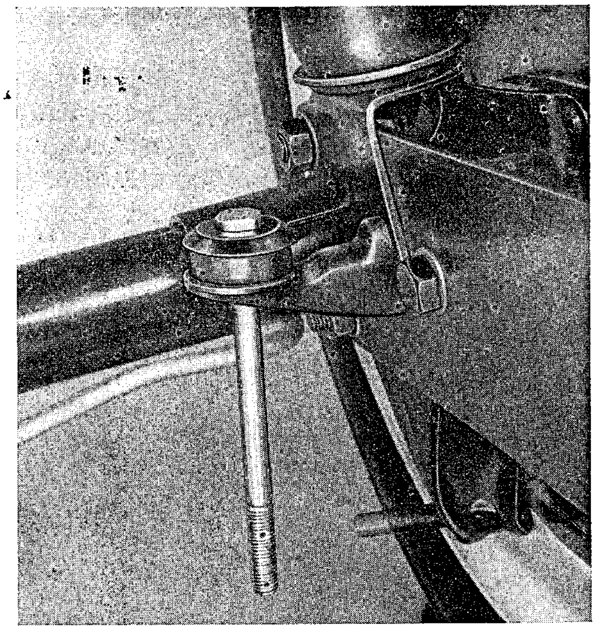


Fig. 5

5. Place rubber mount on center block of compensating spring.

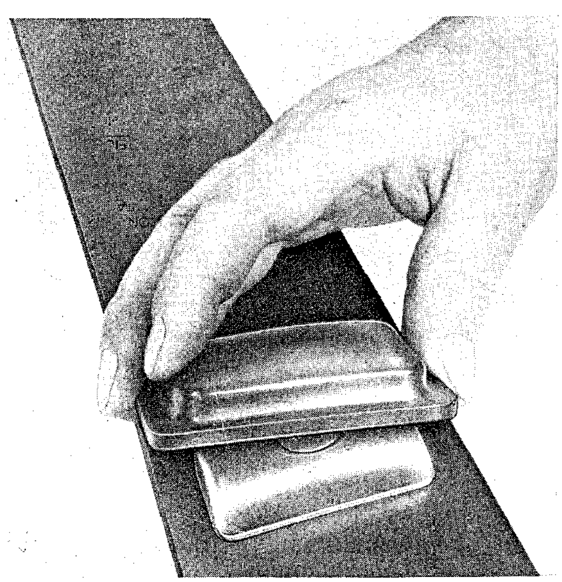


Fig. 6

6. Place the centering plate on the rubber support and install on tie bolt with a castle nut.

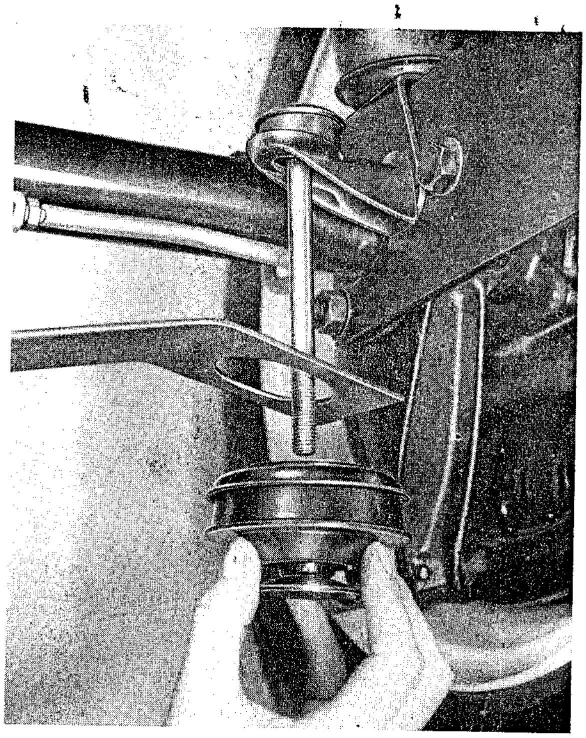


Fig. 7

7. Engage the rubber pad of the center block into the spring support and fasten the end of the compensating spring with centering plate, rubber mount and castle nut.

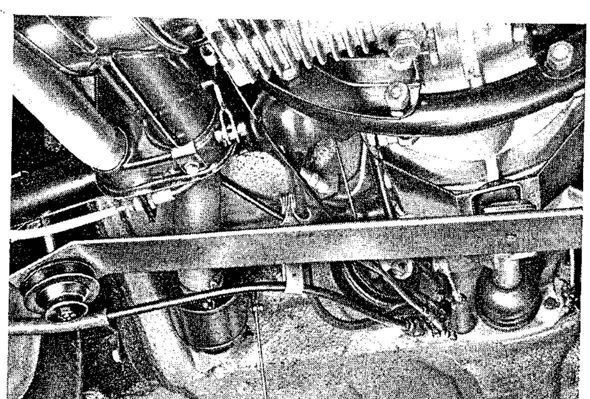


Fig. 8

Adjustment

1. For all models 1600, 1600 S, 1600 S-90 as well as Carrera having a dry weight of less than 900 kg (1980 lb.) the castel nut is positioned so that the lower cotter key bore is used.

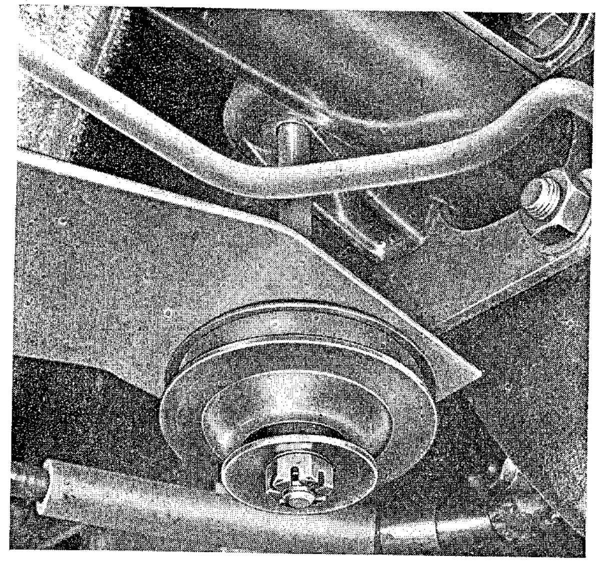


Fig. 9

2. For models over 900 kg (1980 lb.) such as Carrera de Luxe, the castle nut is positioned so that the upper cotter key bore is used.

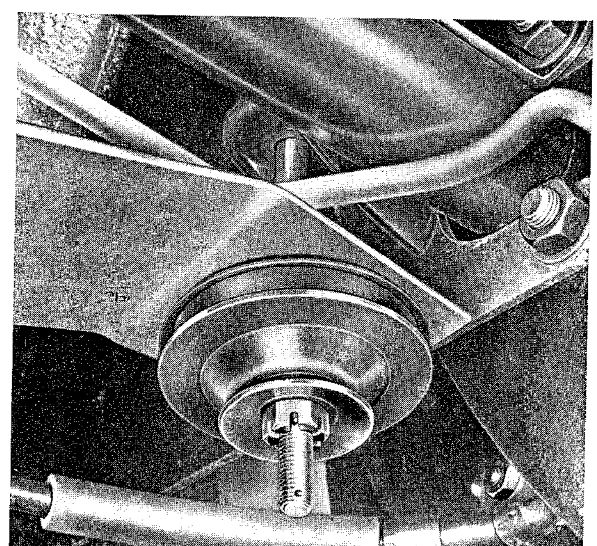


Fig. 10

Note

These compensating spring adjustments are to be observed when any rear axle work is performed. After making adjustments a new cotter key must be installed.

Gear Shift Lock

A theft proof gear shift lock can be installed in the following 356 B models beginning with identification number (chassis no.):

Coupe	110730
Cabriolet/Hardtop	153150
Roadster	87595

The gear shift lock is installed in the shift lever base directly behind the shift lever. The lock engages a collar on the shift shaft which enables the transmission to be locked in any gear.
The parts required are:

1 Lock with key	695.424.245.00	1 Lock collar	695.424.206.00
1 Coil spring	695.424.231.00	1 Roll pin	6 x 32 DIN 1481

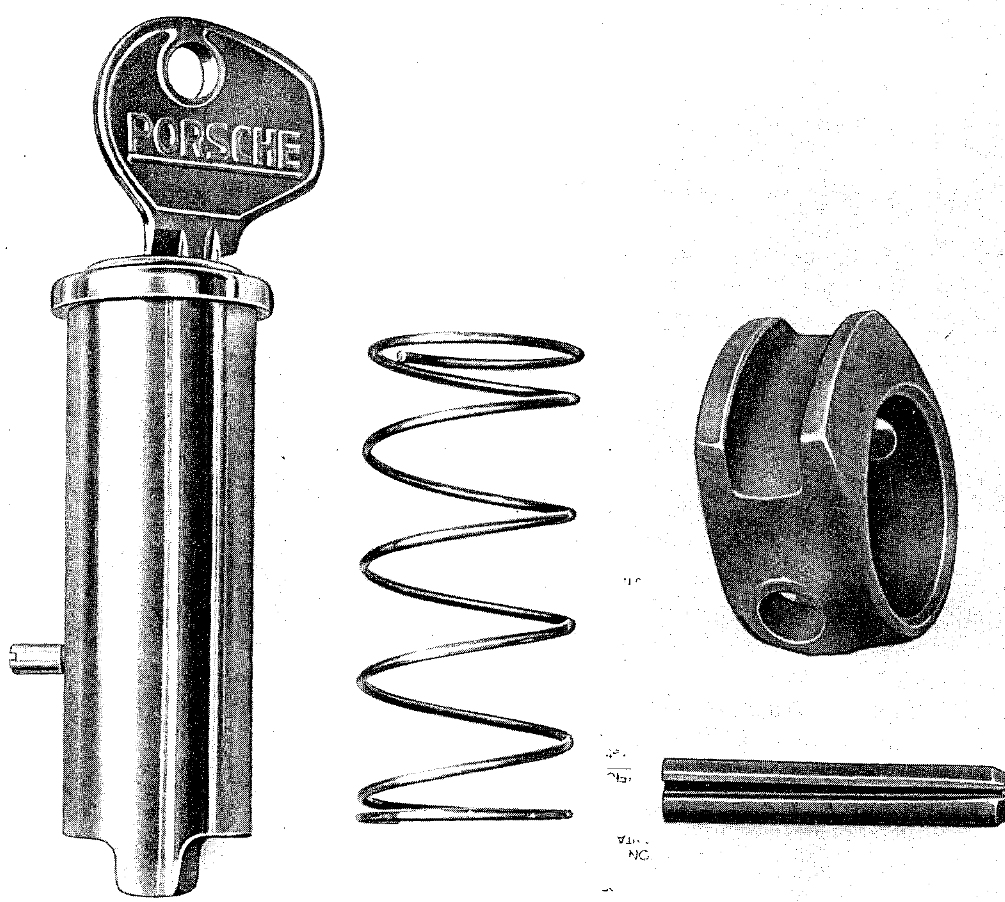


Fig. 1

Installation:

1. Move shift lever to neutral position.

2. Remove shift lever base, shift shaft and shift shaft guide (see Service Manual Supplement 356 B Section R).

3. Place lock collar on shift shaft and secure with roll pin.

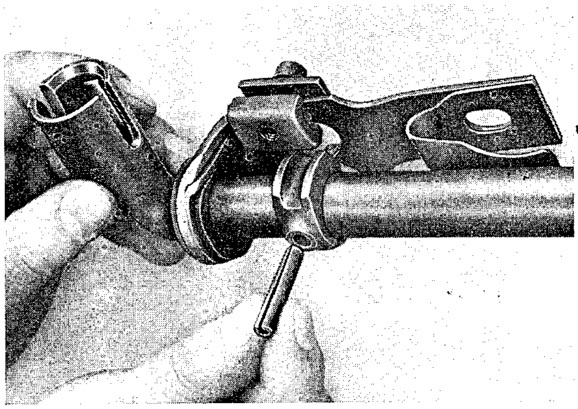


Fig. 2

4. Install shift shaft and shaft guide. Do not fully tighten the set screw on the rubber connector at the gearbox.

5. Align shift shaft guide and tighten allen screws.

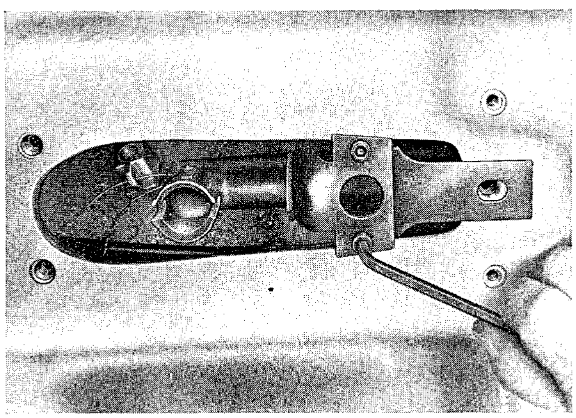


Fig. 3

6. Remove guide pin from side of lock and place coil spring in the bore of the shift lever base. Install lock.

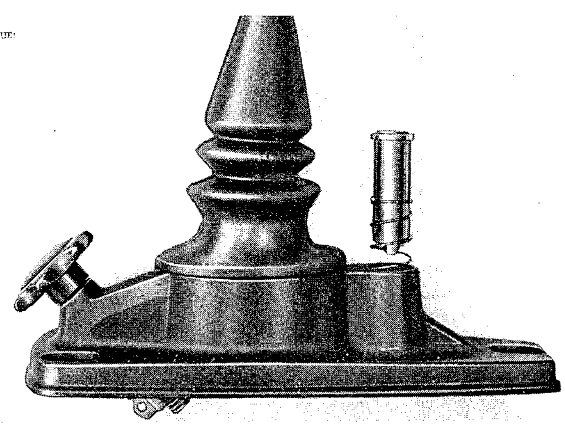


Fig. 4

7. Press the lock fully downward and install guide pin.

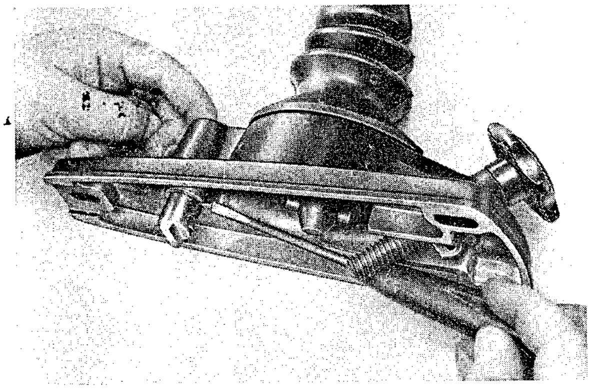


Fig. 5

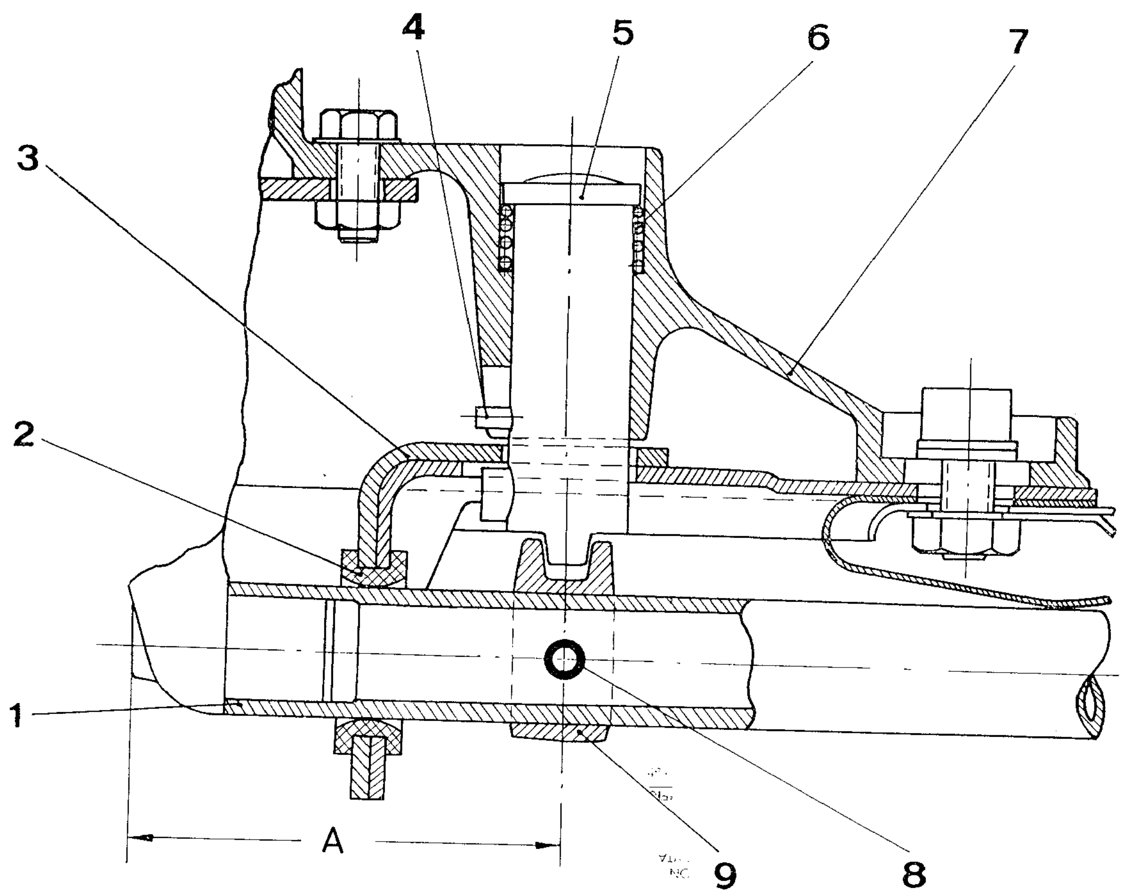
8. Install shift lever base (Service Manual Supplement Section R). Before securing the three allen screws, engage neutral and lock in position by pressing down lock cylinder and turning the key to the right.
Tighten allen screws.

9. Adjust shift linkage (Section R, page R 71). Tighten clamp bolt and replace rubber boot.

10. Test function of shift lock in all gears.

Shift Lever Base with Shift Lock (Section View):

① Shift shaft
② Support ring
③ Shift shaft guide
④ Guide pin
⑤ Lock
⑥ Coil spring
⑦ Shift lever base
⑧ Roll pin
⑨ Lock collar



A = 65.5 ± 0.2 mm

Fig. 6

Headrests

General

Two mounting brackets on the seat frame as shown below are standard on all seats so that headrests can be installed. The outer brackets are fastened to these inner mounts through the upholstery by two B 4.9 x 16 DIN 7973 screws each.

Dimensions

A = 15 mm

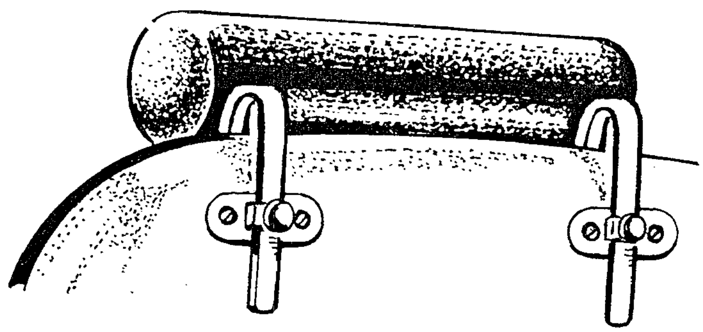
B = 8 mm

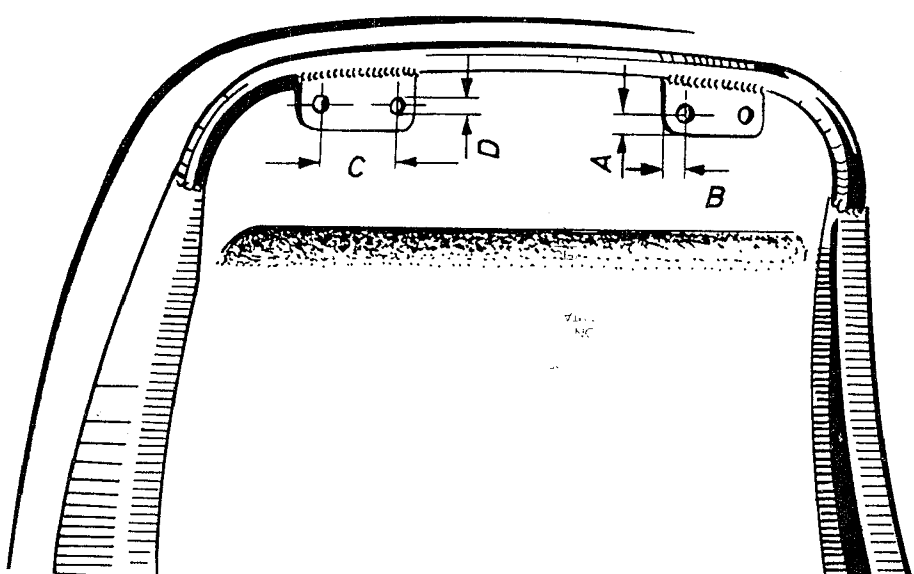
C = 44 mm

D = 3.5 mm dia.

Installation

1. Locate the inside brackets by pressing on the upholstery of the backrest.
2. Using a punch, locate the screw holes in the brackets.
3. Fasten the outer brackets with two screws each.
4. Install headrests and adjust position with the set screws.





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SECTIONS INDEX

FORWORD

All technical changes and improvements are published as supplements and are to be filed in the supplement binder of the 356 B workshop manual.

Changes and new pages have purposely not been issued as annexes to the existing manual in order to retain it as a fixed reference.

All supplements are changes which have been made since the publication of the complete manual.

Only operations which differ from the basic manual as a result of technical changes are described in the supplements.

An index, containing the main group headings without individual operations is supplied with the first supplements. The separate operations must be listed by the workshop as they are received. Only in the event of a large number of supplements will a more complete index be furnished.

Supplement pages are numbered consecutively and have the group identification letter as in the basic manual. To prevent the possibility of confusing these pages with those in the manual, the letter "S" is added to the page designation.

This binder, together with the basic manual, is intended to assist the workshops in maintening Porsche cars in accordance with the latest technical improvements.

DR.-ING. h. c. F. PORSCHE K.-G. · STUTTGART-ZUFFENHAUSEN

Register for Supplements - Workshop Manual 356 B

Please file the supplements in the Workshop Manual Supplement Folder and enter the filing date in the table below.

Supplement No.	Filing date	Signature
I-VI		
VII		
VIII		
IX		
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INDEX

Supplements for Group E: Engine and Clutch

Description of the 1600 S-90 Engine

General

The 1600 S-90 engine (intern 616/7) is a further development of the 1600 S engine. The following description is principally concerned with the new developments.

Crankcase

The crankcase is a light alloy three piece casting consisting of two crankcase halves and a timing case cover. The three sections are machined as a unit and must be replaced as such. It is possible to replace the timing case cover separately.

In order to prevent the split steel shell bearing inserts from turning in the crankcase, index grooves have been cut into the bearing bores (dowel pins in the 1600 S engine).

Two dowel sleeves have been installed in the crankcase at main bearing No. 2 in order to secure the two crankcase sections.

Crankshaft and Connecting Rods

The four connecting rods run on steel shell split insert bearings on the crankshaft.

The connecting rods have bronze piston pin bushings.

The crankshaft, which is supported on three steel shell split insert bearings and one sleeve type light alloy bearing, is mild-nitrated on all bearing surfaces (1600 S engine has 4 light alloy main bearings). Main bearing No. 4 may be replaced by removing the timing case cover and therefore does not require that the crankcase be disassembled. Main bearing No. 1 acts as crankshaft thrust bearing. The flywheel (1600 S-90 engine 6.5 kg = 14.4 lb.; 1600 S engine 8.7 kg = 19.2 lb.) with integral starter ring gear is fastened to the crankshaft by a central gland nut and eight dowel pins. Crankshaft main bearing journals 1, 2 and 3 are 55 mm in diameter (1600 S engine 50 mm). The timing and distributor pinions are secured to the crankshaft by a woodruff key. The V-belt pulley is also secured by a woodruff key and is bolted to the end of the crankshaft. The crankshaft is sealed by an oil seal at the flywheel end and at the pulley end by an oil seal and oil slinger ring.

Pistons

The light alloy pistons of the 1600 S-90 engine have 4 rings; the bottom ring being an oil control ring (1600 S engine, 3 rings). The piston pins are fully floating and are secured by lock rings in the pistons.

Cylinders

The cylinders of the 1600 S-90 engine are cast light alloy with flame sprayed carbon steel bore surfaces which have extremely good wear characteristics. (1600 S engine has light alloy cylinders with hard chromed bore surfaces.) For better heat transfer to the cooling air the finned cylinders are blackened.

Cylinder Heads

Each pair of cylinders carries a common, heavily finned, blackened, cylinder head of cast light alloy with shrunk in valve seats and guides. The spark plug sockets have Heli-Coil thread inserts. The valves are overhead in a "V". The diameter of the intake valve has been increased 2 mm over the size of the 1600 S engine valve. No gasket is employed for the cylinder to cylinder head joint. A ball check valve has been installed in the rocker box cover vents to prevent oil loss while traveling in curves.

Timing Gear

The camshaft is supported at three places directly in the crankcase without bearing inserts or bushings. The camshaft is driven by a cast, light alloy, helical, timing gear. The valves are operated from the camshaft through flat tappets, light alloy pushrods, and rocker arms. Each cam operates alternately a valve in each of two opposed cylinders. The exhaust valves are coated with high grade chrome-nickel steel.

Cooling System

The engine is cooled by blower circulated air. The blower is mounted on an extension of the generator shaft and is driven from the crankshaft by a V-belt. The blower draws air through an opening in the fan housing and forces it over the cooling fins on the cylinders and cylinder heads. The cooling air is guided by guides and duct plates to the lower air channel from which it either escapes to the atmosphere or is used as heating for the passenger compartment. The lower air channel has double outlet flaps (1600 S engine has only one) which, together with the inlet funnel on the fan housing, increase the air flow by 10 %.

V-Belt

The high grade small cross-section V-belt has blue markings and writing on its circumference in contrast to the ones used on the other models which are yellow.

Centrifugal Valve

In order to insure a constant oil supply from the sump even while the car is traveling in a high speed curve, a centrifugally actuated valve has been installed at the oil intake between the strainer and magnetic filter.

Longitudinal Section View of 1600 S-90 Engine

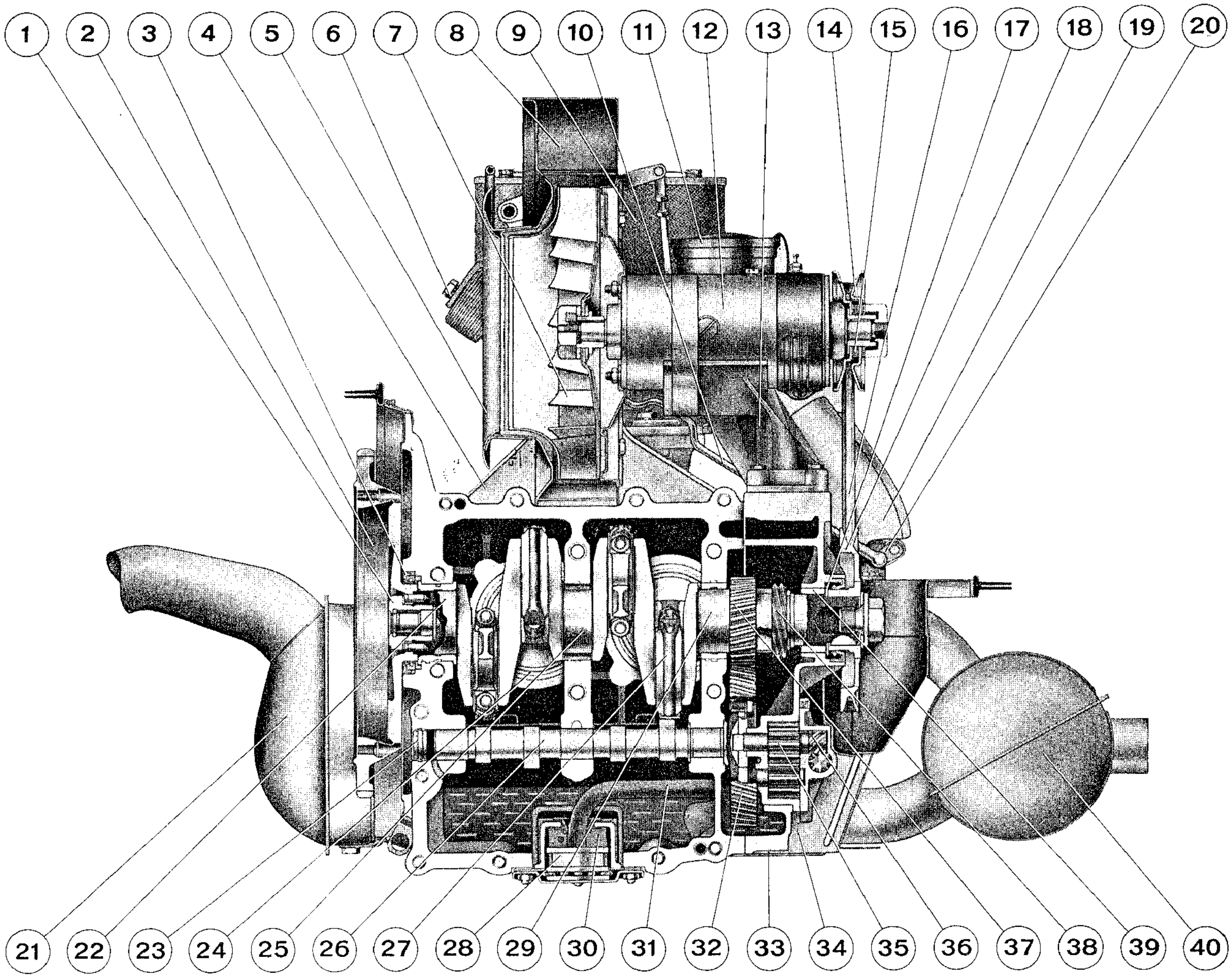

Fig. 1

1. Gland nut
2. Flywheel
3. Oil seal
4. Air guide plate
5. Cooling air inlet funnel
6. Engine compartment heater thermostat
7. Blower impeller
8. Fan housing
9. Metal mesh air filter
10. Engine compartment heater control rod
11. Oil filler cap
12. Generator
13. Generator bracket
14. Generator V-belt pulley
15. V-belt tension adjusting spacers
16. V-belt
17. Oil slinger washer
18. Crankshaft V-belt pulley
19. Duct for engine compartment heater
20. Engine compartment heater control lever
21. Heater junction box (heat exchanger)
22. Main bearing journal No. 1
23. Camshaft end plug
24. Piston and cylinder
25. Main bearing journal No. 2
26. Camshaft
27. Connecting rod bearing cap
28. Magnetic oil filter
29. Main bearing journal No. 3
30. Centrifugal valve
31. Oil suction pipe
32. Camshaft itming gear
33. Timing case cover
34. Lower air guide
35. Gear oil pump
36. Tachometer drive pinion
37. Timing pinion
38. Distributor drive gear
39. Main bearing No. 4
40. Muffler

Main Bearings

General

Main bearings 1, 2, and 3 are split, steel shell, insert bearings with bearing No. 1 (flywheel side) the crankshaft thrust bearing. These steel shell bearings are so called tri-metal bearings which consist of a steel shell, and a lead bronze base, a very thin layer of nickel, and the white metal bearing surface (0.02 to 0.025 mm thick). Besides the bearing layers a fine coat of lead alloy covers the entire insert to act as corrosion inhibitor, break-in surface, and an aid in sliding the insert into the bearing seat.

Bearing inserts are supplied to the repair shops ready to be installed. They are available in one crankshaft undersize and one crankcase seat oversize.

The crankshaft main bearings should always be replaced in complete sets.

The crankshaft must be sent to the factory to be reground on either the main or connecting rod journals. Lapping the bearing surfaces will damage the mild-nitrated surface and would result in rapid crankshaft wear. Therefore all crankshaft reworking must be done by the factory.

Removing and Installing Main Bearings

Removal

1. Disassemble crankcase.
2. Remove crankshaft.
3. Remove bearing inserts from the crankcase halves, and inspect whether white metal surface is reusable. If the lead bronze layer is visible a complete set of new main bearings should be installed.

Inspection

1. Clean crankcase and bearing seats thoroughly.
2. Assemble empty crankcase and tighten cap nuts to 4 mkg (29 ft. lb.) torque.
3. Using VW 247 gauge ring measure the bearing bores in the crankcase (for dimensions see SE 15).

Installation

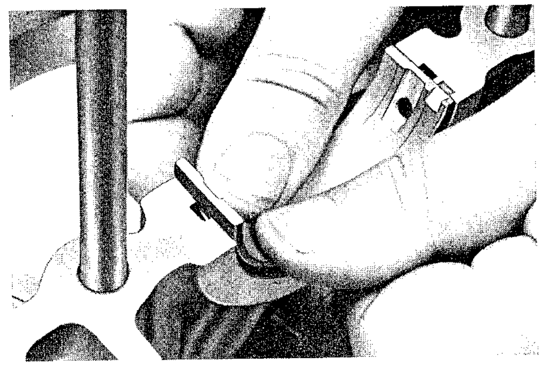

Fig. 2

Note

The bearing seats have an index recess into which the insert index fits in order to prevent the bearing from rotating in the crankcase.

1. Thoroughly clean the crankcase halves and insure that bearings, bearing seats, and oil passages are clean.
2. Install bearing insert at index first; then press firmly into place (Fig. 2).
3. Lay the crankshaft on the well oiled bearings observing the fit of the thrust faces at bearing No. 1. Apply a uniform thin coat of sealing compound to the crankcase joint allowing no compound to enter the bearing surfaces or into the oil passages. Install right crankcase half and tighten cap nuts to the prescribed torque.
4. Turn crankshaft and check free rotation.

Adjusting End Play

General

The end play (new installation) for the 1600 S-90 engine is 0.10 to 0.18 mm. To achive the correct clearance, five sizes of thrust washers are available.

Size A = 2.80 mm

Size B = 2.85 mm

Size C = 2.90 mm

Size D = 2.95 mm

Size E = 3.00 mm

The thrust washers are marked with a letter indicating the size group.

1. Install bearing inserts into both crankcase halves.
2. Install the crankshaft in the well oiled bearings.
3. Place the thrust washer on the end of the installed crankshaft.

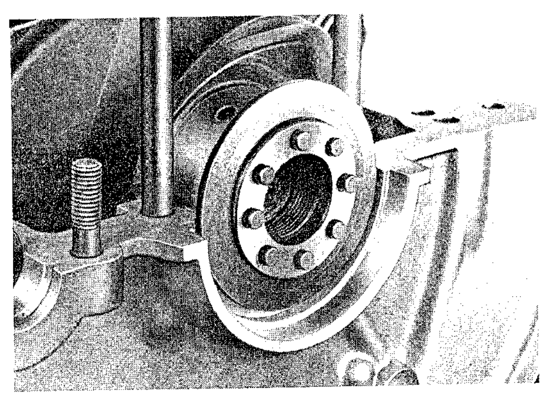

Fig. 3

4. Install the right crankcase half and tighten the cap nuts to the prescribed torque.

5. Install a soft iron gasket on the crankshaft and bolt the flywheel to crankshaft with 45 to 50 mkg (326 to 363 ft. lb.) torque.

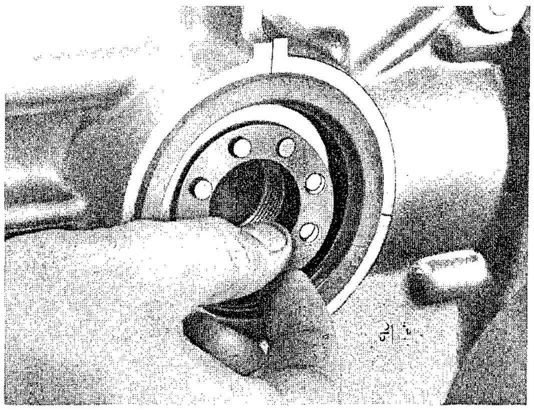

Fig. 4

6. Attach special tool P 17 and dial gauge to the crankcase flange so that the feeler of the dial gauge contacts the rim of the flywheel and travels parallel to the crankshaft.

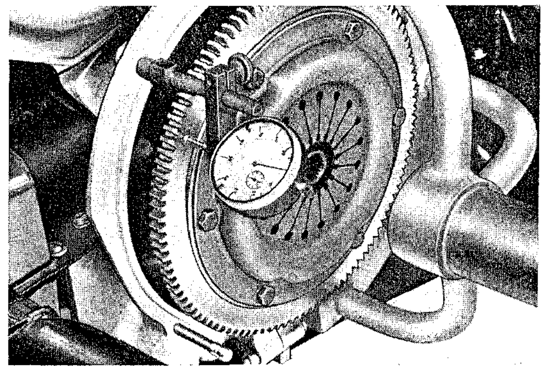

Fig. 5

7. Measure end play by moving the crankshaft axially in both directions. Correct the end play by installing a thinner or thicker thrust washer as required.

Removing and Installing Valves

Inspecting Valve Springs

A 5% deviation from the listed pressures is permissible in the case of used springs.
It is desirable that the valve springs of the 1600 S-90 engine have a pressure of at least 94 kg (208 lb.) at a compressed length of 30.15 mm.
These valve springs have been installed in all 356 B engines for some time and replace those mentioned in the basic manual having a free length of 47 mm. Only valve springs of the same type and free length should be installed in one engine due to their different spring characteristics.

Testing Installed Length

Note

The intake and exhaust valve springs are of equal length. The difference in the installed length is obtained by the use of spacer washers. All the valve springs of the 1600 S-90 engine have an additional 1.5 mm steel washer to increase the spring pressure.

Important

The valve springs must not bear on the shims but must always seat on the steel washer. The springs will damage the shims if they are not protected by the steel washer.

Free length		49 mm	1.929 in.	
Cross-section dia.		4,5 mm	.177 in.	
Pressure at 41 mm, 1.614 in. Compressed length	35 kg	+ 2,5 kg – 1.0 kg	77.3 lb.	+ 5.5 lb. – 2.2 lb.
Pressure at 30.15 mm 1.187 in. Compressed length	93 kg	+ 7 kg – 3 kg	205.5 lb.	+ 20 lb. – 6.6 lb.

1. Install special tool P 10 in the cylinder head together with the corresponding valve, spring retainer, and keepers.

Installed length for intake valve springs	**41.0 mm 1.614 in.**
Installed length for exhaust valve springs	**40.0 mm 1.575 in.**

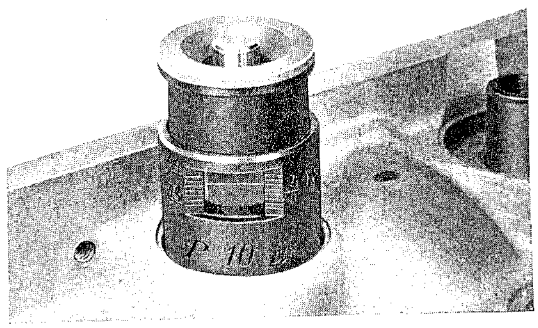

Fig. 6

2. Adjust with shims until the correct length is obtained.

3. Install valve springs so that the closely wound coils are nearest the cylinder head and rest on the steel washer (Fig. 7).

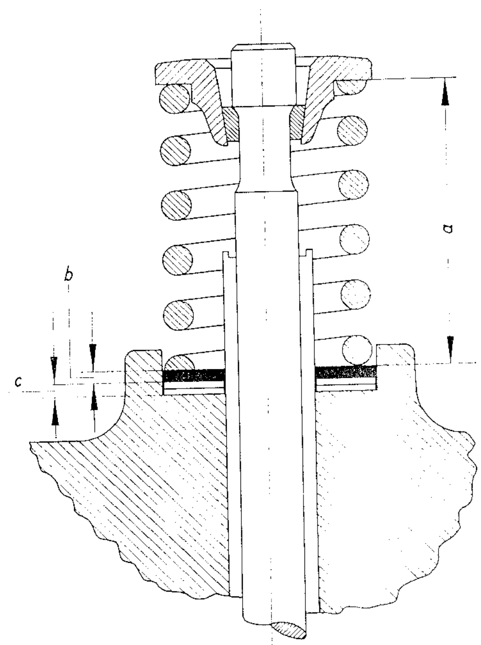

Fig. 7

a = Installed length
b = Steel washer
c = Shims

Lower Air Channel

In order to increase the flow of cooling air of the 1600 S-90 engine, a specially designed lower air channel having two outlet flaps and an intake funnel for the fan housing have been incorporated in the cooling system.

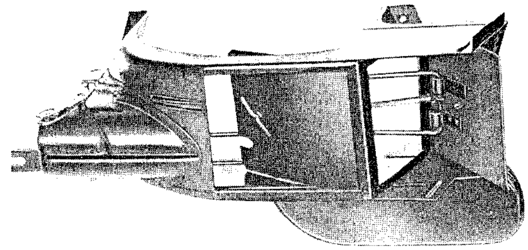

Fig. 8

Inspecting Cylinders

The 1600 S-90 engine is equipped with light alloy cylinders with ferral bore surfaces. The following size group table is valid for the 1600 S-90 engine only.

Size group divisions

Group	Cylinder Dia mm	Piston Dia. mm
A	82.460-82.465	82.430-82.435
B	82.465-82.470	82.435-82.440
C	82.470-82.475	82.440-82.445
D	82.475-82.480	82.445-82.450
E	82.480-82.485	82.450-82.455
F	82.485-82.490	82.455-82.460
G	82.490-82.495	82.460-82.465
H	82.495-82.500	82.465-82.470
I	82.500-82.505	82.470-82.475
K	82.505-82.510	82.475-82.480

Matching cylinder and piston pairs are marked with the same letter. The cylinders are marked at the base while the pistons are marked on the face.

Only cylinders and pistons of the same size group are to be matched.

Matching cylinder and piston pairs are marked with the same letter. The cylinders are marked at the base while the pistons are marked on the crown. Only cylinders and pistons of the same size group are to be matched. Cylinders must be measured using an inside micrometer and gauge ring P 13 c.

Cylinder measurement should be taken approximately 30 mm (13/16 in.) from the bottom of the bore.

Piston cylinder clearance, new, should be from 0.025 to 0.035 mm (.00098 to .00138 in.). The wear limit is 0.1 mm (.00394 in.).

Cylinders approaching the wear limit should be replaced together with their pistons by new pairs of the same size group. Within one engine it is permissible to have a size group difference of not more than four, i. e. A and D sizes may be used, but not A and E.

Note

Cylinder heights between the base and the cylinder head mounting surface are available in four height groups.

Only cylinders of the same height group may be installed under a common cylinder head. The height group is marked on the cylinder base in an equilateral taringle next to the size group with a 5, 6, 7, or 8.

Installing Piston Rings

When installing piston rings observe the "TOP" marking. The top marking as well as the inside bevel on the compression rings must be up or toward the piston crown. The first compression ring is made of a specially hard alloy and is distinguishable by the marking "E 120" next to the word "TOP". This ring must not be installed in the other grooves (Fig. 9).

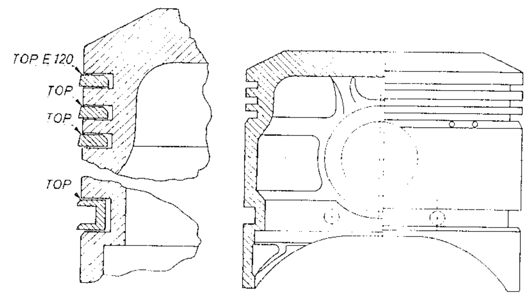

Fig. 9

Measuring Points and Markings of Pistons

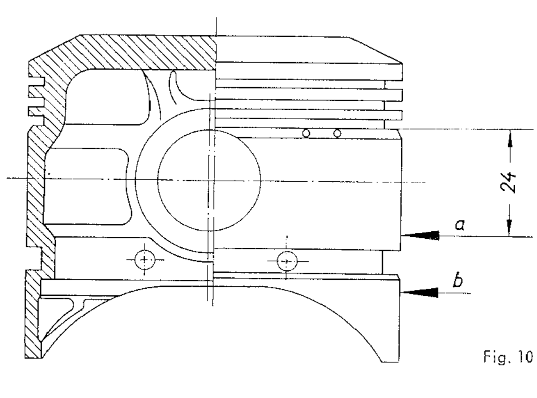

Fig. 10

1600 S-90 Engine

Nominal piston diameter 82.5 mm

Characteristic features:

Broad bevel around high piston crown.

Three compression rings above the piston pin and one oil control ring below the piston pin.

Nominal diameter measuring point at arrows "a" and "b".

For piston dimension see page SE 9.

9. Rotate the crankshaft pully one half revolution (exactly 180°) counter clockwise and adjust the valves of cylinder II.

10. Procede likewise for the remaining cylinders.

11. Clean the rocker box covers with solvent and inspect the cork gasket. Replace the gasket if required.

12. Test the free movement of the ball check valve and correct deficiencies.

13. Install rocker box covers.

14. Start engine and check for oil leaks.

Adjusting Ignition Timing

General

The ignition point is 3° before TDC or approx. 3.6 mm (9/64 in.) at the rim of the crankshaft pulley measured in the direction of rotation (marked with a pencil). This mark is then aligned with the mark on the crankcase with the distributor rotor pointing toward the notch in the distributor housing.

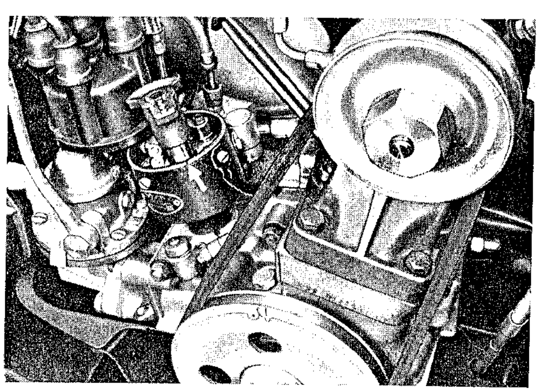

Fig. 13

Adjusting

1. Remove the distributor cover and bring the engine and distributor to the timing mark for cylinder I (3° BTDC or 3.6 mm, 9/64 in. at pulley rim).
2. Loosen clamping bolt at distributor base.
3. Connect one lead of a 6 V test lamp to terminal one on the distributor housing and the other to ground.
4. Switch on ignition.
5. Rotate distributor clockwise until the breaker contacts close (lamp goes out), then rotate counter clockwise until the test lamp lights and hold at the exact position.
6. Tighten clamp.
7. Install distributor cap.

Note

The ignition timing of all four cylinders is correct if the test lamp lights exactly when the pencil mark, 3° or 3.6 mm (9/64 in.) before TDC comes in line with the crankcase mark while the crankshaft is slowly rotated clockwise.

Centrifugal Valve

General

The centrifugal valve insures that the oil suction pipe, and therefore the lubrication system, receves oil even while traveling in fast curves.

Operation

Two valves, which are attached to the ends of a common sliding stem, open alternately to either side. In a curve the sliding valves move toward the outside of the curve just as the oil in the sump does. The closed valve prevents air from entering the suction pipe while the open valve remains submerged in oil.

Removal

1. Remove 10 nuts securing the sump plate.
2. Remove sump cover with magnetic filter.
3. Remove gaskets, centrifugal valve assembly, and oil strainer
4. Clean all parts using solvent.

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. The oil suction pipe must seat firmly in the crankcase.
2. Clean the crankcase seating surface removing old gasket material.
3. Use three new gaskets.
4. The centrifugal valve must move freely and seat properly in the housing.
5. The strainer must fit easely in the grooves of the centrifugal valve body.
6. Install centrifugal valve assembly with oil strainer so that the sliding valve is offset to the rear (to the muffler).
7. Install sump plate with the magnetic filter and new gasket.
8. Tighten 10 nuts uniformly.

Section view of oil strainer with magnetic oil filter and centrifugal valve

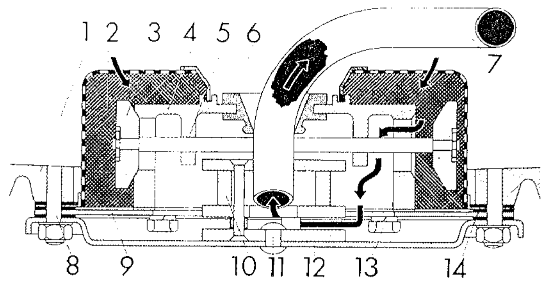

Fig. 14

1. Crankcase
2. Oil strainer
3. Valve
4. Centrifugal valve housing
5. Common valve stem
6. Oil suction pipe gromet
7. Oil suction pipe
8. Stud
9. Base plate
10. Magnetic oil filter
11. Magnetic filter retaining rivet in sump plate
12. Oil sump plate
13. Cap screw for fastening valve housing to base plate
14. Gasket

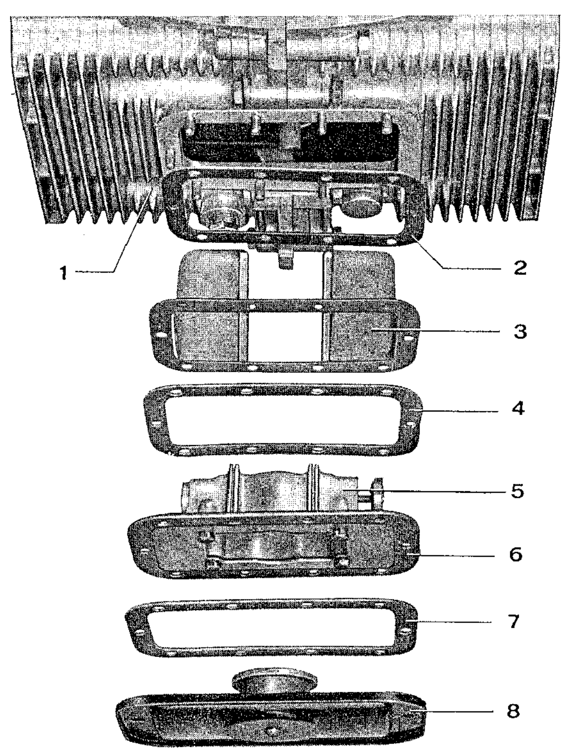

Fig. 15

1. Crankcase
2. Gasket
3. Oil strainer
4. Gasket
5. Housing with centrifugal valve
6. Base plate
7. Gasket
8. Oil sump plate with magnetic filter

Ball Check Valve in Rocker Box Covers

A ball check valve has been installed in the rocker box covers to prevent oil loss through the breather hole while traveling in fast curves. The check valve should be cleaned with solvent and inspected for proper operation when the valve clearance is adjusted. Disassemble and clean the valve if necessary.

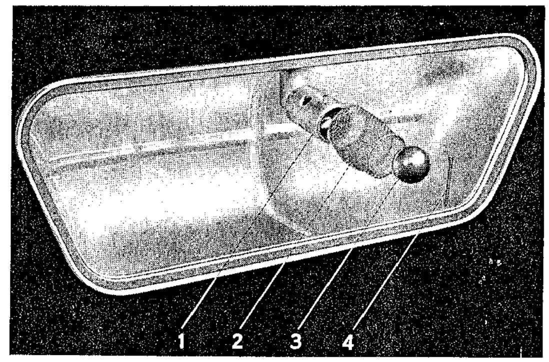

Fig. 16

① Valve housing
② Screen
③ Ball
④ Cotter key

Crankshaft and Main Bearing Dimensions for 1600 S-90 Engines

Main Bearings

Item	Type		Bearings 1, 2 and 3 mm
Journal	standard	diameter	54.990 - 54.971
Bearing	int. dia. standard ext. dia. standard	wall thickness	2.615 - 2.603
Crankcase bore	standard	diameter	60.24 ± 0.005
Journal	standard	diameter	54.990 - 54.971
Bearing	int. dia. standard ext. dia. oversize	wall thickness	2.740 - 2.728
Crankcase bore	for oversize bearing	diameter	60.49 ± 0.005
Journal	1. undersize	diameter	54.740 - 54.721
Bearing	int. dia. undersize ext. dia. standard	wall thickness	2.740 - 2.728
Crankcase bore	standard	diameter	60.24 ± 0.005
Journal	1. undersize	diameter	54.740 - 54.721
Bearing	int. dia. undersize ext. dia. oversize	wall thickness	2.865 - 2.853
Crankcase bore	for oversize bearing	diameter	60.49 ± 0.005
Journal	2. undersize	diameter	54.490 - 54.471
Bearing	int. dia. undersize ext. dia. standard	wall thickness	2.865 - 2.853
Crankcase bore	standard	diameter	64.24 ± 0.005
Journal	2. undersize	diameter	54.490 - 54.471
Bearing	int. dia. undersize ext. dia. oversize	wall thickness	2.990 - 2.978
Crankcase bore	for oversize bearing	diameter	60.49 ± 0.005

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Crankshaft and Main Bearing Dimensions for 1600 S-90 Engines

Main Bearings

Item	Type		Bearings 1, 2 and 3 mm
Journal	3. undersize	diameter	54.240 - 54.221
Bearing	int. dia. undersize ext. dia. standard	wall thickness	2.990 - 2.978
Crankcase bore	standard	diameter	60.24 ± 0.005
Journal	3. undersize	diameter	54.240 - 54.221
Bearing	int. dia. undersize ext. dia. oversize	wall thickness	3.115 - 3.103
Crankcase bore	for oversize bearing	diameter	60.49 ± 0.005

Crankshaft journal and insert dimensions for main bearing No. 4 as well as crankshaft journal and insert dimensions for connecting rod bearing are the same as for 1600 and 1600 S engines.

Crankshafts for 1600 S-90 engines can only be regrinded at the factory and/or obtained through the exchange service, as these crankshafts demand a special treatment of material.

Undersize bearings are available as spare parts. When ordering note whether the crankcase bores are standard or oversize.

Measuring point for wall thickness of bearing inserts.

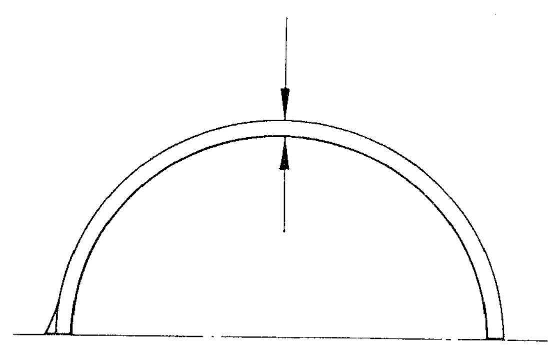
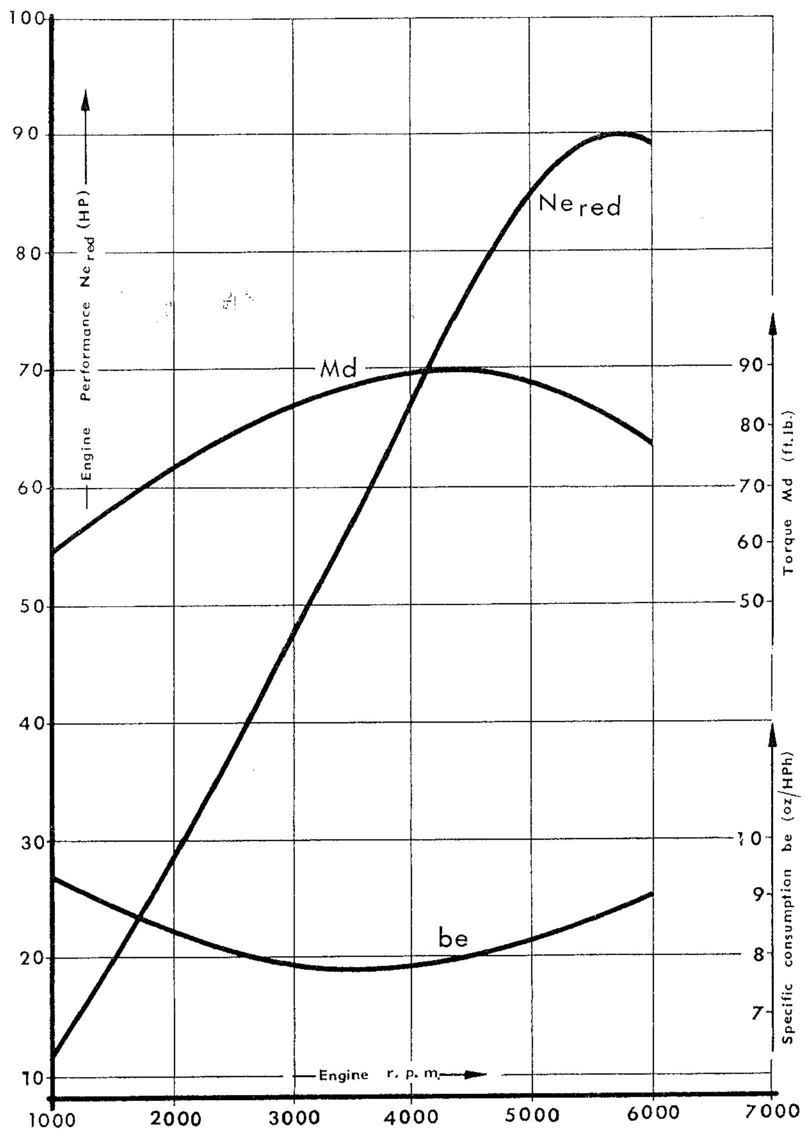
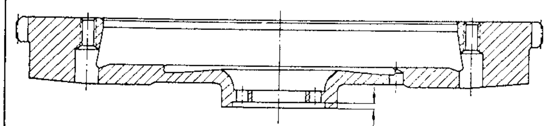
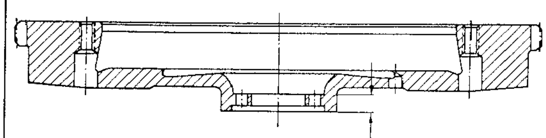


Fig. 17

Performance and Fuel Consumption 1600 S-90 Engine (DIN HP)



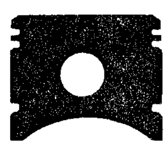
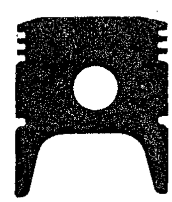
Measuring Point	Tolerance (new) mm	Wear Limit mm	
7. Flywheel Depth of flywheel recess	2.10 – 2.15	–	
8. Oil seal bearing surface width	8.250 – 9.250	–	
9. Valve springs Free length Installed length exhaust intake	 49.00 41.00 40.00		See Fig. 7 Page SE 8

TYPE 1600 S ENGINE

(Reference 616 / 12)

The type 1600 S engine (Ref. No. 616/2) has been modified to a certain extent and will be referred to as No. 616/12. The modifications apply to engines commencing with Engine Serial No. 700 001.

The following charts show the extent of changes made.

616/2 Engine	Characteristic	616/12 Engine	Characteristic
Light alloy cylinders	See text	Cast iron cylinders	See text
Piston with 2 compression rings and 1 oil control ring.		Pistons with 3 identical compression rings and 1 oil control ring.	
Fan housing with screened air intake.	See text	Fan housing with air funnel without screen. *	See text
Fuel line.		Contoured fuel line for installation with fan housing with air funnel. *	See text
Light - alloy pushrods.		Pushrods combined of light - alloy and steel.	

* This modification also applies to the engine type 1600

616/2 Engine	Characteristic	616 / 12 Engine	Characteristic
Oil cooler without air baffles between cooling tubes.	See text	Oil cooler with reinforced base plate and air baffles between cooling tubes.	See text
Right and left bell - crank support brackets welded to fan housing.	See text	Left bell-crank support welded to air blower housing, right support of spring steel, bolted to fan housing. *	See text
Valve clearance: Inlet 0.15 mm (.006 in.) Exhaust 0.10 mm (.004 in.)		Valve clearance: Inlet 0.10 mm (.004 in.) Exhaust 0.15 mm (.006 in.)	
Cooling air outlet duct with one gate.	See text	Cooling air outlet duct with two gates.	See text
Rocker box cover without ball valve.	See text	Rocker box cover with ball valve.	See text

* This modification also applies to Type 1600 and 1600 S - 90 engines

TIMING GEAR BACKLASH

Engine Types 1600, 1600 S, and 1600 S-90

Installation tolerance (new) for backlash between the timing gear and crankshaft gear has been changed to 0.015 - 0.025 mm (.0006 to .0010 in.). This tolerance must be maintained when repairing any engine with the 3-piece crankcase.

CONNECTING ROD BEARING INSERTS

The Type

1600	engines - beginning with engine No.	P-606 801
1600 S	engines - beginning with engine No.	P-700 001
1600 S-90	engines - beginning with engine No.	P-804 001

will be equipped with modified connecting rod bearing inserts. The spare part number for this new type has not been changed. The modified connecting rod bearing inserts are not readily reconizable.

The main feature of this modification is that the bearing inserts are by 0.02 to 0.035 mm thinner for a length of 7 mm, starting from the mating surfaces of both bearing inserts (see Fig. 2).

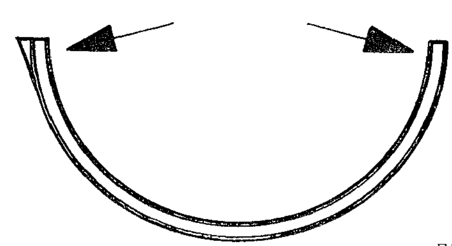


Fig. 2

It is important to make sure that only the modified bearing inserts are used for the Type 1600 S - 90 engines.

C L U T C H

Commencing with Engine-Nr. 804 001 , the 1600-S 90 engines(Ref. Nr. 616 / 7) will be equipped with the A-12 HAEUSSERMANN clutch. The following table indicates the extent of changes made.

A-10 Clutch	Characteristic	A-12 Clutch	Characteristic
Clutch disc facing outside diameter 179 - 181 mm	See text	Clutch disc facing outside diameter 199-201 mm	See text
Clutch disc facing inside diameter 124 - 125 mm	See text	Clutch disc facing inside diameter 130 - 131 mm	See text
Clutch disc facing thick - ness without load, 9.1 - 9.5 mm	See text	Clutch disc facing thick - ness without load, 9.7 - 10.1 mm	See text
Clutch disc facing thick - ness underload, 8.2 - 8.6mm Wear tolerance 7.5 mm	See text	Clutch disc facing thick - ness under load, 9.0 - 9.4 mm, Wear tolerance 8.0 mm.	See text
Disc spring Code Nr. 692	See text	Disc spring Code - Nr. 692 / 3 A	See text

The description and outline of service operations presented in the basic volume of the 356 B Service Manual remains same with the exception that changed specifications must be noted.

In this connection we again wish to stress the following:

Permature clutch slippage may often be attributed not to mechanical wear but to abnormal dragg in the pivot points of the disc spring.

When encountering clutch slippage, or when access to clutch is gained as a result of a service operation, the following work should be performed:

1. Check if pivot points of disc spring are well lubricated with grease containing molybdenum-sulphide additives. If the points are not sufficiently lubricated, disassemble clutch and thoroughly clean it.
2. Grease all pivot points of clutch disc spring (See Fig. 1).
3. Assemble clutch. Check tolerances and correct deficiencies, if noted (refer to service operation 60-MO, Group M, basic volume of 356 B Service Manual).

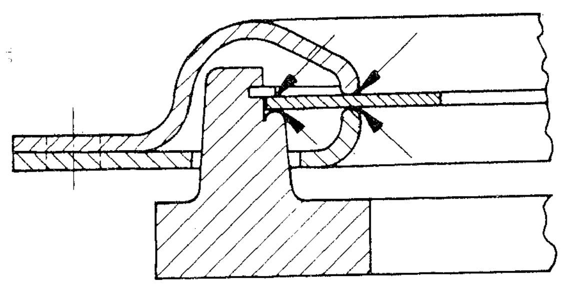


Fig. 1

Heating System Type 356 B/ T 6, Acceptance Code No. S 50

(This heating system is being manufactured on account of a legal regulation for Western Germany)

Description of the 356 B/ T 6 Heating System

The entire fresh air supply enters through slots in the engine compartment lid (1), being drawn in by the cooling air blower. Part of the fresh air flow, required for heating of the passenger compartment, is diverted from the cooling air blower (2) into a separate duct (3).

The fresh air (outside air) flows from the supply duct through the two heat exchangers (4) at the engine. The heat exchangers consist of closed sheetmetal jackets which enclose the exhaust pipes (5). All detachable and welded joints of the exhaust system (6) have been excluded from the confines of the heat exchanger jackets.

The heating air flows from both heat exchangers through connecting hoses (7), air gates (8), guide ducts (9), and silencers included within the longitudinal chassis support members, to outlets which are arranged in pairs.

Warm air outlets are provided as follows:
For defrosting windshield (11) and the rear window (12) by way of defroster nozzles.
For the forward leg area (pedal area) by way of sliding gates (13) located alongside the longitudinal chassis supports next to both seats.

The air gates (8) are so designed as to permit a continuous flow of air through the heat exchangers (over the exhaust pipes) regardless whether the heat is turned on or off.

Additionally, cold outside air may be let in through the ventilating system (14) in front of the windshield, independently of the car's heating system.

The heater is controlled by a turning knob located in front of the gearshift lever.

By turning the knob counter-clockwise, the heater is turned on; it is turned off by turning the knob clockwise. When the knob is turned, control flaps in the air gates (8) are actuated by way of cables. Should the control cable break, the hot air flow automatically shuts off and, simultaneously, the safety outlet opens up.

Sliding gates (13) are provided for the forward leg room and are located on the right and left inboard sides of the longitudinal support members next to the front seats. Part of the inflowing warm air, namely that flowing to the leg area, may thus be regulated or completely shut off.

When the sliding gate is pushed forward, the air outlet for the leg area is shut off.

When the sliding gate is closed, the entire warm air supply enters the passenger compartment through the defroster nozzles (11 and 12).

Additional ventilation is possible through the ventilating system (14) which is controlled by means of control levers mounted on the dashboard.

Caution!

To ensure proper cooling of engine, a certain amount of backpressure must exist within the heating system, which is achieved -with the engine installed -through the existence of heating ducts and air gates.

Therefore, when running performance tests on engines which are dismounted from the car, it is absolutely essential to create a backpressure within the heating system.

Proper backpressure may be maintained on dismounted engines by installing an air flow restrictor cap on the hot air discharge ducts of the heat exchangers; the caps are fastened to the heat exchangers by hose clamps.

Reference Fig. 1 for specifications for local manufacture of restrictor caps.

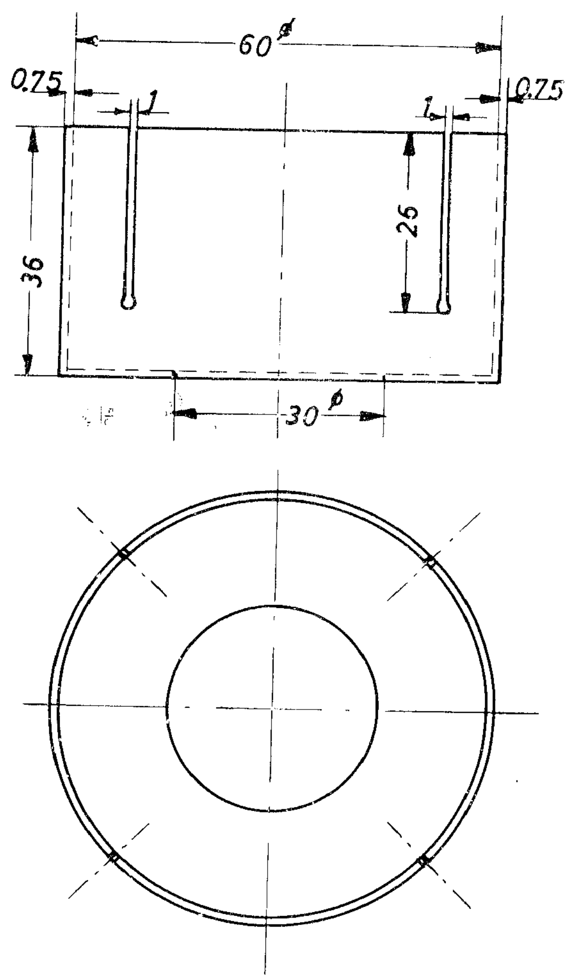


Fig. 1

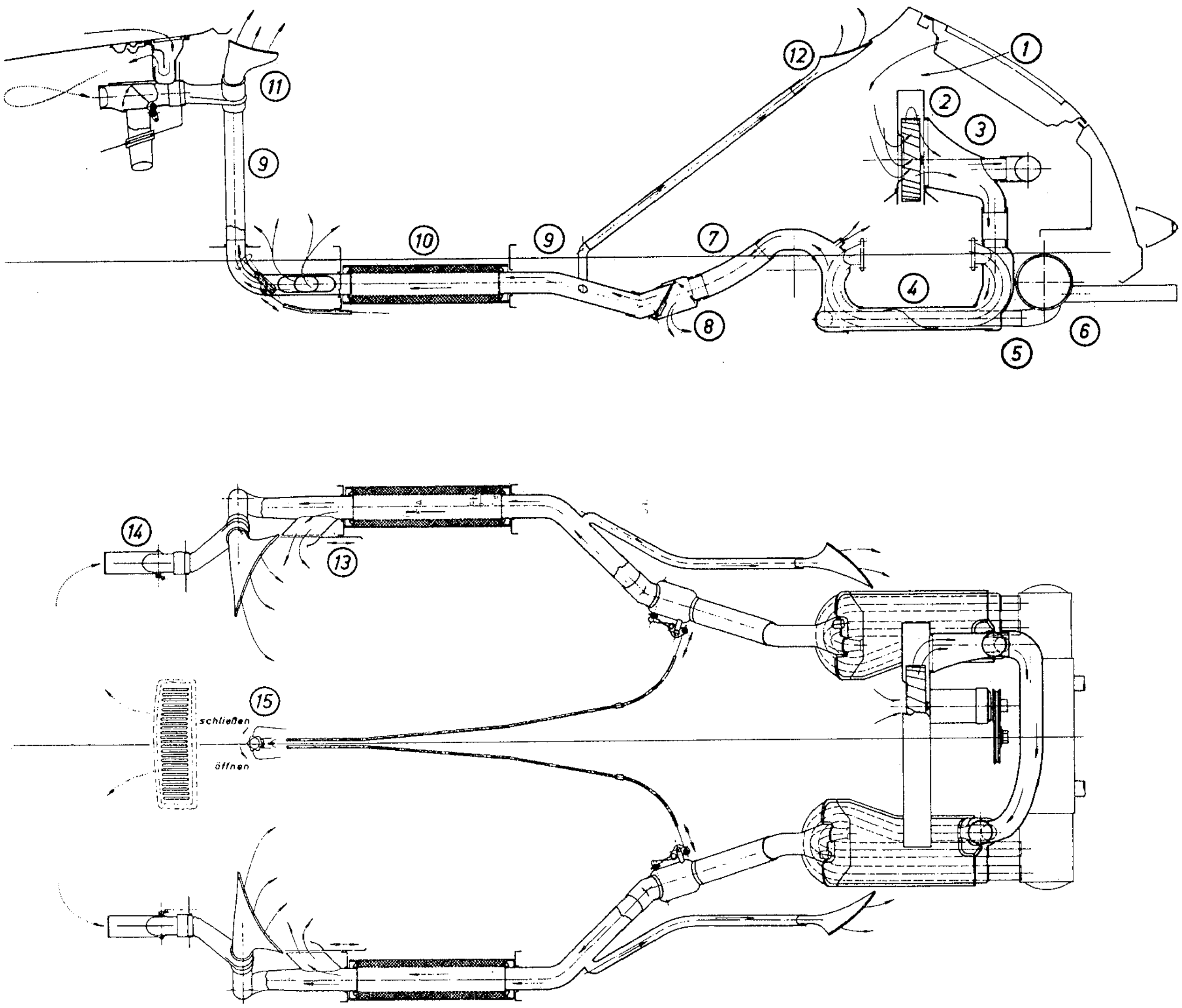


Fig. 2

Schematic View of Type 356 B/ T 6 Heating System

1 Engine compartment lid
2 Cooling air blower
3 Connecting duct
4 Heat exchangers
5 Exhaust pipes
6 Exhaust muffler
7 Connecting hoses
8 Air gates
9 Duct tubes
10 Silencers
11 Defroster nozzles, windshield
12 Defroster nozzles, rear window
13 Sliding gate, leg room
14 Ventilating system
15 Turning knob

Removing and Installing Engine

Note: As a result of the introduction of the 356 B/T 6 heating system, certain changes ensued in the engine removal and installation procedures.

Removal

1. Jack up car or place it on stand.
2. Disconnect battery terminal cables.
3. Shut off fuel valve.
4. Raise engine compartment lid.
5. Disconnect heater air hose in engine compartment.

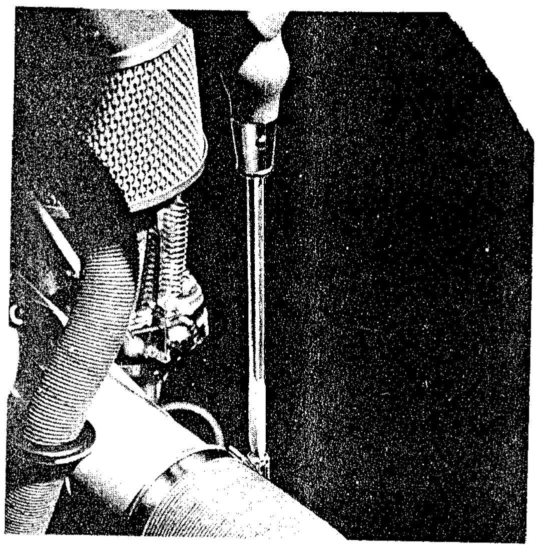


Fig. 3

6. Detach connecting duct from air blower housing (ref. page SE 37).
7. Remove fuel pump shield.

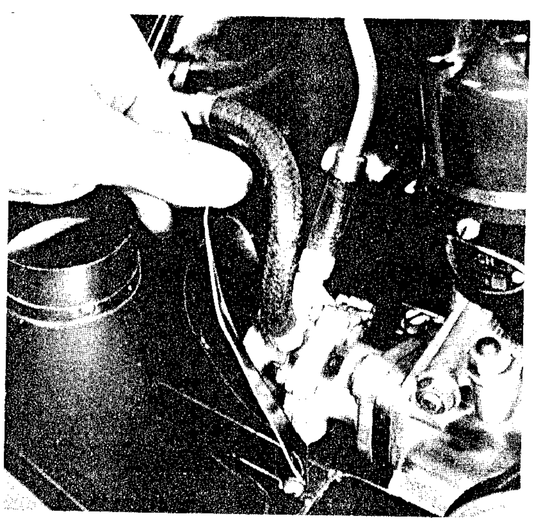


Fig. 4

8. Remove retaining screws from rear engine cover plate and pull it up diagonally.

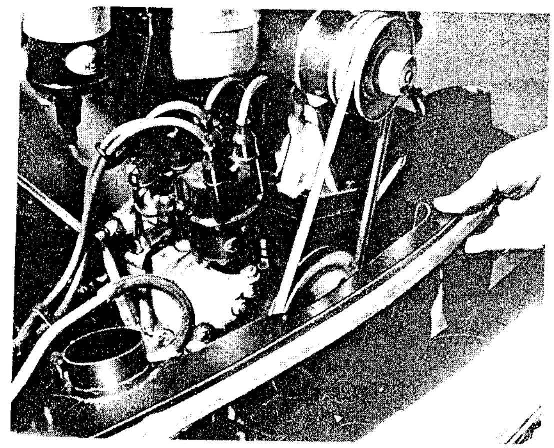


Fig. 5

9. Pull out cable connecting oil temperature sender (black/green).
10. Disconnect (black) lead from ignition coil (Terminal 15).
11. Disconnect (green) lead from oil pressure sender.
12. Disconnect generator leads D- (yellow/white), DF (black), and D+ (red).
13. Detach ball joint throttle linkage and pull it out downward.

Fig. 6

14. Loosen both heater flex hoses from engine.
15. Loosen tail pipe clamp screws at muffler and remove tail pipes.
16. Disconnect fuel line by sliding hose off tubing.
17. Detach tachometer drive.
18. Remove two engine mounting nuts from lower mounting studs.
19. Place dolly or engine jack under engine.
20. Hold two upper engine mounting bolts and have assistant remove the nuts.
21. When using a dolly: lower the car until engine comes to rest on dolly.
    When using an engine jack: raise jack until engine rests on its platform.
22. Move engine away from the gearbox until mainshaft clears the clutch plate.
23. Lower the engine and pull it out to the rear.

Installation

The engine is installed in reversed order of the above, following instructions outlined on page E 6, Section 1 EN; however, points 11 and 12 should be disregarded.

Removing and installing muffler

Removal

1. Loosen exhaust pipe clamps at muffler and remove tail pipe extensions.
2. Loosen clamp bolts.

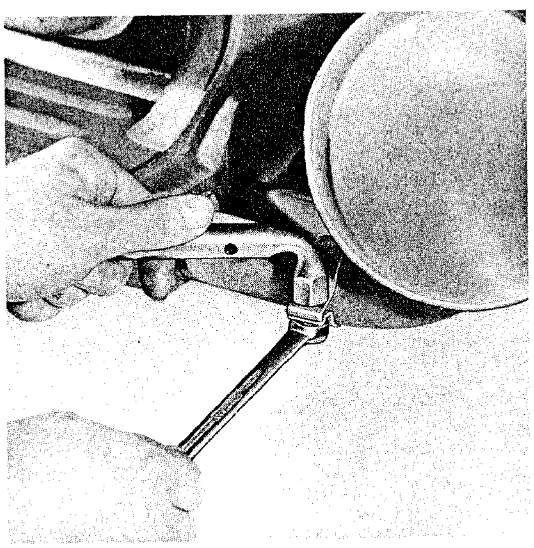


Bild 7

3. Loosen and remove both muffler clamps.

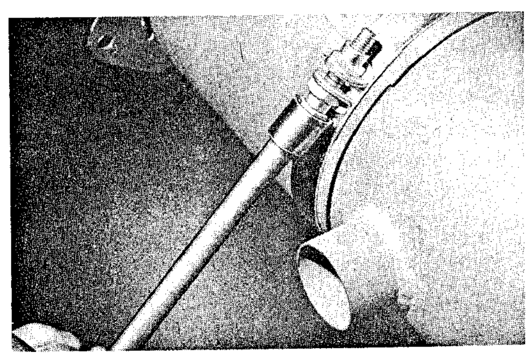


Fig. 8

4. Remove muffler by gently tapping with a rubber mallet on exhaust pipe joints.

Installation

Installation is accomplished in reversed order of the above, noting the following points:

1. Prior to installation, carefully inspect the muffler and exhaust pipes for damage or leaks.
2. Straighten dented or bent pipes, replace if necessary. Leaks in the exhaust pipes could allow exhaust gasses to enter the engine compartment and, with heater turned on, into the car's interior.
3. Once the engine is installed, the muffler or exhaust pipes should not touch the body.

Removal (engine dismounted from car)

1. Loosen carburetor heating hose clamps at heat exchangers and pull the hose off.

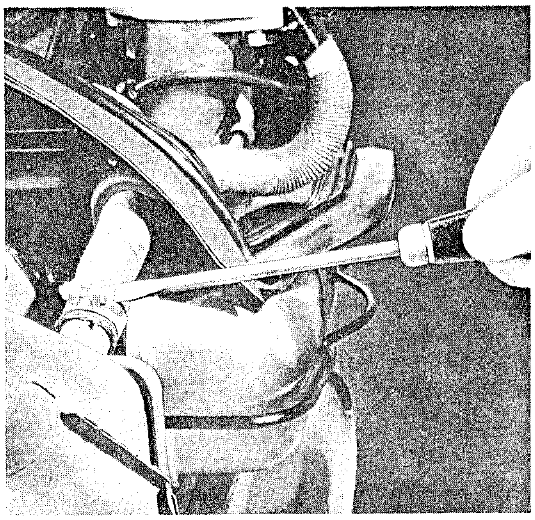


Fig. 9

2. Detach forward engine cover plate

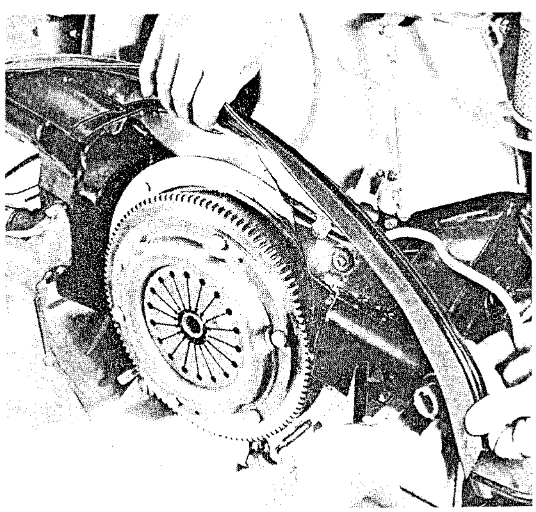


Fig. 10

3. Remove attaching bolt on front part of heat exchanger.

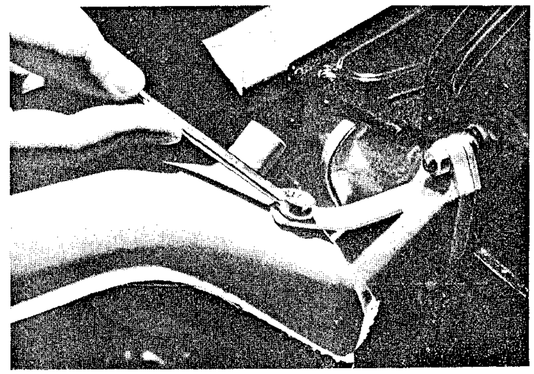


Fig. 11

4. Remove front and rear exhaust flange retaining nuts.

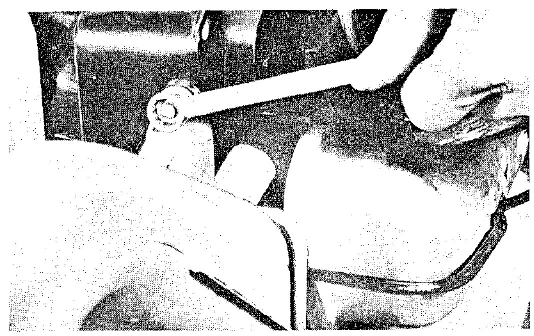


Fig. 12

5. Remove lower air guides.

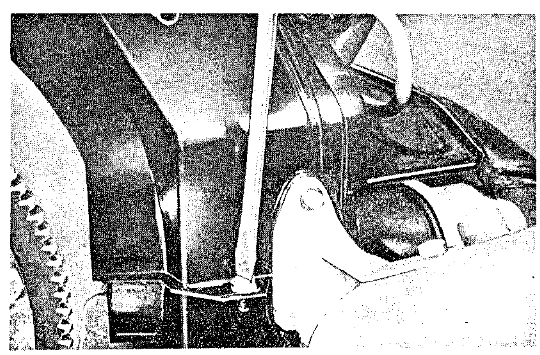


Fig. 13

6. Pull front and rear exhaust pipes away so that flanges clear the studs, remove heat exchanger assembly by moving it downward.

Note:

In the early versions, where the front part of the heat exchangers is screwed on, it is necessary to first detach it when disassembling or assembling the unit in order to gain clearance necessary for pulling the exhaust pipes off the studs.

Installation

The installation is accomplished in reversed order of the above, observing the following points:

1. Inspect heat exchangers and exhaust pipes for leaks or damage.
2. Flange sealing surfaces must be straight and clean; warped flanges should be straightened.
3. Use new gaskets.
4. Slip edge of lower air guides between the first fins of cylinder head.

Removing and installing air blower connecting duct

Note:

The air blower housing utilized with 356 B/T 6 heating system differs from earlier models, but only inasmuch as it has an air outlet for the heating system. For assembly or disassembly, follow instructions outlined in Section 4 EN, Basic Volume, 356 B Workshop Manual.

1. Detach heating hose from connecting stack.

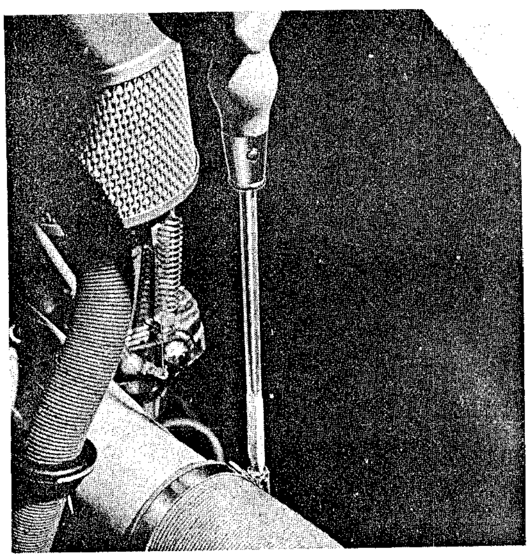


Fig. 14

2. Withdraw breather hose, with grommet, from bracket at the connecting duct and remove duct by moving it up diagonally.

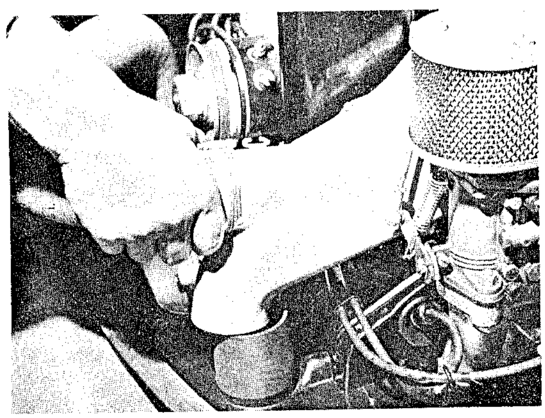


Fig. 15

Installation

1. Check position of counter nut on stud which secures the connecting duct. The position of the hext nut should be so as to ensure proper alignment of the duct with the air blower housing and, also, exclude the possibility of misalignment when tightened.

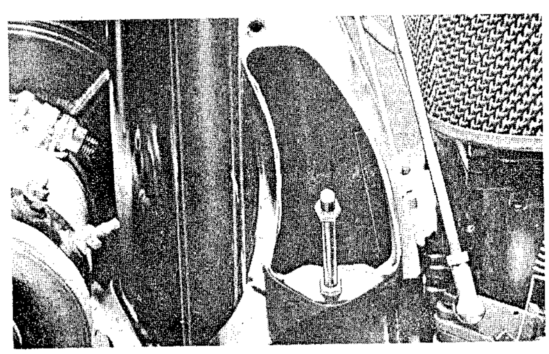


Fig. 16

2. Inspect heating and breather hoses for leaks or damage.

Removing and installing 356 B/T 6 heater cables

General

The heater cables need not be removed, except when replacement is contemplated.

Removal

1. Detach cable ends from connecting levers at air gate assemblies.
2. Remove floor tunnel cover.
3. Mark original position of shift lever base to simplify reassembly.

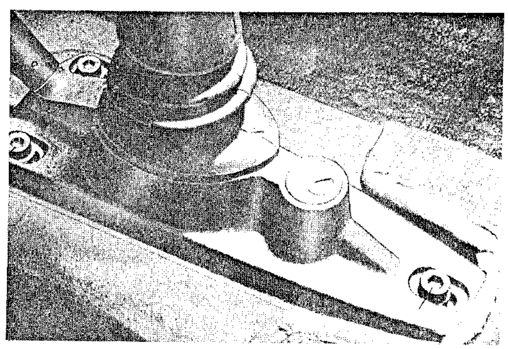


Fig. 17

4. Remove the three retaining bolts from shift lever base.
5. Lay shift lever base on its side.
6. Remove lock ring from heater spindle with a small screwdriver, turn spindle now until spindle nut is removed.

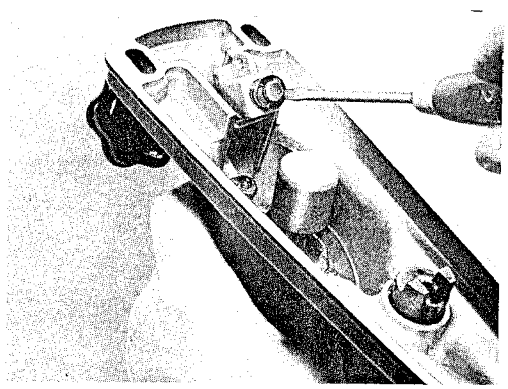


Fig. 18

7. Pull out heater cables.

Installation

1. Thread one end of heater cable through eye in spindle nut and pull cable through to the bend.
2. Insert both ends of cable into conduit tubes; make certain that cables do not cross.
3. Install spindle nut on heater control spindle with cable eye pointing to the front of car.

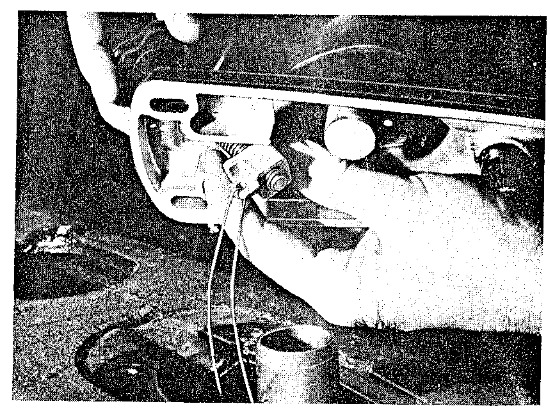


Fig. 19

4. Install lock ring on control spindle.

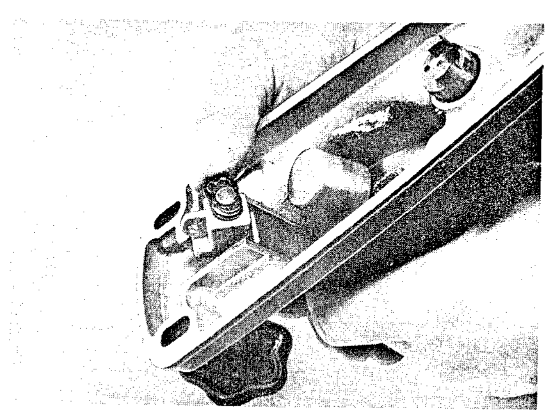


Fig. 20

5. Install gearshift base and start the three Allen-head screws, do not tighten.

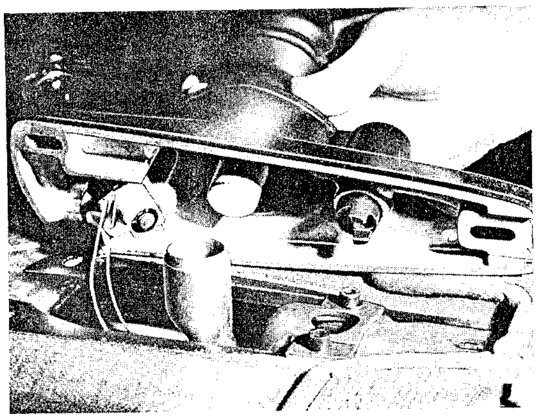


Fig. 21

6. Align gearshift base with markings, tighten screws.

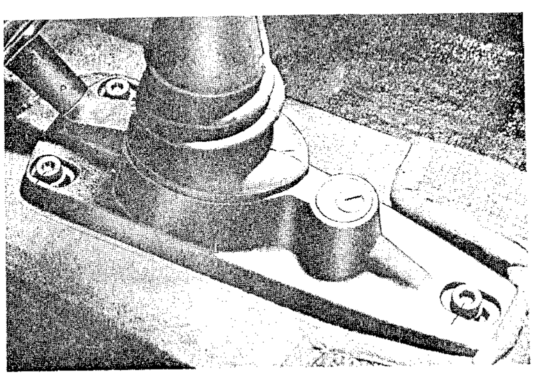


Fig. 22

7. Turn control knob to the lowest position of spindle nut, that is, until it rests against the lock ring.

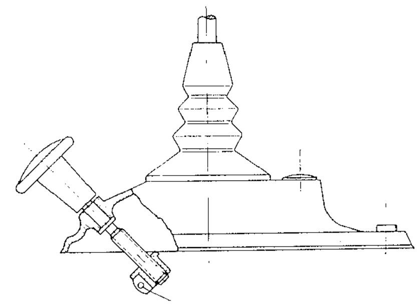
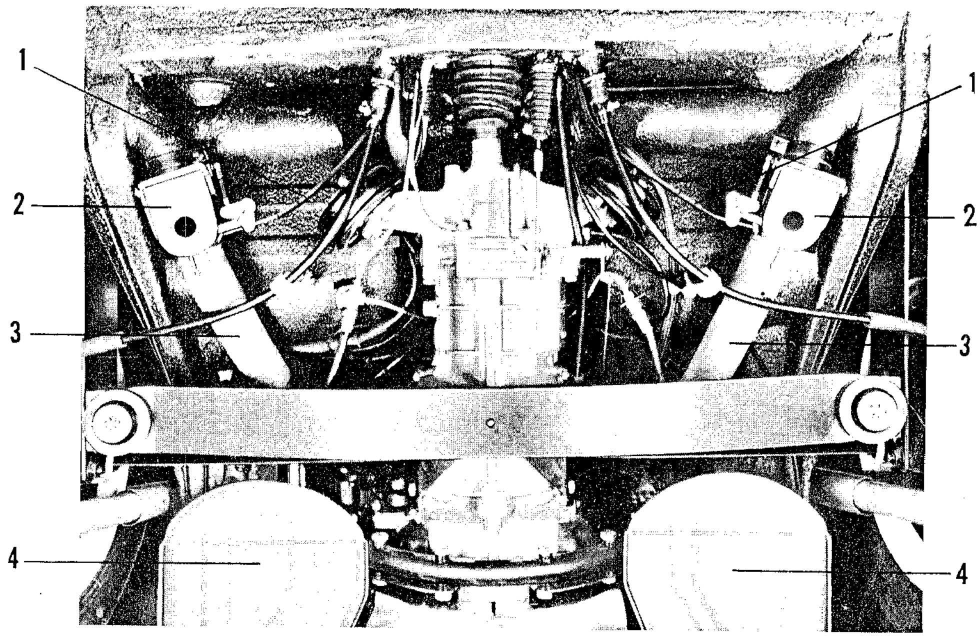


Fig. 23

8. Attach control cable ends to connecting levers at air gate assemblies. Make certain that the heater flaps work in unison, opening and closing fully.

Bottom View



1 Heater cable
2 Air gate assemblies

3 Heater hose
4 Heat exchanger

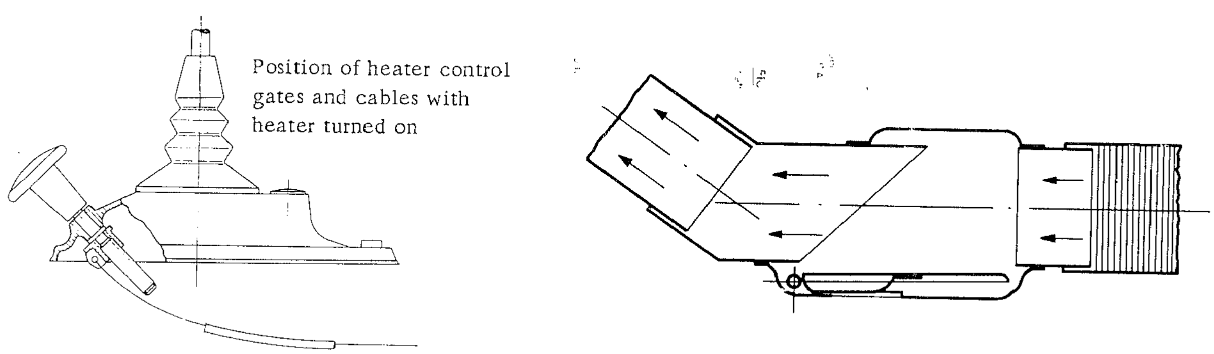


Fig. 25

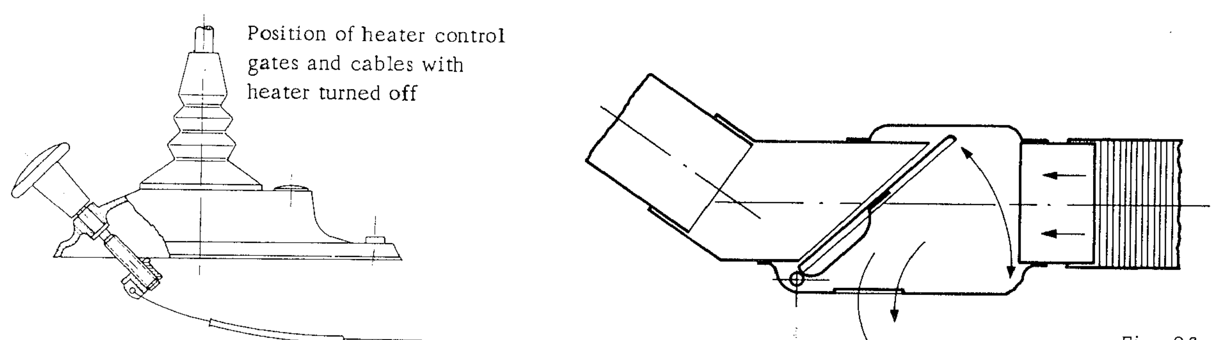


Fig. 26

Heater Control

Beginning with the following Chassis Serial Nos., a heater control lever is utilized in place of the control knob:

Coupe	126 001 or 215 001, respectively
Cabriolet	159 001

The lever is more convenient to use for setting the heater output; also, it is possible to visually check the setting position.

Removing and Installing Heater Control Cable

Removal

1. Detach cable ends from connecting levers at the air gate assemblies.
2. Remove floor tunnel cover.
3. Mark original position of shift lever base to ensure quick reassembly.
4. Remove the three retaining bolts from shift lever base.
5. Withdraw shift lever assembly.
6. Move heater control lever slightly away from the tunnel and pull out control cable.

Installation

Note:
It should be noted that there are two connecting holes in the control lever. Cars originally delivered in Germany and Sweden are equipped with the 356 B/T 6 heating system (page SE 31) which connects to the smaller hole in the control lever (Point 1, Fig. 1); in all other cars, the control cables are connected to the larger hole in the lever (Point 2, Fig. 1).

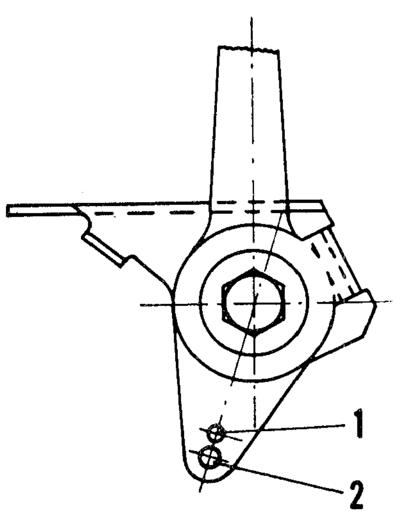


Fig. 1

1. Thread one end of control cable through the respective hole in the control lever and pull through to the bent end.

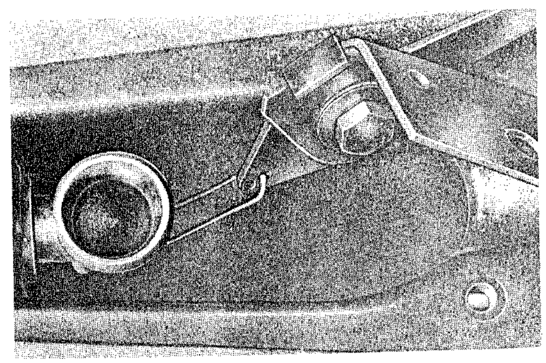


Fig. 2

2. Insert both ends of cable into conduit tubes; make certain that cables do not cross.

3. Mount shift lever assembly taking care that the guide dowel fits into the hole provided for aligning the lever bracket (Fig. 3).

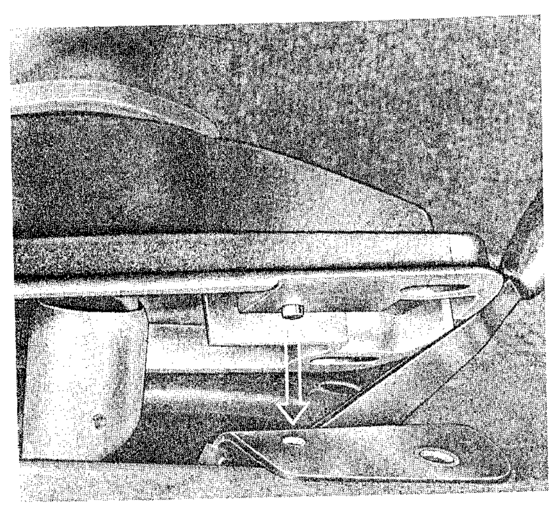


Fig. 3

4. Align gearshift lever assembly according to markings made during disassembly, and tighten Allen-head retaining bolts.
5. Move control lever forward to stop, into "closed" position.
6. Attach cable ends to connecting levers at the air gate assemblies. Make certain that the heater flaps work in unison, opening and closing fully.

Disassembling and Reassembling Control Lever Assembly

Disassembly

1. Hold head of hexagon bolt in a vise and remove self-locking nut.
2. Remove component parts one by one.

Reassembly

1. Hold head of hexagon bolt in a vise.
2. Install component parts as shown in Fig. 4.
3. Tighten self-locking nut to 0, 5 mkg (3. 6 lbs/ft), then turn back one complete turn (360°).
4. Adjust by testing friction of lever brake, which should be 10 ± 1 kg (22 lbs ± 2. 2 lbs), measured with a spring scale attached to the lever, through the upper hole, at a 90° angle (Fig. 5).

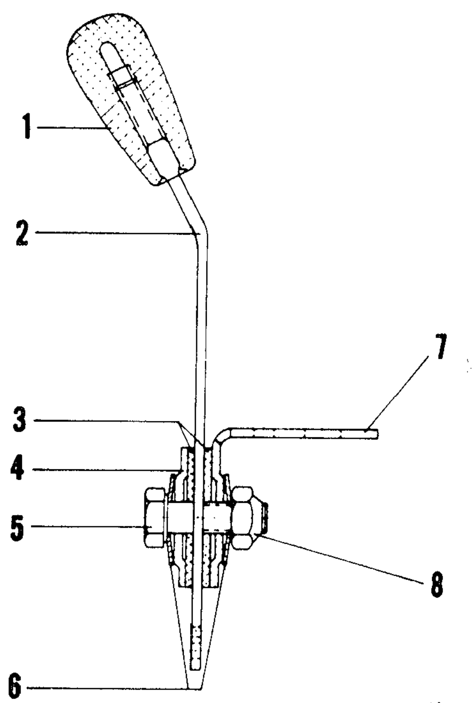


Fig. 4

1. Control lever grip
2. Control lever (left-hand drive cars)
3. Friction discs
4. Pressure disc
5. Hexagon bolt
6. Diaphragm spring
7. Supporting bracket
8. Self-locking nut

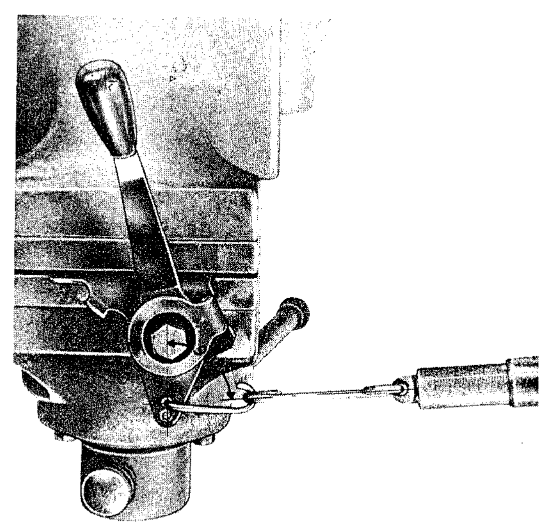


Fig. 5

Lever friction will increase when the hexagon nut is tightened, and decrease when the nut is loosened.

DESCRIPTION OF ENGINE TYPES 1600 C (616/15) and 1600 SC (616/16)

GENERAL

The 1600 C engine (Design No. 616/15) is an improved version of the 1600 S engine (616/12); the 1600 SC engine (616/16) is an improved version of the 1600 S-90 (616/7).
The following outline is for comparison with the 1600 S and 1600 S-90 engines. Minor modifications which are of insignificant nature are not included herein.

CRANKCASE

The cast light alloy crankcase consists of two halves and a timing gear cover. The three parts are machined to form one complete assembly; as such, they should not be replaced individually although it is possible to replace the timing gear cover alone.
To simplify stocking, identical crankcases are utilized for both engine types, i.e., the 1600 C and 1600 SC.
To ensure good seating of the split, steel-reinforced main bearing inserts, grooves have been machined into the crankcase bearing seats.

CRANKSHAFT AND CONNECTING RODS

The four connecting rods ride on plain-bearing crankshaft journals and are provided with exchangeable, steel--reinforced, tri-metal bearing inserts.
All connecting rods accomodate bronze bushings for the pistons pins.
The 1600 C and 1600 SC crankshafts are identical in dimensions, material, and fabrication features; the only difference in the 1600 SC crankshaft is that it has counter weights for better balance.
Both engines employ soft-nitrited crankshafts. The 1600 C and 1600 SC crankshafts ride in 4 main bearings. Bearing 1 and 4 are light-alloy sleeves, bearings 2 and 3 are split, steel-backed lead-bronze inserts. The diameter of main bearing journal is, in both engines, as follows: Bearing 1 = 50 mm diameter (1.969 in.), Bearings 2 and 3 = 55 mm (2.165 in.), and Bearing 4 = 40 mm (1.574 in.).

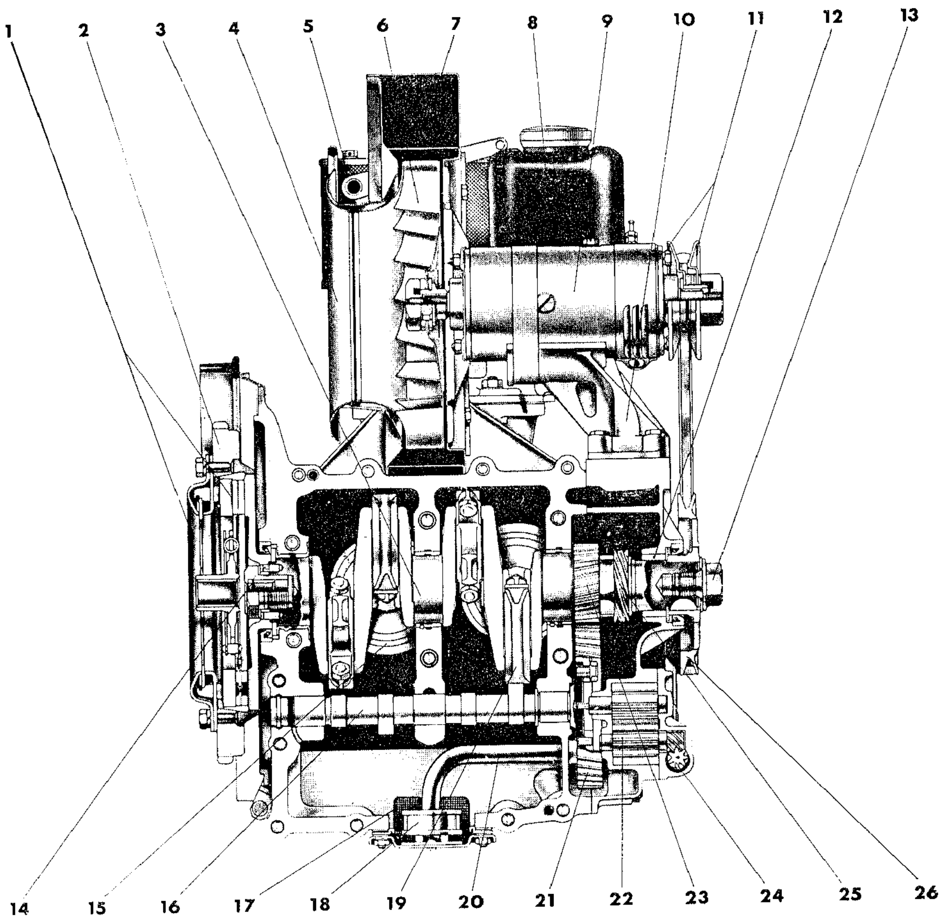


Fig. 1

1. Clutch
2. Flywheel
3. Main bearing journal, bearing # 2
4. Cooling air inlet
5. Air cleaner
6. Blower impeller
7. Blower housing
8. Oil filler
9. Generator
10. Generator support
11. Generator pulley halves
12. Main bearing sleeve, bearing # 4
13. Retaining bolt
14. Gland nut
15. Cylinder and piston
16. Camshaft
17. Oil screen
18. Magnetic oil filter
19. Connecting rod bearing cap
20. Oil suction tube
21. Timing gear
22. Oil pump
23. Camshaft drive gear
24. Tachometer drive pinion
25. Distributor drive pinion
26. Crankshaft pulley

CYLINDER HEAD

The intake and exhaust ports have been modified to improve cylinder breathing and volumetric efficiency. Also, the exhaust valve seats have been repositioned by 1.5 mm (.06 in.) and the exhaust valve heads enlarged from 31 mm (1.22 in.) to 34 mm (1.34 in.); diameter of the intake valves is 38 mm (1.50 in.). The intake and exhaust valve stems have grooved valve keeper seats.

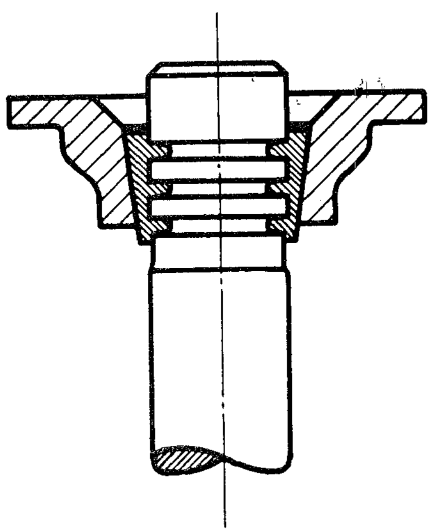


Fig. 2

The valve spring retainers have been strengthened and reshaped to accomodate the new valve keepers.

Installed length of valve springs remains unchanged.

Type 1600 C:	Intake	= 42.5 mm (1.66 in.)
	Exhaust	= 41.5 mm (1.63 in.)
Type 1600 SC:	Intake	= 41.0 mm (1.61 in.)
	Exhaust	= 40.0 mm (1.58 in.)

To keep oil losses at a minimum, the intake valves have been provided with sealing caps. When installing the sealing caps, it should be noted that first the valve is pushed into the valve guide and then the sealing cap pulled over the valve guide until the base of the cap comes to rest against the valve guide.

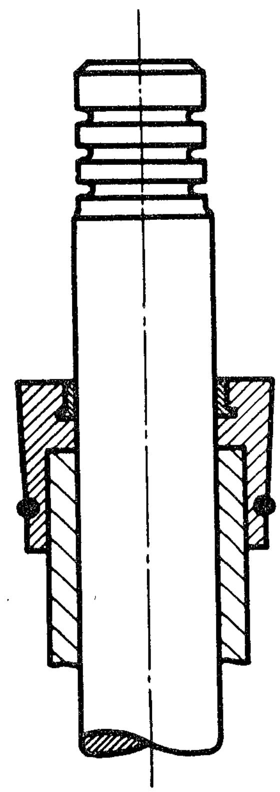


Fig. 3

Cylinder heads which become unserviceable due to defects or wear in the valve guides, valve seats, or spark plug seats, may be sent in to the factory for reconditioning. At time of manufacture, all cylinder heads are tested for combustion chamber displacement and the appropriate value in cubic centimeters is stamped into each unit.

It is essential that each engine is fitted with cylinder heads of like displacement; a difference of 1 cc (.06 cu. in.) is permissible. If the cylinder heads are reconditioned locally, their cubic displacement must be established subsequent to the overhaul and the new values stamped in.

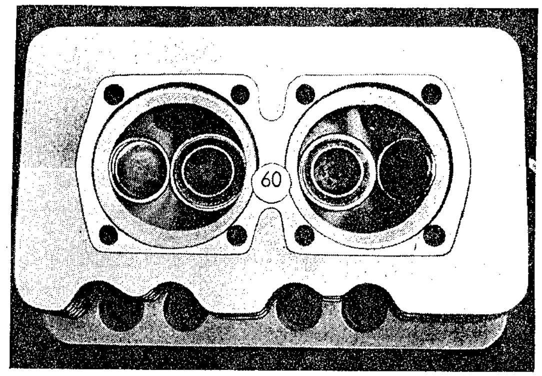


Fig. 4

VALVE CLEARANCE and TIMING

VALVE CLEARANCE

Valve clearance should be checked and adjusted only when the engine is cold. The following values apply:

	1600 C (616/15)	1600 SC (616/16)
Intake	0.10 mm (.004 in.)	0.15 mm (.006 in.)
Exhaust	0.15 mm (.006 in.)	0.10 mm (.004 in.)

The valve clearance must be checked at regular intervals and adjusted when necessary; this work requires skilled care.

VALVE TIMING

Due to the introduction of a differently cut camshaft in the 1600 C engine (616/15), the valve timing values have changed as follows:

Engine Type	1600 C (616/15)	-	1600 S (616/12)	1600 SC (616/16)	-	1600 S-90 (616/7)
Intake opens before TDC	10°	-	17°	17°	-	17°
Intake closes after BDC	44°	-	53°	53°	-	53°
Exhaust opens before BDC	42°	-	50°	50°	-	50°
Exhaust closes after TDC	6°	-	14°	14°	-	14°
Valve lift: Intake	10 mm (.394 in.)	-	10.8 mm (.425 in.) /	10.8 mm (.425 in.)	-	10.8 mm (.425 in.)
Exhaust	8.6 mm (.339 in.)	-	9.2 mm (.362 in.) /	9.2 mm (.362 in.)	-	9.2 mm (.362 in.)

NOTE: These values are applicable with a valve clearance of 1.00 mm (.039 in.) and the engine cold. The valve clearance must be readjusted to normal values upon completion of the valve timing test.

ADJUSTING CRANKSHAFT END PLAY

GENERAL

Crankshaft end-play (for installation) in the 1600 C and 1600 SC engines is 0.13 mm (.005 in.) to 0.18 mm (.007 in.). To compensate for size variations, thrust shims are available in 6 thickness groups:

Group A = 0.80 mm (.032 in.)

Group B = 0.85 mm (.034 in.)

Group C = 0.90 mm (.036 in.)

Group D = 0.95 mm (.037 in.)

Group E = 1.00 mm (.039 in.)

Group F = 1.05 mm (.041 in.)

Thrust shim size is indicated on the shims with alphabetical group symbols.

1. Insert bearing inserts for main bearing 2 and 3 into the two crankcase halves, and coat with oil.
2. Oil bearing sleeve for main bearing 1 and slide onto crankshaft journal, mount crankshaft.
3. Place thrust shim on crankshaft at main bearing 1.

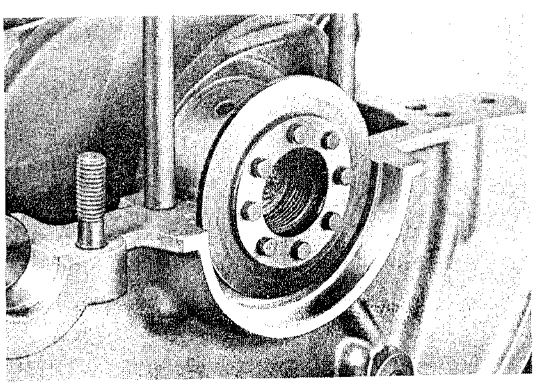


Fig. 5

4. Install the second crankcase half and tighten crankcase nuts to specified torque.
5. Install flywheel and soft iron gasket, tighten gland nut to 45 - 50 mkg (325 to 362 lbs/ft).

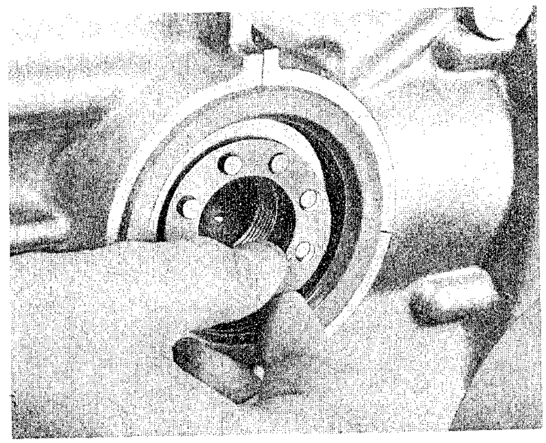


Fig. 6

6. Attach dial gauge to crankcase using special tool (P 17) so that the gauge sensor touches the flywheel at right angle.

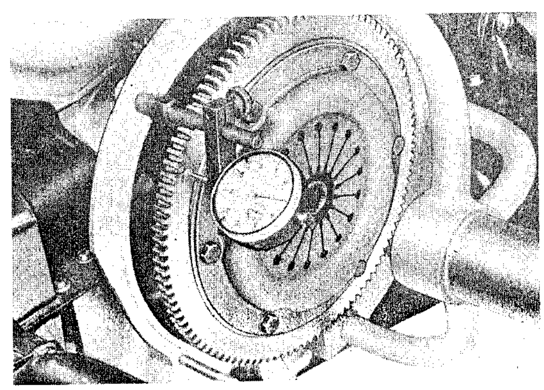


Fig. 7

7. Check the end-play by moving the crankshaft axially from stop to stop; if necessary, adjust to specification by using a different thrust shim of appropriate size.

MAIN BEARING and CRANKSHAFT DIMENSIONS

for Engines Type 1600 C (616/15) and 1600 SC (616/16)

MAIN BEARINGS

Nomenclature	Version		Bearing 2 to 3 (in mm)	Bearing 1 (in mm)
Crankshaft Journal	Standard	Diameter	54,990 - 54,971	49,991 - 49,975
Bearing Insert	Inside standard	Wall thickness	2,615 - 2,603	5,096 - 5,108
	Outside standard	Outside dia.	-	60,29 + 0,02
Crankcase Bore	Standard	Diameter	60,24 ± 0,005	60,24 ± 0,005
Crankshaft Journal	Standard	Diameter	54,990 - 54,971	49,991 - 49,975
Bearing Insert	Inside standard	Wall thickness	2,740 - 2,728	5,221 - 5,233
	Outside oversize	Outside dia.	-	60,54 + 0,02
Crankcase Bore	Oversize	Diameter	60,49 ± 0,005	60,49 ± 0,005
Crankshaft Journal	1st undersize	Diameter	54,740 - 54,721	49,741 - 49,725
Bearing Insert	Inside undersize	Wall thickness	2,740 - 2,728	5,221 - 5,233
	Outside standard	Outside dia.	-	60,29 + 0,02
Crankcase Bore	Standard	Diameter	60,24 ± 0,005	60,24 ± 0,005
Crankshaft Journal	1st undersize	Diameter	54,740 - 54,721	49,741 - 49,725
Bearing Insert	Inside undersize	Wall thickness	2,865 - 2,853	5,346 - 5,358
	Outside oversize	Outside dia.	-	60,54 + 0,02
Crankcase	Oversize	Diameter	60,49 ± 0,005	60,49 ± 0,005
Crankshaft Journal	2nd undersize	Diameter	54,490 - 54,471	49,491 - 49,475
Bearing Insert	Inside undersize	Wall thickness	2,865 - 2,853	5,346 - 5,358
	Outside standard	Outside dia.	-	60,29 + 0,02
Crankcase Bore	Standard	Diameter	60,24 ± 0,005	60,24 ± 0,005
Crankshaft Journal	2nd undersize	Diameter	54,490 - 54,471	49,491 - 49,475
Bearing Insert	Inside undersize	Wall thickness	2,990 - 2,978	5,471 - 5,483
	Outside oversize	Outside dia.	-	60,54 + 0,02
Crankcase Bore	Oversize	Diameter	60,49 ± 0,005	60,49 ± 0,005

Nomenclature	Version		Bearing 2 to 3 (in mm)	Bearing 1 (in mm)
Crankshaft Journal	3rd undersize	Diameter	54,240 - 54,221	49,241 - 49,225
Bearing Insert	Inside undersize Outside standard	Wall thickness Outside dia.	2,990 - 2,978 -	5,471 - 5,483 60,29 + 0,02
Crankcase Bore	Standard	Diameter	60,24 ± 0,005	60,24 ± 0,005
Crankshaft Journal	3rd undersize	Diameter	54,240 - 54,221	49,241 - 49,225
Bearing Insert	Inside undersize Outside oversize	Wall thickness Outside dia.	3,115 - 3,103 -	60,54 + 0,02
Crankcase Bore	Oversize	Diameter	60,49 ± 0,005	60,49 ± 0,005

Dimensions of crankshaft journals and bearing inserts for main bearing 4, as well as crank pin journals and bearing inserts for connecting rods are the same as for engines Type 1600 (616/1), 1600 S (616/12), and 1600 S-90 (616/7).

Crankshafts for engines Type 1600 C and 1600 SC can be reconditioned or exchanged only at the factory since these must be subjected to a special metal treatment.

The respective undersize bearings are to be ordered as spare parts whereby it must first be established if the main bearing seats in the crankcase are standard or oversize.

Measuring point for establishing thickness of bearing inserts

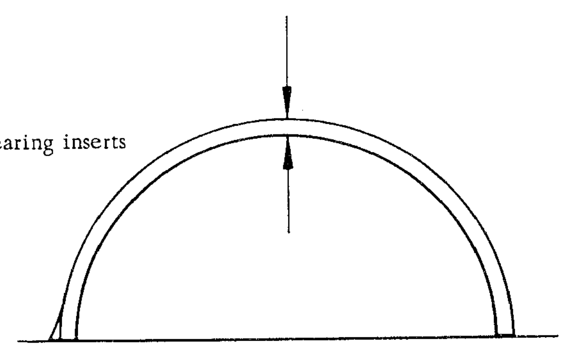


Fig. 8

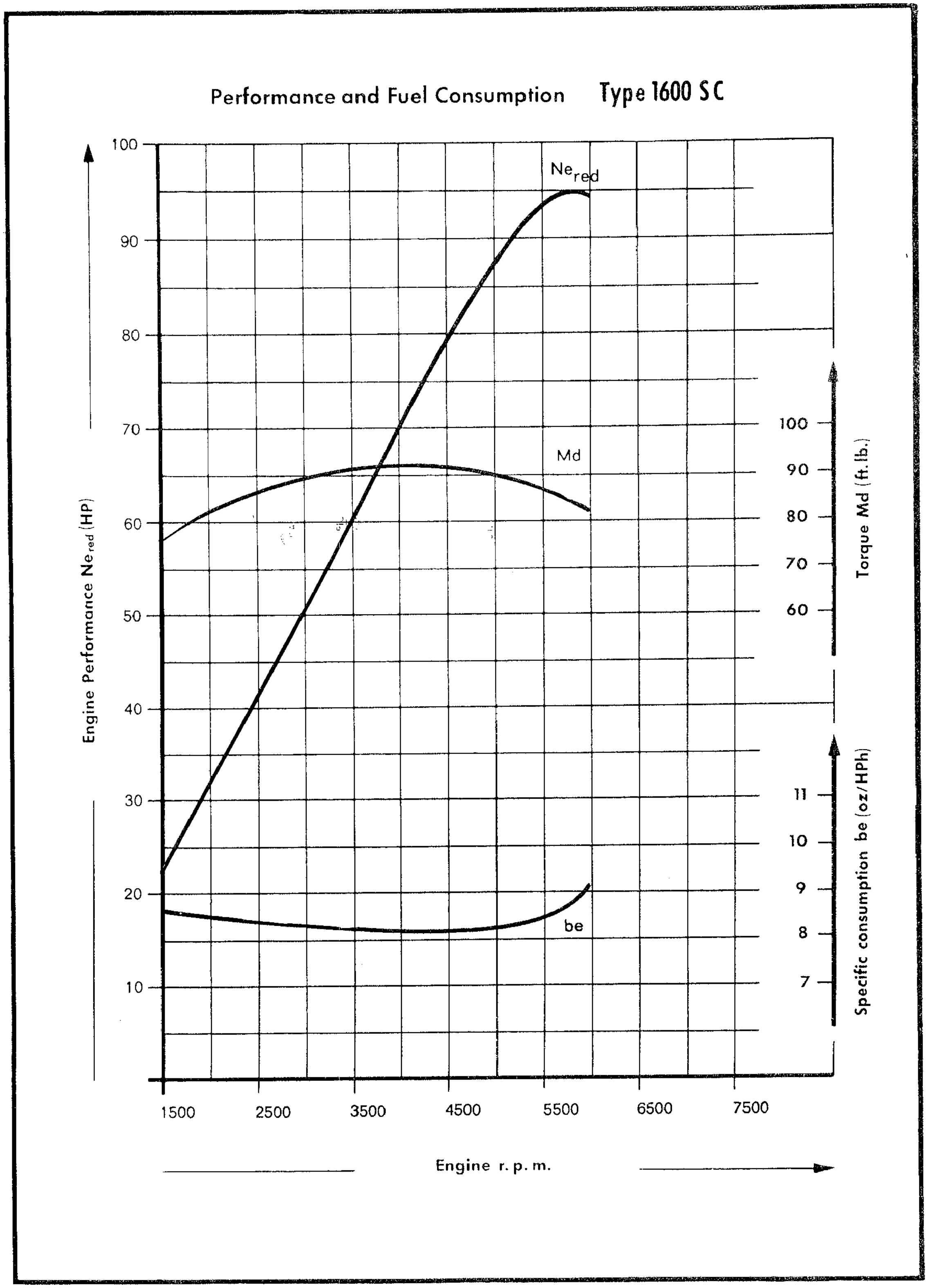
Measuring Point		Tolerance (new)	Wear Limit	
7. Depth of recess to web	mm	3.10 - 3.15	-	
	in.	.1220 - .1240	-	
8. Width of oil seal surface	mm	8.250 - 9.250	-	
	in.	.3248 - .3642	-	
9. Valve springs Free length	mm	49.00	-	
	in.	1.93		
Installed length				
Intake	mm	41.0	-	
	in.	1.61		
Exhaust	mm	40.0	-	
	in.	1.575		

TOLERANCES and WEAR LIMITS

TYPE 1600 C ENGINE

Measuring Point		Tolerance (new)	Wear Limit	
1. Piston/cylinder clearance	mm	0.041 - 0.059	0.20	
	in.	.0016 - .0023	.0079	
2. Piston ring gap	mm	0.25 - 0.50	0.95	
	in.	.010 - .020	.037	
3. Compression ring/groove clearance Ring 1	mm	0.075 - 0.107	0.30	
	in.	.0030 - .0042	.0118	
Ring 2	mm	0.060 - 0.080	0.30	
	in.	.0024 - .0031	.0118	
Ring 3	mm	0.035 - 0.062	0.30	
	in.	.0014 - .0024	.0118	
4. Oil ring/groove clearance	mm	0.025 - 0.052	0.30	
	in.	.0010 - .0020	.0118	
5. Crankshaft/main bearing clearance (end-play)	mm	0.130 - 0.180	0.30	
	in.	.0051 - .0071	.0118	
6. Crankshaft journal/main bearing clearance				
Bearing 1	mm	0.028 - 0.078	0.170	
	in.	.0011 - .0031	.0067	
Bearing 2 and 3	mm	0.035 - 0.090	0.170	
	in.	.0014 - .0035	.0067	
Bearing 4	mm	0.040 - 0.104	0.170	
	in.	.0016 - .0041	.0067	

Measuring Point		Tolerance (new)	Wear Limit	
7. Depth of recess to web	mm	3.10 - 3.15	-	
	in.	.1220 - .1240	-	
8. Width of oil seal surface	mm	8.250 - 9.250	-	
	in.	.3248 - .3642		
9. Valve springs Free length	mm	49.00	-	
	in.	1.93		
Installed length				
Intake	mm	42.5	-	
	in.	1.67		
Exhaust	mm	41.5	-	
	in.	1.63		



Performance and Fuel Consumption
Type 1600 SC
Engine Performance Ne red (HP)
100
90
80
70
60
50
40
30
20
10
Ne red
Md
be
1500
2500
3500
4500
5500
6500
7500
Engine r. p. m.
Torque Md (ft. lb.)
100
90
80
70
60
Specific consumption be (oz/HPh)
11
10
9
8
7

SECTION INDEX

Supplement to Group F: Fuel System

SOLEX 40 PII-4
Twin Throat Downdraft Carbureter

General Description

The 1600 S-90 engine in type 356 B cars is equipped with SOLEX 40 PII-4 twin throat downdraft carbureter; the throats measure 1 37/64 in. (40 mm) in diameter. As a result of the low mounting of the carbureters it was possible to omit chokes or similar starting aids.

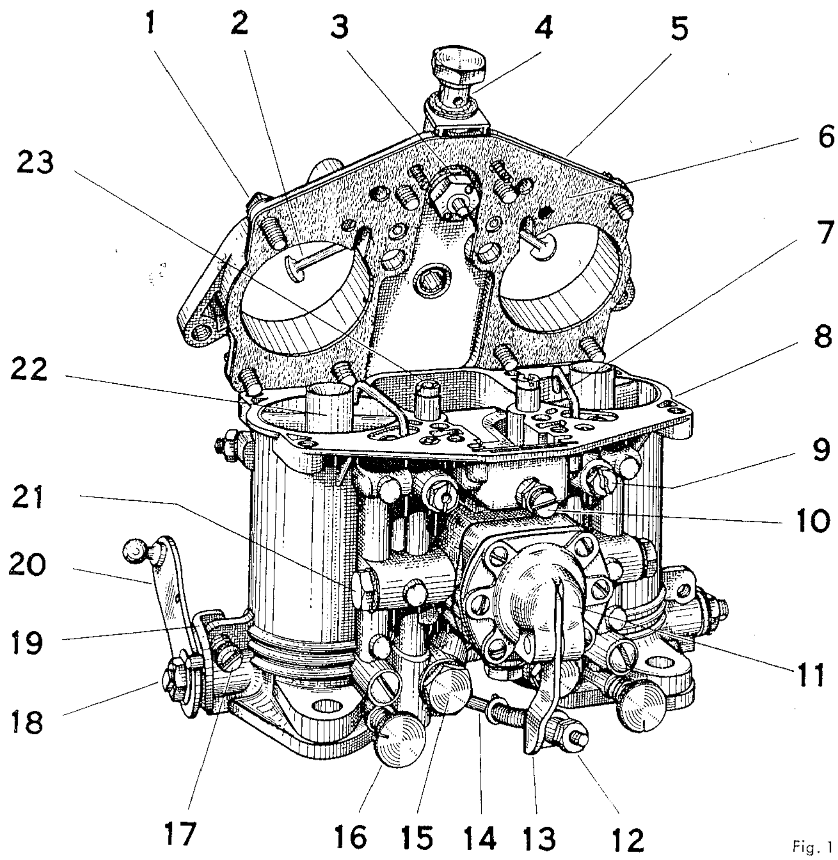


Fig. 1

① Float chamber cover retaining screw
② Power enrichment nozzle
③ Float needle valve assembly
④ Fuel inlet bolt
⑤ Float chamber cover
⑥ Float chamber gasket
⑦ Accelerating pump nozzle
⑧ Carbureter body
⑨ Idle jet
⑩ Float level adjustment
⑪ Accelerating pump
⑫ Accelerating pump adjustment
⑬ Accelerating pump lever
⑭ Accelerating pump rod
⑮ Main jet carrier with jet
⑯ Idle mixture adjustment
⑰ Idle speed adjustment
⑱ Throttle shaft
⑲ Thrust block
⑳ Throttle arm
㉑ Accelerating pump jet
㉒ Primary venturi
㉓ Air correction jet

Operating Principles

The carbureter consists basically of the main body and the float chamber cover, with a gasket separating the two. The main body contains two induction barrels, each having an independent idle speed and power metering system. The throttle shaft, which passes through both barrels, controls two throttle valves and carries a thrust block and a throttle arm.

Schematic View of Carbureter

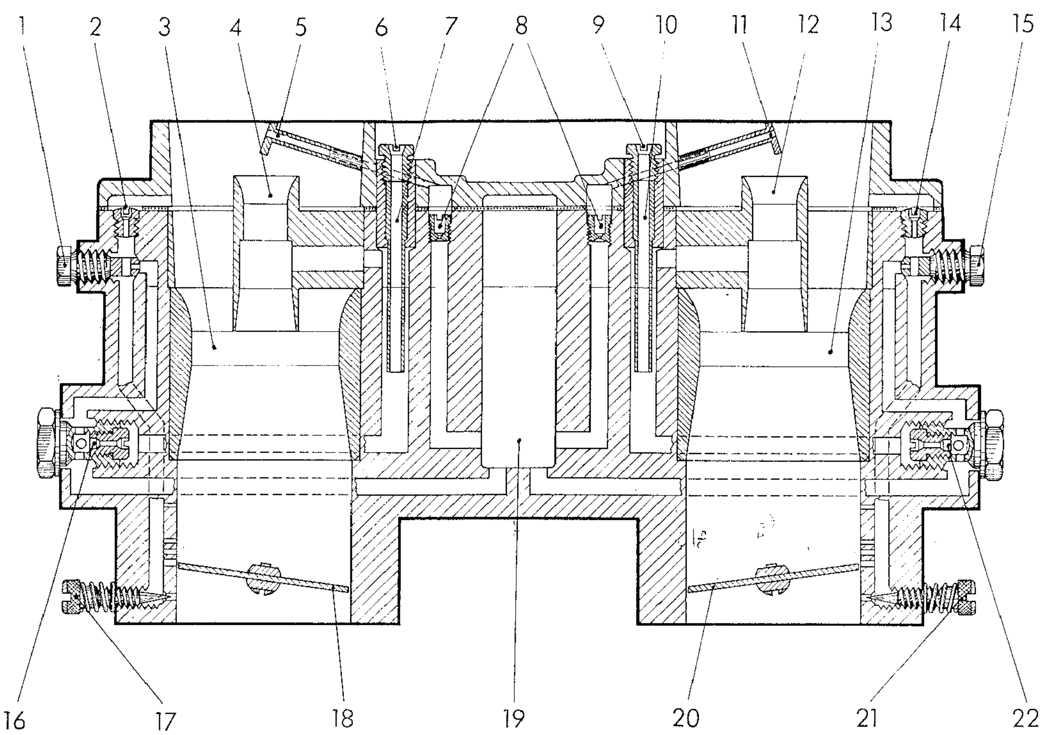


Fig. 2

For reasons of schematic clarity the throttle shaft is purposely shown in an untrue, transverse arrangement.

1. Idle metering jet
2. Idle air bleed
3. Main venturi
4. Primary venturi
5. Power enrichment nozzle
6. Air correction jet
7. Emulsion tube
8. Power enrichment jets
9. Air correction jet
10. Emulsion tube
11. Power enrichment nozzle
12. Primary venturi
13. Main venturi
14. Idle air bleed
15. Idle metering jet
16. Main jet carrier
17. Idle mixture adjustment
18. Throttle valve
19. Float chamber
20. Throttle valve
21. Idle mixture adjustment
22. Main jet carrier

The accelerating pump is located on the broad side of the carbureter; it is actuated through an adjustable rod and supplies fuel to both induction barrels.

① Primary venturi

② Accelerating pump nozzle

③ Accelerating pump jet

④ Accelerating pump diaphragm spring

⑤ Accelerating pump diaphragm

⑥ Fuel inlet from float chamber to check valve

⑦ Check valve with return flow port

⑧ Pump rod spring

⑨ Pump lever

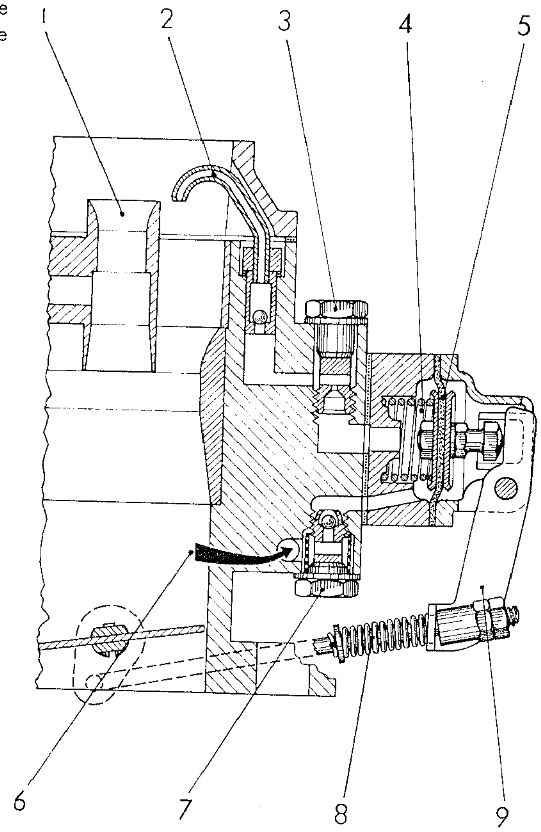


Fig. 3

The float chamber is situated between both induction barrels. The fuel level in the float chamber is controlled through the buoyancy of the float whose toggle causes the float needle valve to open or shut. The float level can be raised or lowered by a screw which controls the height of the intermediate swivel joint, which makes it possible to easily adjust the fuel level in the float chamber to suit the particular grade of fuel used. The fuel level may be checked by removing the plug in the inspection port.

① Float chamber vent

② Float needle valve

③ Float chamber cover

④ Threads for fuel inlet bolt

⑤ Inspection port plug

⑥ Float

⑦ Float level adjustment

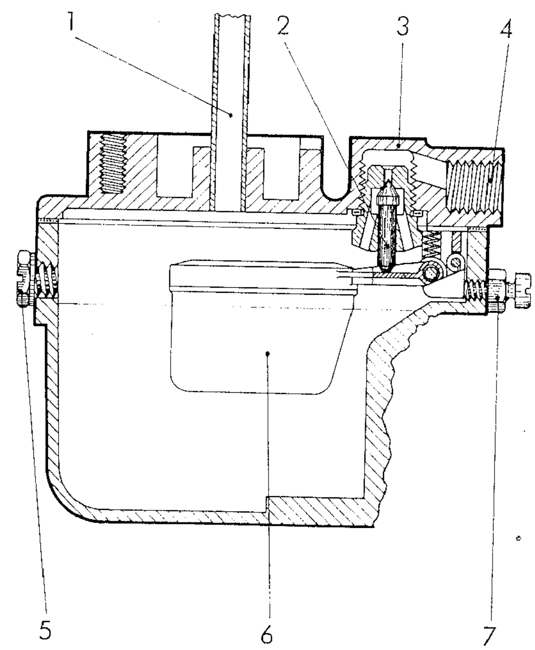


Fig. 4

Located in the float chamber cover is the fuel inlet, the float chamber vent, and the float needle valve assembly — the latter being situated inside the float chamber cover. In addition, two power enrichment nozzles are pressed into the float chamber cover.

Idle Metering

The fuel passes through the idle metering jet (g) where it mixes with air entering through the idle air bleed (u) and converts into an emulsion. The emulsion is channelled to four small orifices located near the throttle valve. The amount of emulsion which is discharged through the lowest orifice is controlled by the idle mixture screw (w). Emulsion drawn into the induction barrel through the idle mixture orifice combines with induction air entering through the partly open throttle valve whereupon it atomizes into an idle mixture.

The idle mixture can be leaned out by turning the adjustment screws in, and enriched by turning the screws out. Both screws should always be equally set.

The idle speed adjustment controls the idle rpm; that is, by turning the idle speed adjustment clockwise the rpm are increased, by turning the adjustment counter-clockwise the rpm are decreased.

The idle system incorporated in this carbureter is known as an independent system. This is because the fuel is drawn from a point short of the main jet (y). As a result, negative pressure occuring in the induction barrels brings about a continuous response from the idle metering system. Due to this arrangement certain amount of the idle mixture continues to enter the induction barrels during normal power settings as well.

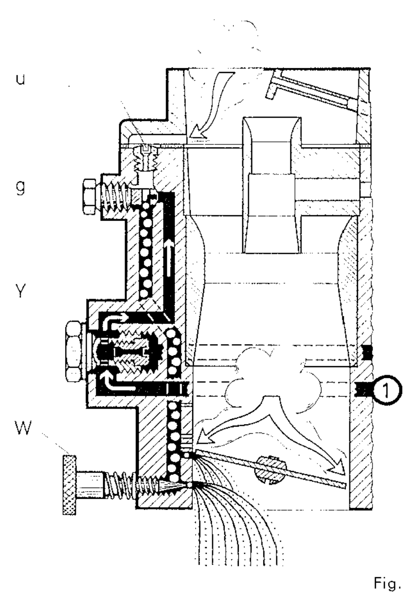


Fig. 5

Intermediate Metering

The three by-pass ports located above the idle mixture discharge orifice serve the purpose of intermediate metering but have varying functions. The lowest port, situated at the throttle crack and above the idle orifice, discharges idle mixture when the throttle is set for idling. The two upper ports begin to discharge the fuel mixture only after the throttle has been slightly opened. This system was devised to provide smooth transition from idle speeds to power settings.

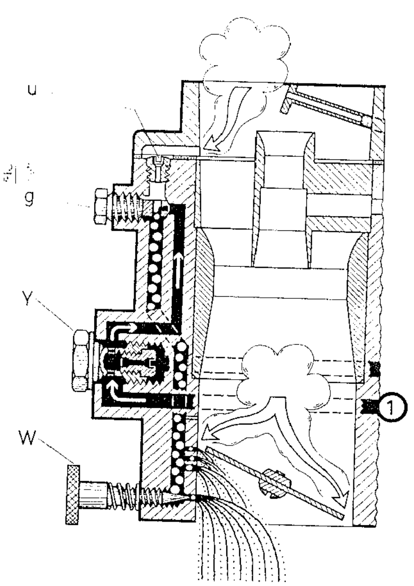


Fig. 6

Power Metering (normal operation)

The fuel flows through the main jet carrier (y) and the therein located main jet (Gg) into a well which connects with the primary venturi (x) and, thus, with the induction barrel. Placed into the well is the emulsion tube (s) together with the air correction jet (a) which is located directly above it. Vaccum in the induction barrel draws the fuel into the primary venturi where it is mixed with air; the fuel/air mixture then passes through the main venturi (k) where it is fully atomized. As the increasing vaccum effect causes the fuel level in the well to drop, air passes through the air correction jet and through calibrated orifices in the emulsion tube to mix with fuel metered by the main jet, thus emulsifying and effecting a derichment of the fuel/air mixture.

As long as the engine operates in the lower RPM range under partial or full load, only the main metering system is supplying the fuel. However, as the engine RPM increase, the vaccum effect at the power enrichment nozzle becomes so intense that it begins to draw fuel from the power enrichment system. The power enrichment system consists of a discharge nozzle and a metering jet; the fuel is drawn directly from the float chamber. This system feeds supplemental fuel into the primary venturi when the engine operates under full-power conditions at high RPM.

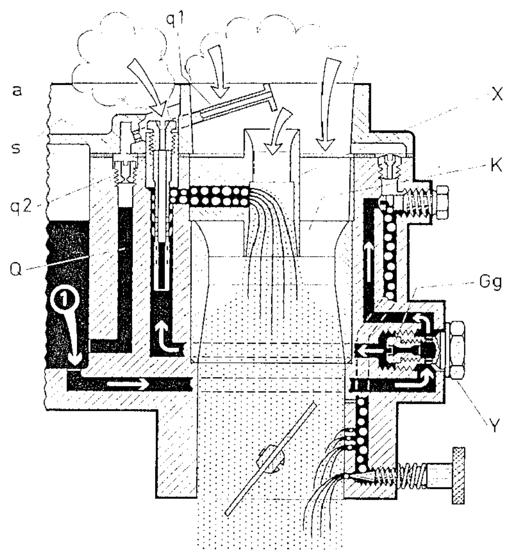


Fig. 7

Partial Load

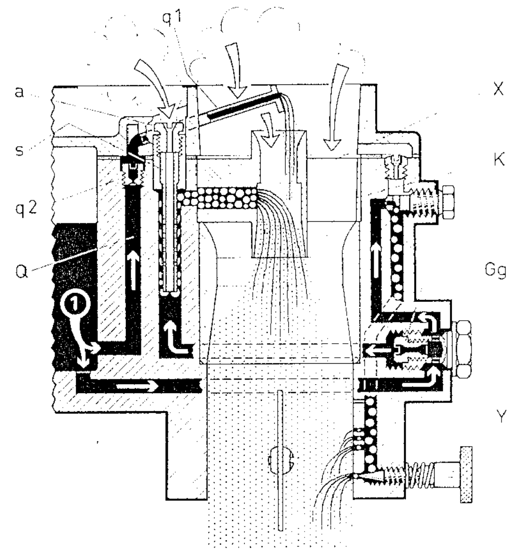


Fig. 8

Full Power with Enrichment

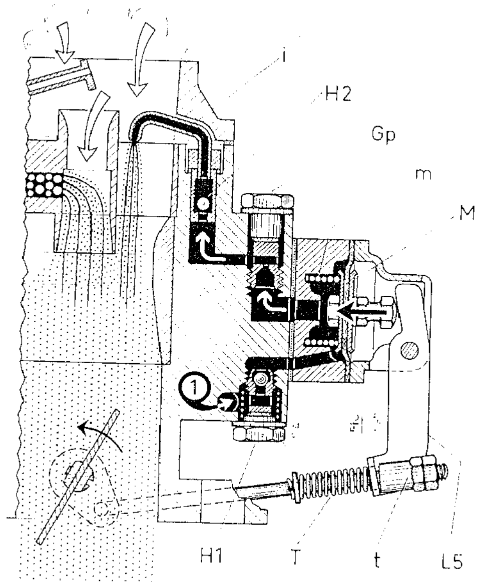
Incorporation of the fuel enrichment system into the main metering system makes it possible to finely balance and properly dose the fuel/air mixture with due regard to the desired fuel economy as well as to highest maximum performance upon demand.

Acceleration

A mechanically actuated diaphragm-type accelerating pump (R) is utilized. The pump is flooded with fuel supplied directly from the float chamber. When the pump is at rest, the diaphragm (M) is forced outward by the diaphragm spring (m). When the throttle valve is opened, the pump is acted upon over the pump rod (T) and the pump lever (L 5) which push the diaphragm inward, thus forcing the fuel to pass through the pump jet (Gp) and the calibrated injection nozzle (i) into the main venturi; this enrichment of the fuel/air mixture provides a smooth acceleration.

The check valve (H 1) located in the pump inlet prevents the fuel from flowing back into the float chamber. A second check valve (H 2), located at the base of the injection nozzle, keeps air from entering the pump through the injection nozzle when the pump is on the inlet stroke.

Quantity of fuel injected during acceleration is adjustable and depends upon the length of the pump stroke. The pump adjustment (t) affects the pump stroke and, thus, determines the quantity of fuel to be injected during acceleration. The pump jet together with the calibrated injection nozzle controls only the duration of injection.



Acceleration

Fig. 9

The check valve assembly (H 1) is provided with a return flow port measuring .0142" (0.36 mm) in diameter. The return flow port serves the purpose of preventing excessive enrichment of the fuel/air mixture during acceleration; that is, depending upon the stroke velocity of the pump plunger, larger or smaller amounts of fuel are permitted to escape through the return flow port.

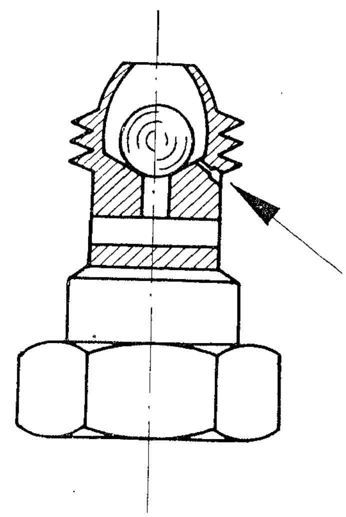


Fig. 10

Subject	Page	Remarks
Fuel Pump		
Fuel Tank		
Fuel Selector Valve		

Carbureter Specifications
For Engine Type 1600 S-90

Title	Specifications	Remarks
Carbureter	Solex 40 PII-4	2 per engine
Main venturi (K)	32	2 per carbureter
Main jet (Gg)	0115	2 per carbureter
Air correction jet (a)	180	2 per carbureter
Idle metering jet (g)	57.5	2 per carbureter
Idle air bleed (u)	1.8	2 per carbureter
Accelerating pump	No. 72	1 per carbureter
Pump jet (Gp)	50	2 per carbureter
Accelerating pump nozzle	high-type, with 0.4 restrictor	2 per carbureter
Float needle valve (spring-loaded)	175	1 per carbureter
Float	7.4 g	1 per carbureter
Emulsion tube	No. 25	2 per carbureter
Main jet carrier	6	2 per carbureter
By-pass ports	1.7; 1.4; 1.0	
Injection quantity (warm season)	0.45 cc (.122 fl. dram.) from 2 strokes, each nozzle	2 nozzles per carbureter
Injection quantity (cold season)	0.65 cc (.176 fl. dram.) from 2 strokes, each nozzle	

Main jet metering is of great importance when operating at considerably varying altitudes for which the following rule-of-thumb may be applied: Change main jet calibration by 6% for each 1,000 m (3,280′) altitude variation. For example: normal main jet calibration at an altitude of 400 m (1,312′) is 0115; proper jet size for an altitude of 1,400 m (4,592′) is 0110.

Removing and Installing Carbureters

Spezial Tool:
P-75, Carbureter Adjustment Gauge

The following procedures apply to both carbureters.

Removal

1. Close fuel valve.
2. Remove air cleaner.
3. Remove fuel inlet bolt at carbureter.
4. Detach throttle rod from throttle lever.
5. Remove carbureter flange nuts.
6. Withdraw carbureter.
7. Cover intake manifold stack.

Installation

Assemble in reversed order observing the following:

1. Install new carbureter flange gaskets.
2. Uniformly cross-tighten carbureter flange nuts.
3. Adjust throttle rod so that throttle valves can fully open.
4. Check fuel inlet bolt gaskets, replace with new if necessary.
5. If necessary, clean and oil air cleaners.
6. Adjust idle speed. Adjust carbureter by using adjustment gauge (P-75).

Cleaning Carbureters

The following procedures apply to both carbureters.

1. Remove carbureter.
2. Wash carbureter in clean gasoline.
3. Remove float chamber cover retaining screws.
4. Withdraw float chamber cover, watch float pin retainers.
5. Remove float pin.
6. Remove main, idle, and pump jets.
7. Remove air correction jets, shake out emulsion tubes.
8. Remove power enrichment jets and idle air bleed.
9. Remove float needle valve assembly.
10. Clean all jets and ports.
11. Reassemble carbureter.

Carbureters should be cleaned in a utensil containing clean gasoline. All jets and ports should be cleared with compressed air. In no case should wire or other mechanical means be used for cleaning the jets because the calibrated orifices can be damaged or enlarged.

7. Install main venturis. When installing the venturis make certain that the venturi throat is facing up, that is, so that the writing on the venturi tubes can be read from above. Firmly tighten venturi securing screws but do not overtighten.

8. Check for radial play of throttle shaft. Excessive play will allow false air to enter the induction barrel, thus impairing engine starting and idling.

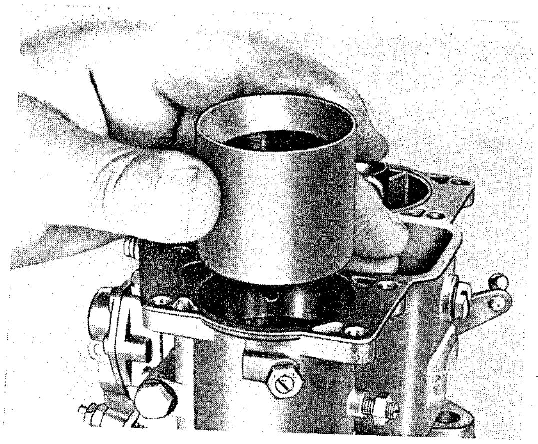


Fig. 12

9. Inspect idle mixture screws; burred, bent, or broken needle tips are unsatisfactory requiring replacement of screw.

Adjusting Idle Speed

Spezial Tool:

P-75, Carbureter Synchronizing Unit

1. Remove idle mixture adjusting screws and inspect needle tips for burrs, grooves, and misalignment. If in doubt, install new adjustment screws.

2. Bring engine to normal operating temperature and remove air cleaners.

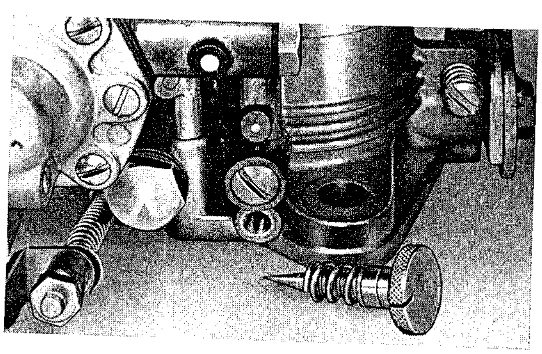


Fig. 13

3. Detach throttle rods from throttle levers.

4. Uniformly turn idle speed adjustment screws in until the engine idles at about 1,000 rpm.

5. Following any convenient sequence turn idle mixture screws fully in on both carbureters — do not tighten or else needle tips will be damaged — then back off $1^1/_2$ turns. From this position turn the screws in or out until fastest idle is achieved. In no case should the idle mixture screws be left fully turned in.

6. Adjust idle speed screws until the idle speed drops to 800—900 rpm.

7. Place carbureter adjustment gauge (P-75) on carbureter throat and adjust plunger glass to vertical position.

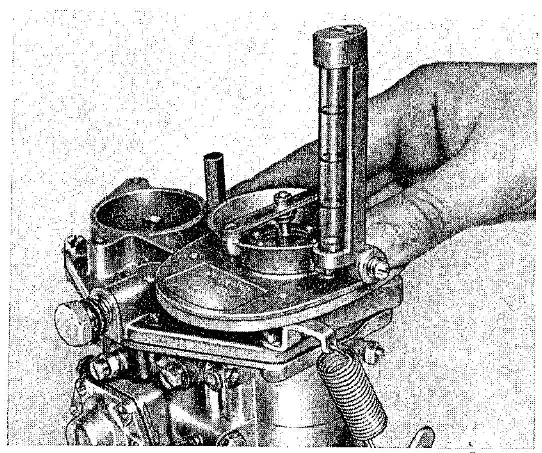


Fig. 14

8. Turn adjustment screw on gauge until plunger moves to about half-way between two scriber marks on glass tube; this accomplished, no further adjustments should be made on gauge as it is set for the particular engine.

9. Place gauge (P-75) on the second throat of same carbureter; plunger should move up to same point as obtained during procedure outlined under Point 8, above. Should a different reading be obtained it will be necessary to resynchronize both throttle valves; this is easily accomplished by slightly twisting the throttle shaft. Using the adjustment gauge check if throttle valves are properly synchronized by comparing subsequent readings obtained at the two carbureter throats.

10. Without changing gauge settings place gauge (P-75) on second carbureter and adjust throttle valve with idle speed screw so that plunger in glass tube moves to same position as obtained in previous testing outlined under Point 8, above. Also check throttle valve synchronization according to outline under Point 9, above, and correct if necessary.

11. Should it be noted during the adjustment procedure that idle rpm has changed, corrective adjustment must be made with idle speed screws, whereupon synchronization of carbureters must be rechecked with carbureter gauge (P-75) and corrected if necessary.

12. Reconnect throttle rods to throttle levers.

Note: Carbureter rods must be so adjusted as to reconnect with throttle levers without causing tension elsewhere.

13. Set hand throttle to 1,200—1,300 rpm and using gauge (P-75) check if both carbureters are still synchronized, following instructions under Point 8 and 9. If the gauge shows unequal readings on both carbureters it will be necessary to again resynchronize the carbureters by marking proper adjustments on both throttle rods.

14. Recheck idle speed.

15. Check injection quantity (warm season 0.45 cc from each nozzle on two pump strokes, cold season 0.65 cc).

16. Check accelerator pedal stop screw and adjust if necessary. When the accelerator pedal is depressed against the stop screw the carbureter lever should be clearing the carbureter stop block by about 1 mm (.039 in.).

17. Install air cleaners with gaskets and tighten securing screws.

Adjusting Accelerating Pump

Spezial Tool:
P-25 a, Liquid Graduate

1. Adjust idle speed.

2. Run engine to fill float chamber with fuel.

3. Stop engine, remove both air cleaners.

4. Work throttle lever until air bubbles cease to show at the pump injection nozzle.

5. Hold liquid graduate (P-25 a) at the tip of the nozzle and rapidly move throttle lever two times from stop to stop.

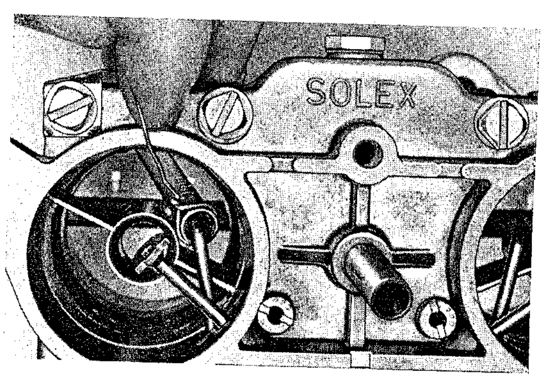


Fig. 15

6. Check injection quantity, empty the graduate glass, and repeat the procedure on the second injection nozzle.

7. Injection quantity from each nozzle on two pump strokes should be 0.45 cc (.122 fl. dram.) in warm season, 0.65 cc (.176 fl. dram.) in cold season.

8. Perform injection quantity check on the second carbureter.

9. If necessary, readjust injection quantity by resetting the adjustment nut on the pump rod. If an adjustment should not be possible due to lack of threads, place a spacer between the pump lever and the adjustment nut to gain way.

Note: The jet of squirting fuel should not strike the primary or main venturi and must pass through the slit between the carbureter throat and the opening throttle valve (see Fig. 16).

Apply the following procedure if a float level gauge (P-78) is not at hand:

1. Place car on level base.

2. Start engine.

3. Remove plug from the float level inspection port. If the float level is correct, the fuel can be seen or it will just begin to come outside.

4. If necessary, readjust float level.

Note:

Turn adjustment screw in to lower the **fuel** level.

Turn adjustment screw out to raise the **fuel** level.

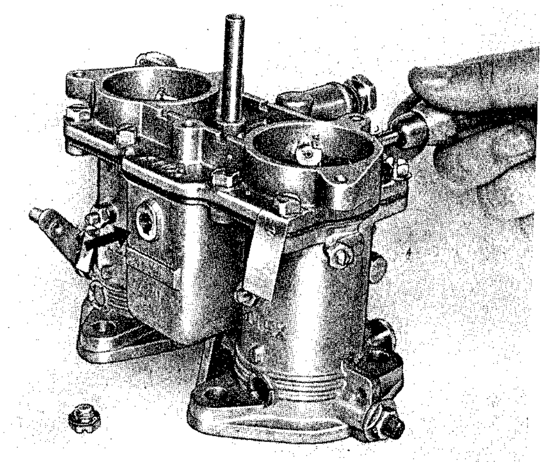


Fig. 18

Note:

Turning the adjustment screw in causes the float to drop which, in turn, causes some fuel to run out through the inspection port. Therefore, when this occures while making adjustments allow the engine to consume the excess fuel before making final adjustments.

Servicing Air Cleaners

The oil-wetted wire mesh air cleaners remove dust particles and impurities from the induction air. The air cleaners should be serviced at intervals dictated by local dust or air contamination conditions.

1. Remove retaining screws.

2. Withdraw air cleaners.

3. Wash air cleaners in clean solvent or gasoline.

4. Thoroughly clear air cleaners with compressed air.

5. Apply a thin coat of oil to wire mesh.

6. Reinstall air cleaners with gaskets and tighten retaining screws.

REMOVING AND INSTALLING FUEL SELECTOR VALVE

The fuel selector valve has to be removed when cleaning the tank or the tank wire screen.

Removal

1. Remove tank and drain gasoline.
2. Remove nut which holds fuel selector valve, withdraw valve from tank.
3. Blow out wire screen with compressed air.

Installation

Install the valve by reversing the removal procedure and observing the following points:

1. Thoroughly clean fuel tank.
2. Install new gaskets which seal wire screen flange (one gasket on each side of the flange).
3. Make certain that fuel valve stub lines up with selector lever; if necessary, loosen fuel valve retaining nut and slightly turn the fuel valve to proper position.
4. Check all connections for possible leaks.

SPECIAL TOOLS

Applicable to the Supplements in

GROUP F

FUEL SYSTEM SECTION

Carbureter Service Diagnosis

The following service diagnosis is applicable only if the carbureter components match the specifications listed in the table on page SF 9.

Malfunction	Possible Cause	Remedy
1. Engine does not start despite properly functioning ignition and adequate fuel in tank	a. Lack of fuel in fuel system b. Carbureter floods	a. Clean main jet. Check fuel supply lines. Remove fuel line connecting fuel pump with carbureter and, with ignition off, actuate starter; if pump supplies fuel, float needle valve is plugged; if pump does not supply fuel, trouble may be in stuck pump check valves, faulty pump mechanism, or dirty fuel selector valve b. Check and clean float needle valve. Check gasket at float needle valve. Check float, if damaged replace with new one
2. Uneven idling	a. Wrong idle settings b. Idle jet or idle air bleed plugged c. Leak in the intake manifold d. Damaged idle mixture screw	a. Readjust idle speed b. Clean idle jets or idle air bleed respectively c. Check intake manifolds, flange connections, and gaskets d. Install new idle mixture screw
3. Poor transition (flat spot)	a. Idle settings too lean b. Improper float level c. Improper injection quantity d. Leak in the intake manifold	a. Readjust idle system, check idle jets b. Readjust float level c. Check injection quantity d. Check intake manifolds, flange connections, and gaskets
4. Engine stalls when throttle is quickly shut	Wrong idle settings	Readjust idle system
5. Engine runs unevenly, misses, backfires	a. Mixture too rich b. Mixture too lean c. Leak in the intake manifold	a. Check fuel pump pressure. Check float level. Check float needle valve. Check float b. Clean main jets. Check fuel lines. Check float level c. Check intake manifolds, flange connections, and gaskets
6. High fuel consumption	a. High fuel pressure overriding float needle valve b. Leak in float c. Float needle valve not closing	a. Check fuel pressure b. Install new float c. Check float needle valve

FUEL SYSTEM

General Description

The fuel system of the Porsche motor car consists of the fuel tank with a fuel selector valve, fuel gauge sending unit, fuel lines, mechanical fuel pump, and two twin throat downdraft carbureters.

The fuel tank has a capacity of 13.3 US gallons (50 liters) and is accessible through the front luggage compartment. The fuel selector valve, located under the tank and accessible to occupants of the front seats, has three positions, namely, ZU (closed), AUF (open), and RESERVE. The fuel reserve of appr. 1.6 US gallons (6 liters) may be tapped by setting the fuel selector valve on RESERVE, that is, by turning the lever clockwise.

A modified fuel tank has been adapted commencing with chassis serial numbers as follows:

Coupé	identification-No.	117 601
Cabriolet	identification-No.	155 601
Hardtop	identification-No.	201 601
Roadster	identification-No.	89 601

REMOVING AND INSTALLING FUEL TANK

Removal

1. Take out spare tire, jack, and tool kit.
2. Undo rubber pad and take out.
3. Close fuel valve.
4. Pull rubber fuel hose off fuel valve.
5. Remove cotter pin which secures selector, lever to fuel valve and pull selector lever somewhat to rear.
6. Remove screw which holds ground wire to fuel gauge sending unit, disconnect fuel gauge wire from snap-on connector.
7. Detach cover panels and rubber seal at filler neck; the two upper sheetmetal screws are accessible from the tank compartment, the two lower sheet-metal screws from the wheel well side.
8. Loosen hose clamp on rubber (seal (Ref. Fig. 2).

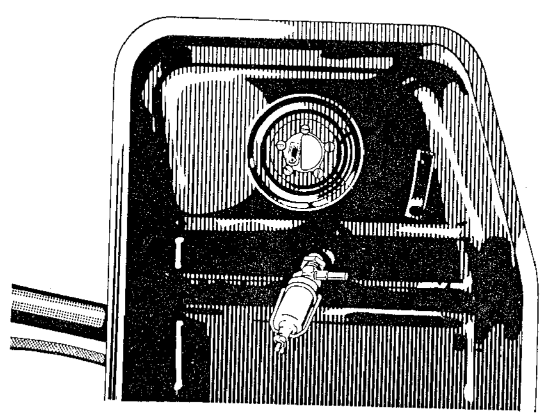


Fig. 1

Second Edition of this page, November 1961

FUEL SELECTOR VALVE

1. Gasket
2. Fuel valve retaining nut
3. Fuel hose connector
4. Filter
5. Sediment bowl
6. Wire screen
7. Fuel outlet (AUF: open)
8. Gasket
9. Rubber grommet
10. Plug

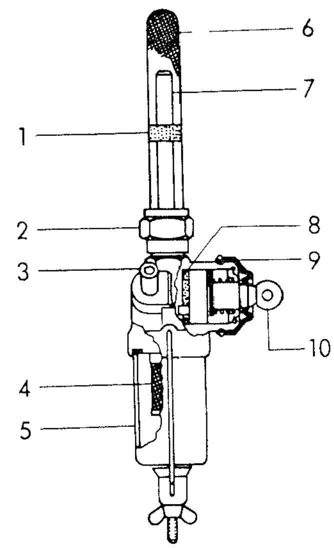


Fig. 4

REMOVING AND INSTALLING FUEL GAUGE SENDING UNIT

Removal

1. Disconnect cable at battery.
2. Drain (hose) gasoline.
3. Place a basin underneath the fuel tank to collect fuel.
4. Remove fillister-head screws holding fuel gauge sending unit and remove unit.

   In case of extremely dirty fuel, remove and thoroughly clean tank (see page SF 21).

Installation

Install fuel gauge sending unit by reversing the removal procedure and observing the following points:

1. Replace "Thiokol" gasket, if necessary.
2. Upon reassembly, check sending unit for possible leaks.

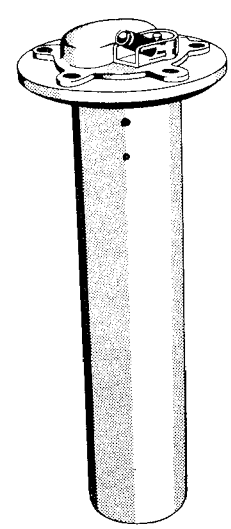


Fig. 5

CARBURETOR LINKAGE, HAND THROTTLE AND BELL CRANK

From identification-No.

Coupé	117 601	Hardtop	201 601
Cabriolet	155 601	Roadster	89 601

the carburetor linkage has been modified.

General Remarks

The metal connecting piece between the long accelerator rod and the tie rod on the bell crank is replaced by a flexible piece, see Fig. 6/3. This eliminates the vibration between engine and accelerator pedal.

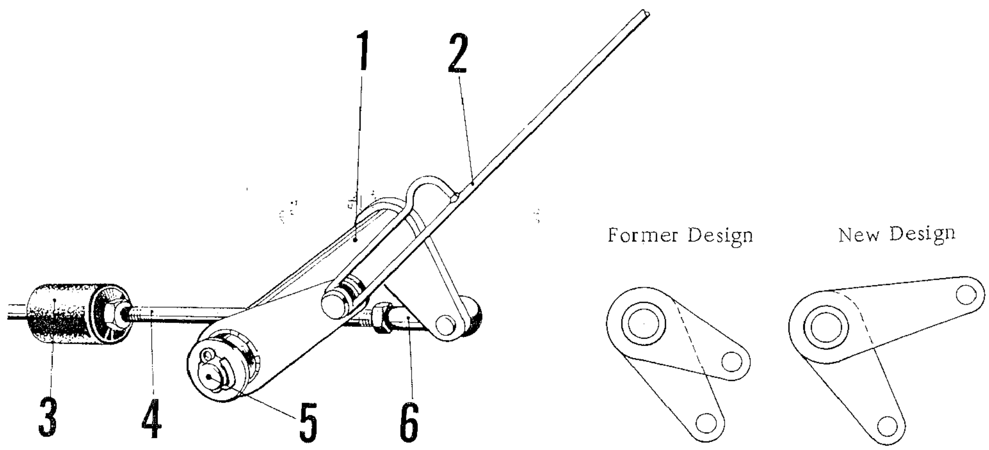


Fig. 6

1. Bell crank
2. Accelerator rod
3. Flexible piece
4. Accelerator rod to the accelerator pedal
5. Bearing bolt
6. Control-rod

By modifying the bell crank of the carburetor linkage on transmission, a progressive opening of the throttles is possible. This allows a slow opening of the throttles during the first one third of the accelerator pedal travel and results in soft driving, especially in traffic. The table below shows the relation of the throttle valve position to the accelerator pedal travel.

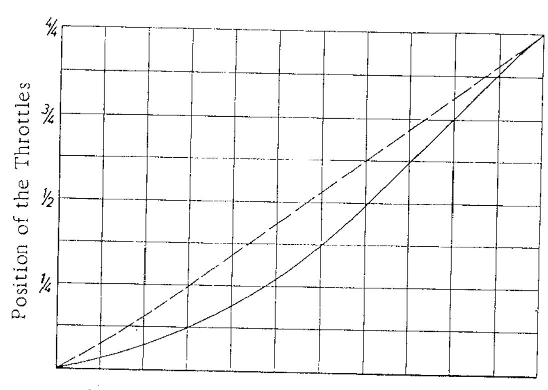


Fig. 7

General

Fuel is pumped to the carburetors by a diaphragm pump which is mounted on the engine block. The fuel pump is operated by the distributor shaft eccentric over an actuating plunger. The quantity of fuel delivered by the pump is metered automatically in direct proportion to the amount of fuel dispensed by the carburetors.
The fuel pump consists of an upper and lower assembly. The upper assembly accomodates an inlet and outlet valve, and a fuel filter. The lower assembly contains an actuating plunger. Located between both assemblies is a diaphragm spring. The diaphragm is built up of several layers of a fuel-proof material, and is sandwiched between two supporting discs which are riveted to the plunger coupling.

Operation

The eccentric on the distributor shaft presses against the diaphragm plunger. The plunger transmits the pressure to the diaphragm coupling against the plunger spring but with the support of the diaphragm spring. As a result, the sucked-in fuel is forced to the carburetors through the outlet valve and the fuel line. When the actuating plunger moves back, a vacuum is created above the diaphragm, thus sucking the fuel into the pump, through the inlet valve. This process repeats itself with every revolution of the eccentric (once every two revolutions of the crankshaft).

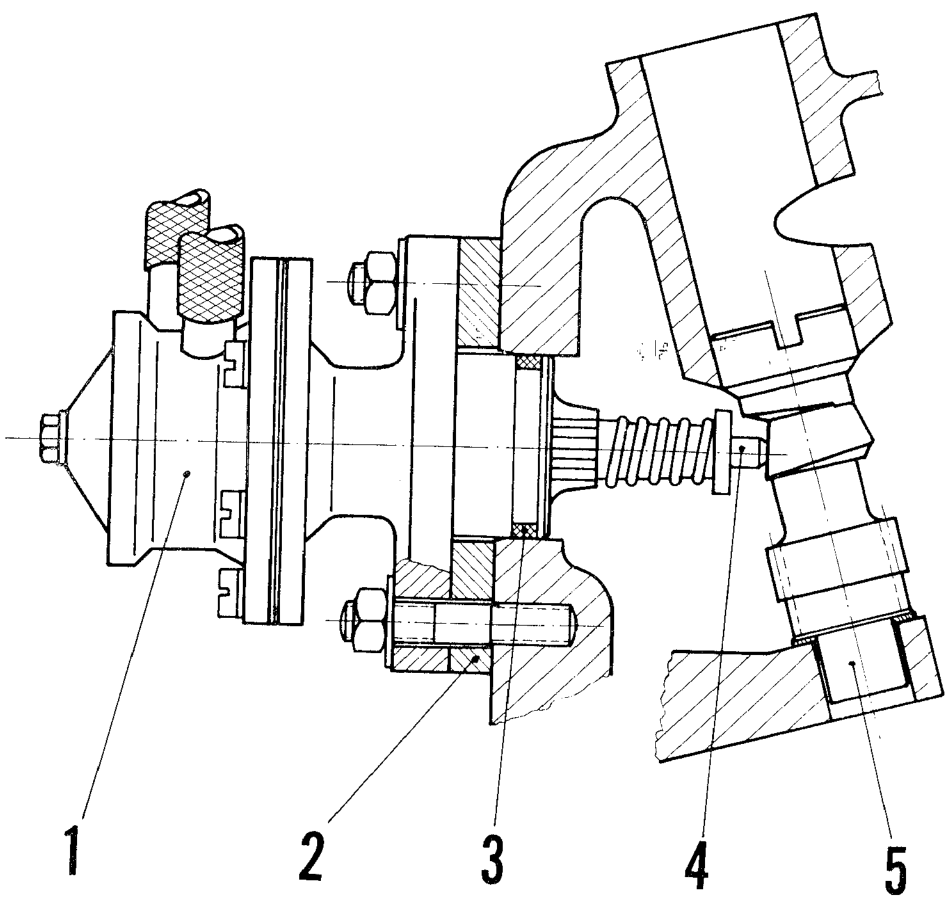


Fig. 2

1 Fuel pump
2 Pump insulating flange
3 O-ring
4 Actuating plunger
5 Distributor shaft

Fuel pump components

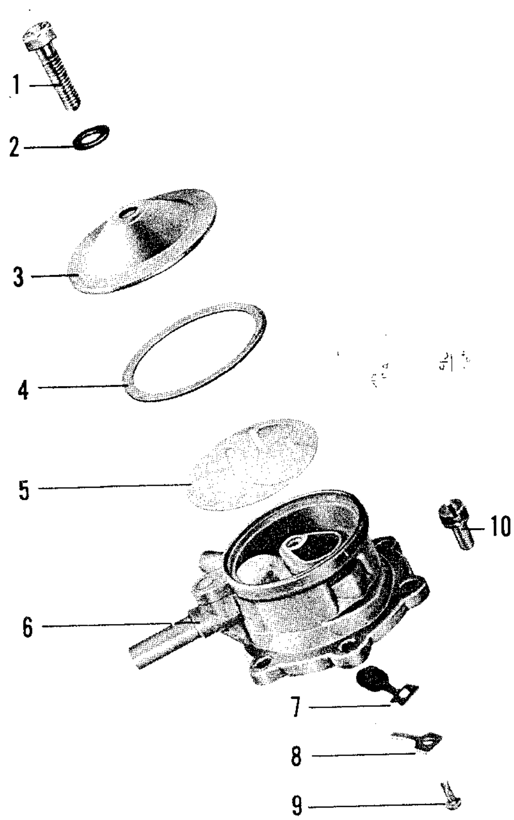


Fig. 3

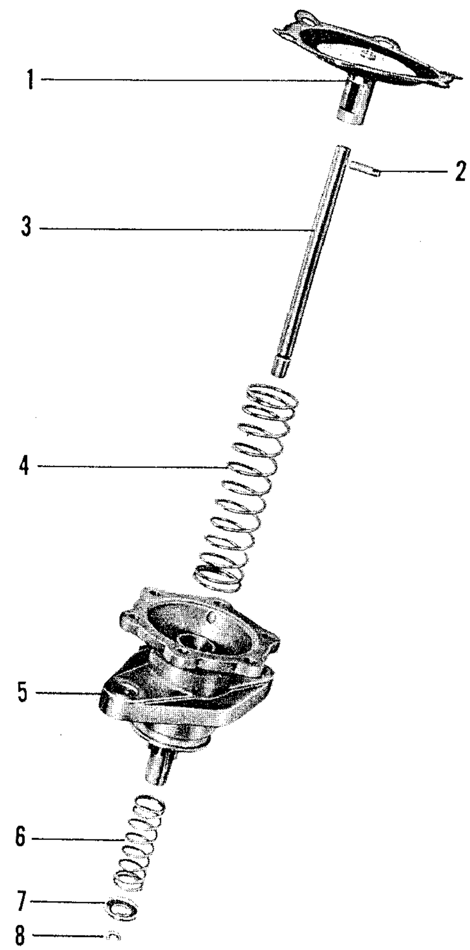


Fig. 4

1 Hex-head bolt
2 Gasket
3 Cover
4 Gasket
5 Fuel screen
6 Pump, upper assembly
7 Leaf spring
8 Valve stop
9 Self-threading screw M 3x8
10 Cheese-head screw w/washer

1 Diaphragm assembly
2 Coupling pin
3 Plunger
4 Diaphragm spring
5 Pump, lower assembly
6 Plunger spring
7 Spring retainer
8 Lock ring

Testing pump pressure

General

The pump pressure is governed by the degree of spring compression on intake stroke. The spring tension is so calibrated that it allows the fuel to enter the carburetor only as long as the float needle valve is open. When the buoyancy of the float forces the float needle valve to shut, pressure builds up in the fuel line and pump housing causing a decrease in pump stroke. In normal operation, the diaphragm stroke amounts to only a few tenths of a milimeter.

The lower assembly is vented through two orifices in the casting. Also, should fuel leak into this part of the pump, it can drain out through the venting holes.

Testing

The pump pressure should be 0.20 to 0.24 atmospheres (ATÜ) when the float needle valve is closed and the engine running at 1,000 to 3,000 rpm. Minimum fuel delivery should be 30 liters per hour, which equals 500 cc per minute, at 4,500 rpm.

The simplest way to check the fuel pump pressure is with the aid of a pressure gauge, by inserting a T-joint into the fuel line between the pump and the carburetor. A fuel valve is built into the fuel line behind the pressure gauge.

Essential to proper pump pressure is correct spring tension and serviceable condition of diaphragm and valves.

Excessive pump pressure results in carburetor flooding and, in almost all cases, leads to oil dilution. A too low pressure results in lean mixture and, thus, a rough running engine, misfiring at high rpm, and loss of power.

Removing and installing fuel pump

Removal

1. Pull fuel hoses off at pump.
2. Remove pump shield.

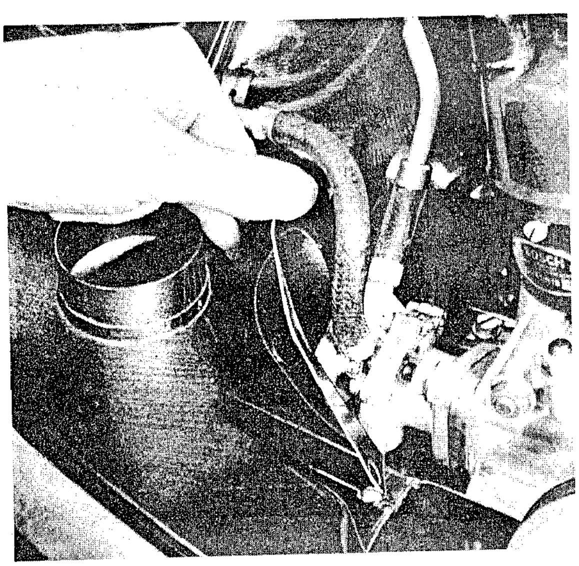


Fig. 5

3. Remove pump attaching nuts at flange.

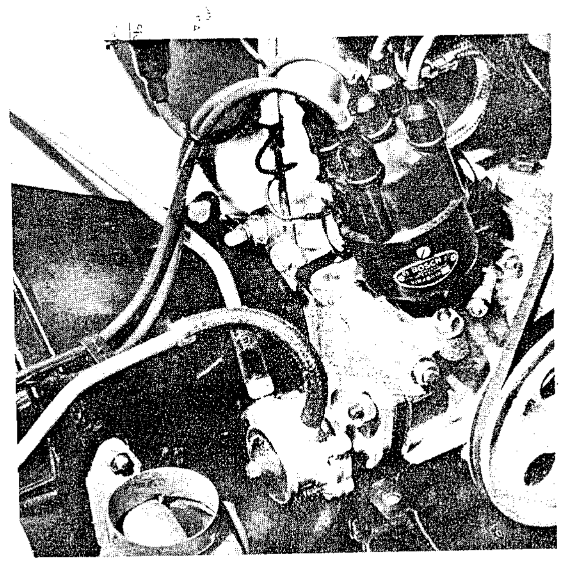


Fig. 6

4. Remove pump and insulating spacer.

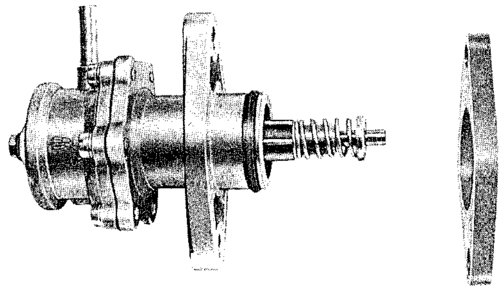


Fig. 7

Installation

Installation is accomplished in reversed order. It should be ascertained that the O-ring is in good condition, otherwise it should be replaced.

Reconditioning fuel pump

Disassembly

1. Remove hex bolt which secures cover.
2. Remove cover and fuel screen.
3. Remove six cheese-head screws securing the upper assembly, withdraw assembly.

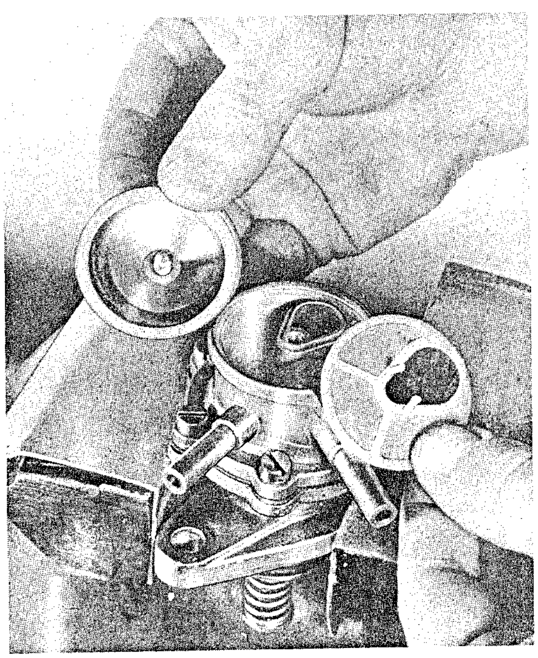


Fig. 8

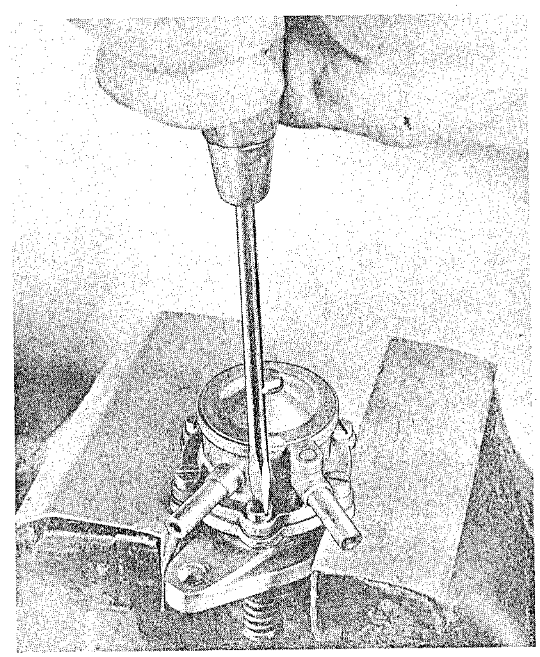


Fig. 9

4. Rest the lower assembly of pump on the diaphragm supporting disc, push spring retainer down with pliers, remove lock ring, spring retainer and spring.

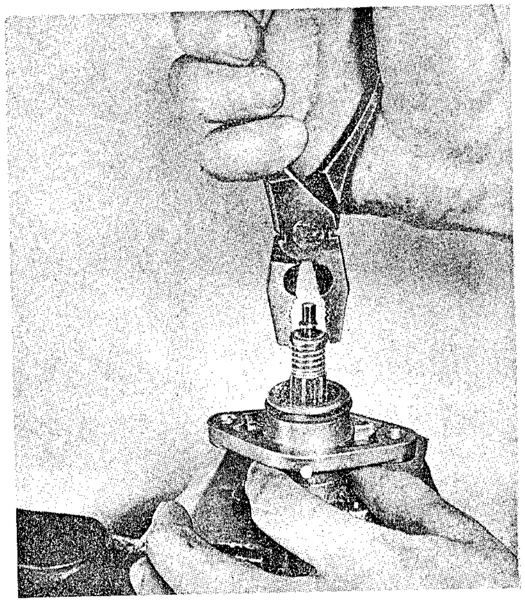


Fig. 10

5. Withdraw the diaphragm-plunger-spring assembly from lower pump casting; ascertain that there is no grit around the lock ring groove in plunger to prevent damaging the oil scraper.

6. Remove coupling pin from actuating plunger with a punch, detach diaphragm from plunger.

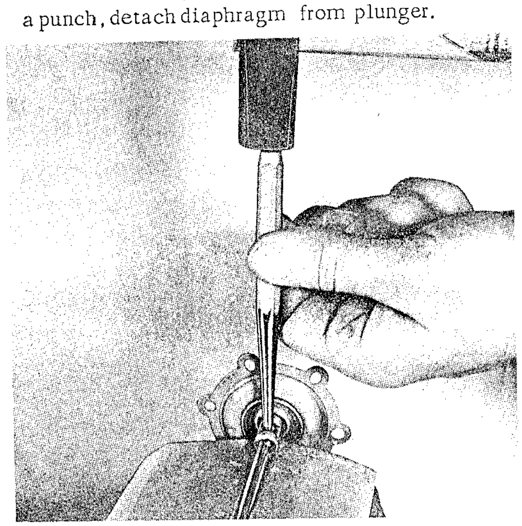


Fig. 11

7. Remove self-threading cheese-head screw at inlet valve and remove leaf spring and spring stop (outlet valve cannot be dismounted).

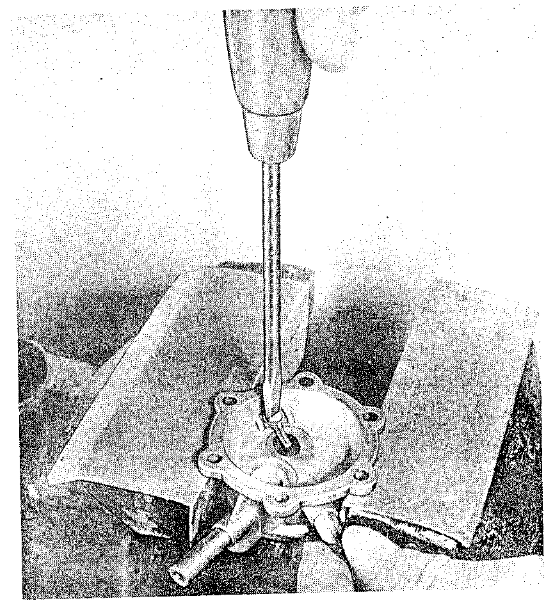


Fig. 12

8. Clean pump components with gasoline.

Reassembly

Reassembly is accomplished in reversed order of the above, noting the following points:

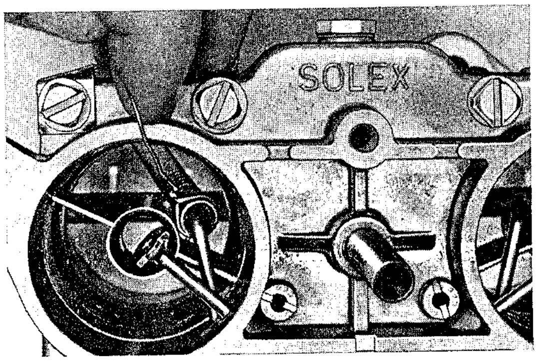
1. Check proper functioning of outlet valve in upper assembly.
2. Check sealing surfaces of inlet valve.
3. Install leaf spring and spring stop, check for proper operation.
4. Reconnect diaphragm and plunger with pin, check free movement of plunger in diaphragm coupling. Center coupling pin in plunger.
5. When mounting pump upper assembly, make certain that diaphragm is not creased. Evenly tighten screws in cross-sequence.
6. Check gasket at pump cover, replace if necessary.

Engine type	1600 C	Notes
Carburetor Zenith	32 NDIX	2 per engine
Characteristics	dependent idling	
Venturi K	28	2 per carburetor
Main jet Gg	0130	2 per carburetor
Air correction jet a	210	2 per carburetor
Idling jet g	55	2 per carburetor
Idling air jet u	140	2 per carburetor
Pump jet Gp	40	2 per carburetor
Accelerating pump nozzle	No. 8 short	2 per carburetor
Float needle valve (spring loaded)	125	1 per carburetor
Float weight	per float 5,2 g	2 per carburetor
Emulsion tube	No. 1 S	2 per carburetor
By-pass ports	1,4/1,4	
Injection quantity (warm season)	0,25 cc from 2 strokes, each nozzle	2 nozzles per carburetor
Injection quantity (cold season)	0,35 cc from 2 strokes, each nozzle	2 nozzles per carburetor
Float level	18,5 $\pm$ 1,0 mm .728" $\pm$ .04"	mesured with cover closed and a test pressure of 1,8 m WC

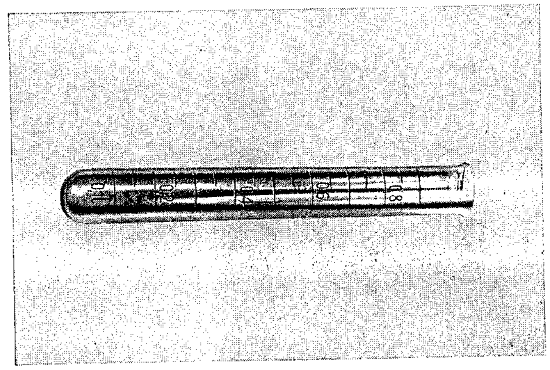
Main jet metering is of great importance when operating at considerably varying altitudes for which the following rule-of-thumb may be applied: Change main jet calibration by 6% for each 1,000 m (3,280') altitude variation. For example: normal main jet calibration at an altitude of 400 m (1,312') is 0115; proper jet size for an altitude of 1,400 m (4,592') is 0110.

Liquid Graduate

P 25a



Example of use


Tool

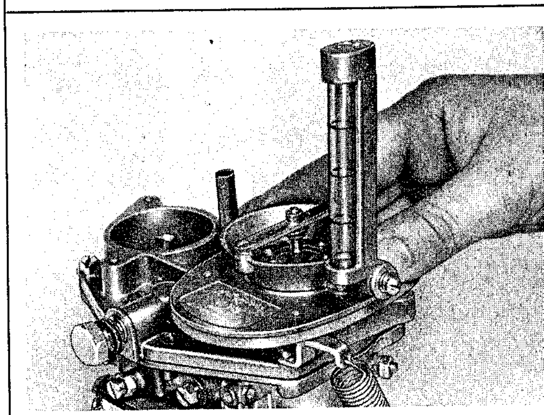
Use: To check injection quantity

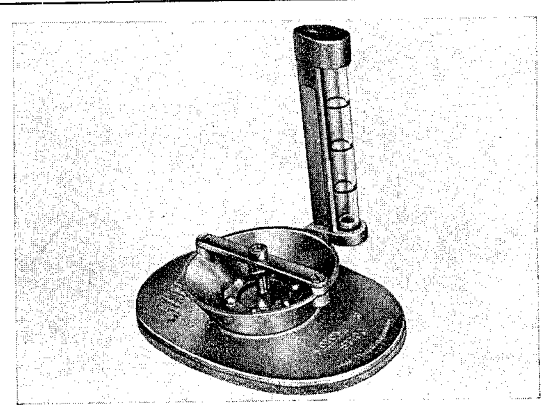
See operation page SF 15

Subject to change

Carbureter Synchronizing Unit

P 75


Example of use


Tool

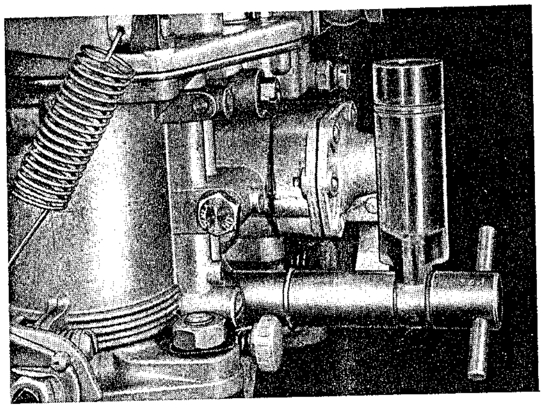
Use: To synchronize both carbureters

See operation page SF 13

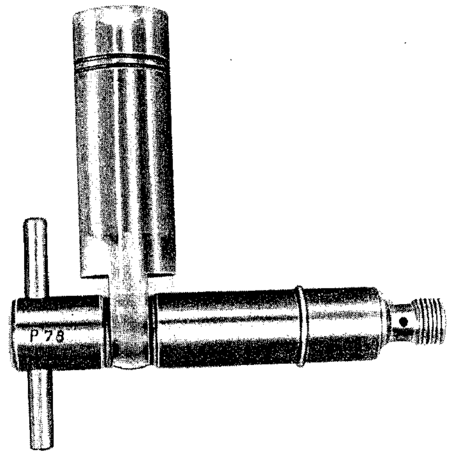
Subject to change

Float Level Gauge

P 78



Example of use



Tool

Use: To check float level Carbureter Solex 40 PII-4

See operation page SF 16

Subject to change

CARBURETOR ADJUSTMENT DATA

Engine type	1600 SC	Notes
Carburetor type	Solex 40 PII-4	2 per engine
Venturi K	32	2 per carburetor
Main jet Gg	0115	2 per carburetor
Air correction jet a	180	2 per carburetor
Idling jet g	57, 5	2 per carburetor
Idling air jet u	1, 8	2 per carburetor
Injection tube No.	72	1 per carburetor
Pump jet Gp	50	2 per carburetor
Accelerating pump nozzle	high-type with 0, 4 restrictor	2 per carburetor
Float needle valve (spring-loaded)	175	1 per carburetor
Float	7, 4g	1 per carburetor
Emulsion tube	No. 25	2 per carburetor
Main jet carrier	6, 0	2 per carburetor
By-pass ports	1, 7/1, 4/1, 0	
Injection quantity (warm season)	0, 45 cc (.122 fl. dram) from 2 strokes, each nozzle	2 nozzles per carburetor
Injection quantity (cold season)	0, 65 cc (.176 fl. dram) from 2 strokes, each nozzle	2 nozzles per carburetor

Main jet metering is of great importance when operating at considerably varying altitudes for which the following rule-of-thumb may be applied: Change main jet calibration by 6% for each 1, 000 m (3, 280') altitude variation. For example: normal main jet calibration at an altitude of 400 m (1, 312') is 0115; proper jet size for an altitude of 1, 400 m (4, 592') is 0110.

INDEX

Supplements for Group R: Rear Axle and Transmission

Change in Transmission Front Suspension

The change effects all vehicles after identification No. (chassis No.):

Coupe	110 407
Cabriolet/Hardtop	153 023
Roadster	87 492

Beginning with transmission No. 35 001 a gear box cover with two support brackets is used, which connects the transmission by way of two rubber cushions to the rear suspension tube. The torque rod of the centrally supported transmission is no longer required and is omitted.

The installation of the transmission is accomplished in the same sequence as in section R, operation 1 RA, observing the following points in particular:

1. Before installation the two rubber mounts with sockets must be installed on the brackets of the gear box cover.

2. When engaging the transmission supports into the mounts on the body, note that the body section lies between the two clamping plates.

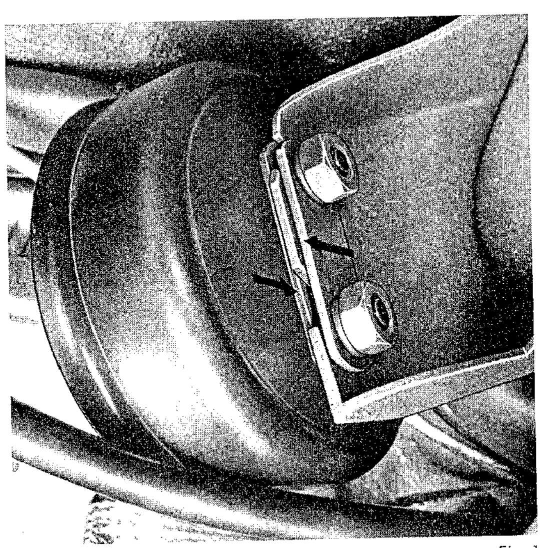


Fig. 1

Throttle Linkage

The throttle cable bell crank has been mounted on the bearing plate (intermediate plate) instead of the cover. For this reason an extension is required between the cable and bell crank.

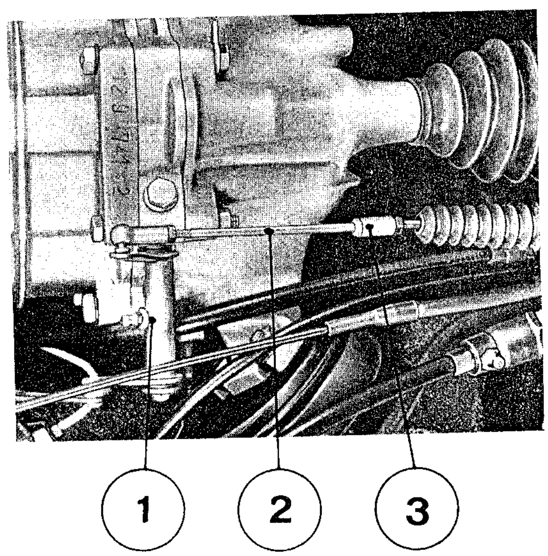


Fig. 2

① Bell crank
② Connector
③ Extension

Removing and Installing Gear Shift Shaft

The removal and installation of the shift linkage is accomplished in the same sequence as in section R, operation 21 RA, observing the following points in particular:

1. After removing the shift lever and base remove the shift shaft guide and tensioner by removing the allen head screws.

2. The shift shaft can be pulled forward and out of the floor tunnel after disconnecting the shaft from the rear shift link.

3. The installation is accomplished in the reverse order of removal.

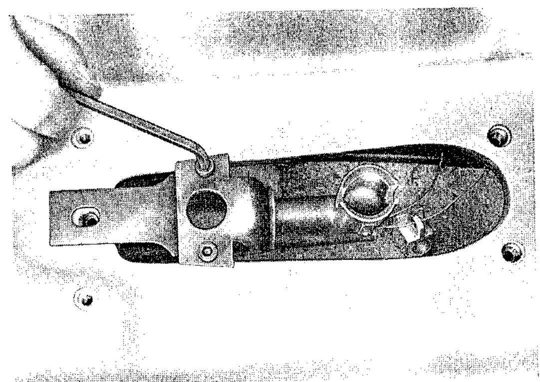


Fig. 3

Shift Linkage Connector

A sliding coupling has been incorporated in the rubber connector of the shift linkage to absorb the axial movement normally transmitted from the gear box to the shift shaft.

Note

The adjustment of the shift linkage is to be performed as in section R, operation 21 RA.
Incorrect adjustment renders the sliding coupling useless.

Old type connector

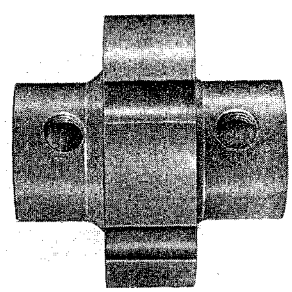


Fig. 5

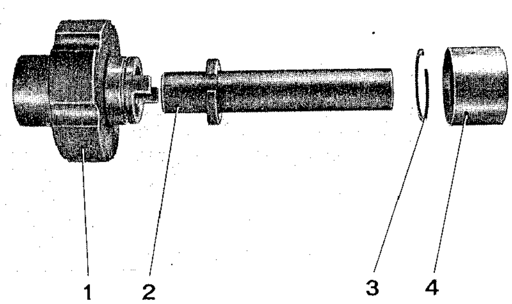


Fig. 4

Only complete couplings can be delivered.

① Rubber connector
② Sliding section
③ Lock ring
④ Collar

TRANSMISSION 741

(two point front suspension)

Section View

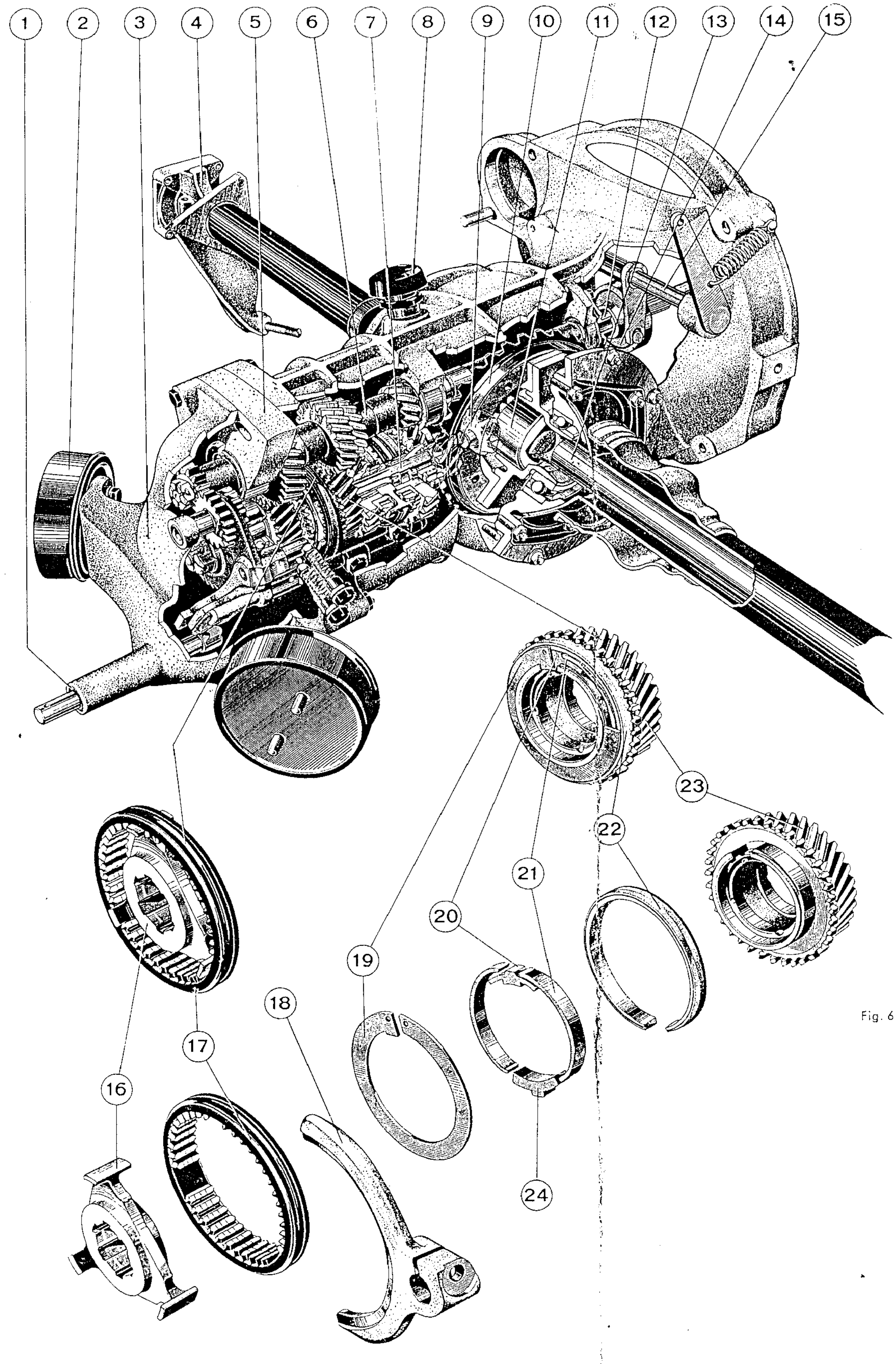


Fig. 6

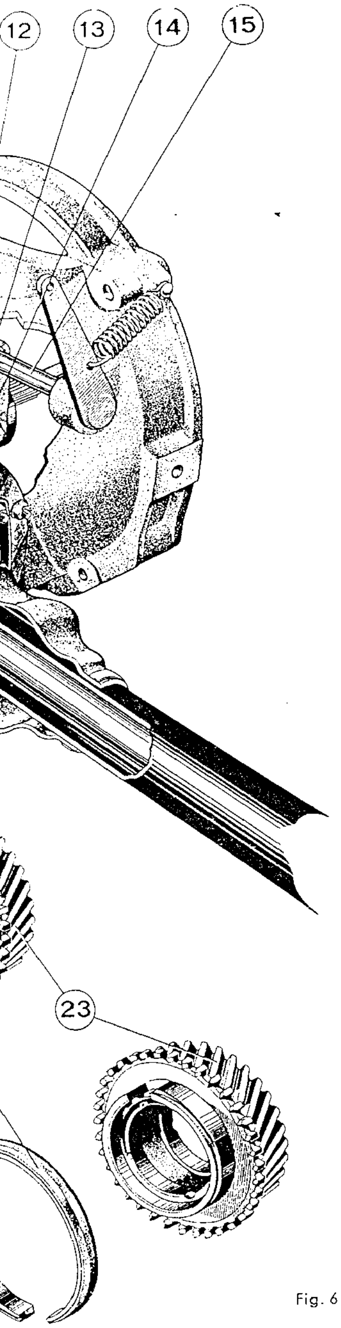


Fig. 6

Porsche Rear Axle and Lock Synchronized Gearbox, Type 741

(Section View)

1. Oil Seal
2. Front transmission mounting
3. Gearbox cover
4. Axle tube end flange with shock absorber extension
5. Intermediate plate
6. Main shaft
7. Pinion shaft and pinion
8. Breather
9. Differential pinion
10. Ring gear
11. Differential side gear
12. Clutch release bearing guide
13. Rear axle shaft
14. Clutch release bearing
15. Clutch release pivot shaft
16. Spider
17. Sliding sleeve
18. Selector fork
19. Lock ring
20. Brake band stop
21. Brake band
22. Synchronizing ring
23. Third gear on pinion shaft with synchronizing element
24. Slider

Special Gear Combinations

Converting the Pinion Shaft

For competition events it may become necessary to install a gear set to match the particular circuit. In the following, the various changes required to use a third gear in the place of a fourth gear are shown. The disassembly and assembly of the pinion shaft is accomplished in the same sequence as in section R, operation 3 and 6 RA, observing the following points in particular:

1. Carefully select the correct ratio and note that both gear wheels have the same pairing number. Always keep needle bearings, bearing sleeve, and gear as a unit. Do not use different gear wheels on a needle bearing which has run in another gear.

2. Install new fourth gear inner bearing race (bearing sleeve) and install needle bearing for third gear. This bearing has a smaller cage as shown in Fig. 7.

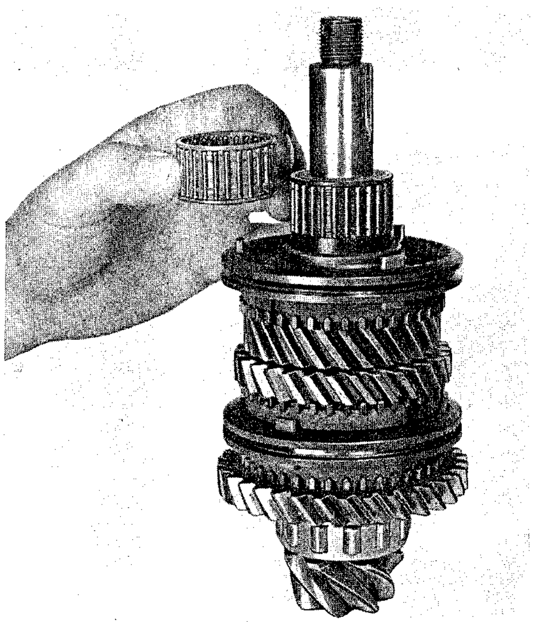


Fig. 7

3. In case of gears where the sliding sleeve will not pass over the gear teeth as in the case of 3 E, install the sliding sleeve before mounting the gear.

4. Install gear with synchronizing components.

5. Install cup shaped spacer washer on shaft.

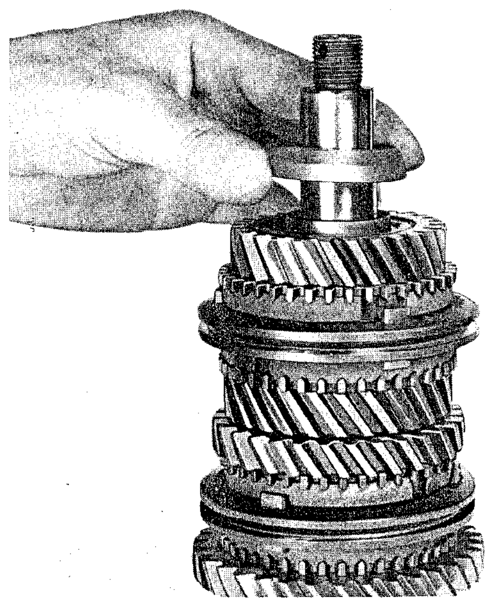


Fig. 8

6. To tighten pinion shaft nut using stand P 31 with P 31a, engage third gear.

Note

Type 741 transmission after No. 33 392 can be converted easily as described in the foregoing section. The differences lie in that a third gear needle bearing is used on a fourth gear innner race, a third gear is used in place of the fourth gear, and a cup shaped spacer washer is used in place of the flat spacer and thrust washer. The changes on the main shaft are that a third gear wheel is used in place of the fourth gear. This gear is narrower than the gear normally used and therefore requires a spacer ring.

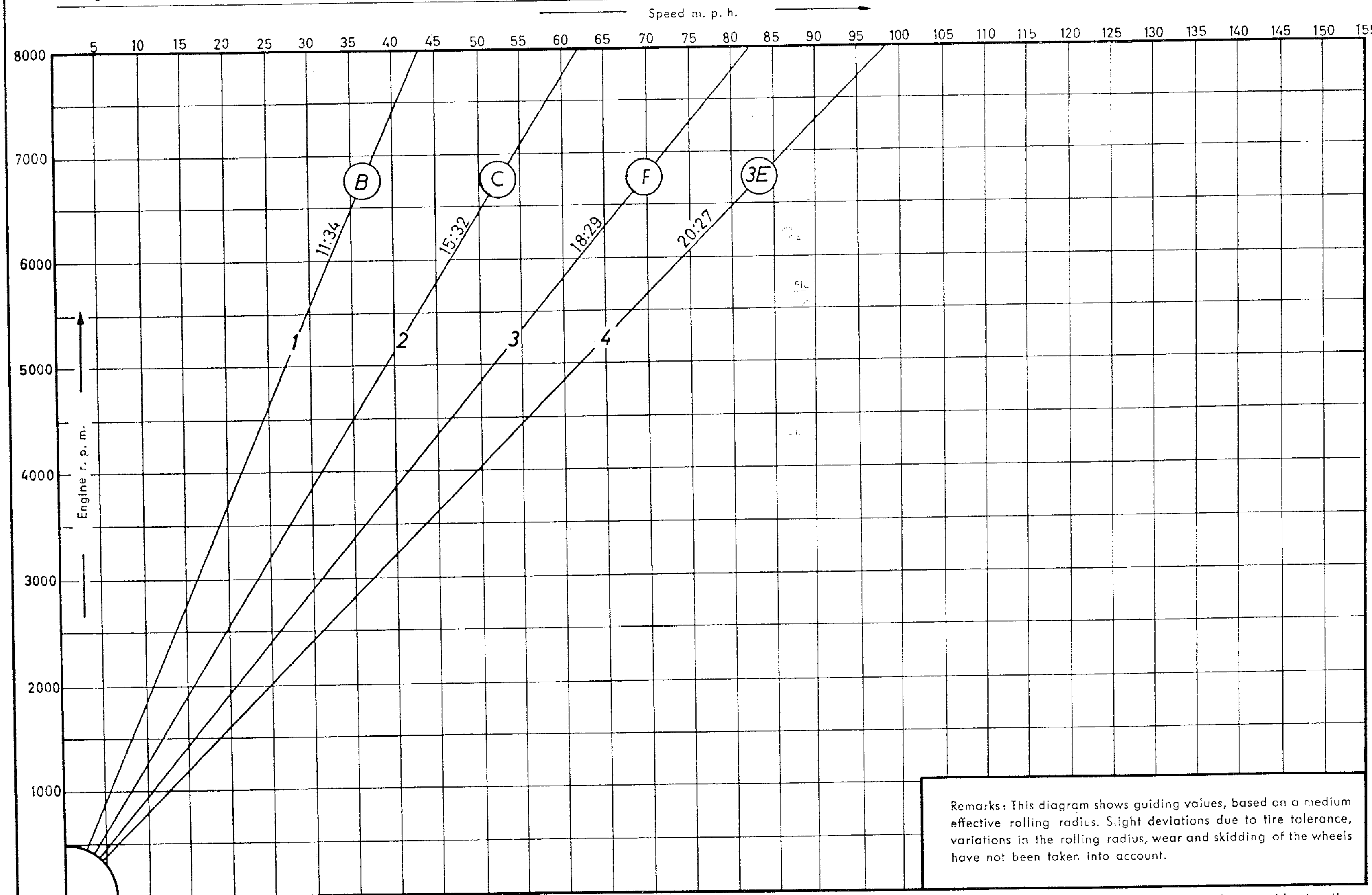
PORSCHE

Transmission Diagram

Type 356 B/1600 GS-Carrera GT (Gran Turismo) Special gear ratio for hill climbing

Tires: 165-15 or 5.90-15

Bevel gear Crown wheel ratio 7 to 31



Remarks: This diagram shows guiding values, based on a medium effective rolling radius. Slight deviations due to tire tolerance, variations in the rolling radius, wear and skidding of the wheels have not been taken into account.

Subject to change without notice

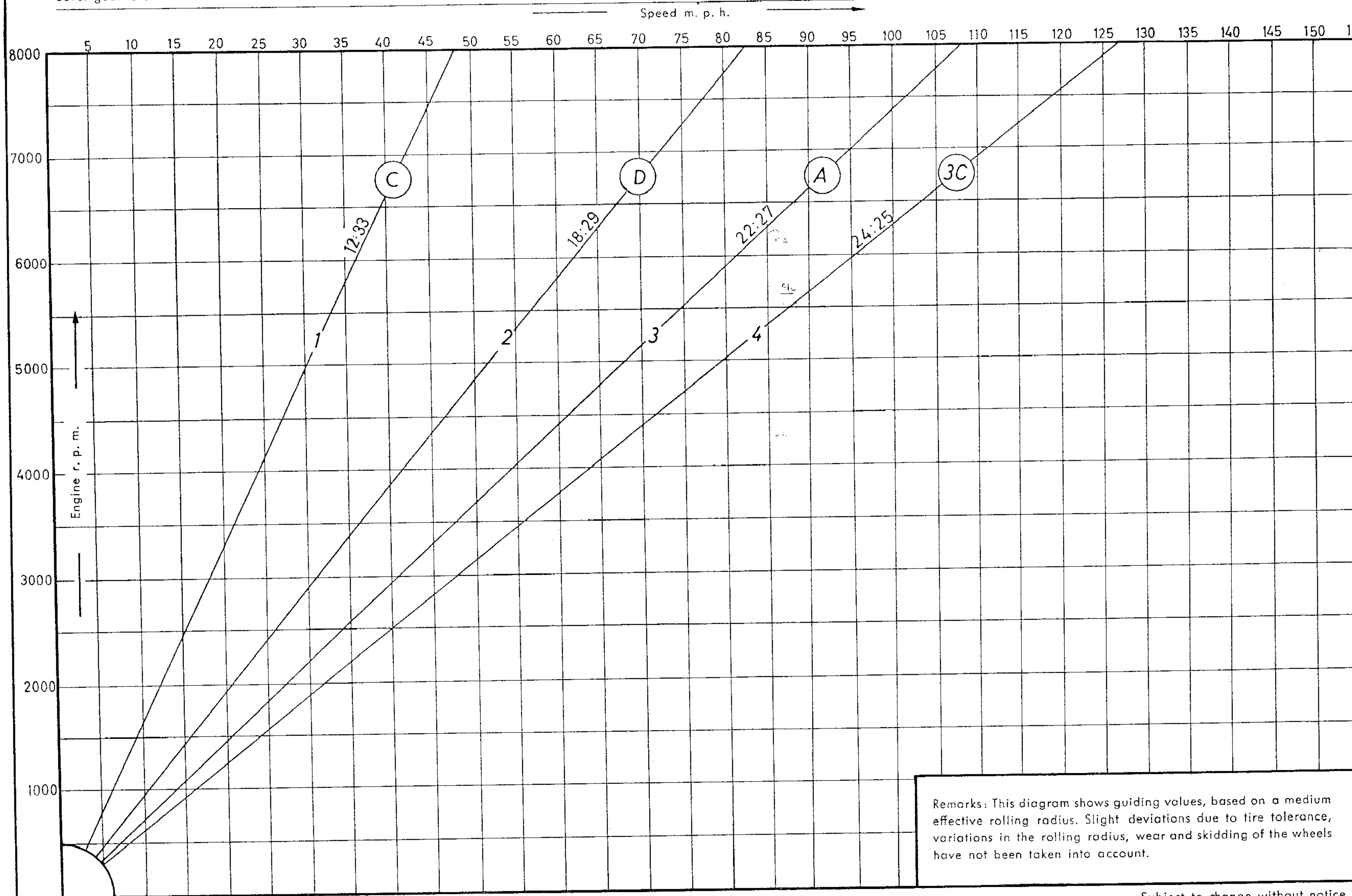
PORSCHE

Transmission Diagram

Type 356 B/1600 GS-Carrera GT (Gran Turismo) Special gear ratio for the Nürburgring

Bevel gear Crown wheel ratio 7 to 31

Tires: 165-15 or 5.90-15



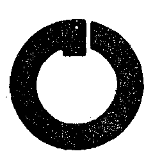
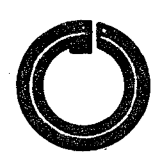
Remarks: This diagram shows guiding values, based on a medium effective rolling radius. Slight deviations due to tire tolerance, variations in the rolling radius, wear and skidding of the wheels have not been taken into account.

Subject to change without notice

TYPE 741 TRANSMISSION

Commencing with transmission Serial No. 50 001

Shown below for comparison with the previous version are modifications incorporated into transmissions beginning with serial No. 50 001. Service operations outlined in the 356 B Service Manual and supplements are not affected by these changes.

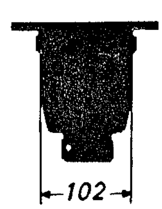
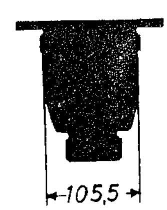
Up to Transmission No. 49 500		Beginning with Transmission No. 50 001	
Nomenclature, Part Number, and Interchangeability	Characteristic	Nomenclature, Part Number, and Interchangeability	Characteristic
Brake band segment 716.302.316.02 interchangeable with 741.302.316.00, but only in conjunction with stop 741.302.317.00		Brake band segment 741.302.316.00	
Stop 716.302.317.02 inter - changeable with 741.302.317.00 but only in conjunction with brake band segment 741.302.316.00		Stop 741.302.317.00	
Locking ring 716.302.321.01		Locking ring 741.302.311.00 reinforced	

Second Edition of this page, November 1961

TYPE 741 TRANSMISSION

Beginning with transmission Serial No. 51017

Shown below for comparison with type 741 transmission up to transmission No. 51016 are modifications incorporated into transmissions beginning with transmission No. 51017. Service operations outlined in the 356 B Service Manual and supplements are not affected by these changes.

Up to Transmission No. 51016		Beginning with transmission No. 51017	
Nomenclature, Part Number, and Interchangeability	Charac-teristic	Nomenclature, Part Number, and Interchangeability	Charac-teristic
Gearbox housing 741 . 301 . 010 . 00 light alloy casting	See text	Gearbox housing 741 . 301 . 010 . 00 light alloy casting with infused cast iron bearing seat inserts	See text
Intermediate plate 741.301.221.01 light alloy casting	See text	Intermediate plate 741.301.221.01 light alloy casting for gearbox 741/0A and 741/2A. Intermediate plate 741.301.221.10 cast iron for gearbox 741/8A	See text
Input shaft 519.20.249, 1st speed with 11 teeth. (Usable only with differential housing 519.32.101)		Input shaft 741.302.101.10, 1st speed with 11 teeth	
Differential housing 519 . 32 . 101		Differential housing 741.332.101.00 usable only with input shaft 741.301.101.10 *	
No. 2 gear for 1st speed, gear tooth width 10,8 mm		No. 2 gear for 1st speed, gear tooth width 12.4 mm. This gear cannot be installed in gearbox housings preceding No. 51 017 *	

* For the present only installed in cars with engine type 1600 S-90

SERVO-THRUST SYNCHRONIZATION

Beginning with Gearbox No. 50 001

Figure 1 shows, in addition to component parts numbered 1 through 8, a cross-sectional view of the Porsche servo-thrust synchronization with the two corresponding gears, either of which couples with the output shaft by pushing the sliding sleeve to left or right, respectively.

The clutch carrier (3) is firmly attached to the gear and carries the synchronizing ring (4), slider (5a), stop (6), and the two brake band segments (7). The assembly is kept in place by the locking ring (8). Located between the two gears, which rotate freely on the output shaft, is the sliding sleeve (1); the sleeve is free to move sideways even though it is in constant lock with the output shaft by way of the three-pronged spider (2).

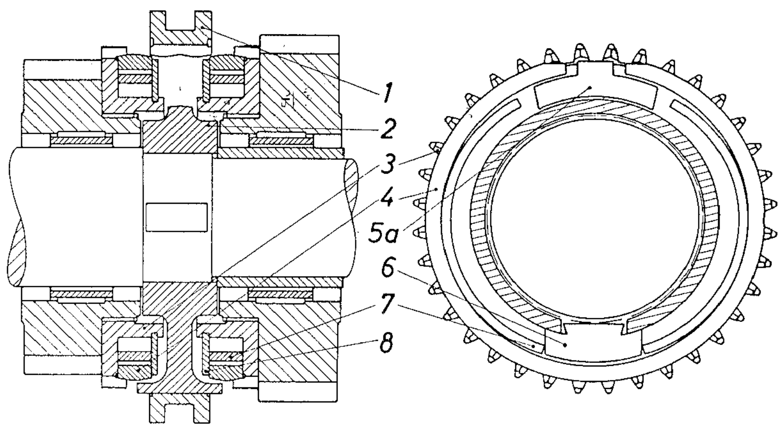


Fig. 1

The Porsche synchronization operates on the servo-thrust principle. The frictional force, which is created by pushing the sliding sleeve onto the synchronizing ring, is multiplied by the servo-thrust mechanism located within the synchronizing ring without creating additional resistance to the gearshift lever. The synchronization components automatically control the extent of the servo action required in each particular instance, thus resulting in quick shifts with little effort.

When a shift is made with the gears at standstill, the selector fork moves the synchronizing ring from the center position and engages it with the gear teeth in the synchromesh drive ring of the respective gear. In the above process the synchronizing ring compresses to fit inside the sliding sleeve and then comes to rest in a groove machined on the inner surface of the sliding sleeve. This requires only the amount of force needed to overcome the static resistance of the synchronizing ring, which results from the tension of the ring and the angle inclination of the cone.

It is not possible to push the sliding sleeve beyond the clutch carrier because the travel space between gearbox front cover and the intermediate plate has been appropriately limited and, in addition, gears of the 1st and 2nd speed are larger than the inside diameter of the sliding sleeve.

When a shift is made with the car in motion, entirely different conditions prevail. The synchronizing mechanism must equalize the difference in rotation speed existing between the output shaft and gear 2 (countergear) of the gear to be engaged; it must also prevent that the sliding sleeve comes into contact with the toothed drive ring on the clutch carrier prior to equalization of the rotation speed.

The mechanical connection between the engine and gearbox must be positively broken whenever shifts are made; that is to say, the clutch must be fully disengaged. This is necessary because the clutch plate represents part of the mass to be synchronized and, thus, must be accelerated or slowed down, as the case may be.

As illustrated in Fig. 2. the friction contact between the sliding sleeve (1) and the synchronizing ring (4) causes the synchronizing ring to slip somewhat, with one of its ends coming to rest against the slider (5a). The slider pushes against one of the brake band segments (7) which, in turn, presses against the inner surface of the sliding sleeve (4), with the stop (6) acting as its anchor. As a result, radial thrust is exerted upon the sliding sleeve (4) by the brake band segment (7) and by the stop which pivots on its base.

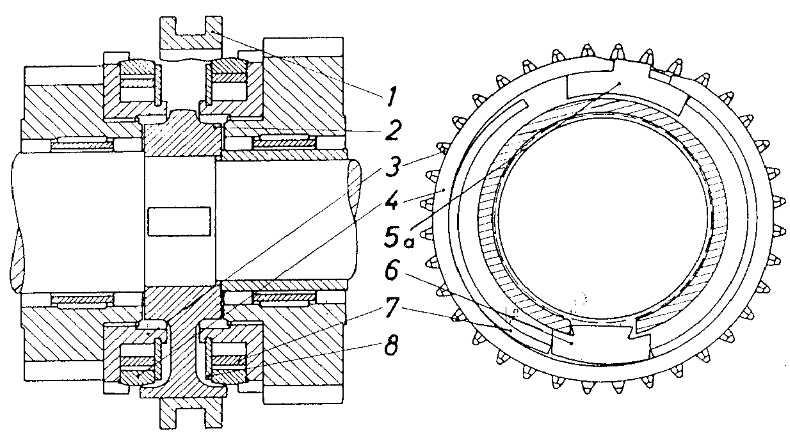


Fig. 2

At the beginning of the synchronization process, the frictional forces existing between the sliding sleeve and synchronizing ring were caused only by the spring tension of the synchronizing ring. As the synchronization process continued, the servo-thrust mechanism came into action and began to exert an additional and increasing radial thrust upon the synchronizing ring.

Thus, the synchronization utilizes a servo-thrust coming from within and exerted upon the sliding sleeve via the brake band segments. The servo-thrust mechanism is so designed that the servo effect governs itself and prevents a self-lock.

As long as there is a difference in rotation speed between the sliding sleeve, with its coupled output shaft, and the gear to be engaged, the radial thrust of the servo mechanism prevents a reduction of the diameter of the synchronizing ring and, in this way, prevents an engagement of the sliding sleeve. On the other hand, the frictional forces at the synchronizing surfaces decrease in proportion to a decrease in rotation speed difference existing between the sliding sleeve and respective gear.

When rotation speed of both parts equalize, the servo-thrust mechanism relaxes, the brake band segment is relieved and creases to exert resistance towards the necessary diameter reduction of the synchronizing ring, thus making it possible to push the sliding sleeve over the synchronizing ring with very little effort until the synchronizing ring is caught in the arresting groove inside the sliding sleeve (Ref. Fig. 3). A shift lock in respective gear positions is no longer necessary.

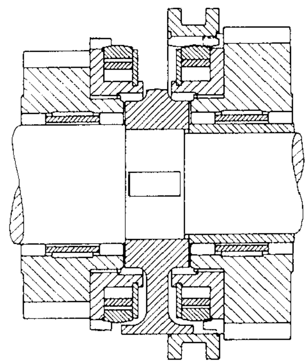


Fig. 3

All forward speeds of the gearbox are equipped with identical synchronization and servo-thrust components, with the exception of the 1st speed which is used for starting. Care was taken to ensure that the frequently shifted 1st speed engages with little effort when the car is not in motion. This has been accomplished by installing in the synchronization mechanism of the 1st gear only one brake band segment and by changing the shape of the slider.

Figure 4 illustrates the synchronization at time of engagement of 1st speed, with engine running and car standing still. Due to the fact that the idle rpm of the engine are low and the clutch plate rpm drop after clutch is disengaged, it is very easy for the synchronization mechanism to slow down the gear for engagement. The slipping synchronizing ring with one end presses the slider which rests with its tab against the clutch carrier. Since the tab is slanted, the slider is raised against the inner surface of the synchronizing ring whose frictional contact is increased just enough to permit a clash-free, effortless engagement of the gear.

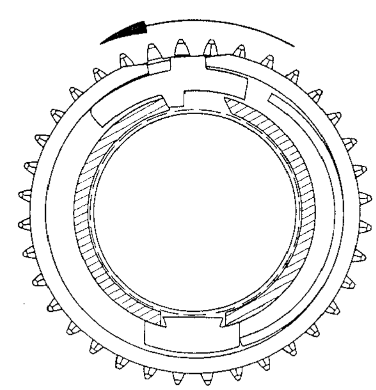


Fig. 4

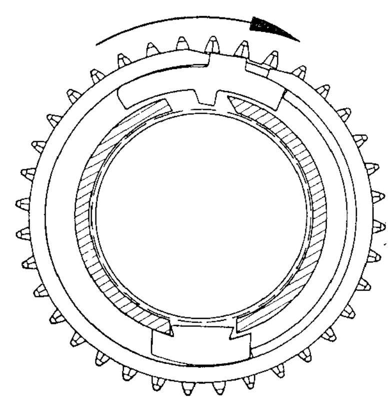


Fig. 5

Figure 5 illustrates the synchronization mechanism at time of engagement of 1st speed with car in motion. Contrary to engagement of 1st speed with car standing still, the gear is not slowed down but has to be accelerated. Therefore, the normal brake band segment has been installed on the side of the servo-thrust mechanism which is to function in this case to ensure the full benefit of the servo-thrust effect obtained in all other gears.

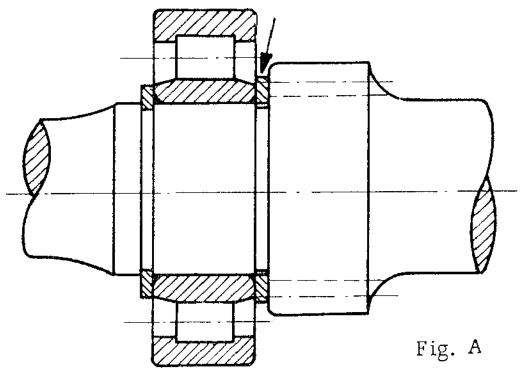


Fig. A

Fig. A illustrates the standard location of an intermediate ring between gear 1 for the 1st speed on the input shaft 741. 302. 101. 10 and the roller bearing, from transmission No. 51017.

The intermediate ring has spare part No. 741. 302. 296. 00.

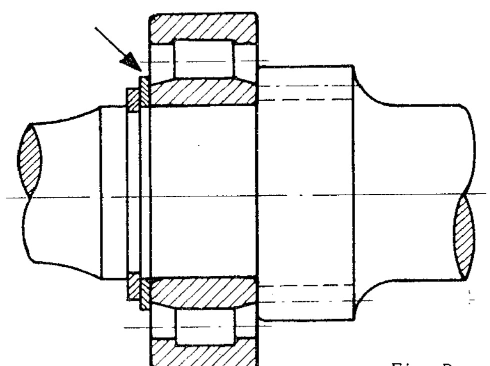


Fig. B

Fig. B illustrates the location of the intermediate ring when installed with input shaft 741. 302. 101. 10 in a transmission housing 644. 20. 010 or 716. 301. 010 or 741. 301. 010. 00.

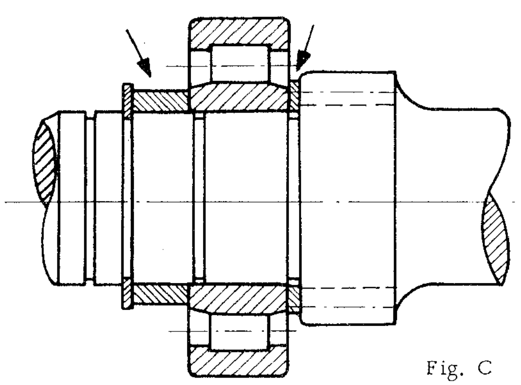


Fig. C

Fig. C illustrates the location of the intermediate ring and distance ring, when installed with input shaft 519. 20. 249 in a transmission housing 741. 301. 010. 10.

The distance ring has spare part No. 644. 20. 209.

TRANSMISSION 741

Starting with gearbox No. 50 001

Section View

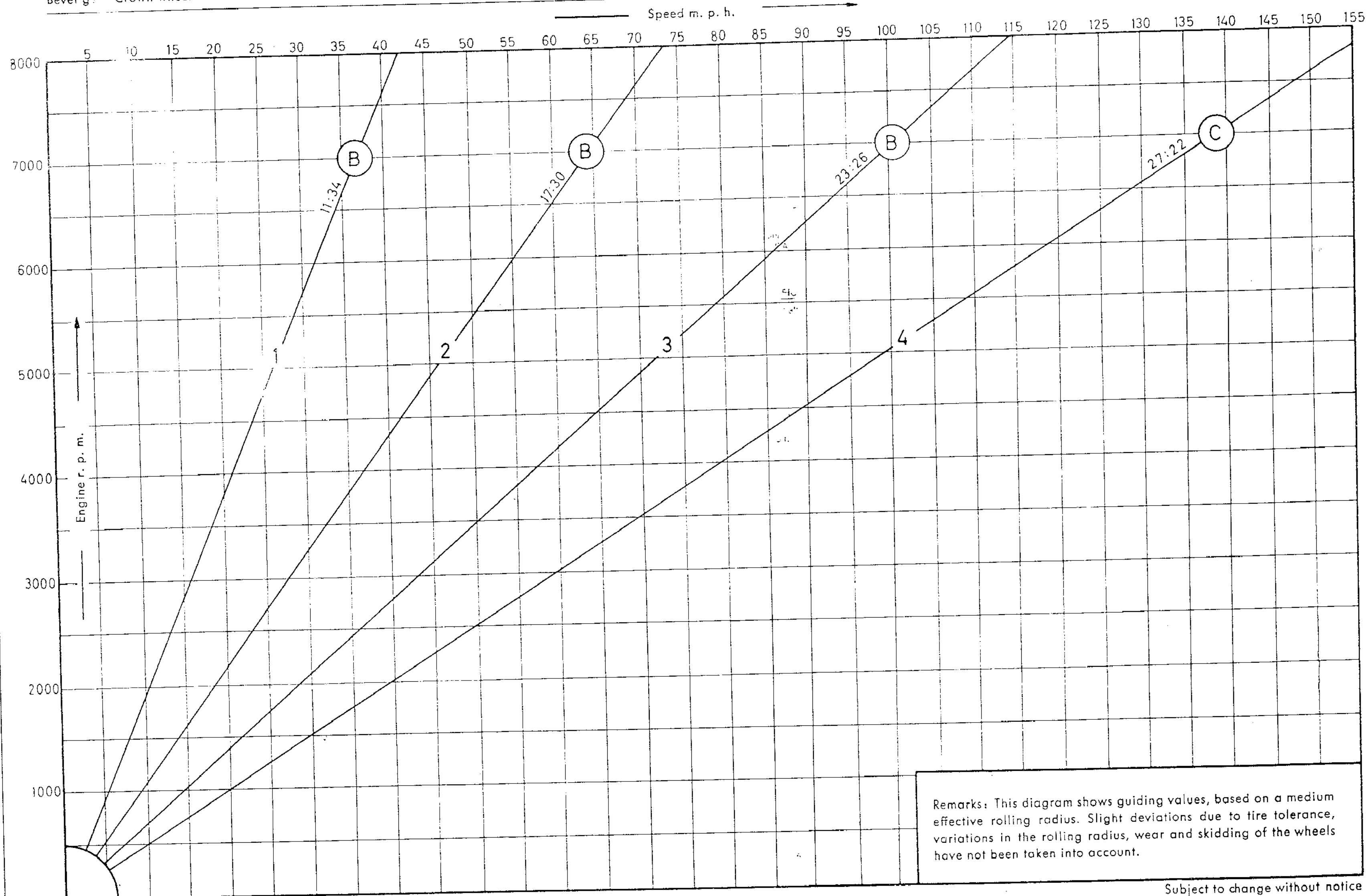
PORSCHE

Type 356 B / 1600, - / 1600 S Coupé, Cabriolet, Hardtop, Roadster
Equipment for Europe

Transmission Diagram
741 / 0 A

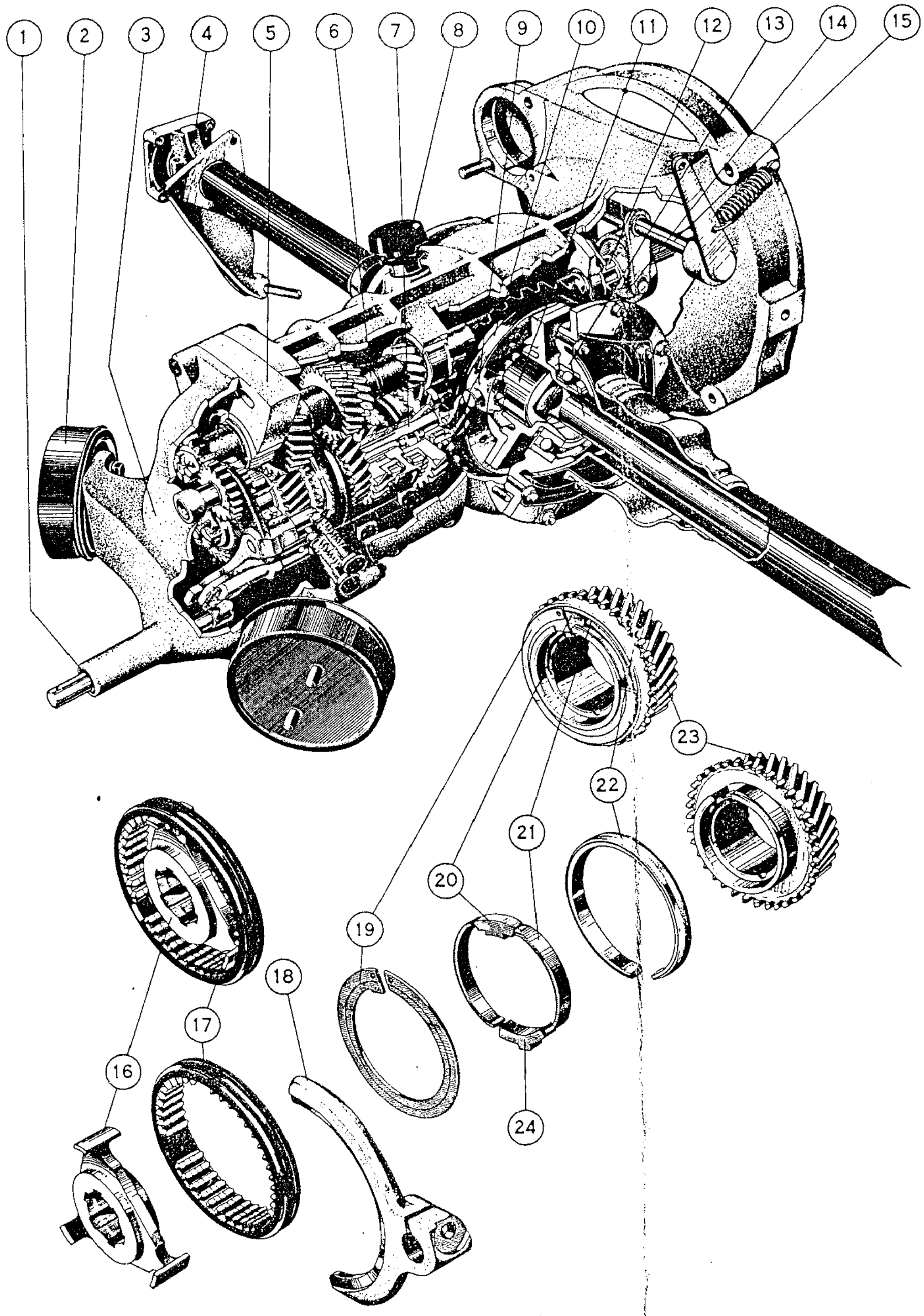
Tires: 5.60 – 15

Bevel g... - Crown wheel ratio 7 to 31



Remarks: This diagram shows guiding values, based on a medium effective rolling radius. Slight deviations due to tire tolerance, variations in the rolling radius, wear and skidding of the wheels have not been taken into account.

Subject to change without notice



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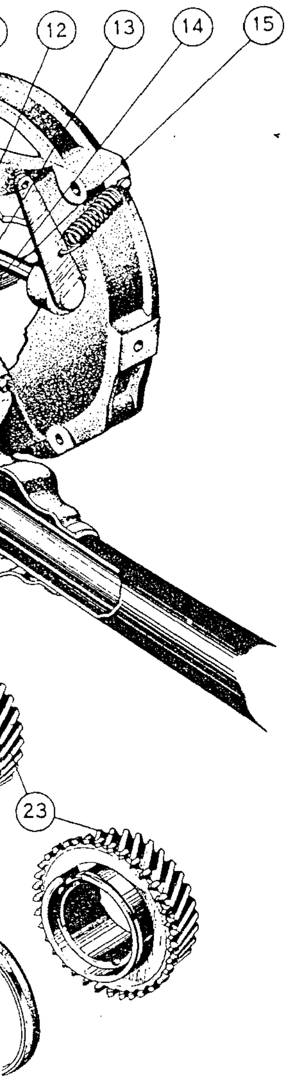


Porsche Rear Axle and Lock Synchronized Gearbox, Type 741

(Section View)

1. Oil Seal
2. Front transmission mounting
3. Gearbox cover
4. Axle tube end flange with shock absorber extension
5. Intermediate plate
6. Main shaft
7. Pinion shaft and pinion
8. Breather
9. Differential pinion
10. Ring gear
11. Differential side gear
12. Clutch release bearing guide
13. Rear axle shaft
14. Clutch release bearing
15. Clutch release pivot shaft
16. Spider
17. Sliding sleeve
18. Selector fork
19. Lock ring
20. Brake band stop
21. Brake band
22. Synchronizing ring
23. Third gear on pinion shaft with synchronizing element
24. Slider

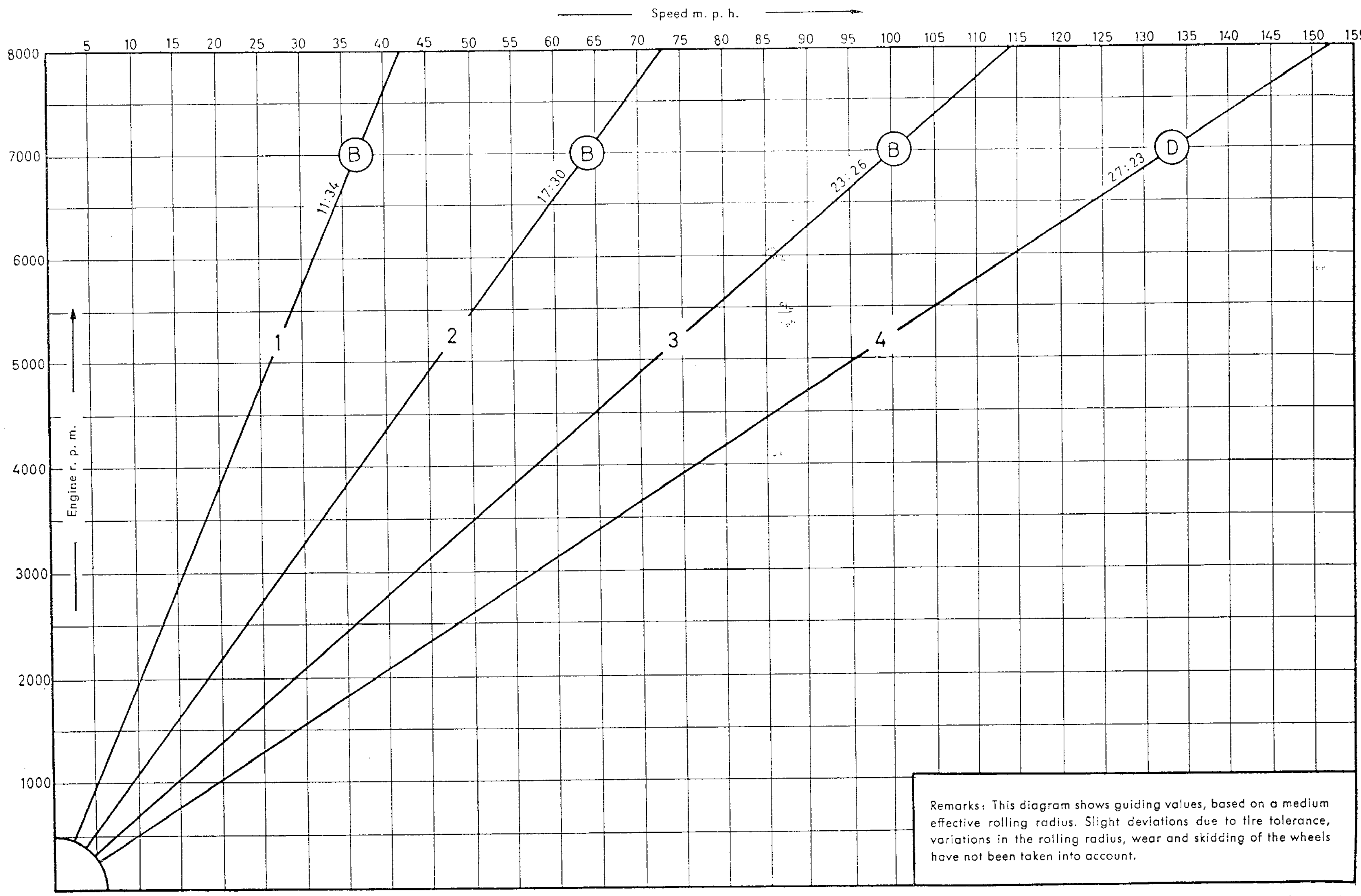
PORSCHE

Type 356 B / 1600, - / 1600 S Coupé, Cabriolet, Hardtop, Roadster
Equipment for USA

Transmission Diagram
741/2 A

Bevel gear Crown wheel ratio 7 to 31

Tires: 5.60–15



Remarks: This diagram shows guiding values, based on a medium effective rolling radius. Slight deviations due to tire tolerance, variations in the rolling radius, wear and skidding of the wheels have not been taken into account.

Subject to change without notice

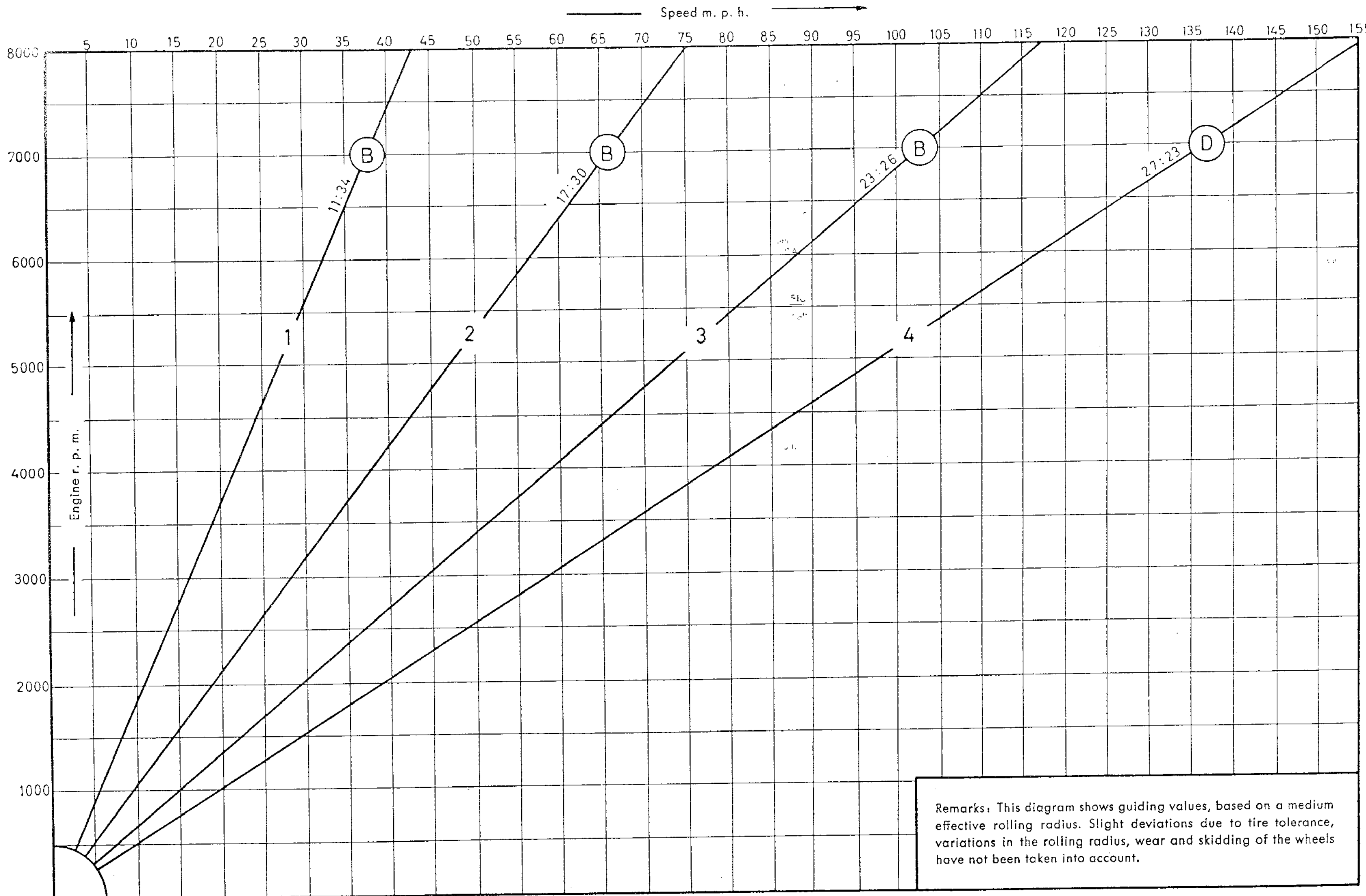
PORSCHE

Type 356 B / 1600 S-90 Coupé, Cabriolet, Hardtop, Roadster
Equipment for Europe and USA

Transmission Diagram
741/2 A

Bevel gear Crown wheel ratio 7 to 31

Tires: 165–15



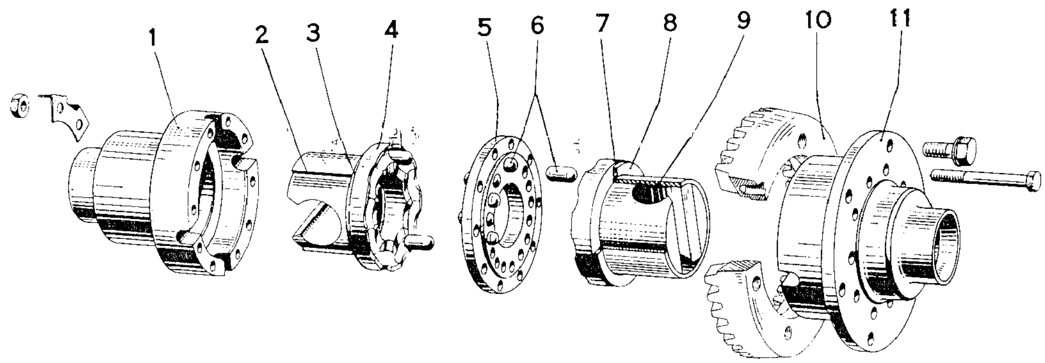
Remarks: This diagram shows guiding values, based on a medium effective rolling radius. Slight deviations due to tire tolerance, variations in the rolling radius, wear and skidding of the wheels have not been taken into account.

Subject to change without notice

ZF (AXIAL SELF SERVO) LIMITED SLIP DIFFERENTIAL

Description

The ZF limited slip differential is a self activating curved track geared unit which retards differential rotation by friction brakes. In place of pinions and side gears a driver plate runs between two curved track elements. The sliding studs of the driver plate exert high axial force on the curved tracks when transmitting power. The hemispherical ends of the sliding studs effect a high pressure angle on the curved tracks thereby pressing them against the differential carrier. This pressure supplies the braking force which prevents differential movement of the two curved tracks. The difference in the number of curves on the two tracks allows the two elements to rotate in opposite directions as a customary differential gear. One track has eight and the other nine curves.



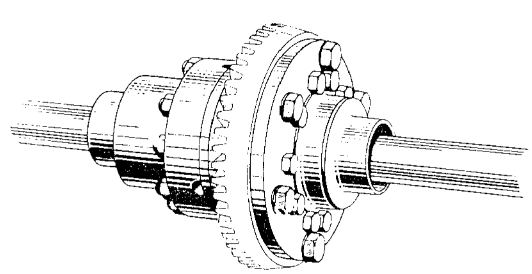
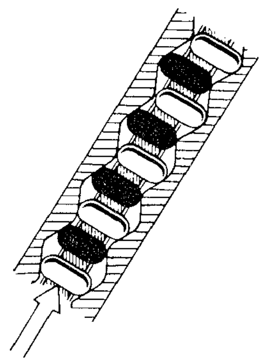


Fig. 7

1. Carrier half without flange
2. Axle joint body
3. Brake ring
4. Curved track element
5. Driver plate
6. Slidingstud
7. Curved track element
8. Brake ring
9. Axle joint body
10. Ring gear
11. Carrier half with flange

The torque from the ring gear is transmitted through the differential carrier, which is composed of two halves and the driver plate, to the sliding studs running in the curved tracks. Since the curved tracks have a different number of curves they do not have parallel surfaces. For this reason the sliding studs are prevented from advancing past the curved tracks effecting rotation of the axle shafts together with the driver plate. Under full load the differential becomes practically locked through the high axial force on the brake rings while under light loads such as when negotiating certain portions of a sharp curve the wheels are free to rotate differentially. Driving under half power through curves such as in city driving, places very high demands on the curved tracks and brake rings and is not recommended.

Section view of a linear development of the curved tracks, driver plate and sliding studs



The black studs transmit power when force is in direction shown

Fig. 8

Characteristics

1. Permits differential rotation of the wheels in curves.
2. Transmits equal rotation to both wheels under power.
3. Prevents independent wheel spin in the event of poor traction.
4. Independent wheel spin occurs only when one wheel has no traction or is off the ground for a greater time whereby the force necessary for the differential brake ceases. Short periods of poor traction such as intermittent wheel lift are spanned by the unit before the braking effect has time to dissipate since the inertia of the free wheel is sufficient to activate the brake.

ZF LIMITED SLIP DIFFERENTIAL

Removal and installation

The ZF limited slip differential is removed and installed in the same manner as described in section Rear axle item 8 RA of the 356B Shop Manual.

Disassembly

1. Free safety taps of through bolts.
2. Remove through bolts and open the differential carrier.
3. Clean all parts in cleaning solvent.

Assembly

1. Inspect cleaned parts for wear and material failures. The sliding studs must not vary in length more than 0, 05 mm (. 002 in).
2. Apply molykote G paste lubricant to the curved tracks and sliding studs. Parts must first be free of oil.
3. Insert sliding studs in the driver plate.
4. Install brake rings on the axle joint bodies and place in differential carrier. Assemble carrier halves to driver plate fasten through bolts.
5. Measure the total axial play of the axle joint bodies within the carrier halves. Permissible play 0, 2 to max. 0, 3 mm (. 008 to . 012 in). If play is excessive use thicker brake rings to obtain the correct play.
6. With the correct axial play the differential gear must turn freely by hand.
7. When the differential is completely assembled check rotational play by holding one axle joint body fixed with the carrier housing and rotating the opposite joint. Free travel observed through the carrier housing openings should be from 1 to 1, 2 mm (. 040 to . 047 in) measured on the outer circumference of the curved track.
8. Tighten the nuts of the connecting screws with a tension wrench to Md = 2, 3 - 2, 5 mkg (ft lb = 16, 6 - 18) and secure with securing strip.

Note:

Through wear of the curved track the rotational play can become as great as 3 to 4 mm without affecting the function of the differential. However, such play will cause noises during power reversal which have no effect on the functioning of the unit.

Gear Lubricant:

The proper lubricant is SAE 90 Hypoid Gear Lubricant.

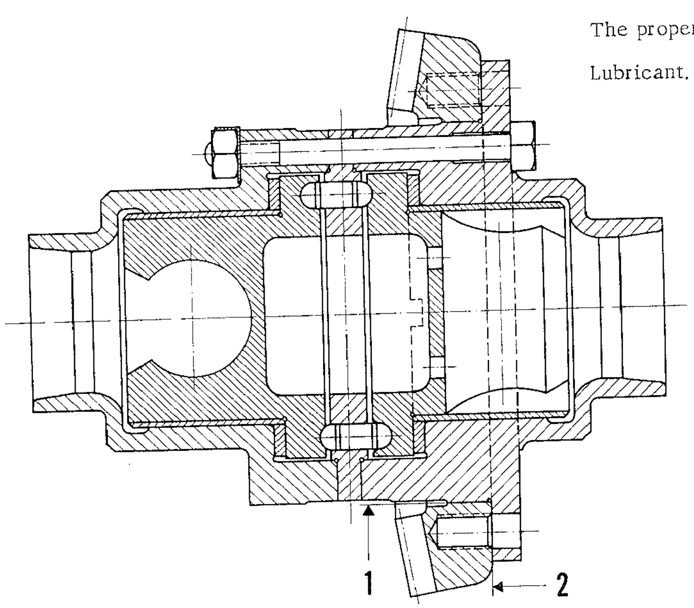


Fig. 9

1. Eccentricitiy max. 0, 05 mm (. 002 in)
2. Wobble max. 0, 003 mm (. 0012 in)

REAR WHEEL SUSPENSION 356 C

Torsion bars of different specifications are installed in the following cars, beginning with chassis serial numbers as indicated:

Coupe 126 001 and 215 001, respectively
Cabriolet 159 001 (except Carrera 356C/2000 GS and 356 C/2000 GS/GT).

General Characteristics

The utilization of torsion bars of different specifications resulted in improved driving comfort and road holding qualities. In comparison, the new suspension is softer than that in Type 356 B. Attached to each axle tube suspension flange and radius arm is a progressively acting rubber buffer which absorbs axle shock in the upper part of axle deflection.

A compensating spring may be installed upon request, whereby it is no longer necessary to replace the torsion bars, requiring only a readjustment to proper specifications.

Torsion Bars

The torsion bars have a length of 552 mm (21.73 in.), as compared with the previously used length of 627 mm (24.69 in.); the diameter is 22 mm (.866 in.) as compared with 24 mm (.945 in.) and 23 mm (.906 in.) bars previously used.

Note:

The torsion bars are pre-stressed during manufacture. Therefore, right and left torsion bars are not interchangeable. To provide means for positive identification, the right and left torsion bars are marked with an "R" and "L", respectively.

Removing and Installing Torsion Bars

Removal

1. Place car on stands in level position, remove rear wheels.
2. Preload radius arm with compressing tool (P 53a) so that the load is off the shockabsorber.
3. Remove shockabsorber.
4. Pry open sheetmetal brake hose retainer and remove brake hose clamp from axle tube.
5. Remove the three hex bolts which hold axle tube suspension flange. Move rubber buffer and support flange to rear and let hang on hand brake cable.
6. Push axle tube rearward, away from the radius arm.
7. Remove compressing tool (P 53a).
8. Remove radius arm cover retaining bolts and withdraw cover.

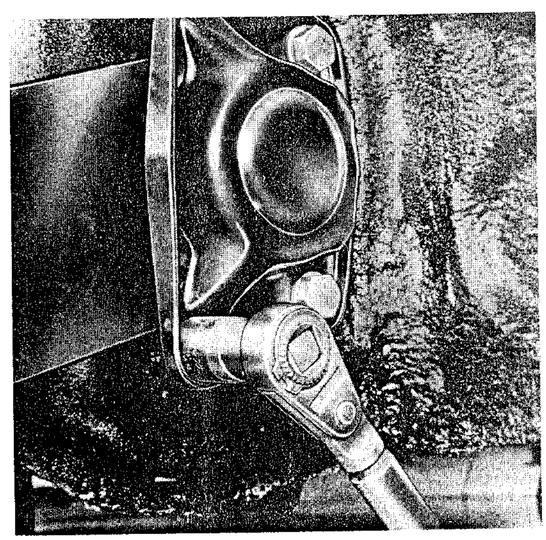


Fig. 1

9. Withdraw rubber bushing.
10. Remove radius arm and inner rubber bushing.
11. Remove torsion bar through hole provided in the body.

Note:

In instances where the torsion bar has sheared off, the remaining stub can be forced out of its splined seat by first removing the torsion bar on the opposite side and then pushing through with a steel rod.

Installation

Reassembly is accomplished in reversed order of the above, by noting the following points:

1. Check the torsion bar for damaged splines, chipped paint finish, and especially rust spots; replace if necessary.
2. Lubricate torsion bar splines.
3. Insert the torsion bar and radius arm, making certain that the proper bar is being installed ("R" and "L" markings), and adjust (see page SR 33).
4. Apply flaked graphite to rubber bushing and install.
5. Raise radius arm with compressing tool (P 53) until the lower edge of arm is above the lower stop. Drive radius arm into place with a copper mallet.
6. Install outer rubber bushing. Make sure that the four protruding ribs fit properly into the depressions within the radius arm cover.

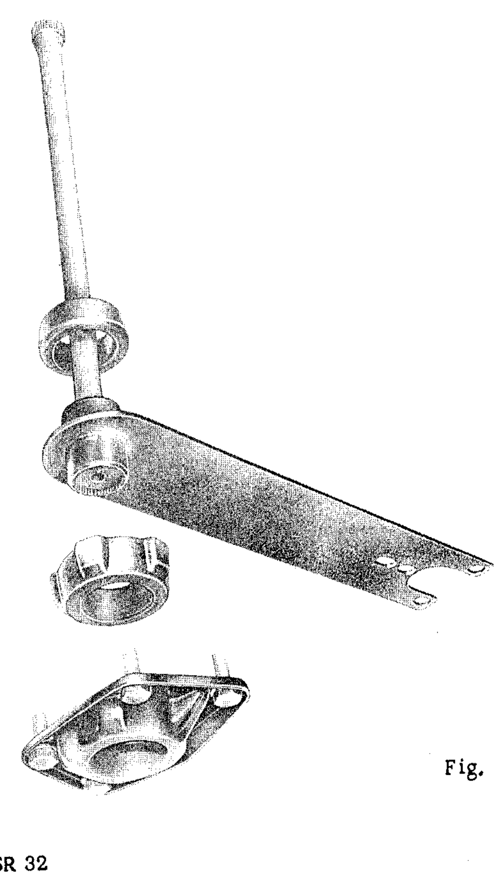


Fig. 2

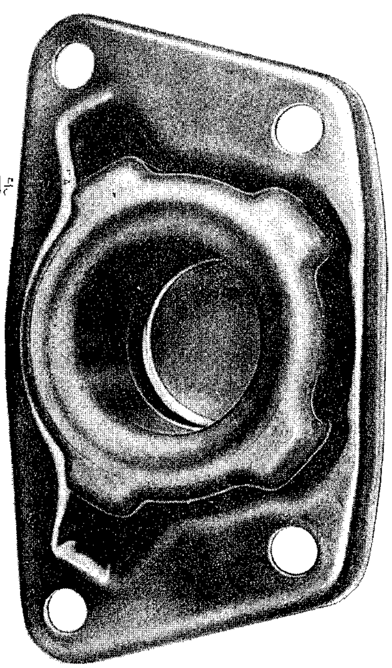


Fig. 3

7. Tighten cover retaining bolts.

Adjusting Rear Wheel Suspension

Exact adjustment of the torsion bars is accomplished by measuring the angle of inclination of the radius arm in relation of the horizontal plane of the car; the radius arm must not be under load.

Make sure that the chassis is standing in level position by placing the protractor (VW 245a) on the floor tunnel. Readings for the slacked radius arm are as follows:

Type 356 C/1600 C and 1600 SC:

Coupe and Cabriolet

21^{o} 30' without compensating spring

17^{o} with compensating spring

(optional equipment)

Type 356C/2000 GS, with compensating spring (rear suspension 356 B)

Coupe and Cabriolet

19^{o}

Camber: + 10' to + 1^{o} 30' (car empty)

Type 356 C/2000 GS/GT (with compensating spring) (rear suspension 356 B)

Coupe

13^{o}

Camber: - 30' to - 1^{o} 30' (car empty)

It is essential that both radius arms are adjusted to identical readings to ensure that the suspension is properly aligned and can function satisfactorily under all normal loads since this affects the car's roadability. If adjustment was required on one side only, the other side should be checked as well and readjusted if necessary.

Adjustments are performed as follows:

1. Insert the torsion bar so that its splines engage those within the socket in the frame.
2. Slide radius arm onto the splined outer end of the torsion bar.
3. Hang protractor (VW 245a) on slacked radius arm.
4. Set protractor pendulum so that bubble lines up in the center.

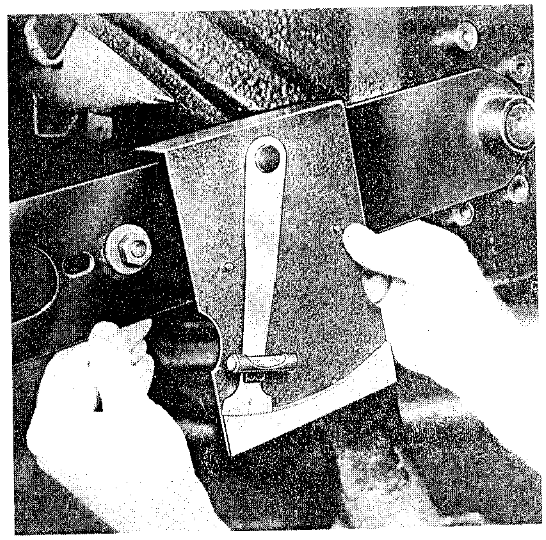


Fig. 4

If the protractor reading reveals an excessive tolerance deviation from the specified value, position of the radius arm must be corrected. Due to an unequal number of splines on the torsion bar ends, it is possible to finely adjust the radius arm angle, that is,

inside end (car's center) has 40 splines
outside end has 44 splines.

When the torsion bar is reset by one spline, it turns 9^{o}; when the radius arm is reset by one spline, an angle difference of approximately 8^{o} 10' results. This makes possible minimal changes of 50'. Should it not be possible to achieve an equal setting on both radius arms, the adjusting procedure should be repeated by using a different radius arm until the required angle of inclination is obtained.

Note:

The alignment of rear wheels can be correctly chekked only on the optical wheel alignment ramp (see page W 5, Group W, basic volume of 356 B Workshop Manuel).

REAR AXLE PIVOT STOP

Type 356 C

General

An axle pivot stop has been introduced in conjunction with the recalibrated rear wheel suspension. The pivot stop is located adjacent to the rubber buffer. It is the purpose of the pivot stop to limit vertical axle travel and thus protect the shockabsorber (fig. 1).

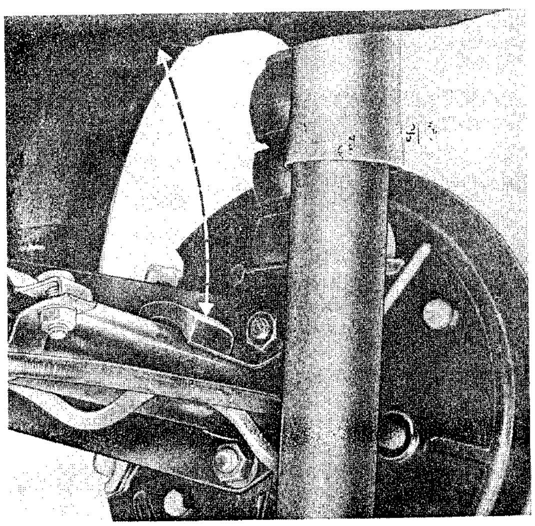


Fig. 1

The pivot stop should be replaced when the rubber pad shows signs of considerable wear and the possibility of hard, metallic impact is imminent.

Removal

1. Raise car and remove rear wheels.
2. Preload radius arm with the compressing tool (P 53a) until the load is off the shockabsorber.
3. Remove shockabsorber.
4. Remove pivot stop retaining nut and pull bolt out.
5. Carefully detach pivot stop from the rubber buffer support (spot-welded).

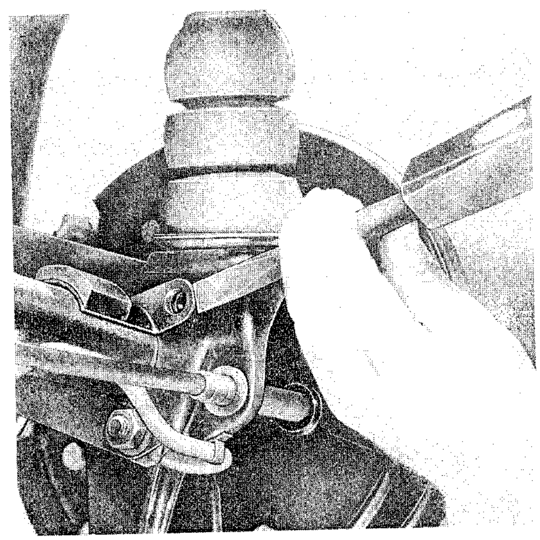


Fig. 2

6. Remove spot weld remnants and grit.

Installation

Install in reversed order of the above. The new pivot stop does not require welding since the bolt attachment is sufficient.

INDEX

Supplements for Group T: Tires, Brakes, and Wheels

PORSCHE - DISC BRAKES

General

The Porsche 356 B/2000 GS is equipped with Porsche-ATE disc brakes. Only the first units of this model were equipped with standard drum brakes.

The disc brake differs from the customary drum brake in the following ways: Flat brake lining segments of equal area are pressed against the surfaces of a disc by hydraulic pistons situated in a caliper which encloses the disc. Since equal pressure is exerted on both sides of the disc, no deformation of the disc occurs.

The disc, due to its ability to dissipate heat rapidly, is less temperature sensitive and therefore does not fade like the drum brake. The heat generated during braking is dissipated quickly because the disc rotates exposed to the air on all sides. Cooling is even better since the friction surface is directly exposed to the air while the heat in a drum must first be transmitted through the drum wall. In addition, the expansion resulting from increased temperature is primarily radial and therefore has no effect on the braking surface.

In contrast to the drum brake, the disc brake is not self-servo acting and therefore is not as greatly affected by changes in the coefficient of friction.

In the event that water or dirt comes in contact with the drum, the centrifugal force of rotation or the application of the brake linings quickly cleans the disc.

Description of the Brake System

The service brake is hydraulically operated consisting of:

a) master cylinder which transmits pedal pressure to the hydraulic system,

b) wheel cylinders located in the brake calipers which press the linings against the discs,

c) the discs which are attached to the wheels retard the wheel rotation,

d) the hydraulic lines feed equal pressure to all points in the system giving equal braking to the front and rear wheels respectively.

The hydraulic system makes use of the principle of fluid mechanics which states that pressure in a fluid is equally distributed in all directions.

The master cylinder converts mechanical pedal pressure to hydraulic pressure in the lines which forces the wheel cylinders in the calipers against the brake jaws.

Through this direct transmission of force, the braking effort increases linear to the increase of pedal pressure.

When the pedal is released a return spring in the wheel cylinders pulls back the pistons a fixed predetermined distance. This spring is part of the automatic adjustment device.

Master Cylinder

The master cylinder is equipped with a special large bore check valve which prevents residial pressure in the lines. The valve has a 0. 7 mm dia. bore which allows rapid return of brake fluid upon release of the pedal.

This valve is the only item in which the master cylinder for disc brakes differs from the master cylinder for drum brakes.

Note: The master cylinder is not the same as the one for drum brakes and is not interchangeable. For this reason the master cylinder has a metal band with the inscription "Zylinder hat Spezial-Bodenventil" (cylinder has special bottom valve).

Brake Caliper

The brake caliper is clamped on to a fin extending from the axle bracket so that the disc which is supported on a spider is grasped from within. Two cylinders are located in each jaw of the caliper. Equal pressure is led to all four pistons which are held by automatic adjusters within the cylinder. The equal pressure assures that no net lateral forces act to bring the disc out of alignment.

The cylinder diameter of the front calipers is larger, 33 mm dia., than the diameter of the rear calipers, 25 mm dia., so that maximum braking can be obtained from weight shift.

Automatic adjustment

The disc brake caliper contains a self adjusting mechanism, which keeps the gap between the lining and disc constant. The adjustment device is contained within each cylinder. If the mechanism becomes defective, a new cylinder should be installed. Repair of the defective unit should not be attempted.

Note: The automatic adjustment requires no servicing.

Brake Discs

The discs of front and rear brakes are of equal thickness and differ only in that the rear disc has a hand brake shoulder on the inside. When new, the disc thickness is 9. 95 mm $\pm$ 0. 5 mm. The rear disc may be reworked to a minimum of 9. 0 mm and the front disc to a minimum of 9, 3 mm. The surfaces must be plane and parallel within 0. 02 mm to prevent brake chatter.

Brake discs should not be resurfaced unless absolutely necessary. Surface grooves in circumference have no effect on the function of the brake.

Removal

1. Hoist car. Remove wheels.
2. Remove splash shields.
3. Rotate the spider until the brake retaining pin is exposed.

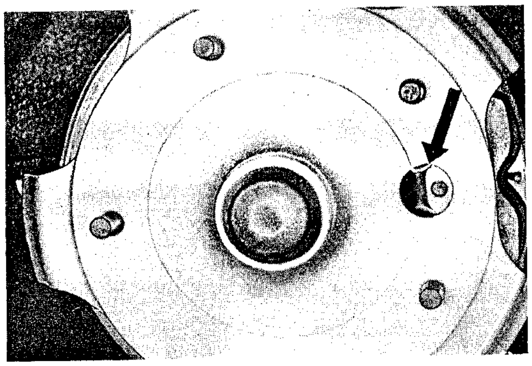


Fig. 1

4. Remove the cotter key and extract the retaining pin.

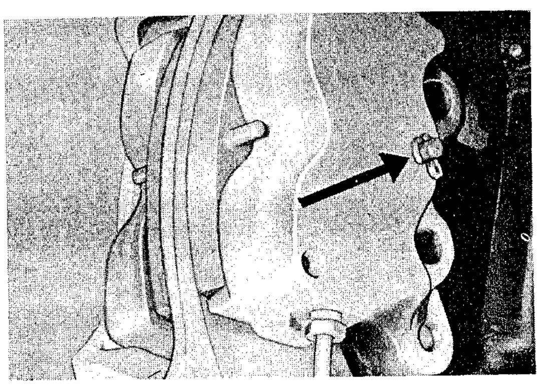


Fig. 2

5. Remove brake lining pads.
6. Disconnect and remove hydraulic lines from the caliper.
7. Rotate the spider until one of the large allen screws is visible. Using tool P 81 (Inhex 54 IC, 12 mm), 12 mm allen wrench to remove the screw. Remove second allen screw in the same manner.
8. Remove caliper halves using a soft hammer if necessary. Mark caliper halves in pairs so that they can be installed in the same positions as they were. The inner halves have tapped holes for mounting the splash shield.

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. The mating surfaces of the caliper halves and the holder plate must be meticulously clean.
2. Tighten the allen screws to 8 mkg (58 ft. lb.) torque.
3. The brake pads are to be placed in the same locations where they were.
4. Carefully bleed the entire system.

Renewing brake pads

General

The thickness of the linings should be visually inspected at every servicing. The new lining not including the backing plate is 10 mm thick. The wear limit is 2 mm front and 4 mm rear. For best performance all linings of the front wheels or rear wheels should be renewed together. The front and rear pads differ slightly and are therefore marked "V" and "H", front and rear (in German) respectively on their back sides. Never use different lining materials front and rear. Only Porsche approved linings are to be installed.

The standard brake pads have "Textar 504" lining material. These are marked "TE 1" on the back.

For competition use "Ferodo DS 11" linings are available as optional extra. These pads which are marked "FE 4" can be installed on request.

Textar lining material has a dark grey color and contains visible brass fibers. The Ferodo lining has a black copper toned color. The Textar lining is somewhat softer than the Ferodo lining and therefore wears more rapidly. In contrast the harder Ferodo lining requires more pedal pressure.

The lining wear depends among other things on driving style and driving conditions. Wet winter driving with sand and salt on roads or muddy surfaces increase wear considerably. For sporting events where high braking demands are met, the splash shields may be removed for better cooling and decreased wear.

Changing brake pads:

1. Hoist car. Remove wheels.
2. Rotate the spider until the brake pad retaining pin is exposed.

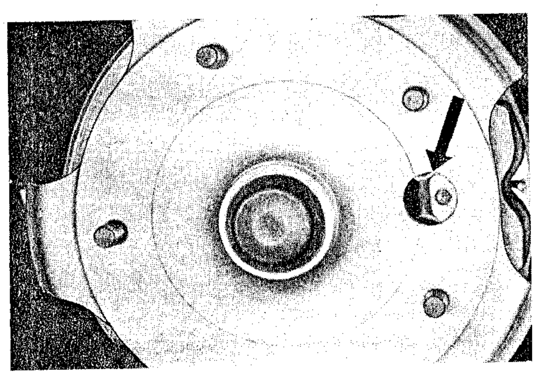


Fig. 3

3. Remove the cotter key and extract the retaining pin.

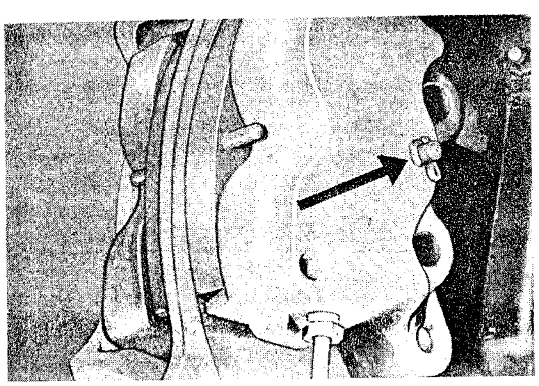


Fig. 4

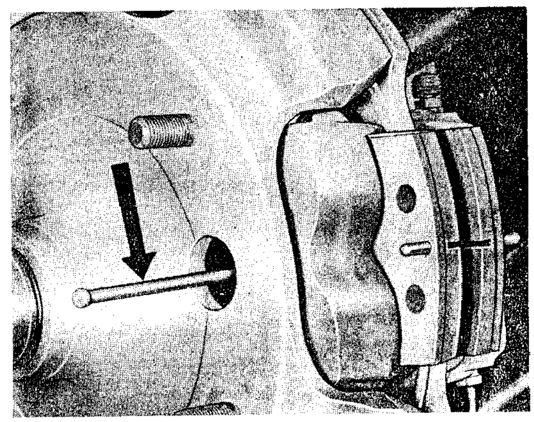


Fig. 5

4. Remove only one brake pad.
5. With a suitable tool press the pistons back to the stop.

   Note! Take care not to damage the rubber dust covers.

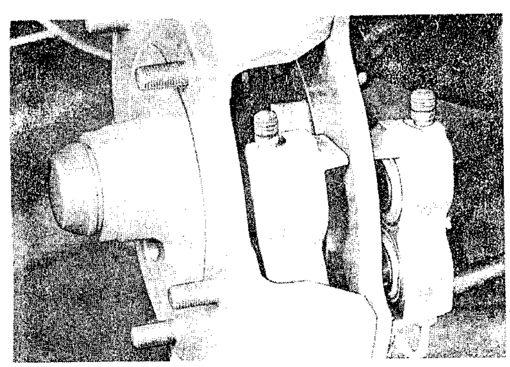


Fig. 6

6. Scrape away caked up dirt and blast clean with compressed air.

Note! Do not use rubber dissolving agents to clean the brake caliper since these will damage the dust covers.

7. Insert new lining pad. The pads for the front and rear brakes differ slightly and are therefore marked "V" and "H" for front and rear (in German) respectively.

8. Remove the second brake pad and proceed as before to return the pistons, clean the caliper and insert a new brake pad.

9. Install brake pad retaining pin and secure with a cotter key.

10. Repeat the same operations on the remaining brake calipers in the same manner.

11. With the car on the hoist, actuate the brake padel several times until the pads are against the discs. Until the brakes are worn in, the pedal travel will be somewhat greater than normal.

12. When pressing the piston into the caliper, brake fluid is returned to the reservoir. When installing new brake pads, a full reservoir will overflow. For this reason it is necessary to top up the brake fluid after installing brake pads.

    Use "ATE blue" or "Pentosin Super" fluid. These may be mixed.

13. New linings must be worn in through moderate application at intervals until a "solid" feeling is obtained. Only after proper wearing in can full braking be achieved.

14. If old linings are installed they must be marked so that they are re-installed in the same location.

REMOVING AND INSTALLING BRAKE DISCS

FRONT WHEEL

Removal

1. Hoist car. Remove wheels.
2. Remove splash shield.
3. Rotate the spider until the brake pad retaining pin is exposed.
4. Remove the cotter key and extract the retaining pin.
5. Remove both brake pads and mark according to position.
6. Punch mark the spider and disc for proper match.
7. Remove the 5 retaining nuts (13 mm wrench). Using a soft mallet, remove the disc from the spider.
8. Remove the spider as described in section ST 2 of the Shop Manual 356 B.
9. Remove disc.

Note

Brake discs should not be resurfaced unless absolutely necessary. Surface grooves in circumference have no effect on the function of the brake. The disc may be turned down on a lathe using its mating spider mounted on special tool P 38.

REAR BRAKE

Removal

1. Loosen rear axle nut.
2. Hoist car. Remove wheels and axle nut.
3. Remove splash shield.
4. Rotate the spider until the brake pad retaining pin is exposed.
5. Remove the cotter key and extract the retaining pin.
6. Remove both brake pads and mark their positions.
7. Mark the location of the spider on the axle shaft and the disc on the spider.
8. Remove the 5 nuts (13 mm wrench) of the brake disc and remove the spider using a soft mallet if necessary.
9. Remove the two allen screws of the caliper and remove the brake disc.

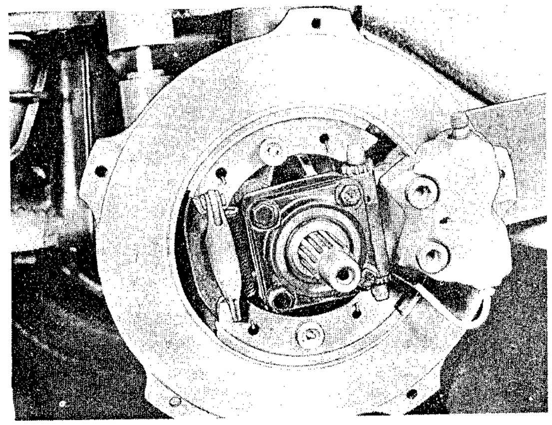


Fig. 11

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Brake disc wobble must be less than max. 0.2 mm. To measure alignment the axle nut must be tightened to at least 20 mkg (145 ft. lb.) torque. If necessary reposition the spider on the axle until the disc runs true.
2. The allen screws of the caliper must be tightened to 8 mkg (58 ft. lb.) torque.
3. The brake pads must be installed in their original positions.

REMOVING AND INSTALLING CALIPER PISTONS

Removal

1. Remove caliper half.
2. Remove the retaining ring from the dust cover.

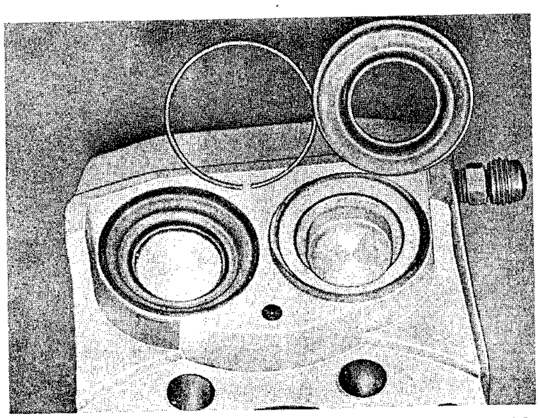


Fig. 12

3. Remove dust cover.
4. Using compressed air or better a hydraulic master cylinder, press the piston out of the caliper. The automatic adjustment is not to be disassembled in Porsche shops. When the adjuster is defective always install a new piston.

Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. The piston ring must be fully seated in the groove of the piston.
2. Carefully insert the piston in the caliper using ATE paste. All parts must be entirely clean. To prevent damage to the cylinder and piston ring, do not cant the piston.
3. Install cleaned dust covers. If covers show wear install new ones.

Renewing Hand Brake Linings

1. Loosen rear axle nut.
2. Hoist car. Remove wheel and axle nut.
3. Remove splash shield.
4. Remove the service brake pads.

   Warning! Do not depress the brake pedal since this will press the pistons out of the caliper.
5. Remove the 5 nuts (13 mm wrench) of the brake disc and remove the spider using a soft mallet if necessary. Mark mating parts before removal.
6. Remove retaining spring and retainer pins.

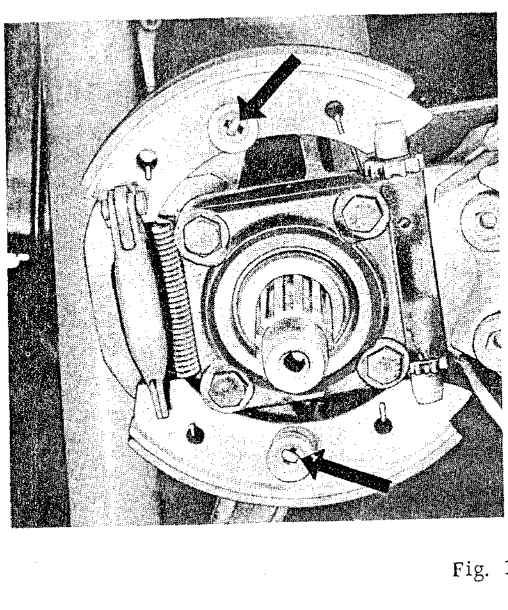


Fig. 13

7. Disconnect return spring and remove brake shoes.

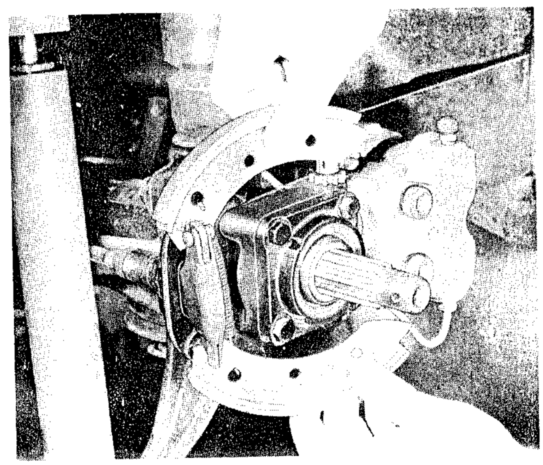


Fig. 14

8. Assemble the brake in the reverse order. The actuating mechanism is the same as the VW Standard mechanical brakes (see Fig. 15 + 16).

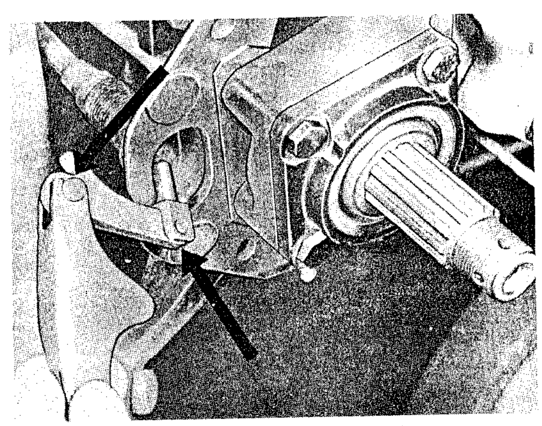


Fig. 15

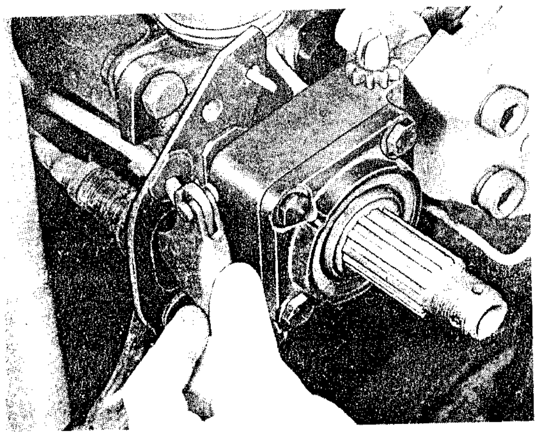
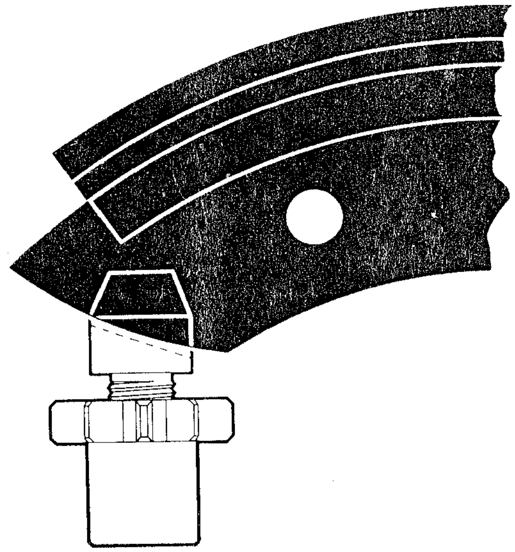


Fig. 16



Note that the slanted slot of the adjustment screw corresponds to the angle of the brake shoes as in Fig. 17.

This part is not identical to any part of the VW or Porsche drum brake.

9. Adjust the handbrake. The brake must be adjusted again after the first use.

Adjusting the Handbrake

The adjustment is primarily performed at the brake shoe as with drum brakes. The adjustment screw is accessible through the hole in the spider. Both the upper and lower shoe must be adjusted equally. The adjusting screw is turned until the brake shoe is tight against the disc and turned back 3 to 4 clicks.

For the adjustment of the hand brake cables see sections 17 and 18 ST of the shop manual.

It is to advantage to remove the brake pads while adjusting the hand brake.

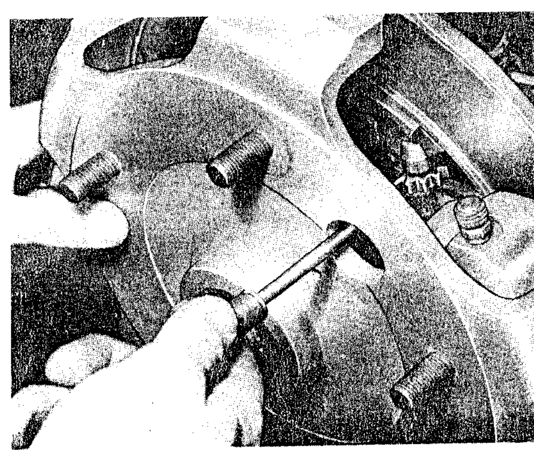


Fig. 18

SECTION INDEX

Supplements to Group B: Body

COMMON FAILURES AND CORRECTIVE MEASURES

Failure	Cause	Corrective action
Brake pedal goes to floor or is very spongy	a) Air in hydraulic system b) Low on brake fluid	a) Bleed system b) Fill reservoir and then bleed system
Brake pedal goes to floor after bleeding. No brake action	a) Leaking brake line b) Bad main or wheel cylinder (adjuster)	a) Repair leak b) Install new piston ring or new brake pads
Poor braking even though pedal pressure is high	a) Oiled brake pads b) Scorched linings	a) Repair axle seal or oil cooler leak. Install new brake pads b) Install new brake pads
Brakes heat up when not in use, brakes do not release	a) Return bore in master cylinder clogged b) Insufficient play between push rod and master cylinder piston c) Sticking wheel cylinder d) Rubber parts have swollen as a result of contact with improper brake fluid e) Discs run untrue or axle shaft bent f) Lining separating from backing plate	a) Clean out obstruction b) Adjust free pedal travel c) Install new piston and seal using ATE paste d) Drain and dismantle entire brake system and replace all rubber parts, hoses and brake light switch. Fill with ATE blue fluid e) Replace disc or axle shaft as necessary f) Renew all pads of both wheels

Failure	Cause	Corrective action
Brakes pull to one side	a) Oiled brake linings b) Extremely worn brake linings on one side c) Front brake caliper not parallel to disc d) Brakes not properly bled	a) Renew rear axle seal and install new brake pads b) Install new brake pads c) Inspect seating of caliper plate, install new support plate if necessary d) Bleed brakes
Squeeking brakes	a) Linings are loose on backing plates	a) Install new brake pads on both wheels
Brakes chatter	a) Brake disc runs out of true b) Brake linings are not seated c) Excessive wobble of the wheel rim d) Loose wheel leavings, king pin, or tie bolts	a) Align brake disc b) Wear in linings through moderate use c) Inspect wheels and install new rims if necessary d) Adjust where necessary and replace worn parts
Brake fluid reservoir needs refilling often	a) Leaks in the system b) Leaking master cylinder c) Leaking wheel cylinder	a) Inspect all lines and connections for leakes while applying pressure to the brake pedal b) Inspect master cylinder and repair or replace c) Inspect wheel cylinder and renew piston ring if necessary
Leaking wheel cylinder	a) Piston ring has shrunk b) Scored cylinder wall c) Rusty cylinder wall	a) Install new piston ring b) Install new caliper c) Remove rust traces. Install new caliper in case of reserve rust. Install new dust covers
Hand brake gives pulsating effect	a) Unround disc b) Hand brake cable casings severely bent	a) Mount disc and spider on tool P 38 and turn out on lathe. Allowable tolerance 0.15 mm b) Slacken brake cable and adjust at front for proper alignment

ATE DISC BRAKE (DUNLOP-LICENSE)

The ATE disc brake is standard equipment in Type 356 C cars, with the following chassis serial numbers applying:

Coupe	126 001
also	215 001
Cabriolet	159 001

General

The ATE disc brake is very simple in design and consists basically of the pot-shaped brake disc and the caliper assembly (see Fig. 1).

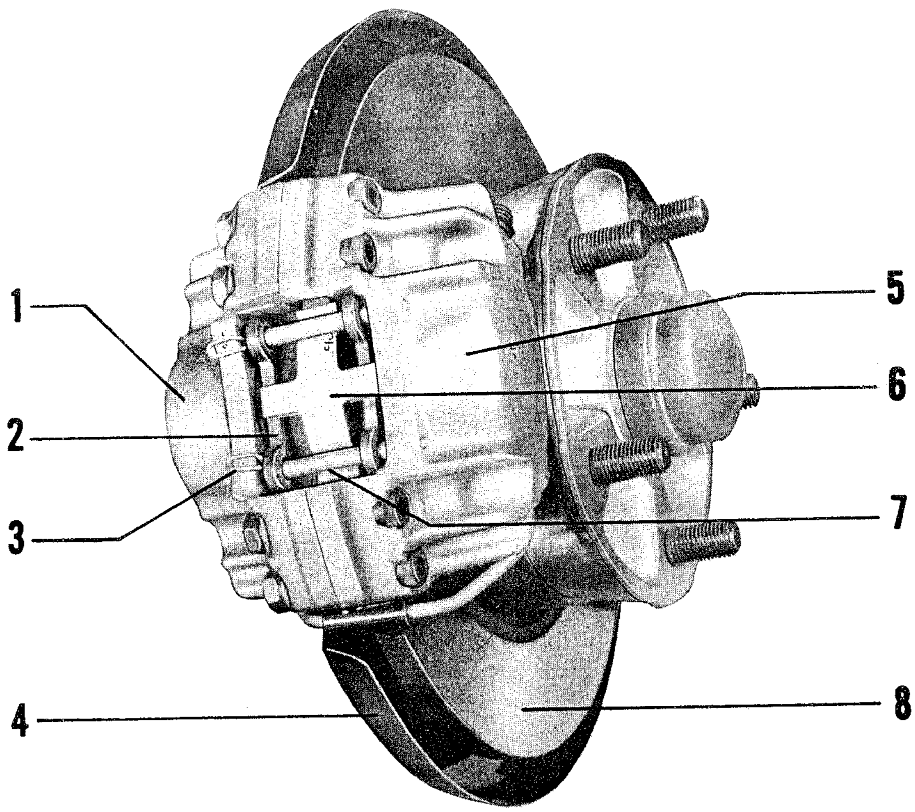


Fig. 1

1 Flange housing	3 Pin retaining clip	5 Cover housing	7 Retaining pin
2 Brake pad segment	4 Disc shroud	6 Cross-spring	8 Brake disc

The front wheel brake disc is attached to the wheel hub flange by separate retaining bolts and is centered by the collar on the wheel hub flange.

The rear wheel brake disc is also centered by the collar on the wheel hub flange, and fastened to the flange by two countersunk screws; however, the rear wheel brake disc is held in place primarily by the wheel lugs.

The brake caliper wraps around the outside of the disc and is fastened to the steering knuckle or the axle flange, respectively, by two bolts.

The flange housing (Point 1, Fig. 1) and the cover housing (Point 5, Fig. 1) are bolted together with four bolts and make up the caliper assembly.

The brake cylinder bore in each housing has a machined groove for the accomodation of a brake piston seal.

The brake cylinders and pistons are protected against the effects of dust, road dirt, and moisture by a dust cap.

A clamp ring holds the dust cap on the housing collar and the inherent tension holds it on the extended piston body.

The brake pad segment (brake pad and brake pad plate) has axial freedom within the well of each housing and is held in place by two retaining pins which are secured by retaining clips.

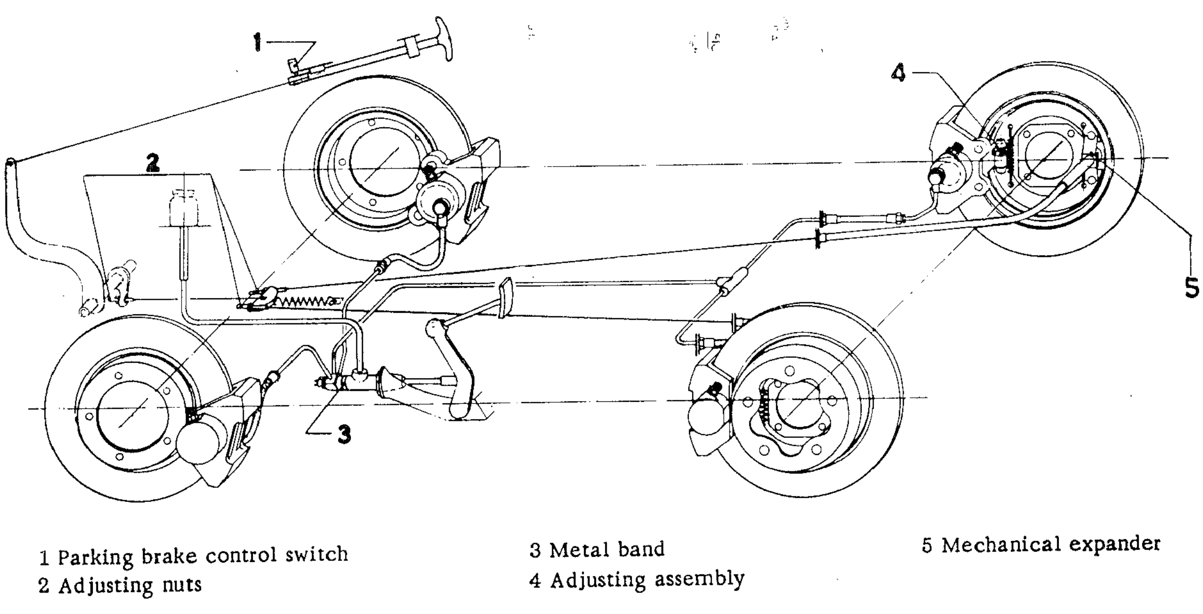
A cross-spring, situated beneath the retaining pins and exerting radial pressure upon the brake pad segments, keeps the brake pad segments from rattling and serves as a brake pad wear indicator.

The brake disc is protected against dirt and water spray by an inboardly mounted disc shroud.

Note:
When the brakes are put to hard use, such as in competition driving or the like, it is recommended that the disc shrouds be removed to facilitate a better cooling of the brake discs and, consequently, reduce the wear factor.

Caution:
When greasing the car, make certain that no grease is deposited on the brake discs or the calipers. Place a piece of paper or sheetmetal between the link pin joints and the brake discs, wiping off all excess grease from the link pin heads.
When spraying the underbody with corrosion preventives, make positively sure that the brake disc assemblies are covered up.

Disc Brake Schematic



1 Parking brake control switch
2 Adjusting nuts

3 Metal band
4 Adjusting assembly

5 Mechanical expander

Fig. 2

Brake Operating Principle

When the foot brake is applied, the piston in the brake master cylinder is forced forward transmitting fluid pressure to cylinders in the brake calipers through hydraulic lines and hoses. The fluid pressure acts on the brake caliper pistons causing the brake pad segments to bear against the rotating discs, squeezing these from both sides and creating the friction required for stopping. The brake pedal pressure is in proportion to brake pad pressure being exerted upon the brake discs and, thus, the degree of braking action.

When the brake pedal is released, the hydraulic system connecting to the brake caliper cylinders is rendered fully depressurized, the pistons and brake pad segments move slightly away from the friction surfaces of the brake discs, freeing these completely, and the unbraked condition is regained.

Brake Master Cylinder

The brake master cylinder is equipped with a purging check valve which causes a complete depressurization within the hydraulic lines.

The purging check valve differs from the normal check valves inasmuch that the check valve cone has a bored out pressure purging passage of 0,7 mm (.276 in.) diameter. The purging provision ensures a full depressurization of the system but also a "repumping" by fast actuation of the brake pedal as is required in refilling and bleeding operations carried out without the usual bleeding aids. The hydraulic fluid reservoir is located in the forward luggage compartment next to the spare wheel.

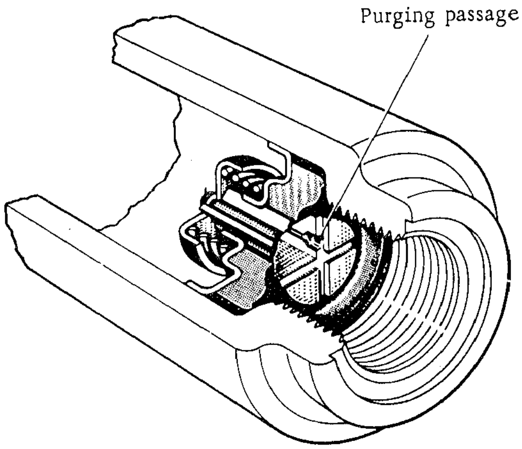


Fig. 3

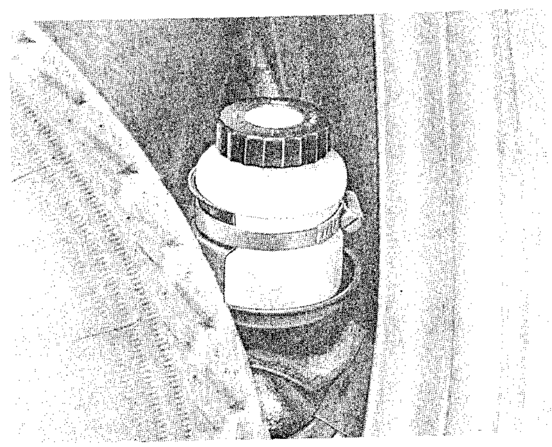


Fig. 3a

Caution:
This brake master cylinder is not interchangeable with brake master cylinders utilized in drum-type brake systems. For this reason, the brake master cylinder has been identified with a metal band reading: "This cylinder has a purging check valve" (German: " Zylinder hat Spezial-Bodenventil").

Brake Calipers

The brake calipers differ in size for front and rear wheels and are, therefore, not interchangeable.

The diameter of the brake master cylinder is 48 mm (1.890 in.) at front and 35 mm (1.378 in.) at rear.

Brake Discs

The outside diameter of the front wheel disc is 274, 5 mm (10, 81 in.) and rear wheel disc 285 mm (11, 22 in.). Factory new brake discs for front wheels have a thickness of 10, 5 - 10, 3 mm (.413 - .406 in.) and for rear wheels 10, 0 - 9, 8 mm (.394 - .386 in.). Slightly damaged or worn brake discs may be refinished providing that the disc thickness is not reduced by more than 0, 5 mm (.020 in.).
The maximum permissible tolerance for thickness variations of the braking surfaces is 0, 03 mm (.0012 in.) since otherwise the brake will tend to chatter.
The brake discs should be machined only if absolutely necessary. Linear grooves in the brake disc have no detrimental effects and it is, therefore, not necessary to refinish the surface.

Automatic Adjustment

The disc brake pads need not be adjusted (the hand brake is an exception) due to a built-in self-adjusting mechanism. The mechanism is contained within the pistons in the calipers and includes an arresting element which, in connection with a stud in the flange and cover housing, effects the automatic brake pad adjustement.

The self-adjusting device with its clearance provision cannot be modified or repaired. In the event that malfunctions occur, it will be necessary to replace the complete piston assembly.

Hand Brake

The hand brake is of the twin-servo type and provides good braking effect through high exploitation of the self-energizing forces. The pot-shaped part of the rear wheel discs serves as the brake drum; thus, the hand brake drum and the brake disc are one unit.
The brake linings are riveted to the brake shoes in the usual way. Only brake linings recommended by the Porsche Company may be utilized.
The hand brake is mechanically actuated and acts on rear wheels only. The hand brake and service brake systems are two completely separate systems.

Hand Brake Operating Principle

When the hand brake is pulled out, two brake shoes in each rear wheel are pressed against the drum part of the rear disc, the force being transmitted by brake cables and mechanical expanders. If the wheels turn forward or backward, a self-energizing effect is created by the action of the advancing primary shoe. Since the free-floating adjusting assembly serves as an anchoring point for both brake shoes, the anchoring force of the primary shoe provides additional forces for pressing the secondary brake shoe. As a result, the receding brake shoe is also activated and the braking effect equally good in both directions of rotation.

Specifications

Service brake
Effective braking area per wheel: front 52, 5 cm^2 (8. 14 sq. in.), rear 40, 0 cm^2 (6. 20 sq. in.)
Total effective braking area: 40, 0 cm^2 (28. 68 sq. in.)

Hand brake	
Brake drum diameter:	180 mm (7. 1 in.)
Brake lining width:	30 mm (1. 18 in.)
Total effective braking area:	194 cm^2 (30. 1 sq. in.)

Rear Wheel Brake
Cross-sectional View

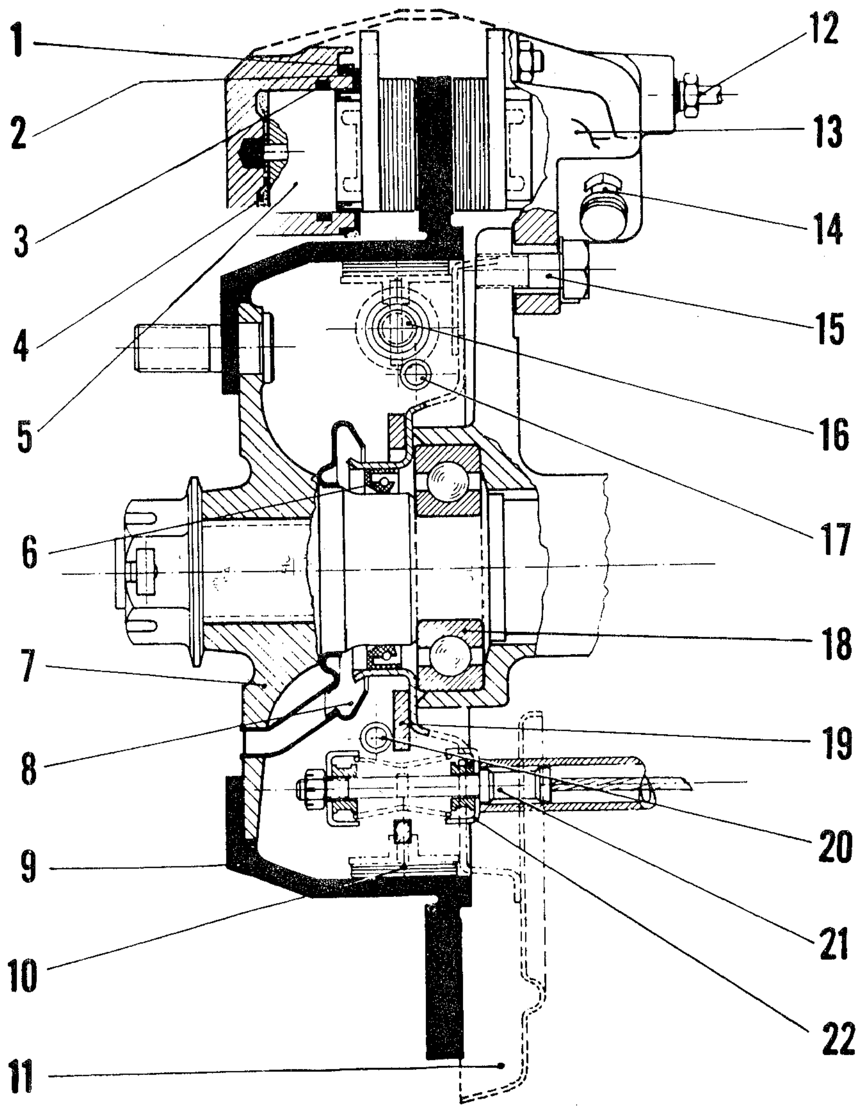


Fig. 4

1 Clamping ring
2 Dust cover
3 Piston seal
4 Brake fluid
5 Piston
6 Oil seal
7 Wheel hub
8 Oil deflector
9 Brake disc
10 Hand brake shoe
11 Disc shroud

12 Hydraulic line
13 Brake caliper
14 Bleeder valve
15 Retaining screw
16 Adjusting assembly
17 Return spring
18 Wheel bearing
19 Anchor plate
20 Return spring
21 Brake cable
22 Mechanical expander

Hand Brake
Cross-sectional View

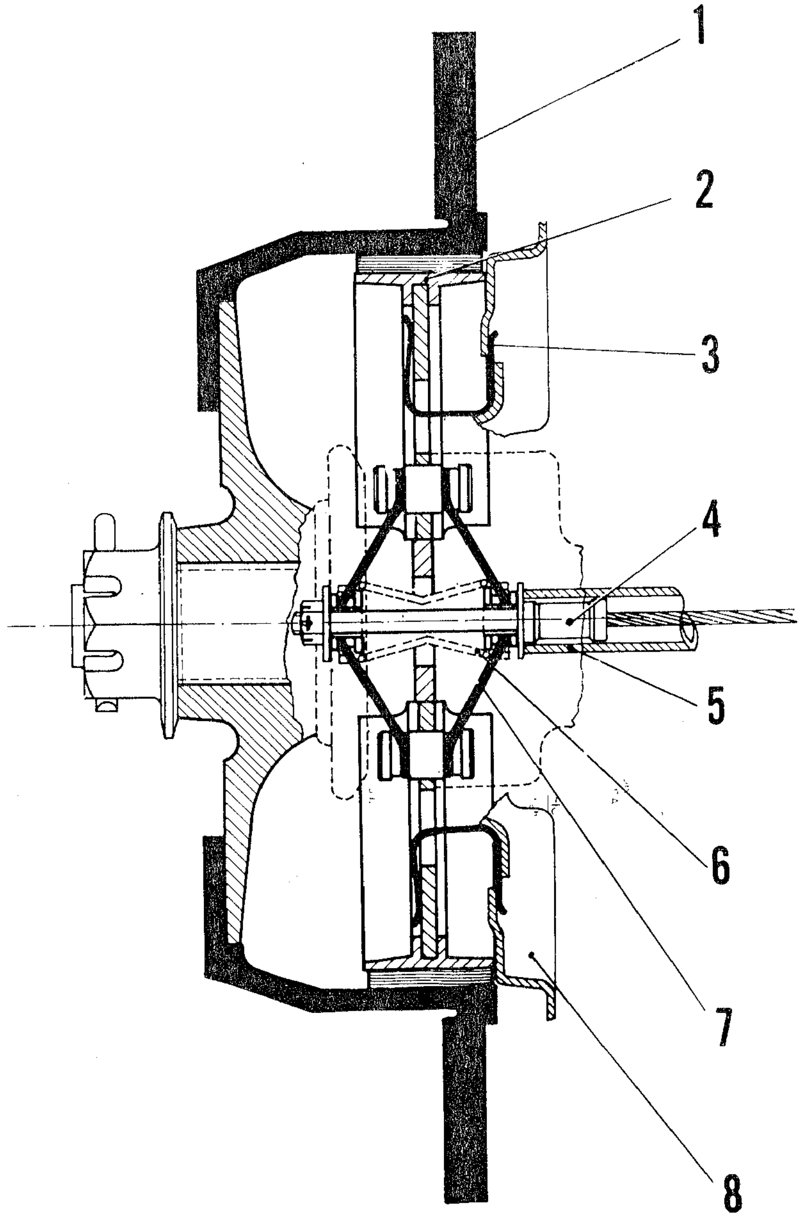


Fig. 5

1 Brake disc
2 Hand brake shoe w/lining
3 Retaining spring
4 Brake cable

5 Brake cable conduit
6 Spring
7 Mechanical expander
8 Anchor plate

Bleeding Hydraulic Brake System

Note:
It is necessary to bleed the entire hydraulic brake system whenever any hydraulic brake connection had to be disconnected for any reason (an exception to the above is the hydraulic fluid line connecting the fluid reservoir with brake master cylinder).

The brake system should be bled also when the brake pedal travel is too long or the braking action uneven.

If the hydraulic brake system has been completely drained for any reason (brake overhaul, etc.), it may have to be bled for the second time subsequent to a short test drive.

The pedal free travel will remain constant due to the automatic brake self-adjustment, providing that the brake system has been properly bled; pedal travel to the point of brake actuation is about 30 to 50 % of the total brake pedal travel. The pedal travel normally will be somewhat greater following the installation of new pads and until these are run in.

Caution:
The hydraulic brake fluid will run out of the fluid reservoir, through the by-pass port in the brake master cylinder, when any hydraulic connection is detached. This may be avoided by propping the brake pedal in a slightly depressed position, thus bringing the piston cup past the compensating (by-pass) port.

Bleeding Brakes without Filling and Bleeding Devices

Two persons are required for this operation. The procedure is always initiated at the farthest point from the brake master cylinder in the following order (applies to cars with left-hand drive):

1. Left rear wheel, outer bleeder valve, inner bleeder valve.
2. Right rear wheel, outer bleeder valve, inner bleeder valve.
3. Right front wheel, outer bleeder valve, inner bleeder valve.
4. Left front wheel, outer bleeder valve, inner bleeder valve.

Note:
When the system has been drained, it must first be filled. Open bleeder valve by one-half turn, depress brake pedal, close bleeder valve, and release brake pedal. Repeat the above until brake fluid begins to come out through the bleeder hose, continuing on all bleeder valves in the above given sequence and performing the actual bleeding operation only after the primary filling has been accomplished.

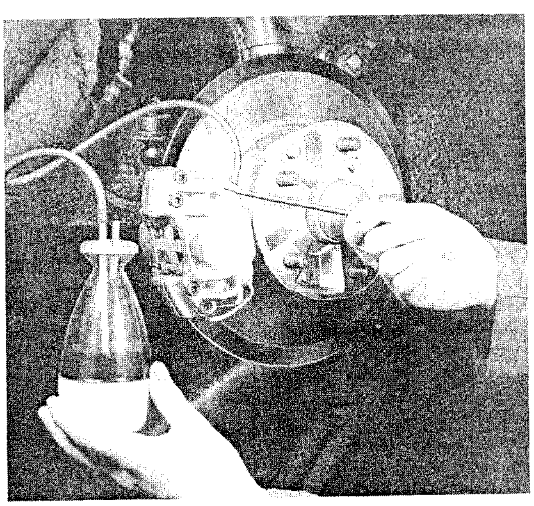


Fig. 6

Bleeding the Brake System

1. Remove dust cap from bleeder valve and attach bleeder hose.
2. Place the free end of the bleeder hose into a glass container partly filled with brake fluid so that hose end is submerged.
3. Quickly pump the brake pedal several times until pressure can be felt. Holding the pedal down, open the bleeder valve by one-half turn and push the pedal all the way down. Do not release pedal pressure until the bleeder valve has been closed. This procedure is to be repeated until there are no more air bubbles in the brake fluid coming out of the bleeder hose.
4. Remove bleeder hose and replace dust cap.
5. Repeat the above procedure on the remaining bleeder valves by following the above given sequence. It should be ensured that the brake fluid reservoir does not run dry since this would allow more air to enter the system.

Caution: Hydraulic brake fluid may damage painted surfaces.

Hydraulic brake fluid which has been pumped out of the brake system may not be reused.

6. Check for proper bleeding and absence of leaks by applying pressure to the brake pedal.

7. Replenish hydraulic brake fluid in the reservoir.

The hydraulic fluid level in the reservoir must be checked at regular intervals and replenished if necessary. Due to the relatively large cylinder cross-section in the brake calipers, the brake fluid level in the reservoir will decrease much faster as a result of brake pad wear than is the case with drum-type brakes.

Use only original ATE-BLAU (blue) hydraulic brake fluid.

Replacing Brake Pads

General

Severity of use as well as road conditions are some of the wear factors for brake pads. Increased wear may be anticipated especially when driving over wet, dirty roads (winter-serviced), and as a result of hard use (generation of high temperatures).

The brake pad thickness should be visually checked during all service operations.

A clearance must exist between the cross-spring and the brake pad segment (see Fig. 7). The permissible wear tolerance is reached when the brake pad segment touches the cross-spring or if its thickness is reduced to 2 mm (5/64 or .079 in.).

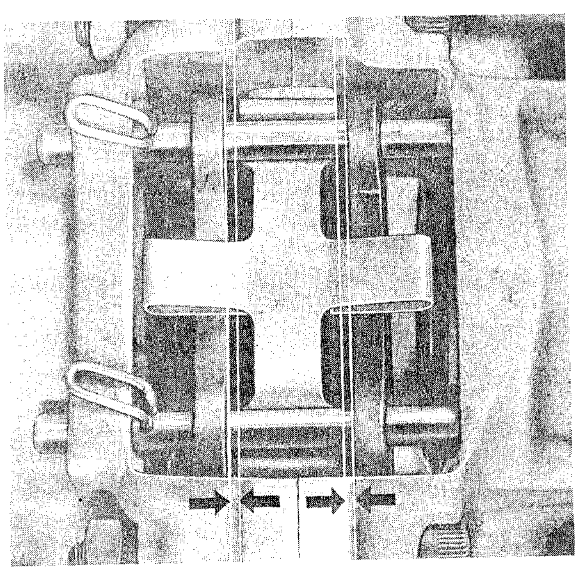


Fig. 7

The thickness of the brake pad segment at installation is about 15 mm (19/32 or .591 in.). Brake pad segments for the front and rear wheels differ in size and are, therefore, not interchangeable.

Two types of brake pads are available, that is, one type for normal use and the other for competition driving. The pads for competition use will wear slower but require higher pedal pressures. The brake pads are identified as to type by inscription on the pad plate. The designation "FE 4" is for competition brake pads and "TE 5" for normal brake pads.

The competition brake pads should be exchanged for normal brake pads at the beginning of the cold season. Only brake pads recommended by the Porsche Company may be utilized.

Same type of brake pads must be used on the front or the rear axle. Even though the brake pads can be replaced individually, we recommend that at least all brake pads of one particular axle are replaced at any one time.

Note:

Used brake pads must be marked prior to removal from the caliper to ensure proper reinstallation (in the original position). Used brake pads may not be interchanged or installed in different brake calipers.

Replacing Brake Pad Segments

1. Place car on stands and remove wheels.
2. Remove pin retaining clips.

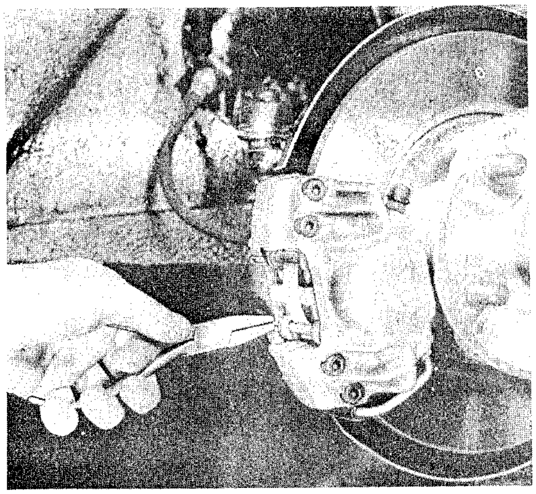


Fig. 8

3. Remove retaining pins (towards center of car) while depressing the cross-spring.

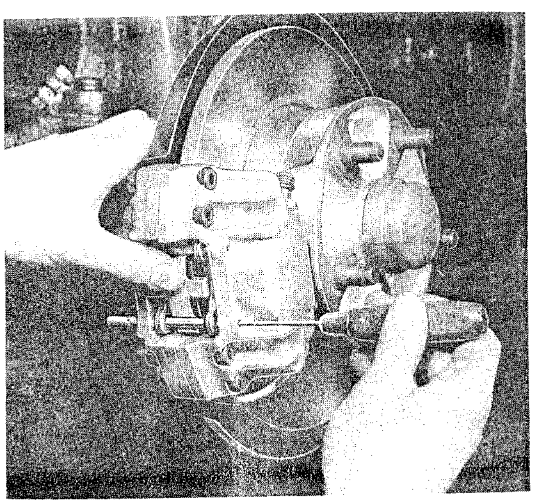


Fig. 9

4. Appropriately mark brake pad segments which may still be used.

5. Remove brake pad segments with a hook.

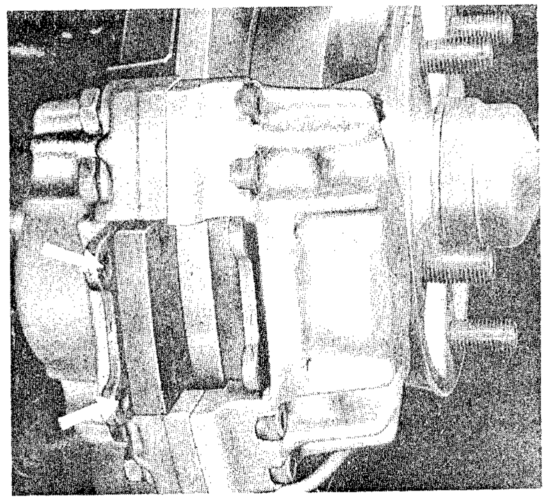


Fig. 10

6. Force pistons fully back by using the piston depressor (P 83); if not available, a piece of hardwood may be used for this purpose. Different tools may not be used due to the possibility of damaging the pistons or brake discs.

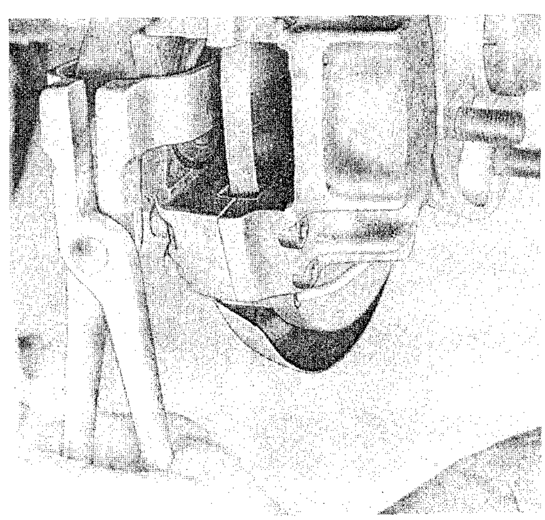


Fig. 11

Caution:

When the pistons are forced back, hydraulic brake fluid flows back into the reservoir. To prevent spillage, syphon the fluid out of the reservoir. The syphon or suction aid used must be clean and free of any substance other than hydraulic brake fluid.

7. Clean seating and supporting surfaces of brake pads within the respective wells. Do not use mineral solvents or sharp-edged metal tools; if necessary, alcohol may be used.

8. Check dust covers and clamping rings for serviceability. Hardened and porous dust covers must be replaced with new.

9. Clean brake discs with fine-grade emery cloth.

10. Install new brake pads in the housing wells and secure with retaining pins, cross-spring, and pin retaining clips; check pin retaining clips and replace if damaged or deformed in any way. The brake pad segments must freely move within their wells.

11. Repeat the above procedure on all other brake calipers.

Caution:

Before the car is driven, the brake pedal should be depressed a few times as far as is possible in order to bring the brake pistons and pads into their normal position. Afterwards check the level of hydraulic fluid in the reservoir.

Running-in Brake Pads

Factory new brake pads will lose their braking efficiency (fade) once, after installation, but this occurence will disappear after a running-in distance of about 125 miles (200 km). During the run-in period, the brakes should not be used hard at high speeds unless absolutely necessary since new brake pads must be run in at light pedal pressures applied at not too frequent intervals. It is only after the run-in period that the brakes become fully effective.

Removal and Installation of Disc Brakes

Front Wheel Brakes

Removal

1. Place car on stands and remove wheels.

2. Remove brake pad segments (refer to outline pertaining to replacement of brake pad segments, page ST 23, Points 2 to 5).

3. Loosen brake hose at brake caliper by one turn (prior to this, prop brake pedal in slightly depressed condition to avoid brake fluid spillage).

4. Remove brake caliper retaining bolts, withdraw brake caliper, and detach brake hose.

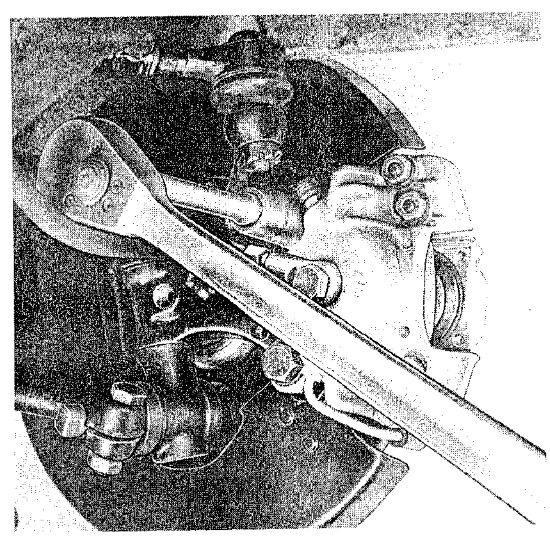


Fig. 12

5. Remove grease cup by using two large screwdrivers (remove cotter key from speedometer drive in left grease cup.)

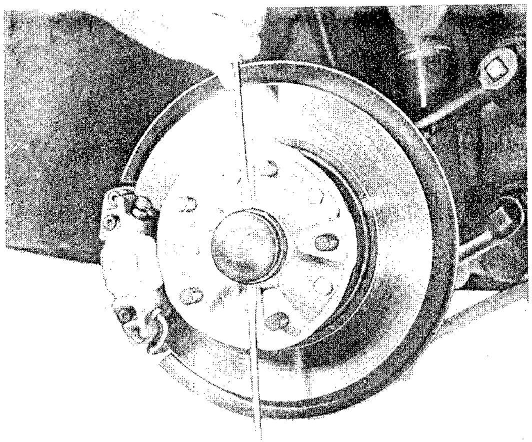


Fig. 13

6. Loosen Allen-head bolt in clamping nut and unscrew clamping nut.

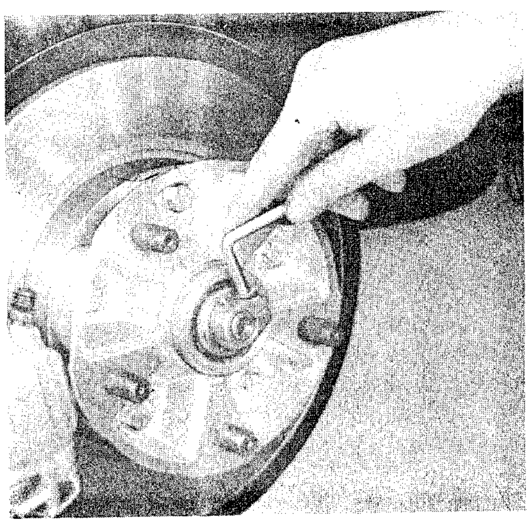


Fig. 14

7. Holding the brake disc with both hands, withdraw with a quick draw; if disc does not come off, use a puller but in no case should the disc be hammered on.

8. Undo safety locks which secure disc shroud retaining bolts, remove bolts and disc shroud.

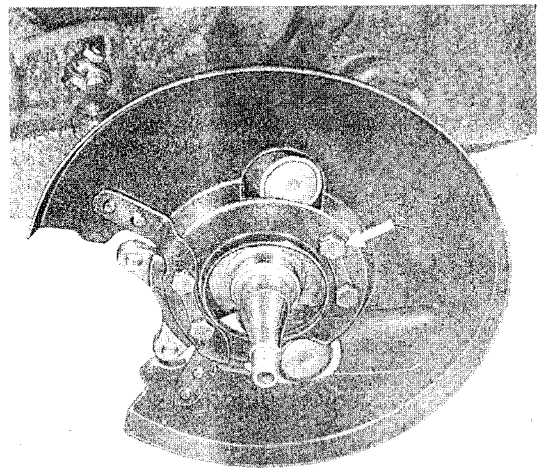


Fig. 15

Installation

The front wheel brake disc is installed in the reversed order of the above by noting the following points:

1. Clean all parts from dirt and grease.
2. Check wheel bearing, spacer, and seal for serviceability, replace if necessary.
3. Fill bearings with about 50 cm^3 or 45 g (3cu. in. or 1 1/2 oz.) of multi-purpose Lithium grease as indicated in the lubrication plan.
4. Use new safety lock plates and tighten disc shroud retaining bolts to 2,5 mkg (18.1 lbs/ft).
5. Ensure that the wheel bearings are properly adjusted, as outlined in the basic volume of the 356 B Workshop Manual, Section 4 ST, page S 11.

6. Maximum permissible lateral whip of the brake disc is 0,2 mm (.079 in.). Fig. 16 shows method of checking lateral whip.

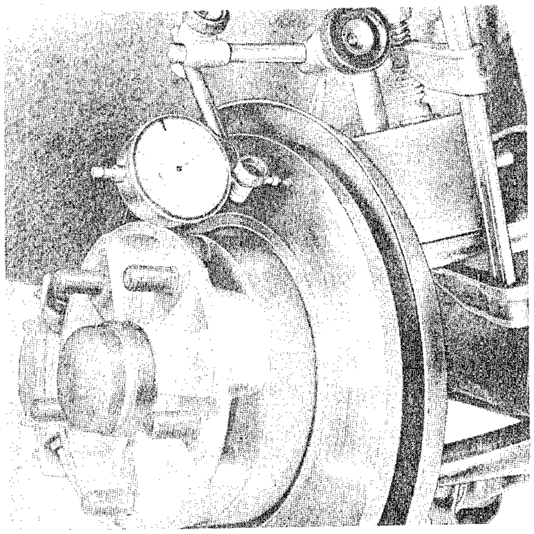


Fig. 16

7. Tighten brake caliper retaining bolts (front) to 7,8 mkg (56.4 lbs/ft); use new spring washers.

8. Install all brake pad segments in their original locations.

9. Bleed brakes.

Removing and Installing Front Wheel Bearings

Removal

1. Mark brake disc and wheel hub, remove disc retaining bolts and withdraw wheel hub.

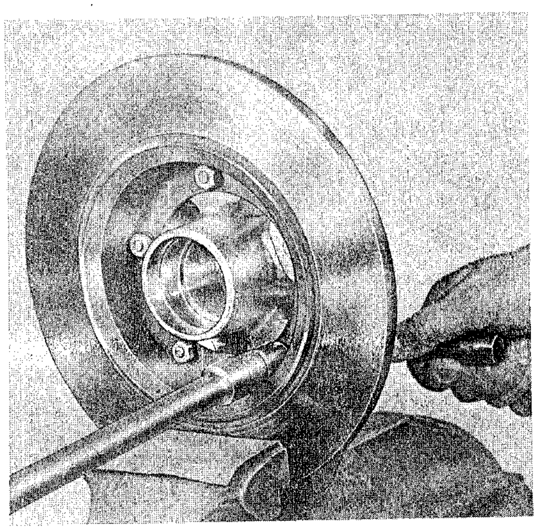


Fig. 17

2. Heat wheel hub to 120 - 150° C (248 - 270° F).

3. Press out inner taper-roller bearing and the seal on VW Press 400F, using special tools VW 407, VW 421 and VW 447g.

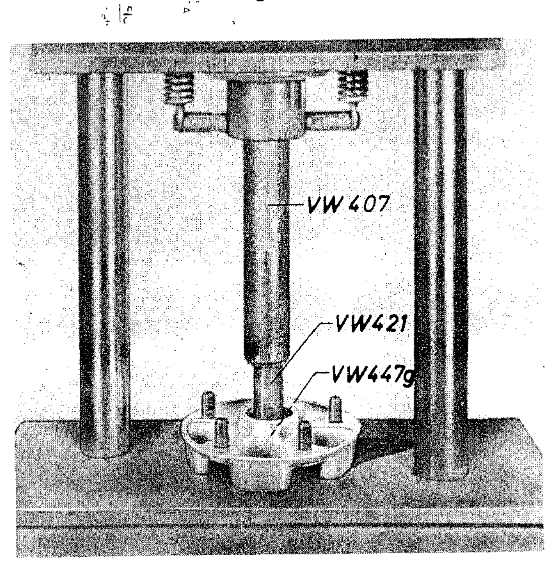


Fig. 18

4. Press out race of outer taper-roller bearing on VW Press 400 F, using special tools VW 407, VW 418, VW 447f, Spacer 1, and VW 401.

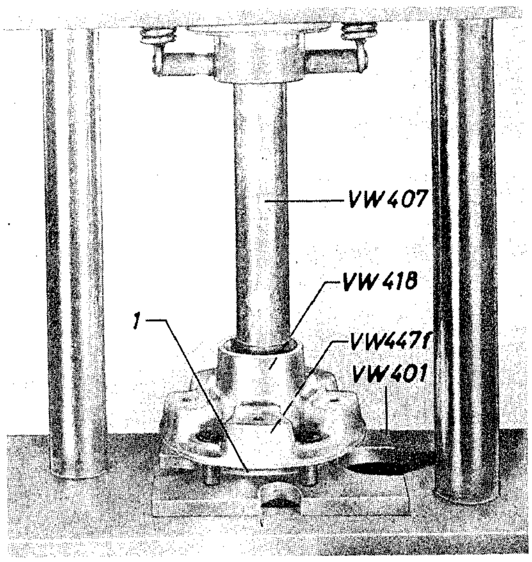


Fig. 19

Sketch for local manufacture of Spacer 1

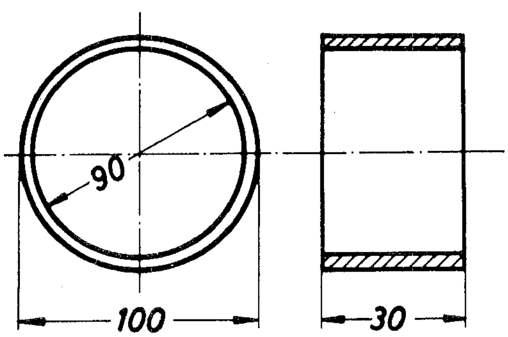


Fig. 20

90 mm = 3. 54 in., 100 mm = 3. 94 in., 30 mm = 1. 18 in.

Installation

The following should be observed during installation:

General

Taper-roller bearings of various brands (SKF, FAG, and Timken) are used during assembly at the plant.

New bearing components, such as the outer race or the inner race with rollers, may be interchanged within a given brand but care must be taken that the complete bearing consists of components manufactured by the same company.

1. Thoroughly clean both taper-roller bearings and check for wear or damage, replace if necessary.
2. Heat wheel hub to 120 - 150° C (248 - 270° F).
3. Press in the race of the inner taper-roller bearing on VW Press 400 F, using special tools VW 407, VW 447i, Spacer 1, and VW 401.

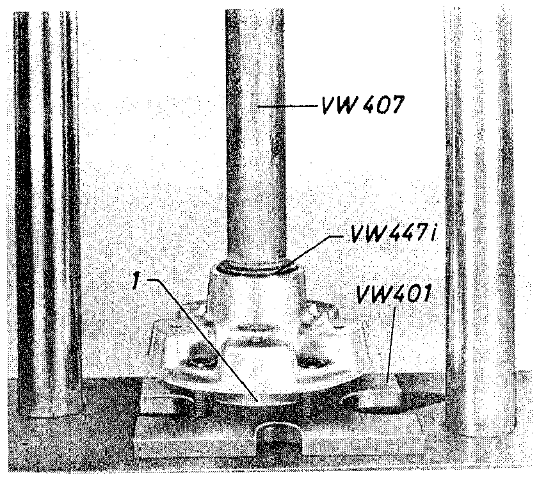


Fig. 21

4. Insert the inner race into the inner taper-roller bearing and press oil seal on VW Press 400F, using special tools VW 410, VW 433, Spacer 1, and VW 401 until the oil seal is flush with the wheel hub housing.
5. Press in the outer race of the outer taper-roller bearing on VW Press 400 F, using special tools VW 407, VW 447h, and VW 401.

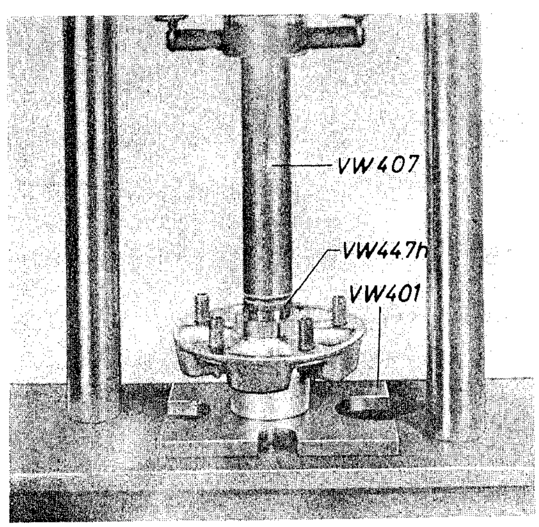


Fig. 22

6. Fill wheel hub with about 50 cm^3 or 45 g (3 cu. in. or 1 1/2 oz.) of multi-purpose Lithium grease as in the lubrication plan.

7. Place brake disc on the wheel hub so that the markings line up.

8. Tighten brake disc retaining bolts (at wheel hub) to 2, 2 - 2, 4 mkg (15. 9 - 17. 4 lbs/ft). Make certain that 1 spacer is placed under the bolt head and a new spring washer is placed under the nut.

Removing and Installing Oil Deflector at Rear Wheel Hub

Removal

1. Bend back safety-flared tube end of oil deflector.
2. Withdraw oil deflector by using 2 large screwdrivers and 2 spacer plates.

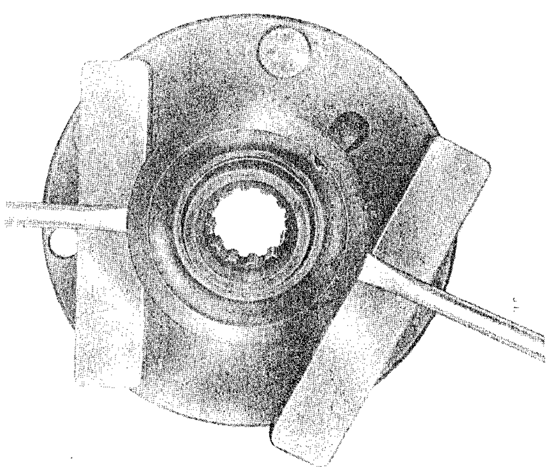


Fig. 23

Installation

1. Place oil deflector on the wheel hub by inserting the drain tube into the appropriate hole.
2. Press on the oil deflector on VW Press 400 F, using special tools VW 412, Pipe 2, VW 432, and VW 401.

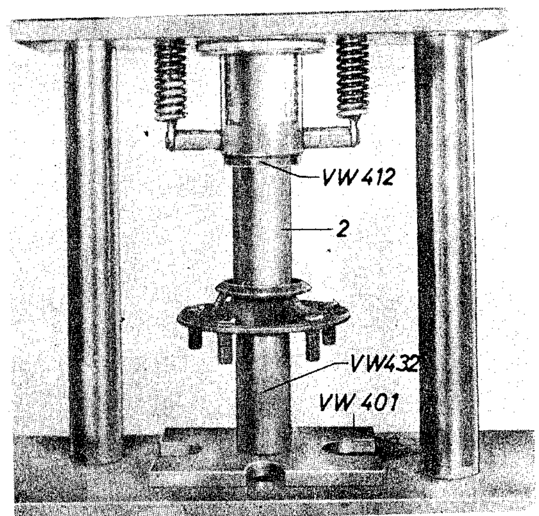


Fig. 24

3. Using a flare punch, flare out the drain tube end to secure it.

Sketch for local manufacture of Pipe 2

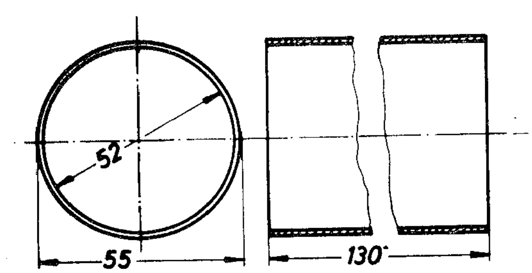


Fig. 25

52 mm = 2. 05 in., 55 mm = 2. 17 in., 130 mm = 5. 12 in.

Rear Wheel Brakes

Removal

1. Place car on stands and remove wheels.
2. Remove brake pad segments (refer to outline pertaining to replacement of brake pad segments, page ST 23, Points 2 to 5).
3. Loosen brake line at the brake caliper (prop brake pedal in slightly depressed condition to prevent spillage of brake fluid).
4. Remove brake caliper retaining bolts and withdraw the caliper forward and up, away from the brake line.

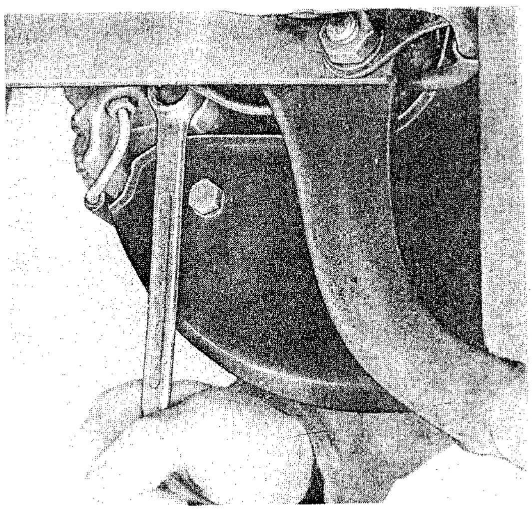


Fig. 26

5. Remove countersunk disc retaining screws and withdraw disc.

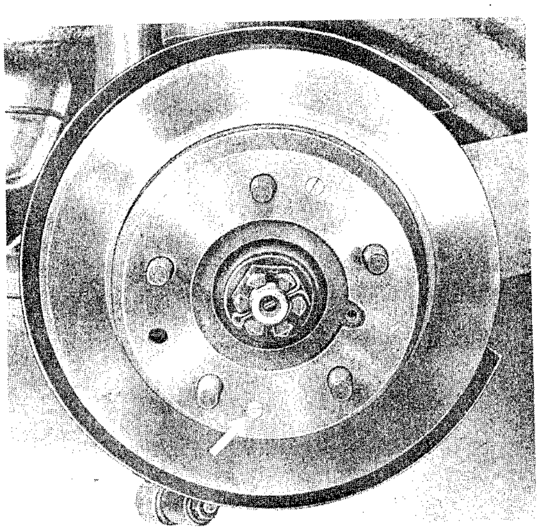


Fig. 27

6. Pull out cotter key and unscrew castellated nut from brake cable, pull out cable towards the car's center.

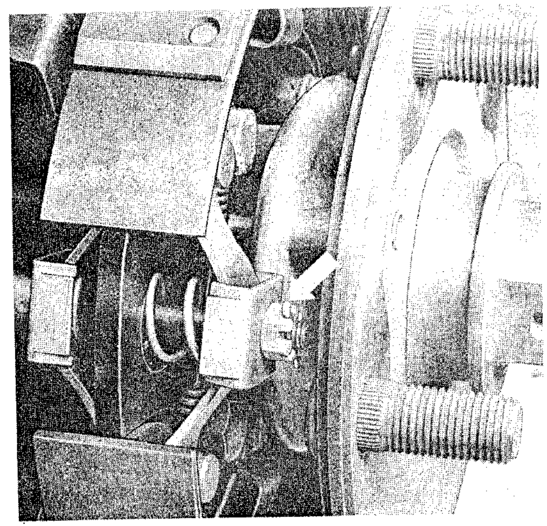


Fig. 28

7. Using a screwdriver, raise brake shoes at rear and remove mechanical expander and spring.

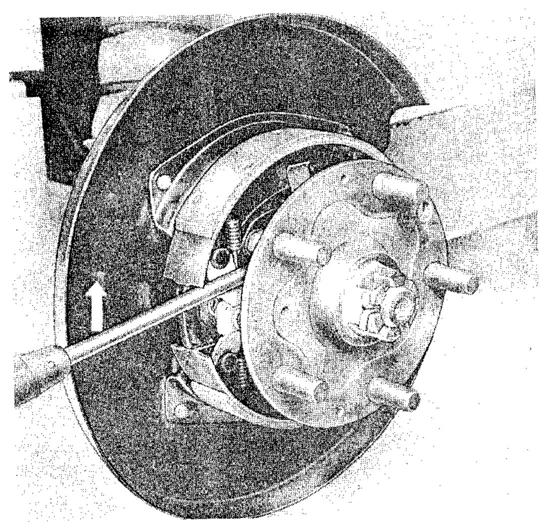


Fig. 29

8. Using a screwdriver, raise brake shoe at front and withdraw adjusting assembly.

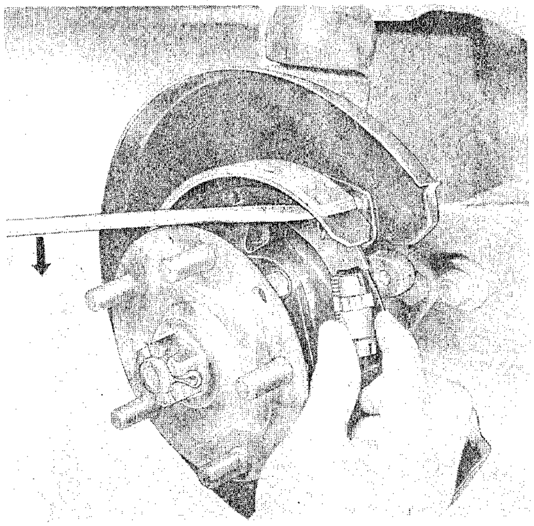


Fig. 30

9. Detach forward return spring.
10. Spread brake shoes apart at front until retaining springs are free, then remove both brake shoes rearward.
11. Remove brake shoe retaining springs.
12. Remove disc shroud retaining bolts and remove shroud.

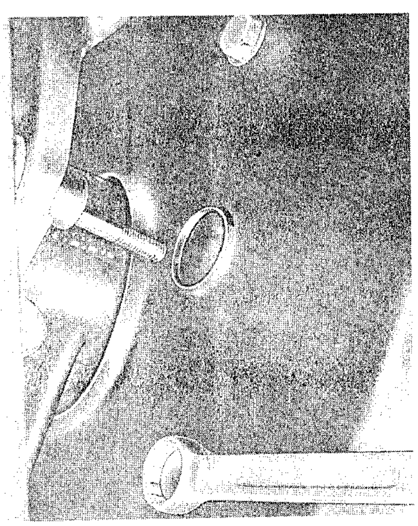


Fig. 31

13. Remove cotter key from castellated rear axle nut and remove nut using special tool P 36.
14. Mark wheel hub and axle shaft with center punch, remove wheel hub by lightly tapping it with a rubber mallet or the like.

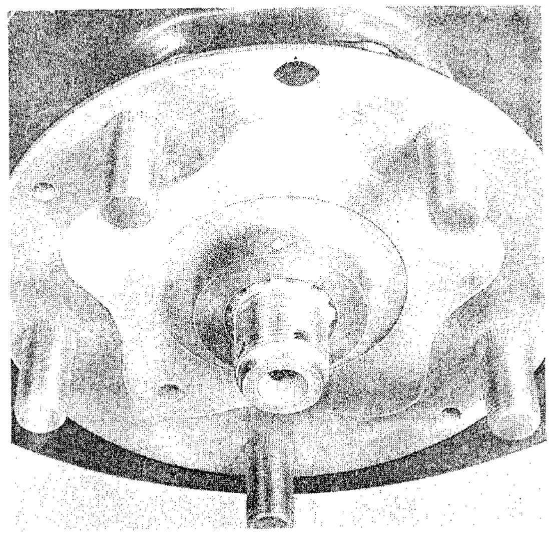


Fig. 32

Note: Transmission oil will drain out through axle tube, therefore drain first if deemed necessary.

15. Remove hand brake anchor plate retaining bolts and remove anchor plate.

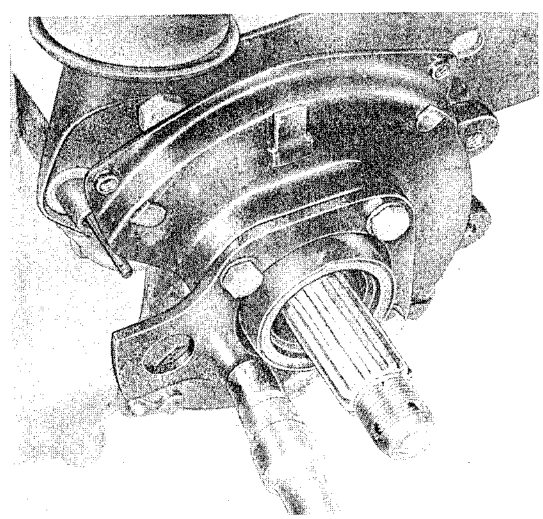


Fig. 33

Installation

Installation is accomplished in the reversed order of the above order. The following should be noted:

1. Clean all parts from dirt.

2. Check wheel bearing, seal, and seal race, replace defective or worn parts.

3. Install new O-rings pasting the large O-ring in groove with a little grease. Tighten anchor plate retaining bolts to 2,5 mkg (18,1 lbs/ft).

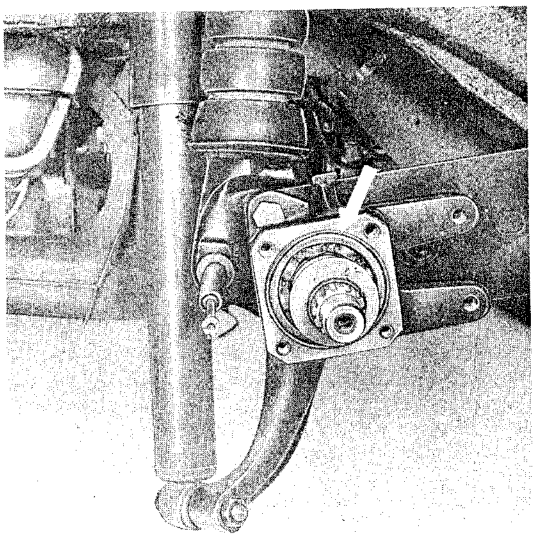


Fig. 34

4. Install wheel hub in such manner that the punch marks line up.

5. Tighten rear axle nut to 55 mkg (397,8 lbs/ft).

6. Install lower brake shoe and retaining spring.

7. Install upper brakes shoe retaining spring.

8. Attach rear return spring to lower brake shoe, then to the upper brake shoe. Pull the brake shoe up and insert in its proper place.

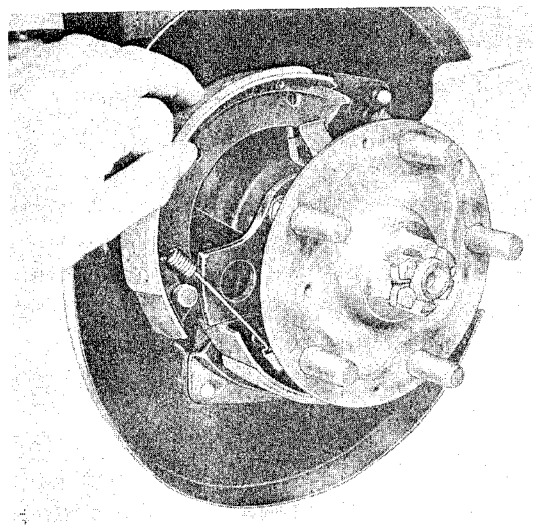


Fig. 35

9. The rear return spring should be so mounted that the spring windings point towards the center of the axle (Fig. 36). Ensure proper seating of spring.

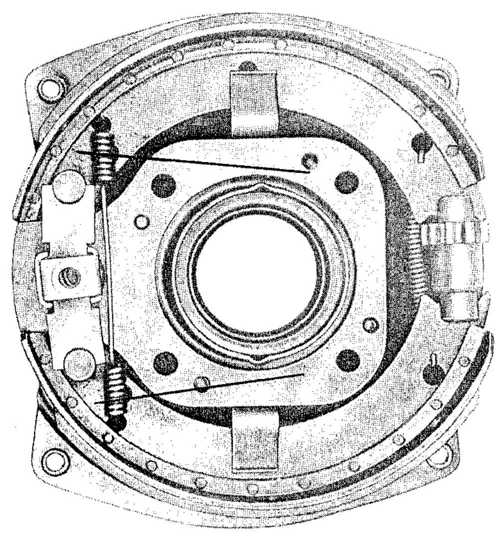


Fig. 36

10. Attach forward return spring from the back and install adjusting assembly (Fig. 36).

11. Install adjusting assembly so that the adjusting spur wheel points up at the right brake, and down at the left brake.

12. Make sure that the mechanical expander is well seated in the brake shoe studs (see Fig. 5).

13. Turn castellated nut at the end of the brake cable until the hole for the cotter pin lines up with one of the slots in the nut, then safety with a new cotter pin.

14. Check brake disc for lateral whip. This is accomplished by first fastening the brake disc with wheel lug nuts. However, to prevent warping the disc, flat-machined spacers must be placed under the nuts. The nuts are then tightened across (in star pattern) to 10 mkg (72.3 lbs/ft). The maximum permissible lateral whip is 0,3 mm (.118 in.). Minor deviations can be corrected at times by resetting the wheel hub in relation to the axle, in the splines, until a satisfactory condition is effected. When checking for lateral whip, the rear axle must be pushed towards the differential.

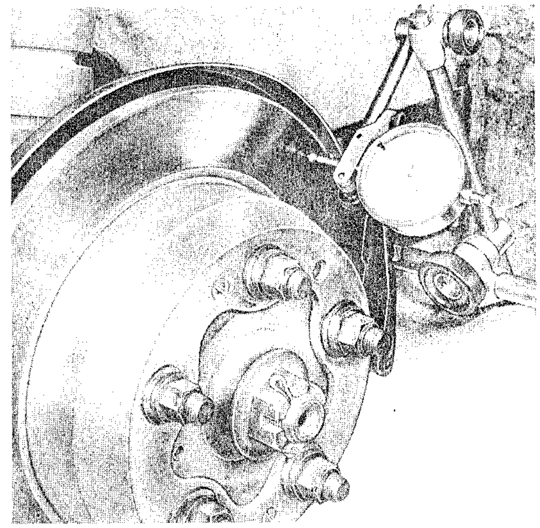


Fig. 37

15. Tighten brake caliper retaining bolts (at rear) to 6,5 mkg (47.0 lbs/ft) using new spring washers.

16. Install brake pad segments in their original positions.

17. Bleed brakes.

18. Check level of transmission oil and replenish if necessary; car must stand on wheels.

19. Adjust hand brake (see instructions below).

Adjusting Hand Brake

1. Place car on stands and remove rear wheels.

2. Release hand brake and push brake pads back until the brake discs can be turned freely.

3. Turn the adjusting spur wheel with a screwdriver inserted through the opening in the rear brake disc until it begins to drag but so that it still can be turned by hand.

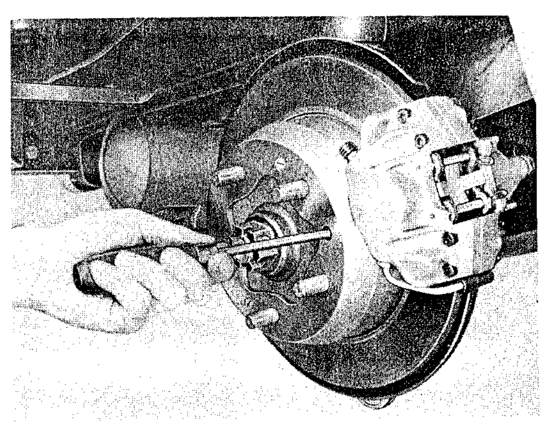


Fig. 38

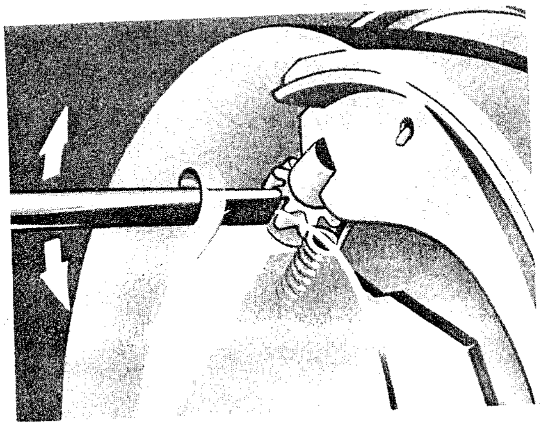


Fig. 39

4. Repeat the above procedure on the opposite brake.
5. Remove rubber covering from the center tunnel in front of the gearshift lever. Check if the brake equalizer is at a right angle to the brake cables. The cable adjusting nuts should rest against the equalizer without play. If necessary, correct the cable adjustment.

6. Adjust forward brake cable at the pivot arm until there is no play at the hand brake handle.

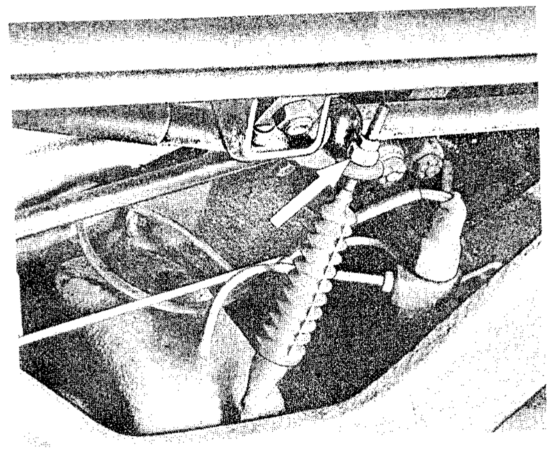


Fig. 41

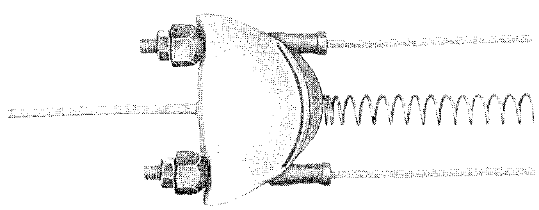


Fig. 40

7. Back off hand brake adjusting spur wheel by 4 to 5 teeth.

Caution:

Prior to driving the car, depress the foot brake pedal several times as far as it will go to bring the pistons and brake pads into their normal position, afterwards check level of hydraulic brake fluid in reservoir and replenish if necessary.

Removing and Installing Disc Shrouds

Removal (front wheel brakes)

Follow procedures applying to the removal of front disc brakes on page ST 24. The applicable points are: 1, 4 (do not detach brake hoses), 5, 6, 7, and 8.

Caution: Do not let the brake calipers to hang free on the brake hoses but attach to the car underside.

Installation (front wheel brakes)

Installation is accomplished in reversed order of the above by noting the following points, as described under installation of front disc brakes, in the follow - ing sequence: 1, 2, 3, 4, 5, and 7; see page ST 25.

Removal (rear wheel brakes)

Follow procedures applying to the removal of rear wheel brakes on page ST 29. The applicable points are: 1, 4 (slightly bend the brake line clamping strap and loosen holder at axle tube), 5, 6, and 12 – in that order.

Caution: Do not bend the brake line. Attach brake caliper to the underbody; do not let it hang free on the brake line.

Installation (rear wheel brakes)

Installation is accomplished in reversed order of the above by noting the following points, as described under installation of the rear disc brakes, in the following sequence: 1, 13, 15, and 19; see page ST 31.

Caution:
Prior to driving the car, depress the foot brake pedal several times as far as it will go to bring the pistons and brake pads into their normal position, afterwards check level of hydraulic fluid in reservoir and replenish if necessary.

Removing and Installing Pistons in Brake Calipers

Removal

1. Remove brake caliper from vehicle according to instructions outlined in sections applicable to removal of the front and / or rear disc brake, Points 1 - 4.
2. Remove brake line connecting both housing halves.
3. Remove the 4 Allen-head screws in the brake caliper and separate both housing halves.
4. Remove clamping ring which secures dust cover.

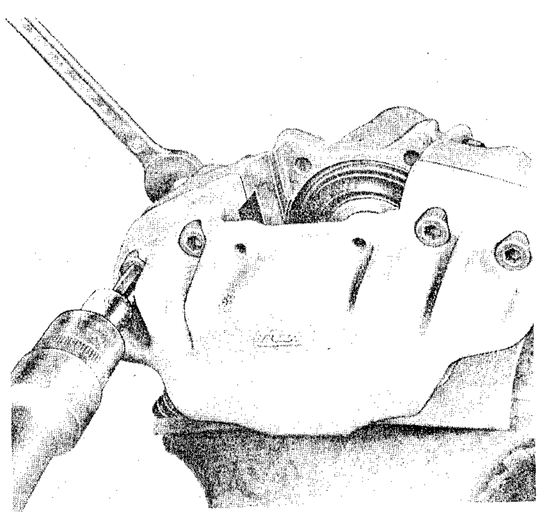


Fig. 42

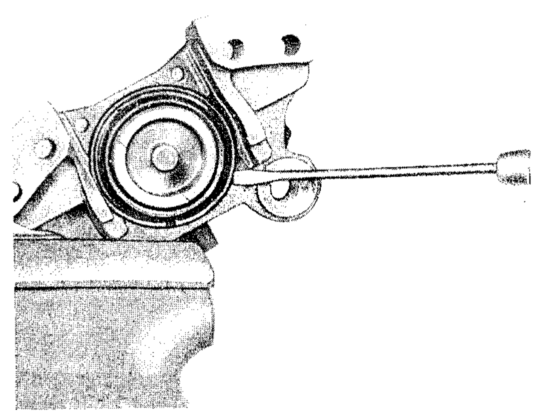


Fig. 43

5. Remove pistons from the cylinders by applying compressed air (max. pressure 2 atm. or 29.4 psi) to the inlet opening; during this operation, keep the piston from popping out by using the piston depressor (P 83) or by holding the housing half with the piston facing the work bench.

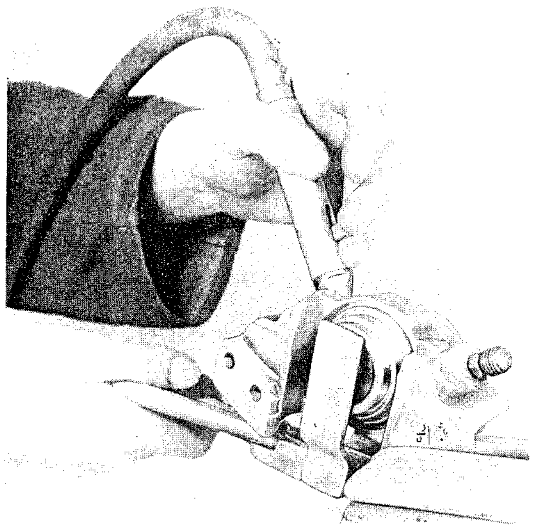


Fig. 44

6. Remove the piston seal from its groove (make sure not to damage the groove).

Note:

Handle the housing half with care so as not to damage the flange surfaces. Clean all parts in alcohol. Components of the self-adjusting mechanism cannot be exchanged; if found defective, the whole piston unit must be replaced.

Installation

1. Check cylinder bore and piston for possible damage; defective parts must be exchanged.
2. A new piston seal, dust cover, Allen-head screws, spring washers, and nuts must be installed whenever the unit has been disassembled.
3. To ease assembly and to provide protection against corrosion, the cylinder bore, piston, and piston seal should be treated with a thin layer of ATE brake cylinder compound.
4. Insert piston seal in the groove provided within the cylinder.

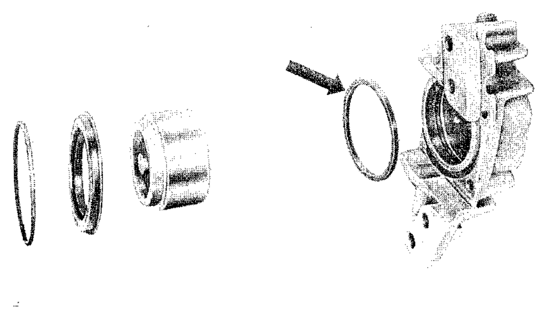


Fig. 45

5. Using the piston gauge (P 84), install the piston in such way that the stepped-down part of the piston pressure area faces towards the brake disc's rotational entry.

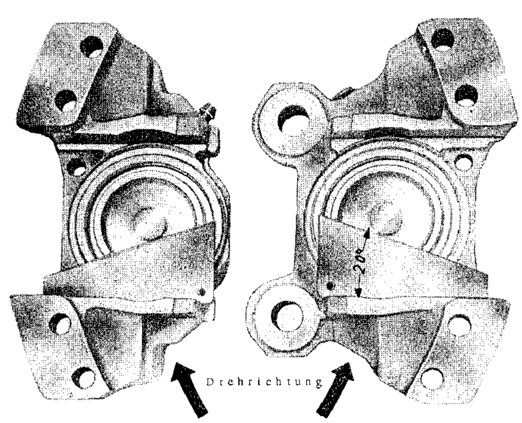


Fig. 46

6. The piston gauge must be inserted into the brake caliper always from the direction of the axle's center and the stepped-down part of the piston must line up with the slanted edge of the piston gauge. When aligning the pistons in the front brake calipers, the right-angle edge of the gauge is placed on the bottom edge of the caliper. When aligning the rear brake calipers, the right-angle edge of the gauge is placed against the upper edge of the calipers. Fig. 47 shows a brake caliper for the front brake.

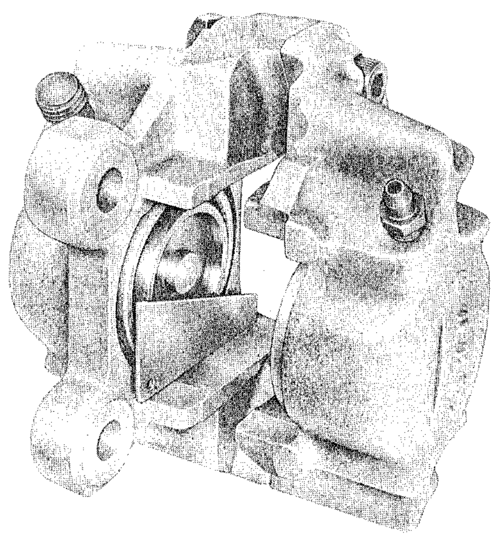


Fig. 47

7. Once again clean the flange mating surfaces of both housings with alcohol and bolt the two halves together. With the nuts tightened only slightly, align both housing halves in such way that the machined surfaces within the brake pad well are flush one with another.

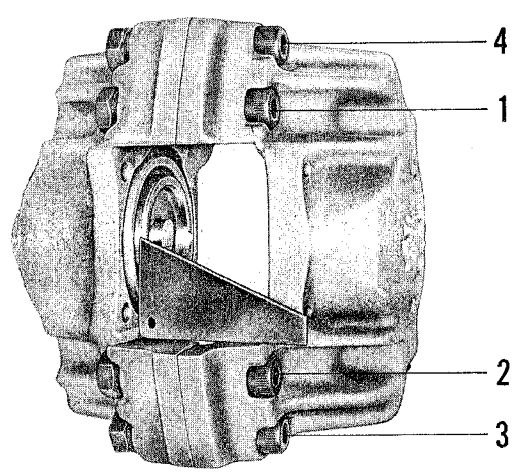


Fig. 48

8. Tighten the bolts in two stages (in first stage, apply 50% of the specified torque, in second stage 100%) and in the sequence shown in Fig. 48.

Torque Specifications:

Front brake calipers, Allen-head bolts M 8 x 50 (10 k): 3,4 mkg (24.6 lbs/ft)

Rear brake calipers, Allen-head bolts M 6 x 45 (12 k): 1,8 mkg (13.0 lbs/ft)

When tightening the Allen-head bolts, mount the caliper assembly in a vice provided with protective jaws by holding the caliper by its mounting ears. Make certain that the mounting surfaces are not damaged.

9. Install dust cover and clamping ring.

10. Install hydraulic line connecting both housing halves.

11. Install brake caliper assembly in vehicle by adhering to the instructions outlined in the section dealing with disc brake installation, page ST 25 or ST 31, respectively.

Caution:

The banjo brake line connector in the front brake caliper should not rest against the milled edge of the housing. To prevent this, it is necessary to select a gasket of appropriate thickness for insertion between the caliper housing and the banjo connector.

ELECTRICALLY-OPERATED SLIDING ROOF

The electrically-operated sliding roof is controlled by a switch on the instrument panel. The electric motor and the transmission are installed in the forward part of the roof structure and joined by a flexible shaft. A drive pinion engages into the windings of the conveyer cables and pulls the sliding roof forward or rearward, depending upon the direction of rotation. A friction clutch is provided in the transmission as a safety precaution to prevent damage to the drive assembly in case of malfunctions, and to minimize the possibility of accidental injury. The motor and transmission are easy accessible through a zipper provided in the head lining.

Manual Operation

Should the electric drive fail, it is possible to close or open the sliding ròof lid with a hand crank provided for that purpose. It will be necessary to withdraw the plastic cap and remove the slotted head screw in the drive shaft. When removing the slotted head screw pay attention not to lose the shims necessary for adjusting the clutch.

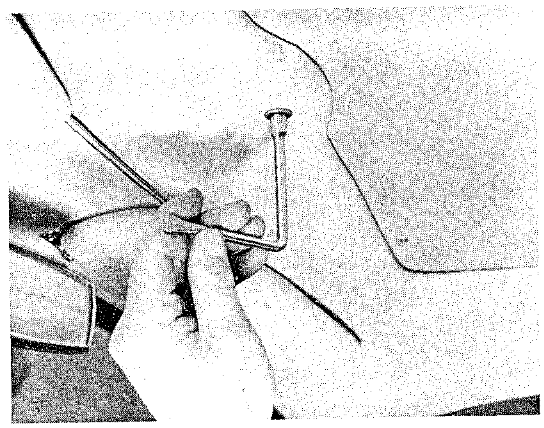


Fig. 1

Removing and installing sliding roof lid

Removal

1. Move lid to half-open position.
2. Remove both sheetmetal screws holding head lining to forward corners.
3. Pull head lining forward to roof structure.

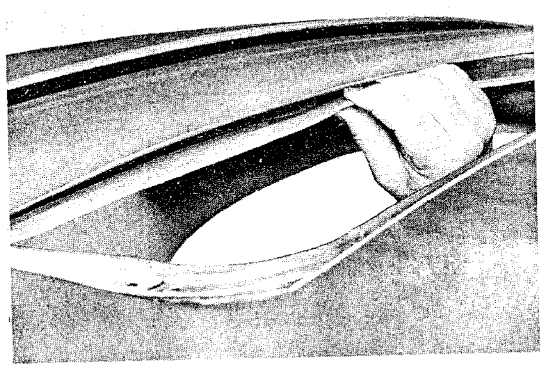


Fig. 2

4. Withdraw head lining frame reinforcement from head lining frame brace; the head lining frame reinforcement is secured at each end with adhesive tape.

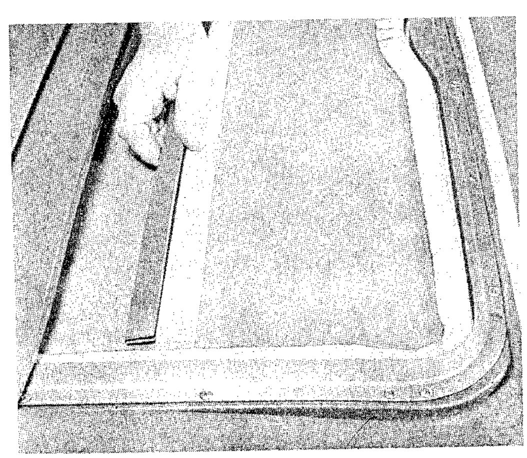


Fig. 3

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Removal

1. Remove sliding roof lid as outlined on preceding pages.
2. Remove drive housing cover located in the center of forward roof structure.
3. Remove retaining plate located above drive pinion.

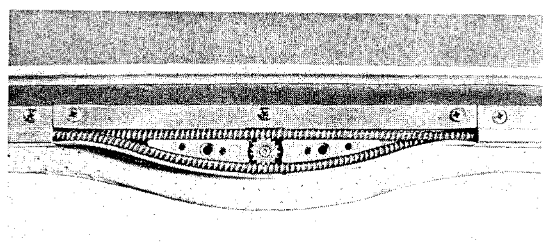

Fig. 7

4. Remove both connections, top and bottom, in forward roof structure, also both guide elbows, top.
5. Pull conveyer cables and rear guides out of guide rails.

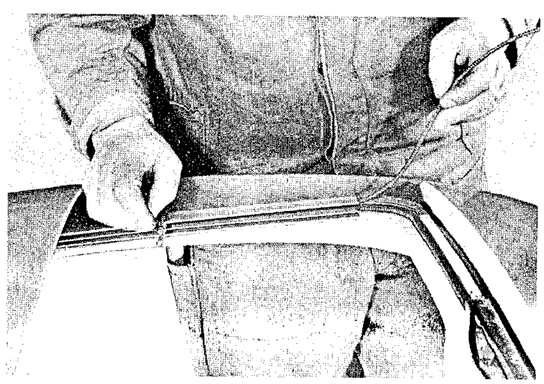

Fig. 8

Installation

NOTE

Check conveyer cables for wear, bends, or other faults prior to installation; install new parts if necessary. In order to ensure a free and even movement of the lid, we recommend that both cables be replaced even if only one should be defective.

If new cables are installed, they can be somewhat longer but should never be shorter than specified.

We recommend that grease containing molybdenum-sulphide additive be used for lubricating the cables.

1. Slide conveyer cables and guides into guide rails reaching end stops.
2. Install both guide elbows, top, and connections, top and bottom, in forward part of roof structure. Make certain that rails and guide elbows are flush with each other, straighten if necessary.
3. Insert cables in drive housing in such way that right cable lies in front of drive pinion and left cable lies behind it.
4. Insert retaining plate with released chamfer from the front and mount drive housing cover.
5. Check lid for free movement, adjust if necessary.

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5. Pull head lining up to above the roof structure and remove by pulling forward.

6. Pull lid to within 2 inches of closed position.

7. Remove guides after loosening screws in both forward corners.

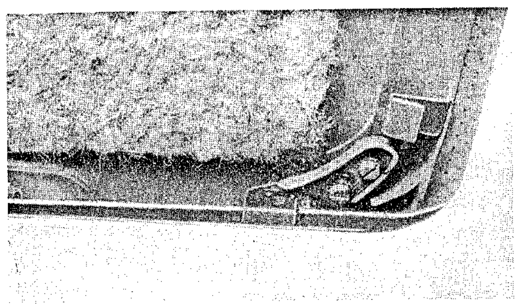

Fig. 4

8. Remove slotted retaining screws at guides, detach shackle from its bracket.

9. Using a screwdriver, push lifters off studs and take out.

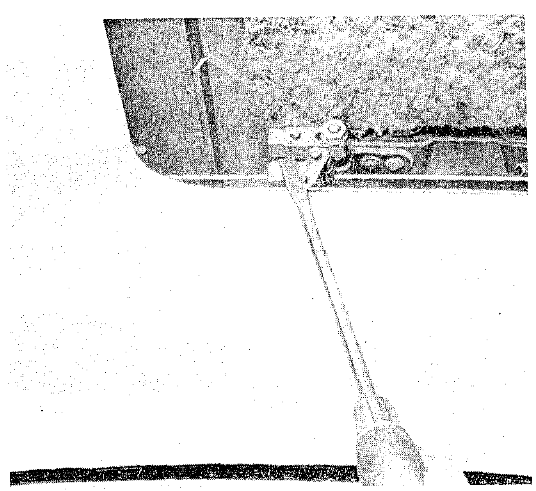

Fig. 5

10. Raise forward end of lid and slide it out.

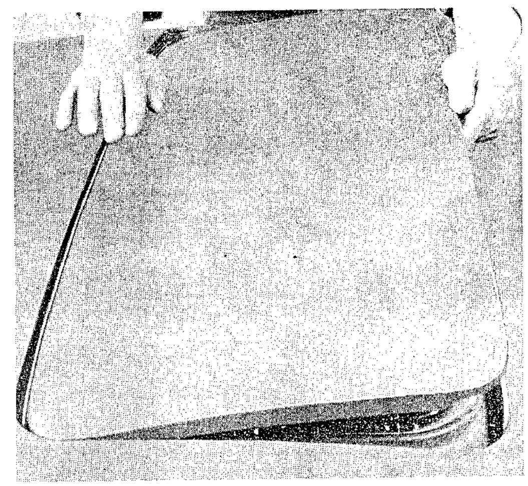

Fig. 6

Installation

1. Slide the lid in, make sure that both cable guides are completely in the back (within the cut out).

2. Mount lid lifters on studs of cable guides. Connect shackle to bracket and secure with screw. Notch the leaf spring, fixed to the cover, beneath the studs of the guide of the lifter.

3. Check if lid moves uniformly, i.e., does not bind sideways; if necessary adjust cable in the drive housing (refer to instructions, pages SB 6 and SB 7).

4. Adjust lifters and lid lever (refer to page SB 6).

5. Install head lining and head lining frame reinforcement.

6. Push head lining frame reinforcement over head lining frame brace and secure both ends with adhesive tape.

7. Check sliding roof for proper seating and free movement.

REMOVING AND INSTALLING SLIDING ROOF MOTOR

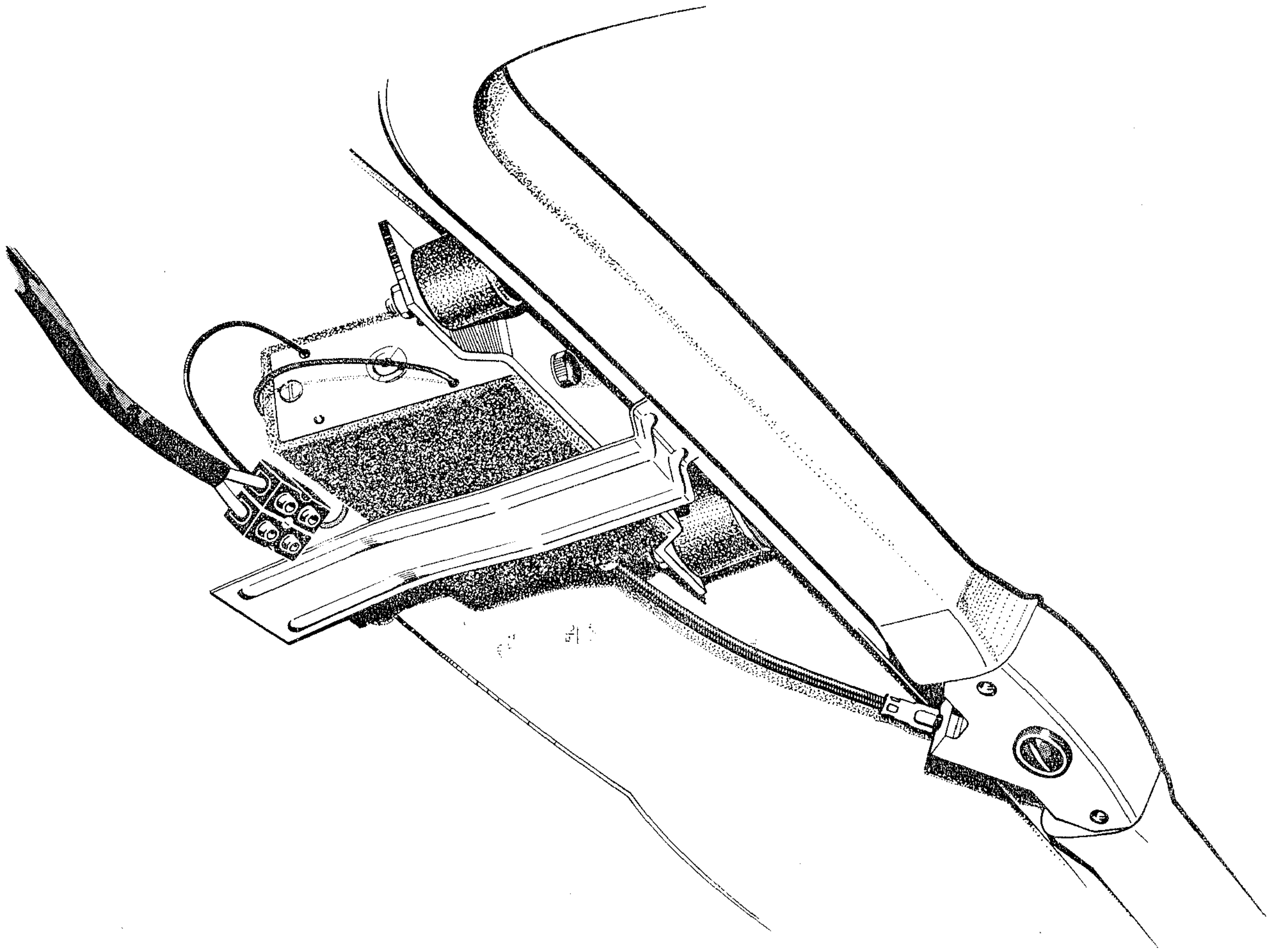

Fig. 9

Removal

1. Open zipper in roof lining.
2. Disconnect wire at porcellain insulator.
3. Withdraw flexible shaft from sockets and take out.
4. Remove both motor hold-down nuts at rubber bushings.
5. Slide motor over reinforcing bar and take it out.

Installation

1. Prior to installation, glue a 1/4" thick felt strip around motor to muffle noises.
2. Slide motor in through space above reinforcing bar and secure to studs in rubber bushing using 6 mm nuts.
3. Insert flexible shaft into sockets.
4. Connect electrical wires and check motor for proper operation. Shift motor in oval orifice until smoothness of action of the flexible shaft is possible. Tighten 6 mm nuts in this position.
5. Close zipper, check condition of roof lining.

REMOVING AND INSTALLING SLIDING ROOF TRANSMISSION

NOTE

It is necessary to pull off some of the forward roof lining when removing the transmission box.

Removal

1. Open sliding roof lid.
2. Remove drive housing cover located in center of forward roof structure.
3. Remove retaining plate located above drive pinion.
4. Remove both connections, top and bottom, of forward roof structure.
5. Remove drive housing.
6. Open zipper in roof lining.
7. Withdraw flexible shaft from sockets in transmission and motor.
8. Detach roof lining where necessary.
9. Remove both transmission retaining screws, withdraw transmission.

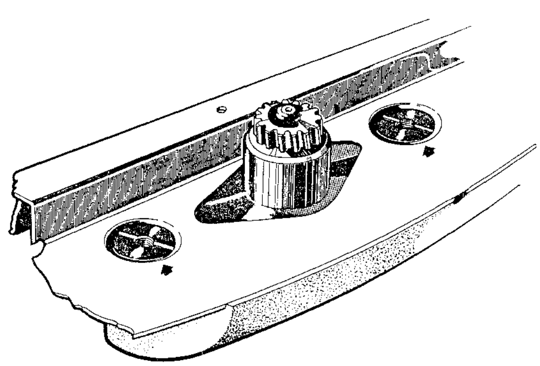

Fig. 10

Installation

1. Insert transmission and secure with screws.
2. Glue roof lining in.
3. Install flexible shaft connecting transmission with motor.
4. Slide drive housing over drive pinion and secure with screws.
5. Place conveyer cables in connections, top and bottom, and screw to forward roof structure.
6. Insert conveyer cable in drive housing so that right cable lies in front of drive pinion and left cable lies behind it.
7. Install retaining plate making sure that drive shaft does not lie above it.
8. Reinstall drive housing cover.
9. Check lid for free movement, readjust if necessary.

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ADJUSTING SLIDING ROOF

Adjusting Position of Sliding Roof Lid

a) Forward end, right and/or left side:

1. Remove sliding roof lining and frame (see p. SB 1)

2. Lid lever is adjusted by resetting lock nuts (2). Loosen bolts (4) securing guide (3), raise or lower sliding roof lid (1) by resetting lock nut (2), retighten guide.

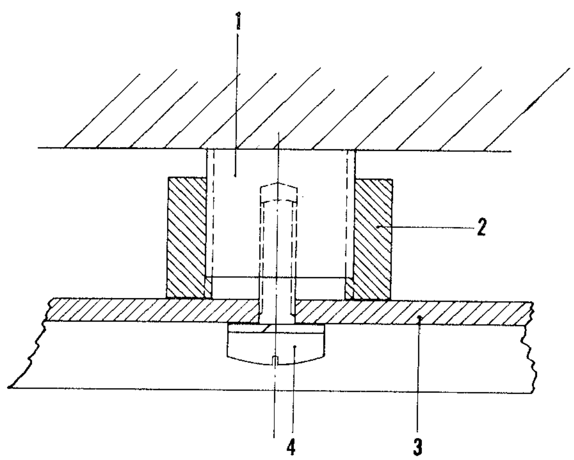


Fig. 11

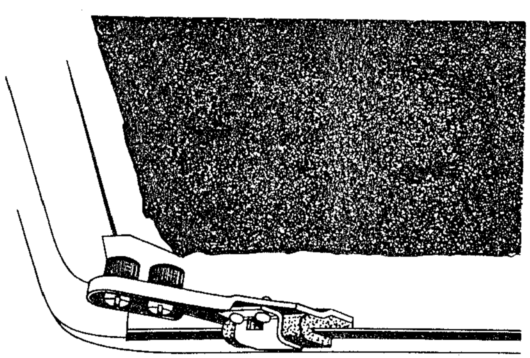


Fig. 12

3. Check lid for free movement.

4. Reinstall head lining (see page SB 2)

b) Rearward end, right and/or left side:

1. Remove head lining (see page SB 1).

2. Loosen nut (1) on stud (3); nut is 5 mm. By turning adjustment screw (2) in right or left direction, stud in oval orifice of lifter (4) is brought to desired position.

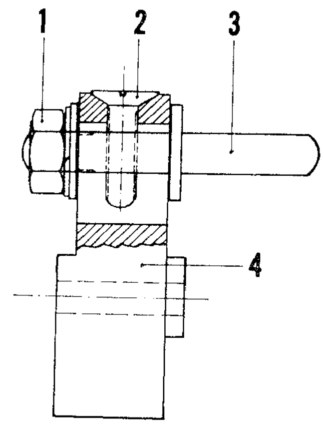


Fig. 13

3. Retighten nut on stud.

4. Check lid for free movement.

5. Reinstall head lining (see page SB 2).

CORRECTING ONE-SIDED LIFT OF SLIDING ROOF

Inspection and Corrective Action

1. Lifter ramp located in gutter of sliding roof frame must be flush with lid lifters.
2. Open sliding roof fully.

NOTE

The spot on which each lifter comes into contact with rear part of ramp can be visually determined.

3. Straighten ramp so that lifter contacts center of ramp. The ramps must be so positioned that when the front-edge of cover contacts the velvet sealer, the lifters are at an angle of 45°. By adjusting the position of the ramp, the point of contact of the lifters changes.
4. If necessary, readjust lifter (see page SB 6, par. b).
5. To adjust lifter it is necessary to remove head lining as outlined on page SB 1.
6. Check sliding roof lid for free movement.

CORRECTING UNEVEN TRAVEL OF SLIDING ROOF

1. Determine which side of lid is slow by letting lid close.
2. Open lid.
3. Remove drive housing cover.
4. Pull retaining plate upward over drive pinion.
5. Reinstall retaining plate in drive housing.
6. Reinstall drive housing cover.
7. Check sliding roof lid for free movement.

Adjusting

Example:
Should right side of sliding roof lid be slow, raise forward laying cable over drive pinion, pull to left by one or more teeth, reinsert cable.

CHECK AND ADJUST FRICTION CLUTCH

Check

The adjustment of the friction clutch is in order, when on closing the sliding roof the switch is operated longer than necessary in the "Z" (closed) position and the motor runs slowly in spite of the already closed sliding roof. This shows that the friction clutch works. If the switch is operated in the "Z" (closed) position when the sliding roof is closed, the stalled motor must not put into action the friction clutch. The setting of the friction clutch can be adjusted by addition or removal of shims.

Adjust

1. Remove plastic cap at the bottom of the gear unit.
2. Remove slotted-head screw with crank.
3. Add one or more shims and reinsert and tighten slotted-head screw.
4. Check sliding roof lid for free movement.

NOTE
Each automobile equipped with an electrically operated sliding roof is furnished with a crank and a plastic bag containing 3 shims.

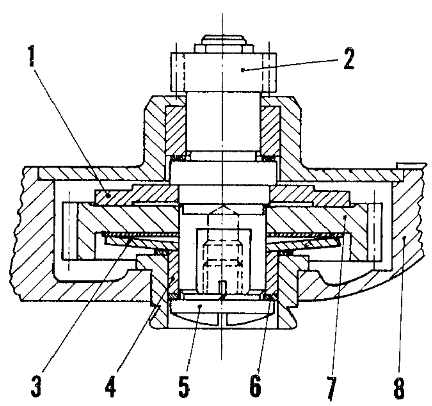


Fig. 14

1. Counter plate
2. Pinion
3. Elastic pressure plate
4. Bearing bush acting as pressure piece
5. Adjusting screw
6. Spacers
7. Gear
8. Housing

Second Edition of this page, November 1961

REPAIR OF SLIDING ROOF WATER DRAINS

If the water drain hoses are blocked, they can be cleaned with compressed air. Cleaning with a flexible steel cable is also possible. If this procedure is not successful, renew the water drain hose. Pull off some of the lining and insert the new hose without bending it.

SEAL SLIDING ROOF

1. Glue the large velvet sealer on the front and both sides of the roof cut-out and the small velvet sealer on to the rear of the lid.
2. Pay attention that the small velvet sealer is glued right to the end of the rear radius of the lid. The large velvet sealer must be glued on in such a way that there is no intermediate space between the two velvet sealers.
3. Furthermore, right behind the small velvet sealer there is a weather strip glued on the rear lid profile with its short side, so that its long side lies under the rim of the small velvet sealer.
4. The small velvet sealer and the rear weather strip can only be renewed after removal of the lid.

RELINING SLIDING ROOF

1. Remove head lining as described under "Removing and installing sliding roof", items 1 to 5.
2. Pull off damaged or soiled head lining from frame and remove traces of glue.
3. Glue head lining, consisting of artificial leather, plastic material and center holding strip, held together by the seam running across the center, on head lining frame.

   Make sure that a plastic strip (4 mm thick) is first glued on the lower part of the rear head lining frame brace.
   The center holding strip is so glued on the front to head lining frame brace that the head lining frame reinforcement can be pushed on from behind. Glue the head lining only to the upper side of the head lining frame brace, so that the head lining frame can slide in the head bracket.
4. Install sliding roof as described under "Removing and installing sliding roof".

VENTILATING PLANT

General Remarks

The fresh air vent is located on the center piece under the windshield. A water receptacle, located under the fresh air vent, collects the water which may enter the vent and drains it.

There are two fresh air ducts located in the inner wall of the luggage compartment. Their two ventilation flaps can be operated from the passenger compartment, allowing the air to enter according to their position.

Description of Function

When the vehicle is in motion, the air pressure causes air to be pressed into the luggage compartment, from where it enters the passenger compartment through the adjustable air flaps in the fresh air ducts, and is then conveyed either to the windshield or the floor. An intermediate position of the ventilation lever divides the air accordingly between the floor level and the windshield.

Ventilation lever and flap position

Ventilation lever position 1

The ventilation flaps in the fresh air ducts are closed: no air can enter the luggage compartment.

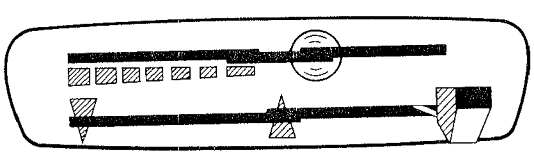


Fig. 14

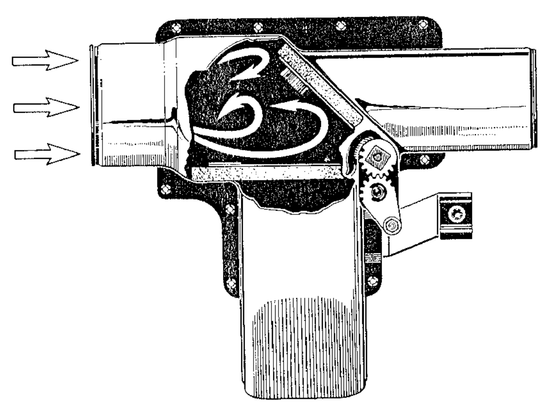


Fig. 15

Ventilation lever position 2

The ventilation flaps convey the air entering when vehicle is in motion to the windshield defroster slots.

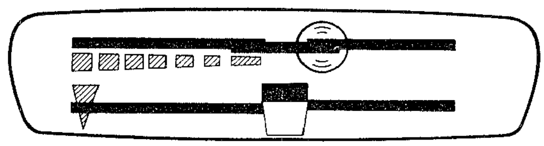


Fig. 16

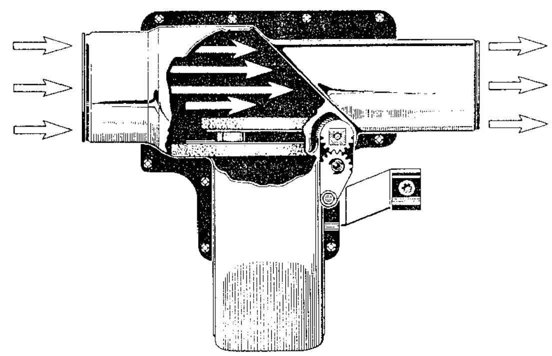


Fig. 17

Ventilation lever position 3

The ventilation flaps in the fresh air ducts convey the air entering when vehicle is in motion to the floor level.

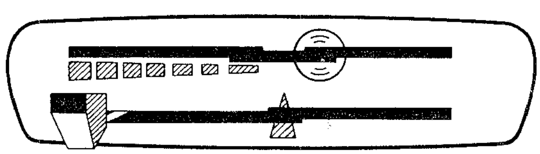


Fig. 18

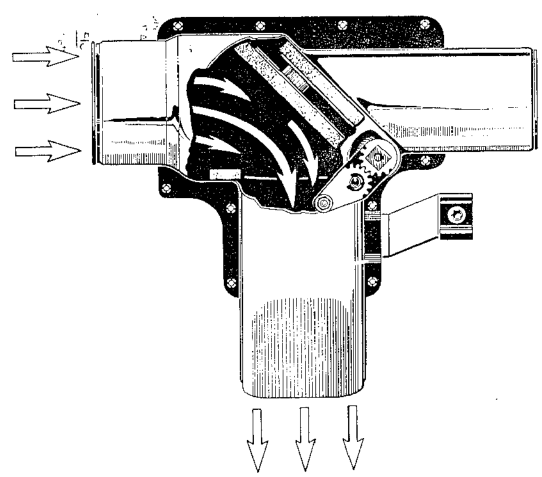


Fig. 19

Remove and Install Fresh Air Ducts

General Remarks

The fresh air duct is held to the luggage compartment wall by means of a 6 mm long bolt and fastened with the corresponding nut. The ventilation flaps are operated from the instrument panel by means of a bowden control. The ventilation flap shafts must be lubricated from time to time.

Removal

1. Loosen bowden control at fastening clip and at bell crank for ventilation flaps, and remove.
2. Loosen fresh air ducts by unscrewing from the wheel well side the nut from the fastening bolt.
3. Loosen fresh air ducts from the hose connection by twisting it slightly, and remove.

Installation

1. Before installing the fresh air ducts, check ventilation flaps for proper operation and free movement, rectify if necessary.
2. Rub hoses with tallow to facilitate installation.
3. Insert fresh air ducts in hoses.
4. Adjust the air ducts to the openings for the hoses by means of 6 x 18 washers.
5. Fasten the air ducts from the wheel well side, insert first 6 x 18 washer, then tighten with M 6 nut and finally apply packing material on nut and washer.
6. Hoses must be properly packed with Teroson packing putty at the fresh air ducts as well as at the opening between luggage compartment and passenger compartment. The same applies also for the openings of the bowden controls in the partition.

Bowden Control Adjustment

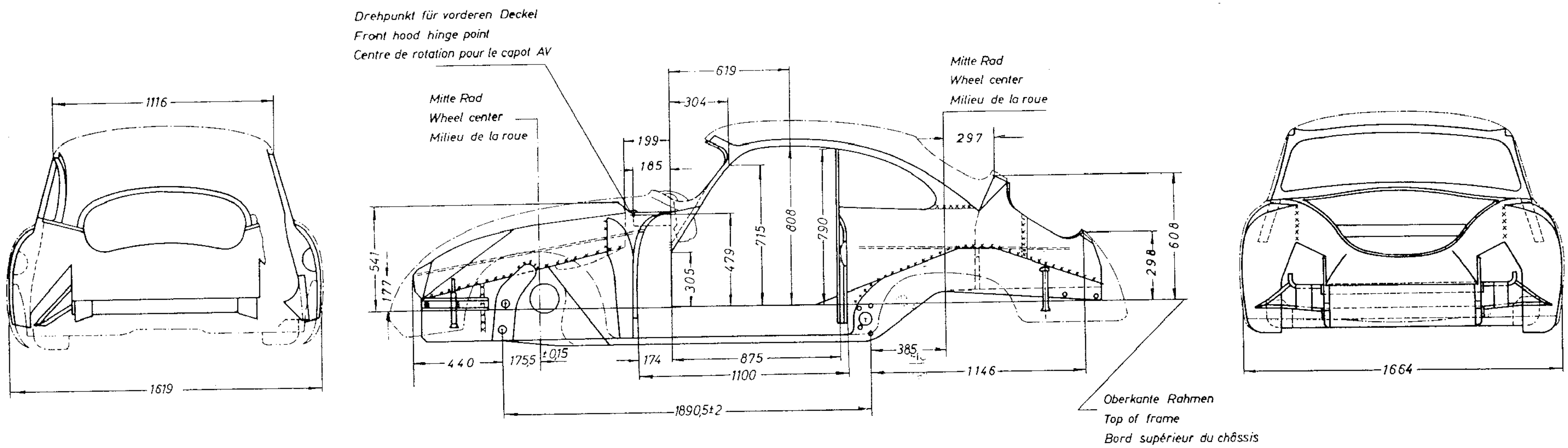
1. Special attention must be paid that the bowden control be attached to the fastening clip in a soft arch from the ventilation lever.
2. Place ventilation lever in position 2.
3. Tighten bowden control with a hex. wrench on the appropriate fastening clip.
4. Fasten bowden control to bell crank by inserting it in the screw hole. The ventilation flaps must be in the position shown in Fig. 17.
5. Operate ventilation lever, check position of ventilation flaps and of bell crank, adjust if necessary.
6. Adjust possible tension between bowden control and bell crank by regulating the position of the fastening link.

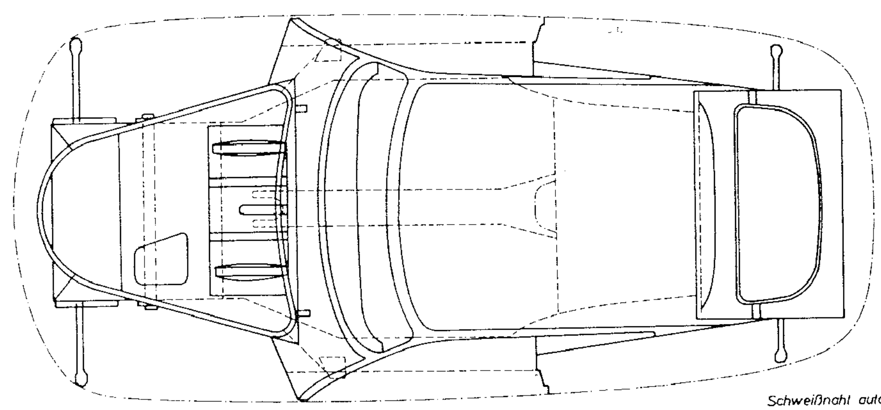
Remove and Install Ventilation Lever

Removal

1. Remove electric clock.
2. Loosen bowden control from the fastening clip and from the locking disc.
3. Loosen fastening nuts from the ventilation lever.
4. Remove ventilation lever.

The ventilation lever is installed in the reverse order of removal.





Reparatur-Anweisung für Coupe Innenverkleidung

Body Work Dimensions for Interior of Coupe

Instructions de réparation pour le parement intérieur du Coupé

Schweißnaht autogen

Weldet seam

Joint de soudure

+++++++++++++++

×××× ×××

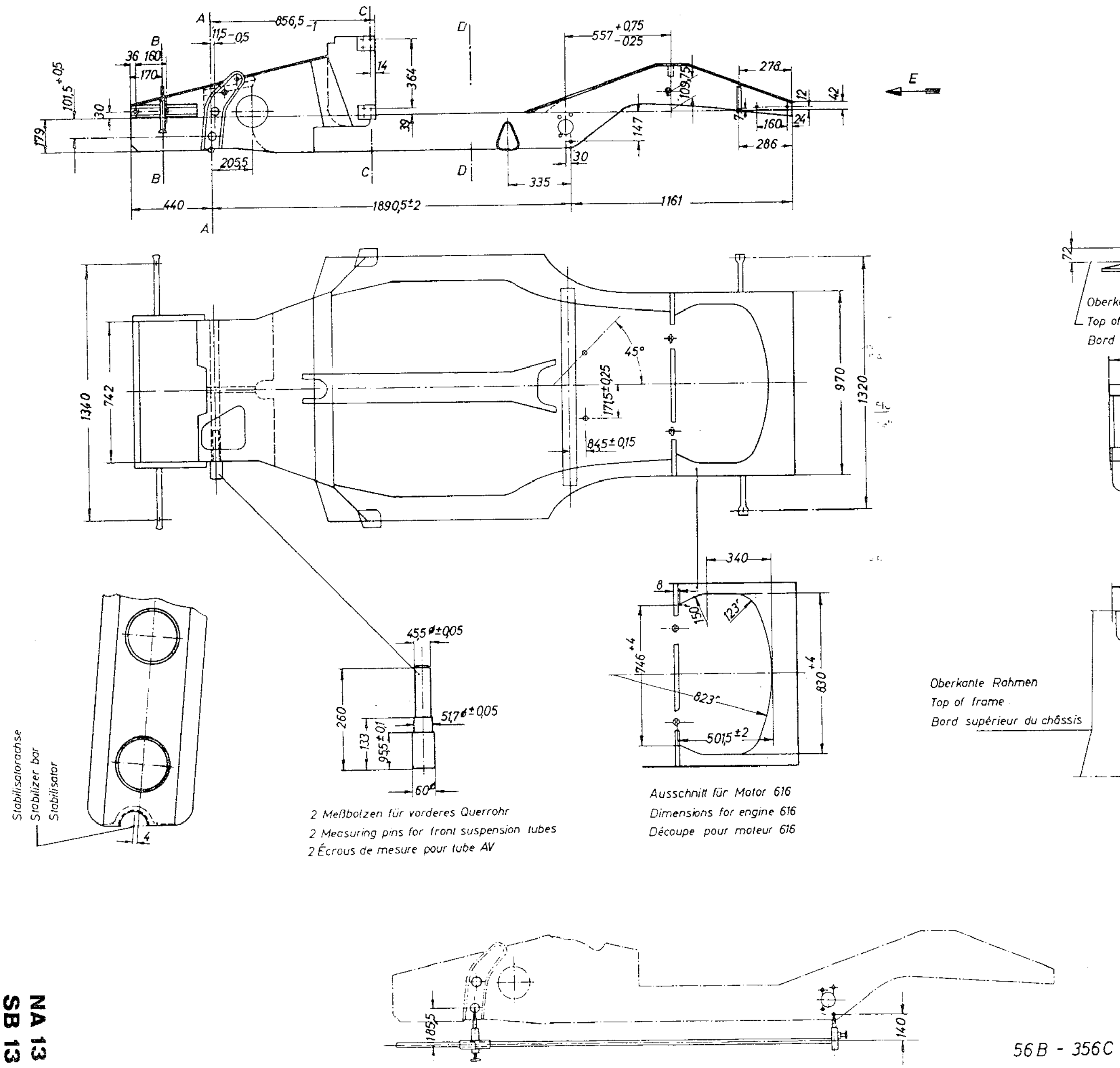
Puntschweißnaht

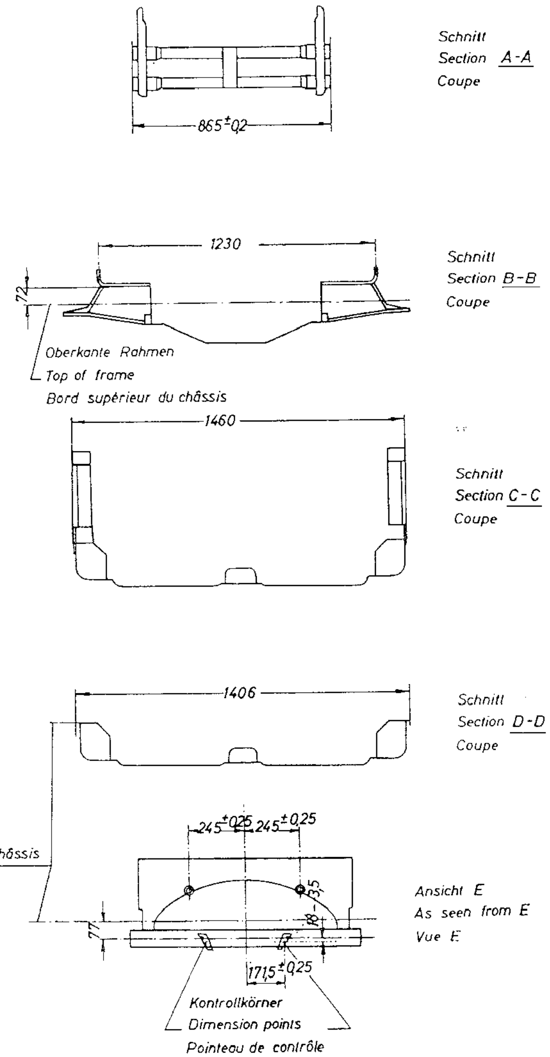
Spot welding

Soudure par points

56 B - 356 C

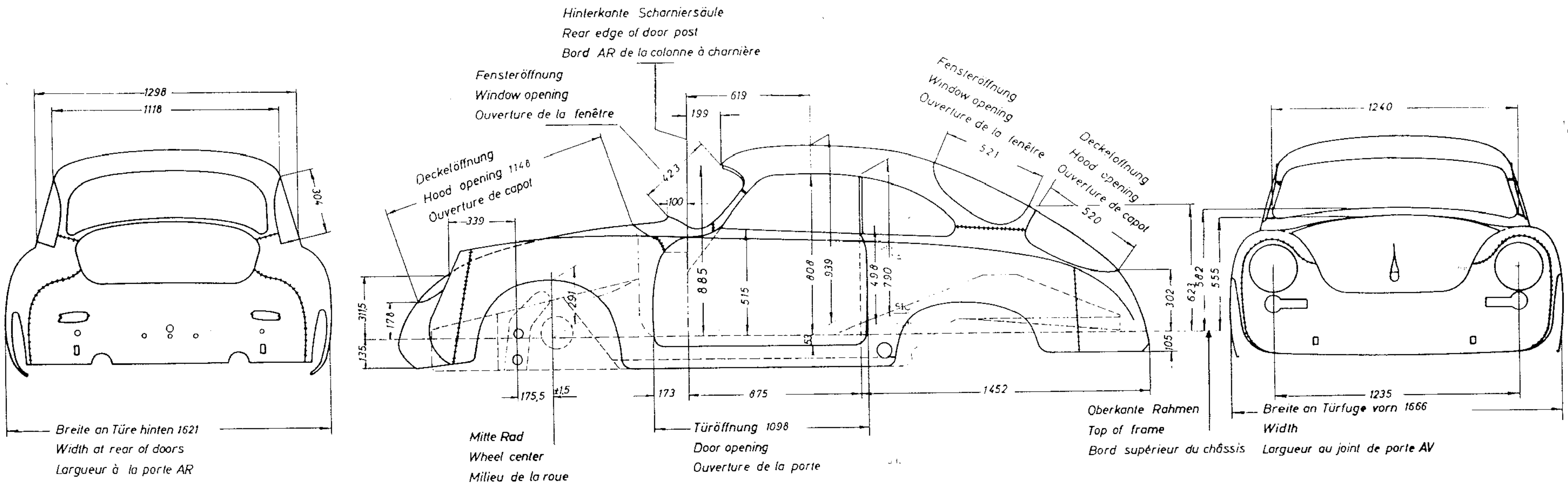
NA 15
SB 15
SC 15

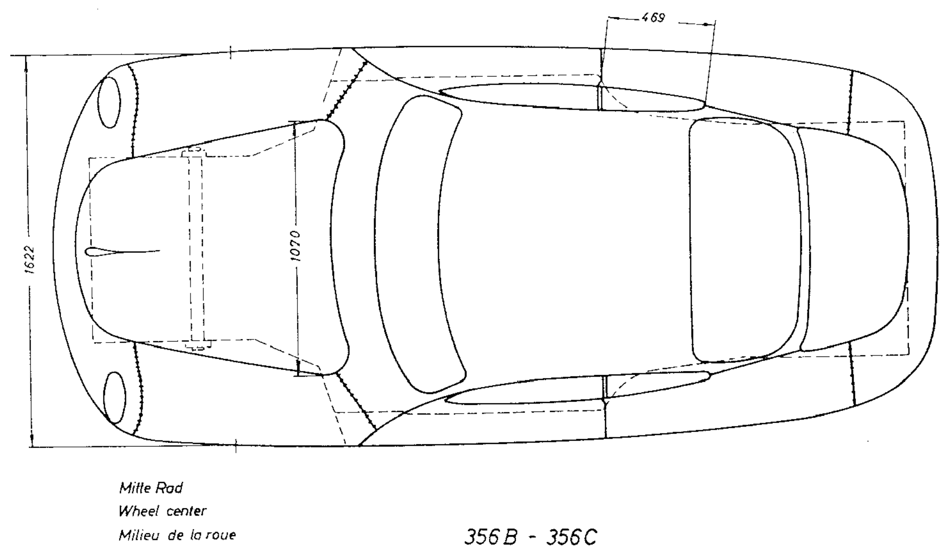




Kontrollmaße für Rahmen
Chassis Dimensions
Cotes de contrôle du châssis

NA 13
SB 13
SC 13





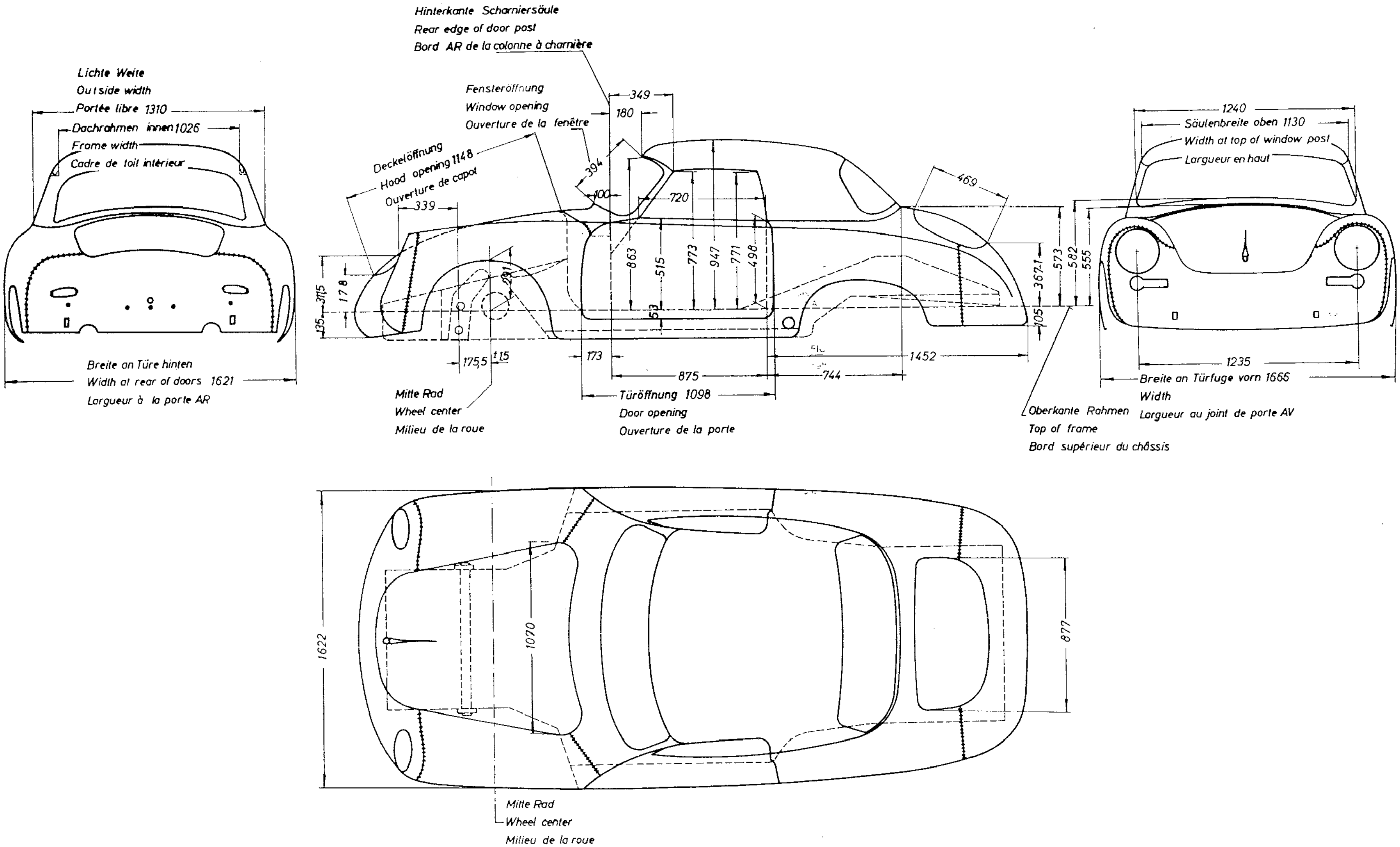
Reparatur-Anweisung für Coupe Außenverkleidung

Body Work Dimensions for Coupe

Instructions de réparation pour le parement extérieur du Coupé

356 B - 356 C

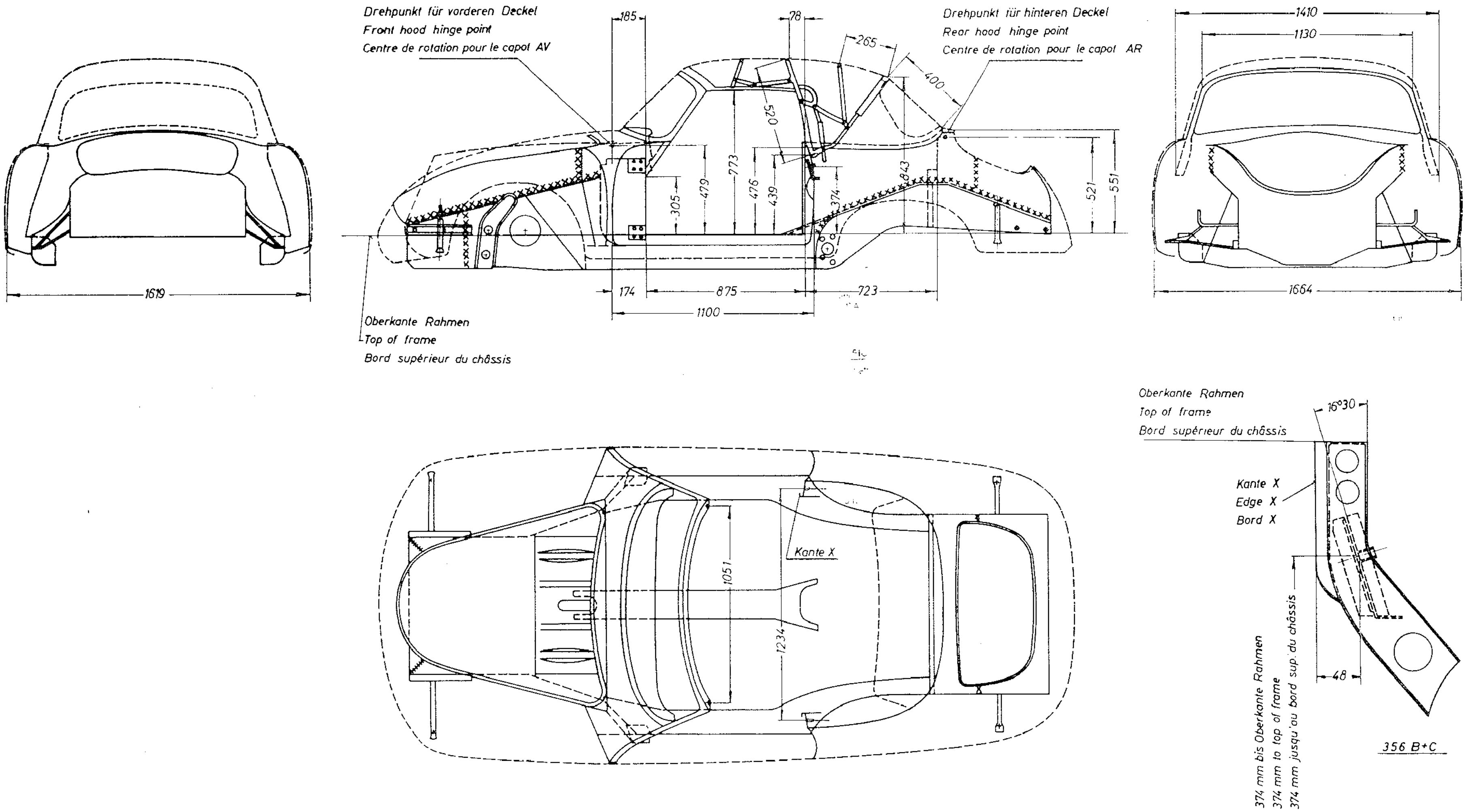
NA 14
SB 14
SC 14



NA 16
SB 16
SC 16

Schweißnaht autogen
Weldet seam
Joint de soudure

Reparatur-Anweisung für Hardtop (Cabriolet) Außenverkleidung
Body Work Dimensions for Cabriolet/Hardtop
Instructions de réparation pour le parement extérieur du Hardtop (Cabriolet)



356 B - 356 C

Reparatur-Anweisung für Hardtop (Cabriolet) Innenverkleidung

Body Work Dimensions for Interior of Cabriolet/Hardtop

Instructions de réparation pour le parement intérieur du Hardtop (Cabriolet)

NA 17
SB 17
SC 17

SECTION INDEX

Supplements to Group L: Lights and Electrical System

WINDSHIELD WIPER ASSEMBLY

From

Coupé	identification-No.	117 601
	identification-No.	210 001
Cabriolet	identification-No.	155 601
Hardtop	identification-No.	201 601

a modified, variable-speed windshield wiper unit will be installed.

General

The windshield wiper motor, with the attached reduction gearbox, is mounted on a support bracket behind the instrument panel. The windshield wiper arms are actuated by a bell crank which is mounted on the splined gearbox output shaft.

The wiper motor is controlled by a push-pull rheostat switch on the instrument panel; by turning the switch knob, wiper arm speed can be progressively varied between 40 and 80 cycles per minute.

Removal

1. Remove wiper arms.

2. Remove rubber sleeve, hex. nut, cup washer and rubber cap.

3. Disconnect wires at snap-on connectors (refer to Fig. 1).

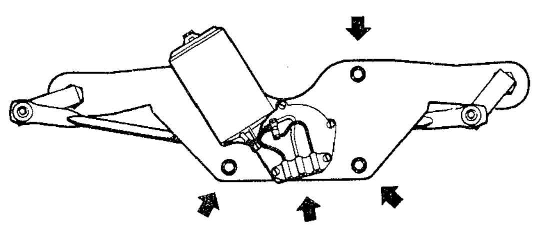


Fig. 1

4. Remove right joint bar from both ball sockets. Remove left joint bar from ball socket of the crank of the windshield wiper arm bearing.

5. Remove the 3 retaining nuts and withdraw support bracket with wiper motor (refer to Fig. 1).

Installation

Attention should be paid to the following points:

1. The removable joint bar (spare part No. 644.628.021.12) must be mounted on the right-hand side. An incorrect installation changes the transmission ratio and the switched off wiper arms do not return completely to the left end position.

2. A rubber spacer washer (spare part No. 999.704.122.50) must be installed between the crank of the windshield wiper arm bearing and the joint bar, see Fig. 2.

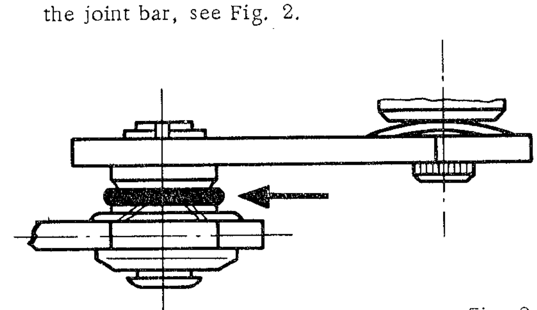


Fig. 2

3. Make certain that the wires are properly connected, otherwise a discharge of the battery will occur. Before connecting the wire to a wiper motor terminal, check the color of the wire with that of the switch terminal.

Second Edition of this Page, March 1962

4. In order to properly seal the holes in the body panelling, mount the rubber caps according to Fig. 3.

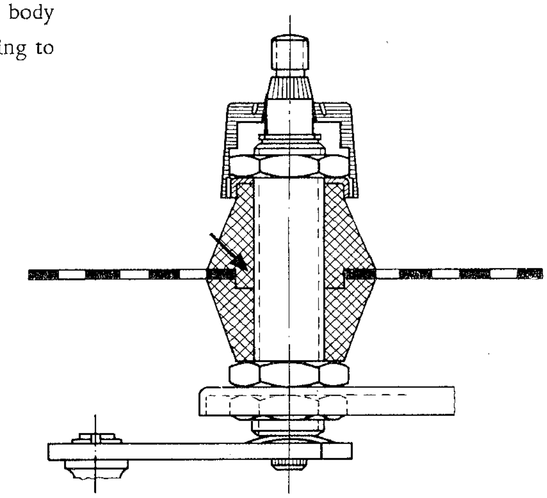


Fig. 3

Trouble and remedy

Rattling of the windshield wiper:
Check whether rubber spacer washers are mounted between the crank of the windshield wiper arm bearing and the joint bar; install these washers, spare part No. 999. 704. 122. 50, if necessary.

Check whether the rivets of the tension piece for the wiper arm are properly fixed, if not, retighten the rivets.

The wiper rubber must turn after each wiper cycle. If it remains in one position, turn the wiper arm so that it travels parallel to the windshield.

Remove any traces of oil, as, owing to a different coefficient of friction, the wiper blades rattle at low speed.

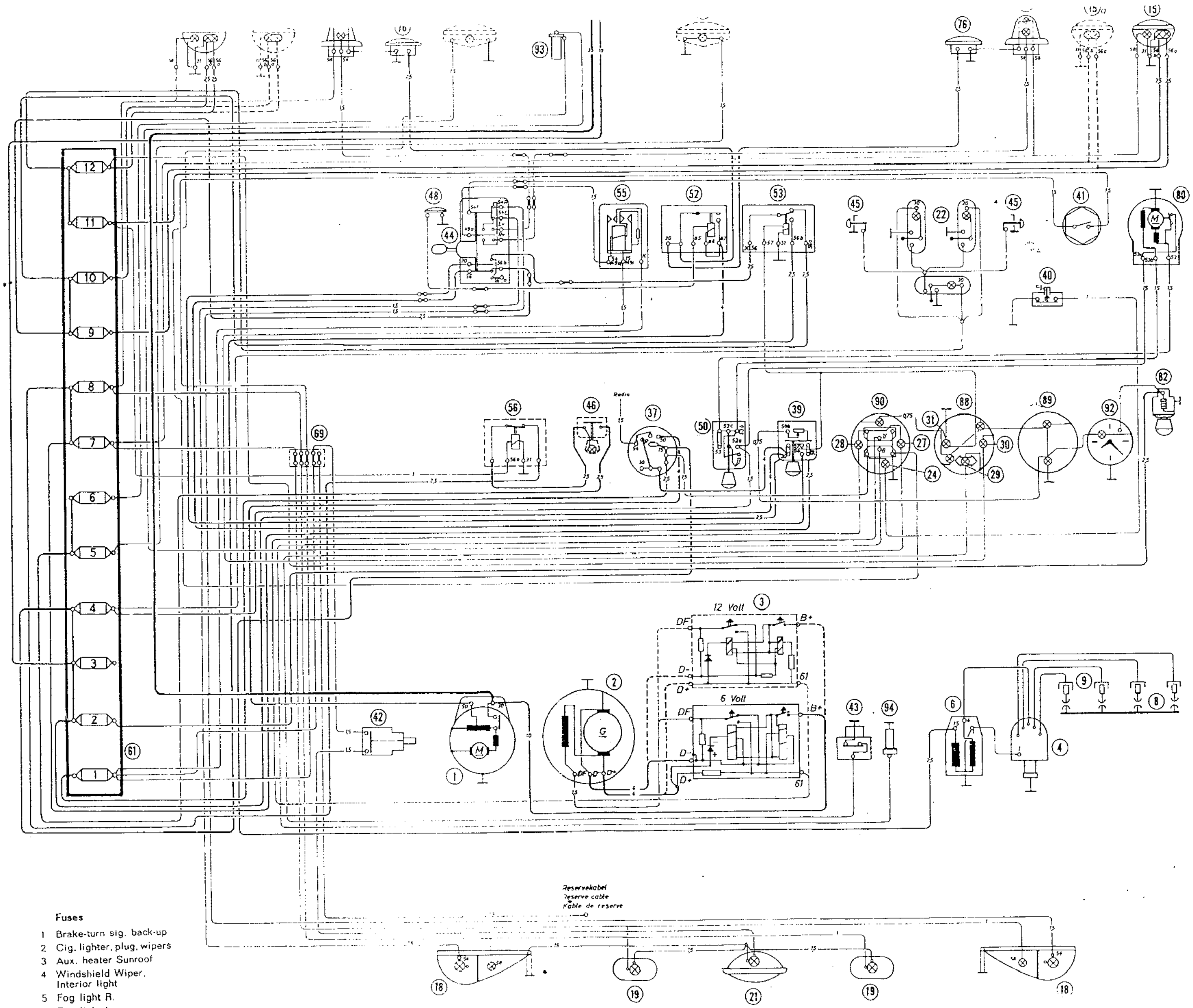
Maintenance

Ball sockets of the joint bars require no servicing. Ascertain that wiper blades rest properly on the windshield, and that they have an equal amount of travel.

WIRING DIAGRAM 356 B

Starting from numbers below

Coupé	identification-Nr.	117 601
Cabriolet	identification-Nr.	155 601
Hardtop	identification-Nr.	201 601

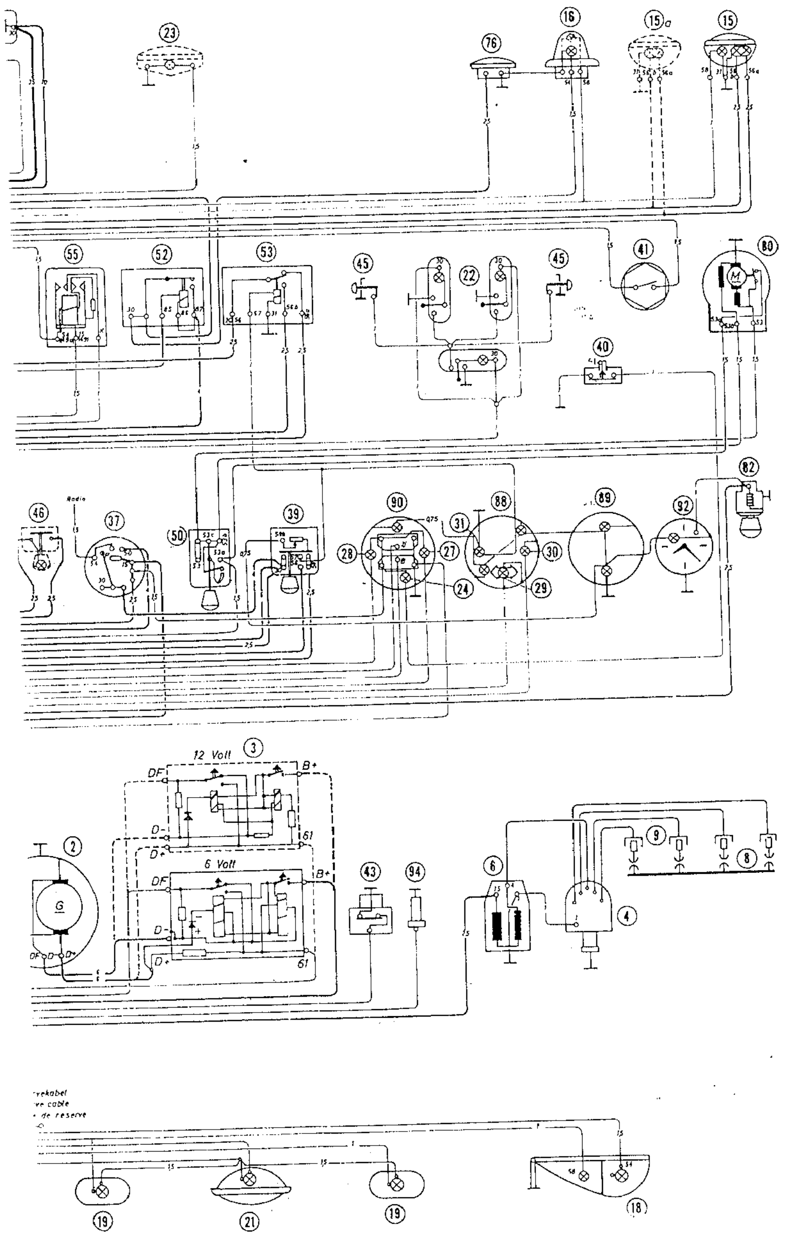


No.	Item	Remarks
1	Starter	
2	Generator	
3	Regulator	
4	Distributor	
6	Ignition coil	
8	Spark plug	
9	Spark plug socket	
13	Battery	
15	Headlight with parking light	
15a	Sealed Beam	USA-Export only
16	Signal light	USA with parking light
18	Brake tail light	
19	License plate light	
21	Back up light	
22	Interior light	Coupe 2 ea., Cabrio 1 ea. Hardtop 1 ea.
23	Fog lights	optional
24	Hand brake warning light	
27	Oil pressure warning light	Combi-Instrument
28	Generator warning light	
29	Turn signal indicator light	
30	High beam indicator light	on tachometer
31	Parking light indicator light	
37	Ignition-starter switch	
39	Head light switch	
40	Hand brake indicator switch	
41	Brake light switch	
42	Back-up light switch	
43	Oil pressure switch	
44	Signal dimmer switch	
45	Door contact switches	
46	Fog light switch	optional
48	Horn button	
50	Windshield wiper switch	
52	Horn relay	
53	Light signal relay	
55	Turn signal flasher	
56	Fog light relay	optional
61	Fuse box	
63	Forward wire loom	
64	Battery ground strap	
65	Instrument wire loom	
66	Rear wire loom	
67	Ignition cables	
69	Plug connector	
76	Twin horns	
80	Windshield wiper	
82	Cigar lighter	not with 644.46
88	Tachometer	
89	Speedometer	
90	Combination instrument	
92	Electric clock	not with 644.46
93	Fuel gauge sender	
94	Oil thermometer sender	

Fuses

1 Brake-turn sig. back-up
2 Cig. lighter, plug, wipers
3 Aux. heater Sunroof
4 Windshield Wiper, Interior light
5 Fog light R.
6 Fog light L.
7 Tail + lic. plate R.
8 Tail + lic. plate L.
9 Low beam R.
11 High beam R.

Note Fuses 2, 3, 9, 10, 11, 12 are 25/40 amp. For 12 Volt system all



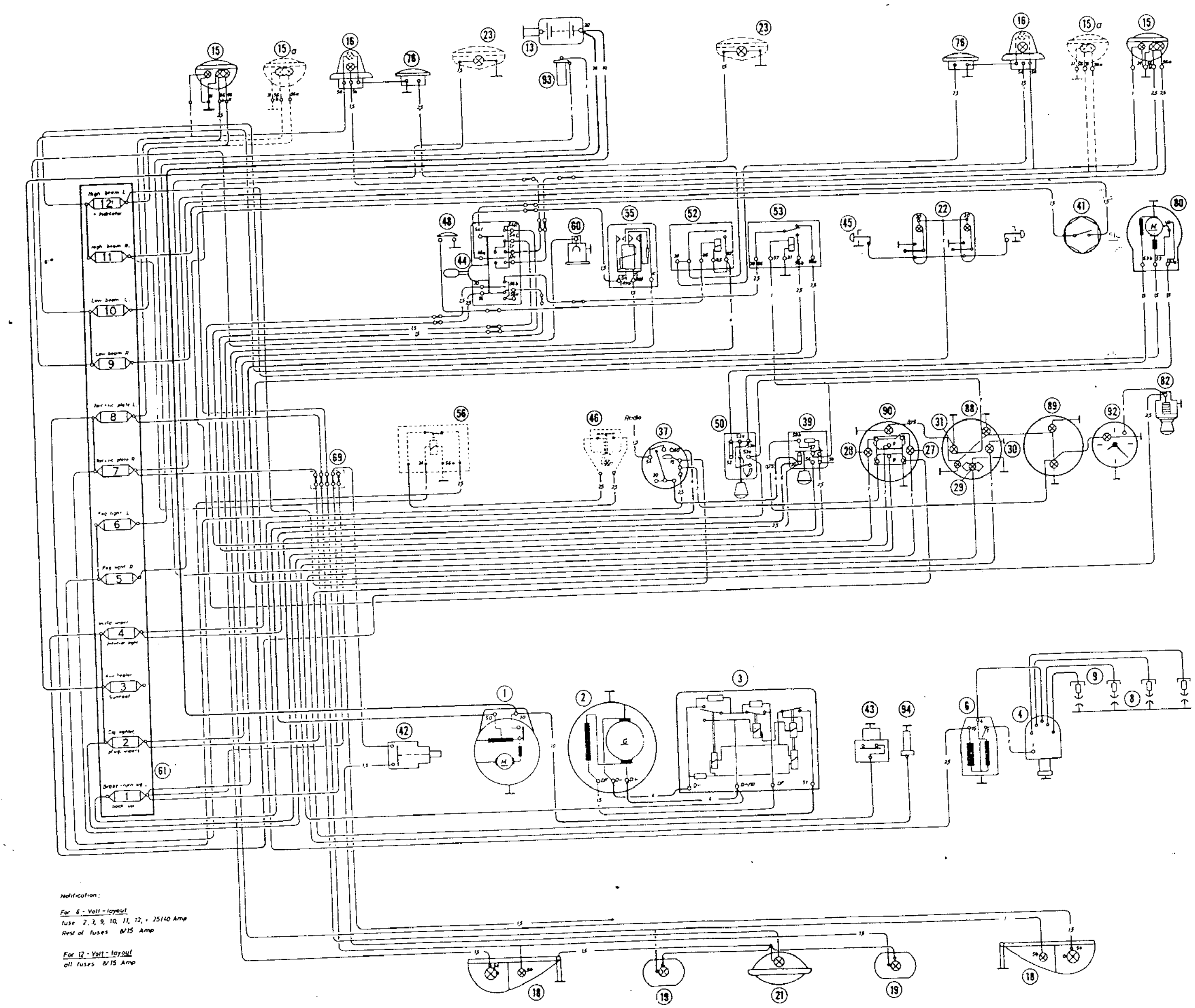
11, 12 are 25/40 amp.
8/15 amp.

For 12 Volt system all
fuses are 8/15 amp.

No.	Item	Remarks
1	Starter	
2	Generator	
3	Regulator	
4	Distributor	
6	Ignition coil	
8	Spark plug	
9	Spark plug socket	
13	Battery	
15	Headlight with parking light	
15a	Sealed Beam	USA-Export only
16	Signal light	USA with parking light
18	Brake tail light	
19	License plate light	
21	Back up light	
22	Interior light	Coupe 2 ea., Cabrio 1 ea Hardtop 1 ea.
23	Fog lights	optional
24	Hand brake warning light	
27	Oil pressure warning light	Combi-Instrument
28	Generator warning light	
29	Turn signal indicator light	
30	High beam indicator light	on tachometer
31	Parking light indicator light	
37	Ignition-starter switch	
39	Head light switch	
40	Hand brake indicator switch	
41	Brake light switch	
42	Back-up light switch	
43	Oil pressure switch	
44	Signal dimmer switch	
45	Door contact switches	
46	Fog light switch	optional
48	Horn button	
50	Windshield wiper switch	
52	Horn relay	
53	Light signal relay	
55	Turn signal flasher	
56	Fog light relay	optional
61	Fuse box	
63	Forward wire loom	
64	Battery ground strap	
65	Instrument wire loom	
66	Rear wire loom	
67	Ignition cables	
69	Plug connector	
76	Twin horns	
80	Windshield wiper	
82	Cigar lighter	not with 644.46
88	Tachometer	
89	Speedometer	
90	Combination instrument	
92	Electric clock	not with 644.46
93	Fuel gauge sender	
94	Oil thermometer sender	

WIRING DIAGRAM

356 C

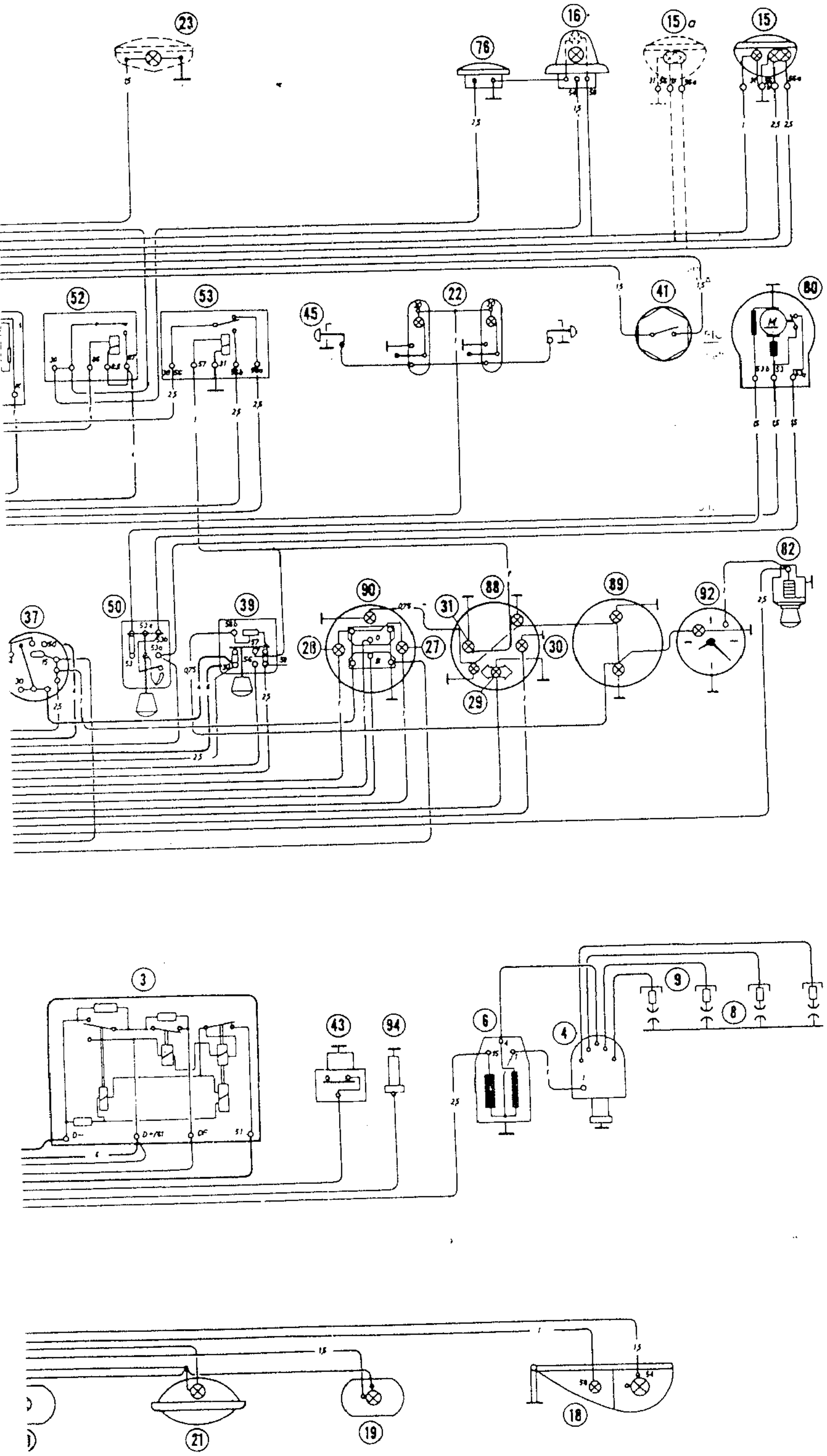


Notification:

For 6 - Volt - layout
fuse 2, 3, 9, 10, 11, 12, = 25/40 Amp
Rest of fuses 8/15 Amp

For 12 - Volt - layout
all fuses 8/15 Amp

2	Generator	
3	Regulator	
4	Distributor	
6	Ignition coil	
8	Spark plug	
9	Spark plug socket	
13	Battery	
15	Headlight	with parking light
15 a	Sealed Beam	U. S. A. -Export
16	Signal light	
18	Brake tail light	
19	License plate light	
21	Back up light	
22	Interior light, Coupe 2 ea., Cabriolet, Hardtop 1 ea.	
23	Fog lights	optinal
27	Oil pressure warning light	Combination inst.
28	Generator warning light	Combination inst.
29	Turn signal indicator light	on tachometer
30	High beam indicator light	on tachometer
31	Parking light indicator light	on tachometer
37	Ignition-starter switch	
39	Head light switch	
41	Brake light switch	
42	Back-up light switch	
43	Oil pressure switch	
44	Signal dimmer switch	
45	Door contact switches	
46	Fog light switch	optinal
48	Horn button	
50	Windshield wiper switch	
52	Horn relay	
53	Light signal relay	
55	Turn signal interrupter	
56	Fog light relay	optinal
60	Accessory socket	
61	Fuse box	
63	Forward wire loom	
64	Battery ground strap	
65	Instrument wire loom	
66	Rear wire loom	
67	Ignition cables	
69	Plug connector	
76	Two tone horn	
80	Windshield wiper	
82	Cigarette lighter	
83	Tachometer	
89	Speedometer	
90	Combination instrument	
92	Electric clock	
93	Fuel gauge sender	
94	Oil thermometer sender	



No.	I t e m	Remark
1	Starter	
2	Generator	
3	Regulator	
4	Distributor	
6	Ignition coil	
8	Spark plug	
9	Spark plug socket	
13	Battery	
15	Headlight	
15 a	Sealed Beam	with parking light
16	Signal light	U. S. A. -Export
18	Brake tail light	
19	License plate light	
21	Back up light	
22	Interior light, Coupé 2 ea., Cabriolet, Hardtop 1 ea.	
23	Fog lights	optinal
27	Oil pressure warning light	Combination inst.
28	Generator warning light	Combination inst.
29	Turn signal indicator light	on tachometer
30	High beam indicator light	on tachometer
31	Parking light indicator light	on tachometer
37	Ignition-starter switch	
39	Head light switch	
41	Brake light switch	
42	Back-up light switch	
43	Oil pressure switch	
44	Signal dimmer switch	
45	Door contact switches	
46	Fog light switch	optinal
48	Horn button	
50	Windshield wiper switch	
52	Horn relay	
53	Light signal relay	
55	Turn signal interrupter	
56	Fog light relay	optinal
60	Accessory socket	
61	Fuse box	
63	Forward wire loom	
64	Battery ground strap	
65	Instrument wire loom	
66	Rear wire loom	
67	Ignition cables	
69	Plug connector	
76	Two tone horn	
80	Windshield wiper	
82	Cigarette lighter	
83	Tachometer	
89	Speedometer	
90	Combination instrument	
92	Electric clock	
93	Fuel gauge sender	
94	Oil thermometer sender	

SERVICE SCHEDULE

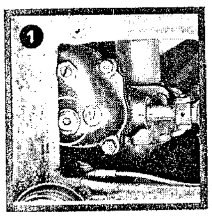
Break in Period 300	1500	3000	6000	Service items	milese at every
				Check carburetor and fuel pump for leaks	
				Check tire pressure	
				Clean air filters, oil mesh filter, air blast micronic filter	
				Check steering gear for leaks	
				Check battery acid level	
				Check hand and service brakes, adjust where necessary. Inspect all brakeline connections and check brake fluid reservoir level	
				Check clutch adjustment	3000
				Check fan belt tension	
				Check distributor contact point gap	
				Check ignition timing	
				Check valve clearance	
				Check wheel lug nuts for tightness	
				Check carburetor for adjustment of linkage and idling	
				Test drive	
				Check front suspension and adjust if loose	
				Check steering and adjust as prescribed if necessary	
				Check entire electrical system from batteries through lights, starter, generator, ignition and accessories	
				Check fuel system and clean sediment bowl and strainer in fuel pump	
				Air cleaner: Clean and moisten mesh filter with oil. Install new micronic filter	6000
				Check engine for oil leaks	
				Check transmission for oil leaks	
				Check spark plugs for correct gap and cleanliness	
				Compression test	
				Check wheel alignment on EXACTA optical measuring device upon customer request at own expense*	
				Brakes: Remove all brake drums and inspect linings. Check free movement of brake cylinders Check for leaks and inspect brake fluid level. Adjust service and hand brake	18 000
				Repack front wheel bearings	

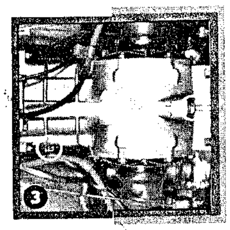
* To be performed on an Exacta optical alignment device only at the request and expense of the customer

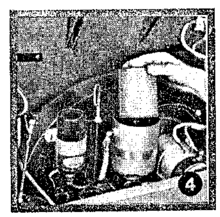
LUBRICATION SCHEDULE FOR 356 C

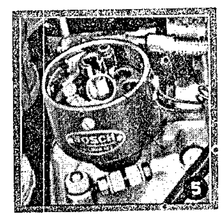
Mileage at which to perform lubrication — Break-in period 300	1500	3000	4500	6000	Lubrication point	Fig. No.	Type of lubricant	Specifications	miles at every
					King pin	14	Chassis lubricant	Temperature stable, water resistant. Melting point: 200° C (390° F). ASTM Penetration: unworked c. 290, worked c. 300	1500
					Engine oil change *	7–8	Quality HD oil	Summer SAE 30, Winter SAE 20	3000
					Transmission: Check oil level	3	Gear lubricant	Hypoid SAE 90	
					Front axle: Lubricate axle tubes	12	Chassis lubricant	Temperatur stable, water resistant. Melting point: 200° C (390° F). ASTM Penetration: unworked c. 290, worked c. 300	
					Tie rods	10, 11			
					Doors and lid latches and hinges		Chassis lubricant		
					Engine: Clean oil strainer and magnet	6		At oil change	6000
					Engine: Replace By-pass oil filter element	4			
					Check steering gear lubricant	1	Gear lubricant	SAE 90 or Hypoid SAE 90	
					Distributor cam	5	Special grease	BOSCH Ft 1 v 8 (distributor cam grease)	
					Carburetor linkage	9	Chassis lubricant		
					Transmission oil change	3	Gear lubricant	Hypoid SAE 90 **	12000
					Shift lever	2	Engine oil		
					Front wheel bearings	13	Chassis lubricant	Use no more than 50 grams per wheel	
					Carburetor linkage, clutch cable, heater cables, windshield wiper linkage		Chassis lubricant	Temperature stability, water resistant	Beginning of Winter

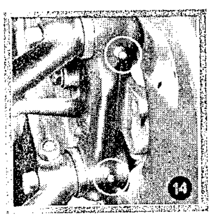
* If the car is used mostly in city driving during the cold season the engine oil should be changed every 2500 km (1500 miles).
** In areas of very low temperature Hypoid SAE 80 is preferable.
For capacity see page 27.

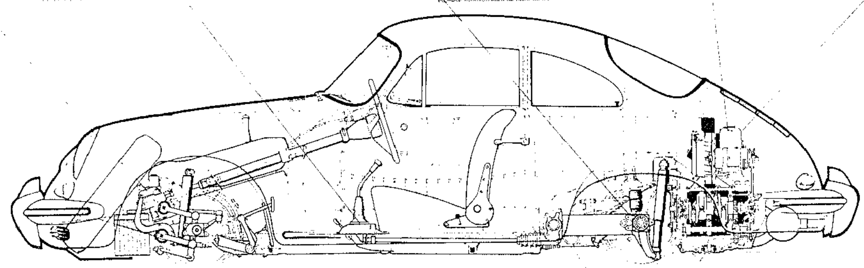


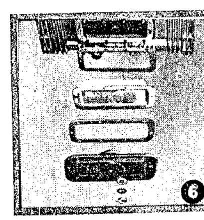


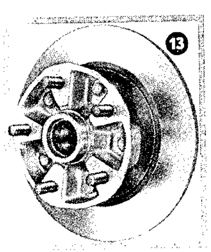


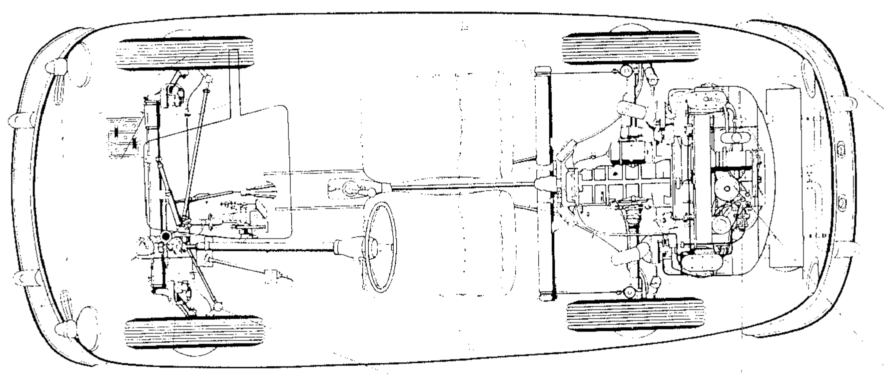


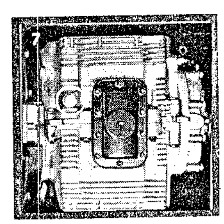


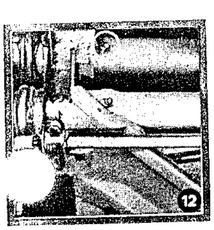


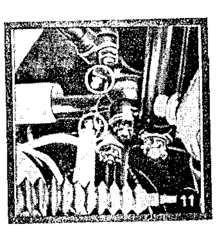


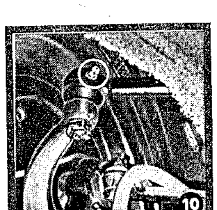


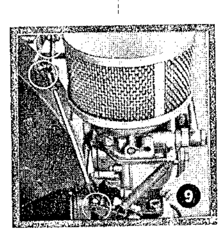


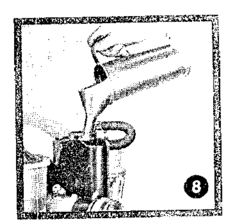












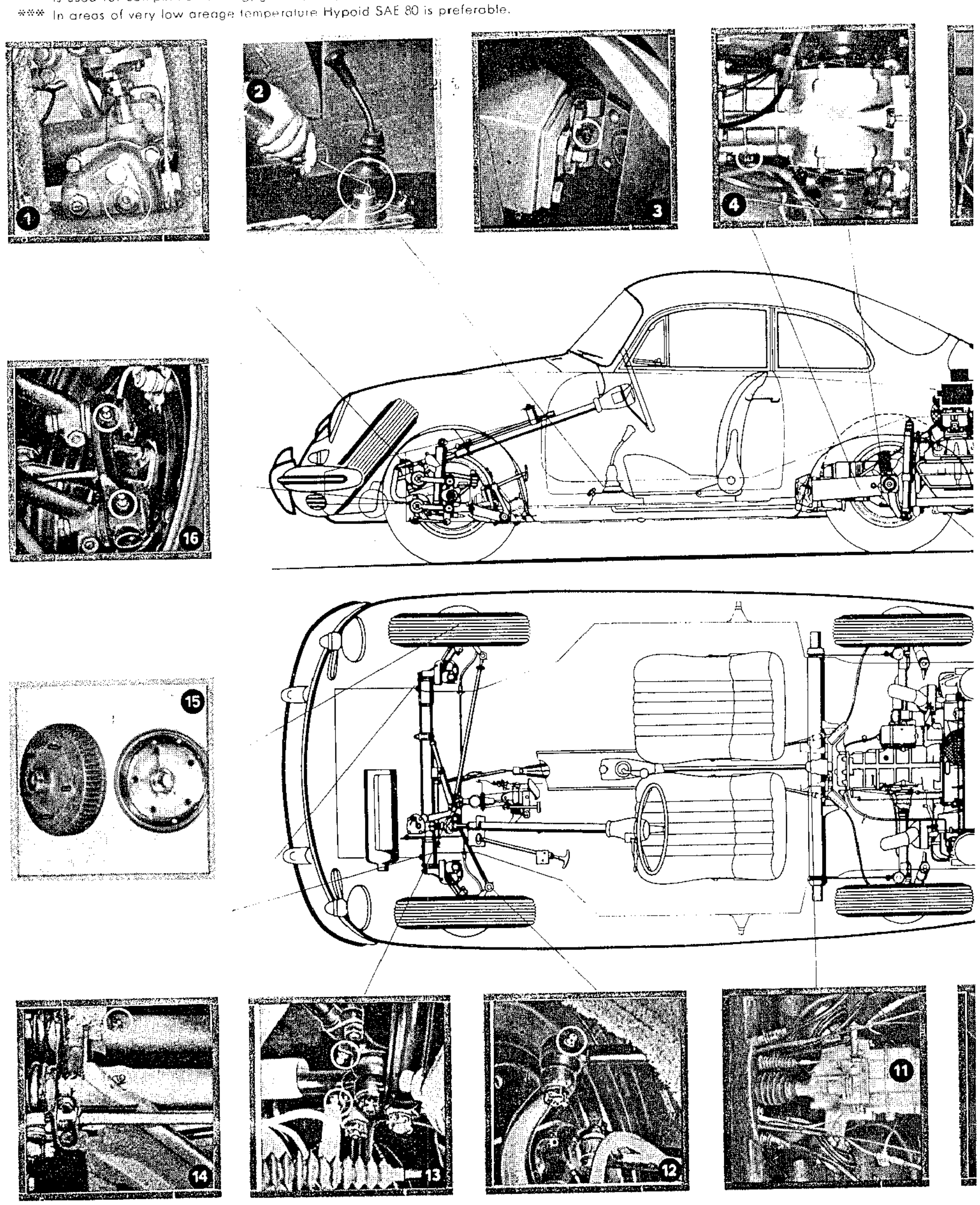
LUBRICATION SCHEDULE FOR 356 B MO

Mileage at which to perform Lubrication — Break-in period: 300	900	1500	3000	4500	6000	Lubrication point	Fig. No.	Type of Lubricant	S
						King pin	16	Chassis lubricant	Temperat Melting p ASTM Per
						Front suspension	14		
						Engine oil change *	7–9	Quality HD oil **	Summer S
						Transmission	4	Gear lubricant	Hypoid S
						Tie rods	12, 13	Chassis lubricant	Temperat Melting p ASTM Per
						Doors and lid latches and hinges	3	Chassis lubricant	
						Clean oil strainer and magnet	7		At oil cha
						Clean oil filter	5		
						Change Transmission lubricant	4	Gear lubricant	Hypoid S
						Check steering gear lubricant	1	Gear lubricant	Hypoid S
						Hand brake cable	11	Chassis lubricant	
						Distributor cam	6	Special grease	BOSCH
						Carburetor linkage	10	Chassis lubricant	
						Shift lever	2	Engine oil	
						Front wheel bearings	15	Chassis lubricant or wheel bearing grease	Use no
						Hand brake cable, carburetor linkage, clutch cable, heater cables, windshield wiper linkage.		Chassis lubricant	Temperc

* If the car is used mostly in city driving during the cold season the engine oil should be changed every 2500 km (1500 miles)

** For engines of the type 1600 S and 1600 S-90 good quality HD-oil for Diesel engines should be used. For engines of the type 1600 for normal is used for competition driving, good quality HD-oil for Diesel engines should be used.

*** In areas of very low areage temperature Hypoid SAE 80 is preferable.



SERVICE SCHEDULE

Break in Period 300	1500	3000	6000	Service items	miles at every
				Check carburetor and fuel pump for leaks	
				Check tire pressure	
				Brakes: Check clearance between push rod and brake master cylinder	
				Check steering gear for leaks	
				Check battery acid level	3000
				Clean air filters, oil mesh filter, air blast micronic filter	3000
				Check ignition timing	3000
				Check valve clearance	3000
				Check wheel lug nuts for tightness	3000
				Check hand and service brakes Inspect all brake line connections and check brake fluid reservoir level	3000
				Front axle: Check front wheel bearing and suspension arm link pin play	3000
				Check steering play	3000
				Check entire electrical system for proper operation	3000
				Fuel system: Clean filter housing and fuel cock filter. Clean fuel pump filter	3000
				Air filter: Install new micronic filter	3000
				Brakes: Remove and check disc brake pads. Check rubber boots in brake callipers	6000
				Check clutch play	6000
				Check fan belt tension	6000
				Check contact breaker points	6000
				Check and clean spark plugs	6000
				Compression test	6000
				Check carburetor idling	6000
				Test drive	6000
				Check wheel alignment *	6000
				Repack front wheel bearings	12000
				Brakes: Check brake master cylinder and wheel cylinder. Remove rear handbrake discs, check handbrake	12000

* To be performed on an Exacta optical alignment device only at the request and expense of the customer

The term "check" includes adjustments, readjustments, rectifications and replenishments, however exludes repairs, exchanges and reconditioning of parts or units

TECHNICAL DATA

TYPE 356 C/1600 C, 1600 SC

Engine Type	1600 C	1600 SC
ENGINE		
Design Type	Air cooled, gasoline combustion engine; clutch, transmission and rear axle in one unit located at rear of car.	
Number of Cylinders	4	4
Cylinder Arrangement	Horizontally opposed, two cylinders per bank (pancake type)	
Bore	82.5 mm (3.248 in.)	82.5 mm (3.248 in.)
Stroke	74.0 mm (2.913 in.)	74.0 mm (2.913 in.)
Piston Displacement	1582 cc (96.5 cu. in.)	1582 cc (96.5 cu. in.)
Compression Ratio	8.5 : 1	9.5 : 1
Dry weight	Approx. 115 kg (254 lbs)	Approx. 115 kg (254 lbs)
Crankcase	Light alloy, three piece	Light alloy, three piece
Cylinders	Individual units	Individual units
Cylinder Metal	Grey cast iron	Light alloy
Cylinder Bore	Base metal	Ferral-coated
Cylinder Heads	Common light alloy cylinder head for each two cylinders	
Valve Seat Inserts	Shrunk-in	Shrunk-in
Valve Guides	Shrunk-in, special bronze	Shrunk-in, special bronze
Spark Plug Inserts	Helicoil	Helicoil
Crankshaft	Forged	Forged, with counterweights
Crankshaft Bearings	4 plain bearings	4 plain bearings
Main Bearing 1 and 4	Light alloy sleeve bearings	Light alloy sleeve bearings
Main Bearing 2 and 3	Tri-metal split-sleeve inserts	Tri-metal split-sleeve inserts
Connection Rods	Forged-steel connecting rods, H-section shank	
Connection Rod Bearings	Tri-metal	Tri-metal
Piston Pin Bearings	Pressed-in bronze bushings	Pressed-in bronze bushings
Pistons	Light alloy	Light alloy
Piston Rings	3 compression rings 1 oil scraper ring	3 compression rings 1 oil scraper ring
Valve Timing	1 camshaft (below crankshaft, through pushrods and rocker arms	
Camshaft	Cast, in 3 plain bearings riding on base metal of crankcase	
Camshaft Drive	2 helical spur gears	2 helical spur gears
Valve Arrangement	OHV	OHV
Valve Springs	1 coil spring per valve	1 coil spring per valve
Valve Clearance in Cold Engine		
Intake:	0.10 mm (.004 in.)	0.15 mm (.006 in.)
Exhaust:	0.15 mm (.006 in.)	0.10 mm (.004 in.)
Valve Timing (with valve clearance set to 1 mm or .040 in.)		
Intake opens before TDC	10°	17°
Intake closes after BDC	44°	53°
Exhaust opens before BDC	42°	50°
Exhaust closes after TDC	6°	14°

Engine Type	1600 C	1600 SC
Engine Cooling	Air cooling by blower mounted on generator shaft extension	
Blower Drive	Off crankshaft by V-belt	Off crankshaft by V-belt
Cooling Air Volume	310 ltr/sec (11 cu. ft./sec) at 2000 rpm 620 ltr/sec (22 cu. ft./sec) at 4000 rpm	
Lubrication	Pressure lubrication through gear oil pump	
Oil Cooling	Oil cooler located in air stream within air blower housing	
Oil Pressure Indication	From pressure sensor to green control lamp on dashboard	
Ignition Type	Battery ignition	
Ignition Coil	Bosch TK 6 A 3	Bosch TK 6 A 3
Ignition Distributor	Bosch VJR 4 BR 18	Bosch VJR 4 BR 18
Breaker Point Gap	0.4 mm (.016 in.)	0.4 mm (.016 in.)
Firing Point	5° before TDC	3° before TDC
Firing Order	1 - 4 - 3 - 2	1 - 4 - 3 - 2
Spark Plugs		
Bosch	W 225 T 1, W 225 T 7, respectively	
Champion	L 85	L 85
Beru	D 225/14	D 225/14
Spark Plug Thread	14 x 1.25 mm	14 x 1.25 mm
Spark Plug Gap	0.5 - 0.6 mm (.020 - .024 in.) for Bosch W 225 T1 and Champion L 85 0.6 - 0.7 mm (.024 -. 028 in.) for Bosch W 225 T7 0.7 mm (.028 in.) for Beru D 225/14	

CLUTCH

Design Type	Single plate, dry, Type A-12 (Häussermann)	
Clutch Pedal Free Travel	approx. 20 mm (.8 in.)	approx. 20 mm (.8 in.)
Total Clutch Lining Area	approx. 265 cm^2 (41.1 sq. in.)	

FUEL SYSTEM

Carburetors	Zenith 32 NDIX	Solex 40 PII-4
Air Cleaners	Induction silencer with micronic cartridge	Oil-wetted wire mesh
Fuel Pump	Diaphragm pump	Diaphragm pump
Fuel Pump Pressure	0.20 - 0.24 atm (2.94 - 353 psi)	
Fuel Valve	Three-position with Reserve	Three-position with Reserve
Fuel Filtering	Fuel screen and sediment bowl within fuel valve assembly; filter screen in fuel pump	

ELECTRICAL SYSTEM

Electrical System	6 Volt	6 Volt
Battery	6 V/84 Ah	6 V/84 Ah
Generator	Bosch LJ/GEG 200/6/2600 L	Bosch LJ/GEG 200/6/2600 L
Voltage and Current Regulator	Bosch RS/VA 200/6/3	Bosch RS/VA 200/6/3
Ratio, Crankshaft/Generator	approx. 1 : 1.8	approx. 1 : 1.8

Engine Type	1600 C	1600 SC
Windows		
Windshield	Single piece, constant radius	
Door Windows	Crank-down windows, quarter-panel wind wings in Coupe and Cabriolet/Hardtop	
Side Windows	Opening outward, with arresting latch	
Rear Window	Single piece, contoured shape	
Glass Type	Windshield of laminated safety glass, rear and side windows of tempered safety glass	
Windshield Wipers	Electric, 2 wiper arms moving parellel to each other	
Compartment Lids		
Front	Hinged at rear with automatically locking and releasing hold-open locks, theft-proof from outside, lid lock release under dashboard, lid secured by snap-bolt and safety latch	
Rear	Engine compartment lid opening at rear, hinges with automatically locking and releasing hold-open locks, lock release behind driver's seat	
Seats		
Seating Capacity	2/2	2/2
Front	2 fully reclining, adjustable bucket seats	
Rear	2 limited-accomodation seats with folding backrests which form a luggage deck	
Instrument Panel	Speedometer with indicators for total mileage and trip mileage, illuminated dial Tachometer with built-in control lamps for high-beam indicator, parking light and blinkers, illuminated dial Combination instrument containing fuel gauge, oil temperature gauge, generator control light, oil pressure control light, and parking brake control light, illuminated dial Windshield wiper switch (progressively variable), ignition/starter switch, light switch, cigar lighter (socket can be used as an electrical outlet), ventilation control, locking glove compartment, ashtray, and hand grip; Combination switch on steering post, controlling directional signals, high/low headlamp beams, and light-signal (headlamp flicker) Steering wheel with horn button	
Interior Fittings		
Floor	Covered with rubber mat	
Floor Tunnel	Forward part covered with rubber, rear with fabric	
Forward Side Panels	Covered with fabric	
Doors and Side Panels	Upholstered	
Headlining	Lined with plastic material	
Heating	Hot air heating with remote control, 2 defroster outlets for the windshield, 2 defroster jets for rear window, 2 hot air outlets on floor level below door posts	
Fresh Air Ventilation	Fresh air for heating is drawn through slits in engine compartment lid and for cold air ventilation through inlet below windshield; outlets are the defrosters and openings on floor level below door posts	
Sliding Sun Roof		
Type	Golde (electrically operated)	
Aperture Length	approx. 260 mm (10.2 in.)	
Aperture Width	approx. 780 mm (30.7 in.)	

SECTION INDEX

Supplements to Group TRA: Technical Remarks, Accessories

SUBSEQUENT INSTALLATION OF WINDSHIELD WIPER ASSEMBLY

From

Coupé	identification-No.	101 693
Cabriolet	identification-No.	150 001
Hardtop	identification-No.	200 001

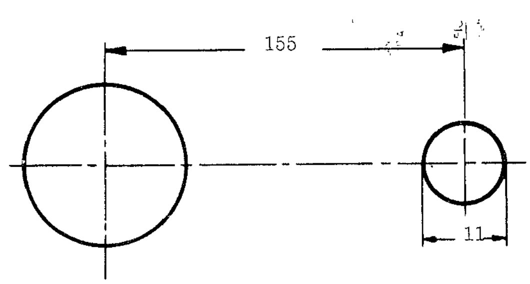
the windshield wiper assembly 644. 628. 017. 12 for the above mentioned types can be installed subsequently.

The windshield wiper assembly may be installed in same sequence as described in group L of the Supplement to the Workshop Manual 356 B.

Attention should be paid to the following points:

1. To facilitate removal and installation the glove box has to be removed.

2. Install push-pull rheostat switch No. 644. 613. 511. 00, as illustrated in Fig. 1.



Orifice for cigar lighter

Orifice for push-pull switch

Fig. 1

3. Reposition wires as appropriate, see page SL 3 Wire cross-section should be at least 1. 5 sq. mm (. 0023 sq. in.). Wires should be connected according to wiring diagramm page SL 3

4. Enlarge wiper arm openings in the body to 18.2mm (. 717 in.). dia.

When installing the windshield wiper assembly in automobiles with right-hand drive, attention should be paid to the following points:

1. The connecting rod of the windshield wiper must in the end position be turned 180°, as opposed to the left-hand drive automobiles, namely pointing to the left.
2. Mount the removable joint bar on the right-hand side.

The end position of the wiper blades is on the right.

Second Edition of this Page, March 1962

DESCRIPTION of the LOUDSPEAKER INSTALLATION in VEHICLES TYPE 356A and 356B

From				
	Coupé	Chassis - No.		117 601
	Cabrio	"	"	155 601
	Hardtop	"	"	201 601
	Roadster	"	"	89 601

a modified loudspeaker system will be installed. Figures 1 and 2 show the difference in the exterior appearance of the systems. The tone of the new loudspeaker has been improved.

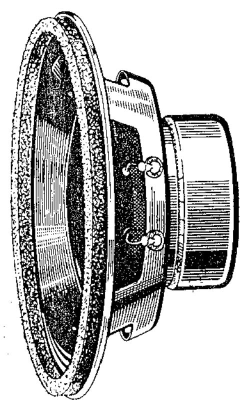


Fig. 1

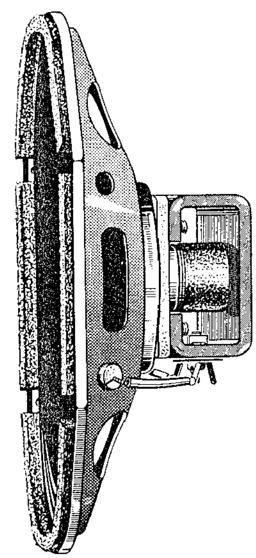


Fig. 2

The following parts are required for installation:

New loudspeaker system

2	Loudspeakers	644. 645. 504. 00
2	Retaining rings	644. 645. 515. 00
2	Decorative frames	644. 645. 513. 01
2	Grilles	644. 645. 511. 01
8	Fixing angles	644. 645. 517. 00
8	Cheese head tapping screws	B 3,5x22 DIN 7971

Old loudspeaker system

2	Loudspeakers	644. 645. 501. 00
2	Grilles	644. 645. 511. 00
2	Decorative frames	644. 645. 513. 00
8	Cheese head screws	M 4x10 DIN 84
8	Washers	4,3 DIN 125
8	Spring washers	A 4 DIN 137

INSTALLATION

1. Solder the cables supplied to the two loudspeakers. The cable ends must not touch the loudspeaker case. With "Becker" radio models the cables have to be extended. Cable diameter 0,75 mm^2.

Pay attention not to damage the membrane.

2. Cut out the lining covering the loudspeaker cups on the right and left sidewall. Determine their position by going over the lining with the hand.

3. Find the holes for the fixing screws of the loudspeaker in the same way. Cut out the lining covering the holes.

Description of the BN-4 Ventilating Combustion Heater

General

The BN-4 ventilating combustion heater, Test Code S-036, is manufactured by the Eberspächer Company of Esslingen, Germany.

The heater is a special order item. It can be installed in the space behind the spare tire in the front compartment of the below listed types of cars commencing with serial numbers as follows:

Coupe,	from Chassis Serial No. 117 601
Convertible,	from Chassis Serial No. 155 601
Hardtop,	from Chassis Serial No. 201 601

The BN-4 heater is a self-contained heat generating unit operating independently of the car's combustion engine and, consequently, will produce heat regardless whether the car is in motion or the engine running. However, when using the heater with the car parked, battery charge level should be taken into consideration since the battery supplies the electrical energy for the heater.

The operating voltage is 6 Volts DC and power draw is approx. 50 Watts, meaning that the drain on the battery equals $\frac{50}{6} = 8.4$ Ah. Correspondingly, when using a battery with a capacity of 84 Ah, and assuming that the battery is only half-charged, the heater will operate with the car at standstill for only $\frac{42}{8.4} = 5$ hours, at which time the battery would be fully discharged.

The BN-4 heater is standard equipment on Type 356 B/2000 GS (Carrera 2) cars. The operating voltage of heaters supplied for these cars is 12 Volts.

Technical Data

Heat output	progressively variable from	1080 to 4000	kcal/h
Ventilating air flow	approx.	150	kg/h
Fuel		carburetor fuel	
Fuel consumption	min.	0,2	l/h
	max.	0,65	l/h
Power draw		50	Watts
Operating voltage		6	Volts DC
Weight	approx.	11	kg
Warm air temperature		40 to 100	°C

progressively variable

as shown in heat output diagram on page S TRA 6

Heat Output Diagram

Heat output diagram for Type BN-4 ventilating heater (1 kcal = 3.96 BTU)

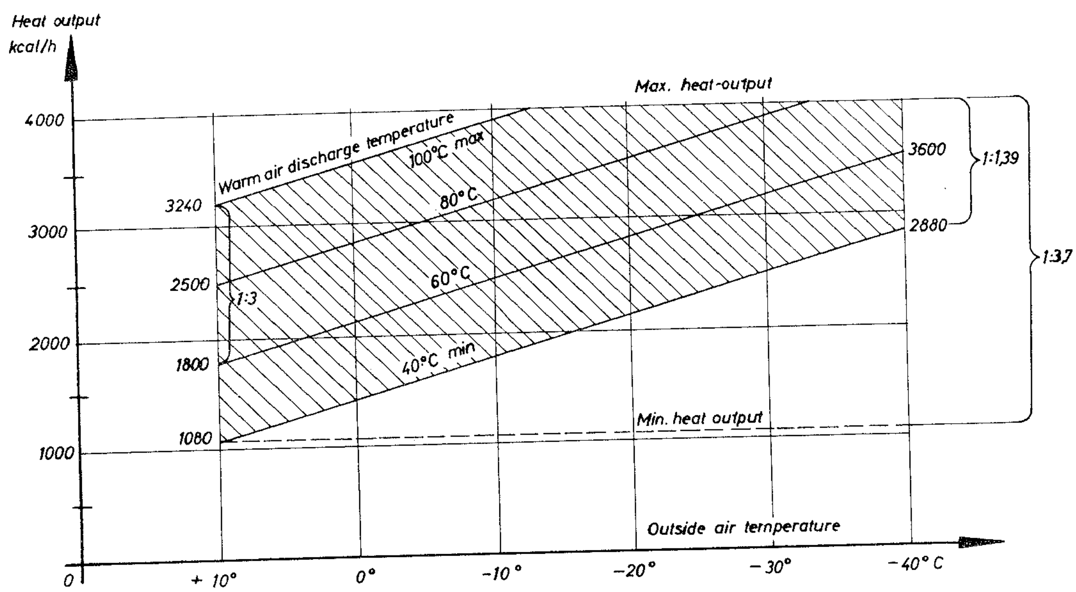


Fig. 1

Explanatory notes to the heat output diagram

The above heat output diagram shows the temperatures of outside air prior to heating, from +10° C to -40° C (X-coordinate), and the rate of heat output up to 4000 kcal/h (Y-coordinate). The diagonal lines in the dia gram represent values of constant discharge air temperature from 40° C to 100° C. As may be seen, the diagram shows a limit of maximum heat output of 4000 kcal at the top of the diagram. The minimum heat output is 1080 kcal with a discharge air temperature of 40° C at an outside air temperature of +10° C. Accordingly, this represents a maximum variability ranging from 1080 to 4000 kcal, or a ratio of 1:3.7. Variability range at -40° C is 1:1.39, i.e., 2800 to 4000 kcal. The indicated discharge air temperatures apply only to readings obtained at the heater since a temperature drop occurs during the transfer of the heated air to the car's interior.

Fresh air flowing at the rate of 150 kg/h, at an outside temperature of +10° C, will receive a maximum of only 3240 kcal because a top limit of 100° C is set for the heated air discharge temperature. The maximum transfer of heat to ventilating air occurs at an outside temperature of -11° C. The heat output of 4000 kcal remains constant at lower outside air temperatures, and decreases to 3240 kcal at higher outside air temperatures of between -11° C and +10° C. At 0° C outside air temperature the heat output is 3600 kcal with a heated air temperature of 100° C. The decrease in generation of heat at rising outside air temperatures is of an advantage inasmuch that less energy is required to heat warmer outside air.

The diagram is based on an air flow of approximately 150 kg/h, a maximum temperature differential of 110° C, and a maximum heat output of 4000 kcal/h, with warm air discharge temperature variability ranging from 40° C to 100° C.

Cross-Sectional View of the BN-4 Heater

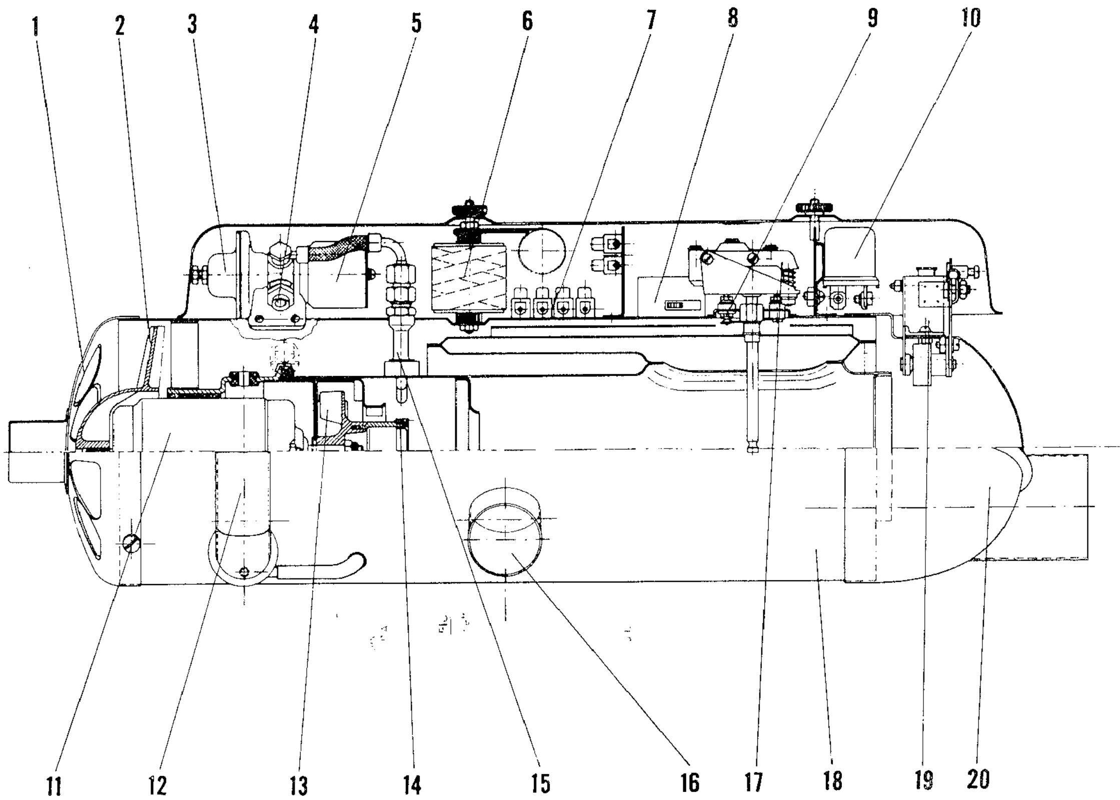


Fig. 2

1. Ventilating air intake
2. Ventilating air blower
3. Pressure regulator
4. Fuel line connector
5. Fuel solenoid
6. Ignition coil
7. Junction block
8. Safety switch
9. Overheat switch
10. Relay switch
11. Blower motor
12. Combustion air intake
13. Combustion air blower
14. Diffuser
15. Nozzle
16. Exhaust duct
17. Thermoswitch with heat sensor
18. Outside shell
19. Heat control switch
20. Warm air distributor

Heat system components

The heat exchanger is enclosed by a cylindrical jacket of 150 mm diameter, and consisting of a central cylinder with a concentric annular area. Located in the front end of the heat exchanger is the combustion chamber and an electric motor with blower fans for combustion and ventilating air. A sheetmetal shell encases the heater assembly. Mounted on the shell is a pressure regulator with a fuel solenoid valve. The fuel flows from the electric fuel pump to the pressure regulator and the fuel solenoid, then to a nozzle which is located in a vertically positioned tube.

Upper lever (for ventilator and temperature control)

Position 4: Ventilator and heater turned off.

Position 5: Ventilator blowing fresh air into car's interior (for ventilation at slow speeds or when parking). The lower lever must be anywhere between Position 2 and 3.

Position 6: Heater turned on. By moving the lever anywhere between Position 6 and 7, the required temperature setting is made for temperatures ranging from approx. 40° C to approx. 80° C.

The lower lever controls the flow of air to the defrosters or the floor area, or to both.

Lower lever

Position 1: With lever fully to the right, the flow of air is completely shut off. The heater will not operate when the lever is in this position.

Position 2: Warm air is directed to the defrosters.

Position 3: Warm air is directed to the floor area.

By moving the lever anywhere between Position 2 and 3, an appropriate distribution of air to both, the defrosters and the floor area is effected.

By moving the upper lever to Position 6, all appropriate heater components are put into operation, as follows:

The motor driving the blowers for combustion and ventilating air receives current. The coil is energized. The glow plug receives current through the thermoswitch. The electric fuel pump and fuel solenoid receive current. Thus, all electric components of the heater are provided with current and the heater begins to operate. The combustion air blower forces air into the combustion chamber. The electric fuel pump forces fuel through the pressure regulator and fuel solenoid to the nozzle which sprays the fuel onto the rotating diffuser. The atomized mixture combines with combustion air in the combustion chamber and is ignited by the spark plug, or the glow plug. The flame spreads and combustion gases flow through the combustion chamber and the heat exchanger. The ventilating air blower draws air through the louvered vent below the windshield and forces the air to pass along the jacket of the heat exchanger, causing the air to heat up in the process.

It should be noted that the spark plug operates continuously since the breaker points are actuated by the blower motor.

To maintain the pre-set temperature, the heater has to work intermittently, that is, when the warm air which leaves the heater reaches the pre-set temperature, the fuel solenoid is closed and the generation of heat discontinued. The fuel solenoid is governed by the heat control switch which operates in accordance with settings made or heat required.

To ensure a maximum safety of operation, the heater has been equipped with the following safety devices:

1. Overheat switch

   This switch controls the flow of current to the fuel solenoid. If the temperature in the heater should rise to a predetermined maximum, the overheat switch will shut off the fuel.

2. Thermoswitch (purge switch)

   When the heater is turned off, the thermoswitch allows the blower motor to run for a short period of time to facilitate cooling and purging the heat exchanger. The thermoswitch also controls the flow of current to the glow plug and safety switch at the initial engagement of the heater.

3. Safety switch

The safety switch comes into action when, for instance, the heater should fail to ignite or warm up, in which instance the safety switch shuts off the flow of current to the fuel solenoid and, thus, interrupts the flow of fuel to the combustion chamber.

Subsequent Installation of the BN-4 Heater

General:

The BN-4 heater may be subsequently installed into all cars commencing with the following chassis serial numbers:

Coupe	Chassis Serial No.	117 601
Convertible	Chassis Serial No.	155 601
Hardtop	Chassis Serial No.	201 601

Parts needed for installation of the heater in 6 Volt systems are available under Part No. 644. 572. 001. 06, for 12 Volt systems under Part No. 644. 572. 002. 02. The installation kits consist of the following parts:

1	each	Control unit for heating and ventilation, complete
1	each	Heating and ventilation unit
1	each	Fuel pump
1	each	Fuel line with "T" joint
1	each	Fuel hose, fuel cock to fuel pump A 6x240 SN 710
1	each	Hose strap 140 SN 907
1	each	Holding clamp
2	each	Rubber support for fastening heating unit
1	each	Rubber support for fastening exhaust duct
3	each	Hexagon bolt M 6x8 DIN 933-8G gal Zn 9
3	each	Hexagon nut M 6 DIN 934-6S gal Zn 9
6	each	Spring washer B 6 DIN 137
1	each	Sealing plate
1	each	Sealing rubber
1	each	Felt strip
1	each	Clamp
1	each	Support for heating and ventilation unit
2	each	Tapping screw, hexagon head, galvanized BZ 4,8x13 DIN 7976
2	each	Washer, galvanized A 5,3 DIN 9021-St
2	each	Mecano speed nut SNU-0537-B
1	each	Warm air hose, 1500 mm long
1	each	Warm air hose, 1400 mm long
2	each	Contact relay
1	each	Relay support
1	each	Cheese-head screw, galvanized AM 5x20 DIN 84-5S
3	each	Spring washer A 5 DIN 137
2	each	Hexagon nut, M 5 DIN 934-6S gal Zn 9
1	each	Cable set for heating unit

The following work must be performed to install the heater:

1. Remove both floor boards.

2. Withdraw rubber seal for battery cable located in conduit tube accessible from the front compartment; the seal is embedded in the tube for about 1 cm.

3. Working from the front compartment side, insert cable strand for heater into the battery cable conduit tube and guide it into the car's interior. Make certain that the undivided cable strand end (with 5 cable terminals) is inserted. To simplify the insertion of the cable, join the loose five ends with adhesive tape. The cable strand should be guided alongside the battery cable, through the rectangular opening on right tunnel side up to the tunnel middle, then to the forward part of the tunnel parallel to the cable strand which leads to the fuse box, up to behind the instrument panel. The red cable end is to be guided through the transverse panel of the front compartment, along the cable strand up to the fuse box, and fastened to No. 3 terminal in the fuse box. The black cable end (snap-on connector) is to be connected with No. 54 terminal at the ignition/starter switch.

4. Disconnect Bowden cables at both fresh air ducts. Remove clock and ventilation controls.

5. Install new heater and ventilation controls taking care not to bend the Bowden cables. Located about 25 mm below the cable strand passage in the transverse panel of the front compartment, and covered with sound-proofing material, is an opening for the heater Bowden control cable. Punch a hole through the material and guide the cable through it. Connect the three remaining cable ends of the cable strand to like colored terminals in the heater control unit. Reinstall clock. Attach and adjust Bowden cables to fresh air ducts as outlined on page SB 11.

6. Remove the three sheetmetal covers in the front compartment by gently tapping with a hammer from the axle tube side (one cover is for access to the fuel pump, the other two for exhaust and intake ducts).

7. Drill three holes for mounting the relay support (see Fig. 4 and 5). Mount support so that the angular end faces up. Mount both relay switches so that the terminal side points to left (driver's side).

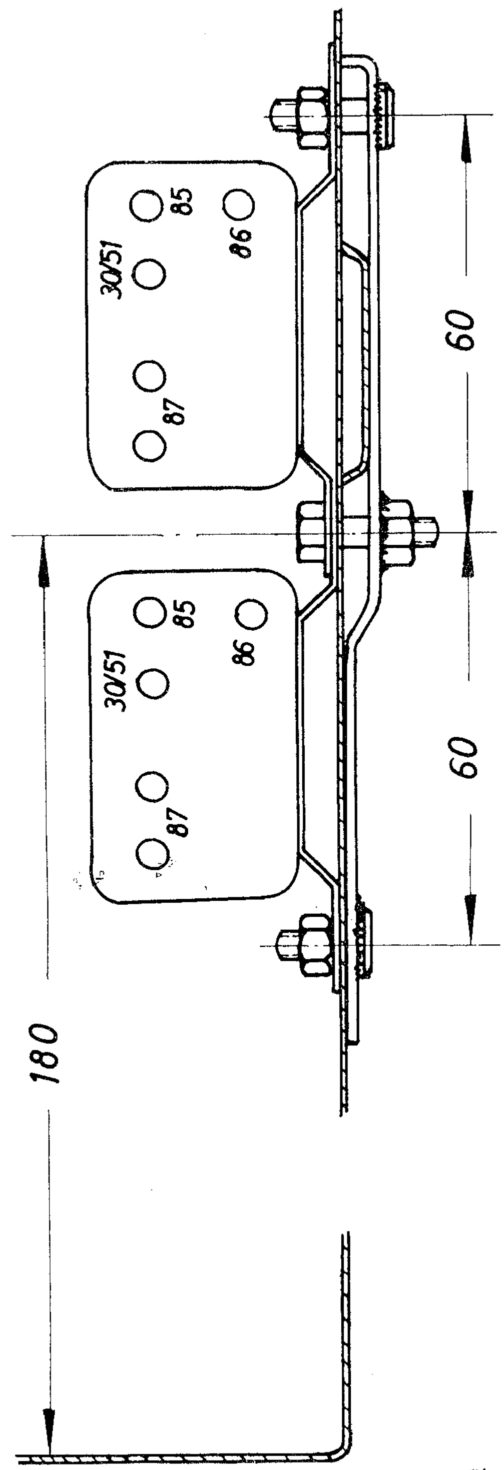


Fig. 4

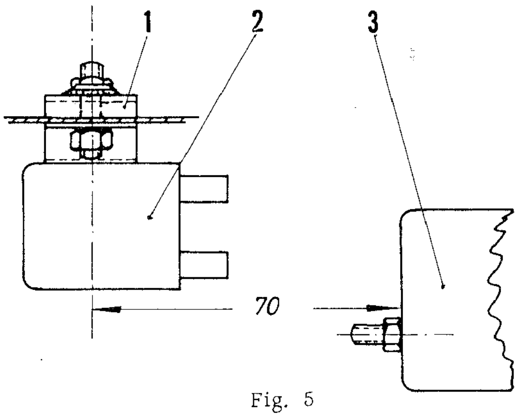


Fig. 5

1 Relay support
2 Relay switch
3 Electric fuel pump

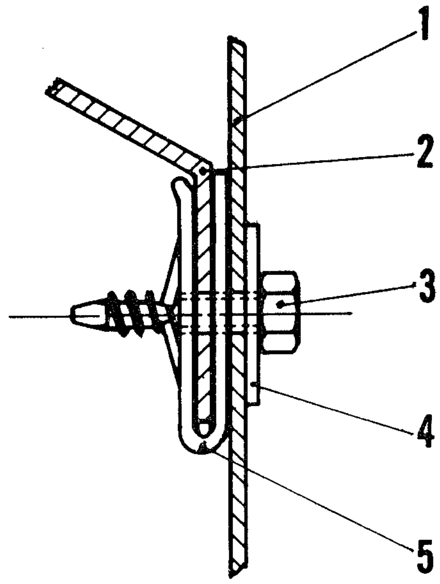


Fig. 6

1 Front compartment transverse panel
2 Heater support
3 Tapping screw
4 Washer
5 Speed nut

8. Remove both plastic plugs from the front compartment transverse panel and fasten the angular heater support with both speed nuts; place bolts and washers from outside (see Fig. 6 and 7).

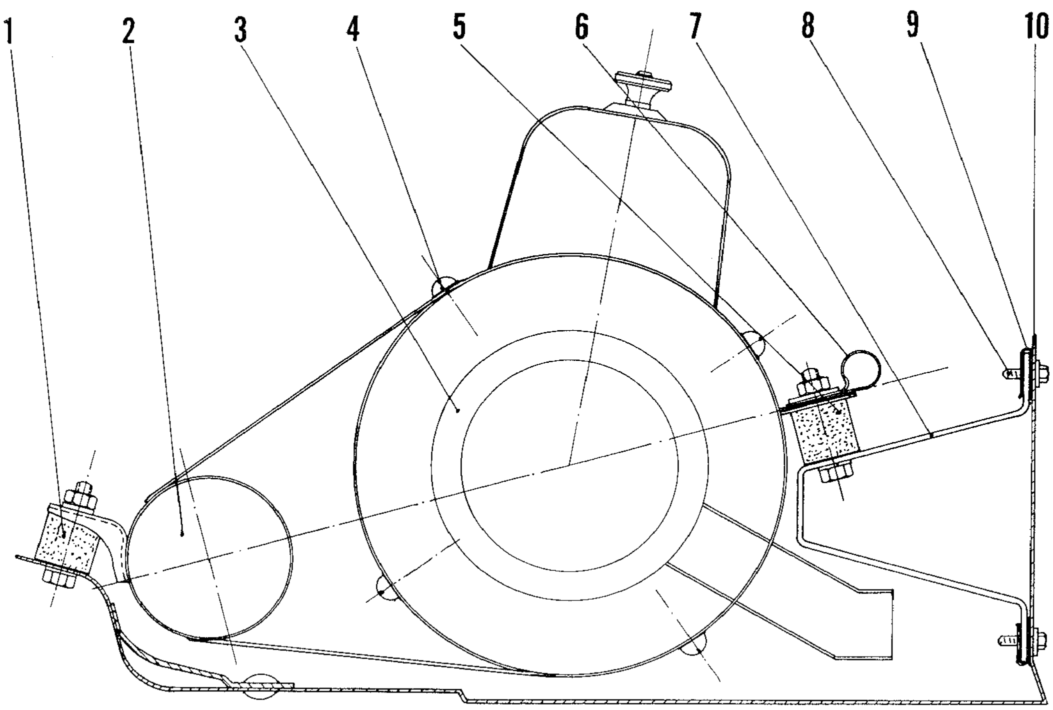


Fig. 7

1 Rubber support
2 Warm air distributor
3 Heater
4 Distributor retaining screw
5 Rubber support
6 Holding clamp
7 Heater support
8 Tapping screw
9 Speed nut
10 Front compartment transverse panel

9. Remove the 6 mm plastic plug from spare tire recess. Install rubber support by placing the M 6x8 bolt from underneath.

10. Mount the other rubber support at the rectangular opening in the angular support. Altogether, three rubber supports are required for mounting - 1 for the exhaust duct and 2 for the heater; the shorter rubber support is for the exhaust duct.

11. Apply some talc powder to the rubber mount at the left wheel skirt. Make certain that the exhaust and intake ducts are properly centered in the openings provided in the body, horizontally as well as vertically. The horizontal adjustment (for height) may be made by loosening the four screws (slotted) which secure the warm air distributor.

12. Replace fuel line from fuel cock (Part No. 644.201.921.00) with fuel line with "T" joint (Part No. 644.201.095.00) which is included in the heater kit.

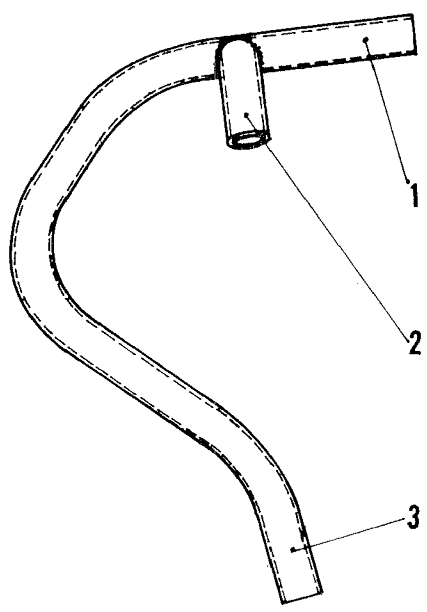


Fig. 8

1 To electric fuel pump for heater
2 From fuel cock
3 To mechanical fuel pump at engine

13. Insert sealing rubber and plate at the heater fuel pump inlet, fasten fuel line connector with coupling nut at fuel pump inlet so that the bent end points upward. Slide fuel hose (24 cm long) onto the fuel line connector; slide other end of hose onto the free connector of fuel line described in Point 12. Fasten fuel pump to support bracket with clamp. Remember to insert felt pad between support bracket and fuel pump. Secure fuel hose to bracket on bottom side of fuel tank with hose strap.

Note: Inlet and outlet connectors on heater fuel pump are marked with arrows.

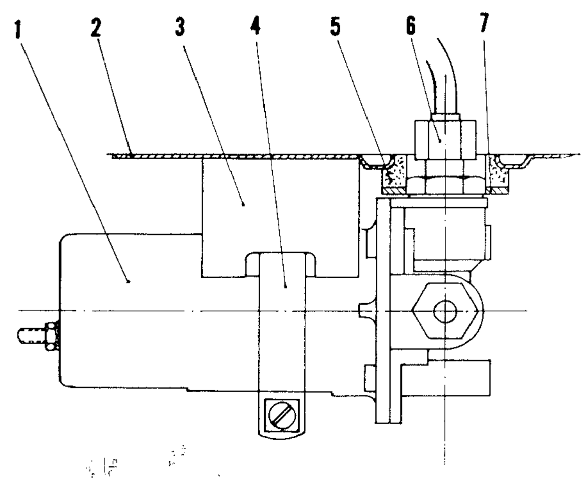


Fig. 9

1 Electric fuel pump
2 Front compartment panel
3 Support bracket
4 Clamp
5 Sealing rubber
6 Coupling nut
7 Sealing plate

14. Secure fuel line between fuel pump and heater. The long fuel line is mounted between pump and filter, the short between filter and heater. The filter and fuel line are mounted at the right rubber support at the heater (see Fig. 10).

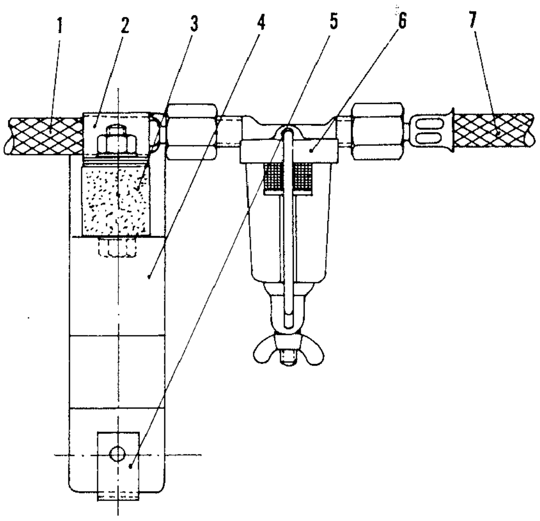


Fig. 10

1 Fuel line from fuel pump
2 Clamp
3 Rubber support
4 Heater support
5 Speed nut
6 Fuel filter
7 Fuel line to fuel solenoid

15. Fasten exhaust and intake ducts. Insert intake duct and rubber seal into sheetmetal sleeve (see sketch) until the seal comes to rest against the compartment panel; the exhaust duct opening must point upward. Secure duct by bending sheetmetal ears on body (see sketch). A plastic ring is utilized on the exhaust duct. The metal ring is also slid on from the outside, and the sheetmetal ears are bent to secure the unit.

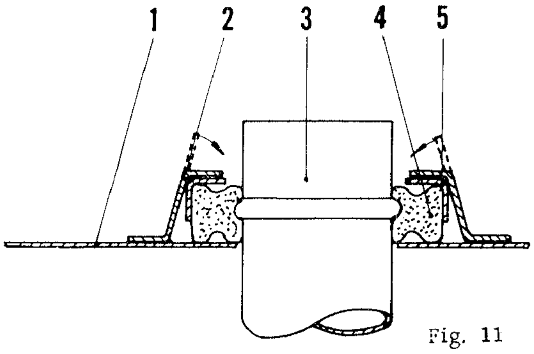


Fig. 11

1 Compartment panel
2 Sheetmetal ear
3 Intake duct
4 Rubber seal
5 Sheetmetal sleeve

16. Remove stabilizing bar bushing covers, move stabilizing bar down. Fasten the short rubber support at the bottom of the exhaust duct. Insert the exhaust duct into the exhaust tube in heater. Fasten rubber support to the diagonal chassis member through hole provided, making certain that the exhaust duct does not block the parking brake lever shaft. Drill a 3.2 mm hole, from the bottom, in the exhaust duct (see Fig. 12), and screw in a 4 mm sheetmetal screw to keep the duct from loosening or turning. Reinstall stabilizing bar.

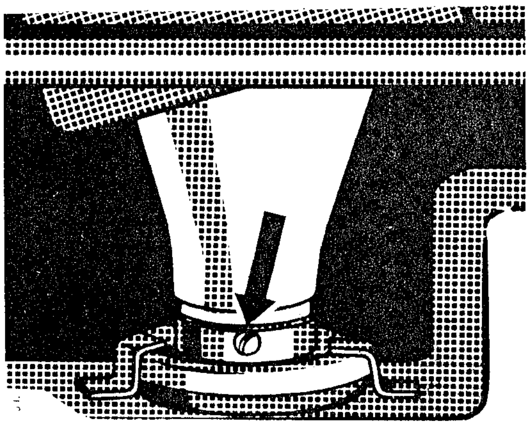


Fig. 12

17. Following the wiring diagram, connect cable terminals to the fuel pump, relay switches, and heater. The upper relay switch is designated No. 2, the lower switch is No. 1. Both relay switches are identical. See Fig. 13 for relay switch terminals. Wiring diagram applicable to the heater is shown on page S TRA 17.

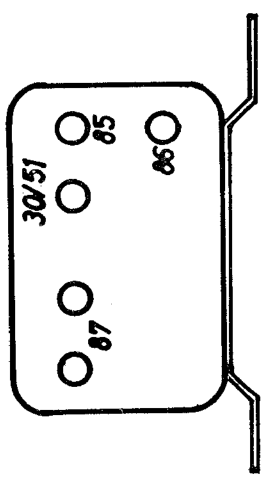


Fig. 13

Wiring Diagram for the BN-4 Heater

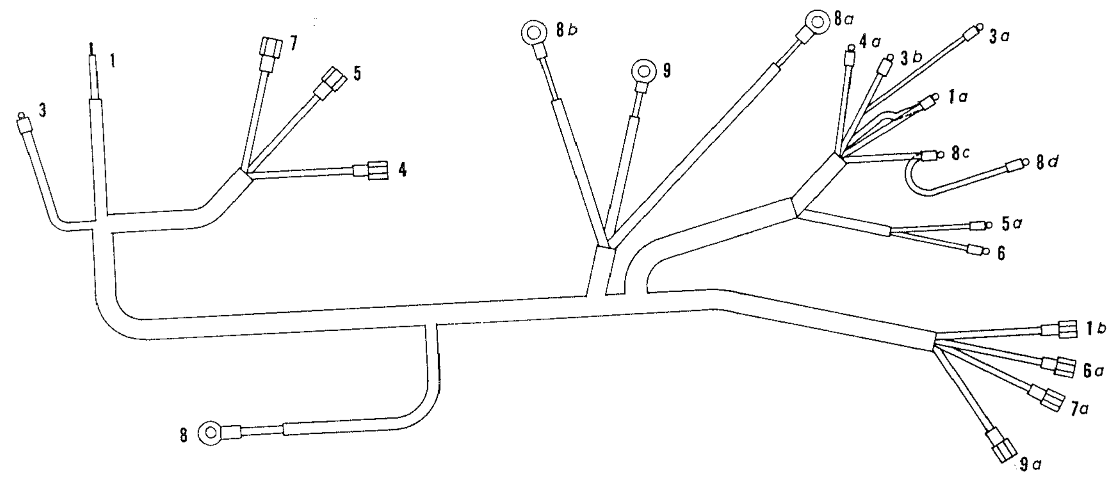


Fig. 17

No.	Color	Connecting Terminal
1	red	Fuse No. 3
1 a	red	Relay switch No. 1, terminal 30/51
1 b	red	Heater, terminal 2
3	black	Ignition/starter switch, terminal 54
3 a	black	Relay switch No. 2, terminal 85
3 b	black	Relay switch No. 1, terminal 85
4	red/white	Control unit
4 a	red/white	Relay switch No. 1, terminal 87
5	blue/white	Control unit
5 a	blue/white	Relay switch No. 2, terminal 30/51
6	blue	Relay switch No. 2, terminal 87
6 a	blue	Heater, terminal 1
7	green/white	Control unit
7 a	green/white	Heater, terminal 4
8	brown	Ground, at chassis
8 a	brown	Ground, at heater
8 b	brown	Ground, at fuel pump
8 c	brown	Ground, at relay switch No. 1, terminal 86
8 d	brown	Ground, at relay switch No. 2, terminal 86
9	green	Fuel pump
9 a	green	Heater, terminal 3

INSTALLATION OF SAFETY BELTS

As of serial Nos.

Coupe	120 620
	210 931
Cabriolet	156 850

anchorages for the mounting of safety belts are standard equipment.

Location of the anchorage points and mounting of the necessary parts:

Provision for the anchorage of the different types of belts (air-line type, diagonal shoulder type and diagonal-plus-lap type) has been made at the following points:

a) Air-line safety belts

The spare part No. of the air-line safety belt supplied by us is: 644. 803. 011. 01.

The following anchorage parts are necessary:

2 Shackles	644. 803. 111. 02
4 Spring washers B8 DIN 137 bost.	900. 028. 010. 01
8 Hexagon nuts M 8x1 DIN 934-6S gal Zn 9	900. 076. 014. 02

The anchorage points are located behind the front seats between the floor and the vertical sheeting. The measures of the points for the fastening of the shackles and/or bolts are shown in the figure below.

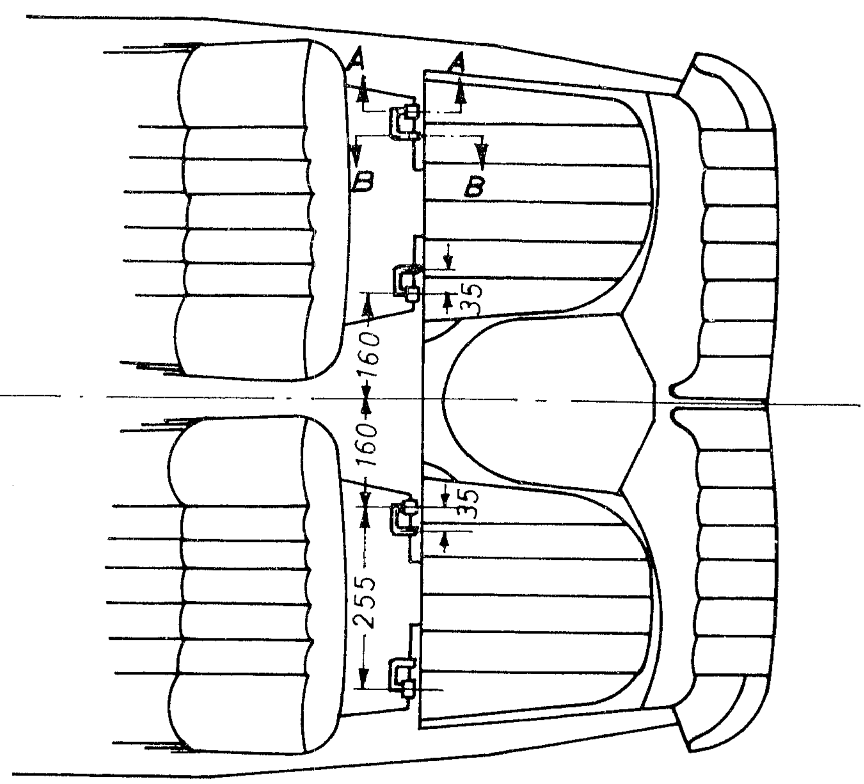


Fig. 1

b) Diagonal shoulder safety belts

A diagonal shoulder safety belt (complete) is supplied by us under the spare part No. 644. 803. 011. 02, with the following anchorage parts:

1	Shackle	644. 803. 111. 02
2	Spring washers B 8 DIN 137 bost.	900. 028. 010. 01
4	Hexagon nuts M 8x1 DIN 934-6S gal Zn9	900. 076. 014. 02
1	Retaining bolt	644. 803. 121. 00
1	Round anchor plate	644. 803. 123. 00
1	Spring ring 8 DIN 7980 bost.	900. 142. 002. 01
1	Spring ring 12 DIN 7980 bost.	900. 142. 004. 01
1	Head screw M 8x45 DIN 6912-8G gal Zn 9	900. 119. 007. 02

The installed diagonal shoulder belt passes from the right bottom side over the left shoulder of the occupant sitting on the left side and is fastened with a retaining bolt to the left rear side of the car's interior. The belt for the right seat occupant passes over his right shoulder and is mounted to the right rear side.

Mounting anchorage parts

Install shackle behind the front seat, see item a).
Cut out lateral covering at the anchorage point in the rear of the car's interior (see Fig. 5)

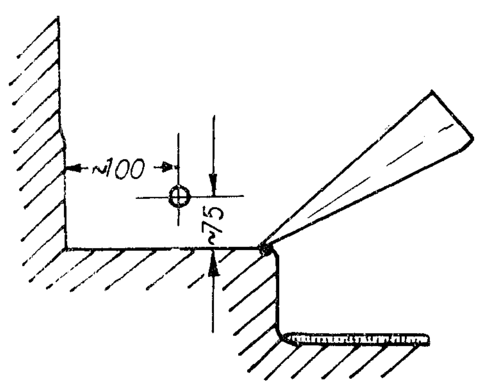


Fig. 5

Insert spring ring 12 DIN 7980 bost. in the welded-in metal piece, mount round anchor plate and fasten retaining bolt (644. 803. 121. 00)with head screw M 8x45 DIN 6912-8G gal Zn 9 on the metal piece. Add a spring ring 8 DIN 7980 bost. under the head screw.

Modified anchorage parts for safety belts

Shackle 644. 803. 111. 02 is being replaced by retaining bolt 644. 803. 122. 00.

(However shackle 644. 803. 111. 02 is still being used for subsequent installation into vehicles without anchorage points.)

Retaining bolt 644. 803. 122. 00 can be installed into all vehicles as of serial No.

Coupe	120 620
and/or	210 931
Cabriolet	156 850

Mounting retaining bolt:

Remove countersunk screw in A -A and screw in retaining bolt with spacer tube (see sketches).

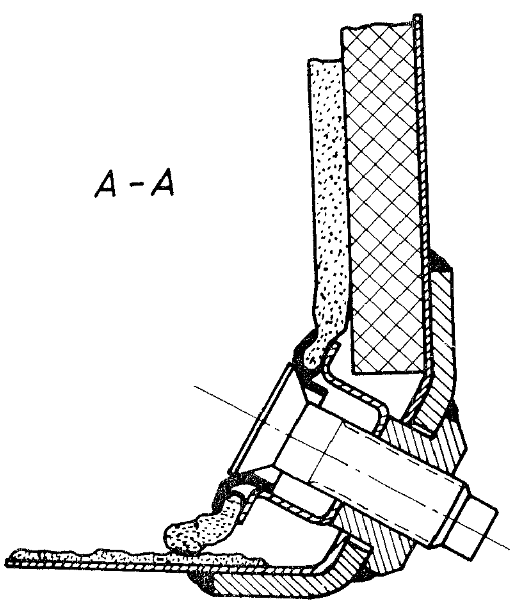


Fig. 7

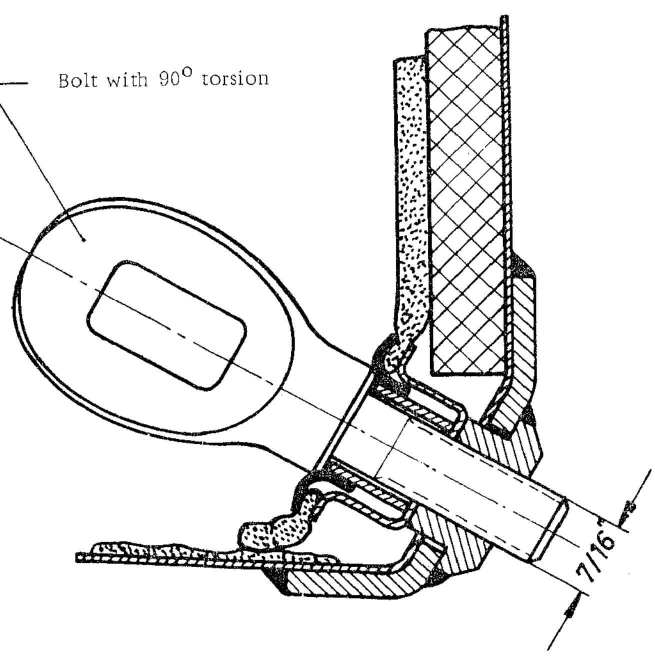


Fig. 8

Subsequent installation of anchorage parts for safety belts

In vehicles as of type 356 A

Coupe	101 693
Cabriolet	150 001
Speedster	83 792

a subsequent installation of anchorage parts for air-line safety belts, diagonal shoulder safety belts or combined diagonal-plus-lap safety belts is possible.

As anchorage parts are used: shackles, spare part No. 644. 803. 111. 02; with nuts M 8x1 DIN 934-6S gal Zn 9, spare part No. 900. 076. 014. 02, 4 each; and spring washers B 8 DIN 137 bost., spare part No. 900. 028. 010. 01, 2 each; and/or spring rings 8 DIN 7980 bost., spare part No. 900. 142. 002. 01, 2 each. The shackles are screwed on to the vertical sheeting by means of a reinforcement plate from the outside. The same shackles are used for the fastening of diagonal shoulder safety belts to the rear side-wall of the car's interior. To obtain the necessary rigidity, two reinforcement plates for each shackle have to be made (as per sketch), and mounted as described.

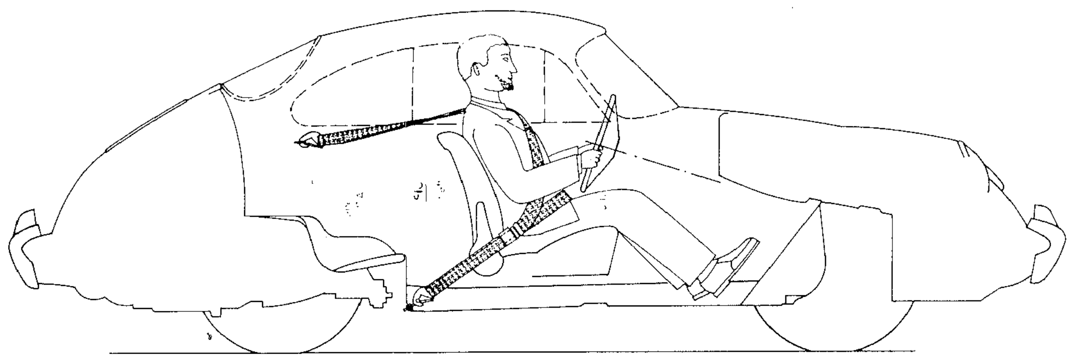


Fig. 1

Mounting of anchorage parts for diagonal shoulder safety belts in the rear of the car's interior

Operation

1. Make reinforcement plates (as per sketch) to fasten the shackles to the side-wall in the rear of the car's interior (see Fig. 2).

2. Remove cover strip and/or lateral covering in the rear of the Cabriolet.

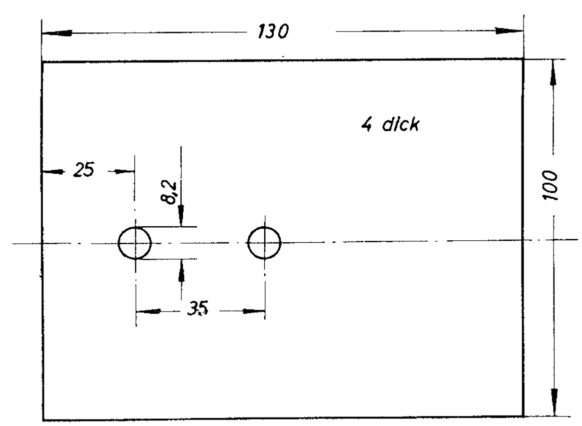


Fig. 2

3. Trace holes (as per sketch) to fasten the shackles (for the Coupe see Fig. 3 and 4, for the Cabriolet Fig. 5 and 6).

Coupe

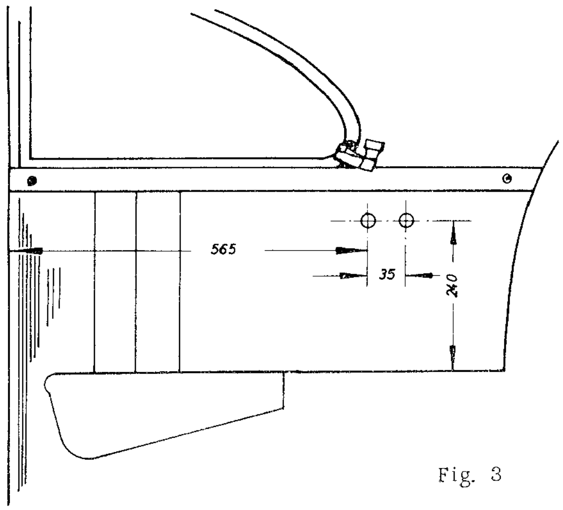


Fig. 3

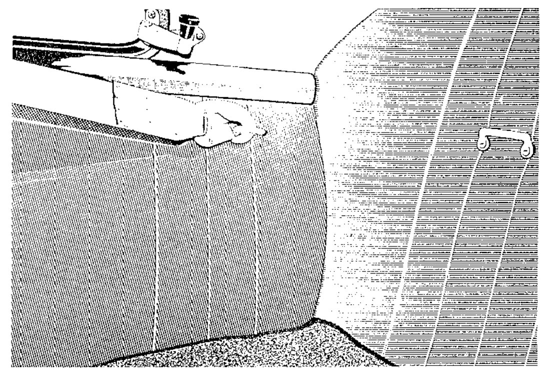


Fig. 4

Cabriolet

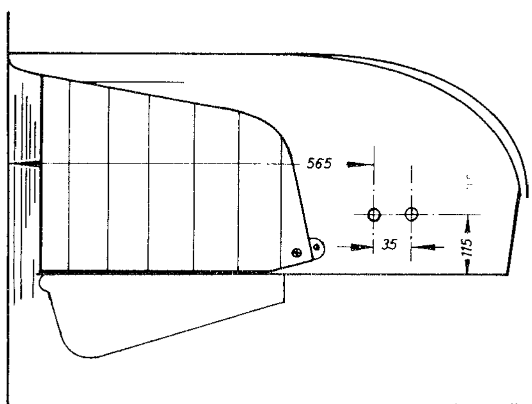


Fig. 5

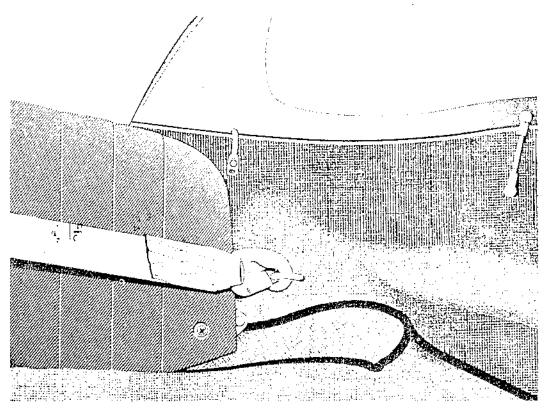


Fig. 6

4. To avoid a rolling up or tearing of the covering, press one of the punched reinforcement plates to the marked spot of the covering when piercing the holes from the inside to the outside of the vehicle.

5. With the Coupe remove the retaining clips for the interior covering and detach with palm the covering of the wheel housing.

6. Push the shackle through the interior covering and unscrew the nuts behind the covering so far that the loop of the shackle protrudes about 18 mm into the rear of the car.

Installation of anchorage parts for air-line or diagonal shoulder safety belts to the vertical sheeting

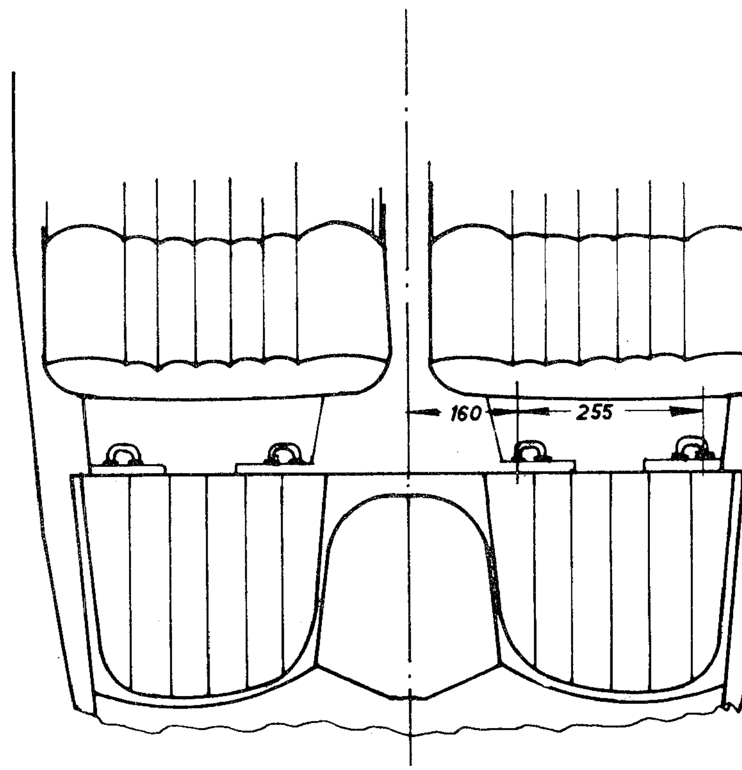


Fig. 8

1. Mark the position of the 4 shackles according to sketch and trace through the covering by means of an awl (see Fig. 8).
2. Detach covering and pierce through the side-wall with a 8,2 mm Ø driller.
3. Punch the marked positions of the Boucle-covering with a 8 mm Ø hollow punch.
4. Push the shackle through the Boucle-covering and screw on counter nuts. Treat reinforcement flap with body sealing compound and push shackle through the holes of the vertical sheeting. Mount reinforcement flap and tighten with spring ring and nut (see Fig. 9).
5. Treat the fastening, from the outside, with body sealing compound.

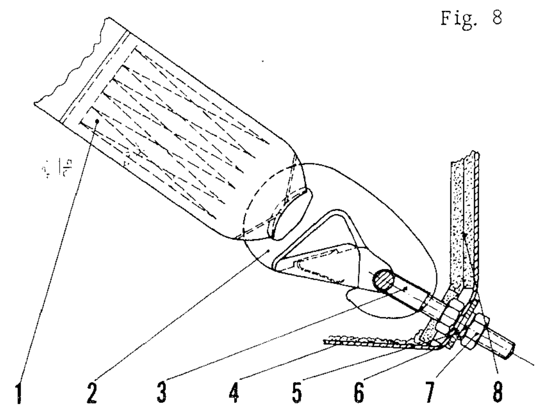


Fig. 9

1. Safety belt
2. Hook
3. Shackle
4. Body bottom
5. Reinforcement flap
6. Spring ring
7. Nut
8. Covering (Bouclé)

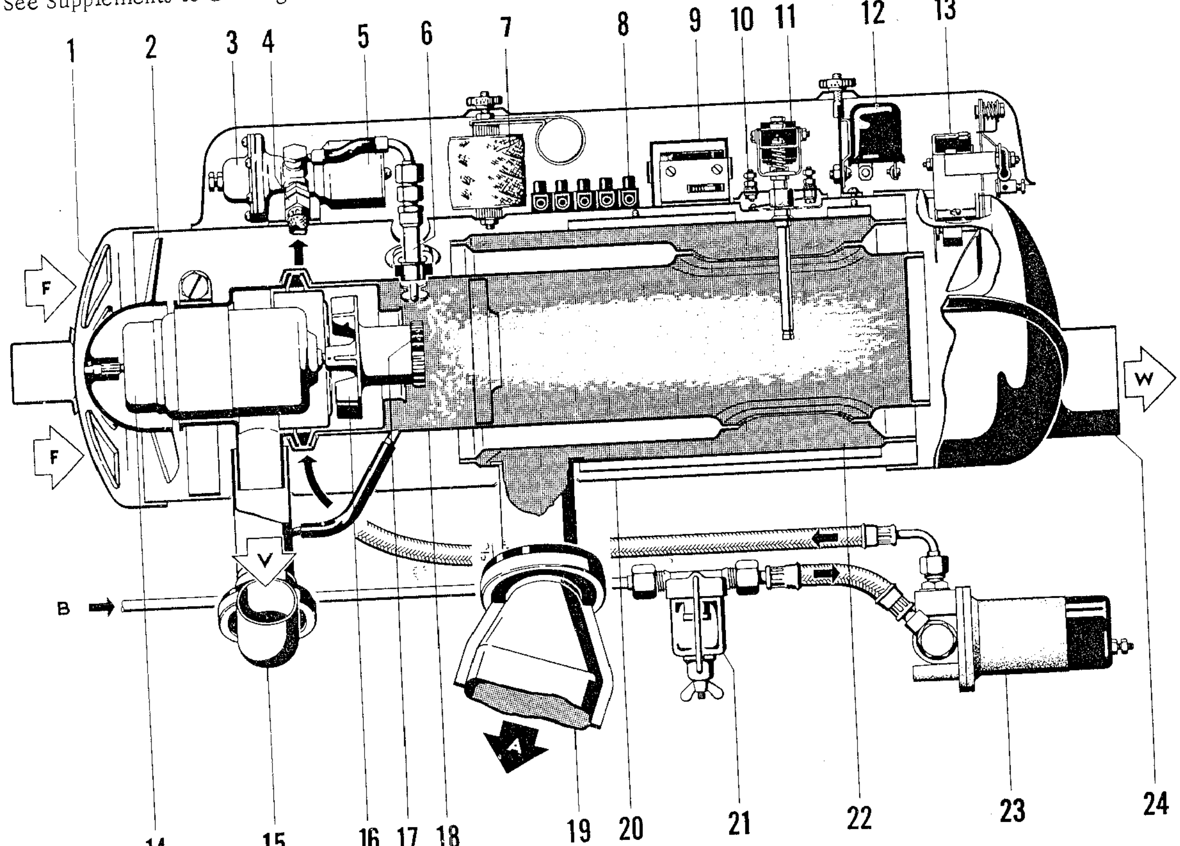
Note:

The shackles mounted to the vertical sheeting have a test-load of about 1500 kg each. This corresponds to American standards.

For cars not registered in the Federal Republic, verify, whether the 1500 kg test-load corresponds to the regulations of the country in question.

The Eberspächer BN 4 Heater will be installed either in the 6 or the 12 volt execution, according to the car's electrical system. Please pay the necessary attention when ordering spare parts.

See Supplements to Catalogue of Spare Parts 356 B, Group 7/13 aA and 7/13 A.



1. Cover plate
2. Fresh air fan
3. Pressure governor
4. Fuel line connection
5. Magnetic valve
6. Injector
7. Ignition coil
8. Cable connector
9. Safety switch
10. Overheat safety switch
11. Thermo switch
12. Relay
13. Governor switch
14. Electric motor
15. Air intake
16. Fan for burner
17. Atomizer gear
18. Combustion chamber
19. Exhaust pipe
20. Outer housing
21. Fuel filter
22. Heat exchanger
23. Fuel pump
24. Hot air discharge

Fig. 1

F = fresh air
W = hot air
V = combustion air
A = exhausts

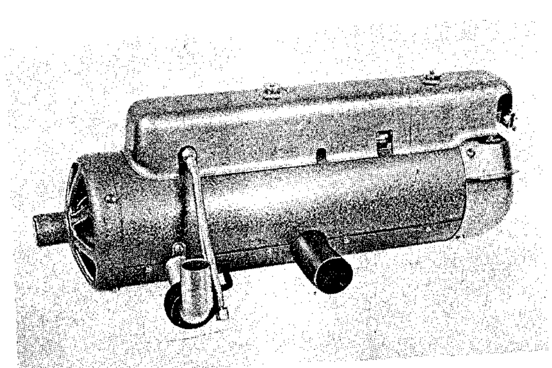


Fig. 2

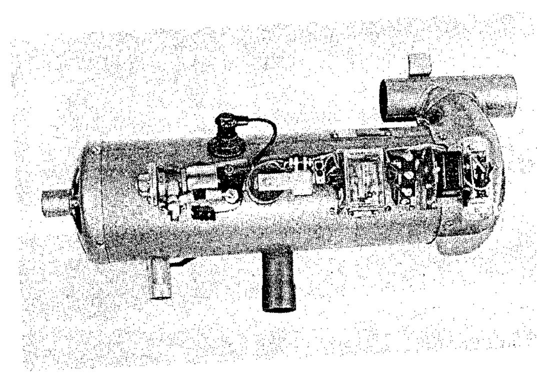


Fig. 3

Disassembly

1. Unscrew two knurled attaching nuts and remove heater cover (reference Fig. 2 and 3).

2. Detach fuel inlet line at base of pressure regulator while holding second coupling nut with another wrench, otherwise damage might occur to micro-filter insert.

3. Detach fuel outlet line on body of pressure regulator by unscrewing the banjo bolt. Loosen fuel line coupling on top of fuel nozzle (note filter screen located between fuel nozzle and fuel line, handling it with care).

4. Disconnect wire connection of fuel solenoid at No. 3 terminal, pull wire out of conduit hose.

5. Unscrew four round-head retaining screws at base of body and remove pressure regulator.

11. The coil and condenser may be removed from the supporting stud after having removed the retaining hex-nut and both wire connections at the condenser.

12. Detach wire terminals at safety switch.

13. Safety switch may be removed after loosening two round-head retaining screws on the foreside of switch.

14. Detach three wire terminal connections of thermo-switch.

15. Loosen coupling nut and pull out sensor tube of safety switch, going about it without the use of force; if necessary, apply a rust solvent and withdraw switch with a slight twisting motion (reference Fig. 5 and arrow).

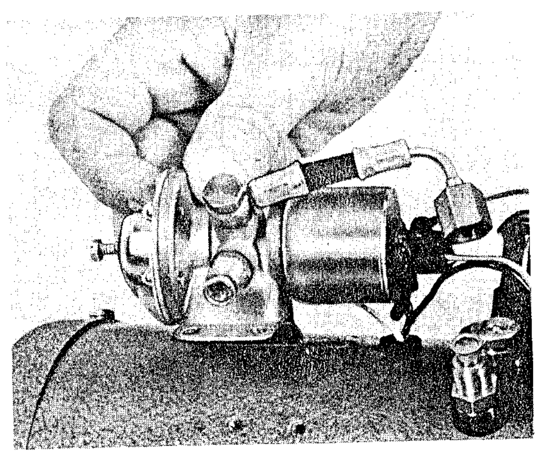


Fig. 4

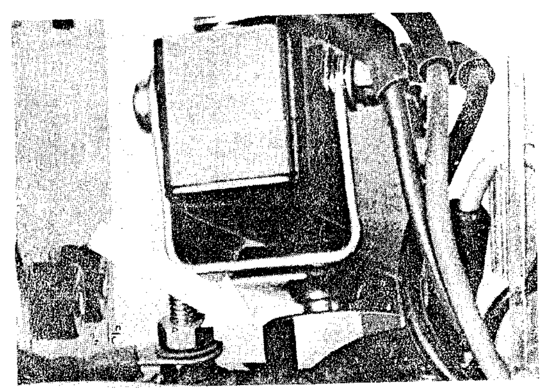


Fig. 5

6. Unscrew coupling nut and remove fuel line.

7. Unscrew intermediate piece containing filter insert.

8. While holding nozzle carrier with a wrench, unscrew nozzle and withdraw from carrier.

9. Pull spark plug cap off, remove and inspect spark plug.

10. The preheat plug, or glow plug, is of stick-type. It is located next to the nozzle and may be removed using a spark plug wrench.

16. Having removed the thermoswitch and detached wire terminals of overheat switch, the latter can be removed by unscrewing four round-head retaining screws.

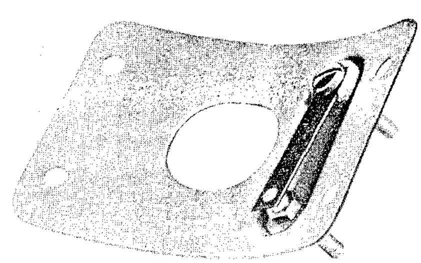


Fig. 6

Reassembling Heater Unit

A defective air blower assembly or heat exchanger are to be replaced as whole units, repairs being not permissible (ref. page S TRA 36, Heat Exchanger).

Reassembly

Reassembly is accomplished in reversed order of the above, devoting attention to the following points:

1. When mounting blower unit in heat exchanger, make certain that the ventilating air intake duct lines up with the exhaust duct.
2. Slide the outside shell over blower and heat exchanger, pull electric wire for blower through the orifice provided, and insert rubber grommet.
3. Install and connect remaining components in appropriate order.
4. Contact spring in overheat switch should have a preload pressure of 70 grams, and should open at a discharge air temperature of 150 to 200°C. The contact spring cannot be readjusted and must be replaced when defective.
5. When installing the thermoswitch, care should be taken not to allow the coupling nut to rest against the outside case of the heater when tightened.
6. Before installing the safety switch, check if both coil terminals (small cylindrical case), as well as the contact surfaces are in good condition.
7. Safety switch should be adjusted after the heater has been reassembled (reference page S TRA 34, Description of Safety Switch). Repairs are not permissible.
8. Install coil and condenser. The coil may be tested in the same way as engine coils are (testing at the rate of 5000 interruptions, with spark crossing a 6 mm gap).
9. Before installing fuel nozzle, clear the permanently seated micro-filter with a blast of clean compressed air, blowing only in the direction of fuel flow.
10. Check filter insert in intermediate piece for defects in filter screen, replace if necessary.
11. When tightening couplings, it is always necessary to hold the counterpart with another wrench.
12. Nozzle spray pattern should be checked when reassembly is completed. This visual inspection is made possible by removing the spark plug and glow plug, and illuminating the diffuser wheel through the glow plug orifice. The spray pattern must fall 1 mm off center of diffuser wheel in the direction of the ventilating air blower.

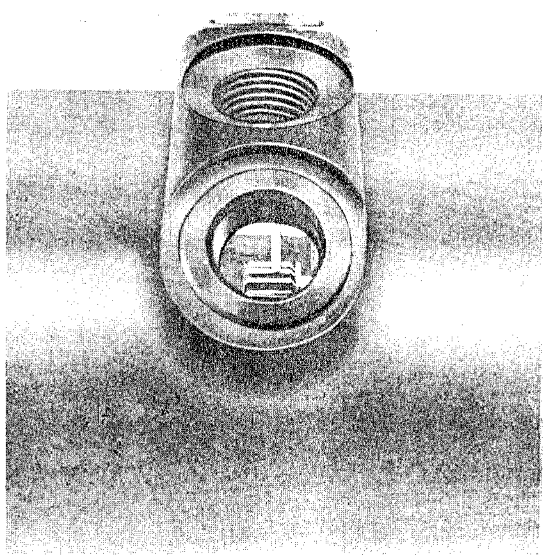


Fig. 12

13. Inspect spark plug prior to installation. Spark plug gap should be 2.5 mm. Carbon deposits must be removed from the electrode insulator by means of a brass brush or sand blasting.
14. The glow plug may be cleaned in the same way as the spark plug.
15. Install pressure regulator and fuel solenoid assembly, connect fuel lines.

F U E L   P U M P

Description

The electric fuel pump is capable of drawing fuel to the height of 1 meter; it develops a pumping pressure of 0.1 atmospheres.

When the pump is at rest, the points are in contact. The current passes through the coil so that the armature plate - and with it the entire diaphragm system - is pulled towards the breaker mechanism, thus sucking fuel into the combustion chamber through the suction valve. At the end of the stroke, the circuit is broken by the breaker mechanism and a spring brings the diaphragm system back to its original position, thus forcing fuel from the pumping chamber through the delivery valve into the supply line.

Inspection and adjustments

The pump should be mounted in horizontal position with the fuel outlet pointing up (see arrow). Contact gap, with blade against the stop, should be 1 mm (gently press the lower contact blade against housing). An adjustment is possible by means of an adjustment screw. It is recommended to lightly lubricate the rocker pivot points once per year.

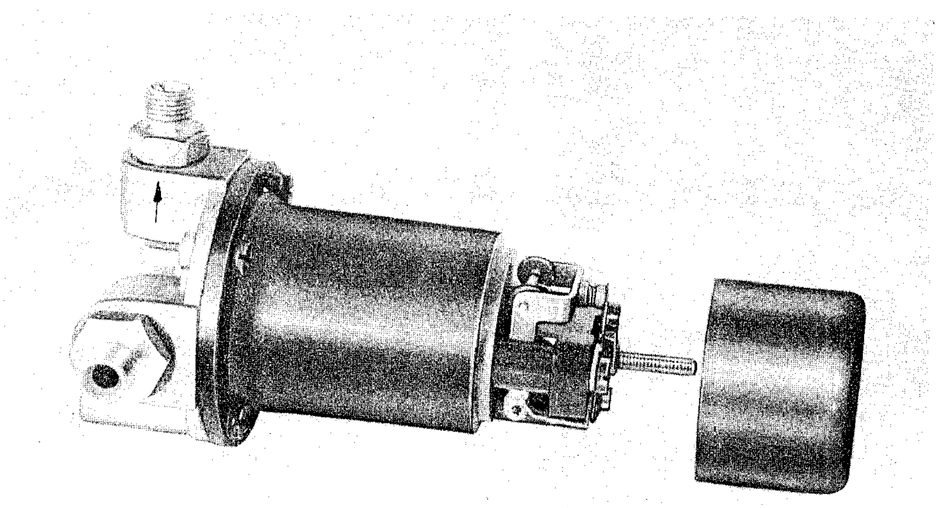


Fig. 13

PRESSURE REGULATOR AND FUEL SOLENOID ASSEMBLY

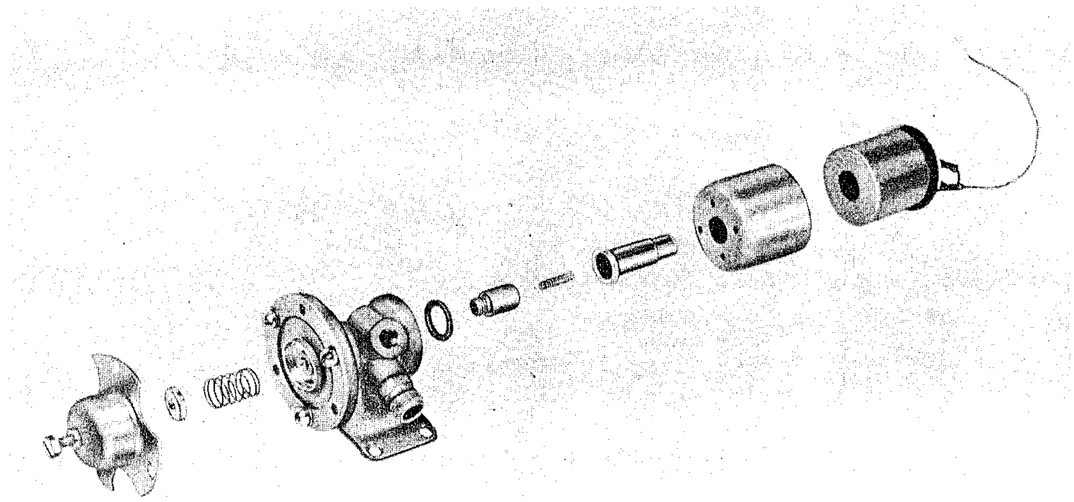


Fig. 14

Description

The pressure regulator governs the rate of fuel flow according to preset diaphragm settings. An exact adjustment to the rated output of .65 liter/hour can be accomplished only when the assembly is installed in the heater unit.

Inspection and Adjustments

With heater unit installed, it is necessary to first remove the cover and detach the fuel supply line. Next, the fuel nozzle has to be removed, its fuel supply line reconnected, and the nozzle held at the same level as in the installed position. The fuel emitted from the nozzle should then be trapped in a graduated measuring glass; the collected amount of fuel, after an elapsed time of two minutes, should be 20 to 21 cc. When necessary, the pressure regulator can be readjusted by turning the fourfold sealed adjustment screw on the forside of the unit (the seal is by means of paint): by turning the screw clockwise, the emission of fuel is increased; by turning it counter-clockwise, the emission is decreased. At time of this service operation attention should be devoted to the safety switch which should cut off the flow of current after a maximum elapsed time of 3 1/2 minutes.

Disassembly

Disassembling is permissible but only when complete exchange assemblies are not available.

1. Located in the cover on the foreside of the pressure regulator is a red, paint-sealed adjustment screw with a lock nut. The cover may be removed after unscrewing three round-head retaining screws (spaced 120° apart); this will expose the pressure plate, spring, and diaphragm.

2. The diaphragm may be withdrawn after removing the retaining collar which is secured by three round-head screws. The parts may not be repaired and if found defective, must be replaced.

3. The housing which accomodates the pressure rod, spring, and shut-off valve may now be removed with the help of a socket wrench.

Reassembly

Reassembly is accomplished in reversed order of the above, devoting attention to the following points:

1. It should be ascertained that the pressure rod moves freely in its guide after the parts have been thoroughly cleaned.
2. The diaphragm must be placed in such way that the brass disc faces towards the pressure rod.
3. When installing the housing cover, first insert the pressure spring into the sheetmetal receptacle of the diaphragm, and then place the pressure plate in appropriate position making certain that the adjustment screw rests in the cavity in the plate.

4. Adjustment of the rate of fuel flow is accomplished on ready assembled heater unit; refer to Description, Inspection and Adjustment of Pressure Regulator.

F U E L S O L E N O I D V A L V E

Description:

The fuel solenoid shuts off the fuel supply as soon as the combustion process is interrupted by the heater control switch. The flow of fuel is stopped by a synthetic-rubber valve which is pressed against the valve seat.

Inspection

The proper functioning of the fuel solenoid may be audibly verified by a clicking noise which is released by the slamming action of the valve in valve guide when it is energized. If the valve sticks, functioning only when jarred, it will be necessary to completely disassemble the fuel solenoid. However, it is recommended that in such case the complete pressure regulator and fuel solenoid assembly is removed from the heater unit.

Disassembly

1. Remove round-head screw located on foreside of fuel solenoid, remove cover, detach ground wire connection, and withdraw solenoid coil from housing.

2. Remove four lens-head screws in base of housing and carefully withdraw housing with valve guide. Note that the valve may jump out if under spring pressure (reference Fig. 4).

Reassembly

Reassembly is accomplished in reversed order of the above, devoting attention to the following points:

1. The valve should not show any trace of corrosion on the cylindrical shaft; if corroded, it must be replaced.

2. The sealing side of the synthetic-rubber valve should be visually inspected for proper seating, that is, the seating impression must be round and in the center. If the impression is imperfect, it will be necessary to replace the pressure regulator housing and valve seat.

3. In no case may the pressure spring be lengthened or shortened.

SAFETY SWITCH

Description

This switch prevents that the heat exchanger is flooded with fuel if combustion should fail for any reason. The switch consists of a coil, wired parallel to the glow plug, which heats a bi-metal contact strip which interrupts the flow of current to the fuel pump and fuel solenoid after having been energized for 2 to 3 1/2 minutes (this cannot be determined by the position of the red lever).

Inspection and Adjustments

The inspection and adjustment procedure can be undertaken only in a closed, draft-free room. The rated activation time, at nominal voltage, is 2 to 3 1/2 minutes after energizing the coil. Is a corrective adjustment necessary, the paint-sealed adjustment screw located on the right side of the base plate (reference Fig. 15 and arrow) should be turned clockwise to shorten the activation period, and counter-clockwise to extend it (allow 15 minutes for cooling prior to each test). If found defective, the complete switch assembly will have to be replaced.

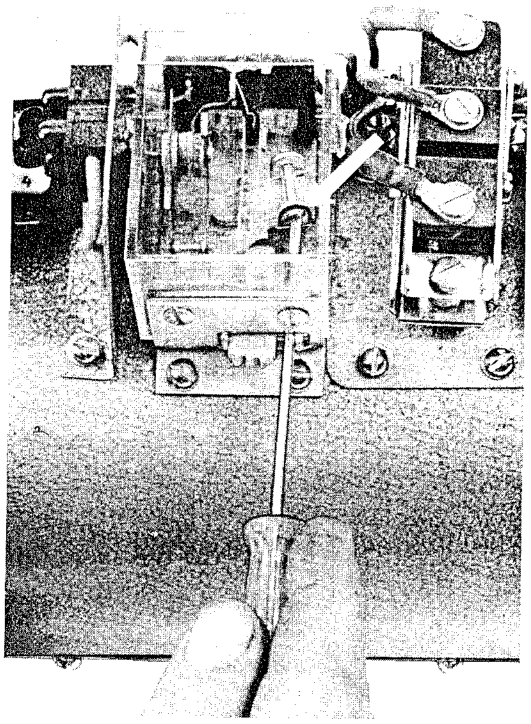


Fig. 15

THERMOSWITCH

Inspection and adjustments

The thermoswitch is correctly adjusted when the blower motor continues to run for approximately 3 minutes during the purging cycle, when the heater has been turned off after reaching normal operating temperature. If the purging cycle is too long, the thermoswitch adjusting screw should be turned clockwise; if it is too short, the screw must be turned counter-clockwise. Refer to paragraph 4, Reassembly, for basic settings of the switch.

Disassembly

1. Remove the red or green paint-sealed adjusting screw, and pull out helical spring.
2. Raise the now hinging switch, together with arm, remove leaf spring, and withdraw the quartz bar by slanting the switch on its pivot (see illustration).

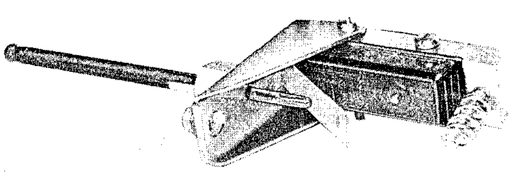


Fig. 16

Reassembly

Reassembly is accomplished in reversed order of the above, devoting attention to the following points:

1. It should be noted that the switch guide fixture can be easily turned; if necessary, slightly loosen the retaining screw (CM 3. 5 x 30).
2. The inside part of the thermoswitch sensor tube must be clean.
3. The quartz bar ends should not show any sign of damage and should be freely movable inside the sensor tube.
4. Following reassembly, the thermoswitch should be readjusted. The basic adjustment at time of reassembly is made as follows: the red paint-sealed adjusting screw is tightened during reassembly until the switching throw takes place within the switch (audibly noticeable click), then the screw is turned another 1/3 turn (120°).
5. The exact adjustment is accomplished in manner outlined at the beginning of this chapter.

HEATER CONTROL SWITCH

Description

Depending upon the discharge air temperature, the current supply for the fuel pump and fuel solenoid is opened or shut by a bi-metal spiral which is a part of the microswitch (heat thermostat). The switch response temperatures should be 45 to 55° C at the lowest heat output settings, and 80 to 90° C at high settings (readings taken in hot air duct).

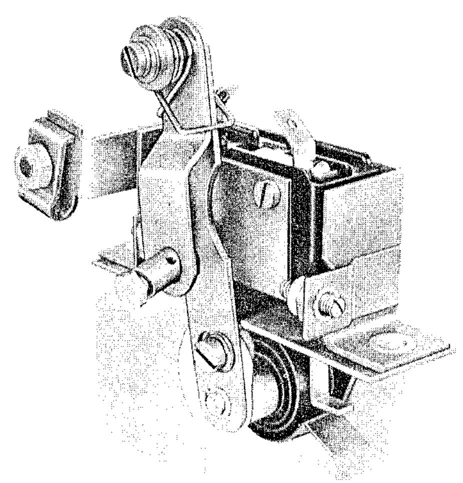


Fig. 17

Inspection and Adjustment

If the prescribed temperatures can not be realized, it is possible to rectify this trouble by readjusting the terminal stop screws of the control lever. If the microswitch had to be replaced for any reason, it will be necessary to completely readjust the new switch. Should it happen that the adjustment range of the terminal stop screws turns out to be insufficient it will be necessary to change the basic setting by loosening one round-head screw and changing the position of the lever in relation to the bi-metal spiral (oval orifice in the lever).

Disassembly

1. Remove two cylindric-head screws seated in switch body (at the level of Bowden-cable terminal) and withdraw the switch with the contact finger up.
2. To take out the Thermoflex spiral, it is necessary to remove the retaining ring on the pivot shaft, loosening the set screw in the control lever, and removing the control lever.

Reassembly

Reassembly is accomplished in reversed order of the above, devoting attention to the following points:

1. Make certain that the retaining screws on both contact lugs are firmly tightened.
2. The heater control switch must respond to a temperature of 45 to 50° C at lowest heat output setting, and to 90 to 100° C at the highest setting.
3. A subsequent adjustment of the heater control switch can be accomplished as outlined at the beginning of this chapter.

HEAT EXCHANGER

If the heater has been subjected to a prolonged operation under conditions involving an insufficient air supply (improper combustion resulting in soot deposits), it will be necessary to burn clean the heat exchanger and exhaust tube. This is accomplished in a shop, by a mechanic, without removing or disassembling the heater unit. By short-wiring (by-passing) the heater control switch, the heat exchanger is brought to a glowing, dark-red temperature (may be seen through intake opening), causing the carbon deposits to burn off under emission of sharp-smelling, grey-green fumes (the heat-cleaning procedure must be performed in an open area for obvious reasons). As soon as the smoke emission ceases, the ashlike deposits can be loosened by light tapping on the exhaust tube; the ash will then be blown out by the combustion blower. It is not permissible to repair the heat exchanger, and when found to be defective, it must be replaced as a unit.

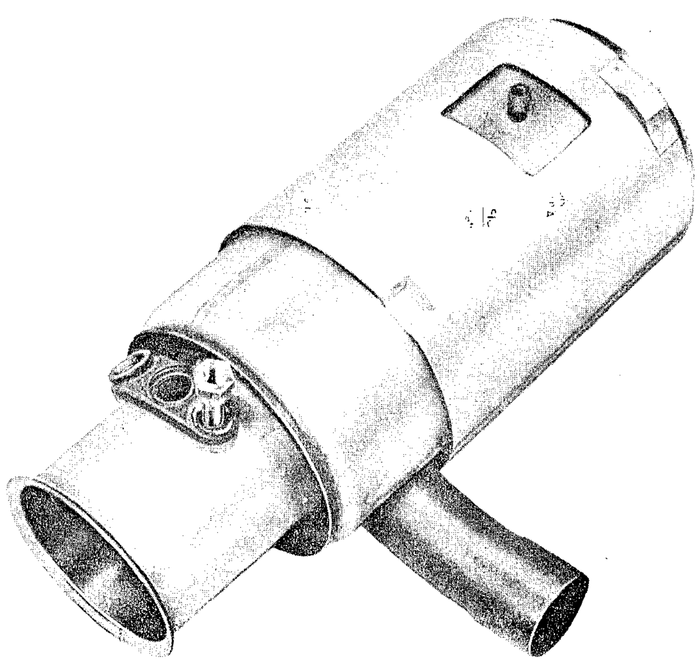
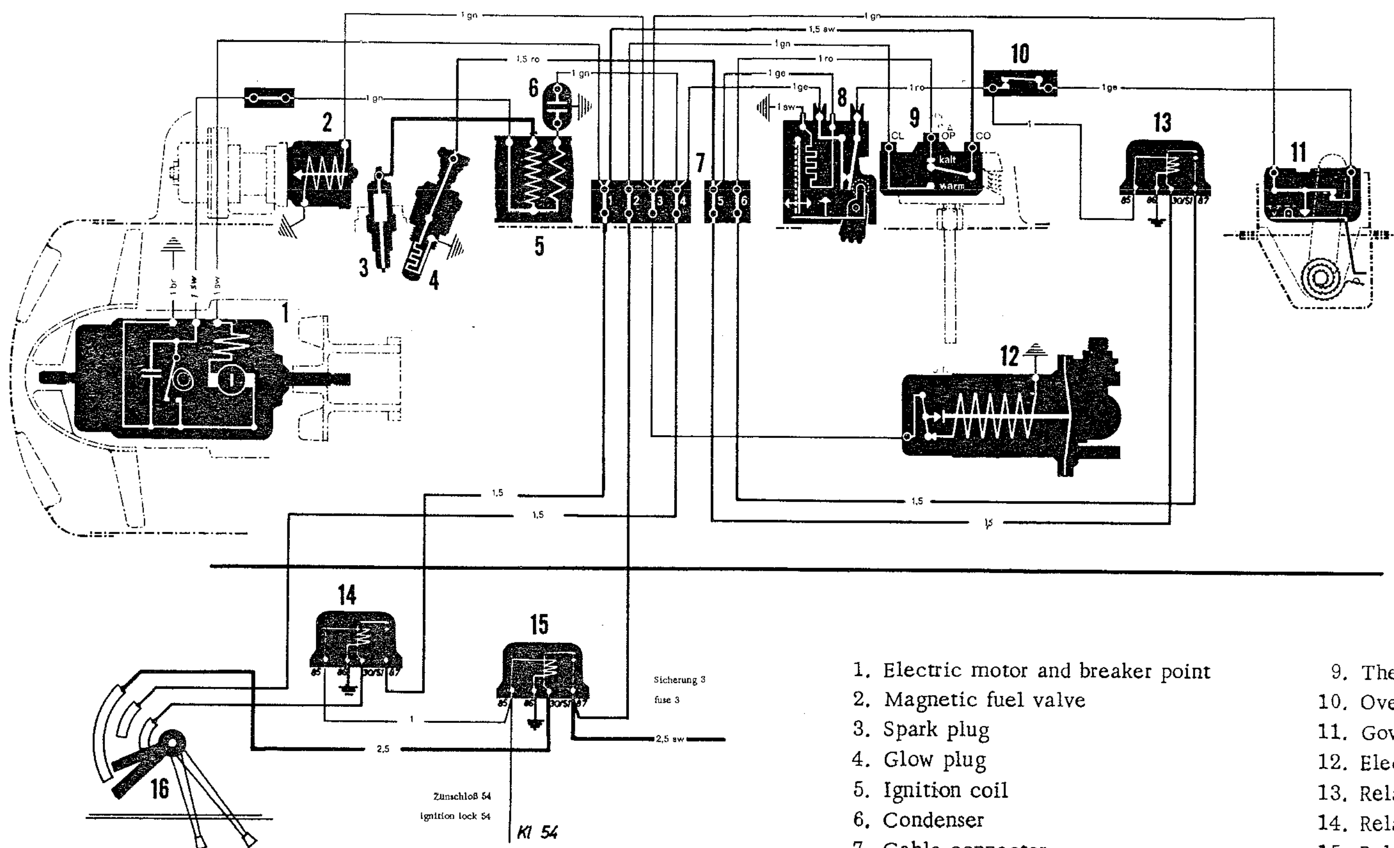


Fig. 18

W I R I N G   D I A G R A M



bl = blue
br = brown
ge = yellow
gr = green
ro = red
sw = black
we= white

1. Electric motor and breaker point
2. Magnetic fuel valve
3. Spark plug
4. Glow plug
5. Ignition coil
6. Condenser
7. Cable connecter
8. Safety switch
9. Thermo switch
10. Overheat safety switch
11. Governor switch
12. Electric fuel pump
13. Relay
14. Relay
15. Relay
16. Operating switch

HOW TO FIND FAILURES AT THE HEATER BN 4

The functional test can be carried out with the aggregate installed in the car.

Deficiency	Cause	Corrective Measures
Fan does not operate	Electric current interrupted	Check main fuses and relays
No fuel supplied	Safety switch has interrupted the fuel supply after 2-3.5 minutes of preheating	Press red lever to reset safety switch. If necessary wait 2 minutes for cooling down of heater resistor, so that switch can be reingaged
	Safety switch improperly adjusted	Check safety switches and adjust (see S TRA 34)
	Magnetic valve at the pressure governor does not open, coil faulty	Remove coil and replace by new one, see S TRA 33
	Fuel pump sticks	Clean breaker points and readjust, see S TRA 31
Fuel supply interrupted	Fuel line or filter leaking, fuel pump receives air	Check connections of fuel lines, especially gasket of filter inspection glass
	Filter clogged	Clean, arrow must correspond to flow direction to prevent internal clogging
	Hair filter at pressure control clogged	Remove pump pressure tube at the pressure control and clean hair filter with compressed air
	Control switch damaged	Check connections and function, see S TRA 35
	Safety switch damaged	Check contacts, see S TRA 35
	Pump has no output supply, noisy	Open fuel cock, pump receives air, relief valve on the pressure side of the pump is dry and sticks - remove pump pressure line and moisten with a few drops of fuel

Deficiency	Cause	Corrective Measures
Fuel feed stopped	Fuel pump does not operate	Check breaker points, oil the spring plates and bearings (see S TRA 31)
	Pressure governor and magnetic valve not operating	Clean pressure governor and adjust (see S TRA 32)
	Magnetic valve jammed	Remove pressure governor with magnetic valve. Dismantle magnetic valve, clean or replace valve, if necessary (see S TRA 33)
	Fuel jet clogged or damaged	Fuel jet is damaged, does not inject fuel correctly to the gearing of the diffuser gear (observe through spark plug hole). See S TRA 30/12 Remove fuel line, clean jet, using dry compressed air (sealed-in hair sieve)
Ignition does not occur	Spark plug damaged or incorrect gap	Exchange spark plug, or adjust (spark gap: 2. 5 mm)
	Ignition coil faulty, cable to spark plug interrupted, spark too weak	Exchange ignition coil, repair ignition cable
	Breaker point damaged	Exchange complete burner chamber
No air being supplied	Electric contacts for fan damaged or not connected	Tighten connection clamp No. 1 (see wiring diagram), check operating mechanism
	Electric motor faulty	Exchange complete combustion fan unit
Fan does not supply enough air	Intake combustion air is clogged through road dirt	Clean intake
	Exhaust back pressure too high, because of dirt or improper modifications	Clean, remove modification
Heater does not switch off	Incorrect wiring	Electric contact must be made on clamp 3, together with fuel pump and control switch (see wiring diagram)

Deficiency	Cause	Corrective Measures
Fan runs continuously	Improper adjustment of thermoswitch causes fan to run after heater shuts off	Adjust thermoswitch, see S TRA 34
	Fan runs continuously after heater shuts off	Quartz-element of thermoswitch broken, remove thermoswitch, replace quartz-element(see S TRA 34)
Heater aggregate soots, smokes, or works irregularly		
1. Excessive fuel	Fuel jet damaged	Exchange; clean only with compressed air in flow direction. Do not damage sealed-in hair sieve
	Pressure control not properly adjusted	Adjust pressure control. See S TRA 32
2. Lack of combustion air	Battery voltage below prescribed value of 5.8, 5.9 or 11.5 volts	Tighten cable connections, check battery, charge, if necessary
	Intake tube for combustion air clogged	Clean intake
	Fan does not reach prescribed speed of 5000 r.p.m. at correct voltage	Exchange combustion fan unit
	Guide vane housing damaged	Replace heat exchanger
3. Ignition misfires	Spark plug fouled through combustion products, insolation damaged	Clean spark plug, check gap of middle electrode (mean value 2.5 mm), replace, if necessary
	Ignition coil damaged or internal arcing	Replace ignition coil
	Relay jammed (see wiring diagramm relay No. 13)	Replace
Heater fails to start	Fan motor has damaged bearings or windings	Replace complete combustion fan unit, do not attempt disassembly, since the unit has matched on balanced parts
	Diffuser gear is damaged or jammed in the guide vane housing	Replace complete combustion fan
	Breaker point worn or damaged	Replace complete combustion fan, both breaker points are not adjustable (riveted)

Installing Fresh-Air Blower

The Behr fresh-air blower can be installed as special order item in the below listed types of cars:

Coupe	from	Serial No.	117 601
Cabriolet	from	Serial No.	155 601
Karmann Hardtop	in	Serial No.	201 601 - 202 299
Karmann Coupe	from	Serial No.	210 001

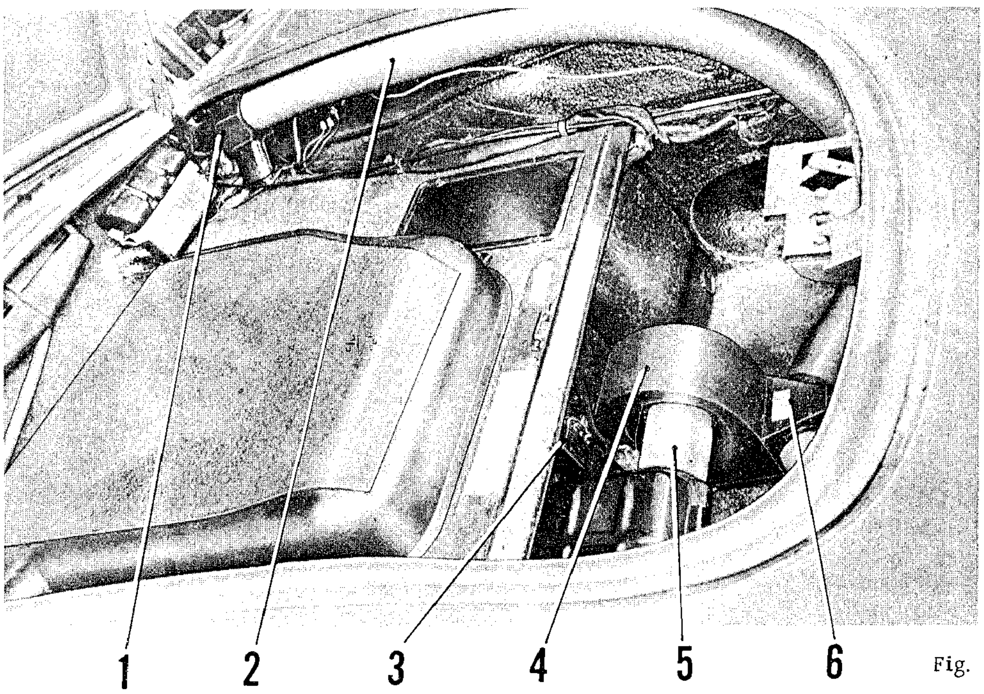


Fig. 1

1 Fresh air duct
2 Flexible hose
3 Relay
4 Blower housing
5 Blower motor
6 Distributing manifold

The radially acting fresh-air blower is being installed in the front compartment behind the spare tire. With the fresh-air blower switched on, fresh air enters through the grill in front of the windshield and is pressed through the distributing manifold into the fresh air ducts via flexible hoses at the right and left compartment side. The fresh air is then conveyed either to the windshield or to the floor by adjustment of the lower lever of the control unit.

The fresh-air blower has 2 control steps and is operated from the instrument panel. It is the same control unit as for the Eberspächer heater.

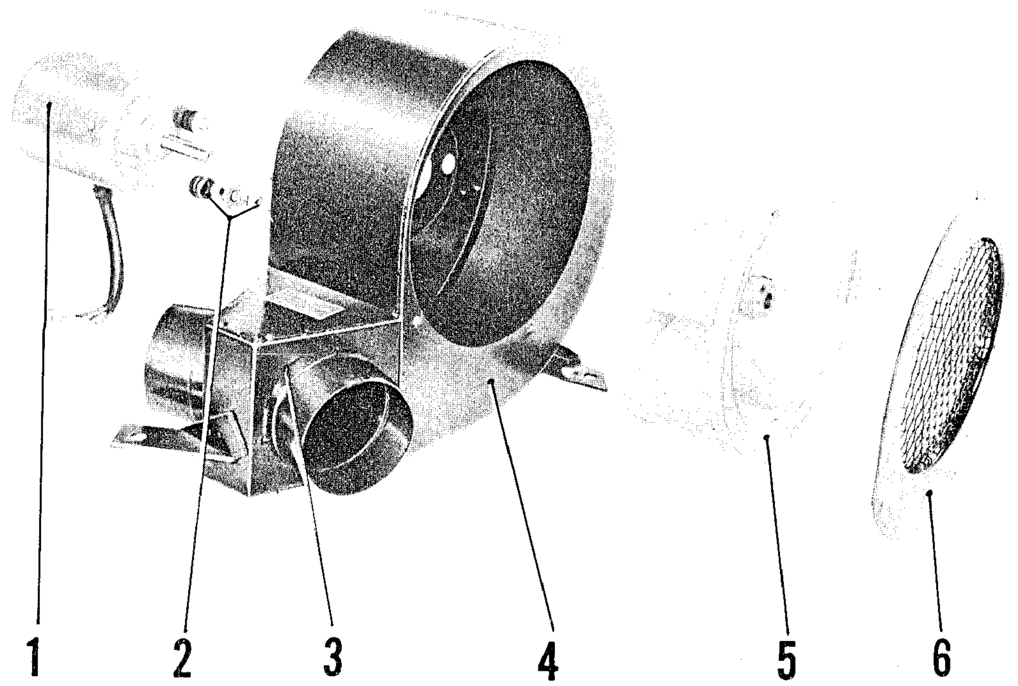


Fig. 2

1 Blower motor
2 Rubber bearing and fastening
3 Distributing manifold
4 Blower housing
5 Blower impeller
6 Cover plate

Operation:

First control step (see Fig. No. 3): Blower impeller rotates at 3000 r. p. m.

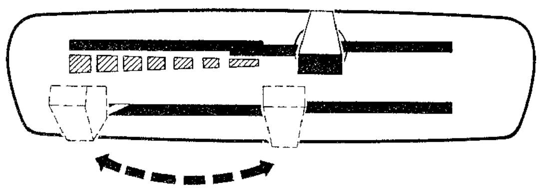


Fig. 3

Second control step: Blower impeller rotates at 4500 r.p.m., current consumption thereby approx. 70 Watt. Highest rate of air flow 2,8 m^3 per minute at 4500 r. p. m.

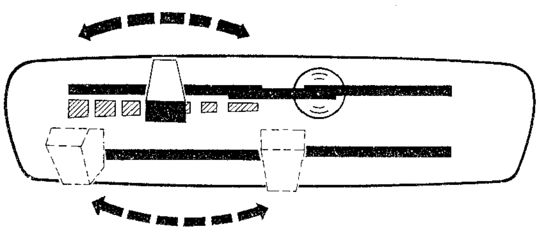


Fig. 4

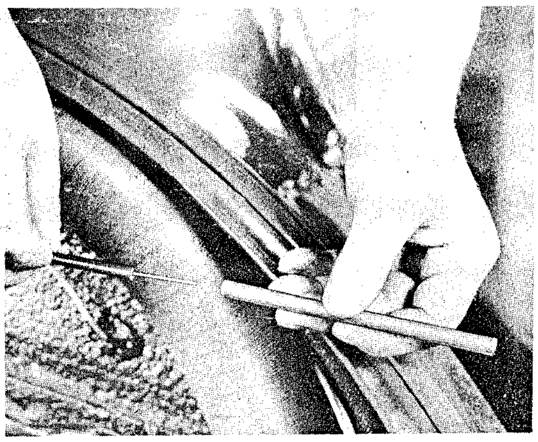


Fig. 5

For the removal and installation of the control unit and the Bowden control adjustment see Supplements Workshop Manual SB 11.

Attention!

The Bowden wire of the control unit, which serves to control the Eberspächer heater, is not necessary for the fresh-air blower. The Bowden wire can be removed or laid parallel to the left Bowden wire along the cable tree. In order to prevent a jamming of the Bowden wire at the envelope's end, a protective tubing must be slid on and fixed by compressing.

10 cm of a fuel pipe would offer a good protection.

Installing Fresh-Air Blower

1. Take out spare tire and remove plastic cover above fuel tank.

2. Mark holes to fix relay support on the rear wall of the front compartment (see Fig. 6) and bore with a 5.5 mm bore.

3. Working from the outside, insert relay support into these holes and mount nuts together with washers and spring rings.

4. Mount relay at the upper supporting stud and in the center of the relay support by means of a 5 mm cheese-head screw, so that the electric relay connections point to the left in driving direction.

5. Tighten the relay.

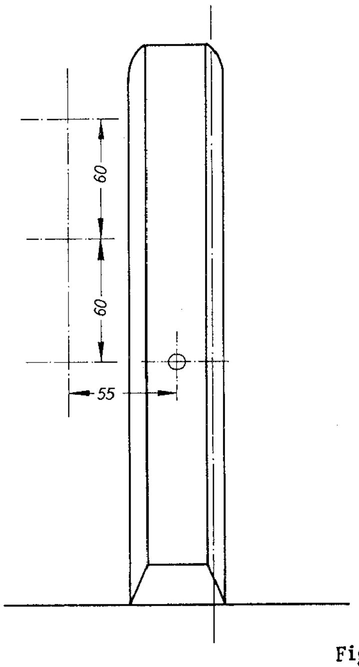


Fig. 6

6. Insert a 3 mm diam. welding wire into the cable tunnel which guides the battery cable to the rear.

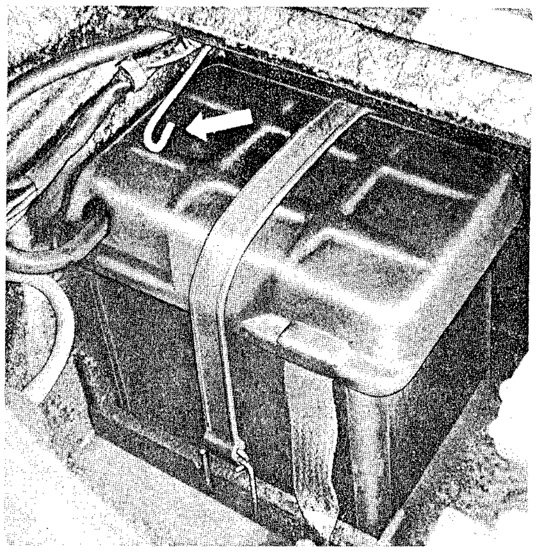


Fig. 7

7. Fasten the cable tree to the welding wire and pull it from the front compartment into the floor compartment.

8. Lay and fix cable tree behind the instrument panel. Slide cable No. 1 (see wiring diagram) into the front compartment, along the main wire loom.

9. Connect cable tree, see wiring diagrams.

10. Mark fixing points for rubber-metal bearings for fresh-air blower (see Fig. 8) and bore with a 6.5 mm bore.

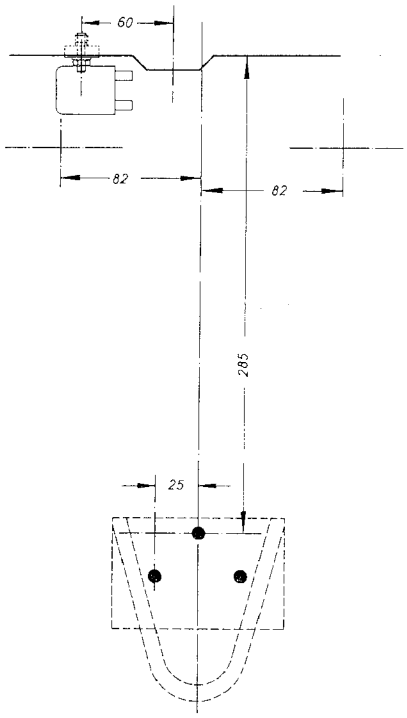


Fig. 8

11. Shorten supporting studs for the two rear rubber-metal bearings by approx. 5 mm.

12. Fix the three rubber-metal bearings with their proper screws onto the fresh-air blower.

13. Insert into bores the fresh-air blower with rubber-metal bearing studs and fix together with washer, spring ring and nut.

14. Connect plug-in connections of the cable tree with engine connection.

15. Slide onto the distributing manifold both elastic hoses and place them along the right and left front compartment side wall.

16. Slide on hose ends at air-inlet of fresh air ducts.

17. Check function of fresh-air blower and fresh air ducts.
See Supplements Workshop Manual SB 9 to SB 11.

18. Reinstall fuel tank cover and spare tire.

Wiring diagram

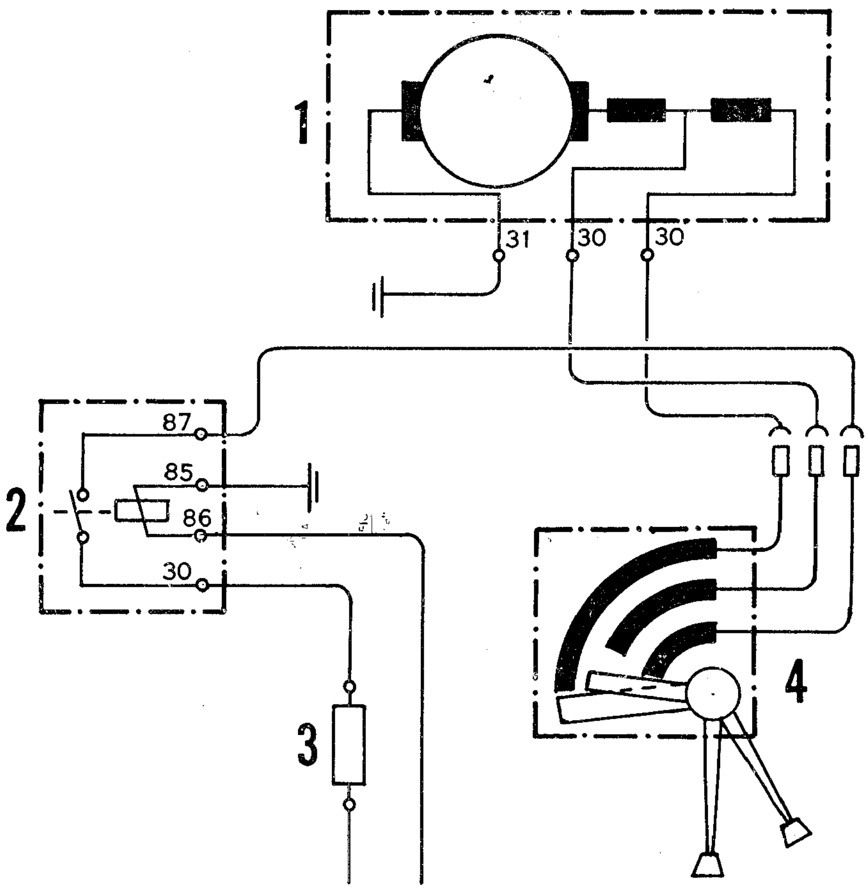


Fig. 9

1 Blower motor
2 Relay
3 Fuse 3 at fuse box
4 Control unit

Cable connections

Cable at plug-in connection of blower motor	brown	blue	black
Cable at cable tree end for blower motor	brown	blue/white	green/white

Cable at plug-in connection of control unit	green/white	blue/white	red/white
Cable at cable tree end for control unit	blue/white	green/white	red/white

Wiring diagram

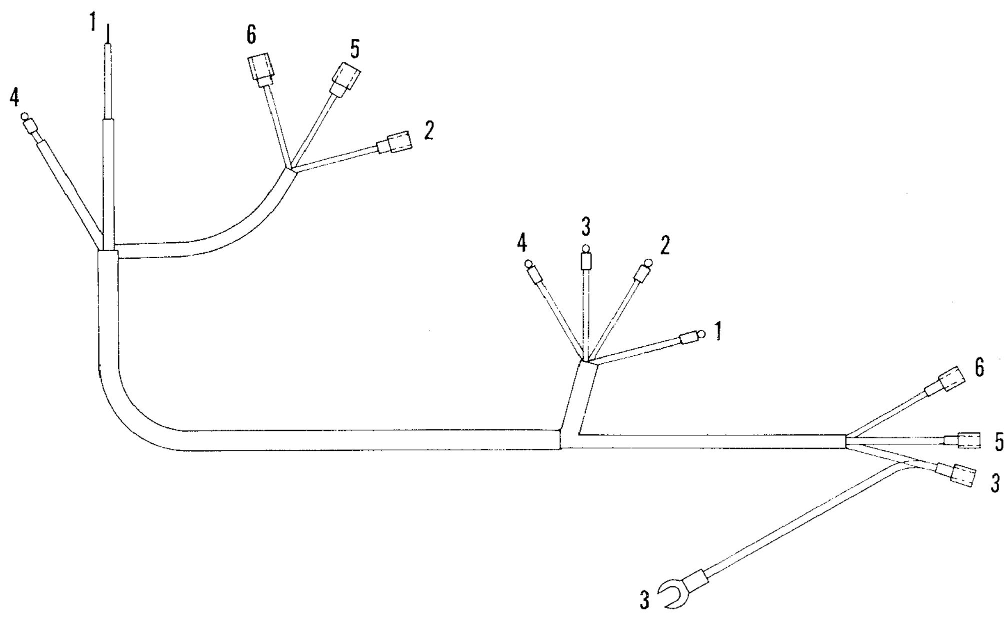


Fig. 10

No.	mm^2	Colour	from	to
1	2,5	red/black	Fuse 3	Relay 30/51
2	2,5	red/white	Control unit	Relay 87
3	2,5	brown	Ground - body	Engine relay 86
4	1	red/black	Ignition starter switch 54	Relay 85
5	1,5	blue/white	Control unit	Blower motor
6	1,5	green/white	Control unit	Blower motor

Subsequent Installation of an Outside/Inside Thermometer

Messrs VDO Tachometerwerke and Moto-Meter offer an outside/inside thermometer for installation.

Following indications are for the installation into vehicles as of

Serial No.	Coupe	117 601
	and	210 601
	Cabriolet	155 601

(On former vehicles without a clock, a 61 mm diam. orifice for the installation of the indicator can be practised in a suitable position on the dashboard.)

General:

The proper function of the outside/inside thermometer depends on the correct installation of the outside sensor. The outside sensor must be fixed in such a way that it is not exposed to the direct air stream or the sun and where it is safe from damage. The inside of the bumper is the most favourable position. The capillary tube from the outside sensor to the indicator must be carefully handled and must not get bent or pulled. Moreover, any contact with current-carrying parts must be avoided.

Installing outside/inside thermometer

(The indicator is to be installed instead of the clock and the clock on the right hand side beside the clove box.)

1. Take out spare tire and disconnect battery.

2. Mark and then practise orifice on the right hand side beside the clove box (see Fig. 1).

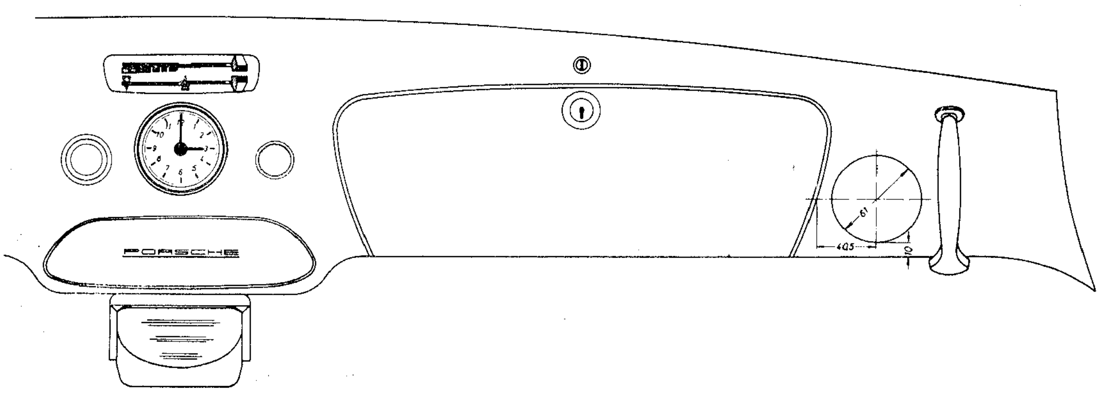


Fig. 1

3. Remove clock and reinstall into orifice beside the clove box. Reposition cables as appropriate.

4. Disconnect battery connecting terminal of cable and pull cable into driver's compartment.

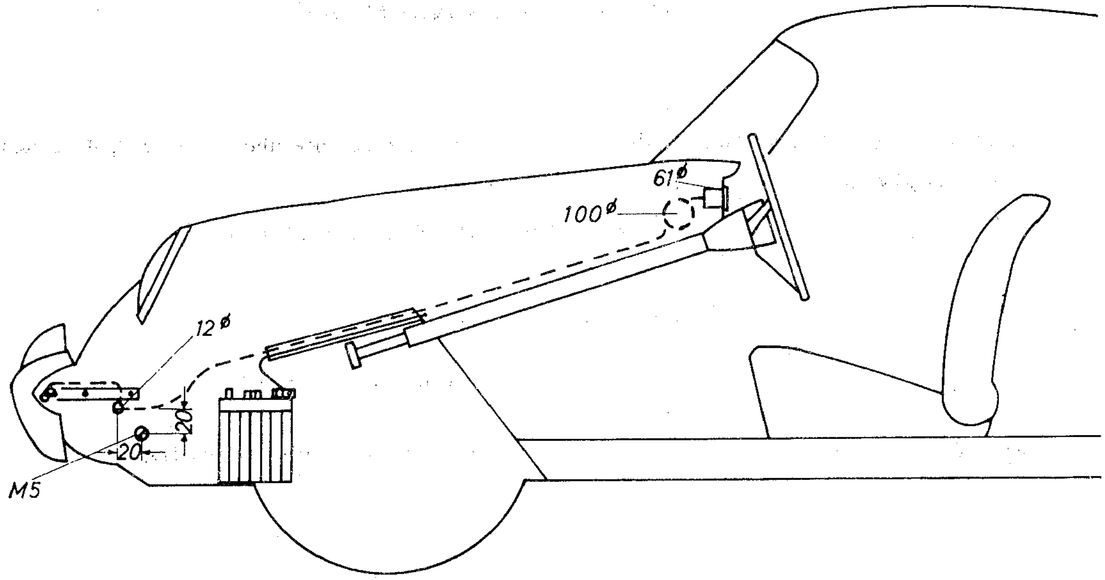


Fig. 2

5. Drill a 12 mm diam. hole into the right panel of the front compartment in front of the battery just above the earthing screw M 5 (see Fig. 2).

6. Guide the outside sensor through the orifice on the dashboard to the right hand side, then via the battery cable tube into the front compartment and through the 12 mm bore down to the bumper.

7. Fix the VDO outside sensor to the studs of the trim strip at the inside of the bumper using the screws showing to the right from the car's middle.

7a. The Moto-Meter outside sensor is best mounted by means of a clip lined with 2 mm thick rubber (see specifications for local manufacture Fig. 3). Fix the clip onto the first screw of the right bumper bracket, seen from the car's middle.

When using this clip a piece of flat steel must be fixed onto the above mentioned screw in order to facilitate the fixing.

8. Properly lay capillary tube from outside sensor over bumper bracket up to indicator.

   Seal 12 mm bore in the front compartment with grommet. Roll up and fix behind the dashboard any possibly remaining capillary tube (see Fig. 2).

9. Connect indicator lamp to circuit of instrument light (58b).

10. Connect indicator warning lamp to ignition/starter terminal 15/54.

11. Pull battery cable back into front compartment and connect.

12. To fix indicator mount clamp bracket from behind and tighten with clamp nuts.

Note: Any inaccurate indication can only be adjusted by the manufacturers or their representatives.

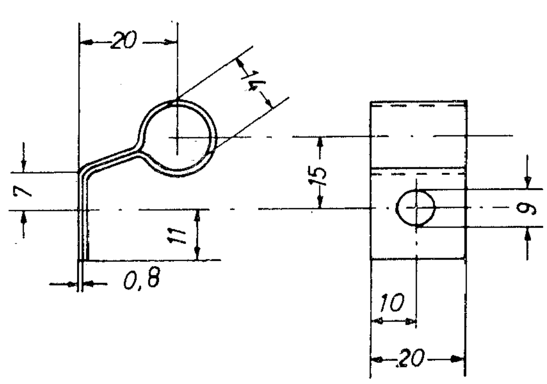


Fig. 3

TRAILER HITCH

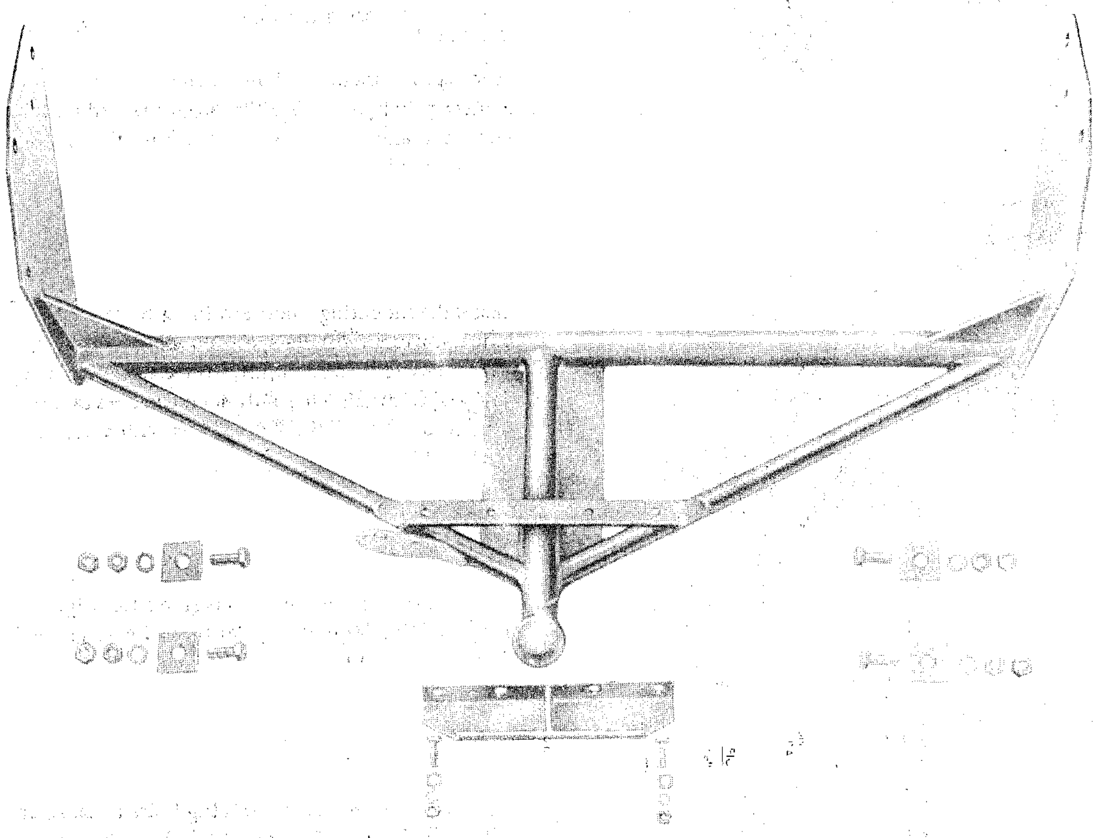


Fig. 1

Installation

1. Loosen bumper bracket retaining bolts at body and bumper.

2. Pull bumper back by about 1/2 inch and detach cable for license plate illumination.

3. Withdraw bumper, together with brackets, from the body.

4. Scrape off undercoating in the areas to be covered by the hitch mounting plate and, on the engine side, where washers will fit, in order to provide a clean, metallic base for mounting.

5. Slide the trailer hitch assembly into place and secure with bumper bracket retaining screws (see Fig. 2 and 3).

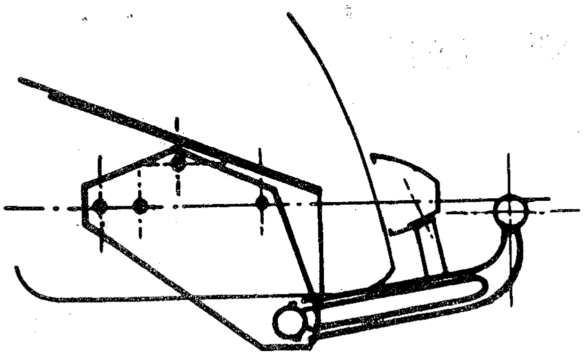


Fig. 2

6. Using an angle-head drill and a short drill bit of 12.5 mm (1/2 inch) diameter, drill the two additional mounting holes by using the mounting plate as guide.

7. Drill the holes on the opposite side of car.

   Note:

   The topmost mounting hole can be marked with a center punch and drilled from within the engine compartment.

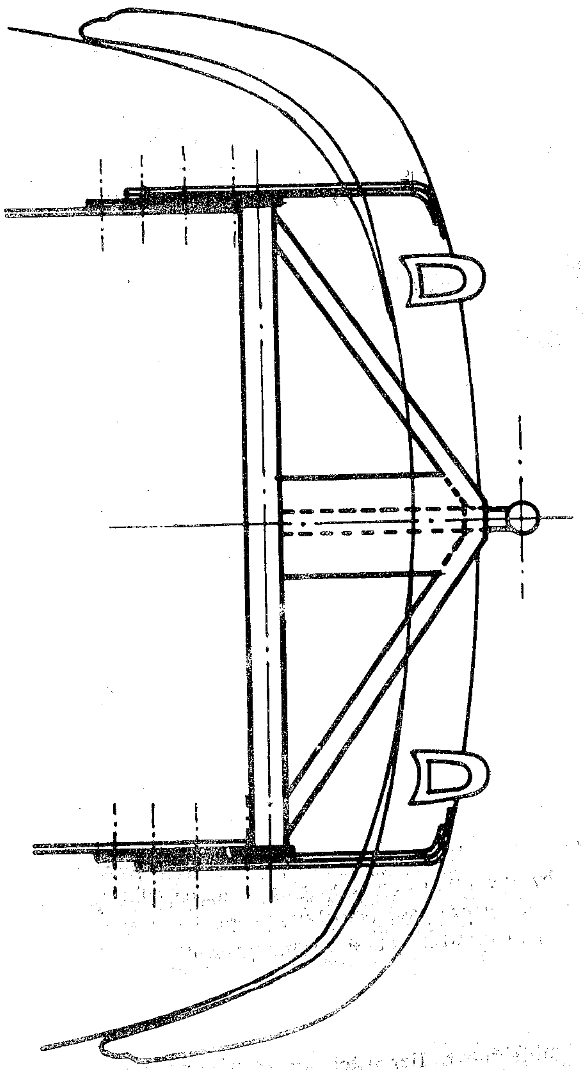


Fig. 3

8. Insert the mounting plate retaining bolts for both sides, together with the large washers which are supplied with the hitch kit, insert lock-washers, and tighten with nuts, then secure with a second nut to lock.

9. Remove bracket retaining bolts (used for aligning plate for drilling).

10. Loosen bumper bracket retaining bolts at bumper and reset brackets by the width of mounting brakket thickness (approx. 5 mm or .2 inch). If necessary, lengthen mounting holes in bumper brakkets.

11. Guide bumpers, together with brackets, into openings in the body. Attach license plate illumination cable according to color code.

12. **Insert bumper bracket retaining screws through holes in brackets, together with washers and lock washers, and align bumper.**

Make sure that the body does not rub against the bumper brackets. If necessary, enlarge bracket holes in the body, repainting worked surfaces to protect against rost.

13. Mark holes for bumper hitch support in bumper and drill to 8.5 mm (.32 in.) diameter.

14. Insert bumper reinforcing plate behind bumper and fasten the hitch support with bolts.

15. Tighten mounting plate and bumper bracket supporting bolts at body and bracket ends in bumper.

16. Install trailer light wiring.

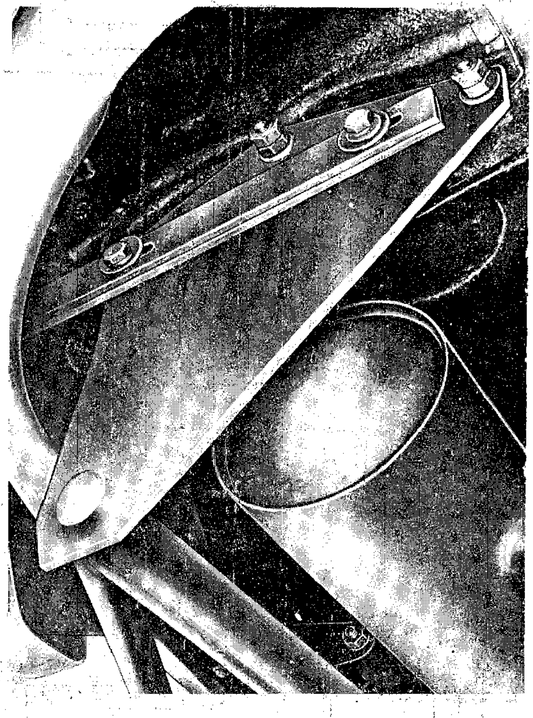


Fig. 4

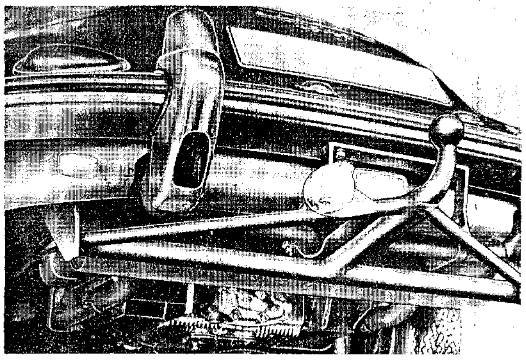


Fig. 5

Trailer Light Wiring

The following outline makes provision for the installation of a separate directional signal (blinker) control lamp on the instrument panel in driver's ligne of sight.

The system includes blinker lights and cable base manufactured by SWF, and the 5-terminal plug and socket by Hella.

It is always possible to utilize components manufactured by other firms.

1. In place of the standard blinker flasher and base with terminal bar, connect the parts 6, 7, and 7a (see Wiring Diagram).
2. Install the separate (additional) blinker control lamp to the left of the combination instrument (see Point 5, Wiring Diagram)
3. The connecting cables for the trailer tail/ stop lights and license plate illumination should be connecting to the appropriate wires in the car, as shown in the Wiring Diagram.

Wiring Diagram

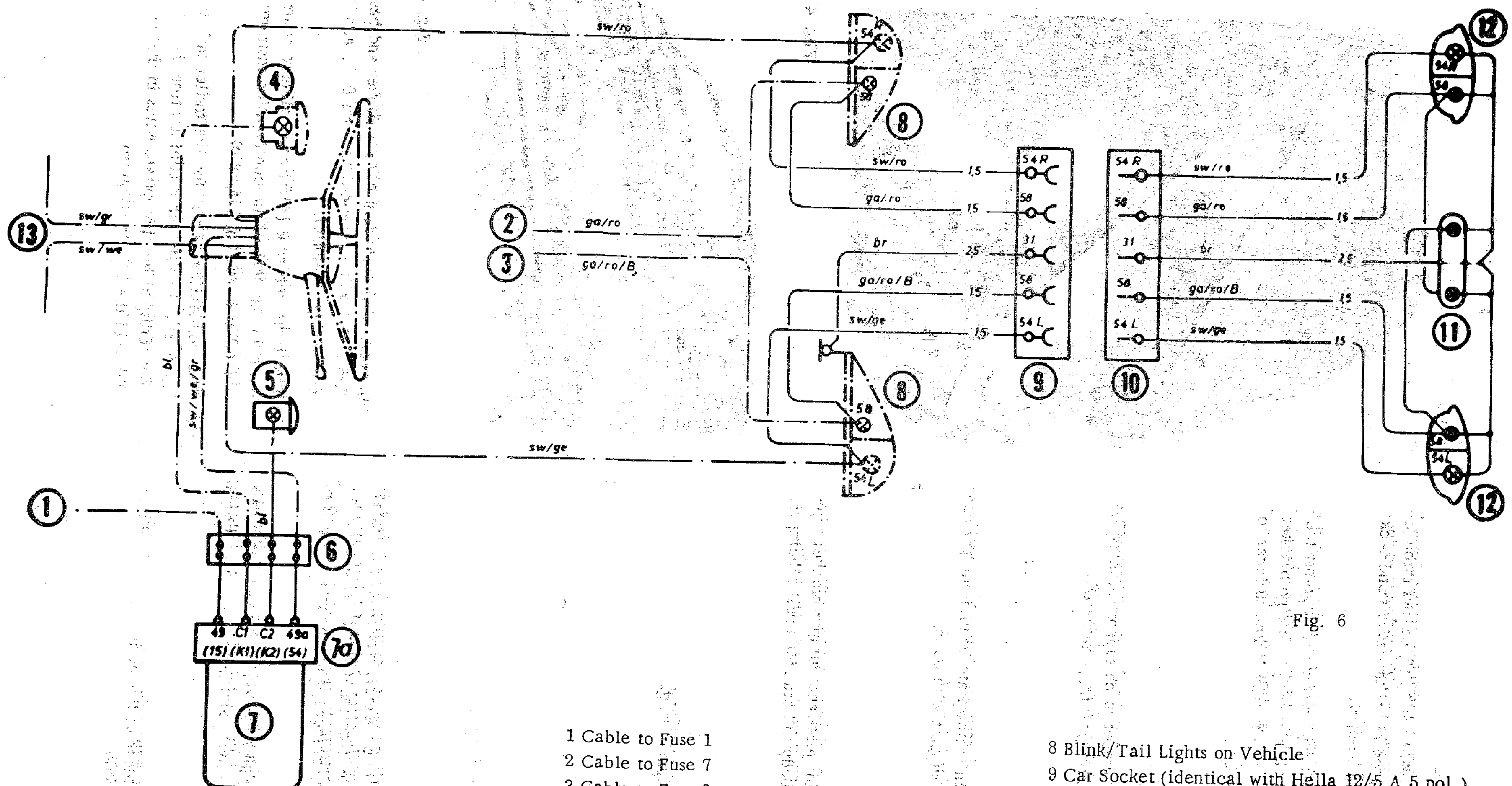


Fig. 6

sw = black
we = white
ro = red
ga = grey
br = brown

ge = yellow
bl = blue
gr = green
B = with identification strip

1 Cable to Fuse 1
2 Cable to Fuse 7
3 Cable to Fuse 8
4 Blinker Control Light in Tachometer
5 Trailer Blinker Control Light (subsequently installed)
6 Terminal Bar (identical with WEKO 404 tr 4 pol.)
7 Blinker Flasher (identical with SWF BGDO 1)
6 Volt = No. 51502
12 Volt = No. 51503

8 Blink/Tail Lights on Vehicle
9 Car Socket (identical with Hella 12/5 A 5 pol.)
10 Trailer Plug (identical with Hella 12/5 B 5 pol.)
11 License Plate Illumination (on trailer)
12 Blink/Tail Lights on Trailer
13 Cables for Forward Blinkers

— · — · — Original Cables in Car
———— New Cables Required