Atlas Copco
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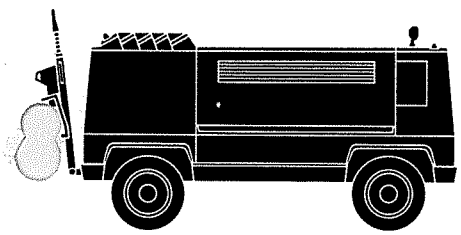

Instruction Book for

Air Partner MAS6 Gd

with General Motors diesel engine

Applies to units from Serial Number ARP 992 000 onwards

ATLAS COPCO AIRPOWER n.v. — B-2610 WILRIJK — BELGIUM

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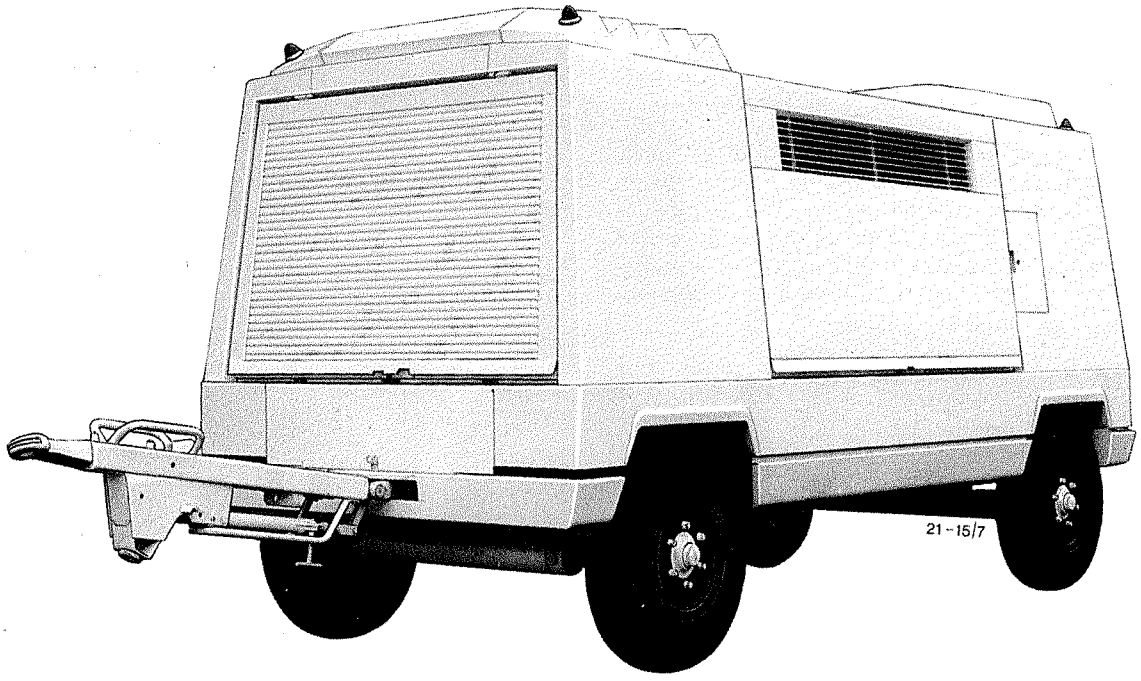
1. Introduction

The Air Partner is designed to start aircraft engines equipped with turbine starters. It can also be used for limited air conditioning, de-icing and checking auxiliary systems.

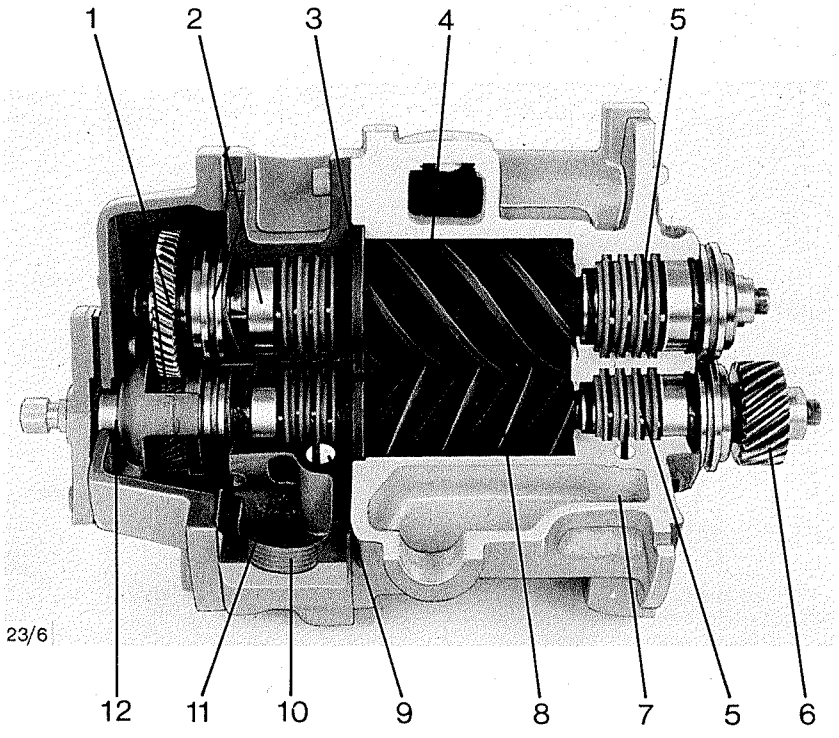
The compressor delivers a continuous non-pulsating flow of warm, completely oil-free and surge-free compressed air, for driving the small high speed turbine starter geared to each jet or turbo-prop engine, the continuous air flow ensuring against mis-starts. As the air is heated by the compression itself, efficient starting is obtained without using a combustion heat exchanger. The oil-free air eliminates fire hazards. For de-icing, the standard connections and outlets of the aircraft are used.

The Air Partner can also be used for most of the aircraft ground checks ; the capacity is sufficient for motoring the engines, thus facilitating these checks.

Contents



General view of unit



1. Timing gears
2. Rotor bearings
3. End plate
4. Female rotor
5. Sealing packages
6. Drive gear wheel
7. Cooling jacket
8. Male rotor
9. Vent-hole, air leak
10. Oil outlet port, element to oil sump
11. Drain hole, bearing oil return
12. Balancing piston

Fig. 1. Cut-away view of a compressor element

2. Leading particulars

2.1 General description

The MAS6 Gd is a portable single-stage rotary screw compressor, driven by a two stroke liquid-cooled diesel engine manufactured by General Motors Corporation.

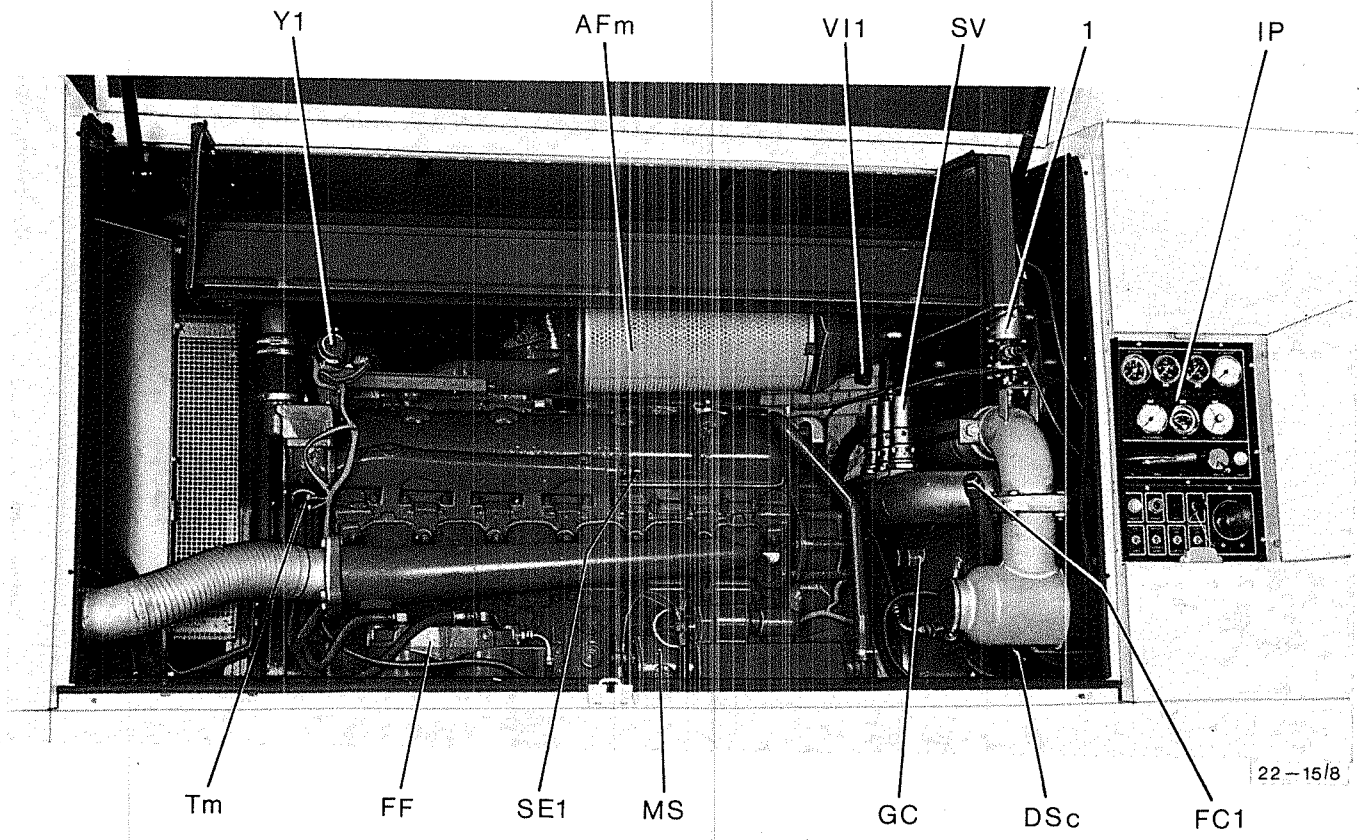
The compressor has two elements of different size, bolted to a common step-up gear casing which also incorporates the compressor oil sump. The engine is directly flanged to the step-up gear casing by means of an adapter housing. The power from the engine is transmitted to the step-up gear shaft through a flexible coupling, ensuring vibration free running.

Each compressor element comprises two screw type precision machined meshing rotors, mounted on ball and roller bearings. The male rotor, driven by the step-up gear, and the female rotor are synchronized through a set of timing gears which maintain the slight clearance provided between the male and female rotor lobes.

The male rotor has four lobes, the female rotor six. The absence of contact between the rotors and also between the rotor crests and the casing, practically eliminates the possibility of wear and power loss.

Oil is used for jacket cooling of the compressor elements, as well as for lubricating the rotor bearings, timing gears, driving and step-up gears.

In order to prevent air and oil leakages along the rotor shafts, sealing rings held in special retainers are fitted on the shafts. The sealing packages located next to the compression space prevent air leakage and those



AFm. Air intake filters, engine
DSc. Compressor oil level dipstick
FC1. Compressor oil filler plug
FF. Fuel filters, engine
GC. Compressor step-up gear casing
IP. Instrument panel
MS. Starting motor assembly
SE1. Sensing element, engine coolant temperature
SV. Safety valves
Tm. Engine temperature safety switch
Y1. Engine stop solenoid
VI1. Service indicator, engine air intake filters
1. Pressure operating valve

Fig. 2. L.H. Side view of compressor/engine unit

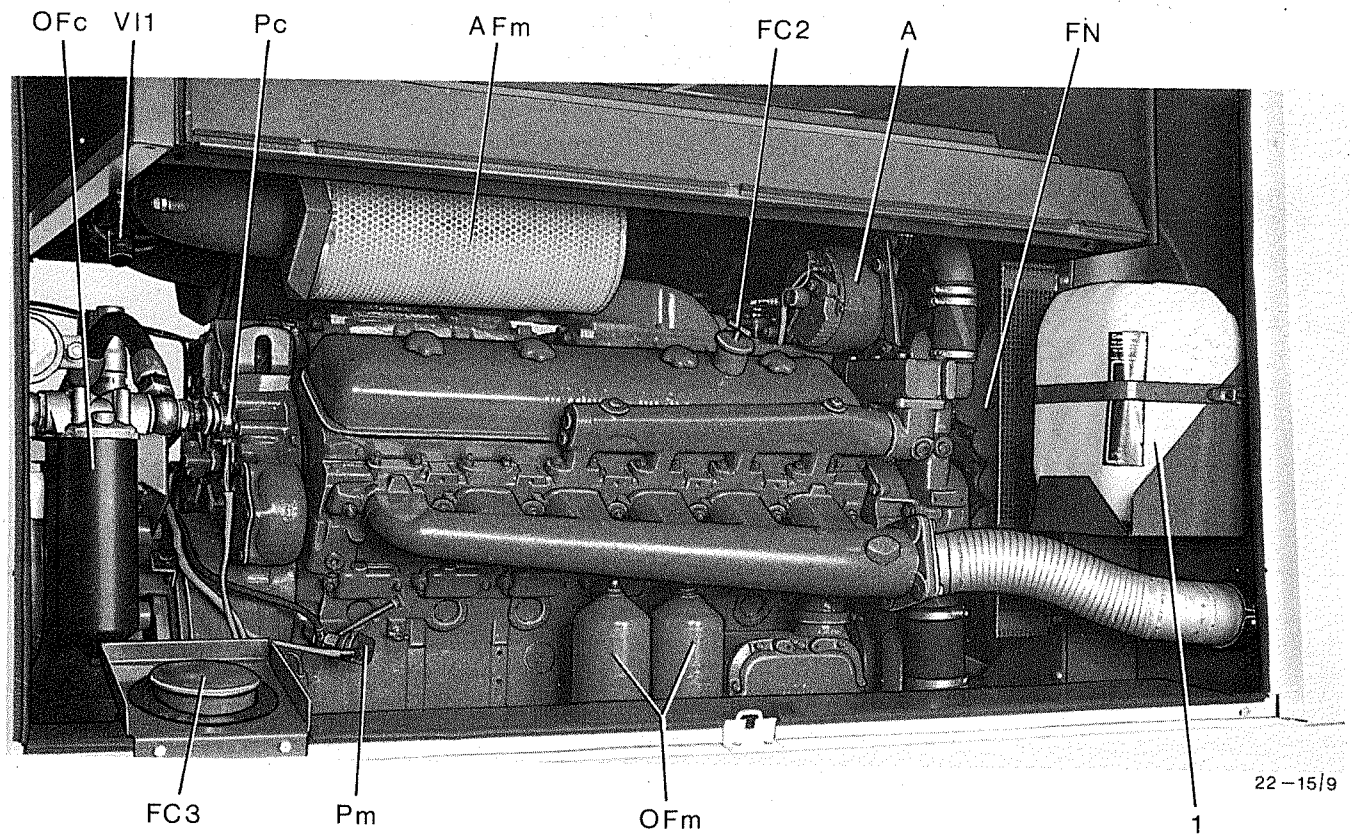
located next to the rotor bearings prevent the lubricating oil from entering the compression space. To avoid penetration of oil into the compression space, drains evacuate any oil that might gather between the oil and air sealing packages.

The air outlet system of the compressor comprises an air delivery manifold with two outlet pipes and three safety valves, a discharge silencer, regulating valve and blow-off silencer. The air pressure is controlled by the regulating valve in conjunction with a pressure operating valve. Shut-off valves are fitted on the outlet pipes.

The compressor/engine unit is enclosed in a modern sectional pressed steel canopy with doors providing easy access for routine operations and normal maintenance. The instrument panel is installed behind a small door at the rear of the L.H. side panel. The complete unit is mounted on a U-beam undercarriage equipped with two torsion bar type axles with independent suspension of each wheel. The four wheels are equipped with pneumatic tyres and run on taper roller bearings. The rear wheels are fitted with a parking brake. The front axle is provided with automotive type steering, adjustable track rods and a hinged drawbar, which can be locked in the raised position. The unit may be equipped with a pneumatic brake system.

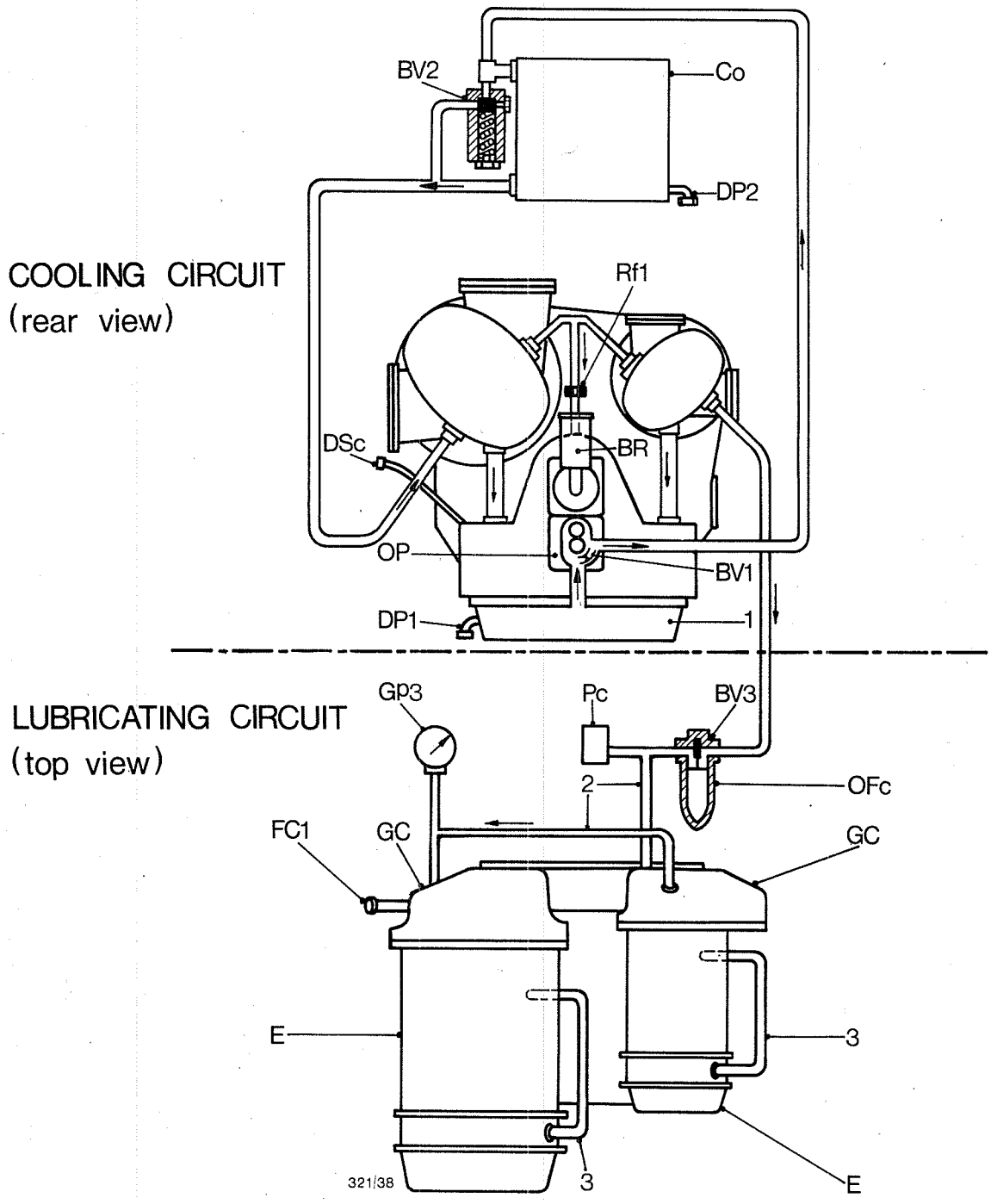
The unit is equipped with a 24V, negative earthed electrical system. Pressure and thermal switches, connected to an engine stop solenoid, safeguard the unit against damage in the event of overheating or oil pressure failure. A selector switch is provided to override the safety switches during starting of the aircraft jet engines.

Two data plates mentioning the type, serial number, maximum permissible working pressure and the maximum operating speed are fitted.



A. Alternator
AFm. Air intake filters, engine
FC2. Engine oil filler cap
FC3. Filler cap, fuel tanks
FN. Cooling fan
OFc. Compressor oil filter
OFm. Engine oil filters
Pc. Compressor oil pressure safety switch
Pm. Engine oil pressure safety switch
VI1. Service indicator, engine air intake filters
1. Radiator overflow tank

Fig. 3. R.H. Side view of compressor/engine unit



BR. Breather
BV1. By-pass valve, oil pump
BV2. By-pass valve, oil cooler
BV3. By-pass valve, oil filter
Co. Oil cooler
DP1. Drain plug, compressor oil sump
DP2. Drain plug, oil cooler
DSc. Oil level dipstick
E. Compressor elements
FC1. Filler plug, compressor oil
GC. Step-up gear casing
Gp3. Oil pressure gauge
OFc. Oil filter
OP. Oil pump
Pc Oil pressure safety switch
Rf1. Flow restrictor
1. Compressor oil sump
2. Oil pipes to front rotor bearings and step-up gears
3. Oil pipes to rear rotor bearings and timing gears

Fig. 4. Oil flow diagram

2.2 Lubrication and cooling oil system (Fig. 4)

The compressor elements are jacket cooled by the oil of the compressor lubricating circuit.

Oil from the sump, located in the bottom of the step-up gear casing (GC), is pumped through the cooling/lubricating system by a gear-type oil pump (OP) mounted on the rear of the step-up gear casing. The pump is driven from the compressor main drive shaft.

The oil is pumped through the fan-cooled oil cooler (Co) to the cooling jacket of the large compressor element and from there to the cooling jacket of the small compressor element. Upstream of the latter, part of the oil is returned to the sump via a flow restrictor (Rf1). From the small compressor element the oil passes through the full flow oil filter (OFc) before entering the oil ducts and hoses of the compressor elements to lubricate the front and rear rotor bearings, step-up and timing gears. The oil then flows back to the sump.

Three by-pass valves protect the oil system against overpressure :

1. One in the oil pump housing (BV1) : it allows oil to by-pass back to the oil sump whenever the maximum permissible pressure is exceeded on the delivery side of the pump.
2. One (BV2) in the oil cooler circuit : it opens when the pressure rise over the cooler is above normal, allowing the oil to be pumped direct through the cooling jackets and oil filter without passing through the oil cooler.

   This happens mainly when starting the compressor from cold in low ambient temperatures to ensure rapid warming of the lubricating oil to the normal working temperature.
3. One (BV3) in the header of the oil filter, which opens when the pressure drop over the filter is above normal due to the clogging of the filter element. The oil is then pumped unfiltered to the lubrication points.

   Regular filter maintenance is therefore imperative, as unfiltered oil can cause excessive wear.

A low oil pressure safety switch (Pc) and an oil pressure gauge (Gp3) are also comprised in the system. A breather (BR) with replaceable elements is fitted on the compressor step-up gear casing.

2.3 Pneumatic system (Fig. 5)

2.3.1 Compressor air flow

Air drawn through the three filter elements (AFc) and air intake chamber (13) into the compressor elements (E) is compressed and discharged through silencer (AS) to the air delivery manifold (AM), and from there either to the atmosphere via regulating valve (RV) and blow-off silencer (BS) or to the aircraft through the shut-off valves (AV) and special hoses.

The regulating valve is pneumatically operated by a pressure operating valve (1).

Air operated balancing pistons (BP) equalize the load on the rear and front thrust bearings of the male rotors. The pistons are actuated by air at working pressure.

The system also comprises :

1. an air pressure gauge (Gp2)
2. three safety valves (SV)
3. a loading control valve (5)
4. an air pressure selector valve (2)
5. a combined air temperature gauge/safety switch (Gt/Tc - Fig. 8).

The loading control valve is operated by the engine speed control lever (7).

The air pressure selector valve enables to select the operational alternative, i.e. low or high air discharge pressure. Low working pressure is used to operate the aircraft airconditioning packs, high working pressure to start the aircraft jet engines.

2.3.2 Regulating system

During operation the air delivery pressure is controlled by the regulating valve and the pressure operating valve.

The function of the regulating devices is :

a. to exhaust to the atmosphere all the air delivered by the compressor during the start-up and idle periods, without appreciable pressure build-up in the air delivery manifold.

b. to maintain a constant working pressure(e) of approx. 3 bar (43.5 psi) or 1.7 bar (25 psi), uninfluenced by variations of the air take-off, providing the air take-off does not exceed the output of the compressor at its rated maximum speed.

Operation

Start-up and idle periods

The engine speed control lever (7) is in the low speed position.

Under this condition :

1. the ports of loading control valve (5) are closed.
2. regulating valve chamber (9) is not yet pressurized.
3. valve (11) is open and allows all the air delivered by the compressor to be discharged to blow-off silencer (BS).

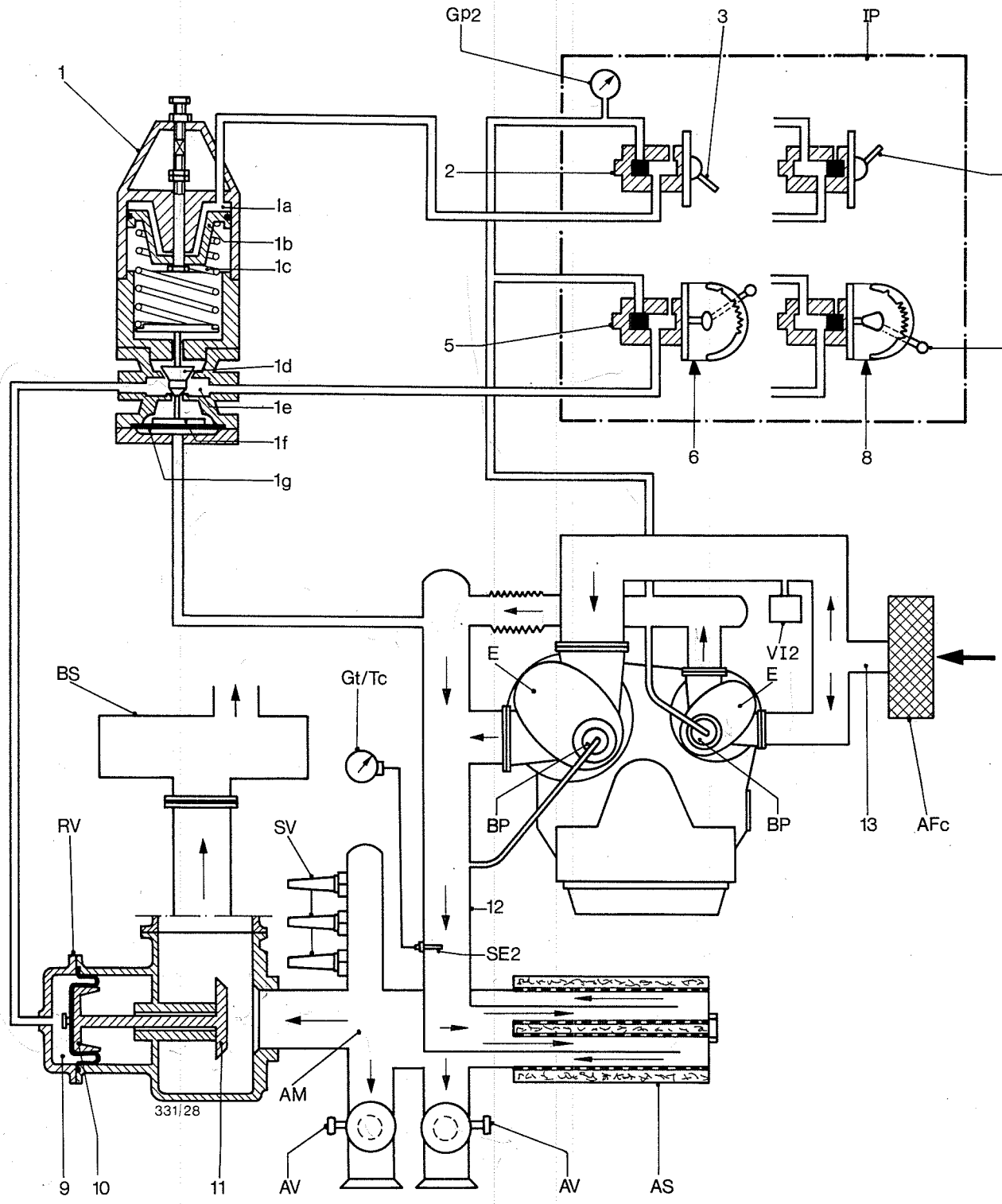
Working periods

After the engine has warmed up, engine speed control lever (7) is moved to the left to increase the speed of the engine. The operating plunger of loading control valve (5) is then depressed by the cam of the lever.

Air pressure selector valve (2) is in the "Low" pressure position.

Under this condition :

1. pressure operating valve chamber (1a) is open to the atmosphere through the air pressure selector valve. Spring (1c) holds valve (1d) on its seats.
2. the ports of control valve (5) being open, air from delivery manifold (12) is fed via pressure operating valve chamber (1e) to regulating valve (RV). The control air at minimum pressure exerts a pressure on



AFc. Air intake filters, compressor
AM. Air outlet manifold
AS. Air silencer
AV. Air outlet valves
BP. Balancing pistons
BS. Blow-off silencer
E. Compressor elements
Gp2. Air pressure gauge
RV. Regulating valve
SE2. Sensing element, compressor air temperature gauge and safety switch (Gt/Tc)
SV. Safety valves
VI2. Service indicator, compressor air intake filters
1. Pressure operating valve
1a. Chamber
1b. Piston
1c. Spring
1d. Valve
1e. Chamber
1f. Plunger
1g. Chamber
2. Air pressure selector valve
3. Low pressure position
4. High pressure position
5. Loading control valve
6. Idle position
7. Engine speed control lever
8. Working position
9. Chamber
10. Piston
11. Valve
12. Air delivery manifold
13. Air intake chamber

Fig. 5. Air flow diagram

diaphragm-sealed piston (10), so that valve (11) starts moving towards its seat. Pressure starts consequently building up in the air delivery manifold, as well as in chamber (1g) of the pressure operating valve.

3. valve (11) continues moving towards its seat until the pressure in chamber (1g) is sufficient to overcome the force exerted by spring (1c) on valve (1d), connected to plunger (1f) by a stem. Plunger (1f) will then open valve (1d) to allow control air to escape to the atmosphere. The pressure of the control air stabilizes, whereby the preset "Low" working pressure in the air delivery manifold is maintained.

When the air pressure selector valve (2) is subsequently switched to "High" pressure (4), the operational condition is then as follows :

4. air at low pressure from the air delivery manifold is admitted to chamber (1a) of the pressure regulating valve via the selector valve.

5. piston (1b) moves and increases the tension of spring (1c). The spring seat pushes down valve (1d) with increased force towards its seats. The pressure in chambers (1e) and (9) increases and causes valve (11) to close further until the pre-set "High" working pressure is reached in the air delivery manifold.

The pressure operating valve is adjusted to maintain the minimum or low working pressure(e) at approx. 1.7 bar (25 psi) and the maximum or high working pressure(e) at approx. 3 bar (43.5 psi).

The safety valves (SV) blow-off if and when the manifold pressure(e) exceeds 3.7 bar (53.5 psi).

2.4 Engine coolant recovery system

The engine radiator is provided with a coolant recovery system, consisting principally of a special radiator pressure cap and a transparent overflow tank (1 - Fig. 3). The system has the advantage of providing a simple visual check of the coolant level and a method of inspecting for small cooling system leaks not readily visible.

The pressure cap comprises a pressure valve and a vacuum valve. It provides for sealing and water flow both in and out of the radiator. The overflow tank is connected to the standard overflow connection on the radiator filler neck by means of a flexible hose. The hose enters the tank at the top and dips into the coolant.

When the engine is in operation, the coolant heats and expands so that it will lift the pressure valve and flow from the radiator top tank to the overflow tank. When cooling, the cooling system will pull a vacuum and coolant will flow in the opposite direction through the vacuum valve. If there are leaks in the cooling system, air will be drawn into the engine during the cooling off cycle instead of coolant from the overflow tank. Thus, by observing that the coolant level does rise and fall in the overflow tank as intended, it can be determined whether or not the cooling system is tight.

If for any reason the system traps air in the space above the radiator top tank baffle, the cooling system can continue to lose water without affecting the level in the overflow tank. For this reason the level in the radiator top tank should be checked occasionally when the cooling system is at ambient temperature.

The overflow tank is marked for maximum and minimum coolant level.

2.5 Electrical system and safety devices (Fig. 6)

The 24V negative earthed electrical system of the engine is adapted to match and integrate the electrical system of the compressor, consisting of an engine safety shut down and a fault indication circuit.

The basic electrical system of the engine comprises :

1. Two 12V batteries, connected in series
2. A starting motor assembly
3. An alternator with built-in voltage regulator and d.c. rectifier
4. An engine coolant low level warning device.

The electrical system of the compressor comprises :

1. Thermal and pressure safety switches
2. An engine stop solenoid
3. An electrical control board
4. An instrument panel with fault indicator lamps.

The alternator is belt driven by the engine. In operating, it supplies direct current to keep the batteries charged to operate the accessories of the unit.

When the starting motor assembly is energized, the starting pinion is engaged with the flywheel ring gear to crank and start the engine. The starting pinion is disengaged when the starting motor is de-energized.

The thermal and pressure safety switches, which are fitted at various points on the engine and compressor, are connected to the engine stop solenoid via the electrical control board, and to the fault indicator lamps on the instrument panel, as well. The switches serve to prevent damage resulting from :

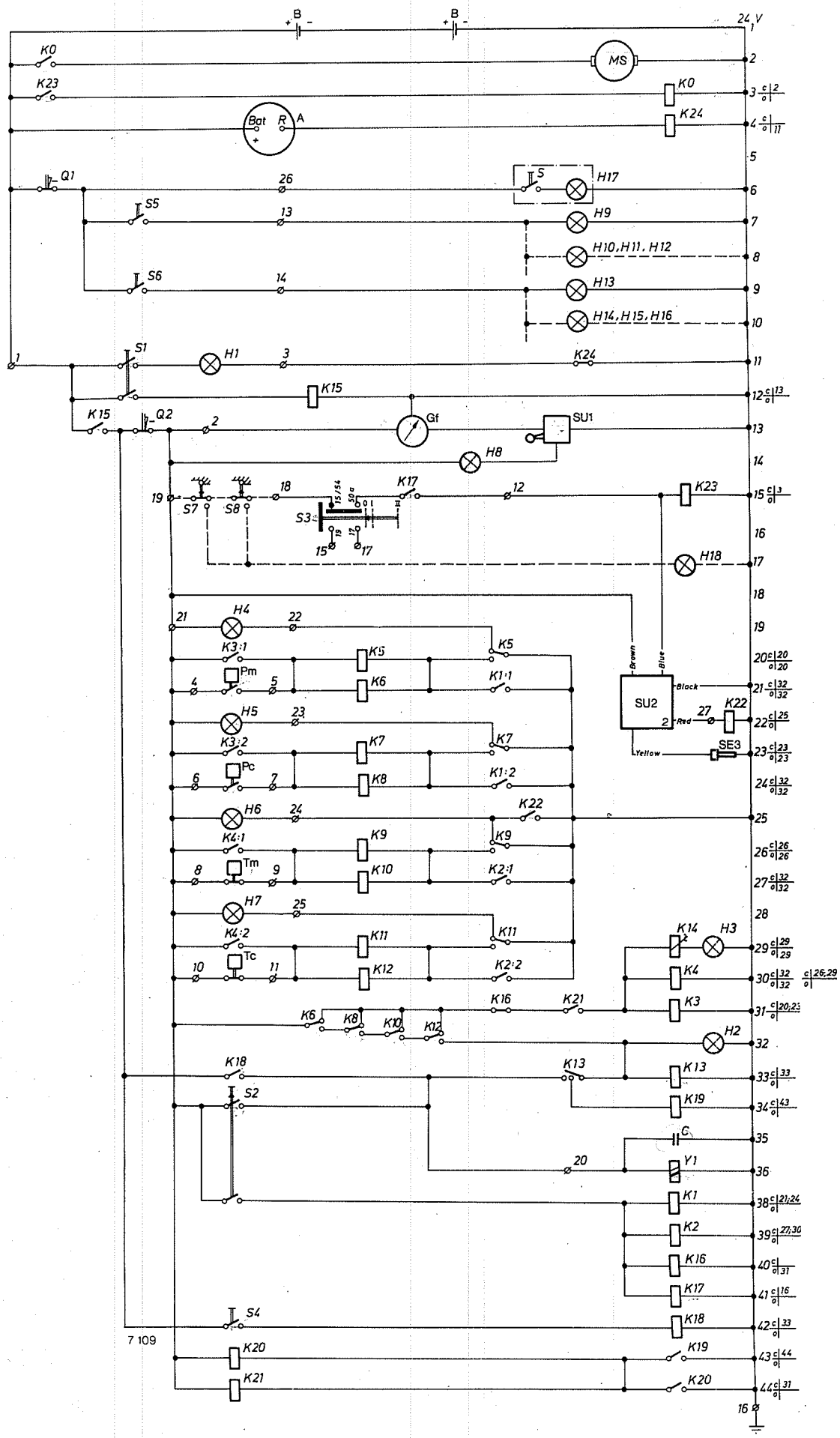
- Low lubricating oil pressures
- High engine coolant temperature
- High compressor air discharge temperature.

The plunger of the stop solenoid is connected to the engine stop lever on the speed governor by means of an adjustable pull-in rod. The solenoid must be energized to run.

If an abnormal temperature or lubricating oil pressure arises while the unit is running with the operating mode selector switch (S4 - Fig. 8) set to "EQUIPMENT", the operative safety switch will break the circuit to the stop solenoid, thus causing the engine to stop and the fault indicator lamp of the switch concerned to light up. With the selector switch set to "AIRCRAFT" the safety circuit is partly overridden. Under this condition the lamp of the operative safety switch will light up, but the engine will not be stopped.

All the instruments, controls and control board are grouped to form a compact single instrument panel (See Fig. 8). The board contains all the relays of the control and safety systems.

The general faults flasher lamp (H3) is connnected through a relay in the circuit of the safety switches. Thus when an abnormal condition arises during operation,


+B -
+B -
24 V
K0
MS
K23
K0
Bat
R
A
K24
Q1
26
S
H17
S5
13
H9
H10, H11, H12
S6
14
H13
H14, H15, H16
S1
H1
3
K24
K15
K15
Q2
2
Gf
SU1
H8
S7
S8
18
15/54
30a
K17
12
K23
S3
19
15
17
H18
H4
21
22
K3:1
K5
K5
Pm
4
5
K6
K1:1
H5
23
K3:2
K7
K7
Pc
6
7
K8
K1:2
H6
24
K22
K4:1
K9
K9
Tm
8
9
K10
K2:1
H7
25
K4:2
K11
K11
Tc
10
11
K12
K2:2
K16
K21
K6
K8
K10
K12
K18
K13
K13
S2
K19
C
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Y1
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K19
K21
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SU2
Brown
Blue
Black
Red
Yellow
27
K22
SE3
K14
H3
K4
K3
H2
1
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3 c|2
4 c|11
5
6
7
8
9
10
11
12 c|13
13
14
15 c|3
16
17
18
19
20 c|20 o|20
21 c|32 o|32
22 c|25 o|
23 c|23 o|23
24 c|32 o|32
25
26 c|26 o|26
27 c|32 o|32
28
29 c|29 o|29
30 c|32 o|32 c|26;29 o|
31 c|20;23 o|
32
33 c|33 o|
34 c|43 o|
35
36
38 c|21;24 o|
39 c|27;30 o|
40 c|31 o|
41 c|16 o|
42 c|33 o|
43 c|44 o|
44 c|31 o|
16

A. Alternator
B. Batteries
C. Capacitor
Gf. Fuel gauge
H1. Alternator charging pilot lamp
H2. Run warning lamp
H3. General faults flasher lamp
H4. Engine oil pressure fault indicator lamp
H5. Compressor oil pressure fault indicator lamp
H6. Engine temperature or coolant low level fault indicator lamp
H7. Compressor temperature fault indicator lamp
H8. Fuel low level warning lamp
H9. Position light
H10. Position light
H11. Position light
H12. Position light
H13. Instrument panel light
H14. Instrument panel light
H15. Interior light
H16. Interior light
H17. Spotlamp
H18. Air shut-off VALVES open warning lamp
K1. Auxiliary relay (N.O.), safety circuits
K2. Auxiliary relay (N.O.), safety circuits
K3. Auxiliary relay (N.O.), safety circuits
K4. Auxiliary relay (N.O.), safety circuits
K5. Blocking relay, H4 lamp circuit
K6. Blocking relay, RUN lamp circuit
K7. Blocking relay, H5 lamp circuit
K8. Blocking relay, RUN lamp circuit
K9. Blocking relay, H6 lamp circuit
K10. Blocking relay, RUN lamp circuit
K11. Blocking relay, H7 lamp circuit
K12. Blocking relay, RUN lamp circuit
K13. Blocking relay, engine stop solenoid
K14. Flasher relay
K15. Auxiliary relay, run circuit
K16. Auxiliary relay, flasher circuit
K17. Auxiliary relay, start circuit
K18. Auxiliary relay, safety system overriding circuit
K19. Auxiliary relay, flasher circuit
K20. Blocking relay, flasher circuit
K21. Auxiliary relay, flasher circuit
K22. Auxiliary relay, engine coolant level sending unit
K23. Start relay
K24. Charge indication relay
Pc. Compressor oil pressure safety switch
Pm. Engine oil pressure safety switch
Q1. Thermic release switch (5 A), light circuits
Q2. Thermic release switch (10 A), general circuit
S1. Contact switch
S2. Safety system overriding push button
S3. Starter switch
S4. Equipment/Aircraft starting selector switch
S5. Switch, position lights
S6. Switch, instrument panel and interior lights
S7. Limit switch, air outlet valve
S8. Limit switch, air outlet valve
SE3. Sensor, engine coolant low level
SU1. Sending unit, fuel gauge
SU2. Sending unit, engine coolant level sensor
Y1. Engine stop solenoid

Fig. 6. Electrical circuit diagram

attention is attracted immediately by the flasher lamp and as there is a marker between the fault indicator lamps and the panel gauges, the source of the trouble can easily be spotted.

The engine temperature fault indicator lamp (H6) is also connected to the engine coolant low level warning device. In addition to its normal function, the lamp also lights up if and when the coolant in the engine radiator should drop to too low a level. Under this condition, the flasher unit will then however not be activated, nor the engine be stopped. If the warning is ignored and the condition allowed to worsen to the point that the engine shut down temperature is reached, the flasher unit will be activated, and the engine stopped through the action of the engine temperature safety switch.

The warning lamp (H18) of the air shut-off valves is connected through limit switches (S7 and S8) to the starting circuit. The switches are actuated by the operating levers of the valves. The engine cannot be started unless the valves are closed. During operation, the warning lamp lights up as soon as one of the valves is opened.

Override button (S2) is used to temporarily "by-pass" the engine and compressor oil pressure switches during starting, as their contacts are normally open when the engine is at rest and the oil pressures zero. They close when the pressures are normal. The switches should be overridden until RUN warning lamp (H2) lights up, which indicates that the oil pressure switches have closed.

Thermic release switch (Q2) cuts out if an overload occurs in one of the safety circuits. However, if it cuts out with the operating mode selector switch (S4) set to "Aircraft" the engine will continue to run. Thermic release switch (Q1) safeguards the light circuits. The switches can be reset ,after a short period of cooling off ,by pressing their push button.

The control board can easily be removed for checking and inspecting the relays. All the wires of the electrical system are coloured for identification. The wires to and from the safety switches and accessories served and governed by the control board are grouped in wire harnesses and a terminal block attached to the rear panel of the board.

2.5.1 Operation, wiring diagrams and trouble shooting

A Service Bulletin, Printed Matter No. 80500, dealing with the above mentioned subjects is available on request.

2.5.2 Location and function of the safety switches

(see table on next page)

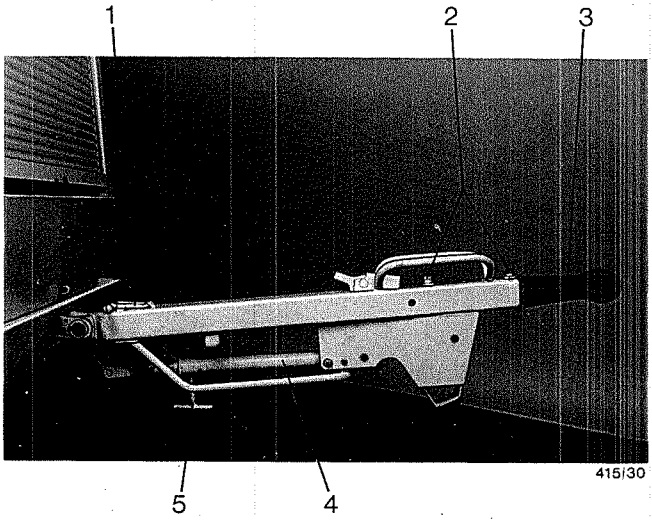
It is assumed that the Equipment/Aircraft starting selector switch (S4) is set to "Equipment".

Switch			Compr. oil pressure	Compr. temperature	Engine oil pressure	Engine temperature
Location			On oil filter outlet piping	Air delivery manifold	Rear of crankcase below last cylinder	Cooling water outlet manifold
CONTACT	Unit at rest	Open	•		•	
		Closed		•		•
	Unit running	Open				
		Closed	•	•	•	•
Setting value		Breaks at	Oil pressure(e) below 0.52 - 0.72 bar (7.5 - 10.5 psi)	Air temperature above 240°C (464°F)	Oil pressure(e) below 1.2 - 0.8 bar (17 - 11 psi)	Engine temperature above 96°C (205°F)
		Makes at	Rising oil pressure		Rising oil pressure	
Result			Engine stops	Engine stops	Engine stops	Engine stops
Fault indicator lamps lighting up			H5-H3	H7-H3	H4-H3	H6-H3

Note : If the engine has been stopped through the action of a safety switch, the fault must first be traced and remedied before a new starting attempt is made.

3. Operating instructions

For easy lifting and attaching the unit to the towing vehicle, the drawbar is equipped with a lockable weight compensator (See Fig. 7). The lock must be released after the unit has been attached to the towing vehicle and before driving off.



1. Lock for securing drawbar in raised position
2. Grease nipples
3. Towing eye
4. Weight compensator
5. Lock, weight compensator

Fig. 7. Drawbar

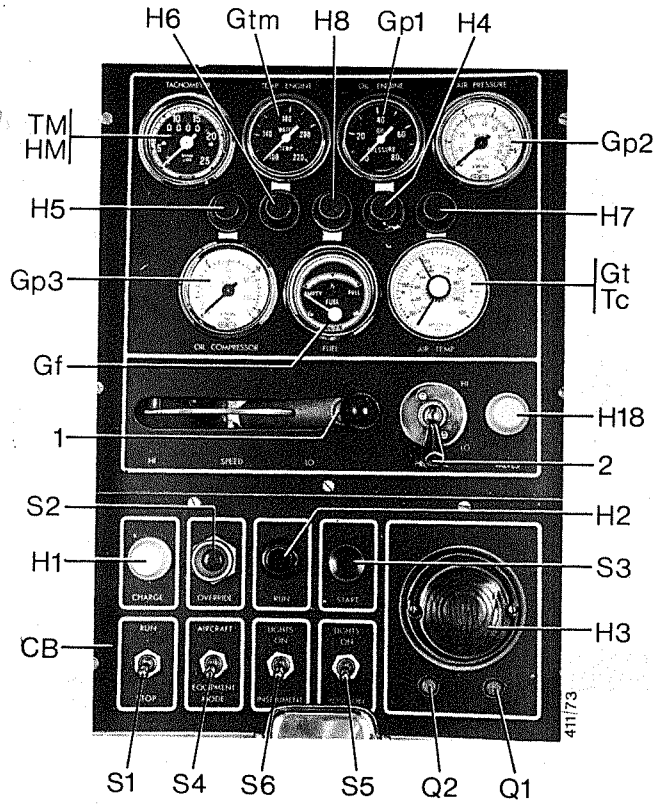
Before driving off, always ascertain that the parking brake (2 - Fig. 9) has been released.

3.1 Before starting

1. Carry out or see that the daily maintenance instructions have been carried out.

3.2 Starting (Fig. 8)

1. Check that engine speed control lever (1) is in the low speed or idle position, i.e. the pawl of the speed control lever engaged in the first tooth of its rack (See Fig. 17).
2. Flick operating mode selector switch (S4) to position EQUIPMENT starting. The engine safety shut down system is thus operational.
3. Set the lever of compressor HIgh-LOw air pressure selector valve (2) to LOw pressure.
4. Check that the levers of the air shut-off valves (AV - Fig. 9) are pushed against their perpendicular stop. Thus the valves are closed, as well as the valve limit switch contacts (S7-S8) in the starting circuit.
5. Flick contact switch (S1) to RUN, and check that the yellow alternator charging pilot lamp (H1) and the four red fault indicator lamps (H4, H5, H6 and H7) are alight. Air valves open warning lamp (H18) should be out.



CB. Electrical control board
Gf. Fuel gauge
Gp1. Engine oil pressure gauge
Gp2. Air pressure gauge
Gp3. Compressor oil pressure gauge
Gtm. Engine coolant temperature gauge
H1. Alternator charging pilot lamp (yellow)
H2. Run warning lamp (green)
H3. General faults flasher lamp (red)
H4. Engine oil pressure fault indicator lamp (red)
H5. Compressor oil pressure fault indicator lamp (red)
H6. Engine temperature or coolant low level fault indicator lamp (red)
H7. Compressor temperature fault indicator lamp (red)
H8. Fuel low level warning lamp (red)
H18. Air valves open warning lamp (yellow)
S1. Contact switch
S2. Safety system overriding push button
S3. Starter switch
S4. Operating mode selector switch
S5. Switch, position lights
S6. Switch, illuminating lights
Gt/Tc. Compressor air temperature gauge and safety switch
TM/HM. Tachometer and hourmeter, engine
Q1. Thermic release switch, light circuits
Q2. Thermic release switch, general circuit
1. Engine speed control lever
2. Air pressure selector valve

Fig. 8. Instrument panel and control board

If there is less than approx. 180 litres (47 US gal.) of fuel in the tanks, the red fuel low level warning lamp (H8) also lights up.

6. Press and hold OVERRIDE button (S2) depressed, and check that the engine and compressor temperature fault indicator lamps (H6 and H7) are out.

7. Fully pull out START knob (S3) to engage the starting motor.

   Release the knob as soon as the engine fires. The knob must then return to its neutral position by spring pressure, thus disengaging the starting motor.

   Do not hold the starting motor engaged for more than 10 seconds at a time to avoid overloading the batteries and starting motor. Always allow the engine to come to rest before re-engaging the starting motor. Wait a few minutes between each starting attempt. If the engine fails to start after three to four starting attempts, determine the cause and take remedial action before making further starting attempts.

   Starting at ambient temperatures below 5°C (40°F) requires the use of a cold weather starting aid (Consult Engine Operators Manual).

8. Release OVERRIDE button (S2) immediately after the engine and compressor oil pressure fault indicator lamps (H4 and H5) have gone out, and the green RUN warning lamp (H2) is alight. The lightening of this lamp indicates that the engine and compressor oil pressure safety switches have closed.

   Operators are warned not to keep the OVERRIDE button pressed in longer than 20 seconds, as otherwise the engine or compressor may be seriously damaged.

9. Check that CHARGE lamp (H1) is out. This indicates that the alternator is charging the batteries.

10. When the engine has been running 30 seconds at low idle speed (approx. 950 r/min), move speed control lever (1) to the left and set its pawl in the second tooth of the rack. The engine speed should then be approx. 1100 r/min. Allow the engine to run at this speed for approx. 5 minutes in order to warm up.

    During the warming up period carefully inspect the unit for fuel, oil or coolant leaks. Also check :

    a. the engine oil pressure(e) (Gp1), not less than 1.7 bar (25 psi). Normal operating pressure should be higher.

    b. the engine coolant temperature (Gtm), which should be approx. 82°C (180°F).

    c. the compressor oil pressure(e) (Gp3). The average pressure(e) should be 1.1 bar (16 psi) ; the minimum safe pressure(e) is approx. 0.7 bar (10 psi).

11. When the engine has warmed up sufficiently, move the engine speed control lever gradually further to the left. With the lever in the utmost HIgh position the engine speed should be approx. 2100 r/min. and the air pressure(e) registered on gauge (Gp2) 1.7 bar (25 psi). When the lever of the compressor pressure

selector valve (2) is switched from LOw to HIgh a pressure(e) of 3 bar (43.5 psi) should read on gauge (Gp2).

The maximum permissible operating time at continuous operation is one hour at 3 bar (43.5 psi) or four hours at 1.7 bar (25 psi).

If a malfunction occurs the unit will shut down, unless the lever of selector switch (S4) is placed in the AIRCRAFT position.

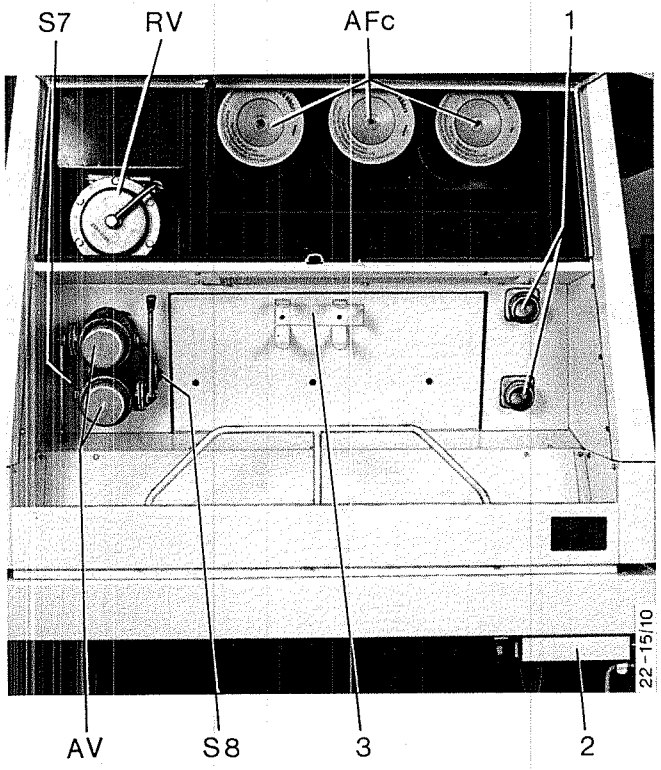
Caution : Never open the air shut-off valves when the unit is operating and while the air delivery hoses are folded up in the stowing compartment and connected to the valves. Always lay out the hoses straight before opening the valves.

3.3 Stopping (Fig. 8)

1. With the lever of pressure selector valve (2) in the LOw position, slowly move the speed control lever (1) to the right to bring the engine speed to approx. 1100 r/min. Allow the engine to run at this speed for four to five minutes to permit temperatures to equalize ; do not stop the engine directly from full load.
2. Move the speed control lever to the low idle position. Wait for about 30 seconds before stopping the engine.
3. Place contact switch (S1) in the STOP position to shut down the engine.

3.4 Equipment/aircraft starting (Fig. 8)

1. See that the Air Partner is warmed up and ready for service. Park the unit near the aircraft. If the towing vehicle is disconnected, apply the parking brake.
2. Connect the air delivery hose(s) to the air intake point(s) on the aircraft. Lay out the hose(s) without straining ; eliminate sharp bends and taut conditions.
3. Start up the engine and increase its speed to approx. 1100 r/min. Run the unit at this speed until it has reached its operating temperature.
4. Ascertain that air pressure selector valve (2) is in the LOw pressure position, i.e. the position for operating the aircraft airconditioning packs, and that operating mode selector switch (S4) is in the EQUIPMENT position.
5. Check that all temperatures and pressures are normal.
6. Increase the engine speed to above 1400 r/min.
7. Fully open the air shut-off valve(s) (AV - Fig. 9). The yellow VALVES warning lamp (H18) lights up and remains alight as long as one of the shut-off valves is open.
8. Adjust the engine speed between 2100 - 1200 r/min. to maintain the working pressure(e) at 1.7 bar (25 psi) and warn the pilot that the aircraft airconditioning packs can be operated.



AFc. Air intake filters, compressor
AV. Air outlet valves
RV. Regulating valve
S7. Valve limit switch
S8. Valve limit switch
1. Holders for aircraft side hose couplings
2. Parking brake
3. Clamp; fire extinguisher

Fig. 9. Rear view of Air Partner (fire extinguisher and optional air delivery hoses not shown)

9. Upon signal from the pilot, flick operating mode selector switch (S4) to position AIRCRAFT. Subsequently place the lever of air pressure selector valve (2) in the HIgh position, and adjust the position of the speed control lever to maintain the working pressure(e) at 3 bar (43.5 psi).

   General recommendations

   a. Keep a constant check on the air pressure gauge (Gp2) during operation. Adjust the engine speed to maintain the specified working pressure, but do not exceed the maximum permissible speed of 2100 r/min.

   b. Advise the pilot to avoid starting the next jet engine before the cut-off speed is attained on the engine being started, as otherwise there will be a drop in the working pressure, which will affect the acceleration of the engine to be started.

   c. If any of the fault indicator lamps and the flasher lamp on the instrument panel light up during the aircraft engine starting operation, **the starting routine must not be interrupted in order to avoid a so called "hot start" of the jet engine being started.**

10. When the aircraft starting routine is completed, set the lever of the air pressure valve to LOw, decrease

the engine speed to 1100 r/min, flick the operating mode selector switch to EQUIPMENT and close the air shut-off valve(s).

11. Shut down the engine after the cooling off periods as specified under "Stopping" have been observed.

12. Disconnect the air delivery hose(s) from the aircraft. Fold up the hose(s) in the stowing compartment.

4. Maintenance

4.1 Preventive maintenance schedule for the compressor

The maintenace schedule below contains a summary of the maintenance instructions.

The inspections are cumulative, i.e. items on the 10 hour inspection schedule should be included on the 50-60 hour inspection schedule, etc.....

The maintenance intervals are given as a guide. They can be adapted to coincide with the maintenance schedule of the engine and/or maintenance routines practiced by the user.

Refer to the Engine Operators Manual for particulars of engine maintenance.

Daily

1. Check the level of the coolant in the overflow tank (1 - Fig. 3) of the engine radiator, which should be at or slightly below the MAX. mark. Remove the siphon hose from the tank and add coolant, if necessary.

   Always use a clean soft water and rust inhibitor solution in the cooling system (See Engine Operators Manual). If the engine will be exposed to freezing temperatures a protective solution consisting of a high boiling point type ethylene glycol anti-freeze is to be used. Follow the makers recommendations, for the amount of anti-freeze to be used in relation to the capacity of the cooling system and the prevailing weather. Have a ready mixed stock of anti-freeze solution available for topping-up purposes.

2. Check the level of the engine oil. Add oil, if necessary, to bring the level to the upper mark on the dipstick. Consult the Engine Operators Manual for the type and viscosity grade of the engine oil.

3. Check the oil level in the compressor sump. Add oil, through pipe (FC1 - Fig. 2), if necessary, to bring it to the proper level on the dipstick (DSc - Fig. 2). Consult section "Lubrication" for the correct type of oil to be used.

4. If the unit has been standing idle for several days, or if operated in a warm climate, check the electrolyte level in the batteries. Top up, if necessary, with distilled water to just above the top of the lead plates. Check the battery terminals for cleanness and tightness.

5. Check the contents of the fuel tanks. Fill the tanks at the end of the day's run. This helps prevent moisture in the air from condensing on the inside walls of the tanks and contaminating the fuel with water.

   To check the contents, flick the contact switch (S1 - Fig. 8) to RUN and read the level on the fuel gauge (Gf - Fig. 8). Top up with a reputable brand of the proper diesel fuel oil (See Engine Operators Manual). Flick the contact switch to STOP after checking or filling.

   After filling the tanks for the first time, or if the tanks have been allowed to run dry, vent the fuel injection system as per instructions given in the Engine Operators Manual.

6. Check the compressor and engine air intake filter service indicators. If the red part is showing in the perspex window of an indicator, service the five filter elements.

Every 10 hours of operation or weekly

1. Clean down the unit. Inspect for fuel, oil or coolant leaks.

2. Check the electrolyte level in the batteries. Check the battery terminals for cleanness and tightness.

3. Check the pressure of the tyres. Check and tighten the wheel nuts to the specified torque after the first 50 Km (30 miles) travel and subsequently at regular intervals.

4. Check that the pressure operating valve and the regulating valve maintain the pre-set operating pressures. Before doing so, and as a safety precaution, lay out the air delivery hoses in a relaxed manner.

Every 50-60 hours of operation or monthly

1. Check the coolant level in the engine radiator top tank. Clean the pressure cap.

2. Clean and inspect the air intake filter elements. If the unit is operated in a dust-laden atmosphere the filter elements should be cleaned more frequently.

3. Drain any water or sediment which may have collected in the fuel tanks. Drain until clean fuel flows from the drain cock of each tank.

4. Lubricate the ball- and -socket joints of the engine stop solenoid operating rod, door hinges and locks, etc....

5. Check the condition and tension of the engine fan belts. Adjust the tension, if necessary. Replace the belts if they are worn or frayed.

6. Check the condition of the air delivery hoses.

7. Check the fire extinguisher. See that the seal is intact. Follow the instructions given on the data plate attached to the extinguisher.

8. Check that the fault indicator lamps on the instrument panel are operative. Replace any defective bulbs.

Note : The first renewal of the compressor lubricating oil and of the compressor oil filter element is to be

made after the first 50 hours of operation. Subsequent oil and oil filter element renewals are to be made after every 500 hours of operation or yearly.

Every 150-180 hours of operation or half-yearly

1. Grease the towing eye shaft, drawbar to steering gear shaft, steering gear, wheel axles and brake cables. Use graphite grease for the brake cables.
2. Remove and grease the Bowden cable connecting the speed control lever to the engine governor with graphite grease.
3. Inspect the exterior of the radiator and compressor oil cooler cores.

   Remove any accumulated dust and dirt with a stiff-fibre brush. Never use a wire brush or metal objects.

   If the dirt is of an oily nature and cannot be removed by air jet, or if compressed air is not available, clean the cores with a quality grease solvent. A spray gun should preferably be used to apply the solvent to the cores. Rinse with a powerful water jet and blow dry with compressed air, if available. Repeat the process as many times as necessary.

   Another method of cleaning the cores is the use of steam or a steam cleaning device, if available. Protect the electrical and regulating components during steam cleaning.
4. Check the specific gravity of the electrolyte solution in all battery cells with a hydrometer, then refer to the maker's instruction label attached to each battery to determine the condition of the batteries.

Every year or 500 hours of operation

1. Renew the compressor and engine air intake filter elements.
2. Drain the lubricating oil from the compressor sump and oil cooler while the unit is thoroughly warm. Drain plugs (DP1 and DP2 - Fig. 4) are provided on both these components for that purpose. Securely tighten the plugs after draining.
3. Renew the compressor oil filter element.
4. Refill the sump to the upper mark on the dipstick with fresh oil of the correct type and viscosity grade (See "Lubrication"). Start the unit and run it for a few minutes, and check the oil level again. Top up, if necessary.
5. Clean the breather of the step-up gear housing.

   Remove the breather, dismantle it and wash the two steel mesh pads in diesel fuel oil or some similar cleaning solvent. Wash the sinter bronze filter disk in trichlor-ethylene. Dry the parts with compressed air, reassemble and reinstall the breather on the pipe.
6. Remove and inspect the rubber diaphragm of the balancing piston (BP - Fig. 5) of each compressor element. Also inspect the rolling diaphragm of the regulating valve.
7. Dismantle, clean and inspect the parts of the pressure operating valve.
8. Test the safety valves.
9. Test the safety switches.
10. Check the greasing of the suspension wheel bearings.

Engine fuel filters (FF - Fig. 2)

The absolute necessity of regular fuel filter maintenance as laid down in the Engine Operators Manual is hereby specially stressed. Clogged fuel filters mean fuel starvation and reduced engine performance.

The condition and the quality of the fuel determine the frequency of filter renewals.

4.2 Lubrication

4.2.1 Engine

The manufacturer recommends oils meeting the requirements of the U.S. Military Specifications MIL-L-2104B/1964 MS or the American Petroleum Institution CC/SC.

Consult the Engine Operators Manual for the viscosity recommendations and engine oil change intervals.

4.2.2 Compressor

The same additive type "Heavy Duty Lubricating Oil" as specified for the engine should be used for the compressor.

The SAE viscosity grade should be selected according to the ambient temperature and as shown in the following table.

Ambient temperature consistently	Viscosity grade
above — 10°C (14°F)	SAE 20W/20
below — 5°C (23°F)	SAE 10

Never use the SAE 30 or SAE 40 engine oil for the compressor or SAE 20 W/20 for the engine.

4.3 Storage

If the unit is to remain idle for a long period of time, the oil film on the moving parts should be renewed once a week by running it until it is thoroughly warm. This will circulate the oil and prevent rusting from condensation. Load the unit a few times during running in order to operate the regulating components. Make sure that the air valves are closed.

If it is not possible to run the unit from time to time during the storage period, protective measures must be taken as described in Service Bulletin, Printed Matter No. 80500. This bulletin can be obtained on request.

5. Adjustments and servicing procedures

5.1 Pressure operating valve (Fig. 10)

The pressure operating valve has three chambers (5, 17 and 24) and consists of a valve housing (21) and a cylinder (29) with spring housing (26). The valve housing comprises a membrane sealed plunger (15) and a valve (25) ; the cylinder and spring housing comprises an "O" ring-sealed piston (7) and a spring (27) with spring seat (9).

The piston has a normal stroke or travel of approx. 41 mm (1 5/8"). The plunger, valve and spring seat are mounted on a common stem and guided in dry low-friction type bushes. The valve is loaded by the spring through the spring seat.

The tension of the spring can be adjusted by means of adjusting screw (1) and the piston stroke by means of adjusting nuts (3) provided on the piston rod.

The operation of the pressure operating valve is as described in section 2.3.

Plunger (15) is so designed that if membrane (19) were to tear or rupture, sufficient sealing will remain between the plunger and its bore. Thus the air pressure on the plunger will not decrease, resulting in pressure increase in the air delivery manifold.

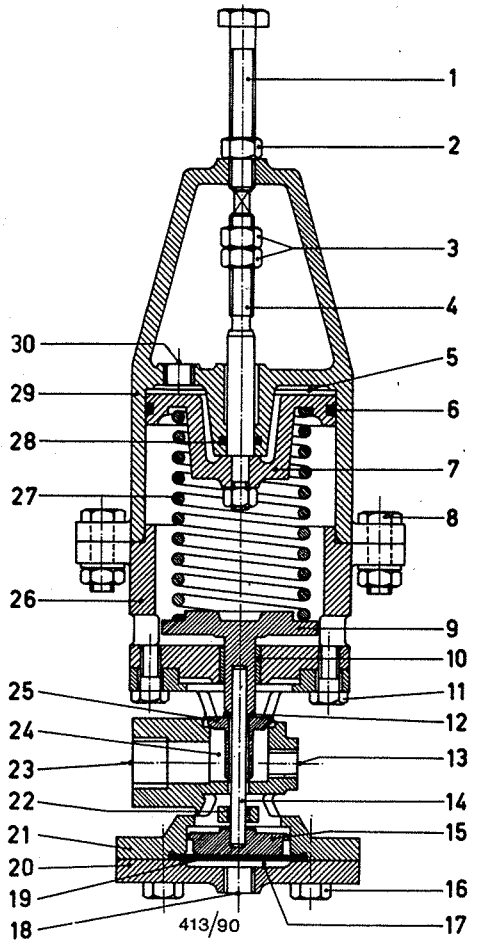
5.1.1 Adjustment

As can be noted from section 2.3 the pressure operating valve does control :

a. the minimum or low working pressure(e) in the range of 1.2—3 bar (18—43.5 psi).

b. The maximum or high working pressure(e) in the range of 2.2—3 bar (32—43.5 psi).

The low working pressure is determined by the tension of spring (27). This tension can be increased to raise the pressure and decreased to lower the pressure, by screwing adjusting screw (1) in or out. This screw is locked by check nut (2).
The high working pressure is determined by the stroke or travel of piston (7). This stroke can be increased to raise the pressure and decreased to lower the pressure, by loosening and screwing up or down adjusting nuts (3). Lock the adjusting nuts on the piston rod after adjustment. Holding the piston rod is imperative when loosening and locking the adjusting nuts.



1. Adjusting screw, "Low" working pressure
2. Check nut
3. Adjusting nuts, "High" working pressure
4. Piston rod
5. Chamber
6. O-ring
7. Piston
8. Bolt
9. Spring seat
10. Guide bush
11. Setscrew
12. Ring
13. Connection to air delivery pipe via loading control valve
14. Stem
15. Plunger
16. Setscrew
17. Chamber
18. Connection to air delivery pipe
19. Membrane
20. Cover
21. Valve housing
22. Guide bush
23. Connection to regulating valve
24. Chamber
25. Valve
26. Spring housing
27. Spring
28. O-ring
29. Cylinder
30. Connection to air pressure selector valve

Fig. 10. Pressure operating valve

5.1.2 Maintenance

The pressure operating valve should be dismantled, cleaned and inspected for wear or damage at least once a year. For dismantling and reassembling proceed as follows :

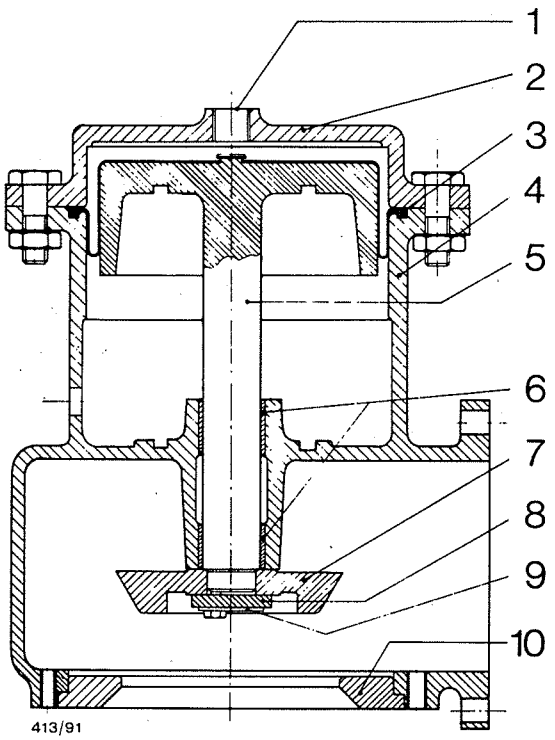
1. Disconnect the three hoses from the operating valve and remove the latter from the air delivery pipe.
2. Unscrew adjusting screw (1) until piston (7) butts against its stop in the cylinder. Remove the two bolts (8) and separate cylinder (29) and spring housing (26). The cylinder is spring loaded and must be held while the bolts are being removed.
3. Remove the setscrews (11) and lift off valve housing (21) complete with stem (14) and valve (25).
4. Take off the nuts (3) from the piston rod, withdraw the piston from the cylinder and remove the "O" rings (6 and 28).
5. Remove the setscrews (16) and lift off cover (20). The membrane, plunger, valve and stem can now be removed from the valve housing. Discard the membrane and the "O" rings.

6. Thoroughly clean all the parts taking care not to damage the piston or the cylinder bore. Never use abrasive materials on these latter items. If the bushes in the valve and spring housing need replacing, they should be pressed out with a suitable tool.
7. Fit new "O" rings on the piston and in the cylinder, and using Molykote MoS2 Super S or SS assembly paste lubricate lightly the "O" rings, piston rod, cylinder bore and the valve stem.
8. Reassemble the operating valve in reverse order of dismantling. Use a new membrane (19) and take care that ring (12) is correctly installed between the valve and the spring seat. Renew the "O" rings in the fittings of the pipe that connects the operating valve to the air delivery pipe.
9. Install the operating valve on the air delivery pipe, reconnect the flexible hose, test run and adjust the low and high working pressures as required.

5.2 Regulating valve (Fig. 11)

The regulating valve consists of a diaphragm - sealed piston, and a valve with seat. The ram or piston is guided in dry low-friction type bushes. This feature ensures long service life without lubrication or adjustments.

When rolling diaphragm (3) has to be serviced, the following instructions apply for dismantling and reassembling :



1. Connection to pressure operating valve
2. Cover
3. Rolling diaphragm
4. Valve housing
5. Piston
6. Bushes, dry low-friction type
7. Valve
8. Disk
9. Lock plate
10. Valve seat

Fig. 11. Regulating valve

1. Disconnect the flexible hose from cover (2).
2. Remove the six setscrews securing cover (2) to housing (4) and lift off the cover.
3. Remove the rolling diaphragm from the piston.
4. Lightly smear both sides of the new rolling diaphragm with Molykote MoS2 Super S or SS assembly paste and install it with its woven side over the piston, taking care that the diaphragm centre hole fits snugly over the boss on the piston top.
5. Carefully tuck the diaphragm into the annular space between the piston and its bore in the housing with a suitable wooden spatula (thickness 2 mm = .08", width 10 mm = .40"). All the sharp edges of the spatula should be broken in order to avoid damaging the diaphragm.
6. Insert the bead of the diaphragm correctly in the groove provided for that purpose in the flange of the housing.
7. Reassemble in reverse order of dismantling.

5.3 Air intake filter elements

The compressor is equipped with three, the engine with two air intake filter elements of the cartridge dry replaceable paper type. Maximum protection against wear due to the ingression of dust is only possible if the cartridges are serviced or renewed at regular intervals. Periods between servicing operations depend upon the working conditions.

A service indicator is fitted on the air induction system downstream of each filter set. The indicators show red when the cartridges are due for servicing. After servicing, the indicators can be reset by pushing the small knob located in the extremity of the indicator body.

5.3.1 Recommendations

1. For minimum compressor down time, replace the dirty cartridges by new or cleaned ones.
2. If the engine service indicator is showing red, also service the compressor filter cartridges and vice versa.
3. Never replace the cartridges while the unit is running.
4. Service the compressor and engine filter cartridges every month ; replace them at least once a year.
5. Discard the cartridges when damaged or torn.

5.3.2 Servicing

1. Remove the filter cartridges from the compressor and engine.
2. Using a damp cloth, clean down the front panel of the compressor air intake suction chamber, on which the cartridge sealing surfaces bear, taking care that no dirt drops inside the chamber.
3. Clean the cartridges as follows : carefully knock the end surfaces on a flat surface, e.g. the palm of a

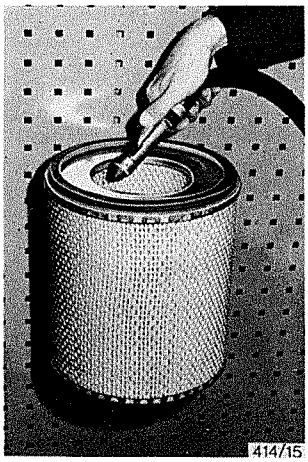


Fig. 12. Cleaning the cartridge by air jet

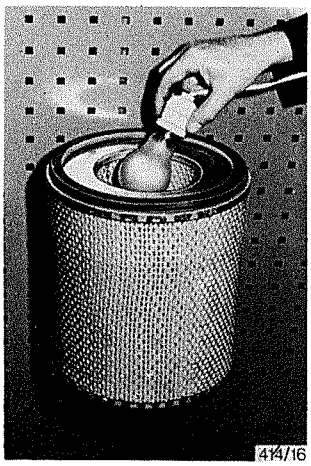


Fig. 13. Inspecting the cartridge

hand or a car tyre. This will remove much of the heavy dry contaminant. Then blow dry air up and down the **inside** of the cartridges (Fig. 12), subsequently blow up and down the length of the pleats on both sides of the cartridges.

The air pressure(e) may not exceed 5 bar (73 psi) and a reasonable distance must be maintained between the hose nozzle and the pleats.

If the contaminant is of an oily nature, the cartridges can be washed in lukewarm water in which a non-foaming detergent, such as MANN 053, is dissolved. Rinse the cartridges thoroughly with soft water and let them dry after cleaning. Do not heat the cartridges to hasten drying.

The cartridges may be cleaned 5 times, whereafter they have to be discarded.

4. Inspect the cleaned cartridges for damage by placing a bright light inside them (Fig. 13). Thin spots, pin holes or the slightest rupture of the paper render the cartridges unfit for further use. New cartridges must also be inspected for tears or punctures before they are installed.
5. Install the cleaned or new cartridges into place.
6. Inspect and tighten all the connections of the air intake induction systems. Watch all connections for mechanical tightness. In case of leakage and if adjustment does not correct the trouble replace the necessary parts or gaskets.

5.4 Compressor oil filter (Fig. 14)

The oil filter assembly of the compressor comprises an element mounted on an adapter head.

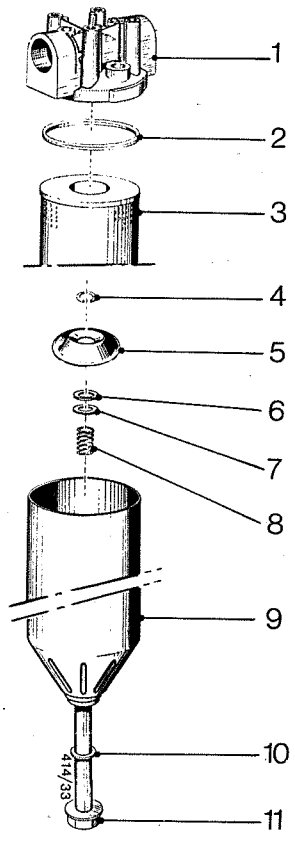
Service the oil filter as follows :

5.4.1 Dismantling

1. Place a drain pan under the filter, unscrew through-bolt (11), remove bowl (9) and withdraw filter element (3).
2. Remove circlip (4) from bolt (11) and withdraw guide (5), gasket (6), washer (7) and spring (8). The through-bolt together with gasket (10) can now be removed. A method to remove the circlip is to hit the bolt at its threaded end with a hide or plastic hammer.
3. Inspect the element when the filter is serviced after every 500 hours of operation. Retain the element unless it is covered with sludge. Never attempt to clean the element. Discard the element after every 1000 hours of operation.
4. Rinse the bowl and all other filter parts in a suitable cleaning solvent and blow dry by air jet. Clean the filter adapter and bowl mounting recess, and inspect the gaskets. Renew the gaskets if they are hardened or damaged.

5.4.2 Reassembly

1. Place gasket (10) on the bolt and insert the latter in the bowl.
2. Place spring (8) on the bolt, then washer (7), gasket (6), guide (5) and secure by fitting circlip (4).
3. Place the retained or new element in the filter bowl. Fit the retained or new gasket (2) to the adapter head.
4. Position the filter bowl on the adapter recess and tighten the through-bolt finger tight. Rotate the bowl slightly, right and left, to be sure it is properly seated and draw up the through-bolt tight.



1. Adapter head with by-pass valve
2. Gasket, adapter head
3. Element
4. Circlip
5. Guide
6. Gasket, element
7. Washer
8. Spring
9. Bowl
10. Gasket, bolt
11. Through-bolt

Fig. 14. Oil filter

5.5 Adjustment of the engine stop solenoid linkage (Fig. 15)

The engine stop solenoid (10) has a pull-in winding and a hold-in winding. When current is supplied both windings are energized and plunger (7) is drawn into the core of the solenoid against the pressure of return spring (9). As the plunger nears the end of its stroke it operates a set of contacts which open to cut off the current supply from the pull-in winding. Current supply is continued to the low power hold-in winding to keep the solenoid in the operated condition.

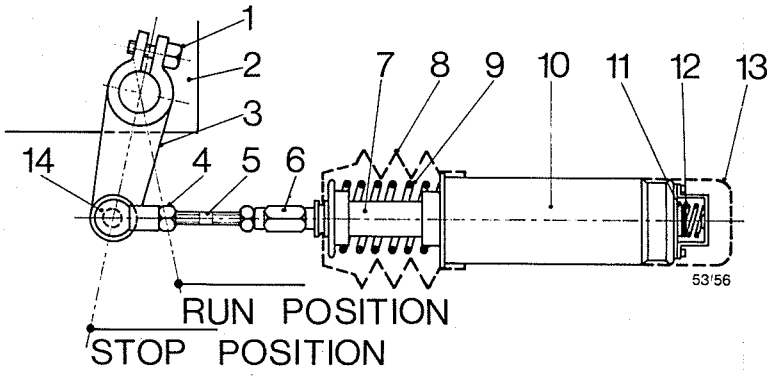
The plunger travel is limited by a stop pin. When the solenoid is energized the gap between the fixed and moving contacts should be between 1.3—1.8 mm (0.05"—0.07"). Failure to maintain the correct gap results in overheating the windings. For this reason, care is to be taken that the length of solenoid pull-in rod is and always remains correctly adjusted, as otherwise the pull-in winding will remain energized. The protecting thermic release switch (Q2 - Fig. 8) will then cut out and prevent the engine from being started. When the solenoid is de-energized the pull-in rod must also be able to return and hold the engine stop lever to its stop position under the impulse of the return spring. Any mechanical hindrance in this respect will prevent the engine from being stopped.

To check and adjust the solenoid linkage, proceed as follows :

1. Loosen the clip of cap (13) and withdraw the cap from the solenoid body.
2. Loosen check nut (4) and disconnect rod (5) from engine stop lever (3).
3. Turn the contact switch to ON and depress the OVERRIDE button. The solenoid will then be energized and the pull-in rod fully retracted.
4. Pull stop lever (3) to the run position. Adjust the length of rod (5) by screwing in or out ball joint (14), without releasing the lever from its run position, until the ball is in line with its socket. Reconnect the rod to the stop lever.
5. Check the gap between the fixed and moving contacts (11 and 12), which should be between 1.3 and 1.8 mm (0.05"—0.07").

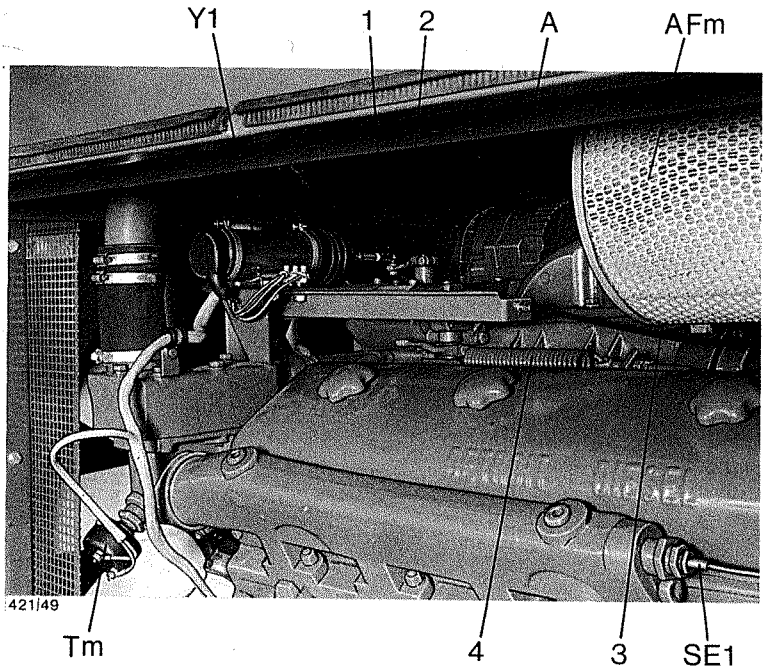
   Do not attempt to measure the gap with a feeler gauge, as this would short-circuit the electrical system.

   If the gap is too small, increase the length of the pull-in rod until the specified gap is obtained.
6. Release the OVERRIDE button two or three times and check the adjustment again.
7. Start the engine in the usual way. If the engine fails to start, shuts down shortly after starting or does not stop when the contact switch is turned to OFF, repeat the adjustment.
8. Tighten nut (4) and reinstall cap (13) after adjustment.



1. Locking screw
2. Variable speed mechanical governor
3. Engine stop lever
4. Check nut, ball joint
5. Solenoid pull-in rod
6. Ball joint
7. Solenoid plunger
8. Rubber bellows
9. Return spring
10. Solenoid
11. Fixed contact
12. Moving contact
13. Rubber cap
14. Ball joint

Fig. 15. Engine stop solenoid and linkage



A. Alternator
AFm. Air intake filter
SE1. Sensing element, engine coolant temperature gauge
Tm. Engine temperature safety switch
Y1. Engine stop solenoid
1. Solenoid pull-in rod
2. Engine stop lever
3. Engine speed control cable
4. Speed governor booster spring

Fig. 16. Engine accessories

5.6 Trimming of the engine speed (Fig. 17)

It is assumed that the engine is in good mechanical condition and will run to its pre-set maximum no-load speed of 2225—2300 r/min when the speed control lever on the variable speed mechanical governor is actuated by hand. Whenever a governor adjustment is necessary, consult the Engine Operators Manual.

The engine speed control lever on the instrument panel and that on the governor are linked by means of a Bowden cable.

If, as a result of the settling of the speed control linkages or the Bowden cable, the engine speeds no longer correspond with the positions of the engine speed control lever on its rack, then this can be corrected as follows :

1. Start and warm up the engine.
2. Set engine speed control lever (12) so that its pawl engages in the last but one tooth of rack (11). The engine is then running loaded.
3. Pull and hold speed control lever (2) on the governor against its maximum speed stop. Loosen cable socket (4a), draw up the slack of the cable, push and secure the socket against the lever.
4. Loosen cable socket (4b) and set speed control lever (12) in the first tooth of the rack. With the lever in this position the engine should run at approx. 950 r/min. If this is not the case adjust the engine idle speed as per instructions given in the Engine Operators Manual. Secure socket (4b) against the lever on the governor.
5. Set the speed control lever in the second tooth of the rack. The engine should now run at a speed of approx. 1100 r/min. If it does not, the speed can be raised or lowered by adjusting the length of the outer sleeve (5) of the Bowden cable. To raise the engine speed loosen outer nut (8) and tighten inner nut (7).

   To lower the engine speed loosen nut (7) and tighten nut (8).

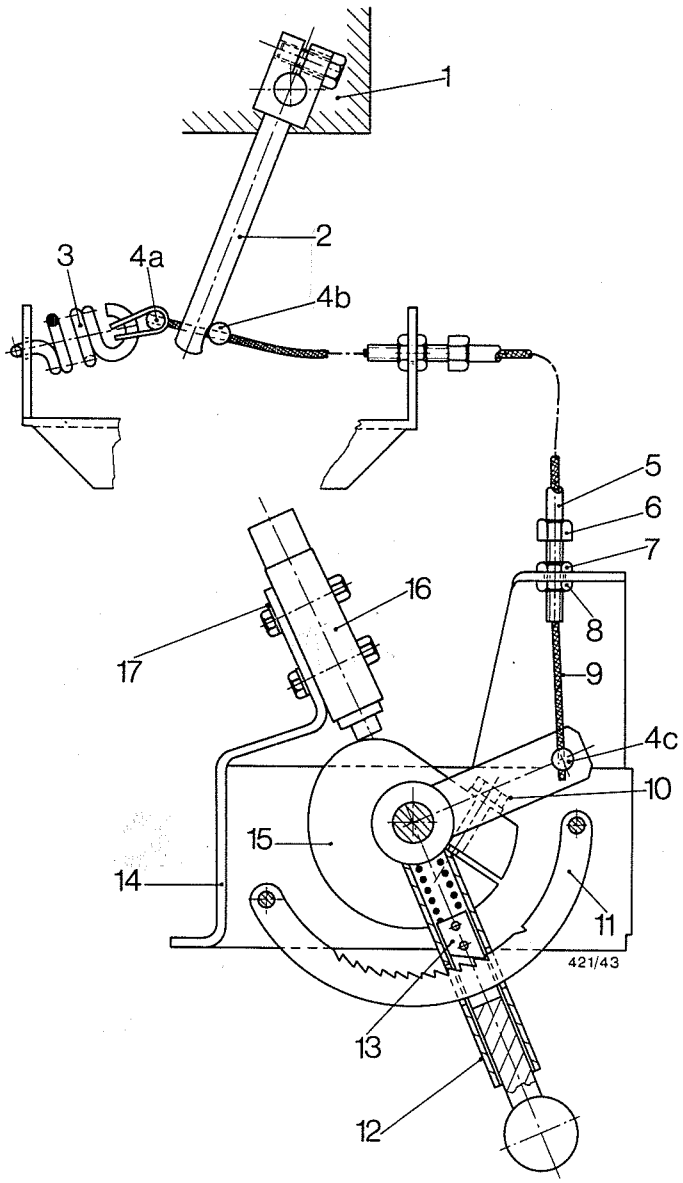
   Note that there will be a small gap between socket (4a) and lever (2). This implies that the engine will not accelerate immediately when the speed control lever is moved from the first to the second tooth of the rack.
6. Check the adjustment by moving the speed control lever slowly to and fro several times while observing at the same time the engine r/min. With the lever in the utmost left position, the engine full load speed should be as shown in the table below :

Working pressure(e)		Engine full load speed
bar	psi	
3	43.5	2120 - 2070
2.7	39	2140 - 2090
2	29	2160 - 2110
1.3	18.8	2175 - 2125

Caution : Do not open the air valves during the checking procedure, unless the air delivery hoses have been laid out straight.

5.7 Trimming of compression stopping in relation to the engine speed (Fig. 17)

Compression is started by diverting compressed air from the air delivery manifold to the regulating valve. This is effected by depressing the plunger of loading control valve (16) by means of cam (15) clamped on the hub of the engine speed control lever. The minimum load speed should be slightly less than 1200 r/min., i.e. pawl of the speed control lever positioned between the third and second tooth on the rack.



1. Engine speed governor
2. Governor speed control lever
3. Return spring
4. Cable sockets
5. Bowden cable outer sleeve
6. Ferrule
7. Inner nut
8. Outer nut
9. Bowden cable
10. Lock screw
11. Rack
12. Engine speed control lever
13. Pawl
14. Supporting bracket on instrument panel
15. Cam
16. Loading control valve
17. Slotted holes

Fig. 17. Engine speed control levers, cable and linkages (1100 r/min)

If, after full load operation, compression does not stop at decreasing speed between 1200 and 1150 r/min, i.e. just before the engine no load speed of 1100 r/min is reached, this can be corrected by adjusting the position of control valve (16) on its support.

In the adjusting procedure below it is assumed that the position of the valve, as well as that of the cam have been completely disturbed. If the position of the latter has not been disturbed, the steps marked with an asterisk * can be omitted.

1. *Secure valve (16) on its support so that the three clamping screws sit in the middle of the slotted holes (17).
2. *Set the speed control lever with its pawl in the second tooth of the rack. Loosen lock screw (10). Insert a screwdriver in the slot of cam (15) and using it as a lever, adjust the position of the cam so that it contacts the plunger of the valve as lightly as possible.
3. Start and warm up the engine. Keep the air valves closed.
4. Disconnect the flexible hose between the control valve and the pressure operating valve at the latter. Slowly increase the engine speed from 1100 to 1200 r/min, while checking at the same time the moment at which air starts escaping from the hose. This should happen just before the pawl of the speed control lever drops into the third tooth of the rack. Change the position of the control valve, if necessary and as required.

   To advance the compression start move the valve towards the cam ; to retard it move the valve away from the cam. Reconnect the flexible hose.
5. Check the adjustment. First move the speed control lever to the maximum speed position, then slowly decrease the engine speed while observing the engine r/min and the air pressure. The pressure should fall to zero at a speed of between 1200 and 1150 r/m.

5.8 Safety valves

The three safety valves, which are fitted on the air delivery manifold, should be tested statically on an outside or separate compressed air line at least once a year.

The valves should open at a pressure(e) between 3.5—3.7 bar (51—53 psi). Fit a new spring, if necessary.

5.9 Testing of the safety switches

5.9.1 Temperature switches

Testing of the mechanical condition of the engine and compressor temperature switches can be effected by immersing the switch sensing element in hot oil. The contact of the engine temperature switch should open at 96°C (205°F) and that of the compressor temperature switch at 240°C (464°F). Test by means of an Ohmmeter or a test lamp with battery and a reliable thermometer. Gently stir the oil during the testing operation.

The setting of the compressor temperature switch can be adjusted by means of a slotted screw protruding through the protecting glass of the switch temperature indicator scale (Gt/Tc - Fig. 8).

To prevent tampering, the screw bears a protecting cap with two holes. A special key, supplied with the machine, can be applied through the holes in the slot to turn the screw as required, until the switch trips at the specified temperature.

5.9.2 Oil pressure switches

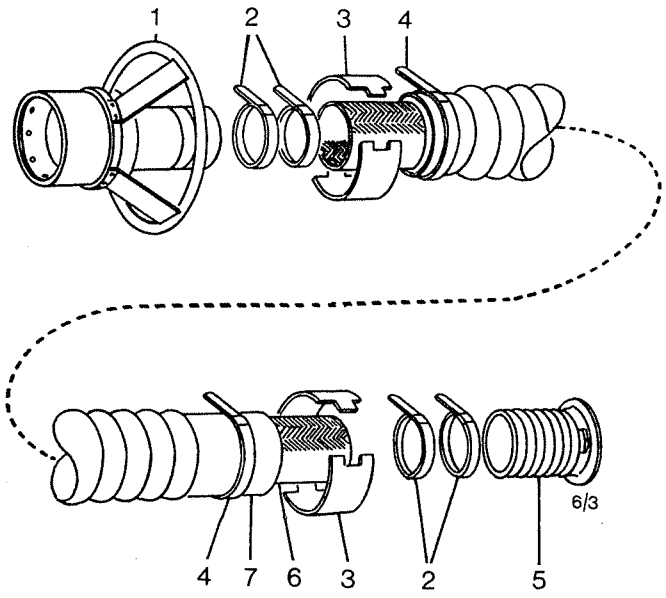
Testing of the engine and compressor oil pressure switches can be effected on a compressed air line by means of a pressure reducing valve, small air receiver, pressure gauge and an Ohmmeter or a test lamp with battery.

The engine oil pressure switch should make at rising pressure(e) at a point between 0.8 and 1.2 bar (12 and 17 psi) and the compressor oil pressure switch at a point between 0.52 and 0.72 bar (7.5—10.5 psi).

Notes :

a. The engine temperature switch, as well as the oil pressure switches have no setting device ; they should be replaced in case of malfunctioning.

b. In testing the switches, take care that the test current intensity does not exceed 1A at 24V as otherwise the contacts will be damaged.



1. Coupling, aircraft side
2. Clamps, securing duct liner
3. Cuff
4. Clamp, securing scuffer jacket
5. Coupling, Air Partner side
6. Duct liner
7. Scuffer jacket

Fig. 18. Exploded view of air delivery hose

5.10 Parking brake adjustment

The unit is equipped with a parking brake as standard. The spindle of the brake handle has a useful stroke of approx. 100 mm (4 in.). If the parking brake cables are stretched to such an extend that the guided spindle nut goes to the end of its stroke when the hand brake is applied, shorten the length of the three cables by means of their clevises. To do this, loosen the brake cable jam nuts, remove the lock spring pins from the clevises and then draw up the slack by screwing up the clevises on the cables. Take care that the equalizer of the wheel brake cables remains square to the axle.

Grease the parking brake cables, as well as the spindle of the brake handle with graphite grease at least every three months. A grease nipple is provided on each cable for that purpose. Grease the spindle with a brush.

5.11 Air delivery hoses

The air delivery hoses, supplied as optional equipment with the Air Partner, consist each of a Dacron reinforced duct liner (6 - Fig. 18) and scuffer jacket (7). The hoses are provided with couplings (1 and 5), which fit corresponding connections on the aircraft and Air Partner.

The scuffer jacket envelops the duct liner and protects it against damage from rough handling and dragging over rough concrete ramps. Proper maintenance should be observed at all times including replacement of the worn or damaged scuffer jackets as required for adequate protection of the duct.

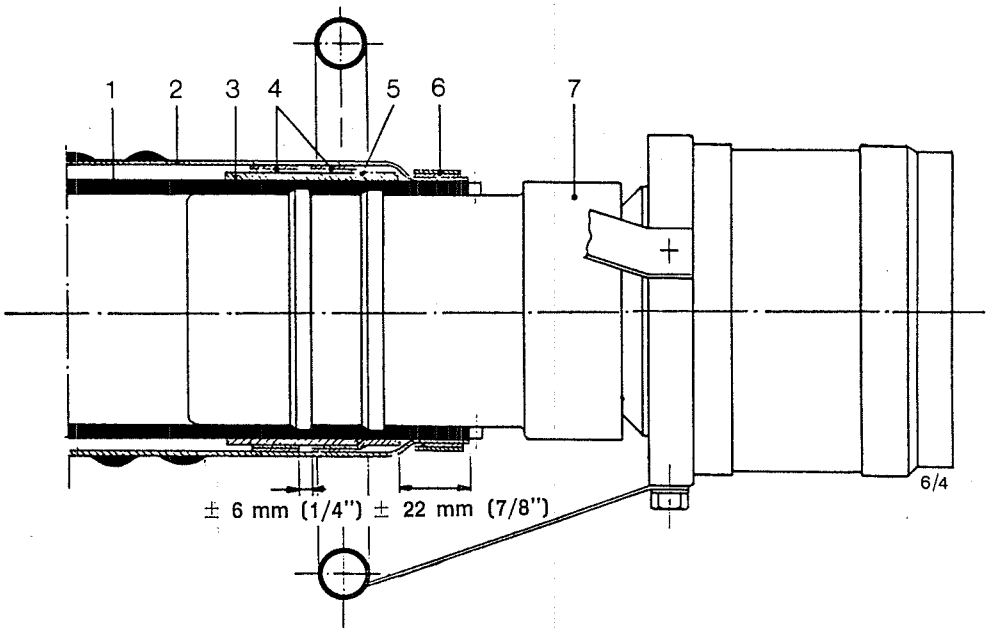
The life of the hose assemblies can be extended by normal and reasonable care as follows :

1. Lay out the hoses on the ground between the aircraft and Air Partner in a relaxed manner away from vehicular traffic.
2. Eliminate sharp bends and taut conditions.
3. Do not twist the hoses when attaching the couplings to the aircraft and Air Partner.
4. Always use the ducts in conjunction with the scuffer jackets.

The seamless duct liners are made of extruded silicone rubber for high heat resistance and low temperature flexibility. Due to the reversion characteristics of silicone when confined under compression and heat, the area of the duct liner connected to the couplings can revert or deteriorate. However, in this case the duct can be recoupled after removing about 50 mm (2") from its ends.

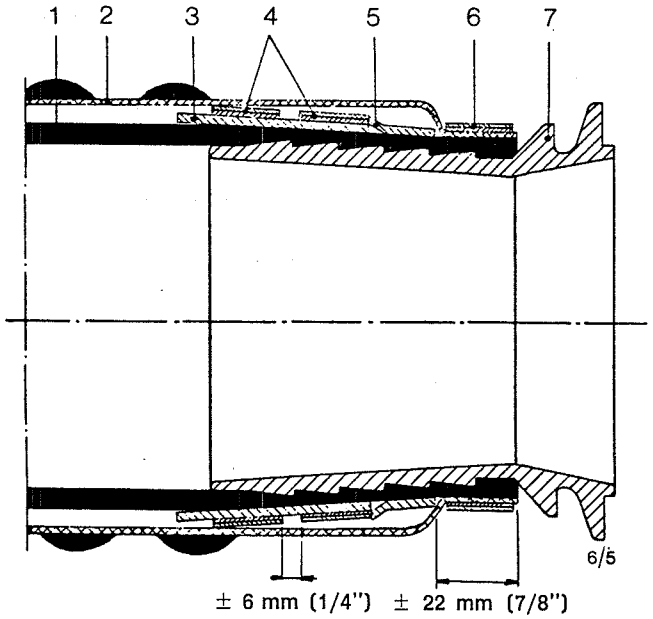
It is recommended that the hose assemblies be inspected after approx. every 50 hours of effective operation corresponding to approx. 600 aircraft starts. Proceed as follows :

1. Remove clamps (4 - Fig. 18) securing the jacket to couplings (1 and 5). This can easily be done after the band stub ends have been bent back from the clamp buckless.



1. Duct liner
2. Scuffer jacket
3. Cuff
4. Clamps, securing duct liner
5. Cuff stop
6. Clamp, securing scuffer jacket
7. Coupling, aircraft side

Fig. 19. Assembly of coupling to air delivery hose, aircraft side



1. Duct liner
2. Scuffer jacket
3. Cuff
4. Clamps, securing duct liner
5. Cuff stop
6. Clamp, securing scuffer jacket
7. Coupling, Air Partner side

Fig. 20. Assembly of coupling to air delivery hose, Air Partner side

2. Draw off the jacket ends from the couplings. Remove the clamps (2) and cuffs (3) from the duct, and withdraw the duct from the jacket.

Inspect the ducts carefully. If the ends of the duct are reversed or deteriorated trim them as described above. Replacement of a duct is imperative if it has become cracked, deteriorated or damaged.
The ducts should also be replaced after approx. 4500 aircraft starts.

Thorougly clean the shank of the couplings. Slide the jacket over the duct, slip three new clamps on each hose extremity and insert the couplings into the duct as far as they will go.

Secure the duct and jacket with the pair of cuffs and clamps to coupling (1 - Fig. 18) as shown in Fig. 19 and to coupling (5 - Fig. 18) as shown in Fig. 20.
The clamps are tightened by means of tool No. 1091.2705 which is used as follows :

a. Place the free end of the clamp band in the tool and tighten the clamp to proper tension by turning the tool handle (Fig. 21).

b. Rotate the tool over the clamp buckle backing off with the tension handle throughout the entire course of the band.

c. Shear the band with the knife incorporated in the tool (Fig. 22) and hammer the band stub end against the clamp buckle.

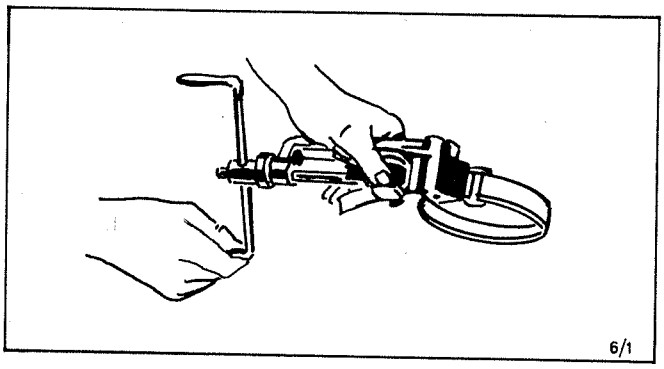


Fig. 21

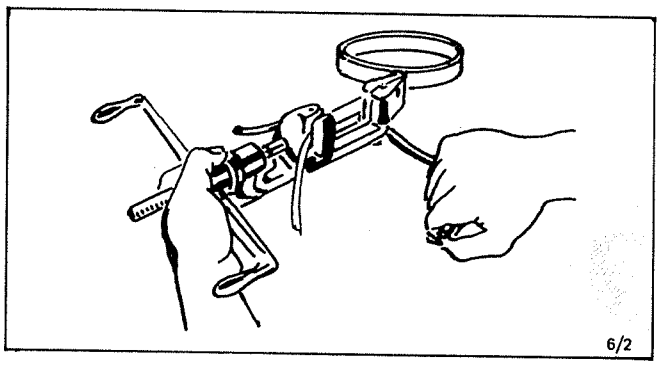


Fig. 22

6. Problem solving

If the unit fails to operate normally, the chart hereafter has been prepared as a guide to solve the various mechanical problems which could possibly arise.

It is assumed that the engine is in good mechanical condition and before any other adjustments are made, ascertain that there is adequate fuel flow to the filters and injection equipment.

If the engine has shut down through the action of a safety switch, first trace and remedy the fault before restarting the unit.

Do not keep the override button depressed for more than 20 seconds, if the RUN lamp does not light up during starting.

CONDITION	POSSIBLE FAULTS	SUGGESTED REMEDY
1. Contact switch S1 set to RUN, but engine temperature fault lamp H6 remains alight when OVERRIDE button S2 is depressed	Low coolant level in engine radiator due to loss of coolant	Service cooling system. Top-up level in radiator and overflow tank **Note :** Coolant level in overflow tank should slightly rise and fall after starting and stopping ; if not, replace radiator pressure cap
2. Engine operates normally, but compressor capacity or air pressure is lower than normal	a. Choked compressor air intake filter elements b. Air leak at gaskets of air discharge system c. Safety valve(s) leak d. Pressure operating valve incorrectly set e. Regulating valve malfunctioning	a. Service or replace elements b. Check and tighten leaking connection. Replace gaskets where necessary c. Remove leaking valve(s). Clean and inspect d. Adjust valve, as required e. Remove and inspect rolling diaphragm of valve piston for tears or rupture

CONDITION	POSSIBLE FAULTS	SUGGESTED REMEDY
	f. Membrane or "O"-rings of pressure operating valve damaged	f. Dismantle and replace parts where necessary
	g. Compressor element(s) not in order	g. Consult an Atlas Copco service representative
3. Engine shuts down with operating mode selector switch S4 set to EQUIPMENT and compressor oil pressure fault lamp H5 lights up	a. Oil level too low	a. Top up level
	b. Oil filter element clogged (only possible if filter by-pass valve remains stuck in closed position)	b. Remove and inspect element. Check by-pass valve
	c. Oil pump by-pass valve stuck in open position	c. Remove by-pass valve. Clean and inspect
	d. Compressor oil pressure safety switch out of order	d. Remove and test switch. Replace, if necessary
	e. Oil pump failure	e. Remove pump and inspect parts for wear
4. Same as above, but engine oil pressure fault lamp H4 lights up	a. Engine oil pressure too low	a. Consult Engine Operators Manual
	b. Engine oil pressure safety switch out of order	b. Remove and test switch. Replace, if necessary
5. Same as under 3, but engine temperature fault lamp H6 lights up	a. Engine overheating	a. Consult Engine Operators Manual
	b. Engine temperature safety switch out of order	b. Remove and test switch. Replace, if necessary
6. Same as under 3, but compressor temperature fault lamp H7 lights up	a. Oil cooler clogged by dust and dirt externally	a. Check and clean cooler core, if necessary
	b. Low compressor oil pressure	b. See 3
	c. Compressor air temperature switch incorrectly set	c. Check and adjust setting, if necessary
	d. Ambient temperature, working pressure or altitude too high	d. Decrease working pressure
	e. Engine fan belts slipping	e. Adjust tension of belts or install new belts
7. Engine running with OVERRIDE button depressed, but engine oil pressure fault lamp H4 remains alight and RUN lamp H2 does not light up within approx. 20 s after starting	a. Engine oil pressure too low	a. See 4a
	b. Engine oil pressure safety switch out of order	b. See 4b
8. Same as above, but compressor oil pressure fault lamp H5 remains alight	See 3	See 3
9. Pressure does not build up when speed is increased to above 1200 r/min	a. Loading control valve and/or cam of engine speed control lever incorrectly positioned	a. Adjust as required, see section 5.7
	b. Regulating valve malfunctioning	b. See 2e. Check piston for free movement
	c. Pressure operating valve malfunctioning	c. See 2f
10. Part of the compressed air is blown off through silencer when air is delivered to aircraft and pressure drops more than 0.2 bar (3 psi) below pre-set working pressure	a. Flexible hose of regulating system leaking or leak at hose connection	a. Check and replace hoses where necessary. Tighten leaky connections
	b. Diaphragm or valve of regulating valve damaged	b. Inspect rolling diaphragm, valve and seat. Replace damaged parts
	c. Pressure operating valve parts worn or damaged	c. Remove and dismantle valve. Replace parts where necessary
11. Excessive oil fumes or air flow coming from gear case breather	Balancing piston diaphragm of compressor element cracked	Replace diaphragm

7. Principal data

Compressor		MAS6 Gd
Manufacturer		Atlas Copco Airpower n.v.
Type of compressor elements		One Z-stage 4 One Z-stage 3
Max. outlet pressure(e) at compressor air outlet flange	bar psi	3 43.5
Load control setting, normal high (100 % air flow)	bar psi	3 43.5
Load control setting, normal low (100 % air flow)	bar psi	1.7 25
Pressure range (adjustable to within)	bar(e) psig	1.2—3 18—43.5
Air discharge temperature at end of hoses, at 3 bar(e) (43.5 psi) working pressure, 15.6°C (60°F) ambient temperature and 1.013 bar(a) (14.7 psi) barometric pressure (approx.)	°C °F	185 365
Oil pressure(e) at max. speed	bar psi	4 58
I.D. of aircraft hoses	mm in	76 3

Engine

Manufacturer		General Motors C°
Type (two stroke, liquid cooled diesel)		12V71
Number of cylinders		12
Type of fuel injectors		N70
Idle speed	r/min	950
Maximum speed	r/min	2100
Electrical system	V	24
Batteries, number and capacity		Negative earthed, 2X205 Ah-12V

Refill capacities

Fuel tanks, approx	l US gal	560 148
Engine cooling water system	l US gal	120 31.7
Engine lube oil system	l US gal	32 8.45
Compressor lube oil system		
Initial fill	l US gal	70 18.5
Refill, approx.	l US gal	55 14.5

Fire extinguisher

Manufacturer	Walter Kidde
Model	5KS
Charge	CO_2

Compressor		MAS6 Gd
Approx. overall dimensions, weight and tyres		
Length (drawbar raised)	mm in	4790 189.6
Width	mm in	1840 72.4
Height	mm in	2000 78.7
Weight (dry)	kg lbs	5120 11265
Tyre size	in	7.50x16 PR12XY
Tyre pressure(e)	bar psi	6.4 93
Tightening torque, wheel nuts	Nm ft.lb	270 195

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