SERVICE MANUAL

"VELVET DRIVE"®

HYDRAULIC TRANSMISSION

REDUCTION GEAR ASSEMBLY

2.57:1 AND 2.91:1 RATIO

Warner Gear

DIVISION OF BORG-WARNER CORPORATION

BORG WARNER®

PRICE $1.50

GENERAL OFFICES, 1106 EAST SEYMOUR STREET, MUNCIE, INDIANA 47302

R.S. 14. 72C

2.57:1

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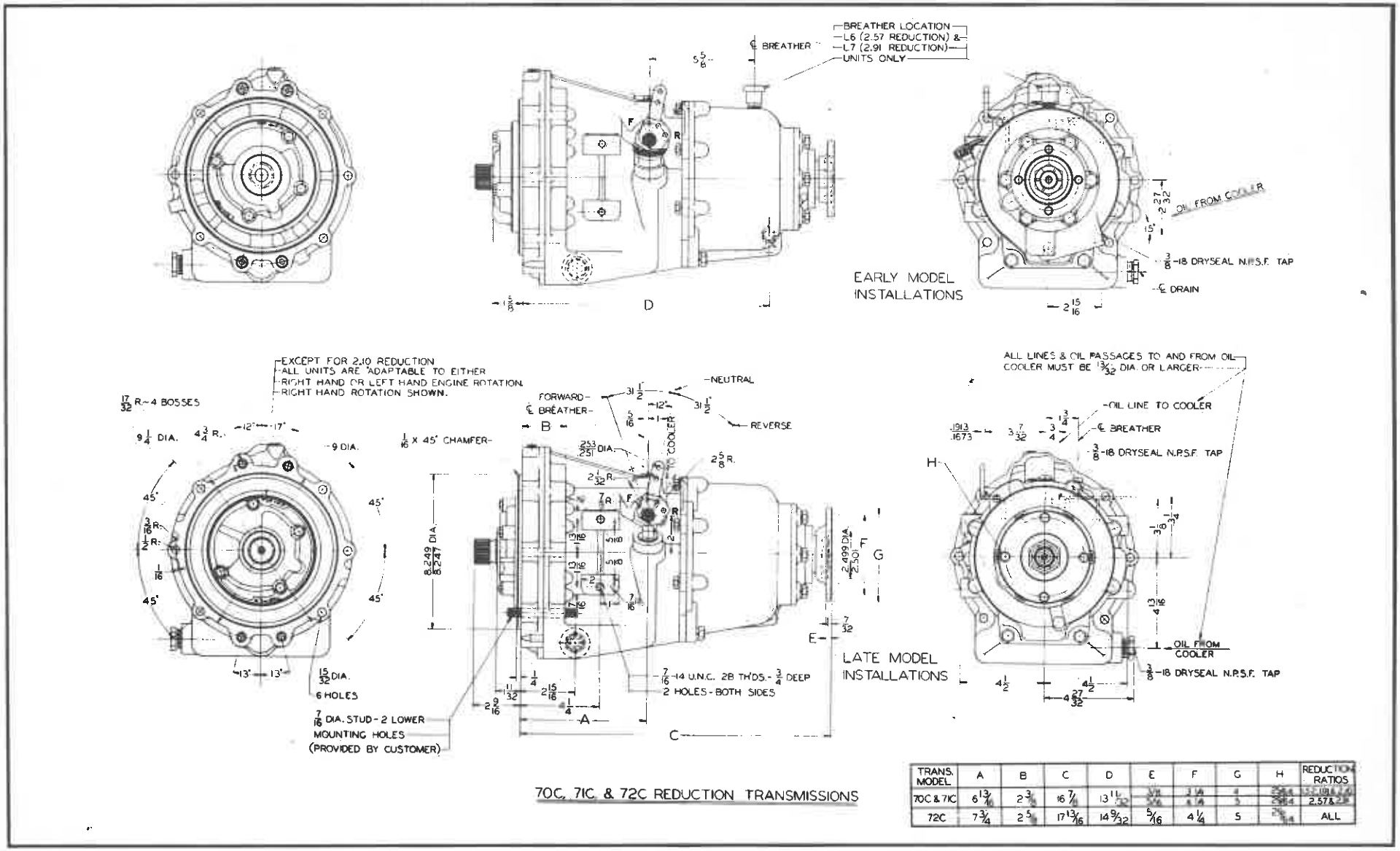


TRANS. MODEL	A	B	C	D	E	F	G	H	REDUCTION RATIOS
70C & 71C	6 13/16	2 3/8	16 7/8	13 11/32	5/16	3 1/8	4	2 5/8 & 4	1.52, 1.91 & 2.10
						4 1/8	5	2 5/8 & 4	2.57 & 2.91
72C	7 3/4	2 5/8	17 13/16	14 9/32	5/16	4 1/4	5	2 5/8 & 4	ALL

Fig. 1 Installation Drawing for all Series 70C, 71C & 72C Reduction Transmissions

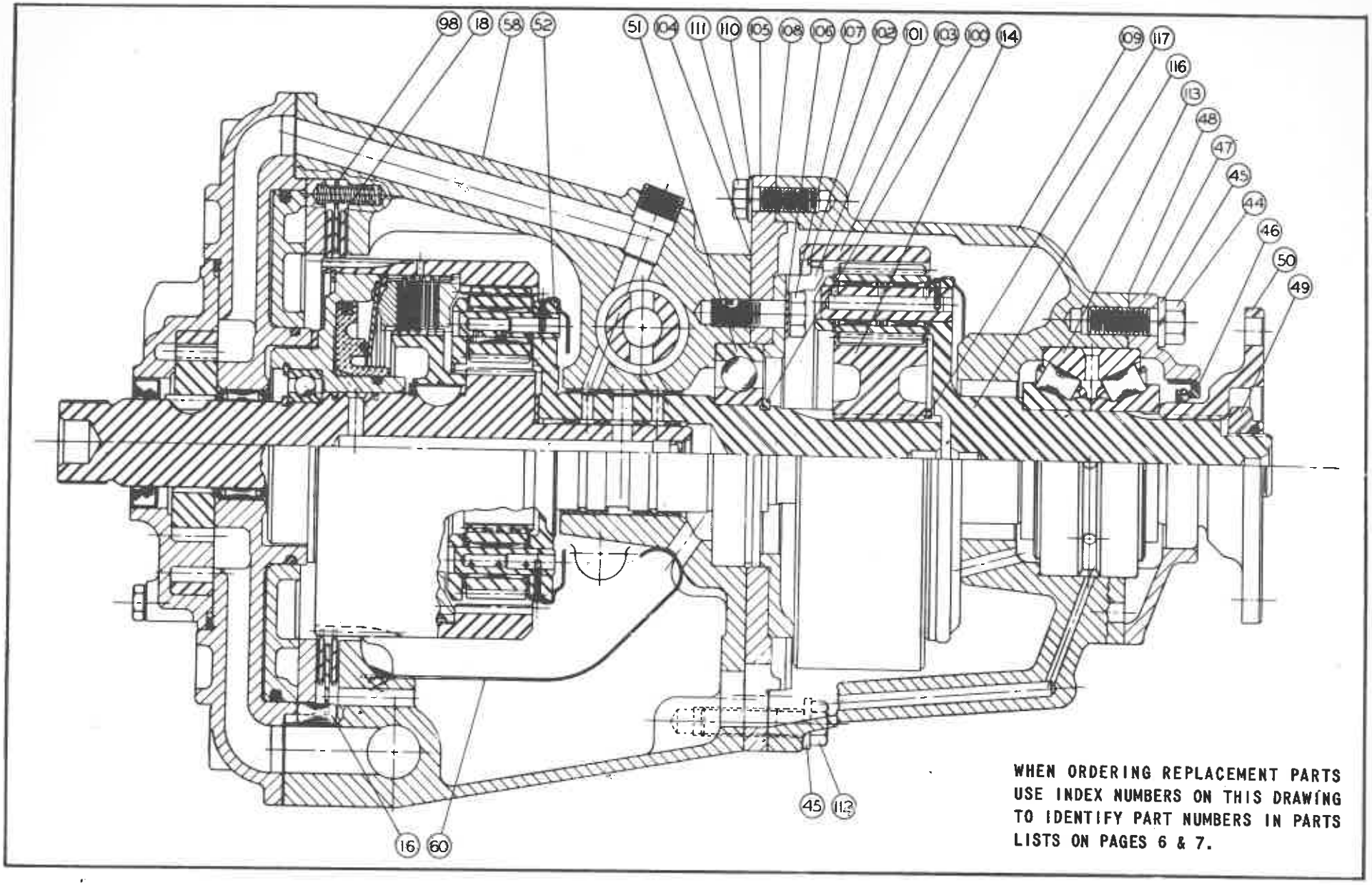
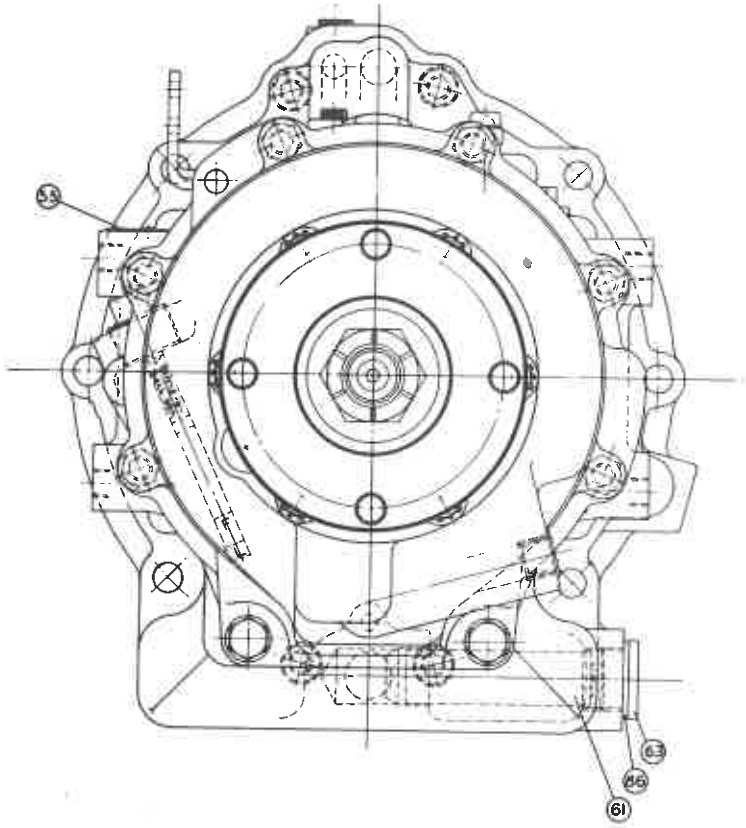


Fig. 2 Cross Sectional View of an AS14-71C Transmission

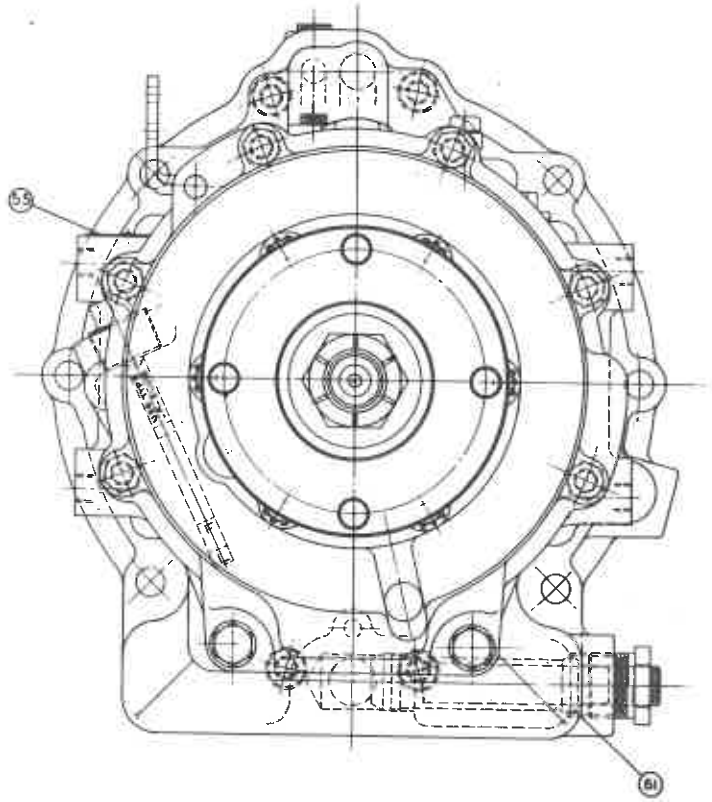
The AS14-70C, AS14-72C, AS15-70C, AS15-71C and AS15-72C transmissions are all similar to the AS14-71C transmission except for minor differences, which can be noted from parts lists on pages 6 & 7. Unnumbered parts for forward & reverse section of these reduction transmissions should be ordered from the approprate direct drive manual, 70C & 71C or 72C.



EARLY MODEL

WHEN ORDERING REPLACEMENT PARTS USE INDEX NUMBERS ON THIS DRAWING TO IDENTIFY PART NUMBERS IN PARTS LISTS ON PAGES 6 & 7.

Fig. 3 Rear View of Early Model Reduction Transmission.



LATE MODEL

WHEN ORDERING REPLACEMENT PARTS USE INDEX NUMBERS ON THIS DRAWING TO IDENTIFY PART NUMBERS IN PARTS LISTS ON PAGES 6 & 7.

Fig. 4 Rear View of Late Model Reduction Transmission.

FORWARD AND REVERSE SECTION PARTS LIST

NOTE: THE FOLLOWING PARTS LIST IDENTIFIES ONLY THOSE PARTS IN THE FORWARD AND REVERSE SECTION OF THE AS14-70C, AS15-70C, AS14-71C, AS15-71C, AS14-72C AND AS15-72C REDUCTION TRANSMISSION WHICH DIFFER IN DESIGN OR IN QUANTITY FROM THE CORRESPONDING DIRECT DRIVE TRANSMISSIONS. USE THE APPROPRIATE DIRECT DRIVE MANUAL PARTS LIST TO IDENTIFY THOSE PARTS WHOSE INDEX NUMBERS ARE NOT LISTED IN THE FOLLOWING PARTS LIST.

ALSO INCLUDED IS THE NECESSARY INFORMATION FOR REPAIRING EARLY MODEL TRANSMISSIONS WITH DESIGN FEATURES WHICH DIFFER FROM PRESENT PRODUCTION. THESE ARE IDENTIFIED WITH AN ASTERISK (*). SEE (PARAGRAPH 1, PAGE 8) FOR ADDITIONAL INFORMATION ON FORWARD AND REVERSE SECTIONS.

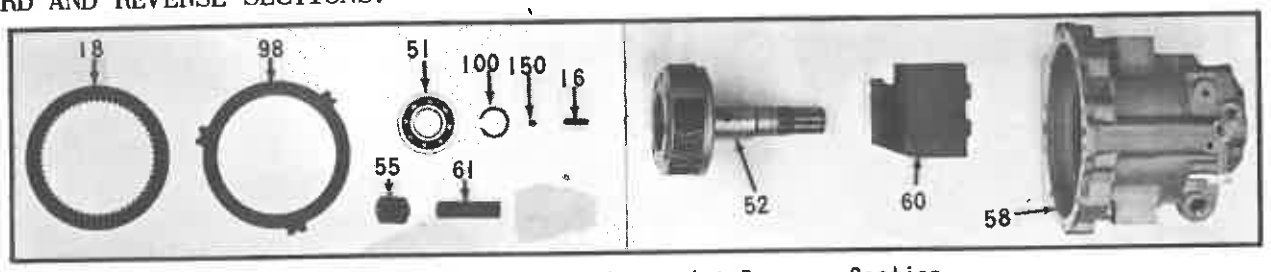


Fig. 5 Parts Display for Forward & Reverse Section

INDEX NO.	PART NAME	NO. REQ'D	PART NUMBER VS MODEL AS14-70C AS15-70C	AS14-71C AS15-71C	AS14-72C AS15-72C
16	DOWEL PIN	3		R6-177	4622E
16*	DOWEL PIN	3		71-87*	71-87*
18	REVERSE CLUTCH PLATE	2		72A-66B	
	" " "	3			72A-66B
18*	REVERSE CLUTCH PLATE-use when clutch cavity is 25/32" deep	1		71-86*	
18*	REVERSE CLUTCH PLATE-use when clutch cavity is 29/32" deep	3			72A-66*
51	BEARING (was X3244G)	1	B308AGS		B308AGS
52	PINION CAGE & OUTPUT SHAFT ASSEMBLY: NOTE (1)	1	71-1A2C	71-1A2C	72-1A2C
55	NAME PLATE AS14-70C (blue)	1	4636LC		
	AS15-70C (blue)	1	4636LD		
	AS14-71C (red)	1		4636HR	
	AS15-71C (red)	1		4636LE	
	AS14-72C (green)	1			4636FV
	AS15-72C (green)				4636FW
58	TRANSMISSION CASE & BUSHING ASSEMBLY: NOTE (2)	1	71-A1L	71-A1K	72-A1K
60	OIL BAFFLE	1	71-140	71-140	
61	OIL STRAINER-USE FOR ALL REPLACEMENTS	1	71C-A98A	71C-A98A	71C-A98A
63*	DRAIN PLUG-USED WITH ANNULAR GASKET (SEE FIG. 10)	1	453006*	453006*	453006*
86*	ANNULAR GASKET ---------- (SEE FIG. 10)	1	120428*	120428*	120428*
98	OUTER REVERSE CLUTCH PLATE	1		72-176	
	" " " "	2			72-176
100	SNAP RING	1	4816	4816	4816
150*	TAPER PLUG, (used with index No. 58 when breather is located in reduction housing), NOM..353 DIA.	1	4572Q*	4572Q*	4572Q*
	NOM..508 DIA.	1	4572C*	4572C*	4572C*

* NOT CURRENT PRODUCTION, AVAILABLE FOR REPAIRING EARLIER UNITS.

USE THE CORRECT PART NUMBERS SHOWN IN PARTS LIST WHEN ORDERING REPLACEMENT PARTS. INDEX NUMBERS ARE USED ONLY TO IDENTIFY PARTS SHOWN ON CROSS SECTIONS & PARTS DISPLAY PICTURES AND THE SAME PARTS IN THE PARTS LISTS.

(1) SEE SPECIAL SERVICE KITS IN THE DIRECT DRIVE MANUALS FOR INFORMATION REGARDING REPLACING ONE OR MORE PINIONS IN THESE ASSEMBLIES.

(2) SEE SPECIAL SERVICE KITS IN DIRECT DRIVE MANUALS FOR INFORMATION REGARDING TRANSMISSION CASE SERVICE BUSHINGS.

REDUCTION PARTS LIST

NOTE: THE FOLLOWING PARTS LIST IDENTIFIES ONLY THOSE PARTS IN THE REDUCTION UNIT OF THE AS14-70C, AS15-70C, AS14-71C, AS15-71C, AS14-72C AND AS15-72C REDUCTION TRANSMISSION. FOR REPLACEMENT PART INFORMATION OF THE FORWARD AND REVERSE SECTION OF THE TRANSMISSION USE THE FORWARD AND REVERSE SECTION PARTS LIST, (PAGE 6), OR APPROPIATE DIRECT DRIVE MANUAL PARTS AS REQUIRED.

ALSO INCLUDED IS THE NECESSARY INFORMATION FOR REPAIRING EARLY MODEL TRANSMISSIONS WITH DESIGN FEATURES WHICH DIFFER FROM PRESENT PRODUCTION. THESE ARE IDENTIFIED WITH AN ASTERISK (*). SEE (PARAGRAPHS 2-5, PAGE 9) FOR ADDITIONAL INFORMATION ON THE REDUCTION SECTION OF THIS TRANSMISSION.

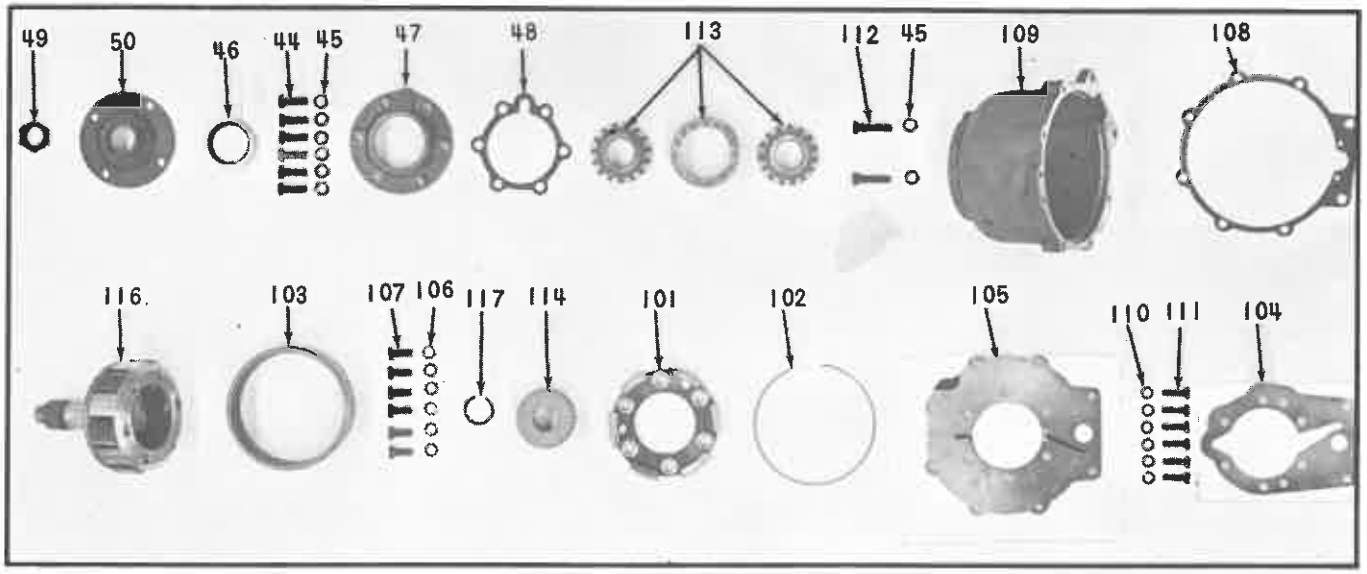


Fig. 6 Parts Display for the 2.57 and 2.91 to 1.00 Reduction Units

INDEX NO.	PART NO.	PART NAME	NO. REQ'D	INDEX NO.	PART NO.	PART NAME	NO. REQ'D
44	179860	7/16-14 x 1-1/4 HEX HEAD BOLT	6	106	114607	7/16 INCH LOCK WASHER	6
45	103322	7/16 INCH LOCK WASHER	8	107	4853E	7/16-14 x 1-1/4 LOCK BOLT	6
46	3-62	OIL SEAL	1	108	L4-146	ADAPTER GASKET-Rear	1
47	L4-7	BEARING RETAINER	1	109	L7-1A	REDUCTION HOUSING(Late)	1
48	L4-147	BEARING RETAINER GASKET	1		L7-1* or	REDUCTION HOUSING(Early)	1
49	4775Q	MAIN SHAFT NUT	1	110	103321	3/8 INCH LOCK WASHER	6
50	4912	COUPLING	1	111	179840	3/8-16 x 1-1/8 HEX HEAD BOLT	6
101	L7-31	STATIONARY GEAR PLATE(2.91:1)	1	112	179864	7/16-14 x 1-3/4 HEX HEAD BOLT	2
	L6-31 or	STATIONARY GEAR PLATE(2.57:1)	1	113	4920	BEARING	1
102	4756D	SNAP RING(2.91:1)	1	114	L7-104	SUN GEAR(2.91:1)	1
	4756E or	SNAP RING(2.57:1)	1		L6-104 or	SUN GEAR(2.57:1)	1
103	L3-6	RING GEAR(2.91:1)	1	116	L7-A2D	PINION CAGE ASSEMBLY(2.91:1)	1
	L6-6 or	RING GEAR(2.57:1)	1		L6-A2D or	PINION CAGE ASSEMBLY(2.57:1)	1
104	L4-145	ADAPTER GASKET-Front	1	117	4734	SNAP RING	1
105	L7-8A	REDUCTION UNIT ADAPTER(Late)	1				
	L7-8* or	REDUCTION UNIT ADAPTER(Early)	1				

* NOT CURRENT PRODUCTION, AVAILABLE FOR REPAIRING EARLIER UNITS, (SEE FIG. 8).

USE THE CORRECT PART NUMBERS SHOWN IN PARTS LIST WHEN ORDERING REPLACEMENT PARTS. INDEX NUMBERS ARE USED ONLY TO IDENTIFY PARTS SHOWN ON CROSS SECTIONS & PARTS DISPLAY PICTURES AND THE SAME PARTS IN THE PARTS LIST.

(1) SEE SPECIAL SERVICE KITS (PAGE 19) FOR INFORMATION REGARDING PLANETARY SERVICE PARTS.

OIL CIRCULATION VARIATIONS IN 2.57 & 2.91 REDUCTIONS

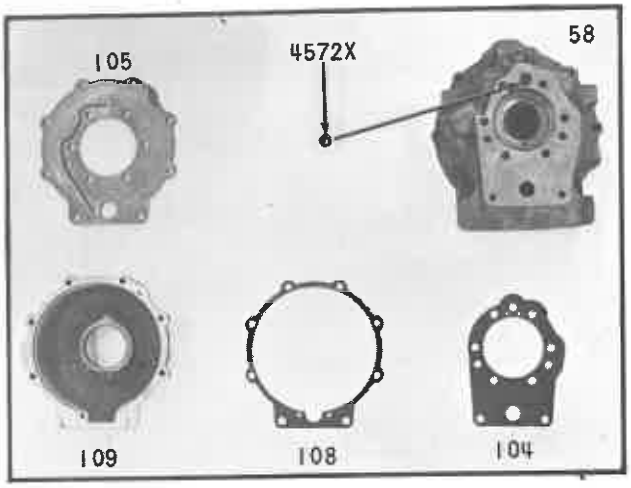


Fig. 7 2.57 & 2.91 Reduction Parts Used with Revised Oil Circulation System

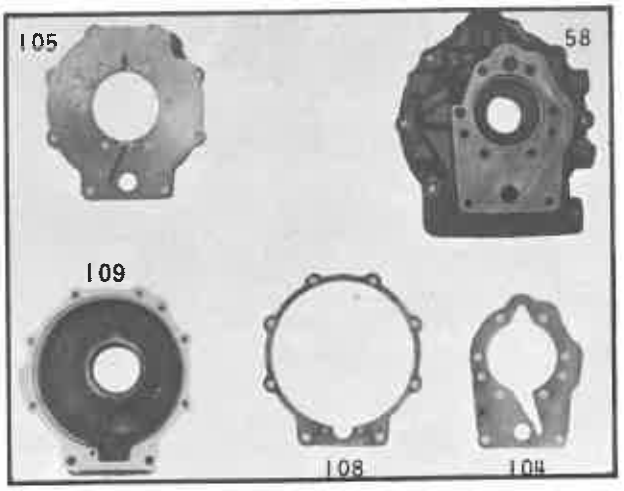


Fig. 7A 2.57 & 2.91 Reduction Parts Used with Latest Oil Circulation System

DESCRIPTION OF OIL CIRCUITS

Three different oil circulation systems in the reduction transmissions have been used to provide cooler flow and lubrication to the reduction planetary gear set and the rear bearing.

The earliest circulation system, with parts shown in (Fig. 8), returned the cooler oil to the reduction housing (Figs. 1 and 12). External identification of this system can be quickly made by examining the transmission reduction housing for a tapped hole in the reduction housing for the cooler oil return. If the reduction housing has no tapped hole, and the cooler oil must be returned to the lower front of the forward and reverse transmission case (Figs. 1 and 11) the transmission has one of the two latest oil circulation systems. These last two oil circulation systems can be differentiated after disassembly by comparing the oil passages with those shown in (Figs. 7 and 7A). The current design (Fig. 7A) is the only one of these two systems for which service parts will be available. When any transmission containing parts as identified in (Fig. 7) is serviced it should be rebuilt with parts as shown in (Fig. 7).

The effective serial numbers of the reduction transmissions revised to the latest oil circulation system are as follows:

MODEL	SERIAL NO.
AS14-70C & AS14-70CR	312
AS14-71C & AS14-71CR	5539
AS14-72C & AS14-72CR	11281
AS15-70C & AS15-70CR	1119
AS15-71C & AS15-71CR	1058
AS15-72C & AS15-72CR	2623

Any transmission with a serial number prior to those shown above which has been rebuilt to the latest circulation system at our plant, has the letter "Z" hand stamped in the lower right hand corner of the name plate opposite the name of Warner Gear Division.

PART DIFFERENCES IN REDUCTION UNIT DESIGN

1. With the introduction of the oil circulation characterized by (Fig. 7) the forward and reverse transmission cases were changed, but the part number remained the same. This new case can be used as a replacement for all reduction transmissions, of the various circulation systems, with the same part number. However the old forward and reverse transmission cases cannot be used with a transmission with the revised oil circulation system characterized by the cast oil passage in the reduction unit adapter as shown in (Fig. 7).

   The new version of the case has additional metal added to the upper and right side as shown in (Fig. 7)

to accommodate the pressure lubrication system to the reduction planetary gear set and rear bearing. With the relocation of the pressure lubrication passage to a location where the annular groove in the outside diameter of the bearing is utilized as an oil passage, the newer version of the case is not required.

NOTE: WHEN THE PARTS ARE ASSEMBLED AS SHOWN IN (FIG. 7A) THE BALL BEARING SHOULD ALWAYS BE INSTALLED SO THAT THE GROOVE ON ITS OUTSIDE DIAMETER IS ALWAYS TO THE REAR, VISIBLE FROM THE BACK OF THE TRANSMISSION AFTER INSTALLATION.

With the introduction of the latest oil circulation system, characterized by the parts illustrated in (Fig. 7A), the 4572X orifice plug has been removed from the 3/4" O.D. hole in the rear face of the transmission case. This plug should also be removed from any transmission, represented by parts illustrated in (Fig. 7), when it is rebuilt to the newer version shown in (Fig. 7A).

2. Both adapter gaskets (L4-145 and L4-146) front and rear, respectively, have been changed, but the part numbers remain the same. The new gaskets (Fig. 7A) can be used on all reduction transmissions, but the earlier gaskets (Fig. 8) can only be used in reduction transmissions with the old oil circulation system.

3. Reduction unit adapter (L7-8A) is used on these reduction transmissions with the new circulation system and replaces part (L7-8) used with the old circulation system. These parts are not interchangeable and care must be exercised in ordering the correct part for the transmission. The new adapter may be identified by its oil lubrication passage with drilled .12 hole to supply lubrication to the rear bearing, (Fig. 7A).

4. Reduction housing (L7-1A) is used on the reduction transmissions with the new circulation system and replaces part (L7-1) used with the older circulation system. These parts are not interchangeable and care must be exercised in ordering the correct part for the transmission. The new housing (L7-1A) may be identified by the absence of the tapped hole where the cooler oil previously returned to the reduction housing (Figs. 11 and 12).

5. The new reduction transmission oil circulation system returns the oil to the cooler return bushing at the front of the forward and reverse transmission case in the same manner that has been used on the Model 72C direct drive. The oil strainer assembly and related parts required in this new system are illustrated in (Fig. 9).

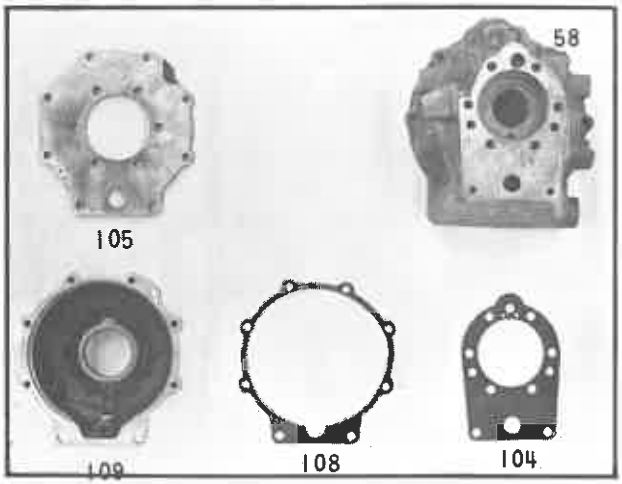


Fig. 8 2.57 & 2.91 Reduction Parts Used with Former Circulation System

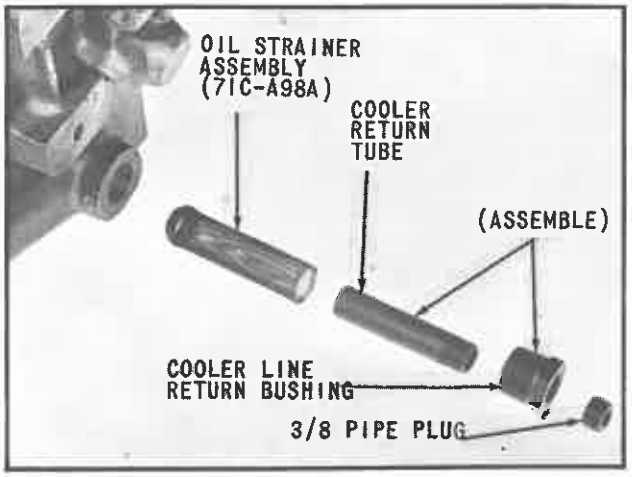


Fig. 9 Installation of Oil Strainer with Cooler Return bushing Assembly

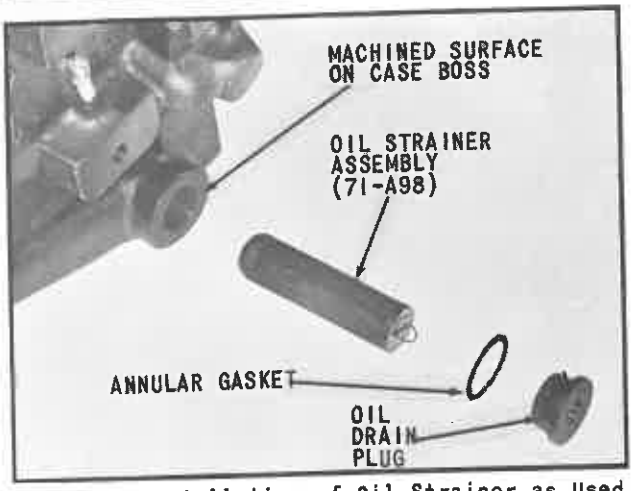


Fig. 10 Installation of Oil Strainer as Used with Drain Plug and Annular Gasket

NOTE: CAUTION SHOULD BE OBSERVED NOT TO USE OIL STRAINER ASSEMBLY 71-A98, WITH THE CLOSED END AND WIRE RING, IN A REDUCTION TRANSMISSION WITH THE NEW OIL CIRCULATION SYSTEM AS IT WOULD BLOCK THE FLOW OF THE COOLER RETURN OIL.

6. The replacement parts for the old circulation system are illustrated in (Fig. 10). Oil strainer assembly 71C-A98A has now replaced the old oil strainer assembly 71-A98, but these two parts are fully interchangeable in this oil circulation system.

7. Some of the reduction transmissions with the old circulation system requiure the use of an annular gasket and oil drain plug with a different thread than presently used. These assemblies can be easily identified by the machined surface on the transmission case boss which mates with the annular gasket (Fig. 10).

DESCRIPTION

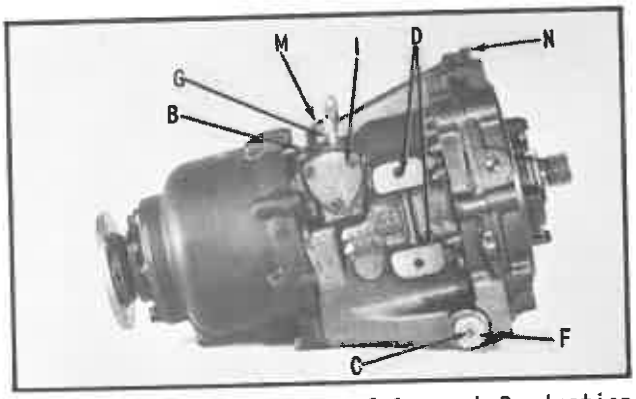


Fig. 11 Right Side View of Current Production Transmission

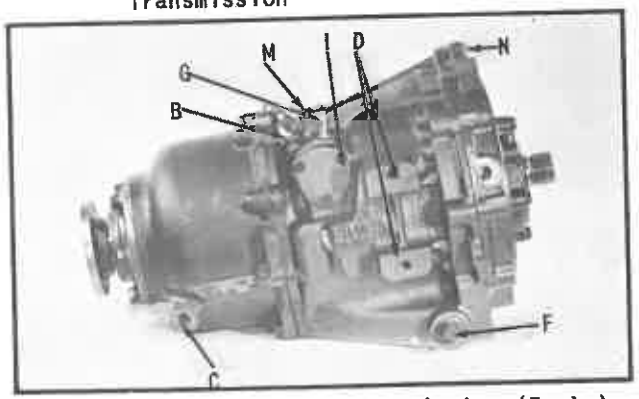


Fig. 12 Right Side of Transmission (Early)

The 2.57 or 2.91 to 1 reduction gear box operates in conjunction with any of the following models: Model 70, 70R, 70C, 70CR, 71, 71R, 71C, 71CR, 72, 72R, 72C, and 72CR, Each consists of a planetary gear set which reduces the input revolutions by a fixed 2.57 or 2.91 to 1 ratio.

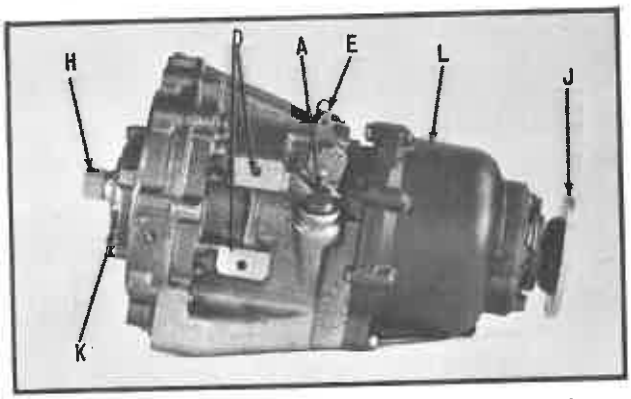


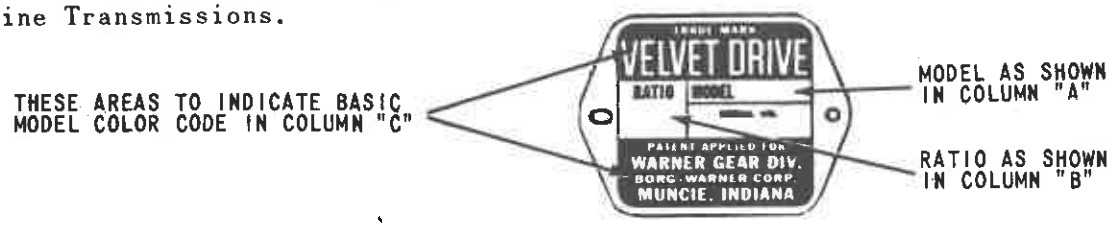
Fig. 13 Left Side of Current Transmission

The following list identifies the important features of the various model transmissions in (Figs. 11, 12 and 13).

A. Oil Filler Cap
B. Oil Output Opening to Cooler
C. Oil Inlet Opening from Cooler
D. Mounting Pads and Mounting Bolt Holes
E. Shift Lever
F. Oil Drain Plug
G. Breather
H. Drive Gear
I. Valve Cover
J. Coupling
K. Oil Pump
L. Reduction Gear Box
M. Main Line Pressure Tap
N. Reverse Clutch Pressure Tap

The direction of rotation of the splined output shaft of the reduction gear box is the same as engine rotation and is coaxial with the input shaft of the main unit. Lubrication pressure is supplied by the pump in the main transmission.

The following are the identification markings for the Warner Gear "VELVET DRIVE"® Marine Transmissions.



"A" MODEL	HAND OF ROTATION	"A" MODEL	HAND OF ROTATION	"B" RATIO	"C" COLOR	WEIGHT EMPTY
*AS14-72C	CLOCKWISE	*AS14-72CR	COUNTER CLOCKWISE	2.57:1	GREEN	154
AS4-72	CLOCKWISE	AS4-72R	COUNTER CLOCKWISE	2.57:1	GREEN	154
*AS14-71C	CLOCKWISE	*AS14-71CR	COUNTER CLOCKWISE	2.57:1	RED	144
AS4-71	CLOCKWISE	AS4-71R	COUNTER CLOCKWISE	2.57:1	RED	144
*AS14-70C	CLOCKWISE	*AS14-70CR	COUNTER CLOCKWISE	2.57:1	BLUE	143
AS4-70	CLOCKWISE	AS4-70R	COUNTER CLOCKWISE	2.57:1	BLUE	143
*AS15-72C	CLOCKWISE	*AS15-72CR	COUNTER CLOCKWISE	2.91:1	GREEN	154
AS5-72	CLOCKWISE	AS5-72R	COUNTER CLOCKWISE	2.91:1	GREEN	154
*AS15-71C	CLOCKWISE	*AS15-71CR	COUNTER CLOCKWISE	2.91:1	RED	144
AS5-71	CLOCKWISE	AS5-71R	COUNTER CLOCKWISE	2.91:1	RED	144
*AS15-70C	CLOCKWISE	*AS15-70CR	COUNTER CLOCKWISE	2.91:1	BLUE	143
AS5-70	CLOCKWISE	AS5-70R	COUNTER CLOCKWISE	2.91:1	BLUE	143

The hand of rotation referred to above is when viewed from stern of boat looking forward.
*TRANSMISSION ASSEMBLIES PRESENTLY IN PRODUCTION.

LUBRICATION RECOMMENDATIONS

THE PROPERTIES OF THE OIL USED IN THE TRANSMISSION ARE EXTREMELY IMPORTANT TO THE PROPER FUNCTION OF THE HYDRAULIC SYSTEM. THEREFORE, IT IS EXTREMELY IMPORTANT THAT THE RECOMMENDED OIL, AUTOMATIC TRANSMISSION FLUID (ATF), TYPE "A", SUFFIX "A" OR DEXRON BE USED.

For other important information pertaining to filling of the transmission with oil, checking oil level, or changing transmission oil, refer to section "Lubrication Recommendations", of the appropriate 70C & 71C, or 72C direct drive manuals.

MODEL	TRANSMISSION OIL CAPACITY (QUARTS)	
	15° INCLINED	LEVEL
AS14-70C or CR	2.7	2.5
AS14-71C or CR	2.7	2.5
AS14-72C or CR	2.8	2.7
AS15-70C or CR	2.7	2.5
AS15-71C or CR	2.7	2.5
AS15-72C or CR	2.8	2.7

NOTE: OIL CAPACITY DOES NOT INCLUDE CAPACITY NEEDED FOR TRANSMISSION COOLER AND OIL LINES, WHICH MAY IN MANY CASES REQUIRE AN ADDITIONAL AMOUNT GREATER THAN IN ABOVE TABLE.

TRANSMISSION INSTALLATION PRECAUTIONS & OPERATION

It is recommended that all installations using a reduction gear have a suitable locking device or brake to prevent rotation of the propeller shaft when the boat is not under direct propulsion. If the marine gear is not in operation and the forward motion of the boat causes the propeller shaft to rotate, lubricating oil will not be circulated through the gear because the oil pump is not in operation. Overheating and damage to the marine gear may result unless rotation of the propeller shaft is prevented.

Except in an emergency, shift from forward to reverse drive through neutral at engine speeds below 1000 rpm to prevent damage to the engine, or marine gear.

For other important information refer to sections, "Installation Precautions" and "Transmission Operation", of the appropriate 70C & 71C, or 72C direct drive manuals.

DISASSEMBLY OF TRANSMISSION

REMOVE REDUCTION HOUSING FROM FORWARD AND REVERSE TRANSMISSION

1. Place transmission right side up on a clean bench and loosen the main shaft nut.

2. Place an inch thick block under the rear of forward and reverse transmission just forward of reduction unit adapter so that reduction unit will clear bench.

3. Remove the two 7/16 bolts and lock washers, which fasten the reduction housing and the reduction adapter to the forward and reverse transmission case, and the 3/8 bolts, which fasten the reduction adapter to the reduction housing. Slide the reduction housing and pinion cage and driven shaft assembly from the forward and reverse transmission.

DISASSEMBLE STATIONARY GEAR PLATE, RING GEAR AND REDUCTION UNIT ADAPTER

4. Remove snap ring and sun gear from output shaft (Fig. 24).

5. Remove the six nylock bolts and lock washers and stationary gear plate and ring gear assembly as shown in (Fig. 23).

6. Remove the reduction unit adapter (Fig. 22). Tap gently on the exposed edges of reduction unit adapter while exerting a pull until adapter is free of snap fit on bearing O.D.

7. Remove the snap ring and separate the stationary gear plate and ring gear, (Fig. 20).

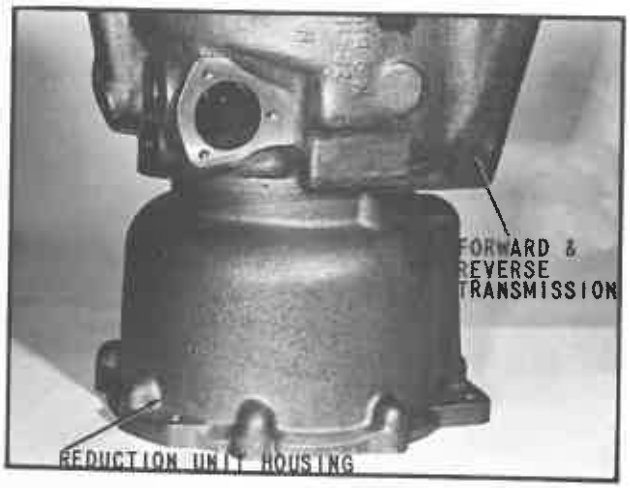


Fig. 14 Reduction Housing Used as Stand

REMOVAL OF MAIN SHAFT, COUPLING, AND BEARING FROM REDUCTION HOUSING

8. Remove main shaft nut and coupling as shown in (Fig. 30).

9. Remove main shaft and pinion cage assembly from reduction housing as shown in (Fig. 29).

10. Remove the six hex head bolts and lock washers and then remove the bearing retainer, as shown in (Fig. 28).

11. Remove the rear tapered roller bearing cone from outer race.

12. Place the reduction housing, rear face down, on a clean flat surface in an arbor press. Place a suitable tool against the forward face of forward tapered roller bearing cone and press remaining parts of the bearing out through the rear of housing.

DISASSEMBLY OF FORWARD AND REVERSE TRANSMISSION

13. If necessary to disassemble forward and reverse section of transmission, remove the snap ring, behind bearing, from output shaft assembly, (Fig. 19).

14. Place reduction housing on front face and place forward and reverse transmission assembly, rear face, on rear face of reduction housing, (Fig. 14).

15. Follow disassembly procedure given in Service Manual "Velvet Drive" Hydraulic Transmission either Model 70C, 71C or 72C as required for disassembly of forward and reverse transmission.

INSPECTION AND GENERAL INSTRUCTIONS

1. Cleanliness is absolutely necessary during assembly to insure proper functioning of transmission. Transmission case passages should always have plugs removed to allow for thorough cleaning. When available, use compressed air to dry parts before they are assembled. Do not wipe parts with rags to clean or dry them as lint from the cloth may cause erratic valve action.

2. Inspect all parts for damage or wear. Replace defective parts.

3. All gaskets, oil seals and rubber sealing rings should be replaced except in relatively new units. Judgement should then be exercised as to need for replacing these parts.

4. Oil seals and bearings are best installed by using an arbor press, suitable fixtures, and tools to properly align parts being assembled. Hammering seals and bearings into position can severely damage parts.

5. Automatic transmission fluid, type "A" suffix "A" or Dexron should be used to lubricate parts as they are assembled. Petroleum jelly may be used on gaskets or other parts that must be held in position during assembly. All Parts will assemble more freely if lubricated.

6. Tighten all bolts and screws evenly to the recommended torque.

7. Reduction pinion cage service instructions are covered under Planetary Service Kits in this manual, (Page 18).

ASSEMBLY OF TRANSMISSION

INSTALLATION OF PINION CAGE AND OUTPUT SHAFT ASSEMBLY AND BEARING INTO TRANSMISSION CASE

1. Mount the pinion cage and output shaft assembly on the same clutch and planetary assembly fixture as would be used for a direct drive transmission on an arbor press.

   NOTE: Pinion cage and output shaft assemblies (71-1A2C) and (72-1A2C) have been supplied with three oil grooves and without oil grooves as shown in (Fig. 15). The grooved shafts may be used in transmission cases having bronze bushings and in transmission cases without bronze bushings. The ungrooved shafts may be used only in transmission cases which have bushings installed.

2. Place the transmission case over the pinion cage and outout shaft assembly so transmission case rests squarely on arbor press table which is supporting assembly tool (Fig. 16).

3. Inspect the bearing bore for possible dirt or burrs.

Fig. 15 Ungrooved and Grooved Model Pinion Cage and Output Shafts

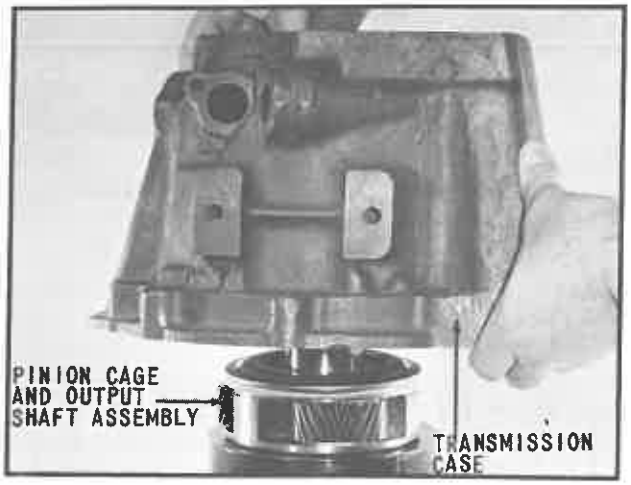


Fig. 16 Assembling Case over Output Shaft Assembly

4. Inspect the rear bearing for scored or damaged balls and races and for loose or cracked ball retainer. Replace the bearing with a new part if damage is detected.

5. Inspect the bearing for presence of dirt. If dirt is present, wash bearing until clean and lubricate with automatic transmission fluid, type "A", suffix "A" or Dexron, before assembly.

6. With the groove on the outside diameter of the bearing located toward the rear of the transmission, as shown in (Fig. 17), place the bearing over the projecting output shaft and squarely in the bearing bore.

7. Using an assembly tool designed to press evenly on the bearing outer and inner races, press bearing down until seated against shaft or case shoulder, (Fig. 18).

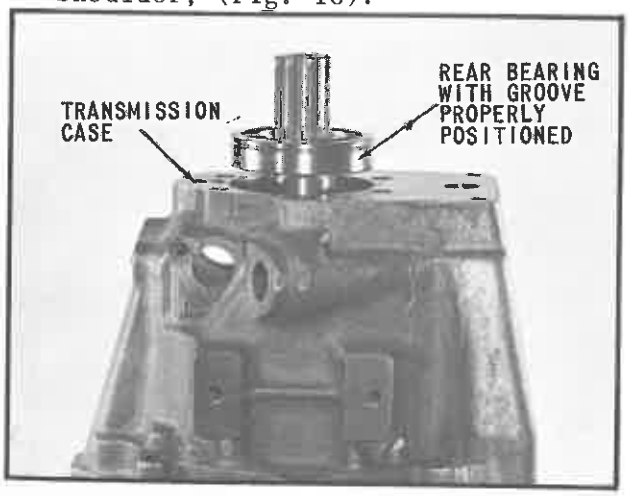


Fig. 17 Output Shaft Bearing Properly Positioned for Assembly

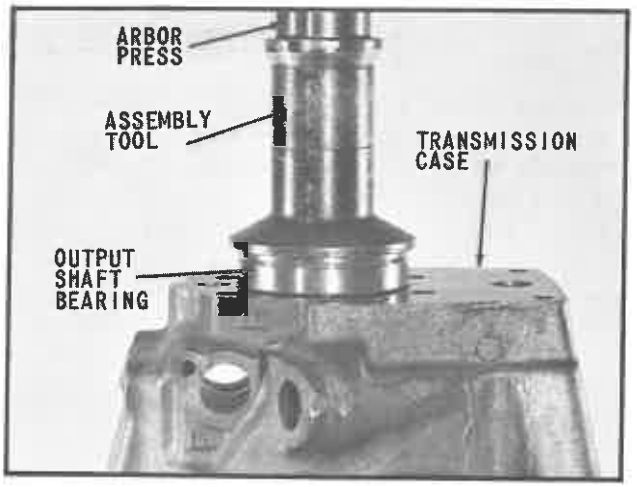


Fig. 18 Pressing Bearing into Case

8. Install the snap ring behind bearing and into the exposed groove of output shaft (Fig. 19).

9. Complete forward and reverse transmission assembly by following instructions given in either Service Manual for Model 70C & 71C, or 72C "Velvet Drive" Hydraulic Transmission as required.

ASSEMBLING STATIONARY GEAR PLATE AND RING GEAR

10. Install the stationary gear plate into the ring gear until it rests against the shoulder as shown in (Fig. 20).

11. Install the snap ring firmly into groove of the ring gear (Fig. 20).

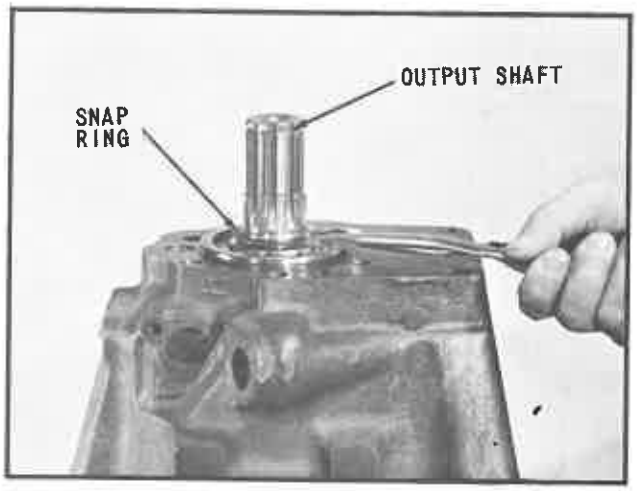


Fig. 19 Installing Snap Ring on Output Shaft

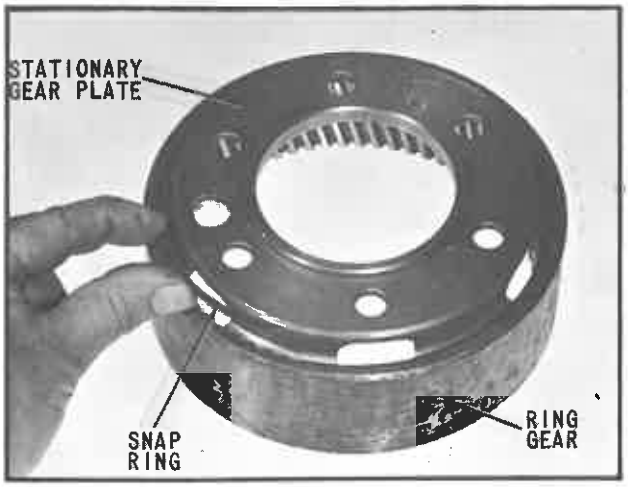


Fig. 20 Assembling Stationary Gear Plate and Ring Gear

INSTALLATION OF REDUCTION UNIT ADAPTER AND RING GEAR ASSEMBLY ON THE FORWARD AND REVERSE TRANSMISSION ASSEMBLY

12. Support the forward and reverse transmission assembly on its forward face on a clean surface using suitable blocks.

13. Place the reduction unit adapter gasket-front in position on rear face of transmission (Fig. 21). Gasket may be coated with petroleum jelly for easier assembly.

14. Install the reduction unit adapter on rear of the transmission case locating on the outer diameter of bearing (Fig. 22).

15. Install the parts assembled in steps 10 and 11, locating hub of the stationary gear plate in bearing pilot bore of the reduction unit adapter (Fig. 23).

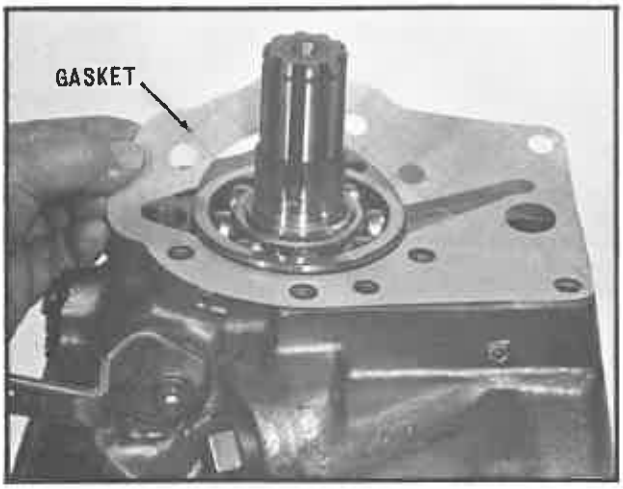


Fig. 21 Assembling Gasket

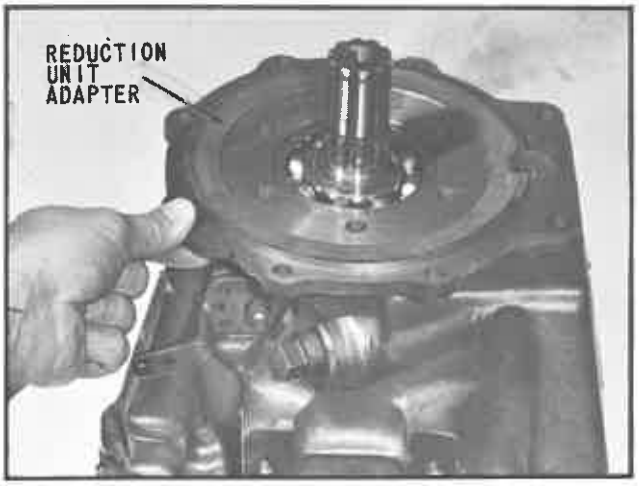


Fig. 22 Assembling Reduction Adapter

16. Install the six 7/16-14 x 1-1/4 nylock bolts and 7/16 lock washers (Fig. 23). Install the two 7/16-14 x 1-3/4 hex head bolts to insure alignment of all bolt holes. Tighten evenly to specified torque the nylock bolts and then remove the two 7/16-14 x 1-3/4 hex head bolts.

ASSEMBLING SUN GEAR ON OUTPUT SHAFT

17. Install the sun gear on the output shaft until it is seated against the shoulder and then assemble the snap ring firmly into groove (Fig. 24).

ASSEMBLING BEARING INTO REDUCTION HOUSING

18. Place the reduction housing on an arbor press resting the front face on a clean flat surface. The position of the bearing parts are shown in (Fig. 25).

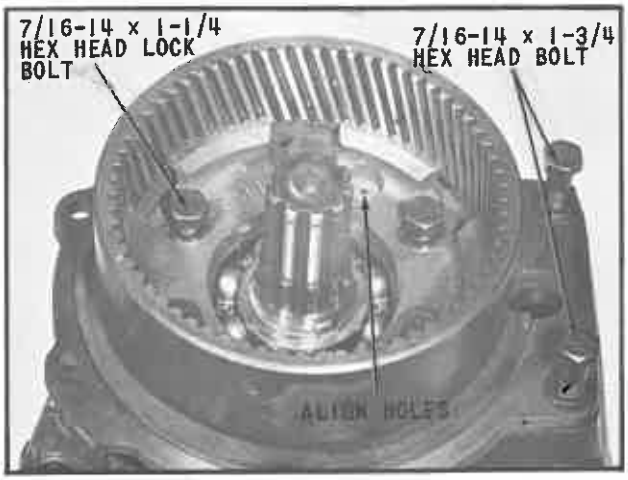


Fig. 23 Bolting Reduction Unit Adapter to Transmission Case

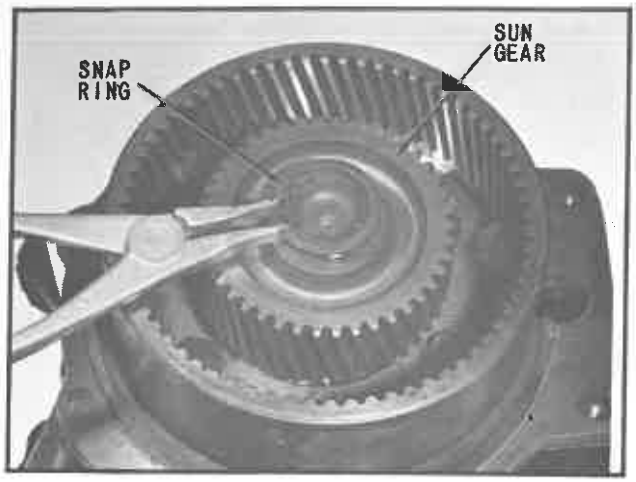


Fig. 24 Installing Snap Ring

NOTE: Bearings are received in matched sets and match marks must check. One bearing cone will have a number with an "A" suffix, the other will have the same number without the "A" suffix. The outer race will have the same number with the suffix "A" on one end and no number on the other end. The parts with the "A" suffix should be placed together (Fig. 26) and the end of the outer race with no number should be placed with the bearing cone without the "A" suffix.

19. Install the first row of the tapered bearing so that the outer ring rests against the shoulder in the reduction housing.

20. Lubricate the outer diameter of outer race with automatic transmission fluid and press it into the reduction housing, using a suitable tool as shown in (Fig. 27), until the outer race is seated firmly against the shoulder in the reduction housing.

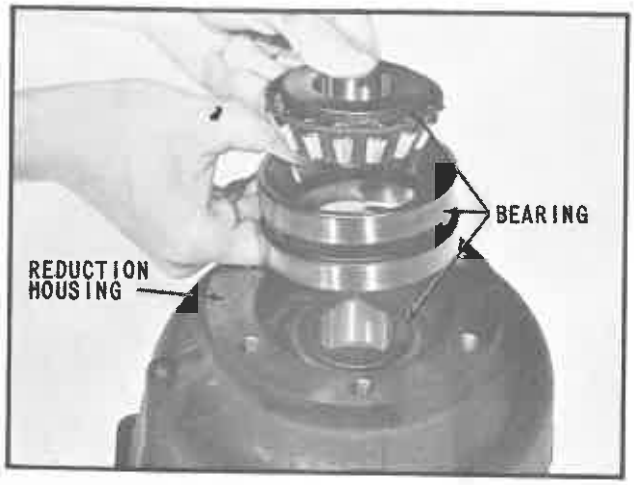


Fig. 25 Assembling Bearing into Reduction Housing

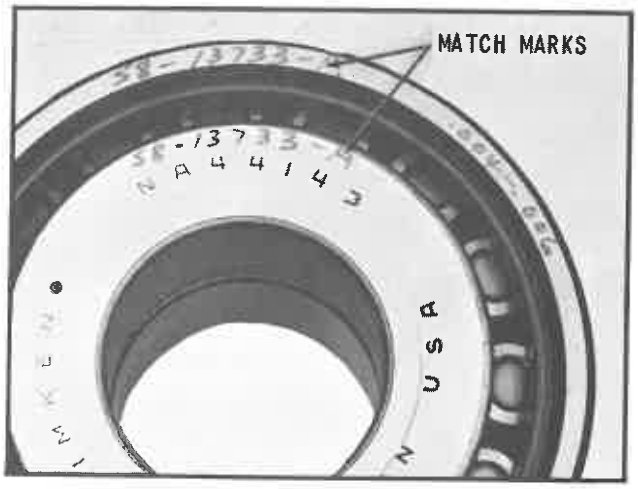


Fig. 26 Inspecting Bearing Match Marks

21. Install the rear set of tapered rollers and check again for agreement of match marks.

ASSEMBLING BEARING RETAINER AND GASKET ONTO REDUCTION HOUSING

22. Place the bearing retainer gasket on the reduction housing, aligning the slot in the gasket with the oil hole in the housing (Fig. 28).

23. Inspect the rubber lip of oil seal for cuts, cracks, or other damage that could cause leakage, and replace if necessary. Assemble the bearing retainer on the reduction housing, aligning the oil passages as shown in (Fig. 28).

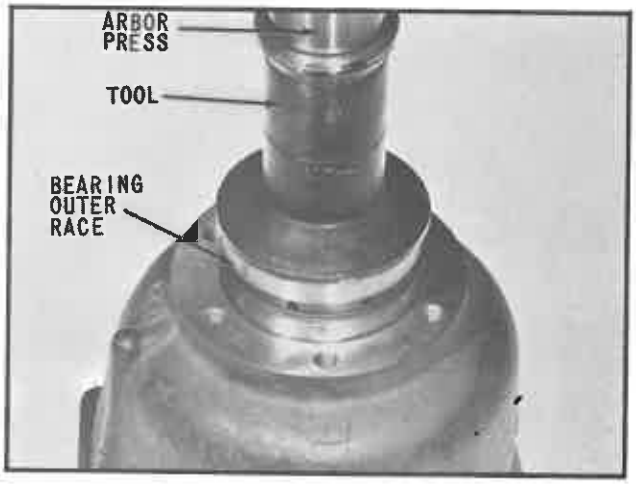


Fig. 27 Installing Outer Bearing Race

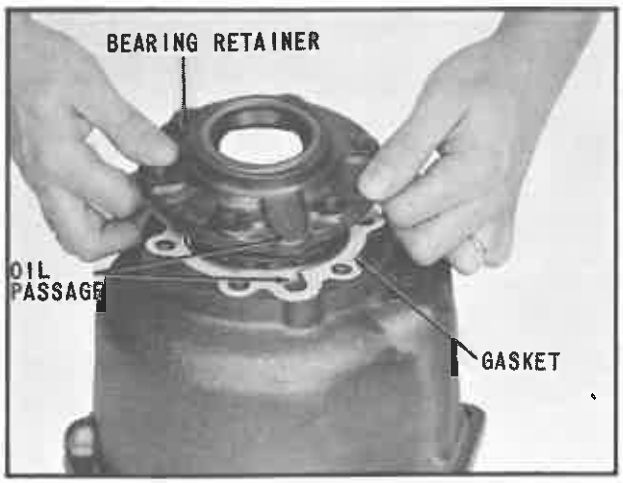


Fig. 28 Installing Bearing Retainer and Gasket

24. Install the six 7/16-14 x 1-1/4 hex head bolts and six 7/16 lock washers and tighten to specified torque.

ASSEMBLING MAIN SHAFT, COUPLING AND MAIN SHAFT NUT TO REDUCTION HOUSING

25. Install pinion cage and main shaft assembly into the bearing as shown in (Fig. 29). If the shaft does not assemble completely into rear bearing, do not use force. The shaft may be pulled fully into the bearing as the main shaft nut is assembled.

26. Inspect the coupling sealing diameter to make sure that there are no burrs or sharp edges, which might damage the seal or prevent proper sealing. Lubricate the sealing diameter and the internal splines with automatic transmission fluid. Align the splines of the coupling to those of the main shaft and press the coupling down until contact with the bearing inner race is made.

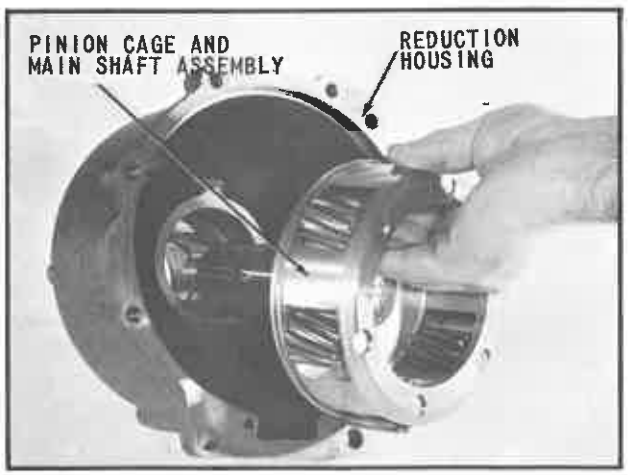


Fig. 29 Assembling Pinion Cage and Main Shaft Assembly

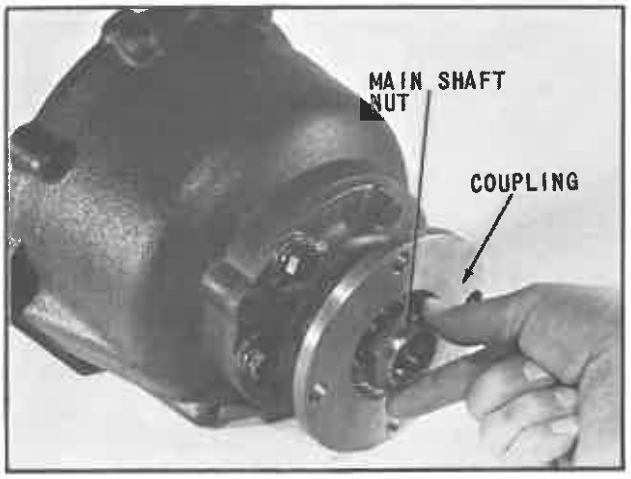


Fig. 30 Installing Coupling and Nut

27. Assemble the main shaft nut on output shaft (Fig. 30) and tighten to specified torque.

ASSEMBLY OF REDUCTION HOUSING, AND PINION CAGE AND MAIN SHAFT ASSEMBLY TO THE FORWARD AND REVERSE TRANSMISSION ASSEMBLY

28. Supporting the parts previously assembled in steps 1 through 17 on their front face on a clean flat surface or block, install the reduction housing adapter gasket-rear on the adapter as shown in (Fig. 31).

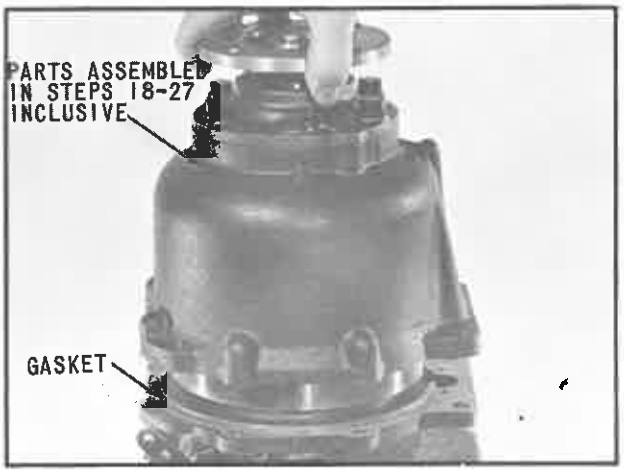


Fig. 31 Assembling Reduction Unit to Forward and Reverse Transmission

29. Install the parts assembled in steps 18 to 27 over the parts assembled in steps 1 through 17, by engaging the teeth of the sun gear and ring gear. Assemble until reduction housing bore is engaged with the pilot diameter of the reduction unit adapter. The bolt holes should be properly aligned in the completed assembly.

30. Install the two 7/16-14 x 1-3/4 hex head bolts and 7/16 lock washers, the six 3/8-16 x 1-1/8 hex head bolts and 3/8 lock washers as shown in (Fig. 32). Tighten bolts to specified torque.

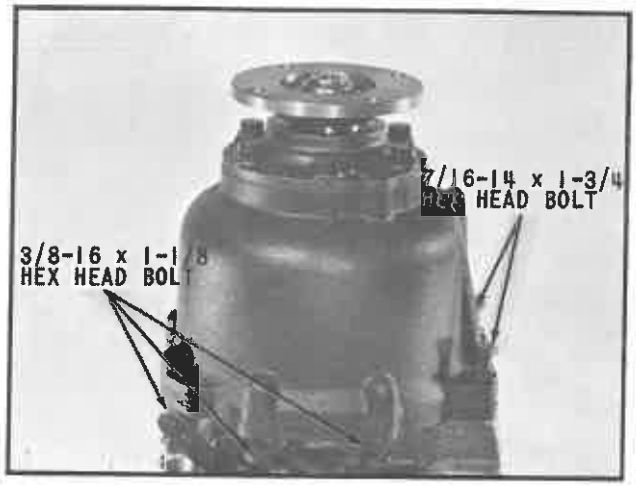


Fig. 32 Bolting Reduction Unit to Forward and Reversing Transmission

SPECIAL INFORMATION AND INSTRUCTIONS 2.57 & 2.91 REDUCTIONS

OUTPUT SHAFT VARIATIONS

Two output shaft and planetary cage assemblies have been used with the 2.57 and 2.91 reduction transmissions.

The present production shaft assemblies (L6-A2D and L7-A2D), having 24 involute splines and an outside diameter of 1.4908-1.420, replaced the earlier assemblies (L6-A2A and L7-A2A), having 10 straight sided splines and an outside diameter of 1.147-1.162.

Present production parts (L6-A2D and L7-A2D) and related parts are shown in parts list on (Page 7). Replacement parts for earlier transmissions having the 10 spline shafts must be ordered from the following parts list.

PARTS LIST FOR UNITS HAVING 10 SPLINED SHAFTS

INDEX NO.	PART NO.	PART NAME	NO. REQ'D.
116	L6-A2A	PINION CAGE ASSEMBLY (2.57 ONLY)	1
	L7-A2A	PINION CAGE ASSEMBLY (2.91 ONLY)	1
49	4775L	MAIN SHAFT NUT	1
50	4547BA	COUPLING (4") STD.70-71 OPT.72	1
	4547AY	COUPLING (5") STD.72 OPT. 70-71	1
113	4920A	BEARING (FORMERLY X3372)	1

VARIATIONS IN BREATHER ASSEMBLIES

The breather assembly, now located in the forward and reverse transmission case, was formerly located in the reduction housing. At this former location two different assemblies were used. 4740B (.498-.502 dia. hole) was a drive-in type, and AJ2-87 was a screw-on type for a 3/8 pipe thread.

SPECIAL SERVICE PARTS

NOTE: SPECIAL SERVICE KITS ARE AVAILABLE TO THE ORIGINAL EQUIPMENT MANUFACTURER FOR DISTRIBUTION TO THEIR VARIOUS DEALERS. THESE KITS OFFER CONVENIENCE IN REPAIRING THE VARIOUS 70, 71 AND 72 FORWARD AND REVERSE GEAR TRANSMISSIONS FOR WHICH OUR STANDARD MARINE WARRANTY HAS EXPIRED. THIS SECTION COVERS ONLY THE SPECIAL SERVICE KITS FOR REPAIR OF THE FIXED REDUCTION PORTION OF THE 2.57 AND 2.91 RATIO FORWARD AND REVERSE GEAR TRANSMISSIONS. FOR SPECIAL SERVICE KIT INFORMATION PERTAINING TO THE FORWARD AND REVERSE SECTION OF THE 2.57 AND 2.91 REDUCTION TRANSMISSIONS REFER TO THE APPROPRIATE 70C and 71C, or 72C DIRECT DRIVE MANUAL. ONLY THOSE DEALERS WHO ARE WELL QUALIFIED IN THE REPAIR OF THE MARINE TRANSMISSION SHOULD BE PERMITTED TO SERVICE PLANETARY GEAR SETS.

PLANETARY SERVICE KITS

These repair kits make possible the replacement of individual pinions and related parts of the planetary gear sets and eliminate the necessity of replacing the entire planetary assembly.

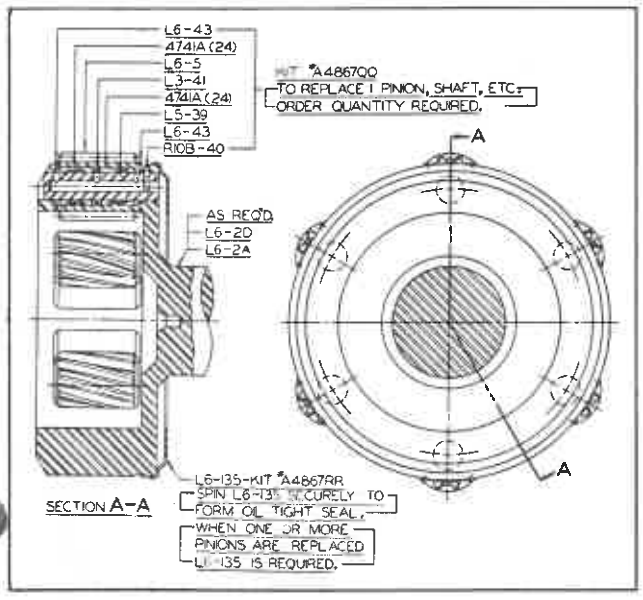
THE PARTS SHOWN IN KIT NUMBER A4867QQ (Fig. 33) SHOW THE PARTS REQUIRED TO REPLACE ONLY ONE PINION IN THE 2.57 REDUCTION PLANETARY ASSEMBLY. THE PARTS SHOWN IN KIT NUMBER A4867LL (Fig. 34) SHOW THE PARTS REQUIRED TO REPLACE ONLY ONE PINION IN THE 2.91 REDUCTION PLANETARY ASSEMBLY. IN EACH PLANETARY ASSEMBLY THE PROPER SEPARATE KITS MUST BE ORDERED FOR EACH PINION WHICH IS TO BE REPLACED.

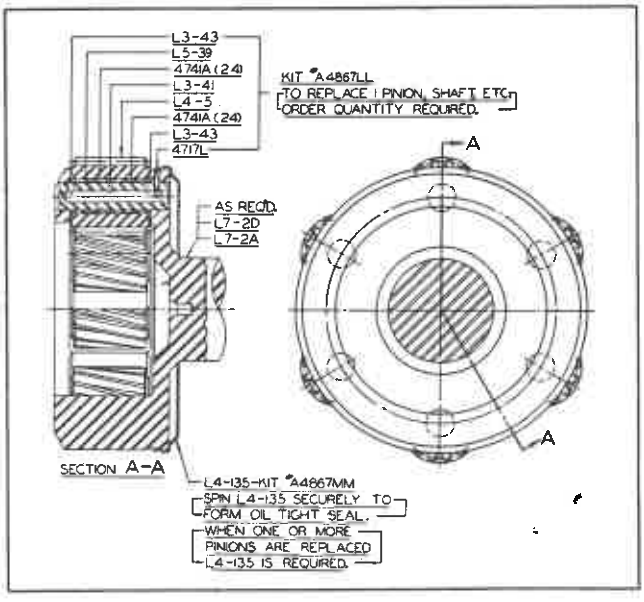
NOTE: In disassembling the individual gear sets the pinion shaft pin retaining the pinion pin should be removed intact after the removal of the oil collector ring. The pinion shaft pin should not be removed by pounding on the end of the pinion pin to break the retaining pin, as this distorts the immediate area of the pinion carrier and will produce a damaged thrust surface and improper pinion end clearance when the planetary is reassembled.

OIL COLLECTOR RING KIT

After assembly of the individual pinions in the planetary, the oil collector ring must be assembled and securely fastened to the planetary carrier. The oil collector ring which was removed to repair the planetary assembly should always be discarded and replaced with a new part, (A4867MM) or (A4867RR) as required.

NOTE: WHERE NEEDED ASSEMBLY INSTRUCTION SHEETS ARE INCLUDED IN THE SERVICE KITS.





Warner Gear

GENERAL OFFICES, 1106 EAST SEYMOUR STREET, MUNCIE, INDIANA 47302, TELEPHONE: 317/284-8411

BORG WARNER

MARINE TRANSMISSION STANDARD WARRANTY TO ENGINE MANUFACTURERS

Seller guarantees its products against defective material or workmanship for a period of 12 months or 400 hours whichever occurs first from date of delivery to the first owner-operator. Seller's obligation under this guarantee is limited to replacement or repair of any defective material when returned f.o.b. Seller's factory at Muncie, Indiana and shall be subject to Seller's inspection and verification of claim.

Purchasers of engines or boats using our products should follow the procedure designated in the warranty policy supplied by the company from whom the product was purchased.

WARNER GEAR
Division of Borg-Warner Corporation
Muncie, Indiana