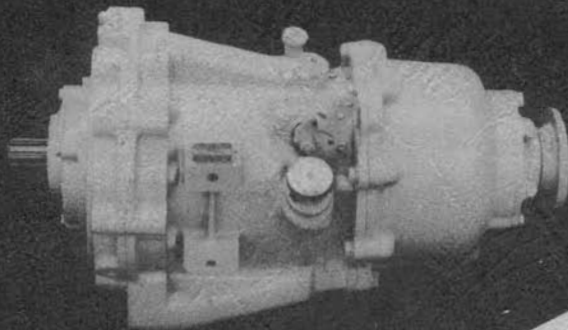


SERVICE MANUAL

VELVET DRIVE[®]

HYDRAULIC TRANSMISSION

REDUCTION GEAR ASSEMBLY
2100 : 1 RATIO



WARNER GEAR

marine
transmissions



Muncie, Indiana • DIVISION OF BORG WARNER CORPORATION

PRICE \$1.50

"VELVET DRIVE"[®]

HYDRAULIC TRANSMISSION

REDUCTION GEAR ASSEMBLY

2.100:1 RATIO

Service Manual Supplement for 2.100 to 1 Reduction Units, for either right hand or left hand rotation units. This manual to be used in conjunction with models 70, 71 and 72 Service Manuals which will have slight variations as noted in this supplement.

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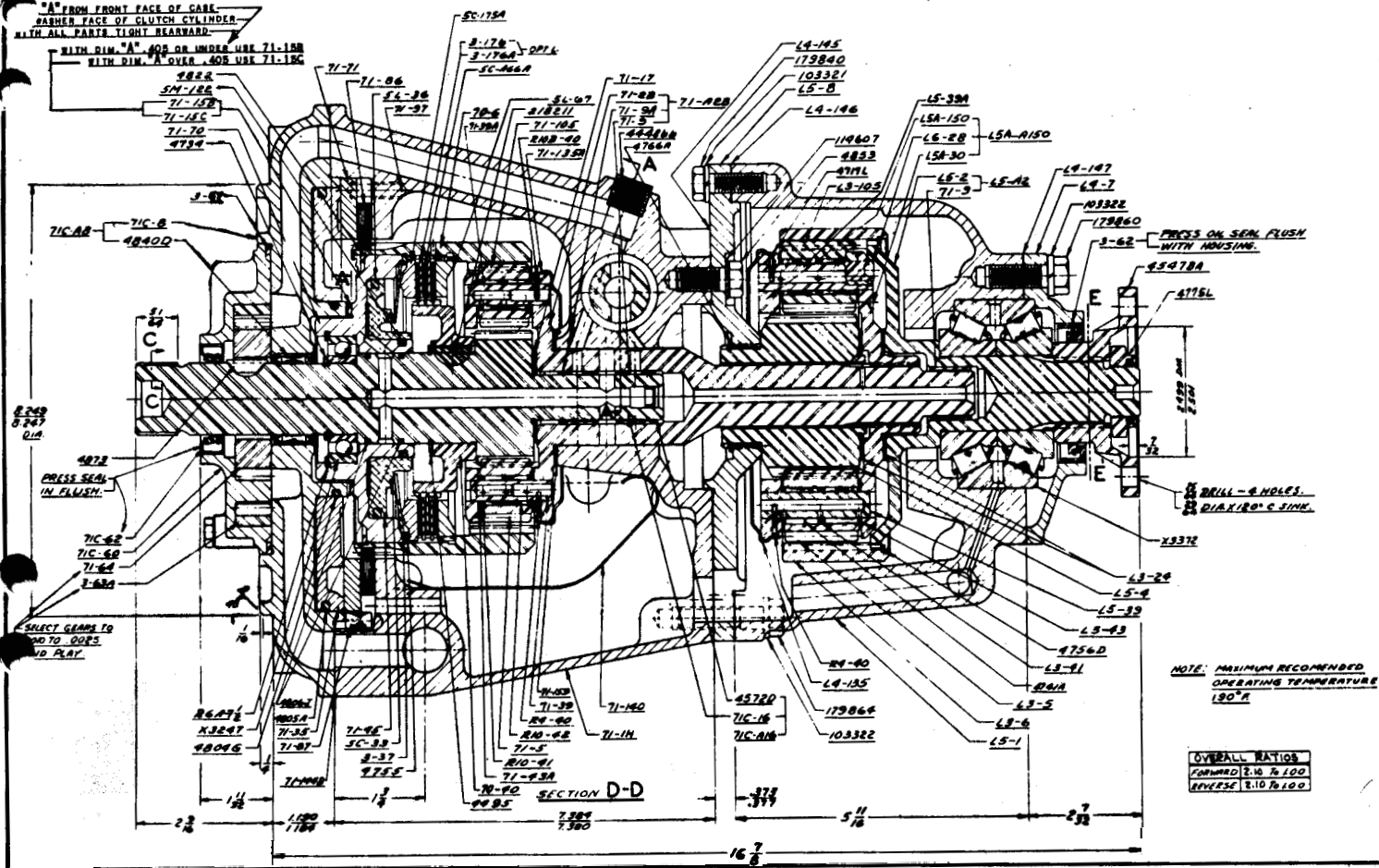


Fig. 1 Cross Section of AS3-70C Transmission

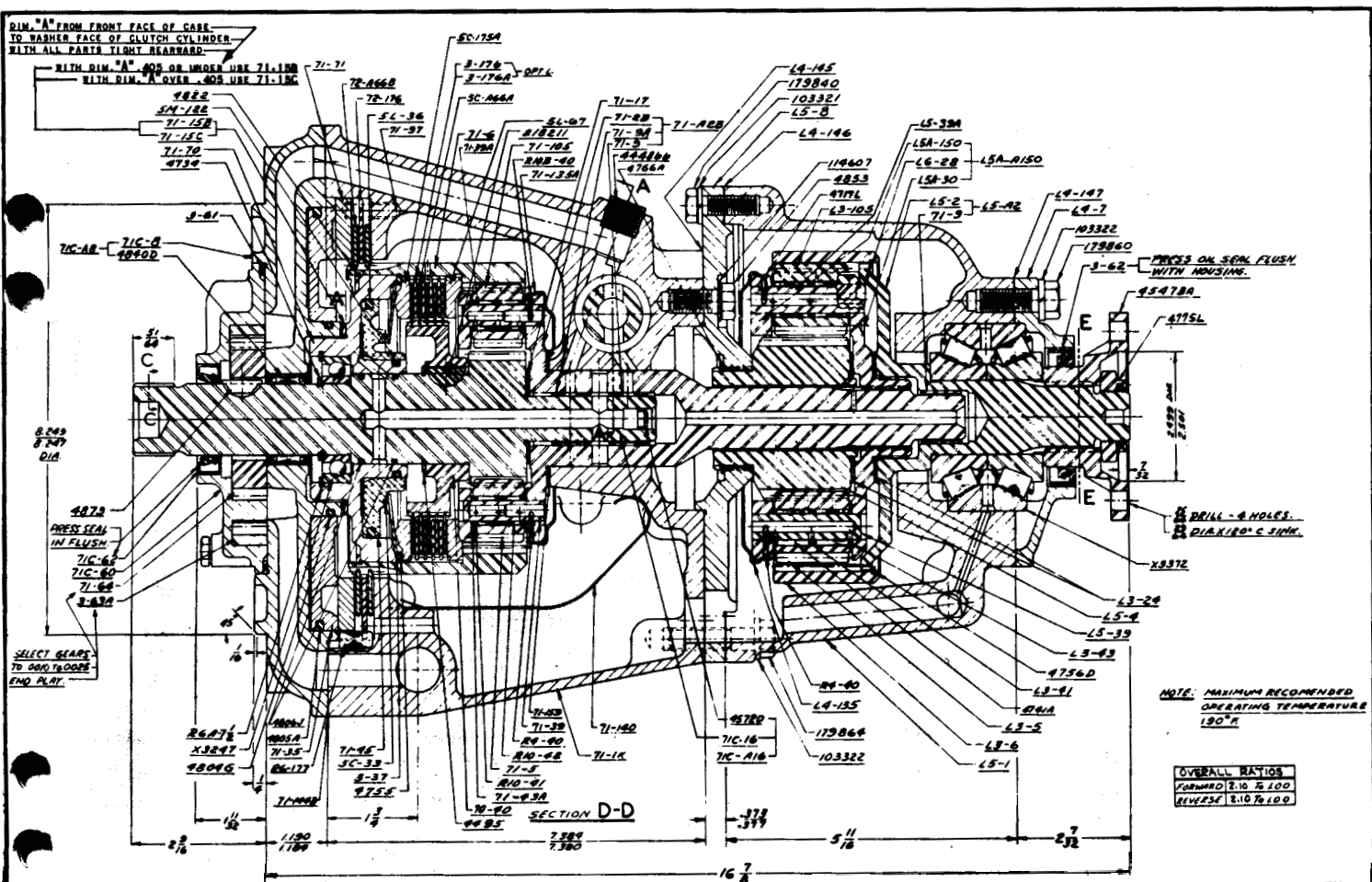


Fig. 2 Cross Section of AS3-71C Transmission

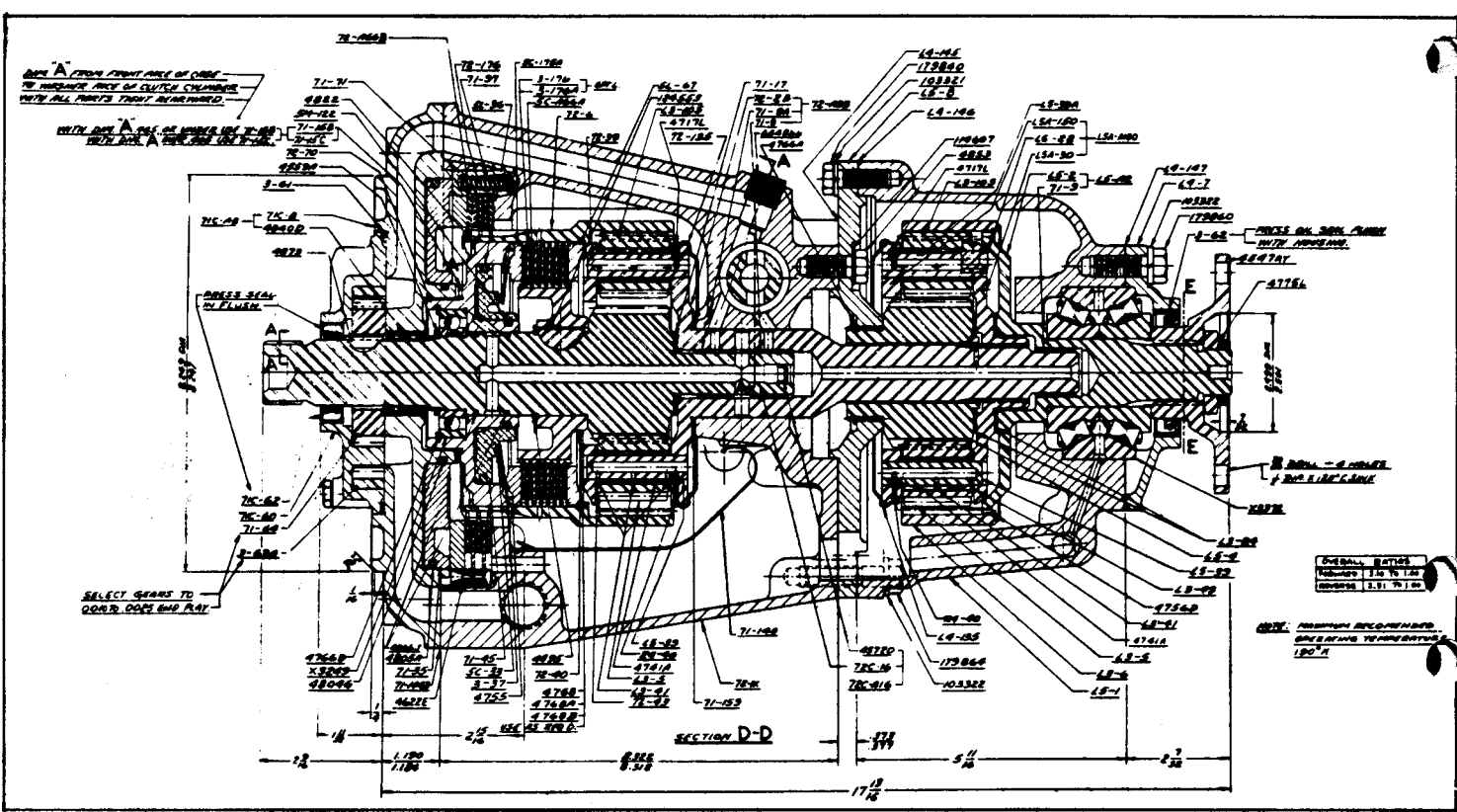


Fig. 3 Cross Section of ASI3-72C Transmission

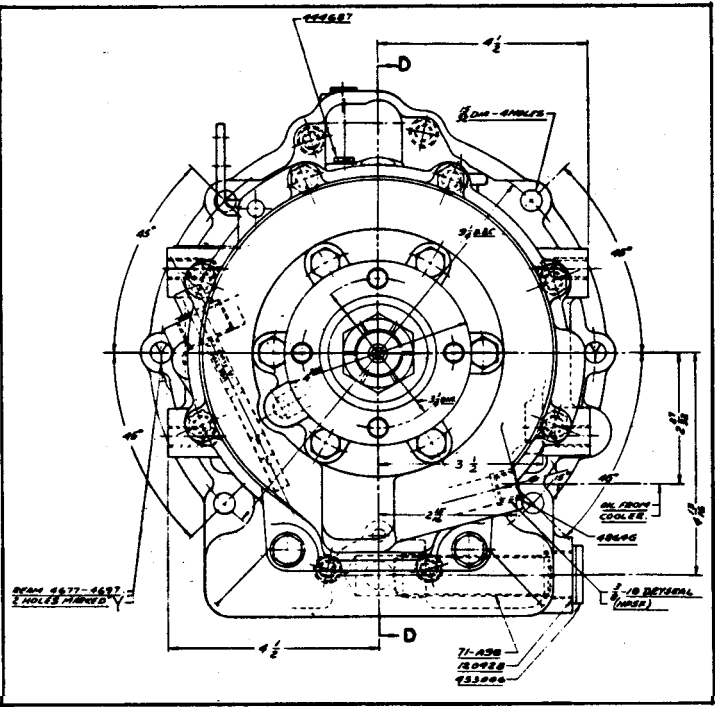


Fig. 4 Rear View of Model 70C & 71C Transmissions

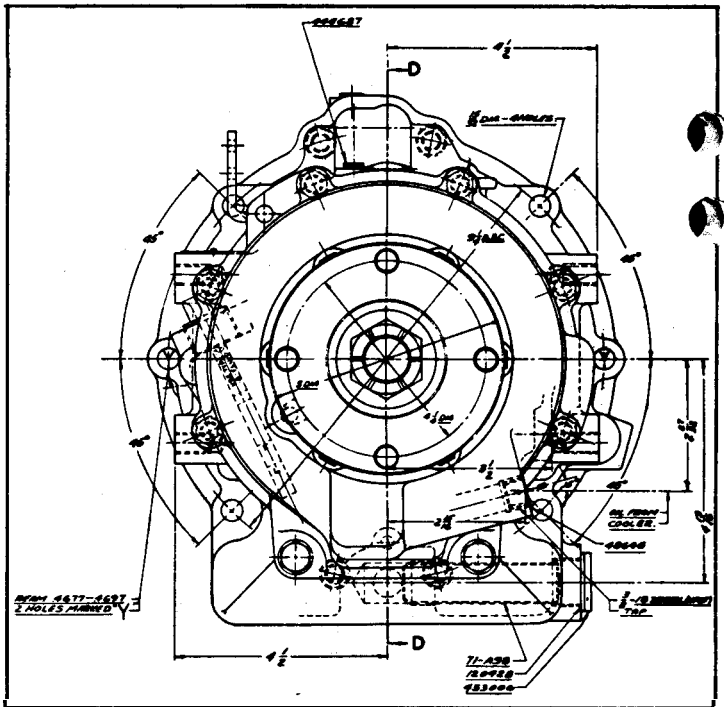


Fig. 5 Rear View of Model 72C Transmission

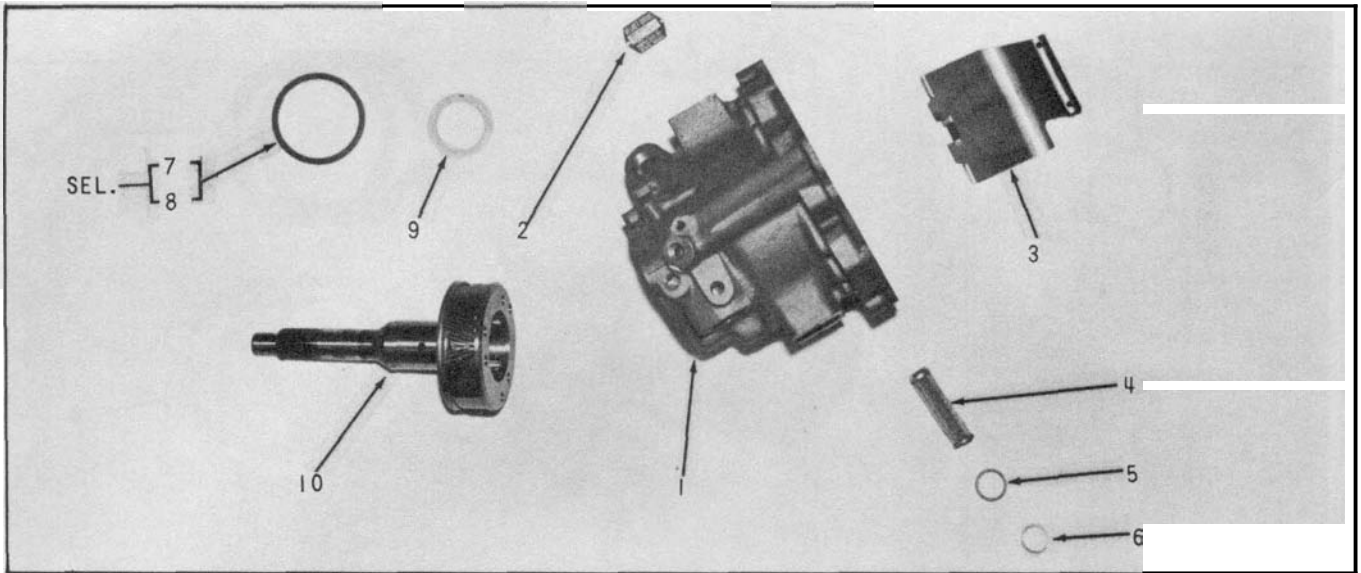


Fig. 6 Parts Display for Forward & Reverse Section of the AS3-70C Transmission.
Only Those Parts Different from the ASI-70C Assembly Illustrated..

INDEX NO.	PART NO.	PART NAME	INDEX NO.	PART NO.	PART NAME	NO. REQ'D
1	71-1H	TRANSMISSION CASE	1	6	OIL DRAIN PLUG	1
2	4636EZ	NAME PLATE	1	7	71-15B	1
3	71-140	BAFFLE	1	8	71-15C ^{or}	1
4	71-A98	OIL STRAINER ASSEMBLY	1	9	71-159	1
5	120428	ANNULAR GASKET	1	10	71-1A2B	1

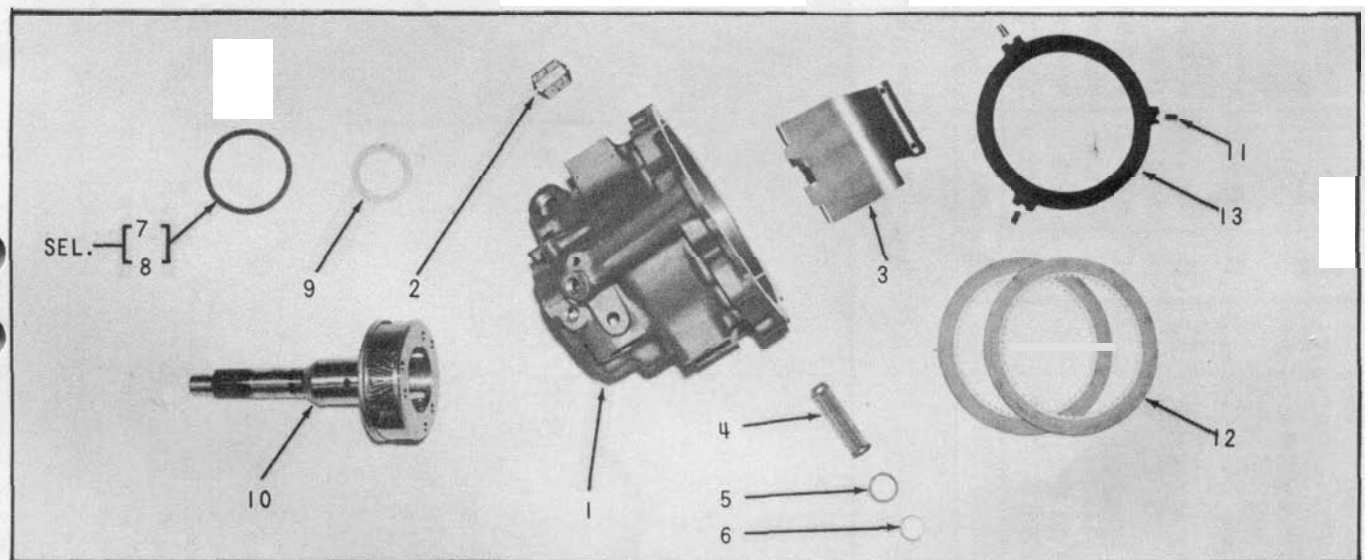


Fig. 7 Parts Display for Forward & Reverse Section of the AS3-71C Transmission.
Only Those Parts Different from the ASI-71C Assembly are Illustrated.

INDEX NO.	PART NO.	PART NAME	NO. REQ'D	INDEX NO.	PART NO.	PART NAME	NO. REQ'D
1	71-1K	TRANSMISSION CASE	1	9	71- 59	THRUST WASHER	1
2	4636FG	NAME PLATE	1	10	71-1A2B	PINION CAGE & OUTPUT SHAFT ASS'Y.	1
3	71-140	BAFFLE	1	11	R6-177	DOWEL PIN	3
4	71-A98	OIL STRAINER ASSEMBLY	1	12	72-A66B	REVERSE CLUTCH PLATE	2
5	120428	ANNULAR GASKET	1	13	72-176	OUTER CLUTCH PLATE	1
6	453006	OIL DRAIN PLUG	1				
7	71-15B						
8	71-15C ^{or}	SELECTIVE THRUST WASHER	1				

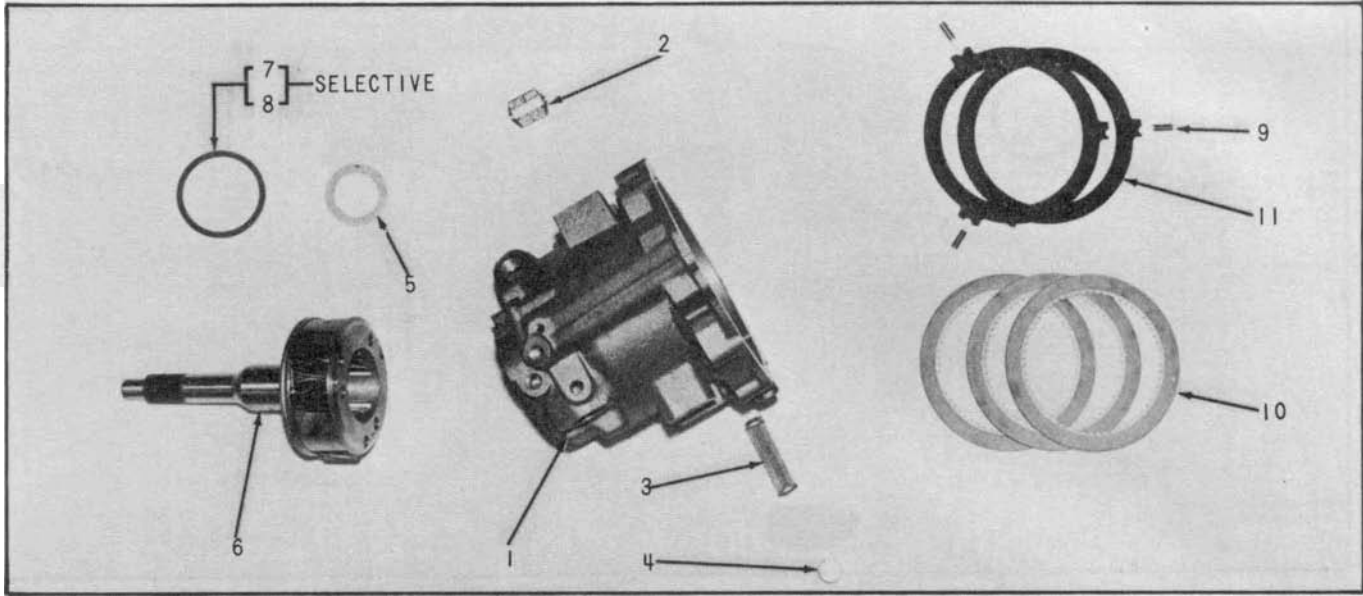


Fig. 8 Parts Display for Forward & Reverse Section of the AS13-72C Transmission. Only Those Parts Different from the AS11-72C Assembly are Illustrated.

INDEX NO.	PART NO.	PART NAME	NO. REQ'D	INDEX NO.	PART NO.	PART NAME	NO. REQ'D
1	72-1K	TRANSMISSION CASE	1	7	71-15B	SELECTIVE THRUST WASHER	1
2	4636FU	NAME PLATE	1	8	71-15C		
3	71-A98	OIL STRAINER ASSEMBLY	1	9	46228	DOWEL PIN	3
4	453006	OIL DRAIN PLUG	1	10	72-A66B	REVERSE CLUTCH PLATE	3
5	71-159	THRUST WASHER	1	11	72-176	OUTER CLUTCH PLATE	2
6	72-1A2B	PINION CAGE & OUTPUT SHAFT	1				

DESCRIPTION

The 2.100 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.

The reduction gear box consists of a planetary gear set which is always engaged and reduces the input revolution by a 2.100 to 1 ratio. The splined output shaft of the reduction gear box is coaxial with the input shaft of the main unit and with the transmission operating in forward its direction of rotation is the same as that of the engine rotation. Lubricating oil is supplied by the pump in the main transmission and is returned to the main transmission by gravity and jet flow.

Location of several transmission details are shown in (Figures 10 and 11). as follows:

- A. Oil Filler Plug
- B. Oil outlet Opening to Cooler
- C. Oil Inlet Opening from Cooler
- D. Mountings Pads and Mounting Bolt Holes
- E. Shift Lever
- F. Oil Drain Cap
- G. Breather
- H. Drive Gear
- I. Valve Cover
- J. Coupling
- K. Oil Pump
- L. Reduction Gear Box

CAUTION

NOTE: Either item 17 or 18 on the preceding page is used depending upon the transmission rotation. As can be seen by checking the two parts in Figure 9 the pinion placement is different for the two assemblies.

DO NOT USE THE WRONG ASSEMBLY

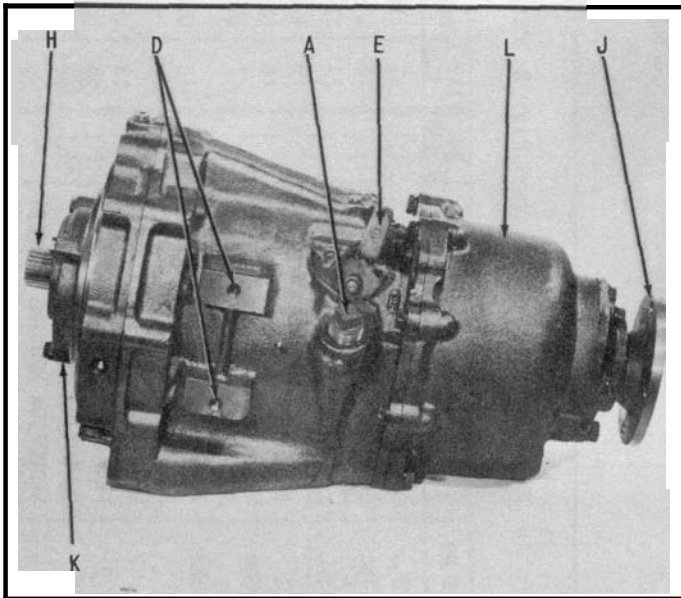


Fig. 10 Left Side of Transmission

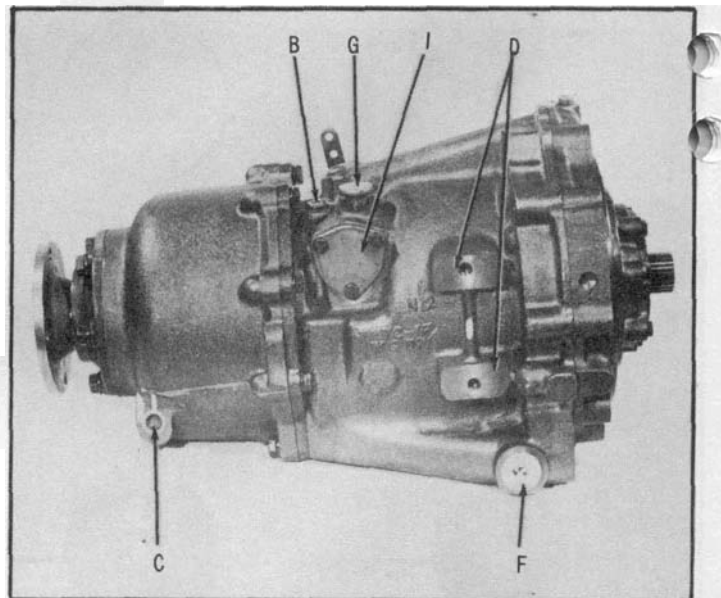


Fig. 11 Right Side, of Transmission

DISASSEMBLY OF TRANSMISSION

REMOVAL OF REDUCTION HOUSING, RING GEAR AND MAIN SHAFT ASSEMBLY

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.

NOTE: A transmission stand similar to the one shown in (Fig. 12) may be built from one inch angle iron. One piece is placed to hold the transmission from sliding forward and a second angle is placed to support the case just forward of the reduction unit adapter. The two angles may be welded to any suitable supporting pieces.

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, ring gear and main shaft assembly rearward off the transmission.

REMOVAL OF PINION CAGE ASSEMBLY

4. Remove thrust washer from rear of planet cage.
5. Slide planet cage assembly rearward from unit.
6. Remove thrust washer from rear of sun gear.

REMOVAL OF REDUCTION UNIT ADAPTER AND SUN GEAR ASSEMBLY

7. Remove six lock bolts and lock-washers that retain reduction unit adapter, then remove adapter and sun gear assembly from forward and reverse transmission.

8. Remove snap ring from sun gear, then remove sun gear from reduction unit adapter.

DISASSEMBLY OF RING GEAR, MAIN SHAFT, COUPLING AND BEARING FROM REDUCTION HOUSING

9. Remove main shaft nut and coupling and slide ring gear and main shaft from reduction housing.
10. Remove snap ring and main shaft from ring gear.
11. Remove bearing retainer after removing six hex head bolts and lock-washers that retain it.
12. Lift rear bearing cone from its cup.
13. The outer race and front cone can be pressed from reduction housing on an arbor press. Press on rear face of front bearing cone while reduction housing is supported on its rear face on a clean flat surface.

DISASSEMBLY OF FORWARD & REVERSE TRANSMISSION

14. Follow disassembly procedures given in Service Manual 'Velvet Drive' Hydraulic Transmission either Model 70, 71, or 72 as required for disassembly of forward and reverse transmission.

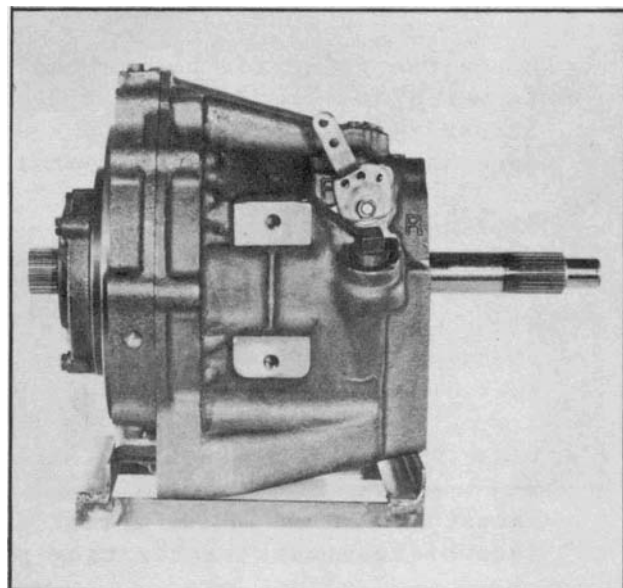


Fig. 12 Transmission on stand

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 the 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' 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 rubber parts will slide more freely if lubricated.
6. Tighten all bolts and screws evenly to the recommended torque. (see page 16).
7. All pinion cage service instructions are covered in the Service Manual 'Velvet Drive' Hydraulic Transmission under Pinion Cage Service Instruction sheets.

ASSEMBLY OF TRANSMISSION

ASSEMBLY OF PINION CAGE & OUTPUT SHAFT IN THE TRANSMISSION CASE

Place the reduction housing on its forward face, and then set the transmission case so that its rear face is supported on the rear face of the reduction housing. This will provide proper support for the transmission case during the assembly of the forward and reverse unit when the pinion cage and output shaft assembly protrudes from the rear of the case.

2. Coat steel back of thrust washer with petroleum jelly. Install thrust washer on inside thrust surface of case with washer tang pos-

itioned in case groove as shown in (Fig. 13).

3. Install pinion cage and output shaft flush against thrust washer as shown in (Fig. 14). Avoid rotation of pinion cage and output shaft during assembly as it tends to unseat washer tang from its groove.

NOTE: Pinion cage and output shaft assembly (72-1A2B) is now being supplied with three oil grooves around the large shaft diameter as shown in (Fig. 15). This new shaft can be used to replace earlier shafts. However the earlier shafts without the grooves must not be used with the latest forward and reverse.

transmission cases supplied without 71-28R bushings.

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

SELECTION OF PROPER THRUST WASHER FOR SATISFACTORY END CLEARANCE

5. Forward and reverse unit end clearance should be checked by placing an indicator on either input shaft or output shaft as shown in (Fig. 16). Shove all parts to front of case, set indicator on zero, and then move all parts to rear of case by pushing on drive gear. End clearance should read between .004 and .043 inch.
6. Replace selective thrust washer if necessary to bring end play within above limits.

NOTE: End play checked during disassembly permits selection of correct washer during reassembly.

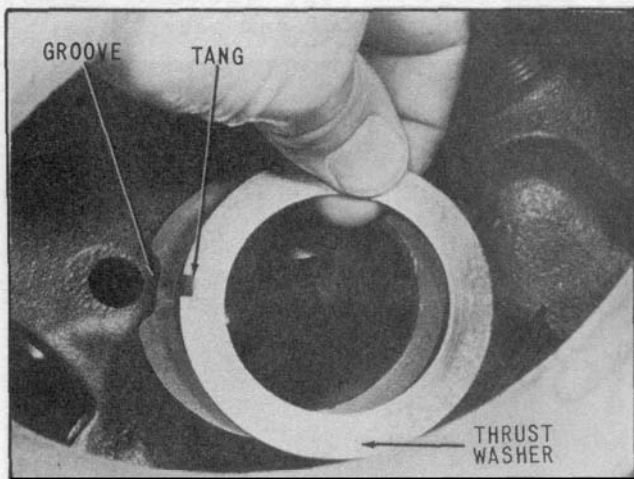


Fig. 13 Thrust Washer with Tang and Groove Aligned

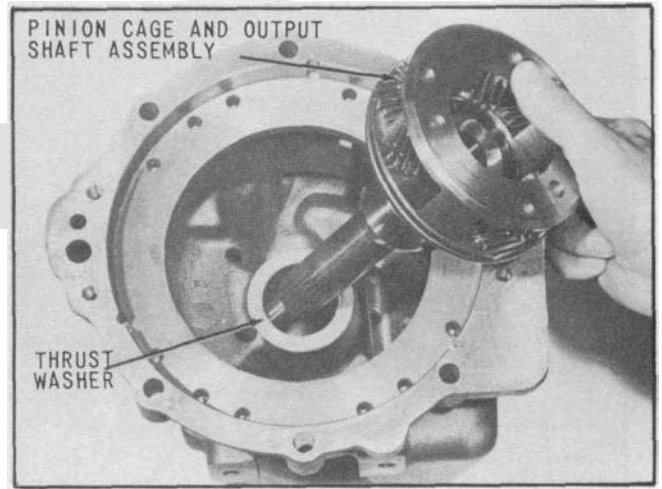


Fig. 14 Installing Pinion Cage and Output Shaft

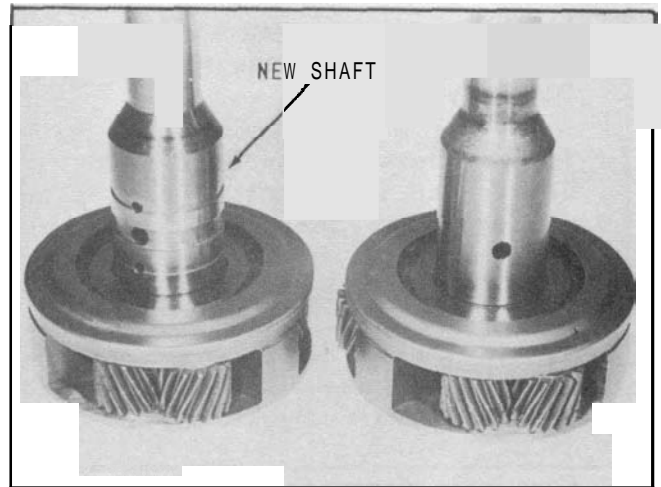


Fig. 15 Late and Early Model Pinion Cage and Output Shafts

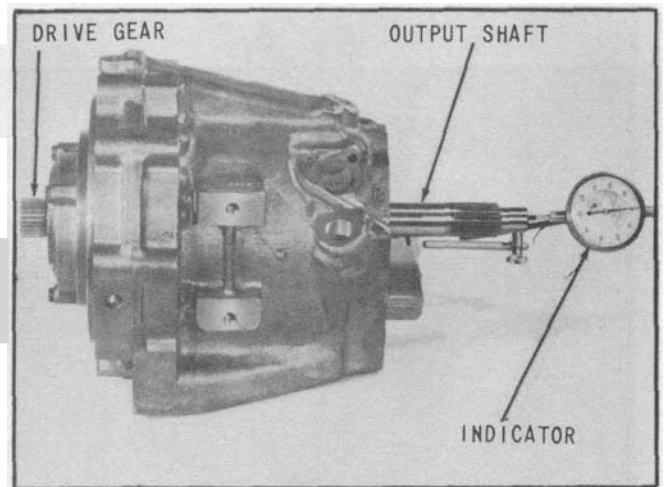


Fig. 16 Checking End Play

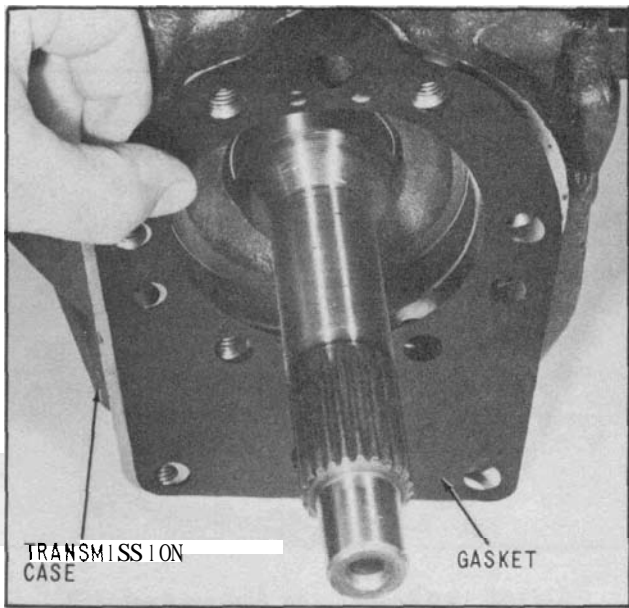


Fig. 17 Installing Reduction Unit Adapter Gasket-Front

ASSEMBLY OF SUN GEAR AND REDUCTION UNIT ADAPTER ON FORWARD & REVERSE TRANSMISSION CASE.

7. Support Forward and Reverse transmission on its front face or place it upright on bench with an inch block under back of transmission to give clearance needed for assembling reduction unit parts. A transmission stand may also be used as described in the disassembly section of this manual.
8. Coat rear face of case with petroleum jelly and install reduction unit adapter gasket-front on rear face of transmission case as shown in (Fig. 17).

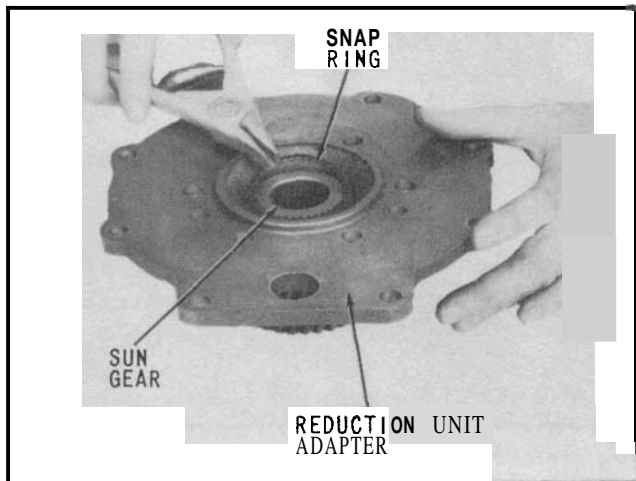


Fig. 18 Installing Sun Gear Snap Ring

9. Slide sun gear splines into reduction unit adapter splines until gear bottoms on shoulder of adapter.
10. Support reduction unit adapter and sun gear on rear face of sun gear and install snap ring firmly into its groove as shown in (Fig. 18).
11. Install adapter and sun gear over the transmission output shaft and locate pilot of adapter into bore provided in rear of transmission case.
12. Assemble the two 7/16-14 x 1-3/4 hex head bolts to insure correct alignment, but do not tighten.
13. Install six NEW 7/16-14 x 1 nylock bolts and external tooth lockwashers shown in (Fig. 19). Tighten bolts evenly and torque to 42-50 pounds-foot.
14. Remove the two 7/16-14 x 1-3/4 hex head bolts, which were installed in step (6).

ASSEMBLY OF PINION CAGE ASSEMBLY TO TRANSMISSION

15. Install the thrust washer on hub of sun gear as shown in (Fig. 20).
16. Engage pinion gears with sun gear teeth as planet cage assembly is slowly rotated to align pinion cage splines with output shaft splines, then bottom cage against thrust washer on rear of sun gear.

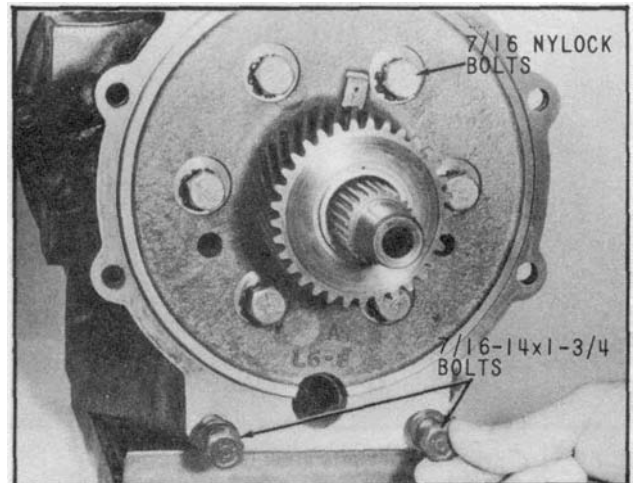


Fig. 19 Removing the Two 7/16 inch Bolts After Tightening the 6 Nylock Bolts

CAUTION: Two planetary cage and pinion sub-assemblies are available for the 2.100-1 ratio reduction units. Selection of proper sub-assembly is dictated by direction of transmission rotation. Part numbers and matching direction of rotation are shown in (Fig. 9). Correct cage assembly must be used at all times. The pinions are located differently in the two assemblies.

17. Install thrust washer on the hub of pinion cage as shown in (Fig. 21).

ASSEMBLY OF RING GEAR TO MAIN SHAFT

18. Install mainshaft into ring gear.
19. Assemble snap ring firmly into ring gear groove as shown in (Fig. 22).

20. Assemble ring gear and mainshaft over pinion carrier rotating the ring gear to properly align gear teeth as the ring gear slides onto the pinion gears.

ASSEMBLY OF BEARING INTO THE REDUCTION HOUSING

21. Place the reduction housing on an arbor press, resting the front face on a clean flat surface.
22. Install the first row of tapered bearing so that inner ring rests against the shoulder in the reduction housing. The relationship of the bearing parts are shown in (Fig. 23).

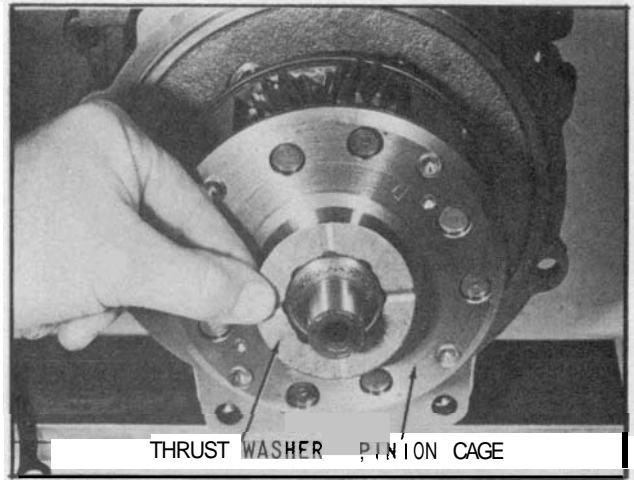


Fig. 21 Installing Pinion Cage Thrust Washer

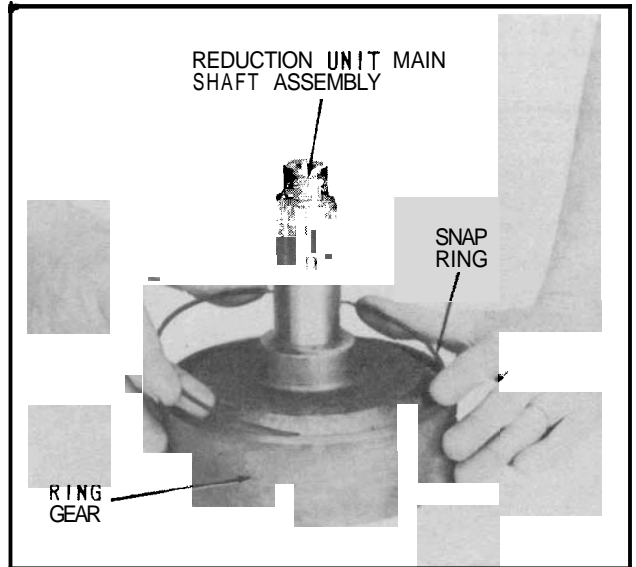


Fig. 22 Assembling Snap Ring

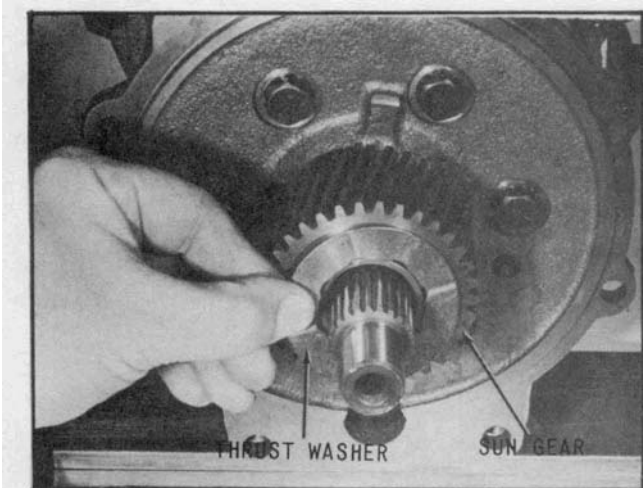


Fig. 20 Installing Sun Gear Thrust Washer

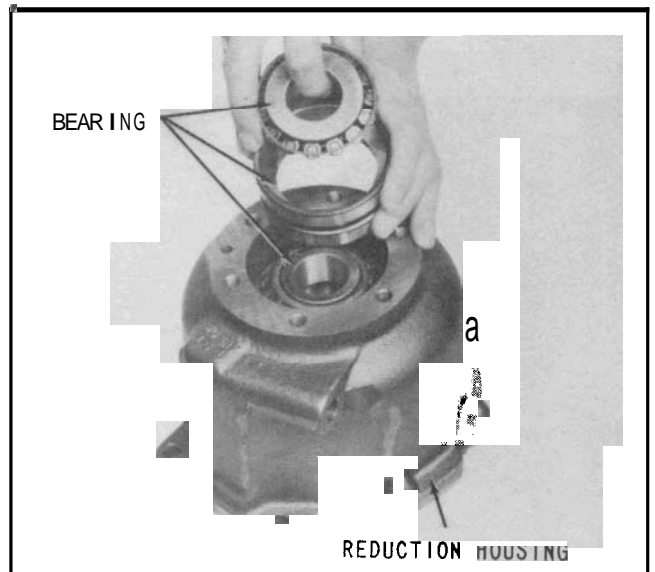


Fig. 23 Assembling Bearing into the Reduction Housing

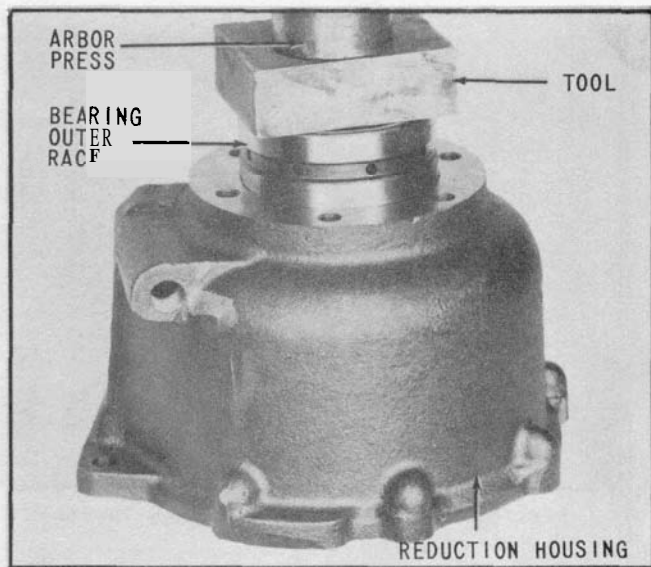


Fig. 24 Installing Outer Bearing Race

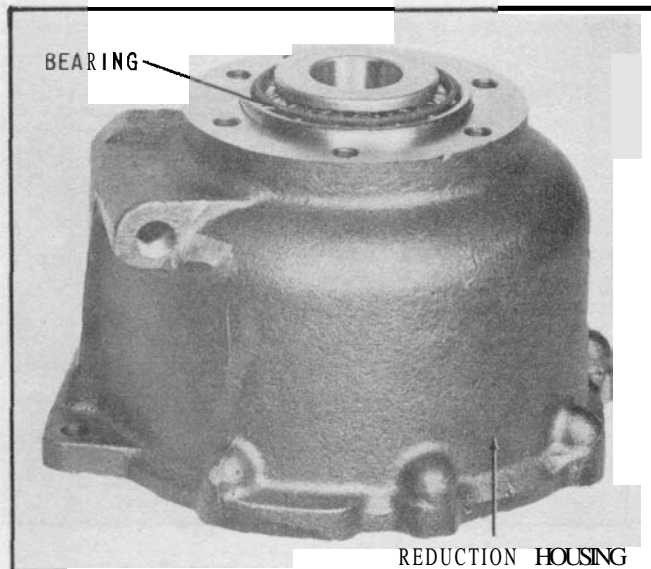


Fig. 25 Installing Rear Inner Bearing Race

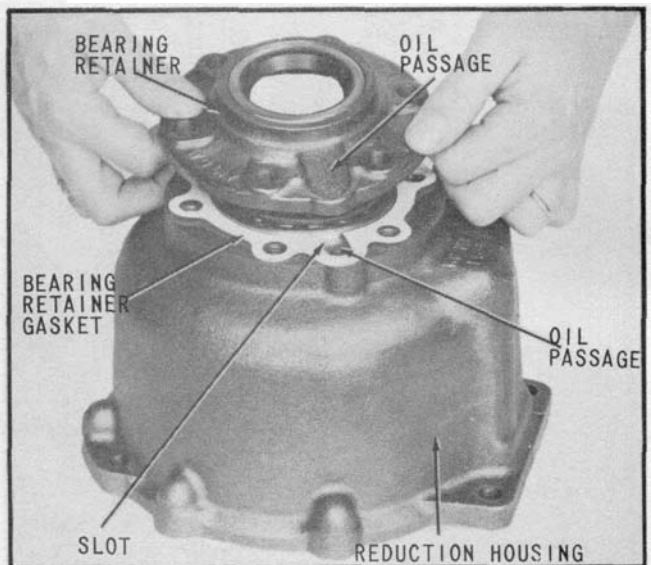


Fig. 26 Installing Bearing Retainer and Gasket

NOTE: Bearings are received in matched sets and match marks should 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 and the end of the outer race with no number should be placed with the bearing cone without the 'A' suffix.

23. Lubricate the outer diameter of the outer race with automatic transmission fluid, then using a suitable tool as shown in (Fig. 24) press race in until it is firmly seated against shoulder in the reduction housing.

24. Install the rear bearing cone into the outer race as shown in (Fig.25).

ASSEMBLY OF MAIN SHAFT ASSEMBLY, BEARING RETAINER, COUPLING AND MAIN SHAFT NUT IN REDUCTION HOUSING

25. Place bearing retainer gasket on reduction housing, aligning the slot with the passages as shown in (Fig. 26). Gasket may be coated with petroleum jelly for easier assembly.

26. Inspect rubber lip of the oil seal for cuts, cracks or other damage which might cause leakage and replace if necessary. Oil seal is pressed in flush with the rear retainer face. Assemble the bearing retainer onto reduction housing aligning the oil passages as shown in (Fig. 26).

27. Install the six 7/16-14 x 1-1/4 hex head bolts and lockwashers and torque to 42-50 pounds feet as shown in (Fig. 27).

ASSEMBLY OF REDUCTION HOUSING, RING GEAR AND MAIN SHAFT ASSEMBLY TO THE FORWARD AND REVERSE TRANSMISSION

28. Use petroleum jelly to hold reduction housing gasket-rear in position as shown in (Fig. 28).
29. Assemble reduction housing and bearing assembly over output shaft and position it against rear face of the reduction adapter.
30. Install the six 3/8-16 x 1-1/8 hex head bolts and lockwashers and the two 7/16-14 x 1-3/4 hex head bolts and lockwashers as shown in (Fig. 29). Torque the 7/16 bolts to 42-50 pounds feet and the 3/8 bolts to 27-32 pounds feet.
31. Inspect coupling sealing diameter to make sure that there are no burrs or sharp edges which might damage the oil seal or prevent proper sealing, replace if damaged. Lubricate the sealing diameter and internal splines with automatic transmission fluid. Align splines of coupling to those of the main shaft and press coupling down until contact with bearing inner race is made.
32. Assemble main shaft nut as shown in (Fig. 30) and tighten to 100-200 pounds feet.

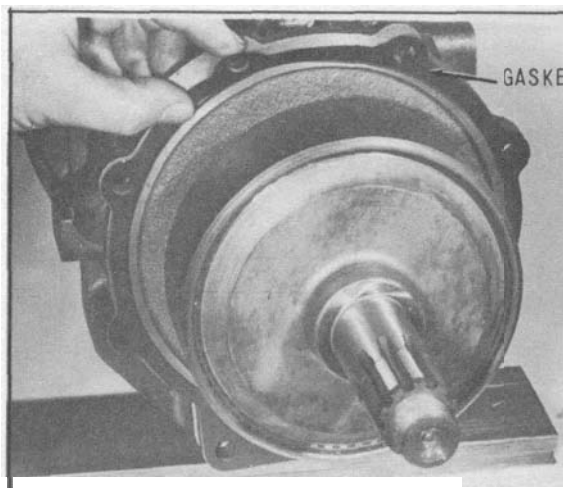


Fig. 28 Installing the Reduction Housing Gasket-Rear

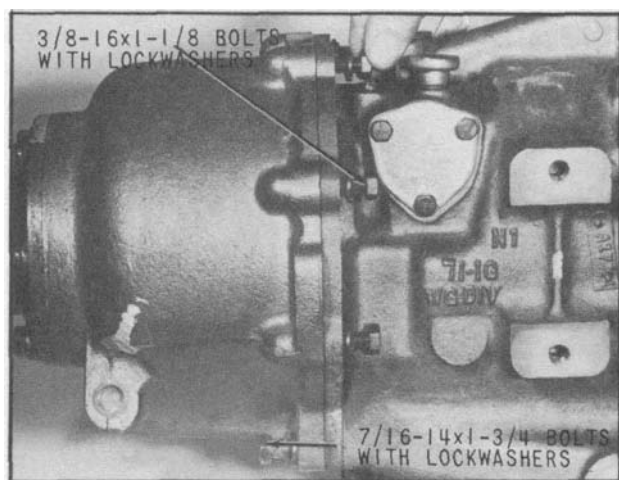


Fig. 29 Installing Reduction Housing Retaining Bolts

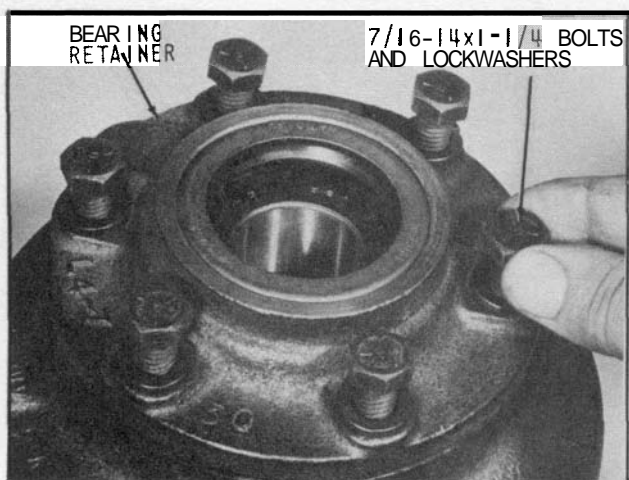


Fig. 27 Installing the Six 7/16 Hex Head Bolts and Lockwashers

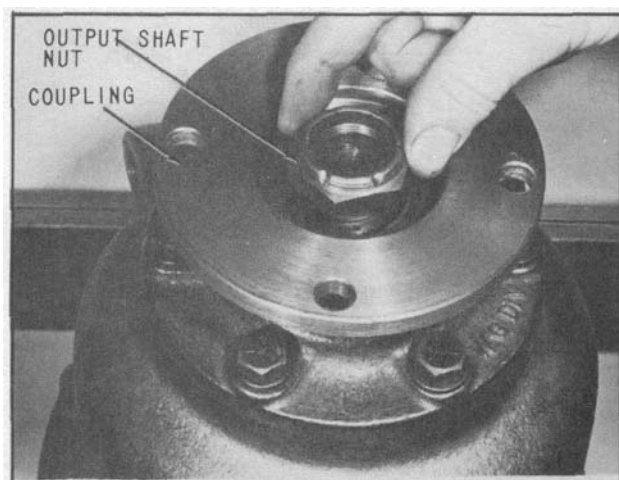


Fig. 30 Installing Output Shaft Nut

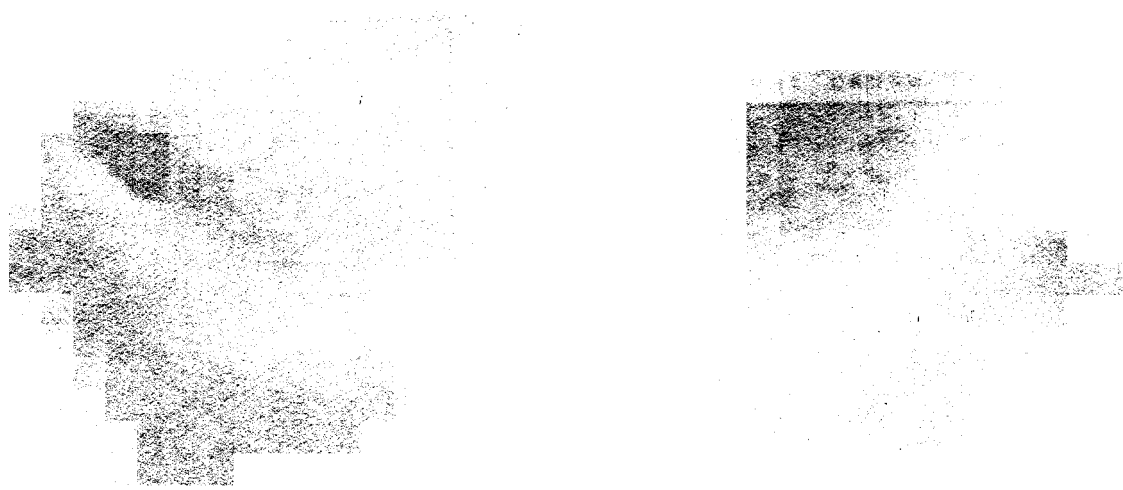
TORQUE SPECIFICATIONS

PART NUMBER	DESCRIPTION	APPLICATION	TORQUE LBS. FT.
179840	3/8-16 x 1-1/4 HEX HEAD BOLT	REDUCTION ADAPTER TO REDUCTION HOUSING	27-32
179860	7/16-14 x 1-1/4 HEX HEAD BOLT	BEARING RETAINER TO REDUCTION HOUSING	42-50
179864	7/16-14 x 1-3/4 HEX HEAD BOLT	REDUCTION HOUSING AND ADAPTER TO CASE	42-50
4853	7/16-14 x 1 HEX HEAD BOLT, LOCKING	REDUCTION ADAPTER TO CASE	42-50
4775L	1-20 NUT	OUTPUT SHAFT NUT	100-200

GENERAL INFORMATION

MODEL	WEIGHT, LBS. EMPTY	TRANSMISSION OIL CAPACITY (QUARTS)	
		LEVEL	15° INCLINED
AS3-70C or CR	143	2.5	2.7
AS3-71C or CR	143	2.5	2.7
AS13-72C or CR	153.5	2.7	2.8

NOTE: OIL CAPACITY DOES NOT INCLUDE CAPACITY NEEDED FOR TRANSMISSION COOLER AND OIL LINES.



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.

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