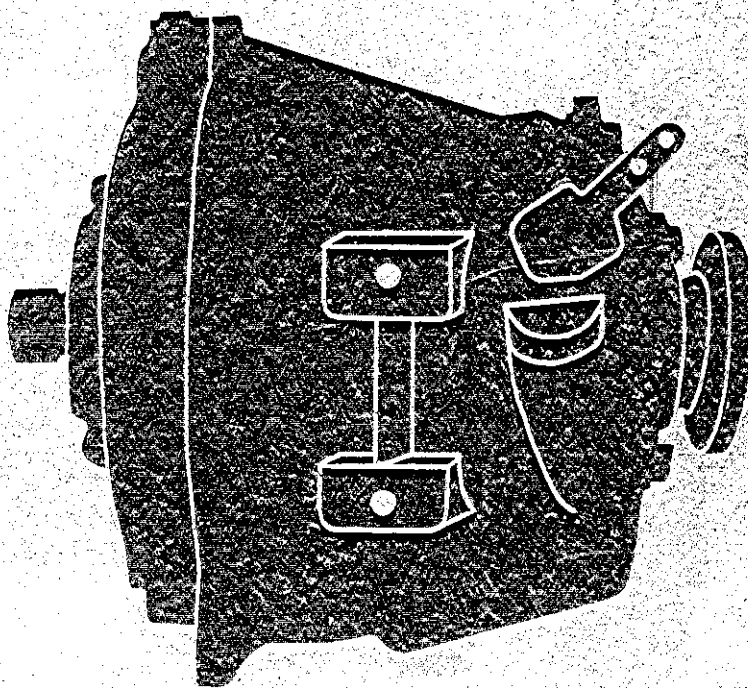


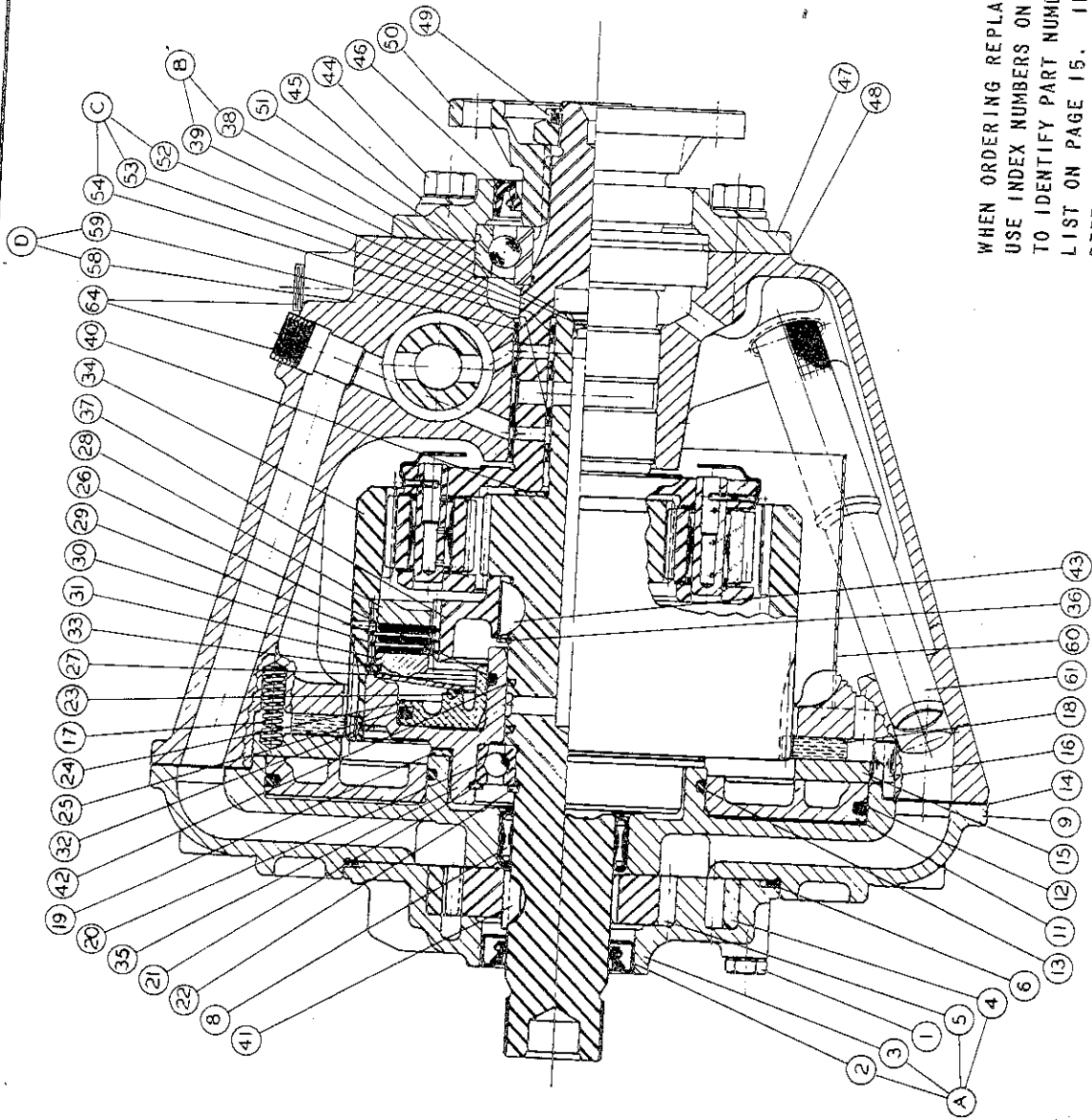


Velvet Drive Marine Transmission Service Manual Models 70C & 71C



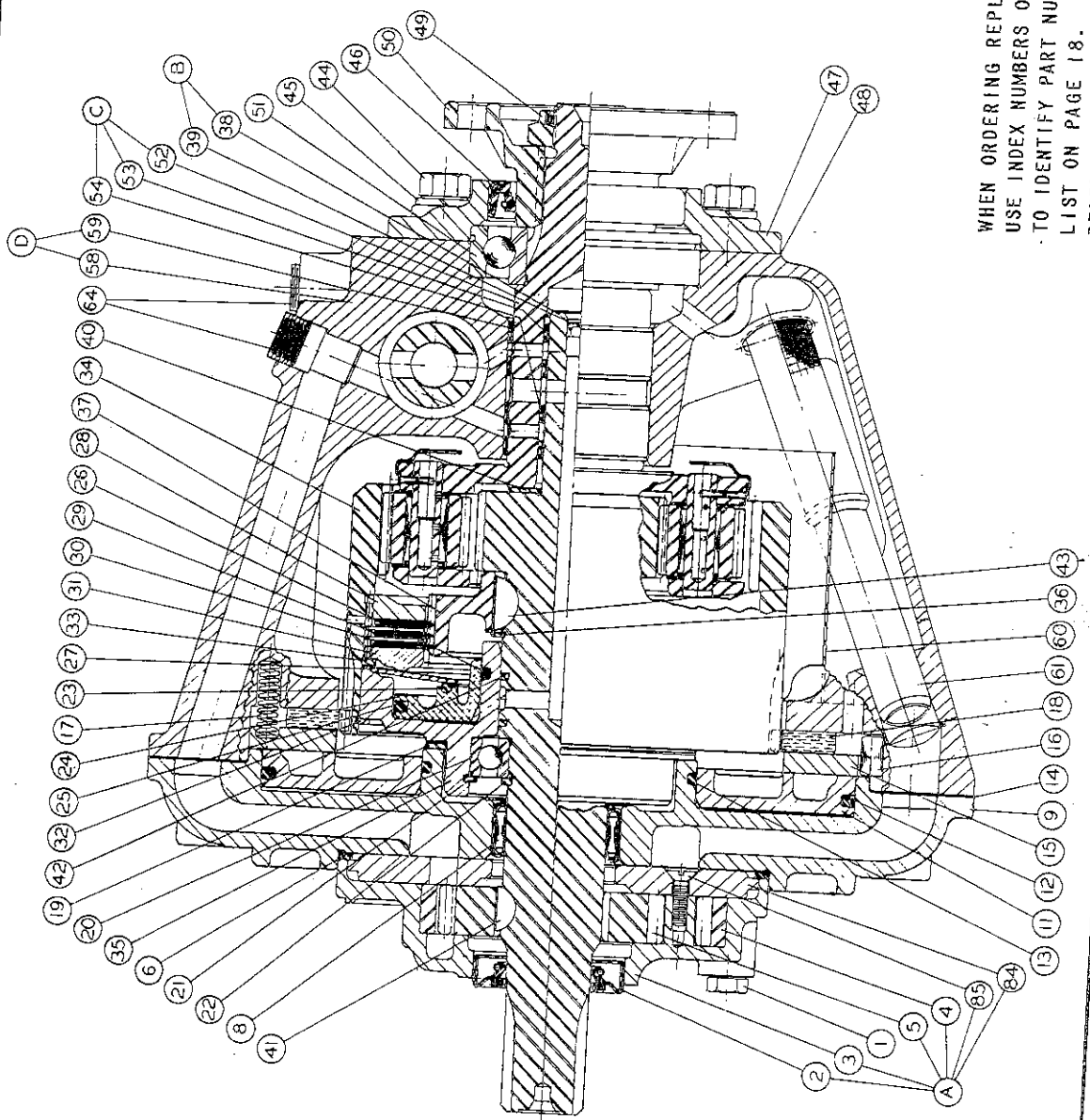
Warner Gear
Division of Borg-Warner Corporation

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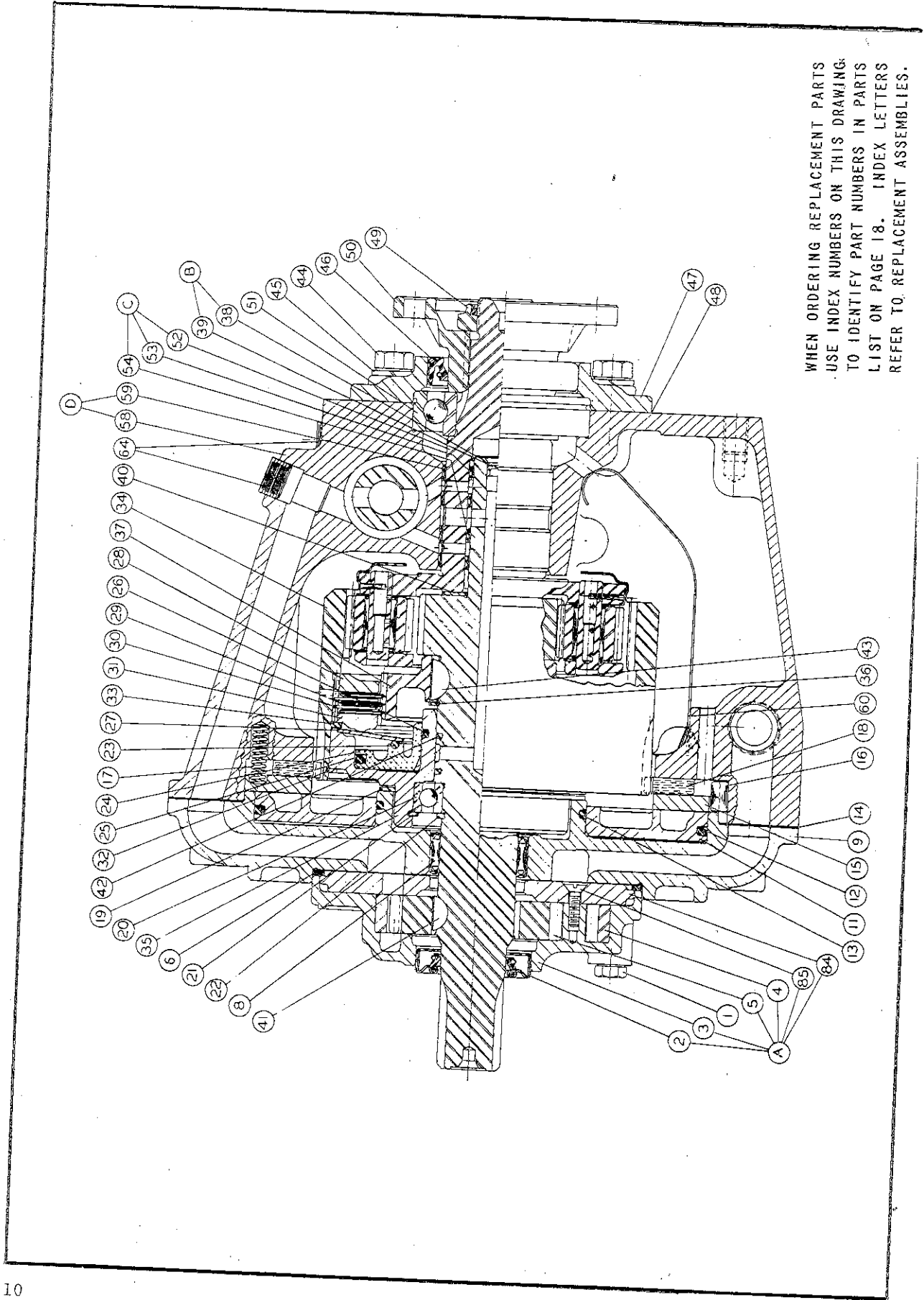
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 USE INDEX NUMBERS ON THIS DRAWING
 TO IDENTIFY PART NUMBERS IN PARTS
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Fig. 2 Cross Section of Model ASI-70C Transmission

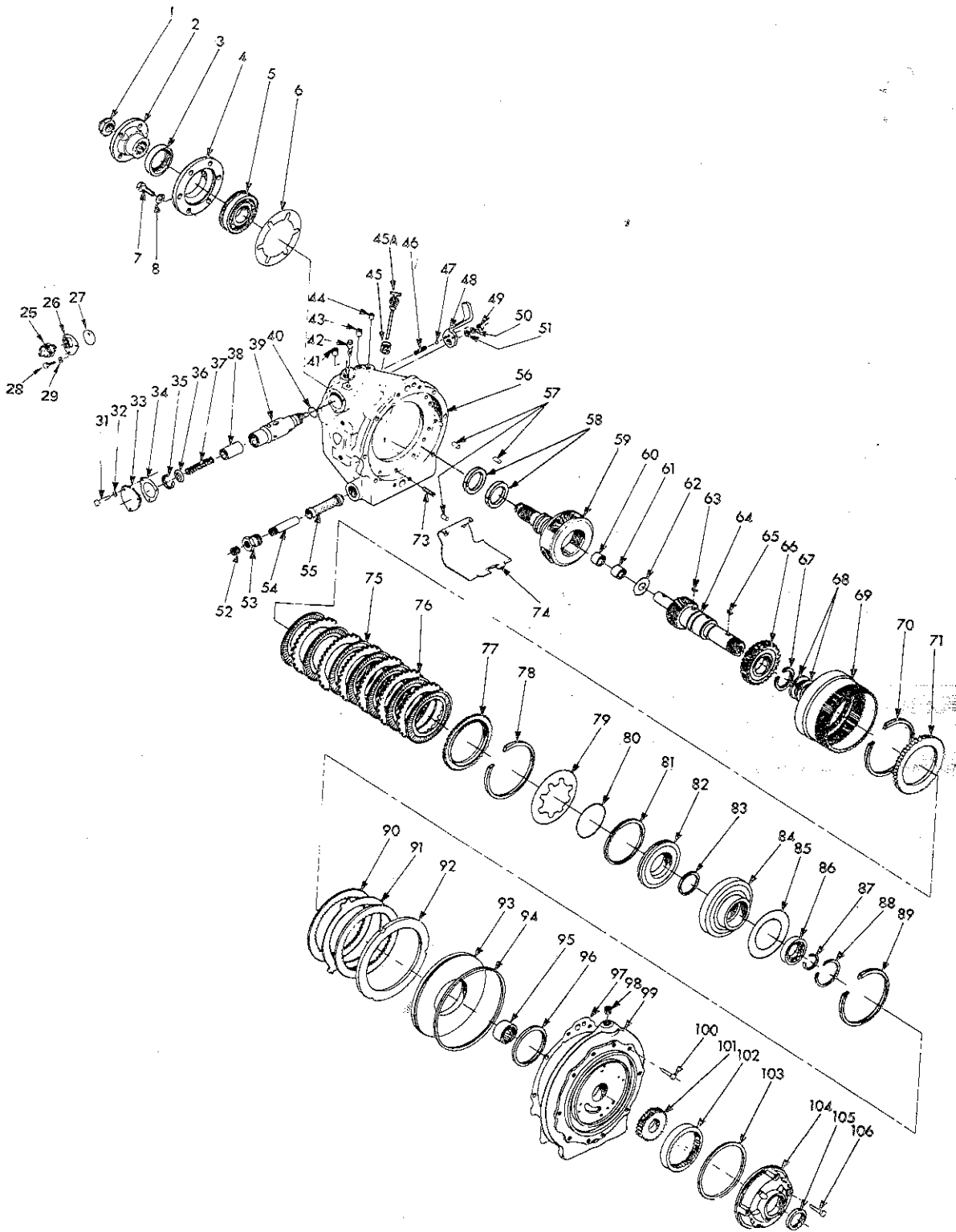


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Fig. 11 (over sheet)



WHEN ORDERING REPLACEMENT PARTS
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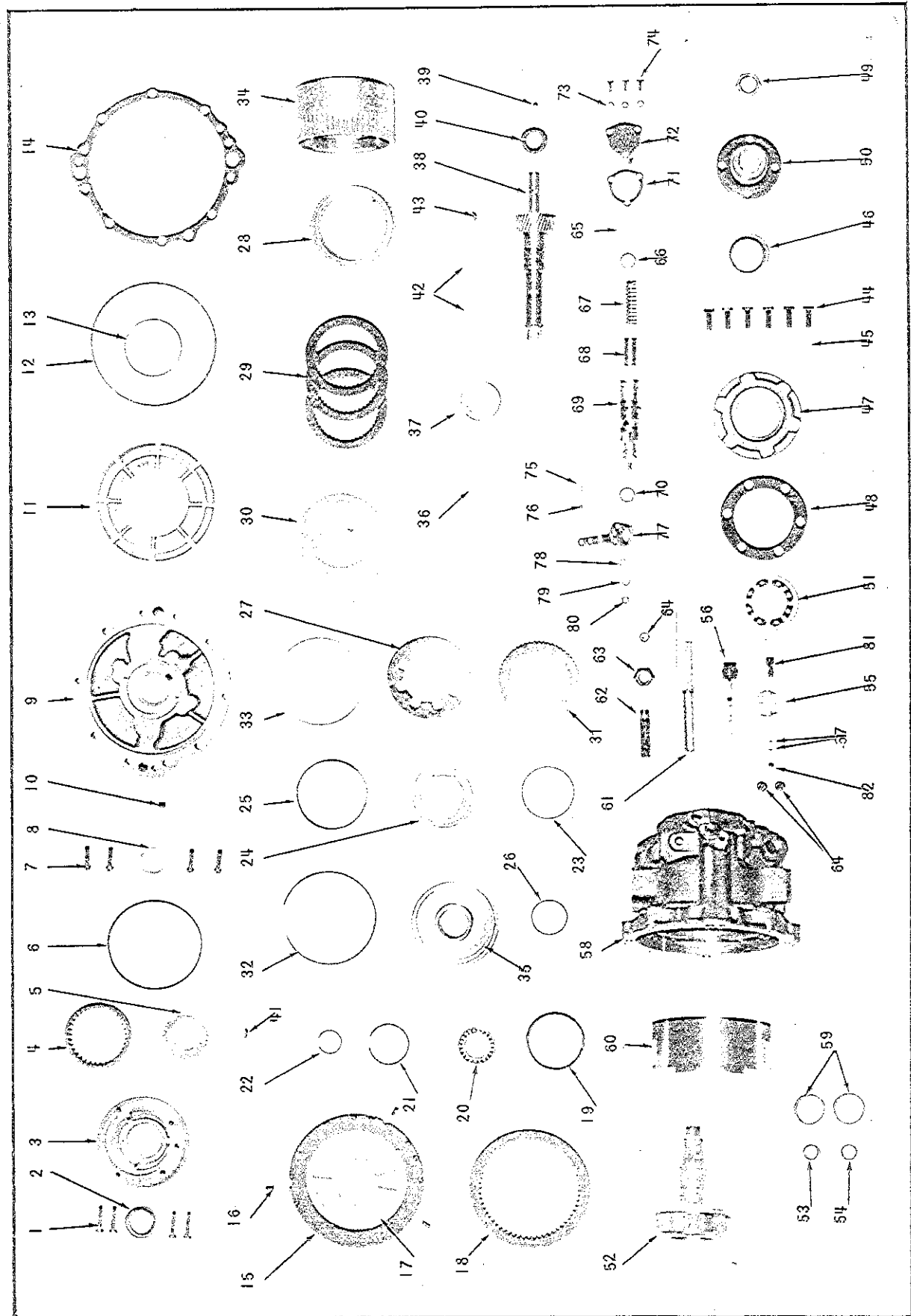


Fig. 11 Parts Display for Forward & Reverse ASI-70C Transmission

DESCRIPTION

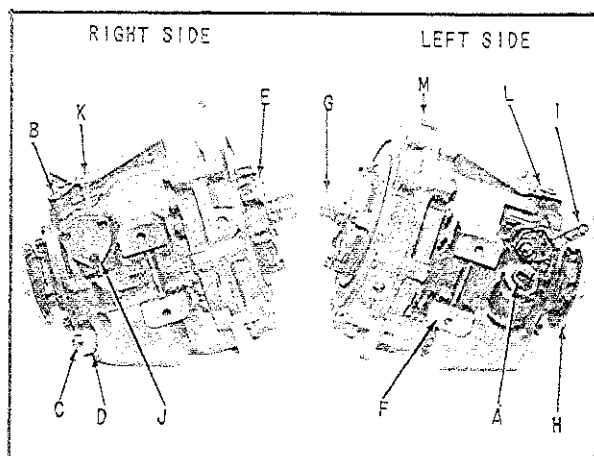


Fig. 16 External Views ASI-70C or ASI-71C

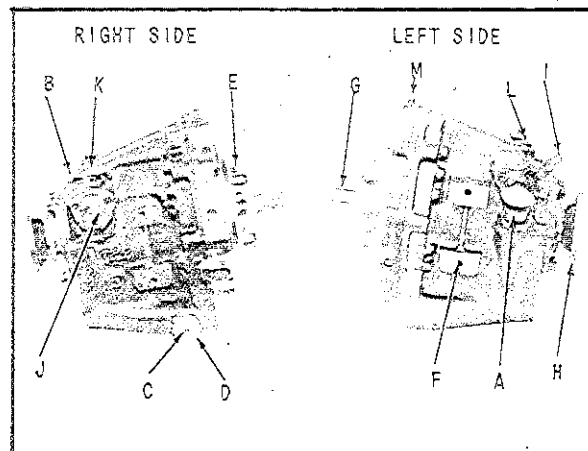


Fig. 16A External Views ASI-70 or ASI-71

This manual is prepared primarily for the Model 70C & 71C direct drive transmissions. However, all additional supplementary descriptions and illustrations are included to allow it to be used for the Model 70B, 71B, 70 and 71 transmissions.

The material in this manual is also used in conjunction with the proper reduction gear manuals for servicing all 70, 70R, 70C, 70CR, 71, 71R, 71C and 71CR reduction gear transmissions.

The following list identifies the important features of the various model transmissions in (Figs. 16 and 16A):

- | | |
|--|--------------------------------|
| A. Oil filler cap & dipstick assembly | G. Drive Gear |
| B. Oil outlet to cooler | H. Output shaft flange |
| C. Oil inlet from cooler | I. Shift lever |
| D. Oil drain plug | J. Valve cover |
| E. Oil pump | K. Breather |
| F. Mounting pads & mounting bolt holes | L. Main line pressure tap |
| | M. Reverse clutch pressure tap |

The transmission consists of a planetary gear set, a forward clutch, a reverse clutch, an oil pump, and a pressure regulator and rotary control valve. All of these are contained in a cast iron housing along with necessary shafts and connectors, to provide forward, reverse and neutral operation. A direct drive ratio is used for all forward operation. In reverse, the speed of the output shaft is equal to input speed,

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
*AS1-71C	CLOCKWISE	*AS1-71CR	COUNTER CLOCKWISE	1:1	RED
AS1-71B	CLOCKWISE	AS1-71BR	COUNTER CLOCKWISE	1:1	RED
AS1-71	CLOCKWISE	AS1-71R	COUNTER CLOCKWISE	1:1	RED
*AS1-70C	CLOCKWISE	*AS1-70CR	COUNTER CLOCKWISE	1:1	BLUE
AS1-70B	CLOCKWISE	AS1-70BR	COUNTER CLOCKWISE	1:1	BLUE
AS1-70	CLOCKWISE	AS1-70R	COUNTER CLOCKWISE	1:1	BLUE

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

but in the opposite direction. Helical gearing is used to provide quieter operation than can be obtained with spur gear gearing.

The transmission is fast shifting to give the boat operator complete control of the vessel. Shifting is accomplished by the fore and aft movement of the shift lever, (Fig. 16). This movement rotates the control valve and directs oil under controlled pressure to the required channels.

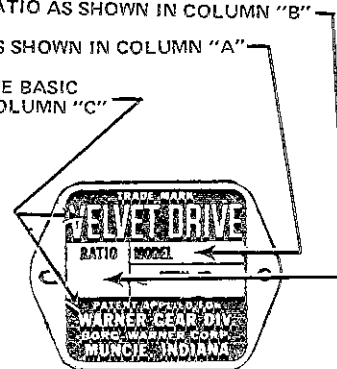
Oil pressure is provided by the crescent type pump, the drive gear of which is keyed to the drive shaft and operates at transmission input speed to provide screened oil to the pressure regulator.

From the regulator valve the oil is directed through the proper circuits to the bushings and anti-friction bearings requiring lubrication. A flow of lubricant is present at the required parts whenever the front pump is turning and it should be noted that supply is positive in forward, neutral and reverse conditions.

The unit has seals to prevent escape of oil.

Both the input and output shafts are coaxial, with the input shaft splined for the installation of a drive damper, and the output shaft provided with a flange for connecting to the propeller shaft.

RATIO AS SHOWN IN COLUMN "B"
MODEL AS SHOWN IN COLUMN "A"
THESE AREAS TO INDICATE BASIC MODEL COLOR CODE IN COLUMN "C"



TRANSMISSION OPERATION

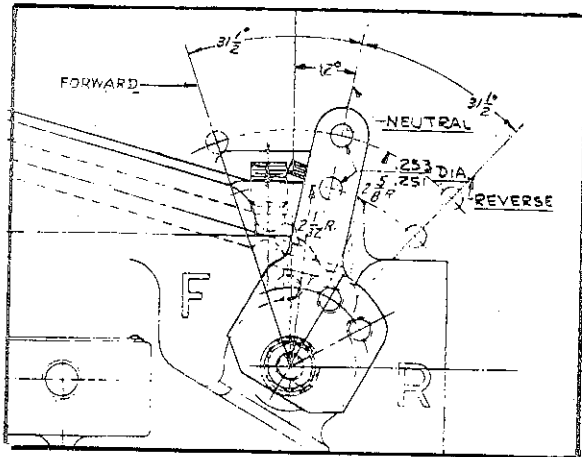


Fig. 17 ASI-71C Shift Lever Positions

FORWARD

Move the transmission shift lever to the extreme forward position where the spring-loaded ball enters the chamfered hole in the side of the shift lever and properly locates it in the "forward" position, (Fig. 17). With the shift lever so located, oil at regulated pressure flows from the control valve into porting in the transmission case, output shaft, drive gear, forward clutch cylinder, and into the forward clutch cavity. The resulting movement of the forward clutch piston and the lever action of the clutch spring forces the multiple discs of the forward clutch together and, with the aid of the forward clutch hub, locks the input shaft to the ring gear. This in turn prevents rotation of the planetary pinions about their own axes and thus locks the input shaft, ring gear and output shaft together, causing them to rotate as a solid concentric coupling. In this way, input shaft speed and direction of rotation are transmitted directly to the output shaft.

NEUTRAL

Move the transmission shift lever to the center position where the spring-loaded ball enters the chamfered hole in the side of the shift lever and properly locates it in the "neutral" position, (Fig. 17). With the shift lever so located, flow of pressurized oil to the clutches is blocked at the control valve. The clutches are also vented, by a different portion of the control valve, to the sump area inside the transmission case and thus free-running open clutches are insured.

REVERSE

Move the transmission shift lever to the extreme rearward position where the spring-loaded ball enters the chamfered hole in the side of the shift lever and properly locates it in the "reverse" position, (Fig. 17). With the shift lever so located, oil at regulated pressure flows from the control valve into porting in the transmission case, thence back to the adapter and into the reverse clutch cavity. The resulting movement of the reverse clutch piston and the reverse clutch pressure plate locks the reverse clutch plate to the transmission case. The stationary reverse clutch plate, through splined connectors, thus prevents rotation of the ring gear. With the ring gear held and the sun gear rotating at input speed, the pinions of the compound planetary gearset are free to rotate about their own axes and reverse the direction of rotation of the pinion carrier and output shaft.

FREEWHEELING

Under sail with the propeller turning, or at trolling speeds with one of two engines shut down, the design of the Velvet Drive gear maintains adequate cooling and lubrication.

OIL PRESSURES

Transmission line pressure should be between 110-150 PSI at engine speeds between 450 and 2000 RPM at normal operating temperatures of 150-165°F.

When operating the transmission at low temperatures or excessive speeds pressures of 200-250 PSI may be obtained.

A maximum transmission oil temperature of 190°F. is recommended.

See page 23 for pressure specifications on 10-17 units.

DISASSEMBLY OF TRANSMISSION

NOTE: Tear down procedure should not begin until the transmission exterior and work area have been thoroughly cleaned.

OIL DRAINING PROCEDURE

1. Remove oil filler plug located below the shift lever on rear left side of transmission case.
2. If space permits, place container having approximately two (2) quart capacity under drain cap, located as shown in (Fig.18). Unscrew the drain plug and cooler return tube assembly, reach into the opening with a suitable tool, and remove the strainer assembly, (Fig. 77). Allow oil to drain into pan.

DISASSEMBLY OF VALVE AND SPRING ASSEMBLY FROM TRANSMISSION

3. Remove three (3) hex head bolts, lockwashers, valve cover and valve cover gasket, as shown in (Fig. 74).
4. Remove shift lever and associated parts, (Fig. 75).
5. Tap with soft hammer on exposed threaded shaft, upon which shift lever was mounted, and pull valve

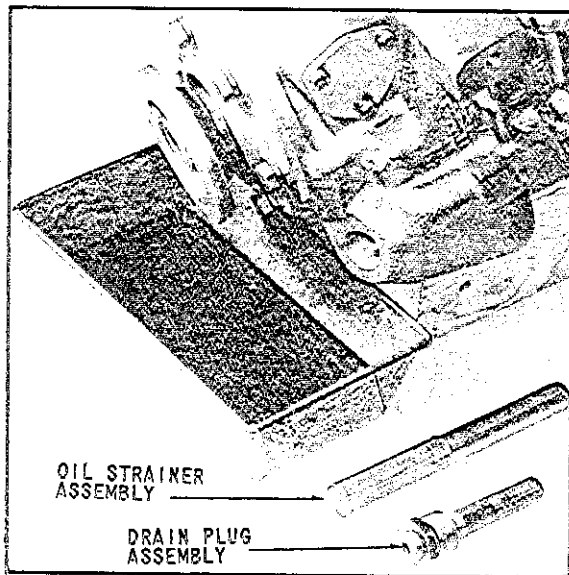


Fig. 18 Draining Transmission Oil

and spring assembly out of case from right side, (Fig. 73).

6. Place valve and spring assembly in a suitable holder, (Fig. 71). Depress the valve spring retainer and valve spring until the snap ring is free to be removed. The components of the valve and spring assembly can now be removed in the order shown in (Fig. 70).

NOTE: The control valve assembly can also be disassembled by using an arbor press with suitable tools as shown in (Fig. 72).

REMOVAL OF FRONT PUMP ASSEMBLY

7. Remove the four (4) front pump attaching bolts, (Fig. 69), place a protective covering over splines to prevent damage to seal lip, and lift pump assembly squarely up and over the protruding input shaft, (Fig. 67).
8. Remove pump drive gear, front pump gasket, and Woodruff key, (Fig. 66).

NOTE: Two different pump assemblies are used. One includes a backing plate which must be removed before the gears are exposed. For additional information and description see pages 40 and 48-51.

9. For the pump assembly with the backing plate, remove the one (1) flat head machine screw, (Fig. 96) and lift backing plate to expose gears.
10. Mark gears to identify for proper relocation of gear faces during reassembly, (Figs. 65 and 94). (Figs. 62 and 91) show views of the different front pump parts when completely disassembled.

25. Remove forward clutch sealing rings, as shown in (Figs. 39 & 40).

REMOVAL OF PINION CAGE AND OUTPUT SHAFT ASSEMBLY FROM TRANSMISSION CASE

26. Remove main shaft nut shown in (Fig. 33).
27. Using bearing puller, pull coupling from output shaft.
28. Remove six (6) hex head bolts and lockwashers, (Fig. 31).
29. Remove bearing retainer and gasket.

REMOVAL OF REAR BEARING

NOTE: The following paragraphs (30 & 31) describe alternate methods of removing the rear bearing. Either method is equally desirable.

30. Using bearing puller, grasp bearing by exposed groove in outside diameter and gently pull bearing from case, (Fig. 20).

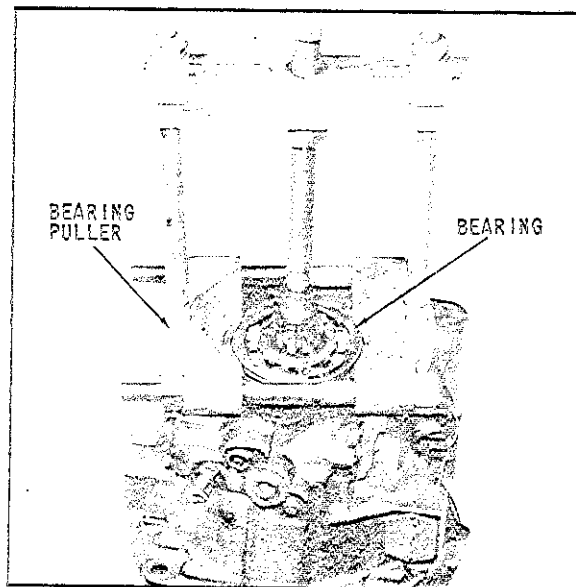


Fig. 20 Removing Bearing from Case

31. Place transmission, with front face down, on arbor press. Using suitable tool, press down on exposed end of output shaft until shaft is free of bearing inside diameter. Protect pinion cage and output shaft from damage from fall during this operation.

REASSEMBLY PRECAUTIONS

The following list contains a number of assembly problems which it is felt requires special attention during the reassembly of the direct drive transmissions. The information below includes the locations in the manual where information and instructions are available on these important assembly features.

1. Installation of proper pinion cage and output shaft assembly in transmission cases without bushings, (Page 52, Paragraphs 18 & 19).
2. Selection of the proper clutch spring snap ring, (Page 31, Paragraph 23).
3. Selection of the proper ring gear snap ring, (Page 33, Paragraph 30).
4. Installation of adapter on transmission case should follow the procedures outlined, (Page 39, Paragraph 56), for tightening the capscrews. If bolts are not alternately tightened a small amount, damage can result to the needle bearing and its input shaft race.
5. Protection of pump seal during assembly of pump assembly over input drive gear, (Page 41, Paragraph 65).
6. Mounting pump to correspond to the engine rotation, (Page 42, Paragraph 67).
7. Check input shaft to insure that it rotates freely when turned by hand after transmission is assembled (Page 42, Paragraph 69).

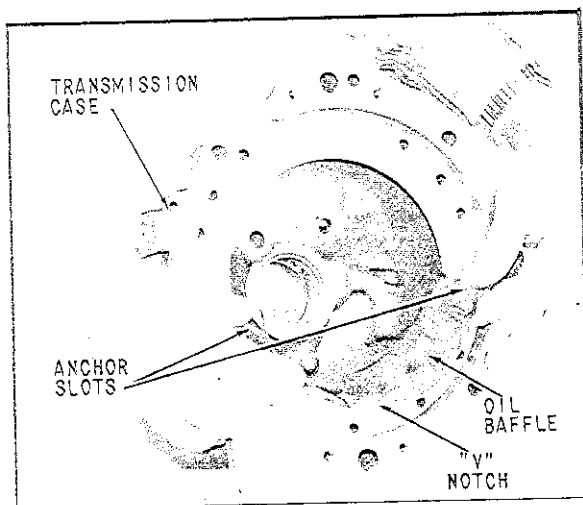


Fig. 23 Installing Model 71B & 71C Baffle

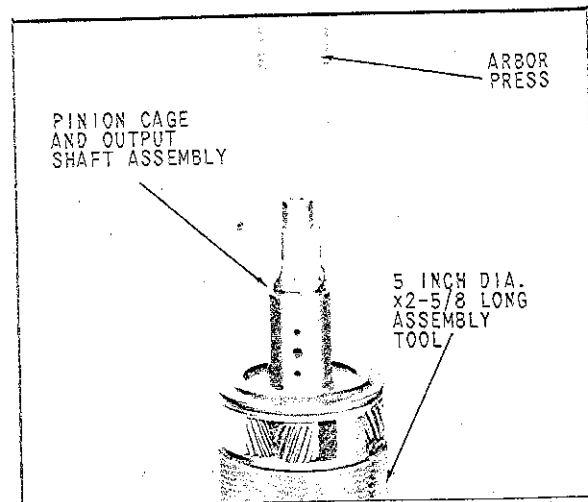


Fig. 25 Pinion Cage and Output Shaft Assembly in Place on Arbor Press

INSTALLATION OF THE BAFFLE IN THE TRANSMISSION CASE

4. Insert the baffle inside the transmission case with the notched side toward the front and the curve of baffle toward the bottom of the transmission case, (Fig. 23).
5. Press down on the baffle and snap the rectangular slots at each end on to the cast bosses at each side of the case, (Fig. 24). These bosses will position and hold the baffle in its proper place.

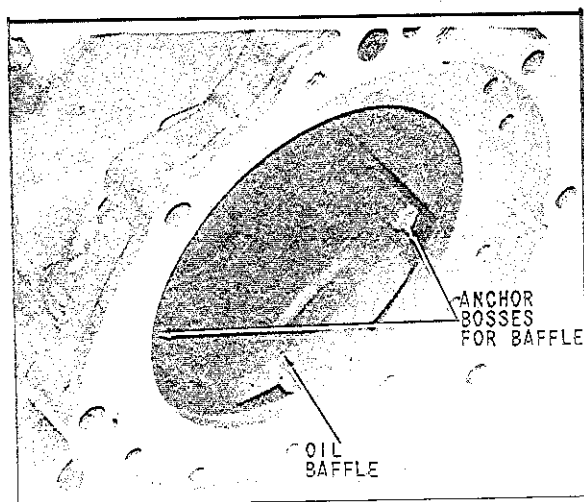


Fig. 24 Model 70B & 70C Oil Baffle Properly Installed

INSTALLATION OF PINION CAGE AND OUTPUT SHAFT ASSEMBLY IN THE TRANSMISSION CASE

6. Place the pinion cage and output shaft assembly on a 5 inch diameter by 2-5/8 long assembly tool, which in turn is mounted on an arbor press, as indicated in (Fig. 25).

NOTE: If the transmission case does not have bronze bushings for the output shaft journal, use only the output shafts of the design with three oil grooves as shown in (Fig. 26). See page 52 (paragraphs 18 & 19), for further information.

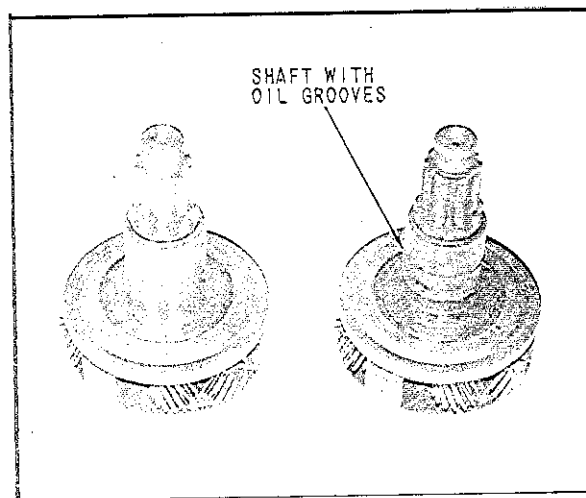


Fig. 26 Late and Early Model Pinion Cage and Output Shafts

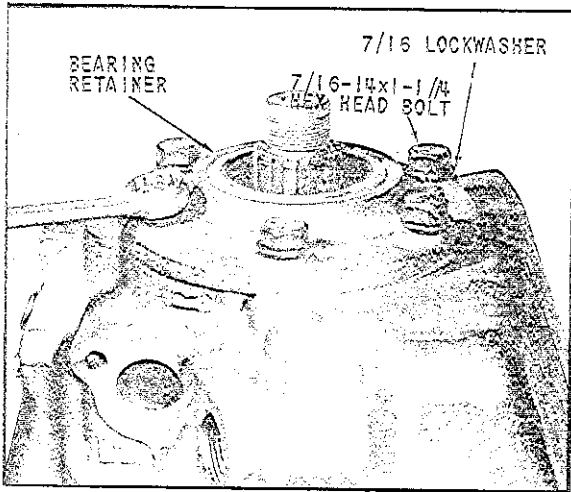


Fig. 31 Assembling Bearing Retainer on Rear of Case

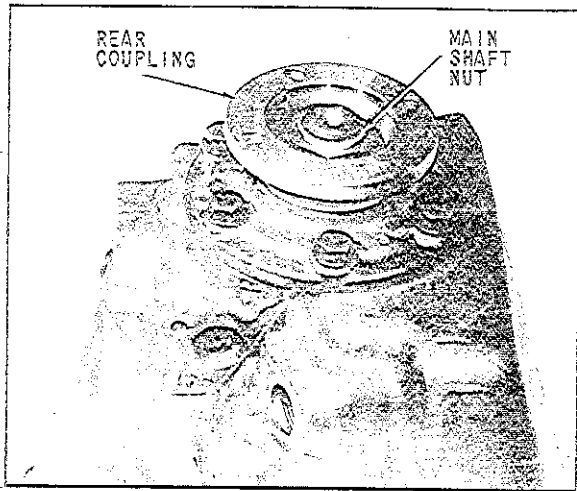


Fig. 33 View of Completely Assembled Output Shaft

13. Place bearing retainer gasket on rear of transmission case as shown in (Fig. 30). Gasket may be coated with petroleum jelly for easier assembly.
14. Place bearing retainer in place on rear of case as shown in (Fig. 31). Install six (6) 7/16 lockwashers and six (6) 7/16-14 hex head bolts; tighten bolts to a torque of 42-50 pounds-feet.

15. Inspect and lubricate the hub diameter of rear coupling which runs in contact with the rubber lip of oil seal. If this surface is scratched or burred, replace the part with a new piece to prevent seal-lip damage and subsequent oil leakage.
16. After lubricating the splined portion of coupling, assemble the splined coupling onto the externally splined portion of the output shaft. When the coupling has been aligned squarely on the output shaft and hand assembly has proceeded as far as possible, place a suitable tool on the coupling, (Fig. 32), and gently press the coupling with arbor press until contact with the bearing inner race is made.

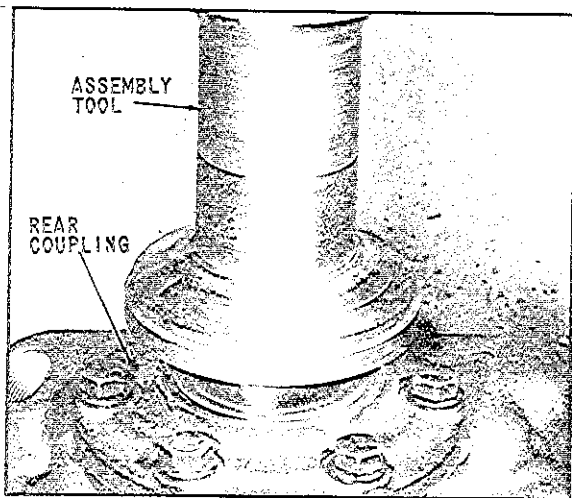


Fig. 32 Pressing Rear Coupling in Place

17. Assemble main shaft nut in place on output shaft and tighten to prescribed torque of 100 to 200 pounds-feet. This should bring inner race of bearing solidly in contact with the shoulder on output shaft and eliminate any detectable end play in the coupling and output shaft combination, (Fig. 33).

SNAP RING IS .090 TO .093 INCHES THICK AND HAS A FREE DIAMETER OF $5-19/32 + 1/16$ INCHES.

24. With the concave side of the clutch spring down, install in ring gear, as shown in (Fig. 38). Assembly is complete when the clutch spring is seated firmly and squarely on clutch snap ring.
25. Assemble on the forward clutch piston, the clutch spring bearing

ring and a lubricated clutch sealing ring, as shown in (Fig. 39). Inspect the inside diameter of the forward clutch piston having contact with the sealing ring; remove all burrs or scratches and lubricate before assembly.

26. Install in forward clutch cylinder a well lubricated sealing ring, (Fig. 40). Lubricate entire forward clutch cylinder before continuing assembly.

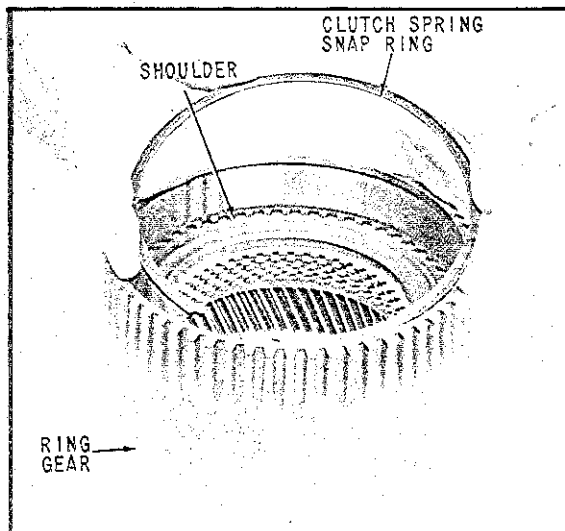


Fig. 37 Installing Clutch Spring Snap Ring

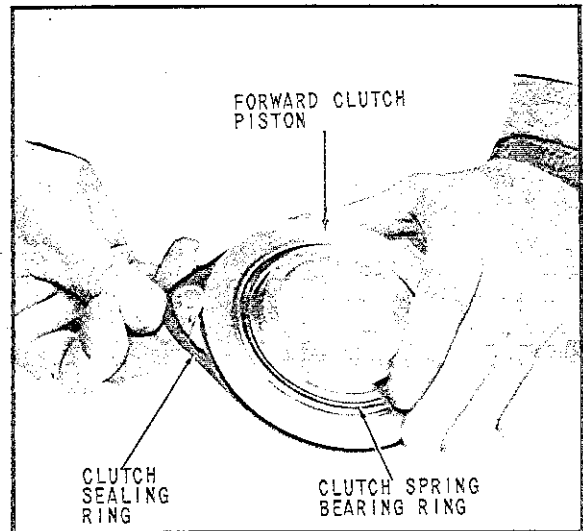


Fig. 39 Installing Clutch Sealing Ring

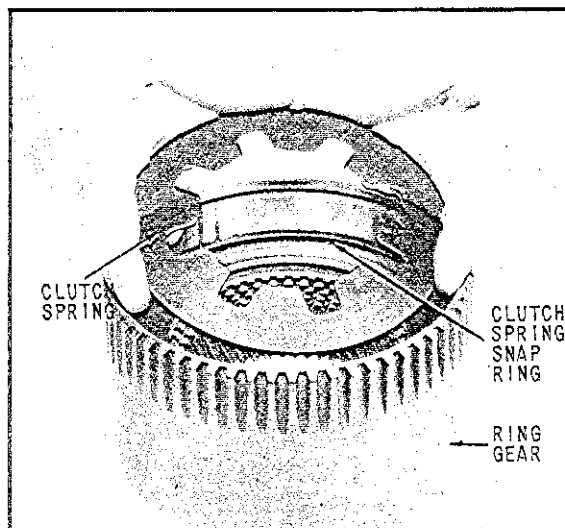


Fig. 38 Installing Clutch Spring

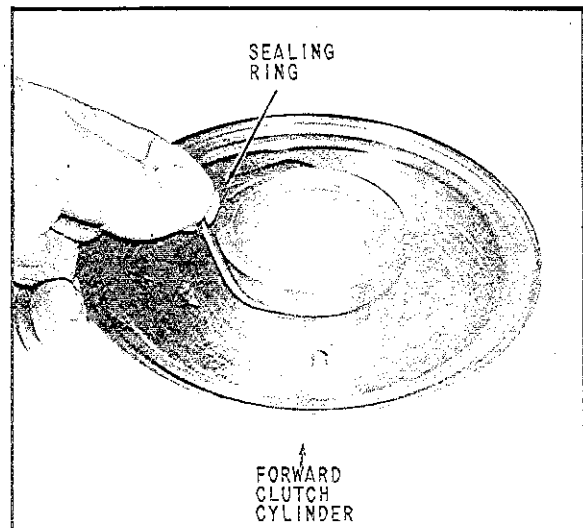


Fig. 40 Installing Sealing Ring

ASSEMBLY OF FORWARD CLUTCH HUB AND SEALING RINGS ON DRIVE GEAR

31. Place the forward clutch hub on a suitable support placed on an arbor press in the position shown in (Fig. 44).
32. Assemble Woodruff key in the keyway provided on the drive gear, (Fig. 44).
33. Lubricate the outside diameter of the drive gear on that area which presses into the forward clutch hub.

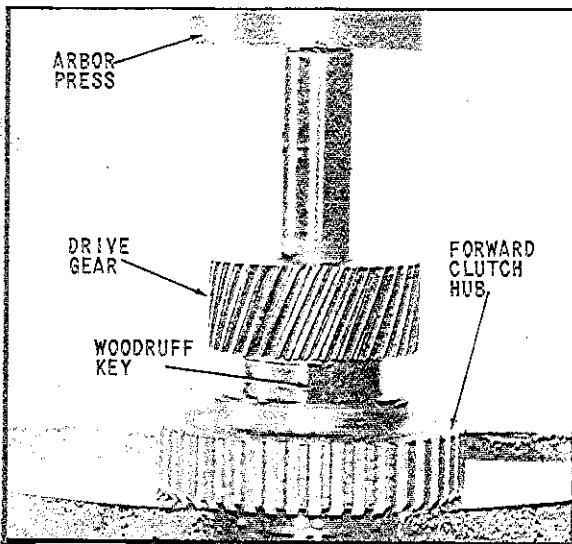


Fig. 44 Pressing Drive Gear into Forward Clutch Hub

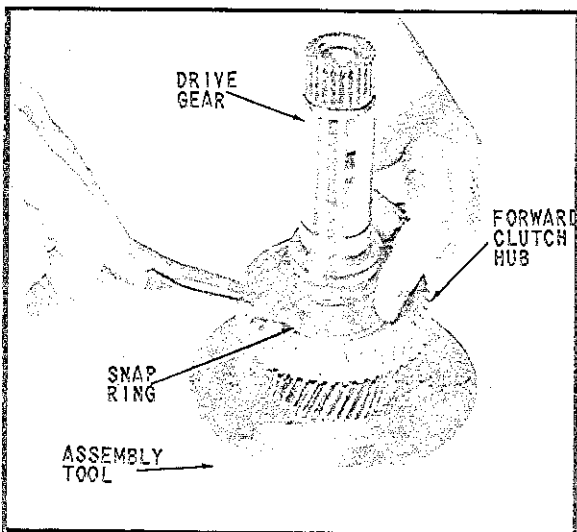


Fig. 45 Installing Clutch Hub Snap Ring

34. Install the drive gear and Woodruff key squarely into the forward clutch hub, being careful to align the Woodruff key with the mating keyway in the forward clutch hub, (Fig. 44). Press the drive gear into the forward clutch hub until the gear "bottoms" on the face of the forward clutch hub and the groove for the snap ring is fully uncovered.
35. Invert the parts referred to in step 34 and install snap ring in the groove provided, (Fig. 45). Tap ring after assembly with suitable tool to insure full seating in groove.

36. Install two (2) forward clutch sealing rings in grooves provided on drive gear, (Fig. 46). After installing rings in groove, hook ends and turn rings to insure freedom of rotation.

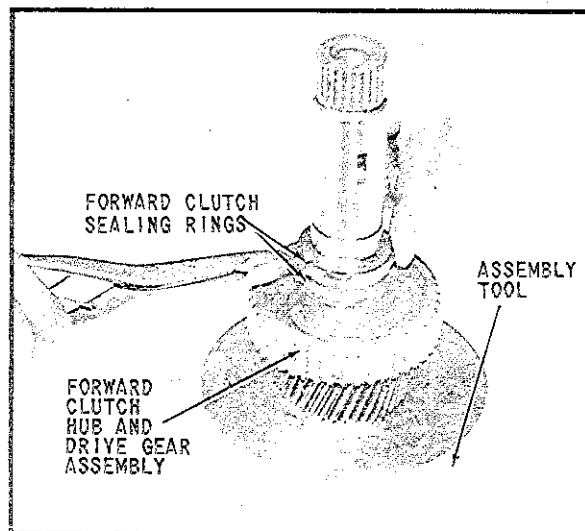


Fig. 46 Installing Forward Clutch Sealing Rings on Drive Gear

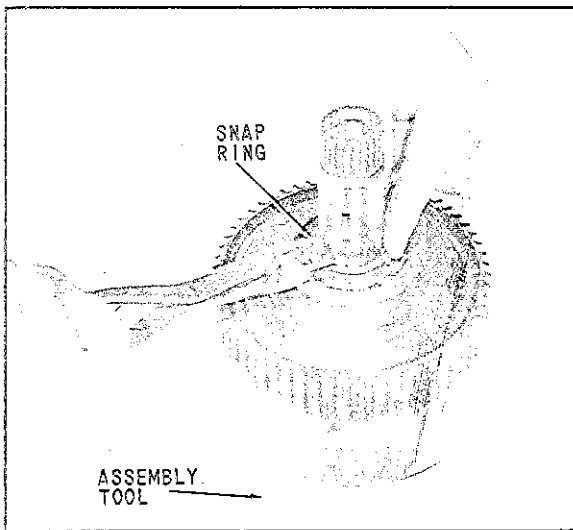


Fig. 50 Installing Snap Ring

40. Install external snap ring on drive gear, (Fig. 50).
41. Install internal snap ring in clutch cylinder, (Fig. 51).

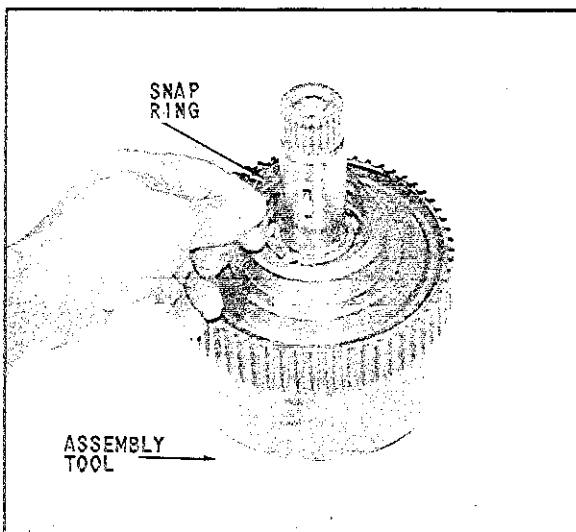


Fig. 51 Installing Snap Ring

INSTALLATION OF DRIVE GEAR AND CLUTCH ASSEMBLY, REVERSE CLUTCH PLATE, AND REVERSE CLUTCH PRESSURE PLATE IN TRANSMISSION CASE

42. Place the parts assembled in steps 1 through 17 inclusive, on a smooth, clean surface in the upright position indicated in (Fig. 52). In this position, the rear face of rear coupling will provide sufficient base to enable assembly to proceed.

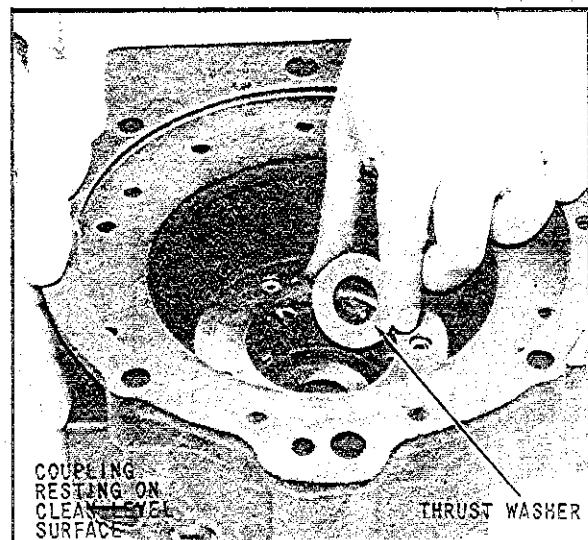


Fig. 52 Installing Thrust Washer

43. Coat the drive gear thrust washer with petroleum jelly and assemble into pinion cage and output shaft assembly, as shown in (Fig. 52). Center the washer carefully over bore provided for rear of drive gear.
44. After lubricating the rear end of the drive gear and checking centered position of the thrust washer, install the drive gear and clutch assembly into the case and pinion cage and output shaft assembly, (Fig. 53). Care and proper centering must be exercised at this point to prevent damage to the bushings when the rear diameter of the drive gear enters the output shaft.

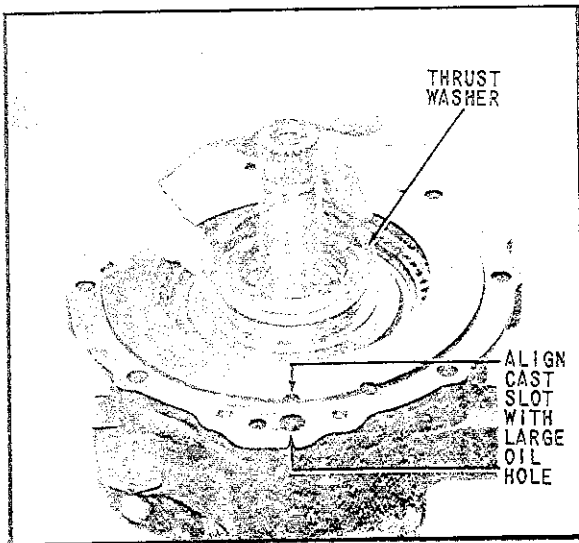


Fig. 56 Installing Thrust Washer and Reverse Clutch Pressure Plate

49. Coat thrust washer with petroleum jelly and assemble, as shown in (Fig. 56).

ASSEMBLY OF REVERSE CLUTCH PISTON INTO ADAPTER

50. After checking adapter for the following, place it on clean surface in position, shown in (Fig. 57).

- (a) Clean needle bearing assembly, properly installed and free from damage.

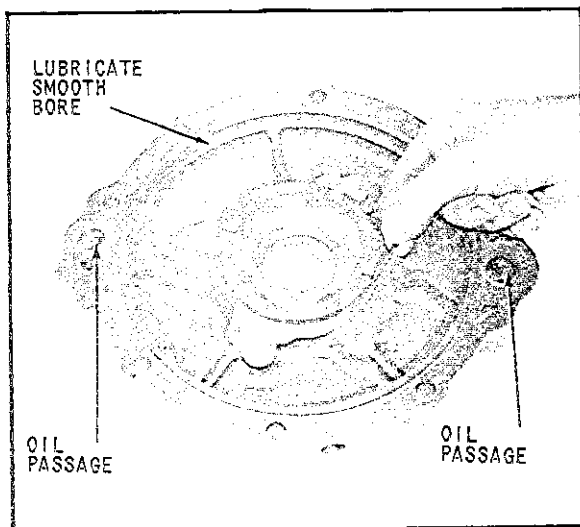


Fig. 57 Assembling Sealing Ring

- (b) Oil passages free from presence of dirt and obstruction.

- (c) Reverse clutch cavity outer wall, smooth clean surface free from scratches or burrs and coated generously with petroleum jelly.

Coat sealing ring with petroleum jelly and install in groove of adapter hub, as shown in (Fig. 57).

51. After lubricating sealing ring with petroleum jelly, assemble in groove of reverse clutch piston, as shown in (Fig. 58).

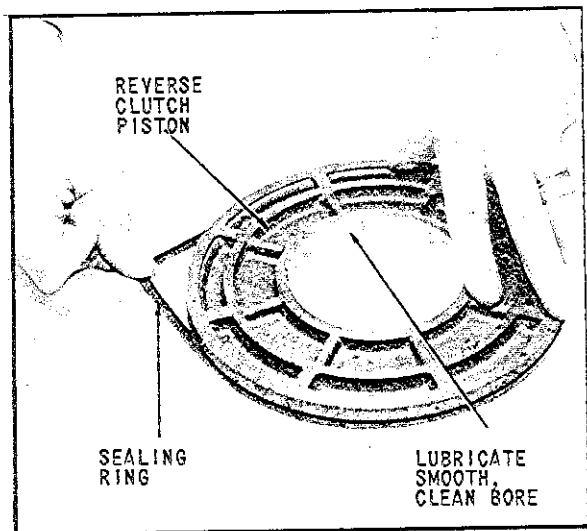


Fig. 58 Assembling Sealing Ring

52. Examine inside diameter of reverse clutch piston for smooth clean surface free from scratches or burrs and coat generously with petroleum jelly.

53. Place the reverse clutch piston, as assembled in step 51 on the adapter, as assembled in step 50, (Fig. 59). Press down on reverse clutch piston while pulling a smooth, clean screwdriver blade around the exposed portion of the sealing ring. This will aid the chamfered bore in the adapter to compress the sealing ring into the groove in the outside diameter of the piston. Assembly can be completed by using hand pressure until piston has "bottomed" in reverse clutch cavity.

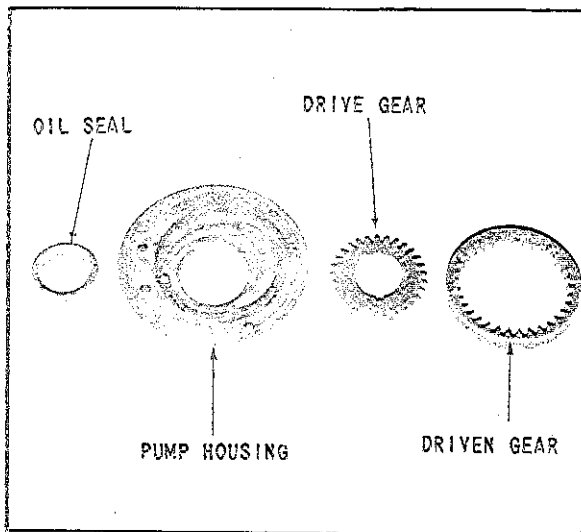


Fig. 62 Front Pump Parts for Assembly 71C-A60

ASSEMBLY OF FRONT PUMP

57. Collect the parts shown in (Fig. 62) and check carefully for the following:

- (a) Scoring in gear pockets, crescent, and gear face.
- (b) Oil seal lip for brittle condition, cracks and cuts. Oil seal outside diameter for dents or scratches.
- (c) Gear teeth for burrs.

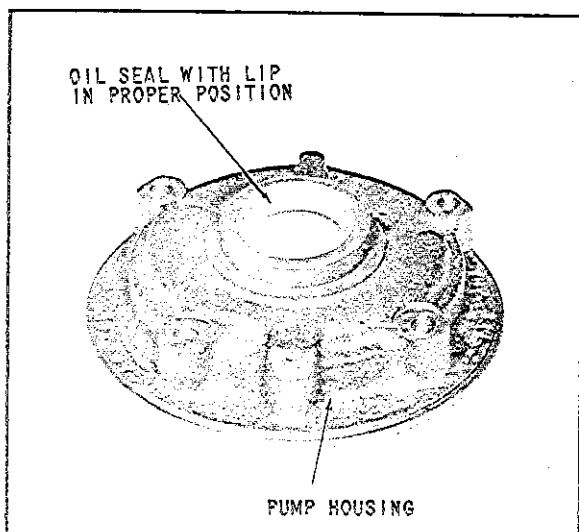


Fig. 63 Installing Pump Oil Seal

NOTE: Two different pump assemblies have been used on the Model 70C & 71C transmission. If the pump assembly on your transmission includes a backing plate see page 48 (paragraphs 5 through 10) for important information concerning its assembly and service.

The front pump assembly without the backing plate can only be used with the new (71C-A8) adapter (Fig. 61), the new key (4873), and the new version of the drive gear with the relocated pump keyway. For identification of the proper parts see (Fig. 90).

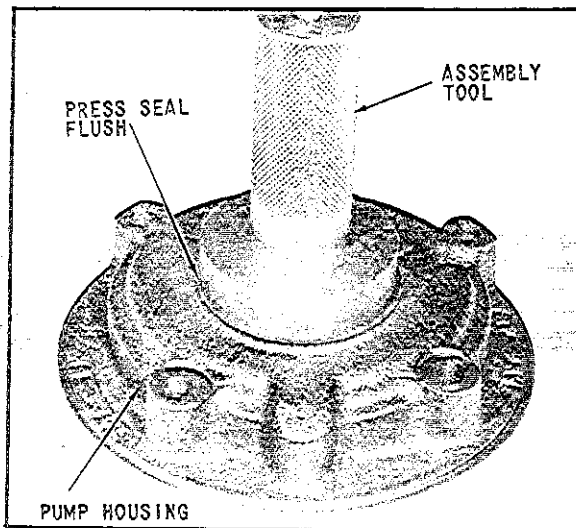


Fig. 64 Pressing Pump Oil Seal into Housing

- 58. Place pump housing squarely on arbor press table. Apply a suitable sealant to the outside diameter of seal before installing squarely into bore of housing with seal lip positioned as shown in (Fig. 63). Caution should be observed to insure that too much sealant is not used, that any excess is wiped away after the seal is installed, and that the sealant does not get on the sealing element.
- 59. Using an arbor press and suitable tool, press seal into housing until front face of seal is flush with front face of pump housing (Fig. 64).

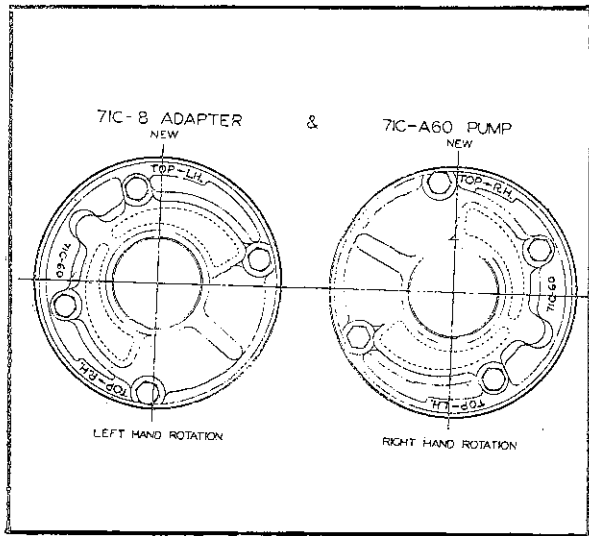


Fig. 68 Orientation Markings for Present 71C-A60 Pump on the 71C-8 Adapter

67. Orient the pump mounting bolt holes and arrow indicating direction of rotation to correspond with the direction of rotation required by the engine, (Fig. 68). If not installed for the proper rotation the pump will not produce oil pressure to operate the transmission when engine is started.

NOTE: WITH THE EXCEPTION OF THE 2.10/1 REDUCTION GEAR THE ORIENTATION OF THE PUMP ON THE TRANSMISSION MAY BE CHANGED FOR INSTALLATION ON ENGINES WITH ROTATION OPPOSITE TO THAT FOR WHICH THE TRANSMISSION

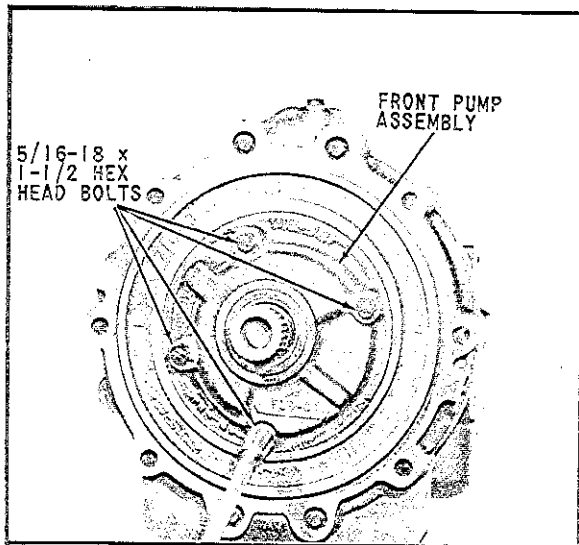


Fig. 69 Mounting Front Pump to Adapter

WAS ORIGINALLY ASSEMBLED. THE HAND OF ROTATION OF THE PUMP ON A 2.10/1 TRANSMISSION SHOULD ALWAYS AGREE WITH ORIGINAL FACTORY INSTALLATION AND MUST NOT BE CHANGED.

68. With the pump assembled squarely against the adapter and pump gasket, and the seal assembly tool removed, install four (4) 5/16-18 hex head bolts, (Fig. 69). Tighten hex head bolts evenly to torque of 17-22 pounds-feet.
69. Check freedom of rotation of pump gears in pump housing by rotating the input shaft. If the pump will not rotate freely, disassemble the pump and check for foreign material

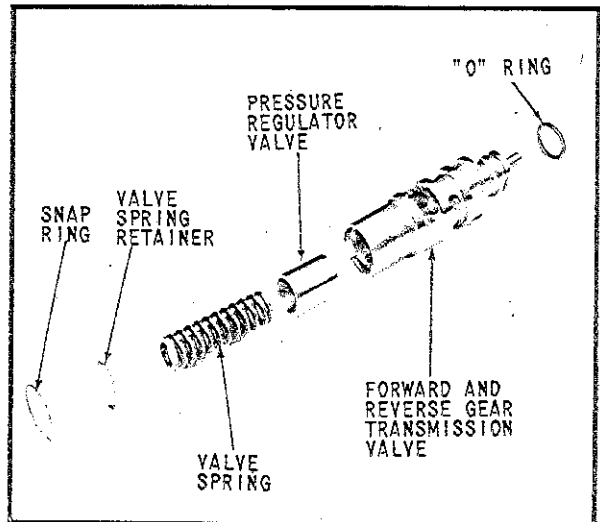


Fig. 70 Exploded View of Valve and Spring Assembly

in the pump. Any dirt particles on the adapter face will also tend to cock the pump when mounted on the adapter and cause it to seize.

ASSEMBLING VALVE AND SPRING ASSEMBLY

70. Collect the valve and spring assembly components, as shown in (Fig. 70) on a clean surface and note carefully the following:
- (a) The hollow portion of the pressure regulator valve faces the valve spring.

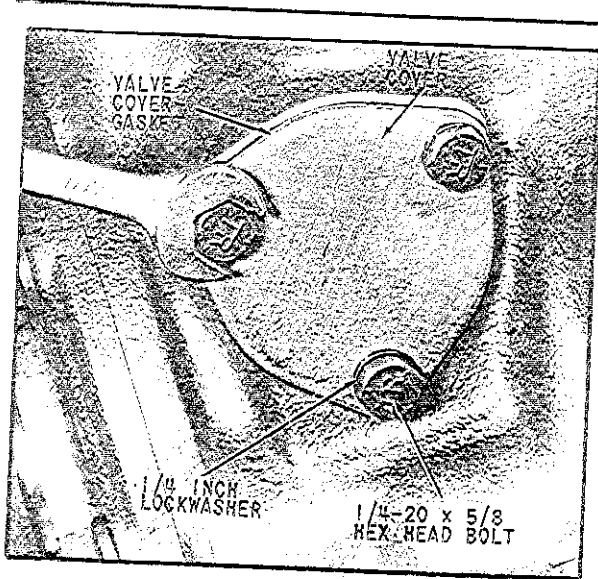


Fig. 74 Assembly of Valve Cover

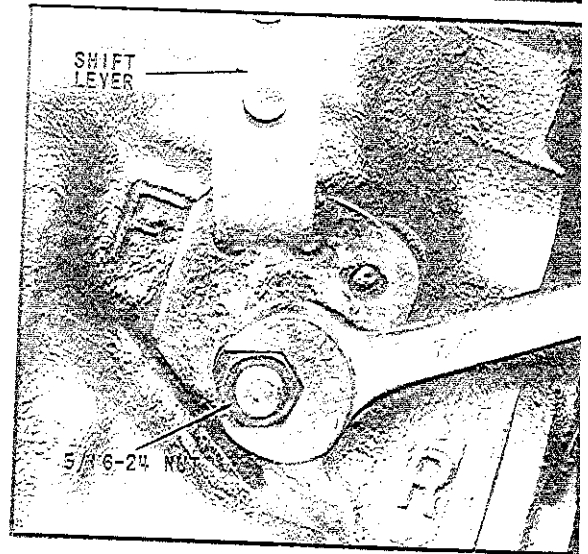


Fig. 76 Shift Lever Assembled

ASSEMBLY OF SHIFT LEVER

74. To insure neutral positioning of valve and easier assembly of lever, align .369-.376 width slot in valve with bottom 1/4-20 bolt hole in valve cover face of case as shown in (Fig. 73).
75. Assemble the valve cover gasket, valve cover, lockwashers and hex head bolts as indicated in (Fig. 74). Torque hex head bolts to 8-11 pounds-feet.
76. Assemble shift lever and related parts in the order shown in (Fig. 75). Torque the hex nut 8 to 11 pounds-feet, (Fig. 76). Rotation of the valve and spring assembly through the forward, neutral and reverse positions should require no more than fingertip effort. If valve binds in rotation, remove and inspect.

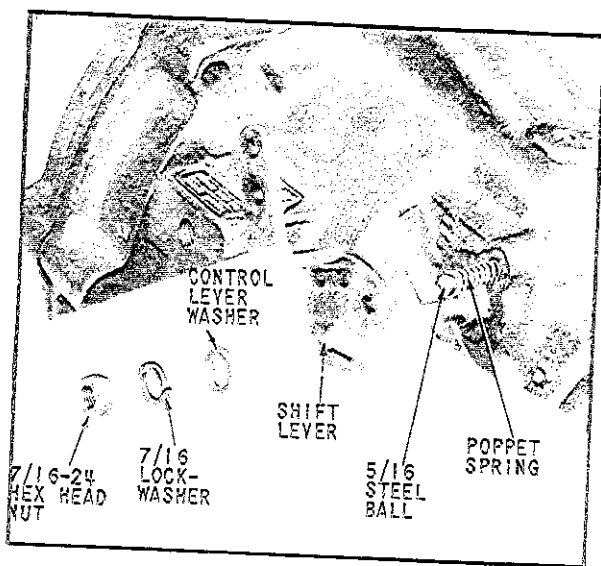


Fig. 75 Assembly of Shift Lever and Related Parts

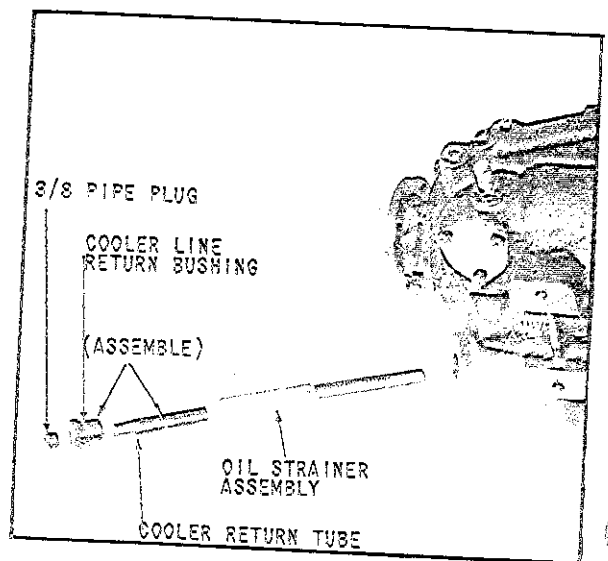


Fig. 77 Installing Oil Strainer & Cooler Return Tube & Bushing Assembly

5. Collect the parts shown in (Fig. 91) and check carefully for the following:

- (a) Scoring in gear pockets, crescent, backing plate and gear faces.
- (b) Dents and burrs on both faces of backing plate.
- (c) Oil seal lip for brittle condition, cracks and cuts. Oil seal outside diameter for dents or scratches.
- (d) Gear teeth for burrs.

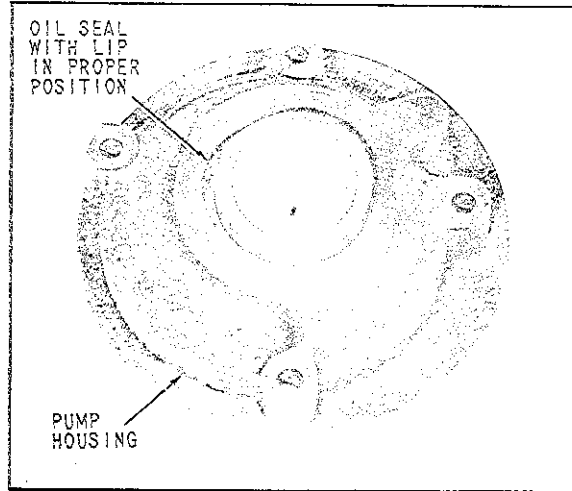


Fig. 92 Installing Oil Seal

6. Place pump housing squarely on arbor press table. Apply a suitable sealant to the outside diameter of seal before installing squarely into bore of housing with seal lip positioned as shown in (Fig. 92). Caution should be observed to insure that too much sealant is not used, that any excess is wiped away after the seal is installed, and that the sealant does not get on the sealing element.

7. Using an arbor press and suitable tool, press seal into housing until front face of seal is flush with front face of pump housing, (Fig. 93).

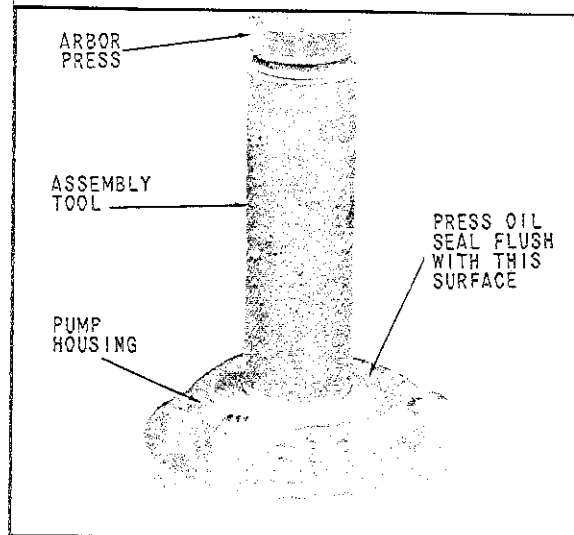


Fig. 93 Pressing Oil Seal

8. Place housing, lubricated with automatic transmission fluid type "A", suffix "A", and complete with seal in position shown in (Fig. 94). Install lubricated gears as shown, with reassembly identification marks matched, (Fig. 94).

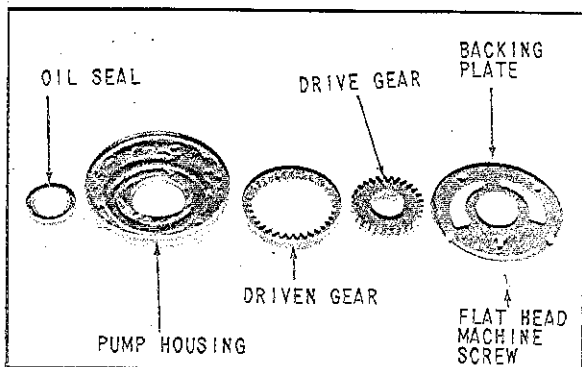


Fig. 91 Front Pump Parts with Backing Plate, Assembly 71-1A60

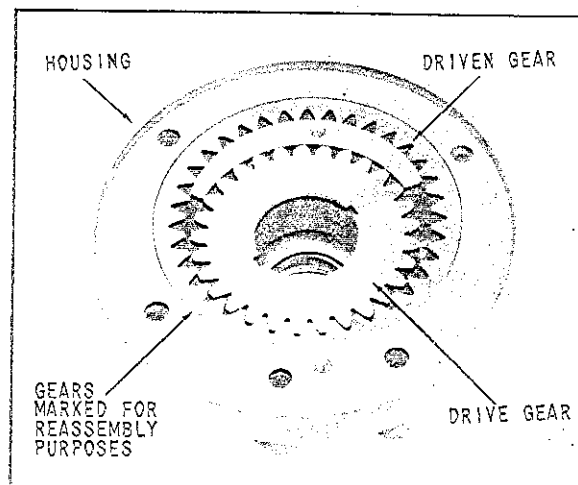


Fig. 94 Installing Pump Gears

SPECIAL INFORMATION AND INSTRUCTIONS

MODEL 70C & 71C TRANSMISSIONS

NOTE: It may be found that in a Model 70C or 71C transmission assembly a number of components may vary from the description and illustrations presented in the preceding portion of this manual. This results from changes which have been made since the first introduction of this model. In this section the information and description is presented for those features which are no longer incorporated in the current production models.

INSTALLATION OF OIL FILLER CAP AND DIP STICK ASSEMBLY

1. Place oil filler cap and dipstick assembly in the oil filler tube provided on rear left side of transmission case, (Fig. 85). Push down on filler cap and dipstick until assembly "bottoms" on tube, then turn cap to right as far as cap screw permits.

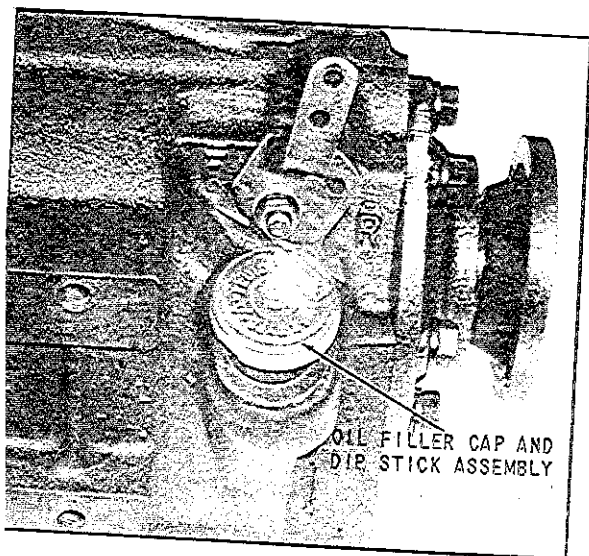


Fig. 85 Installation of Oil Filler Cap and Dipstick Assembly

INSTALLATION OF OIL STRAINER ASSEMBLY AND OIL DRAIN PLUG INTO TRANSMISSION CASE

2. Assemble the oil strainer assembly (71B-A98) and cooler line return bushing (4885A) in the order shown in (Fig. 86). The small end of oil strainer assembly should protrude out of tapped hole in case approximately 1/16 inch when installed to full depth.

NOTE: Bushing (4885B) illustrated in (Fig. 77) as used with present oil strainer assembly, may be used with the old oil strainer assembly (71B-A98) shown in (Fig. 85). On the other hand, the old bushing (4885A) is not threaded the entire length of its internal thread. Therefore, it cannot be assembled with the cooler return tube (71C-84 shown in (Fig. 77). Either complete assembly of parts, illustrated in (Fig. 77) or (Fig. 86), can be used as they are interchangeable.

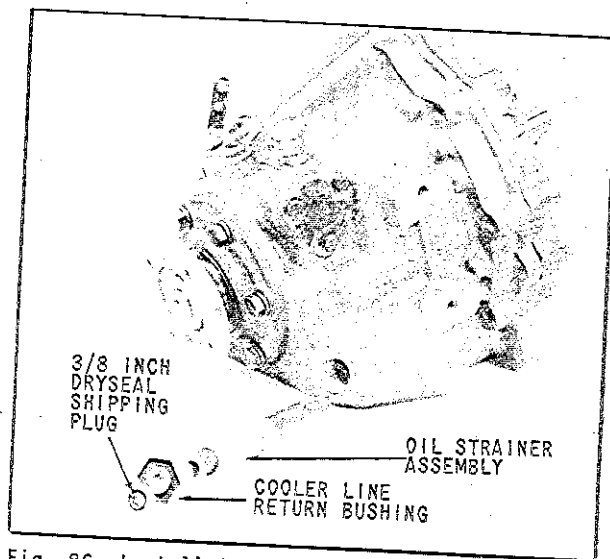


Fig. 86 Installation of Oil Strainer Assembly and Cooler Line Return Bushing

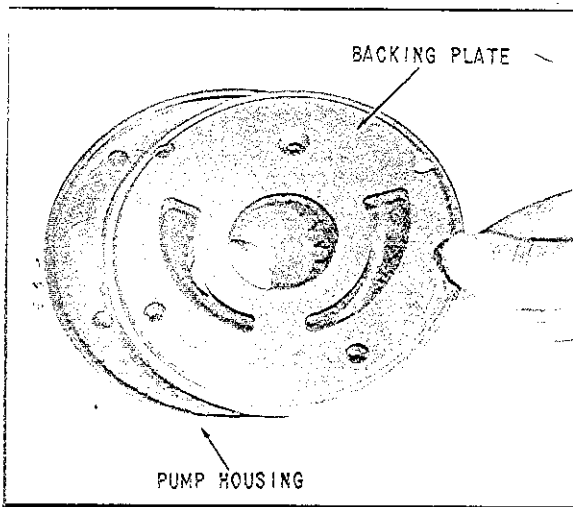


Fig. 95 Installing Backing Plate

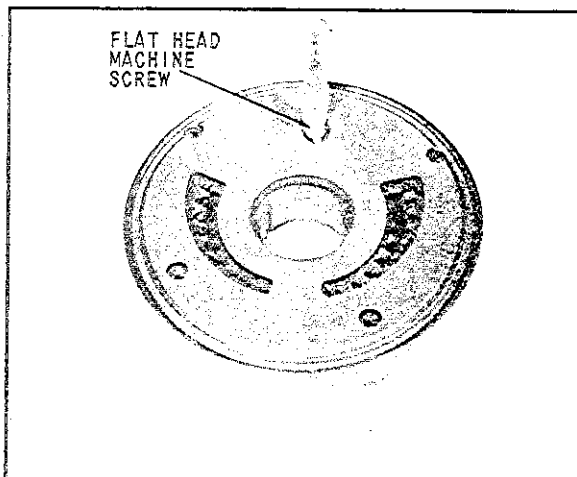


Fig. 96 Installing Flat Head Machine Screw through Backing Plate

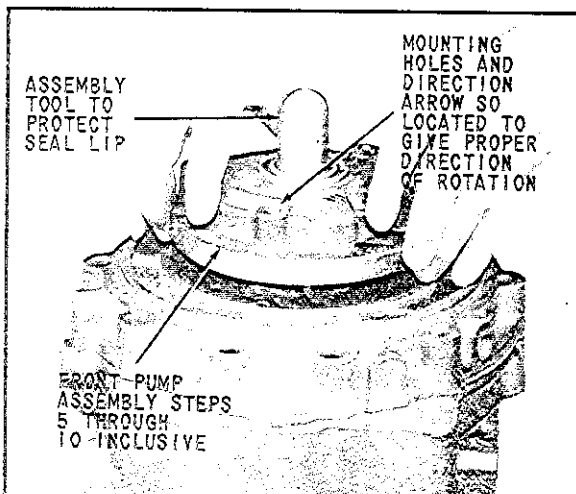


Fig. 97 Mounting Front pump

9. Inspect both faces of backing plate for dirt, lubricate and assemble, as shown in (Fig. 95).

10. Install the flat head machine screw and tighten to final torque of 25 to 35 pounds-inch, (Fig. 96). Check rotation of gears as assembled in pump housing; disassemble and inspect if gears do not turn freely.

MOUNTING FRONT PUMP ON TRANSMISSION

11. Place assembled transmission on rear face of coupling in upright position, as shown in (Fig. 97). Inspect upper exposed adapter face for dirt and obstructions, then lubricate and install front pump gasket.

12. Install Woodruff key.

NOTE: Check (Fig. 90) to determine that proper key and shaft are used.

13. Use a suitable tool to cover the splined portion of the input shaft and thereby protect the rubber lip on the oil seal during assembly of front pump, (Fig. 97).

14. After checking the following items, place the front pump assembly, steps 5 through 10 inclusive, squarely down over the protruding input shaft and assembly tool, (Fig. 97).

(a) Alignment of Woodruff key slot in drive gear with mating Woodruff key on the input shaft.

(b) Orientation of pump mounting bolt holes and direction of rotation arrow, depending on desired direction of input rotation, (Fig. 98 or Fig. 99).

(c) Freedom of rotation of pump gears in housing.

SPECIAL INFORMATION AND INSTRUCTIONS MODEL 70B & 71B TRANSMISSIONS

NOTE: Except for the discussions and illustrations on the features included in this section all other information concerning the Model 70B and 71B Transmissions may be found in preceding sections of the manual containing information for the assembly or disassembly of the Model 70C and 71C Transmission, or in the special supplementary section for these transmissions, pages 47 to 52.

INSTALLATION OF BREATHER ASSEMBLY

1. Assemble the screw-in type breather assembly as shown in (Fig. 104).

ASSEMBLY OF FRONT PUMP

2. The pump assembly for the Model 70B and 71B transmissions (71-A60) contains a different seal than the pump assembly with backing plate for the Model 70C and 71C (71-1A60). They are identical in all other respects. Therefore, when assembling the front pump assembly 71-A60 follow the information in (paragraphs 5-15) pages 48 to 51, with the exception that the seal should be pressed into the pump housing until front face of seal is 1/8 inch above front face of pump housing, (Fig. 105).

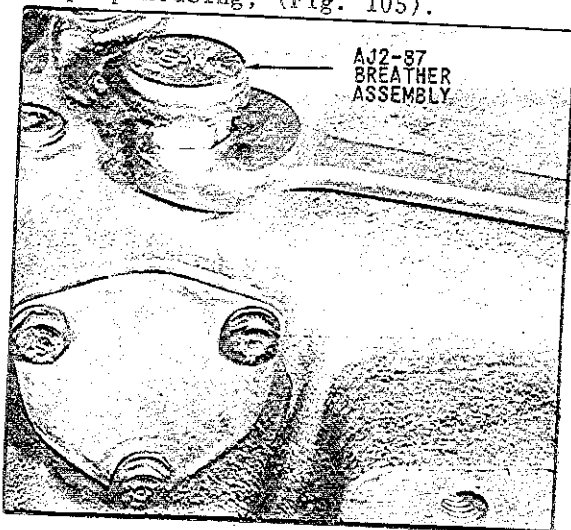


Fig. 104 Installation of Breather Assembly

DRIVE GEAR & PLUG ASSEMBLY

3. The drive gear assembly has a different input drive spline. For other instructions see page 52, (paragraph 17).

ASSEMBLY OF SHIFT LEVER

4. For assembly of shift lever see page 44, (paragraph 76). The assembly procedure is the same for the Model 70B and 71B Transmissions as that described and illustrated for the Model 70C and 71C. Although the

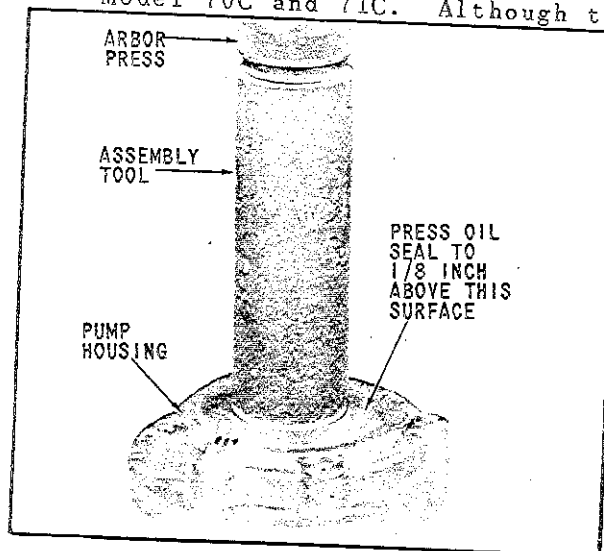


Fig. 105 Pressing Oil Seal

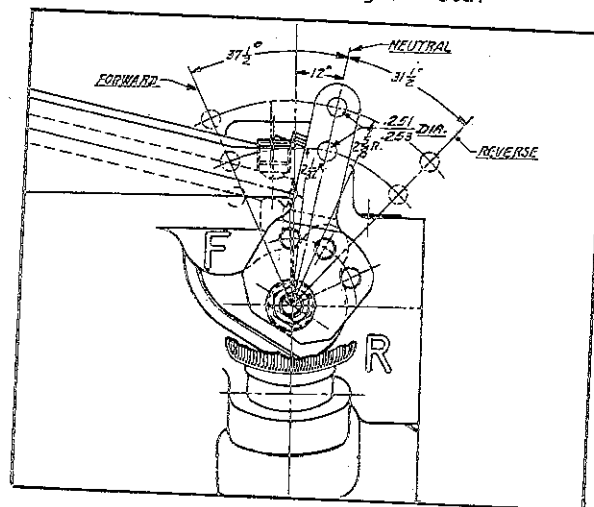


Fig. 106 ASI-71B & ASI-70B Shift Lever Positions

present shift lever (71-79B), (Fig. 17), can be substituted for the lever shown in (Fig. 106), it would change the travel of the control linkage for shifts between "Neutral" and "Forward" positions, see (Fig. 17) and (Fig. 106).

SPECIAL INFORMATION AND INSTRUCTIONS MODEL 70 & 71 TRANSMISSIONS

NOTE: Except for the discussions and illustrations on the features included in this section all other information concerning the Model 70 and 71 Transmissions may be found in the manual information for the assembly or disassembly of the Model 70C and 71C Transmission, or in the special supplementary sections, pages 47 to 53.

ASSEMBLY OF FRONT PUMP

1. On early production Model 70 and 71 transmissions the overall height of the pump housing between faces measured 1-7/8 inches instead of 1-5/8 on all other latter pump assemblies. For any pump housing having the 1-7/8 inch dimension, assemble the seal 1/8 inch below appropriate pump face. For all other information regarding the front pump see page 53, (paragraph 2).

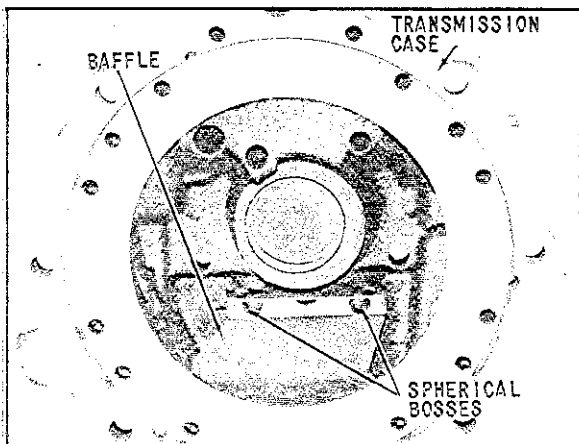


Fig. 107 Installing Baffle

ADAPTER CAPSCREWS

5. The 3/8-16x1-1/4 hex socket cap-screws (138243) formerly used to fasten the adapter to the transmission case have now been replaced with a twelve (12) point cap screw (4911) which has better locking characteristics. The two types are completely interchangeable.

INSTALLATION OF THE BAFFLE IN THE TRANSMISSION CASE

2. Place the baffle inside the transmission case with the curved portion below the cast spherical bosses in the case as shown in (Fig. 107). Also refer to (Fig. 6) and (Fig. 7).
3. Position the front end of the baffle so that the center of the baffle rests on top of the boss at the front center of the transmission case and the turned down corners of the baffle are located below the cast spherical bosses at the front of the transmission case.

Snap the baffle into position by lifting up on the curved portion so that the two large holes are located firmly on the spherical bosses at the rear of the transmission case as shown in (Fig. 107).

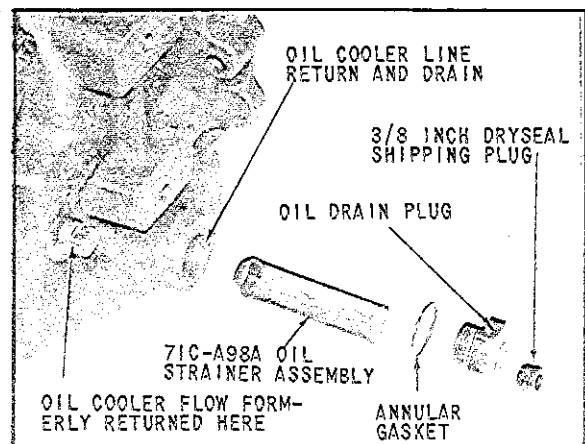


Fig. 108 Installation of Oil Drain Plug and Related Parts

IMPORTANT

SERIES 10-17 AND 10-18 SERVICE INSTRUCTIONS

Practically all information which has been written for the 71C and 72C Velvet Drive transmissions applies to the 10-17 and 10-18 assemblies. Use the appropriate instructions given in the 71C and 72C service manuals when servicing the 10-17 and 10-18 transmissions.

Chart Comparing New Models to Early Models

NEW TRANSMISSION ASSEMBLY NUMBER	TEN DIGIT NUMBER FOR ORIGINAL TRANSMISSION	ORIGINAL TRANSMISSION ASSEMBLY NUMBER	INPUT TO OUTPUT SPEED RATIO		ROTATION (1)			Pump Arrow Points (2)	PROP. REQ'D (3)
			FWD.	REV.	INPUT SHAFT	Output Shaft			
						FWD.	REV.		
10-17-000-001	10-04-000-036	AS1-71C	1:1	1:1	CW	CW	CCW	↗	RH
10-17-000-002	10-04-000-037	AS1-71CR	1:1	1:1	CCW	CCW	CW	↖	LH
10-17-000-003	10-04-000-038	AS1-71CB	1:1	1:1	CW	CW	CCW	↗	RH
10-17-000-004	10-04-000-039	AS1-71CBR	1:1	1:1	CCW	CCW	CW	↖	LH
10-17-000-005	10-04-000-042	AS2-71C	1.52:1	1.52:1	CW	CW	CCW	↗	RH
10-17-000-006	10-04-000-043	AS2-71CR	1.52:1	1.52:1	CCW	CCW	CW	↖	LH
10-17-000-007	10-04-000-050	AS7-71C	1.91:1	1.91:1	CW	CW	CW	↗	RH
10-17-000-008	10-04-000-051	AS7-71CR	1.91:1	1.91:1	CCW	CW	CCW	↖	RH
10-17-000-009	10-04-000-044	AS3-71C	2.10:1	2.10:1	CW	CW	CCW	↗	LH
10-17-000-010	10-04-000-045	AS3-71CR	2.10:1	2.10:1	CCW	CCW	CW	↖	RH
10-17-000-011	10-04-000-046	AS14-71C	2.57:1	2.57:1	CW	CW	CCW	↗	LH
10-17-000-012	10-04-000-047	AS14-71CR	2.57:1	2.57:1	CCW	CCW	CW	↖	RH
10-17-000-013	10-04-000-048	AS15-71C	2.91:1	2.91:1	CW	CW	CCW	↗	LH
10-17-000-014	10-04-000-049	AS15-71CR	2.91:1	2.91:1	CCW	CCW	CW	↖	RH
10-17-000-015	10-04-000-040	AS20-71C	1:1	1:1	CW	CW	CCW	↗	LH
10-17-000-016	10-04-000-041	AS20-71CR	1:1	1:1	CCW	CCW	CW	↖	LH
10-18-000-001	10-05-000-024	AS11-72C	1:1	1:10:1	CW	CW	CCW	↗	RH
10-18-000-002	10-05-000-035	AS11-72CR	1:1	1:10:1	CCW	CCW	CW	↖	RH
10-18-000-003	10-05-000-038	AS12-72C	1.52:1	1.68:1	CW	CW	CCW	↗	LH
10-18-000-004	10-05-000-039	AS12-72CR	1.52:1	1.68:1	CCW	CCW	CW	↖	LH
10-18-000-005	10-05-000-046	AS17-72C	1.91:1	2.10:1	CW	CCW	CW	↗	RH
10-18-000-006	10-05-000-047	AS17-72CR	1.91:1	2.10:1	CCW	CW	CCW	↖	RH
10-18-000-007	10-05-000-040	AS13-72C	2.10:1	2.31:1	CW	CW	CCW	↗	LH
10-18-000-008	10-05-000-041	AS13-72CR	2.10:1	2.31:1	CCW	CCW	CW	↖	RH
10-18-000-009	10-05-000-042	AS14-72C	2.57:1	2.83:1	CW	CW	CCW	↗	LH
10-18-000-010	10-05-000-043	AS14-72CR	2.57:1	2.83:1	CCW	CCW	CW	↖	RH
10-18-000-011	10-05-000-044	AS15-72C	2.91:1	3.20:1	CW	CW	CCW	↗	LH
10-18-000-012	10-05-000-045	AS15-72CR	2.91:1	3.20:1	CCW	CCW	CW	↖	RH
10-18-000-013	10-05-000-036	AS20-72C	1:1	1.10:1	CW	CW	CCW	↗	LH
10-18-000-014	10-05-000-037	AS20-72CR	1:1	1.10:1	CCW	CCW	CW	↖	LH

(1) Input and output shaft rotation is described as clockwise (CW) or counter clockwise (CCW) when the observer is standing behind transmission coupling facing towards front or input shaft end of transmission.

(2) Pump rotation is described when the observer is standing in front of transmission facing the pump. The arrow located nearest the top of pump face must point in the direction pump will be driven by the input shaft. IT SHOULD BE REALIZED THAT INDEXING THE PUMP FOR OPPOSITE ROTATION DOES NOT CAUSE OUTPUT SHAFT ROTATION TO BE REVERSED, but does permit the transmission to be used behind an opposite rotating engine.

CAUTION: The pump indexing on all assemblies except 2.10:1 reduction units is the only difference between C and CR units. The planetary gears and cage assembly used in C units is different than the one used in CR units in the 2.10:1 reduction units; therefore, indexing the pump for opposite rotation is not permitted on these assemblies. No warranty claims will be allowed for failures caused by improper pump indexing on 2.10:1 reduction units.

(3) The propeller is described when the observer is standing behind the boat looking forward. A right hand (RH) prop. will move the boat forward when rotated clockwise.

KEY TO TROUBLE SHOOTING CHART

1. Loose bolts-tighten.
2. Damaged gasket.
3. Damaged oil seal.
4. Oil line fittings loose-tighten.
5. Case leaks, porosity-replace.
6. Oil filler plug or cap leaks-replace or tighten.
7. Damaged control valve "O" ring.
8. Foreign material on mating surfaces-clean.
9. Damaged oil cooler, water and oil mixing-replace.
10. No oil-check at once.
11. Pump improperly located for engine rotation-locate correctly.
12. Sheared drive key-replace.
13. Faulty oil gauge-clean or replace, bleed air from gauge line.
14. Dirty oil screen-clean or replace.
15. Low oil level-add oil to proper level.
16. Regulator valve stuck-clean surfaces of burrs, dirt, or scoring. Polish inner bore with crocus cloth until valve moves freely.
17. Worn oil pump-replace if necessary.
18. Regulator spring weight low-replace. 98-108 # @ 1-1/16 inch height
19. High oil level-drain oil to proper level.
20. Low water level in cooling system.
21. Dirty oil cooler-clean or replace.
22. Cooler too small-replace with larger cooler.
23. Worn or misaligned bushings in transmission case-replace.
24. Worn or damaged clutch piston oil seals.
25. Worn or damaged clutch sealing rings.
26. Clutch improperly assembled.
27. Damaged or broken belleville spring.
28. Worn or damaged clutch plate(s)-replace.
29. Damaged or broken clutch springs.
30. Regulator valve not notched-see (Paragraph 16, Page 51).
31. Inadequate torque on output shaft nut-tighten.
32. Nicks on gears-remove with stone.
33. Excessive runout between engine housing and crankshaft.
34. Wrong damper assembly.
35. Damaged damper assembly parts-replace.
36. Body-fit bolts not used in mounting holes.
37. Control linkage improperly adjusted-see (Page 23).
38. Control lever and poppet ball corroded-clean and lubricate.
39. Control linkage interference-check.
40. Wrong oil used in transmission-change.
41. Cold Oil.
42. Planetary gear failure-replace or repair if necessary.
43. Ring gear mounting plate not securely held(only reduction units AS4- , AS14- , AS5- , and AS15-).

TORQUE SPECIFICATIONS

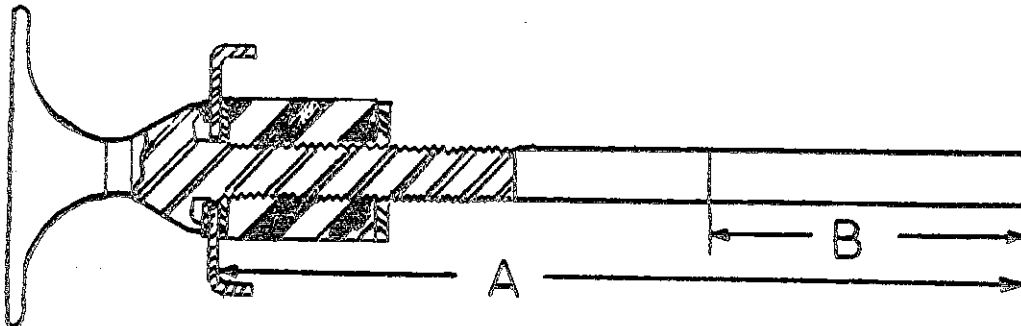
PART NUMBER	DESCRIPTION	APPLICATION	TORQUE LBS.- FT.
179822	5/16-18 x 1-1/2 HEX HEAD BOLT	PUMP TO ADAPTER	17-22
4911	3/8-16 x 1-1/4 12 POINT CAPSCREW	ADAPTER TO CASE	27-37
179793	1/4-20 x 5/8 HEX HEAD BOLT	VALVE COVER TO CASE	8-11
115729	5/16-24 NUT	SHIFT LEVER TO VALVE	8-11
179859	7/16-14 x 1-1/4 HEX HEAD BOLT	BEARING RETAINER TO CASE	27-32
4775L	1-20 NUT	OUTPUT SHAFT NUT	100-200
4885B	3/4-14 BUSHING	COOLER RETURN TO CASE	25-35
444687	1/8-27 DRYSEAL PIPE PLUG	CASE	7-12
444691	1/4-18 DRYSEAL PIPE PLUG	ADAPTER	12-20
444866	3/8-18 DRYSEAL PIPE PLUG	CASE	17-27
71-A195	3/4-14 PIPE PLUG	DIPSTICK ASS'Y. INTO CASE	10-15

***NOTE #2**

SUBJECT: DIPSTICK OIL LEVEL MARKING CHANGE.

The low oil level mark has been removed from all Velvet Drive Marine Transmission dipsticks. A single mark on the dipstick indicates level at which the oil should be maintained.

Three dipstick assemblies are involved in this change. Dipstick 10-04-559-001 is used in all 70C, 71C and 72C reduction units. Dipstick 10-13-559-001 is used in all CR2 units and all 70C, 71C and 72C direct drive units. Dipstick 10-06-559-001 is used in all 73C units and all V-Drive units.



The approximate distance from end of dipstick to the under side of the cap (dimension A) and from end of dipstick to the oil level mark (dimension B) are charted below. These dimensions will help identify each dipstick.

DIPSTICK PART NUMBER	DIMENSION A		DIMENSION B		
	inches	centimeters	inches	centimeters	
10-04-559-001	4.51	11.46	1.76	4.47	Plain
10-06-559-001	6.00	15.24	.75	1.91	Green
10-13-559-001	4.64	11.79	.83	2.11	Red

***NOTE #4**

Subject: Velvet Drive Reverse Clutch Plates.

CHART LISTING REVERSE CLUTCH PLATES

PART NUMBER	DESCRIPTION	PLATE THICKNESS	
		Inch	mm
71-86 (1)	Fiber	.247 -.252	* 6.27-6.40
72-A66	Sintered Copper	.0605-.063	1.54-1.60
72-A66B	Sintered Copper	.1135-.116	2.88-2.95
10-17-666-001	Cellulose	.113 -.118	2.87-3.00
72-176	Steel	.0665-.071	1.69-1.80

(1) No longer available from Warner Gear.

The following chart will simplify the selection of the correct reverse clutch plates for field servicing of Velvet Drive transmission. The reverse clutch cavity depth should be measured and a suitable clutch plate and dowel combination should be selected according to the model and cavity depth as shown in the following chart. The new cellulose plates 10-17-666-001 are recommended; however proper combinations of earlier clutch plates can be used.

COMBINATION

	TRANSMISSION MODEL	CLUTCH CAVITY DEPTH		PART NUMBER OF PLATES	NUMBER REQ'D.	OTHER COMBINATIONS
		Inch	mm			
1	70 & 71 All	.782	19.9	71-86 71-87 dp*	1 3	2 or 10
2	72 Direct Drive	.782	19.9	72-A66 72-176 71-87 dp*	2 1 3	None
3	71 Reductions 72 Direct Drive	.857	21.8	72-A66B 72-176 R6-177 dp*	2 1 3	8
4	72 Reductions	1.074	27.3	72-A66B 72-176 4622E dp*	3 2 3	9
5	72 Reductions	.911	23.1	72-A66 72-176 71-87 dp*	3 2 3	None
6	71 Direct Drive	.646	16.4	72-A66B 71-87A dp*	1 3	7
7	71 Direct Drive	.646	16.4	10-17-666-001 71-87A dp*	1 3	6
8	71 Reductions 72 Direct Drive	.857	21.8	10-17-666-001 72-176 R6-177 dp*	2 1 3	3
9	72 Reduction	1.074	27.3	10-17-666-001 72-176 4622E dp*	3 2 3	4
10	70 & 71 All	.782	19.9	10-17-666-001 72-176 71-87 dp*	1 2 3	1

*dp = dowel pin

All kits have been discontinued except for the following:

- | | |
|---------------|---|
| A4867AB | "72C" Forward Clutch Pack Kit |
| A4867AE | "71C" Forward Clutch Pack Kit |
| A4867DD | Output Shaft Bushing Kit |
| A4867HA | Oil Seal & Sealing Ring Kit |
| A4867VV | Case Bushing Kit |
| A4867HB | Gasket, Oil Seal & Sealing Ring Kit for "73C" |
| A4867HS | Pilot Light Kit |
| A4867DW | Small Parts Kit for "73C" |
| A4867HN | Drive Gear Alarm Kit |
| 10-04-420-052 | Neutral Switch Kit |
| 10-95-410-002 | Snap Ring Kit for All 70C, 72C, & 72C Units |
| 10-13-410-001 | Gasket & Seal Kit for All CR2 Units |
| 10-13-410-002 | Small Parts Kit for CR2 Units |
| 13-08-410-001 | V-Drive Overhaul Kit |

Individual parts may still be purchased from kits that have been obsoleted even though the kits will no longer be serviced. Use kits 10-95-410-002 and A4867HA to replace kit A4867WW.