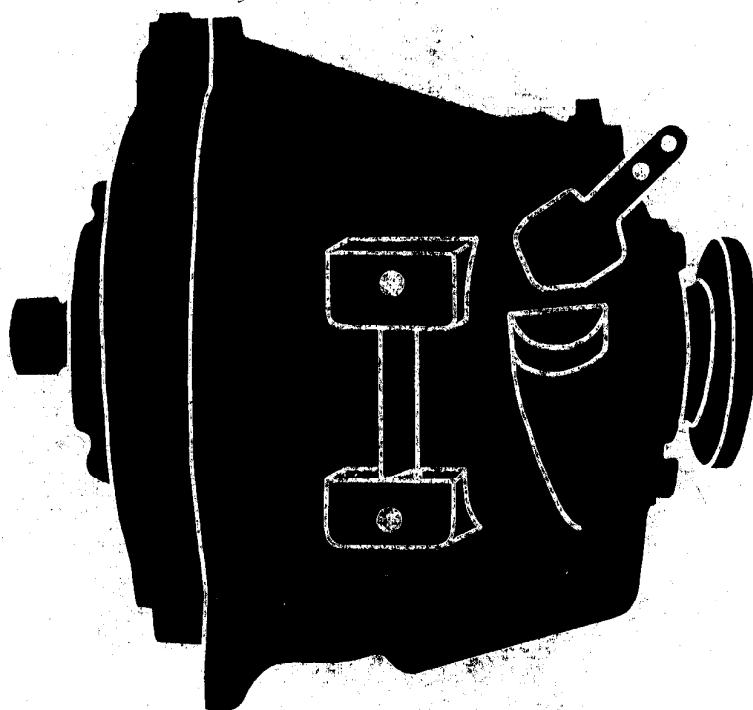




**BorgWarner  
Automotive**

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

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SERVICE MANUAL

Price \$ 5.00

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# **"VELVET DRIVE"<sup>®</sup>**

## **HYDRAULIC TRANSMISSION**

DIRECT DRIVE  
MODEL 70C & 71C SERIES

This Service Manual is prepared and illustrated for the ASI-70C and ASI-71C direct drive transmission, but it also contains supplementary information and illustrations which allow it to be used for the servicing of the other earlier model transmissions, ASI-70B, ASI-71B, ASI-70 and ASI-71.

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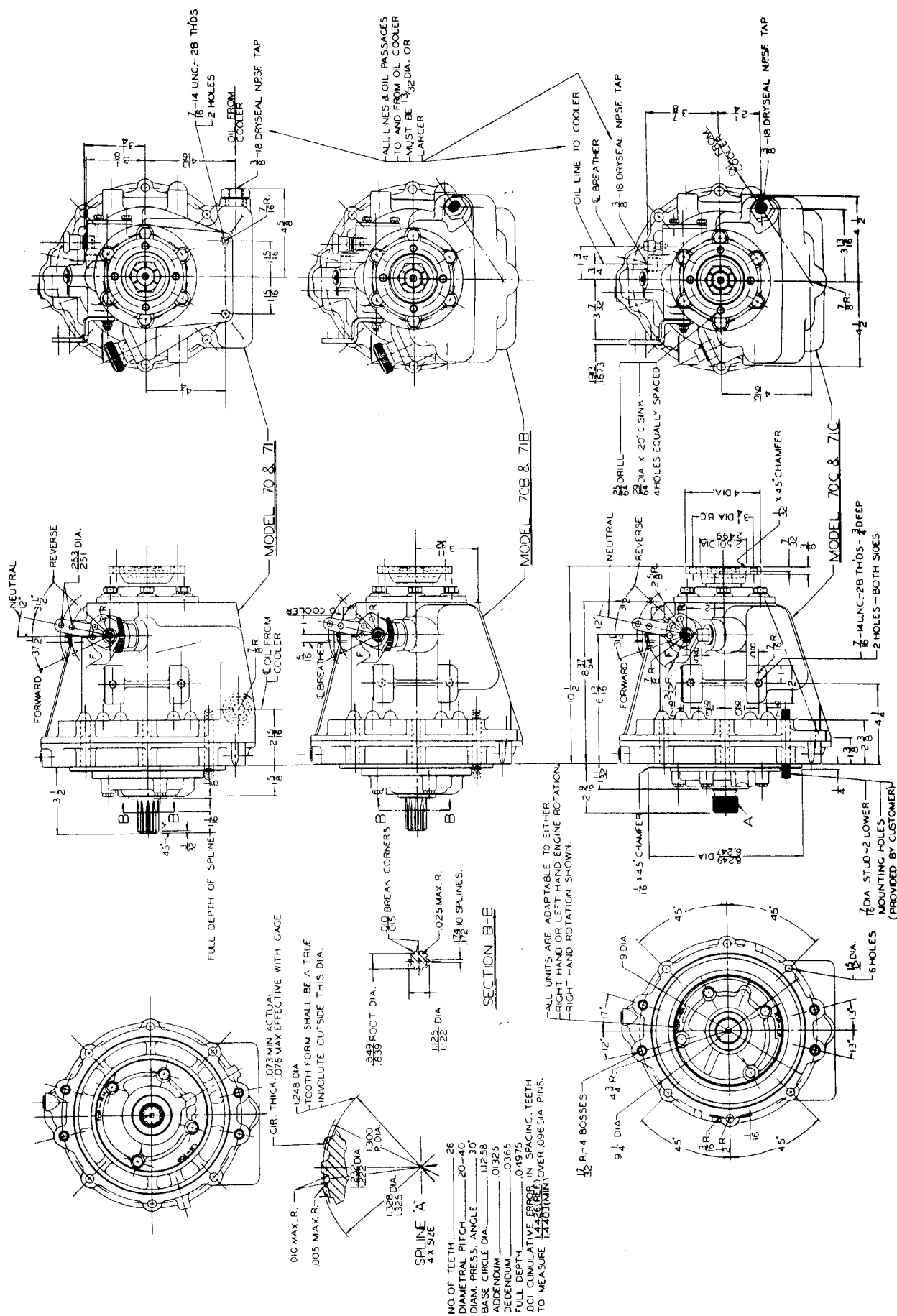
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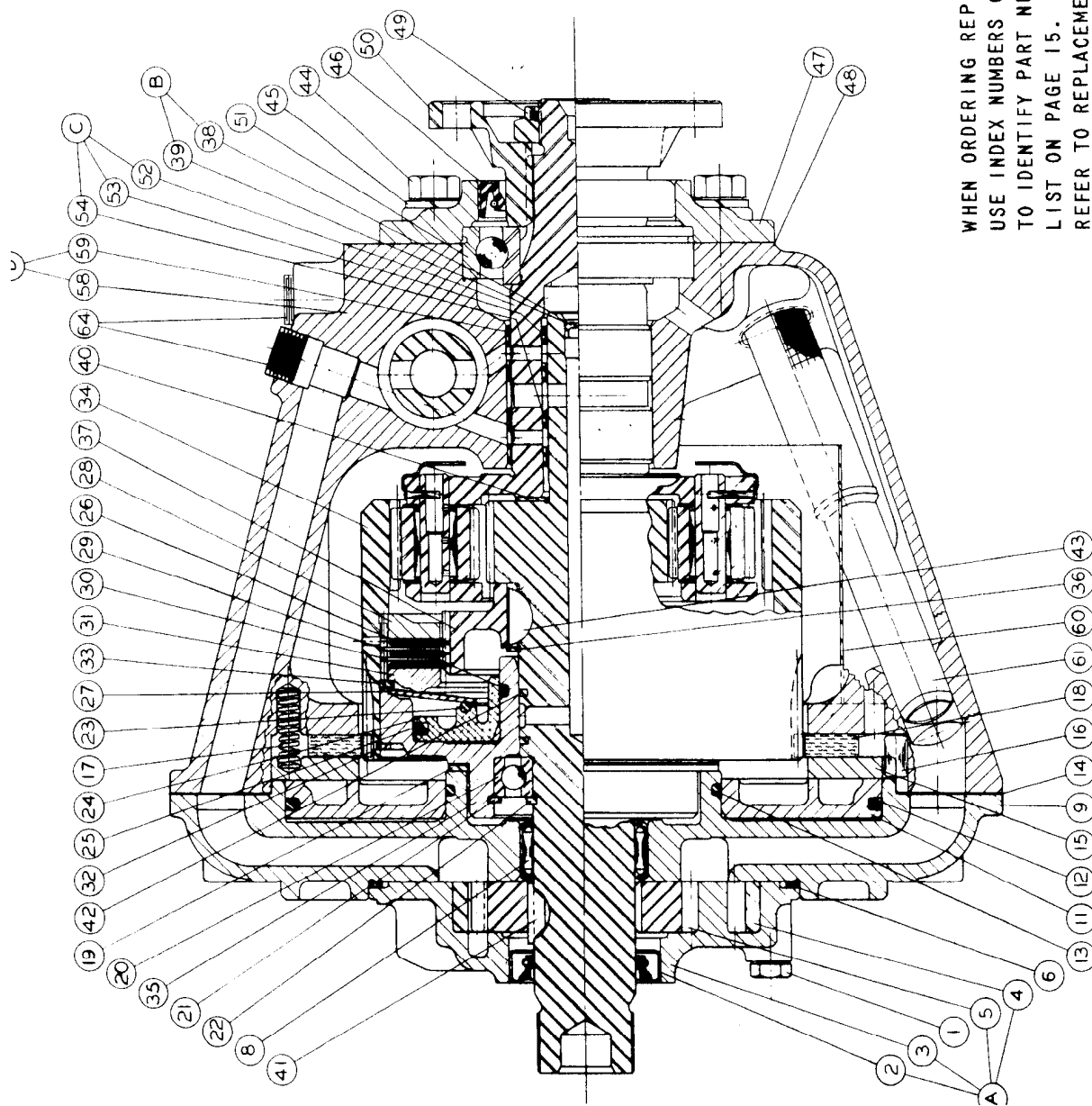
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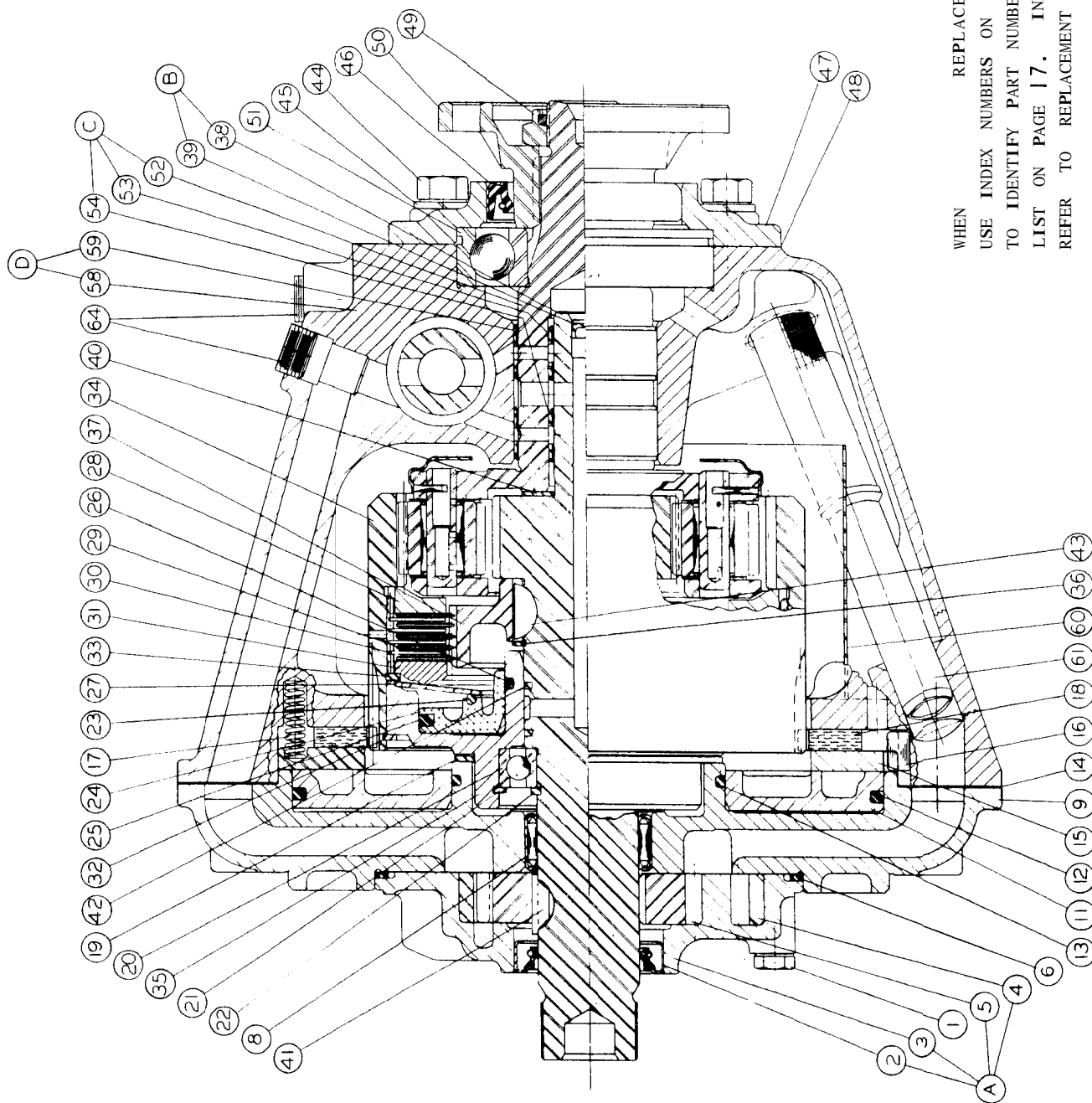
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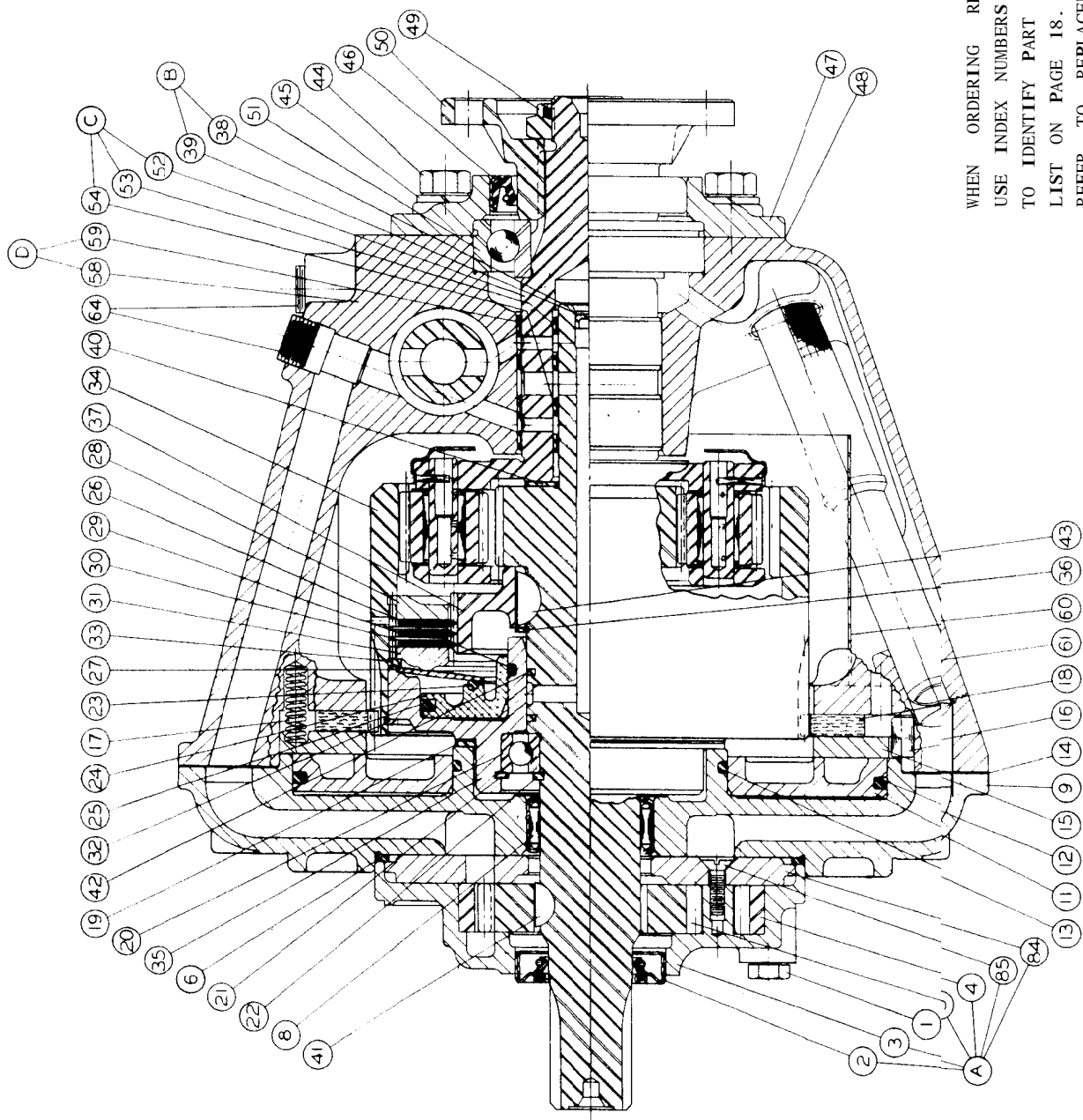
WHEN ORDERING REPLACEMENT PARTS  
USE INDEX NUMBERS ON THIS DRAWING  
TO IDENTIFY PART NUMBERS IN PARTS  
LIST ON PAGE 15. INDEX LETTERS  
REFER TO REPLACEMENT ASSEMBLIES.

Fig. 2 Cross Section of Model ASI-70C Transmission



WHEN REPLACEMENT PARTS  
USE INDEX NUMBERS ON THIS DRAWING  
TO IDENTIFY PART NUMBERS IN PARTS  
LIST ON PAGE 17. INDEX LETTERS  
REFER TO REPLACEMENT ASSEMBLIES.

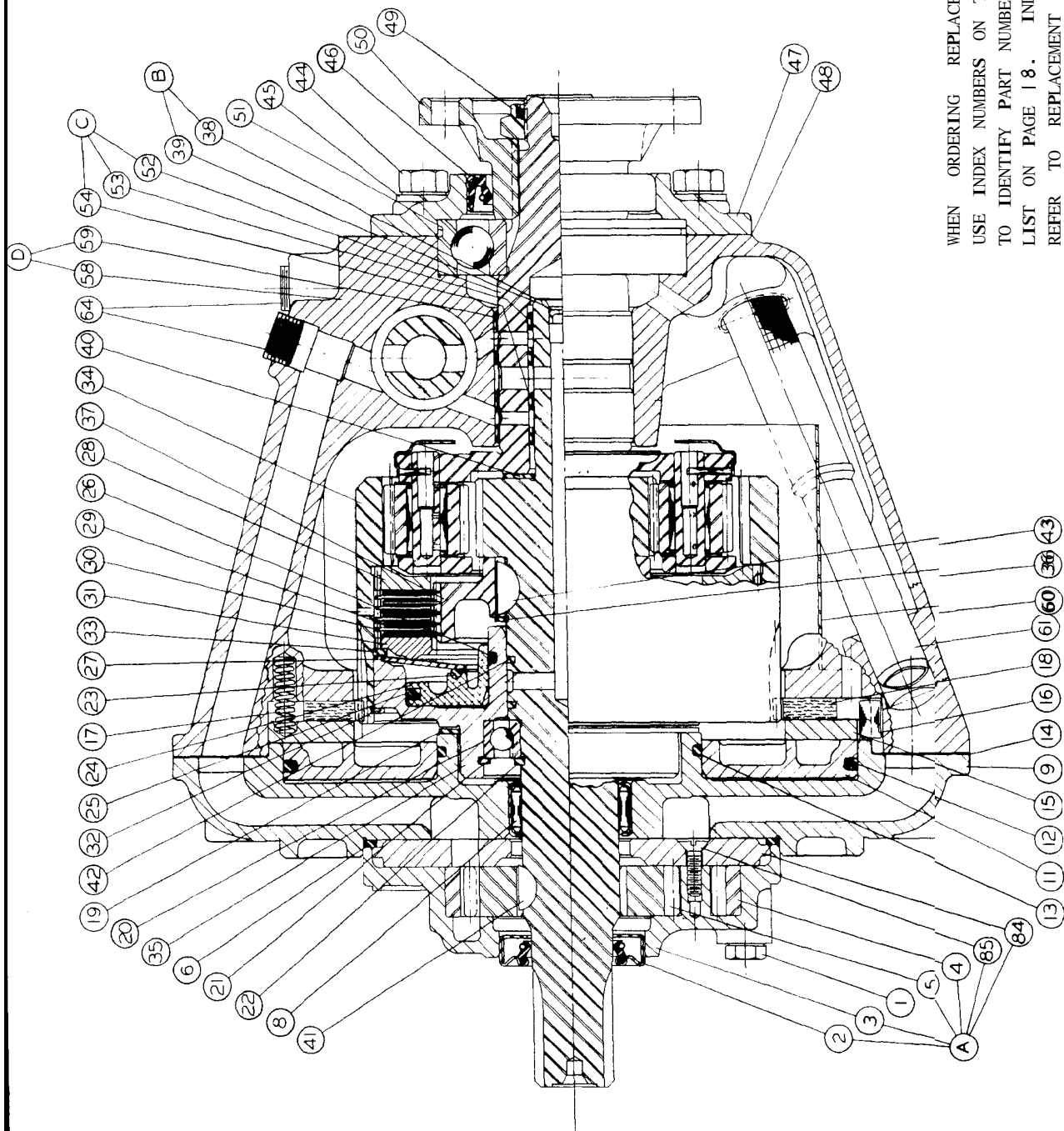
Fig. 3 Cross Section of Model ASI-71C Transmission



WHEN ORDERING REPLACEMENT PARTS  
USE INDEX NUMBERS ON THIS DRAWING  
TO IDENTIFY PART NUMBERS IN PARTS  
LIST ON PAGE 18. INDEX LETTERS  
REFER TO REPLACEMENT ASSEMBLIES.

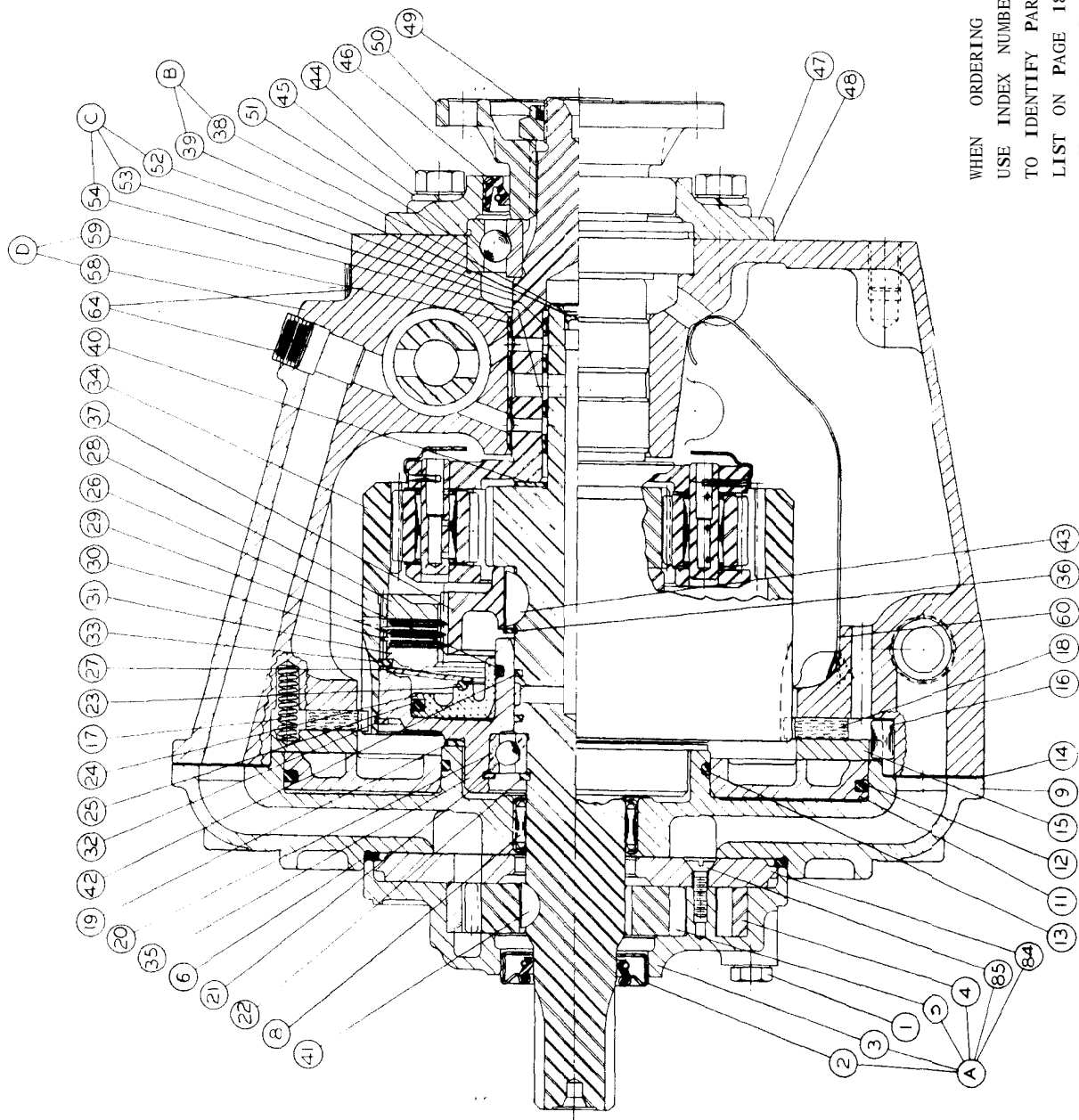
Fig. 4 Cross Section of Model AS1-70B Transmission





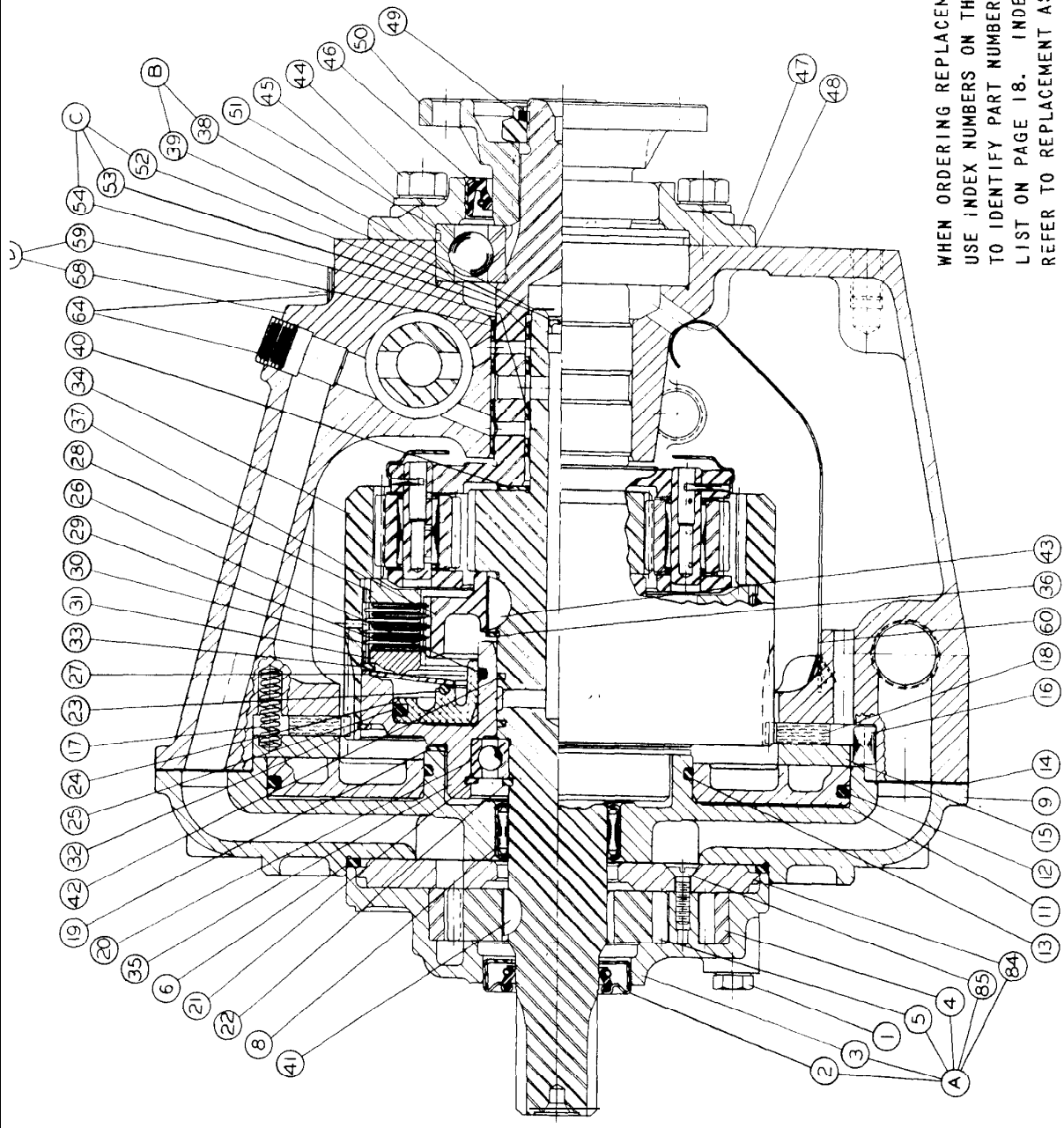
WHEN ORDERING REPLACEMENT PARTS  
USE INDEX NUMBERS ON THIS DRAWING  
TO IDENTIFY PART NUMBERS IN PARTS  
LIST ON PAGE 18. INDEX LETTERS  
REFER TO REPLACEMENT ASSEMBLIES.

Fig. 5 Cross Section of Model ASL-71R Transmission



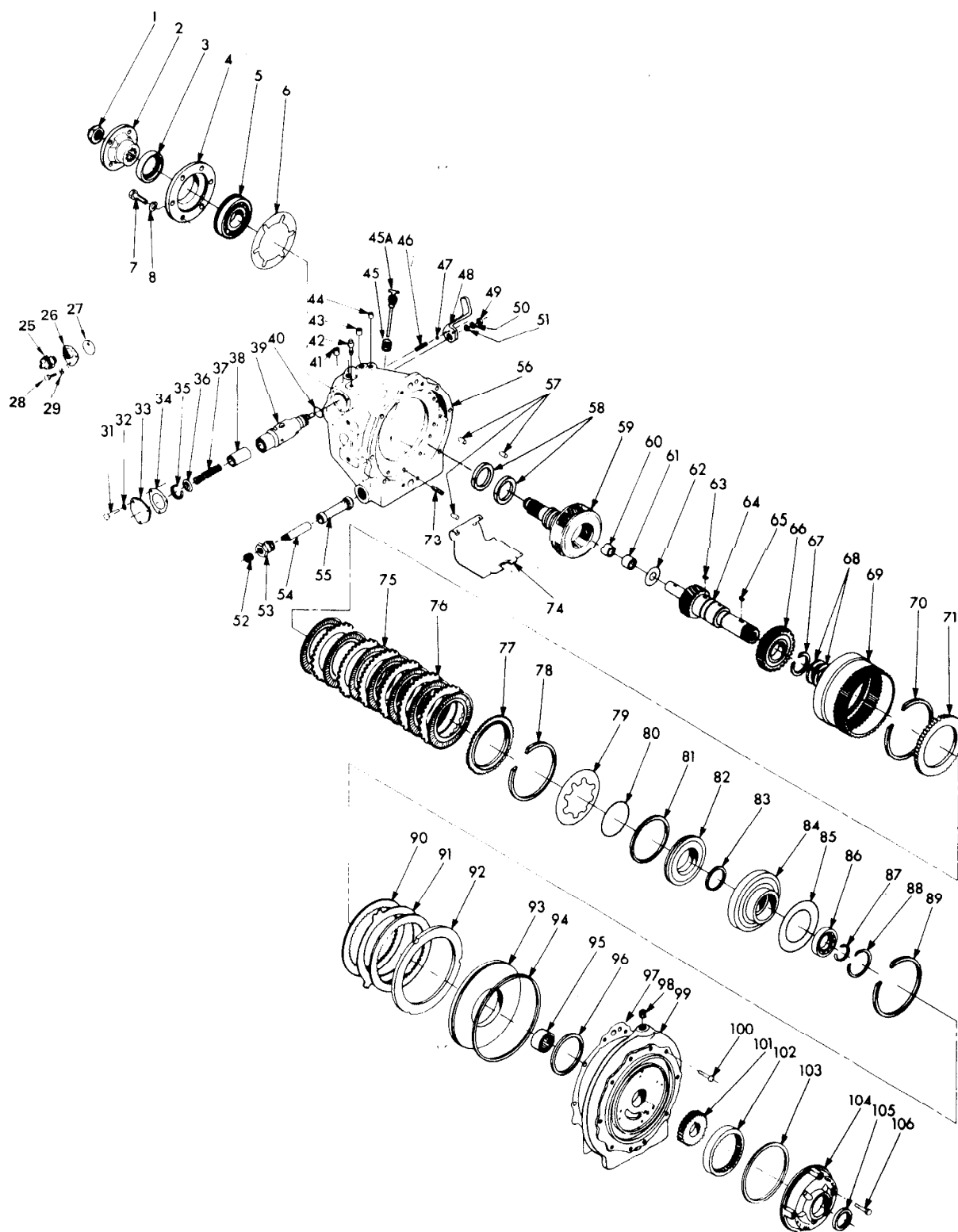
WHEN ORDERING REPLACEMENT PARTS  
USE INDEX NUMBERS ON THIS DRAWING  
TO IDENTIFY PART NUMBERS IN PARTS  
LIST ON PAGE 18. INDEX LETTERS  
REFER TO REPLACEMENT ASSEMBLIES.

Fig. 6 Cross Section of Model AS1-70 Transmission



WHEN ORDERING REPLACEMENT PARTS  
USE INDEX NUMBERS ON THIS DRAWING  
TO IDENTIFY PART NUMBERS IN PARTS  
LIST ON PAGE 18. INDEX LETTERS  
REFER TO REPLACEMENT ASSEMBLIES.

Fig. 7 Cross Section of Model ASL-71 Transmission



10-18-000-001

# PARTS LIST FOR 10-I 7 & 10-18 DIRECT DRIVE UNITS:

INDEX NO.	T.S. PART NO.	DESCRIPTION	NO. REQ.	INDEX NO.	T.S. PART NO.	DESCRIPTION	NO. REQ.
1	4776L	Main shaft nut	1	74	71-140	Oil baffle (10-18)	1
2	4547AY	Coupling (10-18)	1		71B-140	Oil baffle (10-17)	1
	4547BA	Coupling (10-17)	1	7	5C-A66A	Clutch inner plate (10-18) *NOTE 4	7
3	71C-110	Oil seal	1			Clutch inner plate (10-17) *NOTE 4	5
4	72-7	Bearing retainer (10-18)	1	76	3-176	Clutch plate (steel) (10-18)	6
	71-7	Bearing retainer (10-17)	1			Clutch plate (steel) (10-17)	4
5	B309AGS	Annular bearing (10-18)	1	77	5C-175A	Clutch pressure plate	1
	B308AGS	Annular bearing (10-17)	1	78	4755	Clutch spring snap ring	1
6	72-147	Bearing retainer gasket (10-18)	1	79	3-37	Clutch spring	1
	71-147	Bearing retainer gasket (10-17)	1	80	5C-33	Clutch spring bearing ring	1
7	10-00-183-043	7/16-14 x 1-1/8 Hex head bolt (10-18)	6	81	5L-36	Clutch ring	1
	0000179859	7/16-14 x 1-1/8 Hex head bolt (10-17)	6	82	10-16-124-001	Forward clutch piston	1
8	0000103322	7/16 Lockwasher (10-17)	6	83	5M-122	Sealing ring ("O" ring)	1
25	10-00-140-007	Neutral switch	1	84	72-70	Forward clutch cylinder (10-18)	1
26	10-16-039-001	Valve cover	1		71-70	Forward clutch cylinder (10-17)	1
27	10-16-099-001	Switch cam	1	85	71-15B	Thrust washer	1
28	0000179796	1/4-20 Hex head bolt	3		10-16-193-001	Thrust washer	1
29	0000103319	Lockwasher	3	86	B108A	Annular bearing (10-18)	1
31	0000179791	1/4-20 x 1/2 Hex head bolt	3		B107A	Annular bearing (10-17)	1
33	71-4	Valve cover	1	87	4559A	Snap ring (10-18)	1
34	71-14	Valve cover gasket	1		4734	Snap ring (10-17)	1
35	4821	Snap ring	1	88	4766B	Snap ring (10-18)	1
N.I.	71-A244A	Valve & spring assembly	1		R6A-7 1/2	Snap ring (10-17)	1
	10-04-739-001	Valve & spring assembly	1	89	4822	Ring gear snap ring	1
36	71-246	Valve spring retainer	1	90	72-A66B	Reverse clutch plate assembly (10-18)	2
37	71-242	Spring (black)	1			Reverse clutch plate assembly (10-17)	1
38	71-243	Pressure regulator valve	1	91	72-176	Outer clutch plate (10-18)	1
39	71-244A	Forward "reverse gear trans. valve	1	92	71-71	Reverse clutch pressure plate	1
40	4804H	"O" ring	1	93	71-35	Reverse clutch piston	1
41	10-00-191-002	3/8-18 Plastic plug	1	94	4805A	Sealing ring	1
42	A4740G	Breather assembly	1	95	4840D	Needle bearing	1
43	444866	3/8-18 Pipe plug	1	96	4804G	Sealing ring	1
44	444687	1/8-27 Pipe plug	1	97	71-144B	Case & adapter gasket	1
45	10-04-034-002	Dipstick tube *NOTE 2	1	98	444858	1/4 Pipe plug	1
45A	10-17-559-001	Dipstick assembly *NOTE 2	1	99	71C-A8	Forward & reverse adapter	1
46	71-42	Poppet spring	1	100	4911	3/8-16 x 1-1/4 Cap screw	4
47	453632	5/16 Steel ball	1	N.I.	71C-A60	Pump assembly (includes 101, 102, 104, & 105)	1
48	71-79B	Forward & reverse shift lever	1	101	Not serviced	Pump drive gear (order assembly)	1
49	115729	5/16-24 Hex nut	1	102	Not serviced	Pump driven gear (order assembly)	1
50	108579	5/16 Lockwasher	1	103	3-61	Pump gasket	1
51	103340	Control lever washer	1	104	Not serviced	Pump housing (order assembly)	1
52	10-00-191-002	3/8-18 Plastic plug	1	105	10-00-044-014	Oil seal assembly	1
53	4885B	Bushing	1	106	10-00-183-021	5/16-18 x 1-3/8 Hex head bolt	4
54	71C-84	Oil return tube	1	N.I.	71C-60	Pump assembly	1
55	71C-A98A	Oil strainer assembly (10-18)	1	N.I.	Kit A4867VV	2 Presized case bushings	1
	71C-A98	Oil strainer assembly (10-17)	1				
	71C-98	Oil shield assembly (10-18 units)	1				
N.I.	5L-222	Spring	1				
N.I.	35-143	Flat washer	1				
56	71B-A1A	Case with bushing (10-17) not available *NOTE 3	1				
56	72-A1J	Case with bushing (10-18) not available *NOTE 3	1				
56	10-17-065-004	Case without bushing (10-17) *NOTE 3	1				
56	10-17-065-006	Case without bushings (10-17)	1				
56	10-18-065-001	Case without bushings (10-18)	1				
57	R6-177	Dowel pin (10-18)	1				
	71-87A	Dowel pin (10-17)	3				
58	4806B	Sealing ring	4				
59	72-1A2	Pinion cage & output shaft (10-18) *NOTE 3	1				
	71-1A2	Pinion cage & output shaft (10-18) *NOTE 3	3				
	10-17-659-012	Pinion cage & output shaft (10-17) *NOTE 3	1				
	10-18-659-006	Pinion cage & output shaft (10-18) *NOTE 3	1				
60	Kit A4867DD	2 Presized bushings	1				
61	Kit A4867DD	2 Presized bushings	1				
62	71-17	Thrust washer	1				
63	0000124553	Woodruff key (10-18)	1				
	0000218211	Woodruff key (10-17)	1				
64	72C-2A16	Drive gear & plug assembly (10-18)	1				
	71C-3A16	Drive gear & plug assembly (10-17)	1				
65	4873	Woodruff key	1				
66	10-16-179-001	Forward clutch hub (10-18)	1				
	71-40	Forward clutch hub (10-17)	1				
67	4495	Snap ring	1				
68	4806J	Sealing ring	2				
69	72-6	Ring gear (10-18)	1				
	71-6	Ring gear (10-17)	1				
70	4768	Snap ring selective .052 inch (1.32 mm) (10-18)	1				
	4768A	Snap ring selective .076 inch (1.93 mm) (10-18)	1				
	4768B	Snap ring selective .098 inch (2.49 mm) (10-18)	1				
	10-00-139-018	Snap ring selective .064 inch (1.63 mm) (10-18)	1				
	10-00-139-019	Snap ring selective .086 inch (2.18 mm) (10-18)	1				
	10-00-039-048	Snap ring selective .035 inch (0.89 mm) (10-17)	1				
	10-00-139-049	Snap ring selective .052 inch (1.32 mm) (10-17)	1				
71	5L-67	Clutch pressure plate	1				
73	71-97	Pressure plate spring	11				

N.I.-NOT ILLUSTRATED

\*NOTE 2 - See page 62

\*NOTE 3 - See page 63

\*NOTE 4 - See page 64

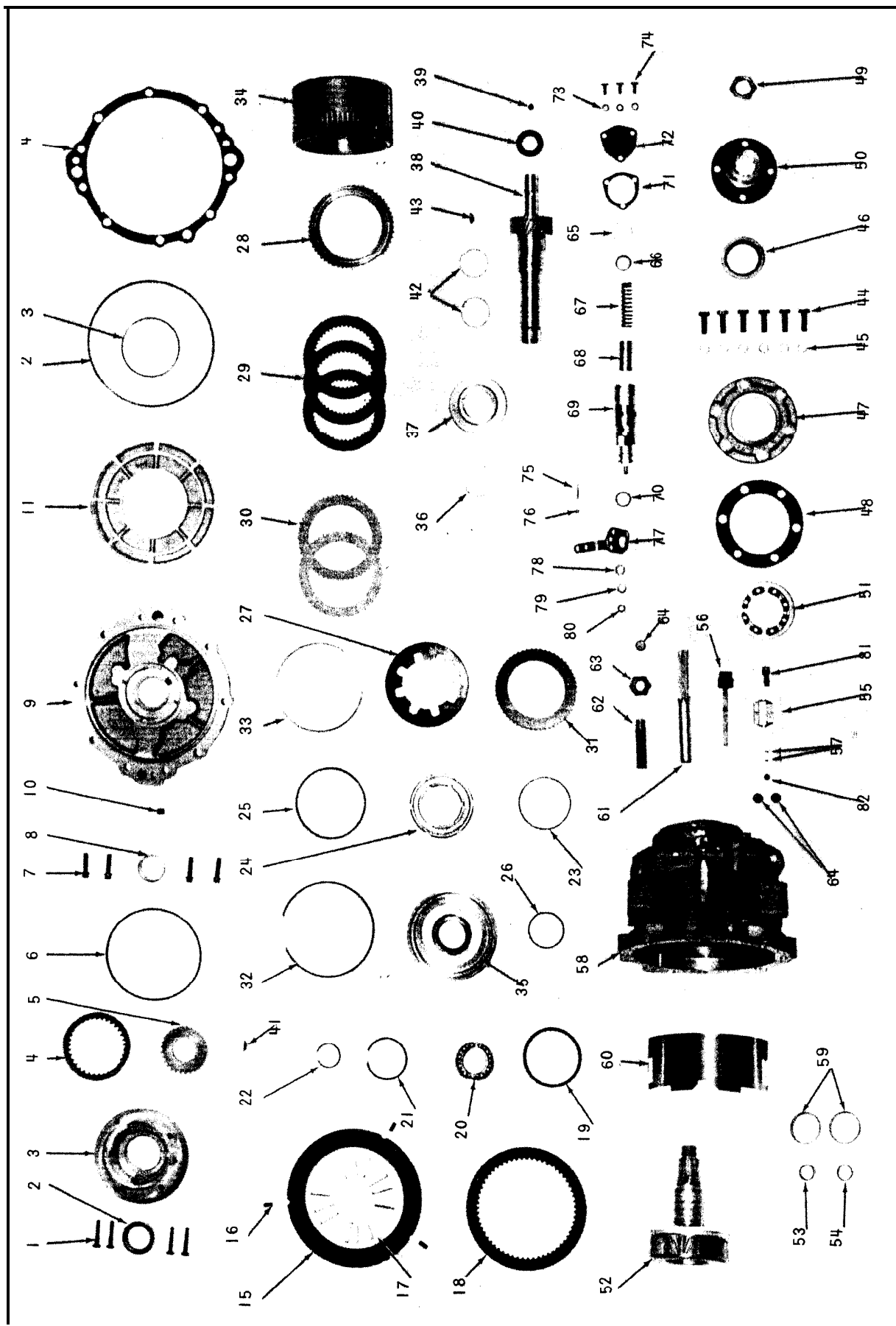


Fig. 11 Parts Display for Forward &amp; Reverse ASI-70C Transmission

# AS1-70C PARTS LIST

JDEX NO.	W.G. PART NO.	DESCRIPTION	Q. EQ.	NDEX NO.	W.G. PART NO.	DESCRIPTION	Q. EQ.
1	C1000179822	1/16-18 x 1-1/2 Hex Head Bolt	4	N.I.	10-04-559-001	Dipstick Assembly-New Type	1
N.I.	10-00-1 83-02 1	1/16-18 x 1-3/8 Hex Head Bolt	4	N.I.	10-04-034-002	Dipstick Tube	1
A	71 C-A60	Front Pump Assembly	1	57	0300145366	Drive Screw	2
2	71 C-62A	Oil Seal Assembly	1	58	70B-A1A	Transmission Case & Bushing Assembly	1
3	N.S.S.	Front Pump Housing	1	59	Kit A4867VV	Case Bushings (Two Presized Bushing)	1
4	N.S.S.	Front Pump Driven Gear	1	60	71B-140	Baffle	1
5	N.S.S.	Front Pump Drive Gear	1	61	71 C-A98	Oil Strainer Assembly	1
6	3-61	Front Pump Gasket	1	62	71 C-84	Oil Return Tube	1
7	4191 1	Screw - 12 Point Head	4	63	4885B	Reducing Pipe Bushing	1
8	4840D	Needle Bearing	1	64	0000444866	3/8-18 Dryseal Plug	3
9	71 C-A8	Forward & Reverse Adapter	1	E	71-A244A	Valve & Spring Assembly	1
10	C100044469 1	1/4-27 Dryseal Plug	1	65	4821	Snap Ring	1
11	71-35	Reverse Clutch Piston	1	66	71-246	Valve Spring Retainer	1
12	4805A	Sealing Ring	1	67	71-242	Valve Spring	1
13	4804G	10" Ring	1	68	71-243	Pressure Regulator Valve	1
14	71-1448	Case & Adapter Gasket	1	69	71-244A	Forward & Reverse Gear Trans. Valve	1
15	71-71	Reverse Clutch Pressure Plate	1	70	4804H	10" Ring	1
N.I.	71-87	Dowel Pin (Used With Fiber Plate)	3	71	71-14	Valve Cover Gasket	1
16	71-87A	Dowel Pin (Used With Metalic Plate)	3	72	71-4	Valve Cover	1
17	71-97	Pressure Plate Spring	12	73	0000103319	1/4 Lockwasher	3
18	71-86	Reverse Clutch Plate Fiber	1	74	0000179793	1/4-20 x 5/8 Hex Head Bolt	3
N.I.	72-A66B	Reverse Clutch Plate Metalic	1	75	71-42	Poppet Spring	1
19	71-158	Thrust Washer	1	76	0000453632	5/16 Steel Ball	1
20	B107A	Ball Bearing	1	77	71-798	Forward & Reverse Shift Lever	1
21	R6A-7 1/2	Snap Ring	1	78	0000103340	Control Lever Washer	1
22	41734	Snap Ring	1	79	0000108579	5/16 Lockwasher	1
23	5C-33	Clutch Spring Bearing Ring	1	80	0000115729	5/16-24 Hex Nut	1
24	71-45	Forward Clutch Piston	1	81	A.4740G	Breather	1
25	5L-36	Sealing Ring	1	82	0000444687	1/8-27 Dryseal Plug	1
26	5M-122	10" Ring	1	N.I.	A.4867AH	Clutch Pack Kit	
27	3-37	Clutch Spring	1	N.I.	A.4867AQ	Forward Clutch Cylinder Kit	
28	5L-67	Clutch Pressure Plate	1	N.I.	A.4867HA	Gasket & Seal Kit	
29	5C-A66A	Clutch Inner Plate Assembly	3	N.I.	A.4867WW	Small Parts Kit	
30	3-176	Clutch Outer Plate	2				
31	5C-175A	Clutch Pressure Plate	1				
32	41822	Ring Gear Snap Ring	1				
33	41755	Clutch Spring Snap Ring	1				
34	70-6	Ring Gear	1				
35	71-70	Forward Clutch Cylinder	1				
36	41495	Snap Ring	1				
37	71-40	Forward Clutch Hub	1				
38	71C-3A16	Drive Gear & Plug Assembly	1				
39	N.S.S.	3/8 Taper Plug	1				
40	71-17	Thrust Washer	1				
41	4873	Key No. 9 - No Rock	1				
42	4806J	Sealing Ring	2				
43	0000218211	Woodruff Key	1				
44	0000179859	7/16-14x 1-1/8 Hex Head Bolt	6				
45	0000103322	7/16 Lockwasher	6				
46	71C-110	Oil Seal	1				
47	70-J	Bearing Retainer	1				
48	71-147	Bearing Retainer Gasket	1				
49	4775L	Main Shaft Nut	1				
50	4547BA	Coupling	1				
51	B208AGS	Annular Bearing	1				
52	71-1A2	Pinion Cage & Output Shaft Assembly	1				
53	Kit A4867DD	Main Drive Gear Bushing - Two Presized Bushing in Kit					
54	4636E X	Name Plate	1				
56	71-A195	Dipstick Assembly-Screw-in Type	1				

N.I. - NOT ILLUSTRATED

N.S.S. - NOT SERVICED SEPARATELY

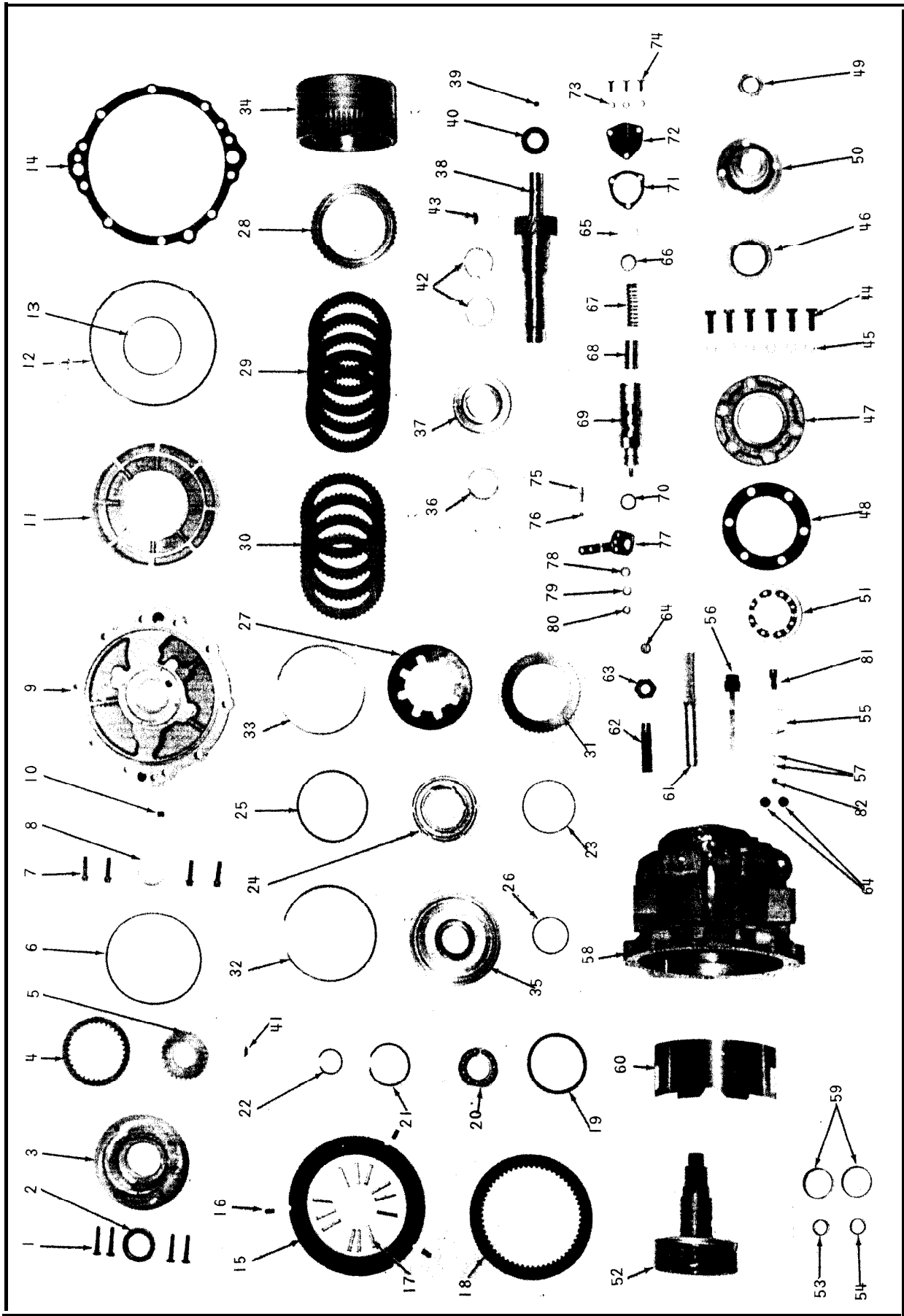


Fig. 12 Parts Display for Forward &amp; Reverse ASI-71C Transmission



# AS1-71C PARTS LIST

INDEX NO.	W.O. PART NO.	DESCRIPTION	NO. EQ.	INDEX NO.	W.O. PART NO.	DESCRIPTION	NO. REQ.
1	0001 79822	1/16-18 x 1-1/2 Hex Head Bolt	4	V.I.	10-04-559-001	Dipstick Assembly-New Type	1
N.I.	0-00-183-021	1/16-18 x 1-3/8 Hex Head Bolt	4	V.I.	10-04-034-002	Dipstick Tube	1
A	1C-A60	Front Pump Assembly	1	57	0000145366	Drive Screw	2
2	1C-62A	Oil Seal Assembly	1	58	71B-A1A	Transmission Case & Bushing Assembly	1
3	J.S.S.	Front Pump Housing	1	59	Kit A4867VV	Case Bushings (Two Presized Bushing)	1
4	J.S.S.	Front Pump Driven Gear	1	60	71B-140	Baffle	1
6	J.S.S.	Front Pump Drive Gear	1	61	71C-A98	Oil Strainer Assembly	1
6	I-61	Front Pump Gasket	1	62	71C-84	Oil Return Tube	1
7	I911	Screw - 12 Point Head	4	63	4885B	Reducing Pipe Bushing	1
8	I840D	Needle Bearing	1	64	0000444066	3/8-18 Dryseal Plug	1
9	1C-A8	Forward & Reverse Adapter	1	E	71-A244A	Valve & Spring Assembly	1
10	1000444691	1/4-27 Dryseal Plug	1	65	4821	Snap Ring	1
11	I-35	Reverse Clutch Piston	1	66	71-246	Valve Spring Retainer	1
12	I805A	Sealing Ring	1	67	71-242	Valve Spring	1
13	I804G	"O" Ring	1	68	71-243	Pressure Regulator Valve	1
14	71-144B	Case & Adapter Gasket	1	69	71-244A	Forward & Reverse Gear Trans. Valve	1
15	71-71	Reverse Clutch Pressure Plate	1	70	4804H	"O" Ring	1
N.I.	71-87	Dowel Pin (Used With Fiber Plate)	3	71	71-14	Valve Cover Gasket	1
16	71-87A	Dowel Pin (Used With Metallic Plate)	3	72	71-4	Valve Cover	1
17	71-97	Pressure Plate Spring	12	73	0000103319	1/4 Lockwasher	3
18	71-86	Reverse Clutch Plate - Fiber	1	74	0000179793	1/4-20 x 5/8 Hex Head Bolt	3
N.I.	72-A66B	Reverse Clutch Plate - Metallic	1	76	71-42	Poppet Spring	1
19	71-15B	Thrust Washer	1	76	0000453632	5/16 Steel Ball	1
20	3107A	Ball Bearing	1	77	71-79B	Forward & Reverse Shift Lever	1
21	R6A-7 1/2	Snap Ring	1	78	0000 103340	Control Lever Washer	1
22	4734	Snap Ring	1	79	0000108579	5116 Lockwasher	1
23	5C-33	Clutch Spring Bearing Ring	1	80	0000115729	5/16-24 Hex Nut	1
24	71-45	Forward Clutch Piston	1	81	A4740G	Breather	1
25	JL-36	Sealing Ring	1	02	0000444607	1/8-27 Dryseal Plug	1
26	5M-122	"O" Ring	1	N.I.	A4867AE	Clutch Pack Kit	
27	3-37	Clutch Spring	1	N.I.	A4867AQ	Forward Clutch Cylinder Kit	
28	5L-67	Clutch Pressure Plate	1	N.I.	A4867HA	Gasket & Seal Kit	
29	5C-A66A	Clutch Inner Plate Assembly	5	N.I.	A4867WW	Small Parts Kit	
30	3-176	Clutch Outer Plate	4				
31	5C-175A	Clutch Pressure Plate	1				
32	4822	Ring Gear Snap Ring	1				
33	4755	Clutch Spring Snap Ring	1				
34	71-6	Ring Gear	1				
35	71-70	Forward Clutch Cylinder	1				
36	4495	Snap Ring	1				
37	71-40	Forward Clutch Hub	1				
38	71C-3A16	Drive Gear & Plug Assembly	1				
39	N.S.S.	3/8 Taper Plug	1				
40	71-17	Thrust Washer	1				
41	4873	Key No. 9 - No Rock	1				
42	4806J	Sealing Ring	2				
43	0000218211	Woodruff Key	1				
44	0000179859	7/16-14 x 1-1/8 Hex Head Bolt	6				
45	0000103322	7/16 Lockwasher	6				
46	71C-110	Oil Seal	1				
47	71-7	Bearing Retainer	1				
48	71-147	Bearing Retainer Gasket	1				
49	4775L	Main Shaft Nut	1				
50	4547BA	Coupling	1				
51	8308AGS	Annular Bearing	1				
52	71-1A2	Pinion Cage & Output Shaft Assembly	1				
53	Kit A4867DD	Main Drive Gear Bushing Two Presized Bushing in Kit					
54	4636FD	Name Plate	1				
56	71-A195	Dipstick Assembly-Screw-in Type	1				

N.I. - NOT ILLUSTRATED

N.S.S. - NOT SERVICED SEPARATELY

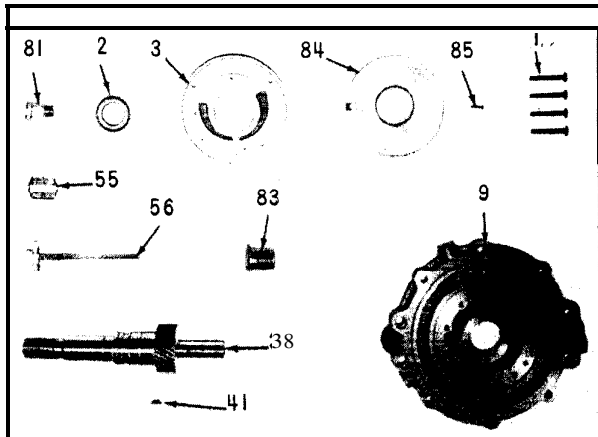


Fig. 13 Parts Display for Forward & Reverse ASI-70B & ASI-71B Transmissions. Only Those Parts Different from the ASI-70C & ASI-71C Assembly Are Illustrated.

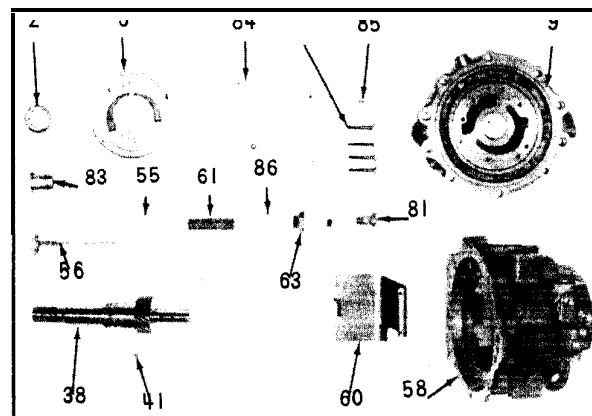


Fig. 14 Parts Display for Forward & Reverse ASI-70 & ASI-71 Transmissions. Only Those Parts Different from the ASI-70C & ASI-71C Assembly Are Illustrated.

#### ASI-71B & ASI-70B PARTS LIST

INDEX NO.	PART NO.	PART NAME	NO. REQ'D
I	179825	5/16-18x1-7/88 HEX HEAD BOLT	4
A	71-A60	FRONT PUMP ASSEMBLY	1
INDEX PARTS 2,3,4,5,84, & 8 MUST BE ORDERED AS ABOVE ASSEMBLY. SEAL (INDEX NO. 2) IS AVAILABLE SEPARATELY FOR REPLACEMENT OR IN SMALL PARTS KIT(A4867M). INDEX PARTS 84 & 85 MAY BE OBTAINED SEPARATELY.			
2	71-62	OIL SEAL ASSEMBLY	1
3	71-60	PUMP HOUSING	1
9	71-88	FORWARD & REVERSE ADAPTER	1
B	71-A16	DRIVE GEAR & PLUG ASSEMBLY	1
INDEX PARTS 38 & 39 MUST BE ORDERED AS ABOVE ASSEMBLY.			
38	71-16	DRIVE GEAR	1
41	431787	WOODRUFF KEY # 61	1
55	4636EK	NAME PLATE(ASI-70B ONLY)	1
	4636EL	NAME PLATE(ASI-71B ONLY)	1
56	3-2A195	OIL FILLER CAP & DIPSTICK ASSEMBLY	1
81	AJ2-87	BREATHING ASSEMBLY	1
83	3-196	OIL FILLER TUBE	1
84	71-3	PUMP BACKING PLATE	1
85	110533	#10-24x3/4 FLAT HEAD MACHINE SCREW	1

NOTE: WHEN ORDERING PARTS FOR ASI-70B, ASI-71B, ASI-70 & ASI-71 TRANSMISSIONS, USE THE APPROPRIATE ASI-70C or ASI-71C PARTS LIST TO IDENTIFY THOSE PARTS WHOSE INDEX NUMBERS ARE NOT LISTED IN THE ABOVE PARTS LIST. THE ABOVE ASI-70B, ASI-71B, ASI-70 & ASI-71 PARTS LIST SHOW ONLY THOSE PARTS WHICH DIFFER FROM THOSE IN ASI-70C & ASI-71C.

#### ASI-71 & ASI-70 PARTS LIST

INDEX NO.	PART NO.	PART NAME	NO. REQ'D
I	179825	5/16-18x1-7/8 HEX HEAD BOLT	4
A	71-A60	FRONT PUMP ASSEMBLY	1
INDEX PARTS 2,3,4,5,84, & 85 MUST BE ORDERED AS ABOVE ASSEMBLY. SEAL (INDEX NO. 2) IS AVAILABLE SEPARATELY FOR REPLACEMENT, OR IN SMALL PARTS KIT(A4867M). INDEX PARTS 84 & 85 MAY BE OBTAINED SEPARATELY.			
2	71-62	OIL SEAL ASSEMBLY	1
3	71-60	PUMP HOUSING	1
9	71-88	FORWARD & REVERSE ADAPTER	1
B	71-A16	DRIVE GEAR & PLUG ASSEMBLY	1
INDEX PARTS 38 & 39 MUST BE ORDERED AS ABOVE ASSEMBLY.			
38	71-16	DRIVE GEAR	1
41	431787	WOODRUFF KEY # 61	1
55	4636DF	NAME PLATE(ASI-70 ONLY)	1
	4636DL	NAME PLATE(ASI-71 ONLY)	1
56	3-2A195	OIL FILLER CAP & DIPSTICK ASSEMBLY	1
D	70-A1C	TRANSMISSION CASE & BUSHING ASSEMBLY(ASI-70 ONLY)	1
	71-A1G	TRANSMISSION CASE & BUSHING ASSEMBLY(ASI-71 ONLY)	1
INDEX PARTS 58 & 59 MUST BE ORDERED AS ABOVE ASSEMBLY. BUSHINGS (INDEX NO. 59) ARE AVAILABLE FOR REPLACEMENT IN SERVICE KIT (A4867VV).			
58	70-1C	FORWARD & REVERSE TRANSMISSION CASE(ASI-70 ONLY)	1
	71-1G	FORWARD & REVERSE TRANSMISSION CASE(ASI-71 ONLY)	1
60	71-140	BAFFLE	1
61	71-A98C	OIL STRAINER	1
63	9885	BUSHING	1
81	AJ2-87	BREATHING ASSEMBLY	1
83	3-196	OIL FILLER TUBE	1
84	71-3	PUMP BACKING PLATE	1
85	110533	#10-24x3/4 FLAT HEAD MACHINE SCREW	1
86	120428	ANNULAR GASKET	1

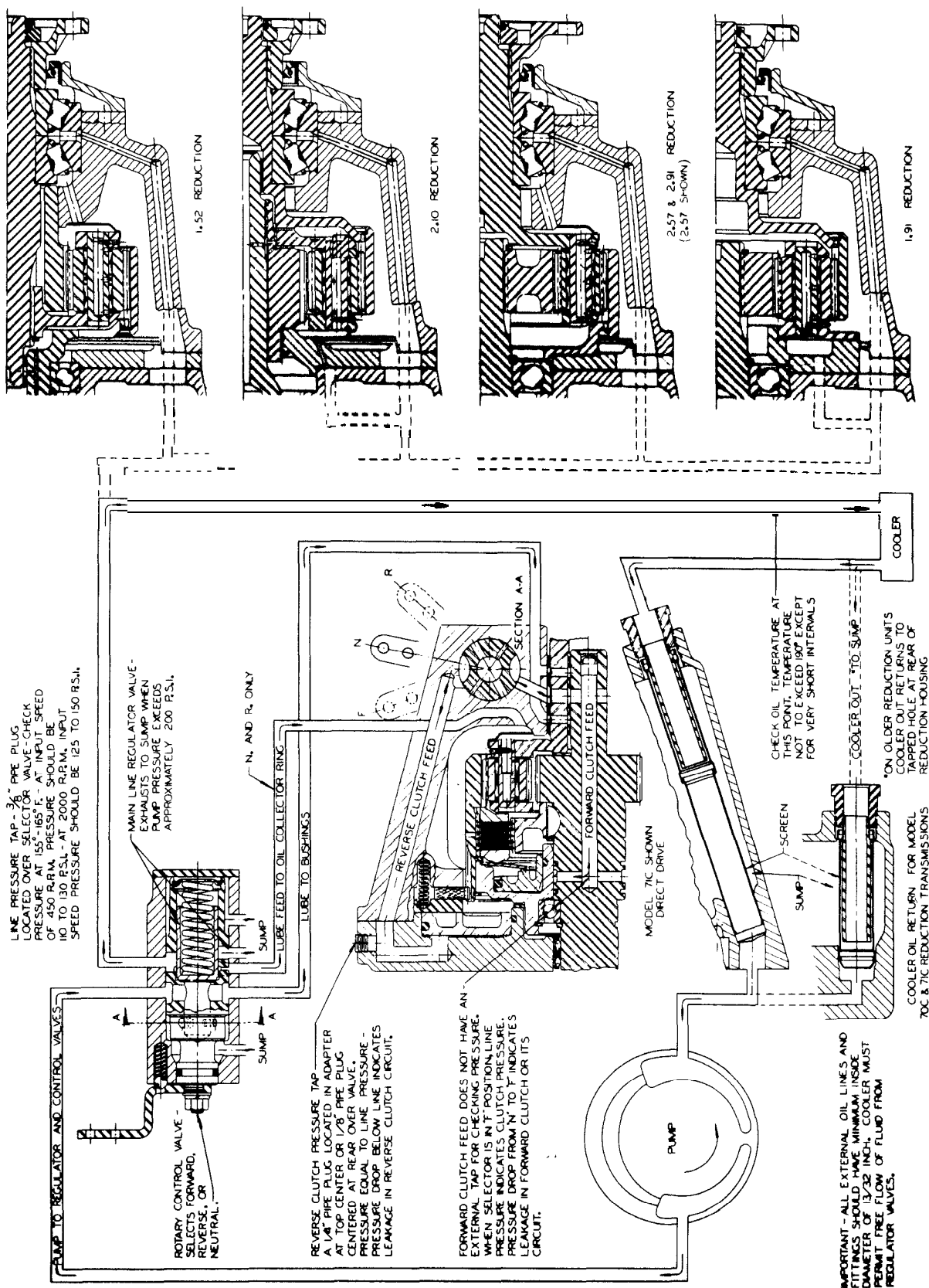


Fig. 15 70C & 71C Transmission Hydraulic Circuit Diagram

## DESCRIPTION

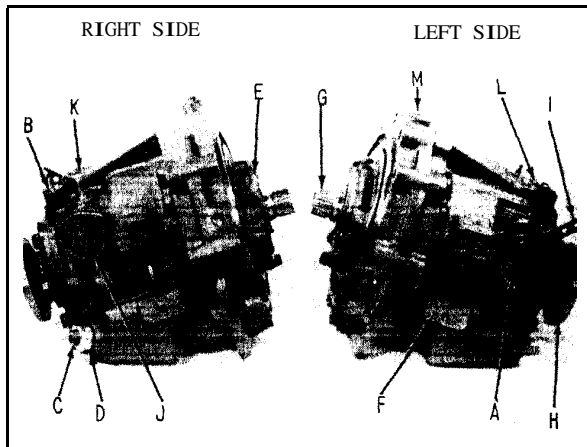


Fig. 16 External Views ASI-70C or ASI-71C

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 to 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 lap |

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.

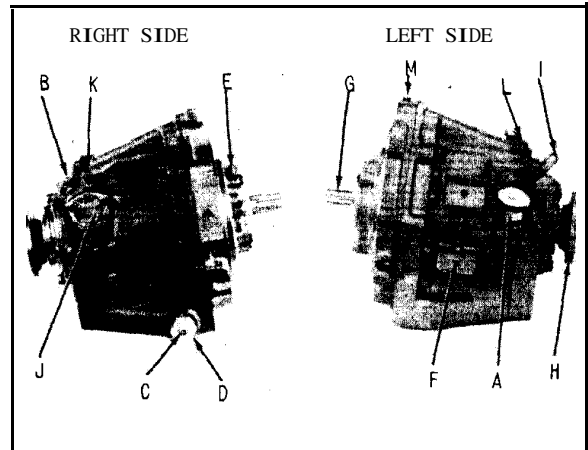


Fig. 16A External Views ASI-70 or ASI-71

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"



# INSTALLATION PRECAUTIONS

## TRANSMISSION OIL COOLER

The oil cooler must be properly connected to the transmission before the engine is cranked or started. Failure to properly connect the oil cooler will result in the blowing out of the forward clutch piston due to over pressurization. NO WARRANTY claims due to this type failure will be allowed as this is the responsibility of the Boat Builder, Engine Manufacturer or Conversion Engine Manufacturer.

A cooler of sufficient size shall be used to assure that the maximum oil temperature of the transmission will not exceed 190°F. Failure to provide proper cooling may result in damage to the transmission from insufficient oil flows and pressures if the transmission is operated at temperatures above the maximum recommended.

The proper oil cooler inlet and outlet connections are shown in (Figures 16 & 16A).

## CONTROL LEVER POSITION

The position of the control lever on transmission when in forward should be shifted to the point where it covers the letter "F" on the case casting, and is located in its proper position by the poppet ball. The WARRANTY is cancelled if the shift lever poppet spring and/or ball is permanently removed, or if the control lever is changed in any manner, or repositioned, or if linkage between remote control and transmission shift lever does not have sufficient travel in both directions. This does not apply to transmissions equipped with Warner Gear electrical shift control.

## FRONT PUMP MOUNTING

Before mounting the transmission on the engine be sure that the pump is correctly installed. Orient the pump mounting bolt holes and arrows indicating direction of rotation to correspond with the direction of rotation required by the engine. If the pump is not installed for the proper rotation the pump will not produce oil pressure to operate the transmission when engine is started.

# LUBRICATION RECOMMENDATIONS

## PROCEDURE FOR FILLING TRANSMISSION WITH OIL

When filling the transmission, oil should be added until it reaches the full mark on the dipstick. The quantity of oil depends upon the angle of the installation, but information to serve as a guide on possible amount needed may be found in chart below. The unit should be turned over at engine idle speed for a short time in order to fill all circuits, including the cooler and cooler piping.

**NOTE: Be sure the cooler is properly installed and the transmission contains oil before cranking or starting engine.**

## CHECKING OIL LEVEL

Check the oil level daily before starting the engine. Oil will sometimes drain back into the transmission from the cooler when improperly installed. It is important that oil level checks on new installations be made immediately after the engine has been shut off and before the oil has had a chance to drain back. If you have drain back, correct the installation.

## CHANGING OIL

A seasonal oil change is recommended in pleasure boats. Work boats require more frequent changes. Change oil anytime the oil becomes contaminated, changes color, or becomes rancid smelling.

## TRANSMISSION FLUID

Dexron® II, Type F, and other hydraulic transmission fluids which meet the Detroit Diesel Allison Type C3 specifications are recommended for use in all Velvet Drive® marine transmissions.

Lubricating oils which are recommended for use in diesel engines and also meet Detroit Allison Type C3 specifications may be used if the engine speed does not exceed 3000 RPM. SAE #30 is preferred. SAE #40 is acceptable if high operating temperatures are to be encountered. Multi-viscosity oils such as 10W-40 are not acceptable. The first choice is an oil which falls in the SAE-API service Class "CD." The second choice would be an oil which falls in the SAE-API service Class "CC."

The equivalent DOD mil specs are:

"CD" Mil-L-21048

"CC" Mil-L-45199

The new C3 specifications were developed by Detroit Diesel Allison Division of General Motors to outline the requirements of an oil suitable for use in their heavy duty hydraulic automatic and powershift transmissions. The oil companies should be able to provide information as to the suitability of their product for use in a given application.

## OIL CAPACITY

TRANSMISSION MODEL	TRANSMISSION OIL CAPACITY (QUARTS)	
	LEVEL	15° INCLINED
AS1-70C or CR	1.8	1.3
AS1-71C or CR	1.8	1.3

**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 OPERATION

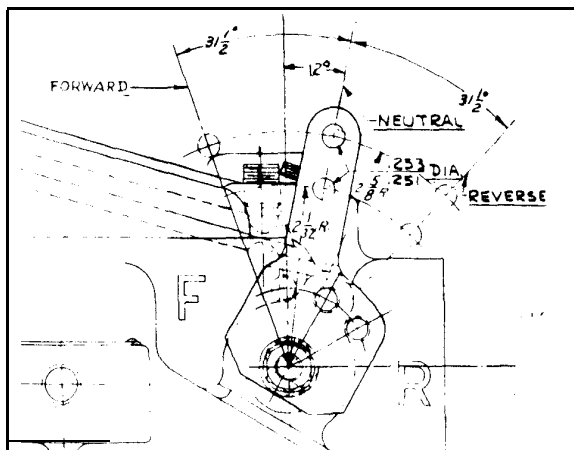


Fig. 17 ASI-71C Shift Lever Positions

### 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 side 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

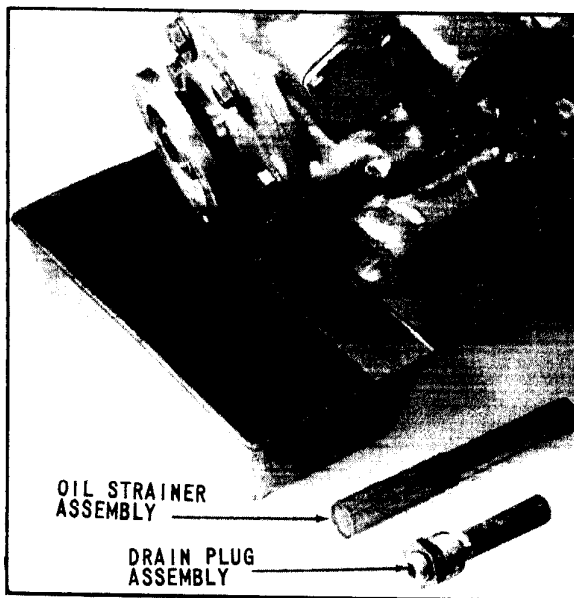


Fig. 18 Draining Transmission Oil

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.

## DISASSEMBLY OF ADAPTER AND REVERSE CLUTCH PISTON

11. Remove the four (4) cap screws (12 point 'head'), (Fig. 61). Lift the adapter and reverse clutch piston, (Fig. 60). If necessary, tap the adapter with a soft hammer to remove.

**CAUTION:** The reverse clutch pressure plate may stick momentarily to the reverse clutch piston. To avoid damage, prevent pressure plate from dropping.

12. Force compressed air into reverse clutch cavity while holding piston, as shown in (Fig. 19) and piston will pop up out of reverse clutch cavity.
13. Remove sealing rings as shown in (Figs. 57 and 58).

## REMOVAL OF THRUST WASHER, REVERSE CLUTCH PRESSURE PLATE, PRESSURE PLATE SPRINGS AND DOWEL PINS

14. Thrust washer can now be lifted from position shown in (Fig. 56).
15. Remove clutch pressure plate as shown in (Fig. 55).
16. The twelve (12) pressure plate springs and the three (3) dowel pins can now be removed, (Fig. 54).

## DISASSEMBLY OF DRIVE GEAR AND CLUTCH ASSEMBLY

17. Grasp the exposed front end of the input gear and lift straight up; drive gear and clutch assembly parts easily lift out of opening in front, (Fig. 53).
18. Remove thrust washer located between drive gear and planetary carrier, (Fig. 52).
19. Stand drive gear and clutch assembly in suitable fixture and remove internal & external snap rings at ball bearing from the drive gear and clutch cylinder, (Figs. 50 and 51). Do not permit drive gear to move forward after the above snap rings are removed.

20. While holding the ring gear, tap the front end of the drive gear with soft hammer. The drive gear and forward clutch hub assembly will pass through the ring gear and forward clutch assembly to come out of the rear end of the ring gear, (Fig. 47).

## DISASSEMBLY OF FORWARD CLUTCH

21. Remove bearing from clutch cylinder by tapping with soft blunt tool.
22. Remove ring gear snap ring, (Fig. 43).
23. While holding ring gear, tap with soft blunt tool on exposed face of forward clutch cylinder inside of ring gear. Forward clutch cylinder will move forward to disassemble out of front of ring gear. After removing the clutch spring and the clutch spring snap ring, all parts of the forward clutch can be disassembled as shown in (Figs. 34, 35, 36, 37 & "38).
24. Piston can be removed from forward clutch cylinder to position in (Fig. 41) by applying compressed air to clutch cavity through one of three (3) holes in inside diameter of forward clutch cylinder, while other holes are blocked.

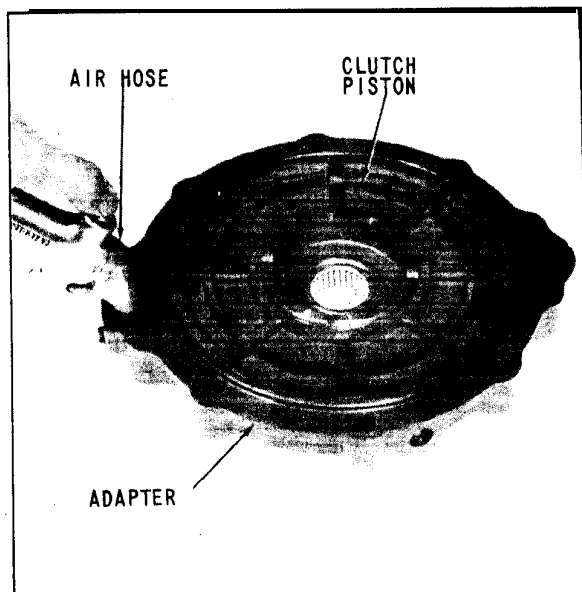


Fig. 19 Disassembling Reverse Clutch Piston in Adapter



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).

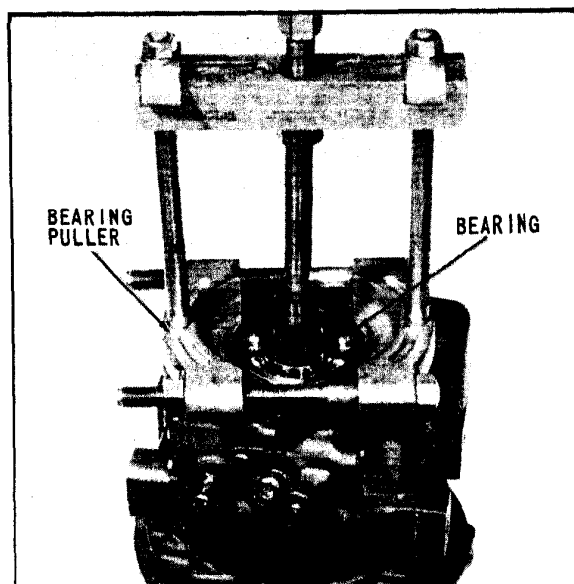


Fig. 20 Removing Bearing from Case

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).

## INSPECTION AND GENERAL INSTRUCTIONS

1. Cleanliness is absolutely necessary during assembly to insure proper functioning of transmission. Transmission case passages should always have pipe 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 60).

## ASSEMBLY OF TRANSMISSION

### ASSEMBLING OIL SEAL IN BEARING RETAINER

1. Inspect rubber lip of seal for cracks, holes or brittle condition of rubber lip material.
2. Place front face of bearing retainer 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. 21). Caution should be observed to insure that too much sealant is not used.

3. Using arbor press and suitable tool, as shown in (Fig. 22), press the oil seal into the bearing retainer until the rear face of the oil seal is flush with the rear face of the bearing retainer,

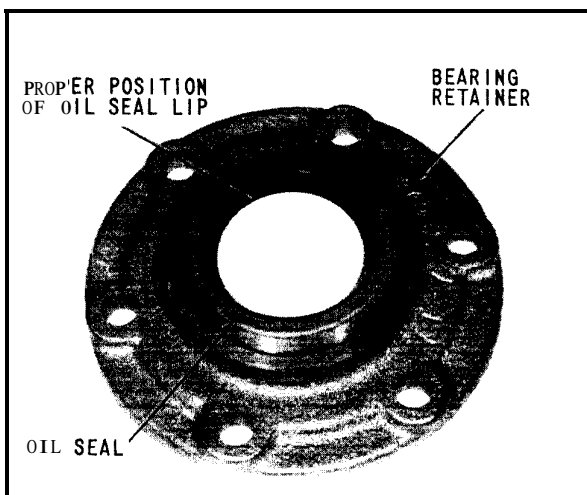


Fig. 21 Installing Oil Seal

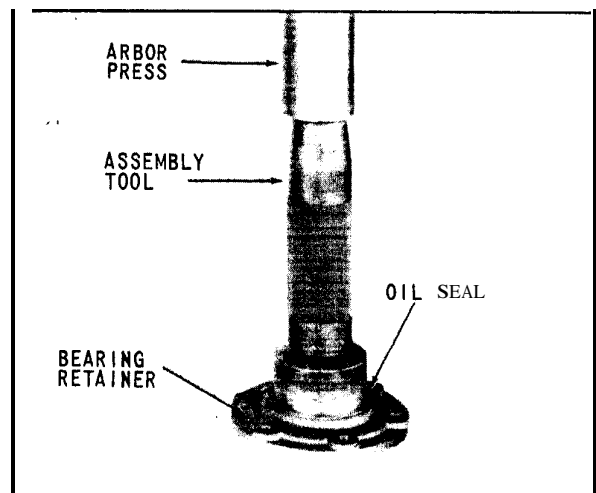


Fig. 22 Pressing Oil Seal in Retainer

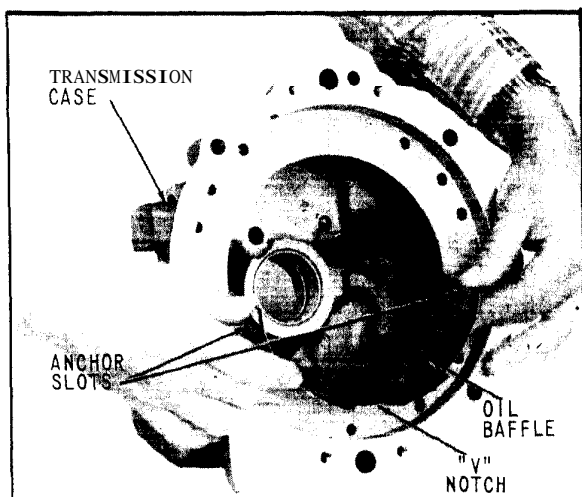


Fig. 23 Installing Model 71B & 71C Baffle

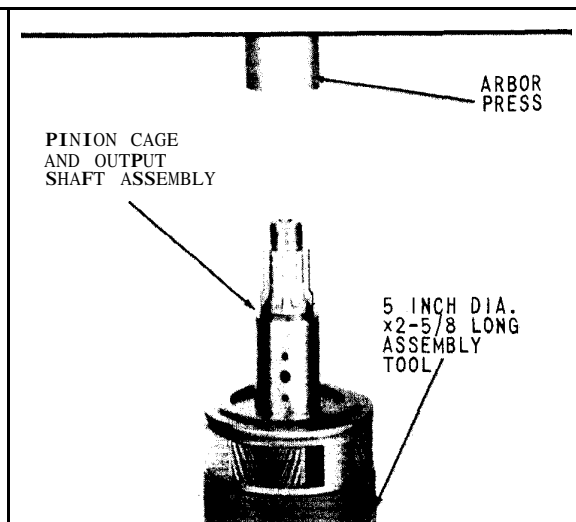


Fig. 25 Pinion Cage and Output Shaft Assembly in Place on Arbor Press

#### 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.

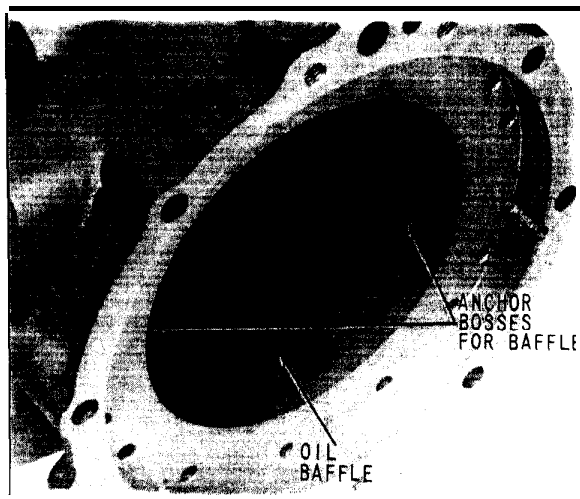


Fig. 24 Model 708 & 70C Oil Baffle Properly Installed

#### 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 1 8 & 19) for further information.

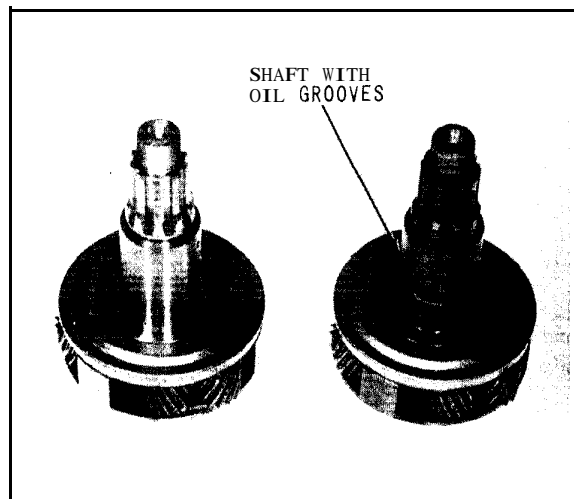


Fig. 26 Late and Early Model Pinion Cage and Output Shafts

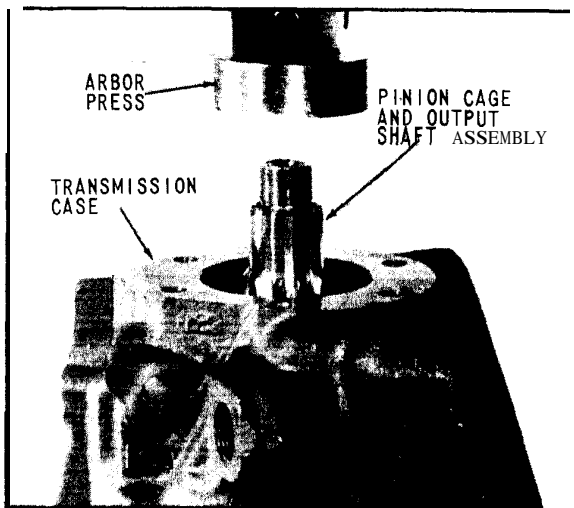


Fig. 27 Case Assembled over Pinion Cage and Output Shaft Assembly and Assembly Tool

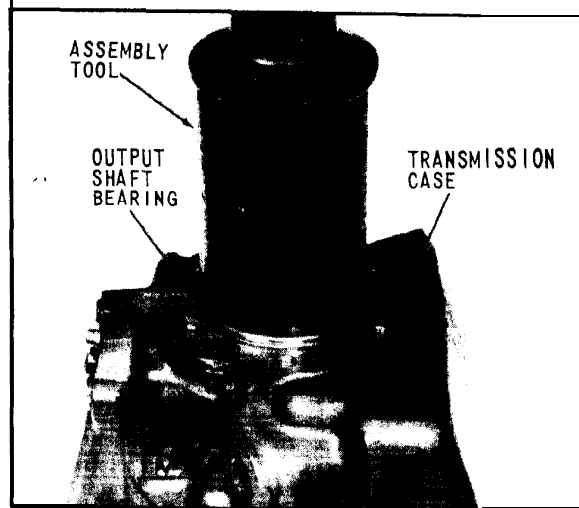


Fig. 29 Rear Bearing Pressed in Place

7. Place the transmission case over the pinion cage and output shaft assembly so transmission case rests squarely on arbor press table which is supporting assembly tool (Fig. 27).
8. Inspect the bearing bore for possible dirt or burrs.
9. 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.
10. Inspect the bearing for presence of dirt. If dirt is present, wash bear-

ing until clean and lubricate with automatic transmission fluid, type "A", suffix "A", before assembly.

11. With the groove on the outside diameter of the bearing located toward the rear of the transmission, as shown in (Fig. 28), place the bearing over the projecting output shaft and squarely in the bearing bore.
12. 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. 29).

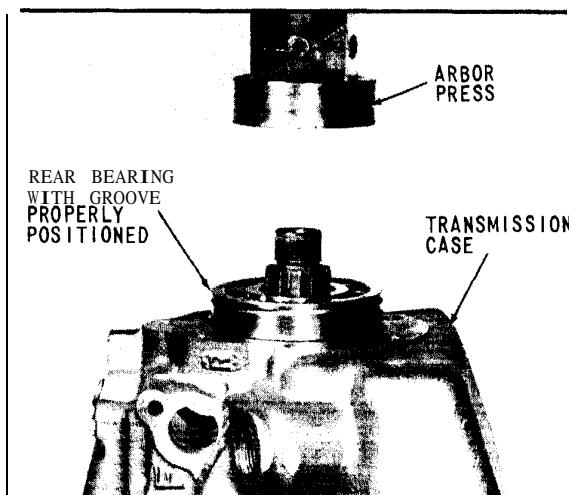


Fig. 28 Rear Bearing Properly Positioned on Transmission Case

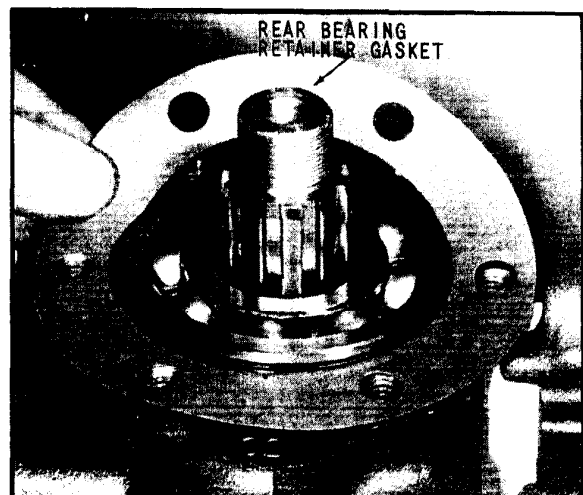


Fig. 30 Bearing Retainer Gasket in Place

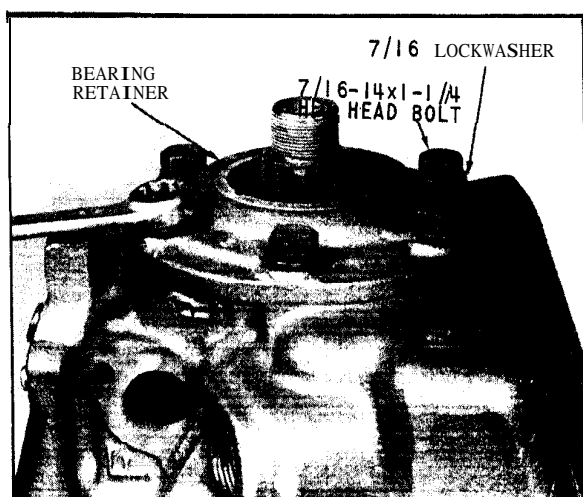


Fig. 31 Assembling Bearing Retainer on Rear of Case

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.

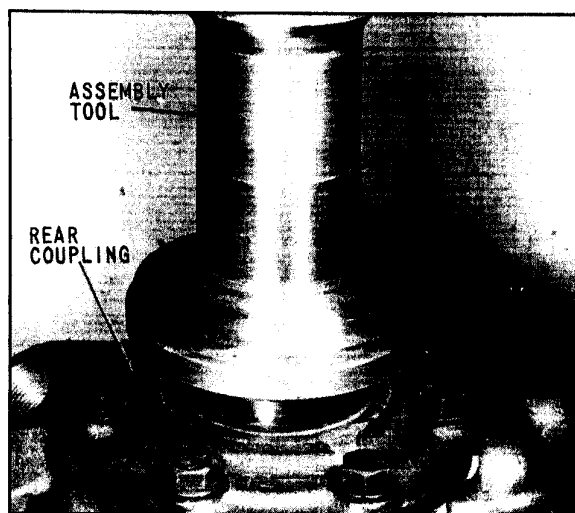


Fig. 32 Pressing Rear Coupling in Place

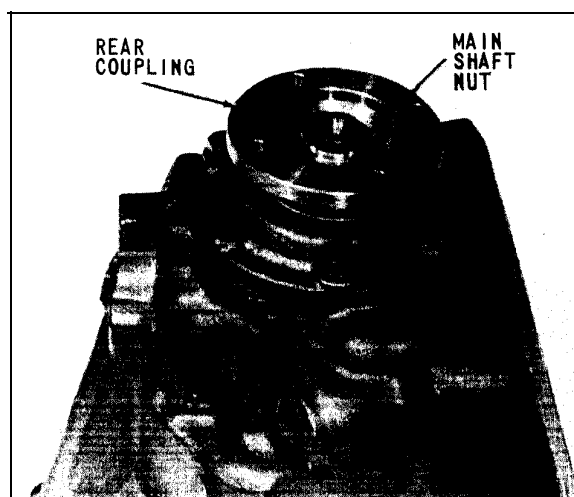


Fig. 33 View of Completely Assembled Output Shaft

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.
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).

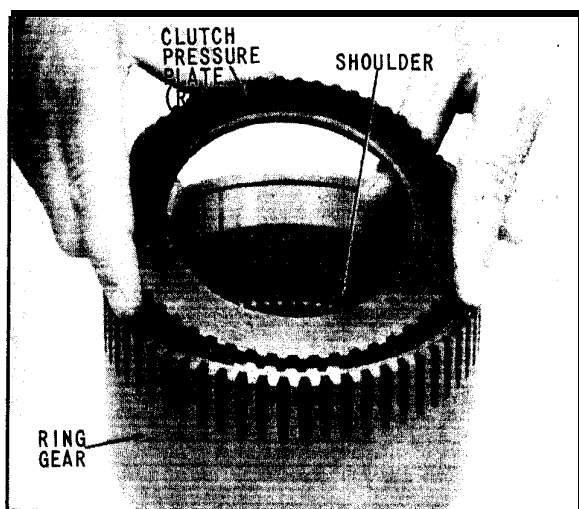


Fig. 34 Installing Clutch Pressure Plate (Rear)

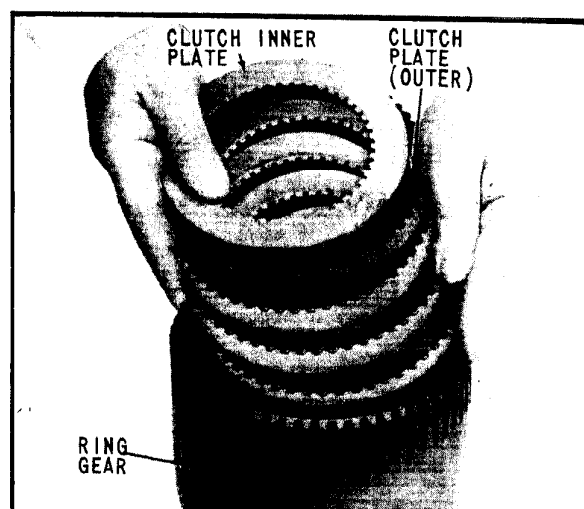


Fig. 35 Installing Forward Clutch Plates

#### ASSEMBLY OF THE FORWARD CLUTCH INTO THE RING GEAR

18. Place the ring gear on a clean surface with the external teeth up, as shown in (Fig. 34).
19. Remove all dirt and solid particles from the shoulder inside the gear formed by the top of the internal helical gear, (Fig. 34).
20. With the smoothly ground face in the upward position, install the clutch pressure plate (rear) in the ring gear, as shown in (Fig. 34). Assembly is complete when the clutch pressure plate is firmly and squarely seated on the shoulder at the bottom of the internal splines.
- 21A For the Model 71C lubricate five (5) clutch inner plates and four (4) outer clutch plates, arrange and assemble, as shown in (Fig. 35).
- 21B For the Model 70C lubricate three (3) clutch inner plates and four (2) outer clutch plates, arrange and assemble, as illustrated in (Fig. 35) for the Model 71C.
22. Install clutch pressure plate (front) with flat face down in contact with clutch plate, as shown in (Fig. 36).
23. Install clutch spring snap ring, (Fig. 37). Assembly is complete when snap ring is squarely and firmly seated on the internal shoulder provided by the top of the internal splines.

CAUTION: BE SURE YOU HAVE THE PROPER SNAP RING. THE CLUTCH SPRING

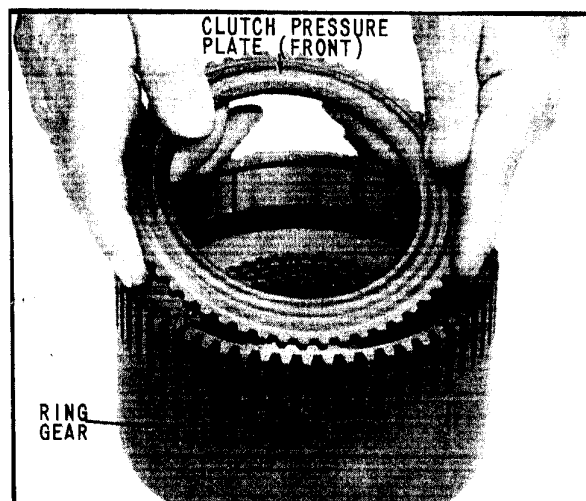


Fig. 36 Installing Clutch Pressure Plate (Front)

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.

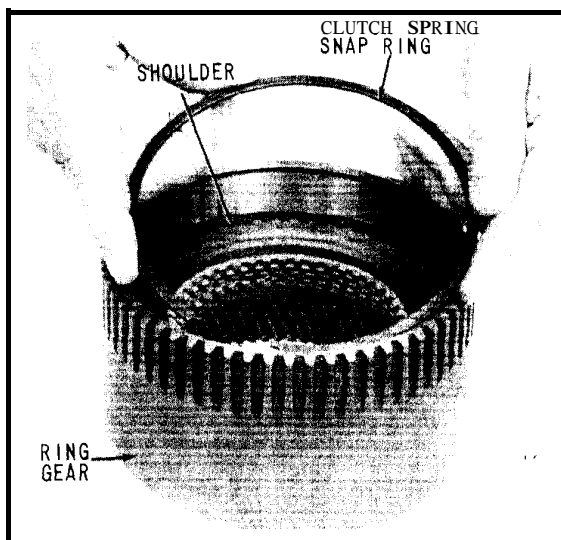


Fig. 37 Installing Clutch Spring Snap Ring

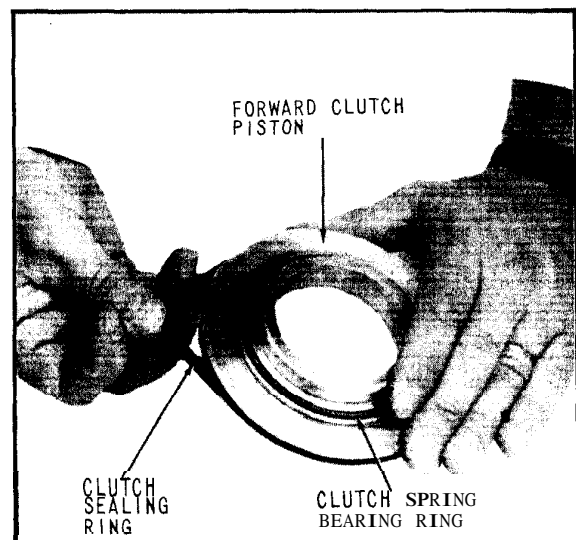


Fig. 39 Installing Clutch Sealing Ring

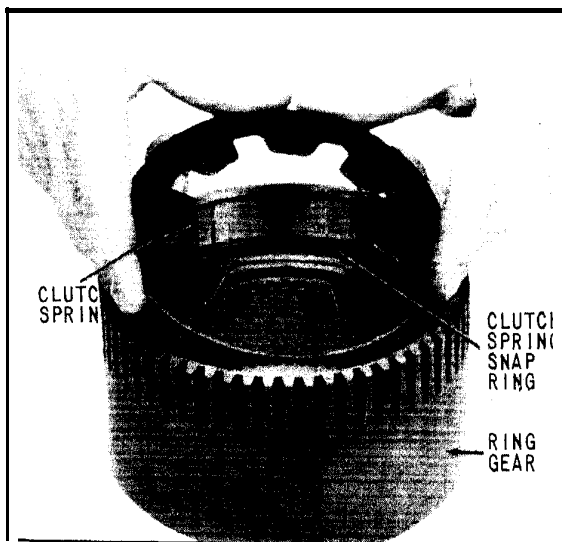


Fig. 38 Installing Clutch Spring

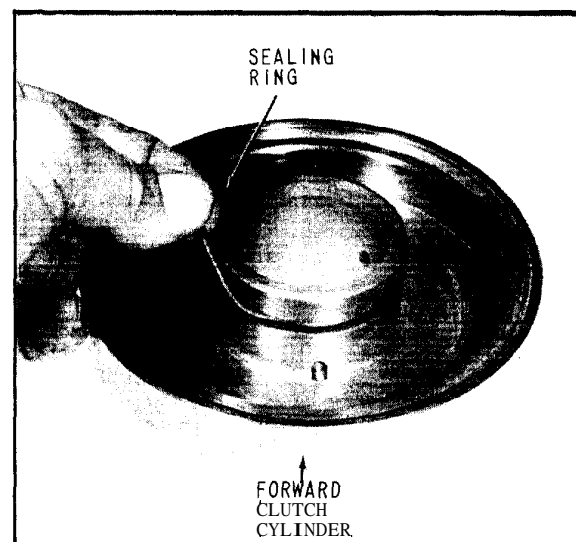


Fig. 40 Installing Sealing Ring

27. After aligning the assembled forward clutch piston squarely on the assembled forward clutch cylinder, press the clutch piston into the forward clutch cylinder, as shown in (Fig. 41). This is a hand assembly and should not require pounding by hammer or pressing on arbor press. Assembly is complete when piston "bottoms" in forward clutch cylinder.

28. Place the combined parts, as assembled in steps 18 through 24 inclusive, on a suitable support which has been placed on an arbor press, (Fig. 42). Center the clutch spring in the ring gear.

29. Place the parts assembled in steps 25 through 27 inclusive into the open top of the assembly described in step 28, (Fig. 42). Place a suitable assembly tool squarely on top of the forward clutch cylinder and press down with the arbor press until the forward clutch cylinder is firmly seated on the snap ring and the groove for the snap ring is fully exposed. Check, by looking into rear of ring gear, to be sure that the clutch spring bearing ring is properly assembled on the forward clutch piston.

30. While maintaining load from arbor press, assemble ring gear snap ring, (Fig. 43). Tap ring while in place to insure full seating of ring in groove.

CAUTION: BE SURE YOU HAVE THE PROPER SNAP RING. THE RING GEAR SNAP RING IS .074 TO .078 INCHES THICK AND HAS A FREE DIAMETER OF  $5-7/8 + 1/16$  INCHES.

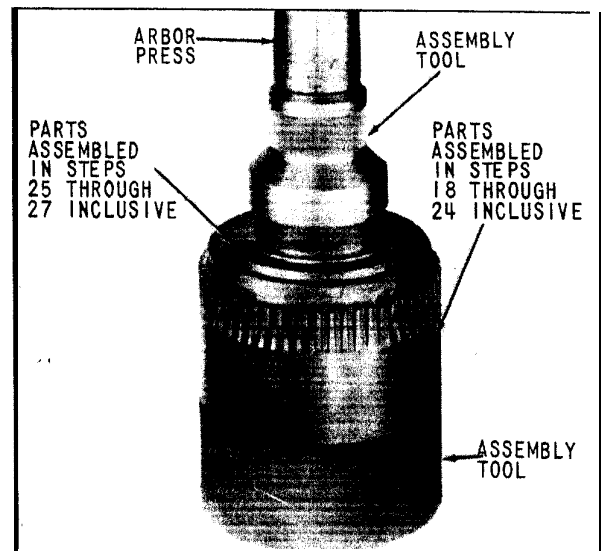


Fig. 42 Pressing Forward Clutch Cylinder into Ring Gear

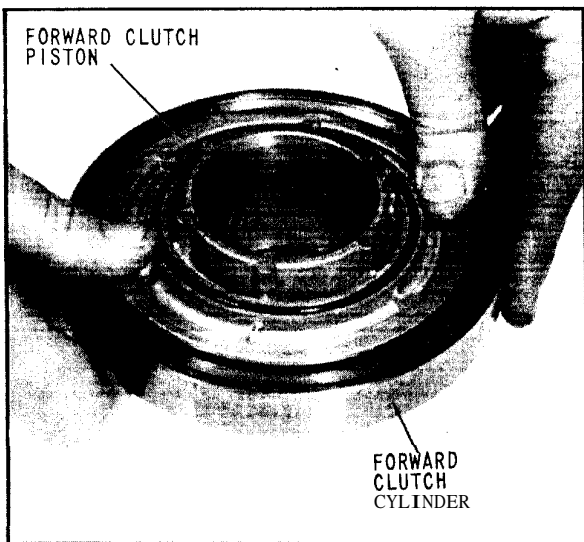


Fig. 41 Installing Forward Clutch Piston

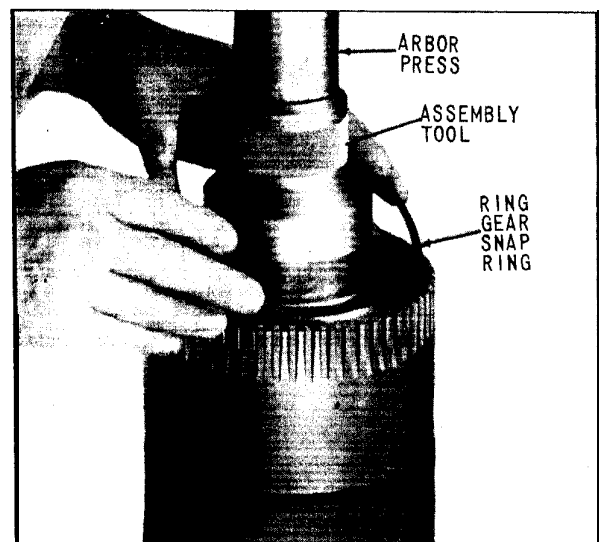


Fig. 43 Installing Ring Gear Snap Ring



## 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.

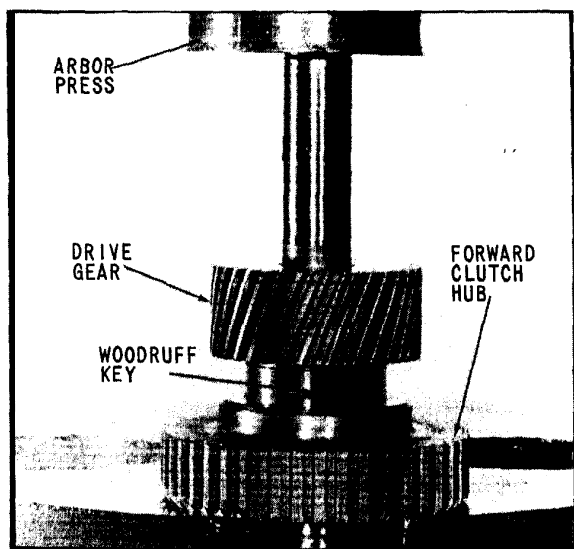


Fig. 44 Pressing Drive Gear into Forward Clutch Hub

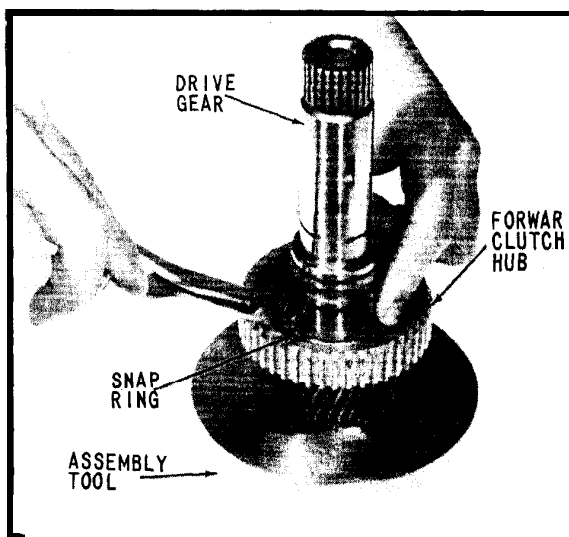


Fig. 45 Installing Clutch Hub Snap Ring

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.

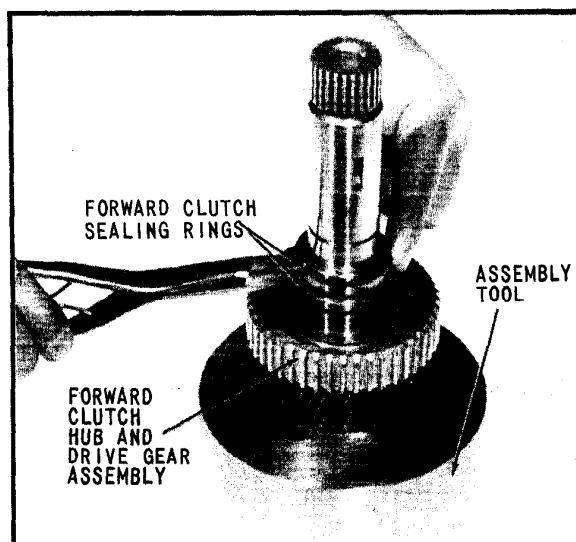


Fig. 46 Installing Forward Clutch Sealing Rings on Drive Gear

## ASSEMBLING DRIVE GEAR AND CLUTCH ASSEMBLY

37. With drive gear and clutch hub in assembly tool as shown in (Figs. 45 and 46), place ring gear and forward clutch assembly over drive gear as shown in (Fig. 47).
38. Lower ring gear and clutch assembly until internal teeth of clutch plates begin to engage teeth on forward clutch hub. Rotate ring gear to align teeth of plates with teeth on clutch hub. Do not force ring gear, as damage to teeth on plates will result. When ring gear and clutch are in correct position, rear end of ring gear should be against the assembly tool or "flush" with the rear thrust face of drive gear, as shown in (Fig. 48). Do not remove drive gear and clutch assembly from assembly tool or move drive gear forward until steps 39, 40 and 41 are completed. Any movement of the drive gear forward will result in the clutch plates becoming disengaged with clutch hub and sealing rings moving out of position.

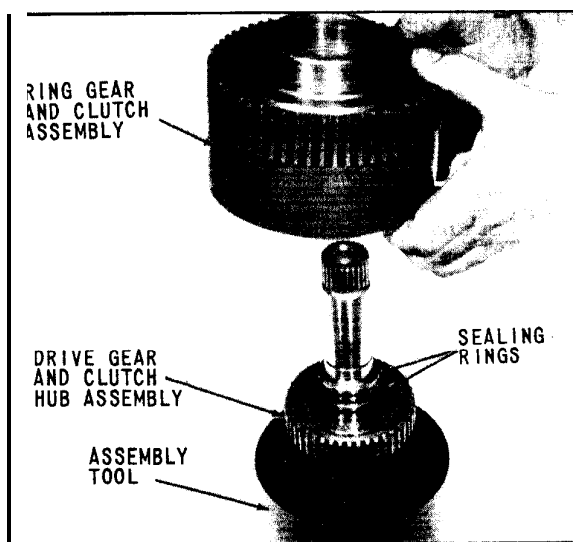


Fig. 47 Assembling Ring Gear and Clutch Assembly on Drive Gear

39. Place aligned parts and assembly tool in place on arbor press. Place bearing over protruding drive gear and squarely into bore at front of forward clutch cylinder; press bearing down with arbor press until bearing is fully seated on shoulder and snap ring grooves in front of bearing are exposed (Fig. 49).

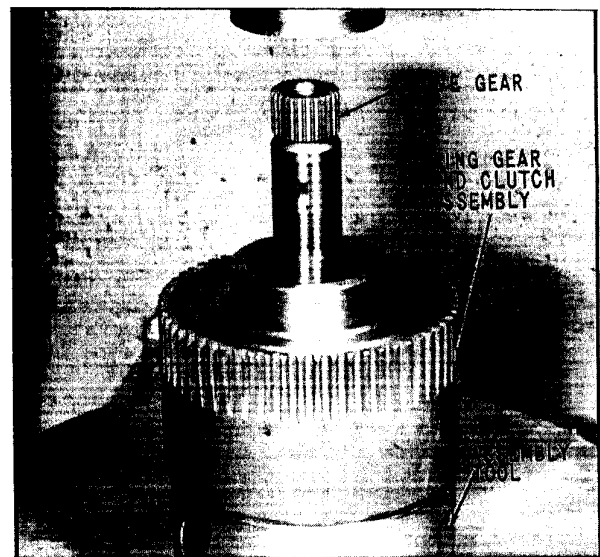


Fig. 48 Assembling Ring Gear and Clutch Assembly on Drive Gear

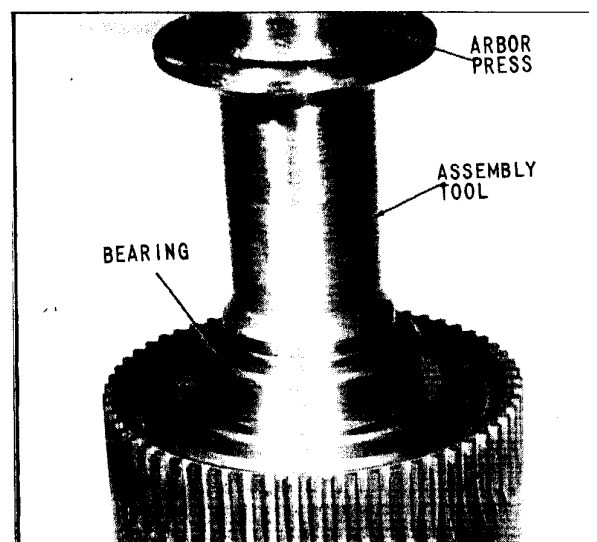


Fig. 49 Pressing Clutch Bearing in Place

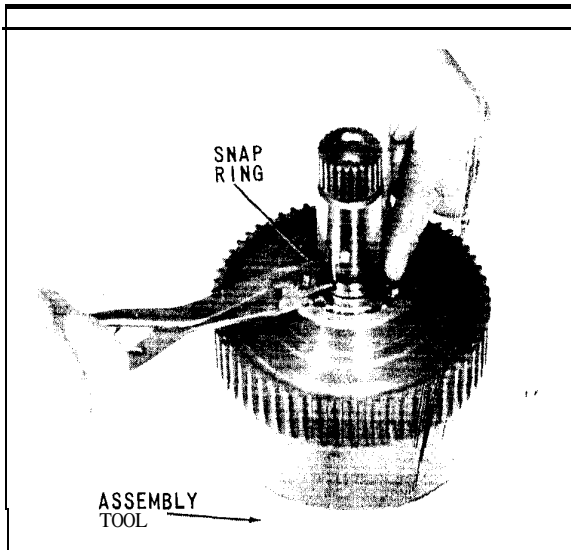


Fig. 50 Installing Snap Ring

40. Install external snap ring on drive gear, (Fig. 50).

41. Install internal snap ring in clutch cylinder, (Fig. 51).

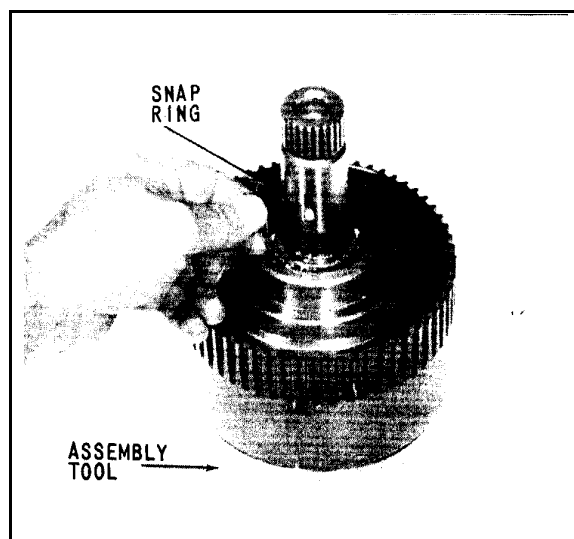


Fig. 51 Installing Snap Ring

## 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.

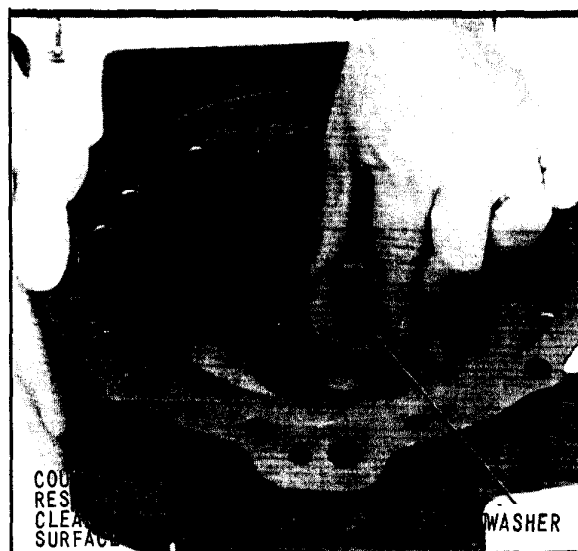


Fig. 52 Installing Thrust Washer

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.

45. Install the twelve (12) pressure plate springs in the holes provided in the reverse clutch cavity, (Fig. 54). The holes should be free from dirt and all springs should be firmly seated.

46. Coat the three (3) dowel pins with petroleum jelly and assemble them in the three (3) grooves provided at the outside diameter of the reverse clutch cavity, (Fig. 54). Assembly is complete when the dowel pin is firmly seated on end and into the groove, as far as groove contour will permit.

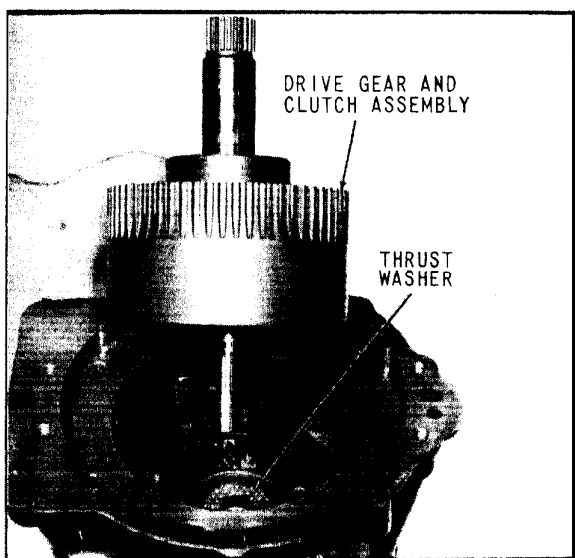


Fig. 53 Installing Drive Gear and Clutch Assembly

47. Install reverse clutch plate over exposed splined teeth of ring gear. Clutch plate must be firmly and evenly seated on the case face forming the rear of the reverse clutch cavity, (Fig. 55).

48. Install the reverse clutch pressure plate with the twelve (12) holes in the downward position. Align the cast slot in the pressure plate with the large oil hole in the front face of the transmission case, (Fig. 55). Since the twelve (12) pressure plate springs are not evenly spaced, the slot and oil hole alignment are

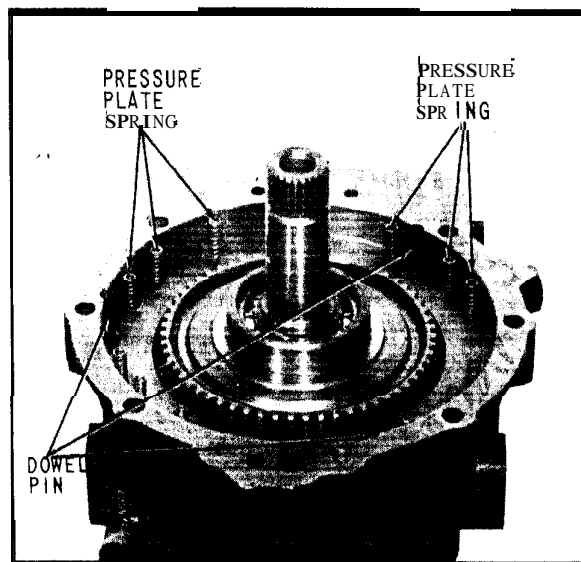


Fig. 54 Installation of Twelve (12) Pressure Plate Springs and Three (3) Dowel Pins

required to locate the pressure plate with relation to the pressure plate springs, (Fig. 55). A properly assembled reverse pressure plate will appear as shown in (Fig. 56). If pressure plate does not drop down to position, approximately flush with transmission case front face, check the three (3) dowel pins for possible misalignment.

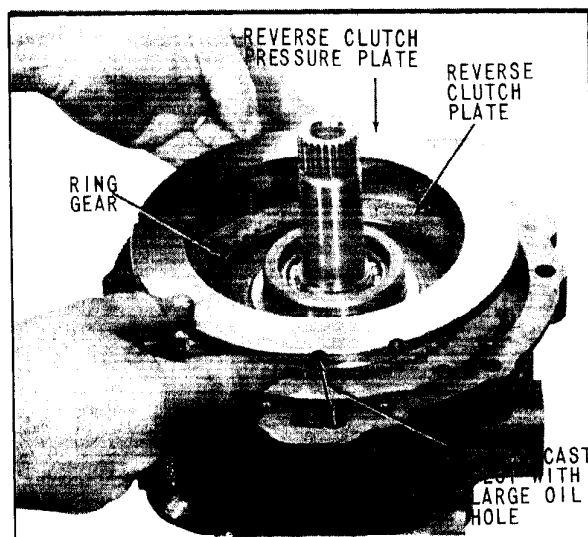


Fig. 55 Installing Reverse Clutch Pressure Plate

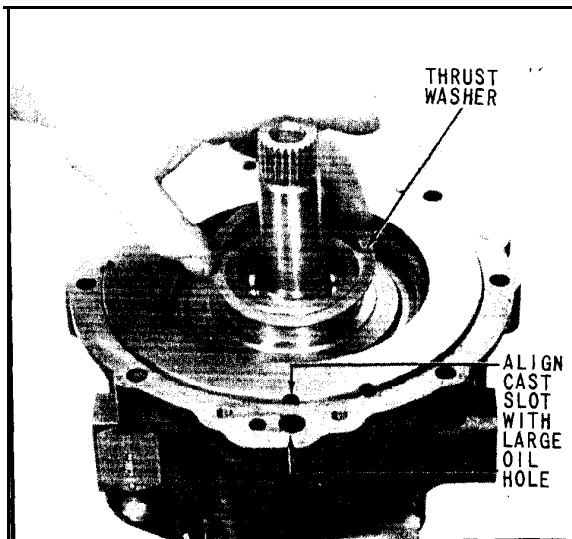


Fig. 56 Installing Thrust Washer and Reverse Clutch Pressure Plate

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.

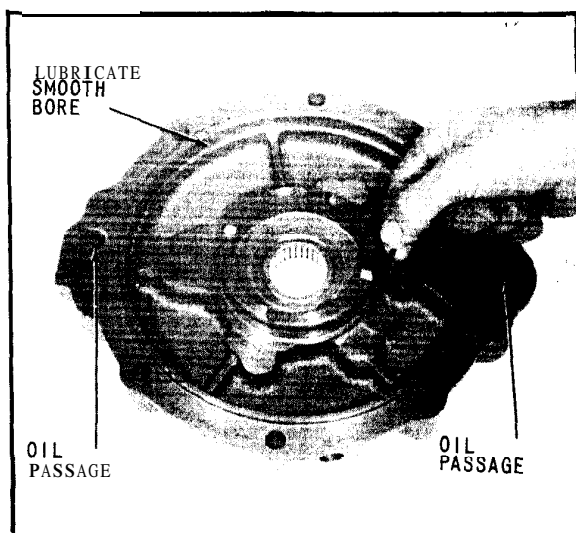


Fig. 57 Assembling Sealing Ring

- (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).

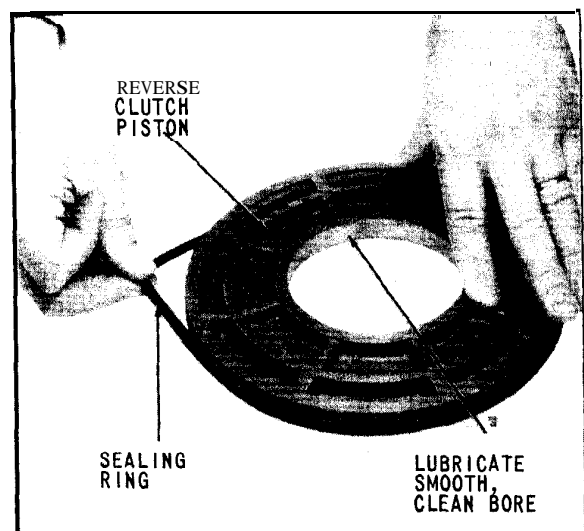


Fig. 58 Assembling Sealing Ring

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.

Exposed face of clutch piston should be flush with adjacent surrounding surface on adapter when assembly is completed.

#### ASSEMBLY OF ADAPTER AND REVERSE CLUTCH PISTON ONTO TRANSMISSION CASE

54. With parts assembled, in steps 1 through 49 inclusive, resting on the rear face of coupling, coat the exposed front of the transmission case with petroleum jelly and assemble in place the case and adapter gasket, (Fig. 60).

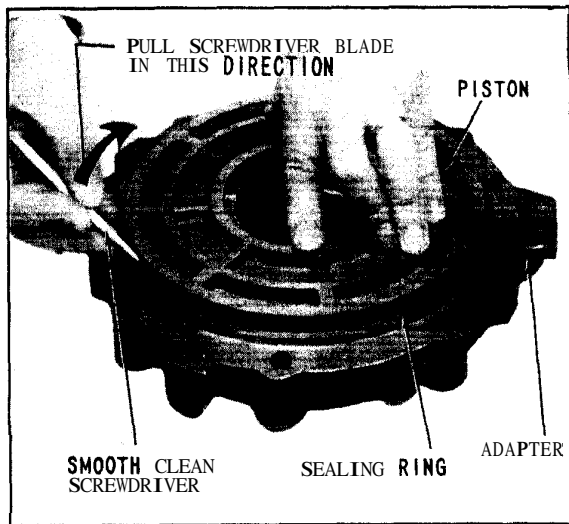


Fig. 59 Installing Reverse Clutch Piston in Adapter

55. Lift combined parts assembled in steps 50 through 53 inclusive, above parts assembled in steps 1 through 49 inclusive, as shown in (Fig. 60). Align the oil holes as indicated in (Fig. 60), then lower the reverse clutch piston and adapter assembly squarely onto the input gear and transmission case.

56. When the shoulder on the rear of the adapter has entered the mating bore in the reverse clutch cavity, located in the front of the transmission case, and a check of the gap between case and adapter indicates the

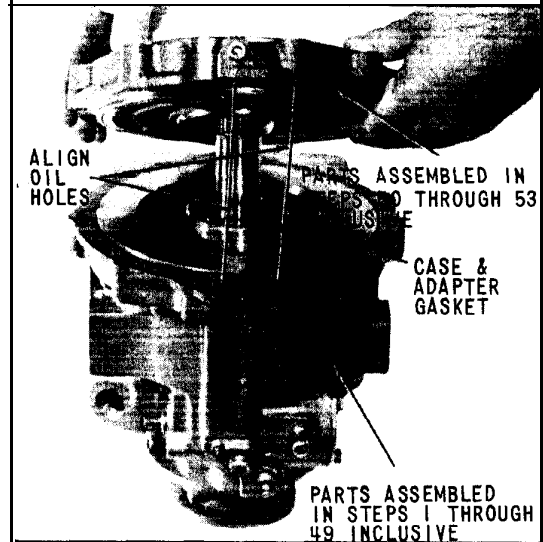


Fig. 60 Assembling Adapter and Reverse Clutch Assembly onto Case

adapter is squarely in place, install the four (4) cap screws, as shown in (Fig. 61). The adapter can now be pulled down squarely, until contact with the case is made, by alternately tightening the cap screws a small amount and checking frequently for binding. When adapter is pulled down as far as possible, tighten the four (4) cap screws to 27 to 37 pounds-feet torque.

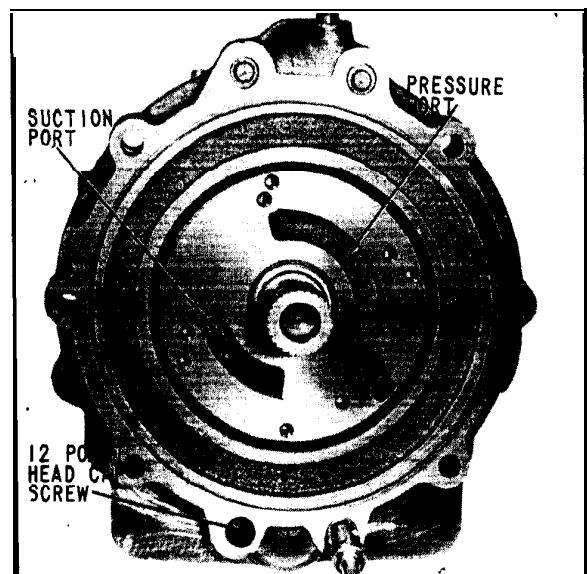


Fig. 61 Mounting Adapter to Case

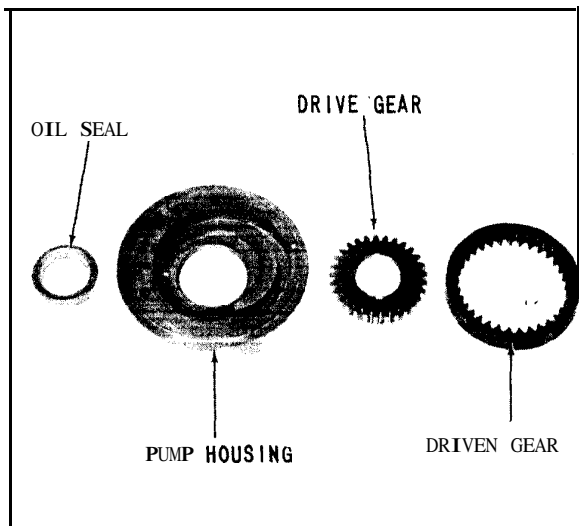


Fig. 62 Front Pump Parts for Assembly 71C-A60

#### 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.

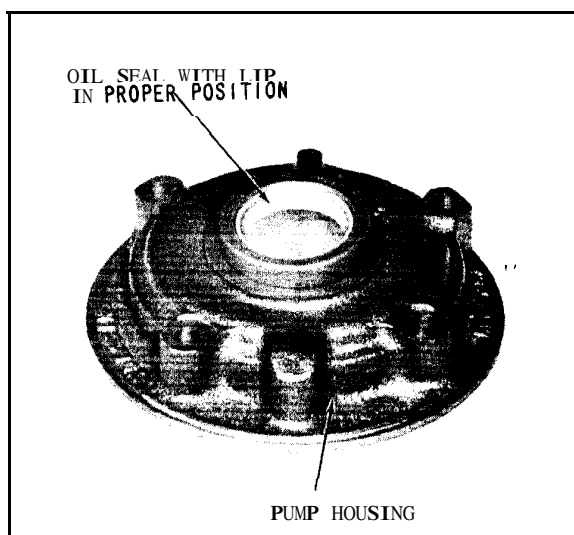


Fig. 63 installing Pump Oil Seal

**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).

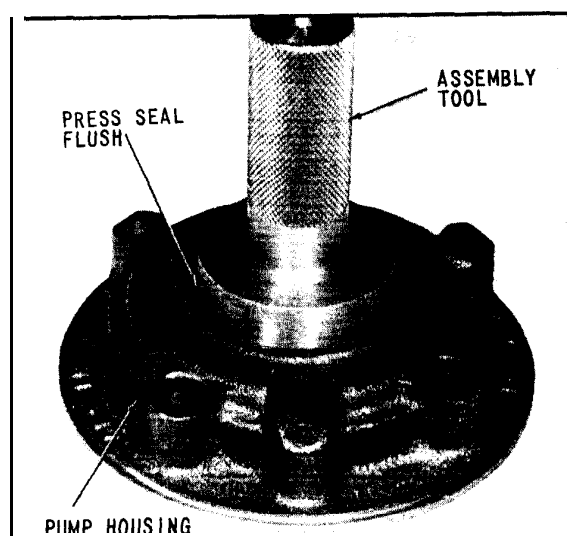


Fig. 64 Pressing Pump Oil Seal into Housing

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).

60. After seal is assembled, lubricate the pump housing with the proper transmission oil and place as shown in (Fig. 65). Install lubricated driven pump gear with identification mark as shown in (Fig. 65).

#### MOUNTING FRONT PUMP ON TRANSMISSION

61. Place parts assembled in steps 1 through 56 inclusive as shown in (Fig. 611, after inspecting the adapter face for dirt and obstructions.
62. Lubricate and install front pump gasket, (Fig. 66).

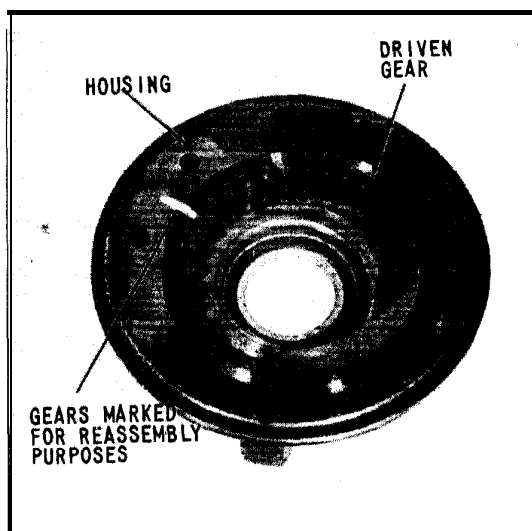


Fig. 65 Installing Pump Driven Gear

63. Install Woodruff key, (Fig. 66).

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

64. Install the pump drive gear on the input shaft, with one of the Woodruff key slots in drive gear mating with the Woodruff key on the input shaft, (Fig. 66).

NOTE: The two pump gears should be assembled so that the same gear faces are matched with the machined face of the pump housing as found at disassembly. Marks should have been applied at disassembly to insure proper reassembly, (Page 24, paragraph 10).

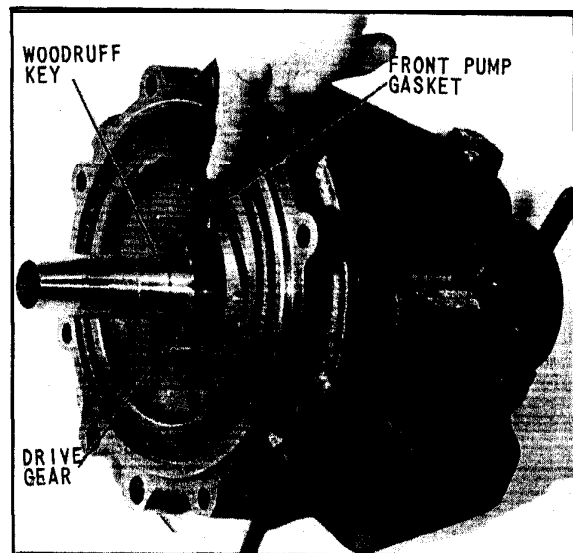


Fig. 66 Installing Pump Drive Gear Key and Front Pump Gasket

65. Cover the splined portion of the input drive gear with a suitable tool to protect the rubber lip on the seal during the assembly of the remaining front pump parts, (Fig. 66).

66. With the pump driven gear properly installed in the front pump housing, assemble the housing and pump driven gear squarely over the protruding input shaft and assembly tool. A slight rotation of the pump housing and pump driven gear will allow engagement of pump gear teeth, (Fig. 67).

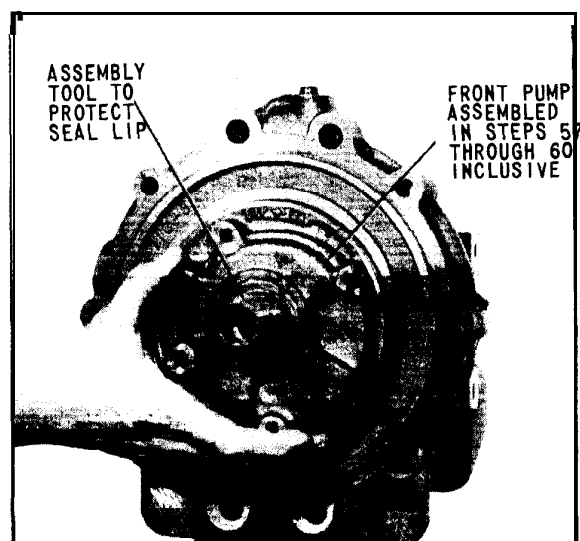


Fig. 67 installing Pump over Seal Protector



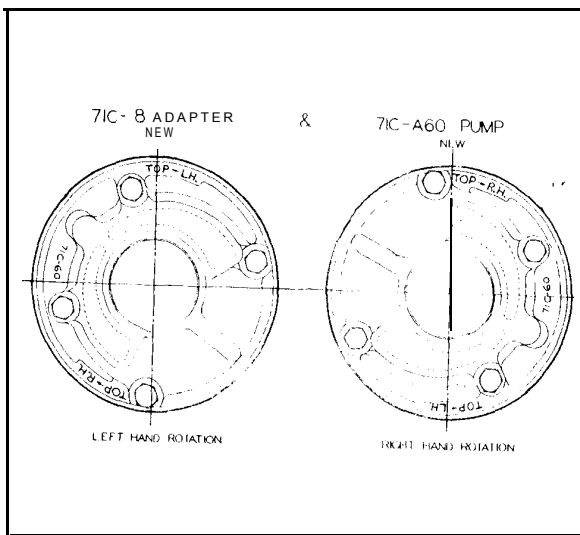


Fig. 68 Orientation Markings for Present 71C-A60 Pump on the 71C-8 Adapter

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

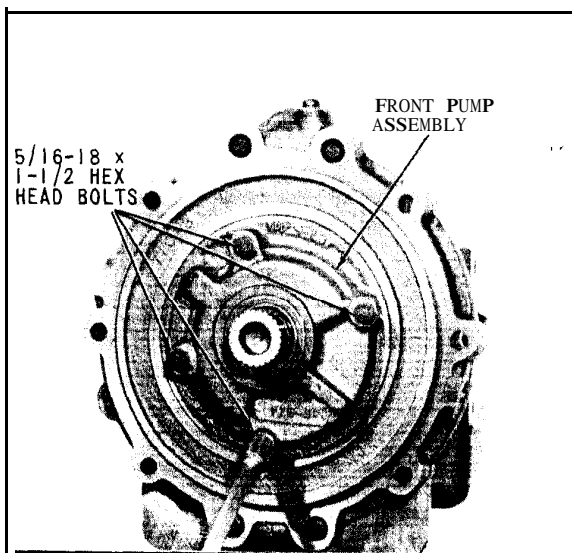


Fig. 69 Mounting Front Pump to Adapter

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

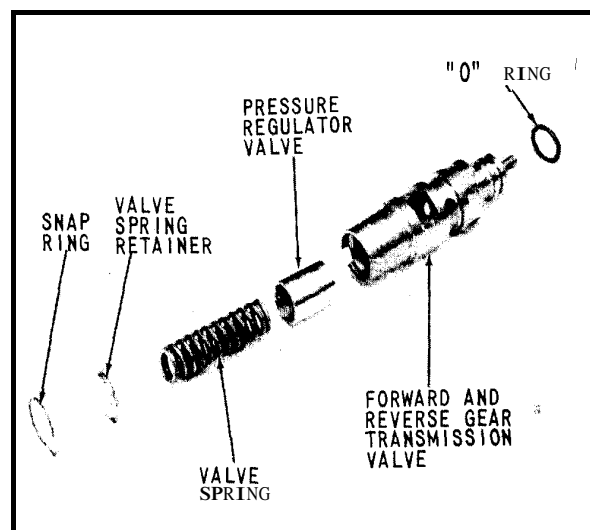


Fig. 70 Exploded View of Valve and Spring Assembly

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.

(b) The valve spring assembles into the pressure regulator valve.

(c) The concave portion of the valve spring retainer assembles over the valve spring.

71. After carefully checking the pressure regulator valve and the bore in the forward and reverse gear transmission valve for dirt and burrs, assemble all valve and spring components shown in (Fig. 70).

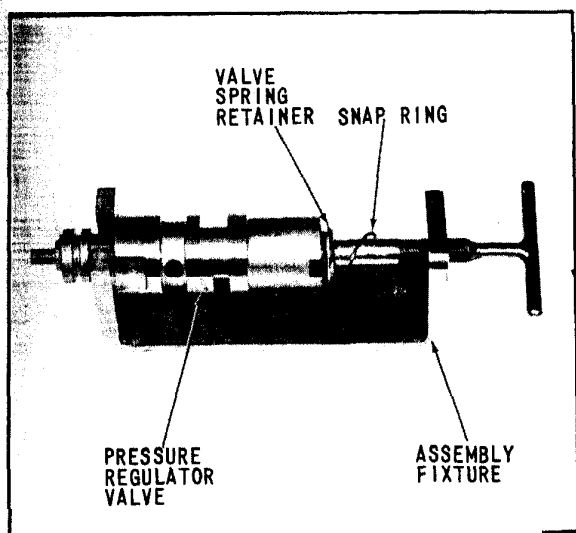


Fig. 71 Control Valve Assembly in Fixture

72. Place the assembled parts in a suitable assembly fixture, (Fig. 71). Turning handle of threaded plunger, compress the regulator valve spring until the groove for the snap ring in the pressure regulator valve is fully exposed. Install snap ring shown in (Fig. 71). The "O" ring shown in (Fig. 70) should be installed on end of valve.

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

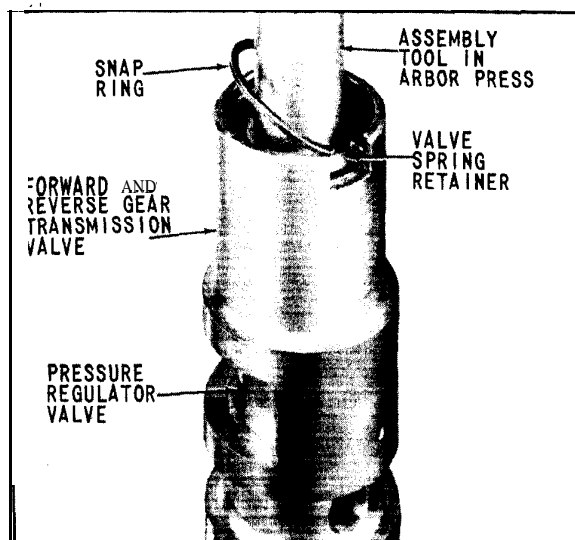


Fig. 72 Installation of Snap Ring

#### INSTALLATION OF THE VALVE AND SPRING ASSEMBLY IN THE TRANSMISSION CASE

73. Place parts assembled in steps 1 through 69 inclusive, on clean flat surface. Into the opening provided high on the right-rear side of the transmission case, place the valve and spring assembly, threaded end entering first, (Fig. 73). This is a hand assembly and is completed when the valve and spring assembly "bottoms" against the shoulder in the case bore.

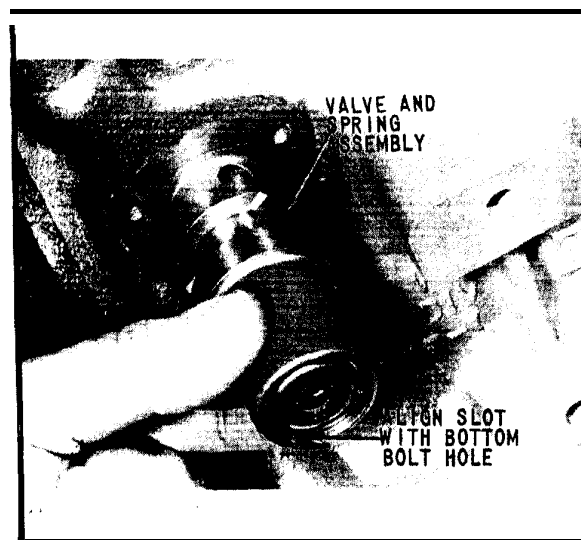


Fig. 73 Installation of Valve and Spring Assembly

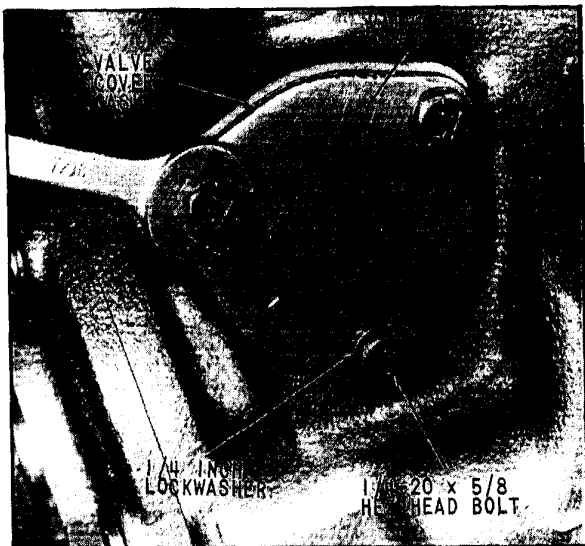


Fig. 74 Assembly of Valve Cover

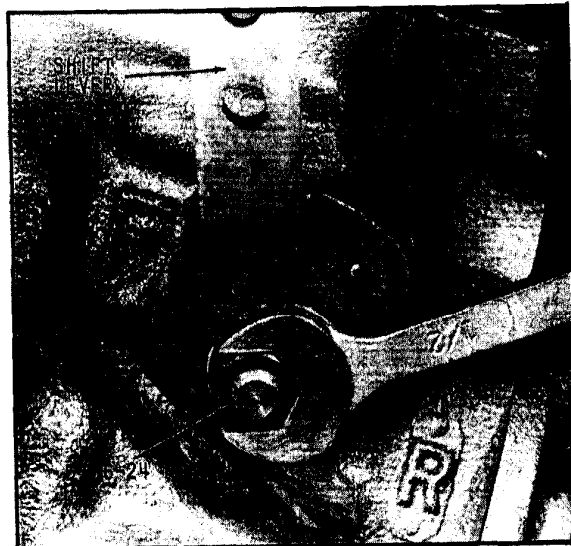


Fig. 76 Shift Lever Assembled

#### 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.

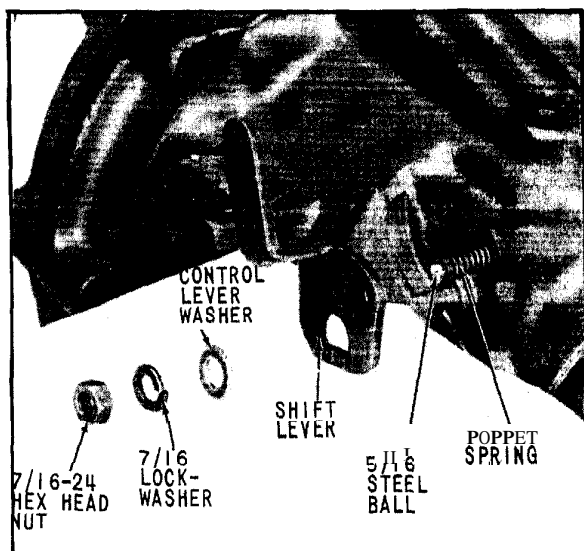


Fig. 75 Assembly of Shift Lever and Related Parts

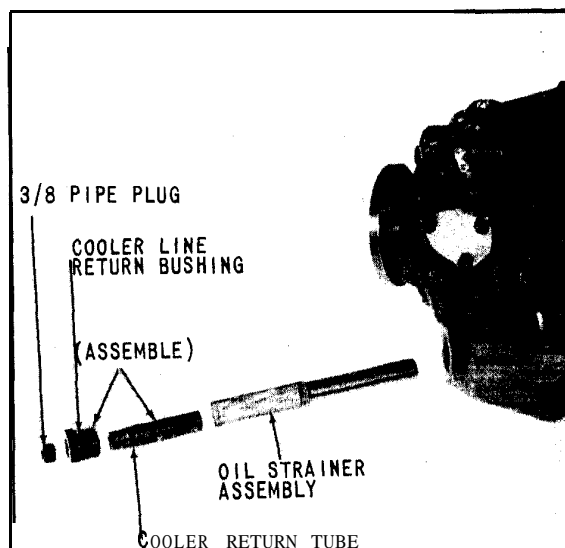


Fig. 77 Install Oil Strainer & Cooler Return Tube & Bushing Assembly

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

77. Assemble the oil strainer assembly, cooler line return bushing and cooler return tube assembly in the order shown in (Fig. 77). The screen end of the oil strainer assembly should be approximately 1/2 inch below the face of the case when the assembly is correctly installed.

78. Tighten cooler line return and oil drain bushing to recommended torque of 25 to 35 pounds feet.

## INSTALLATION OF MISCELLANEOUS TRANSMISSION PARTS

79. Install the breather assembly as shown in (Fig. 78). Do not hammer on the top of the breather assembly illustrated as this will damage the sealing element. For installation of other type breather assemblies see page 48, (paragraphs 3 & 4) for instructions.

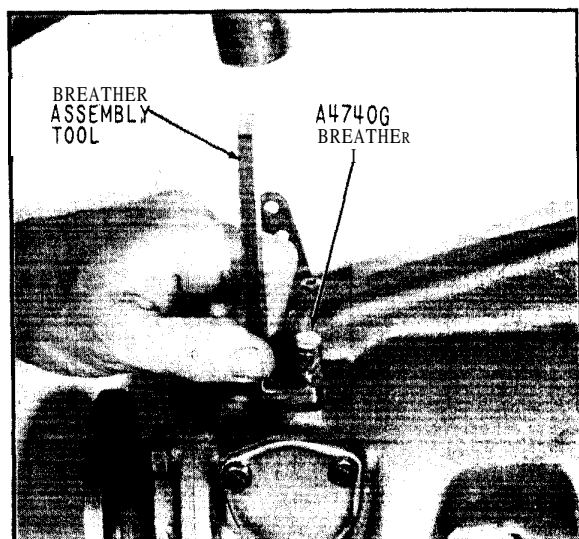


Fig. 78 Installation of Breather Assembly



Fig. 79 Installation of Dip Stick Assembly

80. Install the dipstick assembly as shown in (Fig. 79) and tighten to a torque sufficient only to prevent oil leakage (approximately 10-15 pounds-feet).

81. Install 3/8-18, 1/4-18 and 1/8-27 dryseal plugs, (Fig. 80) and torque to values indicated on page 62.

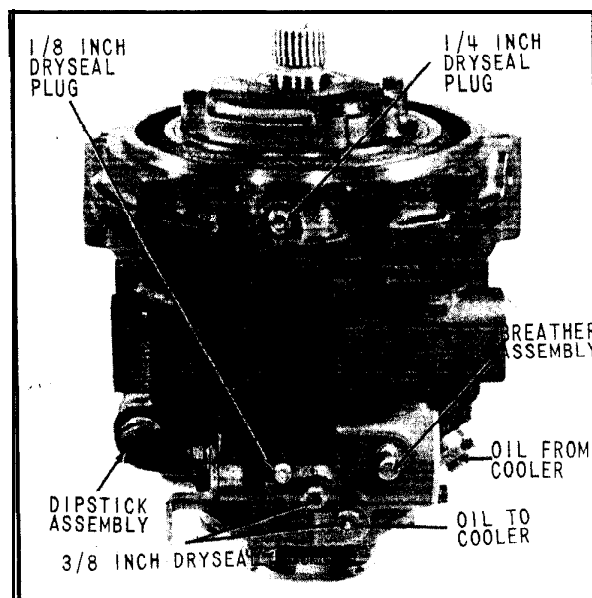


Fig. 80 Installation of Miscellaneous Pipe Plugs

## EXTRA EQUIPMENT

### ASSEMBLY OF NEUTRAL SWITCH KIT

1. Unscrew three (3) hex head bolts, remove valve cover and gasket, as shown in (Fig. 74). Discard valve cover, gasket, hex head bolts and lockwashers.
2. Shift control lever into neutral position, see page 23 (Fig. 17). Assemble gasket provided in neutral switch kit. Assemble neutral switch cam, making sure to align tang "A" on cam with slot "B" in valve, as

shown in (Fig. 82). Neutral switch cam correctly assembled as shown in (Fig. 83).

3. Assemble valve cover and neutral switch with neutral switch located between two (2) top 1/4-20 bolts, as shown in (Fig. 84). Use the three (3) 1/4-20-7/8 inch long hex head bolts provided in neutral switch kit. Tighten hex head bolts to recommended torque of 8 to 11 **pounds-feet** and assemble starter solenoid wires to switch.

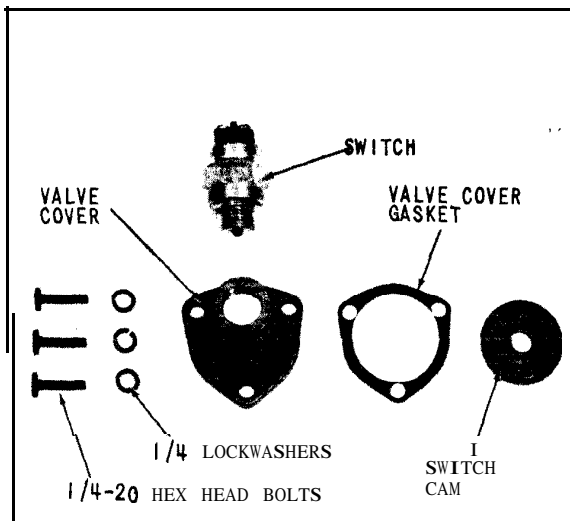


fig. 81 Neutral Switch Parts

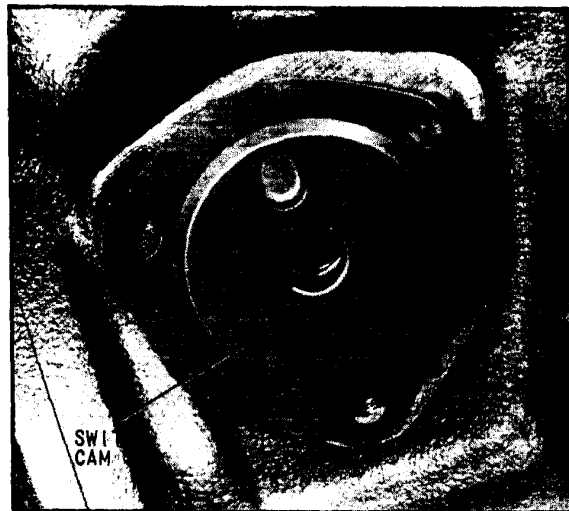


Fig. 83 Neutral Switch Cam in Correct Position

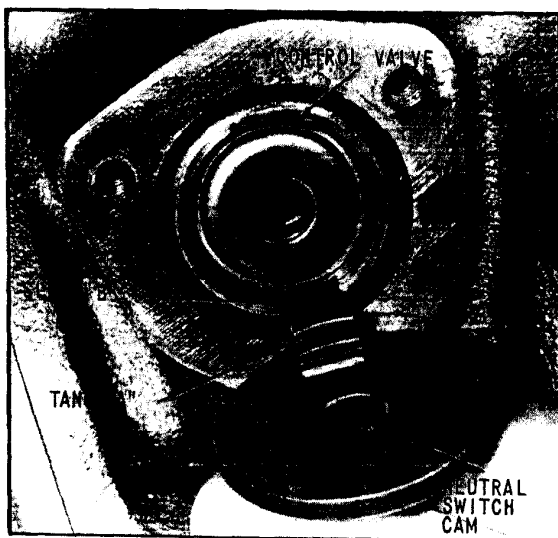


Fig. 82 Assembly of Neutral Switch

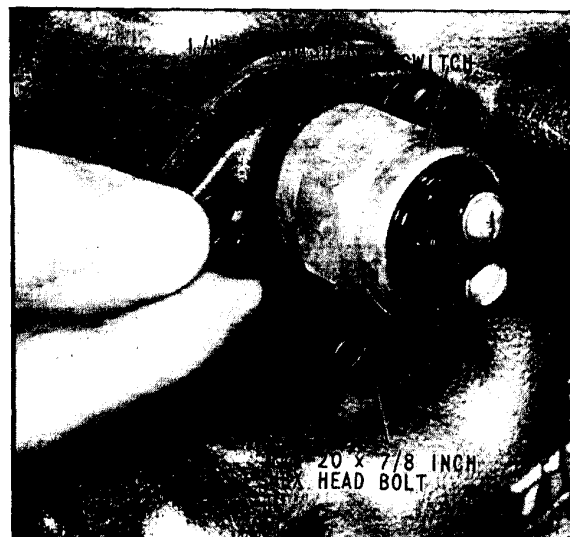


Fig. 84 Neutral Switch Correctly Assembled

## 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.

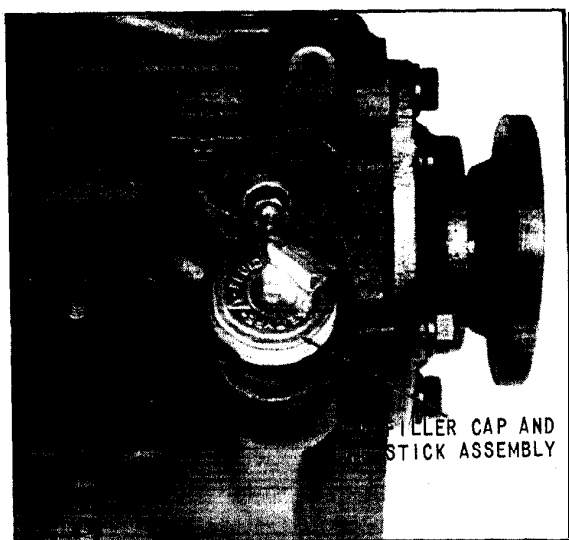


Fig. 85 Installation of Oil Filler Cap and Dipstick Assembly

#### 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.

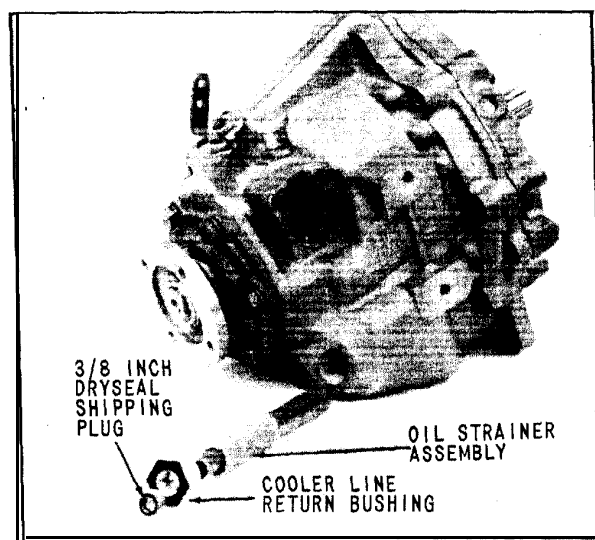


Fig. 86 Installation of Oil Strainer Assembly and Cooler Line Return Bushing

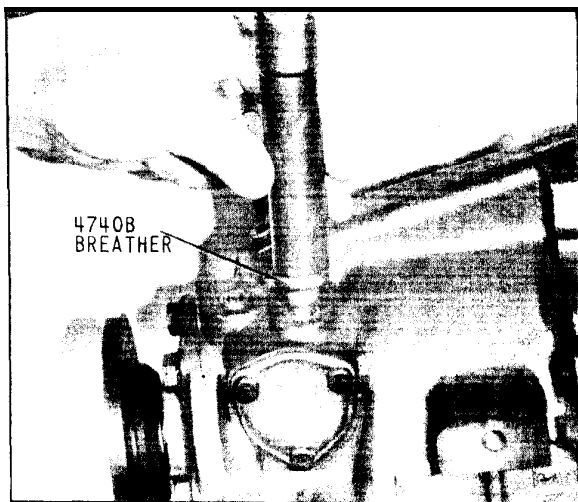


Fig. 87 Installation of Breather Assembly



Fig. 88 Adapting Breather Assemblies

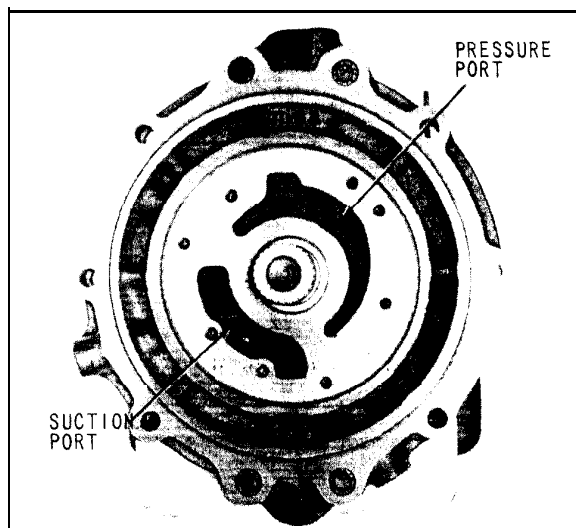


Fig. 89 Pump Porting in 71B-8 Adapter

## INSTALLATION OF BREATHER ASSEMBLY

3. In addition to the breather assembly shown in (Fig. 78), other breather assemblies will be found in use as illustrated in (Fig. 87) and (Fig. 88). The above illustrations demonstrate the manner in which these breather assemblies are installed.
4. The breather in (Fig. 88) is supplied for those installations where a pressure type breather replaces the breather shown in (Fig. 87). This breather is used with an internally threaded bushing which presses into the case before the installation of the threaded breather assembly.

## ASSEMBLY OF FRONT PUMP

NOTE: The following instructions are for the assembly of the front pump with a backing plate, (Fig. 91). This pump can be used with either of the two different adapter housings, but it should normally be found assembled on the one shown in (Fig. 89). Any of the various versions of the input, shafts may be used with this pump, but the proper key must always be used with each shaft. See (Fig. 90) for comparison of the installation of the two pump assemblies and information on the other related parts.

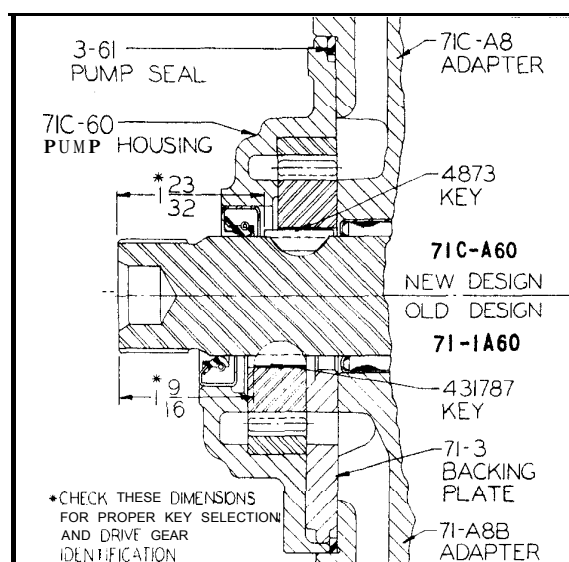


Fig. 90 Illustration of the Installation of the Two Types of Pump Assemblies and Their Related Parts.

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.

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).
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).

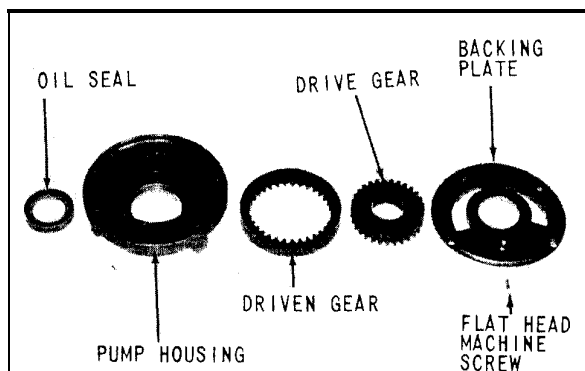


Fig. 91 Front Pump Parts with Backing Plate, Assembly 71-1A60

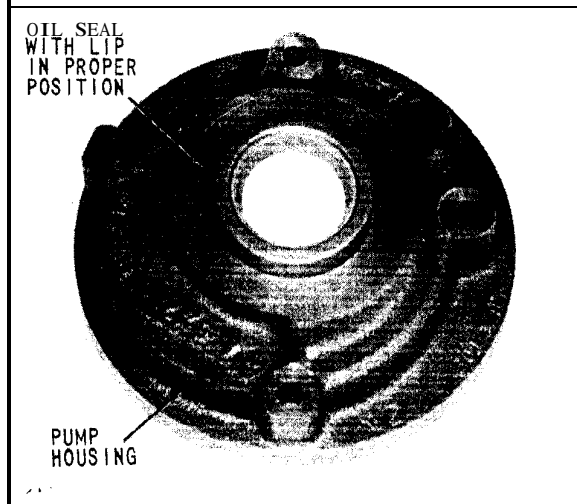


Fig. 92 Installing Oil Seal

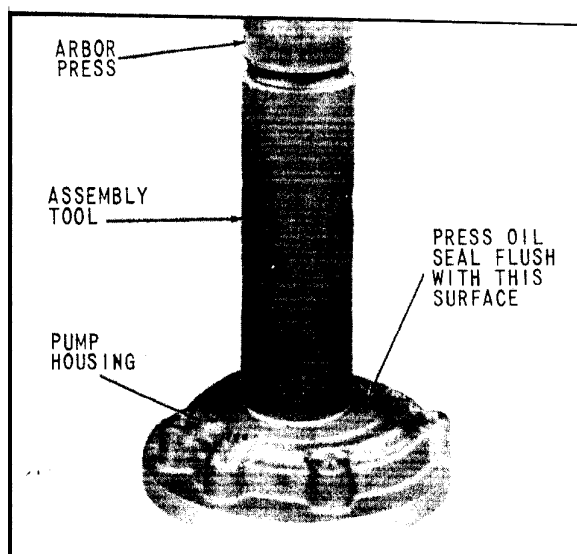


Fig. 93 Pressing Oil Seal

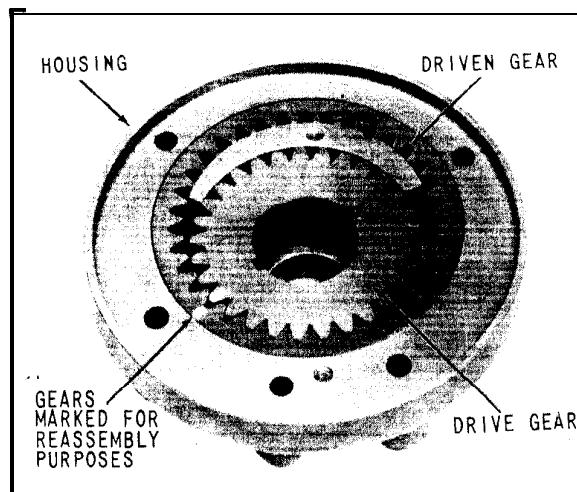


Fig. 94 installing Pump Gears



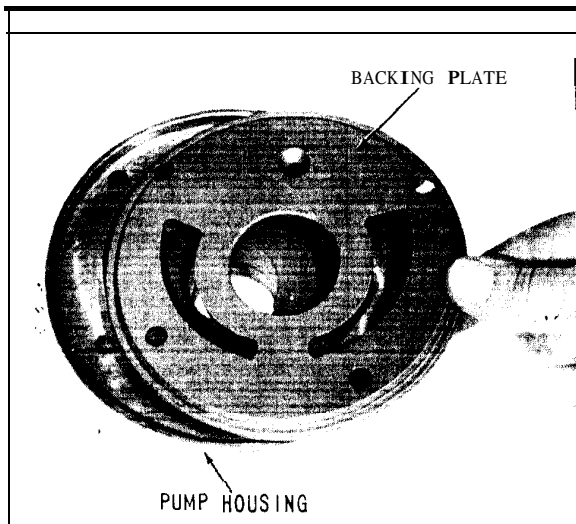


Fig. 95 Installing Backing Plate

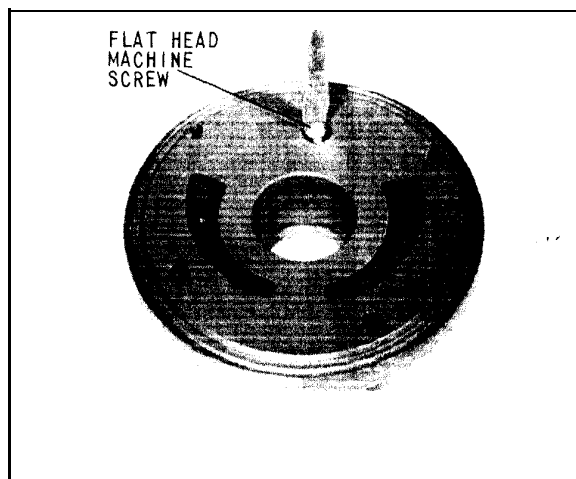


Fig. 96 Installing Flat Head Machine Screw through Backing Plate

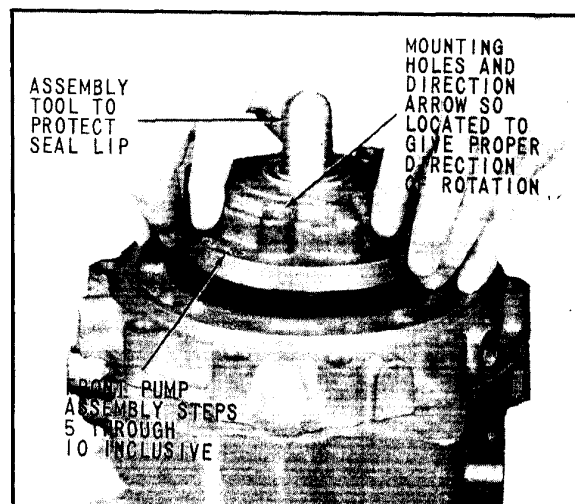


Fig. 97 Mounting Front pump

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.

NOTE: The location of the markings on the 71-60 pump housing identifying the orientation of the pump assembly on the adapter for right or left hand rotation will vary depending upon which pump assemblies and adapters are used.

The newer pump assembly with backing plate, identified by the rib on the pump housing, will be properly mounted when the marking on the pump housing appears as shown in (Fig. 98), when mounted on the 71-8B adapter, (Fig. 89). If the same pump were mounted on the new adapter 71C-8, (Fig. 61), the pump markings would be identical to those illustrated for the new 71C-A60 pump assembly in (Fig. 68).

The older pump assembly with backing plate, identified by the absence of the rib on the 71-60 pump housing, would appear as illustrated in (Fig. 99) when mounted on the old 71-8B adapter (Fig. 89). This older pump assembly with backing plate could also be mounted on the new 71C-8 adapter (Fig. 61), but this has not been illustrated as no original factory installations were made in this manner.

15. With front pump assembly resting squarely on gasket and seal assembly tool removed, install four (4) 1-7/8 long hex head bolts, (Fig. 100). Tighten hex head bolts evenly to torque of 17 to 22 pounds-feet.

#### ELIMINATION OF REGULATOR VALVE BUZZ

16. New pressure regulator valves (71-243) have a relief at the outer diameter at the closed end for the elimination of regulator valve buzz, (Fig. 101). If a transmission should have a valve buzz and contains a 71-243 pressure regulator valve which does not have the relief, the valve should be replaced, or reoperated as illustrated.

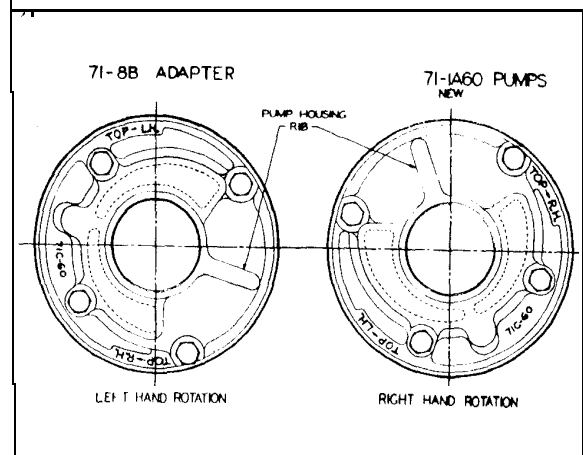


Fig. 98 Orientation Markings for New 71-1A60 Pump Assembly on 71-8B Adapter

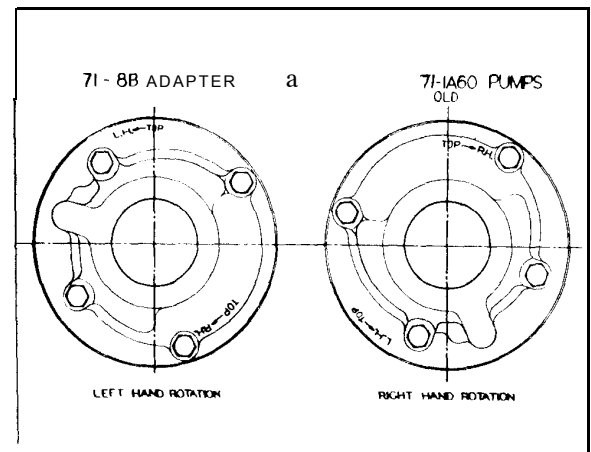


Fig. 99 Orientation Markings for Old 71-1A60 Pump Assembly on 71-8B Adapter



Fig. 100 Bolting Front Pump Assembly

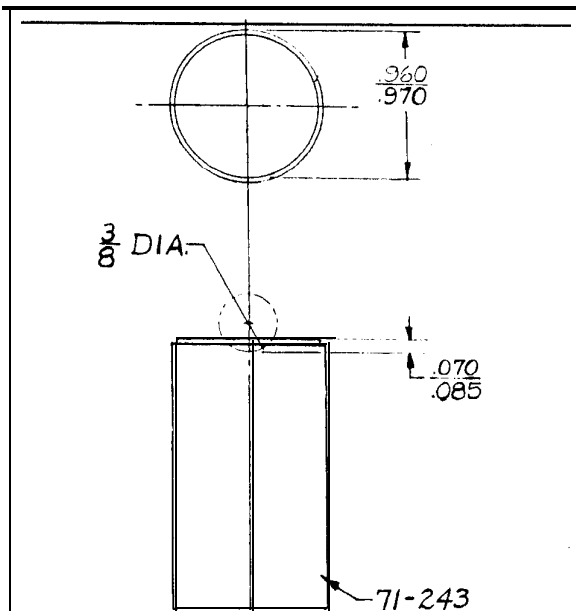


Fig. 101 Reoperation to Eliminate Regulator Valve BUZZ

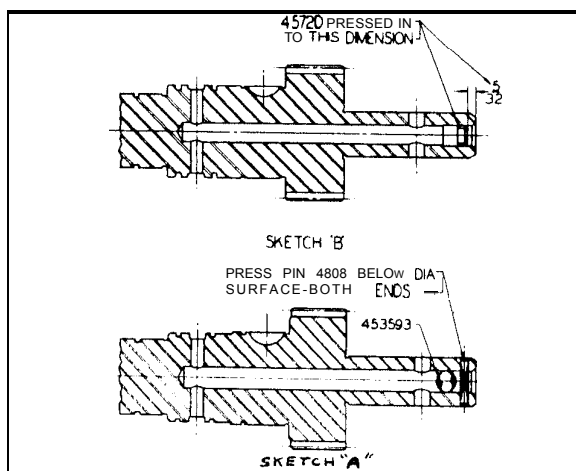


Fig. 102 Versions of Drive Gear and Plug Assemblies

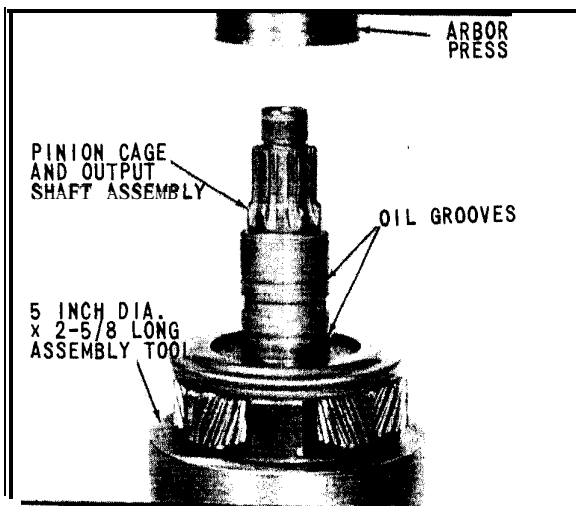


Fig. 103 Pinion Cage and Output Shaft Assembly with Oil Grooves

## DRIVE GEAR AND PLUG ASSEMBLIES

17. The two methods of sealing the end of the drive gear are illustrated in (Fig. 102). Sketch "B" illustrates the method now used and sketch "A" the method formerly used. The two drive gear assemblies, varying only in the method of sealing the end of the shaft, are fully interchangeable.

## PINION CAGE AND OUTPUT SHAFT ASSEMBLY

18. Pinion cage and output shaft assembly has been supplied with three oil grooves around the shaft diameter as shown in (Fig. 103). This shaft can be used to replace any shafts. However, shafts without the grooves must not be used with those forward and reverse transmission cases supplied without the 71-28B bushings.

## FORWARD AND REVERSE GEAR TRANSMISSION CASE AND BUSHING ASSEMBLY

19. Two versions of the transmission case have been supplied; one includes bronze bushings for the output shaft journal, the other is designed for use without the bushings. These two versions of the transmission case are completely interchangeable, except that the case without bushings cannot be used with the output shaft assemblies which do not have the oil groove (Fig. 103). Information regarding the service replacement of case bushings can be found on page 59, (Fig. 111). If it becomes necessary to replace a case of the design without bushings because of worn journals, it can be returned to your engine supplier. He can return the case to Warner Gear for reoperation and installation of bushings and can furnish information concerning the cost of this service.

## 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 S-15) pages 48 to 51, with the exception that the seal should be pressed into the pump housing until front face of seal is  $\frac{1}{8}$  inch above front face of Pump housing, (Fig. 105).

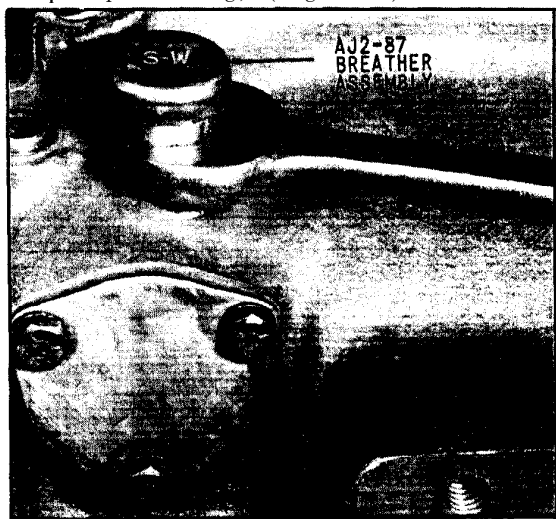


Fig. 104 Installation of Breather Assembly

#### 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

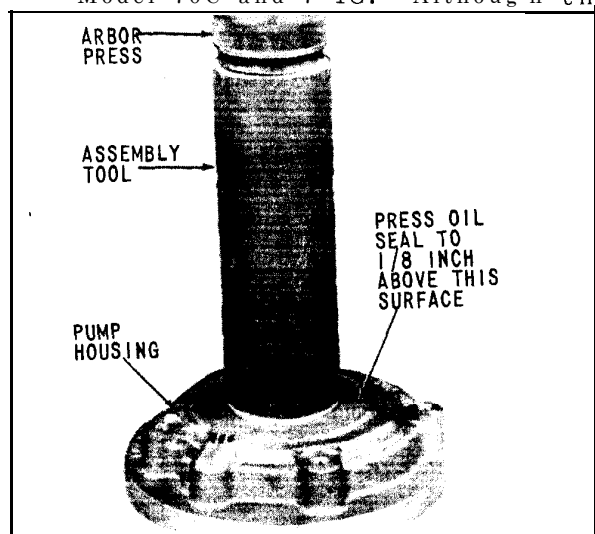


Fig. 105 Pressing Oil Seal

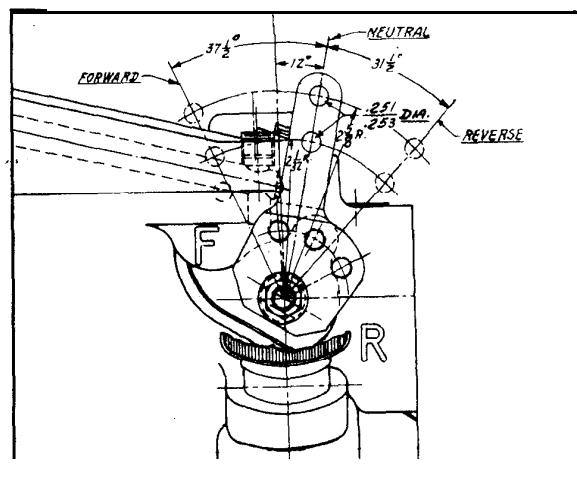


Fig. 106 ASI-71B & ASI-70B Shift Lever Positions

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).

## 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 capscrew (4911) which has better locking characteristics. The two types are completely interchangeable.

## 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).

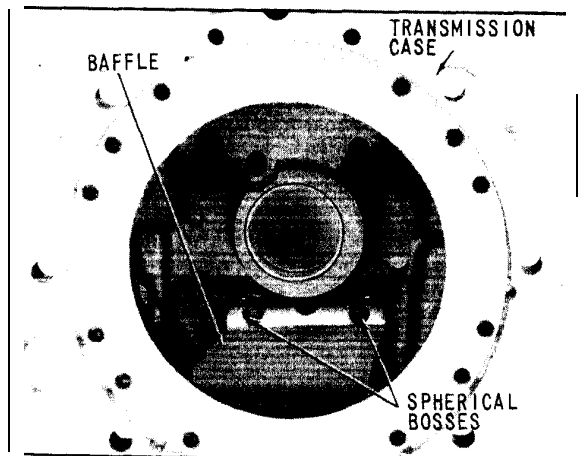


Fig. 107 Installing Baffle

### 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).

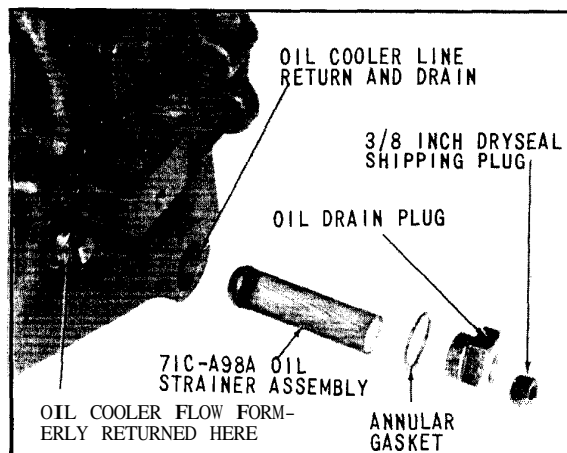


Fig. 108 installation of Oil Drain Plug and Related Parts

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

Using the oil strainer assembly, annular gasket and oil drain plug as shown in (Fig. 108) proceed as follows:

- (a) Insert the oil strainer into the tapped hole provided in the lower-right side of the transmission case. The end of the oil strainer assembly will be approximately 1/2 inch below the finished face of the case boss when properly assembled.
- (b) Mount the annular gasket on the oil drain plug and screw the oil drain plug into the case drain hole. Tighten plug to a torque of 25-35 pounds-feet.

NOTE: The oil strainer assembly 71C-A98A shown in (Fig. 108) has replaced a similar oil strainer assembly 71-A98C, but these two parts are fully interchangeable. However, oil strainer assembly 71-A98, with

the closed end and wire ring, should not be confused with either of the two above oil strainer assemblies. It can only be used when cooler return flow does not return through the oil strainer assembly.

## COOLER RETURN TO TRANSMISSION

5. On the Model 70 and 71 transmissions it is now recommended that the cooler oil flow be returned to the transmission case as shown in (Fig. 1). Transmissions with the cooler flow returning in a manner other than that now recommended need not be changed. However, the arrangement now recommended conforms to practices followed on other transmission installations and permits better control of the cooler return oil flow to the pump suction.

NOTE: If cooler return flow is changed to the new location be sure that the oil strainer installed is similar to the one illustrated in (Fig. 108). The old strainer assembly with one end enclosed would block the flow of the cooler return oil.

# **— IMPORTANT —**

## **SERIES 10-17 AND 10-18 SERVICE INSTRUCTIONS**

Practically all information which has been written for the 71 C 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.

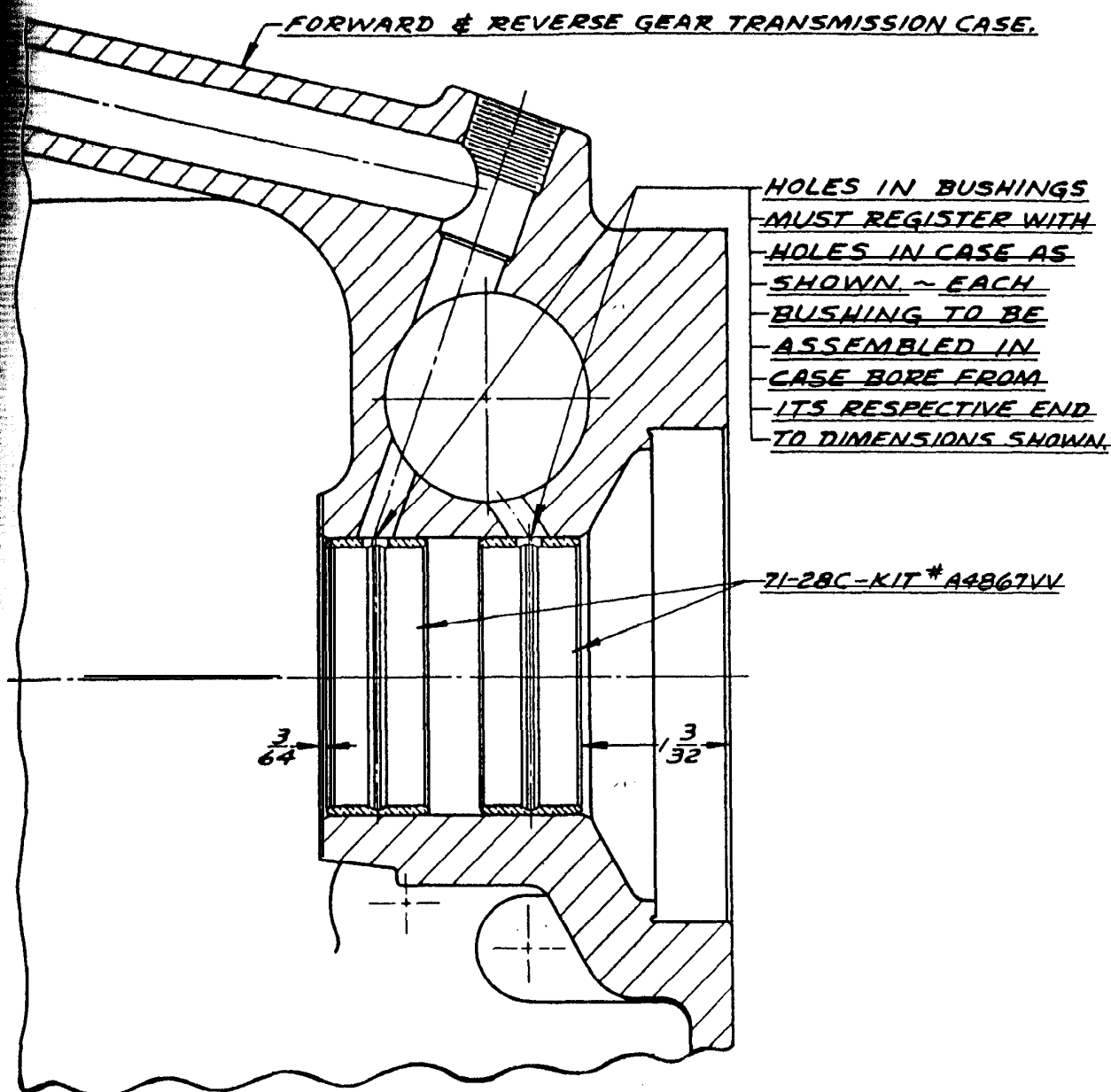
Chart Comparing New Models to Early Models

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			
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	AS2-71C	1.91:1	1.91:1	CW	CCW	cw	↗	LH
10-17-000-008	10-04-000-051	AS2-71CR	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	↗	RH
10-17-000-010	10-04-000-045	AS3-71CR	2.10:1	2.10:1	CCW	ccw	cw	↘	LH
10-17-000-011	10-04-000-046	AS14-71C	2.57:1	2.57:1	CW	cw	ccw	↗	RH
10-17-000-012	10-04-000-047	AS14-71CR	2.57:1	2.57:1	CCW	ccw	cw	↘	LH
10-17-000-013	10-04-000-048	AS15-71C	2.91:1	2.91:1	CW	cw	ccw	↗	RH
10-17-000-014	10-04-000-049	AS15-71CR	2.91:1	2.91:1	CCW	ccw	cw	↘	LH
10-17-000-015	10-04-000-040	AS20-71C	1:1	1:1	CW	CW	ccw	↗	RH
10-17-000-016	10-04-000-041	AS20-71CR	1:1	1:1	CCW	CCW	cw	↘	LH
10-18-000-001	10-05-000-034	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	↘	LH
10-18-000-003	10-05-000-038	AS12-72C	1.52:1	1.68:1	CW	cw	ccw	↗	RH
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	↗	LH
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	↗	RH
10-18-000-008	10-05-000-041	AS13-72CR	2.10:1	2.31:1	CCW	ccw	cw	↘	LH
10-18-000-009	10-05-000-042	AS14-72C	2.57:1	2.83:1	CW	cw	ccw	↗	RH
10-18-000-010	10-05-000-043	AS14-72CR	2.57:1	2.83:1	CCW	ccw	CW	↘	LH
10-18-000-011	10-05-000-044	AS15-72C	2.91:1	3.20:1	CW	CW	CCW	↗	RH
10-18-000-012	10-05-000-045	AS15-72CR	2.91:1	3.20:1	CCW	CCW	CW	↘	LH
10-18-000-013	10-05-000-036	AS20-72C	1:1	1.10:1	CW	CW	CCW	↗	RH
10-18-000-014	10-05-000-037	AS20-72CR	1:1	1.10:1	CCW	CCW	cw	↘	LH

- 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.
- 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.

- 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.



NOTE: THE 71-28C BUSHING IS THE PRE-SIZED BUSHING FOR FIELD SERVICE OF THE ORIGINAL 71-288 BUSHING INSTALLED AT FACTORY.

## TRANSMISSION CASE 8 SERVICE BUSHINGS INSTRUCTION

Fig. III



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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- ).

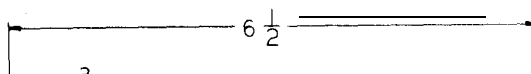
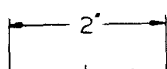
## TROUBLE SHOOTING CHART

COMPLAINTS & SYMPTOMS	REMEDY	
	TRANSMISSION IN BOAT	TRANSMISSION REMOVED
<b>INTERNAL &amp; EXTERNAL LEAKS</b>  1. OIL LEAKS AT PUMP 2. OIL ON EXTERIOR OF TRANSMISSION 3. OIL LEAKS AT REAR BEARING RETAINER 4. WATER IN TRANSMISSION OIL OR OIL IN COOLING WATER	1 4 6 7 1 2* 3* 8 9	1 2 3 8 2 5 8
<b>TRANSMISSION MALFUNCTIONS IN ALL RANGES</b>  1. NO OIL PRESSURE 2. LOW OIL PRESSURE 3. HIGH OIL TEMPERATURE 4. FAILURE OF REDUCTION GEAR	10 13 14 15 16 18 9 15 19 20 21 22	11 12 17 42 42 43
<b>TRANSMISSION MALFUNCTIONS IN FORWARD RANGE</b>  1. LOW OIL PRESSURE 2. FORWARD CLUTCH ENGAGES IMPROPERLY 3. FORWARD CLUTCH DRAGS 4. REDUCTION UNIT FAILURE	13 14 15 16 18 37 37	17 12 23 24 25 26 27 2 26 27 28 42 43
<b>TRANSMISSION MALFUNCTIONS IN REVERSE RANGE</b>  1. LOW OIL PRESSURE 2. REVERSE CLUTCH ENGAGES IMPROPERLY 3. REVERSE CLUTCH DRAGS 4. REVERSE GEAR SET FAILURE 5. REDUCTION GEAR SET FAILURE	13 14 15 16 18 37 37	17 24 26 28 29 26 28 29 42 42 43
<b>TRANSMISSION MALFUNCTIONS IN NEUTRAL</b>  1. OUTPUT SHAFT DRAGS EXCESSIVELY IN FORWARD ROTATION 2. OUTPUT SHAFT DRAGS EXCESSIVELY IN REVERSE ROTATION	37 37	26 27 28 26 28 29 42
<b>MISCELLANEOUS TRANSMISSION PROBLEMS</b>  1. REGULATOR VALVE BUZZ 2. GEAR NOISE-FORWARD 3. GEAR NOISE-REVERSE 4. PUMP NOISE 5. DAMPER NOISE OR FAILURE 6. SHIFTS HARD 7. HIGH OIL PRESSURES	30 31 31 15 16 39 16 40 41	32 43 32 42 43 17 32 33 34 35 36 7 37 38

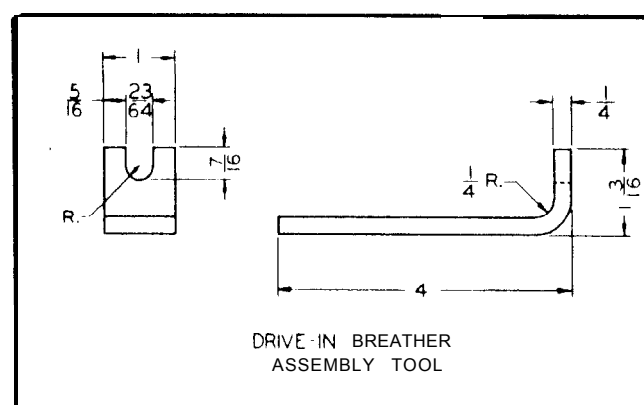
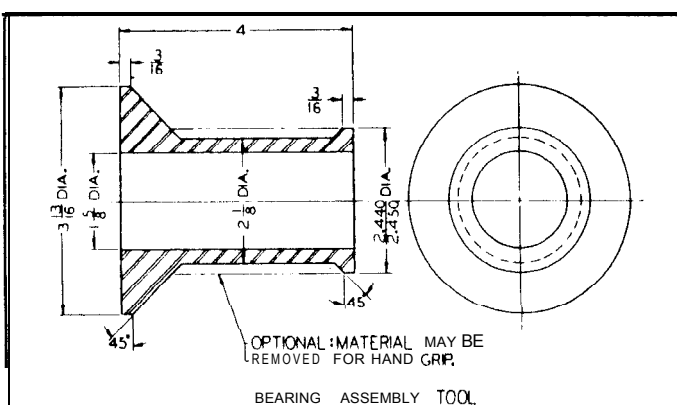
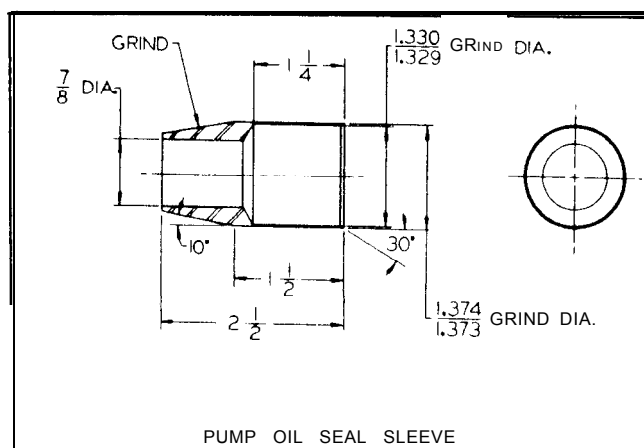
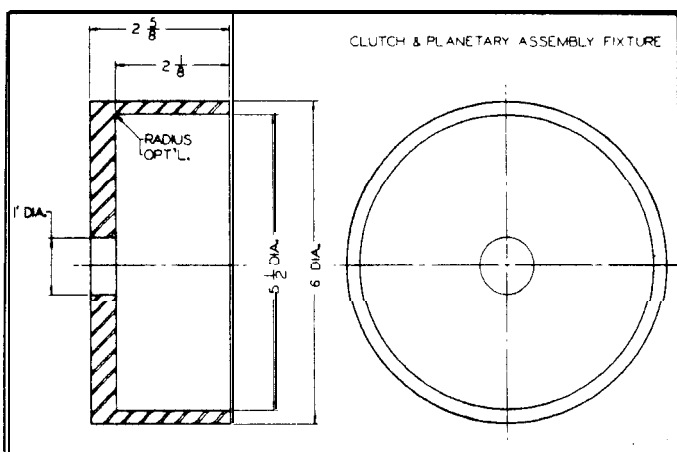
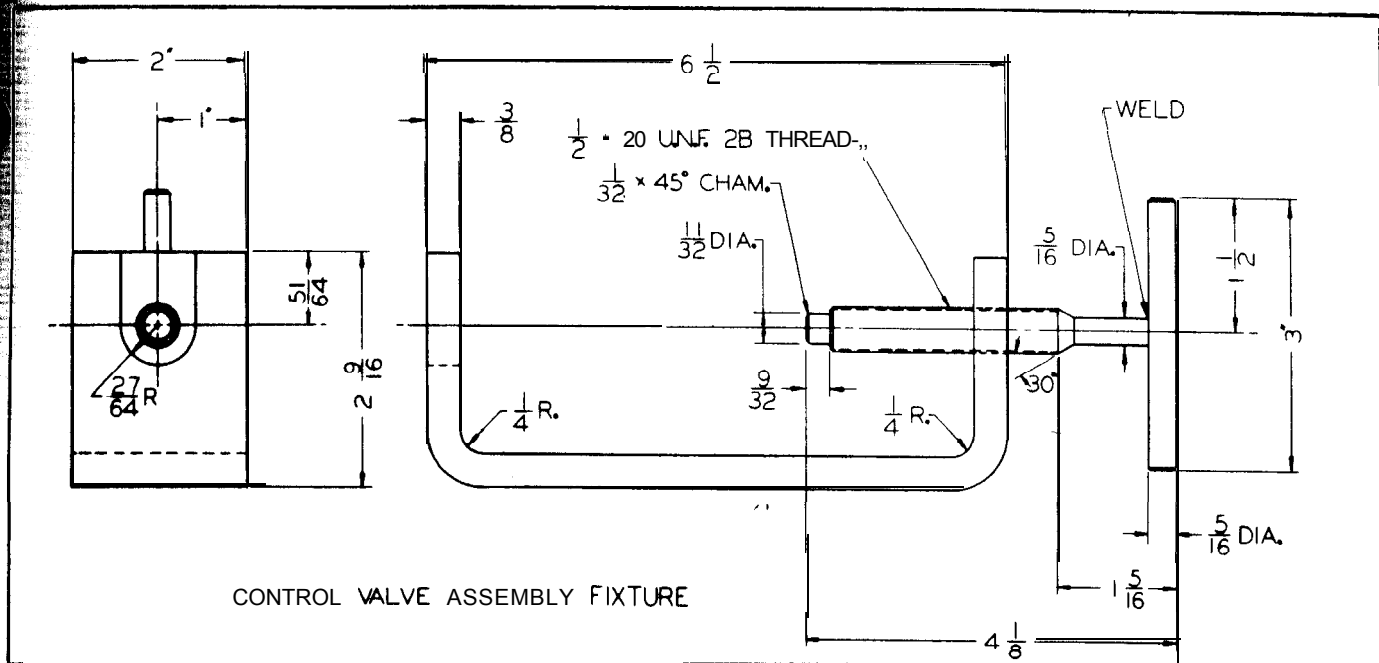
\*IF INSTALLATION ALLOWS ACCESS, OTHERWISE REMOVE TRANSMISSION.

## TORQUE SPECIFICATIONS

PART NUMBER	DESCRIPTION	APPLICATION	TORQUE LBS.-FT
79822	5/16-18 x 1-1/2 HEX HEAD BOLT	PUMP TO ADAPTER	17-22
1911	3/8-16 x 1-1/4 12 POINT CAPSCREW	ADAPTER TO CASE	27-37
79793	1/4-20 x 5/8 HEX HEAD BOLT	VALVE COVER TO CASE	8-11
15729	5/16-24 NUT	SHIFT LEVER TO VALVE	8-11
79859	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
144866	3/8-18 DRYSEAL PIPE PLUG	CASE	17-27
71-A195	3/4-14 PIPE PLUG	DIPSTICK ASS'Y. INTO CASE	10-15



WELD



The assembly tool drawings shown on this page are included to illustrate how these tools may be made. Most will provide convenience in assembling and disassembling the transmission and their functions may be performed by the substitution of other objects or pro-

cedures. However, the use of the oil pump assembly tool, or other means of protecting the seal lip, is a necessity.

The drawings are provided as a convenience.

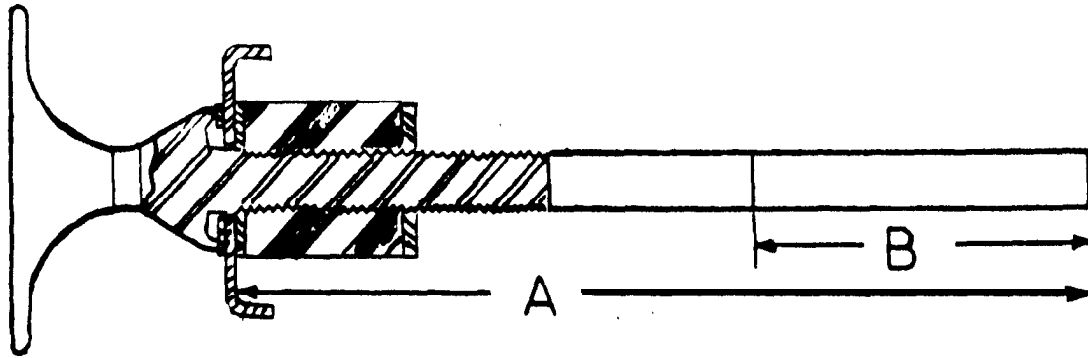
WARNER GEAR DOES NOT MANUFACTURE OR SELL ANY OF THE TOOLS ILLUSTRATED.

## \*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, 71 C and 72C reduction units. Dipstick 10-13-559-001 is used in all CR2 units and all 70C, 71 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 tinder 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
10-06-559-001	6.00	15.24	.75	1.91
10-13-559-001	4.64	11.79	.a3	2.11

Plain  
Green  
Red

## \*NOTE #3

SUBJECT: SEALING RINGS ADDED TO ALL IN-LINE AND V-DRIVE ASSEMBLIES

All Velvet Drive In-Line and V-Drive assemblies have been changed to use four 48068 cast IRON sealing rings. New pinion cage and output shaft assemblies having four ring grooves for the sealing rings will be used in the forward and reverse portion of these assemblies. These new pinion cage and output shaft assemblies have a larger diameter; therefore the 71-159 thrust washer when used will be replaced by a new 10-17-193-001 thrust washer with a larger inside diameter,

The two bushings, which were pressed into the 1.989-1.990" (50.5-50.55 mm) bore at the rear of the forward and reverse transmission case are no longer required and will be removed. The case bore size will be changed to 2.000-2.005" (50.8-50.93 mm) diameter to accommodate the new sealing rings. Early units may be updated by using all three new parts as required. The 10-04-000-001 and 10-05-000-001 units are the forward and reverse portion of the V-Drive units,

<u>Trans. Assy.</u>	<u>Old Case</u>	<u>New Case</u>	<u>Old Shaft</u>	<u>New Shaft</u>	<u>Uses Thrust Washer</u>
10-04-000-001	10-04-565-003	10-04-565-005	71-1A2A or 10-17-659-002	10-17-695-020	Yes
10-05-000-001	10-05-565-002	10-05-565-012	72-1A2A or 10-18-659-002	10-18-659-014	Yes
10-17-000-001	71B-A1A	10-17-065-004	71-1A2	10-17-659-012	-
10-17-000-002	71B-A1A	10-17-065-004	71-1A2	10-17-659-012	-
10-17-000-003	71C-A1	10-17-065-006	71-1A2	10-17-659-012	-
10-17-000-004	71C-A1	10-17-065-006	71-1A2	10-17-659-012	-
10-17-000-005	71-A1K	10-17-565-002	10-17-659-002	10-17-659-020	Yes
10-17-000-006	71-A1K	10-17-565-002	10-17-659-002	10-17-659-020	Yes
10-17-000-007	71-A1K	10-17-565-002	71-1A2C	10-17-659-018	-
10-17-000-008	71-A1K	10-17-565-002	71-1A2C	10-17-659-018	-
10-17-000-009	71-A1K	10-17-565-002	10-17-659-004	10-17-659-016	Yes
10-17-000-010	71-A1K	10-17-565-002	10-17-659-004	10-17-659-016	Yes
10-17-000-011	71-A1K	10-17-565-002	71-1A2C	10-17-659-018	-
10-17-000-012	71-A1K	10-17-565-002	71-1A2C	10-17-659-018	-
10-17-000-013	71-A1K	10-17-565-002	71-1A2C	10-17-659-018	-
10-17-000-014	71-A1K	10-17-565-002	71-1A2C	10-17-659-018	-
10-17-000-015	71-A1K	10-17-565-002	71-1A2A	10-17-659-020	Yes
10-17-000-016	71-A1K	10-17-565-002	71-1A2A	10-17-659-020	Yes
10-18-000-001	72-A1J	10-18-565-001	72-1A2	10-18-659-006	-
10-18-000-002	72-A1J	10-18-565-001	72-1A2	10-18-659-006	-
10-18-000-003	72-A1K	10-18-565-002	10-18-659-002	10-18-659-014	Yes
10-18-000-004	72-A1K	10-18-565-002	10-18-659-002	10-18-659-014	Yes
10-18-000-005	72-A1K	10-18-565-002	72-1A2C	10-18-659-012	-
10-18-000-006	72-A1K	10-18-565-002	72-1A2C	10-18-659-012	-
10-18-000-007	72-A1K	10-18-565-002	10-18-659-004	10-18-659-010	Yes
10-18-000-008	72-A1K	10-18-565-002	10-18-659-004	10-18-659-010	Yes
10-18-000-009	72-A1K	10-18-565-002	72-1A2C	10-18-659-012	-
10-18-000-010	72-A1K	10-18-565-002	72-1A2C	10-18-659-012	-
10-18-000-011	72-A1K	10-18-565-002	72-1A2C	10-18-659-012	-
10-18-000-012	72-A1K	10-18-565-002	72-1A2C	10-18-659-012	-
10-18-000-013	72-A1K	10-18-565-002	72-1A2A	10-18-659-014	Yes
10-18-000-014	72-A1K	10-18-565-002	72-1A2A	10-18-659-014	Yes
10-18-000-015*	72-A1K	10-18-565-002	72-1A2A	10-18-659-008	-
10-18-000-016"	72-A1K	10-18-565-002	72-1A2A	10-18-659-008	-

\*Inactive Lists

## \*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	a
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 11-87A 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  
A4867 AE  
A4867DD  
A4867HA  
A4867VV  
A4867 HB

A4867HS  
A4867DW  
A4867HN  
1 0-04-420-052  
1 0-95-4 1 0-002  
  
10-13-410-001  
10-13-410-002  
13-08-4 1 0-001

"72C" Forward Clutch Pack Kit  
"71C" Forward Clutch Pack Kit  
Output Shaft Bushing Kit  
Oil Seal & Sealing Ring Kit  
Case Bushing Kit  
Gasket, Oil Seal & Sealing Ring  
Kit for "73C"  
Pilot Light Kit  
Small Parts Kit for "73C"  
Drive Gear Alarm Kit  
Neutral Switch Kit  
Snap Ring Kit for All 70C, 72C,  
& 72C Units  
Gasket & Seal Kit for All CR2 Units  
Small Parts Kit for CR2 Units  
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.

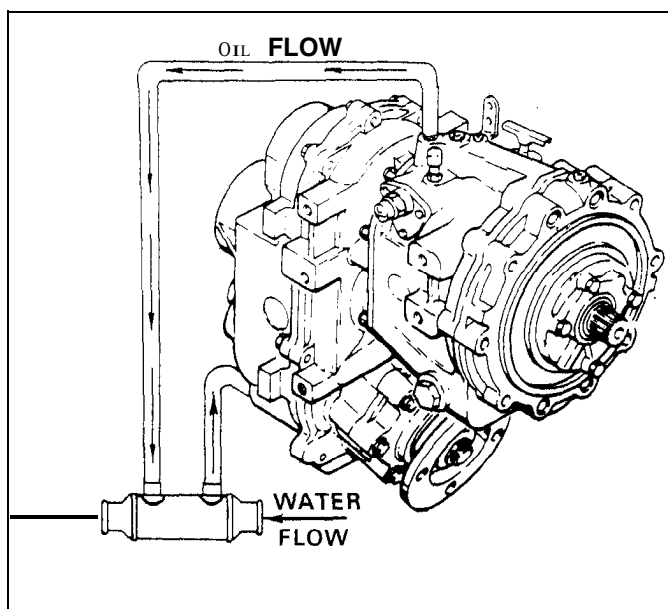
# Installation & Service Bulletin

Original Issue 7/15/86

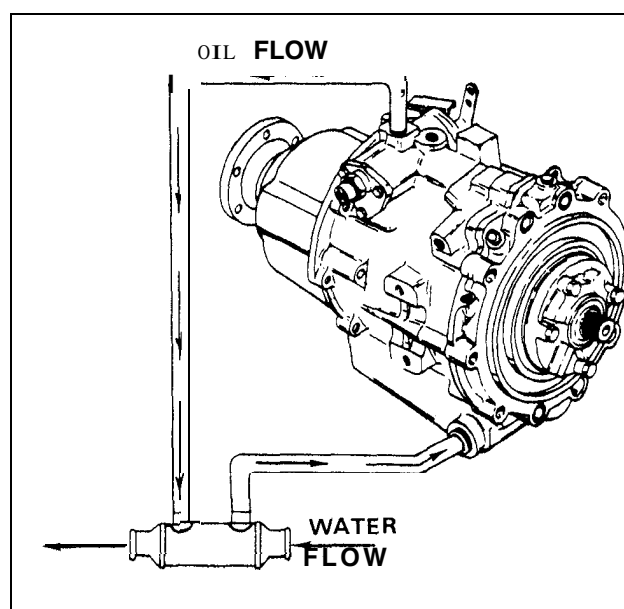


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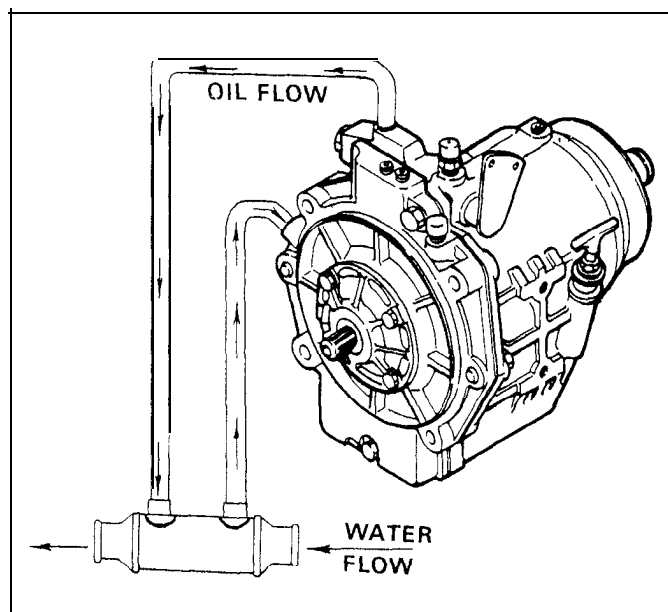
**SUBJECT:** Cooler installation on current Borg-Warner Velvet Drive marine transmissions.



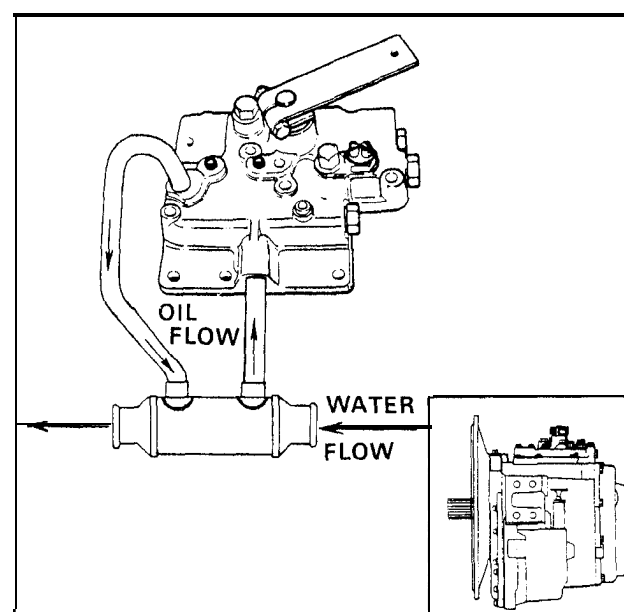
Cooler circuit for 1 O-04 and 1 O-05 "V-Drive" units.



Cooler circuit for 1 O-06 (73C) units.



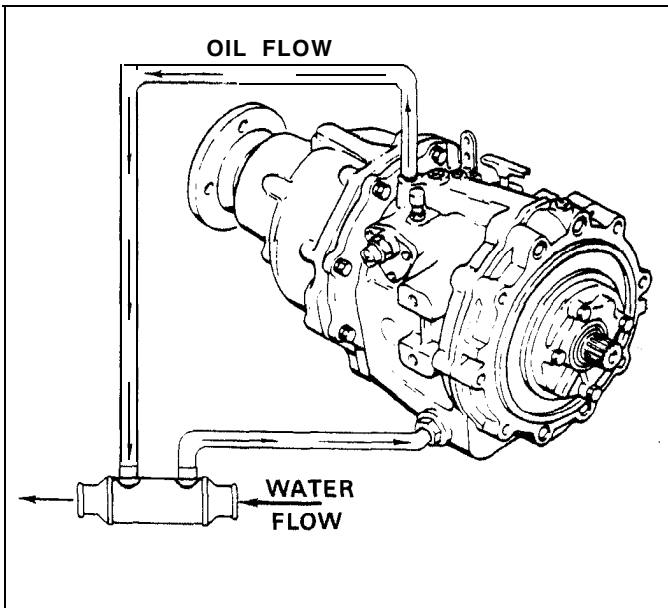
Cooler circuits for 1 O-23 (series 1500) units.



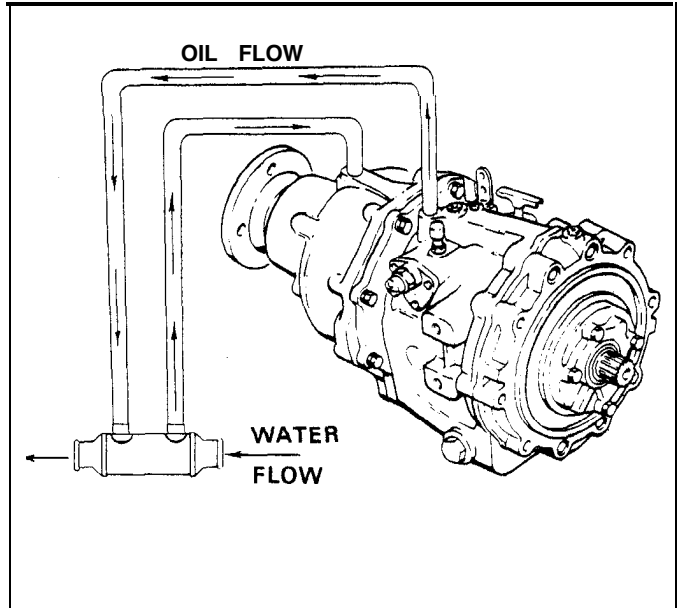
Cooler circuit for 10-26 (series 7000) units.

(SEE OTHER SIDE)

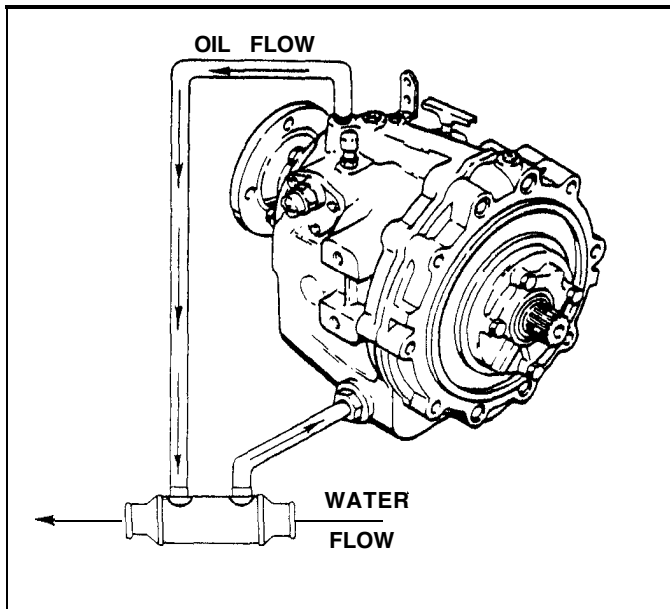




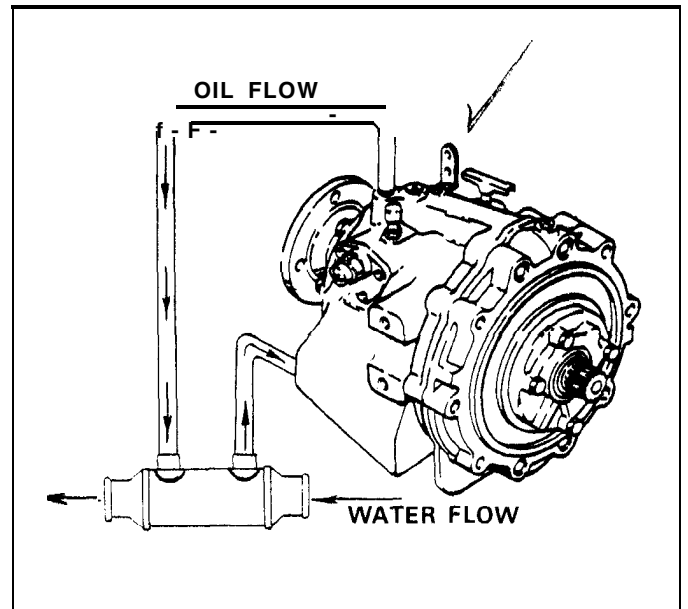
Cooler circuit for 1 O-I 3 and 1 O-I 4 drop-center units and 1 O-I 7 and 1 O-I 8 reduction units EXCEPT 2.10:1 ratio.



Cooler circuit for 1 O-I 7 and 1 O-I 8 reduction units 2.10:1 ratio.



Cooler circuit for 1 O-I 7 and 1 O-I 8 direct-drive units EXCEPT 10-I 7-000-001, -002, -003, and -004 models.



Cooler circuit for 1 O-I 7-000-001, -002, -003, and -004 models.

# Installation & Service Bulletin

July 1, 1982



## **SUBJECT: Lubrication Recommendations**

This bulletin updates our recommendations for the oils recommended for use in all Velvet Drive® marine gears.

Dexron® II, Type F, and other hydraulic transmission fluids which meet the Detroit Diesel Allison Type C3 specifications are recommended for use in all Velvet Drive® marine transmissions.

Lubricating oils which are recommended for use in diesel engines and also meet the Detroit Allison Type C3 specifications may be used if the engine speed does not exceed 3000 RPM. SAE #30 is preferred. SAE #40 is acceptable if high operating temperatures are to be encountered. Multiviscosity oils such as 10W-40 are not acceptable. The first choice is an oil which falls in the SAE-API service Class "CD." The second choice would be an oil which falls in the SAE-API service Class "CC."

The equivalent DOD mil specs are:

"CD"	Mil-L-2104B
"CC"	Mil-L-451 99

The new C3 specifications were developed by Detroit Diesel Allison Division of General Motors to outline the requirements of an oil suitable for use in their heavy duty hydraulic automatic and powershift transmissions. The oil companies should be able to provide information as to the suitability of their product for use in a given application.



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# Installation & Service Bulletin

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## SUBJECT: Proper Oil Level in Velvet Drive Marine Transmissions

Due to various installation angles and oil cooler set-ups, it may be necessary to adjust the oil level in your Velvet Drive marine transmission. The following procedure is recommended to achieve the correct oil level.



**WARNING:** Do not remove transmission dipstick with engine running. Hot oil can cause burns.



**CAUTION:** Clean around the area of the dipstick before removing. Small particles of dirt can cause damage to internal components and cause valves to stick.

### Warm Oil Level Check

The transmission should be at operating temperature (190°F maximum) to get an accurate oil level reading. Oil will expand when it is heated, Oil will drain back from the cooler and cooler lines. Expansion and drainback can significantly affect oil level.

When the transmission is at operating temperature, place selector lever in neutral. Shut off engine. Carefully remove transmission dipstick. Immediately insert clean dipstick and read oil level.

**NOTE:** Oil level must be checked immediately after engine shutdown to prevent an incorrect reading. Oil drains back into transmission from the cooler and cooler lines.

Add or remove oil if necessary, Repeat the above checking procedure as required until oil is at the dipstick mark.

### Cold Oil Level Check

For ease of checking the oil level prior to engine start-up, a cold oil level mark can be made. To find the cold oil level mark, the oil level must first be set according to the warm oil level checking procedure. Then, let the boat sit overnight. Insert clean dipstick and read oil level, Put a mark on the dipstick at the cold oil level reading.

You can use the new mark to check the oil level when cold. If oil level adjustment is needed, add oil to the new mark.

### Type of Oil

Dexron II, Type F, or any hydraulic fluid which meets the C-3 oil specification is acceptable. Do not mix different brands or types of oil. If engine doesn't exceed 3000 R.P.M., a premium grade 30 weight engine oil is acceptable. 40 weight and multi-viscosity oils are not recommended.

If the transmission oil temperature has exceeded 190°F, the oil must be **changed** in the transmission and oil cooler system. If the transmission alarm sounds, the oil must be **changed** also.

Any changes or modifications to the transmission cooling system will require that the oil level be readjusted.

Any additions to the boat which will change the installation angle of the transmission at rest (such as extra fresh water tanks, fuel supply etc.) will require an oil level adjustment.

