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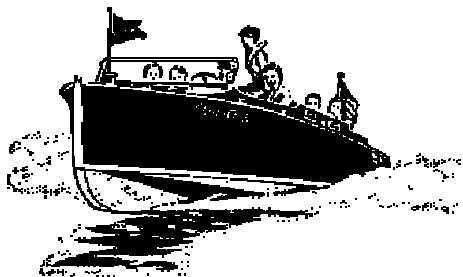
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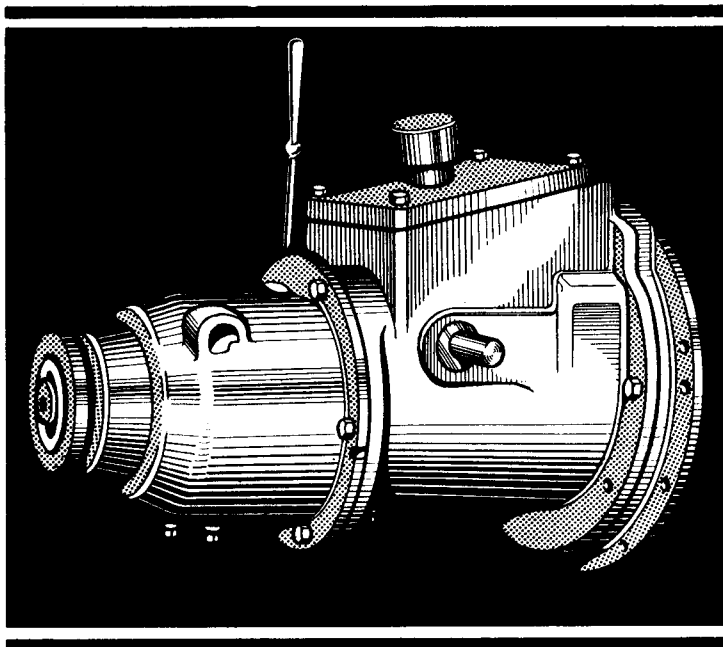
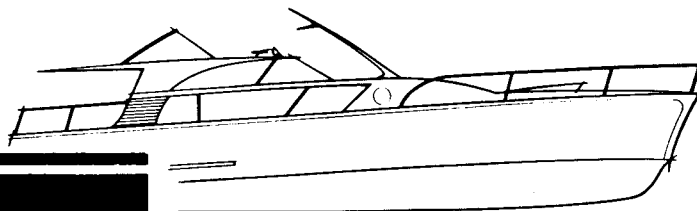
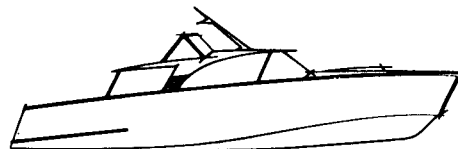
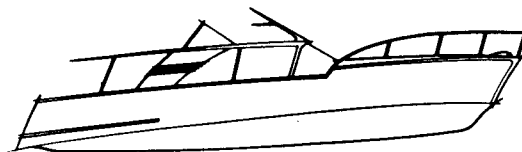
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SERVICE MANUAL

FOR
MANUAL
REVERSE GEARS

K-M Series
Engines



MODELS OXKB — 1XE — 2XE —
25XE — 3XE — 35XE — 4XE3

Paragon[®]
REVERSE & REDUCTION GEARS

PARAGON GEAR WORKS INC., TAUNTON, MASS., U.S.A.

Price \$1.25

FOREWORD

This service manual covers the OXKB, 1XE, 2XE, 25XE, 3XE, 35XE and 4XE3 manual reverse gears. Because of the similarity of these units, this manual is based upon the 2XE size reverse gear with notes to cover any special cases. This manual covers only the reverse gear portion of a transmission since the reduction gear portion is covered in a separate service manual. However, coverage is extended through the reduction adapting material as well as covering the direct drive models.

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PARAGON MANUALLY OPERATED REVERSE GEARS MODELS OXKB-1XE-2XE-3XE-35XE-4XE3

Description

The Paragon manually operated reverse gear units consist of a multiple disc clutch and a planetary reverse gear train. Some units are self contained and are independent of the engine lubrication system. These units are called "separately enclosed" units. Other units rely upon the engine lubricating oil for lubrication and are referred to as "common lubricated" units.

Operation

On the forward drive, the reverse gear case and multiple disc clutch are locked together as a solid coupling. The multiple disc clutch is locked or clamped by the pressure produced when the shift lever is moved to the forward position. Thus the propeller shaft turns in the same direction as the engine.

The reverse drive is obtained by clamping the reverse band around the reverse gear case which contains the planetary reverse gear train. The reverse band is clamped when the shift lever is moved to the reverse position. The reverse motion is then obtained by driving through the gears thus turning the propeller shaft opposite to the engine rotation.

With the shift lever in the neutral position the multiple disc clutch and the reverse band are unclamped and the planet gears run idle and the propeller shaft remains stationary.

It is desirable to start the engine with the transmission in neutral, thus avoiding moving the boat in either direction.

It is recommended that the shifting be done at speeds below 1000 RPM and preferably in the 800 RPM range or lower to prolong the life of the engine, transmission and of the boat.

Lubrication

On those units which are separately enclosed, it is recommended that SAE 30 oil be used for lubrication. The common lubricated models rely upon the engine oil for lubrication.

For the separately enclosed units, the quantity of oil depends upon the angle of installation as well as the reduction model. The level should be maintained at the high mark on the dipstick or the housing should be approximately half full on those models without a dipstick. The level should be checked periodically to ensure proper operation.

The engine manufacturer's recommendation should be checked for the common lubricated models as to type and quantity of oil.

The number of hours that can be run between oil changes varies with the operating conditions. Under normal conditions, the oil should be changed every 100 hours or each season, whichever is shorter.

Model and Serial Numbers and Part Numbers

The model numbers and serial numbers are on the name plate on the cover of the transmission. This information is also duplicated on the periphery of the gear case located at the forward end. Always refer to these numbers when ordering parts for a particular transmission.

The parts lists accompanying the exploded views are intended only to identify the parts in regards to disassembly and assembly and are not intended to be used to identify parts by number. To order parts, refer to the part numbers and names as given in the above mentioned parts lists, the page number and figure number referred to and which service manual found in. Example: Key No. 12 - Gear Case Roller Bearing Race - Fig. No. 1. Manual Gear Service Manual. Model 2XE-90 - Serial No. 4J-1234.

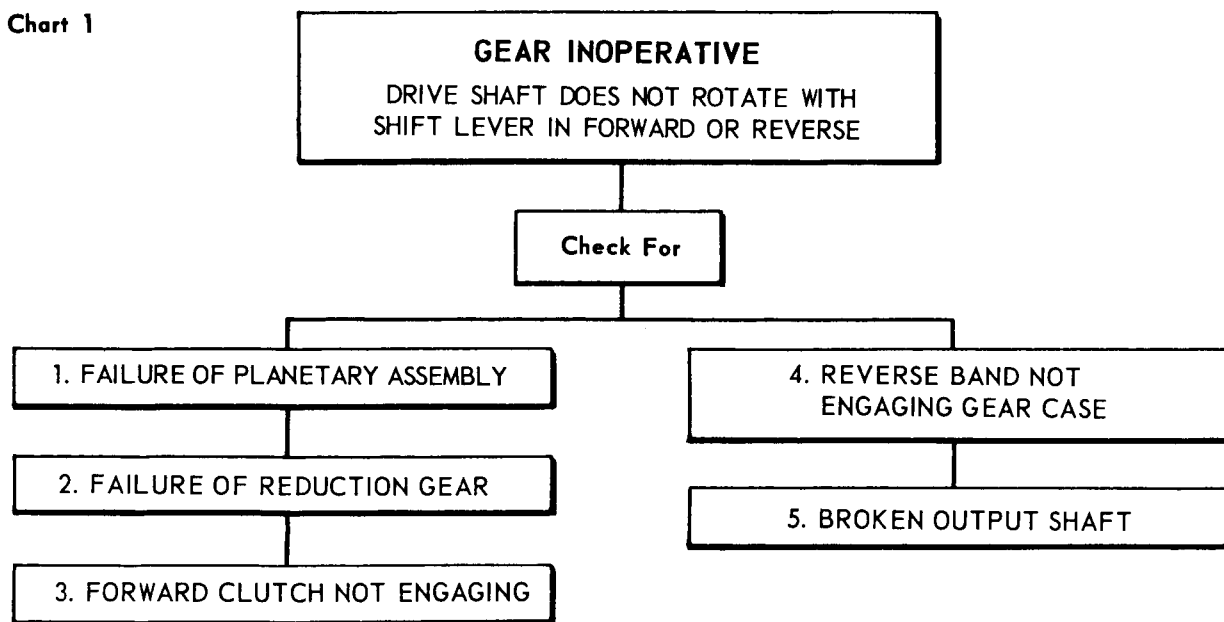
TROUBLE SHOOTING

The trouble shooting charts below and on the next page should be studied and the suggestions carried out prior to any disassembly to determine as best as possible what the trouble may be. Also, the exploded views and the accompanying discussions should be carefully read and understood so that any or all of the service work as indicated from the trouble shooting charts may be carried out properly.

ALWAYS GIVE MODEL NUMBER AND SERIAL NUMBER OF TRANSMISSION WHEN ORDERING PARTS.

TROUBLE SHOOTING CHART

Chart 1

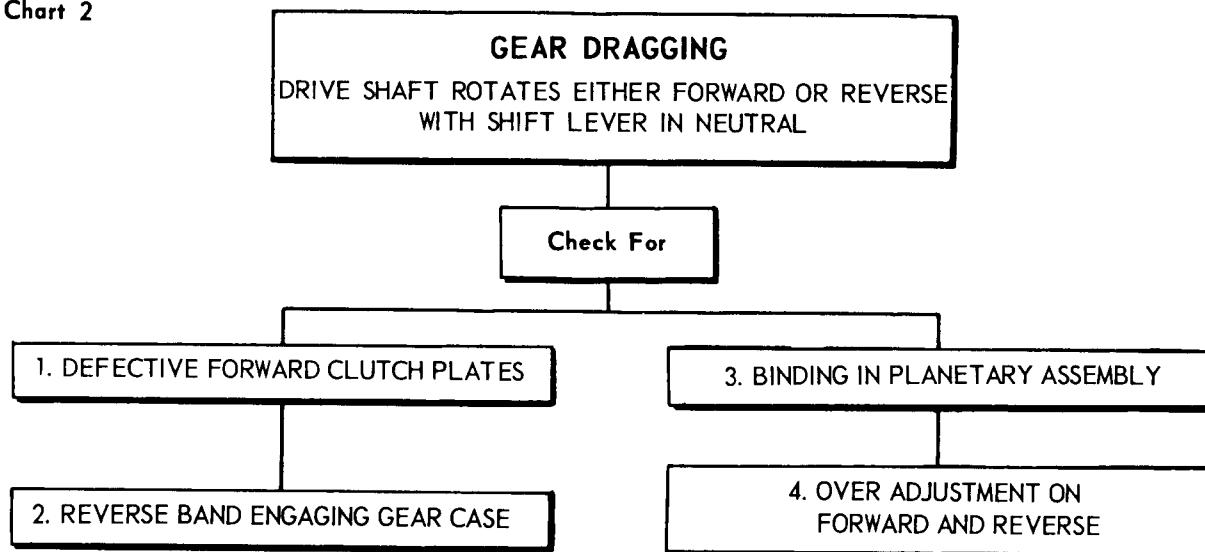


REMEDY

1. Remove gear case assembly and check for defective or damaged parts. Replace defective or damaged parts.
2. Remove reduction gear assembly and check for defective or damaged parts. Replace defective or damaged parts. Refer to reduction gear service manual.
3. Check the following items:
 - a. Improper forward clutch adjustment. Adjust forward clutch as outlined under adjustment.
 - b. Forward clutch plates worn. Replace clutch plate.
4. Check the following items:
 - a. Improper reverse band adjustments. Adjust reverse band as outlined under adjustment.
 - b. Reverse band lining worn. Replace lining.
 - c. Cracked ears or bent or damaged linkage parts. Replace defective material.
5. Check for broken output shaft. Replace defective shaft.

TROUBLE SHOOTING CHARTS

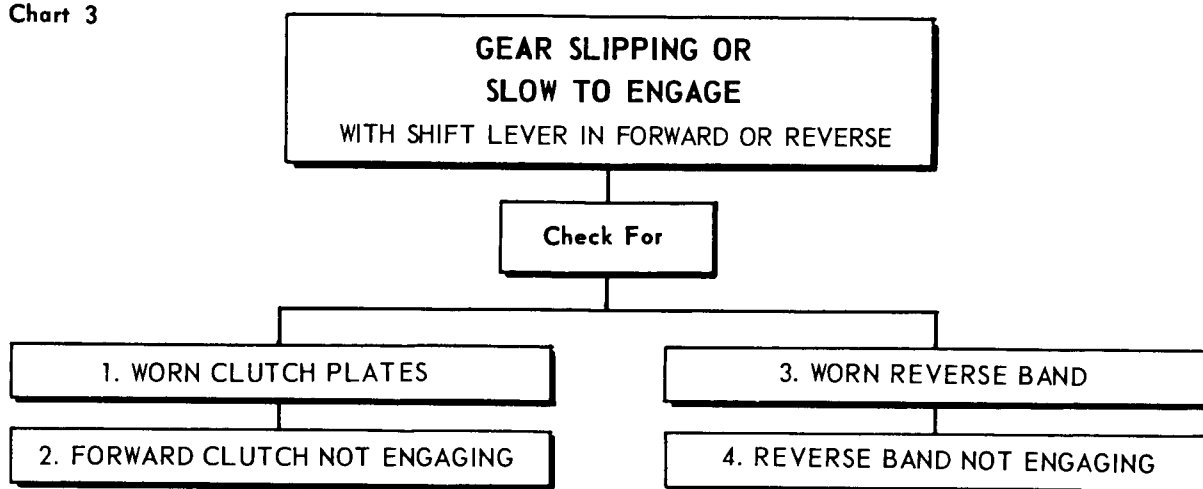
Chart 2



REMEDY

- | | |
|--|--|
| <p>1. Forward clutch plate warped and sticking. Remove and replace clutch plates.</p> <p>2. Improper reverse band adjustment. Adjust reverse band as outlined under adjustment.</p> <p>3. Check the following items:</p> <p style="margin-left: 20px;">a. Bearings and gears worn excessively in gear case. Replace necessary parts.</p> | <p style="margin-left: 20px;">b. Engine gear bearings worn excessively, causing misalignment of engine shaft. Replace necessary parts. Check misalignment of engine gear.</p> <p>4. Over-adjustment of either forward and reverse or both will result in loss of neutral. Check and readjust as outlined under adjustment.</p> |
|--|--|

Chart 3



REMEDY

- | | |
|--|---|
| <p>1. Remove forward clutch plates and check for wear. Replace if worn excessively.</p> <p>2. Improper forward clutch adjustment. Adjust as outlined under adjustment.</p> | <p>3. Remove reverse band and check for wear. Replace lining if worn below rivets.</p> <p>4. Improper reverse band adjustment. Adjust as outlined under adjustment.</p> |
|--|---|

DISASSEMBLY OF TRANSMISSION

This manual is intended to serve as a guide in servicing the OXKB, 1XE, 2XE, 25XE, 3XE, 35XE and 4XE3 transmissions since these units are similar in most details except for size. The procedure for disassembly and assembly covers the 2XE size transmission with notes covering special adaptations and other details that may vary with the different models.

As in any servicing operation, cleanliness is a must and all rules for good workmanship apply. Some of these rules are as follows:

1. Use only clean fluid in any cleaning or washing of parts.
2. Use only clean oil for lubrication when pressing parts together.
3. Never use a hammer to drive ball bearings in place.
4. Never press a ball bearing so that the force is carried through the balls.
5. Use only properly sized wrenches in removing or securing nuts and capscrews.
6. Replace gaskets and "O" rings with new material.
7. Work on a clean bench and protect gear teeth and oil seal surfaces from nicks and scratches.

Before removing the transmission from the engine all of the shifting links and water lines should be disconnected. On the enclosed units, the oil should be drained from the reverse gear and reduction gear. And on the common lubricated models, the oil in the engine must be drained or lowered to allow the transmission to be removed without spilling the oil. The propeller half coupling should be disconnected and slid back approximately 4 inches.

DISASSEMBLY NEED BE CARRIED OUT ONLY AS FAR AS IS NECESSARY TO CORRECT THOSE DIFFICULTIES WHICH INTERFERE WITH PROPER MARINE GEAR OPERATION.

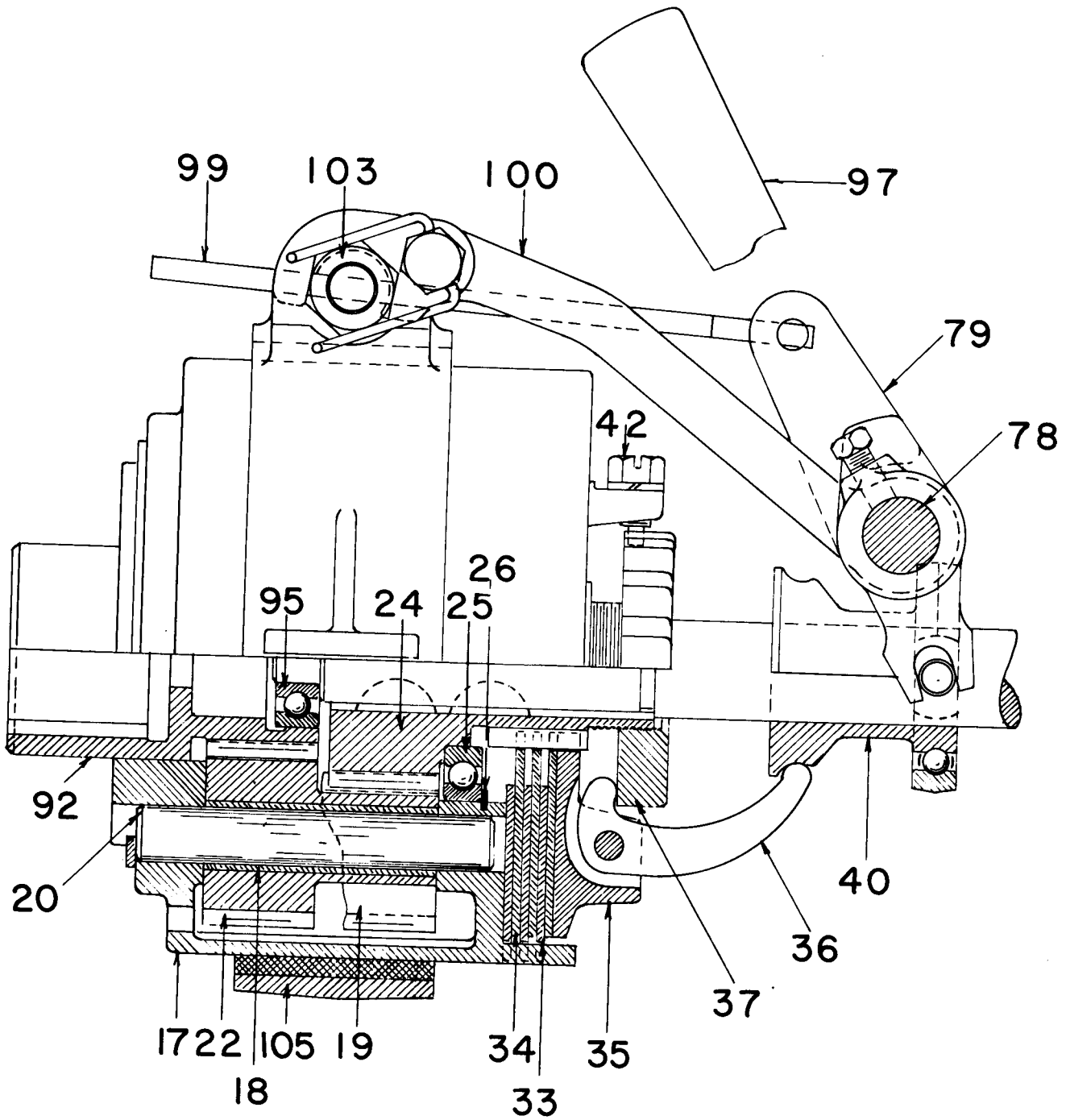
REMOVAL OF TRANSMISSION FROM ENGINE

Many of the Paragon manual transmissions are assembled into housings manufactured by the engine builders. These housings vary in some respects. Therefore, the instructions for disassembly and assembly are general and are intended to serve only as a guide in servicing these transmissions.

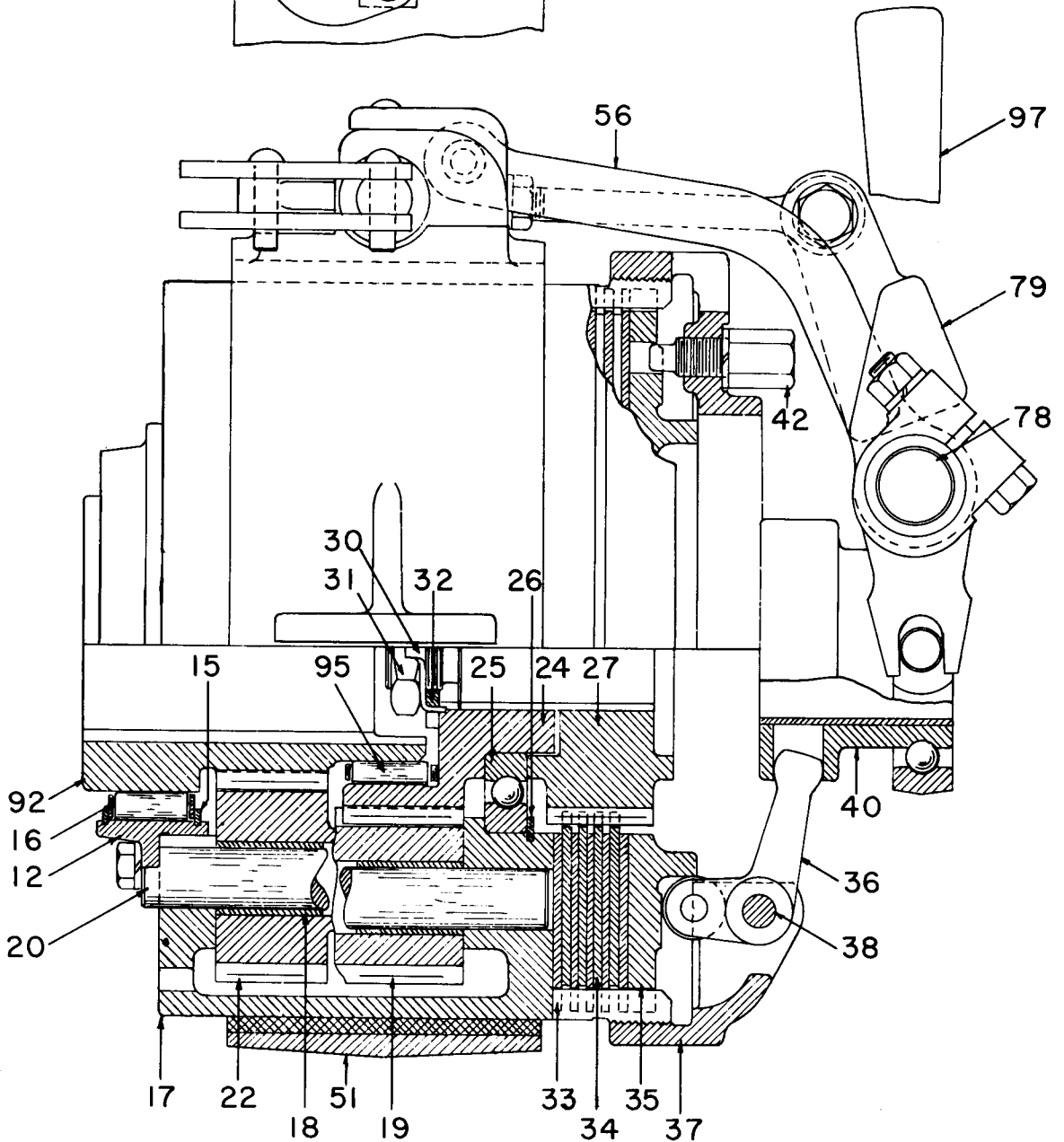
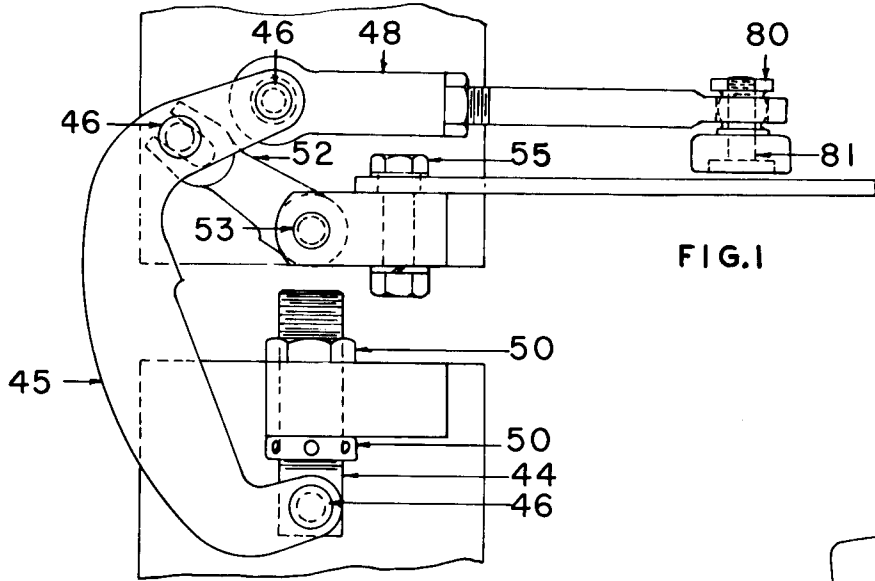
REMOVAL OF REDUCTION GEAR ASSEMBLY FROM REVERSE GEAR HOUSING

NOTE: To facilitate removal of the transmission from the engine, it is simpler to remove the reduction gear assembly first. Make certain that all of the oil is removed from the reverse and reduction unit before removal is attempted.

OXKB YOKE GEAR

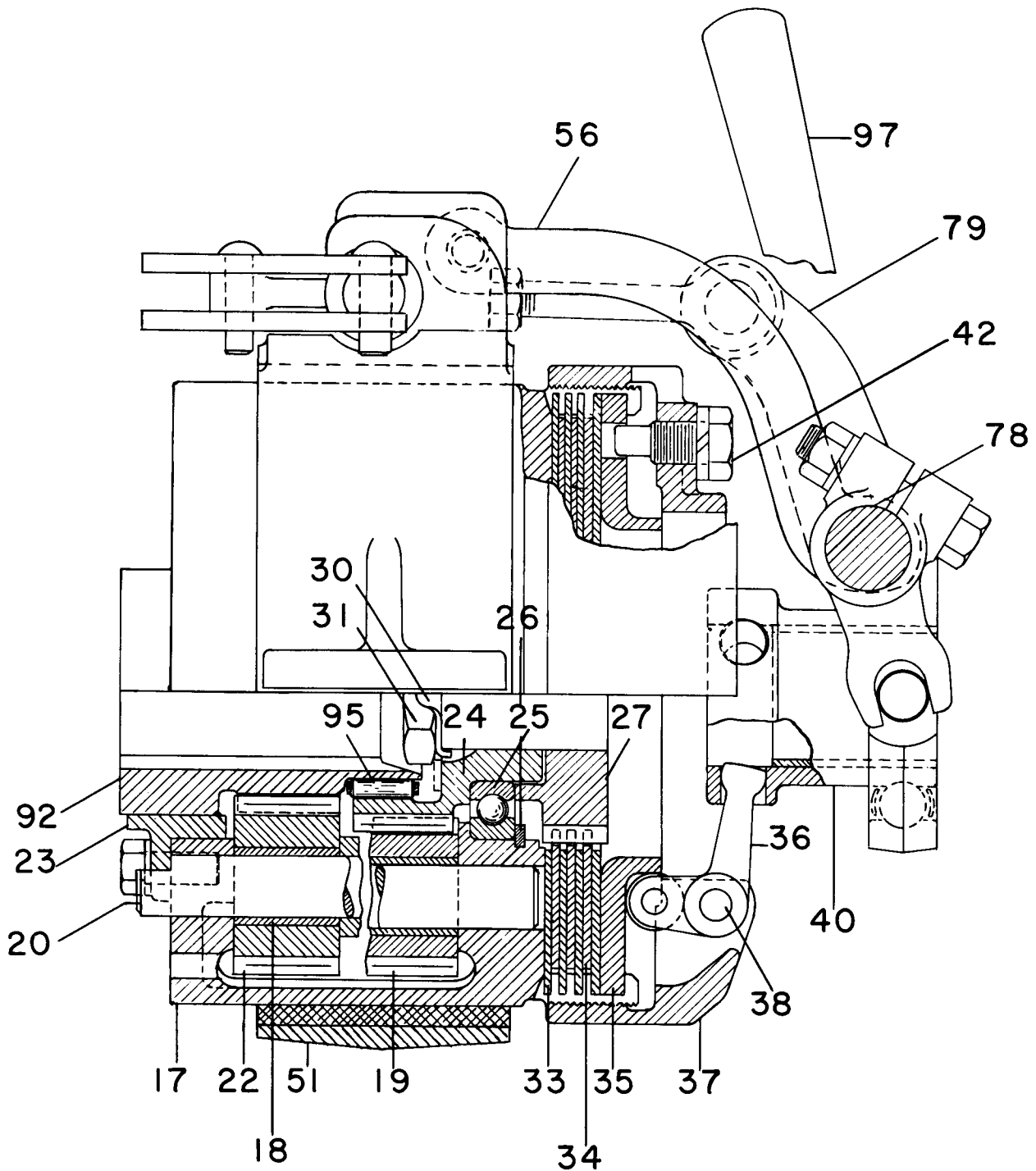


1XE - 2XE YOKE GEAR



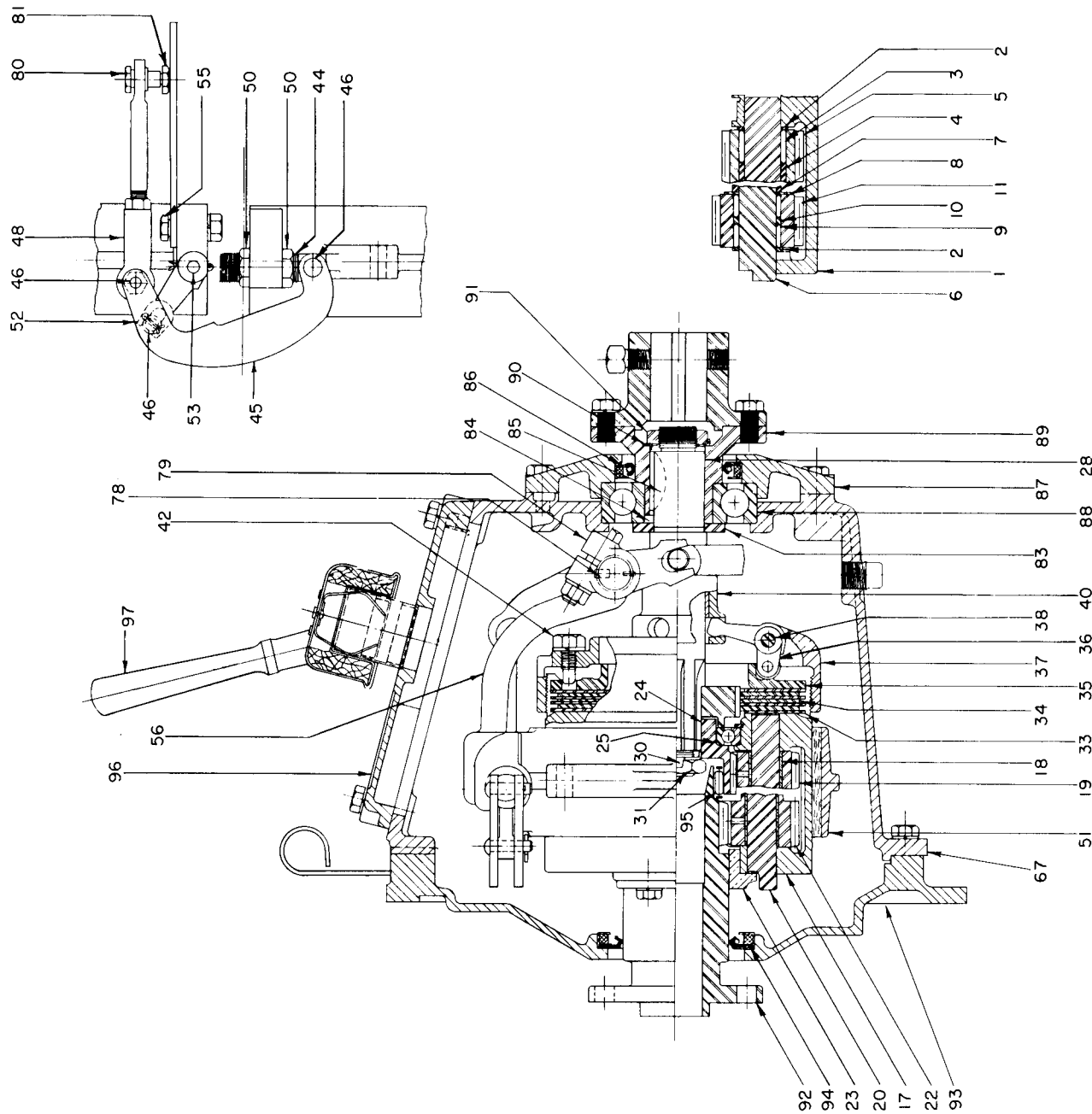
3XE - 4XE3 YOKE GEAR

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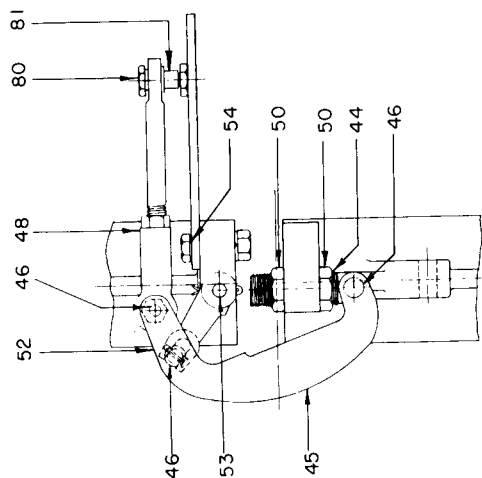


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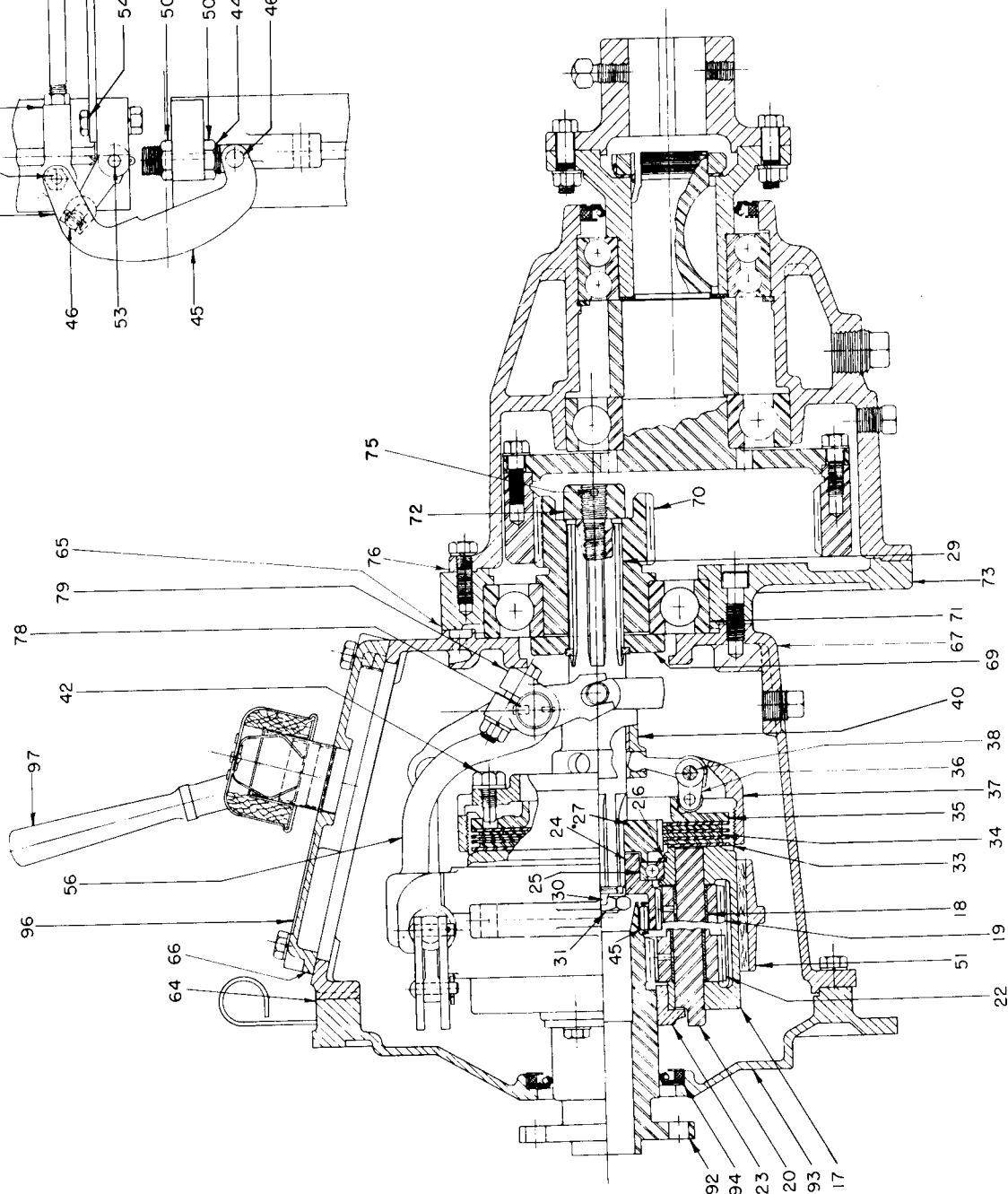
FM2/FM3 SEPARATELY ENCLOSED GEARS



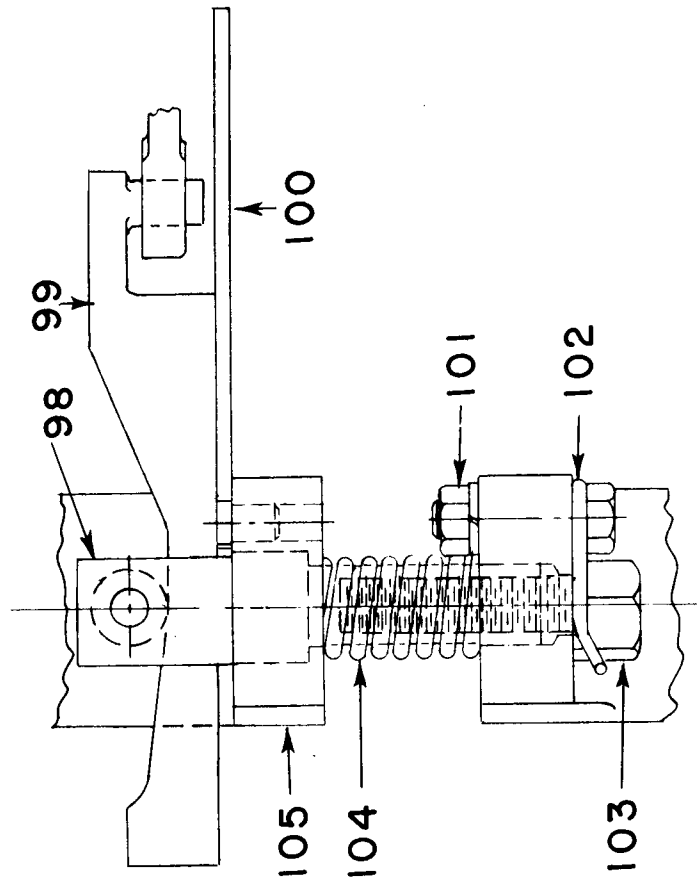
FM2/FM3 WITH REDUCTION



NOTE: REFER TO REDUCTION
GEAR SERVICE MANUAL FOR
SERVICE INFORMATION



REVERSE BAND ASSEMBLY - CAM OPERATED



OPEN THIS FOLDOUT FOR ASSEMBLY VIEWS

1. Remove capscrews and lockwashers around flange of reduction gear housing.
2. Strike gear half coupling flange with soft mallet to break reduction gear unit from reduction adapter plate. Slide entire reduction unit straight back approximately 3 inches until reduction unit clears reduction drive gear and lift reduction unit clear of reverse gear housing assembly.

NOTE: Refer to reduction gear service manual for disassembly and assembly of reduction unit.

REMOVAL OF REVERSE GEAR HOUSING ASSEMBLY FROM ENGINE

1. Remove capscrews and lockwashers from flange of cover (96) and remove cover.
2. Remove capscrews and lockwashers that secure reverse gear housing (67) to front end plate (93) or timing gear cover.
3. Slide entire reverse gear housing straight back approximately 3 inches until housing is clear of engine gear (92) and lift reverse gear housing assembly clear of engine.

NOTE: Most transmissions are light enough to handle without supporting by chain fall. However, the 4XE3-90 transmission should be supported by a properly rigged chain fall.

4. Remove pilot roller bearing (95) from engine gear (92) if it remains on engine gear.
5. Remove front end plate (93) from engine on flywheel end on separately enclosed models.

6. Remove engine gear (92) from engine, following engine manufacturer's recommendation, only if necessary to replace.

7. If necessary to replace, remove oil seal (94) from front end plate on separately enclosed models.

REMOVAL OF GEAR CASE ASSEMBLY FROM REVERSE GEAR HOUSING

REDUCTION MODEL

1. Remove screw (81) from arm of yoke (79) and remove ball joint (80) and lockwasher (82) from eye of link on reverse band assembly.
2. Loosen capscrews in yoke and remove cross shafts (78) from sides of housing being careful not to damage oil seals (68) in housing.
3. Remove yoke (79) from operating sleeve assembly (40) through cover opening in housing.
4. Remove reverse band assembly from gear case assembly from front of housing.

NOTE: On reverse bands using the drag link, it will be necessary to remove the pins that anchor the reverse band to the housing before removing reverse band from housing.

5. Remove cotter pin (75) from reverse gear tailshaft and remove reverse gear tailshaft nut (72).
6. Support reverse gear housing face down so that gear case may drop free approximately 2 inches.
7. Press on reverse gear tailshaft until

tailshaft is free of reduction drive gear (70).

8. Lift reverse gear housing straight up until housing clears tailshaft.
9. Remove capscrews and lockwashers from crescent (74) and remove crescent.

NOTE: Crescent is not required on common lubricated models and is used on only some of the separately enclosed models.

10. Remove capscrews that secure reduction adapter plate (73) to reverse gear housing and remove reduction adapter plate, ball bearing (71) and reduction drive gear (70) from reverse gear housing.
11. Press ball bearing (71) and reduction drive gear (70) from reduction adapter plate (73) and press ball bearing from reduction drive gear.

NOTE: When disassembling direct drive units, use the following procedure.

12. Bend tang of lockwasher (90) away from locknut (91) and remove from reverse gear tailshaft by holding gear half coupling (89) with spanner wrench.
13. Support reverse gear housing face down so that gear case may drop free approximately 2 inches.
14. Press on reverse gear tailshaft until tailshaft is free of gear half coupling. Lift reverse gear housing straight up from gear case assembly until housing clears tailshaft.
15. Remove capscrews and lockwashers that secure direct drive plate (87) to

reverse gear housing (67) and remove direct drive plate (87), ball bearing (88) and gear half coupling (89) from reverse gear housing (67).

16. Press gear half coupling (89) from ball bearing (88) and press ball bearing from direct drive plate (87).
17. If necessary to replace, remove oil seal (86) from direct drive plate (87).

DISASSEMBLY OF THE REVERSE BAND - TOGGLE OPERATED TYPE

1. Remove screw (55), nut (58) and lockwasher (57) that secures brace (56) to ear of reverse band (51).
2. Remove cotter pin (54) from ear of reverse band and remove pin (53) that holds short lever (52) in forked ear of reverse band. Remove short lever.
3. Remove locknut (50) from adjusting screw (44) and remove adjusting screw and assembled levers from reverse band.
4. Remove adjusting nut (50) from adjusting screw.
5. Remove cotter pins (47) from ends of pins in assembled levers and disassemble link (48), adjusting bolt (44) and pins (46).

CAUTION: Do not disassemble link (48) or (61) or disturb setting of jam nut.

6. If necessary to re-line reverse band, remove rivets holding reverse band lining to reverse band.

DISASSEMBLY OF THE REVERSE BAND- TOGGLE OPERATED TYPE - (25XE-90)

1. Remove screw (55), nut (58) and lock-

washer (57) that secures brace (63) to ear of reverse band (62).

2. Remove cotter pin (54) from ear of reverse band and remove pin (53) that holds short lever (52) in forked ear of reverse band. Remove short lever.
3. Remove locknut (50) from adjusting screw (44) and remove adjusting screw and assembled levers from reverse band.
4. Remove adjusting nut (50) from adjusting screw.
5. Remove cotter pins (47) from ends of pins in assembled levers and disassemble link (61), adjusting bolt (44) and pins (46) and (60).
6. If necessary to re-line, remove rivets holding reverse band lining to reverse band.

DISASSEMBLY OF GEAR CASE

1. Remove thrust washer (69) from end of reverse gear tailshaft on reduction units and Woodruff key (85), seal washer (84) and thrust washer (83) from end of tailshaft on direct drive units.

NOTE: On 2XE and 25XE reduction tailshafts, retaining ring (43) must be removed.

2. Remove lockscrew (42) and lockwasher (41) from screw collar (37) and remove screw collar from gear case by unscrewing. Lift operating sleeve assembly (40) from tailshaft when removing screw collar.
3. If finger assembly (36) seems loose or worn, remove from screw collar (37) by removing cotter pins (39) and finger pins (38).

4. Lift pressure plate (35) and clutch plates (34) and (33) from end of gear case.
5. Bend tang of lockwasher (30) away from sides of locknut (31) inside propeller gear (24) and remove locknut and lockwasher while clamping reverse gear tailshaft.
6. Properly support gear case on clutch plate carrier (27) and press tailshaft (29) or (28) from propeller gear (24) and clutch plate carrier (27). Lift clutch plate carrier from gear case.
7. Remove case ball bearing retaining ring (26) from groove in gear case.

NOTE: On models 3XE, 35XE and 4XE3 the propeller gear can be removed from the gear case at this time.

8. Remove capscrews (14) and lockwashers (13) from case roller bearing race (12) or case bushing (23).
9. Remove case roller bearing retaining rings (15) from case roller bearing race (12) and remove case roller bearing (16) from race.
10. Before removal of the short or long pinions is attempted, first inspect the gear teeth for indication of wear. Also, rotate each pinion to check for rough spots during rotation. If further inspection or replacement is necessary, proceed with the disassembly. However, do not disassemble unless required.
11. Drive pinion shaft (6) of one of the short pinions (11) from threaded end of gear case approximately 1/2 inch. Push pinion shaft on through with dummy shaft sized according to the following table:

For Roller Bearing Construction Only

	DIAMETER	LENGTH
2XE	.719	2.06
3XE	.832	2.62
35XE	.832	2.62
4XE3	.832	2.62

Push dummy shaft until centered in short pinion (11) and short pinion spacer (7). Remove pinion shaft (6) from front end of gear case. Remove short pinion and dummy shaft from inside of gear case.

12. Remove remaining short pinions from gear case.

NOTE: On models 1XE, 2XE and 25XE, the propeller gear (24) can be pressed from the case ball bearing (25) at this time.

13. Remove long pinions (5) using dummy shaft as in removing short pinions.
14. Remove thrust pads (2) from inside gear case (1).

NOTE: Some models use either bushings or cartridge type needle bearings instead of loose roller bearings under the long and short pinions. These units are easier to disassemble because thrust pads (2) loose roller bearings (3) and (9) and bearing spacers (4) and (10) are not required since the cartridge needle bearings or bushings are pressed into the long and short pinions. However, follow the procedure outlined above for sequence of operations.

INSPECTION

All parts should be thoroughly cleaned

before inspection. Parts showing excessive wear should be replaced.

1. Ball and roller bearings should be examined for indication of corrosion and pitting on balls or rollers and races.
2. Long and short pinion roller bearings or bushings should be examined for wear.
3. Pinion shafts should be examined for wear or "brinelling".
4. Long and short pinion thrust pads, roller spacers and short pinion spacers should be examined for wear.
5. Long and short pinion bore diameters should be examined for wear.
6. All gear teeth should be examined for "pitch line pitting", uneven wear pattern or excessive wear.
7. All shafts should be examined for wear on splines and shoulders.
8. Clutch plates should be examined for flatness roughness, indication of excessive heating and wear or peening of driving lugs.
9. Clutch plate carrier should be examined for wear and peening of lugs and splines.
10. Examine all oil seals for rough or charred lips.
11. Reverse band links, pins, etc. should be examined for wear or bending.
12. Reverse band lining should be examined for wear.

NOTE: Lining should be replaced before rivets come in contact with gear case.

13. Gear case should be examined for wear from reverse band lining, short or long pinions wearing into inside faces or wear in clutch plate slots on threaded end.
14. Screw collar and finger assembly should be examined for wear.
15. Pressure plate should be examined for wear from rollers on finger assembly.
16. All old gaskets should be replaced.
17. Operating sleeve assembly should be examined for wear.
18. Engine gear should be examined for wear on oil seal surfaces, case roller bearing race, pilot bearing race and gear teeth for "pitch line pitting", uneven wear or excessive wear.

NOTE: When uneven gear teeth wear has been noticed, check engine gear for eccentricity. Maximum eccentricity at pilot bearing race is .005 inches.

19. Where special vibration dampers are used as flexible couplings, check springs and splines for wear.

ASSEMBLY OF GEAR CASE

1. If pinion gears (5) and (11), roller bearings (3) and (9), and pinion shafts (6) were removed from gear case (1), assemble as follows:

- (a) Place long pinion (5) on end on thrust pad (2) and insert dummy shaft into pinion.

NOTE: Use same dummy shaft as used in disassembly.

- (b) Insert four roller bearings (3) equally spaced around dummy shaft

to center shaft in gear; then assemble remaining rollers.

NOTE: Smear dummy shaft with cup grease to prevent rollers from dropping out. Install bearing spacer (4) in gear next to first row of rollers. When handling roller filled pinions, keep a thrust pad on each end on pinion to prevent rollers from dropping out.

- (c) Lay gear case (1) on side and insert long pinion (5) in case to align with hole in outer row. Insert thrust pad (2) between pinion and front wall of gear case. Note that each thrust pad aligns with one hole on outer row and one hole on inner row and that the curvature of the thrust pad follows the curvature of the gear case.

- (d) Insert pinion shaft (6), plain end first, into unthreaded end of gear case and push through thrust pad and pinion as far as rear wall of gear case, forcing out the dummy shaft.

- (e) Remove dummy shaft, insert second thrust pad (2) between pinion and rear wall of gear case and start pinion shaft into rear wall of case. Do not drive pinion shaft all the way into gear case until all shafts are inserted.

- (f) Assemble remaining long pinions in gear case.

NOTE: On models 1XE, 2XE and 25XE, the propeller gear (24) must be inserted into the gear case from the front end. This must be done after the long pinions have

been installed and prior to installing the short pinion. On model 1XE insert pilot roller bearing (95) before installing short pinions.

(g) Using dummy shaft, insert short rollers (9) into short pinion (11) in same manner covered in paragraph (a) and (b) above. With short pinion, use pinion spacer (7) with thrust-washer (8) between spacer and pinion. Also, use bearing spacer (10) between paths of short rollers (9).

(h) Insert short pinion (11) into gear case, pinion toward front of case, to line up with hole in inner row and insert pinion shaft (6) as described in (d) above.

(i) Assemble remaining short pinions in gear case.

NOTE: Some models use either bushings or cartridge type needle bearings instead of loose roller bearings under the long and short pinions. These units are easier to assemble because thrust pads (2), loose roller bearings (3) and (9) and bearing spacers (4) and (10) are not required since the cartridge needle bearings or bushings are pressed into the long and short pinion. However, follow the assembly procedure outlined above for sequence of operations.

2. Assemble case roller bearing race (12) to gear case with edges of race in line with flats on pinion shafts. Replace lockwashers (13) and capscrews (14).

NOTE: Some models use case bushing (23) instead of case roller bearing (16).

3. Assemble retaining rings (15) and case roller bearing (16) into case roller bearing race.

4. Insert propeller gear (24) through rear of gear case in mesh with long pinions.

NOTE: On models 1XE, 2XE and 25XE, the propeller gear must be inserted into the gear case from the front end. This must be done after the long pinions have been installed and prior to installing the short pinions.

On model 4XE3 the pilot roller bearing (95) must be installed into the propeller gear before the propeller gear is installed into the gear case.

5. Press case ball bearing (25) into gear case and onto propeller gear by supporting entire assembly on propeller gear inside front end of gear case. Make certain that case ball bearing is seated properly on propeller gear and into gear case. Install case ball bearing retaining ring (26) in groove in gear case next to case ball bearing.

6. Press clutch plate carrier (27) onto reverse gear tailshaft (28) or (29).

7. Align splines on reverse gear tailshaft and press tailshaft through propeller gear until propeller gear is seated against the clutch plate carrier already on tailshaft. Support the entire assembly on propeller gear inside front end of gear case during pressing operation.

8. Place lockwasher (30) over end of tailshaft inside propeller gear with tang engaged in hole in propeller gear and install locknut (31) over end of shaft.

NOTE: On 3XE, 35XE and 4XE3 install propeller gear washer (32) over end of

tailshaft before installing lockwasher (30).

9. Clamp portion of reverse gear tailshaft extending out of gear case and tighten locknut (31).
10. Bend tang of lockwasher (30) up against flat side of locknut (31).
11. Install clutch plates in clutch plate cavity in rear of gear case starting first with bronze clutch plate (33) and alternating steel clutch plate (34) and bronze clutch plate.

12. Install pressure plate (35) on top of last bronze clutch plate in clutch plate cavity.

NOTE: Make certain that all plates ride freely and that no binding is apparent during assembly.

13. Assemble finger assembly (36) to screw collar (37) using finger pin (38) and securing with cotter pin (39).
14. Thread screw collar onto gear case assembly approximately half of the thread length.
15. Place operating sleeve assembly (40) onto tailshaft. Position ball ends of finger assembly into holes in operating sleeve assembly.
16. Continue screwing screw collar onto gear case until finger assembly will snap over center and lock into position against the shoulder on the pressure plate.
17. Push operating sleeve assembly forward until finger assemblies are free.
18. Place lockwasher (41) over end of lock-screw (42) and thread lock screw into

one hole near edge of screw collar. Rotate screw collar until dog on end of lock screw lines up with closest hole in pressure plate.

19. Tighten lock screw making certain that dog on end of lock screw enters hole in pressure plate.
20. On 2XE and 25XE reduction tailshafts, install retaining ring (43) on reverse gear tailshaft making certain that retaining ring is seated properly in groove in reverse gear tailshaft.

CAUTION: The forward clutch is not properly adjusted at the end of this assembly. Proper adjustment is made after installation in boat is complete. Follow instructions as outlined under section on adjustments.

REVERSE BAND ASSEMBLY - TOGGLE OPERATED TYPE

1. If reverse band is to be re-lined, drill holes in new lining using holes in reverse band as guide. Countersink holes inside lining to half the thickness of the lining. Clinch rivets over, being careful not to crack or split new lining.
2. Place flattened end of adjusting bolt (44) between ends with one hole of long levers (45). Line up holes and install pin (46) securing with cotter pin (47). Make certain that heads of pins (46) are assembled at top of assembly.
3. Place flattened end of link (48) between ends with two holes of long levers (45), using the last hole. Install ball joint (49) in end of link (48) before placing between long levers. Line up holes and install pin (46) securing with cotter pin (47).

4. Install pin (46) in remaining hole in long levers (45) and secure with cotter pin (47).
5. Thread adjusting nut (50) on adjusting bolt (44) to end of thread.
6. Install adjusting bolt (44) into ear with large hole in reverse band (51) and thread on locknut (50) making finger tight.
7. Place short lever (52) in opening in forked ear of reverse band (51). Line up holes and install pin (53) until cotter pin hole on side of ear lines up with hole in pin (53). Install cotter pin (54) and secure.
8. Install screw (55) in small end of brace (56) and install screw (55) into hole in forked ear of reverse band (51) and secure with lockwasher (57) and nut (58).

REVERSE BAND ASSEMBLY - TOGGLE OPERATED TYPE (25XE-90)

1. If reverse band is to be re-lined, drill holes in new lining using holes in reverse band as guide. Countersink holes inside lining to half the thickness of the lining. Clinch rivets over, being careful not to crack or split new lining.
2. Place flattened end of adjusting bolt (44) between ends with one hole of long levers (59). Line up holes and install pin (46) securing with cotter pin (47). Make certain that heads of pins (46) are assembled at top of assembly.
3. Place flattened end of link (61) between ends with two holes of long levers (59), using the last hole. Install ball joint (49) in end of link (61) before placing between long levers. Line up holes and

install pin (46) securing with cotter pin (47).

4. Install pin (60) in remaining hole in long levers (59) and secure with cotter pin (47).
5. Thread adjusting nut (50) on adjusting bolt (44) to end of thread.
6. Install adjusting bolt (44) into ear with large hole in reverse band (62) and thread on locknut (50) making finger tight.
7. Place short lever (52) in opening in forked ear of reverse band (62). Line up holes and install pin (53) until cotter pin hole on side of ear lines up with hole in pin (53). Install cotter pin (54) and secure.
8. Install screw (55) in small end of brace (63) and install screw (55) into hole in forked ear of reverse band (62) and secure with lockwasher (57) and nut (58).

ASSEMBLY OF REVERSE GEAR CASE IN REVERSE GEAR HOUSING

Many of the manual reverse gears are enclosed in housings manufactured by the engine builders. Because of this, the procedure will vary with each different housing. Therefore, the following procedure is only a general guide to this portion of the assembly.

REDUCTION MODEL

1. Place new gaskets on front, rear and top of reverse gear housing (67).
2. If removed for replacement, install new oil seals (68) in cross shaft holes in housing.
3. Support gear case assembly on propeller gear inside front end of gear case so

that reverse gear housing (67) will not rest on face when lowered over gear case assembly.

4. Lower reverse gear housing (67) over gear case assembly with reverse gear tailshaft protruding through bore in rear of housing.
5. Place thrust washer (69) with counter-bored side down over reverse gear tailshaft. (Make certain that thrust washer seats properly on shoulder of retaining ring (43) on tailshaft (29) on 2XE and 25XE models).
6. Press reduction drive gear (70) into ball bearing (71).
7. Press reduction drive gear and ball bearing on reverse gear tailshaft until ball bearing is seated against thrust washer. Thread on reverse gear tailshaft nut (72).
8. Press reduction gear adapter plate (73) over ball bearing and secure with necessary bolts.
9. Install reduction gear crescent (74).

NOTE: Crescent is not required on common lubricated models and is used on only some of the separately enclosed models.

10. Tighten all capscrews. Tighten reverse gear tailshaft nut until cotter pin (75) can be installed through castellation in nut and hole in reverse gear tailshaft.
11. Install cotter pin (75) and bend ends over nut.
12. Place new gaskets on reduction adapter plate (73).

13. Install reverse band assembly onto gear case assembly in reverse gear housing.

NOTE: On reverse bands using the drag link, it will be necessary to attach links to housing with pins at this time.

14. Install Woodruff keys (77) in cross shafts (78) and install cross shafts in housing, being careful not to damage oil seals in housing.
15. Install yoke (79) through cover opening in housing, placing forked arms over pins on operating sleeve assembly (40).
16. With small end or propeller end of transmission towards mechanic, push right hand cross shaft into hole in yoke, lining up hole in brace with end of cross shaft and seating cross shaft against yoke.
17. Push left hand cross shaft into hole in yoke.
18. Secure cross shafts in yoke by tightening capscrews in yoke.
19. Install ball joint (80) in eye of link on reverse band assembly.
20. Install screw (81) in hole in arm of yoke and screw into thread in ball joint (80) and tighten. Make certain that lockwasher (82) is between arm of yoke and end of ball joint protruding through eye of link.

NOTE: When assembling direct drive units, use the following procedure.

21. After paragraph 4 above place thrust washer (83) over reverse gear tailshaft place seal washer (84) over reverse gear tailshaft against thrust washer and install Woodruff key (85) in keyway in reverse gear tailshaft.

22. If removed for replacement, press new oil seal (86) into direct drive plate (87). Press ball bearing (88) into direct drive plate.
23. Place direct drive plate, oil seal and ball bearing assembly on suitable support and press gear half coupling (89) into oil seal and ball bearing until gear half coupling is seated against ball bearing. Care must be taken not to damage oil seal during assembly.
24. Place direct drive plate and gear half coupling lined up with key in reverse gear tailshaft and press together until ball bearing is seated against thrust washer (83).
25. Place lockwasher (90) over reverse gear tailshaft with tang in keyway in gear half coupling and thread locknut (91) on reverse gear tailshaft.
26. Install lockwashers and capscrews in holes in direct drive plate and bolt to reverse gear housing.
27. Tighten all capscrews. Tighten locknut (91) and bend up one tang on lockwasher (90) over locknut.
28. Continue with paragraph 13 through 20.

ASSEMBLY TO REVERSE GEAR HOUSING ASSEMBLY TO ENGINE

1. If removed, replace engine gear (92) on crankshaft or flywheel depending upon installation. Check engine manufacturer's recommendations for proper method of assembly.
2. After installing on engine, check engine gear for runout. Maximum eccentricity is .005 inches at pilot bearing race.

3. Install gasket (as supplied by engine manufacturer) to face of flywheel or timing gear cover.
4. If front end plate (93) is used as on a flywheel end applicator, replace seal (94) if removed and install front end plate on engine over engine gear. Do not damage oil seal during assembly.
5. Install two studs 3 inches long in two opposite bolt holes in timing gear cover.
6. Check to be certain that pilot roller bearing (95) is properly installed in propeller gear inside gear case.

NOTE: Most transmissions are light enough to handle without supporting by chain fall. However, the 4XE3-90 transmission should be supported by a properly rigged chain fall.

7. Start reverse gear housing assembly over two studs in timing gear cover and slide entire assembly over engine gear tight up against timing gear cover making certain that the pilots are properly engaged.

NOTE: It may be necessary to rotate gear case slightly to properly mesh teeth on engine gear and short pinions in gear case.

8. Install lockwashers and capscrews in holes around flange of housings.
9. Remove two studs and install remaining lockwashers and capscrews. Tighten all capscrews.

ASSEMBLY OF REDUCTION GEAR ASSEMBLY TO REVERSE GEAR HOUSING ASSEMBLY

NOTE: Refer to reduction gear service manual for assembly of reduction gear.

1. Install two studs 3 1/2 inches long in two opposite holes in reduction adapter plate.
2. Position reduction gear assembly over studs with oil drain plug at bottom and slide onto reduction drive gear. It may be necessary to rotate reduction ring gear slightly to properly mesh gear teeth.
3. Install lockwashers and capscrews around flange of reduction gear housing and tighten uniformly.

ADJUSTMENTS

With the transmission secured to the engine, replace all water lines, etc. However, do not connect the shifting linkage until all of the adjustments have been made and are satisfactorily tested.

Before securing the propeller half coupling to the gear half coupling, check to make certain that the couplings do not run out more than .002 inches with respect to each other.

The transmission should be filled with new oil as specified under lubrication. Be certain to replace any oil that was removed from the engine.

The transmission can be partially adjusted before the engine has been run. However, a complete running test is necessary to satisfactorily determine whether the adjustments have been properly made.

The preliminary adjustments for the forward drive are made as follows:

1. Back out the lock screw (42) until the dog on the end of the lock screw is clear of the hole in the pressure plate (35).

2. Rotate the screw collar (37) to the right until the lock screw (42) is opposite the next hole in the pressure plate (35).
3. Tighten the lock screw making certain that the dog on the end properly enters the hole in the pressure plate.
4. Continue this until a decided effort is required to shift into forward.

The preliminary adjustments for the reverse drive are made as follows:

1. Loosen the lock nut (50) on the inside of the upright ear at the top of the reverse band.
2. Tighten the adjusting nut (50) on the outside of the ear until both nuts are again tight against the ear of the reverse band.
3. Repeat until a decided snap is required to shift into reverse.

Replace the cover on the reverse gear housing. The transmission is ready for a preliminary test which may be done at dockside.

Check all of the mooring lines before continuing the test.

With the engine running at idle speed, shift the transmission into forward and reverse noting how well the transmission responds.

If the transmission does not engage in one or both of the forward or reverse positions further dockside adjustments are necessary. Continue the adjustments as outlined above until the transmission will engage in both forward and reverse drives.

A complete running test is necessary to determine that the transmission is properly adjusted. The transmission should not slip or "break" away under full power conditions in the forward drive and should hold in reverse under all normal reversing conditions.

If further adjustments are necessary, continue the adjustments as outlined above until satisfactory operation is reached. It should be noted however that the adjustments should be carried out only until satisfactory operation is reached since it is possible to over-adjust the transmission. If the transmission is over-adjusted, it will be more difficult to shift into forward and reverse and the parts will be heavily stressed and subject to early fatigue failure. Therefore, once the preliminary adjustments have been made, only a very small amount of adjustment will be necessary for either forward or reverse. Usually, an adjustment of a half a step on the forward, or at the most, a full step is required for full adjust-

ment. Only a very small adjustment is required for the reverse drive.

On the forward drive, a full step of adjustment is as outlined above or is made by loosening the lock screw (42) and rotating the screw collar (37) to the right until the next hole in the pressure plate (35) can be lined up under the lock screw. A half a step is made by taking the lock screw out of the hole that it is in and placing it in the hole adjoining it in the screw collar. Then rotate the screw collar to the right until the next hole in the pressure plate is lined up under the dog of the lock screw. Make certain that the lock screw enters the hole properly or it will bind up the forward clutch.

When the transmission is properly adjusted, replace the cover and secure all external bolts and fasteners. Before replacing the shifting linkage, check to make certain that it operates freely and does not bind or drag. Replace the linkage on the transmission shift lever and secure properly.

GEAR CASE ASSEMBLY

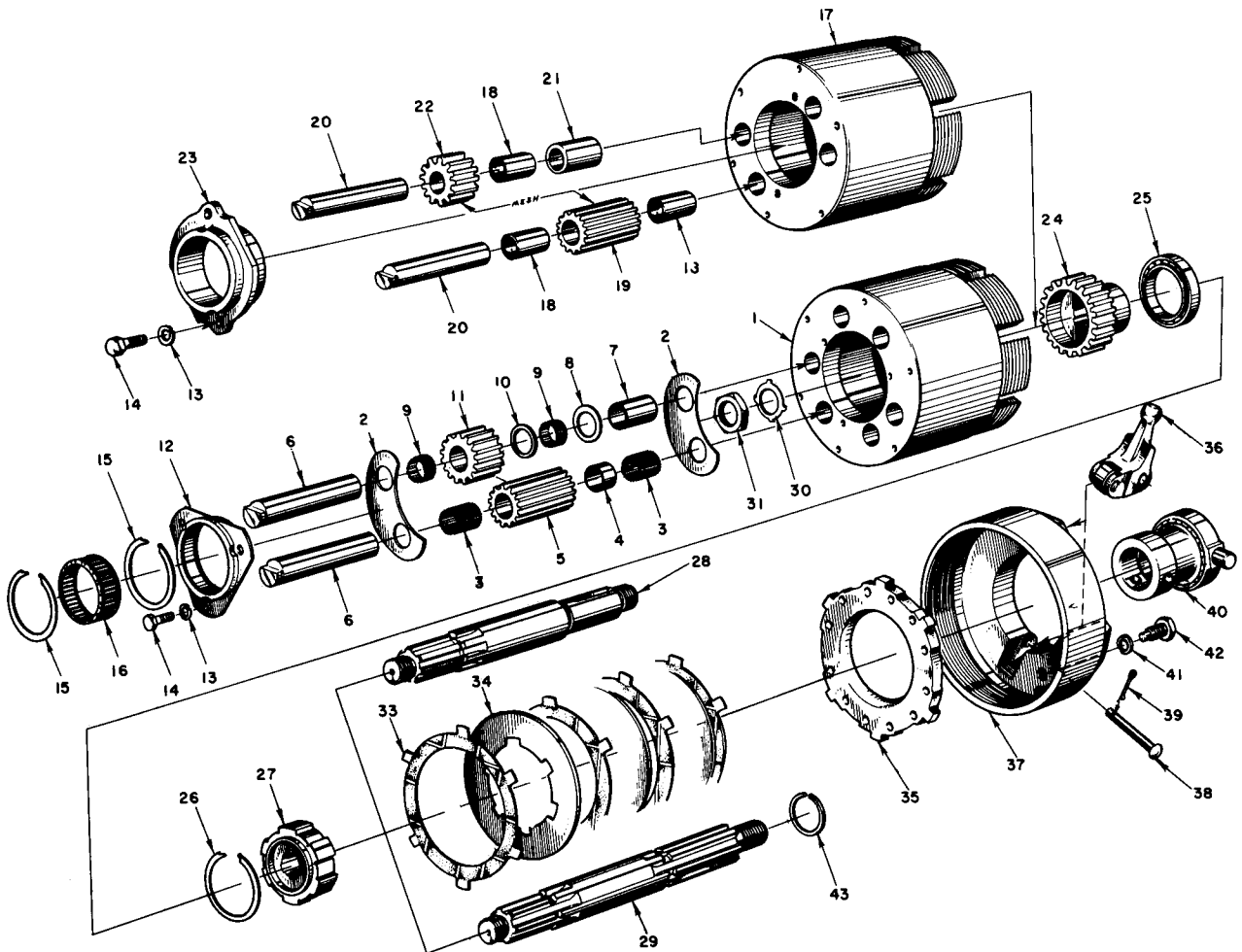


Fig. 1

PARTS LIST

KEY NO.	DESCRIPTION	KEY NO.	DESCRIPTION
1	Gear Case - Roller Pinion Type	23	Gear Case Bushing
2	Thrust Pad	24	Propeller Gear
3	Long Pinion Roller Bearing	25	Gear Case Ball Bearing
4	Long Pinion Bearing Spacer	26	Gear Case Ball Bearing Retaining Ring
5	Long Pinion - Roller Bearing Type	27	Clutch Plate Carrier
6	Pinion Shaft - Roller Pinion Type	28	Tailshaft - Direct Drive
7	Short Pinion Spacer	29	Tailshaft - Reduction Drive
8	Short Pinion Thrust Pad	30	Propeller Gear Lockwasher
9	Short Pinion Roller Bearing	31	Propeller Gear Locknut
10	Short Pinion Bearing Spacer	32	Propeller Gear Spacer Washer
11	Short Pinion - Roller Bearing Type	33	Bronze Clutch Plate
12	Gear Case Roller Bearing Race	34	Steel Clutch Plate
13	Lockwasher	35	Pressure Plate
14	Capscrew	36	Finger Assembly
15	Roller Bearing Retaining Ring	37	Screw Collar
16	Case Roller Bearing	38	Finger Pin
17	Gear Case - Bushed Pinion Type	39	Cotter Pin
18	Pinion Bushing	40	Operating Sleeve Assembly
19	Long Pinion - Bushed Type	41	Lockwasher
20	Pinion Shaft - Bushed Type	42	Lockscrew
21	Short Pinion Spacer	43	Tailshaft Retaining Ring
22	Short Pinion - Bushed Type		

TOGGLE OPERATED REVERSE BAND ASSEMBLY - STANDARD

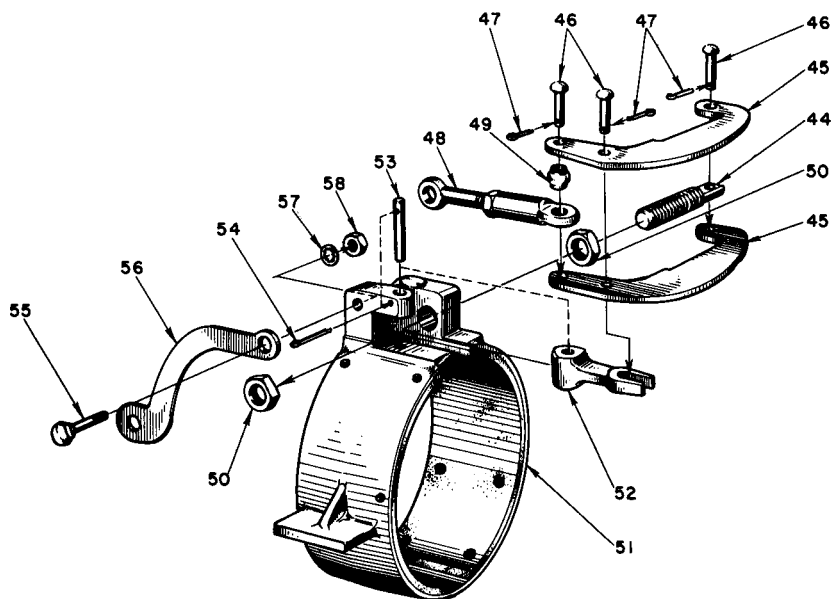


Fig. 2

TOGGLE OPERATED REVERSE BAND ASSEMBLY - 25XE TYPE

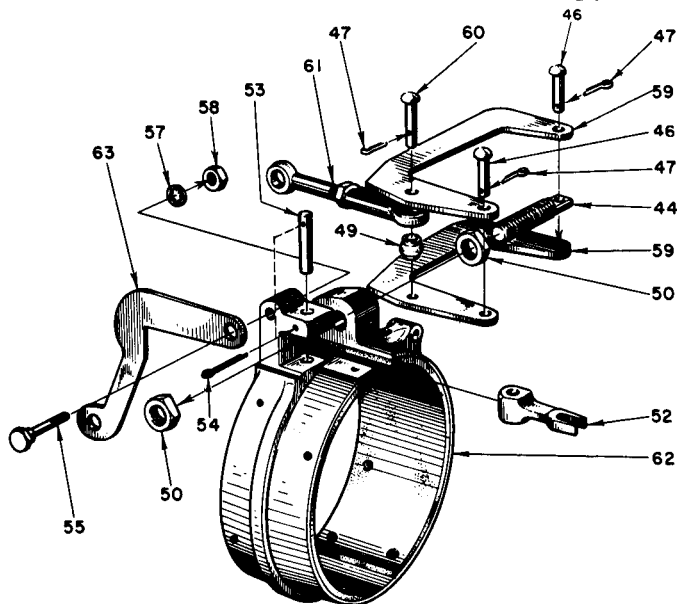


Fig. 3

PARTS LIST

KEY NO.	DESCRIPTION	KEY NO.	DESCRIPTION
44	Adjusting Bolt	54	Cotter Pin
45	Long Lever - Standard	55	Screw
46	Long Lever Pin	56	Brace - Standard
47	Cotter Pin	57	Lockwasher
48	Link - Standard	58	Nut
49	Ball Joint	59	Long Lever - 25XE
50	Adjusting Nut	60	Long Lever Pin - 25XE
51	Reverse Band Assembly	61	Link - 25XE
52	Short Lever	62	Reverse Band Assembly - 25XE
53	Short Lever Pin	63	Brace - 25XE

ASSEMBLY OF REVERSE BAND AND YOKE TO GEAR CASE ASSEMBLY

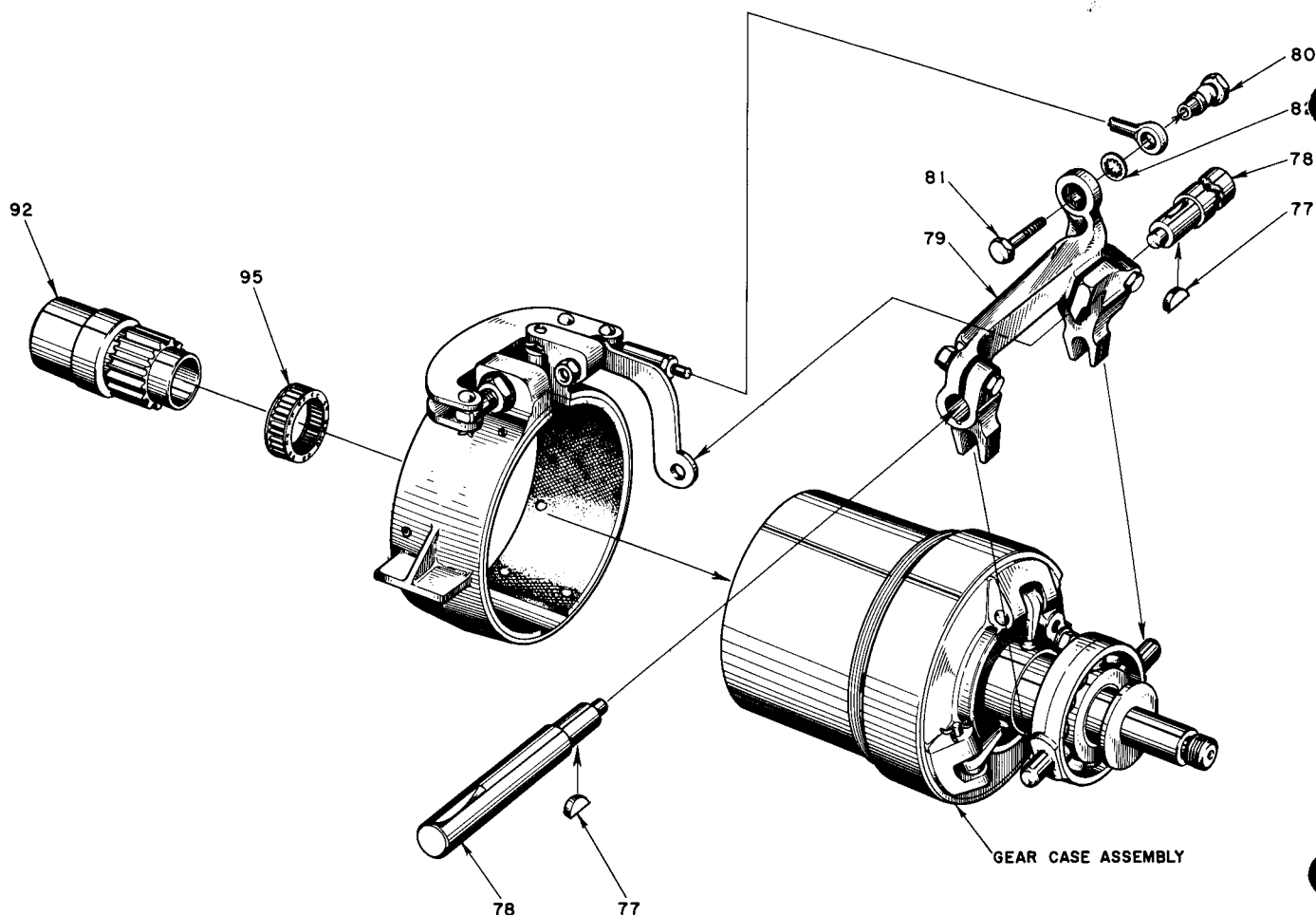


Fig. 4

PARTS LIST

KEY NO.	DESCRIPTION	KEY NO.	DESCRIPTION
64	Front Gasket	85	Woodruff Key
65	Rear Gasket	86	Rear Oil Seal
66	Top Gasket	87	Direct Drive Plate
67	Reverse Gear Housing	88	Ball Bearing
68	Cross Shaft Oil Seal	89	Gear Half Coupling
69	Reverse Gear Tailshaft Thrust Washer	90	Lockwasher
70	Reduction Drive Gear	91	Locknut
71	Ball Bearing	92	Engine Gear
72	Reverse Gear Tailshaft Nut	93	Front End Plate
73	Reduction Adapter Plate	94	Front Oil Seal
74	Crescent	95	Pilot Roller Bearing
75	Cotter Pin	96	Cover
76	Reduction Gasket	97	Lever
77	Woodruff Key	98	Reverse Cam Slide Assembly
78	Cross Shaft	99	Reverse Cam
79	Yoke Assembly	100	Brace
80	Ball Joint	101	Nut
81	Screw	102	Lockspring
82	Lockwasher	103	Adjusting Nut
83	Reverse Gear Tailshaft Thrust Washer	104	Spring
84	Reverse Gear Tailshaft Seal Washer	105	Reverse Band

