

# HD-11EP

and

## 11-B

(POWER SHIFT)  
crawler tractors

### service manual

#### TRANSMISSION

S/N 13367-UP

S/N 46Y14651-UP

S/N 25L16001-UP

Form 70666686 English



### WARNING

STUDY THE OPERATION AND MAINTENANCE  
INSTRUCTION MANUAL THROUGH BEFORE STARTING,  
OPERATING, MAINTAINING, FUELING OR SERVICING THIS  
MACHINE.



The Operation and Maintenance Instruction Manual provides the instructions and procedures for starting, operating, maintaining, fueling, shutdown and servicing that are necessary for properly conducting the procedures for overhaul of the related components outlined in this Service Manual.



This symbol is your safety alert sign. It MEANS ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED.



Read and heed all safety instructions carrying the signal words WARNING and DANGER.



Machine mounted safety signs have been color coded yellow with black borders and lettering for warning and red with white borders and lettering for danger points.

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Supplement No. 2  
Service Manual Form 70666686  
Transmission  
HD-11EP, 11-B CRAWLER TRACTORS

( 6-77 )

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Write in the following changes (Changes are underlined)

Page 33 12. . . . . Torque capscrews to 19 - 23 lb. ft. (2.63 - 3.18 kg-m) if  
5/16" (7.9 mm) diameter. Torque capscrews to 64 - 77 lb. ft.  
(8.8 - 10.6 kg - m) if 7/16" (11.1 mm) diameter.

Page 61 1.b Accessory drive gear capscrews  
5/16" (7.9 mm) diam. ---- 19-23 lbs.ft.  
7/16" (11.1 mm) diam. --- 64-77 lbs.ft.  
(8.8 - 10.6 kg -m)

Reason: Add torque required for larger accessory drive gear capscrews  
used on late units.

**NOTICE**  
THESE CHANGES ARE  
INCLUDED IN THIS COPY

## NOTICE OF CHANGE

TO

SERVICE MANUAL FORM 0666686-1

TORQUE CONVERTER, TRANSMISSION, BEVEL GEAR and  
DRIVE SHAFT U-JOINT

HD-11EP CRAWLER TRACTOR (S/N 13367-up)

**NOTICE**  
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**Write in** the following change (change is underlined)

Page 29

Paragraph D. 2. c.

...; make shim pack equal to  
measurement minus .002"  
(0.050 mm) to obtain ...

**Reason:** This mailing changes procedure for determining torque converter  
rear shim pack thickness.

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# SAFETY RULES

## GENERAL

Study the Operation and Maintenance Instruction Manual before starting, operating, maintaining, fueling, or servicing machine.

Read and heed all machine-mounted safety signs before starting, operating, maintaining, fueling or servicing machine.

Machine-mounted safety signs have been color coded yellow with black borders and lettering for warning and red with white borders and lettering for danger points.

Do not allow unauthorized personnel to service or maintain this machine. Do not perform any work on equipment that is not authorized. Follow the Maintenance and Service procedures. Study the Operation and Maintenance Instruction Manual before starting, operating, maintaining, fueling or servicing this machine.

Always wear safety glasses with side shields.

Do not wear rings, wrist watches, jewelry, or loose or hanging apparel, such as ties, torn clothing, scarves, unbuttoned, or unzipped jackets that can catch on moving parts. Wear proper safety equipment as authorized for the job. Examples: hard hats, safety shoes, heavy gloves, ear protectors, safety glasses or goggles, reflector vests, or respirators. Consult your employer for specific safety equipment requirements.

Do not use controls or hoses as handholds when climbing on or off machine. Hoses and controls are movable and do not provide a solid support. Controls may also be inadvertently moved causing accidental machine or equipment movement.

Do not jump on or off machine. Keep two hands and one foot, or two feet and one hand, in contact with steps and grab-rails and handles at all times.

Machine should not be serviced with anyone in the operator's seat unless they are qualified to operate the machine and are assisting in the servicing.

Keep operator's compartment, stepping points, grab-rails and handles clean of foreign objects, oil, grease, mud or snow accumulation to minimize the danger of slipping or stumbling. Clean mud or grease from shoes before attempting to mount or operate the machine.

Never attempt to operate the machine or its tools from any other position than seated in the operator's seat.

Keep operator's compartment clear of loose objects.

If movement of an attachment by means of the machine's hydraulic system is required for service or maintenance, do not raise or lower attachments from any position other than when seated in the operator's seat. Before starting machine or moving attachment or tool, make sure to set brakes, sound horn and call for an all clear. Raise attachment slowly.

Always block with external support any linkage or part on machine that requires work under the raised linkage, parts, or machine per OSHA requirements. Never allow anyone to walk under or be near unblocked raised equipment. Avoid working or walking under raised blocked equipment unless you are assured of your safety.

Never place head, body, limbs, fingers, feet or hands into an exposed portion between uncontrolled or unguarded

scissor points of machine without first providing secure blocking.

Never lubricate, service or adjust a machine with the engine running, except as called for in the Operation and Maintenance Instruction Manuals. Do not wear loose clothing or jewelry near moving parts.

When servicing or maintenance requires access to areas that cannot be reached from the ground, use a ladder or step platform that meets OSHA requirements to reach the service point. If such ladders or platforms are not available, use the machine handholds and steps as provided. Perform all service or maintenance carefully.

Shop or field service platforms and ladders used to maintain or service machinery should be constructed and maintained according to local or national requirements.

Disconnect batteries and TAG all controls according to OSHA requirements to warn that work is in progress. Block the machine and all attachments that must be raised per OSHA requirements.

Never check or fill fuel tanks, storage batteries or use starter fluid near lighted smoking materials or open flame due to the presence of flammable fluid.

Brakes are inoperative when manually released for servicing. Provision must be made to maintain control of the machine by blocking or other means.

Always place the fuel nozzle against the side of the filler opening before starting and during fuel flow. To reduce the chance of a static electricity spark, keep contact until after fuel flow is shut off.

Use only designated towing or pulling attachment points. Use care in making attachment. Be sure pins and locks as provided are secure before pulling. Stay clear of drawbars, cables or chains under load.

To move a disabled machine, use a trailer or low boy truck if available. If towing is necessary, provide warning signals as required by local rules and regulations and follow operation and maintenance instruction manual recommendations. Load and unload on a level area that gives full support to the trailer wheels. Use ramps of adequate strength, low angle and proper height. Keep trailer bed clean of clay, oil and all materials that become slippery. Tie machine down securely to truck or trailer bed and block tracks (or wheels) as required by the carrier.

Never align holes with fingers or hands. Use the proper aligning tool.

Remove sharp edges and burrs from reworked parts.

Use only grounded auxiliary power source for heaters, chargers, pumps and similar equipment to reduce the hazards of electrical shock.

Lift and handle all heavy parts with a lifting device of proper capacity. Be sure parts are supported by proper slings and hooks. Use lifting eyes if provided. Watch out for people in the vicinity.

Never place gasoline or diesel fuel in an open pan.

Never use gasoline or solvent or other flammable fluid to clean parts. Use authorized commercial, non-flammable, non-toxic solvents.

When using compressed air for cleaning parts use safety

# Safety Rules

## GENERAL (Continued)

glasses with side shields or goggles. Limit the pressure to 30 psi according to local or national requirements.

Do not smoke or permit any open flame or spark near when refueling, or handling highly flammable materials.

Do not use an open flame as a light source to look for leaks or for inspection anywhere on the machine.

Be sure all mechanic's tools are in good condition. DO NOT use tools with mushroomed heads. Always wear safety glasses with side shields.

Move carefully when under, in or near machine or implements. Wear required protective equipment, such as hard hat, safety glasses, safety shoes, ear protectors.

When making equipment checks that require running of the engine, have an operator in the operator seat at all times with the mechanic in sight. Place the transmission in neutral and set the brakes and lock. Keep hands and clothing away from moving parts. Shut off engine and disengage the Power Take-Off lever before attempting adjustments or service.

Never use the bucket as a man lift.

The articulation point between frames will not clear a person. Stay clear when engine is running. Support, using device provided when servicing. Return support to carry position and secure before moving machine after servicing. See Operation and Maintenance Instruction Manual.

For field service, move machine to level ground if possible and block machine. If work is absolutely necessary on an incline, block machine and its attachments securely. Move the machine to level ground as soon as possible.

Guard against kinking chains or cables. Do not lift or pull through a kinked chain or cable. Always wear heavy gloves when handling chain or cable.

Be sure cables are anchored and the anchor point is strong enough to handle the expected load. Keep exposed personnel clear of anchor point and cable or chain. **DO NOT PULL OR TOW UNLESS OPERATOR'S COMPARTMENTS OF MACHINES INVOLVED ARE PROPERLY GUARDED** against accidental cable or chain backlash.

Keep maintenance area **CLEAN** and **DRY**. Remove water or oil slicks immediately.

**DO NOT** pile oily, greasy rags — they are a fire hazard. Store in a closed metal container.

Before starting machine or moving attachment check and adjust and lock operator's seat. Be sure all personnel in the area are clear before starting or moving machine and any of its attachments. Sound horn.

Rust inhibitors are volatile and flammable. Prepare parts in well-ventilated place. Keep open flame away — **DO NOT SMOKE**. Store container in a cool well-ventilated place secured against unauthorized personnel.

Do not carry loose objects in pockets that might fall unnoticed into open compartments.

Keep clutches and brakes on machine and attachments such as Power Control Units, winches and master clutches adjusted according to Operation and Maintenance Instruction Manuals of the manufacturer at all times. **DO NOT** ad-

just machine with engine running except as specified.

Wear proper protective equipment such as safety goggles or safety glasses with side shields, hard hat, safety shoes, heavy gloves when metal or other particles are apt to fly or fall.

Wear welder's protective equipment such as dark safety glasses, helmets, protective clothing, gloves and safety shoes when welding. Wear dark safety glasses near welding. **DO NOT LOOK AT ARC WITHOUT PROPER EYE PROTECTION.**

Know your jacking equipment and its capacity. Be sure the jacking point used on the machine is appropriate for the load to be applied. Be sure the support for the jack at the machine and under the jack is appropriate and stable. Any equipment up on a jack is dangerous. Transfer load to appropriate blocking as a safety measure before proceeding with service or maintenance work according to local or national requirements.

Wire rope develops steel slivers. Use authorized protective equipment such as heavy gloves, safety glasses when handling.

Handle all parts with extreme care. Keep hands and fingers from between parts. Wear authorized protective equipment such as safety glasses, heavy gloves, safety shoes.

Inspect your seat belt at least twice a year for signs of fraying, wear, or other weakness that could lead to failure.

Where it is necessary to use diesel fuel as a lubricant make sure all smoking material and open flames are extinguished or that no sparks are near. Place all parts in a closed container of clear diesel fuel for use as needed.

To minimize dangers of fire and explosion, it is recommended that before any welding is done on a fuel tank, the tank be completely drained of fuel, fuel lines disconnected and the ends closed to protect them, and the tank be steam cleaned. All traces of fuel must be removed before welding is started. Flood the tank with carbon dioxide (CO<sub>2</sub>) before and during welding. Caps must be removed and vents and other openings left open during welding.

Dry ice (solid carbon dioxide) is extremely cold and will freeze flesh on contact. Use care to prevent contact with skin, eyes, or other parts of the body to avoid personal injury.

When work is required under or between components, block with an external support capable of holding the components in place according to local or national requirements.

## START UP

Do not run the engine of this machine in closed areas without proper ventilation to remove deadly exhaust gases.

Do not place head, body, limbs, feet, fingers, or hands near a rotating fan or belts. Be especially alert around a pusher fan.

**STARTING FLUID IS FLAMMABLE.** Follow the recommendations as outlined in the Operation and Maintenance Instruction Manual and as marked on the containers. Store containers in cool, well-ventilated place secure from unauthorized personnel. **DO NOT PUNCTURE OR BURN CONTAINERS.** Follow the recommendation of the manufacturer for storage and disposal.

# Safety Rules

## ENGINE

Turn radiator cap slowly to relieve pressure before removing. Add coolant only with engine stopped or idling if hot. See Operation and Maintenance Instruction Manual.

Do not run engine when refueling and use care if engine is hot due to the increased possibility of a fire if fuel is spilled.

Never attempt to check or adjust fan belts when engine is running.

Do not adjust engine fuel pump when the machine is in motion.

Never lubricate a machine with the engine running.

Avoid running engine with open unprotected air inlets. If such running is unavoidable for service reasons, place protective screen over all inlet openings before servicing engine.

## ELECTRICAL

Be sure to connect the booster cables to the proper terminals (+ to +) and (- to -) at both ends. Avoid shorting clamps. Follow the Operation and Maintenance Instruction Manual procedure.

Always turn the master switch (key switch if so equipped) to the off position when maintaining or servicing machine.

**BATTERY GAS IS HIGHLY FLAMMABLE.** Leave battery box open to improve ventilation when charging batteries. Never check charge by placing metal objects across the posts. Keep sparks or open flame away from batteries. Do not smoke near battery to guard against the possibility of an accidental explosion.

Check for fuel or battery electrolyte leaks before starting service or maintenance work. Eliminate leaks before proceeding.

Do not charge batteries in a closed area. Provide proper ventilation to guard against an accidental explosion from an accumulation of explosive gases given off in the charging process.

Disconnect batteries before working on electrical system or repair work of any kind.

## HYDRAULIC

Fluid escaping under pressure from a very small hole can almost be invisible and can have sufficient force to penetrate the skin. Use a piece of cardboard or wood to search for suspected pressure leaks. **DO NOT USE HANDS.** If injured by escaping fluid, see a doctor at once. Serious infection or reaction can develop if proper medical treatment is not administered immediately.

Shut off engine and be sure all pressure in system has been relieved before removing panels, housings, covers, and caps. See Operation and Maintenance Instruction Manual.

When making pressure checks use the correct gage for expected pressure. See Operation and Maintenance Instruction Manual or Service Manual for Guidance.

## ATTACHMENTS

Keep head, body, limbs, feet, hands and fingers away from blade, bucket or ripper when in raised position. Use

authorized blocking as a safety measure before proceeding with service or maintenance per OSHA requirements.

If movement of an attachment by means of the machine's hydraulic system is required for service or maintenance do not raise or lower attachments from any position other than when seated in the operator's seat. Before starting machine or moving attachments or tools, make sure to set brakes, sound horn and call for an all clear. Raise attachment slowly.

Do not use machine to carry loose objects by means other than attachments for carrying such objects.

Never use any gas other than dry nitrogen to charge accumulators. See Operation and Maintenance Instruction Manual.

Keep clutches and brakes on machine and attachments such as power control units, winches and master clutches adjusted according to Operation and Maintenance Instruction Manuals of the manufacturer at all times. **DO NOT** adjust machine with engine running except as specified.

## TIRES (APPLICABLE MACHINES)

Be sure tires are properly inflated to the manufacturer's specified pressure. Inspect for damage periodically.

Stand to one side when changing inflation of tires.

Check tires only when the machine is empty and tires are cool to avoid overinflation. Do not use reworked wheel parts. Improper welding, heating or brazing weakens them and can cause failure.

Never cut or weld on the rim of an inflated tire. Inflate a spare tire only enough to keep rim parts in place — a fully inflated tire might fly apart when it is not installed on a machine.

Use care if you must transport (haul) a fully inflated tire.

When servicing tires block the machine in front and back of all wheels. After jacking up, place blocking under machine to protect from falling per OSHA requirements.

Deflate tires before removing objects from the tread.

Never inflate tires with flammable gases. Explosion and personal injury could result.



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## FOREWORD

This service manual provides information, illustrations, and tool requirements which service personnel should use when performing repair or maintenance operations.

Assure best results and maintain original quality by always using Fiat-Allis parts.

Always furnish Dealer with machine Serial Number when ordering parts.

Many equipment owners employ Dealer's Service Department for all work other than routine lubrication, adjustments, and minor service. This practice is encouraged, as our Dealers are well informed and equipped to render factory approved service.

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## NOTICE

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INDEX 70658800 FOR ALL AVAILABLE  
PUBLICATIONS.

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## TOPIC 1 - GENERAL DESCRIPTION

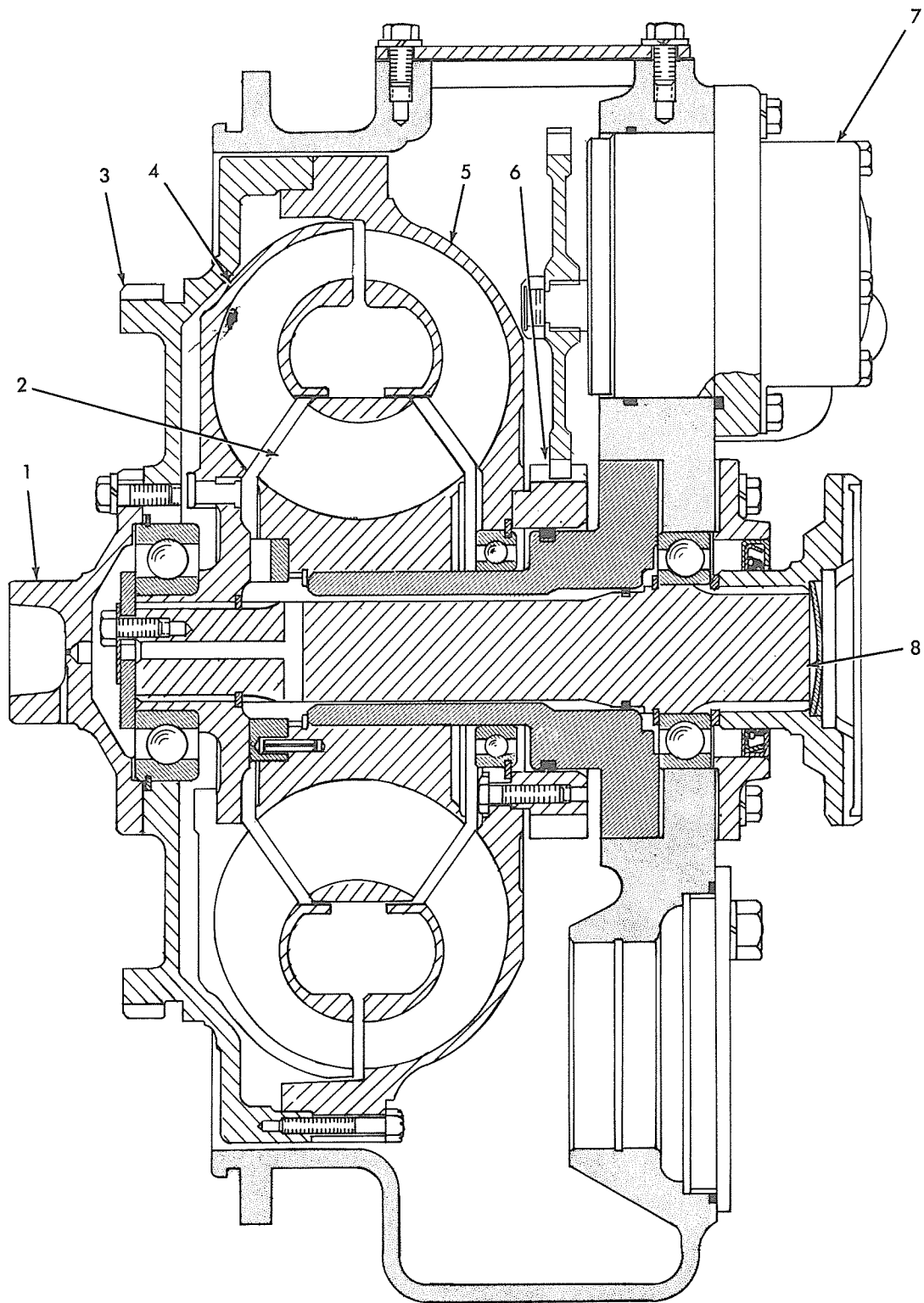


FIG. 1 TORQUE CONVERTER

(T-75026

- |                     |   |
|---------------------|---|
| 1. Input hub        | 5. Impeller                               |
| 2. Stator           | 6. Accessory drive gear                   |
| 3. Rotating housing | 7. Torque converter/transmission oil pump |
| 4. Turbine          | 8. Output shaft                           |

# General Description

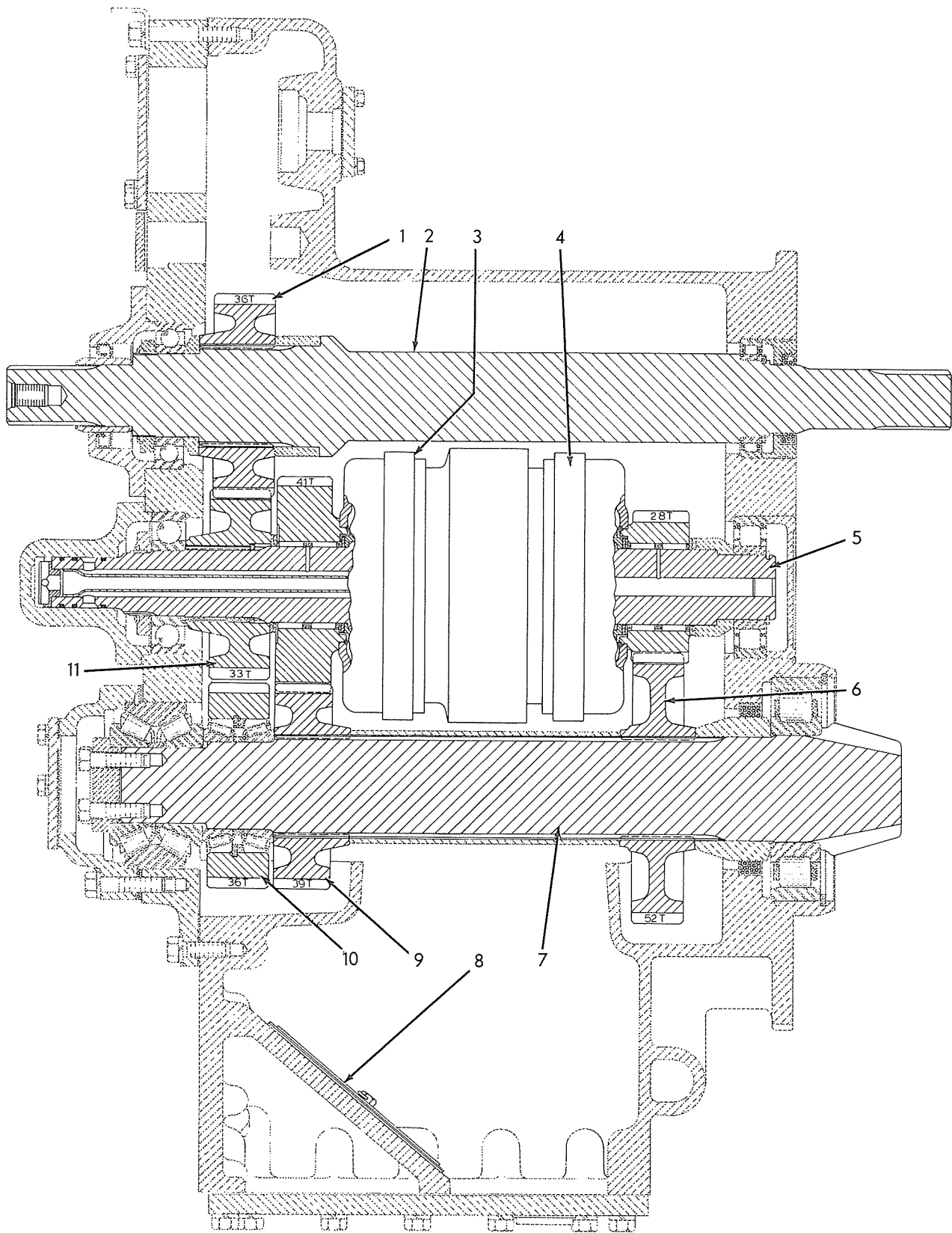


FIG. 2 TRANSMISSION REVERSE RANGE GEAR TRAIN

T-70857



## General Description

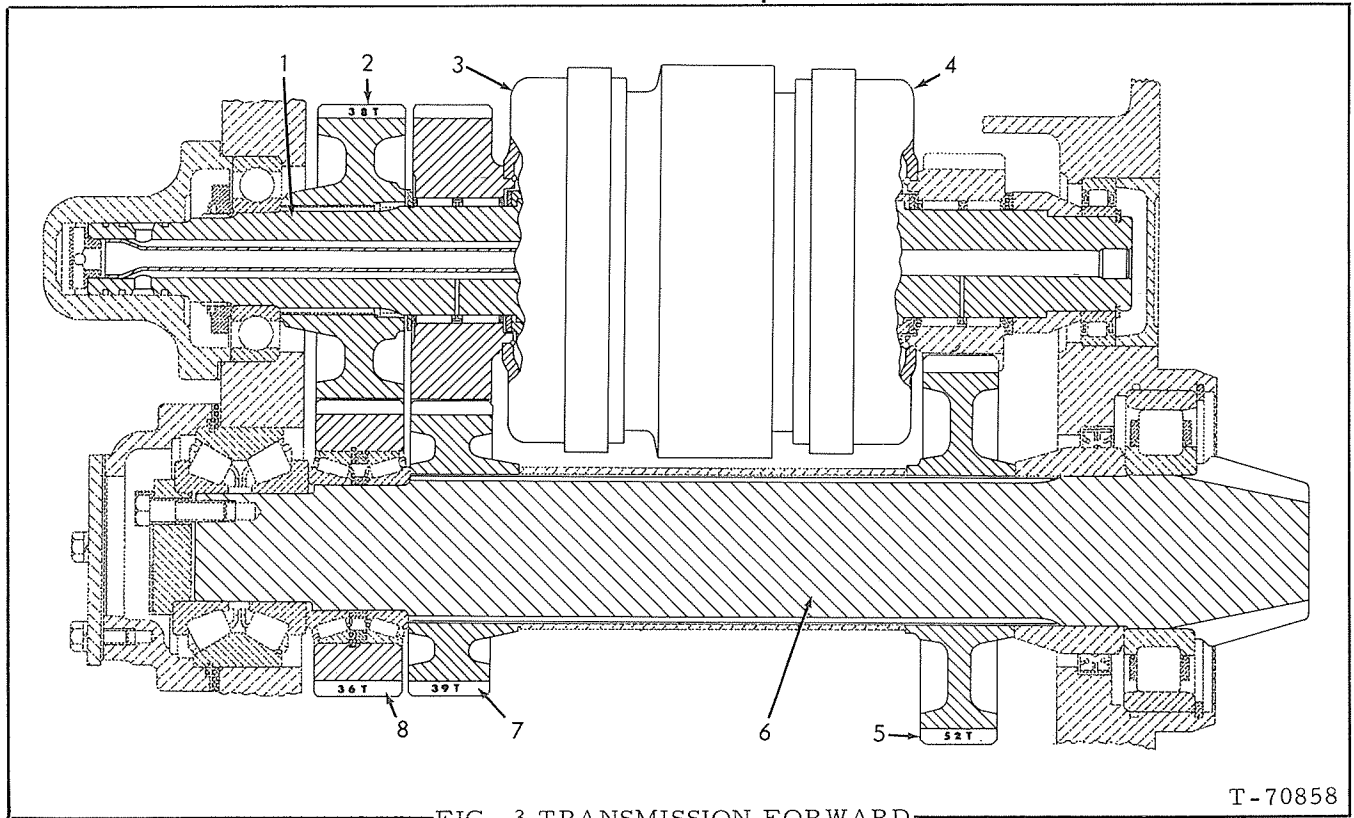


FIG. 3 TRANSMISSION FORWARD  
RANGE GEAR TRAIN

T-70858

- |                               |                                       |
|-------------------------------|---------------------------------------|
| 1. Right clutch shaft         | 5. Bevel pinion shaft low speed gear  |
| 2. Clutch shaft front gear    | 6. Bevel pinion shaft                 |
| 3. Front clutch drum and gear | 7. Bevel pinion shaft high speed gear |
| 4. Rear clutch drum and gear  | 8. Idler gear and bearing             |

### LEGEND FOR FIG. 2

- |                                      |                                       |
|--------------------------------------|---------------------------------------|
| 1. Input shaft front gear            | 7. Bevel pinion shaft                 |
| 2. Input shaft                       | 8. Oil screen                         |
| 3. Front clutch drum and gear        | 9. Bevel pinion shaft high speed gear |
| 4. Rear clutch drum and gear         | 10. Idler gear and bearing            |
| 5. Left clutch shaft                 | 11. Clutch shaft front gear           |
| 6. Bevel pinion shaft low speed gear |                                       |

### A. MECHANICAL OPERATION

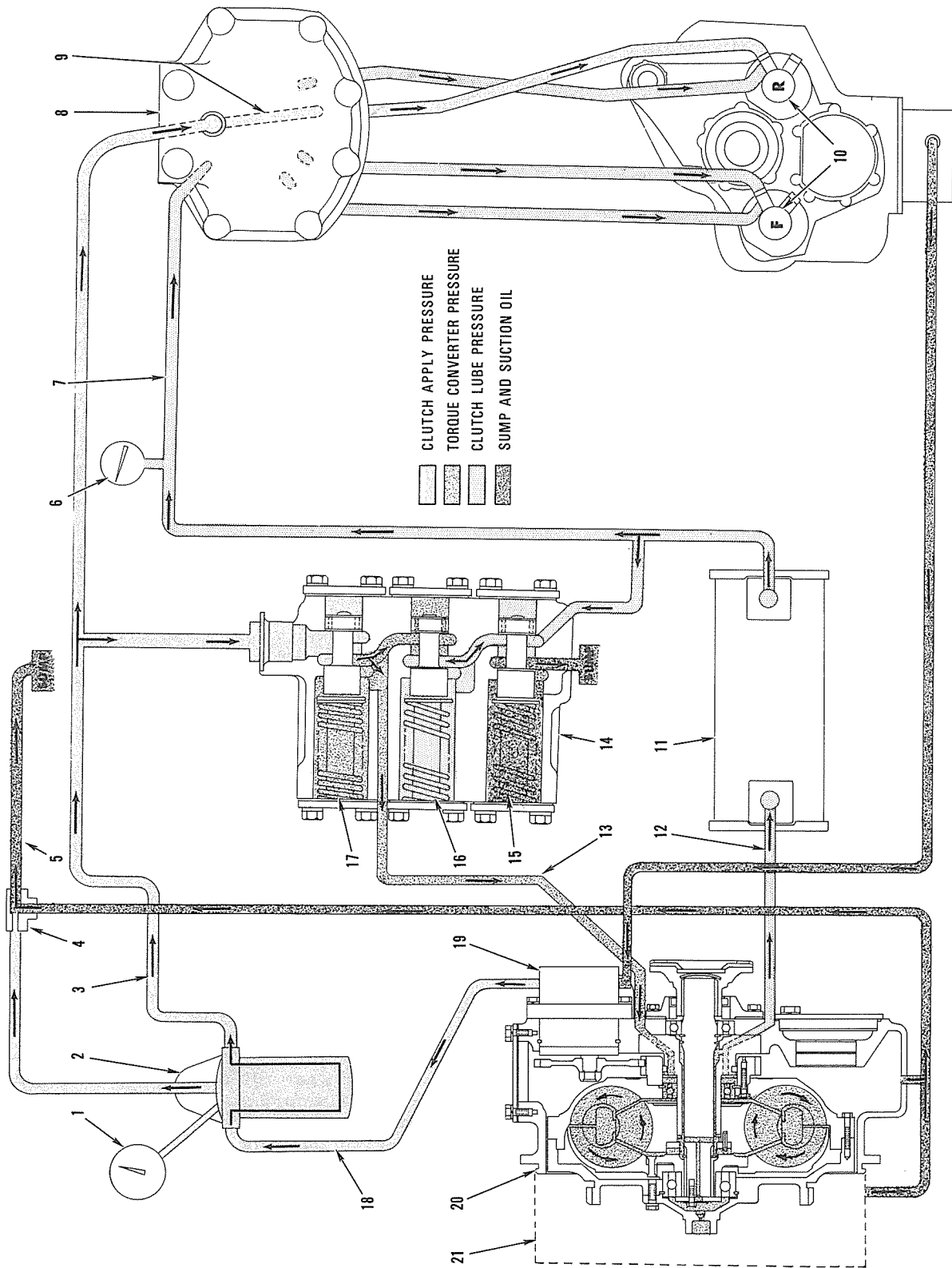
Torque converter, Fig. 1, splined directly to the engine flywheel, is single-stage type with a 3.1 to 1 torque increase ratio. It is composed of 3 major parts: the impeller (connected to engine); the turbine (connected to output shaft); and stator (receives oil from the turbine and returns it to the impeller).

The rotating housing may or may not be considered a basic part, as its function is to enclose the converter circuit. The impeller consists of a series of blades which act as a pump to impart momentum to the oil within the converter circuit. The turbine consists of a single set of blades, hence single-stage torque converter. The stator is also a single set of blades and is stationary. The converter must be full of oil to function properly and operate efficiently.

Prime function of the torque converter is to multiply torque output of the engine. The load or resistance applied to the converter output shaft will determine the extent of torque multiplication. Little or no torque multiplication will occur when the encountered load can be moved with approximately the same amount of torque being produced by the engine. When the load demand increases, torque required at the converter output shaft exceeds torque being produced by the engine; converter then automatically selects the proper output torque required for the demand within its capacity and provides the necessary power.

Oil movement produced by rotation of the impeller is directed against the blades of the turbine; oil passes through the turbine blades and strikes the stator blades; stator redirects the oil back to the impeller. Under a light

# General Description



(T-75039)

FIG. 4 OIL FLOW SCHEMATIC

## General Description

### LEGEND FOR FIG. 4

1. High pressure guage
2. Oil filter
3. Oil flow - 40.5 gpm
4. Venturi pump
5. Oil flow - 3.5 gpm
6. Low pressure gauge
7. Oil flow - 12.6 gpm
8. Speed control valve
9. Valve rotor
10. Transmission oil collectors
11. Heat exchanger
12. Oil flow - 24-27 gpm
13. Oil flow - 28 gpm
14. Pressure relief valve
15. Torque converter transmission lube pressure regulating valve
16. Torque converter safety valve
17. Transmission clutch apply pressure relief valve
18. Oil flow - 42 gpm
19. Hydraulic pump
20. Torque converter
21. Engine flywheel housing

load the oil passes through the converter circuit easily and quickly, striking the blades of the impeller and turbine at a very slight angle. However, as the load demand is increased, the turbine slows down and oil strikes the turbine at a sharper angle. As the fluid passes through the blades at a sharper angle, the output torque of the converter is multiplied more than three times that of the input torque; therefore, a torque ratio of 3.1 to 1 is determined.

Enclosed in torque converter housing and driven from engine flywheel is a separate gear train to drive torque converter/transmission hydraulic pump.

Transmission, Figs. 2 and 3, is constant mesh, with front and rear gear trains. Two power shift hydraulic clutch assemblies provide smooth high speed shifts. Each clutch assembly is actually two clutches on one shaft; right shaft (viewed from rear) carries forward clutches and gears; left shaft carries reverse clutches and gears. Clutches are hydraulically applied and spring released.

With engine running, power flow from the engine is transmitted through the torque converter to the transmission input shaft, Fig. 2 (2). The input shaft gear is in mesh with the front gear (11) on left shaft (5), and drives the left shaft clockwise. The input shaft gear is also in mesh with the idler gear (10) on front end of bevel pinion shaft (7); idler gear is in mesh with the front gear Fig. 3 (2) on transmission right shaft (1), and drives the right shaft counterclockwise.

When tractor is operating in 1st forward the rear clutch on forward clutch shaft is engaged. The respective clutch drum and gear, Fig. 3 (4) drives the low speed gear on bevel pinion shaft; this gear in turn drives the bevel pinion. When tractor is operating in 2nd forward, the front clutch on forward clutch shaft is engaged. The respective clutch drum and gear, Fig. 3 (3) drives the high speed gear on bevel pinion shaft; this gear in turn drives the bevel pinion. When tractor is operating in 1st reverse, the rear clutch on reverse clutch shaft is engaged.

The respective clutch drum and gear, Fig. 2 (4) drives the low speed gear on bevel pinion shaft; this gear in turn drives the bevel pinion. When tractor is operating in 2nd reverse, the front clutch on reverse clutch shaft is engaged. The respective clutch drum and gear, Fig. 2 (3) drives the high speed gear on bevel pinion shaft; this gear in turn drives the bevel pinion.

### B. HYDRAULIC OPERATION

Hydraulic system, shown schematically in Fig. 4 contains two circuits: transmission clutch apply; torque converter and transmission clutch lube. Each circuit contains a shim adjusted pressure regulating valve to maintain specified operating pressure; valves are enclosed in a common housing on top of transmission case.

Included in-line, and between the two pressure regulating valves is the torque converter safety valve. This valve opens only when torque converter pressure exceeds safe operating limit; when valve opens, oil bypasses torque converter and dumps directly to transmission for lubrication or to sump.

Torque converter/transmission oil pump, mounted on rear of torque converter, is driven by engine flywheel through gear train in torque converter housing. Pump gears draw oil from transmission case and supply this oil to charge hydraulic system. System flow description (refer to Fig. 4): oil from pump enters transmission clutch apply circuit and flows through oil filter, venturi pump, and speed control valve. Circuit pressure is maintained by spring regulated valve (17); valve opens at specified pressure and bypasses oil to torque converter and transmission lube circuit.

Oil in torque converter and transmission clutch lube circuit flows first to the torque converter, then returns to lubricate transmission clutches through the heat exchanger and speed control valve. Circuit pressure is maintained by spring regulated valve (15); valve opens at specified pressure and dumps excess oil to transmission sump.

## General Description

Oil in engine flywheel housing and excess oil (seal leakage) from rear of torque converter is returned to sump by venturi pump, Fig. 4 (4). High pressure oil from transmission clutch apply circuit enters venturi pump and flows through a restrictor to "siphon" oil from flywheel housing and torque converter; all oil returns to sump.

Speed control valve directs oil to engage and lubricate transmission clutches. Oil in transmission clutch apply circuit enters valve through passage in valve rotor. When rotor is in neutral position, oil deadheads against valve

body; when rotor is moved (by mechanical linkage) to engage transmission clutch, passage in rotor is aligned with passage in valve body leading to an external oil line, allowing oil to flow through rotor and engage desired clutch.

Transmission clutch lube oil enters valve, flows around rotor, and fills valve body. Oil passages in valve body leading to disengaged clutches are uncovered; oil in valve body enters these passages and flows through external oil lines to lubricate disengaged transmission clutches.

## TOPIC 2 - HYDRAULIC SYSTEM LUBRICANT SPECIFICATIONS, CAPACITY AND SERVICE

### A. LUBRICANT SPECIFICATIONS

Specified oil is SAE 10W crankcase oil meeting the following specifications:

1. Transmission Fluid "Type C-1"
2. American Petroleum Institute (API) classification "Service MS".
3. Military Specification "MIL-L-2104A" or "MIL-L-2104B" Grade 10W.

Automatic Transmission Fluid "Type A - Suffix A" may be used if desired.

API classification "Service DS" or "Series 3" oil is not recommended.

When atmospheric temperature is below -10°F. (-23°C.) Automatic Transmission Fluid "Type A - Suffix A" or lubricating oil meeting Military

Specification "MIL-L-10295A OES" must be used.

#### CAUTION

Do not use "MIL-L-10295A OES" if atmospheric temperature remains consistently above -10°F. (-23°C.).

### B. CAPACITY AND SERVICE

Capacity of system is 14 gallons (52.9 lts.). Normal oil change interval is 1000 hours and oil filter change interval is 500 hours. On new machine, or after major repairs to system components, change oil filter after 50 hours; thereafter at normal intervals. Oil should be at normal operating temperature when drained (for detailed information to perform services, refer to Operating Instructions and Field Maintenance Manual)

## TOPIC 3 - TROUBLE SHOOTING

**IMPORTANT:** Always be certain hydraulic system is filled to proper level with specified lubricant before trouble shooting.

### A. GENERAL

#### UNIT IS LOW ON POWER IN ALL SPEEDS

Loss of power in all speeds indicates torque

converter trouble or engine trouble; engine speed at torque converter stall should be checked to pinpoint trouble. Check "stall speed" as follows:

- a. Operate unit until engine and oil in transmission/torque converter hydraulic system reach normal operating temperature. Set engine to specified high idle speed.

## Trouble Shooting

- b. Block both sprockets with steel, Fig. 5, and move transmission control lever to 2nd forward position. Slowly accelerate engine to full throttle and take rpm reading; decelerate engine and return transmission control lever to neutral.
- c. Specified engine speed at torque converter stall is 1965-1985 rpm. Low rpm indicates engine trouble; refer to Service Manual Form 645121 for trouble-shooting and repair procedures. High rpm indicates torque converter trouble; torque converter trouble is most often caused by malfunction in hydraulic system; refer to **PRESSURE CHECKING** and check pressures in following sequence:
  1. Main pressure
  2. Transmission clutch apply pressure
  3. Torque converter pressure

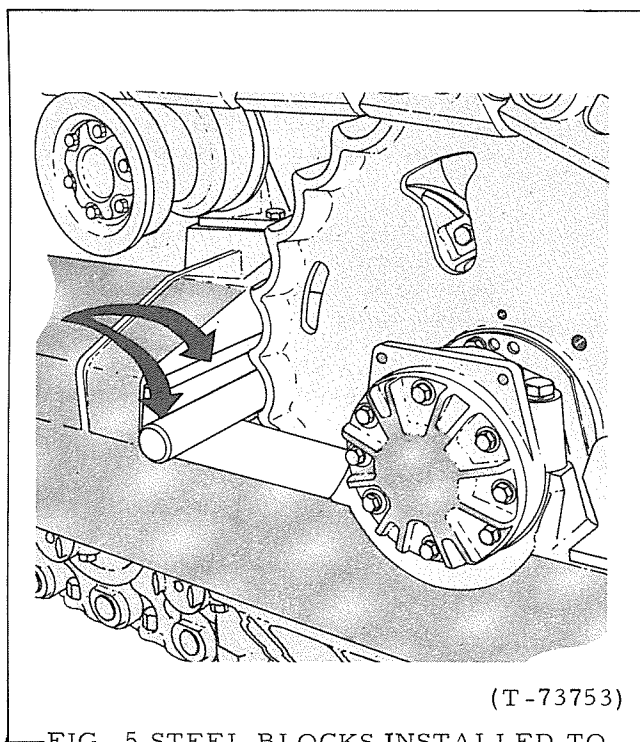


FIG. 5 STEEL BLOCKS INSTALLED TO BLOCK TRACK SPROCKET (12G Shown)

### UNIT WILL NOT OPERATE IN A PARTICULAR SPEED

This indicates a failure in transmission clutch. Remove and disassemble transmission; replace necessary parts in failed clutch (refer to **TRANSMISSION**).

### UNIT CREEPS IN NEUTRAL

Adjust speed shift linkage (refer to speed control valve). If unit still creeps, a transmission clutch is not fully disengaging (dragging) due to warped clutch plates. A clutch which is dragging will raise oil temperature in hydraulic system; high oil temperature can cause extensive damage to hydraulic system. Determine which clutch is dragging as follows:

**NOTE:** Only two clutches will have to be checked as direction of creep will indicate which range (direction of travel) is affected.

- a. Run engine at low idle speed and apply brakes. Engage a transmission clutch in range which unit creeps. Take oil temperature periodically until oil temperature does not change between two checks. Record temperature.
- b. Engage other clutch in same range and repeat oil temperature checks. Record temperature.
- c. Clutch that is disengaged when highest oil temperature is recorded is clutch that is dragging. Remove transmission and make necessary repairs (refer to **TRANSMISSION**).

### **B. PRESSURE CHECKING**

Hydraulic system contains pressure regulating valves to limit and maintain circuit pressures. These valves are adjusted at factory and should not require further adjustment. However, if unit is not operating properly and low pressure is suspected, individual pressure checks should be made.

Main pressure and transmission clutch lube pressure are shown on "Operating Range" type gauges on cowl; hydraulic system pressures may be checked and trouble diagnosed by observing pressures shown on these gauges. However, information in this topic is provided to assist service personnel who wish to record pressures on dial-type (direct reading) gauge.

Check system pressures after service work has been performed on any system component.

**IMPORTANT:** Possible causes given for unsatisfactory pressures are listed in order they are most likely to occur and/or order which is easiest to check. Each cause takes for granted that preceding causes have been checked out and found to be OK.

## Trouble Shooting

PRESSURE CHECK POINTS	PRESSURE BEING CHECKED	SPECIFIED PRESSURE		ENGINE SPEED	TRANS. RANGE POSITION	OIL TEMP.
		PSI	Kg / cm <sup>2</sup>			
FIG. 7	MAIN	230-270 max.	16.17- 18.98 max.	HIGH IDLE	NEUTRAL	180°F (82°C)
FIG.9	TRANS. CLUTCH APPLY	160-190	11.24- 13.36	HIGH IDLE	NOTE #1	
FIG.9	TRANS. CLUTCH LUBE	25-45	1.75-3.16	HIGH IDLE	NOTE #2	
FIG.10	TORQUE CONVERTER	60-90	4.21- 6.32	HIGH IDLE	ENGAGED (ANY RANGE)	

**NOTE #1** ENGAGE EACH TRANSMISSION CLUTCH INDIVIDUALLY; READ PRESSURE AT POINTS INDICATED IN FIG.9

**NOTE #2** CHECK PRESSURE WHEN OPPOSING CLUTCH IS ENGAGED.

(T-74979)

FIG. 6 HYDRAULIC SYSTEM PRESSURE  
SPECIFICATIONS

### 1. MAIN PRESSURE

- a. Disconnect instrument panel oil pressure gauge line from transmission/torque converter oil filter, Fig. 7, and connect pressure gauge to connector on filter.
- b. Refer to Fig. 6 for specified pressure and pressure check procedure.
- c. Pressure check results:
  - (1) NO PRESSURE. Pump drive train damaged; check pump drive shaft (refer to HYDRAULIC PUMP).

- (2) LOW AND ERRATIC PRESSURE. Suction line screen clogged. Remove screen from transmission case and clean.
- (3) LOW PRESSURE. Transmission clutch apply pressure relief valve defective. Check transmission clutch apply pressure and make necessary adjustments. If pressure cannot be raised to specifications pressure pump may be worn; check pump flow, Fig. 8, (refer to FLOW CHECKING).

## Trouble Shooting

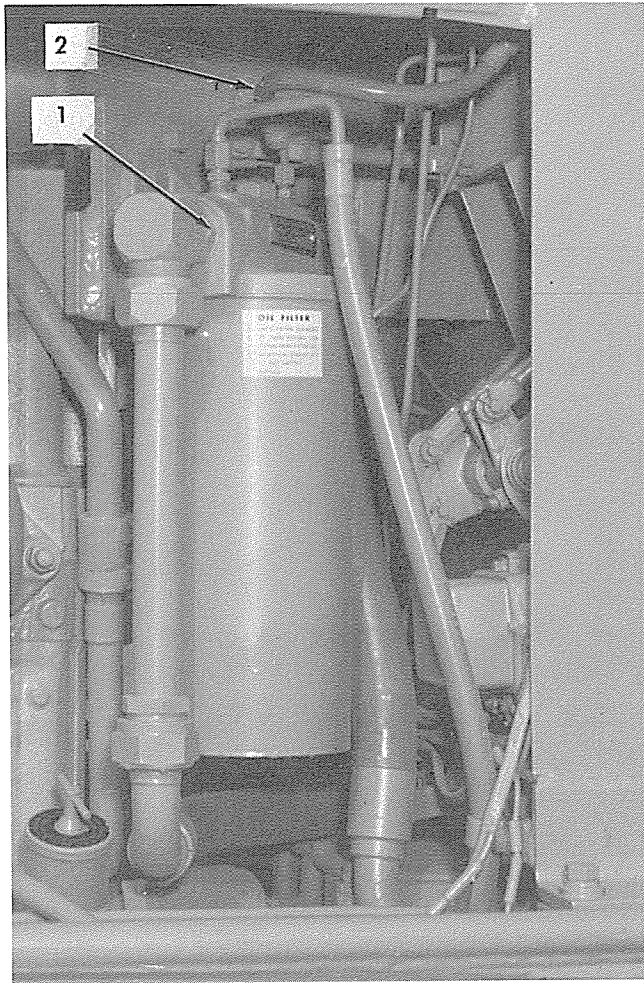
### LEGEND FOR FIG. 7

1. Transmission/torque converter oil filter
2. Oil line to pressure gauge

### LEGEND FOR FIG. 8

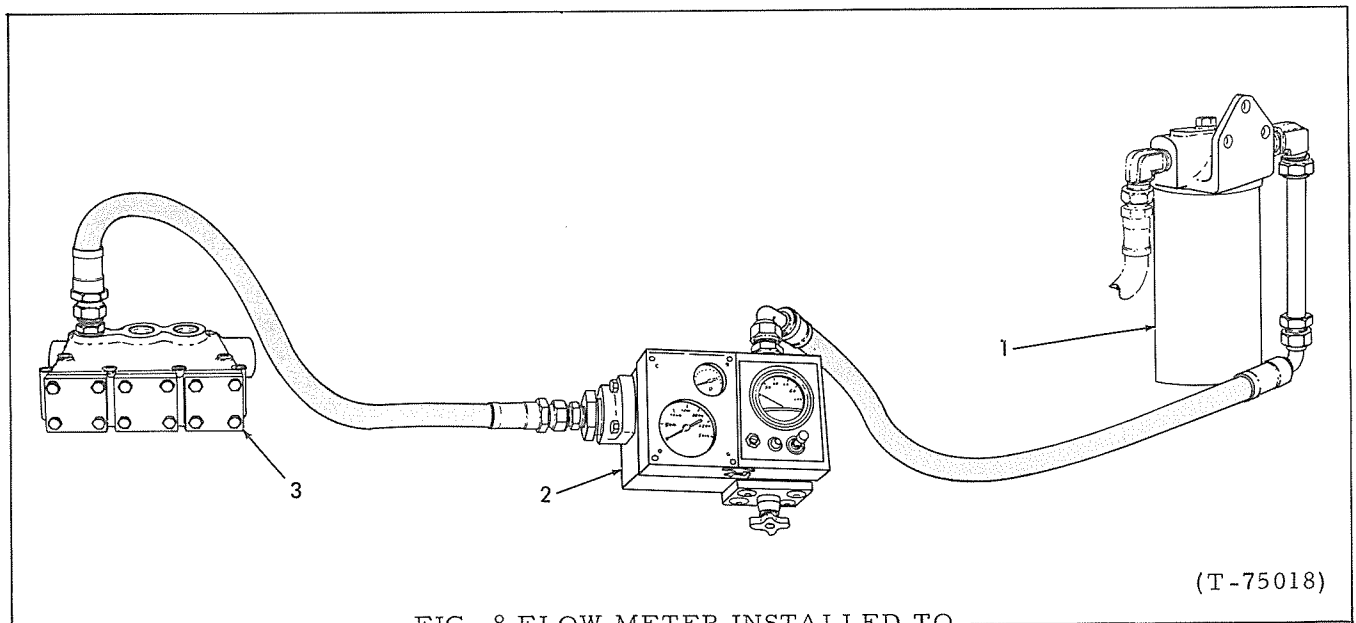
1. Oil filter
- \* 2. Flow meter
3. Pressure relief valve

\*(PFM-100-3) Flo-tech, Inc.  
P.O. Box 574, Barrington, Ill.  
(Y-83+Y-81-2-1) Owantonna Tool Co.  
(PT-100) Schroeder Bros. Corp.  
Nichol Ave. Box 72, McKees Rocks  
(Pittsburgh), Pa.



(T-75020)

FIG. 7 MAIN PRESSURE CHECK POINT



(T-75018)

FIG. 8 FLOW METER INSTALLED TO  
CHECK PUMP FLOW

## Trouble Shooting

### 2. TRANSMISSION CLUTCH APPLY PRESSURE AND TRANSMISSION CLUTCH LUBE PRESSURE

These pressures should be checked at same time on each clutch shaft to detect leakage within clutches or around shaft sealing rings. Proceed as follows:

- a. Remove floor plates; install pressure gauges to check both clutches in one range, Fig. 9.
- b. Refer to Fig. 6 for specified pressures and pressure check procedure.
- c. Repeat procedure to check other range.

#### WARNING

Apply brakes or hold unit stationary in some way when checking clutch apply pressure.

- d. Pressure check results:
  - (1) APPLY PRESSURE LOW (ALL CLUTCHES), indicates relief valve defective. Refer to PRESSURE RELIEF VALVE; make necessary repairs.
  - (2) APPLY PRESSURE LOW IN ONE CLUTCH, LUBE PRESSURE IN OPPOSING CLUTCH NORMAL, indicates leakage in clutch; remove transmission and make necessary repairs.
  - (3) APPLY PRESSURE LOW IN ONE CLUTCH, LUBE PRESSURE IN OPPOSING CLUTCH HIGH, indicates clutch shaft front seals leaking; remove oil collectors and replace seals. If seals are OK, leakage is in clutch; remove transmission and make necessary repairs.
  - (4) APPLY PRESSURE LOW IN TWO OR MORE CLUTCHES, LUBE PRESSURE HIGH IN TWO OR MORE CLUTCHES. Adjust speed shift linkage; refer to SPEED CONTROL VALVE. If linkage is OK, remove speed control valve and check for leakage around rotor.

- (5) APPLY PRESSURE NORMAL, LUBE PRESSURE LOW. Indicates torque converter/transmission clutch lube pressure regulating valve is defective; check torque converter pressure for further confirmation.

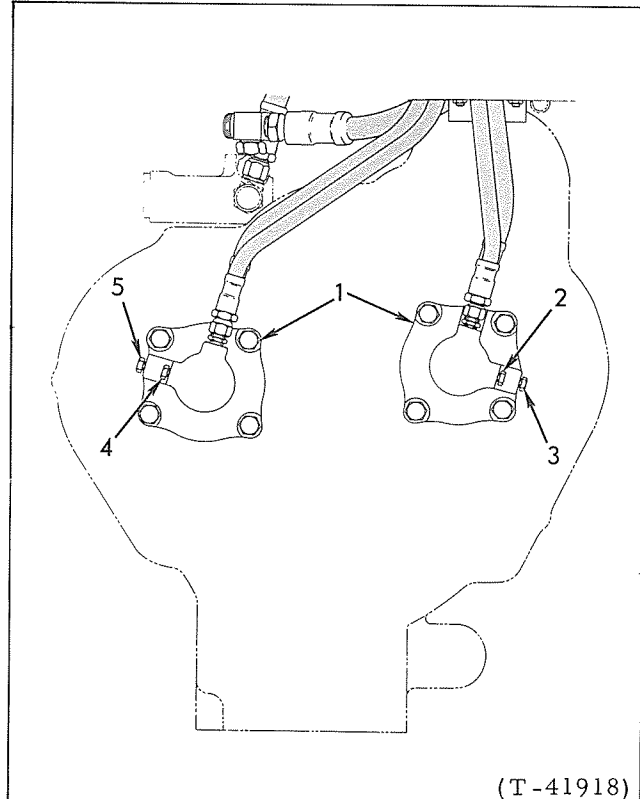


FIG. 9 TRANSMISSION PRESSURE CHECK POINTS

1. 0.1 Collectors
2. 1st reverse
3. 2nd reverse
4. 1st forward
5. 2nd forward

### 3. TORQUE CONVERTER PRESSURE

- a. Remove front floor plates.
- b. Disconnect oil supply line, Fig. 10(6) from torque converter; install necessary fittings and oil lines, Fig. 10, to check pressure.



## Trouble Shooting

- c. Refer to Fig. 6 for specified pressure and pressure check procedure.

NOTE: Apply brakes or install steel blocks in both sprockets, Fig. 5, to hold unit stationery when checking pressure.

- d. Pressure check results:

- (1) LOW PRESSURE (Transmission lube pressure also low). Relief valve defective; refer to PRESSURE RELIEF VALVE and make necessary repairs.
- (2) LOW PRESSURE (Transmission lube pressure normal or high) Torque converter safety relief valve sticking open during normal operation. Remove pressure relief valve and make necessary repairs.
- (3) HIGH PRESSURE (Transmission lube pressure normal). Restriction between torque converter and transmission; check for clogged heat exchanger or pinched oil lines.

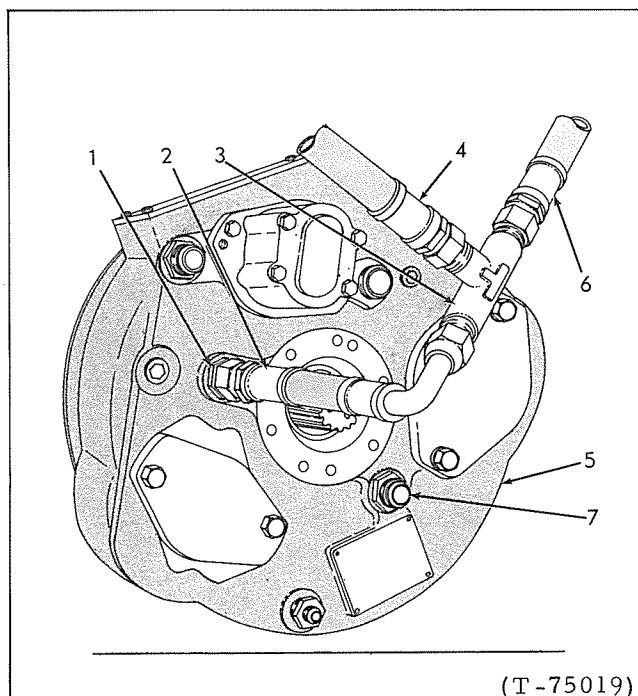


FIG. 10 TORQUE CONVERTER PRESSURE-CHECK POINT

1. Torque converter oil inlet
- \*2. Oil line
- \*3. Tee
- \*4. Oil line (pressure gauge)
5. Torque converter
6. Torque converter oil supply line
7. Torque converter oil outlet

\*Used only to check pressure

## C. FLOW CHECKING

### 1. SPECIFICATIONS AND GENERAL INFORMATION

Pump flow	*42 gpm	(158.9 lts/min)
Torque converter in	28 gpm	(105.9 lts/min)
Torque converter out	24-27 gpm	(90.9-102.1 lts/min)
Transmission lube	12.6 gpm	(47.6 lts/min)
Venturi pump out	3.5 gpm	(13.2 lts/min)

\*40.5 gpm (153.3 lts/min) when checked between filter and valve.

The flow meter should be a "series-type" so in-line connections, similar to one shown in Fig. 8, can be made to check flows. The engine and oil in torque converter/transmission hydraulic system must be at normal operating temperature in order to obtain accurate readings; make all checks with engine at high idle.

### 2. PUMP FLOW

- a. Install flow meter between pump and filter or between filter and pressure relief valve.

NOTE: Flow will be approximately 1.5 gpm (5.6 lts/min) less between filter and pressure relief valve because of flow to the venturi pump. If flow is checked at both places and found to be the same, high pressure oil is not flowing through venturi pump; check venturi pump flow to diagnose trouble.

- b. Check pump flow with all controls in neutral and engine running at high idle speed.

- c. Results of check:

Replace pump if flow is less than 35 gpm (132.4 lts/min) checked between pump and filter; 33.5 gpm (126.8 lts/min) checked between filter and valve.

### 3. TORQUE CONVERTER IN AND TORQUE CONVERTER OUT

- a. Check flow "in" between pressure relief valve and torque converter inlet.
- b. Check flow "out" between torque converter outlet and heat exchanger.
- c. Check flow with transmission in neutral and engine at high idle.

- d. Results of check:

- (1) Low flow "in" and low converter pressure indicate torque converter safety relief valve sticking open; remove valve and make necessary repairs.

## Trouble Shooting

(2) Low flow "in" and high converter pressure indicator restriction in converter system; check for clogged heat exchanger or pinched oil lines.

(3) Excess flow in and normal flow out is an indication of leakage within torque converter. Leakage will result in oil build-up in torque converter and/or increased venturi pump flow; check venturi pump flow to determine if all excess oil is being returned to sump.

(4) Excess flow in and excess flow out is an indication torque converter safety relief valve is not opening at all; refer to PRESSURE RELIEF VALVE and make necessary repairs.

### 4. TRANSMISSION LUBE FLOW

- a. Install flow meter between pressure relief valve and speed control valve.
- b. Check flow with transmission in neutral and engine at high idle.
- c. Results of check:

Excess flow is an indication one or more transmission clutch(s) are leaking. Engage each clutch and note flow; clutch which is engaged when flow is normal is leaking.

### 5. VENTURI PUMP FLOW

- a. Install flow meter between venturi pump and transmission.
- b. Check flow with transmission in neutral and engine at high idle.
- c. Results of Check:

(1) Excess flow indicates torque converter leaking. If venturi pump is returning all torque converter leakage, system will function Ok; if venturi pump is not returning all torque converter leakage, oil build-up in torque converter housing will cause torque converter to run hot and lose efficiency. Disassemble torque converter and check for damaged sealing ring(s).

(2) Low flow indicates venturi pump restrictor clogged or a fitting on "suction" side of pump leaking. Tighten fittings and/or clean restrictor.

## TOPIC 4 - HYDRAULIC SYSTEM COMPONENTS

### A. HYDRAULIC PUMP

NOTE: Refer to HYDRAULIC OPERATION for description and operation of pump.

If erratic hydraulic operation and subsequent pressure and flow checks indicate pump malfunction, pump must be replaced, as no parts are available to rebuild used pumps.

#### 1. REMOVAL

- a. Remove front floor plates; clean pump and surrounding area.
- b. Remove pump access cover, Fig. 11 (1). Remove pump drive gear retaining nut (2) and pump drive gear (3); discard nut. Pump will have to be partially removed before gear can be removed.
- c. Remove capscrews attaching pump to converter housing; use 3" (76mm) long

pusher screws to pull pump from housing.

#### CAUTION

Pump is close fit in bore; turn pusher screws in evenly in no more than 1/2 turn increments while removing. If pump becomes cocked and will not move, release pressure from pusher screws and tap rear of pump lightly; after pump is straightened, continue tightening pusher screws to remove pump. Tapping lightly on front end of pump while tightening pusher screws may aid removal but pump may be damaged if shaft is struck.

- d. Mark pump sections; remove capscrews from rear of pump and pull pump sections apart in order to make visual inspection of parts.

## Hydraulic System Components

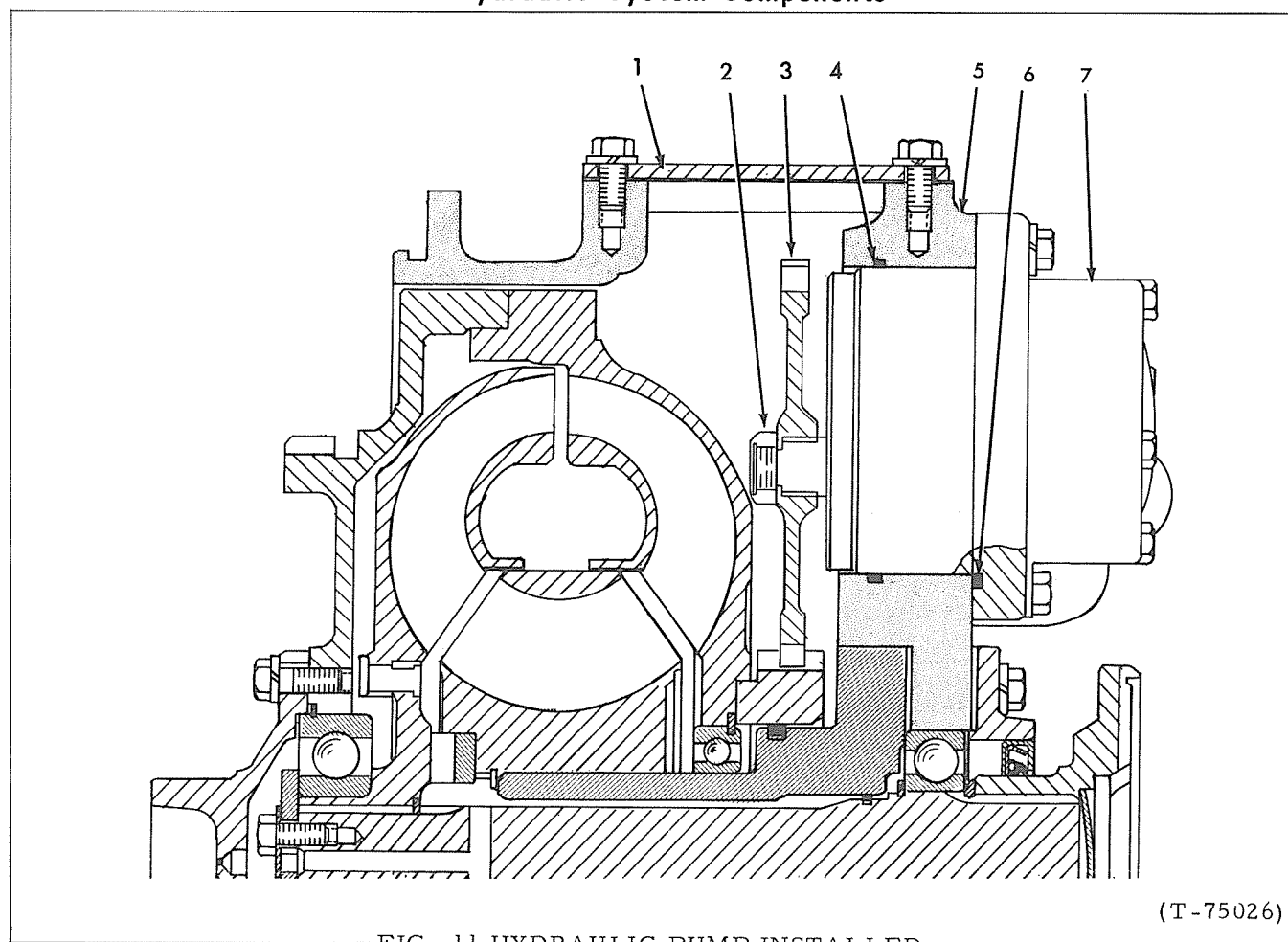


FIG. 11 HYDRAULIC PUMP INSTALLED

- |                                  |                             |
|----------------------------------|-----------------------------|
| 1. Pump access cover             | 4. Inner O-ring             |
| 2. Pump drive gear retaining nut | 5. Torque converter housing |
| 3. Pump drive gear               | 6. Outer O-ring             |
|                                  | 7. Pump                     |

### 2. INSTALLATION

- a. If pump is bench tested prior to installation, following minimum specifications must be met:

Oil: SAE 10W  
 Oil Temp: 175° - 185°F. (79-85 C.)  
 Pump Speed: 2,000 rpm  
 Pressure Pump Output: 40 gpm @ 200 psi (151.4 lts/min. @ 14.06 kg/cm<sup>2</sup>)

- b. Install O-rings, Fig. 11 (4) (6) in groove in pump bore in housing and around pump mounting flange; do not twist or roll O-rings into position. Lubricate O-rings liberally and start pump into its bore; install pump drive gear, Fig. 11 (3) with long hub toward pump. Use attaching capscrews to pull pump into its bore; torque capscrews to 26 to 32 lbs. ft. (3.59-4.42 kg-m) after pump is properly positioned.

### CAUTION

Pump is close fit in bore; turn screws in evenly in no more than 1/2 turn increments while installing. If pump becomes cocked and will not move, release pressure from screws and tap rear of pump; after pump is straightened, continue tightening screws until pump is seated against housing.

- c. Install new gear retaining nut, Fig. 11 (2); torque to 45 lbs. ft. (6.22 kg-m).
- d. Install pump access cover, Fig. 11 (1).
- e. Check main pressure and/or pump flow; refer to TROUBLE SHOOTING AND PRESSURE CHECKING.

## Hydraulic System Components

### B. SPEED CONTROL VALVE

NOTE: Refer to HYDRAULIC OPERATION for description and operation of valve.

#### 1. CONTROL LINKAGE ADJUSTMENT

- a. Remove cover from front end of left battery box, exposing valve, Fig. 12.
- b. Disconnect connecting rods (3) from rotor lever (8).

- c. Move range selector lever (1) to NEUTRAL position and lock into position with safety lever (2).
- d. Move rotor lever (8) to neutral (center) position.
- e. Adjust length of connecting rods so that capscrews slip easily through connecting rod ends and rotor lever; secure capscrews with lockwasher and nuts.
- f. Install battery box front cover.

#### 2. REMOVAL AND DISASSEMBLY

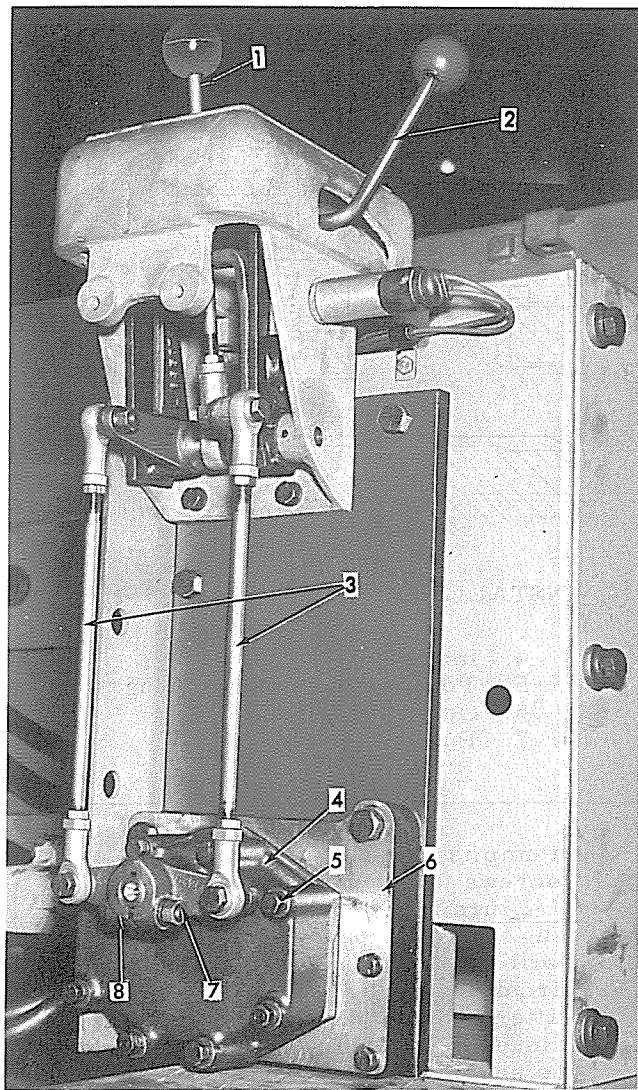
- a. Remove cover from front end of left battery box, exposing valve Fig. 12.
- b. Disconnect connecting rods (3) from rotor lever (8). Loosen rotor lever clamping capscrew (7) and slide rotor lever from key in rotor; remove key from rotor.
- c. Remove capscrews (5); remove speed control valve and gasket from manifold (6).
- d. Remove screw, Fig. 13 (18) from adapter plate (1); remove sealing ring (16) from shaft. Place valve (adapter plate down) on a cloth or similar surface to prevent scratching; lift off cover (9) and gasket (10).
- e. Lift shaft assembly (7) from adapter plate (1).

NOTE: Be careful so that springs (5)(6) under shaft assembly are not lost.

- f. Remove bearing, Fig. 13(8) and washers (14) from shaft. Remove O-ring (4) from wiper (3).
- g. Check bearing (15) in adapter plate and bearing (13) in cover; remove bearings if replacement is necessary. If oil has been leaking from shaft bore in cover, remove bearing (13) and replace seal (12).

#### 3. INSPECTION

- a. Wash all parts.
- b. Inspect bearings for rough or broken needles.
- c. Replace shaft assembly if worn more than .001" (.025 mm) at bearing areas.
- d. Make certain wiper contacts adapter plate squarely and adapter plate is not



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FIG. 12 SPEED CONTROL VALVE AND LINKAGE

1. Range selector lever
2. Safety lever
3. Connecting rods
4. Speed control valve
5. Capscrew
6. Manifold
7. Capscrew
8. Rotor lever

## Hydraulic System Components

excessively grooved. Adapter plate may be machined a maximum of .040" (1.02 mm) to remove grooves.

- e. Oil passages in adapter plate and shaft assembly must be absolutely clean.

### 4. ASSEMBLY AND INSTALLATION

- a. If bearing Fig. 13 (15) was removed,

install new bearing in adapter plate; drive bearing slightly below machined surface on shaft side of adapter plate.

- b. If seal (12) washer (11) and/or bearing (13) were removed, install new parts in cover; drive bearing slightly below counterbore surface in cover.

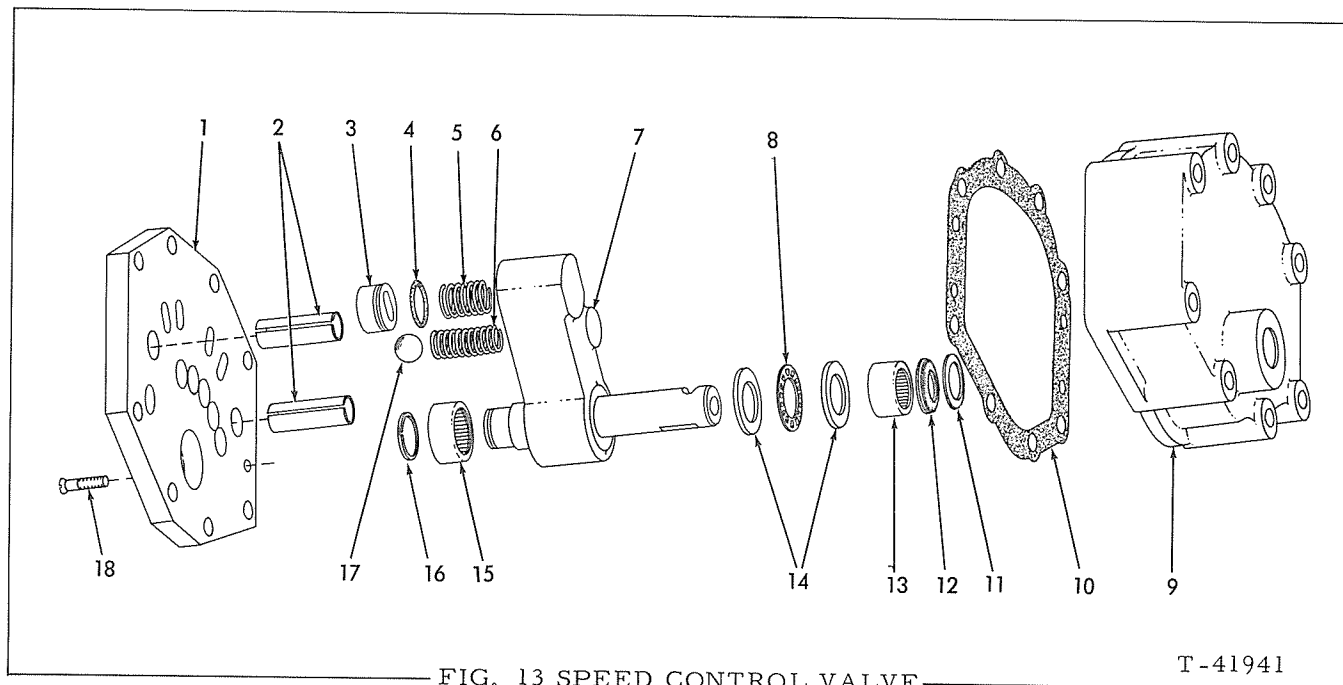


FIG. 13 SPEED CONTROL VALVE

T-41941

1. Adapter plate
2. Roll pin
3. Wiper
4. O-ring
5. Wiper spring
6. Detent ball spring

7. Shaft assembly
8. Thrust bearing
9. Cover
10. Gasket
11. Washer
12. Seal

13. Bearing
14. Thrust washers
15. Bearing
16. Sealing ring
17. Detent ball
18. Screw

- c. Install O-ring, Fig. 13 (4) on wiper (3). Insert wiper spring (5) and wiper (3) into hole in shaft extension; depress wiper spring until wiper O-ring enters hole in shaft extension. Hold wiper in this position and install detent spring (6) into other hole in shaft extension. Place detent ball (17) in center detent hole in adapter plate; install shaft assembly on adapter so that detent spring is against ball.
- d. Install thrust bearing (8) and thrust washers (14) on shaft.
- e. Hold shaft assembly against adapter plate. Install new gasket (10) on adapter plate; install cover (9) over shaft assembly and against adapter plate. Secure cover with screw (18).
- f. Install sealing ring (16) on end of shaft.

- g. Install two capscrews through holes in valve assembly to serve as guide screws. Install valve assembly (with new gasket) on manifold, Fig. 12 (6). Tighten capscrews (5) securely.
- h. Install woodruff key in shaft; install lever (8) on shaft and tighten cap-screw (7).
- i. Position lever (8) in center detent position and lock selector lever (1) in NEUTRAL position.
- j. Adjust and connect valve linkage.

### C. PRESSURE RELIEF VALVE

NOTE: Refer to HYDRAULIC OPERATION for description and operation of valve.

The hydraulic system contains three pressure

## Hydraulic System Components

relief valves which are enclosed in a common housing on top of transmission case. Each relief valve may, if necessary, be removed from valve housing individually and repaired without disturbing other relief valves or removing valve housing from transmission case. This is not recommended. The valve housing is quite accessible and easy to remove; therefore, it is recommended that the valve housing be removed whenever repairs are made to any relief valve in order to keep valve components as clean as possible.

### 1. REMOVAL AND DISASSEMBLY

- a. Remove floor plates and tilt seat forward. Clean valve and surrounding area.
- b. Refer to Fig. 14; disconnect oil lines from valve housing (4); cover openings to prevent entrance of dirt.
- c. Remove capscrews from top of valve housing; remove valve housing and gasket from transmission case.

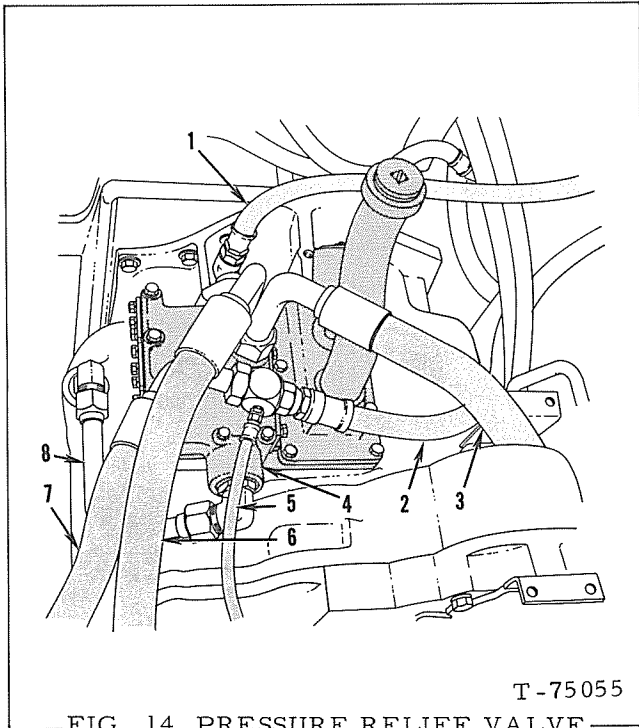
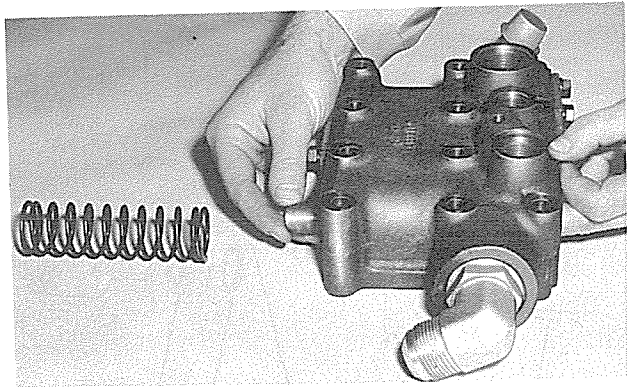


FIG. 14 PRESSURE RELIEF VALVE  
INSTALLED.

1. Oil line to speed control valve (clutch apply)
2. Oil line to speed control valve (clutch lube)
3. Oil line to torque converter
4. Pressure relief valve housing
5. Oil line to pressure gauge on cowl (clutch lube)
6. Main oil supply line (from pump)
7. Oil line from heat exchanger
8. Oil return line to sump

- d. Thoroughly clean outside of valve; place valve on a clean work bench.
- e. Refer to Fig. 16; remove opposing covers (1) from each side of valve housing; push valve spring and valve spool from bore in housing, Fig. 15. Identify valve spring and spool so they will be reinstalled in their original positions. Tie any washers, Fig. 16 (3) to the spring to prevent loss. Repeat this procedure for the remaining two relief valves.
- f. Remove all fittings from valve.



T-70988

FIG. 15 REMOVING VALVE SPRING AND  
SPOOL FROM VALVE HOUSING

### 2. INSPECTION

- a. Clean all valve parts.
- b. Check each valve spool for chips or roughness around sealing area; replace if necessary.
- c. Install each spool in its bore in housing; spool must slide freely, but must not have any side play.
- d. Check tension of valve springs; (refer to Fits and Tolerances for specified tension). Replace any weak spring.

NOTE: Flat washers, Fig. 16 (3) are .109" (2.77 mm) thick. At least one washer is required beneath each spring (spool end); adding an additional washer will raise pressure.

### 3. ASSEMBLY AND INSTALLATION

- a. Clean all parts and apply a light coat of oil on them before assembly.
- b. Refer to Fig. 16, install spools (6)

## Hydraulic System Components

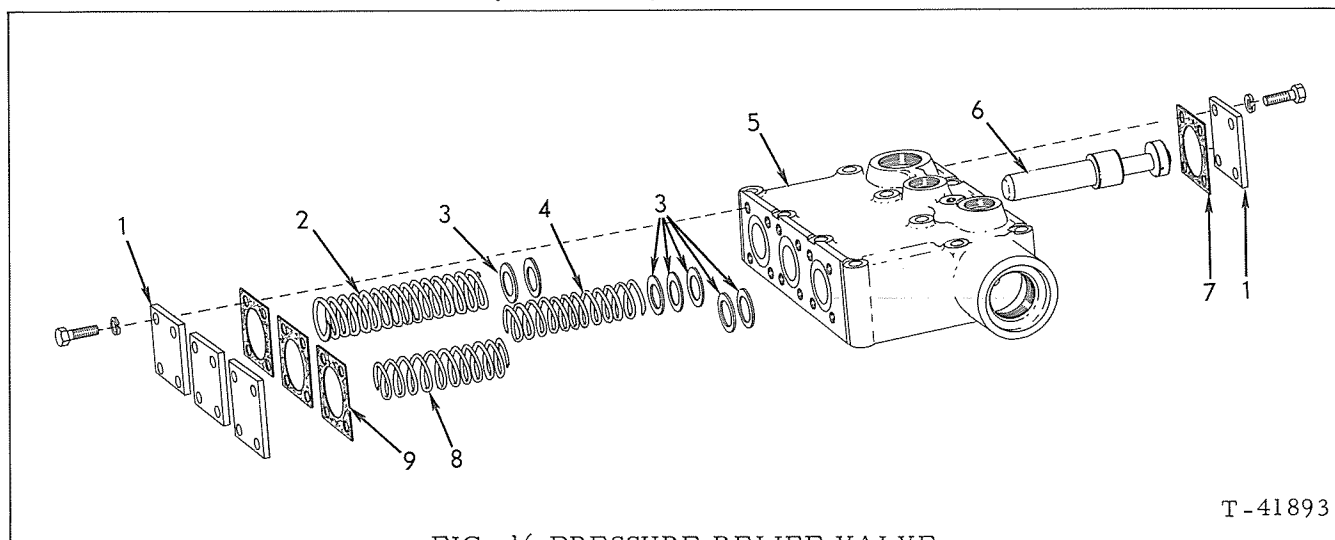


FIG. 16 PRESSURE RELIEF VALVE

T-41893

1. Cover
2. Transmission clutch apply pressure spring
3. Flat washers
4. Torque converter safety relief valve spring
5. Housing

6. Spool
7. Gasket
8. Torque converter and transmission clutch lube pressure spring
9. Gasket

in housing, with grooved end of spools below ports in top of housing. Install covers (1) and gaskets (7) at grooved end of spools.

- c. Turn valve housing so open side is facing up. Install necessary washers, Fig. 16 (3) on valve spools (at least one washer must be installed on each spool).
- d. Install valve springs in their proper positions; compress springs and install covers (1) with gaskets (9).
- e. Install fittings in housing.
- f. Install valve housing (with new gasket) on transmission case, Fig. 14. Connect oil lines to valve.
- g. Test hydraulic system pressures (refer to PRESSURE CHECKING.)

### D. VENTURI PUMP

Venturi pump returns excess oil from torque converter and engine flywheel housing to sump in transmission; pump is mounted on upper left side of transmission. High pressure oil entering pump flows through a restrictor and "siphons" oil from engine flywheel housing and torque converter; oil returns to transmission through external oil line. Venturi pump has no moving parts and therefore should cause no trouble. However, if restrictor becomes

clogged, oil leakage through torque converter rear bearing retainer and oil build-up in engine flywheel housing will be evident. If this happens, venturi pump restrictor should be removed and cleaned or replaced.

### E. PUSH-START PUMP - SPECIAL EQUIPMENT

#### 1. REMOVAL AND DISASSEMBLY

- a. Pump is attached to bevel pinion shaft front cover, Fig. 16a, Remove transmission bottom guard to gain access to pump. Disconnect oil lines from pump; remove pump from transmission.
- b. Place pump on a clean work bench and mark housing sections to facilitate reassembly. Refer to Fig. 16b, remove capscrews from pump housings; separate housings by tapping with soft hammer. Mark gears (5) (12) so they may be re-installed in original position if reused.
- c. Remove snap rings, Fig. 16b (11) and drive gear (12) from drive shaft. Remove key (13) from drive shaft and pull drive shaft from adapter housing (2).
- d. Remove needle bearings from end cover housing (10) and adapter housing (2). Remove snap rings (4) and driven gear (5) from driven shaft.

## Hydraulic System Components

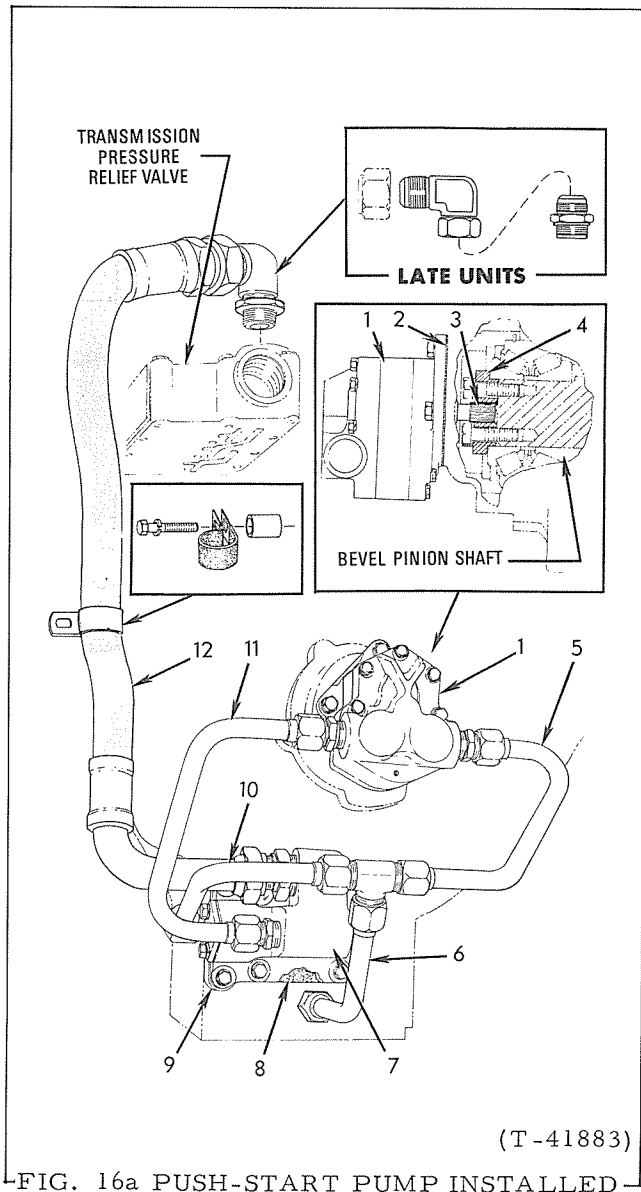


FIG. 16a PUSH-START PUMP INSTALLED

### 2. INSPECTION, ASSEMBLY, AND INSTALLATION

- Clean and inspect pump components; replace shafts and bearings if shafts are worn .001 (.025 mm) at bearing area; replace needle bearings if .021" (.533 mm) feeler gauge can be inserted between needles; replace main housing if gear wear pattern extends beyond dowel on suction side.
- Install needle bearings, Fig. 16b(3) in adapter housing (2) and end cover housing (10). Drive or press bearings .083" (2.11 mm) below machined surface of housings.
- Install drive shaft, Fig. 16b (1) and

driven shaft (6) in adapter housing. Install keys (7) (13), gears (5) (12), and gear retaining snap rings (4)(11) on their respective shaft.

- Install main housing (9) and end cover housing (10) over pump gears and shafts and install capscrews. Torque 1/4" (6.35 mm) capscrews to 10 lbs. ft. (14.88 kg-m); torque 5/16" (7.87 mm) capscrews to 20 lbs. ft. (29.76 kg-m).
- Install pump (with new gasket) on bevel pinion shaft front cover. Connect oil lines to their respective fittings in pump.
- Start engine and check for oil leaks; stop engine and correct any leaks. Install transmission bottom guard.



## Hydraulic System Components

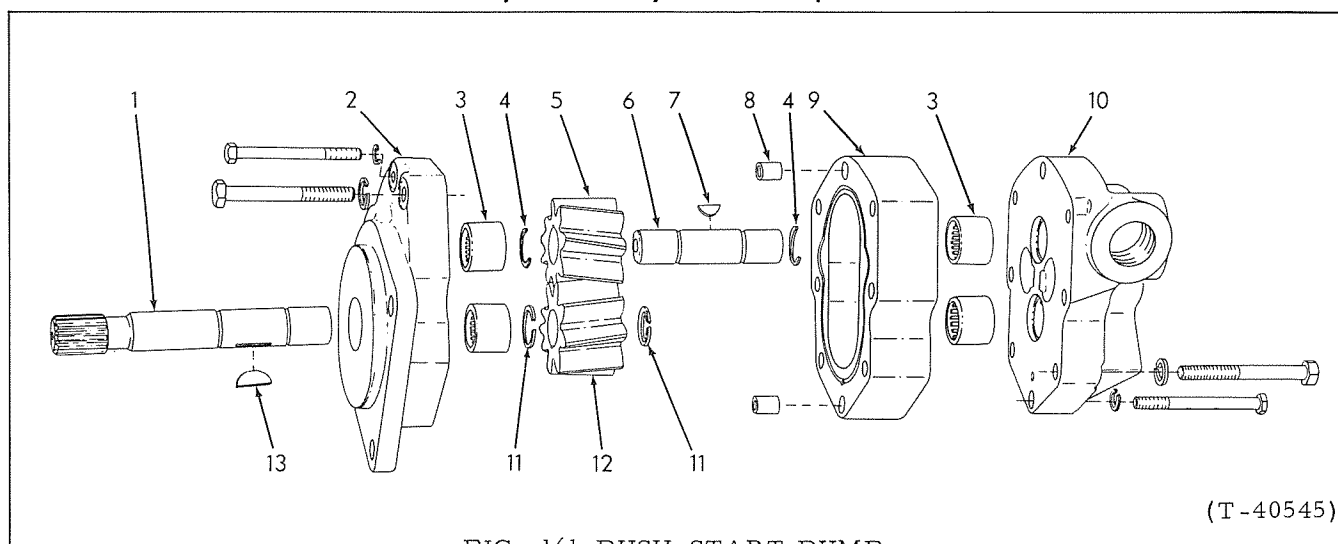


FIG. 16b PUSH-START PUMP

- |                    |                 |                       |
|--------------------|-----------------|-----------------------|
| 1. Drive shaft     | 5. Driven gear  | 9. Main housing       |
| 2. Adapter housing | 6. Driven shaft | 10. End cover housing |
| 3. Needle bearings | 7. Key          | 11. Snap rings        |
| 4. Snap rings      | 8. Hollow dowel | 12. Drive gear        |
|                    |                 | 13. Key               |

### F. DIVERTER VALVE - SPECIAL EQUIPMENT

#### 1. REMOVAL AND DISASSEMBLY

- The diverter valve is located on front of transmission case, beneath the push-start pump. Remove transmission bottom guard from main frame to gain access to the diverter valve.
- Remove oil drain plug from transmission case and allow oil to drain; reinstall drain plug and tighten securely.
- Disconnect oil lines from diverter valve; remove diverter valve from transmission case.

- Place diverter valve on a clean work bench; remove cover plate Fig. 16c (1) and gasket (2); withdraw spring (3) and spool (4) from housing.

Do not remove snap ring (6) unless damaged.

#### 2. INSPECTION, ASSEMBLY, AND INSTALLATION

- Clean valve components thoroughly. Inspect spool and housing bore for scratches and free movement of plunger in bore; inspect spring for cracks or weakness; inspect ground face of housing for smoothness.
- Insert spool, Fig. 16c (4) in housing against snap ring (6); insert spring (3) over spool end.
- Install cover plate (1) and gasket (2); tighten capscrews securely.
- Install diverter valve (with new gasket) on transmission case. Connect oil lines to their respective fittings in valve.
- Fill hydraulic system with specified oil. Start engine and check for oil leaks; stop engine and correct any leaks. Install transmission bottom guard.

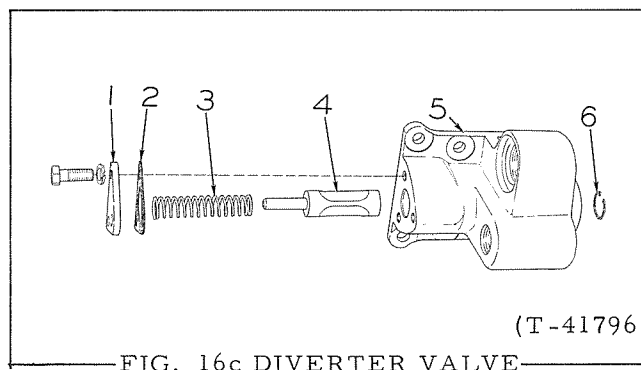


FIG. 16c DIVERTER VALVE

- |                |              |
|----------------|--------------|
| 1. Cover plate | 4. Spool     |
| 2. Gasket      | 5. Housing   |
| 3. Spring      | 6. Snap ring |

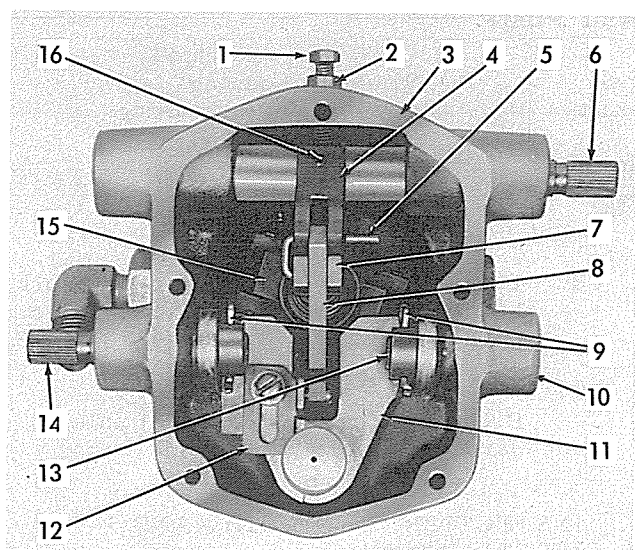
## Hydraulic System Components

### 6. GROUND SPEED GOVERNOR (SPECIAL EQUIPMENT)

Ground speed governor, mounted on upper left side of transmission, automatically maintains constant speed of unit; governor setting is controlled by operator.

#### 1. REMOVAL AND DISASSEMBLY

- a. Remove seat assembly. Disconnect control rods and oil lines from governor; remove governor from transmission case.
- b. Remove housing cover and gasket; remove high speed adjustment screw and jam nut, Fig. 17.



T-35103

FIG. 17 GROUND SPEED GOVERNOR -  
COVER REMOVED

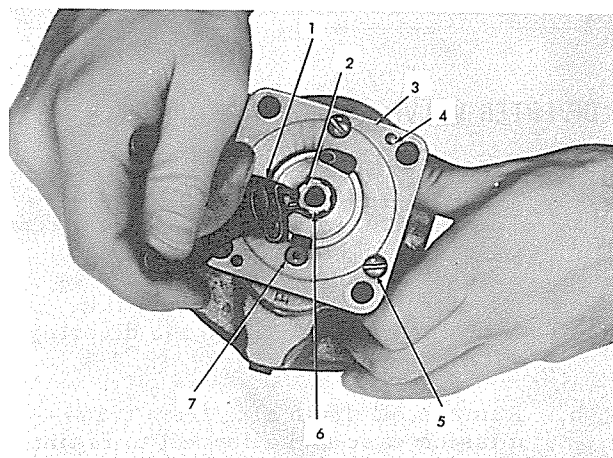
1. High speed adjustment screw
2. Jam nut
3. Housing
4. Speed control lever
5. Pin
6. Speed control shaft
7. Fork
8. Lever
9. Cotter pins
10. Plug
11. Terminal lever assembly
12. Droop adjustment bracket
13. Terminal lever stub shaft
14. Terminal lever shaft
15. Ballarms
16. Roll pin

- c. Remove speed control and terminal shaft levers. Refer to Fig. 17, remove lever pin (5) and roll pin (16);

remove speed control shaft, ballhead plunger (with fork, spring, and bearing assembly), floating lever, and speed control lever.

- d. Remove cotter pins, Fig. 17 (9), terminal shaft Fig. 19 (41) and stub shaft (18). Remove terminal lever assembly, power piston pin (39) and piston (40) from housing.
- e. Remove ballhead shaft snap ring, Fig. 18; pull ballhead assembly from housing.
- f. Remove base, Fig. 19 (2), sealing ring (3), and spacer (4); remove oil inlet plug (42), spring (11), and sleeve (43).

NOTE: Do not remove terminal shaft bearings, Fig. 19 (19) or speed control shaft bearings (16) unless shafts are excessively worn.



T-35117

FIG. 18 REMOVING BALLHEAD SHAFT  
SNAP RING

1. Pliers
2. Snap ring
3. Base
4. Dowel
5. Screw
6. Ballhead shaft
7. Stud

#### 2. INSPECTION

Clean all components in clean solvent and dry with compressed air. Inspect speed control shaft and terminal shafts for wear; if diameter of surfaces contacting bearings is .372" (9.44 mm) or less, shafts and bearings should be replaced. Check power piston for wear, scoring, or grooves. Piston diameter should not be less than .748" (18.9mm); replace if

## Hydraulic System Components

necessary. Inspect ballhead valve plunger for nicking or chipping on land edges; edges must be sharp and clean and contact surfaces should be smooth and free of scoring. Install ballhead valve plunger into ballhead shaft and check for free movement within ballhead shaft. Replace valve plunger if diameter is less than .249" (6.32mm). It is advisable to install new oil seals and gaskets when assembling governor.

### 3. ASSEMBLY

- a. If speed control shaft and terminal shaft bearings were removed, install speed control shaft bearings so inner ends of bearings are .507" to .522" (12.87-13.25mm) apart and equidistant from centerline of ballhead shaft bore. Install terminal shaft bearings so inner

ends of bearings are 2.573" to 2.588" (65.3-65.7mm) apart and equidistant from power piston bore. Ream bearings to .3755"-.3765" (9.53-9.56mm) after installation.

- b. Install oil inlet sleeve, Fig. 19 (43) and spring (11) in bore; install oil inlet plug (42) with washer (12).
- c. Install spacer Fig. 19 (4) and stud (6); install base (2) on housing (use new sealing ring).
- d. Install ballhead assembly Fig. 19 (20), power piston (40) and pin (39) in housing; install ballhead snap ring, Fig. 18.
- e. Install shaft oil seals in their respective bores (sealing lip of seals directed inward); lubricate seals freely.

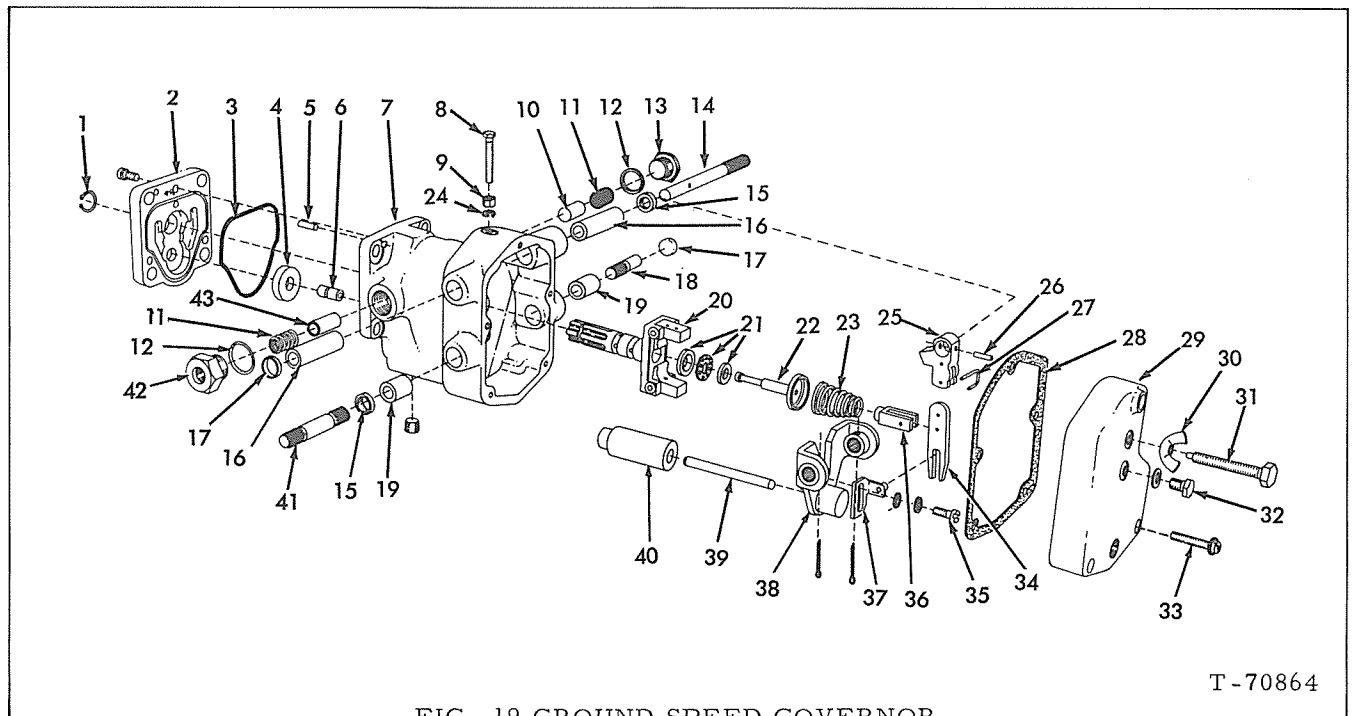


FIG. 19 GROUND SPEED GOVERNOR

- |                                   |                                 |                                |
|-----------------------------------|---------------------------------|--------------------------------|
| 1. Snap ring                      | 15. Oil seal                    | 29. Cover                      |
| 2. Base                           | 16. Speed control shaft bearing | 30. Wing nut                   |
| 3. Sealing ring                   | 17. Plug                        | 31. Low speed adjustment screw |
| 4. Spacer                         | 18. Terminal lever stub shaft   | 32. Vent capscrew              |
| 5. Dowel                          | 19. Terminal shaft bearing      | 33. Screw                      |
| 6. Stud                           | 20. Ballhead                    | 34. Floating lever             |
| 7. Housing                        | 21. Bearing assembly            | 35. Droop adjustment screw     |
| 8. High speed adjustment capscrew | 22. Plunger                     | 36. Fork                       |
| 9. Jam nut                        | 23. Spring                      | 37. Droop adjustment bracket   |
| 10. Plug                          | 24. Washer                      | 38. Terminal shaft lever       |
| 11. Spring                        | 25. Speed control lever         | 39. Pin                        |
| 12. Washer                        | 26. Roll pin                    | 40. Piston                     |
| 13. Plug                          | 27. Pin                         | 41. Terminal shaft             |
| 14. Speed control shaft           | 28. Gasket                      | 42. Plug                       |
|                                   |                                 | 43. Sleeve                     |

## Hydraulic System Components

- f. Refer to Fig. 17, place terminal lever assembly (11) in housing; install terminal lever shafts and secure to terminal lever assembly with cotter pins (9). Install cup plug (10) in stub shaft bore.
- g. Move droop adjustment bracket to maximum droop position, Fig. 20; secure with droop adjustment screw.
- h. With ballarms, Fig. 17 (15) in collapsed position, install thrust bearings, Fig. 19 (21), ballhead valve plunger (22), spring (23), and ballhead spring fork (36) on ballhead assembly.
- i. Place speed control lever, Fig. 17 (4) in housing; install speed control shaft (6) and secure to lever with roll pin (16).
- j. Position floating lever Fig. 17 (8) on droop adjustment bracket (12), ballhead spring fork (7), and speed control lever (4); secure floating lever with pin (5). Lock pin by bending end.
- k. Install housing cover (with new gasket).

### 4. ADJUSTMENT AND INSTALLATION

- a. Turn high speed adjustment screw, Fig. 20 (2) in or out until top of adjustment screw head is .75" (19.05 mm) above housing, DIM. "A"; lock capscrew.
- b. Install low speed adjustment capscrew Fig. 20 (3) w/wing nut; turn capscrew in until it is approximately .88" (22.35 mm) above housing cover.
- c. Turn terminal shaft (6) clockwise as far as possible; install terminal shaft lever (5) with centerline of yoke pin hole 1.34" (34.02 mm) DIM. "B" to the rear of the terminal shaft centerline.
- d. Turn speed control shaft, Fig. 20 (7) clockwise as far as possible; install speed control shaft lever (4) with centerline of yoke pin hole .88 in. (22.35 mm) DIM. "C" above centerline of speed control shaft.
- e. Install governor on transmission case (use new gasket); connect governor oil lines. Move engine controls to low idle position (do not start engine). Hold terminal shaft lever so yoke pin hole centerline is .94" (23.88 mm) rear of vertical; adjust length of lever control rod so swivel pin on rear end of control rod slips easily through yoke pin hole in terminal shaft lever. Secure swivel pin with cotter pin.

- f. Hold speed control shaft lever all the way up; adjust length of governor control rod so swivel pin is slip fit in bellcrank lever (overtravel assembly fully extended). Install swivel pin.
- g. Attach return spring to terminal shaft lever.
- h. Start engine and allow it to warm up. Move governor hand control lever forward as far as possible; pull throttle lever back slightly from low idle stop. Turn low speed adjustment capscrew, Fig. 20 (3) in until terminal shaft lever (5) moves forward. Back capscrew out until terminal shaft contacts internal stop; back screw out an additional 1/2 turn and lock. Adjust engine control linkage to obtain specified low and high idle speeds (refer to Operating Instructions and Field Maintenance Manual)

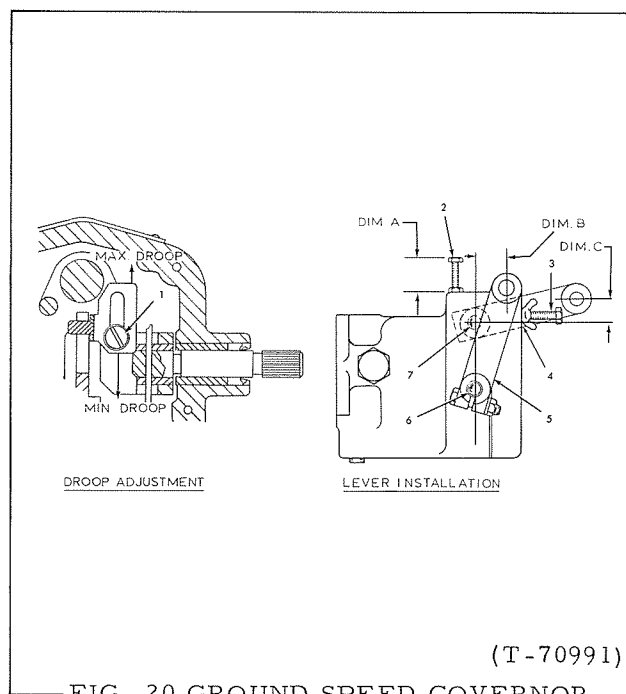


FIG. 20 GROUND SPEED GOVERNOR—  
ADJUSTMENTS

1. Droop adjustment screw
2. High speed adjustment capscrew
3. Low speed adjustment capscrew
4. Speed control shaft lever
5. Terminal shaft lever
6. Terminal shaft
7. Speed control shaft

DIM. "A" .75" (19.05mm)  
 DIM. "B" 1.34" (34.02mm)  
 DIM. "C" .88" (22.35mm)

### H. HEAT EXCHANGER

The heat exchanger must be removed, cleaned, and inspected whenever major

## Hydraulic System Components

repairs are made to the transmission or torque converter. Complete instructions

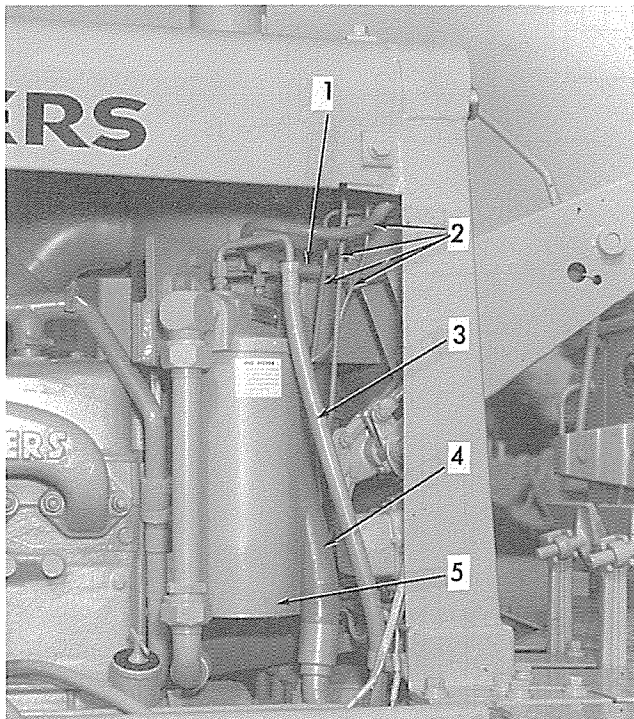
for servicing is contained in Engine Service Manual, Form 645121.

### TOPIC 5 - TORQUE CONVERTER

#### A. REMOVAL

The following procedures cover torque converter removal in a general rather than specific way. Specific locations of disconnect points are left to the discretion of the mechanic and are determined to a great extent by the tools which are available to him.

1. Turn electrical system master switch off.
2. Remove exhaust stack and engine hood. Disconnect air inlet hose and air cleaner restriction indicator hose from air cleaner.



(T-75020)

FIG. 21 COWL INSTALLED

1. Cowl bracing rod
2. Gauge lines
3. Oil line to venturi pump
4. Steering control rods
5. Torque converter/transmission filter
3. Disconnect decelerator and governor control rods from levers beneath cowl.
4. Refer to Fig. 21, disconnect instrument panel gauge lines from front of cowl; disconnect wires in wiring harness.
5. Remove engine temperature gauge tube from water outlet manifold and install a plug to prevent coolant leakage.
6. Disconnect steering control vertical rods (4) from bellcrank beneath cowl. Remove capscrews attaching bellcrank to bottom of cowl.
7. Disconnect cowl bracing rod (1) from cowl.
8. Attach hoist to cowl; remove capscrews attaching cowl to fenders; remove cowl.
9. Remove floor plates.
10. Remove transmission guards from main frame; drain oil from transmission case..
11. Remove floor supporting channel (with shims) and decelerator pedal as an assembly.
12. Disconnect and remove steering control lower (horizontal) rods and front bellcrank.
13. Disconnect all oil lines and vent line from torque converter housing; cover openings to prevent entrance of dirt.
14. Disconnect brake control linkage and parking brake bar. Remove brake pedals, shafts, and brackets as an assembly.
15. Unlock and remove capscrews attaching front and rear yokes to universal joint, slide front yoke forward and remove universal joint.
16. Attach suitable hoist to torque converter and remove capscrews attaching torque converter to flywheel housing; carefully lift torque converter from tractor.

# Torque Converter

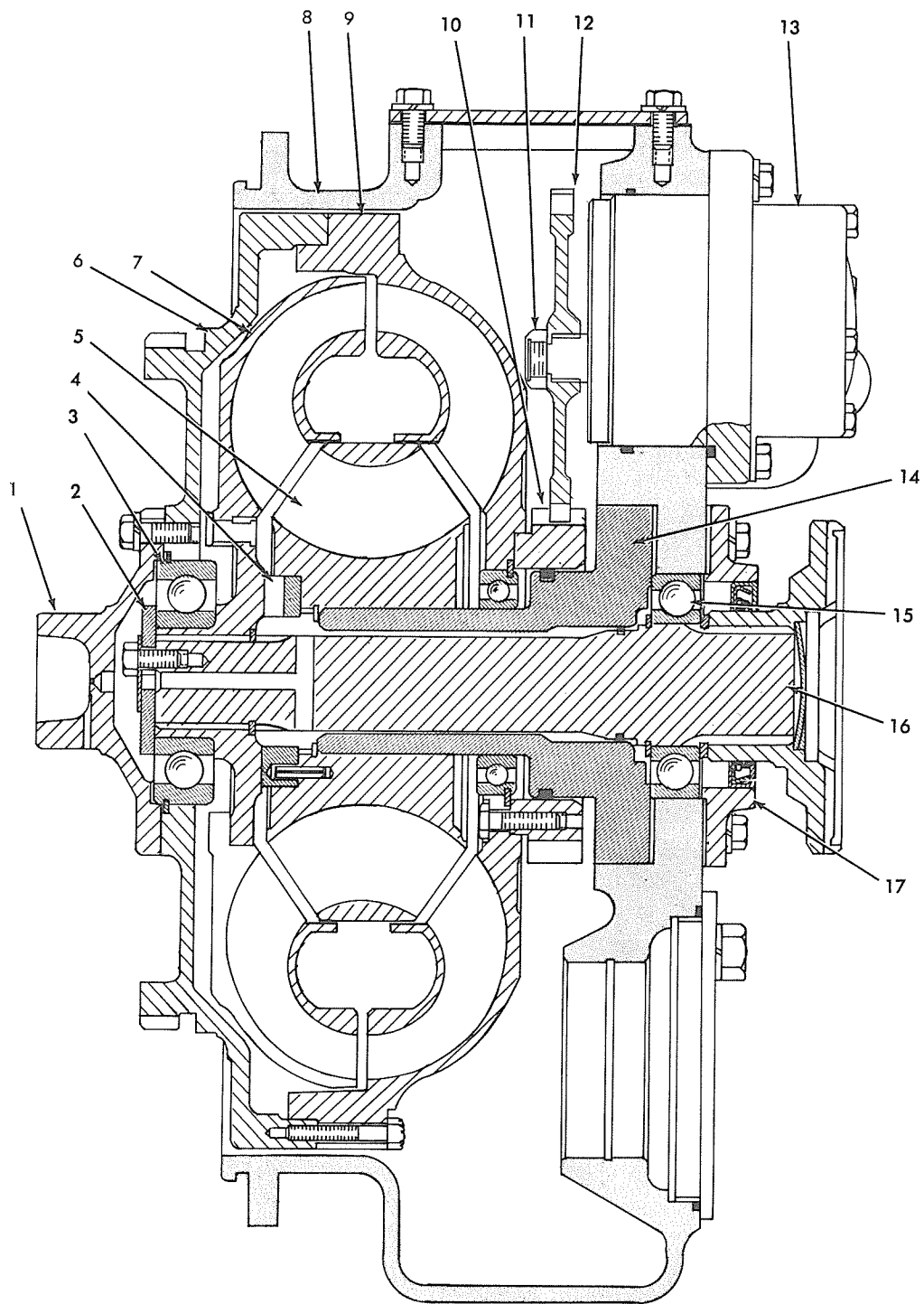


FIG. 22 TORQUE CONVERTER

(T-75026)

- |                     |   |  |
|---------------------|---|--|
| 1. Input hub        | 8. Converter housing                              | 13. Torque converter/transmission pump |
| 2. End washer       | 9. Impeller                                       | 14. Output hub                         |
| 3. Front bearing    | 10. Accessory drive gear                          | 15. Rear bearing                       |
| 4. Spacer           | 11. Gear retaining nut                            | 16. Output shaft                       |
| 5. Stator           | 12. Torque converter/transmission pump drive gear | 17. Rear bearing retainer              |
| 6. Rotating housing |   |  |
| 7. Turbine          |   |  |

## Torque Converter

### B. DISASSEMBLY

1. Remove capscrews and lift input hub, Fig. 22 (1) from rotating housing (6). Keep shims, Fig. 26 (2) intact and attach them to input hub for use during assembly.
2. Unlock and remove capscrews attaching end washer, Fig. 22 (2); remove washer.
3. Lift rotating housing, turbine, stator, impeller, and accessory drive gear from converter housing as an assembly.
4. Remove capscrews attaching impeller assembly to rotating housing and lift off impeller. Do not remove capscrews attaching accessory drive gear to impeller unless impeller, gear, or bearing must be replaced (capscrews are coated with locking compound; the inconvenience of re-coating capscrews at assembly will be avoided if capscrews are not removed).
5. Lift stator, Fig. 22 (5) and spacer (4) out of turbine; do not attempt to remove snap ring from stator bore unless it is damaged.
6. Use suitable driver to remove turbine hub from front bearing, Fig. 22 (3); tap bearing out front of rotating housing.
7. Remove and discard pump drive gear retaining nut, Fig. 22 (11); pull gear (12) from shaft. Remove capscrews attaching pump to converter housing; use 3" (76mm) long pusher screws to remove pump from housing.

#### CAUTION

Pump is close fit in bore; turn pusher screws in evenly in no more than 1/2 turn increments while removing. If pump becomes cocked and will not move, release pressure from pusher screws and tap rear of pump lightly; after pump is straightened, continue tightening pusher screws to remove pump. Tapping lightly on front end of pump while tightening pusher screws may aid removal but pump may be damaged if shaft is struck.

8. Slide universal joint front yoke from output shaft; remove rear bearing retainer, Fig. 22 (17). Keep shims, Fig. 26 (25) intact and attach them to bearing retainer for use during assembly.
9. Tap front end of output shaft to remove it from housing. Remove both snap rings and press bearing, Fig. 22 (15) off rear end of shaft.
10. Inspect output hub (refer to INSPECTION). If output hub must be replaced, use suitable tools assembled as shown in Fig. 23 to press output hub out front of housing. Mark position of output hub before removing.

#### CAUTION

Output hub is .002" - .006" (0.050-1.52 mm) tight in housing; housing may be damaged if output hub is not removed using method shown in Fig. 23.

11. Remove sealing rings, Fig. 26 (21) (17) from output shaft and output hub; press oil seal out of rear bearing retainer.

## Torque Converter

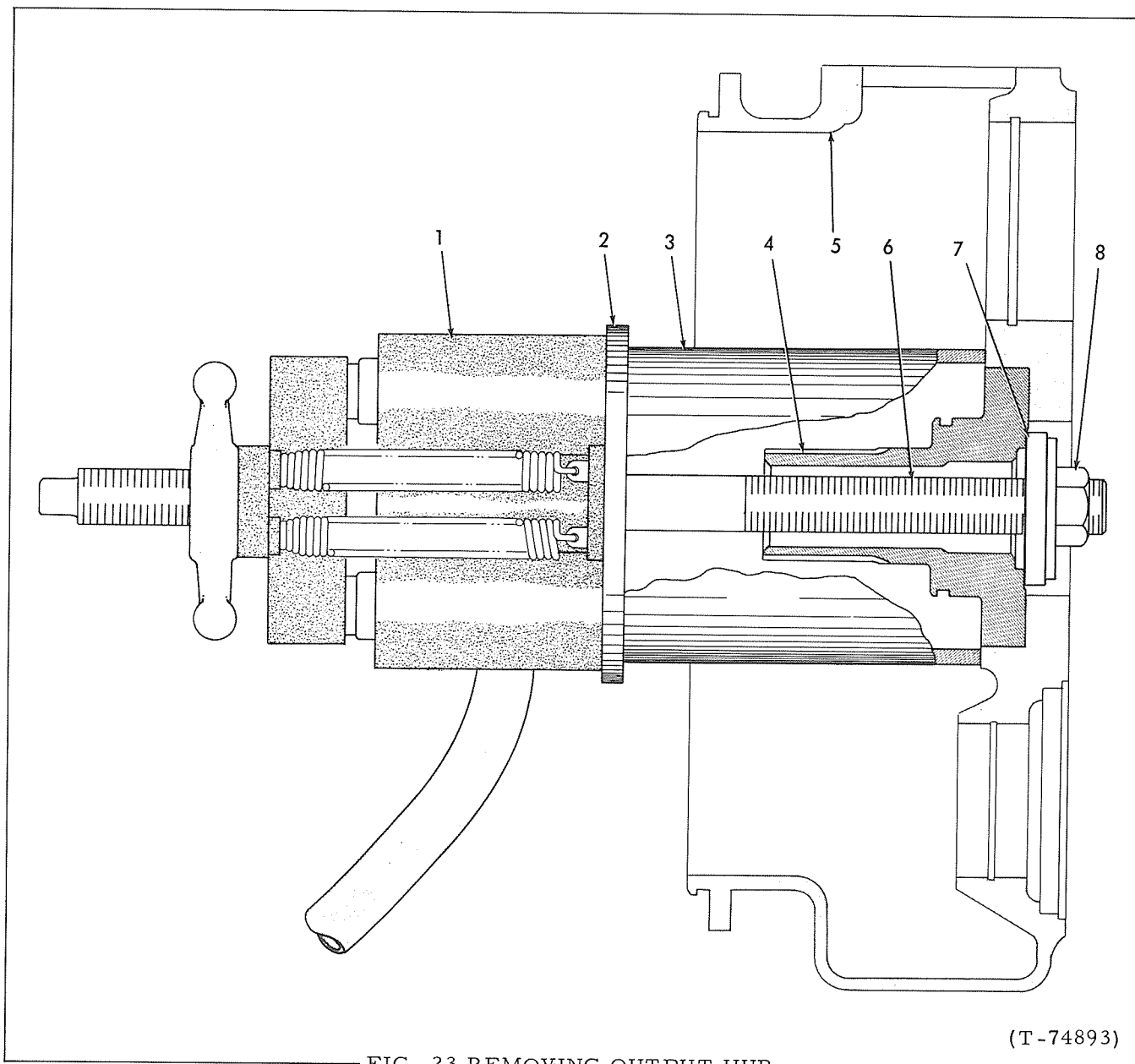


FIG. 23 REMOVING OUTPUT HUB

- |   |  |
|---|--|
| 1. Hydraulic ram  | 5. Housing   |
| 2. Plate (.50" (12.7mm) thick)  | 6. Forcing screw   |
| 3. Tube (6.50"-6.60" (165-167.6mm) I.D.; .25" (6.3mm) wall thickness) | 7. Plate (3.30" - 3.40" (81.2-86.3mm) O.D.; .50" (12.7mm) thick) |
| 4. Output hub   | 8. Nut w/flat washer   |

### C. INSPECTION

1. TURBINE, IMPELLER, AND STATOR. Inspect blades for looseness, nicks, burrs or binding. If blades are nicked, burred, or slightly bent, they may be filed or stoned to smooth the edges; if blades are loose, wheel must be replaced.

#### CAUTION

Never attempt to peen or stake any loose blades.

Replace stator if splines are twisted or too rough to dress down with file.



## Torque Converter

2. OIL SEAL, SEALING RINGS, AND O-RINGS. Replacement at rebuild is recommended. However, any or all may be reused at inspector's option if oil seal lip is pliable, not damaged, and held in proper position by spring; if large sealing ring is pliable and not rounded at corners; if small sealing ring is not broken, severely grooved, or rounded at corners; or if O-rings are pliable and not cut.
3. OUTPUT SHAFT. Inspect for rough or twisted splines; dress rough spots with file. Clean oil passages.
4. STATOR SPACER. Thickness of spacer when new is .635"-.645" (16.12-16.38mm); replace if thickness is less than .620" (15.74mm).
5. BEARINGS. Bearings must roll smoothly and be free of pitted, cracked, or worn balls, rollers, and races; retainers must not be dented or damaged. Badly worn ball bearings can be detected by presence of excessive end play between outer and inner races. Hold one race steady and move other race endwise; compare difference in movement of used bearing with a new bearing. Check outer and inner races for indications of bearing creepage. This can be detected by marks on bearing races or on bearing area of bore or shaft where bearing has been used. If bearings are to be reused, keep bearings clean, well lubricated, and wrapped in clean oil proof paper to prevent rusting and entrance of dirt. When installing new bearings, do not remove bearings from package until ready for assembling; do not wash lubricant from new bearings.
6. GEARS. Clean all gears and inspect for worn, pitted, chipped, or cracked teeth; check internal splines for galling, roughness, and wear. Replace accessory drive gear if I.D. is rough in sealing ring contact area.
7. OUTPUT HUB. Inspect for rough or twisted splines; dress rough spots with file. Replace if I.D. is severely grooved in sealing ring contact area. Clean oil passages.
8. HOUSING. Clean interior and all oil passages.
9. PUMP DRIVE GEAR RETAINING NUT. Nut must be replaced at rebuild.
10. TURBINE WHEEL HUB. Inspect for rough or twisted splines; dress rough spots with file. Replace if thrust washer contact area is severely grooved.

### D. ASSEMBLY

1. Install two guide studs (approximately 2" (50mm) long) in output hub and install gasket over guide studs. Align marks placed on output hub and housing at disassembly and start guide studs through housing. Assemble tools as shown in Fig. 24; be certain push-puller head does not cover holes which are aligned with guide studs. Press output hub into housing until bottomed; remove guide studs.

#### CAUTION

Output hub is .002"-.006" (0.050-0.152mm) tight fit in housing. Freezing output hub in dry ice for 1 to 2 hours will aid installation; freeze with guide studs installed. Housing may be damaged if output hub is not installed using method shown in Fig. 24.

2. Thickness of rear shim pack, Fig. 26 (25) must be determined at this point; proceed as follows:
  - a. Install output shaft rear bearing in housing; bottom bearing against output hub.
  - b. Install rear bearing retainer and gasket; tighten attaching capscrews securely. Oil seal may be installed in bearing retainer if desired.
  - c. Measure gap between bearing and retainer, Fig. 25, at four equally spaced places; make shim pack equal to measurement minus .002" (0.050mm) to obtain specified gap of .000"-.004" (0-0.101mm).
  - d. Remove bearing retainer and bearing; keep shim pack with retainer.

## Torque Converter

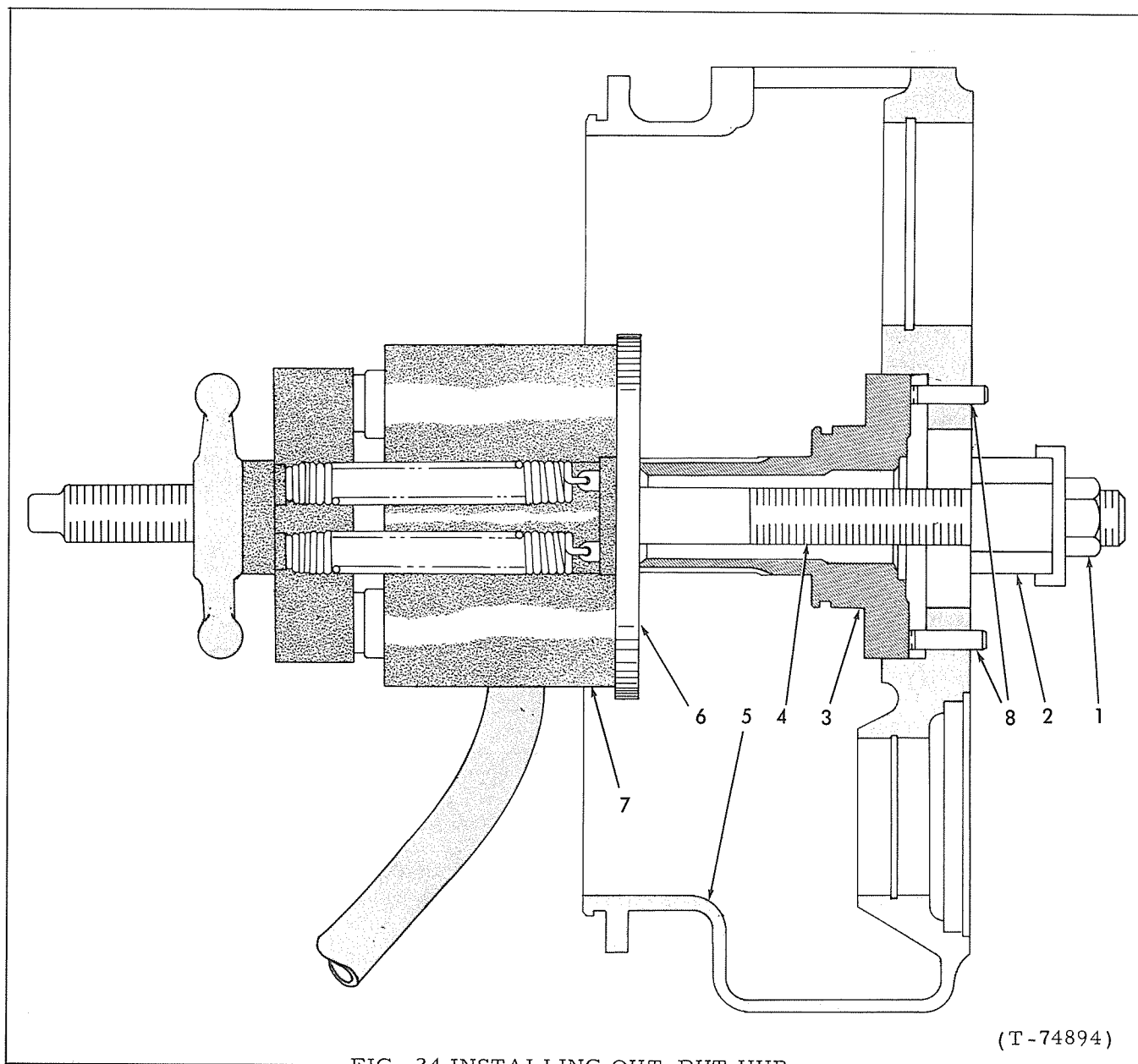


FIG. 24 INSTALLING OUT-PUT HUB

1. Nut
2. Push-puller head
3. Output hub
4. Forcing screw

5. Housing
6. Plate (.50" (12.7mm) thick)
7. Hydraulic ram
8. Guide studs

3. Install snap ring, Fig. 26 (23) in groove in output shaft; press bearing (24) on from rear of shaft against snap ring. Install other snap ring (23).

4. Install sealing ring, Fig. 26 (21) in groove in output shaft next to rear bearing. Install shaft through rear bore; seat rear bearing against output hub.

5. Tap rear oil seal, Fig. 26 (27) into rear bearing retainer with spring side of seal toward front side of retainer. Tap seal in until flush or slightly below flush with rear face of retainer.

6. Install rear bearing retainer Fig. 26 (26) with shim pack determined in step 2. Use new gasket; torque attaching capscrews to 26 to 32 lbs. ft. (3.59-4.42 kg-m).

## Torque Converter

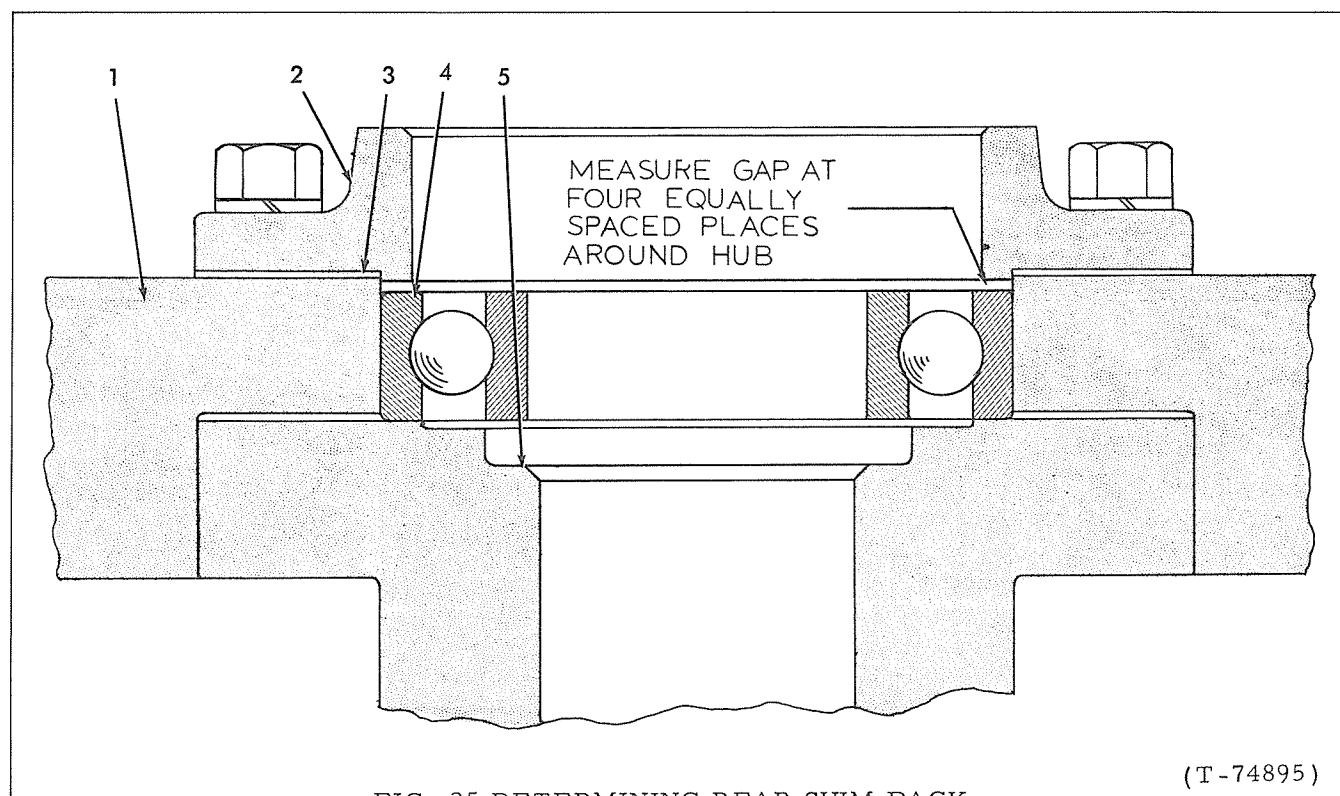


FIG. 25 DETERMINING REAR SHIM PACK THICKNESS

1. Torque converter housing
2. Rear bearing retainer
3. Gasket

4. Rear bearing
5. Output hub

7. Install O-rings, Fig. 26 (31) in groove in torque converter/transmission pump bore in housing and around pump mounting flange; do not twist or roll O-rings into position. Lubricate O-rings liberally and start pump into its bore. Use attaching capscrews to pull pump into its bore; torque capscrews to 26 to 32 lbs. ft. (3.59-4.42 kg-m) after pump is properly positioned.

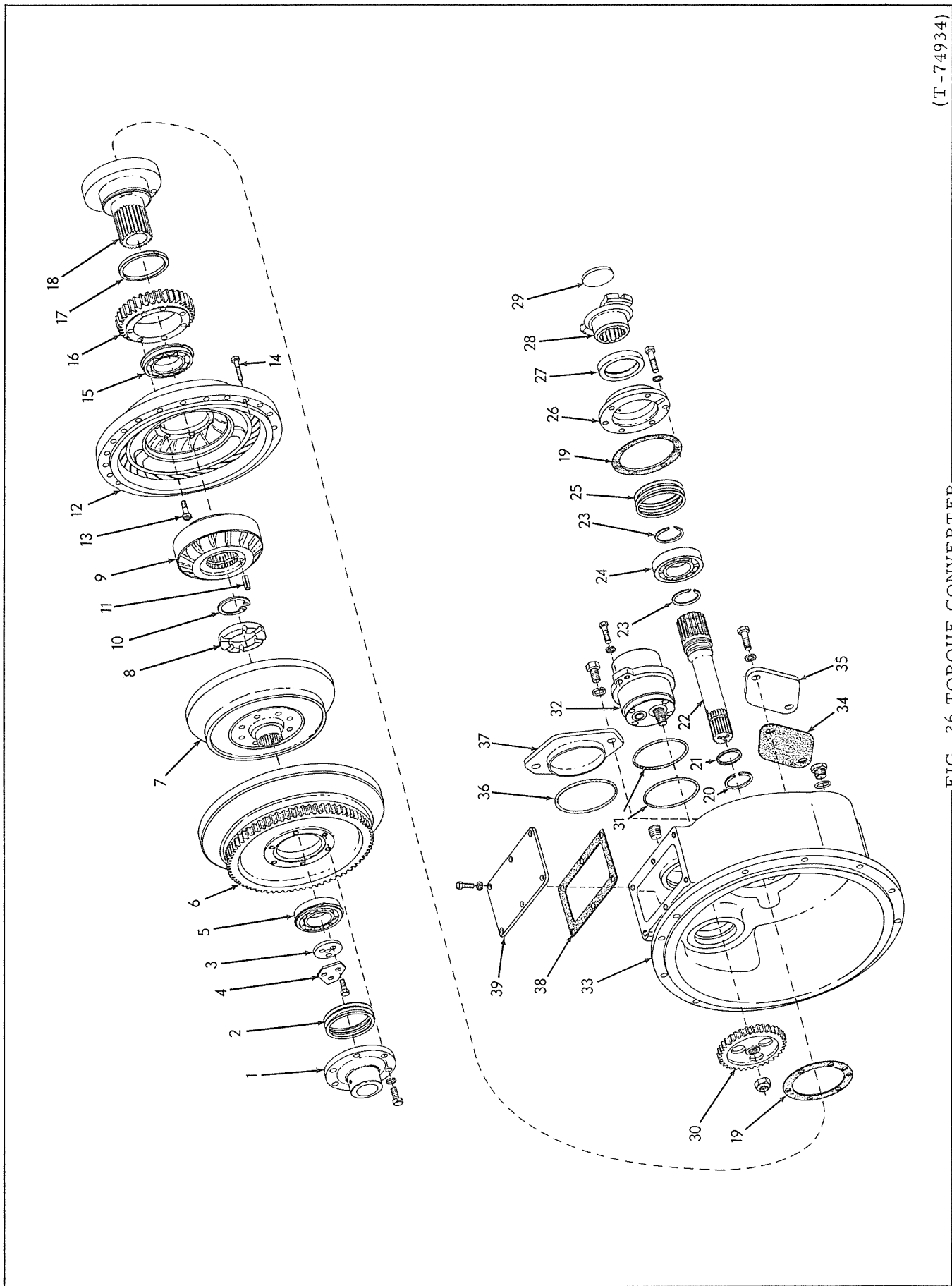
8. Install transmission pump drive gear, Fig. 22 (12), long hub toward pump. Install new gear retaining nut (11) and torque to 45 lbs. ft. (6.22 kg-m).
9. Thickness of front shim pack, Fig. 26 (2) must be determined at this point; proceed as follows:

- a. Install front bearing, Fig. 22 (3) in rotating housing (6); seat bearing snap ring in counterbore. Place original shim pack, Fig. 27 (3) and input hub (2) on bearing.
- b. Hold input hub down firmly with hand pressure; measure gap between input hub and rotating housing, Fig. 27, at four equally spaced places. Add or remove shims (3) to obtain gap of .005" to .015" (0.127-0.381mm).
- c. Remove input hub and bearing; keep shim pack with input hub.

### CAUTION

Pump is close fit in bore; turn screws in evenly in no more than 1/2 turn increments while installing. If pump becomes cocked and will not move, release pressure from screws and tap rear of pump; after pump is straightened, continue tightening screws until pump is seated against housing.

# Torque Converter



(T-74934)

FIG. 26 TORQUE CONVERTER

## Torque Converter

### LEGEND FOR FIG. 26

- |                     |                           |   |
|---------------------|---------------------------|---|
| 1. Input hub        | 15. Impeller bearing      | 28. Universal joint front yoke                    |
| 2. Shims            | 16. Accessory drive gear  | 29. Expansion plug                                |
| 3. Washer           | 17. Sealing ring          | 30. Torque converter/transmission pump drive gear |
| 4. Lock plate       | 18. Output hub            | 31. Pump O-rings                                  |
| 5. Front bearing    | 19. Gasket                | 32. Torque converter/transmission hydraulic pump  |
| 6. Rotating housing | 20. Snap ring             | 33. Housing                                       |
| 7. Turbine          | 21. Sealing ring          | 34. Gasket  |
| 8. Spacer           | 22. Output shaft          | 35. Cover   |
| 9. Stator           | 23. Snap ring             | 36. O-ring  |
| 10. Snap ring       | 24. Rear bearing          | 37. Cover   |
| 11. Roll pin        | 25. Shims                 | 38. Gasket  |
| 12. Impeller        | 26. Rear bearing retainer | 39. Cover   |
| 13. Bolt            | 27. Rear oil seal         |   |
| 14. Bolt            |                           |   |

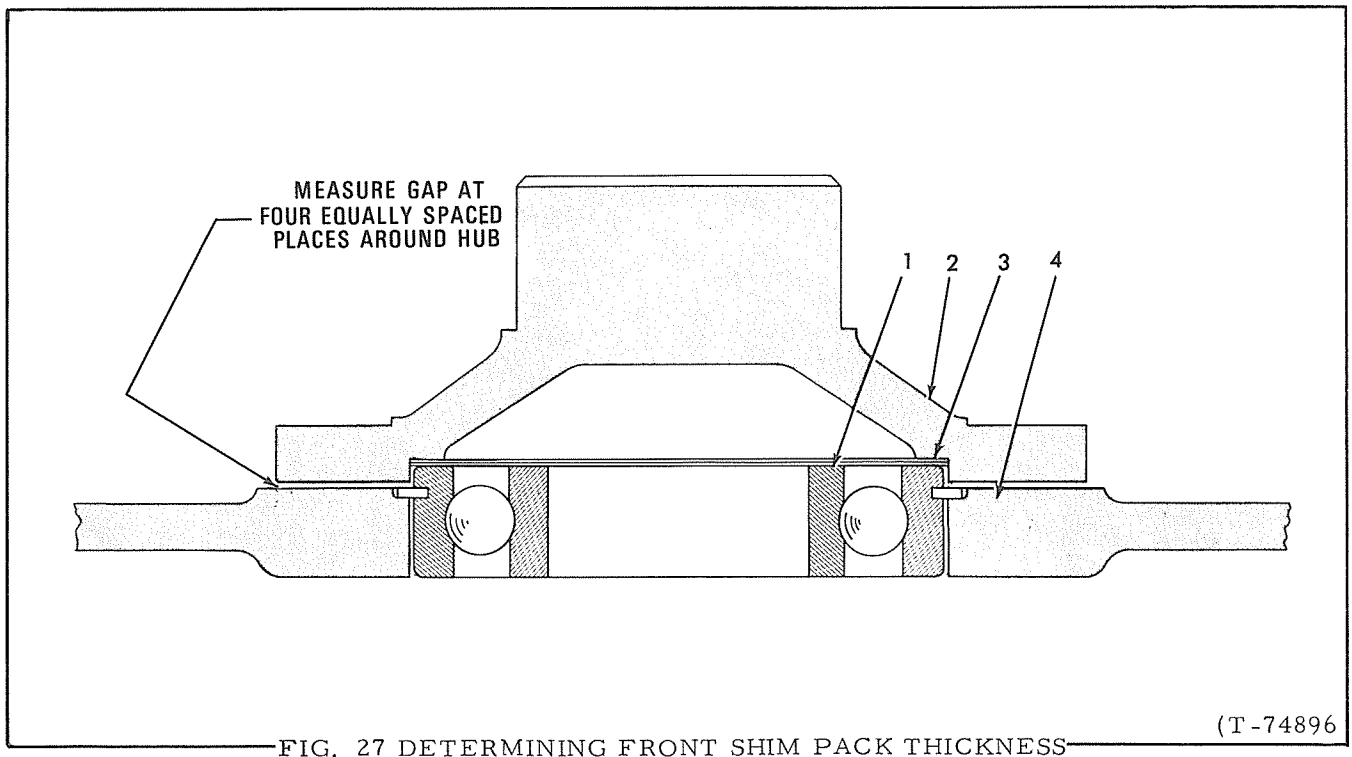


FIG. 27 DETERMINING FRONT SHIM PACK THICKNESS

- |                  |                     |
|------------------|---------------------|
| 1. Front bearing | 3. Shims            |
| 2. Input hub     | 4. Rotating housing |

10. Lay rotating housing front side down; lay turbine Fig. 26 (7) in housing.
11. Be certain snap ring, Fig. 26 (10) is seated in its groove in stator (9). Drive roll pin (11) into stator; place spacer (8) over roll pin. Place stator assembly on turbine with spacer against turbine hub.
12. Install bearing, Fig. 26 (15) from rear side of impeller; seat snap ring in counter-bore. Place accessory drive gear, Fig. 22 (10) on impeller; use attaching capscrews to pull accessory drive gear into position. Torque 5/16" capscrews to 19-23 lbs. ft. (2.63 - 3.18 kgm). Torque 7/16" capscrews to 64-77 lbs. ft. (8.8 - 10.6 kgm).

#### CAUTION

If an accessory drive gear attaching capscrew becomes loose during operation, extensive damage to torque converter will result. Original capscrews or exact replacements must be used; no substitute in capscrew grade or type is permissible. Applying a material adhesive similar to Loctite Stud-Lock 73-41 to capscrews is recommended as an added safety measure; torque capscrews evenly and exactly to specifications.

13. Install impeller on rotating housing;

## Torque Converter

torque attaching capscrews evenly to 17-20 lbs. ft. (2.35-2.76 kg-m).

14. Invert rotating housing assembly and start front bearing, Fig. 26 (5) on turbine hub. Pull bearing into position by installing end washer (3); tighten capscrews securely and lock with plate (4).
15. Install input hub, Fig. 26 (1) with shim pack determined in step 9; torque attaching capscrews to 26-32 lbs. ft. (3.59-4.42 kg-m).
16. Install covers, Fig. 26 (37)(35) on rear of housing; use new mounting O-ring and gasket; tighten capscrews securely.

### E. INSTALLATION

Before attaching torque converter to engine, make certain the torque converter driving ring on engine flywheel is in good condition.

1. Lower torque converter into tractor and engage teeth of torque converter rotating housing with splines in flywheel driving ring; secure torque converter to flywheel housing.
2. Install drive shaft universal joint and attach to front and rear yokes. Lock attaching capscrews with locking plates.
3. Install brake pedal and shaft assembly, Fig. 29; connect brake control linkage and parking brake linkage.
4. Connect oil lines and vent line to torque converters; attach supporting clips.
5. Install steering control lower (horizontal) rods and front bellcrank; connect control rods and retracting springs to steering control valve.

6. Install floor supporting channel (with shims) and decelerator pedal.
7. Install cowl, Fig. 21; attach to rear fenders. Attach cowl bracing rod (1) to cowl.
8. Attach steering control rod bellcrank to bottom of cowl; connect steering control vertical rods, Fig. 21 (4) to bellcrank.
9. Connect wires, engine control linkage, and gauge lines, Fig. 21; connect air inlet hose and air cleaner restriction indicator hose to air cleaner.
10. Install engine hood and exhaust stack.
11. Make certain transmission oil drain plug is installed and tightened; fill hydraulic system with specified oil through oil filler pipe on top of transmission case (refer to HYDRAULIC SYSTEM LUBRICANT SPECIFICATIONS CAPACITY AND SERVICE).
12. Start and run engine at low idle speed for several minutes to fill torque converter with oil. Stop engine and immediately check oil level; add oil if necessary to bring oil level within operating range marks on oil level gauge rod.

#### CAUTION

Engine must be run at low idle speed while torque converter is being filled to prevent damage to torque converter parts.

13. Operate tractor to make certain torque converter is working properly. Check for oil leaks; stop engine; correct any leaks found.
14. Install floor plates and transmission bottom guards.

## TOPIC 6 - TRANSMISSION

NOTE: The ground speed governor is available as special equipment with the power-shift transmission. The following text and illustrations include repair procedures and references to governor and governor drive; ignore these parts of the text if the transmission is not so equipped.

### A. REMOVAL

Before removing the transmission, remove floor plates and transmission bottom guards;

clean transmission and surrounding area. When disconnecting hoses, cover hose openings to prevent entrance of dirt. Identify each hose as it is removed to facilitate assembly.

1. Turn electrical system master switch off; drain oil from transmission case and bevel gear compartment.
2. Remove seat and seat frame. Disconnect ground speed governor control linkage; remove seat support channel assembly.

## Transmission

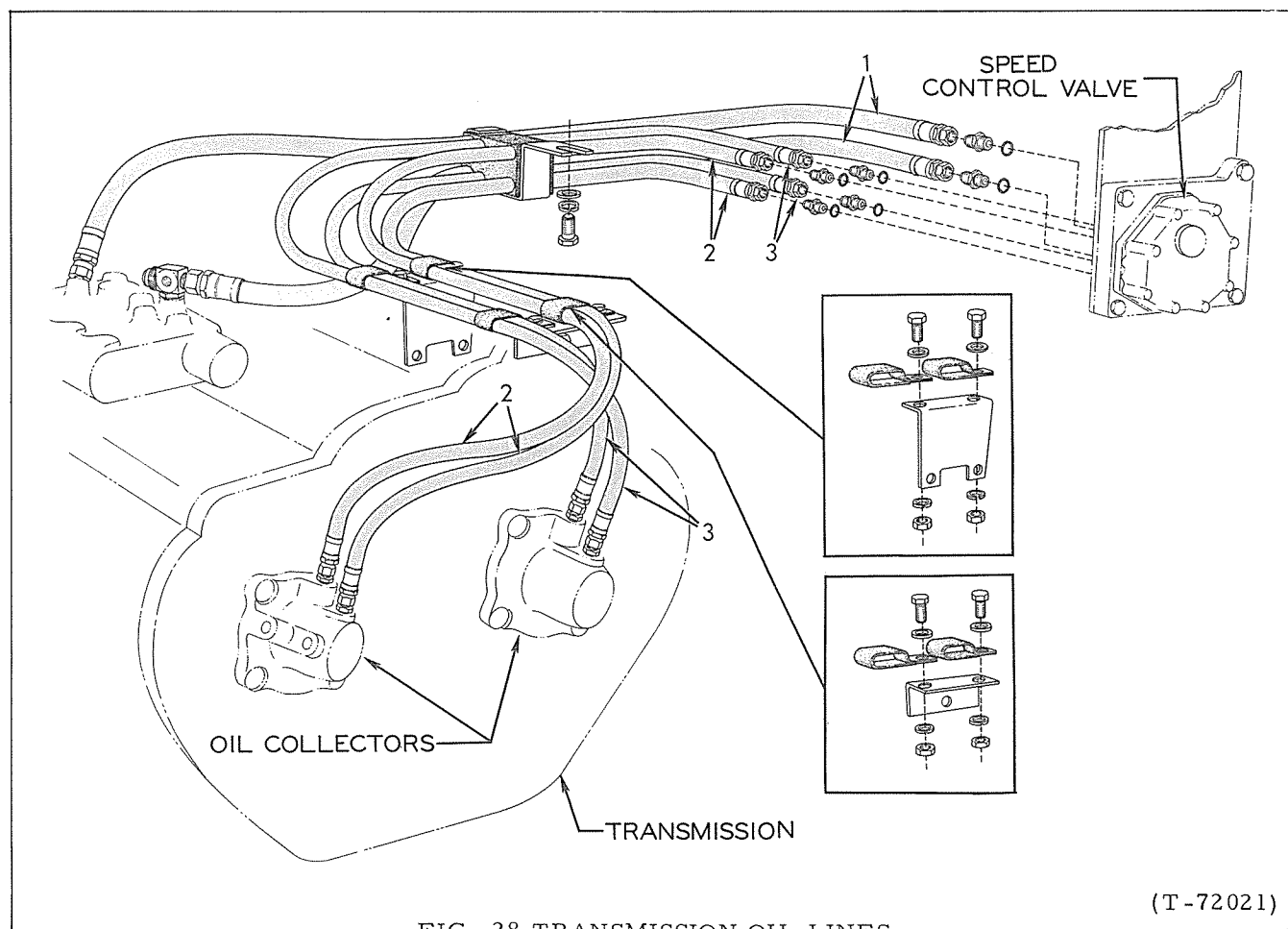
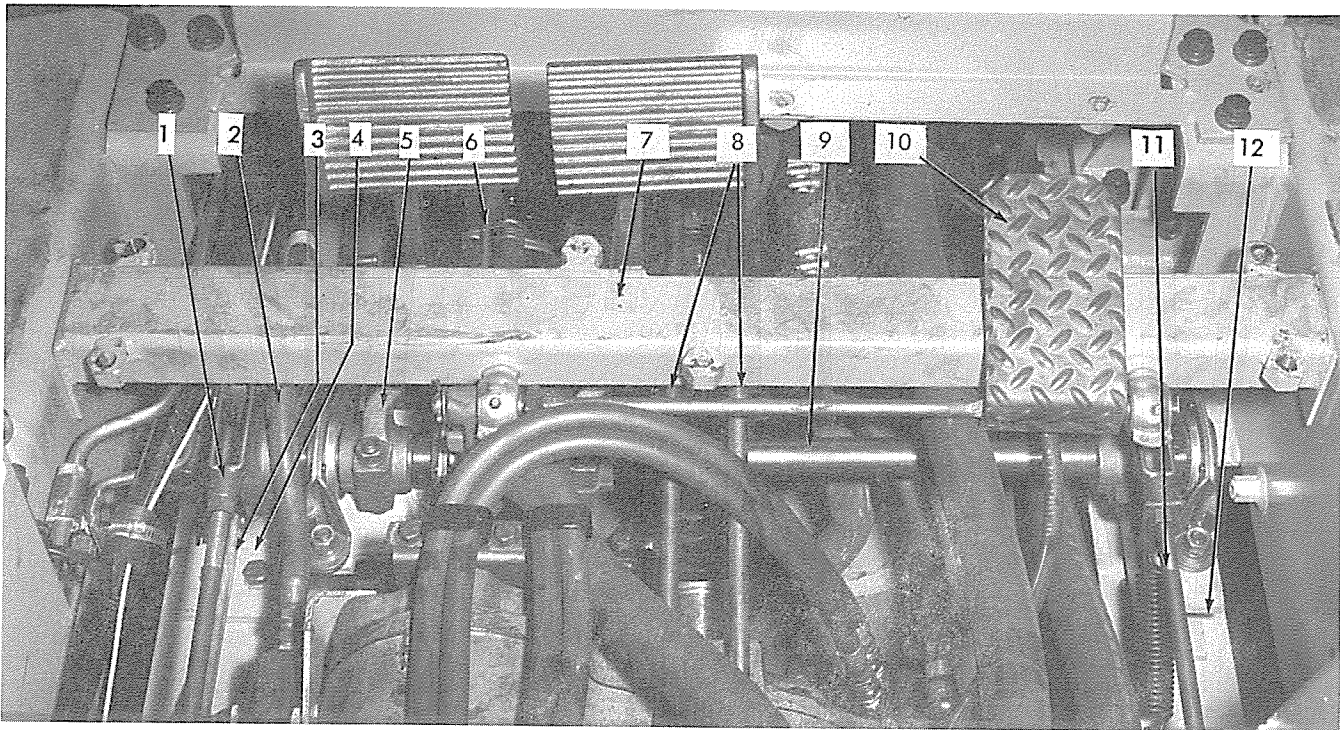


FIG. 28 TRANSMISSION OIL LINES

1. Pressure relief valve-to-speed control valve hoses
2. Oil lines to right oil collector
3. Oil lines to left oil collector
3. Disconnect decelerator pedal control rod from lever beneath cowl. Refer to Fig. 29, remove floor plate supporting channel (with shims on right end) and decelerator pedal as an assembly.
4. Disconnect and remove steering control lower (horizontal) rods.
5. Disconnect oil line from front end of venturi pump.
6. Disconnect brake linkage, Fig. 29; remove brake pedals, shafts, and brackets as an assembly.
7. Unlock and remove capscrews attaching front and rear yokes to universal joint; slide front yoke forward and remove universal joint.
8. Disconnect torque converter vent hose from fitting in transmission front cover.
9. Disconnect oil lines from pressure relief valve housing. Remove supporting clips; lay hoses aside for clearance.
10. Disconnect oil lines, Fig. 28 (2)(3) from oil collectors. Remove supporting clips; lay hoses aside for clearance.
11. Disconnect torque converter/transmission pump suction line and steering pump suction line from lower part of transmission case.
12. Remove transmission filler tube and breather housing from top of transmission.
13. Attach lifting chain and hoist to transmission; raise hoist until lifting chain is tight.
14. Remove capscrews attaching transmission to main housing; move transmission forward and carefully remove it from tractor. Cover bevel pinion bore in main housing to prevent entrance of dirt.
15. Mount transmission in a stand similar to that shown in Fig. 30.

## Transmission



(T-75049)

FIG. 29 BRAKE LINKAGE

- |                                 |                                   |
|---------------------------------|-----------------------------------|
| 1. Left brake control front rod | 7. Floor supporting channel       |
| 2. Oil line to venturi pump     | 8. Steering control lower rods    |
| 3. Parking brake bar            | 9. Right brake pedal and shaft    |
| 4. Left pedal shaft bracket     | 10. Decelerator pedal             |
| 5. Left pedal and shaft         | 11. Right brake control front rod |
| 6. Decelerator control rod      | 12. Right pedal shaft bracket     |

### B. DISASSEMBLY

NOTE: Viewing transmission from pinion end, the left clutch shaft carries reverse range clutches; right clutch shaft carrier forward range clutches. In the following text the shafts will be referred to as left or right rather than reverse or forward. Not all illustrations show the HD-11EP transmission; however, all service procedures and tools shown are applicable to the HD-11EP.

#### 1. REMOVAL OF COMPONENTS FROM TRANSMISSION CASE

- a. Refer to Fig. 30, disconnect and remove ground speed governor oil return line (9); remove ground speed governor (6).
- b. Install holding tool, Fig. 32 on rear end of input shaft. Unlock and remove drive shaft rear yoke retaining

capscrew and washer; pull yoke, Fig. 30 (2) from input shaft.

- c. Remove bevel pinion shaft front bearing retainer (12), input shaft front oil seal retainer (3), and clutch shaft oil collectors (14) from front cover.

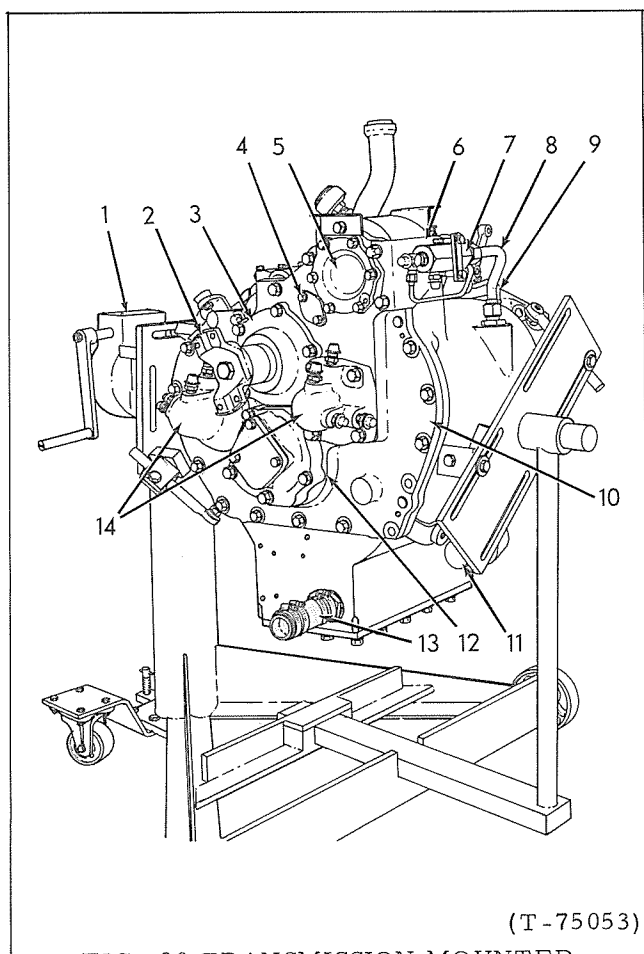
#### CAUTION

Pull clutch shaft oil collectors straight out when removing them. This will prevent damage to the edges of the oil grooves on front end of the clutch shafts.

- d. Refer to Fig. 31, remove oil sealing rings (3) from each clutch shaft. Put several wraps of tape around front part of each shaft to protect the sharp edges on sealing ring grooves and oil grooves.



## Transmission

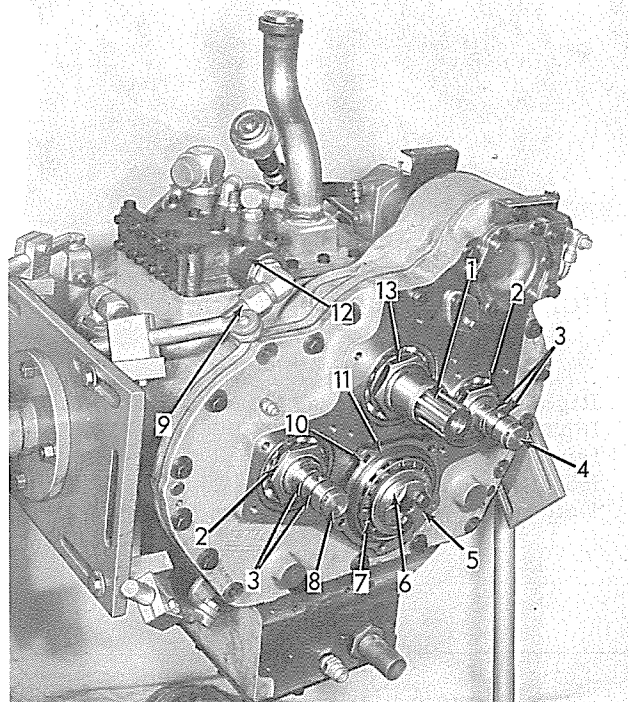


(T-75053)  
FIG. 30 TRANSMISSION MOUNTED  
ON STAND

1. Repair stand
2. Drive shaft rear yoke
3. Input shaft front oil seal retainer
4. Ground speed governor lower shaft cover
5. Ground speed governor upper shaft cover
6. Ground speed governor
7. Venturi pump
8. Venturi pump oil return line
9. Ground speed governor oil return line
10. Transmission front cover
11. Steering pump suction tube
12. Bevel pinion shaft front bearing retainer
13. Transmission oil pump suction tube
14. Clutch shaft oil collectors

- e. Refer to Fig. 31, disconnect and remove oil return tube (9); remove valve housing (12) and gasket from transmission case.
- f. Remove ground speed governor upper shaft cover, Fig. 30 (5) and lower shaft cover (4); remove shims with each cover and tie shims to the respective cover to prevent loss. Remove governor upper gear, gear shaft, and bearings from front cover.

- g. Remove bottom cover from transmission case.
- h. Unlock and remove capscrews attaching end washer, Fig. 31 (6) to bevel pinion shaft; remove end washer.

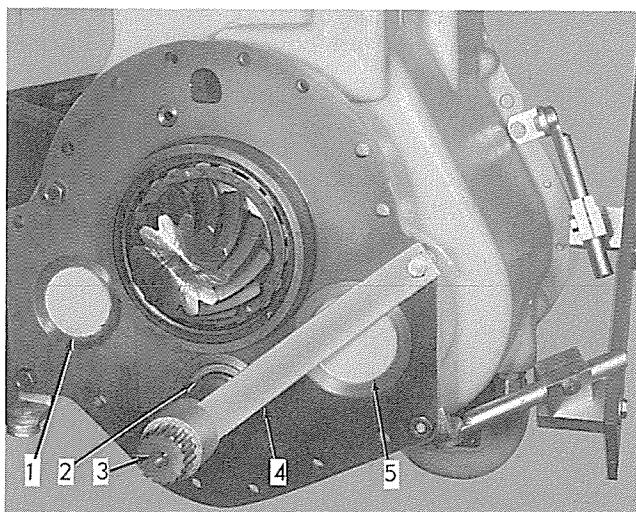


(T-70951)  
FIG. 31 FRONT VIEW OF TRANSMISSION  
WITH OIL COLLECTORS AND RETAINERS  
REMOVED

1. Input shaft
2. Clutch shaft front bearing retaining nut
3. Oil sealing rings
4. Left clutch shaft
5. Locking plate
6. Bevel pinion shaft end washer
7. Bevel pinion shaft front bearing
8. Right clutch shaft
9. Oil return tube
10. Bevel pinion depth adjustment shims
11. Snap ring
12. Pressure relief valve
13. Input shaft front bearing retaining nut

- i. Using service tools shown in Figs. 33 and 34, remove clutch shaft front bearing retaining nuts and input shaft front bearing retaining nut.
- j. Remove input shaft holding tool; turn transmission so that front cover is facing up.

## Transmission



(T-41553)

FIG. 32 INPUT SHAFT HOLDING TOOL  
INSTALLED

1. Right clutch shaft rear bearing plug
2. Input shaft rear oil seal
3. Input shaft
- \*4. Holding tool (Tool #75000505)
5. Left clutch shaft rear bearing plug

### CAUTION

Place blocking or holding strap under rear end of bevel pinion shaft to prevent the shaft from falling when the front snap ring is removed.

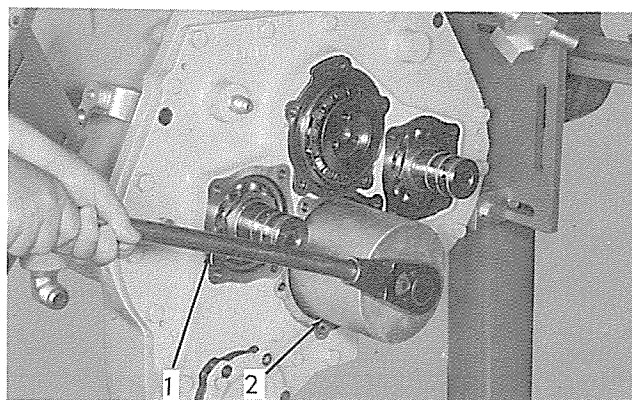
- k. Refer to Fig. 31, remove snap ring (11) from front of bevel pinion shaft. Remove pinion depth adjustment shims (10); tie shims together and lay aside for re-use during assembly.

1. Remove front cover as follows:

NOTE: The clutch shaft front bearings and input shaft front bearing will be removed with front cover.

- (1) Remove capscrews attaching front cover to transmission case and install three 3" (76.2mm) long pusher screws in front cover, Fig. 35.
- (2) Turn pusher screws in far enough to raise front cover no more than .5" (12.7mm). Install tools similar to those shown in Fig. 35 and push the clutch shafts and input shaft down the same distance as front cover was

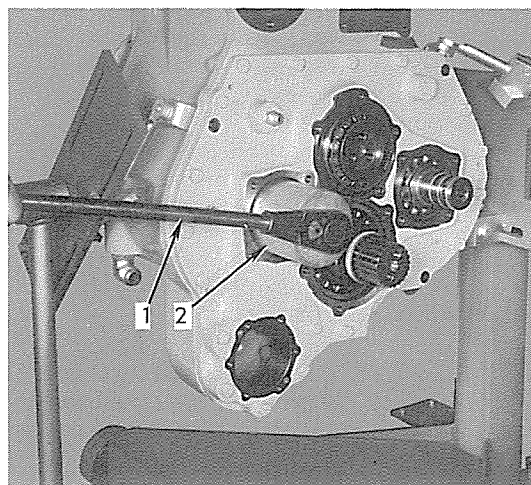
raised. Move pusher tools from shaft to shaft while readjusting pusher screws until front cover and bearings are free of the shafts. Do not hit the shafts with a hammer to push them down.



(T-41551)

FIG. 33 REMOVING INPUT SHAFT FRONT  
BEARING RETAINING NUT

1. Handle
- \*2. Socket (Tool #75000512)



(T-41552)

FIG. 34 REMOVING CLUTCH SHAFT FRONT  
BEARING RETAINING NUT

1. Handle
- \*2. Socket (Tool #75000453)

\*Order from Fiat-Allis dealer

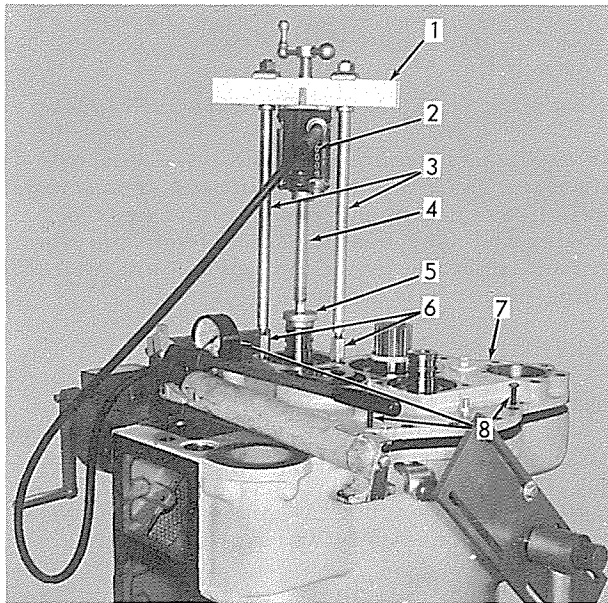
## Transmission

### CAUTION

The shaft rear bearings may be damaged if the shafts are pushed down too far or are misaligned when pushed.

- (3) Lift front cover from transmission case; remove bearings from front cover.
- (4) Install a 3/8" NC capscrew in front end of ground speed governor lower gear shaft. Pull shaft up far enough to remove steel retaining ball; pull shaft from cover; lay shaft, bearings, and gear aside for inspection.
- m. Using suitable lifting tool, remove input shaft assembly from transmission case. Identify and remove front (drive) gears from clutch shafts.
- n. Refer to Fig. 36, install puller (7) beneath bevel pinion shaft front bearing; pull bearing assembly from shaft.

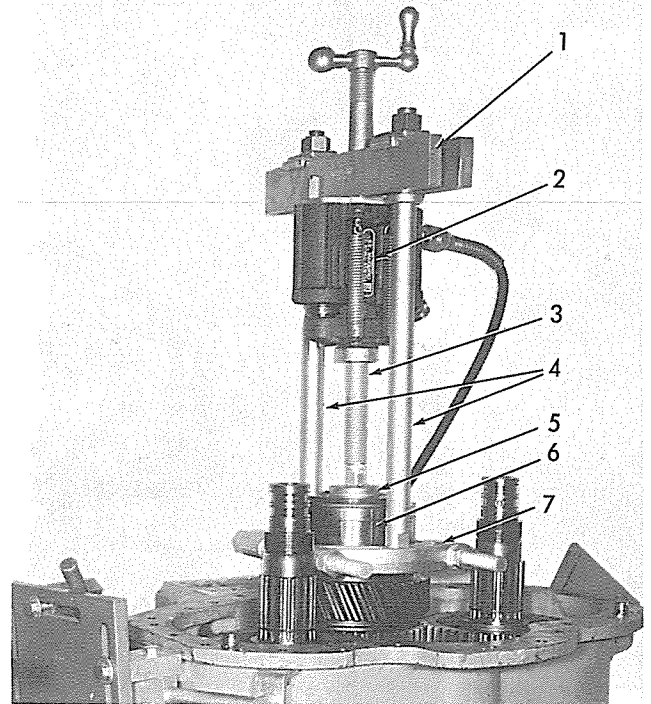
**IMPORTANT:** Identify the bearing cups and cones so they may be installed in their original position if reused.



(T-41555)

FIG. 35 PUSHING CLUTCH SHAFT FROM FRONT BEARING

1. Push-puller
2. Hydraulic ram and pump assembly
3. Legs
4. Forcing screw
5. Shaft protector
6. Adapters
7. Front cover
8. Pusher screws



(T-70579)

FIG. 36 REMOVING BEVEL PINION SHAFT FRONT BEARING

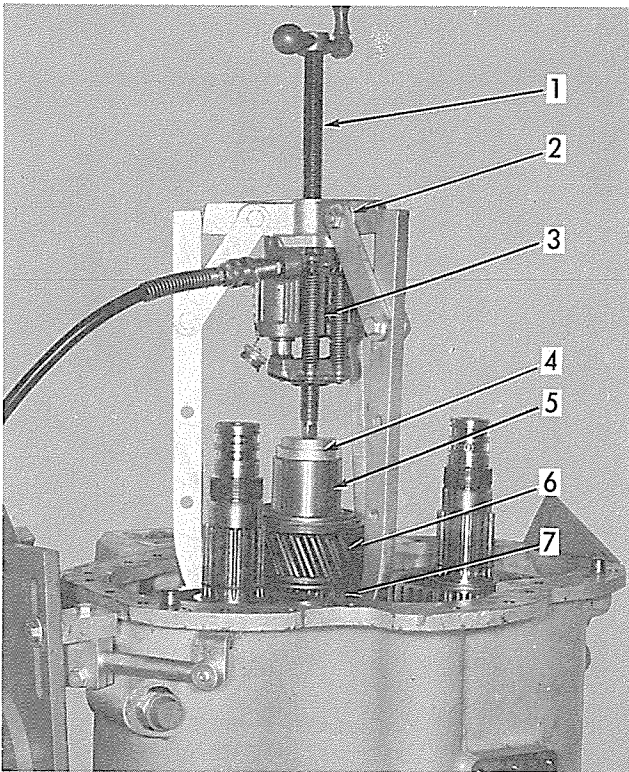
1. Push-puller
2. Hydraulic ram and pump assembly
3. Forcing screw
4. Legs
5. Shaft protector
6. Bevel pinion shaft front bearing
7. Puller attachment

- o. Refer to Fig. 37, install tools similar to those shown. Hook puller legs under bevel pinion shaft high speed gear (7); pull idler gear, bearing assembly, and high speed gear from shaft.

**IMPORTANT:** Put a narrow piece of strap iron between the puller legs and high speed gear. Identify idler gear bearing cups and cones so they may be installed in their original position if reused.

- p. Refer to Fig. 38, remove right and left clutch shaft assemblies from transmission case.
- q. Turn transmission case so that top side is up; remove bevel pinion shaft holding strap from rear of transmission case. Pull bevel pinion shaft from case, use care to prevent damage to rear bearing outer race. Remove bevel pinion shaft low speed gear from transmission case.

## Transmission

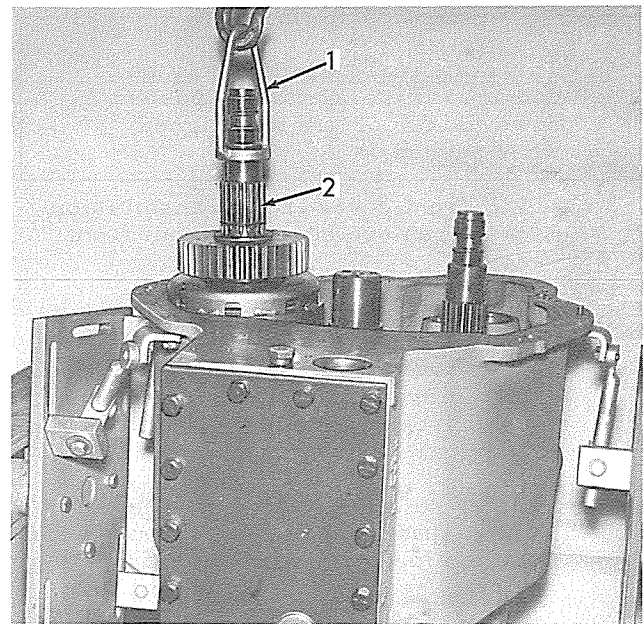


(T-70589)

FIG. 37 PULLING IDLER GEAR AND BEARING FROM BEVEL PINION SHAFT

1. Forcing screw
2. Puller
3. Hydraulic ram and pump assembly
4. Shaft protector
5. Bevel pinion shaft
6. Idler gear and bearing
7. Bevel pinion shaft high speed gear

r. Drive clutch shaft rear bearing retaining plugs, Fig. 32, and rear bearings out toward rear of case. Drive input shaft rear oil seal retainer and rear bearing out toward rear of case. Remove bevel pinion shaft oil seal and rear bearing outer race from bores in case.



(T-70983)

FIG. 38 REMOVING OR INSTALLING CLUTCH SHAFT ASSEMBLY

- \*1. Lifting tool (Tool #75000534)
2. Right clutch shaft assembly

\*Order from Fiat-Allis dealer

### 2. BEVEL PINION SHAFT DISASSEMBLY

Only two pieces remain on the bevel pinion shaft after shaft has been removed from transmission case; the rear bearing and rear oil seal sleeve. The bearing and sleeve may be removed together by using a press and suitable bearing puller attachment.

### 3. INPUT SHAFT DISASSEMBLY

- a. Refer to Fig. 39, remove spacer (4) gear (3) and spacer (2) from front end of shaft.
- b. Remove front oil seal wear sleeve (7) if excessively worn or grooved.
- c. If rear bearing is to be replaced, remove snap ring (13) and pull bearing race from shaft.

## Transmission

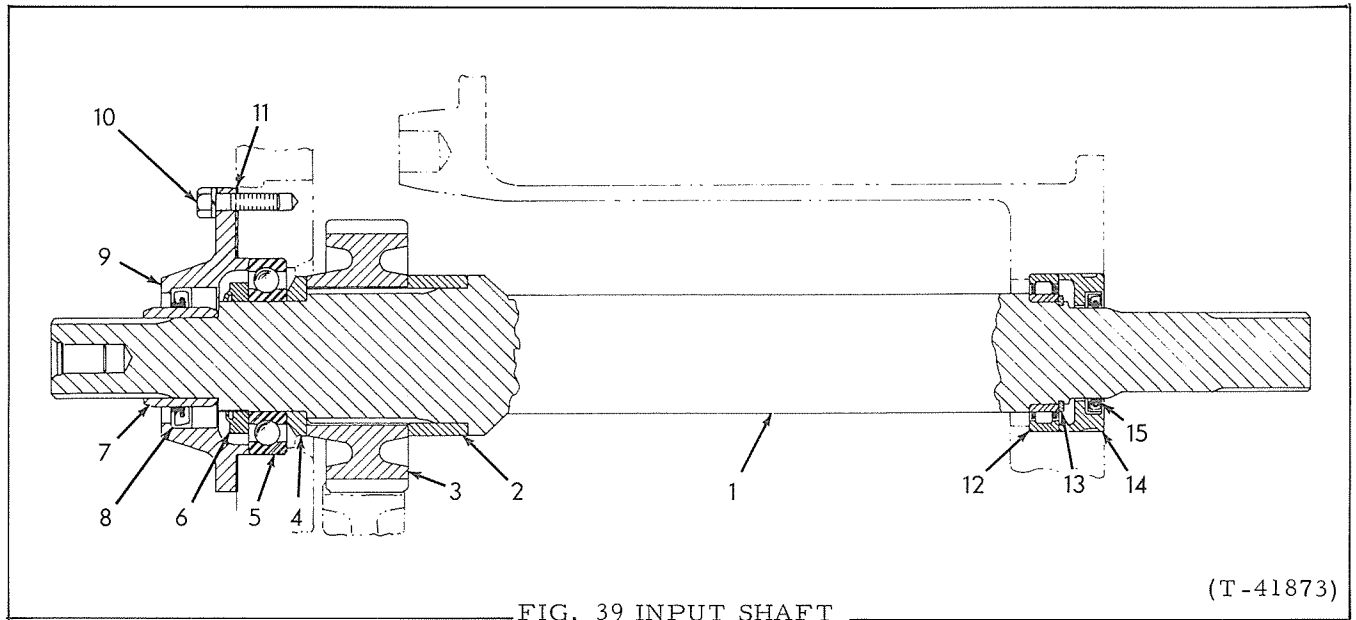


FIG. 39 INPUT SHAFT

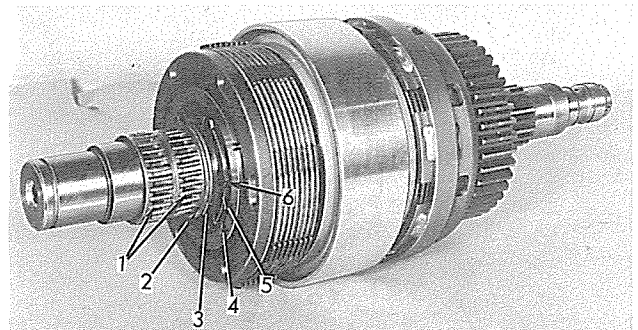
(T-41873)

- |                                |                            |
|--------------------------------|----------------------------|
| 1. Shaft                       | 8. Front oil seal          |
| 2. Spacer                      | 9. Front oil seal retainer |
| 3. Drive gear                  | 10. Capscrew               |
| 4. Spacer                      | 11. Gasket                 |
| 5. Front bearing               | 12. Rear bearing           |
| 6. Front bearing retaining nut | 13. Snap ring              |
| 7. Oil seal wear sleeve        | 14. Rear oil seal retainer |
|                                | 15. Rear oil seal          |

### 4. CLUTCH AND CLUTCH SHAFT ASSEMBLY

NOTE: The following procedure applies to both clutch shaft assemblies.

- a. Remove snap ring from rear end of shaft. Attach puller behind teeth of rear clutch drum gear; remove rear bearing inner race, rear clutch drum and gear, rear bearing spacer, thrust washer, and spacer washer as an assembly.
- b. Refer to Fig. 40, slide bearings (1), spacer (2), thrust washer (3), and capscrew lock plate (5) from shaft.
- c. Remove capscrews, Fig. 40 (6). Press clutch hub back plate down by hand and remove clutch hub retainer (4); remove clutch assembly from shaft.
- d. Remove front clutch drum and gear; remove front clutch assembly as in step c.
- e. Remove actuating piston retaining snap ring from piston housing; install snap ring groove filler ring, Fig. 45 (2), chamfered side of ring toward clutch actuating piston, in snap ring groove. Remove piston housing from piston by bumping end of clutch shaft



(T-70966)

FIG. 40 CLUTCH SHAFT ASSEMBLY - CLUTCH DRUM AND GEAR REMOVED

1. Clutch gear bearings
2. Spacer
3. Thrust washer
4. Clutch hub retainer (two halves)
5. Spacer (capscrew lock plate)
6. Capscrew

lightly on a soft block; remove piston housing and piston from clutch shaft.

- f. Refer to Fig. 41, remove accelerator piston snap ring; remove accelerator pistons from shaft; use care to prevent damage to shaft sealing rings.



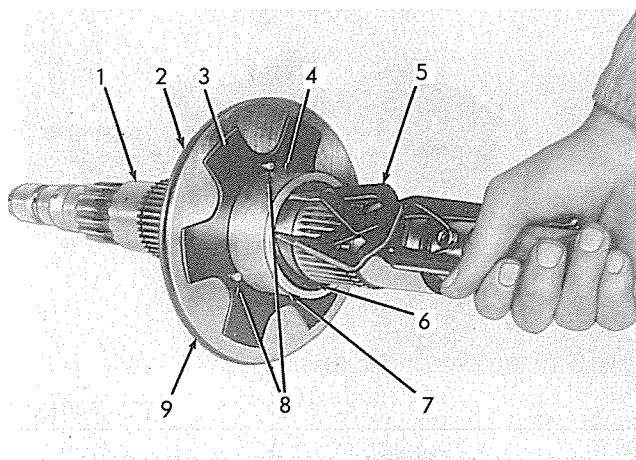
## Transmission

- g. Remove oil sealing rings from accelerator pistons and shaft.
- h. Refer to Fig. 41, remove valve discs and backing discs from separator plate; remove O-ring from separator plate.
- i. If necessary to replace separator plate, remove retaining snap ring from each side of plate. Cut through separator plate to within .38" (9.65 mm) of shaft in two places and drive wedge in one cut to expand separator plate bore; slide separator plate from shaft.

### CAUTION

Do not attempt to press separator plate from shaft as damage to the shaft will result.

- j. Remove clutch hub back plate snap ring and clutch hub snap ring, Figs. 42 and 43; remove locking pin retainer, Fig. 44 (30) back plate (29), and locking pin (26). Remove friction plates from clutch hub. Do not attempt to remove spring retainer from clutch hub.

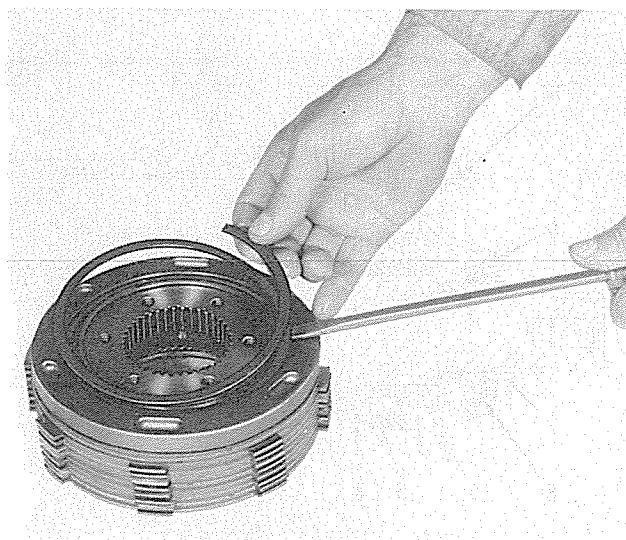


(T-35088)

FIG. 41 REMOVING CLUTCH ACCELERATOR PISTON SNAP RING

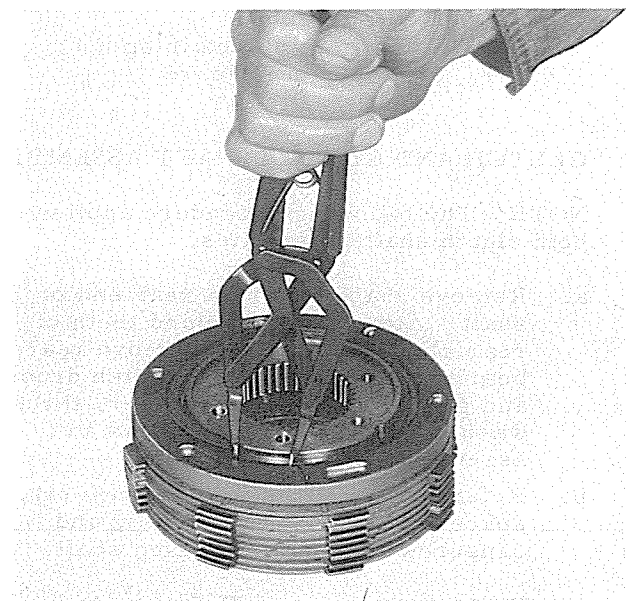
1. Shaft
2. Separator plate
3. Valve and backing discs
4. Accelerator piston
- \*5. Pliers (Tool #75000443)
6. Snap ring
7. Accelerator piston sealing ring
8. Dowels
9. O-ring

\*Order from Fiat-Allis dealer



(T-35069)

FIG. 42 REMOVING CLUTCH HUB BACK PLATE SNAP RING



(T-35070)

FIG. 43 REMOVING CLUTCH HUB SNAP RING

## C. INSPECTION

Thoroughly clean all components in clean solvent or fuel oil before inspection. If, after inspection the components are satisfactory, dip them in clean oil and wrap them in clean paper or cloth until reassembly.

### 1. BEARINGS AND BEARING RACES

Carefully inspect all bearings and bearing

## Transmission

aces for excessive wear, pitting, or chipping; replace if necessary.

**IMPORTANT:** If bevel pinion shaft front bearing and idler gear bearing are to be re-used, the bearing cups and cone assemblies must be kept in their original positions.

### 2. CLUTCH SHAFT ASSEMBLIES

Inspect bearing surfaces where front and rear gear and drum assemblies locate on the shafts. If diameter at these locations is less than 2.498" (63.45mm) the shaft(s) must be replaced.

Make certain each sealing ring turns freely in its groove in the shaft. Dress any tight grooves with a small file until sealing ring turns freely. Make certain all oil passages in the shafts are open.

### 3. CLUTCH DRUM AND GEAR ASSEMBLIES

Inspect bearing area in each clutch drum and gear assembly for roughness or wear. If I.D. of bore is more than 2.879" (73.13mm) replace drum and gear assembly.

### 4. FRICTION PLATES

- a. Bronze Plates - Measure thickness of each plate; each plate must be parallel within .002" (0.050mm) and at least .092" (2.34mm) thick; replace if not. Replace any plate which is scored, glazed or burned.
- b. Steel Plates - Measure thickness of each plate; each plate must be parallel within .002" (0.050mm) and at least .071" (1.80mm) thick; replace if not. Replace any plate which is severely scored or burned.

### 5. PISTON HOUSING, CLUTCH ACTUATING PISTON AND ACCELERATOR PISTONS

Inspect surfaces contacted by O-rings and seal rings for excessive wear or roughness; replace if necessary.

### 6. SEPARATOR PLATE

Inspect valve discs and backing discs for wear or damage; replace if necessary.

Make certain separator plate is not warped.

Make certain all oil passages in the separator plate are open.

### 7. CLUTCH DRUM AND GEAR THRUST WASHERS AND SPACERS

Replace washers and/or spacers if scored or grooved. Replace thrust washers if thickness

is less than .087" (2.20mm); replace spacers if thickness is less than .075" (1.90mm).

### 8. CLUTCH HUB ASSEMBLIES

Inspect clutch hub splines; if rough or heavily indented, replace clutch hub.

### 9. GEARS

Inspect all gears and gear teeth for wear, pits, chips, or cracks; replace if necessary.

### 10. OIL COLLECTORS

Inspect sealing ring wear areas in I.D. of oil collectors; if indented or excessively worn replace oil collector(s).

### 11. OIL SEALS, SEALING RINGS, AND O-RINGS

It is advisable to replace all oil seals, sealing rings, and O-rings when the transmission is reassembled. Before being installed, they should be lubricated with a good grade of clean oil to prevent damage to them or mating components. All sealing rings must turn freely in their grooves after installation.

## D. ASSEMBLY

All parts must be clean and well lubricated before assembly and kept clean after assembly. Proceed as follows:

### 1. CLUTCH AND CLUTCH SHAFT ASSEMBLY

- a. If separator plate was removed from shaft, heat new separator plate in oil to 200°F. (93°C.), also chill the shaft in dry ice for 2 hours. Quickly install separator in position against snap ring on shaft so the separator will be located properly. Install snap ring on other side of separator plate and allow assembly to cool. Check separator plate with a straight edge after it cools; replace if warped.
- b. Install O-ring, Fig. 44 (13) in separator plate.
- c. Install valve disc (6) and backing disc (5) on each side of separator plate, in position on separator plate dowel pins.
- d. Install sealing rings in grooves in shaft nearest separator plate; interlock ends of sealing rings.
- e. Install accelerator pistons on shaft, over sealing rings and against valve discs; secure each piston with snap ring, Fig. 41.
- f. Install sealing rings in grooves in accelerator pistons, Fig. 41 and in grooves in shaft closest to accelerator pistons; interlock ends of sealing rings.

# Transmission

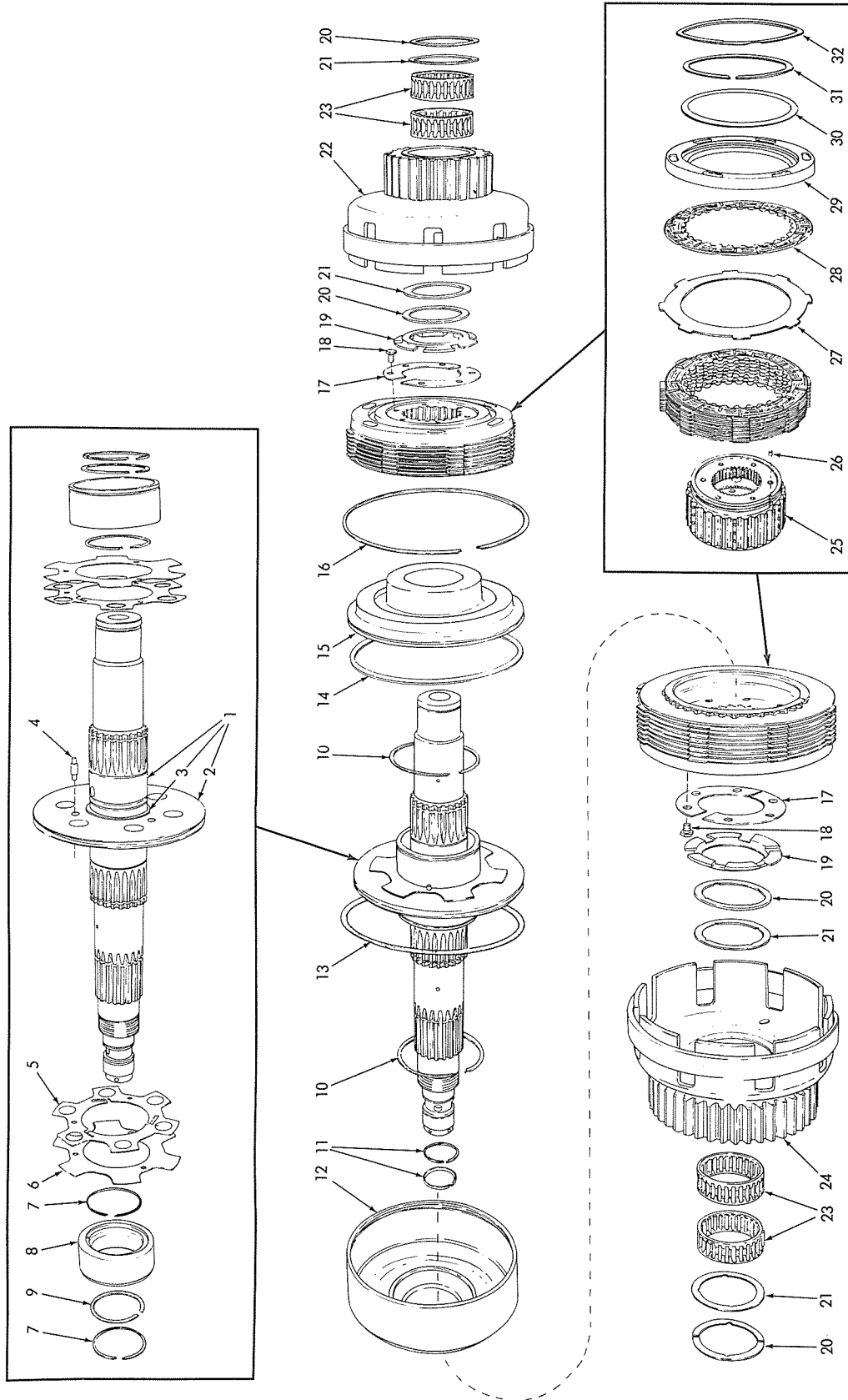


FIG. 44 CLUTCH SHAFT ( T - 72362 )

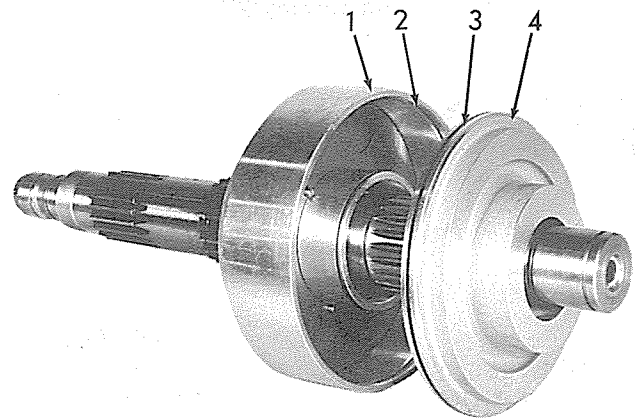


## Transmission

### LEGEND FOR FIG. 44

1. Shaft
  2. Separator plate
  3. Snap ring
  4. Valve actuating pin
  5. Backing disc
  6. Valve disc
  7. Shaft sealing ring
  8. Accelerator piston
  9. Snap ring
  10. Accelerator piston sealing ring
  11. Shaft sealing ring
  12. Piston housing
  13. O-ring
  14. Sealing ring
  15. Actuating piston
  16. Snap ring
  17. Clutch hub retainer
  18. Capscrew
  19. Spacer (capscrew lock plates)
  20. Thrust washer
  21. Spacer
  22. Low speed clutch drum and gear
  23. Bearings
  24. High speed clutch drum and gear
  25. Clutch hub
  26. Locking pin
  27. Steel friction plate
  28. Bi-metallic friction plate
  29. Back plate
  30. Retainer
  31. Clutch hub snap ring
  32. Back plate snap ring
- g. Install snap ring groove filler ring, Fig. 45 (2) in piston housing; install piston housing (1) from front end of shaft. Carefully slide housing over sealing rings on shaft and accelerator piston, and separator plate O-ring.
- h. Refer to Fig. 45, install actuating piston sealing ring (3); install actuating piston from rear end of shaft. Carefully slide actuating piston over shaft sealing ring, accelerator piston sealing ring, and into piston housing. Remove snap ring groove filler ring and install snap ring in piston housing.
- i. Turn clutch hub spring retainer so that springs are not twisted. Lay clutch hub with spring retainer side down; alternately install friction plates on clutch hubs (nine bronze and eight steel plates each hub). Start and finish each stack with a bronze plate.
- j. Install clutch hub back plate, Fig. 44 (29) (flat side against friction plates) on clutch hub; align locking pin grooves in clutch hub and back plate; install locking pin (26).
- k. Install locking pin retainer, Fig. 44 (30), clutch hub snap ring (31), and clutch hub back plate snap ring (32).

- l. Start clutch hub assembly (hub end first) onto shaft to align splines in clutch hub and spring retainer with splines on shaft without twisting clutch hub springs. Withdraw clutch hub assembly from shaft and reinstall (spring retainer end first) on shaft.
- m. Press clutch hub back plate down and install clutch hub retainers, Fig. 40 (4) in groove in shaft. Align bolt holes in retainers with holes in clutch hub. Draw clutch hub up against retainers by tightening clutch hub retainer capscrews (6). Turn capscrews so that slots in spacer (5) will go over capscrew heads; install spacer on shaft with flat side against clutch hub retainers.
- n. Install thrust washer, Fig. 40 (3), spacer (2), and bearings (1) on shaft.
- o. Install proper clutch drum and gear over bearings and clutch; use care to prevent damage to clutch plates.



(T-70968)

FIG. 45 ACTUATING PISTON PRIOR TO INSTALLATION IN PISTON HOUSING

1. Piston housing
  2. Snap ring groove filler ring
  3. Actuating piston sealing ring
  4. Actuating piston
- p. Refer to Fig. 46, install spacer and thrust washer (5) on shaft (spacer against clutch gear); install rear bearing spacer (4). Using a suitable driver, install rear bearing inner race (3) and secure with snap ring.
- q. Turn clutch shaft end for end, install front clutch and hub on shaft; secure with clutch hub retainer and capscrews. Turn capscrews so that slots in spacer will go over capscrews heads; install

## Transmission

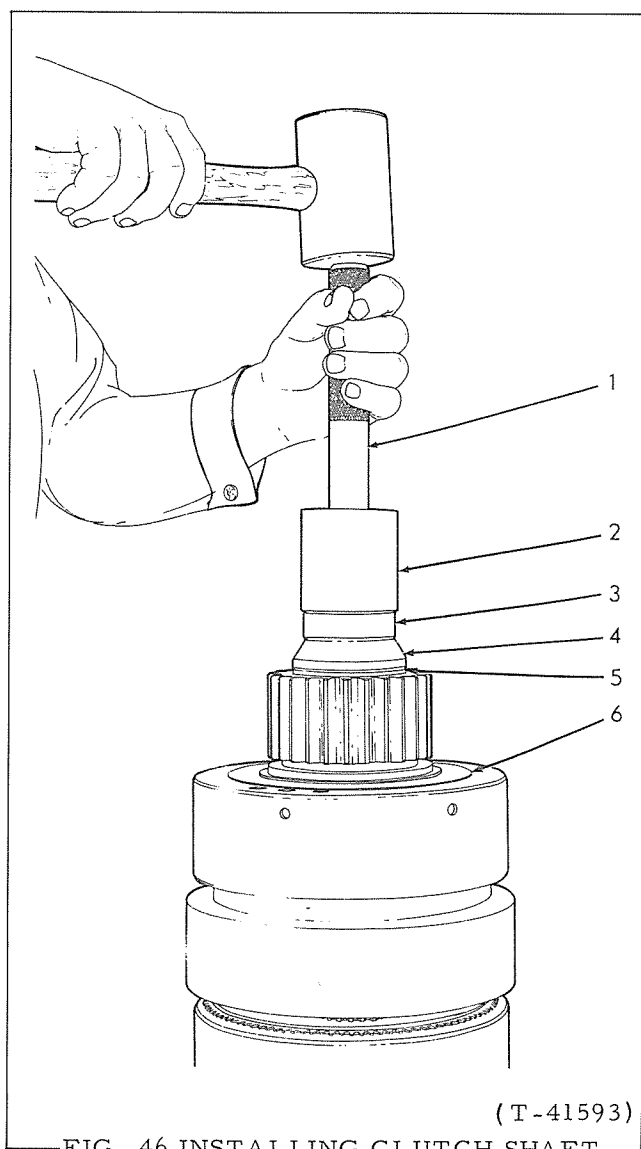


FIG. 46 INSTALLING CLUTCH SHAFT—  
REAR BEARING INNER RACE

1. Mandrel
2. Driver
3. Bearing race
4. Rear bearing spacer
5. Thrust bearing and spacer
6. Clutch drum and gear

spacer with flat side against clutch hub retainer.

- r. Install bronze thrust washer, spacer, and clutch drum gear bearings on shaft.
- s. Install proper clutch drum and gear over bearings and clutch; use care to prevent damage to clutch plates.
- t. Install spacer against clutch gear and bronze thrust washer against spacer. Install snap ring in groove in shaft. Tie clutches together with a piece of wire.

### 2. BEVEL PINION SHAFT ASSEMBLY

Using suitable press, install rear bearing, Fig. 48 (16) and oil seal sleeve (14) on bevel pinion shaft.

NOTE: Tapered end of sleeve must go toward front of shaft.

### 3. INPUT SHAFT ASSEMBLY

- a. Install front oil seal sleeve, Fig. 39 (7) on shaft.
- b. Install rear bearing inner race and secure with snap ring (13).

### 4. INSTALLATION OF COMPONENTS IN TRANSMISSION CASE

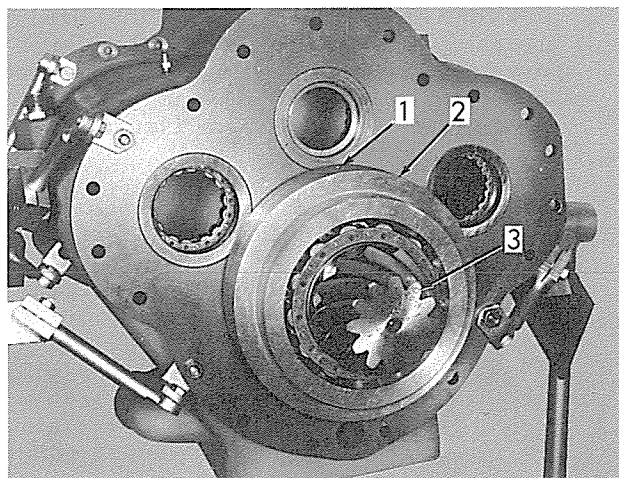
Thoroughly clean inside of transmission case before installing components.

- a. Using suitable drivers, install clutch shaft rear bearings and input shaft rear bearing. Make certain the bearings are seated in their bores.
- b. Install input shaft rear seal retainer in bore against bearing with counter-bore for seal toward rear of case. Do not install oil seal at this time.
- c. Using suitable driver, install bevel pinion shaft rear bearing race in bore. Do not install bearing race retaining snap ring at this time.
- d. Install bevel pinion shaft oil seal, Fig. 48 (15) in its bore; make certain the seal is fully seated in its bore.
- e. Position low speed gear (bevel pinion shaft rear gear) in case.

NOTE: The gear may be installed either way.

- f. Refer to Fig. 47, install guide tool (2) over rear bearing boss and against rear bearing outer race. Hold guide tool in position by tightening setscrew (1).
- g. Carefully install bevel pinion shaft through guide tool, rear bearing race, oil seal, and low speed gear. Support both ends of shaft and pull shaft into position in housing.
- h. Remove guide tool and install support strap under rear end of shaft. Install rear bearing race retaining snap ring, Fig. 48 (17).

## Transmission



LEGEND FOR FIG. 47

- 1. Setscrew
- \*2. Guide tool (Tool #75000513)
- 3. Bevel pinion shaft
- \* Order from Fiat-Allis dealer

(T-70585)

FIG. 47 BEVEL PINION SHAFT GUIDE TOOL  
INSTALLED

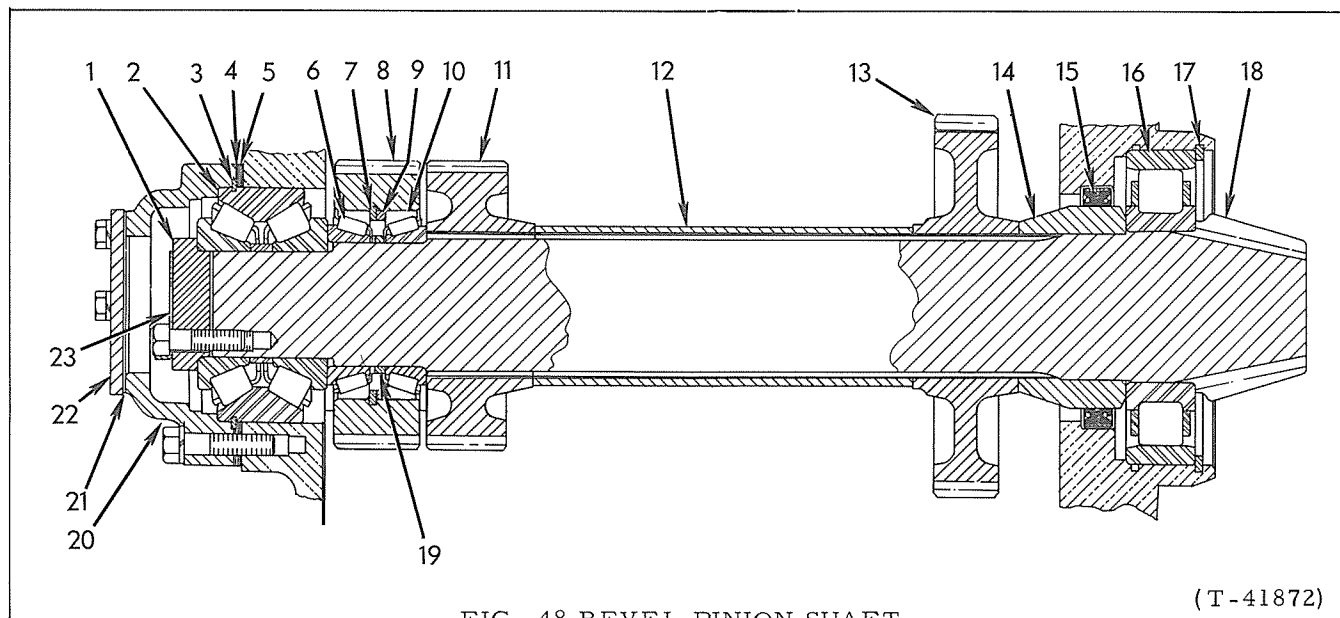


FIG. 48 BEVEL PINION SHAFT

(T-41872)

- 1. End washer
- 2. Front bearing
- 3. Snap ring
- 4. Bearing retainer shims
- 5. Pinion depth adjustment shims
- 6. Bearing cone
- 7. Snap ring
- 8. Idler gear
- 9. Spacer
- 10. Bearing cup
- 11. High speed gear

- 12. Sleeve
- 13. Low speed gear
- 14. Oil seal sleeve
- 15. Rear oil seal
- 16. Rear bearing
- 17. Snap ring
- 18. Shaft
- 19. Spacer
- 20. Front bearing retainer
- 21. Gasket
- 22. Cover
- 23. Locking plate

- i. Refer to Fig. 38, install right and left clutch shaft assemblies in transmission case. Remove retaining wire from clutch drums.

### CAUTION

Make certain the shaft bearing races are properly seated in rear bearings.

## Transmission

- j. Using suitable lifting tool, install input shaft in transmission case. Make certain the rear bearing race is properly seated in rear bearing.
- k. Install sleeve, Fig. 48 (12) and high speed gear (11) on bevel pinion shaft, with long hub of gear toward sleeve.
- l. Install spacer, Fig. 39 (2) and gear (3) on input shaft, with long hub of gear toward front of shaft. Install spacer (4) on shaft, flat side of spacer against gear.
- m. Install front (drive) gears on clutch shaft from which they were removed; seat counterbore in gears against snap ring on shafts.

**IMPORTANT:** The following two steps contain installation instructions for the bevel pinion shaft idler gear and bearing. If the bearing is being re-used, the cups

and cone assemblies must be installed in their original positions. However, if a new bearing is being installed, either cup may be used with either cone assembly, regardless of any marking that may be on the bearing.

- n. Heat idler gear bearing cones in oil at 275°F. (135°C.).
- o. Refer to Fig. 48; install idler gear and bearing as follows:
  - (1) Install rear cone assembly (6) on shaft; tap cone assembly with a suitable driver to make certain it is seated against shoulder on shaft. Install spacer (19).
  - (2) With bearing cups (10), spacer (9), and snap ring (7) installed in gear, install idler gear (8) on shaft against rear cone assembly.

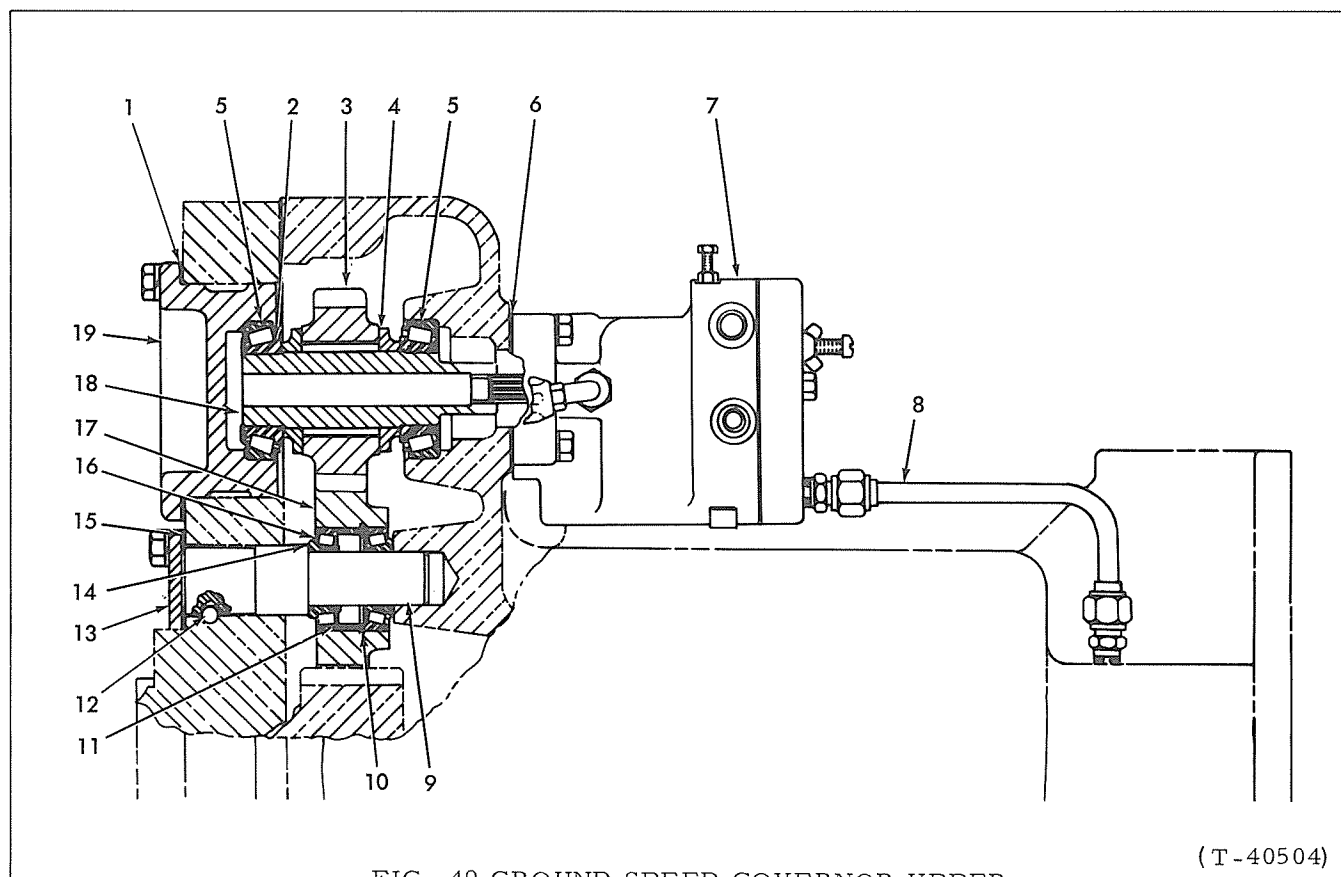


FIG. 49 GROUND SPEED GOVERNOR UPPER AND LOWER DRIVE SHAFT ASSEMBLIES

- |                                      |                          |                                 |
|--------------------------------------|--------------------------|---------------------------------|
| 1. Shims                             | 7. Ground speed governor | 14. Lower gear bearing assembly |
| 2. Upper shaft bearing cone assembly | 8. Oil return line       | 15. Shims                       |
| 3. Upper gear                        | 9. Lower shaft           | 16. Lower gear bearing cup      |
| 4. Upper gear spacer                 | 10. Snap ring            | 17. Lower gear                  |
| 5. Upper shaft bearing cup           | 11. Bearing spacer       | 18. Upper shaft                 |
| 6. Gasket                            | 12. Retaining ball       | 19. Upper shaft cover           |
|                                      | 13. Lower shaft cover    |                                 |

## Transmission

- (3) Install front cone assembly (6) on shaft; tap cone assembly with a suitable driver to make certain it is seated in bearing cup.

- p. Refer to Fig. 49, install ground speed governor upper and lower shaft assemblies in transmission case.
- q. Install front cover (with new gasket) on transmission case. Secure front cover with attaching capscrews; install hose supporting clips under proper capscrews.

### 5. INSTALLATION AND ADJUSTMENT OF FRONT BEARINGS

- a. Raise ground speed governor lower shaft, Fig. 49 (9) far enough to install steel ball (12) in hole in shaft; lower shaft into position.
- b. Hold cover (13) (without shims) firmly against lower shaft; measure distance between lower shaft cover and transmission front cover. Make a shim pack equal to the measurement plus .004" (.102mm) to obtain specified shaft end play. Install lower shaft cover, Fig. 49 (13) with shim pack (15) on transmission front cover.
- c. With bearing cup, Fig. 49 (5) installed in ground speed governor upper shaft cover (19), hold cover (without shims) firmly against upper shaft bearing. Measure distance between upper shaft cover and transmission front cover; make a shim pack equal to the measurement plus .005" (.127mm) to obtain specified shaft end play. Install upper shaft cover (19) with shim pack (1) on transmission front cover.

**IMPORTANT:** The following two steps contain installation instructions for the bevel pinion shaft front bearing. The one piece bearing cup can be installed in only one position - with snap ring groove toward front cover. If bearing is reused, the cone assemblies must be installed in their original position; if a new bearing is used, the cone assemblies may be installed in either position.

- d. Heat bevel pinion shaft front bearing cones in oil at 275°F. (135°C.).
- e. Refer to Fig. 48, install bevel pinion shaft front bearing as follows:

- (1) Install rear cone assembly on shaft; tap cone assembly with a suitable driver to make certain it is seated against idler gear bearing.

- (2) Install spacer on shaft against rear cone assembly.

- (3) Install snap ring in groove in bearing cup; install bearing cup in front cover bore against rear cone assembly.

- (4) Install front cone assembly on shaft; tap cone assembly with a suitable driver to make certain it is seated in bearing cup.

- f. Install end washer, Fig. 48(1) and locking plate (23) on bevel pinion shaft. Torque attaching capscrews to 95 to 105 lbs. ft. (13.13-14.52 kg-m). Hit capscrew heads with a hammer several times to make certain the shaft components are properly seated; re-torque capscrews to specified torque. Repeat this until capscrew torque does not change when capscrews are hit with hammer. Lock capscrews with locking plate.

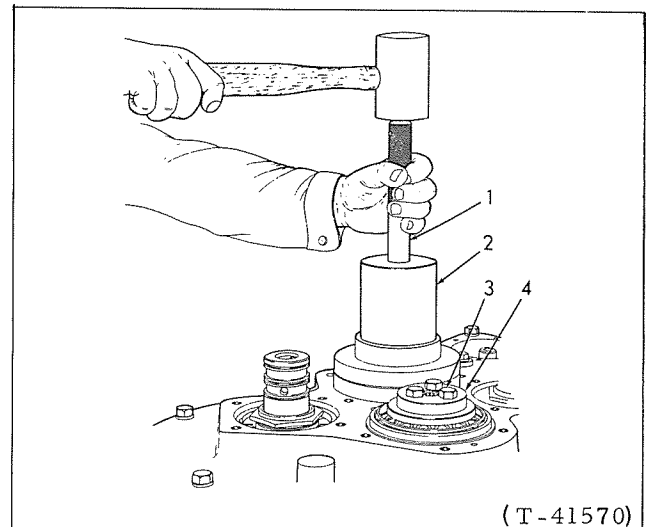


FIG. 50 INSTALLING INPUT SHAFT FRONT BEARING

- \*1. Mandrel (Tool #75000520)
- \*2. Driver (Tool #75000514)
- 3. Locking plate
- 4. Bevel pinion shaft end washer

\* Order from Fiat-Allis dealer

- g. Force bevel pinion shaft front bearing snap ring against front cover. Hold bevel pinion shaft front bearing retainer (without shims) firmly against front bearing; measure distance between bearing retainer and transmission front cover. Make a shim pack equal to measurement plus .001" (.025mm) to obtain specified bearing end play. Remove bearing retainer and tie to shim pack for later use.

## Transmission

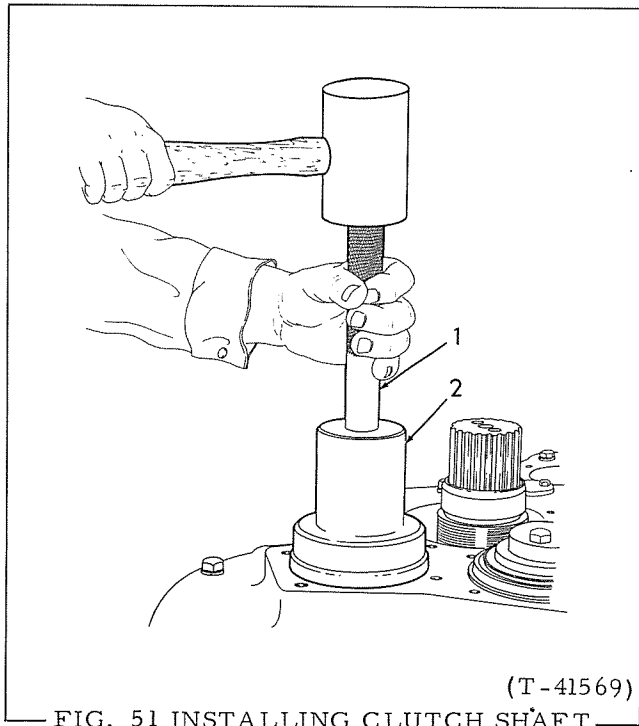


FIG. 51 INSTALLING CLUTCH SHAFT FRONT BEARING

- 1. Mandrel
- \*2. Driver (Tool #AC-1019)

\* Order from Service Tools, Inc.  
1901 Indiana Ave., Chicago, Illinois 60616

- h. Raise bevel pinion shaft slightly and remove snap ring from front bearing. Install pinion depth adjustment shims, Fig. 48 (5) which were removed at disassembly, or a shim pack approximately .095" (24.13mm) thick. Install snap ring (3) in bearing (2); push shaft down until snap ring is against shims.

- i. Refer to Figs. 50 and 51, install clutch shaft front bearings and input shaft front bearing. Make certain the bearings are seated on the shafts and in counterbore in front cover.

**IMPORTANT:** When installing front bearing on a shaft, raise shaft slightly and support rear end of shaft to prevent damage to shaft rear bearing.

- j. Install input shaft holding tool, Fig. 32.

- k. Lubricate threads of front bearing retaining nuts and threads on shafts with graphite base grease; install front bearing retaining nuts on their respective shafts. Using special sockets, Figs. 33 and 34, and torque wrench and extensions, Fig. 52, torque front bearing retaining nuts to 480 to 520 lbs. ft. (66.36-71.40 kg-m).

- l. Install oil sealing rings, Fig. 31 (3); interlock ends of the sealing rings. Coat sealing rings with clean oil; make certain they turn freely in their grooves.
- m. Install pressure relief valve, Fig. 31 (12), with new gasket, on transmission case; connect oil return tube (9).

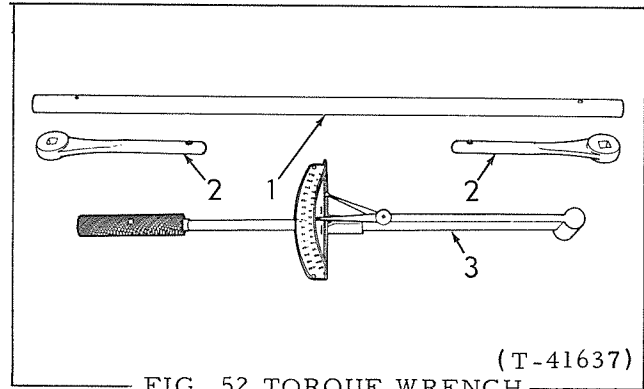


FIG. 52 TORQUE WRENCH AND EXTENSIONS

- \*1. Tube (Tool #M-32-60-A)
- \*2. End drive adapter (Tool #MS-52-AS)
- \*3. Torque wrench (Tool #5300)

\* Order from Service Tools Inc.  
1901 Indiana Ave., Chicago, Illinois 60616

- n. Refer to Fig. 30, install ground speed governor (6) and venturi pump (7); install oil return lines (8) (9).
- o. Install oil collectors (with new gaskets) over clutch shafts and in proper position on front cover, Fig. 30. Use care to prevent damage to shaft sealing rings.
- p. Install new oil seal in input shaft front oil seal retainer, with sealing lip of seal directed toward rear side of retainer. Lubricate seal with clean oil and install input shaft front oil seal retainer on front cover (with new gasket). Use care when installing to prevent damage to front oil seal.
- q. Install drive shaft rear yoke on input shaft; install retaining washer and capscrew. Torque capscrew to 270-290 lbs. ft. (37.33-40.10 kg-m); lock capscrew with locking wire. Remove input shaft holding tool.
- r. Install bevel pinion shaft front bearing retainer (with shim pack which was previously determined) on front cover.
- s. Clean suction oil screen and reinstall in transmission case; (replace if necessary). Install bottom cover (with

## Transmission

new gasket) on transmission case.

- t. Install clutch shaft rear bearing plugs in rear bearing bores in transmission case. Make certain the plugs are seated against bearings. Install input shaft rear oil seal, Fig. 39 (15) with sealing lip directed outward.
- u. Cover all openings in housing, fittings, or hoses to prevent entrance of dirt.

### E. INSTALLATION (with bevel gear and pinion adjustment checks)

1. Before installing transmission, the bevel gear shaft bearings must be checked for end play. As it is impractical to check the bearing pre-load as described in BEVEL GEAR AND SHAFT (steering clutches removed), refer to Fig. 53 and check bearing end play by positioning a dial indicator through power take-off access hole (if tractor has rear mounted equipment, remove bevel gear compartment cover and work through top of bevel gear compartment). Pry bevel gear in both directions (not too hard), if ANY end play is shown on dial indicator, refer to BEVEL GEAR AND SHAFT and adjust bevel gear shaft bearings preload.

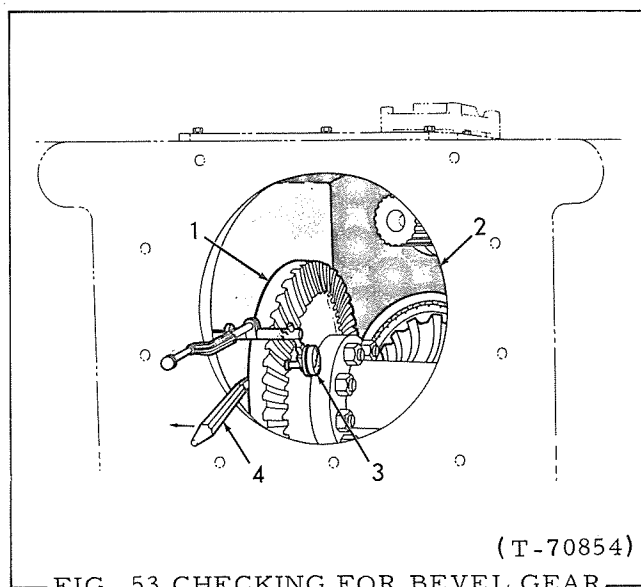


FIG. 53 CHECKING FOR BEVEL GEAR—  
END PLAY

1. Bevel gear
  2. Power take-off access hole
  3. Dial indicator
  4. Small pry bar
2. Install two guide studs in main housing; place a new transmission mounting gasket over guide studs. Attach hoist to transmission and install transmission onto guide studs; secure transmission to main housing with proper attaching capscrews; remove hoist.

3. Check backlash between bevel gear and bevel pinion; also make certain tooth contact pattern is correct. The following procedure is to be used only when bevel gear is in good condition and was not removed and/or replaced; if bevel gear was removed and/or replaced, refer to BEVEL GEAR AND SHAFT for complete procedure.

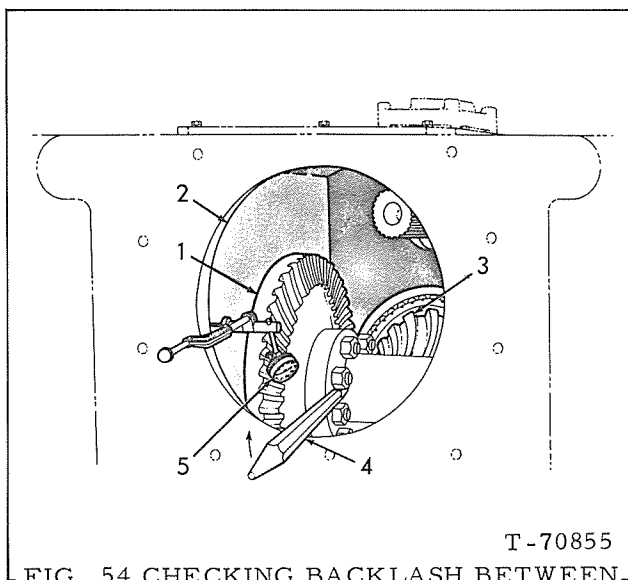


FIG. 54 CHECKING BACKLASH BETWEEN—  
BEVEL GEAR AND BEVEL PINION

1. Bevel gear
2. Power take-off access hole
3. Bevel pinion
4. Small pry bar
5. Dial indicator

- a. Refer to Fig. 54 and position a dial indicator as shown. Block bevel pinion solid. Insert a small pry bar and rotate gear back and forth; the total gear movement, as indicated by reading on dial indicator, is the backlash. Check backlash at several points around the gear; block bevel pinion solid each time.

#### CAUTION

Several attempts may be necessary to become accustomed to the "feel" in order to obtain correct backlash readings. Do not hurry this step!

- b. The specified backlash is .008" to .014" (.203-.355mm). If backlash is only slightly less than .008" (.203mm) or slightly more than .014" (.355mm) (and tooth contact pattern has not been set), it is possible to obtain the correct backlash by adding or removing pinion depth adjustment shims between transmission case and snap ring on bevel pinion shaft front bearing.

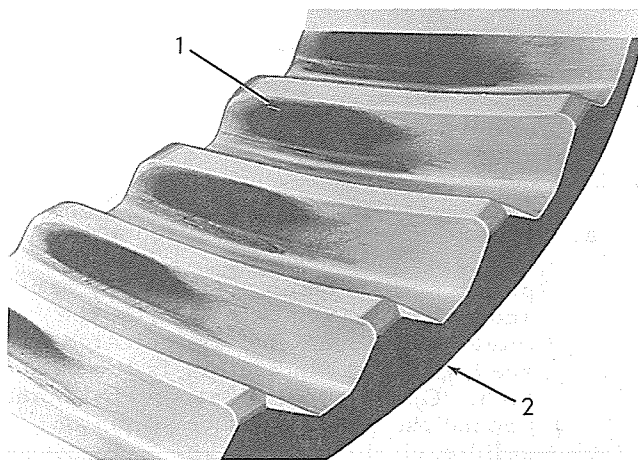
## Transmission

If specified backlash cannot be obtained in this manner, refer to BEVEL GEAR AND SHAFT for complete procedure.

- c. Check bevel gear -to-bevel pinion tooth contact pattern by applying a marking compound (bluing or red lead) to approximately 12 bevel gear teeth. Rotate bevel gear far enough to mesh with bevel pinion teeth and show a tooth contact pattern.

NOTE: The gears may be rotated by moving tractor (pushing, pulling, etc.) or by raising tractor and rotating the track.

- d. The correct tooth contact pattern is shown in Fig. 55. If contact pattern is not satisfactory, add or remove pinion depth adjustment shims (between transmission case and snap ring on bevel pinion shaft front bearing) until pattern is satisfactory.
- e. Re-check backlash! If backlash is not within specifications refer to BEVEL GEAR AND SHAFT and perform complete procedure.



( T-31450 )

FIG. 55 SATISFACTORY TOOTH CONTACT - NO LOAD

1. Contact pattern
2. Bevel gear
4. Install oil filler tube and breather housing on transmission (use new gasket).
5. Connect torque converter/transmission oil pump suction hose and steering oil pump suction hose to lower part of transmission.
6. Connect torque converter vent hose to transmission front cover.

7. Connect transmission oil supply hoses, Fig. 28 (2) (3) to clutch shaft oil collectors. Connect oil lines to pressure relief valve, Fig. 14. Install hose supporting clips.
8. Install drive shaft universal joint assembly.
9. Install brake pedal and shaft assembly, Fig. 29; connect brake control linkage and parking brake linkage.
10. Connect steering control lower (horizontal) rods to steering control valve plungers and bellcrank levers beneath cowl. Adjust length of rods if necessary.

NOTE: The steering control linkage is properly adjusted if the steering hand levers contact upper side of bracket when steering control valve plungers are in neutral position.

11. Install seat support channel assembly; connect ground speed governor control linkage. Connect control rod to ground speed governor.
12. Install floor plate supporting channel (with original amount of shims on right end); connect decelerator pedal linkage.
13. Make certain transmission drain plug is tightened securely. Fill hydraulic system with specified oil through oil filler pipe on top of transmission housing (refer to LUBRICANT SPECIFICATIONS, CAPACITY, AND SERVICE).
14. Make certain bevel gear compartment drain plug is tight; fill steering clutch hydraulic system to proper level with specified oil.
15. Start engine and observe pressure gauges. If all gauges indicate pressures within "Operating Range", run tractor long enough to charge hydraulic system oil lines and components. Stop engine and immediately check oil level; oil level must be within operating range marks on gauge rod.

### CAUTION

If no pressure is indicated by gauges, engine must be stopped immediately and cause determined and corrected.

16. Move unit a short distance in each speed range to be certain transmission is working properly. Check for oil leaks; stop engine; correct any leaks found.
17. Install floor plates and transmission bottom guards.



## TOPIC 7 - BEVEL GEAR AND SHAFT

Bevel gear, located in center compartment of Main housing, is attached to flange on bevel gear shaft, Fig. 56. Bevel gear shaft is supported at each end by tapered roller bearings

contained in removable cages, and is driven by transmission bevel pinion. Power from bevel gear is transmitted through steering clutches to final drives.

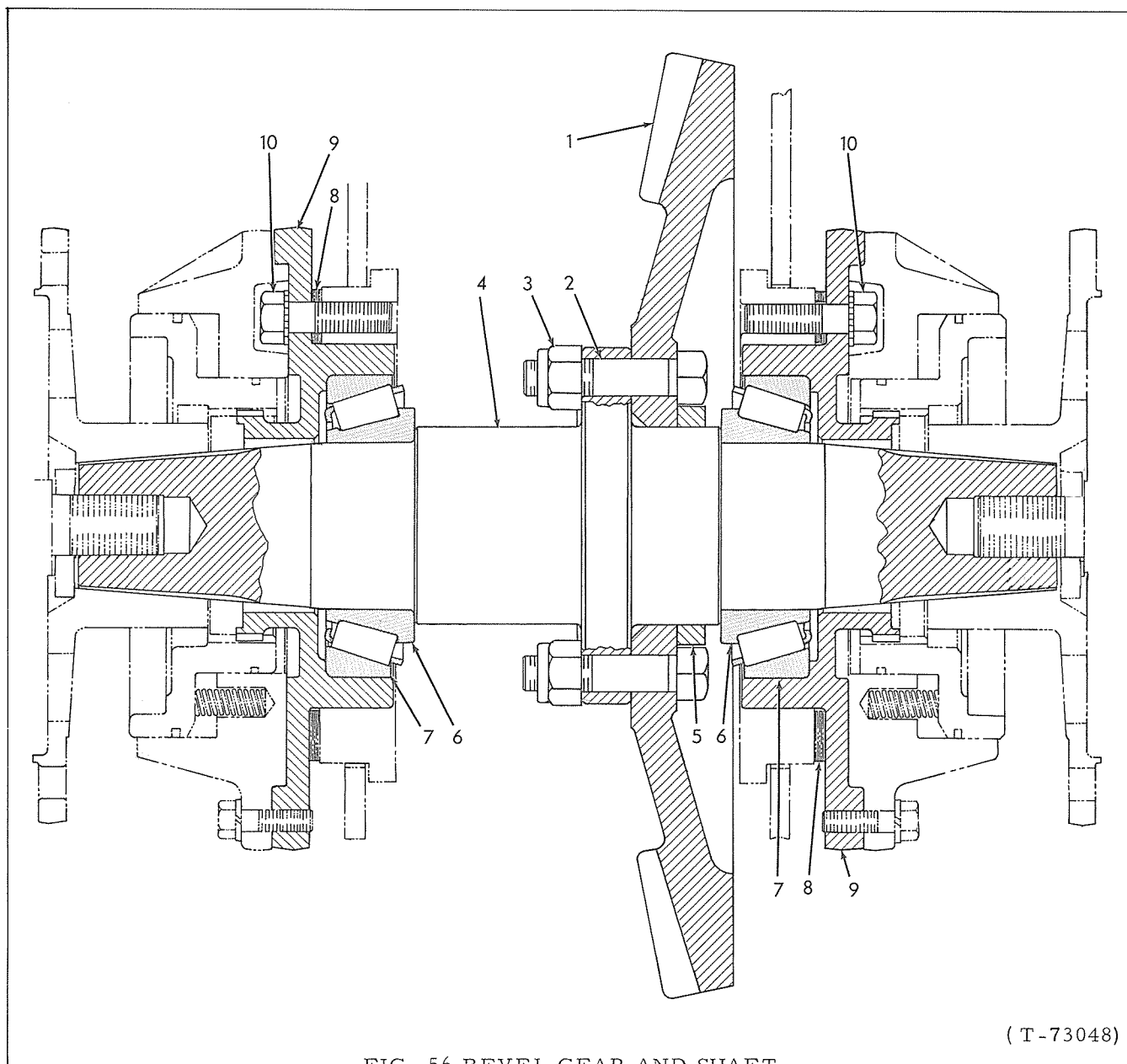


FIG. 56 BEVEL GEAR AND SHAFT

- 1. Bevel gear
- 2. Capscrew
- 3. Nut

- 4. Shaft
- 5. Locking ring
- 6. Bearing cone

- 7. Bearing cup
- 8. Shims
- 9. Cage
- 10. Capscrew

### A. REMOVAL

Bevel gear, shaft, and shaft bearings may be removed and replaced without removing transmission. If transmission has been removed, install bevel gear, shaft and bearings and set pre-load before installing transmission.

If bevel gear, shaft or bearings are to be replaced without removing transmission, pre-load on bevel gear shaft bearings must be adjusted without bevel gear installed on shaft. After bearings are properly adjusted, remove shaft and install bevel gear. Remove bevel gear and shaft as follows:

## Bevel Gear and Shaft

1. Before bevel gear and shaft can be removed, it is necessary to remove steering clutches, brakes, and steering clutch throwout bearing assemblies; refer to Steering Clutches and Brakes service manual for detailed information.
2. Remove bevel gear compartment cover; remove nuts securing bevel gear to flange on bevel gear shaft.
3. Refer to Fig. 56, remove capscrews attaching bearing cages (9) to inner walls of steering clutch compartments; place wooden block under bevel gear to support gear and shaft and remove bearing cages; tie bearing adjustment shims (8) to their respective cages to prevent loss. Mark bearing cages so they will be reinstalled in their original positions (left and right).
4. Refer to Fig. 57, place wooden blocks between bevel gear teeth and compartment wall to hold gear stationary. Install puller tools on end of shaft facing bevel gear teeth; pull bevel gear shaft from bevel gear.

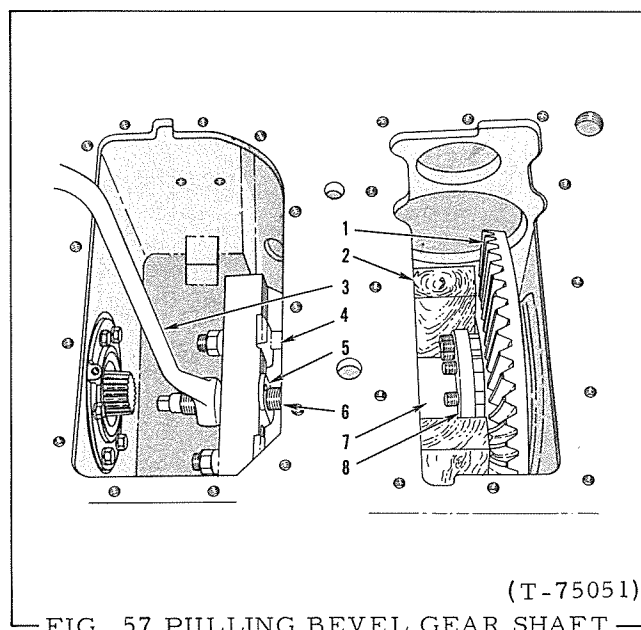


FIG. 57 PULLING BEVEL GEAR SHAFT

1. Bevel gear
2. Wooden blocks
3. Wrench
4. Legs
5. Push-puller
6. Puller screw
7. Bevel gear shaft
8. Bolting flange

5. Remove puller tools, remove bevel gear shaft (with other bearing cone) through steering clutch compartment; remove bevel gear, bearing cone, capscrew locking ring, and wooden blocks from bevel gear compartment.

6. Remove bearing cone from bevel gear shaft; remove bearing cups, Fig. 56 (7), from bearing cage assemblies.
7. Clean and inspect all parts for damage or excessive wear.

## B. INSTALLATION

If service work was done on bevel gear components without removing transmission, preload on bevel gear shaft bearings must be adjusted without bevel gear installed on shaft; then remove shaft and install bevel gear.

1. Refer to Fig. 56; press one bearing cone (6) on long end of shaft with large O.D. of bearing tight against shoulder on shaft. Place bevel gear on suitable work bench (with teeth of gear downward). Position capscrew locking ring (5) on bevel gear and install capscrews (2) in bevel gear; turn capscrew heads as necessary to clear locking ring as capscrews are installed.

NOTE: Installation of bearing cones on bevel gear shaft will be much easier if bearing cones are heated in oil to approximately 275°F. (135°C.) before installation.

2. Remove locking ring and position bevel gear in bevel gear compartment Fig. 56. Install bevel gear shaft through steering clutch compartment on tooth side of bevel gear and align capscrews in bevel gear with holes in bolting flange of shaft. Bump or drive bevel gear shaft into bevel gear until nuts (3) can be started on capscrews. Install locking ring (5) and tighten nuts evenly until bevel gear is properly located on shaft.
3. Lubricate other bearing cone, Fig. 56 (6) and start it on short end of bevel gear shaft with large O.D. of bearing toward bevel gear. Refer to Fig. 58, install puller screw in tapped hole in end of shaft and place tube against inner race of bearing cone. Install tube cap, thrust washer, and hexnut; tighten hex-nut until bearing cone is tight against shoulder on shaft; remove tools.
4. Press bearing cups, Fig. 56 (7) into bearing cages (9); be certain cups are seated firmly in cages. Lubricate bearings with clean oil and install each bearing cage (with original bearing adjustment shims) in bore from which it was removed.
5. Start bearing cage attaching capscrews (10), but do not tighten.

## Bevel Gear and Shaft

6. Torque nuts, Fig. 56(3), on bevel gear attaching capscrews to 165 to 175 lbs.ft. (22.81-24.20 kg-m).
7. Tighten bearing cage attaching capscrews; bump cages to be certain bearings are properly seated; retighten cage attaching capscrews if necessary.

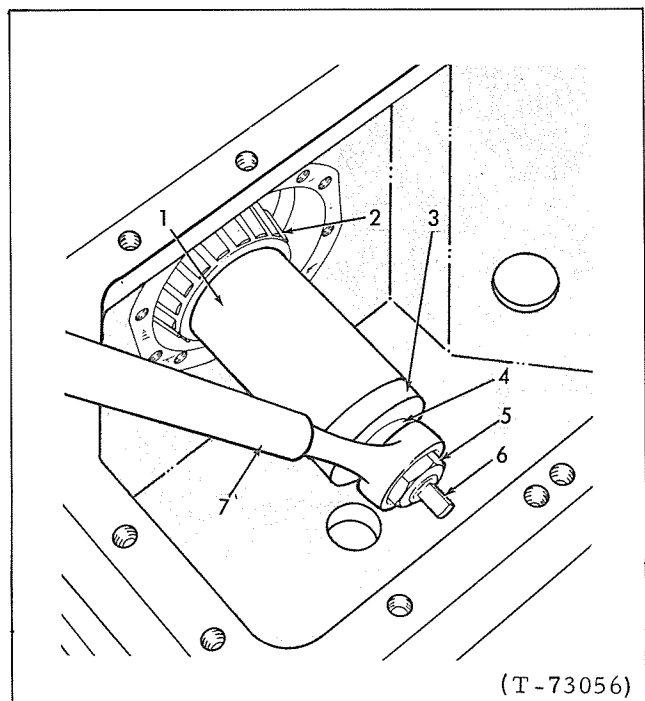


FIG. 58 INSTALLING BEVEL GEAR SHAFT-BEARING CONE

- |             |                               |
|-------------|-------------------------------|
| 1. Tube     | 5. Nut                        |
| 2. Cone     | *6. Puller screw (OTC #938-2) |
| 3. Tube cup | 7. Wrench                     |
| 4. Washer   |                               |

\* Order from Service Tools Inc., 1901 Indiana Avenue, Chicago, Illinois 60616

### C. ADJUSTMENTS

#### 1. BEVEL GEAR SHAFT BEARING PRE-LOAD

- a. Install capscrew in end of bevel gear shaft and tighten until it bottoms.
- b. Refer to Fig. 59, turn bevel gear shaft with pounds inch indicating torque wrench to determine pre-load on bearings; specified pre-load is 10 to 20 lbs. in (.003" - .004" tight) (11.52-23.04 kg-cm (.076-.101mm tight)).
- c. Add or remove bearing adjustment shims (equally) under bearing cages to obtain specified preload. When adjusting, bump bearing cages to be certain bearings are properly seated.

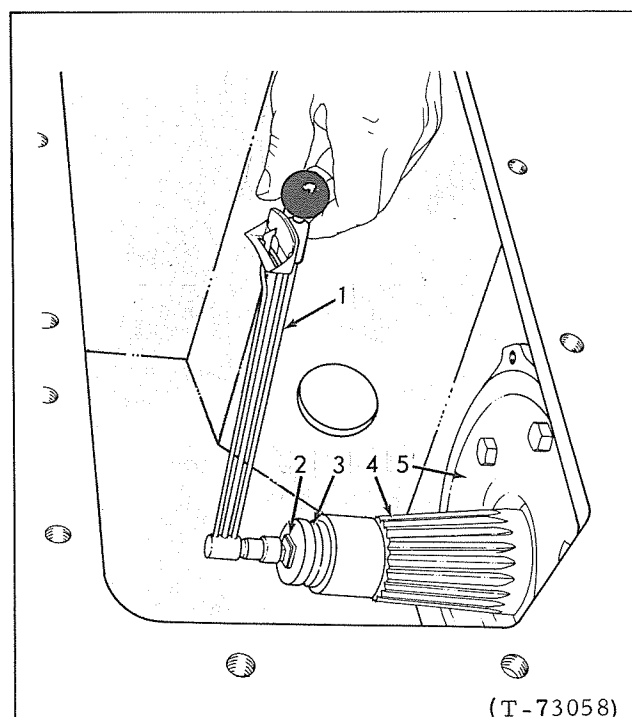


FIG. 59 CHECKING PRE-LOAD OF BEVEL GEAR SHAFT BEARINGS

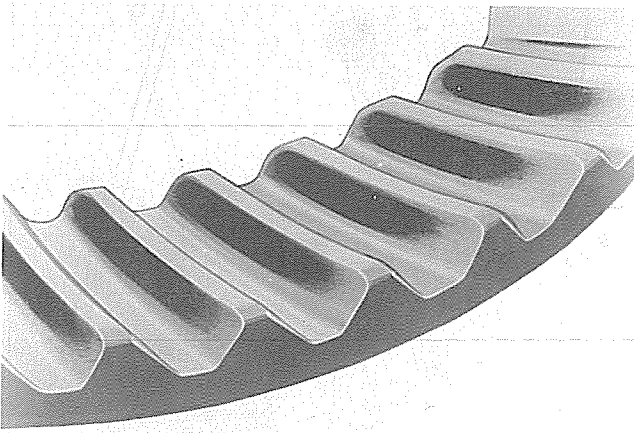
- |                                |           |
|--------------------------------|-----------|
| 1. Torque wrench (pounds inch) | 3. Socket |
| 2. Adapter                     | 4. Shaft  |
|                                | 5. Cage   |

#### 2. BACKLASH AND GEAR TOOTH CONTACT PATTERN

- a. Install transmission (if removed), refer to TRANSMISSION.
- b. Check backlash between bevel gear and bevel pinion. Refer to Fig. 54, mount dial indicator so readings can be taken from bevel gear. Check backlash at four points (90° apart) around gear; block bevel pinion solid each time reading is taken.
- c. Specified backlash is .008" - .014" (0.203-0.355mm); adjust backlash by transferring bearing adjustment shims from under one bevel gear shaft bearing cage to other. In this manner, bevel gear is moved, but pre-load on bearings will remain as adjusted; move bevel gear toward pinion to decrease backlash, or away from pinion to increase backlash.
- d. Check tooth contact pattern. Paint approximately 12 bevel gear teeth with marking compound or bluing and turn transmission pinion; tooth contact pattern will show plainly on bevel gear teeth. Area of contact (no load) must favor toe of gear tooth, extend approximately 1/2 of the tooth

## Bevel Gear and Shaft

length toward heel, and be centered between top and bottom of booth, Fig. 55. Area of contact when gears are loaded should increase in length as shown in Fig. 60.



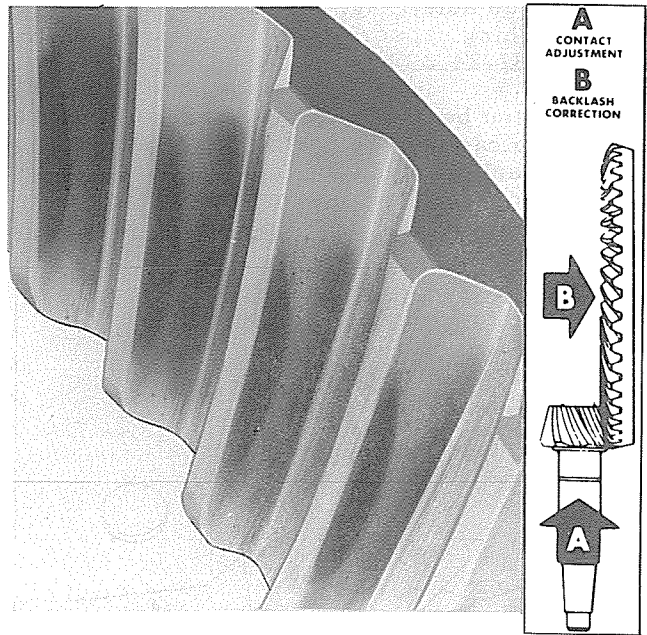
(T-31449)

FIG. 60 SATISFACTORY TOOTH CONTACT - GEARS LOADED

- e. **HIGH CONTACT** as shown in Fig. 61 is not desirable and will result in galling and rolling over of top edges of teeth. To correct high contact pattern, move bevel pinion toward bevel gear by adding pinion depth adjustment shims between transmission case and pinion shaft rear bearing retainer. This adjustment will decrease backlash between bevel pinion and bevel gear. Specified backlash is .008" to .014" (0.203-0.355mm). Increase backlash by moving bevel gear away from bevel pinion; move gear away from pinion by transferring bevel gear shaft bearing adjustment shims from bearing cage on tooth side of gear to bearing cage on flat side of gear.

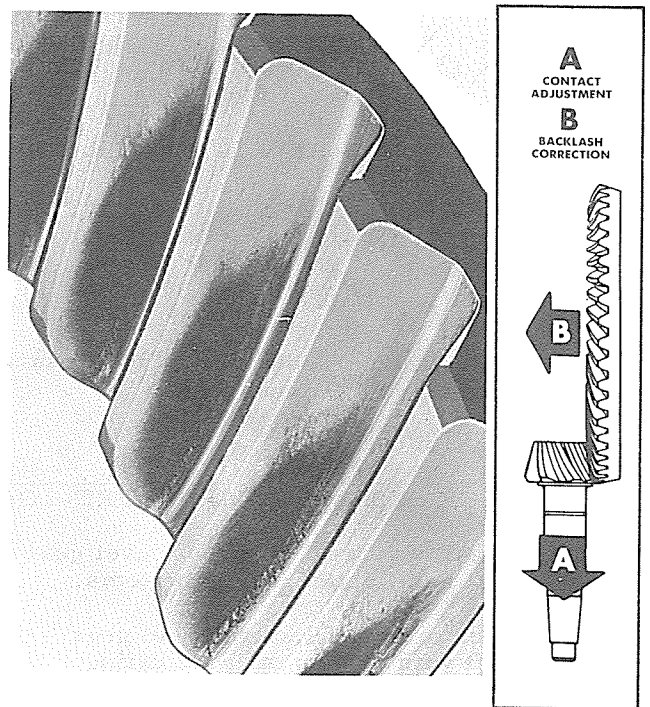
NOTE: Each .005" (0.127mm) bevel gear shaft bearing adjustment shim transferred will change backlash approximately .003" (0.076mm).

- f. **LOW CONTACT** as shown in Fig. 62 will result in galling and grooving of teeth. To correct low contact, move bevel pinion away from bevel gear by adding pinion depth adjusting shims between transmission case and snapping on pinion shaft front bearing. This adjustment will increase backlash between bevel pinion and bevel gear. Specified backlash is .008" to .014" (0.203-0.355mm). Decrease backlash by moving bevel gear toward



(T-71900)

FIG. 61 HIGH CONTACT - NO LOAD

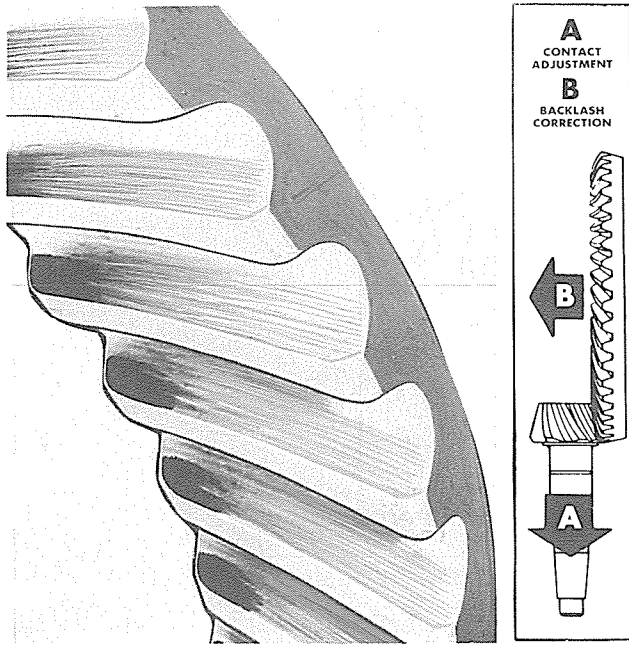


(T-26963)

FIG. 62 LOW CONTACT - NO LOAD

bevel pinion; move gear toward pinion by transferring bevel gear shaft bearing adjustment shims from bearing cage on flat side of gear to bearing cage on tooth side of gear.

## Bevel Gear and Shaft



(T-71901)

FIG. 63 SHORT TOE CONTACT - NO LOAD

- g. SHORT TOE CONTACT as shown in Fig. 63 will result in chipped tooth edges and excessive wear due to small contact area. To correct short

toe contact move bevel pinion away from bevel gear by adding pinion depth adjusting shims between transmission case and snap ring on pinion shaft front bearing. This adjustment will increase backlash between bevel pinion and bevel gear. Specified backlash is .008" to .014" (0.203-0.355mm); decrease backlash by moving bevel gear toward bevel pinion. Move gear toward pinion by transferring bevel gear shaft bearing adjustment shims from bearing cage on flat side of bevel gear to bearing cage on tooth side of bevel gear.

NOTE: Several adjustments of both bevel pinion and bevel gear may be necessary before correct tooth contact pattern and correct backlash are obtained.

### D. FINAL INSTALLATION

1. Clean interior of bevel gear compartment and steering clutch compartments. Install bevel gear compartment cover.
2. Install steering clutch throwout bearing assemblies, steering clutches, and steering brakes; fill hydraulic system with specified lubricant. Refer to Steering Clutches and Brakes service manual for detailed information.

## TOPIC 8 - DRIVE SHAFT UNIVERSAL JOINT

Power from engine is transmitted through torque converter to transmission through drive shaft universal joint. Main parts of universal joint are: center yoke, front and rear spider assemblies, and front and rear yokes. Universal joint can be disconnected and removed for removal of torque converter and/or transmission without disturbing engine or bevel gear and steering clutches.

Universal joint assembly has three lubrication fittings, one in each spider assembly and one in front yoke.

### A. REMOVAL, DISASSEMBLY, AND INSPECTION

1. Turn electrical system master switch off; remove floor plates.
2. Refer to Fig. 64, unlock and remove cap-screws attaching universal joint to front and rear yokes; pry front yoke forward and remove universal joint. Remove front yoke from torque converter output shaft.

3. Refer to Fig. 64, unlock and remove cap-screws (5); remove front and rear spider assemblies (2) from center yoke (4).
4. Remove bearing assemblies from spider assemblies; identify bearing assemblies so they may be installed in original position if re-used.
5. Wash all components in clean solvent. Inspect for excessive wear or damage.

### B. ASSEMBLY AND INSTALLATION

If bearings or bearing journals on spiders show damage or excessive wear, it will be necessary to replace spider and bearings as a complete assembly. If spider and bearings are in good condition, assemble each spider as follows:

1. Refer to Fig. 64, install new sealing washers (3) in each bearing cup; lubricate bearings with light coat of grease and install bearing cups on spider journals from which they were removed. Be certain

## Drive Shaft Universal Joint

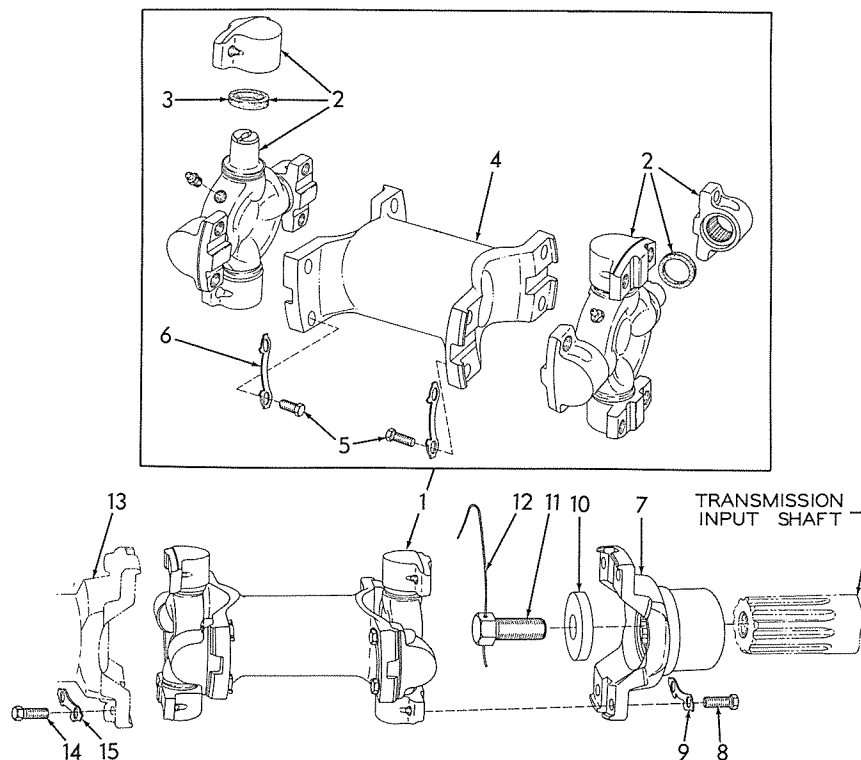


FIG. 64 DRIVE SHAFT UNIVERSAL JOINT

T-74884

1. Joint assembly
2. Spider assembly
3. Sealing washer
4. Center yoke
5. Capscrew
6. Lock
7. Rear yoke

8. Capscrew
9. Lock
10. Washer
11. Capscrew
12. Lock wire
13. Front yoke
14. Capscrew
15. Lock

bearings are fully seated on spider journals. Install front and rear spider assemblies (2) on center yoke (4); secure with attaching capscrews (5). Lock capscrews with locking plates.

NOTE: Install spider assemblies on connecting yoke with lubricating fittings in line. This will allow both fittings to be lubricated without turning drive shaft.

2. Refer to Fig. 64, install front yoke (13) on torque converter output shaft. Place universal joint assembly on rear yoke

(with lubrication fittings aligned with lubrication fitting in front yoke) and install attaching capscrews; lock capscrews with locking plates.

3. Align universal joint with front yoke; move front yoke rearward and install attaching capscrews. Lock capscrews with locking plates.
4. Lubricate universal joint.
5. Install floor plates; turn electrical system master switch on.

## TOPIC 9 - FITS AND TOLERANCES

### A. HYDRAULIC SYSTEM

#### 1. SPEED CONTROL VALVE

- a.  $\left\{ \begin{array}{l} \text{Adapter plate} \\ \text{Wiper} \end{array} \right\}$  if worn or scored, may be ground . . . .040" (1.02mm) max.

- b. Maximum wear on shaft at bearing locations - - - - - .001" (.025mm)

#### 2. PRESSURE RELIEF VALVE

##### a. Spools

O.D. - - - - - .9985"-.9990" (25.36-25.37mm)

I.D. of bore(s) in housing - - - - - .9995"-1.0005" (25.38-25.41mm)

##### b. Transmission clutch apply pressure spring

Approximate free length - - - - - 3.87" (93.29mm)

Load when compressed to 2.82" (71.62mm) - - - - - 71.5-78.5 lbs. (9.89-10.85 kg-m)

##### c. Torque converter/transmission clutch lubricating pressure spring

Approximate free length - - - - - 4.45" (113.03mm)

Load when compressed to 2.82" (71.62mm) - - - - - 24.5-27.0 lbs. (3.39-3.73 kg-m)

##### d. Torque converter safety valve spring

Approximate free length - - - - - 4.28" (108.71mm)

Load when compressed to 2.82" (71.62mm) - - - - - 42-46 lbs. (5.81-6.36 kg-m)

#### 3. HYDRAULIC PUMP BENCH TEST SPECIFICATIONS

Oil: SAE 10W

Oil Temperature: 175°-185°F. (79-85°C)

Pump Speed: 2,000 rpm

Pressure Pump Output: 40 gpm @200 psi (151.4 lts/min @14.06 kg/cm<sup>2</sup>)

#### 4. VENTURI PUMP

Size of restrictor - - - - - .091"-.094" (2.31-2.38mm)

### B. TORQUE CONVERTER

#### 1. TORQUE CONVERTER HOUSING

- a. Bore diameter for output hub - - - - - 6.298"-6.300" (159.9-160.0mm)

Bore diameter for torque converter/transmission pump - 4.3743"-4.3753" (111.10-111.13 mm)

Rear bearing bore diameter - - - - - 3.9369"-3.9377" (99.99-100.00mm)

#### 2. OUTPUT SHAFT

- a. O.D. at rear bearing location - - - - - 2.1653"-2.1659" (54.99-55.01mm)

- b. Width of sealing ring groove - - - - - .095"-.101" (2.41-2.56mm)

#### 3. STATOR SPACER

- a. Thickness - - - - - .635"-.645" (16.12-16.38mm)

- b. Replace if thickness is less than - - - - - .620" (15.74mm)

- c. Must be flat within - - - - - .002" (0.050mm)

#### 4. OUTPUT HUB

- a. O.D. at housing locations - - - - - 6.302"-6.304" (160.0-160.12mm)

- b. O.D. at impeller bearing location - - - - - 2.5580"-2.5586" (64.97-64.98mm)

- c. I.D. at shaft sealing ring location - - - - - 2.000"-2.002" (50.80-50.85mm)

- d. Width of sealing ring groove - - - - - .165"-.170" (4.10-4.31mm)

#### 5. TURBINE BALANCE TOLERANCE - - - - - 50 oz. in. (36.6 gm-cm)

## Fits and Tolerances

### 6. IMPELLER

- a. I.D. of bearing bore - - - - - 3.9355"-3.9365" (99.96-99.98mm)
- b. Balance tolerance - - - - - .50 oz. in. (36.6 gm-cm)

### 7. FRONT BEARING

- a. I.D. - - - - - 1.9680"-1.9685" (49.98-50.0mm)
- b. O.D. - - - - - 4.3306"-4.3307" (108.99-110.0mm)

### 8. IMPELLER BEARING

- a. I.D. - - - - - 2.5585"-2.5591" (64.98-65.00mm)
- b. O.D. - - - - - 3.9364"-3.9370" (99.98-99.99mm)

### 9. REAR BEARING

- a. I.D. - - - - - 2.1648"-2.1654" (54.98-55.00mm)
- b. O.D. - - - - - 3.9364"-3.9370" (99.98-99.99mm)

## C. TRANSMISSION

### 1. CLUTCH FRICTION PLATES

- a. Steel Plates
  - Thickness - - - - - .081"-.085" (2.05-2.15mm)
  - Replace if thickness is less than - - - - - .071" (1.80mm)
  - Must be flat within - - - - - .002" (0.050mm)
- b. Bronze Plates:
  - Thickness - - - - - .098"-.102" (2.48-2.59mm)
  - Replace if thickness is less than - - - - - .092" (2.34mm)
  - Must be flat within - - - - - .002" (0.050mm)

### 2. BRONZE THRUST WASHERS

- a. Thickness - - - - - .091"-.095" (2.31-2.41mm)
- b. Replace if thickness is less than - - - - - .087" (2.20mm)
- c. Must be flat within - - - - - .001" (0.025mm)

### 3. CLUTCH SHAFTS

Replace shaft if O.D. at clutch drum bearing area is less than - - - - - 2.498" (63.45mm)

### 4. CLUTCH DRUM AND GEAR

Replace any drum in which bearing bore is more than - - - - - 2.879" (73.13mm)

### 5. BEARING ADJUSTMENT

- a. Bevel pinion shaft front bearing - - - - - .000"-.002" loose (0-.050mm)
- b. Ground speed governor shaft bearings
  - Upper shaft - - - - - .004"-.006" loose (.102-.152mm)
  - Lower shaft - - - - - .003"-.005" loose (.076-.127mm)

## D. BEVEL GEAR AND SHAFT

- 1. BACKLASH - - - - - .008"-.014" (0.203-0.355mm)
- 2. BEARING PRELOAD - -10-20 lbs. in. (.003"-.004" tight) (11.52-23.04 kg-cm) (0.076-0.101mm)



## Fits and Tolerances

### E. SPECIFIED TORQUES

#### 1. TORQUE CONVERTER

- a. Transmission/torque converter pump retaining nut - - - - -45 lbs. ft. (6.22 kg-m)
- b. Accessory drive gear capscrews - - - - (5/16") - - - -19-23 lbs. ft. (2.63-3.18 kg-m)  
(7/16") - - - - -64-77 lbs. ft. (8.8 - 10.6 kgm)
- c. All others - - - - - Refer to Torque Converter Assembly

#### 2. TRANSMISSION

- a. Bevel pinion shaft front  
capscrews - - - - -95-105 lbs. ft. (13.13-14.52 kg-m)
- b. Front bearing retaining nuts - - - - -480-520 lbs. ft. (66.36-71.90 kg-m)
- c. Universal joint rear yoke - - - - -270-290 lbs. ft. (37.33-40.10 kg-m)
- d. All others - standard torque

#### 3. BEVEL GEAR

Bevel gear attaching capscrews - - - - -165-175 lbs. ft. (22.81-24.20 kg - m)

## TOPIC 10 - SERVICE TOOLS

No service tools other than standard hand tools and/or shop tools are required for servicing components covered in this manual except when tools are listed (with manufacturer and manufacturer's tool numbers) under illustrations in this manual.



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