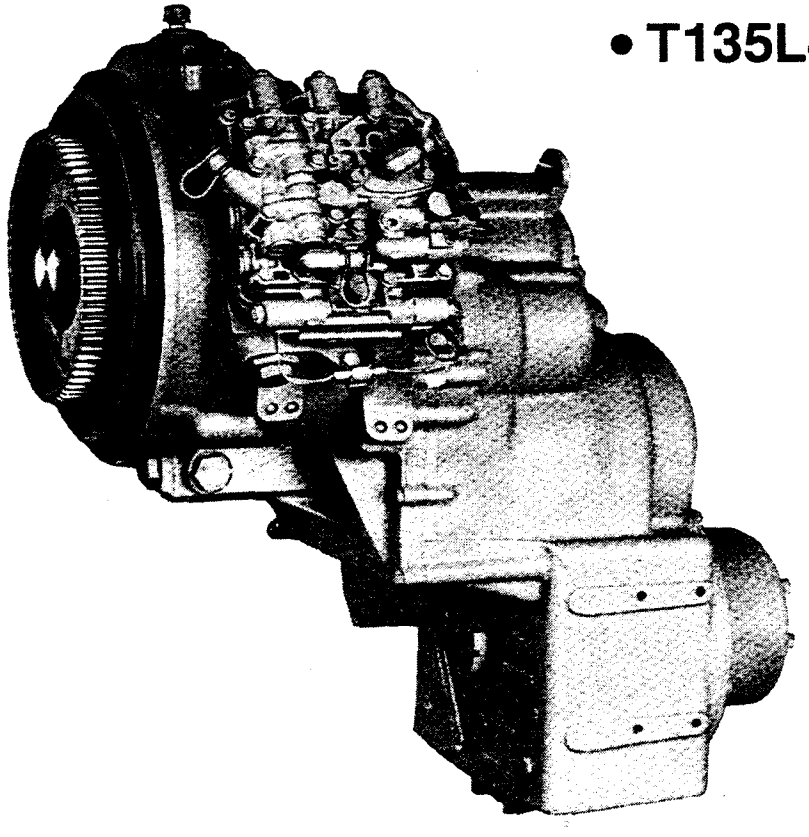
MAINTENANCE MANUAL NO. 27A
ISSUED 3-90

Off-Highway Transmission

Rockwell



• T135L43KW8000

Important Safety Information

Most accidents involving product operation, maintenance and repair are caused by failure to observe basic safety rules or precautions. An accident can often be avoided by recognizing potentially hazardous situations before an accident occurs. A person must be alert to potential hazards. This person should also have the necessary training, skills and tools to perform these functions properly.

Improper operation, lubrication, maintenance or repair of this product can be dangerous and could result in injury or death.

Do not operate or perform any lubrication, maintenance or repair on this product, until you have read and understood the operation, lubrication, maintenance and repair information.

Safety precautions and warnings are provided in this manual and on the product. If these hazard warnings are not heeded, bodily injury or death could occur to you or other persons.

The hazards are identified by the "Safety Alert Symbol" and followed by a "Signal Word" such as "WARNING" as shown below.

⚠ WARNING

The meaning of this safety alert symbol is as follows:

Attention! Become Alert! Your Safety is Involved.

The message that appears under the warning, explaining the hazard, can be either written or pictorially presented.

Operations that may cause product damage are identified by NOTICE labels on the product and in this publication.

Rockwell cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this publication and on the product are therefore not all inclusive. If a tool, procedure, work method or operating technique not specifically recommended by Rockwell is used, you must satisfy yourself that it is safe for you and others. You should also ensure that the product will not be damaged or made unsafe by the operation, lubrication, maintenance or repair procedures you choose.

The information, specifications, and illustrations in this publication are on the basis of information available at the time it was written. The specifications, torques, pressures, measurements, adjustments, illustrations, and other items can change at any time. These changes can affect the service given to the product. Obtain the complete and most current information before starting any job.

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peration And Maintenance

Specifications

ystems Operation

Testing And Adjusting

Special Tooling

Disassembly And Assembly

⚠ WARNING

SAFETY

⚠ WARNING

The proper and safe lubrication and maintenance for this transmission, recommended by Rockwell, are outlined in the OPERATION & MAINTENANCE SECTION of this manual. Improper performance of lubrication or maintenance procedures is dangerous and could result in injury or death. Read and understand the OPERATION & MAINTENANCE SECTION before performing any lubrication or maintenance.

The servicemen or mechanic may be unfamiliar with this transmission. This makes it important to use caution when performing service work. A knowledge of the system and/or components is important before the removal or disassembly of any component.

Because of the size of some of the machine components, the serviceman or mechanic should check the weights noted in this Manual. Use proper lifting procedures when removing any components.

Following is a list of basic precautions that should always be observed.

1. Read and understand all Warning plates and decals on the machine before operating, lubricating or repairing this product.

2. Always wear protective glasses and protective shoes when working around machines. In particular, wear protective glasses when pounding on any part of the machine or its attachments with a hammer or sledge. Use welders gloves, hood/goggles, apron and other protective clothing appropriate to the welding job being performed. Do not wear loose-fitting or torn clothing. Remove all rings from fingers when working on machinery.

3. Disconnect battery and discharge any capacitors before starting to work on machine. Hang "Do Not Operate" tag in the Operator's Compartment.

4. If possible, make all repairs with the machine parked on a level, hard surface. Block machine so it does not roll while working on or under machine.

5. Do not work on any machine that is supported only by lift jacks or a hoist. Always use blocks or jack stands to support the machine before performing any disassembly.

6. Relieve all pressure before any lines, fittings or related items are disconnected or removed. Be alert for possible pressure when disconnecting any device from a system that utilizes pressure.

7. Block, if necessary, all implements before performing any work on the machine to prevent them from dropping unexpectedly.

8. To avoid back injury, use a hoist when lifting components which weigh 23 kg (50 lb.) or more. Make sure all chains, hooks, slings, etc., are in good condition and are in the correct capacity. Be sure hooks are positioned correctly. Lifting eyes are not to be side loaded during a lifting operation.

9. To avoid burns, be alert for hot parts on machines which have just been stopped and hot fluids in lines, tubes and compartments.

10. Be careful when removing filler caps, breathers and plugs on the machine. Hold a rag over the cap or plug to prevent being sprayed or splashed by liquids under pressure. The danger is even greater if the machine has just been stopped because fluids can be hot.

11. Always use tools that are in good condition and be sure you understand how to use them before performing any service work.

12. Reinstall all fasteners with same part number. Do not use a lesser quality fastener if replacements are necessary.

13. Repairs which require welding should be performed only with the benefit of the appropriate reference information and by personnel adequately trained and knowledgeable in welding procedures. Determine type of metal being welded and select correct welding procedure and electrodes, rods or wire to provide a weld metal strength equivalent at least to that of parent metal.

14. Do not damage wiring during removal operations. Reinstall the wiring so it is not damaged nor will it be damaged in operation by contacting sharp corners, or by rubbing against some object or hot surface. Do not connect wiring to a line containing fluid.

15. Be sure all protective devices including guards and shields are properly installed and functioning correctly before starting a repair. If a guard or shield must be removed to perform the repair work, use extra caution.

⚠ WARNING

16. Loose or damaged fuel, lubricant and hydraulic lines, tubes and hoses can cause fires. Do not bend or strike high pressure lines or install ones which have been bent or damaged. Inspect lines, tubes and hoses carefully. Do not check for leaks with your hands. Pin hole (very small) leaks can result in a high velocity oil stream that will be invisible close to the hose. This oil can penetrate the skin and cause personal injury. Use cardboard or paper to locate pin hole leaks.

17. Tighten connections to the correct torque. Make sure that all retainers and guards are installed correctly to avoid excessive heat, vibration or rubbing against other parts during operation.

18. Do not operate the transmission if any rotating part is damaged or contacts any other part during operation. Any high speed rotating component that has been damaged or altered should be checked for balance before reusing.

Operation And Maintenance

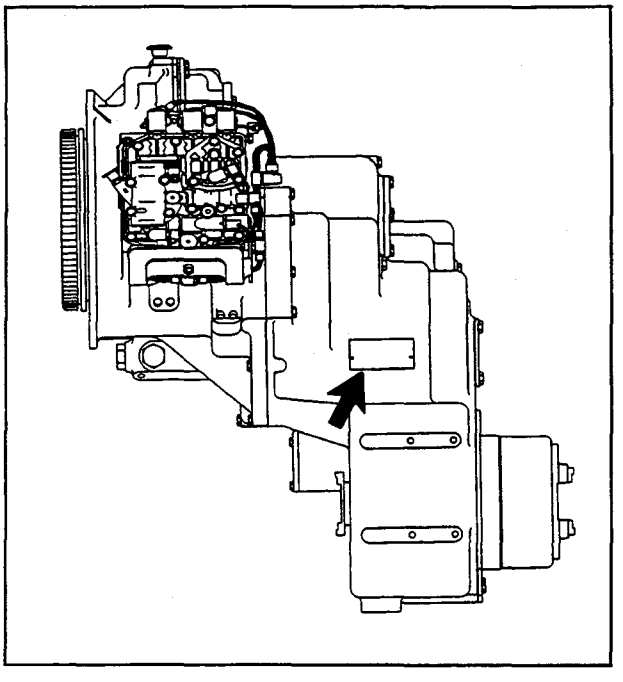
Serial Number Location and Monitoring Features

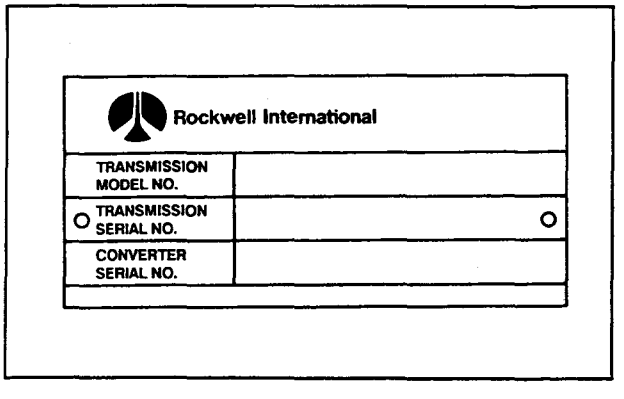
Serial Number Location

A serial number will be used to identify the product.

The serial number plate is located on the control valve side of the transmission.

For quick reference, record the serial number in the space provided below the illustration.

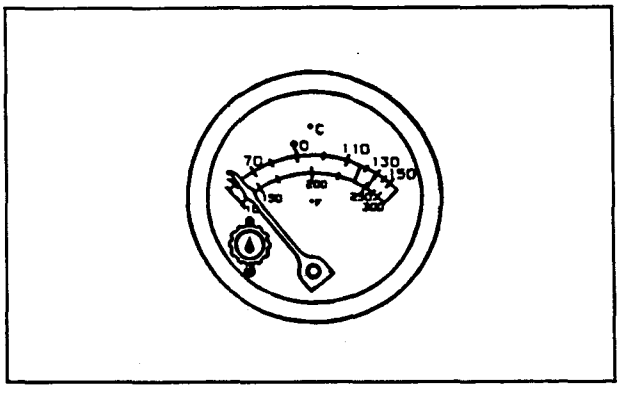




Transmission Serial Number_____

Monitoring Features

Transmission Oil Temperature (If Equipped)



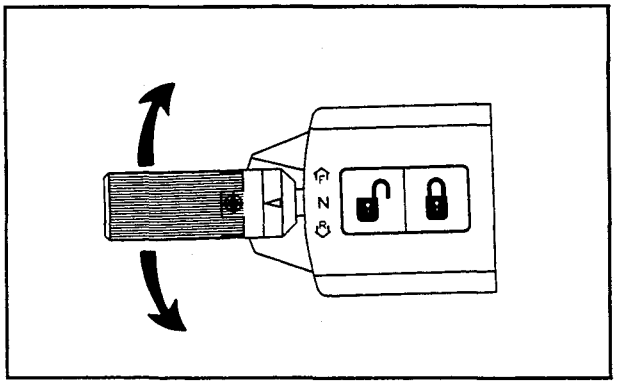
Transmission Oil Temperature – Indicates the temperature of the transmission oil. The maximum temperature is 130°C (265°F).

Controls

4F-3R Control

The control is for a 4 speed forward, 3 speed reverse transmission.

Direction Selector

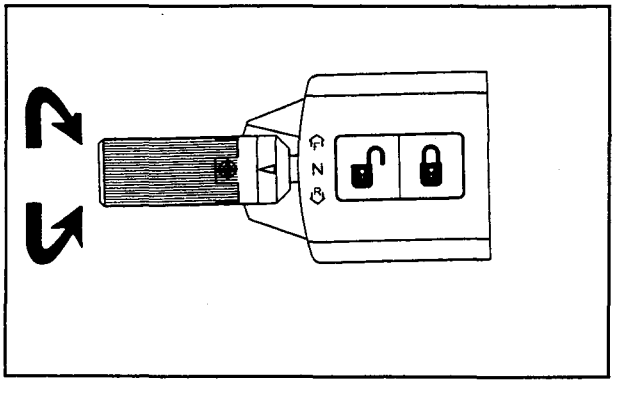


Forward – Push the transmission lever forward. The machine will move forward.

Neutral – The machine should not move when transmission lever is in neutral.

Reverse – Pull the transmission lever toward the operator. The machine will move in reverse.

Speed Selector



Rotate the transmission lever to the desired gear speed:
1 – First Speed (forward and reverse)
2 – Second Speed (forward and reverse)
3 – Third Speed (forward and reverse)
4 – Fourth Speed (forward only)

NOTICE

Welding on the machine may damage the transmission hand controls beyond repair.

All three (3) connectors leading to the hand control should be disconnected before welding on the machine.

Lubricant Specifications and Refill Capacity

Transmission Oil

Use service classification CD/TO-2 oils. Failure to follow this recommendation can cause shortened transmission life due to material incompatibility and inadequate frictional requirements for disk materials.

The use of multi grade oils containing viscosity index improvers in powershift transmissions is not recommended as gears and bearings do not derive the benefits of the viscosity index improver.

Lubricant Viscosities

LUBRICANT VISCOSITIES FOR AMBIENT (OUTSIDE)TEMPERATURES					
Compartment or System	Oil Viscosities	°C		°F	
		Min	Max	Min	Max
Transmission Oil	SPC [1] SAE 5W20	-30	+10	-22	+50
	SAE 10W	-20	+10	-4	+50
	SAE 30	0	+35	+32	+95
	SAE 40	+5	+45	+41	+113
	SAE 50	+10	+50	+50	+122

[1] SPC is a designation for special synthetic oils that do not contain viscosity improvers.

Refill Capacity

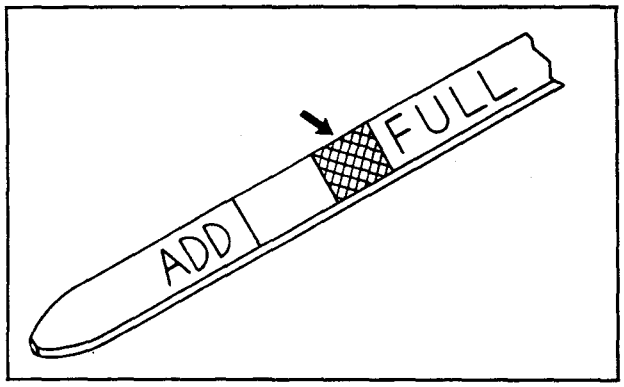
REFILL CAPACITY (APPROXIMATE)			
Compartment or System	Liters	U.S. Gal.	Imperial Gal.
Transmission	21	5.5	4.6

Transmission System Maintenance Intervals

You must read and understand the warnings and instructions contained in the Safety section of this manual, before performing any operation or maintenance procedures.

Transmission Oil

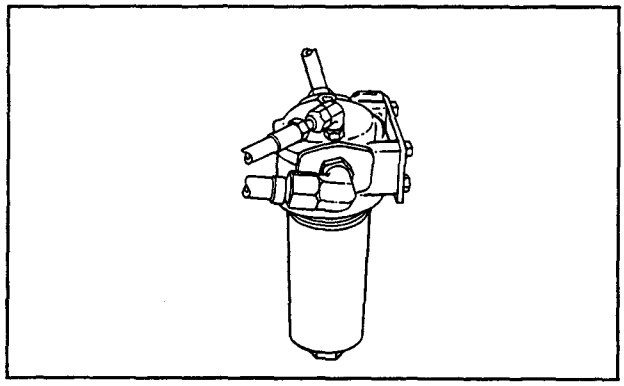
Check the Transmission Oil Level - Daily



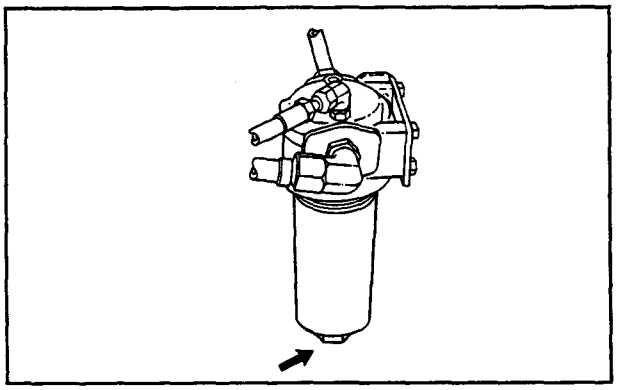
Maintain the oil level to the full mark on the dipstick with the engine at low idle, the transmission warm and in neutral. The full mark corresponds to the center of the output shaft.

Transmission Filter

Change Filter - Every 500 Service Hours or 3 Months



The transmission filter location varies with application. Consult your machine's operation manual for location.



1. Remove the drain plug from the bottom of the filter housing.

2. Remove the filter housing.

3. Remove and discard the element from the filter housing.

4. Clean the filter housing with a clean, nonflammable solvent.

5. Clean the housing base.

6. Insert a new filter element into the filter housing.

7. Inspect the filter housing seal. Replace the seal, if it is damaged.

8. Install the filter housing into the housing base, hand tight.

NOTICE
Do not use air wrench to tighten filter housing.

9. Clean and install the drain plug in the bottom of the filter housing.

10. Start the engine and operate at low idle to prime all lines.

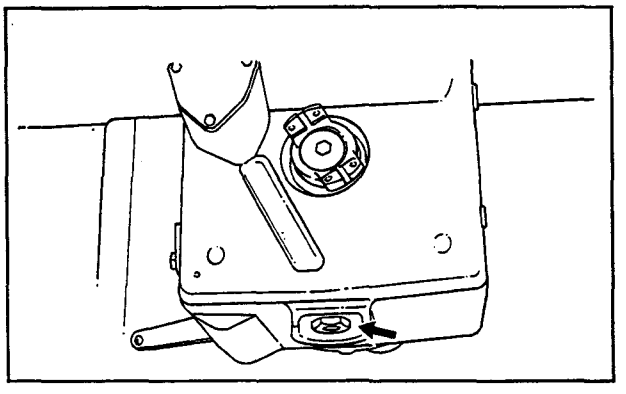
11. Inspect for leaks.

12. Maintain the oil level to the full mark on the dipstick with the engine at low idle, the transmission warm and in neutral.

Transmission Oil

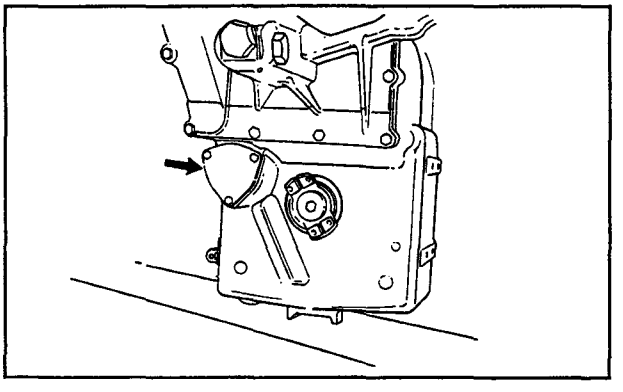
Change Transmission Oil - Every 1000 Service Hours or 6 Months

Operate the transmission long enough to warm the oil.



1. Remove the transmission drain plug and drain the oil.

2. Change the filter element.



3. Remove the magnetic strainer cover.

4. Remove the magnets from the housing.

5. Remove the screen from the housing.

6. Wash the screen in a clean, nonflammable solvent.

7. Clean the magnets with a cloth, a stiff bristle brush or air pressure.

NOTICE

Do not drop or rap the magnets against any hard objects. Replace any damaged magnets.

8. Clean the cover and inspect the seal. Replace the seal, if it is damaged.

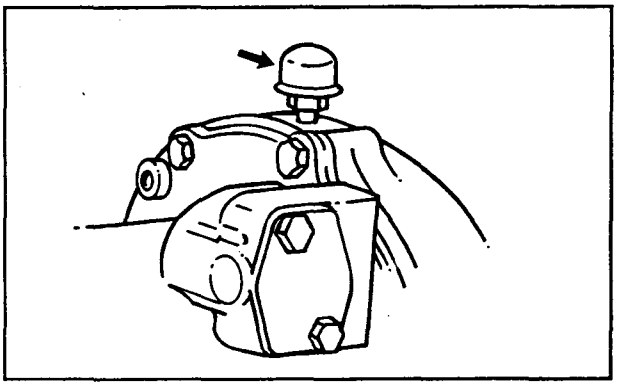
9. Insert the magnets in the screen.

10. Insert the screen and magnets in the housing.

11. Install the cover. Tighten the cover bolts.

12. Clean and install the transmission drain plug.

13. Fill the transmission with oil through the dipstick/fill tube. See the "Refill Capacity" chart in this section.



14. Remove the transmission breather. Wash the breather in clean, nonflammable solvent. Install the transmission breather.

15. Start the engine and operate at low idle to prime all lines.

16. Inspect for leaks.

17. Maintain the oil level to the full mark on the dipstick with the engine at low idle, the transmission warm and in neutral.

Specifications

Standard Torque Specifications

NOTE: When fasteners are to be reused, unless otherwise directed, clean with a non-corrosive cleaner and apply engine oil to threads. If thread lock or other compounds are to be applied, do not apply engine oil.

Exceptions to these torques are given in the Specifications Section where needed.

NOTICE

Be very careful never to mix metric with U.S. customary (standard) fasteners. Mismatched or incorrect fasteners will cause machine damage or malfunction and may even result in personal injury.

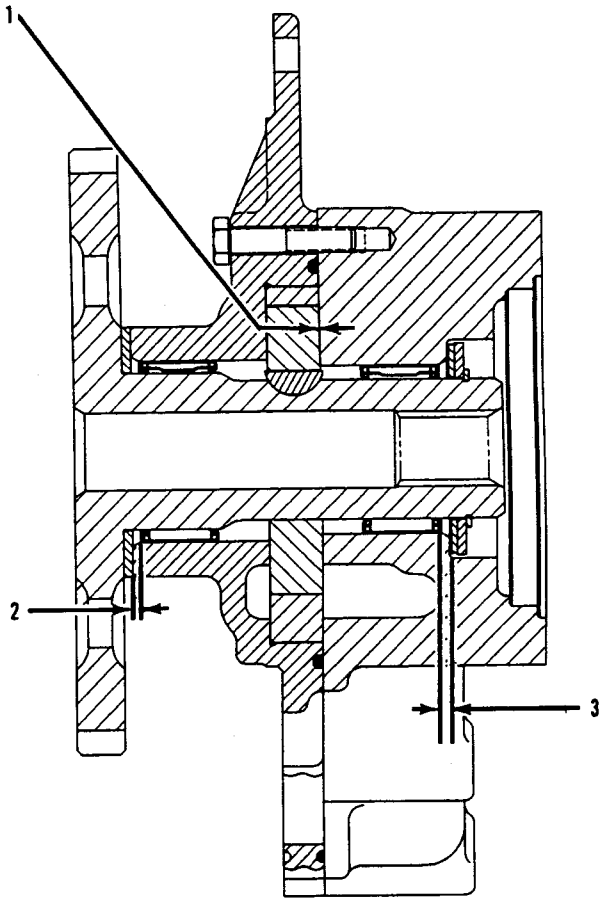
Original fasteners removed from the machine should be saved for reassembly whenever possible. If new fasteners are needed, they must be of the same size and grade as the ones that are being replaced. Metric hardware must be replaced with metric hardware. Check parts book for proper replacement.

METRIC NUTS AND BOLTS		
THREAD SIZE (mm)	STANDARD TORQUE	
	N•m	(lb. ft.)
M6	12 ± 4	9 ± 3
M8	25 ± 7	18 ± 5
M10	55 ± 10	41 ± 7
M12	95 ± 15	70 ± 11
M14	150 ± 20	110 ± 15
M16	220 ± 30	160 ± 22
M20	450 ± 70	330 ± 50
M24	775 ± 100	570 ± 75
M30	1600 ± 200	1180 ± 150
M36	2700 ± 400	2000 ± 300

INCH NUTS AND BOLTS		
THREAD SIZE inch	STANDARD TORQUE	
	N•m	(lb. ft.)
1/4	12 ± 4	9 ± 3
5/16	25 ± 7	18 ± 5
3/8	45 ± 7	33 ± 5
7/16	70 ± 15	50 ± 11
1/2	100 ± 15	75 ± 11
9/16	150 ± 20	110 ± 15
5/8	200 ± 25	150 ± 18
3/4	360 ± 50	270 ± 37
7/8	570 ± 80	420 ± 60
1	875 ± 100	640 ± 75
1-1/8	1100 ± 150	820 ± 110
1-1/4	1350 ± 175	1000 ± 130
1-3/8	1600 ± 200	1180 ± 150
1-1/2	2000 ± 275	1480 ± 200

Transmission Oil Pump

(Type 1 - Gerotor)



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Rotation is counter clockwise when seen from drive end. For bench test, use SAE 10W oil at 49°C (120°F).

Output (minimum) ..... 23 liter/min (6 U.S. gpm)
With pump at ..... 850 rpm
At a pressure of ..... 2650 kPa (385 psi)

Output (minimum) ..... 76 liter/min (20 U.S. gpm)
With pump at ..... 2400 rpm
At a pressure of ..... 3000 kPa (435 psi)

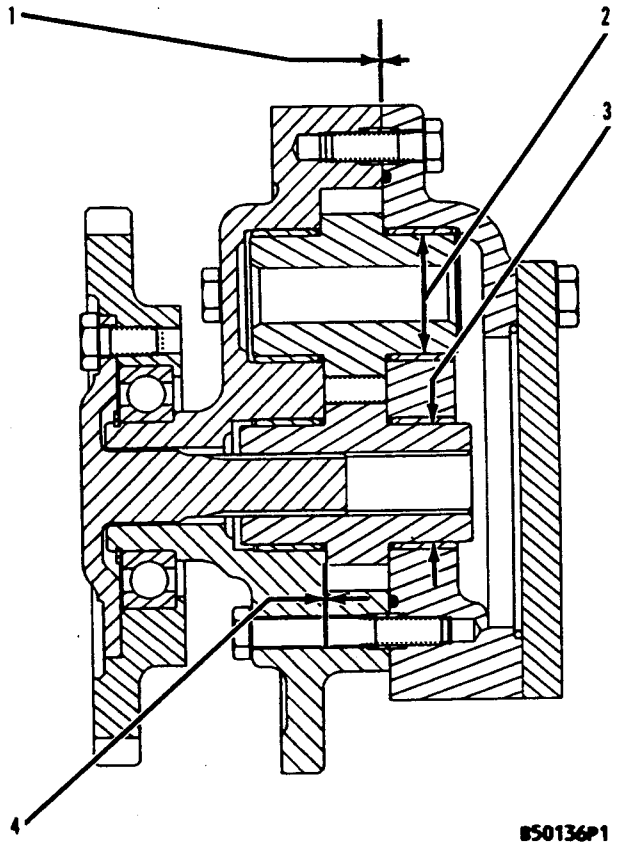
(1) Clearance between the gears and the manifold assembly ..... 0.025 to 0.063 mm (.0010 to .0025 in)

(2) Depth to install bearing ..... 3.0 ± 0.5 mm (.12 ± .02 in)

(3) Depth to install bearing ..... 3.0 ± 0.5 mm (.12 ± .02 in)

Transmission Oil Pump

(Type 2 - Gear)



B50136P1

Rotation is counter clockwise when seen from drive end. For bench test, use SAE 10W oil at 49°C (120°F).

Output (minimum) ..... 65 liter/min (17 U.S. gpm)
With pump at ..... 1800 rpm
At a pressure of ..... 2750 kPa (400 psi)

(1) Clearance between the gears and the cover ..... 0.089 ± 0.028 mm (.0035 ± .0011 in)

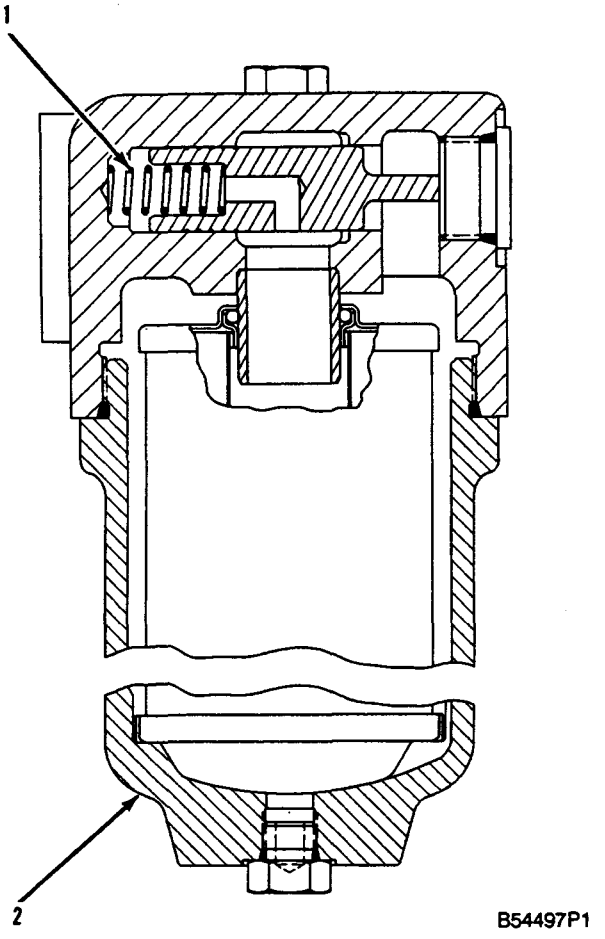
(2) Bore of bearings ..... 41.283 ± 0.008 mm (1.6253 ± .0003 in)

(3) Diameter of shafts ..... 41.232 ± 0.005 mm (1.6233 ± .0002 in)

(4) Depth to install all bearings ... 1.5 ± 0.5 mm (.06 ± .02 in)

Transmission Filter Group

(Attachment)

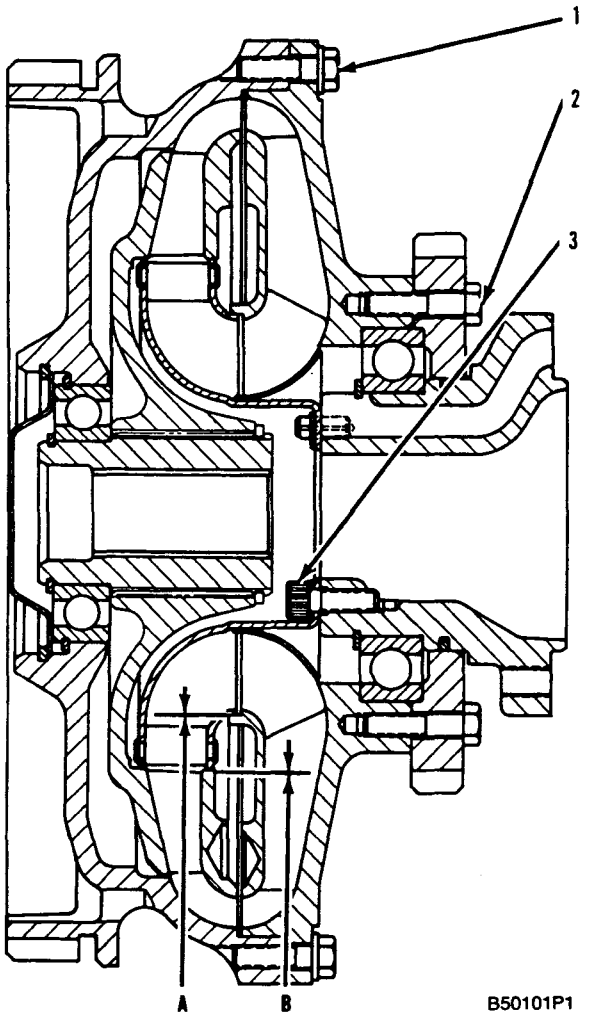


Difference in pressure at which the bypass valve will open ..... 248 ± 21 kPa (36 ± 3 psi)

(1) LM1986 Spring for the bypass valve:
Length under test force ..... 25.4 mm (1.00 in)
Test force ..... 111 ± 9 N (24.9 ± 2.0 lb)
Free length after test ..... 47.2 mm (1.86 in)
Outside diameter ..... 12.7 mm (.50 in)

(2) Use torque required to ensure shoulder of housing contacts bottom of base. Do not use air wrench.

Torque Converter



(1) Torque for 12 bolts ..... 30 ± 7 N•m (22 ± 5 lb ft)

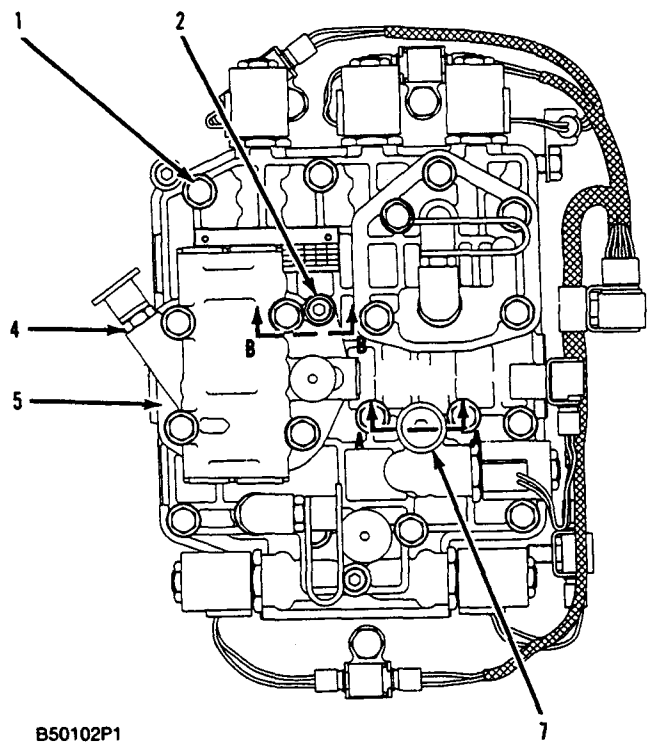
(2) Torque for six bolts ..... 30 ± 7 N•m (22 ± 5 lb ft)

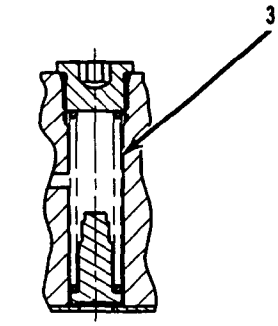
(3) Torque for six bolts ..... 30 ± 7 N•m (22 ± 5 lb ft)

Clearance between		Across the Diameter	Running[1]
(A) Stator & Turbine	new	0.31 to 0.47 mm (.012 to .018 in)	0.15 to 0.23 mm (.006 to .009 in)
	max. worn	0.76 mm (.030 in)	0.38 mm (.015 in)
(B) Stator & Impeller	new	0.30 to 0.46 mm 0.12 to .018 in)	0.15 to 0.23 mm (.006 to .009 in)
	max. worn	0.76 mm (.030 in)	0.38 mm (.015 in)

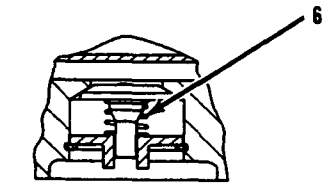
[1] Half the clearance across the diameter.

Transmission Hydraulic Control Group





SECTION A—A



SECTION B—B

(1) Torque for 17 bolts ..... 30 ± 4 N•m (22 ± 3 lb ft)

(2) Torque for socket head bolts (three places) ..... 30 ± 4 N•m (22 ± 3 lb ft)

(3) GY2291 Spring (orange stripe):
Length under test force ..... 52.86 mm (2.081 in)
Test force ..... 31.7 ± 1.6 N (7.13 ± .36 lb)
Free length after test ..... 61.8 mm (2.43 in)
Outside diameter ..... 15 mm (.6 in)

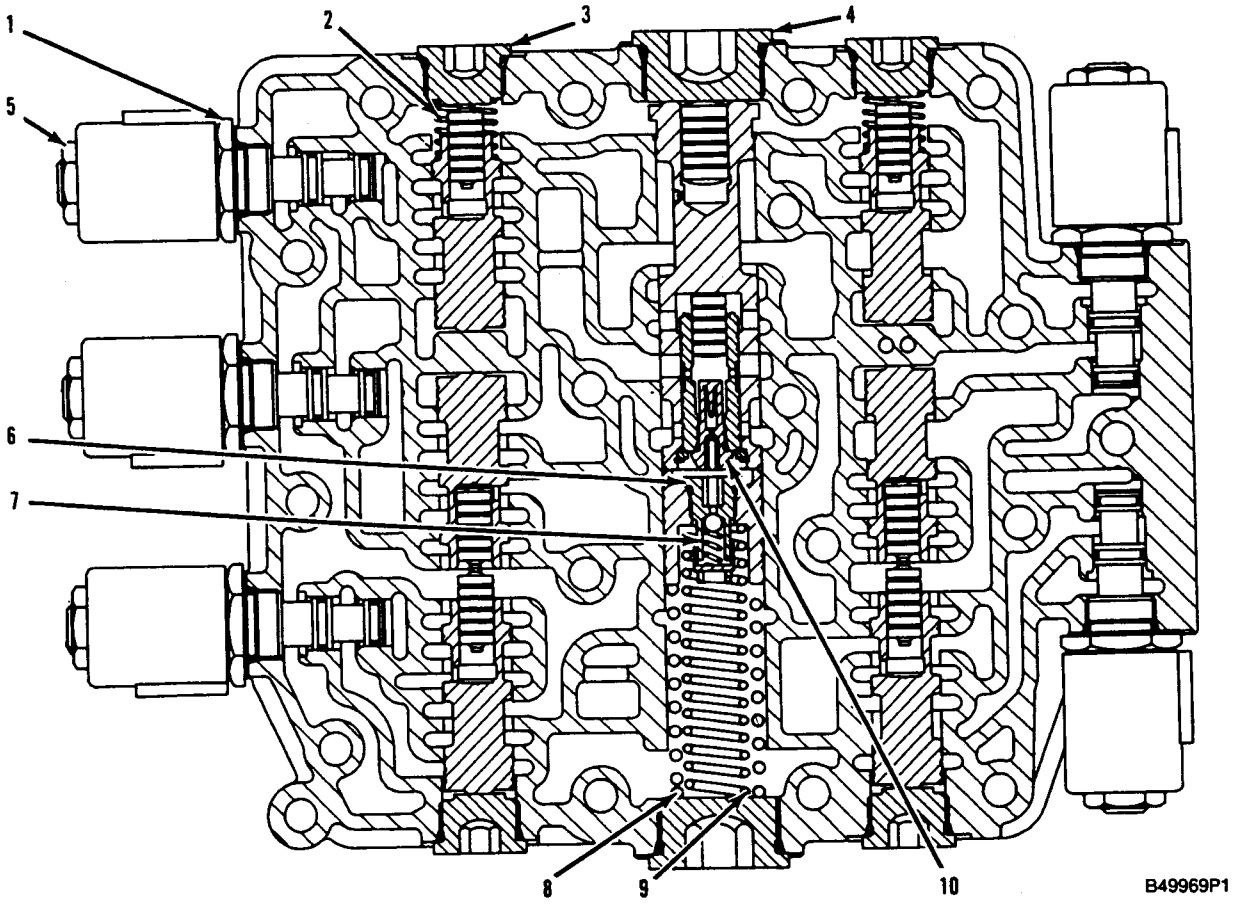
(4) Torque for GV3965 Nipple Assemblies ..... 14 ± 2 N•m (10 ± 1 lb ft)

(5) GY7622 Valve Group (Attachment)

(6) CJ6956 Spring:
Length under test force ..... 12.70 mm (.500 in)
Test force ..... 2.0 ± 0.1 N (.38 ± .02 lb)
Free length after test ..... 19.1 mm (.75 in)
Outside diameter ..... 9.6 mm (.38 in)

(7) Torque for plug ..... 25 ± 4 N•m (18 ± 3 lb ft)

Selector And Pressure Control Valve



(1) Torque to install cartridge assembly (six places) ..... 50 ± 5 N•m (37 ± 4 lb ft)

(2) GY0871 Spring (two places)
Length under test force ..... 15.0 mm (.59 in)
Test force ..... 12.2 ± 1.0 N (2.75 ± .22 lb)
Free length after test ..... 32.3 mm (1.27 in)
Outside diameter ..... 17.1 mm (.67 in)

(3) Torque for plug (four places) ..... 37 ± 5 N•m (27 ± 4 lb ft)

(4) Torque for plug (two places) ..... 75 ± 7 N•m (55 ± 5 lb ft)

(5) Torque for nut on coil assemby (six places) ... 5 ± 1 N•m (4 ± 1 lb ft)

(6) Torque for KW5226 Valve Assembly ..... 1.2 ± 0.2 N•m (11 ± 2 lb in)

(7) KW5792 Spring:
Length under test force ..... 9.98 mm (.393 in)
Test force ..... 3.1 ± 0.2 N (.70 ± .05 lb)
Free length after test ..... 23.6 mm (.93 in)
Outside diameter ..... 4.50 mm (.177 in)

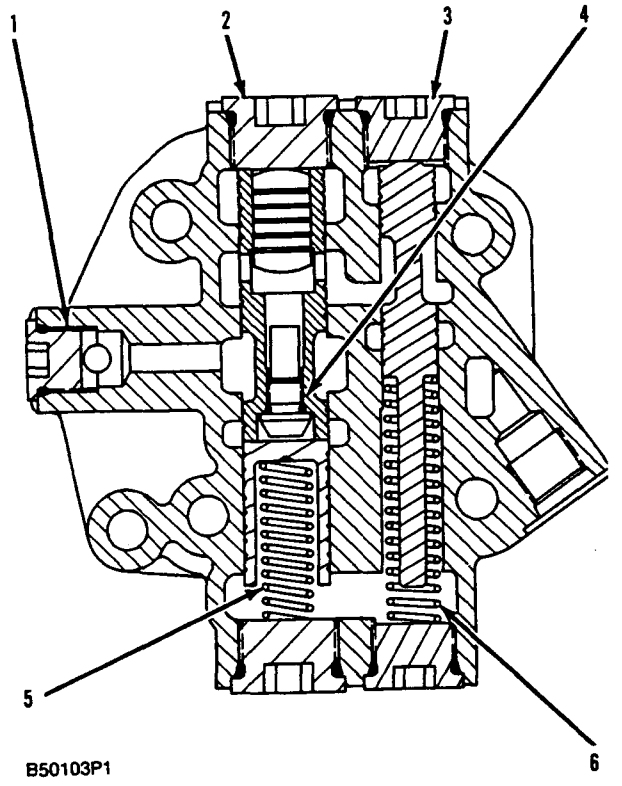
(8) GY3940 Spring (outer with dark blue stripe):
Length under test force ..... 37.2 mm (1.46 in)
Test force ..... 130.6 ± 6.5 N (29.39 ± 1.46 lb)
Free length after test ..... 53.66 mm (2.113 in)
Outside diameter ..... 23.5 mm (.925 in)

(9) KW8301 Spring (inner with white stripe):
Length under test force ..... 73.0 mm (2.87 in)
Test force ..... 31.5 ± 1.6 N (7.09 ± .36 lb)
Length under test force ..... 53.75 mm (2.116 in)
Test force ..... 98.3 ± 3.6 N (22.18 ± .81 lb)
Free length after test ..... 82.1 mm (3.23 in)
Outside diameter ..... 17.53 mm (.690 in)

(10) Torque for KW8839 Plug ..... 0.6 N•m minimum (5 lb in minimum)

GY7622 Dump Valve Group

(Attachment)



(1) Torque for plug ..... 14 ± 2 N•m (10 ± 1 lb ft)

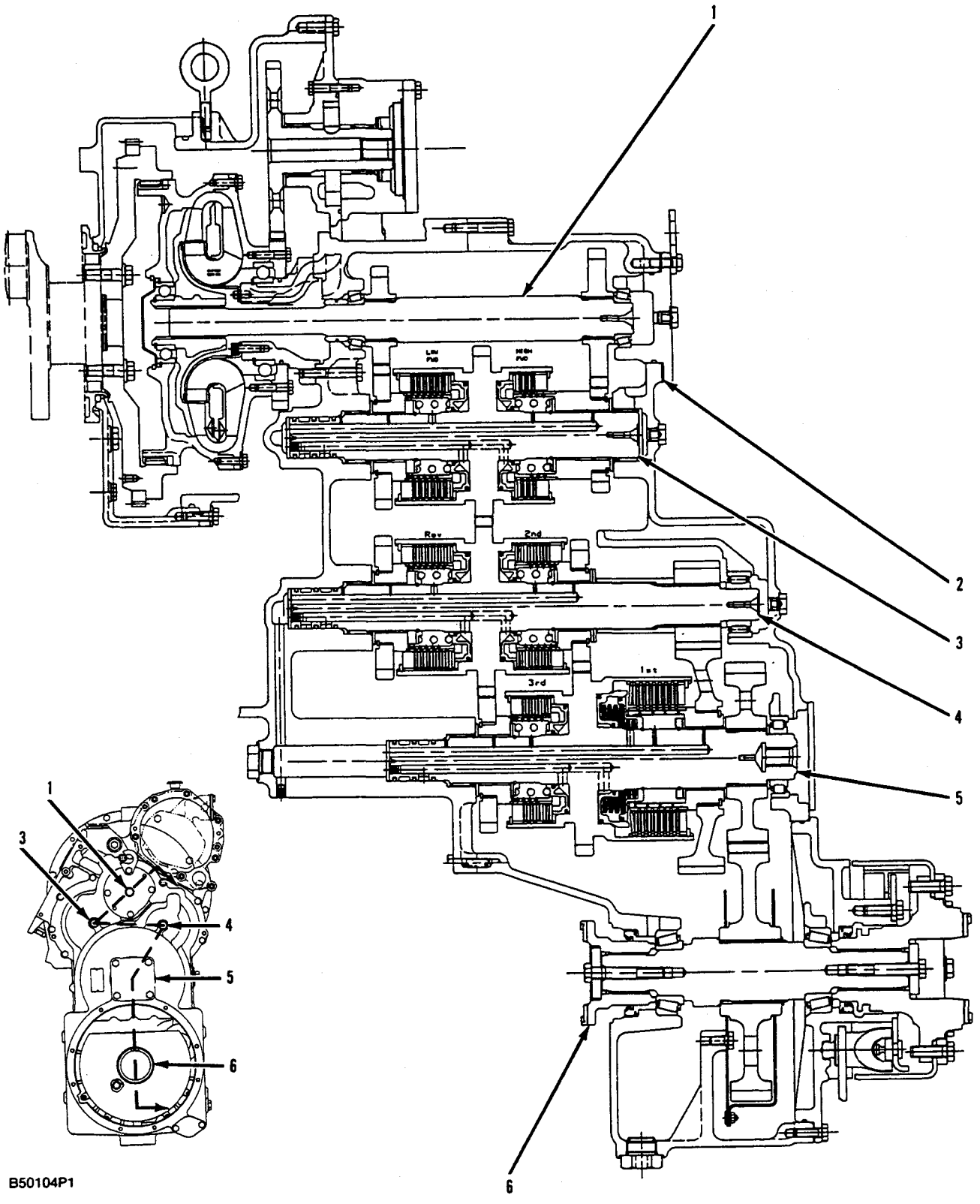
(2) Torque for two plugs ..... 37 ± 5 N•m (27 ± 4 lb ft)

(3) Torque for two plugs ..... 25 ± 4 N•m (18 ± 3 lb ft)

(4) Torque for plug ..... 0.6 N•m minimum (5 lb in minimum)

(5) KL9188 Spring:
- Length under test force ..... 43.18 mm (1.70 in)
- Test force ..... 15.6 ± 1.3 N (3.5 ± .3 lb)
- Free length after test ..... 57.9 mm (2.28 in)
- Outside diameter ..... 11.18 mm (.440 in)

(6) JP0346 Spring:
- Length under test force ..... 53.8 mm (2.12 in)
- Test force ..... 88 ± 4 N (19.8 ± 1.0 lb)
- Free length after test ..... 59.9 mm (2.36 in)
- Outside diameter ..... 11.91 mm (.469 in)


1
2
3
4
5
6
Rev
2nd
3rd
1st
1
3
4
5
6
B50104P1

(1) Input shaft (part of JE2340 Case Group)

(2) Use shims as necessary to get 0.05 ± 0.05 mm (.002 ± .002 in) endplay on input shaft.

See Procedure To Set Input Shaft Bearing Endplay

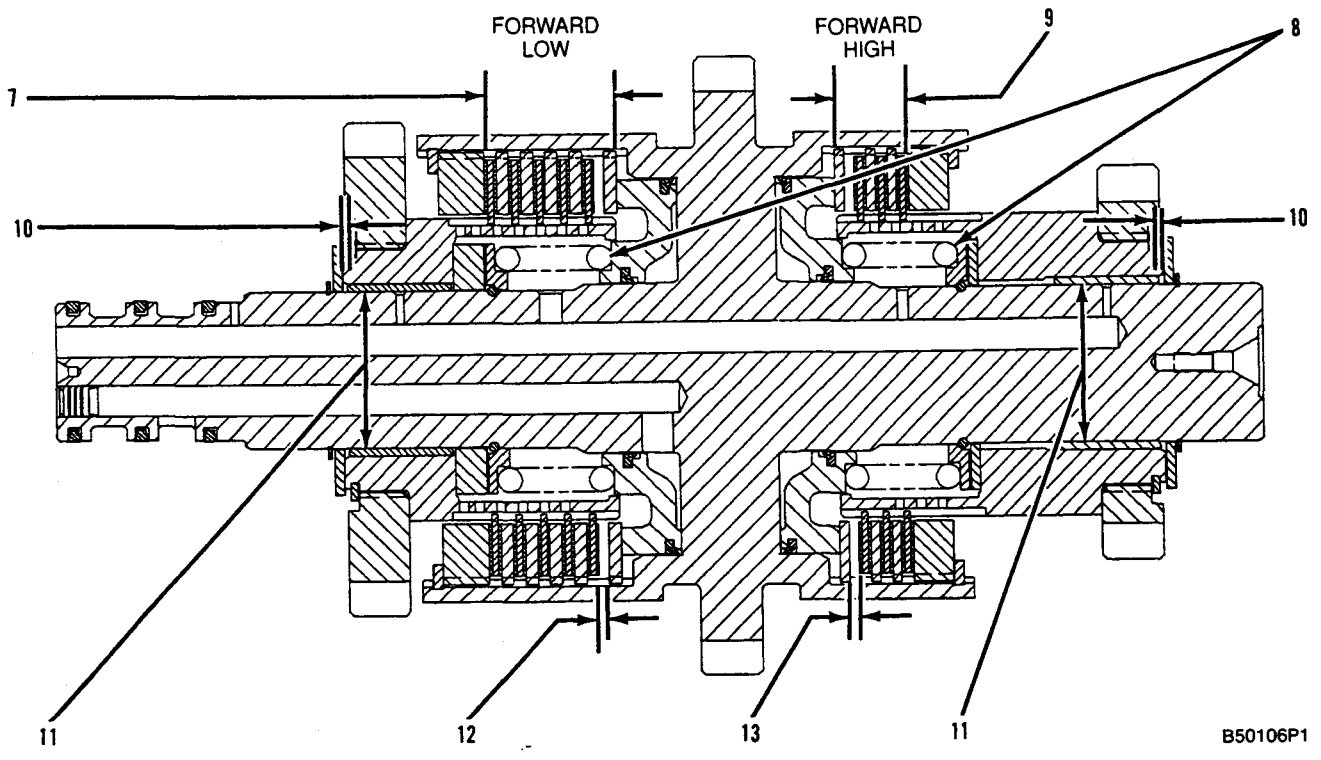
(3) KW7726 Clutch Group (Forward Low and Forward High)

(4) KW6883 Clutch Group (Reverse and Second)

(5) KW6884 Clutch Group (Third and First)

(6) GY0235 Output Gear Group

KW7726 Clutch Group (3)



(7) Thickness of five new disc assemblies and five new plates for the Forward Low Clutch ..... 40.00 ± 0.80 mm (1.575 ± .032 in)

NOTE: This dimension is only the thickness of five new discs and five new plates. It does not include the running clearance of the clutch pack. See Procedure To Measure Running Clearance

Thickness of one new GY7968 Disc Assembly ..... 4.00 ± 0.08 mm (.157 ± .003 in)
Minimum allowable thickness for reusability ..... 3.80 mm (.149 in)
Thickness of one new JE0682 Plate ..... 4.00 ± 0.08 mm (.157 ± .003 in)

(8) GY7818 Spring:
Length under test force ..... 34.50 mm (1.358 in)
Test force ..... 1245 ± 62 N (280 ± 14 lb)
Free length after test ..... 50.37 mm (1.983 in)
Outside diameter ..... 78.86 mm (3.105 in)

(9) Thickness of three new discs and three new plates for the Forward High clutch ..... 21.00 ± 0.48 mm (.827 ± .019 in)

NOTE: This dimension is only the thickness of three new discs and three new plates. It does not include the running clearance of the clutch pack. See Procedure To Measure Running Clearance

Thickness of one new GY7968 Disc ..... 4.00 ± 0.08 mm (.157 ± .003 in)
Minimum allowable thickness for reusability ..... 3.80 mm (.149 in)
Thickness of one new GY5631 Plate ..... 3.00 ± 0.08 mm (.118 ± .003 in)

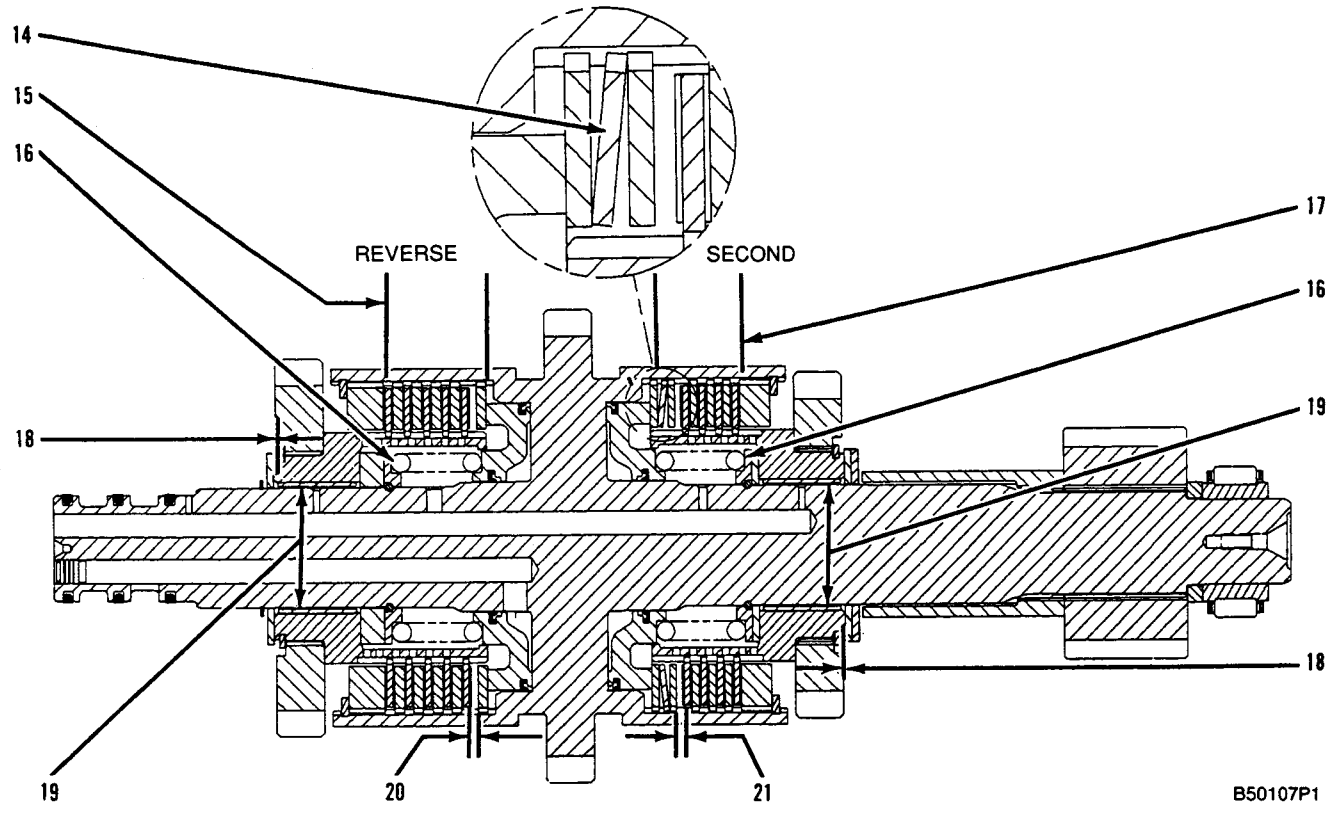
(10) Depth to install bearing ..... 1.5 ± 0.3 mm (.059 ± .012 in)

(11) Diameter of bearing after assembly ..... 50.075 ± 0.039 mm (1.9715 ± .0015 in)
Diameter of shaft in bearing area ..... 49.992 ± 0.008 mm (1.9682 ± .0003)

(12) Running clearance (new) .. 3.5 ± 0.5 mm (.138 ± .020 in)
Running clearance (used-maximum) .... 5.00 mm (.197 in)
See Procedure To Measure Running Clearance

(13) Running clearance (new) .. 3.5 ± 0.5 mm (.138 ± .020 in)
Running clearance (used-maximum) .... 4.60 mm (.181 in)
See Procedure To Measure Running Clearance

KW6883 Clutch Group (4)



(14) GY6934 Coned Disc Spring
Free height ..... 4.25 mm (.167 in)
Load when flattened ..... 3610 ± 290 N (812 ± 65 lb)

NOTICE
Coned disc spring must be assembled as shown or internal transmission damage will result.

(15) Thickness of five new disc assemblies and five new plates for the Reverse Clutch ..... 40.00 ± 0.80 mm (1.575 ± .032 in)

NOTE: This dimension is only the thickness of five new discs and five new plates. It does not include the running clearance of the clutch pack. See Procedure To Measure Running Clearance

Thickness of one new GY7968 Disc Assembly ..... 4.00 ± 0.08 mm (.157 ± .003 in)
Minimum allowable thickness for reusability ..... 3.80 mm (.149 in)
Thickness of one new JE0682 Plate ..... 4.00 ± 0.08 mm (.157 ± .003 in)

(16) GY7818 Spring:
Length under test force ..... 34.50 mm (1.358 in)
Test force ..... 1245 ± 62 N (280 ± 14 lb)
Free length after test ..... 50.37 mm (1.983 in)
Outside diameter ..... 78.86 mm (3.105 in)

(17) Thickness of four new discs and five new plates for the Second Gear Clutch .. 31.00 ± 0.72 mm (1.220 ± .028 in)

NOTE: This dimension is only the thickness of four new discs and five new plates. It does not include the running clearance of the clutch pack. See Procedure To Measure Running Clearance

Thickness of one new GY7968 Disc ..... 4.00 ± 0.08 mm (.157 ± .003 in)
Minimum allowable thickness for reusability ..... 3.80 mm (.149 in)
Thickness of one new GY5631 Plate ..... 3.00 ± 0.08 mm (.118 ± .003 in)

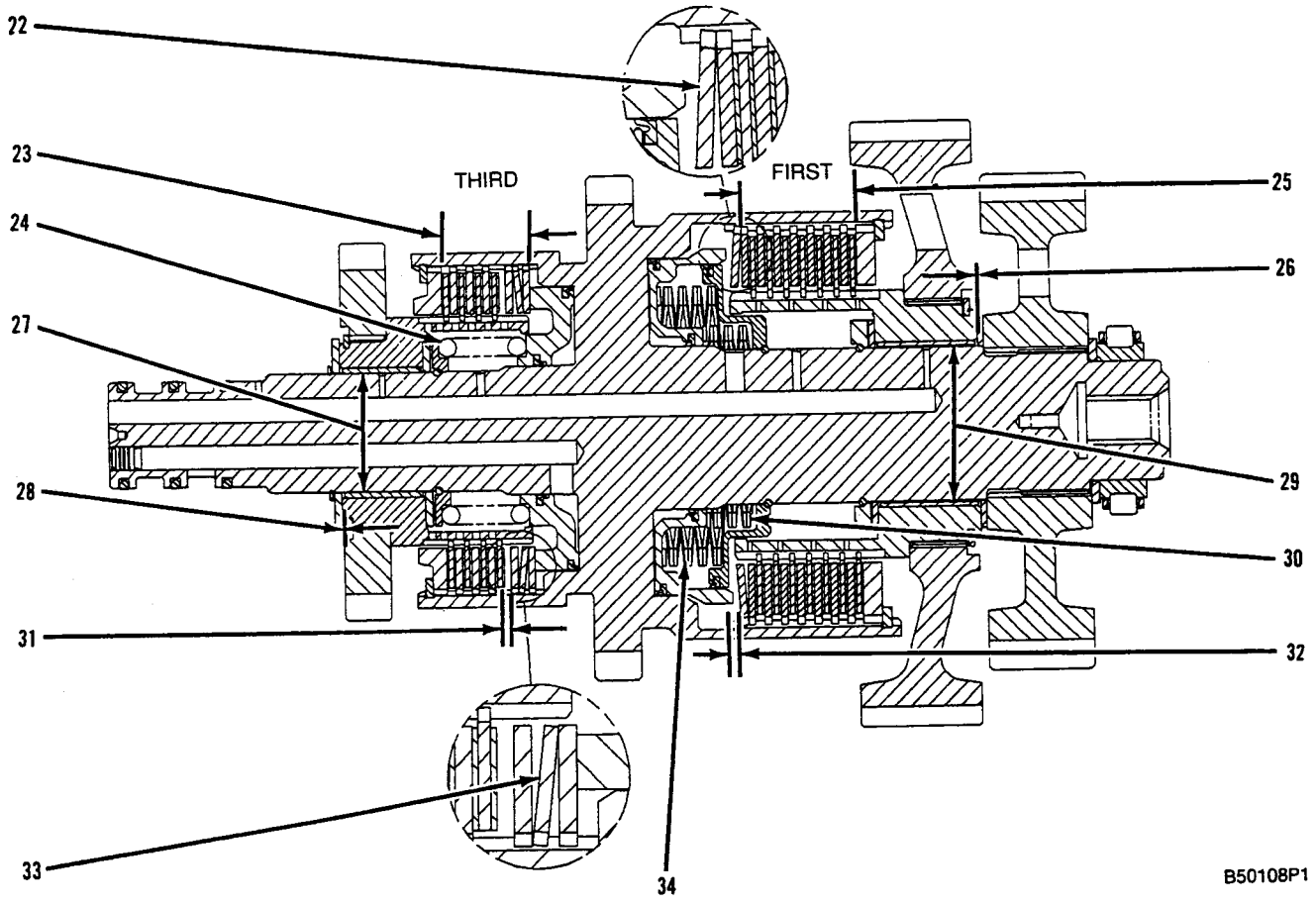
(18) Depth to install bearing ..... 1.5 ± 0.3 mm (.059 ± .012 in)

(19) Diameter of bearing after assembly ..... 50.075 ± 0.039 mm (1.9715 ± .0015 in)
Diameter of shaft in bearing area ..... 49.992 ± 0.008 mm (1.9682 ± .0003)

(20) Running clearance (new) .. 3.5 ± 0.5 mm (.138 ± .020 in)
Running clearance (used-maximum) .... 5.00 mm (.197 in)
See Procedure To Measure Running Clearance

(21) Running clearance (new) ..... 3.25 ± 0.5 mm (.128 ± .020 in)
Running clearance (used-maximum) .... 4.55 mm (.179 in)
See Procedure To Measure Running Clearance

KW6884 Clutch Group (5)



(22) GY8560 Coned Disc Spring

Free height ..... 5.0 mm (.20 in)
Load when flattened ..... 3700 ± 300 N (825 ± 67 lb)

NOTICE

Coned disc spring must be assembled as shown or internal transmission damage will result.

(23) Thickness of four new discs and five new plates for the Third Gear Clutch ..... 31.00 ± 0.72 mm (1.220 ± .028 in)

NOTE: This dimension is only the thickness of four new discs and five new plates. It does not include the running clearance of the clutch pack. See Procedure To Measure Running Clearance

Thickness of one new GY7968 Disc ..... 4.00 ± 0.08 mm (.157 ± .003 in)
Minimum allowable thickness for reusability ..... 3.80 mm (.149 in)
Thickness of one new GY5631 Plate ..... 3.00 ± 0.08 mm (.118 ± .003 in)

(24) GY7818 Spring:

Length under test force ..... 34.50 mm (1.358 in)
Test force ..... 1245 ± 62 N (280 ± 14 lb)
Free length after test ..... 50.37 mm (1.983 in)
Outside diameter ..... 78.86 mm (3.105 in)

(25) Thickness of seven new discs and seven new plates for the First Gear Clutch ..... 49.00 ± 1.12 mm (1.929 ± .044 in)

NOTE: This dimension is only the thickness of seven new discs and seven new plates. It does not include the running clearance of the clutch pack. See Procedure To Measure Running Clearance

Thickness of one new GY7922 Disc ..... 4.00 ± 0.08 mm (.157 ± .003 in)
Minimum allowable thickness for reusability ..... 3.80 mm (.149 in)
Thickness of one new HT6219 Plate ..... 3.00 ± 0.08 mm (.118 ± .003 in)

(26) Depth to install bearing ..... 1.0 ± 0.3 mm (.039 ± .012 in)

(27) Diameter of bearing after assembly ..... 50.075 ± 0.039 mm (1.9715 ± .0015 in)
Diameter of shaft in bearing area ..... 49.992 ± 0.008 mm (1.9682 ± .0003)

(28) Depth to install bearing ..... 1.5 ± 0.3 mm (.059 ± .012 in)

(29) Diameter of bearing after assembly ..... 65.046 ± 0.039 mm (2.5609 ± .0015 in)
Diameter of shaft in bearing area ..... 64.961 ± 0.010 mm (2.5575 ± .0004)

(30) GY8000 Wave Spring
Length under test force ..... 21.74 mm (.856 in)
Test force (approximately) ..... 178 N (40 lb)
Length under test force ..... 19.25 mm (.756 in)
Test force ..... 289 ± 31 N (65 ± 7 lb)
Free length after test ..... 25.65 mm (1.010 in)
Outside diameter ..... 84.84 ± 0.51 mm (3.340 ± .020 in)

(31) Running clearance (new) ..... 3.25 ± 0.5 mm (.128 ± .020 in)
Running clearance (used-maximum) .... 4.55 mm (.179 in)
See Procedure To Measure Running Clearance

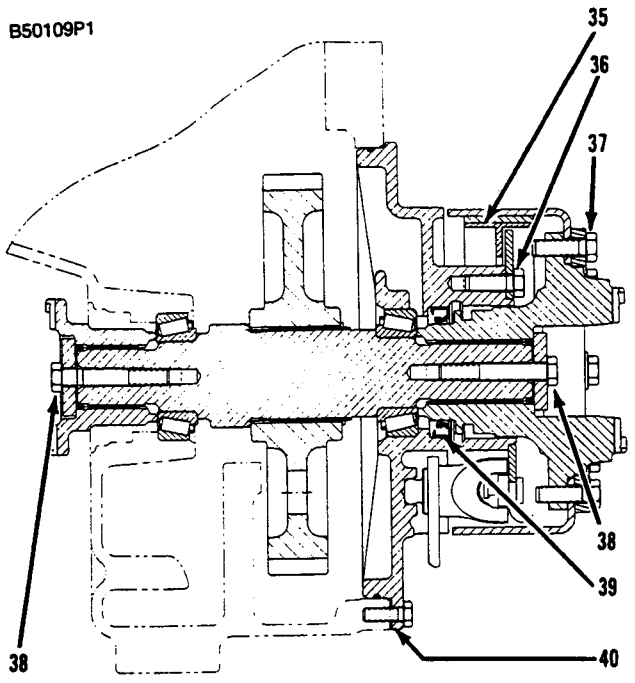
(32) Running clearance (new) .. 2.5 ± 0.5 mm (.098 ± .020 in)
Running clearance (used-maximum) .... 4.40 mm (.173 in)
See Procedure To Measure Running Clearance

(33) GY6934 Coned Disc Spring
Free height ..... 4.25 mm (.167 in)
Load when flattened ..... 3610 ± 290 N (812 ± 65 lb)

NOTICE
Coned disc spring must be assembled as shown or internal transmission damage will result.

(34) GY7999 Wave Spring
Length under test force ..... 26.70 mm (1.051 in)
Test force (approximately) ..... 311.5 N (70 lb)
Length under test force ..... 24.21 mm (.953 in)
Test force ..... 578.5 ± 44.5 N (130 ± 10 lb)
Free length after test ..... 33.02 mm (1.300 in)
Outside diameter ..... 117.35 ± 0.51 mm (4.620 ± .020 in)

Output Gear Group



(35) Thickness of new lining ..... 4.50 mm (.177 in)
Minimum allowable thickness ..... 2.50 mm (.098 in)

(36) Torque for four bolts ..... 125 ± 15 N•m (90 ± 11 lb ft)

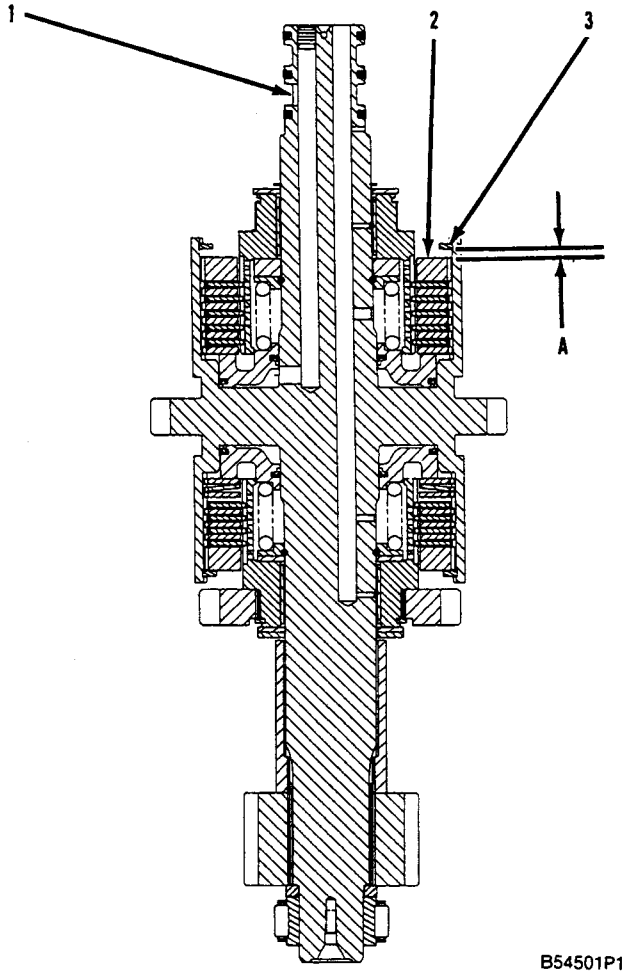
(37) Torque for eight bolts ..... 125 ± 15 N•m (90 ± 11 lb ft)

(38) Torque for one bolt ..... 125 ± 15 N•m (90 ± 11 lb ft)

(39) Coat seal bore with HM7260 Liquid Gasket and allow to dry before installing seal.

(40) Use shims as necessary to get 0.06 to 0.13 mm (.002 to .005 in) endplay on output shaft.

Procedure To Measure Running Clearance



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Use this procedure to check for proper clutch assembly.

1. Position the assembled clutch group with the shaft in the vertical position and the end plate of the clutch to be measured facing upward.
2. Make sure end plate (2) is free.
3. Position the tip of a dial indicator on end plate (2) and zero the indicator.

⚠ WARNING

Make sure lock ring (3) is securely in place before applying air pressure to clutch pack.

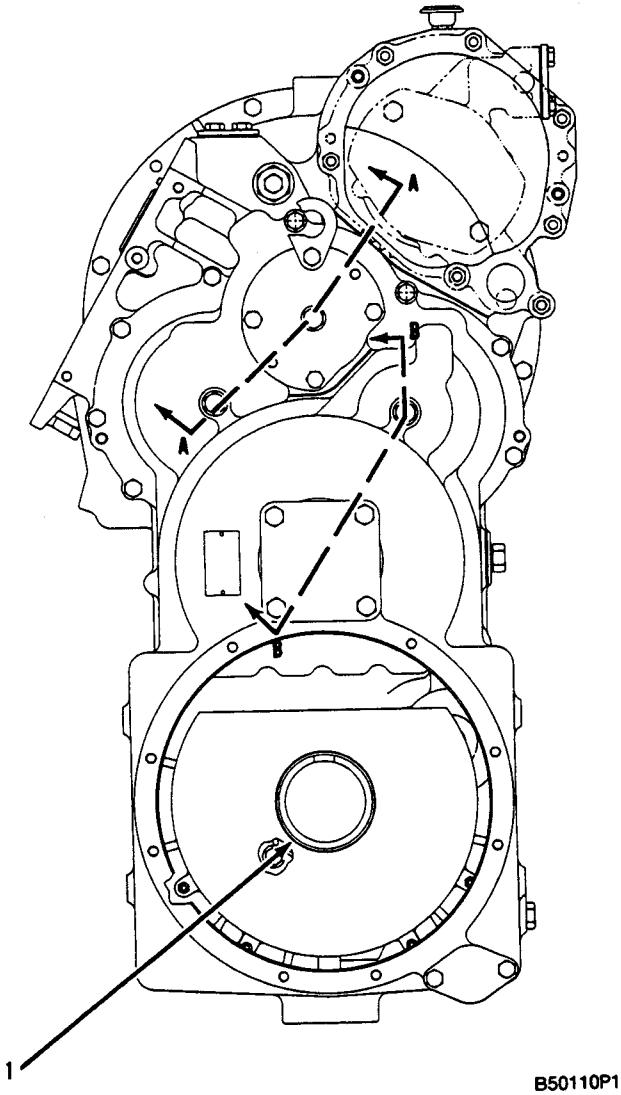
4. Apply approximately 140 kPa (20 psi) air pressure to appropriate passage (1) in the shaft for the clutch being checked.
5. End plate (2) should move and contact lock ring (3). With the end plate contacting lock ring (3), determine the distance the end plate has moved from the dial indicator. This is the clutch pack running clearance.

NOTE: Verifying that running clearances on used clutch packs are within specification does not necessarily mean that one or two discs are not badly worn. The most effective way to measure for clutch wear is to disassemble the clutch pack and individually measure each disc for wear.

NOTE: In clutch packs that contain a coned disc spring, the running clearance assumes that the coned disc spring is not flattened when the pack is compressed for measurement.

CLUTCH PACK RUNNING CLEARANCE (A)		
Clutch	**New**	**Used (Maximum)**
Forward Low	3.50 ± 0.50 mm (.138 ± .020 in)	5.00 mm (.197 in)
Forward High	3.50 ± 0.50 mm (.138 ± .020 in)	4.60 mm (.181 in)
Reverse	3.50 ± 0.50 mm (.138 ± .020 in)	5.00 mm (.197 in)
First	2.50 ± 0.50 mm (.098 ± .020 in)	4.40 mm (.173 in)
Second	3.25 ± 0.50 mm (.128 ± .020 in)	4.55 mm (.179 in)
Third	3.25 ± 0.50 mm (.128 ± .020 in)	4.55 mm (.179 in)

Transmission Case Group



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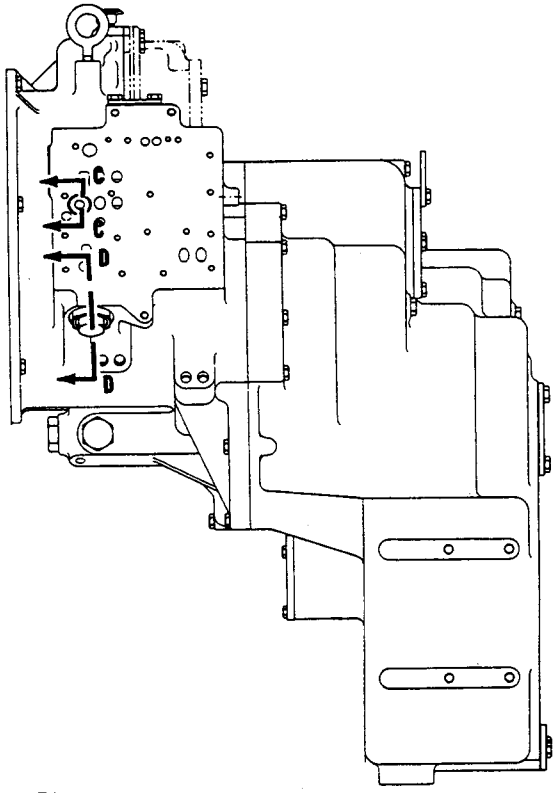

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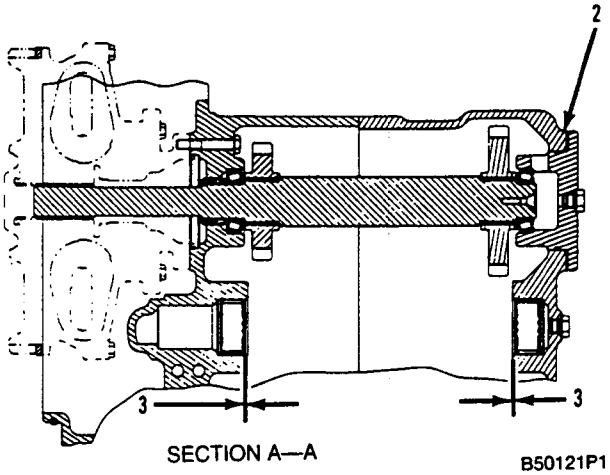

SECTION A—A

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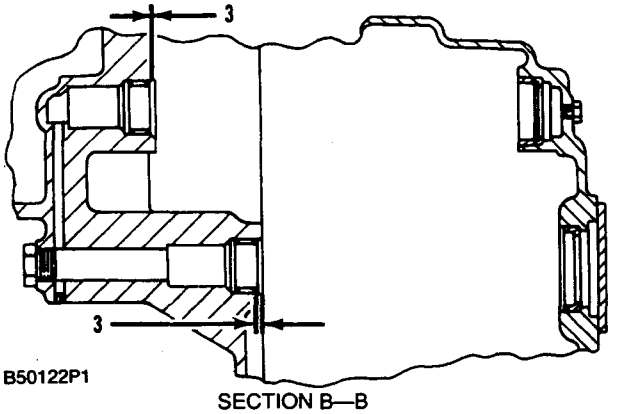
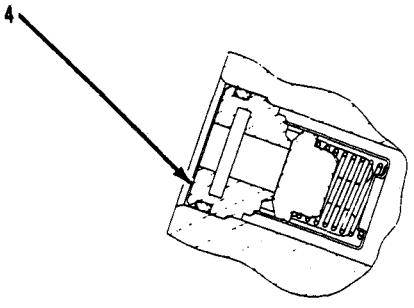
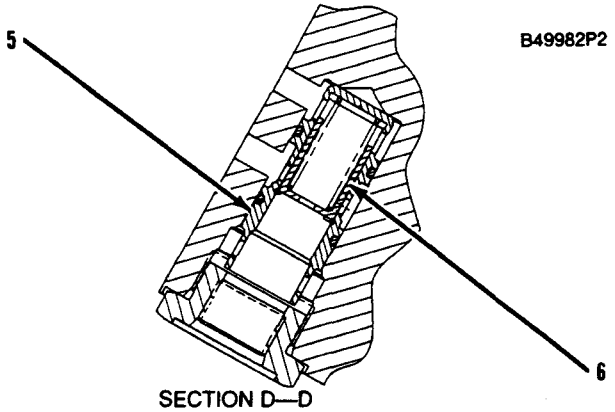


SECTION B—B



SECTION C—C



SECTION D—D

(1) Coat seal bore with HM7260 Liquid Gasket and allow to dry before installing seal.

(2) Use shims as necessary to get 0.05 ± 0.05 mm (.002 ± .002 in) endplay on input shaft.

See Procedure To Set Input Shaft Bearing Endplay

(3) Depth to install bearing ..... 3.5 ± 0.5 mm (.138 ± .020 in)

(4) GY2102 Relief Valve Group (Torque Converter)

(5) KW7189 Flow Control Valve

(6) DM7945 Spring:
Length under test force ..... 53.8 mm (2.12 in)
Test force ..... 15.2 ± 1.2 N (3.41 ± .27 lb)
Free length after test ..... 65.0 mm (2.56 in)
Outside diameter ..... 17.3 mm (.68 in)

Procedure To Set Input Shaft Bearing Endplay

1. Make sure that the bearing cups and cones are seated against their respective housing and shaft shoulders before assembly.
2. Install the bearing cage without shims (2).
3. Install two bolts 180° apart. Tighten finger tight.
4. Torque the bolts to 1.5 N•m (13.5 lb in) using the GV4980 Torque Screwdriver Tool Group.
5. Rotate or oscillate the input shaft the equivalent of three revolutions.

NOTE: To rotate the input shaft, remove the plug in the bearing cage and use a M10 X 1.5 bolt 100 mm (4 in) long threaded into the hole in the end of the input shaft. (In some transmissions, the threaded hole in the shaft may be M6.)

6. Torque the bolts to 3.0 N•m (27 lb in) and repeat Step 5. Retorque the bolts to 3.0 N•m (27 lb in).
7. Using a feeler gauge, measure the gap between the case and the outside diameter of the bearing cage flange radially outward from the center of each bolt.

NOTE: If the difference between the measurements taken in Step 7 is greater than 0.3 mm (.012 in), perform Steps 2 through 7 again.

8. Add the dimensions found in Step 7 and divide by two.
9. Add 0.15 mm (.006 in) to the dimension found in Step 8. This is the required shim pack thickness to provide the specified input shaft bearing endplay of 0.05 ± 0.05 mm (.002 ± .002 in).

NOTE: If the shim thickness determined in Step 9 or the bearing adjustment is questionable, repeat Steps 2 through 9. If the "repeat" shim thickness is within 0.05 mm (.002 in) of the original thickness, use the lesser of the two measurements.

10. Assemble enough shims (2) to equal the dimension found in Step 9. Verify the thickness with a micrometer.
11. Install the bearing cage, shims, and bolts.

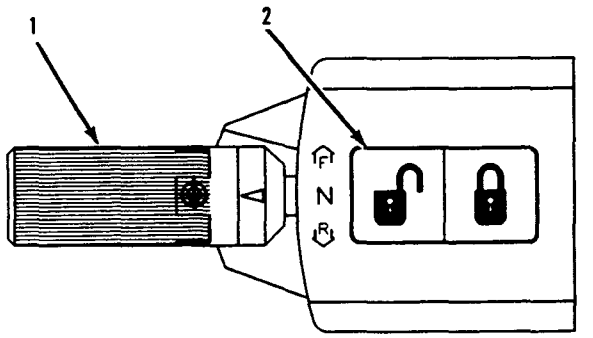
Systems Operation

General Information

Power from the engine is sent from the flywheel to the torque converter. Power flows directly from the torque converter to the transmission input shaft.

The transmission is a four speed forward-three speed reverse powershift transmission. The transmission is a constant mesh countershaft type and has six clutches that are engaged hydraulically and released by spring force.

Direction and speed are changed manually by the operator with the transmission control lever. Transmission control lever (1) is a dual function lever with gear (speed) selection made by twisting the lever and FORWARD or REVERSE selection made by moving the lever toward the front or back. Switches in the transmission control lever energize solenoids on the transmission control valve to engage correct clutches for the gear selected. The transmission control lever can be locked in NEUTRAL with neutral lock (2).



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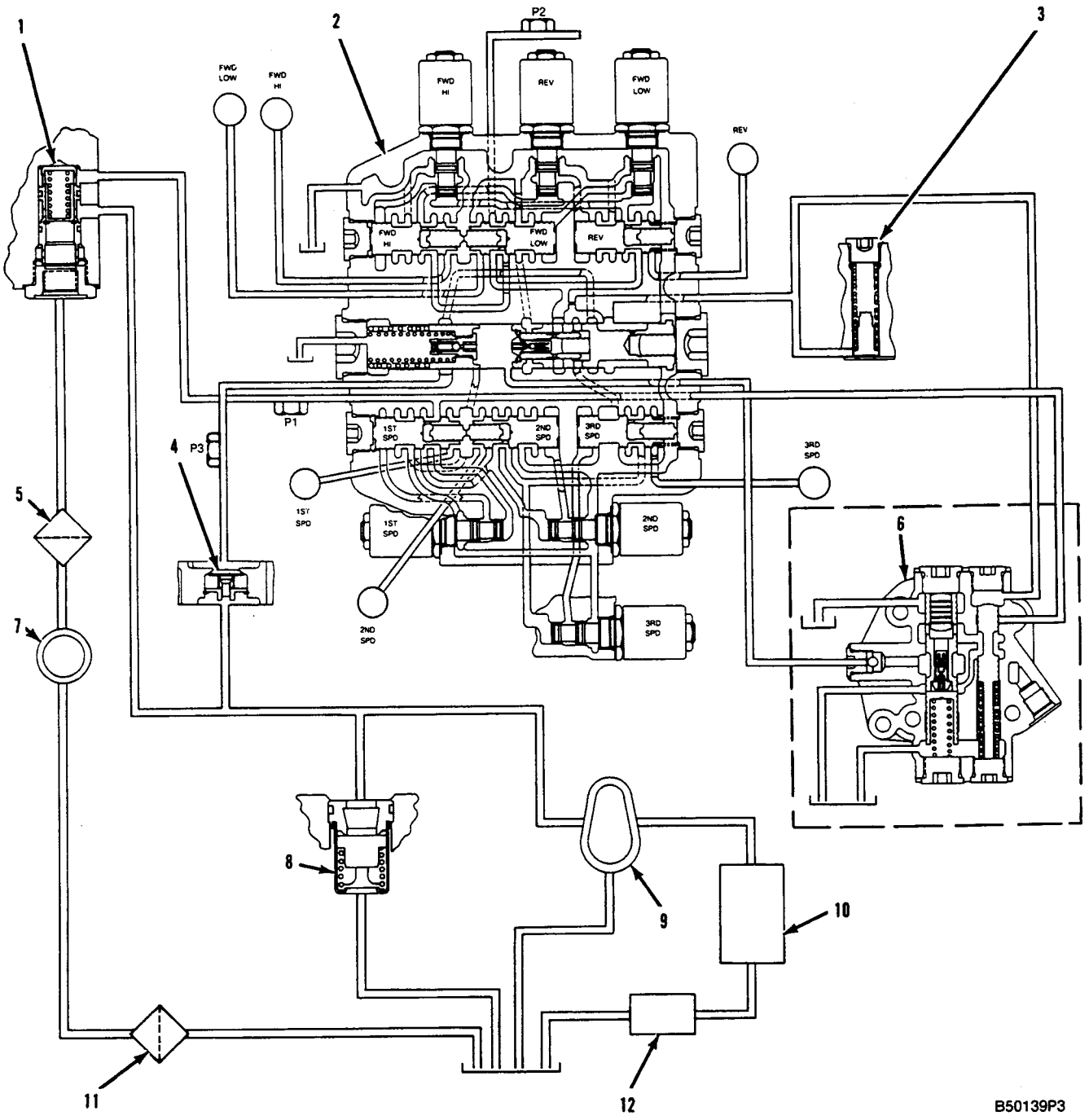
Transmission Controls
(1) Control lever (for speed and direction selection). (2) Neutral lock.

There is a neutralizer switch available as an attachment. When the switch is actuated, the clutches in the transmission are disengaged. This allows the engine rpm, and thereby the hydraulic pump output to be increased without moving the transmission shift lever to the NEUTRAL position.

Transmission Hydraulic System



Schematic Of Transmission Hydraulic System
(1) Flow control valve. (2) Transmission control valve. (3) Differential valve. (4) Converter backflow check valve. (5) Transmission oil filter. (6) Dump valve group. (7) Transmission and torque converter oil pump. (8) Torque converter inlet relief valve. (9) Torque converter. (10) Oil cooler. (11) Suction screen and magnet. (12) Transmission lubrication.

NOTE: The terms P1, P2, and P3 are used throughout this section. P1 signifies the pressure to speed clutches, P2 signifies the pressure to direction clutches, and P3 signifies the inlet pressure to the torque converter.

NOTE: Dump valve group (6) is an attachment. If the transmission control valve does not have dump valve group (6), the three lines leading to the dump valve group are blocked.

The transmission hydraulic system consists of suction screen and magnet (11), transmission and torque converter oil pump (7), filter (5), flow control valve (1), converter backflow check valve (4) [part of transmission control valve (2)], transmission control valve (2), differential valve (3) [part of transmission control valve (2)], dump valve group (6), torque converter (9), torque converter inlet relief valve (8), and oil cooler (10).

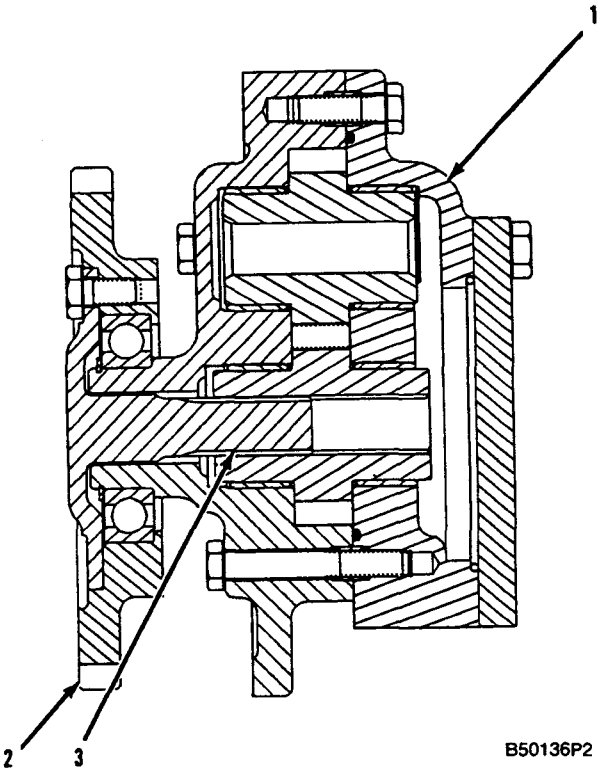
The bottom of the transmission case provides the oil sump. One positive displacement single section pump (7) supplies oil to the power train hydraulic system. Oil is supplied to the pump inlet cavity through passages in the transmission case and cover. Before reaching the pump, the oil flows through suction screen and magnet (11). Pressurized oil exits the pump outlet cavity and flows to externally mounted transmission filter (5). From the transmission filter, the oil flows to flow control valve (1) located in the transmission case. Flow control valve (1) sends 23 liter/min (6 U.S. gpm) of oil to transmission control valve (2) and supplies torque converter (9) with the remainder of the oil.

Spools in transmission control valve (2) send oil to engage the correct clutches for the speed and direction selected. To make the vehicle move, one directional clutch (FORWARD LOW, FORWARD HIGH, or REVERSE) and one speed clutch (FIRST, SECOND, or THIRD) must be engaged. Return oil from the control valve can enter the torque converter circuit through converter backflow check valve (4) [part of transmission control valve (2)]. Converter backflow check valve (4) prevents higher pressure from the torque converter charging circuit from entering control valve (2) when the control valve pressure is low during a shift.

Torque converter inlet relief valve (8) limits torque converter inlet pressure to a maximum of 895 kPa (130 psi). Torque converter inlet relief valve (8) is installed in the transmission case below control valve (2). The control valve must be removed to obtain access to the torque converter inlet relief valve. The outlet oil from the torque converter flows to oil cooler (10). Oil from the oil cooler provides lubrication and cooling to the transmission. The lubrication oil is transmitted through each transmission shaft to lubricate and cool the bearings, gears, and clutches.

All oil passages are inside the transmission case and the transmission control valve body except for external lines to and from oil filter (5) and external lines to and from oil cooler (10).

Torque Converter And Transmissiom Pump



Transmission And Torque Converter Oil Pump
(1) Transmission and torque converter oil pump. (2) Gear. (3) Shaft.

Transmission and torque converter oil pump (1) is a positive displacement pump. Two types of pumps are used: a single section gerotor type pump (Type 1); and a single section gear type pump (Type 2). The pump is bolted to the transmission cover. A provision is made for auxilliary pumps to be mounted on and driven by the transmission and torque converter pump.

A pump drive gear fastened to the torque converter impeller drives gear (2). Gear (2) is fastened to splined shaft (3) which drives the pump.

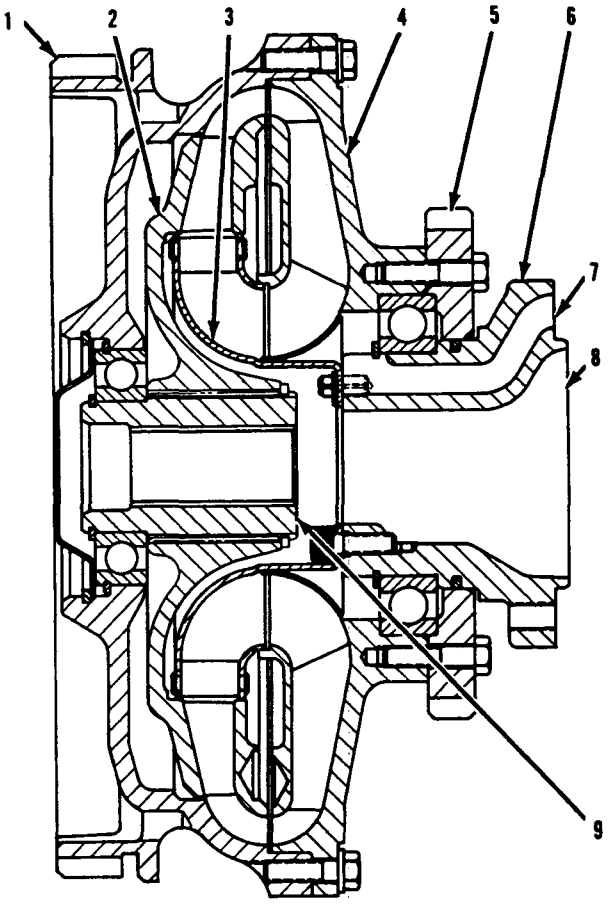
Transmission Oil Filter (Attachment)

The externally mounted oil filter has a bypass valve. If there is a restriction in the oil filter or if the viscosity of the oil is very high, the bypass valve in the filter housing will open.

If the inlet pressure to the oil filter is 227 to 269 kPa (33 to 39 psi) greater than the outlet pressure, the bypass valve will open. When the oil does not go through the filter element, the debris in the oil will cause damage to other components in the hydraulic system.

Correct maintenance recommendations must be followed to make sure that the element does not become full of debris and stop the flow of clean oil to the hydraulic system. The filter is remote mounted.

Torque Converter



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Torque Converter
(1) Housing. (2) Turbine. (3) Stator. (4) Impeller. (5) Gear (pump drive). (6) Carrier. (7) Outlet passage. (8) Inlet passage. (9) Hub.

The torque converter connects the engine to the transmission. This connection between the engine and the transmission is a hydraulic connection. There is no direct mechanical connection between the engine and the transmission.

The torque converter uses oil to send torque from the engine to the transmission. When the machine is working against a load, the torque converter can multiply the torque from the engine and send a higher torque to the transmission.

The oil for the operation of the torque converter comes from the oil pump for the transmission. The oil pump is driven by gear (5). The oil flows to a flow control valve in the transmission case where the oil flow is divided. Oil is directed to the transmission circuit and to the torque converter circuit. The torque converter inlet oil pressure is controlled by the torque converter inlet relief valve. The converter inlet relief valve is mounted in the transmission case below the transmission control valve. The relief valve limits the maximum pressure to torque converter to 895 kPa (130 psi). The torque converter inlet relief valve protects the torque converter from high pressure due to cold oil or some other restriction in the torque converter or cooler circuit.

Housing (1) is connected to the engine flywheel. Impeller (4) and gear (5) for the oil pump are connected to the rotating housing. These components turn with the engine flywheel at engine speed.

Stator (3) is connected to carrier (6) which is fastened to the transmission cover. The stator does not turn.

Turbine (2) is connected to the hub (9) by splines. Hub (9) is connected to the transmission input shaft by splines.

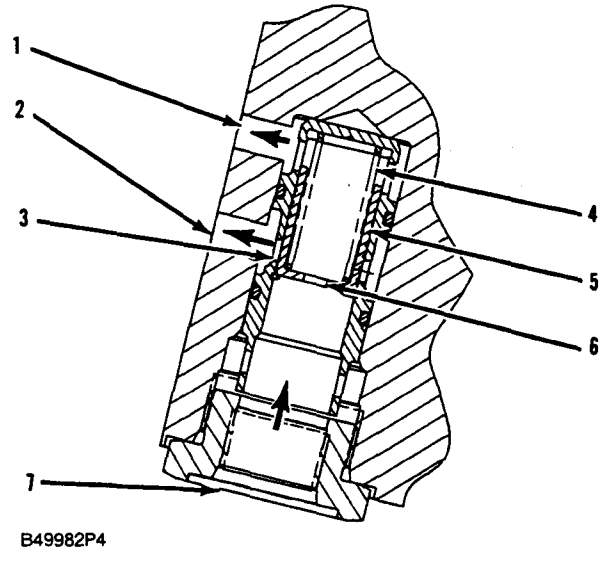
Oil from the hydraulic controls of the transmission goes into the torque converter through inlet passage (8) in carrier (6) to impeller (4). The rotation of the impeller gives force to the oil.

Impeller (4) [which turns with rotating housing (1) at engine speed] makes the oil go toward the outside of the impeller, around the inside of housing (1), and against the blades of turbine (2). The force of the oil that hits the turbine blades causes turbine (2) and hub (9) to turn. This sends torque to the input shaft of the transmission. At this point in time, the torque given to the turbine by the force of the oil from the impeller cannot be more than the torque output of the engine to the impeller.

After the oil hits the turbine blades, the oil goes toward the inside of turbine (2). As the oil leaves from the turbine, it moves in a direction opposite the direction of impeller rotation. Stator (3) redirects the oil back into impeller (4) in the direction of rotation.

The force of the oil from the stator can now add to the torque output from the engine to the impeller. This extra force can give an increase to the torque output of the engine to the turbine. The larger the difference between the speeds of the impeller and the turbine, the larger the amount of force of the oil from the stator. Since it is the load on the machine that changes the speed of the turbine, the higher the load, the larger the difference in the speeds of the impeller and the turbine. It is the different loads on the machine that control the amount of torque multiplication that the force of the oil from the stator can add. Torque multiplication of the torque converter is at maximum when the torque converter is at stall (output shaft rpm at zero). Oil from outlet passage (7) goes to the oil cooler and then to the transmission lubrication system.

Flow Control Valve



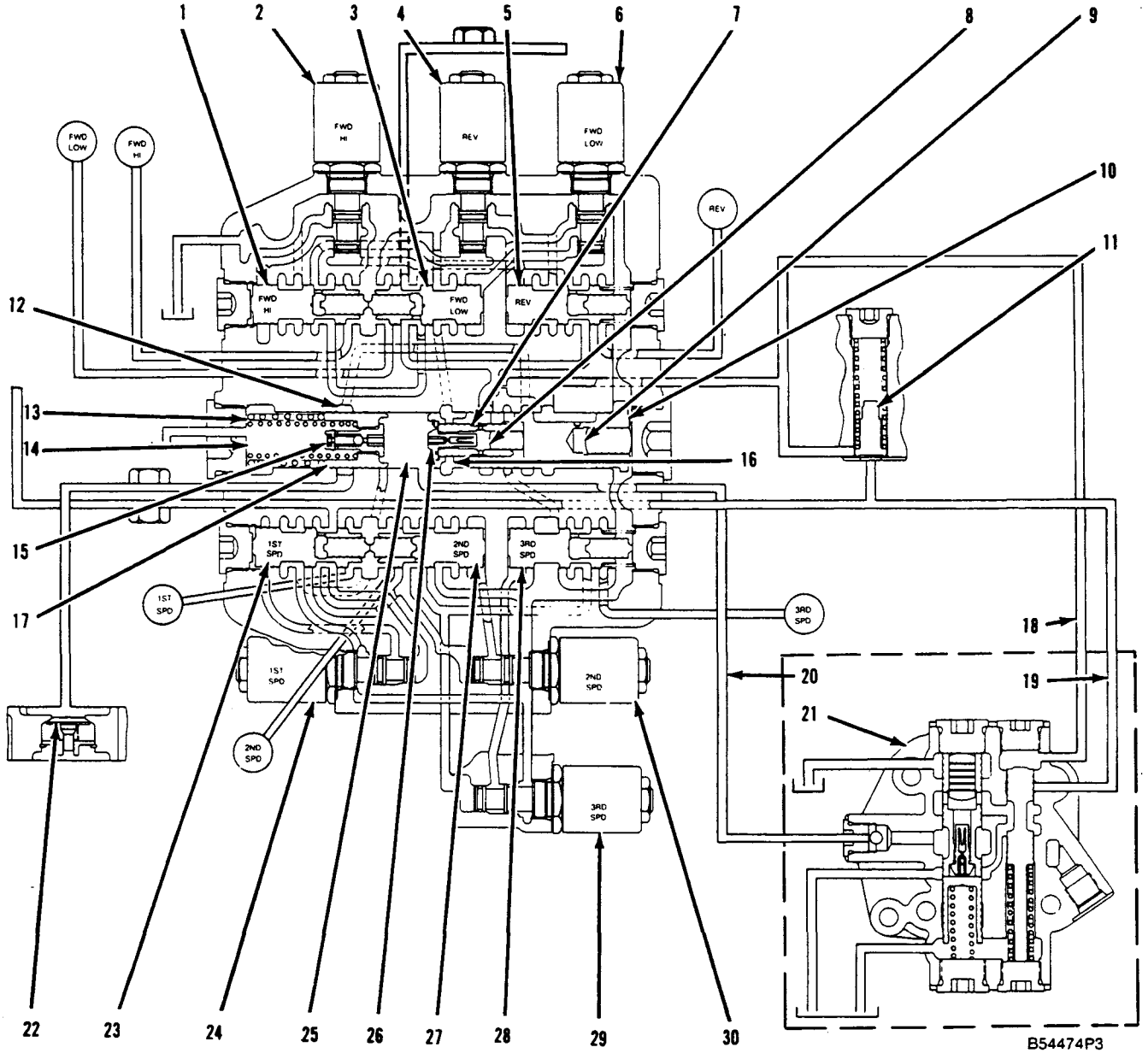
Flow Control Valve
(1) Passage to transmission control.(2) Passage to converter.
(3) Port holes to converter. (4) Spring. (5) Piston. (6) Orifice.
(7) Passage from filter.

The function of the flow control valve is to limit the flow of oil to the transmission control to 23 liter/min (6 U.S. gpm) and direct the remaining flow to the converter circuit. The result of this controlled flow requirement is to provide a constant clutch fill time through the entire engine speed range.

The flow across orifice (6) to passage (1) to the transmission controls remains constant because spring (4) exerts a constant force on piston (5) creating a constant differential pressure across orifice (6). Piston (5) directs remaining flow to the converter circuit by metering on port holes (3) to converter.

The flow control valve is located in the transmission case beneath the transmission controls. The flow control valve is under the fitting in the return line from the filter.

Transmission Control Group



Components Of The Transmission Control Valve
(1) Selecter spool and slug (FORWARD HIGH). (2) FORWARD HIGH solenoid. (3) Selecter spool and slug (FORWARD LOW). (4) REVERSE solenoid. (5) Selecter spool and slug (REVERSE). (6) FORWARD LOW solenoid. (7) Check valve. (8) Check valve slug cavity. (9) Modulating relief valve slug cavity. (10) Modulating relief valve. (11) Differential poppet. (12) Passage. (13) Load piston springs. (14) Load piston spring cavity. (15) Load piston relief valve. (16) Passage. (17) Load piston. (18) Passage. (19) Passage. (20) Passage. (21) Dump valve. (22) Converter backflow check valve. (23) Selector spool and slug (FIRST SPEED). (24) FIRST SPEED solenoid. (25) Load piston cavity. (26) Screen orifice. (27) Selecter spool and slug (SECOND SPEED). (28) Selecter spool and slug (THIRD SPEED). (29) THIRD SPEED solenoid. (30) SECOND SPEED solenoid.

Introduction

NOTE: Dump valve group (21) is an attachment. If the transmission control valve does not have dump valve group (21), the three lines leading to the dump valve group are blocked.

The transmission hydraulic control valve is mounted on the side of the transmission case. Inlet oil from the transmission pump goes through the externally mounted transmission oil filter and then back to the flow control valve located in the transmission case below the transmission controls. The flow control valve sends 23 liter/min (6 U.S. gpm) of oil to the transmission control valve and supplies the torque converter with the rest of the oil.

The main components of the transmission control valve are solenoid valves (2), (4), (6), (24), (29), and (30); selector spools and slugs (1), (3), (5), (23), (27), and (28); differential poppet (11); converter backflow check valve (22); load piston (17); load piston relief valve (15); modulating relief valve (10); check valve (7); and dump valve (21).

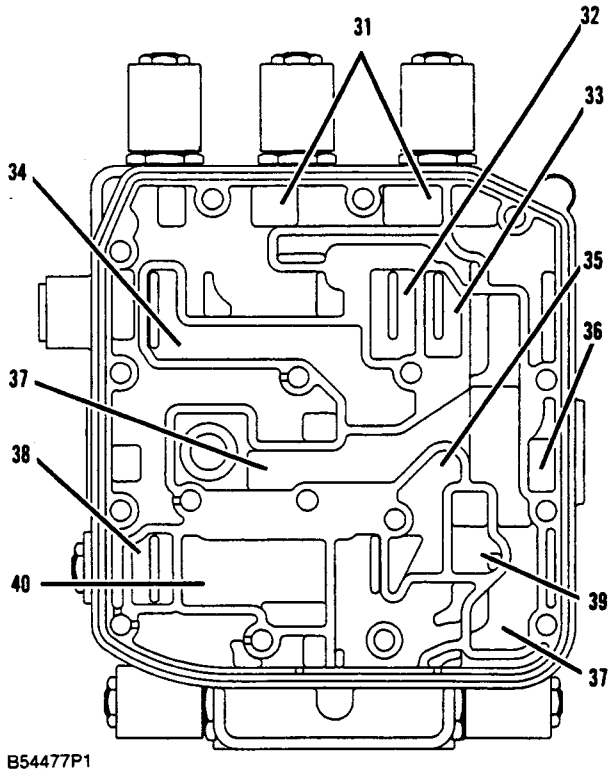
The function of each of these components is explained in the chart that follows.

Component Function Chart	
Component	**Function**
Solenoid Valves (2), (4), (6), (24), (29), (30)	Directs P1 or P2 oil to the selector spools to keep the selector spools in either the engaged or disengaged position.
Selector Spools (Speed Clutches) (23), (27), (28)	Routes P1 oil to FIRST, SECOND, and THIRD SPEED clutches.
Selector Spools (Directional Clutches) (1), (3), (5)	Routes P2 oil to FORWARD HIGH, FORWARD LOW, and REVERSE clutches.
Differential Poppet (11)	Maintains P1 pressure 345 kPa (50 psi) higher than P2.
Converter Backflow Check Valve (22)	Prevents excessive flow in the converter circuit from dumping into the load piston spring cavity during a shift.
Modulating Relief Valve (10)	Works with load piston (17) to provide a controlled pressure rise in the clutches and to control P2 pressure. Sends excess oil to the torque converter.
Load Piston (17)	Works with modulating relief valve (10) to provide a controlled pressure rise in the clutches and to control P2 pressure.
Load Piston Relief Valve (15)	Limits P2 pressure in case load piston (17) gets stuck.
Check Valve (7)	Senses low P2 pressure during a shift and moves right opening load piston cavity (25) to drain. Closes after clutch fill and allows modulating relief valve (10) to complete a controlled pressure rise.
Dump Valve (21) (Attachment)	Rapidly removes pressure oil in load piston cavity (25) during a shift to allow load piston (17) to fully reset.

Each clutch has a solenoid and a selector spool and slug. When a solenoid is activated, the solenoid plunger is shifted. This directs oil through the solenoid valve to the selector spool. The oil pressure shifts the selector spool, which then directs oil to the selected clutch.

The following chart gives the combination of the solenoids energized and the clutches engaged for each FORWARD and REVERSE speed.

Vehicle Range/Direction	Solenoids Energized And Clutches Engaged
1-F	First Speed/Forward Low
2-F	Second Speed/Forward Low
3-F	Third Speed/Forward Low
4-F	Third Speed/Forward High
N	None
1-R	First Speed/Reverse
2-R	Second Speed/Reverse
3-R	Third Speed/Reverse

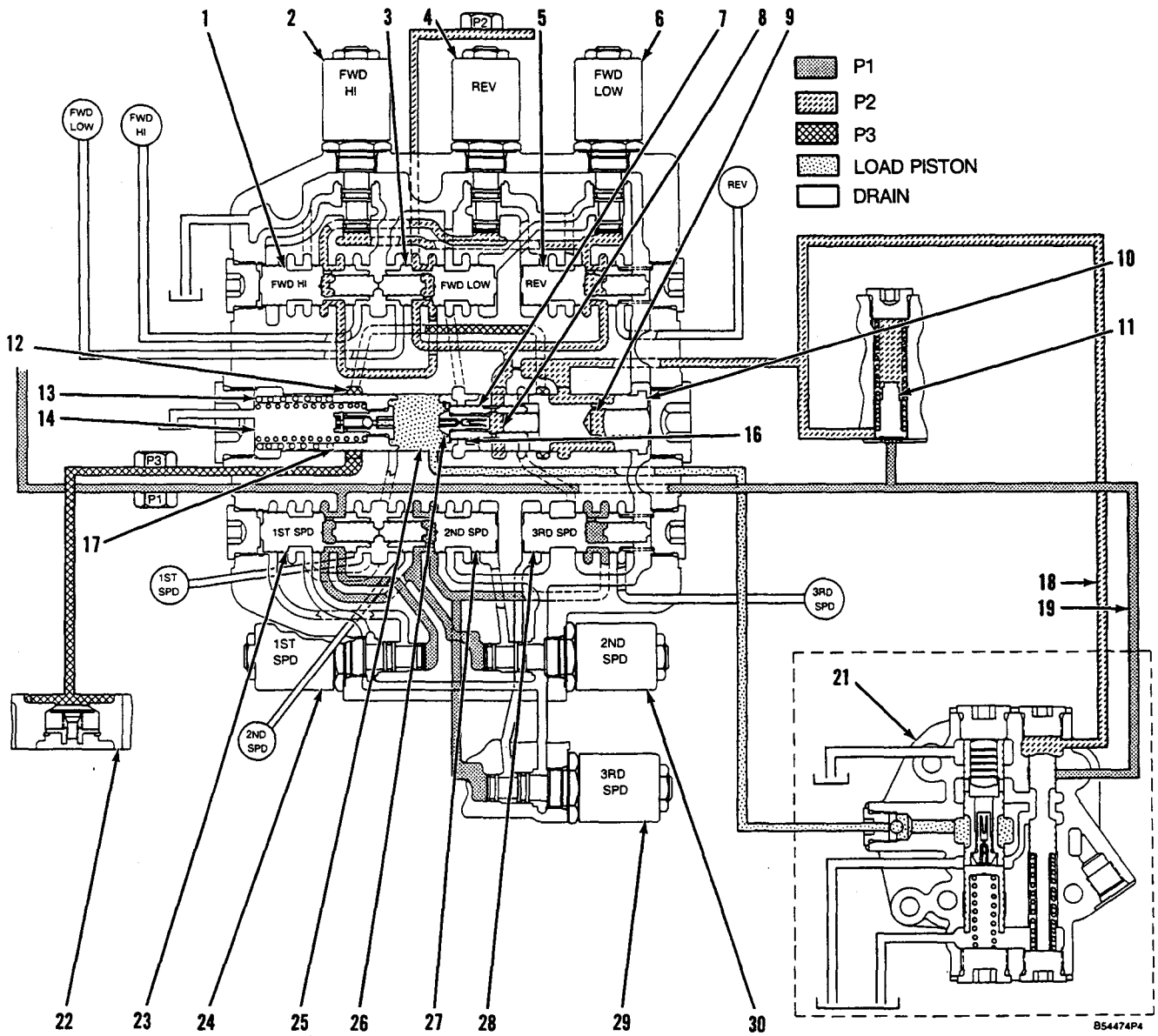


Control Valve Manifold (Viewed From The Bottom) (31) Drain. (32) No. 1 (FORWARD LOW) clutch. (33) No. 2 (FORWARD HIGH) clutch. (34) No. 3 (REVERSE) clutch. (35) No. 4 (SECOND SPEED) clutch. (36) Load piston drain. (37) Torque converter (from flow control valve). (38) No. 5 (THIRD SPEED) clutch. (39) Supply (from flow control valve). (40) No. 6 (FIRST SPEED) clutch.

Pump oil from the flow control valve enters the transmission control valve through passage (39).

Oil from the transmission control valve is sent through passages (32), (33), (34), (35), (38), and (40) in the manifold to passages in the transmission case to the appropriate clutches for the speed and direction selected.

Oil from the flow control valve for the operation of the torque converter flows through passage (37) and the transmission case to the torque converter. Converter inlet relief valve and converter backflow check valve both open into passage (37).



Engine Running (Transmission In NEUTRAL)
(1) Selecter spool and slug (FORWARD HIGH). (2) FORWARD HIGH solenoid. (3) Selecter spool and slug (FORWARD LOW). (4) REVERSE solenoid. (5) Selecter spool and slug (REVERSE). (6) FORWARD LOW solenoid. (7) Check valve. (8) Check valve slug cavity. (9) Modulating relief valve slug cavity. (10) Modulating relief valve. (11) Differential poppet. (12) Passage. (13) Load piston springs. (14) Load piston spring cavity. (16) Passage. (17) Load piston. (18) Passage. (19) Passage. (21) Dump valve. (22) Converter backflow check valve. (23) Selector spool and slug (FIRST SPEED). (24) FIRST SPEED solenoid. (25) Load piston cavity. (26) Screen orifice. (27) Selecter spool and slug (SECOND SPEED). (28) Selecter spool and slug (THIRD SPEED). (29) THIRD SPEED solenoid. (30) SECOND SPEED solenoid.

Engine Running (Transmission In NEUTRAL)

NOTE: In the above illustration, all passages with no pattern are open to drain.

When the engine is started, oil from the oil pump flows to the external oil filter and back to the flow control valve in the transmission case. The flow control valve directs 23 liters (6 U. S. gpm) of oil to the transmission control valve and allows the rest of the oil to go to the torque converter circuit.

Oil (P1) from the flow control valve goes through the transmission control valve to differential poppet (11); speed clutch solenoids (24), (29), and (30); speed clutch selector spools and slugs (23), (27), and (28); and through passage (19) to dump valve (21) (see Dump Valve for a description of dump valve operation).

The P1 oil enters the slug cavities of the speed selector spools and maintains the selector spools in the clutch disengaged position. When the pressure in the P1 circuit reaches approximately 345 kPa (50 psi), differential poppet (11) opens. Oil through differential poppet (11), which maintains a 345 kPa (50 psi) difference between P1 and P2 pressures, flows to modulating relief valve (10); directional clutch solenoids (2), (4) and (6); and directional clutch spools and slugs (1), (3), and (5), where the oil enters the slug cavities of the directional clutch selector spools and maintains the selector spools in the clutch disengaged position.

Oil in the P2 circuit also enters modulating relief valve slug cavity (9), check valve slug cavity (8), and flows through screen orifice (26) to load piston cavity (25). Oil in the P2 circuit also flows through passage (18) to dump valve (21) (see Dump Valve for a description of dump valve operation).

The increasing P2 pressure in check valve slug cavity (8) moves check valve (7) to the left closing off passage (16) and load piston cavity (25) to drain.

The increase in P2 pressure is also felt in modulating relief valve slug cavity (9). When P2 pressure reaches the initial setting of modulating relief valve (10), the modulating relief valve moves left against load piston (17) and load piston springs (13) until the passage to the P3 (torque converter) circuit is open. This lets excess oil go to the P3 circuit, which is open to drain through passage (12) and load piston spring cavity (14).

As the oil pressure increases in load piston cavity (25), the pressure moves load piston (17) to the left against load piston springs (13). The pressure in the load piston cavity also acts against modulating relief valve (10) moving it slightly to the right reducing the flow to the torque converter circuit through passage (12). The pressure continues to rise in load piston cavity (25) moving load piston (17) to the left against load piston springs (13).

The movement of modulating relief valve (10) and load piston (17) continues until load piston (17) moves far enough left until it is metering load piston cavity flow to drain through a passage in the valve body and modulating relief valve (10) is metering excess pump flow to the torque converter circuit through passage (12). At this time, load piston (17) and load piston springs (13) working with modulating relief valve (10) are controling the pressure of P2 oil. Pressure in the system will be limited by the final spring force on load piston.

Differential poppet (11) maintains P1 pressure at 345 kPa (50 psi) above P2 pressure.

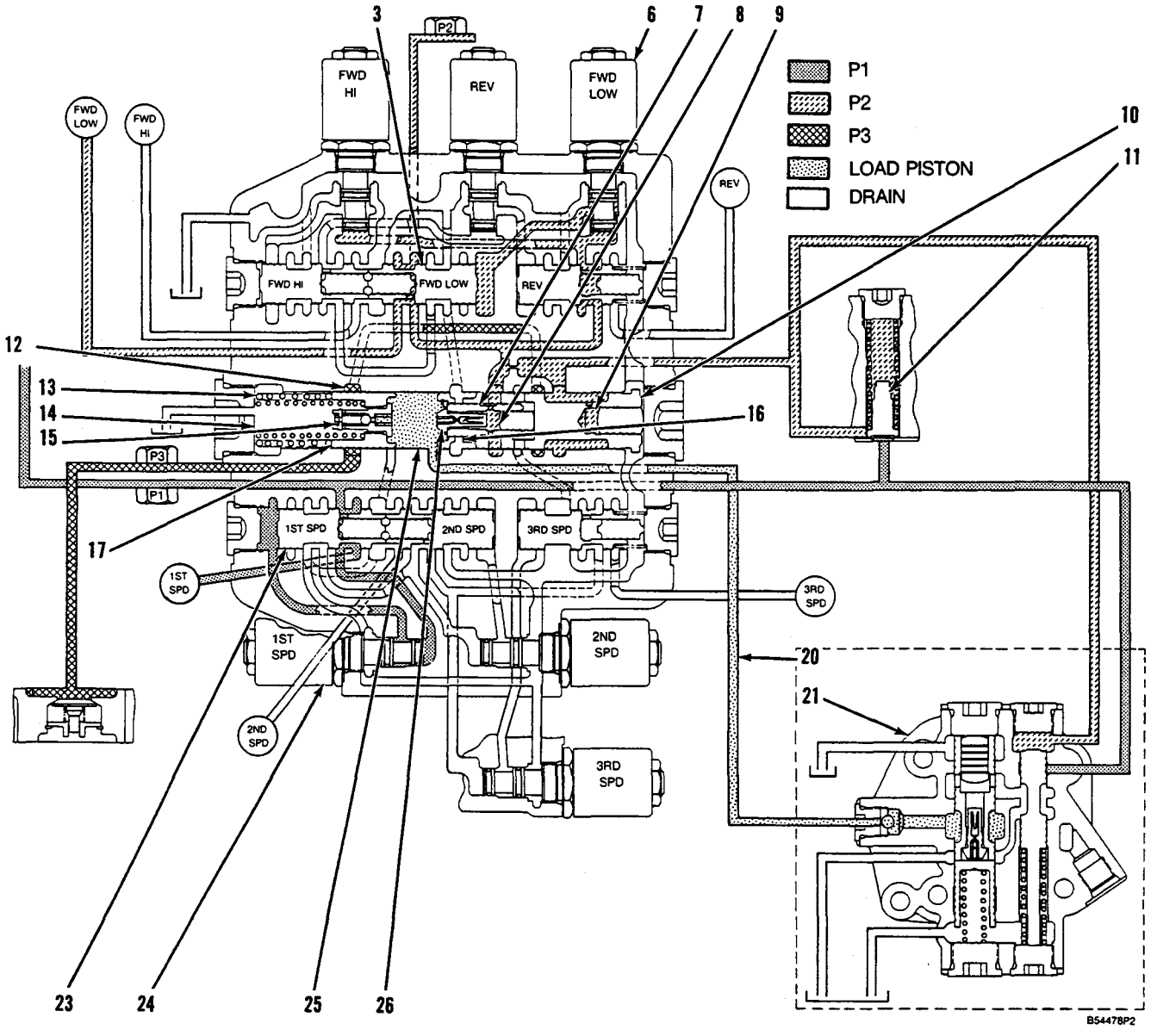
With the transmission in NEUTRAL, none of the solenoids are shifted, therefore pressure oil is not directed to any clutch.

Converter Backflow Check Valve

During the first 65% of the stroke of load piston (17), the oil being relieved to the torque converter circuit by the modulating relief valve (10) is connected to drain through passage (12) and load piston spring cavity (14). This allows modulating relief valve (10) to begin modulation from a 310 kPa (45 psi) initial setting. For the remaining portion of the load piston stroke the passage to drain is blocked, and the oil flows to the torque converter circuit.

The function of converter backflow check valve (22) is to stop the excess flow in the 550 kPa (80 psi) converter circuit from also dumping into the load piston spring cavity causing a high initial setting of the modulating relief valve.

Engine Running (NEUTRAL To FIRST SPEED FORWARD)



Engine Running (NEUTRAL To FIRST SPEED FORWARD)
(3) Selecter spool and slug (FORWARD LOW). (6) FORWARD LOW solenoid. (7) Check valve. (8) Check valve slug cavity. (9) Modulating relief valve slug cavity. (10) Modulating relief valve. (11) Differential poppet. (12) Passage. (13) Load piston springs. (14) Load piston spring cavity. (15) Load piston relief valve. (16) Passage. (17) Load piston. (20) Passage. (21) Dump valve. (23) Selector spool and slug (FIRST SPEED). (24) FIRST SPEED solenoid. (25) Load piston cavity. (26) Screen orifice.

NOTE: In the above illustration, all passages with no pattern are open to drain.

When the transmission selector lever is moved to FIRST SPEED FORWARD, FORWARD LOW solenoid (6) and FIRST SPEED solenoid (24) are energized.

Selector spool (23) for the FIRST SPEED clutch receives oil through FIRST SPEED solenoid (24) and moves to the right directing oil to the FIRST SPEED clutch. Full flow (6 GPM) is available for the FIRST SPEED clutch fill. During clutch fill, P1 pressure drops below 345 kPa (50 psi) and the spring closes differential poppet (11). Selector spool (3) for the FORWARD LOW clutch does not move until the speed clutch has filled because differential poppet (11) is closed and blocks flow to the P2 (directional) circuit.

With differential poppet (11) closed, the pressure in the P2 (directional) circuit begins to drop. Check valve (7) senses the lower pressure and moves to the right to open load piston cavity (25) to drain through passage (16) in modulating relief valve (10) and a passage in the valve body. When the P2 pressure drops below 1034 kPa (150 psi), dump valve (21) rapidly dumps the remaining pressure in the load piston cavity to drain through passage (20) (see Dump Valve for a description of dump valve operation). With the pressure in load piston cavity (25) dumping to drain, springs (13) move load piston (17) all the way to the right until it is touching modulating relief valve (10). Modulating relief valve (10) has also moved to the right and blocks the passage to the P3 circuit.

With load piston (17) moved to the right, passage (12) in the P3 circuit is opened to drain through load piston spring cavity (14). This insures low back pressure for modulating relief valve (10) so that modulation can start at the initial setting.

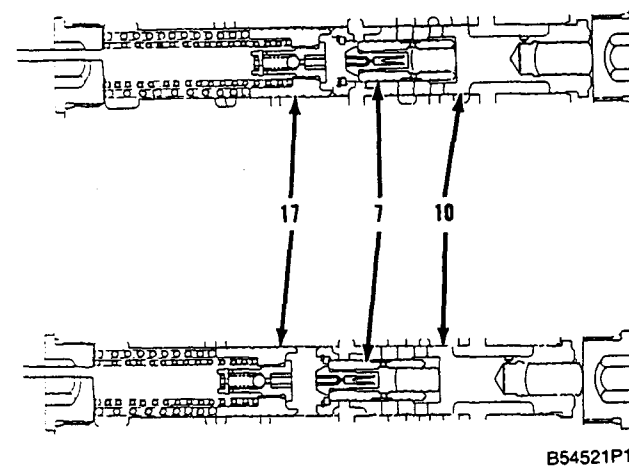
At this time the FIRST SPEED clutch has filled and P1 pressure begins to increase. Differential poppet (11) opens when the pressure reaches 345 kPa (50 psi) and oil flows to the P2 circuit.

Selector spool (3) for the FORWARD LOW clutch receives oil through FORWARD LOW solenoid (6) and moves to the left directing oil to the FORWARD LOW clutch which begins to fill.

Oil in the P2 circuit also flows to dump valve (21), modulating relief valve slug cavity (9), check valve slug cavity (8), and through screen orifice (26) to load piston cavity (25).

When the FORWARD LOW clutch is full of oil, the pressure in the P2 circuit starts to increase. This pressure increase is felt in check valve slug cavity (8) and moves check valve (7) to the left which closes load piston cavity (25) to drain. Dump valve (21) also closes off passage (20) from load piston cavity to drain (see Dump Valve for a description of dump valve operation). The pressure increase is also felt in modulating relief valve slug cavity (9). When the pressure in the directional clutch circuit reaches the initial setting of the modulating relief valve, the modulating relief valve has moved to the left until passage (12) to the P3 circuit is open. This lets excess oil go to the P3 circuit, which is still open to drain through passage (12) and load piston spring cavity (14).

The P2 pressure felt by the modulating relief valve is also felt in check valve slug cavity (8). Screen orifice (26) in check valve (7) controls the rate of flow to load piston cavity (25). As the pressure increases in load piston cavity (25), load piston (17) moves to the left. The movement of load piston (17) to the left compresses springs (13) causing an increase in pressure in load piston cavity (25). This pressure in the load piston cavity also acts against modulating relief valve (10) moving it slightly to the right reducing the flow to the torque converter circuit through passage (12). The pressure continues to rise in load piston cavity (25) moving load piston (17) farther to the left against load piston springs (13). The modulating relief valve also continues to move very slightly to the right further restricting flow to the torque converter circuit through passage (12).



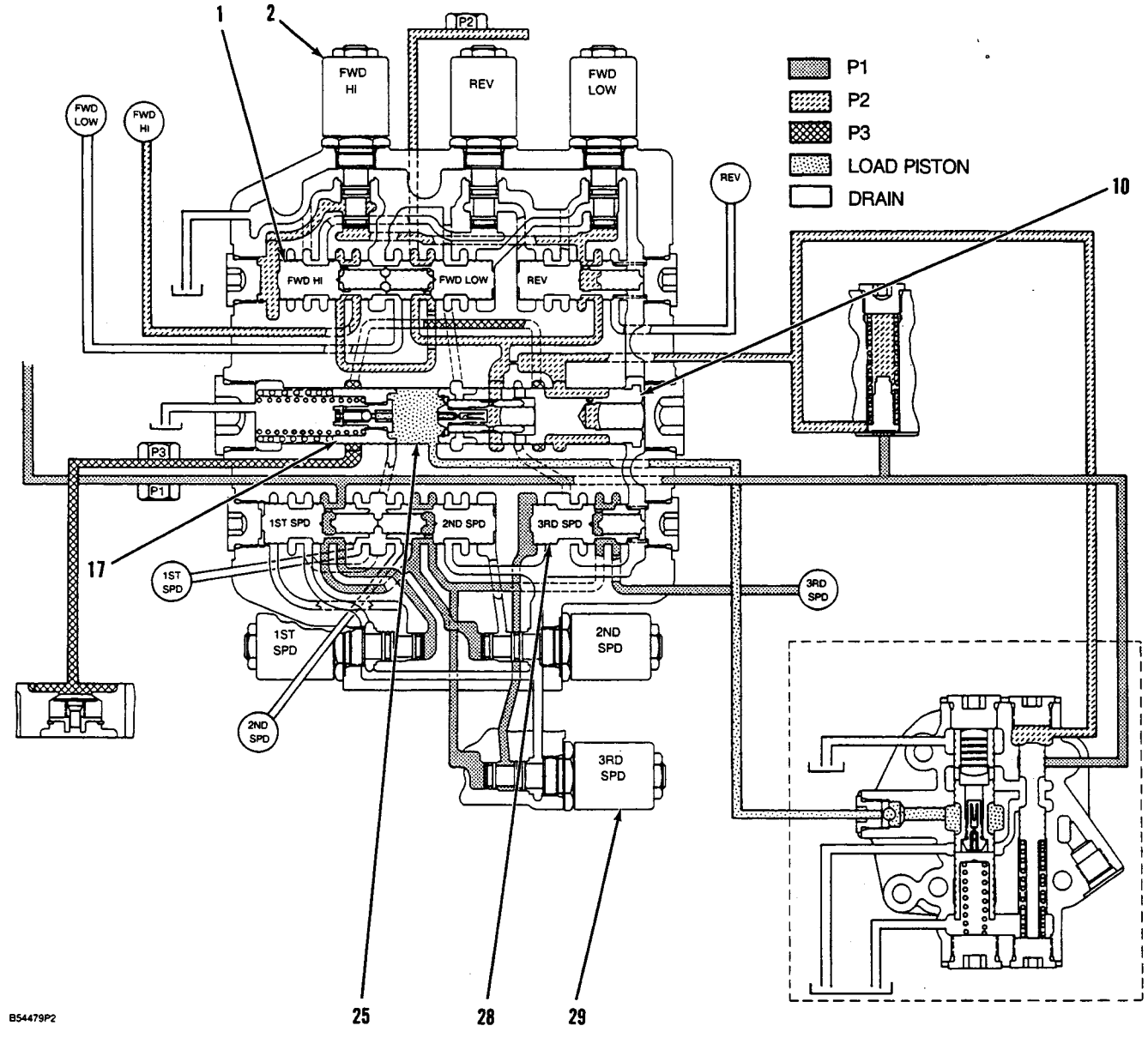
Load Piston And Modulating Relief Valve Positions At Dump (Top) And At Start Of Modulation (Bottom)
(7) Check valve. (10) Modulating relief valve. (17) Load piston

This movement of the modulating relief valve and the load piston causes the clutch pressure to increase gradually. This gradual increase in pressure is known as modulation.

After about ⅔ of total load piston movement, the load piston has moved far enough to close off passage (12) to drain through load piston spring cavity (14). P3 flows around load piston (17) to the torque converter circuit. The load piston movement to the left stops when the load piston moves to the drain passage. At this time, modulation stops. As oil comes through screen orifice (26) to load piston cavity (25), oil goes out the drain passage. This keeps load piston (17) in position without any further movement. Load piston (17) and load piston springs (13) working with modulating relief valve (10) are controlling the pressure of P2 oil. Pressure in the system will be limited by the final spring force on load piston. At this time, the modulating relief valve meters excess oil flow to the torque converter circuit through passage (12).

If load piston (17) sticks during modulation, load piston relief valve (15) will open and relieve the load piston pressure when it reaches 690 kPa (100 psi).

Engine Running (Transmission in FOURTH SPEED FORWARD)



Engine Running (Transmission in FOURTH SPEED FORWARD)
(1) Selecter spool and slug (FORWARD HIGH) (2) FORWARD HIGH solenoid. (10) Modulating relief valve. (17) Load piston. (25) Load piston cavity. (28) Selector spool and slug (THIRD SPEED). (29) THIRD SPEED solenoid.

NOTE: In the above illustration, all passages with no pattern are open to drain.

When the transmission selector lever is in FOURTH SPEED FORWARD, FORWARD HIGH solenoid (2) and THIRD SPEED solenoid (29) are engaged.

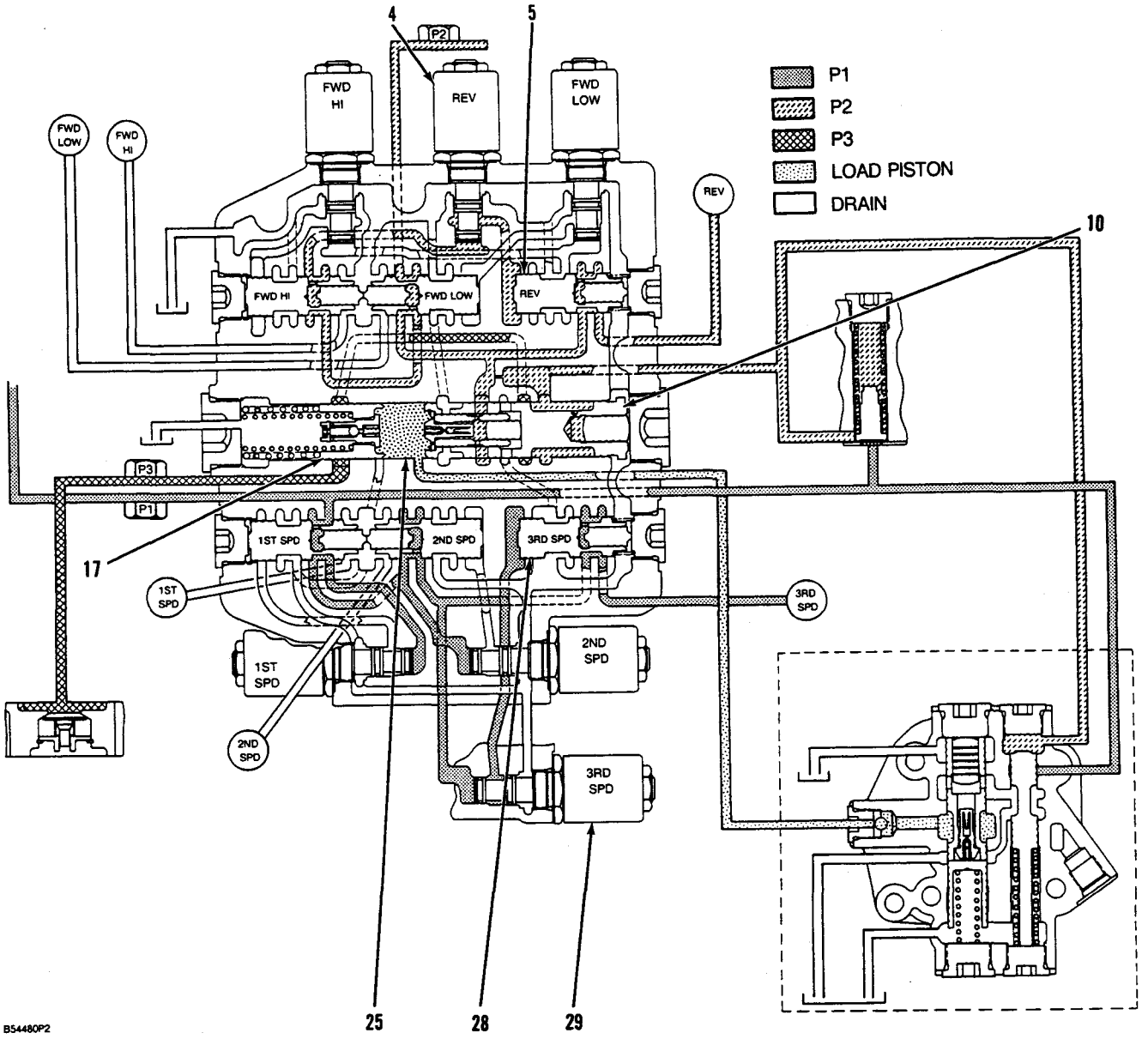
Pressure oil through THIRD SPEED solenoid (29) has moved selector spool (28) for the THIRD SPEED clutch to the right. This allows P1 pressure oil to go to and engage the THIRD SPEED clutch .

Pressure oil through FORWARD HIGH solenoid (2) has moved selector spool (1) for the FORWARD HIGH clutch to the right. This allows P2 pressure oil to go to the FORWARD HIGH clutch .

Modulation (as described in the text for NEUTRAL To FIRST SPEED FORWARD) has occurred. Modulating relief valve (10) has moved to the left and is metering oil to the torque converter circuit through passage (12). Load piston (17) has also moved to the left where it is metering load piston cavity (25) pressure to drain.

P1 and P2 pressure are stabilized and the transmission is in steady state operation.

Engine Running (Transmission in THIRD SPEED REVERSE)



Engine Running (Transmission in THIRD SPEED REVERSE)
(4) REVERSE solenoid. (5) Selecter spool and slug (REVERSE). (10) Modulating relief valve. (17) Load piston. (25) Load piston cavity. (28) Selector spool and slug (THIRD SPEED). (29) THIRD SPEED solenoid.

NOTE: In the above illustration, all passages with no pattern are open to drain.

When the transmission selector lever is in THIRD SPEED REVERSE, REVERSE solenoid (4) and THIRD SPEED solenoid (29) are engaged.

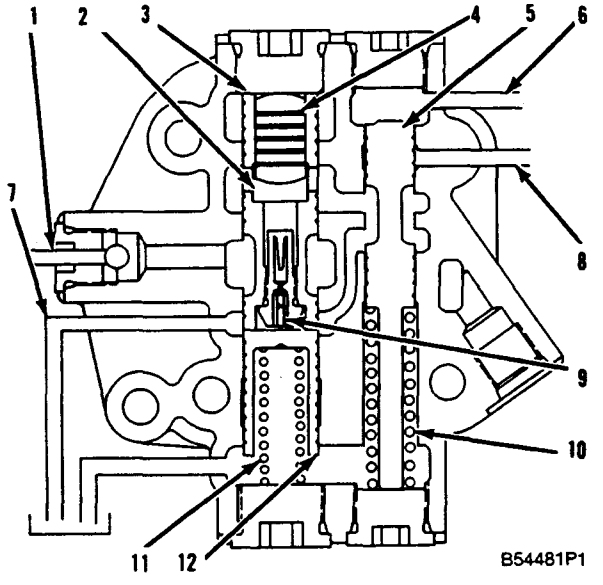
Pressure oil through THIRD SPEED solenoid (29) has moved selector spool (28) for the THIRD SPEED clutch to the right. This allows P1 pressure oil to go to and engage the THIRD SPEED clutch.

Pressure oil through REVERSE solenoid (4) has moved selector spool (5) for the REVERSE clutch to the right. This allows P2 pressure oil to go to the REVERSE clutch.

Modulation (as described in the text for NEUTRAL To FIRST SPEED FORWARD) has occurred. Modulating relief valve (10) has moved to the left and is metering oil to the torque converter circuit. Load piston (17) has also moved to the left where it is metering load piston cavity (25) pressure to drain through passage (12).

P1 and P2 pressure are stabilized and the transmission is in steady state operation.

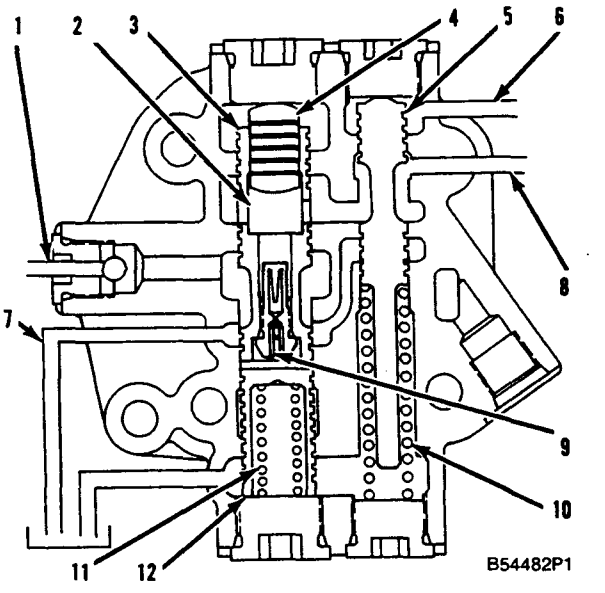
Dump Valve (Attachment)



Dump Valve (Normal Operation)
(1) Passage. (2) Slug cavity. (3) Spool. (4) Slug. (5) Spool. (6) Passage. (7) Drain passage. (8) Passage. (9) Orifice. (10) Spring. (11) Spring. (12) Piston.

The function of the dump valve is to assist in reducing pressure in the load piston cavity to allow the load piston to fully reset. This insures full modulation of clutch pressure and smooth clutch engagement.

When the transmission is in gear, directional clutch pressure (P2) from the transmission control valve enters the dump valve through passage (6). This pressure moves spool (5) downward against spring (10). Load piston pressure (LP) enters the dump valve through passage (1). Speed clutch pressure (P1) from the transmission control valve, through passage (8) is blocked by spool (5).

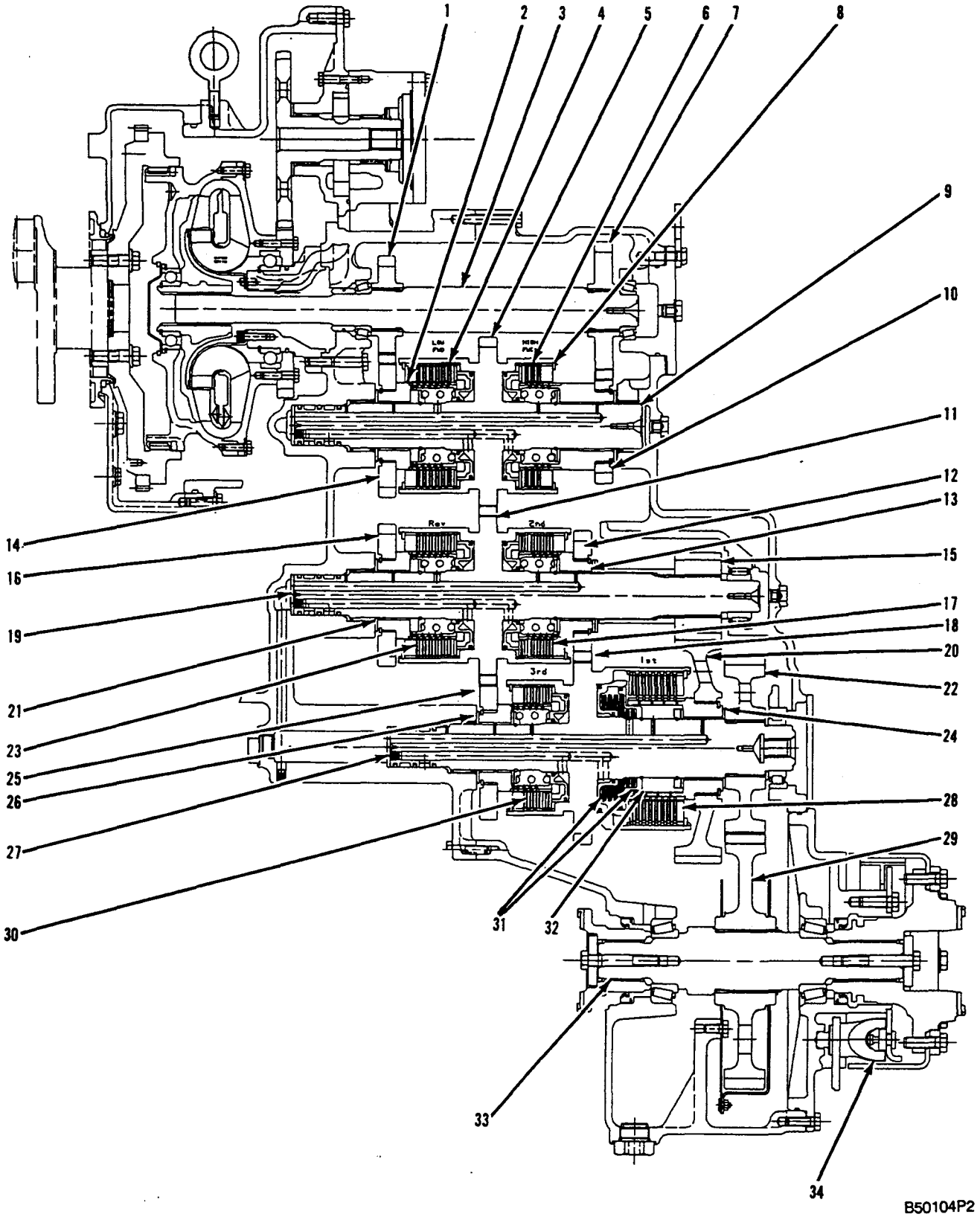


Dump Valve (During A Shift)
(1) Passage. (2) Slug cavity. (3) Spool. (4) Slug. (5) Spool. (6) Passage. (7) Drain passage. (8) Passage. (9) Orifice. (10) Spring. (11) Spring. (12) Piston.

When a shift of the transmission is made, directional clutch pressure (P2) drops. When directional clutch pressure drops below 1034 kPa (150 psi), spring (10) moves spool (5) upward against the reduced P2 pressure. This opens slug cavity (2) to P1 pressure through passage (8).

P1 pressure in slug cavity (2) moves spool (3) and piston (12) downward against spring (11). This opens LP pressure in passage (1) to drain through passage (7) causing P2 pressure to drop to 310 kPa (45 psi) (initial pressure).

Pressure through orifice (9) acts on spool (3) causing it to slowly move upward closing off LP flow from passage (1) to drain passage (7). Orifice (9) is sized to provide a delay in closing LP pressure to drain. When LP pressure is closed to drain, the modulating relief valve is allowed to perform its function. When P2 pressure rises to 1034 kPa (150 psi), spool (5) moves downward blocking P1 pressure from slug cavity (2) and opening slug cavity to drain. Spring (11) then pushes piston (12) upward until it contacts spool (3). This returns spool (3) to the reset position for the next shift.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Transmission Components
(1) Gear. (2) Hub assembly. (3) Input shaft assembly. (4) FORWARD LOW clutch. (5) Gear [part of shaft assembly (9)]. (6) FORWARD HIGH clutch. (7) Gear. (8) Hub assembly. (9) Shaft assembly. (10) Gear. (11) Gear [part of shaft assembly (19)]. (12) Gear. (13) Hub assembly. (14) Gear. (15) Gear. (16) Gear. (17) SECOND SPEED clutch. (18) Gear [part of shaft assembly (27)]. (19) Shaft assembly. (20) Gear. (21) Hub assembly. (22) Gear. (23) REVERSE clutch. (24) Hub assembly. (25) Gear. (26) Hub assembly. (27) Shaft assembly. (28) FIRST SPEED clutch. (29) Gear. (30) THIRD SPEED clutch. (31) Wave spring. (32) Balance piston. (33) Output shaft assembly. (34) Parking brake assembly.

The transmission is a constant mesh power shift transmission that has four forward speeds and three reverse speeds. The transmission has six clutches that are engaged hydraulically. Five of the clutches are disengaged by a coil spring. FIRST SPEED clutch (28) is disengaged by two wave springs (31) and balance piston (32). Balance piston (32) positively disengages FIRST SPEED clutch (28) and prevents the clutch from dragging during an over speed condition, such as coasting down a hill. Balance piston (32) and wave springs (31) assemble inside the clutch piston. When the FIRST SPEED clutch is not engaged, force from wave springs (31) and lube oil pressure between the clutch piston and balance piston (32) combine to move and hold the clutch piston in the clutch disengaged position.

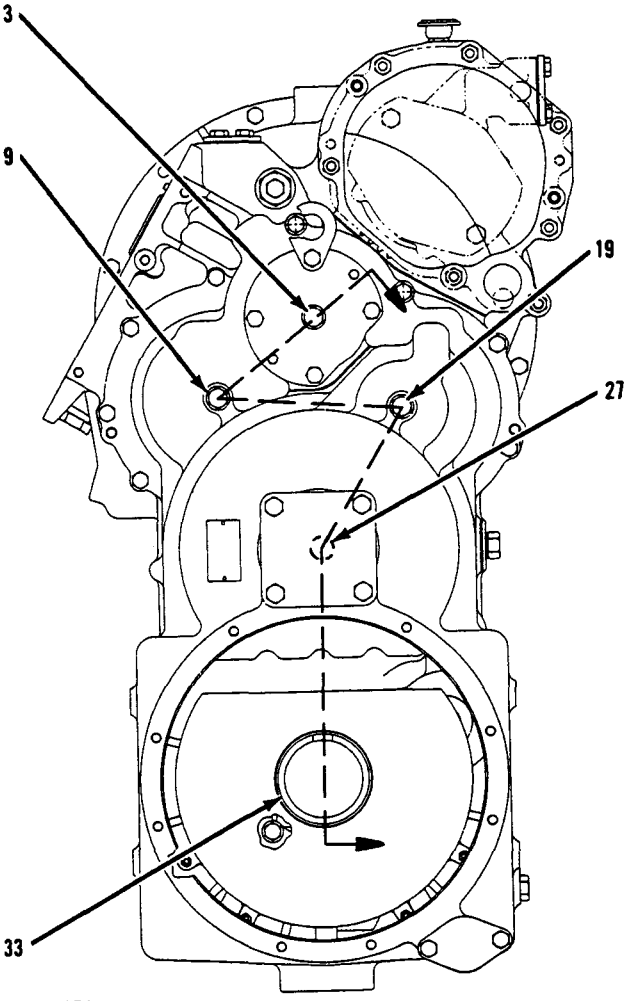
The transmission has five shafts: input shaft assembly (3), output shaft assembly (33), and three main gear and clutch carrying shafts. Input shaft assembly (3) is driven by the torque converter turbine. Shaft assembly (9) contains FORWARD LOW clutch (4) and FORWARD HIGH clutch (6). Shaft assembly (19) contains REVERSE clutch (23) and SECOND SPEED clutch (17). Shaft assembly (27) contains THIRD SPEED clutch (30) and FIRST SPEED clutch (28).

Each of the three clutch carrying transmission shafts have three internal oil passages. One passage is for carrying oil for the lubrication and cooling of the clutches, bearings and gears. The other two passages are for carrying pressure oil for the engagement of the clutches on each shaft.

A speed clutch and a direction clutch must both be engaged to send power through the transmission. The speed and direction of the vehicle must be selected manually by the operator. The chart gives the combination of the solenoids energized and the clutches engaged for each FORWARD and REVERSE speed. No clutches are engaged in NEUTRAL.

Parking brake assembly (34) is mounted to the transmission case.

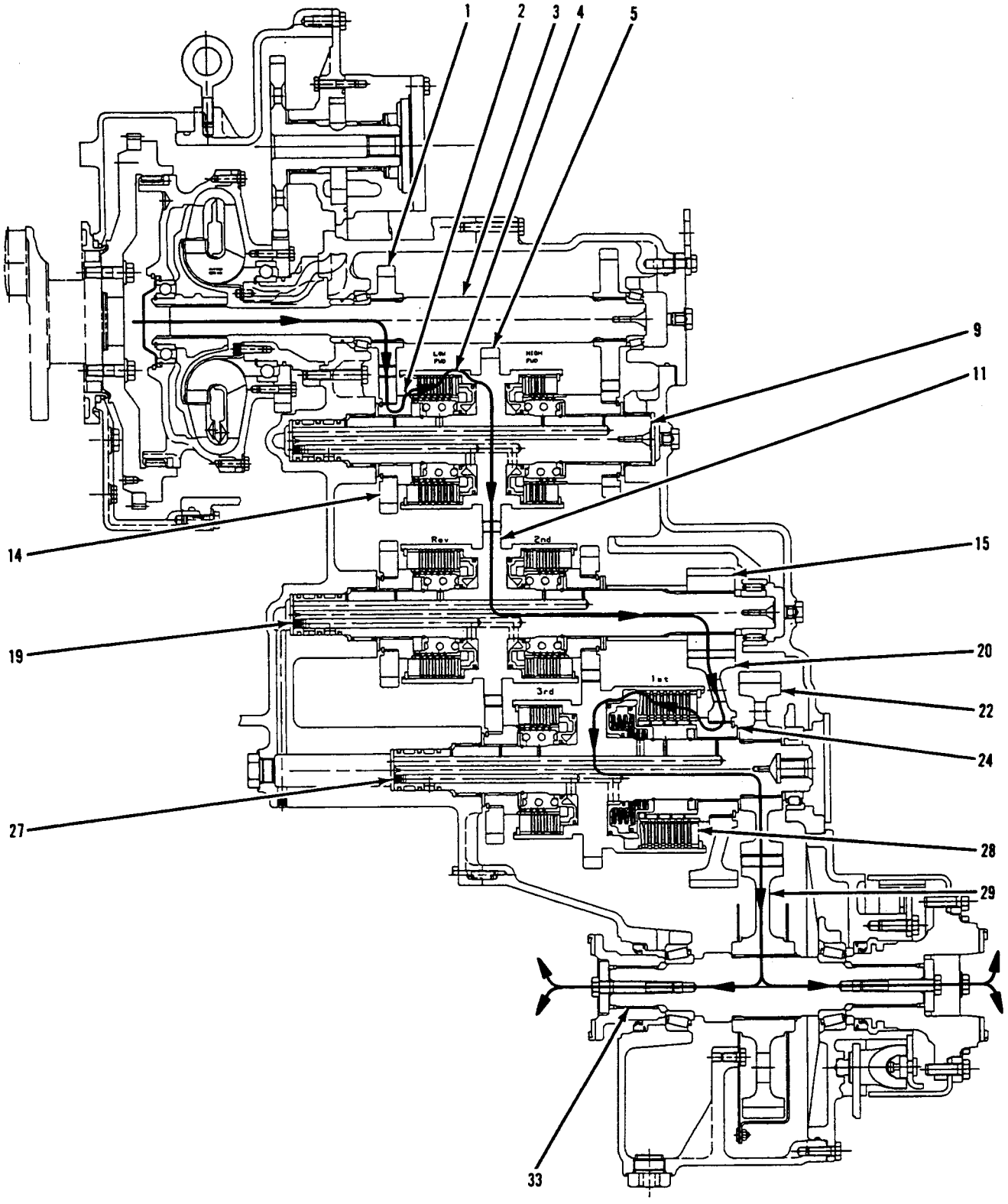
Vehicle Range/Direction	Solenoids Energized And Clutches Engaged
1-F	First Speed/Forward Low
2-F	Second Speed/Forward Low
3-F	Third Speed/Forward Low
4-F	Third Speed/Forward High
N	None
1-R	First Speed/Reverse
2-R	Second Speed/Reverse
3-R	Third Speed/Reverse



B50110P2

Transmission Shaft Locations
(3) Input shaft assembly. (9) Shaft assembly (FORWARD LOW and FORWARD HIGH clutches). (19) Shaft assembly (REVERSE and SECOND SPEED clutches). (27) Shaft assembly (THIRD SPEED and FIRST SPEED clutches). (33) Output shaft assembly.

First Speed Forward



B50104P3

Power Flow In FIRST SPEED FORWARD
(1) Gear. (2) Hub assembly. (3) Input shaft assembly. (4) FORWARD LOW clutch. (5) Gear [part of shaft assembly (9)]. (9) Shaft assembly. (11) Gear [part of shaft assembly (19)]. (14) Gear. (15) Gear. (19) Shaft assembly. (20) Gear. (22) Gear. (24) Hub assembly. (27) Shaft assembly. (28) FIRST SPEED clutch. (29) Gear. (33) Output shaft assembly.

When the transmission is in FIRST SPEED FORWARD, FORWARD LOW clutch (4) and FIRST SPEED clutch (28) are engaged. Torque from the engine is transferred through the torque converter to input shaft assembly (3). Gear (1) is splined to input shaft assembly (3) and is in mesh with and turns gear (14).

Gear (14) is splined to and turns hub assembly (2). Torque is transferred from input shaft assembly (3) through gear (1) and gear (14) to hub assembly (2). With FORWARD LOW clutch (4) engaged, torque is transferred from hub assembly (2) through the engaged FORWARD LOW clutch to shaft assembly (9).

Gear (5) is part of shaft assembly (9). Gear (5) is in mesh with and turns gear (11). Gear (11) is part of shaft assembly (19). Torque is transferred from shaft assembly (9) through gear (5) and gear (11) to shaft assembly (19).

Gear (15) is splined to shaft assembly (19). Gear (15) is in mesh with and turns gear (20) which is splined to hub assembly (24). Torque is transferred from shaft assembly (19) through gear (15) and gear (20) to hub assembly (24). With FIRST SPEED clutch (28) engaged, torque is transferred from hub assembly (24) through the engaged FIRST SPEED clutch to shaft assembly (27).

Gear (22) is splined to shaft assembly (27) and is in mesh with and turns gear (29). Gear (29) is splined to output shaft assembly (33). Torque is transferred from shaft assembly (27) through gear (22) and gear (29) to output shaft assembly (33).

Second Speed Forward

When the transmission is in SECOND SPEED FORWARD, FORWARD LOW clutch (4) and SECOND SPEED clutch (17) are engaged. Torque from the engine is transferred through the torque converter to input shaft assembly (3). Gear (1) is splined to input shaft assembly (3) and is in mesh with and turns gear (14).

Gear (14) is splined to and turns hub assembly (2). Torque is transferred from input shaft assembly (3) through gear (1) and gear (14) to hub assembly (2). With FORWARD LOW clutch (4) engaged, torque is transferred from hub assembly (2) through the engaged FORWARD LOW clutch to shaft assembly (9).

Gear (5) is part of shaft assembly (9). Gear (5) is in mesh with and turns gear (11). Gear (11) is part of shaft assembly (19). Torque is transferred from shaft assembly (9) through gear (5) and gear (11) to shaft assembly (19).

With SECOND SPEED clutch (17) engaged, torque is transferred from shaft assembly (19) through the engaged SECOND SPEED clutch to hub assembly (13). Gear (12) is splined to hub assembly (13) and is in mesh with and turns gear (18). Gear (18) is part of shaft assembly (27). Torque is transferred from hub assembly (13) through gear (12) and gear (18) to shaft assembly (27).

Gear (22) is splined to shaft assembly (27) and is in mesh with and turns gear (29). Gear (29) is splined to output shaft assembly (33). Torque is transferred from shaft assembly (27) through gear (22) and gear (29) to output shaft assembly (33).

Third Speed Forward

When the transmission is in THIRD SPEED FORWARD, FORWARD LOW clutch (4) and THIRD SPEED clutch (30) are engaged. Torque from the engine is transferred through the torque converter to input shaft assembly (3). Gear (1) is splined to input shaft assembly (3) and is in mesh with and turns gear (14).

Gear (14) is splined to and turns hub assembly (2). Torque is transferred from input shaft assembly (3) through gear (1) and gear (14) to hub assembly (2). With FORWARD LOW clutch (4) engaged, torque is transferred from hub assembly (2) through the engaged FORWARD LOW clutch to shaft assembly (9).

Gear (5) is part of shaft assembly (9). Gear (5) is in mesh with and turns gear (11). Gear (11) is part of shaft assembly (19) and is in mesh with and turns gear (25). Gear (25) is splined to hub assembly (26). Torque is transferred from shaft assembly (9) through gear (5), gear (11), and gear (25) to hub assembly (26).

With THIRD SPEED clutch (30) engaged, torque is transferred from hub assembly (26) through the engaged THIRD SPEED clutch to shaft assembly (27).

Gear (22) is splined to shaft assembly (27) and is in mesh with and turns gear (29). Gear (29) is splined to output shaft assembly (33). Torque is transferred from shaft assembly (27) through gear (22) and gear (29) to output shaft assembly (33).

Fourth Speed Forward

When the transmission is in FOURTH SPEED FORWARD, FORWARD HIGH clutch (6) and THIRD SPEED clutch (30) are engaged. Torque from the engine is transferred through the torque converter to input shaft assembly (3). Gear (7) is splined to input shaft assembly (3) and is in mesh with and turns gear (10).

Gear (10) is splined to and turns hub assembly (8). Torque is transferred from input shaft assembly (3) through gear (7) and gear (10) to hub assembly (8). With FORWARD HIGH clutch (6) engaged, torque is transferred from hub assembly (8) through the engaged FORWARD HIGH clutch to shaft assembly (9).

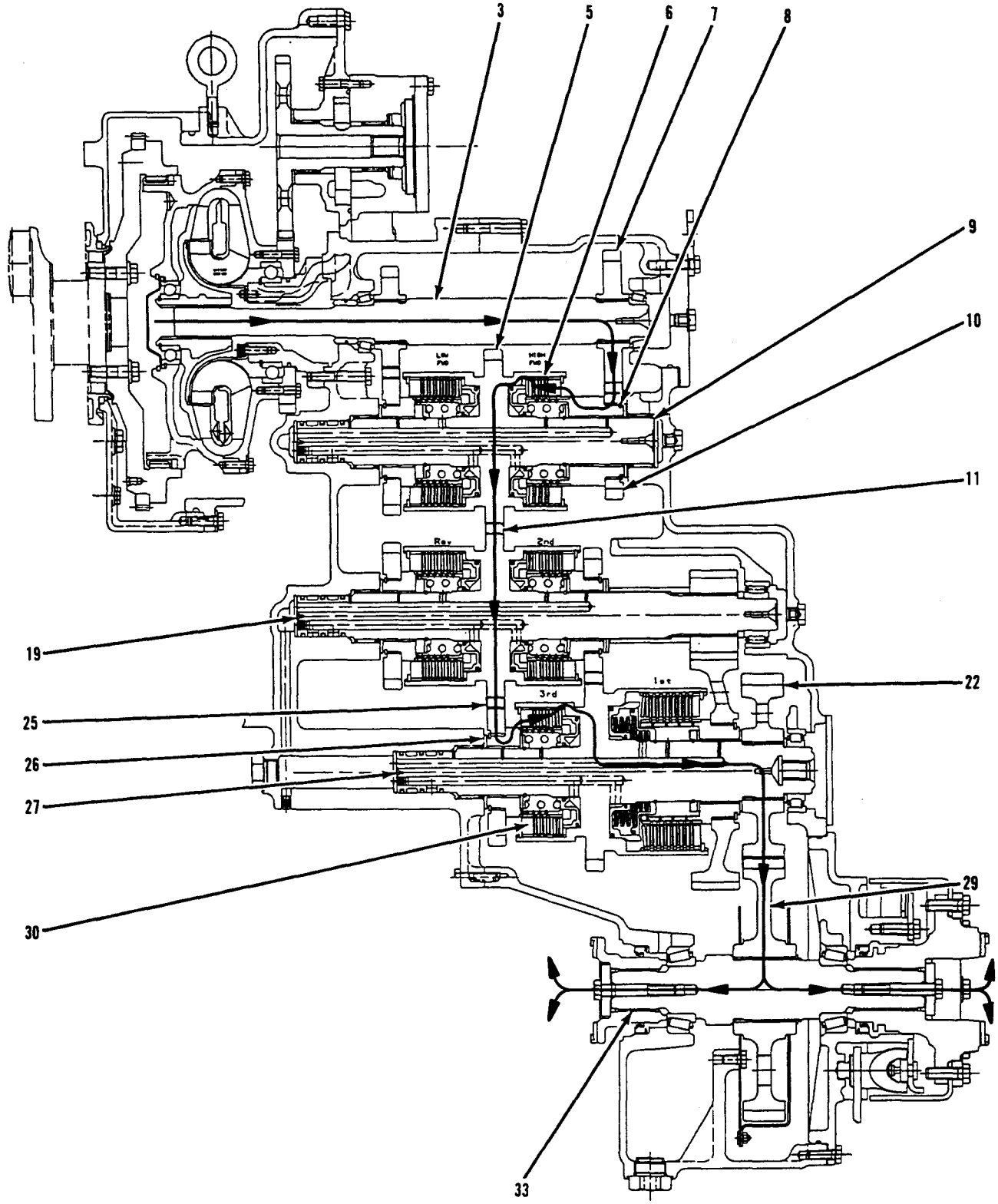
Gear (5) is part of shaft assembly (9). Gear (5) is in mesh with and turns gear (11). Gear (11) is part of shaft assembly (19) and is in mesh with and turns gear (25). Gear (25) is splined to hub assembly (26). Torque is transferred from shaft assembly (9) through gear (5), gear (11), and gear (25) to hub assembly (26).

With THIRD SPEED clutch (30) engaged, torque is transferred from hub assembly (26) through the engaged THIRD SPEED clutch to shaft assembly (27).

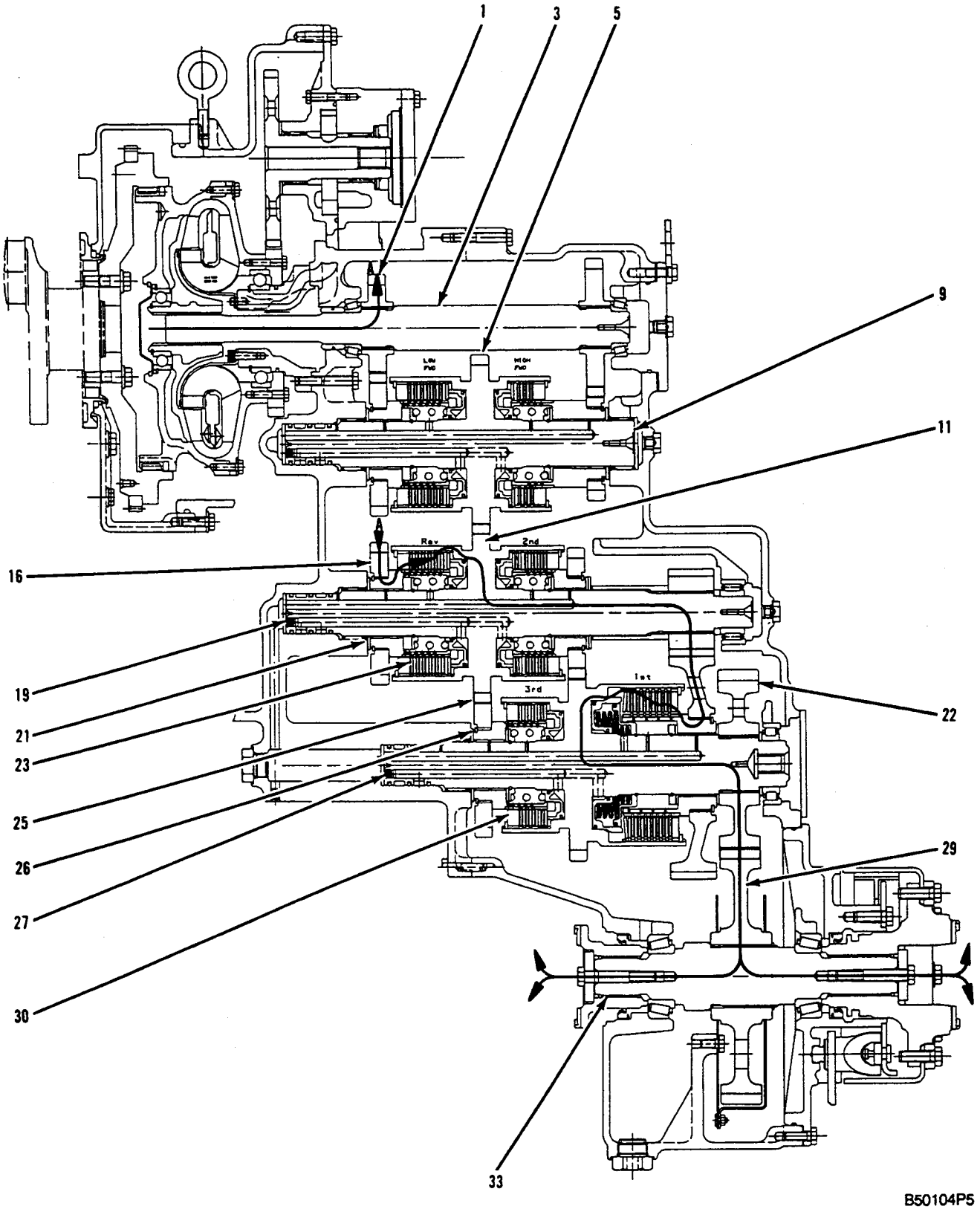
Gear (22) is splined to shaft assembly (27) and is in mesh with and turns gear (29). Gear (29) is splined to output shaft assembly (33). Torque is transferred from shaft assembly (27) through gear (22) and gear (29) to output shaft assembly (33).

Neutral

When the transmission is in NEUTRAL, there are no clutches engaged. Torque from the engine is transferred through the torque converter to input shaft assembly (3). Since FORWARD LOW clutch (4), FORWARD HIGH clutch (6), or REVERSE clutch (23) are not engaged, there is no torque transfer from input shaft assembly (3) to either shaft assembly (9) or shaft assembly (19).



Power Flow In FOURTH SPEED FORWARD
(3) Input shaft assembly. (5) Gear [part of shaft assembly (9)]. (6) FORWARD HIGH clutch. (7) Gear. (8) Hub assembly. (9) Shaft assembly. (10) Gear. (11) Gear [part of shaft assembly (19)]. (19) Shaft assembly. (22) Gear. (25) Gear. (26) Hub assembly. (27) Shaft assembly. (29) Gear. (30) THIRD SPEED clutch. (33) Output shaft assembly.



Power Flow In THIRD SPEED REVERSE
(1) Gear. (3) Input shaft assembly. (5) Gear [part of shaft assembly (9)]. (9) Shaft assembly. (11) Gear [part of shaft assembly (19)]. (16) Gear. (19) Shaft assembly. (21) Hub assembly. (22) Gear. (23) REVERSE clutch. (25) Gear. (26) Hub assembly. (27) Shaft assembly. (29) Gear. (30) THIRD SPEED clutch. (33) Output shaft assembly.

First Speed Reverse

When the transmission is in FIRST SPEED REVERSE, REVERSE clutch (23) and FIRST SPEED clutch (28) are engaged. Torque from the engine is transferred through the torque converter to input shaft assembly (3). Gear (1) is splined to input shaft assembly (3) and is in mesh with and turns gear (16).

Gear (16) is splined to and turns hub assembly (21). Torque is transferred from input shaft assembly (3) through gear (1) and gear (16) to hub assembly (21). With REVERSE clutch (23) engaged, torque is transferred from hub assembly (21) through the engaged REVERSE clutch to shaft assembly (19).

Gear (15) is splined to shaft assembly (19). Gear (15) is in mesh with and turns gear (20) which is splined to hub assembly (24). Torque is transferred from shaft assembly (19) through gear (15) and gear (20) to hub assembly (24). With FIRST SPEED clutch (28) engaged, torque is transferred from hub assembly (24) through the engaged FIRST SPEED clutch to shaft assembly (27).

Gear (22) is splined to shaft assembly (27) and is in mesh with and turns gear (29). Gear (29) is splined to output shaft assembly (33). Torque is transferred from shaft assembly (27) through gear (22) and gear (29) to output shaft assembly (33).

Second Speed Reverse

When the transmission is in SECOND SPEED REVERSE, REVERSE clutch (23) and SECOND SPEED clutch (17) are engaged. Torque from the engine is transferred through the torque converter to input shaft assembly (3). Gear (1) is splined to input shaft assembly (3) and is in mesh with and turns gear (16).

Gear (16) is splined to and turns hub assembly (21). Torque is transferred from input shaft assembly (3) through gear (1) and gear (16) to hub assembly (21). With REVERSE clutch (23) engaged, torque is transferred from hub assembly (21) through the engaged REVERSE clutch to shaft assembly (19).

With SECOND SPEED clutch (17) engaged, torque is transferred from shaft assembly (19) through the engaged SECOND SPEED clutch to hub assembly (13). Gear (12) is splined to hub assembly (13) and is in mesh with and turns gear (18). Gear (18) is part of shaft assembly (27). Torque is transferred from hub assembly (13) through gear (12) and gear (18) to shaft assembly (27).

Gear (22) is splined to shaft assembly (27) and is in mesh with and turns gear (29). Gear (29) is splined to output shaft assembly (33). Torque is transferred from shaft assembly (27) through gear (22) and gear (29) to output shaft assembly (33).

Third Speed Reverse

When the transmission is in THIRD SPEED REVERSE, REVERSE clutch (23) and THIRD SPEED clutch (30) are engaged. Torque from the engine is transferred through the torque converter to input shaft assembly (3). Gear (1) is splined to input shaft assembly (3) and is in mesh with and turns gear (16).

Gear (16) is splined to and turns hub assembly (21). Torque is transferred from input shaft assembly (3) through gear (1) and gear (16) to hub assembly (21). With REVERSE clutch (23) engaged, torque is transferred from hub assembly (21) through the engaged REVERSE clutch to shaft assembly (19).

Gear (11) is part of shaft assembly (19) and is in mesh with and turns gear (25). Gear (25) is splined to hub assembly (26). Torque is transferred from shaft assembly (9) through gear (5), gear (11), and gear (25) to hub assembly (26).

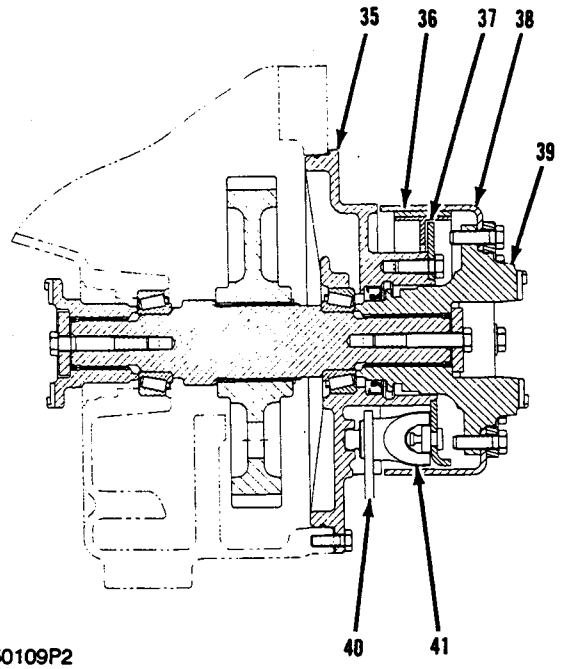
With THIRD SPEED clutch (30) engaged, torque is transferred from hub assembly (26) through the engaged THIRD SPEED clutch to shaft assembly (27).

Gear (22) is splined to shaft assembly (27) and is in mesh with and turns gear (29). Gear (29) is splined to output shaft assembly (33). Torque is transferred from shaft assembly (27) through gear (22) and gear (29) to output shaft assembly (33).

Transmission Lubrication

All clutches, gears, and bearings in the transmission are lubricated by pressure oil. After the oil has been cooled by the oil cooler, it flows back to the transmission case where internal passages carry the oil to a passage in each clutch carrying transmission shaft. Drilled cross-holes carry the oil to the bearings, clutches, and gears.

Parking Brake



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Output Gear Group
(35) Bearing cage. (36) Brake shoe. (37) Plate assembly. (38) Brake drum. (39) Yoke. (40) Lever assembly. (41) Cam [part of lever assembly (40)].

The parking brake is a shoe type brake that is engaged and released by the parking brake control. The parking brake is part of the output gear group. Plate assembly (37) is fastened to bearing cage (35) for the output gear group. Brake shoes (36) and components are mounted on plate assembly (37). Brake drum (38) is fastened to yoke (39).

When the parking brake control is actuated, linkage pulls up on lever assembly (40). Cam (41) [a part of lever assembly (40)] expands brake shoes (36) outward against the inner surface of brake drum (38) to engage the parking brake.

Transmission Electrical System

The main components of the transmission electrical system are the transmission hand control group and six solenoid valves. A transmission neutralizer switch is available as an attachment.

The transmission hand control group is a non-serviceable, environmentally sealed unit. The transmission control group allows the operator to select a speed range by rotating the control lever and a direction by moving the control lever forward or backward. By twisting and/or moving the lever, switches are selected to energize the appropriate transmission solenoids.

When the control lever is in NEUTRAL, a switch in the control group is closed to complete the circuit from the key switch to the start relay, which allows the vehicle to be started with the key.

When the control lever is moved to REVERSE, a switch in the control group is closed, which activates the backup alarm.

The solenoids are installed in the transmission control valve body. The solenoids are two position-three way and are normally open to drain. When energized, the solenoid plunger moves to direct pressure oil to the clutch selector spool.

The transmission neutralizer switch allows the transmission to be disengaged without shifting to NEUTRAL. When the neutralizer switch is actuated, the power to the transmission solenoids is interrupted, thereby neutralizing the transmission.

Testing And Adjusting

Troubleshooting the Transmission Hydraulic System

Make reference to the following warning and pressure tap locations for all checks and tests of the transmission hydraulic system. If the problem area is not known, do the checks and tests in the order they are given.

For all tests, the oil must be at normal temperature of operation.

⚠ WARNING

When testing and adjusting the transmission and power train, move the machine to an area clear of obstructions, with safe ventilation for the exhaust. Sudden movement of the machine or release of oil under pressure can cause injury to persons on or near the machine. To prevent possible injury, do the procedure that follows before testing and adjusting the transmission and power train.

1. Permit only one operator on the machine. Keep all other personnel either away from the machine or in view of the operator.

2. Move the machine to a smooth horizontal location. Move away from working machines and personnel.

3. Put the transmission FORWARD/REVERSE control lever in it's NEUTRAL position and any speed position. Lock the transmission hand control. Stop the engine.

4. Put blocks in front of and behind the wheels.

5. Activate the parking brakes.

6. Lower any implements to the ground.

7. Make sure all hydraulic pressure is released before any fitting, hose or component is loosened, tightened, removed or adjusted.

Troubleshooting can be complex. A list of some possible problems and corrections is on the pages that follow.

This list of some possible problems and their corrections will only give an indication of where a problem may be and what repairs are needed. Normally, more or other repair work is needed beyond the recommendations on the list. Remember that a problem is not necessarily caused only by one part, but by the relation of one part with other parts. This list cannot give all possible problems and corrections. The service personnel must find the problem and its source, then make the necessary repairs.

Always make visual checks first. Check the operation of the machine and then check with instruments.

Visual Checks For The Transmission Hydraulic System

⚠ WARNING

Make reference to the WARNING in the previous section TROUBLESHOOTING THE TRANSMISSION HYDRAULIC SYSTEM.

Do Visual Checks first when troubleshooting a problem. Make the checks with the engine OFF and the parking brakes ON. Put the transmission shift control lever in NEUTRAL. Lock the transmission hand control. During these checks, if necessary, use a magnet to separate ferrous (iron) particles from non-ferrous particles (O-ring seals, aluminum, bronze, etc.).

Check 1:

Check the oil level in transmission sump. Look for air or water in the oil. Many problems in the transmission are caused by low oil level or air in the oil. Add oil to the transmission oil sump if it is needed. See Operation And Maintenance Guide for recommended oil grade and viscosity.

a. Air (bubbles) may be caused by a loose or damaged fitting that allows air to enter the suction side of the system along with allowing oil to leak out. Air may also be the result of gears agitating oil in the sump if the transmission oil level is too high (overfill).

b. Coolant in the oil can be caused by a leaking transmission oil cooler. Water may enter the system if the filler cap or dipstick is not properly installed.

Check 2:

Inspect all oil lines, hoses, and connections for damage or leaks. Look for oil on the ground under the machine.

NOTE: If oil can leak out of a fitting or connection, air can leak in. Air in the system can be as harmful as not enough oil.

Check 3:

Remove the drain plug in the bottom of the transmission case. This will drain all of the oil out of the transmission. Remove and clean suction screen. Inspect the oil and suction screen for foreign material. Remove and inspect (cut apart if necessary) the transmission oil filter for foreign material.

NOTE: There is an oil filter bypass valve on the inlet side of the transmission oil filter. The oil filter bypass will open and let oil bypass (go around) the oil filter element whenever the pressure difference between inlet oil and outlet oil through the oil filter is above 248 ± 21 kPa (36 ± 3 psi). Any oil that does not go through the filter element goes directly into the hydraulic control circuit. This dirty oil may cause restrictions in valve orifices, sticking valves, etc.

a. Rubber particles indicate seal or hose failure.

b. Shiny steel particles indicate mechanical failure or gear wear of the transmission or pump.

c. A heavy accumulation of fiberous material indicates worn clutch discs in the transmission.

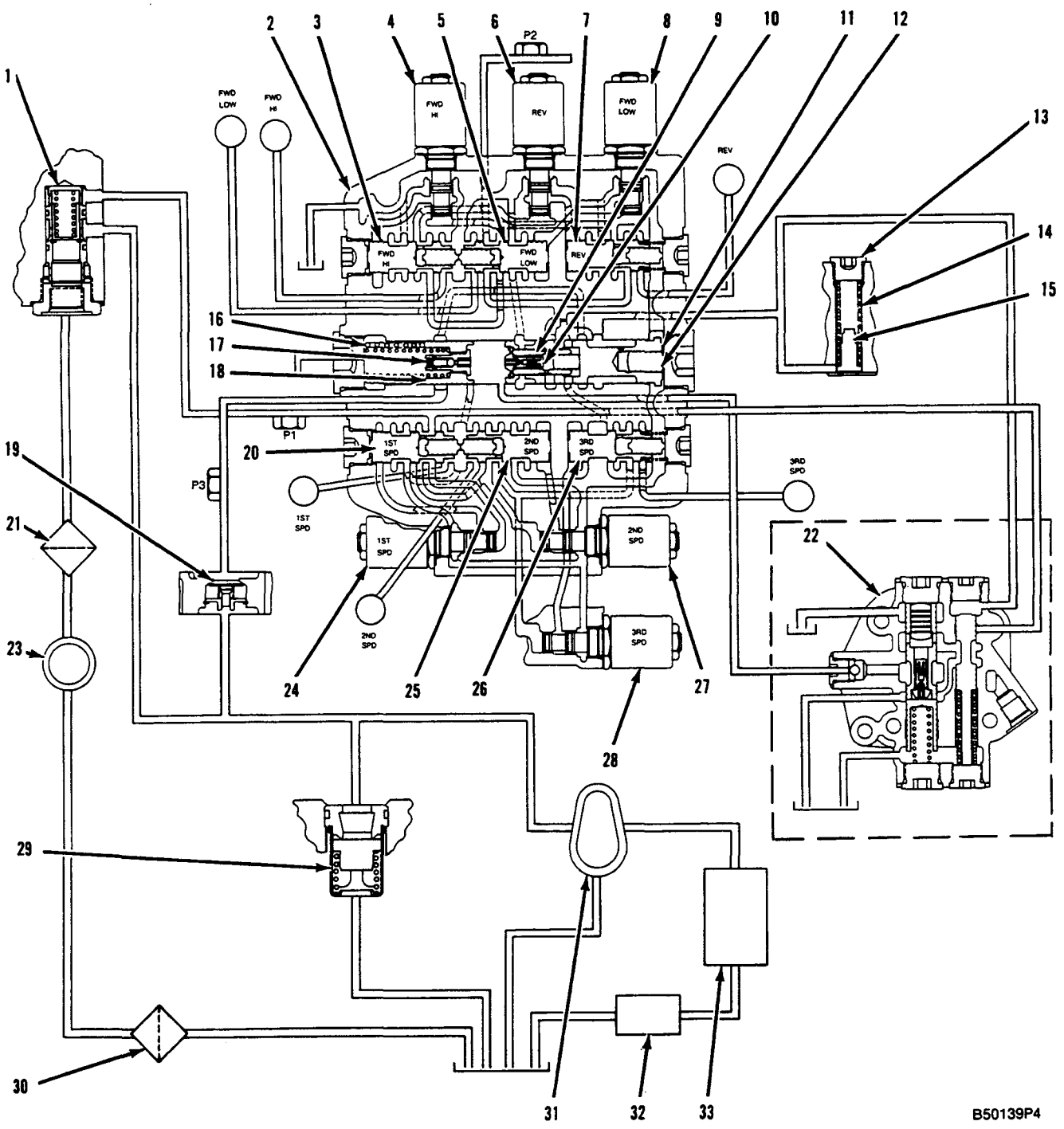
d. Aluminum particles indicate torque converter wear or failure, clutch piston wear, or worn control valve body, selector spools, or load piston in the transmission control valve.

e. Iron or steel chips indicate broken components in transmission.

NOTE: If any of the above particles are found during any visual check, all components of the transmission hydraulic system must be cleaned. Do not use any damaged parts. Any damaged parts must be removed and new parts installed.

Check 4:

The drive shaft(s) and universal joints must be free to rotate except when cold oil causes a resistance. If the shafts are not free to turn, disconnect them and see if the transmission will turn.



Schematic Of Transmission Hydraulic System
(1) Flow control valve. (2) Transmission control valve. (3) Selecter spool and slug (FORWARD HIGH). (4) FORWARD HIGH solenoid. (5) Selecter spool and slug (FORWARD LOW). (6) REVERSE solenoid. (7) Selecter spool and slug (REVERSE). (8) FORWARD LOW solenoid. (9) Check valve. (10) Screen orifice. (11) Modulating relief valve. (12) Slug. (13) Differential valve. (14) Spring. (15) Poppet. (16) Load piston springs. (17) Load piston relief valve. (18) Load piston. (19) Converter backflow check valve. (20) Selecter spool and slug (FIRST SPEED). (21) Transmission oil filter. (22) Dump valve. (23) Transmission oil pump. (24) FIRST SPEED solenoid. (25) Selecter spool and slug (SECOND SPEED). (26) Selecter spool and slug (THIRD SPEED). (27) SECOND SPEED solenoid. (28) THIRD SPEED solenoid. (29) Torque converter inlet relief valve. (30) Suction screen and magnet. (31) Torque converter. (32) Transmission lubrication circuit. (33) Oil cooler.

Operational Checks

⚠ WARNING

Make reference to the WARNING on the first page of Testing And Adjusting section.

Operate the machine in each direction and in all speeds. Note the noises that are not normal and find their source. If the operation is not correct, refer to the following problems and possible causes.

NOTE: In the following troubleshooting, for numbers in parentheses, refer back to the schematic. Dump valve group (22) is an attachment. If the transmission control valve does not have dump valve group (22), the three lines leading to the dump valve group are blocked. Possible Causes that include the dump valve do not apply.

Troubleshooting Index

Problem 1: The transmission does not operate in any speed or slips in all speeds.

Possible Causes:

1. Transmission control fuse is open or blown.
2. Problem in the electrical circuit (see Electrical Troubleshooting).
3. Low system voltage.
4. Transmission shift control unit (shift lever) is defective.
5. Low oil pressure caused by:
   a. Low oil level.
   b. Restriction in the oil flow circuit such as a dirty oil strainer.
   c. Oil pump failure.
   d. Air leaks on the inlet side of the pump.
   e. Load piston relief valve (17) is stuck or has come apart.
   f. Leakage inside the transmission:
      Worn or damaged seal rings on the clutch shaft.
      Worn or damaged seals around the clutch piston.
   g. Modulating relief valve (11) stuck open.
6. Torque converter failure.
7. Mechanical failure in the transmission.
8. Clutch discs and plates are worn too much.
9. Transmission neutralizer switch is inoperative.
10. Check valve (9) stuck open.

Problem 2: Transmission gets hot.

Possible Causes:

1. Low coolant level in the engine radiator.
2. Wrong application for the vehicle. There is too much torque converter slippage caused by too much load.
3. Incorrect transmission gear for load on machine. Shift to a lower gear.
4. Defective temperature gauge.
5. Incorrect (high or low) oil level.
6. Oil cooler or lines are restricted.
7. Clutch slips too much.
   a. Low oil pressure. See Problem: Transmission does not operate in any speed or slips in all speeds.
   b. Damaged clutch.
8. Low oil flow caused by pump wear or leakage in the hydraulic system.
9. Air mixed in the oil. Air leaks on the intake side of the pump.
10. Torque converter inlet relief valve (29) is stuck open, which causes low oil flow through the torque converter.
11. Clutch or clutches not fully released (drag).
    a. Warped plates or discs.
    b. Broken or weak return spring.

Problem 3: Pump noise not normal.

Possible Causes:

1. A loud sound at short time periods indicates that foreign material is in the transmission hydraulic system.
2. A constant loud noise indicates pump failure.
3. Air at the inlet side of the pump.

Problem 4: Noise in the transmission that is not normal.

Possible Causes:

1. Transmission components are worn or damaged:
   a. Damaged gears.
   b. Worn teeth of clutch plates and/or clutch discs.
   c. Slipping clutch plates and disc noise.
   d. Other component parts that are worn or damaged.

Problem 5: Transmission operates in FORWARD only.

Possible Causes:

1. Transmission REVERSE solenoid valve (6) is inoperative (see Solenoid Test).
2. Problem in the electrical circuit (see Electrical Troubleshooting).
3. REVERSE clutch not engaged (slips) because of:
   a. Low oil pressure because of leaking seals on piston or shaft.
   b. Discs and plates have too much wear.
   c. Broken components.
4. Selector spool (7) is stuck.

Problem 6: Transmission operates in REVERSE and FOURTH SPEED FORWARD only.

Possible Causes:

1. Transmission FORWARD LOW solenoid valve (8) is inoperative (see Solenoid Test).
2. Problem in the electrical circuit (see Electrical Troubleshooting).
3. FORWARD LOW clutch not engaged (slips) because of:
   a. Low oil pressure because of leaking seals on piston or shaft.
   b. Discs and plates have too much wear.
   c. Broken components.
4. Selector spool (5) is stuck.

Problem 7: Transmission operates in REVERSE and FIRST through THIRD SPEED FORWARD only.

Possible Causes:

1. Transmission FORWARD HIGH solenoid valve (4) is inoperative (see Solenoid Test).
2. Problem in the electrical circuit (see Electrical Troubleshooting).

3. FORWARD HIGH clutch not engaged (slips) because of:
   a. Low oil pressure because of leaking seals on piston or shaft.
   b. Discs and plates have too much wear.
   c. Broken components.

4. Selector spool (3) is stuck.

Problem 8: Transmission does not operate in FIRST SPEED FORWARD or REVERSE.

Possible Causes:

1. FIRST SPEED solenoid valve (24) is inoperative (see Solenoid Test).

2. Problem in the electrical circuit (see Electrical Troubleshooting).

3. FIRST SPEED clutch not engaged (slips) because of:
   a. Low oil pressure because of leaking seals on piston or shaft.
   b. Discs and plates have too much wear.
   c. Broken components.

4. Selector spool (20) stuck.

Problem 9: Transmission does not operate in SECOND SPEED FORWARD or REVERSE.

Possible Causes:

1. SECOND SPEED solenoid (27) is inoperative (see Solenoid Test).

2. Problem in the electrical circuit (see Electrical Troubleshooting).

3. SECOND SPEED clutch not engaged (slips) because of:
   a. Low oil pressure because of leaking seals on piston or shaft.
   b. Discs and plates have too much wear.
   c. Broken components.

4. Selector spool (25) stuck.

Problem 10: Transmission does not operate in THIRD SPEED FORWARD or REVERSE and FOURTH SPEED FORWARD.

Possible Causes:

1. THIRD SPEED solenoid (28) is inoperative (see Solenoid Test).

2. Problem in the electrical circuit (see Electrical Troubleshooting).

3. THIRD SPEED clutch not engaged (slips) because of:
   a. Low oil pressure because of leaking seals on piston or shaft.
   b. Discs and plates have too much wear.
   c. Broken components.

4. Selector spool (26) stuck.

Problem 11: Transmission does not operate in FOURTH SPEED FORWARD but does operate in THIRD SPEED FORWARD.

Possible Causes:

1. Transmission FORWARD HIGH solenoid valve (4) is inoperative (see Solenoid Test).

2. Problem in the electrical circuit (see Electrical Troubleshooting).

3. FORWARD HIGH clutch not engaged (slips) because of:
   a. Low oil pressure because of leaking seals on piston or shaft.
   b. Discs and plates have too much wear.
   c. Broken components.

4. Selector spool (3) is stuck.

Problem 12: Low pressure at pressure taps for P1 (speed) and P2 (direction) clutches in all speeds and directions.

Possible Causes:

1. Modulating relief valve (11) stuck.

2. Load piston relief valve (17) stuck open or missing.

3. Low oil pressure. See Problem: Transmission does not operate in any speed or slips in all speeds.

4. Load piston springs (16) weak, damaged, or missing.

5. Dump valve (22) stuck open.

6. Flow control valve (1) stuck open.

7. Check valve (9) stuck open.

Problem 13: Low pressure at P2 clutch pressure tap in REVERSE speeds.

Possible Causes:

1. Too much leakage in the REVERSE clutch piston or shaft seals.

Problem 14: Low pressure at P2 clutch pressure tap in FORWARD speeds.

Possible Causes:

1. Too much leakage in the FORWARD clutch piston or shaft seals.

Problem 15: High pressure at pressure taps for P1 (speed) and P2 (direction) clutches in all speeds and directions.

Possible Causes:

1. Operation of modulating relief valve (11) sticky.
2. Load piston (18) stuck.
3. Wrong load piston springs (16).
4. Worn slug (12) or worn modulating relief valve (11) bore.

Problem 16: Pressure differential between P1 and P2 not correct.

Possible Causes:

1. Operation of pressure differential valve (13) not correct.
   a. Weak or damaged spring (14).
   b. Wrong spring (14).
   c. Faulty poppet (15).
2. Flow control valve (1) stuck closed.

Problem 17: Clutch engagement is sudden (rough shifts).

Possible Causes:

1. Operation of pressure differential valve (13) not correct.
   a. Weak or damaged spring (14).
   b. Wrong spring (14).
   c. Faulty poppet (15).
2. Load piston (18) stuck.
3. Load piston springs (16) are wrong or damaged.
4. Dump valve (22) stuck closed.
5. Backflow check valve (19) not seating or missing.

Problem 18: Clutch engagement is slow (slow shifts-all gears).

Possible Causes:

1. Check valve (9) for the load piston is not closing (open to drain) or screen orifice (10) for the load piston is dirty (plugged).
2. Low oil pressure. See Problem: Transmission does not operate in any speed or slips in all speeds.
3. Load piston springs (16) are weak or have damage.
4. Modulating relief valve (11) is stuck.

Problem 19: Clutch engagement is slow (slow shifts-all FORWARD gears or all REVERSE gears or any one gear in both FORWARD and REVERSE).

Possible Causes:

1. Low clutch pressure because of leaking seals on the piston or shaft for the affected gear.

Problem 20: Loss of power during or after a THIRD GEAR to FIRST GEAR shift.

Possible Causes:

1. Two clutches wrongly engaged because the return spring for selector spool (26) is broken or missing.

Problem 21: Transmission stays engaged when the neutralizer is actuated.

Possible Causes:

1. Transmission neutralizer switch out of adjustment.
2. Failure in transmission neutralizer switch.
3. Transmission control group (lever) problem.

Problem 22: Transmission engages but the machine does not move and the engine lugs down.

Possible Causes:

1. Machine brakes are locked up.
2. Parking brake not released or locked up.
3. Mechanical failure in a differential (front or rear).
4. Mechanical failure in a final drive.
5. Mechanical failure in the transmission.

Problem 23: Backup alarm does not sound when selection lever is put in REVERSE.

Possible Causes:

1. Failure of backup alarm fuse.
2. Failure of backup alarm.
3. Failure in the wiring
   a. Loose or defective connector.
   b. Broken wire.
4. Transmission control group (lever) problem.

Problem 24: Low stall speed.

Possible Causes:

1. Engine performance is not correct.
2. Cold oil.

Problem 25: High stall speed in both directions.

Possible Causes:

1. Low oil level.
2. Air in the oil.
3. Clutches are slipping.
4. Torque converter failure.

Problem 26: High stall speed in one speed or in one direction.

Possible Causes:

1. There is a leak in the clutch circuit.
2. There is a clutch failure in the speed or direction that there is high stall speed.

Problem 27: Low lubrication pressure.

Possible Causes:

1. Converter inlet relief valve (29) passing flow (see High Converter Pressure and Low Converter Pressure).
2. Low pump flow or pressure. See Problem: Transmission does not operate in any speed or slips in all speeds.

Problem 28: High lubrication pressure.

Possible Causes:

1. Blocked lube holes in clutch shaft.

Problem 29: High converter pressure.

Possible Causes:

1. A restriction inside the converter.
2. A restricted oil passage or oil cooler.

Problem 30: Low converter pressure.

Possible Causes:

1. Converter inlet relief valve (29) is stuck open.
2. Low pump flow or pressure. See Problem: Transmission does not operate in any speed or slips in all speeds.

Problem 31: Torque converter gets hot.

Possible Causes:

1. Wrong application for the vehicle. There is too much torque converter slippage caused by too much load.
2. Incorrect transmission gear for load on machine. Shift to a lower gear.
3. Incorrect (high or low) oil level in the transmission.
4. Low water level in the engine radiator.
5. Restrictions in the oil cooler or lines.
6. Not enough oil to the converter because of:
   a. Converter inlet relief valve (29) bypassing too much flow.
   b. Low pump flow or pressure. See Problem: Transmission does not operate in any speed or slips in all speeds.

Transmission Pressure Tests

⚠ WARNING

Make reference to the WARNING on the first page of Testing And Adjusting section.

Transmission Pump (Type 1-Geroter)

Specifications For Bench Test

Type ..... Geroter

Number of sections ..... One

Rotation ..... Counterclockwise

Output (minimum) [using SAE 10W oil at 49°C (120°F)] ..... 76 liter/min (20 U.S. gpm)

Based on speed of ..... 2400 rpm

When developing pressure of ..... 3000 kPa (435 psi)

Transmission Pump (Type 2-Gear)

Specifications For Bench Test

Type ..... Gear

Number of sections ..... One

Rotation ..... Counterclockwise

Output (minimum) [using SAE 10W oil at 49°C (120°F)] ..... 65 liter/min (17 U.S. gpm)

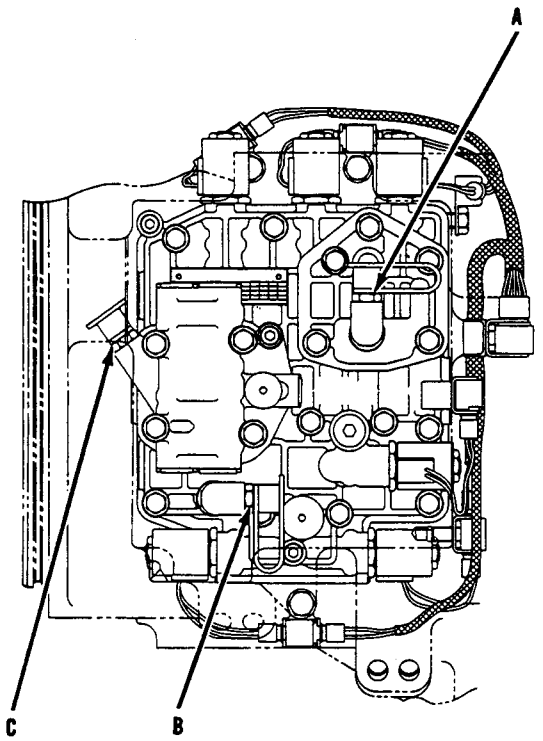
Based on speed of ..... 1800 rpm

When developing pressure of ..... 2750 kPa (400 psi)

Location Of Pressure Taps

Many of the pressure taps for testing the power train hydraulic system have quick disconnect nipples already installed.

Do not connect or disconnect hose fittings to or from the nipples when there is pressure in the system. This will prevent damage to the seals that are in the fitting.



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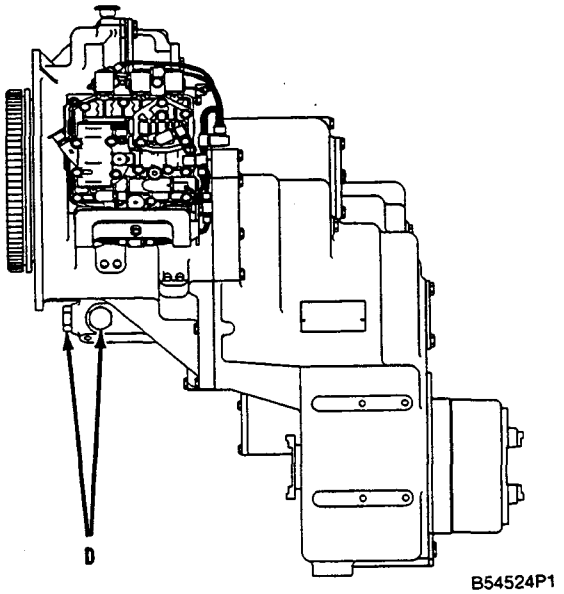
Location Of Pressure Taps
(A) Direction clutch (P2). (B) Speed clutch (P1). (C) Torque converter inlet (P3).



Location Of Pressure Taps
(D) Transmission lubrication.

Transmission Pressure Chart		
Pressure	**Spec.**	**Actual**
P1 High Idle	345 ± 70 kPa (50 ± 10 psi) higher than P2	
P1 Low Idle	345 ± 70 kPa (50 ± 10 psi) higher than P2	
P2 High Idle	1896 ± 170 kPa (275 ± 25 psi)	
P2 Low Idle	1896 ± 170 kPa (275 ± 25 psi)	
P3 High Idle	552 ± 70 kPa (80 ± 10 psi)	
Lube High Idle	200 ± 34 kPa (30 ±5 psi)	

Torque Converter Stall Test

The converter stall test is a test of the engine, torque converter, drive train, and brake system as a unit. The converter output is stalled while the engine is operated at full throttle. This test will give an indication, by the speed the engine reaches, whether the engine and transmission performance is acceptable (satisfactory) under full load. A lower or higher speed than that given as normal are indications of either engine or transmission problems. If the engine performance is correct, and the stall speed is not correct, the problem is in the converter or transmission.

The drive wheels must not turn during the stall test. Put the vehicle in position against a solid object (if available), that will not move (such as a loading dock). Engage the parking brake. When tests are made, the wheel brakes must be engaged. Make sure the transmission oil is at normal temperature for operation, 82 to 93° C (180 to 200° F).

⚠ WARNING

Make tests in a clean level area only and with safe ventilation for the exhaust. There must be only one operator. Keep all other personnel away from the machine. Check the operation of the brakes before the tests are made.

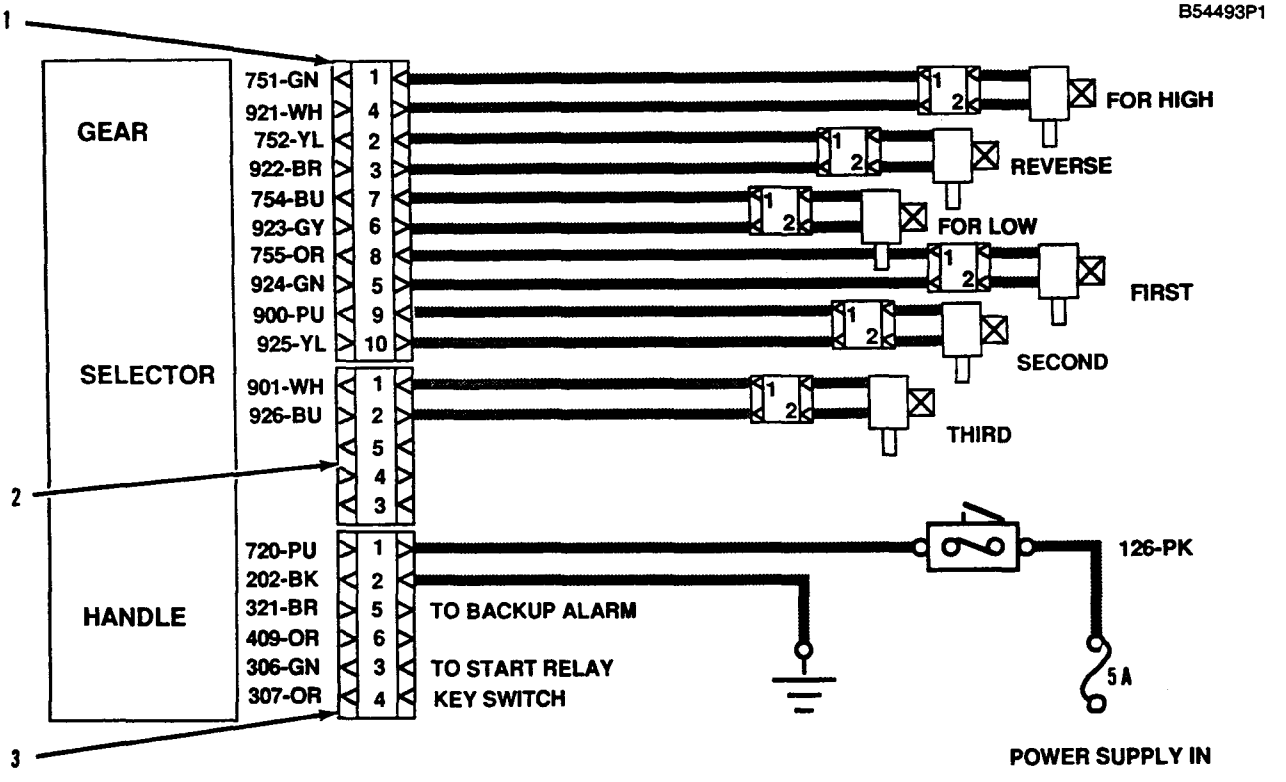
1. Install a test tachometer on the engine.
2. Engage the wheel brakes and start the engine.

NOTICE

To make sure that the transmission oil does not get hot, do not keep the torque converter in a full stall condition for more than ten seconds. After the torque converter is stalled, put the control in NEUTRAL and run the engine at 1200 to 1500 rpm to cool the oil.

3. Push the accelerator pedal down completely. Put the transmission control lever in FOURTH SPEED FORWARD. Allow the engine rpm to stabilize and take a reading from the tachometer.
4. See service manuals for the engine to determine the correct stall speed.

Stall speeds that are low are an indication that engine performance is not correct. If the test is to be repeated, allow at least two minutes between tests with the transmission in NEUTRAL.



Transmission Control Schematic
(1) Ten position female connector. (2) Seven position female connector. (3) Seven position male connector.

Gear	10 Position Female Connector	7 Position Female Connector
N	None	None
1F	Pin 5 (924-GN) and socket 8 (755-OR) Pin 6 (923-GY) and socket 7 (754-BU)	None
2F	Socket 9 (900-PU) and pin 10 (925-YL) Pin 6 (923-GY) and socket 7 (754-BU)	None
3F	Pin 6 (923-GY) and socket 7 (754-BU)	Socket 1 (901-WH) and pin 2 (926-BU)
4F	Socket 1 (751-GN) and pin 4 (921-WH)	Socket 1 (901-WH) and pin 2 (926-BU)
1R	Pin 5 (924-GN) and socket 8 (755-OR) Socket 2 (752-YL) and pin 3 (922-BR)	None
2R	Socket 9 (900-PU) and pin 10 (925-YL) Socket 2 (752-YL) and pin 3 (922-BR)	None
3R	Socket 2 (752-YL) and pin 3 (922-BR)	Socket 1 (901-WH) and pin 2 (926-BU)

Most of the electrical connectors between components are "Sure-Seal" connectors. If the connections are not made properly, they can cause either continuous or intermittent problems. Make sure all connectors in a problem circuit are fastened correctly before tests are performed.

The chart gives the pin and socket numbers across which a voltage measurement should be taken when the gear selector is in the gear shown.

The seven position and ten position female connectors are all output voltages and should be measured on the connector coming from the shift control.

These measurements must be made with the key on and the engine off.

Use the chart that follows for the identification of wire colors.

ABBREVIATION	COLOR
GN	Green
OR	Orange
GY	Gray
BU	Blue
PU	Purple
YL	Yellow
WH	White
BR	Brown
BK	Black

Additional Checks

These checks are to be performed on the seven position male connector coming from the shift control.

Neutral Start

With the shift control lever in NEUTRAL, there must be continuity between socket 3 and socket 4. This indicates the ability to start the vehicle. If there is no continuity, the vehicle will not start and the shift control must be replaced.

Back-Up Alarm

With the shift control lever in REVERSE, there must be continuity between socket 2 and pin 5. This activates the back-up alarm. If there is no continuity, the back-up alarm will not work and the shift control must be replaced.

Input Voltage To Shift Control

This check to be performed on the seven position female connector coming from the vehicle harness.

Input voltage to the shift control can be checked on the vehicle side of the seven position female connector between socket 1 and pin 2. The voltage measured should be equal to the vehicle system voltage except when the neutralizer (if equipped) is activated. If no voltage is measured, check all connectors and the 5 amp supply fuse.

NOTICE

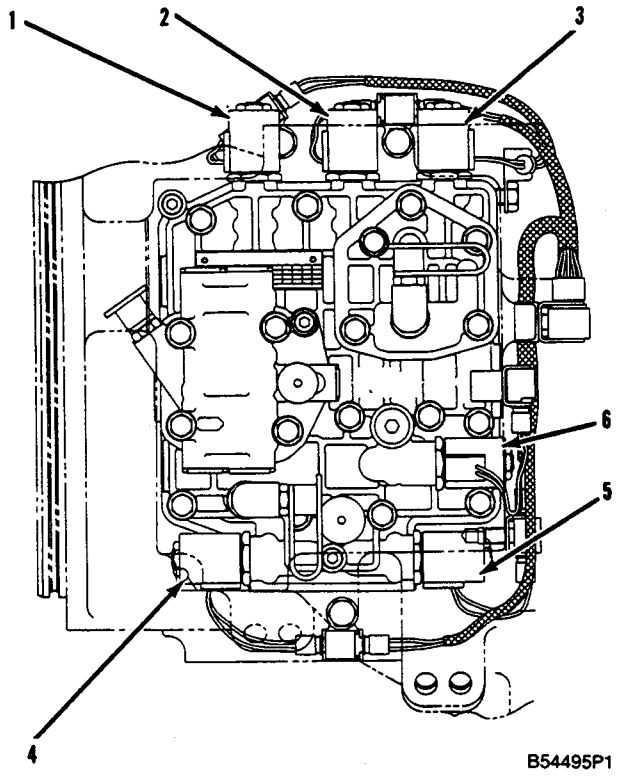
Welding on the machine may damage the transmission hand controls beyond repair.

All three (3) connectors leading to the hand control should be disconnected before welding on the machine.

Solenoid Test

This test will determine if the electrical coil is energizing and the plunger is shifting to permit oil flow.

Hearing a solenoid click or checking to see if the coil is energized by checking magnetically with a screw driver does not insure the solenoid plunger has shifted. The following test will tell if the solenoid plunger is shifting.



Solenoid Valve Location
(1) FORWARD HIGH solenoid. (2) REVERSE solenoid.
(3) FORWARD LOW solenoid. (4) FIRST SPEED solenoid.
(5) SECOND SPEED solenoid. (6) THIRD SPEED solenoid.

⚠ WARNING

Make reference to the WARNING on the first page of Testing And Adjusting section.

1. Install a 0-4000 kPa (0-600 psi) gauge and hose on P2 pressure tap.
2. Activate the parking brake and start the engine. Run the engine at LOW IDLE.

Vehicle Range/Direction	Solenoids Energized And Clutches Engaged
1-F	First Speed/Forward Low
2-F	Second Speed/Forward Low
3-F	Third Speed/Forward Low
4-F	Third Speed/Forward High
N	None
1-R	First Speed/Reverse
2-R	Second Speed/Reverse
3-R	Third Speed/Reverse

3. Depress and hold the brake pedal. While watching the pressure gauge, move the shift lever from NEUTRAL to FORWARD. The needle on the pressure gauge should drop and then return to the original pressure. Shift through all FORWARD speeds. The same pressure drop should be noted in all speeds.

4. Perform Step 3 for all REVERSE speeds. The pressure drop should be noted in all REVERSE speeds.

If the pressure drop can be seen, the solenoid and it's related electrical circuit is functioning.

If the pressure drop can not be seen, check to see if the solenoid coil is energized with a screw driver. If the screw driver indicates that the coil is energized, the problem is in the solenoid cartridge. The problem could be a bent stem, dirty or clogged screen, or a weak or broken spring.

NOTE: If the solenoid cartridge rattles when shaken, it is no good. The spring which seats the plunger is weak or broken.

If the screw driver does not indicate that the coil is energized, the problem is in the electrical circuit. Possible problems include a bad solenoid coil, a bad connection in a connector, a broken wire, or a faulty shift control group.

Special Tooling

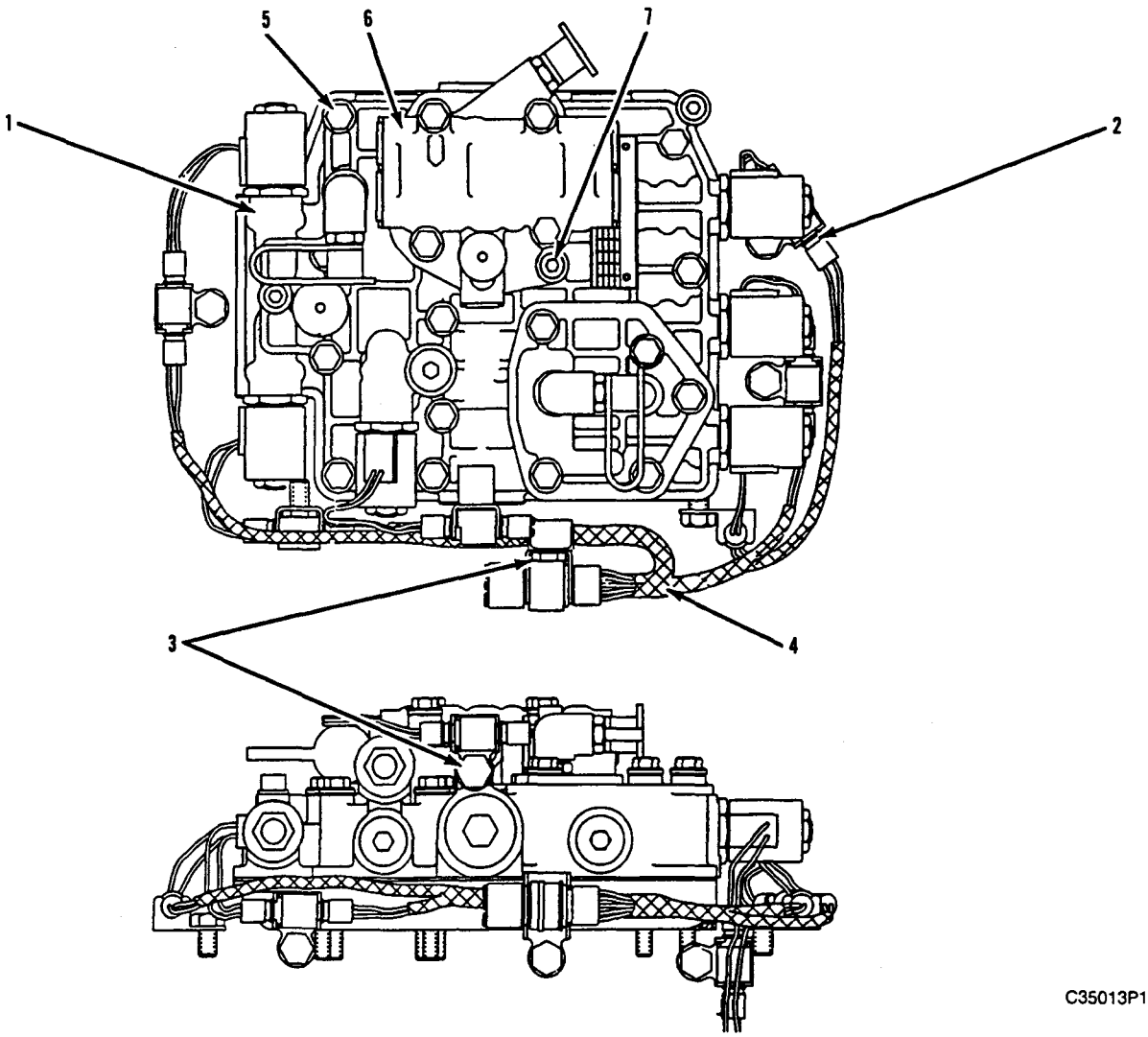
NOTE: The following tools are not required but will facilitate disassembly and assembly.

SPECIAL TOOLS FOR TRANSMISSION DISASSEMBLY AND ASSEMBLY		
ROCKWELL PART NO.	**TOOL NAME**	**PURPOSE**
DC6136	Lifting Bracket	Remove and install shaft assemblies
DC6137	Bearing Installer	Install BW1141 bearings in case group
DC6142	Spacer	Used with DC6137 to vary installation depth
AP0531	Handle	Used with DC6137
DC6143	Clutch Piston Installer	Assists with clutch piston installation
DC6399	Compressor Assembly	Assists in removing and installing First Gear clutch snap ring
DC3652	Compressor Assembly	Assists in removing and installing all but First Gear clutch snap ring
GV4980	Torque Screwdriver Tool Group	Used to set input shaft bearing endplay and install screen plugs and valve assembly in control valve
BP8312	Snap Ring Pliers (External)	Remove and install external snap rings
EP4758	Snap Ring Pliers (Internal)	Remove and install internal snap rings
GV2156	Link Bracket	Lift cover

Disassembly And Assembly

Transmission Control Valve

Remove And Install Transmission Control Valve



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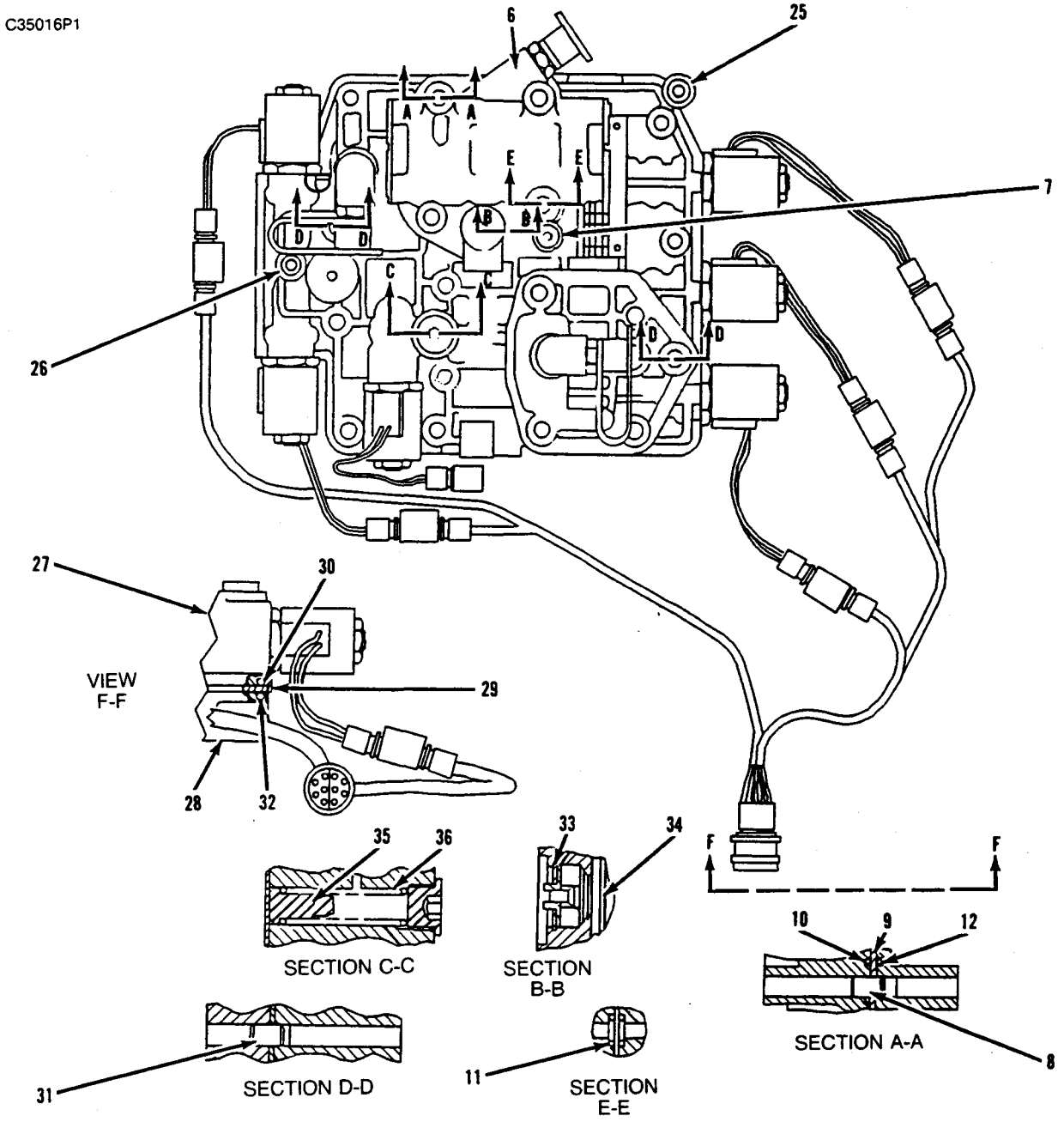
1. Disconnect five wire connectors (2) from transmission control valve (1).
2. Remove wire clamp (3) and remove wiring harness (4) from the transmission control valve.
3. Remove seventeen hex head bolts (5) that hold the transmission control valve to the transmission.

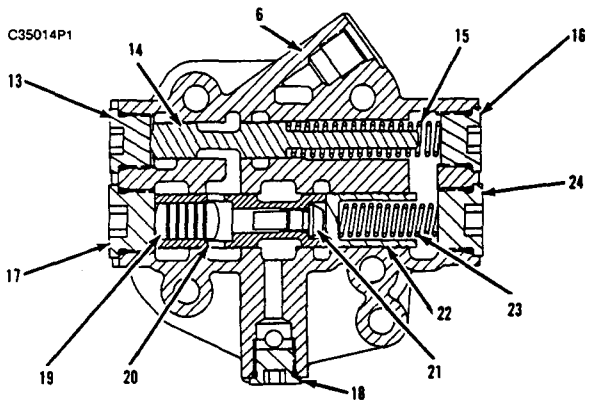
Remove transmission control valve (1) and install a cover over the transmisson control valve surface of the transmission.

NOTE: Install in the reverse order. Refer to the SPECIFICATION section of this service manual for necessary torques.

Disassemble And Assemble
Transmission Control Valve



1. Remove allen head bolt (7) and then remove dump valve (6) from the transmission control valve.
2. Remove manifold plate (9) and two dowels (8), if necessary.
3. Remove rubber seal (10) and O-ring seals (11) from the dump valve manifold. Inspect all the seals.
4. Remove rubber seal (12) from the back side of the dump valve. Inspect the seal.



5. Turn dump valve (6) over. Remove plugs (13) and (16). Inspect the O-ring seals on the plugs. Remove spring (15) and valve spool (14) from the valve.

6. Remove plugs (17) and (24). Inspect the O-ring seals on the plugs. Remove spring (23), piston (22) and valve spool (20) from the dump valve.

7. Remove slug (19) and then remove screen orifice plug (21) and inspect.

8. Remove plug (18) and inspect the O-ring seal.

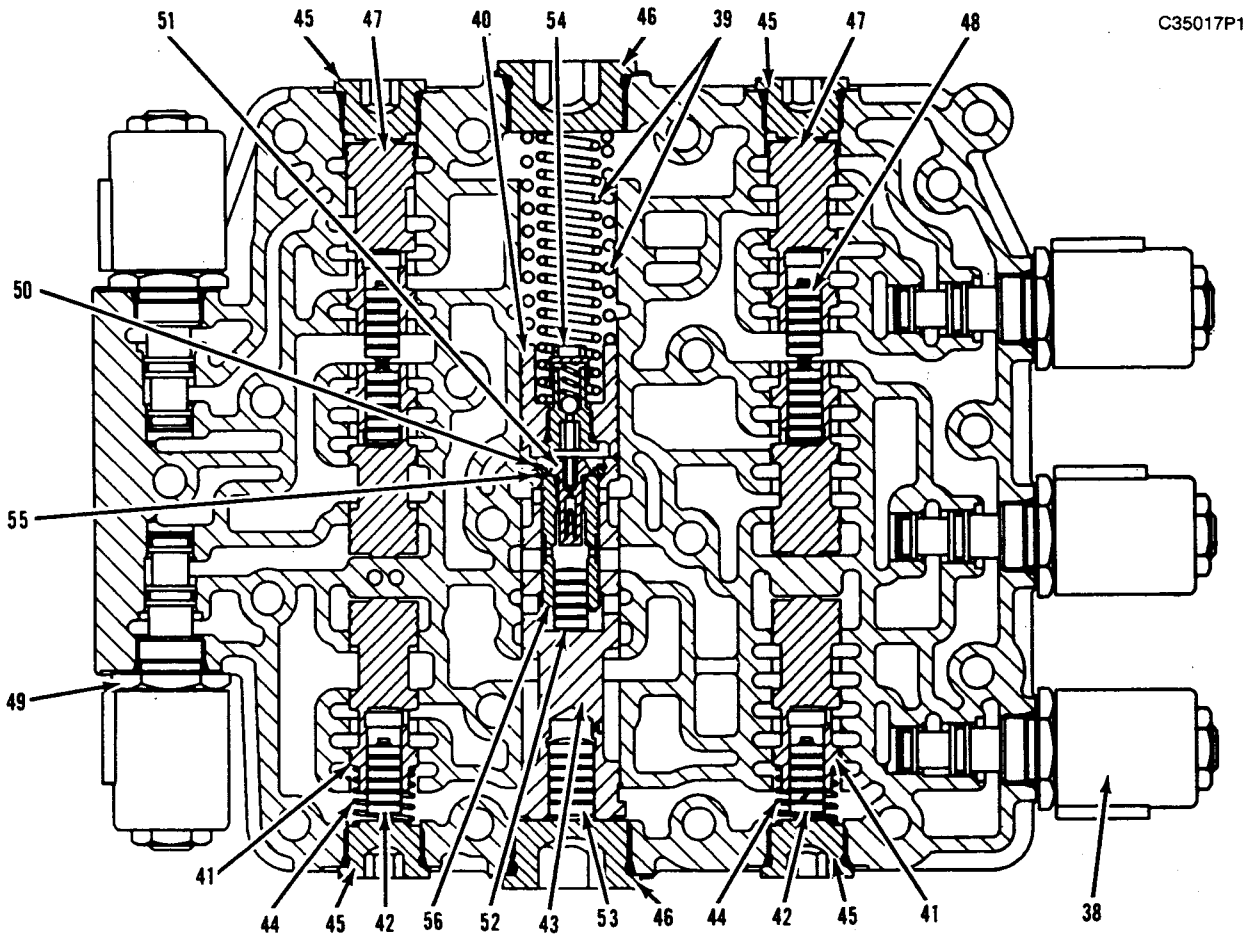
9. Remove allen head bolts (25) and (26) to separate manifold (28) from control valve (27).

10. Remove spacer plate (29). Remove poppet (35) and spring (36) from the underside of contol valve (27).

11. Remove and inspect seal (30). Remove two dowels (31) from manifold (28).

12. Turn manifold (28) over and remove seal (32).

13. Remove retainer ring (33) and then remove Torque converter back flow check valve (34).



14. Remove six coils (38) and solenoids (49). Inspect all O-rings.

NOTE: One method of removal, is to shake out these non-magnetic pieces. If the coils and solenoids are not removed these pieces may be difficult to remove.

15. Remove four plugs (45). Remove spools (47), springs (44) and slugs (42) and (48).

16. Remove plugs (46). Push against springs (39) and remove modulating spool (43), and slug (53). Remove slug (52), retaining ring (50), spacer (55) and spool (56). Remove screen orifice plug.

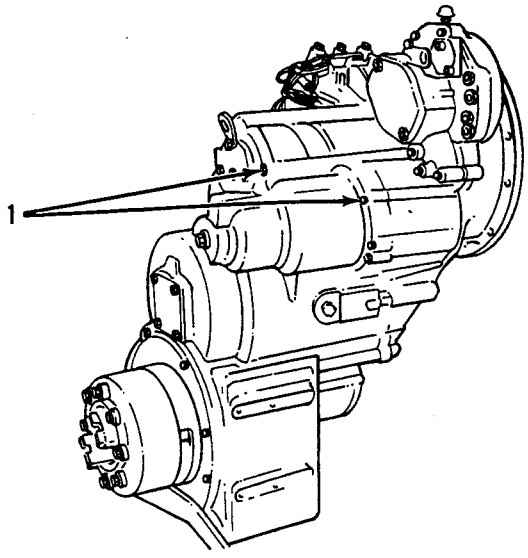
17. Remove springs (39), ball, seat and spring assembly (54). Inspect all parts.

NOTE: Assemble in the reverse order. Refer to the SPECIFICATION section of this service manual for necessary torques.

Torque Converter

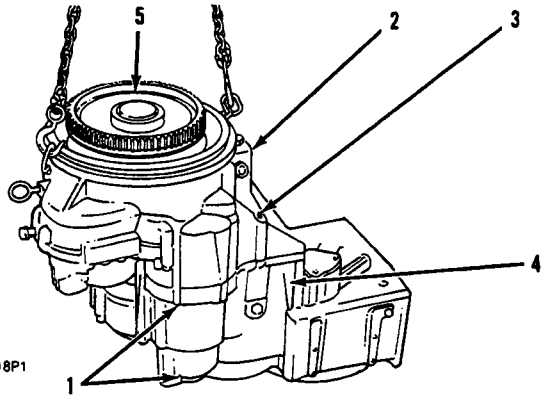
Disassemble And Assemble Torque Converter

C35024P1



1. Remove eight bolts (1) and then put the transmission in the position shown in the next illustration.

NOTE: For easy disassembly and assembly of cover (2) and case (4), case (4) should be horizontal and level.



C35018P1

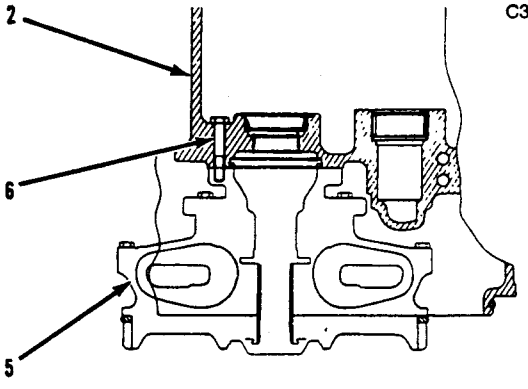
2. Fasten the two lifting brackets and a hoist to the flange of the torque converter cover.

3. Remove six bolts (3) that holds cover (2) and case (4) together.

4. Lift torque converter (5) and cover (2) off of case (4).

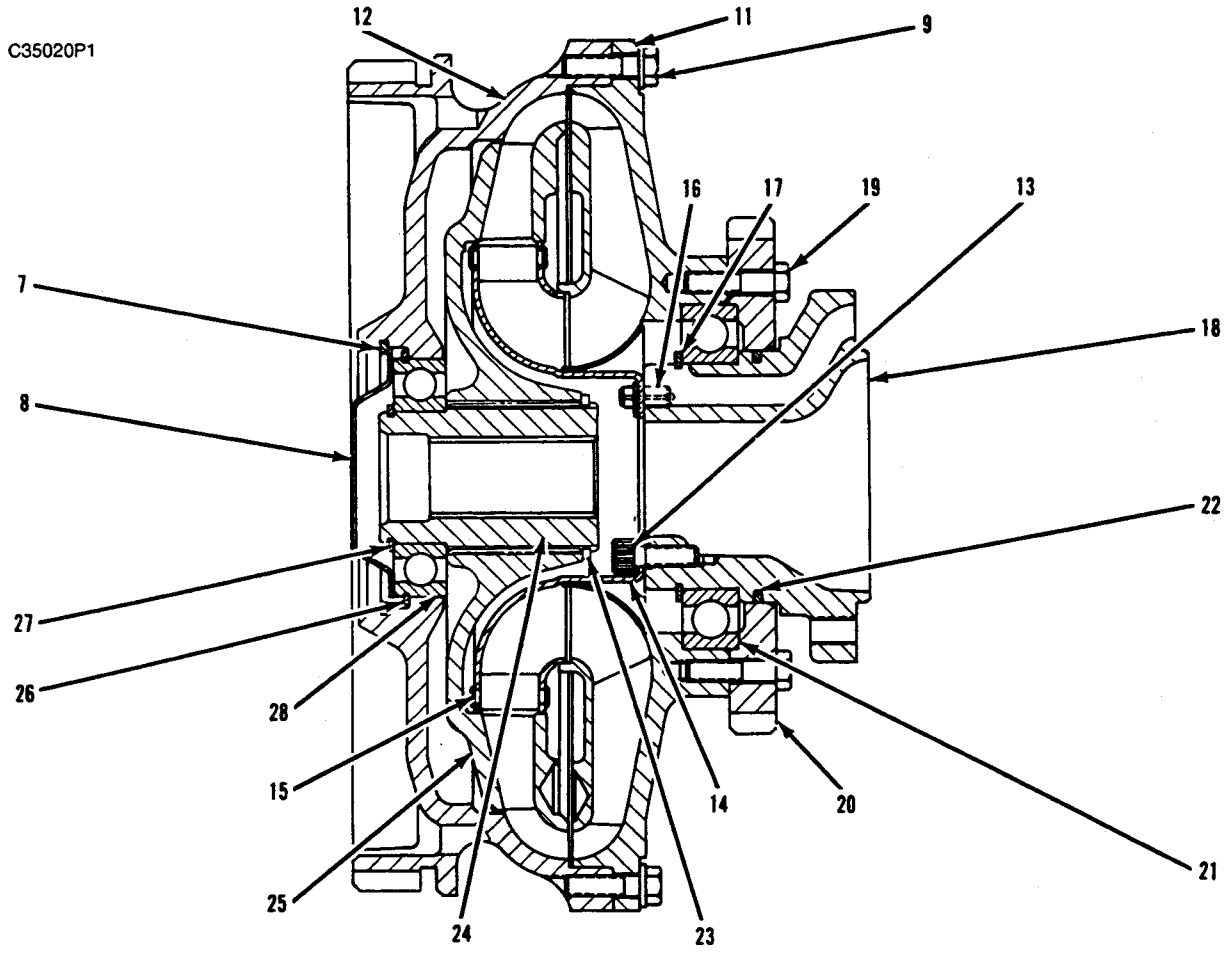
NOTE: It may be necessary to tap on cover (2) with a plastic mallet to get cover (2) and case (4) to separate.

5. Put cover (2) in position on the floor with the torque converter side down.



C35019P1

6. Remove six bolts (6) that hold the torque converter. Lift cover (2) with a hoist off of torque converter (5).



7. Put the torque converter in position on a bench. Remove retainer ring (7) and cap (8).

8. Turn the torque converter over and remove twelve bolts (9).

9. Install two bolts (9) into the threaded holes and use them as forcing screws to separate converter impeller (11) from rotating housing (12). Remove converter impeller (11).

10. Remove retainer ring (23). Press hub (24) from turbine (25) and rotating housing (12).

11. Remove turbine (25) from rotating housing (12).

12. Remove retaining ring (26) from bearing (28).

13. Remove retaining ring (27) and then remove bearing (28) from hub (24), if necessary.

14. Turn converter impeller (11) over. Remove six bolts (13) and plates (14) under the bolts.

15. Use two pry bars equally spaced and pry wheel (15) up and remove.

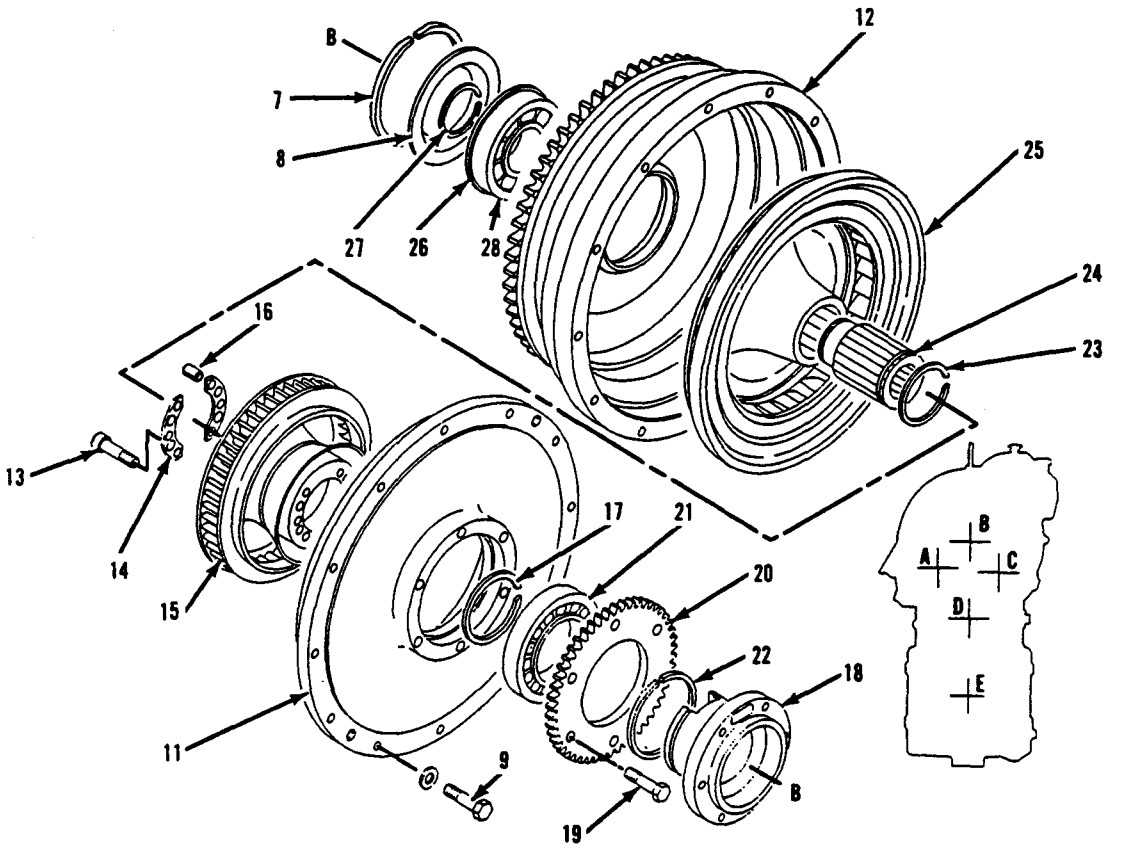
16. After removing stator (15), remove two pins (16).

17. Remove retainer ring (17). Put the converter assembly in a press and press carrier (18) out.

18. Turn the converter impeller over and remove six bolts (19), gear (20) and bearing (21).

19. Remove seal ring (22) from the carrier if necessary.

NOTE: The following steps are for the assembly of the torque converter.



C35021P1

20. Heat bearing (28) to maximum temperature of 275 F° (135 C°) and install it on hub (24).

21. Install retaining ring (27) and retaining ring (26).

22. Put rotating housing (12) in position on a press. Press hub (24) gently into the rotating housing until movement is stopped by retaining ring (26).

23. Put turbine (25) in position in the rotating housing.

24. Put rotating housing and turbine in position in a press. Slowly and gently press turbine (25) onto hub (24).

25. Install retaining ring (23) on the hub (24).