CATERPILLAR®

FORM NO. SENR2256-01

FOR USE IN SERVICE MANUAL:
950B & 950E WHEEL LOADERS, SENR2249

Systems Operation Testing & Adjusting

950B & 950E Wheel Loaders Power Train

VEHICLE:	TRANSMISSION:	
22Z1-UP	1BC1-UP	4RA1-UP
31R1-UP	2ZE1-UP	8SA1-UP
63R1-UP	3EB1-UP	8SA1-UP
65R1-UP	3EE1-UP	7DA1-UP

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.

Caterpillar 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 Caterpillar 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. Caterpillar dealers have the most current information available. For a list of the most current publication form numbers available, see the Service Manual Contents Microfiche, REG1139F.

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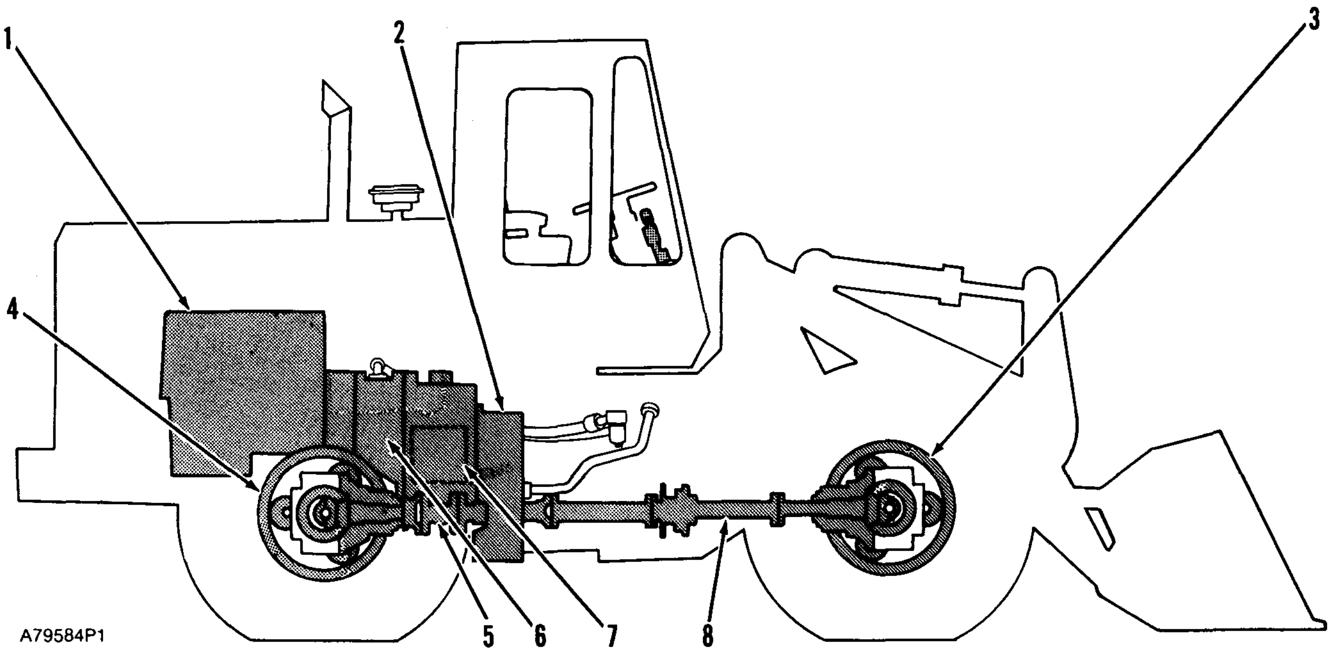
Specifications

REFERENCE: For Specifications with illustrations, make reference to the SPECIFICATIONS FOR 950B and 950E WHEEL LOADERS POWER TRAIN, Form SENR2255. If the Specifications in Form SENR2255 are not the same as in the Systems Operation and the Testing and Adjusting, look at the printing date on the back cover of each book. Use the Specification in the book with the latest date.

NOTE: A "C" in the left margin is an indication of a change from the former issue.

Systems Operation

General Information



Location Of Power Train Components
(1) Diesel engine. (2) Output transfer gears. (3) Front final drives. (4) Rear final drives. (5) Rear drive shaft. (6) Torque converter. (7) Transmission. (8) Front drive shaft.

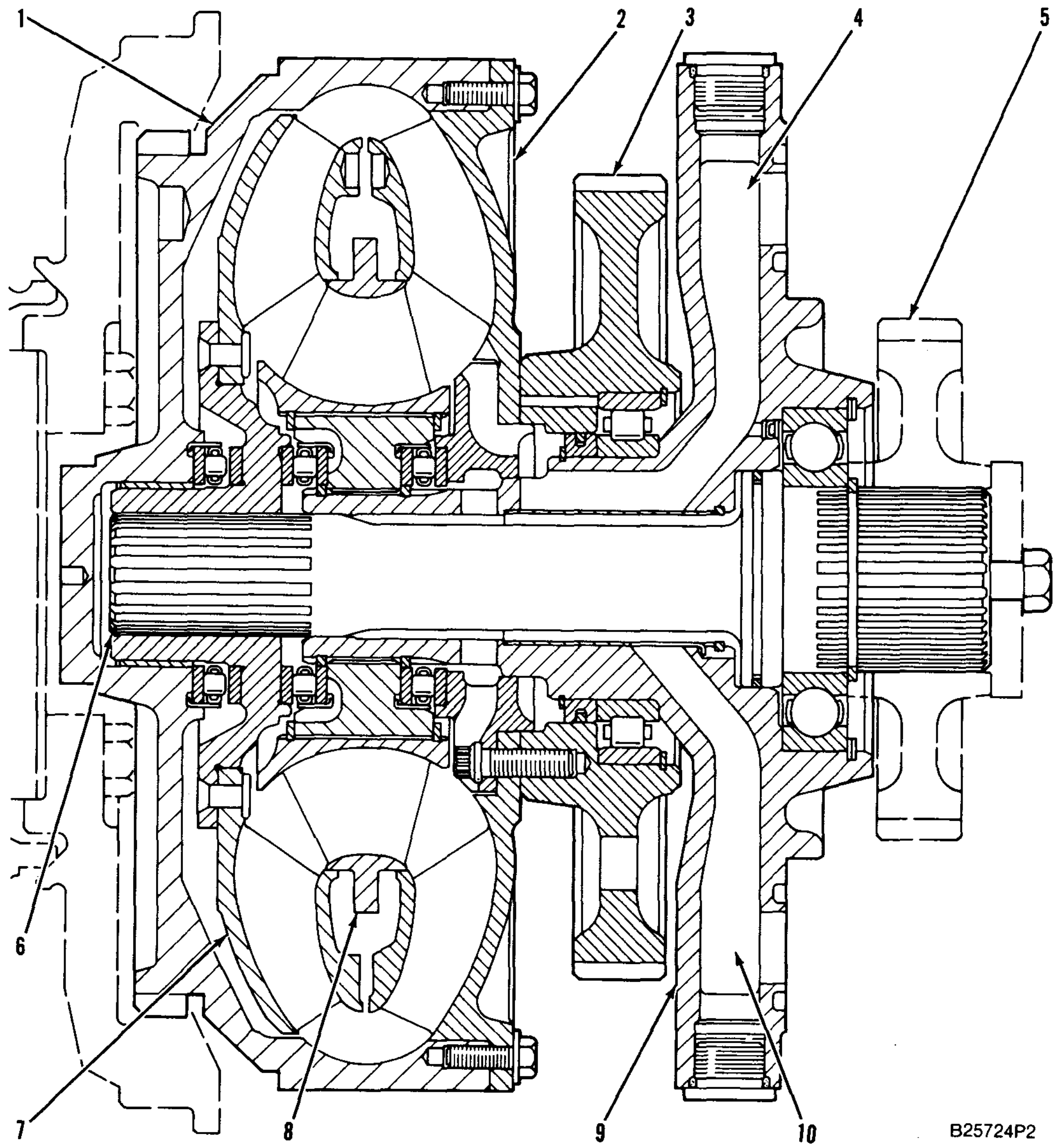
Power from diesel engine (1) is sent from the flywheel to torque converter (6). The torque converter output gear is connected to the transmission input gear.

Six hydraulically activated clutches in the transmission, give four forward speeds and four reverse speeds. Speed and direction selections are made manually.

The transmission output shaft is connected to a gear in the output transfer gear case by splines. Power is sent through the gear to the output gear. The output gear sends power through drive shaft (5) to the rear drive pinion. The output gear also sends power to the front drive pinion through drive shaft (8).

The pinions, bevel gears and gears of each differential turn their respective axles. The axles are connected to final drives (3) and (4). The final drives turn the wheels.

Torque Converter



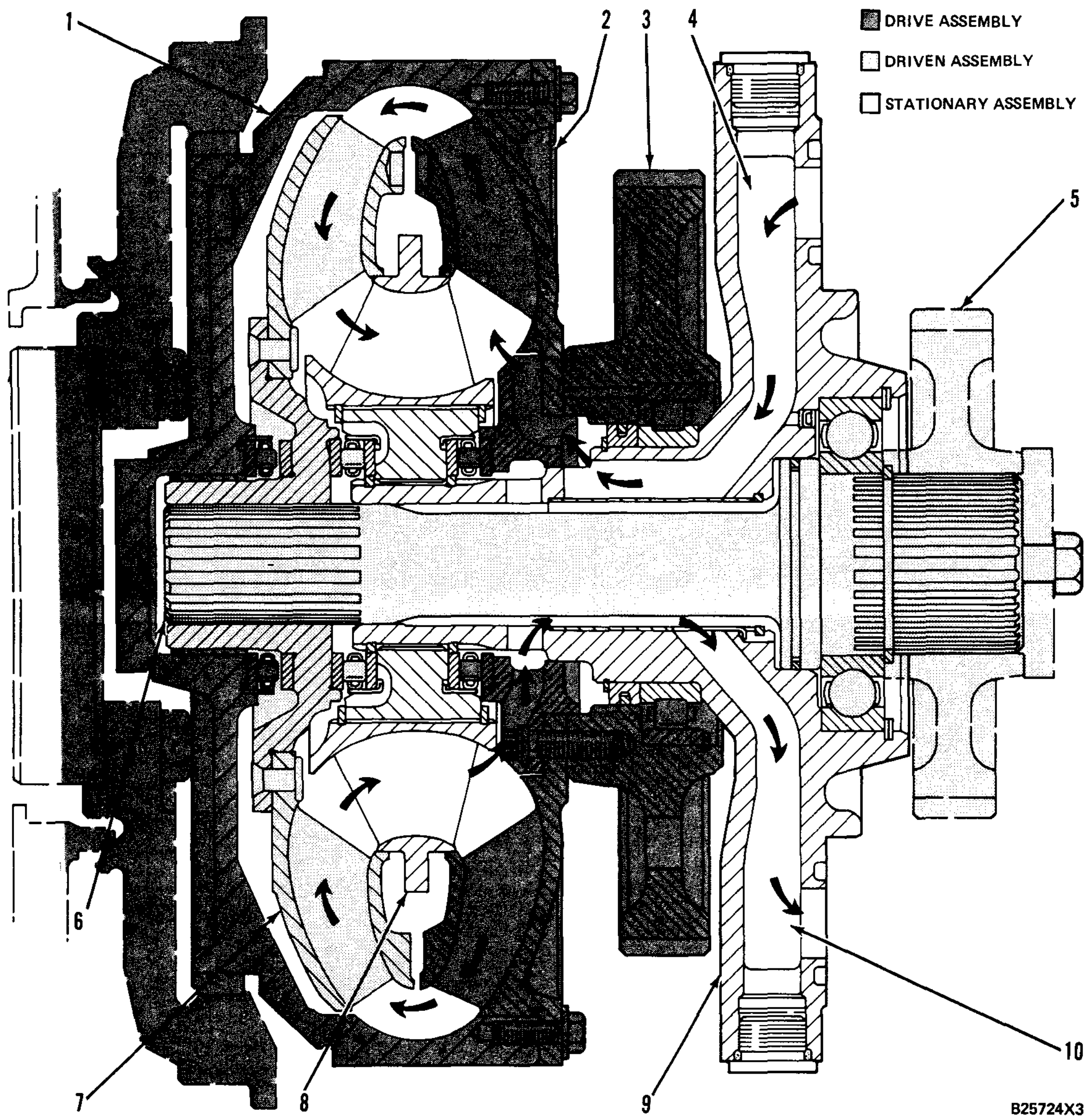
Torque Converter Components (Earlier Style Shown)
(1) Rotating housing. (2) Impeller. (3) Gear. (4) Inlet port. (5) Output gear. (6) Output shaft. (7) Turbine. (8) Stator. (9) Carrier assembly. (10) Outlet port.

The torque converter is located at the input end of the transmission. The converter housing is bolted to the flywheel housing. Output torque from the converter enters the planetary transmission through either the No. 1 or No. 2 sun gear. The gear that receives the output, is dependent upon the directional clutch engaged.

Oil for the operation of the converter is supplied by the transmission oil pump. The converter inlet oil pressure is controlled by the inlet pressure valve for the torque converter. This valve limits the pressure to the converter to 965 kPa (140 psi) maximum when the oil is cold. It is part of the selector and pressure control valve group in the transmission hydraulic controls.

The outlet oil pressure is controlled by the relief valve for torque converter outlet. This valve is mounted on the right side of the converter cover and does not allow converter outlet pressure to go below 415 kPa (60 psi).

Rotating housing (1), impeller (2), and oil pump drive gear (3) are driven by the flywheel and rotate as a unit at engine speed.

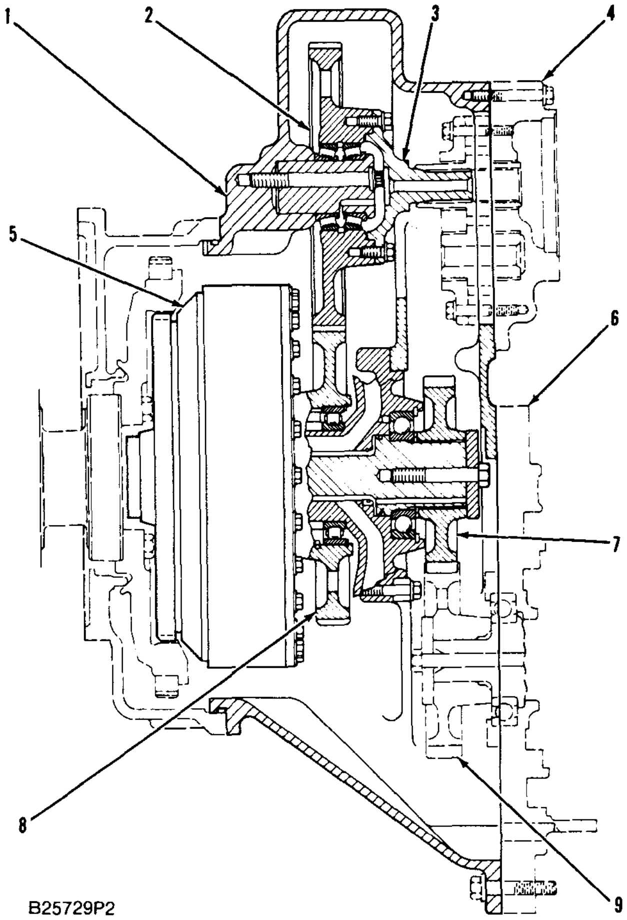


Flow Of Power In Torque Converter (Typical Example)
(1) Rotating housing. (2) Impeller. (3) Gear. (4) Inlet port. (5) Output gear. (6) Output shaft. (7) Turbine. (8) Stator. (9) Carrier assembly. (10) Outlet port.

Oil from the transmission hydraulic controls enters the torque converter through inlet port (4) in carrier (9). Oil is directed to the inlet port by a passage in the converter housing. From inlet port (4), the oil goes through carrier (9) and through a passage in the hub. As impeller (2) rotates, it acts as a pump to direct oil to turbine (7). The turbine is riveted to a hub, which is connected to output shaft (6) by splines. The turbine directs oil to stator (8), which is held stationary. The stator is connected to carrier (9) by splines. Carrier (9) is bolted to the torque converter housing.

The oil goes through a passage in carrier (9) to outlet port (10). From outlet port (10), oil is directed to the converter outlet relief valve. All the oil from the outlet relief valve goes to the oil cooler, where the temperature of the oil is lowered. From the oil cooler, the oil is then sent to the transmission where it is used to cool and lubricate the internal components.

c Torque Converter And Pump Drive Housing

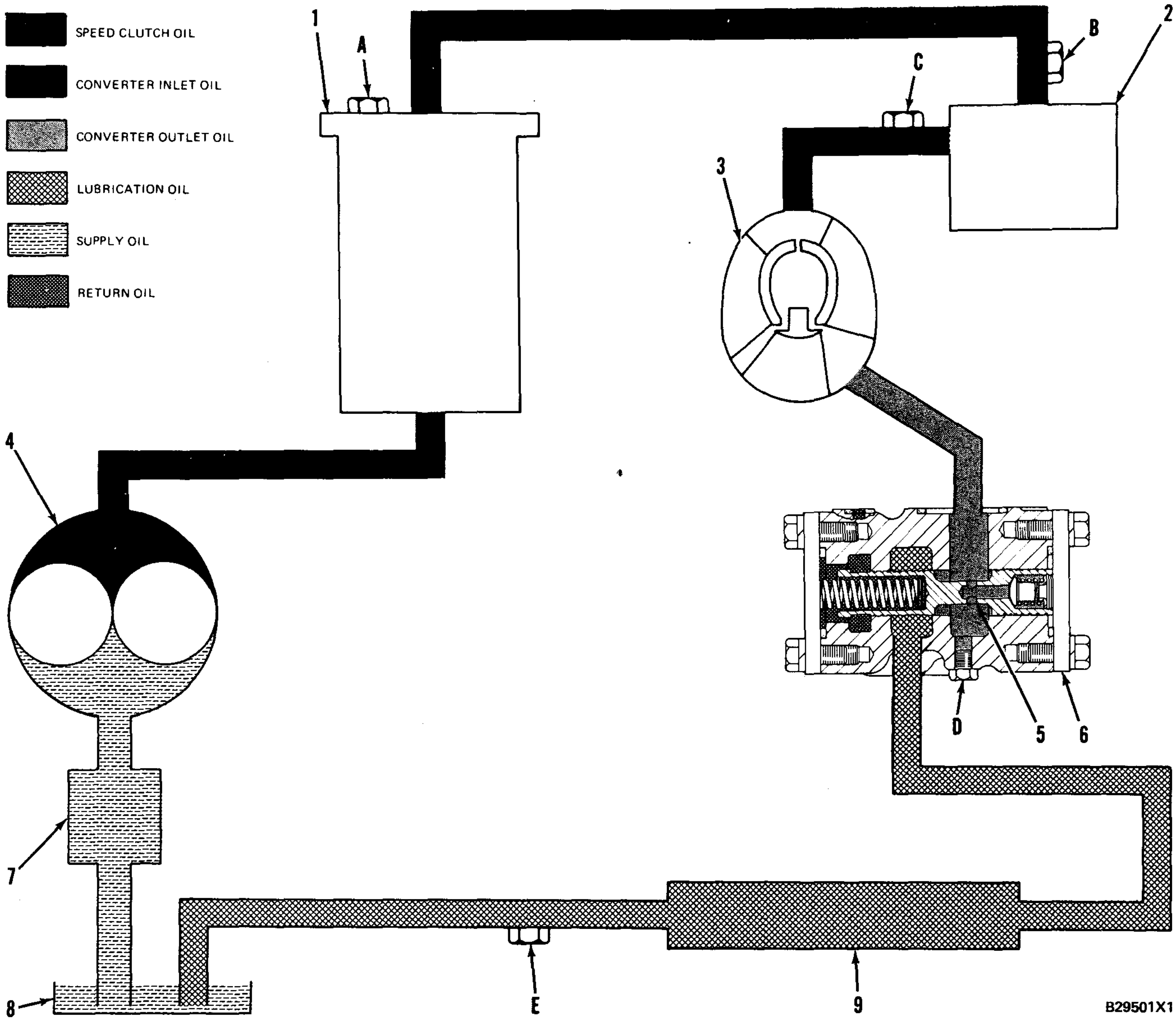


Torque Converter And Pump Drive Housing (Typical Example)
(1) Housing. (2) Transmission and implement pump drive gear. (3) Pump drive flange. (4) Transmission oil pump. (5) Torque converter. (6) Transmission housing. (7) Torque converter output gear. (8) Drive gear. (9) Input gear for planetary transmission.

Transmission oil pump (4) and the hydraulic implement pump are mounted on torque converter housing (1). Housing (1) is between the engine flywheel housing and transmission housing (6).

Gear (8) turns transmission and implement pump drive gear (2). Pump drive flange (3) is connected by splines to transmission oil pump (4). The hydraulic implement pump is fastened to transmission oil pump (4). Torque converter output gear (7) sends power to input gear for planetary transmission gear (9).

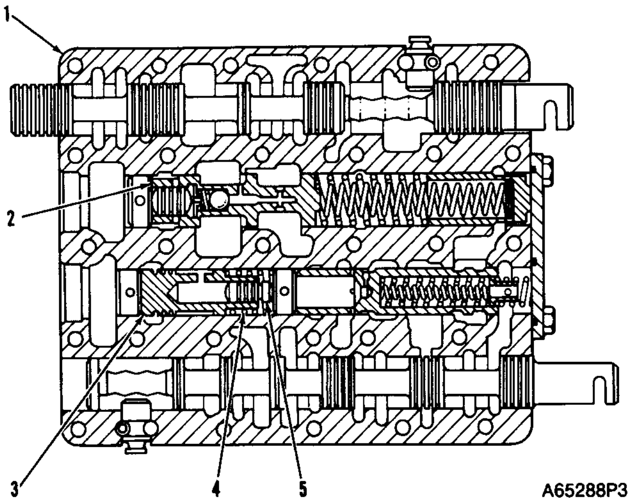
Torque Converter Hydraulic System



Torque Converter Hydraulic Controls (Earlier Style Shown)
(1) Oil filter. (2) Transmission hydraulic controls. (3) Torque converter. (4) Oil pump. (5) Relief valve for converter outlet. (6) Body of relief valve for converter outlet. (7) Screen. (8) Oil reservoir. (9) Oil cooler. (A) Pressure tap for oil pump (on filter). (B) Pressure tap for relief valve. (C) Pressure tap for converter inlet. (D) Pressure tap for converter outlet. (E) Pressure tap for lubrication.

Two control valves make up the hydraulic system for the torque converter. These valves are the inlet pressure valve for the torque converter and the relief valve for converter outlet.

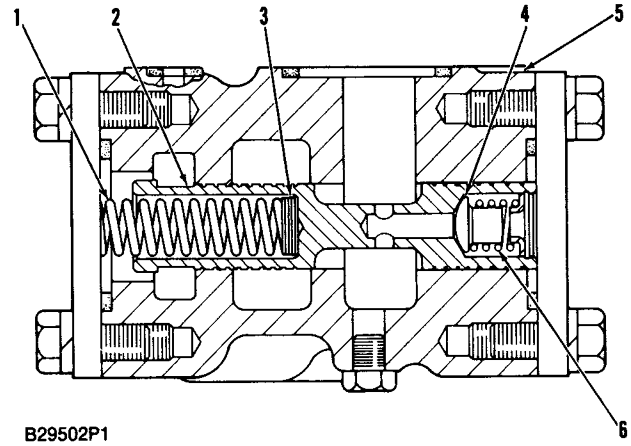
Ratio Valve For The Torque Converter



Location Of Ratio Valve For The Torque Converter
(1) Transmission selector and pressure control valve.
(2) Modulation relief valve. (3) Ratio valve for the torque converter. (4) Spring. (5) Slug.

The ratio valve for the torque converter controls the maximum pressure to the converter. The main purpose of the ratio valve is to prevent damage to converter components when the engine is started and the oil is cold. It limits the maximum pressure to the converter to approximately 965 kPa (140 psi). This pressure is not adjustable.

Relief Valve For Converter Outlet



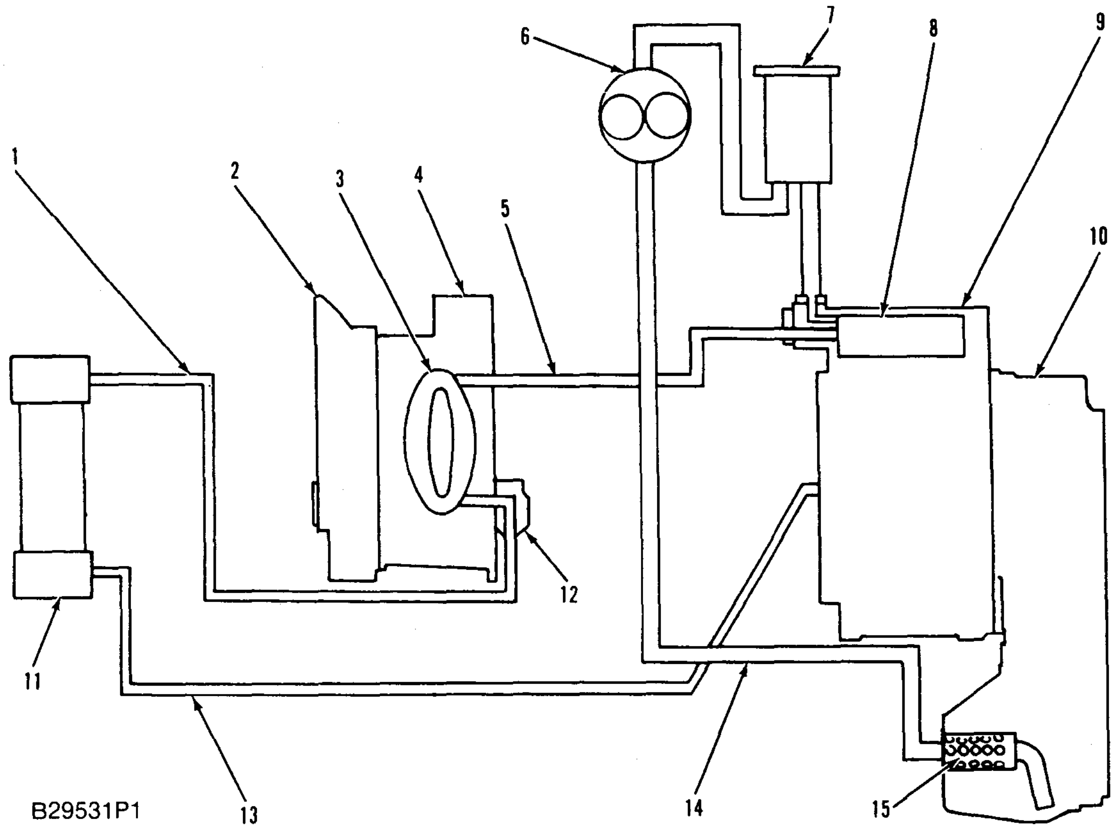
Relief Valve For Converter Outlet
(1) Spring. (2) Valve spool. (3) Spacers. (4) Poppet. (5) Valve body. (6) Spring.

C The relief valve for converter outlet controls the minimum pressure in the torque converter. When the pressure in the converter is approximately 415 kPa (60 psi) or less, spool (2) moves with the force of spring (1) to limit oil to the oil cooler.

The outlet relief valve is mounted to the right side of the converter cover.

Spacers (3) are used to make an adjustment to the opening pressure of the valve.

Transmission Hydraulic System



Schematic Of Hydraulic System
(1) Outlet line from torque converter. (2) Flywheel housing. (3) Torque converter. (4) Case for torque converter. (5) Inlet line to torque converter. (6) Oil pump. (7) Oil filter. (8) Transmission hydraulic controls. (9) Transmission case. (10) Case for output transfer gears. (11) Oil cooler. (12) Relief valve (for converter outlet). (13) Outlet line (from oil cooler). (14) Supply line to oil pump. (15) Magnetic screen.

The hydraulic system has a common reservoir. The reservoir is at the bottom of case (10) for the output transfer gears. It supplies oil for the operation of the torque converter and transmission. It also gives lubrication oil for the different components in the system.

Oil is pulled from the reservoir through magnetic screen (15) by oil pump (6). Pump (6) sends pressure oil to oil filter (7). The oil goes through the filter. If restrictions are present in the oil filter, a bypass valve in the filter housing lets the oil go around the filter.

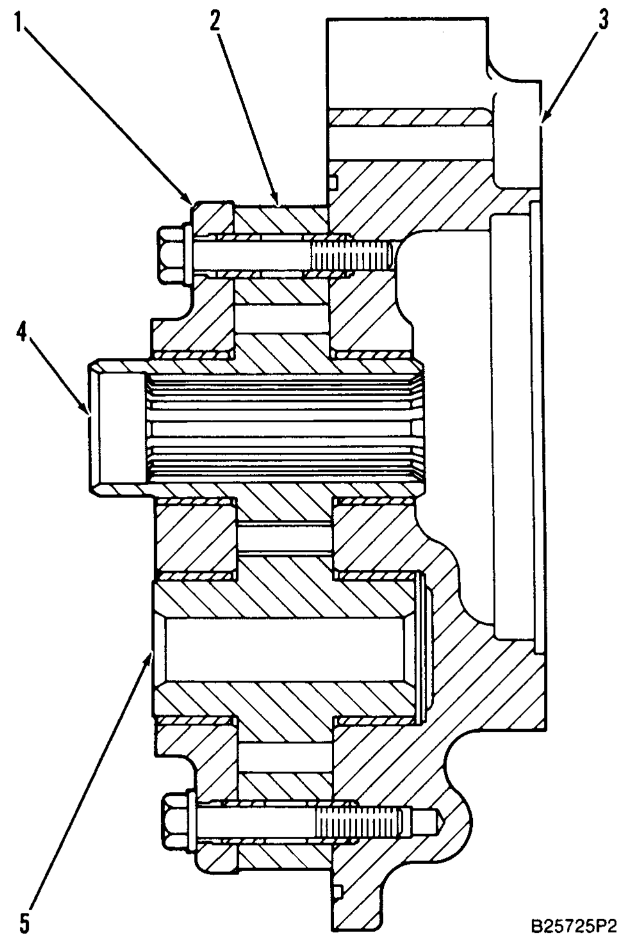
From filter (7), the oil goes to transmission hydraulic controls (8). The transmission selector and pressure control valve (part of the transmission hydraulic controls), controls the pressure and flow of the oil to the transmission clutches for engagement. It also controls the inlet oil to the torque converter.

Inlet oil, for operation of the torque converter, goes through line (5). The inlet pressure valve for the torque converter (part of the selector and pressure control valve) controls the oil pressure to the converter. Leakage oil from torque converter (3) is for lubrication of the internal components. After lubrication of the components, oil goes to the bottom of torque converter case (4). A passage at the bottom of converter case (4) lets the oil go to the bottom of transmission case (9). The transmission case also has a passage at the bottom that lets all the oil go to the main reservoir in case (10).

Outlet oil from the converter goes to relief valve (12) for converter outlet. The relief valve (12) keeps the pressure inside the converter at approximately 60 psi (415 kPa) minimum. From the outlet relief valve, the oil goes through line (1) to oil cooler (11).

After going through the cooler, the oil at a lower temperature, goes through outlet line (13) to the transmission planetary. This oil is for lubrication of the transmission.

Oil Pump



Oil Pump Construction
(1) Cover assembly. (2) Body assembly. (3) Manifold assembly. (4) Gear. (5) Gear.

The oil pump is a single-section gear-type mounted between the hydraulic implement pump and the housing assembly (torque converter housing).

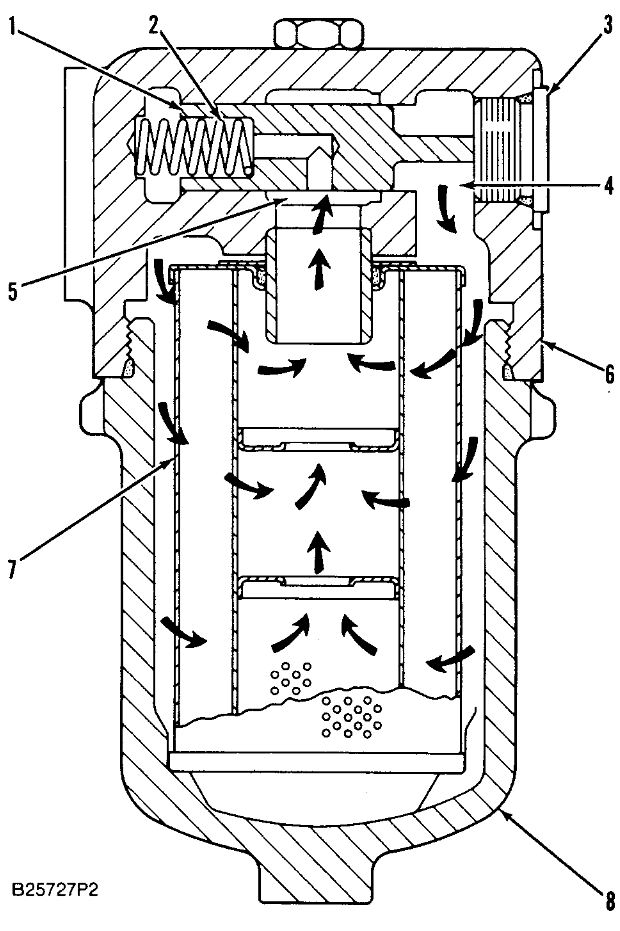
The main components of the oil pump are: body assembly (2), cover assembly (1), manifold assembly (3), gear (4) and gear (5).

Drive gear (4) is connected by splines to the pump drive. The hydraulic implement pump is driven by drive gear (4).

In operation, oil comes from the reservoir in the output transfer gear case, through the magnetic screen to an opening in manifold assembly (3). The oil fills the spaces between the teeth of gears (4), and (5) and body (2). As the gears turn, oil is pushed from body (2). The oil goes through another passage in manifold assembly (3) to an oil line. The oil then goes to the filter.

C On earlier machines when the engine is not running, air is present in the pump. When the engine is started, a line on the outlet side of the pump lets the air go from the pump. This prevents air from getting into the system. After all air is out of the pump, an orifice in the line lets a specific amount of oil go to the relief valve for converter outlet.

Oil Filter



Components Of The Oil Filter
(1) Bypass valve. (2) Spring. (3) Plug. (4) Inlet passage. (5) Outlet passage. (6) Base. (7) Element. (8) Housing.

C The oil filter is located under and to the right side of the upper articulating hitch assembly.

Pressure oil, from the oil pump, goes in filter base (6) through inlet passage (4). The oil goes through the filter base to housing (8). Oil fills the space between the inside of housing (8) and filter element (7). Normally, oil goes through the filter element and then to the outlet passage. The oil then goes to the remainder of the hydraulic system. The filter element stops any debris that is in the oil.

If the filter element becomes full of debris, the restriction to the flow of oil causes a pressure increase inside the filter. The increase in pressure causes bypass valve (1) to open. The oil then goes to the hydraulic system. When the oil does not go through the filter element, it is dirty and the debris in the oil can cause damage to other components in the hydraulic system.

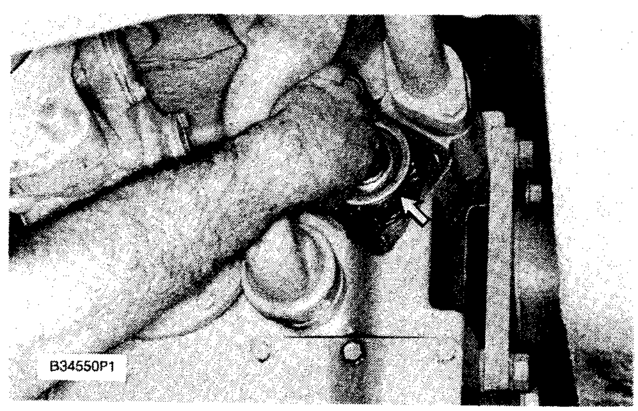
Correct maintenance must be used to make certain that filter element (7) does not become full of debris and stop the flow of clean oil to the hydraulic system.

Magnetic Screen

A magnetic screen is inside of the transfer gear case. Oil from the bottom of the transfer gear case goes through an inlet passage. As the oil goes through the screen, foreign particles that are in the oil are stopped by the screen and can not go into the transmission hydraulic system.

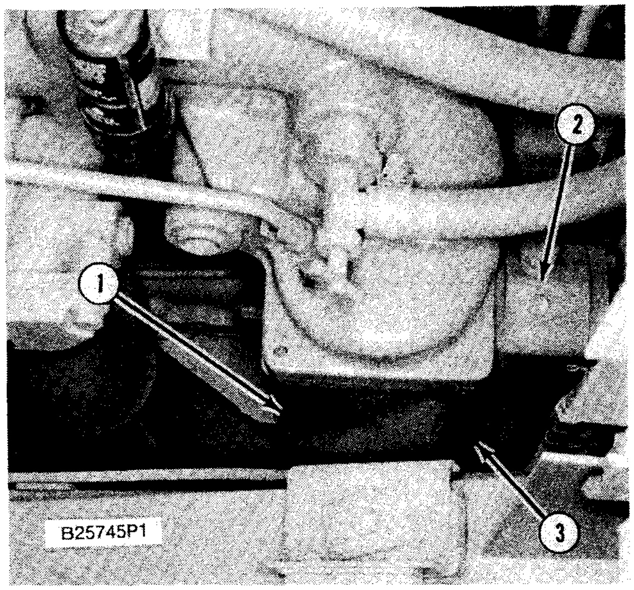
After the oil goes through the screen, it goes around and through magnets. The magnets are installed on the tube assembly so that the same magnetic ends are next to each other. Smaller metal particles that go through the screen are stopped and held by the magnets. These magnets will not let the metal particles go with the oil through the hydraulic system.

The oil then goes through the outlet passage to the transmission pump.



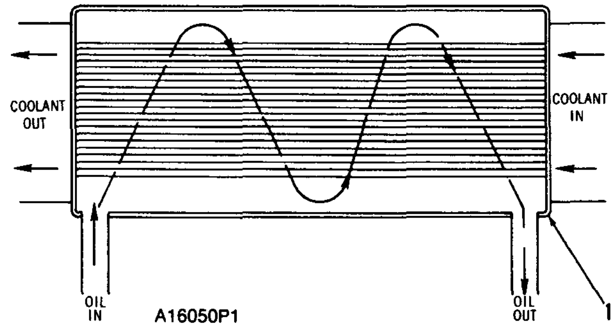
Location Of Magnetic Screen

Power Train Oil Cooler



Power Train Oil Cooler
(1) Oil cooler. (2) Torque converter outlet. (3) Outlet passage.

Coolant from the engine comes in at the end. The coolant goes through the many long tubes that are in cooler (1). After the coolant goes through the tubes, it goes out through the other end of the cooler and returns to the engine cylinder block.

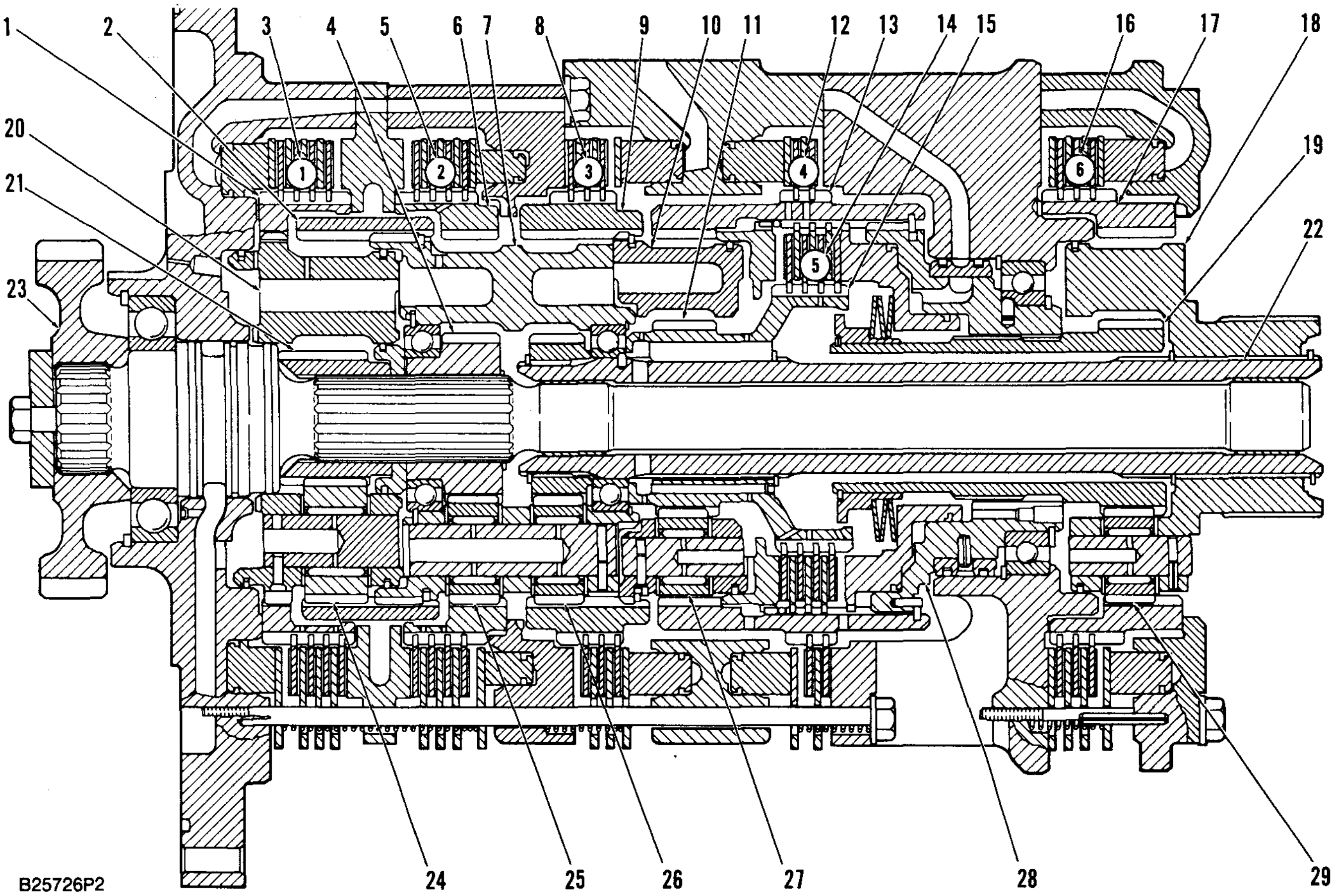


Transmission Oil Cooler (Schematic)
(1) Oil cooler.

Hydraulic system oil with a high temperature comes from torque converter outlet (2). This oil comes in at the side of the cooler. The flow of oil is around and along the many tubes inside the cooler. In this procedure, heat is removed from the oil and is given to the coolant of the engine. The engine coolant goes through the tubes inside the cooler and takes the heat from the oil. The coolant is then cooled by the cooling system of the engine.

After the oil goes along the tubes in the cooler, it goes out through the outlet passage at the bottom and has a lower temperature. The colder oil then goes to the transmission for lubrication and cooling.

Transmission



Transmission Components (Earlier Style Shown)
(1) Ring gear for No. 1 clutch. (2) Coupling gear. (3) No. 1 clutch. (4) No. 2 sun gear. (5) No. 2 clutch. (6) Ring gear for No. 2 clutch. (7) No. 2 and No. 3 carrier. (8) No. 3 clutch. (9) Ring gear for No. 3 clutch. (10) No. 4 carrier. (11) No. 4 sun gear. (12) No. 4 clutch. (13) Ring gear for No. 4 clutch. (14) No. 5 clutch. (15) Rotating hub. (16) No. 6 clutch. (17) Ring gear for No. 6 clutch. (18) No. 6 carrier. (19) No. 6 sun gear. (20) No. 1 carrier. (21) No. 1 sun gear. (22) Output shaft. (23) Input gear and shaft. (24) No. 1 planetary gears. (25) No. 2 planetary gears. (26) No. 3 planetary gears. (27) No. 4 planetary gears. (28) Housing assembly. (29) Ring gear for No. 6 clutch.

The transmission has six hydraulically activated clutches that give four speeds FORWARD and four speeds REVERSE. Speed and direction are both manually selected.

The transmission is fastened between the torque converter cover and the case for the output transfer gears. Input power to the transmission comes from the torque converter through an input gear.

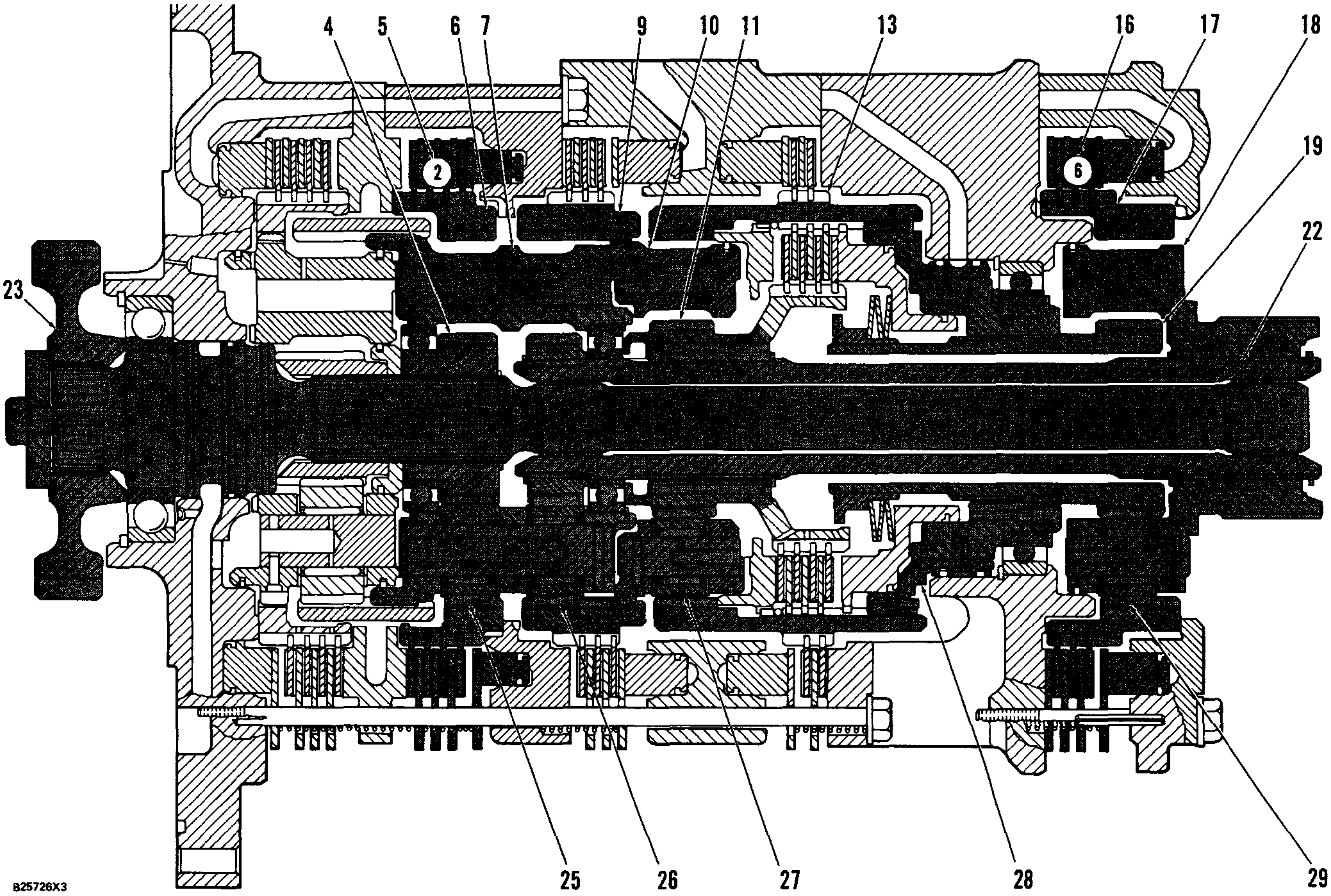
A speed clutch and a direction clutch must both be engaged, in that order, to send power through the transmission. The chart gives the combination of the clutches engaged for each FORWARD and REVERSE speeds.

Transmission Selection	**Clutches Engaged In Transmission**
Neutral	3
First Speed Forward	2 and 6
Second Speed Forward	2 and 5
Third Speed Forward	2 and 4
Fourth Speed Forward	2 and 3
First Speed Reverse	1 and 6
Second Speed Reverse	1 and 5
Third Speed Reverse	1 and 4
Fourth Speed Reverse	1 and 3

The two clutches, No. 1 and No. 2, nearest the input end of the transmission are the direction clutches. The No. 1 clutch is the REVERSE direction clutch. The No. 2 clutch is the FORWARD direction clutch.

The No. 3, No. 4, No. 5 and No. 6 clutches are the speed clutches. The No. 3 clutch gives FOURTH speed. The No. 4 clutch gives THIRD speed. The No. 5 clutch gives SECOND speed. The No. 6 clutch gives FIRST speed.

First Speed Forward



Power Flow In First Speed Forward (No. 2 and No. 6 Clutches Engaged)
(4) No. 2 sun gear. (5) No. 2 clutch. (6) Ring gear for No. 2 clutch. (7) No. 2 and No. 3 carrier. (9) Ring gear for No. 3 clutch. (10) No. 4 carrier. (11) No. 4 sun gear. (13) Ring gear for No. 4 clutch. (16) No. 6 clutch. (17) Ring gear for No. 6 clutch. (18) No. 6 carrier. (19) No. 6 sun gear. (22) Output shaft. (23) Input gear and shaft. (25) No. 2 planetary gears. (26) No. 3 planetary gears. (27) No. 4 planetary gears. (28) Housing assembly. (29) No. 6 planetary gears.

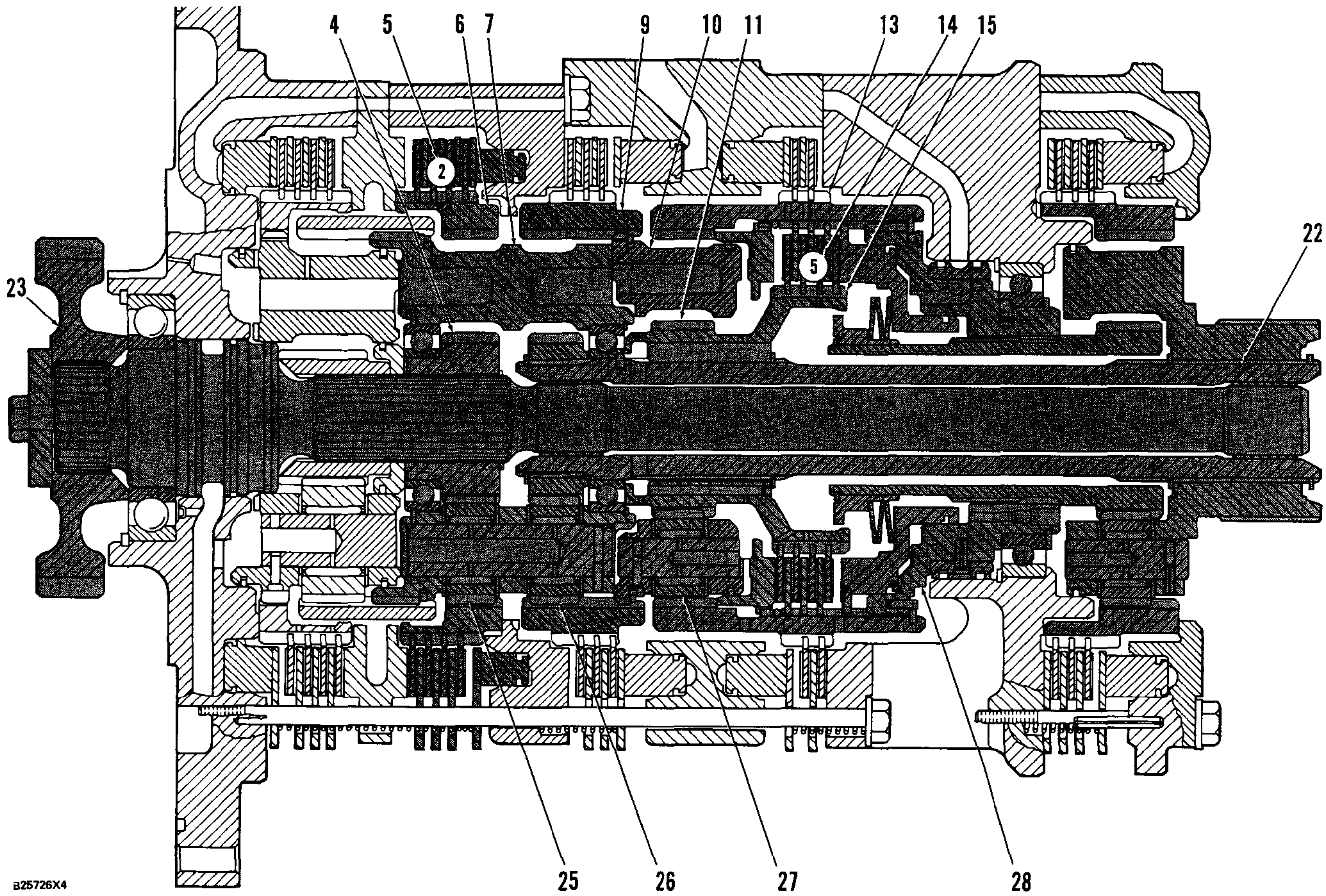
When the transmission is in FIRST SPEED FORWARD, No. 6 and No. 2 clutches are engaged. The No. 2 clutch holds ring gear (6) for the No. 2 clutch stationary. The No. 6 clutch holds ring gear (17) for the No. 6 clutch stationary. Input shaft (23) turns No. 2 sun gear (4). No. 2 sun gear turns No. 2 planetary gears (25).

Since ring gear (6) is held stationary by the No. 2 clutch, planetary gears (25) move around the inside of the ring gear. The movement of planetary gears (25) causes No. 2 and No. 3 carrier (7) to turn in the same direction as input shaft (23). As the No. 2 and No. 3 carrier turns, No. 3 planetary gears (26) turn. The No. 3 planetary gears turn ring gear (9) for the No. 3 clutch and output shaft (22). Ring gear (9) turns No. 4 carrier (10). As the No. 4 carrier turns, No. 4 planetary gears (27) turn. The No. 4 planetary gears turn ring gear (13) for the No. 4 clutch, which is fastened to housing assembly (28) by bolts. The No. 4 planetary gears also turn No. 4 sun gear (11). No. 4 sun gear turns output shaft (22).

Since ring gear (17) is held stationary by the No. 6 clutch, planetary gears (29) move around the inside of the ring gear. The movement of planetary gears (29) and No. 6 carrier (18) causes No. 6 sun gear to turn. No. 6 sun gear turns housing assembly (28) and output shaft (22).

As a result, torque to output shaft (22) is divided through No. 3 planetary gears (26), No. 4 sun gear (11) and No. 6 sun gear (19). From the output shaft, power goes through the output transfer gears to the differentials.

Second Speed Forward



Power Flow In Second Speed Forward (No. 2 and No. 5 Clutches Engaged)
(4) No. 2 sun gear. (5) No. 2 clutch. (6) Ring gear for No. 2 clutch. (7) No. 2 and No. 3 carrier. (9) Ring gear for No. 3 clutch. (10) No. 4 carrier. (11) No. 4 sun gear. (13) Ring gear for No. 4 clutch. (14) No. 5 clutch. (15) Rotating hub. (22) Output shaft. (23) Input gear and shaft. (25) No. 2 planetary gears. (26) No. 3 planetary gears. (27) No. 4 planetary gears. (28) Housing assembly.

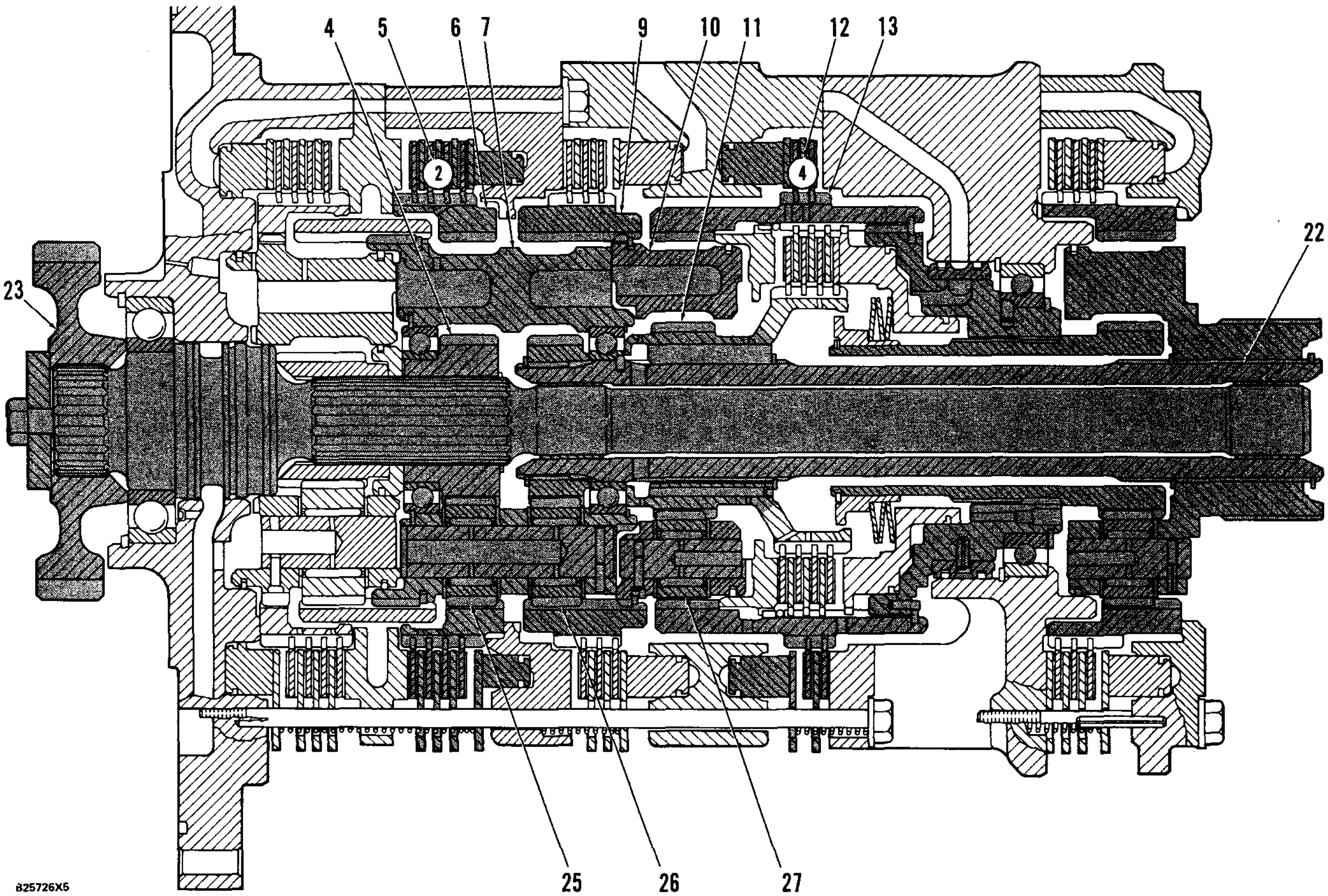
When the transmission is in SECOND SPEED FORWARD, No. 5 and No. 2 clutches are engaged. The No. 2 clutch holds ring gear (6) for the No. 2 clutch stationary. The No. 5 clutch holds rotating hub (15) stationary. Input shaft (23) turns No. 2 sun gear (4). No. 2 sun gear turns No. 2 planetary gears (25).

Since ring gear (6) is held stationary by the No. 2 clutch, planetary gears (25) move around the inside of the ring gear. The movement of planetary gears (25) causes No. 2 and No. 3 carrier (7) to turn in the same direction as input shaft (23). As the No. 2 and No. 3 carrier turns, No. 3 planetary gears (26) turn. The No. 3 planetary gears turn ring gear (9) for the No. 3 clutch and output shaft (22). Ring gear (9) turns No. 4 carrier (10). As the No. 4 carrier turns, No. 4 planetary gears (27) turn. The No. 4 planetary gears turn ring gear (13) for the No. 4 clutch, which is fastened to housing assembly (28) by bolts. The No. 4 planetary gears also turn No. 4 sun gear (11). No. 4 sun gear turns output shaft (22).

Since rotating hub (15) is held stationary by No. 5 clutch (14), power is sent through the No. 5 clutch to rotating hub (15). Rotating hub (15) turns output shaft (22).

As a result, torque to output shaft (22) is divided through No. 3 planetary gears (26), No. 4 sun gear (11) and rotating hub (15). From the output shaft, power goes through the output transfer gears to the differentials.

Third Speed Forward



Power Flow In Third Speed Forward (No. 2 and No. 4 Clutches Engaged)
(4) No. 2 sun gear. (5) No. 2 clutch. (6) Ring gear for No. 2 clutch. (7) No. 2 and No. 3 carrier. (9) Ring gear for No. 3 clutch. (10) No. 4 carrier. (11) No. 4 sun gear. (12) No. 4 clutch. (13) Ring gear for No. 4 clutch. (22) Output shaft. (23) Input gear and shaft. (25) No. 2 planetary gears. (26) No. 3 planetary gears. (27) No. 4 planetary gears.

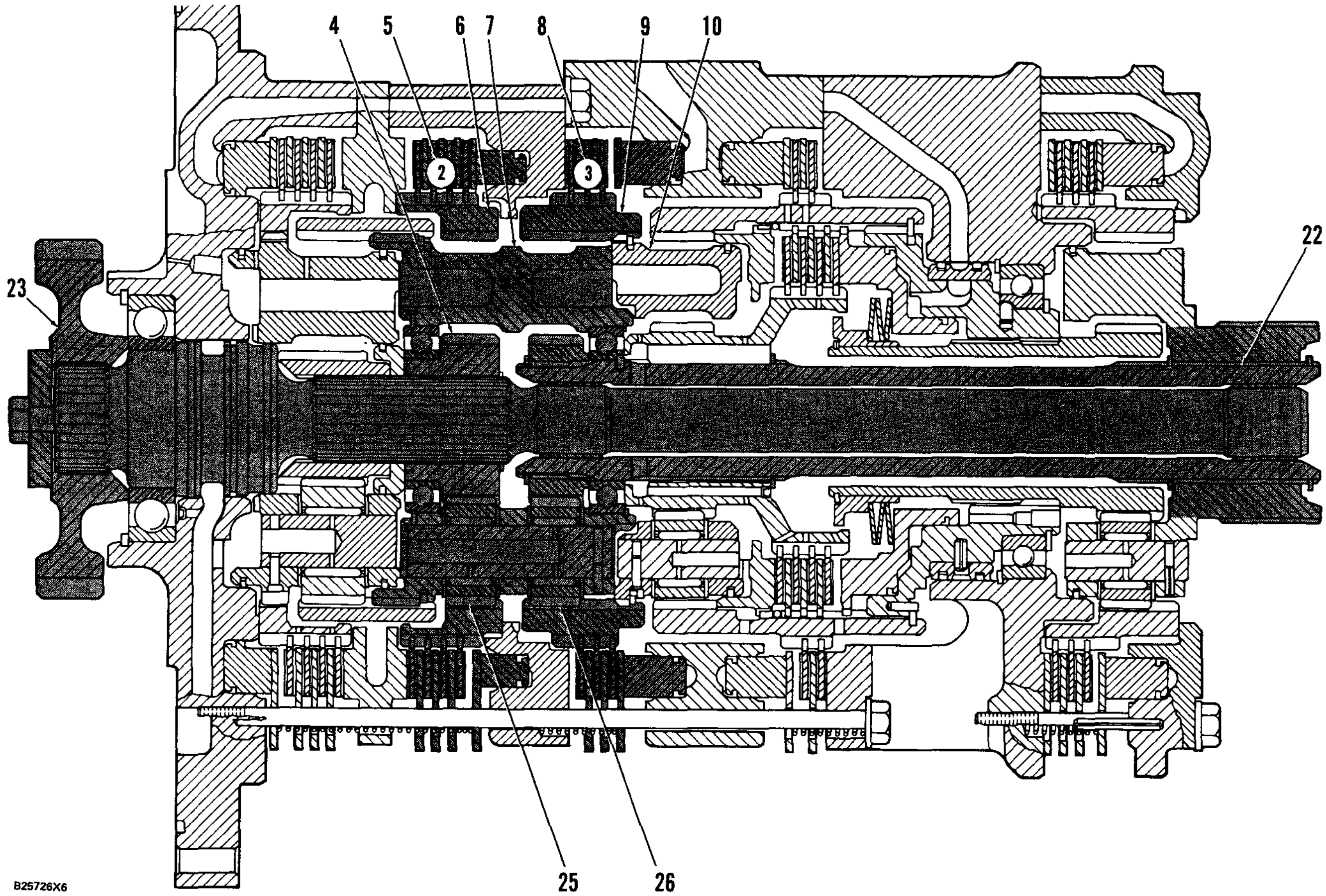
When the transmission is in THIRD SPEED FORWARD, No. 4 and No. 2 clutches are engaged. The No. 2 clutch holds ring gear (6) for the No. 2 clutch stationary. The No. 4 clutch holds ring gear (13) for the No. 4 clutch stationary. Input shaft (23) turns No. 2 sun gear (4). No. 2 sun gear turns No. 2 planetary gears (25).

Since ring gear (6) is held stationary by the No. 2 clutch, planetary gears (25) move around the inside of the ring gear. The movement of planetary gears (25) causes No. 2 and No. 3 carrier (7) to turn in the same direction as input shaft (23). As the No. 2 and No. 3 carrier turns, No. 3 planetary gears (26) turn. The No. 3 planetary gears turn ring gear (9) for the No. 3 clutch and output shaft (22). Ring gear (9) turns No. 4 carrier (10).

Since ring gear (13) is held stationary by the No. 4 clutch, planetary gears (27) move around the inside of the ring gear. The movement of planetary gears (27) and No. 4 carrier (10), causes No. 4 sun gear (11) to turn. No. 4 sun gear turns output shaft (22).

As a result, torque to output shaft (22) is divided through No. 3 planetary gears (26) and No. 4 sun gear (11). From the output shaft, power goes through the output transfer gears to the differentials.

Fourth Speed Forward



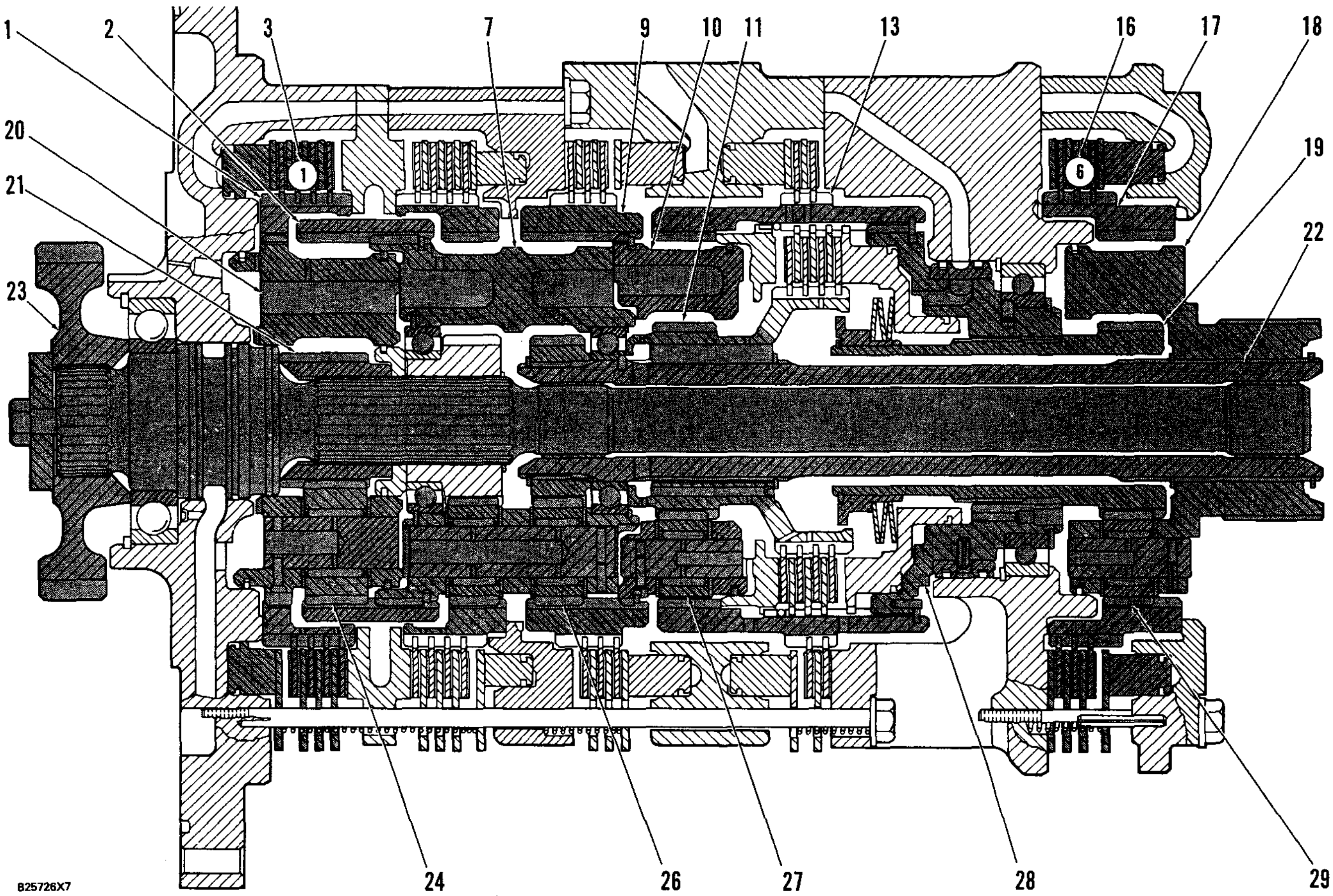
Power Flow In Fourth Speed Forward (No. 2 and No. 3 Clutches Engaged)
(4) No. 2 sun gear. (5) No. 2 clutch. (6) Ring gear for No. 2 clutch. (7) No. 2 and No. 3 carrier. (8) No. 3 clutch. (9) Ring gear for No. 3 clutch. (10) No. 4 carrier. (22) Output shaft. (23) Input gear and shaft. (25) No. 2 planetary gears. (26) No. 3 planetary gears.

When the transmission is in FOURTH SPEED FORWARD, No. 2 and No. 3 clutches are engaged. The No. 2 clutch holds ring gear (6) for the No. 2 clutch stationary. The No. 3 clutch holds ring gear (9) for the No. 3 clutch stationary. Input shaft (23) turns No. 2 sun gear (4). No. 2 sun gear turns No. 2 planetary gears (25).

Since ring gear (6) is held stationary by the No. 2 clutch, planetary gears (25) move around the inside of the ring gear. The movement of planetary gears (25) causes No. 2 and No. 3 carrier (7) to turn in the same direction as input shaft (23).

Since ring gear (9) is held stationary by the No. 3 clutch, the movement of No. 2 and No. 3 carrier (7) causes No. 3 planetary gears (26) to move around the inside of the ring gear. The No. 3 planetary gears turn output shaft (22). From the output shaft, power goes through the output transfer gears to the differentials.

First Speed Reverse



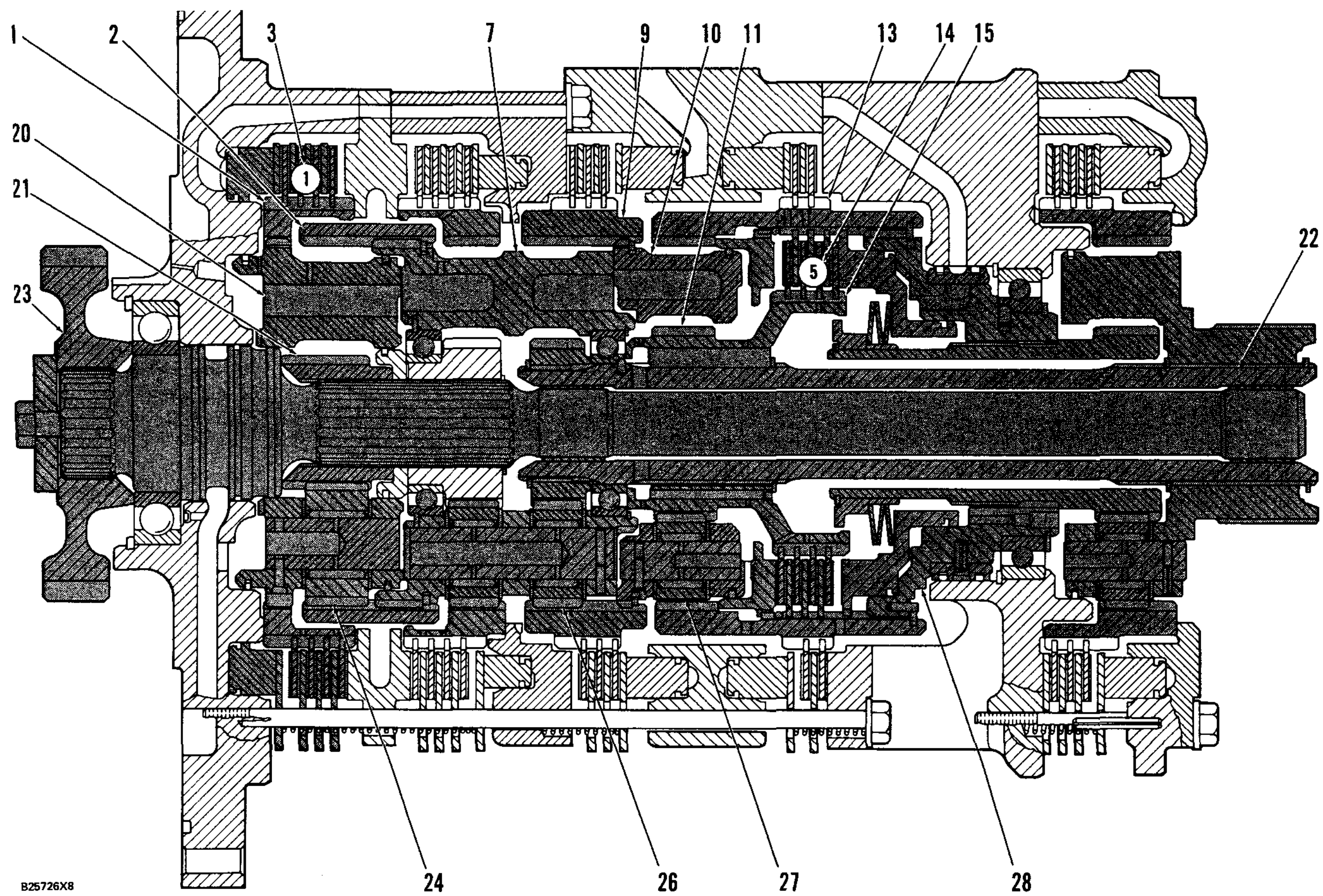
Power Flow In First Speed Reverse (No. 1 and No. 6 Clutches Engaged)
(1) Ring gear for No. 1 clutch. (2) Coupling gear. (3) No. 1 clutch. (7) No. 2 and No. 3 carrier. (9) Ring gear for No. 3 clutch. (10) No. 4 carrier. (11) No. 4 sun gear. (13) Ring gear for No. 4 clutch. (16) No. 6 clutch. (17) Ring gear for No. 6 clutch. (18) No. 6 carrier. (19) No. 6 sun gear. (20) No. 1 carrier. (21) No. 1 sun gear. (22) Output shaft. (23) Input gear and shaft. (24) No. 1 planetary gears. (26) No. 3 planetary gears. (27) No. 4 planetary gears. (28) Housing assembly. (29) No. 6 planetary gears.

When the transmission is in FIRST SPEED REVERSE, No. 1 and No. 6 clutches are engaged. The No. 1 clutch holds ring gear (1) for the No. 1 clutch stationary. The No. 6 clutch holds ring gear (17) for the No. 6 clutch stationary. Input shaft (23) turns No. 1 sun gear (21). No. 1 sun gear turns No. 1 planetary gears (24). No. 1 carrier (20) is in direct mechanical connection with ring gear (1).

Since ring gear (1) is held stationary by the No. 1 clutch, so is No. 1 carrier (20). The movement of No. 1 planetary gears (24) causes coupling gear (2) to turn in the opposite direction of input shaft (23). Coupling gear (2) is in direct mechanical connection with No. 2 and No. 3 carrier (7). As the No. 2 and No. 3 carrier turns, No. 3 planetary gears (26) turn. The No. 3 planetary gears turn ring gear (9) for the No. 3 clutch and output shaft (22). Ring gear (9) turns No. 4 carrier (10). As the No. 4 carrier turns, No. 4 planetary gears (27) turn. The No. 4 planetary gears turn ring gear (13) for the No. 4 clutch, which is fastened to housing assembly (28) by bolts. The No. 4 planetary gears also turn No. 4 sun gear (11). No. 4 sun gear turns output shaft (22). Since ring gear (17) is held stationary by the No. 6 clutch, planetary gears (29) move around the inside of the ring gear. The movement of planetary gears (29) and No. 6 carrier (18), causes No. 6 sun gear to turn. No. 6 sun gear turns housing assembly (28) and output shaft (22).

As a result, torque to output shaft (22) is divided through No. 3 planetary gears (26), No. 4 sun gear (11) and No. 6 sun gear (19). From the output shaft, power goes through the output transfer gears to the differentials.

Second Speed Reverse



Power Flow In Second Speed Reverse (No. 1 and No. 5 Clutches Engaged)
(1) Ring gear for No. 1 clutch. (2) Coupling gear. (3) No. 1 clutch. (7) No. 2 and No. 3 carrier. (9) Ring gear for No. 3 clutch. (10) No. 4 carrier. (11) No. 4 sun gear. (13) Ring gear for No. 4 clutch. (14) No. 5 clutch. (15) Rotating hub. (20) No. 1 carrier. (21) No. 1 sun gear. (22) Output shaft. (23) Input gear and shaft. (24) No. 1 planetary gears. (26) No. 3 planetary gears. (27) No. 4 planetary gears.28.Housing assembly.

When the transmission is in SECOND SPEED REVERSE, No. 1 and No. 5 clutches are engaged. The No. 1 clutch holds ring gear (1) for the No. 1 clutch stationary. The No. 5 clutch holds rotating hub (15) stationary.

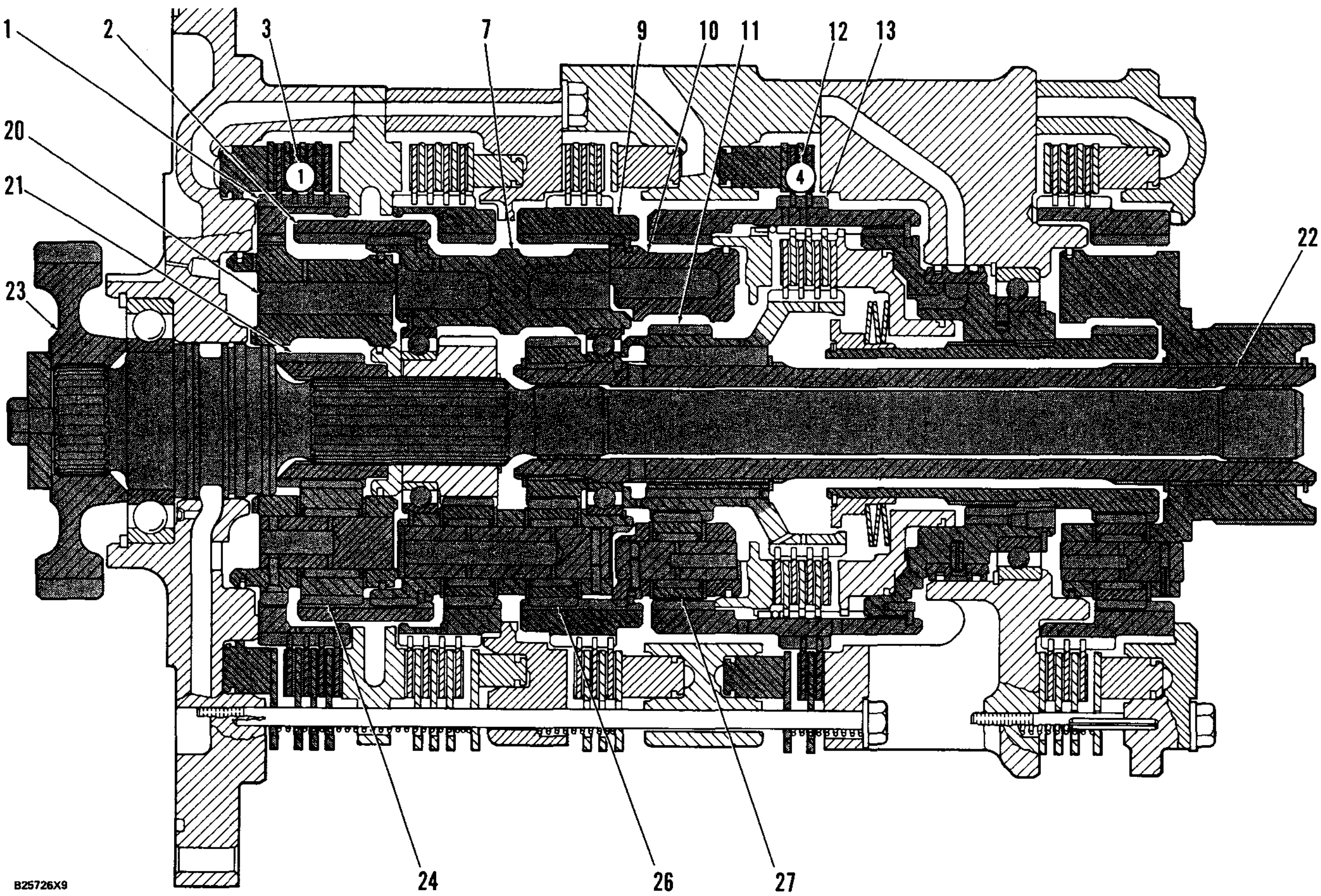
Input shaft (23) turns No. 1 sun gear (21). No. 1 sun gear turns No. 1 planetary gears (24). No. 1 carrier (20) is in direct mechanical connection with ring gear (1).

Since ring gear (1) is held stationary by the No. 1 clutch, so is No. 1 carrier (20). The movement of No. 1 planetary gears (24) causes coupling gear (2) to turn in the opposite direction of input shaft (23). Coupling gear (2) is in direct mechanical connection with No. 2 and No. 3 carrier (7). As the No. 2 and No. 3 carrier turns, No. 3 planetary gears (26) turn. The No. 3 planetary gears turn ring gear (9) for the No. 3 clutch and output shaft (22). Ring gear (9) turns No. 4 carrier (10). As the No. 4 carrier turns, No. 4 planetary gears (27) turn. The No. 4 planetary gears turn ring gear (13) for the No. 4 clutch, which is fastened to housing assembly (28) by bolts. The No. 4 planetary gears also turn No. 4 sun gear (11). No. 4 sun gear turns output shaft (22).

Since rotating hub (15) is held stationary by No. 5 clutch (14), power is sent through the No. 5 clutch to rotating hub (15). Rotating hub (15) turns output shaft (22).

As a result, torque to output shaft (22) is divided through No. 3 planetary gears (26), No. 4 sun gear (11) and rotating hub (15). From the output shaft, power goes through the output transfer gears to the differentials.

Third Speed Reverse



Power Flow In Third Speed Reverse (No. 1 and No. 4 Clutches Engaged)
(1) Ring gear for No. 1 clutch. (2) Coupling gear. (3) No. 1 clutch. (7) No. 2 and No. 3 carrier. (9) Ring gear for No. 3 clutch. (10) No. 4 carrier. (11) No. 4 sun gear. (12) No. 4 clutch. (13) Ring gear for No. 4 clutch. (20) No. 1 carrier. (21) No. 1 sun gear. (22) Output shaft. (23) Input gear and shaft. (24) No. 1 planetary gears. (26) No. 3 planetary gears. (27) No. 4 planetary gears.

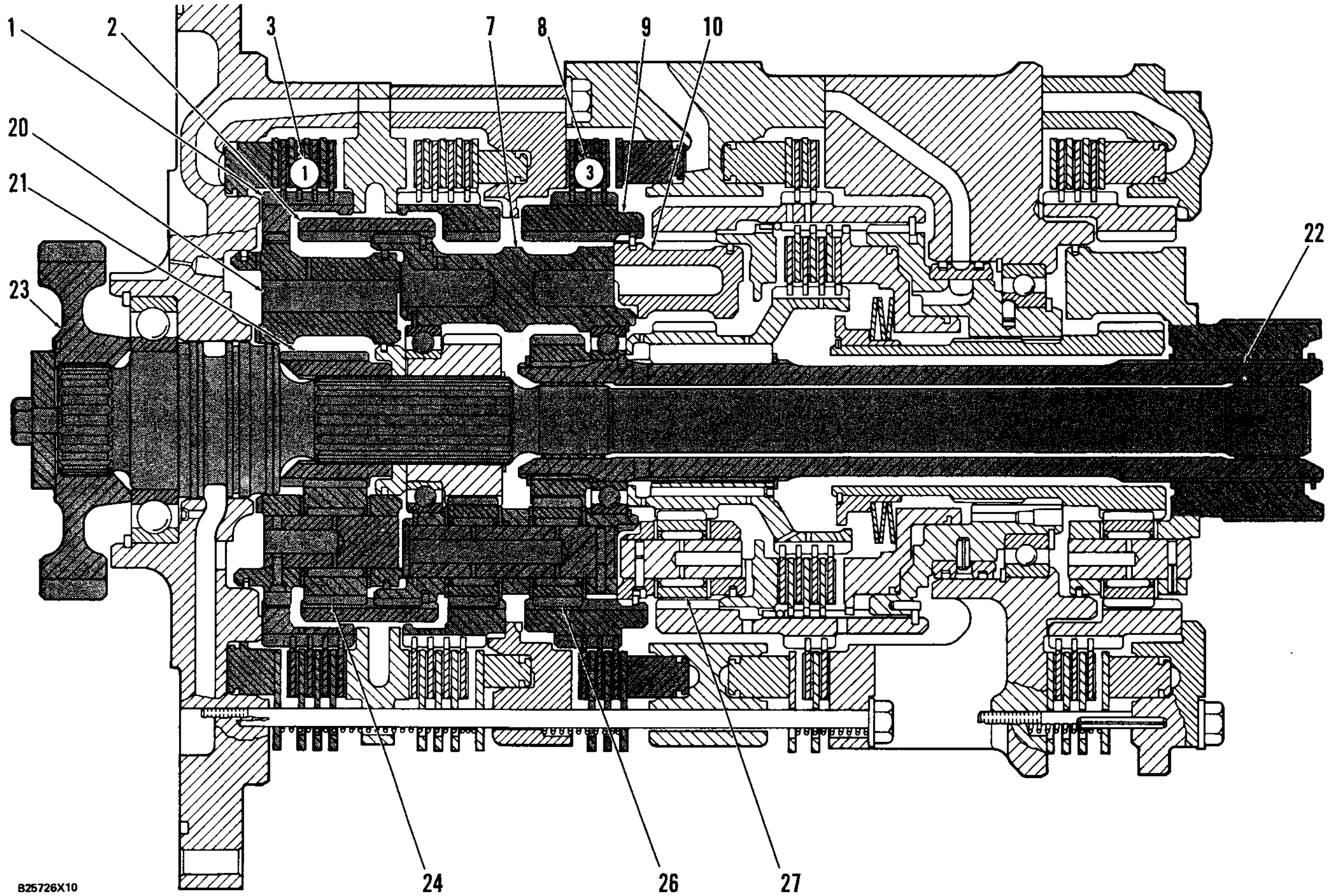
When the transmission is in THIRD SPEED REVERSE, No. 1 and No. 4 clutches are engaged. The No. 1 clutch holds ring gear (1) for the No. 1 clutch stationary. The No. 4 clutch holds ring gear (13) for the No. 4 clutch stationary. Input shaft (23) turns No. 1 sun gear (21). No. 1 sun gear turns No. 1 planetary gears (24). No. 1 carrier (20) is in direct mechanical connection with ring gear (1).

Since ring gear (1) is held stationary by the No. 1 clutch, so is No. 1 carrier (20). The movement of No. 1 planetary gears (24) causes coupling gear (2) to turn in the opposite direction of input shaft (23). Coupling gear (2) is in direct mechanical connection with No. 2 and No. 3 carrier (7). As the No. 2 and No. 3 carrier turns, No. 3 planetary gears (26) turn. The No. 3 planetary gears turn ring gear (9) for the No. 3 clutch and output shaft (22). Ring gear (9) turns No. 4 carrier (10).

Since ring gear (13) is held stationary by the No. 4 clutch, planetary gears (27) move around the inside of the ring gear. The movement of planetary gears (27) and No. 4 carrier (10), causes No. 4 sun gear (11) to turn. No. 4 sun gear turns output shaft (22).

As a result, torque to output shaft (22) is divided through No. 3 planetary gears (26) and No. 4 sun gear (11). From the output shaft, power goes through the output transfer gears to the differentials.

Fourth Speed Reverse



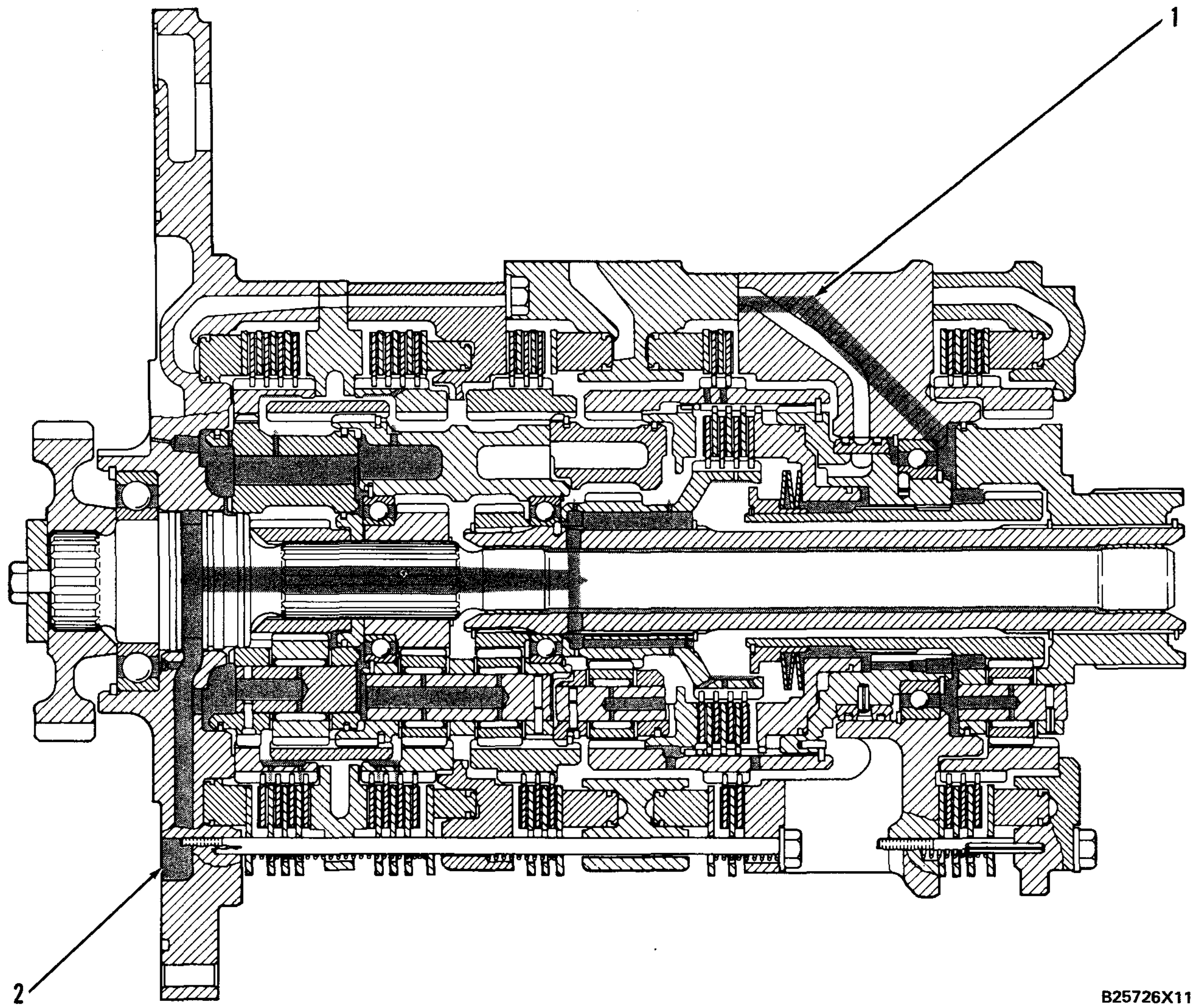
Power Flow In Fourth Speed Reverse (No. 1 and No. 3 Clutches Engaged)
(1) Ring gear for No. 1 clutch. (2) Coupling gear. (3) No. 1 clutch. (7) No. 2 and No. 3 carrier. (8) No. 3 clutch. (9) Ring gear for No. 3 clutch. (10) No. 4 carrier. (20) No. 1 carrier. (21) No. 1 sun gear. (22) Output shaft. (23) Input gear and shaft. (24) No. 1 planetary gears. (26) No. 3 planetary gears. (27) No. 4 planetary gears.

When the transmission is in FOURTH SPEED REVERSE, No. 1 and No. 3 clutches are engaged. The No. 1 clutch holds ring gear (1) for the No. 1 clutch stationary. The No. 3 clutch holds ring gear (9) for the No. 3 clutch stationary. Input shaft (23) turns No. 1 sun gear (21). No. 1 sun gear turns No. 1 planetary gear (24). No. 1 carrier (20) is in direct mechanical connection with ring gear (1).

Since ring gear (1) is held stationary by the No. 1 clutch, so is No. 1 carrier (20). The movement of No. 1 planetary gears (24) causes coupling gear (2) to turn in the opposite direction of input shaft (23). Coupling gear (2) is in direct mechanical connection with No. 2 and No. 3 carrier (7).

Since ring gear (9) is held stationary by the No. 3 clutch, the movement of No. 2 and No. 3 carrier (7) causes No. 3 planetary gears (26) to move around the inside of the ring gear. The No. 3 planetary gears turn output shaft (22). From the output shaft, power goes through the output transfer gears to the differentials.

Planetary Lubrication



Planetary Lubrication
(1) Oil supply passage. (2) Oil supply passage.

All planet gears and bearings are pressure lubricated. After the oil has been cooled by the oil cooler, it will enter through oil passages (1) and (2) and an orifice in the transmission end plate.

Oil for lubrication of the No. 1 clutch comes through an orifice in the transmission end plate.

Oil supply passage (1) is for lubrication of clutches No. 2, No. 3, No. 4 and rotating clutch No. 5.

Oil for the No. 6 clutch is supplied through oil supply passage (2).

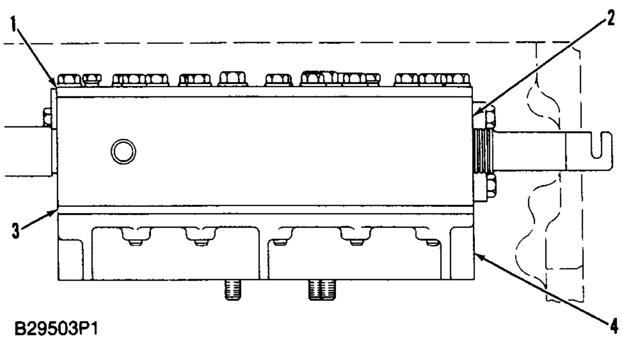
All clutch leakage oil and return oil goes to the bottom of the transmission case. This oil then goes to the main oil reservoir in the output transfer gear case.

The restrictions to the flow of oil inside the planetary, keep the lubrication pressure at 140 kPa (20 psi).

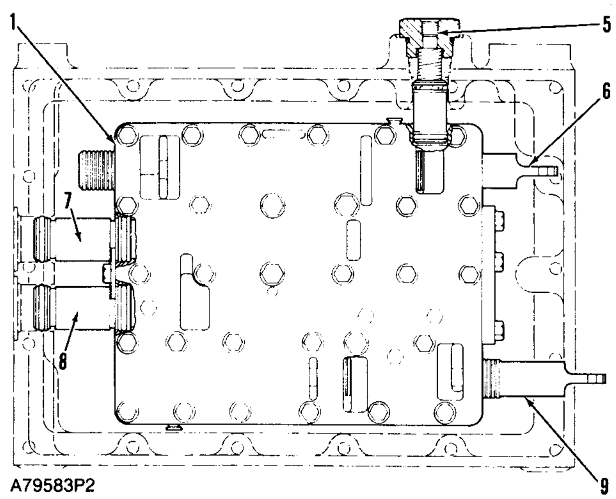
Transmission Hydraulic Controls

Introduction

The transmission hydraulic controls are installed on the transmission planetary. The controls have a top plate (1), selector and pressure control valve group (2), plate (3) and neutralizer valve group (4).



Transmission Hydraulic Controls
(Side View)
(1) Plate. (2) Selector and pressure control valve group. (3) Plate. (4) Neutralizer valve group.

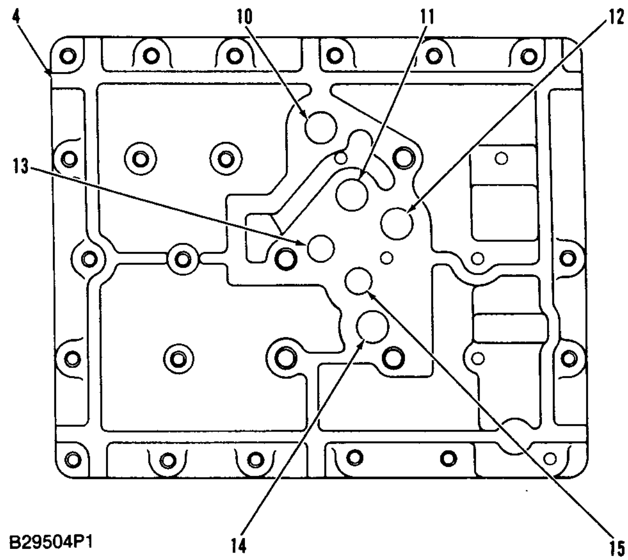


Transmission Hydraulic Controls
(Top View)
(1) Top plate. (5) Air inlet for neutralizer valve. (6) Speed selection spool. (7) Oil tube (inlet from pump). (8) Oil tube (outlet to torque converter). (9) Direction selection spool.

Inlet oil for operation of the hydraulic controls comes from the filter and goes through tube (7) to the pressure control valve.

Oil, for operation of the torque converter, goes through tube (8) and an oil line to the torque converter.

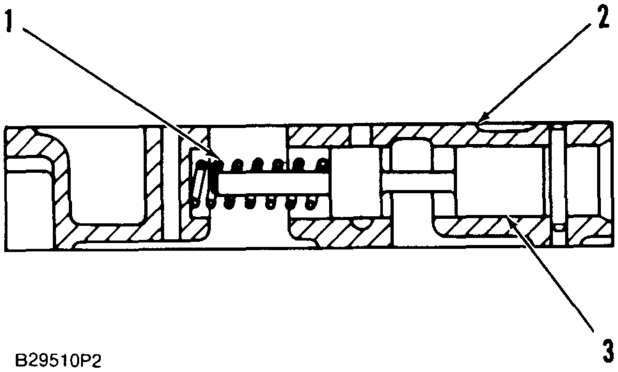
Air pressure for operation of the neutralizer valve, comes through air inlet (5). This air pressure is from the brake system.



Transmission Hydraulic Controls
(Bottom View)
(4) Neutralizer valve group. (10) Opening to No. 2 clutch. (11) Opening to No. 1 clutch. (12) Opening to No. 6 clutch. (13) Opening to No. 3 clutch. (14) Opening to No. 4 clutch. (15) Opening to No. 5 clutch.

Oil, to the clutches, is sent through openings (10), (11), (12), (13), (14) and (15) in the bottom manifold to the appropriate clutches for the speed and direction selected.

Neutralizer Valve



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Transmission Neutralizer Valve
(1) Spring. (2) Manifold. (3) Spool.

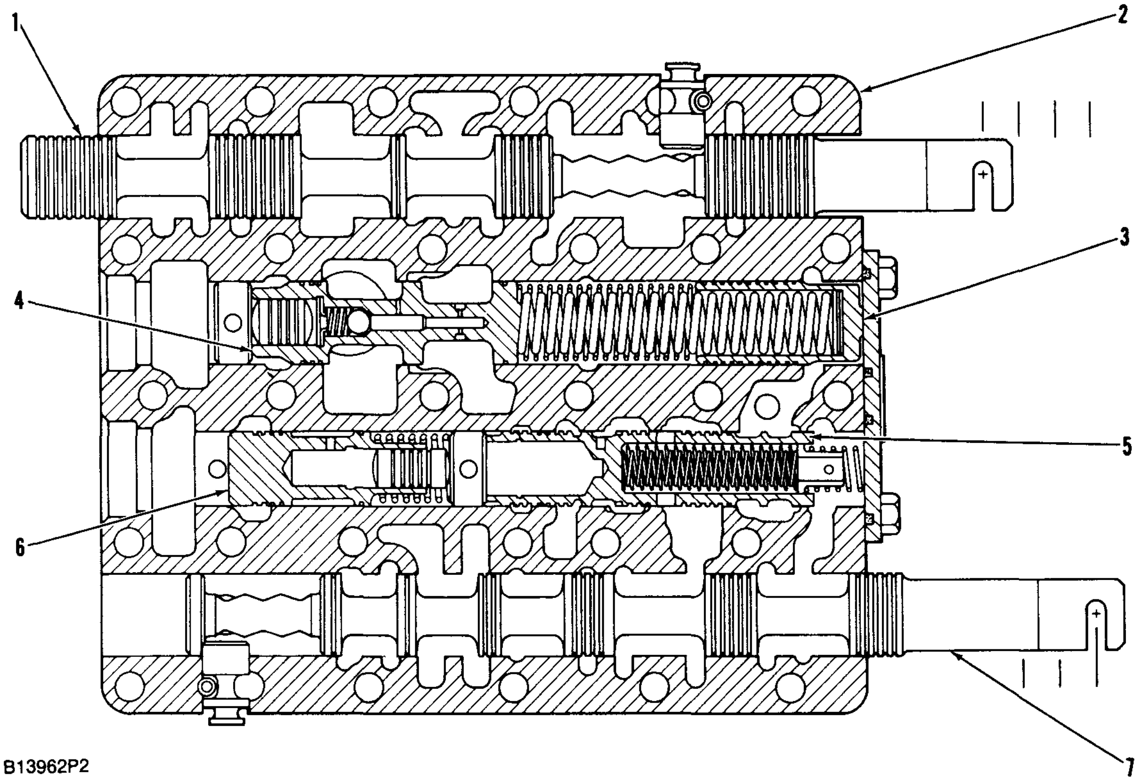
The neutralizer valve is in the bottom manifold of the hydraulic controls.

The neutralizer valve is activated by the left brake pedal. When the left brake pedal is pushed, brake system air pressure moves spool (3) against the force of spring (1). This opens a passage from the pressure differential valve to the reservoir. The oil pressure in the directional clutch circuit decreases, and the directional clutch is no longer engaged.

Since a speed and direction clutch must both be engaged before power goes through the transmission, power does not go through the transmission when the left brake pedal is pushed.

When the left brake pedal is released, the passage to the reservoir is closed. Oil pressure in the directional clutch will then increase until the directional clutch is engaged. Power then goes through the transmission.

Selector And Pressure Control Valve



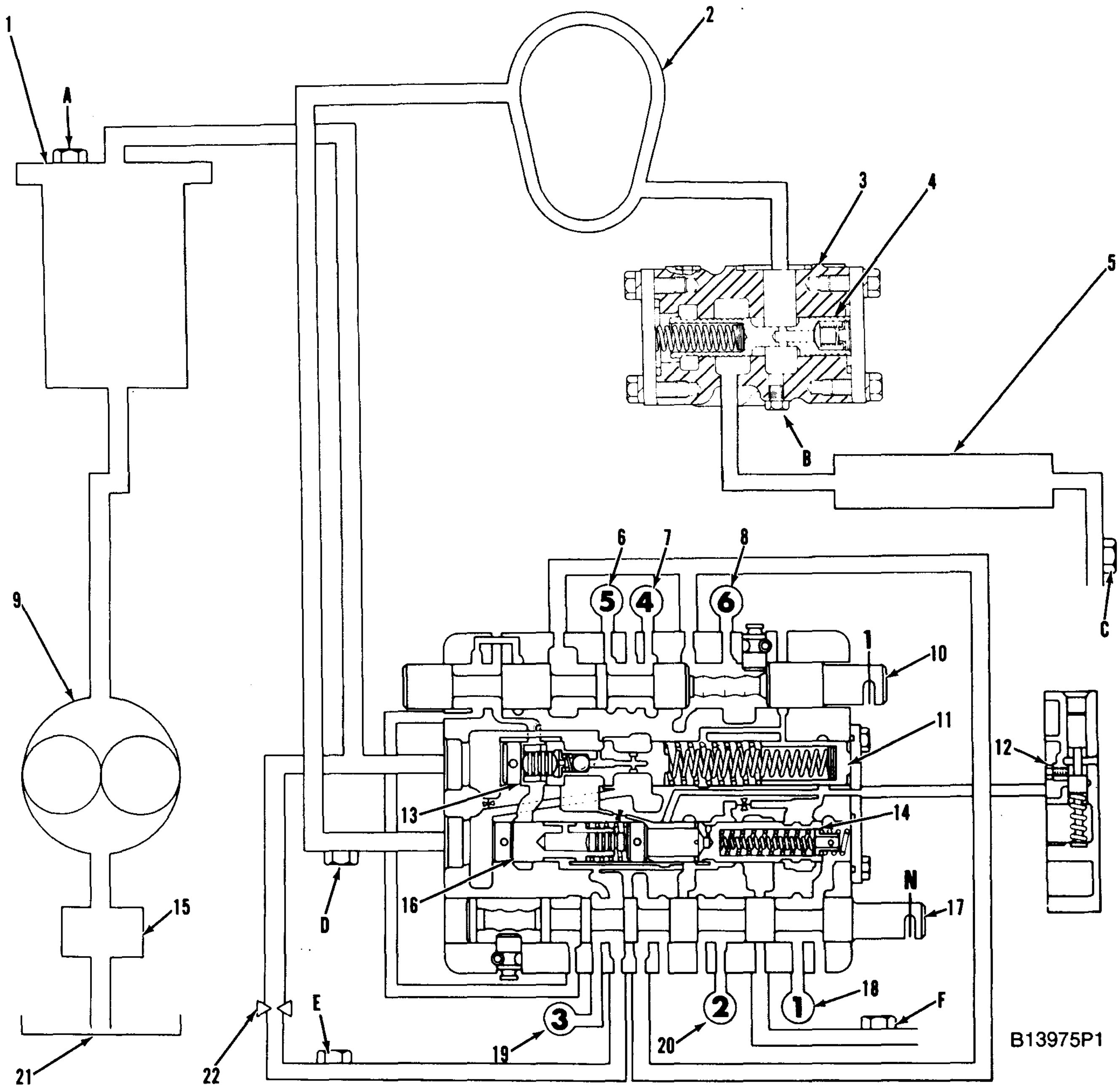
Selector And Pressure Control Valve
(1) Speed selection spool. (2) Valve body. (3) Load piston. (4) Modulation relief valve. (5) Pressure differential valve. (6) Oil pressure valve for torque converter inlet. (7) Direction selection spool.

The selector and pressure control valve is located under the top cover of the transmission.

Speed selection spool (1) is connected to the speed control cable from the transmission control lever.

Direction selection spool (7) is connected to the direction control cable from the transmission control lever.

Valve	Function
(1) Speed selection spool.	Directs oil to a speed clutch.
(3) Load piston.	Controls the rate of pressure increase in the clutches.
(4) Modulation relief valve.	Controls the maximum pressure in the system.
(5) Pressure differential valve.	Keeps a pressure differential between the speed and direction clutches. Prevents movement of the machine if the engine is started with the transmission in a speed and direction.
(6) Ratio valve for converter inlet.	Limits the maximum pressure to the torque converter.
(7) Direction selection spool.	Directs oil to a direction clutch.

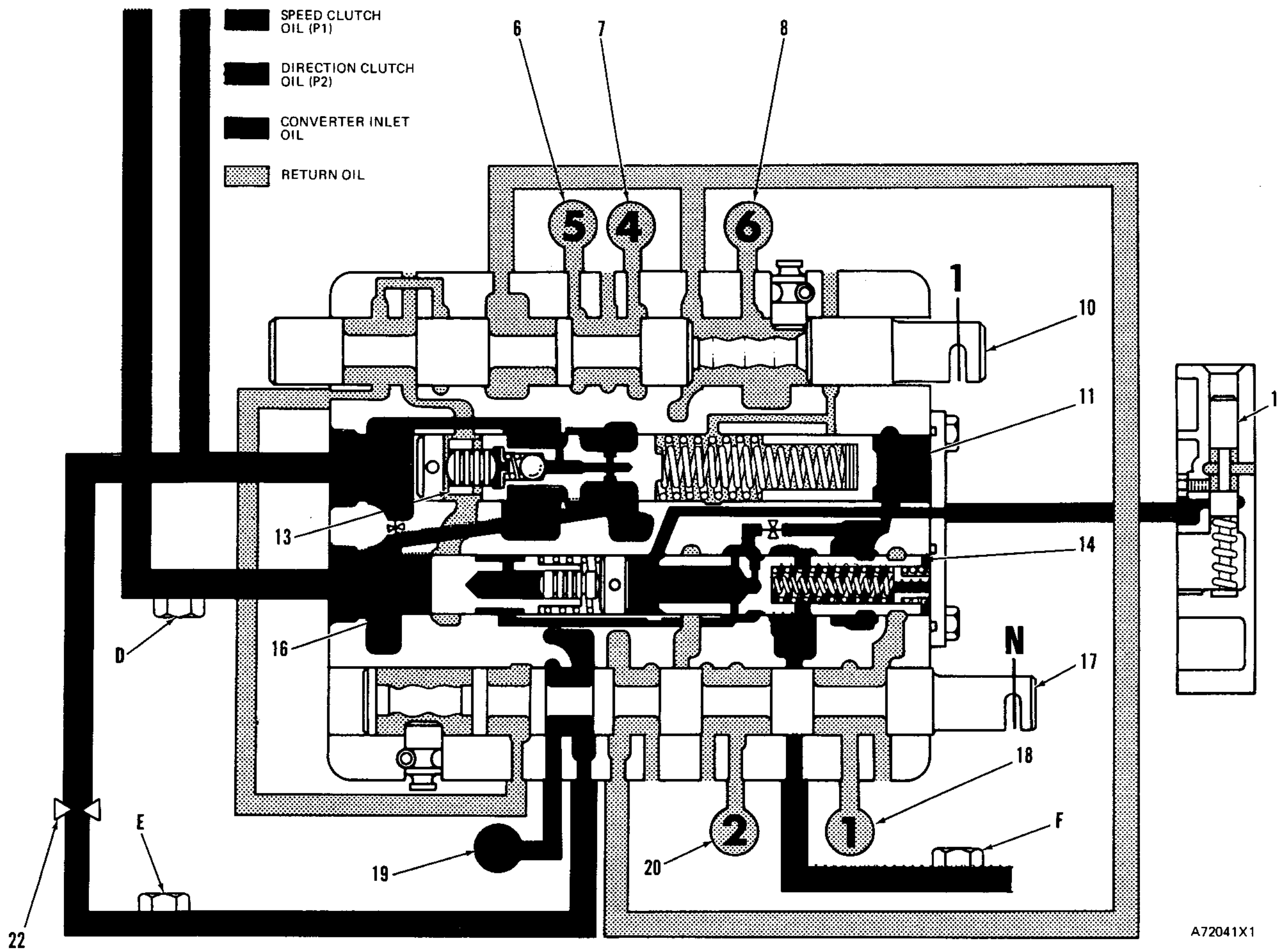


Transmission Hydraulic Controls
(Neutral, Engine Off)
(1) Oil filter. (2) Torque converter. (3) Body of relief valve for converter outlet. (4) Relief valve for converter outlet. (5) Oil cooler. (6) No. 5 clutch. (7) No. 4 clutch. (8) No. 6 clutch. (9) Oil pump. (10) Speed selection spool. (11) Load piston. (12) Transmission neutralizer valve. (13) Modulation relief valve. (14) Pressure differential valve. (15) Screen. (16) Ratio valve for torque converter. (17) Direction selection spool. (18) No. 1 clutch. (19) No. 3 clutch. (20) No. 2 clutch. (21) Reservoir. (22) Flow control orifice. (A) Pressure tap for pump (on filter). (B) Pressure tap for converter outlet. (C) Pressure tap for transmission lubrication. (D) Pressure tap for converter inlet. (E) Pressure tap for speed clutch (P1). (F) Pressure tap for direction clutch (P2).

When the engine is started, oil pump (9) pulls oil from reservoir (21) through magnetic screen (15). The pump sends the oil through filter (1) to the selector and pressure control valve group, which is part of the transmission hydraulic controls.

Operation

Starting the Engine (Transmission in Neutral)



Transmission Hydraulic Controls
(Neutral, Engine Running)
(6) No. 5 clutch. (7) No. 4 clutch. (8) No. 6 clutch. (10) Speed selection spool. (11) Load piston. (12) Transmission neutralizer valve.
(13) Modulation relief valve. (14) Pressure differential valve. (16) Ratio valve for torque converter. (17) Direction selection spool. (18) No. 1 clutch. (19) No. 3 clutch. (20) No. 2 clutch. (22) Flow control orifice. (D) Pressure tap for converter inlet. (E) Pressure tap for speed clutch (P1). (F) Pressure tap for direction clutch (P2).

When the transmission selection lever is in NEUTRAL, direction selection spool (17) is in the position shown in the schematic.

The position of direction selection spool (17) opens No. 3 clutch (19) to pump oil and opens the right end of pressure differential valve (14) to the reservoir. Speed clutches (6), (7) and (8) are opened to the reservoir. The position of direction selection spool (17) also opens direction clutches (18) and (20) to the reservoir.

Oil, from the pump, goes through flow control orifice (22) to No. 3 clutch (19), ratio valve (16) for the torque converter and pressure differential valve (14).

The oil to ratio valve (16) for the torque converter, goes through an orifice in the valve spool and fills the slug chamber.

The oil to pressure differential valve (14) goes through a small orifice in the valve spool and starts to fill the chamber at the left end of the spool.

When the transmission selector lever is in NEUTRAL, direction selection spool (17) closes the passage between the larger orifice in valve spool (14) and the reservoir. This lets the pressure, in the chamber at the left end of valve spool (14), increase. The increase in pressure moves the valve to the right against the force of the springs. The movement of the valve spool closes a passage from the area behind the right end of load piston (11) and the reservoir. At this time, pressure differential valve (14) is in the position shown in the schematic. This lets the pressure in the system increase.

As the pressure in the chamber at the left end of pressure differential valve (14) increases, the valve moves more to the right. This opens the direction clutch circuit to pump oil. It also closes the right end of valve (14) to the reservoir. The pressure in the direction clutch circuit increases. The increase is felt in the spring chamber of valve (14). When the pressure in the direction clutch circuit is at its maximum, the pressure in the spring chambers, plus the force of the springs, moves valve (14) to the left. The valve moves to the left until the flow of pump oil to the direction clutch circuit is stopped. At this time, the movement of the valve spool stops. Now the valve spool moves to the right and then to the left, (meters) to keep a constant pressure in the direction clutch circuit.

Oil, from the pump, also goes to modulation relief valve (13). It fills the chamber around the modulation relief valve. The oil goes through an orifice in the valve spool and opens the poppet valve at the left end of the valve spool. This lets oil fill the slug chamber at the left end of the valve spool.

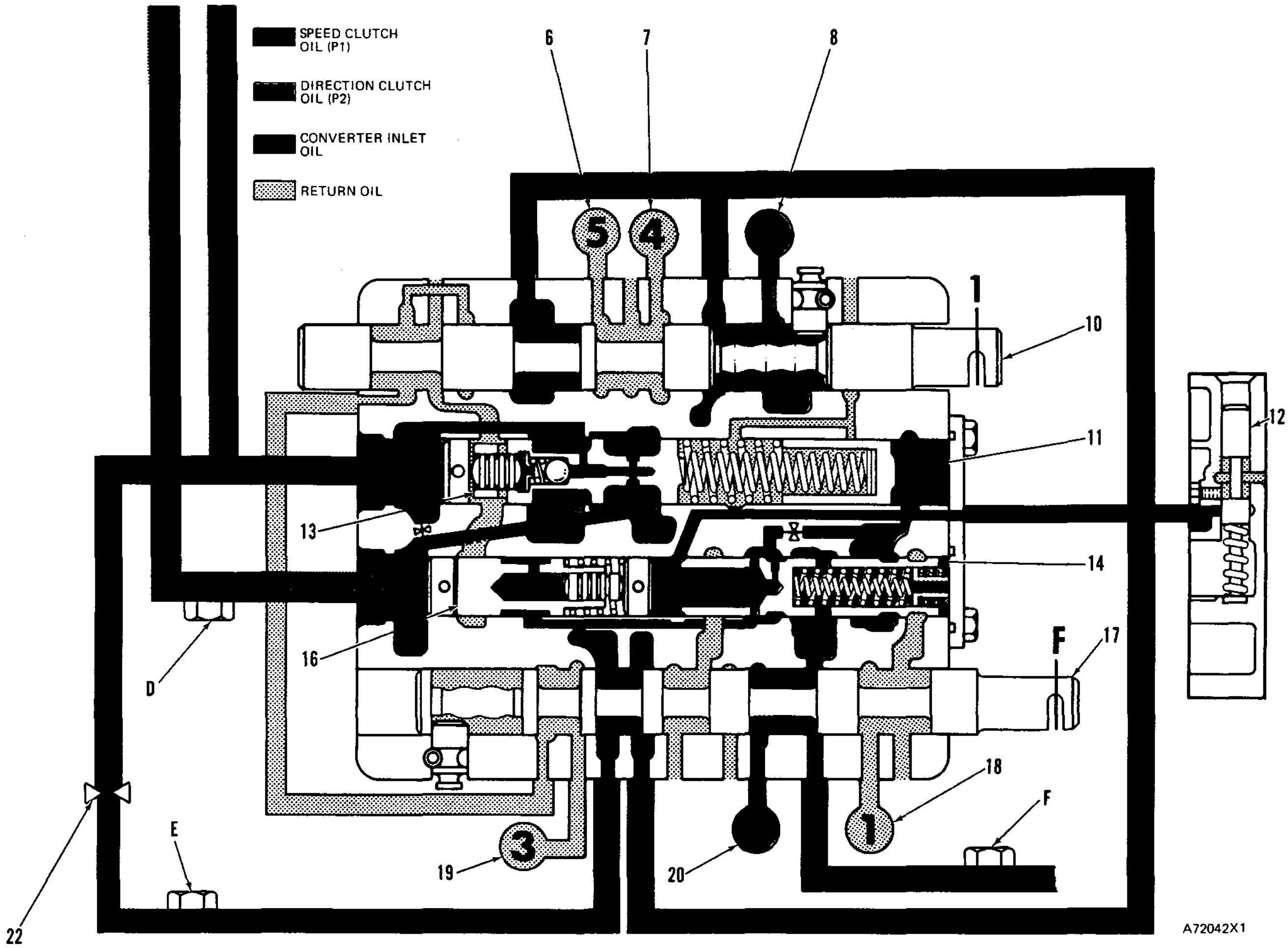
When the No. 3 clutch is full of oil, the pressure in the speed clutch circuit starts to increase. The increase is felt in the slug chamber at the left end of modulation relief valve (13). When the pressure in the speed clutch circuit is at the initial setting of the modulation relief valve, the modulation relief valve moves to the right. This lets extra oil go to the torque converter.

At the same time, pump oil also goes through an orifice to the area between the right end of load piston (11) and the cover on the selector and pressure control valve body. This area is closed to the reservoir by the position of differential valve (14). The amount of flow to the area behind load piston (11) is restricted by the orifice. The pressure felt by the modulation relief valve, because of the increase in pressure in the speed clutch circuit, is also felt behind load piston (11). The orifice in the supply passage causes the oil to go to the area behind the load piston at a specific rate. As the modulation relief valve moves to the right, the load piston moves to the left. This causes the pressure in No. 3 clutch (19) to increase gradually.

This gradual increase in pressure is known as modulation. The load piston moves more to the left, against the force of its springs, until the area behind the load piston is open to a drain passage. At this time, modulation stops. As the oil goes out the drain passage, oil continues to fill the area behind the load piston. This keeps the load piston in a position without any further movement.

The operation of the load piston and the modulation relief valve keeps the system pressure at a constant rate.

Engine Running
(Neutral to First Speed Forward)



Transmission Hydraulic Controls
(First Speed Forward)
(6) No. 5 clutch. (7) No. 4 clutch. (8) No. 6 clutch. (10) Speed selection spool. (11) Load piston. (12) Transmission neutralizer valve. (13) Modulation relief valve. (14) Pressure differential valve. (16) Ratio valve for torque converter. (17) Direction selection spool. (18) No. 1 clutch. (19) No. 3 clutch. (20) No. 2 clutch. (22) Flow control orifice. (D) Pressure tap for converter inlet. (E) Pressure tap for speed clutch (P1). (F) Pressure tap for direction clutch (P2).

When the transmission selection lever is moved to FIRST SPEED FORWARD, speed selection spool (10) and direction selection spool (17) are in the positions shown in the schematic.

The position of direction selection spool (17) opens a passage to No. 2 clutch (20). It also opens passages from No. 3 clutch (19) and No. 1 clutch (18) to the reservoir.

The position of speed selection spool (10) opens a passage from No. 6 clutch (8) to pump oil. It also opens No. 4 clutch (7) and No. 5 clutch (6) to the reservoir.

When the shift to FIRST SPEED FORWARD is made, the No. 3 clutch is opened to the reservoir. The pressure in the system decreases. Springs move modulation relief valve (13) toward the left. Springs move pressure differential valve (14) toward the left until the large orifice at the left end of valve (14) is closed to pump oil by the valve body.

As the pressure differential valve moves toward the left, the chamber behind load piston (11) opens to the reservoir. This lets the springs move the load piston to the right. The pressure differential valve is in a position to let the pressure increase in the speed clutch circuit.

The speed clutch oil starts to fill No. 6 clutch (8).

When the No. 6 clutch is full of oil, the pressure in the speed clutch circuit starts to increase. The increase is felt in the slug chamber of modulation relief valve (13) and the chamber at the left end of pressure differential valve (14).

The oil to pressure differential valve (14) starts to fill the chamber at the left end of the valve spool, through the small orifice.

When the pressure in the No. 6 clutch is approximately 380 kPa (55 psi), pressure differential valve (14) starts to move to the right. The movement of the valve spool opens No. 2 clutch (2) to pump oil. It also closes a passage from the chamber behind load piston (11) to the reservoir.

When the No. 2 clutch is full of oil, the pressure in the direction clutch circuit increases. The increase is felt in the spring chamber of pressure differential valve (14). The pressure in the spring chamber and the force of the springs moves the valve to the left against the speed clutch pressure at the left end of the valve spool.

As the pressure in the speed clutch circuit increases, the pressure in the chamber at the left end of pressure differential valve (14) increases.

The increase in pressure moves the valve spool to the right against the force of the springs. This opens No. 2 clutch (20) to pump oil.

As the pressure in the No. 2 clutch increases, the pressure in the spring chamber of valve (14) increases. The increased pressure in the spring chamber and the force of the springs, moves the valve spool to the left.

This stops the flow of pump oil to the No. 2 clutch. This function continues until the pressure in the No. 2 clutch is at its maximum. At this time, the pressure in the spring chamber and the force of the springs moves the valve spool to the left, until the flow of oil to the clutch is stopped. Now the valve moves to the right and left (meters) to keep a constant pressure in the No. 2 clutch. This pressure is approximately 380 kPa (55 psi) less than the pressure in the speed clutch. This difference is determined by the force of the springs of the pressure differential valve.

Pump oil also goes through flow control orifice (22) to ratio valve (16) for the torque converter. It goes through an orifice in the valve spool and fills the slug chamber.

Oil, from the pump, also goes to modulation relief valve (13). It fills the chamber around the valve spool. The oil goes through an orifice in the valve spool and opens the poppet valve at the left end of the valve spool. This lets oil fill the slug chamber at the left end of the valve spool.

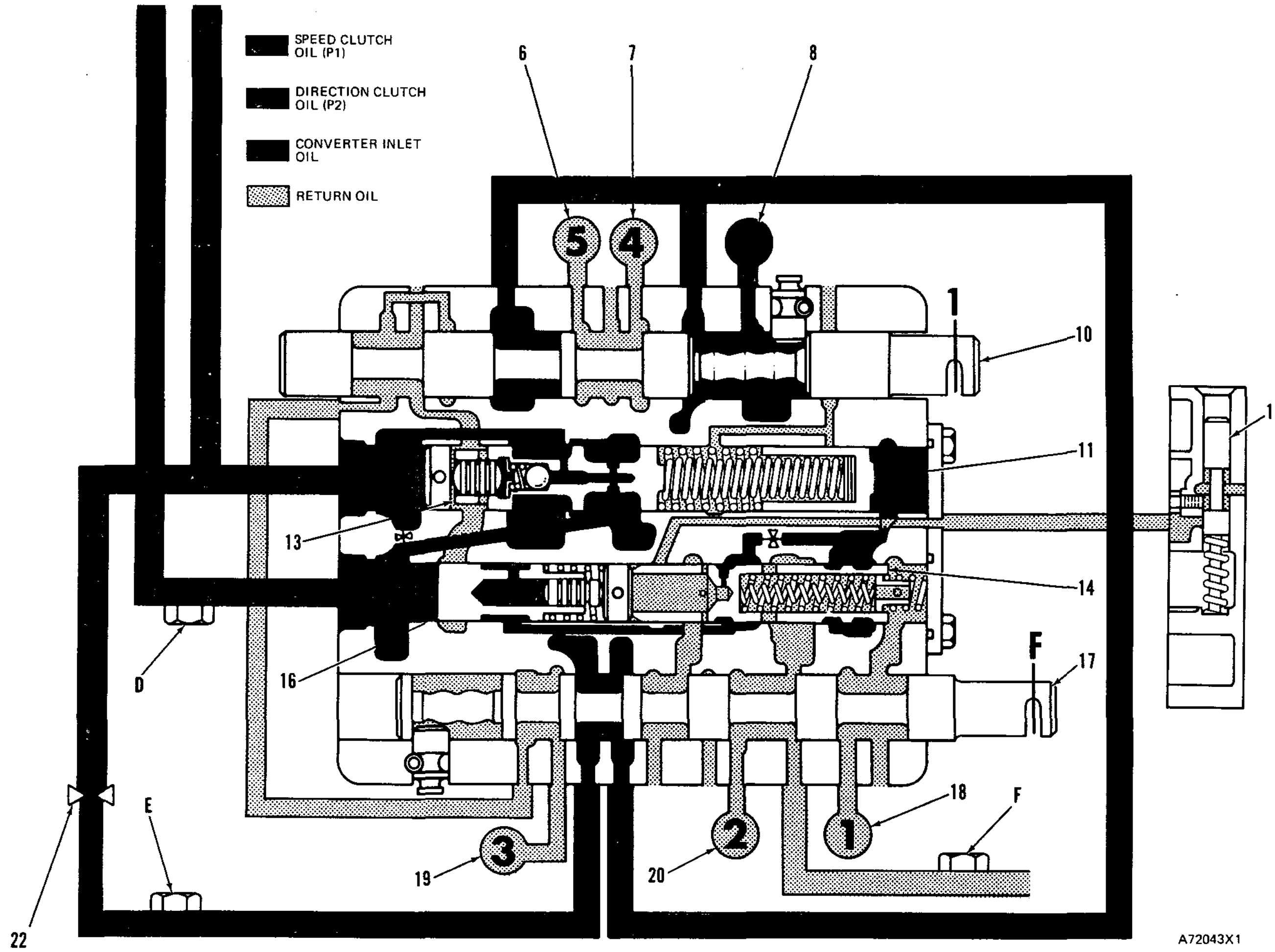
The function of modulation relief valve (13) and load piston (11), is to control the rate of the pressure increase in the speed clutch circuit as follows:

As the pressure in the No. 6 clutch increases, modulation relief valve (13) moves to the right and load piston (11) moves to the left. The orifice in the supply passage to the load piston, causes the oil to go to the area behind the load piston at a specific rate. As the modulation relief valve moves to the right and the load piston moves to the left, the pressure in No. 6 clutch (8) increases gradually. This gradual increase in pressure is known as modulation.

The load piston moves more to the left against the force of its springs, until the area behind the load piston is open to a drain passage. At this time, modulation stops. As the oil goes out the drain passage, oil continues to fill the area behind the load piston. This keeps the load piston in this position. After the pressures in the clutches are at their maximum, modulation relief valve (13) lets the extra oil go to the torque converter.

The operation of the load piston and the modulation relief valve keeps the system pressure at a constant rate.

Starting the Engine
(Transmission in a Speed and Direction)



Transmission Hydraulic Controls
(Engine Started In First Speed Forward)
(6) No. 5 clutch. (7) No. 4 clutch. (8) No. 6 clutch. (10) Speed selection spool. (11) Load piston. (12) Transmission neutralizer valve.
(13) Modulation relief valve. (14) Pressure differential valve. (16) Ratio valve for torque converter. (17) Direction selection spool. (18) No. 1 clutch. (19) No. 3 clutch. (20) No. 2 clutch. (22) Flow control orifice. (D) Pressure tap for converter inlet. (E) Pressure tap for speed clutch (P1).
(F) Pressure tap for direction clutch (P2).

When the engine is started with the transmission selection lever in either FORWARD or REVERSE, the operation of pressure differential valve (14) prevents movement of the machine.

As pump oil goes through the small orifice at the left end of pressure differential valve (14), it starts to fill the chamber. However, when direction selection spool (17) is in either FORWARD or REVERSE, the position of the spool opens a passage from the chamber to the reservoir, through the large orifice at the left end of the valve.

As the pressure in the system increases, the pressure in the chamber at the left end of pressure differential valve (14) does not increase. Since the pressure in the chamber does not increase, the valve can not move to the right against the force of the springs. Since the pressure differential valve does not move to the right, pump oil does not go to a direction clutch.

Direction selection spool (17) must be moved to the NEUTRAL position, to close the passage to the reservoir, before pressure will increase in the chamber at the left end of pressure differential valve (14). At this time, the increase in system pressure is felt in the chamber of valve (14). As the pressure increases in the chamber, the pressure differential valve will move to the right, against the force of the springs. This puts pressure differential valve (14) in a position to let the pressure increase in the direction clutch circuit when direction selection spool (17) is moved from NEUTRAL.

Neutralizer Valve

When the left brake pedal is pushed, air pressure, from the brake system, moves neutralizer valve (12) against the force of its spring. The movement of valve (12) opens the chamber at the left end of pressure differential valve (14) to the reservoir through the neutralizer valve body. The force of the springs and the oil pressure in the spring chamber of the pressure differential valve, move the valve to the left. The movement of valve (14) opens the direction clutch circuit to the reservoir through the right end of the valve. The valve spool moves further to the left, until the flow of pump oil to the direction clutch is stopped. At this time, pressure differential valve (14) is in a position to let the pressure increase in the direction clutch circuit, when the left brake pedal is released.

Ratio Valve for Converter Inlet

The ratio valve (16) for the torque converter, controls the maximum pressure to the converter. Its primary purpose is to prevent damage to the converter components when the engine is started with cold oil.

The pressure to the torque converter, caused by restrictions to flow, is felt against the left end of valve spool (16). This pressure pushes against the whole diameter of the valve spool.

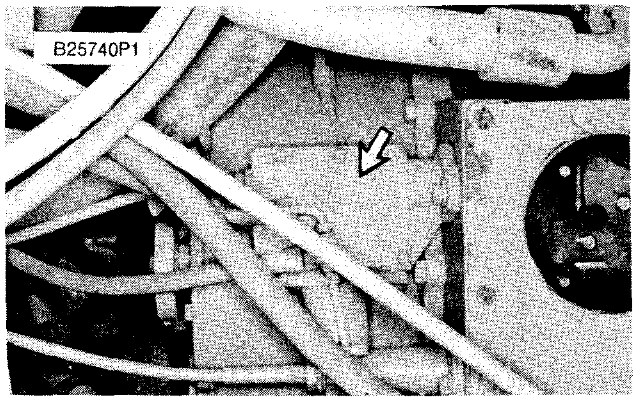
Pressure from the P1 clutch circuit is felt in the slug chamber of the valve spool. This pressure pushes against only the diameter of the slug.

The pressure (on the left end of valve) needed to move the valve to the right is less than the pressure (in slug chamber) needed to move the valve to the left.

When the inlet pressure to the torque converter gets to its maximum, the valve spool moves to the right. This lets the extra oil go to the reservoir. When the pressures are again in balance, the valve moves back to the left.

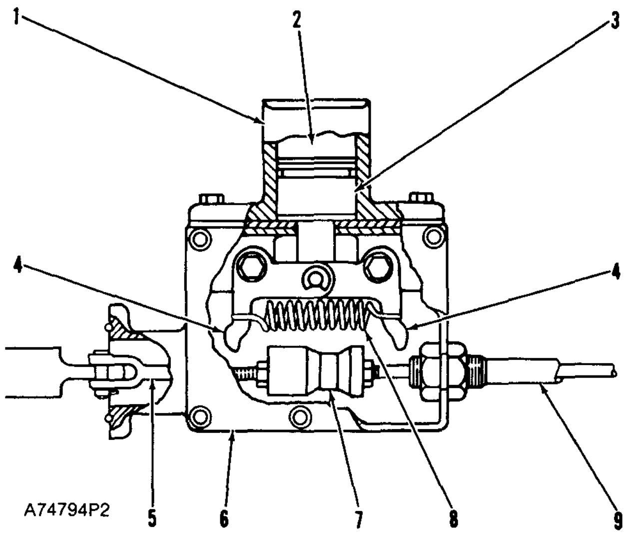
All oil, not used by the clutches goes to the ratio valve for the torque converter.

Transmission Neutralizer Group



Location Of Transmission Neutralizer Group

The transmission neutralizer group is fastened to the front of the transmission case. Rod (5) is connected to the direction selection spool, of the selector and pressure control valve group. Cam (7) is connected to the direction control linkage from the transmission selector lever.



Transmission Neutralizer Group
(Neutral Position, Engine Running)
(1) Piston housing. (2) Chamber. (3) Piston. (4) Levers (two).
(5) Rod. (6) Housing. (7) Cam. (8) Spring. (9) Directional control cable.

The transmission neutralizer group moves the direction selection spool to the NEUTRAL position when the parking brake is engaged, or when the air pressure in the brake system goes below 140 to 205 kPa (20 to 30 psi).

Operation

Parking Brake Not Engaged

When the parking brake is not engaged, air pressure from the air reservoir goes into piston housing (1). The air enters chamber (2) through an air inlet port at the top of the housing. The air pressure moves piston (3) down. The movement of piston (3) causes levers (4) to move apart, against the force of spring (8).

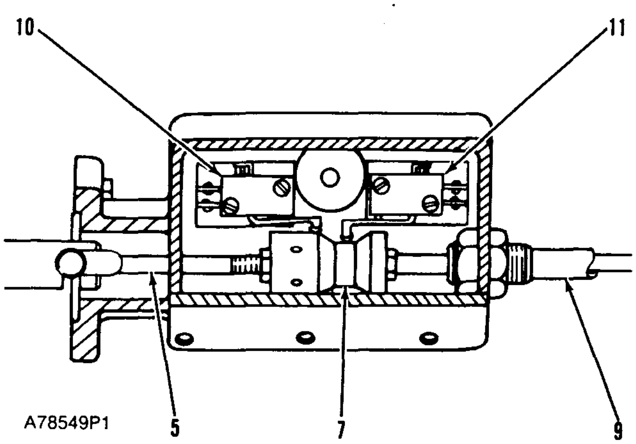
When the transmission selector lever is moved to either FORWARD or REVERSE, cam (7) moves without any resistance. If the selector lever is released, it will stay in that position.

Parking Brake Engaged

When the parking brake is engaged, the secondary and parking brake control valve is activated. This valve is located at the base of the steering column. It is connected by a cable, to the parking brake control knob under the steering wheel. When the control knob is pulled up (engaged position), the secondary and parking brake control valve is activated.

This valve stops (blocks) the air pressure to the neutralizer valve group, parking brake pressure switch and the parking brake.

When the air pressure to the neutralizer valve group is stopped, pressure in chamber (2) decreases. When the pressure in the chamber goes below 140 to 205 kPa (20 to 30 psi), the force of spring (8) causes levers (4) to come together. The movement of the lever causes piston (3) to move up, toward the top of chamber (2).



Transmission Neutralizer Group
(Neutral Position, Top View)
(5) Rod. (7) Cam. (9) Directional control cable. (10) Switch.
(11) Switch.

If the transmission is engaged in either FORWARD or REVERSE, levers (4) will come in contact with cam (7). The force of spring (8) causes cam (7) to move when contact is made with the levers. Since cam (7) is connected to the direction selection spool by rod (5), the direction selection spool will also move. The direction selection spool is moved from the FORWARD or REVERSE position, to the NEUTRAL position.

With the transmission in NEUTRAL, switches (10) and (11) are in the positions shown. See Illustration A.

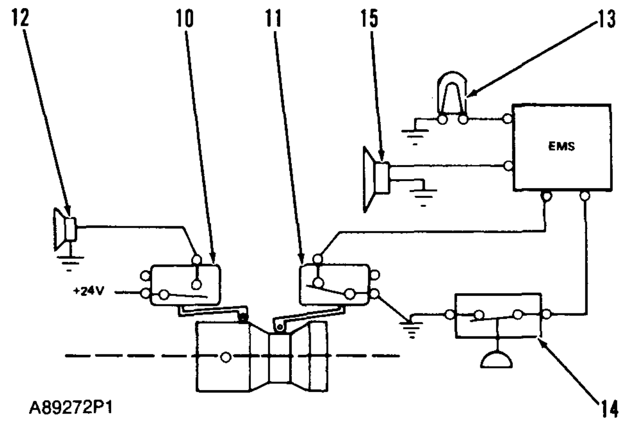


Illustration A
(Engine Running, Transmission in Neutral,Parking Brake Not Engaged)
(10) Switch. (11) Switch. (12) Back-up alarm. (13) Indicator light.
(14) Parking brake pressure switch. (15) Warning alarm.

Switch (10) is part of the back-up alarm system.

Switch (11) is part of the parking brake warning and alarm system.

When a shift is made to either FORWARD or REVERSE, cam (7) moves to the left or right. The movement of cam (7) causes switch (11) to be in the positions shown in ILLUSTRATIONS B and C. When the parking brake is engaged, air pressure is stopped to parking brake pressure switch (14). When the air pressure goes below approximately 450 kPa (65 psi), switch (14) opens and parking brake indicator (13) goes "ON". Indicator (13) is on the EMS (Electronic Monitoring System) panel.

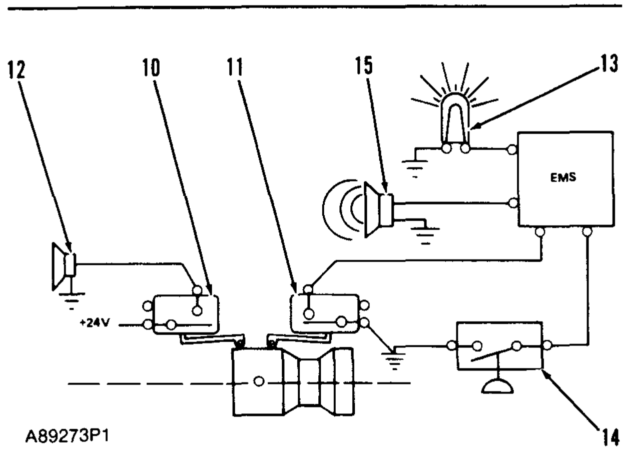


Illustration B
(Engine Running, Transmission in Forward,Parking Brake Engaged)
(10) Switch. (11) Switch. (12) Back-up alarm. (13) Indicator light. (14) Parking brake pressure switch. (15) Warning alarm.

With the parking brake engaged, pressure also decreases at the transmission neutralizer group. The neutralizer group moves the transmission selector lever to the NEUTRAL position.

The transmission selector lever can be held in the FORWARD or REVERSE position, while the parking brake is engaged. At this time however, the master fault light (to the right of the operator's seat) will come "ON" and an alarm will sound.

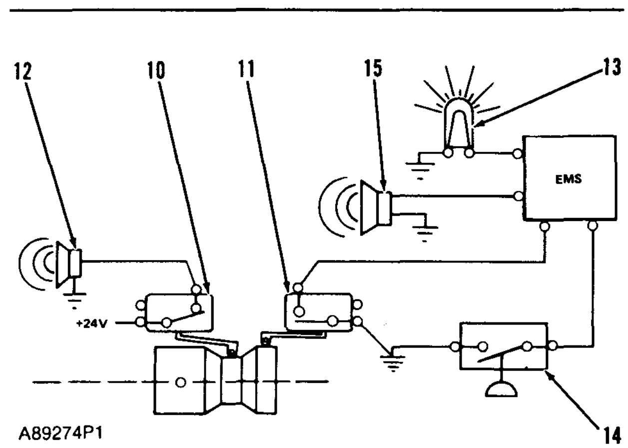


Illustration C
(Engine Running, Transmission in Reverse,Parking Brake Engaged)
(10) Switch. (11) Switch. (12) Back-up alarm. (13) Indicator light. (14) Parking brake pressure switch. (15) Warning alarm.

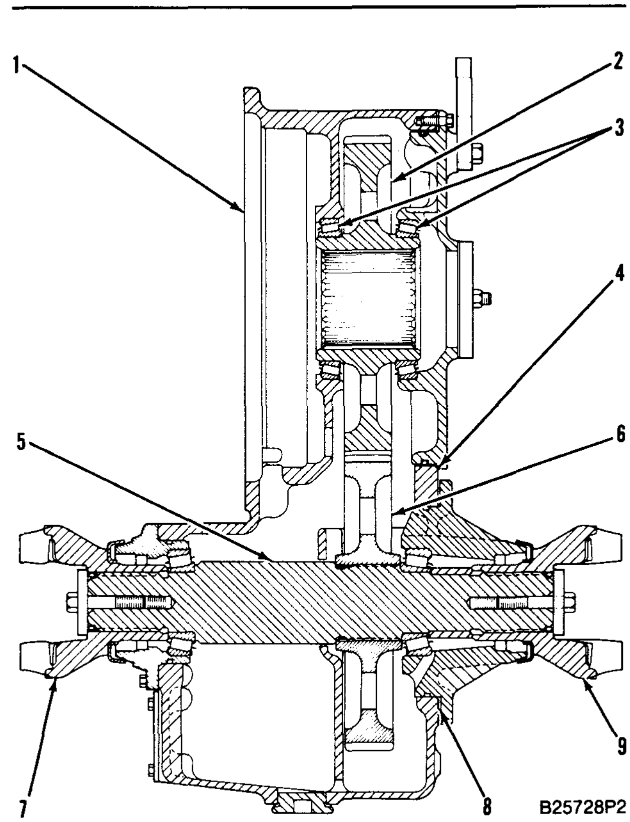
When the transmission lever is released, the lever will return to the NEUTRAL position. At this time, the alarm and the master fault light will go "OFF".

Therefore, before a full warning is given, the parking brake must be engaged and the transmission in either FORWARD or REVERSE.

When a shift is made to the REVERSE position, cam (7) moves to the left. The movement of cam (7) causes switch (10) to be in the position shown in ILLUSTRATION C. Switch (10) is part of the back-up alarm system. At this time, switch (10) closes and the back-up alarm will sound.

When a shift is made to either NEUTRAL or FORWARD, switch (10) opens and the back-up alarm will not sound.

Output Transfer Gears



Output Transfer Gears
(1) Case assembly. (2) Drive gear. (3) Bearings. (4) Shims. (5) Shaft. (6) Gear. (7) Yoke assembly. (8) Shims. (9) Yoke assembly.

The output transfer gears are at the output side of the transmission. The transmission output shaft is connected to drive gear (2) by splines.

Drive gear (2) is engaged with gear (6). Driven gear (6) is connected to shaft (5) by splines. Yoke assemblies (7) and (9) are connected to shaft (5) by splines. Yoke assembly (7) is connected to the short drive shaft that goes to the rear differential. Yoke assembly (9) is connected to the drive shaft that goes to the bearing cage and then to the front differential.

The flow of power through the output transfer gears is:

From transmission output shaft to drive gear (2).
From gear (2) to driven gear (6).
From driven gear (6) to shaft (5).

At shaft (5) the flow of power divides as follows:

Part of the power goes from yoke assembly (7) through a drive shaft to the rear differential.
Part of the power goes from yoke assembly (9) through a drive shaft and bearing cage to the front differential.

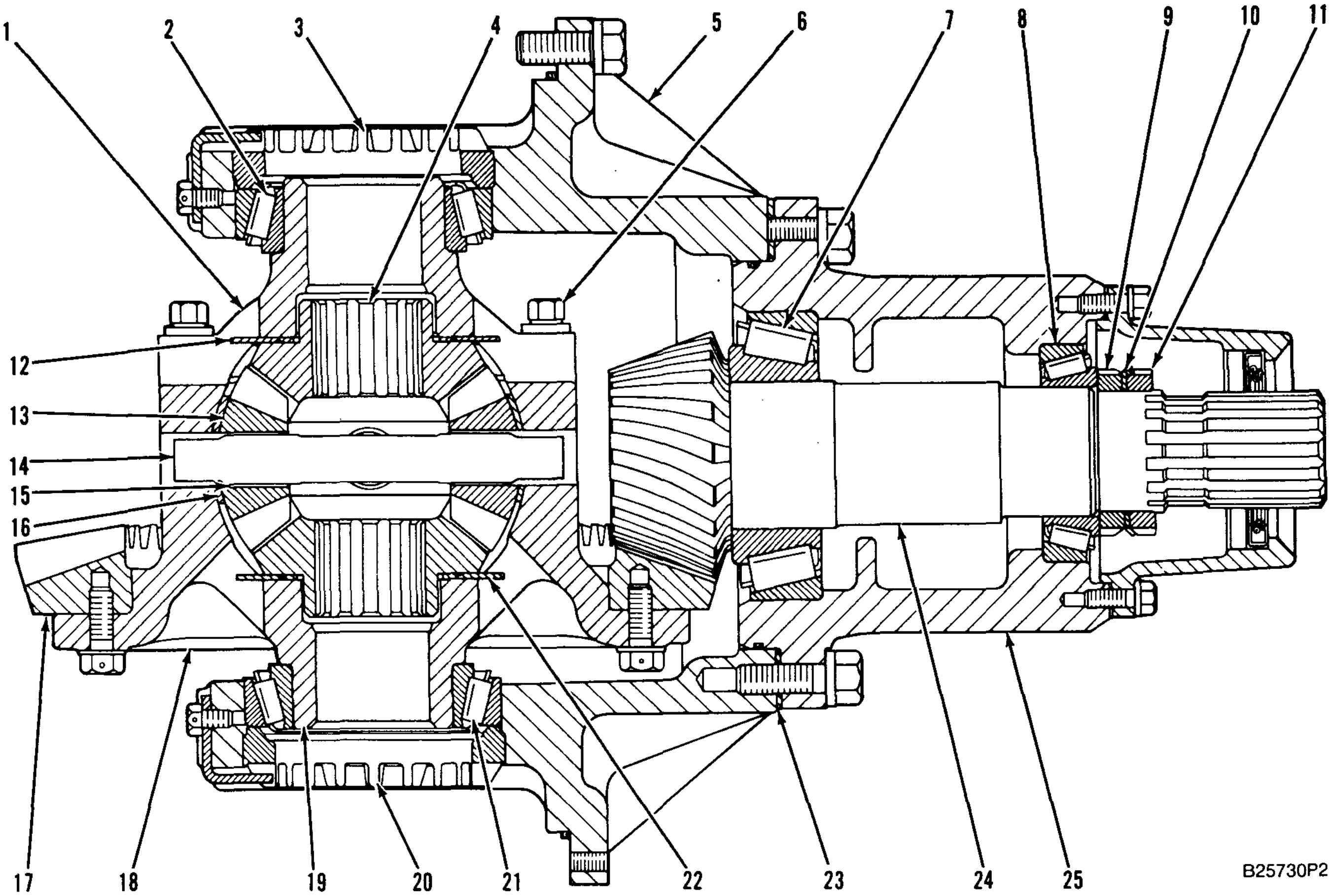
Shims (4) are used to make an adjustment to the end play of gear (2).

Shims (8) are used to make an adjustment to the end play of shaft (5).

Output Transfer Gear Lubrication

Since the transfer gear case is also the reservoir for the transmission circuit, all return oil goes to the bottom of the case. The movement of the gears in the oil causes oil to be thrown on all the components.

Differentials



Differential And Bevel Gear Group (Earlier Style Shown)
(Top View Of Front Differential)
(1) Case. (2) Bearing cup and cone. (3) Adjustment ring. (4) Side gear. (5) Carrier. (6) Bolts. (7) Bearing cup and cone. (8) Bearing cup and cone. (9) Nut. (10) Lock. (11) Nut. (12) Thrust washer. (13) Pinions. (14) Spider. (15) Bearing. (16) Washer. (17) Ring gear. (18) Case. (19) Side gear. (20) Adjustment ring. (21) Bearing cup and cone. (22) Thrust washer. (23) Shims. (24) Pinion. (25) Housing.

A differential divides or causes a balance of the power which is sent to the wheels. When one wheel turns slower than the other, as in a turn, the differential lets the inside wheel go slower in relation to the outside wheel. The differential still sends the same amount of torque to each wheel.

Bevel pinion (24) is connected to a yoke. The yoke assembly is connected to a universal joint from the output transfer gears. Pinion (24) is connected to the yoke assembly by splines. Pinion (24) is engaged with ring gear (17). Ring gear (17) is fastened to the differential group. Differential carrier (5) is fastened to the axle housing.

The differential group has a case (18). Ring gear (17) is fastened to case (18). Case (18) is fastened to case (1) by bolts (6). Inside the differential group is side gear (4), spider (14), four pinions (13) and side gear (19). Spider (14) is installed between the two cases. When the cases are turned, the spider turns. Pinions (13) are installed on the spider and are engaged with the teeth of side gears (4 and 19). The axle shafts are connected to the side gears by splines. Side gears (4 and 19) turn against thrust washers (12 and 22). Pinions (13) turn on bearings (15).

Nuts (9 and 11) and lock (10) are used to make an adjustment to the end play (bearing preload) of bearings (7 and 8) for pinion (24) on earlier style machines. Later stlye machines only have one nut item (11).

Shims (23) are used to make an adjustment to the tooth contact (wear pattern) between pinion (24) and ring gear (17).

Rings (3 and 20) are used to make an adjustment to the free movement (backlash) between pinion (24) and ring gear (17). Rings (3 and 20) are also used to make an adjustment to the bearing preload of bearings (2 and 21).

The inside components of the differential get their lubrication from oil thrown around inside the differential. Flat surfaces on spider (14) let oil go to bearings (15). The supply for lubrication oil is a reservoir in the axle housing.

Operation

Straight Forward or Reverse

When the machine moves in a straight direction with the same amount of traction under each drive wheel, the same amount of torque on each axle holds the pinions so they do not turn on the spider.

Pinion (24) turns ring gear (17). Ring gear (17) turns cases (1 and 18). Cases (1 and 18) turn spider (14). Spider (14) turns side gears (4 and 19) through pinions (13). Pinions (13) do not turn on the spider. The side gears turn the axle shafts. The same amount of torque is sent to each wheel.

This gives the same effect as if both drive wheels were on one axle shaft.

Forward or Reverse Turn

When the machine is in a turn, the inside wheel has more resistance to turn than the outside wheel. This resistance causes different torques on the opposite sides of the differential. It is easier for the outside wheel to turn than it is for the inside wheel. The outside wheel starts to turn faster than the inside wheel.

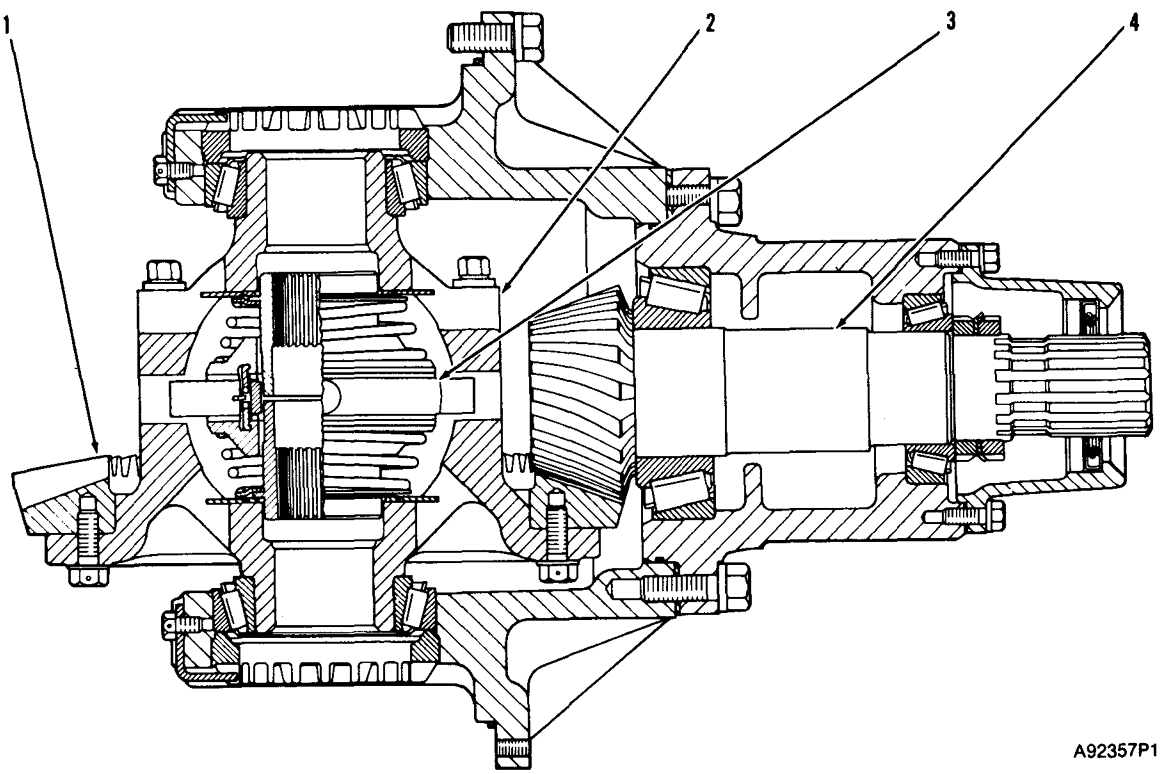
Pinion (24) turns ring gear (17). Ring gear (17) turns cases (1 and 18). Cases (1 and 18) turn spider (14). Spider (14) turns side gears (4 and 19) through pinions (13). Since it takes more force to turn one side gear than it does the other, pinions (13) turn around the spider. As the pinions turn, they move around the side gears. This lets the outside wheel turn faster than the inside wheel.

The same amount of torque is sent to both the inside and outside wheels. This torque is only equal to the amount needed to turn the outside wheel.

Loss of Traction (Wheel Slippage)

When one wheel has more traction than the other, the operation of the differential is the same as in a turn. The same amount of torque is sent to both wheels. This torque is only equal to the amount needed to turn the wheel with the least resistance.

NoSpin Differential Group



NoSpin Differential Group (Earlier Style Shown)
(1) Bevel gear. (2) Case. (3) NoSpin differential. (4) Bevel pinion.

The NoSpin differential group has a bevel gear (1), a case (2), a NoSpin differential (3) and a bevel pinion (4).

The flow of power from the transmission through the differential is:

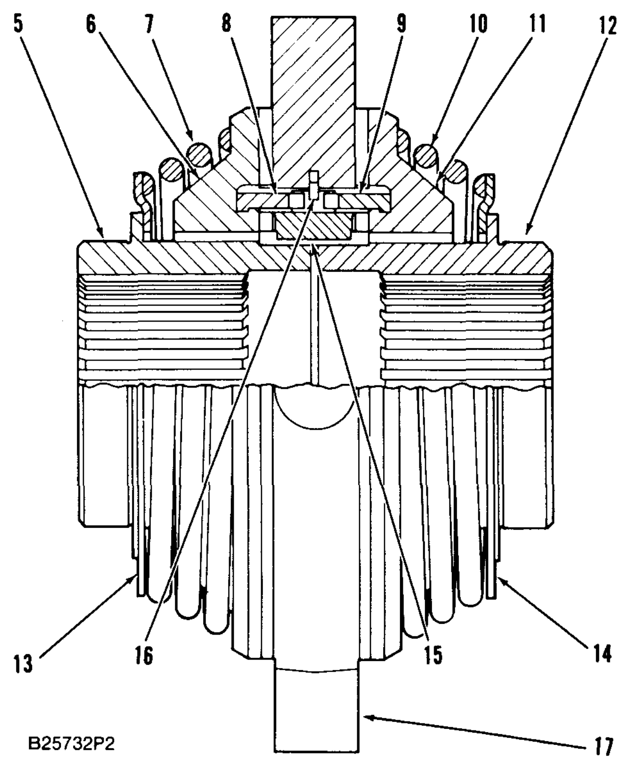
From the transmission through the rear drive shaft to bevel pinion (4).
From bevel pinion (4) to bevel gear (1).
From bevel gear (1) to the differential housing.
From the differential housing through spider (17) to NoSpin differential (3).
From NoSpin differential (3) to the drive axles.

When the speeds of the wheels are the same, the NoSpin differential sends the same amount of torque to each wheel. When the speeds of the wheels are different, the NoSpin differential sends the torque to the wheel that turns slower. A difference in the speeds of the wheels is caused by a turn.

The NoSpin differential lets a wheel (axle) turn faster than the speed of the bevel gear by not engaging it with the bevel gear. For example: During a turn with power, the outside wheel (axle) is not engaged with the bevel gear and turns faster while the inside wheel axle is engaged with the bevel gear and turns at the same speed as the bevel gear. The inside wheel gives the power which moves the machine through the turn.

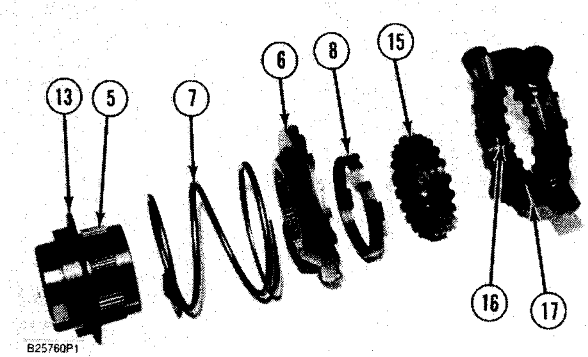
The NoSpin differential is the same on one side of the spider (17) as it is on the other side (symmetrical). The NoSpin has two springs (7) and (10), two side gears (5) and (12), two driven clutches (6 and 11), two holdout rings (8) and (9), a center cam (15), a snap ring (16) and a spider (17).

The inside splines of side gears (5) and (12) are connected to the drive axles. The outside splines of the side gears are connected to the inside splines of drive clutches (6) and (11). The side gears send the power through the axles to the wheels.



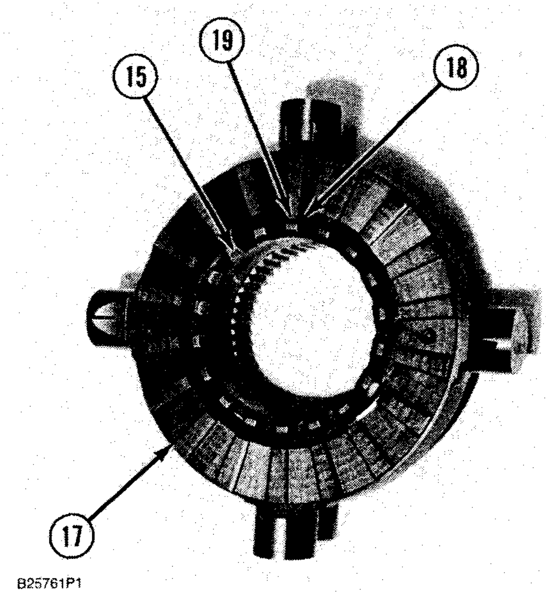
NoSpin Differential (Earlier Style Shown)
(Assembled)
(5) Side gear. (6) Driven clutch. (7) Spring. (8) Holdout ring.
(9) Holdout ring. (10) Spring. (11) Driven clutch. (12) Side gear.
(13) Spring retainer. (14) Spring retainer. (15) Center cam.
(16) Snap ring. (17) Spider.

Spider (17) is fastened to the differential case and turns at the speed of the bevel gear. The spider has clutch teeth on both sides. The spider also has one long tooth. The long tooth is spider key (19). Center cam (15) fits inside the spider and is held in position by snap ring (16). The center cam is turned by spider key (19) which fits inside notch (18). The spider key pushes on either side of notch (18). The direction of the machine, forward or reverse, controls which way the spider turns and which side of notch (18) gets the force.



NoSpin Differential
(Left Side Disassembled)
(5) Side gear. (6) Driven clutch. (7) Spring. (8) Holdout ring.
(13) Spring retainer. (15) Center cam. (16) Snap ring. (17) Spider.

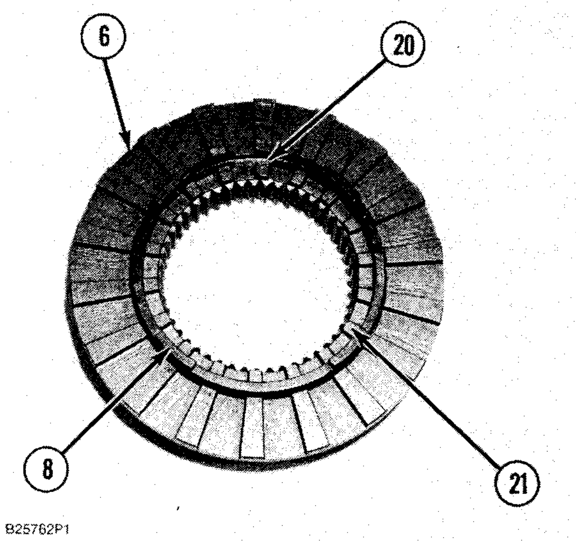
Springs (7) and (10) fit between the side gears and spring retainers (13) and (14). The outside splines of the spring retainers are connected to the inside splines of the driven clutches. The force of the springs holds the driven clutches against spider (17) and the side gears against the differential case.



Spider And Center Cam
(15) Center cam. (17) Spider. (18) Notch in center cam. (19) Spider key.

Driven clutches (6) and (11) are the same. Each driven clutch has a cam (21) which is part of the clutch. The teeth on the cam engage with the teeth of center cam (15). The teeth of the drive clutches engage with the teeth of spider (17). An annular (in the shape of a circle) groove is between the teeth of the driven clutches and the teeth of the cams.

Holdout rings (8) and (9) are the same. Each holdout ring fits in the annular groove between the teeth of the driven clutches and the teeth of the cams. The teeth of the holdout rings engage with the notches in the center cam. Notch (20) in the holdout ring engages with spider key (19). The spider key controls the movement of the holdout ring in relation to the spider. There is no connection, except friction, between the holdout rings and the driven clutches.



Clutch And Holdout Ring
(6) Driven clutch. (8) Holdout ring. (20) Notch in holdout ring. (21) Cam.

Operation Of NoSpin Differential

When a wheel is made to turn faster than the speed of the bevel gear, the "clutch action" (the stopping of power to drive axle) of the NoSpin differential will let this axle turn faster than the speed of the bevel gear.

The "clutch action" of the NoSpin differential is as follows: If spider (17) turns, spider key (19) locates center cam (15) and the spider and the center cam turn at the speed of the bevel gear. The center cam turns holdout ring (8) and cam (21) at the speed of the bevel gear. The spider turns driven clutch (6) at the speed of the bevel gear. The driven clutch turns the side gear, axle and wheel at the speed of the bevel gear.

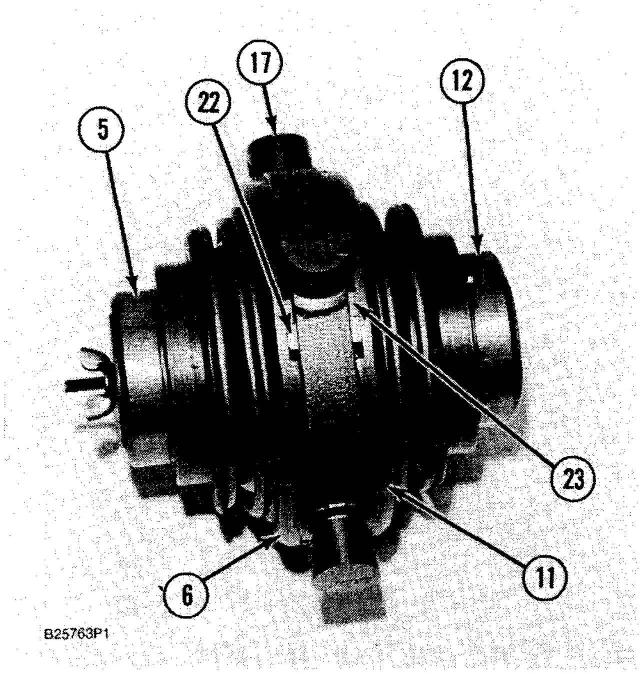
When the wheel is made to turn faster than the speed of the bevel gear, the teeth of center cam (15) work like ramps and the teeth of cam (21) move up the teeth of the center cam. This action causes driven clutch (6) to become disengaged (not engaged) with the spider. The driven clutch pulls holdout ring (8) out of the grooves in the center cam. The friction between the holdout ring and driven clutch turns the holdout ring until notch (20) in the holdout ring engages with spider key (19). The holdout ring is now turned by the spider key at the speed of the bevel gear. The teeth of the holdout ring are now in a position so they can not engage the notches in the center cam. The driven clutch and cam move around the holdout ring at a speed faster than the speed of the bevel gear. The holdout ring keeps the driven clutch and cam from being engaged (engagement) with the center cam and spider. The driven clutch, cam, axle shaft and wheel now turn freely.

The opposite side clutch, cam and holdout ring are held engaged to the center cam and spider by spring (7) as long as the driven wheel turns slower.

When the speed of the wheel that is not engaged becomes slower and near the speed of the bevel gear, the resistance of the ground to the wheel causes the torque on this wheel to be in a small reverse direction. This causes the driven clutch and cam to turn in a direction opposite the direction of the bevel gear. The friction between the holdout ring and the driven clutch causes the holdout ring to move in a direction opposite the direction of the bevel gear. Notch (20) in the holdout ring moves away from spider key (19). When the teeth of the holdout ring are in a position to engage the notches in center cam (15), the force of the spring causes the driven clutch and cam to move to the inside. The driven clutch pushes the holdout ring. The holdout ring now engages the center cam and is turned at the speed of the bevel gear. The teeth of cam (21) now engage the center cam and the teeth of the drive clutch engage the spider. At this time, both wheels are turned at the same speed.

NOTE: When both wheels are turned at the same speed they do not necessarily have equal torque. For example: When one wheel starts to turn faster on ice (tends to spin), both clutches engage and both wheels turn at the same speed. The wheel that is on ice will have less torque.

Straight Forward Operation

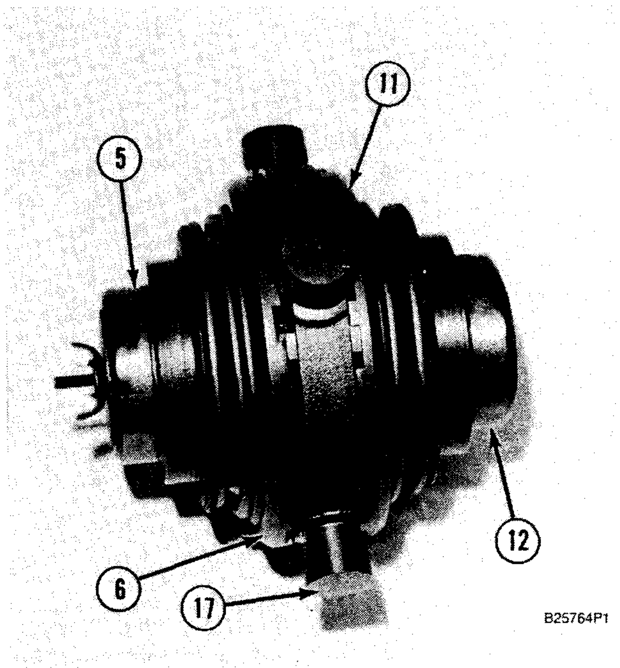


Straight Forward Operation
(5) Side gear. (6) Driven clutch. (11) Driven clutch. (12) Side gear. (17) Spider. (22) Teeth of the spider. (23) Teeth of the driven clutches.

When the machine has straight forward movement, teeth (22) on both sides of spider (17) are fully engaged with teeth (23) of driven clutches (6) and (11). The teeth of cams (21) are engaged with the teeth of center cam (15). The negative angle of the teeth on the clutches and spider, along with the force of springs (7) and (10), cams (21) and center cam (15), push together and the teeth engage.

In this condition, driven clutches (6) and (11) are fully engaged with spider (17). The driven clutches turn side gears (5) and (12) at the same speed as the bevel gear. The two side gears turn the axle shafts and wheels at the same speed as the bevel gear.

Forward Turn With Power



Forward Right Turn With Power
(5) Side gear. (6) Driven clutch. (11) Driven clutch. (12) Side gear. (17) Spider.

The travel of the outside wheel, during a turn, is at a longer distance than the travel of the inside wheel. When the machine turns with power, the NoSpin differential lets the outside wheel turn faster than the speed of the bevel gear (to let the outside wheel have this longer travel) but does not let the inside wheel turn slower than the speed of the bevel gear. The inside wheel turns at the same speed as the bevel gear.

The teeth of the spider send the drive force to the inside driven clutch. The inside driven clutch turns the inside wheel at the same speed as the bevel gear and gives the power that is needed to move the machine through the turn.

The outside wheel is made to turn (by the traction of the road) at a speed faster than the speed of the bevel gear. This causes the driven clutch for the outside wheel to turn faster than the speed of the bevel gear. The movement of one wheel faster than the other wheel starts the "clutch action" of the NoSpin differential.

The teeth of the cam for the driven clutch for the inside wheel are engaged with the teeth of center cam (15) and stay in the same position in relation to spider (17). The teeth of the inside drive clutch are engaged with the spider. The teeth on the other side of center cam (15) are used as ramps. The teeth of the cam for the driven clutch for the outside wheel move up the teeth of the center cam. This causes the outside driven clutch and cam to move away from the spider and center cam. The outside driven clutch and cam are not engaged with the spider and center cam.

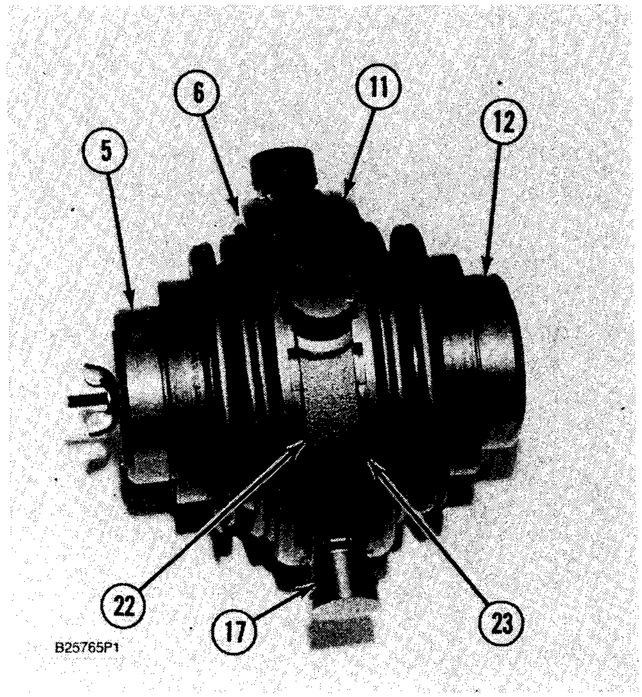
The driven clutch for the outside wheel can not be engaged with the spider until the speed of the outside wheel becomes slower and equal to the speed of the bevel gear. The holdout ring keeps the driven clutch and cam from being engaged with the spider and center cam until the machine moves in a straight direction. At this time the operation of the differential is the same as STRAIGHT FORWARD OPERATION.

Forward Turn With No Power

The operation of the NoSpin differential is the same as for FORWARD TURN WITH POWER. The outside wheel is still made to turn faster (by the traction of the road) than the speed of the bevel gear. The inside wheel is turned at the speed of the bevel gear.

Straight Reverse Operation

When the machine moves in a straight reverse direction, teeth (22) on both sides of spider (17) are fully engaged with teeth (23) of driven clutches (6) and (11). Spider (17) turns in the opposite direction than it turns in straight forward. Since the spider turns in an opposite direction, teeth (22) of the spider push against the opposite face of teeth (23) of the driven clutches.

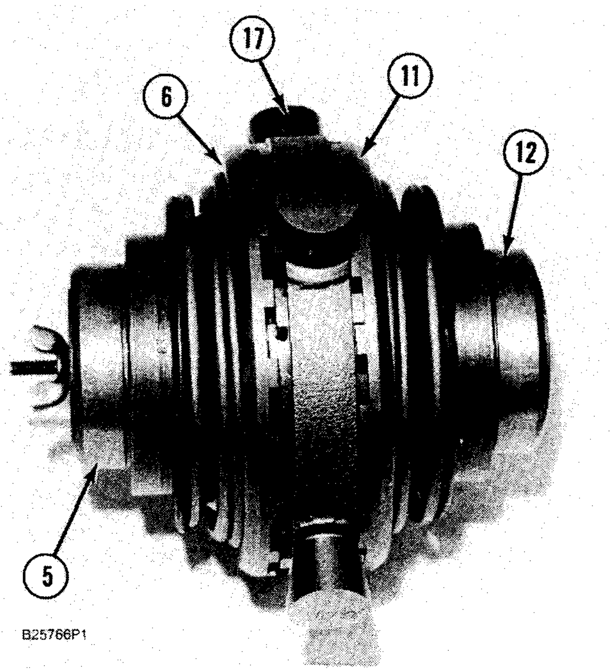


Straight Reverse
(5) Side gear. (6) Driven clutch. (11) Driven clutch. (12) Side gear. (17) Spider. (22) Teeth of the spider. (23) Teeth of the driven clutches.

The action of the differential is the same as it is in the STRAIGHT FORWARD DIRECTION.

Reverse Turn With Power

The action of the differential is the same as it is in the FORWARD TURN WITH POWER condition except spider (17) turns in the opposite direction.

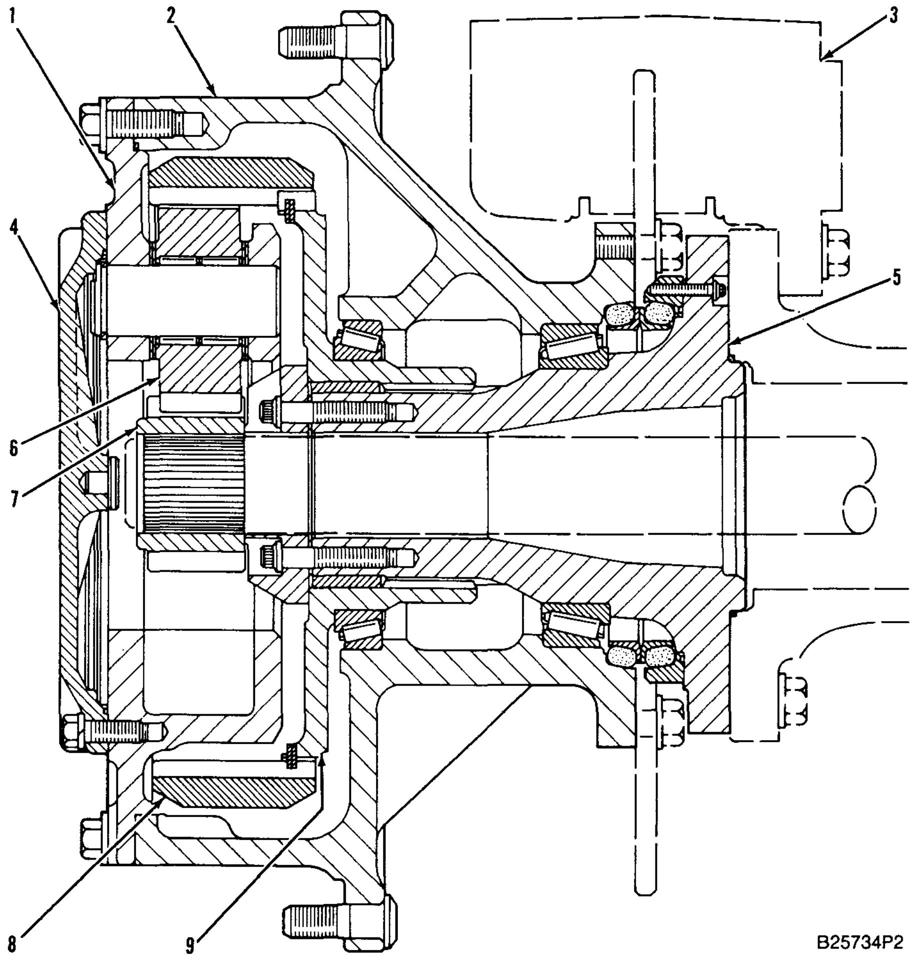


Reverse Right Turn With Power
(5) Side gear. (6) Driven clutch. (11) Driven clutch. (12) Side gear. (17) Spider.

Reverse Turn With No Power

The operation of the NoSpin differential is the same as for REVERSE TURN WITH POWER. The outside wheel is still made to turn faster (by the traction of the road) than the speed of the bevel gear. The inside wheel is turned at the speed of the bevel gear.

Final Drives



Final Drive Components
(1) Carrier. (2) Wheel assembly. (3) Brake group. (4) Cover assembly. (5) Spindle housing. (6) Planetary gears. (7) Sun gear. (8) Ring gear. (9) Hub.

Each final drive has the same components. A final drive causes the last speed reduction and torque increase in the power train.

Ring gear (8) is fastened to hub (9). Hub (9) is connected to spindle housing (5) by splines. Spindle housing (5) is fastened to the axle housing. Ring gear (8), spindle housing (5) and hub (9) are held stationary.

The axle shaft is connected to the differential by splines. Sun gear (7) is connected to the axle shaft by splines. Sun gear (7) is engaged with planetary gears (6). Planetary gears (6) are held in planetary carrier (1). Planetary carrier (1) is fastened to wheel assembly (2).

Power from the differential turns the axle shaft. The axle shaft turns sun gear (7). Sun gear (7) turns planetary gears (6). Since ring gear (8) is held by hub (9), the planetary gears move around the inside of ring gear (8). The movement of the planetary gears causes planetary carrier (1) to turn. The planetary carrier is turned in the same direction as sun gear (7) but at a slower speed. The planetary carrier turns wheel assembly (2).

Each final drive has its own oil reservoir. Oil is put into the final drive through a fill plug on the outside cover. Oil is removed from the final drive through a drain plug.

The components of the final drives get their primary lubrication from the oil inside the final drives.

Testing And Adjusting

Troubleshooting

Use this as a reference for the location and correction of problems in the power train. When more checks are necessary, use the 5P6225 Hydraulic Test Box. Locations of the pressure taps and procedures for tests and adjustments are given in the 950B & 950E POWER SHIFT TRANSMISSION TESTING AND ADJUSTING, Form No. SENR2257.

Always make visual checks first, operation checks second, and instrument checks third.

Visual Checks

1. Check the oil level in the differentials.
2. Check the oil level in the output transfer gear case.
3. Check all oil lines, hoses and connections for leaks or damage.
4. Check all external valves for leaks or damage.
5. Check for oil on the ground under the machine.
6. Check the transmission control linkage for damage and/or adjustment.
7. Let the oil out of the housing for the transmission oil filter. Remove and check the filter element for foreign material.
   a. Shiny steel particles give the indication of wear and/or failure in the oil pump.
   b. Aluminum particles give the indication of a failure in the torque converter.
   c. Rubber particles (seal or hose material) give the indication of a hose or seal failure.
   d. A heavy accumulation of black rubber material on the filter element gives the indication of worn clutch discs in the transmission.
   e. Iron or steel chips give the indication of broken components in the transmission, torque converter or transfer gears.
8. Let the oil out of the case for the output transfer gears. Remove and check the magnetic screen for foreign material.
   a. Iron or steel chips give the indication of broken components in the transmission, torque converter or transfer gears.
   b. Aluminum chips give the indication of a failure in the torque converter.
   c. Rubber particles (seal or hose material) give the indication of a hose or seal failure.
   d. Rubber pieces (transmission clutch disc material) give the indication of a failure in the transmission clutches.

If you find rubber, aluminum, iron or steel particles, all components of the hydraulic system must be washed clean. Do not use parts with damage. Use new parts.

Checks During Operation

⚠ WARNING

When checks are made while the machine is in operation, make sure only approved personnel are on the machine. Keep other personnel off the machine and in view of the operator. Make sure checks are done in a open area.

With the engine running, the parking brake "OFF" and the steering column toward the operator, move the transmission selection lever to all positions. The transmission must engage in all positions. The machine must not move in NEUTRAL. The selection lever must stay in either FORWARD or REVERSE.

With the engine running, the parking brake "ON" and the steering column toward the operator, move the transmission selection lever to either the REVERSE or FORWARD position. The parking brake indicator light and the master fault light must come "ON" and the alarm must sound. Immediately release the selection lever. The alarm must stop and the master fault light must go "OFF", and the lever return to NEUTRAL.

NOTICE

With the parking brake ENGAGED, move the machine in case of an emergency only. Fire and damage to the parking brake can be the result if the machine is moved too far.

Release the parking brake. Operate the machine in each direction and speed. Make note of all noises that are not normal and find their sources.

If the operation of the machine is not correct, make reference to the Check List During Operation for "problems" and "probable causes".

Check List During Operation

Transmission

Problem: Transmission gets hot.

Probable Cause:

1. Low oil level.
2. Restrictions in oil cooler or lines.
3. Magnetic screens in output transfer gear case has too many restrictions.
4. Clutches not released all the way (drag).
5. Operation of ratio valve for the torque converter not correct.
6. Oil pump has wear or damage.
7. Too much leakage in system.

Problem: Transmission does not make a shift from one speed to another speed.

Probable Cause:

1. Adjustment of speed control linkage not correct.

Problem: Transmission does not make a shift from one direction to another direction.

Probable Cause:

1. Adjustment of direction control linkage not correct.

Problem: Transmission shifts slowly.

Probable Cause:

1. Low oil pressure.
2. Control linkages have damage or adjustment not correct.
3. Air leaks on inlet side of oil pump.
4. Failure in the transmission pressure control valve.

Problem: Transmission clutches engage very suddenly (rough shifts).

Probable Cause:

1. Primary pressure setting of modulation relief valve not correct.
2. Load piston in pressure control valve does not move.
3. Operation of pressure differential valve not correct.
4. Springs in the pressure control valve that are weak or have damage.
5. Adjustment of control linkages not correct.

Problem: Transmission does not operate in any speed or clutches do not engage (slip) in all speeds.

Probable Cause:

1. Low oil pressure because of:
   a. Low oil level in transfer gear case.
   b. Failure of oil pump or oil pump drive.
   c. Air leaks on inlet side of pump.
   d. Adjustment of modulation relief valve not correct.
   e. Too much leakage inside the transmission.
   f. Failure in the transmission pressure control valve.
2. Mechanical failure in the transmission.
3. Mechanical failure in transfer gears.
4. Mechanical failure in differentials.
5. Torque converter failure.

Problem: Transmission engages but the machine does not move and the engine stops.

Probable Cause:

1. Mechanical failure in the output transfer gears.
2. Mechanical failure in a differential (front or rear).
3. Mechanical failure in a final drive.
4. Gears in transmission do not turn because of:
   a. Too many clutches engaged.
   b. Mechanical failure in transmission.

Problem: Machine moves when selection lever is in NEUTRAL.

Probable Cause:

1. Adjustment of direction control linkage not correct.
2. Direction clutch engaged.

Problem: Low clutch pressures.

Probable Cause:

1. Clutch seal rings have damage.
2. Operation of modulation relief valve not correct.

Problem: Transmission does not operate in any FORWARD speeds.

Probable Cause:

1. No. 2 clutch not engaged (slips) because of:
   a. Low oil pressure.
   b. Discs and plates have too much wear.
   c. Broken components.
2. Adjustment of direction control linkage not correct.

Problem: Transmission does not operate in any REVERSE speed.

Probable Cause:

1. No. 1 clutch not engaged (slips) because of:
   a. Low oil pressure.
   b. Discs and plates have too much wear.
   c. Broken components.
2. Adjustment of direction control linkage not correct.

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

Probable Cause:

1. No. 6 clutch not engaged (slips) because of:
   a. Low oil pressure.
   b. Discs and plates have too much wear.
   c. Broken components.
2. Adjustment of speed control linkage not correct.

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

Probable Cause:

1. No. 5 clutch not engaged (slips) because of:
   a. Low oil pressure.
   b. Discs and plates have too much wear.
   c. Broken components.
2. Adjustment of speed control linkage not correct.

Problem: Transmission does not operate in THIRD speed FORWARD or REVERSE.

Probable Cause:

1. No. 4 clutch not engaged (slips) because of:
   a. Low oil pressure.
   b. Discs and plates have too much wear.
   c. Broken components.
2. Adjustment of speed control linkage not correct.

Problem: Transmission does not operate in FOURTH speed FORWARD or REVERSE.

Probable Cause:

1. No. 3 clutch not engaged (slips) because of:
   a. Low oil pressure.
   b. Discs and plates have too much wear.
   c. Broken components.
2. Adjustment of speed control linkage not correct.

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

Probable Cause:

1. Operation of modulation relief valve not correct.

Problem: High pressure at P2 (direction) clutch pressure tap in both directions.

Probable Cause:

1. Operation of pressure differential valve not correct.

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

Probable Cause:

1. Operation of modulation relief valve not correct.
2. Operation of load piston not correct.

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

Probable Cause:

1. Too much leakage in the No. 1 clutch.

Problem: Low pressure at P2 clutch pressure tap in FORWARD speed.

Probable Cause:

1. Too much leakage in the No. 2 clutch.

Problem: Transmission stays engaged when the left brake pedal is pushed.

Probable Cause:

1. Failure in transmission neutralizer valve.

Problem: Pump noise not normal.

Probable Cause:

1. Loud sounds at short intervals that give an indication that particles are going through the pump is caused by pump cavitation.

2. A constant loud noise is an indication of pump failure.

3. Air at the inlet side of the pump (aeration).

Problem: Transmission selection lever does not stay in a direction with the engine running and parking brake "OFF".

Probable Cause:

1. Failure in transmission neutralizer group.

2. No air pressure to transmission neutralizer group.

Problem: Back-up alarm does not sound when selection lever is put in REVERSE.

Probable Cause:

1. Adjustment of direction control linkage not correct.

2. Failure of back-up alarm switch.

3. Failure of back-up alarm.

4. Failure in the wiring of back-up alarm circuit.

Problem: With the engine running and the parking brake "ON", the alarm does not sound when transmission selection lever is put in a direction.

Probable Cause:

1. Adjustment of direction control linkage not correct.

2. Operation of transmission neutralizer group not correct.

3. Failure of transmission neutralizer switch.

4. Failure of alarm.

5. Failure in the wiring of the warning system.

Problem: With the engine running and the parking brake "ON", the transmission selection lever does not return to NEUTRAL when put in a direction.

Probable Cause:

1. Failure in transmission neutralizer group.

2. Failure in parking brake system.

Torque Converter

Problem: Torque converter gets hot.

Probable Cause:

1. Low oil level in transfer gear case.

2. Low water level in engine radiator.

3. Restrictions in oil cooler or oil lines.

4. Too much operation of machine at or near stall speed (overload).

5. Too much oil in the converter housing around the converter because of:
   a. Too much oil leakage inside the converter.
   b. Ratio valve for the torque converter does not move (too much inlet oil).

6. Not enough oil to the converter because of:
   a. Ratio valve for the torque converter does not move (not enough inlet oil).
   b. Oil pump failure.
   c. Too much leakage in transmission.

Problem: High pressure at converter outlet relief valve tap.

Probable Cause:

1. Adjustment of converter outlet relief valve not correct.

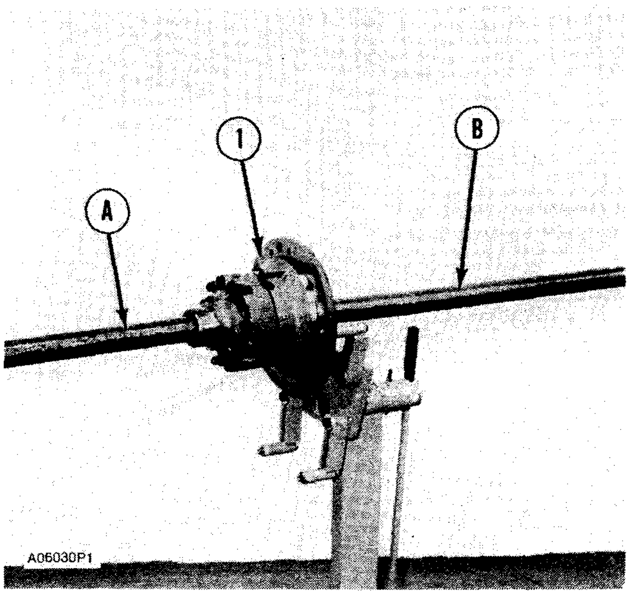
2. Valve spool in outlet relief valve does not move.

NoSpin Differential

NoSpin Differential Test (Before Installation)

After the NoSpin differential has been assembled and before it is installed in the machine, make a test of the operation of the differential as follows:

1. Install the NoSpin differential in the case.
2. Put the case in a stand or a vise to keep it from rotation.
3. Install both axles in the case.

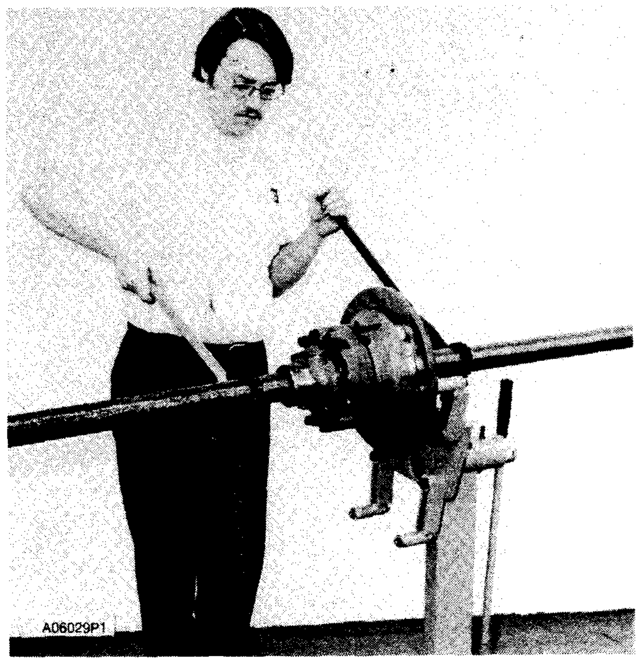


Test Procedure For NoSpin Differential
(1) Case. (A) Axle. (B) Axle.

4. Put a force in a clockwise direction on both axles.
5. Keep the force on axle (A) and turn axle (B) in a counterclockwise direction. A small noise will be heard in the NoSpin differential and axle (B) will turn freely.

NOTE: Make sure the force is kept on axle (A).

6. Keep the force on axle (A) and turn axle (B) in a clockwise direction. A small noise will be heard in the NoSpin differential and axle (B) will not turn any farther.



NoSpin Differential Test

7. Put a force in a counterclockwise direction on both axles.
8. Keep the force on axle (A) and turn axle (B) in a clockwise direction. A small noise will be heard in the NoSpin differential and axle (B) will turn freely.

NOTE: Make sure the force is kept on axle (A).

9. Keep the force on axle (A) and turn axle (B) in a counterclockwise direction. A small noise will be heard in the NoSpin differential and axle (B) will not turn any farther.
10. Do Steps 4 through 9 again, except now hold axle (B) and turn axle (A).

If the NoSpin differential does not have the correct action, inspect the components and check the assembly procedure.