

SERVICE REPAIR

MANUAL

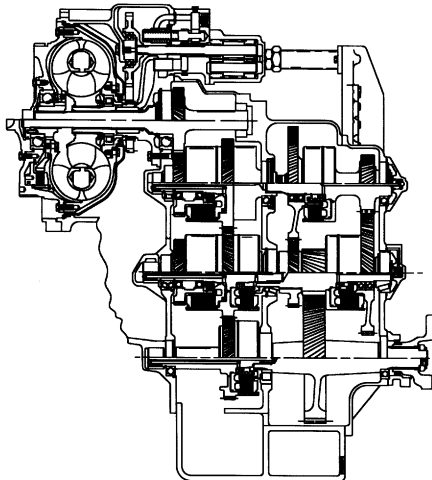
Hyster B227 (HR45-25 HR45-27 HR45-31 HR45-36L
HR45-40LS HR45-40S HR45-45LSX) Diesel Counter
Balanced Truck Service Repair Manual

HYSTER

FOUR-SPEED POWERSHIFT TRANSMISSION

DESCRIPTION AND OPERATION (HR 36000)

H36.00-48.00E (H800-1050E) [D117];
H40.00-52.00XM-16CH (H1050, 1150HD-CH) [E117];
RS45-27CH, RS45-30CH, RS45-27IH, RS46-33CH, RS46-30IH,
RS46-36CH, RS46-33IH [A222];
HR45-25, HR45-27, HR45-31, HR45-40S, HR45-36L, HR45-40LS,
HR45-45LSX, HR45H [A227, B227]



HYSTER

SAFETY PRECAUTIONS

MAINTENANCE AND REPAIR

- When lifting parts or assemblies, make sure all slings, chains, or cables are correctly fastened, and that the load being lifted is balanced. Make sure the crane, cables, and chains have the capacity to support the weight of the load.
- Do not lift heavy parts by hand, use a lifting mechanism.
- Wear safety glasses.
- **DISCONNECT THE BATTERY CONNECTOR** before doing any maintenance or repair on electric lift trucks. Disconnect the battery ground cable on internal combustion lift trucks.
- Always use correct blocks to prevent the unit from rolling or falling. See **HOW TO PUT THE LIFT TRUCK ON BLOCKS** in the **Operating Manual** or the **Periodic Maintenance** section.
- Keep the unit clean and the working area clean and orderly.
- Use the correct tools for the job.
- Keep the tools clean and in good condition.
- Always use **HYSTER APPROVED** parts when making repairs. Replacement parts must meet or exceed the specifications of the original equipment manufacturer.
- Make sure all nuts, bolts, snap rings, and other fastening devices are removed before using force to remove parts.
- Always fasten a **DO NOT OPERATE** tag to the controls of the unit when making repairs, or if the unit needs repairs.
- Be sure to follow the **WARNING** and **CAUTION** notes in the instructions.
- Gasoline, Liquid Petroleum Gas (LPG), Compressed Natural Gas (CNG), and Diesel fuel are flammable. Be sure to follow the necessary safety precautions when handling these fuels and when working on these fuel systems.
- Batteries generate flammable gas when they are being charged. Keep fire and sparks away from the area. Make sure the area is well ventilated.

NOTE: The following symbols and words indicate safety information in this manual:



WARNING

Indicates a condition that can cause immediate death or injury!



CAUTION

Indicates a condition that can cause property damage!

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This section is for the following models:

H36.00-48.00E (H800-1050E) [D117];
H40.00-52.00XM-16CH (H1050, 1150HD-CH) [E117];
RS45-27CH, RS45-30CH, RS45-27IH, RS46-33CH, RS46-30IH,
RS46-36CH, RS46-33IH [A222];
HR45-25, HR45-27, HR45-31, HR45-40S, HR45-36L, HR45-40LS,
HR45-45LSX, HR45H [A227, B227]

**"THE
QUALITY
KEEPERS"**

**HYSTER
APPROVED
PARTS**

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Want to get more information,
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manual**

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click on it.**

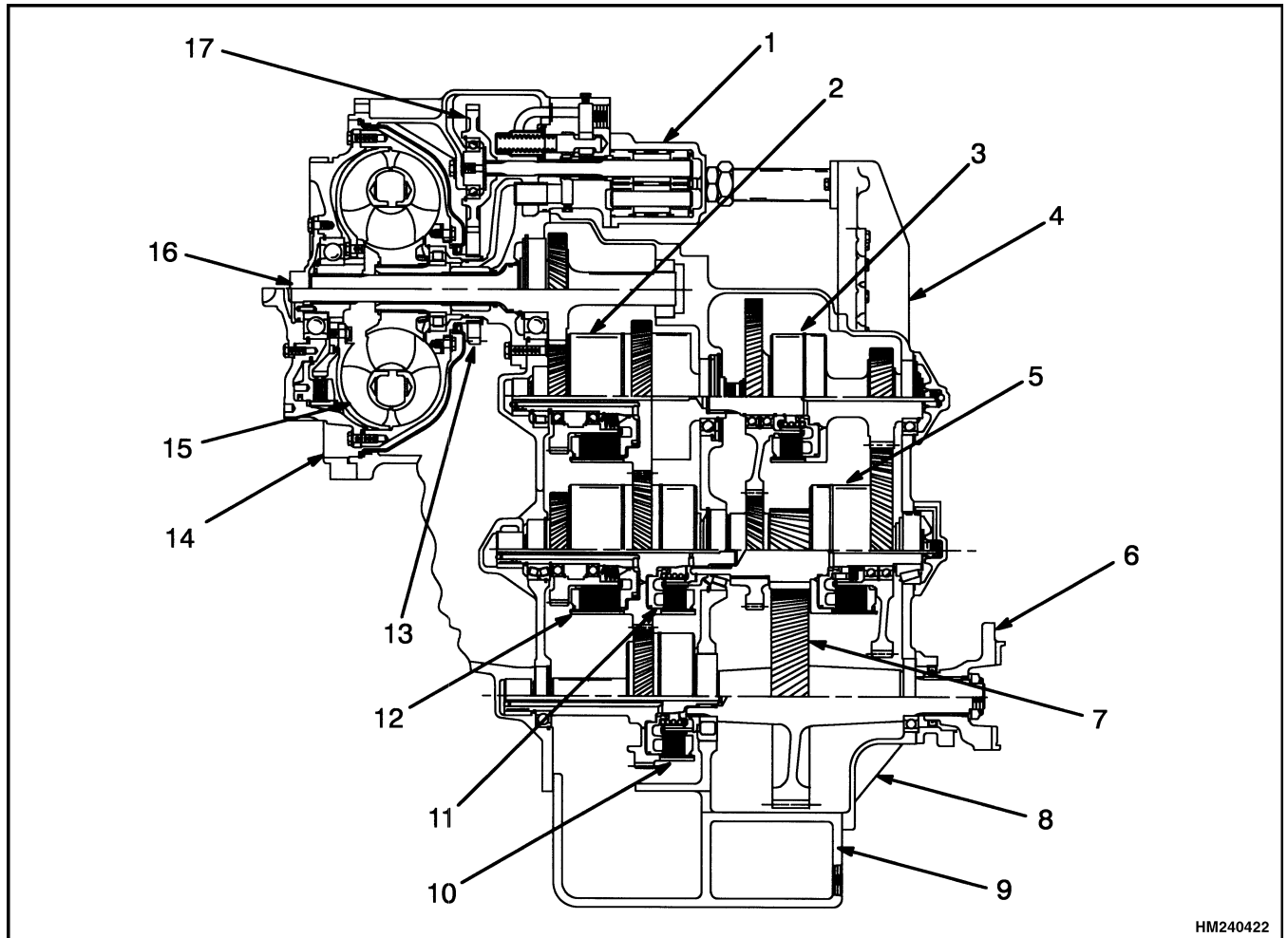
**Have any questions please write to me:
admin@servicemanualperfect.com**

General

This four-speed powershift transmission is an HR-36000 series transmission manufactured by Clark-Hurth®. See Figure 1.

This section describes the following: the Automatic Powershift Control (APC 100), the mechanical

components of the transmission, and the hydraulic operation of the transmission. See the section **Four-Speed Powershift Transmission, Repair (HR 36000)** 1300 SRM 635 for information on repair and troubleshooting of this transmission.



- | | |
|--------------------------|---------------------------------|
| 1. TRANSMISSION OIL PUMP | 10. FOURTH CLUTCH |
| 2. FORWARD CLUTCH | 11. SECOND CLUTCH |
| 3. THIRD CLUTCH | 12. REVERSE CLUTCH |
| 4. REAR COVER | 13. IMPELLER HUB GEAR |
| 5. FIRST-SPEED CLUTCH | 14. TORQUE CONVERTER HOUSING |
| 6. OUTPUT YOKE | 15. TURBINE OF TORQUE CONVERTER |
| 7. OUTPUT GEAR | 16. INPUT SHAFT AND GEAR |
| 8. TRANSMISSION HOUSING | 17. PUMP DRIVE GEAR |
| 9. OIL SUMP AND PAN | |

Figure 1. HR-36000 Transmission (Section View)

Automatic Powershift Control

TRANSMISSION CONTROL SYSTEM

NOTE: There is more information on the APC 100 unit in the section **Four-Speed Powershift Transmission, Repair (HR 36000)** 1300 SRM 635.

This transmission is controlled by a control valve with solenoids. The operation of the solenoids of the valve are controlled by the Automatic Powershift Control (APC 100) unit.

The APC is a small (8-bit) computer with up to 18 inputs from the lift truck components and operator controls. See Figure 2. Inputs are used to determine the position of the control lever, throttle switch, and other switches used to determine the operation of the APC 100.

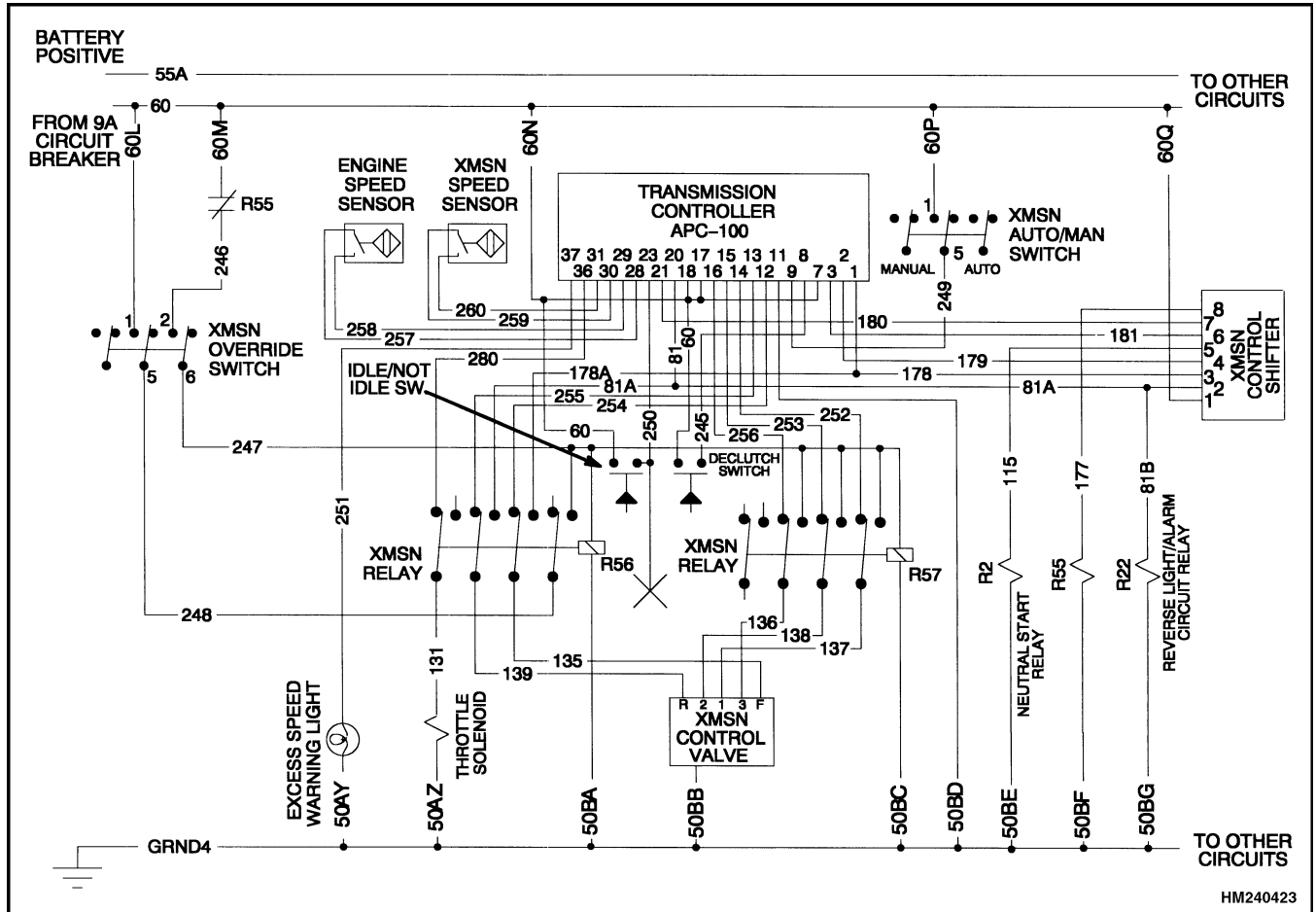
An output is a wire from which the status can be controlled by the APC 100. Outputs of the APC can be used to drive various loads such as solenoid valves, lamps, and warning lights for transmission operation. The APC control unit is located in the operator's compartment. There is a 37-pin connector at the rear of the unit for the inputs and outputs. See Figure 3.

There is also a smaller connector for the connection of a service unit.

There are three LEDs (red, yellow, and green) on the front cover of the control unit. See Figure 3. All three LEDs illuminate for approximately one-half second at startup to check that the LEDs are good. The red FAILURE LED must then go out. If this LED stays on, there is a malfunction of the control unit. The yellow LED is illuminated when the engine or torque converter speed is zero rpm. The green LED is illuminated when the throttle pedal is depressed.

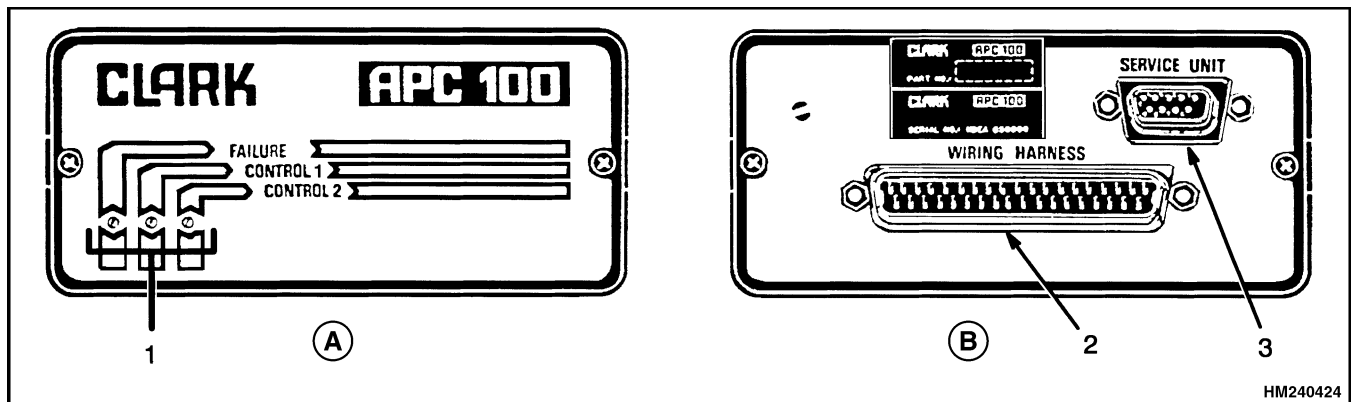
TRANSMISSION CONTROL LEVER

The transmission control lever on the steering column selects the direction of travel and the gear range. There are four gears forward and four gears in reverse. Signals from the control lever go to the APC 100 transmission controller. The controller processes these signals together with the other input signals. The controller then sends signals to operate the solenoid valves of the transmission control valve for correct transmission operation.



NOTE: A222 SHOWN.

Figure 2. Transmission Control Electrical Schematic



A. FRONT COVER

B. REAR COVER

1. INDICATOR LIGHTS
 RED - INTERNAL MALFUNCTION
 YELLOW - ZERO RPM, ENGINE OR TORQUE CONVERTER

2. GREEN - THROTTLE PEDAL DEPRESSED
3. CONNECTOR FOR LIFT TRUCK HARNESS
- CONNECTOR FOR CHECKOUT KIT

Figure 3. APC 100

Mechanical Description and Operation

GENERAL

The torque converter housing is fastened to the engine. The transmission housing is fastened to the torque converter housing. Two sets of pumps for the hydraulic systems of the lift truck are fastened to the transmission housing. These pump assemblies are driven by gears of the two auxiliary pump drives in the transmission.

The transmission pump is also fastened to the transmission housing and supplies oil to both the torque converter and the transmission clutches, bearings, and gears. A pair of external oil filters keep the oil clean. An oil cooler keeps the oil from getting too hot.

The control valve on the side of the transmission directs the oil to the clutches for correct transmission operation. The control spools of the transmission control valve are moved hydraulically as controlled by the solenoid spools. The solenoids of the solenoid valve spools are controlled by the Automatic Power-shift Control (APC).

TORQUE CONVERTER

Description

The torque converter is installed between the engine and transmission and has two functions. The torque converter works as a fluid clutch and multiplies the torque from the engine as needed. The torque converter has three main parts: an impeller, a turbine, and a stator or reaction member. See Figure 4.

The impeller is connected to the engine flywheel by a drive plate. When the engine and impeller rotate, a spline on the hub of the impeller turns the impeller hub gear. A gear on the shaft of the transmission pump engages the impeller hub gear. See Figure 1.

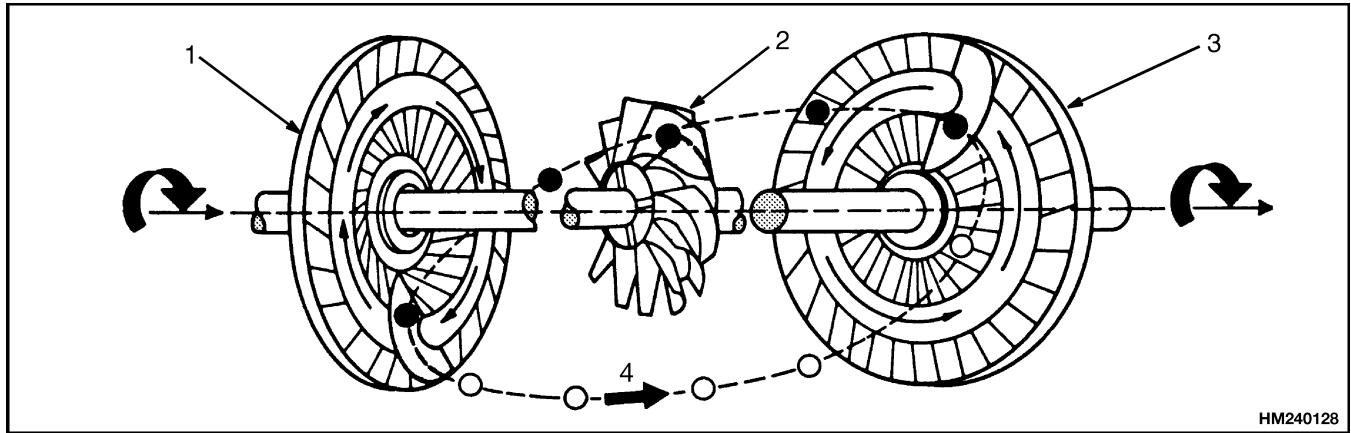
The gears of the auxiliary drives also engage the gear on the pump shaft to operate the pumps for the truck hydraulic systems. These pumps operate whenever the engine is operating. See Figure 1.

The turbine is installed in the torque converter between the cover and the impeller. The input shaft for the transmission fits in the splines of the turbine. The turbine rotates the transmission input shaft. The input shaft is supported on one end by the turbine and on the other end by roller bearings. Ball bearings near the gear at the center support the input shaft.

The stator is installed in the torque converter between the turbine and the impeller. The stator engages splines of the stator support and does not move. The stator support is fastened to the torque converter housing. The input shaft turns freely in the stator and stator support.

Operation

The transmission oil pump sends oil through the transmission filter to the control valve, modulator valve, torque converter, and the lubrication circuit. Oil for the torque converter flows between the stator tube and the input shaft gear. The centrifugal force of the moving impeller causes the oil to flow from the inner edge to the outer edge of the impeller. This oil then flows toward the outer blades of the turbine and returns to the inner blades of the turbine. The oil then leaves the turbine and enters the stator going in the opposite direction of engine rotation. The blades of the stator change the direction of the oil so that oil leaves the stator going in the direction of engine rotation. This oil enters the impeller and helps the impeller increase the output torque of the torque converter. See Figure 4.



1. TURBINE
2. STATOR (REACTION MEMBER)

3. IMPELLER
4. OIL FLOW

Figure 4. Turbine or Torque Converter Operation

CLUTCH ASSEMBLIES

Description

Each of the six clutch assemblies in the transmission has a drum, piston, return spring, friction discs, and separator plates. See Figure 5, Figure 6, Figure 7, and Figure 8. The friction discs and separator plates are installed in the drum in a sequence. Each friction disc is next to a separator plate. The steel separator plates have a smooth surface while the friction discs have a friction material on the surface. The hub in each clutch assembly engages with the inner teeth of the friction discs. The outer teeth of the separator plates engage with grooves in the drum. A pressure plate holds the friction discs and separator plates in the drum. A spring is used to retract the piston against the drum. There is enough clearance in the clutch assemblies to permit the friction discs to rotate freely when a clutch is not engaged.

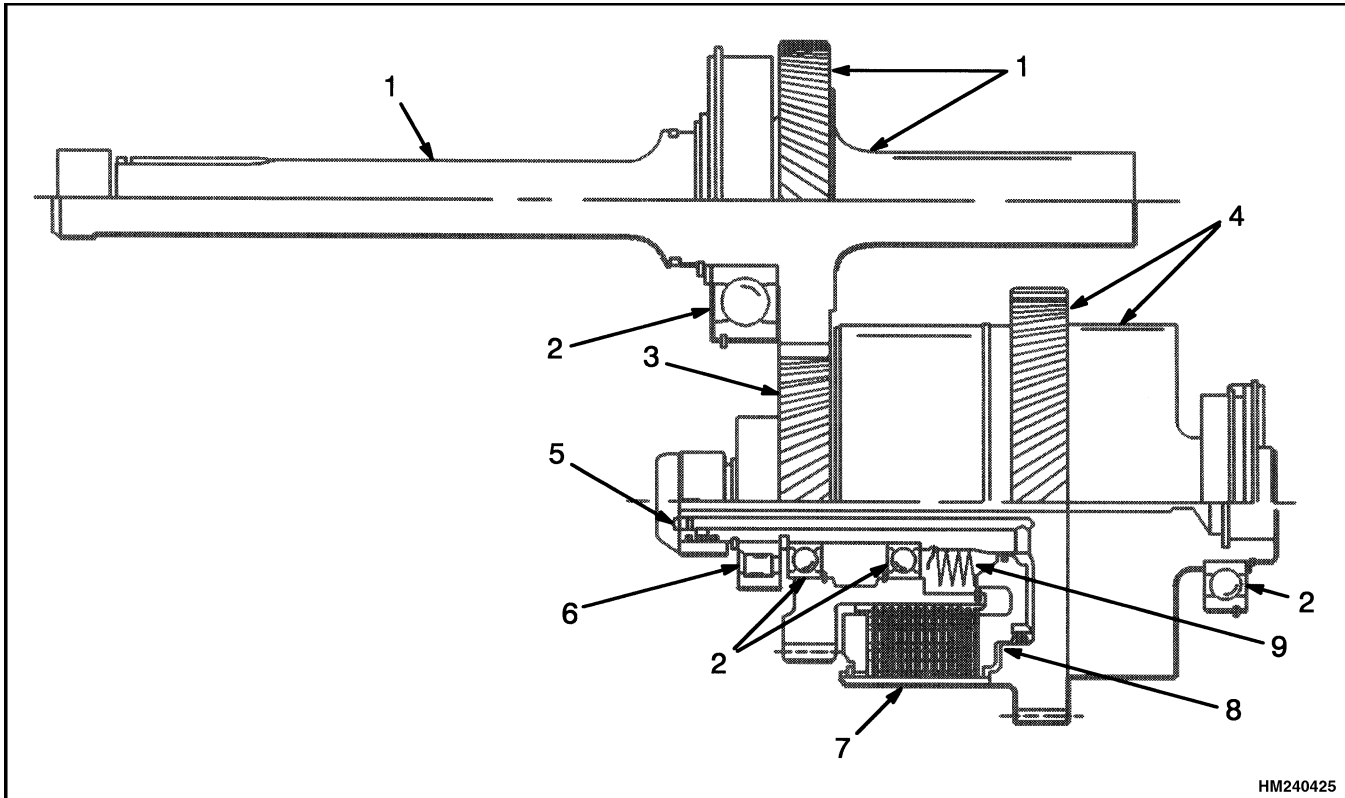
Operation

NOTE: There are additional parts of the transmission that rotate simultaneously with the parts mentioned in the following paragraphs. These additional parts are not mentioned since the other clutches are not engaged to make this rotation important.

Each clutch shaft in the transmission has oil passages for clutch pressure. There are also oil passages for the lubrication of bearings. Seal rings on each clutch shaft seal the oil passages between the following: transmission cover and the shafts and between the manifold and the shafts. When a clutch is applied, oil flows from the control valve, through the shaft to the piston. The oil flows behind the piston and pushes the piston against the separator plates and friction discs. The clutch is then applied and the shaft, drum, gears, and hub of the clutch assembly rotate as one unit. The forward and reverse valve assemblies have modulator valves so the forward and reverse clutches engage more slowly.

When a solenoid valve is energized, the control valve and clutch of the same name operate. If the forward solenoid valve is energized, the spool of the forward control valve also moves to engage the forward clutch in the transmission. The solenoids and clutches that operate for each combination of direction and gear are shown in Table 1.

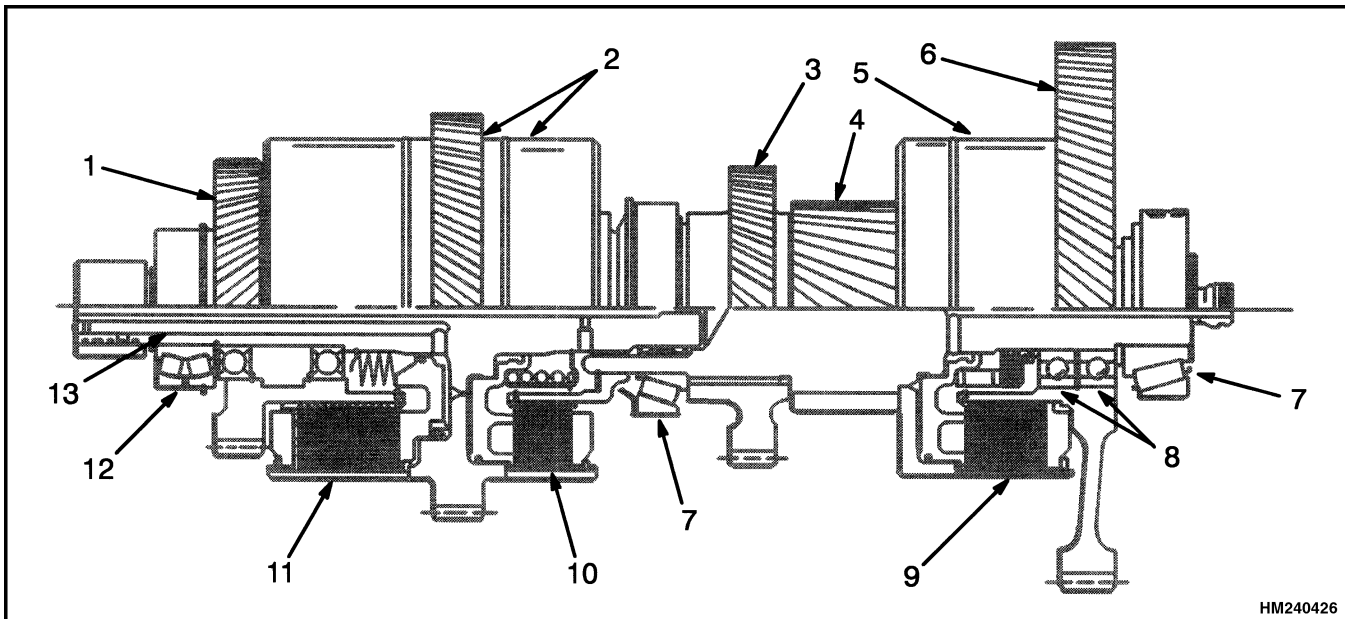
NOTE: The fourth-speed clutch IS engaged (pressure applied) when NONE of the lower speeds (first through third) are selected. There is no-fourth speed solenoid.



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|--------------------------------|-------------------------|
| 1. INPUT SHAFT AND GEAR | 6. ROLLER BEARING |
| 2. BALL BEARING | 7. FORWARD CLUTCH |
| 3. FORWARD GEAR AND SHAFT | 8. PISTON |
| 4. CLUTCH DRUM AND GEAR | 9. PISTON RETURN SPRING |
| 5. PASSAGE FOR CLUTCH PRESSURE | |

Figure 5. Input Shaft and Forward Shaft and Clutch Assembly



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Figure 6. Reverse, Second, and First Speed-Shaft and Clutch Assemblies

Legend for Figure 6

- | | |
|--|---------------------------------|
| 1. CLUTCH-DRIVEN GEAR | 7. TAPERED ROLLER BEARING |
| 2. REVERSE AND SECOND CLUTCH DRUM AND GEAR | 8. BALL BEARING |
| 3. DRIVE GEAR FOR THIRD SPEED | 9. FIRST-SPEED CLUTCH |
| 4. FIRST-SPEED SHAFT AND GEAR | 10. SECOND-SPEED CLUTCH |
| 5. FIRST-SPEED CLUTCH DRUM | 11. REVERSE CLUTCH |
| 6. FIRST-SPEED GEAR | 12. ROLLER BEARINGS |
| | 13. PASSAGE FOR CLUTCH PRESSURE |

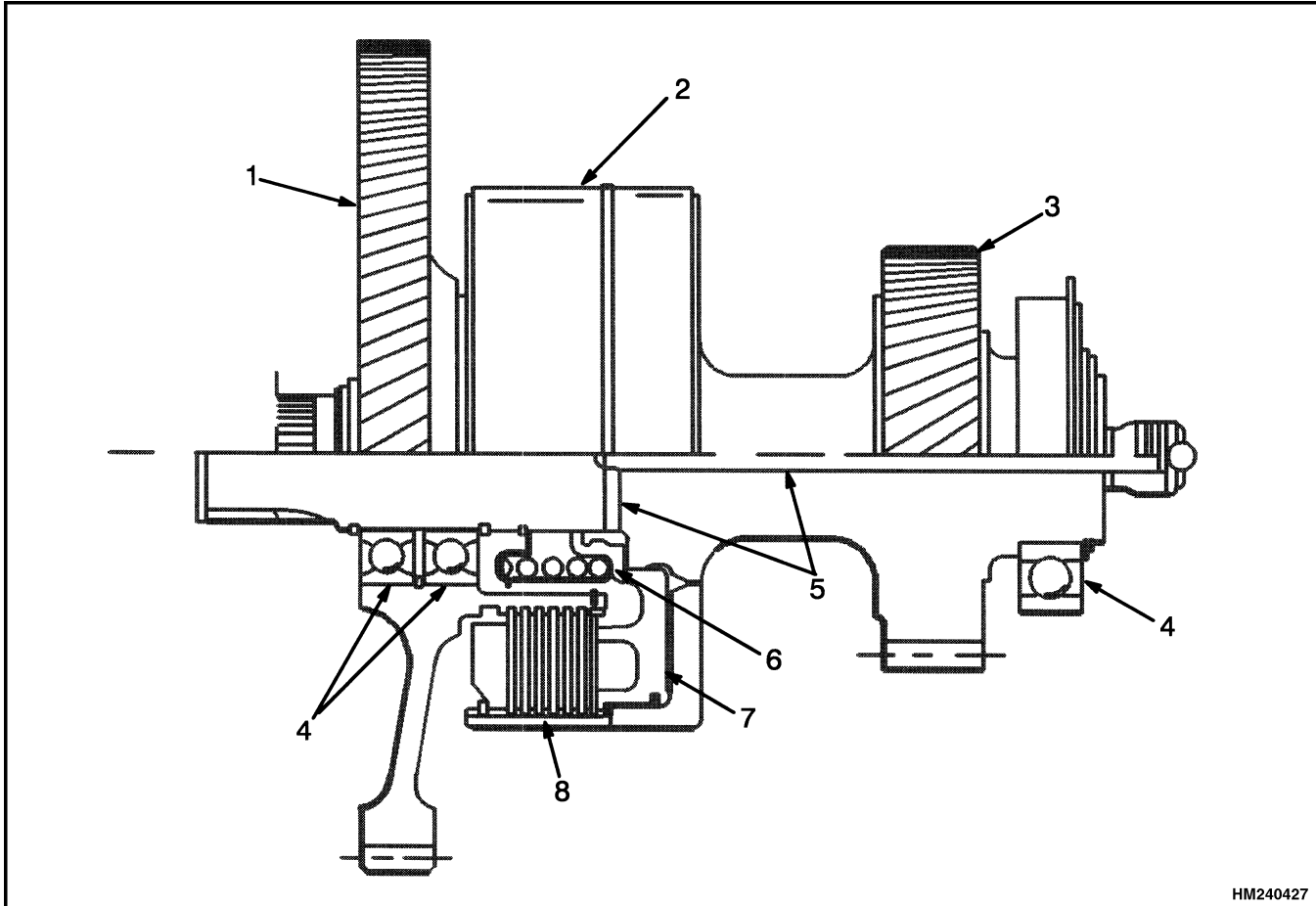
Table 1. Solenoid Controls

Transmission Gear	Activated Solenoids	Activated Clutches
Forward 4	Forward	Forward 4th
Forward 3	Forward 3rd	Forward 3rd
Forward 2	Forward 2nd/3rd	Forward 2nd
Forward 1	Forward 1st/2nd/3rd	Forward 1st
Neutral 4	-	Neutral 4th
Neutral 3	3rd	Neutral 3rd
Neutral 2	2nd/3rd	Neutral 2nd
Neutral 1	1st/2nd/3rd	Neutral 1st
Reverse 4	Reverse	Reverse 4th
Reverse 3	Reverse/3rd	Reverse 3rd
Reverse 2	Reverse/2nd/3rd	Reverse 2nd
Reverse 1	Reverse/1st/2nd/3rd	Reverse 1st

TRANSMISSION OPERATION IN NEUTRAL

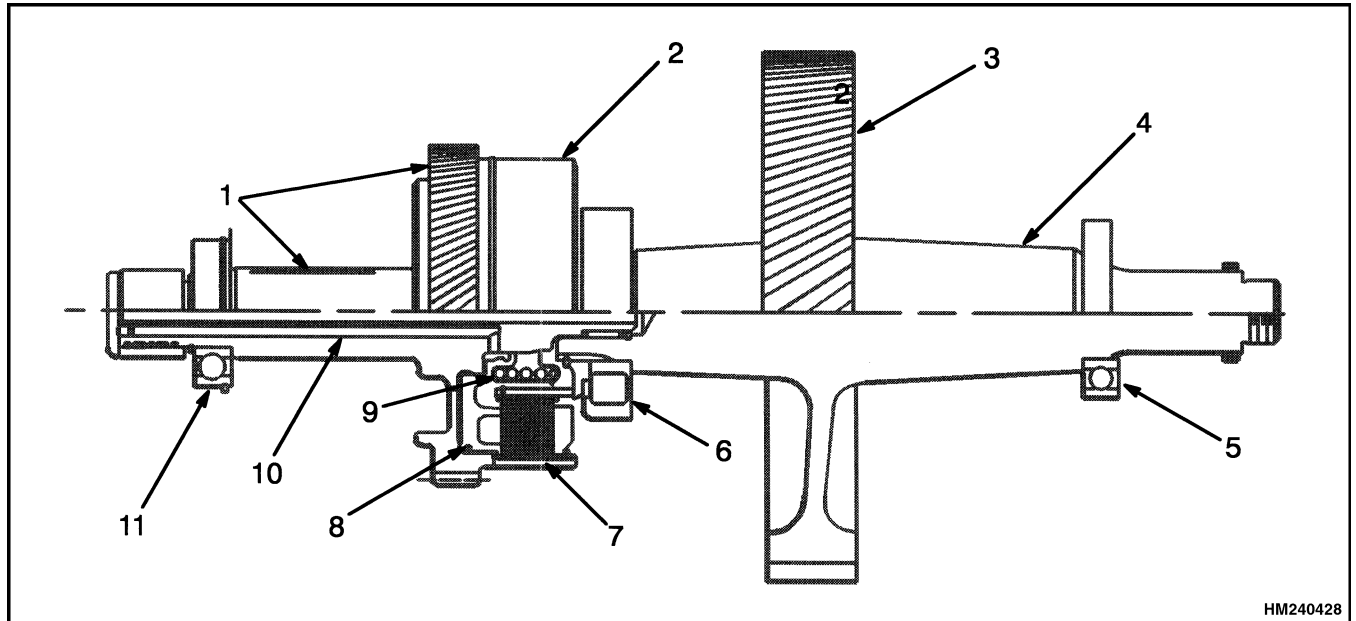
There are two **NEUTRAL** positions as shown in Table 1. The clutches for first speed, second speed, and third speed (first neutral) OR second speed and third speed (second neutral) are engaged for **NEUTRAL**. Since the transmission is in **NEUTRAL** in

either case, only one neutral is apparent during operation. Neither the forward or reverse clutches are engaged for either neutral. Since the forward or reverse clutch is NOT engaged, only the respective clutch hub and gear are rotating with the engine operating. Neither drum is rotating, so no traction power reaches the output shaft. See Figure 1.



- | | |
|--|--------------------------------|
| 1. DRIVEN GEAR FOR THIRD SPEED | 5. PASSAGE FOR CLUTCH PRESSURE |
| 2. THIRD-SPEED DRUM | 6. SPRING |
| 3. CLUTCH SHAFT, GEAR, AND DRUM ASSEMBLY | 7. PISTON |
| 4. BALL BEARING | 8. THIRD-SPEED CLUTCH |

Figure 7. Third-Speed Shaft, Gear, and Clutch Assembly



1. FOURTH-SPEED SHAFT AND DRUM GEAR
2. FOURTH-SPEED DRUM
3. OUTPUT GEAR
4. OUTPUT SHAFT
5. BALL BEARING
6. ROLLER BEARING

7. FOURTH CLUTCH
8. FOURTH-SPEED PISTON
9. RETURN SPRING
10. PASSAGE FOR CLUTCH PRESSURE
11. BALL BEARING

Figure 8. Fourth-Speed Shaft and Clutch Assembly With Output Gear and Shaft

INPUT SHAFT, FORWARD SHAFT, AND CLUTCH ASSEMBLY

Description

The input shaft gear engages the forward gear and hub. See Figure 5. The input shaft rotates on ball bearings. The forward gear and clutch hub rotate on ball bearings. The forward shaft rotates on roller bearings. The forward drum includes a piston, 12 friction discs, 11 separator plates, and the gear of the clutch drum. This clutch drum gear engages the reverse and second drum gear. The reverse clutch assembly and the clutch assembly for second speed are

in a common drum. The third-speed shaft engages the forward drum and shaft with splines.

Operation

The input shaft and gear turns the forward gear and hub on the forward shaft. It also turns the reverse gear and hub on the reverse shaft. When the forward clutch engages, the drum rotates with the hub turning the forward and third-speed shafts. See Figure 9, Sheet 1. The drum gear also turns the second/reverse drum gear, drum, and shaft.

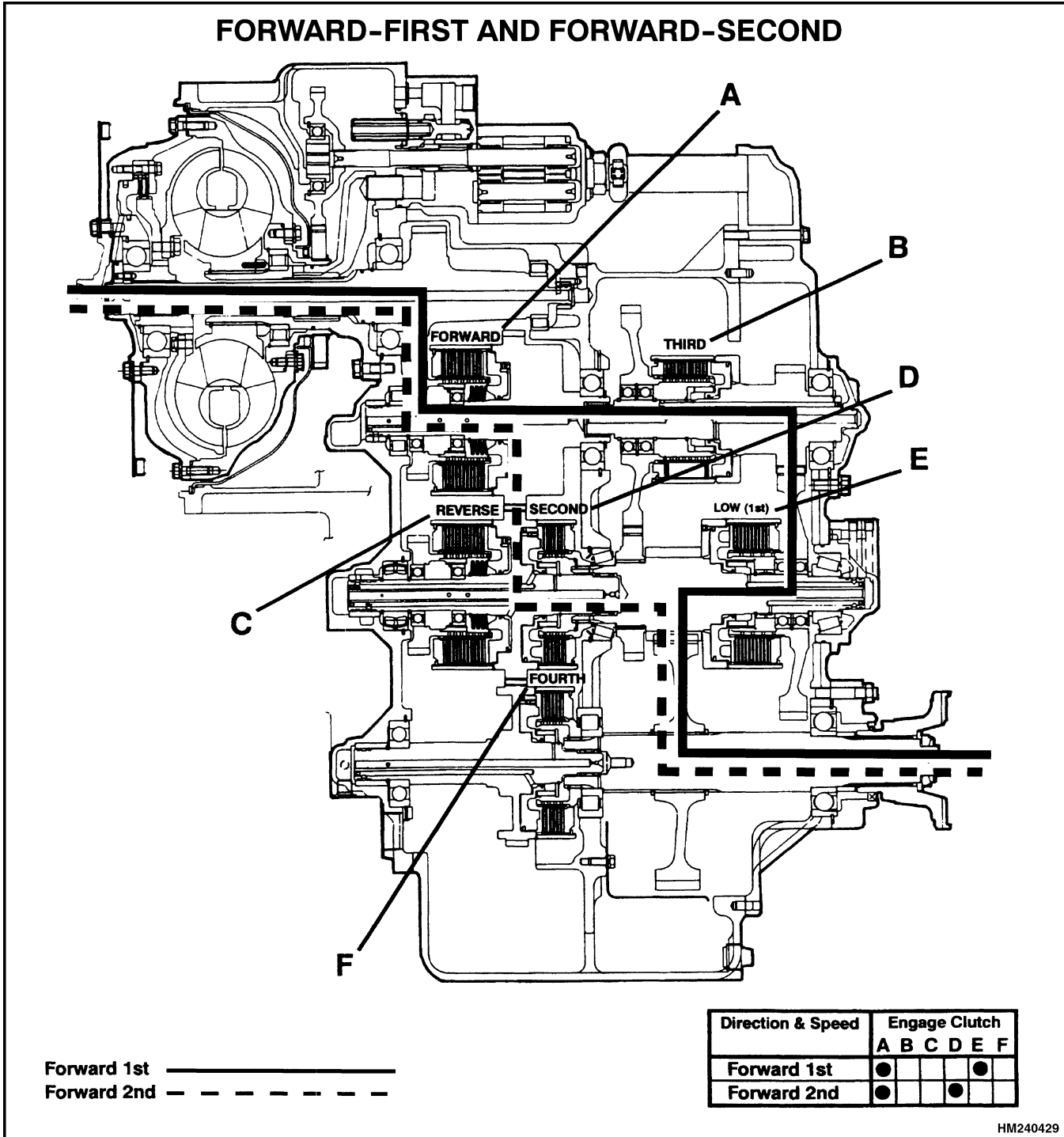


Figure 9. Power Flow Through Transmission (Sheet 1 of 3)

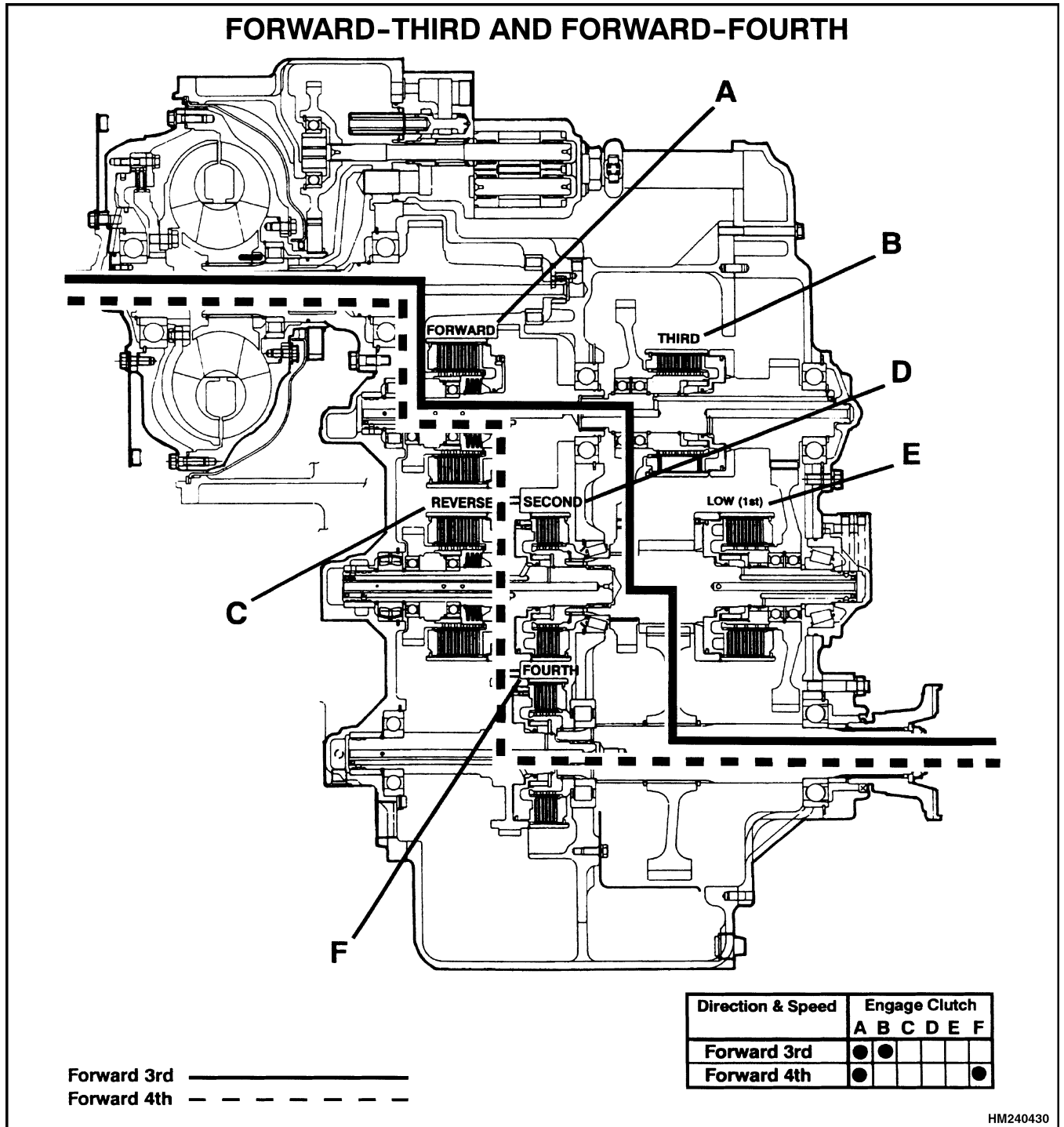


Figure 9. Power Flow Through Transmission (Sheet 2 of 3)

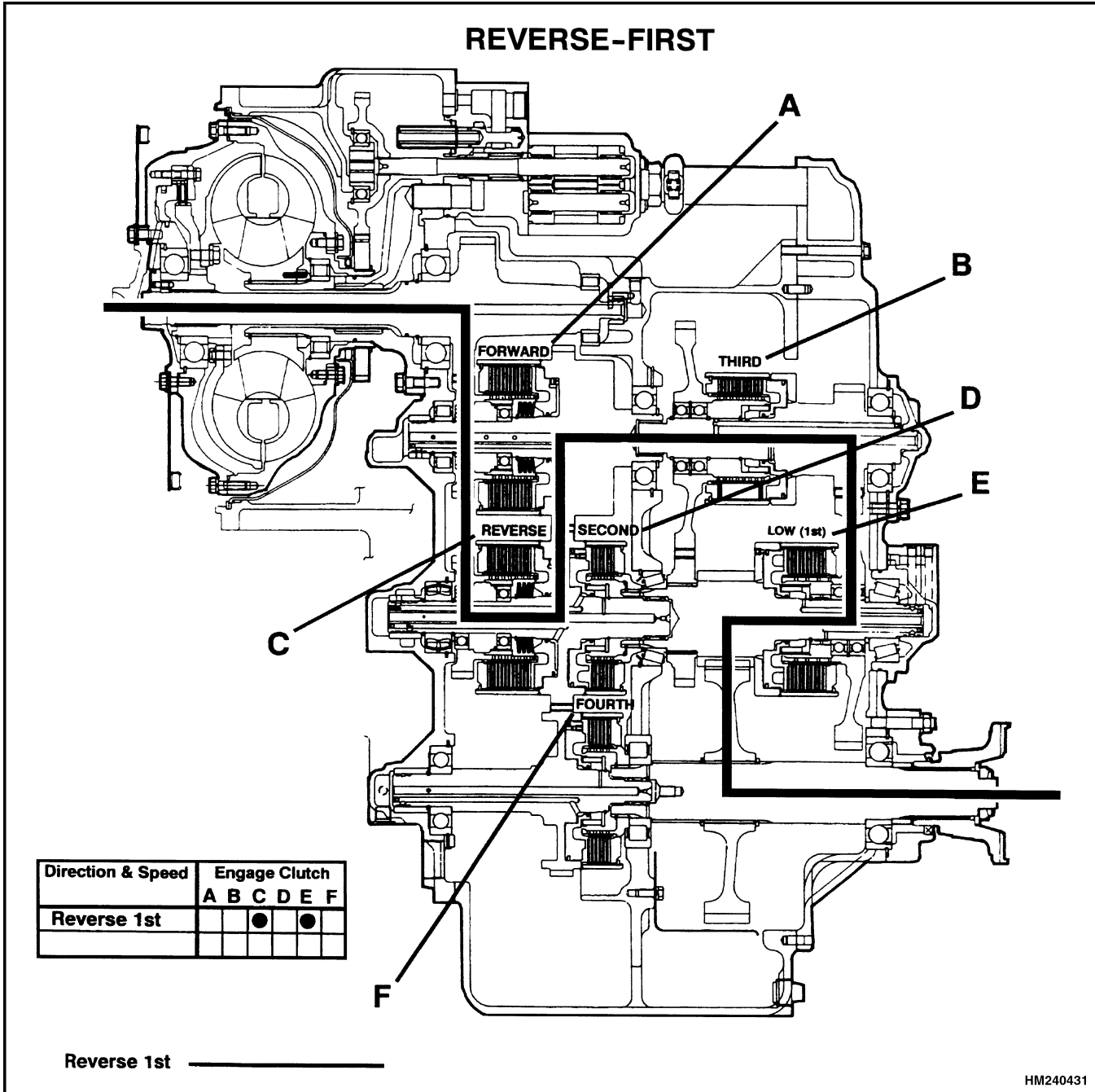


Figure 9. Power Flow Through Transmission (Sheet 3 of 3)

REVERSE, SECOND-SPEED, AND FIRST-SPEED SHAFT AND CLUTCH ASSEMBLIES

Description

The reverse and second-speed assemblies have a common shaft that has the clutch assemblies for reverse and second speed. The reverse clutch assembly and the second-speed clutch assembly share the common drum of the drum and shaft piece. See Figure 6. The reverse clutch assembly has the reverse gear and clutch hub, a piston, 11 friction discs, and 12 separator plates. The reverse gear and clutch hub piece rotate on ball bearings and are driven by the reverse clutch. The shaft of reverse and second rotates on roller bearings and is common with the reverse and second drum. The gear of the reverse and second-speed drum engages the drum gear for forward. This same gear also engages the fourth-speed gear and shaft piece.

The second-speed clutch has the common clutch drum, a piston, six friction discs, six separator plates, and the clutch hub. The clutch hub of the second-speed clutch is engaged in splines on the first-speed shaft and drum piece. The first-speed shaft rotates on tapered roller bearings at both ends. The hub/gear rotates on ball bearings on the shaft. Small ball bearings (pilot bearing) within the end of the first-speed shaft support the reverse/second-speed shaft.

The first-speed clutch assembly has the following: (1) first-speed gear and hub piece and (2) first-speed shaft and drum piece. The first-speed clutch has 10 friction discs and 10 separator plates. The first-speed clutch shaft and drum piece rotates on tapered roller bearings at each end of the shaft. This shaft is driven by the second-speed clutch and hub. The drive gear for third speed is also engaged by splines on this first-speed shaft, so it rotates with the first-speed shaft. The output gear also engages the gear teeth of this first-speed shaft. The first-speed hub and gear piece is driven by the first-speed clutch. This first-speed hub and gear piece rotate on two sets of ball bearings.

Operation

The input shaft and gear turns the reverse gear and hub on the reverse shaft. It also turns the forward

gear and hub on the forward shaft. When the reverse clutch engages, the drum rotates with the hub. This also rotates the forward drum, shaft, and the third-gear shaft/gear. This gear engages the first-speed gear. If the first-speed clutch is also engaged, the first-speed shaft turns with the gear. The shaft gear engages the output gear turning the output shaft. See Figure 9, Sheet 3. If the second-speed clutch is engaged instead, the second-speed hub rotates with the reverse/second drum. This hub rotation rotates the first-speed shaft. The teeth of the shaft engage the output gear turning the output shaft.

The action is similar for forward second gear. The forward clutch engagement makes the forward drum and reverse/second-gear drum rotate. The engagement of the second-gear clutch makes the second-speed hub rotate with the reverse/second drum. This hub rotation rotates the first-speed shaft. The teeth of the shaft engage the output gear turning the output shaft. See Figure 9, Sheet 1.

THIRD-SPEED SHAFT, GEAR, AND CLUTCH ASSEMBLY

Description

The clutch assembly for third speed has the following (see Figure 7): (1) driven gear and hub piece for third speed, (2) a piston, (3) 12 friction discs and 12 separator plates, and (4) a shaft, drum, and gear piece. The driven gear and hub piece for third speed rotate on a set of two ball bearings. The shaft, drum, and gear piece also rotate on ball bearings at each end of the shaft.

Operation

The input shaft and gear turns the forward gear and hub on the forward shaft. When the forward clutch engages, the drum rotates with the hub turning the forward and third-speed shafts. The third-speed clutch engages to rotate the third-speed hub/gear with the drum. The third-speed gear engages the gear of the first-speed shaft. This gear makes the first-speed shaft rotate. The gear teeth of the shaft engage the output shaft gear to rotate the output shaft. See Figure 9, Sheet 2.

FOURTH-SPEED SHAFT AND CLUTCH

Description

The fourth-speed clutch has the fourth-speed gear/shaft, clutch drum, a piston, six friction discs, and six separator plates. See Figure 8. The hub of the clutch engages the output shaft with splines. The shaft/gear/drum rotates on ball bearings at the shaft end and smaller ball bearings (pilot bearing) within the output shaft at the clutch end. The fourth-speed gear and clutch hub rotate on ball bearings.

Operation

The input shaft and gear turns the forward gear and hub on the forward shaft. When the forward clutch engages, the drum rotates with the hub turning the reverse/second drum and the fourth-speed gear/shaft/drum. The fourth-speed clutch engages to rotate the output shaft/hub. See Figure 9, Sheet 2.

OUTPUT SHAFT

Description

The output shaft is installed at the end of the fourth-speed shaft. The shaft is the final output for each of the four speeds in each direction. The output shaft has the output gear and the output yoke. The output gear is driven by gear teeth on the first-speed shaft. The output shaft rotates on ball bearings. The output shaft can be driven by the output gear or the fourth-speed clutch hub.

Operation

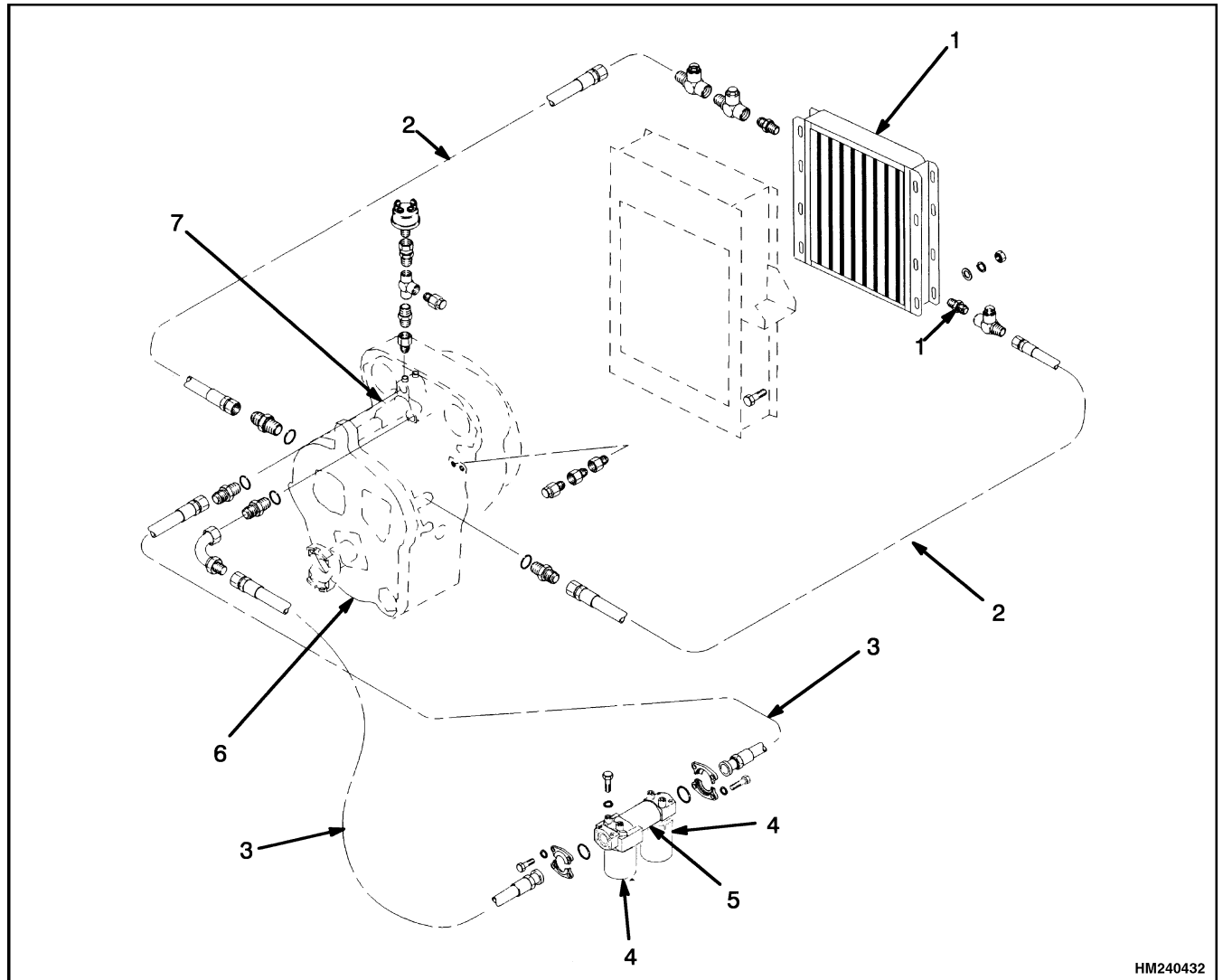
The output shaft rotates as previously described for each of the four speeds and both directions. See Figure 9. The drive shaft for the lift truck is driven by this output shaft to move the lift truck in the correct direction with the correct gear speed selected.

Hydraulic Description and Operation

SUMP, FILTER, AND PUMP

The transmission housing is also the oil sump. See Figure 1. There is an external dual oil filter. This oil filter is replaceable and has a bypass valve. The bypass valve permits oil to flow past the oil filter when it has a restriction. A pressure regulator valve makes sure there is enough oil pressure to the transmission control valve for operating the direction and speed clutches. See Figure 13. The oil pump is installed at the top rear of the transmission. The input shaft drives a gear on the pump shaft for pump operation.

The oil from the sump flows through the suction screen and tube to the transmission pump and then through the oil filter to the pressure regulator valve. The regulator valve uses a small part of this oil for the control valve. The rest of the oil goes through the torque converter circuit to the oil cooler and back to the transmission for positive lubrication of bearings and gears. See Figure 10.



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- | | |
|--------------------|-------------------------|
| 1. HEAT EXCHANGER | 5. FILTER ASSEMBLY |
| 2. COOLING CIRCUIT | 6. TRANSMISSION HOUSING |
| 3. FILTER CIRCUIT | 7. TRANSMISSION PUMP |
| 4. FILTER ELEMENT | |

Figure 10. External Circuits for Transmission Oil