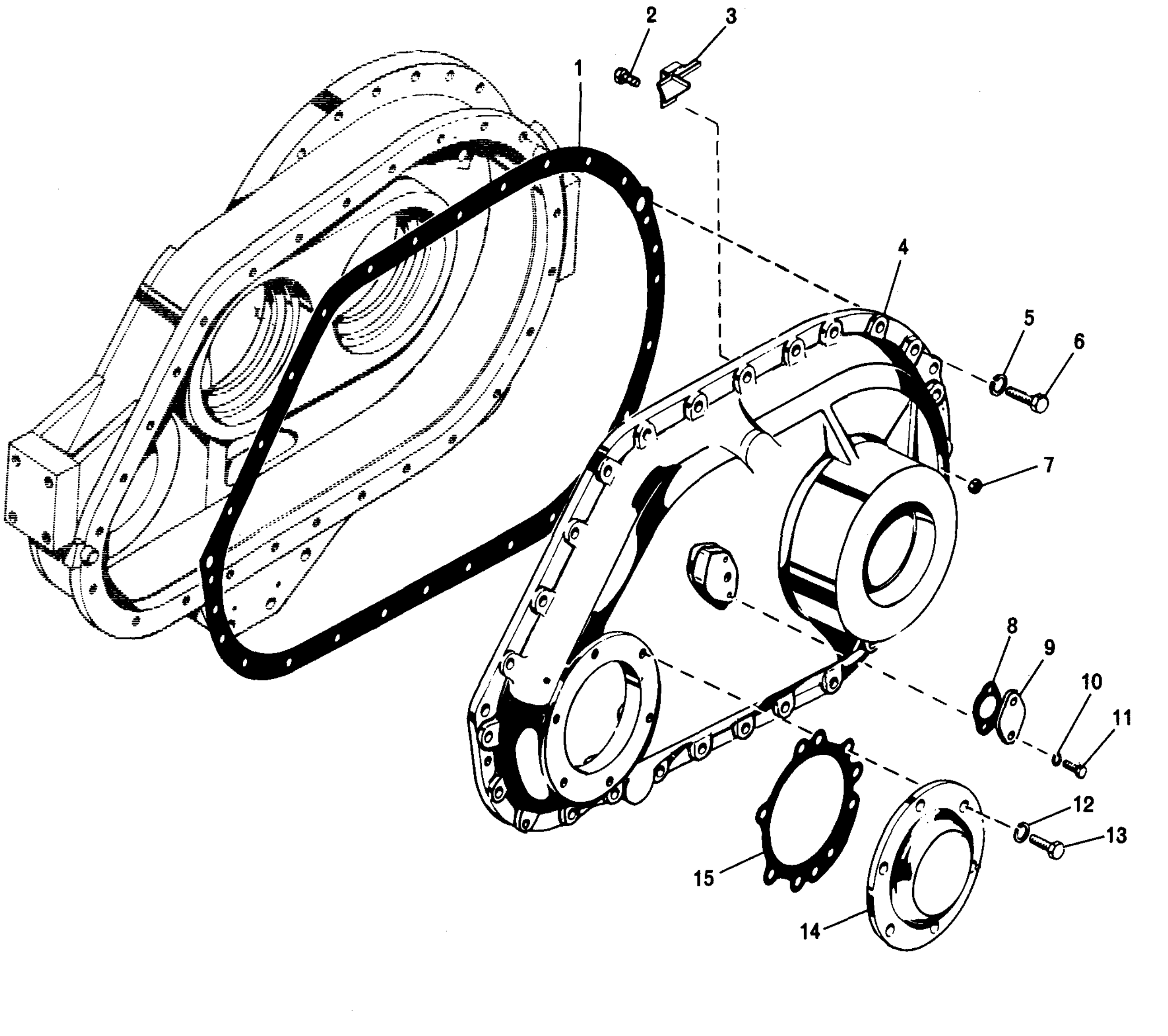

Foldout 20. Horizontal transfer gear housing cover—exploded view

ELECTRIC CONTROL SYSTEMS

SUPPLEMENT

WARNING

The shift tower, cables, connectors, and internal connections used with these transmission control systems must not be altered or modified in any way unless written approval is obtained from:

Transmission Engineering
Detroit Diesel Allison Division
General Motors Corp,
P.O. Box 894
Indianapolis, Indiana 46206

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FOLDOUTS

Section 1. MANUAL-ELECTRIC CONTROL SYSTEM

1-1. GENERAL INFORMATION

Note: The rear unit transmission of scrapers having dual power units have a fail-to-neutral feature. Two solenoids are omitted from the rear unit transmission. Refer to para 2-9 for description.

a. Optional Components. A manual-electric control system is used on some series 5000 and 6000 series transmissions. The system includes an electrically-controlled valve body and a pressure switch on the transmission (fig. 1-1), a manual selector assembly in the vehicle cab (fig. 1-2), and a wiring harness 85 (B, foldout 1), connecting the selector and valve body. These components are available either as an option on current transmissions, or for installation on transmissions originally equipped with other control systems.

b. Solenoids Control Hydraulic Shifting. Seven solenoid (electromagnetic) valves control hydraulic circuits that shift the range control valves. Six forward speeds, neutral, and reverse are selected manually by the driver. The electrical circuit established by each position of the manual selector establishes a hydraulic circuit that provides drive in the forward gear selected, neutral, or reverse.

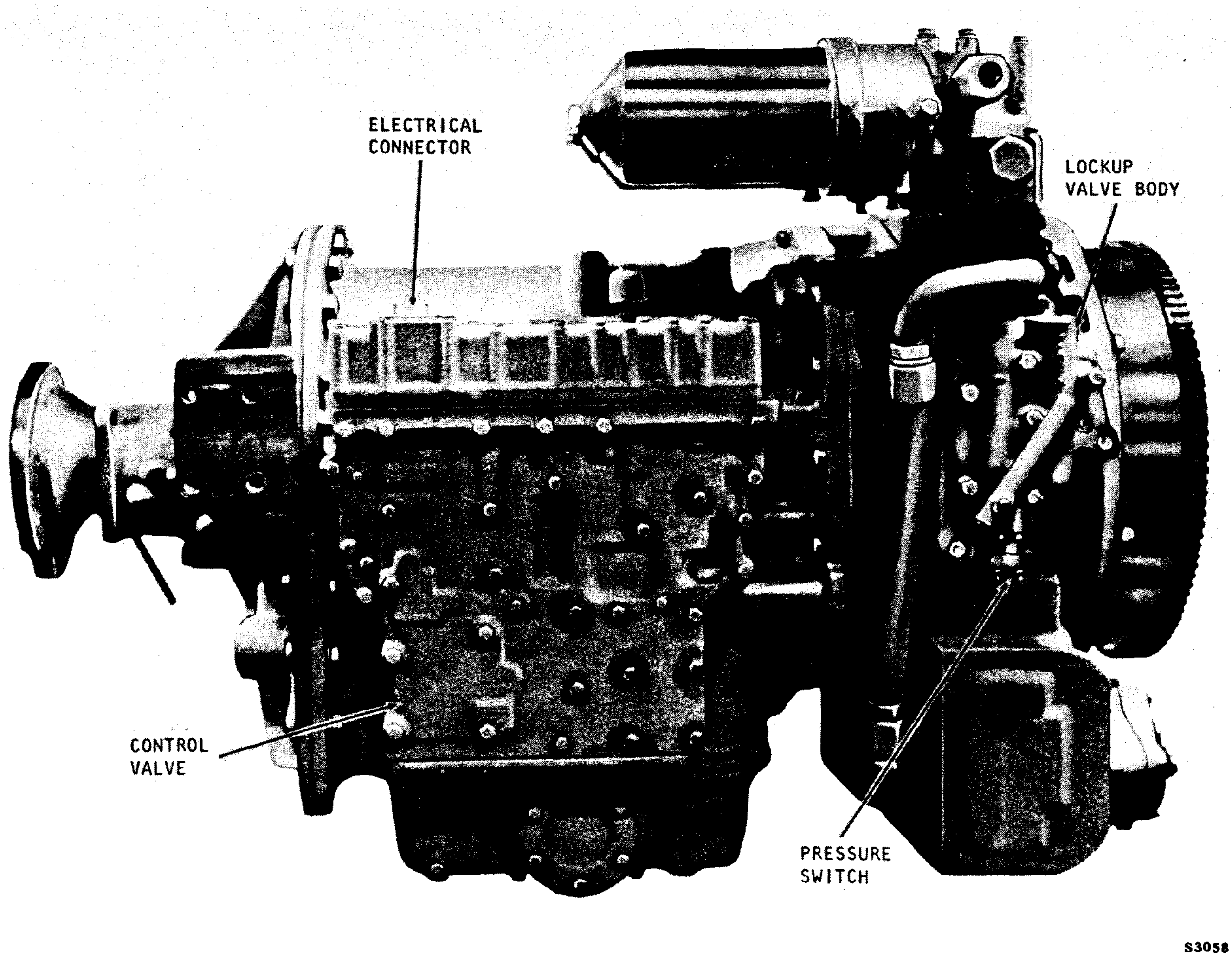


Fig. 1-1 Manual-electric valve body on 6000 series transmission

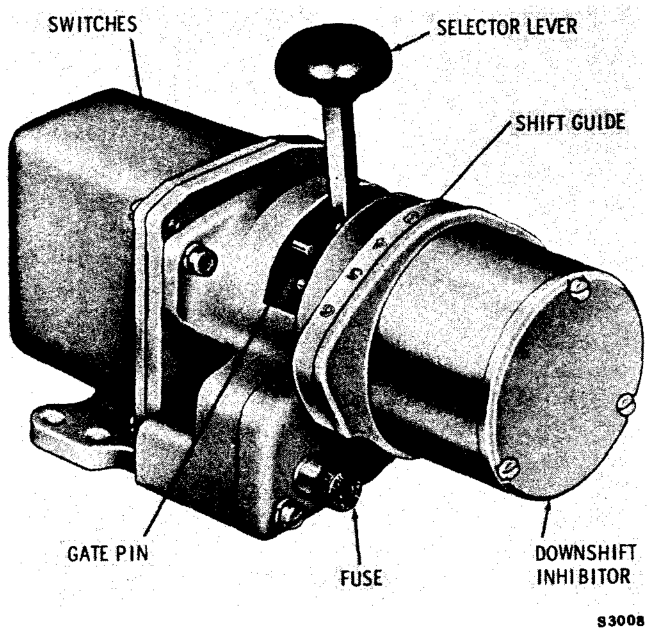


Fig. 1-2. Manual selector assembly

c. Power Source. Electrical power for actuation of the control system is supplied by the vehicle electrical system. Electrical components to match the vehicle system voltage (12 or 24 volts DC) are provided in the control system. An SFE 9A fuse is provided in the selector assembly (fig. 1-2). Earlier selector assemblies do not include a fuse, and the power input circuit must include a fuse.

d. Failure Protection. The system is so designed that if electrical power fails at one solenoid, or fails completely, the transmission will continue to operate in the forward gear in which it was operating at the time of the electrical failure. If total electrical failure occurs in neutral, the transmission will remain in neutral regardless of any gear selection thereafter. If total electrical failure, or failure of only the reverse solenoid occurs while operating in reverse gear, the transmission will go to neutral condition. However electrical failure of only the reverse shift valve solenoid will not prevent normal operation in forward gears. If any single forward shift valve or splitter shift valve fails electrically while energized, the vehicle will continue in operation in the same gear until the engine is stopped or the selector lever is moved. When the engine is stopped after an electrical failure, the "fail-in-range" protection is lost because the hydraulic "hold" pressure is lost. Hydraulic "hold" pressure cannot be regained by restarting the engine. Refer to paragraph 2-8 for information relating to specific solenoid failures.

e. Appearance. Transmissions equipped with the manual-electric control system can be recognized by the 8-pin electrical connector at the top of the control valve assembly, and the absence of mechanical shift linkage. Figure 1-1 illustrates the valve assembly on the transmission.

Note: The electric control valve body previously supplied on certain CLBT 5860 models have a 6-pin electrical connector (refer to Publication SA 1170).

1-2. MODEL DESIGNATION

The model designation of transmissions equipped with the manual-electric control system is not different from those having other control systems.

Note: If 4-speed transmissions should be converted to manual-electric control, they will become 6-speed transmissions. The original model designation will indicate they are 4-speed. When requesting parts or service information for any transmission field-converted to manual-electric control, the request must state that conversion has been made. In addition, the serial number, model and assembly number from the nameplate must be supplied.

1-3. SPECIFICATIONS, DATA

The table below lists specifications and data applicable to the manual-electric control system.

SPECIFICATIONS AND DATA

Type	Manual-electric-hydraulic (manual selection of operating mode energizes solenoids; solenoids control hydraulic pressures to shift valves; valves control hydraulic clutches)
Gear ranges, selector positions	Neutral, 6 forward speeds, reverse
Electrical system:	
power source	vehicle electrical system
voltage	12 or 24 volts DC
current draw:	
12-volt system	0.6 amp per solenoid
24-volt system	0.3 amp per solenoid
solenoids	total quantity 7
Solenoids energized:	
neutral	2
reverse	3
forward gears	2
Wiring harness:	
number of conductors	14
connectors	16-pin (female) at selector; 8-pin (female) at valve body; push-in, thread-tighten type
side branches	6 (refer to fig. 3-4)
Downshift inhibitor:	
type and location	solenoid, in manual selector assembly
activated by	pressure switch on transmission, closed by lockup clutch pressure
Manual selector assembly:	
location	vehicle cab
selector sequence (rear to front)	R, N, 1, 2, 3, 4, 5, 6 (each position gated)
light (connected to vehicle light system)	integral
downshift inhibitor	integral
Oil specifications:	
above -10°F	hydraulic transmission fluid, type C2
below -10°F	hydraulic transmission fluid, type C2—auxiliary preheat required to raise temperature in sump and external circuit

Section 2. DESCRIPTION AND OPERATION

2-1. SCOPE OF SECTION 2

Note: The rear unit transmission of scrapers having dual power units have a fail-to-neutral feature. Two solenoids are omitted from the rear unit transmission. Refer to para 2-9 for description.

This section describes the manual-electric control system used on 5000 and 6000 series transmissions, and explains the function of system components. Explanations include the system's operation in neutral, reverse and six forward gears.

2-2. DESCRIPTION AND FUNCTION OF COMPONENTS

Paragraphs 2-3 through 2-8, below, describe and explain the function of control system components.

Note: Only system components that differ from the manual-hydraulic (standard), and other previous systems (split-range and CLBT 5860 electric valve body) are described and explained. Refer to the applicable service manual(s) for components not covered herein.

2-3. CONTROL VALVE BODY ASSEMBLY

a. Includes All Shift and Trimmer Components (foldout 1)

(1) Control valve body assembly 9 (B, foldout 1) includes all shift and trimmer components for the control system.

(2) Valve body 38 includes twelve bores into which valve and trimmer components are installed. These are: reverse-gear shift valve 34, low-range shift valve 32, intermediate-range shift valve 31, high-range shift valve 28, priority valve 25, splitter shift valve 23, solenoid pressure regulator valve 22, low-splitter trimmer valves 47 and 49, trimmer regulator valve 58 (not included after S/N 59805), intermediate-range trimmer valve 61, low-range trimmer valves 70 and 72, and reverse trimmer valve 73. Seven solenoids 18 in cover and plate assembly 10 control these valves.

(3) Individual valve groups, and their functions, are discussed in b through p, below.

b. Reverse Shift Valve (foldout 3)

(1) The reverse shift valve is a spool-type valve which can move lengthwise in its bore. A spring pushes the valve upward when solenoid B is energized. Hydraulic pressure pushes the valve downward when solenoid B is de-energized and its valve closes.

(2) In its upward position, the valve directs hydraulic pressure to the reverse clutch. In its downward position, the valve exhausts clutch pressure.

c. Low-range Shift Valve (foldout 3)

(1) The low-range shift valve is a spool-type valve which can move lengthwise in its bore. A spring pushes the valve upward when solenoid C is energized. Hydraulic pressure pushes the valve downward when solenoid C is de-energized and its valve closes.

(2) In its upward position, the valve directs hydraulic pressure to the low-range clutch. In its downward position, the valve exhausts clutch pressure.

d. Intermediate-range Shift Valve (foldout 3)

(1) The intermediate-range shift valve is a spool-type valve which can move lengthwise in its bore. A spring pushes the valve upward when solenoid D is energized. Hydraulic pressure pushes the valve downward when solenoid D is de-energized and its valve closes.

(2) In its upward position, the valve directs hydraulic pressure to the intermediate-range clutch. In its downward position, the valve exhausts clutch pressure.

e. High-range Shift Valve (foldout 3)

(1) The high-range shift valve is a spool-type valve which can move lengthwise in its bore. A spring pushes the valve upward when solenoid E is energized. Hydraulic pressure pushes the valve downward when solenoid E is de-energized and its valve closes.

(2) In its upward position, the valve directs hydraulic pressure to the high-range clutch. In its downward position, the valve exhausts clutch pressure.

f. Priority Valve (foldout 3)

(1) The priority valve is so named because it gives the upper ends of the shift valves priority on main pressure when the vehicle engine is first started. This is necessary to insure that the shift valves are all positioned downward (in neutral) so that no apply pressure is directed to a range clutch until a gear is selected.

(2) The valve is held downward by spring pressure until main pressure, reaching the step area of the valve through an orifice, is sufficient to raise the valve against its two springs. When the valve is upward, main pressure enters the bore at a second passage (below the orifice) and flows to the remainder of the circuit. By the time the valve is fully upward, solenoid pressure (main pressure regulated to a lower pressure in the solenoid pressure regulator valve) has pushed all of the shift valves downward, except the splitter shift valve, at which solenoid F is energized and its valve is open.

(3) When the priority valve is fully upward, main pressure is exerted on its lower end, as well as on its step area. Thus, the valve cannot move downward until main pressure falls somewhat below that required to raise it initially.

g. Splitter Shift Valve (foldout 3)

(1) The splitter shift valve is a spool-type valve which can move lengthwise in its bore. A spring pushes the valve upward when solenoid F is energized. Hydraulic pressure pushes the valve downward when solenoid F is de-energized and its valve closes.

(2) When the valve is upward, hydraulic pressure is directed to the low-splitter clutch. When the valve is downward, hydraulic pressure is directed to the high-splitter clutch. When the high-splitter clutch is applied, the low-splitter clutch exhausts through a port at the left side of the valve bore. When the low-splitter clutch is applied, the high-splitter clutch exhausts through the bore of the low-splitter trimmer.

(3) Solenoid G is de-energized (valve closed) during low-splitter operation. This retains low-splitter clutch pressure at the bottom of the valve during low-splitter operation. Solenoid G provides the means (when energized) to exhaust low-splitter pressure at this point when it is desired to shift to high-splitter operation.

h. Solenoid Pressure Regulator Valve (foldout 3)

(1) The solenoid pressure regulator valve is a spool-type valve which can move lengthwise in its bore. Spring pressure pushes downward on the valve, allowing main pressure to flow into the area at the middle of the valve, then to the upper ends of the shift valves and, through an orifice, to the lower end of the regulator valve.

(2) When pressure at the lower end of the valve exceeds the force of the valve spring, main pressure is blocked, preventing solenoid pressure from increasing. When solenoid pressure falls, the valve moves downward, again admitting main pressure. When a balanced condition is reached (solenoid pressure equals spring force), a uniform pressure — somewhat lower than main pressure is established.

i. Failure Protection (all shift valves)

(1) The shift valves (except the splitter shift valve) are arranged in a cascade system. This arrangement insures that only one range clutch can be applied at a given time, because the apply pressure of each depends upon the released position of the preceding valve. Thus, if two valves should be in the apply position, only the one that is first in line can receive apply pressure.

(2) Each of the forward operation shift valves directs its clutch apply pressure to the spring cavity beneath the valve at the same time the clutch is charged. This insures that the valve will stay in the upward position (clutch applied) even though the solenoid at the upper end of the valve is de-energized (by electrical failure). This hydraulic "hold" can be relieved only by the upward movement of an adjacent valve, or, in the case of the low-range shift valve, by energizing solenoid A. The splitter shift valve, in low-splitter position, is unlocked by energizing solenoid G, to exhaust the pressure from beneath the valve.

(3) These features are referred to as "fail-in-range," because the operating range is retained even though an electrical failure occurs during operation. Loss of hydraulic pressure, as caused by stopping the engine, will relieve all hydraulic "holds" and only neutral will be obtained when the engine is restarted (if there is an electrical failure).

(4) The reverse shift valve has no such "fail-in-range" feature, and will always go to neutral (exhaust position) in the event of electrical failure during reverse operation.

j. Trimmer System (foldout 3)

(1) The trimmer system includes five valve groups in the lower section of the control valve assembly. These are: reverse-gear trimmer, low-range trimmer, intermediate-range trimmer, low-splitter trimmer, and trimmer regulator valve (prior to S/N 59806).

(2) The functions of the four trimmers are similar. Each trimmer regulates the application of the clutch indicated by its designation. Basically, each trimmer limits the apply pressure of its clutch initially, and then permits full apply pressure. The purpose of trimming is to prevent shift shock resulting from abrupt clutch engagement.

(3) The function of the trimmer regulator is the rapid resetting of the reverse, low-range, and intermediate-range trimmer components to operating position after trimming. This is accomplished by directing a regulated pressure, produced in the trimmer regulator, to the lower ends of the reverse, low-range, and intermediate-range trimmers. The low-splitter trimmer is not controlled by the trimmer regulator.

(4) After transmission serial number 59805 the trimmer regulator valve was omitted from the valve body. Trimmer function remains the same except that the cavity below each trimmer plug is now exhausted instead of receiving a regulated pressure. Spring pressure alone returns the valves to operating position.

(5) A secondary function of the low-range, intermediate-range and low-splitter trimmers is regulation of the exhaust of preceding clutches. This prevents both clutch slippage and excessive clutch overlap during shifting.

(6) Individual trimmer system valve groups are described in k through o, below.

k. Reverse-Gear Trimmer (foldout 3)

(1) This valve group includes a valve stop and two springs in the lower end of the valve bore, a valve or valve plug near the middle point in the bore, and a spring and valve at the upper end of the bore. A reverse clutch pressure passage is connected to the upper end of the bore. An exhaust port is provided just below the reverse clutch pressure passage. Prior to S/N 59806 a passage connecting the lower cavity of the bore to the trimmer regulator valve is provided.

(2) When the reverse clutch is applied, apply pressure is sent to the top end of the valve. Initially, the plug and valve are forced downward against the spring until oil escapes at the exhaust port. The escape of oil, as long as it continues, reduces clutch apply pressure. However, oil flows through an orifice in the trimmer valve to the cavity between the trimmer valve and the trimmer valve plug. Pressure in this cavity forces the plug farther downward, to the stop. The plug stops, but the flow through the orifice continues. The pressure below the trimmer valve, because it is acting upon a greater surface area than at the upper end, pushes the trimmer valve to the upper end of the valve bore. This throttles, then stops, the escape of oil to exhaust. When the escape of

oil is throttled, clutch pressure rises. When escape of oil stops, clutch pressure is at maximum. The plug remains downward until the clutch is released.

(3) Upon release of the clutch the spring pushes all the trimmer components to the top of the valve bore. In this position the trimmer is reset and ready for the next clutch application.

l. Low-Range Trimmer (foldout 3)

(1) This valve group includes a valve stop and two springs at the lower end of the trimmer valve bore, a valve near the middle of the bore, and a trimmer valve and spring at the upper end of the bore. A low-range clutch pressure passage is connected to the upper end of the bore. An exhaust port is provided just below the low-range clutch pressure passage. Prior to S/N 59806 there is a passage connecting the lower cavity of the bore to the trimmer regulator valve. After S/N 59805 this passage is exhausted to sump.

(2) In addition, exhaust passages from the high- and low-range shift valve bores connect to the trimmer bore near the middle of the bore. These passages, in conjunction with the position of the trimmer lower valve, control the exhaust rates of preceding clutches.

(3) The trimming function of the low-range trimmer is similar to that of the reverse-gear trimmer. Refer to k(2) and (3), above.

m. Intermediate-range Trimmer (foldout 3)

(1) This valve group includes a valve stop and two springs at the lower end of the trimmer valve bore, a valve near the middle of the bore, and a trimmer valve and spring at the upper end of the bore. An intermediate-range clutch pressure passage is connected to the upper end of the bore. An exhaust port is provided just below the intermediate-range clutch pressure passage. Prior to S/N 59806 there is a passage connecting the lower cavity of the bore to the trimmer regulator valve. After S/N 59805 this passage is exhausted to sump.

(2) In addition, exhaust passages from the intermediate-range shift valve and to the exhaust regulator valve are provided. These passages, in conjunction with the position of the trimmer valve plug, control the exhaust rate of the low-range clutch.

(3) The trimming function of the intermediate-range trimmer is similar to that of the reverse gear trimmer. Refer to k(2) and (3), above.

n. Trimmer Regulator Valve

Note: After S/N 59805 the trimmer regulator valve bore and components are omitted from the control valve body (fig. 4-21). If your transmission includes trimmer regulator valve components, they are essential to proper transmission functions.

(1) The trimmer regulator valve includes a spring (not used after S/N 55743) and regulator valve at the lower end of the bore, and a spring and valve plug at the upper end of the bore. A passage from the reverse shift valve bore is connected to the upper end of the regulator valve bore. Two exhaust ports are provided at the lower end of the valve bore. A main-pressure passage connects near the middle of the bore. A regulator pressure passage connects to the reverse gear, low-range, and intermediate-range trimmer valve bores.

(2) The upper cavity of the valve bore is pressurized only when the transmission is in neutral. The upward movement of any shift valve (except splitter shift valve) interrupts main pressure, and exhausts the passage connected to the regulator valve upper end. When the upper cavity is pressurized (neutral), the valve plug and valve are forced downward. In this position, the regulator valve blocks main pressure at the middle of the bore, and exhausts the regulator pressure passage (leading to trimmer valves).

(3) When in any condition other than neutral, the regulator valve and valve plug are forced upward by the lower spring. In its upward position, the regulator valve admits main pressure to the middle area of the valve. A regulated pressure is directed to the three trimmer valves.

(4) The regulated pressure resets any trimmer valve group that has performed its trimming function, after the trimmed clutch is released. Refer to j(3) and (4), above.

o. Low-splitter Trimmer (foldout 3)

(1) This valve group includes two springs and a valve stop in the lower end of the trimmer valve bore, a trimmer lower valve at the middle of the bore, and a spring and trimmer upper valve at the upper end of the valve bore. A low-splitter clutch pressure passage is connected to the upper end of the trimmer valve bore. An exhaust port is provided just below the low-splitter clutch pressure passage. An exhaust passage from the splitter shift valve bore is connected to the middle of the trimmer valve bore. An exhaust port is provided just below the splitter exhaust passage, and another at the lower end of the trimmer valve bore.

(2) The trimming function of the low-splitter trimmer valve is similar to that of the reverse gear trimmer. Refer to k(2) and (3), above.

(3) A secondary function of the low-splitter trimmer is the regulation of high-splitter clutch exhaust. The position of the splitter lower valve, in relation to the exhaust passages near the middle of the trimmer valve bore, determines the exhaust rate of the high-splitter clutch exhaust.

p. Exhaust Check Valve (foldout 3)

(1) This valve group includes a valve guide pin, a spring, and a mushroom-shaped valve. The valve seats in an opening of a separating plate adjacent to the control valve body. The spring maintains a slight pressure to hold the valve in its seat (closed).

(2) The exhaust check valve is a common point through which several exhaust passages lead. The purpose of the arrangement is to provide an exhaust system which will dissipate almost all pressure, but will retain fluid in the system. When the system is filled with fluid, response to control is quicker.

2-4. SOLENOIDS

a. Seven Solenoids in System. The control system includes seven solenoids. These are identified by letters A through G (refer to foldout 3), in various illustrations and text. The solenoids are all identical in a control valve assembly, and are not marked with letter identification when manufactured. Electrical leads to the solenoids are marked at manufacture — so that any solenoid in the system can be identified by the letter on its connecting wire terminal.

b. Solenoids Include Valves. Solenoids are electrically energized devices which produce a magnetic pull force when energized. In this application, the magnetic force opens a spring-loaded needle valve. The open needle valve bleeds off pressure, at the end of a shift valve, faster than the pressure can be sustained by oil coming into the area through an orifice. This permits the shift valve spring to push the valve toward the solenoid (or relieves pressure at the spring end of a valve when the solenoid is so located). When the solenoid is de-energized, its valve closes by spring pressure, and the cavity fills with oil. Pressure of the oil then pushes the valve away from the solenoid end, against the valve spring.

c. Voltage of Solenoids Matches Vehicle System. Solenoids are designed for either 12- or 24-volt operation. Those designed for 12 volts will not operate satisfactorily with 24 volts. Those designed for 24 volts will not open with 12 volts applied. Power to energize the solenoids is derived from the vehicle electrical system. Thus, the design voltage of the solenoids must match the voltage available in the vehicle electrical system.

2-5. SHIFT SELECTOR ASSEMBLY

a. Manually Operated. The shift selector assembly (shift tower) is manually operated and has eight selector positions. These are (from rear to front): reverse, neutral, first gear, second gear, third gear, fourth gear, fifth gear, and sixth gear. The shift indicator is correspondingly marked R, N, 1, 2, 3, 4, 5, and 6. Each shift position is gated, and the selector lever must be pushed right or left, alternately, to clear the gate separating each gear position from the adjoining position. Refer to figure 1-2.

b. Internal Components

(1) Eight microswitches are operated by a cam attached to the manual selector lever. Each position of the lever opens and closes the proper combination of switches required to energize or de-energize the proper combination of solenoids for that selector position.

(2) A solenoid, which has its axis on a line with the axis of the switch-operating cam, acts as a downshift inhibitor. It is energized when the transmission lockup clutch engages. Lockup clutch pressure closes a pressure-actuated switch (para 2-6, below), which, in turn, energizes the inhibitor solenoid. The inhibitor solenoid engages a dog clutch arrangement which prevents the gear selector lever from being moved to a lower gear position. It may be upshifted, however.

Note: The inhibitor solenoid is not to be confused with the seven solenoids in the control valve assembly, as described in paragraph 2-4, above.

(3) A lamp, which illuminates a translucent shift guide, is included in the selector assembly, and must match the vehicle electrical system voltage. An SFE 9A fuse, in a holder permitting quick replacement, is included in the assembly.

2-6. DOWNSHIFT INHIBITOR PRESSURE SWITCH

A pressure switch (fig. 1-1), closed by lockup clutch pressure, energizes a solenoid in the shift selector assembly (fig. 1-2). The switch is installed into an existing tapped opening in the lockup control valve body. On earlier models, the pressure switch is located on the side of the valve; on later models the switch is located as shown in A, foldout 1. A conductor in the wiring harness connects the switch to the selector assembly (fig. 3-4). Refer to paragraph 2-5b(2), above for explanation of the solenoid in the shift selector assembly.

2-7. WIRING HARNESS

a. Connects Main Components (fig. 3-4)

(1) A wiring harness, of the length required to connect the selector assembly to the control valve assembly, transmits the electrical signals that cause the transmission to respond to the movements of the shift selector lever.

(2) Fourteen wires are in the harness at the point it leaves the selector assembly. Six wires branch off from the harness to attach to various parts of the circuit. The remaining eight wires attach to the control valve assembly.

b. Pin-Type Connectors. A 16-pin (female) connector is attached to the shift selector end of the wiring harness. An eight-pin (female) connector is attached to the control valve end of the harness. These connectors push onto mating connectors on the selector and control valve assemblies. A nut on each connector secures the harness ends.

2-8. MANUAL-ELECTRIC CONTROL IN OPERATION

a. Neutral (foldout 3)

(1) The hydraulic system, as shown in foldout 3, is represented with the selector control at neutral (N), and with the vehicle engine running.

(2) Main pressure (red), leaving the flow valve, is directed to the solenoid pressure regulator valve and to the priority valve. At the solenoid pressure regulator valve, a regulated pressure for controlling the shift valves is produced, and directed to each shift valve. At each shift valve, the oil (solenoid pressure — yellow-white) must pass through an orifice. At the priority valve, main oil (red) passes through an orifice and exerts upward force on the step diameter of the valve. In a parallel branch, oil flows beneath the lower end of the priority valve and is directed to the splitter shift valve, trimmer regulator valve (prior to S/N 59806), two points on the high-range shift valve bore, and to the low-range shift valve bore. Main oil is directed, from the high-range shift valve, through the intermediate- and low-range shift valves, reverse shift valve, and to the splitter shift valve. Main oil is blocked at the lower point on the high-range shift valve. Main oil is directed, from the lower point on the low-range shift valve, to a point on the intermediate-range shift valve where it is blocked.

shift valve. Main oil is directed, from the lower point on the low-range shift valve, to a point on the intermediate-range shift valve where it is blocked.

(3) At the reverse gear shift valve, solenoid B is de-energized and its valve closed. This retains solenoid pressure, and the valve is pushed downward against its spring. The reverse clutch is exhausted through the exhaust check valve.

(4) At the low-range shift valve, solenoid C is de-energized and its valve closed. Solenoid A is energized and its valve open. Solenoid pressure at the upper end of the low-range shift valve holds the valve downward, against its spring. The low-range clutch is exhausted through the intermediate-range shift valve bore, and the exhaust check valve.

(5) At the intermediate-range shift valve, solenoid D is de-energized, and its valve closed. Solenoid pressure, retained at the upper end of the shift valve, holds the valve downward against its spring. The intermediate-range clutch is exhausted through the bore of the high-range shift valve, the bore of the low-range trimmer valve, and the exhaust check valve.

(6) At the high-range shift valve, solenoid E is de-energized and its valve closed. Solenoid pressure, retained at the upper end of the shift valve, holds the valve downward against its spring. The high-range clutch is exhausted through a port at the right side of the valve.

(7) At the splitter shift valve, solenoid F is energized, and its valve open. No pressure is retained at the upper end of the splitter shift valve, and the spring at the opposite end holds the valve upward. In its upward position, the valve directs oil (red-white) to the low-splitter clutch. The same pressure is directed, through an orifice, to the lower end of the splitter shift valve, and to the upper end of the low-splitter trimmer valve. At the lower end of the splitter shift valve, solenoid G is de-energized and its valve closed. Pressure is retained by the closed solenoid valve, and the splitter shift valve will remain upward until solenoid G is energized. At the low-splitter trimmer valve, the trimmer lower valve is held downward. The trimmer valve has performed its "trimming" function as explained in paragraph 2-3o, above.

(8) At the trimmer regulator valve (prior to S/N 59806), main oil is blocked at the middle of the valve bore, by the trimmer regulator valve. At the upper end of the trimmer regulator valve, main oil holds the trimmer valve plug and regulator valve downward.

b. Neutral Fail Protection (foldout 3)

(1) Fail protection as covered herein concerns the design of the system to provide certain safeguards in the event of loss of electrical power at the solenoids.

(2) If there is total failure of electrical power while the transmission is in neutral, the transmission will remain in neutral (engine running) regardless of any position which might be manually selected after the failure. Partial electrical failure (one solenoid loses power) while in neutral will permit continued operation in neutral if the selector lever is not moved. If individual solenoids A or F lose power while the transmission is in neutral, erratic shifting can be expected if other selector positions are selected. Refer to troubleshooting (para 3-3).

c. First-Gear Operation (foldout 3)

(1) When the shift selector lever is moved from neutral (N) to first gear (1), solenoid A is de-energized (valve closes), and solenoid C is energized (valve opens). Solenoid F remains energized (valve open).

(2) When solenoid A is de-energized, there is no immediate result. Its valve is closed to retain low-range clutch pressure which will be directed to the lower end of the low-range shift valve when the shift valve moves upward. This pressure will be utilized, at this point, only for fail protection (refer to d, below).

(3) When solenoid C is energized, its valve opens and releases solenoid pressure (yellow-white) from the upper end of the low-range shift valve. Spring pressure pushes the shift valve upward, and main pressure is

directed to the low-range clutch and to the lower end of the shift valve. The low-range clutch is applied. Pressure at the lower end of the shift valve equals that at the upper end. Thus, if electrical power fails, the valve will remain upward (transmission will remain in low range).

(4) Solenoid F is energized as it was in neutral operation. Thus, the low-splitter clutch is still applied, as it was in neutral operation.

(5) When the low-range shift valve moves upward, main pressure (red) is directed to two locations. These are: bottom of the shift valve to assist the spring in retaining the valve in an upward position, and the low-range clutch piston via the low-range trimmer valve. With the low-range shift valve in an upward position, main pressure to the reverse shift valve and the trimmer regulator valve is cut off. Pressure at these two points is exhausted to sump. (After S/N 59805, the trimmer regulator valve and components were omitted.)

(6) When the low-range clutch is charged initially, the low-range trimmer functions as described in paragraph 2-3l. above.

(7) All other valve components remain in the position they were in during neutral operation.

d. First-Gear Fail Protection (foldout 3)

(1) If electrical power is lost completely during first-gear operation, the transmission will remain in first gear if the vehicle engine is not stopped. If the manual selector lever is moved, first gear will be maintained in all selector lever positions. If the engine is stopped, the transmission will go to neutral when the engine is restarted.

(2) If individual solenoids C or F lose power, the transmission will continue in first-gear operation until manually shifted to another position, or the engine stopped. Thereafter, shifting will be erratic in other selector positions. Refer to troubleshooting (para 3-3).

e. Second-Gear Operation (foldout 3)

(1) When the selector lever is moved from first gear (1) to second gear (2), solenoid F is de-energized (valve closes), solenoid G is energized (valve opens), and solenoid C remains energized (valve open).

(2) When solenoid F is de-energized, its valve closes and solenoid pressure (yellow-white) is retained at the upper end of the splitter shift valve. This pressure exerts a downward force on the shift valve. When solenoid G is energized, and its valve opens, low-splitter pressure (red-white) is released from the lower end of the shift valve. Solenoid pressure pushes the shift valve downward, and the high-splitter clutch is applied and low-splitter clutch exhausted. Solenoid C remains energized to retain low-range clutch engagement.

(3) The low-splitter clutch exhausts through a port at the left side of the valve bore when the shift valve is downward.

f. Second-Gear Fail Protection (foldout 3)

(1) If electrical power is lost completely during operation in second gear, the transmission will continue in second-gear operation if the engine is not stopped. If the manual selector lever is moved, second gear will be maintained in all selector positions. If the engine is stopped, the transmission will go to neutral when the engine is restarted.

(2) If individual solenoids C or G lose power, the transmission will continue in second-gear operation until the selector lever is moved or the engine stopped. Thereafter, shifting will be erratic in other selector positions. Refer to troubleshooting (para 3-3).

g. Third-Gear Operation (foldout 3)

(1) When the selector lever is moved from second gear (2) to third gear (3), solenoids C and G are de-energized (valves close), and solenoids D and F are energized (valves open).

(2) When solenoid D is energized and its valve opens, solenoid pressure (yellow-white) is released from the upper end of the intermediate-range shift valve. The shift valve is pushed upward by its spring. When upward,

the low-range clutch can begin to exhaust through its main-pressure feed line, through the intermediate-range shift valve bore, through a check valve ball, through the intermediate-range trimmer valve bore, and to the exhaust check valve. When partially exhausted, the low-range shift valve moves downward due to solenoid pressure (yellow-white) at its upper end (solenoid C de-energized). When part way down, the shift valve can complete the exhaust of the low-range clutch through another passage which bypasses the ball check valve.

(3) When solenoid G is de-energized, and solenoid F energized, spring pressure pushes the splitter shift valve upward. The high-splitter clutch is released, and the low-splitter clutch is applied. Low-splitter clutch pressure also is directed to the lower end of the shift valve and to the upper end of the low-splitter trimmer.

(4) At the lower end of the splitter shift valve, low-splitter clutch pressure can hold the valve upward in case of solenoid F power failure. At the low-splitter trimmer, the trimmer functions as explained in paragraph 2-3o, above.

(5) When the intermediate-range clutch is charged, clutch pressure is also directed to the intermediate-range trimmer. It functions as described in paragraph 2-3m, above. All other valves remain in the position they were in during second-gear operation.

h. Third-Gear Fail Protection (foldout 3)

(1) If electrical power is lost completely during third-gear operation, the transmission will continue in third gear if the vehicle engine is not stopped. If the selector lever is moved, third gear will be maintained in all selector positions. If the engine is stopped, the transmission will go to neutral when the engine is restarted.

(2) If individual solenoids D or F lose power, the transmission will continue in third gear until the selector lever is moved or the engine stopped. Thereafter, shifting will be erratic in other selector positions. Refer to troubleshooting (para 3-3).

i. Fourth-Gear Operation (foldout 3)

(1) When the selector lever is moved from third gear (3) to fourth gear (4), solenoid F is de-energized (valve closes), solenoid G is energized (valve opens), and solenoid D remains energized (valve open).

(2) When solenoid F is de-energized, its valve closes and solenoid pressure (yellow-white) pushes the splitter shift valve downward. It can move downward because solenoid G was energized, and its valve opened to relieve low-splitter pressure at the lower end of the shift valve. Main pressure is directed to the high-splitter clutch. The low-splitter clutch exhausts through a port at the left side of the splitter shift valve bore. Solenoid D remains energized to retain intermediate-range clutch operation.

j. Fourth-Gear Fail Protection (foldout 3)

(1) If electrical power is lost completely during operation in fourth-gear, the transmission will continue in fourth gear if the engine is not stopped. If the selector lever is moved, fourth gear will be maintained in all selector positions. If the engine is stopped, the transmission will go to neutral when the engine is restarted.

(2) If individual solenoids D or G lose power, the transmission will continue in fourth gear until the selector lever is moved or the engine stopped. Thereafter, shifting will be erratic in other selector positions. Refer to troubleshooting (para 3-3).

k. Fifth-Gear Operation (foldout 3)

(1) When the selector lever is moved from fourth (4) to fifth (5), solenoids D and G are de-energized (valves close), and solenoids E and F are energized (valves open).

(2) When solenoid G is de-energized, and solenoid F is energized, solenoid pressure is released from the upper end of the splitter shift valve. Spring pressure pushes the shift

valve upward, and the valve directs low-splitter clutch pressure (red-white) to the low-splitter clutch. The high-splitter clutch exhausts through the low-splitter trimmer valve bore. This exhaust is regulated by the downward movement of the trimmer lower valve. The low-splitter clutch is "trimmed" by the low-splitter trimmer, as explained in paragraph 2-3o, above.

(3) When solenoid E is energized, solenoid pressure (yellow-white) is released from the upper end of the high-range shift valve, and the valve moves upward. This directs main pressure to the high-range clutch. At the same time, the high-range shift valve (upward) opens a passage through which the cavity at the lower end of the intermediate-range shift valve can exhaust. This permits the intermediate-range shift valve to move downward, due to solenoid pressure (yellow-white) retained when solenoid D was de-energized.

(4) The intermediate-range clutch exhausts through a passage to the high-range shift valve bore, then to the splitter shift valve bore, and then to the low-splitter trimmer valve bore. At the trimmer valve bore, exhaust is initially regulated through an orifice. Then, when the low-splitter trimmer acts, the exhaust is direct (bypassing the orifice).

l. Fifth-Gear Fail Protection (foldout 3)

(1) If electrical power fails completely during operation in fifth gear, the transmission will continue in fifth-gear operation if the engine is not stopped. If the selector lever is moved, fifth gear will be maintained in all selector positions. If the engine is stopped, the transmission will go to neutral when the engine is restarted.

(2) If individual solenoids E or F lose power, the transmission will continue in fifth gear until the selector lever is moved or the engine stopped. Thereafter, shifting will be erratic in other selector positions. Refer to troubleshooting (para 3-3).

m. Sixth-Gear Operation (foldout 3)

(1) When the selector lever is moved from fifth (5) to sixth (6), solenoid F is de-energized (valve closes), solenoid G is energized (valve opens), and solenoid E remains energized.

(2) When solenoid F is de-energized, its valve closes and solenoid pressure (yellow-white) is exerted upon the upper end of the splitter shift valve. When solenoid G is energized, its valve opens and relieves low-splitter clutch pressure at the lower end of the splitter shift valve. The shift valve moves downward, exhausts the low-splitter clutch, and applies the high-splitter clutch.

(3) Solenoid E remains energized, and the high-range shift valve remains upward to retain engagement of the high-range clutch.

n. Sixth-Gear Fail Protection (foldout 3)

(1) If electrical power fails completely during operation in sixth gear, the transmission will continue in sixth gear if the engine is not stopped. If the selector lever is moved, sixth gear will be maintained in all selector positions. If the engine is stopped, the transmission will go to neutral when the engine is restarted.

(2) If individual solenoids E or G lose power, the transmission will continue in sixth-gear operation until the selector lever is moved or the engine stopped. Thereafter, shifting will be erratic in other selector positions. Refer to troubleshooting (para 3-3).

o. Reverse Operation (foldout 3)

(1) Regardless of which forward gear is operating, the manual control must pass through neutral (N) before reverse is selected. In neutral, solenoids A and F are energized (refer to a, above).

(2) When the selector lever is moved from neutral (N) to reverse (R), solenoid B is energized (valve opens), and solenoids A and F remain energized (valves open).

(3) When solenoid B is energized, solenoid pressure (yellow-white) is released from the upper end of the reverse shift valve. The spring at the lower end of the valve pushes the

valve upward. In its upward position, the valve directs main pressure to the reverse clutch, applying the clutch.

(4) Reverse clutch pressure is directed also to the reverse trimmer valve. The reverse trimmer functions as described in paragraph 2-3k, above.

(5) Solenoid F remains energized to retain low-splitter operation. Solenoid A remains energized to prevent trapping low-range clutch pressure at the lower end of the low-range shift valve in the event of a quick shift from first or second gear to reverse (selector would not be in neutral a sufficient length of time to permit the low-range shift valve to bottom, and exhaust the low-range clutch).

p. Reverse Fail Protection (foldout 3)

(1) If electrical power fails completely during reverse operation, the transmission will go to neutral, and remain in neutral, regardless of where the selector lever is placed.

(2) If only solenoid B loses power, the transmission will go to neutral, and remain in neutral until the selector lever is moved to another position. Shifting to neutral or any forward range will be normal.

(3) If individual solenoids A or F lose power the transmission will remain in reverse until the selector lever is moved or the engine stopped. Thereafter, shifting will be erratic when the selector lever is moved to another position. Refer to troubleshooting (para 3-3).

2-9. REAR-UNIT TRANSMISSION

a. Valve Body, Transfer Plate Modified.

(1) When the manual-electric control system is included in transmissions for vehicles having front and rear power units, the rear-unit control system is modified to provide a different mode of fail protection. The front transmission has the usual fail-protection features described in paragraph 2-8, above. The rear transmission will fail-to-neutral if complete electrical failure occurs.

(2) Failure protection characteristics for the rear transmission are obtained by the omission of solenoids A and G (foldout 3), and the venting of the range- and splitter-shift control valves to the transmission sump. These features must be taken into account to distinguish rear-unit valve body assemblies from the usual assemblies covered in each section of this Service Manual.

b. Fail-Protection Characteristics.

(1) If electrical power to the twin power unit fails completely. The front unit will continue to operate as described in paragraph 2-8, above. The rear unit will go to neutral and remain in neutral regardless of any shift made at the selector assembly (shift tower).

(2) A failure of electrical power for any individual solenoid B, C, D or E (foldout 3) in the rear unit will cause the rear unit to go to neutral if the transmission is operating in the range requiring that solenoid to be energized. Operation in other ranges will not be affected.

(3) Failure of electrical power to the splitter shift valve solenoid (solenoid F), will have no affect if operating in second, fourth or sixth gear. However, such a failure during operation in reverse, first, third or fifth gear will cause an upshift to the next higher gear (higher ratio in reverse).

(4) Any neutral condition in the rear unit while the selector is in either a forward or reverse position should be investigated to determine if electrical failure is the reason. Similarly, any conflict between engine speed synchronization of the front and rear units during operation in reverse, first, third and fifth gears should be investigated to determine if splitter valve solenoid electrical failure is the reason.

Section 3. PREVENTIVE MAINTENANCE

3-1. SCOPE OF SECTION 3

Note: The rear unit transmission of scrapers having dual power units have a fail-to-neutral feature. Two solenoids are omitted from the rear unit transmission. Refer to para 2-9 for description.

This section illustrates and/or explains items which are necessary or helpful in maintaining, checking and troubleshooting the electrical and hydraulic system as they pertain to 5000 or 6000 series transmissions equipped with the manual-electric control system. Maintenance of the remainder of the hydraulic system that is common to all 5000 or 6000 transmissions, and the transmission proper is covered in applicable transmission service manuals.

3-2. CHECKING OIL PRESSURES

The oil pressure schedule, and method for checking oil pressures are the same as outlined in the applicable transmission service manuals. Only the location of certain pressure check points is different. Refer to figure 4-19, items 1, 2, 3 and 4.

3-3. TROUBLESHOOTING

a. Improper Shifting (electrical trouble). The following checks should be made.

(1) Check the battery for voltage. Check the power input fuse. When the voltage of a 12-volt system falls below 9 volts, or the voltage of a 24-volt system falls below 18 volts, proper solenoid action cannot be guaranteed.

(2) Check the wiring harness for breaks, signs of chafing, fraying, or deterioration.

(3) Check all connections for tightness and freedom from corrosion. Disconnect, clean and reconnect any connections that may be defective.

(4) Check multipin connectors at the shift tower and valve body assembly. Be sure that all pins and their receptacles are clean, undamaged and tightly reconnected.

(5) Firm, complete connection of each connector is important. Aline the index key and slot, and push the cable end of the connector firmly into its socket. Tighten the retaining nut as tight as possible, by hand. Then push again on the cable end while working it slightly from side to side. Retighten the nut. Continue pushing the cable end and tightening the nut until the connection is firm, and the nut will not tighten further.

b. Field Test Kit. A field test kit is available for checking the shift tower, wiring harness and valve body solenoid circuits. Complete operating and test instructions accompany each test kit.

Note: MANUAL-ELECTRIC FIELD TEST KIT P/N 1920, can be purchased from:

Noel-Smyser Engineering Corp.
5230 West Tenth Street
Indianapolis, Indiana 46224

c. Troubleshooting Without Test Kit

(1) To determine if the proper electrical signals are being transmitted to the valve body, disconnect the 8-pin connectors from the valve body and proceed as outlined in (2) through (5), below.

(2) Use a test lamp of the proper voltage (12 or 24V) to match the system voltage. Ground one test lamp lead.

(3) Check each pin receptacle (female) of the wiring harness for delivery of electrical signals at the proper time by positioning the shift tower control in each selector position and checking each pin receptacle. Touch each pin receptacle with the ungrounded lead of the test lamp. The pin receptacles which should be energized in each range are as follows:

SELECTOR POSITION	PIN RECEPTACLE
R	A, B
N	A, F
1	C, F
2	C, G
3	D, F
4	D, G
5	E, F
6	E, G

(4) Only the pin receptacles listed above should be energized in the selector positions shown. If any others are energized, or if those listed are not all energized, a malfunction of either the shift tower or wiring harness is indicated.

(5) If the terminals do not check out as listed in (3), above, test the shift tower as outlined in paragraph 4-8. Recheck the wiring harness with a properly operating shift tower. If the check is unsatisfactory, the wiring harness is faulty and must be replaced.

Note: If the wiring harness is cut or worn, reroute the new harness to avoid recurrence of the fault.

(6) Check the valve body internal circuits as outlined in (7) through (9), below, with an ohmmeter.

(7) Disconnect the 8-pin connector of the wiring harness from the control valve body. Check between the center pin of the 8-pin connector on the valve body, and the ground. The center pin is grounded to the valve body by an internal lead, and the meter reading should be zero. A resistance reading here indicates a poor or broken connection.

(8) Check each of the solenoid pins (A through G) with the ohmmeter connected between each pin and ground. For 12-volt systems, the readings should be 15 to 30 ohms for each solenoid; for 24-volt systems — 50 to 90 ohms.

(9) If resistance measurements are not within the range prescribed in (8), above, replace the solenoid module shown in figure 4-20. If a spare module is not available, replace the defective solenoid, or repair or replace the internal wiring as required. Refer to paragraph 4-12.

Note: A repair kit, with instructions, is available for repair of the solenoid module wiring. This kit is the only acceptable way to repair the wiring.

d. Checking Hydraulic Circuits. If electrical checks in b or c, above, do not indicate electrical system malfunction, the hydraulic circuit may be at fault. Hydraulic troubles may be in either the control valve assembly or in the related hydraulic components in the transmission. The checks outlined in (1) through (4), below, will locate an inoperative shift valve. Further checks, involving disassembly steps, will determine the reason the valve is inoperative.

(1) A shift valve can be inoperative, or erratic in operation for the following reasons:

- Sticking in its bore
- Dirt in a solenoid
- Dirt in valve body or separator plate orifices.

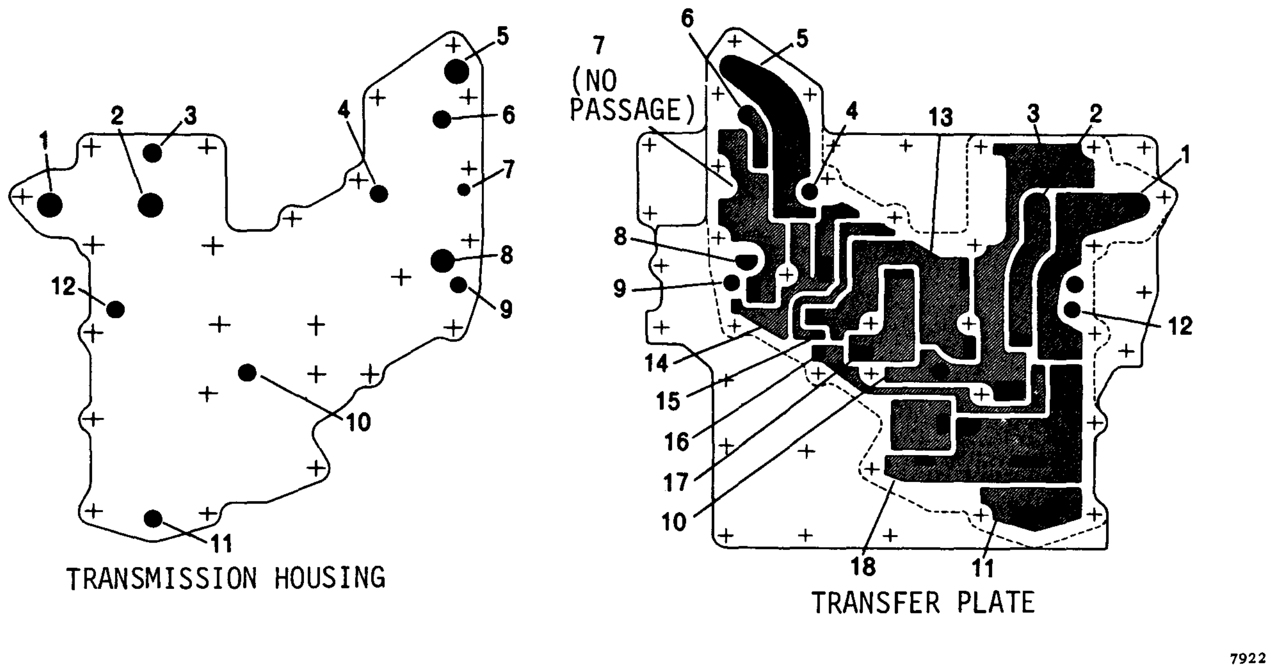
(2) If a specific forward shift valve remains in the "down" position (refer to foldout 3), the transmission will shift normally below that range but not into that range. However, if it is shifted to a higher range it will not downshift except to the range immediately above the range controlled by the inoperative valve.

(3) If a specific forward shift valve remains in the "up" position (refer to foldout 3), the operation in that range and above can be obtained, but no lower ranges, neutral, or reverse can be obtained. The range controlled by the inoperative valve will be retained in all lower selector lever positions.

(4) If the splitter shift valve remains in either the "up" or "down" position (refer to foldout 3), the transmission will operate in all forward gears and reverse, but the gear ratio will depend upon which splitter clutch is engaged. The low splitter clutch may be engaged when the high splitter clutch should be engaged — and vice versa.

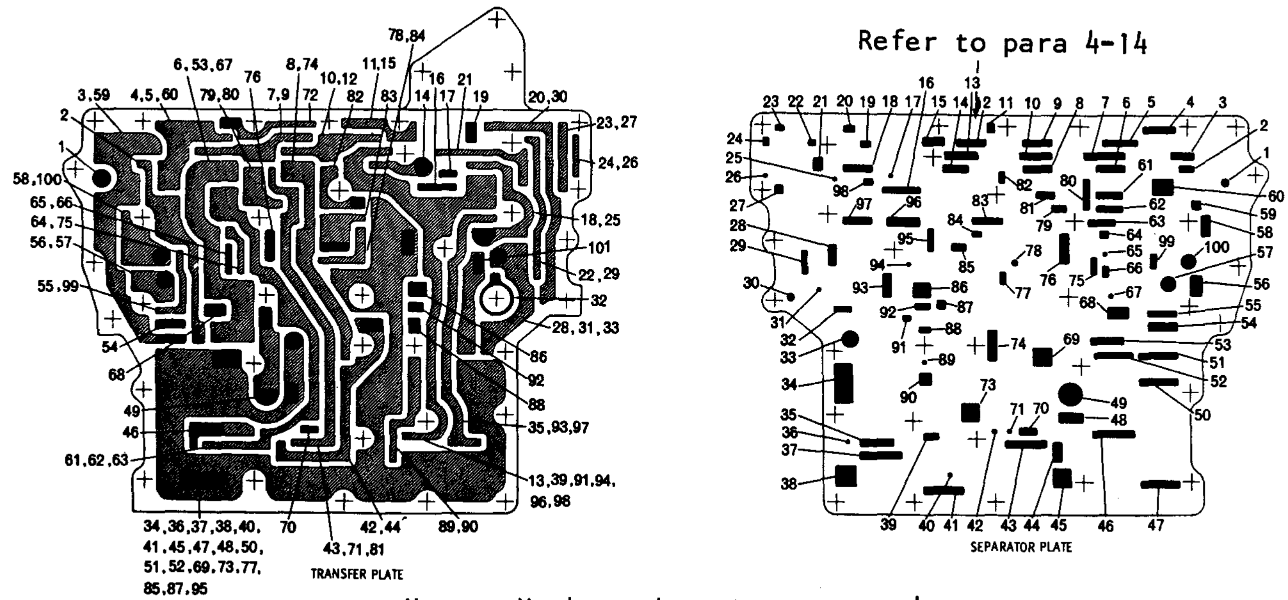
(5) To check for sticking shift valves, remove the solenoid module from the top of the control valve assembly.

(6) An individual solenoid may be removed and a new one installed when it is determined that a particular solenoid is causing the existing condition. One method of checking the physical operation of solenoids is to



1 - Low-range clutch
2 - Intermediate-range clutch
3 - Exhaust
4 - High-range clutch
5 - Main
6 - Neutral, first, reverse lockup block
7 - Pitot (governor)
8 - High-splitter clutch
9 - Low-splitter clutch
10 - Exhaust
11 - Exhaust
12 - Reverse clutch
13 - Check valve exhaust
14 - Exhaust
15 - Neutral, first, reverse lockup block
16 - Neutral signal
17 - Exhaust
18 - Check valve exhaust

Fig. 3-1. Transmission housing and inner side of oil transfer plate—oil passages



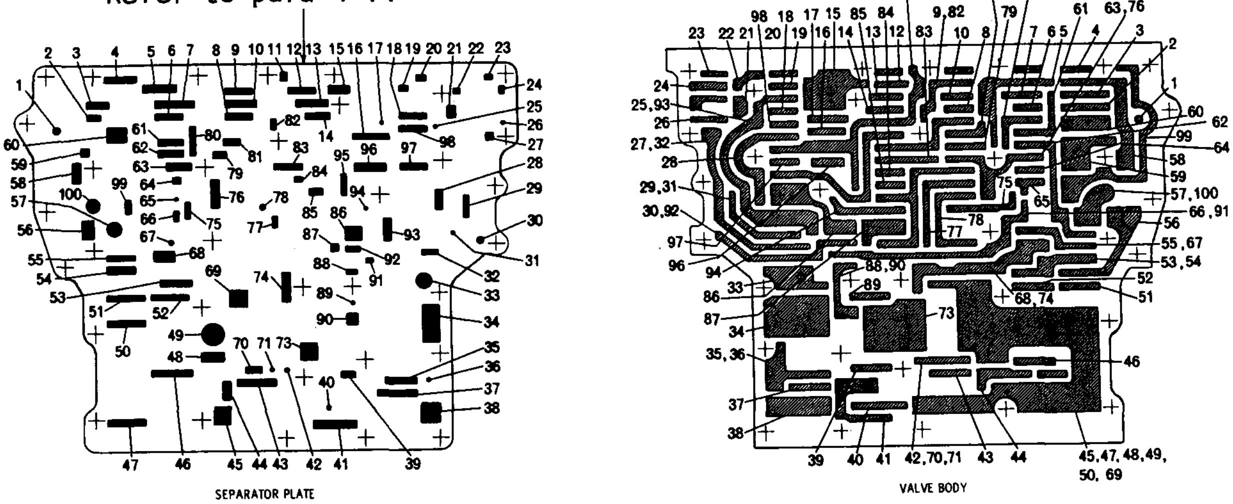
Note: Numbers do not correspond to numbers on part drawing.

7968

1 - Low-range clutch
2 - Neutral signal
3 - Check valve exhaust
4 - Range main
5 - Range main
6 - Low-range clutch
7 - Reverse, low feed
8 - Intermediate-range clutch
9 - Reverse, low feed
10 - Reverse, low, intermediate feed
11 - Exhaust
12 - Reverse, low, intermediate feed
13 - Main
14 - High-range clutch
15 - Exhaust
16 - Main
17 - Priority valve main
18 - High splitter
19 - Neutral, first, reverse lockup block
20 - Neutral, first, reverse lockup block
21 - Main
22 - Low-splitter solenoid
23 - Exhaust
24 - Solenoid pressure regulator
25 - High-splitter exhaust
26 - Solenoid pressure regulator
27 - Exhaust
28 - Low-splitter clutch
29 - Low-splitter solenoid
30 - Neutral, first, reverse lockup block
31 - Low-splitter clutch
32 - Exhaust
33 - Low-splitter clutch
34 - Exhaust
35 - Exhaust
36 - 4-5 overlap
37 - Exhaust
38 - Exhaust
39 - Main
40 - Trimmer regulator exhaust
41 - Exhaust
42 - 3-2 overlap exhaust
43 - Exhaust
44 - Exhaust
45 - Exhaust
46 - Check valve exhaust
47 - Exhaust
48 - Exhaust
49 - Exhaust
50 - Exhaust
51 - Exhaust
52 - Exhaust
53 - Low-range clutch
54 - Low-range clutch
55 - Low-range clutch
56 - Reverse clutch
57 - Reverse clutch
58 - Reverse clutch
59 - Check valve exhaust
60 - Range main
61 - Exhaust
62 - Exhaust
63 - Exhaust
64 - Intermediate-range clutch
65 - Low signal feed
66 - Main
67 - Low-range clutch
68 - Intermediate-range clutch
69 - Exhaust
70 - Check valve exhaust
71 - 2-3 overlap
72 - Void
73 - Exhaust
74 - Intermediate-range clutch
75 - Intermediate-range clutch
76 - Check valve exhaust
77 - Exhaust
78 - Intermediate-range clutch
79 - Exhaust
80 - Exhaust
81 - Exhaust
82 - Main
83 - Exhaust
84 - Intermediate-range clutch
85 - Exhaust
86 - Check valve exhaust
87 - Exhaust
88 - Neutral signal
89 - Neutral signal
90 - Neutral signal
91 - Main
92 - Neutral, first, reverse lockup block
93 - Exhaust
94 - Main
95 - Exhaust
96 - Main
97 - Exhaust
98 - Main
99 - Low-range clutch
100 - Reverse clutch
101 - Void

Fig. 3-2. Outer side of oil transfer plate, inner side of separator plate—oil passages

Refer to para 4-14



Note: Numbers do not correspond to numbers on part drawing.

7958

1 - Low-range clutch
2 - Neutral signal
3 - Check valve exhaust
4 - Reverse main
5 - Range main
6 - Low-range clutch
7 - Main
8 - Intermediate-range clutch
9 - Range main
10 - Main
11 - Exhaust
12 - Range main
13 - Range main
14 - High-range clutch
15 - Exhaust
16 - Main
17 - Orifice main
18 - High splitter
19 - Neutral, first, reverse lockup block
20 - Neutral, first, second, reverse signal
21 - Main
22 - Low-splitter signal
23 - Exhaust
24 - Solenoid feed
25 - High-splitter exhaust
26 - Orifice solenoid feed
27 - Exhaust
28 - Low-splitter clutch
29 - Low-splitter signal
30 - Neutral, first, second, reverse signal
31 - Low-splitter signal
32 - Exhaust
33 - Low-splitter clutch
34 - Exhaust
35 - High-splitter exhaust
36 - High-splitter exhaust
37 - Exhaust
38 - Exhaust
39 - Range main
40 - Trimmer boost
41 - Exhaust
42 - Check valve exhaust
43 - Low-range exhaust
44 - Intermediate range exhaust
45 - Exhaust
46 - Check valve exhaust
47 - Exhaust
48 - Exhaust
49 - Exhaust
50 - Exhaust
51 - Exhaust
52 - Exhaust
53 - Low-range clutch
54 - Low-range clutch
55 - Low-range signal
56 - Reverse clutch
57 - Reverse clutch
58 - Reverse clutch
59 - Check valve exhaust
60 - Range main
61 - Low-range exhaust
62 - Low-range exhaust
63 - Check valve exhaust
64 - Intermediate signal
65 - Orifice range main
66 - Range main
67 - Low-range signal
68 - Intermediate-range clutch
69 - Exhaust
70 - Check valve exhaust
71 - Check valve exhaust
72 - Void
73 - Exhaust
74 - Intermediate-range clutch
75 - Intermediate signal
76 - Check valve exhaust
77 - Exhaust
78 - Intermediate signal
79 - Low-range exhaust
80 - Low-range exhaust
81 - Low-range exhaust
82 - Range main
83 - Intermediate exhaust
84 - Intermediate signal
85 - Exhaust
86 - Check valve exhaust
87 - Exhaust
88 - Neutral signal
89 - Neutral signal
90 - Neutral signal
91 - Range main
92 - Neutral, first, second, reverse signal
93 - High-splitter exhaust
94 - Orifice range main
95 - Exhaust
96 - Range main
97 - High-splitter exhaust
98 - Range main
99 - Low-range signal
100 - Reverse clutch

Fig. 3-3. Outer side of oil separator plate, inner side of valve body—oil passages

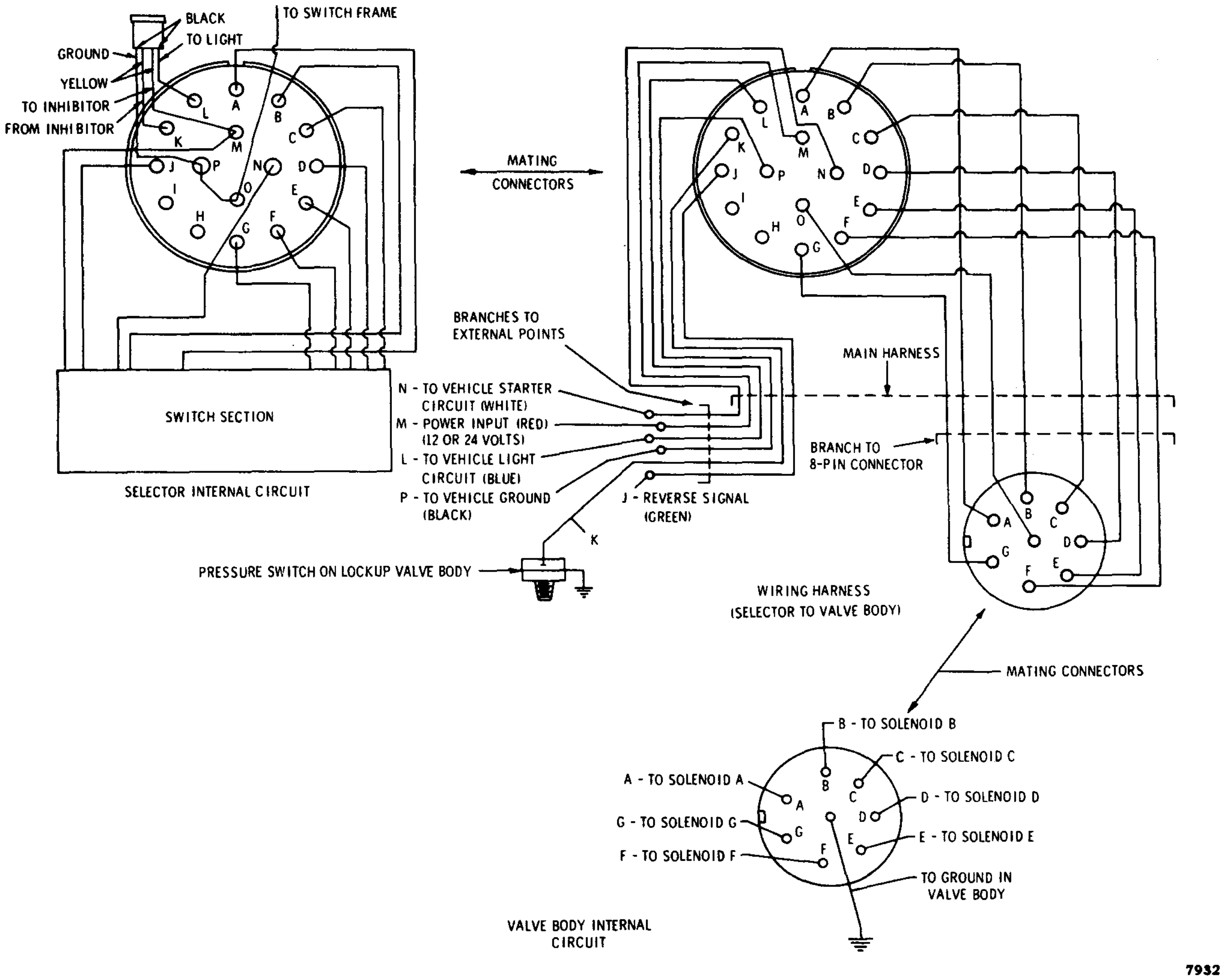


Fig. 3-4. Manual-electric control system wiring—schematic view

invert the solenoid module, fill the pressure cavities with transmission oil and, with the module connected to the wiring harness, shift through all selector positions. Oil should drain out of all cavities at the same rate as solenoids are energized.

(7) Clean all solenoid, valve body or separator plate orifices. Be sure the solenoid oil feed galley is free of all foreign material. Check and replace dirty oil filters. A clogged oil filter will cause the oil to bypass carrying foreign matter directly into the valve body.

(8) Remove the valve body assembly, disassemble and thoroughly clean. Particular attention must be given to cleaning clogged orifices and passages. On later models remove a 1/8-inch pipe plug located at end of the solenoid oil feed galley. Apply pressurized air (through the 0.250 diameter/0.300 deep hole shown in fig. 3-5) to the 14-inch long galley to remove all foreign matter. This cleaning procedure for the solenoid galley is invaluable in removing hidden dirt and preventing control valve malfunctions.

(9) To provide proper accessibility to the solenoid oil feed galley on earlier models, proceed as follows. Drill and remove the two-piece aluminum expansion plug from its bore in the control valve body (fig. 3-5). Do not damage the bore surface. Tap a 1/8-27

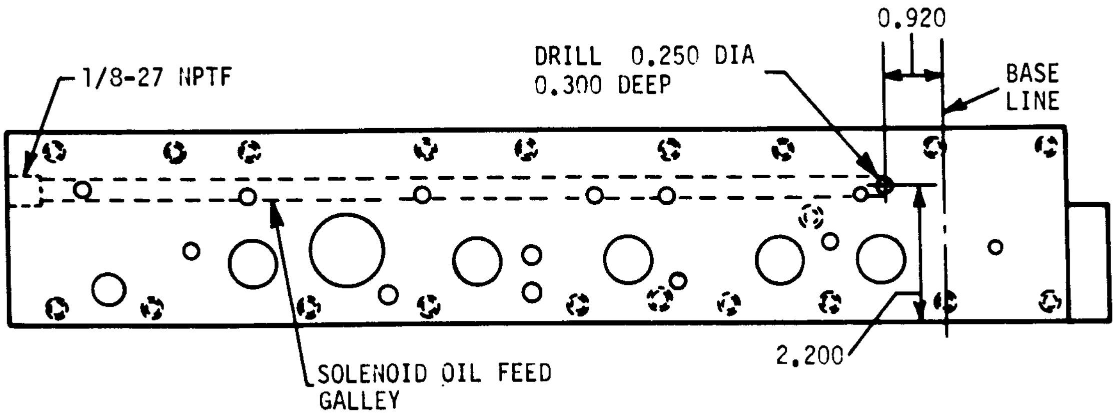


Fig. 3-5. Illustration of drilling location on solenoid surface of control valve

NPTF thread at the opening. Locate and drill a 0.250 diameter hole to a depth of 0.300-inch (fig. 3-5). Apply air under pressure to remove all debris. Install a 1/8-inch pipe plug into the newly tapped hole.

e. Downshift Inhibitor Does Not Engage. The malfunction may be due to a disconnected or broken wiring harness lead to the pressure switch (fig. 1-1), a failed pressure switch, a faulty shift tower, or faulty wiring harness. Make the following checks.

(1) Inspect the wiring harness lead and ground lead (or terminal if no ground lead is used), for corrosion, loose connections and condition.

(2) With vehicle power on, ground the inhibitor wiring harness lead to the body of the pressure switch. If the inhibitor then engages, the pressure switch is faulty (will not close) and should be replaced.

(3) Check the shift tower as outlined in paragraph 4-8.

(4) If checks (1), (2) and (3), above, do not locate the malfunction, a faulty wiring harness is indicated.

f. Downshift Inhibitor Does Not Disengage. Malfunction may be due to a grounded wiring harness lead to the pressure switch, a failed pressure switch, a faulty shift tower, or faulty wiring harness. Make the following checks.

(1) Check the pressure switch lead for a ground. Check that the lead is connected to the pressure switch terminal insulated with a fiber washer (not to the terminal having a star washer).

(2) If disconnecting the pressure switch lead from the switch terminal disengages the inhibitor, the pressure switch is faulty, and must be replaced.

(3) Check the shift tower as outlined in paragraph 4-8. With a properly operating shift tower, the inhibitor should engage (vehicle power on) when the wiring harness lead to the pressure switch is grounded.

(4) If checks (1), (2) and (3), above, do not locate the malfunction, a faulty wiring harness is indicated.

g. Starter Operates In All Gears. The neutral start switch in the shift tower is faulty. Check the switch tower as outlined in paragraph 4-8.

h. Starter Will Not Operate in Neutral. The malfunction may be due to faulty starter, starter solenoid, disconnected or broken wire or terminal in the vehicle system, or a faulty switch tower. Make the following checks.

(1) Using a test light or voltmeter, check for power at the starter solenoid input when the starter switch is activated. If power is present, the starter or solenoid is defective.

(2) If no power is present in check (1), above, check the vehicle wiring system. Refer to the vehicle service manual.

(3) Check the shift tower as outlined in paragraph 4-8.

i. Shift Quadrant Not Illuminated. The malfunction may be due to failed light bulb, defective vehicle wiring or connections, defective wiring harness, or a faulty shift tower. Make the following checks.

(1) Replace light bulb.

(2) Check vehicle wiring and terminals. Refer to vehicle wiring diagram.

(3) Check the shift tower as outlined in paragraph 4-8.

j. Reverse Signal Not Energized. When the reverse signal lead is not energized during reverse operation, make the following checks.

(1) Check the reverse indicator device. Check for power to the indicator.

(2) Check the vehicle wiring system for loose or broken wires and connectors.

(3) Check the shift tower as outlined in paragraph 4-8.

(4) If checks (1), (2) and (3), above, do not locate the malfunction, a faulty wiring harness is indicated.

3-4. OIL PASSAGE IDENTIFICATION

a. Mating Surfaces Illustrated. Figures 3-1 through 3-3 illustrate the mating surfaces of all components which are bolted to the mounting pad at the right side of the transmission housing. Identical callouts in each illustration show the mating passages. A legend identifies the oil passages in each illustration.

b. Helpful in Troubleshooting. The identification of oil passages is helpful in troubleshooting the hydraulic system. Passages may be traced through components and from one component to its mating component.

3-5. LUBRICATION OF SHIFT TOWER

Note: Do not overlubricate. Apply lubricant sparingly in all locations specified below. Excess lubricant tends to retain dust and dirt or it may work into areas where it is harmful.

a. Lubricants

(1) Lubricants recommended for microswitches are: AIRCRAFT SHAFT and INSTRUMENT GREASE, MIL-G-23827A, and MICROSWITCH DIVISION OF HONEYWELL, Spec. No. ES-04815.

(2) Lubricate bushing 12 (foldout 2) with BENTONE 508. Use LUBRIPLATE NO. 107 (or equivalent) in remaining areas.

b. Time Intervals

(1) Shift towers should be lubricated after the first 500 hours of operation and after each 2500 hours of operation thereafter.

(2) The 2500 hour intervals may be shortened if operating conditions are extremely dusty or dirty.

c. Clean Before Lubricating. Using an air gun, thoroughly clean the area to be lubricated. Work the shift handle from side to side while applying the air blast.

d. Lubrication Points

(1) Lubricate the cams on the microswitch with AIRCRAFT SHAFT and INSTRUMENT GREASE MIL-G-23827A or MICROSWITCH DIVISION OF HONEYWELL Spec. No. ES-04815.

(2) Refer to figure 4-10 for the area to be lubricated. The shift handle 16 (foldout 2), where it swivels in rotary key 39, and at its point of contact with leveler 4 should be lubricated. Also, the right end of leveler 4, where it reciprocates in rotary key 39 should be lubricated.

(3) The lubrication points may be reached by a pump-type applicator (Eagle No. 33F or equivalent). Access to the parts to be lubricated is available from the top of the shift tower, through the opening in which the shift handle moves, as well as through an opening at the bottom of the tower (fig. 4-5). Use both access points to insure complete lubrication.

Section 4. TESTS AND REBUILD—MANUAL COMPONENTS

4-1. SCOPE OF SECTION 4

Note: The rear unit transmission of scrapers having dual power units have a fail-to-neutral feature. Two solenoids are omitted from the rear unit transmission. Refer to para 2-9 for description.

This section covers procedures for removal, rebuild and installation of components which make up the manual-electric control system as used on 5000 or 6000 series transmissions. All procedures for the valve bodies are referenced to either line drawings in this section or to foldout 1 in the back of the manual. If it is not necessary to remove certain system components, the instructions for their removal, rebuild and installation may be passed over and work continued with the next applicable step.

4-2. REMOVAL OF WIRING HARNESS

Note: Be sure that power supply from vehicle electrical system is switched off.

a. Disconnection at Valve Body

(1) Loosen and remove the nut which retains the wiring harness at the 8-pin connector at the main valve body.

(2) Pull the socket-type connector off the valve body pin connector.

(3) Remove wire from lockup pressure switch.

b. Disconnection at Shift Tower Assembly

(1) Loosen and remove the nut which retains the wiring harness at the bottom of the shift tower assembly in the vehicle cab.

(2) Pull the 16-pin socket off the shift tower assembly connector.

c. Disconnection of External Branches

(1) Remove the six conductors (or as many as are used) from the vehicle power source, ground, light system, starter circuit, and reverse signal circuit.

Note: These conductors are identified in figure 3-4 as J, K, L, M, N and P. For convenience in reconnecting these leads, they and the points from which they are removed may be tagged with the same letters.

(2) Remove any fastenings which may retain these leads between their points of connection and the main body of the wiring harness.

d. Removal of Harness

(1) Remove any vehicle components which prevent access to the wiring harness fasteners, or which would prevent removal of the harness.

(2) Remove any fasteners which may retain the wiring harness. Remove the harness. If defective, do not attempt to repair. Replace with new harness.

4-3. INSTALLATION OF WIRING HARNESS

a. Mount on Vehicle

(1) Install wiring harness onto the vehicle.

(2) Replace all supports and fasteners.

(3) Replace all vehicle components removed for access to wiring harness.

b. Connection of External Branches

(1) Refer to figure 3-4 for identification of branches (J, K, L, M, N, P) if not marked at removal.

(2) Connect branches to vehicle leads.

Note: Branch K (fig. 3-4) must be attached to pressure switch terminal that does not have a star washer.

c. Connection at Shift Tower Assembly

(1) Inspect connector pins. They must be clean, straight and undamaged.

(2) Aline the index keys and push the 16-pin socket onto the 16-pin connector at bottom of shift tower assembly.

(3) Tighten the connector nut, hand-tight, to retain the socket.

(4) Firm, complete connection of each connector is important. Aline the index key and slot, and push the cable end of the connector firmly into its socket. Tighten the retaining nut as tight as possible, by hand. Then push again on the cable end while working it slightly from side to side. Retighten the nut. Continue pushing the cable end and tightening the nut until the connection is firm, and the nut will not tighten further.

d. Connections at Valve Body

(1) Inspect connector pins. They must be clean, straight and undamaged.

(2) Aline the index keys and push the 8-pin socket onto the 8-pin connector on the valve body.

(3) Tighten the nut, hand-tight, to retain the 8-pin socket. Refer to c(4), above.

4-4. REMOVAL OF LOCKUP (INHIBITOR) PRESSURE SWITCH

a. Clean the area around the pressure switch (fig. 1-1).

b. Remove the pressure switch by rotating it counterclockwise. Install a 1/8-27 pipe plug, temporarily, into the hole from which the switch was removed.

4-5. INSTALLATION OF LOCKUP (INHIBITOR) PRESSURE SWITCH

Install the pressure switch into the 1/8-27 hole (fig. 1-1) and tighten it sufficiently to prevent leakage.

4-6. REMOVAL OF SHIFT TOWER ASSEMBLY

The shift tower assembly (fig. 1-2) may be removed, if necessary, by removing the bolts which are in its base. However, this unit may be checked without removing it. If defective, it may be replaced as a unit or rebuilt. Refer to paragraph 3-3 for troubleshooting information. Refer to paragraphs 4-7 through 4-10 for testing, rebuild and installation of the shift tower assembly.

4-7. TEST EQUIPMENT FOR SHIFT TOWER ASSEMBLY

a. Conventional Test Equipment. The shift tower may be checked with a test light as outlined in paragraph 3-3c. This method requires that the wiring harness be connected to the shift tower assembly. Detailed knowledge of the system circuit, and multiple tests are necessary when conventional equipment is used.

b. Field Test Kit. The test kit described in paragraph 3-3b may be employed for any test of the shift tower assembly. However, detailed knowledge of the system circuit, and multiple tests are necessary.

c. Shop-Constructed Test Lamp Bank

(1) A test lamp bank may be constructed to simplify testing of the shift tower assembly. This lamp bank will check any shift tower assembly used on DP 8000 or VCLT, CLT, VCLBT, CLBT 5000 and 6000 models whether manual-electric or automatic types, 12 or 24 volt systems.

(2) Figure 4-1 illustrates the circuit of the test lamp bank. Listed below are the components required to construct the bank. All components are available from Allied Electronics or any similar source.

- Lamps — G.E. no. 1815 (11)
- Lamp holders — Dialco (11)
  - Red — no. 95-9110-0931-102
  - Green — no. 95-9110-0932-102
  - Amber — no. 95-9110-0933-102
  - White — no. 95-9110-0935-102

- Switch, SPST — Cutler-Hammer no. 8381K22C (1)
- Switch, DPDT — Cutler-Hammer no. 8373K21D (1)
- Connector, 16-pin — MS 3106A; No MS 24-7S (1)
- Wire — AWG no. 18 stranded copper, PVC covered (AR)
- Cable covering — PVC
- Binding posts (to attach battery) — Superior Electric Co. 5-way:
  no. DF 30RC (red) (1)
  no. DF 30BC (black) (1)
- Box — Bud no. CU2110A (1)
- Fuse holder — Allison no. 6839335 (1)
- Fuse — SFE 9 (1)

Note: Sufficient wire, and cable covering, should be obtained to allow a five foot minimum length from the 16-pin connector to the box.

(3) Construct the test lamp bank and label each lamp as shown in figure 4-1.

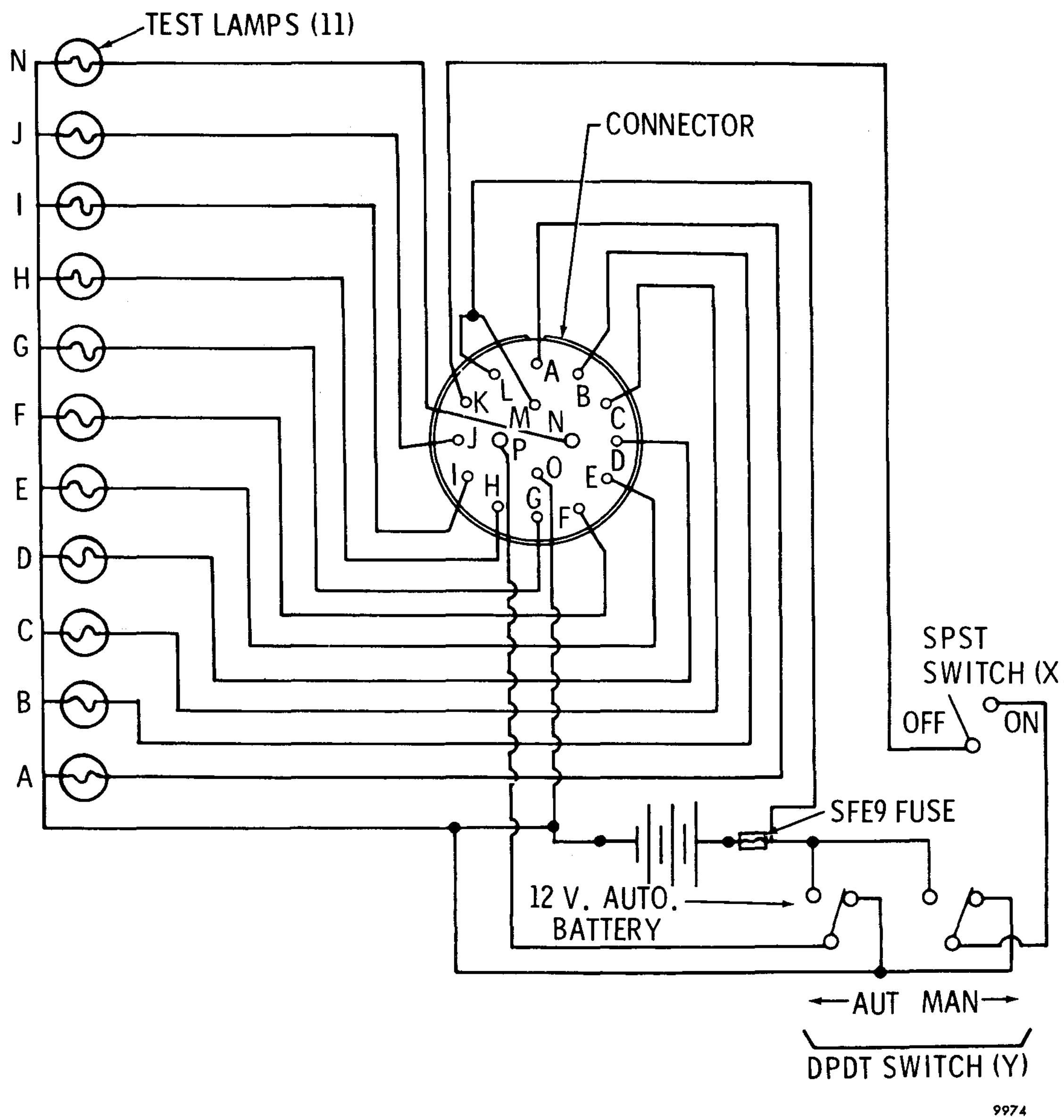


Fig. 4-1. Test lamp bank circuit

4-8. TESTING SHIFT TOWER ASSEMBLY

a. Using Noel-Smyzer 1920 Kit. The field test kit described in paragraph 3-3b may be used for all tests. However, detailed knowledge of the shift tower circuit, and multiple tests are necessary.

b. Using Shop-built Test Lamp Bank

(1) The lamp bank described in paragraph 4-7 is preferred for testing the shift tower assembly. Follow the procedures outlined below.

(2) Throw switches to positions shown in figure 4-1 (X to off; Y to man.). Connect 12 volt battery to lamp bank, observing the polarity indicated in figure 4-1.

(3) Couple the lamp bank connector to the connector on the shift tower assembly.

(4) Check the SFE 9 fuses in both the shift tower assembly and the lamp bank. If either is blown, replace it. If the new fuse blows, there is a ground or short circuit in the shift tower assembly, that must be corrected before proceeding.

Note: Earlier shift tower assemblies had no integral fuse. The fuse was in the power input lead (between the vehicle power circuit and wiring harness conductor M). The fuse in the lamp bank will protect both the shift tower assembly circuit and the lamp bank if there is a short circuit.

(5) Check the shift tower lamp. Note that the lamp circuit is independent of the fuse in the tower assembly. If the lamp fails to light, a failed bulb, defective socket or open circuit is indicated.

(6) Throw switch X (fig. 4-1) to the ON position. This should energize the downshift inhibitor. There should be a "click" when the switch is thrown. When the inhibitor is energized, manual upshifts are possible but downshifts cannot be made. If the "click" does not occur, and downshifts can be made, electrical trouble is indicated. Either the solenoid coil or its connecting circuit is faulty. If the "click" does occur, but downshifts can be made, mechanical trouble is indicated.

(7) Mechanical trouble in the downshift inhibitor is usually due to failure of inner clutch member 2 (foldout 2) or angular misadjustment of solenoid housing 63. Check failure of the clutch member at disassembly (para 4-9a(17). Check adjustment of the solenoid housing as outlined in rebuild (para 4-9c(27)).

(8) Electrical trouble in the downshift inhibitor may be either a faulty solenoid coil or its connecting wire. The solenoid coil can be checked, when removed, by connecting it directly to a battery to determine if it will energize. The wiring and terminals may be checked when the shift tower is disassembled (para 4-9).

(9) Throw the inhibitor switch (X) to the OFF position. This should release the inhibitor solenoid, and permit the selector lever to move either direction. Failure to release, when the switch is OFF could be due to a ground in the conductor leading to contact M in the shift tower connector. A mechanical fault not permitting release could be the failure of outer clutch 78 (foldout 2) to retract from inner clutch 2. Disassembly and inspection (para 4-9) will reveal the fault.

(10) Check each position of the selector lever to determine if the selector switches are operating (making and breaking) satisfactorily. This can be determined by noting which lamps are lit and not lit in each selector position. The following chart shows the desired light pattern.

SELECTOR POSITION	LAMPS LIGHTED
REVERSE	A, B, F, J
NEUTRAL	A, F, N
1	C, F
2	C, G
3	D, F
4	D, G
5	E, F
6	E, G

(11) If the light pattern, in the table above, is obtained, and no other lamps come on, the functioning of the switches is satisfactory. If any other pattern is obtained, either the switch assembly is faulty, or the wiring is faulty or connected improperly to the switches.

(12) A further check, using the lamp bank, is necessary to determine if the switch assembly is properly alined, angularly, with the selector lever. Any clockwise or counterclockwise mislocation of the switch assembly in relation to the selector lever shift positions will affect the sequence timing of the switches.

(13) To make this alinement check, a tool as shown in figure 4-2 is necessary. Place the tool on the selector lever (fig. 4-3). The tool holds the shift lever at the midpoint between two shift positions, but provides a tolerance of movement sufficient for complete switching transition from one shift position to the next. All changes in the light pattern should occur within the movement tolerance. The chart below indicates the light patterns at each test position.

MIDPOINT TEST POSITION	LAMPS LIGHTED WHEN SELECTOR LEVER IS PUSHED TOWARD: UPSHIFT DIRECTION	DOWNSHIFT DIRECTION
5/6	E, G	E, F
4/5	E, F	D, G
3/4	D, G	D, F
2/3	D, F	C, G
1/2	C, G	C, F
NEUT/1	C, F	A, F, N
REV/NEUT	A, F, N	A, B, F, J

If the light pattern shown above is not obtained (but a satisfactory pattern is obtained in (10), above), angular misalinement of the switch assembly is indicated.

(14) To check for the direction (CW or CCW) of misalinement of the switch assembly, place the selector lever at the midpoint between N and 1. Install the alinement gage and push the selector lever toward N.

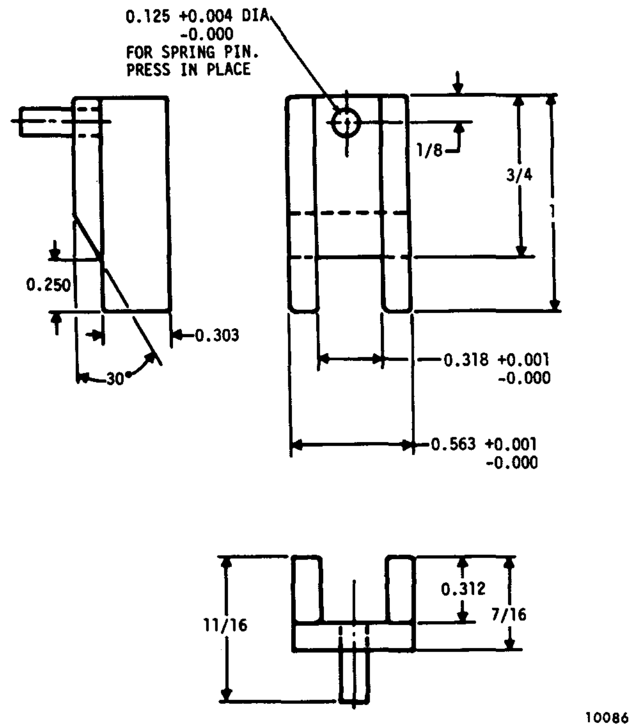


Fig. 4-2. Switch sequence test tool

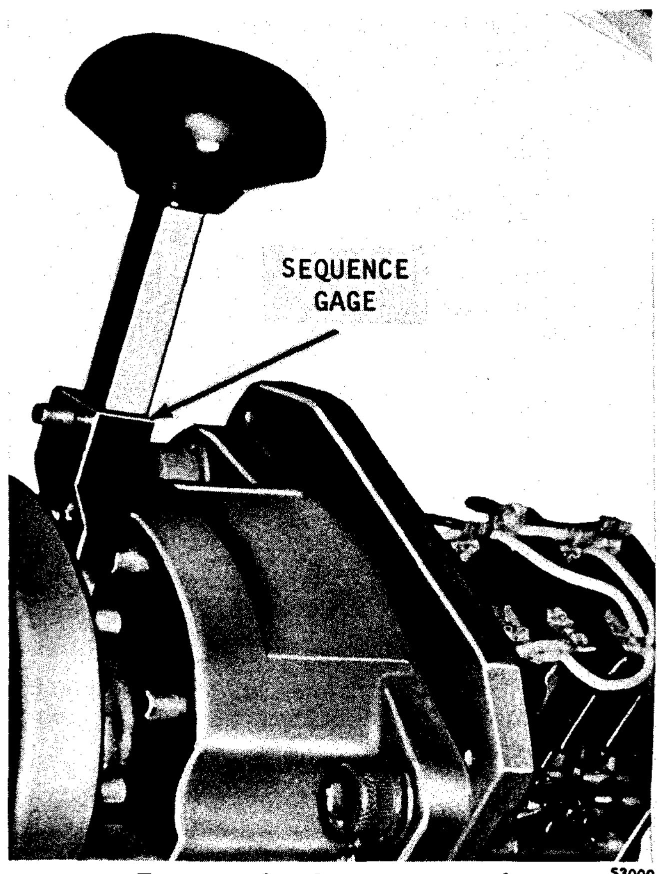


Fig. 4-3. Switch sequence test tool positioned for test

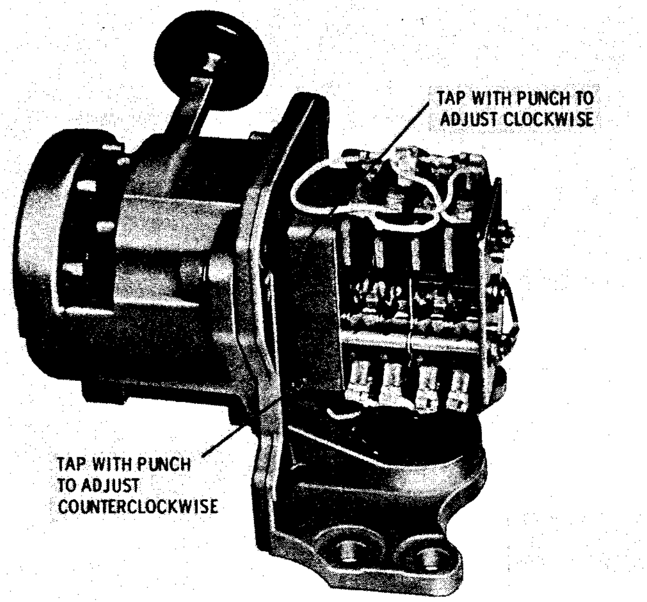


Fig. 4-4. Switch angular adjustment

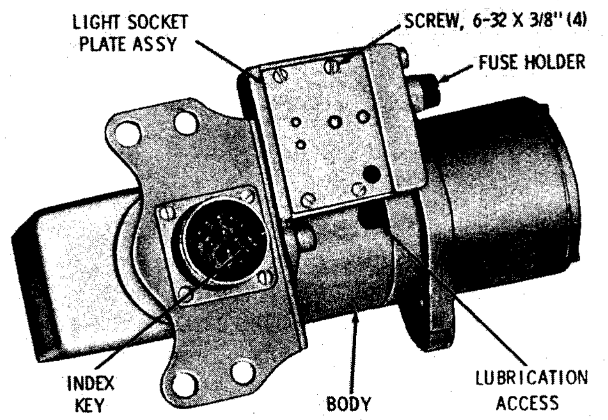


Fig. 4-5. Shift tower assembly-bottom view

If lamp C lights, the switch assembly requires clockwise adjustment (as viewed from switch end of shift tower). Next, push the selector lever toward 1. If lamps A or N light, the switch assembly requires counterclockwise adjustment.

(15) Make any adjustment required for switch alinement by tapping the switch frame with a hardwood dowel and hammer at the points indicated in figure 4-4.

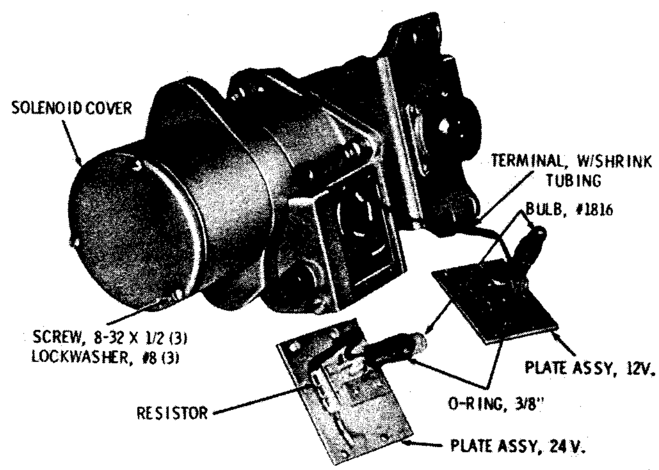


Fig. 4-6. Shift tower assembly—showing 12 and 24 volt light plates

4-9. REBUILD OF SHIFT TOWER ASSEMBLY

a. Disassembly (foldout 2)

(1) Remove four screws that retain the light socket plate assembly (fig. 4-5).

(2) Carefully pull the plate assembly from the shift tower body (fig. 4-6). If necessary, remove the light bulb and O-ring from the socket.

(3) If the light socket plate assembly or wiring is to be replaced, cut the heat-shrink tubing from the wire terminals and disconnect the plate assembly.

(4) If the resistor (in 24V systems) requires replacement, remove it (fig. 4-6).

(5) Remove three screws and lockwashers that retain the inhibitor solenoid cover (fig. 4-6).

(6) Remove the solenoid cover and gasket (fig. 4-7). Remove the plunger and washer from the solenoid.

(7) Remove the heat-shrink tubing from the solenoid and wiring harness leads (fig. 4-7). Disconnect the leads.

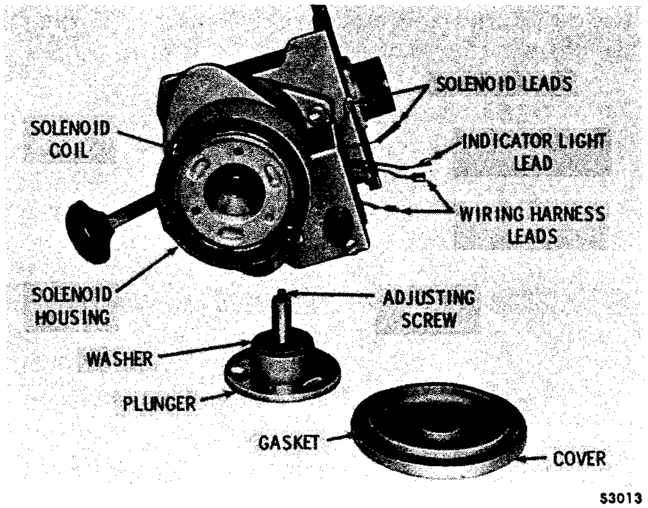


Fig. 4–7. Downshift inhibitor components

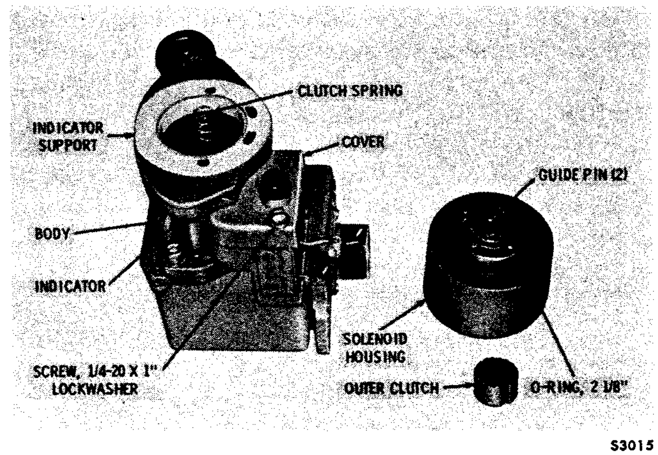


Fig. 4–9. Shift tower assembly with solenoid housing removed

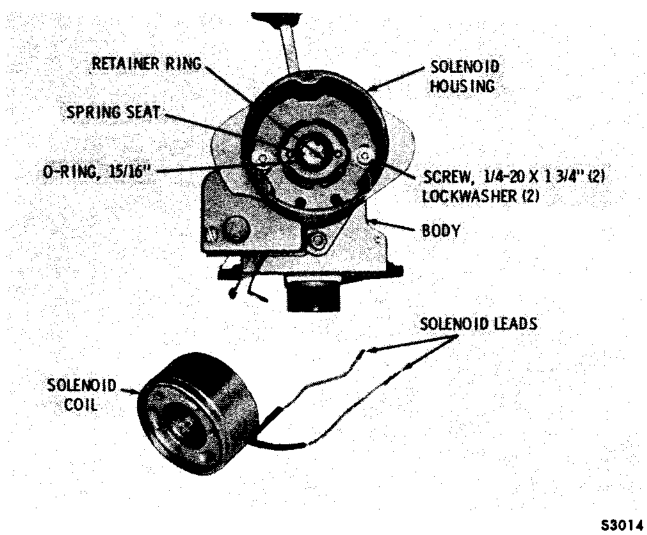


Fig. 4–8. Shift tower assembly with solenoid removed

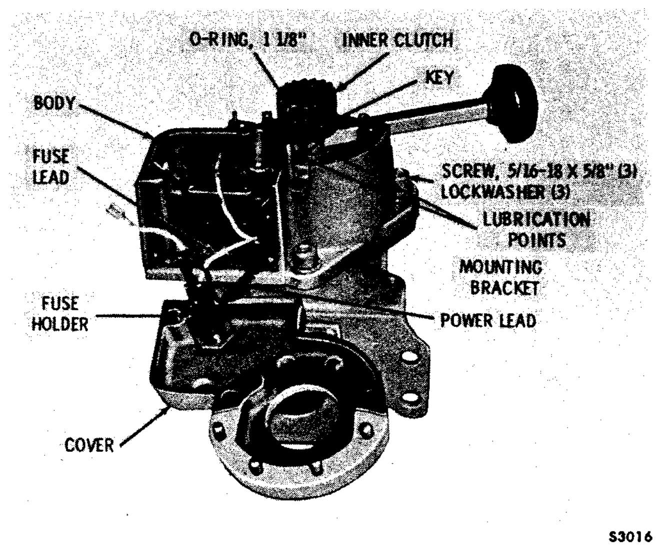


Fig. 4–10. Shift tower assembly with inner clutch exposed

(8) Remove the solenoid coil, working the leads through the holes in the shift tower body and solenoid housing (fig. 4-8). Remove the O-ring, retaining ring, spring seat and spring from the solenoid housing.

(9) Remove two socket-head screws and lockwashers that retain the solenoid housing (fig. 4-8). Remove the housing.

(10) Remove the outer clutch from the solenoid housing (fig. 4-9). Remove the O-ring. Remove the guide pins from the solenoid housing only if new pins are required.

(11) Remove the clutch spring (fig. 4-9). Remove the indicator support.

(12) Remove the screw and lockwasher that retains the cover (fig. 4-9).

(13) Pull the cover from the body (fig. 4-10). Remove the heat-shrink tubing from the power lead terminals. Disconnect the terminals. Disconnect the fuse lead.

(14) Remove the fuse holder from the cover only if replacement is necessary (fig. 4-10).

(15) Remove three socket-head screws and lockwashers that retain the body (fig. 4-10). Remove the body, and its attached parts, from the mounting bracket.

(16) Remove O-ring 20 (foldout 2) from the mounting bracket. Remove 4-pin connector 35 from the body only if replacement is necessary.

(17) Remove O-ring 3 from inner clutch 2. Remove pin 46 from inner clutch 2. Remove inner clutch 2 from rotary key 39.

(18) Remove nut 13 from pin 38. Remove pin 38 from rotary key 39. Remove handle 16 and knob 17 from rotary key 39. Remove leveler 4 and spring 5.

Note: Some of the assemblies include spacer 15. Remove the spacer.

(19) Push rotary key 39 from body 8. Remove O-ring 14 from rotary key 39.

(20) If bushing 12 requires replacement, press the bushing from body 8.

(21) Remove four screws and washers that retain the switch cover (fig. 4-11). Remove the cover and cover seal.

(22) Loosen the set screw that retains the drive adapter on the switch shaft (fig. 4-12). Remove the drive adapter. Remove the shim(s) from the switch shaft.

(23) Disconnect all of the wiring harness leads from the switch assembly (fig. 4-12). Remove two screws and washers that retain the switch assembly. Remove the switch assembly.

(24) Remove the 4-pin socket only if replacement is necessary (fig. 4-12).

(25) Remove the four screws that retain the wiring harness (fig. 4-13). Remove the wiring harness from the mounting bracket.

(26) Remove O-ring 29 (foldout 2) from the wiring harness connector body.

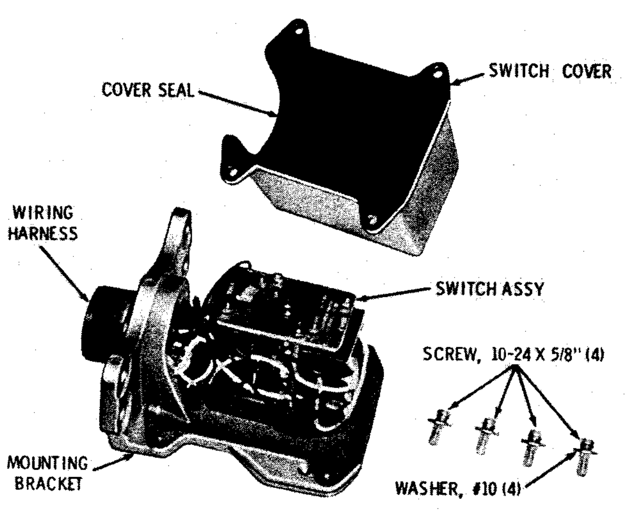


Fig. 4-11. Mounting bracket, switch assembly and cover

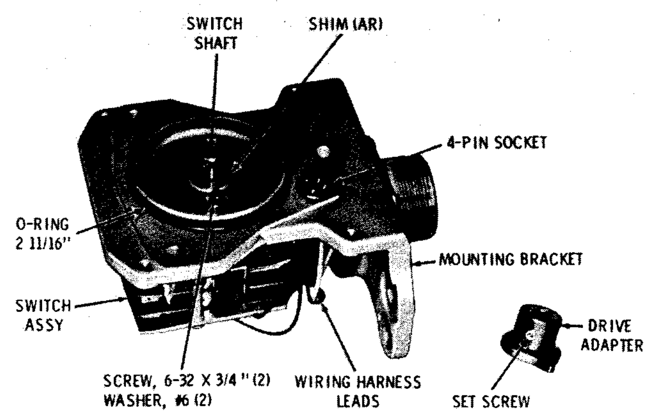


Fig. 4-12. Mounting bracket and shaft-end of switch

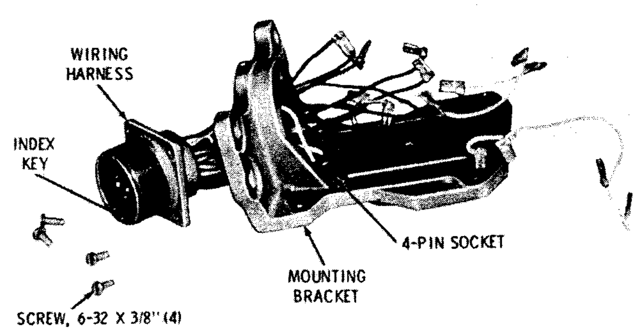


Fig. 4-13. Mounting bracket and switch wiring harness

b. Inspection, Cleaning. Thoroughly clean all parts. Inspect for worn, damaged, or faulty parts.

> Caution: Do not use liquid or vapor cleaning methods on any electrical components.

c. Assembly (foldout 2)

(1) If the 4-pin socket (female) was removed from the mounting bracket, install a new socket (fig. 4-13). The socket is item 36 (foldout 2). Push the socket into the flat side of the mounting bracket until it is flush with the adjacent area. Note the projection on the socket body that indexes with a notch in the mounting bracket.

(2) Install a 1 1/2-inch O-ring over the wires and onto the shoulder of the main wiring harness. Insert the wires through the bottom of the mounting bracket (fig. 4-13). Push the 16-pin connector into the mounting bracket, with the index key toward the flat side of the mounting bracket (fig. 4-5). Retain the connector with four 6-32 x 3/8-inch screws.

(3) Locate the lead coming from pin K in the 16-pin connector. Push its free end through the hole nearest the index projection of the 4-pin socket. Crimp and solder a socket terminal to the lead, and push the lead and terminal into the socket body. Attach the lead from pin M to the 4-pin socket, diametrically opposite from lead K, in the same manner. Attach the lead from pin L to the 4-pin socket at the hole farthest from the mounting bracket base. Attach the separate lead, having two push-on terminals attached, to the 4-pin socket at the remaining hole.

> Note: Do not use acid, or acid core solder. Use only rosin-core solder.

(4) Recheck the connections to make sure that they are correct. Looking at the back of the socket (where wires enter), the light-colored lead from pin K should be nearest the index lug on the socket. Moving clockwise, the separate lead with four connectors is next. Then another light-colored lead to pin M. And last, a dark lead to pin L.

> Note: Refer to figure 4-14, Wiring Diagram, to confirm the locations, but note that the view in the wiring diagram is at the front (mating side) of the socket, and the order of installation is counterclockwise.

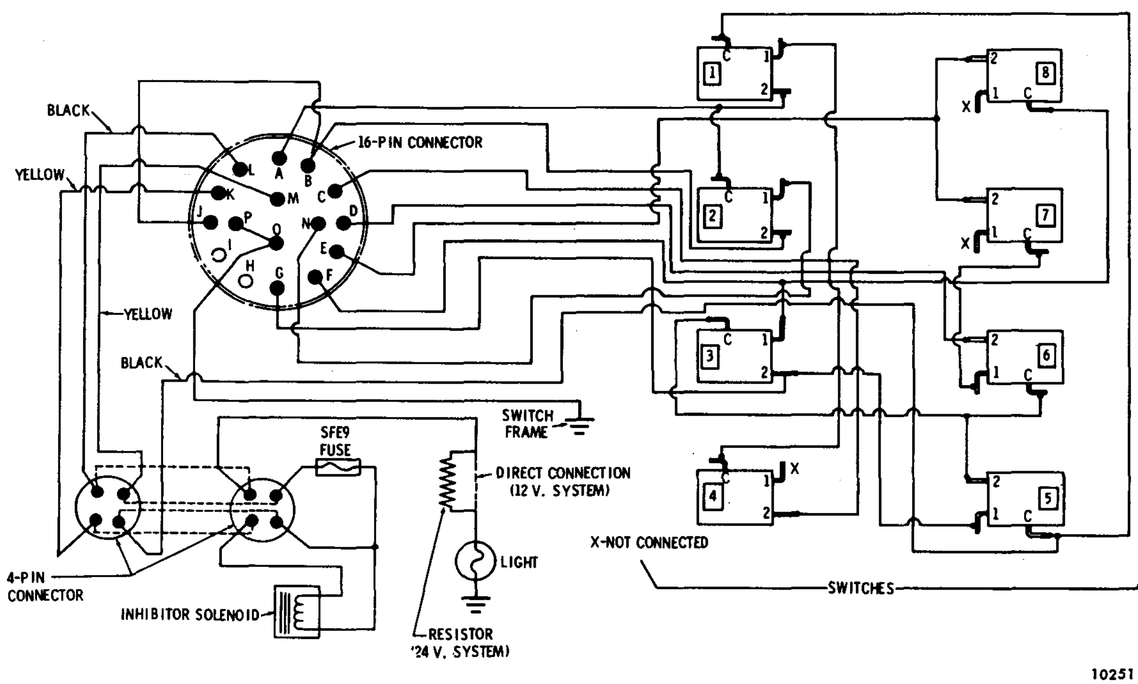


Fig. 4-14. Shift tower assembly wiring diagram

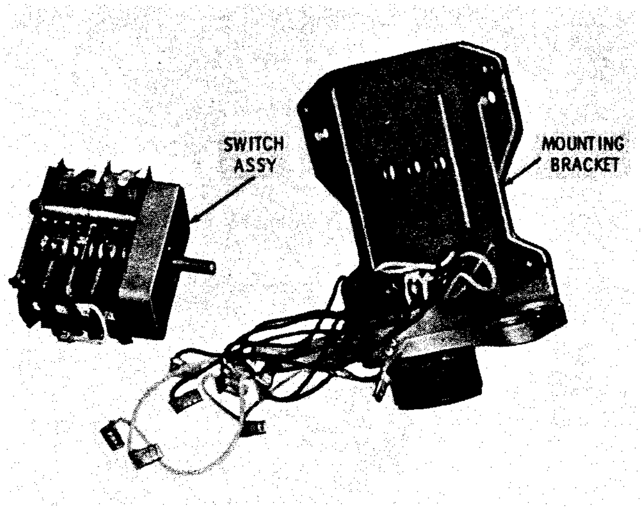


Fig. 4-15. Switch assembly removed from mounting bracket

(5) Install the switch assembly onto the mounting bracket (fig. 4-15). Position the switch assembly on the mounting bracket so that the switch numbers (1 through 8) are not inverted. Retain the assembly with two 6-32 x 3/4-inch screws and lockwashers. The screw holes in the switch assembly should be approximately midway of the elongated holes in the mounting bracket when the screws are tightened.

(6) Follow the wiring diagram (fig. 4-14) to connect the wiring harness leads to the switch assembly. Also connect three jumper leads (from terminal 1 of switch 1, to common terminal of switch 4; from terminal 1 of switch 6, to common terminal of switch 7; and from common terminal of switch 3, to terminal 2 of switch 5, and to common terminal of switch 6). Note also that three switch terminals have no leads connected to them.

(7) Install one shim 19 (foldout 2), darker side first, onto the switch shaft (fig. 4-12).

Note: More shims may be required. This will be determined in (10), below.

(8) Install the drive adapter (fig. 4-12). Position the adapter lightly against the mounting bracket, and tighten the set screw against the falt on the switch shaft.

(9) If the bushing was removed from the selector body, press a new bushing into the body until it is flush with the hub of the body. Hone, or ream, the bushing bore until rotary key 29 (foldout 2) will fit the bore and can be rotated with finger torque only. Install the rotary key (without O-ring 14). Install the selector body onto the mounting bracket, engaging the tongue of the drive adapter with the slot in the rotary key. Retain the body with three 5/16-18 x 5/8-inch socket-head screws and lockwashers.

(10) Using a dial indicator, depth micrometer, or vernier depth gage, determine the end play of the rotary key. If the end play exceeds the thickness of one shim 19 (foldout 2), remove the selector body and the drive adapter, and install an additional shim (or more, if required).

Note: Shims must not bind the rotary key and switch to hinder rotary actuation.

(11) When shim adjustment is completed, remove the selector body to complete its assembly.

(12) Install the 9/16-inch O-ring into the groove of the rotary key. Lubricate the rotary key and O-ring lightly with Texaco Marfak No. 2 (or equivalent) grease. Put a small quantity of grease into the spring recess of the rotary key. Install spring 5 and leveler 4 (both coated lightly with Marfak No. 2 (or equivalent) grease) into the rotary key. Install handle 16 (and spacer 15, if used) into the slot of the rotary key. Push threaded pin 38 through the holes in the rotary key and handle 16 (and spacer 15, if used). Secure the pin with nut 13. Tighten the nut only enough to eliminate end play of the pin. Do not bind movement of the handle in rotary key 39.

(13) If either a new rotary key 39, or a new inner clutch 2, or both, are installed, a drilling guide (fig. 4-16) is required. Install inner clutch 2 (foldout 2) onto rotary key 39 until the rotary key bottoms in the clutch. Install the 1 1/8-inch O-ring onto the inner clutch (fig. 4-10).

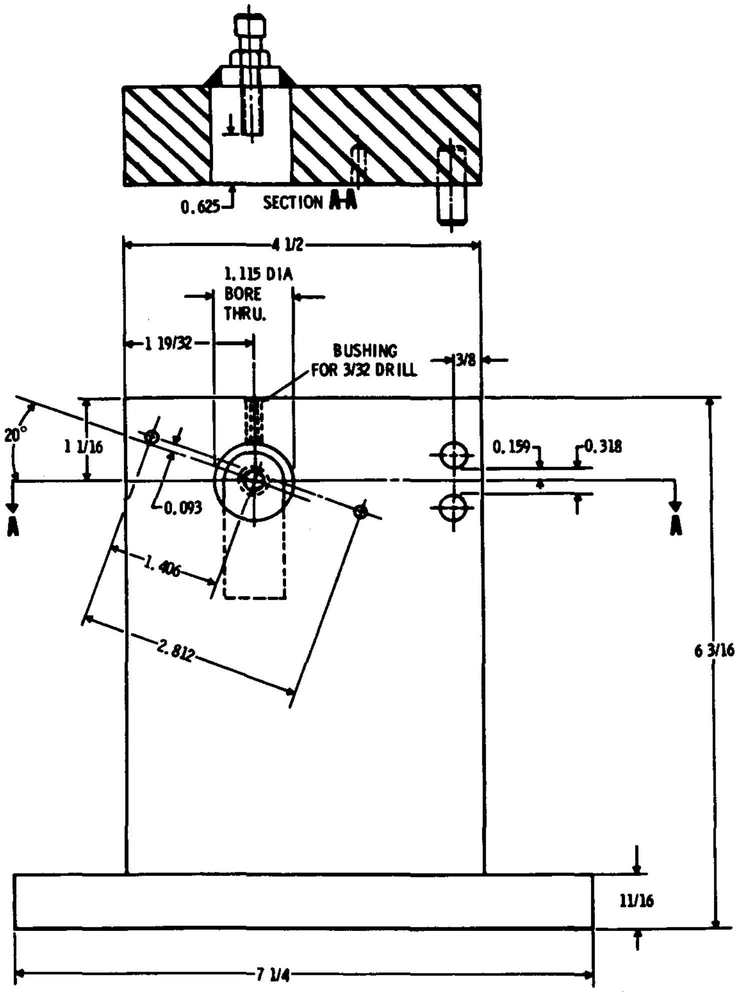


Fig. 4-16. Inner clutch drilling guide

(14) Push the inner clutch, of the assembly built thus far, into the large hole in the drilling guide (fig. 4-16). Position the body dowel pins in the two smaller holes, and the selector handle between the two dowel pins of the guide. Hold the rotary key and inner clutch firmly against the guide's stop screw, and drill a 3/32-inch hole through the clutch and/or rotary key. Install rotary key pin 46 (foldout 2). Remove the assembly from the drill guide.

(15) Install the 4-pin connector (with four leads assembled) into the shift tower body (fig. 4-17). Push the connector into the mounting face of the body until it is flush with the adjacent area. Note that there is a pro-

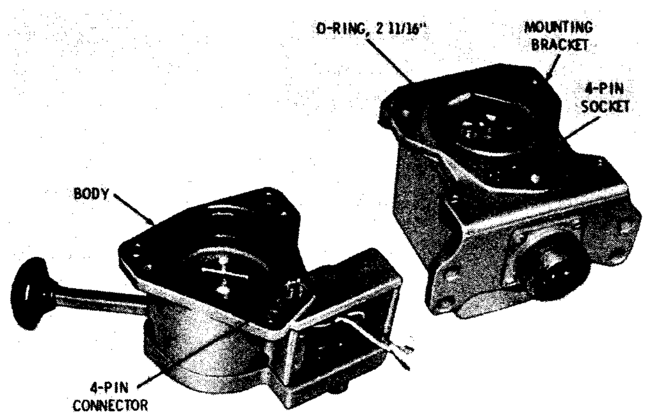


Fig. 4-17. Shift tower body section and switch section separated

jection on the connector body that indexes with a notch in the shift tower body for angular alinement of the connector.

(16) Install the 2 11/16-inch O-ring onto the mounting bracket (fig. 4-12).

(17) Install the assembled body section of the shift tower assembly onto the assembled switch section (fig. 4-10). Install three 5/16-18 x 5/8-inch socket-head screws, and lockwashers, to retain the two sections.

(18) Install the fuse holder into the body cover (fig. 4-10). Retain it with the nut. Connect the fuse lead (coming from M in the 16-pin connector, through the 4-pin connector) to the single lead of the fuse holder. Connect the power lead (coming from the lead in the 4-pin socket that connects to the common terminals of switches 1 and 5 to the black lead of the fuse holder. Lightly lubricate the O-ring on the inner clutch with Texaco Marfak No. 2 (or equivalent) grease.

(19) Install the cover onto the body (fig. 4-9). Retain the cover with one 1/4-20 x 1-inch screw and lockwasher.

(20) If necessary, install a new indicator onto the indicator support (fig. 4-9). Install the indicator support onto the body cover (fig. 4-9). Apply a small quantity of Texaco Marfak No. 2 (or equivalent) grease to the teeth of the inner clutch. Position the clutch spring in the center recess of the inner clutch.

(21) If the guide pins were removed from the solenoid housing, install new pins (fig. 4-9). Press the pins until they are flush with the surface of the housing inner hub.

(22) Install the 2 1/8-inch O-ring onto the solenoid housing (fig. 4-9). Coat the outer surface of the outer clutch lightly with Marfak No. 2 (or equivalent) grease. Install the outer clutch, flat end first, into the solenoid housing. The clutch must move freely, endways, when engaged with the guide pins.

(23) Install the assembled solenoid housing onto the indicator support (fig. 4-9).

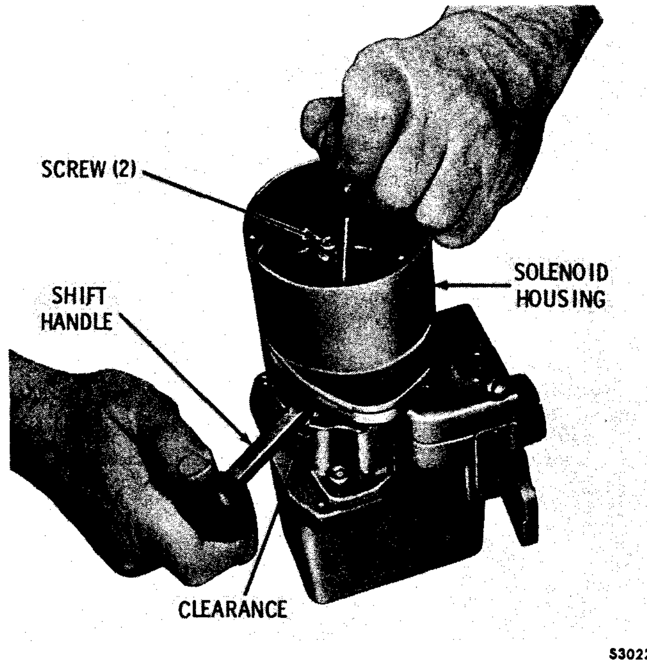


Fig. 4-18. Checking solenoid housing angular adjustment

(24) Install two 1/4-20 x 1 3/4-inch screws, and lockwashers, to retain the solenoid housing (fig. 4-8).

(25) Install override spring 61 (foldout 2) into the center bore of the solenoid housing.

(26) Install the spring seat, and retainer ring (fig. 4-8). Install the 15/16-inch O-ring into the housing counterbore.

(27) Check the angular position of the solenoid housing (fig. 4-18). Push the spring seat downward. While holding the seat downward, push the shift handle, in the upshift direction against a gate pin and then in the opposite direction. The inhibitor clutch should engage, but should allow the shift handle to move away from the gage pin contacted a maximum of 0.060 inch and a minimum of 0.040 inch when hand pressure on the handle knob does not exceed 15 lb. This 0.060 inch maximum movement applies to the gate pin where the least movement is found when all positions are checked. As a result of tolerances in manufacturing, clearance at some gate pins can exceed 0.060 when the clearance is correctly adjusted at the position where least movement occurs. Check the movement at all gate pins.

(28) Too great a clearance, in (27), above, requires a counterclockwise adjustment of the solenoid housing to reduce the clearance; too little requires clockwise adjustment.

Note: When clearance is greatly excessive, a clockwise adjustment may be necessary to engage the inhibitor properly.

To adjust the solenoid housing, loosen the two screws, rotate the housing, and retighten the screws.

(29) Install the solenoid coil into the solenoid housing (fig. 4-8). Thread the solenoid leads through two holes in the solenoid housing, indicator support, and body cover until they can be pulled out of the bottom opening in the body (fig. 4-7).

(30) Install the solenoid plunger and washer into the solenoid coil (fig. 4-7). Install the solenoid housing cover and gasket. Retain the cover with three 8-32 x 1/2-inch screws and lockwashers.

(31) With the solenoid and cover installed, check the shift handle for freedom of movement in both upshift and downshift directions. Any tendency to catch during downshift movement indicates interference between the inner and outer clutch teeth. This may be corrected by removing the cover, gasket, solenoid plunger and washer, and by rotating the adjusting screw (fig. 4-7) clockwise (inward) until there is no interference. Adjust the screw one turn at a time, and recheck for clutch interference after each adjustment.

(32) At this stage of assembly, there are five unconnected leads at the bottom of the selector assembly. Four are light color; one is black (fig. 4-7). Attach the two solenoid leads to the proper two wiring harness leads, insulating each connection with a short length of heat-shrink tubing.

(33) Replace the bulb, O-ring, or resistor in the light socket plate assembly (fig. 4-6). Connect the lead on the plate assembly with the remaining free lead in the shift tower assembly, insulating the connection with heat-shrink tubing.

(34) Install the light socket plate assembly, being careful that wires do not touch the light bulb (fig. 4-5). Retain the plate assembly with four 6-32 x 3/8-inch screws.

(35) Install an SFE 9A fuse into the fuse holder.

(36) Check the circuitry and operation of the shift tower assembly as outlined in paragraph 4-8.

(37) Install the switch cover and cover seal (fig. 4-11). Retain the cover with four 10-24 x 5/8-inch screws and washers.

4-10. INSTALLATION OF SWITCH TOWER ASSEMBLY

The switch tower assembly, if removed, may be installed by replacing the bolts which mount it in the vehicle cab.

4-11. REMOVAL OF VALVE BODY, TRANSFER PLATE

a. Main Control Valve Body Assembly (fig. 4-19)

(1) Remove eleven bolts A and lockwashers.

(2) Remove nine bolts B and their lockwashers.

(3) Remove twelve bolts C and their lockwashers.

(4) Remove two bolts D and their lockwashers, while supporting the valve body.

(5) Remove valve body G, gasket H, separator plate I, and gasket J. Discard the gaskets.

Note: Modification of separator plate I, for assemblies prior to S/N 55963 is recommended. Refer to paragraph 4-14.

b. Oil Transfer Plate (fig. 4-19)

(1) Remove three bolts F and their lockwashers.

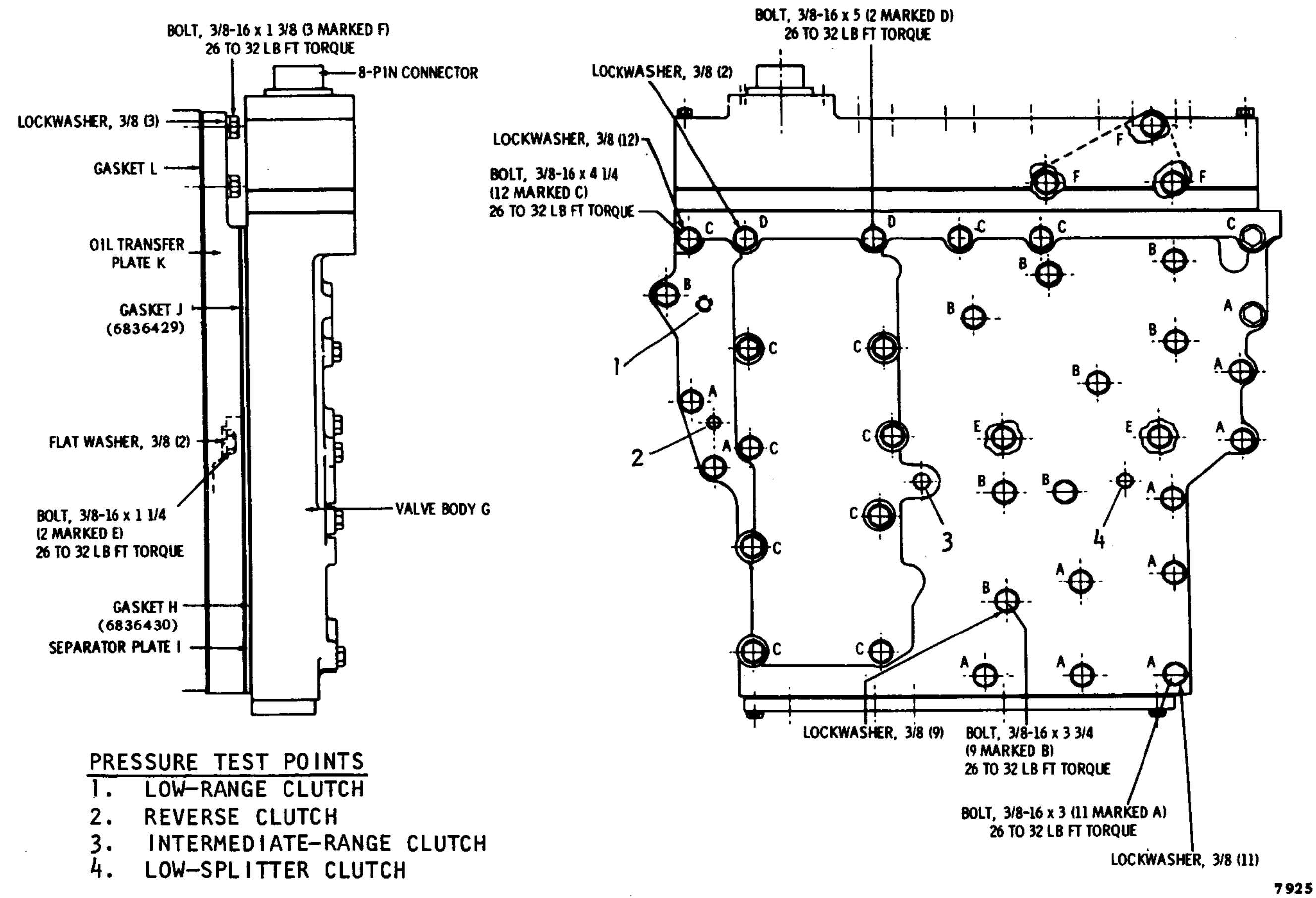


Fig. 4-19. Valve body components and mounting bolts–pictorial view

(2) Remove two bolts E and flatwashers.

(3) Remove oil transfer plate K and gasket L. Discard the gasket.

(4) Refer to paragraph 4-12 for rebuild of the valve body.

4-12. REBUILD OF CONTROL VALVE ASSEMBLY

a. Disassembly (B, foldout 1)

Note: Cover and plate assembly 10 is spring loaded.

(1) Remove four bolts 82, lockwashers 83 (and harness guard 84, if used), fourteen bolts 80 and fourteen lockwashers 79.

(2) Remove cover and plate assembly 10 and gasket 21.

(3) Remove two screws 14, and carefully lift cover 13 until the solenoid leads and ground wire are accessible.

(4) Remove seven elastic rings 20. Remove one bolt 17, washer 16, and the ground wire terminal. Remove seven wiring harness leads from the solenoid leads. Remove cover 13 and gasket 11.

(5) Do not remove wiring harness 12 from cover 13 unless repair or replacement is necessary.

(6) Remove the remaining thirteen bolts 17, lockwashers 16, seven solenoids 18 and gaskets 19.

(7) From the bores in valve body 39, remove two steel balls 36, valve 35, spring

37, valve 33, spring 34, valve 32, spring 31, valve 29, spring 30, springs 27 and 28, valve 26, valve 24, spring 25, spring 22, and valve 23.

Note: Cover 55 is spring loaded, and must be restrained while removing bolts 57.

(8) Position the valve body, top downward, and remove fourteen bolts 57, and lockwashers 56.

(9) Remove cover 55 and gasket 54.

(10) From the bores in valve body 39, remove stop 53, springs 51 and 52, valve 50, spring 49, valve 48, spring 58 (not used after S/N 55743, and should be discarded from all earlier assemblies), valve 59 (after S/N 59805 models did not have a bore at this position, and do not include items 58 through 61), valve plug 60, spring 61, stop 67, springs 65 and 66, valve 64, spring 63, valve 62, stop 68, springs 69 and 70, valve 71, spring 72, valve 73, stop 79, springs 77 and 78, valve plug 76 (valve plug 76 is longer after S/N 59805), spring 75, and valve 74.

(11) Remove four plugs 40 from valve body 39. Remove plug 43 and screen assembly 44. Do not attempt to remove five orifice plugs 41, or plug 42.

(12) Do not remove pin 47, valve 46 or spring 45 unless parts replacement is necessary. Old spring 45 (18 coils) should be replaced with new spring 45 (15 coils) on transmissions with serial numbers 56674 and below.

b. Cleaning, Inspection. Clean and inspect all components as outlined in the applicable transmission Service Manual. Pay particular attention to the cleanliness of valve bores, passages and orifices. Inspect all springs to insure that they conform to specifications in the spring chart (para 4-15).

c. Assembly (B, foldout 1)

Note: A repair kit, with instructions, is available for repair of wiring in control valve assembly.

(1) Install seven gaskets 19 onto plate 15.

(2) Install seven solenoids 18, and retain them, with thirteen 1/4-20 x 3/4-inch bolts 17, each with a lockwasher 16. Leave one bolt 17 and lockwasher 16 out of solenoid A (fig. 4-20) until the ground wire terminal is installed (see (6), below).

(3) Tighten the bolts in six solenoids to 9 to 11 pound feet torque. Leave the remaining bolt (in solenoid A) untightened.

(4) Install gasket 11 (B, foldout 1) onto plate 15.

(5) If wiring harness 12 was removed, install it into cover 13, index its pin in the hole in the cover, and tighten the retaining nut to 20 to 24 pound inches torque.

(6) Place cover 13 into position near plate 15 and connect the wiring harness ground terminal by installing the remaining bolt 17 and lockwasher 16 into solenoid A (fig. 4-20). Tighten the bolt, and its companion bolt, to 9 to 11 pound feet torque.

(7) Connect the seven wiring harness leads as shown in figure 4-20. Recheck the lead connections to insure they are correct. Bind each of the seven leads to the solenoids, using the elastic rings 20 (B, foldout 1) provided.

(8) Install cover 13 (B, foldout 1) onto gasket 11 and plate 15. Be certain that no leads are pinched between cover 13 and plate 15. The gap between the cover and plate should close by the cover's weight — no force is required. Retain the cover with two 10-24 x 1-inch flat-head screws 14. Tighten the screws to 2 to 3 pound feet torque.

(9) Position valve body 39 in an upright position. Install the components into bores A through G, in the order listed in the legend for figure 4-21.

Note: Check the positioning of all components, the configuration of each valve, and the definite identification of springs before installation.

(10) Install gasket 21 (B, foldout 1), two steel balls 36, and cover and plate assembly 10.

Note: Headless 1/4-20 x 4-inch guide bolts installed into valve body 39 will aid in this assembly step.

(11) Install four 1/4-20 x 4-inch bolts 82 (and harness guard 84, if used), with lockwashers 83. Install fourteen 1/4-20 x 3 5/8-inch bolts 81, with lockwashers 80. Tighten the eighteen bolts evenly to 9 to 11 pound feet torque.

(12) Place the valve body in an inverted position.

Note: Do not damage the threads and terminal pins of the electrical connector.

(13) Install the components into bores H through M. Install them in the order listed in the legend for figure 4-21.

Note: Check the positioning of all components, the configuration of each valve, and the definite identification of springs before installation. Spring 19 in bore H (fig. 4-21) should be omitted. Later assemblies (after S/N 59805) do not have a bore at J, and do not include items 16 through 19. Also, after S/N 59805, valve 40 is longer than the valve previously used. The earlier and later valves are interchangeable only if all the associated components in bore N are interchanged.

(14) Install gasket 54 (B, foldout 1), and cover 55.

Note: Headless 1/4-20 guide bolts installed into valve body 39 will aid in this assembly step.

(15) Install fourteen 1/4-20 x 1-inch bolts 57, with lockwashers 56. Tighten the bolts evenly to 9 to 11 pound feet torque.

(16) Install four plugs 40 into valve body 39.

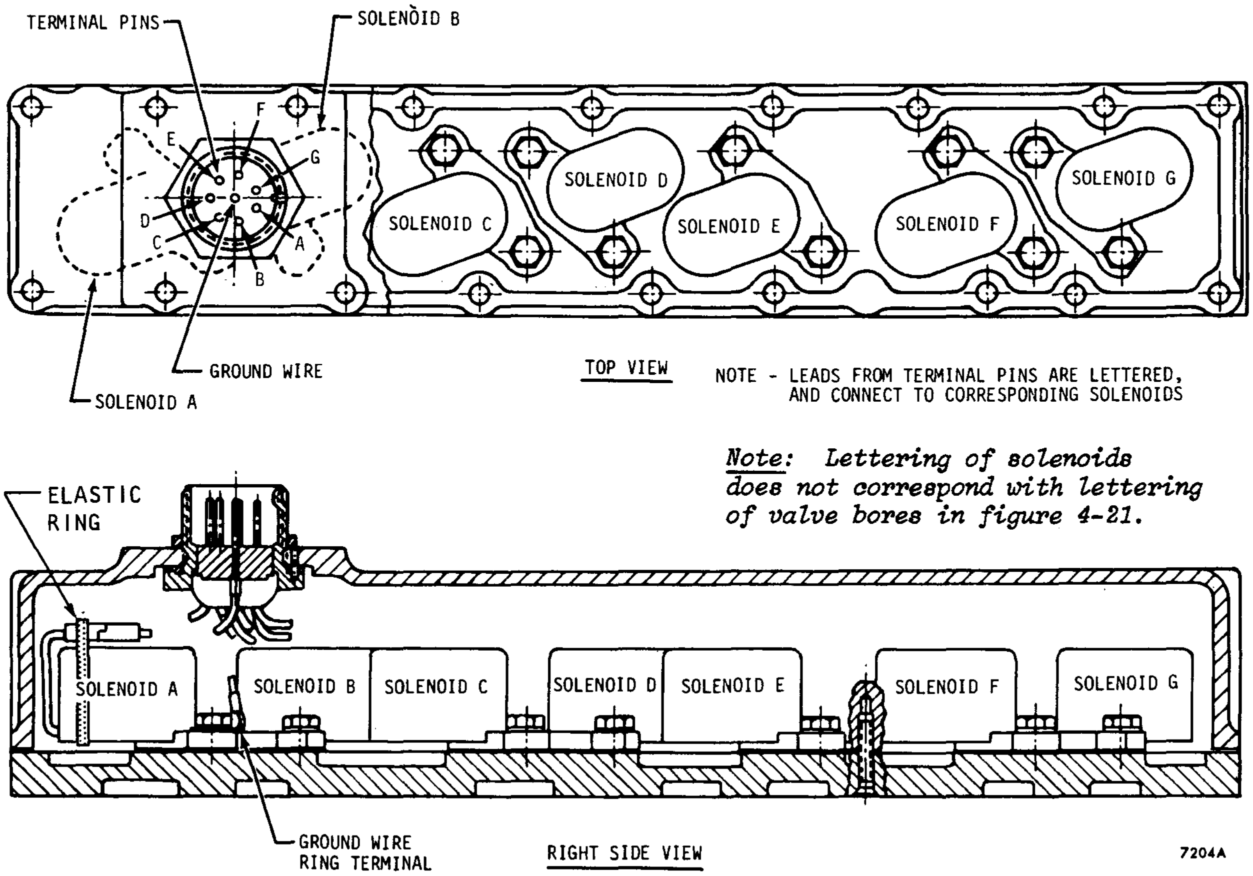
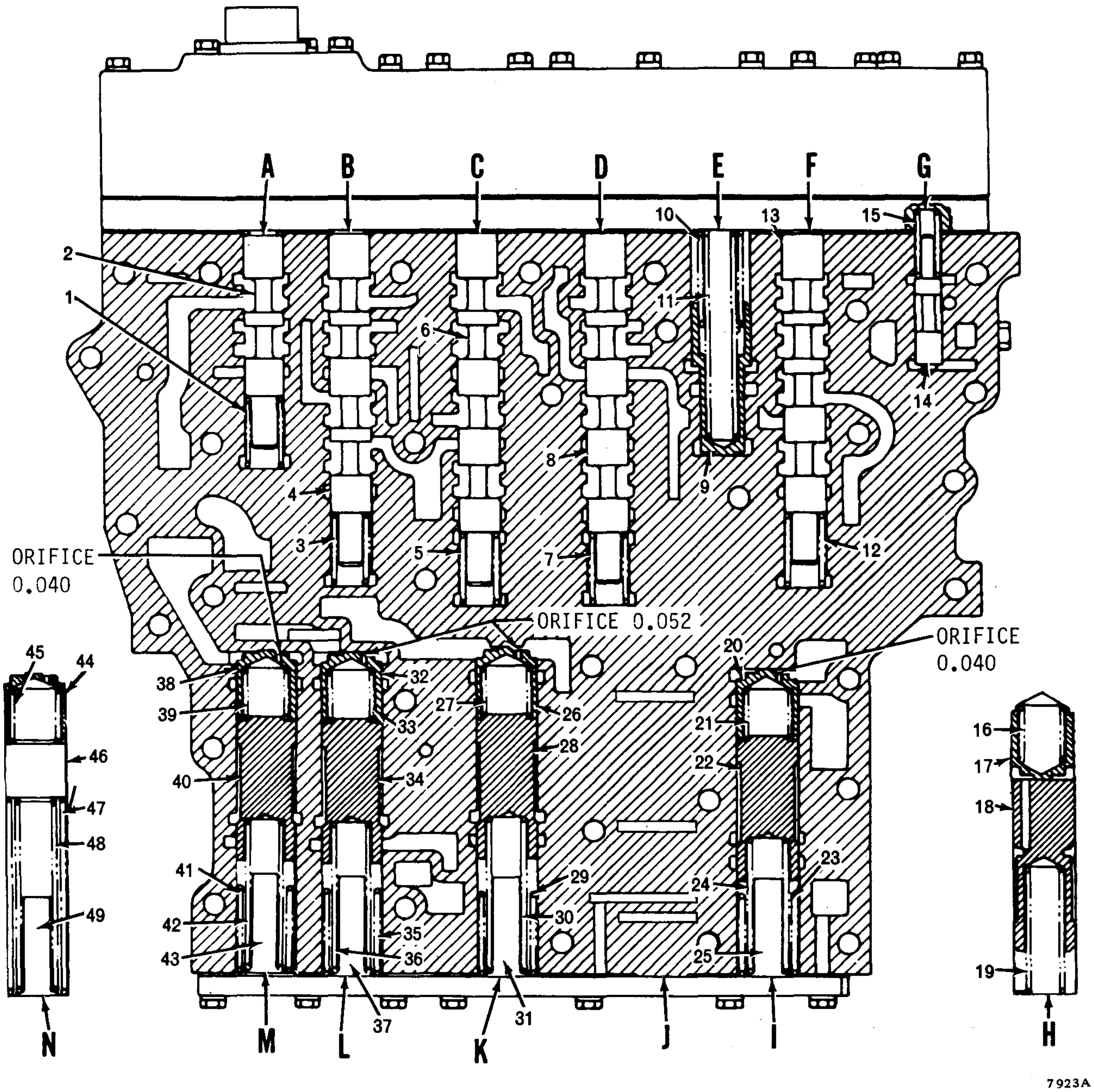


Fig. 4-20. Valve body solenoid electrical connections



A - REVERSE SHIFT VALVE BORE
- 1 - Spring*
- 2 - Reverse-gear shift valve

B - LOW-RANGE SHIFT VALVE BORE
- 3 - Spring*
- 4 - Low-range shift valve

C - INTERMEDIATE-RANGE SHIFT VALVE BORE
- 5 - Spring*
- 6 - Intermediate-range shift valve

D - HIGH-RANGE SHIFT VALVE BORE
- 7 - Spring*
- 8 - High-range shift valve

E - PRIORITY VALVE BORE
- 9 - Priority valve
- 10 - Outer spring*
- 11 - Inner spring*

F - SPLITTER SHIFT VALVE BORE
- 12 - Spring*
- 13 - Splitter shift valve

G - SOLENOID PRESSURE REGULATOR
- 14 - Solenoid pressure regulator valve
- 15 - Spring*

H - TRIMMER REGULATOR VALVE BORE (Used in models built before S/N 59806)
- 16 - Spring*
- 17 - Trimmer regulator valve plug (no orifice)
- 18 - Trimmer regulator valve (drilled internal passage)
- 19 - Regulator valve spring* (not used after S/N 55743)

I - LOW-SPLITTER TRIMMER VALVE BORE
- 20 - Low-splitter trimmer valve upper (0.040 orifice)
- 21 - Spring*
- 22 - Low-splitter trimmer lower valve
- 23 - Outer spring*
- 24 - Inner spring*
- 25 - Stop

J - TRIMMER REGULATOR VALVE BORE
Trimmer regulator valve, valve components and the valve bore were removed from the valve body after S/N 59805.

K - INTERMEDIATE-RANGE TRIMMER BORE
- 26 - Intermediate-range trimmer upper valve (0.052 orifice)
- 27 - Trimmer valve spring*
- 28 - Intermediate-range trimmer lower valve
- 29 - Outer spring*
- 30 - Inner spring*
- 31 - Stop

L - LOW-RANGE TRIMMER BORE
- 32 - Low-range trimmer upper valve (0.052 orifice)
- 33 - Trimmer valve spring*
- 34 - Low-range trimmer lower valve
- 35 - Outer spring*
- 36 - Inner spring*
- 37 - Stop

M - REVERSE TRIMMER BORE (Used after S/N 59805)
- 38 - Reverse trimmer upper valve (0.040 orifice)
- 39 - Trimmer valve spring*
- 40 - Reverse trimmer lower valve
- 41 - Outer spring*
- 42 - Inner spring*
- 43 - Stop

N - REVERSE TRIMMER BORE (Used before S/N 59806)
- 44 - Reverse trimmer valve (0.050/0.053 orifice)
- 45 - Trimmer valve spring*
- 46 - Reverse trimmer valve plug
- 47 - Outer spring*
- 48 - Inner spring*
- 49 - Stop

*Before installing, refer to spring chart (para 4-15) for positive identification.

Fig. 4-21. Valve body, with components installed in each bore—cross-section view

(17) If spring 45, valve 46 and pin 47 were removed, reinstall them. Place valve 46, convex side first, onto pin 47. Install spring 45 (refer to a(12), above) onto pin 47, against the concave side of valve 46.

(18) Press pin 47, with valve and spring, into the bore in valve body 39. Press on the pin until the head of the pin is 0.340 inch above the mounting face of the valve body.

(19) Install screen assembly 44, open end first, into valve body 39. Retain it with plug 43.

4-13. INSTALLATION OF CONTROL VALVE BODY COMPONENTS

Note: In earlier models, the oil transfer tubes, in holes 1 and 2 in the transmission housing (fig. 3-1), may work outward toward the oil transfer plate. This will partially block the free flow of oil in the transfer plate passages. To prevent this, remove the oil transfer tubes from holes 1 and 2 (fig. 3-1) and squeeze the larger diameter ends to a slightly out-of-round shape so they will fit firmly in the transmission holes. Later oil transfer plates are designed to retain the tubes, and deforming the tubes is not necessary.

a. Oil Transfer Plate (fig. 4-19)

(1) Install two 3/8-16 x 6-inch headless guide bolts into holes marked C at the front and rear of the valve body mounting pad on the transmission housing.

(2) Install gasket L onto the guide bolts.

(3) Install oil transfer plate K and retain it with three 3/8-16 x 1 3/8-inch bolts F, with lockwashers.

(4) Also, through oil transfer plate K, install two self-locking, 3/8-16 x 1 1/4-inch bolts E, with flat washers. Tighten bolts E and F to 26 to 32 pound feet torque.

b. Separator Plate, Valve Body (fig. 4-19)

(1) Install gasket J (6836429), separator plate I (refer to para 4-14) and gasket H (6836430).

Note: Do not interchange gaskets J and H. Each gasket is marked for location. Gasket J (P/N 6836429) is installed against transfer plate K. Then plate I is installed followed by gasket H (P/N 6836430).

(2) Install valve body G.

(3) Install the following bolts, all with lockwashers:

Eleven 3/8-16 x 3-inch, marked A

Nine 3/8-16 x 3 3/4-inch, marked B

Twelve 3/8-16 x 4 1/4-inch, marked C (remove 6-inch guide bolts for two)

Two 3/8-16 x 5-inch, marked D

(4) Tighten all of the bolts installed in (3), above, to 26 to 32 pound feet torque.

4-14. REWORK OF OIL SEPARATOR PLATE

a. Applicable to Assemblies Prior to S/N 55963. To provide more efficient operation, an additional exhaust passage is provided in separator plate 8 (B, foldout 1) beginning with S/N 55963. It is recommended that all plates prior to S/N 55963 be reworked to conform.

b. Rework Procedures

(1) Drill a 0.141 inch diameter hole in the separator plate at the location indicated in figure 4-22. Use either gasket 6 or 8 (B, foldout 1) as a template for location of the hole. The gasket used must be either P/N 6836429 or 6836430 (these have holes corresponding to the hole to be drilled).

(2) Remove burs caused by drilling, and clean the separator plate thoroughly.

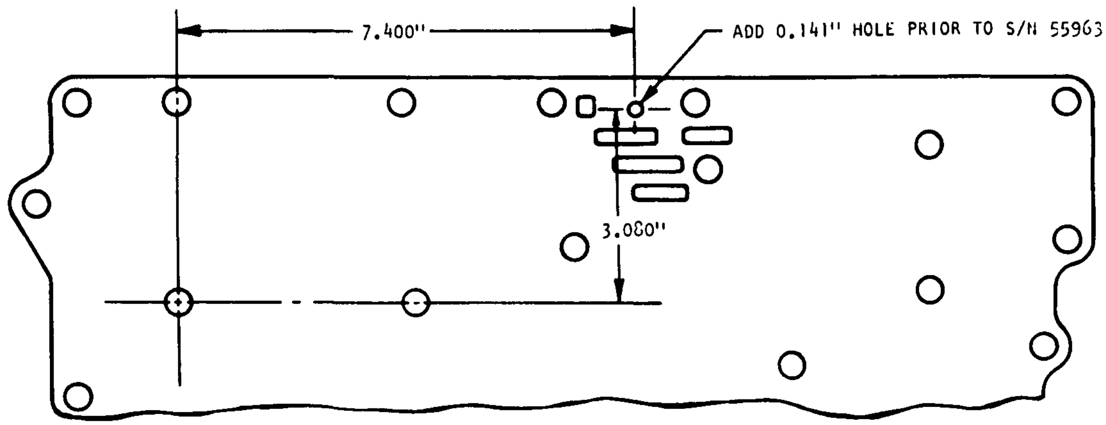


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Fig. 4-22. Location of added hole in separator plate

4-15. SPRING CHART

The following chart will aid in identification and inspection of all springs in the valve bodies. Each spring is keyed to B, foldout 1. In addition, springs are keyed to figure 4-21 by letters and numerals in parentheses.

SPRING CHART

Model 5000, 6000 **Valve body assy.** ________ **Transmission assy.** ________

Fold-out	Ref	Spring	Part No.	No. coils	Diameter of wire	Outside diameter	Free length	under load Length	Pounds
B, 1	22	Solenoid pressure regulator valve	6835394	12	0.061/0.063	0.440	1.56	1.02	19.5 to 23.7
		(G-15)[1]							
B, 1	25, 30,	Shift valve (A-1, B-3, C-5, D-7,	6832304	11	0.0845/0.0875	0.700	1.83	1.22	21 to 25
	31, 34,	F-12)[1]							
	37								
B, 1	27	Priority valve inner (E-11)[1]	6830243	32	0.0705/0.0735	0.565	4.94	2.60	22.5 to 27.5
B, 1	28	Priority valve outer (E-10)[1]	6833223	9.5	0.1005/0.1035	0.830	1.78	1.26	26.1 to 28.9
B, 1	45	Exhaust check valve	6834536	15	0.019/0.021	0.330	1.25	0.94	0.166 to 0.206
B, 1	49, 63	Trimmer valve (I-21, K-27, L-33,	6759964	15	0.0615/0.0635	0.850	4.50	1.03	11.16 to 13.64
	72, 75	M-39)[1]							
B, 1	51	Low-splitter trimmer valve inner	6778009	15	0.1005/0.1035	0.750	3.323	3.05	11.4 to 12.6
		(I-24)[1]							
B, 1	52	Trimmer valve outer (I-23, K-29,	6830014	7	0.1115/0.1145	1.060	1.605	1.06	27 to 33
		L-35)[1]							
B, 1	58	Trimmer regulator valve (H-19)[1,2]	6830245	17	0.0845/0.0875	0.680	3.185	2.40	19 to 21
B, 1	61	Trimmer regulator valve plug	6759964[4]	15	0.0615/0.0635	0.850	4.50	1.03	11.16 to 13.64
		(H-16)[1,4]	6835384[4]	16	0.057/0.059	0.850	4.245	1.03	6.9 to 8.5
B, 1	65, 70	Trimmer regulator valve inner	6830240	18	0.0905/0.0935	0.769	3.775	1.85	38 to 42
		(K-30, L-36)[1]							
B, 1	77	Reverse trimmer lower valve inner	6776677[3]	16	0.0900/0.0930	0.730	2.971	1.58	36.4 to 40.4
		(M-42,[3] N-48[4])[1]	6830240[4]	18	0.0905/0.0935	0.769	3.775	1.85	38 to 42
B, 1	78	Reverse trimmer lower valve outer	6830237	8	0.1185/0.1215	1.060	2.065	1.06	57 to 63
		(M-41,[3] N-47[4])[1]	6830241	12	0.1185/0.1215	1.060	3.575	1.90	57 to 63

[1] LETTER — NUMBER COMBINATIONS REFER TO FIGURE 4-21.

[2] DISCARD IF PRESENT — NOT USED AFTER S/N 55743.

[3] USED AFTER S/N 59805.

[4] USED BEFORE S/N 59806.

Section 5. TESTS AND REBUILD—AUTOMATIC COMPONENTS

5-1. SCOPE OF SECTION 5

This section describes the automatic-electric control system used on the 5000 and 6000 series transmissions. In addition, the tests, disassembly, rebuild, and assembly procedures are covered. References to other sections of this supplement are made for procedures applicable to both electric control systems.

5-2. DESCRIPTION AND OPERATION

a. System Components (A, foldout 4)

(1) The automatic-electric control system consists mainly of the components shown on A, foldout 4 in the back of this supplement. Components are selective for vehicles having either 12- or 24-volt electrical systems, and for four, five, or six forward speed operation.

(2) A system includes a power supply unit—either a 12-to-24 volt converter 4 (for 12-volt vehicle system) or a 24-volt overload protector 5 (for 24-volt vehicle system). Electrical power is derived from the vehicle battery as shown in figure 5-1.

(3) Other components of a system are the shift tower (B, foldout 4), shift pattern generator 1 (A, foldout 4), throttle potentiometer 9, magnetic pickup 8, wiring harnesses 6 and 7, and the control valve assembly (B, foldout 1). Restrictor harness 2 (A, foldout 4), when installed between shift pattern generator 1 and wiring harness 6 restricts the system to four forward speeds. Restrictor harness 3, when installed in the same manner, restricts the svstem to five speeds.

(4) Mechanical components to complete the system are not shown in this manual. These include the linkage to connect throttle lever 10 to the vehicle throttle control, and the rotating element (gear) on the transmission output shaft. The gear teeth run in close proximity to the end of the magnetic pickup to induce electrical impulses in the magnetic pickup.

b. System Operation

(1) The automatic-electric control system selects the proper transmission drive ratio for the most efficient operation of the vehicle under all conditions of speed, load, throttle position and range selection.

(2) The operator selects the range within which he wants the transmission to operate. This may be any one of eight positions at the shift tower. These positions, and the range of operation at each, are shown in figure 5-2.

(3) The shift tower, for the range position selected, transmits an electrical signal pattern to shift pattern generator 1 (A, foldout 4). In addition to this input, the shift pattern generator receives pulse signals, indicating vehicle speed, from magnetic pickup 8, and a signal from throttle potentiometer 9, indicating vehicle throttle position.

(4) The three inputs are converted electronically to a signal pattern which is transmitted to the control valve assembly. The range selected by the operator, the vehicle (transmission output) speed and the throttle position determine the signal pattern sent to the control valve assembly. Solenoids in the valve assembly control the selection of gears (refer to Sec. 2).

(5) The vehicle will start out in first gear and upshift automatically at the proper times under the influence of vehicle speed and throttle position. Automatic downshifts will likewise occur at the proper times. Upshifts and downshifts are influenced by throttle position. At closed throttle, both upshifts and downshifts occur at lower road speeds than at open throttle.

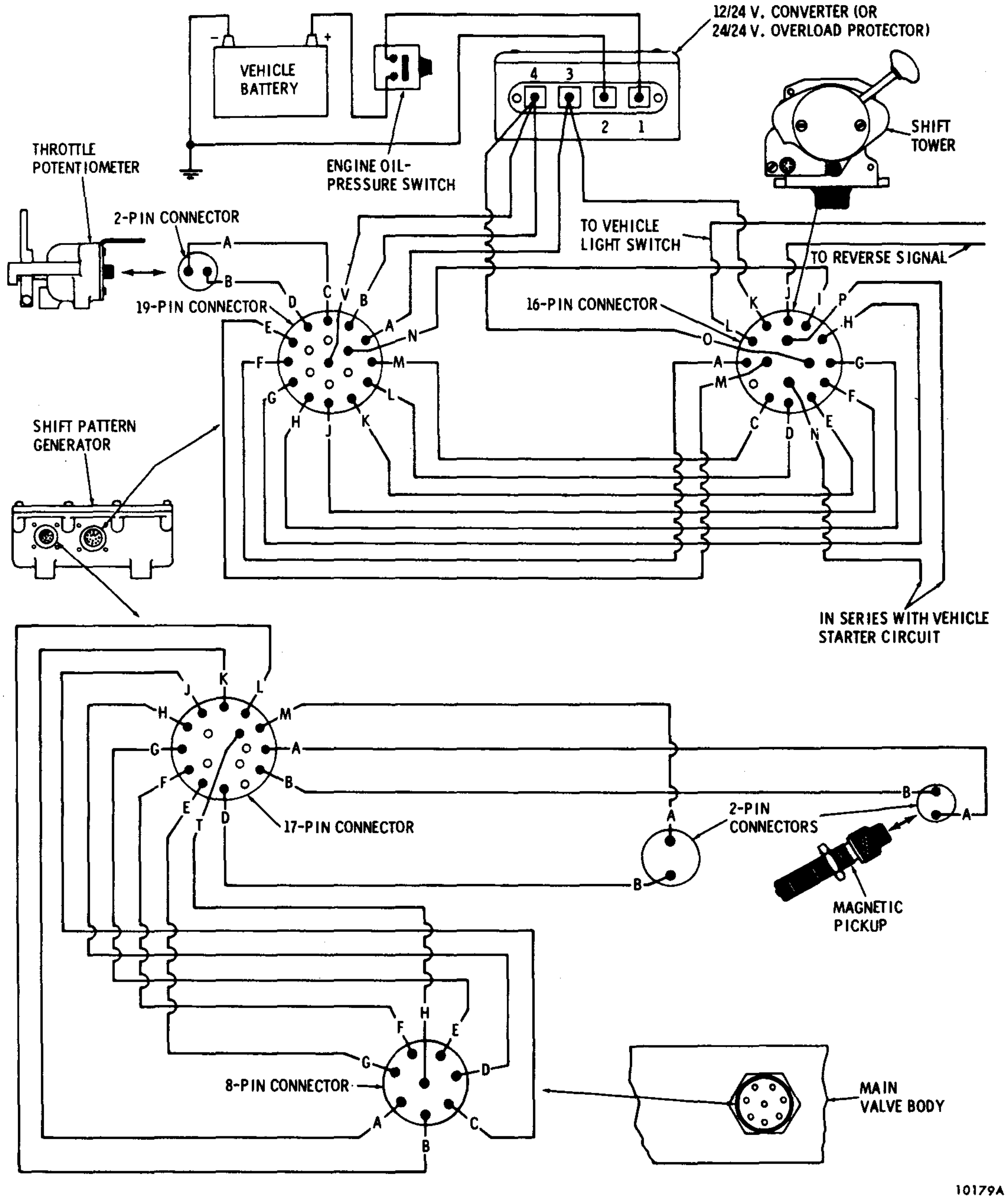

Fig. 5-1. Automatic-electric control system wiring diagram

(6) The shift pattern generator includes electronic components that protect the transmission against downshifts occurring at excessively high speeds. Regardless of what lower range at the shift tower is selected, or if reverse or neutral is selected, downshifts will occur only in normal sequence until the highest gear in the range selected (or neutral or reverse, if selected) is reached. Each downshift will occur at the greatest speed permissible for each gear in the descending sequence. Throttle position will not influence such downshifts.

(7) Study Section 2 for the description and operation of the control valve assembly and lockup trimmer valve. Paragraph 2-6 is not applicable because inhibitor function is electronic as described in (6), above. Paragraph 2-8 is not specifically applicable because it pertains to manual shifting but the responses of the control valve are similar in each gear selection. The control valve assemblies for manual-electric systems are identical to those for automatic-electric systems.

c. Specifications and Data

The following table lists the specifications and data applicable to the automatic-electric control system.

SPECIFICATIONS AND DATA

Automatic-Electric Control System	
Type	Automatic-electric-hydraulic (manual selection of operating mode energizes solenoids; solenoids control hydraulic pressures to shift valves; valves control hydraulic clutches)
Gear ranges, selector positions	Neutral, 6 forward speeds, reverse
Electric System:	
power source	Vehicle electrical system
voltage	12 or 24 volts dc
current draw:	
12-volt system	0.6 amp per solenoid
24-volt system	0.3 amp per solenoid
solenoids energized	Total quantity 9
Solenoids energized:	
neutral	3
reverse	4
forward gears	2
Wiring harness:	
side branches	7
connectors	16-pin at selector; 19 pin at shift pattern generator; 2-pin at throttle potentiometer; 7-pin from shift pattern generator; 2-pin at first gear valve body; 8-pin at main valve body; 2-pin at magnetic pick-up; push in, thread-tighten type
Manual selector assembly:	
location	Vehicle cab
selector sequence	R, N, D, 5, 4, 3, 2, 1 (each position gated)
light (connected to vehicle light system)	Integral

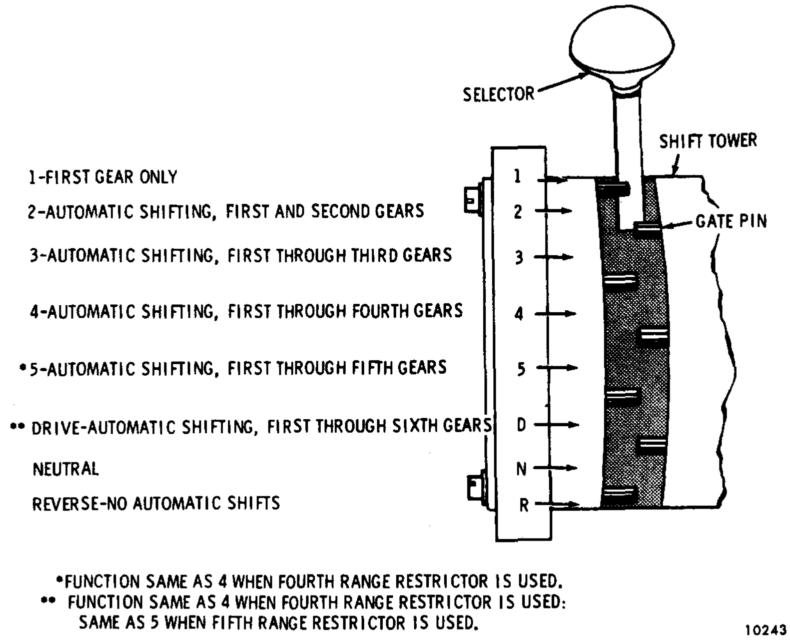

Fig. 5-2. Range selection shift tower

5-3. ELECTRICAL CONNECTIONS

a. Multipin and Individual Connections

(1) In addition to seven (eight, if restrictor harness is included) multipin connectors, there are nine individual leads coming from the cab wiring harness that connects the shift tower and shift pattern generator.

(2) These leads are colored (3 black, 2 red, 2 white, 1 blue and 1 green). These leads are connected as shown in figure 5-3 or 5-4.

(3) Other wiring varies, depending upon whether a negative- or positive-ground system is required.

b. Negative-ground System

(1) Figure 5-3 illustrates a negative-ground system for either a 12-volt vehicle electrical system (which requires the 12/24 volt converter), or a 24-volt vehicle electrical system (which requires the 24/24 volt overload protector).

(2) Note that (in negative-ground system) the wire from No. 1 terminal of the power supply unit connects to the positive pole of the vehicle electrical system. A normally-open engine-oil pressure switch, that closes at a pressure lower than the minimum oil pressure of the engine, is recommended in this line (refer to fig. 5-1).

(3) Note also that the wire from No. 2 terminal of the power supply unit connects to the vehicle battery negative (ground) pole. On later models, the jumper (terminals 2 to 4) is not required for the 24/24 volt overload protector.

c. Positive-ground System

(1) Figure 5-4 illustrates a positive-ground system for a 12-volt vehicle electrical system. Only the 12/24 converter may be used in a positive system (the 24/24 volt overload protector cannot be used in positive-ground systems).

(2) Note that (in positive-ground system) the wire from No. 1 terminal of the converter connects to the positive pole (ground)

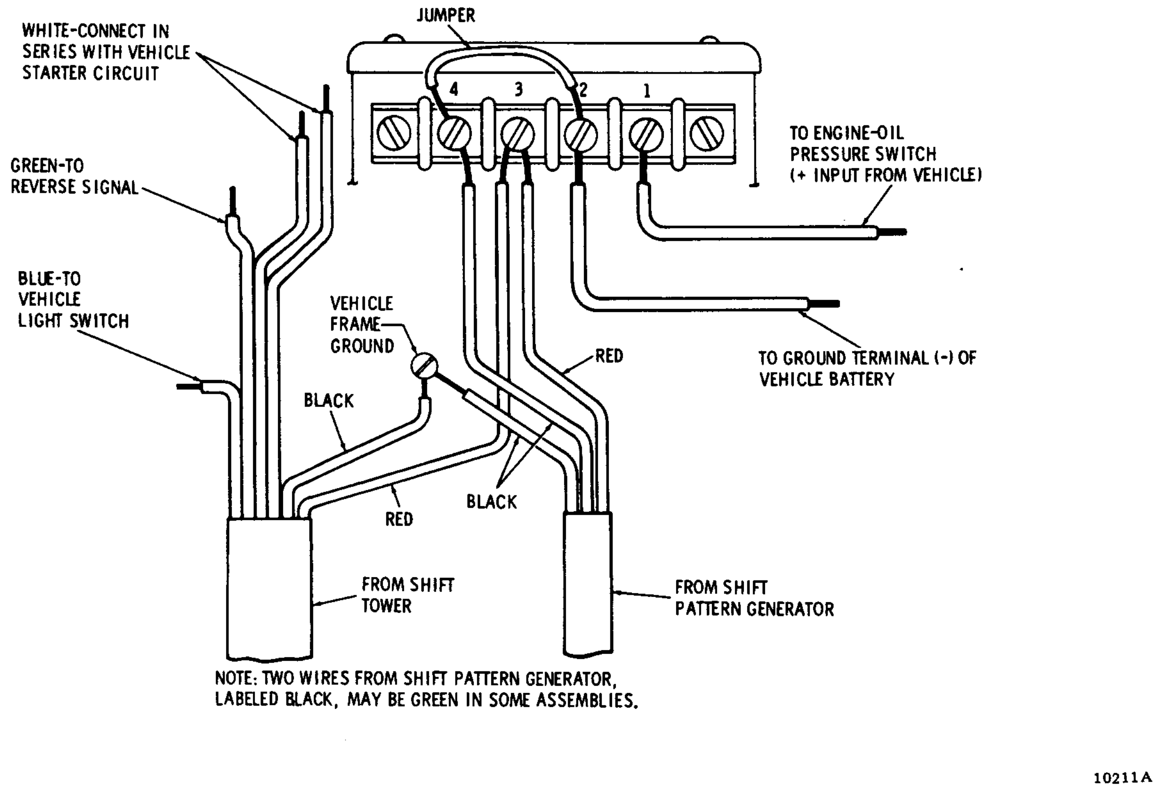

Fig. 5-3. Negative-ground system—connections for 12/24-volt converter, or 24/24-volt overload protector

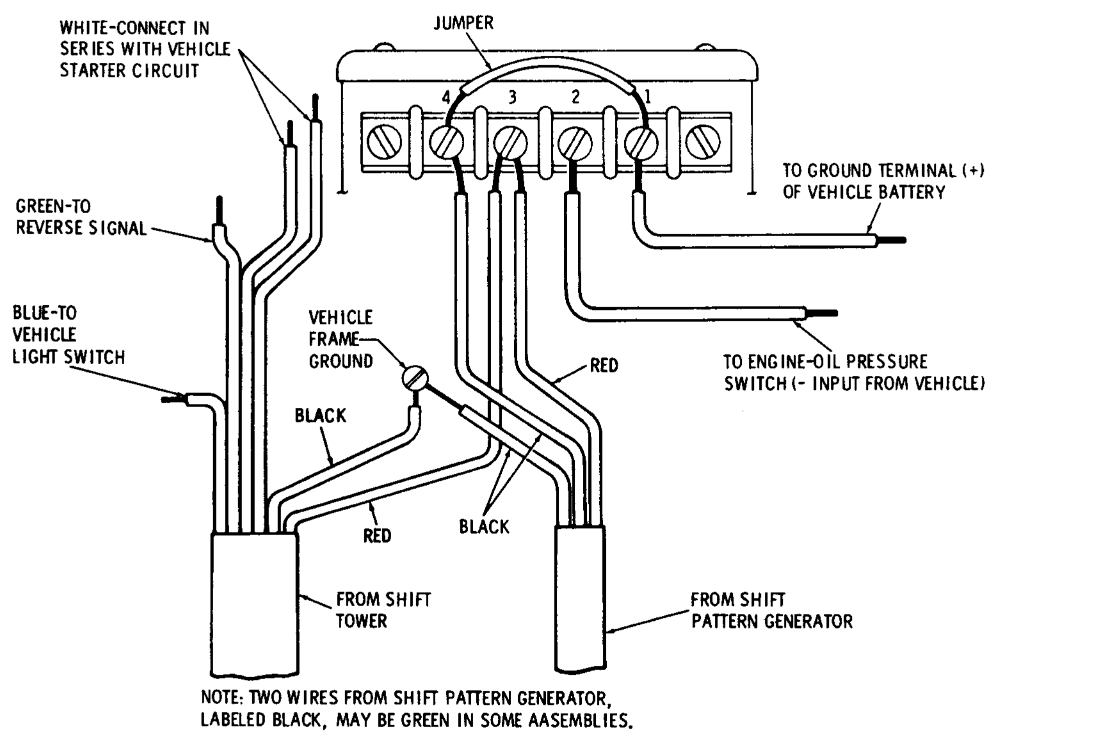

Fig. 5-4. Positive-ground system—connections for 12/24-volt converter

of the vehicle electrical system. A jumper from terminal No. 1 to terminal No. 4 must be installed.

(3) Note also that the wire from No. 2 terminal of the converter connects to the negative pole of the vehicle electrical system. It is recommended that this connection be made through an engine-oil pressure switch of the type described in b(2), above.

d. Fusing and Overload Protection

(1) An SFE 9A fuse is installed in the shift tower. This fuse protects the neutral start switch.

(2) The 12/24 volt converter unit is equipped with an SFE 7 1/2A fuse. This fuse protects the shift system from transient or steady high current from the vehicle system.

(3) The 24/24 volt overload protector is equipped with an electronic circuit breaker that opens when any transient or steady high current is sent to the shift system from the vehicle system. This circuit breaker is automatically reset by interruption of the electrical supply from the vehicle by stopping, then restarting the engine (if engine-oil pressure switch is included).

(4) Replace fuses with only fuses of the prescribed amperage.

Caution: Damage to system components can occur if circuits are overfused.

5-4. TESTS, CHECKS, ADJUSTMENTS

a. Field Test Kit. A field test kit is available for checking the shift tower, wiring harness and valve body solenoid circuits, and shift pattern generator. Complete operating and test instructions accompany each test kit.

Note: Manual-Electric Field Test Kit N 1948 can be purchased from Noel-Smyser Engineering Corp., 5230 West Tenth Street, Indianapolis, Indiana 46224.

b. Test Lamp Bank. If Test Kit N 1948 is not available, the test lamp bank described in paragraph 4-7c can be used for all tests except those required for the shift pattern generator.

c. Testing Automatic-Electric Shift Tower

(1) The wiring harness must be removed from the shift tower during testing.

(2) Refer to paragraph a for shift tower testing equipment.

(3) The test lamp bank shown in figure 4-1 is recommended for testing the shift tower. The test procedures are outlined in (4) through (15), below.

(4) Throw switch Y to AUT position. Throw switch X to OFF position. Connect a 12-volt battery to the lamp bank, observing the polarity shown in figure 4-1.

(5) Couple the lamp bank connector to the connector of the shift tower assembly. Tighten the connector as outlined in d(9).

(6) Check the SFE 9A fuse in the lamp bank, and the SFE 9A fuse in the shift tower. If either is blown, replace it. If the fuse in the lamp bank blows when replaced, there is a ground in the shift tower, that must be corrected before proceeding.

(7) Throw switch X (fig. 4-1) to ON position.

(8) Check the shift tower lamp. If it does not light, a failed bulb, defective socket, open circuit, or failed resistor (24-V vehicle system) is indicated.

(9) Check each position of the selector lever to determine if the selector switches are operating (making and breaking properly). This can be determined by noting the lamps that are lit in each selector position. The following chart shows the desired light pattern.

Selector Position	Lamps Lighted
R	A, J
N	C, N
D	H, I
5	G, I
4	F, I
3	E, I
2	D, I
1	C, I

(10) If the light pattern in the preceding table is obtained, the switches are functioning satisfactorily. If any other pattern is obtained, either the switch assembly is faulty, or the wiring is faulty or improperly connected to the switches.

(11) A further check, using the lamp bank, is necessary to determine if the switch assembly is angularly alined, with the selector lever. Any clockwise or counterclockwise mislocation of the switch assembly in relation to the selector lever shift positions will affect the sequence timing of the switches.

(12) To make this alignment check, place the tool on the selector lever (fig. 4-3). The tool holds the shift lever at the midpoint between two shift positions, but provides a tolerance of movement sufficient for complete switching transition from one shift position to the next. All changes in the light pattern should occur within the movement tolerance. The chart below indicates the light patterns at each test position.

	Lamps Lighted When Selector Lever is Pushed Toward	
Midpoint Test Position	Upshift Direction	Downshift Direction
1-2	D, I	C, I
2-3	E, I	D, I
3-4	F, I	E, I
4-5	G, I	F, I
5-DR	H, I	G, I
DR-N	C, N	H, I
N-R	A, J	C, N

If the light pattern shown above is not obtained (but a satisfactory pattern is obtained in (9), above), angular misalinement of the switch assembly is indicated.

(13) To check for the direction (CW or CCW) of misalinement of the switch assembly, place the selector lever at midpoint between N and DR. Install the alinement gage and push the selector lever toward N. If lamps H or I light, the switch assembly requires clockwise adjustment (as viewed from switch end of switch tower). If lamps C or N light, the switch assembly requires counterclockwise adjustment.

(14) Make any adjustment required for switch alinement by tapping the switch frame with a hardwood dowel and hammer at the points indicated in figure 4-4.

(15) If any fault is found in the shift tower that cannot be corrected by alinement, replacing the SFE 9A fuse, the resistor (in 24-V vehicle systems), or the shift tower lamp, the shift tower should be rebuilt (refer to para 5-6).

d. Improper Shifting or Shift Failure

(1) The most effective approach for checking and troubleshooting the automatic-electric system is to perform each check in the following sequence.

- Check vehicle battery and system input voltages.
- Inspect and clean all multipin connectors.
- Inspect, clean and retighten all branch conductor terminals.
- Check the shift tower.
- Check the cab and vehicle harnesses (and restrictor harness, if used).
- Check the throttle potentiometer.
- Check the magnetic pickup.
- Check the control valve assembly.
- Check the shift pattern generator.
- Check the hydraulic circuits.

The procedures for making these checks are outlined in (2) through (8), below.

(2) If the battery supplies sufficient energy to properly start the vehicle engine, it can be safely assumed that it is producing the minimum voltage required for operation of the control system. However, sufficient voltage may not be reaching the control components.

(3) Check the voltage at terminals 1 and 2 of the 12/24 volt converter or 24/24 volt overload protector while the vehicle engine is running (refer to fig. 5-3 or 5-4 for applicable system).

(4) Voltage at terminals 1 and 2 must be higher than 9 volts for a 12 volt vehicle system, and higher than 18 volts for a 24 volt vehicle system to assure operation of the valve body solenoids.

(5) Check the voltage at terminals 3 and 4 of either the 12/24 volt converter or 24/24 volt overload protector (fig. 5-3 or 5-4). The voltage for either must be 18 volts or higher to assure operation of the valve body solenoids.

(6) Inspect the three wires that come from the shift pattern generator end of the cab harness, and six that come from the shift tower end for breaks, fraying and other faults. Check and clean the terminals of these nine wires (fig. 5-3, 5-4). Be sure all connections are tight, including the jumper on the power supply unit.

(7) If tests prove the converter is faulty, replace it with a new component. The converter is not repairable in the field or by the manufacturer. The SFE 7 1/2A fuse is the only replaceable item. If tests prove that the 24/24 volt overload protector is faulty, replace it with a new component. The overload protector is not repairable in the field or by the manufacturer.

(8) Disconnect each multipin connector (there are 6: shift tower (1), shift pattern generator (2), throttle potentiometer (1), control valve assembly (1), and magnetic pickup (1), and inspect for corrosion or poor contact, clean and reconnect.

(9) Firm, complete connection of each connector is important. The pins must not be bent or otherwise damaged. Aline the index key and slot, and push the cable end of the connector firmly into its socket. Tighten the retaining nut as tight as possible, by hand. Then push again on the cable end while working it slightly from side to side. Retighten the nut. Continue pushing the cable end and tightening the nut until the connection is firm, and the nut will not tighten further.

e. Testing Wiring Harnesses

(1) The cab harness may be checked while it is connected to a properly operating shift tower.

Note: When making the check in (2), below, remove the restrictor harness (if used) and check it separately as outlined in (5) and (6), below. Conduct the cab wiring harness check through only the cab harness.

(2) Disconnect the harness from the shift pattern generator (19-pin connector). Leave all branches connected to the system. Check for continuity of circuit by touching ohmmeter probes to the pin sockets in the connector removed from the shift pattern generator, and shifting the selector lever. Check by the following table.

Selector Position	Continuity (0 ohms) Between Pin Sockets
R	A, F
N	E, M
DR	E, G and E, N
5	E, H and E, N
4	E, J and E, N
3	E, K and E, N
2	E, L and E, N
1	E, M and E, N
Any position (ground)	B, V

If any of these checks show an open circuit, replace the cab harness.

(3) If the checks in (2), above, are satisfactory, the remaining two conductors in the harness should be checked. Connect the ohmmeter between pin sockets C and D. When the vehicle throttle (engine not running) is

closed, the resistance should be 30 to 90 ohms. As the throttle is opened slowly and smoothly, the reading should increase smoothly, with no interruptions, to approximately 275 ohms at fully open throttle. If other values are obtained the potentiometer may require adjustment (refer to para 5-8). If a zero reading is obtained a short circuit in either the wiring harness or throttle potentiometer is indicated. If no circuit continuity (ohmmeter does not move) is obtained, a break in the wiring harness or potentiometer circuit is indicated.

(4) Check the potentiometer alone, after disconnecting the two-pin connector of the wiring harness. Check between pins A and B on the potentiometer in the same manner as pin sockets C and D were checked in (3) above. The prescribed readings should be obtained. If not, the potentiometer should be adjusted (para 5-8) if values differ from the 30 to 275 ohms prescribed. If there is a short circuit, open circuit, or a satisfactory adjustment cannot be obtained, replace the potentiometer element (para 5-8).

(5) Check the fourth range restrictor harness (if used) by checking continuity between its shift pattern generator end and its cab harness end. There should be continuity of circuits between the pin sockets at one end of the harness and the pins at the other having the same letter identification except sockets G, H, P, R, and S (do not have conductors), and socket J should have continuity to pins G, H and J.

(6) Check the fifth range restrictor harness by the method outlined for the fourth range harness ((5), above). All pin sockets should have continuity to pins having the same letters except for pin sockets G, T, U and V (which have no conductors). Also pin socket H should have continuity to both pins G and H.

(7) The vehicle wiring harness may be checked by disconnecting it from only the shift pattern generator. This will leave the control valve assembly and magnetic pickup in the circuit to permit continuity checks. The continuity checks, if satisfactory, will indicate that the wiring harness is satisfactory. If the checks are not satisfactory, further separate testing of the control valve assembly and magnetic pickup will be required to isolate the faulty component (harness, control valve or pickup).

(8) To make the checks, first connect an ohmmeter across pin sockets A and B. The resistance should be 50 to 200 ohms. A short circuit, open circuit or variation from the specified resistance indicates either a faulty harness or magnetic pickup. If the check is unsatisfactory, remove the 2-pin connector and check resistance at the magnetic pickup. A satisfactory reading at the pickup indicates the wiring harness is faulty.

(9) Next, check the resistance between pin socket T (ground) and each of the remaining, active pin sockets (E, F, G, H, J, K, and L). Each check should give a reading of 50 to 90 ohms, and will include the pertinent wiring harness conductors and a valve body solenoid. A short circuit, open circuit or variation from the specified resistance indicates either a faulty wiring harness or control valve circuit or solenoid.

(10) If the check is unsatisfactory, remove the 8-pin connector from the control valve assembly and check the resistance between the center pin and each of the other seven pins (A, B, C, D, E, F and G). A satisfactory reading (50 to 90 ohms) at each of these seven points indicates the valve assembly has no electrical faults but that the wiring harness is faulty.

f. Testing Throttle Potentiometer

(1) Position throttle lever 10 (A, foldout 4) at the full throttle position (approximately 35 degrees CCW from a vertical line through shaft to which lever attaches—viewed from lever end of assembly). Movement of lever 10 from closed throttle to full throttle position must correspond with that of the vehicle throttle control. Adjust the linkage if necessary.

(2) Connect an ohmmeter across connector pins A and B. Resistance should be 272 ohms.

(3) Slowly and smoothly swing the throttle lever clockwise through an arc of

approximately 70 degrees (to closed throttle position), while reading the ohmmeter. The reading should decrease smoothly, and without interruptions, to a value of 30 to 90 ohms at closed throttle position.

(4) If these readings are obtained, the throttle potentiometer is electrically satisfactory and correctly adjusted. If the readings are either high or low, the throttle lever may require adjustment (para 5-8). If the circuit is open, short circuited, or the reading is irregular or intermittent, potentiometer assembly 14 (A, foldout 4) must be replaced.

g. Testing Magnetic Pickup. Connect an ohmmeter across pins A and B (wiring harness removed). The reading should be 50 to 200 ohms. If the reading is not within this range, replace the magnetic pickup. (Refer to para 5-7 for adjustment.)

h. Testing Shift Pattern Generator

(1) A field test kit, such as the Noel-Smyser N 1948 Test Kit, is required for checking the shift pattern generator. However, if the test kit is not available, and if all of the previous tests were satisfactory, the only other way to check the suspected unit is to replace it with a new one. If the new shift pattern generator does not correct the problem, the trouble is most likely to be of a hydraulic or mechanical nature.

Note: When a new shift pattern generator is installed merely for troubleshooting, remove it (if original unit is not proved faulty) and reinstall the original. Do not return the new unit for service or adjustment on the supposition that it is faulty.

(2) If tests prove the shift pattern generator faulty, it should be replaced by a new unit. This component may be returned for factory rebuild. However, no warranty claim will be honored on this unit if the seal wire is broken.

5-5. WIRING HARNESSES

a. Removal

(1) Disconnect all branches (9 leads positive-ground, 7 leads negative-ground) of the cab harness from their screw-type terminals (refer to figure 5-3 or 5-4).

(2) Disconnect all multipin connectors which attach the harness to control components. Remove all vehicle components which prevent access to the harness or its mounting fasteners. Remove the fasteners, and remove the harness.

b. Installation

(1) Install wiring harness, and replace all supports and fasteners. Replace all components removed for access to the harness.

(2) Reconnect all branches of the cab harness (refer to figure 5-3 or 5-4). Connect and tighten each multipin connector (refer to para 5-4d(9) for method of tightening connectors).

5-6. SHIFT TOWER

a. Removal

(1) Remove the multipin connector from the bottom of the shift tower.

(2) Remove the four bolts that retain the shift tower to the vehicle. Remove the tower.

b. Rebuild

(1) Refer to B, foldout 4 for exploded view showing details of the shift tower assembly.

(2) In addition to being a simpler assembly, mechanically, than that used in the manual-electric control system (foldout 2), the electrical connections differ.

(3) Rebuild entails the steps in paragraph 4-9 which are applicable to the automatic-electric shift tower, and connecting the electrical components as shown in figure 5-5.

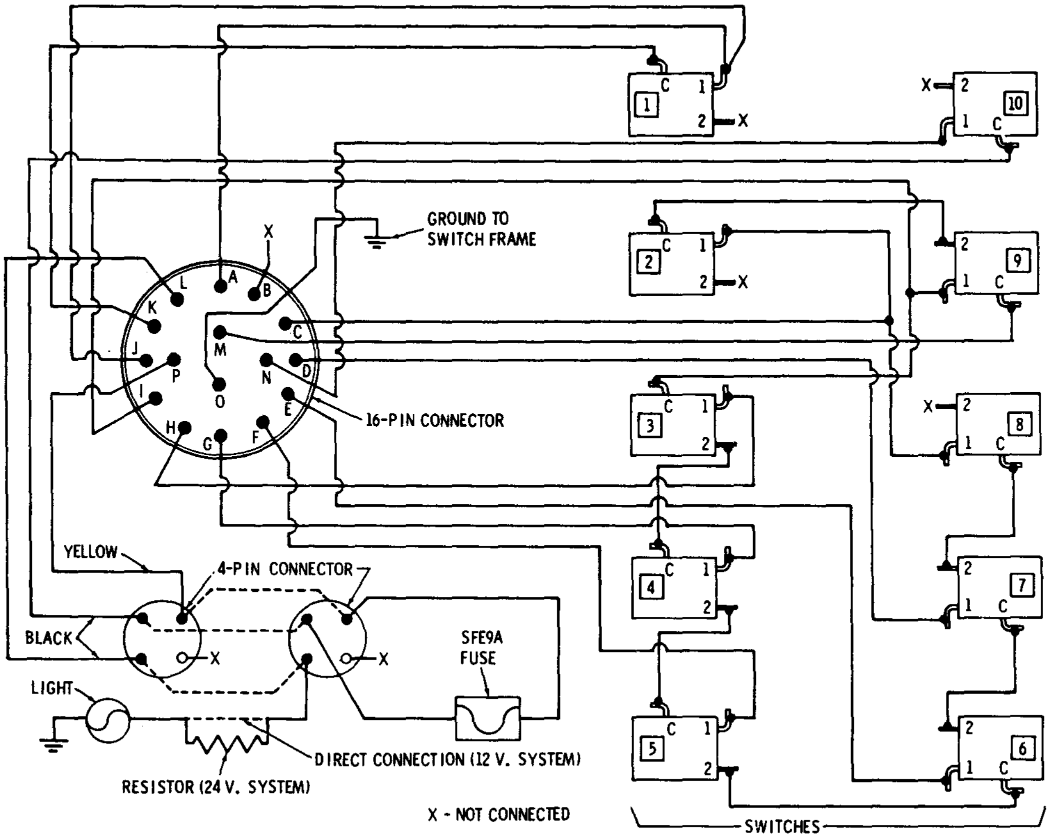

Fig. 5-5. Automatic-electric shift tower assembly internal wiring diagram

c. Installation. The shift tower may be installed by reconnecting the connector and installing the four bolts that retain the unit to the cab.

5-7. MAGNETIC PICKUP

a. Removal

(1) Remove the 2-pin wiring harness connector from the magnetic pickup.

(2) Loosen the locknut on the threaded body of the pickup, and rotate the pickup counterclockwise until it is free of the rear cover (or dropbox).

b. Installation, Adjustment

(1) Thread the locknut onto the magnetic pickup body far enough to prevent interference during subsequent installation.

(2) Thread the magnetic pickup body into the 5/8-18 tapped hole in the transmission rear cover until the end of the pickup contacts the tip of the gear tooth. Then, back out the pickup three-fourths of a turn, hold the pickup firmly, and tighten the locknut to 13 to 16 pound feet torque. Recheck to ensure that there is no interference between the gear teeth and pickup.

Caution: On dropbox models, the tooth spacing on the transfer gear will allow the pickup probe to bottom between the gear teeth. Therefore, be sure to aline the tip of a tooth with the probe during adjustment.

5-8. THROTTLE POTENTIOMETER

a. Removal

(1) Disconnect the throttle linkage from the potentiometer throttle lever.

(2) Disconnect the 2-pin wiring harness connector from the potentiometer assembly. Remove the potentiometer mounting bolts, and remove the potentiometer assembly.

b. Rebuild (A, foldout 4)

(1) Loosen clamp bolt 11.

(2) Remove four screws 17. Rotate seal 12 counterclockwise (viewed from lever end of assembly) until it is free of potentiometer assembly 14.

(3) Remove items 14 through 18 as a unit. This will free lever 10 and seal 12. Remove these two items.

(4) Remove four screws 18. Separate potentiometer assembly 14, gasket 15 and cover 16.

(5) Remove bearing 20 from housing 19 only if replacement is necessary.

(6) Remove and discard packing 13 from seal 12.

(7) Replace parts as required and reassemble as outlined in (8) through (13), below.

(8) Install bearing 20. Press it into housing 19 until flush with the bottom of the counterbore (at lever end of assembly).

(9) Assemble items 14, 15 and 16, and secure them with four screws 18. Tighten screws to 5 to 7 pound-inch torque. Contacts of potentiometer 14 must be toward top of cover 16.

(10) Install the potentiometer shaft into housing 19, placing seal 12 (with new packing 13 installed) and lever 10 on the shaft as it begins to emerge from the housing.

(11) Thread seal 12 onto the potentiometer threads, guiding the index tab of the potentiometer into a matching hole in housing 19.

(12) Tighten seal 12 to 20 to 24 pound-inches torque. Install four screws 17, and tighten them to 24 to 36 pound-inches torque.

(13) Center lever 10, on the shaft, in the available space between bearing 20 and seal 12.

c. Adjustment

(1) Position throttle lever 10 (A, foldout 4) at full throttle position (approx 35° CCW from vertical line through shaft—viewed from the slotted end of shaft).

(2) Connect an ohmmeter across connector pins A and B. The resistance should be 272 ohms. If adjustment is required, rotate the shaft of the potentiometer (slotted end) until the value is attained. Then tighten bolt 11 while maintaining the 35° position of the throttle lever.

(3) Move the lever to the closed throttle position (approx 70° from open throttle position). The resistance should be 30 to 90 ohms.

d. Installation

(1) Mount the potentiometer assembly, and retain it with three bolts. Connect the 2-pin wiring harness connector. (Refer to para 5-4d(9) for connecting procedure.)

(2) Connect and adjust the throttle linkage so that the throttle lever travels through a 70° (approx) arc when the vehicle throttle is moved from closed throttle to open throttle position.

5-9. CONTROL VALVE ASSEMBLY

Refer to paragraphs 4-12 and 4-13 for service of all control valve components.

5-10. FAIL-IN-RANGE OPERATING CHARACTERISTICS

a. Downshift Protection

(1) The fail-in-range protective circuitry in the shift pattern generator (SPG) is activated to prevent sudden downshifts when: the magnetic pickup fails; the wires to the pickup are broken or damaged; a valve body solenoid fails; or severe braking effort (panic stop) occurs.

(2) When the fail-in-range circuitry is activated, it turns off all power to the valve body solenoids. This causes the valves to hydraulically lock the transmission in the range in which it was operating at the time.

b. Reset Procedure

(1) Whenever the fail-in-range circuit has been activated, regardless of the reason, reset the circuit in the following manner.

- Turn off the electrical input power to the SPG, and shutdown the engine for approximately 5 to 10 seconds.
- Start the engine, and turn on the electrical power to the SPG.

Note: In some vehicles the input power to the SPG is dependent on the engine oil pressure switch (ref para 5-3). Other vehicles may provide the input power through the on-off vehicle lock switch.

(2) After resetting the circuit, select the desired operating range. Be sure the transmission is actually in the range selected before increasing the engine throttle.

c. Operation After Reset

(1) If the fail-in-range circuit was activated due to a failed magnetic pickup or the pickup wiring, the vehicle will operate only in first, neutral, and reverse.

(2) If the circuit was activated due to a failed valve body solenoid, the vehicle operation will be somewhat erratic depending on which solenoid failed.

(3) If the circuit was activated due to a panio stop, the reset procedure will return the vehicle to normal operation.

ELECTRIC CONTROL SYSTEMS

SUPPLEMENT

WARNING

The shift tower, cables, connectors, and internal connections used with these transmission control systems must not be altered or modified in any way unless written approval is obtained from:

Transmission Engineering
Detroit Diesel Allison Division
General Motors Corp,
P.O. Box 894
Indianapolis, Indiana 46206

TABLE OF CONTENTS

FOLDOUTS

Section 1. MANUAL-ELECTRIC CONTROL SYSTEM

1-1. GENERAL INFORMATION

Note: The rear unit transmission of scrapers having dual power units have a fail-to-neutral feature. Two solenoids are omitted from the rear unit transmission. Refer to para 2-9 for description.

a. Optional Components. A manual-electric control system is used on some series 5000 and 6000 series transmissions. The system includes an electrically-controlled valve body and a pressure switch on the transmission (fig. 1-1), a manual selector assembly in the vehicle cab (fig. 1-2), and a wiring harness 85 (B, foldout 1), connecting the selector and valve body. These components are available either as an option on current transmissions, or for installation on transmissions originally equipped with other control systems.

b. Solenoids Control Hydraulic Shifting. Seven solenoid (electromagnetic) valves control hydraulic circuits that shift the range control valves. Six forward speeds, neutral, and reverse are selected manually by the driver. The electrical circuit established by each position of the manual selector establishes a hydraulic circuit that provides drive in the forward gear selected, neutral, or reverse.

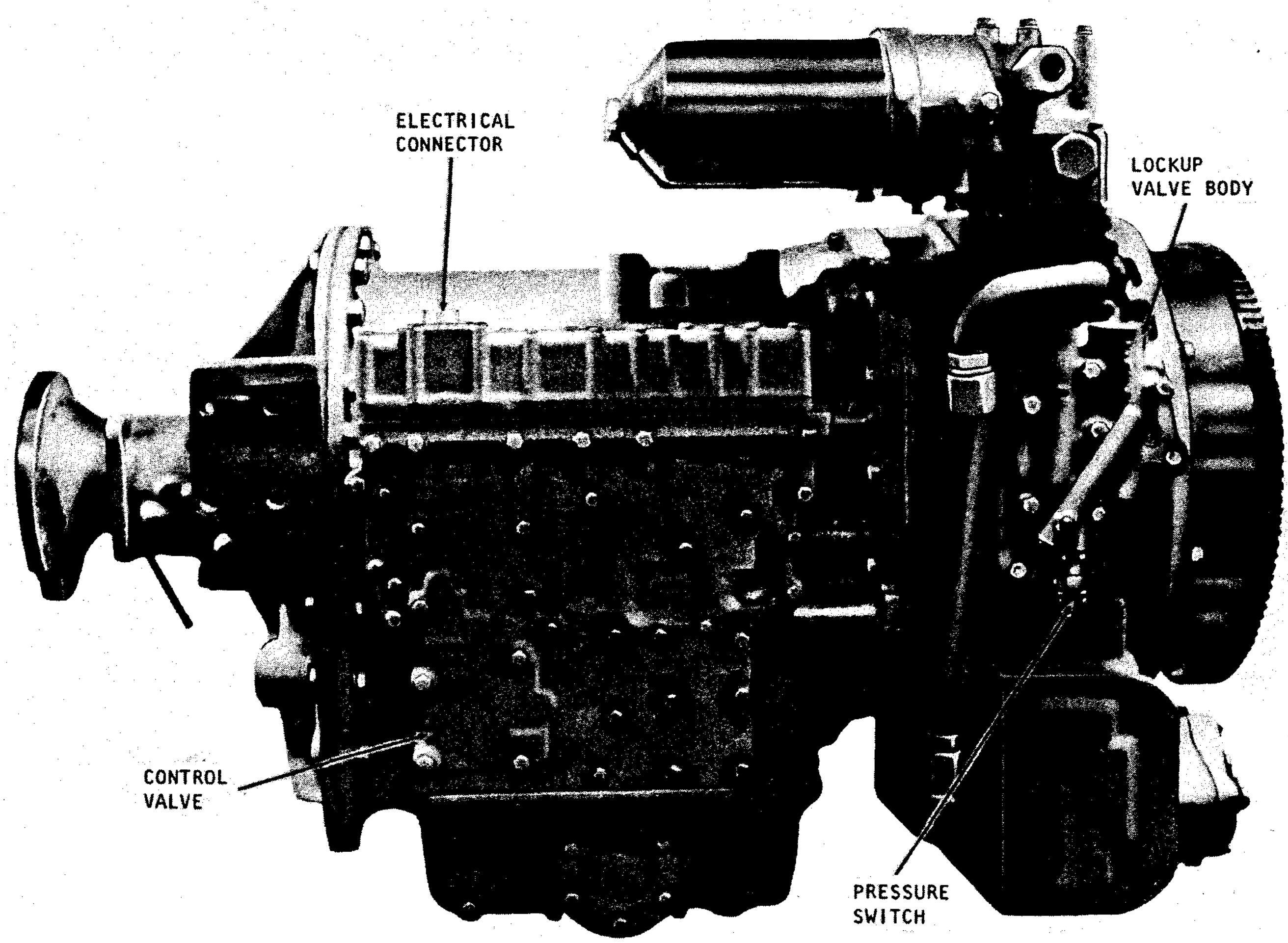

Fig. 1-1 Manual-electric valve body on 6000 series transmission

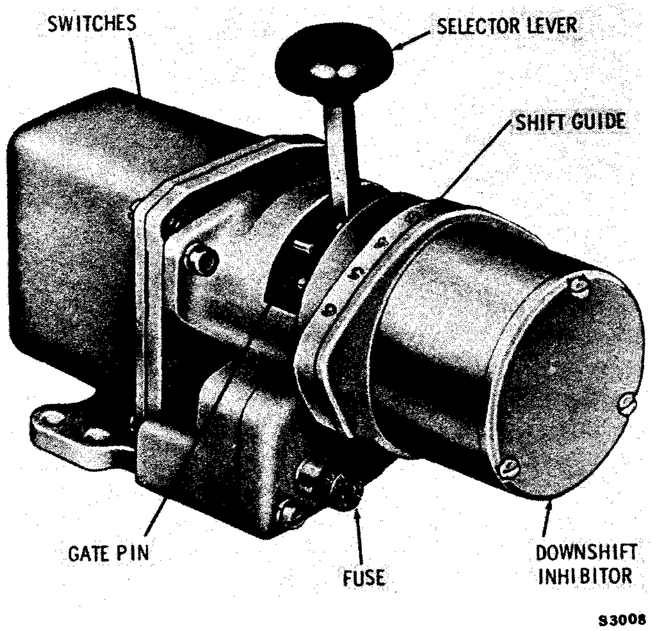

Fig. 1-2. Manual selector assembly

c. Power Source. Electrical power for actuation of the control system is supplied by the vehicle electrical system. Electrical components to match the vehicle system voltage (12 or 24 volts DC) are provided in the control system. An SFE 9A fuse is provided in the selector assembly (fig. 1-2). Earlier selector assemblies do not include a fuse, and the power input circuit must include a fuse.

d. Failure Protection. The system is so designed that if electrical power fails at one solenoid, or fails completely, the transmission will continue to operate in the forward gear in which it was operating at the time of the electrical failure. If total electrical failure occurs in neutral, the transmission will remain in neutral regardless of any gear selection thereafter. If total electrical failure, or failure of only the reverse solenoid occurs while operating in reverse gear, the transmission will go to neutral condition. However electrical failure of only the reverse shift valve solenoid will not prevent normal operation in forward gears. If any single forward shift valve or splitter shift valve fails electrically while energized, the vehicle will continue in operation in the same gear until the engine is stopped or the selector lever is moved. When the engine is stopped after an electrical failure, the "fail-in-range" protection is lost because the hydraulic "hold" pressure is lost. Hydraulic "hold" pressure cannot be regained by restarting the engine. Refer to paragraph 2-8 for information relating to specific solenoid failures.

e. Appearance. Transmissions equipped with the manual-electric control system can be recognized by the 8-pin electrical connector at the top of the control valve assembly, and the absence of mechanical shift linkage. Figure 1-1 illustrates the valve assembly on the transmission.

> Note: The electric control valve body previously supplied on certain CLBT 5860 models have a 6-pin electrical connector (refer to Publication SA 1170).

1-2. MODEL DESIGNATION

The model designation of transmissions equipped with the manual-electric control system is not different from those having other control systems.

> Note: If 4-speed transmissions should be converted to manual-electric control, they will become 6-speed transmissions. The original model designation will indicate they are 4-speed. When requesting parts or service information for any transmission field-converted to manual-electric control, the request must state that conversion has been made. In addition, the serial number, model and assembly number from the nameplate must be supplied.

1-3. SPECIFICATIONS, DATA

The table below lists specifications and data applicable to the manual-electric control system.