TECHNICAL MANUAL

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

RECOVERY VEHICLE, FULL TRACKED: MEDIUM, M88A1 NSN 2350-00-122-6826 WINCH, POWER TAKEOFF AND HOIST SYSTEM

This copy is a reprint which includes current pages from Changes 1 through 5.

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Direct Support and General Support
Maintenance Manual
For
RECOVERY VEHICLE,
FULL-TRACKED:
MEDIUM, M88A1
(NSN 2350-00-122-6826)

WINCH, POWER TAKEOFF AND HOIST SYSTEM

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For
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Direct Support and General Support

Maintenance Manual

RECOVERY VEHICLE, FULL TRACKED:

MEDIUM, M88A1 (NSN 2350-00-122-6826)

WINCH, POWER TAKEOFF AND HOIST SYSTEM

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WARNING

PRESSURE TESTS

COMPONENTS USED FOR CONDUCTING PRESSURE TESTS ON THE HYDRAULIC SYSTEM MUST BE CAPABLE OF WITHSTANDING A WORKING PRESSURE OF 1950-2050 PSI.

WARNING

MAIN WINCH MUST BE IN HIGH RANGE WHEN CONDUCTING TROUBLESHOOTING TESTS FOR FAULTY PILOT OPERATED RELIEF AND UNLOADING VALVE AS POSSIBLE CAUSE FOR SPADE OR BOOM NOT OPERATING.

OBSERVE THE WARNING NOTES THROUGHOUT THIS MANUAL.

TECHNICAL MANUAL

NO. 9-2350-256-34-2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, 16 February 1977

Direct Support and General Support Maintenance Manual For RECOVERY VEHICLE MEDIUM, M88A1 (NSN 2350-00-122-6826)

WINCH, POWER TAKEOFF AND HOIST SYSTEM

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2, located in the back of this manual, direct to: Commander, U.S. Army Tank-Automotive Command, ATTN: AMSTA-MBC, Warren, MI 48397-5000. A reply will be furnished to you.

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CHAPTER 1
INTRODUCTION

Section I. GENERAL

1-1. Scope

a. This technical manual contains instructions for direct support and general support maintenance of the winch, power takeoff, and hoist system of the Recovery Vehicle, Full Tracked: Medium, M88A1 (figs. 1-1 and 1-2). It contains descriptions and procedures for disassembly, inspection, and repair of hydraulic system components.

b. Manuals pertinent to the operation, maintenance and repair of the Recovery Vehicle, Full Tracked: Medium, M88A1, its component assemblies, parts and equipment, are listed in Appendix A.

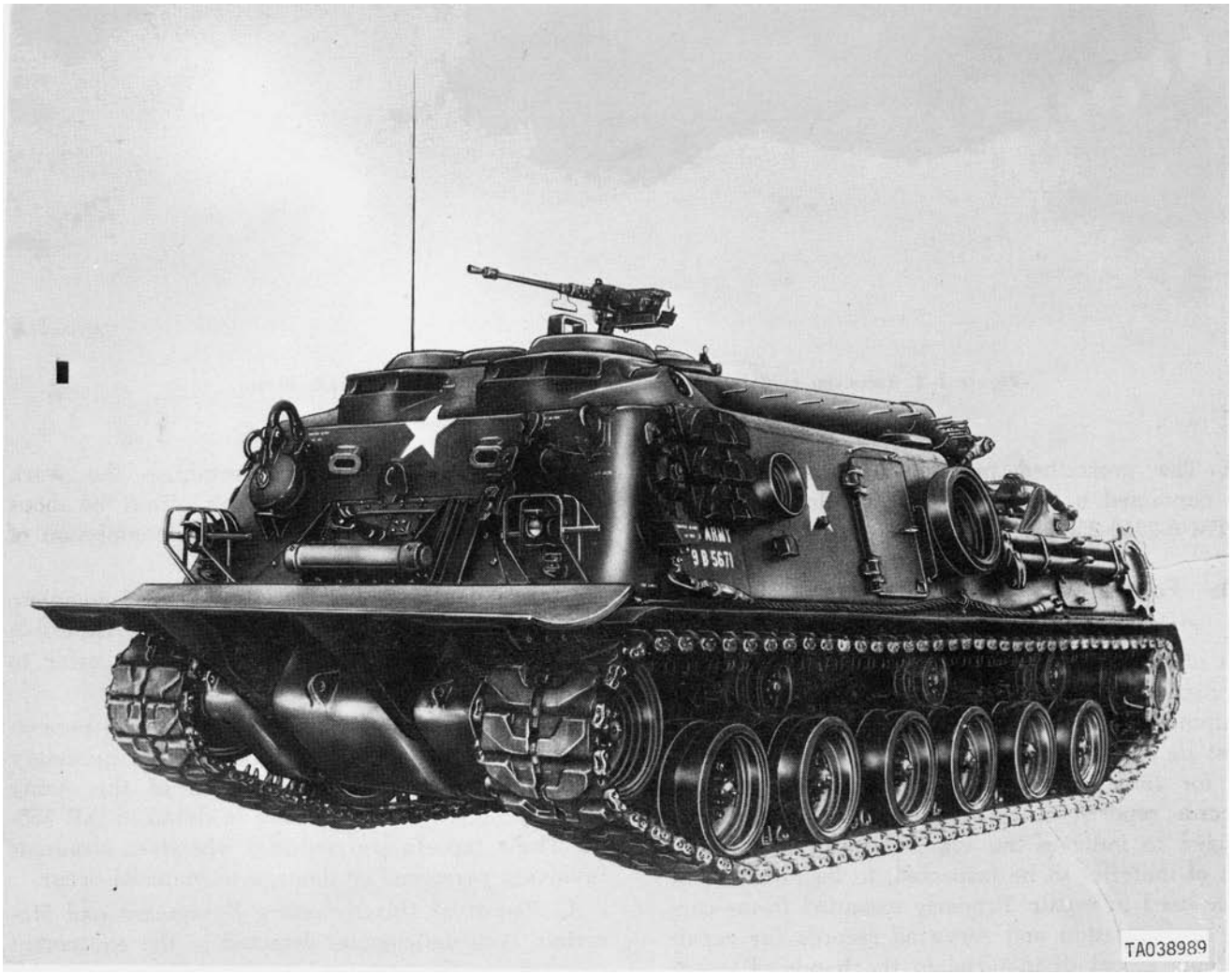


Figure 1-1. Recovery vehicle, full tracked: medium, M88A1—left front view.

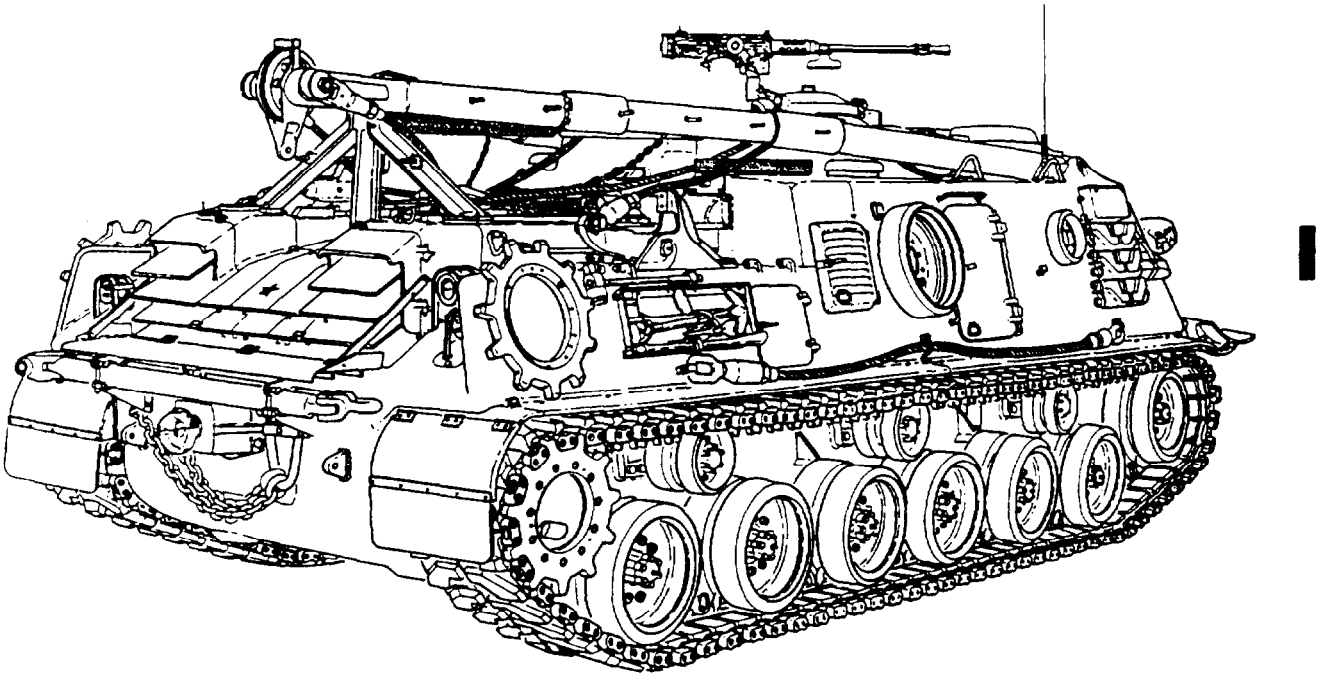


Figure 1-2. Recovery vehicle, full hacked: medium, M88A1-right rear view.

c. The prescribed maintenance responsibilities are contained in the maintenance allocation chart in TM 9-2350-256-20.

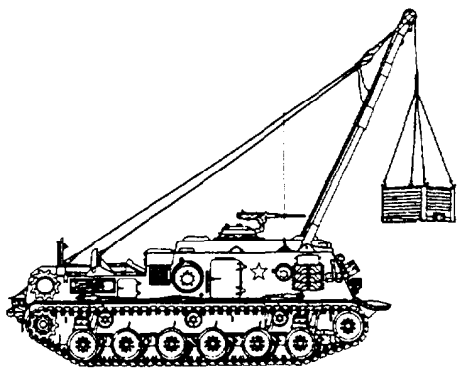
1-2. Forms, Records, and Reports

a. General. Responsibility for the proper execution of forms, records, and reports rests upon the commanding officer of all units maintaining this equipment. However, the value of accurate records must be fully appreciated by all persons responsible for their compilation, maintenance, and use. Records, reports, and authorized forms are normally utilized to indicate the type, quantity and condition of materiel to be inspected, to be repaired, or to be used in repair. Properly executed forms convey authorization and serve as records for repair or replacement of materiel in the hands of troops and for delivery of materiel requiring further repair to ordnance shops in arsenals, depots, etc. The forms, records, and reports establish the work required, the progress of the work within the shops and the status of the materiel upon completion of its repair.

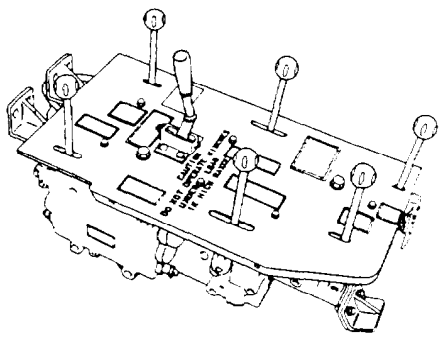
b. Authorized Forms. For current and complete listing of all forms, refer to current DA PAM 310-2. For instructions on use of these forms, refer to TM 38-750.

c. Field Report of Accidents (injury to personnel or damage to materiel). The reports necessary to comply with the requirements of the Army safety program are prescribed in detail in AR 385-40. These reports are required whenever accidents involving personnel or damage to materiel occur.

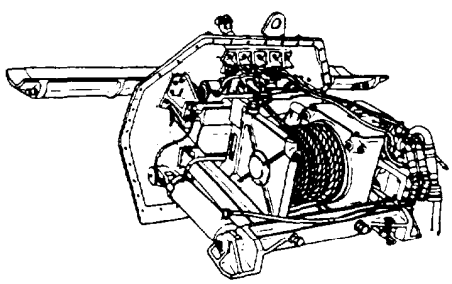
d. Report of Unsatisfactory Equipment and Materials. Any deficiencies detected in the equipment covered herein which occur under the circumstances indicated in TM 38-750 should be immediately reported using DA Form 2407.



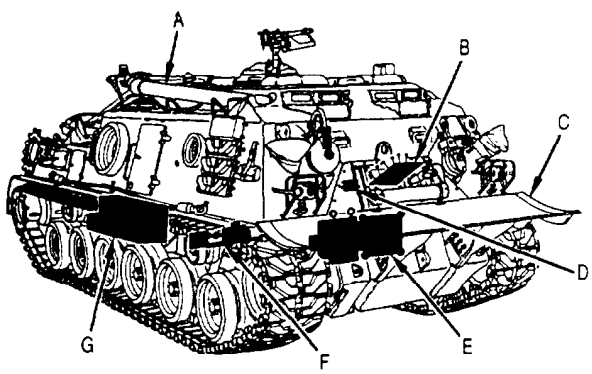
A. HOISTING BOOM ASSEMBLY.

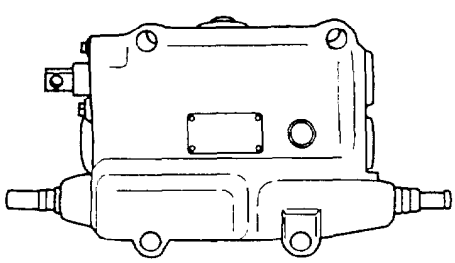


B. HYDRAULIC SUBPLATE ASSEMBLY.

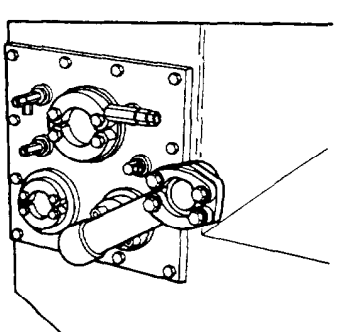


C. MAIN WINCH AND SPADE ASSEMBLY.

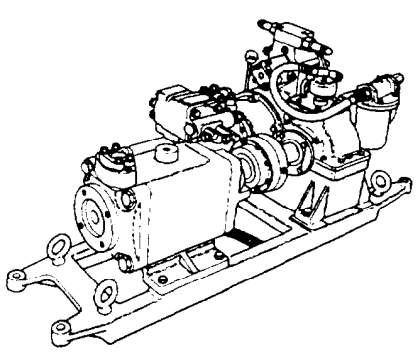




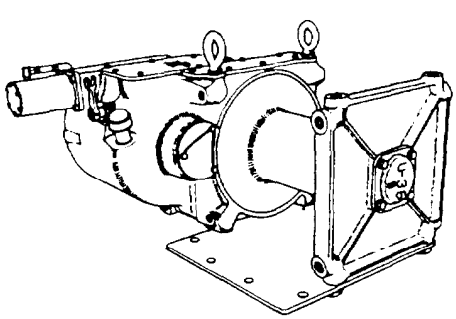
D. SPADE COMBINATION CONTROL VALVE.



G. HYDRAULIC OIL TANK.

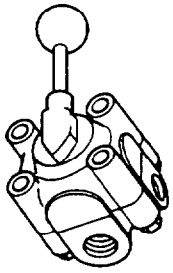


F. MECHANICAL TRANSMISSION AND MAIN HYDRAULIC PUMP ASSEMBLY.

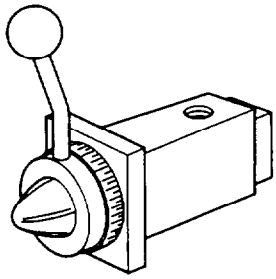


E. HOIST WINCH ASSEMBLY.

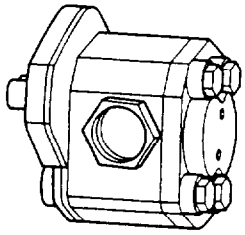
Figure 1-3. Winches, power takeoff and hoist system-visual index (Sheet 1 of 2).



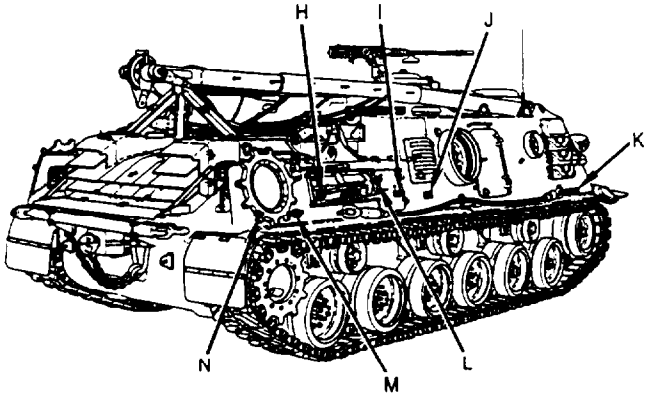
H. FOUR-WAY SELECTOR VALVE.

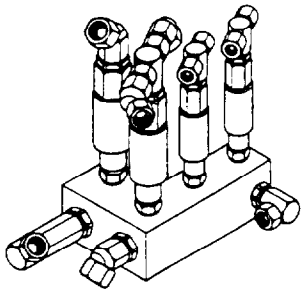


I. ADJUSTABLE FLOW REGULATOR.

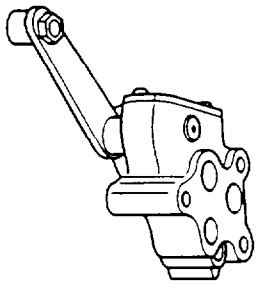


J. AUXILIARY HYDRAULIC PUMP.

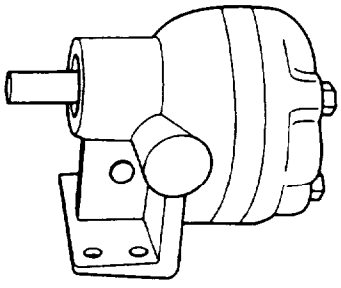




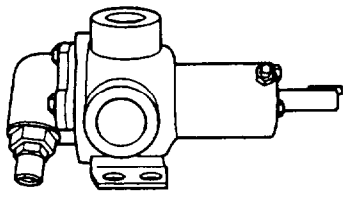
K. FLOW REGULATOR.



L. BOOM LIMIT VALVE.



N. REFUEL MOTOR.



M. REFUEL PUMP.

Figure 1-3. Winches, power takeoff, and hoist system--visual index (Sheet 2 of 2).

Section II. DESCRIPTION AND DATA

1-3. Description

a. General. The Recovery Vehicle, Full Tracked: Medium, M88A1 (figs. 1-1 and 1-2) is a medium armored, full track laying, low silhouette vehicle that performs hoisting, winching, and towing operations for tanks and other vehicles. The vehicle also supports medium and light tank units to effect battlefield recovery. Paragraphs 1-3b through 1-3g (5) cover the description and operation of the various hydraulic system components, and paragraphs 2-10 and 2-11 cover maintenance and operation of the basic circuits in the main and auxiliary hydraulic systems.

b. Main Winch and Spade Assembly.

(*1) Detailed description.*

(a) General. The main winch and spade assembly (figs. 1-4 and 1-5) is installed on the nosepiece of the vehicle with the winch located in the hull beneath the crew compartment, and the spade externally mounted on the front of the vehicle. The major components of the assembly are a spade; two spade-actuating cylinders; a winch cable; a cable level winder valve; a hydraulic motor; a brake cylinder; a main winch combination control value; and the main winch, which is equipped with an internal brake.

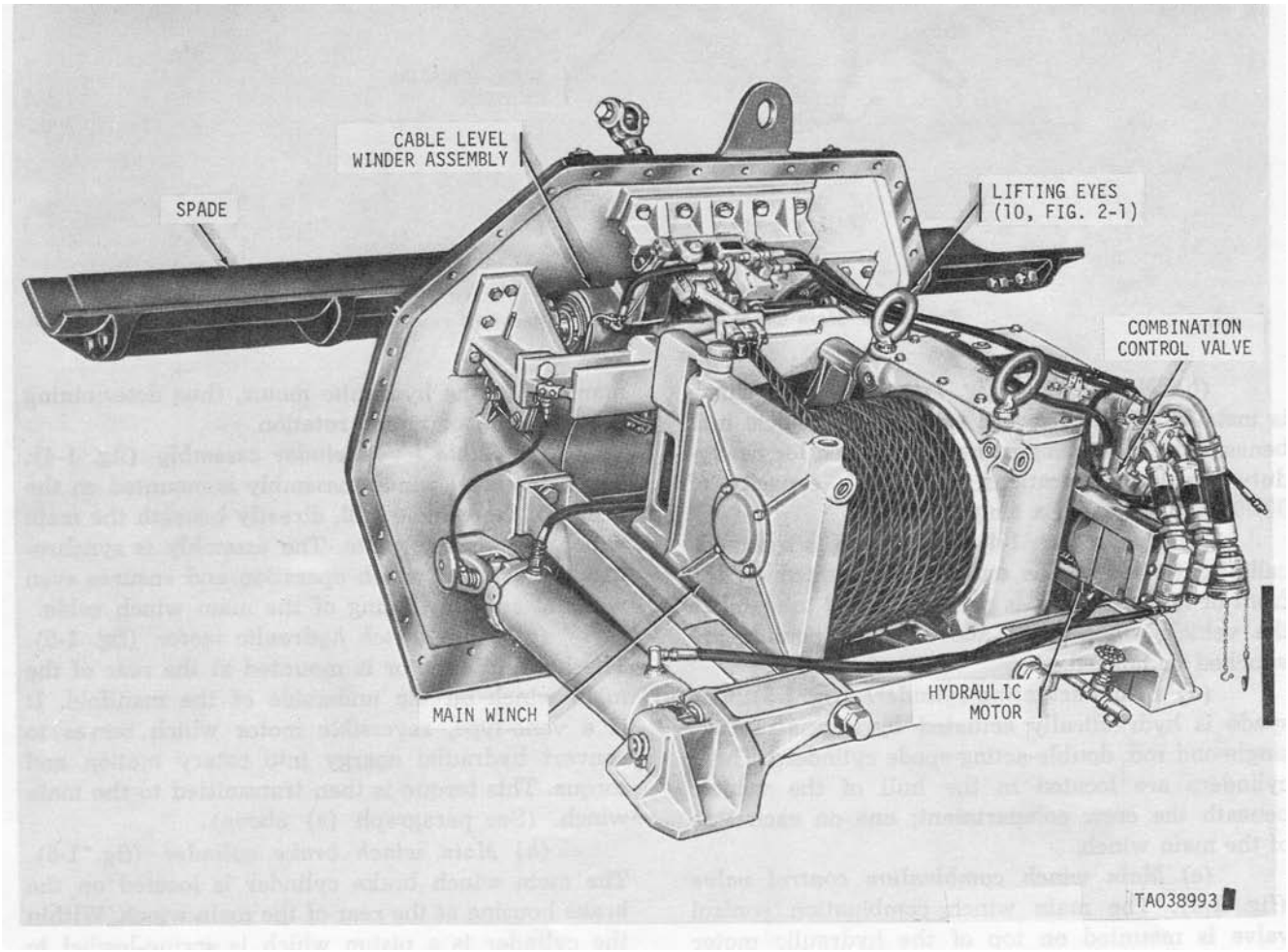


Figure 1-4. Main winch and spade assembly—left rear view.

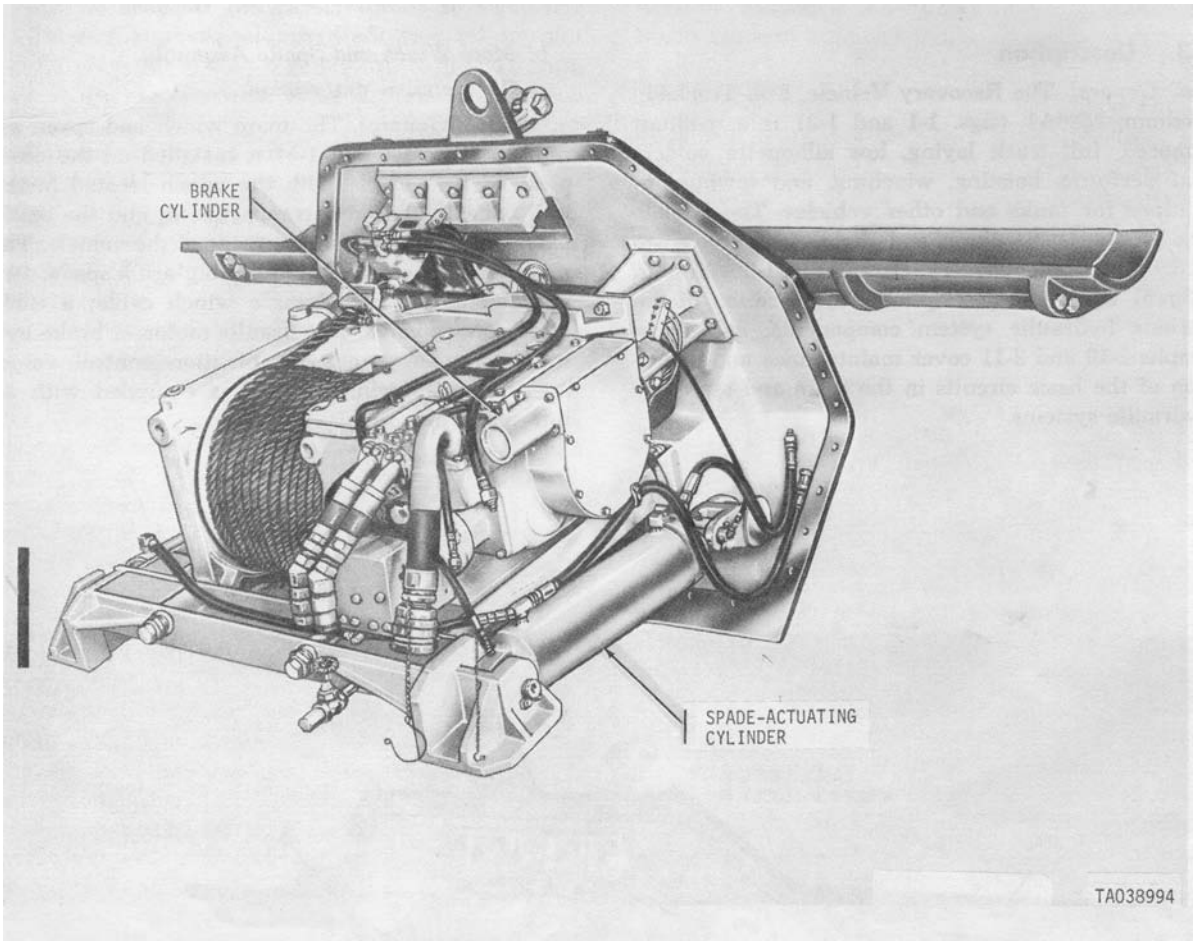


Figure 1-5. Main winch and spade assembly—right rear view.

(b) Main winch (fig. 1-4). The main winch is installed in the forward part of the vehicle hull beneath the crew compartment. It is used for heavy-duty winching operations, and has a capacity of 90, 000 pounds using a single line.

(*c) Spade* (fig. 1-4). The spade is hydraulically controlled and is externally mounted on the front of the vehicle. It is primarily used to stabilize the vehicle when loads above 12, 000 pounds are winched or hoisted.

(d) Spade-actuating cylinders (fig. 1-5). The spade is hydraulically actuated by means of two, single-end rod, double-acting spade cylinders. These cylinders are located in the hull of the vehicle beneath the crew compartment; one on each side of the main winch.

(e) Main winch combination control valve (fig. 1-4). The main winch combination control valve is mounted on top of the hydraulic motor manifold. It is a three-position, center-open valve, and serves to direct hydraulic flow through the -6 Change 1 manifold to the hydraulic motor, thus determining the direction of motor rotation.

(f) Cable level winder assembly (fig. 1-4). The cable level winder assembly is mounted on the inside of the vehicle hull, directly beneath the main winch cable guide plate. The assembly is synchronized with main winch operation and ensures even winding and unwinding of the main winch cable.

(g) Main winch hydraulic motor (fig. 1-5). The hydraulic motor is mounted at the rear of the main winch on the underside of the manifold. It is a vane-type, reversible motor which serves to convert hydraulic energy into rotary motion and torque. This torque is then transmitted to the main winch. (See paragraph (e) above).

(h) Main winch brake cylinder (fig. 1-5). The main winch brake cylinder is located on the brake housing at the rear of the main winch. Within the cylinder is a piston which is spring-loaded to the applied position. The piston exerts force on the brake drum to prevent cable drum movement in

the HOLD position. The piston is backed off and the brake released by introducing hydraulic pressure into the brake cylinder.

(*2) Operation.*

(a) Spade operation. The spade is actuated by two, single-end rod, double-acting hydraulic cylinders. These cylinders retract to raise the spade, and extend to lower it. When the spade control valve is placed in the RAISE position, hydraulic pressure is introduced in front of the cylinder pistons and bled off behind them. The piston rods then retract and actuate the crank arms to raise the spade. When the spade control valve is placed in the LOWER position, hydraulic pressure is introduced behind the pistons and bled off in front of them. The piston rods then extend and actuate the crank arms to lower the spade. Placing the spade control valve in the HOLD position traps all hydraulic fluid in the lines, thus preventing the spade from moving either up or down.

(b) Cable level winder assembly operation. The cable level winder assembly consists of a traversing cylinder; a stationary, double-end piston rod; a cable level winder valve, and mechanical linkage. As the cable is reeled in, it exerts a force on either the right or left side of a guide through which it passes. This force is transmitted to a lever which positions the cable level winder valve. The valve then directs hydraulic pressure to either the right or left side of the traversing cylinder, causing it to move and wind the cable evenly.

(c) Hydraulic motor operation. The hydraulic motor is a reversible, vane-type motor equipped with two identical inlet-outlet ports. Hydraulic pressure introduced at either of these inlet/outlet ports is forced through the vanes of the rotor, thus turning the rotor and the shaft which is splined to it. The direction in which the motor rotates (i.e., clockwise or counterclockwise) depends on which inlet/outlet port the hydraulic pressure was introduced, and is controlled by means of the main winch combination control valve mounted on top of the motor manifold.

(d) Winch gear train operation. When the main winch control valve is in the INHAUL position, the hydraulic motor rotates in the clockwise direction (fig. 1-6) and drives the winch bevel gear and pinion shaft, causing them to rotate clockwise also. (Gear direction of rotation is determined by viewing the winch from the brake assembly side). The pinion gear is splined to the pinion shaft and thus drives the shaft in the same direction. As the pinion shaft rotates, the geared end of the shaft engages the low speed gear and the pinion gear engages the high speed gear, both of which rotate freely around the brake shaft. Between the shaft is the gear clutch. The external teeth of the gear clutch are meshed with the internal teeth of the gear coupling. This coupling is positioned either left or right in order to couple the gear clutch with either the high or low speed gear, thus causing the break shaft to rotate in the counterclockwise direction. The splined end of the brake shaft drives the brake drum assembly while the geared end of the shaft meshes with and drives the countershaft gear which is spline-mounted to the countershaft, in the clockwise direction. Also splined to the countershaft is a pinion. The pinion engages the drum gear assembly, thus causing the cable drum to rotate in the counterclockwise or INHAUL direction. Placing the main winch control valve in the PAYOUT position causes the hydraulic motor to rotate in the counterclockwise direction. All gears then rotate in the opposite direction from that described above, and the cable drum rotates in the clockwise or PAYOUT direction.

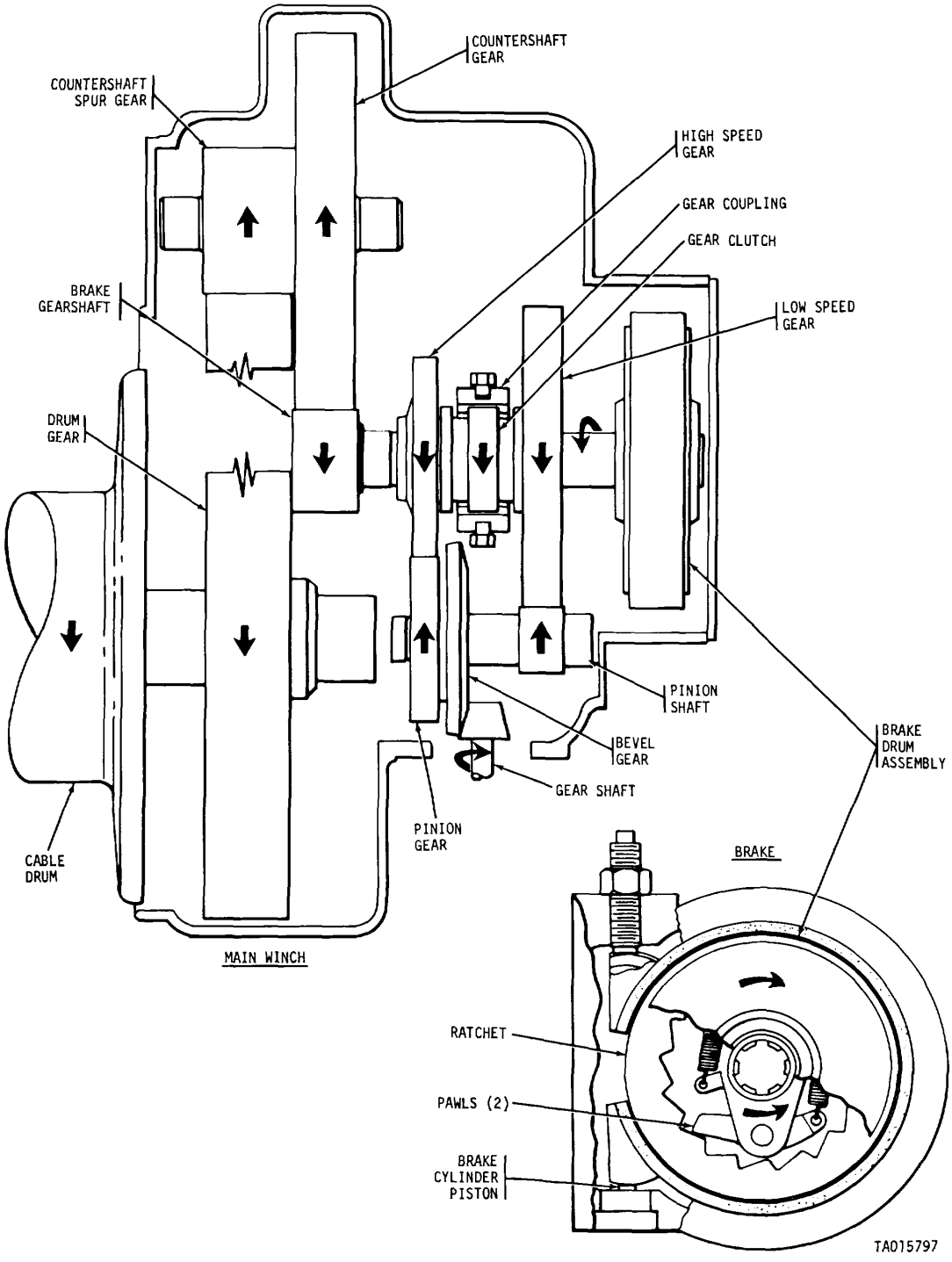


Figure 1-6. Main winch--cross-sectional view.

(e) Winch braking operation. The main winch brake (fig. 1-6) consists of a circular brake band which makes contact with the brake drum, and a ratchet and pawl assembly which allows the drum to rotate only in the clockwise direction. The brake band is held in its normally applied position by a spring-loaded piston in the brake cylinder. The brake is released by introducing hydraulic fluid into the brake cylinder to overcome the spring force. When the cabel is inhauled the brake band is in its normally applied position, and the brake drum, which is not secured to the brake shaft, is held stationary. The two pawls, which are secured directly to the brake shaft, rotate freely in the counterclockwise direction, thus enabling the cable drum to rotate in the counterclockwise or INHAUL direction. When the main winch control valve is placed in the HOLD position, hydraulic motor power is balanced, cable drum rotation ceases, and the brake band remains in its normally applied position. Any weight on the cable is prevented from slipping by the pawls which engage the ratchet teeth on the inside diameter of the drum and prevent cable drum movement. The cable is PAID OUT by introducing hydraulic pressure into the brake cylinder to counteract the piston spring pressure and release the brake band. The entire brake drum assembly is then free to rotate in the clockwise or PAYOUT direction, even though the pawls within the brake drum remain engaged with the ratchet teeth.

c. Hoist Winch Assembly.

(*1) Detailed description.*

(a) General. The hoist winch assembly (figs. 1-7 and 1-8) is installed in the hull of the vehicle beneath the crew compartment. It is used for lifting objects and for guiding and hauling the main winch cable. Major components of the assembly are a winch cable, hoist winch combination control valve, counterbalance valve, reversible hydraulic motor, brake cylinder and winch assembly complete with an internal brake.

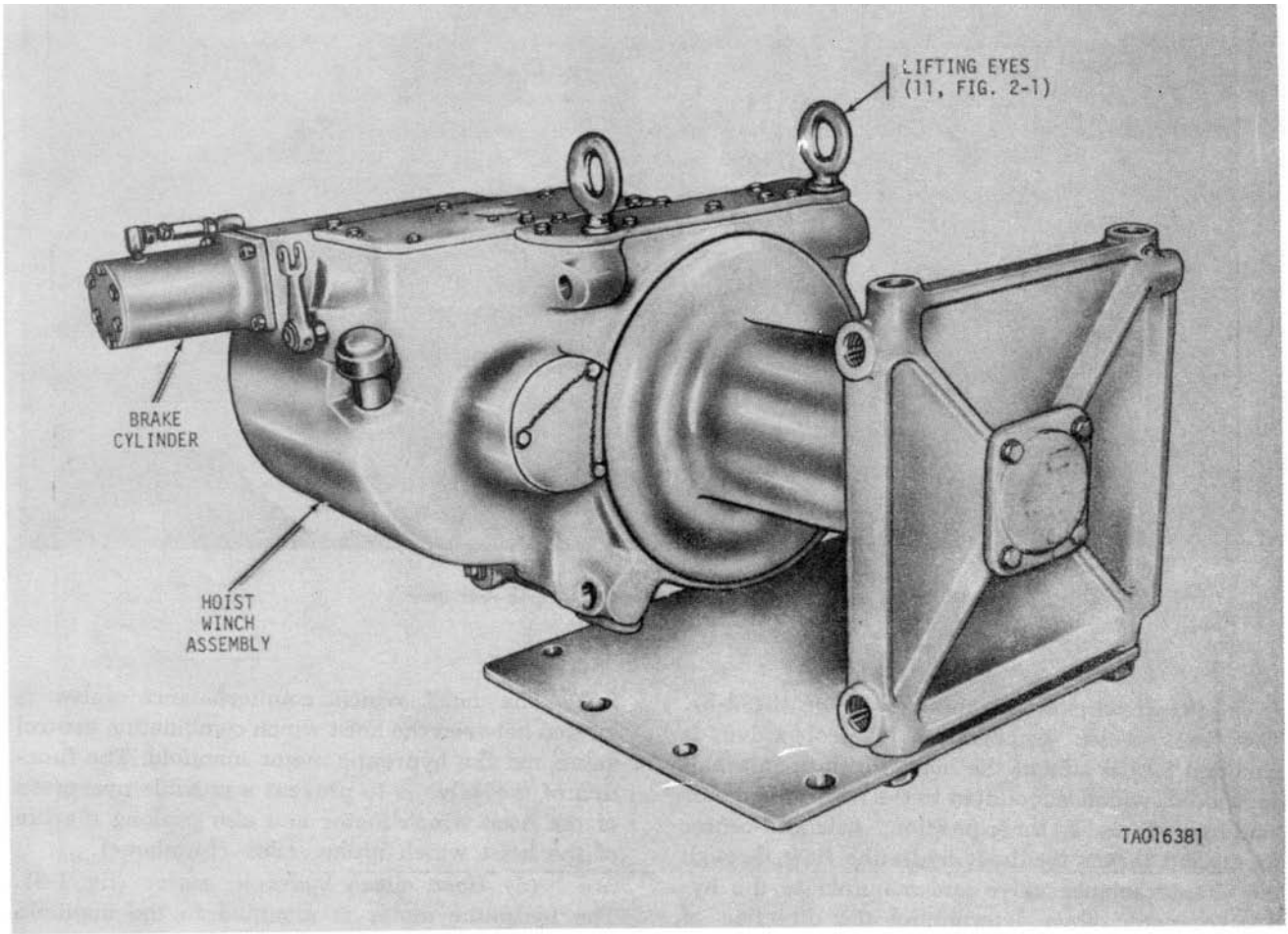


Figure 1-7. Hoist winch assembly-left front view.

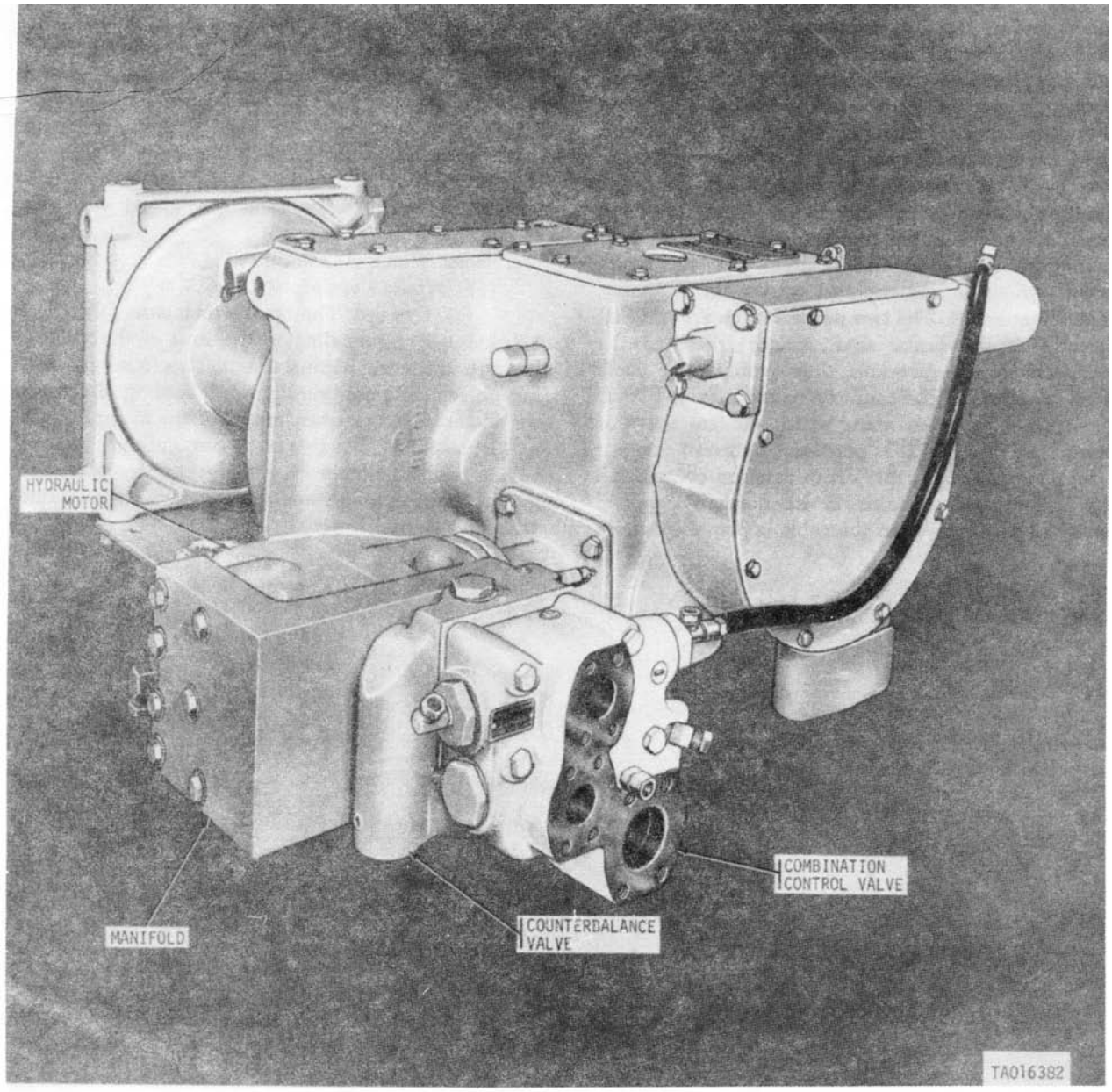


Figure 1-8. Hoist winch assembly--right rear view.

(b) Hoist winch combination valve (fig. 1-8). The hoist winch combination control valve is mounted on the side of the hoist winch counterbalance valve, which is mounted to the hydraulic motor manifold. It is a three-position, balanced-center valve, and serves to direct hydraulic flow through the counterbalance valve and manifold to the hydraulic motor, thus determining the direction of motor rotation.

(c) Hoist winch counterbalance valve (fig. 1-8). The hoist winch counterbalance valve is located between the hoist winch combination control valve and the hydraulic motor manifold. The function of the valve is to prevent a possible overspeed of the hoist winch motor and also prolong the life of the hoist winch brake. (See (b) above).

(d) Hoist winch hydraulic motor (fig. 1-8). The hydraulic motor is mounted to the manifold at the rear of the hoist winch. It is a vane-type, reversible motor which serves to convert hydraulic

energy into rotary motion and torque. This torque is then transmitted to the hoist winch. (See (b) above).

(e) Hoist winch brake cylinder (fig. 1-7). The hoist winch brake cylinder is located on the brake housing at the front of the hoist winch. Within the cylinder is a piston which is springloaded to the applied position. The piston exerts force on the brake drum to prevent drum movement in the HOLD position. The piston is backed off, and the brake released, by introducing hydraulic pressure into the brake cylinder.

(*2) Operation.*

(a) Hoist winch hydraulic motor operation. Hoist winch hydraulic motor operation is the same as main winch hydraulic motor operation. Refer to paragraph 1-3b.

(*b) Winch gear train operation.* When the hoist winch control valve is in the RAISE position, the hydraulic motor rotates in the counterclockwise direction (fig. 1-9) and drives the winch bevel gear and pinion gear, causing them to rotate counterclockwise. (Gear direction of rotation is determined by viewing the hoist winch from the brake assembly side). The pinion gear is splined to the pinion shaft and thus drives the shaft in the same direction. As the pinion shaft rotates, the geared end of the shaft engages the low speed gear and the pinion gear engages the high speed gear, both of which rotate freely around the brake shaft. Between the high and low speed gears, and splined to the brake shaft, is the gear clutch. The external teeth of the gear clutch are meshed with the internal teeth of the gear coupling. This coupling*i*s positioned either left or right in order to couple the gear clutch with either the high or low speed gear, thus causing the brake shaft to rotate in the clockwise direction. The splined end of the brake shaft drives the brake drum assembly, while the geared end of the shaft meshes with and drives *t*he drum gear in a *counterclockwise direction.* The drum gear then rotates the cable drum in a counterclockwise direction to raise the winch cable. Placing the hoist winch control valve in the LOWER position causes the hydraulic motor to rotate in a clockwise direction. All gears then rotate in the opposite direction from that described above and the cable drum rotates clockwise to lower the winch cable.

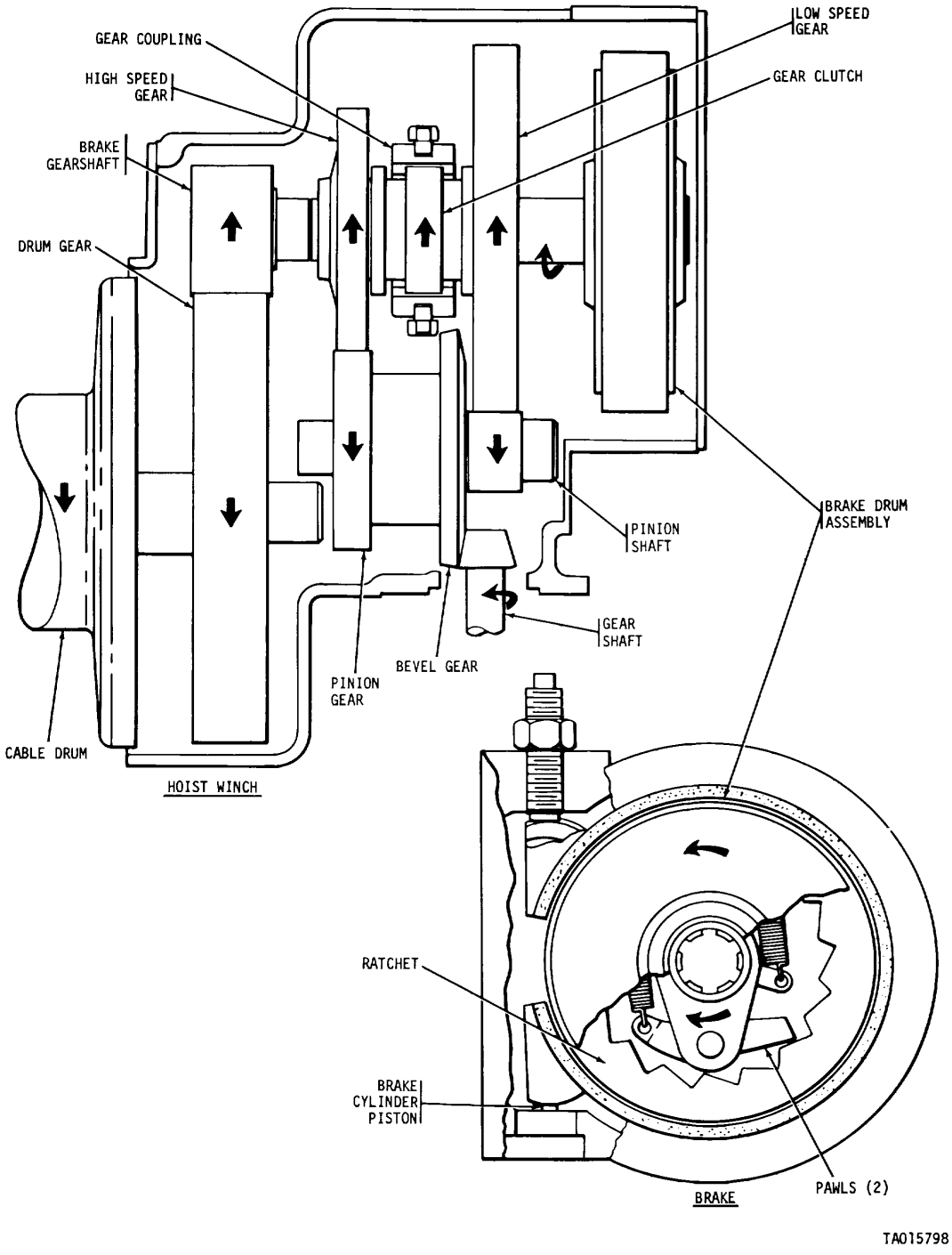


Figure 1-9. Hoist winch assembly—cross sectional view.

(c) Braking operation. The hoist winch brake (fig. 1-9) consists of a circular brake band which makes contact with the brake drum, and a ratchet and pawl assembly which allows the drum to rotate only in the counterclockwise direction. The brake band is held in its normally applied position by a spring-loaded piston in the brake cylinder. The brake is released by introducing hydraulic fluid into the brake cylinder to overcome the spring force. When the cable is raised (fig. 1-9), the brake band is in its normal applied position and the brake drum, which is not secured to the brake shaft, is held stationary. The two pawls, which are secured directly to the brake shaft, rotate freely in a clockwise direction, thus enabling the cable drum to reel in and raise the cable. When the control valve is in the HOLD position, hydraulic motor power is cut off, cable drum rotation ceases, and the brake band remains in its normal applied position. Any weight on the cable is held suspended by the pawls which engage the ratchet teeth on the inside diameter of the brake drum and prevent cable drum movement. The cable is lowered by introducing hydraulic pressure into the brake cylinder to counteract the piston spring pressure and release the brake band. The entire brake drum assembly is then free to rotate in a counterclockwise direction even though the pawls within the brake drum remain engaged with the ratchet teeth.

d. Mechanical Transmission and Main Hydraulic Pump Assembly.

(1) Detailed description. The mechanical transmission and main hydraulic pump assembly (Figs. 1-10 and 1-11) provide hydraulic pressure for powering the winches, hoisting boom and spade. It is mounted in the rear of the winch compartment,

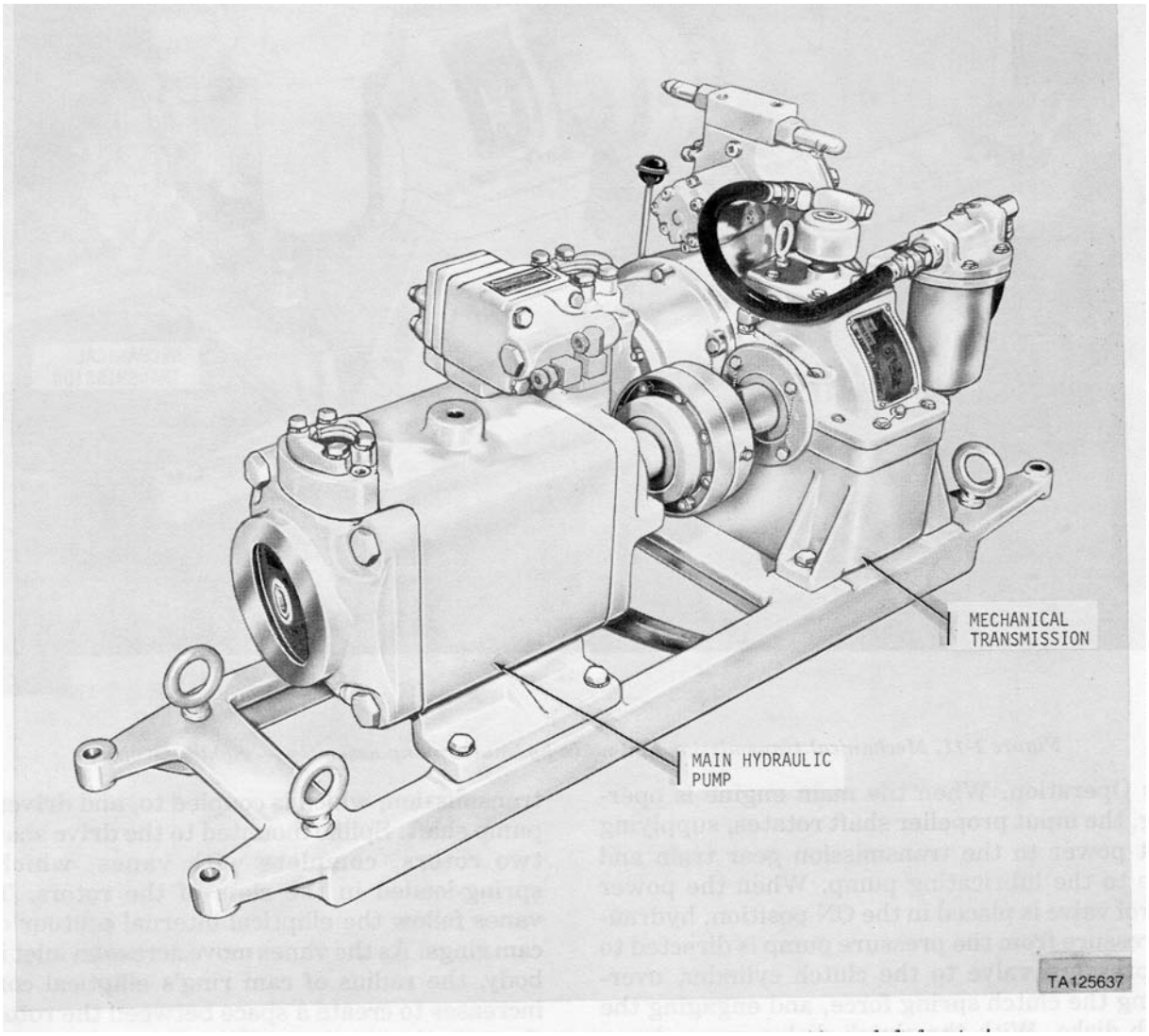


Figure 1-10. Mechanical transmission and main hydraulic pump assembly - left front view.

under the crew compartment. The main engine drives the mechanical transmission in one direction of rotation only, through a propeller shaft and universal joints. The transmission has a single-speed reduction and consists of herringbone tooth gears, a lubrication and pressure pump, a high and low pressure valve and a hydraulically operated disk clutch. The transmission housing provides a reservoir for the oil which is used for lubrication and actuation of the disk clutch. The output shaft of the transmission is coupled to the input shaft of the vane-type, fixed-displacement, hydraulic pump. Mounted on top of the pump is a relief and unloading valve, which consists of spring-loaded valves opposed by hydraulic pressure.

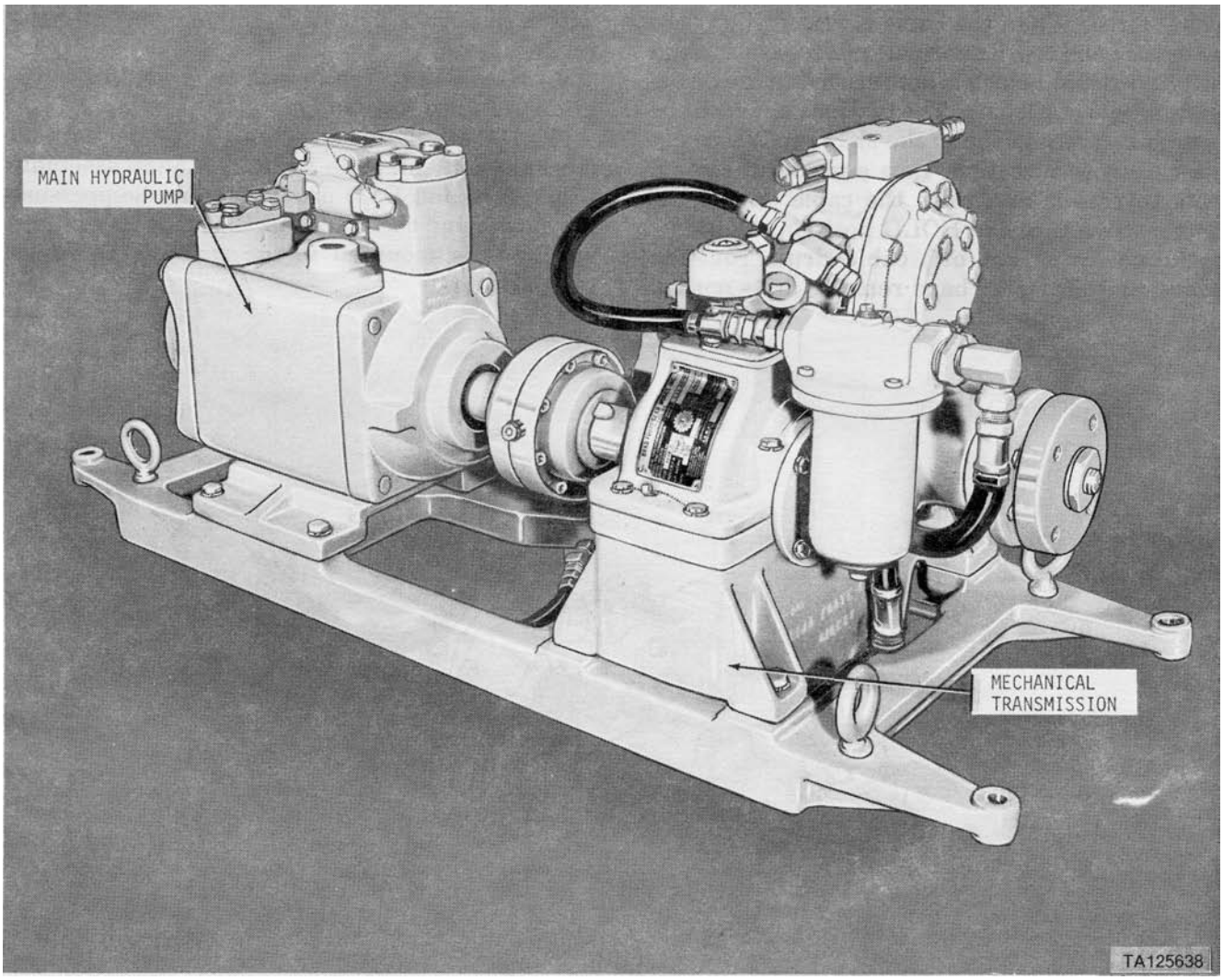


Figure 1-11. Mechanical transmission and main hydraulic pump assembly—right rear view.

(2) Operation. When the main engine is operating, the input propeller shaft rotates, supplying input power to the transmission gear train and drive to the lubricating pump. When the power control valve is placed in the ON position, hydraulic pressure from the pressure pump is directed to the pressure valve to the clutch cylinder, overcoming the clutch spring force, and engaging the clutch disks. With the clutch disks engaged, rotational force is supplied to the output shaft of the transmission, which is coupled to, and drives, the pump shaft. Spline mounted to the drive shaft are two rotors, complete with vanes, which are spring-loaded in the slots of the rotors. These vanes follow the elliptical internal contour of the cam rings. As the vanes move across an inlet in the body, the radius of cam ring's elliptical contour increases to create a space between the rotor and the cam ring contour. Fluid flows into this space and is

trapped between adjacent vanes as they move past the inlet chamber. The fluid is then carried along a path of constant radius to the outlet chamber in the pressure plate. At this point, the radius of the cam ring's elliptical contour decreases, forcing the fluid into the outlet chambers through pressure plate ports and through the outlet ports. Pump output high pressure is directed to the winches and cylinders to operate them.

e. Hoisting Boom Assembly.

(1) Detailed description. The hoisting boom assembly (fig. 1-12) consists of a tubular steel A-frame, two boom-actuating cylinders, and two stayline cylinders. The A-frame, or boom (fig. 1-13), is installed on top of the vehicle hull and is raised or lowered by means of controls within the crew compartment. The boom-actuating cylinders (fig. 1-13) are located within the vehicle on either side of the crew compartment. They are single-end rod, double-acting, hydraulic cylinders which extend to raise the boom and retract to lower it. The two stayline cylinders (fig. 1-13) are identical to the boom cylinders and are located at the rear of the vehicle. They work in unison with the boom cylinders to provide four feet of back-and-forth boom travel in the raised position.

(2) Operation.

(a) Raising the boom. With the power control valve ON, the boom combination control valve in the FORWARD position, and the boom safety

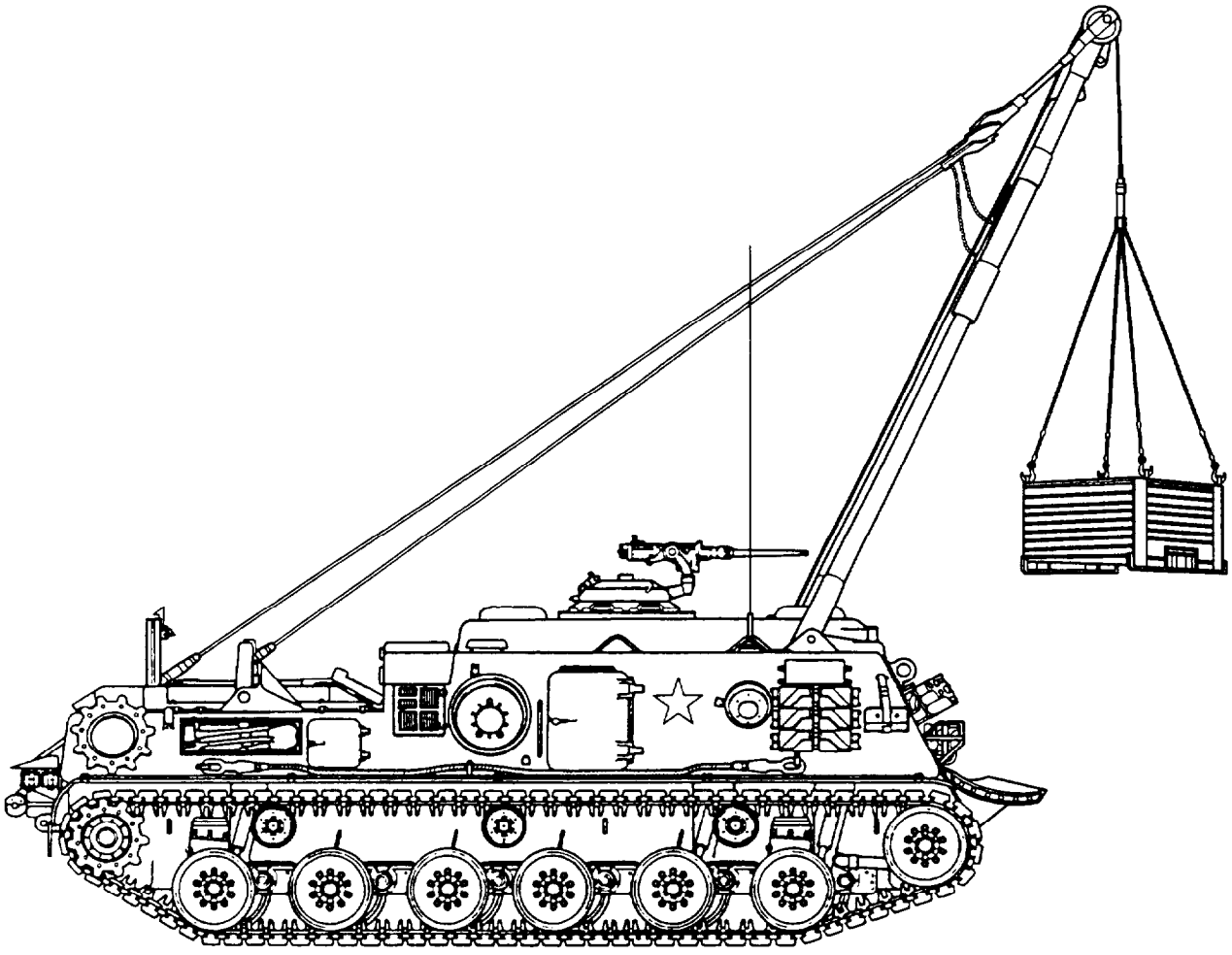


Figure 1-12. Hoisting boom assembly-tight side view.

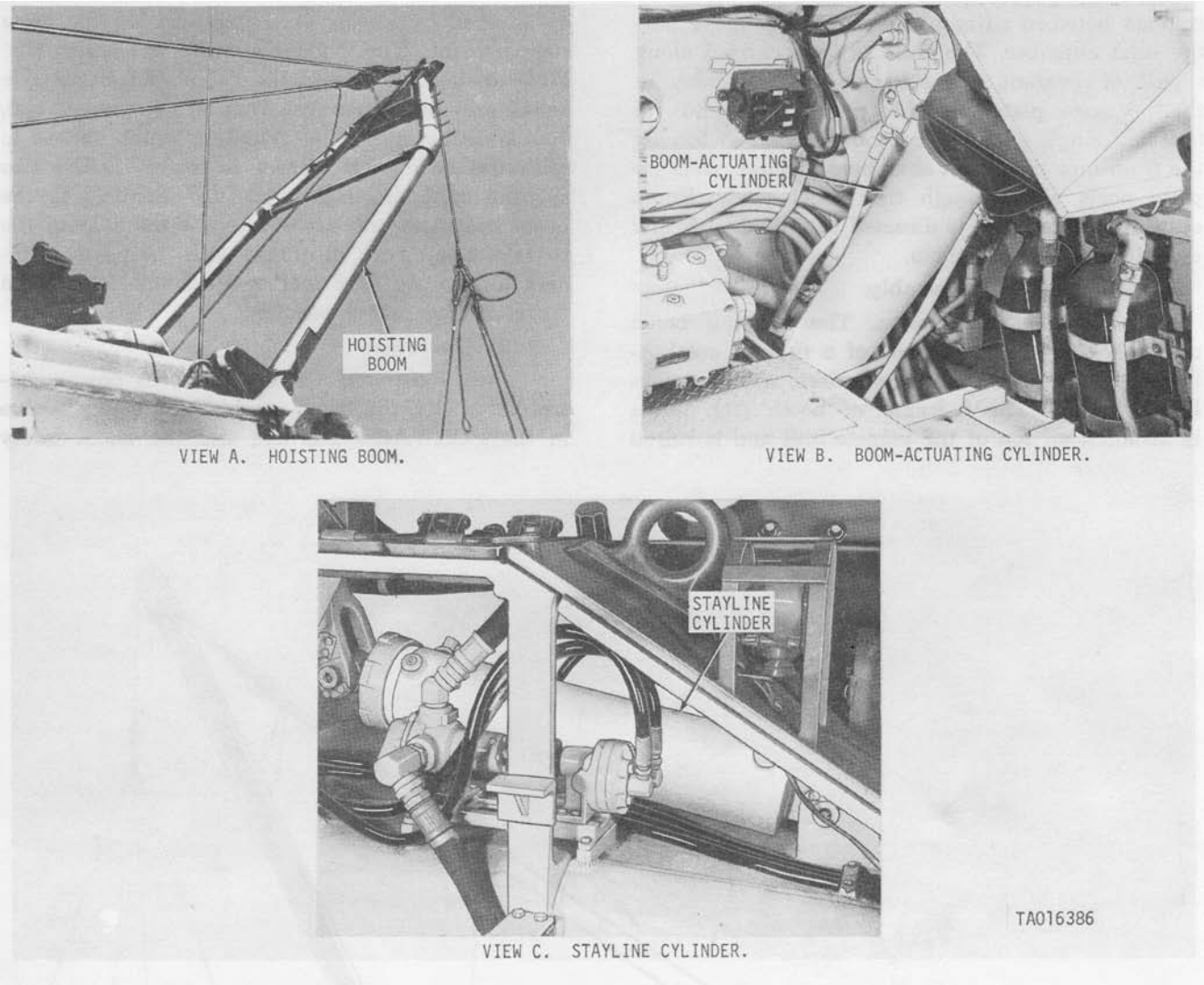


Figure 1-13. Hoisting boom assembly-installed views.

valve held in the STOW position, hydraulic pressure is directed to the back of the boom cylinder; thus causing the piston rod to extend, raising the boom. Since no pressure is directed to the stayline cylinders, the crank arms are mechanically moved to their vertical position by the stayline cables, actuating the boom limit valves. Once the boom is raised, release of the boom safety valve allows the valve to return to its normal live position; thus retricting the boom to four feet of movement.

(b) Lowering the *boom.* With the power control valve ON, the boom combination control valve in the RETRACT/STOW position, and the boom safety valve held in the STOW position, hydraulic pressure is directed to the rod end of the boom cylinders and bled off the back; thus causing the piston rod to retract and lower the boom. Pressure is also directed to the back end of the stayline cylinders causing the crank arm to retract.

f. Main Hydraulic System.

(*1) General.* The main hydraulic system of the vehicle has three functions: to supply power for control and operation of the boom; to supply power for control and operation of the hoist and main winches and their internal brakes; and to supply power for control and operation of the spade.

(*2) Hydraulic oil tank* (fig. 1-14). Hydraulic fluid from the oil tank is supplied to the hydraulic system, under pressure, by means of the main hydraulic pump, which is driven by the mechanical transmission. Through suction, oil passes from the hydraulic oil tank to the main pump and is pressure-discharged to operate the main hydraulic system.

(3) Control valves (hydraulic subplate assembly).

(a) Detailed description. The hydraulic subplate assembly or main control panel (figs. 1-15 and 1-16) is mounted to the right of the driver. Mounted to the subplate are the main winch, hoist winch, boom safety, and power control valves; the system selector control valve; the boom combination control valve, and the auxiliary power unit (APU) emergency winch control valve. The spade control handle is installed on the subplate and connected to the spade combination control valve by a mechanical linkage. The subplate has numerous ports and passages and serves as a manifold and mount for the operator's hydraulic control valves. Bleed valves are installed in the subplate to provide a means of bleeding portions of the hydraulic system.

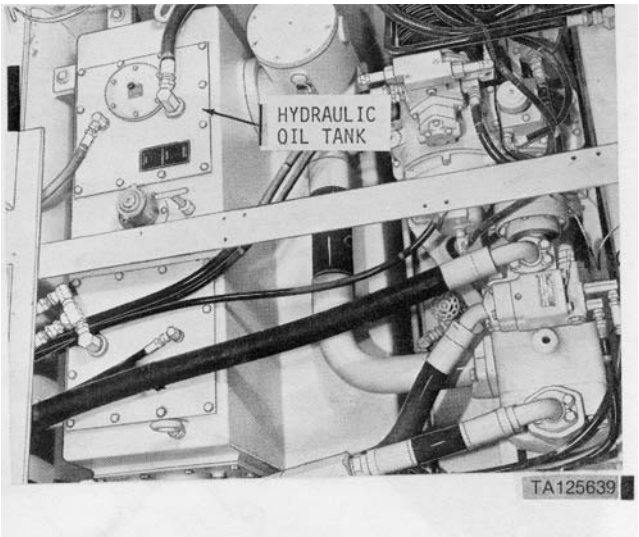


Figure 1-14. Hydraulic oil tank-installed view.

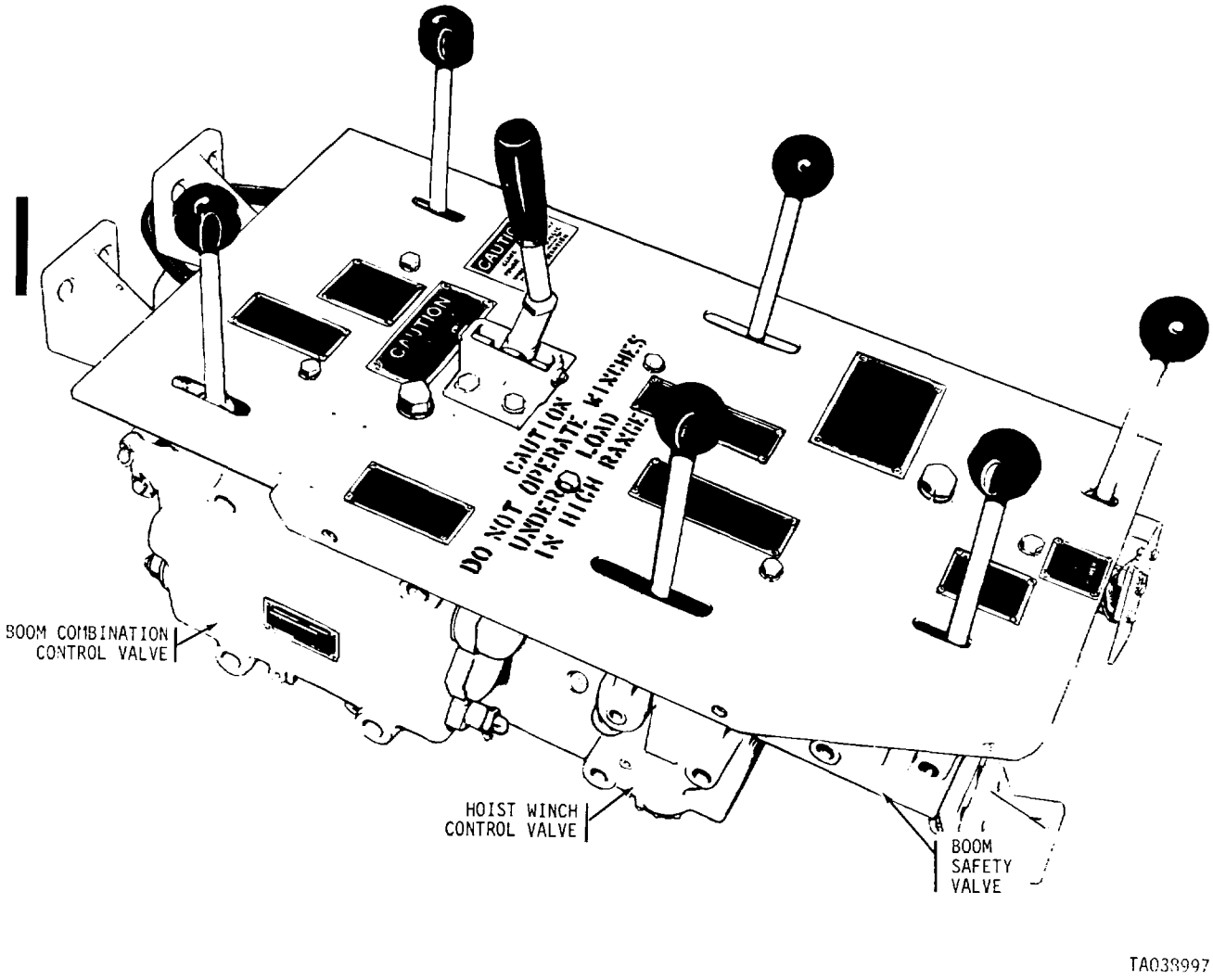


Figure 1-15. Hydraulic subplate assembly — left rear view.

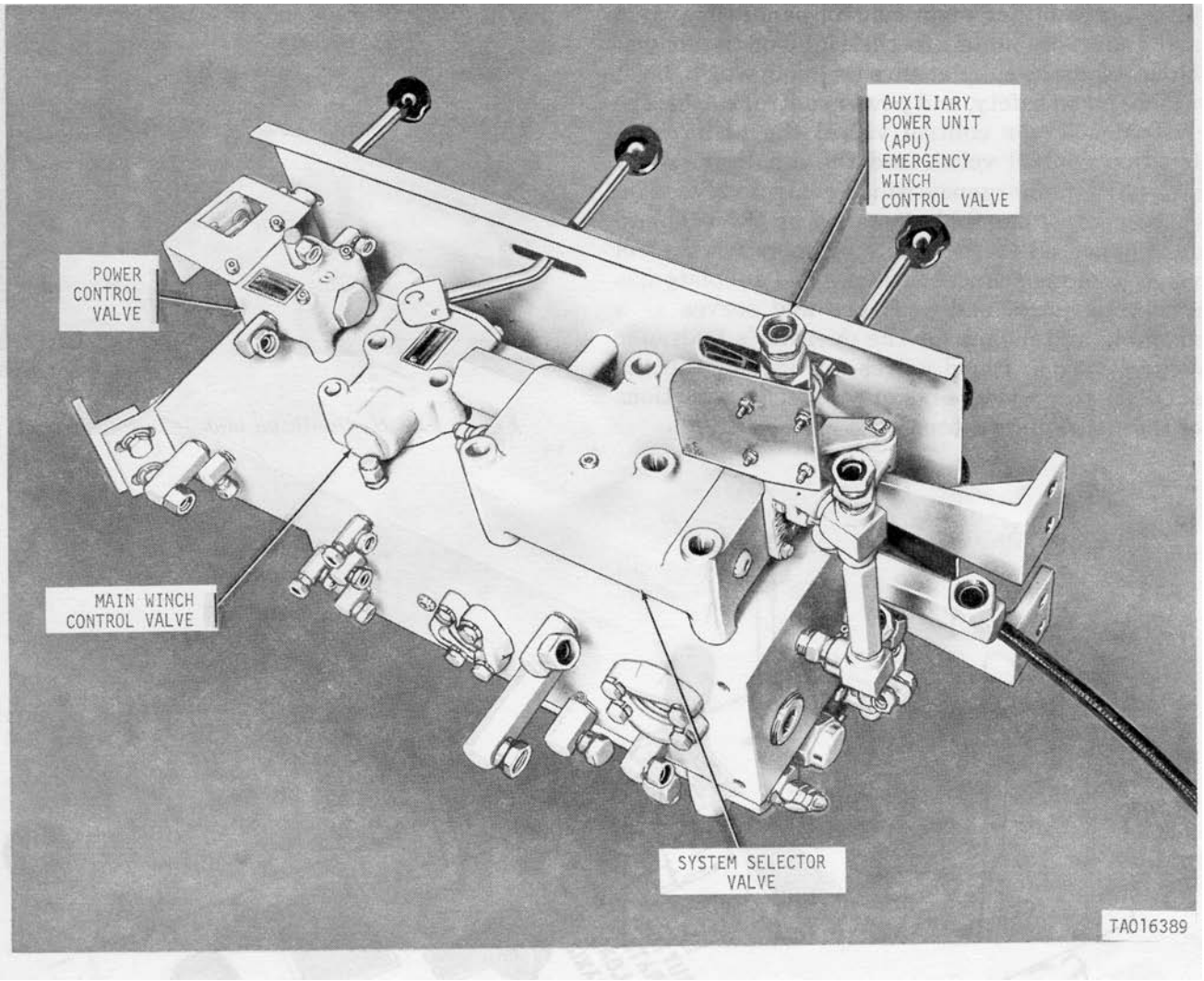


Figure 1-16. Hydraulic subplate assembly — right front view.

1. Main winch and hoist control valves. The main winch and hoist winch control valves are manually operated, three-position, open-center, directional control valves and are springloaded to the HOLD or centered position.

2. Boom combination control valve. The boom combination control valve is a manually operated, three-position, closed-center, directional control valve and is spring-loaded to the HOLD or center position. This control valve also contains one-way check valves and maximum pressure relief valves.

3. Boom safety control valve. The boom safety control valve is a manually operated, two-position, single-flowpath valve, and is springloaded to the LIVE or open position.

4. Power control valve. The power control valve is a manually operated, two-position, directional flow valve. The valve is held in its selected position by an internal mechanical detent.

5. System selector control valve. The system selector control valve is a manually operated, three-position, directional, combination control and relief valve. It is held in its selected position by an internal mechanical detent.

6. Auxiliary power unit (APU,) emergency winch control valve. The auxiliary power unit (APU) emergency winch control valve is a manually operated, two-position (open-closed), single flow path, ball valve.

(b). Operation. The subplate itself serves as a manifold and directs the hydraulic oil through numerous

passages to inlet or outlet ports of the subplate and the attached control valves.

1. Main winch and hoist winch control valves. When the valve is in the spring-centered HOLD position, pilot pressure is directed through the valve to the tank return. Also, pressure is bled from the winch combination control valve to the same tank return. Manually placing the valve in the PAYOUT or LOWER position directs the pilot pressure to the winch combination control valve and the brake cylinder and closes the port opening to the tank return. Moving the valve to the INHAUL or RAISE position blocks the pilot pressure to the control valve and bleeds the pilot pressure from the winch combination control valve and brake cylinder, through the control valve, to the tank return.

2. Boom combination control valve. When this control valve is in the spring-centered HOLD position, main pump pressure is blocked and pilot pressure is directed to the tank return. Manually placing the valve in the FORWARD position cuts off pressure and directs main pump pressure through a one-way check valve and a flow restriction to the boom-actuating cylinders. Pressure from the opposite side of the cylinders is directed by the valve to the tank return. If maximum pressure is exceeded, the relief valve opens and bleed: off pressure to the tank return. Placing the valve in the RETRACT/STOW position cuts off pilot pressure and directs main pump pressure through a one-way check valve and a flow restriction to the boom-actuating cylinders and the stayline cylinders. Pressure from the opposite end of cylinders is ported through the valve to the tank return. The maximum pressure relict valve opens if preset pressure is exceeded.

3. Boom safety control Valve. When the valve is in its spring-loaded LIVE position, pilot pressure is directed to the boom limit valves. Manually placing the valve in the STOW position cuts off pilot pressure to the boom limit valves.

*4. Power control valve. Ma*nually placing the valve in the ON position allows pump pressure to pass through the valve to the transmission clutch cylinder. Moving the valve to the OFF position. blocks the pump pressure and bleeds the oil pressure from the clutch cylinder, through the valve, back to the transmission crankcase return line.

5. System selector control valve. When the manual selector control valve is in the center or MAIN position, main hydraulic pump pressure is directed to the spade combination control valve and the boom combination control valve. Pump pressure to the refuel pump motor control valve impact wrench is blocked and any residual pressure from the auxiliary pump is bled to the tank return. Moving the valve to the AUXILIARY position, directs auxiliary pump pressure to the spade combination control valve and the boom combination control valve. The port opening from the main pump is closed. and residual pressure from the refuel pump motor control valve and impact wrench line is allowed to flow past the valve to the tank return. Placing the valve in the REFUEL position permits the use of main pump pressure and auxiliary pump pressure simultaneously for different operations or the use of just auxiliary pump pressure for refueling or use of the impact wrench. Main pump pressure is directed to the spade and boom combination control valves and auxiliary pump pressure is directed to the refuel pump motor control valve and the impact wrench.

6. Auxiliary power unit (APU) emergency winch control valve. When this valve is in the OPEN position, the auxiliary hydraulic pump directs pressure oil to the hoist winch combination control valve and the main winch combination control valve. (For emergency No Load operation of the winch cables). Hydraulic pump pressure is blocked when this valve is in CLOSED position.

(*4) Combination control valves* (fig. 1-17). Four combination control valves are utilized in the main hydraulic system. Two of these valves are manually operated to combine control, check, and adjustable relief for boom and spade operation. The boom combination control valve is subplate mounted to the control panel, and the spade combination control valve is subplate mounted to the cab front wall. The other combination control valves are pilot operated and combine pressure and directional control with adjustable relief for the winches.

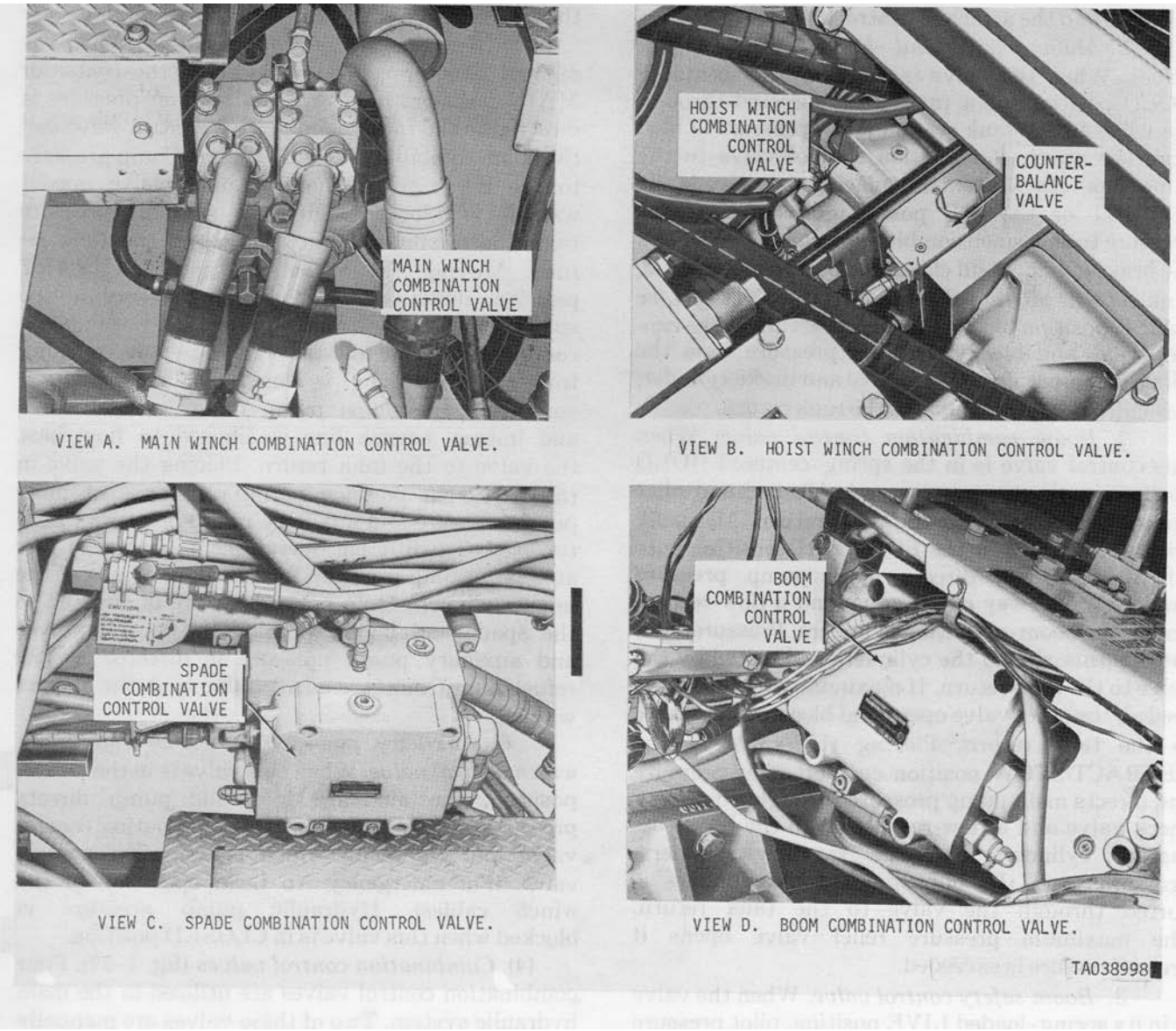


Figure 1-17. *Combination control valves-installed view.*

(5) Flow regulators (fig. 1-18). Four flow regulators are installed in the main hydraulic system. They regulate oil flow in one direction, regardless of pressure, and permit unrestricted flow in the opposite direction. The regulators control the speed of raising and lowering the boom.

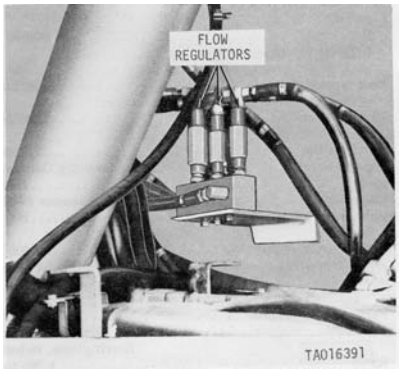


Figure 1-18. Flow regulators — installed view.

g. Auxiliary Hydraulic System.

(1) General. The auxiliary system of the vehicle has the following functions: to supply power for control and emergency operation of the boom; to supply power for control and emergency operation of the spade and winches; and to supply power for operation of refuel pump and impact wrench.

(2) Auxiliary hydraulic pump (fig 1-19). Pressure for the auxiliary hydraulic system is supplied by the auxiliary pump which is bracket mounted to the auxiliary engine. The auxiliary hydraulic system is engaged by moving the system selector control handle to AUX and by operating the auxiliary engine (refer to TM 9-2350-256-10).

(3) Refuel pump motor (fig. 1-20). A gear-type hydraulic motor drives the refuel pump when refueling or defueling. Motor rotation is controlled by a four-way selector valve. The refuel pump motor is mounted on the right rear area above the track in the engine compartment, and is coupled to the refuel pump.

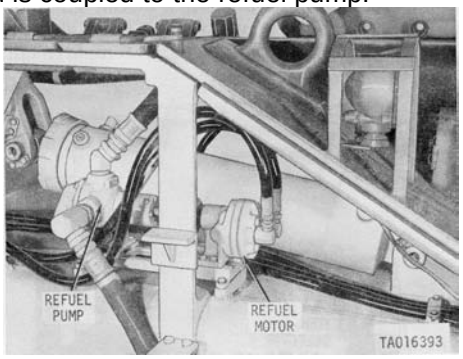


Figure 1-20. Refuel motor and pump assembly —-installed view.

(4) Flow regulator (adjustable) (fig. 1-21). An adjustable flow regulator is installed in the auxiliary hydraulic system to provide adjustment of flow for operation of the fuel transfer pump or hydraulic impact wrench. A calibrated dial and

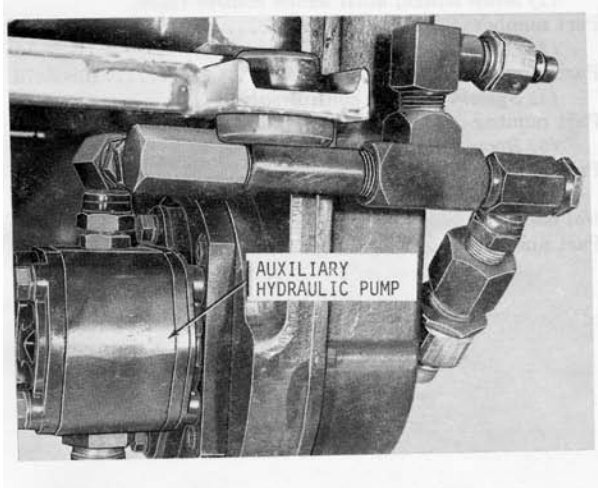


Figure 1-19. Auxiliary hydraulic pump—installed view.

Figure 1-21. Flow regulator (adjustable)—installed view.

control handle are provided for variable settings. To operate the regulator, move the handle so that the indicator points to the desired setting. The regulator is mounted on the right rear area above he track in the engine compartment.

(5) Four-way selector valve (fig. 1-22). A three-position, four-way selector valve is installed in the auxiliary hydraulic system to control the rotation of the refuel pump and motor. The four-way selector valve is mounted on the right rear area above the track in the engine compartment.

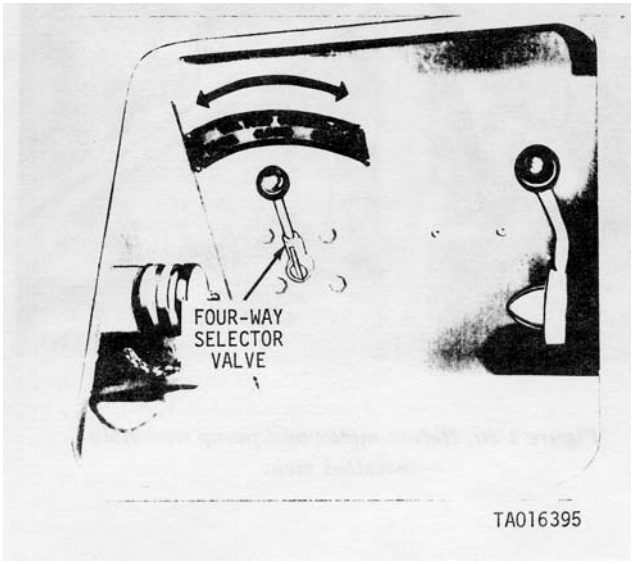


Figure 1-22. Four-way selector value—installed view.

1-4. Tabulated Data

a. Main Winch and Spade Assembly.

(1) Spade assembly.

Part number 10862159

(2) Spade-actuating cylinders.

Part number 10867173

(3) Main winch hydraulic motor.

Part number 11672155

(4) Main winch.

Part number..... 8739010
Manufacturer ..... Pacific Car and Foundry Company
Model no..... U-90B
Cable size..... 25 in Dia. IWRC
Cable length ..... 200 ft
Line pull:
Bare drum ..... 90,000 lb

b. Hoist Winch Assembly.

(1) Hoist winch hydraulic motor.

Part number 11672155

(2) Hoist winch counterbalance valve.

Part number 10923500

(3) Hoist winch.

Part number..... 8739009
Manufacturer....Pacific Car and Foundry Company
Model U35B
Cable size ..... 5/8 diameter IWRC
Cable length ..... 200 ft
Line pull:
Bare drum (4-part line) ..... 50,000 lb

c. Mechanical Transmission and Main Hydraulic Pump Assembly.

(1) Mechanical transmission.

Part number 8379921
Type ..... single reduction, herringbone, reducer
Ratio ..... 1.265 to 1
Rating ..... 150 hp @ 1800 rpm input and 1422 rpm output

(2) Main hydraulic pump.

Part number 7748579
Type ..... Vane fixed-displacement
Output (each section):
at 1350-1450 rpm and0-psi ..... 52 gpm (max.)
at 1350-1450 rpm and 2000 psi...42 gpm (min.)

(3) Relief and unloading valve.

Part number..... 10867008
Pressure range..... 0-2000 psi

d. Hoisting Boom Assembly.

(1) Hoisting boom.

Part number 8676250
Capacity:
Boom ..... 25 ton
Maximum lift height: (center line of hook, vehicle level)
8-foot reach..... 19 ft
4-foot reach..... 22 ft

(2) Cylinder (boom and stayline).

Part number 8743887
Type..... single end rod, double-acting

e. Control Valves (Hydraulic Subplate Assembly).

(1) Main winch; hoist winch control value.

Part number 10866877

(3) Power control value.

Part number 10866876

(4) System selector control valve.

Part number 10866875

(5) Boom combination control valve.

Part number 8379908-1

(6) Auxiliary power unit (APLU) emergency winch control value.

Part number 11640359

CHAPTER 2

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

Section I. REPAIR PARTS, SPECIAL TOOLS AND EQUIPMENT

2-1. General

Tools, equipment, and maintenance parts, over and above those available to the using organization, are issued to direct and general support maintenance personnel.

2-2. Parts

Repair parts are listed in TM 9-2350-256-34P-2, which is the authority for requisitioning replacements. It is important that careful troubleshooting be used to determine, whenever possible, what parts are to be replaced before the component is torn down for repair.

2-3. Common Tools and Equipment

Standard and commonly used tools and equipment having general application are authorized for issue by Tables of Allowances and Tables of Organization and Equipment.

2-4. Special Tools and Equipment

The special tools and equipment, listed in table 2-1 and illustrated in figure 2-1, are the only special tools and equipment necessary to perform the maintenance operations described in this technical manual. Refer to TM 9-2350-256-34P-2 for special tools and equipment allocations and requisitioning authority.

Table 2-1. Special Tools List

Nomenclature	National Stock No.	Reference			Use
		Item,	Fig.	Para.	
Adapter	5120-00-767-9102 (10867497)	9,	2-1	3-6b	Used with puller 8708712 to remove spade hydraulic cylinder pins.
Eye, main winch (2 required)	4910-00-766-1962 (10884606)	10,	2-1	1-3b	Removing and installing main winch
Eye, hoist winch (2 required)	4910-00-766-1963 (10884605)	11,	2-1	1-3c	Removing and installing hoist winch
Gage	6620-00-795-0330 (7950330)	12,	2-1	—	Used with bushing 4730-00-186-3024 to check power takeoff lubricating oil pressure and power takeoff clutch oil pressure. (See TM9-2350-256-20).
Bushing, pipe	4730-00-186-3024 WW-P-471 Type II, Size 1/4-18 x 1/8-27	4,	2-1	—	Used with gage 7950330. (See TM 9-2350-256-20).
Gage	4910-00-766-3355 (10884612)	7,	2-1	2-6c	Checking main winch system pressure, hoist winch system pressure, spade system. pressure, boom system pressure, or auxiliary hydraulic system pressure. (See table 2-3).
Guide, spade shaft	4910-00-767-0419 (10884600)	6,	2-1	3-6b	Used with handle 10867499 to install the spade shaft through the oil seal.

Table 2-1. Special Tools List-Continued

Nomenclature	National Stock No.	Reference Item,	Fig.	Para.	Use
Handle, spade shaft guide	4910-00-766-1964 (10867499)	8,	2-1	3-6b	Used with guide 10884600.
Fuller	5120-00-310-4068 (8708712)	5,	2-1	3-6b	Used with adapter 10867497 to remove hydraulic cylinder pins.
Wrench	5120-00-555-0060 (8395504)	13,	2-1	—	Connecting and disconnecting hydraulic lines. (See TM 9-2350-256-20).
Wrench	5120-00-767-9099 (10884603)	1,	2-1	—	Adjusting level winder cylinder adjusting nut. (See TM 9-2350-256-20).
Wrench	5120-00-777-1388 (10884649)	2,	2-1	—	Adjusting hydraulic cylinder packing nut. (See TM 9-2350-256-20).
Wrench	5120-00-293-0316 (8747917)	3,	2-1	3-6b	Removing and replacing level winder flange nut.
Kit, Parts. Main Hydraulic Pump Pressure Tester Consists of:	N/A (5705354)	14,	2-1	—	Used with gage assembly. 4910-00-166-3355 and bushing 4730-00-193-0869 when checking main hydraulic pump.
Valve, Needle	4820-01-207-1048	14-A.	2-1	—	
Nipple, Pipe	4730-00-815-7483	14-B.	2-1	—	
Tee, Pipe. High Pressure	4730-01-016-2532	14-C.	2-1	—	
Bushing, Pipe	4730-01-046-0373	14-D,	2-1		
Bushing, Pipe	4730-01-029-4573	14-E.	2-1		
Bushing, Pipe	4730-00-193-0869 WW-P-471 Type II, size 3'8-18X1/4-18	15	2-1		Used with gage assembly 4910-00-766-3355 and main hydraulic pump pressure tester kit 5705354 when checking main hydraulic pump.

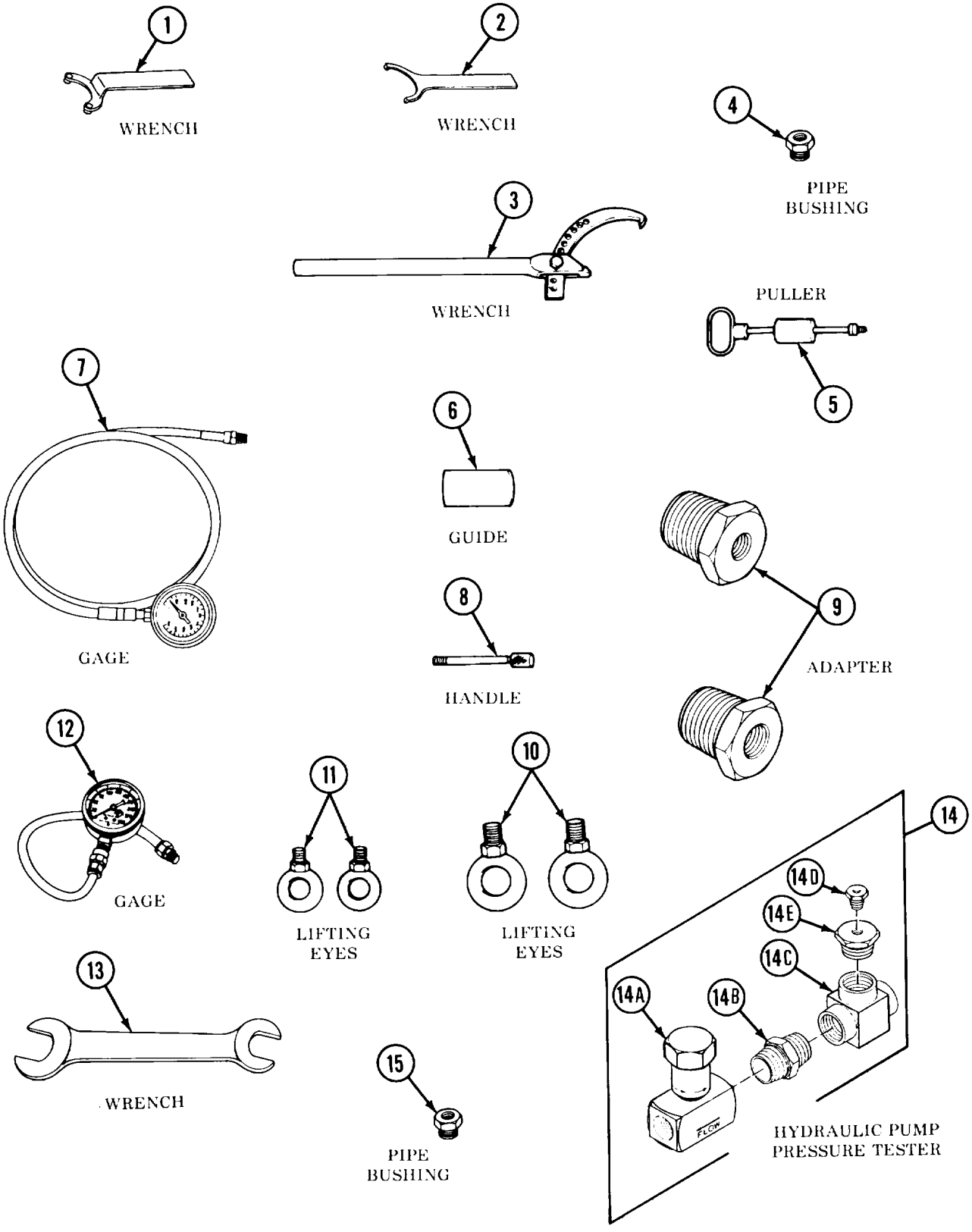


Figure 2-1. Special tools and equipment.

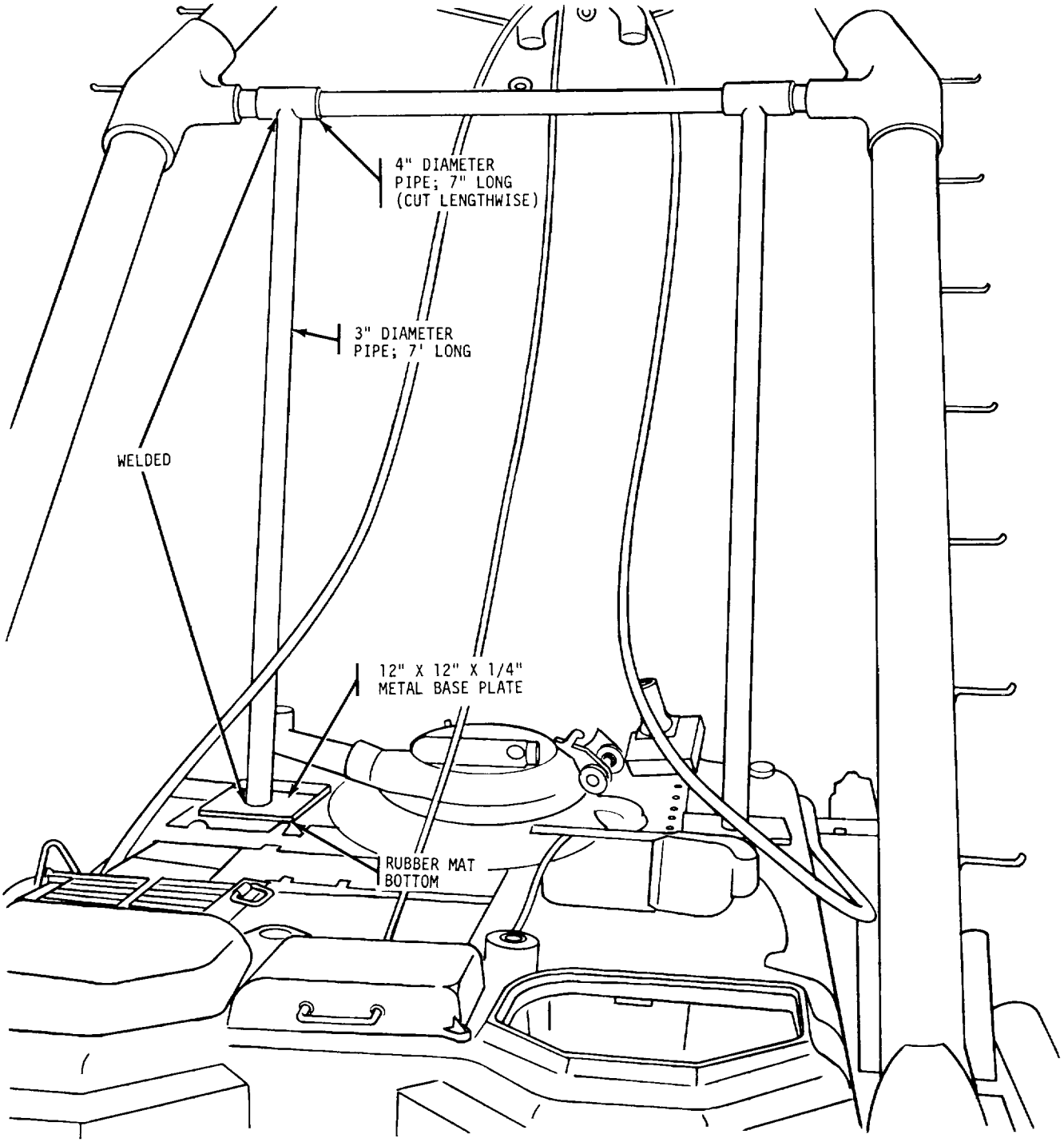
2-5. Improvised Tools and Equipment

a. The improvised safety boom stands (table 2-2) are used to support the boom in a partially raised position, allowing the vehicle to be serviced in a shop area with a low ceiling.

b. The stands can be readily constructed from ordinary wall pipes mounted to a metal base plate. For details of construction, refer to figure 2-2.

*Table 2-2 Improvised Tools for Direct a*nd *General Support Maintenance*

Nomenclature	References		Use
	Fig.	Para.	
Stands, safety boom	2-2	2-5	Used to support boom



TA0389990

Figure 2-2. Safety boom stands.

Section II. TROUBLESHOOTING

NOTE

Information in this section is for use by direct support and general support *(DS/GS)* maintenance personnel in conjunction with and as a supplement to the troubleshooting section in the organizational maintenance manual. It provides continuation of instructions where a remedy in the organizational manual refer to DS/GS maintenance personnel for corrective action.

2-6. Scope

a. This section contains troubleshooting or malfunction information and tests for locating and correcting most of the troubles which may develop in the Recovery Vehicle. Each malfunction or trouble symptom for an individual component, unit, or system is followed by a list of tests or inspections necessary for you to determine probable causes and suggested corrective actions for you to remedy the malfunction.

b. This manual cannot list all possible malfunctions that may occur or all tests or inspections, and corrective actions. If a malfunction is not listed (except when malfunction and cause are obvious), or is not corrected by listed corrective actions, you should notify higher level maintenance activity or major unit commander.

c. Table 2-3 lists the common malfunctions that you may find during the operation or maintenance of the Recovery Vehicle or its components. You should perform the tests/inspections and corrective actions in the order listed.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify higher level maintenance activity or major unit commander.

2-6.1. Adjustment of Main Winch Capability

Refer to paragraph 3-10.1.

2-6.2. Adjustment of Hoist Winch Capability

Refer to paragraph 3-21.1.

Table 2-3. Troubleshooting

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
MAIN WINCH CIRCUIT (MAIN HYDRAULIC SYSTEM)
CAUTION Close auxiliary power unit emergency winch control valve for main hydraulic system operation.
1. MAIN WINCH WILL NOT OPERATE
Step 1. Attempt operation of hoist winch, boom spade. If hoist winch. boom and spade operate, proceed to step 9. If hoist winch, boom and spade do not operate. proceed to step 2.
Step 2 Inspect mechanical transmission drive shaft. If not rotating, repair or replace. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.
Step 3. Inspect mechanical transmission for broken or restricted hose. Replace mechanical transmission hose. Refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1.
Step 4. Inspect mechanical transmission output shaft. If not rotating. proceed with mechanical transmission clutch pressure check. Install pressure gage in mechanical transmission clutch pressure hose. For location, refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1. With engine operating at 1800 rpm. and power control valve lever in ON position, normal operating pressure is 150 ± 10 psi
a. Remove mechanical transmission and main hydraulic pump assembly. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle. MS8A1.
b Replace mechanical transmission Refer to paragraph 3-16.
Step 5. Test for defective power control valve Remove hose no. 66 from valve. With power control valve level in ON position and mechanical transmission input shaft rotating, oil should flow from valve port. Replace power control valve. Refer to TM 9-2350-256-34-1. Medium Recovery Vehicle, MS88A1.
Step 6. Inspect main hydraulic pump for broken or damaged shaft coupling.
a. Remove mechanical transmission and main hydraulic pump assembly. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.
b. Repair or replace shaft coupling. Refer to paragraph 3-16.

Table2-3. Troubleshooting-Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

MAIN WINCH CIRCUIT (MAIN HYDRAULIC SYSTEM)--Continued

WARNING

Test components must be capable of withstanding a working pressure of 1950-2050 psi (step 7 only).

NOTE

After performing main hydraulic pump test, return all plumbing to original configuration.

Step 7. Test main hydraulic pump. Remove check valve and tee between hose no. 4A and 4B. Install main hydraulic pump pressure tester kit (Item 14, Table 2-1) between hose no, 4A and hose no. 4B. Install test pressure gage in tee

CAUTION

Make sure that the load valve is in full open position before performing test. When performing main hydraulic pump pressure test, do not restrict oil flow beyond operating pressure.

With main engine operating at 1800 rpm, operating pressure should be 1950-2050 psi when restricting flow using load valve.

After testing, remove hose no. 413 from pump port no. 1. Remove pilot-operated relief and unloading valve assembly from pump port no. 44. Install hose no. 4B on pump port no. 44.

With main engine operating at 1800 rpm, operating pressure should be 1950-2050 psi when restricting flow using load valve.

a. Remove mechanical transmission and main hydraulic pump assembly. Refer to TM. 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.
b. Replace main hydraulic pump. Refer to paragraph 3-16.

Step 8. Test for improperly adjusted pilot operated relief and unloadling valve. Install test gage in valve gage port. With engine operating at 1800 rpm. and spade in stowed position, placespade combination control valve lever in RAISE position and adjust relief valve.

Adjust relief pressure to 1950-2054 psi. For location of valve gage port, and adjusting screw, refer to views B and C, fig. 3-22.

Step 9. Inspect all hydraulic hoses and connections for visible indication of oil leaks.

Repair leaks or replace hydraulic hose. Refer to TM 9-2350-256-20. Medium Recovery Vehicle, M88A1.

Thble2-3. Troubleshooting-Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

MAIN WINCH CIRCUIT (MAIN HYDRAULIC SYSTEM—Continued

Step 10. Test combination control valve. Install pressure gage in test gage port no. 50 at main winch level winder. Remove hose no. 21A from valve, and plug outlet of valve. If no pressure is indicated on gage when operating hydraulic system. it indicates a faulty combination control valve. For location of test gage port. refer to view L. fig. 3-8.

Replace and adjust combination control valve. Refer to paragraph 3-6. 3-10. and 3-10.1.

Notify next higher level maintenance activity or major unit commander.

Step 11. Test control valve. Install pressure gage in combination control valve port no. 7. If no pressure is established on gage when actuating control valve. but if pressure is established when removing hose no. 21A from control valve and plugging outlet, it indicates a faulty main winch control valve Replace main winch control valve. See view F, figure 3-20, and refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

Step 12. Test for hydraulic motor failure. Remove hose no. 47 from rear of hydraulic motor. A large volume of oil discharged from port when main winch control valve is engaged indicates a faulty motor.
Replace hydraulic motor. Refer to TM 9-2350-256-34-1. Medium Recovery Vehicle, M88A1.

Step 13. Inspect system selector valve lever for improper position.
Place system selector valve lever in MAIN position.

Step 14. Mechanical failure of main winch gear train.
a. Remove main winch and spade assembly. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.
b. Replace main winch. Refer to paragraph 3-6.

1.1. MAIN WINCH PAYS IN AND OUT UNDER NO LOAD, BUT WILL NOT PAY IN OR OUT UNDER LOAD

Step 1. Prepare the hydraulic system for operation per TM 9-2350-256-10. Pay special attention to item 3. page 2-79.
a. Verify that the APU emergency winch control valve is in NORMAL OPERATION position. Refer to fig. 2-26 of TM 9-2350-256-10.

Step 2. Main winch will be in low gear.

Step 3. Conduct all hydraulic operations in 1800 RPM or governed engine speed.

NOTE

TM 9-2350-256-10 states minimum engine speed for winching operations is 1500 RPM.

Step 4. Conduct all hydraulic operation verifications with a hydraulic reservoir temperature of 1 10 F to 1200F.

Step 5. Verify main hydraulic pressure in accordance with step 8 of malfunction no. 1.

Step 6. If hoist winch, boom, and spade operate properly, proceed to steps 9 through 14 of malfunction no. 1.

NOTE

This would indicate satisfactory main hydraulic pump operation.

Step 7. If the problem is still unresolved and system pressure has been verified to be 1950 to 2050 psi perform the following:
a. Install pressure gage (NSN 4910-00-766-3355) in test port no. 50 at main winch level winder. (For location of test gage port. refer to view L fig. 3-8).
b Adjust main winch. Refer to paragraph 3.10.1, b. step 3.
c Verify pressure reading of approximately 1425 psi. The pressure shall be stable. Refer to paragraph 3.10.1, c,step 3.
(1) Extremely low pressure (below 1300 psi) would be an indication of improper relief valve setting or a faulty combination control valve.
(2) Fluctuating and unstable hydraulic pressure is an indication of a faulty combination control valve.
d. If fluctuating and unstable hydraulic pressure is experienced, replace the main winch combination control valve.
e. If extremely low pressure is experienced (below 1300 psi). readjust the main winch pressure to 1400 psi. The pressure must be stable and without fluctuation. If readjustment cannot be accomplished. replace the main winch combination control valve. Adjustment to the valve is accomplished by cutting the lockwire to the acorn nut. removing the nut and loosening the locknut. Turn the adjusting screw 1/8 of a turn at a time for adjustment. Turn the screw "in" to increase pressure. (Turning "out" decreases pressure). the final pressure setting should be verified with the locking nut tightened. Secure the acorn nut with lockwire.

WARNING

Do not exceed a 1400/1450 psi pressure relief setting. Excessive pressure will produce main winch cable pull valves in excess of vehicle specification-bodily injury could occur.

f. Readjust the brakes for proper function Refer to TM 9-2350-256-20.

NOTE

The hydraulic pressures stated above are for troubleshooting only and shall not be used as a substitute for load checks to see main winch cable line pull valve.

Table 2-3. Troubleshooting-Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

MAIN WINCH CIRCUIT (MAIN HYDRAULIC SYSTEM)-Continued

2. MAIN WINCH PAYS IN BUT WILL NOT PAY OUT
   - Step 1. Remove main winch brake cover. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1, anti check if main winch brake is releasing.

     Adjust brake. Refer to TM 9-2350-256-20, Medium Recovery Vehicle, M8A1.
   - Step 2. Remove hydraulic brake cylinder hose no. 29 and inspect for restriction.
     Replace restricted or damaged hose. Refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88SA1.
   - Step 3. Remove main winch brake cylinder and test for malfunction. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.
     Replace main winch brake cylinder.
3. MAIN WINCH PAYS OUT BUT WILL NOT PAY IN
   - Step 1. Inspect for restricted pilot hose between main winch control valve and combination control valve. Refer to fig. FO-3 and trace pilot circuit.

   Replace restricted or damaged pilot hose. Refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1.
   - Step 2. Broken free-wheeling ratchet bracket assemble unit in main winch.
     a. Remove main winch and spade assembly. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, MS8A1.
     b. Replace main winch. Refer to paragraph 3-6.
4. MAIN WINCH CREEPS IN EITHER DIRECTION WHEN IN HOLD POSITION
   - Step 1. Inspect for restricted pilot hose or main control valve. Refer to figs. FO-2 and FO-3 and trace hose and valve for restriction.
     a. Replace any restricted pilot hose. Refer to TM 9-2350-256-20, Medium Recovery Vehicle. MS8A1.
     b. Remove restriction or replace control valve. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle M88A

   NOTE

   In cold weather, oil viscosity increases, causing a retarded flow of oil and possibly causing main winch to creep. Proper warmup will correct.
5. MAIN WINCH WILL NOT HOLD LOAD
   - Step 1. Inspect main winch brake for proper adjustment.
     Adjust main winch brake. Refer to TM 9-2350-256-20), Medium Recovery Vehicle, 1MtSA1.
   - Step 2. Remove main winch brake cover and inspect for worn brake lining. Refer to TM 9-2350-256-34-1, Medium Recover Vehicle. M88A1.

6. INSUFFICIENT MAIN SYSTEM OIL PRESSURE

   - Step 1. Test mechanical transmission clutch pressure. Install pressure gage in mechanical transmission clutch pressure hose. For location, refer to TM 9-2350-256-20, Medium Recovery Vehicle, MI88A1. With engine operating at 1800 rpm, and power control valve lever in ON position, normal operating pressure is 150-10 psi.
     a. Remove mechanical transmission anti main hydraulic pump assembly. Refer to TM 9-2350-256-34-1, Medium Recover Vehicle, M88AI.
     b. Replace mechanical transmission. Refer to paragraph 3.16.

Table 2-3. Troubleshooting-Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

MAIN WINCH CIRCUIT (MAIN HYDRAULIC SYSTEM)-Continued

WARNING

Test components must be capable of withstanding a working pressure of 1950-2050 psi. (Step 2 only).

NOTE

After performing main hydraulic pump test, return all plumbing to original configuration.

Step 2. Test main hydraulic pump. Remove check valve and tee between hose no. 4A and4B. Install main hydraulic pump pressure tester kit (Item 14, Table 2-1) between hose no. 4A and hose no. 4B. Install test pressure gage in tee.

CAUTION

Make sure that the load valve is in full open position before performing test. When performing main hydraulic pump pressure test, do not restrict oil flow beyond operating pressure.

With main engine operating at 1800 rpm. operating pressure should be 1950-2050 psi when restricting flow using load valve.

After testing, remove hose no. 4B from pump port no. 1. Remove pilot-operated relief and unloading valve assembly from pump port no. 44. Install hose no.-4B on pump port no.-44.

With main engine operating at 1800 rpm. operating pressure should be 1950--2050 psi when restricting flow using load valve.

a. Remove mechanical transmission and main hydraulic pump assembly. Refer to TM 9-2350-256-341-1. Medium Recovery Vehicle, M88A81.
b. Replace main hydraulic pump Refer to paragraph 3-16.

Step 3. Inspect system selector valve lever for improper position. Place system selector valve lever in MAIN Position.

Table 2-3. Troubleshooting-Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

MAIN WINCH CIRCUIT (MAIN HYDRAULIC SYSTEM)-Continued

7. LEVELWINDER NOT OPERATING

Step 1. Inspect hoses and fittings for visible indication of oil leaks. Repair or replace hoses and fittings. Refer to paragraph 3-9.

Step 2. Inspect level winder valve spool and cylinder rod for leaks.
a. Remove main winch and spade assembly. Refer to TM 9-2350-256-34-1. Medium Recovery Vehicle, M88A1.
b. Replace level winder. Refer to paragraph 3-9.

Step 3. Inspect level winder control valve actuating mechanism for broken parts.
a. Remove control valve actuating mechanism. Refer to TM 9-2350-256-34-1. Medium Recovery Vehicle. M88A1.
b. Repair control valve actuating mechanism. Refer to figure 3-14.

8. LEVEL WINDER NOT OPERATING PROPERLY

Step 1. Inspect level winder for improper adjustment (evident by uneven wrap of cable).

Adjust level winder assembly. Refer to TM 9-2350-256-20, Medium Recovery Vehicle. M88A1.

HOIST WINCH CIRCUIT (MAIN HYDRAULIC SYSTEM)

CAUTION

Close auxiliary power unit emergency winch control valve for main hydraulic system operation.

9. HOIST WINCH WILL NOT OPERATE

Step 1. Attempt operation of main winch, boom and spade.

If main winch, boom and spade operate, proceed to step 9.

If main winch, boom and spade do not operate, proceed to step 2.

Step 2. Inspect mechanical transmission drive shaft.

If not rotating, repair or replace. Refer to TM 9-2350-256-34-1. Medium Recovery Vehicle. M88A1.

Step 3. Inspect mechanical transmission for broken restricted hose.

Replace mechanical transmission hose. Refer to TM 9-2350-256-20. Medium Recovery Vehicle, M88A1.

Step 4, Inspect mechanical transmission outfit shaft. If not rotatingproceed with mechanical transmission clutch pressure check. Install pressure gage in mechanical transmission clutch pressure line. For location, refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1.
With engine operating at 1800 rpm, and power control valve lever in ON position, normal operating pressure is 140-150 psi.
a. Remove mechanical transmission and main hydraulic pump assembly. Refer to TM 9-2340-256-34-1, Medium Recovery Vehicle, M88A1.
b. Replace mechanical transmission. Refer to paragraph 3-16.

Step 5. Test for defective power control valve. Remove hose No. 66 from valve. With power control valve level in ON position, and mechanical transmission input shaft rotating, oil should flow from valve port. Replace power control valve. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle. M88A1.

Step 6. Inspect main hydraulic pump for broken or damaged shaft coupling.
a. Remove mechanical transmission and main hydraulic pump assembly. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.
a. Repair or replace shaft coupling. Refer to paragraph 3-16.

WARNING

Test components must be capable of withstanding a working pressure of 1950-2050 psi (Step 7 only).

NOTE

After performing main hydraulic pump test. return all plumbing to original configuration.

Step 7. Test main hydraulic pump Remove check valve and tee between hose no. 4A and 4B. Install main hydraulic pump pressure tester kit (Item 14., Table 2-1I between hose no ,4A and hose no. 4B. Install test pressure gage in tee.

Table 2-3. Troubleshooting--Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION	
HOIST WINCH CIRCUIT (MAIN HYDRAULIC SYSTEM)-Continued	
	CAUTION Make sure that the load valve is in full open position before performing test. When performing main hydraulic pump pressure test, do not restrict oil flow beyond operating pressure. With main engine operating at 1800 rpm, operating pressure should be 1950-2050 psi when restricting flow using load valve. After testing, remove hose no. 4B from pump port no. 1. Remove pilot-operated relief and unloading valve assembly from pump port no. 44. Install hose no. 4B on pump port no. 4-1. With main engine operating at 1800 rpm, operating pressure should be 1950-2050 psi when restricting flow using load valve. a. Remove mechanical transmission and main hydraulic pump assembly. Refer to TM 9-2350-256-34-1. Medium Recovery Vehicle. M88A1. b. Replace main hydraulic pump. Refer to paragraph 3-16.
Step 8.	Test for improperly adjusted pilot operated relief and unloading valve. Install test gage in valve gage port. With engine operating at 1800 rpm, and spade in stowed position, place spade combination control valve lever in RAISE position and adjust relief valve. Adjust relief pressure to 1950-2050 psi. For location of valve gage port, and adjusting screw, refer to views B and C, fig. 3-22.
Step 9.	Inspect all hydraulic hoses and connections for visible indication of oil leaks. Repair leaks or replace hydraulic hose. Refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1.
Step 10.	Test combination control valve. Install pressure gage in valve gage port. Remove hose no. 23A from valve, and plug outlet of valve. If no pressure is indicated on gage when operating hydraulic system, it indicates a faulty combination control valve. Refer to view A, fig. 3-24. for location of test gage port. Replace and adjust combination valve. Refer to paragraph 3-19 and 3-21.1.
Step 11.	Test control valve. Install pressure gage in combination control valve port no. 21. If no pressure is established on gage when actuating control valve, but if pressure is established when removing hose no. 23A from control valve and plugging outlet, it indicates a faulty hoist winch control valve. Replace hoist winch control valve. Refer to view P, fig. 3-20, and refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.
Step 12.	Test for hydraulic motor failure. Remove hose no. 48 from rear of hydraulic motor. A large volume of oil discharged from port when hoist winch control valve is engaged indicates a faulty motor. Replace hydraulic motor. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.
Step 13.	Inspect system selector valve lever for improper position. Place system selector valve lever in MAIN position.
Step 14.	Mechanical failure of hoist winch gear train. a. Remove hoist winch assembly. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1. b. Replace hoist winch. Refer to paragraph 3-19.

Table 2-3. Troubleshooting--Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

HOIST WINCH CIRCUIT (MAIN HYDRAULIC SYSTEM)-Continued

10. HOIST WINCH PAYS IN BUT WILL NOT PAY OUT

Step 1. Remove hoist winch brake cover. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1, and check if hoist winch brake is releasing.
Adjust brake. Refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1.

Step 2. Remove hydraulic brake cylinder hose no. 28 and inspect for restriction
Replace restricted or damaged hose. Refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1.

Step 3. Remove hoist winch brake cylinder and test for malfunction. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.
Replace hoist winch brake cylinder.

Step 4. Adjust counterbalance valve. Refer to paragraph 3-21.1.
Replace counterbalance valve if defective. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

11. HOIST WINCH PAYS OUT BUT WILL NOT PAY IN

Step 1. Inspect for restricted pilot hose between hoist winch control valve and combination control valve. Refer to fig. FO-5 and trace pilot circuit.
Replace restricted or damaged pilot hose. Refer to TM 9-2350-256-20, Medium Recovery Vehicle, M8A1.

Step 2. Broken free-wheeling ratchet brake assembly unit in hoist winch
a. Remove hoist winch assembly. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.
b. Replace hoist winch Refer to paragraph 3-19.

12. HOIST WINCH CREEPS IN EITHER DIRECION WHEN IN HOLD POSITION

Step 1. Inspect for restricted pilot hose or hoist winch control valve. Refer to figs. FO-4 and FO-5 and trace hose and valve for restriction.
a. Replace any restricted pilot hose. Refer to TM 9-2350-256-20, Medium Recover Vehicle, M88A1.
b. Remove restriction or replace control valve. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

NOTE

In cold weather, oil viscosity increases, causing a retarded flow of oil and possibly causing winch to creep. Proper warm-up will correct

13. HOIST WINCH WILL NOT HOLD LOAD

Step 1. Inspect hoist winch brake for proper adjustment
Adjust hoist winch brake. Refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1.

Step 2. Remove hoist winch brake cover and inspect for worn brake lining. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, MS88A1.
Replace brake lining. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

Step 3. Defective counterbalance valve.
Replace counterbalance valve. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

14. INSUFFICIENT MAIN SYSTEM OIL PRESSURE

Step 1. Test mechanical transmission clutch pressure. Install pressure gage in mechanical transmission clutch pressure hose. For location, refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1. With engine operating at 1800 rpm, and power control valve lever in ON position, normal operating pressure is 1500 to 1610 psi.
a. Remove mechanical transmission and main hydraulic pump assembly. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.
b. Replace mechanical transmission. Refer to paragraph 3-16.

Table 2-3. Troubleshooting--Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

HOIST WINCH CIRCUIT (MAIN HYDRAULIC SYSTEM)-Continued

WARNING

Test components must be capable of withstanding a working pressure of 1950-2050 psi. (Step 2 only).

NOTE

After performing main hydraulic pump test, return all plumbing to original configuration.

Step 2. Test main hydraulic pump. Remove check valve and tee between hose no. 4A and 4B. Install main hydraulic pump pressure tester kit (Item 14, Table 2-1) between hose no. 4A and hose no. 4B. Install test pressure gage in tee.

CAUTION

Make sure that the load valve is in full open position before performing test. When performing main hydraulic pump pressure test, do not restrict oil flow beyond operating pressure.

With main engine operating at 1800 rpm, operating pressure should be 1950-2050 psi when restricting flow using load valve.

After testing, remove hose no. 4B from pump port no. 1. Remove pilot-operated relief and unloading valve assembly from pump port no. 44. Install hose no. 4B on pump port no. 44.

With main engine operating at 1800 rpm, operating pressure should be 1950-2050 psi when restricting flow using load valve.
a. Remove mechanical transmission and main hydraulic pump assembly. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.
b. Replace main hydraulic pump. Refer to paragraph 3-16.

Step 3. Inspect system selector valve lever for improper position.
Place system selector valve lever in MAIN position.

MECHANICAL TRANSMISSION AND MAIN HYDRAULIC PUMP CIRCUIT (MAIN HYDRAULIC SYSTEM)

15. MECHANICAL TRANSMISSION FAILS TO OPERATE

Step 1. Inspect mechanical transmission drive shaft.
If not rotating, repair or replace. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

Table 2-3. Troubleshooting-Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

MECHANICAL TRANSMISSION AND MAIN HYDRAULIC PUMP CIRCUIT
(MAIN HYDRAULIC SYSTEM) -Continued

Step 2. Inspect mechanical transmission for broken or restricted hose.
Replace mechanical transmission hose. Refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1.

Step. 3. Inspect mechanical transmission output shaft to main hydraulic pump. If not rotating, proceed with mechanical transmission clutch pressure check. Install pressure gage in mechanical transmission clutch pressure line. For location, refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1. With engine operating at 1800 rpm, and power control valve lever in ON position, normal operating pressure is 150 ±10 psi.

a. Remove mechanical transmission and main hydraulic pump assembly. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle. M88A1.

b. Replace mechanical transmission. Refer to paragraph 3-16.

Step 4. Test for defective power control valve or restricted hose. Remove hose no. 66 from mechanical transmission. With mechanical transmission drive shaft rotating, and power control valve lever placed in ON position. oil should flow from hose.

a. Replace defective power control valve. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

b. Replace restricted or damaged hose. Refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1.

16. MAIN HYDRAULIC PUMP FAILS TO ENGAGE

Step 1. Inspect for broken mechanical transmission and main hydraulic pump shaft coupling.

a. Remove mechanical transmission and main hydraulic pump assembly. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

b. Repair or replace shaft coupling. Refer to paragraph 3-16.

Step 2. Test for low hydraulic pressure to mechanical transmission clutch. Install pressure gage in mechanical transmission clutch pressure hose. For location, refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1. With engine operating at 1800 rpm, and power control valve lever in ON position, normal operating pressure should be 150 ± 10 psi.

a. Remove mechanical transmission and main hydrairlic pump assembly. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

b. Replace mechanical transmission. Refer to paragraph 3-16.

17. MECHANICAL TRANSMISSION OVERHEATING

Step 1. Inspect mechanical transmission for low oil level.
Add oil to bring to proper level. Refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1.

Step 2. Test for faulty mechanical transmission lubrication pump. Remove pipe plug from mechanical transmission test gage port and install pressure gage. For location of test gage port, refer to TM 9-230-256-20, Medium Recovery Vehicle, M88A1. With engine operating at 1800 rpm, normal operating pressure is 10 to 15 psi.

a. Remove mechanical transmission and main hydraulic pump assembly. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

b. Replace mechanical transmission. Refer to paragraph 3-16.

Step 3. Test for low hydraulic pressure to mechanical transmission clutch. Install pressure gage in mechanical transmission clutch pressure hose. For location, refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1. With engine operating at 1800 rpm, and power control valve lever in ON position, normal operating pressure should be 150 ± 10 psi.

a Remove mechanical transmission and main hydraulic pump assembly. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

b. Replace mechanical transmission. Refer to paragraph 3-16.

18. MECHANICAL TRANSMISSION SLIPPING OR CHATTERING

Step 1. Test for low hydraulic pressure to mechanical transmission clutch. Install pressure gage in mechanical transmission clutch pressure hose. For location, refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1. With

Table 2-3. Troubleshooting-Continued

MALFUNCTION
TEST OR INSPECTIOS
CORRECTIVE ACTION

MECHANICAL TRANSMISSION AND MAIN HYDRAULIC PUMP CIRCUIT (MAIN HYDRAULIC SYSTEM)-continud

engine operating at 1800 rpm, and power control valve lever in ON position, normal operating pressure should be l50 ± 10 psi.

a Remove mechanical transmission and main hydraulic pump assembly. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

b. Replace mechanical transmission Refer to paragraph 3-16.

19. MECHANICAL TRANSMISSION FAILS TO DISENGAGE MAIN HYDRAULIC PUMP

Step 1. Test for hydraulic overload. Remove hose no. 66 from mechanical transmission clutch housing. If mechanical transmission disengages with hose removed, it indicates a faulty power control valve.

Replace power control valve. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

Step 2. If mechanical transmission does not disengage with hose removed, it indicates a faulty mechanical transmis-don clutch assembly.

a Remove mechanical transmission and main hydraulic pump assembly. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

b. Replace mechanical transmission. Refer to paragraph 3-16.

20. MAIN HYDRAULIC PUMP NOISY

Step L Inspect hydraulic reservoir for low oil level.

Add oil to bring to proper level. Refer to TM 9-2350-256-20. Medium Recovery Vehicle, M88A1.

Step 2 Inspect for collapsed main hydraulic pump suction hose.

Replace suction hose. Refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1.

WARNING

Test components must be capable of withstanding a working pressure of 1950-2050 psi (Step 3 only)

NOTE

After performing main hydraulic pump test, return all plumbing to original configuration.

Step 3. Test main hydraulic pump. Remove check valve and tee between hose no. 4A and 4B. Install main hydraulic pump pressure tester kit (Item 14, Table 2-1) between hose no. 4A and hose no. 4B. Install test pressure gage in tee.

CAUTION

Make sure that the load valve is in full open position before performing test. When performing main hydraulic pump pressure test, do not restrict oil flow beyond opertaing pressure.

With main engine operating at 1800 rpm operating pressure should be 1950-2050 psi when restricting flow using load valve.

After testing remove hose no 4B from pump port no. 1. Remove pilot-operated relief and unloading valve assembly from pump port no. 44. Install hose no. 4B on pump port no. 44.

With main, engine operating at 1800 rpm. operating pressure should be 1950-2050 psi when restricting flow using load valve.

a. Remove mechanical transmission and main hydraulic pump assembly. Refer to TM 9-2350-256-34-1. Medium Recovery Vehicle, M88A1.

5. Replace main hydraulic pump. Refer to paragraph 3-16.

Table 2-3. Troubleshooting-Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

SPADE CIRCUIT (MAIN HYDRAULIC SYSTEM)

21. SPADE WILL NOT OPERATE

Step 1. Attempt operation of main winch, hoist winch and boom
If main winch, hoist winch and boom operate, proceed to step 13. If main winch, hoist winch and boom do not operate, proceed with step 2.

Step 2. Inspect mechanical transmission drive shaft.
If not rotating, repair or replace. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

Step 3. Inspect mechanical transmission for broken or restricted hose.
Replace mechanical transmission hose. Refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1.

Step 4. Inspect mechanical transmission output shaft If not rotating, proceed with mechanical transmission clutch pressure check. Install pressure gage in mechanical transmission clutch pressure line. For location, refer to TM 9-2350-256-20. Medium Recovery Vehicle, M88A1. With engine operating at 1800 rpm. and power control valve lever in OS position. normal operating pressure is 150 ± 10 psi.
a. Remove mechanical transmission and main hydraulic pump assembly. Refer to TM 9-2350-256-34-1. Medium Recovery Vehicle. M88A1.
b Replace mechanical transmission. Refer to paragraph 3-16

Step 5. Test for defective power control valve or restricted hose. Remove hose No. 66 from mechanical transmission. With mechanical transmission drive shaft rotating. and power control valve lever placed in ON position. oil should flow from hose.
a. Replace defective power control valve. Refer to TM 9-2350-256-34-1. Medium Recovery Vehicle. M88A1.
b. Replace restricted or damaged hose. Refer to TM 9-2350-256-20, Medium Recovery Vehicle. M88A1.

Step 6. Inspect main hydraulic pump for broken or damaged shaft coupling
a. Remove mechanical transmission and main hydraulic pump assembly Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.
b. Repair or replace shaft coupling. Refer to paragraph 3-16

WARNING

Test components must be capable of withstanding a working pressure of 1950-2050 psi (step 7 only).

NOTE

After performing main hydraulic pump test. return all plumbing to original configuration.

Step 7. Test main hydraulic pump. Remove check valve and tee between hose no. 4A and 4B. Install main hydraulic pump pressure tester kit (Item 14, Table 2-1) between hose no. 4A and hose no. 4B. Install test pressure gage in tee.

CAUTION

Make sure that the load valve is in full open position before performing test, When performing main hydraulic pump pressure test, do not restrict oil flow beyond operating pressure.

With main engine operating at 1800 rpm. operating pressure should be 1950-2050 psi when restricting flow using load valve.

After testing, remove hose no. 4B from pump port no. 1. Remove pilot-operated relief and unloading valve assembly from pump port no. 44. Install hose no. 4B on pump port no. 44.

With main engine operating at 1800 rpm. operating pressure should be 1950-2050 psi when restricting flow using load valve.
a. Remove mechanical transmission and main hydraulic pump assembly. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.
b. Replace main hydraulic pump. Refer to paragraph 3-16.

Step 8. Test for improperly adjusted pilot-operated relief and unloading valve. Install test gage in valve gage port. With engine operating at 1800 rpm. and spade in stowed position, place spade combination control valve lever in RAISE position and adjust relief valve.
Adjust relief pressure to 1950-2050 psi. For location of valve gage port, and adjusting screw. refer LO views B and C. figure 3-22.

Table 2-3. Troubleshooting-Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

SPADE CIRCUIT (MAIN HYDRAULIC SYSTEM) - Continued

Step 9. Inspect all hydraulic hoses and connections for visible indication of oil leaks.
Repair leaks or replace hydraulic hose. Refer to TM 9-2350-256-20. Medium Recovery Vehicle. M88A1.

Step 10. Inspect system selector valve lever for improper position.
Place system selector valve lever in MAIN position.

Step 11. Inspect auxiliary power unit (APU) emergency winch control valve lever for improper position.
Place auxiliary power unit (APU) emergency winch control valve lever in CLOSED position.

WARNING

Main winch must be in high range (step 12 only).

Step 12. Test for faulty pilot-operated relief and unloading valve. Attempt operation of boom and winches, If winches operate. but boom and spade fail to operate. it indicates a faulty pilot-operated relief and unloading valve. Shift main winch into high range and inhaul cable completely (clevis contacting front of plate). Continue holding main winch control lever in this position and attempt to operate spade combination control valve lever. Release both levers to neutral and operate spade combination control valve lever.
If the spade does not function. replace pilot-operated relief and unloading valve. Refer to TM 9-2350-256-34-1. Medium Recovery Vehicle, M88A1.

Step 13. Test for spade combination control valve failure. Install pressure gage in pilot operated relief and unloading valve gage port. If, when actuating boom combination control valve lever, operating pressure (1950-250 psi) is recorded on pressure gage, but when actuating spade combination control valve lever, on pressure is recorded on gage; it indicates a faulty spade combination control valve. For location of valve gage port, refer to view B, fig. 3-22.
Replace spade combination control valve. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

Step 14. Test for restricted or blocked cylinder return hose. Install pressure gage in pilot operated relief and unloading valve gage port If, when actuating spade combination control valve lever, operating pressure (1950-2050 psi) is recorded, return hose is restricted or blocked. For location of valve gage port, refer to view B, fig 3-22.
Remove any restriction or replace blocked hose. Refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1.

Step 15. Test for mechanical failure of hydraulic cylinders. Install test gage in pilot operated relief and unloading valve gage port. If, when actuating spade combination control valve lever, operating pressure (1950-2050 psi) is recorded and no return hose is blocked, it indicates mechanical failure of a hydraulic cylinder. For location of valve gage port, refer to view B, fig 3-22.
II. Remove main winch and spade assembly. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.
b. Replace spade cylinder. Refer to paragraph 3-6.

22. SPADE WILL NOT HOLD WITH SPADE COMBINATION CONTROL VALVE LEVER IN ANY POSITION

Step 1. Test for spade combination control valve failure. Install pressure gage in pilot operated relief and unloading valve gage port If, when actuating boom combination control valve lever, operating pressure (1950-2050 psi) is recorded on pressure gage, but when actuating spade combination control valve lever, no pressure is recorded on gage; it indicates a faulty spade combination control valve. For location of valve gage port, refer to view B, fig. 3-22.
Replace spade combination control valve. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

Step 2. Worn spade hydraulic cylinder packings.
a. Remove main winch and spade assembly. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle. M88A1.
b. Replace spade cylinder. Refer to paragraph 3-6.

Step 3. Ruptured hydraulic hose.
Replace hydraulic hose. Refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1.

Step 4. Damaged spade release valve.
Replace spade release valve. Refer to TM 9-2350-256-20.

Table 2-3. Troubleshaoting-Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

SPADE CIRCUIT (MAIN HYDRAULIC SYSTEM)-Continued

23. SPADE WILL. OPERATE ONLY PARTIALLY

Step 1. Test for improperly adjusted pilot operated relief and unloading valve. Install test gage in valve gage port. With engine operating at 1800 rpm, and spade in stowed position, place spade combination control valve lever in RAISE position and adjust relief valve.

Adjust relief pressure to 1950-2050 psi. For location of valve gage port and adjusting screw, refer to views B and C, fig 3-22.

Step 2. Inspect for loose spade cylinder attaching pins.

a. Remove main winch and spade assembly. Refer to TM 9-2350-256-34-1, Medium Recovery Valve, M88A1.

b. Repair or replace attaching pins. Refer to paragraph 3-6.

Step 3. Inspect for galled spade pivot pins.

a. Remove main winch and spade assembly, Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

b. Replace spade pivot pins. Refer to paragraph 3-6.

Step 4 Damaged spade release valve.

Replace spade release valve. Refer to TM 9-2350-256-20.

HOISTING BOOM CIRCUIT (MAIN HYDRAULIC SYSTEM)

24. BOOM WILL NOT OPERATE

Step 1. Attempt operation of main winch. hoist winch and spade.

If main winch. hoist winch and spade operate, proceed to step 13. If main winch. hoist winch and spade do not operate. proceed with step 2.

Step 2. Inspect mechanical transmission drive shaft.
If not rotating. repair or replace. Refer to TM 9-2350-256-34-1. Medium Recovery Vehicle. M88A1.

Step 3. Inspect mechanical transmission for broken or restricted hoses.
Replace any broken or restricted hoses. Refer to TM 9-2350-256-20. Medium Recovery Vehicle. M88A1.

Step 4. Test for defective power control valve or restricted hose. Remove hose no. 66 from mechanical transmission. With mechanical transmission drive shaft rotating. and power control valve lever placed in ON position. oil should flow from hose.
a. Replace defective power control valve. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.
b. Replace restricted or damaged hose. Refer to TM 9-2350-256-20. Medium Recovery Vehicle. M88A1.

Step 5. Inspect mechanical transmission output shaft. If not rotating. proceed with mechanical transmission clutch pressure check. Install pressure gage in mechanical transmission clutch pressure line. For location. refer to TM 9-2350-256-20. Medium Recovery Vehicle. M88A1. With engine operating at 1800 rpm. and power control valve lever placed in OS position. normal operating pressure is 150 ± 10 psi.

WARNING

Test components must be capable of withstanding a working pressure of 1950-2050 psi (step 6 only).

NOTE

After performing main hydraulic pump test. return all plumbing to original configuration.

Step 6. Test main hydraulic pump. Remove check valve and tee between hose no. 4A and 4B. Install main hydraulic pump pressure tester kit (Item 14, Table 2-1) between hose no. 4A and hose no. 4B. Install test pressure gage in tee.

CAUTION

Make sure that the load valve is in full open position before performing test. When performing main hydraulic pump pressure test, do not restrict oil flow beyond operating pressure.

With main engine operating at 1800 rpm. operating pressure should be 1950-2050 psi when restricting flow using load valve.

After testing, remove hose no. 4B from pump port no. 1. Remove pilot-operated relief and unloading valve assembly from pump port no. 44. Install hose no. 4B on pump port no. 44.

With main engine operating at 1800 rpm. operating pressure should be 1950-2050 psi when restricting flow using load valve.
a. Remove mechanical transmission and main hydraulic pump assembly. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.
b. Replace main hydraulic pump. Refer to paragraph 3-16.

Table 2-3. Troubleshooting--Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION	
HOISTING BOOM CIRCUIT (MAIN HYDRAULIC SYSTEM)-Continued	
Step 7.	Inspect main hydraulic pump for broken or damaged shaft coupling. a. Remove mechanical transmission and main hydraulic pump assembly. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1. b. Repair or replace shaft coupling. Refer to paragraph 3-16.
Step 8.	Test for improperly adjusted pilot-operated relief and unloading valve. Install test gage in valve gage port. With engine operating at 1800 rpm, and spade in stowed position. place spade combination control valve lever in RAISE position and adjust relief valve. Adjust relief pressure to 1950-2050 psi For location of valve gage port, and adjusting screw, refer to views B and C, figure 3-22.
Step 9.	Inspect all hydraulic hoses and connections for visible indication of oil leaks. Repair leaks or replace hydraulic hose. Refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1.
Step 10.	Inspect system selector lever for improper position. Place system selector lever in MAIN position.
Step 11.	Inspect auxiliary power unit (APU) emergency winch control valve lever for improper position. Place auxiliary power unit (APU) emergency winch control valve lever in CLOSED position.

Table 2-3. Troubleshooting--Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

HOISTING BOOM CIRCUIT (MAIN HYDRAULIC SYSTEM) - Continued

WARNING

Main winch must be in high range. (Step 12 only).

Step 12. Test for faulty pilot operated relief and unloading valve. Attempt operation of spade and winches. If winches operate, but spade and boom fail to operate, it indicates a faulty pilot operated relief and unloading valve. Shift main winch into high range an inhale cable completely (clevis contacting front of plate). Continue holding main winch control lever in this position and attempt to operate boom combination control valve lever. Release both levers to neutral and operate boom combination control valve lever. If boom does not function, replace pilot operated relief and unloading valve. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

Step 13. Test for boom combination control valve failure. Install pressure gage in pilot operated relief and unloading valve gage port. If, when actuating spade combination control valve lever, operating pressure (1950-2050 psi) is recorded on pressure gage, but when actuating boom combination control valve lever, no pressure is recorded on gage, it indicates a faulty boom combination control valve. For location of valve gage port, refer to view B. fig. 3-22. Replace boom combination control valve. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

Step 14. Test for restricted hydraulic hose or flow regulator. Install pressure gage in pilot operated relief and unloading valve gage port. If, when actuating boom combination control valve lever, operating pressure (1950-2050 psi) is recorded on pressure gage, it indicates valve is functioning properly. Inspect for restricted hydraulic hose or obstruction in flow regulator. For location of valve gage port, refer to view B, fig. 3-22.
a. Replace any restricted hydraulic hose. Refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1.
b. Remove any obstruction or replace flow regulator. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

Step 15. Inspect for mechanical failure of boom or hydraulic cylinder attaching pins.
Replace any damaged pins. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

25. BOOM OPERATES PARTIALLY

Step 1. Test for improperly adjusted pilot operated relief and unloading valve. Install test gage in valve gage port. With engine operating at 1800 rpm, and spade in stowed position, place spade combination control valve lever in RAISE position and adjust relief valve.
Adjust relief pressure to 1950-2050 psi. For location of valve gage port, and adjusting screw, refer to views B and C, fig. 3-22.

Step 2. Inspect for mechanical binding of boom and cylinder mounting pins. Replace any broken or damaged pins. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

26. BOOM WILL NOT HOLD IN ANY POSITION

Step 1. Inspect hydraulic hoses and connections for oil leaks
Repair leaks or replace hydraulic hose. Refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1.

Step 2. Test for boom combination control valve failure. Install pressure gage in pilot operated relief and unloading valve gage port. If when actuating spade combination control valve lever, no pressure is recorded on gage, it indicates a faulty boom combination control valve. For location of valve gage port, refer to view B, fig. 3-22.
Replace boom combination control valve. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

27. BOOM WILL NOT STOP AUTOMATICALLY AFTER LIVE BOOM OPERATION

Step 1. Inspect boom limit valve for defective or broken actuating arm linkage.
Repair or replace actuating arm linkage. Refer to TM 9-2350-256-20, Medium Replace Vehicle, M88A1.

Step 2. Inspect boom limit valves for proper adjustment.
Adjust boom limit valves. Refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1.

Table 2-3. Troubleshooting-Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

HOISTING BOOM CIRCUIT (MAIN HYDRAULIC SYSTEM) - Continued

28. BOOM LIVE OPERATION DOES NOT FUNCTION

Step 1. Inspect boom limit valve actuating shafts for binding.

Move boom limit valve actuating arm by hand and lubricate shafts. Refer to TM 9-2350-256-10, Medium Recovery Vehicle, M88A1, for lubrication points.

MAIN WINCH CIRCUIT (AUXILLARY HYDRAULIC SYSTEM)

29. MAIN WINCH WILL NOT OPERATE

Step 1. Inspect all hydraulic hoses and connections for visible indication of oil leaks.

Repair leaks or replace hydraulic hose. Refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1.

Step 2. Inspect system selector valve lever for improper position.

Place system selector valve lever in AUX position.

Step 3. Inspect auxiliary power unit (APU) emergency winch control valve lever for improper position.

Place auxiliary power unit (APU) emergency winch control valve lever in OPEN position.

WARNING

Test components must be capable of withstanding a working pressure of 1450-1550 psi (step 4 only).

Step 1. Test for broken drive mechanism or faulty auxiliary hydraulic pump. Disconnect auxiliary hydraulic pump discharge hose no. 12. Install suitable gage valve. in conjunction with pressure gage, to outlet of auxiliary hydraulic pump. When restricting oil flow, operating pressure should be 1450-1550 psi.

CAUTION

When performing auxiliary hydraulic pump pressure test, do not restrict oil flow beyond operating pressure.

Remove auxiliary power unit from vehicle. and replace broken auxiliary hydraulic pump drive mechanism parts. or faulty auxiliary hydraulic pump. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

Step 5. Test for faulty or improperly adjusted relief valve within system selector valve gage port. With auxiliary power unit operating. and auxiliary power unit (APU) emergency winch control valve lever placed in CLOSED position, place system selector valve lever in AUX position. and adjust relief valve.

a. Adjust relief pressure to 1450-1550 psi. For location of valve gage port, and adjusting screw, refer to view D. figure 3-20.

b. Replace system selector valve if pressure cannot be adjusted to 1450-1550 psi. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

Step 6. Inspect for faulty check valve in hoses. nos. 4B and 6B. Refer to TM 9-2350-256-20. Medium Recovery Vehicle, M88A1, for hose identification.

Replace check valve. Refer to TM 9-2350-256-34-1. Medium Recovery Vehicle, M88A1.

NOTE

Perform following tests using main hydraulic system (step 7 only).

Step 7. Test main winch combination control valve. and control valve. Refer to malfunction 1, steps 10 and 11, in Main Winch Circuit (Main Hydraulic System).

HOIST WINCH CIRCUIT (AUXILIARY HYDRAULIC SYSTEM)

30. HOIST WINCH WILL NOT OPERATE

Step 1. Inspect all hydraulic hoses and connections for visible indication of oil leaks.

Repair leaks or replace hydraulic hose. Refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1.

Step 2. Inspect system selector valve lever for improper position.

Place system selector valve lever in AUX position

Table 2-3. Troubleshooting--Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

HOIST WINCH CIRCUIT (AUXILIARY HYDRAULIC SYSTEM) - Continued

Step 3. Inspect auxiliary power unit (APU) emergency winch control valve lever for improper position.
Place auxiliary power unit (APU) emergency winch control valve lever in OPEN position.

WARNING
Test components must be capable of withstanding a working pressure of 1450-1550 psi (step 4 only).

Step 4. Test for broken drive mechanism of faulty auxiliary hydraulic pump. Disconnect auxiliary hydraulic pump discharge hose no. 12. Install suitable gate valve, in conjunction with pressure gage, to outlet of auxiliary hydraulic pump. When restricting oil flow, operating pressure should be 1450-1550 psi.

CAUTION
When performing auxiliary hydraulic pump pressure test, do not restrict oil flow beyond operating pressure.

Remove auxiliary power unit from vehicle, and replace broken auxiliary hydraulic pump drive mechanism parts, or faulty auxiliary hydraulic pump. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

Step 5. Test for faulty or improperly adjusted relief valve within system selector valve. Install pressure gage in system selector valve gage port. With auxiliary power unit operating, and auxiliary power unit (APU) emergency winch control valve lever placed in CLOSED position, place system selector valve lever in AUX position, and adjust relief valve.
a. Adjust relief pressure to 1450-1550 psi. For location of valve gage port, and adjusting screw, refer to view D, figure 3-20.
b. Replace system selector valve if pressure cannot be adjusted to 1450-1550 psi. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

Step 6. Inspect for faulty check valve in hoses, nos. 4B and 6B. Refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1. Replace check valve. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

NOTE
Perform the following tests using main hydraulic system (step 7 only).

Step 7. Test hoist winch combination control valve, and control valve. Refer to malfunction 9, steps 10 and 11, in the Hoist Winch Circuit (Main Hydraulic System).

SPADE CIRCUIT (AUXILIARY HYDRAULIC SYSTEM)

31. SPADE WILL NOT OPERATE

Step 1. Inspect all hydraulic hoses and connections for visible indication of oil leaks.
Repair leaks or replace hydraulic hose. Refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1.
Step 2. Inspect system selector valve lever for improper position.
Place system selector valve lever in AUX position.
Step 3. Inspect auxiliary power unit (APU) emergency winch control valve lever for improper position.
Place auxiliary power unit (APU) emergency winch control valve lever in CLOSED position.

WARNING
Test components must be capable of withstanding a working pressure of 1450-1550 psi (step 4 only).

Step 4. Test for broken drive mechanism or faulty auxiliary hydraulic pump. Disconnect auxiliary hydraulic pump discharge hose no. 12. Install suitable gate valve, in conjunction with pressure gage, to outlet of auxiliary hydraulic pump. When restricting oil flow, operating pressure should be 1450-1550 psi.

Table 2-3. Troubleshooting--Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

HOIST WINCH CIRCUIT (AUXILIARY HYDRAULIC SYSTEM) - Continued

CAUTION
When performing auxiliary hydraulic pump pressure test, do not restrict oil flow beyond operating pressure.

Remove auxiliary power unit from vehicle, and replace broken auxiliary hydraulic pump drive mechanism parts, or faulty auxiliary hydraulic pump. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

Step 5. Test for faulty or improperly adjusted relief valve within system selector valve. Install pressure gage in system selector valve gage port. With auxiliary power unit operating, and auxiliary power unit (APU) emergency winch control valve lever placed in CLOSED position, place system selector valve lever in AUX position, and adjust relief valve.
a. Adjust relief pressure to 1450-1550 psi. For location of valve gage port, and adjusting screw, refer to view D, figure 3-20.
b. Replace system selector valve if pressure cannot be adjusted to 1450-1550 psi. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

NOTE
Perform following tests using main hydraulic system (step 6 only).

Step 6. Test spade combination control valve, and spade cylinders. Refer to malfunction 21, steps 13, 14 and 15 in Spade Circuit (Main Hydraulic System).

HOIST BOOM CIRCUIT (AUXILIARY HYDRAULIC SYSTEM)

32. BOOM WILL NOT OPERATE

Step 1. Inspect all hydraulic hoses and connections for visible indications of oil leaks.
Repair leaks or replace hydraulic hose. Refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1.

Step 2. Inspect system selector valve lever for improper position.
Place system selector valve in AUX position.

Step 3. Inspect auxiliary power unit (APU) emergency winch control valve lever for improper position.
Place auxiliary power unit (APU) emergency winch control valve lever in CLOSED POSITION.

WARNING
Test components must be capable of withstanding a working pressure of 1450-1550 psi (step 4 only).

Step 4. Test for broken drive mechanism or faulty auxiliary hydraulic pump. Disconnect auxiliary hydraulic pump.; discharge hose no. 12. Install suitable gate valve, in conjunction with pressure gage, to outlet of auxiliary hydraulic pump. When restricting oil flow, operating pressure should be 1450-1550 psi.

CAUTION
When performing auxiliary hydraulic pump pressure test, do not restrict oil flow beyond operating pressure.

Remove auxiliary power unit from vehicle, and replace broken auxiliary hydraulic pump drive mechanism parts, or faulty auxiliary hydraulic pump. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

Step 5. Test for faulty or improperly adjusted relief valve within system selector valve. Install pressure gage in system selector valve gage port. With auxiliary power unit operating, and auxiliary power unit operating, and auxiliary power unit (APU) emergency winch control valve lever placed in CLOSED position, place system selector valve lever in AUX position, and adjust relief valve.
a. Adjust relief pressure 1450-1550 psi. For location of valve gage port, and adjusting screw, refer to view D, figure 3-20.
b. Replace system selector valve if pressure cannot be adjusted to 1450-1550 psi. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

NOTE
Perform following tests using main hydraulic system (step 6 only).

Step 6. Test boom combination control valve and flow regulators. Inspect for mechanical failure of boom or hydraulic cylinder attaching pins. Refer to malfunction 24, steps 13, 14, and 15 in Hoisting Boom Circuit (Main Hydraulic System).

Table 2-3. Troubleshooting--Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

FUEL TRANSFER PUMP (AUXILIARY HYDRAULIC SYSTEM)

33. FUEL TRANSFER PUMP DOES NOT OPERATE

Step 1. Inspect all hydraulic hoses and connections for visible indication of oil leaks.
Repair leaks or replace hydraulic hose. Refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1.

Step 2. Inspect system selector valve lever for improper position.
Place system selector valve lever in REFUEL position.

WARNING
Test components must be capable of withstanding a working pressure of 1450-1550 psi (Step 3 only).

Step 3. Test for broken drive mechanism or faulty auxiliary hydraulic pump. Disconnect auxiliary hydraulic pump discharge hose no. 12. Install suitable gate valve, in conjunction with pressure gage, to outlet of auxiliary hydraulic pump.
When restricting oil flow, operating pressure should be 1450-1550 psi.

CAUTION
When performing auxiliary hydraulic pump pressure test, do not restrict oil flow beyond operating pressure.

Remove auxiliary power unit from vehicle, and replace broken auxiliary hydraulic pump drive mechanism parts, or faulty auxiliary hydraulic pump. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

Step 4. Test for faulty or improperly adjusted relief valve within system selector valve. Install pressure gage in system selector valve gage port. With auxiliary power unit operating, and auxiliary power unit (APU) emergency winch control valve lever placed in CLOSED position, place system selector valve lever in AUX position, and adjust relief valve.
a. Adjust relief pressure to 1450-1550 psi. For location of valve gage port, and adjusting screw, refer to view D, figure 3-20.
b. Replace system selector valve if pressure cannot be adjusted to 1450-1550 psi. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

Step 5. Inspect impact wrench hoses for connection to outlets in compartment.

Disconnect impact wrench hoses.

Step 6. Inspect fuel transfer pump for broken or damaged shaft coupling. Repair or replace shaft coupling. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

Step 7. Inspect adjustable flow regulator lever for improper setting, or faulty adjustable flow regulator.
a. Refer to TM 9-2350-256-10, Medium Recovery Vehicle, M88A1 for proper setting.
b. If adjustable flow regulator lever is properly set, and fuel transfer pump does not operate, replace adjustable flow regulator. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

Step 8. Inspect fuel transfer pump control valve lever for improper position, or faulty control valve.
a. Refer to TM 9-2350-256-10, Medium Recovery Vehicle, M88A1 for position.
b. If fuel transfer pump control valve lever is properly positioned and fuel transfer pump does not operate, replace fuel transfer pump control valve. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

Step 9. Inspect fuel transfer pump hydraulic motor for oil leaks or unusual noise. Remove shaft coupling from fuel transfer pump and hydraulic motor. Operate auxiliary hydraulic system and inspect output shaft of hydraulic motor for rotation in both directions.
a. If hydraulic motor shaft does not operate in both directions, replace hydraulic motor. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.
b. If hydraulic motor leaks oil, or is noisy, replace hydraulic motor. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

Step 10. Inspect fuel transfer pump for unusual noise or fuel leaks.
a. If fuel transfer pump is noisy, or leaks, replace fuel transfer pump. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.
b. If fuel transfer pump is not noisy, or does not leak, and still fails to operate, replace fuel transfer pump. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

Table 2-3. Troubleshooting--Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

HYDRAULIC IMPACT WRENCH (AUXILIARY SYSTEM)

34. IMPACT WRENCH DOES NOT OPERATE

Step 1. Inspect all hydraulic hoses and connections for visible indication of oil leaks.
Repair leaks or replace hydraulic hose. Refer to TM 9-2350-256-20, Medium Recovery Vehicle, M88A1.

Step 2. Inspect system selector system valve lever for improper position.
Place system selector valve lever in REFUEL position.

WARNING
Test components must be capable of withstanding a working pressure of 1450-1550 psi (step 3 only)

Step 3. Test for broken drive mechanism or faulty auxiliary hydraulic pump. Disconnect auxiliary hydraulic pump discharge hose no. 12. Install suitable gate valve, in conjunction with pressure gage, to outlet to auxiliary hydraulic pump.
When restricting oil flow, operating pressure should be 1450-1550 psi.

CAUTION
When performing auxiliary hydraulic pump pressure test, do not restrict oil flow beyond operating pressure.

Remove auxiliary power unit from vehicle, and replace broken auxiliary hydraulic pump drive mechanism parts, or faulty auxiliary hydraulic pump. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

Step 4. Test for faulty or improperly adjusted relief valve within the system selector valve. Install pressure gage in system selector valve gage port. With auxiliary power unit operating, and auxiliary power unit (APU) emergency winch control valve lever placed in CLOSED position, place system selector valve lever in AUX position, and adjust relief valve.
a. Adjust relief pressure to 1450-1550 psi. For location of valve gage port, and adjusting screw, refer to view D, figure 3-20.
b. Replace system selector valve if pressure cannot be adjusted to 1450-1550 psi. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

Step 5. Inspect adjustable flow regulator lever for improper setting, or faulty adjustable flow regulator.
a. Refer to TM 9-2350-256-10, Medium Recovery Vehicle, M88A1, for proper setting.
b. If adjustable flow regulator lever is properly set, and impact wrench does not operate, replace adjustable flow regulator. Refer to TM 9-2350-256-34-1, Medium Recovery Vehicle, M88A1.

Step 6. Inspect fuel transfer pump control valve lever for improper position.
Place fuel transfer pump control valve lever in CLOSED position.

Step 7. Inspect impact wrench for oil leaks or unusual noise.
a. If impact wrench leaks oil, or is noisy, replace impact wrench.
b. If impact wrench does not leak oil, or is not noisy, and still fails to operate, replace impact wrench.

Section III. GENERAL MAINTENANCE

2-7. Installing Lock Wire

Locking wire is to be installed by the double twist method.

2-8. Application of Sealing Compounds

Application of sealing compound to pipe threads is specified in applicable sections of this manual.

2-9. Lubrication

Refer to TM 9-2350-256-10 and TM 9-2350-256-20 for detailed lubrication instructions covering the components of the Recovery Vehicle.

2-10. Maintenance and Operation of Main Hydraulic System

a. General. The main hydraulic system powers and controls the main winch. hoist winch, hoisting boom and spade. The main winch and hoist winch are driven by vane-type hydraulic motors, and the hoisting boom and spade are actuated by hydraulic cylinders. Hydraulic fluid, under pressure for operating the hydraulic motors and hydraulic cylinders, is provided through a closed power circuit by a fixed-displacement, vane-type, double pump driven by a mechanical transmission (power takeoff) from the main engine. The hydraulic pump draws its fluid from the hydraulic oil tank, and pump output is controlled by engine speed. The operation of the hydraulic motors and the hydraulic cylinders is controlled through the control circuit. Each winch hydraulic motor is provided with a pilot-operated, spring-centered, directional combination control valve which directs the fluid in the power circuit to the winch being operated. These directional control valves are remotely controlled by manually operated hydraulic control valves, which direct control pressure to them. The directional combination control valves for the spade and boom cylinders are manually controlled. Any internal leakage through the hydraulic motors, cylinders, or valves is returned to the hydraulic oil tank by tank return. Description of operation of the basic circuits in the main hydraulic system will be found in subparagraphs b through j below. Schematic diagrams of the main hydraulic system idling, and the hydraulic system operating the main winch, hoist winch, hoisting boom, and spade are shown in figures FO-1 through FO-9.

NOTE

Refer to TM 9-2350-256-10 for operating instructions for the winches, power takeoff, and hoist system.

b. Main Hydraulic System-Idling (Fig. FO-1). With the main engine operating at system idling speed, the power control valve is placed in the ON position, directing mechanical transmission pump pressure to the clutch (port no. 228), thus engaging the clutch which permits the mechanical transmission to drive the main hydraulic pump. The pump draws filtered fluid from the hydraulic oil tank (port no. 69) and discharges it through two outlet ports (port nos. 1 and 44) under pressure. The pump discharge pressure is directed to the relief and unloading valve (port no. 2) and the hoist winch combination control valve (port no. 27). Pump discharge pressure passes through the relief and unloading valve, (port no. 3) through the hydraulic subplate (port nos. 136 and 125) of the main hydraulic control panel, and to the system selector valve (port no. 45) which is placed in the MAIN position. The pump pressure is then directed to, and blocked at the spade and boom cumbination control valves (port no. 33), as they are in their normal spring-centered HOLD position. Differential pressure across the pilot pressure valve, in the main relief valve, forces the valve open to allow a parallel flow (port no. 4) of pump discharge pressure to be directed to the hoist winch combination control valve (port no. 22). Differential pressure across the pilot pressure valve, in the hoist winch combination control valve, forces the valve open, directing the pump pressure (port no. 20) to the main winch combination control valve (port nos. 12 and 13), where the action duplicates the hoist winch combination control valve and the hydraulic fluid is returned to the oil tank (port no. 11). Hydraulic pressure is directed to both sides of the winch motors (port nos. 17 and 18) by the spring-centered directional control valve in the winch combination control valves.

c. Main Winch-Payout (Fig. FO-2). With the main winch control valve placed in the PAYOUT position, the pilot pressure (port nos. 15 and 16) tends to equal pump discharge pressure and is directed to both ends of the pilot-operated directional control valve (port nos. 8 and 10) in the main winch combination control valve. The ends of the directional control valve differ in size, the larger end at port no. 10 and the hydraulic differential across the valve causes it to move, directing the flow of pump pressure to one side of the main winch motor (port no. 18), causing the motor to drive the main winch in the PAYOUT direction. The pilot pressure is also directed to the main winch brake cylinder to disengage the winch brake. Pump

discharge pressure (port no. 52) is also directed to the level winder valve (port no. 50) which controls the direction of movement of the cable level winder.

d. *Main Winch-Inhaul* (fig. FO-3). With the main winch control valve placed in the INHAUL position, the hydraulic pressure at the large area end of the pilot-operated directional control valve in the main winch combination control valve, is directed to the tank return (port no. 10). The pilot pressure is directed to one end (port no. 8) of the pilot-operated directional control valve, positioning the valve to direct pump pressure to one side of the main winch motor (port no. 17) and causing the motor to drive the main winch in the INHAUL direction. The hydraulic pressure in the brake cylinder is ported to tank return, causing the brake cylinder springs to engage the brake; and the brake ratchet and pawls are available for instant braking. Pump pressure is also being directed to the level winder valve (port no. 50).

e. Hoist Winch-Lower (fig. FO-4). With the hoist winch control valve placed in the LOWER position, pilot pressure is directed to both ends of the pilot-operated directional control valve (port nos. 19 and 24) in the hoist winch combination control valve. The differential across the directional control valve, due to the difference in size, positions the valve directing the pump pressure (port No. 57) to one side of the hoist winch motor (port no. 17). The hoist winch motor then drives the hoist winch in the LOWER direction. Pilot pressure is directed to the hoist winch brake cylinder, overcoming the spring force, causing the brake band to expand, and allowing the brake drum to rotate.

*f. Hoi*st *Winch-Raise* (fig. FO-5). With the hoist winch control valve placed in the RAISE position, the hydraulic pressure at the large end (port no. 19) of the pilot-operated directional control valve in the hoist winch combination control valve is directed to tank return. The pilot pressure is directed to one end of the pilot-operated directional control valve (port no. 24), positioning the valve to direct pump pressure to one side of the hoist winch motor (port no. 18) and causing the motor to drive the hoist winch in the RAISE position. The brake cylinder pressure is directed to tank return, allowing the brake cylinder springs to compress the brake band around the winch brake drum, and providing instant braking through the brake drum ratchet and pawls.

g. Hoisting Boom-Forward (fig. FO-6). With the manually operated directional control valve, in the boom combination control valve, placed in the FORWARD position and at the same time placing the boom safety valve in the STOW position, pilot pressure is blocked at both valves. (port nos. 31 and 39). Pump discharge pressure (port no. 34) is directed to the boom cylinders, extending the piston rod and raising the boom. The stayline cylinder pistons are retracted mechanically into the stayline cylinders by the crankarms and the fluid behind the piston is forced out to tank return (port No. 62).

h. Hoisting Boom-Retract/Stow (fig. FO-7). With the manually operated directional control valve, in the boom combination control valve, placed in the RETRACT/STOW position, and at the same time placing the boom safety valve in the STOW position, pilot pressure is blocked at both valves (port nos. 31 and 39). Pump discharge pressure is directed to one end of the boom (port no. 61) and stayline cylinders (port no. 62), the opposite cylinder ends are ported to tank return (port nos. 61 and 62), causing the boom cylinders to retract and the stayline cylinders to extend.

i. Spade--Raise (fig. FO-8). With the manually operated directional control valve, in the spade combination control valve, placed in the RAISE position, pilot pressure is blocked at the valve (port no. 30). Pump discharge pressure is directed to one end of the spade cylinders (port no. 59), and the opposite end (port no. 60) is ported to the tank return, causing the cylinder rod to retract and raising the spade.

j. *Spade-Lower* (fig. FO-9). With the manually operated directional control valve, in the LOWER position, pilot pressure is blocked at the valve (port no. 30). Pump discharge pressure is directed to one end of the cylinders (port no. 60) and the opposite end (port no. 59) is ported to the tank return, extending the cylinder rod causing the spade to lower.

2-11. Maintenance and Operation of Auxiliary Hydraulic System

a. *General.* The auxiliary hydraulic system powers and controls the hoisting boom, spade, main winch and hoist winch when the main engine is inoperative. The auxiliary hydraulic system also powers and controls the refuel-defuel pump and the hydraulic impact wrench. The auxiliary system power is supplied by a fixed-displacement, gear-type hydraulic pump which draws fluid from the hydraulic oil tank and is driven by the auxiliary power unit. The auxiliary hydraulic pump output is determined by the governed speed of the power unit engine. Any internal leakage through the hydraulic cylinders or valves is returned to the hydraulic oil tank by the tank return circuit. The operation of the hoisting

boom, spade, main winch and hoist winch is controlled by the same control valves as used in the main hydraulic system. The operation of the refuel-defuel system is controlled by a manually operated four-way selector valve and an adjustable flow regulator. Description of operation of the basic circuits in the auxiliary hydraulic system will be found in*b* through *l* below. Schematic diagrams of the auxiliary hydraulic system idling, the main winch inhaul and payout, the hoist winch raise and lower, the hoisting boom raise and lower, the spade raise and lower, the refuel-defuel pump, and the impact wrench are shown in figures FO-10 through FO-20.

NOTE

Refer to TM 9-2350-256-16 for operating instructions for the boom, winches, spade, refuel-defuel and impact wrench system.

b. Auxiliary Hydraulic System-Idling (Fig. FO-10). With the auxiliary power unit operating, the system selector valve in the MAIN position, and the auxiliary power unit (APU) emergency winch control valve in the CLOSED position, oil is drawn from the hydraulic reservoir (port No. 243) into the pump (port No. 63), and the pump discharges low pressure oil (port No. 64) to the system selector valve (port No. 48) and returns to the reservoir (port No. 236). The above valve lever positions are used when the auxiliary power unit generator is being used to charge the batteries.

c. Main Winch-Inhaul (fig. FO-1 1). With the system selector valve in the AUXILIARY position, and the auxiliary power unit (APU) emergency winch control valve in the OPEN position, hydraulic pressure is directed to the main winch combination control valve (port Nos. 12 and 13), and returns to the reservoir (port No. 237). With the main winch control valve placed in the INHAUL position, the hydraulic pressure at the large area end of the pilot-operated directional control valve, in the main winch combination valve, is directed to tank return (port No. 10). The pilot pressure is directed to one end (port No. 8) of the pilot-operated directional control valve, positioning the valve to direct pump pressure to one side of the main winch motor (port No. 17) and causing the motor to drive the main winch in the INHAUL direction. The hydraulic pressure in the brake cylinder is ported to tank return, causing the brake cylinder springs to engage the brake, and the brake ratchet and pawls are available for instant braking. Pump pressure is also being directed to the level winder valve (port No. 50) which controls the movement of the cable level winder.

d. Main Winch-Payout (fig. FO-12). With the system selector valve in the AUXILIARY position, and the auxiliary power unit (APU) emergency winch control valve in the OPEN position, hydraulic pressure is directed to the main winch combination control valve (port Nos. 12 and 13), and returns to the reservoir (port No. 237). With the main winch control valve placed in the PAYOUT position, the pilot pressure (port Nos. 15 and 16) tends to equal pump discharge pressure and is directed to both ends of the pilot-operated directional control valve (port Nos. 8 and 10) in the main winch combination control valve. The ends of the directional control valve differ in size, the larger end at port No. 10 and the hydraulic differential across the valve causes it to move, directing the flow of pump pressure to one side of the main winch motor (port No. 18), causing the motor to drive the main winch in the PAYOUT direction. The pilot pressure is also directed to the main winch brake cylinder to disengage the winch brake. Pump discharge pressure is also directed to the level winder valve (port No. 50) which controls the direction of movement of the cable level winder.

e. Hoist Winch-Raise (fig. FO-13*).* With the system selector valve in the AUXILIARY position, and the auxiliary power unit (APU) emergency winch control valve in the OPEN position, hydraulic pressure is directed to the hoist winch combination control valve (port Nos. 22 and 27), and returns through the main combination control valve to the reservoir (port No. 237). With the hoist winch control valve placed in the RAISE position, the hydraulic pressure at the large end (port No. 19) of the pilot-operated directional control valve in the hoist winch combination control valve is directed to tank return. The pilot pressure is directed to one end of the pilot-operated directional control valve (port No. 24), positioning the valve to direct pump pressure to one side of the hoist winch motor (port No. 18) and causing the motor to drive the hoist winch in the RAISE direction. The brake cylinder hydraulic pressure is directed to tank return, allowing the brake cylinder springs to compress the brake band around the winch brake drum, and providing instant braking through the brake drum ratchet and pawls.

f. Hoist Winch-Lower (fig. FO-14). With the system selector valve in the AUXILIARY position, and the auxiliary power unit (APU) emergency control valve in the OPEN position, hydraulic pressure is directed to the hoist winch combination control valve (port Nos. 22 and 27), and returns through the main winch combination control valve to the reservoir (port No. 237). With the hoist winch control valve placed in the LOWER position, pilot pressure

is directed to both ends of the pilot-operated directional control valve (port Nos. 19 and 24) in the hoist winch combination control valve. The differential across the directional control valve, due to the difference in size, positions the valve directing the pump pressure to one side of the hoist winch motor (port No. 17). The hoist winch motor then drives the hoist winch in the LOWER direction. Pilot pressure is directed to the hoist winch brake cylinder, overcoming the spring force, causing the brake band to expand, and allowing the brake drum to rotate.

g. Hoisting Boom-Forward (fig. FO-15). With the auxiliary power unit (APU) emergency winch control valve in the CLOSED position, and the system selector valve in the AUXILIARY position, the pressure is directed to the boom combination control valve and the spade combination control valve (port No. 33) and is blocked. The oil then flows over the relief valve in the system selector valve and returns to the reservoir (port No. 236). With the boom combination control valve placed in the FORWARD position, and at the same time placing the boom safety valve in the STOW position, pump discharge pressure is directed to the boom cylinders. The pump pressure, directed to one end of the cylinder (port No. 62) with the other end (port No. 61) ported to the tank return, causes the piston rod to extend, raising the boom. The stayline cylinder pistons are retracted mechanically into the cylinders by the crankarms and the fluid behind the pistons is forced out of the cylinders (port No. 62) to the tank return.

h. Hoisting Boom-Retract/Stow (fig. FO-16). With the auxiliary power unit (APU) emergency winch control valve in the CLOSED position, and the system selector valve in the AUXILIARY position, the pressure is directed to the boom combination control valve and the spade combination control valve (port No. 33) and is blocked. The oil then flows over the relief valve in the system selector valve and returns to the reservoir (port No. 236). With the boom combination control valve placed in the STOW position, pump discharge pressure is directed to the boom cylinders (port No. 61) and stayline cylinders (port No. 62). The pump pressure, directed to one end of the cylinder while the opposite end is ported to the tank return, causes the boom cylinders to retract and the stayline cylinders to extend.

i. Spade-Raise (fig. FO-17). With the auxiliary power unit (APU) emergency winch control valve in the CLOSED position, and the system selector valve in the AUXILIARY position, the pressure is directed to the spade combination control valve and the boom combination control valve and is blocked (port No. 33). The oil then flows over the relief valve in the system selector valve and returns to the reservoir (port No. 236). With the spade combination control valve placed in the RAISE position, pump pressure is directed to the rod end of the spade cylinder (port No. 59). The back end of the cylinder is ported to tank return, (port No. 235). The differential across the piston causes the rod to retract, raising the spade.

j. Spade-Lower (fig. FO-18). With the auxiliary power unit (APU) emergency winch control valve in the CLOSED position, and the system selector valve in the AUXILIARY position, the pressure is directed to the spade combination control valve and the boom combination control valve is blocked (port No. 33). The oil then flows over the relief valve in the system selector valve and returns to the reservoir (port No. 236). With the spade combination control valve placed in the LOWER position, pump pressure is directed to the back end of the spade cylinder (port No. 60). The opposite end is ported to the tank return (port No. 235). The differential across the piston causes the rod to extend, lowering the spade.

k. Refuel {fig. FO-19). With the auxiliary power unit (APU) emergency winch control valve in the CLOSED position, the impact wrench disconnected, and the system selector valve placed in the REFUEL position, pump pressure is directed to the adjustable flow regulator (port IN) and the four-way selector valve. The flow of the hydraulic pressure to the pressure side of the four-way selector valve can be carried by the adjustable flow regulator. Placing the four-way selector valve in the REFUEL position, directs the auxiliary pump pressure to the gear-type refuel-pump motor (port No. 65), which is coupled to and drives the refuel pump. The hydraulic oil (port No. 66) returns to the tank after passing through the refuel pump motor. Placing the four-way selector valve in the DEFUEL position causes the opposite motor and pump rotation.

l. Impact Wrench (fig. FO-20). With the impact wrench hoses connected, the auxiliary power unit (APU) emergency winch control valve in the CLOSED position, and the system se-

lector valve in the REFUEL position, the hydraulic pressure is directed to the adjustable flow regulator and is blocked at the four-way selector valve, which is in the Closed position. Pressure is then directed through the impact wrench and returns to the reservoir (port No. 245).

Section IV. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS

2-12. Hoisting Boom Assembly (Fig. 1-3)

Instructions for removal and installation of the hoisting boom assembly are contained in TM 9-2350-256-34-1.

2-13. Main Winch and Spade Assembly (Fig. 1-3)

Instructions for removal and installation of the main winch and spade assembly are contained in TM 9-2350-256-34-1.

2-14. Hydraulic Subplate Assembly (Fig. 1-3)

Instructions for removal and installation of the hydraulic subplate assembly are contained in TM 9-2350-256-34-1.

2-15. Mechanical Transmission and Main Hydraulic Pump Assembly (Fig. 1-3)

Instructions for removal and installation of the mechanical transmission and main hydraulic pump assembly are contained in TM 9-2350-256-34-1.

2-16. Hoist Winch Assembly (Fig. 1-3)

Instructions for removal and installation of the hoist winch assembly are contained in TM 9-2350-256-34-1.

2-17. Hydraulic Oil Tank Assembly (Fig. 1-3)

Instructions for removal and installation of the hydraulic oil tank assembly are contained in TM 9-2350-256-34-1.

2-18. Spade Subplate and Combination Control Valve Assembly (Fig. 1-3)

Instructions for removal and installation of the spade subplate and control valve assembly are contained in TM 9-2350-256-34-1.

2-19. Flow Regulator Subplate Assembly (fig. 1-3)

Instructions for removal and installation of the flow regulator subplate assembly are contained in TM9-2350-256-34-1.

Section V. ADJUSTMENT AND LOAD TEST PROCEDURES FOR THE MAIN WINCH, HOIST WINCH AND LIVE BOOM CAPABILITY

2-20. Adjustment and Load Test of Main

NOTE

Valves are adjusted by vehicle manufacturer. Should verification of adjustment be required, these procedures shall be used.

a. General. The main winch has an inhaul capacity of 90,000 pounds maximum, using a single part line on bare drum (3 to 5 wraps minimum of cable on bare drum and not to exceed the first layer). The main winch combination control valve shall be adjusted by the following procedures so that main winch will have a capacity as specified.

b. Vehicle Preparation. Prior to adjusting main winch combination control valve, the following shall be accomplished:

WARNING

Test components (pressure gages, hoses, and fittings) must be capable of withstanding a working pressure of 1950 to 2050 psi.

Step 1 Install pressure gage (NSN 4910-00-766-3355) in level wind gage port (figure 2-3).

NOTE

Do not adjust brake if anchoring cable.

Step 2 Place load on winch. Use load cell if available and anchor. If load cell is unavailable, attach winch cable to an anchoring device or adjust winch brake full tight. (Refer to TM 9-2350-256-20 for brake adjustment procedure.)

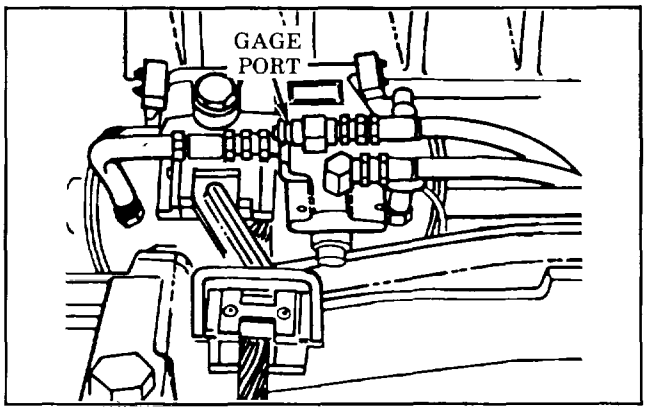


Figure 2-3. Main winch level wind gage port.

Step 3 If using anchor or winch brake, use adjusting screw on main combination control valve (figure 2-4) to reduce pressure as far as possible. Turning in counterclockwise direction will decrease pressure.

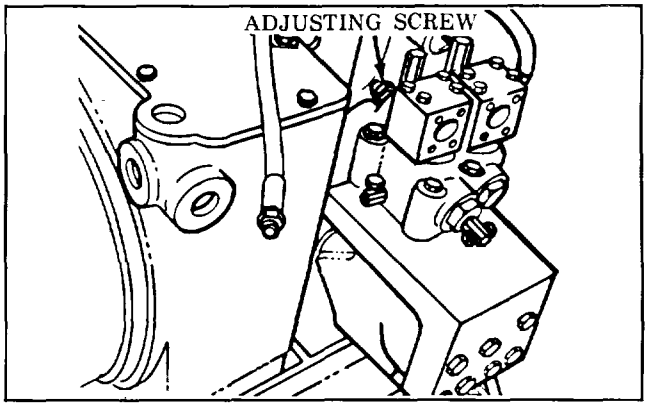


Figure 2-4. Main winch combination control valve adjusting screw.

Step 4 Set engine speed at 1600-1800 rpm.

NOTE

The adjustment and load test shall be accomplished with the hydraulic reservoir oil temperature at 100°F to 130°F.

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c. Main Winch Combination Control Valve Adjustment. Adjust to achieve winching requirements as follows:

CAUTION
Do not exceed 1900 psi relief pressure.

Step 1 If using load cell, adjust relief pressure to achieve desired pull by turning adjusting screw on main winch combination control valve (figure 2-4). Turning in clockwise direction will increase pressure.
- 88,000 - 92,000 lb pull with cable off nose roller
- 83.000 - 87,000 lb pull with cable over nose roller

Step 2 If using load cell, activate winch to INHAUL in low gear. If using anchor, activate winch to INHAUL. If using winch brake, activate winch to pay out.
Step 3 If using anchor or winch brake, adjust relief pressure to original value recorded in Vehicle Log Book.
Step 4 Verify setting with locking nut in locked position, and record new setting in Vehicle Log Book.
Step 5 Disconnect pressure gage. Disconnect load cell or anchor, or readjust winch brake as necessary.
Step 6 Verify pay out and inhaul.

NOTE

If adjustment was done using load cell, no further load test is required. If adjustment was done using anchor or brakes. Proceed with load test below.

d. Load Test.
Step 1 Verify winching capability by attaching winch cable to a vehicle with the towed vehicle transmission in neutral.
Step 2 Winch vehicle at least 10 feet.
Step 3 If vehicle fails to pass the load test, perform adjustment procedures as presented in paragraph 2.20 b thru d.

2-21. Adjustment and Load Test of Hoist Winch

NOTE

Valves are adjusted by vehicle manufacturer. *Should verification* or *adjustment* be required, these procedures shall be used.

a. General. The hoist winch shall have a vertical lifting capacity of 30,000 pounds, full drum and 50,000 pounds bare drum, using a four-part line (3 to 5 wraps minimum of cable on a bare drum). The hoist winch combination control valve shall be adjusted by the following*procedures* so that the hoist will have the lifting capacity as specified.

NOTE

For bare drum verification of hoist winch combination control valve, a test cable may be fabricated not to exceed 110 ft in length, using fabrication instructions in paragraph 3-8e.

b. Vehicle preparation. Prior to adjusting hoist winch combination control valve, the following shall be accomplished:

WARNING
Test components (pressure gages, hoses, and fittings) must be capable of withstanding a working pressure of 1950 to 2050 psi.

Step 1 Install pressure gage (NSN 4810-00-766-3355) in hoist winch combination control valve gage port (figure 2-5).

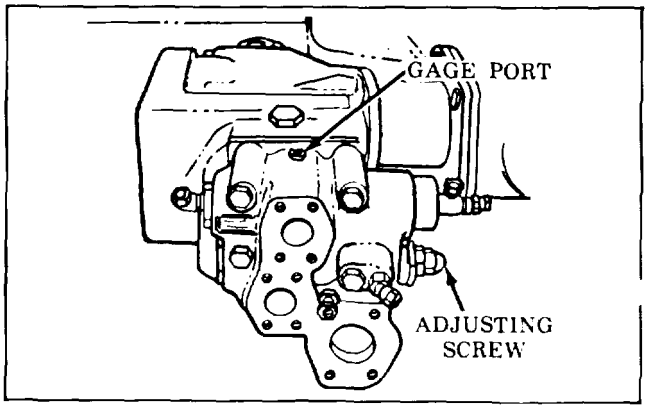

Figure 2-5. Hoist winch combination control valve gage port and adjusting screw.

NOTE

If using anchor, do not adjust brake.

Step 2 Place load on winch. Use calibrated weights or load cell if available. Load cell must be anchored. If loadcell or weights are unavailable, attach cable to an anchor or adjust winch brake full tight. Refer to TM 9-2350-256-20 for brake adjustment procedure.

Step 3 If using anchor or winch brake, use adjusting screw on hoist winch combination control valve (figure 2-5) to reduce pressure as far as possible. Turning in a counterclockwise direction will decrease pressure.

Step 4 Set engine speed at 1600-1800 rpm.

NOTE

The adjustment and load test shall be accomplished with the hydraulic reservoir oil temperature at 100°F to 130°F.

c. Hoist Winch Combination Control Valve Adjustment. Adjust to achieve hoisting requirements as follows:

CAUTION

Do not exceed 1000 psi relief pressure.

Step 1 If using calibrated weights or load cell, use adjusting screw on hoist winch combination control valve (figure 2-5) to adjust relief pressure to achieve maximum lift of 50,000 to 55,000 lb. Turning in a clockwise direction will increase pressure.

Step 2 Activate winch to raise in low gear.

CAUTION

Do not exceed 1000 psi relief pressure.

Step 3 If using anchor or winch brake, adjust relief pressure tooriginal value recorded in Vehicle Log Book.

Step 4 Verify setting with locking nut in locked position, and record new setting in Vehicle Log Book.

Step 5 Disconnect pressure gage. Disconnect weights, load cell or anchor or readjust winch brake.

NOTE

If smooth lowering capability is not obtained, adjust counterbalance valve (figure 2-6). Refer to paragraph 2-21 e for adjustment procedure.

Step 6 Verify smoothness of lowering capability.

NOTE

If adjustment was done using calibrated weights or a load cell no further load test is required. If relief valve was set with anchor or brake, proceed with load test given below.

d. Load Test.

Step 1 Verify lifting capability by rigging a four part line and raising and lowering a load of at least 25,000 pounds. The rear of an M88A1, a medium tank, or equivalent may be used.

NOTE

If a smooth lowering capability is not obtained, adjust counterbalance valve (figure 2-6). Refer to paragraph 2-21 e for adjustment procedure.

Step 2 Verify smoothness of lowering capability.

Step 3 If vehicle fails to pass the load test, perform adjustment procedures as presented in paragraph 2.21 b and c.

e. Counterbalance Valve Adjustment. With engine operating at 1600 to 1800 rpm and HOIST WINCH operating lever in LOVER position, adjust counterbalance valve (figure 2-6) by turning adjusting screw until hoist winch provides a smooth lowering capability.

2-22. Adjustment and Load Test of Live Boom Capability.

a. Vehicle preparation. Prior to adjusting boom combination control valve (figure 2-7) the following shall be accomplished:

WARNING

Test components (pressure gages, hoses, and fittings) must be capable of withstanding a working pressure of 1950 to 2050 psi.

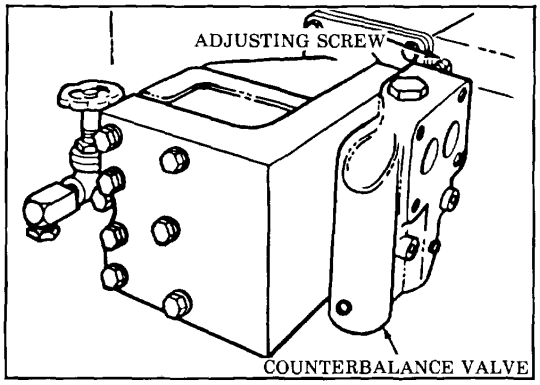

Figure 2-6. Counterbalance valve adjusting screw.

Step 1 Install pressure gage (NSN 4910-00-766-3355) in boom combination control valve rear gage port (toward rear of vehicle). Refer to figure 2-7 for location of test gage port.

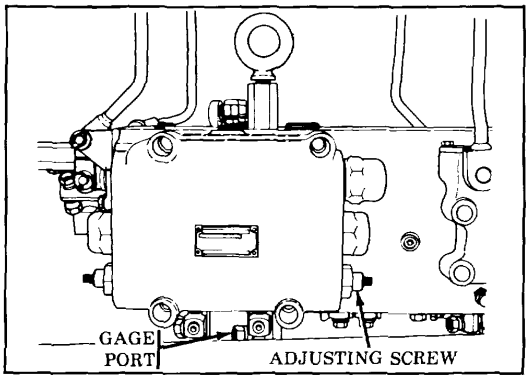

Figure 2-7. Boom combination control valve gage port and adjusting screw.

Step 2 If using load cell or calibrated weights, rig a four-part line and extend the boom to an 8-foot reach. Attach load cell or weights. Load cell must be anchored. If a load cell or weights are not available, place boom in STOW position. Then block boom in a partially raised position using 2 x 4 wooden blocks on top of each armor air intake cover. (Covers are located at the top rear of the crew compartment.)

Step 3 Set engine speed at 1600-1800 rpm.

NOTE

The adjustment and load test shall be accomplished with the hydraulic reservoir oil temperature at 1000F to 1300F.

b. Boom combination control valve adjustment. (figure 2-7) Adjust to achieve live boom capability as follows:

CAUTION

Do not exceed 1700 psi relief pressure.

Step 1 If using load cell or weights, activate boom valve to RETRACT position and use adjusting screw on boom combination control valve (figure 2-7) to achieve a pull of 50,000 to 55,000 pounds. Turning in a clockwise direction will increase pressure. If blocking the boom, place the boom operating lever in RETRACT position and boom safety control lever in STOW position. Adjust boom combination control valve rear relief (toward rear of vehicle) to 1600 psi by turning the adjusting screw (figure 2-7). Turning in clockwise direction will increase pressure.

NOTE

Pressure should be between 1550 and 1650 psi. Do not exceed 1650 psi.

Step 2 Verify pressure with locking nut set in locked position and record new setting in Vehicle Log Book.

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Step 3 Disconnect pressure gage. Remove load cell or weights. Remove blocking.

NOTE

If adjustment procedure was done using load cell or calibrated weights, no further load test is required. If adjustment was made with boom blocked, verify capabilities with the load test given below.

c. Load Test.

Step 1 Rig a four-part line and extend the boom to an 8-foot reach.
Step 2 Attach load. Use load cell or calibrated weights if available. The rear of an M88A1, a medium tank, or equivalent may be used if the load cell or weights are unavailable.
Step 3 Activate boom valve to RETRACT position.
Step 4 If vehicle fails to pass the load test, perform adjustment procedures as presented in paragraph 2-22 a and b.

CHAPTER 3
REPAIR INSTRUCTIONS

Section I. REPAIR OF HOISTING BOOM ASSEMBLY

3-1 Description

The hoisting boom (fig. 1-13) is a tubular A-frame, and is pivot-mounted to the top front of the vehicle. Hydraulic pressure raises or lowers the boom by means of two boom-actuating cylinders which are activated by the boom control lever. The hoisting boom is capable of holding a 25-ton load. In operating position, the boom is supported by a stayline cable secured to crank arms located at the rear of the hull. These crank arms are connected to hydraulically actuated stayline cylinders which govern the reaching capacity of the hoisting boom. A boom travel lock is provided for preventing movement of the boom, particularly sideways, while traveling.

3-2 Disassembly of Hoisting Boom Assembly into Subassemblies

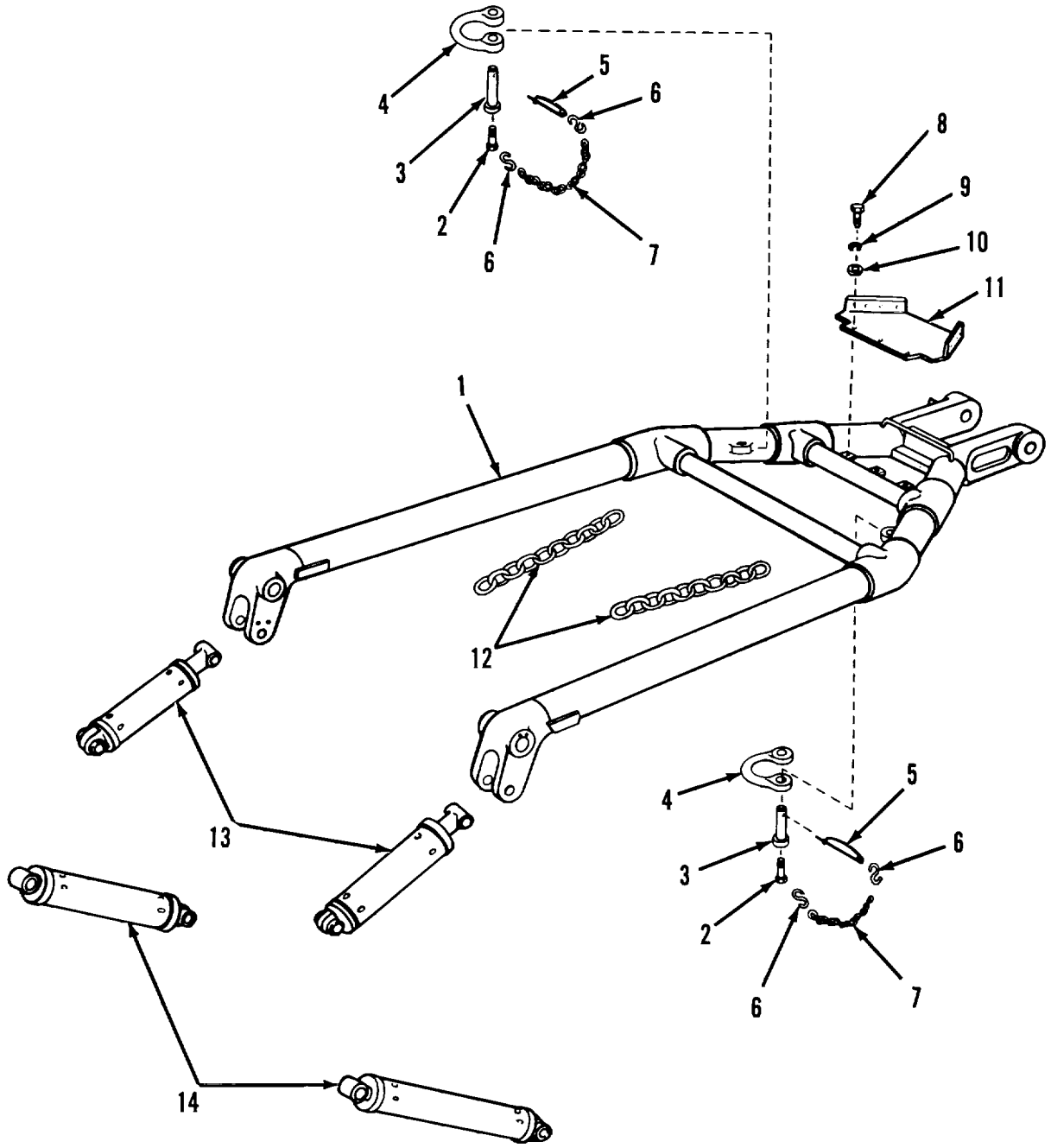
CAUTION

LOAD TEST REQUIREMENT

a. Load testing of main winch, hoist winch and boom is mandatory, prior to use under any of the following conditions:
   (1) When new.
   (2) Following any repairs, disassembly and assembly, adjustments or parts replacement of hoist winch or boom.
   (3) When modifications are made that could affect the strength or lifting capabilities of the vehicle.
b. Load testing will be accomplished by support maintenance activities.
c. Refer to Chapter 2, Section V for detailed step-by-step procedures.

a. General. Figure3-1 shows the subassemblies and attaching parts of the hoisting boom assembly.

b. Disassembly Procedure. The peculiar nature of the hoisting boom assembly makes it necessary to disassemble it into subassemblies during removal. For detailed instructions concerning removal and disassembly into subassemblies, refer to TM 9-2350-256-34-1.



LEGEND:

1	Boom (A)	5	Retaining pin (B)	9	Lockwasher (A)	13	Boom cylinder
2	Screw (B)	6	S-hook (B)	10	Washer (A)	14	Stayline cylinder
3	Shackle pin (B)	7	Chain, shackle (B)	11	Tray (A)		
4	Shackle attachment (B)	8	Screw (A)	12	Chain assembly (B)		

Note: The letters in parentheses refer to figure 3-2 view.

Figure 3-1. Hoisting boom assembly, partially exploded view--disassembly and assembly.

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3.3. Repair of Hoisting Boom

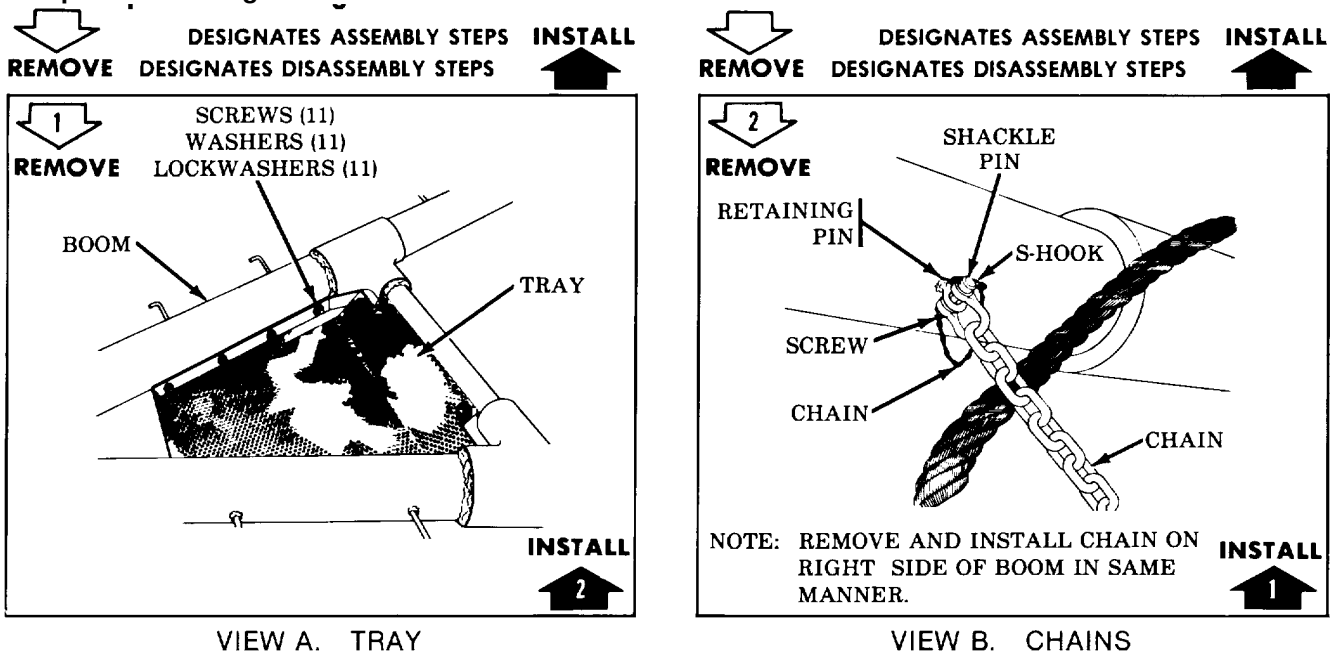

Figure 3-2. Repair of Hoisting Boom

a. General. Refer to TM 9-2350-256-34-1 and Figure 3-2 for instructions on disassembly of the hoisting boom.

b. Cleaning. Wash the boom assembly with hose and water or steam clean. Scrape off chipped or peeled paint.

CAUTION

Load test of hoist winch and boom assembly is mandatory. Refer to Chapter 2, Section V for step-by-step procedures.

c. Inspection and Repair.

(1) Inspect hoisting boom for nicks, bends and burrs. Remove nicks and burrs with a rough file.

(2) Inspect welds for cracks and defects. Reweld where necessary and repaint all bare metal.

(3) Inspect the pin and last link of the chain for defects and wear.

d. Assembly. Refer to TM 9-2350-256-34-1 and figure 3-2 for instructions on assembly of the hoisting boom.

3-4 Assembly of Hoisting Boom from Subassemblies

CAUTION

Load test of hoist winch and boom assembly is mandatory. Refer to Chapter 2, Section V for step-by-step procedures.

The peculiar nature of the hoisting boom assembly makes it necessary to assemble the subassemblies during installation. For detailed instructions concerning assembly and installation, refer to TM 9-2350-256-34-1.

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Section II. REPAIR OF MAIN WINCH AND SPADE ASSEMBLY

3-5 Description

The main winch and spade assembly (figures 1-4 and 1-5) consists of a spade, two spade-actuating cylinders, a hydraulic motor, a combination control valve, a winch cable, a cable level winder, a brake cylinder, and the main winch. The winch is installed in the hull of the vehicle beneath the crew compartment, and the spade is externally mounted on the front of the vehicle.

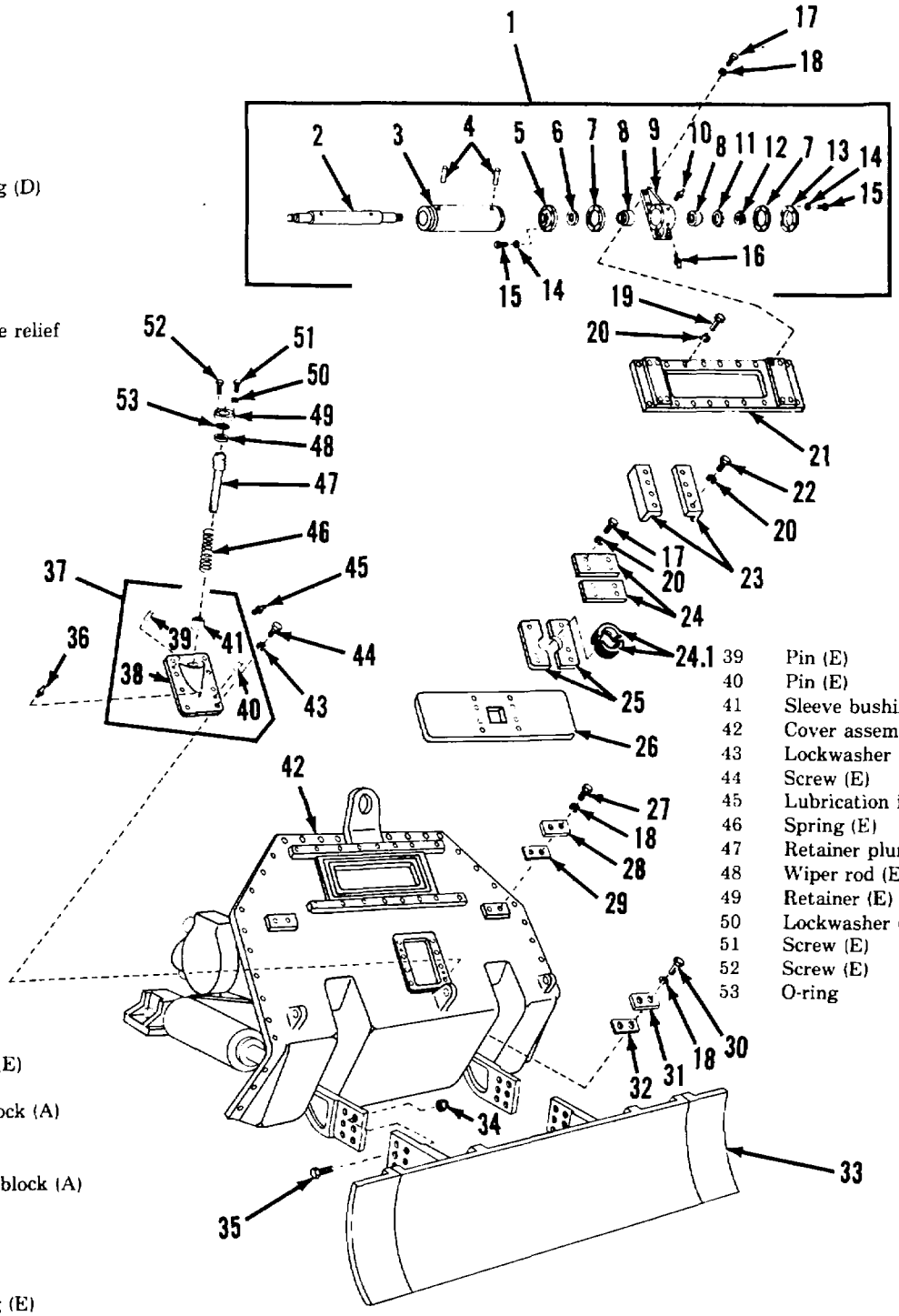
3-6 Disassembly of Main Winch and Spade Assembly into Subassemblies

a. General. Figures 3-3 through 3-7, with accompanying legends, serve to identify all subassemblies and attaching parts. The legends also provide an index to the step-by-step removal of each particular item or subassembly.

CAUTION

Load test of main winch is mandatory. Refer to Chapter 2, Section V for step-by-step procedures.

b. Disassembly Procedure. Disassemble the main winch and spade assembly into subassemblies as shown in figure 3-8.



1 Cable roller assembly (D)
2 Roller shaft (D)
3 Roller (D)
4 Pin (D)
5 Retainer (D)
6 Seal (D)
7 Gasket (D)
8 Roller bearing (D)
9 Roller bracket (D)
10 Lubrication fitting (D)
11 Key washer (D)
12 Round nut (D)
13 Bearing cover (D)
14 Lockwasher (D)
15 Screw (D)
16 Lubricant pressure relief valve (D)
17 Screw (D)
18 Lockwasher (D)
19 Screw (D)
20 Lockwasher (D)
21 Frame (D)
22 Screw (E)
23 Guide (E)
24 Retainer (E)
24.1 Half bushing (E)
25 Cover (E)
26 Cable guide plate (E)
27 Screw (A)
28 Top spade stop block (A)
29 Shim (A)
30 Screw (A)
31 Lower spade stop block (A)
32 Shim (A)
33 Spade (C)
34 Locknut (B)
35 Screw (B)
36 Lubrication fitting (E)
37 Spade latch housing assembly (E)
38 Spade latch housing (E)
39 Pin (E)
40 Pin (E)
41 Sleeve bushing (E)
42 Cover assembly (D)
43 Lockwasher (E)
44 Screw (E)
45 Lubrication fitting (E)
46 Spring (E)
47 Retainer plunger (E)
48 Wiper rod (E)
49 Retainer (E)
50 Lockwasher (E)
51 Screw (E)
52 Screw (E)
53 O-ring

Note: The letters in parentheses refer to figure 3-8 view

Figure 3-3. Spade, Cover Assembly, and Attaching Parts

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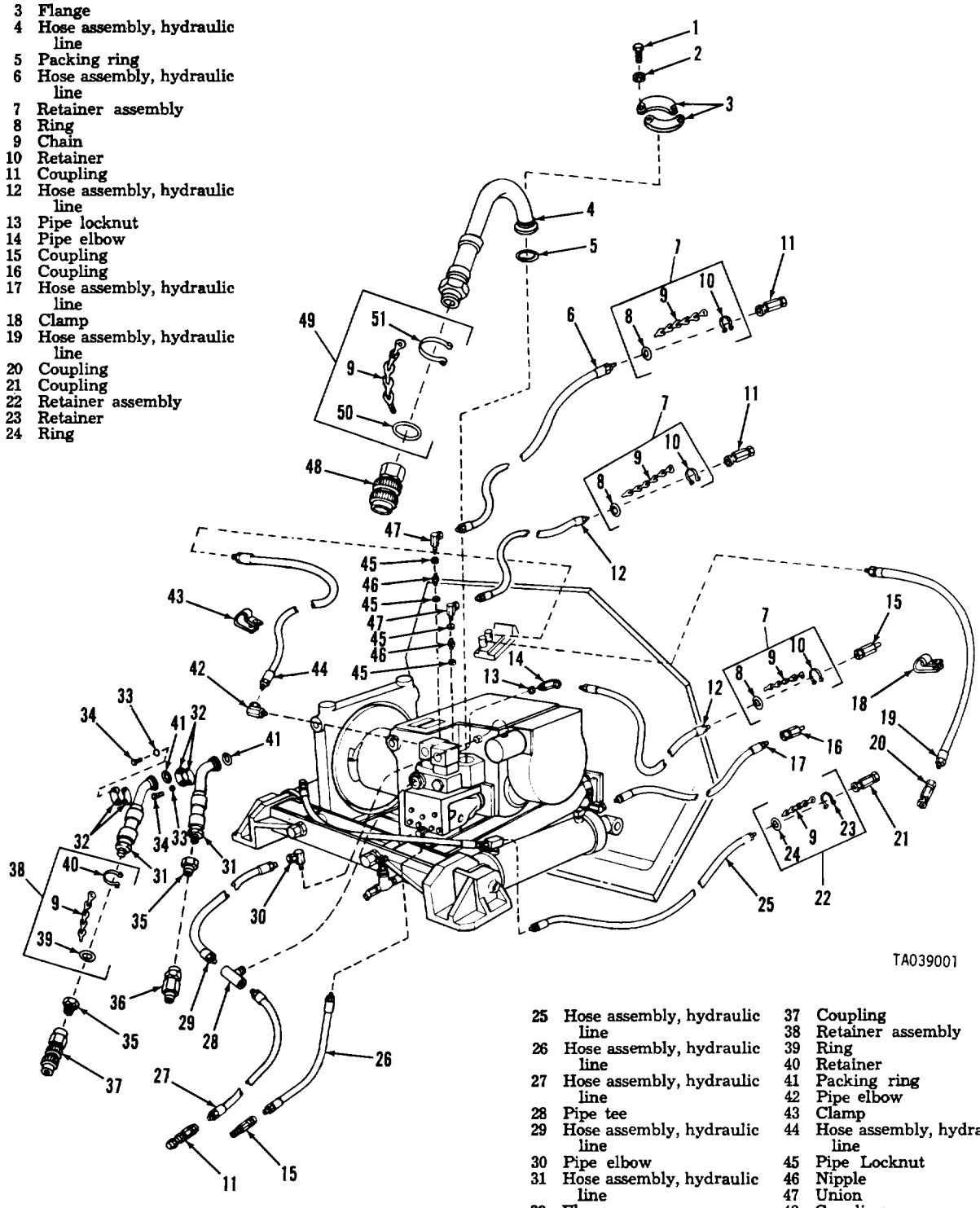
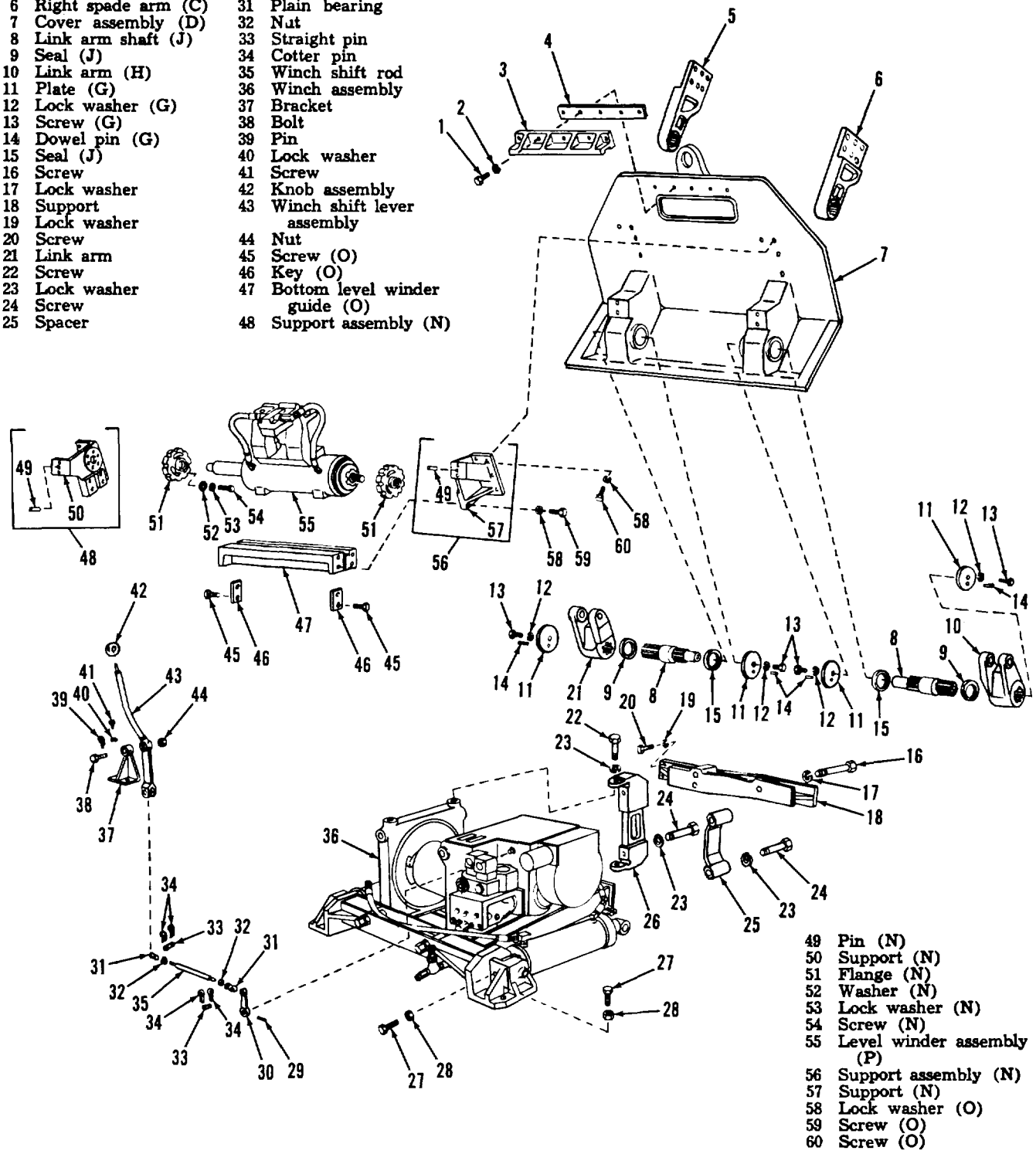


1 Screw
2 Lock washer
3 Flange
4 Hose assembly, hydraulic line
5 Packing ring
6 Hose assembly, hydraulic line
7 Retainer assembly
8 Ring
9 Chain
10 Retainer
11 Coupling
12 Hose assembly, hydraulic line
13 Pipe locknut
14 Pipe elbow
15 Coupling
16 Coupling
17 Hose assembly, hydraulic line
18 Clamp
19 Hose assembly, hydraulic line
20 Coupling
21 Coupling
22 Retainer assembly
23 Retainer
24 Ring
25 Hose assembly, hydraulic line
26 Hose assembly, hydraulic line
27 Hose assembly, hydraulic line
28 Pipe tee
29 Hose assembly, hydraulic line
30 Pipe elbow
31 Hose assembly, hydraulic line
32 Flange
33 Lock washer
34 Screw
35 Adapter union
36 Coupling
37 Coupling
38 Retainer assembly
39 Ring
40 Retainer
41 Packing ring
42 Pipe elbow
43 Clamp
44 Hose assembly, hydraulic line
45 Pipe Locknut
46 Nipple
47 Union
48 Coupling
49 Retainer assembly
50 Ring
51 Retainer

Figure 3-4. Main winch and hydraulic lines.

1 Screw (M)
2 Lock washer (M)
3 Guide (M)
4 Shim (M)
5 Left spade arm (C)
6 Right spade arm (C)
7 Cover assembly (D)
8 Link arm shaft (J)
9 Seal (J)
10 Link arm (H)
11 Plate (G)
12 Lock washer (G)
13 Screw (G)
14 Dowel pin (G)
15 Seal (J)
16 Screw
17 Lock washer
18 Support
19 Lock washer
20 Screw
21 Link arm
22 Screw
23 Lock washer
24 Screw
25 Spacer
26 Spacer
27 Screw
28 Nut
29 Spring pin
30 Winch shift lever
31 Plain bearing
32 Nut
33 Straight pin
34 Cotter pin
35 Winch shift rod
36 Winch assembly
37 Bracket
38 Bolt
39 Pin
40 Lock washer
41 Screw
42 Knob assembly
43 Winch shift lever assembly
44 Nut
45 Screw (O)
46 Key (O)
47 Bottom level winder guide (O)
48 Support assembly (N)



49 Pin (N)
50 Support (N)
51 Flange (N)
52 Washer (N)
53 Lock washer (N)
54 Screw (N)
55 Level winder assembly (P)
56 Support assembly (N)
57 Support (N)
58 Lock washer (O)
59 Screw (O)
60 Screw (O)

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Note: The letters in parentheses refer to figure 3-8 view.

Figure 3-5. Main winch, cover, *level winder, and attaching parts.*

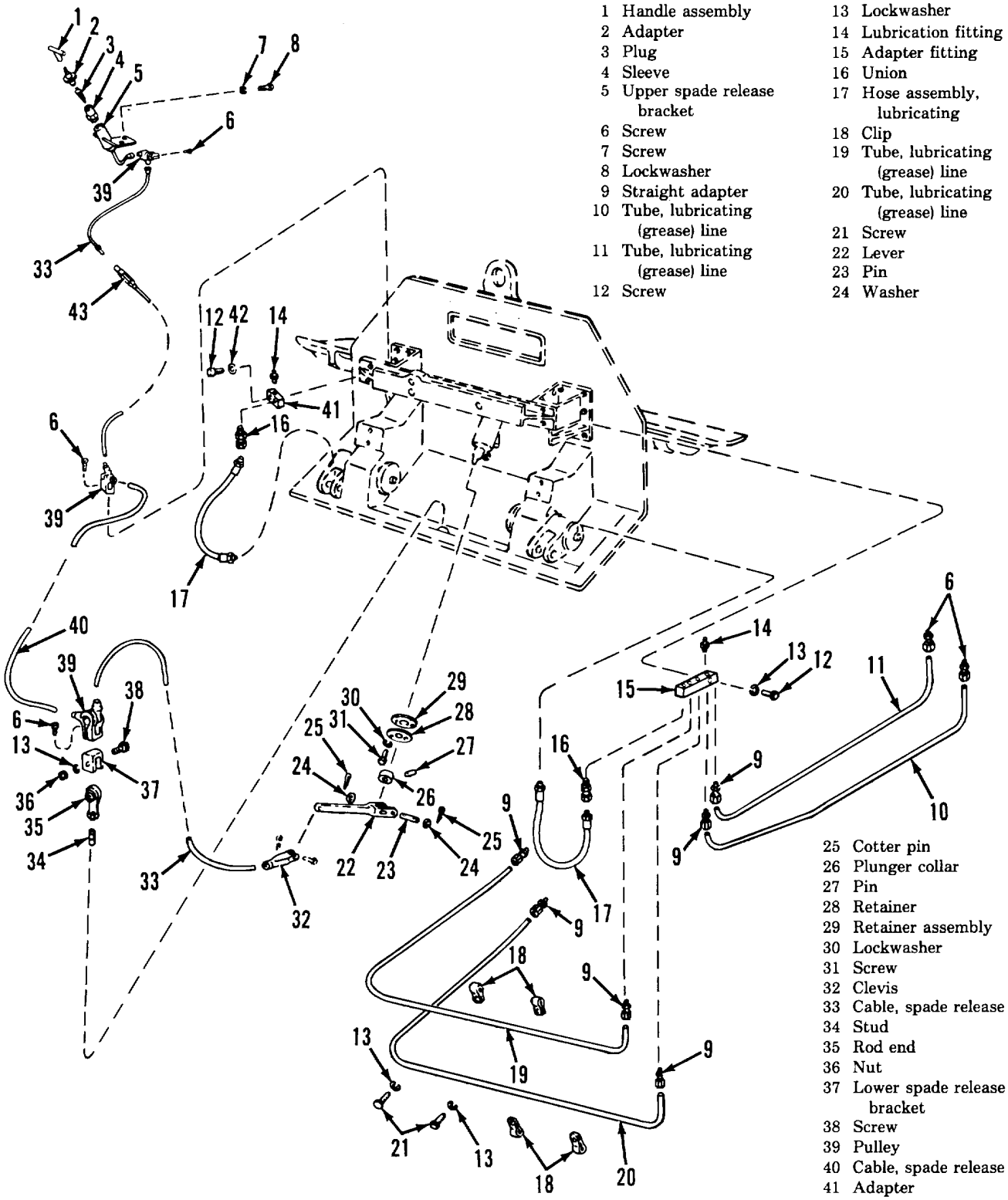
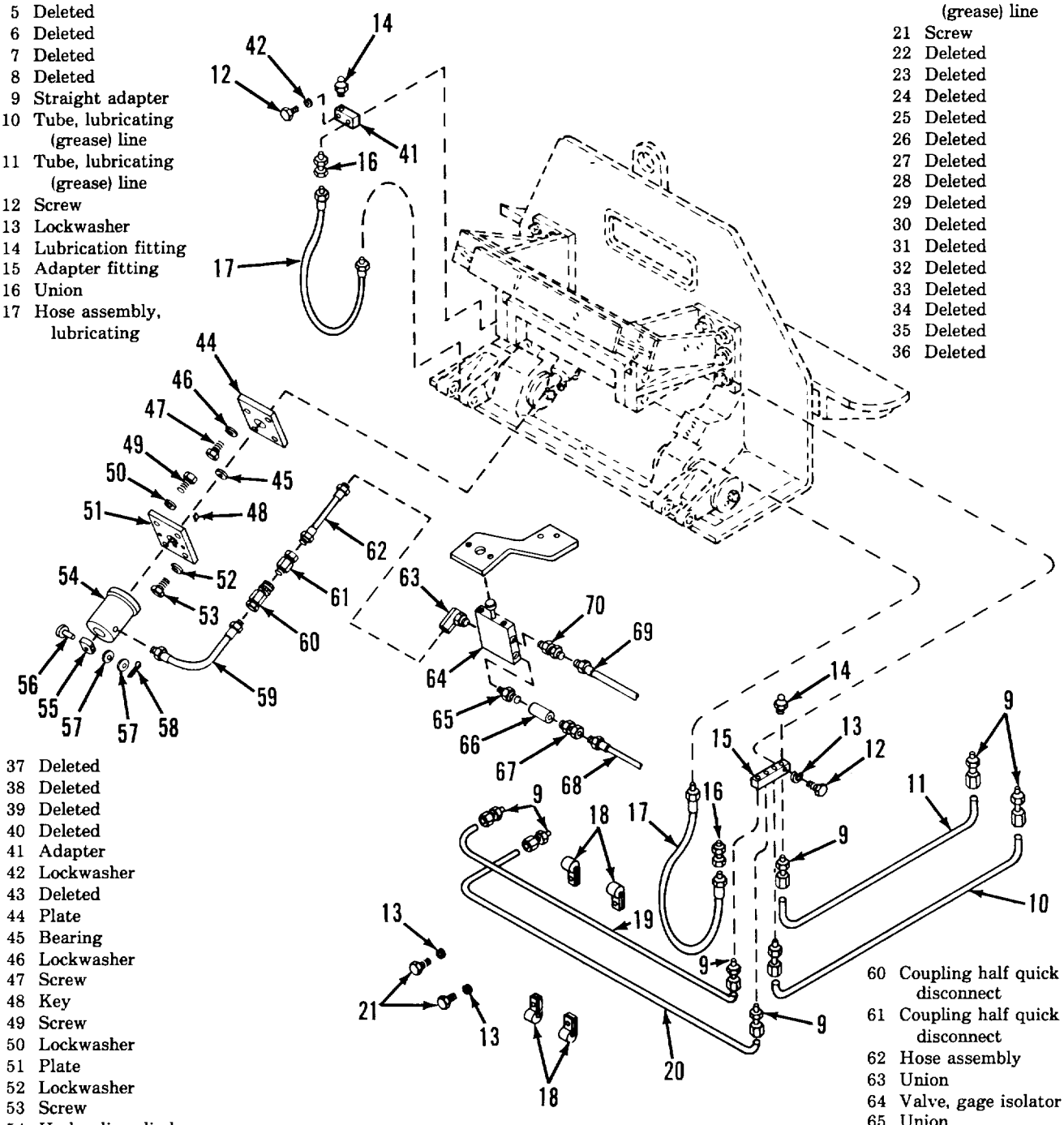


Figure 3-5.1 Cover assembly and lubricating lines, mechanical spade release.

1 Deleted
2 Deleted
3 Deleted
4 Deleted
5 Deleted
6 Deleted
7 Deleted
8 Deleted
9 Straight adapter
10 Tube, lubricating (grease) line
11 Tube, lubricating (grease) line
12 Screw
13 Lockwasher
14 Lubrication fitting
15 Adapter fitting
16 Union
17 Hose assembly, lubricating

18 Clip
19 Tube, lubricating (grease) line
20 Tube, lubricating (grease) line
21 Screw
22 Deleted
23 Deleted
24 Deleted
25 Deleted
26 Deleted
27 Deleted
28 Deleted
29 Deleted
30 Deleted
31 Deleted
32 Deleted
33 Deleted
34 Deleted
35 Deleted
36 Deleted



37 Deleted
38 Deleted
39 Deleted
40 Deleted
41 Adapter
42 Lockwasher
43 Deleted
44 Plate
45 Bearing
46 Lockwasher
47 Screw
48 Key
49 Screw
50 Lockwasher
51 Plate
52 Lockwasher
53 Screw
54 Hydraulic cylinder
55 Plunge collar
56 Pin
57 Washer
58 Cotter pin
59 Hose assembly (67A)

60 Coupling half quick disconnect
61 Coupling half quick disconnect
62 Hose assembly
63 Union
64 Valve, gage isolator
65 Union
66 Valve
67 Union
68 Hose assembly (68)
69 Hose assembly (69)
70 Union

Figure 3-6. Cover Assembly, Hydraulic and Lubricating Lines, Hydraulic Spade Release.

TA171830

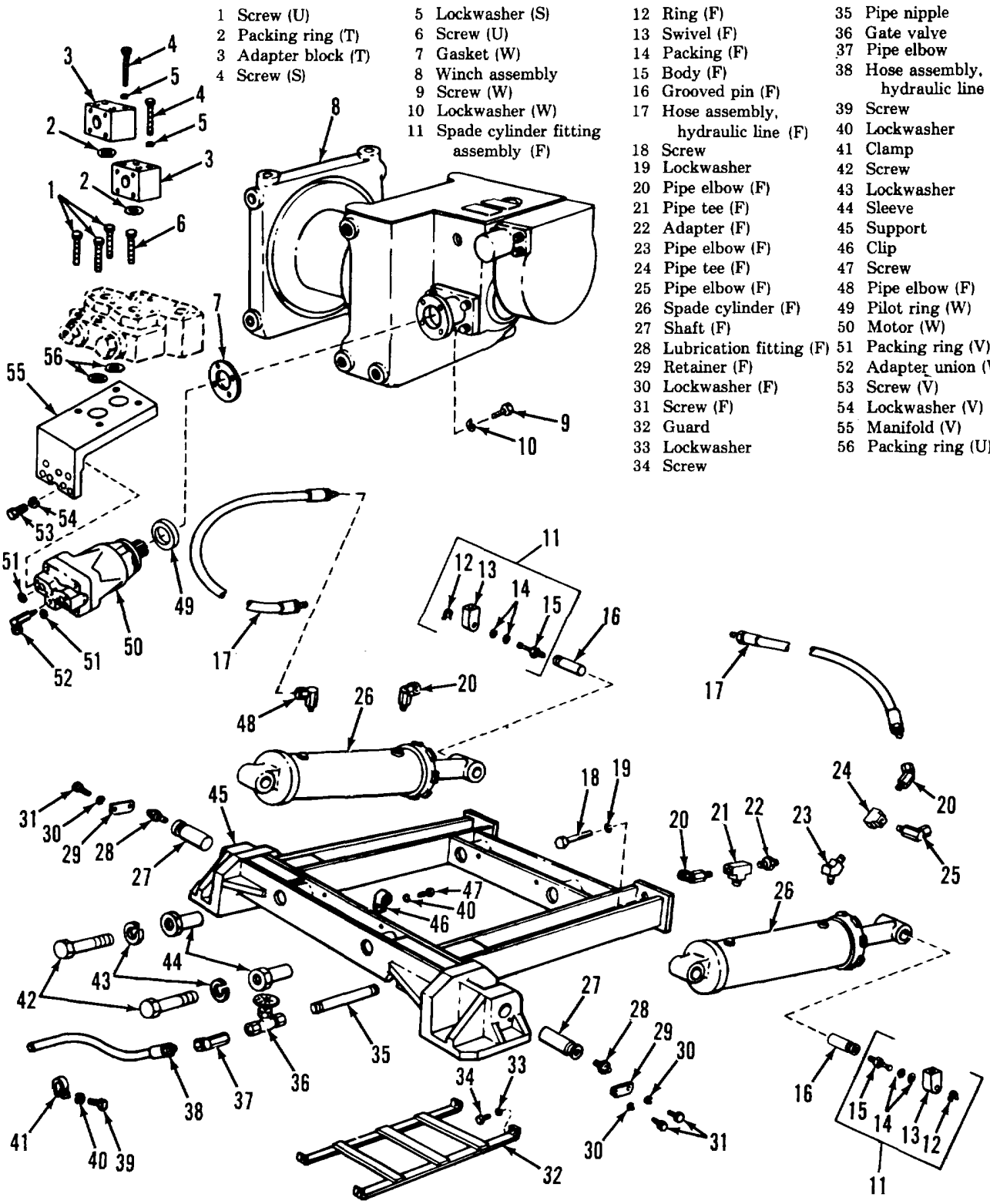


Figure 3-7. Main Winch, Motor, and Attaching Parts.

TA171822

Note: The letters in parentheses refer to figure 3-8 view.

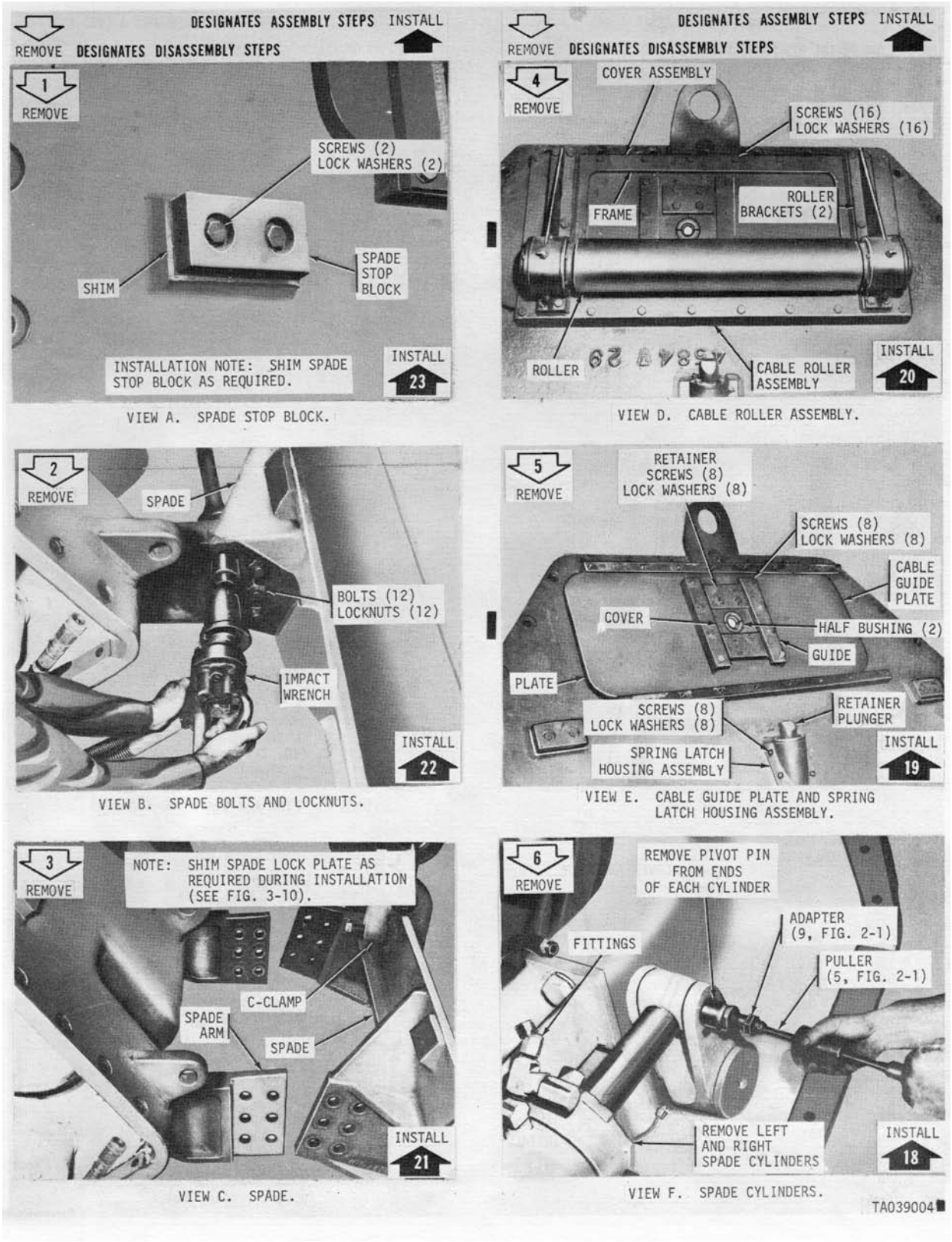


Figure 3-8. Disassembly of main winch and spade assemblies into subassemblies (Sheet 1 of 4).

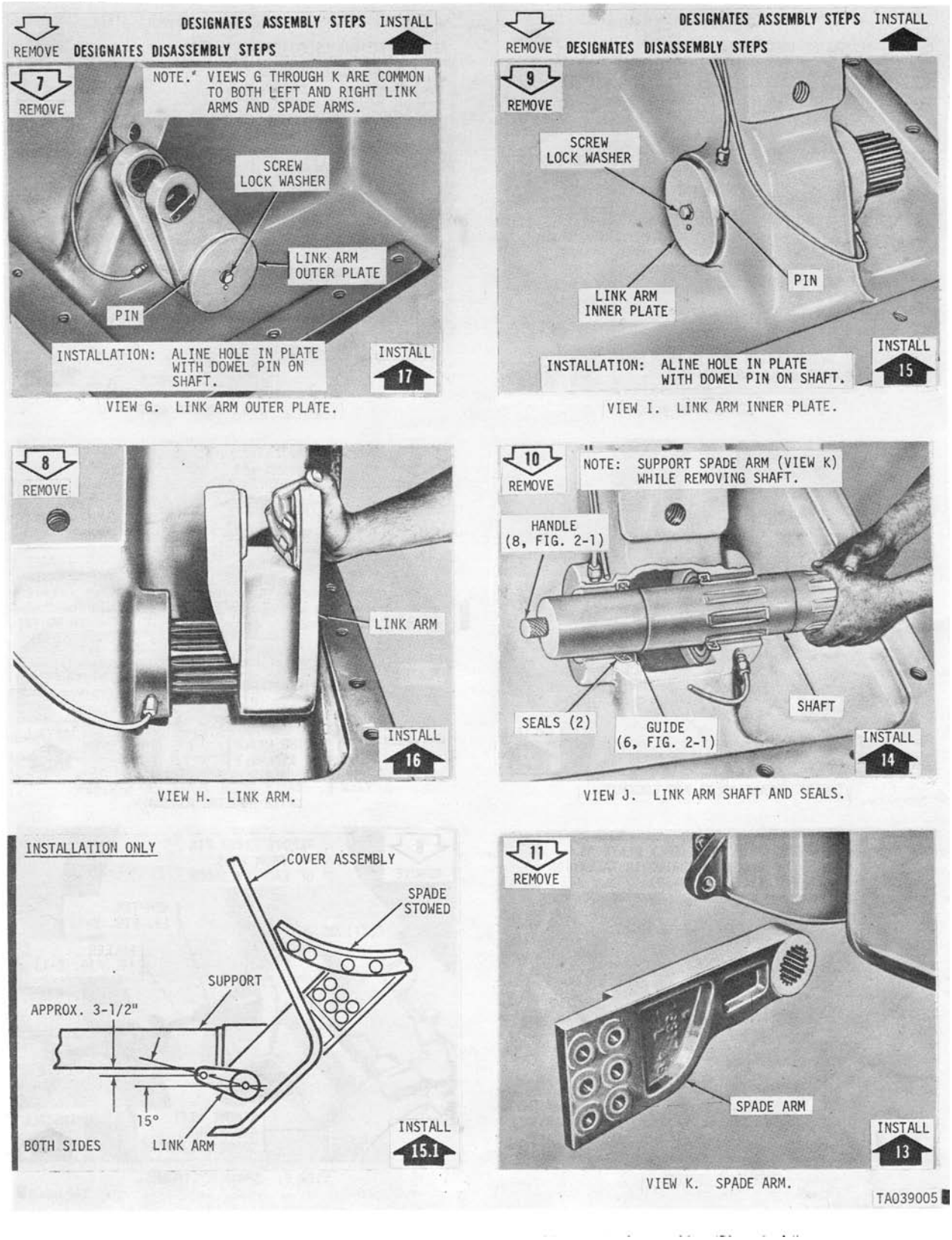


Figure 3-8. Disassembly of main winch and spade assemblies into subassemblies (Sheet 2 of 4).

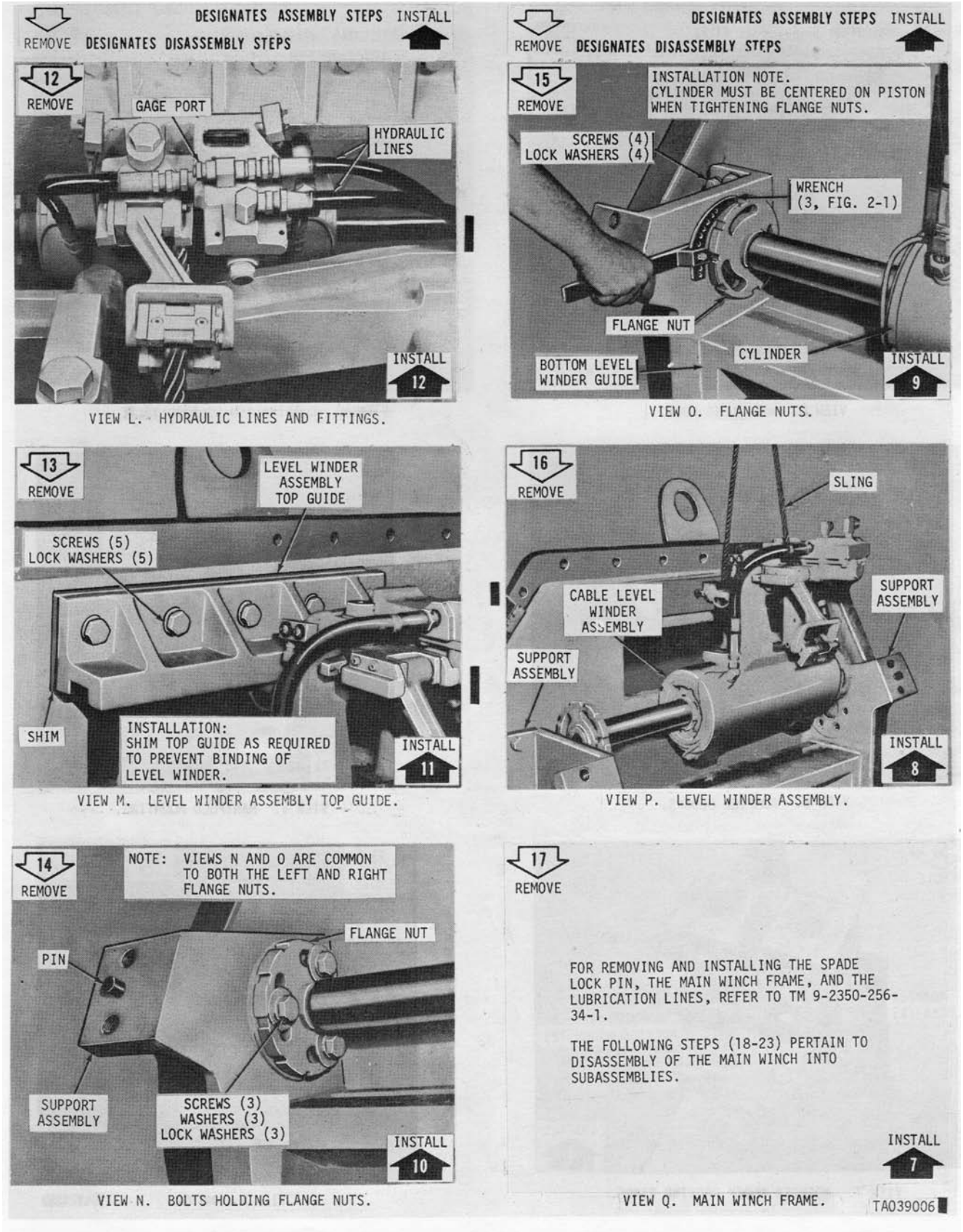
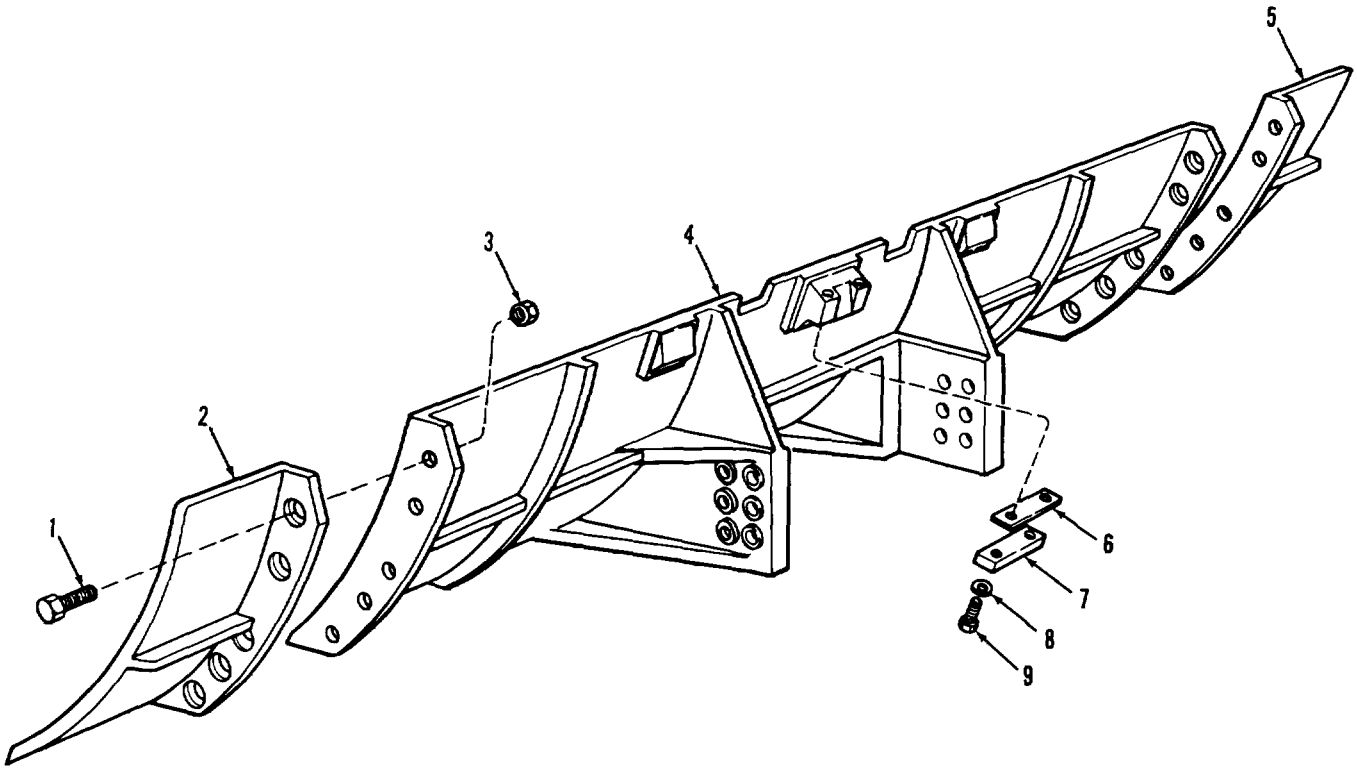


Figure 3-8. Disassembly of main winch and spade assemblies into subassemblies (Sheet 3 of 4).



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1	Screw (B)	4	Spade (B)	7	Striker plate (A)
2	Spade extension (B)	5	Spade extension (B)	8	Lock washer (A)
3	Locknut (B)	6	Shim (A)	9	Screw (A)

Note: The letters in parentheses refer to figure 3-10 view.

Figure 3-9. Spade-exploded view.

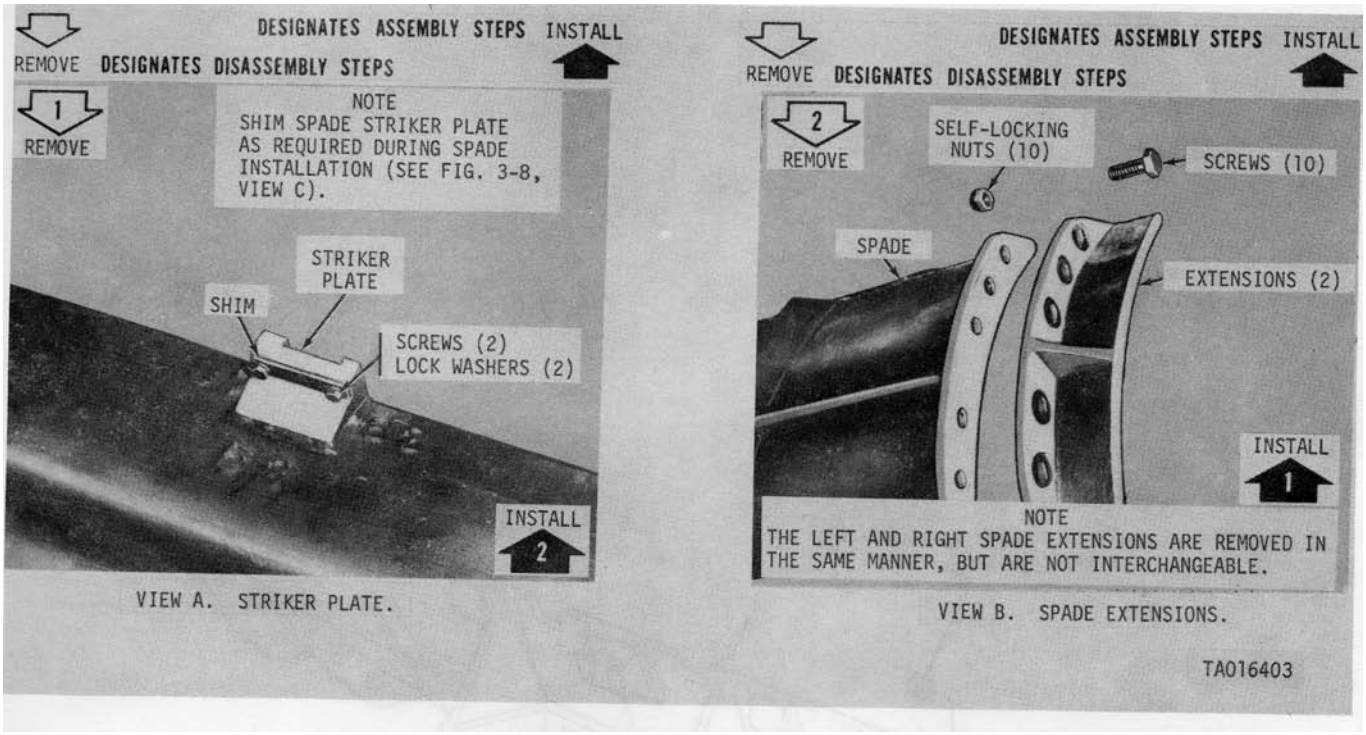


Figure 3-10. Repair of spade.

3-7. Repair of Spade

a. General. Figure 3-9 with is accompanying legend, serves to identify all parts of the spade. The legend also provides an index to the step-by-step removal of each component during disassembly.

b. Disassembly Procedure. Disassemble the spade as shown in figure 3-10.

c. Cleaning. Scrape accumulated mud and dirt from the spade. Wash with hose and water or steam-clean. Scrape off chipped and peeled paint.

d. Inspection and Repair.

(1) Inspect spade for nicks, dents, burs and distortion. Remove nicks and burs with a rough file. Straighten distorted edges and hammer out dents.

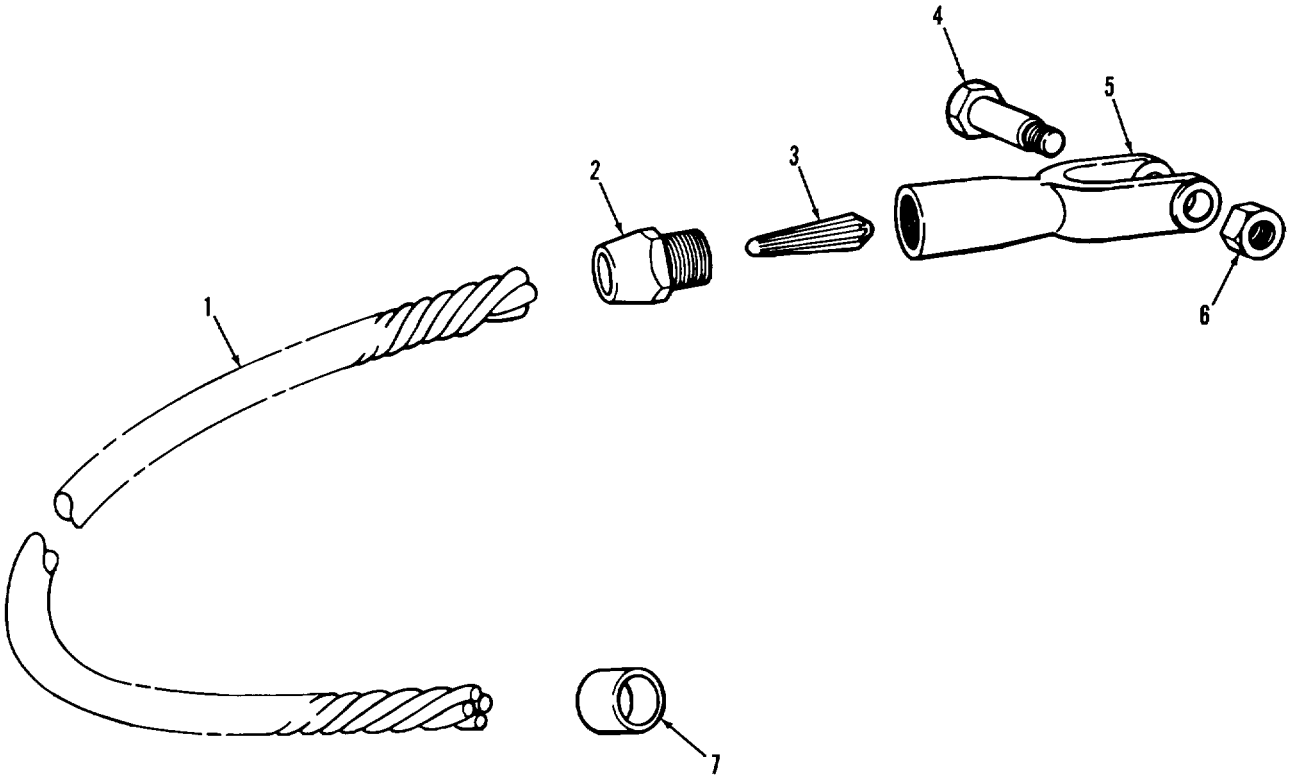
(2) Check welds for cracks and defects. Repair damaged welded joints by welding. Paint all areas where bare metal has been exposed, due to filing, hammering, or peeling.

e. Assembly. Assemble the spade in reverse order of disassembly (fig. 3-10).

3-8. Repair of Main Winch Cable

a. General. Figure 3-11, with its accompanying legend, serves to identify all parts of the main winch cable. The legend also provides an index to the step-by-step removal of each component during disassembly.

b. Disassembly Procedure. Disassemble the main winch cable as shown in figure 3-12.



1	Cable (C)	3	Tapered plug (C)	5	Clevis (B)	7	Ferrule (D)
2	Sleeve (A)	4	Bolt (B)	6	Nut (B)		

Note: The letters in parentheses refer to figure 3-12 view.

TA015806

*Figure 3-11. Main winch c*able--*explo*ded v*ie*w.

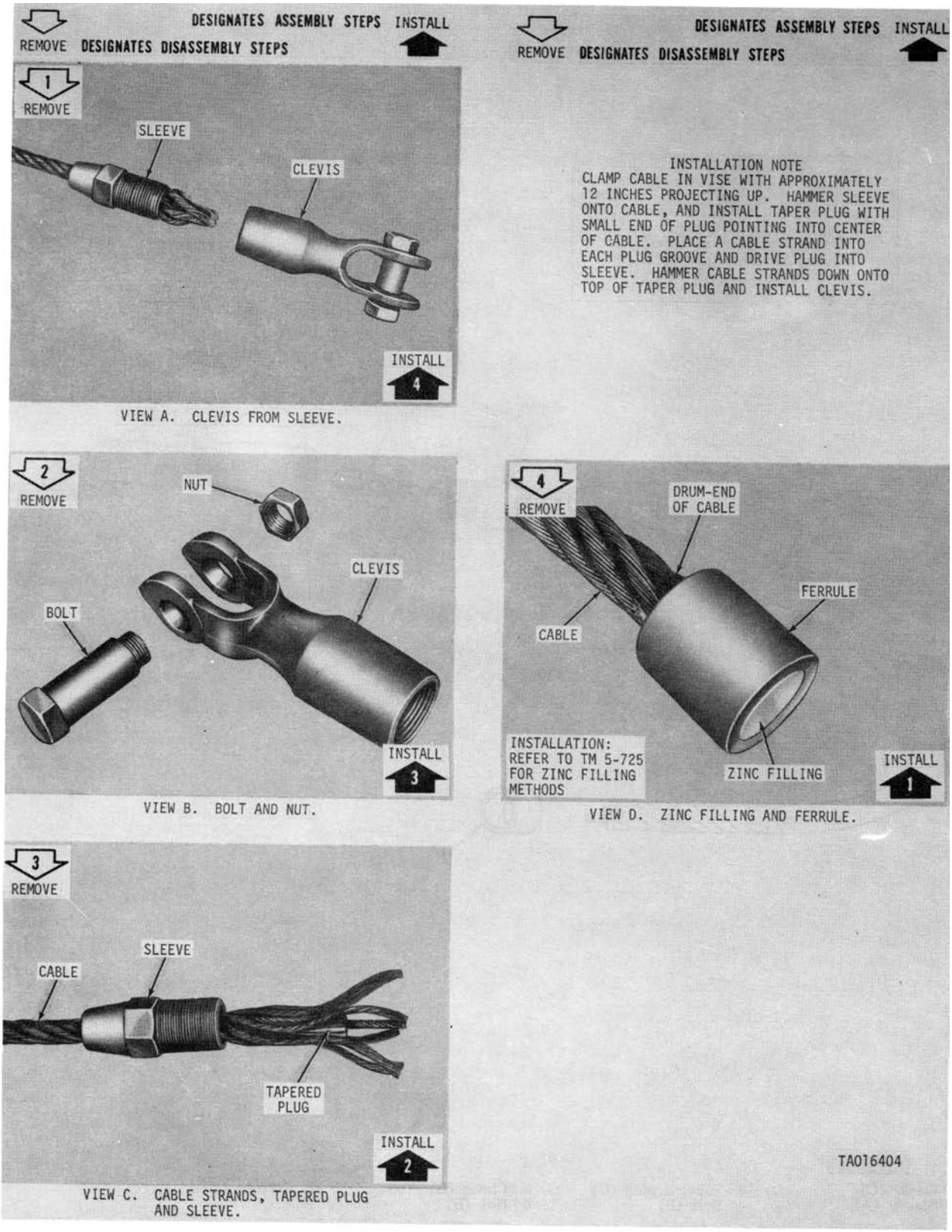


Figure 3-12. Repair of main winch cable.

c. Cleaning. Wash all parts in dry cleaning solvent or mineral spirits paint thinner, and dry with moisture-free compressed air.

d. Inspection and Repair.

NOTE

Unless otherwise specified, parts should be replaced if any of the defects described below are detected.

(1) Inspect cable for kinks or broken strands.

(2) Inspect clevis assembly and ferrule for distortion, cracks, and chipped surfaces.

(3) Inspect all parts for nicks, burs, rust and corrosion. Remove rust, corrosion, burs, and nicks with a fine file or crocus cloth.

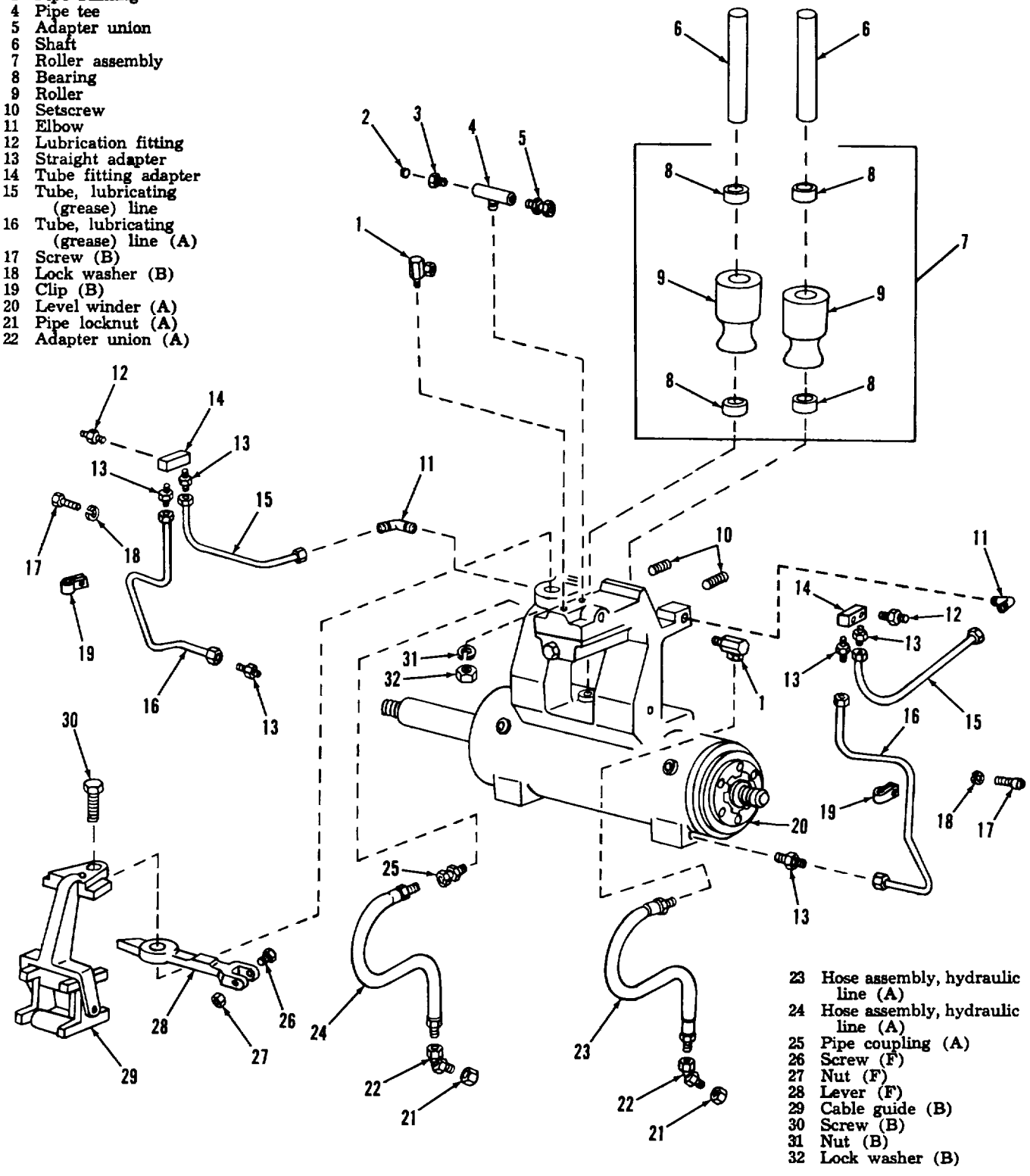
e. Assembly.

(1) Assemble the main winch cable in reverse order of disassembly (fig. 3-12).
(2) Lubricate cable in accordance with LO 9-2350-256-12.

3-9. Repair of Main Winch Level Winder Assembly

a. General. Figures 3-13 and 3-14, with accompanying legends, serve to identify all parts of the level winder assembly. The legends also provide an index to the step-by-step removal of each component during disassembly.

b. *Disassembly Procedure.* Disassemble the level winder assembly as shown in figure 3-15.



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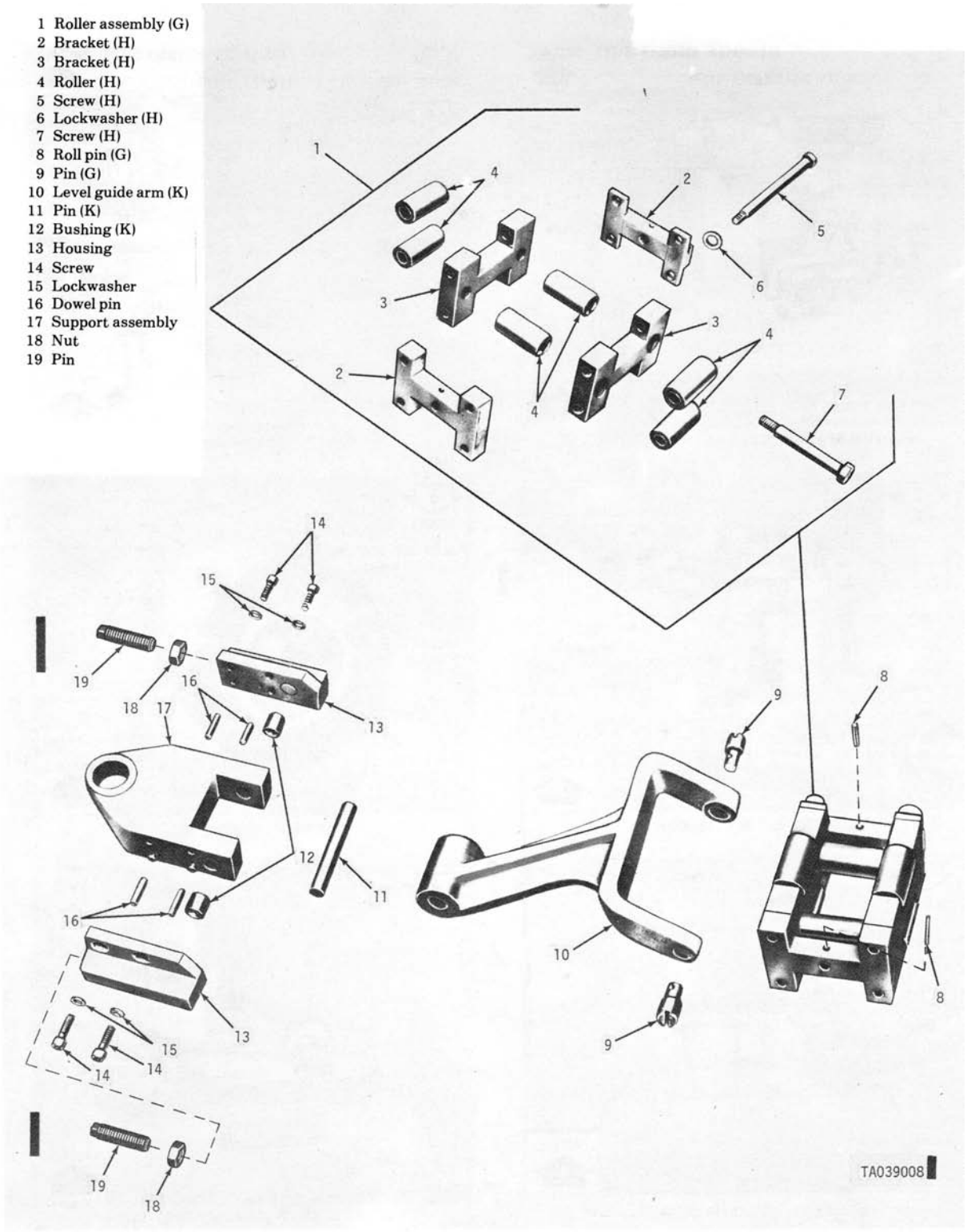
Note: The letters in parentheses refer to figure 3-15 view.

Figure 3-13. Main winch level winder assembly, lubricating and hydraulic lines.



Note: The letters in parentheses refer to figure 3-15 view.

Figure 3-14. Level winder arm assembly.

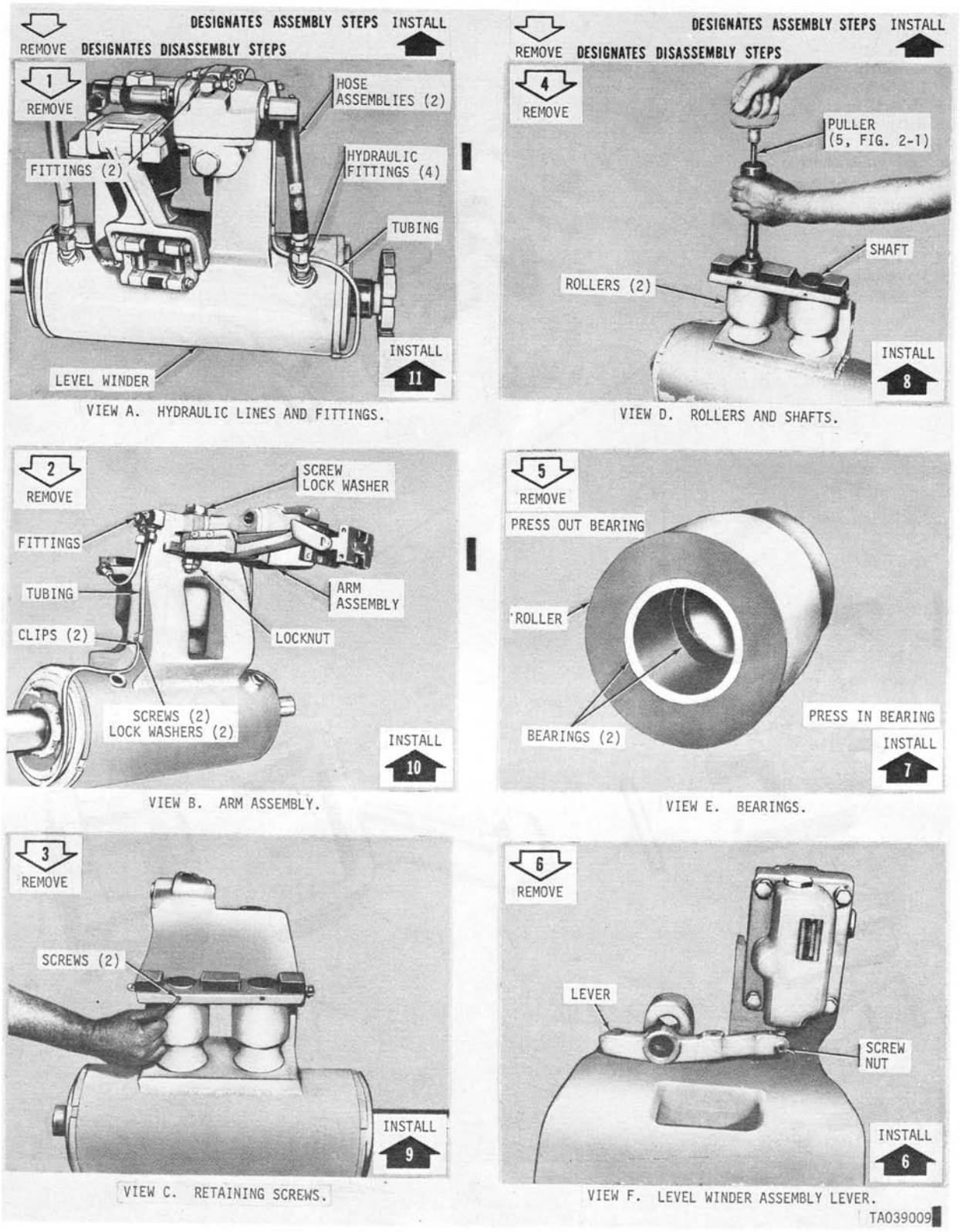
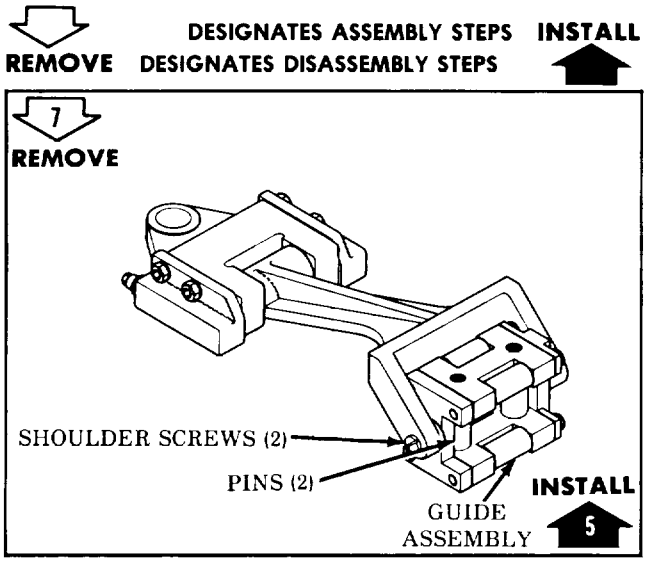
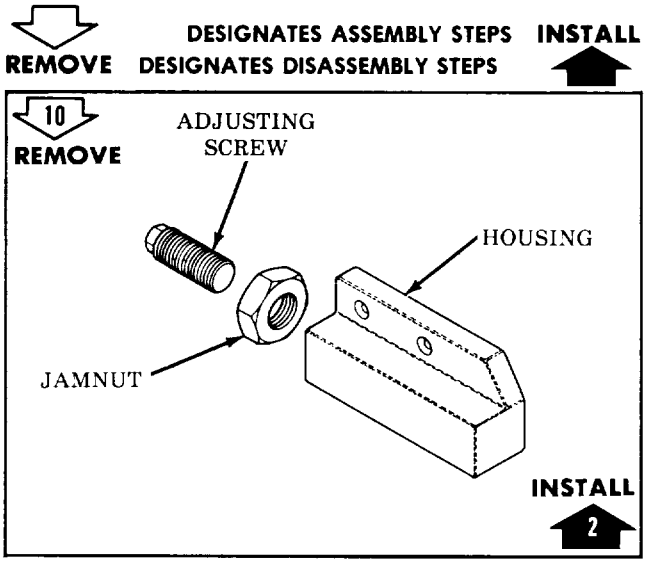


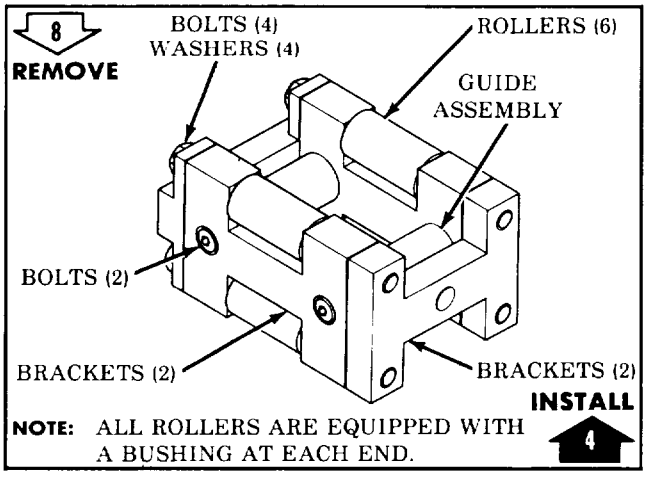
Figure 3-15. Repair of main winch level winder assembly (Sheet 1 of 2).



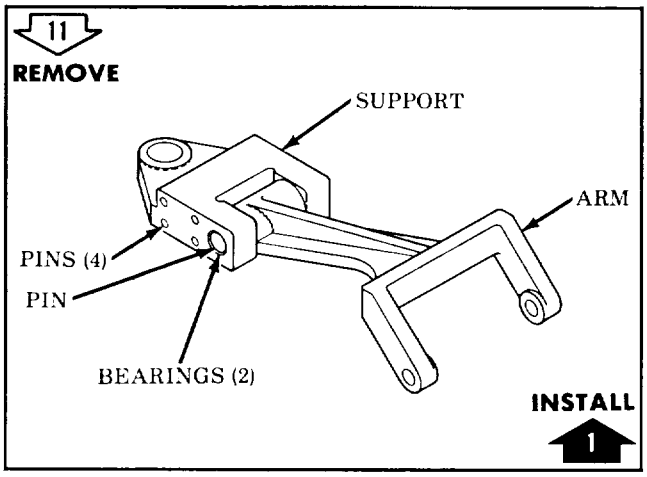
VIEW G. GUIDE ASSEMBLY



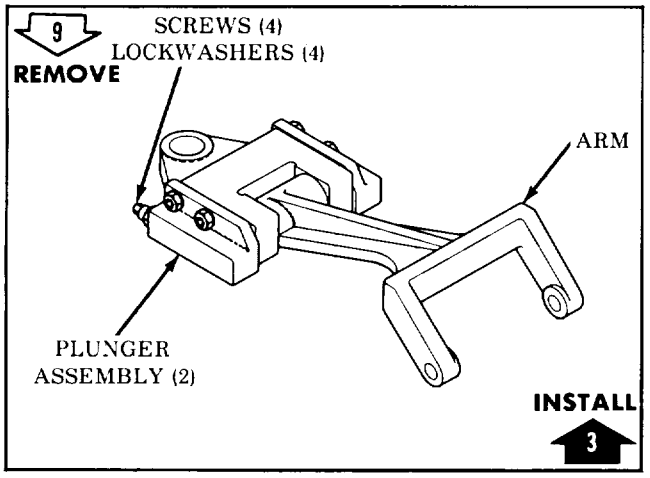
VIEW J. PLUNGER ASSEMBLY.



VIEW H. ROLLERS AND BRACKETS.



VIEW K. LEVEL GUIDE ARM.



VIEW I. ARM AND PLUNGER ASSEMBLY.

Figure 3-15. Repair of Main Level Winder Assembly (Sheet 2 of 2).

c. Cleaning. Wash all parts, except seals and gaskets, in dry-cleaning solvent or mineral spirits paint thinner. Blow parts dry with moisture-free compressed air; then immerse parts in clean oil OE-10, to prevent rusting.
d. Inspection and Repair.

NOTE

Unless otherwise specified, parts are to be replaced if any of the defects described below are detected.

(1) Inspect all threaded parts for burrs and damage to threads. Repair damaged threads with a thread chaser.
(2) Inspect all hex nuts, hex head screws, and socket head screws for rounded corners. Check screws for bending.
(3) Inspect rollers for freedom of movement.

e. Assembly. Assemble the main winch level winder assembly in reverse order of disassembly (fig. 3-15).

f. Adjustments. Refer to TM 9-2350-256-20 for adjustment of the main winch level winder assembly.

3-10. Assembly of Main Winch and Spade Assembly from Subassemblies.

a. Assemble the main winch and spade assembly in reverse order of disassembly (fig. 3-8). Lubricate winch in accordance with LO 9-2350-256-12.

b. The link arm is indexed correctly (view H. 1, fig. 3-8) on the link arm shaft when the spade is in the stowed position and the hole for the pivot pin for each spade cylinder is three and one-half inches below the bottom of the winch support.

3-10.1 Adjustment of Main Winch

Valves are adjusted by the vehicle manufacturer. Should verification need to be made, refer to para 2-20 for procedure.
a. Deleted.
b. Deleted.
c. Deleted.

SECTION III. REPAIR OF HYDRAULIC SUBPLATE ASSEMBLY

3-11. Description.

The hydraulic subplate assembly (figs. 1-15 and 1-16) is located in the crew compartment, mounted to the right of the driver. Mounted to the subplate are the control valves for the hydraulic system. The spade control handle is also installed on the subplate and connected by a mechanical linkage to the spade combination control valve.

3-12. Disassembly of Hydraulic Subplate Assembly into Subassemblies

a. General. Figures 3-16 through 3-19, with accompanying legends, serve to identify all subassemblies and attaching parts. The legends also provide an index to the step-by-step removal of each particular subassembly.

b. Disassembly Procedure. Disassemble the hydraulic subplate assembly into subassemblies as shown in figure 3-20.

1 Union (Z)
2 Clamp (Z)
3 APU control valve (Z)
4 Elbow (Z)
5 Elbow (X)
6 Adapter union (X)
7 Pipe nut (X)
8 Front mounting bracket
9 Lock washer
10 Screw
11 Control lever and cable
12 Cotter pin
13 Pin
14 Knob
15 Magnetic pipe plug (V)
16 Rod end
17 Bleeder valve (V)
18 Magnetic pipe plug (V)
19 Extension stud
20 Support (W)
21 Washer (W)
22 Lock washer (W)
23 Screw (W)
24 Bracket (W)
25 Screw (W)
26 Handle
27 Rod
28 Nut
29 Connector
30 Screw
31 Handle bracket
32 Screw
33 Lock washer
34 Screw
35 Cover plate
36 Spacer
37 Adjustment screw
38 Jamnut
39 Pin
40 Main subplate
41 Tee (X)
42 Nipple (Z)
43 Elbow (Z)
44 Nipple (Z)
45 Tee (Z)
46 Plate (Z)
47 Lock washer (Z)
48 Nut (Z)

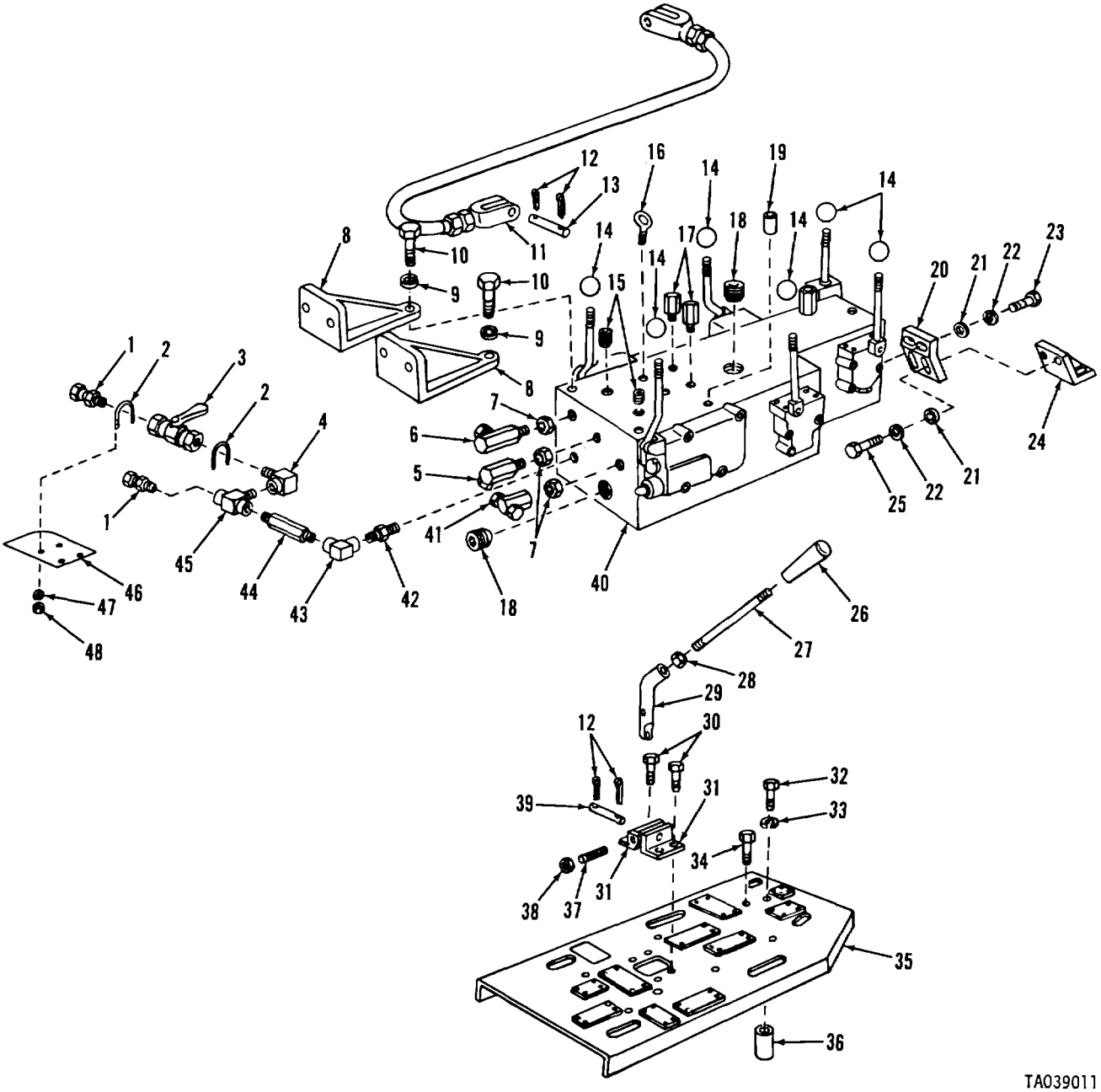
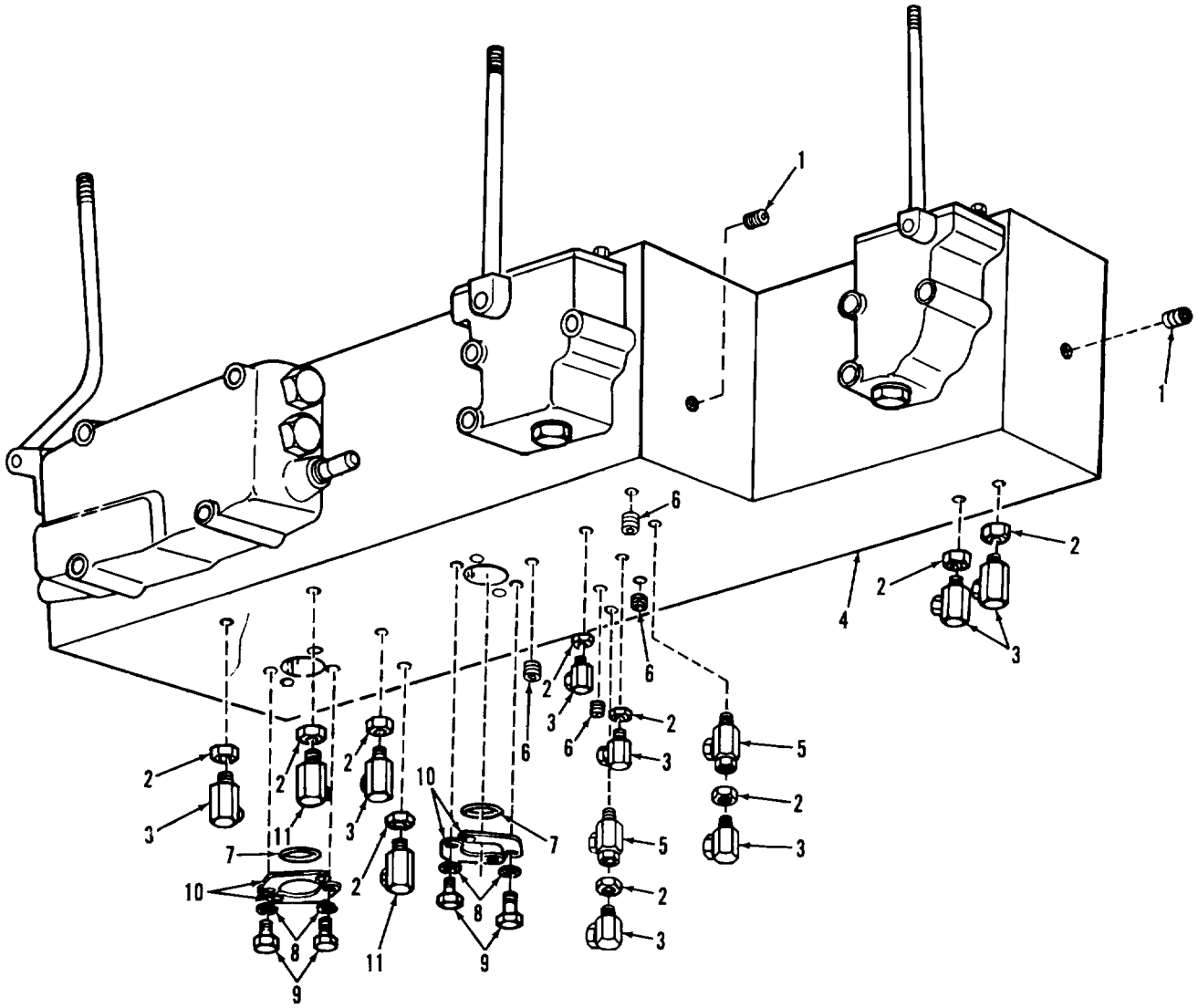


Figure 3-16. Hydraulic subplate, cover plate and parts.



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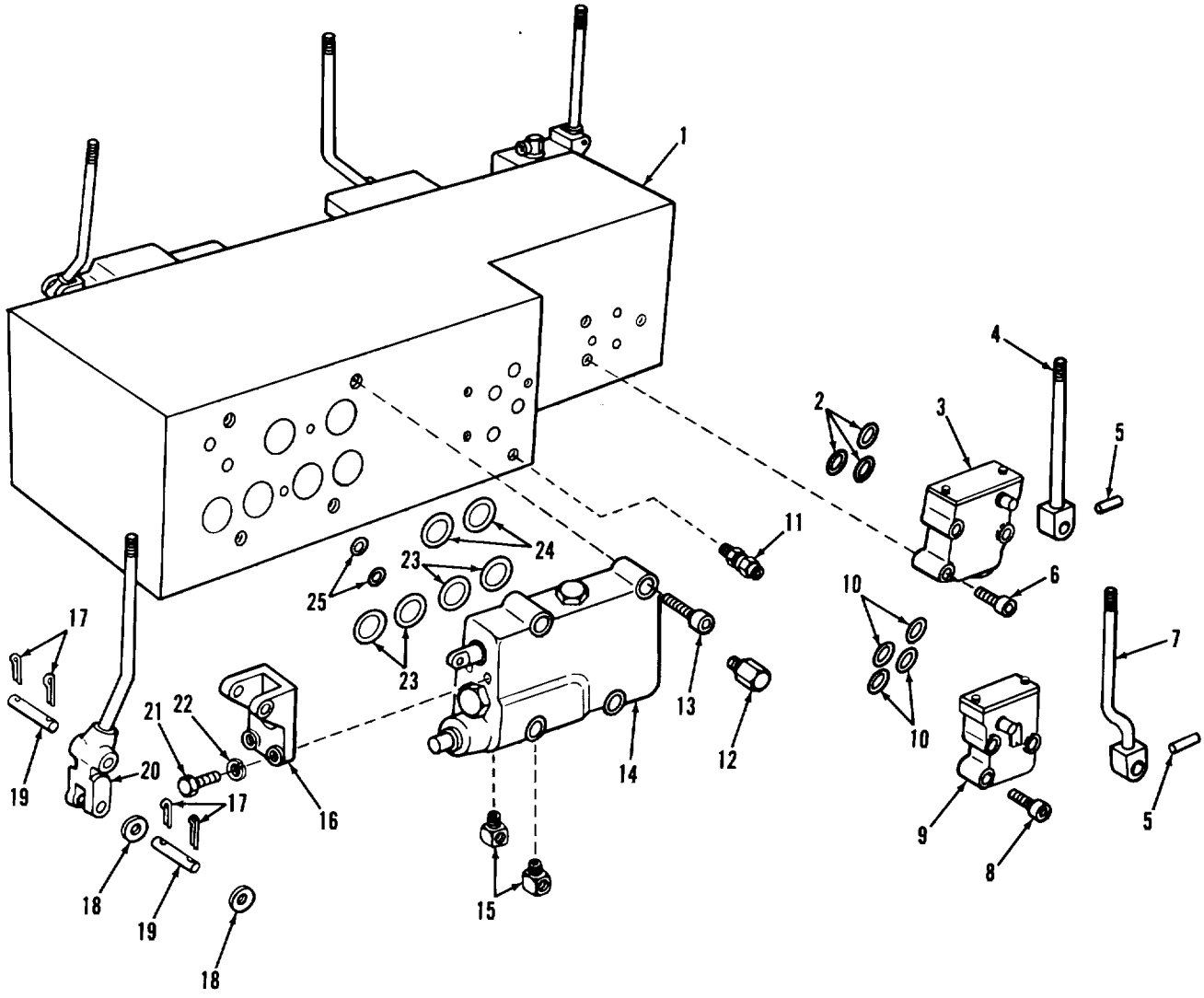
1 Magnetic plug (X)
2 Pipe nut (X)
3 Elbow (X)
4 Subplate (X)
5 Tee (X)
6 Magnetic plug (X)
7 Packing ring (X)
8 Lock washer (X)
9 Screw (X)
10 Flange (X)
11 Elbow (X)

Note: The letters in parentheses refer to figure 3-20 view.

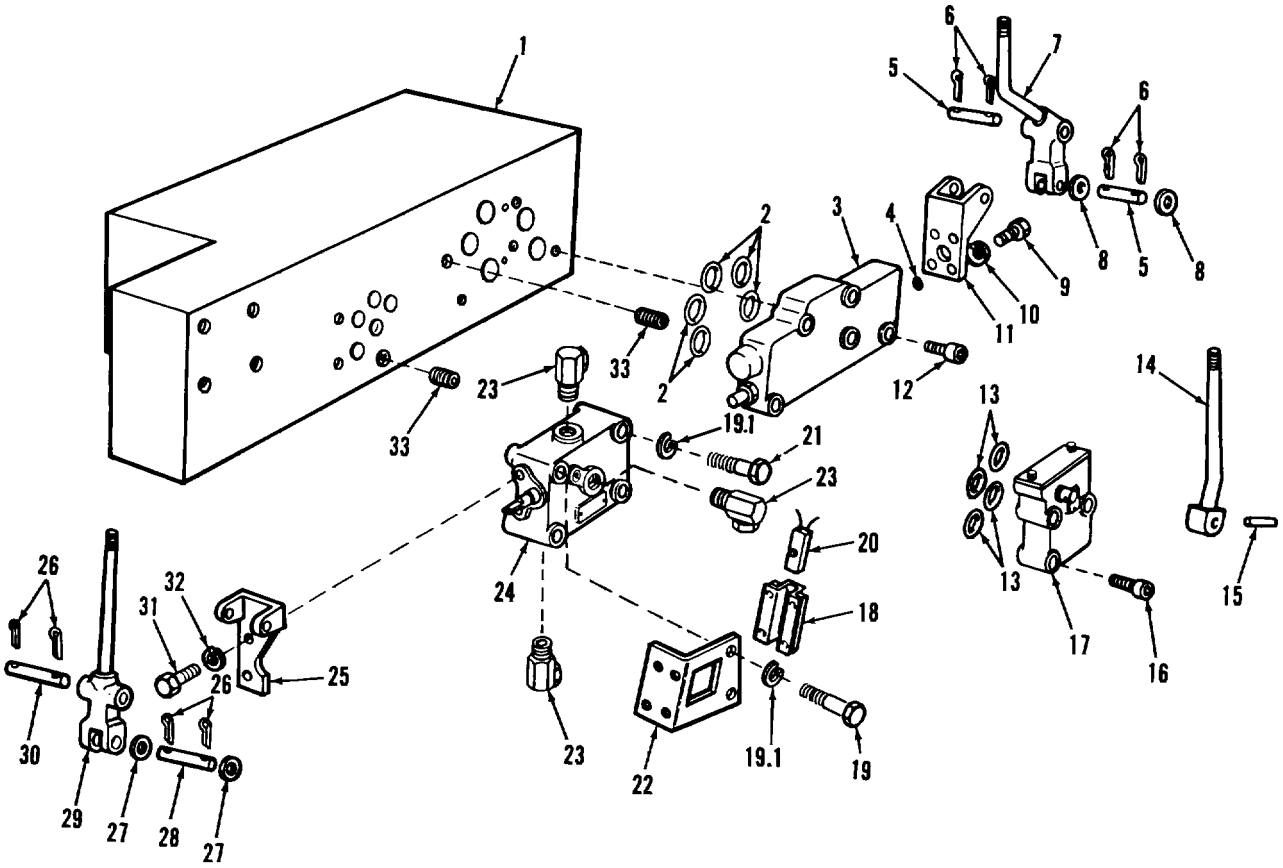
Figure 3-17. Subplate, fittings and plugs.



1 Subplate (X)
2 Packing ring (T)
3 Boom safety valve (S)
4 Lever (U)
5 Roll Pin (U)
6.Screw (S)
7 Lever (R)
8 Screw (P)
9.Hoist winch control valve (Q)
10 Packing ring (Q)
11 Bleeder valve (Q)
12 Magnetic plug (Q)
13 Screw (L)
14 Boom combination control valve (L)
15 Elbow (L)
16 Bracket (O)
17 Cotter pin (N)
18 Washer (N)
19 Pin (N)
20 Boom control valve lever (N)
21 Screw (O)
22 Lock washer (O)
23 Packing ring (M)
24 Packing ring (M)
25 Packing ring (M)

Note: The letters in parentheses refer to figure 3-20 view.

Figure 3-18. Boom safety valve, control valves, and control levers.



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1 Subplate (X)
2 Packing ring (B)
3 System selector valve (B)
4 Wiper (E)
5 Pin (C)
6 Cotterpin (C)
7 Lever (C)
8 Washer (C)
9 Screw (C)
10 Lockwasher (C)
11 Bracket (E)
12 Screw (A)
13 Packing ring (G)
14 Lever (H)
15 Spring pin (H)
16 Screw (F)
17 Main winch control valve (F)
18 Switch bracket
19 Screw
19.1 Lockwasher
20 Switch
21 Screw (I)
22 Bracket
23 Adapter union (I)
24 Power control valve (I)
25 Bracket (K)
26 Cotter pin (J)
27 Washer (J)
28 Pin (J)
29 Power control valve lever (J)
30 Pin (J)
31 Screw (K)
32 Lockwasher (K)
33 Magnetic plug (G)

Figure 3-19. System selector valve, control valves, and control levers.

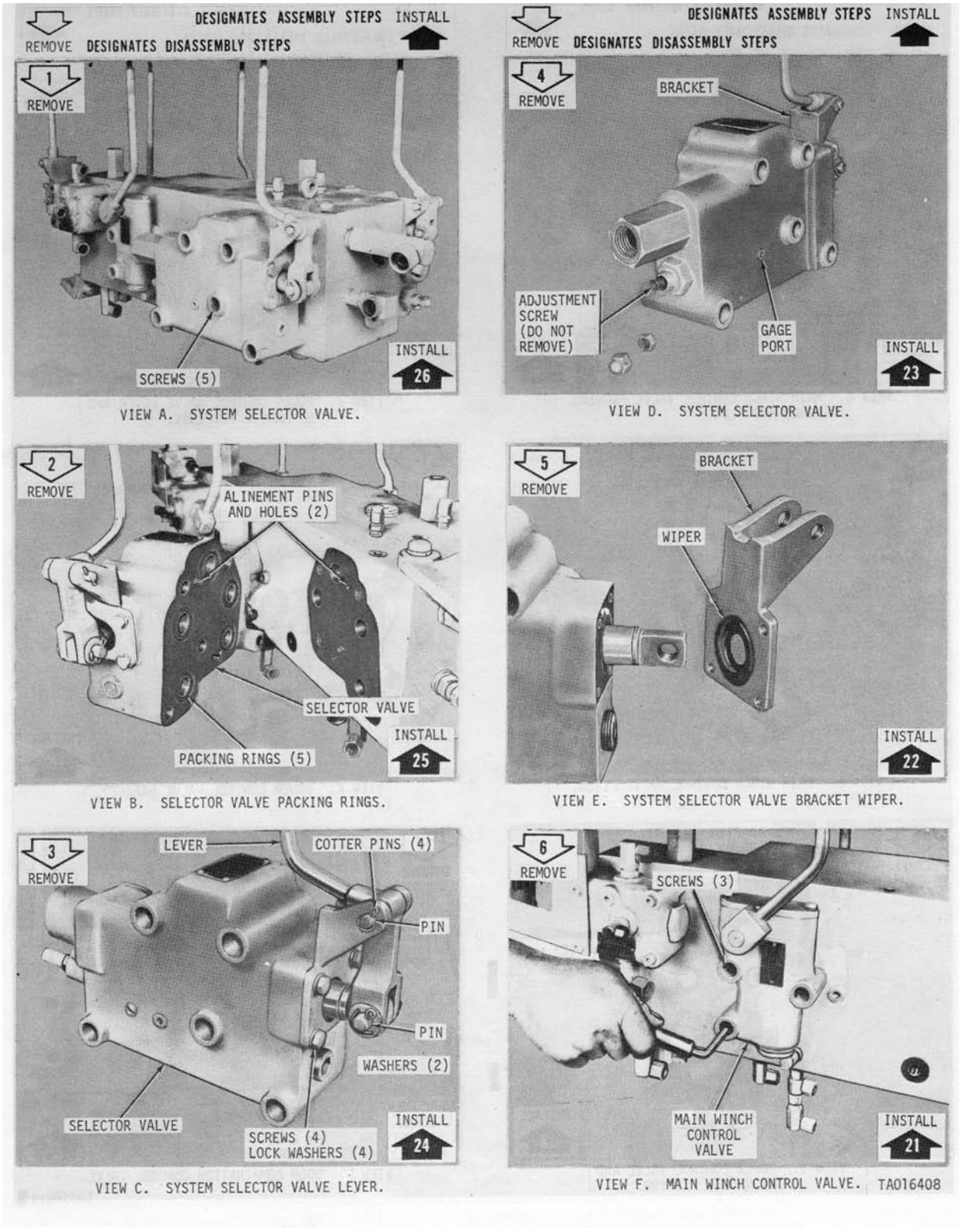

Figure 3-20. Disassembly of hydraulic subplate assembly into subassemblies (Sheet 1 of 5).

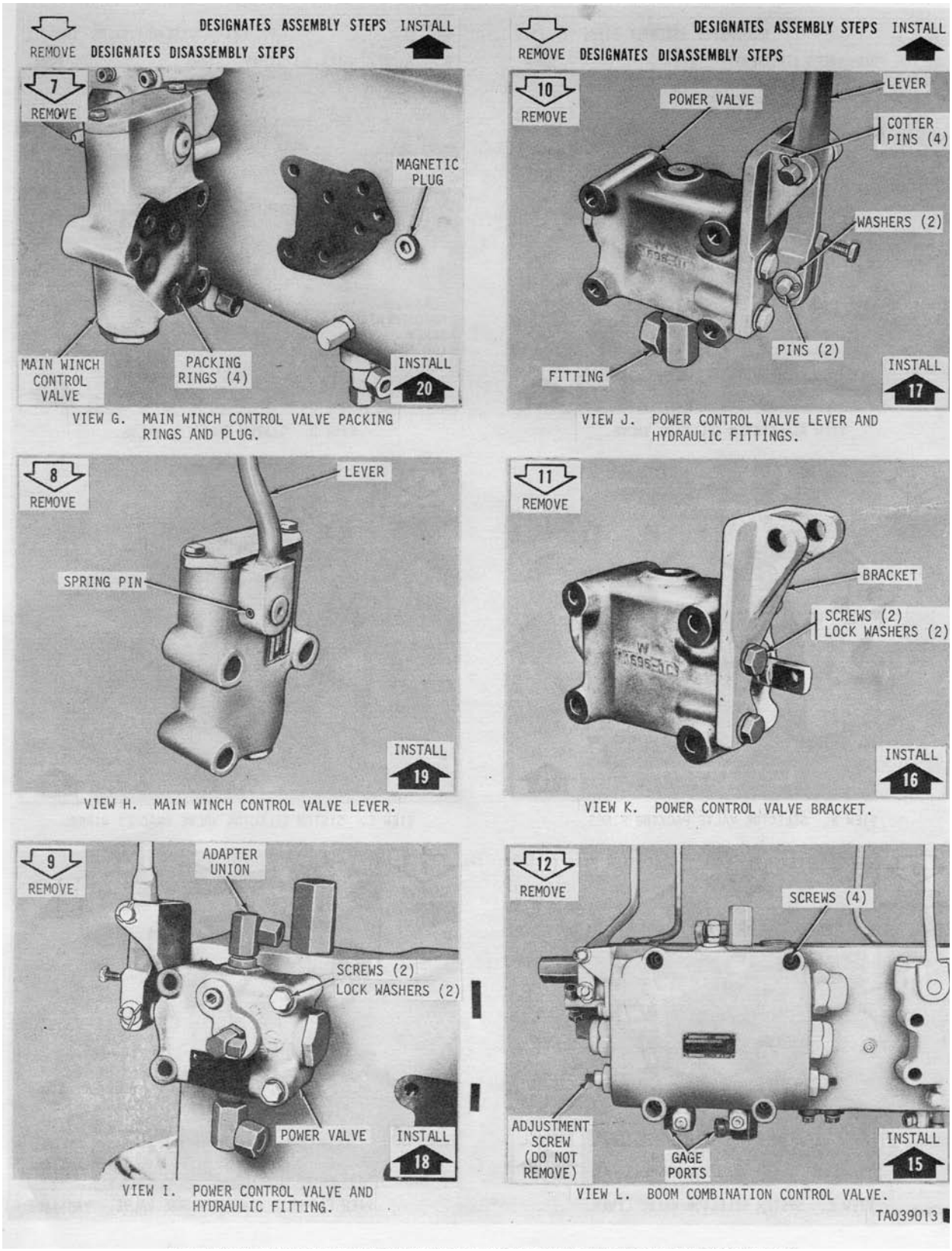

Figure 3-20. Disassembly of hydraulic subplate assembly into subassemblies (Sheet 2of5).

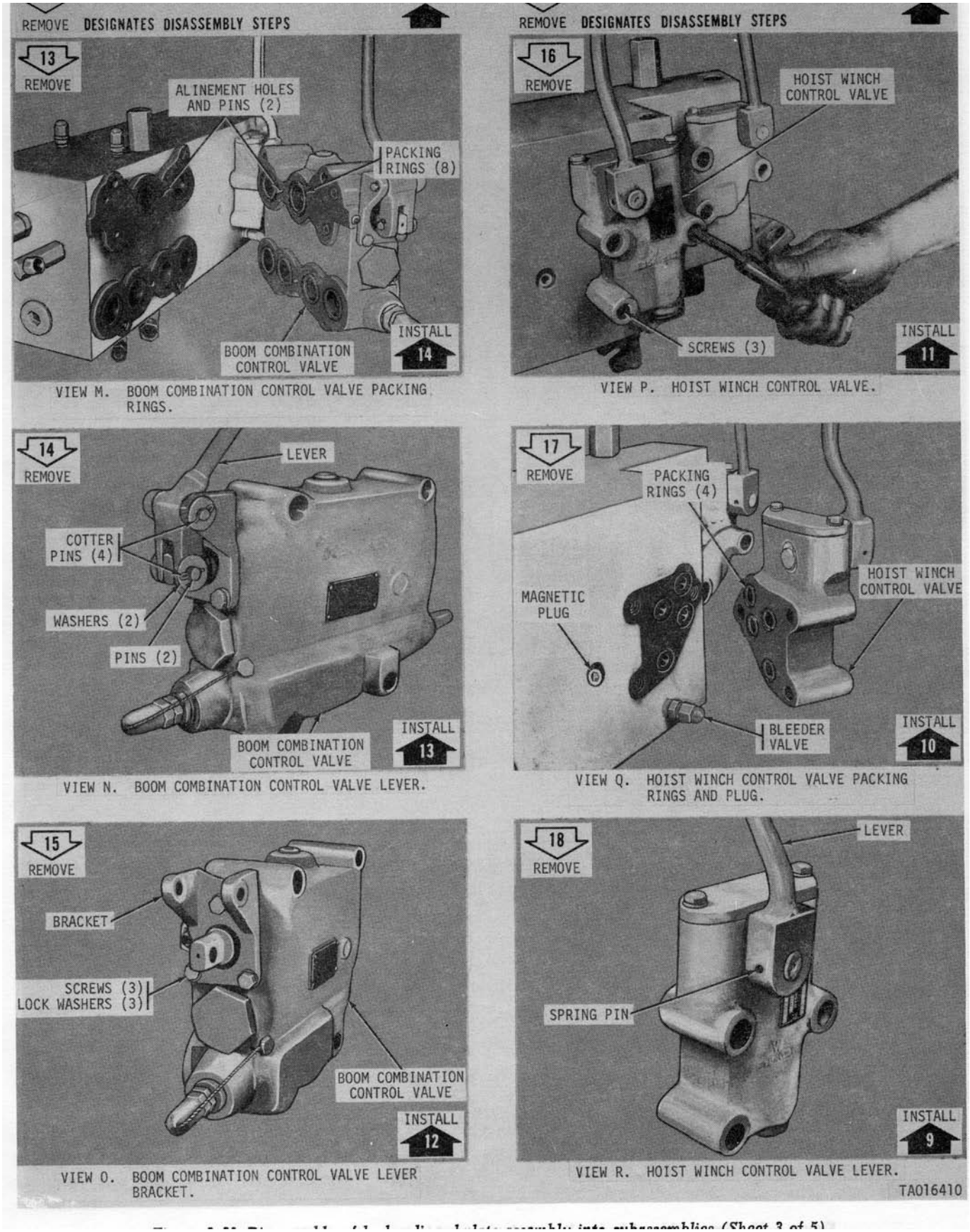

Figure 3-20. Disassembly of hydraulic subplate assembly into subassemblies (Sheet 3 of 5).

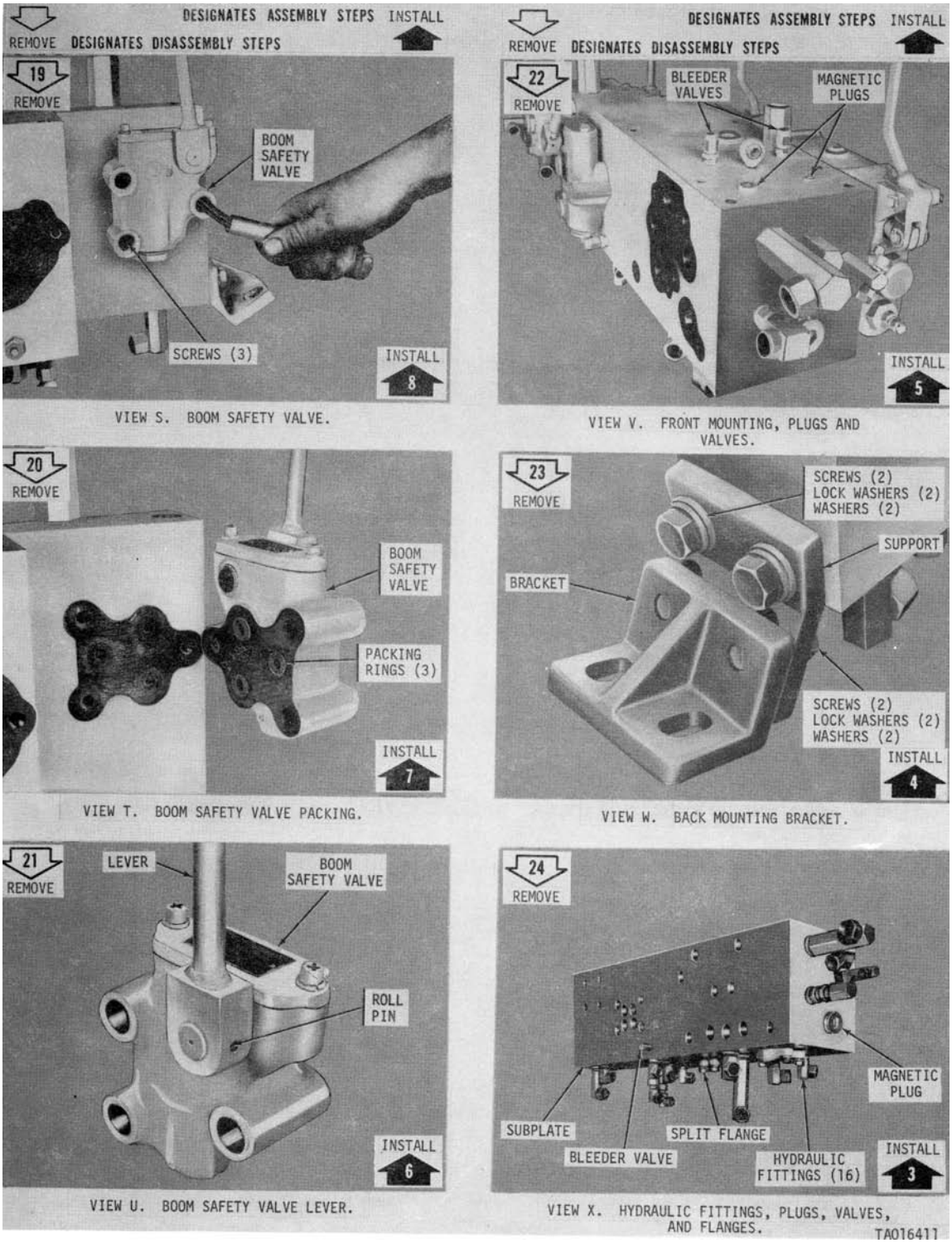

Figure 3-20. Disassembly of hydraulic subplate assembly into subassemblies (Sheet 4 of 5)

3-13. Repair of Hydraulic Subplate Assembly Components

a. General. Remove and replace defective component following sequence indicated in figure 3-20.

b. Cleaning. Wash parts, except seals and gaskets, in drycleaning solvent or mineral spirits paint thinner. Blow parts with moisture-free compressed air; then immerse parts in clean OE-10 oil, to prevent rusting.

c. Inspection and Repair.

(1) Inspect all screws, plugs, nuts and fittings for damaged threads and hex or socket heads for rounded corners.

(2) Inspect all tapped holes for damaged threads. Repair damaged threads with thread chaser.

(3) Inspect valve bodies for cracks.

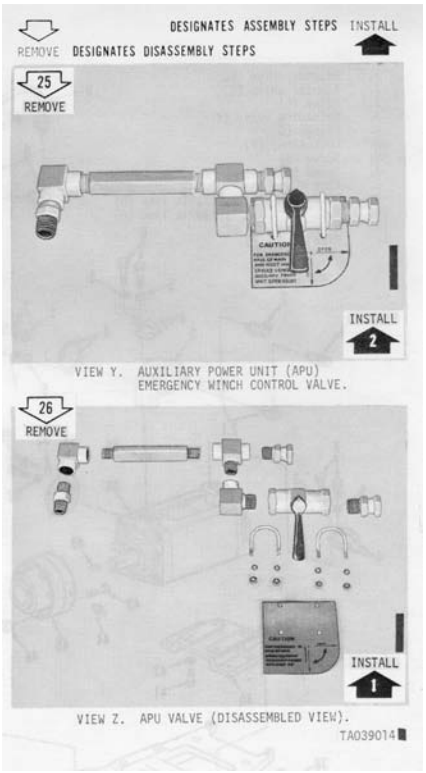

Figure 3-20. Disassembly of hydraulic subplate assembly into subassemblies (Sheet 5 of 5).

3-14. Assembly of Hydraulic Subplate Assembly from Subassemblies

Assemble the hydraulic subplate assembly in reverse order of disassembly (fig. 3-20)

Section IV. REPAIR OF MECHANICAL TRANSMISSION AND MAIN HYDRAULIC PUMP ASSEMBLY

3-15. Description

The mechanical transmission and main hydraulic pump assembly (figs. 1-10 and 1011) is mounted in the hull beneath the crew compartment. A power takeoff from the main engine drives the transmission which is coupled to the hydraulic pump. The power hydraulic takeoff is engaged or disengaged by an internal transmission clutch,

3-16. Disassembly of Mechanical Transmission and Main Hydraulic Pump Assembly into Subassemblies

a. General. Figure 3-21, with its accompanying legend, serves to identify all subassemblies and attaching parts. The legend also provides an index to the step-by-step removal of each particular subassembly.

b. Disassembly Procedure. Disassemble the mechanical transmission and main hydraulic pump assembly into subassemblies as shown in figures 3-21 and 3-22

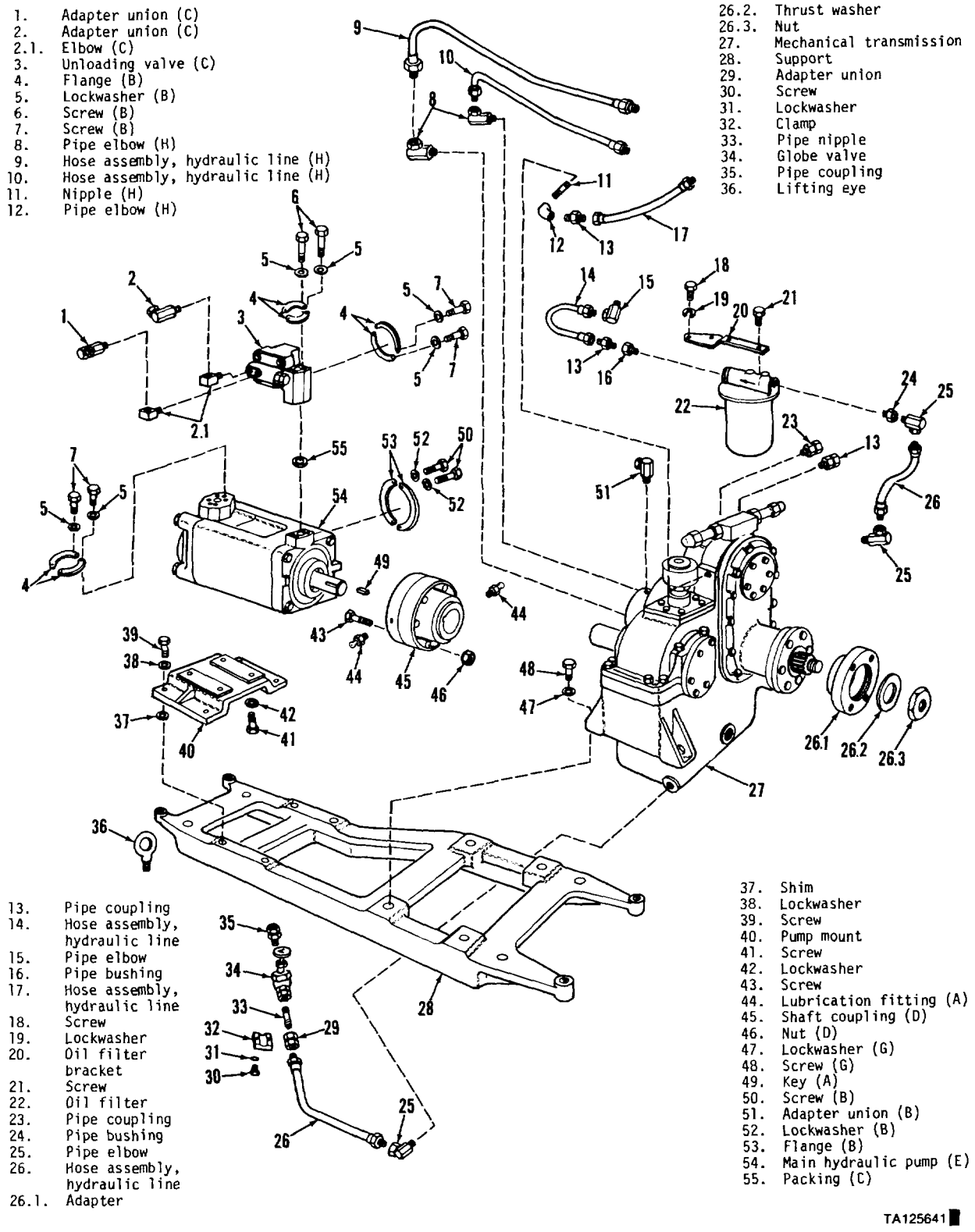

Figure 3-21. Mechanical transmission and main hydraulic pump assembly-partial exploded view disassembly and assembly.

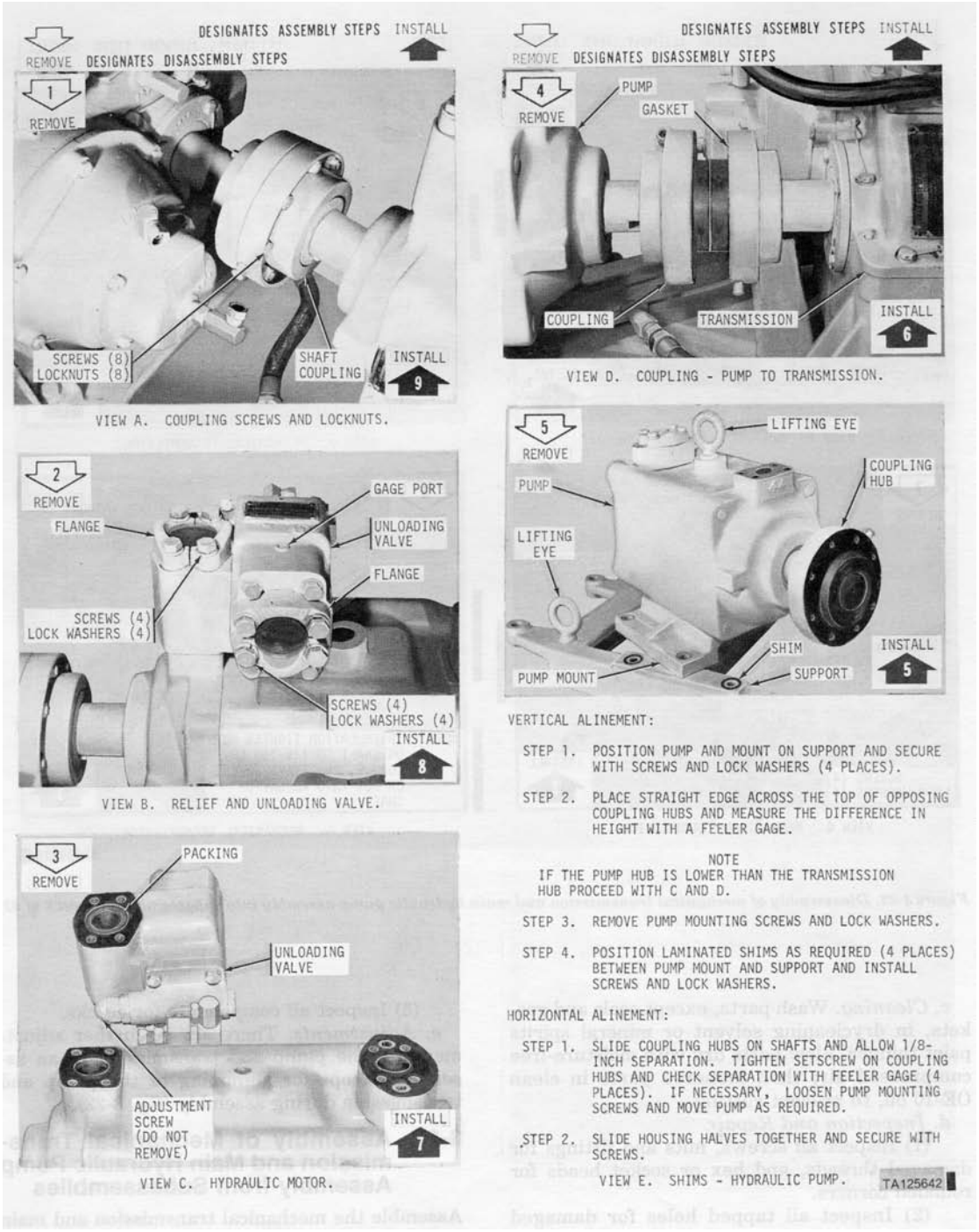

Figure 3-22. Disassembly of mechanical transmission and main hydraulic pump assembly into subassemblies (Sheet 1 of 2).

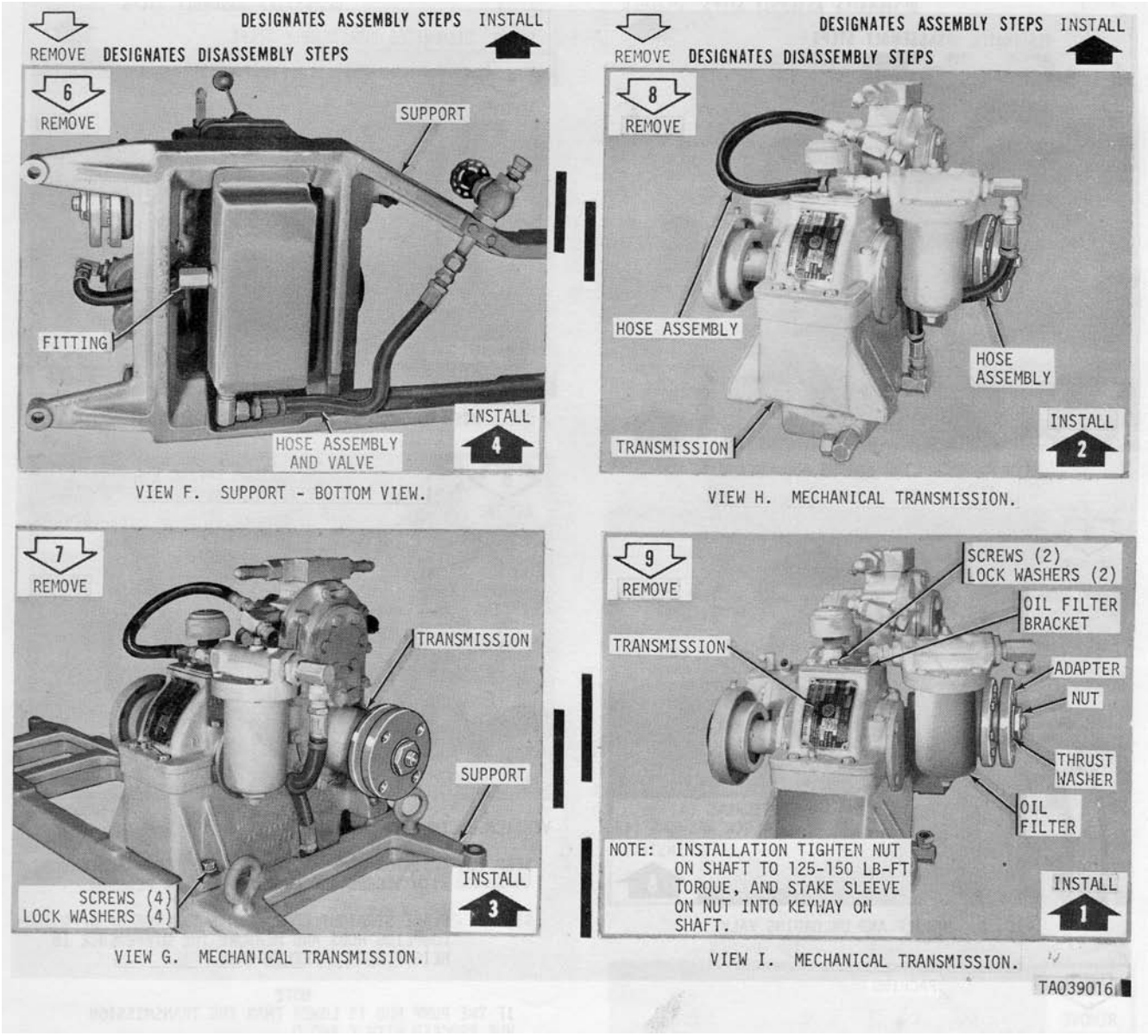

Figure 3-22. Disassembly of mechanical transmission and main hydraulic pump assembly into subassemblies (Sheet 2 of 2).

c. Cleaning. Wash parts, except seals and gaskets, in drycleaning solvent or mineral spirits paint thinner. Blow parts dry with moisture-free compressed air; then immerse parts in clean OE-10 oil, to prevent rusting.

d. Inspection and Repair.

(1) Inspect all screws, nuts and fittings for damaged threads, and hex or socket heads for rounded corners.

(2) Inspect all tapped holes for damaged threads. Repair damaged threads with a thread chaser.

(3) Inspect all components for cracks.

e. Adjustments. There are no further adjustments of the pump and transmission as an assembly except for shimming of the pump and transmission during assembly (fig. 3-22).

3-17. Assembly of Mechanical Transmission and Main Hydraulic Pump Assembly from Subassemblies

Assemble the mechanical transmission and main hydraulic pump assembly in reverse order of disassembly (figs. 3-21 and 3-22).

Section V. REPAIR OF HOIST WINCH ASSEMBLY

3-18. Description

The hoist winch assembly (figs. 1-7 and 1-8) consists of a hydraulic motor, a combination control valve, a counterbalance valve, a winch cable, a brake cylinder, and the hoist winch. The hoist assembly is installed in the hull of the vehicle beneath the crew compartment.

3-19. Disassembly of Hoist Winch Assembly into Subassemblies

a General. Figure 3-23, with its accompanying legend, serves to identify all subassemblies and attaching parts. The legend also provides an index to the step-by-step removal of each particular subassembly.

b. Disassembly Procedure. Disassemble the hoist winch assembly into subassemblies as shown in **fig**ure 3-24.

3-20. Repair of Hoist Winch Cable

a General. The hoist winch cable is the same as the main winch cable except for size.

b. Repair. Refer to paragraph 3-8 for repair instructions.

Legend for fig. 3-23
1 Adapter union (B)
2 Gate valve (B)
3 Nipple(B)
4 Winch assembly (B)
5 Locknut(A)
6 Pipe tee(A)
7 Hose assembly, hydraulic line (A)
8 Adapter union (A)
9 Screw (D)
10 Lockwasher(D)
11 Packing ring(B)
12 Screw(B)
13 Magnetic plug (A)
14 Union(A)
15 Adapter union (A)
16 Screw(A)
17 Adapter union (A)
18 Sealnut(A)
19 Screw(A)
20 Packing (A)
21 Counterbalance valve (B)
22 Manifold (C)
23 Lockwasher (C)
24 Screw (C)
25 Packing ring (C)
26 Adapter union (C)
27 Motor(D)
28 Ring D)
29 Gasket(D)
30 Combination control valve

NOTE

The letters in parentheses refer to figure 3-24 view.

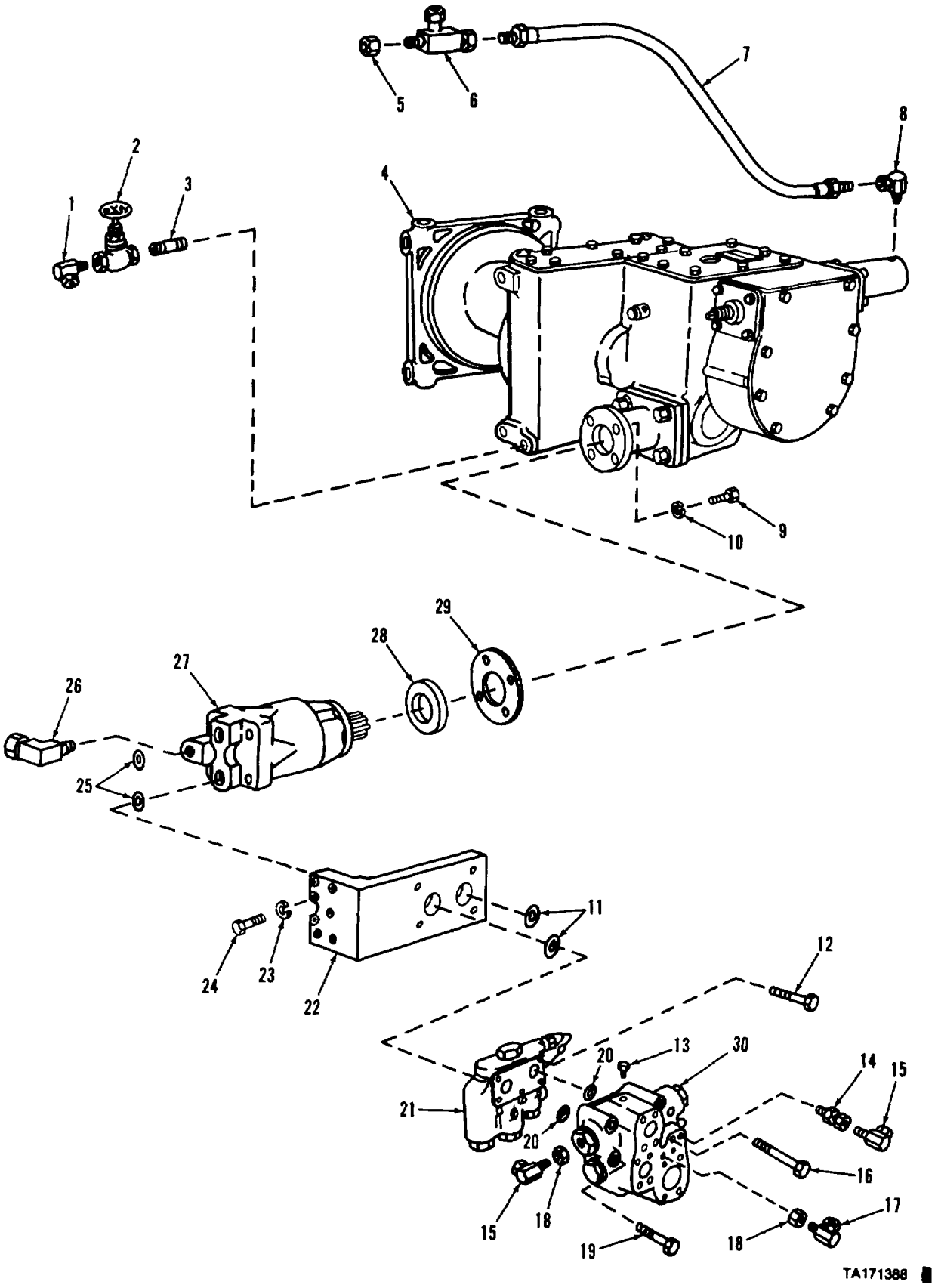

Figure 3-23. Hoist winch assembly-partial exploded view-disassembly and assembly.

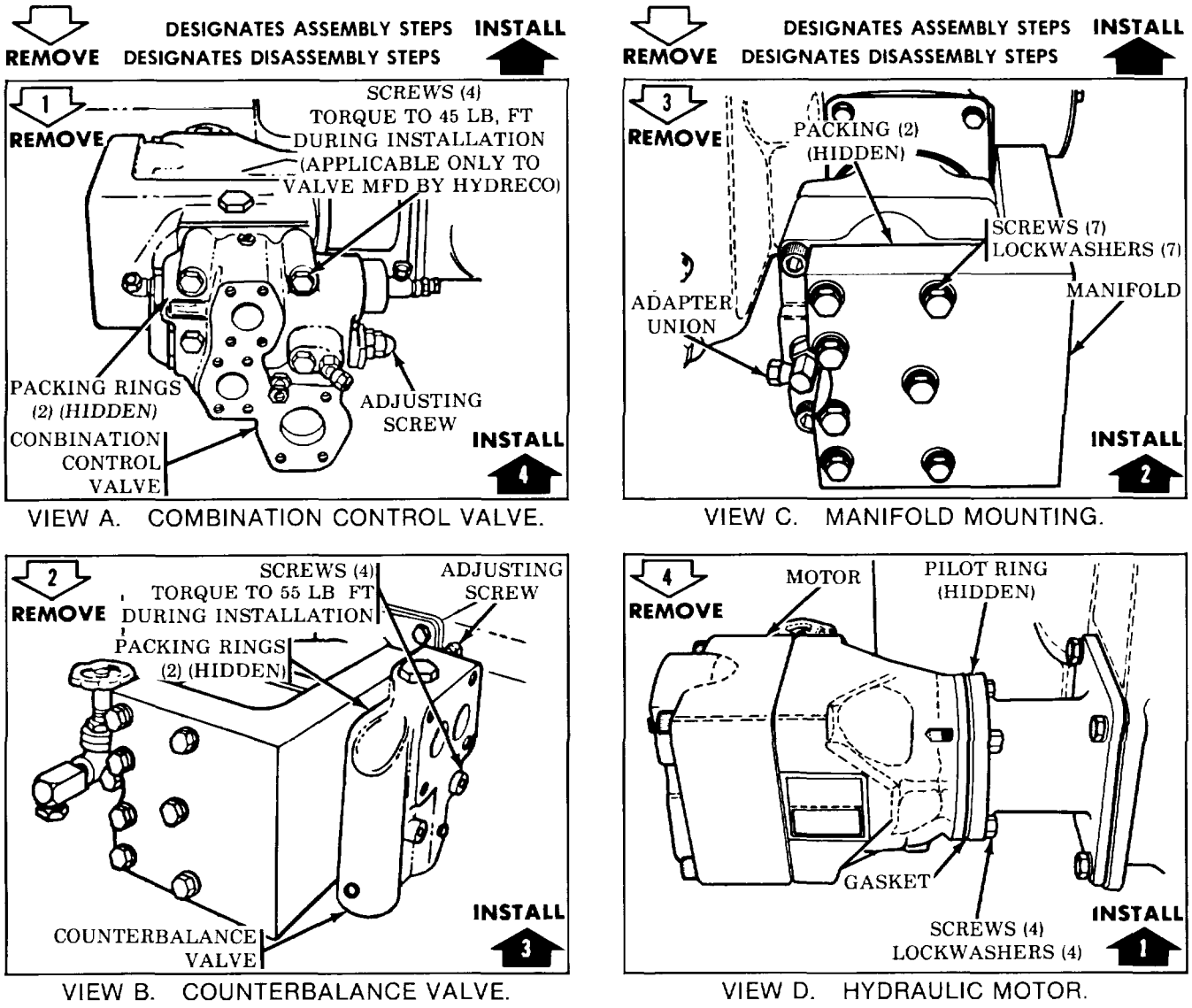

Figure 3-24. Disassembly of Hoist Winch Assembly into Subassemblies.

c Test. Before installing cable on winch, the wire rope assembly is to be tested to 17,400 lb prior to attaching ferrule on winch end, with the clevis installed and the winch end clamped.

3-21 Assembly of Hoist Winch Assembly from Subassemblies

Assemble the hoist winch assembly in reverse order of disassembly (fig. 3-24).

3-21.1 Adjustment of Hoist Winch

Valves are adjusted by the vehicle manufacturer. Should verification need to be made, refer to paragraph 2-21 for procedure.

a. Deleted.
b. Deleted.
c. Deleted.
d. Deleted.

3-21.2 Adjustment of Live Boom Capability

Refer to paragraph 2-22 for adjustment procedure.

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SECTION VI. REPAIR HYDRAULIC OIL TANK ASSEMBLY

3-22. Description

The hydraulic oil tank assembly (fig. 1-14) is mounted in the hull beneath the crew compartment. It supplies hydraulic fluid to the hydraulic system.

3-23. Disassembly of Hydraulic Oil Tank Assembly

a. General. Figures 3-25 and 3-26, with accompanying legends, serve to identify all parts of the hydraulic oil tank assembly. The legends also provide an index to the step-by-step removal of each component during disassembly.

b. Disassembly Procedures. Disassemble the hydraulic oil tank assembly as shown in figure 3-27.

Legend for fig. 3-25

1 Gasket(G)
2 Hydraulic oil tank(A)
3 Nipple (J)
4 Gate valve (J)
5 Adapter union (J)
6 Pipe tee (J)
7 Adapter union (J)
8. Cover assembly (H)
9 Screw (H)
10 Lockwasher (H)
11 Screw (H)
12 Lock washer(H)
13 Flanges(H)
14 Flanges (H)
15 Pipe (H)
16 Pipes (H)
17 Packing(H)
18 Packing(H)
19 Cover (H)
20 Lockwasher(G)
21 Screw(G)
22 Flange(G)
23 Lockwasher(G)
24 Screw(G)
25 Nipple(G)
26 Elbow(G)
27 Nipple(G)
28 Flange(G)
29 Screw(G)
30 Elbow (G)
31 Screw(G)
32 Screw(G)
33 Union(G)
34 Nut(G)
35 Adapter union (G)
36 Adapter union (G)
37 Adapter union (G)
38 Check valve (G)
39 Straight adapter (G)

NOTE

The letters in parentheses refer to figure 3-27 view.

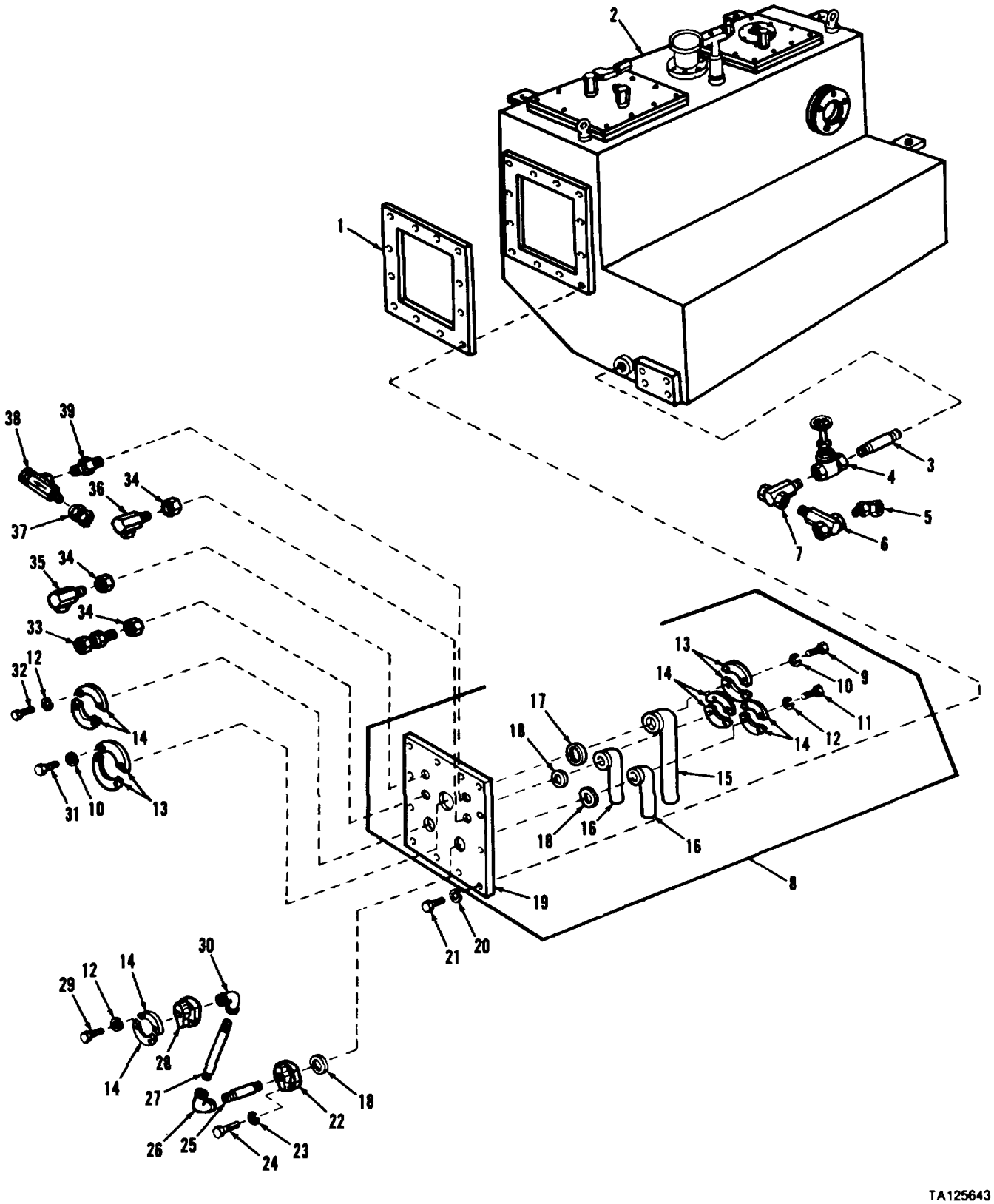


Figure 3-25. Front cover assembly and attaching parts - hydraulic oil tank.

1 Cover assembly (F)
2 Screw (F)
3 Lock washer (C)
4 Nut (K)
5 Lock washer (K)
6 Screw (K)
7 Magnet (K)
8 Screw (K)
9 Bracket (K)
10 Bracket (K)
11 Lock washer (K)
12 Nut (K)
13 Nipple (F)
14 Cover (E)
15 Screw (C)
16 Nut (C)
17 Adapter union (E)
18 Adapter union (E)
19 Nut (C)
20 Lock washer (A)
21 Cap assembly (A)
22 Neck assembly (A)
23 Gasket (A)
24 Filter (B)
25 Adapter union (C)
26 Screw (C)
27 Identification plate (C)
28 Adapter union (C)
29 Cover (D)
30 Pipe (D)
31 Gasket (D)
32 Pipe (I)
33 Packing (I)
34 Bolt (D)
35 Gage rod (D)
36 Tank (F)
37 Flanges (I)
38 Lock washer (I)
39 Screw (I)
40 Gasket (C)
41 Screws (C)
42 Lockwashers (C)
43 Harness Assembly (C)
44 Switch (C)
45 Transmitter (C)
46 Housing (D)
47 Cap (D)
48 Gasket (C)

Note: The letters in parentheses refer to figure 3-27 view.

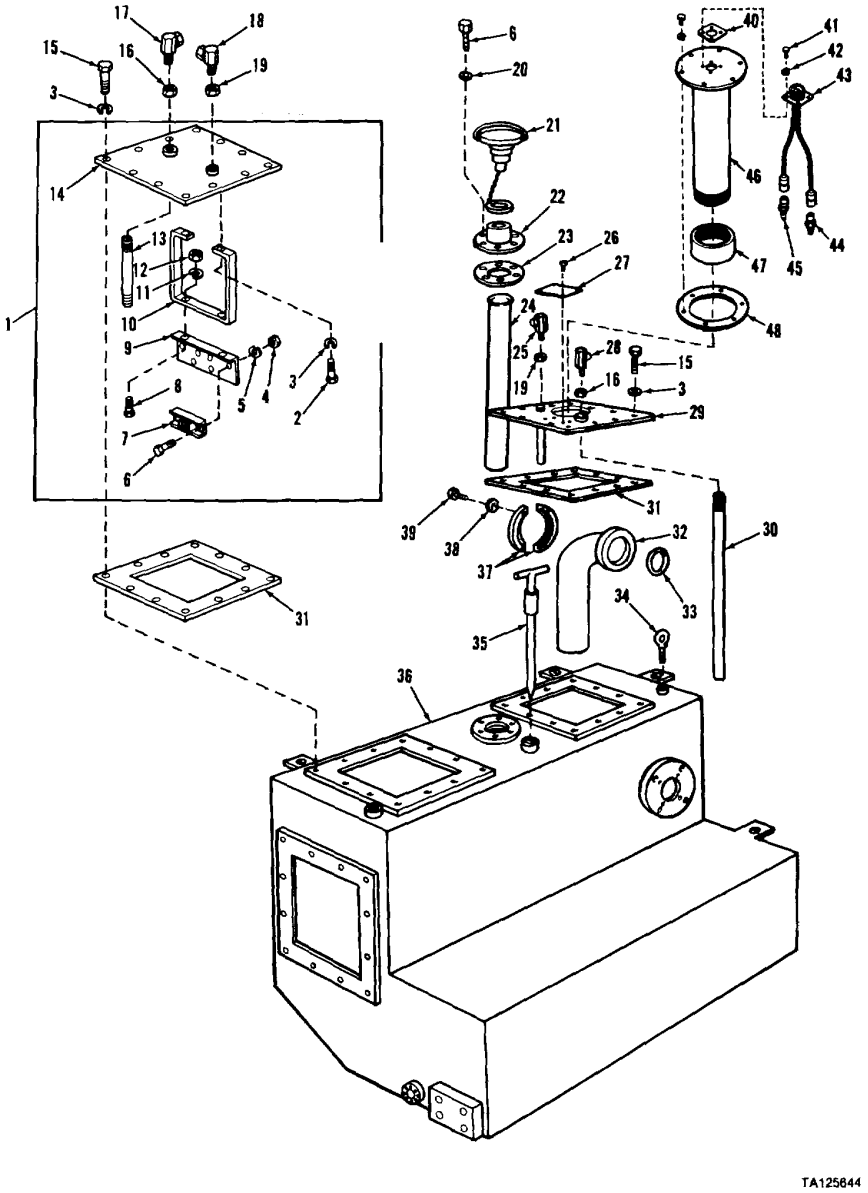


Figure 3-26. Top covers, and attaching parts - hydraulic oil tank.

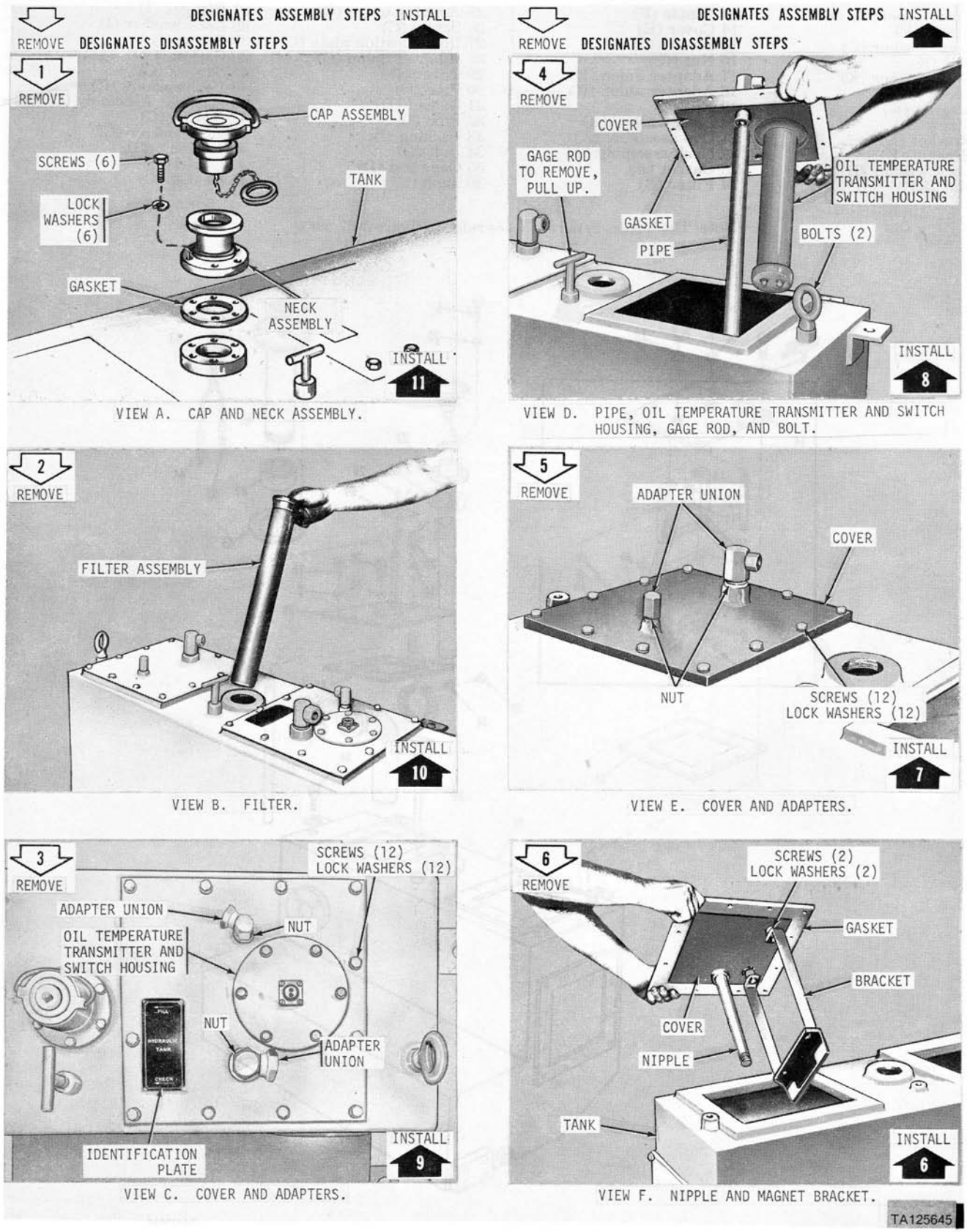


Figure 3-27. Repair of hydraulic oil tank (Sheet 1 of 2).

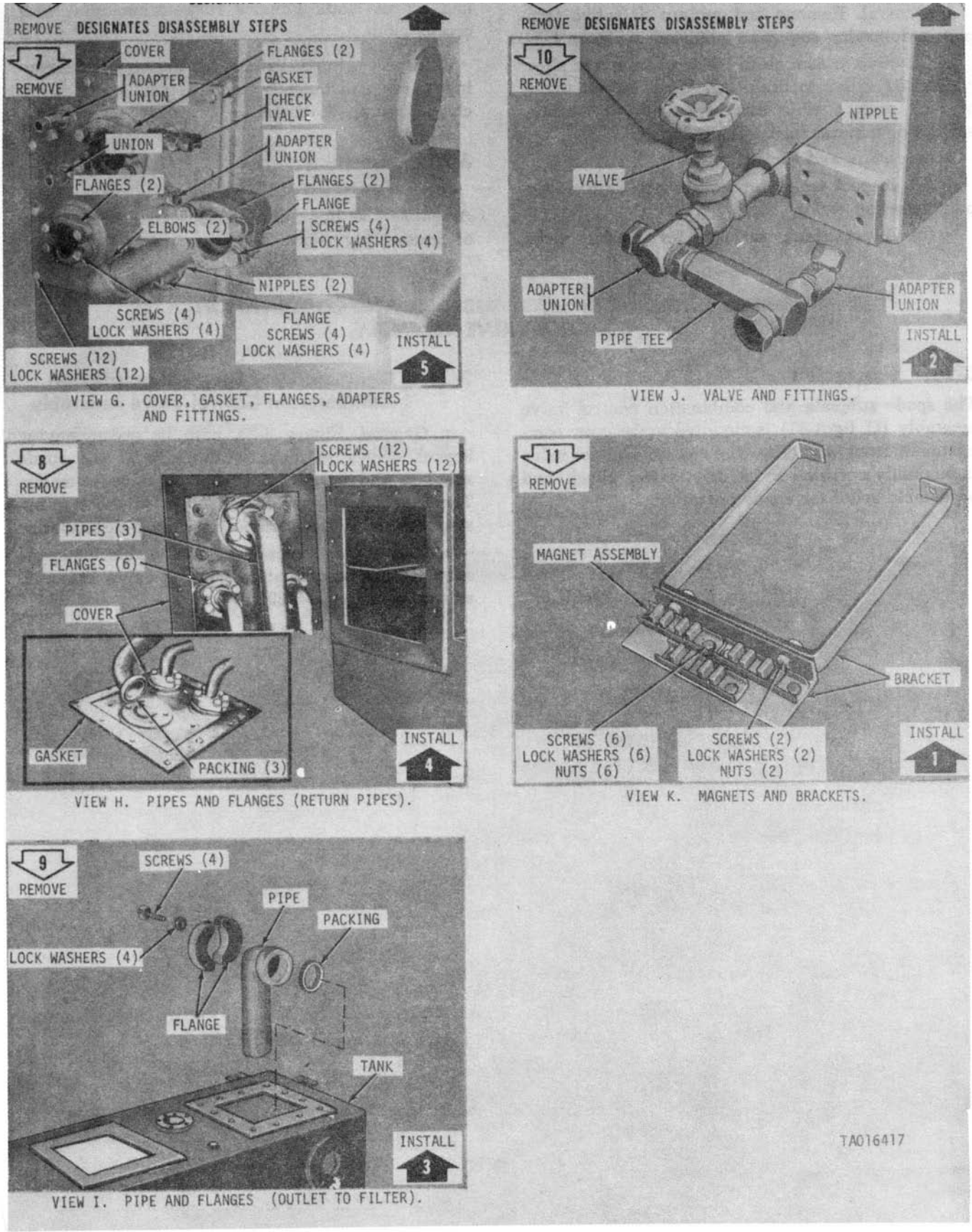


Figure 3-27. Repair of hydraulic oil tank (Sheet 2 of 2).

3-24. Repair of Hydraulic Oil Tank

a. General. Remove and replace defective component following sequence indicated in figure 3-27.

b. Cleaning. Steam clean inside of tank and allow condensed water to drain off. Wash down outside of tank with a cloth saturated with dry-cleaning solvent or mineral spirits paint thinner.

c. Inspection and Repair.

(1) Inspect welds for cracks and defects. Repair defective welds.

(2) Inspect tank surfaces for cracks, nicks, rust and corrosion. Remove nicks with a fine file and crocus cloth. Remove rust or corrosion with crocus cloth.

d. Inspect painted surfaces for chipping and scraping. Clean and touch up painted surfaces that are chipped, scraped, rusted, or corroded.

3-25. Assembly of Hydraulic Oil Tank Assembly from Subassemblies

Assemble the hydraulic oil tank in reverse order of disassembly (fig. 3-27).

Section VII. REPAIR OF SPADE SUBPLATE AND COMBINATION CONTROL VALVE ASSEMBLY

3-26. Description

The spade subplate and combination control valve assembly (C, fig. 1-17) is mounted to the crew compartment front wall. The combination control valve is manually operated to include control, check, and adjustable relief for spade operation.

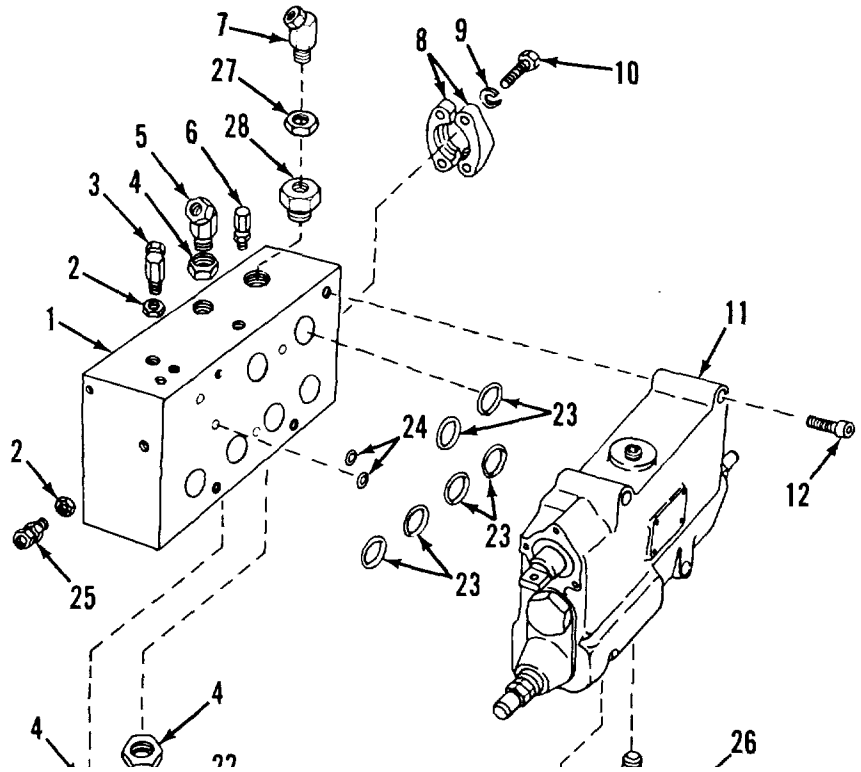
3-27. Disassembly of Spade Subplate and Combination Control Valve Assembly

a General. Figure 3-28, with its accompanying legend, serves to identify all parts of the spade subplate and combination control valve assembly. The legend also provides an index to the step-by-step removal of each component during disassembly.

b. Disassembly Procedure. Disassemble the spade subplate and combination control valve assembly as shown in figure 3-29.

1 Subplate(A)
2 Nut(C)
3 Adapter union(C)
4 Nut(C)
5 Adapter union(C)
6 Valve(C)
7 Adapter union(C)
8 Flange
9 Lockwasher (B)
10 Screw(B)
11 Combination control valve(A)
12 Screw
13 Elbow(A)
14 Retainer assembly(A)
15 Retainer(A)
16 Chain(A)
17 Ring(A)
18 Coupling(A)
19 Coupling(A)
20 Hose assembly, hydraulic line(A)
21 Marker band
22 Elbow(B)
23 Packing(D)
24 Packing(D)
25 Union(A)
26 Plug(B)
27 Nut(C)
28 Bushing(C)

2 Nut (C)
3 Adapter union (C)
4 Nut (C)
5 Adapter union (C)
6 Valve (C)
7 Adapter union (C)
8 Flange (B)
9 Lockwasher (B)
10 Screw (B)
11 Combination control valve (A)
12 Screw
13 Elbow (A)
14 Retainer assembly (A)
16 Chain (A)
17 Ring (A)
18 Coupling (A)
19 Coupling (A)
20 Hose assembly, hydraulic line (A)
21 Marker band
22 Elbow (B)
23 Packing (D)
24 Packing (D)
25 Union (A)
26 Plug (B)
27 Nut (C)
28 Bushing (C)



NOTE: The letters in parenthesis refer to figure 3-29 view.

Figure 3-28. Spade subplate and combination control valve assembly-exploded view-disassembly and assembly.

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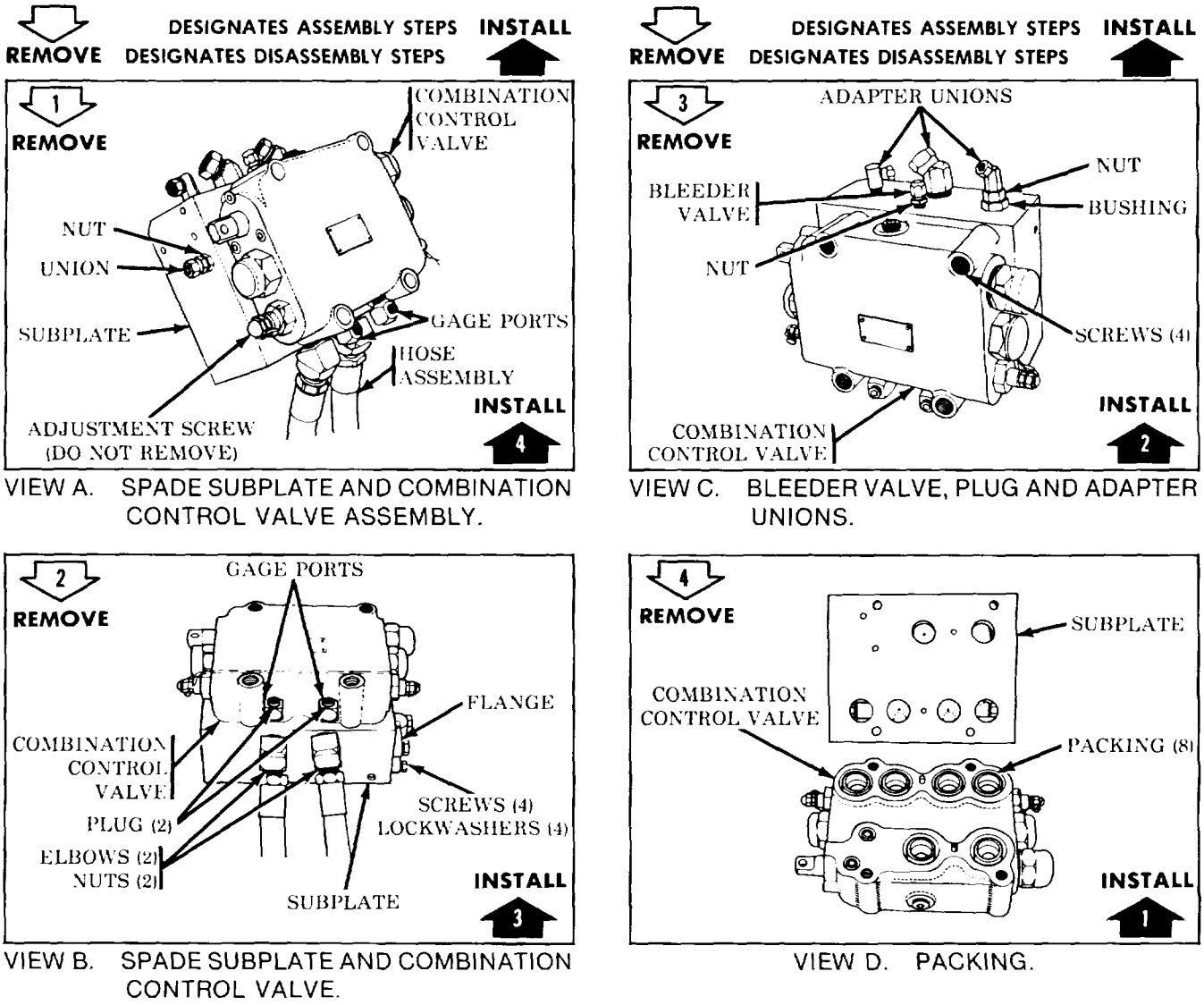

Figure 3-29. Disassembly of space subplate and combination control valve assembly.

3-28. Repair of Spade Subplate and Combination Control Valve Assembly Components

a. General. Remove and replace defective component following sequence indicated in figure 3-29.

b. Cleaning. Wash all parts in dry-cleaning solvent or mineral spirits paint thinner. Dry parts with moisture-free compressed air; then immerse parts in clean OE-10 oil, to prevent rusting.

c. Inspection.

(1) Inspect all threaded parts for nicks, burrs, and cross-threading. Repair with a thread chaser.

(2 Inspect control valve for cracks or dented surfaces.

(3) Inspect fittings for nicks, burrs, cracks, or leakage. Remove burrs with a fine, hard, sharpening stone.

3-29. Assembly of Spade Subplate and Combination Control Valve Assembly

Assemble the spade and subplate and combination control valve assembly in reverse order of disassembly (figure 3-29).

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Section VIII. REPAIR OF FLOW REGULATOR SUBPLATE ASSEMBLY

3-30. Description

The flow regulator subplate assembly is mounted to the wall behind the right front boom cylinder in the crew compartment. The four flow regulators in this assembly are installed in the main hydraulic system, regulate oil flow in one direction regardless of pressure, and permit unrestricted flow in the opposite direction. The regulators control the speed of raising and lowering the boom and spade.

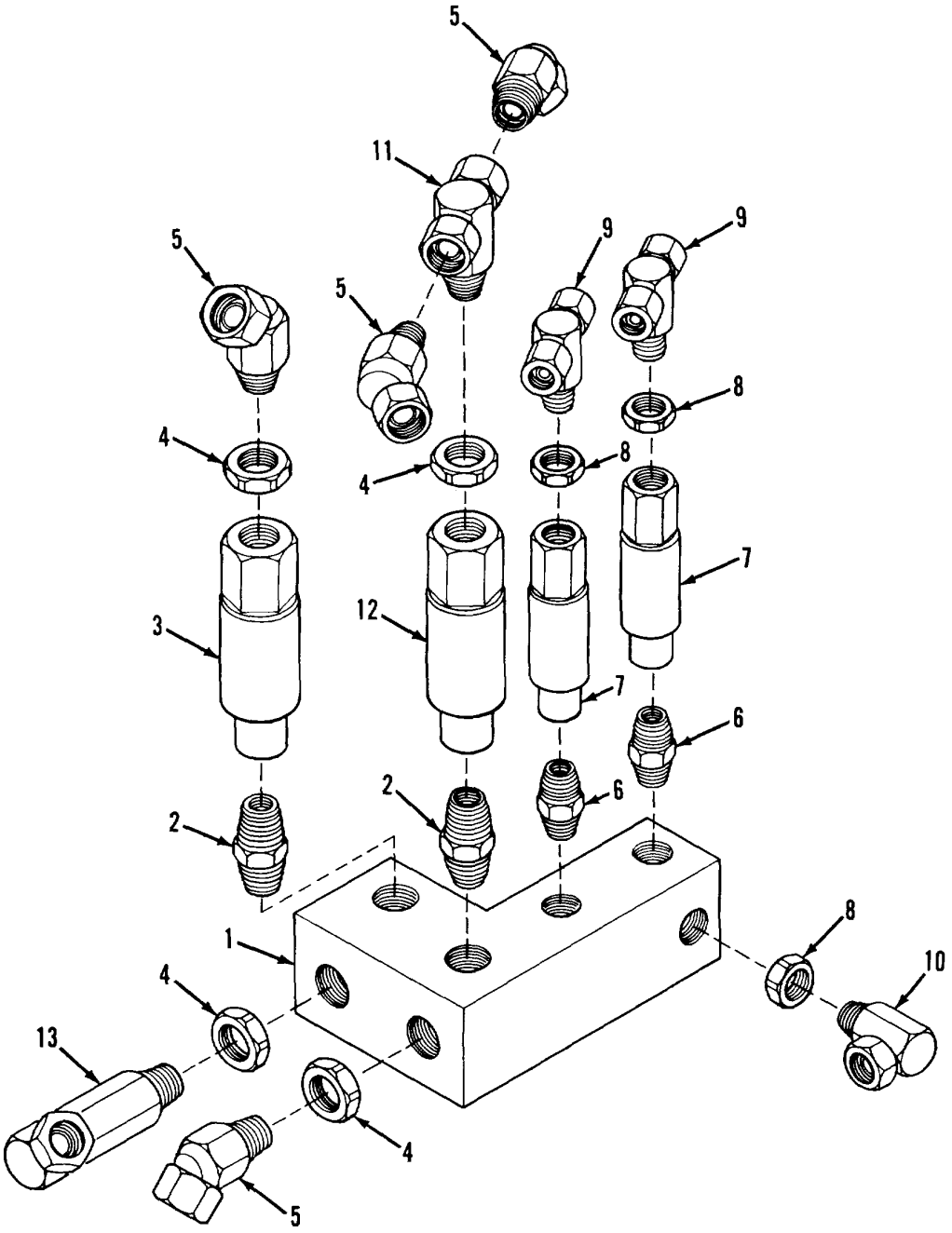
3-31. Disassembly of Flow Regulator Subplate Assembly

a. General. Figure 3-30, with its accompanying legend, serves to identify all parts of the flow regulator subplate assembly. The legend also provides an index to the step-by-step removal of each component during disassembly.

b. Disassembly Procedure. Disassemble the flow regulator subplate assembly as shown in figure 3-31.

LEGEND:

1 Subplate(A)
2 Nipple(D)
3 Flow Regulator(D)
4 Nut(B)
5 Adapter union(B) (C)
6 Nipple(D)
7 Flow regulator(D)
8 Nut(C)
9 Adapter union (C)
10 Adapter union(B)
11 Adapter union (C)
12 Flow regulator(D)
13 Adapter union(B)



NOTE: The letters in parentheses refer to figure 3-31 view.

Figure 3-30. Flow Regulator Subplate Assembly, Exploded View - Disassembly and Assembly.

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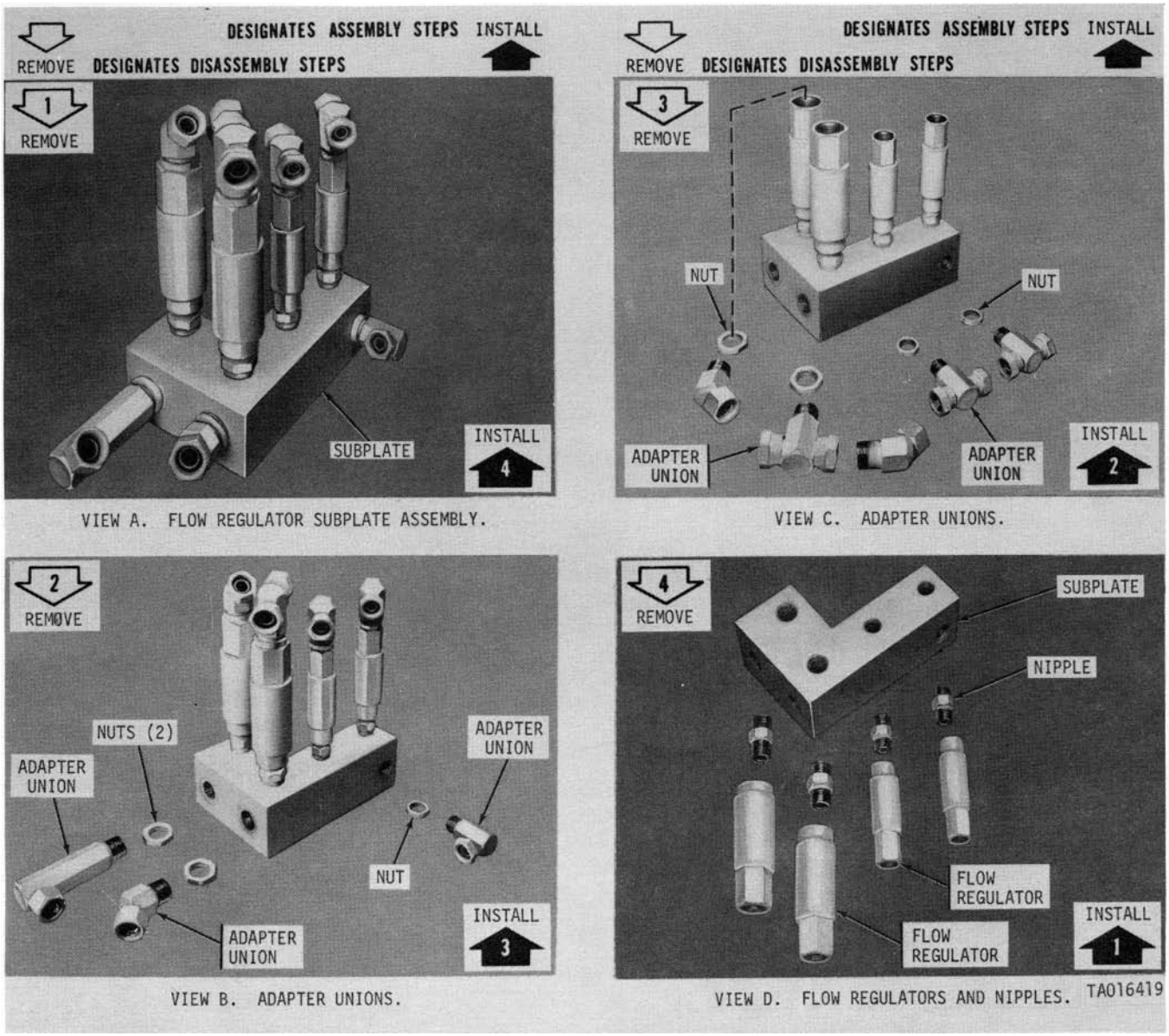

Figure 3-31. Disassembly of flow regulator subplate assembly.

3-32. Repair of Flow Regulator Subplate Assembly Components

a. General. Remove and replace defective component following sequence indicated in figure 3-31.

b. Cleaning. Wash all parts in dry-cleaning solvent or mineral spirits paint thinner. Dry parts with moisture-free compressed air; then immerse parts in clean OE-10 oil, to prevent rusting.

c. *Inspection.*

(1) Inspect all threaded parts for nicks, burs, and cross-threading. Repair with a thread chaser.

(2) Inspect flow regulators for cracks or dented surface.

(3) Inspect fittings for nicks, burs, cracks or leakage. Remove burs with a fine,hard, sharpening stone.

3-33. Assembly of Flow Regulator Subplate Assembly

Assemble the flow regulator subplate assembly in reverse order of disassembly (fig. 3-31).

CHAPTER 4
FINAL INSPECTION

4-1. General

A final inspection will be performed on all items repaired or replaced, to determine whether all necessary work has been accomplished and to determine whether repairs have been performed satisfactorily. This inspection involves visual checks, checks with test instruments, operational checks, safety checks, or any combination thereof necessary to insure that the equipment has been restored to a completely serviceable condition for return to the user or to stock.

4-2. Specific Procedures

Specific checks to be performed on items repaired or replaced are contained, where necessary, in the component repair or installation instructions.

4-3. Load Test Requirement

a. Load testing of main winch, hoist winch and boom is mandatory prior to use under any of the following conditions:

(1) When new.
(2) Following any repair, disassembly and assembly, adjustments or parts replacement of hoist winch boom.
(3) When modifications are made that could affect the strength or lifting capabilities of the vehicle.

b. Load testing will be accomplished by support maintenance activities.

c. Refer to Chapter 2, Section V for detailed step-by-step procedures.

APPENDIX A

REFERENCES

A-1. Publications Referenced

The following publications are referenced within this manual:

Operator's Manual for Recovery Vehicle, Full Tracked: Medium, M88A1	TM 9-2350-256-10
Deleted	
Organizational Maintenance Manual for Recovery Vehicle, Full Tracked: Medium, M88A1	TM 9-2350-256-20
Organizational Maintenance Repair Parts and Special Tools List for Recovery Vehicle, Full Tracked: Medium, M88A1 (To be published)	TM 9-2350-236-20P
Direct Support and General Support Maintenance Manual for Recovery Vehicle, Full Tracked: Medium, M88A1	TM 9-2350-256-34-1
Direct Support and General Support Maintenance Repair Parts and Special Tools for Recovery Vehicle, Full Tracked: Medium, M88A1 (To be published)	TM 9-2350-256-34P-1
Direct Support and General Support Maintenance Repair Parts and Special Tools for Recovery Vehicle, Full Tracked: Medium, M88A1 (To be published)	TM 9-2350-256-34P-2
The Army Maintenance Management System (TAMMS)	TM 38-750
Accident Reporting and Records	AR 385-40
Military Publications: Index of Blank Forms	DA Pam 310-2

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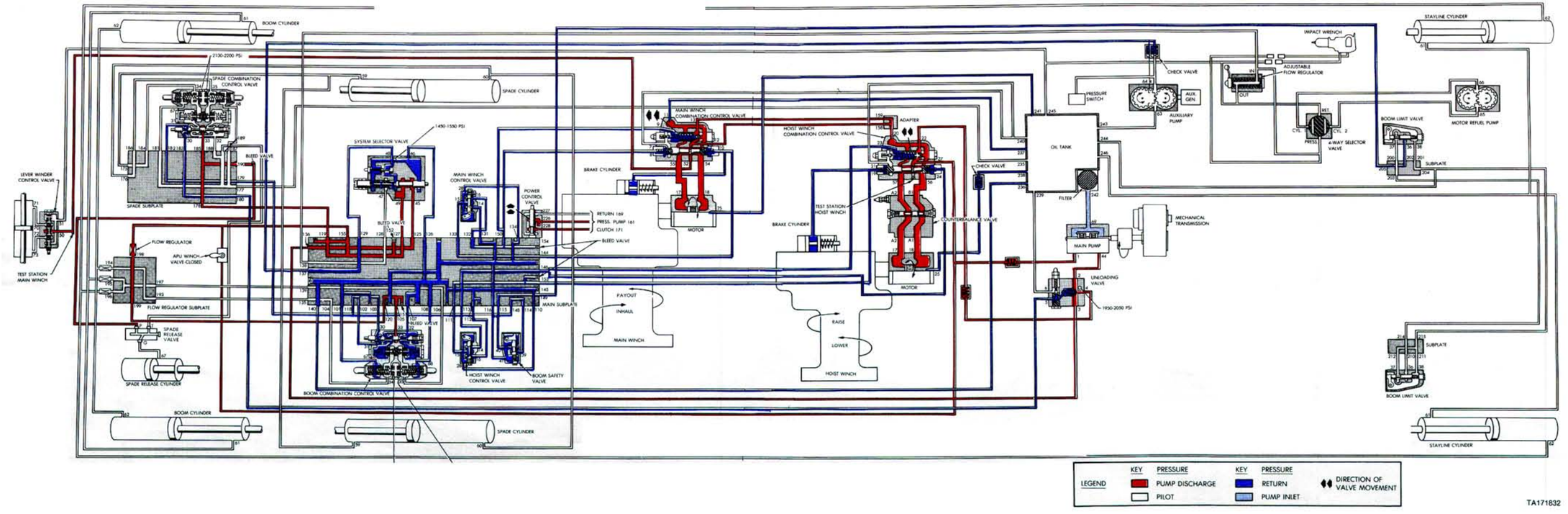
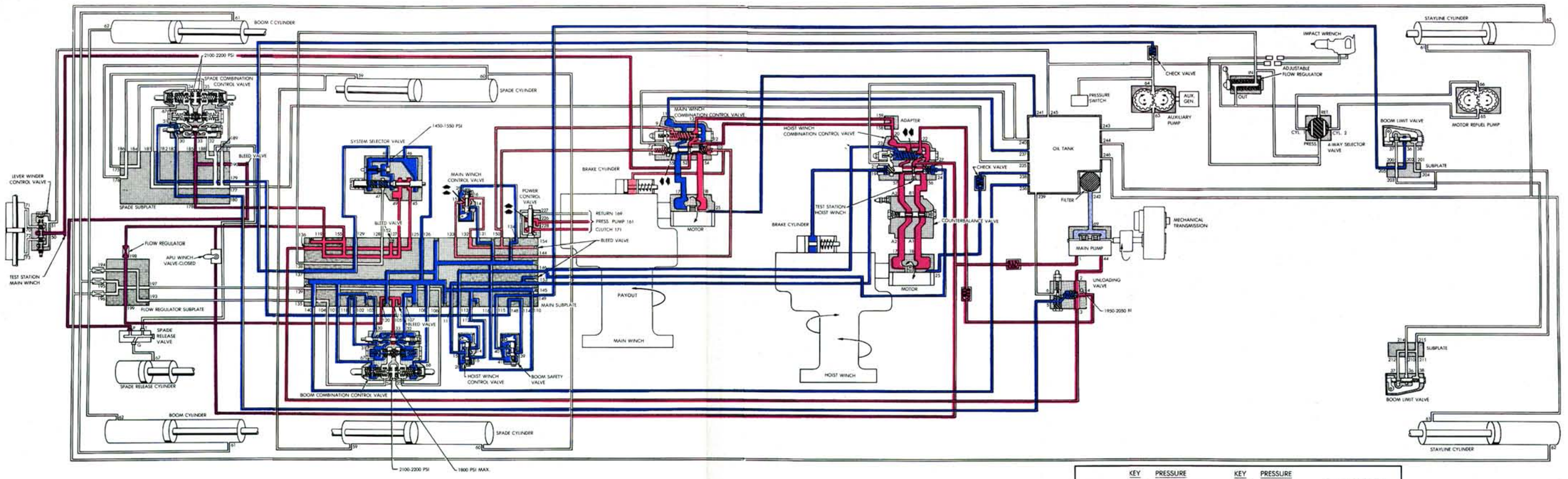


TA171832

FO—1. Winch, Power Takeoff, and Hoist System— Schematic Diagram — Main Hydraulic System Idling.

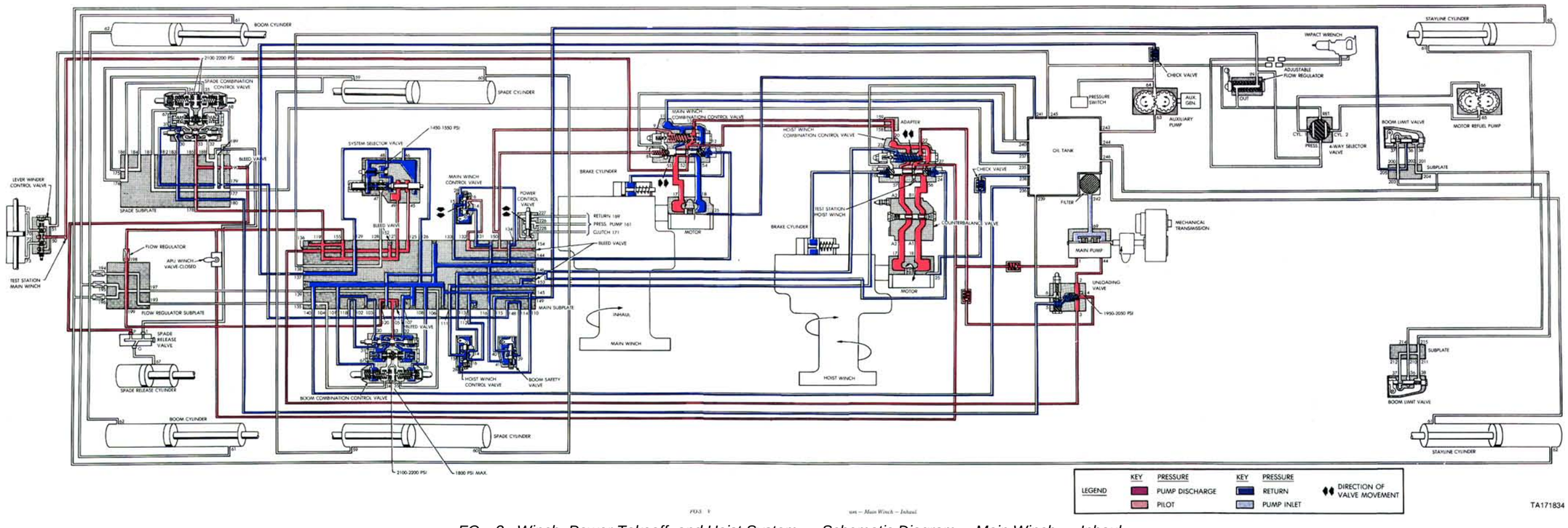
TA171832



TA171833

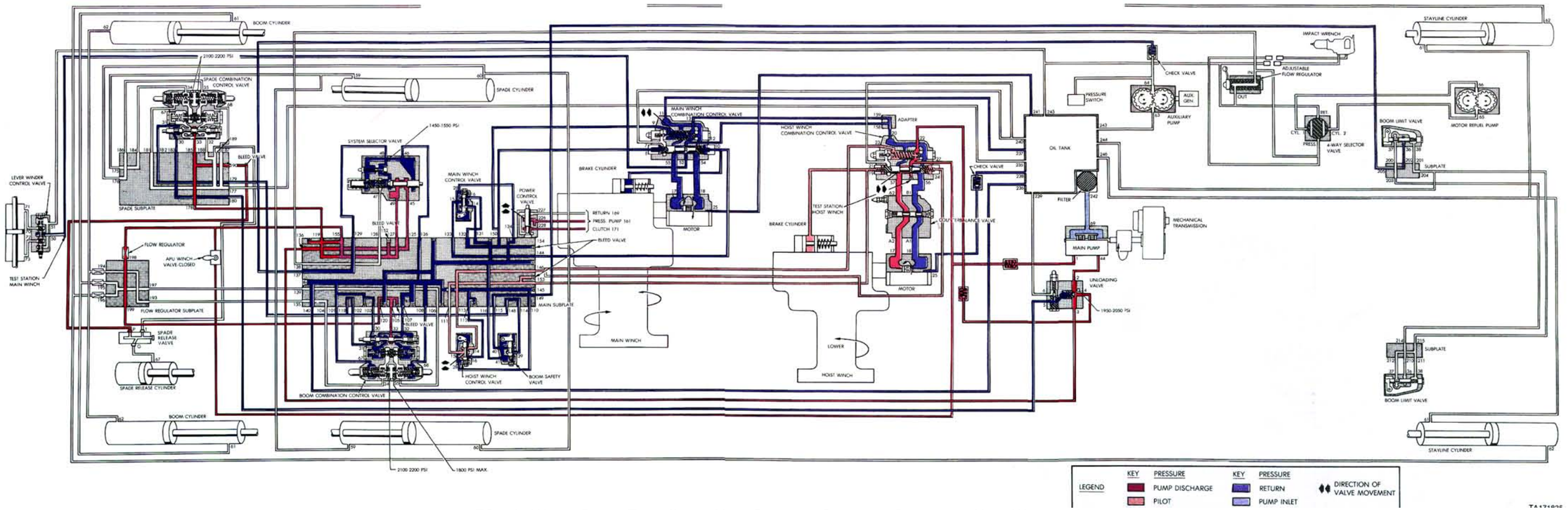
FO—2. Winch, Power Takeoff, and Hoist System — Schematic Diagram — Main Winch — Payout.

TA171832



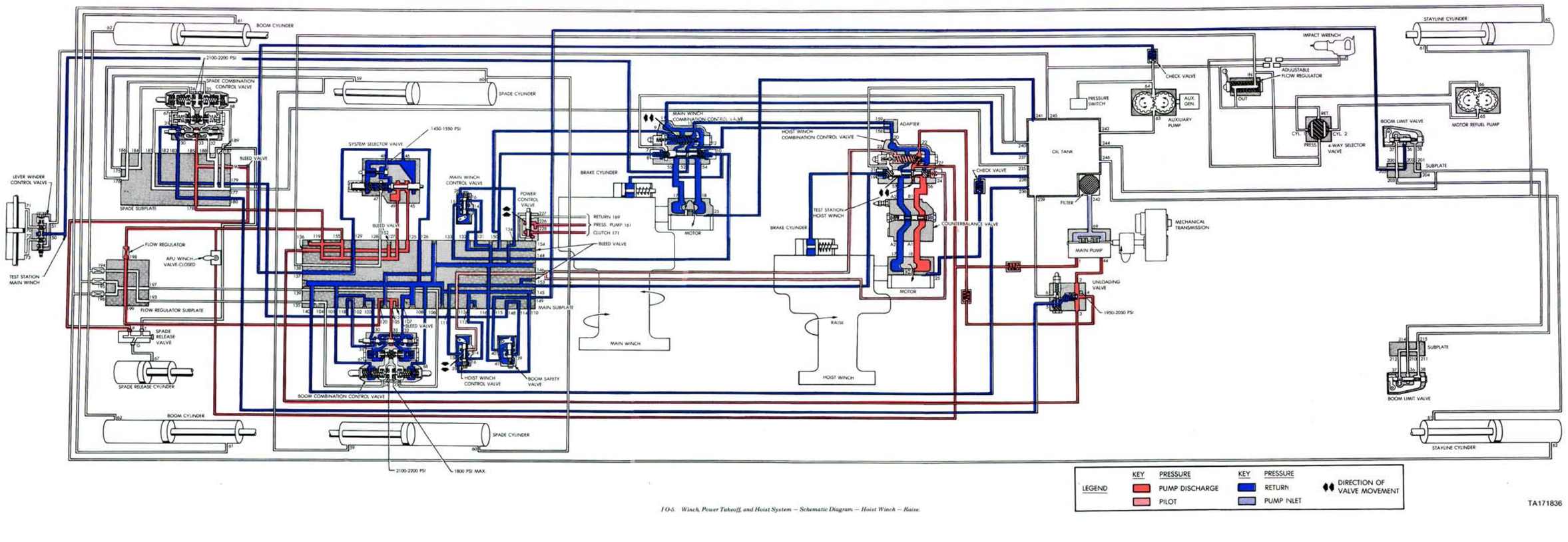
FO—3. Winch, Power Takeoff, and Hoist System — Schematic Diagram —Main Winch — Inhaul.

TA171834



FO—4. Winch, Power Takeoff, and Hoist System —Schematic Diagram — Hoist Winch — Lower.

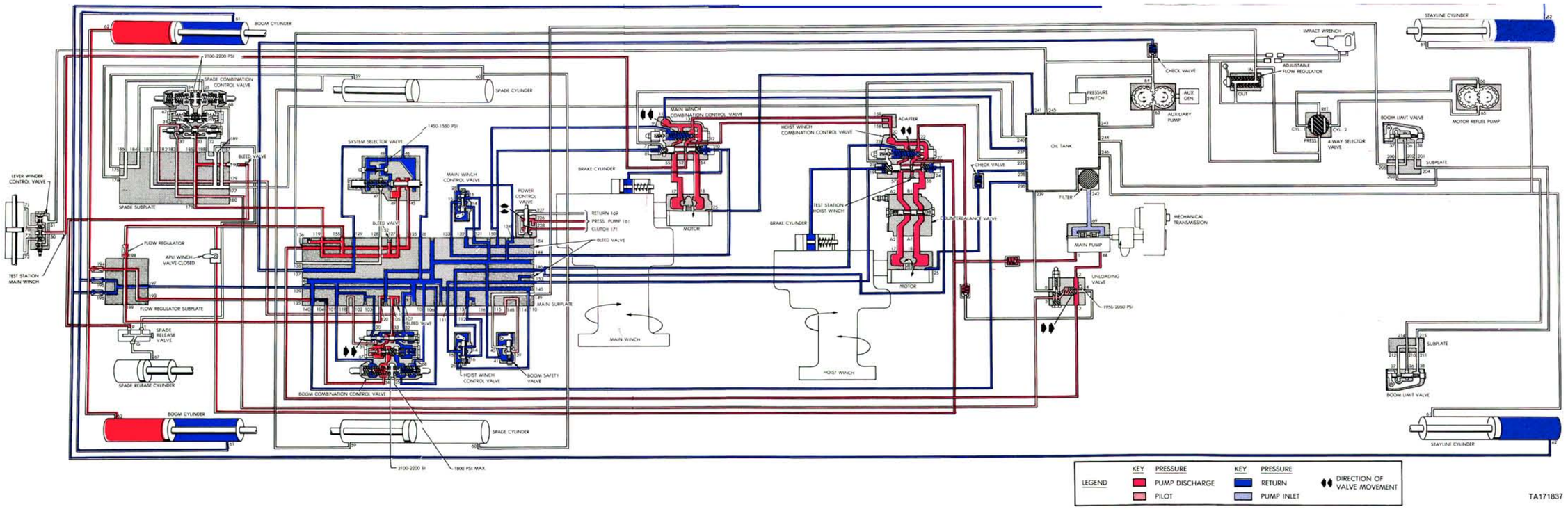
TA171835



FO-5. Winch, Power Takeoff, and Hoist System — Schematic Diagram — Hoist Winch — Raise.

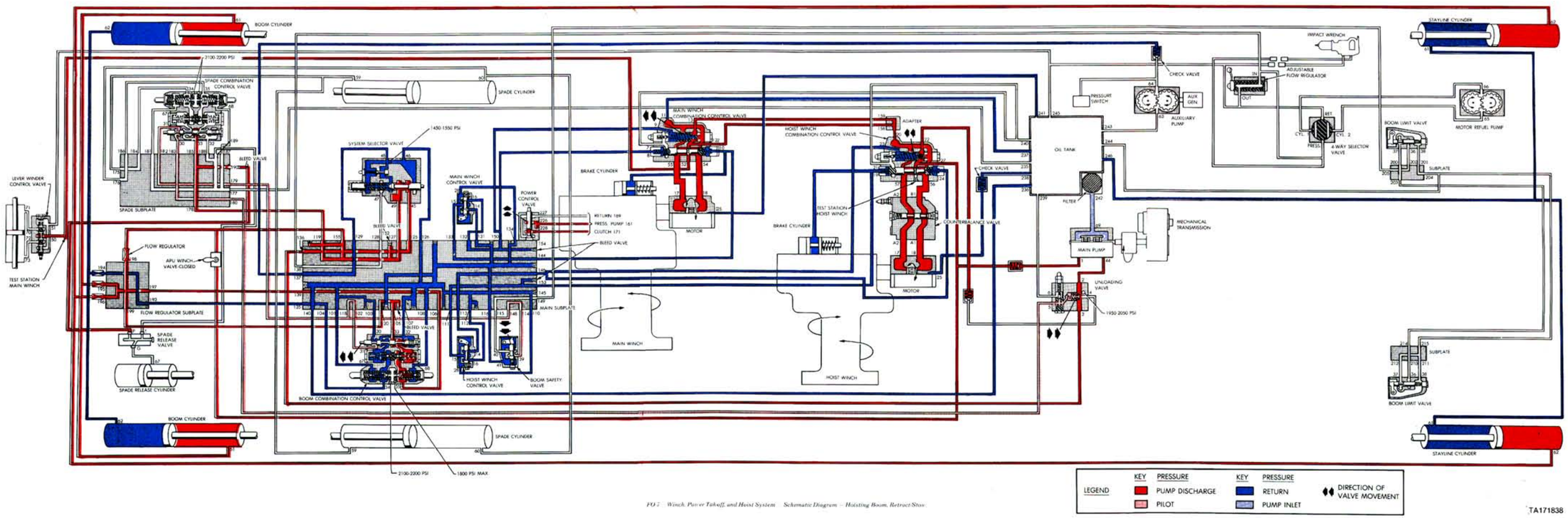
FO-5. Winch, Power Takeoff, and Hoist System - Schematic Diagram - Hoist Winch - Raise.

TA171836



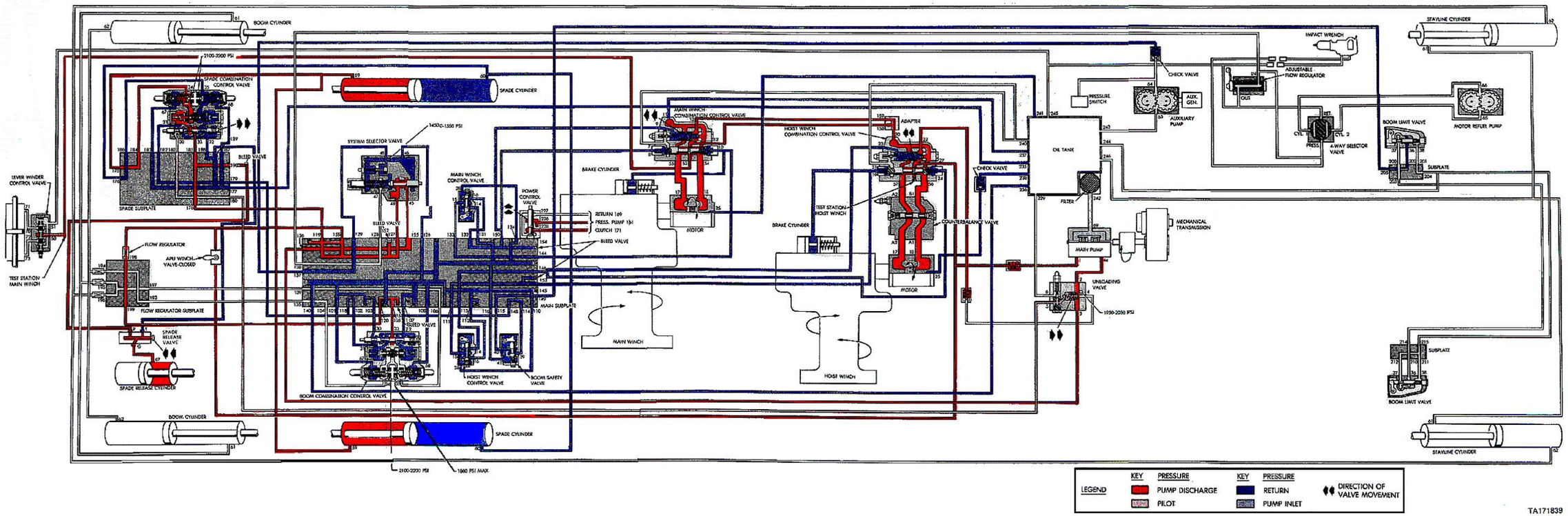
FO-6. Winch Power Takeoff, and Hoisting System -Schematic Diagram - Hoisting Boom - Forward.

TA171837



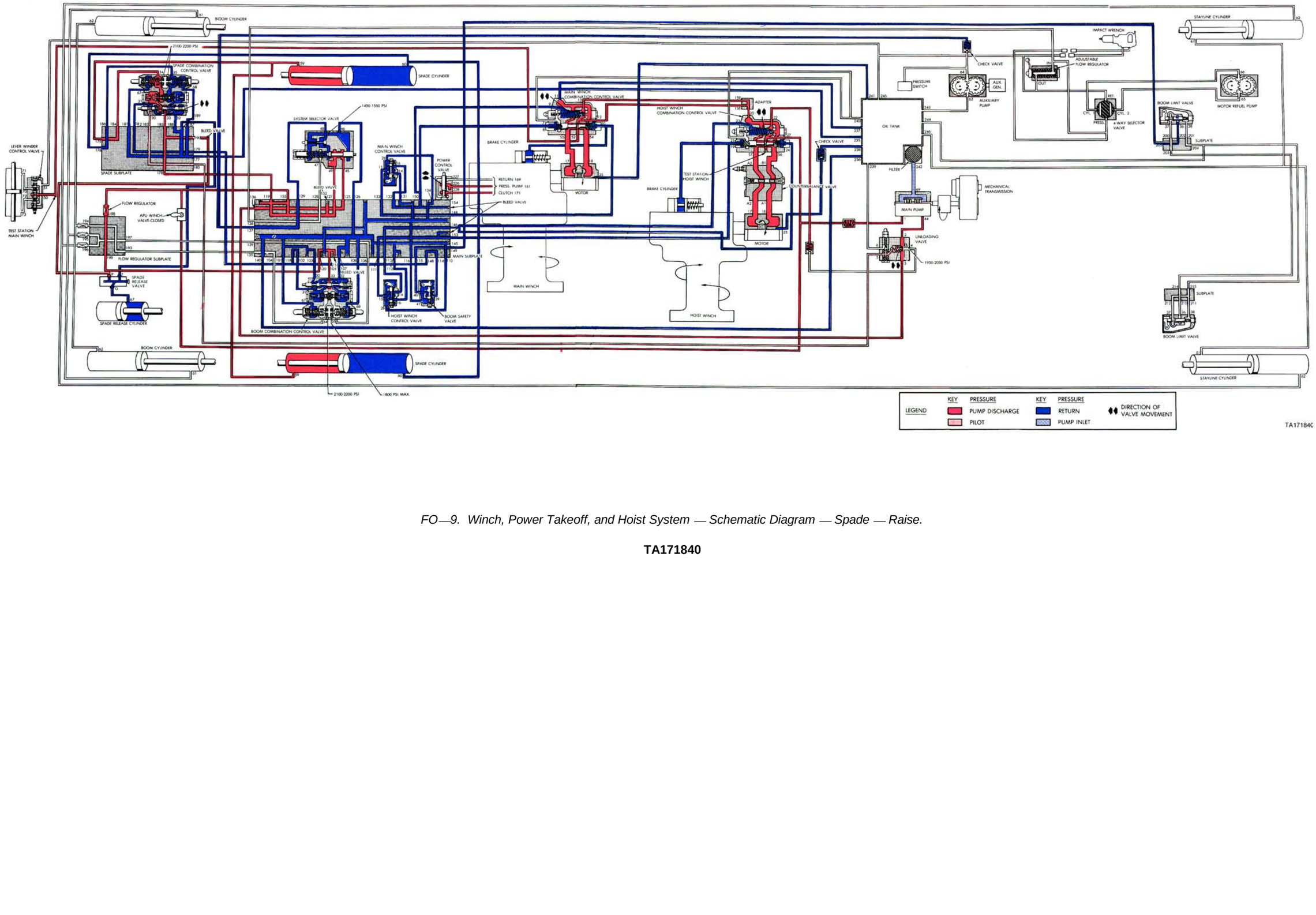
FO-7. Winch, Power Takeoff, and Hoist System — Schematic Diagram — Hoisting Boom, Retract/Stow.

TA171838



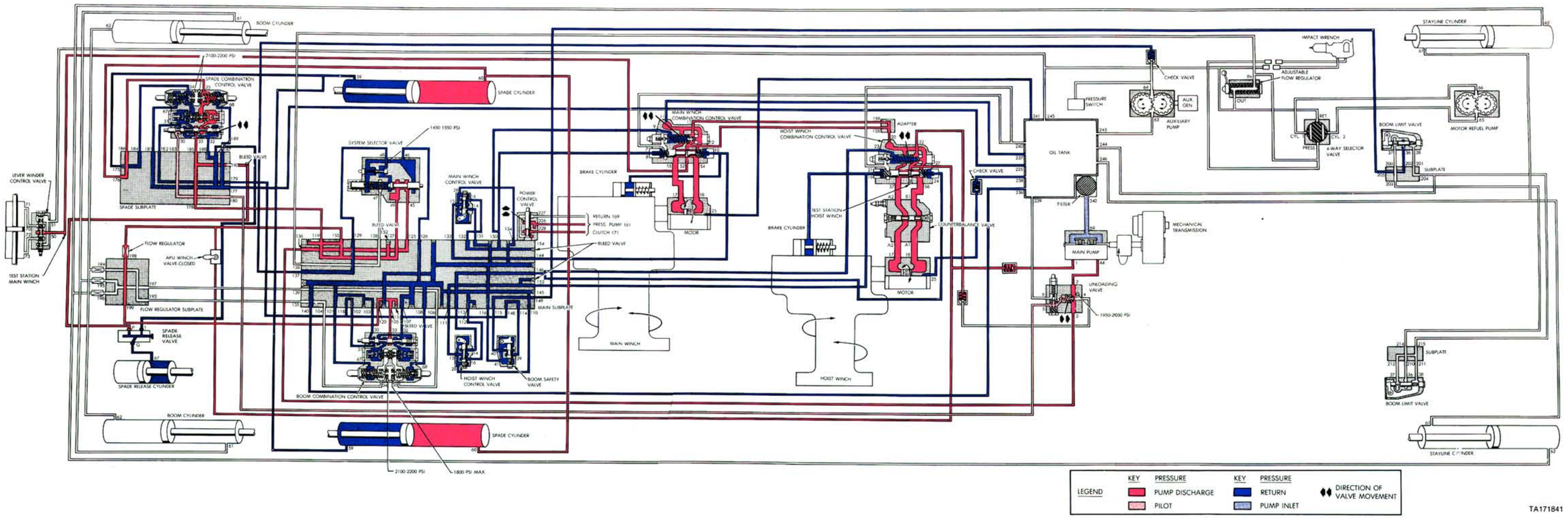
FO-8. Winch, Power Takeoff, and Hoist System — Schematic Diagram — Spade — Release.

TA171839



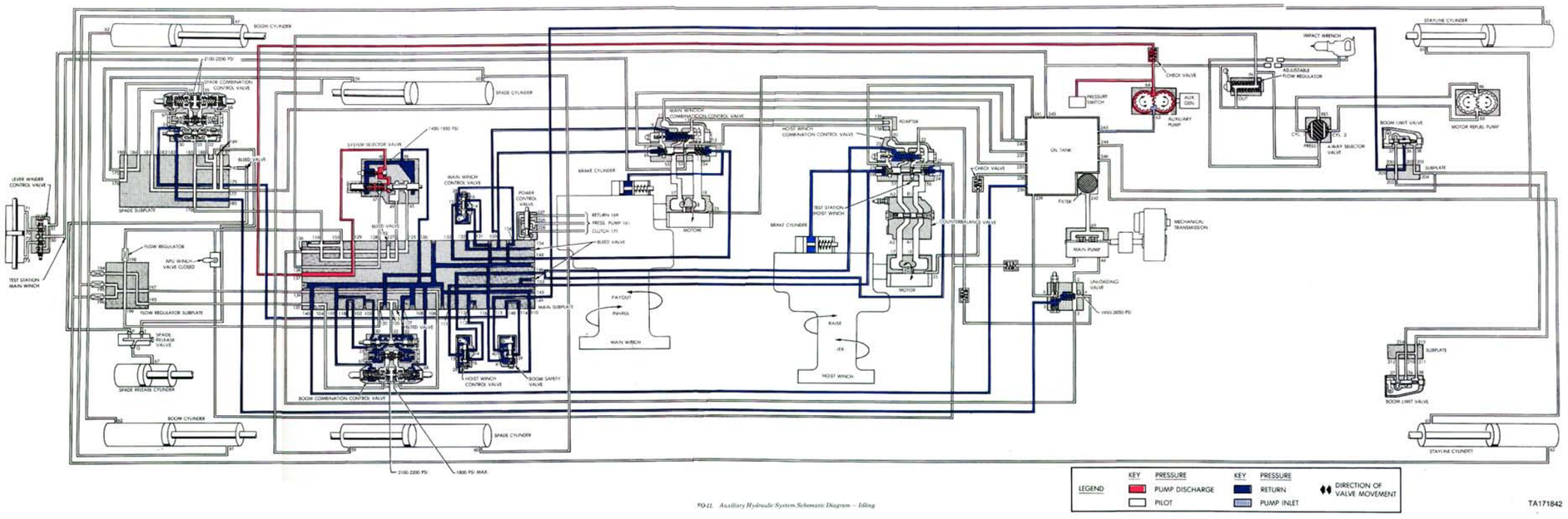
FO—9. Winch, Power Takeoff, and Hoist System — Schematic Diagram — Spade — Raise.

TA171840



FO—10. Winch, Power Takeoff, and Hoist System — Schematic Diagram — Spade —Lower.

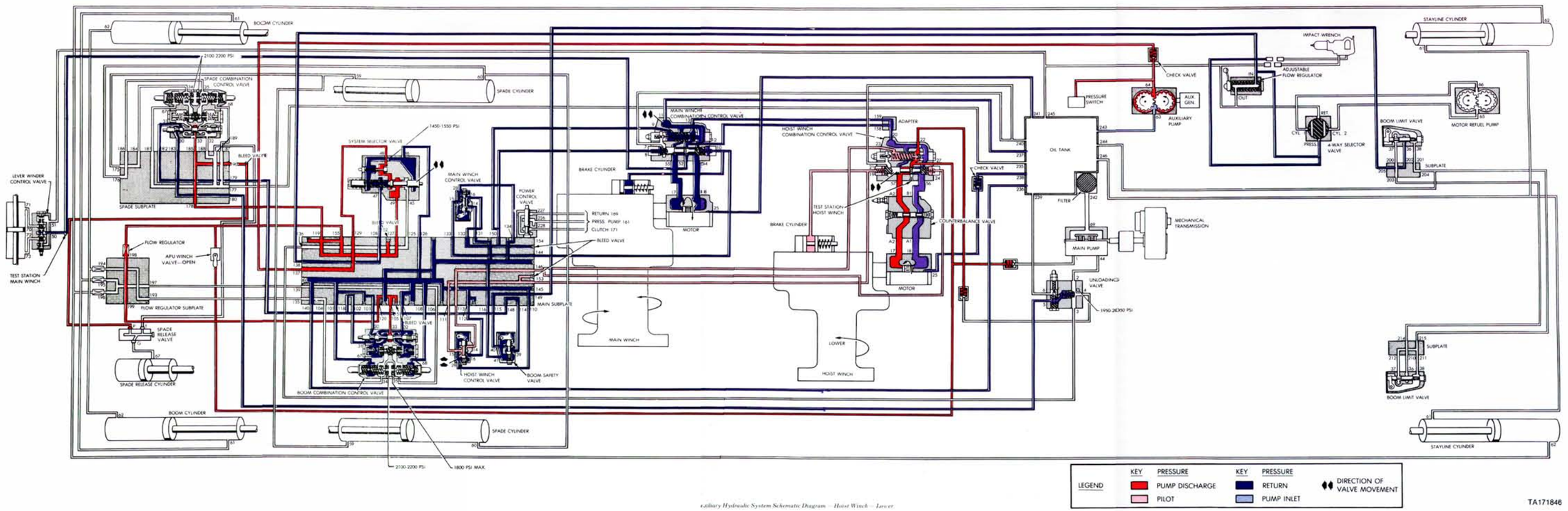
TA171841



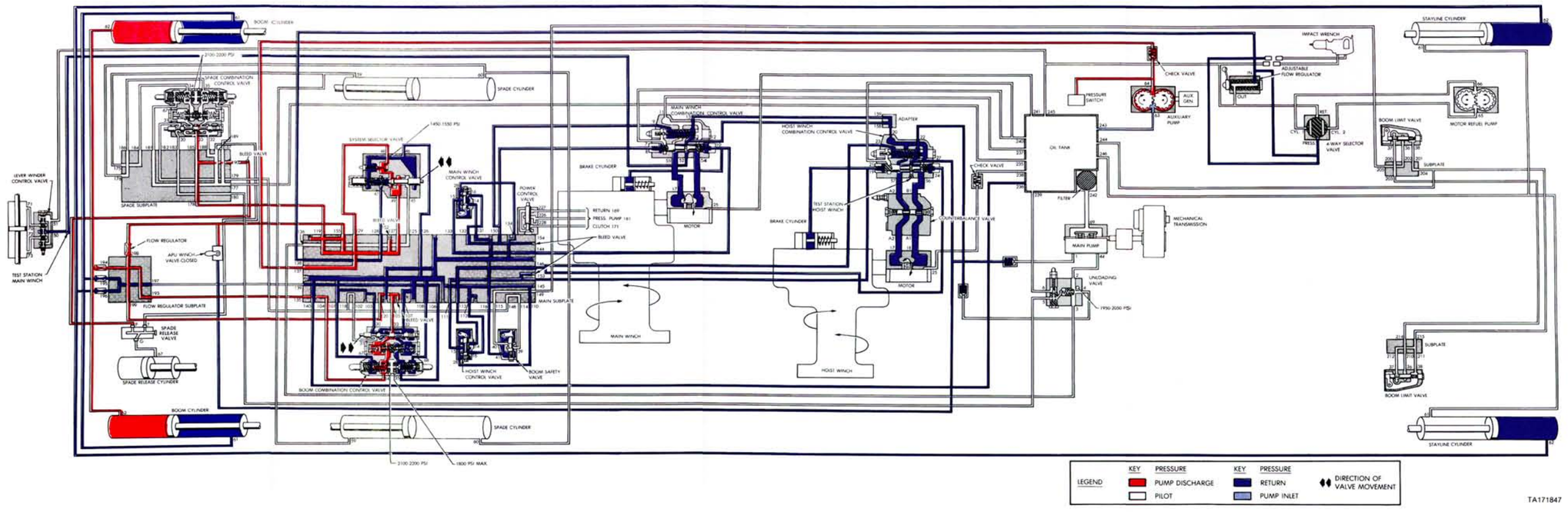
FO-11. Auxiliary Hydraulic System Schematic Diagram — Idling.

FO—11. Auxiliary Hydraulic System Schematic Diagram— Idling.

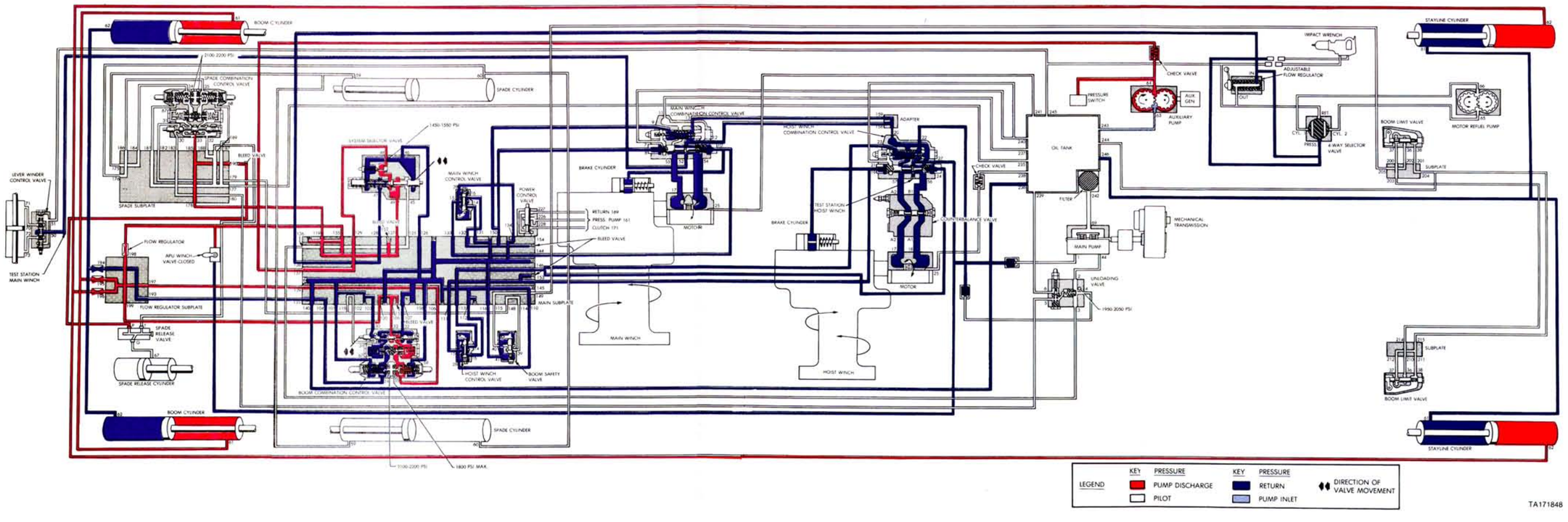
TA171842



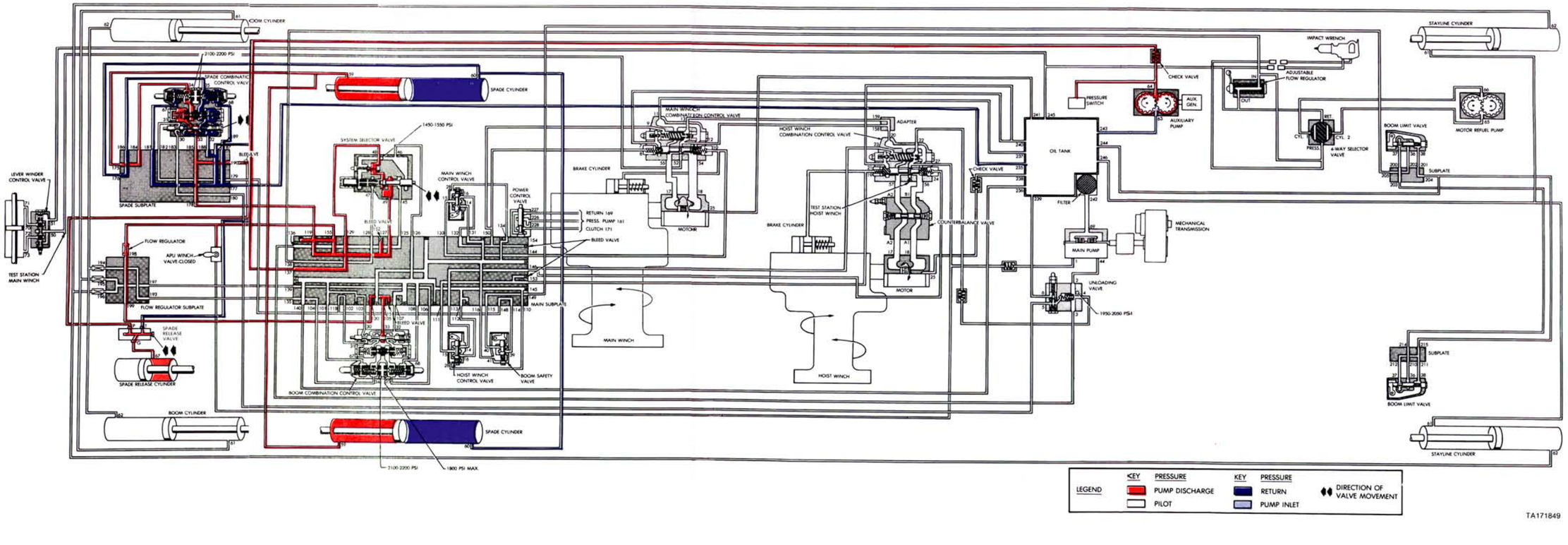
FO-15. Auxiliary Hydraulic System Schematic Diagram - Hoist Winch - Lower.



FO-16. Auxiliary Hydraulic System Schematic Diagram - Hoisting Boom - Forward.

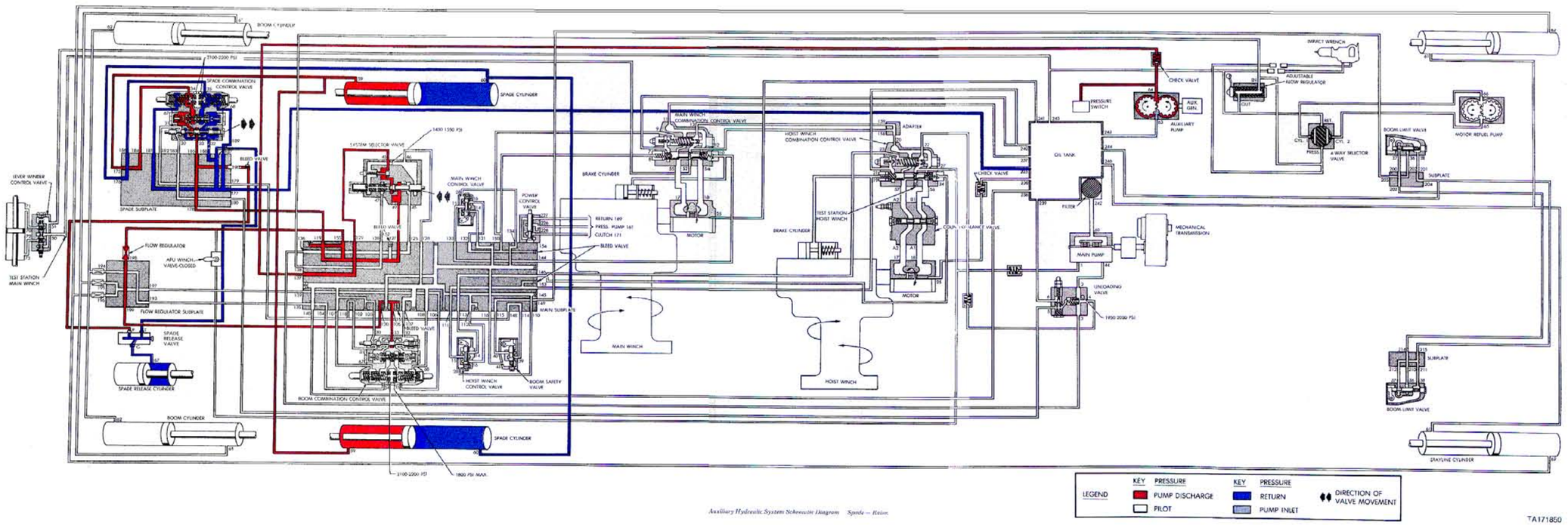


FO-17. Auxiliary Hydraulic System Schematic Diagram - Hoisting Boom - Retract/Stow.



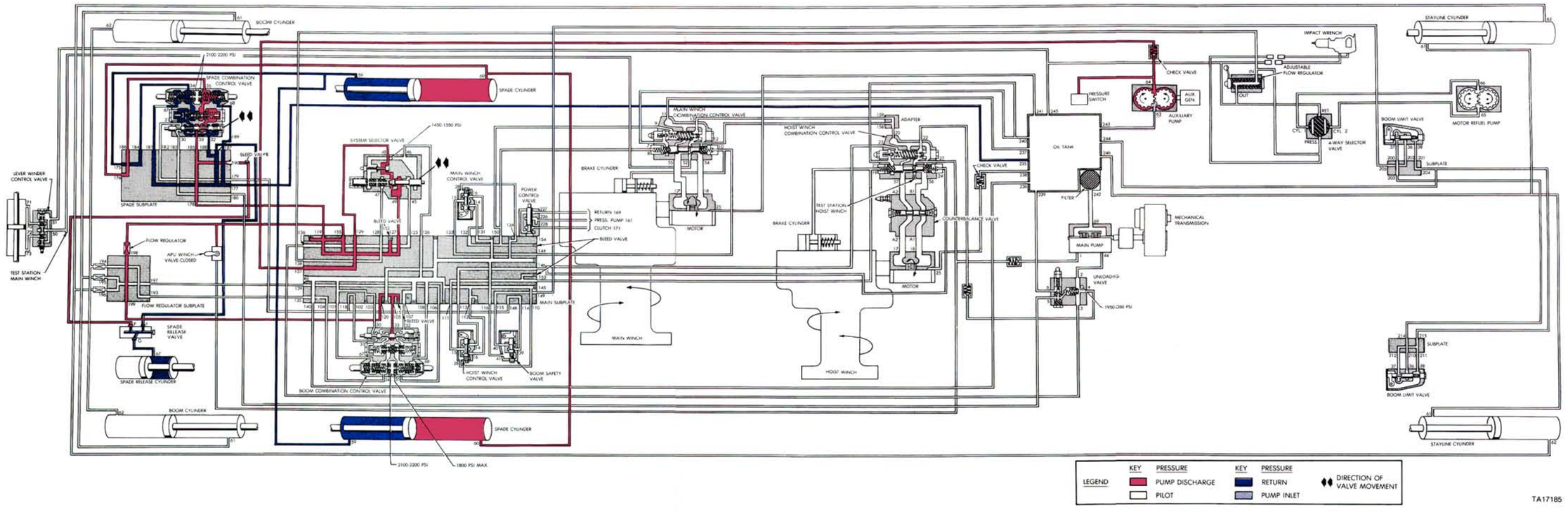
TA171849

FO-18. Auxiliary Hydraulic System Schematic Diagram - Spade - Release.



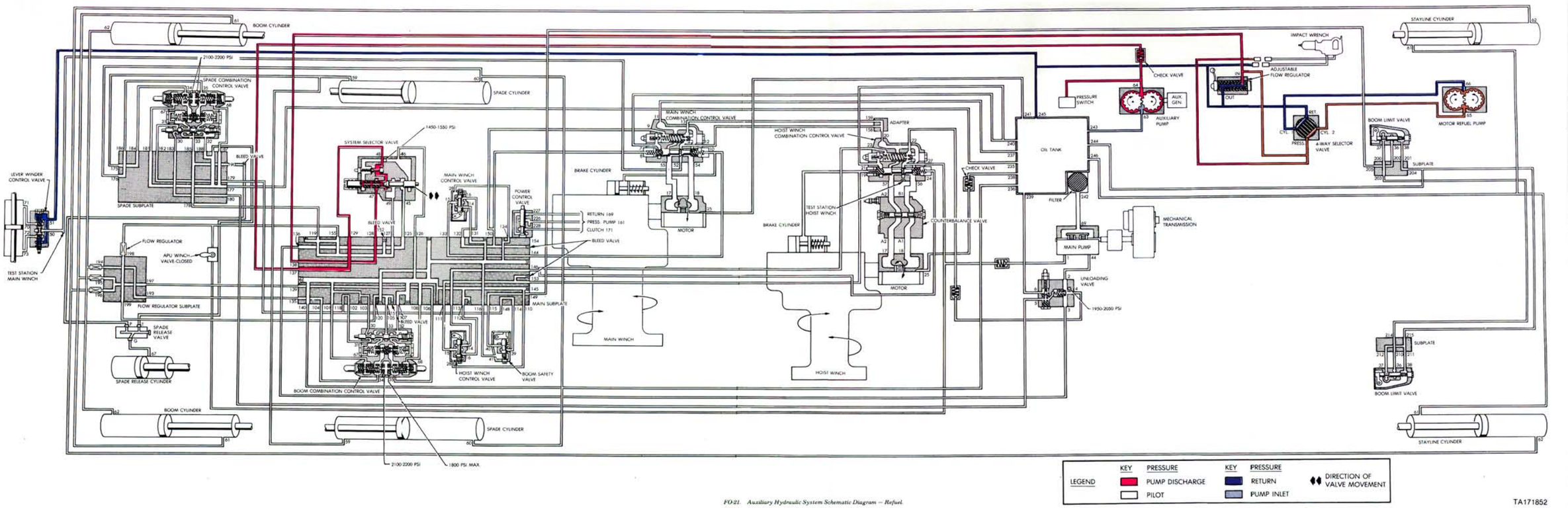
FO-19. Auxiliary Hydraulic System Schematic Diagram — Spade — Raise.

TA171850



FO-20. Auxiliary Hydraulic System Schematic Diagram — Spade — Lower.

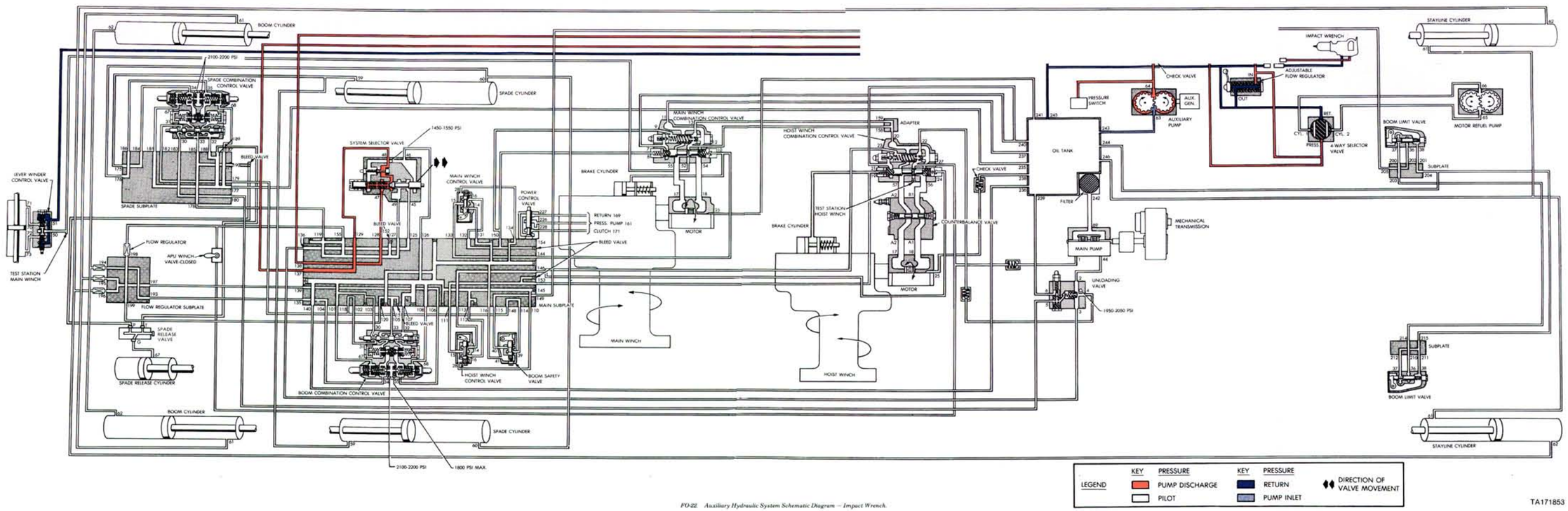
TA171851



FO-21. Auxiliary Hydraulic System Schematic Diagram — Refuel.

FO-21. Auxiliary Hydraulic System Schematic Diagram — Refuel.

TA171852



FO-22. Auxiliary Hydraulic System Schematic Diagram — Impact Wrench.

TA171853

*B*y Order of the Secretary of the Army:

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Chief of Staff

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