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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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.

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.

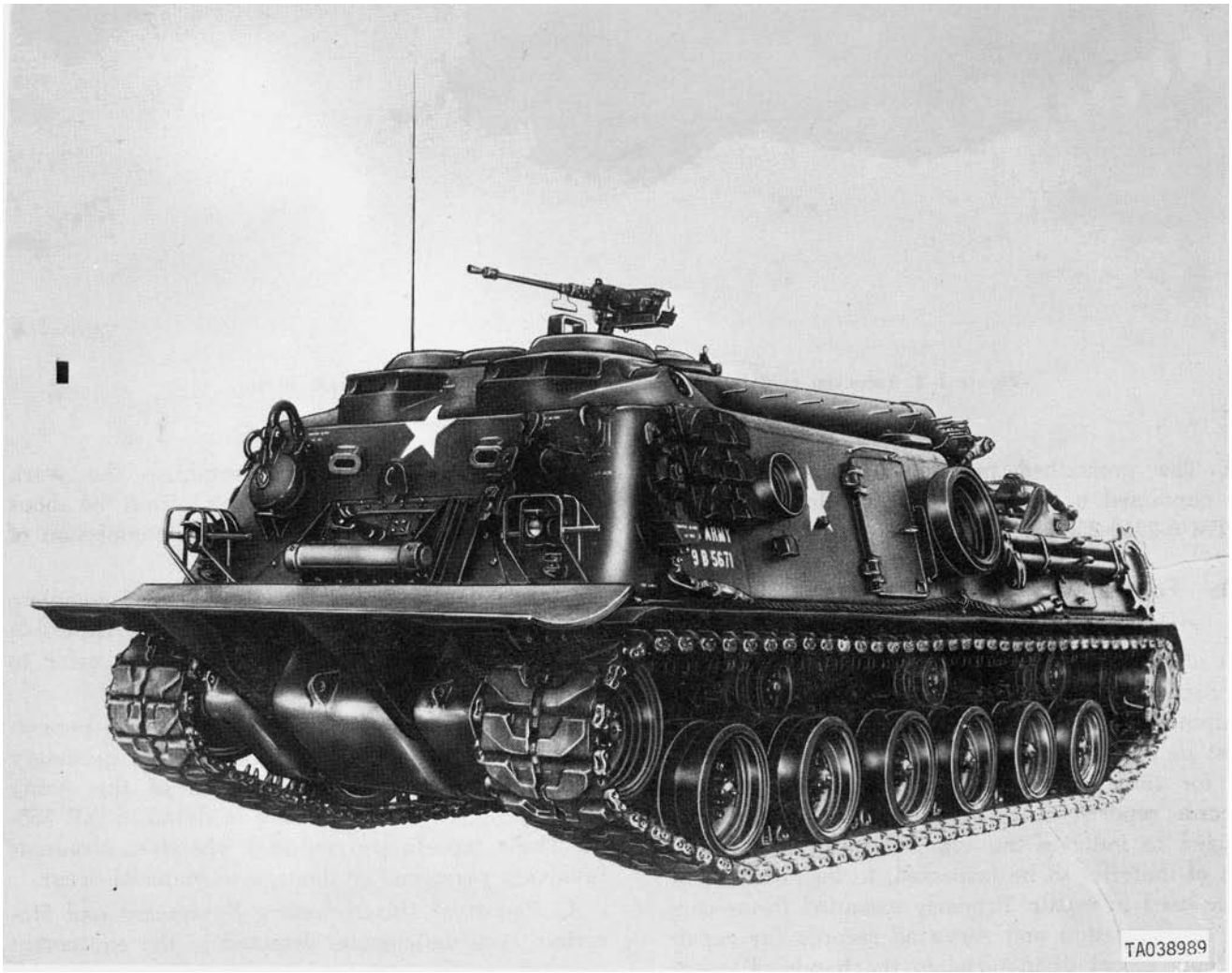


Figure 1-1. Recovery vehicle, full tracked: medium, M88A1—left front view.

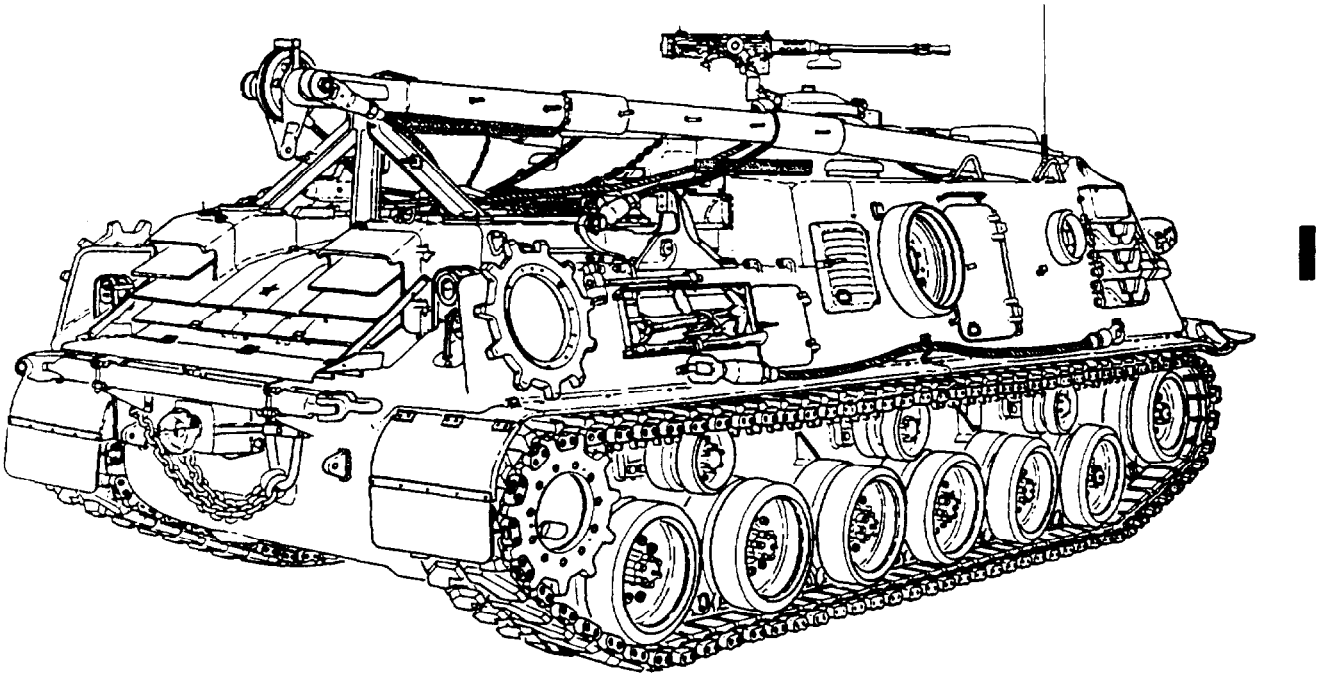


Figure 1-2. Recovery vehicle, full hacked: medium, M88A1-right rear view.

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

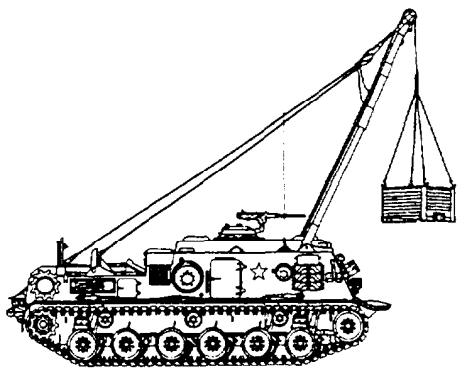
1-2. Forms, Records, and Reports

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.

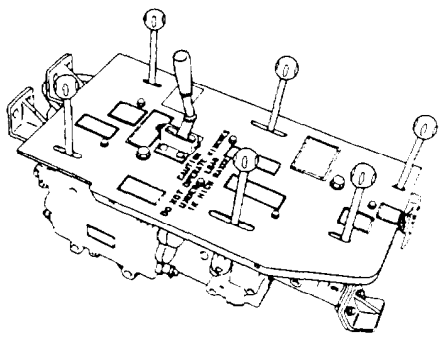
b. Authorized Forms. For current and complete listing of all forms, refer to current DA PAM 310-2. For instructions on use of these forms, refer to TM 38-750.

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.

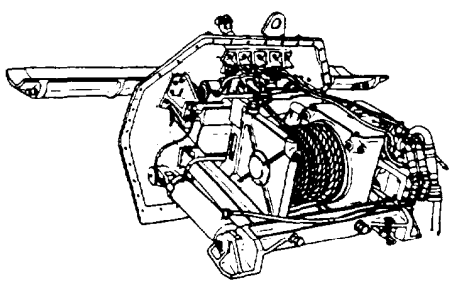
d. Report of Unsatisfactory Equipment and Materials. Any deficiencies detected in the equipment covered herein which occur under the circumstances indicated in TM 38-750 should be immediately reported using DA Form 2407.



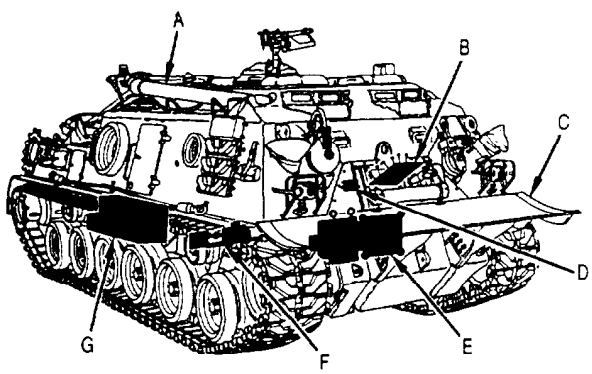
A. HOISTING BOOM ASSEMBLY.

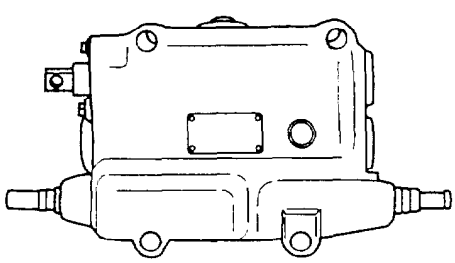


B. HYDRAULIC SUBPLATE ASSEMBLY.

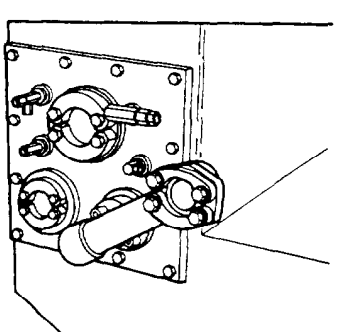


C. MAIN WINCH AND SPADE ASSEMBLY.

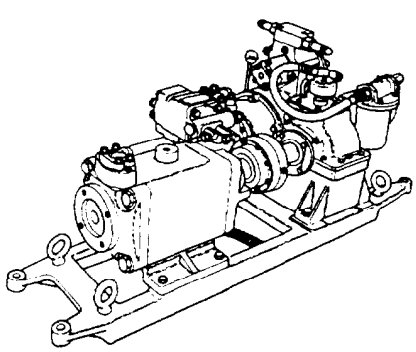




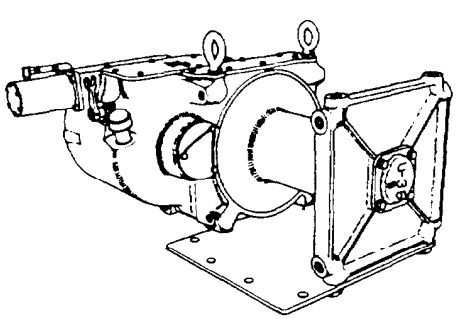
D. SPADE COMBINATION CONTROL VALVE.



G. HYDRAULIC OIL TANK.

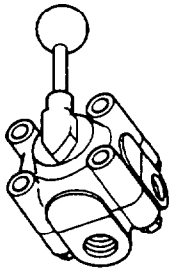


F. MECHANICAL TRANSMISSION AND MAIN HYDRAULIC PUMP ASSEMBLY.

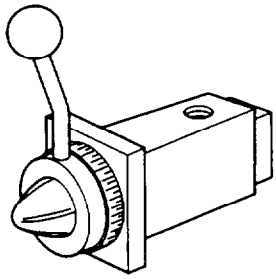


E. HOIST WINCH ASSEMBLY.

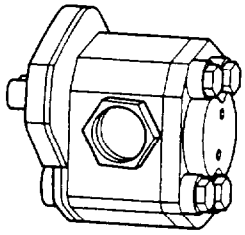
Figure 1-3. Winches, power takeoff and hoist system-visual index (Sheet 1 of 2).



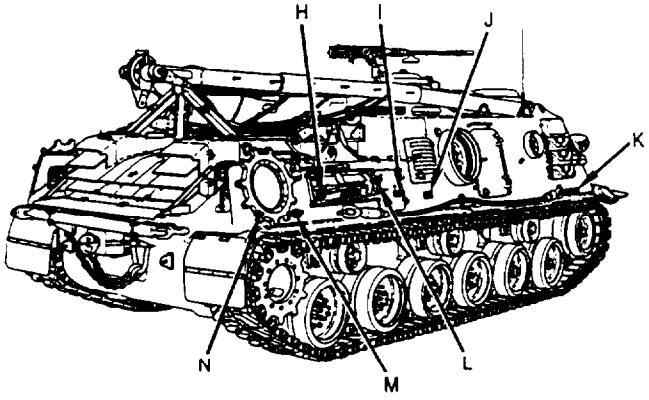
H. FOUR-WAY SELECTOR VALVE.

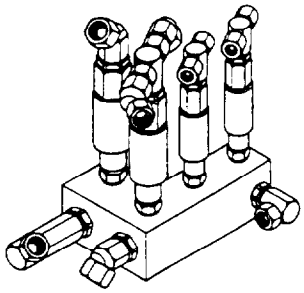


I. ADJUSTABLE FLOW REGULATOR.

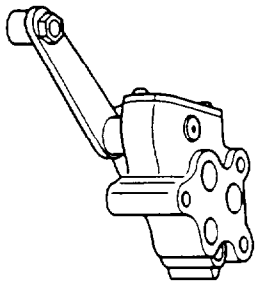


J. AUXILIARY HYDRAULIC PUMP.

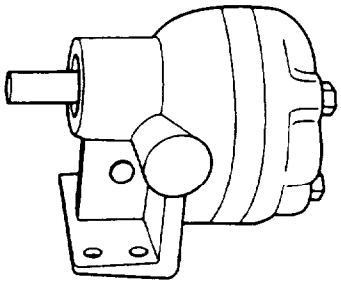




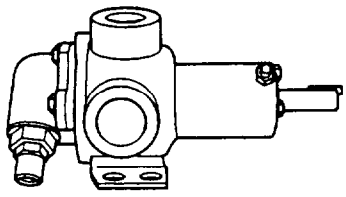
K. FLOW REGULATOR.



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.

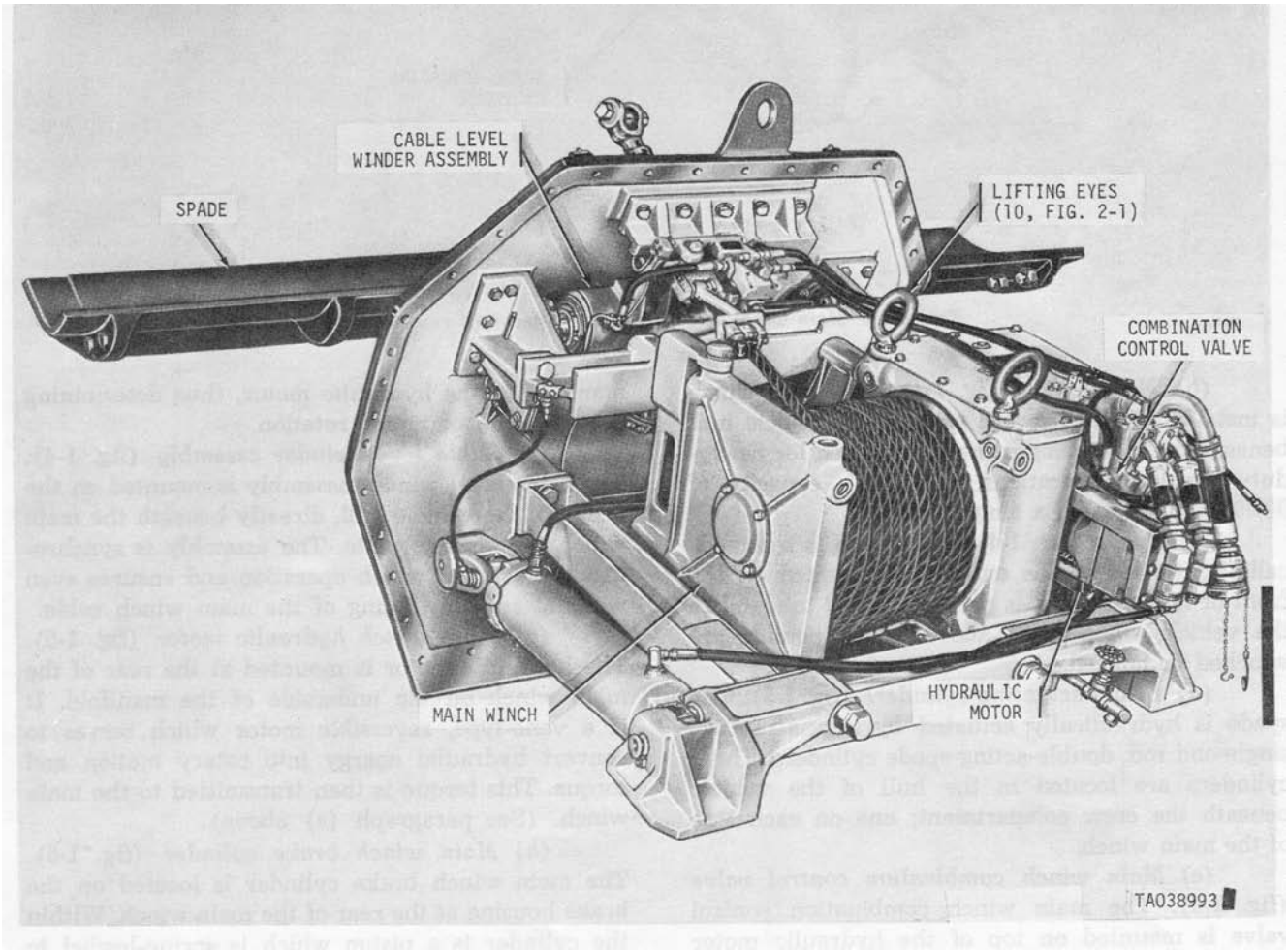


Figure 1-4. Main winch and spade assembly—left rear view.

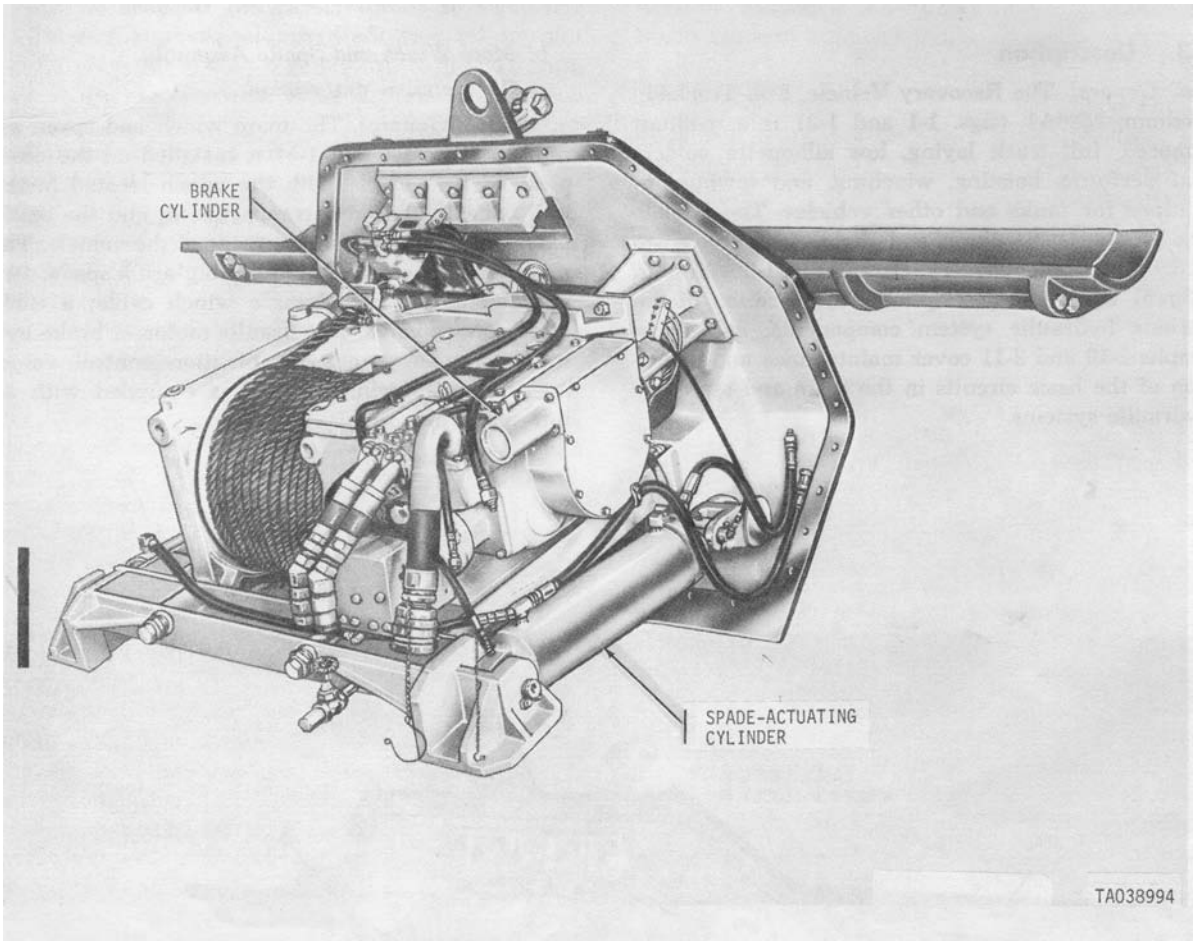


Figure 1-5. Main winch and spade assembly—right rear view.

(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.

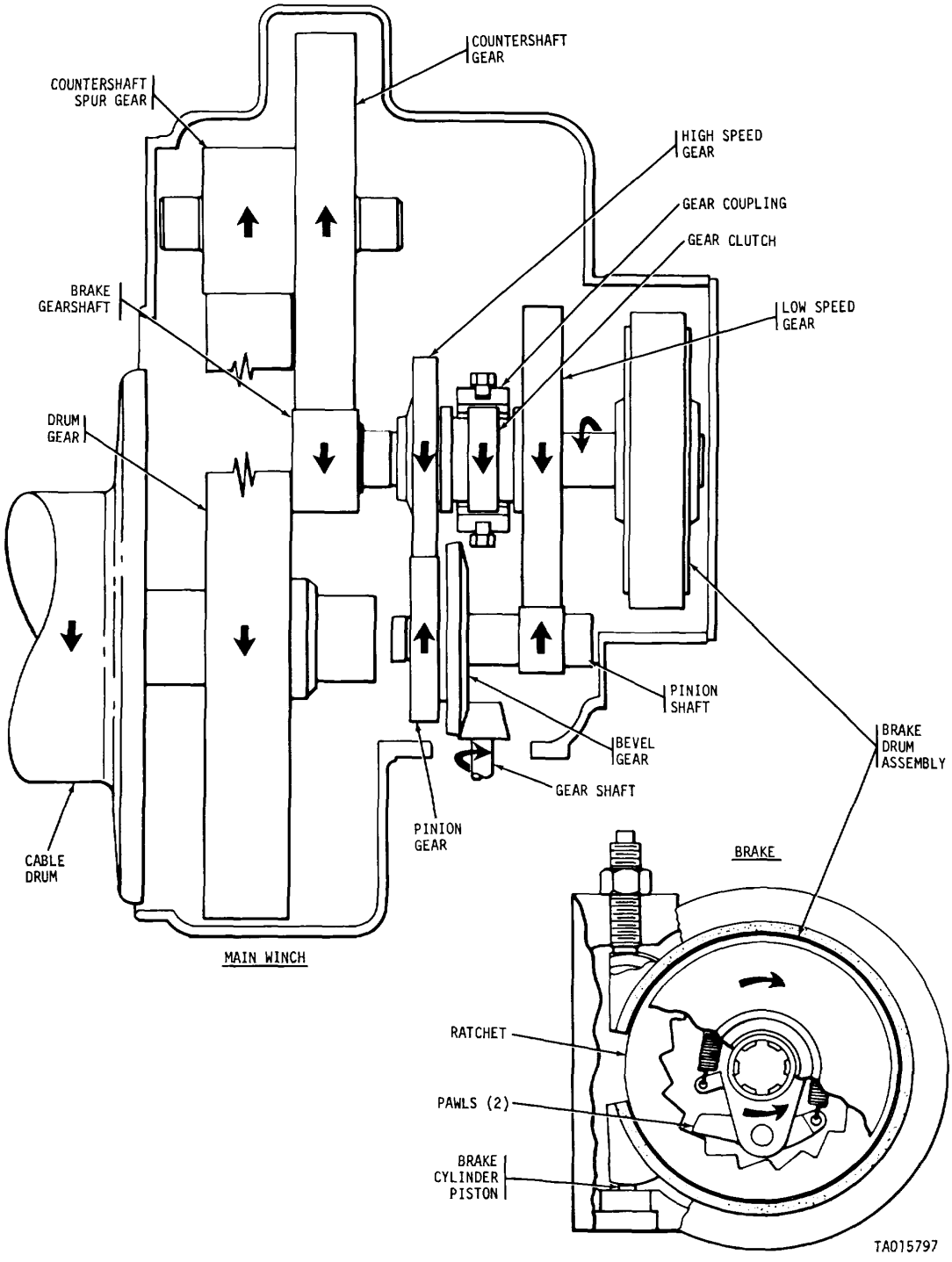


Figure 1-6. Main winch--cross-sectional view.

(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.

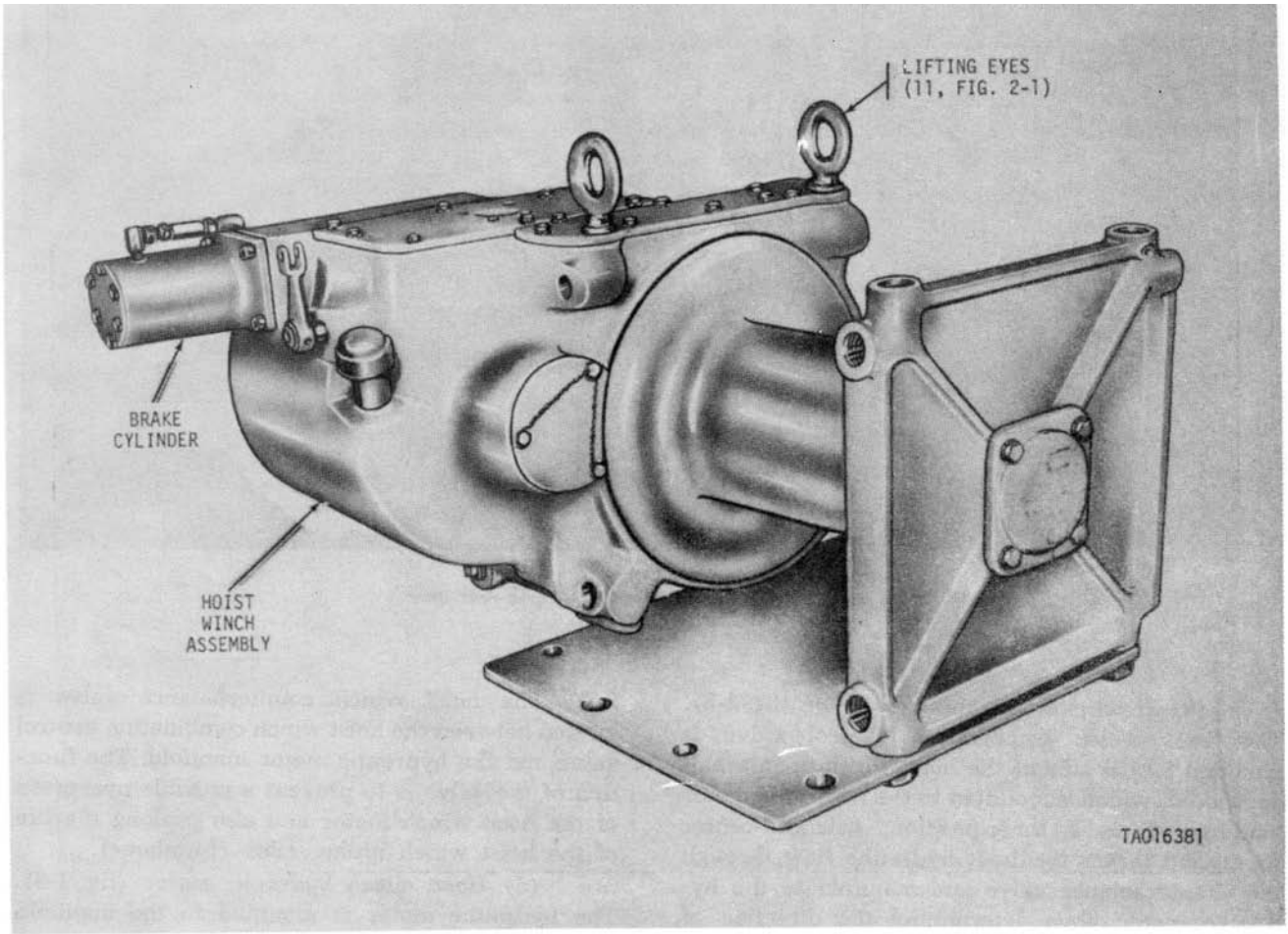


Figure 1-7. Hoist winch assembly-left front view.

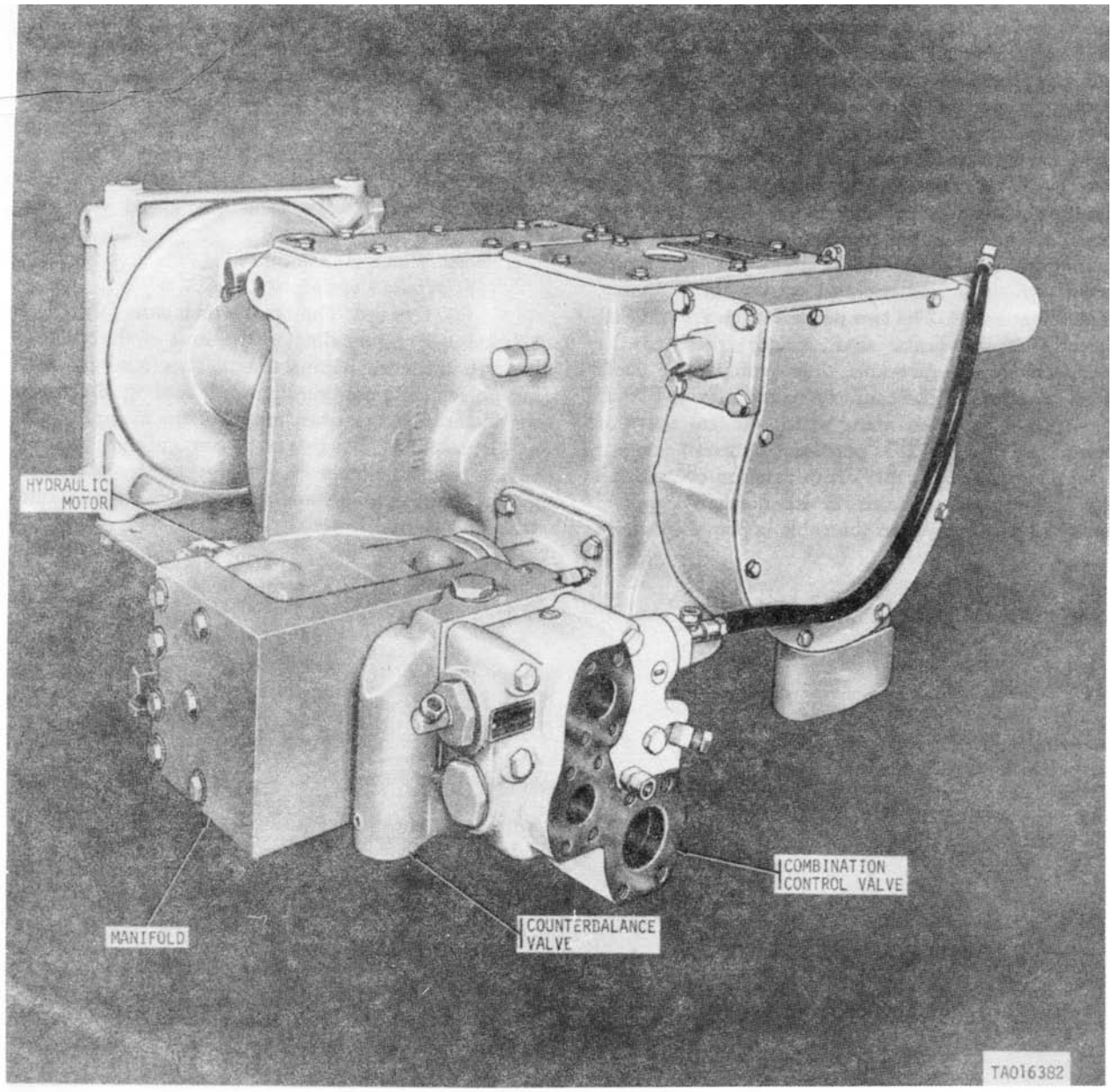


Figure 1-8. Hoist winch assembly--right rear view.

(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.