BULLETIN T-100-5

PLAINTIFF'S
EXHIBIT
USX-238

P&H®
ELECTRIC
HOISTS

BALANCED DESIGN HEVI-LIFT HOISTS

CARE AND OPERATION MANUAL

P.O. 536-98624
#4 GALV. LINE DUCT HANDLING

P&H
QUALITY & SERVICE
SINCE 1884

HARNISCHFEGER

Milwaukee, Wisconsin 53246

USHO 002203

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SECTION I
DESCRIPTION

GENERAL

This manual describes the installation, adjustment, operation and general maintenance procedures necessary for the most efficient operation of P&H Balanced Design Hevi-Lift Hoists.

An outline for a preventive maintenance program is also included.

DESCRIPTION OF OPERATION

The wire rope drum is driven by an electric motor through a three reduction gear case. Two timed drum pinions are meshed with the drum gear to provide equal distribution of load as well as positive control of the drum movement at all times. A reversing contactor, with mechanical interlock, completes the power supply to the hoist motor only when either the RAISE or LOWER control circuits are completed through the push buttons. For optional control, such as two speed and variable speed, additional contactors, relays and resistors are required.

A direct acting DC magnetic brake provides instantaneous release and braking action for the motor. As the brake coil is energized it pulls an armature against the face of a spring loaded brake pot, releasing the rotating friction discs. De-energizing the coil releases the armature from the brake pot by means of the compression spring, thus applying required braking forces to the friction discs. Because the friction discs are coupled directly to the motor pinion shaft through a splined disc hub, the motion stops.

A mechanical load brake, included in the gear case, will prevent the load from lowering itself. In some cases, an electric load brake (optional) or a D.C. dynamic lowering control (optional) is used to accomplish this.

A plugging type limit switch (standard equipment) prevents the bottom block from accidently being raised too high and inflicting damage to the drum and wire rope. An adjustable geared limit switch (optional) can be pre-set to open the circuit when the bottom block reaches the upper and lower safe limits of travel.

All this equipment is fully described and illustrated in the OPERATION section of this manual (Section III).

WARRANTY

The terms under which this hoist is guaranteed are clearly defined under the warranty which is shown on page 1-2. This warranty, while generous, will be voided if the hoist is operated with loads in excess of its rated capacity. Also, shockloading, incorrect power source, side pulling and unauthorized modifications will void the warranty. Authorization for any modifications must be approved by the Harnischfeger Corporation Regional Service Office in your area. (For area listings see the last page of this manual.)

SAFETY

A separate section of this manual has been devoted entirely to safe operating practices. It is most important that the persons operating the hoist be familiar with these practices before operating the hoist, both for their own protection, and for the protection of other workmen.

WARRANTY

The Company warrants every part and detail of the equipment to be delivered hereunder to be of proper materials and first class workmanship. Engines, motors, generators, buckets, and other accessories not of the Company's manufacture are not included in the foregoing warranty; these being covered by the warranties of their respective manufacturers. The foregoing warranty is exclusive and in lieu of all other warranties whether written, oral, or implied (including any warranty of merchantability or fitness for purpose).

The Company's liability under its foregoing warranty shall be discharged by furnishing, without charge, F.O.B. Milwaukee, Wisconsin, any part or parts as shall appear to the Company, upon its inspection, to be defective under normal and proper use within the warranty period of one (1) year or 2000 hours of operation, whichever expires first. Where claims for defects are made, the defective part or parts shall be delivered to the Company prepaid at Milwaukee, Wisconsin, for inspection. The Company will not be liable for the cost of repairs, alterations or replacements, or any expense connected therewith made or incurred by the purchaser or its agents or servants, except upon written authority from the Company's Milwaukee office, nor will the Company be liable for any damages caused by defective materials, parts, machinery tools or equipment except for replacement of parts as above provided. The Company makes no warranties, express or implied, except that of title and those above stated.

LIMITATION OF LIABILITY

In no event shall the Company be liable for special or consequential damages claimed to arise under this contract, nor shall it be liable for any loss or damage sustained or caused by the operation and use of the equipment while any of the parts are loose, broken, or out of order, nor will the Company be liable in any manner if the equipment is improperly operated or its successful operation impaired by the natural elements after its delivery to the purchaser.

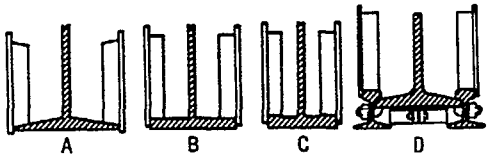
SECTION II
INSTALLATION

GENERAL

Prior to installing the hoist, carefully inspect it for possible shipping damage.

CAUTION

Before installing a trolley mounted hoist, make certain that the trolley wheel contour is correct for the type of beam the trolley will run on. There are three basic wheel contours used on four types of beams as illustrated in Figure 2-1. These are the crown tapered wheel for standard I-beam, the flat crowned wheel for wide flanged I-beam and the flat tread wheel for either a patented monorail beam or a T-rail installation.



A – CROWN TAPERED WHEEL FOR STANDARD I-BEAM
B – FLAT CROWNED WHEEL FOR WIDE FLANGE I-BEAM
C – FLAT TREAD WHEEL FOR PATENTED MONORAIL BEAM
D – FLAT TREAD WHEEL FOR T-RAIL INSTALLATION

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Figure 2-1. Trolley Wheel Contours

MOUNTING

Balanced Design Hevi-Lift Hoists are either lug mounted standard headroom or low headroom units, or they are fixed mounted (base, ceiling, deck, wall). The lug mounted hoists are usually equipped with either a plain trolley, hand chain geared trolley, single speed motor trolley or a variable speed motor trolley. These are illustrated in Figures 2-2, 2-3, 2-4 and 2-5.

All four types of trolleys utilize spacers between the drum hanger and the truck sides to adjust for the width of the beam they operate on. For straight track standard I-beams and straight track wide

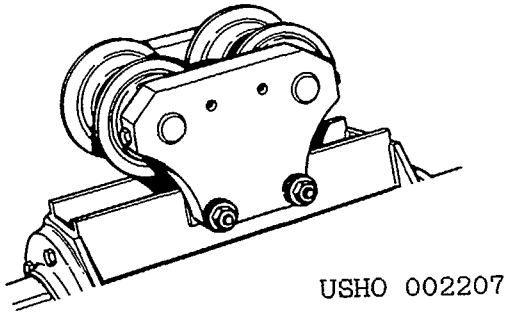

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Figure 2-2. Plain Trolley Mounting

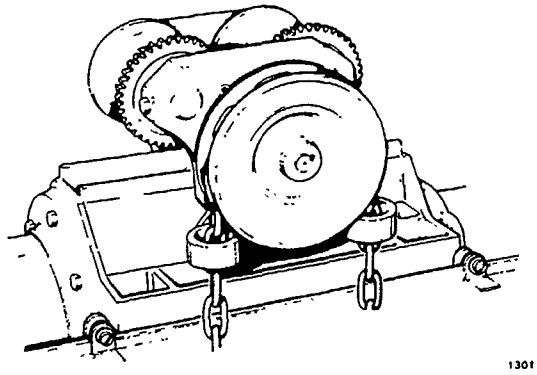

Figure 2-3. Geared Trolley Mounting

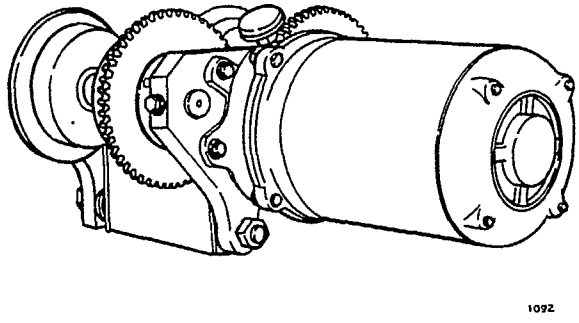

Figure 2-4. Single Speed Motor Trolley

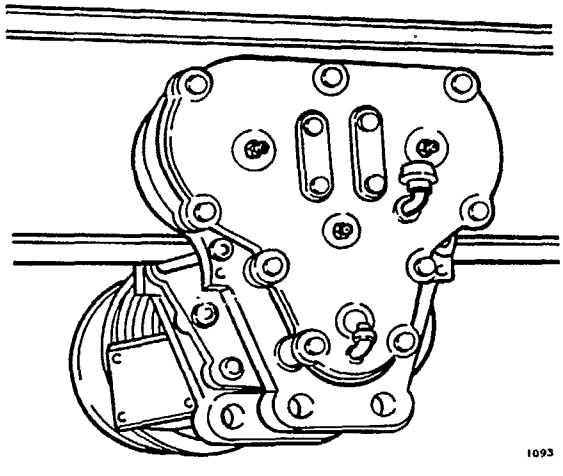

Figure 2-5. Variable Speed Motor Trolley

flange I-beams, the distance between the wheel flanges should be approximately 1/4 to 3/8 inch more than the nominal beam flange width. For straight track patented monorail beams, the distance between the wheel flanges should be approximately 1/16 to 1/8 inch more than the nominal beam flange width. For straight track T-rail installations, the distance between wheel flanges should be approximately 1/4 to 3/8 inch more than the width between the outside edges of the T-rail. If additional spacers are required to adjust wheel flange spacing, punch washers may be used on all but motor driven trolleys.

NOTE

When trolleys run on curved track beams, the distance between trolley wheel flanges must be slightly more than for straight track of the same nominal beam flange width. The increased spacing depends upon the radius of the curved track. Generally, the hoist is built for a particular application and the proper spacing is provided at the factory. If your application for the hoist changes, contact your regional sales or service office of Harnischfeger Corporation giving complete details of type of beam, curve radii and hoist serial number.

INITIAL LUBRICATION

Refer to the lubrication instructions in the MAINTENANCE section to lubricate the hoist prior to start up.

CAUTION

All Balanced Design Hevi-Lift hoists are shipped with the gear case filled to the proper level. If the hoist is equipped with a motor geared trolley, the trolley gear case is also filled with gear oil prior to shipment. However, to avoid the possibility of seriously damaging the hoist, these oil levels must be checked and gear oil added if necessary, prior to operating the hoist. Geared trolley wheels are not lubricated at the factory because abrasives will contaminate the grease during shipment and must be lubricated prior to start up.

ELECTRICAL CONNECTIONS

CAUTION

Be sure that the power supply is the same as indicated on the P&H nameplate. If the hoist is operated on incorrect voltage or frequency, serious damage to the motor and the control could result.

A wiring diagram for each hoist is secured to the inside of the control cabinet cover. Before energizing the hoist power supply, check that connections are made as indicated on the wiring diagrams furnished with the hoist.

NOTE

To properly connect and check a three phase power connection, refer to the INITIAL OPERATING CHECK portion of this section.

CONDUCTORS AND COLLECTORS

CONDUCTOR TYPES. Bare wire conductors, either round or figure 8 are most commonly used. However, flat bar, angle, T bar or insulated bar may be advantageous in some applications where corrosive, moist or dusty conditions are present.

CONDUCTOR INSTALLATION. Wire conductors require the use of end support and strain insulator at each end of the system (see Figure 2-6). Proper wire tension can be adjusted with the adjusting nuts located on the strain insulator threaded studs.

The required number of intermediate supports will vary with the type of conductor. A general guide to determine the number required is shown below.

Type of Conductor	Distance Between Supports (Feet)	
	Straight Section	Curved Section
Round copper wire, No. 4	40 - (Max. length overall)	Not used
"Figure 8" wire, No. 0	12	3
Flat bar	6	3
T-bar	8	3
Angle	8	3

The location of the conductors in relation to the I-beam will vary with type of trolley, lift, hoist size and type of conductor. Refer to the clearance drawing prepared for your particular hoist.

NOTE

Conductor contact surfaces should be cleaned and polished for most efficient operation.

COLLECTORS. For round or figure 8 wire conductors the standard spring wheel collector is used (Figure 2-7). The standard spring shoe collector is used with open steel current conductors of tee, angle

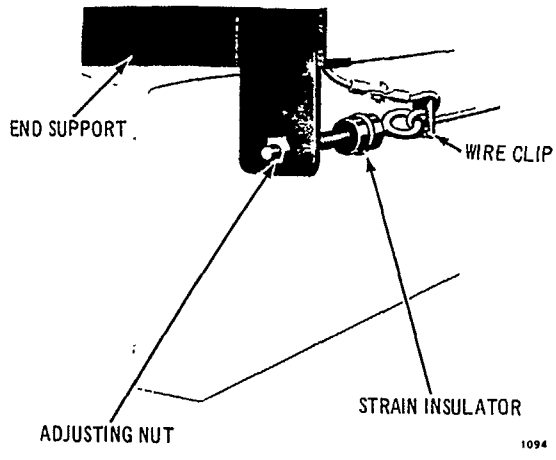

Figure 2-6. Wire Stretcher

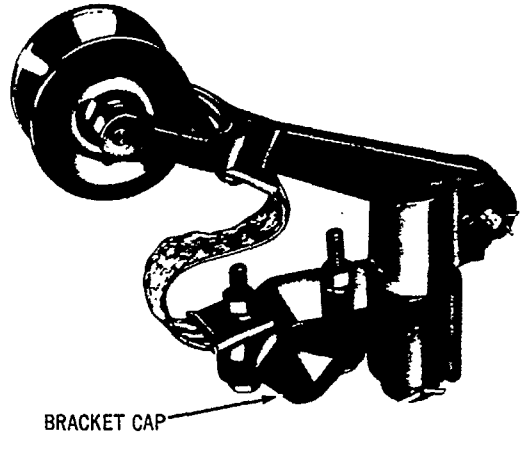

Figure 2-7. Spring Wheel Collector

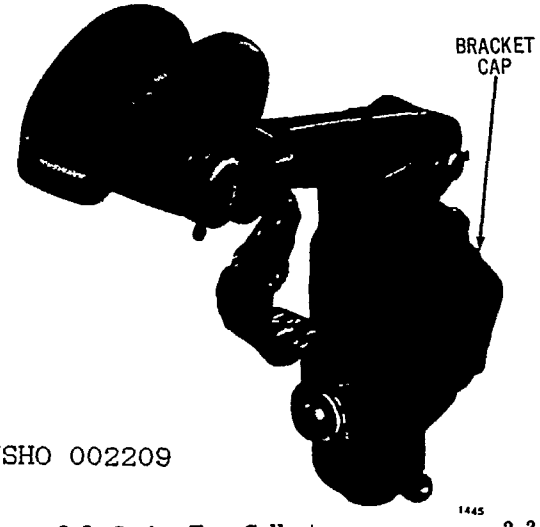

Figure 2-8. Spring Shoe Collector

or bar shaped section (Figure 2-8). The spring loaded arm holds the wheel or shoe firmly against the conductor. Slide the collector assembly to a centralized position with respect to the conductor, taking into consideration the trolley wheel float. To adjust the collector, loosen the bracket cap and slide the collector to the proper position on the collector support bar.

INITIAL OPERATING CHECK

GENERAL. The P&H Balanced Design Hevi-Lift Hoist is tested under load and adjusted for proper operation prior to leaving the factory. Before the unit is placed in service, there are several items that must be checked to insure correct installation and avoid serious trouble.

CHECKING DIRECTION OF ROTATION. Since direction of rotation of three phase AC motors can be reversed by reversing any two of the three line wires, it is important that the motion travel in correct relationship with the button being depressed.

CAUTION

Do not attempt to correct hook travel by changing reversing contactor coil connection or push button wiring. This can only be done at the main power source, load side of reversing contactor or individual motor junction box.

If travel relationship does not correspond to the push button being depressed, do not allow the bottom block to come into contact with the limit switch. Carefully check this as follows:

1. Temporarily connect the three phase power leads to the conductor system.

2. Carefully inch the RAISE or UP button and note the direction of bottom block travel.

3. If the bottom block travel is upward when the RAISE or UP button is depressed, proper phasing has been attained and the temporary connections may now be secured permanently.

4. If the bottom block travels downward when the RAISE or UP button is depressed, proper phasing has not been attained. To correct this, reverse any two of the power line leads at the power source. Again, do not attempt to correct a phase reversal by interchanging the reversing contactor or push button connections, because interchanging these connections will not provide upper limit switch protection.

To correct the direction of travel in DC operation, interchange the two armature leads.

If bottom block travel direction is correct, trolley travel direction should also be correct. However, trolley travel direction should be checked with the push button markings. If the direction is reversed, correct this by reversing any two of the three power lead connections at the trolley contactor only.

CHECKING OPERATION OF UPPER LIMIT SWITCH. With the hoist properly connected to the correct power supply, check the operation of the upper limit switch. Raise the bottom block without a load to within 6 inches of contact with the limit switch counterweight or paddle. Proceed with caution by inching or at slow speed raise the bottom block until

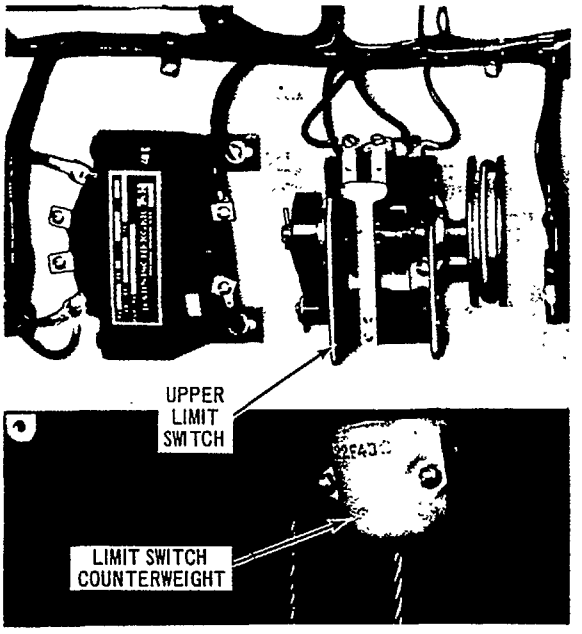

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Figure 2-9. Upper Limit Switch Counterweight

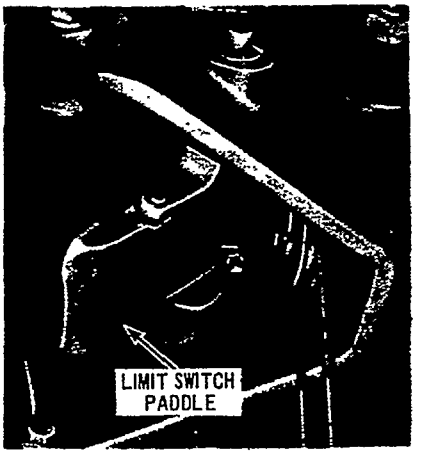

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Figure 2-10. Upper Limit Switch Paddle

the limit switch is tripped. This should open the hoisting circuit and set the motor brake stopping the hoist motion. With the hoist limit switch in the tripped position and control in either the raise or off position, manually operate the limit switch further in the raise position to establish the plugging circuit. Only maintain this position for a sufficient time to insure plugging and that bottom block lowers. If the limit switch does not operate in this manner, refer to the maintenance section of this manual for adjustment procedures.

CHECKING OPERATION OF GEARED LIMIT SWITCH. If the hoist is equipped with a geared limit switch (Figure 2-11) to stop the bottom block at both the upper and lower limits of travel, check it for proper operation as follows:

1. Operate the hoist to raise the bottom block without a load until it is approximately two feet from the hoist drum.

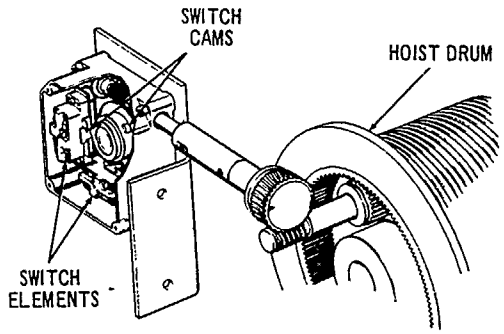


Figure 2-11. Geared Limit Switch

2. Operate the hoist by inching or slow speed until the bottom block raises high enough to actuate the geared limit switch which opens the RAISE circuit and applies the magnetic brake. The switch must actuate when the bottom block is a safe distance from the drum (approximately six inches).

3. Operate the hoist to lower the bottom block until only one and one-half wraps of cable remain on the drum, or until the bottom block has reached the desired lower limit. The geared limit switch should now actuate to open the LOWER circuit and apply the motor brake.

If the geared limit switch does not operate properly, refer to the MAINTENANCE section of this manual for adjustment procedures.

CHECKING OPERATION OF ELECTRIC BRAKE. Operate the hoist in the lowering direction with no load on the hook. With the hoist lowering at full speed for a single or variable speed hoist, and slow speed for a two speed hoist, release the DOWN or LOWER push button. The downward movement will stop, except for the allowable drift. The hook will drift approximately one inch for every 10 FPM (Feet Per Minute) of hook travel speed. This distance should be measured from the time the push button is released to the time the hook comes to rest. As an example, a hoist with a rated speed of 20 FPM will drift approximately 2 inches, when operated at full speed. Test the raising direction in the same manner. It should be noted that when the hoist has a full load on the hook the drift will be less than 1 inch for each 10 FPM of hook speed.

If there is excessive drift, refer to the MAINTENANCE section of this manual.

WARNING

Never operate the hoist unless the brakes are operating properly.

LOAD TESTING

Attach a near capacity load to the bottom block. Raise and lower the hoist several feet to determine if the mechanical load brake is operating correctly. The mechanical load brake will control the descent of the load in the lowering direction when the DOWN or LOWER push button is depressed. Also, it should prevent the load from continuing to lower, except for allowable drift, when the DOWN or LOWER push button is released.

SECTION III
OPERATION

GENERAL

The operation and function of each sub-assembly in the Balanced Design Hevi-Lift Hoist is described in this section. The size and capacity of a unit will not vary the function of these components.

Some of the sub-assemblies listed are optional equipment and may not apply to your particular hoist.

HOIST DRIVE

The drum is driven by the hoist motor through a three reduction gear case, as illustrated in Figure 3-1. Normally, a mechanical load brake is included as part of the reduction. The exceptions to this are the use of either an electric load brake (Magnetorque), dc dynamic lowering control or countertorque control. The drum shaft is joined to the

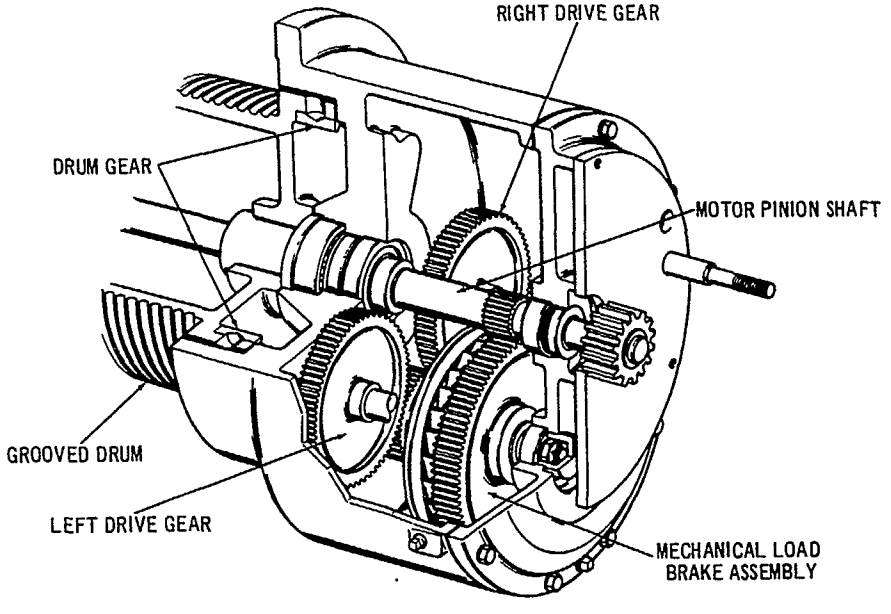


Figure 3-1. Balanced Design Hevi-Lift Hoist Drive

motor shaft and the motor pinion shaft in the gear case by splined couplings. The motor pinion drives the drum pinion shaft assemblies through the mechanical load brake, or through the intermediate shaft assembly when a mechanical load brake is not used. The two drum pinions drive the drum gear, causing the drum to revolve.

MECHANICAL LOAD BRAKE

The functions of the mechanical load brake are to control the lowering speed of the load and to prevent the load from dropping due to failure of the electric motor. The mechanical load brake consists of an ACME (left hand) threaded shaft with a fixed flange, a motor gear with an ACME (left hand) threaded bore, a ratchet with friction linings riveted to each side, and a spring controlled pawl mounted in the gearcase. During the raising cycle, the motor gear is driven counterclockwise and the ACME thread causes the motor gear to compress the ratchet between itself and the fixed flange on the shaft. The spring loaded pawl is thrown away from the ratchet and therefore no braking action takes place. During the lowering cycle, the motor gear is driven clockwise. The load on the hook tends to keep the brake closed. The pawl engages the ratchet and forces the ratchet to slip between the motor gear and flange thereby creating the braking torque.

MOTOR BRAKE

Whenever the hoist motor is energized, the DC magnetic motor brake is energized to pull the armature against the brake compression spring and free the disc type brake linings (see Figure 3-3). When the hoist motor is de-energized, the motor brake is also de-energized and releases the armature, allowing the compression spring to exert force on the disc type brake linings, which in turn apply braking torque to the motor pinion shaft.

These brakes are designed for dc operation. When the hoist power supply is ac, a rectifier assembly is used to provide a dc power supply to the brake.

LIMIT SWITCHES

WEIGHT TYPE UPPER LIMIT SWITCH (Figure 3-4). When the bottom block is in a normal operating position (below the preset upper limit), the re-set weight winds up the spring, positions the limit switch sheave against a stop. The cams are clear of the contact fingers (position 1) so that the hoist circuit contacts (A) are closed and plugging contacts (B) are open. When the bottom block approaches its preset upper limit it contacts the re-set weight,

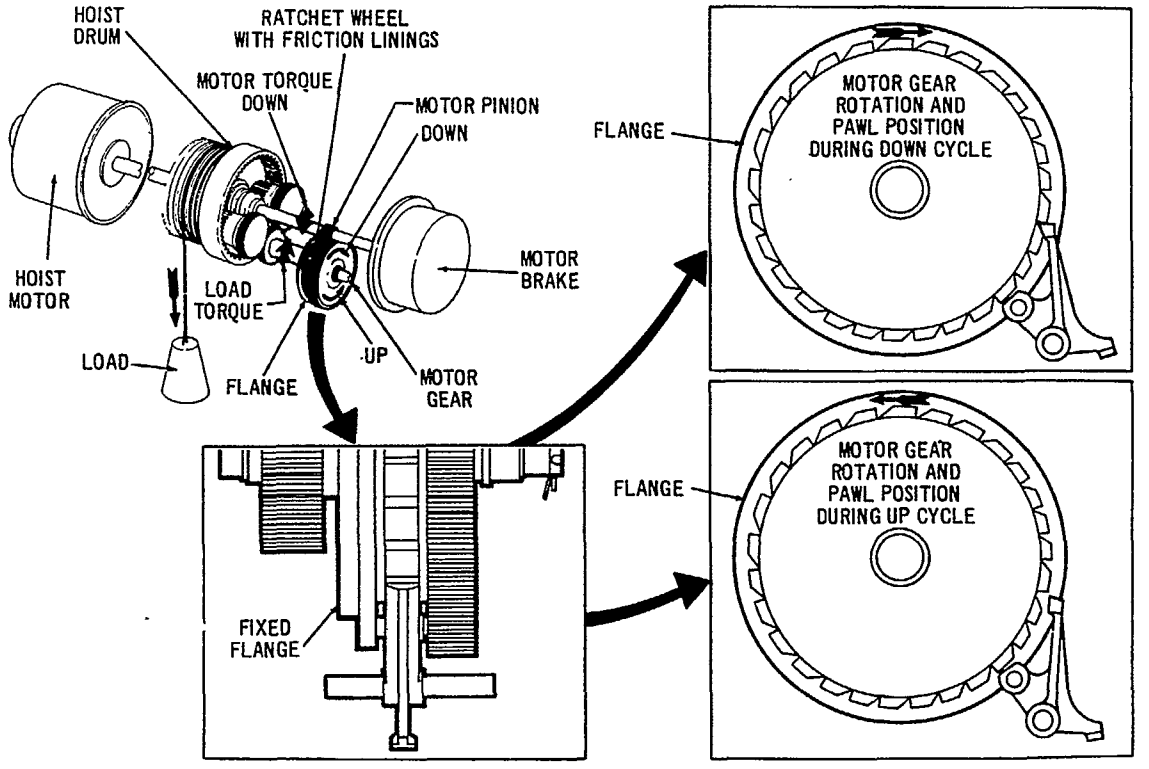


Figure 3-2. Principle of Mechanical Load Brake 1303

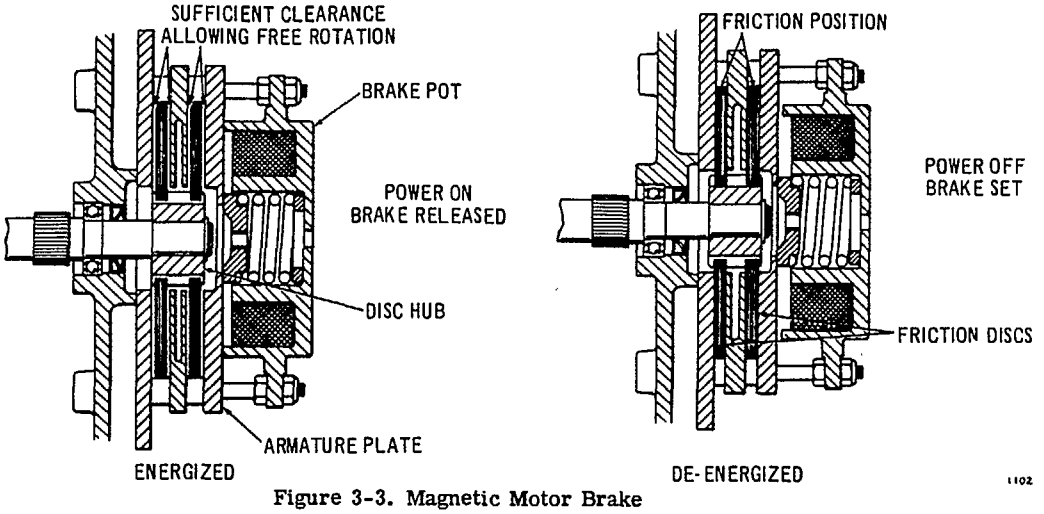


Figure 3-3. Magnetic Motor Brake

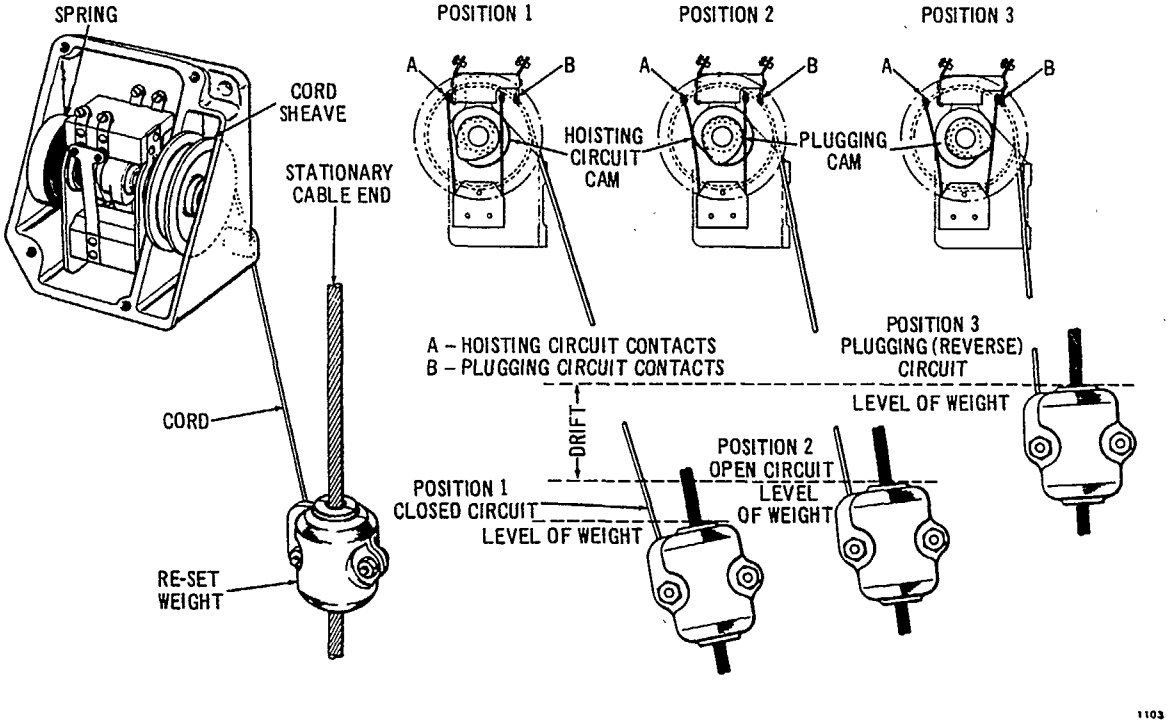


Figure 3-4. Weight Type Upper Limit Switch

raising it to permit spring tension to rotate the switch cams until the hoist circuit cam opens the hoisting circuit contacts (A) to stop the motor and apply the motor brake (position 2). If the bottom block drifts beyond this preset limit, the re-set weight continues to rise and the switch cams rotate still farther until the plugging cam closes the reverse circuit contacts (B) (position 3). This reverses the hoist motor and returns the bottom block to its upper limit position. Should the cord break, the spring will rotate the sheave and cams to a stop where both the hoist contacts (A) and plugging contacts (B) are open.

PADDLE TYPE UPPER LIMIT SWITCHES

PADDLE MOUNTED ON SHAFT. Switch construction is identical to that used for weight type limit

switch but no spring or sheave are used. The paddle is mounted directly on the shaft which carries the two cams (Figure 3-5 upper). The weight of the paddle is sufficient to properly position the cams.

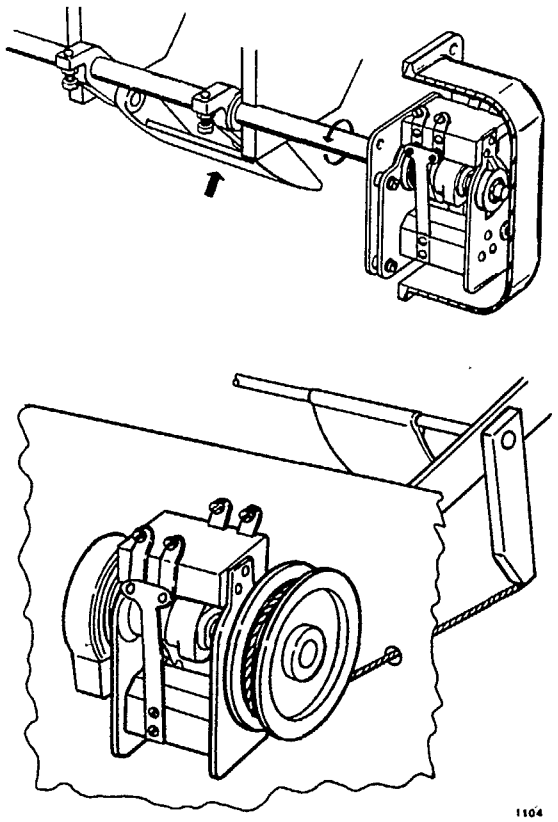


Figure 3-5. Paddle Type Upper Limit Switches

PADDLE MOUNTED ON DRUM HANGER. The spring tension on the sheave is reversed from that on the weight type limit switch. As the bottom block engages the paddle in an upward direction, (Figure 3-5 lower), the cord rotates the sheave which in turn rotates the switch cams until the hoist circuit cam opens the hoisting circuit contacts. If the bottom block drifts beyond this preset limit, the switch cams rotate still farther until the plugging cam closes the plugging circuit contacts. This reverses the hoist motor and returns the bottom block to its upper limit position.

CAM TYPE, WEIGHT AND PADDLE LIMIT SWITCHES. Under normal operation the hoist motion should stop when the hoisting contacts (A) open as in position 2. The plugging contacts (B) position 3 should only close in case of malfunctioning of motor brake causing excessive drift. For brake adjustment see MAINTENANCE section of this manual.

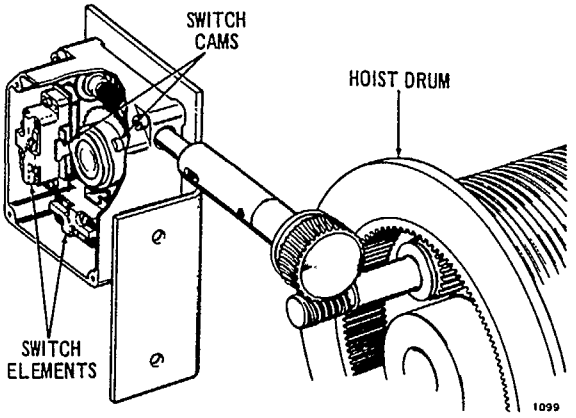


Figure 3-6. Geared Limit Switch

GEARED LIMIT SWITCH. The adjustable geared limit switch opens the RAISE circuit when the bottom block reaches a preset upper limit and opens the LOWER circuit when the bottom block reaches a preset lower limit. The geared limit switch is driven by the drum gear (see Figure 3-6) and actuates after a predetermined number of drum revolutions.

LOAD LIMIT DEVICE (OPTIONAL EQUIPMENT). The load limit device is preset at the factory to open the hoisting circuit when a lift of 125% of rated capacity is attempted. If it is not operating properly, contact the P&H Regional Service Office nearest you. A list of P&H Regional Service Offices is given on the last page of this manual.

CONTROL

PUSH BUTTON STATION. Normally, hoist control is actuated through the use of a weather-proof push button station suspended from the control cabinet. The number of push button elements in the station is determined by the number of motions to be controlled from the push button station.

Three types of push button elements are used, depending on the type of control. For single speed control only one speed can be obtained in either direction.

For two speed control, a three contact element is used. By partially depressing the button, motion, direction and slow speed will operate. By completely depressing the button, slow speed drops out and high speed will operate.

For the five step variable speed control, a five step element button is used. Contact with the directional and five speed points is made by progressively depressing the button in increments of approximately one-eighth inch. As the button is depressed additional contact segments are engaged. These contacts actuate contactors which in turn vary the resistance in the motor circuit. As the button is depressed contactors are closed, shorting resistance

out of the motor circuit and increasing the motor speed.

Also, with variable speed push button control, timers can be added to the circuitry to provide timed acceleration. When required we normally recommend timers for the last two steps of acceleration (optional).

The wiring between the push button station and the controls is a rubber or plastic covered multiconductor control cable. The push button station is suspended from the control cabinet by a chain which removes the strain from the control cable. Individual wires in the control cable are color coded.

CONTROL PANELS. The control panel is mounted directly on the hoist frame, except when otherwise specified. Figures 3-7, 3-8 and 3-9 illustrate typical control panels for ac operation of hoist and trolley motions.

REVERSING CONTACTOR. The reversing contactor completes the power supply to the motor only when directional control circuits are completed through use of the push button station. The contactor incorporates a mechanical interlock to prevent more than one directional control circuit from being operated at the same time. Individual reversing contactors are used for the hoist motion and trolley motion.

Thermal overload protection on the reversing contactor protects the motor. These thermal overloads are manual reset, except when the automatic reset type are specified and used.

Four pole reversing contactors are used up to and including 10 HP. For 15 HP and over, three pole contactors are used, in which case separate relay is used to energize the brake coil.

ACCELERATING CONTACTORS. As the six contact points in the push button are engaged, circuits through the reversing and accelerating contactor are actuated accordingly. Each circuit through the accelerating contactors shorts out additional resistance from the motor circuit and increases the motor speed.

When control requirements do not exceed NEMA size 1 contactor (approximately 30 amps), a four gang single unit contactor is used. For NEMA size 2 and

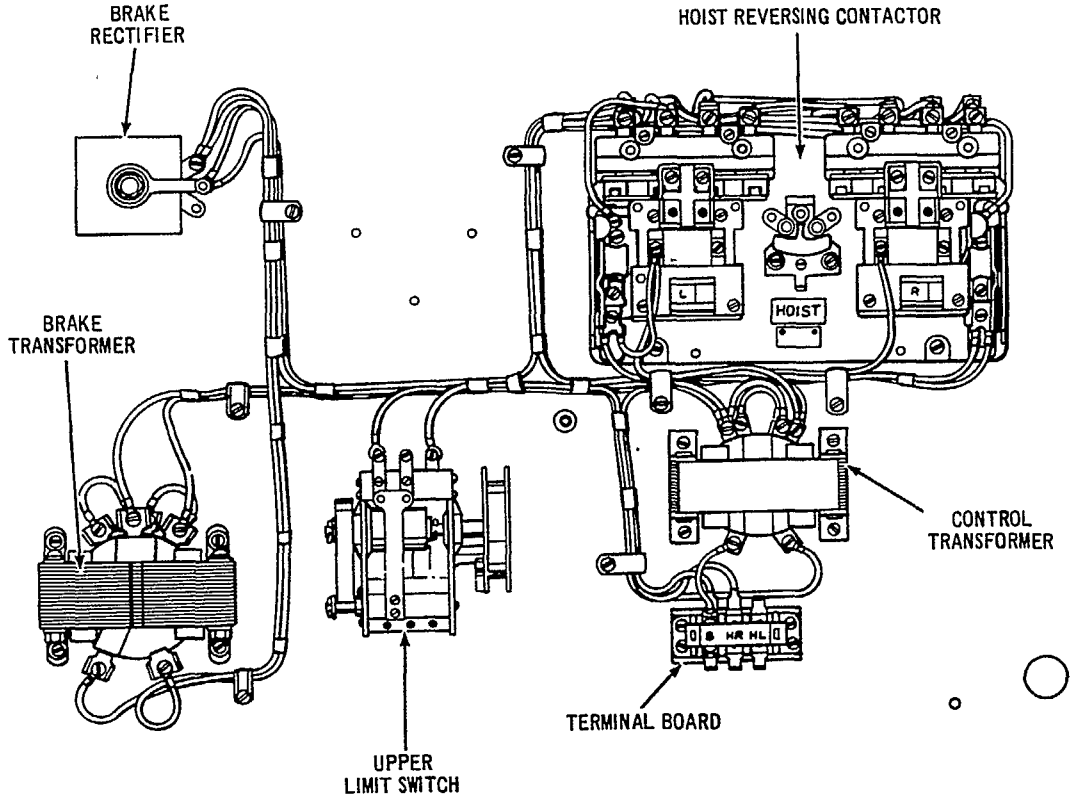


Figure 3-7. Typical AC Single Speed Hoist Control Only

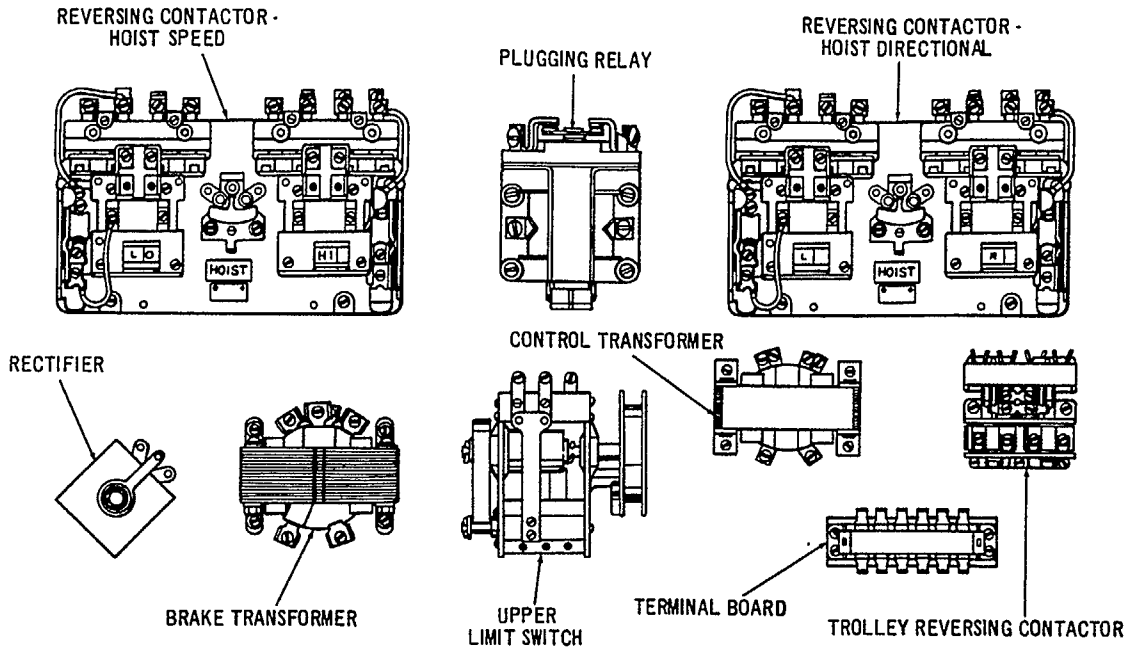


Figure 3-8. Typical AC Two Speed Hoist and Single Speed Trolley Control

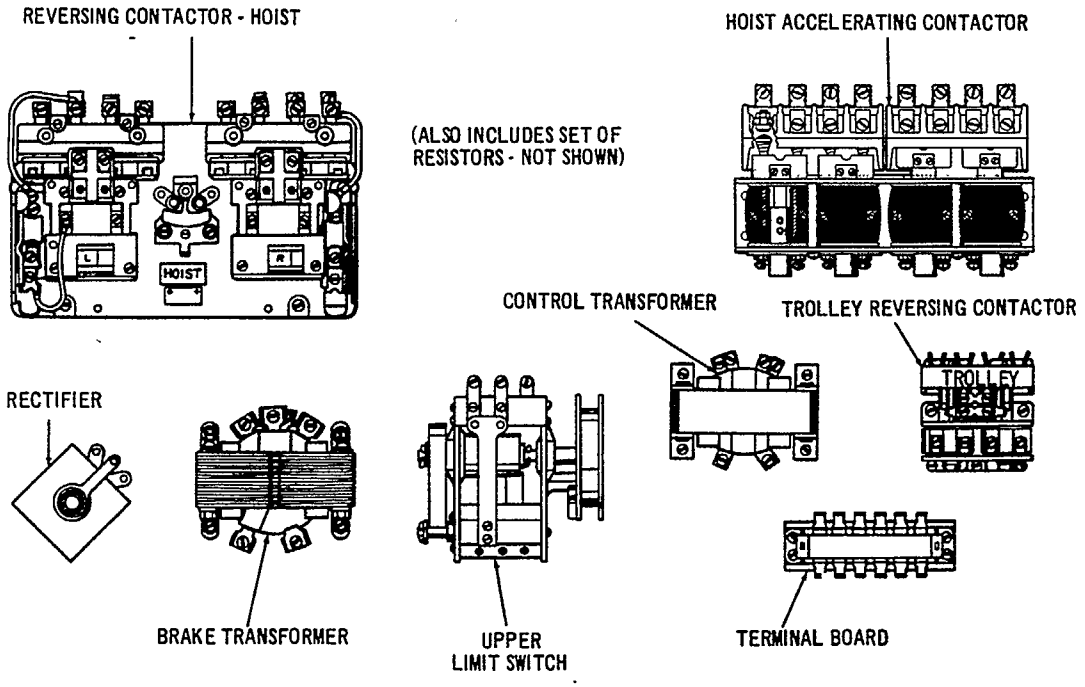


Figure 3-9. Typical AC Variable Speed Hoist and Single Speed Trolley Control Panel

larger contactors, four individual contactors are used to control the motor speed.

TRANSFORMERS. The control circuit transformer is connected to two of the three power supply terminals on 3 phase units and supplies both the control circuit and the magnetic brake circuit. Most AC control systems utilize a control circuit transformer to reduce the control circuit voltage to 24 volts. In the event the control circuit voltage (secondary voltage) is reduced to 110 volts, a second transformer is used to reduce the brake circuit to 24 volt operation. When the control circuit operates on 24 volts, the transformer provided is of adequate capacity to operate both the control and the brake circuits.

RECTIFIER. The magnetic brake is designed to operate on direct current. A rectifier is used in all ac control circuits to rectify the current to DC for proper operation of the magnetic brake coil.

PLUGGING RELAY. A plugging relay is used in every two speed hoist control. At the time the weight or paddle operated upper limit switch is engaged, the plugging relay energizes only the low speed windings of the motor and prevents plugging (reversal) in high speed.

SECTION IV
SAFE OPERATING PRACTICES

GENERAL

Special attention should be given to this section for the purpose of minimizing the possibility of personal injury either to the hoist operator or to those persons working in the area the hoist is operating in. Also, SAFE OPERATING PRACTICES will lessen the occurrence of damage to your property, equipment and material.

All of the situations described in this section have at one time or another, contributed to unnecessary accidents. The operator of the hoist is urged to carefully read this section and to avoid the hazardous operating conditions described herein. It is impossible to foresee all such conditions, and it must remain the responsibility of the operator to anticipate and avoid any unsafe conditions not covered in detail in this manual.

No machine is entirely safe unless it is properly maintained. Therefore, it becomes important to practice a program of periodic inspection and preventive maintenance. The MAINTENANCE section of this manual outlines such a program for you.

WARNING

Never depend on the brakes to suspend the load aloft, unless the operator is at the controls, alert, and in a position of readiness to handle the load.

SAFETY INSTRUCTIONS

1. The hoist should be operated only by designated and trained operators.

2. The operator should not engage in any practice which will divert his attention while actually engaged in operating the hoist.

3. If unsafe conditions exist, the operator should have the authority to refuse to handle any loads until safety has been assured.

4. If a warning signal is furnished, it should be sounded each time before traveling, and intermittently during travel, particularly when approaching workmen.

5. Before leaving his hoist unattended, the operator should land any load attached to the bottom block.

6. The operator should check the operation of each motion and limit switch functions at the start of each shift.

7. All loads should be securely hitched and properly balanced before the lift is made.

8. Chains, ropes and slings used for lifting should be continually observed for damage or wear that could make them unsafe to work with.

9. The hoisting cable should be vertical before the lift is made.

10. No one should ride the hook or load.

11. The load should not catch on obstructions when lifting or traveling.

12. Loads should not pass over the heads of workmen or in any way endanger their safety.

13. The load should not be lowered below the point where less than one and one-half wraps of cable remain on the drum.

14. The hoist should not be used for side pulls.

15. The operator should test the brakes each time a load approaching the rated capacity, is handled, by raising the load a few inches and then stopping it.

16. Never exceed the rated capacity of the hoist which is posted on the bottom block. Be sure to include the weight of special handling devices when figuring the weight of a load. Be sure you are not exceeding capacity before attempting to lift a load.

17. Be certain the hoisting cables are in good operating condition. Visually inspect them for excessive wear, broken wires, stretch, kinking or twisting on a weekly basis.

18. When replacing a cable, always wear protective gloves to guide it on to a drum.

19. Be sure the hook is in good operating condition. A hook that is cracked should be replaced immediately. A hook that is bent so that the throat opening is increased by more than 15%, or twisted more than 10 degrees should be replaced.

20. The upper limit switch should be checked without a load at the beginning of each shift for correct operation. The upper limit switch is a protective device rather than an operating control and should not be actuated during normal operation.

21. Never attempt to repair, adjust or lubricate the hoist unless the power supply is shut off.

THINK SAFETY

The use of hoists is subject to certain hazards that cannot be met by mechanical means, but only by the exercise of intelligence, care and common sense. It is therefore essential to have careful and competent operators, physically and mentally fit and thoroughly trained to the safe operation of hoists and the handling of loads.

The safety recommendations in this section have been taken, in part, from the Safety Code for cranes, derricks and hoists (USAS B30.2.0 - 1967).

SECTION V
MAINTENANCE

PERIODIC INSPECTION AND PREVENTIVE MAINTENANCE

Perform periodic inspection and preventive maintenance procedures as outlined in Table 5-1. These are minimum requirements and both the intervals and operations are based on intermittent operation of the hoist eight hours each day, five days per week. Depending on the activity, severity of service and environment of the hoist, more frequent inspections and maintenance may be required. The operator of the hoist must be responsible for determining the severity of service and operating conditions.

Table 5-1. Periodic Inspection and Preventive Maintenance

TIME INTERVAL	INSPECTION OR MAINTENANCE TO BE PERFORMED
Start of each shift	Check operation of upper limit switch, motor brakes and control.
Weekly	Check wire rope for kinks, abrasion, stretch, corrosion or broken wire strands.
1-3 Months	Remove and inspect magnetic disc plate and linings. Clean or replace them as required. Adjust brake operating clearance.
1-3 Months	Check oil level in hoist gear case. Add oil as required.
1-3 Months	Inspect contacts of control contactors. All contacts are silver alloy and are not harmed by discoloration and slight pitting. Do not file these contacts. Replace them only when silver has worn thin or they are severely pitted.
3-6 Months	Drain and refill hoist gear case.
1-3 Months	Check oil level in motor geared trolley gear case. Add oil as required.
1-3 Months	Clean hoist and trolley gear case breathers in solvent.
1-3 Months	Lubricate exposed teeth on geared trolley wheels.

Table 5-1. Periodic Inspection and Preventive Maintenance (Cont.)

TIME INTERVAL	INSPECTION OR MAINTENANCE TO BE PERFORMED
3-6 Months	Lubricate trolley wheel bearings.
3-6 Months	Lubricate sheave bearings in upper block, equalizer and bottom block.
3-6 Months	Apply a small amount of oil to the shaft bearings of the plugging upper limit switch.
Annually	Check all wiring for evidence of damage and check security of all electrical connections.
Annually	Inspect hook using a magnetic particle, penetrant or other method capable of detecting cracks. Inspect the safety latch and test its operation (if applicable).

LUBRICATION

GENERAL. To ensure continuing good operation of the hoist, all points requiring lubrication must be serviced with the correct lubricant at the proper time interval as indicated for each assembly.

The lubrication intervals recommended in this manual are based on intermittent operation of the hoist eight hours each day, five days per week. If the hoist is operated almost continually or on more than one shift, more frequent lubrication will be required. Also, if the hoist is operated under adverse conditions, such as extremely high temperatures (above 120° F), extremely low temperatures (below 0° F) or in a corrosive atmosphere, both the lubricants and intervals must be adjusted. The operator of the hoist must be responsible for determining the severity of service and the operating conditions.

HOIST GEAR CASE. Drain and refill the hoist gear case at least once every six months. Remove the breather and drain plug (Figure 5-1) to drain the oil into a suitable container. Then replace the drain plug and remove the oil level plug. Add gear oil until oil reaches the oil level plug opening.

NOTE

Oil capacities vary from 3 to 16 pints depending on the size of the gear case. The oil capacity of your hoist is cast in raised letters on the gear case just below the breather opening.

Replace the oil level plug. Clean and reinstall the breather.

NOTE

Remove the oil level plug and check the oil level at least once every three months.

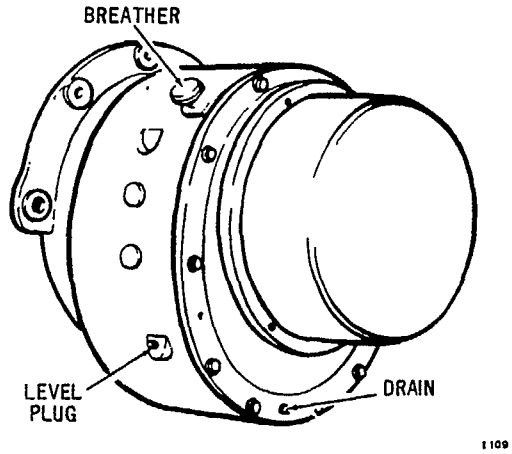
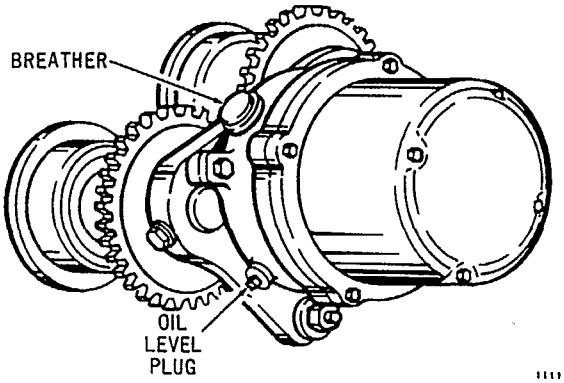


Figure 5-1. Hoist Gear Case Lubrication

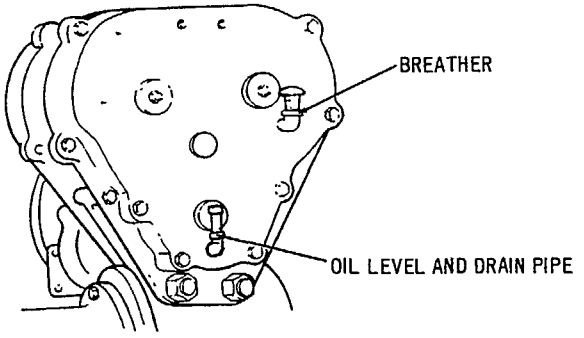
Use a high quality SAE 90 gear oil without EP additives for indoor service and outdoor summer service (ambient temperature range +40° F to +125° F). Use a high quality automatic transmission fluid, type "A", for outdoor winter service (ambient temperature range -25° F to +40° F). The following are some of the products which meet these requirements:

SAE 90 Gear Oil P&H Specification No. 486	Automatic Transmission Fluid, Type "A" P&H Specification No. 494
American of Indiana Oil No. 95 Humble Lub. Oil No. 1062 Mobil DTE BB Mobil Vactra BB Texaco Regal G Oil	Amoco Type "A" Humble Auto-Glide A Mobil Fluid 200 Shell Donax T-6 Texamatic 1808 Fluid

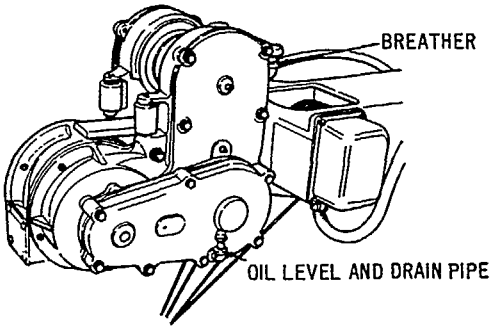
MOTOR GEARED TROLLEY GEAR CASE - SINGLE SPEED OR TWO SPEED. Remove the oil level plug (Figure 5-2) and check the oil level at least once every six months. If necessary, remove the breather and add gear oil until the oil reaches the oil level plug opening. Replace the oil level plug. Clean the breather in a solvent and reinstall it, Use the same type gear oil as used in the hoist gear case.



SINGLE SPEED AND TWO SPEED MOTOR GEARED TROLLEY GEARCASE



VARIABLE SPEED TROLLEY GEAR CASE -STANDARD HEADROOM



VARIABLE SPEED TROLLEY GEAR CASE - LOW HEADROOM

Figure 5-2. Trolley Drive Gear Cases

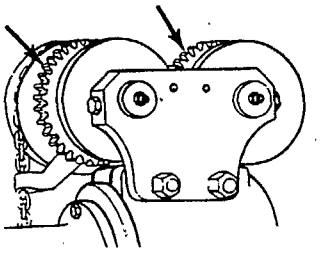
MOTOR DRIVEN TROLLEY GEAR CASE - VARIABLE SPEED. Drain and refill the gear case at least once every six months. Some gear cases are equipped with a drain plug and others with an oil level pipe (Figure 5-2). The oil level pipe must be turned upside down for draining. When empty, return the oil level pipe to its upright position. Then add oil through the breather opening until the oil level reaches the top of the oil level pipe. Replace the pipe cap or pipe plug. Clean and reinstall the breather. Use the same type gear oil as used in the hoist gear case.

Remove the oil level pipe cap to check the oil level at least every three months. The oil level should be to the top of the pipe. Add oil as required.

GEARED TROLLEY WHEELS. Apply gear lubricant at least every six months to the exposed drive and driven gear teeth. More frequent applications will be necessary if the hoist is in constant use or operating under adverse conditions. Apply the gear lubricant sparingly to prevent it from dripping on the beam flanges which will cause the trolley wheels to slip.

CAUTION

Geared trolley wheels are not lubricated at the factory and must be lubricated before the hoist is placed into service.



GEARED TROLLEY WHEELS DO NOT OVER GREASE. EXCESS GREASE ON RUNWAY WILL CAUSE SLIPPAGE.

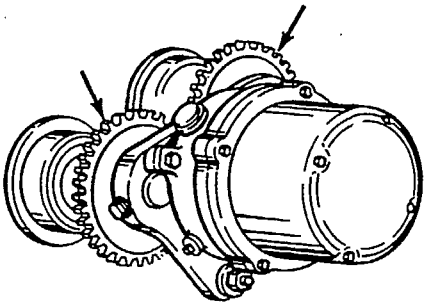


Figure 5-3. Geared Trolley Wheels

Use a high quality open gear lubricant which is adhesive and water resistant. The following are some of the products which meet these requirements:

Indoor Service and Outdoor Summer Service (ambient temperature range +40° F to +125° F) P&H Specification No. 464	Outdoor Winter Service (ambient temperature range -25° F to +40° F) P&H Specification No. 465
Humble Surett N-1550 Mobilcote S Shell Cardium Compound C Texas Crater 2X	Humble Surett N-850 Mobilcote S Shell Cardium Compound B Texas Crater 1X

GREASE FITTINGS. Some trolley wheels are equipped with permanently lubricated and sealed bearings. However, most do require periodic lubrication. If your trolley wheel bearing points and bottom block sheave pins have grease fittings provided, these bearings should be lubricated at least once every six months. Some upper sheave assemblies also have grease fittings provided. These too should be lubricated every six months.

NOTE

Whenever trolley gear cases and bottom blocks are disassembled for service, all bearings should be repacked with grease before reassembling. If the upper sheave assembly (equalizer) is equipped with a bushing, apply grease to the bushing each time the wire rope is being replaced.

Use a high quality No. 2 grade multi-purpose grease, P&H Specification No. 472. The following are some commercial products which meet or exceed these requirements.

American Rykon
Humble Nebula
Mobil Plex
Shell Alvena No. 2
Texaco Marfak MP

LUBRICATION OF NITRIDED DRUM GEAR. A special nitrided drum gear can be provided for heavy duty hoist as an option, where excessive duty cycle application exists.

In addition to the nitrided drum gear, three external lubrication fittings are provided. One fitting for the drum lubrication and the remaining two are for the drum bearings. See Figure 5-4.

Only Shell Darina #2 E.P. grease (do not substitute), shall be used as lubricant for these fittings and shall be applied at three month intervals.

PLUGGING UPPER LIMIT SWITCH. Apply a small amount of lubricating oil to the shaft bearings of the limit switch at least every six months.

The control cabinet cover must be removed for access to the switch on standard headroom hoists. The switch cover must be removed for access to the switch on low headroom hoists.

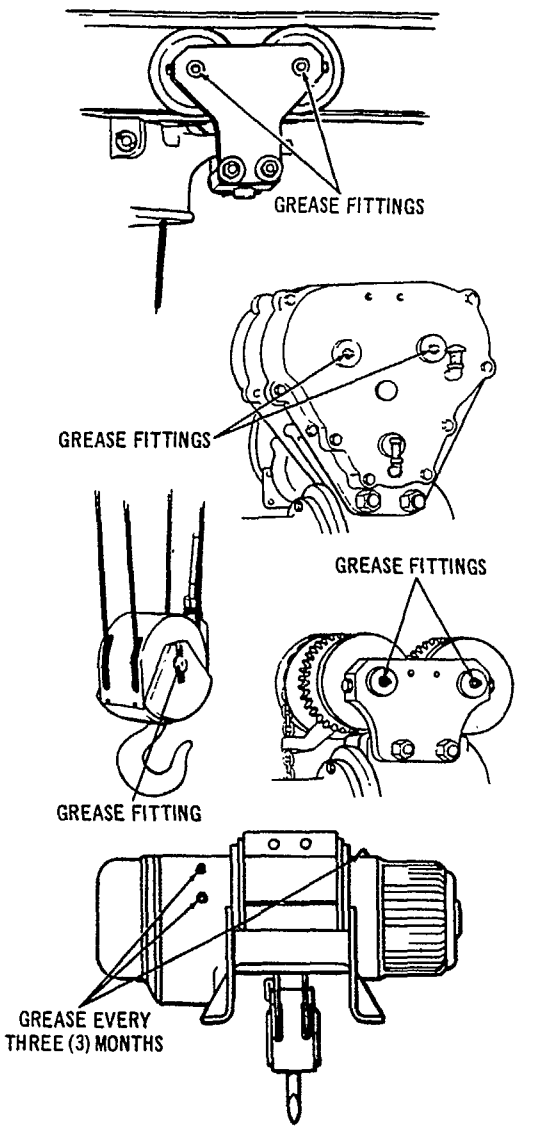


Figure 5-4. Grease Fittings

WIRE ROPE. Wire rope should be maintained in a well lubricated condition, yet no set rule can be given concerning the frequency of wire rope lubrication. The severity of service and the amount of corrosive elements to which the wire rope is subjected will have to serve as a guide in determining the need for relubrication.

The lubricant used should be chemically neutral, able to penetrate between wire strands, non-soluble in water and able to resist oxidation.

ELECTRIC MOTOR LUBRICATION. In all hoist and trolley motors, a sufficient amount of grease is packed and sealed into the motor shaft bearing chamber to last for the normal operating life of the bearing.

ADJUSTMENTS

DIRECT ACTING MAGNETIC BRAKE ADJUSTMENT. The direct acting magnetic brake must be properly adjusted to stop rotation when the power supply is shut off. This adjustment compensates for disc type brake lining wear. At least once every three months inspect the magnetic brake to determine if adjustment is necessary. Air gap 'S' should be 1/32 inch. (Figure 5-5.)

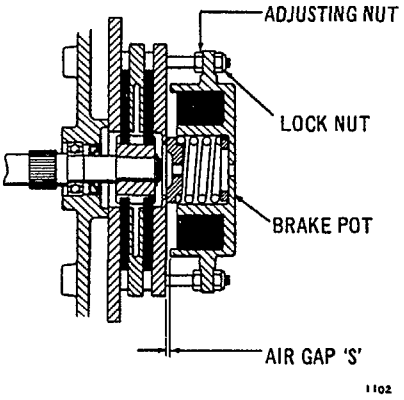


Figure 5-5. Magnetic Brake Adjustment

For adjustment, shut off the power, then remove the brake cover from the hoist. Back off the lock nuts and turn the adjusting nuts until air gap 'S' is 1/32 inch around the entire brake pot. Retighten the lock nuts.

This adjustment procedure is also described on the nameplate attached to the side of the brake pot.

MECHANICAL LOAD BRAKE PAWL ADJUSTMENT. During raising, the ratchet is rotating counterclockwise. The engaging end of the pawl should be clear of the ratchet teeth by 1/16 to 1/8 inch (see Figure 5-6).

If a rapid clicking sound occurs in the gear case when raising, the pawl is touching the tips of the ratchet teeth. Remove the locking set screw with an Allen wrench. Operate the hoist in the raising motion and slowly turn the adjusting set screw counterclockwise until the clicking sound disappears. Then stop the hoist and give the adjusting set screw an additional one half turn. The pawl will then be the proper distance from the ratchet teeth. Insert the locking setscrew and tighten.

Then check the lowering motion to be sure the pawl engages the ratchet firmly at the start of the lowering motion. If the pawl noisily hammers into the ratchet teeth, the clearance is more than 1/8" and should be adjusted accordingly.

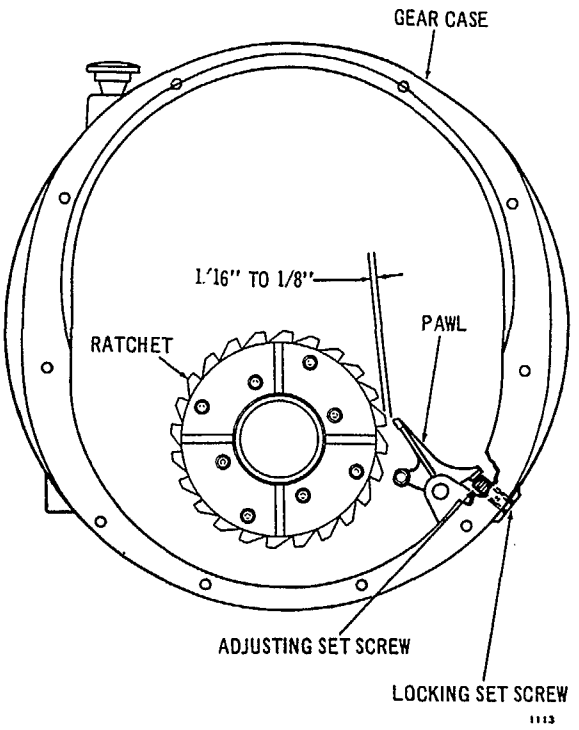


Figure 5-6. Load Brake Pawl Adjustment

If the gear case is disassembled and in a vertical position, install the load brake shaft assembly and the pawl assembly to their normal operating positions. Rotate the load brake shaft assembly by hand and adjust the set screw so the clearance is 1/16 to 1/8 inch with the ratchet rotating counterclockwise.

UPPER LIMIT SWITCH CAM POSITIONING. The actuating cams which open the RAISE circuit and close the LOWER circuit are two separate moldings. The cams are matched and held together by internal and external gear teeth. The gear arrangement provides an adjustment to vary the plugging time (the distance the bottom block moves between opening the RAISE circuit and closing the plugging circuit). The cams are indexed together by a reference line on the hoisting cam and index numbers equally spaced on the exposed face of the plugging cam. The cams are secured to the shaft with cotter pins.

CAUTION

The position of the hoisting cam on the shaft must never be changed.

To change the plugging time, proceed as follows: (See Figure 5-7.)

1. Remove the cotter pin at the end of the plugging cam.

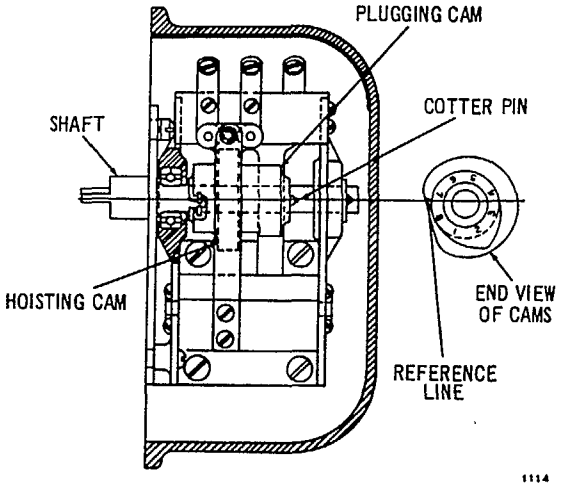


Figure 5-7. Paddle Operated Upper Limit Switch Cam Positioning

2. Slide the plugging cam axially along the shaft until the teeth are disengaged.

3. Rotate the plugging cam to the desired setting.

4. Return the plugging cam to the position where the gear teeth are engaged.

5. Insert the cotter pin in the shaft at the end of the plugging cam.

PADDLE ADJUSTMENT - UPPER LIMIT SWITCH. If it is necessary to adjust the operation of the paddle operated limit switch, loosen the adjusting screw (Figure 5-8) so the paddle is set in its lowest position. Retighten the adjusting screw. Reposition the cams to correct the plugging time as described in the previous paragraph.

GEARED LIMIT SWITCH ADJUSTMENT (OPTIONAL EQUIPMENT). Both the RAISE and LOWER circuits are connected through sets of normally closed contacts in the geared limit switch. Both the upper and lower limits of bottom block travel are preset at the factory. If the geared limit switch requires adjustment, proceed as follows (see Figure 5-9):

NOTE

The lower limit of the geared limit switch should be set so that the LOWER circuit opens when one and one-half wraps of cable remain on the drum. The upper limit should be set so that the bottom block stops a minimum of 6 inches before contacting the hoist drum. Sufficient clearance must be allowed to provide for a few inches of drift after the RAISE circuit is opened by the switch.

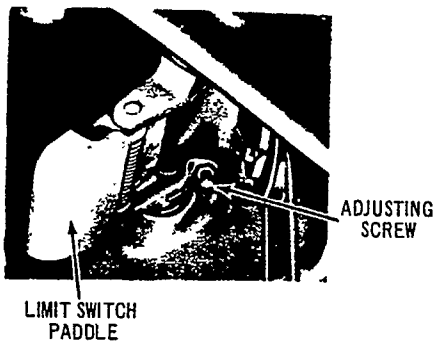


Figure 5-8. Upper Limit Switch Paddle

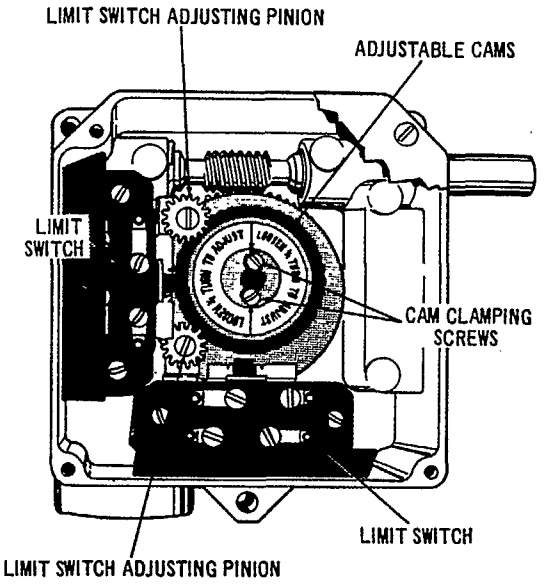


Figure 5-9. Geared Limit Switch Adjustment

1. Remove the cover from the geared limit switch.

2. Operate the hoist to raise the bottom block to the desired upper limit of travel.

3. Loosen the two cam clamping screws 1/4 turn each.

4. Depress the upper limit switch adjusting pinion with a screwdriver until it meshes with the adjustable upper limit cam.

5. Rotate the cam in the direction to open the normally closed contacts. The white marker on the

gear teeth of the cam is directly over the nylon roller which actuates the switch. Continue to rotate the cam until the contacts have just opened.

6. Retighten the two clamping screws.

7. Operate the hoist to lower the bottom block to the desired lower limit of travel.

8. Adjust the lower limit switch cam in a sequence similar to that used in steps 3, 4, 5, and 6.

9. Operate the hoist to check both upper and lower limit settings and readjust if necessary.

10. Replace the switch cover.

HOIST DISASSEMBLY

GENERAL. The following points should be kept in mind during the disassembly of any component.

1. Disassembly should be limited to that required for specific repairs. Never disassemble beyond the point necessary to fix the trouble.

2. Never use heat from a torch to assist in removing parts unless the parts to be heated are already damaged beyond repair. Excessive heat will damage parts beyond repair.

3. Prepare a clean area to place the parts which are removed. Prevent foreign matter from entering the bearings, motor, brake and gear case.

4. Use care that parts are not nicked or otherwise damaged so that fits and performance are not affected.

NOTE

All gaskets, o-rings and oil seals removed during disassembly should be discarded and replaced with new parts.

5. Tag electrical wires when disconnecting them to facilitate proper connections when reconnecting them. Also, refer to the wiring diagram secured to the inside of the control cabinet cover.

WARNING

Before starting any disassembly of the hoist, lower the bottom block to the floor, if possible. If the bottom block cannot be lowered to the floor, secure it to the beam or other mounting support to relieve tension on the wire rope. If the hoist is being removed from its mounting, shut off the power supply and disconnect the power connections to the hoist. If the hoist is to be worked on while still mounted in place, shut off the power and pull the power supply fuses or place the power supply circuit breakers in the off position.

DISASSEMBLY OF MAGNETIC BRAKE. To disassemble the magnetic brake, proceed as follows (see Figure 5-10):

1. Remove the brake cover (5).

2. Disconnect the leads to the magnetic brake pot (6).

3. Insert a 1/2-13 UNC bolt through the opening in the end of the brake pot and thread it into the spring guide (4). Tighten the bolt a few turns to relieve spring pressure on the armature (9) and to ensure that the spring guide is firmly retained by the bolt.

4. Remove the three adjusting nuts and lockwashers from the brake pins and slide the magnetic brake pot off of the pins.

5. Remove the armature (9), the disc type brake linings (10), the disc plate (2) and the back plate (1).

NOTE

If it is necessary to remove the spring guide (4), the compression spring (7) and the spring spacer (8) from the brake pot, set the brake pot on a work bench with the spring guide towards the bench. Hold the brake pot down with one hand while slowly removing the bolt which was inserted in step three. Slowly allow the brake pot to rise as the spring extends.

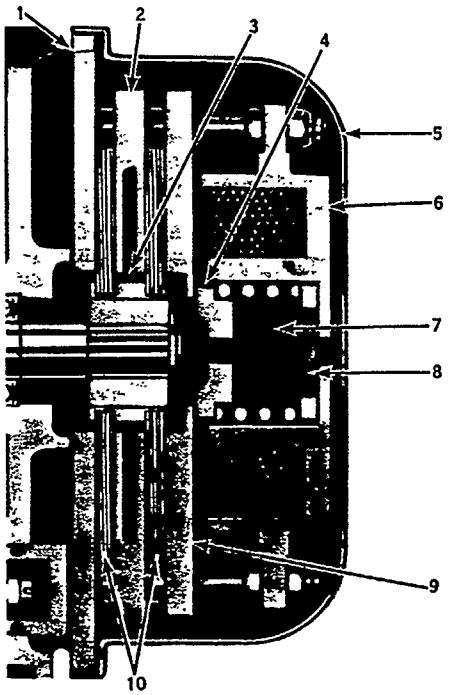


Figure 5-10. Magnetic Brake Assembly

DISASSEMBLY OF GEAR CASE AND GEARING. To disassemble the gear case assembly, proceed as follows (see Figure 5-21 on Page 5-15):

1. Remove the magnetic brake parts as described under DISASSEMBLY OF MAGNETIC BRAKE.

2. Remove the breather and drain plug. Drain the oil into a suitable container.

3. Remove the snap ring (13) and the disc hub (14).

4. Disconnect the conduit from the gear case cover (15).

5. Remove the cap screws and lockwashers to detach the gear case cover from the gear case. Grasp the gear case cover by the brake pins for easy removal. It is advisable to replace all the oil seals in the gear case cover. The bearings do not have to be removed unless they will require replacement. The brake pins are pressed into the cover and are secured with snap rings. Remove the snap rings and press out the pins if replacement is necessary.

6. If the motor pinion shaft did not come out with the gear case cover, withdraw the motor pinion shaft (10) by pulling it straight out from the splined coupling (9). Leave the coupling in place.

7. Remove the pawl pin (27). Slide out the pawl (26) with the load brake spring cap assembly (28).

8. Remove the load brake shaft assembly intact. (If a mechanical load brake is not used, remove the intermediate shaft assembly.)

9. If it is necessary to disassemble the load brake shaft assembly (Figure 5-11), firmly secure the intermediate pinion (1) in a vise with protective jaws. Remove the cotter pin (10) and nut (9). Remove the motor gear (4) by unthreading it, clockwise, from the shaft, as viewed from the motor gear end of the shaft. The motor gear will serve as a jack screw for removal of items 6, 7, and 8. The bearing inner race (11) and pinion are pressed on to the shaft and must be pulled if they are to be removed for replacement.

CAUTION

Be careful not to damage bushing (5) when removing ratchet (2) from the motor gear. Also, do not remove flange (3) from the shaft because the flange and shaft are machined after they are assembled together. If replacement of either is necessary, they must be replaced as an assembly.

10. Remove the left and right drum pinion shaft assemblies (see Figure 5-20). The bearing inner races and the spacer ring may be pulled from the shaft, if necessary, but the shaft and the intermediate gear are serviced ONLY as an assembly.

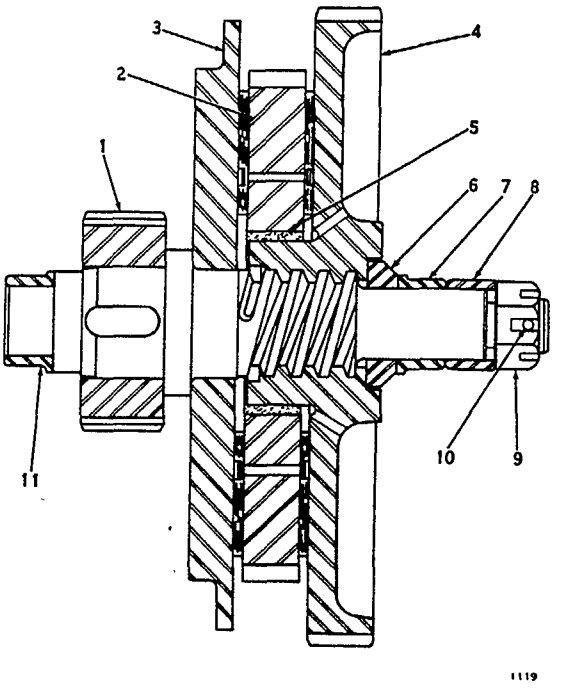


Figure 5-11. Load Brake Shaft Assembly

11. The bearings and oil seals (Figure 5-12, items 1 and 2) for the left and right hand drum pinion shaft assemblies and the bearing (3) for the load brake shaft are pressed into the gear case and should not be removed unless they are to be replaced. It is advisable to replace the oil seals.

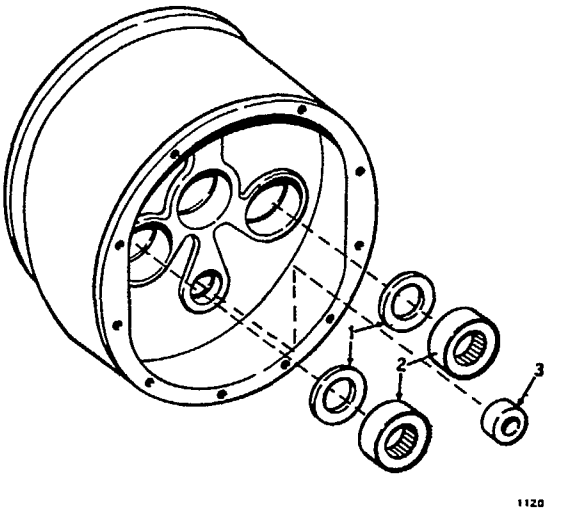


Figure 5-12. Hoist Gear Case

12. The splined coupling (Figure 5-21, 9) ball bearing (8), roller bearing (6) and oil seals (5 and 7) cannot be removed from the gear case unless the gear case is removed as described under REMOVING HOIST DRUM.

REMOVING HOIST MOTOR. To remove the hoist motor, proceed as follows (Figure 5-21):

1. Remove the terminal box plate on the side of the motor.

WARNING

If the motor is being removed with the hoist still mounted, be sure to shut off the power supply. Pull the power supply fuses or put the power supply circuit breakers in the off position.

2. Disconnect and mark the motor terminals.

3. Disconnect the conduit from the terminal box.

4. Firmly support the motor and remove the bolts and lockwashers securing it to the motor bracket (1).

5. Pull the motor straight out from the motor bracket. The splined motor shaft fits into the coupling (2) in the motor bracket.

REMOVING HOIST DRUM. To disassemble the hoist drum, first remove the bottom block and the wire rope from the hoist. Remove the hoist from its mounting so the disassembly can be done on a bench. Then proceed as follows (see Figure 5-21):

1. Remove the magnetic brake assembly, gear case cover, gearing and the hoist motor.

2. Remove the snap ring (3) from the bore of the motor bracket.

3. Using a hardwood rod and a hammer, tap the end of the drum shaft (20) at the gear case end so it can be taken out at the motor bracket end. As the shaft is pulled out with the coupling (2), the bearing (25) will also come out.

NOTE

Seven, eight and nine foot long drum shafts are an integral part of the drum and cannot be removed.

4. Block the drum to hold its position within the drum hanger. Remove the hardware which attaches the gear case to the hanger. Slide the gear case back to clear the drum bearing (6) and remove it from the hanger.

5. To remove the coupling (9) from the gear case, tap the coupling from the drum side of the gear case. It can then be removed with the bearing (8) from the gearing end of the gear case. If necessary, press the coupling out of the bearing.

6. The remaining bearings and oil seals in the gear case are press fitted and should not be removed unless they are to be replaced. Here again, it is advisable to replace the oil seals.

7. Slide drum away from the motor bracket to clear drum bearing (23). Lift drum out of the hanger.

8. Remove bearing (23) and oil seals (22 and 24) from the motor bracket.

9. The two drum sleeves (19) are pressed into the drum and should not be removed unless replacement is necessary.

10. The drum gear (18) is press fitted and doweled in the drum. The ends of the dowel pins are tack welded to the drum. To remove the drum gear, grind off the tack weld from the dowel pins. Drill and tap dowel pins and pull the pins out. Pry out the drum gear.

CLEANING OF REMOVED PARTS

Clean all parts thoroughly, using kerosene, diesel oil or a suitable commercial solvent. Never use a hot alkaline solution on finished parts or bearings. Use a low pressure jet (15 psi) of dry compressed air to dry parts.

CAUTION

Do not immerse prelubricated bearings in cleaning solvent. Never allow a bearing to spin when drying it with compressed air.

INSPECTION OF REMOVED PARTS

All parts should be inspected for wear and damage. Particular attention should be given to the following items:

1. Inspect all gearing for excessively worn, cracked or broken teeth.

2. Inspect all bushings for excessive wear, out-of-round, scoring or galling. Replace worn bushings.

3. Inspect all oil seals for cuts, nicks or loss of elasticity. Replace any that are damaged or appear to be damaged.

4. Inspect all bearings for excessive play, distortion or pitting. Also inspect the balls and rollers for

wear or damage. Replace worn or defective bearings.

5. If ridges caused by wear are apparent on a shaft, replace the shaft. Be especially careful to inspect all surfaces on which seal lips seat. A surface that is not perfectly smooth will result in rapid wear to the seal lips, which in turn causes oil leaks.

6. Inspect all threaded parts and replace those with damaged threads.

7. Inspect the magnetic brake disc plate and disc type brake linings for flatness within 0.005 inch. Linings can be sanded flat and the disc plate can be ground flat. If the linings have become oil soaked, they should be replaced and the source of the oil leak repaired.

8. Inspect the load brake friction disc assembly. Replace it if the linings are worn down to the rivet heads. If the friction disc linings are highly glazed, clean them in a solvent such as kerosene. Allow them to dry and sand them lightly with sandpaper backed up by a flat surface. Coat the friction disc assembly in clean gear oil before reassembly.

9. Carefully inspect the gasket used between the gear case and gear case cover. If it is brittle or torn, oil leaks will very likely occur. If the proper gasket is not available, use a suitable 1/32 inch thick gasket material and cut it to size, using the gear case cover as a template.

10. Inspect all other parts for evidence of damage. Repair or replace any part which is in questionable condition. The cost of the part is often minor compared to the cost of redoing the job if the part should fail.

REASSEMBLY

GENERAL. The following good practices should be considered when reassembling any portion of the hoist.

1. Provided the parts are in sufficiently good condition to reuse, file smooth any nicks, burrs or galled spots on shafts, bores, pins and bushings.

2. All grease passages should be open and clean.

3. Carefully file any nicks or burrs from gear teeth.

4. Polish the edges of all shoulders on shafts to remove small nicks resulting from handling prior to assembly.

5. File all nicks and burrs caused by lockwashers.

6. Replace all gaskets, oil seals and O-rings which have been removed.

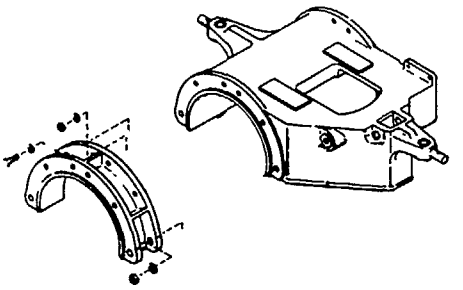
7. File the forward edge of all gearing keyways at a slight angle so that the gear will ride over the key and not tend to cut into the key.

8. Check the fit of keys in keyways. Measure the thickness of the key and compare it with the depth of the corresponding keyways of the gear and shaft. File or grind the key until it is slightly thinner than the combined depth of the keyways.

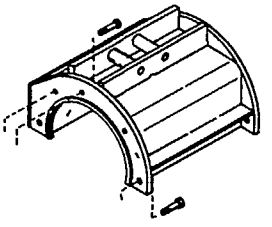
9. When reconnecting the power supply to the hoist, always check the direction of bottom block travel as described in CHECKING DIRECTION OF ROTATION in the ORIGINAL OPERATING CHECK portion of this manual.

HOIST ASSEMBLY. The assembly procedures here will describe the sequence of assembly for a hoist that has been completely disassembled. If repairs were made to only part of the hoist, refer to the portion of these procedures which apply to the area of the hoist that was worked on. Unless otherwise indicated, all references will be to Figure 5-21.

1. Lay the drum hanger down on its back. Subassemble the motor bracket with drum bearing (23) and oil seal (22). Pack the bearing half full of multipurpose grease. Install oil seal (24). Press bearing (25) onto coupling (2). Install bearing and coupling in motor bracket and secure with snap ring (3). If the hoist is a standard headroom model, bolt the motor bracket directly to the drum hanger (Figure 5-15). If the hoist is a low headroom model, bolt the motor bracket to the spacer hanger, and then the two parts to the drum hanger.



LOW HEADROOM DRUM HANGER WITH SPACER HANGER



STANDARD HEADROOM DRUM HANGER

1121

Figure 5-13. Drum Hangers

2. Press drum gear (18) in drum so that the four pre-drilled (but not reamed) holes in the drum gear line up with the original four holes in the drum. Ream the four holes and insert dowels. Plug weld the dowels on the outside of the drum. Grind the welded surface smooth. Apply 1/2 to 3/4 pounds of Shell Darina #2 grease (P&H Spec. No. 476) to the teeth of the drum gear. Slide the drum into the motor bracket being careful not to damage bearing (23) with the drum sleeve. Block the drum so it is level in the hanger.

3. Tap bearing (6) into the center bore of the gear case (4). Pack the bearing half full with multipurpose grease and install oil seals (5 and 7). Tap bearing (17) in the lower bearing seat (blind bore) of the gear case. Install the two oil seals and two bearings in the two side bores of the gear case for the right hand and left hand drum pinion shaft assemblies. Bolt the gear case to the drum hanger.

4. Press bearing (8) onto coupling (9) and install coupling on splined end of drum shaft (20). Insert drum shaft and coupling through center bore of gear case into splined coupling (2).

NOTE

It is helpful to insert the motor pinion shaft (10) into coupling (9) so it can be used as a lever while aligning the drum shaft splines and coupling splines at the opposite end of the drum.

Tap on end of coupling (9) until bearing (8) is seated in gear case bore.

5. Shrink bearing inner race (2, Figure 5-14), shoulder first, on the right and left hand drum pinion shafts until tight against the shoulder of the shaft. Shrink on ring spacer (1) tight against the inner race. Install inner race (3) on the opposite end of shaft. Install the right and left hand drum pinion shaft assemblies in the gear case. Do this carefully so the oil seals in the gear case are not damaged. THE MATCH MARKS ON THE GEAR CASE AND ON THE INTERMEDIATE GEARS MUST BE IN PERFECT ALIGNMENT as shown in Figure 5-15. Note that left and right gears are identified by the letters L and R.

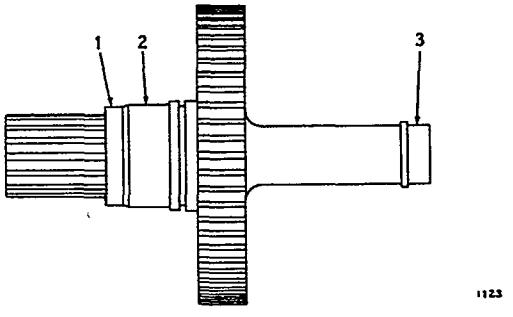


Figure 5-14. Drum Pinion Shaft Assembly, R.H. Shown

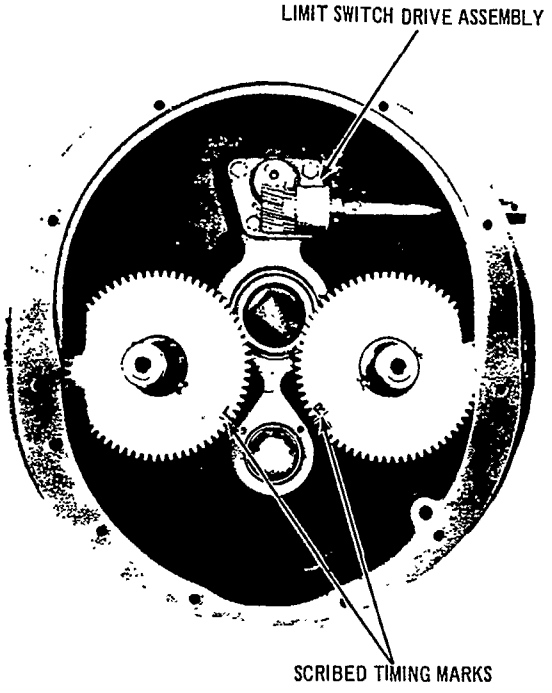


Figure 5-15. Gear Case Assembly Timing Marks

CAUTION

When a drum pinion shaft assembly requires replacement, both the left hand and right hand drum pinion shaft assemblies must be replaced. These will be match marked at the factory. Be extremely careful to install the match marks in perfect alignment. Failure to do so will result in the gearing failing in a very short time.

If a geared limit switch is used, install the drive assembly in the gear case at this time.

6. To reassemble the load brake shaft assembly, proceed as follows (see Figure 5-16):

Press on bearing inner race (11). Install key in keyway. Press on intermediate pinion (1) on the large diameter end of the shaft until it is tight against the shoulder.

Rivet the friction disc linings to the ratchet (2). Carefully press the bushing (5) into the ratchet. File any burrs from the edge of the motor gear (4) hub. Oil the ratchet lining surface. Install the ratchet on the motor gear hub.

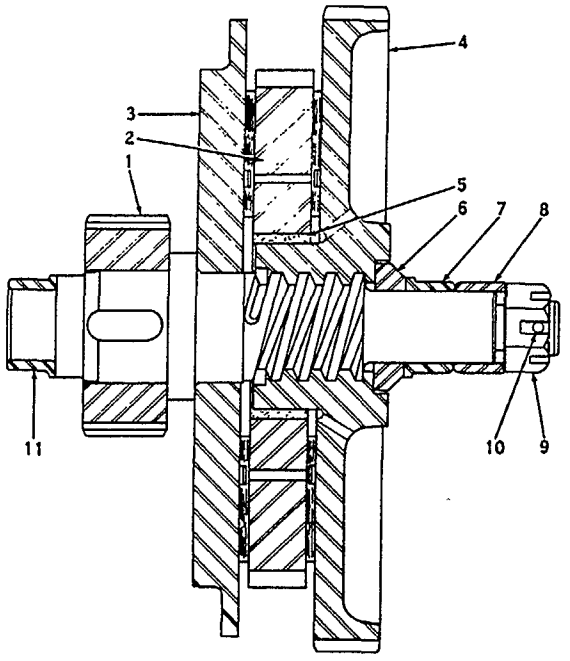


Figure 5-16. Load Brake Shaft Assembly

NOTE

Install the ratchet so that flat of teeth are down on left hand side when viewing the polished side of the motor gear.

Secure the intermediate pinion in a vise with protective jaws. The shaft should be in a vertical position. Lay the gear and ratchet down so the gear is on top. Grasp the two parts together and slide them onto the shaft. Thread the gear and ratchet onto the shaft by turning them in a counterclockwise rotation, as viewed from the gear end of the shaft, until it is tight against the flange. Slip the spacer (6), shoulder first, on the shaft until it is tight against the motor gear. Tap bearing inner race (7), shoulder first, and inner race (8) on the shaft. Tighten nut (9) on the end of the shaft. This will slide the inner races to the proper position on the shaft.

NOTE

If a new load shaft assembly is being installed, loosen the motor gear and remove protective plastic sheets from each side of the ratchet assembly. Oil the ratchet linings by application through the four holes in the motor gear hub. This can be done with a squirt type oil can. The adjusting nut is set at the factory for initial installation and is to be considered a non-adjustable item once assembled in the gear case.

Turn the adjusting nut clockwise until it is tight so the spacer is forced against the motor gear. Back off the nut 1/4 turn and line up the hole on the end of the shaft to the nearest castle nut slot and insert the cotter pin. At this point, do not bend the cotter pin for permanent assembly.

Rotate the motor gear clockwise, viewing from the gear end, until the spacer and inner races are forced back against the adjusting nut. This is what is referred to as "open condition" of the load brake shaft assembly. It is in this "open condition" that the assembly must be installed in the gear case. Care should be taken not to turn the gear to a closed condition which would make the axial float check inaccurate. This axial float check is described in subsequent pages.

Install the mechanical load brake shaft assembly (or the intermediate shaft assembly) into the lower bearing seat of the gear case. Care should be taken not to damage the bearing when installing the shaft.

7. When a hoist is not equipped with a mechanical load brake, an intermediate shaft assembly is used, and should be assembled as follows (see Figure 5-17):

Install the keys in keyways of the intermediate shaft (1) and press on the intermediate pinion (2) until it is tight against the shoulder. Press on motor gear (3) until it is tight against the other side of the shoulder. Tap on bearing inner races (4) on each end of shaft. Install the shaft assembly into the lower bearing seat of the gear case.

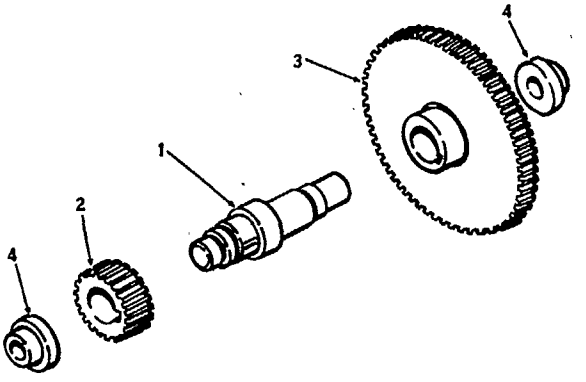


Figure 5-17. Intermediate Shaft Assembly

8. Slide the load brake spring cap assembly into the pawl. Compress the spring cap and insert the pawl between the load brake flange and gear. Engage the pawl between the ears which are part of the gear case and install the pin to secure the pawl to the

gear case. By hand, rotate the gear counterclockwise and adjust the set screw until the pawl clears the ratchet teeth by 1/16 to 1/8 inch. See Figure 5-6 for this adjustment.

9. Press bearing (11) on motor pinion shaft (10) and install shaft in the splined coupling in the center bore of the gear case; Figure 5-21.

10. Before installing the gear case cover, perform the following operations (see Figure 5-18):

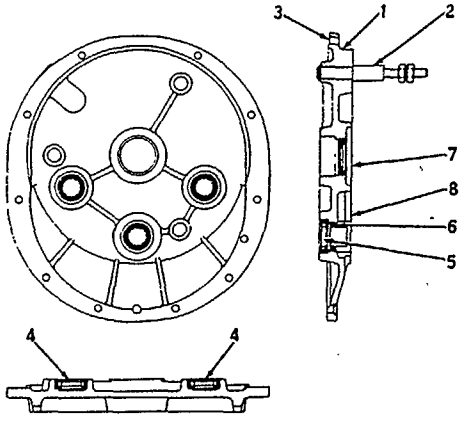


Figure 5-18. Gear Case Cover Assembly

Press three brake pins (2) into brake side of gear case cover and secure with snap rings (3). Tap in two bearings (4) for right and left hand drum pinion shaft assemblies. Tap in bearing (5) for load brake shaft (or intermediate shaft) assembly. Install oil seal (7) for motor pinion shaft.

NOTE

Do not install O-ring (6) or bearing cap (8) at this time. On some previous hoists an oil seal was used in this bore instead of the present bearing cap and O-ring. If a complete new load brake shaft assembly is purchased, a bearing cap and O-ring is included with it. In some cases where the hoist already has a bearing cap, the cap may not have sufficient clearance for the length of the load brake shaft. In this case, redrill the existing bearing cap deeper to obtain adequate clearance for the longer shaft. An additional 1/4 inch is usually adequate.

11. Cement a new gasket (Figure 5-21, 16) to the gear case.

12. Install the gear case cover assembly to the gear case. Be careful not to damage the oil seals during this operation. Bolt the gear case cover to the gear case using only four or five bolts at this time.

13. Then check axial float. A pair of locking pliers will be required. Grasp across any two flats of the load brake nut with the pliers and, by pushing and pulling, you should obtain a float of at least 1/32 of an inch minimum to 3/32 of an inch maximum. This is required for the successful operation of the load brake assembly. If the axial float is less than 1/32 of an inch, the load brake assembly must be removed and the amount required to obtain 1/32 of an inch minimum will have to be cut off the spacer, which is located between the motor gear and the bearing inner race, which contacts the adjusting nut. The procedure, as outlined previously, must once again be repeated.

If the axial float is found to be more than 3/32 of an inch, either:

A. Remove the gear case cover and place a shim behind the bearing of the load brake shaft against the cover bore. The thickness of the shim should be such to limit the float to less than 3/32 of an inch.

or:

B. Remove the load brake assembly and add a shim washer behind the spacer which is located between the motor gear and the bearing inner race.

If you find that the amount of axial float is within the stated tolerance, bend the cotter pin to its permanent position. Install O-ring (6) and bearing cap (8); as shown in Figure 5-18.

14. To reassemble the magnetic brake (Figure 5-19), slide the disc hub (3) on the spline of the motor pinion shaft and secure in place with the snap ring.

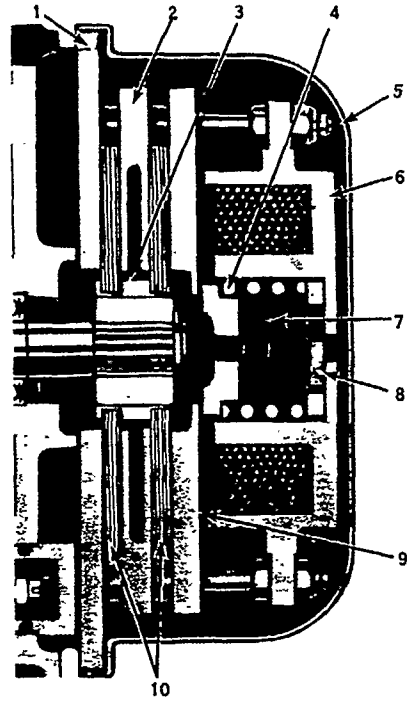


Figure 5-19. Magnetic Brake Assembly

Install back plate (1) onto the pins in the gear case cover with the wiring hole at upper right. Position one disc type brake lining (10) on the disc hub. Install the disc plate (2) on the pins. Position the second disc type brake lining on the disc hub. Slide armature (9), counterbored side first on the pins. Install spring spacer (8) into the center hole of the pot assembly (6). Insert a 1/2-13 UNC bolt through the center of the pot. Place spring (7) and spring guide (4) in pot assembly. Lay the pot, face down, on a work bench. Compress the spring by turning the spring guide on the bolt.

NOTE

Use only the factory recommended spring and spacer. Excessive spring tension can cause sluggish release of the brake and increase the heating of the motor which may result in a motor failure.

Thread the three lock nuts to the pins. Slide the brake pot on the pins. Thread the lockwashers and adjusting nuts to the pins. Remove the bolt used to hold spring assembly in place during assembly.

Attach the conduit to the gear case cover and reconnect the brake pot leads to the wires from the control cabinet. Using the adjusting nuts and lock nuts, position the brake pot on the pins so there is a clearance of 1/32 inch between the armature and the brake pot, as shown in Figure 5-5. Install gasket and brake cover.

15. Install the drain plug to the gear case. Add oil to the gear case up to the oil level plug opening. Be sure the hoist is in a level position before doing this. Install the oil level plug and the breather.

16. Install the motor on the motor bracket. The splined motor shaft will mesh with the splined coupling in the motor bracket. Reconnect the conduit to the motor terminal box. Reconnect the motor leads. Replace the terminal box cover.

17. Reeve the wire rope and bottom block to the hoist. Return the hoist to its mounting. Turn the power on. Put the hoist through the ORIGINAL OPERATING CHECK as described in the INSTALLATION section of this manual, paying particular attention to direction of rotation, of load brake and limit switch operation.

BOTTOM BLOCKS

The procedure for disassembling bottom blocks is given in the WIRE ROPE REPLACEMENT portion of this section.

NOTE

Whenever a bottom block is disassembled for service or wire rope replacement, pack the sheave bearings and the thrust (hook) bearing with a high quality No. 2 grade multi-purpose grease.

WIRE ROPE REPLACEMENT

NOTE

Any time a wire rope is replaced on a hoist equipped with a geared limit switch, the switch must be readjusted. The adjustment procedure is outlined earlier in this section.

GENERAL. Eventually, all wire ropes will deteriorate to a point where they are no longer serviceable. There are three basic causes of wire rope deterioration. They are:

1. Abrasion or wear.

2. Corrosion.

3. Fatigue, caused by pulling, bending, crushing or kinking forces applied to the rope during normal service.

It is important to make at least a weekly inspection of wire rope to determine the degree of deterioration. Any of the following conditions should cause the inspector to question the remaining strength of the rope and consider replacement:

1. Serious corrosion.

2. Breaks occurring in the valley between adjacent strands.

3. Core showing through more than one pair of strands.

4. Kinking damage is severe.

5. Evidence of improper lubrication, combined with other effects.

6. Serious reduction of rope diameter.

7. Evidence of "bird caging", which is a spreading apart of the strands caused by a reverse twist applied to the wire rope.

8. Numerous broken wires or as many as three adjacent broken wires in one rope lay. By definition, a rope lay is the axial distance along the rope in which one strand makes one complete turn around the rope.

When unreeling wire rope, it is imperative that the coil or reel rotate as the rope unwinds. If the coil or reel does not rotate, the wire will be twisted as it is uncoiled, and kinking will result. A kinked rope is severely damaged, and unsafe for maximum service. Figure 5-22 shows the correct methods for unreeling ropes from coils or reels. Another acceptable method of reeling rope off a reel is to place a shaft through the center of the reel and support the shaft so the reel can revolve as the rope is pulled off. If

NOTE

Figure 5-21 is arranged so that the reader may view it in its entirety while reading assembly and disassembly instructions.

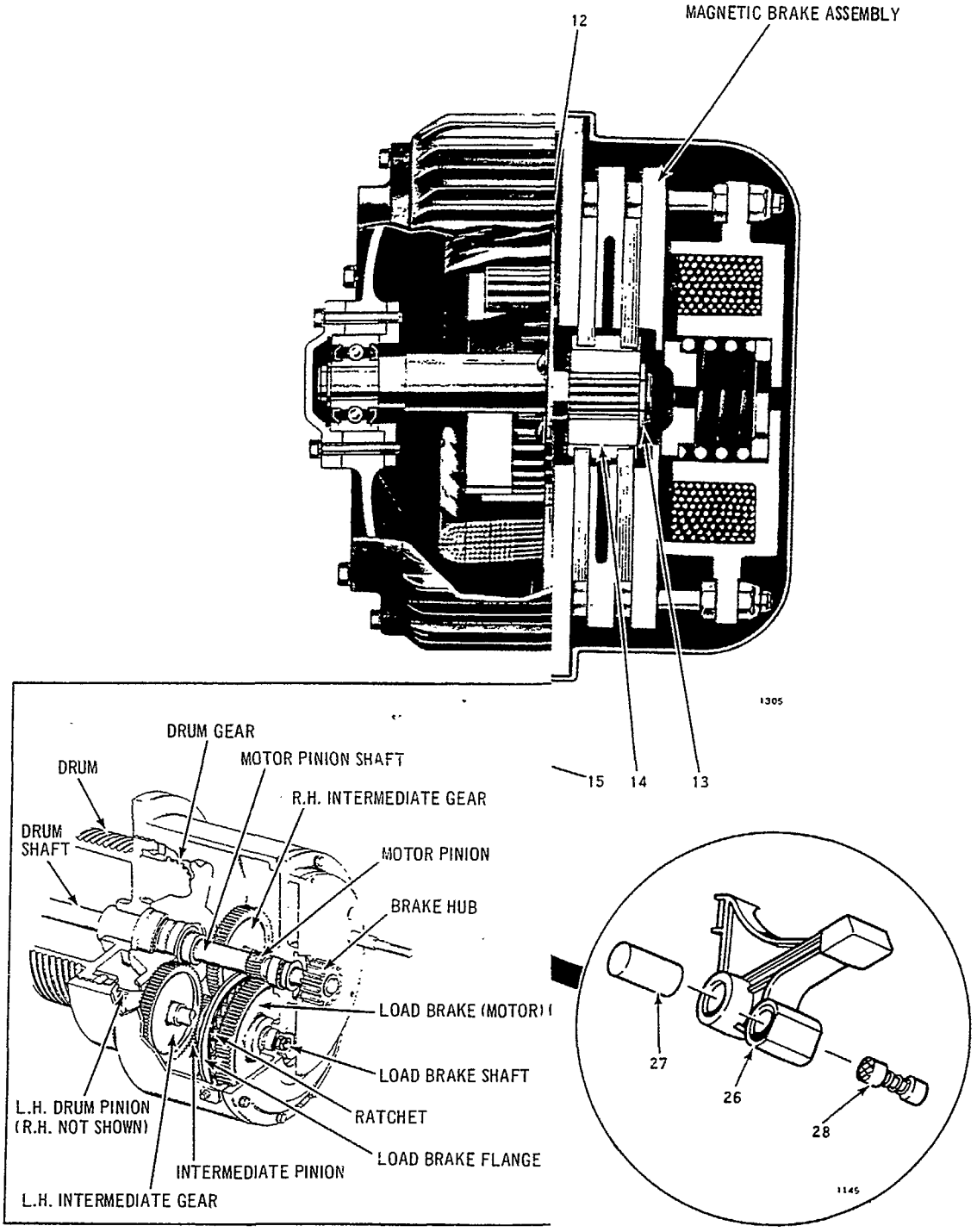
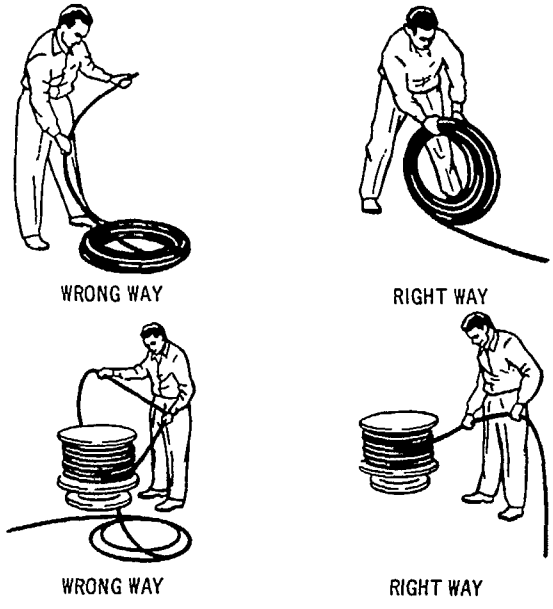


Figure 5-20



WHEN UNREELING OR UNCOILING WIRE ROPE - DO NOT ALLOW ROPE TO FORM A LOOP. IF LOOPS ARE FORMED, KINKING WILL RESULT.

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Figure 5-22. Unreeling Wire Rope

this method is used, the reel should not be allowed to revolve so rapidly that it "throws" rope off. Reel rope off slowly.

Kinking is caused by the rope taking a spiral shape as the result of unnatural twist in the rope. One of the most common causes for this twist is improper unreeling and uncoiling as illustrated. Figure 5-23 shows the progressive stages of a kink, and the end result.

Part 1 of the illustration shows the beginning of a kink. At this stage, no harm will be done if the loop is immediately thrown out to prevent further kinking.

Part 2 of the illustration shows the effect of the application of a load to a kinked line. The rope has been seriously strained and is no longer safe for maximum service.

Part 3 shows the condition of the rope in part 2 after the kink has been straightened out. Strands and wires are out of position. This creates unequal tension and strain and will cause excessive additional wear on the damaged areas.

Figure 5-24 illustrates the basic reeving diagrams for Balanced Design Hevi-Lift Hoists. The reeving procedures for 1 rope, 1 part single (A) and 2 ropes, 1 part double (D) require no special instructions. The following instructions outline the reeving procedures for the other types.

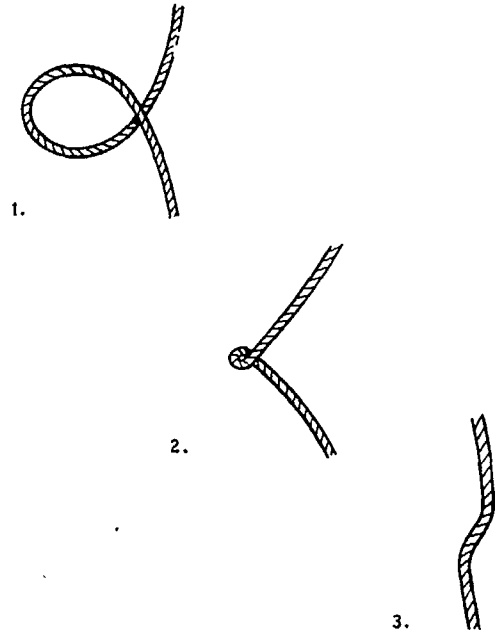

Figure 5-23. Kinking of Wire Rope

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NOTE

These instructions apply only to replacing a wire rope with a wire rope assembly as furnished by Harnischfeger Corporation. These assemblies are furnished complete with swaged wire rope sockets. The use of speltered wire rope sockets is not recommended.

TWO PART SINGLE REEVING. Proceed as follows to replace a two part single reeved wire rope (see Figure 5-24B and Figure 5-25):

1. Lower the bottom block to the floor or onto a bench to relieve tension on the wire rope.

2. Remove the sheave guard by removing the three slotted round head machine screws from one side of the side plate assembly.

3. Remove the snap ring from one end of the sheave pin and slide the sheave pin out from the other end.

4. Lift the sheave from the top of the side plate assembly and remove the wire rope.

5. If used, remove the limit switch counterweight from the wire rope.

6. Remove the dead end pin from the drum hanger to free the wire rope dead end socket.

7. Operate the hoist to completely unwind the wire rope from the drum and remove the wire rope live end socket from the slot in the drum.

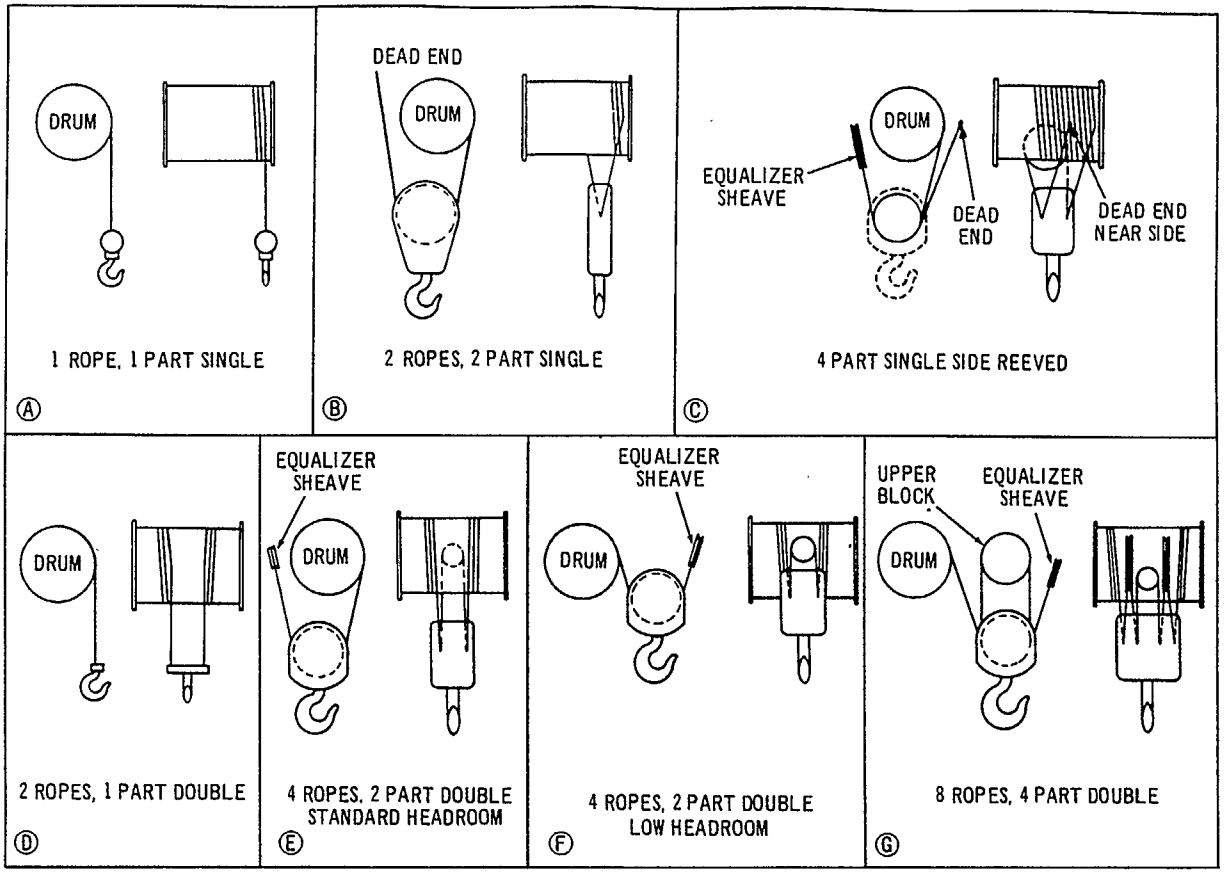


Figure 5-24. Basic Reeving Diagrams

8. Lay the new wire rope out in one continuous length and thread the sheave guard from one end.

9. Loop the wire rope on the sheave and while holding it firmly, slide the sheave into the side plate assembly and install the sheave pin and then the snap ring.

10. Lower the sheave guard on the bottom block and insert the three machine screws.

11. Insert the wire rope live end socket in the slot of the drum and operate the hoist to wind the wire rope on the drum until approximately six feet of it remains unwound.

WARNING

Wear a glove to guide the wire rope on the drum.

12. Insert the wire rope dead end socket in the drum hanger and replace the dead end pin.

13. Reattach the limit switch counterweight.

TWO PART DOUBLE REEVING. Proceed as follows to replace a two part double reeved wire rope (see Figure 5-24, E and F, and Figure 5-26):

1. Lower the bottom block to the floor or onto a work bench to relieve tension on the wire rope.

2. Remove screws (1) and lift off upper sheave guard. Remove screws (2 and 3) and remove lower sheave guards.

3. Remove the wire rope from the sheaves.

4. Operate the hoist to completely unwind the wire rope from the drum and remove the wire rope live end sockets from the slots in the drum.

5. Remove the wire rope from the upper sheave guard.

6. Remove the equalizer sheave pin from the drum hanger to remove the sheave and the wire rope.

7. Lay out the new wire rope with a loop in the center and the two live end sockets together.

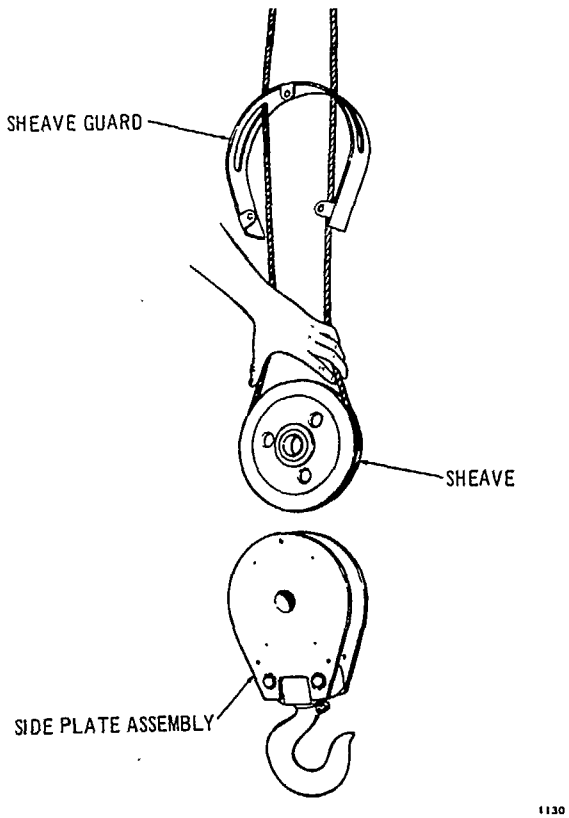


Figure 5-25. Installing Wire Rope in Single Reeved Bottom Block

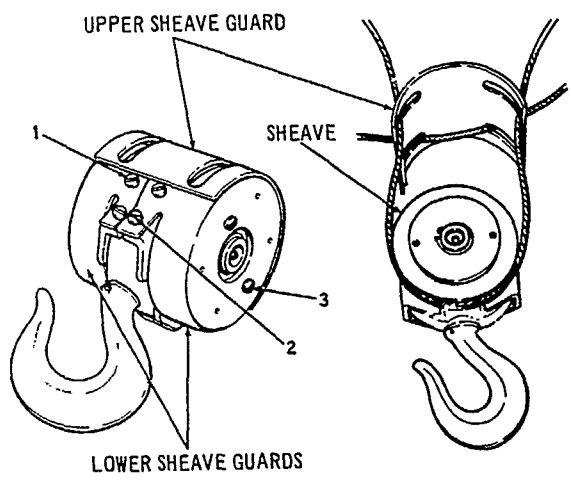


Figure 5-26. Installing Wire Rope in Double Reeved Bottom Block

8. Thread the socket ends of the wire rope through the slots in the upper sheave guard.

9. Loop one part of the wire rope over one of the bottom block sheaves and replace the lower sheave guard for that side. Turn the bottom block over and loop the other part of the wire rope on the second bottom block sheave. Attach the other lower sheave guard and the upper sheave guard to the bottom block.

10. Insert the wire rope live end sockets in the slots in the drum.

11. Operate the hoist to wind the wire rope on the drum until approximately six feet of rope remains unwound.

WARNING

Wear gloves to guide the wire rope on the drum.

12. Place the loop in the center of the wire rope on the equalizer sheave and replace the equalizer sheave in the drum hanger.

FOUR PART SINGLE SIDE REEVING. Replacing a four part single side reeved wire rope (Figure 5-24, C) is the same as replacing a two part double reeved wire rope except that only one end of the wire rope is inserted into the drum and the other end of the wire rope is the dead end which is attached to the hanger. The limit switch counterweight rides on the dead end of the wire rope.

FOUR PART DOUBLE REEVING. Proceed as follows to replace a four part double reeved wire rope (see Figure 5-24, G, Figures 5-27 and 5-28):

1. Lower the bottom block to the floor or onto a bench to relieve tension from the wire rope.

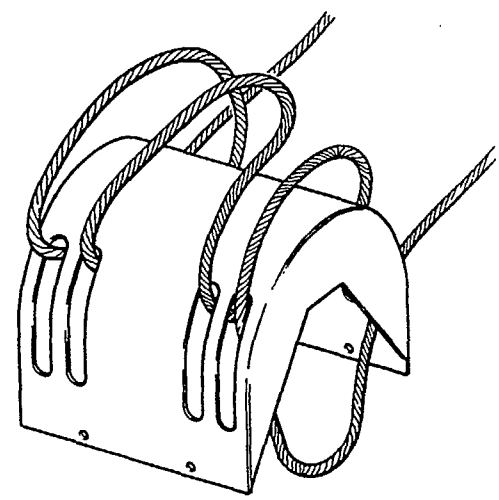


Figure 5-27. Wire Rope Threaded through Sheave Guard of Bottom Block for Four Part Double Reeving

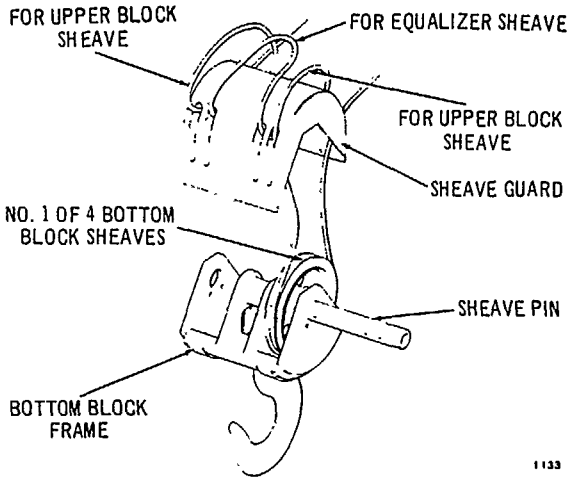


Figure 5-28. Installing First Part of Wire Rope in Four Part Double Reeved Bottom Block

2. Remove the round head screws and lift off the upper sheave guard.

3. Remove the keeper plates and slide out the sheave pin.

4. Lift out the sheaves and remove the wire rope.

5. Operate the hoist to completely unwind the wire rope from the drum and remove the wire rope live end sockets from the slots in the drum.

6. Remove the keeper plates and slide out the sheave pin from the upper block (Figure 5-29). As you slide the pin out, remove the sheaves and spacer one at a time because the sheave pin is the only means of holding them in place. Remove the wire rope from the sheaves.

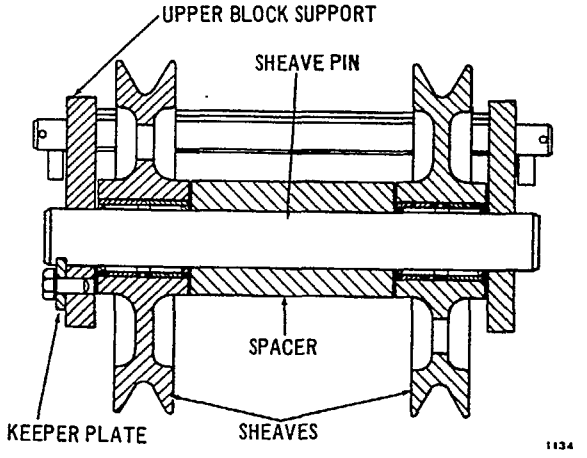


Figure 5-29. Upper Block for Hevi-Lift Hoist with Four Part Double Reeving

7. Remove the equalizer sheave pin from the drum hanger to remove the sheave and the wire rope.

8. Remove the wire rope from the sheave guard.

9. Lay out the new wire rope with a loop in the center and both live end sockets together.

10. Thread the live end sockets through the inner slots of the sheave guard (see Figure 5-27). Then thread the live end sockets through the outer slots of the sheave guard, threading in the same direction as used to thread the inner slots. This will leave four loops of wire on the underside of the sheave guard (one loop for each bottom block sheave) and three loops on the upper side (one loop for each sheave in the upper block and one for the equalizer sheave).

NOTE

Before reassembly, each sheave bearing should be packed with a high quality No. 2 multi-purpose grease.

11. Starting from either end of the bottom block, loop one part of the wire rope from the underside of the sheave guard around a bottom block sheave. Hold the wire rope on the sheave and replace it in the bottom block. Insert the sheave pin through that sheave to hold it in place (Figure 5-28).

12. Repeat this procedure of looping the wire rope around the sheave and insert the sheave in the bottom block until all four sheaves are in place in the bottom block and secured with the sheave pin.

13. Install the keeper plates to secure the sheave pin in the bottom block. Attach the sheave guard to the bottom block.

14. Insert the wire rope live end sockets in the slots of the drum.

15. Operate the hoist to wind the wire rope on the drum until approximately twelve feet remains unwound.

WARNING

Wear gloves to guide wire rope on the drum.

16. Starting from the side of the upper block from which the sheave pin is inserted, loop the wire rope around that sheave. Hold the wire rope in place on the sheave while replacing the sheave in the upper block frame. Slide the sheave pin through that sheave and the spacer. Loop the wire rope around the second sheave, install it into the upper block frame and secure the pin with the keeper plate.

17. Loop the remaining part of the wire rope around the equalizer sheave and install it in place in the drum hanger.

NOTE

For special applications, a reeving diagram can be obtained by contacting the Harnischfeger Corporation Sales or Service Office in your area.

TROLLEY MAINTENANCE. Except for the lubrication of trolleys described in the first pages of this section, all trolley maintenance is covered by a separate manual. Please contact the Harnischfeger Corporation regional service office in your area to obtain this manual.

CONTROL MAINTENANCE

GENERAL. Remove the control cabinet cover for access to the control components.

WARNING

Before removing or checking any of the components, be sure the power supply is shut off and the fuses pulled or the circuit breaker is placed in off position.

Tag all wire leads before disconnecting them to facilitate proper connections when reconnecting them. Also refer to the wiring diagram secured to the inside of the control cabinet cover.

Use an ohmmeter to test the selenium rectifier. There should be a low resistance in one direction and infinite resistance in the other direction.

When electrical components have been replaced and when any wires have been disconnected and reconnected, check with an ohmmeter between terminals L1, L2, and L3 before connecting the power supply to make sure that no direct short circuits exist.

NOTE

A low resistance will be indicated between the L1 and L2 terminals. This is normal since the L1 and L2 leads are connected to the primary terminals of the control transformer and transformer resistance will be indicated by the ohmmeter (see Figure 5-30).

PUSH BUTTON STATION. The three types of push button elements, single speed, two speed and variable speed are replaceable only as a complete unit. All other components in the push button station can be individually replaced.

CONTACTORS. The stationary and movable contacts should be visually inspected at least once every one to three months. These can easily be inspected by

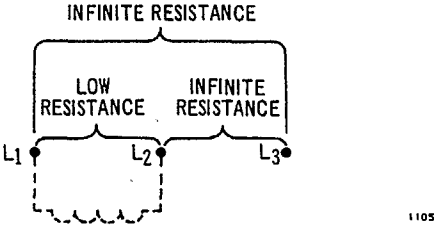


Figure 5-30. Control Circuit Check

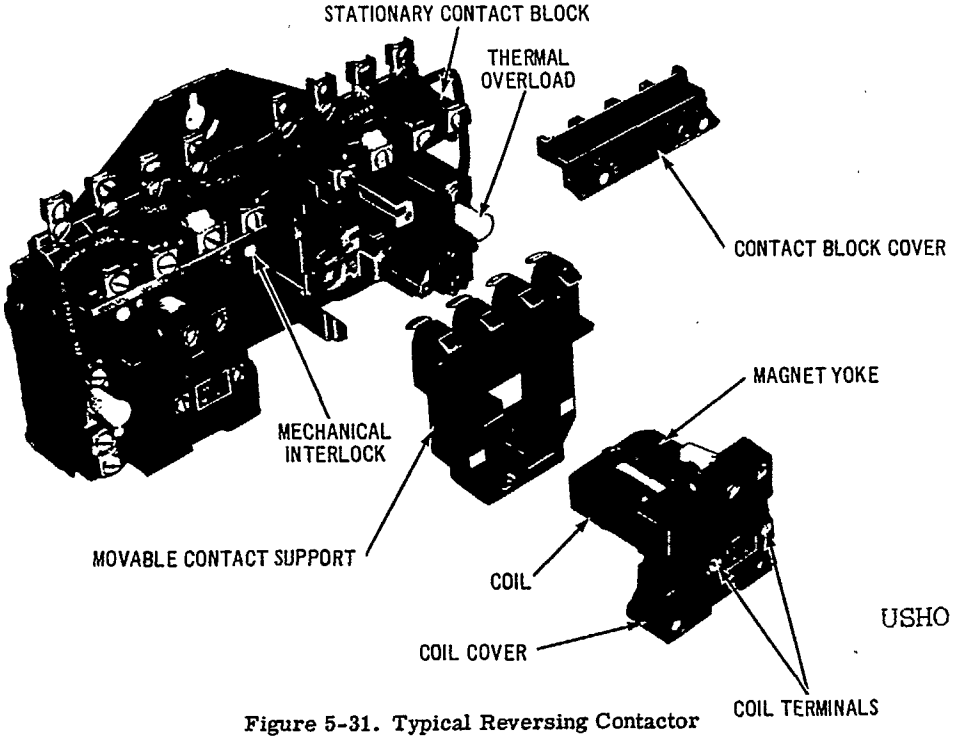


Figure 5-31. Typical Reversing Contactor

removing the contact block cover. Replacement is not necessary if the contacts appear to be dirty. The contacts should be replaced if a general pitted condition exists. To replace the stationary contacts, remove the stationary contact block. Each contact is then individually screwed in place. To replace the movable contacts, remove the four screws holding the coil cover in place and slide out the coil cover. Then slide out the movable contact support. The contacts are held in place by spring tension only.

If the contactor should fail to function, check the voltage across the coil terminals. To replace the coil, remove the coil cover and slide the coil out from the back of the coil cover. Be sure to insert the magnet yoke into the coil before installing it into the coil cover.

To remove the magnet armature (Figure 5-32, 1) from the movable contact support (4), insert a screw driver into the slot of the retainer (2), lift the screw driver and at the same time, push the magnet armature out. The retainer spring (3) will then slide out.

DISC BRAKE RECTIFIER. To check the disc type brake rectifier assembly (Figure 5-33), measure and compare voltage and current with Table 5-3. If rectifier voltage is low, measure and compare the transformer primary and secondary with name plate data. If these agree with the name plate data, it is the rectifier that requires replacement.

CONDUCTOR AND COLLECTOR SYSTEMS

Conductor systems should be maintained straight and true, keeping contact surfaces clean and polished. If copper wire is used, the wire should be free of kinks.

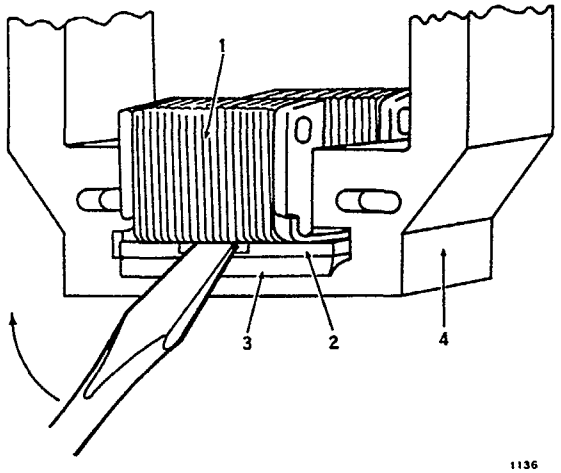
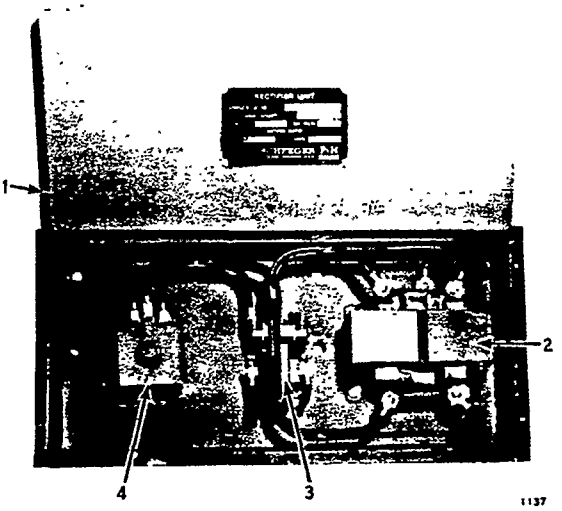


Figure 5-32. Removal of Magnet Yoke



1. Case
2. Transformer
3. Relay
4. Rectifier

Figure 5-33. Rectifier Assembly for Disc Type Brakes

Table 5-3. Disc Brake Rectifier Data

BRAKE SIZE	BRAKE POT ASSEMBLY LIST NO.	BRAKE COIL LIST NO.	BRAKE COIL RES. OHMS	BRAKE COIL & RECT. VOLTS	ACTUAL BRAKE COIL AMPS.	RECTIFIER RATING AMPS.
*CD-0	981F75-1	975F265-1	18.2Ω	18	.99	.74
*CD-1	981E49-1	975F263-1	11.67Ω	18	1.54	1.5
CD-2	981E43-2	975E341-2	9.14Ω	18	1.97	2.4
CD-2D	981E44-2	975E347-2	9.38Ω	18	1.92	2.4
CD-3	981E46-2	975E340-2	7.26Ω	18	2.4	2.4
CD-3D	981E45-2	975E346-2	7.89Ω	18	2.28	2.4
CD-4	981E48-2	975E339-2	5.35Ω	18	3.36	4.0
CD-4D	981E47-2	975E343-2	5.29Ω	18	3.4	4.0
CD-5	981A6-2	975E348-2	5.37Ω	18	3.35	4.0
CD-5D	981A5-2	975E349-2	4.62Ω	18	3.9	4.0
CD-6	981A7-2	975E351-2	4.87Ω	18	3.7	4.0
CD-6D	981A8-2	975E352-2	4.8Ω	18	3.75	4.0

*Intermittent Hoist Service

If a hoist is used intermittently eight hours each day, five days per week, make the following inspections, monthly, as a program of preventive maintenance:

CAUTION

Be sure the power supply is disconnected before attempting inspection.

INSPECTION

1. Keep contact surfaces of conductors clean and polished.

2. Conductor supports should be securely fastened.

3. Insulators must be clean. Wipe them with a clean dry cloth or use an electrical cleaning solvent if necessary. Replace any damaged insulators to prevent the possibility of the conductor shorting to ground.

4. Check for continuous contact of collector to conductor for the full length of the conductor. Adjust collector spring tension as required.

5. Check all terminal and shunt connections for good contact.

6. Check all collector shoes and wheels for excessive wear and for freedom of rotation. Replace shoes, wheels or bearings as required. Lubricate wheel bearings as required.

MOTOR MAINTENANCE

GENERAL. All P&H hoist motors are built specifically for rugged hoist service. They are designed for rapid acceleration and frequent reversals. The motors are totally enclosed, with Class B insulation, rated 30 minutes 75 degrees C. rise. Squirrel cage and wound rotor motors for 220 and 440 volt operation are externally reconnectable. Two speed motors and those of other voltages are not reconnectable.

WARNING

Disconnect the hoist from its power supply before performing any work on the motor.

A.C. MOTORS

RECONNECTION INSTRUCTIONS (DUAL VOLTAGE MOTORS). Dual voltage motors have a connection plate attached to the side of the motor. Should it be necessary to reconnect the motor from low voltage to high voltage (or from high voltage to low voltage), disconnect the power supply leads to the motor, and reconnect the stator terminal leads to the lines in accordance with the connecting plate diagram.

CAUTION

If voltage is changed, be sure transformers and other electrical equipment is suitable for the voltage change.

NOTE

All P&H A. C. hoist motors are connected according to NEMA connection standards. Figure 5-34 illustrates a standard star connection, NEMA standard.

If the direction of rotation is incorrect with respect to the push button markings, reverse any two of the three line leads to the stator at the motor or reversing switch.

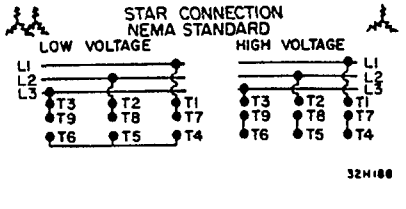
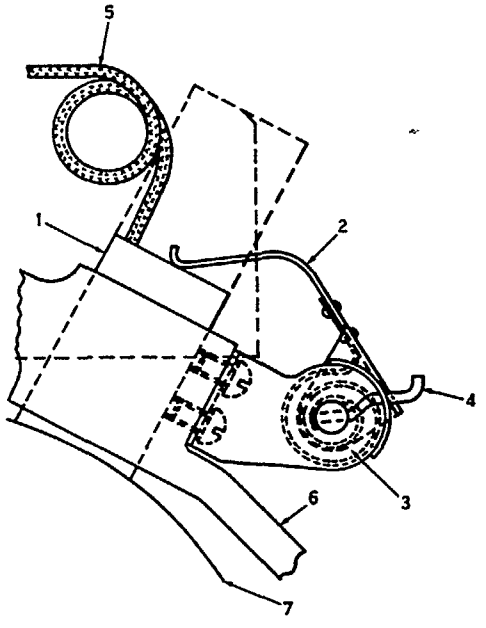


Figure 5-34. Star Connection, NEMA Standard

SLIP RINGS. Clean slip rings when necessary with an electrical cleaning solvent or No. 00 sandpaper. Never use emery cloth. The slip rings should be maintained smooth, clean and concentric. Do not use lubricants of any kind on slip rings.

If slip rings are rough or pitted, turn down with a light cut. Polish with a fine stone or No. 00 or 000 sandpaper.

BRUSH HOLDER. The brush pressure is obtained from a coil spring in the brush holder box and can be adjusted by positioning the adjusting pin in the proper notch.



1. Brush
2. Pressure bar
3. Coil spring
4. Adjusting pin
5. Connector
6. Brush holder box
7. Slip ring

Figure 5-35. A.C. Brush Holder Assembly

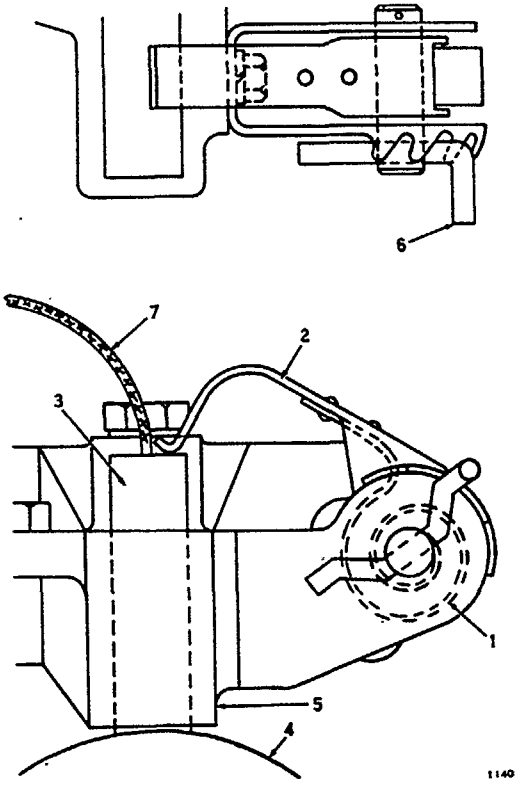
BRUSH ADJUSTMENT. When any maintenance work is performed to the motor, such as bearing replacement, brush replacement, or turning down of the slip rings, the brush pressure should be checked as follows:

1. Check all brushes to see that they make good contact with the slip rings and move freely in the brush holder box.

2. Maintain brush pressure between 3-1/2 and 4-1/2 pounds per square inch of contact area. Brush pressure may be maintained by adjusting the pin (4, Figure 5-35) in the provided notches.

D.C. MOTORS

BRUSHES AND BRUSH HOLDERS (Figure 5-36). Brush pressure should be maintained between 4 and 6 pounds per square inch of contact area. Brush pressure is maintained by positioning the adjusting pin (6). When replacing or renewing brushes, they



1. Tension spring
2. Pressure bar
3. Brush
4. Commutator
5. Brush holder box
6. Adjusting pin
7. Connector or brush shunt

Figure 5-36. Brush Holder Assembly for D.C. Motors

should be carefully fitted to the contour of the commutator with No. 00 sandpaper.

After seating the brushes, remove them from the holders, clean the brush sides and the holders to insure free movement of brushes in the holders.

Clean brushes and motor by blowing with an air stream, vacuum cleaning or brushing off the dust with a clean cloth.

The brush holder box sides should be parallel and equally spaced around the commutator circumference.

The flexible copper shunt (7) should be securely fastened to the brush holder.

INTERNAL CONNECTIONS. Figures 5-37 through 5-39 illustrate the wiring diagrams for the D.C. motors most commonly used on P&H Balanced Design Hevi-Lift hoists.

STORAGE

If the hoist is to be stored for more than six months, it should be protected as follows:

1. Drain the hoist gear case (and the trolley gear case if a motor geared trolley is used) and fill with fresh gear oil to the oil level plug opening. Replace the gear case breather with a pipe plug.

2. Every six months, remove the hoist from storage and operate it on a test bench for a few minutes. Replace the gear case breather for the test bench operation.

3. Every six months, remove the magnetic brake armature and disc plate and inspect them for rust.

4. Replace the gear case breather when the hoist is removed from storage.

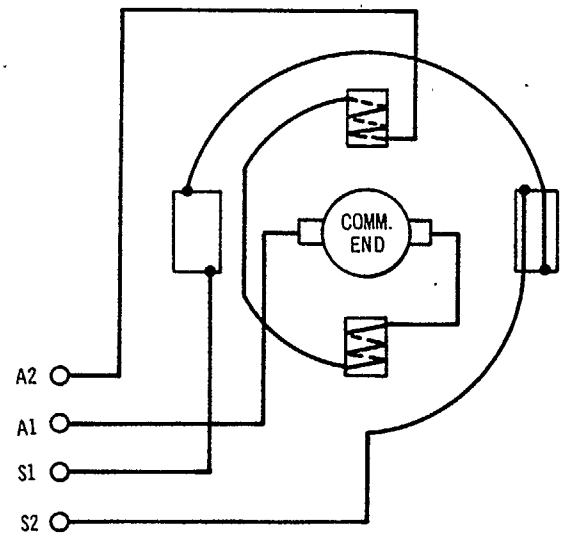


DIAGRAM SHOWING TERMINAL LEADS ON L. H. SIDE VIEWED FROM COMM. END.

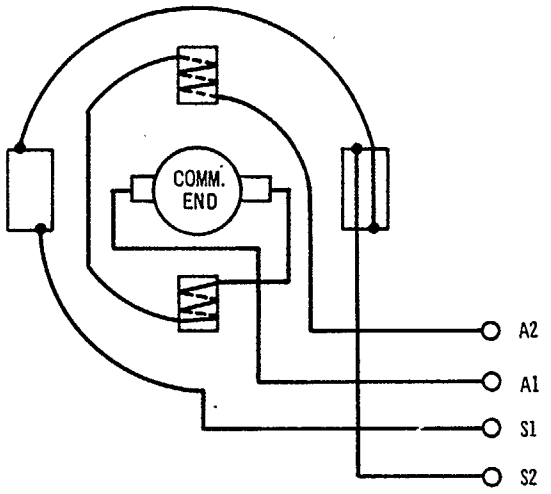


DIAGRAM SHOWING TERMINAL LEADS ON R.H. SIDE VIEWED FROM COMM. END.

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Figure 5-37. Wiring Diagram for 2 Pole Type DS Reversible Series D.C. Motor with Interpoles

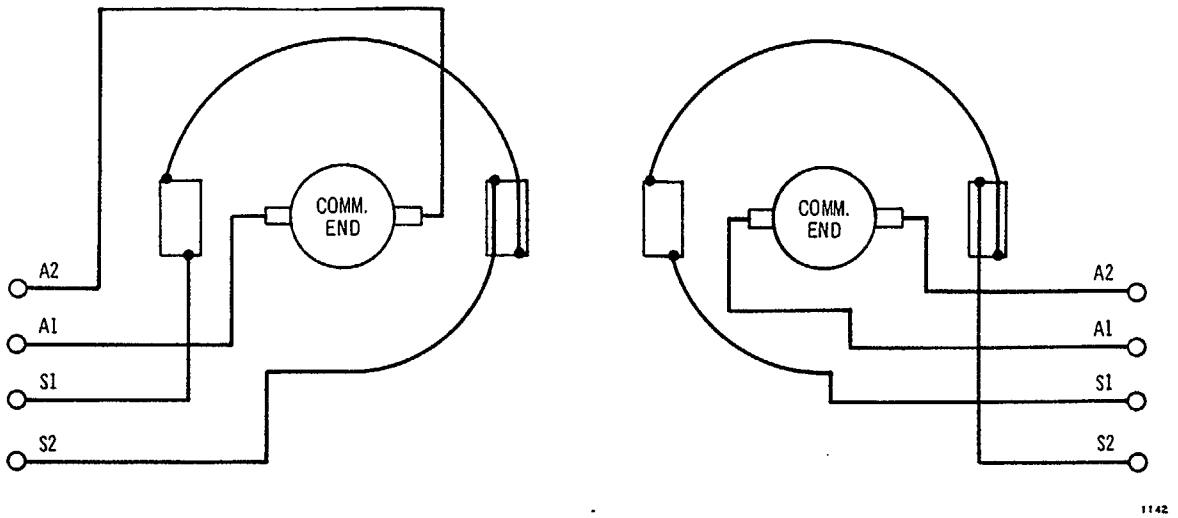


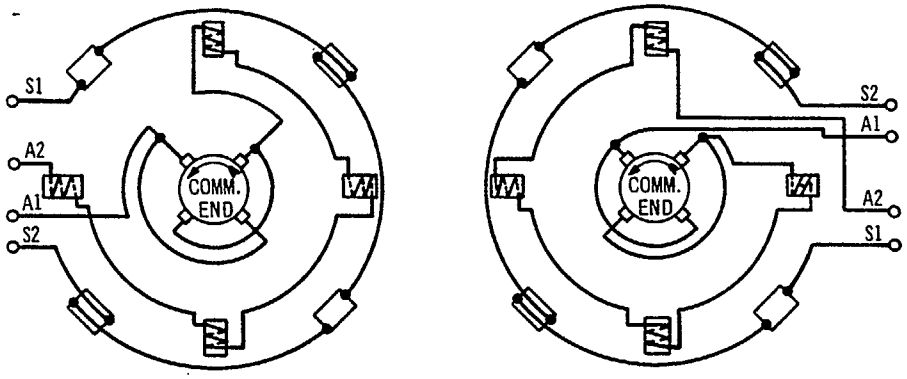
DIAGRAM SHOWING TERMINAL LEADS ON L.H. SIDE VIEWED FROM COMM. END.

DIAGRAM SHOWING TERMINAL LEADS ON R.H. SIDE VIEWED FROM COMM. END.

Figure 5-38. Wiring Diagram for 2 Pole Type DS Reversible Series D.C. Motor without Interpoles

LEADS ON L. H. SIDE AS VIEWED FROM COMMUTATOR END

LEADS ON R.H. SIDE AS VIEWED FROM COMMUTATOR END



TO REVERSE DIRECTION OF ROTATION INTERCHANGE CONNECTIONS TO A1 & A2

Figure 5-39. Wiring Diagram for 4 Pole Type DS Reversible Series D.C. Motor with Interpoles

SECTION VI
TROUBLE SHOOTING

TROUBLE	PROBABLE CAUSE	POSSIBLE REMEDY
Bottom block doesn't raise or lower.	No power.	Check switches, breakers, fuses, and power line connections for open circuit, grounded or faulty connections.
	Contactor not operating.	Check connections in control circuit. Check contactor coils and push button control cable for open or short circuit. Reset overload relay if used.
	Limit switch open circuit.	Check limit switch contacts.
	Magnetic brake not releasing.	Check adjustment. Check for loose connections. Check auxiliary contacts, rectifier, brake circuit transformer, and brake coil.
	Excessive load.	Check weight of load and rated capacity.
Bottom block moves in wrong direction.	Three phase power supply has phase reversal.	Interchange any two of the three power lead connections either at the reversing contactor, motor or at the power source.
	Hoist cable wound on wrong side of drum.	Rewind and check hoist cable for damage. Check operation of lower limit switch.
Bottom block doesn't stop at extremes of travel.	Limit switch(es) are not opening circuit.	Check operation and setting of limit switch(es).

TROUBLE	PROBABLE CAUSE	POSSIBLE REMEDY
Bottom block fails to stop quickly.	Magnetic brake slips.	Disc type brake linings excessively worn or dirty. Check condition of surface on each side. Clean or replace as necessary. Check brake adjustment.
Magnetic brake does not release.	Solenoid coil is open or shorted. Open brake circuit. Defective rectifier or transformer.	Check connections. Check solenoid coil for open or short circuit. Check rectifier and transformer.
Motor overheats.	Excessive load.	Check weight of load. Do not exceed hoist capacity.
	Incorrect voltage or frequency.	Check data stamped on nameplate for correct power supply. Voltage should be within ± 10% of nameplate rating.
	Three phase power supply phase failure or unbalanced current.	Check motor windings for open or short circuits. Check supply lines for balanced voltages.
	Brake does not release completely.	Check brake adjustment. Check brake control circuit and brake coil.
Load brake inoperative.	Load brake slipping due to excessively worn or dirty friction disc assembly.	Clean or replace friction disc assembly.
	Load brake is not engaging due to worn or damaged ratchet parts.	Replace worn or damaged ratchet assembly, pawl, pawl spring cap assembly or pawl pin.
Load lowers when hoist not being operated.	Both the magnetic brake and the load brake are inoperative.	Refer to magnetic brake and load brake troubles.
Load accelerates during lowering.	Load brake slipping.	Replace worn lining.
	Load brake not engaging.	Check installation of ratchet for proper direction for engagement with pawl. Check for damaged pawl or spring cap assembly. Replace bushing in ratchet if worn.
Hoist operates intermittently.	Collectors make poor contact.	Check collectors for free movement of spring loaded arm, weak spring, connections, and free movement of shoe or roller.
	Normally closed contacts of upper limit switch are arcing.	Replace normally closed contacts.
Excessive hoist cable wear.	Lack of lubrication.	Lubricate cable.
	Hoist is being used for side pulling.	Hoist cable should be vertical before starting lift so that cable wraps smoothly on drum.
Oil leaks.	Gasket leakage between gear case and cover.	Tighten any loose bolts. Replace gasket if necessary.
	Oil seals worn or damaged.	Replace oil seals.

SECTION VII
WIRING DIAGRAMS

Figures 7-1 through 7-5 are typical basic wiring diagrams for Balanced Design Hevi-Lift hoists. These wiring diagrams are included for the convenience for the users of this manual.

There are many variations of these diagrams as well as completely special applications which cannot all be covered in this manual. For these special applications, separate wiring diagrams are furnished with the hoist.

In all cases, the proper wiring diagram for the hoist is secured to the inside of the control cabinet cover, except when the control is not furnished by Harnischfeger Corporation.

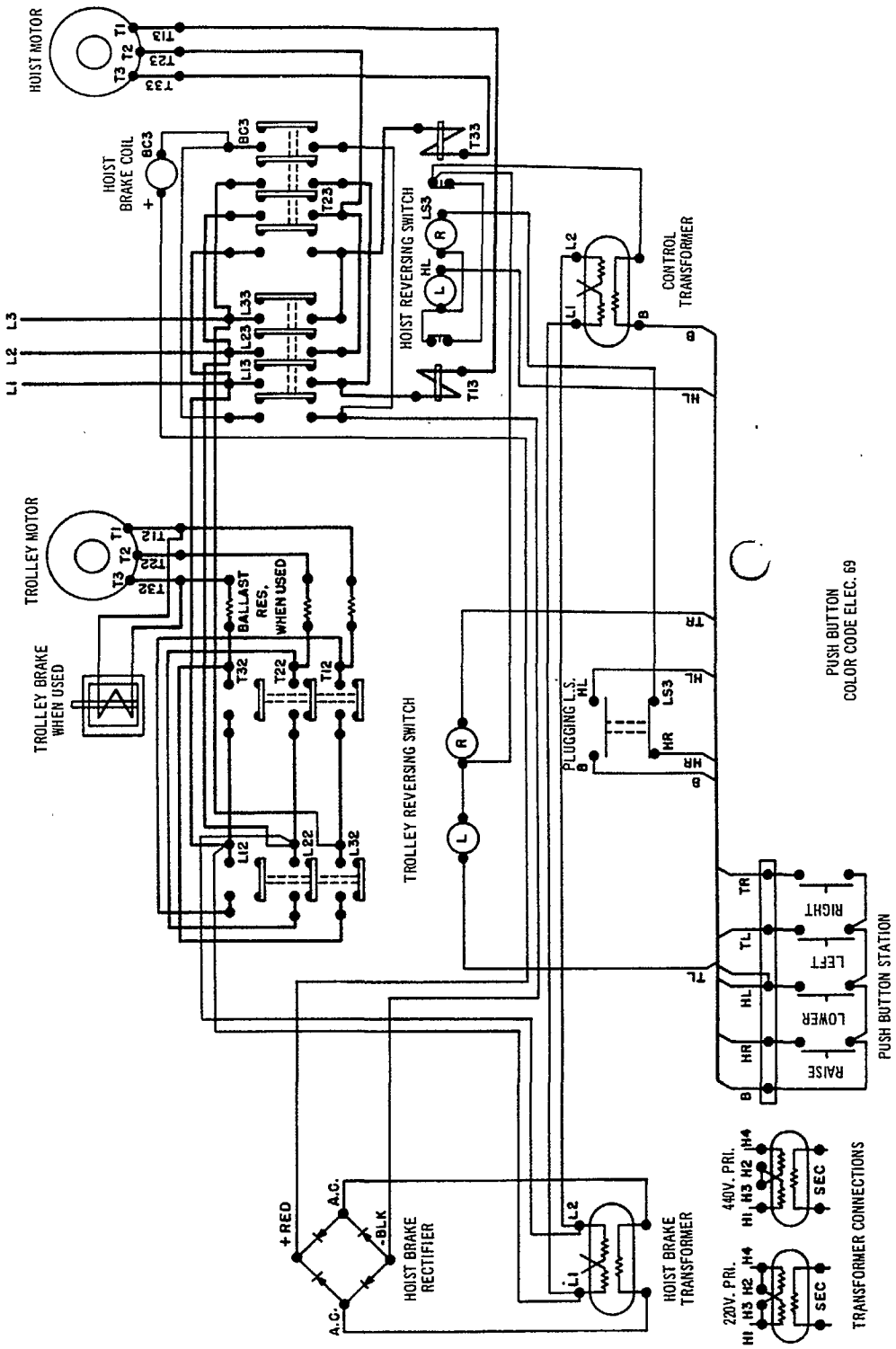


Figure 7-1. A. C. Wiring Diagram, Three Phase 220/440 Volts, 110 Volt Controls, Single Speed Hoist and Trolley Motors

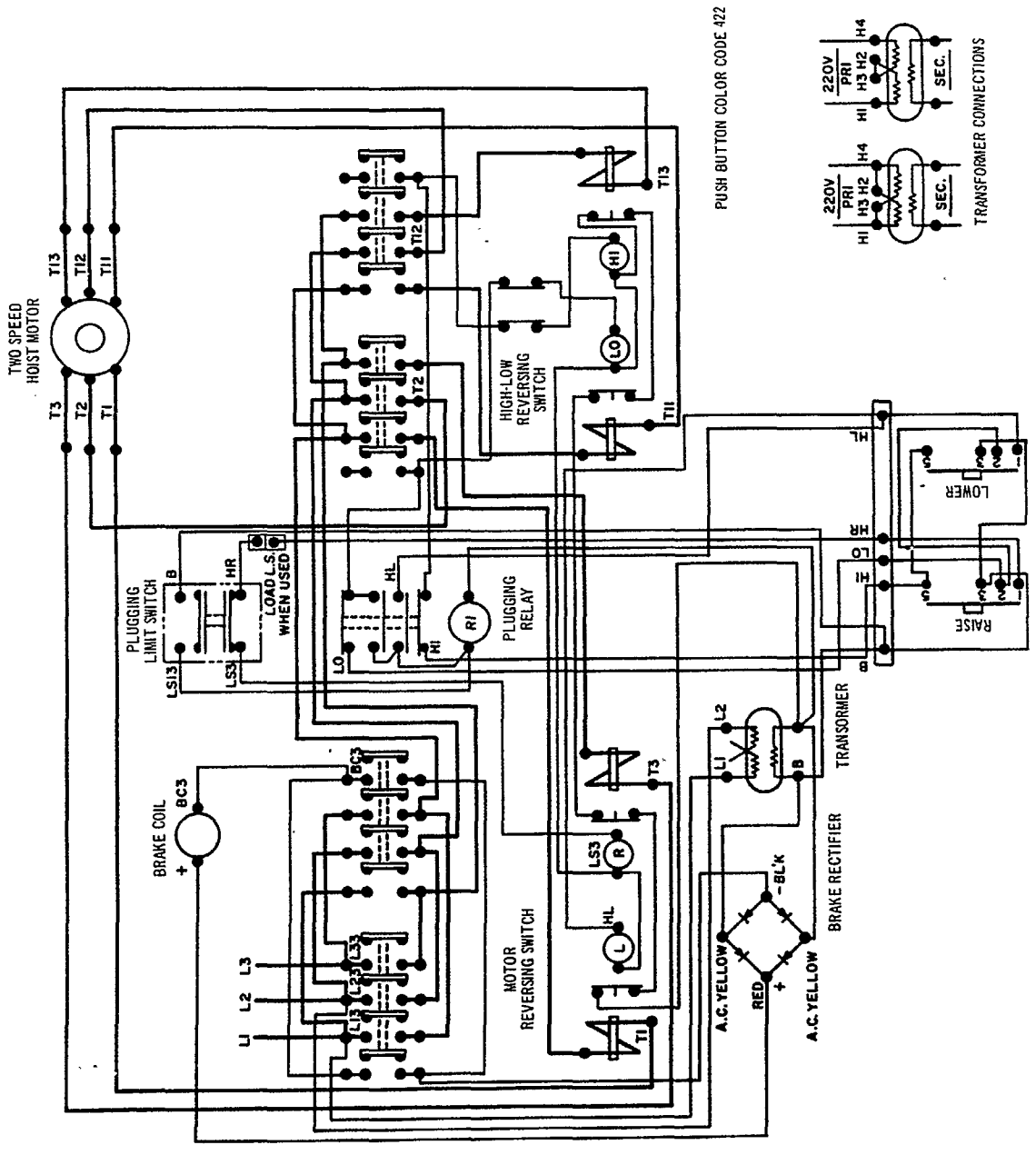


Figure 7-2. A.C. Wiring Diagram, Three Phase 220/440 Volts, 24 Volt Controls, Two Speed Hoist Motor

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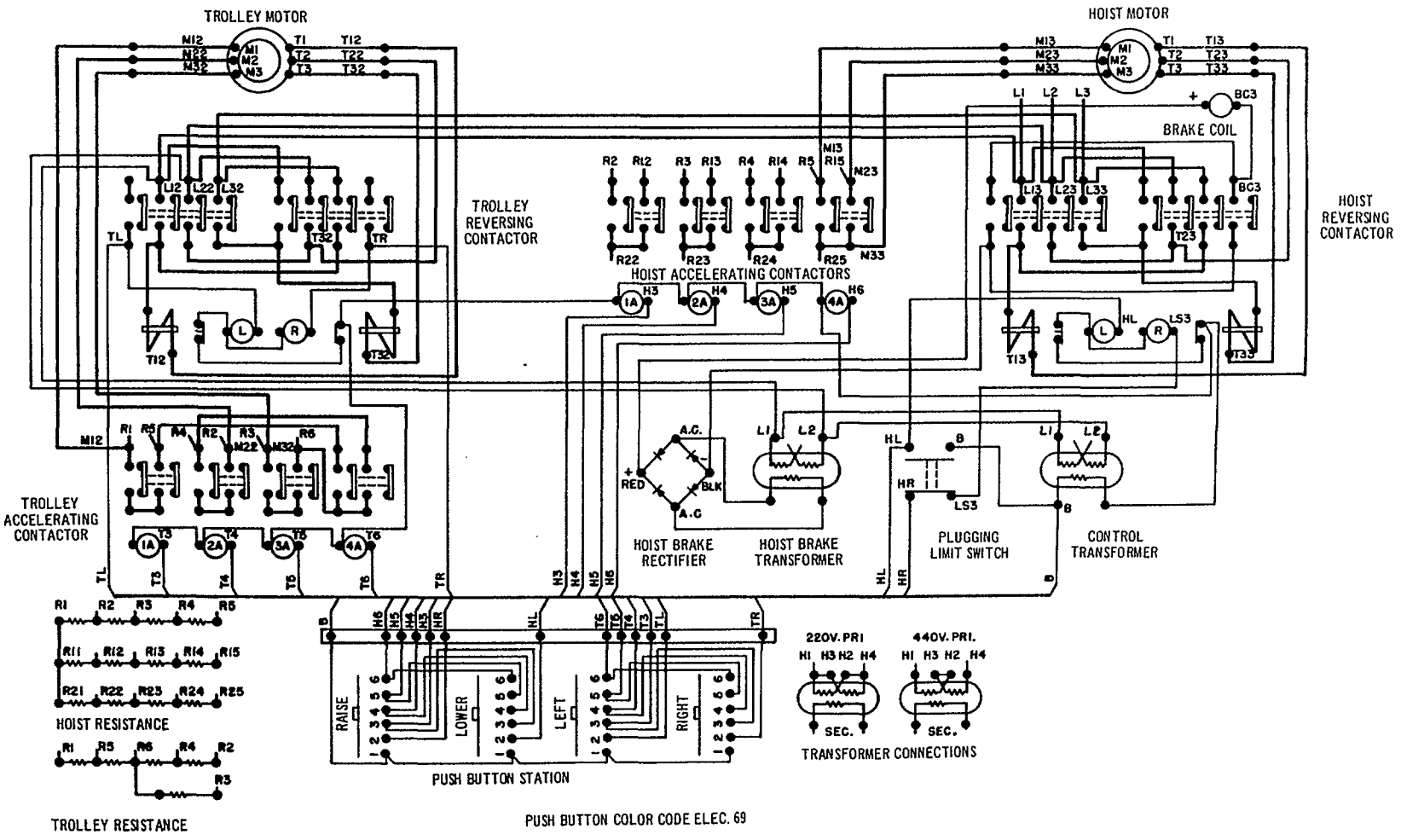

Figure 7-3. A.C. Wiring Diagram, Three Phase 220/440 Volts, 110 Volt Controls, Variable Speed Hoist and Trolley Motors

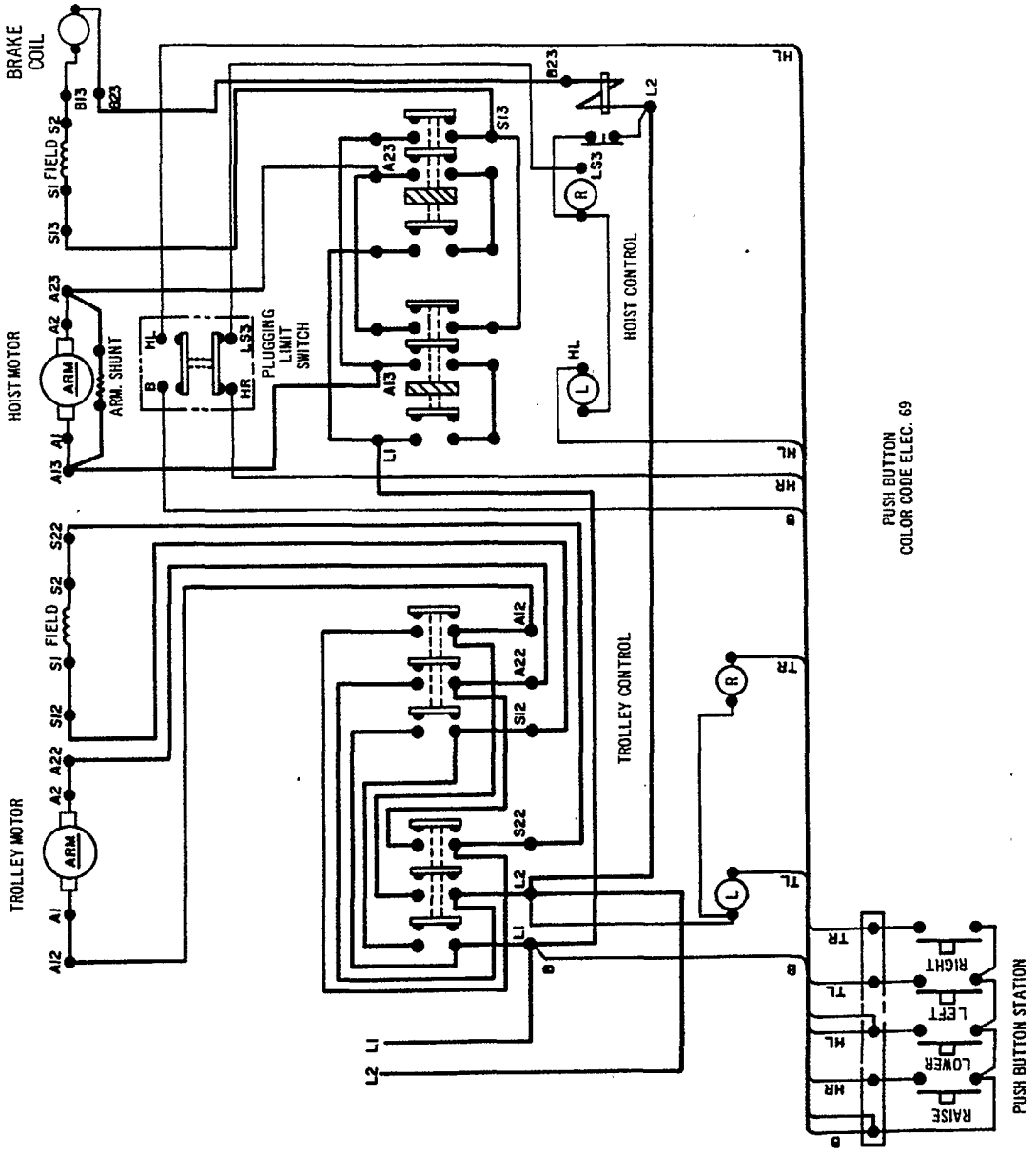

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Figure 7-4. D.C. Wiring Diagram, Single Speed Hoist and Trolley Motors

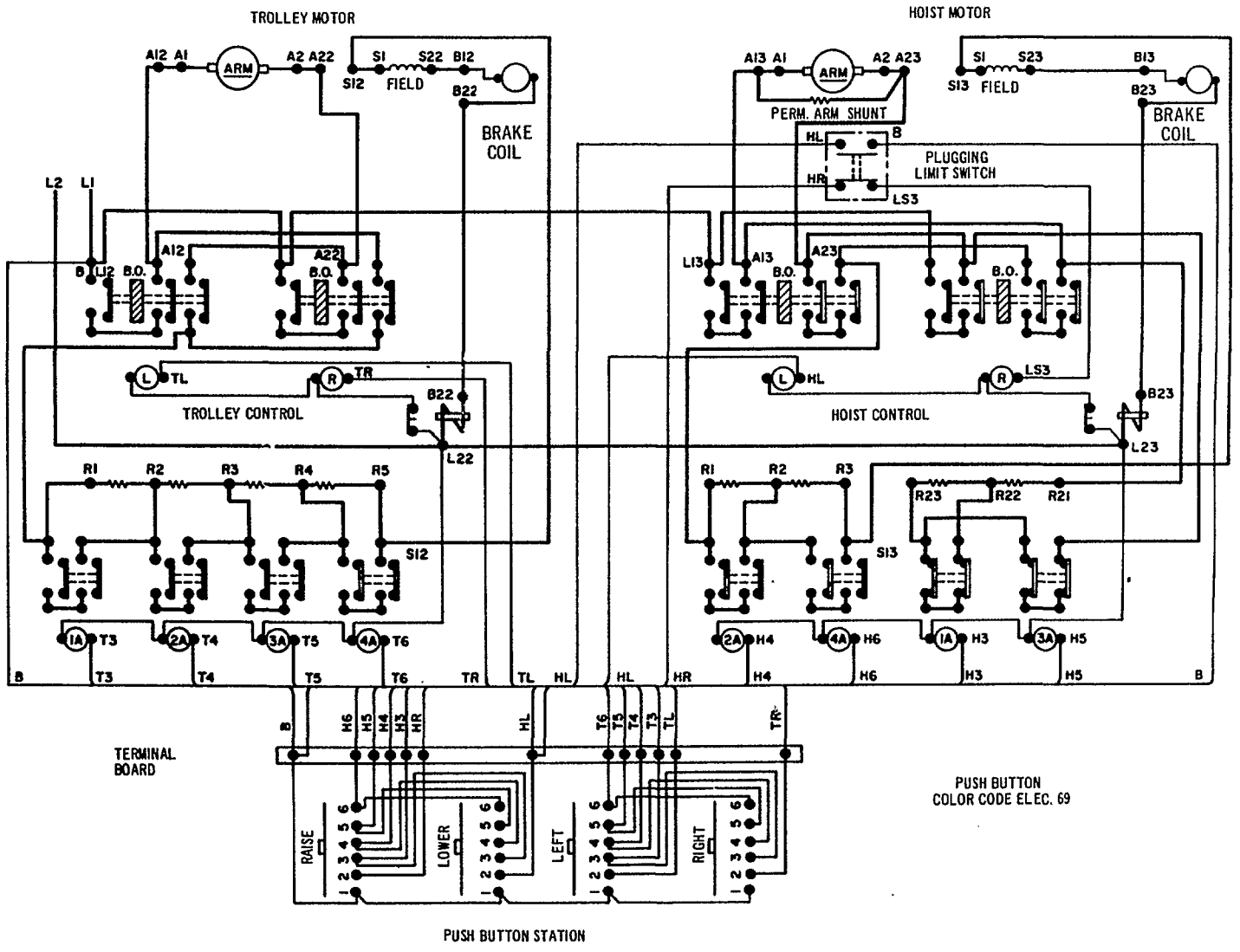

Figure 7-5. D.C. Wiring Diagram, Variable Speed Hoist and Trolley Motors

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