

SECTION VI – BRIDGE MECHANICAL COMPONENTS

6-1. TYPES OF DRIVES. The material presented in this catalog is of a general nature. The user must identify components used on his bridge with those described in this manual. As an aid in this identification, illustrations of bridge drives, identified as A1, A2 etc., through A6 are shown on pages 61 and 62. The user should compare these illustrations with his crane bridge drive and select the one which applies.

6-2. SPEED REDUCERS.

a. General. Figures 6-1 through 6-6 illustrate bridge speed reducers in common use. These reducers use either spur or helical type gearing. All have oil splashed lubricated bearings, oil level stand pipe, or pipe plug, breather and inspection covers. These reducers are further classified as follows:

1. Face mounted motor type. This style reducer uses a cast iron housing and is available only in ball bearing and spur gearing. Refer to Figure 6-2.

2. Foot mounted type. This style reducer is furnished with either ball or roller bearings depending upon application. Gearing is helical. Refer to Figure 6-1 and 6-3.

3. Web mounted type. This style reducer is furnished with either ball or roller bearings depending upon application. Gearing is helical. Refer to Figure 6-4.

b. Construction. Both ball or roller bearing versions of these reducers are constructed in the same manner. The pinions may be separate or integral with the shaft depending upon the size of the pinion. All gears are pressed on their shafts and keyed. Bearings are held in position by either retaining rings or by the use of spacers between the bearing outer race and the bearing retainer covers. (Note, when spacers are used a shim set is also required.) Bearing spacers must be shimmed so that total end movement of the shaft is held to a maximum of .005 inches (.127 mm). Aluminum castings form the housings for the more popular sizes. Other sizes are furnished in either cast iron or welded steel. In general, the brake drum is mounted on the extended motor pinion shaft with a tapered fit for ease in brake drum removal and replacement.

c. Inspection and Maintenance. When inspecting these reducers, examine the gear teeth for general wear pattern, galling or spalling of the tooth surfaces and any other signs of abnormal tooth condition. Spalling and/or galling of the teeth may indicate lubrication failure or overloading of the reducer. All shafts should be checked for end play, looseness of bearing fits and general alignment. Motor shafts should be rotated by hand to insure freedom of rotation. (This will require disconnection of input and drive couplings.)

Bearings should be inspected for obvious visual defects (pitted or rusted surfaces, etc.). If condition is doubtful, rotate the bearing by hand in order to "feel" for smooth rotation. Bearings which do not rotate freely are to be replaced. The lubricant must be checked, and replaced if found to contain water, metal particles and other sludge or contamination resulting from the surrounding environment.

Air breathers are to be cleaned periodically. Refer to SECTION X for schedule of inspection and maintenance.

6-3. BRAKES.

a. General. Crane bridges which are floor controlled are usually equipped with solenoid operated electric shoe, or disc type brakes. Refer to SECTION V Electrical, for information on these brakes. Hydraulic service brakes are used on cab operated cranes where the cab is fixed to the bridge. Where cranes operate and are parked outdoors, a parking brake is required. The hydraulic service brake may incorporate a parking feature, or a separate electrically operated brake can be used. As an optional feature, the brake system may incorporate a remote control bleeder-reservoir. The function of this device is that it allows the operator in the cab, by means of an electric bleeder button and the hydraulic foot pedal, to purge the air from the brake system without additional assistance.

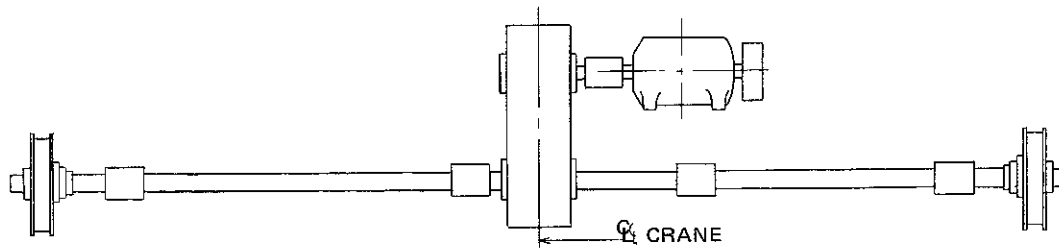
b. Operation. All hydraulic brakes are spring released. Braking is accomplished by applying force to the brake foot pedal. This action moves the piston in the control (master) cylinder, causing fluid under pressure to be displaced in the line leading to the brake. The brake is equipped with a hydraulic operating cylinder which, through linkage moves the brake shoes against the brake drum as a result of fluid from the line under pressure acting on the operating cylinder piston. Increasing the foot pedal force increases the brake shoe pressure against the drum. Stopping of the crane, either rapidly or slowly, is under the complete control of the operator. Care should be exercised so that braking never results in skidding of the driver wheels.

CAUTION

The operator should avoid using excessive force, such as standing with full weight or jumping on brake pedal as damage to the complete crane may result.

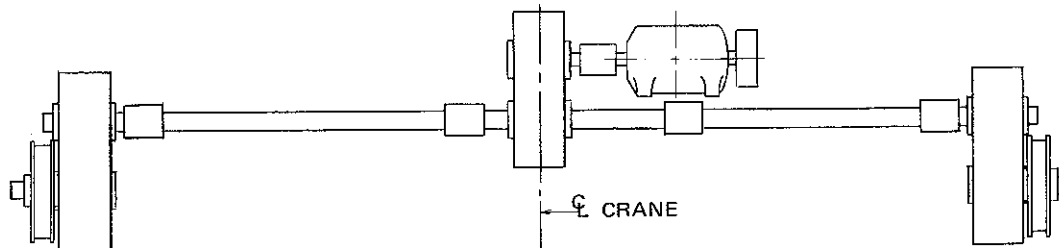
If the hydraulic service brake incorporates a parking feature, an additional spring applied, hydraulically released, parking cylinder is attached to the extended brake arm. Also included in this system is an electrically operated brake control unit. This unit consists of a rectifier, solenoid operated check valve, and a pressure switch. Initial fluid under pressure is trapped between the check valve and the parking cylinder. When this pressure reaches 400 psi (275 newton/cm²) the switch closes and energizes a green light located in the cab. This light acts as a signal to tell the operator that the brake is ready to be used as a hydraulic service brake. With electric power on, initial stroking of the foot pedal displaces fluid under pressure to the parking cylinder. This action allows the parking cylinder to gradually compress the parking spring, until the spring is fully compressed. (As indicated by the green signal light.) Compressing the parking spring releases the brake shoes from the brake drum, and allows use as a service brake. Whenever power to this control unit is interrupted, pressure is released in the parking cylinder hydraulic line, allowing the parking spring to set the brake.

A1 DRIVE



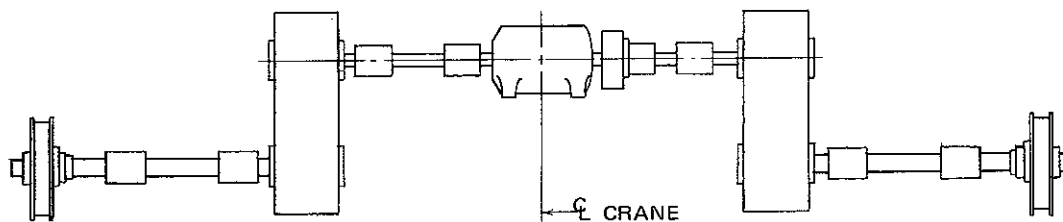
A-1 Drive: The motor is located near the center of the bridge and connected to a self contained gear reduction unit located near the center of the bridge. Output of the gear reduction is connected directly to the truck wheel axles by means of line shafts and couplings.

A2 DRIVE



A-2 Drive: The motor is connected to a self contained gear reduction unit located near the center of the bridge. The track wheels are driven through gears pressed and keyed on their axles or by gears fastened to, or integral with, the truck wheels and with pinions mounted on the end sections of the line shaft. The end sections of the line shaft shall be connected by suitable couplings. Truck gears are of the open guarded type.

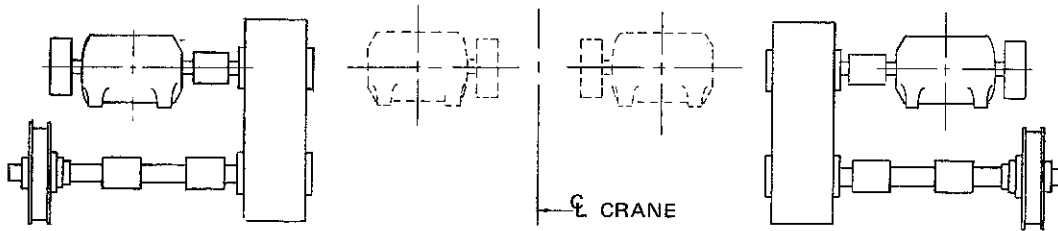
A3 DRIVE



A-3 Drive: The motor is located at the center of the bridge and is connected directly to the line shaft and the gear reduction units with couplings. Self-contained gear reduction units located near each end of the bridge are connected to wheel axles by means of shafts with suitable couplings.

A4 DRIVE

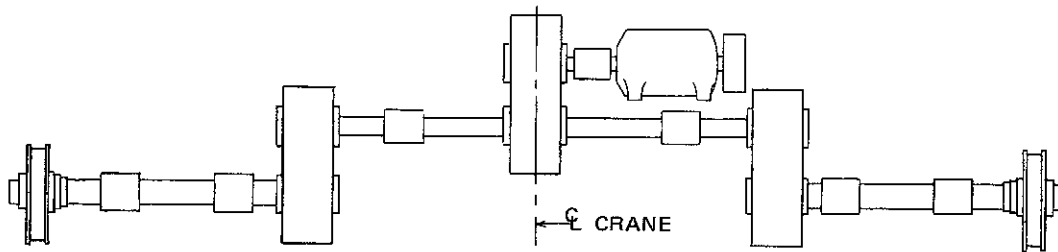
12157-A4



A-4 Drive: The motors are located near each end of the bridge without connecting line shaft. The motors are connected to self-contained gear reduction units. The gear reduction units are connected to the track wheels by means of shafts and couplings.

A5 DRIVE

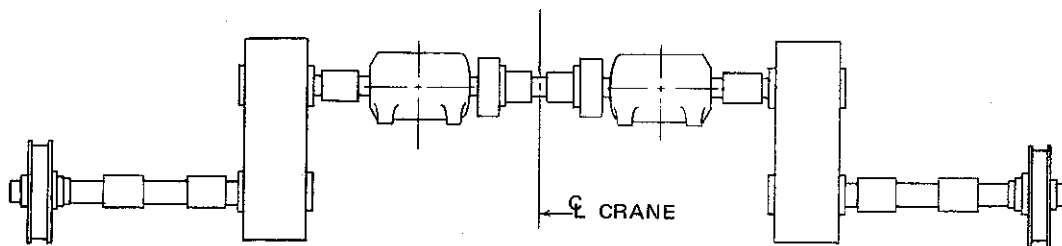
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A-5 Drive: The motor, located near the center of the bridge, is connected to a self-contained gear reduction unit located near the center of the bridge. This reduction unit shall be connected by sections of line shaft and couplings to self-contained gear reduction units located near each end of the crane, and these in turn connected to truck wheel axles by means of shafts with couplings.

A6 DRIVE

12157-A6



A-6 Drive: The motors are located near each end of bridge and connected with a torque shaft. On the drive end, the motors shall be connected to self contained gear reduction units by couplings. The output of the gear reduction units shall be connected directly to the truck wheel axle by means of shafts and couplings.

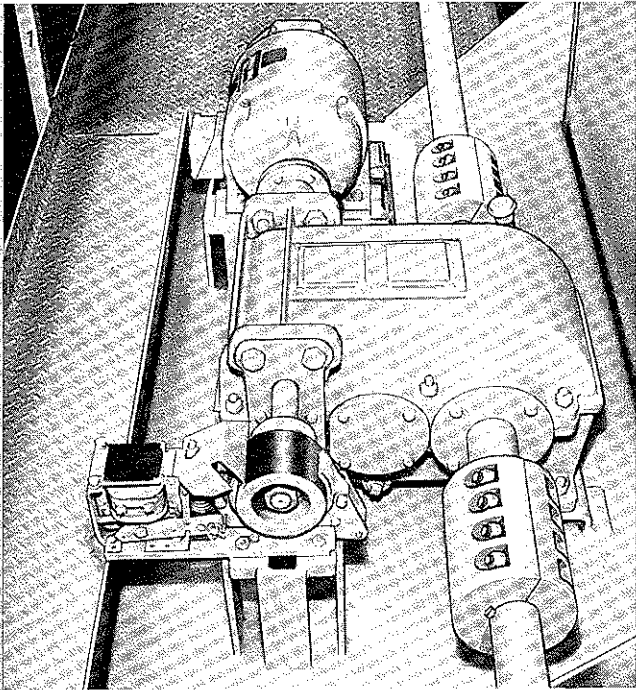


Figure 6-1. Triple Reduction Drive with Electric Brake and Foot Mounted Motor.

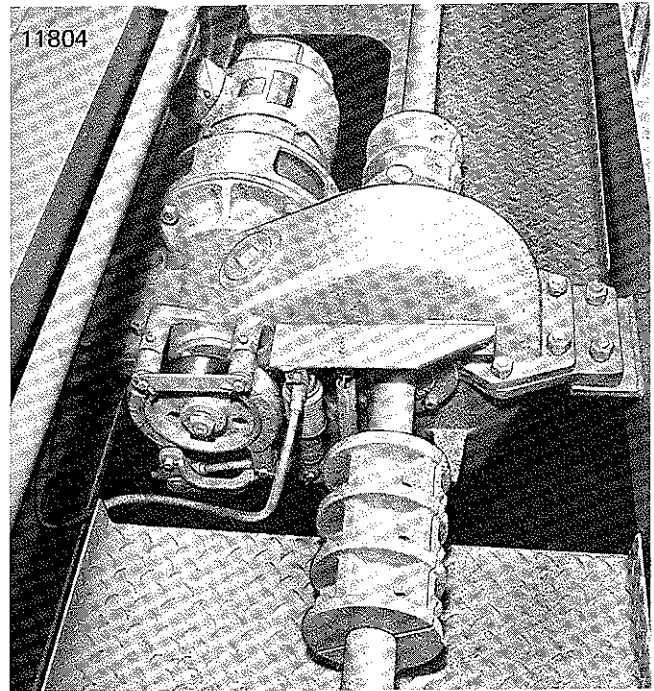


Figure 6-2. Double Reduction Drive with Hydraulic Brake and Face Mounted Motor.

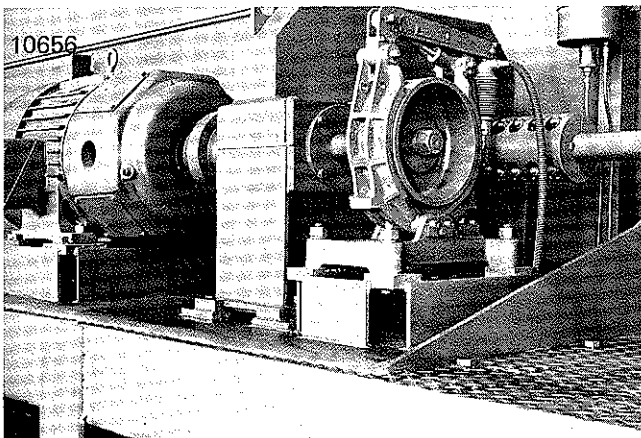


Figure 6-3. Double Reduction Drive with Hydraulic Brake and Remote Bleeder-Reservoir.

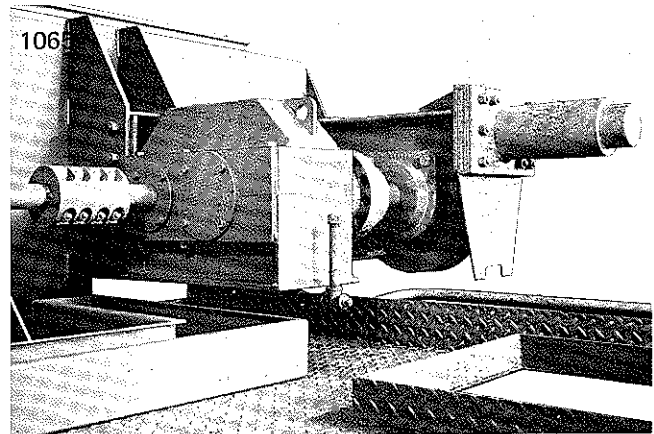


Figure 6-4. Single Reduction A-5 End Speed Reducer.

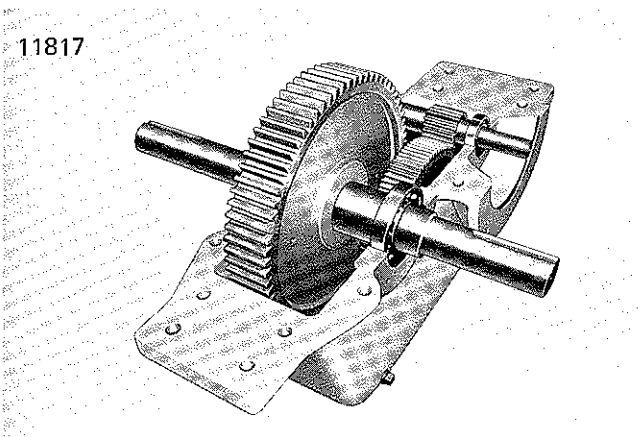


Figure 6-5. General Arrangement of Gearing and Bearings of Reducer Shown in Figure 6-2.

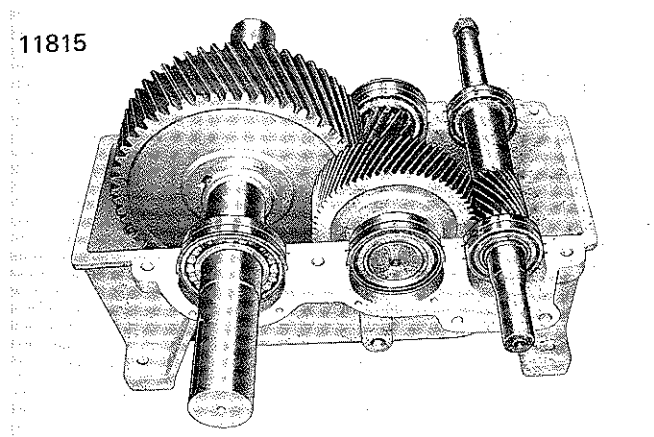


Figure 6-6. Typical Arrangement of Gearing and Bearings for Reducers Shown in Figure 6-1, 6-3 and 6-4.

c. Description of systems. Schematics of the most commonly used brake systems are shown in Figure 6-7 and 6-8. Note that these systems can be furnished with or without a remote bleeder, which also acts as an additional brake fluid reservoir.

d. Filling and bleeding brake system. Use only Wagner Lockheed 21B super heavy duty brake fluid. The use of other fluids may not be compatible with the material used in the seals and could cause damage.

1. Units with remote controlled bleeder.

(a) Adjust brake linkage and shoe clearance before bleeding.

(b) Fill remote bleeder - reservoir to capacity of 113 cubic inches (1851 cm³). At the control cylinder, open the reservoir bleeder screw (located on side away from foot pedal). Attach a bleeder hose to the bleeder screw and keep hose immersed in a small container containing brake fluid. Opening the bleeder screw allows air to escape, and causes fluid to flow from the remote bleeder-reservoir filling the control cylinder reservoir. Close bleeder screw after all air is vented and only clear fluid escapes. Refill the remote bleeder-reservoir to capacity.

(c) Set pedal arm on the control cylinder so that foot pedal is 17 inches (43 cm) from floor. (This will give maximum displacement of fluid from cylinder and aid in filling the system.)

(d) Turn crane power on by depressing the START button.

CAUTION

Be certain crane is clear of people, workmen alerted if on the crane, and all controls are in the OFF position.

(e) Filling and bleeding of the system is accomplished by depressing and holding the remote control bleeder pushbutton in while stroking the foot pedal. The foot pedal should be depressed and released slowly. Keep checking fluid level in the reservoir and do not allow reservoir to go empty as this will allow air to be introduced into the system.

(f) The copper tubing used for the hydraulic line has an outside diameter of 5/16 inches (7.94 mm) with a volume of .6 cubic inches per foot (32.77 cm³/m). One full stroke 17 inches (43 cm) of the foot pedal results in filling approximately 7 feet (2.13 m) of hydraulic line. Control cylinder displacement per stroke is approximately 4-1/2 cubic inches (73 cm³). Thus a full reservoir will allow about 25 strokes of the foot pedal and fill 175 feet (53.3 m) of hydraulic line.

(g) A standard hydraulic service brake system is completely filled and bled when the system is operated without

the bleeder pushbutton and the brake pedal has a solid feel with 3 to 4 inches (7 to 10 cm) of travel. Reset foot pedal to 8 inches (20 cm) above floor.

(h) If a parking brake system is used, the following additional steps are required:

(1) Attach a bleeder hose to the bleeder screw on the parking cylinder and open the bleeder screw. Bleeder hose should be immersed in a small container filled with brake fluid.

(2) Pump the brake pedal until only clear fluid is expelled from the bleeder hose into the container.

(3) Close the parking cylinder bleeder screw and repeat at the second parking brake if so equipped.

(i) It is recommended that the system is again bled, after a short period of operation, using the same method as described above.

2. Units without remote control bleeder.

(a) Remove filler plug on control cylinder and fill reservoir to a capacity of 70 cubic inches (1150 cm³).

(b) Attach a bleeder hose with fluid container to the bleeder screw on the operating cylinder and open bleeder screw.

(c) Set pedal arm on the control cylinder so that pedal is 17 inches (43 cm) from floor. (This will give maximum displacement of fluid from the control cylinder.)

(d) One full stroke 17 inches (43 cm) of the foot pedal results in filling approximately 7 feet (2.13 m) of hydraulic lines. A full reservoir will allow approximately 15 strokes and fill 105 feet (32 m) of line.

(e) Filling and bleeding of the system is accomplished by repeated stroking of the foot pedal. Keep reservoir adequately supplied with fluid, do not allow it to become empty. Filling and bleeding is completed when clear fluid (without air bubbles) is expelled from the bleeder hose into the container of fluid.

e. Brake Adjustment. Adjustment instructions are shown on Figure 6-9 for the more common types of hydraulic brakes. Compare your brake against those shown and adjust accordingly.

f. Inspection and Maintenance. Periodic inspection of brake lining wear pattern is to be made. Correctly installed brakes will produce a symmetrical wear pattern of both shoes. Examine brake wheel for surface wear, glazing, cracking or discoloration as a result of overheating. Over heating may result from improper operation or be a sign that the brake is improperly sized for the work to be done. Cracking or glazing of the brake wheel is cause for replacement. Check all pivot points for freedom of movement and lubricate by a few drops of oil or by grease, if the pivot pins are equipped with grease fittings. Check reservoir, and fill with correct brake fluid. If loss of fluid is noticed, check all hydraulic fittings for oil leakage. For schedule of lubrication, inspection and maintenance see SECTIONS IX and X.

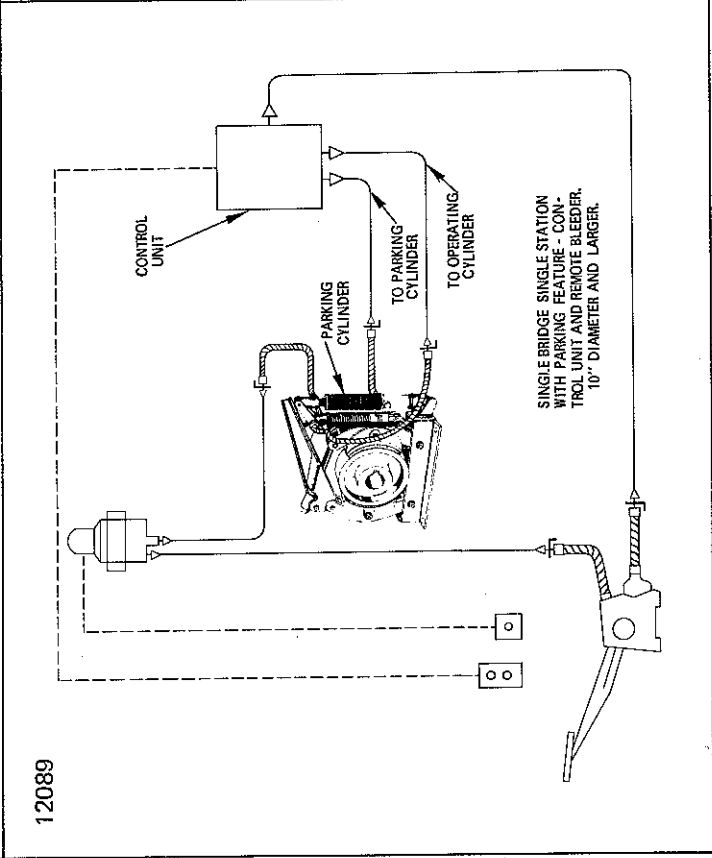
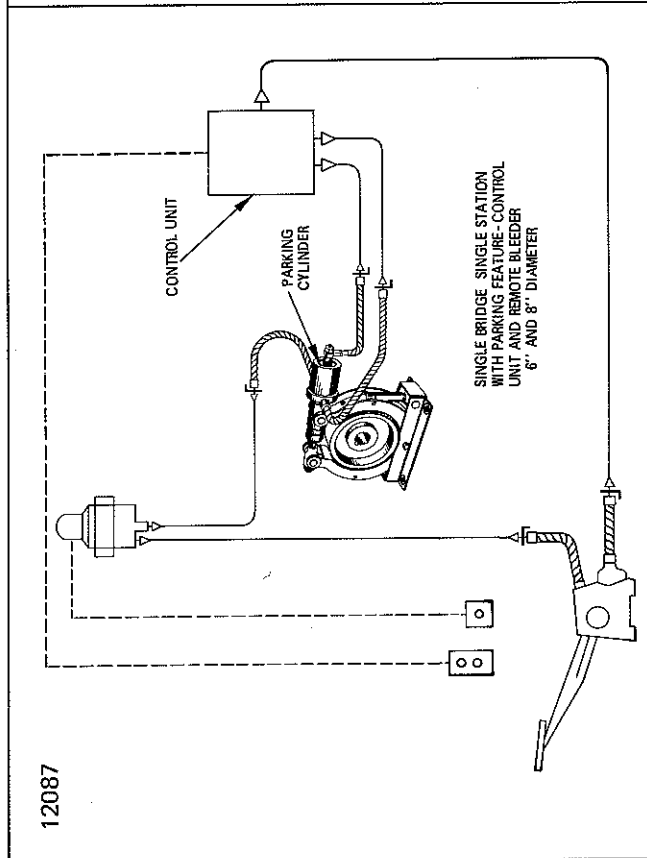
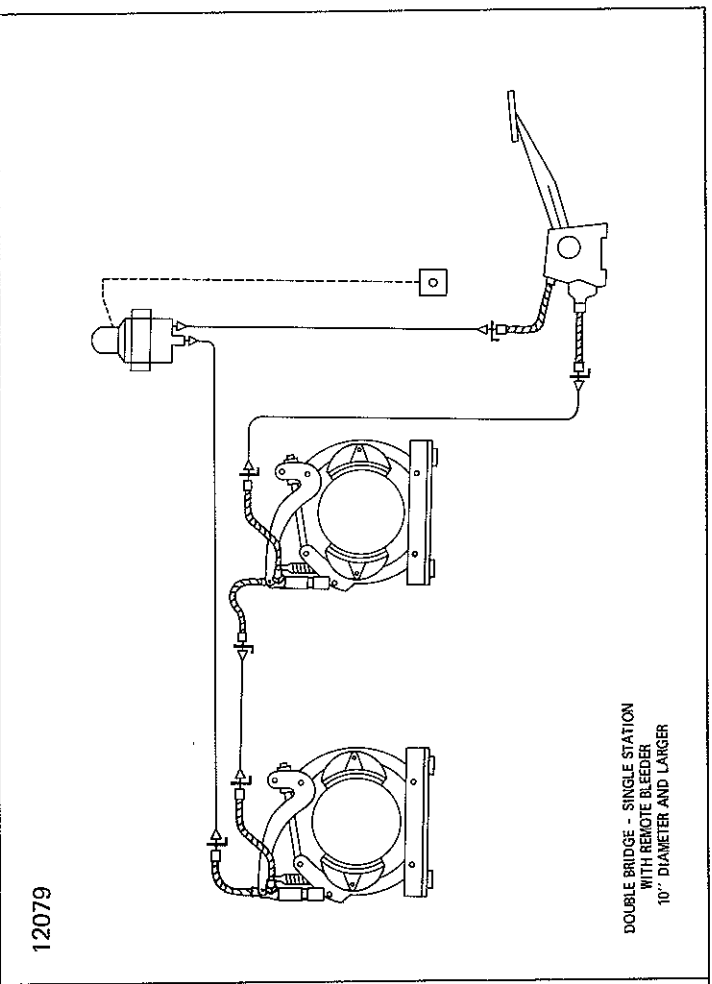
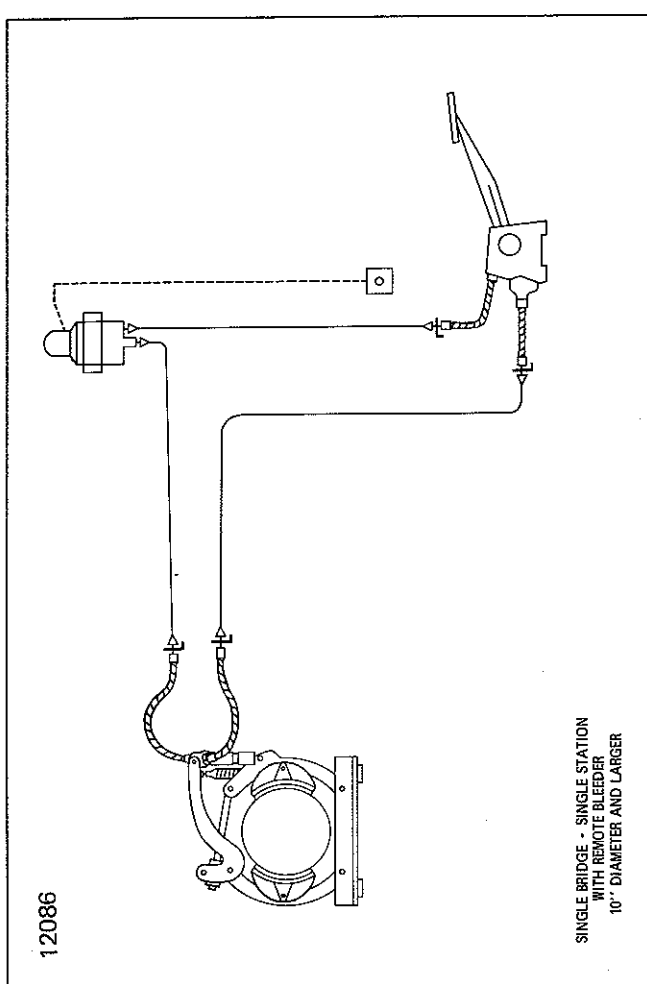
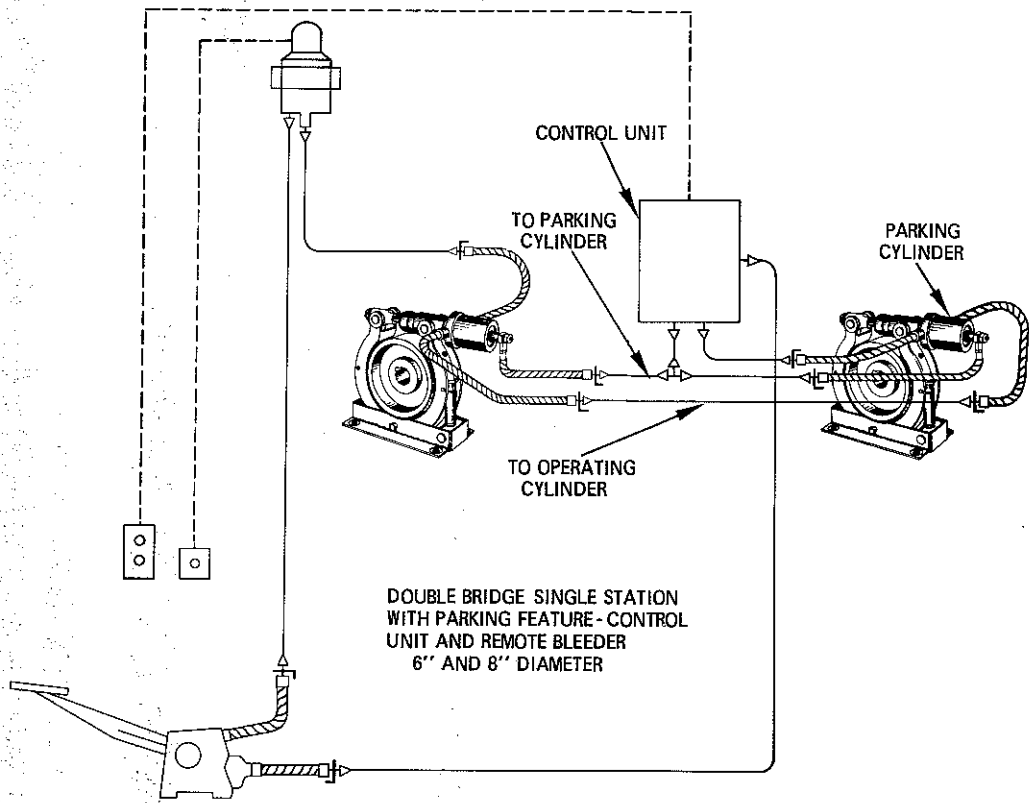
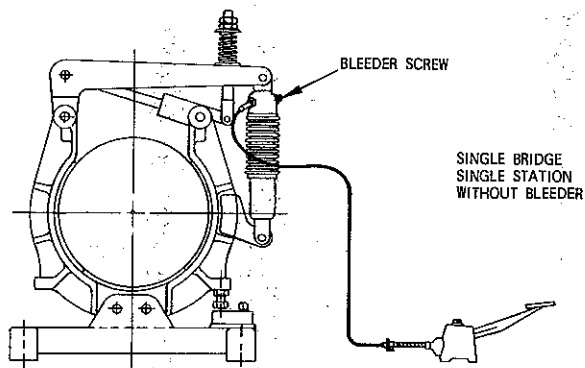


Figure 6-7. Hydraulic Diagrams.

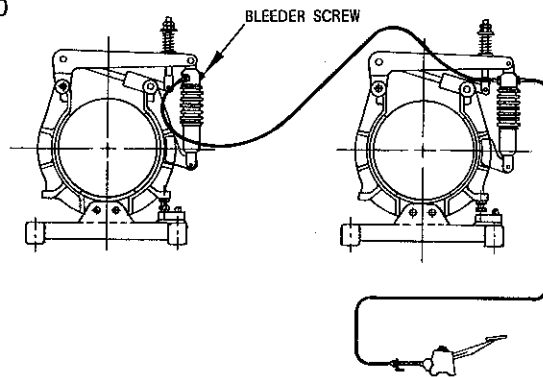
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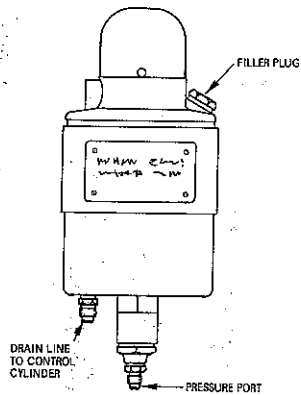
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12150



12082L



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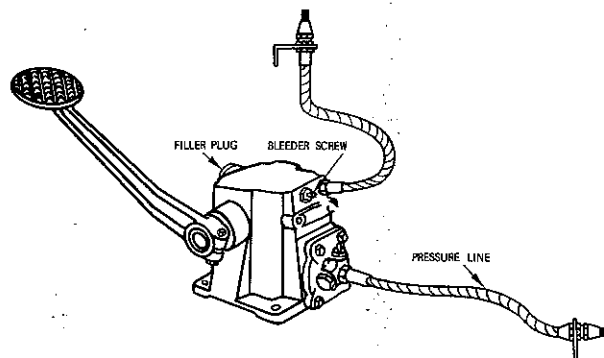
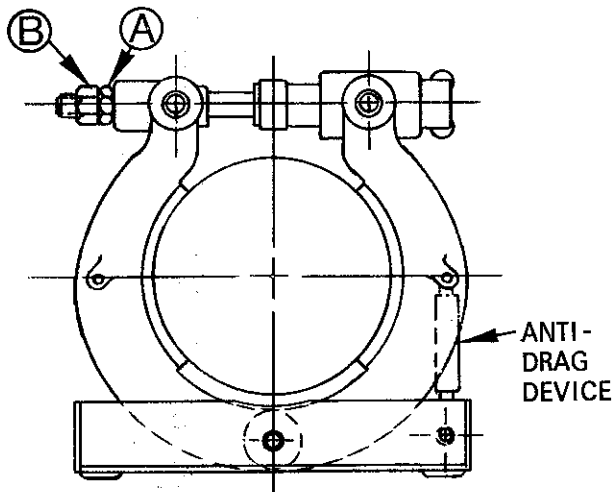


Figure 6-8. Hydraulic Diagrams.

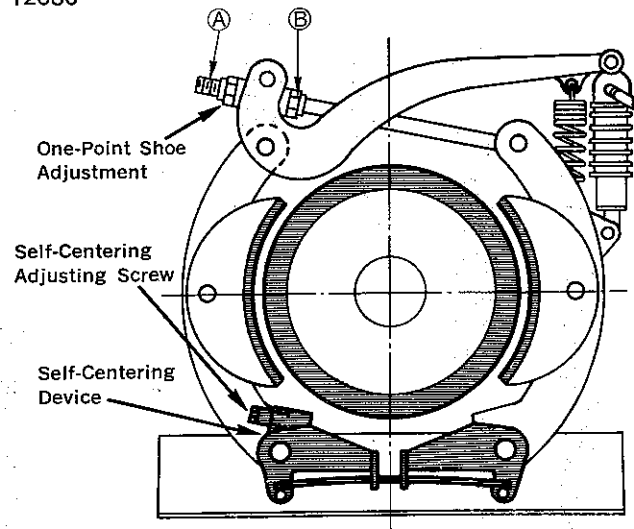
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6" AND 8" DIAMETER

1. Loosen nut (A) and tighten nut (B) until shoes are tight against brake wheel.
2. Loosen nut (B) 2-1/2 turns and tighten clamp nut (A).
3. Both shoes should have 1/32 inch (.75 mm) clearance to wheel.
4. Re-adjust brake when clearance increases to 1/16 inch (1.59 mm).

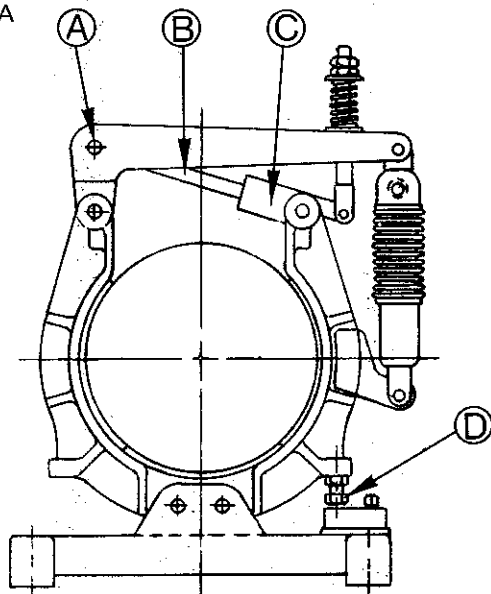
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10" DIAMETER AND LARGER

1. Loosen nut (B) and tighten nut (A) until shoes are tight against brake wheel.
2. Loosen nut (A) 3 turns and tighten clamp nut (B).
3. Both shoes should have 1/32 inch (.75 mm) clearance to wheel. Adjust self-centering device to equalize clearance.
4. Re-adjust brake when clearance increases to 1/16 inch (1.59 mm).

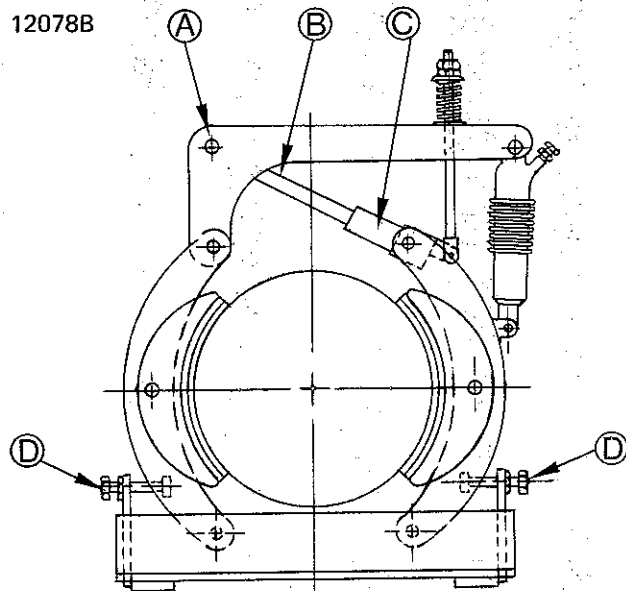
12078A



Type "C"

1. Remove pin (A) and adjust eyebolt (B) in swivel (C) to set shoes with 1/32 inch (.75 mm) clearance to brake wheel.
2. Adjust equalizing screw (D) to provide uniform clearance to brake wheel of both shoes.
3. Re-adjust brake when clearance increases to 1/16 inch (1.59 mm).

12078B



Type "MTW"

1. Remove pin (A) and adjust eyebolt (B) in swivel (C) to set shoes with 1/32 inch (.75 mm) clearance to brake wheel.
2. Set adjusting screw (D) so that heaviest brake arm is vertical. Brake shoe arms automatically hold equal clearance around wheel.
3. Re-adjust brake when clearance increases to 1/16 inch (1.59 mm).

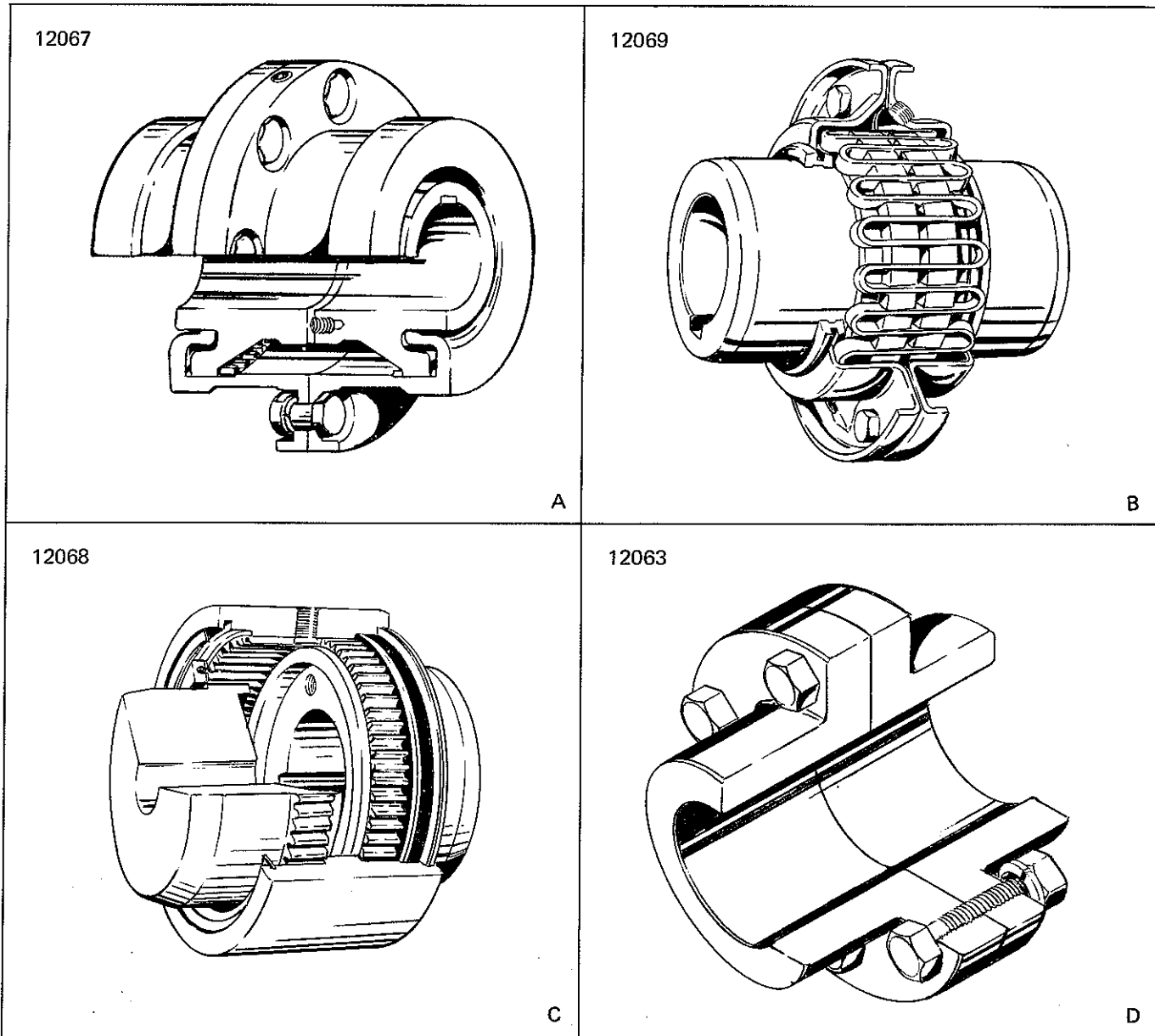
Figure 6-9. Brake Adjustment

6-4. COUPLINGS.

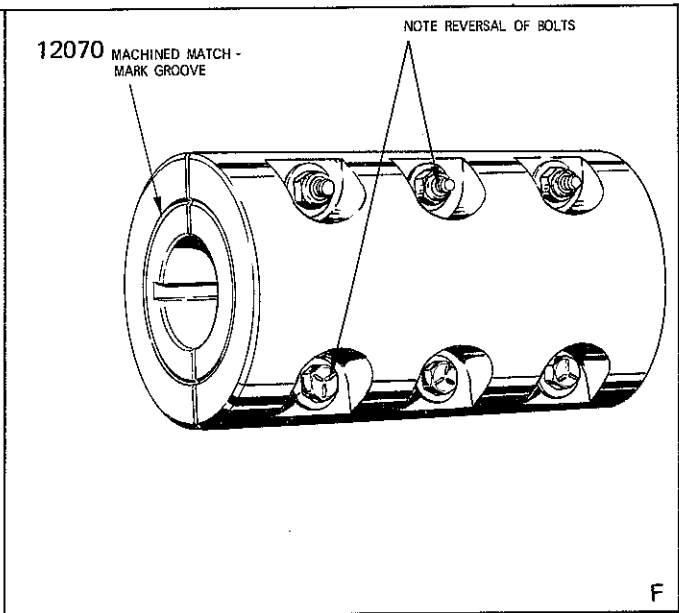
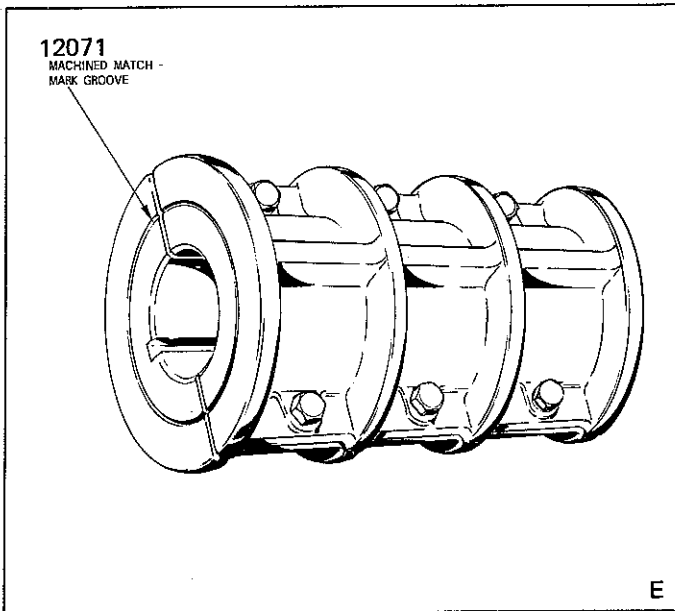
a. Description. Bridge drive arrangements utilize various types of flexible and rigid couplings. Examples of the types most commonly used are shown in Figure 6-10. The user should, by examination of his bridge, note the coupling types used and identify them in this manual by comparison. Figure 6-10A and 6-10C are both full flexible gear type couplings. Torque is transmitted, on these types, from the driver hub to the driven hub by gear teeth which engage similar gear teeth machined on the inside of the housing. In Figure 6-10A, the housing is made of two pieces bolted together at the parting surface, while in Figure 6-10C, the housing is cylinder shaped and held in place by snap rings. Figure 6-10B is also a full flexible coupling, which uses a "grid" member to connect the gear teeth of the driver hub to the gear teeth of the driven hub. This grid member transmits the torque. The housing is used only to enclose the coupling and prevent the grid member from uncoiling. Figure 6-10D is a rigid type flanged coupling which is held

together by flange bolts. Couplings of the type shown in Figures 6-10A and 6-10D use special close fitting bolts to hold the flanges. Figure 6-10E illustrates a rigid ribbed type clamp coupling. This type of coupling is held together by either six or eight standard mild carbon bolts with split washers and hexagon nuts. The coupling is made of plain cast iron. Tightening effort of bolts should completely compress the spring effect of the split washer, bringing the fastener to a solid grip.

Figure 6-10F illustrates a rigid non-ribbed type clamp coupling. This coupling is also furnished in either six or eight bolts. The material used for this coupling is high strength ductile iron. Special holding bolts of hi-tensile (American Society for Testing and Materials ASTM A-325) steel are used. Attention must be given to the installation and tightening of these bolts. A hardened flat washer is used under both the head and the nut. The nut is a self locking type. The correct coupling bolt is identified by three raised radial marks on the head. Torque values to be



Figures 6-10A through 6-10D Types of Couplings.



Figures 6-10E and 6-10F Types of Couplings

applied to the bolts holding the coupling together are listed in the following table:

Outside Diameter		Torque	
Inches	cm	Ft.-lbs.	Newton-Meters
4.375	11.11	18.	24.40
6.000	15.24	45.	61.01
8.000	20.32	90.	122.02
9.500	24.13	160.	216.93

It should be noted that clamp couplings have a circular match mark machined into one face of the coupling. These couplings must be reassembled with this mark mated. See Figure 6-10E and 6-10F. Also required in reassembly, is the complete removal of cosmoline or other preservative from the shaft as well as the bore of the coupling.

Proper assembly of the bolts holding the coupling halves together are made with the bolt heads on one side of the coupling inserted in the opposite direction from those on the other side. See Figure 6-10F.

b. Inspection and Maintenance. Periodic inspection is to be made to insure tightness of all bolts, (the primary cause of coupling failure is loose bolts) and sufficient lubrication. On occasion, this inspection should also involve examination of the gear teeth and/or grid; flushing out lubricant, cleaning and relubrication. See SECTION IX and X for schedule of inspection and maintenance.

6-5. PILLOW BLOCKS.

a. Description. In general, the pillow blocks used on your crane are self aligning, and equipped with either roller or ball bearings. The housings for ball bearings are one piece cast iron construction and are shown in Figure 6-11. Pillow

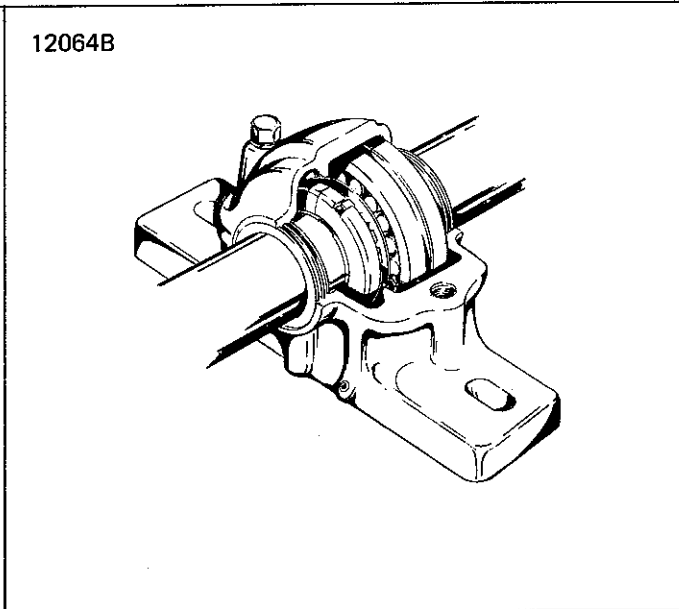
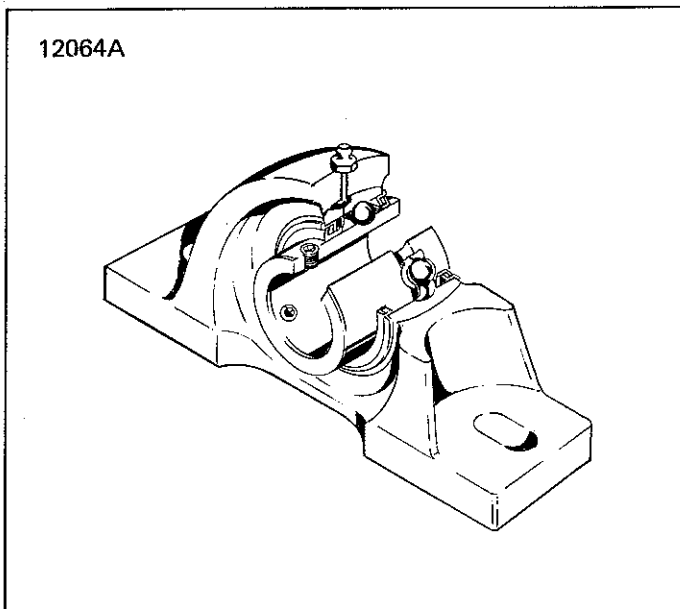
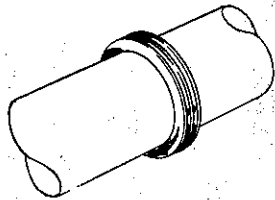
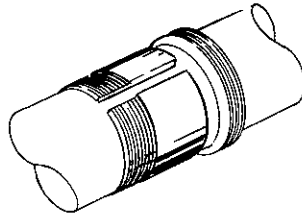


Figure 6-11. Ball Bearing Pillow Block

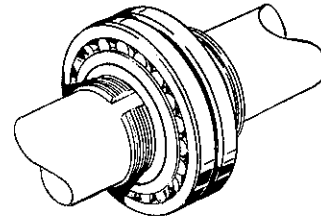
Figure 6-12. Roller Bearing Pillow Block



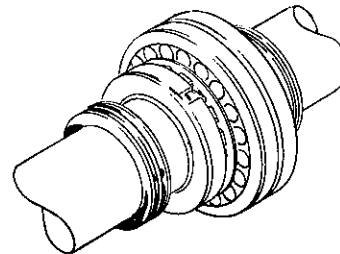
1 Slide Inner Seal on Shaft.



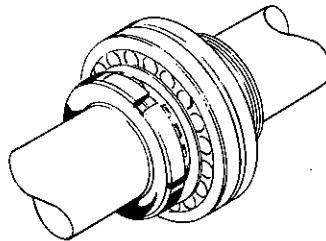
2 Position Adapter Sleeve on Shaft.



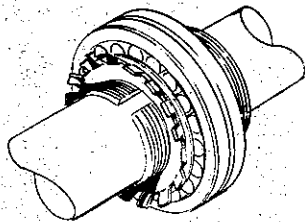
3 Mount Bearing on Adapter Sleeve.



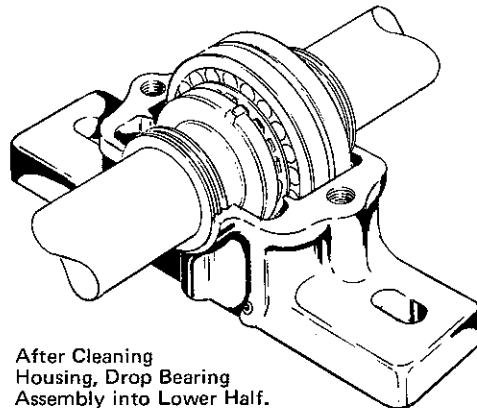
6 Slide Outer Seal on the Shaft.



5 Thread Locknut on Adapter and Tighten Until the Bearing Wedges the Adapter Tightly to the Shaft. Bend Prong of Lockwasher Into One of Locknut Slots.



4 Position Lockwasher on Adapter with Inner Prong of Lockwasher Toward the Bearing — and Located in the Slot of The Adapter.



7 After Cleaning Housing, Drop Bearing Assembly into Lower Half. Carefully Match the Grooves of Both Seals with the Housing Labyrinths. Replace Cap.

Figure 6-13. Pillow Block Assembly to Shaft.

blocks equipped with roller bearings are held in a split type cast iron housing shown in Figure 6-12. Both types are grease lubricated through grease fittings mounted on the housing. Ball bearings are secured to the shaft by the use of set screws through the extended inner race. The roller bearings are held to the shaft through use of a tapered split adapter sleeve and nut. Installation of the ball bearing type involves sliding entire pillow block assembly over the shaft. Assembly of the roller bearing type is shown in Figure 6-13.

b. Inspection and Maintenance. Periodic inspection involves examination of the set screws and/or adapter nut to insure that the inner race is held to the shaft and is rotating with the shaft. Bolts holding the pillow block to the structural support as well as cap bolts on split housings must be checked for tightness. Excessive leakage of grease may be an indication of a faulty seal, improper type grease

(temperature) or a bearing failure. Correction by replacement of parts is required after determining the cause. See SECTION IX and X for lubrication and maintenance.

6-6. WHEEL ASSEMBLY.

a. General. All bridges employing connecting line shaft drives are equipped with taper tread driver wheels unless otherwise specified by the buyer. In addition, on these types, the trailer wheels are also tapered.

CAUTION

Wheels must be mounted on the bridge so that the largest tread diameter is toward the span (inside) side of the end trucks.

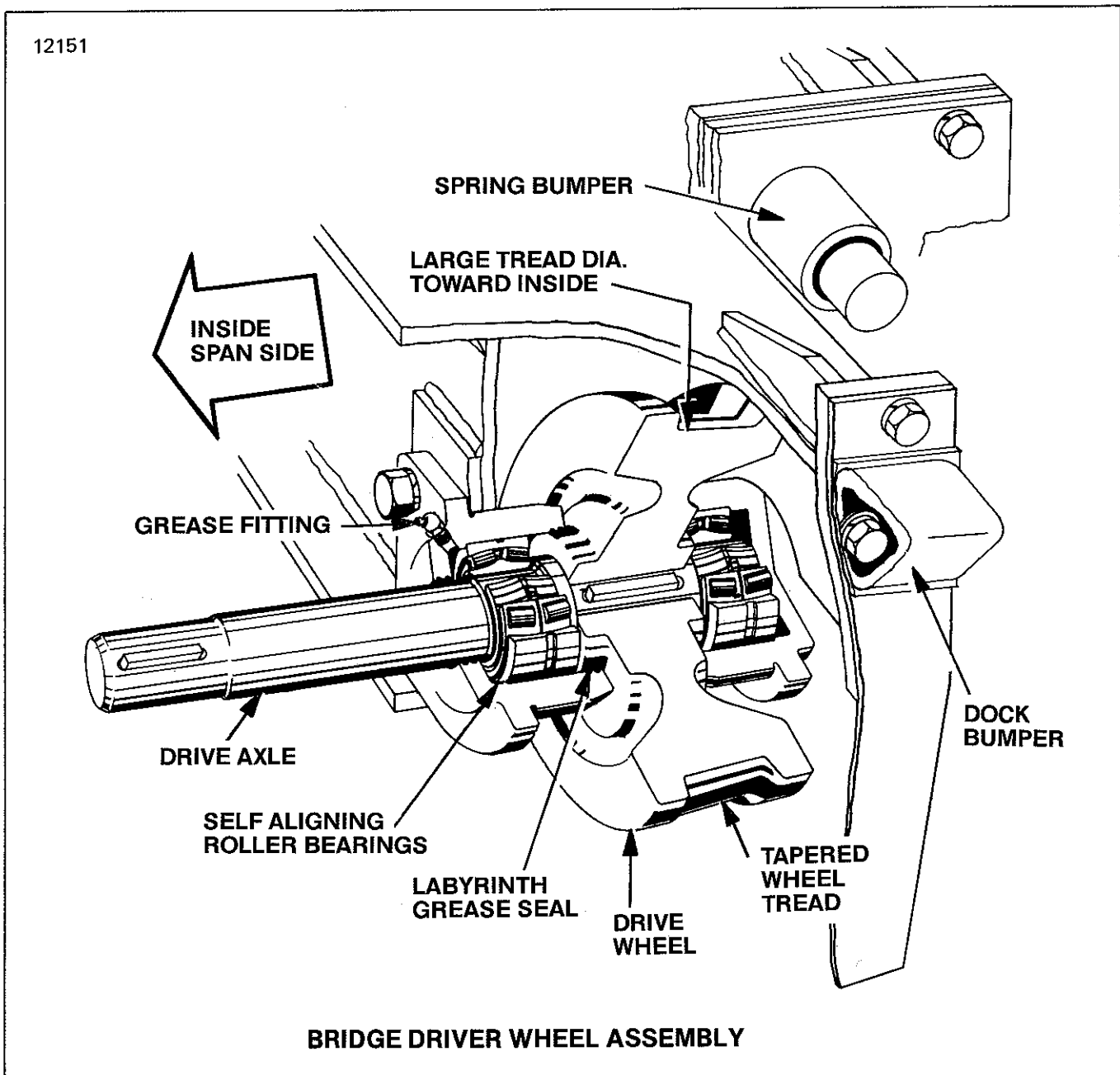


Figure 6-14. Typical Wheel Assembly.

Cranes which use drives that are not connected together by line shafting (such as A4, page 62) are usually equipped with flat or straight tread wheels. All driver wheels are closely mated in circumference in order to provide proper operation of the bridge on the runway rails.

b. Construction. Figure 6-14 shows typical construction and arrangement of the wheel axle, and bearing assembly. Note that the large tread diameter of the wheel is toward the drive (inside) end of the axle. The wheels are pressed and keyed onto the axle against a locating shoulder machined on the axle. Self aligning roller bearings or ball bearings are also tightly fitted to the axle in accordance with the manufacturer's standards. The bearings are held in capsules which are firmly fastened to the truck as shown in Figure 6-14, or clamped in a seat which has a parting surface intersecting the axle bore at 45 degrees. As can be seen, the bearing capsule extends over the closely machined hub of the wheel to form a labyrinth type grease seal. On assemblies equipped with ball bearings, a sealed bearing is used rather than the extended capsule labyrinth. The trailer assembly duplicates the driver except that the keyway and key are omitted.

c. Inspection and Maintenance. Inspection and schedule of maintenance is outlined in SECTION X and is to be followed along with these points:

1. Check wear pattern on the wheel tread surface and flanges for any abnormal signs such as galling, spalling or cracking.
2. The full length of the runway rail is to be checked for abnormal surface wear, mushrooming, loose rail clamps, bad joints, etc., and on occasion a check on the span (center to center of the rails).
3. Check the circumference of the driver wheels by a cloth tape. Variation exceeding 1/16 inch (1.59 mm) between drive wheels is cause for replacement.

CAUTION

Driver wheels should only be replaced in matched pairs.

4. Inspect the wheels for looseness on the axle, the axle for end play, and the bearing for defects. This will require slight jacking of the truck and disconnection of the drive coupling so that the wheel can be rotated by hand.
5. Check for adequacy of lubrication.
6. Check all bolts for tightness and retighten if required.
7. Since the tread width of the wheels vary considerably with the application, it is recommended that the width of all wheel treads be measured and recorded when the crane is received, and periodically measured thereafter to determine rate of wear and replacement schedule.

6-7. BRIDGE (MAIN) COLLECTORS AND RUNWAY CONDUCTORS.

a. Description. Collectors are devices which contact the runway conductors and provide a continuous electrical supply between the power source located in the building and the bridge of the crane as it moves back and forth along the length of the runway. The variation in the sizes and types of collectors are of such a magnitude that inclusion of all types in this manual is prohibitive. The specific collector used on your crane will be identified in the Customized Parts Identification Manual issued for your crane. A brief description of the more prominent types generally used are as follows (types Y and X are not used for new installations):

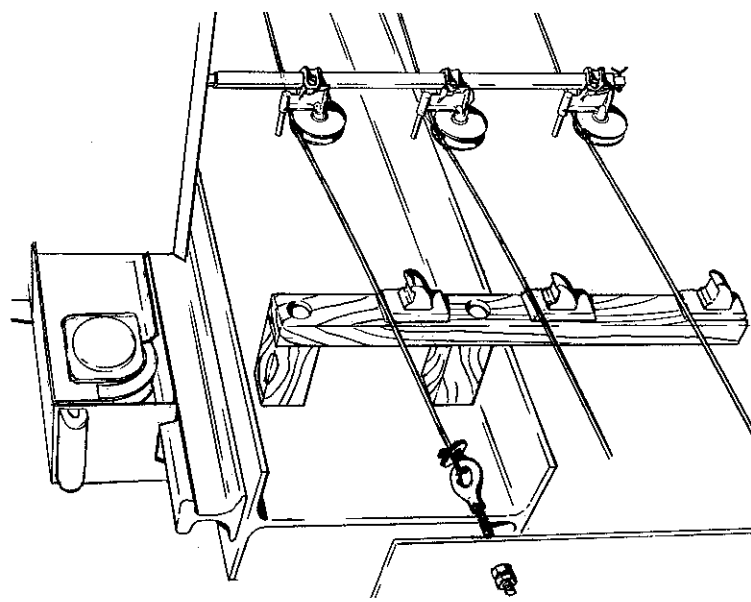
1. Dresser Type "Y". Reference Figure 6-15. This is a system employing bare round hard drawn copper wire, which is stretched along the runway, receiving its support on insulators spaced every 20 feet (6.1 m). The ends of these conductors are terminated into structural end anchors, attached to the runway beam, by insulated eye bolts. These eye bolts are fabricated with a generous length of threaded rod for use in providing proper tension to the conductor. The collector is a rigid single wheel type which clamps to an insulated jacketed steel pole, mounted to the bridge.

Contact pressure is made by the collector wheel lifting and supporting a portion of the conductor weight. Long life is the result of the rolling contact of the wheel to the conductor. Collector height is set so that collectors pass over the insulator support surface with a clearance of 1/2 inch (12.7 mm) and raises the conductor 1/4 inch (6.35 mm) above the support hole in the end anchor.

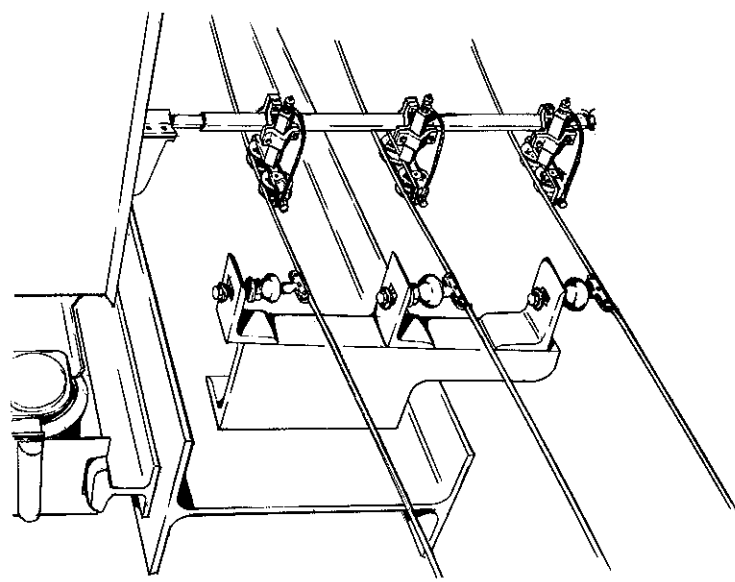
2. Dresser Type "X". Reference Figure 6-16. This system employs bare hard drawn grooved copper wire which is stretched along the runway. The ends of these conductors are terminated into structural steel end anchors and fastened by insulated eye bolts. These eye bolts are fabricated with a generous length of threaded rod for use in providing proper tension to the conductor. Intermediate insulated clamp type hanger supports are located every 20 feet (6.1 m) along the runway. These hanger clamps are held in their supports so that the conductor and clamp is free to move upward 15/16 inch (23.8 mm) from its normal hanging position. The collector is a rigid equalized tandem wheel type, which clamps to an insulated jacketed steel pole mounted to the bridge. Contact pressure is made by the collector wheels lifting and supporting a portion of the conductor weight. Correct setting height of the collector, is when it lifts the conductor 9/16 inch (14.3 mm) in passing the hanger clamp. Also the collector must, when near the end anchor, lift the conductor 1/4 inch (6.35 mm) above the support hole in the end anchor.

3. Insulated Figure "8" Bar. Reference Figure 6-17. This system employs a rigid Figure "8" bar which is enclosed for its full length in an insulated cover. The conductors are supported every 5 feet (1.52 m) by small clamps attached to support brackets. The collector is a sliding type, spring loaded, free to swivel and adjust for minor misalignments which occur as a result of skewing and end float of the bridge. The collector head is completely enclosed by insulation when mated to the insulated conductor.

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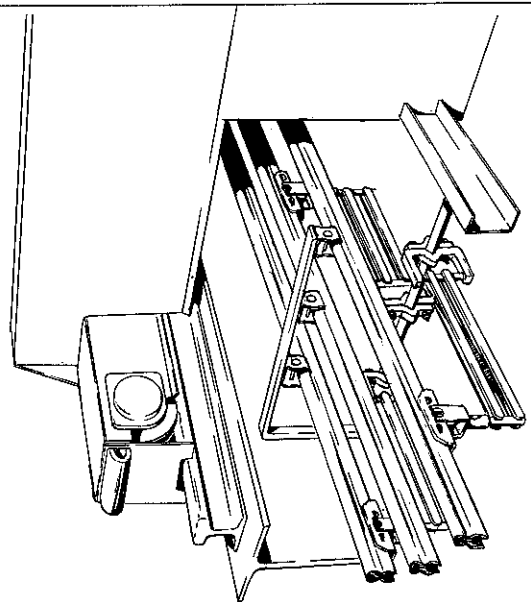


Figure 6-15. Type "Y".

Figure 6-16. Type "X".

Figure 6-17. Insulated Figure "8".

b. Inspection and Maintenance. Collectors and conductors must be periodically inspected. Frequency of inspection is governed by the amount of usage and environment to which the system is subjected. Cranes which are standby service and rarely used may be troubled with a dielectric film forming on the conductor, while cranes subjected to severe and continuous service may require frequent replacement of wear parts. In any inspection the following minimum points are to be examined:

WARNING

The mainline power switch serving the runway conductors shall be locked in the open position whenever working on the collector-conductor system.

1. Check alignment of the conductors to the runway rail (not to the runway beam since the crane bridge is guided and aligned by the runway rails).
2. Check alignment of the main collector support staff and adjustment of the collectors to the conductor.
3. Examine the electrical connections to the collectors. Bolts must be tight. Replace shunts if they are frayed or have broken strands.
4. On rigid conductor systems, examine all joints for looseness and re-tighten if required. Outdoor installed bare copper wire systems may require tension adjustment due to seasonal temperature changes.
5. Collector wheels used on type "Y" and "X" system are equipped with self lubricating bearings, and do not

require additional lubrication. Pivot and hinge points of collectors should be given a few drops of oil. See SECTION IX lubrication.

6. Systems used in abnormal or corrosive environments such as taconite, dust, cement dust, fertilizer plants, acid vapors, etc., will require more frequent and specialized maintenance.

7. Correct procedure for setting the height of the collector shoes on either the type "X" or "Y" systems is as follows:

(a) Position bridge at extreme end of the runway (this places the collector pole close to the end anchor).

(b) Adjust collectors so that they raise the wire 1/4 inch (6.35 mm) above their terminating hole in the end anchor.

(c) Move bridge through full travel of runway to the extreme opposite end. As the collectors pass by the intermediate supports check that the collector clears the top of the support insulator by 1/2 inch (12.7 mm) on the type "Y" system; or with a type "X" system that the collector lifts the conductor approximately 9/16 inch (14.3 mm).

(d) With the bridge at the extreme opposite end of runway, check to insure that collector is lifting the conductor 1/4 inch (6.35 mm) above the terminating hole in that anchor. If these conditions are not attained, then repositioning of the end anchor and intermediate supports may be required.

(e) Insulated eye bolt must not be rigidly attached to the end anchor. Both nut and jam nut are to be placed on outside of end anchor so that eye bolt is free to "wobble" in its support.

SECTION VII—TROLLEY MECHANICAL COMPONENTS.

7-1. TYPES OF DRIVES.

a. Standard trolley drive arrangements can be classified into three configurations which are described as follows and shown in Figure 7-1:

1. Double reduction helical gear reducers using a face mounted motor as shown in Figure 7-1A. The gear unit is mounted outboard of trolley side, with drive gear keyed directly onto axle. This arrangement is shown in Figure 7-1F. Wheel axles are one piece, extending across trolley gage, and to which both drive wheels are keyed. This arrangement uses a single bearing at each wheel.

2. Double reduction gear reducers using a worm for first reduction and helical gears for second reduction and with unit mounted outboard of trolley side. The output shaft is connected to drive axle by a full flexible coupling (see Figure 7-1B and 7-1C). The drive motor may be either face or foot mounted. Usually, if motor is face mounted, drive axle is one piece as described in 7-1a.1 above, with single bearings for each wheel. On larger trolleys, where foot mounted motors are used, the wheel is carried by short axles with a bearing on either side of wheel. This type uses a separate shaft extending across gage to connect drive axles. Refer to Figure 7-1G.

3. This drive arrangement, shown in Figure 7-1D, has speed reducer mounted between drive wheels. Drive consists of a foot mounted motor flexibly connected to either a double or triple reduction helical gear reducer. Double extended output shafts of reducer are rigidly coupled by means of short shafts, to wheel drive axles.

7-2. SPEED REDUCERS.

a. General: Trolley traverse speed reducers are described by following three basic types:

1. In-line all helical gear, double reduction units.
2. Worm reducer consisting of a high speed worm reduction coupled with a helical gear second reduction.
3. Parallel shaft double or triple reduction all helical gear unit.

b. Construction: A general description of each of the three types of units used follows:

1. The reducer identified in paragraph 7-2a.1 above is constructed in cast aluminum, and is ball bearing equipped. Gearing is helical type with all gearing and bearings oil splash lubricated. The drive gear is keyed to wheel axle and held on axle by a retaining ring. The motor pinion is keyed to motor shaft and held by a retaining washer and self locking cap screw.

2. The reducers identified in paragraph 7-2a.2 may be constructed in cast iron, cast aluminum or welded steel depending upon size, and are further classified as arranged for face mounted motors or foot mounted motors.

(a) Face mounted motor types usually have motor mounting cast as an integral part of gear case housing. The input shaft is splined to receive a slip on splined coupling. All shafts are carried on ball bearings, which are mounted

directly into bored seats in housing. The bearings are pressed on their shafts against a positioning shoulder and held in place by retainer plates. These retainer plates are held by cap screws into housing. All bearings are oil splash lubricated except the bearing on worm shaft directly opposite the motor, which is grease lubricated. Gears are pressed on and keyed to their shafts. Lip type oil seals are used where shafts extend out of speed reducer. These seal lips must be pointing toward inside of reducer when unit is reassembled.

(b) Foot mounted motor types have no provision for face mounting, or adapter mounting of motor. The input and output shaft extensions are equipped with standard parallel keys. The worm shaft, and worm gear shaft are held by tapered roller bearings pressed against shaft shoulders. Shafts are held in place by retainer plates secured by cap screws. Shim sets are provided for use in adjusting bearing tightness and also for positioning worm gear to worm. These shims are arranged to fit between housing and bearing retainer. Bearings supporting output shaft may be either ball or self aligning roller bearing type. Regardless of type, bearings are pressed onto shaft against locating shoulders, and held in place by retainer plates secured by cap screws. All bearings are oil splash lubricated. Gears are pressed on and keyed to their shafts. Lip type oil seals are used where shafts extend out of reducer. These seals must be arranged with lips pointing toward the inside of the reducer when unit is reassembled.

3. The reducers identified in paragraph 7.2.a.3 above are identical in type and construction to those used for bridge drives. Refer to SECTION VI for a detailed description of construction, inspection and maintenance.

c. Inspection and Maintenance — Inspection of these reducers should include, but not be limited to, the following:

1. Worm and worm gear teeth as well as helical gear teeth are to be checked for wear pattern (tooth alignment), galling, spalling or other signs of abnormal tooth conditions. Spalling and/or galling of teeth may indicate lubrication failure (improper selection of lubricant) or overloading of reducer.

2. The back lash of the worm gear set should be measured and recorded. In this manner wear rate can be established and control of replacement parts maintained.

3. All shafts should be checked for end play, looseness of bearing fits and general alignment.

4. Motor shafts should be rotated by hand to insure freedom of rotation. (This will require disconnection of input and output couplings.)

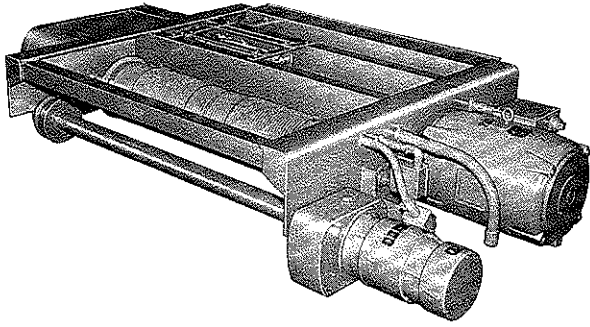
5. Bearings should be inspected for obvious visual defects (pitted or rusted surfaces, etc.) and if condition is doubtful, rotate by hand in order to "feel" smooth rotation. Bearings which do not rotate freely are to be replaced.

6. Check lubricant for freedom from water, metal particles, sludge or other contamination resulting from the surrounding environment.

7. Periodically clean air breathers.

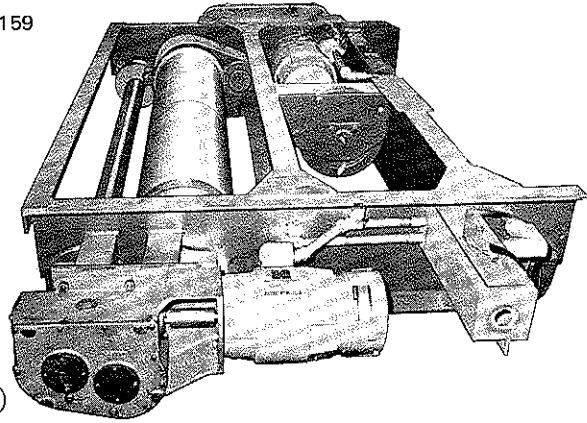
8. In assembling gear case after disassembly of worm shaft or worm gear shaft, be certain that all shims used are

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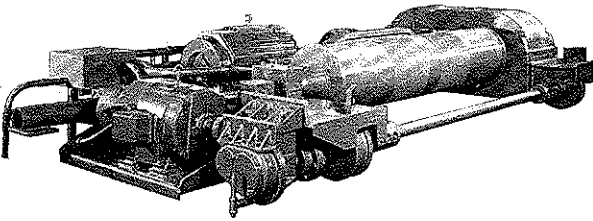
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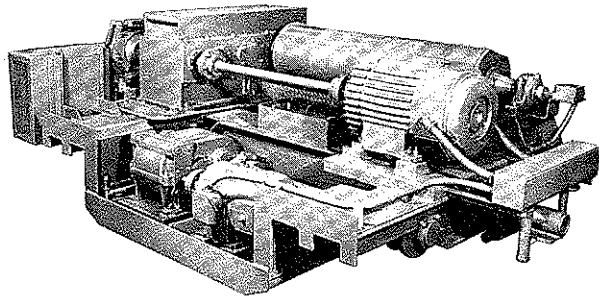
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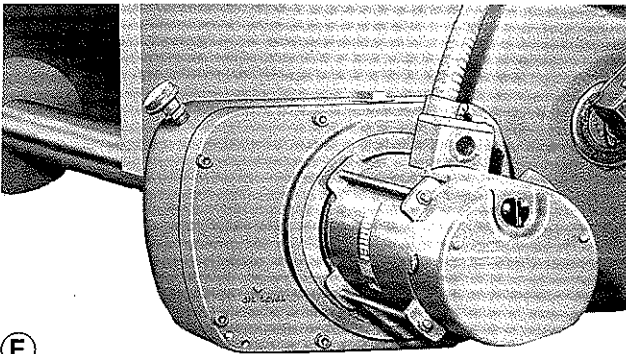
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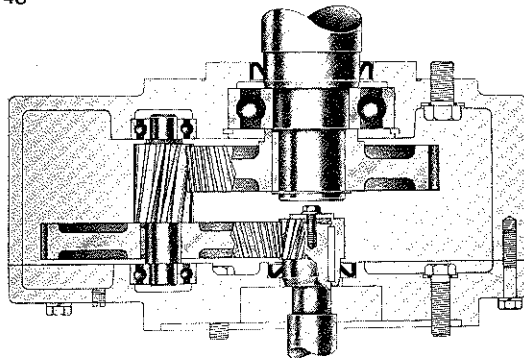
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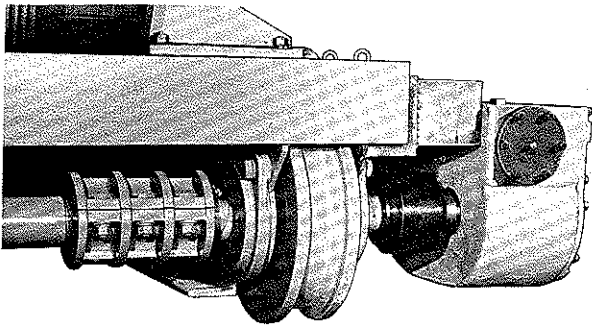
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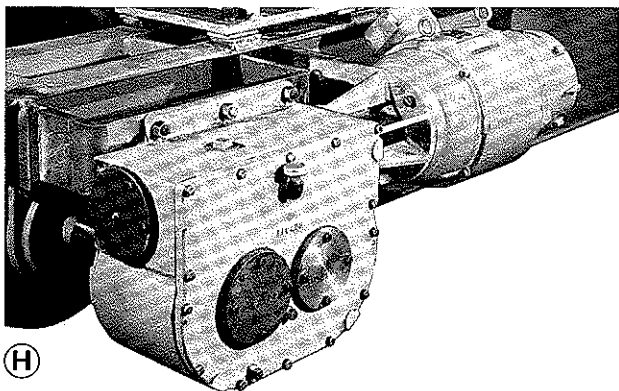
(F)

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(G)

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(H)

Figure 7-1. A through H Trolley Drive Arrangements.

replaced in the exact manner in which they were removed. Severe misalignment may result if these shafts are improperly shimmed.

9. For schedule of lubrication and maintenance refer to SECTIONS IX and X.

7-3. BRAKES. Trolley traverse brakes, where used, are either shoe type, spring set, electrically released, or motor mounted disc type which is also spring set, electrically released. A complete description of these brakes is given in SECTION V, ELECTRICAL.

7-4. COUPLINGS. Couplings used on trolley for connection of motors to speed reducers, or of output shaft of reducer to drive axle are exact same type as described in SECTION VI.

7-5. WHEEL ASSEMBLY.

a. General. Flat or straight treads are used for both driver and trailer wheels on all trolleys. These wheels have a "float" allowance of approximately 3/8" (.981 cm). That is, distance between inside flanges of wheels is 3/8" (.98 cm) wider than width of rail head on which they operate. Driver wheels must be mated to insure correct operation.

b. Construction. Two types of arrangements are used in trolley wheel assemblies. These are described as single bearing or double bearing. A further description of each follows:

1. Single bearing. Refer to Figure 7-2. This design employs a single driver axle extending across the trolley gage terminating into one trolley side, while extending through the opposite trolley side for coupling to speed reducer. Driver wheels are pressed and usually keyed onto the axle against a locating shoulder machined on the axle. A single ball bearing or self aligning roller bearing is also tightly fitted to the axle outboard of each wheel. These bearings are held in flanged capsules. Capsules are fitted to a machined bore in the trolley side, and held in place by bolts which clamp capsule to trolley side. The axle holding trailer wheels, duplicates driver axle except that it is not extended for coupling to reducer.

2. Double bearing. Figure 7-3 shows typical construction and arrangement of this type wheel axle and bearing assembly. The wheels are pressed and keyed onto axle against a locating shoulder machined into the axle. The assembly uses either ball bearings or self aligning roller bearings which are tightly fitted to axle. These bearings are usually held in flanged capsules. Capsules are fitted to machined bores in trolley sides, and held in place by bolts which clamp capsule to trolley side. An alternate method of securing the capsule is also shown in Figure 7-3. The assembly shown uses sealed ball bearings which prevents grease escaping past the bearing on the wheel side. When roller bearings are used, the bearing capsule extends over the closely machined hub of the wheel to form a labyrinth type grease seal. The trailer assembly duplicates the driver except the keyway and key are eliminated.

c. Inspection and Maintenance. The schedule for inspection and maintenance is outlined in SECTION X and is to be followed along with these points:

1. Check wear pattern on the wheel tread surface and flanges for signs of galling, spalling or cracking. Wheels showing these kinds of problems should be replaced.

2. The full length of the bridge (trolley) rail is to be checked for abnormal wear, such as mushrooming of the head over the sides of the rail head, and scheduled for replacement if conditions warrant. The rail should also be examined for loose rail clamps, bad joints or cracked welds on cranes where the bridge rail is welded to the girder. If any of these conditions are found, immediate corrective action should be taken.

3. Check the circumference of the driver wheels by a cloth tape. Variations exceeding 1/32 inch (.08 cm) between driver wheels is cause for replacement.

CAUTION

Driver wheels should only be replaced in matched pairs.

4. Inspect wheel assemblies for looseness of the wheel on axle, axle in bearing or the bearing in the capsule. Jack driver wheels free of the rails, disconnect drive coupling and rotate wheels by hand. In this manner, bearings having defects can be felt. Replace bearings if found defective.

5. Check for adequacy of lubrication.

6. Check all bolts for tightness and retighten if required.

7-6. TROLLEY COLLECTORS AND BRIDGE CONDUCTORS.

a. Trolley collectors are devices which contact bridge conductors and provide a continuous supply of electrical current to hoist and trolley electrical systems, as trolley moves back and forth across bridge. Because of the magnitude of variations in sizes and types of collectors, a detailed description of each type is prohibitive. However, the specific collector used on your crane will be identified in Customized Parts Identification Manual issued for your crane. A brief description of most frequently used types are as follows (bare wire is not used on new installations):

1. Bare copper wire. Refer to Figure 7-4. In this system, bare round hard drawn, copper wire is stretched along the bridge girder. The ends of these wire conductors are terminated into structural end anchors, attached to the bridge girder, by insulated eye bolts. These eye bolts are fabricated with a generous length of threaded rod for use in providing proper tension to the conductor. Intermediate supports (wire carriers) are spaced at intervals of approximately 16 feet (4.88 m). These wire carriers are molded from a resilient insulating type material, which has sufficient strength to support a portion of weight of conductor. Also as can be seen from Figure 7-4 the vertical portion extends upward and nearly touches the bottom side of the carrier immediately above so as to completely capture the wire. Procedure for correct tensioning of the wire is as follows:

WARNING

The main disconnect switch serving the runway is to be locked in open position whenever working on trolley collector or bridge conductors.

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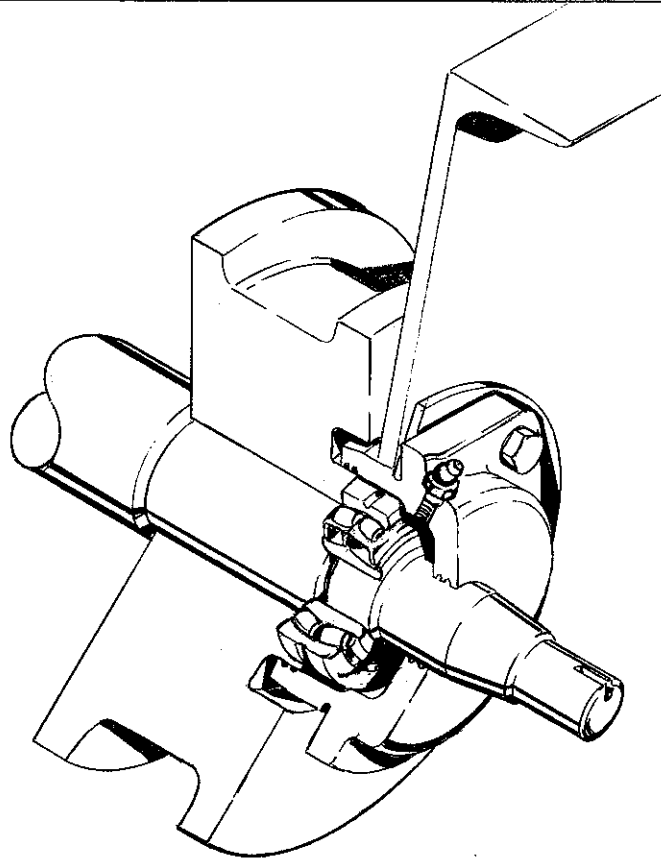


Figure 7-2. Single Axle Bearing Wheel Assembly.

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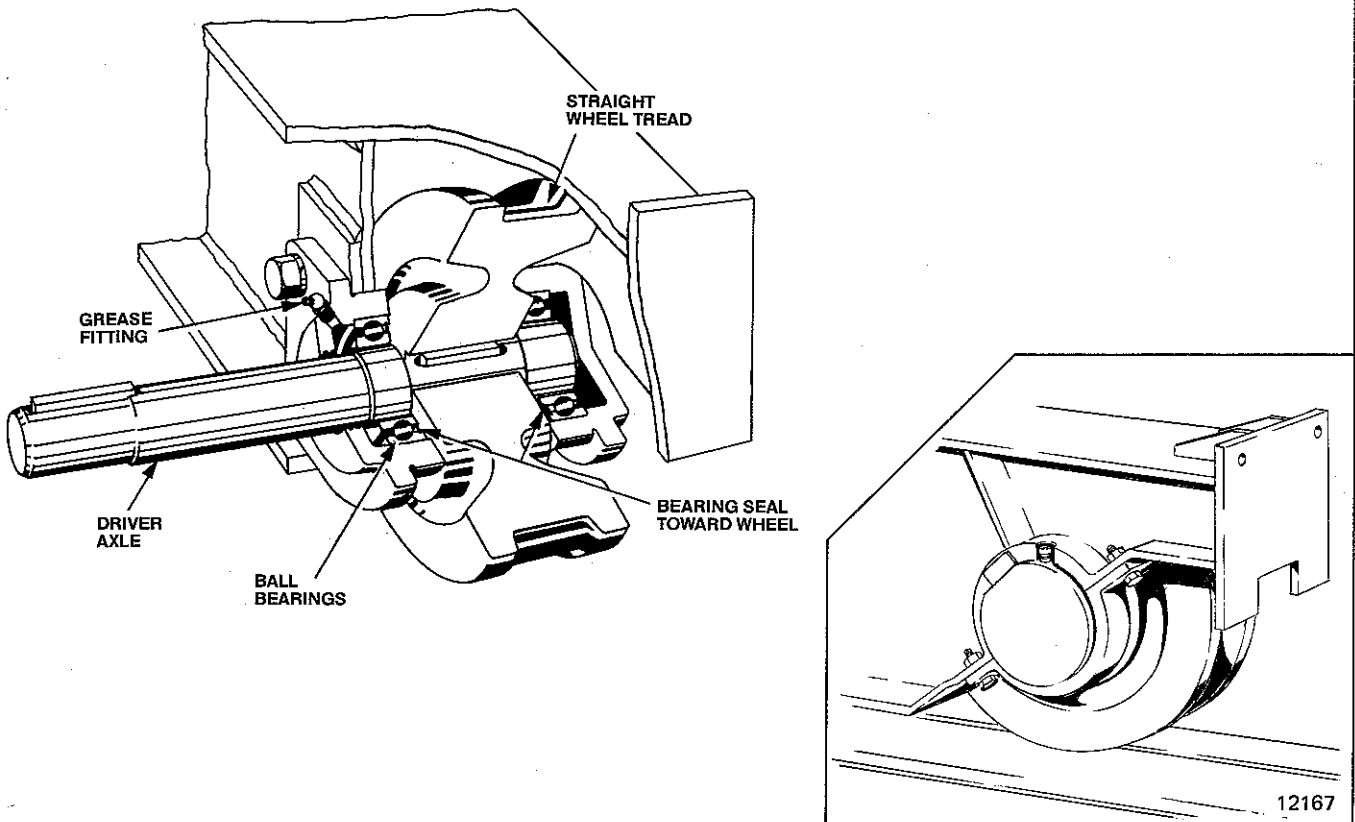


Figure 7-3. Double Axle Bearing Wheel Assembly.

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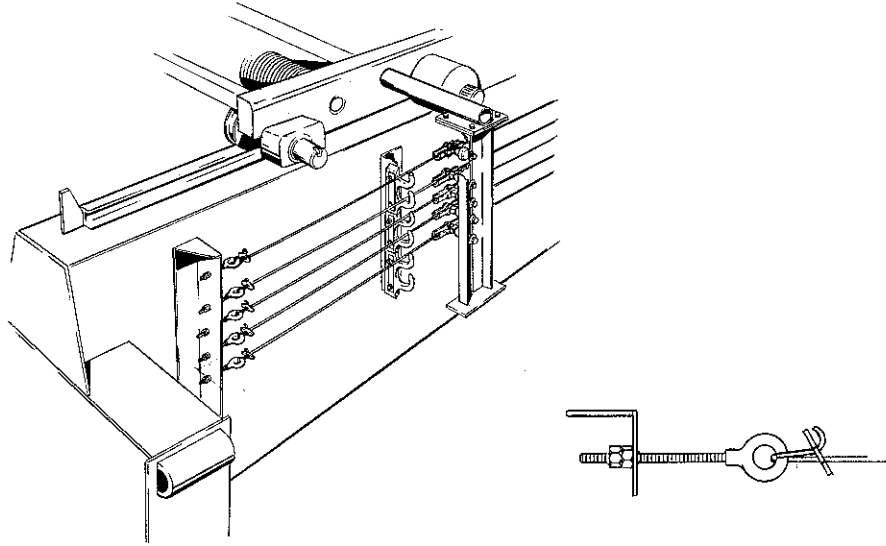


Figure 7-4. Bare Wire System.

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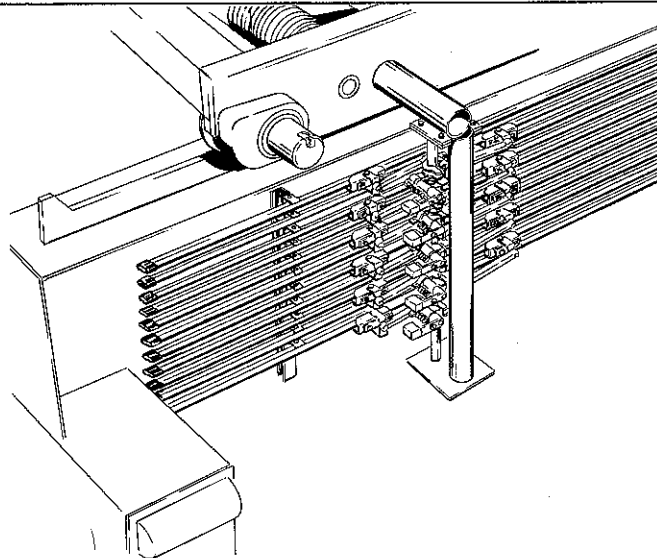


Figure 7-5. Insulated Figure "8" System.

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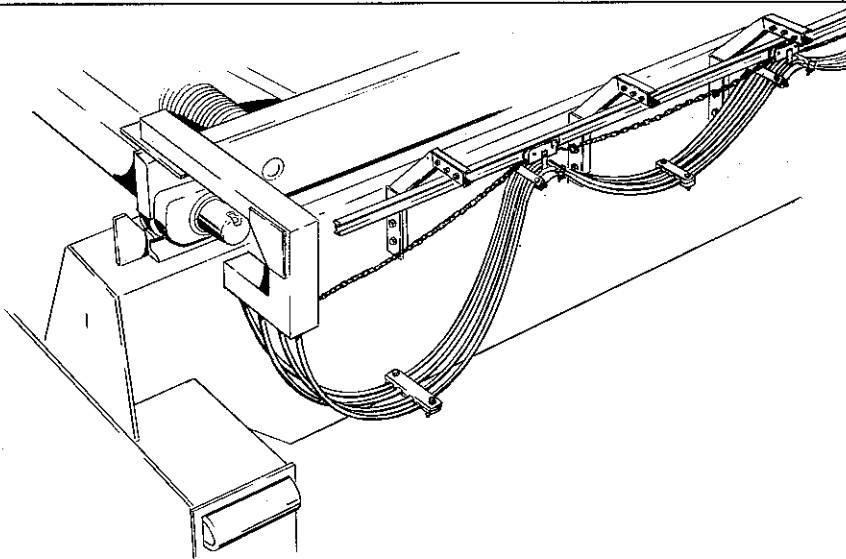


Figure 7-6. Festooned Cable System.

(a) Remove collectors so that they do not contact conductors.

(b) Tighten wires until a small amount of sag exists. Wires when properly tightened, will drape slightly on the intermediate wire carriers allowing them to support a portion of the conductor weight.

CAUTION

Be certain that insulated eye bolt is fastened to end anchor so that both nuts are outside of end anchor. This allows eye bolt to "wobble" in the support.

Proper vertical adjustment of collector shoes to wire conductor is made by positioning trolley at its extreme hook approach. In this position, collector shoes are set 1/4 inch (.64 cm) above conductor positioning hole in end anchor.

After adjusting collectors as above, move trolley to extreme opposite hook approach. As collector shoes pass each intermediate support, make certain that they clear horizontal portion of support. At the extreme opposite hook approach, check that collector is lifting wire 1/4 inch (.64 cm) above conductor positioning hole in end anchor. The collector is a rigid shoe type, free to pivot, which is insulator mounted to a steel bracket fastened to trolley. Contact pressure is made by collector shoe lifting and supporting a portion of conductor weight. Permanent lubrication of shoe contact surface is by means of graphite lubricant, which is impregnated into bronze casting.

2. Insulated Figure "8" bar. Refer to Figure 7-5. This collector system is completely described in SECTION VI, paragraph 6-7a.3. Figure 7-5 shows a "lateral" type installation in which collectors operate in a horizontal plane. In this application conductors are mounted outside of rear bridge girder.

(a) A vertical type mount similar to that shown in SECTION VI, Figure 6-16, is also used for bridge conductor systems. The vertical system is generally used for outdoor installation, and depending upon application may be covered with a full length shield.

3. Festooned cable.

(a) Refer to Figure 7-6. This system is more adequately described as a collectorless system because separate collectors are not used. The system consists of several multi-conductor cables which have one of their ends terminated

in a junction box fastened to bridge girder. The cables are looped out across the span of bridge reaching hoist trolley, which for this illustration is positioned at the end opposite the bridge junction box. At each loop (number depends upon the bridge span) the cables are clamped by foamed PVC (polyvinyl chloride) material to a curved steel plate. This plate is suspended by hanger clamps from a four wheel carrier trolley supported by a small steel I-beam. The beam is cantilever supported to bridge girder. At hoist trolley, cables are anchored to a structural pick-up bracket and ends terminated at various motors and devices which they serve. A sturdy chain connecting each carrier trolley is used to take all the effort in pulling the system, thus relieving electrical cable of any strain. With hoist trolley in its extreme position, as shown in Figure 7-6, electrical cable must sag no less than a distance equal to 10% of distance between carrier trolleys. The first loop from hoist-trolley bracket, and from bridge terminal box should have a sag of approximately 25%. The hoist-trolley in traversing back and forth across bridge cause loops of cables to sag to a greater or less degree.

(b) Other festooned systems (not shown) using different hardware from that described above may also be furnished depending upon total number of electrical cables involved as well as service for which crane was specified. A popular system which is used very frequently when only one or two multi-conductor cables are required consists of a Uni-strut type track equipped with small trolleys each supporting cable loop by a formed sheet steel hanger plate. The system description is very similar to that described above.

b. Inspection and Maintenance.

WARNING

The main disconnect switch serving the runway is to be locked in open position whenever working on the trolley collectors or bridge conductors.

1. Inspection and maintenance of bare wire and insulated Figure "8" system is similar to that given in SECTION VI, paragraph 6.7b.

2. The festooned system requires checking carrier trolleys for wear and adequate lubricants when wheels are equipped with grease fittings. Also check tightness of all bracket bolts, cable clamps and fastening of chain at each trolley. Terminal connections of all conductors should be checked for loose bolts or improper contact.

SECTION VIII — HOIST MECHANICAL COMPONENTS

8-1. TYPE OF DRIVES

a. Standard hoist drives can be classified into three configurations which are described as follows and shown in Figure 8-1.

1. Hoist motor, face mounted on the rear trolley side outboard of the gage and connected to the speed reducers' input shaft by means of a shaft extending across the trolley gage. On trolleys equipped with a single hoist, this shaft passes through the sheave pin of the upper block. This sheave pin is hollow and serves as a bearing support for the connecting shaft. The double reduction speed reducer is vertically mounted on the front trolley side outboard of the gage. This type of drive is shown in Figure 8-1A.

2. Hoist motor, face mounted on the front trolley side, directly coupled to the speed reducer input shaft. The double reduction speed reducer is also vertically mounted on the front trolley side outboard of the gage. The output shaft of this reducer passes through a clearance hole in the trolley side and terminates in the drum speed reducer. The drum speed reducer located inboard of the gage is also supported by the front trolley side. Figure 8-1C is typical of this type drive.

3. Hoist motor, foot mounted to the trolley frame and directly coupled to the speed reducer input shaft, or connected by means of a long floating shaft to the reducer input shaft. The speed reducer which may be either double or triple reduction is bolted to the top of the trolley side, or is welded to form an integral part of the trolley side. A shoe type magnetic brake is foot mounted to a steel support outboard of the reducer on the extended motor pinion shaft. Figure 8-1E shows a typical arrangement of this drive.

b. These hoist drives may incorporate an eddy current control brake. Refer to SECTION V paragraph 5-4.d. for a description of control. When an eddy-current brake is used, it is foot mounted and placed between the motor and the speed reducer, except for the drive described in 8-1.a.2. above. In that drive the eddy current brake is foot mounted and coupled to the extended motor shaft.

8-2. SPEED REDUCERS

a. General. Hoist speed reducers can be divided into the following types.

1. Vertically split housings with the housing bolted to the trolley sides. This type reducer is shown in Figure 8-1B and 8-1D. This double reduction unit is usually equipped with a cast aluminum housing and helical gearing. Shafts are carried on ball bearings, except that the load brake shaft for the arrangement shown in Figure 8-1D, uses a self-aligning roller bearing on the pinion end. A spider bolted to the gear case housing forms the support for one end of each shaft. The units shown are equipped with a roller ratchet type of mechanical load brake. Certain types of controls incorporating electrical control braking, such as eddy-current

braking, do not use a mechanical load brake in the gear train. With those types, the mechanical load brake is replaced by an intermediate shaft with an integral pinion on which the motor gear is pressed and keyed. As shown in Figure 8-1D, this gearcase is also used in conjunction with a drum speed reducer. This drum reducer is welded to the trolley side as shown in Figure 8-1D. The double reduction units described above are usually equipped with an internal motor disc brake which is actuated by either a single or double coil actuator.

2. Horizontally split housings, with the housing either bolted or welded to the top of the trolley side. This type reducer is shown in Figure 8-1F, and is usually arranged for three reductions of helical gearing. Bearings may be either ball or self-aligning roller bearings, but regardless of the type, are held in position by retainers bolted to the gearcase. Gears are pressed and keyed to their shafts, while the pinions may be integral with the shaft. Housings are of welded steel. The brake drum is mounted on the extended motor pinion shaft by means of a tapered fit and lock nut. A single thrust bearing on the drum shaft in the reducer is held in position (fixed) and so attached to the shaft so that it does not allow axial movement of the drum. The illustration shown does not have a mechanical load brake. When a mechanical load brake is used it is mounted on the motor gear shaft, and is of the pawl and ratchet type. The brackets holding the pawls are welded to the bottom of the lower half of the reducer.

b. Inspection and Maintenance. In general, the inspection and maintenance of these speed reducers follows the same procedure as that outlined in SECTION VI. However, the reducer described in 8-2.a.1. will be further discussed in paragraph 8-6 Mechanical Load Brakes.

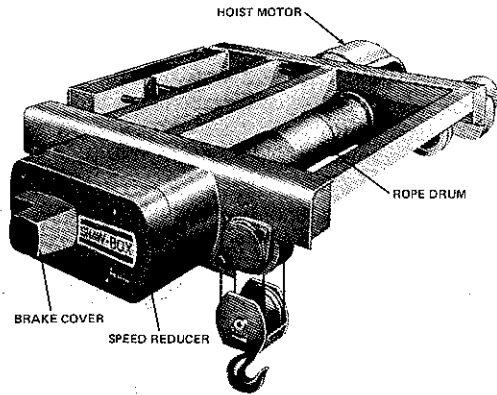
8-3. COUPLINGS.

Connection of the hoist motor to the speed reducer is made by various types of couplings previously described in SECTION VI. However, in some cases, where face mounted motors connect to reducers of the type shown in Figure 8-1D, a solid rigid barrel type coupling is used. This coupling is splined on one end and keyed on the other to fit the reducer shaft and motor shaft respectively. Refer to SECTION VI for inspection and maintenance of these couplings.

8-4. ROPE AND ROPE DRUMS.

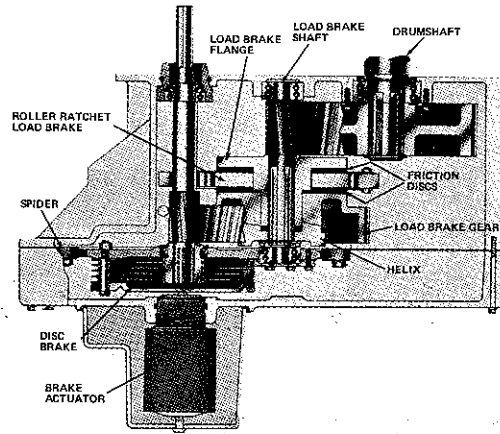
a. Rope Construction. The type and construction of wire rope used for hoisting cable on overhead cranes varies through a wide range depending upon the application, environment, usage and other factors. These ropes may be furnished in Bright Steel, Stainless Steel, Galvanized and other types of material and protective coatings. The strength of the rope, along with other properties such as fatigue life, wear resistance, etc., is materially affected by this wide choice of materials and construction. For a more complete understanding of this subject, contact any of the major rope manufacturers, most of whom have highly informative handbooks covering construction, care, lubrication and maintenance of rope. For identification of component parts of hoisting rope see Figure 8-2.

(A)



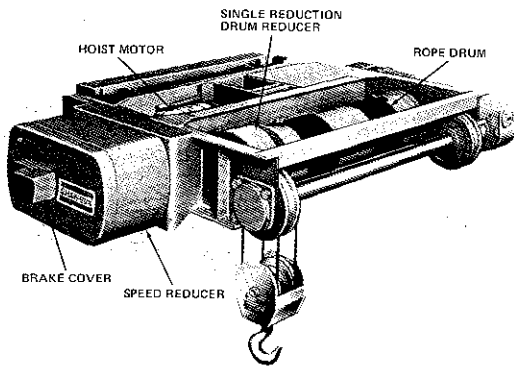
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(B)



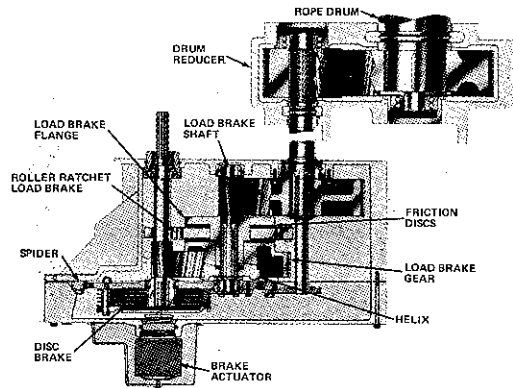
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(C)



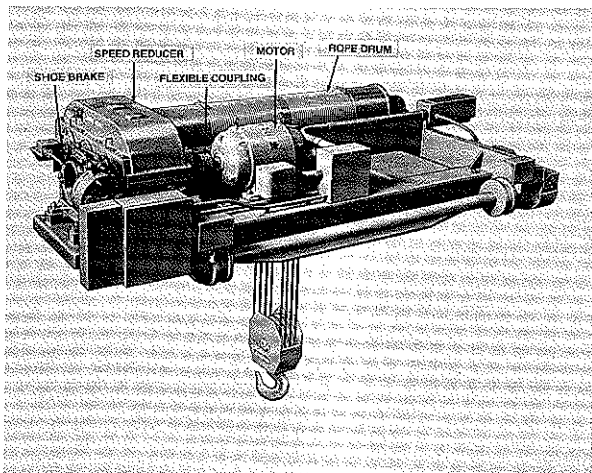
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(D)



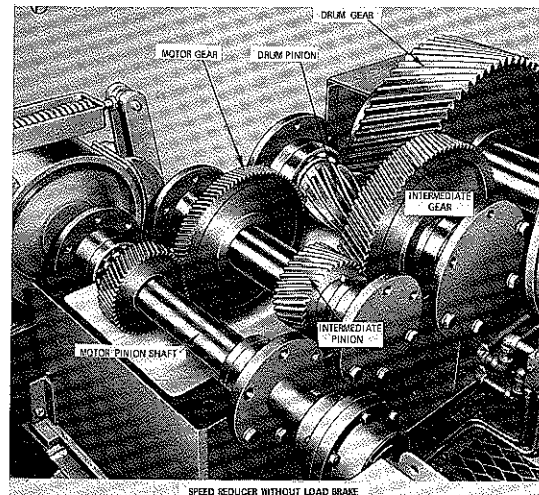
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(E)



11755B

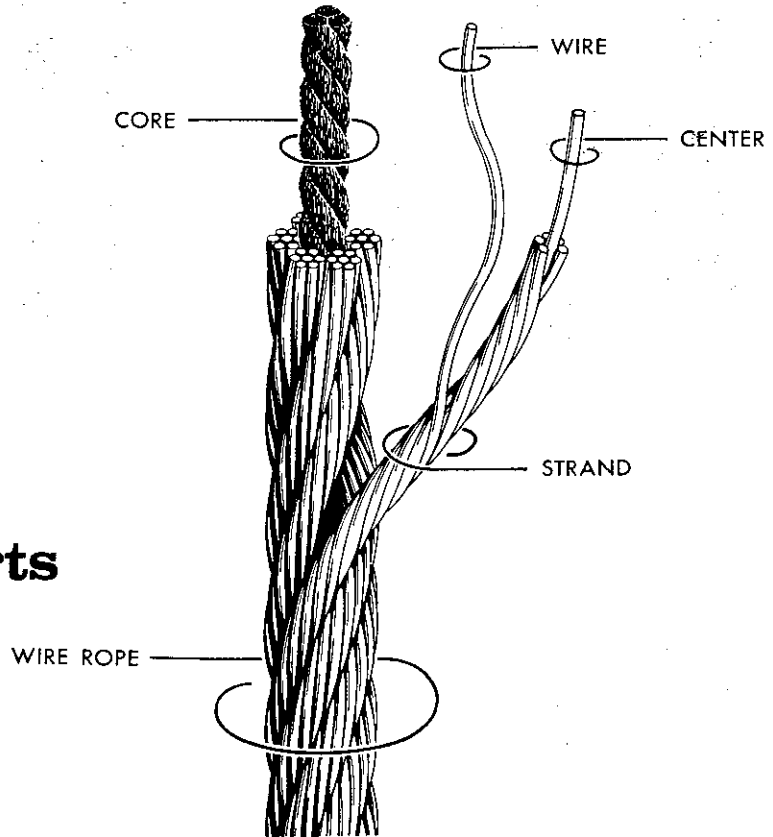
(F)



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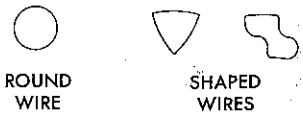
Figure 8-1. Hoist Machinery Arrangements.

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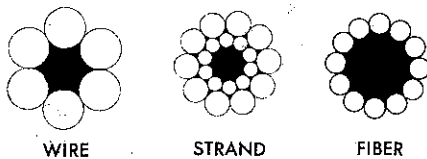
Component Parts

WIRE



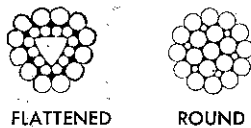
The basic element of a wire rope is a single metallic wire. It may be either round or shaped.

CENTER



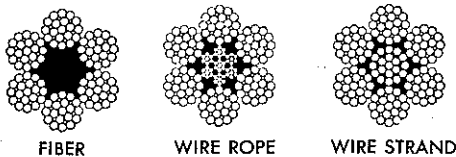
The center is the axial member of a strand about which the wires are laid. It may be cotton or polypropylene fiber or one or more wires.

STRAND



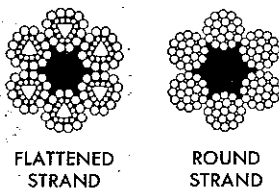
A strand is a plurality of round or shaped wires helically laid around a center in one or more layers.

CORE



The core of a wire rope is the axial member around which the strands are laid to form a wire rope. It may be either steel, natural fibers, or polypropylene.

ROPE



A number of strands laid helically around a core form a rope.

Figure 8-2. Component Parts.

CAUTION

Replacement rope must be equal to the original rope furnished with the crane. It is recommended that replacement rope be supplied only by the Crane Builder.

b. Rope Inspection. Hoisting rope is completely exposed to all sorts of external damage as a result of usage and environment, and is usually difficult to properly lubricate. This exposure to damage and lubrication problems make it mandatory that the rope be frequently inspected and maintained. All wire ropes will eventually deteriorate to a point where they are not safe and will require replacement. The schedule for inspection, lubrication and maintenance can be found in SECTION IX and X. The inspection of hoisting rope should be made by an authorized person and a determination made when further use of the rope would constitute a safety hazard. Inspections revealing, but not limited to, the following conditions should cause the inspector to question remaining strength of rope and consider replacement:

1. Reduction of rope diameter due to loss of core support, internal or external corrosion or wear of outside wires from nominal diameter of more than: 3/64 inch (1.19 mm) for diameter to and including 3/4 inch (19.05 mm); 1/16 inch (1.58 mm) for diameter 7/8 inch (22.22 mm) to 1-1/8 inch (28.57 mm) inclusive; 3/32 inch (2.38 mm) for diameter 1-1/4 inch (31.75 mm) to 1-1/2 inches (38.10 mm) inclusive. Correct method of measuring hoisting rope is shown in Figure 8-3.

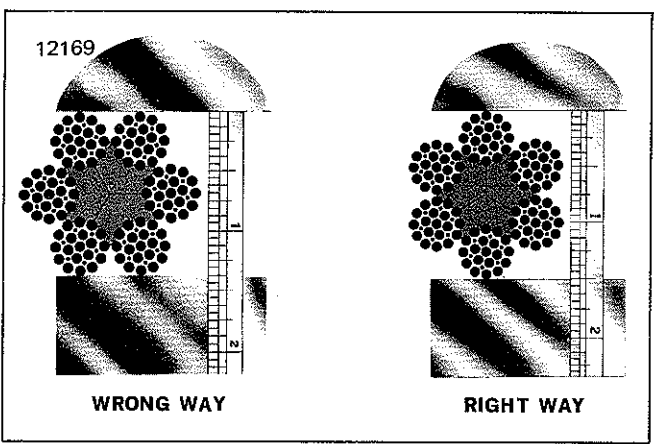


Figure 8-3. Correct method of measuring rope.

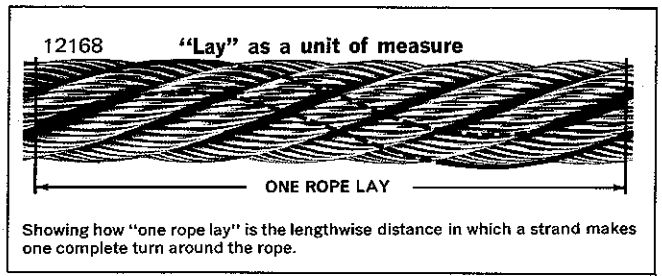


Figure 8-4. Description of one rope lay.

2. Broken outside wires exceeding twelve randomly distributed wires in one rope lay, or four broken wires in one strand in one rope lay.

3. Worn outside wires in which wear exceeds one-third of the original diameter of outside individual wires.

4. Sections of rope which may be hidden by the sheave housing or the rope passing over the equalizer sheave must be given close inspection as these are likely points for rope failure.

5. Corroded or broken wires at end connections or improperly applied end connections.

6. Severe kinking, crushing, bird caging or any other damage resulting in distortion of the rope structure.

7. Evidence of gross neglect of lubrication.

8. Ropes which have been idle exceeding one month due to shut-down or storage of the crane.

c. Rope Maintenance. Rope should be maintained in a well lubricated condition. It is important that those sections of rope which are located over sheaves or otherwise hidden be given special attention when lubricating. Proper lubrication reduces both internal and external wear of the individual wires, and also provides some protection from corrosion. If the rope is to be stored, proper precaution is to be taken so that damage or deterioration does not occur. Correct handling of the rope has been previously discussed in SECTION II, paragraph 2-8. Cutting of the hoist cable is not recommended, however, if cutting is required rope must have seizings applied to the rope on each side of the place where the rope is to be cut.

On pre-formed rope, one seizing on each side of the cut is required. On non-pre-formed ropes of 7/8 inch (22.2 mm) diameter or smaller, two seizings on each side of the cut are required, and for 1 inch (25.4 mm) diameter and larger three seizings must be used. Each seizing should consist of 8 closely wound wraps of seizing wire. The distance between seizings should be equal to one rope diameter, except where cut is to be made. Distance should be increased if cut is by torch. Seizing should be fully annealed iron wires. For rope up to and including 7/8 inch (22.2 mm) diameter, seizing wire is .063 inches (1.60 mm) diameter; and for rope 1 inch (25.4 mm) up to 1-1/2 inches 38.10 mm) diameter, seizing wire should be .092 inches (2.93 mm) diameter. Cutting may be accomplished by practically any method which produces a clean cut. Flame (torch) cutting, when properly done, leaves the wire ends welded together.

d. Rope Drums. Rope drums are of all welded steel construction, with stub ends machined for the gear and bearing fits. Balanced reeving is used which provides for two ropes operating on the drum in machined right and left hand grooves. Each end of this rope is anchored to the drum by a curved steel plate held to the drum by taped bolts and lock washers. The rope straddles these bolts and is captured between the groove in the drum and the curved plate. Bolts should be tightened until they flatten the lock washers. Tightening of the bolts produces a clamping pressure which securely holds the rope in place. This anchorage is shown in Figures 2-12 and 2-13 in SECTION II.

e. Drum Inspection and Maintenance. Inspection should consist of, but not limited to, the following:

1. Check to insure that the rope clamps are in correct position and tightly clamped.
2. Check that the inactive rope on the drum has been properly lubricated.
3. Check the wear of the grooves in the drum and general condition of the drum grooves and land between grooves. (It is recommended that the bottom diameter of the drum groove is measured and recorded at the time crane is received and subsequently measured at inspection intervals. With this data, scheduled drum replacement can be determined.)
4. The drum bearing supporting the drum end away from the speed reducer should be checked for adequacy of lubrication and general condition.

8-5. HOLDING BRAKES.

a. General. Crane hoists are equipped with holding brakes which apply torque to the motor shaft sufficient to hold the load. Two styles are employed depending upon the type of crane. Cranes with hoisting drives as shown in Figures 8-1A through 8-1D use a disc type brake, operating in oil and mounted on the motor pinion shaft inside of the double reduction hoist speed reducer. Cranes with hoisting drives shown in Figures 8-1E and 8-1F are equipped with a shoe type, spring set, solenoid released electric brake. A complete description including adjustment, inspection and maintenance of the shoe brakes used is given in SECTION V Electrical. The remaining discussion will involve only the internal disc brake.

b. Construction. The internal disc brake is a spring set, solenoid released electric brake which operates in the gearcase lubricant. The brake consists of four brake discs which are fastened to the motor pinion shaft by means of a spline, and which revolve with the motor shaft. These discs are separated by stationary plates to which friction lining is bonded. The stationary plates slide over pilot studs fastened to the spider and which prevents the discs from rotating. Each stationary plate is separated by small springs mounted on the pilot studs. These springs act to separate each disc when the brake is released. The final stationary plate is solid (referred to as the compression plate), and post

mounted. Retaining rings on the pilot stud holds the assembly together. See Figure 8-5 below.

This portion of the brake is enclosed within the gearcase by the gearcase cover. The brake actuating mechanism is mounted on the outside of the gearcase cover. Earlier cranes use an AC actuating mechanism (Figure 8-7); later model cranes use DC.

c. Adjustment. Frequency of brake adjustment is dependent upon usage. The greater the usage the more frequently the brake will require adjustment. The brake should be checked for adjustment shortly after being placed into service and thereafter as your experience dictates. In addition to the following instructions, motor brake adjustment instructions may be found inside the brake cover.

WARNING

Before attempting Motor Brake adjustment be certain Crane Mainline Switch is locked in the open position with the hoist lower block resting on the floor.

Single Coil AC Brake (Top diagram — Figure 8-8)

1. Remove brake cover (see Figure 8-7).
2. Back off lock nut "A".
3. Measure distance from face of coil to outside of solenoid arm (see Figure 8-7).
4. Holding scale in same position as for above measurement, manually push solenoid arm to depressed position (see Figure 8-8). Read this measurement. The difference between the first and second measurement is the solenoid stroke (see Figure 8-8, point 'C'). The proper solenoid stroke is 1/2".

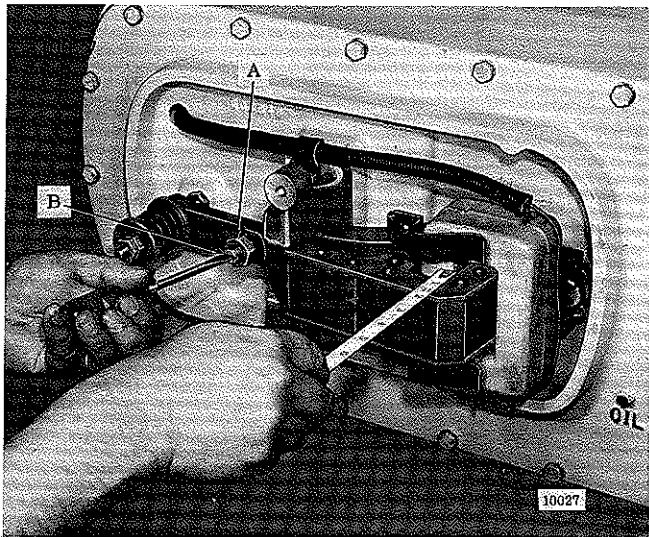


Figure 8-7. Adjusting Motor Brake.

5. Turn adjusting screw 'B' clockwise if stroke is more than 1/2" (counterclockwise if less than 1/2") and repeat step "4" above. Continue adjustment until arm stroke is 1/2". Retighten locknut 'A'.

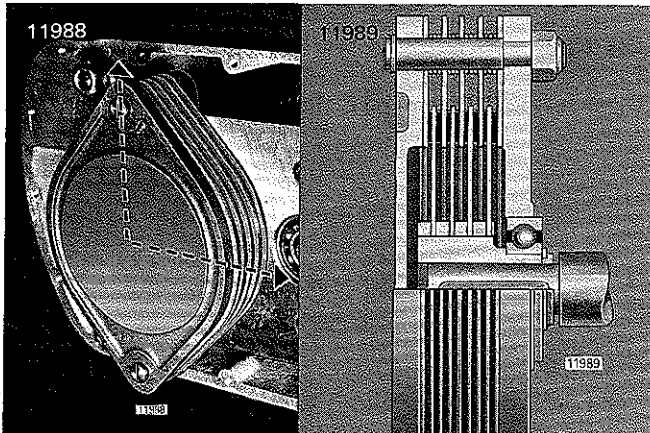


Figure 8-5. Motor brake friction plates.

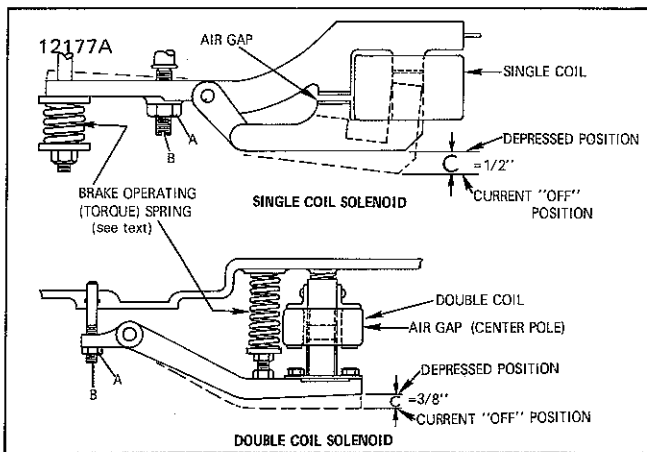


Figure 8-8. Recommended Solenoid Stroke.

6. To test air gap place a .002" feeler gage between magnet pole faces (located to the left of the coil). Manually push solenoid to "depressed" position. If the feeler gage is not free, remove the hoist from service and replace the magnet.

7. Do not adjust operating (torque) spring on opposite end of arm from coil. This spring is preset at the factory and usually does not require adjustment unless it has been tampered with or the brake arm has been removed. If it becomes necessary to reset this spring, proceed as follows:

(A) Manually push solenoid arm to depressed position.

(B) Adjust spring retaining nut so working length of spring over holding cups is 1-5/8" with brake arm in depressed position.

8. Replace brake cover.

9. If, after above adjustment, the load hook continues to "drift" downward more than normal for this hoist, check the general condition of solenoid coil, pole faces and make a complete inspection of motor brake actuating mechanism including friction surfaces.

Double Coil AC Brake (Lower diagram — Figure 8-8)

1. Remove brake cover.

2. Measure distance between center poles of moving and stationary core (visible between coils). With brake properly adjusted, the distance between poles "C" is 3/8" at the inside edge of the pole. (7/16" at the outside edge)

3. If adjustment is required, back off locknut "A" and turn adjusting screw "B" until poles are properly spaced with solenoid arm in current "off" position. (See Figure 8-8)

4. Manually push solenoid arm to depressed position. Using a .002" feeler gage, test air gap at the center pole face. If the feeler gage is not free, remove the hoist from service and replace the magnet.

5. Do not adjust operating (torque) spring. This spring is factory adjusted and usually does not require adjustment unless it has been tampered with or the brake arm has been removed. If it becomes necessary to reset this spring, proceed as follows:

(A) Be certain solenoid arm stroke has been adjusted to dimension shown in step "2" above. With arm in current "off" position exposed length of spring (between face of knurled bushing and raised portion of spring pocket) should be 3-5/8".

(B) To adjust, back off jam nut from knurled spring bushing. Rotate knurled bushing until exposed spring length is 3-5/8".

(C) Retighten jam nut securely.

6. If, after above adjustments, the load hook continues to "drift" more than normal for this hoist, check the general condition of the solenoid coil, pole faces and make a complete inspection of motor brake actuating mechanism including friction surfaces.

WARNING

DO NOT USE OR ATTEMPT TO REPAIR A DEFECTIVE BRAKE SOLENOID. Severe Damage And A Dropped Load Could Result.

DC Brake

1. Remove one hex socket button head cap screw from brake cover and then remove brake cover.

2. Loosen set screw at gear case cover.

3. Turn actuating mechanism clockwise, by hand, until it bottoms out and stops.

4. Back unit off (counterclockwise) 2-1/2 turns.

5. Insert rod, furnished with unit, through the brake cover attachment hole in the end of the body assembly until the rod bottoms against the plunger.

6. Actuate the hoist and visually measure the travel of the rod. It should be approximately 1/16 inch.

7. Screw actuating mechanism in or out, as required, to obtain rod travel of approximately 1/16 inch.

8. Retighten set screw.

NOTE: Do not overtighten set screw. Damage to actuator or gear case threads may occur.

9. Replace brake cover.

10. If, after above adjustment, the load hook continues to "drift" downward more than normal for this hoist, make a complete inspection of motor brake mechanism including friction surfaces.

WARNING

DO NOT USE OR ATTEMPT TO REPAIR A DEFECTIVE BRAKE BODY ASSEMBLY. Severe Damage And A Dropped Load Could Result.

d. Inspection and Maintenance.

WARNING

Before attempting removal of the Gearcase Cover be certain Crane Mainline Switch is locked in the open position and that all load is removed from the Drum by resting the Lower Block on the floor.

AC Brake Only

1. Remove two fillister head screws and lift brake cover from gearcase cover. Check general condition of solenoid coil or coils, base unit and lever assembly. Check freedom of brake plunger. If coil shows evidence of over-heating or pole faces of the lever unit and the base unit entering coil are damaged, they should be replaced. Also check that coil spacer and shading strip are properly seated on base unit.

2. Check adjustment of brake lever as outlined in 8-5.c. above.

3. If conditions warrant that inspection of the brake discs is required (Figure 8-9 below) drain oil from gearcase. Disconnect solenoid coil leads at connection near the solenoid. Remove hex head cap screws which secure gearcase cover to the gearcase. Remove gearcase cover with attached motor brake actuating mechanism from gearcase.

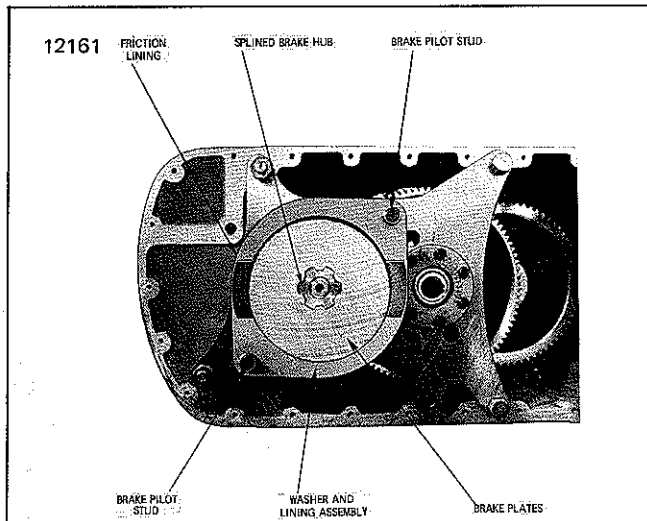


Figure 8-9. View showing friction discs.

DC Brake Only

1. Remove one hex socket button head cap screw from brake cover and lift brake cover off.

2. Unplug electrical leads and loosen set screw in gear case cover. Turn actuating mechanism counter-clockwise, by hand or with a plumber's strap, and remove from gear case cover.

3. Check to see that brake plunger moves freely. Inspect for evidence of overheating or other damage.

4. Replace all worn or damaged parts. Operating spring on actuating mechanism is color coded for brake torque; when replacing spring use spring having same color code. When replacing body assembly, also replace brake operating spring.

5. If conditions warrant that inspection of the brake discs is required (Figure 8-9 above), drain oil from gear case. Remove brake actuating mechanism per Paragraphs 8-5d. 1. and 8-5.d. 2. above. Remove hex head cap screws which secure gear case cover to the gear case. Remove gear case cover from gear case.

AC and DC Brake

1. Remove retaining rings from the brake pilot studs and lift off the compression plate. Lift off washer and lining assemblies, release springs, and motor brake plates. (Note for re-assembly, that two of the washer and lining assemblies have friction surfaces on one side only and must be replaced at each end. Three washer and lining assemblies, with friction surfaces on both sides and release springs, are replaced between the motor brake plates; see Figure 8-5.) Check motor brake plates for warping, scoring or other signs of deterioration. Also check spline fit of motor brake plates to the brake hub for gouging, mushrooming of the plates or other signs of distress or wear. Replace plates if these conditions are found. Brake plates which are replaced because of spline wear should also receive a replacement brake hub. Check condition of friction material on the washer and lining assemblies, and replace assemblies if required. Reinstall brake plates, release springs, and friction washers in sequence as shown in Figure 8-5 and replace retaining rings. Clean and flush gearcase and replace gearcase cover using a new gasket. Refill with new lubricant.

8-6. MECHANICAL LOAD BRAKES.

a. General. Where mechanical load brakes are used in the crane hoist gear system, they are of the "Weston" type, and operate automatically. Brakes are located within the gearcase and operate in the gearcase lubricant.

b. Construction. Refer to Figure 8-1B. As previously noted, two styles of load brakes are standard. A roller-ratchet type is used on crane hoists with speed reducers of the type shown in Figures 8-1A and 8-1C. A pawl and ratchet type is used with reducers shown in Figure 8-1E. The difference between these is primarily in the method used to prevent rotation of the brake in the lowering direction. As shown in Figure 8-1B the roller-ratchet brake is incorporated on the shaft next to the input (high speed) shaft and consists of the load brake flange, friction discs, load brake ratchet, gear with helix machined into the face of the hub and the helix which is splined to the shaft, all assembled as shown. The pawl and ratchet type is assembled as shown in Figure 8-10.

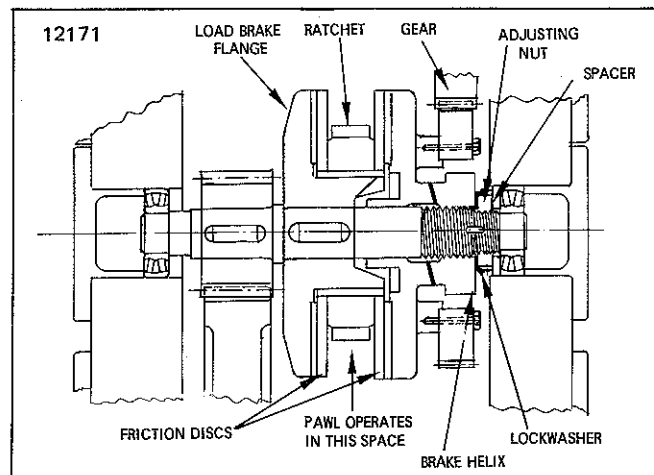


Figure 8-10. Assembly of pawl-ratchet load brake.

Notice that the major difference is in location of the pawl and ratchet and that the helix is threaded to the shaft.

c. Operation. Figure 8-11 shows the action of the roller-ratchet load brake in both hoisting and lowering. The slots cut into the ratchet are sloped in a manner which forms a clearance between the rollers and the retaining plate (outer race) when the ratchet is rotated in the hoisting direction. However, when rotating the ratchet in the lowering direction, the slot slopes so as to force the roller into a wedged position. This action stops the ratchet from further rotation.

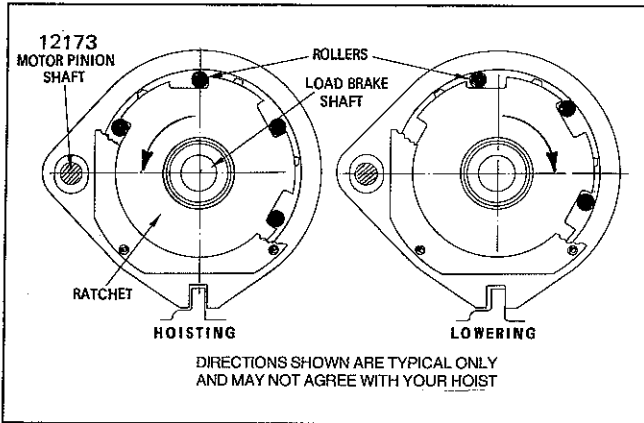


Figure 8-11. Illustration of roller-ratchet brake.

Figure 8-12 is a similar illustration of the pawl and ratchet action during hoisting and lowering. In this arrangement, the pawls fit between the load brake flanges. The sides of the pawls are equipped with spring loaded brass plugs which are held in position by the load brake flanges. The brass plugs pressing against the load brake flange develops a frictional force on the pawls from rotation of the load brake flange causing the pawl to engage the sprocket teeth during lowering, and move away from the sprocket during hoisting.

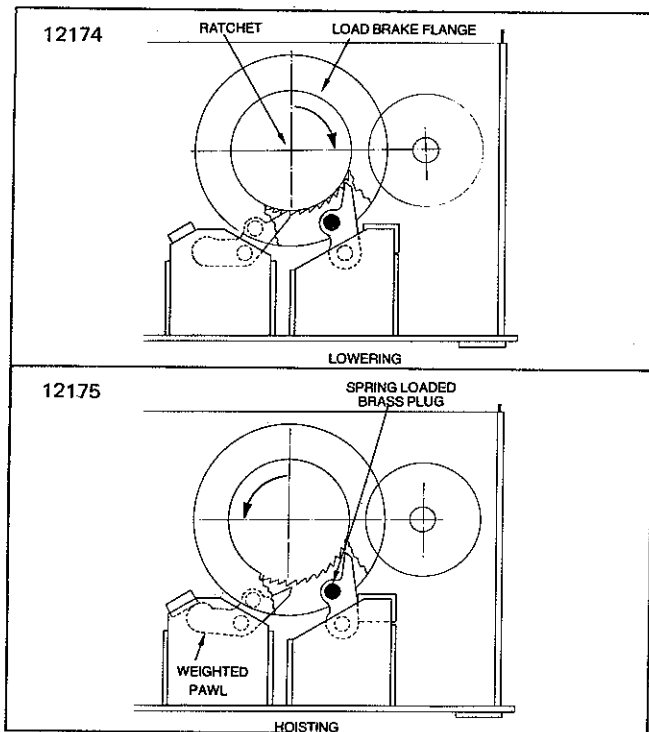


Figure 8-12. Illustration of pawl-ratchet brake.

d. Adjustment. The roller-ratchet load brake is non-adjustable. The pawl-ratchet type load brake does incorporate means for adjustment, however, adjustment should not be required except when replacing the friction washers or other parts of the load brake assembly. When adjustment is required proceed as follows: (Refer to Figure 8-10.)

1. Loosen lockwasher lug from the locknut.
2. Tighten locknut against the brake helix until all friction parts are in tight contact.
3. Loosen locknut approximately 1/4 to 1/2 turn.
4. Secure locknut in this position by bending lug of lockwasher into a slot in the locknut.

5. Be certain spacer washer is in place, washer is only a spacer and does not fit tightly between the nut and bearing.

e. Inspection and Maintenance.

WARNING

Lock Crane Mainline Switch in the open position and be certain that all weight is removed from the Hoist by resting the Hook Block on the floor before working on the Mechanical Load Brake.

Inspection of the pawl-ratchet load brake assembly can be made by removing the gearcase cover, and if further inspection of the parts is required the complete shaft assembly can be lifted out and removed to a bench. To inspect the roller-ratchet brake and gearing, drain oil from the gearcase, remove brake cover, and disconnect solenoid coil leads at connection near the coil. Remove gearcase cover by removing the hex head cap screws holding cover to the case. Remove the assembled spider and motor brake from the gearcase by removing hex nuts and hex head bolts with lockwashers holding spider to the gearcase for the single coil brake. On the double coil brake, spider is held by two hex nuts and two hex head bolts with lockwashers, plus a locating dowel. In addition, the load brake shaft is held to the spider by a retainer plate and seven cap screws which holds the load brake shaft bearing to the spider. This bearing is held to the shaft by a retaining ring which must be removed in order to remove the spider. At this point the interior of the gearcase can be inspected along with the gears and shafts. (See Figure 8-13.)

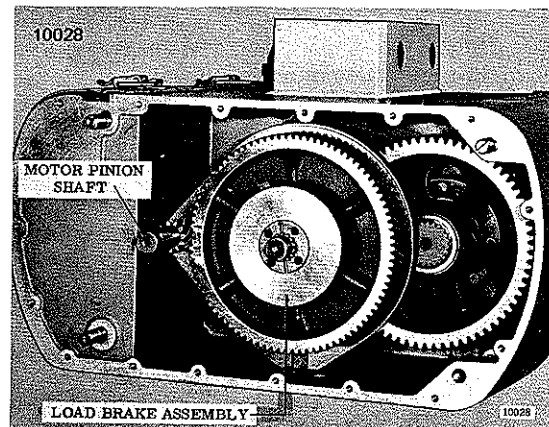


Figure 8-13. View of gearing with spider removed.

If further inspection is required of the load brake and gearing, continue disassembly as follows:

1. Pull out motor pinion shaft.
2. The complete load brake assembly can be pulled out from the gearcase or removed part by part.

CAUTION

The complete mechanical load brake assembly is heavy (approximately 150 lbs.) (68.18 kg). Provide adequate means to support weight of assembly before removal from the gearcase.

3. To further disassemble the mechanical load brake either in or out of the gearcase, remove the two or three self-locking screws from each of the two retaining plates, and remove plates from groove on splines of brake shaft (see Figure 8-14).

4. Pull off brake helix (see Figure 8-1B).

5. Pull off load brake gear (see Figure 8-1B). Note: Push on load brake shaft while removing load brake gear so as to prevent load brake shaft from being pulled out of gearcase.

6. Remove friction washer, then the roller-ratchet assembly followed by another friction washer.

7. Remove load brake shaft and flange assembly.

8. Check condition of all parts for evidence of wear or damage. Replace worn or damaged parts. Do not attempt to repair the roller ratchet assembly.

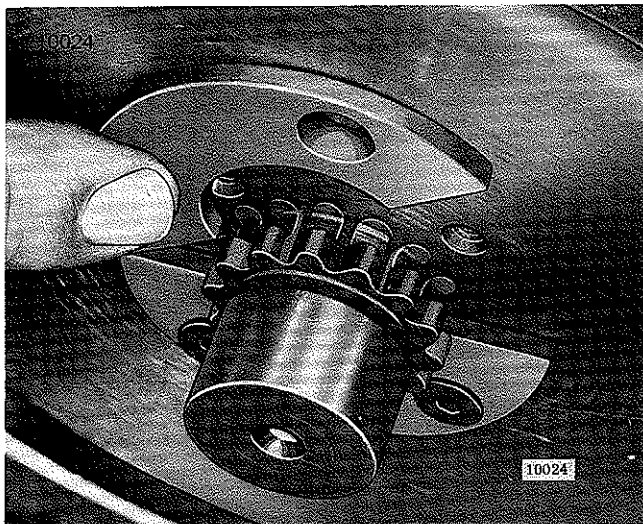


Figure 8-14. Installing retainer plates on load brake shaft.

9. Reassemble in reverse procedure, after cleaning all parts and interior of gearcase.

10. Refill case with fresh lubricant.

8-7. UPPER BLOCK.

a. General. The upper block as previously defined in the Glossary is the sheave arrangement supported by the trolley structural frame, and which supports the hoisting ropes. For typical arrangements see Figures 8-15 and 8-16 below.

b. Construction. If the crane hoist is reeved to Conventional Reeving, (see SECTION II, paragraph 2.8), one sheave will be positioned at right angles to the rest of the sheaves. If the crane hoist is reeved with Cross Reeving, all sheaves are in line and carried on a common pin.

c. Inspection and Maintenance. Check sheaves for adequate lubrication, freedom to rotate, and worn or damaged grooves. Check spacers between sheaves (if so equipped) for wear, corrosion or other signs of defects. Replace any parts required. On conventional reeved cranes, the equalizer

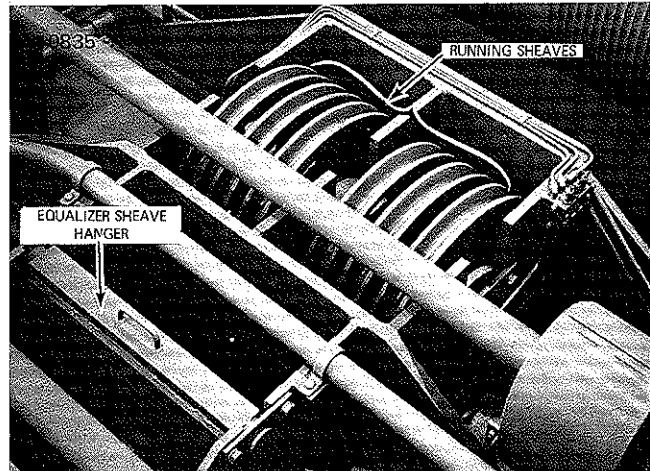


Figure 8-15. Upper block with conventional reeving.

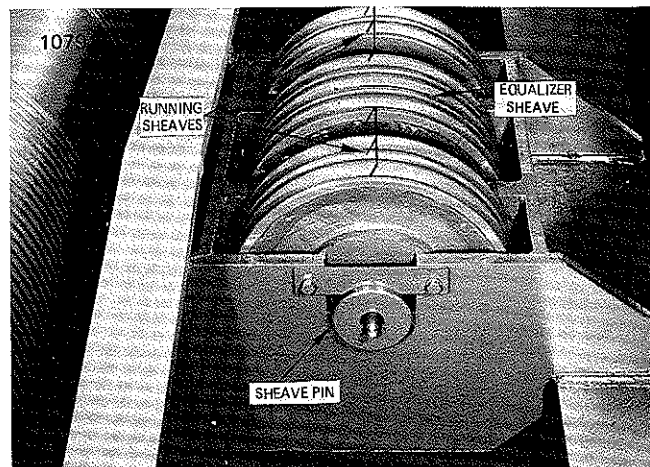


Figure 8-16. Upper block with cross reeving.

sheave which is in a separate hanger support will require occasional light oiling of the sheave bushing and at the support points of the hanger.

8-8. LOWER BLOCK.

a. General. As previously defined the lower block is the assembly of sheaves into a frame to which the hook is attached. In most applications the lower block is connected to the crane hoist by ropes only, so that the block is free to swing in any direction.

b. Construction. All sheaves are carried by a common pin, with each sheave rotating on a separate anti-friction bearing. In some designs the inner race of the bearing is eliminated and the rollers operate directly on the pin.

Where this is the case, the pin is a special alloy steel heat treated for the application. All sheaves are of the same diameter on cranes using Cross Reeving. The two inner sheaves are slightly larger than the other sheaves on cranes employing Conventional Reeving. The hook is held in its support (crosshead) by a hook nut threaded to the shank of the hook. A drilled hole through the hook nut and shank into which a dowel pin is tightly fitted prevents the hook nut from loosening. A thrust bearing is imposed between the hook nut and crosshead which allows hook to rotate. Depending upon the application and size of the lower block, the crosshead may either be fixed or free to swivel.

c. Inspection and Maintenance.

1. Check lubrication of all parts. If the thrust bearing is not equipped with a grease fitting, lubricate with a general purpose oil. Also lubricate the shank of the hook which passes through the crosshead.

2. Check each sheave to insure rope groove is smooth and free from burrs, or other surface defects.

3. Check each sheave for freedom of rotation, replace bearings if defective.

4. Make certain that dowel pin holding the hook nut to the hook, is securely in position.

5. If hook is equipped with a safety latch or rotational lock, check to determine that they are in good operating condition.

6. Check throat opening of hook. (Refer to Figure 8-17.) It is recommended that upon receipt of the crane, a measurement be made and recorded of the hook throat opening. OSHA regulations require that the hook be replaced if the throat opening exceeds 15 percent of the original opening, or if the hook is twisted more than 10 degrees from the unbent plane. A gage block, properly identified to the crane, similar to the one shown in Figure 8-17 is suggested to be made for each hook for use in these measurements.

7. Hooks showing signs of cracks must be replaced.

8. Check wear of the hook, especially at the saddle and replace if badly worn.

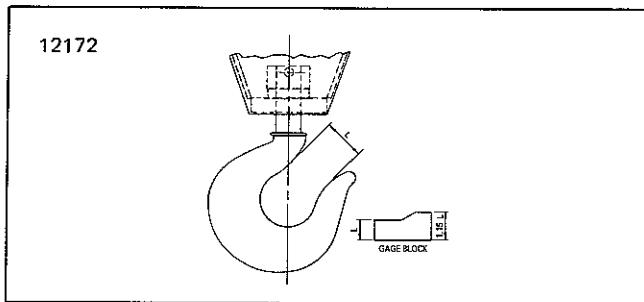


Figure 8-17. Method of measuring hook throat opening.

8-9. LIMIT SWITCHES.

a. Screw Type (Refer to Figure 8-18.)

1. General. This switch is a self-contained unit incorporating a worm and worm gear. The switch is usually located in line with the rope drum at the end opposite the speed reducer. The switch is driven by a pin extending from the drum shaft which engages a horse shoe type coupling fastened to the input shaft of the switch.

2. Inspection, Adjustment and Maintenance. Instructions for this switch are given in SECTION V, Electrical, Paragraph 5-5.i. However, in any inspection, check to be certain that the drive pin and coupling are securely in place and in good condition.

b. Block Operated Type. (Refer to Figure 8-19.)

1. General. As can be seen in Figure 8-19 this switch is equipped with a counter-weighted lever arm used to operate the switch. A steel cable holding a weight is attached to the limit switch lever. This weight is heavier than the counter-

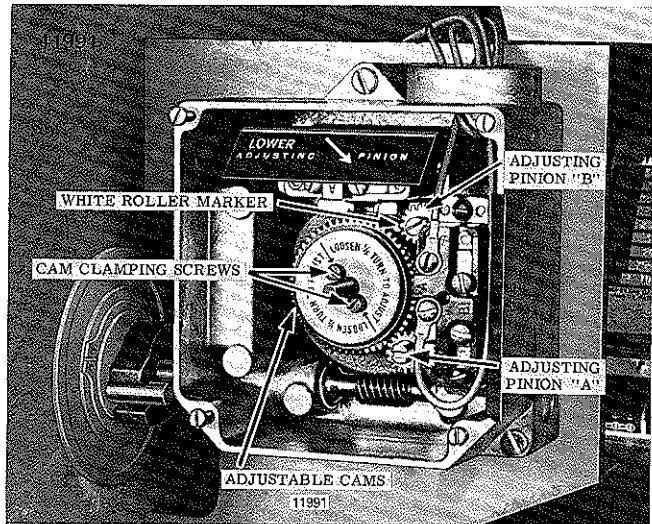


Figure 8-18. General Arrangement of Geared Type Switch..

weight on the limit switch arm, and when freely hung, it overcomes the counterweight and moves the lever down, holding lever in the down stopped position. As the lower block approaches the high hook position, it contacts and lifts the weight, thus relieving the limit switch of this weight. With the weight removed, the counter-weight moves the lever arm up, to the tripped position. Note: Arrangement shown is typical only. Arrangements vary depending upon parts of rope and other considerations.

2. Inspection, Adjustment and Maintenance. Instructions for this type switch are given in SECTION V, Electrical, Paragraph 5-5.i. However, in any inspection, the rope, rope attachments and weight guide should be checked for security and wear. Rope should be checked to be certain that it is not rubbing any part of the trolley frame and hangs freely to the weight. Check lever arm of limit switch to be certain it is tight to its shaft.

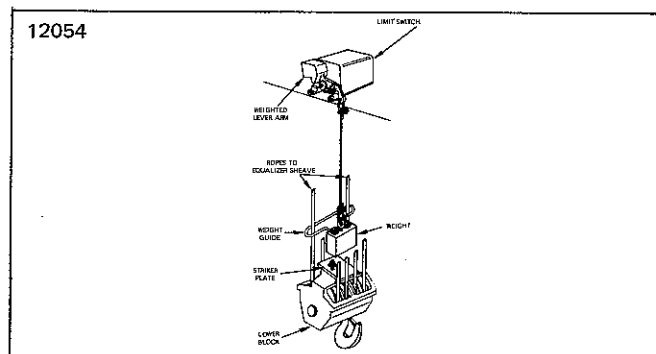


Figure 8-19. Typical arrangement of block operated switch.

SECTION IX — LUBRICATION

9-1. GENERAL.

Lubrication services outlined in this manual should be performed at regular intervals to reduce friction and wear between moving parts. The intervals between lubrication recommended in this Section are average for moderate duty crane installations. Moderate duty, as considered here, is a crane in a normal indoor environment having 20 percent "on" time installed in a plant which operates one 40 hour shift per week (8 hrs. per day, 5 days per week). For moderate duty the recommended lubrication interval is based on 400 hours per year crane operation. If the user finds that his plant operates more than one 40 hour shift per week or the crane duty is greater or less than 20 percent of plant operating time, the lubrication interval must be adjusted proportionately. However, lubrication intervals for standby, infrequent or light service cranes should not exceed the following for normal indoor environment: Speed reducer oil changes—24 months, greasing—6 months, general oiling to prevent rust and corrosion—1 month.

Environmental conditions in which the crane operates are important considerations for the user when adjusting lubrication intervals. Equipment subjected to severe atmospheric environmental conditions such as, cement or other dust, corrosive vapors, extreme heat or cold and other air borne contaminants may require more frequent lubrication or special lubricants. For example, a crane operating in an atmosphere of corrosive vapor which dissolves in the speed reducer oil and diminishes the lubrication quality of the oil, would require frequent changes of oil or a special lubricant. Extreme temperature changes, which commonly occur with outdoor service, can cause condensation to accumulate in the speed reducers. In this case, frequent oil changes should be made to avoid dispersing water into the bearings, seals and other critical areas. Environmental conditions often require more frequent lubrication and oil replacement. The user should be alert for all environmental conditions and adjust the lubricant and/or the lubrication interval as may be required. Consult Dresser Field Service Department for advice for unusual conditions.

The lubricants and specifications shown in paragraph 9-5 are based on latest product information available at the time of publication. Typical commercial products listed are for convenience only. A local equivalent product which meets the specifications and is produced by any reputable manufacturer may be used. Many interchange lists are available which show equivalent lubricants for brands produced in various localities. Contact your local lubricant distributor for information.

Since there are many variations of crane bridge, trolley and hoisting arrangements, all of the possible configurations are not shown in this section, but rather the components and typical arrangements. The general outline on the following pages for proper lubrication applies to any crane equipped with the components shown regardless of the arrangement of these components.

Actual size of the component may vary depending on the capacity and design of the bridge, hoist or trolley. In so far as practical, the illustrations (Figures 9-1 thru 9-4) show a true representative physical shape of the different com-

ponents. This enables the user to distinguish, for example, a worm type speed reducer from a spur gear speed reducer, each requiring a different lubricant. The proper lubricant and interval of lubrication is coded near each component illustration.

For equipment manufactured by other than Dresser that may be furnished with the crane, see manufacturer's manual concerning lubrication instructions. The manufacturer's instructions take precedence over lubrication recommendations in this manual should any conflict exist. Manuals for equipment manufactured by others are furnished to the user with each crane order in a separate customized parts identification manual. Lubrication instruction for electrical equipment such as motors, brakes, limit switches, etc., may be found in SECTION V — ELECTRICAL.

Lubrication fittings on your crane have been greased at the factory with a lithium base multipurpose grease. Mixing different types of lubricants is not recommended since they may not be compatible. If at any time during the life of the crane the type of grease at any lubrication point is unknown, the existing grease should be removed and the bearing thoroughly cleaned before adding the new lubricant.

Speed reducers on your crane were filled with lubricant for factory testing. However, during preparation for shipment of the crane, the oil may have been drained from the speed reducers. When the speed reducers have been drained at the factory, the oil is not shipped with the crane. Quantities of proper lubricant to refill all speed reducers will be provided by the user at the crane installation site.

The quantity of oil required for the various speed reducers on the bridge, trolley and hoist is indicated on a label attached to the speed reducer. The type of oil to be used is indicated by a letter identity code on bridge, trolley and hoist illustrations on the pages following. Lubricant specifications for the letter identity codes are tabulated in paragraph 9-5 of this section. The lubricant properties described in paragraph 9-5 are not a complete description of the product required. Where the environment in which the cranes operate is other than normal atmospheric environment, special lubricants may be required. Consult Dresser Field Service Department for recommendations.

The following practices should be observed when lubricating your crane:

- a. With a clean rag, wipe all fittings before and after lubricating.
- b. Be certain lubricants are not contaminated before using.
- c. Do not overfill gear cases. Use oil level riser or oil level plug to determine proper level.
- d. Wipe up any spilled or excess lubricants.
- e. Do not allow oil or grease to come in contact with brake shoes or wheels, or any electrical equipment where no oil is desired.

For cranes equipped with Centralized Lubricating Systems see instructions in separate customized parts identification manual furnished with your crane. Always contact Dresser Field Service Department whenever lubrication requirements are not known.

9-2. LUBRICATION OF CRANE BRIDGES. Figure 9-1 shows a typical crane bridge and the main points requiring lubrication attention. Standard crane bridges have similar areas requiring lubrication, such as bridge speed reducers, whether located near the center of the span or at each end of the bridge, cross shaft brackets (pillow blocks), bridge driver and trailer wheels, all flexible couplings and fettioned cross conductor arrangements. The bridge brake system, described in other sections of this manual depending on whether hydraulically or electrically operated, may also require general oiling and periodic checking of hydraulic fluid, if hydraulically operated. (See BRAKES, SECTION V, paragraph 5-5, or SECTION VI, paragraph 6-3).

Bridge lubricant recommendations and intervals, shown on Figure 9-1, are based on moderate service in normal indoor environment. Because environmental conditions may vary with each crane installation, the user should adjust this lubrication schedule to provide adequate lubrication for the existing operating conditions and service. For outdoor installations where temperature variation is seasonal and condensation or other foreign matter may accumulate in the speed reducers, the speed reducers should be drained and flushed and the oil replaced at least every six months. Extreme atmospheric environmental conditions and/or severe service require more frequent lubrication and oil replacement. For severe or unusual conditions consult Dresser Field Service Department for advice.

For standby, infrequent and light service cranes, lubrication intervals may be extended for normal indoor environment. Greasing intervals should not exceed 12 months for standby service and 6 months for more frequent service. Cranes in these service classes installed outdoors are subject to atmospheric environmental changes which may cause condensation or foreign matter to enter gear cases. Before using outdoor cranes which have been idle for long periods, drain a quantity of oil from the speed reducer; check for oil discoloration, presence of water, sludge or dirt. Replace oil if it contains any foreign matter to avoid dispersing foreign matter into the bearings, seals or other critical areas. Regrease all points with fittings to prohibit entry of water, dirt or corrosive vapors. General oiling to prevent rusting should be performed each month during idle periods. Crane user should provide lubrication, based on the existing environmental and operating conditions, to protect idle crane and 'keep ready' for operation.

Figure 9-1 shows recommended lubricants and intervals for the standard bridge components regardless of the component size or arrangement on the bridge. Components manufactured by other than Dresser may require individual lubrication consideration. This is usually furnished in a separate customized parts manual shipped with the crane.

General oiling should be performed each week to prevent rusting and provide limited lubrication for points not having lubrication fittings nor considered normal wear points. Pins, levers, rods, hinges, and other linkages and moving parts, where rusting could occur and interfere with normal operation, should be oiled with a few drops of GO oil. (See paragraph 9-5.) During each oiling it is recommended that a visual inspection be made for any leakage of oil or grease from any speed reducer or other lubricated component.

CAUTION

Leakage of oil or grease may indicate damaged seals, over lubrication or worn parts. Determine and correct the cause before operating crane bridge.

9-3. LUBRICATION OF TROLLEY AND HOIST. Figures 9-2, 9-3 and 9-4 show trolley and hoist general arrangements and major components that require lubrication. The component illustrations represent the actual physical shape of the various components to assist the user to identify the lubricant and interval to be used. Select a component on your trolley or hoist to be lubricated. Turn to Figure 9-2, 9-3 or 9-4 and find the component illustration representative of the one to be lubricated. Lubricant and interval for each component is shown in a rectangle near the component.

Standard hoists have either a mechanical load brake (MLB) or an eddy current brake (ECB) lowering control. Refer to the Electrical Data Sheet furnished with your crane to verify type braking. (Refer to paragraph 5-6 in Electrical Section for sample Electrical Data Sheet.)

Example: Assume the hoist speed reducer with mechanical load brake on your hoist is illustrated in Figure 9-2. The recommended oil for this speed reducer with a load brake is MGCO (see paragraph 9-5) and the refill interval is 6-9 months for normal conditions.

If the Electrical Data Sheet had indicated no mechanical load brake (MLB), then the recommended oil would have been GCO and the refill interval 12 months.

Lubricant recommendations and intervals shown on Figures 9-2, 9-3 and 9-4 are based on moderate service, as previously defined, in normal environment. Because environmental conditions may vary with each trolley and hoist installation, the user should adjust the lubrication schedule to provide adequate lubrication for existing operating conditions and service. For outdoor installations where seasonal temperature variations or atmospheric environment may cause condensation or other foreign matter to accumulate in the speed reducers, the speed reducers should be drained and flushed and the oil replaced at least every six months. Severe environmental conditions require more frequent lubrication and oil replacement. For unusual conditions consult Dresser Field Service Department for advice.

For standby, infrequent or light service, lubrication intervals may be extended for normal indoor environment. Greasing intervals should not exceed 12 months for standby service and 6 months for more frequent service. Hoists and trolleys in these service classes installed outdoors are subject to atmospheric environment which may cause condensation or foreign matter to enter the speed reducers. Before using outdoor cranes which have been idle for long periods, drain a quantity of oil from the speed reducer. Check oil for discoloration, presence of water, sludge or dirt. Replace oil if it contains any foreign matter to avoid dispersing foreign matter into bearings, seals or other critical areas. Regrease all points with fittings to prohibit entry of water, dirt, dust, or air borne chemicals. General oiling to prevent

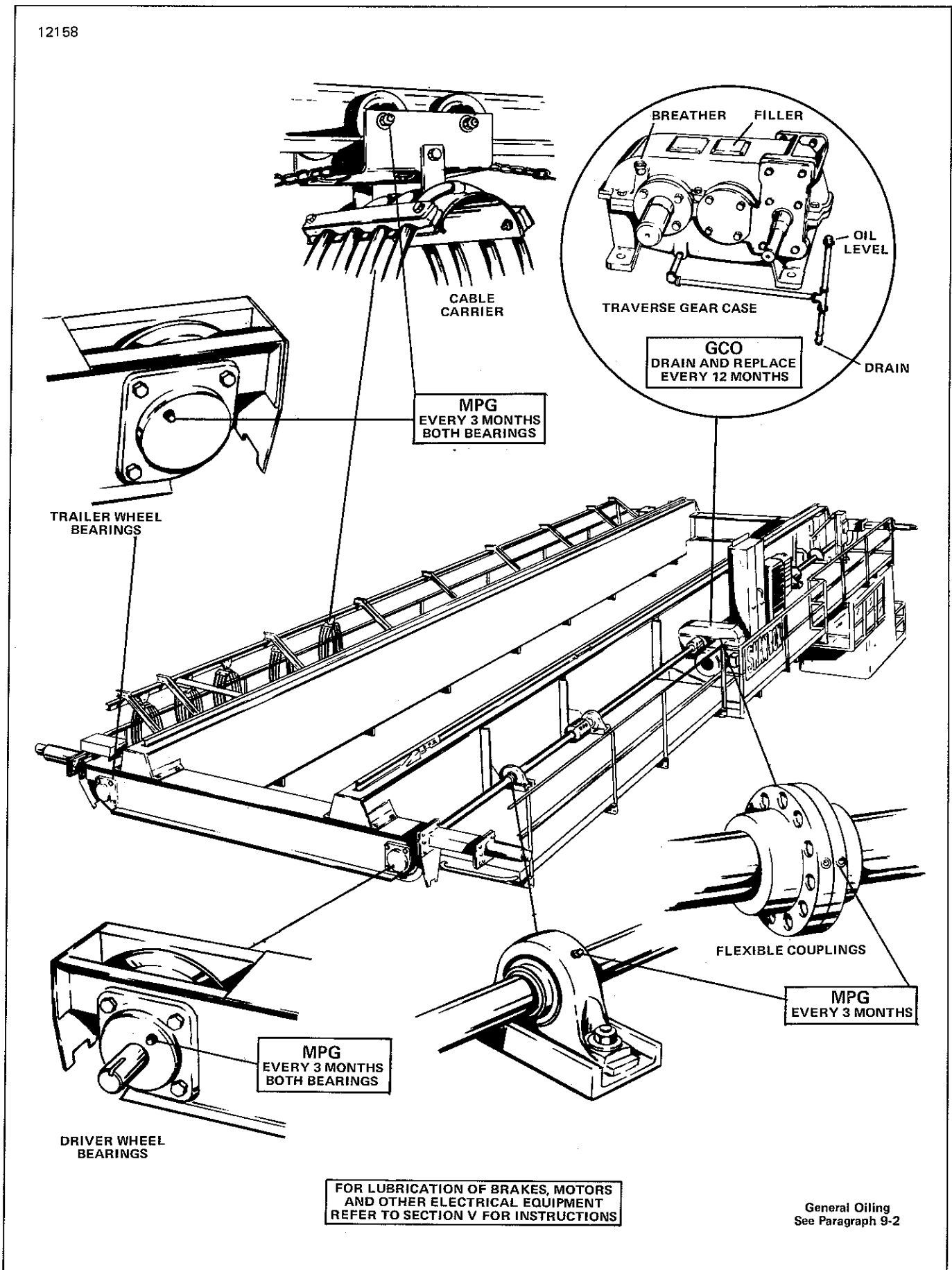


Figure 9-1. Typical Crane Bridge Lubrication Chart.

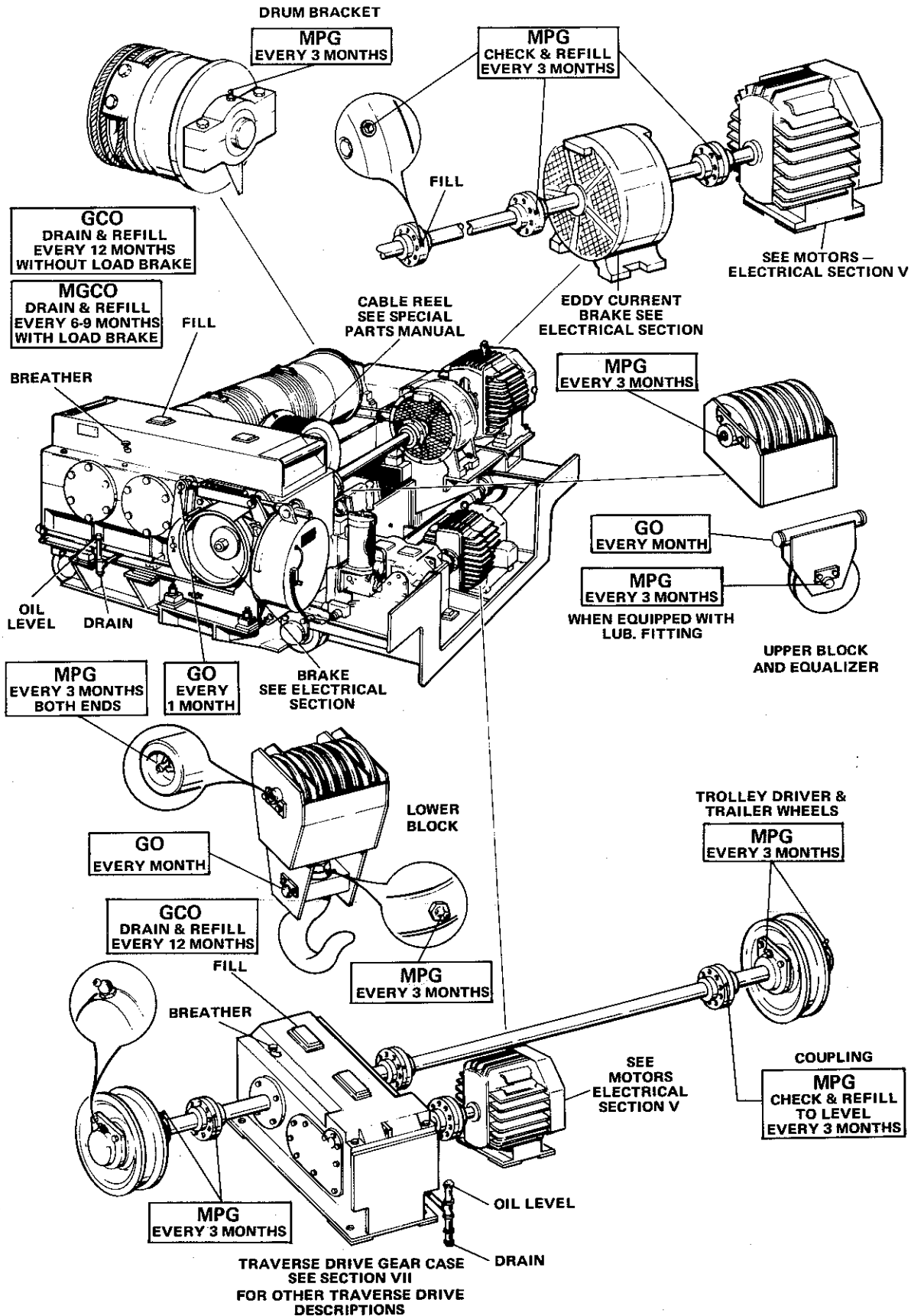
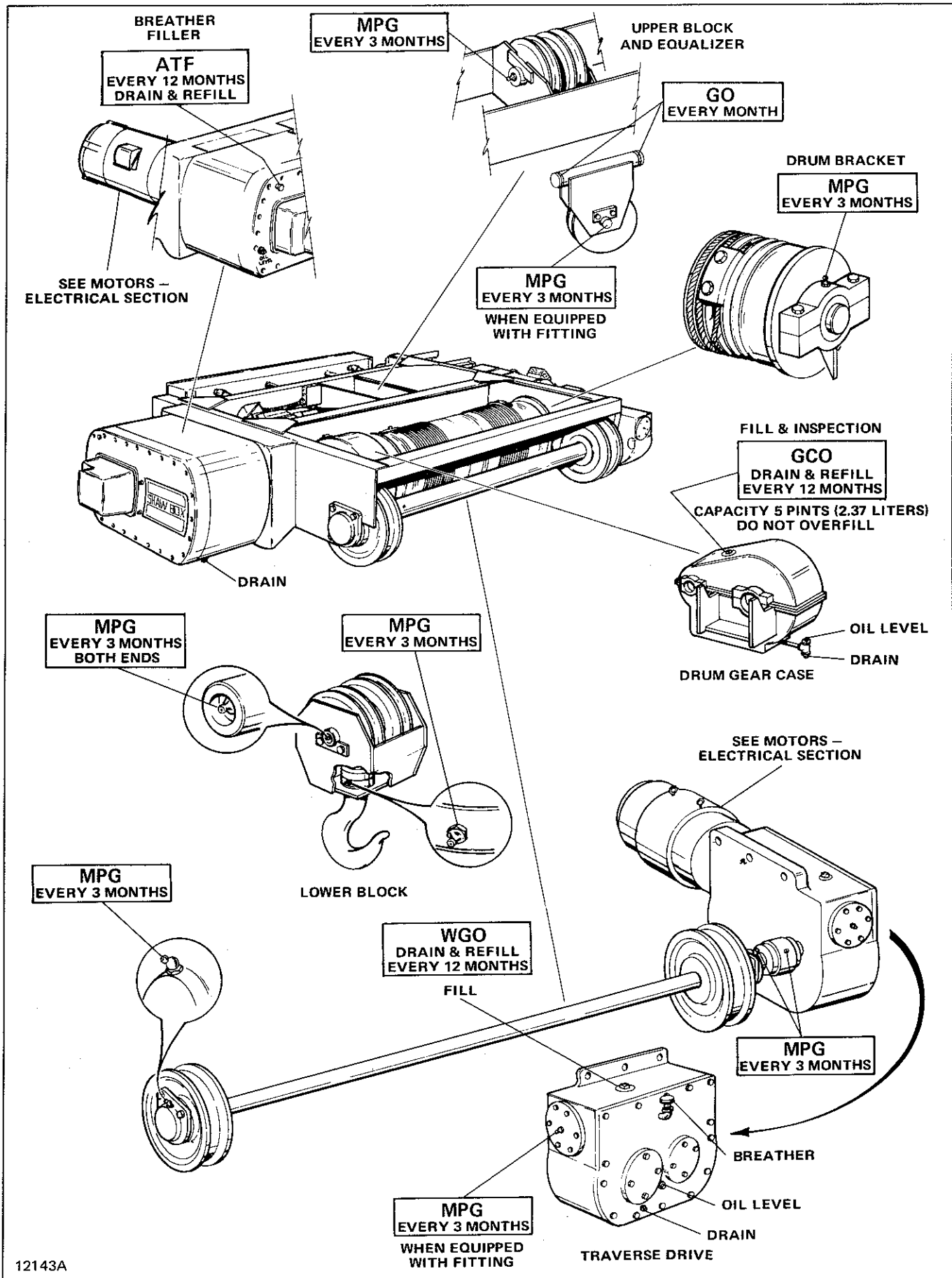


Figure 9-2. Typical Trolley-Hoist Lubrication Chart—Exhibit 1.



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Figure 9-3. Typical Trolley-Hoist Lubrication Chart—Exhibit 2.

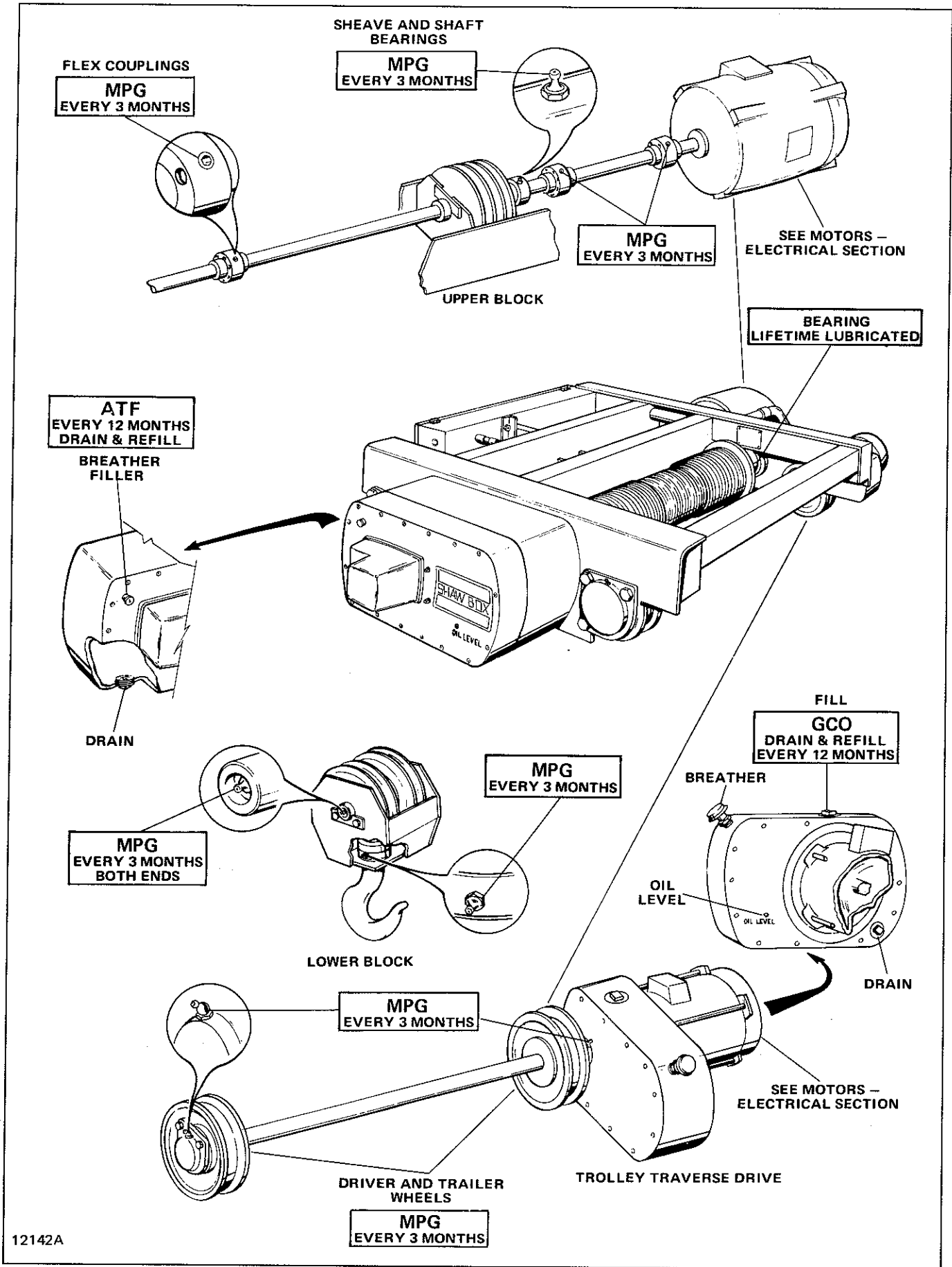


Figure 9-4. Typical Trolley-Hoist Lubrication Chart—Exhibit 3.

rusting should be performed each month during idle periods. The user should provide lubrication, based on the existing environmental and operating conditions, to protect idle hoist and trolley and 'keep ready' for operation.

Figures 9-2, 9-3 and 9-4 show the recommended lubricant and intervals for standard components. Trolleys may have two or more hoists or arrangement may differ from the illustrations. However, the standard components can be identified from the component illustrations which show the lubricant and interval of lubrication. For trolleys having components which were manufactured by others, lubrication requirements are usually furnished in a separate customized parts manual shipped with trolley.

General Oiling should be performed once a week to prevent rusting and provide limited lubrication for points not having lubrication fittings nor considered normal wear points. Pins, levers, rods, hinges, linkages, current collectors, and other moving parts where rusting or corrosion may interfere with normal operation, should be oiled with a few drops of GO oil (see paragraph 9-5). During each oiling a visual inspection is recommended for any leakage of oil or grease from any speed reducer or other lubricated component.

CAUTION

Leakage of oil or grease may indicate damaged seals, over lubrication or worn parts. Determine and correct the cause of leaks before operating hoist or trolley.

9-4. LUBRICATION OF WIRE (HOIST) ROPE. Wire rope is one of the most important components on your crane requiring lubrication. As the rope bends over sheaves and drums the internal wires continually move and rub against each other. Each wire becomes a bearing surface that grinds and wears against other wires if all are not properly lubricated. Lubrication not only helps prevent wire rope wear but also helps protect the wires from corrosion and deterioration of the core.

Lubrication interval for wire rope depends on the conditions to which the rope is subjected. Active ropes should be lubricated regularly not only to prevent corrosion but also to reduce wear of rope and allied equipment. Inactive ropes such as those used for standby, or infrequent service are subject to corrosion quickly, unless they are adequately protected by thorough lubrication. The severity of the duty and the degree to which the rope is subjected to corrosive elements will serve as an index for the user to determine an adequate lubrication interval. No set rule can be given for the frequency of wire rope lubrication.

Wire ropes that have been in service should always be cleaned thoroughly before they are relubricated. Rope can be cleaned with wire brushes, scrapers or compressed air. Remove all foreign matter and old lubricant from the valleys between the strands and the spaces between the outer wires.

Wire rope lubricant can be applied to rope using a brush or swab. Lubricant, applied hot, will penetrate wires and form filler and coating to resist water and corrosion.

Another method of applying lubricant to wire rope is 'pour-on' method. Select a point where the rope passes around a sheave, that can be reached with a measuring type oil can with a spout. Slowly rotate the rope through this sheave while pouring oil on the rope. Always hold a wiping swab on side of the sheave paying out the rope.

WARNING

Rotating ropes thru sheaves with hands nearby is dangerous. Use extreme caution when lubricating moving ropes.

Be certain that ropes normally hidden during lubrication are properly lubricated. Rope not normally unwound from rope drum and those passing over or attached to equalizers require special attention.

Use lubricant (CL) as recommended in Lubricant Specifications (paragraph 9-5) or approved equal.

9-5. LUBRICANT SPECIFICATIONS.

Gear Case Oil		APPLICATION Speed Reducers (except worm type) not having Load Brakes		
SPECIFICATION	Dresser C&H	ENG-7-14.51	ENG-7-14.4	ENG-7-14.5
	AGMA	No. 1 or 2 Mod.	No. 4	No. 5
Viscosity @ 100° F (38° C) SSU Viscosity Index Pour Point		Use in Ambient Temperatures		
		-20° to +50° F	50° to 125° F	125° to 250° F
		(-29° to +10° C)	(10° to 52° C)	(52° to 121° C)
		140-500 30 min. -30° F (-34° C)	626-765 60 min. 10° F (-12° C)	918-1122 60 min. 15° F (-9° C)
Identity Code GCO	Typical Commercial Products			
	Sun Oil Co. Shell Oil Corp. Amoco Oil Co. Arco Texaco Inc.	Solnus 150 Clavus 68 Rykon 46 Duro AW 68 Rando Oil 32	Sunvis 75 Vitrea 150 Am. Ind. 150 Duro 150 Rando Oil 220	Sunvis 99 Vitrea 220 Am. Ind. 260 Duro 220 Regal Oil 220

Gear Case Oil, Modified		APPLICATION Speed Reducers with Pawl and Ratchet Load Brakes in Oil Bath		
SPECIFICATION	Dresser C&H	ENG-7-14.57	ENG-7-14. 3.1	*
	AGMA	No. 1 or 2 Mod.	No. 3 Mod.	
Premium type oil with oxidation, anti-foam, anti-rust and anti-corrosion inhibitors. Viscosity @ 100° F (35° C) SSU Viscosity Index Pour Point		Use in Ambient Temperatures		
		-20° to +50° F	50° to 125° F	125° to 250° F
		(-29° to +10° C)	(10° to 52° C)	(52° to 121° C)
		210-310 90 min. -25° F (-32° C)	417-510 90 min. 10° F (-12° C)	
Identity Code MGCO	Typical Commercial Products			
	Sun Oil Co. Shell Oil Corp. Amoco Oil Co. Arco Teaxco Inc.	Sun Hyd. Oil Omala 68 Rykon 46 Duro AW 68 Rando Oil 68	Sunvis 951 Omala 150 Am. Ind. 100 Duro AW 100 Rando Oil 150	

* Refer to Dresser Field Service Department.
Page 98

General Oil		APPLICATION General Oiling to prevent rusting and provide limited lubrication for points not considered normal wear points (lever, linkages, pin, etc.).		
SPECIFICATION	Dresser C&H	ENG-7-14.55	ENG-7-14. 2.0	*
	AGMA	No. 1 Mod.	No. 2	
	SAE	10	20	
Viscosity @ 100° F (30° C) SSU Viscosity Index Pour Point		Use in Ambient Temperatures		
		-20° to +50° F	50° to 125° F	125° to 250° F
		(-29° to +10° C)	(10° to 52° C)	(52° to 121° C)
		100-210 95 min. -25° F (-32° C)	284-347 60 min. 10° F (-12° C)	
Identity Code GO	Typical Commercial Products			
	Sun Oil Co. Shell Oil Corp. Amoco Oil Co. Arco Texaco Inc.	Sun Hyd. Oil Omala 68 Rykon 46 Duro AW 68 Rando 68	Sunvis 31 Vitrea 68 Am. Ind. 68 Duro AW 68 Rando 68	

Multipurpose Grease		APPLICATION Grease Lubricated Wear Points provided with fittings. Grid or Gear Type flexible couplings.		
SPECIFICATION	Dresser C&H	ENG-7-14.21	ENG-7-14.22	ENG-7-14.22
	NLGI	No. 1	No. 2	No. 2
ASTM Worked Penetration Dropping Point Base		Use in Ambient Temperatures		
		-20° to +50° F	50° to 125° F	125° to 250° F
		(-29° to +10° C)	(10° to 52° C)	(52° to 121° C)
		310-340 360° F (182° C) Lithium	265-295 360° F (182° C) Lithium	265-295 360° F (182° C) Lithium
Identity Code MPG	Typical Commercial Products			
	Sun Oil Co. Shell Oil Corp. Amoco Oil Co. Arco Texaco Inc.	Prestige 41 Alvania Gr. 1 Amolith Gr. 1 Litholine Onyx E.P. 1 Multifak E.P. 1	Prestige 42 Alvania Gr. 2 Amolith Gr. 2 Arco Multi-purpose Multifak 2	Prestige 42 Alvania Gr. 2 Amolith Gr. 2 Arco Multi-purpose Multifak 2

*Refer to Dresser Field Service Department.

Worm Gear Oil		APPLICATION Worm Speed Reducers and Worm Gears with other Gears.		
SPECIFICATION	Dresser C&H	ENG-7-14.53	ENG-7-14.7	ENG-7-14.8
	AGMA	No. 1 or 2 Comp.	No. 7 Comp.	No. 8 Comp.
Compounded with 3 to 10% acidless tallow or other suitable fat. Viscosity @ 100° F (38° C) SSU Viscosity Index Pour Point		Use in Ambient Temperatures		
		-20° to +50° F	50° to 125° F	125° to 250° F
		(-29° to +10° C)	(10° to 52° C)	(52° to 121° C)
		193-347 60 min. -25° F (-32° C)	1919-2346 90 min. +25° F (-4° C)	2837-3467 90 min. +25° F (-4° C)
Identity Code WGO	Typical Commercial Products			
	Sun Oil Co. Shell Oil Corp. Amoco Oil Co. Arco Texaco Inc.	Gr. Oil SAE 75 Omala 68 Gr. Lub SAE 80 Pennant NL 68 Meropa 68	Sun Gr. Oil 7C Valvata J460 Am. Wrm. Gr. Oil Modac 125 Vanguard Cyl. Oil 460	Sun Gr. Oil 8C Valvata J680 Cyl. Oil 680 Modac 175 Pinnacle Cyl. Oil 680

Automatic Transmission Fluid Dexron (G.M. Trademark)		APPLICATION Speed Reducers with Roller Ratchet Load Brake in Oil Bath.		
SPECIFICATION	Dresser C&H	ENG-7-14.30	ENG-7-14.30	ENG-7-14.30
	G.M. Trademark	Dexron II	Dexron II	Dexron II
Viscosity @ 100° F (38° C) SSU Viscosity Index Pour Point		Use in Ambient Temperatures		
		-20° to +50° F	50° to 125° F	125° to 250° F
		(-29° to +10° C)	(10° to 52° C)	(52° to 121° C)
		185-210 150 min. -40° F (-40° C)	185-210 150 min. -40° F (-40° C)	185-210 150 min. -40° F (-40° C)
Identity Code ATF	Typical Commercial Products			
	Sun Oil Co. Shell Oil Corp. Amoco Oil Co. Arco Texaco Inc.	Dexron II Donax TG Amoco Dexron Arco ATF Dexron II Texamatic Fluid 9226	Dexron II Donax TG Amoco Dexron Arco ATF Dexron II Texamatic Fluid 9226	Dexron II Donax TG Amoco Dexron Arco ATF Dexron II Texamatic Fluid 9226

Hydraulic Brake Fluid		APPLICATION Hydraulic Brake Systems		
SPECIFICATION	Dresser C&H		ENG-7-14.10	
	Federal Spec.		VV-H-910	
	SAE		70 R1	
Brake fluid to be of non-mineral type. Low evaporation. Remain fluid at low temperature. Confined rubber swelling properties.		Use in Ambient Temperatures		
		-20° to +50° F	50° to 125° F	125° to 250° F
		(-29° to +10° C)	(10° to 52° C)	(52° to 121° C)
Identity Code HBF	Typical Commercial Products			
	Wagner or Lockheed Texaco Inc. or Gulf		21 B Heavy Duty Super HD Brake Fluid	

Cable Lubricant		APPLICATION Wire Rope Lubricant		
SPECIFICATION	Dresser C&H	ENG-7-14.62	ENG-7-14.18	*
Tacky Compound Lubricant Water repellent Extreme Pressure (E.P.) Properties		Use in Ambient Temperatures		
		-20° to +50° F	50° to 125° F	125° to 250° F
		(-29° to +10° C)	(10° to 52° C)	(52° to 121° C)
Identity Code CL	Typical Commercial Products			
	Sun Oil Co.	Suntac 152 WR		
	Shell Oil	Aeroshell Gr. 50		
	Amoco Oil Co.	Amovis Lub 2X	Amovis Lub 2X	
	Texaco Inc.	Texclad 1	Texclad 1	

*Refer to Dresser Field Service Department.

SECTION X – INSPECTION AND MAINTENANCE

10-1. GENERAL. Regular inspection and preventive maintenance programs not only help reduce overall maintenance costs but may also prevent serious shutdowns by forewarning of problems that could cause these shutdowns. Regular inspections, periodic minor adjustments, regular cleaning and lubrication, and replacement of worn parts can help preserve good performance and operation of your crane.

Many factors influence the inspection and preventive maintenance program required for each crane. Frequency and severity of service, material handled, local environmental conditions and various applicable codes are some of the factors that the user must consider to adjust inspection and maintenance program described in this section to meet his specific conditions.

The inspection and preventive maintenance program recommended and outlined in this section is considered average for moderate duty crane installations. Moderate duty installation is defined here as crane installation in a plant which operates one shift of 40 hours per week (8 hours per day, 5 days a week) with crane operating 20 percent of this time in a normal environment. Moderate duty is based on 400 hours per year crane operation. If the user finds that his plant operates more than one 40-hour shift per week or that the crane duty is greater or less than 20% of plant operating time, the frequency of inspection and maintenance program should be adjusted in proportion to increase or decrease of crane duty requirements.

Environmental conditions in which the crane operates are also important considerations for the user when adjusting crane inspection and maintenance program to local conditions. Equipment subjected to severe atmospheric environmental conditions such as corrosive vapors, extreme heat or cold, cement or other dust and other air borne contaminants require more frequent inspection and maintenance than recommended herein.

A typical condition requiring special consideration for frequency of inspection and degree of maintenance is an outdoor installation where temperatures vary considerably. In this environment, condensation can form in gearcase and cause rusting or corrosion of gearcase components. Another condition, where corrosive vapor may exist, the oil seals, current conductors, and other parts exposed to these vapors may also become corroded and adversely affect crane operation.

The user should carefully consider all environmental conditions, and increase frequency of inspection and degree of the maintenance program for his local conditions. Consult Dresser Crane & Hoist Field Service Department for advice for unusual environmental conditions.

Various codes also regulate inspection and maintenance programs. Attention must be given to applicable Federal Standards, National Standards, OSHA regulations, state and local codes which may include mandatory rules relating to crane inspection and maintenance. The user should become familiar with all applicable codes in his area and be guided accordingly.

10-2. INSPECTION AND PREVENTIVE MAINTENANCE

a. General. Listed below and on the Inspection Schedule and Maintenance Report following, are recommended inspection frequencies and requirements. Perform these inspections regularly as scheduled and additional inspections as may be required for activity, severity of service and environment of your crane. Close attention must be given to the crane the first few days and weeks of operation, following which routine inspection procedures should be instituted. The crane operator should be alert to any defects which might appear during operation and refuse to continue operation until a determination has been made by a qualified person as to whether a safety hazard exists.

Inspections listed under Operator Daily Inspections marked with a solid dot (●) are mandatory inspection requirements (OSHA). Daily Inspections listed must be performed in addition to weekly, monthly, semi-annual or annual inspections listed herein. Any defect should be reported to your foreman and the defect should be carefully examined to determine whether a safety hazard exists before operating the crane.

b. Operator Daily Inspections.

- 1. Inspect all functional operating mechanisms for maladjustment interfering with proper operation. This includes items such as limit switches, control systems, brakes, power plants. Adjust as required.
- 2. Inspect air or hydraulic systems for leakage or deterioration.
- 3. Visually inspect hooks for throat opening, twisting, cracks or saddle wear.
- 4. Visually inspect hoist and load attachment chains for excessive wear, twist, distorted or stretched links.
- 5. Visually inspect rope slings, including end connections, for excessive wear, broken wires, abrasions, twisting.
- 6. Inspect all components of functional operating mechanisms including items such as, limit switches, controller components, drive components, brake linings and contactor tips for excessive wear.
- 7. Visually inspect hoist ropes for excessive wear, broken wires, abrasions, kinks, twisting or evidence of not spooling properly on drum, and proper lubrication.

c. Weekly Inspections. In addition to daily inspections the following should be performed each week:

1. Inspect all gearcases for proper oil level. Lubricate pins, levers, rods, hinges, linkages, collector wheel or slide pivot pins where general oiling is required.
2. Inspect all brakes and adjust, if required. (See SECTION 5-5b and 6-3.)
3. Check fluid level of hydraulic master cylinder.
4. Check hoist rope for proper seating in all sheaves and drum grooves.

A general description of inspection and maintenance procedures recommended are outlined under the headings, Monthly Inspection, Semi Annual Inspection and Annual Inspection. A more complete description of individual maintenance and inspection required for a particular unit or

part is given in various sections of this manual. Refer to the Index in this manual for specific units or parts.

d. Monthly Inspection.

1. Perform steps outlined under Weekly Inspection.
2. Check all operating mechanisms for wear, distortion or fractures.
3. Inspect general condition of all contacts on all contactors, relays, disconnect switches, circuit breakers, limit switches, master switches and pushbutton stations.
4. Check all gearcases for proper oil level. Add oil per SECTION IX, if required.
5. Check conductor and collector shoe alignment, and wear on collector shoes, if so equipped.
6. Check motor brushes to be certain they have enough stock for wear and move freely in brush holders.
7. Check all motor and speed reducer hold down bolts for tightness.
8. Inspect crane hooks for distortion and throat opening. Record throat opening. (See Section 8-8.)
9. Inspect hoist ropes per Section 8-4.
10. Inspect all sheaves and drums for wear, cracks or other damage or corrosion.

e. Semi-Annual Inspection.

1. Perform steps outlined under Monthly Inspection.
2. Record voltage and amperage reading at main hoist panel while lifting maximum load. This should be done with crane at the greatest distance from the runway conductor feed point. Voltage readings should be less than $\pm 10\%$ of rated line voltage.
3. Check crane with a megger for high resistance ground faults.
4. Inspect all motor resistors, control panel components, and other electrical connections for tightness and broken wires. (See SECTION V.)
5. Inspect wheels for diameter and flange or tread wear. (See SECTION VI, paragraph 6 and SECTION VII, paragraph 5.)
6. Conduct complete inspection of crane components as shown on Inspection Schedule. Refer to index for recommendations for specific units.

f. Annual Inspection.

1. Perform the steps outlined in Semi-Annual Inspection.
2. Inspect all structural members for deformation, cracks, corrosion or other damage.
3. Inspect crane hooks by magnetic particle examination.
4. Inspect all structural connections for loose bolts or rivets or other signs of wear. Inspect fitted bolts by removing and inspecting for signs of wear.
5. Inspect all drive mechanisms and parts, such as pins, bearings, shafts, gears, rollers, locking and clamping devices for wear, cracking or distortion.

6. Inspect general condition of crane — rust, corrosion, paint, accumulation of dirt and debris.

7. Drain and flush all gearcases. Refill with new lubricant as recommended in SECTION IX.

g. Inspection Schedule and Maintenance Report Form. Shown in this section is a recommended Inspection Schedule and Maintenance Report form. The user should revise the inspection interval, add additional units or provide a similar form to suit particular conditions which may exist. However, written, dated and signed inspection reports should be maintained particularly on critical items, such as crane hooks, hoisting ropes, sheaves, drums and brakes. Periodic review of old inspection reports can point out service life of crane components, forecasting need for adjustment, repair or replacement of these components.

As a matter of expedience, appointed maintenance personnel inspecting crane can also take care of minor adjustments, repairs and cleaning, where required. Note column on Inspection Schedule and Maintenance Report form headed Corrective Action and Notes. When corrective action is made during inspection, note condition of part or unit as inspected in appropriate Condition column with a check mark (\checkmark). Note "during inspection" corrective action taken and date in space provided. In this manner, items requiring further attention will be checked (\checkmark) without showing corrective action. This will advise the designated person responsible for crane operation and safety who reviews the reports that deficiencies exist. The designated person will check all deficiencies as listed and re-examine or otherwise determine whether they constitute a safety hazard.

WARNING

Deficiencies may be hazardous to personnel and equipment. Do not operate a crane having deficiencies unless a designated qualified person has determined that these deficiencies DO NOT constitute a safety hazard.

Written, dated and signed inspection reports for many items are mandatory under OSHA regulations, and many state safety codes. It is strongly recommended that the Inspection Schedule and Maintenance Report, shown herein, be completed by a qualified person designated with the responsibility for crane operation and safety or an inspector appointed by this person.

Inspection records can point out the service life of crane components and help forecast the need for adjustments, repairs and ordering of replacement parts. File and review these reports after each inspection.

10-3. REPAIR AND TESTING.

a. Precautions Before Performing Maintenance or Repair. Before performing adjustments, maintenance or repairs, observe the following precautions:

1. Get permission from your foreman.

INSPECTION SCHEDULE AND MAINTENANCE REPORT

CRANE SERIAL NO. (MFGRS) _____
 CAPACITY _____
 SPAN _____
 VOLTAGE _____

CUSTOMER CRANE IDENTITY NO. _____
 LOCATION IN PLANT _____
 THIS INSPECTION IS MONTHLY ANNUAL
 SEMI-ANNUAL

INSPECTED BY _____ DATE _____

COMPONENT, UNIT OR PART and location on crane		* Recommended Inspection Interval			CONDITION (Check column best indicating condition when part or unit is inspected. Use note column to the right if condition is not listed below.)						CORRECTIVE ACTION NOTES
		MONTHLY	SEMI-ANNUAL	ANNUAL	GOOD	ADJUSTMENT REQUIRED	REPAIR REQUIRED (Loose Parts or Wires)	REPLACEMENT REQUIRED (Worn or Damaged)	LUBRICATION REQUIRED (Low oil or Grease Rust or Corrosion)	CLEANING OR PAINTING REQUIRED	
BRIDGE	Motor	<input type="radio"/>									(Indicate corrective action taken during inspection and note date. For corrective action to be done after inspection, a designated person must determine that the existing deficiency does not constitute a safety hazard before allowing crane to operate. When corrective action is completed, describe and note date in this column.)
	Brake & Hyd. System	<input type="radio"/>									
	Shaft Couplings	<input type="radio"/>									
	Shaft Bearings	<input type="radio"/>									
	Gears & Bearings	<input type="radio"/>									
	Wheels		<input type="radio"/>								
	Trucks			<input type="radio"/>							
	Girders & Connections			<input type="radio"/>							
	Footwalk & Handrail			<input type="radio"/>							
	Guards & Covers			<input type="radio"/>							
	Bumpers		<input type="radio"/>								
CONTROL PANELS	Bridge	<input type="radio"/>									
	Trolley	<input type="radio"/>									
	Main Hoist	<input type="radio"/>									
	Auxiliary Hoist	<input type="radio"/>									
	Mainline Panel	<input type="radio"/>									
RESISTORS	Bridge			<input type="radio"/>							
	Trolley			<input type="radio"/>							
	Main Hoist			<input type="radio"/>							
	Auxiliary Hoist			<input type="radio"/>							
CONTROL STATION CAB OR PUSHBUTTON	Master Switches			<input type="radio"/>							
	Pushbutton			<input type="radio"/>							
	Warning Device	<input type="radio"/>									
	Fire Extinguishers	<input checked="" type="radio"/>									
	Wiring			<input type="radio"/>							
MAIN HOIST	Motor	<input type="radio"/>									
	Motor Brake	<input type="radio"/>									
	Mechanical Load Brake	<input type="radio"/>									
	Dynamic Load Brake	<input type="radio"/>									
	Couplings	<input type="radio"/>									
	Gears, Shafts & Bearings	<input type="radio"/>									
	Upper Block	<input type="radio"/>									
	Lower Block	<input type="radio"/>									
	Hook & Throat Opening	<input checked="" type="radio"/>		X						Record Hook Throat Opening	
	Hoist Rope	<input checked="" type="radio"/>									
	Rope Drum		<input type="radio"/>								
	Guards		<input type="radio"/>								
Limit Switch	<input type="radio"/>										

* See text for DAILY & WEEKLY REQUIREMENTS.
 MAXIMUM INSPECTION INTERVAL.

SIGNED & DATED REPORT REQUIRED - OSHA.
 MAGNETIC PARTICLE EXAMINATION REQUIRED.

INSPECTION SCHEDULE AND MAINTENANCE REPORT

CRANE SERIAL NO. (MFGRS) _____ CUSTOMER CRANE IDENTITY NO. _____
 LOCATION IN PLANT _____

COMPONENT, UNIT OR PART and location on crane		* Recommended Inspection Interval		CONDITION (Check column best indicating condition when part or unit is inspected. Use note column to the right if condition is not listed below.)							CORRECTIVE ACTION NOTES			
		MONTHLY	SEMI-ANNUAL	ANNUAL	GOOD	ADJUSTMENT REQUIRED	REPAIR REQUIRED (Loose Parts or Wires)	REPLACEMENT REQUIRED (Worn or Damaged)	LUBRICATION REQUIRED (Low oil or Grease Rust or Corrosion)	CLEANING OR PAINTING REQUIRED				
LOCATION	COMPONENT, UNIT OR PART											DATE		
AUXILIARY HOIST	Motor	<input type="radio"/>												
	Motor Brake	<input type="radio"/>												
	Mechanical Load Brake	<input type="radio"/>												
	Dynamic Load Brake	<input type="radio"/>												
	Couplings	<input type="radio"/>												
	Gears, Shafts & Bearings	<input type="radio"/>												
	Upper Block	<input type="radio"/>												
	Lower Block	<input type="radio"/>												
	Hook & Throat Opening	<input checked="" type="radio"/>		X							Record Hook Throat Opening			
	Hoist Rope	<input checked="" type="radio"/>												
	Rope Drum	<input type="radio"/>												
	Guards	<input type="radio"/>												
	Limit Switch	<input type="radio"/>												
TROLLEY	Motor	<input type="radio"/>												
	Brake	<input type="radio"/>												
	Couplings	<input type="radio"/>												
	Gears, Shafts & Bearings	<input type="radio"/>												
	Frame			<input type="radio"/>										
	Wheels			<input type="radio"/>										
	Bumpers			<input type="radio"/>										
	Guards			<input type="radio"/>										
	Rails			<input type="radio"/>										
	Conductors	<input type="radio"/>												
RUNWAYS	Rails Including Span			<input type="radio"/>										
	Rail Joints			<input type="radio"/>										
	Main Conductors	<input type="radio"/>												
	Main Collectors	<input type="radio"/>												
MISC.	General Condition			<input type="radio"/>										
	Load Attachment Chains	<input checked="" type="radio"/>												
	Rope Slings & Connections	<input checked="" type="radio"/>												
	Change Gearcase Lub.			<input type="radio"/>										
	Grounding Faults			<input type="radio"/>										
ELECTRICAL	WITH RATED HOOK LOAD RECORD VOLTAGE & AMPERAGE				VOLTS			Amps. Up-Forwd.			Amps. Down-Rev.			Control Voltage
					Leg 1-2	Leg 2-3	Leg 3-1	1	2	3	1	2	3	
	Main Hoist Panel			<input type="radio"/>										
	Trolley Panel			<input type="radio"/>										
	Bridge Panel			<input type="radio"/>										
Auxiliary Hoist Panel			<input type="radio"/>											

* See Text for DAILY & WEEKLY REQUIREMENTS. X MAGNETIC PARTICLE EXAMINATION REQUIRED.
 MAXIMUM INSPECTION INTERVAL
 SIGNED & DATED REPORT REQUIRED - OSHA

Dresser C&H recommends that a designated Inspector(s) complete, sign and date this Inspection Schedule and Maintenance Report each inspection. Inspection records can point out the service life of crane components and help forecast the need for adjustments, repairs and ordering replacement parts. Maintain Inspection Files for each crane.

2. Inform operator before boarding crane. Be certain operator understands what you are to do and what he is to do.

3. When boarding a crane always use platforms, steps and ladders provided.

4. Have operator move crane to be inspected or repaired to a location where it will not interfere with other cranes or floor operations.

5. Lock main power switch in open position.

6. Display "WARNING" or "OUT OF ORDER" signs on the crane and also on the floor beneath the crane.

7. Provide rail stops to prevent interference with the idle crane by other cranes operating on the same runway. A signalman may be used if temporary rail stops are not available.

8. Raise and lower all tools or parts with a hand line or block and tackle. Be certain that parts and tools do not fall to floor. Keep both hands free when using ladders.

9. Replace all guards, safety devices or other parts removed to facilitate repairs. Remove all tools and temporary rail stops, if used.

10. Inform crane operator that inspection, maintenance or repairs are completed.

In addition to the above precautions, if repair required is part of the hoisting units, the lower block should be lowered to the floor. If this is not possible secure lower block to a part of the crane that will adequately support it.

b. General Disassembly Instructions. Some general disassembly instructions are listed below. More specific instructions are given in the components sections of this manual. Refer to the index to find the part or units that you may be repairing. General recommendations for disassembly are as follows:

1. Be certain that power is "OFF" and main switch is locked in the open position before attempting repair. Place warning signs on the main switch.

2. Disassemble a unit only to a point required to make the repair.

3. Use of heat from a torch to remove parts may damage the part permanently. If the part is to be replaced and reused, such as a shaft having new bearing races installed, torch heating may reduce the strength of the shaft which could later fail and damage equipment or cause serious accidents. Never use a torch to assist in removing parts unless the part will not be reused.

4. Using a great deal of force to disassemble a unit is usually not required. Parts which may have force or interference fits should be removed by use of an arbor press or puller.

5. Use care in disassembly of all parts. Nicking, scarring or abrasions on parts may reduce the strength of the part or cause trouble in reassembling.

6. When removing and replacing electrical components, tag or identify the wires removed. Use the appropriate wiring diagram furnished with the crane to help identify the wires.

7. Always secure parts which are too heavy to handle

conveniently with a rope or chain to prevent them from falling to the floor. Protect surfaces which contact rope or chain with cloth or heavy paper.

c. General Repair and Inspection Instruction. Whenever major components of a crane have been disassembled to repair or replace a part, other parts of the component should be cleaned and inspected for wear, damage or corrosion. Some items which require particular attention are listed below:

1. Inspect gearing for worn, cracked, chipped or broken teeth.

2. Oil seals and O-rings should be replaced.

3. Inspect anti-friction bearings for end play, roller and race wear or damage, or seal damage, if so equipped.

4. Inspect bushings for wear, scoring or galling.

5. Replace all threaded items having damaged threads.

6. Seal surfaces on shafts must be very smooth to prevent seal lip from wearing away. Smooth out any ridges, nicks or burrs with fine emery.

7. Replace any parts which are in questionable condition.

d. General Reassembly Instructions. When reassembling units which have been disassembled, follow instructions for the various components. The general instructions listed here require attention and should be observed.

1. Make certain all parts have been thoroughly cleaned and properly lubricated.

2. Bearings which require heating for assembly purposes should be immersed in an oil bath to insure that they are heated throughout. For bearings with inseparable races, do not heat a part of the bearing, such as the inner race alone. Doing so may damage the bearing.

3. Keys should drop into keyways with a snug fit. File or grind the key to obtain this fit.

4. Replace all gaskets with new gaskets of the same material and thickness as the old gaskets.

5. For threaded parts requiring specific torque values refer to components sections of this manual.

6. Always prepack grease lubricated anti-friction bearings with proper grease before final assembly.

e. Testing After Repairs.

1. Operational Testing. All cranes which have been altered or have undergone major repairs shall be tested for the following operations:

(a) Hoisting and lowering — slow to maximum speed.

(b) Trolley travel — slow to maximum speed.

(c) Bridge travel — slow to maximum speed.

(d) Limit switches and safety devices.

(1) Adjust trip setting of hoist limit switches so that with empty hook traveling at maximum speed (start with slower speeds) the limit switch trips before lower block or hook drifts to contact any part of trolley.

(2) Test and properly adjust any other safety devices installed on the crane.

2. Load Testing. All new cranes and cranes which have been altered or extensively repaired should be tested to confirm the load rating of the crane by or under the supervision of an appointed person qualified to make this test. The confirmed load rating should not be more than 80 percent of the test load. Test loads shall not exceed 125 percent of the rated load of the crane.

WARNING

Before attempting to test crane with a test load equal to 125% of the rated load, an appointed person shall have determined that the crane runway and other crane and building supporting structures are capable of safely supporting the test load and the weight of complete crane. Failure to provide adequate support for testing could cause injury to equipment and personnel.

Apply test load of 125% of the rated load to hoist using adequate attachments and having trolley located on the bridge so that the test load produces maximum loading on the bridge structure, as determined by the appointed person. The purpose of this test is to confirm the load rating of bridge, trolley and hoist structures. Lifting test load to full height or moving test load with trolley or bridge motions is not recommended.

At the time of crane installation, load testing, at the discretion of the user, may have included testing all motions — bridge, trolley and hoist — in addition to moving the rated load across and along the full runway. However, major repairs made only to hoisting equipment, such as

hoist gearing replacement, load brake repair or replacement, structural alteration of hoist frame require a confirmation of load rating for hoist only.

Repairs on bridge and trolley drive components not involving structural alterations may require load testing, if required by the user or safety codes.

Maintain and file reports on all load tests for future reference.

f. Spare Parts. Regular review of the Inspection Schedule and Maintenance reports can identify parts requiring replacement sufficiently in advance of actual need to permit ordering of parts when approaching need is identified. It is generally advisable to carry on hand a reasonable minimum inventory of repair parts. The required inventory varies with the type and age of crane, the severity of service, repair history and availability of parts. Typical recommended spares may include:

- Brake solenoids, coils, discs, linings
- Hoist limit switches
- Contactors
- Contact Kits
- Timing relays
- Pushbutton stations or parts
- Crane wheels, and guide rollers
- Motor couplings and brushes
- Current collectors or collector shoes
- Bearings
- Load hooks, nuts and thrust bearings
- Hoisting ropes
- Load brake parts

Parts listed above can be ordered from Dresser Crane & Hoist Spare Parts Department.

10-4. TROUBLE SHOOTING.

(See following pages.)

10-4. TROUBLE SHOOTING.

TROUBLE	PROBABLE CAUSE	POSSIBLE REMEDY
<p>10-4. a. Crane (Either Hoist Or Trolley Or Bridge Or All Motions) Will Not Operate.</p>	<p>(1) No power to crane.</p> <p>(2) Mainline contactor not functioning.</p> <p>(3) Defective control transformer.</p> <p>(4) No power to hoist, trolley or bridge panel.</p> <p>(5) Loose connections or broken wires in panel.</p> <p>(6) Contactors in the panels not functioning properly.</p> <p>(7) Wrong voltage or frequency.</p> <p>(8) Open motor secondary for wound rotor motor. (Gearing may sound as though there is excessive back lash.)</p> <p>(9) Motor burned out.</p> <p>(10) Damaged secondary resistor (for a wound rotor motor) or loose or broken terminal connections at the resistor.</p> <p>(11) Thermal overload relay tripped.</p>	<p>(1) Check main collectors for making proper electrical contact with the runway conductors. Check main disconnect switch and main fuses or main circuit breaker. Measure supply voltage by a voltmeter and check against electrical data sheet and motor nameplate.</p> <p>(2) Shut off main power supply. Check connections to mainline contactor. Check contact points. Replace if excessively burned or pitted. Check for open circuited or short circuited coil. Also check connections for start-stop buttons at pendant station or cab, especially the common wire.</p> <p>(3) Check transformer windings for signs of overheating. Replace if burned.</p> <p>(4) Shut off main power supply. Check power fuses in panels. Also check control fuses, if any.</p> <p>(5) Shut off main power supply. Check wiring connections. Check also wiring connections at pushbutton station or master switches.</p> <p>(6) Shut off main power supply. Check connections to contactors. Check contact points. Replace, if excessively burned or pitted. Check for open circuited or burned short circuited coil.</p> <p>(7) Check data on motor nameplate against actual power supply.</p> <p>(8) Shut off main power supply. Check connections at motor secondary and secondary resistor. Check accelerating contacts for burnt or pitted tips.</p> <p>(9) Replace motor.</p> <p>(10) Disconnect main power supply. Inspect resistor. Tighten all connections. Replace, if required.</p> <p>(11) Reset relay to 115%.</p>
<p>10-4. b. Hook Moves in Wrong Direction.</p>	<p>(1) Hoist panel or hoist push-buttons (or hoist master switch) wired wrong.</p> <p>(2) Reverse phasing on three phase hoist.</p>	<p>(1) Check wiring connections with appropriate wiring diagram.</p> <p>(2) Interchange any two supply lines.</p>
<p>10-4. c. Hook Will Raise But Not Lower.</p>	<p>(1) Lowering electrical circuit open.</p>	<p>(1) Check for loose connections in the lowering contactor circuit. See that the reversing jumpers are properly installed. Check connections at the lowering button in pushbutton station or lowering circuit in hoist master switch.</p>

TROUBLE	PROBABLE CAUSE	POSSIBLE REMEDY
	<p>(2) Lower (down) contactor is malfunctioning.</p> <p>(3) Defective limit switch.</p> <p>(4) Mechanical load brake malfunction.</p>	<p>(2) Shut off main power supply. Check contact points. Replace, if excessively burned or pitted. Check for open circuited or burned short circuited coil.</p> <p>(3) Check limit switch.</p> <p>(4) Inspect mechanical load brake per Paragraph 8-6.</p>
<p>10-4. d. Hook Will Lower But Not Raise.</p>	<p>(1) Excessive load.</p> <p>(2) Hoisting circuit is open.</p> <p>(3) Defective limit switch.</p> <p>(4) Hoisting (up) contactor malfunctioning.</p>	<p>(1) Reduce loading to rated capacity of hoist, as shown on nameplate.</p> <p>(2) Check for loose connection both in hoist panel and at the up-button in pushbutton station or up-circuit in hoist master switch.</p> <p>(3) Check limit switch.</p> <p>(4) Shut off main power supply. Check contact-points. Replace, if excessively burned or pitted. Check for open circuited or burned short circuited coil.</p>
<p>10-4. e. Hoist Will Not Lift Rated Load.</p>	<p>(1) Low voltage.</p> <p>(2) Motor brake actuating mechanism sticking or out of adjustment.</p>	<p>(1) Check voltage at motor terminals against motor nameplate data. Check wire size of power supply lines for hoist motor.</p> <p>(2) Disassemble actuating mechanism and inspect for defective, worn or damaged parts. Check voltage to brake coil.</p>
<p>10-4. f. Load Drifts Excessively When Hoist Is Stopped.</p>	<p>(1) Excessive load.</p> <p>(2) Motor holding brake is not functioning properly.</p> <p>(3) For hoist with mechanical load brake, load brake is not functioning properly.</p>	<p>(1) Reduce loading to rated capacity of hoist, shown on nameplate.</p> <p>(2) With no load, check hoist for drift. If drifting is excessive, inspect and adjust brake for proper torque and lining wear per section 5-6b.</p> <p>(3) With full load: (a) Test load brake with load a short distance off the floor. Release motor holding brake manually and note if load drops to floor. If it drops slowly, load brake is OK. If load falls free to floor inspect load brake. (b) If load brake checks OK holding brake needs adjustment — see (2) above.</p>
<p>10-4. g. Hoist Motor Overheats.</p>	<p>(1) Excessive load.</p> <p>(2) Excessive duty-cycle.</p> <p>(3) Wrong voltage or frequency.</p> <p>(4) Malfunctioning of accelerating contactors.</p> <p>(5) Loose connections in the motor secondary resistor for a wound rotor motor.</p> <p>(6) Gear box is bound up or not functioning freely, causing a strain on the motor.</p> <p>(7) Defective motor or worn bearings.</p> <p>(8) Motor brake actuating mechanism sticking or out of adjustment.</p>	<p>(1) Reduce loading to rated capacity of hoist shown on nameplate.</p> <p>(2) Reduce frequency of lifts or amount of jogging.</p> <p>(3) Check power supply against motor nameplate data.</p> <p>(4) Check sequence of contactors in the hoist panel against wiring diagram.</p> <p>(5) Disconnect main power supply. Inspect secondary resistor and tighten all connections. Check accelerating contacts for burnt or pitted tips.</p> <p>(6) Inspect gear box.</p> <p>(7) Disassemble motor and inspect for defective, worn or damaged parts.</p> <p>(8) Disassemble actuating mechanism and inspect for defective, worn or damaged parts. Check voltage to brake coil.</p>

TROUBLE	PROBABLE CAUSE	POSSIBLE REMEDY
	(8) Improper lubricant or level too low.	(8) Check lubricant and/or level.
10-4. h. Trolley Starts With A Jerk.	<p>(1) Intermediate steps in pushbutton or master switch are malfunctioning or loose connecting wires.</p> <p>(2) Accelerating contactors malfunctioning.</p> <p>(3) Damaged secondary resistor (for a wound rotor motor) or loose or broken terminal connections at the resistor.</p> <p>(4) Burnt off or damaged contact tips.</p> <p>(5) Trolley with squirrel cage motor and <u>without a ballast resistor</u> is producing excessive starting torque.</p> <p>(6) Trolley <u>with squirrel cage motor and a ballast resistor</u> has improper ballast resistor settings.</p>	<p>(1) Check pushbuttons or master switch for proper contact sequence. Tighten all wires.</p> <p>(2) Inspect accelerating contactors for proper sequence.</p> <p>(3) Disconnect main power supply. Inspect resistor. Tighten all connections. Replace if required.</p> <p>(4) Check contact tips.</p> <p>(5) Add proper ballast resistor.</p> <p>(6) Check ballast resistor and adjust.</p>
10-4. i. Bridge Does Not Work At All Speed Points, Except Forward and Reverse.	<p>(1) Damaged secondary resistor or broken or loose connections at resistor.</p> <p>(2) Intermediate steps on pushbuttons or master switch not working.</p> <p>(3) Accelerating contactors malfunctioning.</p> <p>(4) Damaged secondary resistor (for a wound rotor motor) or loose or broken terminal connections at the resistor.</p>	<p>(1) Disconnect main power supply. Inspect resistor. Tighten all connections. Replace if required.</p> <p>(2) Check pushbuttons or master switch for proper contact sequence. Tighten all wires.</p> <p>(3) Check contactors for loose connections, broken contacts, short circuited or open circuited coil.</p> <p>(4) Disconnect main power supply. Inspect resistor. Tighten all connections. Replace if required.</p>
10-4. j. Bridge Does Not Work At All.	<p>(1) No power supply to bridge panel, if the reversing contactor coils are "pulling in" the armature of the contactor.</p> <p>(2) No control voltage if contactor is not "pulling in".</p>	<p>(1) Check bridge power supply with meter at reversing contactors, working your way back to the main supply.</p> <p>(2) Check control transformer power supply working your way through the coil circuit.</p>
10-4. k. Hoist Operates Intermittently.	(1) Main collectors making poor contacts. Grease, dirt or paint spray on main conductor runways.	(1) Check main collectors and main conductor runway system.

POSSIBLE REMEDY	PROBABLE CAUSE	TROUBLE
<p>(2) Check all wiring in mainline panel.</p> <p>(3) Check all wiring in hoist panel.</p> <p>(4) Check pushbutton station and hoist master switch.</p> <p>(5) Check cross conductors and collectors.</p> <p>(6) Check secondary resistor. Tighten all leads. Check brushes. Adjust if required.</p> <p>(7) Check pushbutton cable for continuity of each wire in cable.</p>	<p>(2) Loose connection in mainline panel.</p> <p>(3) Loose connection in hoist panel.</p> <p>(4) Loose connection in hoist pushbuttons or master switch.</p> <p>(5) Cross conductor collectors making poor contacts. Grease, dirt or paint spray on cross conductors.</p> <p>(6) Loose hoist motor secondary resistor leads. Brushes hanging up in brushholders.</p> <p>(7) Broken wire in pushbutton cable which sometimes makes contact when cable is twisted.</p>	<p>10-4.1. Load Swings Excessively When Crane (Bridge) Is Stopped.</p>
<p>(1) Decrease brake torque, see SECTION 5-5b.</p> <p>(2) Check wheels and runway alignment.</p>	<p>(1) Bridge brake is set too tight, causing too abrupt a stop.</p> <p>(2) Bridge wheels are rubbing on track, causing crane to jar to a stop.</p>	<p>10-4. m. Motor Runs (Any Motion) But Machinery Does Not.</p>
<p>(1) Tighten or replace coupling.</p> <p>(2) Replace key.</p>	<p>(1) Broken or loose motor coupling.</p> <p>(2) Shaft key sheared.</p>	<p>10-4.n. Bridge Skews.</p>
<p>(1) Check alignment.</p> <p>(2) Measure diameters.</p> <p>(3) Tighten or replace coupling.</p> <p>(4) Replace keys.</p> <p>(5) Check with transit level.</p>	<p>(1) Track misalignment.</p> <p>(2) Drive wheel diameters not equal.</p> <p>(3) Loose or broken coupling — one end.</p> <p>(4) Sheared keys in couplings or wheels.</p> <p>(5) Track elevation not same on both sides.</p>	<p>10-4.p. Bridge Bounces Excessively While Traveling.</p>
<p>(1) Change wheels in pairs.</p> <p>(2) Reinforce runway and change wheels in pairs.</p>	<p>(1) Flat spot on wheel.</p> <p>(2) Wave pattern on wheel.</p>	



SHAW-BOX

A. Seller warrants that its products and parts, when shipped, and its work (including installation, construction and start-up), when performed, will meet applicable specifications, will be of good quality and will be free from defects in material and workmanship. All claims for defective products or parts under this warranty must be made in writing immediately upon discovery and, in any event, within one (1) year from shipment of the applicable item unless Seller specifically assumes installation, construction or start-up responsibility. All claims for defective products or parts when Seller specifically assumes installation, construction or start-up responsibility, and all claims for defective work or start-up made in writing immediately upon discovery and, in any event, within one (1) year from completion of the applicable work by Seller, provided; however, all claims for defective products and parts must be made in writing no later than eighteen (18) months after shipment. Defective items must be held for Seller's inspection and returned to the original f.o.b. point upon request. THE FOREGOING IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, WHATSOEVER, EXPRESS, IMPLIED AND STATUTORY, INCLUDING, WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS.

B. Upon Buyer's submission of a claim as provided above and its substantiation, Seller shall at its option either (i) repair or replace its product, part or work at either the original f.o.b. point of delivery or at Seller's authorized service station nearest Buyer or (ii) refund an equitable portion of the purchase price.

C. This warranty is contingent upon Buyer's proper maintenance and care of Seller's products, and does not extend to fair wear and tear. Seller reserves the right to void warranty in event of Buyer's use of inappropriate materials in the course of repair or maintenance, or if Seller's products have been dismantled prior to submission to Seller for warranty inspection.

D. The foregoing is Seller's only obligation and Buyer's exclusive remedy for breach of warranty, and is Buyer's exclusive remedy hereunder by way of breach of contract, tort, or otherwise. In no event shall Buyer be entitled to or Seller liable for incidental or consequential damages. Any action for breach of this agreement must be commenced within one (1) year after the cause of action has accrued.

WARRANTY AND LIMITATION OF LIABILITY

WARRANTY

or phone: 616/733-0821

Muskegon, Michigan 49443
Dresser Industries, Inc.
Crane & Hoist Division

nearest repair station, write:

Parts for your crane are available from your local authorized SHAW-BOX repair station. For the location of your

NOTE: When ordering parts always furnish Crane Serial Number, Rated Load, Motor Horsepowers, Voltage, Phase and Frequency.

Brake discs, linings
Hoist limit switches
Contactors
Contact Kits
Timing relays
Trolley wheels
Crane wheels

Motor couplings and brushes
Bearings
Load hooks, nuts, thrust bearings and latches
Hoisting ropes
Load brake parts
Current collectors
Pushbutton stations

Certain parts of your crane will, in time, require replacement under normal wear conditions. It is suggested that the following parts be purchased for your crane as spares for future use.

Recommended Spare Parts
for Your SHAW-BOX Crane