INSTRUCTION MANUAL

BUCYRUS-ERIE

MODEL 25-B 40-T

SHOVEL-CLAMSHELL DRAGLINE-HOE-CRANE

CRAWLER & TRANSIT®

BOOK 1

Applicable to
Serial No. 121994 thru 133888

ADDITIONAL MANUALS $2.00 EACH
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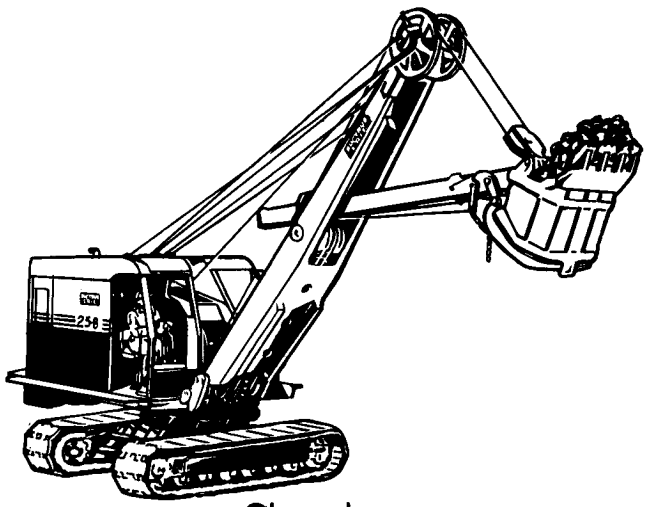
BUCYRUS-ERIE COMPANY
GENERAL OFFICES: SOUTH MILWAUKEE, WISCONSIN, U.S.A.

25B Crawler Machine



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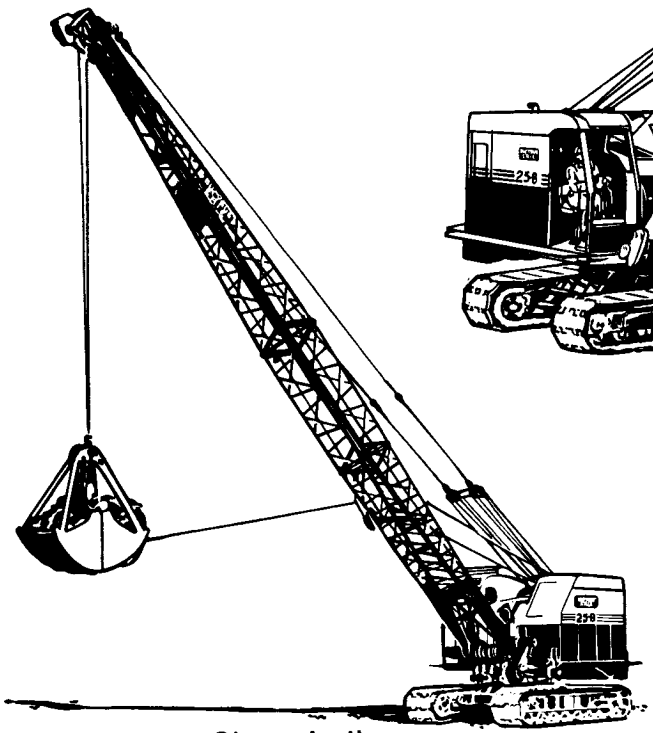

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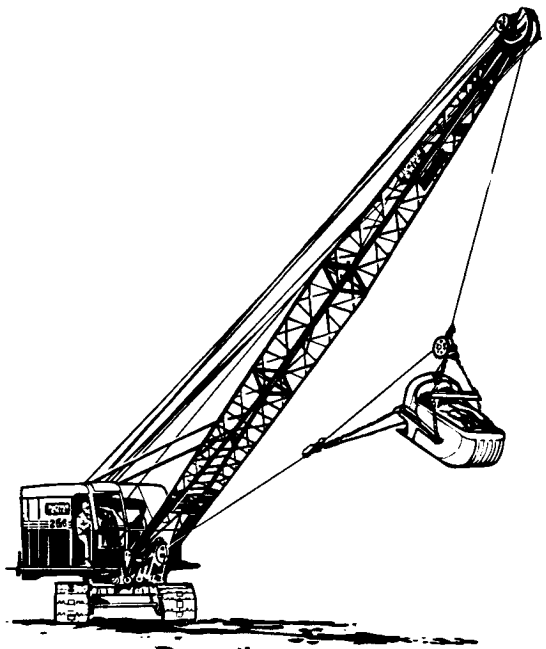

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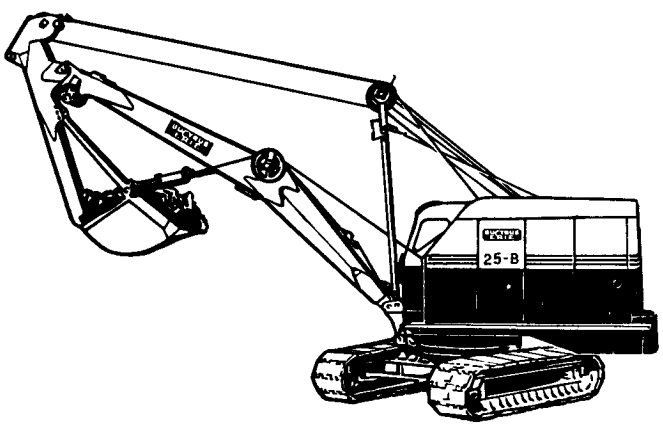

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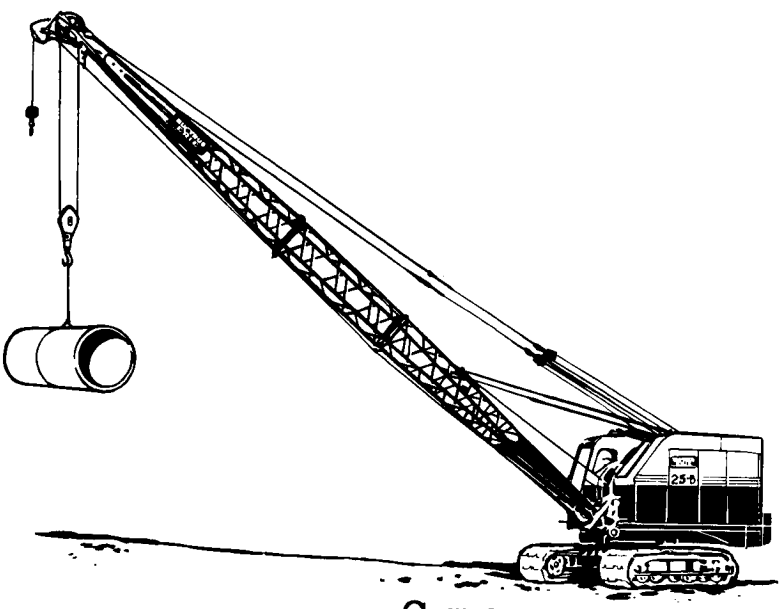

Crane

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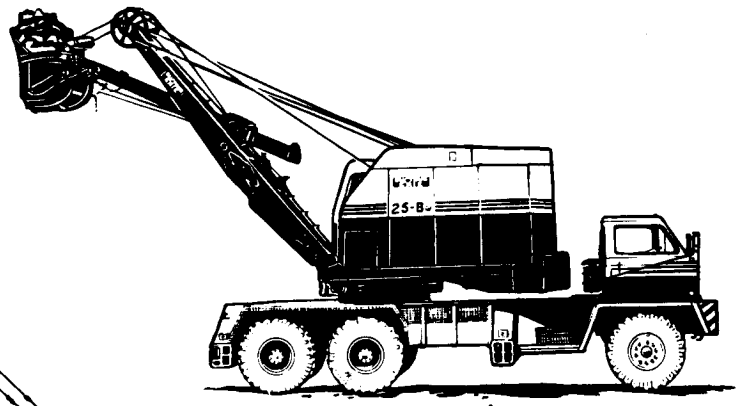

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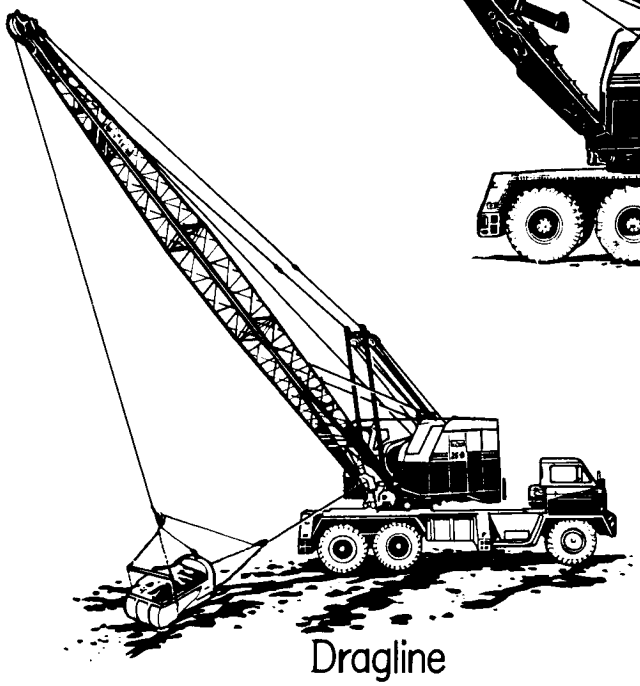

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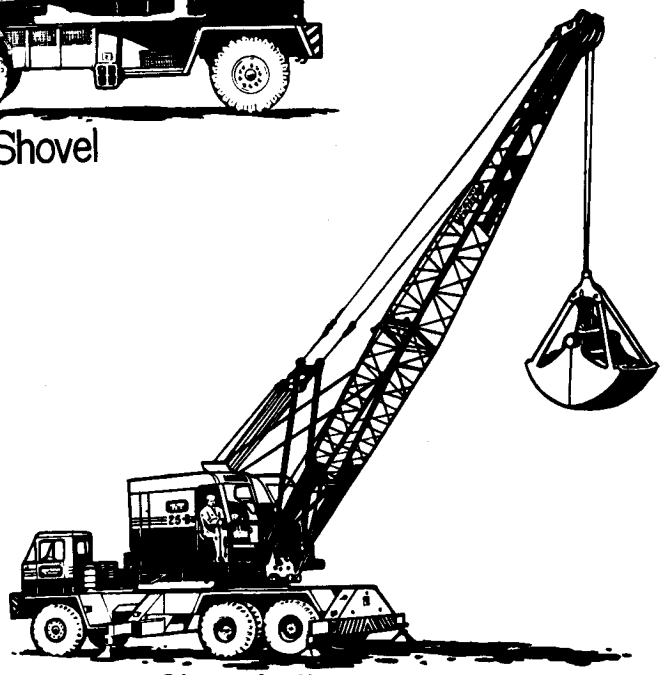

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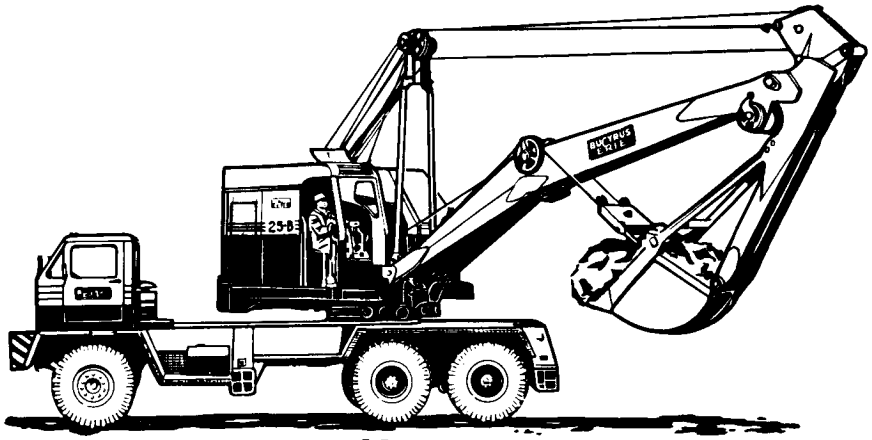

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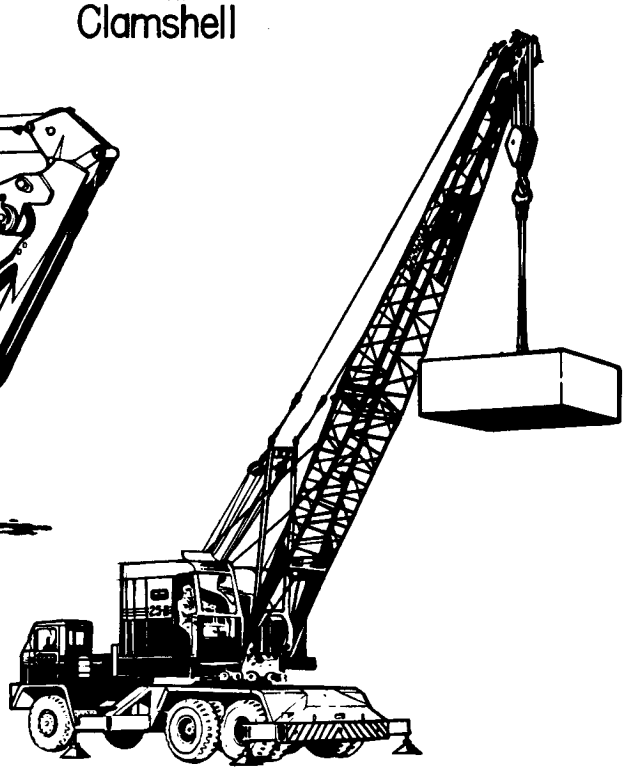

Crane

INTRODUCTION

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GENERAL INSTRUCTIONS

I. Read Instruction Manual and Safety Rules Carefully

This manual has been compiled to give the owner, operator, and mechanic, information as to the care, operation, and maintenance of the machine. For convenience this Instruction Manual has been written in sections. The first page of each section lists the headings contained in that section. Familiarize yourself with the Instruction Manual so that you can easily locate the particular information you may need.

A capacity plate which shows the lifting limitations of the machine is mounted inside the operator's cab. Never exceed the loads and/or conditions stated.

The safety rules included with this manual represent a minimum set of standards for safe machine operation, and every operator should be familiar with, and follow them at all times.

Each machine has a specific serial number assigned to it so that it can be readily identified. The serial number of your machine is stamped on a plate which is mounted on the right hand machinery side frame. This serial number should always be included in any correspondence with Bucyrus-Erie Company or any of its distributors.

Every effort has been made to have this manual as complete as possible at the time of printing. However, since Bucyrus-Erie Company reserves the right to improve its products continually, changes may have been made that will not be covered in this manual.

WHEN ORDERING PARTS, ALWAYS USE THE PARTS CATALOG TO INSURE GETTING THE CORRECT PART FOR YOUR SPECIFIC SERIAL NUMBERED MACHINE. REFER TO THE PARTS CATALOG FOR CORRECT PROCEDURE IN ORDERING PARTS.

II. To the Owner

As an owner of a Bucyrus-Erie Company machine, you are entitled to all the high performance, quality, low-cost operation, and long life that is built into said machine.

Your machine has been carefully checked and put through an operational test at the factory. In addition, your Bucyrus-Erie Company Distributor has performed rigid inspections and made final adjustments before placing machine into service. To further guard your interests as a Bucyrus-Erie Company

customer, you are entitled to receive two (2) after-delivery service calls. These calls are at 30 days or 200 hours and 60 days or 400 hours. Contact your Bucyrus-Erie Company Distributor for a mutually agreeable time to receive this service.

To keep your machine at its maximum efficiency, and to avoid dangerous and costly accidents, a great deal depends on the operator and maintenance personnel. Insist that this manual be read by those responsible for operation of your machine and that all recommended services be performed.

III. Warranty

Reproduced below in its entirety is the standard BUCYRUS-ERIE Warranty covering all construction machines and spare parts manufactured by the Company.

BUCYRUS-ERIE COMPANY

GUARANTY: We warrant the machinery, and all spares, replacements and auxiliary equipment, now or hereafter furnished by us therefor, to be built in a workmanlike manner of sound high-grade material, and, under normal use and proper attention, to operate properly. Any claim made under this warranty must be presented to us in writing at Evansville, Indiana, within six months after final shipment or, in the case of Transit Crane carrier units whether or not sold separately, or any parts thereof, within six months after shipment or 4,000 miles travel, whichever first occurs. We are to have the option of replacing f.o.b. works any element proved to be defective or of remedying any proved defect, but our liability in any event shall not exceed the replacement value of the defective element f.o.b. works, and in the case of units or parts purchased by us, our liability shall not exceed the settlement which we are able to obtain from our supplier. We are to have a reasonable length of time, after recognition of claim, in which to exercise our above option, and shall have the right to require the return of the alleged defective element, transportation charges prepaid, before recognizing any claim. No allowance will be made for repairs or alterations undertaken without our written consent. If parts other than of the original manufacturer are used in replacement without our written consent, or if you fall in arrears in making any payment herein provided, or if the machinery without our written consent is repaired or altered in such a way as in our judgment to reduce its stability or reliability, or if the machinery is subjected to misuse, negligence or accident, all warranties are thereby waived. The foregoing warranty is in lieu of all tort liability and all other warranties or representations or rights of rejection, express or implied, by law or by contract. More specifically, but without restriction thereto, there is no representation or express or implied warranty that the machinery complies with the laws of any state.

NOTE: Warranty claims on Bucyrus-Erie Company machines are processed through your authorized Distributor. This Distributor will submit the formal claim, in writing, to Bucyrus-Erie Company.

Although this manual may give disassembly and rebuilding instructions for various components, no component which fails within the warranty period is to be opened or disassembled by the customer or distributor, and must be returned intact to Bucyrus-Erie Company for factory inspection and liability consideration.

DISASSEMBLY OR TAMPERING WITH COMPONENTS DURING THE WARRANTY PERIOD, WILL VOID THE WARRANTY.

IV. Terms and Definitions

"Basic Machine" is the machine without front end equipment attached.

"Lower Works" is that section of the machine which includes the truck frame, propel machinery, crawlers, and the swing rack. It does not revolve.

"Lower Works" for TRANSIT machine is the transit carrier.

"Upper Works" is that section which revolves and to which the front end equipment is attached.

"Right Side" of machine is at observer's right when standing at the power unit and facing the boom.

"Left Side" is opposite to the right side.

"Rear" of the lower works is the end where the propel drive chains are located.

"Front End Equipment" includes the boom, dipper handle, and dipper.

V. Machine Inspection and Maintenance

There is no substitute for preventive maintenance. A regular schedule of preventive maintenance should be set, so that any apparent troubles are found before extensive damage is done to the machine.

Many critical components on the machines are subject to wear and other deterioration or damage which limit their useful life; thus, they are expendable. When new, all such parts have a built-in reserve strength against unknown conditions and reasonable loss of strength due to gradual deterioration. However if replacement is neglected, these parts can eventually reach a condition

where they become a safety hazard. Failure to maintain correct adjustments of the various mechanisms to assure proper performance of the machine also can be a safety hazard.

SINCE THE MACHINE MANUFACTURER HAS NO DIRECT CONTROL OVER THE FIELD INSPECTION AND MAINTENANCE, SAFETY IN THIS AREA IS THE RESPONSIBILITY OF THE USER.

Inspection — All machines in active service should be inspected at regular intervals for proper adjustment of operating mechanisms, excessive wear or deterioration of components, accidental damage and any other defects which might be questionable as to safety. Any deficiences noted should be carefully investigated and determination made as to whether they constitute a safety hazard. Inspection is vital to safe operation. It should be performed by competent personnel and on a regular and systematic basis.

Inspection Frequency — Frequency requirements of inspection depend upon numerous factors such as machine activity, severity of service, vulnerability of parts to wear and damage and the extent to which parts may be deemed critical in relation to safety. Inspection frequency can be divided into two general categories as follows:

1. Daily to monthly intervals including observation during operation for any defects which might appear between regular inspections.

    a. All control mechanisms for maladjustment interferring with proper operation.
    b. All control mechanisms for excessive wear of components and contamination by lubricants or other foreign matter.
    c. All safety devices for malfunction.
    d. Deterioration or leakage in air system.
    e. Crane hooks with deformations or cracks.
    f. Rope reeving for noncompliance with crane manufacturer's recommendations.
    g. Electrical apparatus for malfunctioning, signs of excessive deterioration, dirt, and moisture accumulation.

2. One to twelve month intervals. A complete machine inspection including items as in 1 above and in addition the following:

    a. Deformed, cracked, or corroded members in the crane structure and boom.
    b. Loose bolts or rivets.
    c. Cracked or worn sheaves and drums.

d. Worn, cracked or distorted parts such as pins, bearings, shafts, gears, rollers and locking devices.
e. Excessive wear on brake and clutch system parts, linings, pawls, and ratchets.
f. Load, boom angle, and other indicators over their full range, for any significant inaccuracies.
g. Gasoline, diesel, electric, or other power plants for improper performance or noncompliance with safety requirements.
h. Excessive wear of chain-drive sprockets and excessive chain stretch.
j. Crane hooks. Magnetic particles or other suitable crack detecting inspection should be performed at least once each year.
k. Travel steering, braking, and locking devices, for malfunction.

Maintenance — Preventive maintenance programs based on the recommendations contained in this manual should be established. However, due to the wide variation in job applications, severity of service, machine activity and environment it is impossible for us to develop a single, complete standard procedure which will fit all applications. Therefore such programs should be developed by trained and experienced personnel, responsible for maintenance of the machine, by adjustment and extension of our general recommendations, to suit the particular needs.

Adjustments, Replacements & Repairs — Any conditions, disclosed by the inspection requirements above, which are considered to constitute safety hazards should be corrected before operation of the machine is resumed, to assure that the equipment will always be operated in a safe condition.

Replacement Parts — It is recommended that all replacement parts be obtained from the original equipment manufacturer in order that the strength and quality of the original machine may be maintained.

Lubrication — Regular and systematic lubrication should be maintained on the machine, in accordance with the lubrication charts and general recommendations contained in this manual. All machinery should be stopped while lubricating except in cases where the lubrication system is designed for safe application while the machinery is in motion. Any guards or panels which must be removed for access to some points for lubrication or inspection should always be replaced before resuming operation.

Maintenance Tools — Routine maintenance tools should be available at all times.

Fire Extinguisher — A carbon dioxide or dry chemical hand fire extinguisher should be kept in the operator's cab at all times.

Remember that the matter of keeping bolts and nuts tight is just as much an item of maintenance as lubricating or adjusting the machine. A bolted connection which is not quite tight will quickly pound itself into a loose and dangerous connection.

A weld which has cracked due to excessive strain can be easily repaired by "V-ing" it out and rewelding, but if the crack is allowed to go, it may spread so much that proper alignment of the parts is lost. A satisfactory repair is then hard to make.

An item of maintenance not to be overlooked is cleanliness. Clean and paint the machine as part of your regular preventive maintenance schedule.

CLEAN IT FIRST — KEEP CLEAN FROM START TO FINISH.

VI. Machine Application and Operation

General — This is probably the most important area relative to safety since it involves the greatest frequency of exposure to hazards. The operator should be fully competent physically, mentally and emotionally to understand and apply established operating safety rules. He should be able to exercise good judgment in dealing with the many situations which cannot be anticipated and covered herein. SINCE THE MANUFACTURER HAS NO DIRECT CONTROL OVER MACHINE APPLICATION AND OPERATION, CONFORMANCE WITH GOOD SAFETY PRACTICE IN THIS AREA IS THE RESPONSIBILITY OF THE USER OR HIS OPERATING PERSONNEL.

Application — Only machines of proper rated capacity and type should be assigned to the job to be done. Anything less constitutes a safety hazard.

Operation — In general, established operating safety rules where applicable should be observed in performing operating functions. Operating safety rules are found in sources such as the following:

1. Occupational Safety and Health Act of 1970, as amended.

2. ANSI Standard Safety Code for Crawler, Locomotive and Truck Cranes, ANSI B30.5.

3. Power Crane and Shovel Association — "60 Rules on Safety".

4. This Instruction Manual.

It is recognized that written rules cannot cover all situations which might be encountered on the job. To meet such unanticipated situations the operator must be able to supplement his own rules based on good judgment.

Capacity Ratings — Manufacturers' ratings should never be exceeded. The stipulations pertinent to these ratings should always be carefully observed. Under some conditions even the full standard capacity ratings cannot be recommended and must be adjusted downward to compensate for special hazards.

Rating Based on Structural Competence — As the shorter rated radii are approached in the lifting operation the load required to tip the machine increases very rapidly to a point where the actual tipping load is almost unlimited. Rated loads based on excessive tipping loads cannot be covered by adequate design factors since this would result in excessive machine weight and limitation of the machine's usefulness. Consequently, some of the ratings shown on the chart may be based on machine's structural competence rather than stability, in which cases the full use of stability in lifting loads is not intended or approved. It is therefore unsafe to apply any load, which is greater than the rated load shown on the chart for that radius.

Counterweight — The maximum counterweight approved by the manufacturer for use on a given machine should never be exceeded. Unauthorized addition of counterweight in the field constitutes a safety hazard in two ways. First, the higher loading of machine parts has not been taken into account in the design. Second, the backward stability margin built into the machine for the user's protection could be reduced beyond that considered safe practice.

Level Machine — All load ratings are based on levelness of the machine in both directions. Any deviation from this condition introduces a safety hazard, the degree of which depends upon the amount of deviation, and must be taken into account by the operator in loading and handling the machine.

Unattended Machines — Before leaving his control station the operator should rest the attachment on ground, place controls in neutral position and set all locking devices as necessary to secure the machine.

Ground or Support Conditions — Capacity ratings are based on the condition of a firm supporting surface under the machine. Operating personnel should consider and allow for unusual conditions, since yielding of the supporting surface during operation may be a hazard.

Operation Near Electric Power Lines — Consult references listed above or possible local codes.

Hand Signals — Included in this manual.

Operation With Attachment or Counterweight Removed — Operation including swinging, traveling or transporting of machine with attachment removed, but with counterweight in place, or conversely, counterweight removed and attachment in place, may involve condition of dangerous instability. Such operation should be performed only if proper precautions are taken to prevent machine from tipping.

VII. Rope Inspection, Replacement, and Maintenance

Inspection — All running ropes in continuous service should be visually inspected once every working day. A thorough inspection of all ropes in use shall be made at least once a month and a full written, dated, and signed report of rope condition kept on file where readily available. All inspections shall be performed by an appointed or authorized person. Any deterioration, resulting in appreciable loss of original strength, such as described below, shall be carefully noted and determination made as to whether further use of the rope would constitute a safety hazard:

1. Reduction of rope diameter below nominal diameter due to loss of core support, internal, or external corrosion or wear of outside wires.

2. A number of broken outside wires and the degree of distribution of concentration of such broken wires.

3. Worn outside wires.

4. Corroded or broken wires at end connections.

5. Corroded, cracked, bent, worn, or improperly applied end connections.

6. Severe kinking, crushing, cutting, or unstranding.

Heavy wear and/or broken wires may occur in sections in contact with equalizer sheaves or other sheaves where rope travel is limited, or with saddles. Particular care shall be taken to inspect ropes at these locations.

All rope which has been idle for a period of a month or more due to shut down or storage of a crane on which it is installed shall be given a thorough

inspection before it is placed in service. This inspection shall be for all types of deterioration and shall be performed by an appointed or authorized person whose approval shall be required for further use of the rope. A written and dated report of the rope condition shall be filed.

Particular care shall be taken in the inspecting of non-rotating rope,

Replacement — No precise rules can be given for determination of the exact time for replacement of rope, since many variable factors are involved. Safety in this respect depends largely upon the use of good judgment by an appointed or authorized person in evaluating remaining strength in a used rope after allowance for deterioration is disclosed by inspection. Safety of rope operation depends upon this remaining strength.

Conditions such as the following should be sufficient reason for questioning rope safety and for consideration of replacement:

1. In running ropes, six randomly distributed broken wires in one lay or three broken wires in one strand in one lay.

2. Wear of one-third the original diameter of outside individual wires.

3. Kinking, crushing, bird caging, or any other damage resulting in distortion of the rope structure.

4. Evidence of any heat damage from any cause.

5. Reductions from nominal diameter of more than:

   a. 3/64 inch for diameters to and including 3/4 inch.
   b. 1/16 inch for diameters 7/8 inch to 1-1/8 inches inclusive.
   c. 3/32 inch for diameters 1-1/4 to 1-1/2 inches inclusive.

6. In standing ropes, more than two broken wires in one lay in sections beyond end connections or more than one broken wire at an end connection.

In order to establish data as a basis of judging the proper time for replacement, a continuing inspection record shall be maintained.

Maintenance — Rope shall be stored to prevent damage or deterioration.

Unreeling or uncoiling of rope shall be done as recommended by the rope manufacturer and with extreme care to avoid kinking or inducing a twist.

Before cutting a rope, seizings shall be placed on each side of the place where the rope is to be cut to prevent unlaying of the strands. On preformed rope, one seizing on each side of the cut is required. On nonpreformed ropes of 7/8 inch diameter or smaller, two seizings on each side of the cut are required, and for nonpreformed rope of 1 inch diameter or larger, three seizings on each side of the cut are required.

During installation care shall be observed to avoid dragging of the rope in dirt or around objects which will scrape, nick, crush, or induce sharp bends in it.

Rope should be maintained in a well lubricated condition. It is important that lubricant applied as part of a maintenance program shall be compatible with the original lubricant and to this end the rope manufacturer should be consulted. Those sections of rope which are located over sheaves or otherwise hidden during inspection and maintenance procedures require special attention when lubricating rope. The object of rope lubrication is to reduce internal friction and to prevent corrosion. Periodic field lubrication is particularly important for non-rotating rope.

When an operating rope shows greater wear at well defined localized areas than on the remainder of the rope, rope life can be extended in cases where a reduced rope length is adequate, by cutting off a section at one end, and thus shifting the wear to different areas on the rope.

VIII. Handling the Load

Size of Load — No crane shall be loaded beyond the rated load, except for test purposes.

When loads which are limited by structural competence rather than by stability are to be handled, the person responsible for the job shall ascertain that the weight of the load has been determined within plus or minus 10 percent before it is lifted.

Attaching the Load — The hoist rope shall not be wrapped around the load.

The load shall be attached to the hook by means of slings or other approved devices.

Moving the Load — The individual directing the lift shall see that:

1. The crane is level and where necessary blocked properly.

2. The load is well secured and properly balanced in the sling or lifting device before it is lifted more than a few inches.

Before starting to hoist, note the following conditions:

1. Hoist rope shall not be kinked.
2. Multiple part lines shall not be twisted around each other.
3. The hook shall be brought over load in such a manner as to prevent swinging.
4. If there is a slack rope condition, it should be determined that the rope is properly seated on the drum and in the sheaves.

During hoisting care shall be taken that:

1. There is no sudden acceleration or deceleration of the moving load.
2. Load does not contact any obstructions.

Side loadings of booms shall be limited to freely suspended loads. Cranes shall not be used for dragging loads sideways.

The operator shall not hoist, lower, swing, or travel while anyone is on the load or hook.

The operator should avoid carrying loads over people.

On truck mounted cranes, no loads shall be lifted over the front area except as approved by the crane manufacturer.

The operator shall test the brakes each time a load approaching the rated load is handled by raising it a few inches and applying the brakes.

Outriggers shall be used when the load handled at that particular radius exceeds the rated load without outriggers as given by the crane manufacturer. Where floats are used they shall be securely attached to the outriggers.

Neither the load nor the boom shall be lowered below the point where less than two full wraps of rope remain on their respective drums.

When two or more cranes are used to lift one load, one designated person shall be responsible for the operation. He shall analyze the operation and instruct all personnel involved in the proper positioning, rigging of the load and the movements to be made.

In transit the following additional precautions shall be exercised:

1. The boom shall be carried in line with the direction of motion.

2. The upper works shall be secured against rotation, except when negotiating turns when there is an operator in the cab or the boom is supported on a dolly.

3. The empty hook shall be lashed or otherwise restrained so that it cannot swing freely.

Before traveling a crane with load, a designated person shall be responsible for determining and controlling safety. Decisions such as position of load boom location, ground support, travel route, and speed of movement shall be in accord with his determinations.

A crane with or without load shall not be traveled with the boom so high that it may bounce back over the cab.

When rotating the crane, sudden starts and stops shall be avoided. Rotational speed shall be such that the load does not swing out beyond the radii at which it can be controlled. A tag or restraint line shall be used when rotation of the load is hazardous.

When a crane is to be operated at a fixed radius, the boom hoist pawl or other positive locking device shall be engaged.

Holding the Load — The operator shall not leave his position at the controls while the load is suspended.

No person should be permitted to stand or pass under a load on the hook.

If the load must remain suspended for any considerable length of time, the operator shall hold the drum from rotating in the lowering direction by activating the positive controllable means of the operator's station.

IX. Safety Precautions

1. Always correct any faulty conditions that may cause damage to the machine or result in personnel injury.

2. Do not allow open flame or smoking around flammable material or when servicing the batteries.

3. When servicing batteries take care not to get electrolyte on skin, clothing or in eyes.

4. Do not fill fuel tank while engine is running. Be sure there are no open flames or exposed heated parts that can ignite fuel vapors while tank is being filled. Keep fuel nozzle in contact with tank being filled, or provide a ground to prevent static sparks from igniting fuel.

5. Before starting engine, be sure all operating levers and foot pedals are in neutral.

6. Stop all other operation when cleaning, adjusting, or lubricating the machine.

7. When making adjustments or cleaning machine, be sure the engine clutch is disengaged unless specific adjustments require engagement.

8. When adjusting the engine clutch, the engine must not be running.

9. Engage swing brake before propelling. Watch for low overheads and narrow side clearances during propelling. Look out for power lines. Avoid soft ground. Cross railroad tracks slowly.

10. Keep machine free of grease, oil, ice, and mud to prevent slipping and falling.

11. Except for specific adjustments which must be made while the engine is running, do not work on engine while in operation.

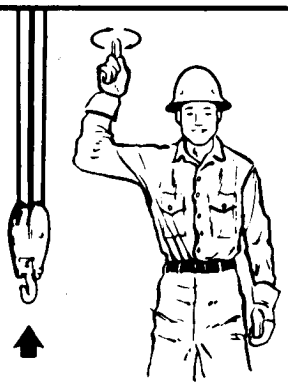
12. Use extreme caution in releasing the radiator cap when the engine has been overheated. If possible, wait until the engine is cool before removing the cap.

13. In severe cold weather, do not touch any metal parts of the machine with exposed flesh, as the flesh can stick to the metal and cause severe injury.

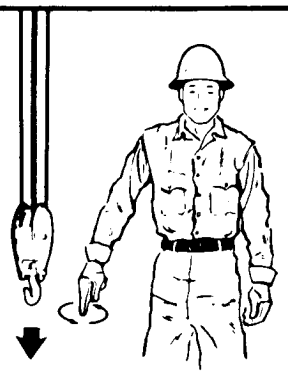
14. Reduce throttle when maneuvering in tight quarters.

CAUTION

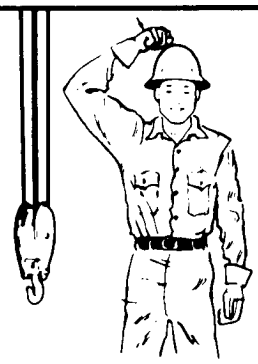
This equipment must not be operated in a location where any of its parts or load can be brought closer than ten (10) feet to power lines, unless current has been shut off and the lines grounded.



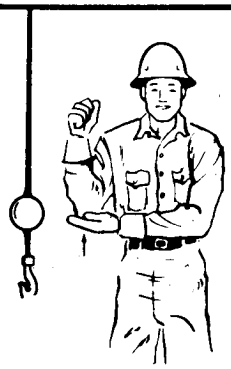
HOIST. With forearm vertical, forefinger pointing up, move hand in small horizontal circle



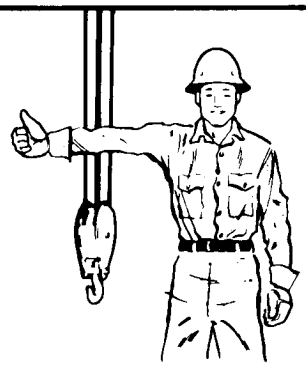
LOWER. With arm extended downward, forefinger pointing down, move hand in small horizontal circles.



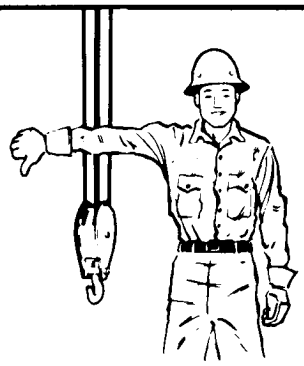
USE MAIN HOIST. Tap fist on head; then use regular signals



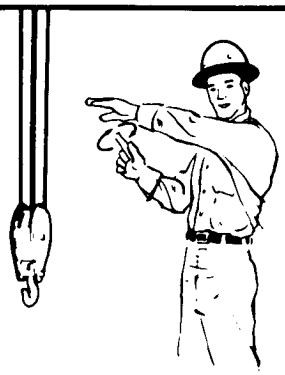
USE WHIP LINE. (Auxiliary Hoist) Tap elbow with one hand; then use regular signals.



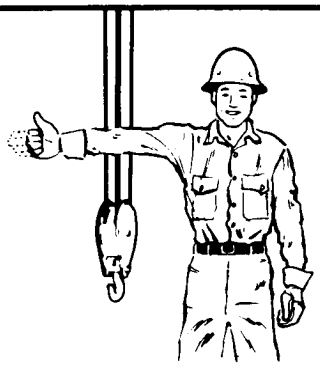
RAISE BOOM. Arm extended, fingers closed, thumb pointing upward.



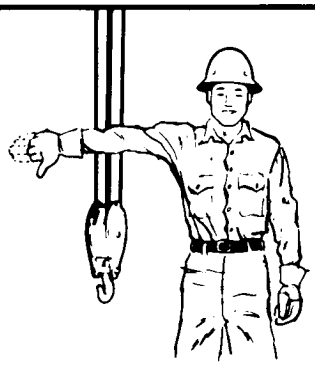
LOWER BOOM. Arm extended fingers closed, thumb pointing downward.



MOVE SLOWLY. Use one hand to give any motion signal and place other hand motionless in front of hand giving the motion signal. (Hoist Slowly shown as example)

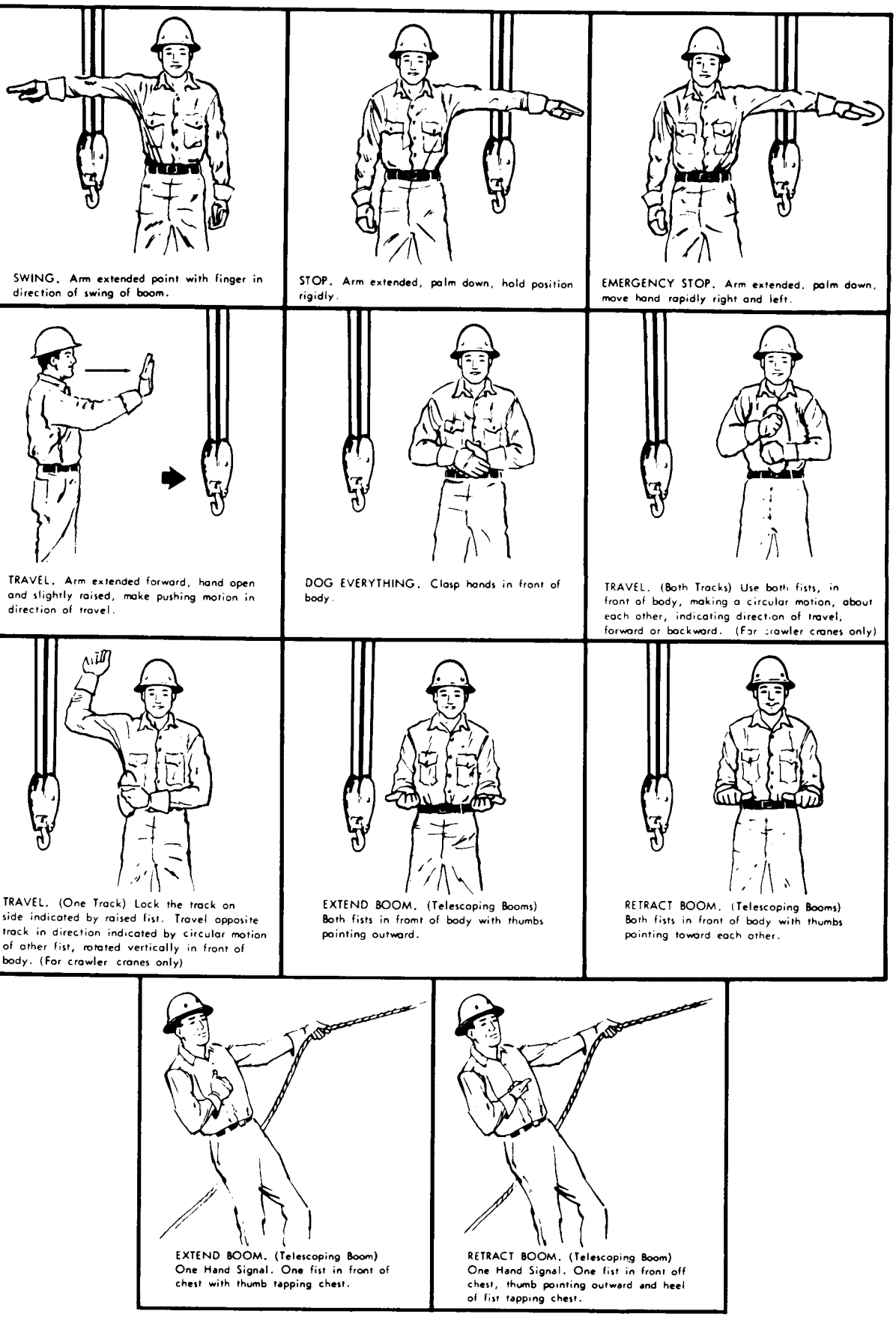


RAISE THE BOOM AND LOWER THE LOAD. With arm extended thumb pointing up, flex fingers in and out as long as load movement is desired.



LOWER THE BOOM AND RAISE THE LOAD. With arm extended, thumb pointing down, flex fingers in and out as long as load movement is desired.

HAND SIGNALS



SWING. Arm extended point with finger in direction of swing of boom.

STOP. Arm extended, palm down, hold position rigidly.

EMERGENCY STOP. Arm extended, palm down, move hand rapidly right and left.

TRAVEL. Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel.

DOG EVERYTHING. Clasp hands in front of body.

TRAVEL. (Both Tracks) Use both fists, in front of body, making a circular motion, about each other, indicating direction of travel, forward or backward. (For crawler cranes only)

TRAVEL. (One Track) Lock the track on side indicated by raised fist. Travel opposite track in direction indicated by circular motion of other fist, rotated vertically in front of body. (For crawler cranes only)

EXTEND BOOM. (Telescoping Booms) Both fists in fromt of body with thumbs pointing outward.

RETRACT BOOM. (Telescoping Booms) Both fists in front of body with thumbs pointing toward each other.

EXTEND BOOM. (Telescoping Boom) One Hand Signal. One fist in front of chest with thumb tapping chest.

RETRACT BOOM. (Telescoping Boom) One Hand Signal. One fist in front off chest, thumb pointing outward and heel of fist tapping chest.

OPERATION

PAGE 2-2 CHECK LISTS

PAGE 2-5 HINTS

PAGE 2-9 OPERATOR'S STATION

I. Levers Controlling Main Functions
II. Levers Controlling Auxiliary Functions

PAGE 2-19 ADDITIONAL FEATURES

I. Telescoping Crawler Side Frames
II. Crawler Counterweight Removal
III. Transit Counterweight Removal
IV. Hoe Down
V. Ratchet Type Foot Brake
VI. Boom Folding and Carrying
VII. Two Speed Transmission

HAND SIGNALS FOR SHOVEL - CRANE OPERATION
POWER FLOW DIAGRAMS

CHECK LISTS

These check lists have been set up to acquaint a new operator with a routine for taking care of his machine. General basic points have been outlined with space left for any additions the operator may want to make. By the time this check list is filled out the operator will have established his routine and will only use this section of the manual for review.

It is understood that when an item is "checked" and found incorrect, the fault be remedied.

I. Pre-Operation

Inspect ground and machine for water, fuel, lubricant leaks.													
Drain water from air tanks.													
Check power unit for water, oil and fuel.													
Service air cleaner.													
Be sure engine master clutch is disengaged.													
Start engine as described in engine manual.													
Lubricate as outlined in lubrication section.													
Remove covers over rope openings.													
Have 100# air pressure.													
Have all operating clutches in neutral.													
Engage master clutch lightly check that machinery is clear, engage master clutch completely.													
Check operation of all clutches and brakes.													

II. During Operation

Check power unit for:													
Unusual noise.													
Loss of Power.													
Bad response to control.													
Check all gauges for proper reading.													
Check master clutch for slipping.													
Cables should not be crossed on drums.													
Check crawler drive chain tension.													
Check crawler belt tension.													
Controls operating properly.													

III. Post-Operation

Put machine in safe overnight position.													
Examine all cables.													
Clean up machinery.													
Clean excessive mud from crawler belts.													
Let dipper, bucket or load down to ground.													
Set all brakes.													
Disengage all clutches.													
Shut down engine as described in engine manual.													
Close windows, doors and rope openings.													
Clean bugs from engine radiator.													
Check worn or loose fan belt.													
Check for collapsed or deteriorated radiator hoses.													

HINTS

I. General

Before starting your shift, adjust the seat to suit your arms and legs.

Develop a smooth well-balanced cycle, with maximum safe overlap of motions.

Keep a neat clean machine.

Keep busy while waiting. Do necessary adjusting, move up, loosen the bank, clean up corners, etc.

In sticky material, try to save any dry sand or loose dirt to spread in the bottom of the truck as a help to ease dumping.

Use mats or corduroy the ground with saplings if footing is excessively soft.

If blasting is necessary, banks should be well blasted. Power is cheaper than equipment.

Try to keep trucks rolling with even distribution.

Try to handle your grade and digging layout tc provide drainage so your machine always operates on dry footing.

Keep machine working with full length of both crawlers on a solid footing. Concentrated loads invite trouble. If there is a hump, dig it out or move around it.

Do not ride brakes unnecessarily.

II. Shovel

Keep dipper teeth sharp.

Load the dipper quickly and easily with thin slices.

Save loading time with two-truck spotting. Have truck spotted in as close to digging as is safe, always the same distance from center of rotation.

Many short move ups will permit keeping close enough to the bank to maintain most efficient digging conditions. Unless safety requires it, never work your bank at the end of your handle - doing so places undue stress on the machine and reduces digging efficiency.

Don't keep scraping the bank. When dipper is full pull it out of bank.

Have drive chains at rear, away from digging. This puts a tight crawler belt on ground.

Shovel booms are usually worked at 45° to 50° for general digging. Lowering the boom permits a longer cut in a shallow bank and gives extra reach. A high boom increases dumping height and improves stability for heavy digging.

III. Dragline

Use a bucket size to fit your machine.

Keep teeth sharp and built up to proper size.

Work with boom at highest angle that will allow the reach and accuracy needed. A low boom gives longer reach, better control of the throw, more accurate grading and dumping. A high boom increases stability, decreases swing power requirements.

Take even cuts and heap the bucket. Don't gouge.

Keep drag hitch adjusted for best penetration of materials.

With the proper length of dump-rope the bucket can be picked up at a considerable distance ahead of the machine without spilling dirt. When the dump rope is too long it is necessary to pull the loaded bucket close to the Fairlead to keep it level, and causes the bucket to dump before it gets out for maximum reach.

Keep bucket adjusted for fast filling, carrying and dumping in the particular material with which you are working and also at the level you are digging.

Avoid piling dirt on your "door step".

Hoist bucket just as soon as it is filled.

Inspect ropes, chains and links. Extend chain life by reversing it end for end or top for bottom. If both ends are worn, cut chain in middle and reverse the sections, using repair links for rejoining them.

Make dump rope from salvaged hoist or drag ropes.

Clean out dirt brought in by the drag rope. Release the drag brake gradually when dumping bucket to avoid jerking the boom.

IV. Crane

Always have good level solid footing.

Never exceed the conditions or limits stated on the capacity plate.

Use right rope length for each boom length.

Inspect all ropes daily.

Use sufficient parts of line.

Never lift loads that are not hitched properly.

Never travel machine with boom at high angle.

Never travel with heavy loads. Pick up and swing load ahead, set it down and move around it, repeat as necessary.

If moving with a load, have the load behind the drive chains. Always snub the load.

On machines not equipped with power controller lowering, precision lowering can be had by "backing the load down". With the load suspended on the brake, disengage the engine master clutch and engage the hoist clutch. Release the brake gradually and the load will lower and turn the machinery in reverse. This way the friction of the machinery aids the brake in controlling the load.

CAUTION: The load should not be "backed down" on machines equipped with a Morin Tagmaster unless the drive chain for this unit is removed. If the chain is not removed the cable gets tangled and damages the unit.

V. Clamshell

Always have good level solid footing.

Use a bucket size to fit your machine.

Keep tagline properly adjusted and lubricated.

Never exceed the conditions and/or limits stated on the capacity plate.

Keep boom away from wires and other obstructions.

Remember that when swinging a bucket, it will move out beyond the boom point.

Start to swing as soon as bucket is clear.

VI. Hoe

Don't use the hoe as a pick.

Don't swing into ditch walls.

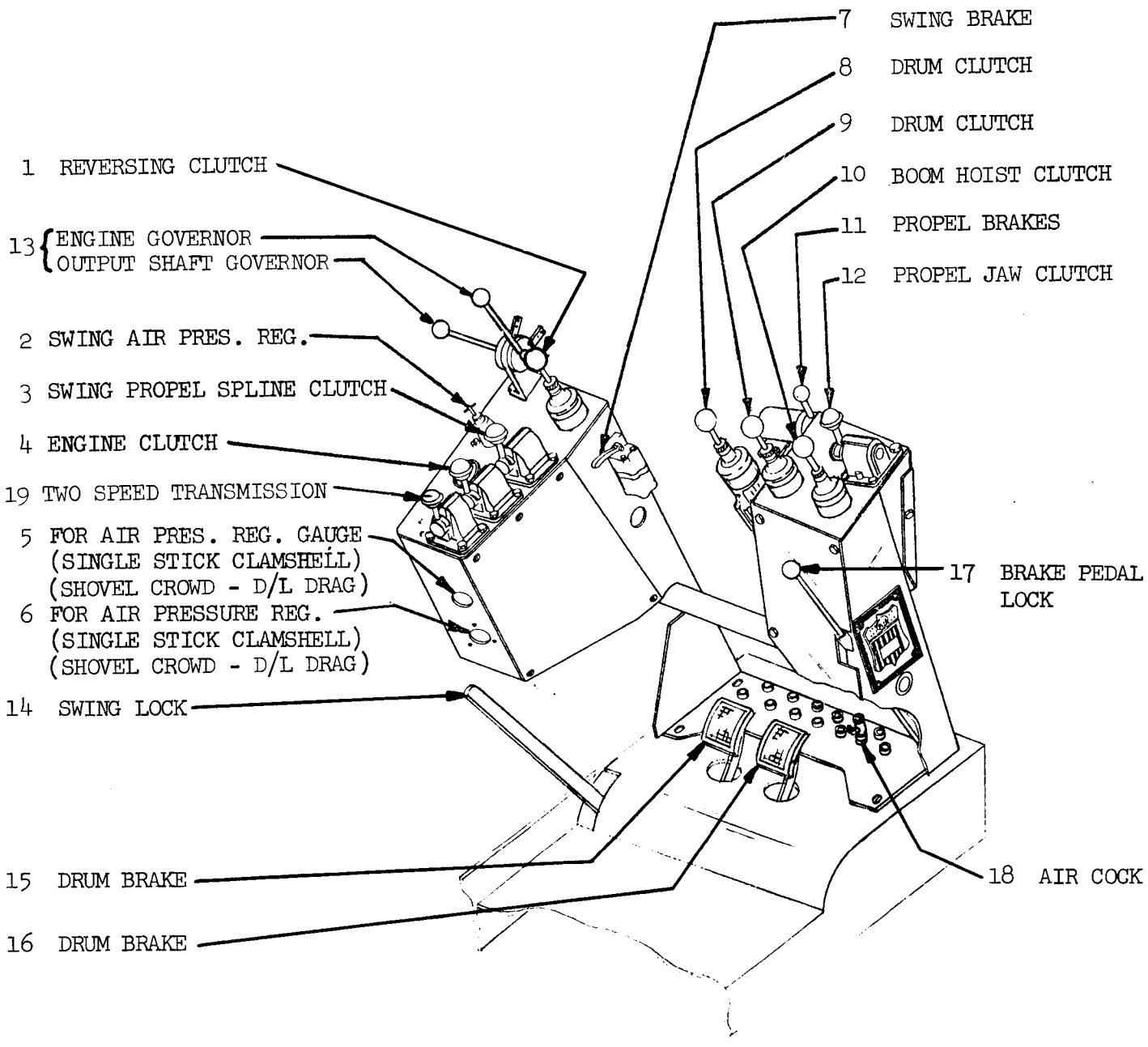
When dumping into trucks, always raise the boom simultaneously with releasing the drag rope.

Maintain good position for best digging.

Blast hard material, don't use dipper as a ripping tooth.

OPERATOR'S STATION

The valve stand as shown below illustrates the arrangement of the valves. Each valve has a name plate which identifies the position of the valve handle and the function performed.



I. LEVERS CONTROLLING MAIN FUNCTION (Refer to page 2-9)

A. Swing (#1)

Whenever the swing spline clutch is engaged, swinging the machine is controlled by lever #1.

1. To swing to the left - pull

2. To swing to the right - push

3. To stop the swing - move lever for swinging in opposite direction.

A pressure regulator #2 is installed to the left of the reversing clutch lever for the purpose of controlling the amount of air pressure to the clutch cylinders. There is no predetermined pressure setting as this will depend on the type of work encountered. The pressure is decreased by turning the adjusting screw counter-clockwise. Full pressure is again available to the swing valve when the swing propel lever is put in the propel position.

B. Drum Clutches (#8 & #9)

#8 Forward - Shovel crowd, dragline and hoe drag, crane auxiliary hoist line, clamshell holding line.

NOTE: Some machines will have an air pressure regulator for the shovel crowd and dragline drag in position #6. You will get a smoother acting clutch by decreasing the air pressure in these lines.

#8 Backward - Shovel retract

#8 Toward left - Shovel dipper trip

#9 Forward - Hoist line - all front ends

#9 Backward - Controlled lowering of hoist line for crane.

#9 Toward left - Air Horn

Clamshell Operation

On clamshell machines there is single stick control which means that the closing, hoisting and holding are controlled by lever #9. An air regulator, #6 quick release valve and double check valve form the connection between the front drum clutch line and the rear drum clutch line. The regulator should be set between 2 and 12 pounds so that when the closing, hoisting clutch is engaged there is just enough drag on the holding clutch to keep the line from getting too slack. There should never be enough pressure on

the clutch so that the holding line overtakes the closing line and dumps the bucket. To decrease the pressure to the holding line clutch, turn the adjusting screw in a counter-clockwise direction. Tank air pressure can always be put on the holding clutch by pushing #8.

C. Drum Brakes (#15 & #16)

#16 - Hoist line brake for all front ends.

#15 - Shovel crowd brake, crane auxiliary hoist line brake, dragline and hoe drag brake, clamshell holding line brake.

D. Brake Pedal Lock (#17)

To lock the brakes in set position, pull up on lever #17 then depress the pedals until lock engages. Always remove foot pressure gradually to be sure lock is engaged. To release the brake, push down lever #17 then depress the pedal. Only the pedal pushed down will unlatch.

II. LEVERS CONTROLLING AUXILIARY FUNCTIONS (Refer to page 2-9)

A. Propel, Steering or Digging Brakes (#11)

These brakes have a dual purpose, aiding in steering when each brake is set individually, and holding the machine against digging reactions.

1. Valve lever vertical. Brakes are spring set, with no air to either brake.

2. Valve lever midway between extreme forward and vertical position. The left brake is spring set with air assist while the right brake is air released. The brake valve in this position together with the steering jaw clutches in the left position will cause the machine to make a sharp left turn.

3. Valve lever in extreme forward position. Air to both brakes releasing them for propelling.

4. Valve lever midway between extreme rear and vertical position. The right brake is spring set with air assist while the left brake is air released. The brake valve in this position together with the steering jaw clutches in the right position will cause the machine to make a sharp right turn.

5. Valve lever in extreme rear position. Both brakes are spring set with air assist. This position is used to resist digging reactions or for any emergency where the spring set brakes need an air assist.

A safety feature is that the brakes will set if the air fails, no matter what position the valve is in.

NOTE: When using the steering brakes to make sharp right or left turns it is absolutely necessary to first disengage the appropiate steering jaw clutch.

B. Propel Jaw Clutches (#12)

The lever that controls the steering jaw clutches, is close to the digging brake lever so that they can be moved simultaneously with one hand.

1. To steer the machine straight ahead, put the steering clutch lever in the middle or vertical position.

2. To make a gradual turn to the right (cat driving chains to the rear), move the lever to the extreme rear position. To make a sharp turn to the right, refer to "5" under "Propel, Steering and Digging Brakes".

3. To make a gradual turn to the left (cat driving chains to the rear), move the lever to the extreme forward position. To make a sharp turn to the left, refer to "2" under "Propel, Steering and Digging Brakes".

   The steering clutches are in effect jaw clutches and must not be shifted when the machine is in motion. It is however generally necessary to lightly engage one or the other of the friction reversing clutches to relieve the load on the steering clutch being shifted.

   These clutches slide on splines on the two outer horizontal propel shafts and are spring engaged and air disengaged. The air and mechanical arrangement make it possible to disengage only one clutch at a time.

C. Swing and Propel Spline Clutches (#3)

1. Left position - Swing clutch engaged, propel clutch disengaged.

2. Vertical position - No air to either clutch.

3. Right position - Propel clutch engaged, swing clutch disengaged.

Remember in engaging these jaw clutches it is necessary to throttle the engine down to idling speed and feel them into mesh by lightly engaging one or the other of the reverse clutches.

Don't disengage swing spline clutch until swing brake or swing lock is engaged.

D. Swing Lock (#14)

To engage the dog in the swing rack (for propelling) pull the lever back. To disengage the dog, (for swinging) push the lever forward. This is a spring loaded toggle arrangement and considerable effort is required to engage or disengage the dog. It may be necessary to "feel" the dog in by lightly engaging either swing clutch until the dog meshes with the teeth in the swing rack.

Don't disengage the swing spline clutch without first engaging the swing lock.

Don't propel the machine without first engaging the swing lock.

E. Swing Brake (#7)

When the lever is in the set position, there is no air in the cylinder and the brake is spring set. To release the brake push the lever forward. The brake can be set to any degree to produce a drag on the brake housing by simply pulling the lever toward the set position.

F. Propel (#1)

Movement of the machine forward or backward is controlled by one lever.

To propel the machine proceed as follows:

1. Move the governor control lever to low idle position.
2. Engage the engine clutch.
3. Engage the swing brake and/or swing lock.
4. Move the swing and propel spline clutch lever to the right.
5. Release the propel brake.
6. Push the reversing clutch lever to propel forward (crawler driving chains to the rear.) Pull the lever to propel backward.
7. Pull back the governor control lever to give the desired engine speed.
8. Stop propelling by engaging the swing clutch for travel in the opposite direction then set the propel brakes to keep the machine from moving.

NOTE: When propelling the machine where overhead clearance is limited, be sure there is enough room between the obstruction and the highest point of the machine.

After the move has been completed prepare for swinging as follows:

1. Move the governor control lever back to low idle position.
2. Move the swing and propel spline clutch lever to the left.
3. Release the swing brake and/or swing lock.
4. Pull the governor control lever to desired engine speed.
5. Control swinging with the swing clutch lever.

G. Boom Hoist (#10)

The boom hoist clutch brake and pawl are all controlled by one lever.

1. Neutral -- Both clutches released -- brake set, pawl engaged.
2. Left then forward -- Lowering clutch set, brake released, pawl disengaged.
3. Rear -- Hoisting clutch set, brake released.

There is a detent in the forward and rear position.

The locking pawl, to prevent the boom from "creeping down", is controlled by moving the valve lever to the left. It is impossible to move the lever forward without first moving the lever to the left. It is not necessary to release the pawl when raising the boom, but it can be done by moving the lever to the left. If it is desired to lock the pawl in the released position this can be done by first moving the lever to the left, releasing the pawl, and then turn the shut-off cock #18 on the air header. This traps air in the cylinder and line. When the pawl is locked in the released position, the boom is only held by the spring set boom hoist brake. To engage the pawl just open the shut-off cock. It may be necessary at times to raise the boom slightly to take the pressure off of the pawl before it will release.

After the boom has been raised or lowered, the drum may come to rest with the pawl not fully engaged. To fully engage the pawl, turn the shut-off cock to prevent air from going to the pawl cylinder, and then with the engine idling lower the boom easily.

If the boom hoist has not been used for some time, it is advisable to check its operation carefully by raising the boom slightly before releasing the pawl and lowering the boom. It is a good idea to let the pawl engaged while lifting a heavy load with the boom hoist.

H. Power Controlled Load Lowering (#9)

The controlled lowering equipment for the main hoist line makes it possible to raise or lower the load under control of the engine rather than relying on the brake only for lowering the load. The arrangement is such that the lowering speed is approximately one-half the hoisting speed. By throttling the engine, the lowering speed can be precisely controlled.

The equipment consists of a clutch and sprocket mounted on the rear drum shaft and connected to a sprocket on the front drum hoist lagging by a roller chain. The hoist clutch on the front drum shaft drives the hoist drum direct for hoisting and the load is held stationary by the brake on the front drum. For lowering, the rotation of the front drum is controlled by the clutch on the rear drum shaft through the connecting roller chain. Thus the hoist drum is under full control of the engine for both raising and lowering the load, therefore, the speed of the front drum can be controlled by changing the engine speed. The lowering clutch holds the hoist drum from rotating faster than the engine and machinery when the load is being lowered.

Operation:

Operation of the machine with controlled lowering equipment does not differ greatly from ordinary crane operation except that the hoist lever and the right foot lever are used to control the main load line.

1. Raise the load by pushing forward on the hoist lever to engage the hoist clutch at the same time releasing the right foot brake.

2. Hold the load by applying the right foot brake and disengage the hoist clutch.

3. To lower the load under control of the engine, throttle the engine to low idling speed, pull back on the hoist lever to engage the lowering clutch, then release the hoist brake. Control speed of lowering by adjusting the speed of the engine, and further reducing the speed, if necessary, by applying the brake.

4. To stop lowering, set the brake and then disengage the lowering clutch. As explained above, the brake may be set while the lowering clutch is engaged because the band tends to unwrap when the driver turns faster than the housing.

I. Dipper Trip (#8)

The dipper trip on a shovel can be actuated by moving lever #8 to the left.

J. Air Horn

If the machine is equipped with an air horn it can be sounded by moving lever #9 to the left.

ADDITIONAL FEATURES

I. TELESCOPING CRAWLER SIDE FRAMES

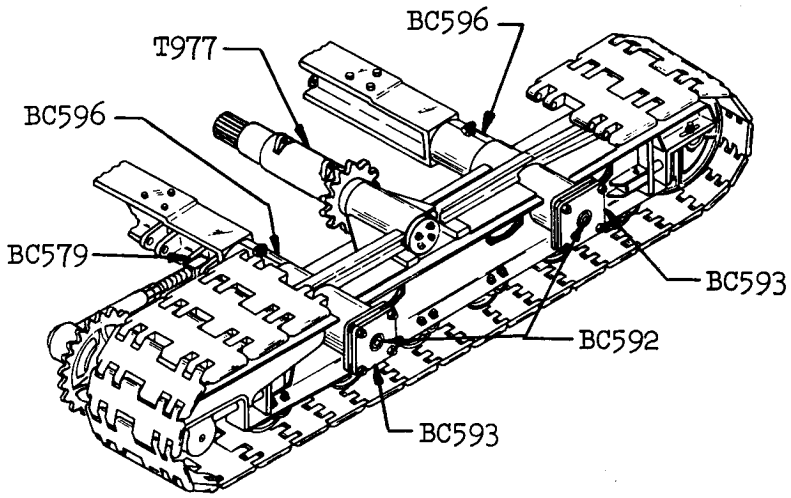
The following is taken from the warning plate on the side frame:

> "Keep crawler fully extended except during transportation of machine. Boom must be kept in line with crawlers whenever crawlers are in retracted position. Always extend crawlers fully before swinging upper works. Machine will trip over backwards if upper works is swung over side of crawlers while retracted."

Keep splines, screws and sliding surfaces clean and well lubricated.

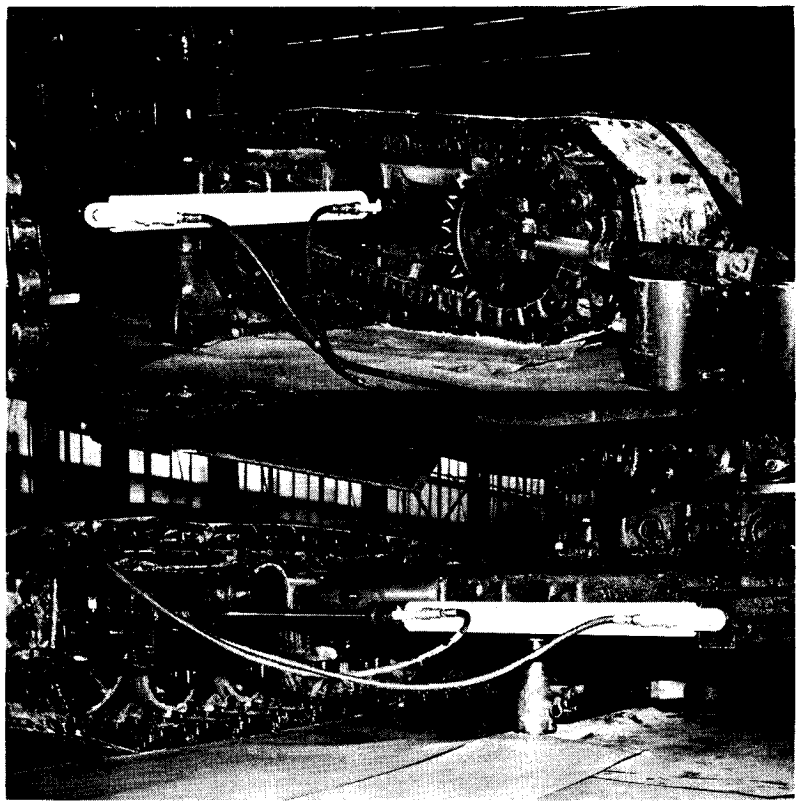
A. To extend manually:

1. Raise one side of machine to take weight off of treads.
2. Remove pin BC579 and rotate outboard bearing support out of the way.
3. Turn screws BC592 simultaneously until axle covers BC596 and propel shaft cover T977 can be put in place.
4. Connect outboard bearing support, lower crawler.
5. To retract side frame reverse above procedure as required



B. To extend hydraulically:

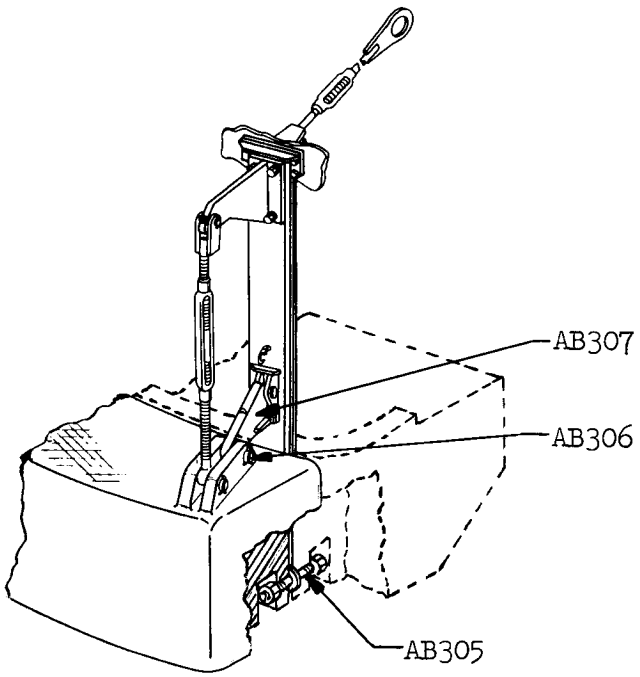
1. Raise one side of machine to take weight off of treads.
2. Remove pin BC579 and rotate outboard bearing support out of the way.
3. Remove plates BC593 and turn screws BC592 out $11\frac{1}{4}$".
4. Place both cylinders as shown and extend to move side frames out.
5. Install axle covers BC596 and propel shaft cover T977.
6. Snug up screws BC592 and replace plates BC593.
7. Connect outboard bearing support, lower crawler.
8. To retract side frames reverse above procedure as required.



II. CRAWLER COUNTERWEIGHT REMOVAL

A. Manual

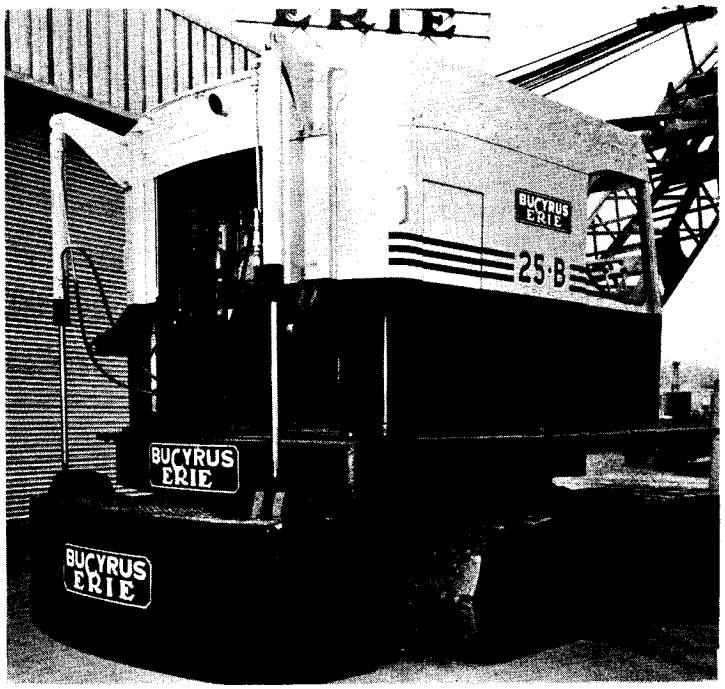
1. Lubricate fittings and threads.
2. Rotate turnbuckles to raise counterweight, remove weight from pins and bolts.
3. Remove pins AB306 and bolts AB305. Hook AB307 up out of the way.
4. Rotate turnbuckles and lower counterweight on blocking at least 18" high.
5. To install counterweight reverse above procedure as required.



B. Hydraulic

1. Same as manual except hydraulic cylinders replace turnbuckles and counterweight can be lowered to ground.

OBSERVE CAUTIONS ON HYDRAULIC PUMP MOTOR TO AVOID DAMAGING MOTOR.



III. TRANSIT MACHINE HYDRAULIC COUNTERWEIGHT REMOVAL

The hydraulic counterweight removal device enables the machine to attach and remove its own counterweight.

To remove the counterweight, rope from either the front or rear drum may be used as follows:

1. Lower the boom, remove the hook block and wind all rope on drum.

2. Reeve the rope over the two sheaves in the lower boom section and reeve a two part line using a ten ton single sheave hook block.

3. Swing the machine so that the counterweight is over the two hydraulic jacks and set the swing brake.

4. Use the two hydraulic pumps at the left rear of the carrier cab and raise the counterweight enough so that the pins and bolts supporting the counterweight can be removed. Raise counterweight to clear machine.

5. Hook the two supporting brackets up out of the way and swing the machine so that the boom is over the counterweight.

6. Attach the two part line to the counterweight, lift it, swing it and lower it on blocks.

7. To install the counterweight reverse the above procedure.

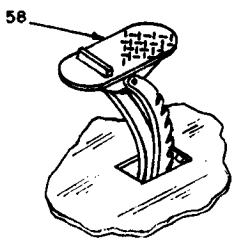
IV. HOE DOWN

The valves that control the cylinder are automatically operated by the hoist and drag levers.

The cylinder does not push the boom down, it holds the boom down. Whenever the hoist valve is actuated the cylinder valves are open to allow the boom to raise.

V. RATCHET TYPE FOOT BRAKE

This arrangement allows the brakes to be locked in several positions. To set and lock the brake with a certain amount of holding power, depress the pedal and rotate foot so that the teeth on the curved arm engage the stop. Always remove your foot slowly to be sure the tooth is in proper engagement. The brake can always be released by depressing the pedal slightly and rotating the foot to disengage the teeth.



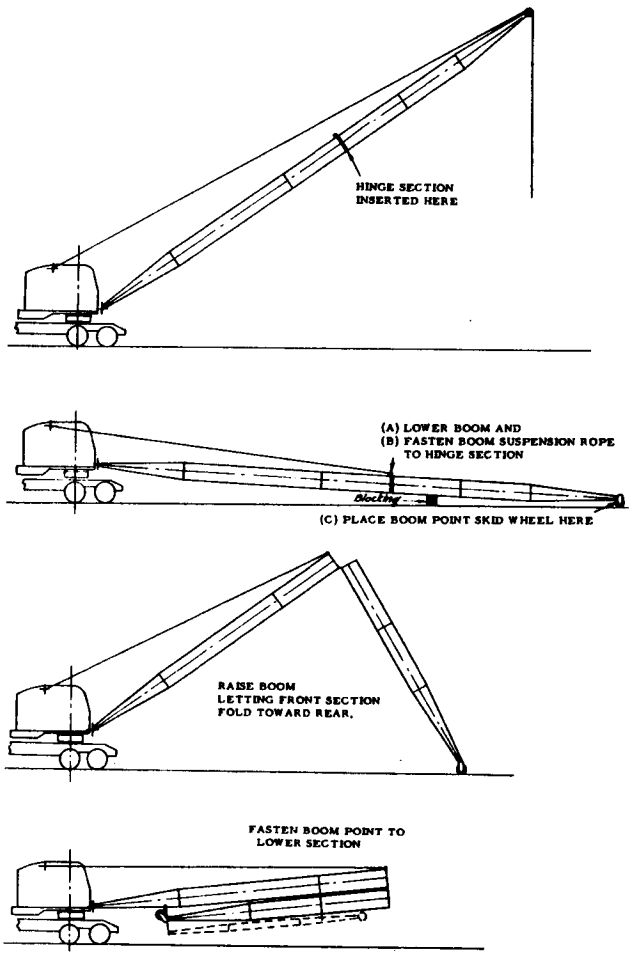
VI. BOOM FOLDING AND CARRYING

Booms 60 feet through 90 feet can be folded for transportation. This folding equipment is special and consists of a hinging section inserted in the boom between two regular sections, boom point skid wheels, and a boom point hanger.

To fold booms for transportation, raise the hook to the point sheaves, and lower the boom so that it rests on blocks. Remove the jib if one is used, attach wheels and axles and raise boom off of blocks. Lower the boom so that the wheels rest on the ground. Disconnect the pendants at the splice and attach them to the eyes on the boom. (Refer to Reeving Section.) Remove upper pendants. Take all slack out of suspension and

remove the upper pins at the pinned hinged joint. Raise the boom and the point will move in towards the machine. As the upper portion of the boom passes the vertical position, an experienced operator can lower the boom and continue the movement of the point toward the machine. In some cases it may be necessary to push the point past dead center until it moves by itself. When the boom point is all the way in, put the hanger through the lower boom so that it rests on the lower chord members and put the carrying rope sling around the boom point. The upper pendants can be put on top of the folded section and secured so they will not fall off. A jib may also be carried under the folded boom by supporting it with two rope slings.

The hinged section should always be located so that when the boom is folded there is clearance between the rear of the carrier and the boom point.



VII. TWO SPEED TRANSMISSION (19)

A two speed transmission either direct and underdrive or direct and overdrive is available on some engine installations.

To shift gears the engine governor control lever (13) must be in the low idle position and the engine clutch (4) must be disengaged. Shift gears by moving lever 19. It may be necessary to engage the engine clutch slightly and feel the two speed transmission clutch into engagement.

TWO LEVER DUAL GOVERNORS

Engines equipped with torque converters also have specially designed dual governors. One is the engine governor, driven by the engine and controlled by the black lever at the operators station. The other is the output shaft governor, driven by the output shaft and controlled by the red lever at the operators station.

What does the engine governor do

The engine governor controls the power the engine can produce.

What does the output shaft governor do

The output shaft governor controls the output shaft speed.

How do these work

As an example, assume that the black engine lever is in the 3/4 open position and the red output shaft lever is in the 1/2 open position. Without any load on the output shaft the engine will be running just fast enough to give 1/2 speed to the output shaft. As a load is applied and the output shaft slows down the engine will pick up until the shaft is again turning at 1/2 speed. As more load is applied, the engine will again pick up until the shaft is again turning at 1/2 speed. This can continue until the engine reaches the setting of the black lever. (In this case 3/4 open). At no time will the engine run faster than the black lever governor setting. If the load is reduced, the output shaft governor will reduce fuel to the engine and it will run slower, but still keep the output shaft at half speed.

Starting and Stopping Engine

When starting the engine the engine governor should be partially open. To stop the engine the engine governor lever is moved all the way forward to the closed position, or the key turned off.

Shovel, Hoe or Dragline Operation

For normal operation, both levers are moved back to the "wide open" setting. For close grades the engine lever should be moved back to the "wide open" setting and the output shaft lever set for low speed. The operator then has a slow line speed with maximum line pull and can control the depth of cut easily.

Clamshell Operation

For clamshell operation the engine lever is moved back to the "wide open" setting and the output shaft lever moved to get the desired line speed.

Crane Operation

For normal crane operation the output shaft lever is moved back to the "wide open" setting and all line speed and power is controlled by the engine lever or foot throttle.

To pick up, hold and lower a heavy load.

A. Machines Not Equipped with Power Load Lowering.

1. Have output shaft lever "wide open," engine lever at idle.

2. Engage hoist clutch.

3. Pull engine lever back to obtain desired hoist speed.

4. Hold load with brake and disengage hoist clutch. (Do not change setting of engine lever.)

5. To continue raising, engage hoist clutch and disengage brake.

   CAUTION:
   If engine governor setting was changed while load was suspended be sure it is brought back to same or higher setting before raising load further. If engine lever is not at same or higher setting, the load will lower when clutch is engaged and brake is released.

6. To lower a load, pick up load as in steps 1, 2, and 3, then push engine lever forward until load drops slowly. (Turning machinery backwards.)

   CAUTION: DO NOT RUN MACHINERY BACKWARDS IF MACHINE IS EQUIPPED WITH A MORIN TAGMASTER.

7. Control the load by changing engine governor setting and with brake.

B. Machines Equipped with Power Load Lowering.

Steps 1 through 5 are the same as in "A".

6. To lower a load, pick up load as in steps 1, 2, and 3, then hold load with brake, disengage raising clutch, push engine governor lever to idle position, engage lowering clutch, release brake.

7. Control the load by changing engine governor setting and with brake.

To have sufficient live pull to pick up a long boom, have engine governor at least 1/4 open.

ADJUSTMENTS

PAGE 3-2 LOWER WORKS

I. Tread Belts
II. Propelling Chains
III. Propel Brakes
IV. Steering Clutches
V. Cone Rollers
VI. Swing Propel Spline Clutches
VII. Tractor Type Crawlers (Caterpillar D-7)
VIII. Tractor Type Crawlers (International Harvester TD-20)

PAGE 3-9 UPPER WORKS

I. Engine Clutch
II. Transmission Chain
III. Boom Hoist Clutch and Brake
IV. Reverse Clutches
V. Main Brakes
VI. Drum Clutches
VII. Swing Brake
VIII. Swing Lock

PAGE 3-13 FRONT END EQUIPMENT

I. Crowd Chain
II. Crowd and Retract Ropes
III. Dipper Handle Slide Plates
IV. Dipper Trip
V. Dipper Teeth
VI. Dragline Fairlead
VII. Dragline Bucket Teeth
VIII. Drag Chains
IX. Clamshell Tagline

This section covers all ordinary adjustments required in normal service. No unit should be adjusted without carefully reading the instructions covering that unit and following the procedure described.

Before changing the adjustments of any unit, check over the machinery and controls very carefully to make sure a bent reach rod, worn pins, grease or oil or water on the lining or housing, or binding of some part is not causing the trouble. Correct adjustment cannot be made unless the control levers, reach rods, bell cranks, etc., are in good condition.

The removal and installation of protective guards is not described in the following adjustments. It is understood that all protective guards are in place when the machine is operating.

LOWER WORKS ADJUSTMENTS

I. TREAD BELTS (Refer to Drawing 852508 at end of section)

No definite rule can be given as to how tight or loose the tread belts should be, as the correct adjustment depends on the type of ground over which the machine is to be moved. In general, the belts should be kept as loose as possible without losing proper tracking of the driving tumblers. For normal service, when the belt is tight on the bottom, there should be about three inches of up and down movement on the upper side between the upper idler rollers.

Watch the belts closely when the machine is working in loose dirt, sand, or mud and loosen the adjustment of the belt if the dirt takes up all the slack. PROPELLING WITH TIGHT BELTS IS EXTREMELY HARD ON THE PROPELLING MACHINERY.

Adjustment is made at the take-up tumbler end (opposite end from drive-chains) of each side frame. Each belt requires changing two adjusting units, one on each side of the side frame. Steps are identical, so the following are applied at all four adjusting points:

1. Loosen take-up tumbler shaft bearing bolt 159.
2. Remove lock bar 107 from adjusting nut.
3. Turn adjusting nut 106 until desired belt tension is obtained.
4. Replace lock bar and tighten take-up tumbler shaft bearing bolt after adjustment has been made.

CAUTION: Be sure to turn adjusting nuts on both sides of a side frame exactly the same amount so that the take-up tumbler shaft is kept parallel to the front of the truck frame.

II. PROPELLING CHAINS (Refer to Drawing 852508)

A chain is in correct adjustment when there is three or four inches of up and down motion in one side when the other is tight. Adjustment of each chain requires turning two adjusting nuts on each side frame at the drive tumbler end of the machine, plus turning the outboard bearing adjusting nuts. The following steps can be applied to each side frame:

1. Loosen two drive tumbler shaft bearing bolts 160.
2. Remove two adjusting nut lock bars, 107.
3. Turn nuts, 106 until correct adjustment is reached.
4. Replace lock bars, and tighten bearing bolts.
5. Adjust length of 122 by turning bottom nut 170 hand tight. Lock both nuts with wrenches.

CAUTION: DO NOT USE NUTS 170 FOR ADJUSTING CHAIN TENSION. Doing so, could invoke unnecessary loading on the bearing and cause its failure. Adjusting nuts 106 on each side of frame should be turned exactly the same amount in order to keep the sprockets in correct alignment. These nuts only are to be used for adjusting drive chain tension.

III. PROPEL BRAKES (Refer to Drawing 852508)

The propel brakes are spring set and air released. Since they do not slip in normal operation the rate of wear is extremely slow and adjustment is seldom required. There is no adjustment to increase the spring holding power of the brake. To adjust the bands for wear follow these steps:

1. Remove steering clutch guard, 82 under truck frame.
2. Set propel brake lever in the "off" position.
3. Tighten bolt 65 so that there is 1/16" clearance between the band and housing.

IV. STEERING CLUTCHES (Refer to Drawing 852508)

Adjustment of the steering clutches is ordinarily not required, as the clutches are set to move the proper distance when the machine is built and this setting does not change. KEEP THE SPLINES CLEAN AND WELL LUBRICATED.

If it is necessary to remove any parts of the steering clutch operating linkage, be sure to measure the length of the spring 51 and the reach rod 48 which connects the two clutch shifter levers, so that when reassembly

is started, these parts can be replaced exactly as removed. After assembly, the entire mechanism should be carefully checked to make sure that both clutches can engage fully without restriction, and that each clutch can be completely disengaged when the other is engaged. Steering jaw clutches are spring engaged and air disengaged.

The tension of the clutch engaging spring 51 should be adjusted by turning the adjusting nut at the end of the clutch return spring. Be sure to tighten the lock nut after making the adjustment. Keep this spring tight enough to positively keep the clutches in the engaged position when the air is released from the clutch operating air chambers. Check this periodically.

CAUTION: Dirt on the splines or lack of lubrication can also cause sluggish action of the clutches. At least once a week the operating linkage should be lubricated with generous squirts of oil from a hand oil can.

V. CONE ROLLERS

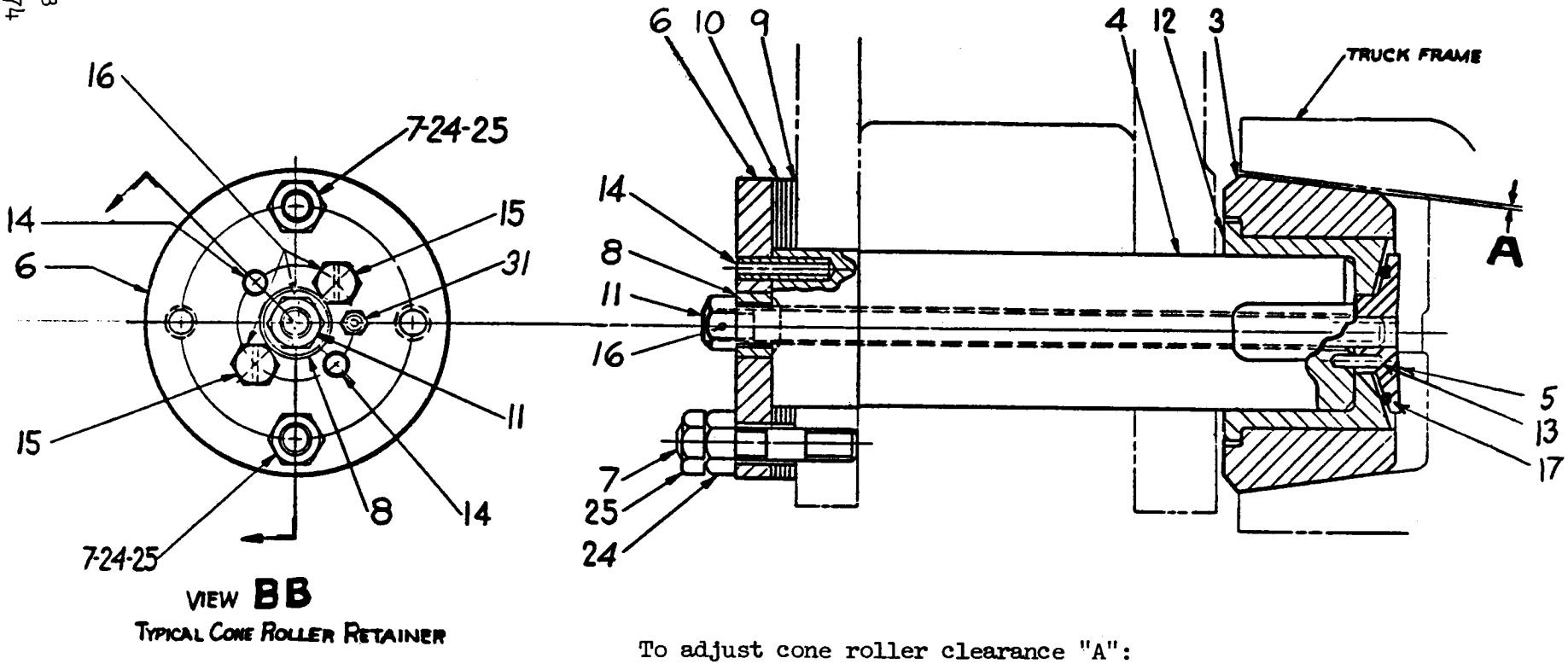
a. Adjustable bushing type. (See page 3-5)

b. Adjustable anti-friction type. (See page 3-6)

VI. SWING PROPEL SPLINE CLUTCHES

These clutches are set at the factory and under normal conditions should not require any further adjustment.

At least once a year, remove the front covers over the gears in the revolving frame and inspect the clutches and linkage. To prevent the clutch from jumping out of engagement worn parts should be replaced or built up to original shape.



VIEW **BB**

TYPICAL CONE ROLLER RETAINER

To adjust cone roller clearance "A":

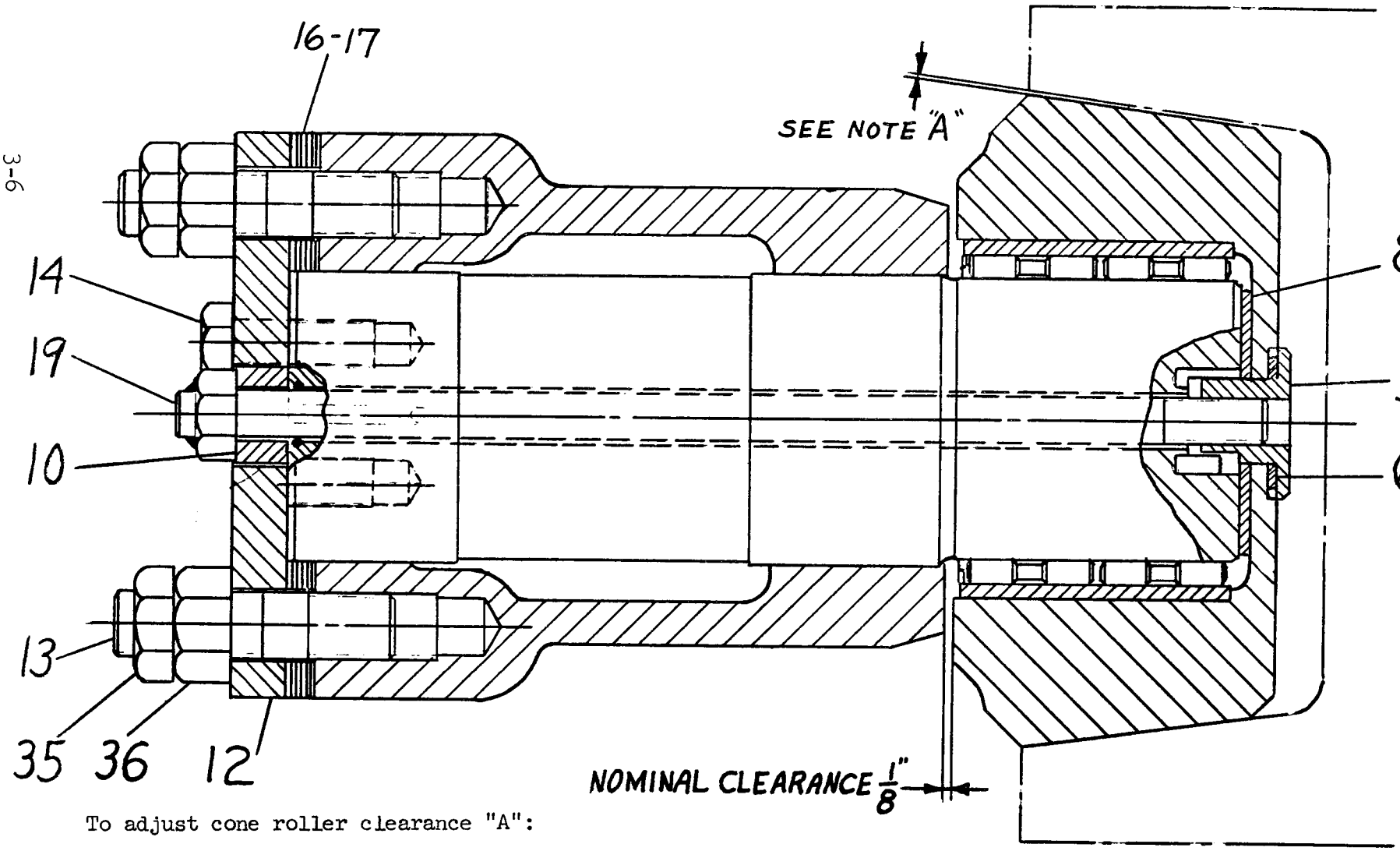
1. Take machine weight off of roller.

2. Remove capscrews 15, nuts 24 and 25 and retainer 6.

3. Add or remove shims 9 and 10 so that dimension "A" is .020" to .030" between the largest dia. of each roller and the smallest section of roller path, when the retainer, capscrews, and nuts are securely in place and machine weight on roller.

CAUTION: When assembling new rollers, tighten nut 11 so that cone unit 5 is tight against shaft 4. Check to be sure that rollers turn freely.

ADJUSTING INSTRUCTIONS FOR BUSHING CONE ROLLERS



To adjust cone roller clearance "A":

1. Take machine weight off of roller.
2. Remove capscrews 14, nuts 35 and 36 and retainer 12.
3. Add or remove shims 16 and 17 so that dimension "A" is .020" to .030" between the largest dia. of each roller and the smallest section of roller path, when the retainer, capscrews and nuts are securely in place, and machine weight on roller.

CAUTION: When assembling new rollers, tighten rod bolt 19 hand tight to avoid binding washer 8 between roller pin and roller. Rollers must turn freely.

ADJUSTING INSTRUCTIONS FOR ANTI-FRICTION CONE ROLLERS

VII. TRACTOR TYPE CRAWLERS (CATERPILLARS D-7)

A. Propelling Chains

Same procedure as in heading II.

B. Recoil Springs

Two recoil springs, one on each track frame, absorb end shock on the front idler and provide smooth operation of the track. The springs do not put tension on the track; they take the recoil from the idler when a shock load or obstruction in the track causes the idler to move back along the track roller frame. These springs are set at the factory to the correct length and this setting should not be changed. If it is necessary to disassemble the spring it must be reset to its original length when reassembled. After the tracks have broken in they may develop too much slack. This can be checked by placing a block under one of the track shoe grousers and propelling forward until all the slack is out of the bottom of the track. Lay a straight edge across the two track carrier rollers and measure the slack between the rollers. If the slack exceeds 2" tighten the adjusting nuts in front of the recoil spring until the spring nearly starts to compress. In making this adjustment the nuts on both sides of the side frame should be turned an equal amount to maintain correct alignment of the idler tumblers.

C. Track Shoe Bolts

Check these bolts periodically and make sure they are tight. The torque for these bolts should be from 205 - 230 ft. pounds.

VIII. TRACTOR TYPE CRAWLERS (INTERNATIONAL HARVESTER TD-20)

A. Propelling Chains

Same procedure as in heading II.

B. Recoil Springs

Tension of the track is maintained by a pair of coil springs located on each side of the track frame. These springs are set at the factory to the correct length and this setting should not be changed. If it is necessary to disassemble the spring it must be reset to its original length when reassembled. After the tracks have broken in they may develop too much slack. This can be checked by putting a block under one of the track shoe grousers and propelling forward until all the slack is out of the bottom of the track. Lay a straight edge along the top of the track and measure the slack between the two upper idler rollers. If the

slack exceeds 1" the idler tumbler should be moved forward to compensate for the slack. An adjusting nut is provided for this purpose at the forward end of each recoil spring rod. Loosen the lock nut and then turn the adjusting nut until the spring nearly starts to compress. In making this adjustment the nuts on both sides of the side frame should be turned an equal amount to maintain correct alignment of the idler tumbler. After the alignment has been checked, and corrected if necessary, the lock nuts should be tightened to hold the adjustment.

C. Track Shoe Bolts

These bolts should be checked periodically to make sure they are tight. The torque value for them should be 200 - 220 ft. pounds.

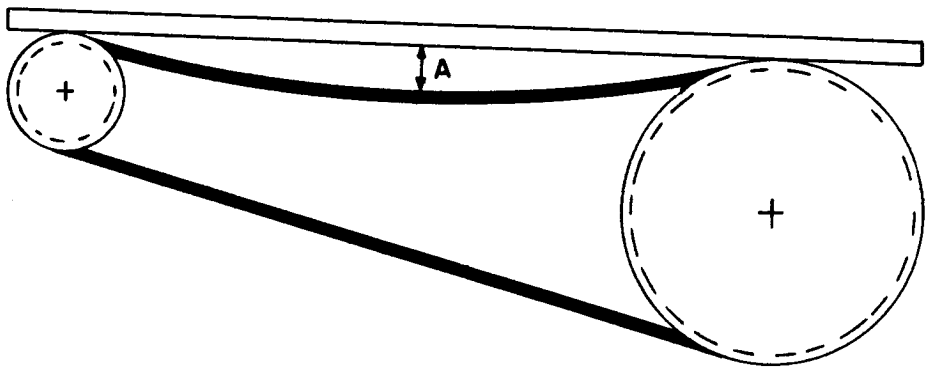
UPPER WORKS ADJUSTMENTS

I. ENGINE CLUTCH

The disc type clutch, mounted on the engine flywheel is normally used only when starting the engine and will seldom require adjustment. However, if at any time it slips under normal operation stop immediately and adjust it. Watch a new or relined clutch carefully as the clutch may require frequent adjustment until the friction surfaces are worn into a good bearing.

To adjust the clutch see the instruction plate on the clutch housing. When correctly adjusted, the clutch will toggle in with a distinct snap.

II. TRANSMISSION CHAIN



For standard and heavy duty crawler dim. A should be $1\frac{1}{8}" \pm \frac{1}{8}"$.

For transit and super crawler dim. A should be $1\text{-}7/16" \pm \frac{1}{8}"$.

To adjust sag, loosen nuts securing engine stand to revolving frame and move engine up by jacking and adding shims under stand supports. After adjusting, tighten engine mounting nuts.

III. BOOM HOIST CLUTCH AND BRAKE

The boom hoist raising clutch is adjusted when assembled at the factory and requires no further adjustments for wear.

Check the pawl for correct engagement. If for some reason there is improper engagement, lengthen the reach rod until the pawl does engage all the way.

The boom hoist lowering clutch is on the left side of the machine forward of the front drum shaft. It may be a single internal expanding band actuated by one push type air cylinder, or it may be a multiple friction disc actuated by a ring diaphragm. To adjust the internal expanding band

clutch proceed as follows:

1. Adjust live end eye bolt so that stroke of piston rod from clutch release to clutch set is approximately $1\frac{3}{4}$".

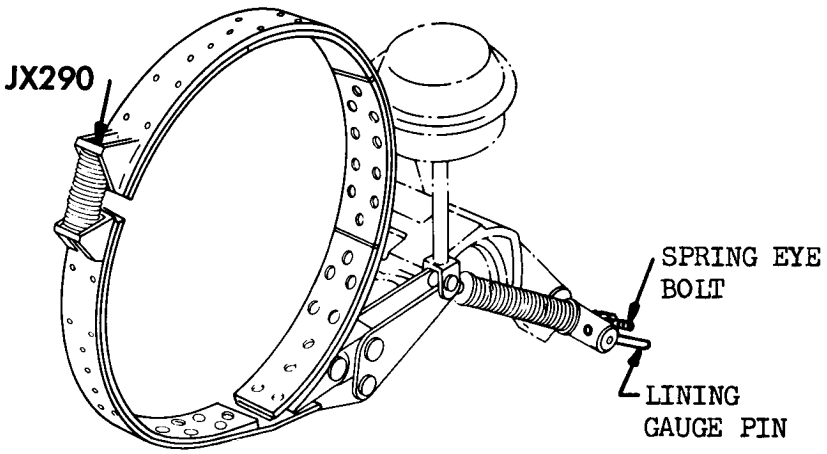
2. Adjust dead end capscrew so there is 1/16" clearance between dead end of band and housing. Special attention should be given to this clutch so that all loads raised can be lowered properly.

The friction disc clutch does not require adjustment.

To adjust boom hoist brake for wear proceed as follows:

1. Brake is spring set air released. Lower boom to ground and with at least 100 pounds of air pressure, engine stopped, put boom hoist lever in raise or lower detent position. This releases brake.

2. Take up on bolt JX290 so that when brake is set, spring eye bolt is flush with lining guage pin. There is no adjustment for more brake holding power.

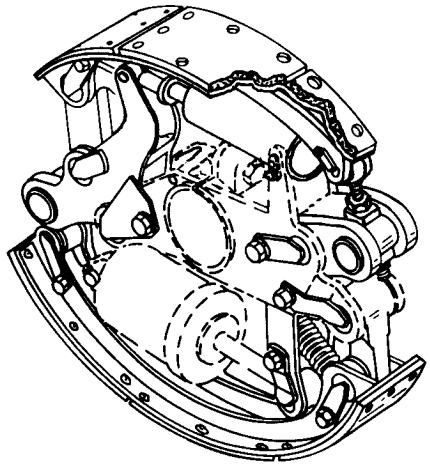


To clean a greasy or dirty band, remove it and clean it carefully with gasoline or other solvent, dry thoroughly, then reassemble and adjust as described above.

IV. REVERSE CLUTCHES

The two reverse clutches as well as the main operating clutches (total of five) are of the internal expanding two shoe type, and are interchangeable. Both shoes are actuated by a single air cylinder. To compensate for lining wear, adjust each clutch as follows:

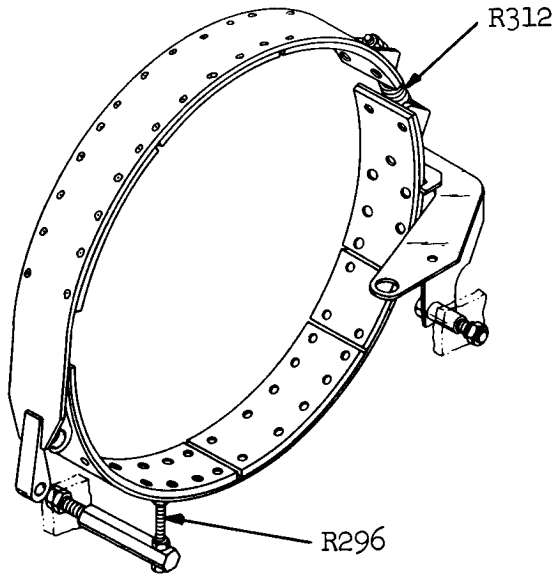
1. With the clutch disengaged adjust nuts on the live and dead end until there is .030" clearance between the housing and the shoe ends.



V. MAIN BRAKE BANDS

The main brake bands on the outside of the drum clutch housing are interchangeable and are easily adjusted to compensate for lining wear.

When the lining wears so that the brake will not hold the load when the pedal is pushed all the way down, an adjustment is necessary. Adjust by turning the nuts on the adjusting bolt, R312 just enough so that the pedal will latch when depressed with the brake lever pulled up.



Adjust the tension springs, below the right deck plate, so they have just sufficient tension to return the brake pedals to high position when the brakes are released. The adjusting capscrew R296 underneath supports the weight of the band when it is released. The capscrew should be adjusted so the band just clears the housing, all the way around, when the brake is released.

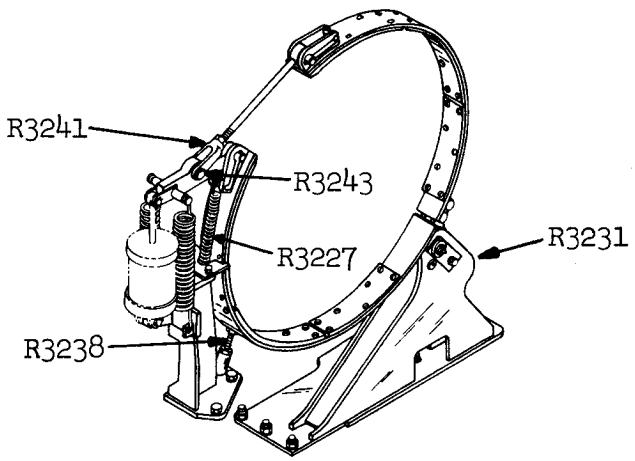
VI. DRUM CLUTCHES

The procedure followed in adjusting the main drum clutches is identical to that outlined in paragraph IV.

VII. SWING BRAKE

This brake is spring set and air released. To adjust the swing brake to compensate for lining wear, proceed as follows:

1. With brake released, remove bolt R3243.
2. Loosen lock nut and screw yoke R3241 further on rod.
3. Reconnect yoke to cylinder lever.
4. Set and release brake and measure amount of piston rod travel. When properly adjusted piston rod has a travel of 1 & 5/16". Shorten or lengthen reach rod until this dimension is obtained. Tighten yoke lock nut.
5. With brake released, adjust supporting capscrews R3238 and R3231 and release spring R3227 so that band is free of housing all the way around.



VIII. SWING LOCK

Periodically check for proper toggle engagement into the swing rack. To get deeper engagement remove the pin and back out the eye bolt threaded into the swing lock dog.

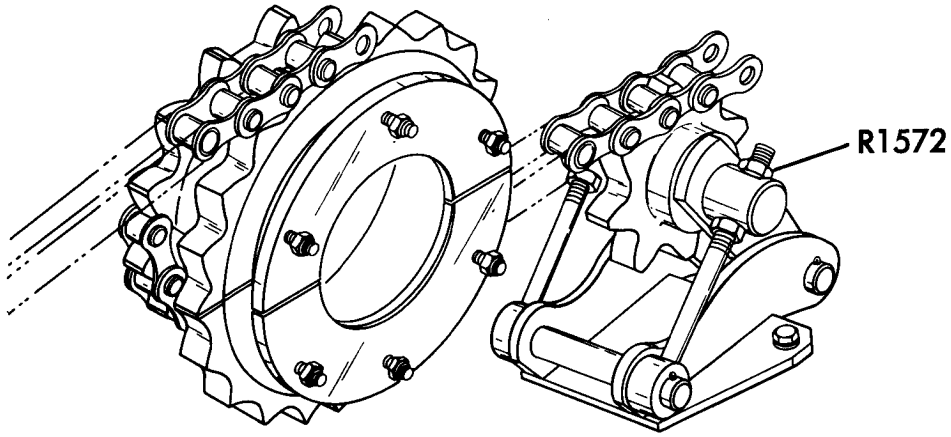
FRONT END EQUIPMENT ADJUSTMENTS

I. CROWD CHAIN

If the roller chain between the crowd drive sprocket and the rope drum at the foot of the boom becomes loose enough so that it rides the ends of the sprocket teeth or whips excessively adjust it as follows:

1. Loosen locking nuts R1572 at upper end of adjusting bolts and turn both adjusting nuts R1572 under the shaft same amount to raise idler sprocket until there is about two inches up and down movement of lower side of chain when upper side is tight.

2. Tighten locking nuts against idler sprocket shaft.



II. CROWD AND RETRACT ROPES

When installing new crowd and retract ropes or if the ropes develop excessive slack, adjust the ropes as follows:

1. Crowd dipper so that handle is fully extended and hold in position with crowd brake.

2. Tighten eye bolt at lower end of dipper handle until all slack is taken out of both crowd and retract ropes.

NOTE: When installing a new retract rope, be sure to run eye bolt out so maximum adjustment is available for further tightening. New ropes always stretch until broken in.

III. DIPPER HANDLE SLIDE PLATES

If the wearing plates which hold the dipper handle in the saddle block become worn so that there is more than $\frac{1}{8}$" clearance between the handle and the wearing plates insert one or more of the shims included with the tools and supplies as follows:

1. Raise dipper so that handle is horizontal.

2. Loosen two capscrews holding each wearing plate. Insert one or more shims as needed to reduce clearance to no more than $\frac{1}{8}$". (Be sure two wearing plates on the same side of handle have equal clearance so that handle will not be forced out of line.)

3. Tighten capscrews securely to clamp shims in place. If all shims have been inserted and dipper handle is still loose in saddle block remove capscrews holding shims and wearing plates in place and install new wearing plates.

IV. DIPPER TRIP

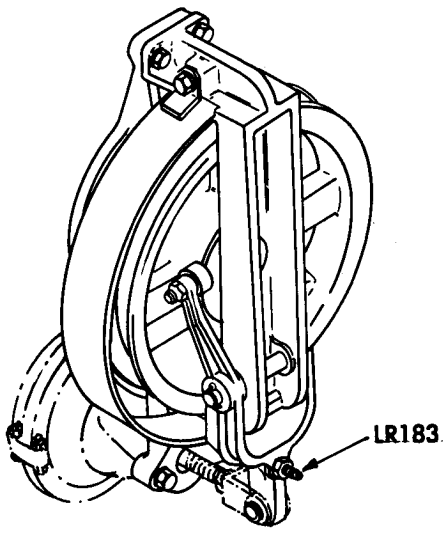
The dipper trip arrangement at the right end of the main drum shaft is driven by a friction disc. The dipper trip latch on the dipper door must be correctly adjusted before dipper trip will work properly.

If the dipper door will not stay closed or will not unlatch in response to push on the dipper trip lever, check adjustment of the latch on the dipper door as follows:

1. Clean out any stones or dirt in opening in latch keeper.

2. Inspect latch keeper and end of latch bar. If either are badly worn they must be reconditioned to eliminate rounded corners. Latch keeper insert is reversible, so when one edge is rounded off, drive it out of latch keeper, reverse it, drive it back into place. When both edges are rounded, replace it with a new one or build up wedges by welding and grind down to original size. To recondition a worn latch bar, grind off tip to its original shape or build up by welding with high carbon rod and finish grind until tip has straight sharp edges.

3. Adjust latch bar for correct bite. (The end of bar should drop into latch keeper about $\frac{1}{2}$".) Rough adjustment is made by attaching one or the other of dump chain links in pinch link.



Make final adjustment by moving the washers on the fulcrum pin from one side of the door rib to the other. (Moving the washers from the upper side of the rib to the nut end of the fulcrum pin increases the "bite" of the latch bar in the keeper.)

With the latch properly adjusted as described above, adjust the dipper trip drum clutch as follows:

For more tension in the dipper trip rope, turn in the screw LR183 under the housing. For less tension, back out screw. There should always be just enough friction between the faces of the trip clutch so the trip rope will follow the movement of the dipper handle without tripping the dipper door.

V. DIPPER TEETH

Inserted dipper teeth wear away faster on the upper side and best life is obtained by reversing them occasionally so that they will wear uniformly on the two sides. To remove a dipper tooth for replacement or reversal proceed as follows:

1. Remove split pin (cotter).
2. Insert wedge, provided with tools, below tooth shank and drive tooth loose in socket.
3. Remove tooth and shims.

Always reverse all teeth at the same time or install a full set of new teeth so that all points line up for even cutting. Replace the dipper teeth as follows:

Insert one of the soft steel shims along either V-shaped side of the sprocket so that the tooth will be tight when the cotter pin hole is lined up with the opening in the dipper lip. If necessary in order to line up the teeth for even cutting, more than one shim may be used for some teeth but be sure there is not more than $\frac{1}{4}$" between the base of the tooth shoulder and the dipper lip.

VI. DRAGLINE FAIRLEAD

To save excessive drag rope wear, the fairlead should be adjusted proportionately with the level at which the bucket will be working. If the bucket is digging at a considerable depth the washers are removed from between the lower fairlead bracket and revolving frame, thus aligning the fairlead with the drag cable.

In like manner, transfer as many washers as are needed from the front of the fairlead bracket to the back of the bracket between the revolving frame if the cut is relatively level.

To install fairlead, see section covering conversion and installation of the various front-end equipment.

VII. DRAGLINE BUCKET TEETH

The inserted teeth on the dragline bucket are similar to those on the shovel dipper although not interchangeable with them. To distribute the wear on both surfaces of the dragline bucket teeth reverse them as described for reversal of the shovel dipper teeth.

VIII. DRAG CHAINS

The drag chains are attached to the front of the dragline bucket by reversible clevises. For ordinary digging the clevises are assembled so that the drag chains are carried in low position. For deeper cutting the clevises are reversed so that drag chains are carried in the high position. For removal of the clevises for reversal or replacement proceed as follows:

1. Take out lock pin holding clevis pin in place.
2. Remove clevis pin.
3. Free clevis from drag chain wearing ring, turn clevis over, and replace it in wearing ring. (Clevis must be reversed in wearing ring, so as not to twist drag chains.)
4. Attach clevis to bucket by replacing clevis pin and lock pin.

Better life of drag chains can be obtained by reversing them end for end periodically. Chain is attached at both ends by two piece links. To separate links for reversal or replacement:

1. Drive out rivets in half links at both ends of chain.
2. Take out chain, turn it end for end and replace it.
3. Assemble half links and install new rivets.

IX. CLAMSHELL TAGLINE

Due to simplicity of the mechanism in the barrel, there is nothing to get out of order inside, unless the spring is overwound and pulled out of shape. If this should happen remove the spring and bend new hook on end. To install tagline see section covering conversion and installation of the various front equipment.

NUMBER	DESCRIPTION	PART NO.
199	TEE, PIPE STR. 1" M.I.	
	150 # BL	20830450
200	PLUG, PIPE SQ. HD 1"	
	C.I. 150 # BL	20767800

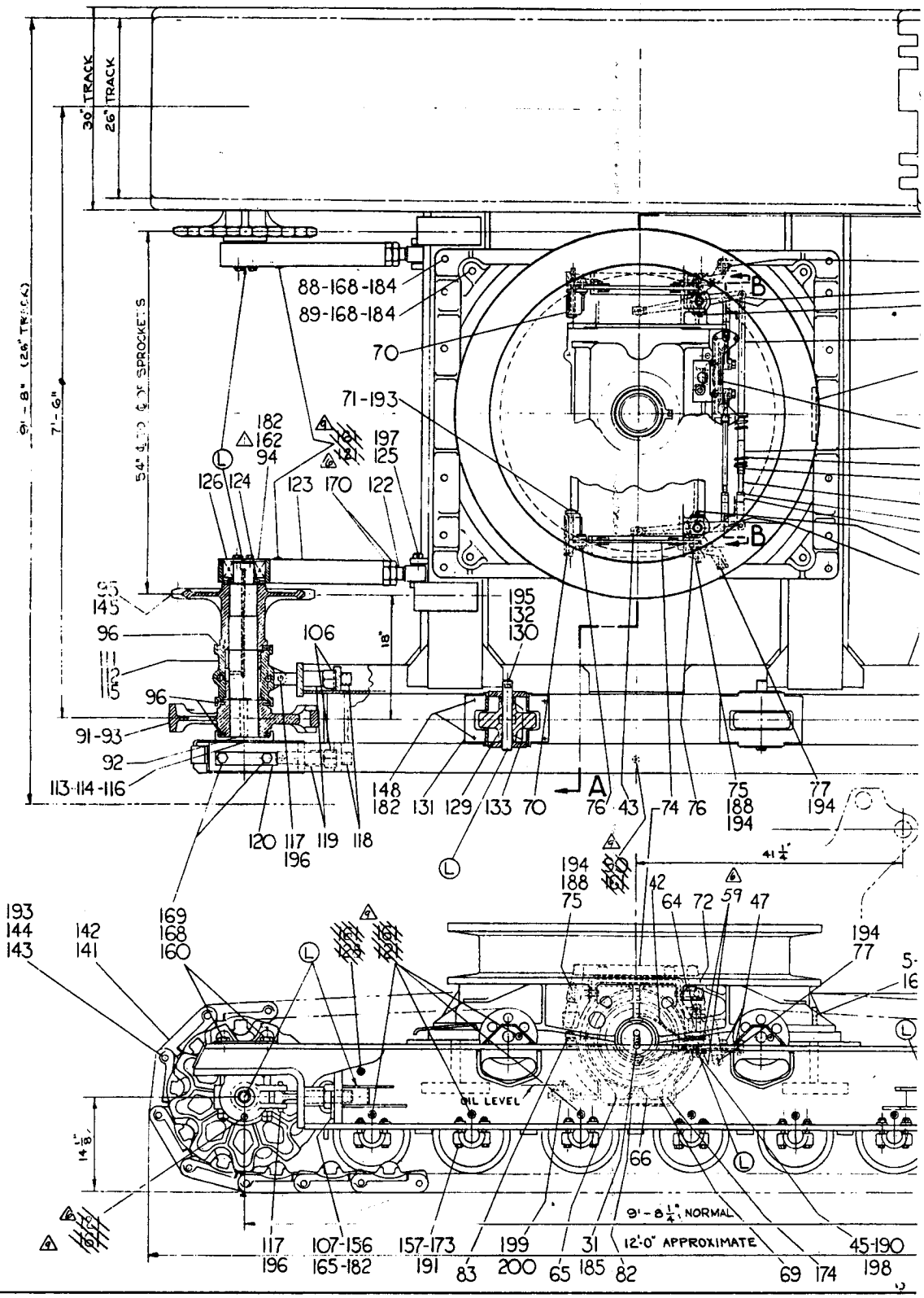
NUMBER	DESCRIPTION
181	WASHER, SPRING LOCK ⅛"
182	WASHER, SPRING LOCK ¼"
183	WASHER, SPRING LOCK ⅜"
184	WASHER, SPRING LOCK 1"
185	LOCKWIRE #12 X 8"
186	LOCKWIRE #12 X 13"
187	WASHER, PLAIN ⅛"
188	WASHER, PLAIN ¾"
189	WASHER
190	WASHER, PLAIN 1¼"
191	WASHER, BEVEL ⅛" M-1
192	
193	PIN COTTER ⅛" X 1"
194	PIN COTTER 5/32" X 1¼"
195	PIN COTTER 3/32" X 1"
196	PIN COTTER 5/16" X 1¼"
197	PIN COTTER 3/16" X 2 ¼"
198	PIN COTTER 5/16" X 2"

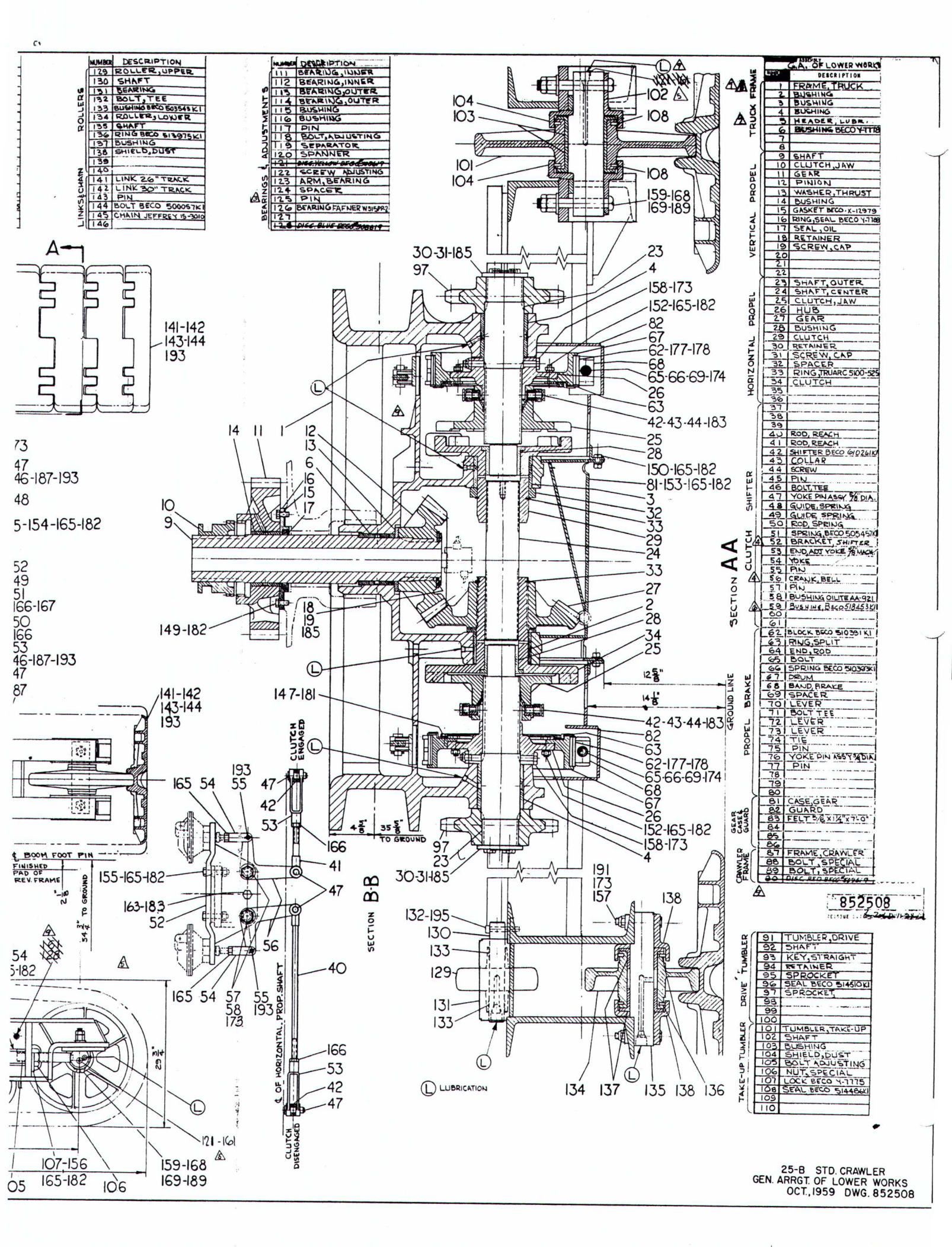
FASTENERS

NUMBER	DESCRIPTION
165	NUT, FULL ½" UNF
166	NUT, FULL ⅝" UNF
167	NUT, JAM ⅝ UNF
168	NUT, FULL 1" UNC
169	NUT, JAM 1" UNC
170	NUT, JAM 2" UN
171	
172	
173	LOCKNUT "A" ⅝" UNF
174	LOCKNUT "A" ¾" UNF
175	
176	
177	RIVET, SEMI-TUBULUR FLAT CSK HD #10 X 1/32"
178	RIVET, SEMI-TUBULAR FLAT CSK HD #10 X 3/32"
179	
180	

FASTENERS

NUMBER	DESCRIPTION
147	SCREW CAP ⅜ X ¼ UNF
148	SCREW CAP ½ X 1" UNF
149	SCREW CAP ¼ X 1" UNC
150	SCREW CAP ½ X 1¼ UNF
151	SCREW CAP ½ X 1¼ UN
152	BOLT, SPECIAL
153	SCREW CAP ⅜ X 1" UNF
154	SCREW CAP ¼ X 1¼ UN
155	SCREW CAP ⅛ X 1¼ UN
156	SCREW CAP ¼ X 2¼ UNF
157	SCREW CAP ⅝ X 4" UN
158	BOLT HEX ⅝ X 7½ UN
159	BOLT SQ 1" X 7½ UNC
160	BOLT HEX 1" X 12" UNF
161	SCREW DRIVE #X 1¼"
162	SCREW CAP ⅜ X 1¼ UNF
163	SCREW, CAP ⅝ X 1½ UNF
164	




ROLLERS
LINKS & CHAIN
BEARINGS & ADJUSTMENTS
TRUCK FRAME
VERTICAL PROPEL
HORIZONTAL PROPEL
CLUTCH SHIFTER
PROPEL BRAKE
GEAR CASE & GUARD
CRAWLER FRAME
TUMBLER DRIVE
TAKE-UP TUMBLER
SECTION AA
SECTION B-B
CLUTCH ENGAGED
CLUTCH DISENGAGED
GROUND LINE
TO GROUND
BOOM FOOT PIN
FINISHED PAD OF REV. FRAME
LUBRICATION
852508
25-B STD. CRAWLER
GEN. ARRGT. OF LOWER WORKS
OCT., 1959 DWG. 852508

LUBRICATION

PAGE 4-2 - GENERAL INFORMATION

PAGE 4-4 - LOWER WORKS

I. Reference Notes

PAGE 4-8 - UPPER WORKS

I. Reference Notes For Deck Machinery

II. Power Plant

PAGE 4-12 - FRONT END EQUIPMENT

I. Reference Notes

The story of lubrication is - - - - -
The correct lubricant
The right quantity
The right time
Properly applied

Clean outside of gun before using and wipe fittings so grit is not forced in with the grease.

Drain oil cases when hot so the draining oil carries off the sludge.

Keep funnels, plugs and oil spouts clean. Wipe off oil can covers before using.

Watch for signs of incorrect lubrication such as an accumulation of excess grease.

The section contains copies of the lubrication charts that are permanently fixed to the machine at appropriate places.

The following lists some widely known oil companies and their products that comply with the type of lubricant shown on charts. Oil viscosity such as SAE 10, 20 or 30 and grease consistency such as grade 0, 1 or 2 will vary depending on ambient temperatures. We do not wish to imply that no other makes of lubricants would be satisfactory, but would suggest that if a substitution is made, then the corresponding products should be the equivalent of those listed.

EO (Engine Oil)

Standard Oil Co.	-	Essolube HDX 100
	-	Pendor HDX 10 W
Gulf Oil Co.	-	Dieselube 10W
Shell Oil Co.	-	Rotella Oil 10W
Sinclair Oil Co.	-	TBT SAE 10
Socony Mobile Oil Co.	-	Delvac 910
Texaco Oil Co.	-	HD 10W

OL (Open Gear Lubricant)

Standard Esso	-	Swett N350
Gulf	-	Lubcote "O"
Shell	-	Cardium D or EP fluid F
Sinclair	-	ONYX 500 or JET #8
Socony	-	Dorcia #150
Texaco	-	Crater 2X

MPG (All our recommended MPG greases are Extreme Pressure Greases.)

Standard	-	Penola Nebula EP - #2
Gulf	-	Gulfcrown EP - #2
Shell	-	Alvania EP - #2
Sinclair	-	Litholine - Industrial #2 - EP
Socony	-	Mobilplex EP - #2
Texaco	-	Multifac EP - #2

MPL (Multi Purpose Gear Lubricant)

Standard ESSO	-	Motor 2105 SAE 90
Gulf	-	MPL 90
Shell	-	Omala 72
Sinclair	-	Opaline Gear Lub BX
Socony	-	Hobilube EP 90
Texaco	-	Meropa #3

WRL (Wire Rope Lubricant)

Refer to lubricant supplier for lubricant that will penetrate and lubricate rope core.

Keep a written record on the sheets provided at the end of this section to show just which points have been serviced on a given date.

The frequency of lubrication, as given in the charts, is intended as a guide and it does not mean that under certain unusual operating conditions some points may not require more frequent lubrication or other special attention. Use good judgement and common sense in lubricating a machine.

New bushings sometimes overheat from being too tight to allow normal distribution of lubricant. An old bushing may overheat because it is worn so that grease would not stay in for the full stated frequency of lubrication. In some cases it may be necessary to "baby" the bearing along by frequent greasing until it is worked in or the cause of the trouble is overcome.

The most common cause of overheating of an anti-friction bearing is churning of the grease which occurs when the bearing is packed too full. If grease leaks out of an anti-friction bearing it is almost a sure sign that too much grease was added to the bearing. Don't change the frequency of greasing but decrease the amount of grease added at each servicing. CAUTION: Only use hand grease gun when greasing anti-friction bearings to avoid rupturing grease seals or building up excess pressure in bearing enclosure.

When propelling long distances extra attention should be given to the lower works. After propelling always lubricate the entire machine because the rocking motion tends to squeeze grease out of the bearings.

I. REFERENCE NOTES

NOTE: 1. Steering Clutches - Keep splines clean and lightly lubricated for free movement. Their return into engagement is by spring action.

It is important that the steering clutches are not lubricated excessively as the excess grease may fall onto the friction surfaces of the propel brakes.

NOTE: 2. Propel Gear Case - Every 50 hours check oil level with machine on level ground and add lubricant if necessary. Oil level is the top of the pipe tee at the rear of the case. When machine has been operated in deep water or following a heavy rain remove drain plug and allow any accumulation of water to drain off.

Twice a year, or when temperature changes make it necessary, drain the propel gear case immediately after propelling, and fill with lubricant of the correct grade.

NOTE: 3. Swing Roller Path - Keep all contact surfaces of the double flanged roller path thinly coated with open gear lubricant. If dirt accumulates, wash off old lubricant with gasoline or other solvent and apply fresh coat.

NOTE: 4. Track Link Pins - Some operators prefer to run these dry but field tests indicate better service can be obtained if a small quantity of drained crankcase oil is poured onto the tread pins. Lubricate the track link pins frequently when the machine is being propelled long distance.

NOTE: 5. Cone Rollers - Clean off excess grease which may ooze out so that it will not get on the cone roller path.

NOTE: 6. Track rollers, (upper & lower) drive tumblers and take-up tumblers. Lubricate these every 1/2 hour when propelling long distances.

NOTE: 7. Super Crawlers

A. Propel shaft bushing in crawler frame. Lubricate every 10 hours.

B. Propel shaft splines. This fitting is under the shaft, outside of the sprocket. Lubricate every 50 hours.

C. Side frame extension screws. Remove plates and remove screw. Lubricate as necessary for easy turning screws. CAUTION: DO NOT OPERATE MACHINE WHILE SCREWS ARE REMOVED.

NOTE: 8. Tractor Type D-7 Crawlers

A. Track Rollers and Track Carrier Rollers

Lubricate the rollers through the fittings on both sides of the machine every 100 hours. If the machine is operating in deep water or mud, lubricate every 5 hours. Use a regular track roller lubricant. In sub-zero weather, crank case lubricating oils may be used when track roller lubricant is too heavy to handle.

B. Front Idler and Rear Sprocket

Grease the idlers and sprockets every shift. Use general purpose chassis grease.

C. Track Links

Under no circumstances should the track be lubricated. The stiffness noted between the links of a new track is not caused by a lack of clearance between the track pins and bushings, and it will disappear as the track wears in.

D. Recoil Piston

Lubricate every shift with multipurpose grease.

NOTE: 9. Tractor Type TD-20 Crawlers

A. Track Rollers and idler rollers.

These rollers are lubricated by gear oil (S.A.E 90 in winter and S.A.E. 140 in summer) carried in a cavity within the roller shaft assembly. Every 100 hours remove the pipe plugs in the ends of the roller shafts, insert the nozzle of the low pressure lubricating pumps and pump oil in the roller until the oil overflows, then replace the pipe plug. Do not use any lubricant heavier than S.A.E. 140 gear oil in these rollers because adequate lubrication of the roller bushings requires a lubricant that will flow from the reservior to the bushings. NOTE: Some machines may be equipped with button head fittings instead of pipe plugs. The lubrication frequency and the type of lubricant is the same for either type. Do not use pressure gun grease in the rollers of machines equipped with button head fittings. Use 90 or 140 gear oil in a gun with button head adapter.

B. Idler and Drive Tumbler Bushings.

Grease the idler tumblers and drive tumbler bushings every 8 hour shift. Use general purpose chassis grease.

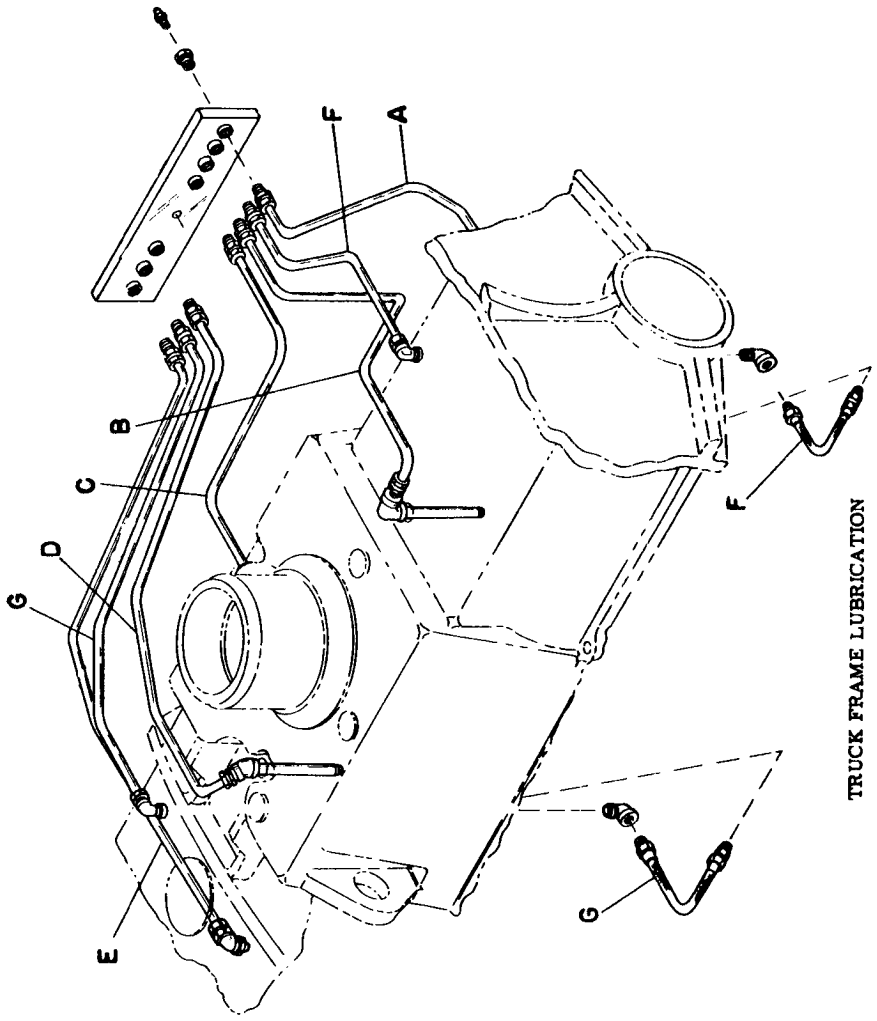
C. Track Links

Do not lubricate the track link pins under ordinary circumstances. However, if the tracks appear to be stiff, the application of fuel oil or used engine oil diluted with kerosene will help to loosen them up.

D. Recoil Piston

Lubricate every shift with multipurpose grease.

NOTE: 10. Pins and linkages without lubrication fittings. Lubricate with an oil can every 10 hours.



TRUCK FRAME LUBRICATION

SYM.	PART LUBRICATED
A	R.H. Outer Bearing - Horizontal Propel Shaft
B	R.H. Inner Bearing - Horizontal Propel Shaft
C	Lower Bearing - Vertical Propel Shaft
D	L.H. Inner Bearing - Horizontal Propel Shaft
E	L.H. Outer Bearing - Horizontal Propel Shaft
F	R.H. Jaw Clutch
G	L.H. Jaw Clutch

710265

LUBRICATION CHART 25-B LOWER WORKS CRAWLER

Interval Hours	Identification	Number Points	Lube	Quantity
10	Cone Rollers	8	MPG	4 Shots
	Brake Foot Lever	2	MPG	1 Shot
	Brake Lock	2	MPG	1 Shot
	Fulcrum Pins	2	EO	Oil Can
	Horizontal & Vertical Propel	5	MPG	2 Shots
50	Outer Bearing Drive Tumbler	2	MPG	4 Shots
	Front Tumbler Bearing	2	MPG	4 Shots
	Inner Bearing Drive Tumbler	2	MPG	4 Shots
	Swing Roller Path	-	OL	-
	Lower Idlers	12	MPG	4 Shots
	Upper Idlers	4 or 8	MPG	4 Shots
	Track Link	-	EO	Brush
	Propel Chain	-	EO	Brush
250	Cone Roller Equalizer	8	MPG	4 Shots
	Track Adjustment Take-Up	8	MPG	4 Shots
	Jaw Clutch	2	MPG	2 Shots

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I. REFERENCE NOTES FOR DECK MACHINERY

NOTE: 1. Oil Can Points - Oil all reach rod end pins and all moving parts of mechanical linkage.

NOTE: 5. All Clutch linkage pins are chrome-plated, turn in oilite bushings and do not require lubrication.

II. POWER PLANT

For detailed engine lubrication information refer to the engine manufacturers instruction book.

For lubrication information on the power take off clutch refer to the name plate on the clutch housing and to the manufacturers instruction book attached to the clutch.

The pilot bearing of the clutch is lubricated through the end of the clutch shaft. To get at this fitting you have to remove the quick release valve and rotor seal on the rear shaft and the chain case cover.

For detailed torque converter lubrication information refer to the manufactures instruction book.

The output shaft governor drive cable should be lubricated at least once a month. Proceed as follows:

1. Remove the shaft from the casing.
2. Coat the entire shaft lightly with a good grade of general purpose grease.
3. Reassemble shaft and casing and install on machine.
4. Never force grease into the casing with a grease gun or pressure lubricator.

If, at any time, the cable starts to squeal or gets uncomfortably hot to touch, the machine should be shut down and the cable lubricated in accordance with the above instructions.

LUBRICATION CHART 25-B MACHINERY

Interval Hours	Identification	Number Points	Lube	Quantity
5	Swing Rack & Pinion	Gun	MPG	6 Shots
10	Center Pintle	1	MPG	2 Shots
	Vertical Propel Shaft	1	MPG	2 Shots
	"A" Frame Sheaves	7	MPG	2 Shots
	Swing Locking Dog	2	MPG	1 Shot
	Swing To Propel	1	MPG	1 Shot
	Hoist Brake Bearings	2	MPG	1 Shot
50	Boom Hoist Roller Chain	-	EO	Brush
	Chain Case Check Level (See 1000 HR)	-	EO	To Level
	Gear Case Check Level (See 1000 HR)	-	MPL	To level
100	Levers & All Moving Parts	-	EO	Oil Can
250	Vertical Swing Shaft Bearings	2	MPG	4 Shots
	Rear Shaft Bearing Cover R.H.	1	MPG	2 Shots
	Front Shaft Bearing Cover R.H.	1	MPG	2 Shots
	Transmission Shaft	1	MPG	2 Shots
	Brake Dead End Pins	2	MPG	1 Shot
500	Rear & Front Drum Housing	2	MPG	4 Shots
	Rear Shaft Clutch Housing	1	MPG	4 Shots
	Drag & Back Haul Clutch	1	MPG	4 Shots
	Boom Hoist Drum	1	MPG	2 Shots
1000	Gear Case - Drain Main Gear Case & Rev. Frame Gear Case - Refill	Cover	MPL	32 Qts.
	Chain Case - Drain & Refill	Cover	EO	3 Qts.

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EO - Engine Oil
MPG - Multi Purpose Type Grease
MPL - Multi Purpose Gear Lubr.
OL - Open Gear Lubricant

NOTE:

1. Front End Equip.-See Chart On Boom
2. Engine - See Chart on A-Frame Yoke
3. Carrier - See Chart in Cab
4. Crawlers - See Chart on Truck Frame

LUBRICATION CHART 25-B POWER PLANT

Interval Hours	Identification	Number Points	Lube	Quantity
	Air Cleaner - Service daily or more often in extremely dusty conditions. Clean cup and refill to oil level mark when oil becomes thick or ½" of dirt collects in cup bottom. Use SAE 20 in summer and SAE 10 in winter.	-	EO	-
	Torque Converter-See Instruction Plate on Converter.	-	-	-
10	Crankcase - Check Level	Dipstick	EO	-
	Clutch Shifter Collar (Machine Without Converter)	1	MPG	1 Shot
50	Crankcase - Drain and Refill	Dipstick	EO	
	Oil Filter - Change Element	-	EO	
100	Oil Cups - Distributor - Generator - Starter - Governor Linkage	-	EO	Oil Can
	Bearings- Clutch Main & Pilot (Machines Without Converter)	2	MPG	2 Shots

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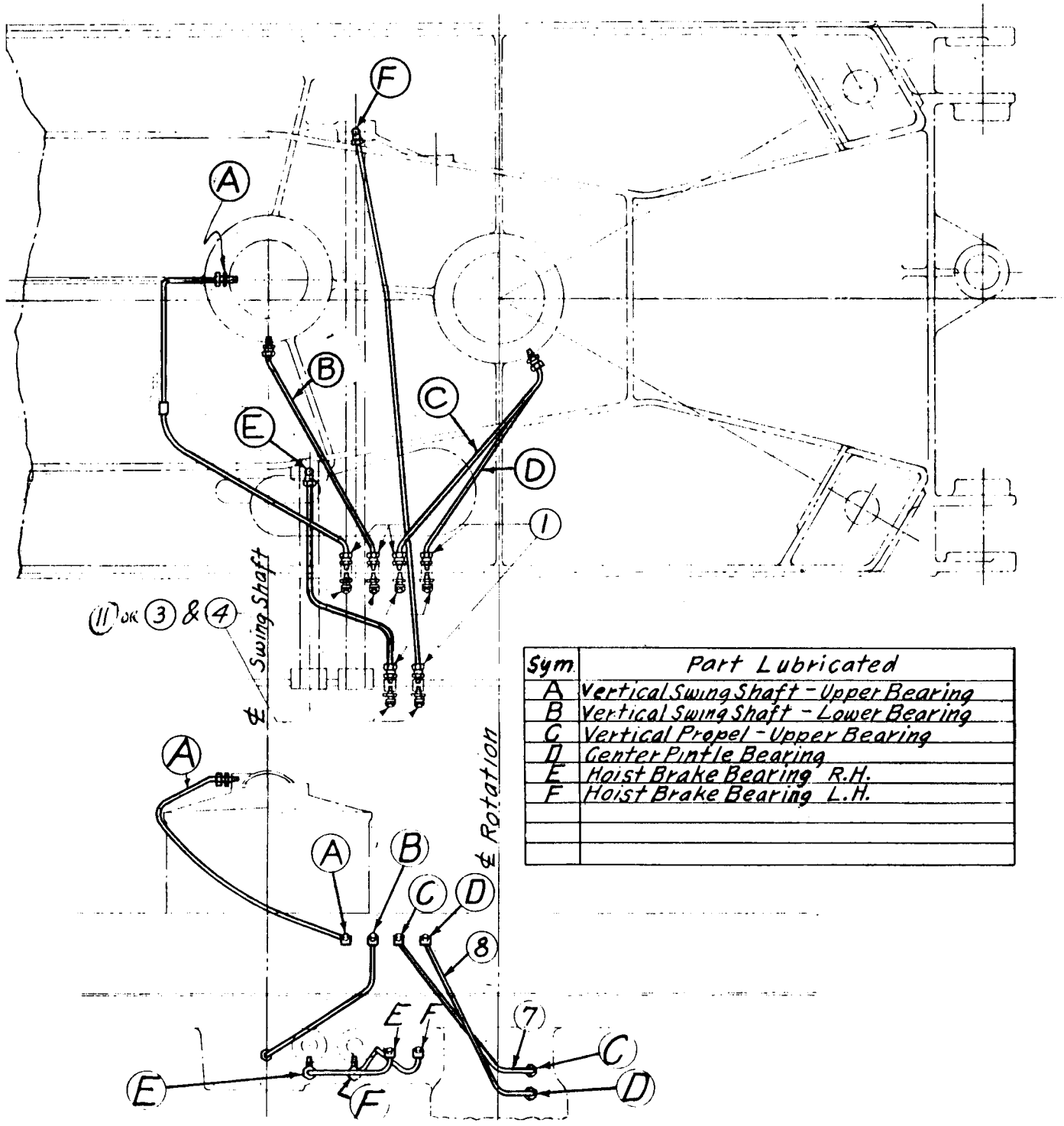
E.O. Engine Oil - Use SAE 5W-20 or 10-W Below 10° F. SAE 10W-20 or 10-W from 10° F. to 32° F. to 60° F. and SAE 30 above 60° F.



Sym.	Part Lubricated
A	Vertical Swing Shaft - Upper Bearing
B	Vertical Swing Shaft - Lower Bearing
C	Vertical Propel - Upper Bearing
D	Center Pintle Bearing
E	Hoist Brake Bearing R.H.
F	Hoist Brake Bearing L.H.

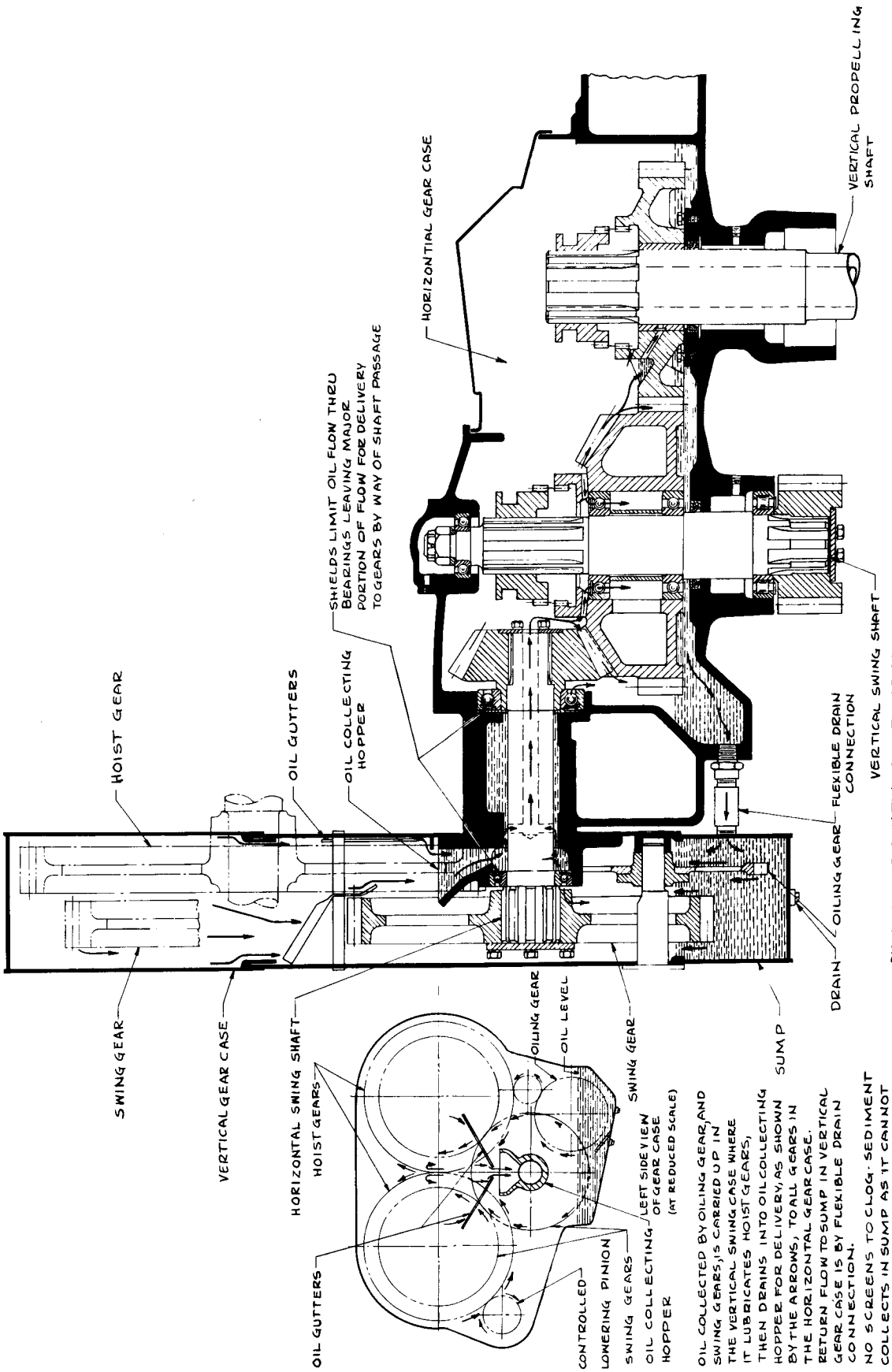


DIAGRAM OF CONTINUOUS FLOOD OIL LUBRICATION OF GEARS AND BEARINGS FOR SWING, PROPELLING MACHINERY, AND DRUM SHAFT GEARS ON REVOLVING FRAME.
(PROPELLING SHAFT SWUNG 90° FOR PURPOSE OF ILLUSTRATION)

OIL COLLECTED BY OILING GEAR AND SWING GEARS, IS CARRIED UP IN THE VERTICAL SWING CASE WHERE IT LUBRICATES HOIST GEARS, THEN DRAINS INTO OIL COLLECTING HOPPER FOR DELIVERY, AS SHOWN BY THE ARROWS, TO ALL GEARS IN THE HORIZONTAL GEAR CASE. RETURN FLOW TO SUMP IN VERTICAL GEAR CASE IS BY FLEXIBLE DRAIN CONNECTION.

NO SCREENS TO CLOG. SEDIMENT COLLECTS IN SUMP AS IT CANNOT BE CARRIED UP BY GEARS TO OIL COLLECTING HOPPER

I. REFERENCE NOTES

NOTE: 2. Dipper Latch Bar - Every 10 hours lubricate all wearing surfaces of the latch bar by pouring on a little engine oil. Keep trip mechanism on back of dipper free of dirt.

NOTE: 3. Tagline - Keep tagline barrel half full of oil, use same oil as used in engine crankcase. There is some slight leakage of oil through the bushings but one filling should last for several months. If leakage is excessive use heavier grade of oil.

NOTE: 4. Dragline Bucket Dump Sheave - Once a shift, rotate sheave so plug is at top, remove plug and add heavy oil if needed.

For sheaves using anti-friction bearings, lubricate with multi-purpose grease every 10 hours.

NOTE: 5. Hoe Down Cylinder

For the initial filling of oil, the piston rod is to be pulled out to its maximum length. Remove filler cap and fill the cylinder with SAE 10 oil. In extremely cold weather automatic Transmission Fluid can be used. The 25-B will hold about 7 quarts of oil.

The piston rod is then forced back into the cylinder to its minimum length. The oil level should then be checked and it should be 2" below the filler cap.

When the unit is working and the oil level is to be checked, the boom should be raised to maximum height and the oil level should be 2" below the filler cap.

LUBRICATION CHART SHOVEL				
Interval Hours	Identification	Number Points	Lube	Quantity
4	Shipper Shaft	2	MPG	2 Shots
	Shipper Shaft Drum	1	MPG	2 Shots
	Crowd Drum	2	MPG	2 Shots
	Boom Point Pin	4	MPG	2 Shots
	Dipper Trip Drum	1	MPG	2 Shots
	Dump Lever	1	MPG	2 Shots
	Padlock Sheave	1	MPG	2 Shots
	Padlock	1	MPG	2 Shots
	Chain Take-Up Shaft	1	MPG	2 Shots
8	Dipper Stick	-	OL	Brush
	Crowd Chain	-	OL	Brush
	Dipper Latch	-	EO	Oil Can
100	Ropes & Rope Surfaces - All	-	WRL	-
	Dipper Trip Bracket	1	MPG	2 Shots

LUBRICATION CHART CRANE-CLAMSHELL-DRAGLINE				
Interval Hours	Identification	Number Points	Lube	Quantity
8	Suspension Sheaves (Bushings)	4	MPG	4 Shots
	Fairlead Sheaves	2	MPG	4 Shots
	Boom Foot Pin	4	MPG	6 Shots
	Mast Foot	2	MPG	6 Shots
	D/L Dump Block Sheave	1	MPG	8 Shots
	Boom Point Sheaves (Bushings)	3	MPG	4 Shots
100	Ropes & Rope Surfaces - All	-	WRL	-
	Fairlead Frame	1	MPG	10 Shots
	Suspension Sheaves (Transit)	6	MPG	4 Shots
	Boom Point Sheaves (Transit)	3	MPG	4 Shots
	Guide Roller	2	MPG	2 Shots
	Jib Mast Sheave	1	MPG	4 Shots
	Jib Point Sheave	1	MPG	4 Shots
	NOTE: Hoist Blocks and Clamshell Buckets To Be Lubricated As Per Individual Requirements.			

LUBRICATION CHART 25-B HOE				
Interval Hours	Identification	Number Points	Lube	Quantity
4	Sheaves & Shaft Aux. "A"-Frame	4	MPG	2 Shots
	Guide Roller	1	MPG	2 Shots
	Deflector Sheave	4	MPG	2 Shots
	Boom Point Pin	2	MPG	2 Shots
	Hoist Link Pin	2	MPG	2 Shots
	Hoist Link Sheave	1	MPG	2 Shots
	Hoist Link Sheave Guard	2	MPG	2 Shots
	Hoist Link Guard Pin	1	MPG	2 Shots
	Padlock Pin	1	MPG	4 Shots
100	Ropes & Rope Surfaces - All	-	WRL	-

REEVING

PAGE 5-2 - GENERAL SUGGESTIONS

PAGE 5-3 - REEVING INSTRUCTIONS

I. General Reeving Instructions
II. Shovel Reeving

PAGE 5-5 - REEVING DIAGRAMS

GENERAL SUGGESTIONS

The wire rope, used as the final link in the transmission of power from the prime mover to the work, is just as much a part of the machinery as the gears, clutches, etc. and deserves the same attention to lubrication and inspection.

DON'T cut wire rope without first applying proper seizing.

DON'T pull wire rope off coils or reels without rolling coil or turning reel to prevent kinking.

DON'T operate the machine with wraps crossed on the drum.

DON'T overlook suspension ropes when inspecting cables.

DON'T put off replacement of any rope which is badly worn or has many broken strands.

DON'T operate sheaves with worn grooves or broken flanges.

DON'T store wire rope without properly lubricating it.

After attaching wedge type rope sockets, apply the load gradually and make sure the wedge is pulled all the way in. The load does the final tightening.

Rope clips are sometimes used where rope sockets would not be satisfactory. Always use a rope thimble when making a connection with clips to prevent bending rope on too small a radius. Three or four clips (Crosby type) are usually used. These must ALWAYS be applied with all U-bolts on short end of rope. Space clips so that distance between clips is six times diameter of rope. Tighten nuts on each clip alternately. After rope has been in service for an hour or two retighten clips. When inspecting ropes always check to make sure nuts are tight and that rope has not slipped.

Always use ropes of the correct diameter, length and construction. (See your distributor).

REEVING INSTRUCTIONS

I. GENERAL REEVING INSTRUCTIONS:

A. For a dragline, clamshell, or crane, lower the boom on to suitable blocking at the point end so that it is nearly horizontal. To block the shovel boom, rest the dipper on the ground, with the handle fully extended, then lower the boom until it rests on a timber placed across the dipper handle just back of the front stop. For a hoe the dipper should be tucked in under the boom as far as it will go, then the boom lowered so that the dipper rests on the ground.

B. Spool off all remaining cable from the boom hoist drum by pushing the boom hoist lever forward. On a hoe front end this will lower the auxiliary A-Frame until it rests on the boom.

C. Remove half of the boom hoist sleeve to make the rope anchor accessible. Drive out the wedge in the drum and remove the rope socket from the right side of A-Frame and detach the rope by driving out the wedge. Remove the old rope from the sheaves.

D. Support the reel or coil of new rope so that it can be spooled off without kinking.

E. Use the correct rope.

After reeving, spool all slack rope on drum and check anchors to be sure wedges are holding properly.

II. SHOVEL REEVING

A. Crowd and Retract Ropes

1. Run dipper handle out till stop rests against saddle block.

2. Rest dipper on ground and disconnect retract rope from eyebolt.

3. Remove rope guard from anchor casting on end of dipper handle. Drive out wedges holding the ends of crowd and retract ropes in crowd drum and take off the old rope.

4. Apply a liberal coating of grease to anchor casting so that crowd rope will equalize readily.

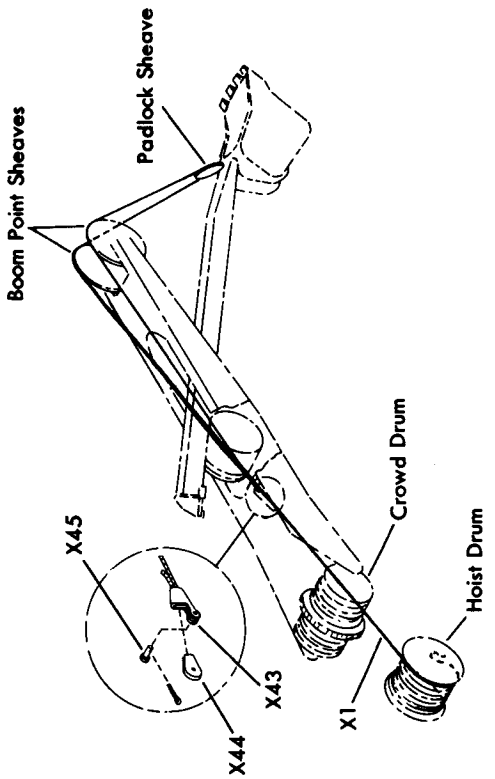
5. Loop middle of crowd rope over anchor casting and reeve over shipper shaft drum through center of boom. Passing ropes over crowd drum, anchor two cable ends to rope sockets at each end of the crowd drum. (Be sure the rope from the left groove on shipper shaft is attached to left end of crowd drum and rope from right groove to right end of drum.

6. Wind up all slack by turning crowd drum in direction for crowding then set crowd brake to hold drum.

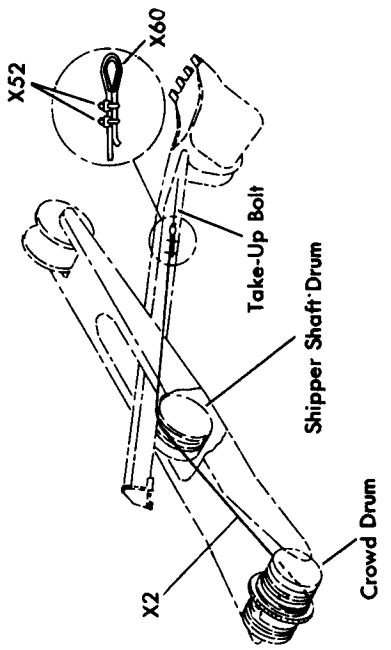
7. With drum stationary, put approximately one wrap on drum and anchor end of retract rope in socket at center of crowd drum. Lead rope from bottom of drum up through the boom and over center groove on shipper shaft drum.

8. Attach cable to adjusting bolt at lower end of dipper handle. Be sure to turn nuts on adjusting bolt back to end of bolt to provide room for maximum adjustment later when rope stretches. Thread cable through eye-bolt and fasten with rope clips.

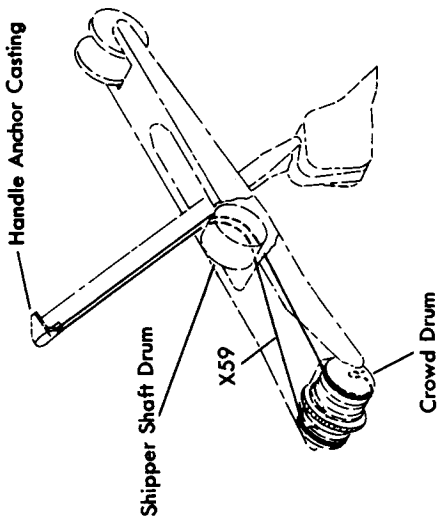
9. Release foot-brake and draw up on adjusting bolt until there is about two inches sag in the retract rope when the dipper is fully extended with the handle horizontal.



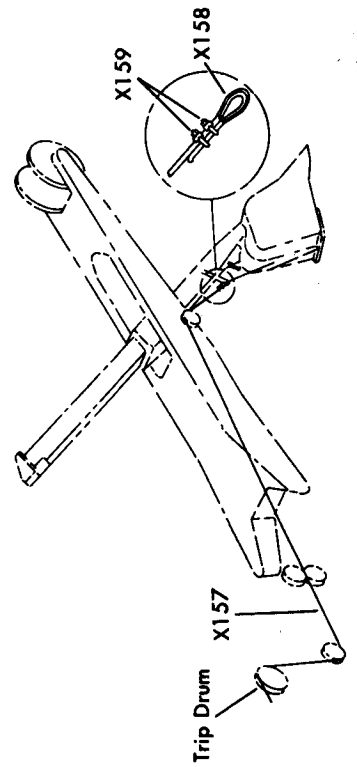
HOIST ROPE



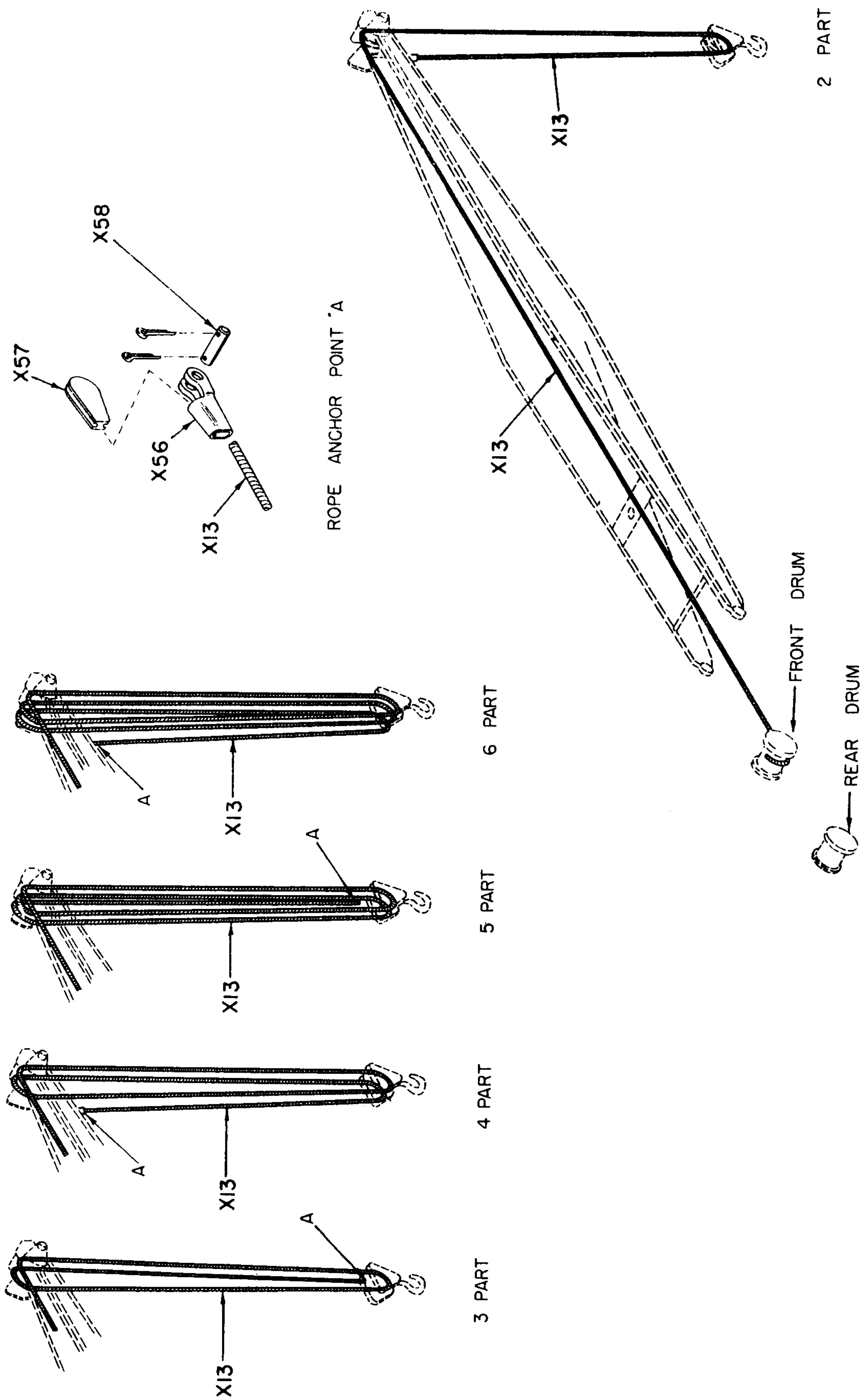
BACK HAUL ROPE



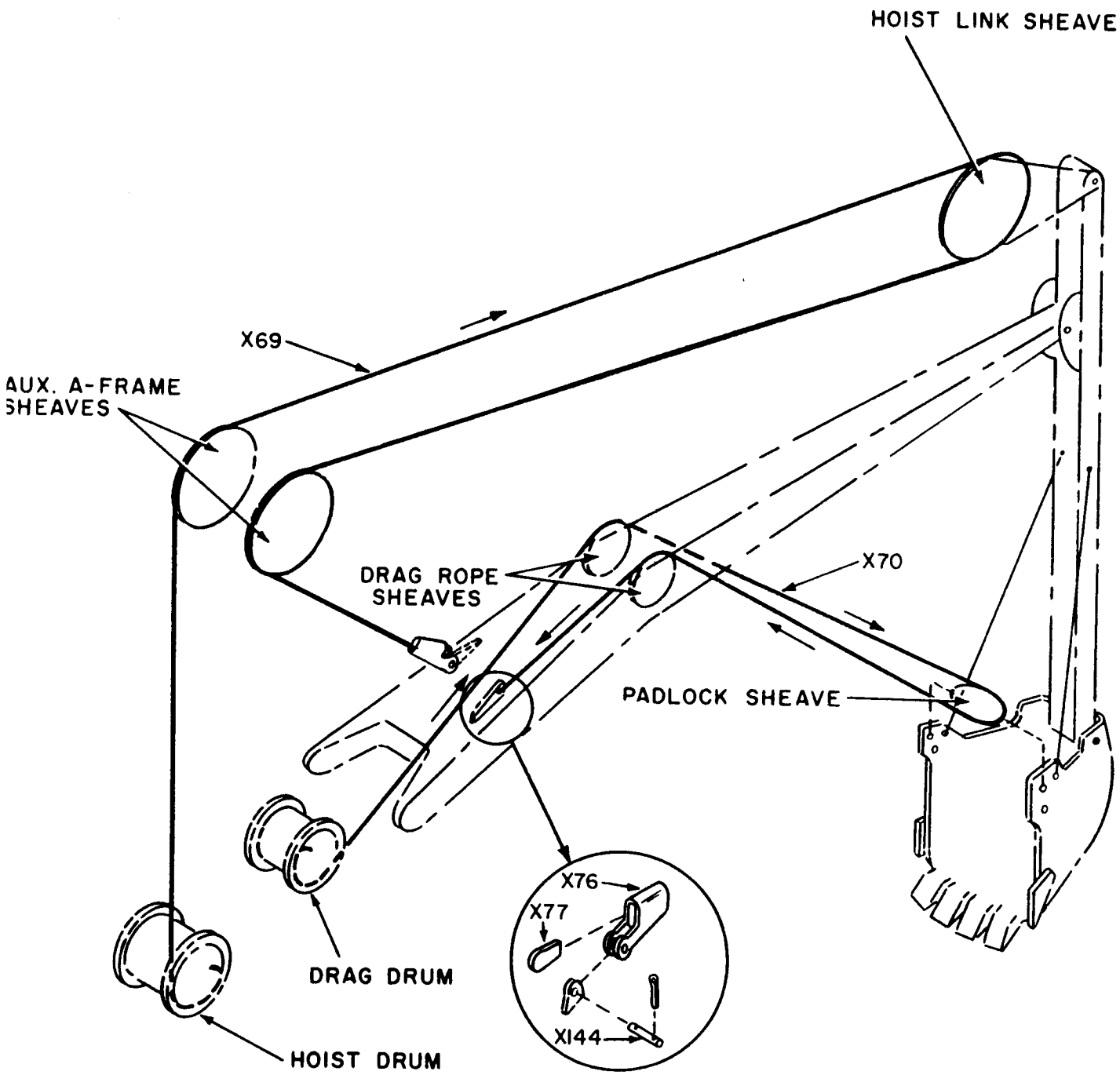
CROWD ROPE

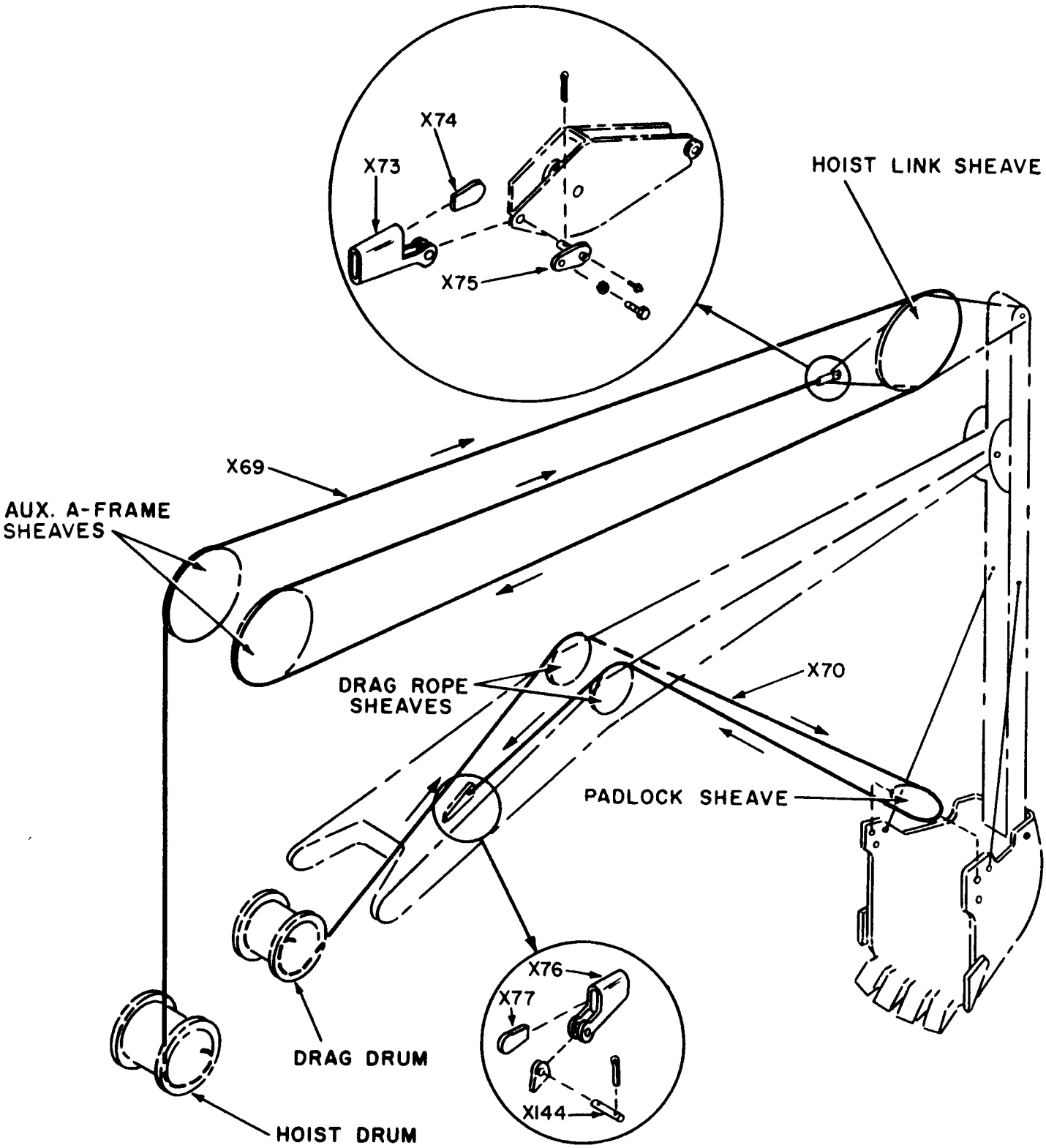


DIPPER TRIP ROPE

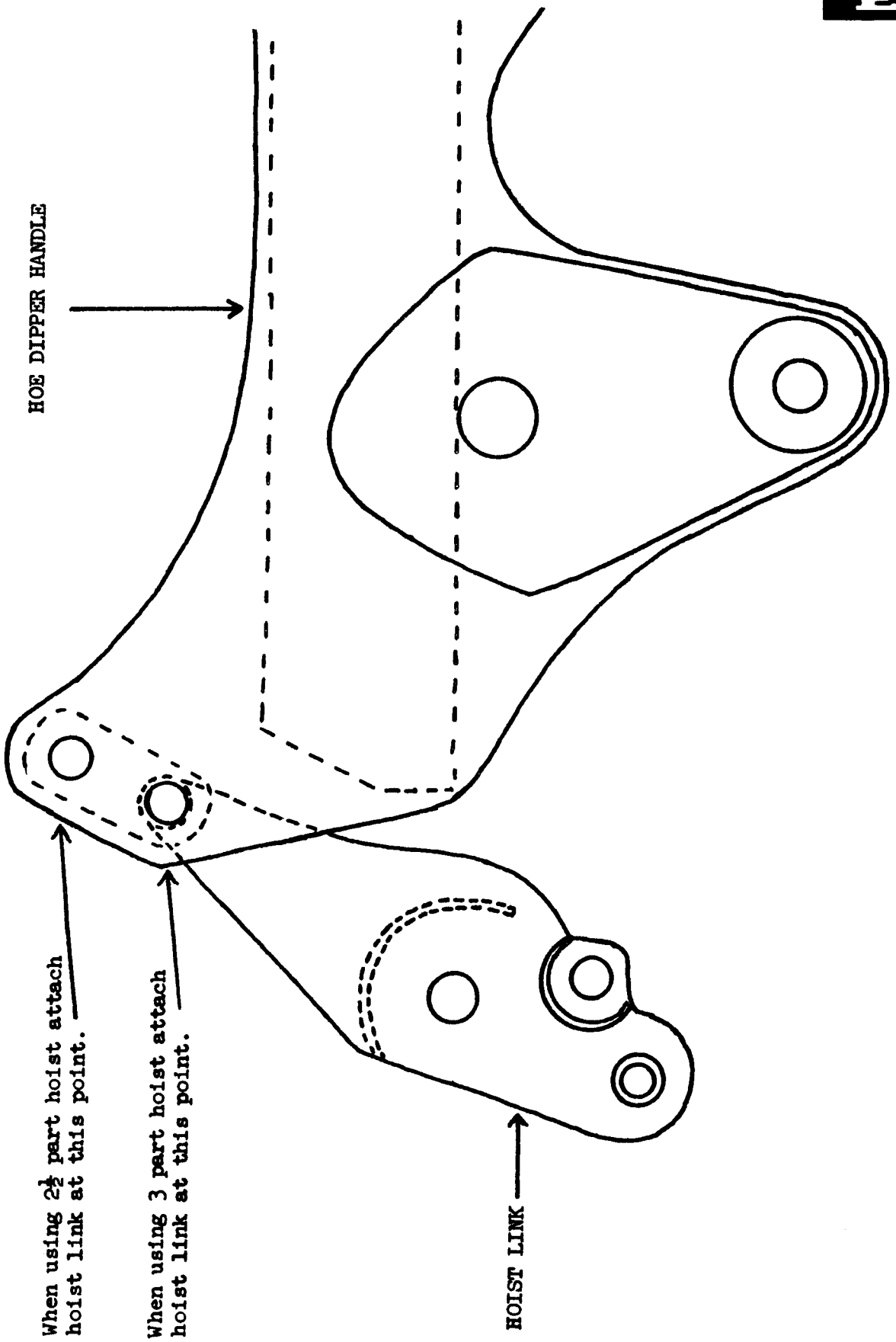


CRANE OPERATING ROPES


HOIST LINK SHEAVE
X69
AUX. A-FRAME SHEAVES
DRAG ROPE SHEAVES
X70
PADLOCK SHEAVE
X76
X77
X144
DRAG DRUM
HOIST DRUM

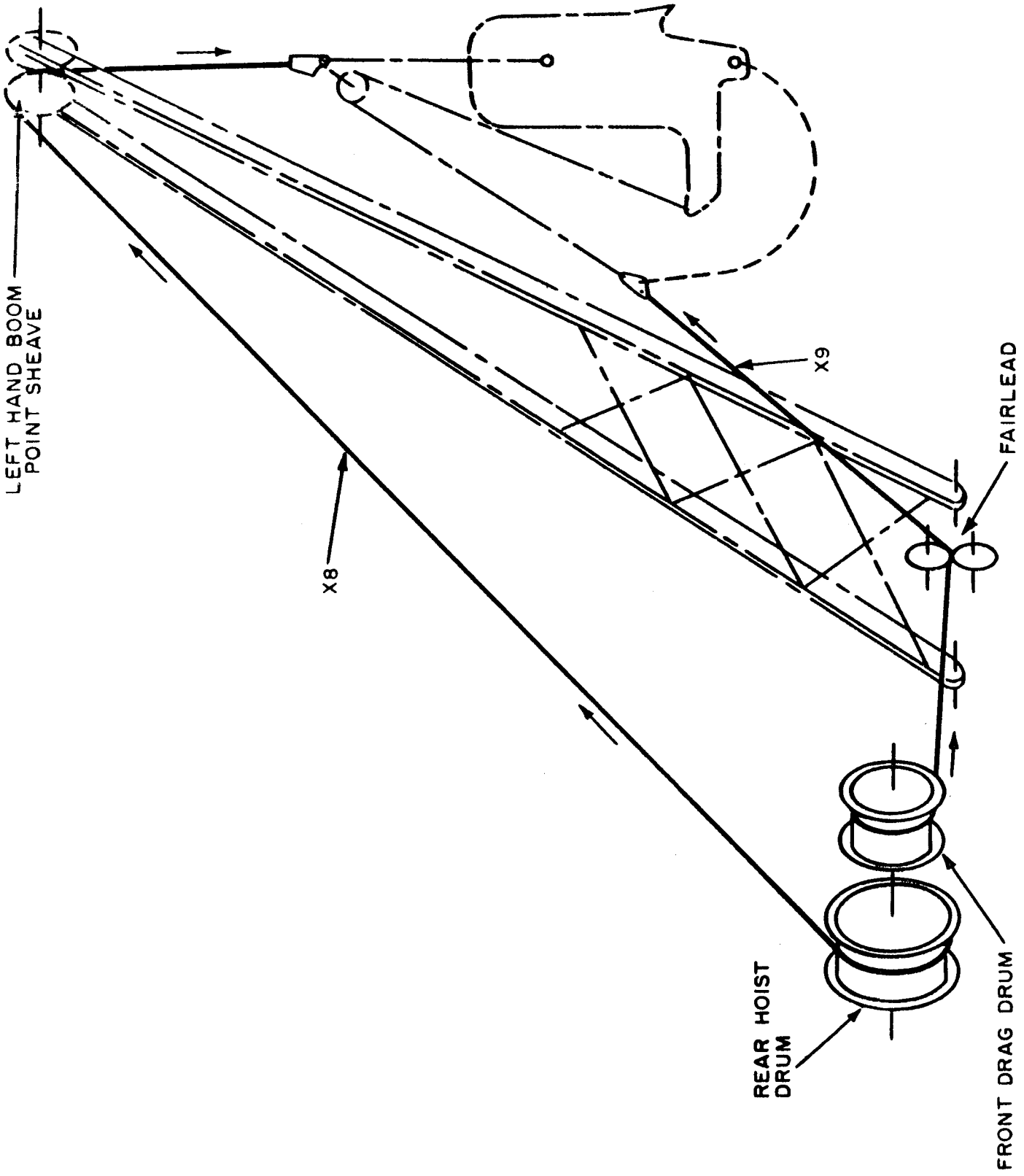


3 PART HOIST
HOE OPERATING ROPES

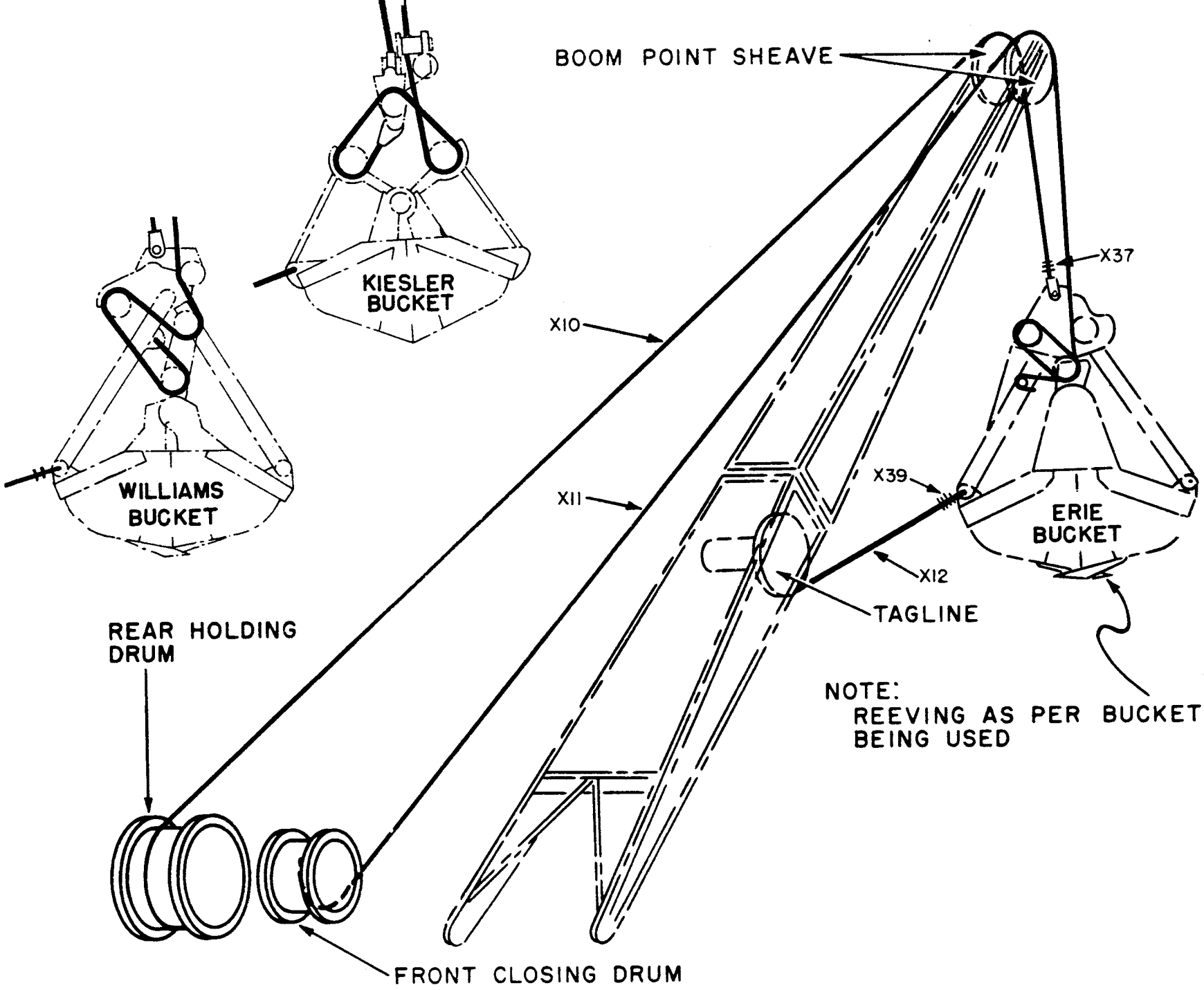


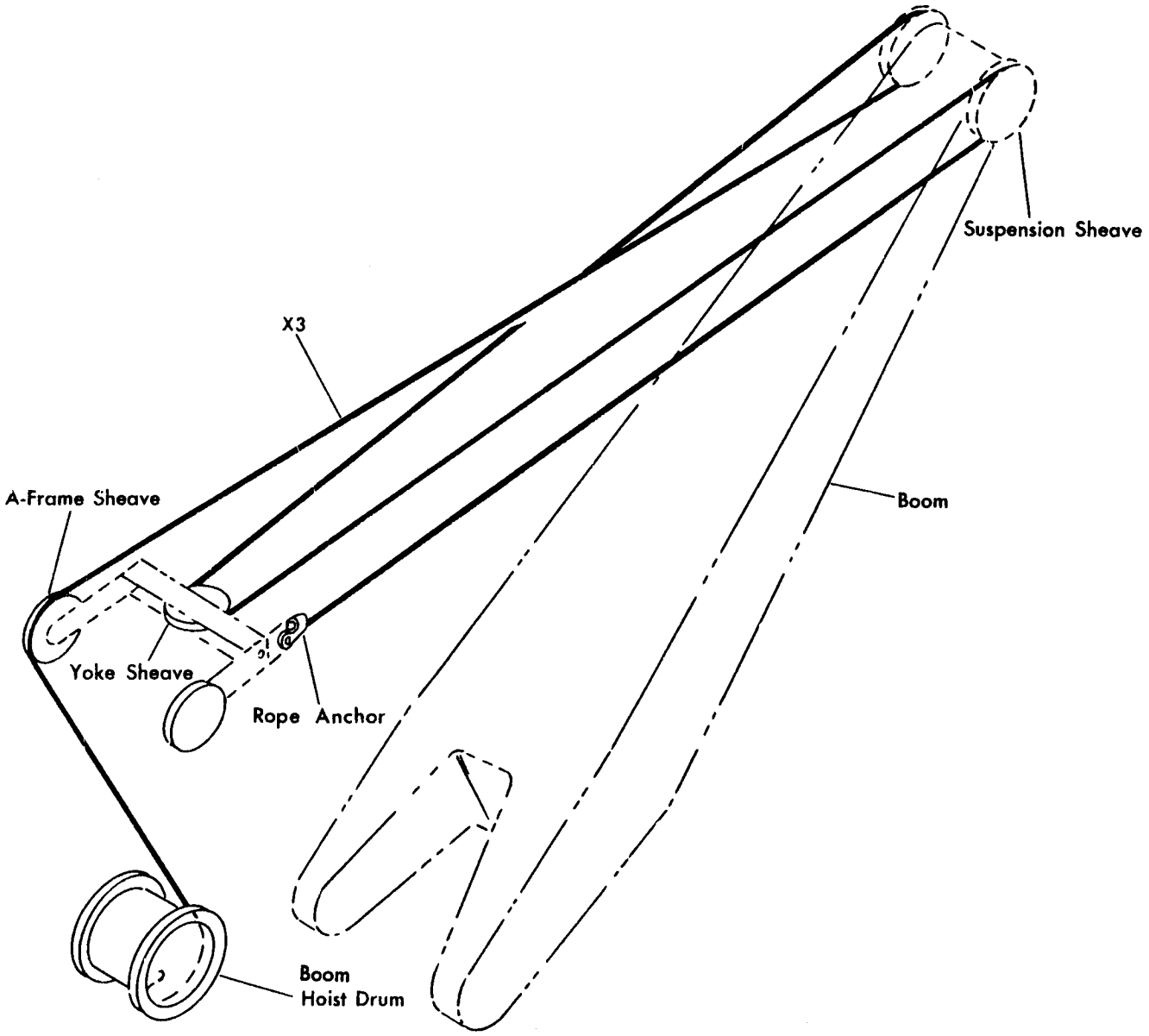
25-B
X-2176

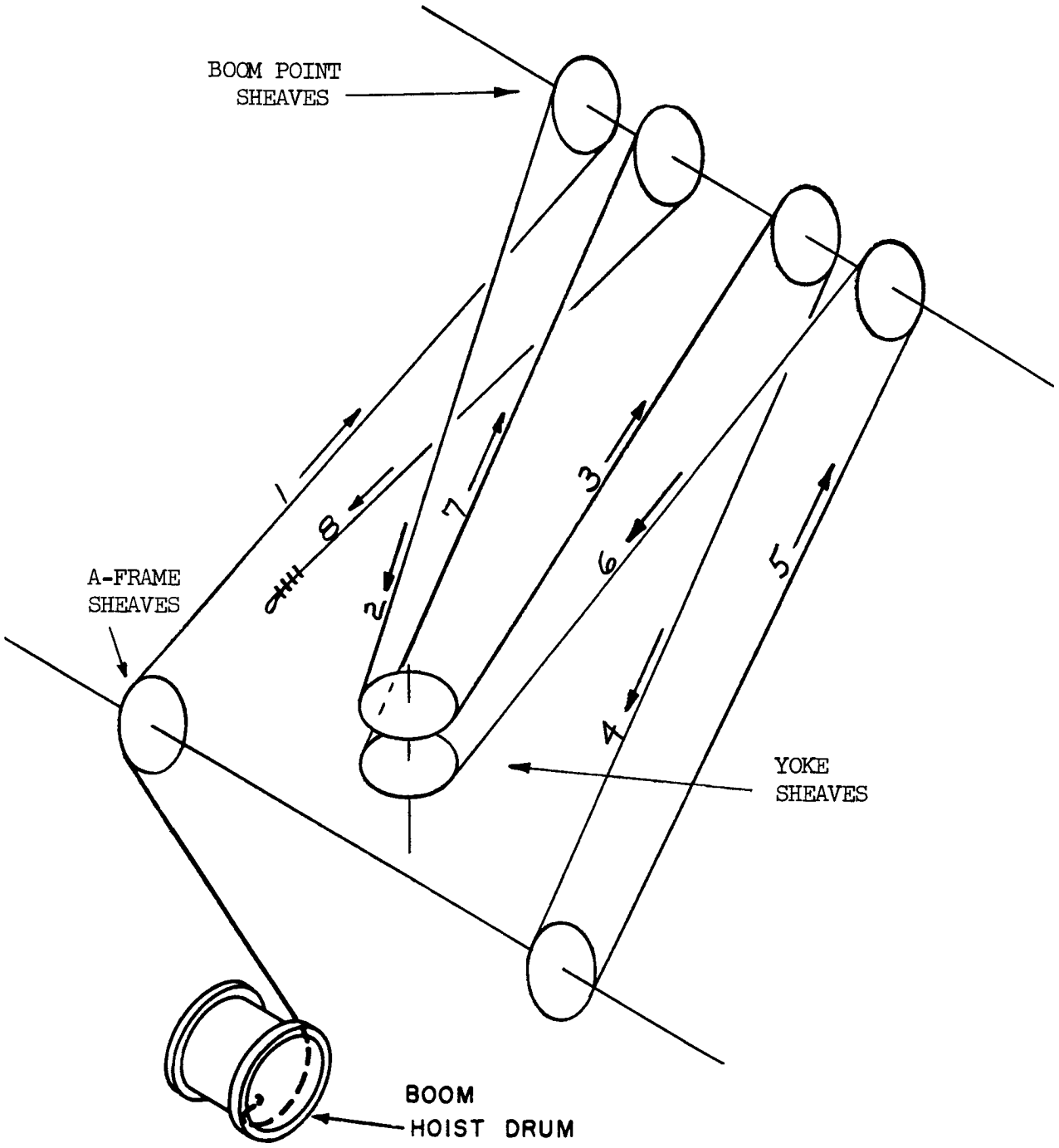
Attachment of hoist link to hoe handle
2½ or 3 part hoist line

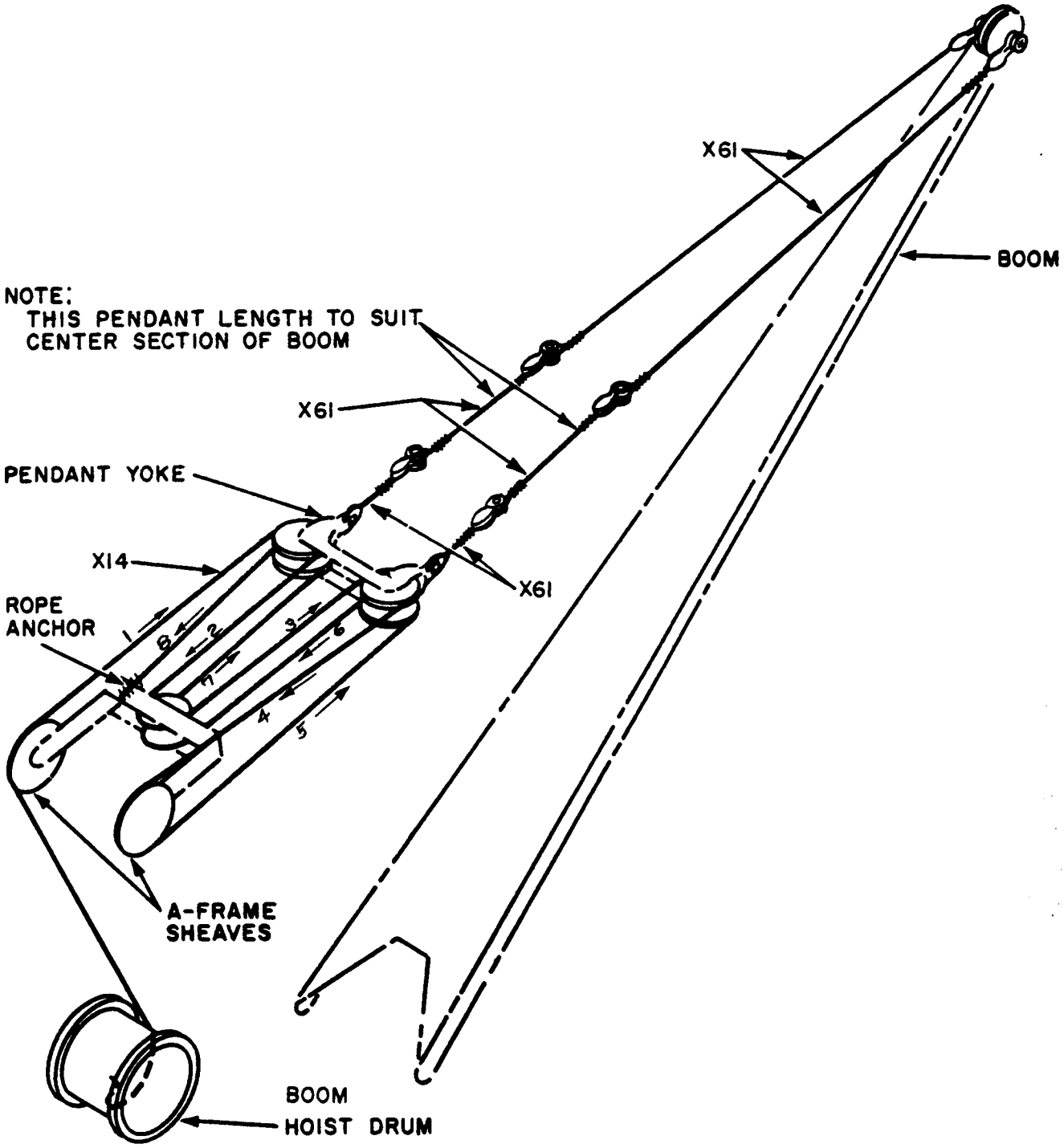


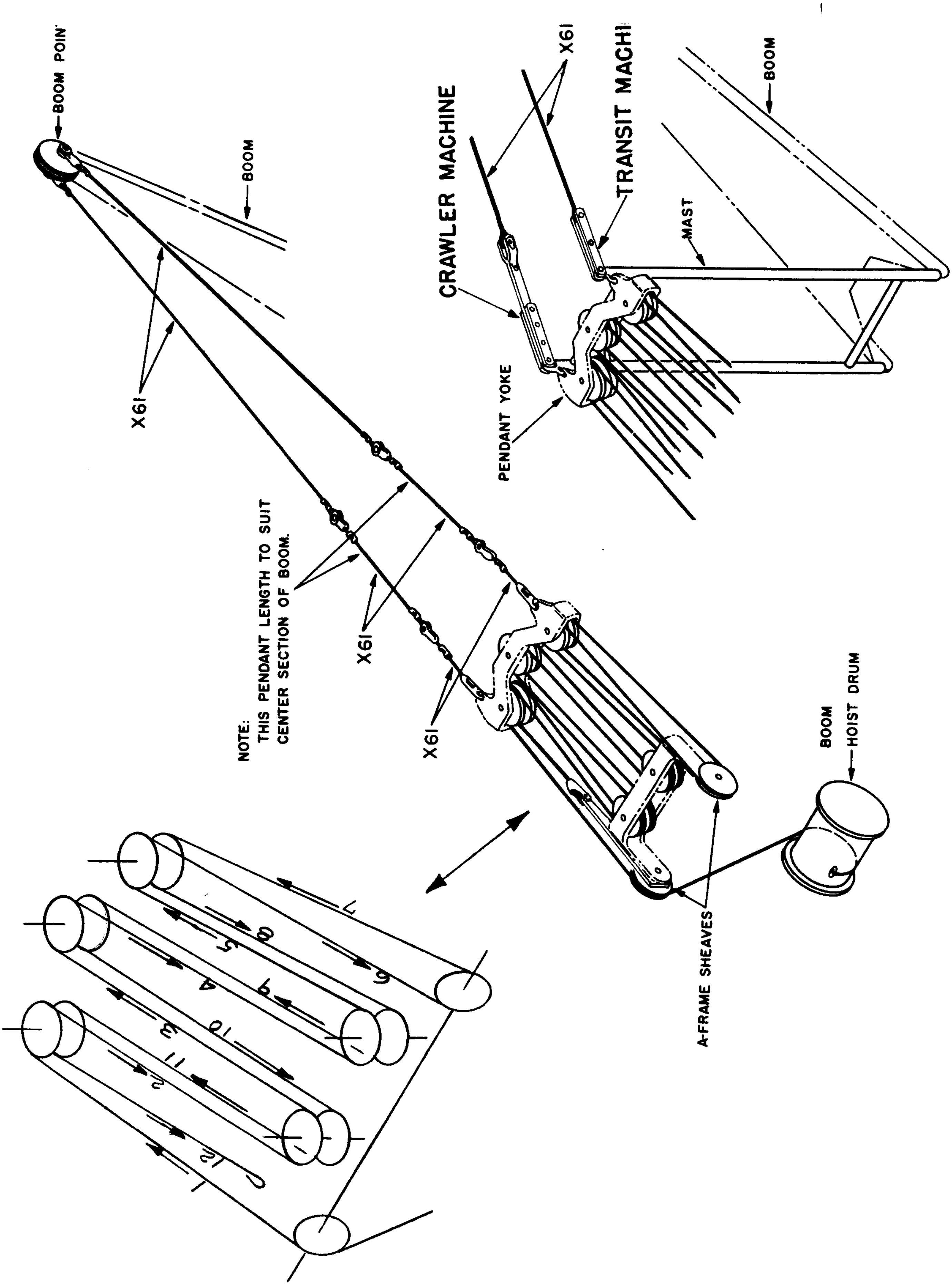
DRAGLINE OPERATING ROPES


BOOM POINT SHEAVE
KIESLER BUCKET
WILLIAMS BUCKET
X10
X11
X37
X39
X12
ERIE BUCKET
TAGLINE
REAR HOLDING DRUM
FRONT CLOSING DRUM
NOTE:
REEVING AS PER BUCKET BEING USED

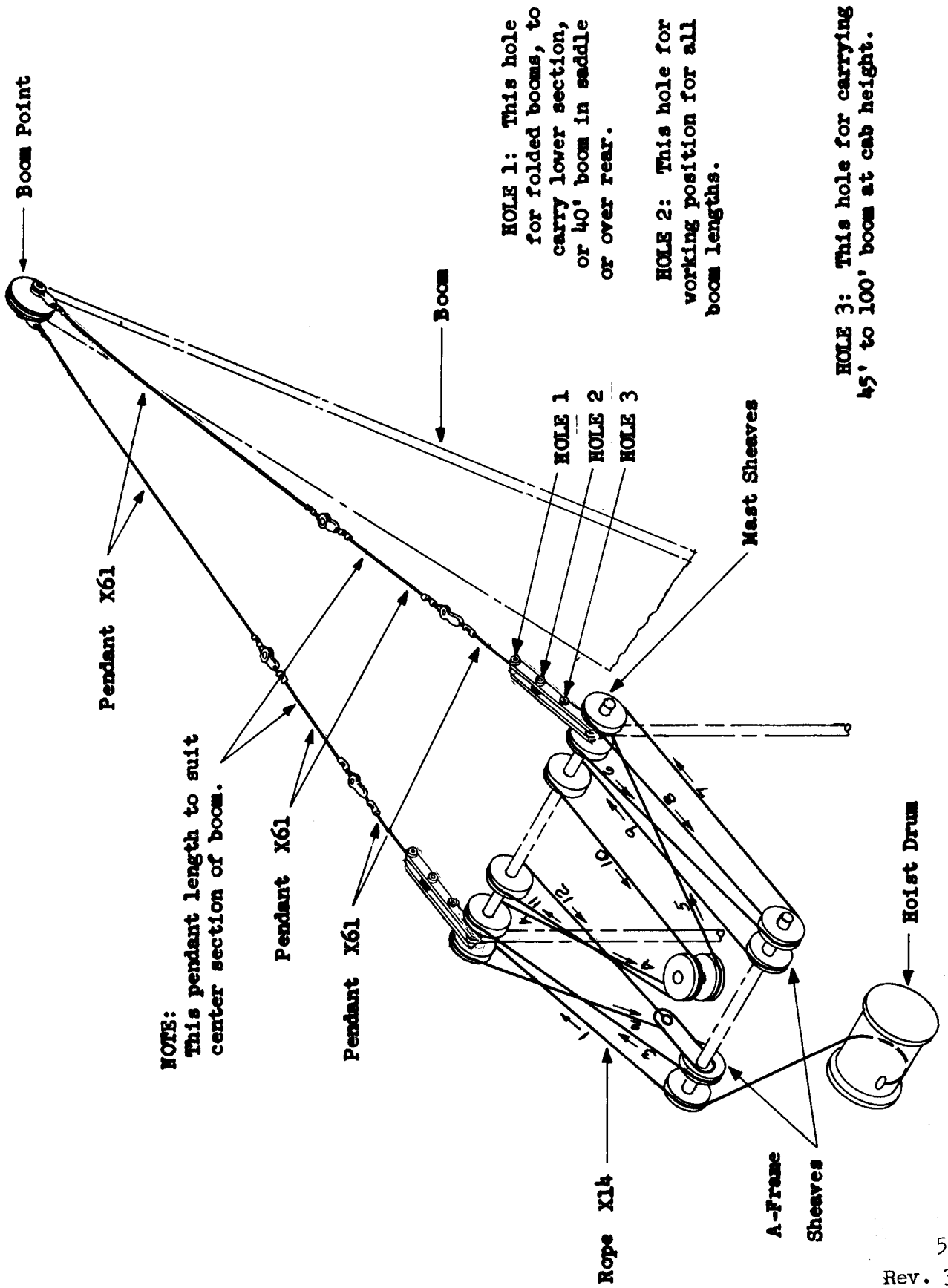

Suspension Sheave
X3
A-Frame Sheave
Boom
Yoke Sheave
Rope Anchor
Boom
Hoist Drum

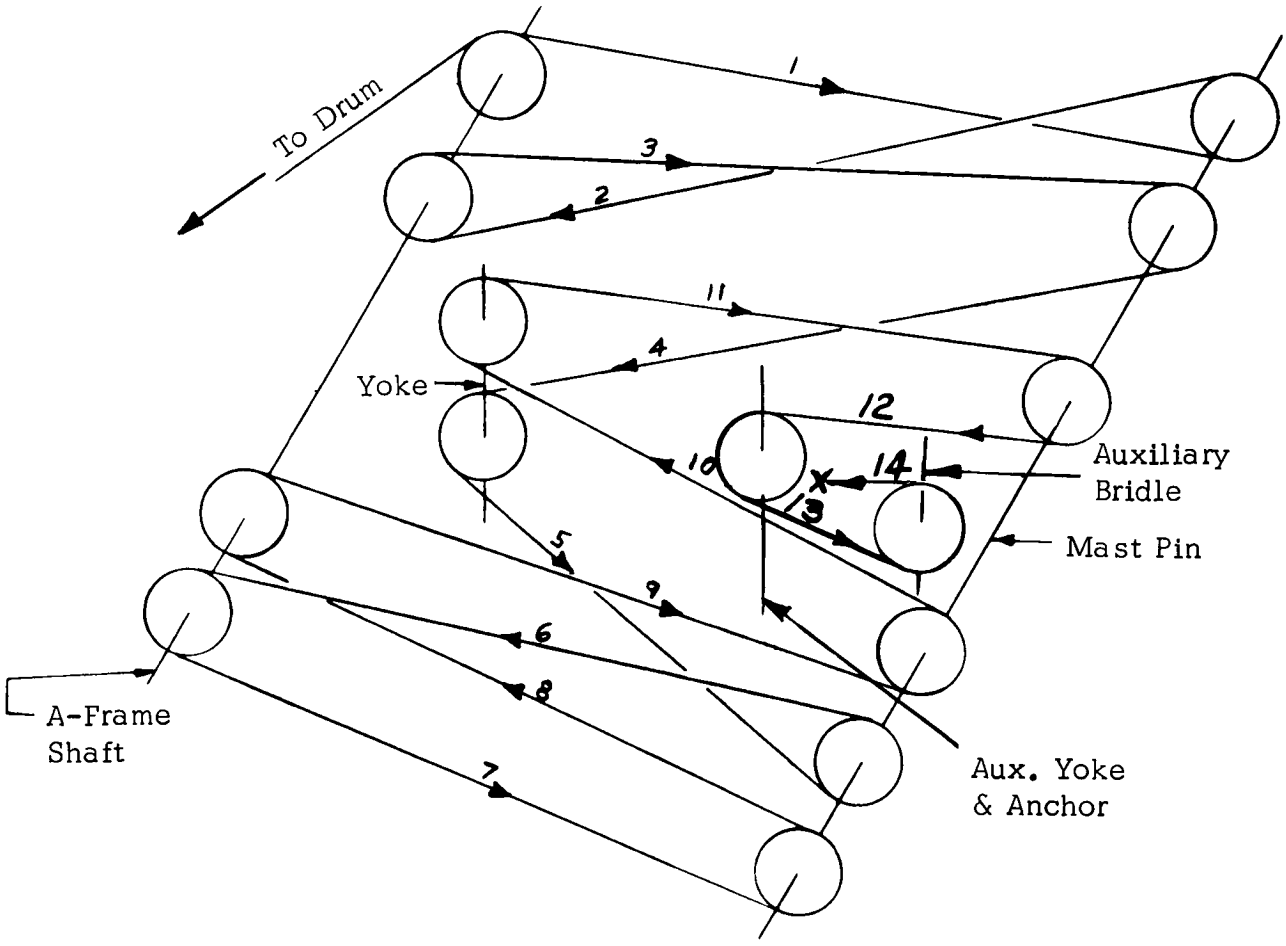

BOOM POINT
SHEAVES
A-FRAME
SHEAVES
YOKE
SHEAVES
BOOM
HOIST DRUM
1
2
3
4
5
6
7
8

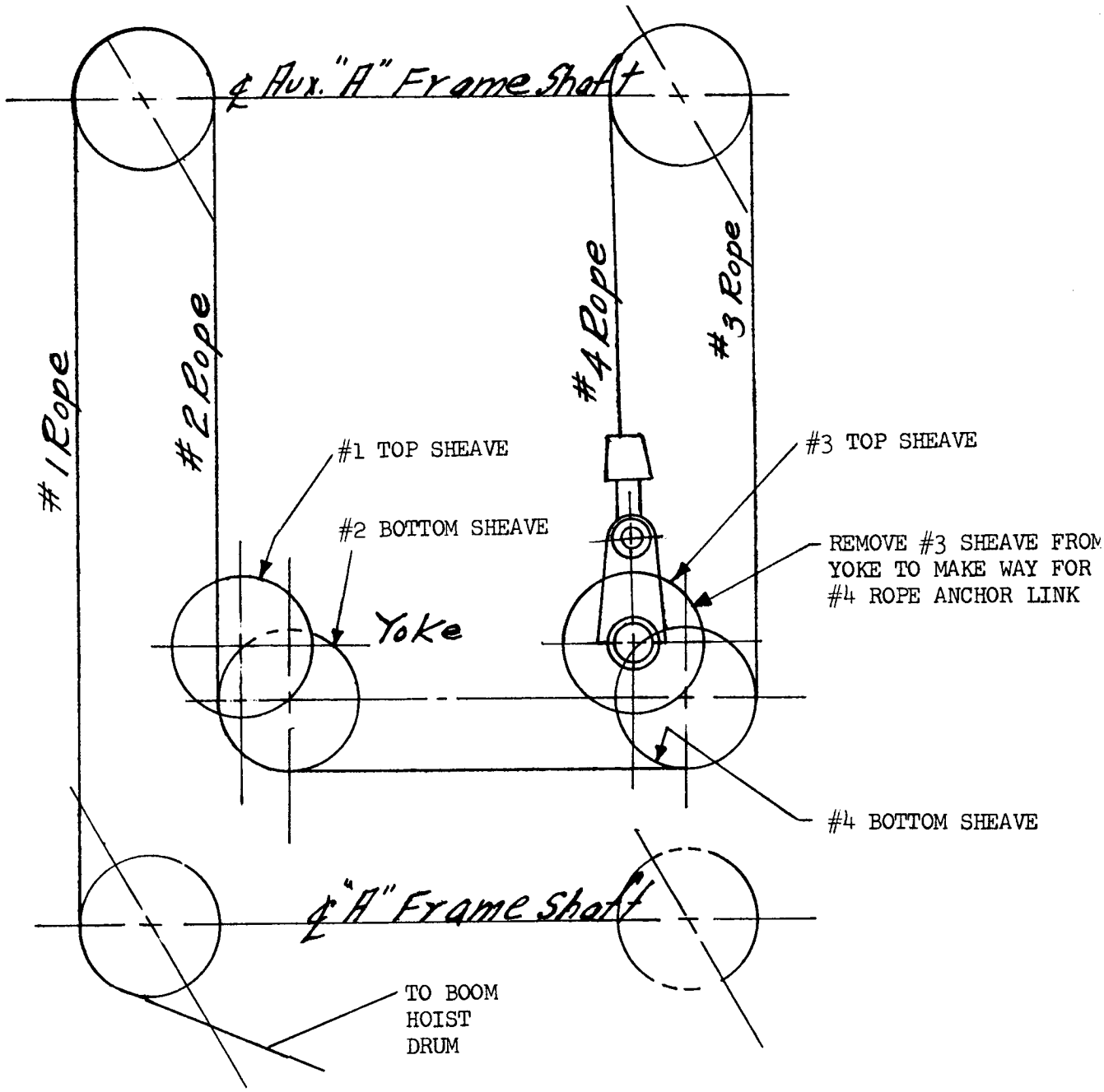

X61
BOOM
NOTE:
THIS PENDANT LENGTH TO SUIT
CENTER SECTION OF BOOM
X61
PENDANT YOKE
X14
X61
ROPE
ANCHOR
1
8
2
7
3
6
4
5
A-FRAME
SHEAVES
BOOM
HOIST DRUM



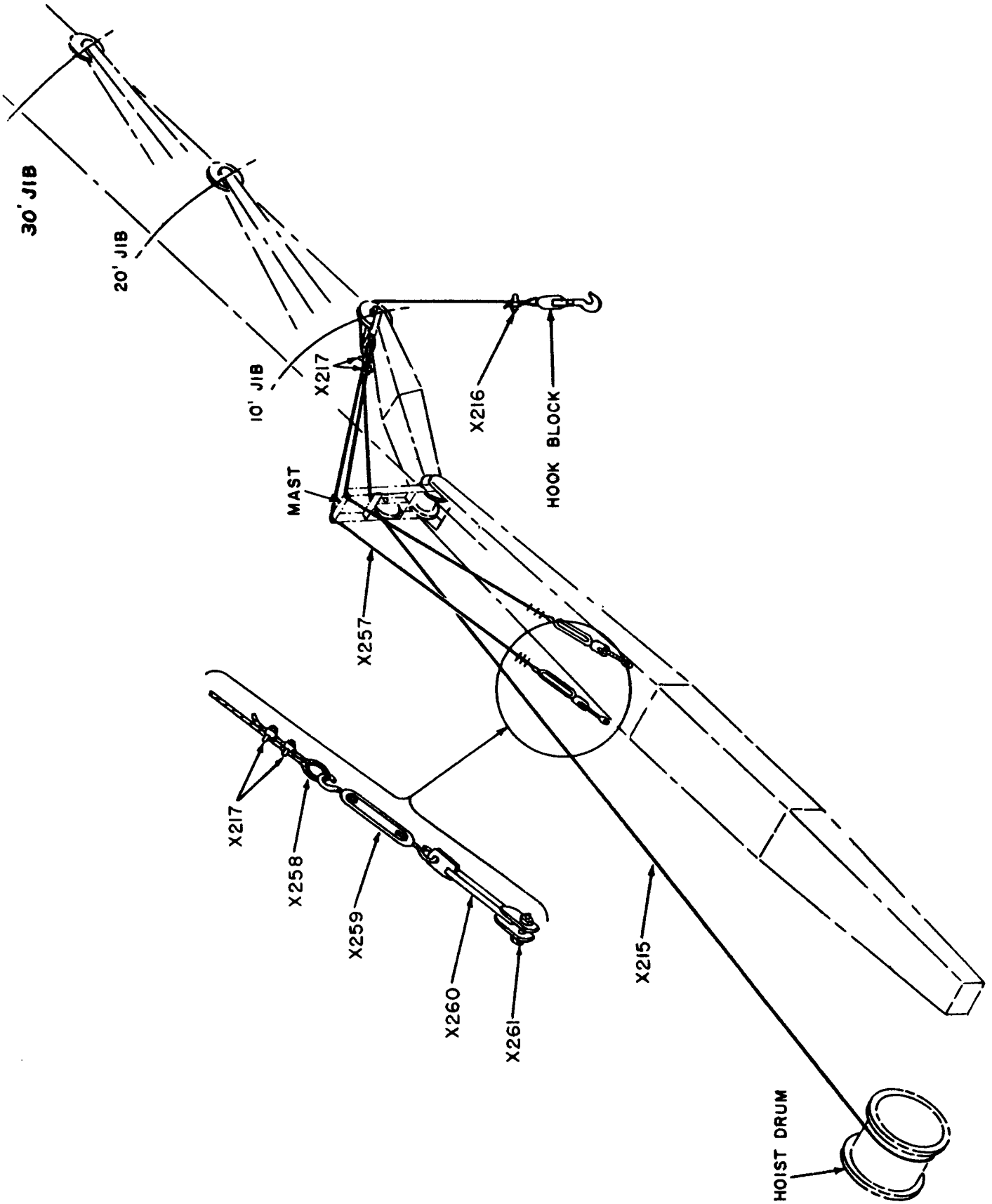
12 PART PENDANT SUSPENSION


Boom Point
Boom
HOLE 1: This hole for folded booms, to carry lower section, or 40' boom in saddle or over rear.
HOLE 2: This hole for working position for all boom lengths.
HOLE 3: This hole for carrying 45' to 100' boom at cab height.
HOLE 1
HOLE 2
HOLE 3
Mast Sheaves
Pendant X61
Pendant X61
Pendant X61
NOTE:
This pendant length to suit center section of boom.
Hoist Drum
Rope X14
A-Frame Sheaves


To Drum
1
3
2
11
4
Yoke
12
10
X
14
13
Auxiliary
Bridle
Mast Pin
5
9
6
8
7
A-Frame
Shaft
Aux. Yoke
& Anchor

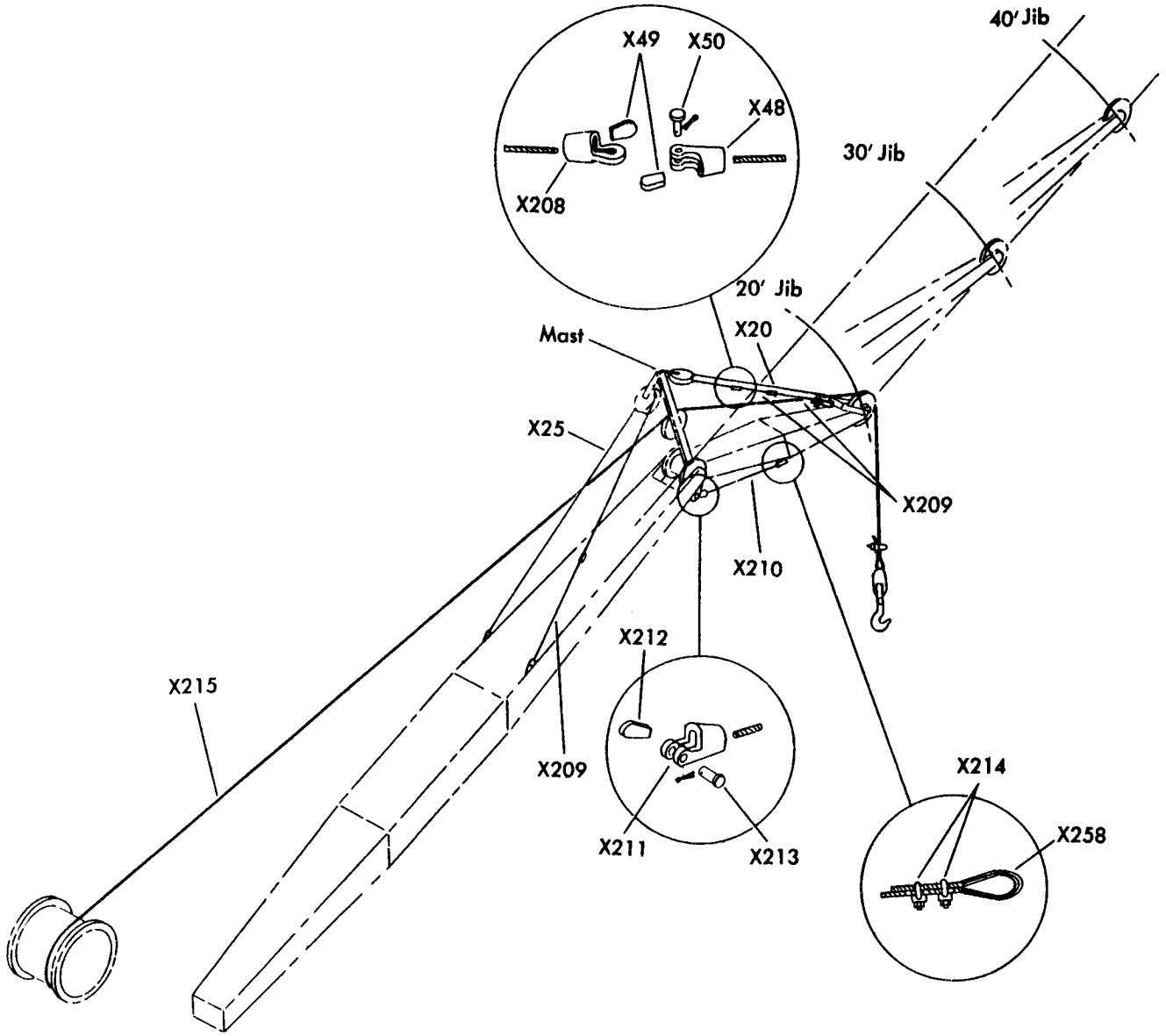


4 PART SUSPENSION REEVING
WITH #4 ROPE, ANCHOR LINK
ATTACHED TO SHEAVE PIN WITH
#4 SHEAVE REMOVED



JIB ROPES

STRUCTURAL STEEL JIBS


X49
X50
X48
X208
40′ Jib
30′ Jib
20′ Jib
Mast
X20
X25
X209
X210
X212
X215
X209
X211
X213
X214
X258

JIB ROPES

CONVERSION

PAGE 6-2 SHOVEL TO DRAGLINE, HOE, CLAMSHELL OR CRANE

I. Removal of Shovel Boom, Dipper and Handle
II. Deck Machinery Changes
III. Control Changes
IV. Installation of Dragline Fairlead
V. Installation of Dragline, Clamshell, or Crane Boom
VI. Installation of Hoe Boom
VII. Rudomatic Clamshell Tagline Installation
VIII. Installation of Crane Jib

PAGE 6-9 DRAGLINE, CLAMSHELL, HOE OR CRANE TO SHOVEL

I. Removal of Dragline, Hoe, Clamshell or Crane Boom
II. Deck Machinery Changes
III. Control Changes
IV. Installation of Shovel Boom, Dipper and Handle

PAGE 6-11 DRAGLINE, CLAMSHELL AND CRANE CONVERSION

I. Changing Boom Length
II. Control Changes

PAGE 6-13 VARIABLE EQUIPMENT

I. Single Stick Clamshell Control
II. Push to Pull Operation
III. Power Controlled Lowering

I. REMOVAL OF SHOVEL BOOM, DIPPER AND HANDLE

If the shovel equipment is going to be put back on the machine, it is not necessary to take off the dipper handle. Remove the entire front end assembly as follows:

A. Fully extend the dipper handle and lower the dipper until the heel of the dipper rests on a couple of timbers placed on the ground just forward of the boom point.

B. Lower the boom with the boom hoist. As it nears horizontal, place a timber across the dipper handle just back of the front handle stop. Continued lowering until the boom comes to rest on the timber.

C. Build a solid crib to support the foot of the boom.

D. Spool off the hoist cable, lubricate it thoroughly and store it in a dry place for future use. Also remove and store the dipper trip cable.

E. For hoe operation the suspension rope will be too long and for dragline, clamshell or crane service it will be too short and therefore must be replaced. Spool it off by running engine with brake released, lubricate and store it in a dry place for future use. Refer to the wire rope specifications in Section V for the correct length suspension rope to use.

F. Part the crowd drum roller chain at any link. Soak in oil and store the chain.

G. Take out the locking bolts in the boom-foot pins and remove the pins. (It may be necessary to jack the foot of the boom slightly to relieve the load on the pins.)

H. Back the machine away from the shovel boom.

II. DECK MACHINERY CHANGES

For dragline, hoe, clamshell or crane operation the two-piece chain sprocket on the front drum is replaced by a grooved lagging. (Refer to machine specifications for selection of the correct lagging.) To make the change, proceed as follows:

A. Remove the small center panel at the front of the cab.

B. Remove the crowd chain adjusting bracket. (For clamshell or crane operation, this bracket may be left in place.)

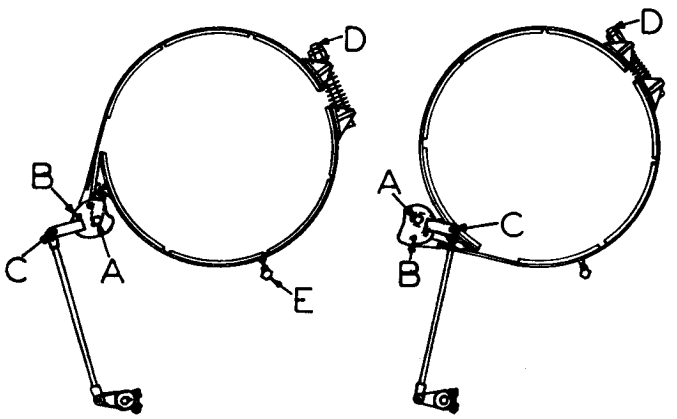
C. Remove the bolts fastening the two halves of the crowd chain sprocket together. Take out one half of the sprocket at a time by removing the bolts holding it to the housing.

D. Place one-half of the drum lagging in position on the drum sleeve and install the bolts by reaching through the opening in the clutch housing to insert the bolts. Fasten by tightening nuts and install the other half of the lagging in a similar manner after turning the housing 180°.

E. Install false drum flange on rear drum. (For Crane Only).

F. Replace the sections of cab which were removed.

The general arrangement of the forward drum brake band (as assembled for shovel operation, is shown in Fig. 2b. For hoe, dragline, clamshell or crane operation the live and dead ends of the forward drum brake band are reversed as shown in Fig. 2a. To make this change proceed as follows:



1. Remove pins "A", "B" and "C" and adjusting bolt "D".

2. Turn the bell crank over and interchange the live and dead end halves of the band.

3. Reassemble pins "A", "B" and "C" and adjusting bolt "D".

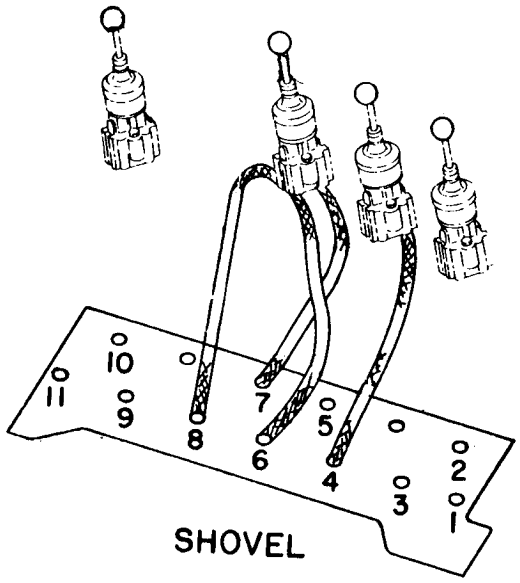
III. CONTROL CHANGES - Refer to page 6-4.

A. For dragline and hoe operation the hoist valve function is the same. The crowd valve functions will have to be changed at the header for the various front ends as shown.

B. For clamshell operation the air line should be connected as shown.

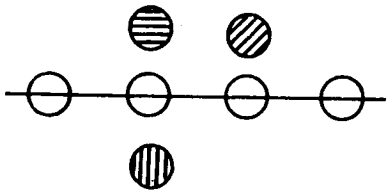
C. If for crane operation the hoist line is reeved to the forward drum and the auxiliary line is reeved to the rear drum, the functions of the air valves should be as shown.

AIR LINE HOOK UP



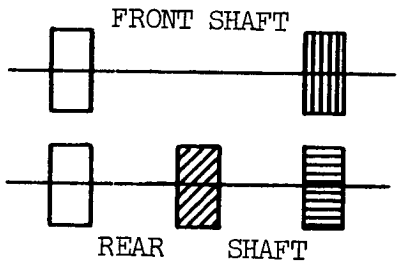
SHOVEL

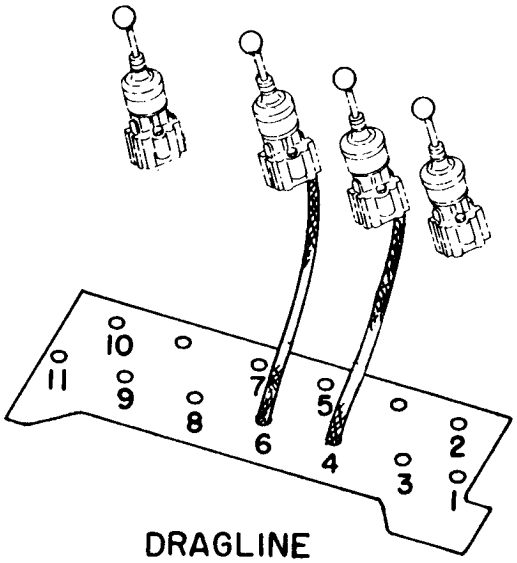
VALVE POSITION AND CLUTCH ACTUATED



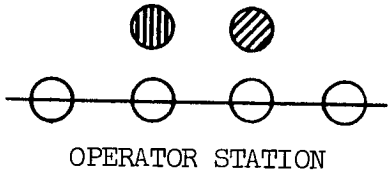
OPERATOR STATION

SHOVEL



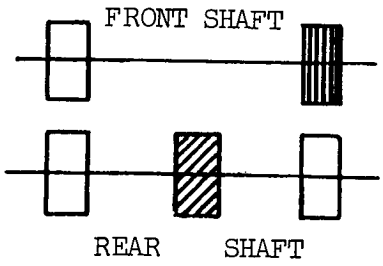


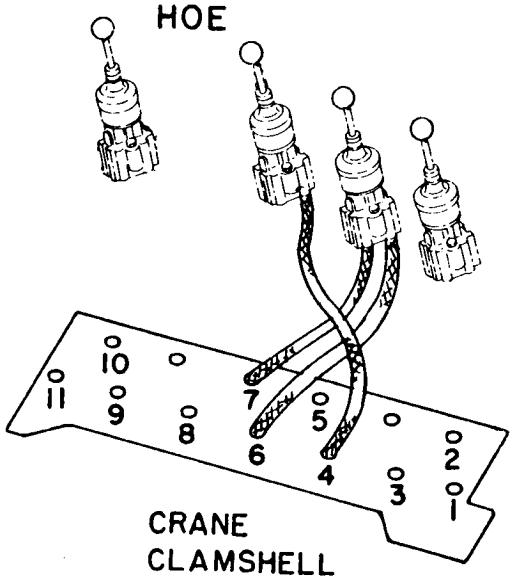
DRAGLINE
HOE



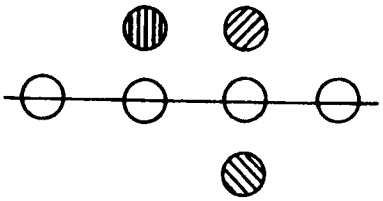
OPERATOR STATION

D/L, HOE



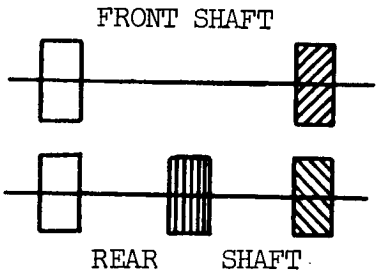


CRANE
CLAMSHELL



OPERATOR STATION

CRANE, C/S



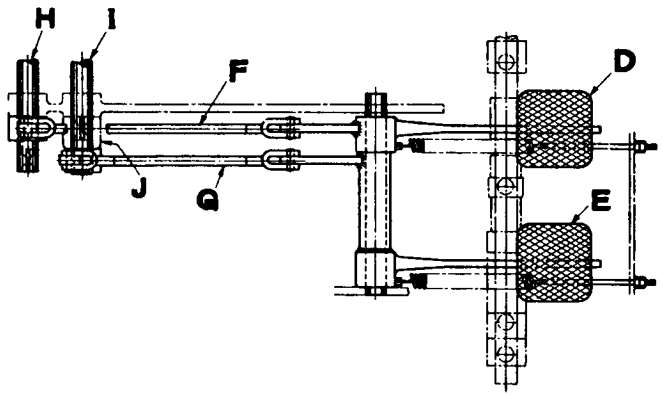
D. For crane and clamshell operation, the functions of the foot levers should be interchanged as follows:

1. Disconnect reach rods "F" and "G" which connect Foot Levers to short levers on brake shafts "H" and "I". (Below deck and to rear of operator).

2. Remove short levers and spacing collar "J". Place spacing collar "J" on rear shaft "H" and clamp one short lever in the keyway position on end of shaft "H".

3. Connect long reach rod "F" to foot lever "E" and to short lever on end of shaft "H". Foot Lever "E" now controls forward drum brake.

4. Replace other short lever on shaft "I" in keyway position next to shaft bearing. Connect short reach rod "G" to Foot Lever "D" and short lever on shaft "I". Foot Lever "D" now controls rear drum brake.



The reason for changing the brake functions is that the right valve and the right pedal should always control the same drum. Likewise the left valve and the left pedal should always control the same drum. An operator should never have valve and pedal functions crossed.

IV. INSTALLATION OF DRAGLINE FAIRLEAD

A. Raise fairlead assembly into place.

B. Insert special fairlead boom foot pins through boom foot, revolving frame lugs, and fairlead bracket.

C. Insert locking pin through boom foot lugs and boom foot pins.

D. Bolt lower fairlead bracket to revolving frame.

NOTE: To remove the fairleads reverse the above procedure.

V. INSTALLATION OF DRAGLINE, CLAMSHELL OR CRANE BOOM

A. Build two or more cribs as required to support boom sections to make up a boom of desired length. Build cribs high enough so boom foot will be at same height as boom foot lugs.

B. Insert splice bolts. Pull nuts up snug but do not tighten so much that bolts might be stretched.

C. Propel machine so that boom foot enters lugs on revolving frame. (Raise or lower boom foot slightly, if necessary). Insert boom foot pins and install lock pins. Bolt boom stops between "A" frame and boom.

D. Reeve new suspension rope between A-Frame and boom point sheaves as described in Section 5. For eight-part suspension remove spacers in A-Frame yoke and install second sheave. For twelve-part suspension a different yoke is required.

E. Install drum ropes in accordance with diagrams in Section 5. Raise boom to working position with boom hoist.

Do not leave the large outside counterweight casting on the machine when operating as a shovel, for a long period. It is permissible for short jobs.

VI. INSTALLATION OF HOE BOOM

The hoe boom is pin connected to the same lugs on the revolving frame used for attachment of shovel or crane type booms.

A. Support boom on cribbing so that boom foot will be at same height as boom foot lugs.

B. Propel machine so that boom foot enters lugs on revolving frame.

C. Install auxiliary A-Frame by pin connecting it to top set of holes just back of boom foot holes.

D. On main A-Frame, fasten bracket for boom stop and install boom stop from A-Frame to auxiliary A-Frame.

E. Reeve auxiliary A-Frame, hoist and drag ropes as shown in Section 5.

VII. RUDOMATIC CLAMSHELL TAGLINE INSTALLATION

If the machine is going to be used as a clamshell, it is also necessary to install a tagline to keep the clamshell bucket from spinning.

This tagline is of the spring loaded wheel type mounted on the bottom chord angle of the boom as shown.

1. Place the tagline barrel in approximate position and assemble the clamping straps around the boom chord angle.

2. Shift the position of the tagline slightly so that the tagline wheel is directly in line with the bottom chord angle of the boom at a point "X" about midway between the location of the tagline barrel and the point of the boom, then tighten the clamps securely.

3. Fasten the sheave block to the lower chord angle of the boom as shown in Fig. 1.

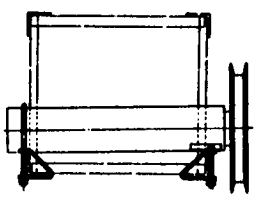
4. Check the oil in the tagline barrel. Add oil if necessary to half fill the barrel. Heavy engine oil in summer, lighter oil in winter.

5. Install the tagline rope and wind up the spring inside the tagline barrel by turning the rope wheel counter clockwise.

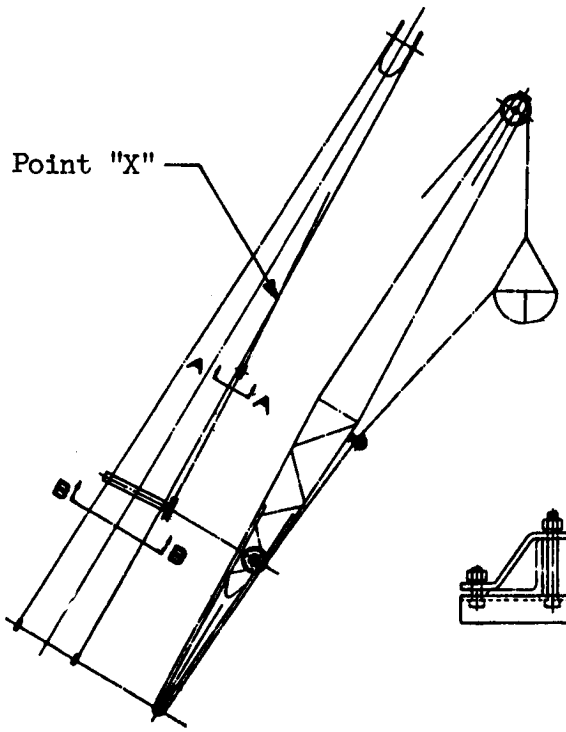
   Model 6-36, 4 to 6 turns from neutral
   Model 6-48, 8 to 10 turns from neutral

6. Attach the end of the tagline rope to the clamshell bucket using a rope thimble and rope clips.

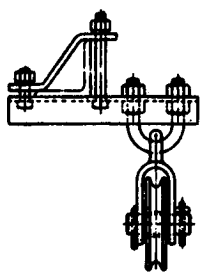
Due to the simplicity of the mechanism in the barrel, there is nothing to get out of order inside, unless the spring is overwound and pulled out of shape. If this should happen, remove the spring and bend new hook on end.



Sect. BB



Transit machine installation shown. Crawler machines have tagline wheel on left side of boom.



Sect. AA

VIII. INSTALLATION OF CRANE JIB.

A. Structural Steel Jib

1. Slide jib foot into position straddling main boom point sheaves. Secure in place by bolting on jib foot clamp bolts.

2. Install jib guy ropes as shown in Section 5.

3. Reeve auxiliary hoist line from rear drum as shown in Section 5.

B. Alloy Steel Jib

The alloy steel jib is attached to the upper boom section with pins in the same manner that the boom attaches to the revolving frame.

Attach suspension ropes and reeve the hoist rope as shown in the reeving section.

I. REMOVAL OF HOE, DRAGLINE, CLAMSHELL OR CRANE BOOMS

Before removing the boom, on machines having an outside counterweight, take off the counterweight casting so that the machine will have increased stability for propelling into the shovel boom foot. Take off the lattice type boom as follows:

A. Prepare suitable cribbing to support boom in lowered position.

B. Lower boom onto the cribbing. If machine is a crane with jib, also, support point of the jib as boom approaches horizontal position.

C. Detach dragline or clamshell bucket or crane hook block and take off all ropes. Lubricate ropes thoroughly then coil up or wind on reel and store in dry place. Tag each cable so that it can be easily identified when needed.

D. Disconnect crane jib (if any).

E. On hoe remove auxiliary A-Frame and backstop.

F. Remove telescoping boom stops, take out boom foot pins, back machine out of way. If machine is to be used as shovel for some time and lattice type boom is removed, separate the boom sections and pile on blocking.

G. If machine was operating as a dragline remove fairlead by taking out pin lock and removing pin.

II. DECK MACHINERY CHANGES

Before starting installation of the shovel deck machinery clean the machinery and parts carefully to remove dirt or rust which may have accumulated.

Install the crowd gear rim and drive sprocket as follows:

A. Remove front center section of cab.

B. Remove two halves of lagging on front drum.

C. Place one-half of crowd sprocket in position and install bolts fastening it to the front drum housing. Turn housing 180°, bolt other half of sprocket in place, then install bolts holding two halves of crowd sprocket together.

D. Bolt crowd chain adjusting bracket in place.

E. Remove false flange from rear drum. (Crane Only)

Reverse the live and dead ends of the forward drum brake band so as to secure the arrangement shown in Fig. 2b on page 6-3.

III. CONTROL CHANGES - Refer to page 6-4.

A. To change from a dragline or hoe to a shovel, connect the air lines as shown for a shovel.

B. If the machine was a clamshell, connect the air lines as shown for a shovel. If the clamshell had single stick control, shut the air regulator on the left rear of the control stand. This is to prevent air from going to the hoist clutch when the crowd valve is opened.

The function of the foot levers must be interchanged so that the left foot pedal will control the dront drum brake and the right pedal control the rear drum brake. (See drawing on page 6-4.)

C. To change from a crane to a shovel, connect the air lines as shown for a shovel and interchange the function of the foot levers as described for clamshell. (See drawing on page 6-4).

IV. INSTALLATION OF SHOVEL BOOM, DIPPER AND HANDLE

If the boom, dipper and handle are not already assembled, proceed as follows:

A. Jack up shovel boom on cribbing so that boom foot is same height as lugs on front of revolving frame.

B. Propel machine into boom, and attach boom by inserting boom foot pins and lock.

C. Install and adjust crowd and retract chains.

D. Reeve the suspension rope as described in Section 5.

E. Use boom hoist to raise boom to about 45° with the horizontal.

F. If not already assembled, attach dipper handle to dipper back by inserting pitch braces and handle end pin. Also attach dipper padlock to the dipper.

G. Remove anchor casting at upper end of handle.

H. Raise saddle block up to approximate working position and fasten it in place.

I. Propel the machine forward and guide end of dipper handle between saddle block side plates.

J. Replace the anchor casting on the end of dipper handle.

K. Reeve the hoist, crowd back haul and dipper trip ropes as described in Section 5.

DRAGLINE, CLAMSHELL AND CRANE CONVERSON

Draglines, clamshells and cranes are easily changed from one type of operation to the other as it is generally unnecessary to make any change in the front end equipment. The dragline fairlead can be left in place as it does not interfere with either clamshell or crane operation.

Similarly, the clamshell tagline can be left in place on the boom when the machine is operating as a dragline or crane.

No change in drum lagging is required if standard drum combinations are used.

I. CHANGING BOOM LENGTH

The length of the boom is easily changed to suit the job as follows:

A. Lower boom on cribbing and take out splice bolts.

B. Pay off suspension and main drum ropes enough to accommodate new length boom. If boom length is changed more than five feet, it may be necessary to install new ropes.

C. Insert center section of boom and bolt in place using additional splice bolts for extra joints.

II. CONTROL CHANGES

To change from a dragline to clamshell or crane proceed as follows:

A. Connect the air lines as shown for a crane or clamshell.

B. Interchange the brake pedal functions as described under D on page 6-5.

You should now have forward motion of the hoist valve and the right brake pedal control the front drum.

Although the standard set up for a crane is to have the main line on the front shaft, the operator could reeve the main line to the rear shaft. When the main line is on rear shaft, the brake pedal functions should remain the same as for shovel.

I. SINGLE STICK CLAMSHELL CONTROL

Your machine can easily be converted to single stick control by installing the valves and lines as shown below.

A. With regulating valve turned to zero (closed) the unit operates as a standard two stick clamshell control.

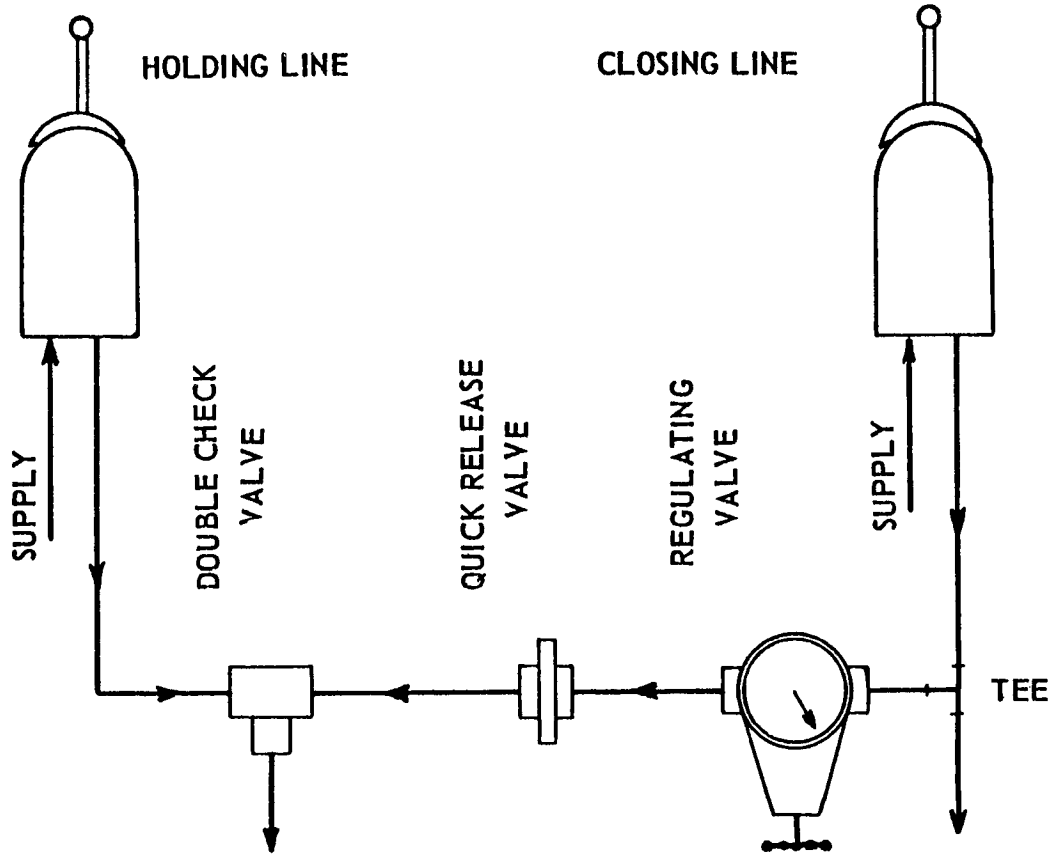
B. With regulating valve set at 5 or 6 lbs. of pressure the unit operates as a single clamshell control.

1. Adjust air pressure within the 5 to 6 lb. range for degree of control wanted.

2. Use closing line (hoist)control to operate.

3. See sketch below for location of air valve.

4. See sketch below for direction of air flow as outlined by arrows.



II. PUSH TO PULL OPERATION

All of the control changes that were described were based on "Push" type operation. For "Pull" type operation the front and rear air line should be interchanged at the valve.

III. POWER CONTROLLED LOAD LOWERING

To add power controlled load lowering to a crane, bolt sprocket to front drum clutch housing and connect to rear shaft sprocket with roller chain. Refer to air line hook up on page 6-4 for correct air line connections.

To convert to a standard style crane, clamshell, dragline or hoe, remove the front drum sprocket, change the front lagging if required, and remove the roller chain between the front and rear shafts. Refer to air line hook up on page 6-4 for correct air line connections.

DISASSEMBLY

PAGE 7-2 - GENERAL SUGGESTIONS

PAGE 7-3 - MACHINE DISASSEMBLY

I. Front End Equipment
II. Upper Works

PAGE 7-5 - LOWER WORKS

I. Crawler Mounting
II. Propelling and Steering Machinery

PAGE 7-9 - UPPER WORKS

I. Main Brake Bands (Front and Rear Shafts)
II. Main Clutch Bands
III. Front Shaft
IV. Rear Shaft
V. Vertical Swing Shaft
VI. Horizontal Swing Gear
VII. Horizontal Swing-Propel Shaft
VIII. Transmission Shaft
IX. Transmission Drive Chain
X. Power Take-Off Clutch
XI. Boom Hoist

No attempt is made to describe removal of guards, air lines or cab parts which may have to be removed to reach the machinery parts being disassembled. When removing guards it is a good plan to replace the bolts and nuts so that the correct bolt will be immediately available when reassembling the guards. Instructions are given covering disassembly only. Reassemble parts by a reverse procedure as necessary.

Before starting on a repair or overhaul job, move the machine to a dry spot. If much disassembling is to be done, the machine should be moved to a shop or other building where it will be protected from the weather.

Clean as thoroughly as possible all parts of the unit which are being disassembled.

When disassembling any control linkage do not disturb the adjustments of reach rods any more than necessary. If it is necessary to remove or change the position of a reach rod end, make a record of the exact length before disassembling it so the original length can be restored.

In removing levers or other parts with split hubs, loosen the clamp bolts and expand the hub by driving in a small wedge.

When disassembling any unit, especially one with a number of similar parts, keep the parts together and in order as far as is possible. It is a good plan to loosely reassemble parts after removal from the machine so that small parts will not be mislaid.

Attach tags or identify all parts by matchmarking.

Before assembling any unit, be sure all parts are in good condition and thoroughly clean.

Apply grease or oil to bearing surfaces at the time of assembly.

In making press fits, coat the contact surfaces with white lead so they can slide easily.

When assembling parts on a shaft, make sure the shaft and the bore of the parts being assembled are smooth and completely free of burrs. File or use emery cloth to smooth any rough spots.

Carefully examine all keyways to make sure the metal has not been upset along the edges.

In replacing bolts and pins be sure they are locked by means of lock washers, split pins, lock nuts, etc., as in the original assembly.

All guards and protective devices should be in place before the machine is operated.

After operating the machine a few hours, check over the assembly and tighten all bolts.

MACHINE DISASSEMBLY

I. FRONT END EQUIPMENT

When the lower works is to be repaired it is sometimes more convenient to take off the front end equipment and remove the upper works from the lower works. This can be done with very little disassembly of the deck machinery.

Shovel, dragline, hoe, clamshell or crane front end equipment is easily removable from the machine without disassembly of any other deck machinery.

Full instructions on the procedure to follow in removing the various front end equipment are given in Section 6 covering conversion of the machine from one front end equipment to another.

On machines having outside counterweight on the rear of the revolving frame, it is advisable to take off the counterweight before trying to propel the machine with the front end equipment removed.

II. UPPER WORKS

The entire upper works with all machinery assembled can be removed from the lower works either by crane or jacking.

If an overhead crane is not available, then a supply of sawed ties for cribbing is required. Four hydraulic or screw jacks of from 5 to 10 - ton capacity are also necessary.

Before starting removal of the upper works, take off all counterweight. Remove the front end equipment as described in Section 6.

If a crane of sufficient capacity is not available, position upper works crossways of lower works and proceed as follows:

A. Build suitable cribbing under rear end and around front end so that jacks can be placed under central portion of revolving frame. Do not block permanently in front of opening for rolling out lower works. Be sure to jack against substantial frame members.

B. Jack up lower works just enough to remove load from cone rollers.

C. Remove rod bolt at center of cone roller shaft and take out two capscrews at outer end of each roller pin.

D. Insert these capscrews in tapped holes in same retainer plate and turn to start each roller pin out.

E. Pull roller pins part way out, roll cone rollers to one side and lift rollers off roller path.

F. Remove front cover from swing and propel gear case and remove air swivel.

G. Upper works can now be jacked up off lower works. Jack each corner evenly to keep the upper works level and follow up closely with blocking to prevent accidents. CAUTION: Keep blocking solid.

H. When upper works is clear of the truck frame assembly, drag lower works out from under the upper works.

LOWER WORKS

Careful attention should be paid to tread pins since excessive clearance between tread pins and tread bores will cause excessive wear on driving tumbler lugs and on the lugs of the tread pads. This high wear will always occur when tread pins are worn to such a point that proper pitch between lugs on tumblers and pads can not be maintained. Worn pins will also increase crawler belt effective length to a point where all adjustment of crawler belts and propel chains is utilized and high wear is experienced on all component parts of the crawler frames and belts.

All shafts and bushings should be checked regularly and if excessive wear is noted bushings and/or shafts should be replaced as soon as possible. Due to the weight of machines, it is very important that these bushings and shafts be maintained. After bushings are badly worn they can cause damage to shafts, necessitating replacement, which would not be experienced if bushings would have been replaced sooner.

A good rule of thumb to follow is to replace bushings on shafts when total wear reaches .050 inches per inch of diameter. This is only a figure to go by and each bushing and shaft should be treated separately.

In order to replace any shafts or bushings in crawler frames, it is always best to disconnect crawler belts so that all parts to be repaired may be removed and each part inspected before reassembly.

I. CRAWLER MOUNTING

A. Tread Removal

To remove one tread, propel the machine so that the tread to be removed is on the bottom of the belt between the take-up tumbler and the first idler roller. This allows a long rod to be used to drive out the pins from the opposite side of the crawler frame.

1. Remove tread pin retainer and pins.

2. Propel machine backwards and remove tread.

B. Removal of Crawler Belt

1. Part belt as described under "Tread Removal".

2. Roll top half of belt back off of crawler frame.

3. Jack machine up so that lower rollers can clear the treads.

4. Drag belt out from under crawler frame.

NOTE: Crawler belt may be pulled clear of crawler frame with power by swinging boom point in line with crawler belt and attaching hoist cable.

CAUTION: Lower boom to almost horizontal before applying power.

C. Installation of New Crawler Belt

1. Split old belt as described under "Tread Removal".

2. Assemble correct number of treads to make up new belt, then connect end tread of new belt to top tread of old belt.

3. Propel machine backward until new belt is in place.

4. Disconnect old belt and connect ends of new belt.

D. Upper Idler Rollers

1. With machine on firm level ground, travel a short distance to get all slack in top of belt.

2. Pry up track near roller for clearance and insert a block to hold belt clear of roller.

3. Remove tee bolt and pull out the shaft, remove roller.

If bore in roller is worn, replace roller and shaft with new parts. (Upper rollers do not have bushings.)

E. Lower Idler Rollers

1. Propel machine up on blocking or over hole to get all of sag or slack in lower part of the belt. Remove bolts holding shaft in place and take out shaft and roller assembly.

2. Bushings in roller can be removed by pressing outward.

F. Take-Up Tumblers

1. Travel machine so as to get all the slack in the upper portion of belt.

2. Place a 4 x 4 or suitable timber on ground. Travel machine on timber until the timber is under first idler back of tumbler.

3. Split belt as under "Tread Removal". Fold back upper part of tread belt.

4. Remove two bearing bolts and roll tumbler assembly out.

G. Drive Tumblers (See Drawing 852508)

1. Disconnect tread belt under drive tumbler and propel machine forward until there are no links wrapped around drive tumbler.

2. Disconnect adjusting screws by removing pins 117 and 125.

3. Disconnect propel chain.

4. Remove bearing bolts and pull shaft assembly out towards rear of machine.

II. PROPELLING AND STEERING MACHINERY (See Drawing 852508)

A. Brake bands (See Drawing 852508)

1. Remove steering clutch guard, "82", under truck frame.

2. Put propel digging brakes in "off" position, and remove pin that holds cylinder rod to lever "72". Remove "72".

3. Remove pins "47" and remove rod "48" and yokes "53". (Be sure to measure distance between pins for rod "48" for proper assembly.)

4. Remove pin "45" and move shifter "42" towards center of machine.

5. Remove cotter pins and lever "70".

6. Remove bolt "65".

7. Remove split ring flange "63".

8. Slide bands toward center of machine and work them out.

9. To assemble reverse the above procedure.

B. Center horizontal propel shaft and bevel gear.

1. Propel machine so that all slack is in top of crawler belt. Block up belt.

2. Drain oil from gear case and remove bottom of gear case, guards and right-hand drive chain.

3. Remove retainer No. 30 and pull out sprocket No. 97.

4. Remove brake bands as described in "A".

5. Remove brake 67 and bolt 158.

6. Pull out shaft 23 and take out clutch jaw 25 and brake hub 26.

7. Remove snap ring 33 and work clutch driver No. 34 out to the right of the machine, while supporting bevel gear.

8. Remove center shaft 24 and bevel gear 27 will drop down.

If the center propel shaft cannot be worked out to the right, the left-hand propel shaft will have to be removed and the center propel shaft pulled out to the left.

C. The vertical propel shaft can be removed without taking the upper works off of the lower works by proceeding as follows:

1. Remove half of lagging from front shaft.

2. Remove swing and propel gear case cover.

3. Drain oil from gear case in lower works and remove cover.

4. Remove air swivel and capscrews and plate that holds bevel pinion in place. Block up bevel pinion.

5. Remove air swivel, center air shaft, shifter yoke and shifter collar spline clutch.

6. Remove horizontal propel gear.

7. Remove 4 capscrews holding oil seal retainer plate, and remove plate and oil seal.

8. Lift vertical propel shaft out being careful that bevel pinion does not drop and cause damage.

When this shaft is reinstalled extreme caution should be used so that the oil seal is not injured when shaft is dropped through it.

UPPER WORKS

I. MAIN BRAKE BANDS (FRONT AND REAR SHAFTS)

A. Remove adjusting bolt from band end lugs.

B. Remove lever fulcrum pin which holds band to lugs on Bridge casting.

C. Remove pin connecting reach rod to lever.

D. Raise lever enough so that remaining pin will clear lugs on bridge casting and remove pin.

E. Lift out both halves of band (loosening the guide nut at bottom of band if necessary.)

II. MAIN CLUTCH BANDS

A. With clutch released, screw in capscrews and rod ends to have large clearance between shoe and housing.

B. Remove pins and remove shoes.

III. FRONT SHAFT

A. Remove brake band as described in I.

B. Remove nuts that hold bearings in place.

C. Lift out front shaft hitch under boom hoist drum.

IV. REAR SHAFT

A. Remove all rope from rear drum. Remove brake band as described in I.

B. Unpin front A-frame legs at top of A-frame and move them forward.

C. If used as a shovel, remove chain between front and rear shafts.

D. Remove nuts that hold bearings in place.

E. Lift rear shaft assembly out by hitching around rear drum and just to left of center clutch housing.

V. VERTICAL SWING SHAFT

A. Swing rear of cab over drive chain end of crawlers to get clearance to drop vertical swing shaft.

B. Place boards under vertical swing shaft so that shaft will drop on them.

C. Remove bearing retainer from bridge between front and rear shaft.

D. Remove split pin and large nut holding shaft at top. Tap it and it will drop down.

For reassembly, large nut should be tightened and split pin inserted. This will provide correct backlash.

VI. HORIZONTAL SWING GEAR

A. Remove vertical swing shaft.

B. Raise rear shaft assembly about 6".

C. Remove rear cover under rear shaft.

D. Remove spline shifter collar.

E. Work combination gear out by using a hitch around A-frame yoke.

F. Continue to work gear out between the engine and right, main machinery, side frame.

VII. HORIZONTAL SWING - PROPEL SHAFT

A. Remove main gear case cover.

B. Remove round cover on left side of gear case and remove capscrews in gear retainer plate.

C. Remove rear bridge cover under rear shaft and remove capscrews and plate holding bevel pinion.

D. Support swing gear and pull out shaft. (It may be necessary to drop the chain case to get clearance for the shaft.)

In order to remove the bevel pinion it will be necessary to drain the oil, remove the vertical swing shaft and move the combination gear over, and to pull the horizontal swing - propel shaft out about 8".

To remove the swing gear, remove the horizontal swing propel shaft. Drain the oil and remove the sump. Remove a portion of the deck, pull out oil gear shaft and the oil gear will drop down. Now the swing gear can be lowered.

VIII. TRANSMISSION SHAFT

A. Drain oil in chain case, and remove chain case and drive chain.

B. Drain oil in gear case and remove sump.

C. Remove bearing cap from right side of gear case.

D. Use a long bar and push shaft out but be careful that hoist pinion is supported when shaft is pushed out.

IX. TRANSMISSION DRIVE CHAIN

A. Remove chain case cover.

B. Turn transmission sprocket until connecting link is in mesh with sprocket on transmission shaft.

C. Remove connecting link cotter pins.

D. Pull out connecting link pins and remove slip fit center plates.

NOTE: When reassembling the transmission chain be sure to put the chain on the sprockets so the cotter pins of the links, except the connecting link, are toward the engine.

X. POWER TAKE-OFF CLUTCH

The power take-off clutch between the engine and the transmission drive chain case, is either a Rockford or a Twin Disc. The Rockford clutch plate assembly can be removed as follows:

A. Remove cover of chain case and disconnect roller chain.

B. Drain oil from chain case and take out bracket supporting rear of chain case which will permit lowering rear of case to clear chain sprocket.

C. Disconnect control rod at outer end of clutch shifter shaft.

D. Take out capscrews securing clutch housing to engine flywheel housing.

E. Remove capscrews fastening back plate to engine flywheel.

F. The entire clutch assembly can then be withdrawn from the flywheel after which the clutch plate assembly is free to slide off the splines on the clutch shaft. The entire Twin Disc clutch is removed in exactly the same steps as the Rockford clutch with the exception that before the plate assembly can be removed the clutch shaft nut must be removed.

NOTE: Do not forget to clean and repack the pilot bearing with special high temperature ball bearing grease before replacing the clutch assembly.

XI. BOOM HOIST

A. Raising Clutch Band

1. Lower the boom to the ground and have slack in the boom hoist cable.

2. Have the boom hoist lever in the neutral position.

3. Remove all cable from the front lagging. Remove lagging and boom hoist cover.

4. Remove the band guide between the cylinders, and the bar pin retainer. To turn the shaft over so that bolts and pins are accessible, engage the power take-off clutch, put the governor lever in the "off" position, and depress the starting button, momentarily.

5. Remove the two pins that hold the piston rod ends to the lever bracket.

6. Screw in all three band adjusting capscrews.

7. Remove the two 1" diameter pins that hold the lever bracket.

8. Depress the "pull" piston rod and move it toward the center of the shaft so that the adjusting stop on the lever bracket can pass over it.

9. Use capscrews from the band guide to remove the two 1" tapped pins.

10. Remove the dead end link.

11. Remove the band, and spread it slightly to get it over the shaft.

B. Brake Band

1. Put the band in the released position as mentioned before.

2. INSTALL A WASHER AND NUT ON THE SPRING ROD BOLT AND SNUG IT UP TO PREVENT THE ROD FROM BEING PUSHED THROUGH THE AIR CHAMBER WHEN THE BAND IS REMOVED. A washer and nut is provided in the tool box for this purpose. If it is lost, obtain a replacement.

3. Remove the live and dead end pins and the bolt at the band split.

4. Remove the band halves.

WELDING

Page 2 General Instructions

Page 3 General Procedures

Page 5 Main Components

GENERAL INSTRUCTIONS
10-B THRU 88-B MACHINES

All electrodes specified in this bulletin refer to American Welding Society Standards. Consult your electrode supplier for his trade name equivalent.

Materials and welding procedures are subject to change. Therefore, if there is any doubt about applying the instructions contained in this bulletin on any given machine refer the problem to the Service Department, Bucyrus-Erie Company, Evansville, Ind.

The use of tempilstiks to check temperatures during preheating and postheating is recommended.

A. WELDING OF CASTINGS

In the event of a steel casting crack or break, the parent metal in the area of the failure must be thoroughly cleaned and prepared for welding by chipping, grinding or burning. Cracks must be veed out to insure adequate electrode clearance for applying the weld. Unless otherwise specified in the "Main Component Welding Instructions", the area to be welded should be locally preheated to between 300 and 400°F. The metal removed must be replaced 100% by weld that is thoroughly bonded to all sides of the veed out section. Weld material projecting above the casting should be ground off smooth. Unless otherwise specified in the "Main Components Welding Instructions", local post-heating of the welded area to between 1000° and 1100°F. is advisable to relieve the stresses created by welding. Cover with ashes or dry sand to assure a slow cooling rate which should normally require 8 hours. No reinforcements should be added to the casting in the area of the failure without first consulting with the Bucyrus-Erie Company. (Also see "General Procedures" below for further instructions.)

B. AUSTENITIC MANGANESE STEELS TO ALLOY CAST STEELS AND STRUCTURAL STEELS

Do not preheat or postheat Manganese steels. In welding austenitic manganese steel to alloy steel castings or structural steels, the weld must be made with A.W.S. E-308-16 stainless steel welding electrode of 3/16 inch diameter maximum. The welding should be performed so that excessive heat is not added to the manganese part. The casting temperature must be kept low enough around the weld area so that the heat produced will not burn the hand when touching the casting at least six inches around the weld. The more beads that are deposited in a weld the less heat is added to the casting and the possibility of cracking is reduced. Blend welds by grinding the edges at the end of cracks or joints to remove all undercutting or nicks. Use a carbon arc or arc-air for removing stainless steel welds, taking particular care that the manganese steel is not overheated.

GENERAL PROCEDURES (ALL MATERIALS)

Cracks or breaks should be veed out by chipping or burning to insure adequate clearance for the electrode during welding. The metal removed must be replaced by 100% weld that is thoroughly bonded to all sides of the veed out section.

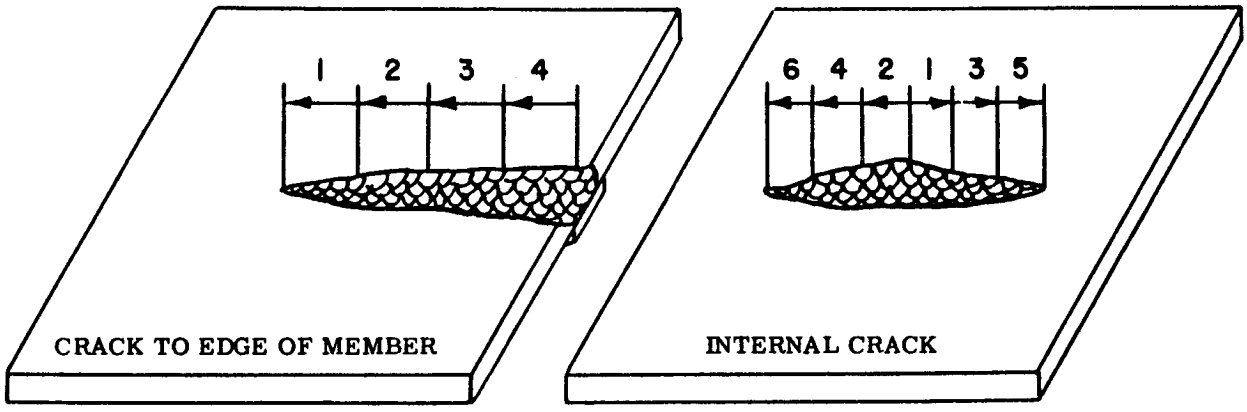
Where a crack or break projects through the complete wall thickness of a section and cannot be "backwelded", the use of a "backup" strip is highly advisable. Backup strips should be not more than $\frac{1}{4}$" thick, and as narrow as practicable and should be tackwelded in place only. The use of filler rods to partially close voids in lieu of weld is not recommended. When practical, weld repair should be completed with backwelds. See sketch next page.

Clean all slag between weld passes.

Peen all weld passes immediately after depositing to help eliminate welding stresses.

Avoid weaving weld more than two times electrode diameter.

Distortion of parent member can be kept to a minimum when welding long cracks by first tack welding in several places and then welding by the "backstep" sequence as shown in sketch below.

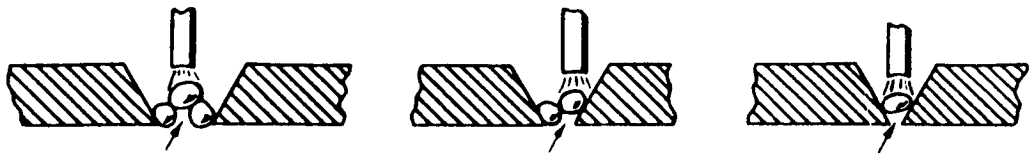


BACKSTEP WELDING SEQUENCE

Start at number 1 and weld in direction of arrow. Then start at number 2 and weld in direction of arrow, etc. Each step should be no longer than the space that one electrode will fill.

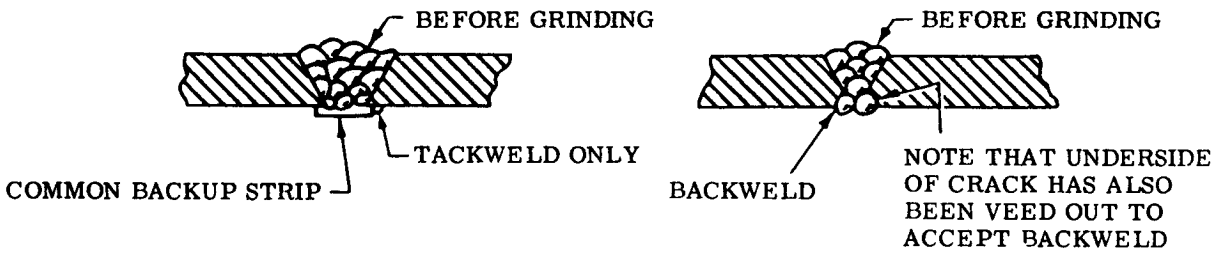
To secure satisfactory welds from low hydrogen welding electrodes, they should be kept in a drying oven at 400°F. for at least eight hours before using and should be redried if they are out of oven over four hours. Moisture in the coating of electrodes will cause pin holes and cracks in the weld metal. Always store electrodes in air tight containers.

We do not recommend weld repair of cast iron or malleable cast iron parts.

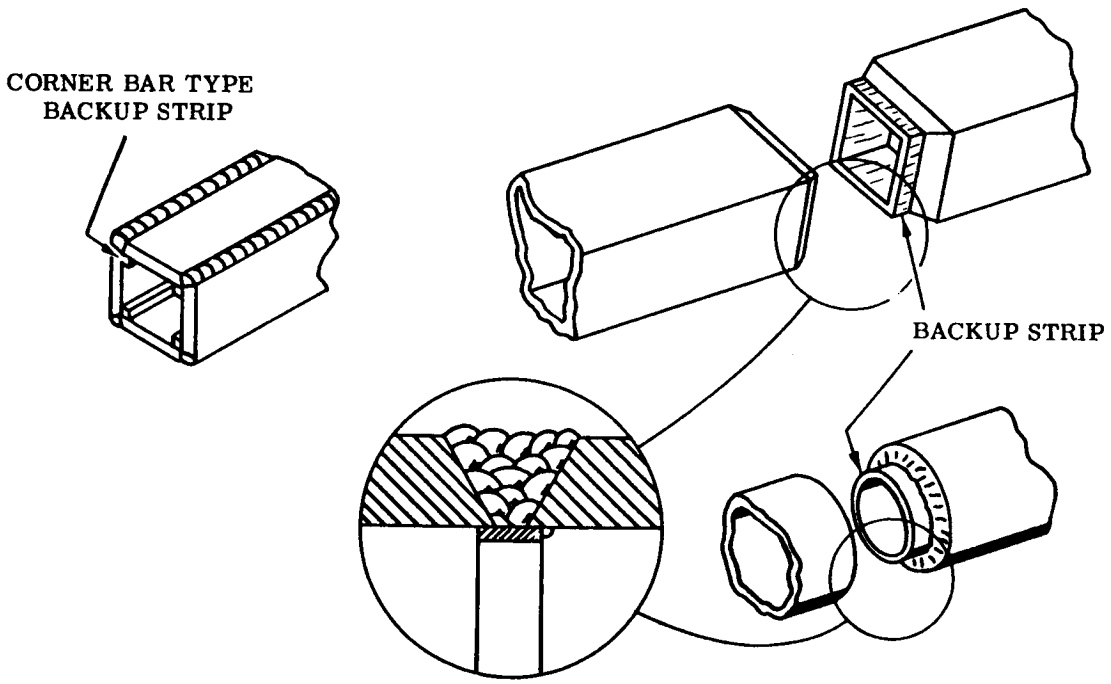


ARROWS POINT TO "BRIDGES" CREATED BY GAPS BELOW SURFACE OF PARENT METAL

DANGEROUS WELDS



IDEAL WELDS



Back-up Strips As Used On Hollow Rounds And Box Sections

MAIN COMPONENTS

A. Crawler Pads - 10-B Through 88-B

Preheat casting to 400°F. Use E-10016 electrodes for repairs to castings and build-up of lugs. NOTE! Lug build-up should not be attempted without aid of template to check form.
Do not preheat the pads roller path as they are flame hardened and will be tempered or softened if preheated. It is doubtful that roller paths can be adequately flame hardened in the field. Use E-10016 electrodes for build-up of path.

B. Drive Tumblers 10-B Through 88-B

All drive tumblers are differentially heat treated to obtain a rim or lug hardness ranging from 325 to 400 Brinnel. This hardness cannot be reproduced in the field with weld. To build up wear of the rim or lugs, use an E-10016 electrode which will furnish a hardness of 225 to 275 Brinnel. Do not preheat or postheat the rim or lugs or cracking will develop. NOTE! Driving rim or lug build-up should not be attempted without aid of template to check form.
For the remainder of the drive tumbler use E-7016 electrodes. Preheat locally to 400°F. Do not postheat.

C. Take-Up Tumblers

10-B Through 30-B

Use an E-7016 electrode for the entire take-up tumbler. Preheat locally to 400°F.

38-B Through 88-B

The rim material in these take-up tumblers are differentially heat treated. Follow the same welding instructions as for drive tumblers in B. above.

D. Tumbler Shafts - 10-B Through 88-B

Weld repairs of cracked or broken tumbler shafts should not be attempted.

E. Lower Rollers

10-B Only

To build up lower rollers on 10-B machines, use E-7016 electrodes. No postheat needed after build-up.

15-B Through 88-B

To build up O.D. of lower rollers, preheat locally to 400°F. and use E-10016 electrodes. To build up bore of lower rollers, preheat to 400°F. and use E-7016 rods. No postheat needed after build-up.

F. Crawler Frames

10-B Through 30-B

If crack is in crawler side frame, jack up axle on side cracked to remove as much weight as possible. If crack is in axle, jack up upper works to remove weight. Use E-7016 electrodes to repair cracks.

38-B Through 88-B

Due to the heavy sections of metal in these castings the following welding procedure should be followed: Jack up axle on side cracked to remove as much weight as possible.

Vee out crack by chipping or burning, if any unsound material is found in cracked areas, remove same. Preheat locally to 400°F. Use E-7016 electrodes and weld in stringers. Lay stringers along both sides of prepared veed bottom, then the center. Repeat this process until the entire veed section void is built up with 100% weld. It is important to postheat.

*54-B with long cat frames is made up of both structural steel and castings. Use E-7016 on the structural portion, E-7016 on the cast and joints between the two.

G. Truck Frames - 10-B Through 88-B

Remove as much weight from truck frame as possible by jacking up revolving frame until cone rollers have roller path clearance at both top and bottom. Chip or strip out parent metal with a welding torch till all evidence of cracks is removed.

Preheat stripped out area to 400°F. Use E-7016 electrodes for repairs. It is advisable to postheat. If postheating is to be applied in an area close to the roller path which is flame hardened do not exceed 900°F.

H. Swing Racks

Note! Build-up of swing rack teeth should not be attempted without aid of template to check tooth form and spacing. Grind teeth to proper template shape on completion of welding.

10-B Through 22-B As Manufactured Prior to 1957

The swing racks of 10-B through 22-B machines are cast integrally with the truck frame casting. To build up or replace missing teeth, preheat local tooth area to between 200° and 350° and then use E-10016 electrodes. When building up two or more adjacent teeth, alternate welding between adjacent teeth, to prevent overheating.

An E-7016 electrode can be used to weld a broken tooth back into rack. No postheat required after work on teeth.

11-B Through 30-B as Manufactured After January 1957

The swing racks of these machines are cast integrally with the truck frame casting and are flame hardened. Follow procedure as outlined under 38-B Through 88-B below.

38-B Through 88-B

38-B Through 88-B Swing racks have cut teeth that are flame hardened. To build up worn or missing teeth or to weld in a broken tooth, preheat tooth area to 300° to 400°F. Use E-10016 electrodes to build up or replace teeth. When welding on two or more adjacent teeth, alternate welding between teeth to prevent overheating. No postheat required.

I. Roller Paths - 10B Through 88-B (Except 11-B)

Preheating not required. Use E-10016 electrodes. Do not postheat. NOTE: Roller path template should be used as a guide for weld build up and for grinding or machining of roller paths to shape.

J. Cone Rollers 10-B Through 88-B (Except 11-B)

Preheat cone roller to 400°F. and build up roller surface with an E-10016 electrode, and grind to size.

K. Revolving Frame

10-B Through 15-B

Use E-7016 electrode.

22-B Through 88-B

Strip out all evidence of crack with cutting torch or by chipping. Preheat locally and weld with E-7016 electrode. Peen each weld pass liberally.

L. Side Frames or Support Castings for Main Shafts

10-B Through 88-B

To repair, use E-7016 electrodes.

M. Main Shafts - 10B Through 88-B

To rebuild worn bearing areas, chrome or nickel plate and grind to size.

We do not recommend reconditioning of main shafts by welding or by metal spraying.

N. Laggings & Drums (No specific Model)

Laggings

All bolt-on type laggings are made of cast steel and repair of cracks or breaks can be made with E-7016 electrodes.

Cable drums which are an integral part of a clutch or brake housing are normally made of cast iron. Welding or brazing of cracks or breaks has not proven satisfactory, therefore, part replacement rather than welding is recommended.

Boom Foot Crowd Drums 71-B and 88-B

For worn bearing areas and repair of cracks use E-7016 electrodes.

Cable grooving wear can be built up with E-10016 electrodes. Grooving must then be machined to proper size.

O. Clutch and Brake Housings 10-B through 88-B

All clutch and brake housing are cast iron of one form or another and resist satisfactory repair by welding.

P. "A" Frame Legs - Crane Masts - Auxiliary "A" Frame Legs.

10-B through 88-B

Use E-7016 electrodes for repairing cracks and breaks.

Q. Sheaves 10-B through 88-B

Cracks and breaks in rims or hubs can be repaired with E-7016 electrodes. Where spokes have broken or cracked it is advisable to "Pie Plate" reinforce by welding in a disc of $\frac{1}{4}$" thick steel extending from hub to rim.

R. Padlock Side Plates 10-B through 88-B

Use E-7016 electrodes for repairing padlock side plates.

S. Saddle Blocks 10-B through 88-B

Strip out all evidence of crack. Preheat locally to between 300 and 400°F. Weld with E-7016 electrode.

T. Shovel and Hoe Boom

10-B through 88-B (Except 11-B)

Use E-7016 electrodes for repair of cracks or breaks.

11-B Only

Use either Murex E-8016Q or Atom Arc 8018-N electrodes on cracks or breaks.

U. Crane Booms 10-B through 88-B

Repairs of small cracks or lacing only should be made to crane booms. In case of chord damage we recommend replacement of boom section affected for safety to all concerned. On special alloy booms use Murex E-8016Q or Atom Arc E-8018-N electrodes. On standard structural steel booms use E-7016 electrodes.

V. Shovel and Hoe Dipper Handles

10-B, 15-B through 88-B (Standard Steel Handles)

Use E-7016 electrodes for repairs of cracks or breaks. (Note! See special instructions pertaining to handle repairs which follows.)

11-B and Special Handles of Alloy Steel

Use either Murex E-8016Q or Atom Arc E-8018-N electrodes on cracks or breaks.

Dipper Handles Tubular & Square

When a dipper handle breaks it is usually with a snap, without bending, which makes it possible to realign accurately. If a crack should run about half way around the circumference, the handle should be cut in two by burning. Proceed as follows to repair a broken handle. See sketch below.

1. Lay handle parts on blocking so that they are approximately in a horizontal position. Burn a 30° chamfer on each end of handle following the break, making a vee gap that will have a 60° angle.

2. For a tubular handle roll a bar 3/16" x 2" to 2-1/2" and required length to overlap the break all round to the inside diameter of the tube which will be used as a backing up strip for the weld. On square handles backup strip can be made of four similar size bars installed in the same manner.

Insert the backup strip into one section of the handle leaving approximately 1" projecting to serve as alignment guide for other section of tube and tack weld to handle on outside of the backup strip. Chamfer the projecting edge of the backup strip for easier entry into the other section of the handle.

3. Butt the broken ends of the handle together, leaving about 1/2" gap. It is important that handle be aligned to its original position so that the rope anchors will line up.

4. To assist in handle alignment, weld bolting lugs on both sides of the break to aid in pulling the tubes together and aligning (see sketch). For round handles attach three pairs of bolting lugs 120° apart, 6 total, (or 4 pair, 8 total, in case of square handle), which should be sufficient to pull the handle straight. Make lugs from 1" bars and use draw bolts. Attach lugs about 2" from the break joint.

5. On tubular handles stretch 3 string lines the full length of the tube about 120° apart to check alignment. On square handles, 2 string lines 90° apart are sufficient. By welding small bars to the handle face at the extreme ends the lines can be kept 1/4" to 1/2" away from the handle. By tightening the proper lug bolts at the joint the handle can be brought into alignment. Gap at bottom of vee should not be less than 1/8". Block the handle after alignment to prevent shifting.

6. With handle in alignment weld bars 1" x 5" x 2'0" on edge to outside of handle (see sketch). Use 3 bars 120° apart on tubular handles and 4 bars 90° apart on square handles straddling the joint. Attach with 1/2" continuous fillet welds, do not weld 2" from each side of the break joint. These bars will keep the handle in position during welding. Remove the bolting lugs after these bars are welded in place.

7. Pre-heat to approximately 400°F., a local area large enough so that the part does not cool down before welding is started. Check temperature with tempilstik.

8. The preferred method of welding is to use two welders working diametrically opposite of each other to minimize misalignment due to welding heat stresses. However, if two welders are not available a single welder should proceed as follows: (refer to accompanying sketches on sequence for single welder). On square handles the first weld passes bonding the handle break together should be applied to half the handle width at one time as per numbers 1 through 8. Passes should then be made as per numbers 9 through 12, filling the remainder of the veed out section. On tubular handles the first passes should be made as per numbers 1 through 8 as shown with each pass restricted to approximately six inches in length. The weld is then completed by following steps 9 through 16 being careful to overlap the 2nd step passes from center to center of the first passes.

Remove the 1" x 5" bars before the final weld passes to avoid their interference.

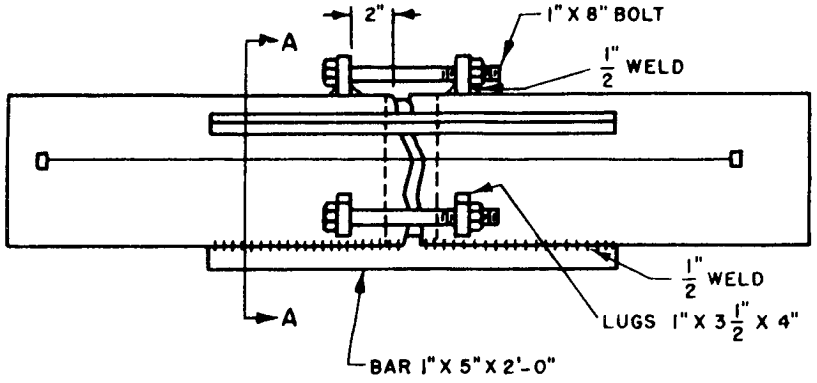
Use E-7016 electrodes for standard handles and Murex 8016-Q weld electrodes for Tri-Ten handles. Use 5/32" rod for the first attaching passes and finish with 3/16" rod. Peen the welds lightly between passes to insure a clean weld.

The Tri-Ten handles are identified by a small nameplate (1-3/4" x 4") stating the material and weld rod specification. This plate is tack-welded to the tube near the backhaul rope anchor.

It is recommended that the repair weld area be postheated to relieve welding stresses. Post heat temperature to be 1000° to 1100°F., and should be checked with tempilstik.

9. Build the weld up slightly higher than the outside of the handle then grind smooth in line with outside of tube. The final surface should be a solid weld, free from surface welding marks.

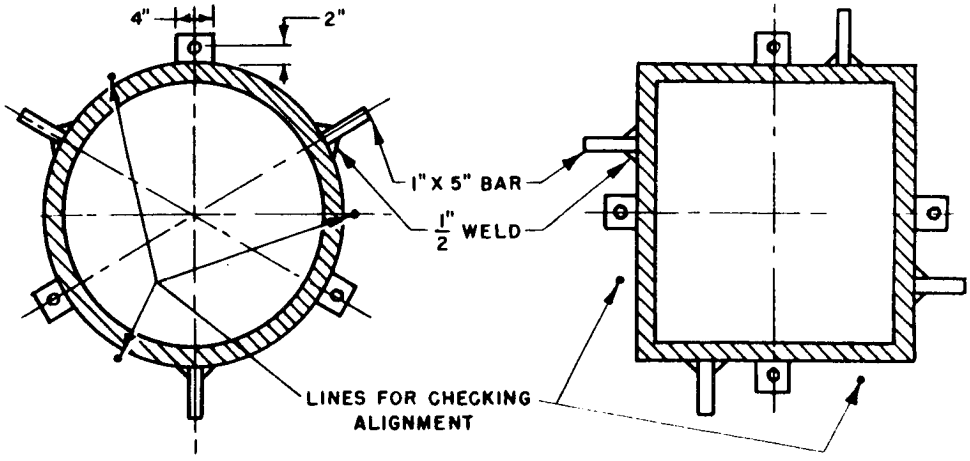
Grind spots where lugs and bars were welded. Add weld if necessary and grind so that the handle tube is smooth.



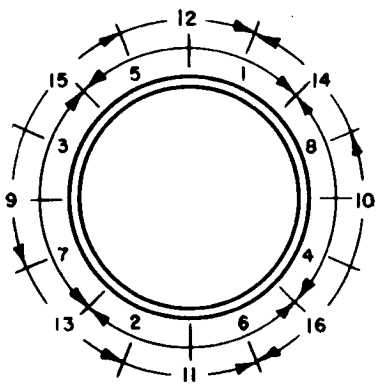
SECTION A-A

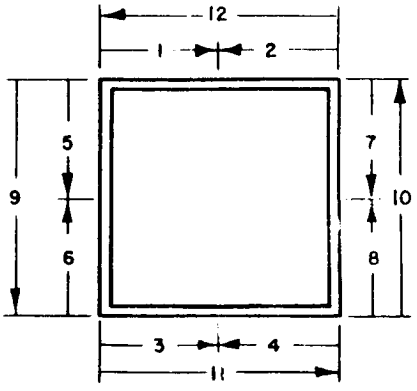
ROUND HANDLE

SQUARE HANDLE

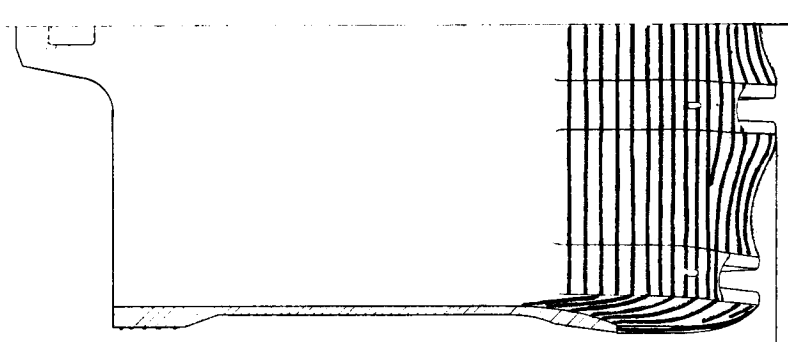


SEQUENCE FOR SINGLE WELDER

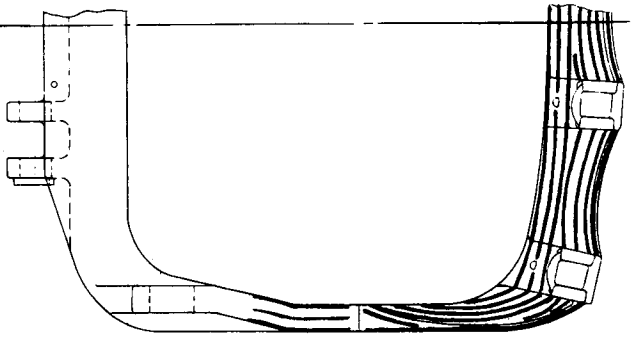


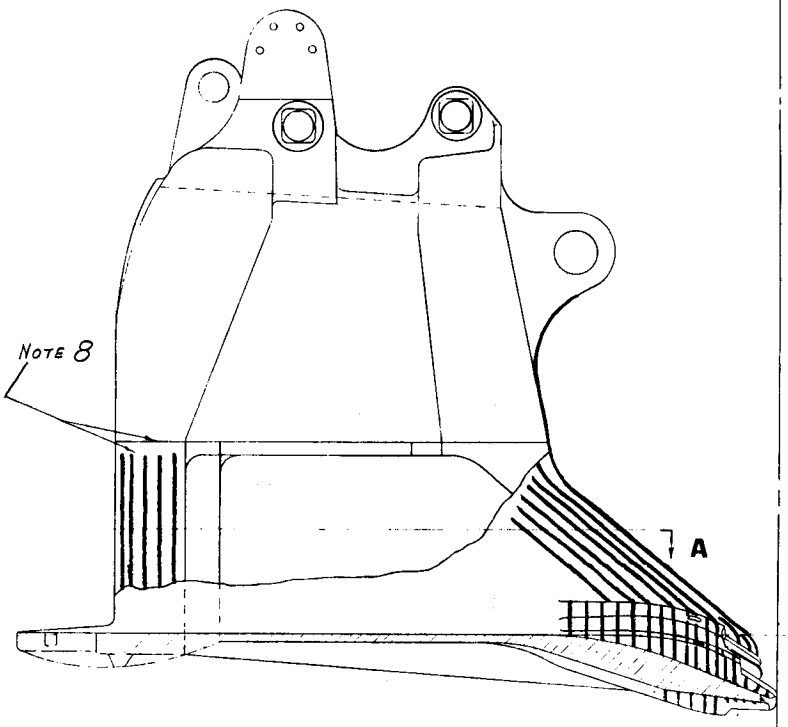


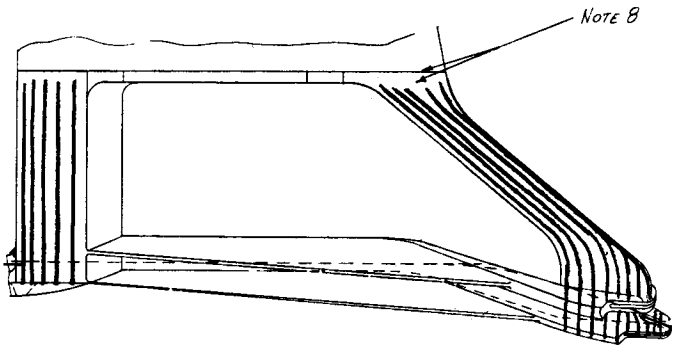
ARROWS INDICATE DIRECTION IN WHICH PASSES SHOULD BE MADE



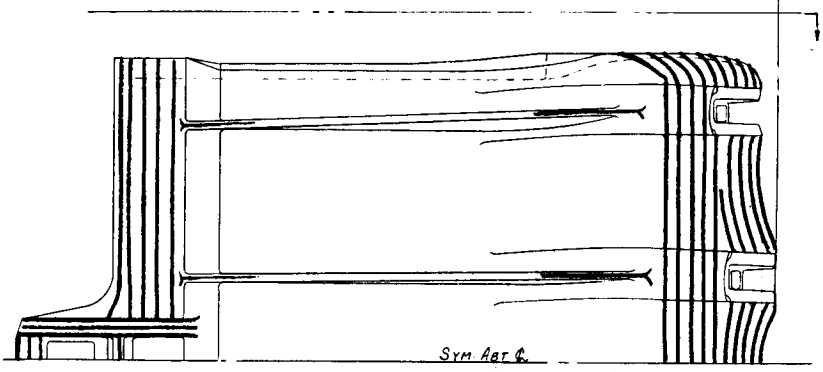
SECT A







VIEW B



1. SPACE BEADS $\frac{3}{4}$" TO $1\frac{1}{4}$" APART.
2. APPLY ALL BEADS PARALLEL TO LINE OF MAXIMUM STRESS IN TENSION.
3. THE NUMBER OF BEADS APPLIED WILL BE DETERMINED BY THE SIZE DIPPER AND THE OPERATING CONDITIONS. BEADS SHOULD BE APPLIED ONLY WHERE ABRASION IS MOST SEVERE.
4. MANGANESE STEEL FRONT: DO NOT PREHEAT. USE SMALLEST PRACTICAL ROD AND APPLY IT WITH THE LEAST POSSIBLE HEAT AND WITH THE SHORTEST ARC.
5. BECOLOY STEEL FRONT: PREHEAT IN COLD WEATHER ONLY TO APPROXIMATELY 350°F AT START OF WELDING.
6. USE RAINITE "B" 3/16" ROD OR EQUAL.
7. BEAD SIZES FOR HARD FACING:
   $\frac{1}{4}$" WIDE X $\frac{1}{8}$" HIGH FOR $\frac{3}{8}$ THRU 5 CU. YD.
   $\frac{3}{8}$" WIDE X $\frac{1}{8}$" HIGH FOR $5\frac{1}{2}$ THRU 21 YD.
   $\frac{1}{2}$" WIDE X $\frac{1}{8}$" HIGH FOR 22 YD. & LARGER.
8. STOP HARD FACING BEAD 1" AWAY FROM WELD JOINING FRONT AND BACK.
9. APPLY ALL HARD FACING AT THE LOWER RANGE OF THE MANUFACTURES RECOMMENDED CURRENT.

ALL SHOVEL DIPPERS
HARD FACING INSTRUCTIONS
12-61 808147

AIR SYSTEM

Page 9-2 - GENERAL INFORMATION

Page 9-3 - COMPONENTS, FEATURES, DIAGRAMS

GENERAL INFORMATION

Consideration for the proper adjustment, lubrication and general maintenance of the air system will insure the best operating efficiency of your machine and is as important as the attention given to the mechanical controls.

Although trouble may appear to be localized to one part of the air system, it may be caused by some other component probably far from where the trouble appears. This should be kept in mind while reading these instructions.

Air pressure drop of 2 pounds per minute is considered normal when machine is idle.

All X-numbers referring to vendor articles will be found in the Vendor section.

Do not operate the machine until 100 pounds per square inch pressure is shown on the air gauge.

Check operation of moisture drain valve frequently.

I. WESTINGHOUSE ALCOHOL EVAPORATOR

The purpose of the Alcohol Evaporator is to evaporate alcohol into the air so that the water in the system will not freeze and cause the valves or cylinders to stick.

Every three months remove the strainer in the bottom of the body near the mounting flange and clean thoroughly using cleaning solvent. Once a year, disassemble and clean all parts.

The Alcohol Evaporator is functioning properly if air bubbles pass through the alcohol when the compressor is compressing air.

The jar should be about two-thirds full of commercially pure methyl 188 proof alcohol. The alcohol should be free of any inhibitor. NOTE: DO NOT USE ENGINE ANTI-FREEZE.

II. WESTINGHOUSE "F" TYPE SAFETY VALVE

A safety valve is installed at the front of the right hand reservior tank. This safety valve insures against excessive pressures which would endanger parts of the air system. When the tank pressure exceeds the blow off setting the valve is forced upward off its seat and air is allowed to escape through the vent holes in the side of the valve assembly.

The safety valve can be adjusted for the desired tank pressure by turning the adjusting nut at the top of the valve assembly clockwise to raise, or counter-clockwise to lower. After the adjustment has been made the lock nut directly beneath the adjusting nut should be tightened. The safety valve should be set for a blow off pressure of approximately 125# P. S. I. This setting should be checked from time to time by increasing the cut out pressure at the unloader pilot until the safety valve blows off. While this is being done someone must be watching the tank pressure guage at the operators stand. If the blow off setting is incorrect an adjustment is needed.

Periodically the safety valve should be disassembled and cleaned in a non-inflamable solvent, and blown dry with a low pressure air jet. Follow the inspection schedule as listed in the Manufacturers' Reference.

III. ARROW LUBRICATOR AND FILTER - (See X-1996)

The lubricator supplies oil to the various devices of the air system. The oil is broken up into fine particals and held suspended in the air system.

IV. AIR CYLINDERS AND AIR CHAMBERS

On this machine air chambers and push and pull type air cylinders are used. The air cylinder has a piston actuated by air being forced against it. The air chamber has a diaphram actuated by the air. The piston rod or push rod should be adjusted for proper travel. This is explained in the "Adjusting Instructions" section of this manual.

Check periodically to make sure that there is not any air leakage out of any of the air cylinders or air chambers. If a diaphram is worn or leaking it should be replaced. With air applied to the air chambers, cover edges of diaphram and bolt holes with soap suds to detect leakage. Leakage is not permissible. Tighten bolts uniformally until leakage is eliminated. Bolts should never be tightened so that the diaphram shows signs of buldging or distorting.

To test air leakage of pull type cylinders apply a soapy solution around breather port. With 80 to 100 P. S. I. air pressure applied to pressure port of cylinder, leakage at the breathers should not exceed a 1" bubble in three seconds. There should be no leakage at shaft seal or around cover seal.

To test air leakage of pull type cylinder it is necessary to immerse the end cover in water with 80 to 100 P. S. I. air pressure applied to pressure port of cylinder. Leakage can then be detected by the appearance of bubbles in the water.

If an air cylinder or air chamber does not function properly the trouble may not be caused by the cylinder or air chamber itself but instead may be caused by a leaky air valve or air line. Trouble which appears to be at the air valve may actually be caused by a leaking air cylinder or air chamber.

The various clutches and brakes are either spring set and air released or vice-versa. The spring which returns the piston rod or push rod to its original position may either be within the air chamber of cylinder or on the clutch or brake mechanism itself. The springs within the air chamber or air cylinder require no attention other than replacement if they become weakened or broken. The adjustment of the springs on the clutches or brakes is covered in the "Adjusting Instructions" sections of this manual.

V. QUICK RELEASE VALVE

Each clutch controlling a main function has a Quick Release Valve to insure snappy clutch release with an absolute minimum of over-travel of the function. This valve exhausts air from the cylinder and speeds up clutch release by reducing the distance the air has to travel to be exhausted. Without this valve all the air would have to travel to the operating valve to be exhausted. The Quick Release Valve is operated by air pressure from the operating lever air valves.

Air enters the inlet port of the Quick Release Valve forcing the diaphram against the exhaust port seat, blocking off the exhaust and permitting air to pass around the edges of the diaphram and out the side connections to the clutch air cylinders. As air pressure is decreased on the inlet side of the diaphram the air pressure and spring on the cylinder side force the outer edge of diaphram to seal against the body and at the same time lift the center part of the diaphram off the exhaust seat thereby opening the exhaust.

Be sure there is not any leakage at the exhaust port while clutches are engaged. This can also be checked by applying a soapy solution. If leakage is noted correct by cleaning or replacing worn diaphram or seat. In some instances it has been necessary to install shims between the valve body and exhaust cover to prevent a Quick Release Valve from trapping air in the cylinder which prevented full release. This has also been necessary in some cases to reduce excessively noisy discharges.

VI. SWIVEL JOINT ASSEMBLY

The ewivel joint assembly at the center of rotation provides a means of supplying air to the air cylinders and air chambers in the lower works. The alper portion of this assembly swivels or rotates with the upper works while the lower portion remains stationary. Worn or defective packing should be replaced. The air lines and fittings to the swivel joint should be checked for air leakage by applying a soapy solution.

VII. AIR COMPRESSOR

The air compressor on this machine is a TU-FLO 500 and is engine lubricated.

VIII. OIL BATH AIR CLEANER

For maintenance see the instruction plate on the oil bowl.

IX. FLEXAIR VALVES - (See X-1992)

For maintenance on the four graduating valves on the front valve stand see the above "X" sheets.

X. GOVERNOR

For maintenance on the Type "D" governor see manufactures manual.

XI. MOISTURE DRAIN VALVE

The Leeper Moisture Drain Valve expels all moisture automatically each time the air compressor unloader system "builds up" pressure or relieves pressure. It expels the moisture before it can freeze and keeps air reservoir and air lines clean and dry. At 100 P. S. I. the valve has a discharge capacity of two cubic inches of moisture per cycle.

This drain valve has a one year guarantee against defective materials and workmanship, however, this does not apply to units disassembled in the field.

XII. PRESSURE REGULATORS - (See X-1759 & 1997)

For maintenance on Norgren regulator 20AG-X see X-1759.

WESTINGHOUSE
Air Brake Company

"A" PILOTAIR® VALVE

BLOCK TYPE

SERVICE INFORMATION

The Block Type "A" PILOTAIR Valve is a three-way, on-off, air directional valve with open exhaust. The body design lends itself to individual or gang mounting operations. The basic valve with various type operators can be quickly assembled, requiring no special tools.

INSTALLATION

The straight, flat sides are identical to provide for either right or left hand mounting by means of two 17/64" diameter holes. The "A" PILOTAIR Valve can be mounted in any convenient position without interfering with its functions.

The "IN" port contains a filter to protect the valve; however the main air supply should be clean and dry but containing an oil mist.

MAINTENANCE

A complete "A" PILOTAIR Valve should be kept in stock at all times for each four valves in service. Schedule the maintenance periods so that complete units can be rotated. The replaced unit can then be serviced without causing production delays.

Dismantle the complete valve. The valve core is easily disassembled after retaining ring (2) has been removed. Clean all parts with a non-flammable solvent and wash all rubber parts with soap and water. Rinse the parts well and dry with a low pressure air jet.

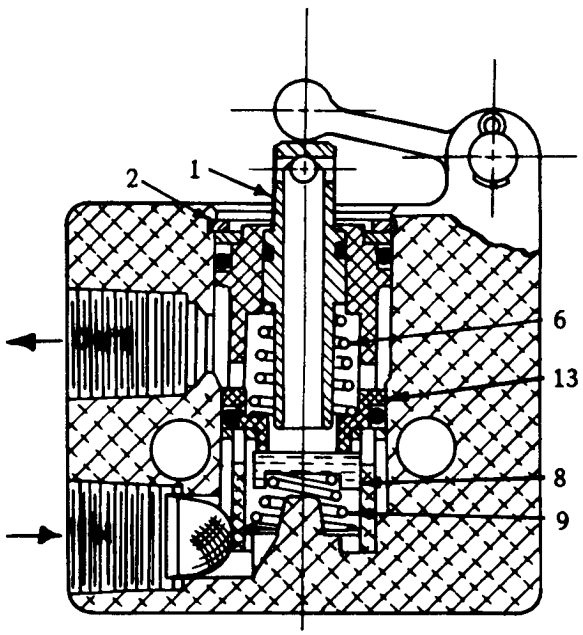
Examine all parts for wear noting particularly the condition of the "O" rings and inlet valve. The worn parts or those that may permit excess leakage before the next maintenance period should be replaced.

Lubricate all metal to metal surfaces with a thin film of No. 107 Lubriplate and all rubber parts with Cosmolube grease. Equivalent lubricants to those recommended can be used.

Reassemble the valve core in the body in the order as shown by the exploded view and then install the valve operator. If the PILOTAIR Valve is not to be returned to service at once, place the complete device in a moisture proof bag for return to storage.

ADJUSTMENT

The Block Type "A" PILOTAIR Valve does not require any adjustment.



ASSEMBLY VIEW

OPERATION

The position of plunger 1 with relation to inlet valve 8 determines the direction of air flow through the valve. With no mechanical force on plunger 1, exhaust valve spring 6 holds the plunger 1 in its uppermost position away from inlet valve 8. In this position the outlet port is open to atmosphere through the hollow plunger 1. The "IN" port is closed by inlet valve spring 9 holding the inlet valve on its seat 13.

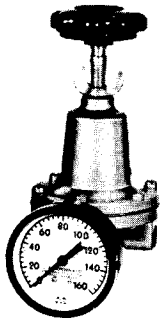
With the plunger 1 depressed, exhaust valve spring 6 is compressed. The plunger contacts inlet valve 8 sealing off the exhaust passage. The inlet valve is moved from its seat 13 thus opening the "IN" port to the "OUT" port.

All combinations of the Block Type "A" PILOTAIR Valve are "Normally Closed" except those designated 2-CA-1B which are "Normally Open".

INSTALLATION, OPERATION AND MAINTENANCE OF PRECISION PRESSURE REGULATOR, TYPE 11-004

(Formerly Type 11,400-2 and 20AL-X2)

"Relieving" type regulators intended for air service. The maximum primary pressure is 400 p.s.i. The maximum recommended flow is 2 cfm.



INSTALLATION

Install in the pipe line as close as possible to the device requiring the regulated pressure. An arrow on the valve body indicates the direction of flow through the regulator. **Do not use** undersize piping, fittings or other controls that restrict flow through the regulator. To protect the regulator from pipe scale, moisture and other contamination, **install a Norgren 25-micron Filter immediately ahead of the Regulator.**

OPERATION

After installing and before turning on air supply, back off adjusting wheel by turning it counter-clockwise until it turns freely. Then turn on air supply. To obtain desired secondary pressure, turn adjusting wheel clockwise until the gauge installed on regulator, or in air line being supplied by the regulator, reads the desired pressure. This adjustment can be made either with or without air flowing through regulator. It is desirable to adjust regulator for required pressure under typical flow conditions. If pressure adjustment is made under "No Flow" conditions, the pressure under "Flow" conditions will be slightly lower than the "No Flow" setting.

MAINTENANCE

All servicing is accomplished by disassembling as follows: Remove bonnet screws, thus permitting the removal of the bonnet, regulating spring, upper spring rest and diaphragm. Remove the valve seat (right hand thread), thus permitting the removal of stainless steel ball and valve spring. The regulator is now completely disassembled and all parts can be examined for possible damage or contamination.

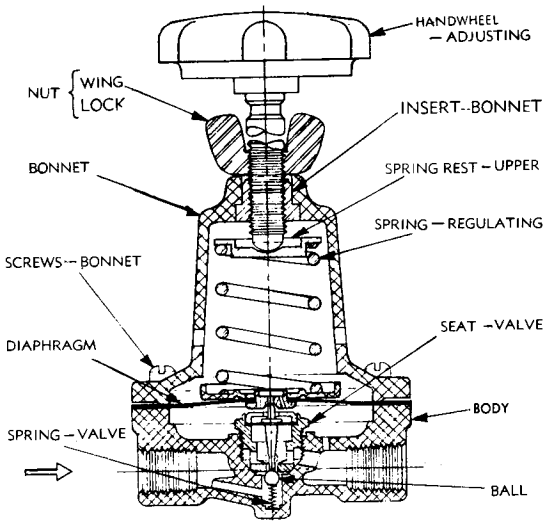
1. **If there is an excessive flow of air from the vent holes** in the regulator bonnet: (a) Examine the seating surface of the relief seat installed in the diaphragm, also the surface of the valve pin which contacts this seat. Both surfaces should be clean and free of abrasive marks, scratches, etc. (b) Examine the seating surface of the valve seat which contacts the ball. There should be no cuts, scars or blemishes on the ball or the surface which it seats on. Clean all parts thoroughly and replace any which give evidence of having been damaged.

2. **If regulator "creeps",** examine parts and replace as described in Item 1. Also, inspect the passage and bleed hole through the relief seat (11-004 -016 thru -039) in the diaphragm to make sure that they are free and clear.

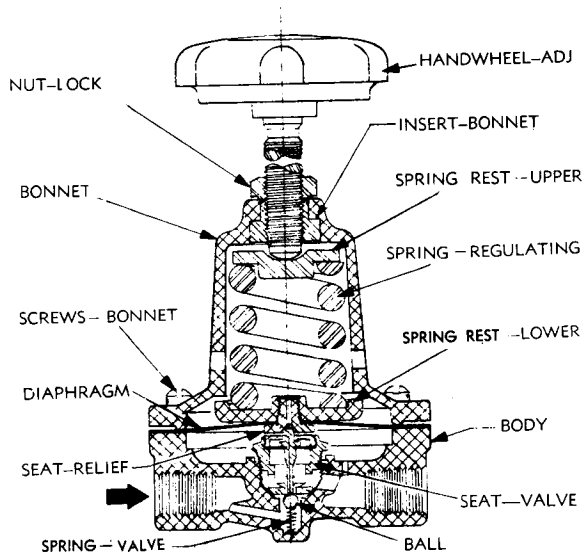
3. **If regulating action is uneven or faulty,** examine parts and replace as described in Item 1. Make sure all passages in body are clean of all obstruction.

4. **If flow seems small or entirely stops,** examine parts and replace as described in Item 1.

5. **If leaking at joint between body and bonnet occurs,** tighten bonnet screws. If this does not stop the leak, disassemble and inspect the diaphragm for possible cuts or imperfections around its circumference. Also examine the diaphragm seat surface on the body to make sure that it is free of imperfections, nicks, etc. Replace any damaged parts. It is important that the diaphragm be firmly held around its entire circumference by the clamping action of the bonnet on the body.



Model 11-004-016 thru -039



Model 11-004-001 thru -004

To order parts see Norgren Parts Price List NP-R28

X-1997

Printed in U.S.A.

INSTRUCTION SHEET

ARROW TOOLS, INC.

1900 SOUTH KOSTNER AVENUE

CHICAGO 23, ILLINOIS

AIRLINE FILTERS – REGULATORS – LUBRICATORS – DRAIN TRAPS AUTOPNEUMATIC CONTROLS – TRIO CONTROLS DUO COMBINATIONS

FILTERS

INSTALLATION—

Install filter units so the airflow is in the direction "IN-OUT" as indicated on the head of all units. Filters should be installed up-stream of regulators or lubricators and as close as possible to the pneumatic tools or appliances being serviced. Normal operating maximums for plastic bowls are 150 P.S.I. or 150° F.

Metal bowls are available for pressures up to 250 P.S.I. or 300° F.

OPERATION ADJUSTMENTS—

Filtering out of dirt, foreign particles and moisture separation is automatic with airflow. There are no moving parts and no adjustments are necessary.

MAINTENANCE—

Accumulated sludge and moisture should be drained off by the petcock regularly. The Arrow Model 5100 Aquamatic Drain Trap connected to the filter bowl at the petcock connection will automatically eject moisture at regular intervals. Transparent bowls show the amount of collected sediment. This sediment should not be permittec to fill above the lower baffle.

Wash filter elements at intervals with a cleaning solvent to maintain filtering efficiency. Unscrew ringnut by hand —DO NOT USE WRENCH. Remove bowl and filter element screw. Then remove element to clean. Dry filter element thoroughly before reassembling. Filter bowls are to be cleaned only with kerosene or soapy water. Inspect gaskets and "O" ring, replacing any which are damaged or distorted. Tighten ringnut by hand, making sure "O" ring seal is in filter head groove.

SEND FOR PARTS LIST SHEET PL-200F

PRESSURE REGULATORS

INSTALLATION—

Install regulators so the airflow is in the direction "IN-OUT" as indicated on the head of all units. Regulators should be installed downstream from filters or upstream from lubricators, but as close as possible to the pneumatic tools or appliances being serviced. The regulator will accurately control secondary pressure between 5 and 125 P.S.I., maximum primary pressure 250 P.S.I. The self-bleed feature permits use on dead-end applications.

OPERATION ADJUSTMENTS—

After the regulator is installed, back off pressure adjusting screw before the air is turned on. This will relieve compression on the regulating spring. Turn on the air supply and regulate the adjusting screw until the pressure gauge shows the desired pressure.

MAINTENANCE—

Screws holding the bonnet to the regulator body must be tight in order to prevent air leakage. On detection of air leaks, pressure fluctuation, or "creep", remove the bonnet screws to disassemble regulator for inspection of the diaphragm seal and valve seat. Clean with kerosene and blow out with air. Dry and reassemble if parts are not damaged or worn. Replace any damaged or worn parts.

SEND FOR PARTS LIST SHEET PL-201R

LUBRICATOR INSTRUCTIONS — PAGE 2

LUBRICATORS

INSTALLATION—

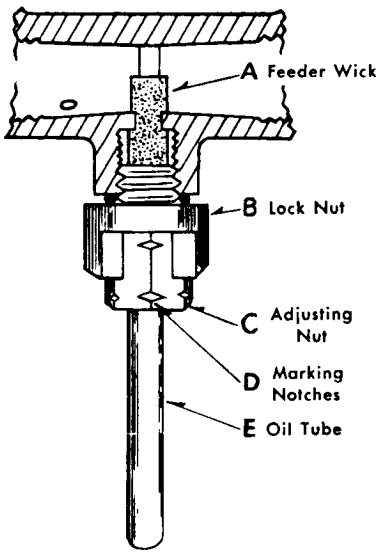
Install lubricators so the airflow is in the direction "IN-OUT" as indicated on the head of all units. Lubricators should be installed downstream from filter or regulator units, but as close as possible to the pneumatic tools or appliances being serviced. Fill the lubricator with SAE 10 oil or lighter. Normal operating maximums for plastic bowls are 150 P.S.I. or 150° F.

Metal bowls are available for pressures up to 250 P.S.I. or 300° F.

OPERATION ADJUSTMENTS—

Arrow lubricators automatically vary oil mist delivery with airflow variations at any adjustment. The lubricator wick element assembly is factory pre-set at a "mean" (halfway) adjustment that has been found correct for most applications. Increased oil mist delivery is obtained by raising the feeder wick (A) higher in the venturi (air-stream). To decrease oil mist delivery lower the oil feeder wick in the venturi. See following instructions.

VENTURI SECTION OF LUBRICATOR HEAD



Note—Feeder Wick at Mean Adjustment

TO ADJUST OIL FEEDER WICK ASSEMBLY (A-C-E)

First —Loosen bowl ringnut BY HAND.
Remove plastic bowl oil reservoir with ringnut.
Loosen locknut (B).

Second—Increase oil mist delivery by turning nut (C) up, to raise feeder wick (A) in venturi or turn nut (C) down to decrease oil mist delivery as desired.

Third —Tighten locknut (B).
The height of the feeder wick (A) in the venturi is visually indicated by the relative position of upper and lower notches (D) on adjusting nut (C) to the bottom of locknut (B).

Fourth —Replace plastic bowl with ringnut, being sure "O" ring seal is correctly set in lubricator head groove. Tighten bowl ringnut BY HAND.

For lubricants over 200 S.S.U. the coarse feeder wick assembly (4C) is recommended. See catalog, page 16.

Model 4102-B Low Flow Lubricator is recommended for low flow applications from 0.1 C.F.M. to 4.0 C.F.M. See catalog, page 6.

MAINTENANCE—

Drain off the sediment collected in the bowl by means of the petcock. Clean the plastic bowl occasionally. If the oil mist delivery rate is noticeably reduced, disassemble ringnut and bowl, remove feeder wick element assembly and clean with kerosene. Reassemble with adjustment at previous setting.

SEND FOR PARTS LIST SHEET PL-202L

AQUAMATIC DRAIN TRAP

INSTALLATION—

Model 5100 Aquamatic Drain Trap attaches to Airline Filter models 3102—¼", 3103—⅜", 3104—½", 3106—¾" and 3108—1" with ⅛" N.P.T. at petcock connection. Petcock must be removed from filter bowl. Model 5100A Drain Trap attaches to Model 3116—2" Filter with ¼" N.P.T. connection.

OPERATION ADJUSTMENTS—

The drain trap automatically ejects accumulated moisture from the filter to any receptacle or may be piped to the service drain. No adjustments necessary.

MAINTENANCE—

Periodically open drain cock—under pressure—to clean out collected sediment in trap, sump or well.

SEND FOR PARTS LIST SHEET PL-200F

AUTOPNEUMATIC CONTROL — TRIO CONTROLS — DUO COMBINATIONS

These assemblies are made up of various combinations of airline filters, pressure regulators, airline lubricators and drain traps. The foregoing instructions for each individual unit are applicable for each unit of these assemblies.

FLEXAIR ® VALVES

SERVICE INFORMATION

The FLEXAIR Valve is a highly versatile pressure control valve with many combinations of internal parts for various control functions. There are three valve cavities in the body which may contain several types of valve assemblies or may be plugged. Two standard handle lengths are available. Various handle guide inserts limit the handle to certain areas of travel. The handle return characteristic may be one of three different types. The valve designation code and piece number determine which of these combinations is included in each complete FLEXAIR Valve. The tabulation attached indicates which combinations apply to each complete piece number.

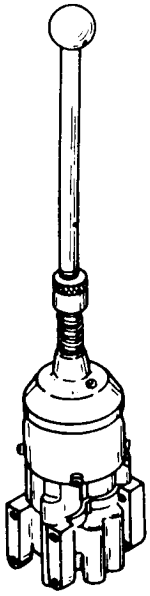


Figure 1

HANDLE LENGTH

The first digit of the designation indicates the handle length. The number 1 indicates a standard long handle, with an effective handle length (Fig. 2) of 20-7/8". The number 2 indicates a standard short handle, with an effective handle length (Fig. 2) of 12".

Changing the handle length of any complete FLEXAIR Valve involves the changing of related internal parts also. For detailed information and repair parts on handles, see Section IV.

HANDLE GUIDE INSERTS

The first letter in the designation indicates the handle guide insert incorporated in the cover (37). These inserts are staked in place and therefore require the replacement of the complete cover assembly when changing this function. For more information, see Section V.

VALVE CAVITIES #1 and #2

The second letter of the designation indicates how many graduating valve assemblies are installed in the complete FLEXAIR Valve.

The letter "A" indicates that a single valve assembly is installed, the unused valve cavities being plugged. PUSH or PULL handle operation can be obtained, as desired, by the proper mounting of the FLEXAIR Valve.

The letter "B" indicates that two valve assemblies are installed; one valve assembly in cavity 1 and the other valve assembly in cavity 2.

Handle movement toward or away from the operator determines which valve assembly is operated. Delivery air pressure will be proportional to handle position. Handle travel away from center position increases delivery pressure. Movement oward center decreases delivery pressure.

With either of the above, preset pressures and full pressure features are available. The preset pressure feature provides a preset amount of delivery pressure at the beginning of pressure graduation rather than attempting to graduate the first few psi. This function is particularly useful when the mechanism being controlled contains an initial spring tension and/or static friction which must be overcome before movement is accomplished. By utilizing the preset pressure feature, sufficient pressure is delivered with the initial handle move-

ment to neutralize the static force, thus making the remainder of the handle travel more effective in controlling the desired operation.

The "full pressure" feature can be provided whereby full supply pressure can be admitted to the delivery line before the handle reaches extreme travel away from the center. This feature is adjustable and is normally set to admit full supply pressure after the first 16° of lever travel

For repair parts on graduating valve assemblies, see Section II.

HANDLE RETURN CHARACTERISTICS

The third letter in the designation indicates the type of handle return. The letter "D" indicates the handle is detented (or self-holding) in the extreme positions away from center as associated with valves No. 1 and No. 2. The handle is self-returning from all other positions. The handle detenting force may be varied as desired to suit the individual operator or the particular installation. (See Adjustment.

The letter "S" indicates the handle is self-returning to center from all positions.

The letter "F" indicates a friction brake which holds the handle in any desired position of its travel as associated with Valves No. 1 and No. 2. This handle is self-returning to center from Valve No. 3 position. The amount of handle friction is adjustable. (See Adjustment). For repair parts on friction brake details, See Section VI.

VALVE CAVITY #3

The last digit in the designation indicates whether or not a valve assembly is included in valve cavity No. 3. A "Zero" indicates this cavity is plugged. The number 1 indicates a three-way, on-off valve is installed. The number 2 indicates a low sensitivity graduating valve is installed.

The valve assembly in this cavity is operated by side movement of the handle from its center position. This may be either to the left or right, depending upon how the FLEXAIR Valve is mounted. If the handle guide insert permits, this valve assembly may be operated simultaneously with either valve assembly in cavities No. 1 and No. 2. For repair parts, see Section III.

INSTALLATION

The valve is end-mounted by either of two mounting pads provided. The four (4) mounting holes are tapped 3/8"--24 UNF-2B.

Four ports are provided in the bottom of the valve for pipe connections Out Ports No. 1, No. 2 and No. 3 correspond to valve cavities No. 1, No. 2 and No. 3 and are tapped 1/4"-18 NPT. If any valve cavity is plugged, the associated port will not be used but does not require an external pipe plug. The In Port (S) is 1/2"-18 NPT.

MAINTENANCE

Clean and lubricate the detent latch (38) and cover (37) every 500 hours of operation with #2 Lime Base Grease or an equivalent low temperature cup grease. Access to these parts is obtained by first backing off adjusting nut (41) to release the spring tension on latch cover (39) and detent latch (38). Then remove the ring (42) and pin (43) from the handle (44). The handle and latch cover details can now be removed. Detent latch (38) can be raised by removing pin (33).

Every 1000 hours of operation clean and lubricate the contact ends of screws (31), handle shaft (30a), the contact area of caps (16), extension (25), and inside of bearing (28).

Remove the complete valve periodically from the installation for inspection, cleaning and lubrication. All maintenance requiring disassembly must be done on a clean well-lighted work bench. To disassemble the FLEXAIR Valve first remove the handle (44), detent latch cover (39) and detent latch (38) as outlined above. Screws (35) at the base of cover (37) are removed and cover (37) slipped from the body exposing the operating mechanism. Operating lever (30) is removed by driving out pin (27). Valve caps (16) can then be lifted from place.

To disassemble the valve portion, remove the three cap screws (2) from the bottom of the valve and lift the spring housing (29) from the body (4). The operating valve assemblies can now be removed. These assemblies should not be interchanged as this may change the operating characteristics of the valve. The graduating valve assemblies (15) are set at the factory and should not be disassembled. When removing these valve assemblies, there may be shims on top of them.

These shims are essential and should be returned to their proper place upon reassembling the valve. The number of shims required is stamped on the underside of spring housing (29).

Before removing or installing snap ring (13) to inspect the supply valve portion, depress the plunger (10) with the finger until the small cross drilled hole in the bottom of (10) is exposed beyond the bottom of the body (4). Insert a pin in this 1/16" hole to keep the spring (7) caged.

If an operating valve is installed in valve cavity #3 these parts can be removed by lifting out plunger (20) and guide (22). The complete supply valve assembly (17) can then be lifted from the valve cavity. If a graduating valve assembly is installed, it is necessary to remove the snap ring before the supply valve assembly can be removed.

All metal parts should be cleaned with a non-flammable solvent. Wash all rubber parts in a mild soap and water solution. All parts should be thoroughly dried with a low pressure air jet. Inspect all parts for wear, cuts and defects and replace as necessary.

Before reassembly, lubricate all valve cavity contact surfaces with 107 Lubriplate and "O" Rings with a low temperature silicone grease such as MIL-L4343A. A lubrication chart on self-adhesive gold foil is available for mounting near the valve for ready reference. If desired, ask for E4-72.03-4.

When installing graduating valve assemblies in valve cavities #1 and #2 make sure that the flat side of the spring washer (F) faces toward valve cavity #3 so that the washers do not ride on the valve parts in cavity #3. Also, before tightening spring housing (29) to body (4), be sure that washers (F) are seated entirely in the recesses provided in body (4). A screwdriver blade can be utilized to slide these parts into their proper place.

ADJUSTMENT

Do not attempt to adjust graduating valve assemblies (15). These assemblies are factory set for the required operating pressure range and locked in position. Complete assemblies must be replaced if worn or it is desired to change the operating range.

Adjustments may be made pertaining to the upper portion of the FLEXAIR Valve and the full pressure feature of the operating valve assemblies which are accessible without removing the complete valve from the installation.

The detenting force of the handle (44) can be varied as desired by means of knurled cover nut (41). Excessive detent force should be avoided as this creates undue wear on the detents and detent latch (38).

The friction holding handle feature on FLEXAIR Valves incorporating the friction brake can be adjusted to provide the desired operating characteristics by turning hex head bolt (64) in or out as desired.

After reasonable service life it may be necessary to readjust set screws (31) to eliminate free handle travel (lost motion) when moving from the center position into the operating zone. Ordinarily, pressure delivery from any port should begin approximately 3° out of the center position. When travel greater than this occurs without pressure buildup, set screws (31) should be adjusted as follows. With the handle perfectly vertical in the center of the handle guide slot, adjust set screws (31) until there is .001" to .003" clearance between it and the cap (16).

The point in the handle travel at which the full pressure feature engages can be adjusted after removal of cover (37), operating lever (30) and full pressure caps (16) to obtain access to the full pressure adjusting screw (M). Turning (M) out will make the full pressure feature engage earlier in the handle travel zone. IT IS IMPORTANT THAT (L) BE HELD STATIONARY DURING THIS ADJUSTMENT. Full pressure engagement is normally set at 16° of handle travel from center.

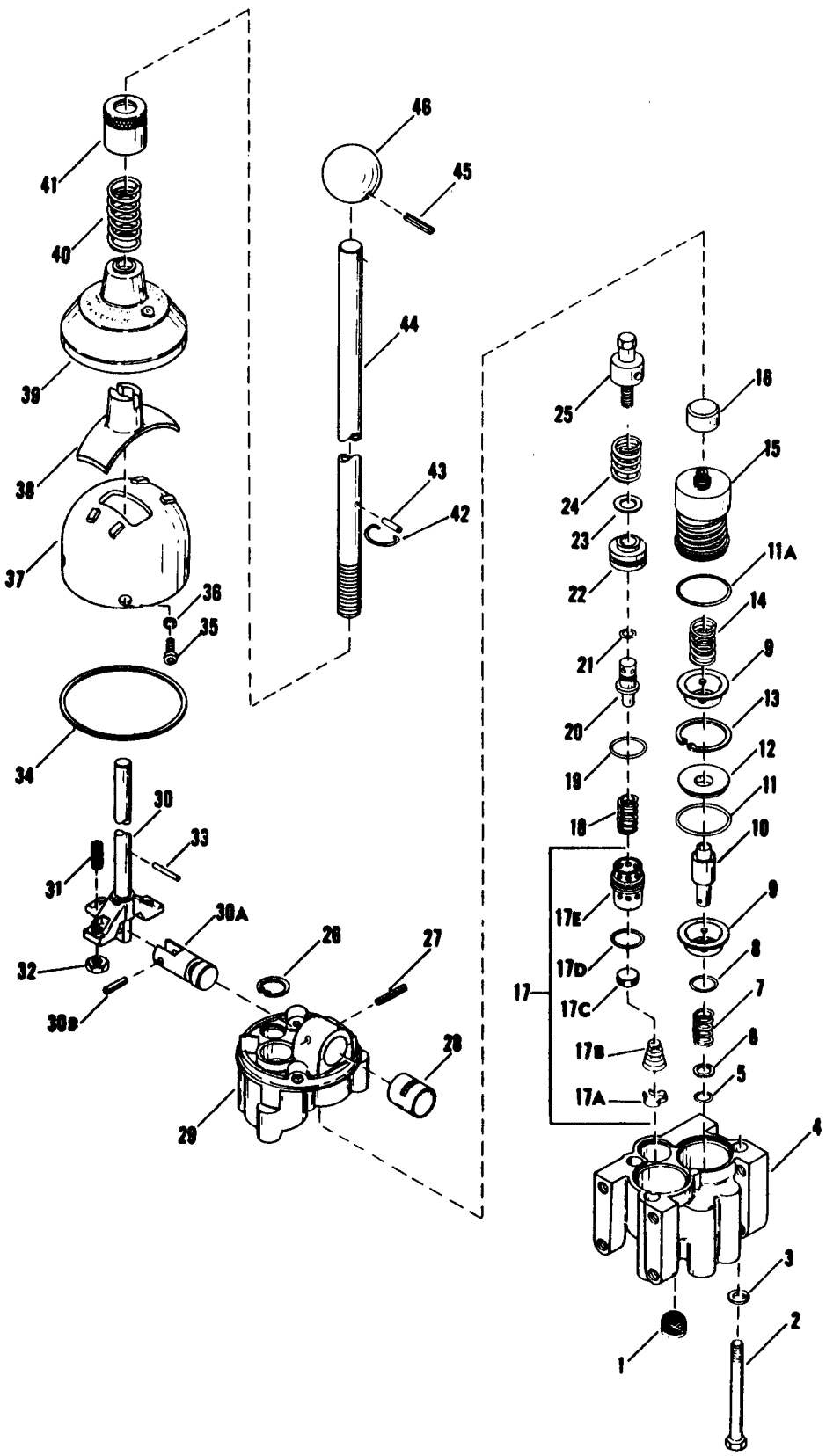

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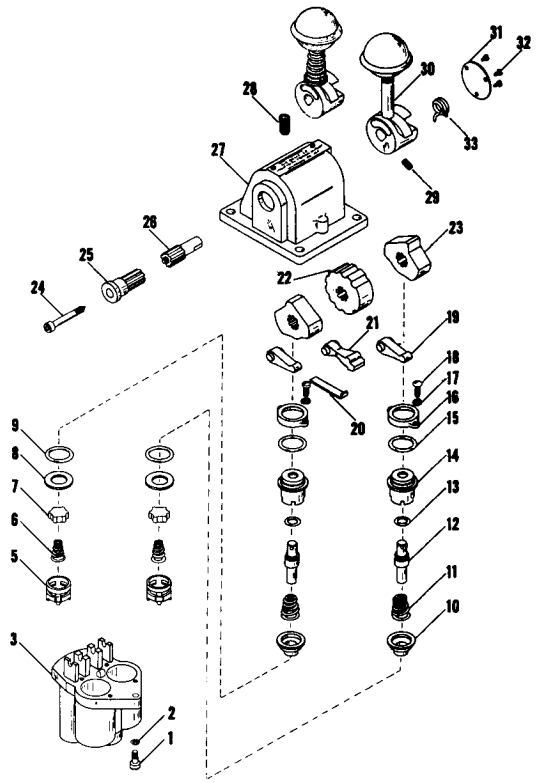
Figure 4

2-HA-2 Pilotair Valve



Several variations of handle holding functions and operation are indicated by the model designation and piece number. (See nameplate on handle for piece number).

2-HA-2 MODEL (P54426-0312)

A spring opposed detent cam holds the handle in its center (upright) and two extreme travel positions when the handle is released. See Fig. 1.

2-HA-2L MODEL (P54781-0312)

A handle latch spring on this model requires manual release when moving the handle from one position to another to insure against unintentional operation. See Fig. 1.

2-HA-2Z MODEL (P54425-0310)

Same as 2-HA-2 model except that the handle is spring returned to the center position from all other positions when released. See Fig. 1.

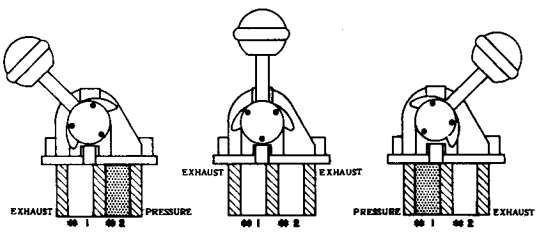


Figure 1

2-HA-2R MODEL (P54426-0242)

A detent cam holds the handle in center and two extreme positions of travel when handle is released. For operation, see Fig. 2.

2-HA-2LR MODEL (P54781-0242)

Same as 2-HA-2R model except that a handle latch spring requires manual release when moving from one position to another. See Fig. 2.

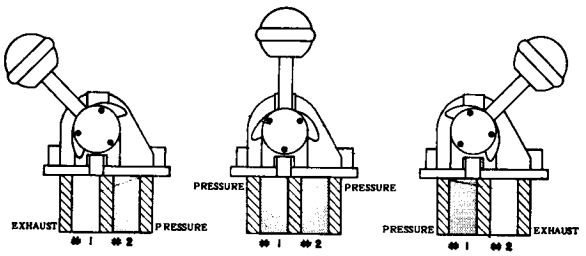


Figure 2

2-HA-2F MODEL (P54427)

A five (5) position, four-way valve. A detent cam holds the handle in all five positions when released. See Fig. 3.

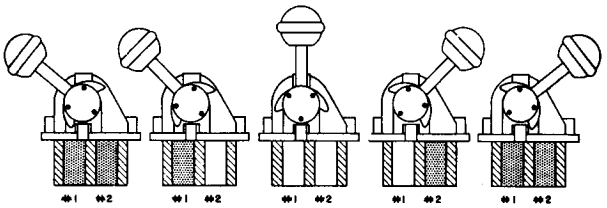


Figure 3

2-HA-2Y MODEL (P54426-0241)

This model has only two positions of operation; toward the operator and away from the operator. In both positions a spring opposed detent cam holds the handle when released. See Fig. 4.

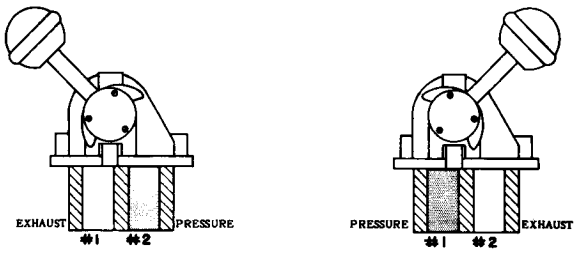


Figure 4

INSTALLATION

The 2-HA-2 PILOTAIR Valve may be mounted in either a horizontal or vertical panel. See outline views for panel opening dimensions. The IN and OUT ports are 1/4" – 18 N.P.T.

MAINTENANCE

Periodically dismantle the valve for cleaning, inspection and lubrication. Wash all metal parts with kerosene or a solvent with like characteristics. Wash all rubber parts with soap and water. Dry all parts with a low pressure air jet.

Examine the inlet valves (7) and rubber packing rings (9), (13), (15) and replace if cracked or worn.

During re-assembly, lubricate all friction surfaces, including packing rings, with a low temperature grease such as MIL-L-4343A or LUBRIPLATE.

ADJUSTMENT

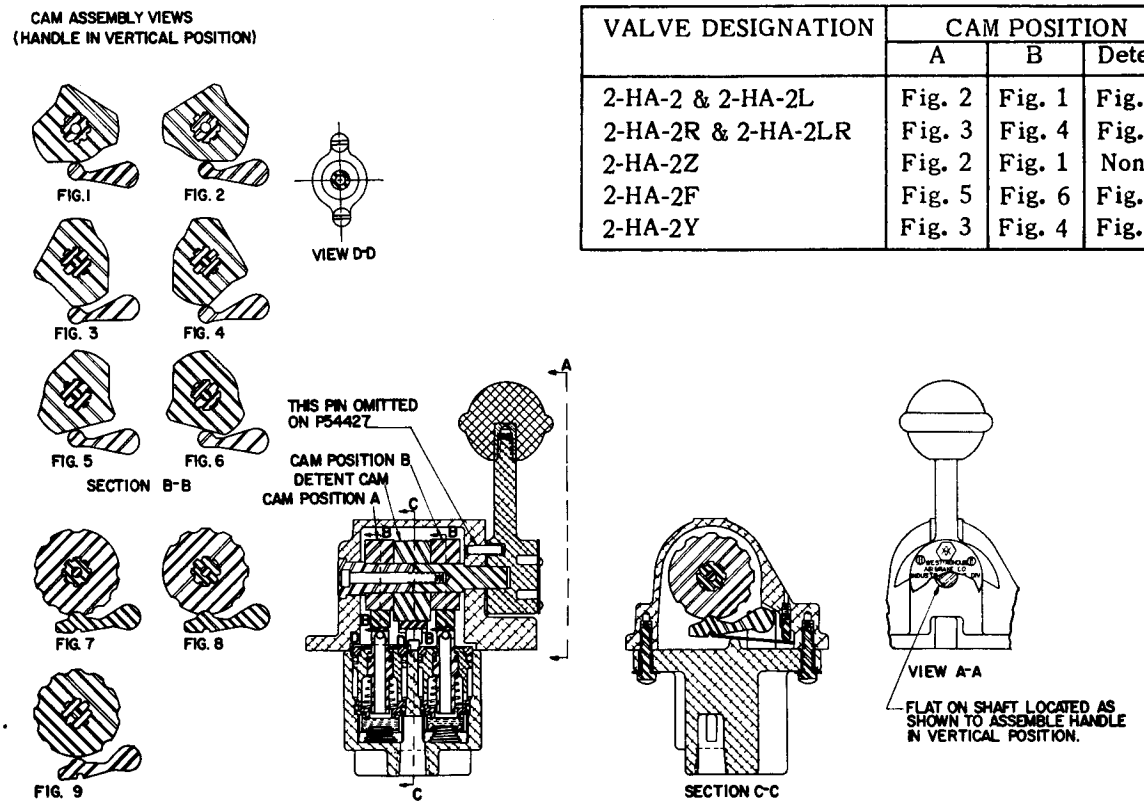
The detent force on the detent cam (22) can be adjusted by the set screw (28). Turn the screw down to increase detent force. Turn the screw out to decrease force.

RE-ASSEMBLY

The cams (23) are multi-purpose cams used in all types of "HA" PILOTAIR Valves. Their position on the cam shaft determines the valves operation. Therefore, it is important that they be assembled correctly.

Assemble the handle shaft (26) to the cam shaft (25) by means of the screw (24). Insert this assembly partially through the cover (27) with the handle shaft (26) in the position shown in view A-A, (Assembly View). Slide cam "A" (23) over the splines on the cam shaft in the position shown in table below and view B-B. Add the detent cam (22) positioned as indicated in view C-C. Cam "B" (23) is also added in accordance with its prescribed position shown in view B-B. Place the handle assembly (30) on the shaft in a vertical position. A flat on the hole in the handle should correspond with the flat on the handle shaft (26). Secure the handle with the set screw (29). Assemble the cover assembly to the body and test for correct operation.

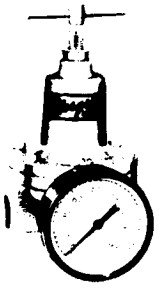
VALVE DESIGNATION	CAM POSITION		
	A	B	Detent
2-HA-2 & 2-HA-2L	Fig. 2	Fig. 1	Fig. 8
2-HA-2R & 2-HA-2LR	Fig. 3	Fig. 4	Fig. 8
2-HA-2Z	Fig. 2	Fig. 1	None
2-HA-2F	Fig. 5	Fig. 6	Fig. 7
2-HA-2Y	Fig. 3	Fig. 4	Fig. 9



Assembly View

INSTALLATION, OPERATION AND MAINTENANCE OF PRESSURE REGULATING VALVES

TYPE 11-002
(FORMERLY TYPE 20A6)



INSTALLATION

Install the regulator in the pipe line as close as possible to the device requiring the regulated pressure. An arrow on the valve body indicates the direction of flow through the regulator. Do not use undersize piping, fittings, or other controls that restrict flow through the regulator.

To facilitate adjustment of the regulated pressure, **install the regulator downstream from any filter units on line; upstream from air-line lubricators.**

OPERATION

After regulator has been installed and before turning on air supply, back off adjusting screw by turning it counter-clockwise until it turns freely, thus releasing all compression on regulating spring. Then turn on air supply. In order to obtain desired secondary pressure turn adjusting screw clockwise until the gauge installed on regulator, or in air line being supplied by regulator, reads the desired pressure. This adjustment can be made either with or without air flowing through regulator. It is desirable to adjust regulator for required pressure under typical flow conditions. If pressure adjustment is made under "no flow" conditions, the pressure under "flow" conditions will be slightly lower than the "no flow" setting.

MAINTENANCE

To prevent abrasive solids, such as rust, sand and pipe scale, from entering the valve, **all regulators are fitted with a screen. Clean this screen regularly** for best performance. It can be removed by removing the valve guide plug at the bottom of the regulator. For protection against dirty, wet air, install an airline filter ahead of the regulator. **Note: When reassembling valve guide plug, regulator MUST be in vertical position.**

These regulators will give long satisfactory service with reasonable care. The following points are offered as a guide in getting the best service from them:

1. **If regulated pressure "creeps"—**
   a. Remove valve guide plug at bottom. Inspect screen and valve for dirt. Clean thoroughly. If valve disc is pitted, rough or is not being held firmly in place, replace valve.
   b. Remove valve guide plug at bottom. Inspect valve seat. If rough or pitted, replace valve seat.
2. **If regulating action is uneven or faulty—**
   a. Remove valve guide plug at bottom of regulator. Check interior of guide and "O" Ring for foreign matter which may have adhered to these parts. Clean thoroughly. Apply generous coat of grease to "O" Ring and Groove.
   b. Disassemble regulator. Check valve pin "O" Ring, and valve seat for nicks, scratches or foreign matter. Clean thoroughly and replace any damaged parts. When replacing valve, apply coat of light grease to valve pin.
3. **If flow seems small or entirely stops—**
   Remove valve guide plug at bottom of regulator. Inspect interior for dirt, scale and other deposits. Clean thoroughly. Be sure screen is clean.
4. **If leaking at joint between body and bonnet occurs—**
   a. Tighten bonnet screws.
   b. If this does not stop the leak, remove bonnet. Inspect diaphragm and replace if necessary. It is important that the diaphragm be firmly held around its entire circumference by the clamping action of the bonnet on the body.
5. **If leaking through hole in bonnet**—(Non-Relieving type)
   Remove bonnet and inspect diaphragm for holes or cracks. Replace diaphragm if necessary.
6. **If continuous leaking through hole in bonnet occurs**—(relieving type)
   a. Remove bonnet and lower spring rest. Inspect seating surface of the relief seat installed in the lower spring rest and the surface of the valve pin which contacts this seat. Both surfaces should be free of abrasive marks, scratches, etc. Also examine diaphragm for holes or cracks. Replace any damaged parts.
   b. Remove bonnet. Check to see that regulating spring is seated properly in lower spring rest. Spring must be seated on the flat surface to insure seal on relief valve seat.
   c. Remove valve guide plug at bottom. Check valve disc and valve seat for nicks, scratches or foreign matter. Clean thoroughly, replace damaged parts.

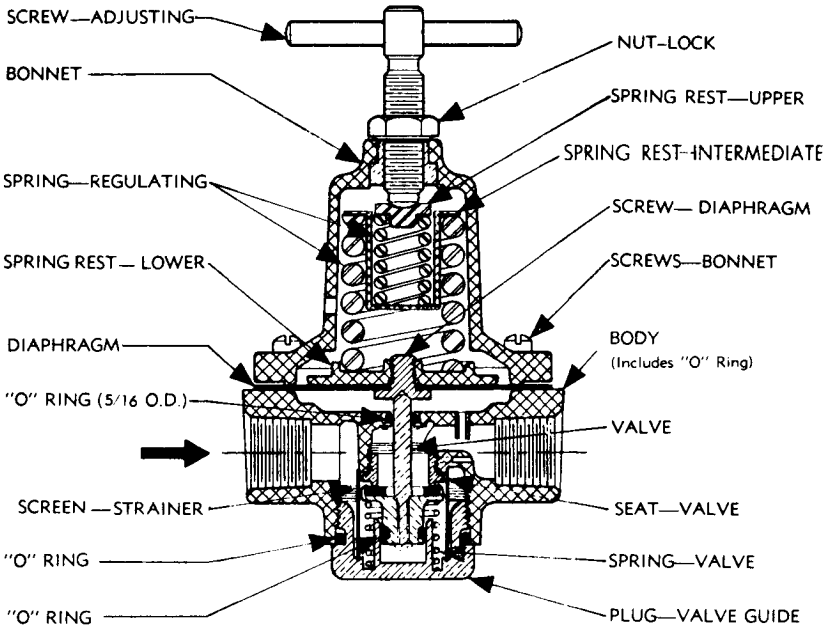


FIGURE 1
Type 11-002 (Non-Relieving)

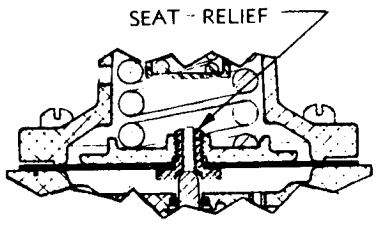


FIGURE 2
Cross-Section of Relief Valve Seat
Type 11-002 (Relieving)

TO ORDER PARTS, SEE NORGREN PARTS PRICE LIST NP-R15

X-1759

INSTALLATION, OPERATION AND MAINTENANCE OF PRESSURE REGULATING VALVES TYPE 11-012 AND 11-016

(FORMERLY TYPE 2E AND 2B)

INSTALLATION

Install the regulator in the pipe line as close as possible to the device requiring the regulated pressure. An arrow on the valve body indicates the direction of flow through the regulator. Do not use undersize piping, fittings or other controls that restrict flow through the regulator.

To facilitate adjustment of the regulated pressure, **install the regulator downstream from any filter units on line; upstream from air-line lubricators.**

OPERATION

After regulator has been installed and before turning on fluid supply, back off adjusting screw by turning it counterclockwise until it turns freely, thus releasing all compression on regulating spring. Then turn on fluid supply. In order to obtain desired secondary pressure turn adjusting screw clockwise until the gauge installed on regulator, or in fluid line being supplied by regulator, reads the desired pressure. This adjustment can be made either with or without fluid flowing through regulator. It is desirable to adjust regulator for required pressure under typical conditions. If pressure adjustment is made under "no flow" conditions, the pressure under "flow" conditions will be slightly lower than the "no flow" setting.

MAINTENANCE

To prevent abrasive solids, such as rust, sand and pipe scale, from entering the valve, **the Type 2E Regulators are fitted with a screen. Clean this screen regularly** for best performance. It can be removed by removing the valve guide plug at the bottom of the regulator. For protection against dirty, wet air, install an airline filter ahead of the regulator. **Note: When reassembling valve guide plug, regulator MUST be in vertical position.**

These Regulators will give long satisfactory service with reasonable care. The following points are offered as a guide in getting the best service from them:

1. **If regulated pressure "creeps"—**
   a. Remove valve guide plug at bottom. Inspect screen and valve for dirt on 2E Series. Clean thoroughly. If valve disc or ball is pitted or rough, replace. If valve disc on 2E Series is not being held firmly in place, replace valve.
   b. Remove valve guide plug at bottom. Inspect valve seat. If rough or pitted, replace valve seat by removing bonnet diaphragm and baffle plate.

2. **If regulating action is uneven or faulty—**
   a. (2E Series). Remove valve guide plug at bottom of regulator. Check interior of guide and square extension of valve for foreign matter which may have adhered to these parts. Clean thoroughly.
   b. Remove bonnet, diaphragm, diaphragm gasket, baffle plate, valve seat, valve pin and valve pin gasket (2E Series). Clean valve pin and valve seat thoroughly.

3. **If flow seems small or entirely stops—**
   a. Remove valve guide plug at bottom of regulator. Inspect interior for dirt, scale and other deposits. Clean thoroughly. Be sure screen is clean on 2E Series.

4. **If leaking at joint between body and bonnet occurs—**
   a. Tighten bonnet screws.
   b. If this does not stop the leak, remove bonnet. Inspect diaphragm and diaphragm gasket. Replace if necessary. It is important that the diaphragm and gasket be firmly held around its entire circumference by the clamping action of the bonnet on the body.

5. **If leaking through hole in bonnet—**
   Remove bonnet and inspect diaphragm for holes or cracks. Replace diaphragm and diaphragm gaskets if necessary.

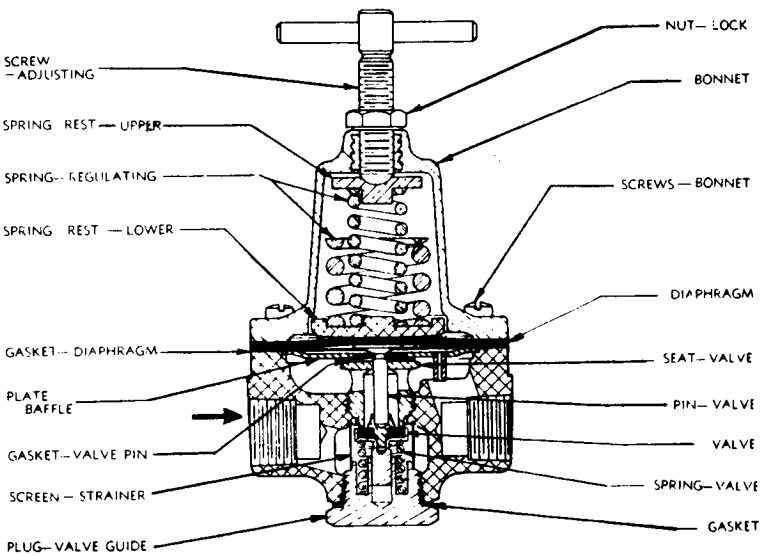


FIGURE 3
Type 11-012 (Butane)

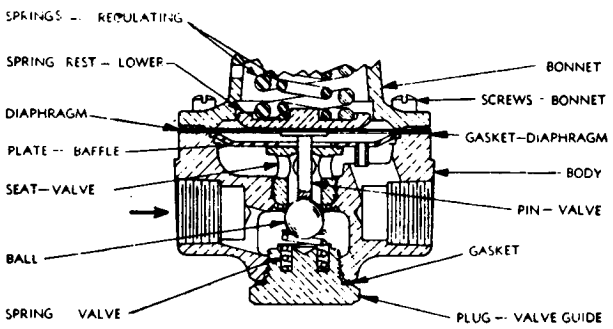


FIGURE 4
Type 11-016 (Steam)

TO ORDER PARTS, SEE NORGREN PARTS PRICE LIST NP-R32 AND NP-R33

Printed in U.S.A.

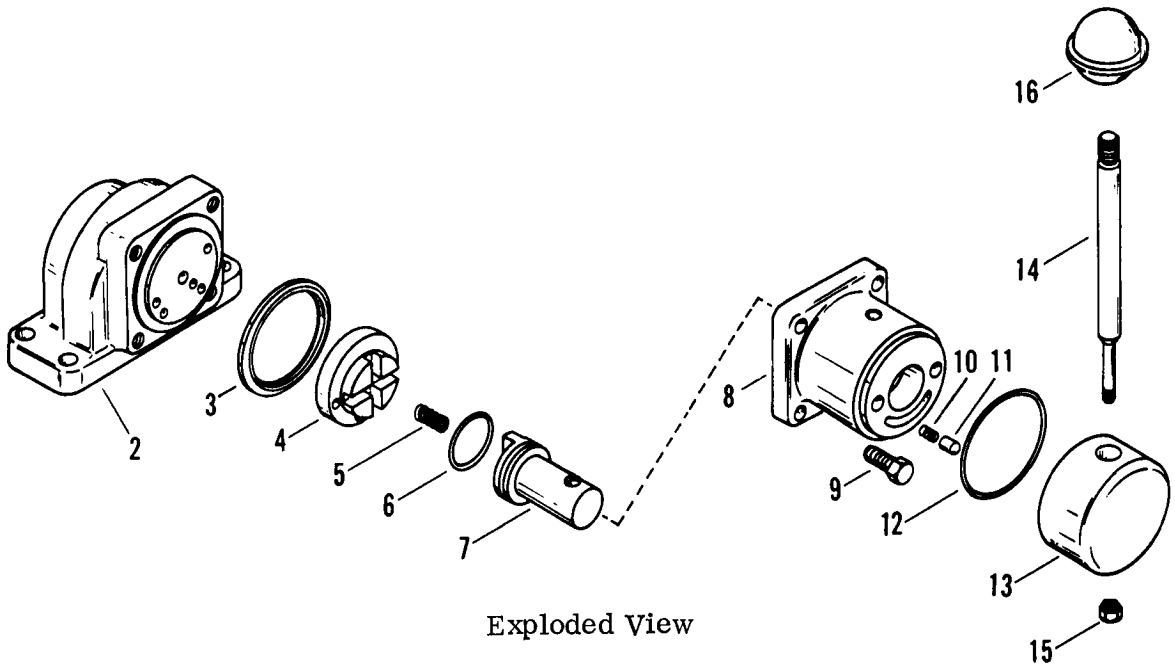
WABCO

INDUSTRIAL PRODUCTS DIVISION

WESTINGHOUSE AIR BRAKE COMPANY / 1963 MERCER ROAD, LEXINGTON, KENTUCKY

5-P-5A ROTAIR® VALVE

SERVICE INFORMATION



Exploded View

5-P-5A ROTAIR® VALVE

Parts List

Ref. No.	Description	Pc. No.	
1	5-P-5A ROTAIR Valve, Complete	P53591	
1	5-P-5A ROTAIR Valve, Complete		P53821
2	SEAT, Rotary Valve	192968	192968
3*	GASKET, Body	81012	81012
4	ROTARY	192960	195345
5*	SPRING, Rotary	1060	1060
6*	RING, 1-1/4" O. D. "O"	524719	524719
7	KEY, Rotary	191992	191992
8	BODY	191982	191982
9	SCREW, Cap (4 req'd)	191917	191917
10*	SPRING, Detent (2 req'd)	191987	191987
11	DETENT (2 req'd)	191986	191986
12*	RING, 2-3/8" O. D. "O"	192009	192009
13	YOKE, Handle	191989	191989
14	SHAFT, Handle	191985	195346
15	NUT, 1/4-28	192416	192416
16	BALL, Handle	539945	539945

*Recommended spare parts to be retained in stock at all times.

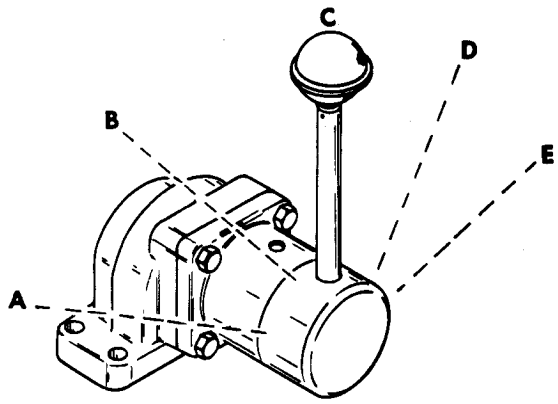
(over)

5-P-5A ROTAIR® VALVE

Schedule Applies to Both Units

HANDLE POSITION	PORTS TO WHICH AIR PRESSURE IS SUPPLIED				
	1	2	3	4	
A		X	X		
B	X		X		
C					
D		X		X	
E	X			X	

Port No. 6 = Supply
Port No. 5 = Exhaust
Ports 1, 2, 3 & 4 are Vented through Port 5 when not supplied.



Handle Positions

MAINTENANCE

Periodically dismantle the valve for inspection, cleaning and lubrication. Wash all metal parts with kerosene or a solvent with like characteristics. Wash all rubber parts with soap and water. Dry all parts with a low pressure air jet.

Replace gasket and packing ring if cracked or worn. Lubricate the rubbing surfaces with a small amount of evenly spread graphite grease.

If the lapped surfaces of the valve or its seat are damaged, these surfaces may be lapped by an experienced mechanic using standard lapping techniques and materials. However, it is preferable that the entire valve be returned to the factory for repairs.

Printed in U. S. A.
5C-1 January, 1963
X-2458

HAND CONTROL VALVE

(VERTICAL HANDLE)

Description

The hand control valve (Fig. AS-16) is of the compensating type and gives the operator graduated control of trailer brakes, independent of tractor foot brake control valves.

Operation

When the control valve handle is moved to apply the trailer brakes, the piston moves downward to close the exhaust valve and open the inlet valve permitting air pressure to pass from the lower cavity of the control valve through the delivery port to the trailer brake system.

The air pressure delivered to the brakes depends on the degree of movement of the handle.

Disassembly (Figure AS-17)

1. Scratch mark end cover (19), body (6), cage assembly (3), and end cap (1) to assist in correct location at reassembly.
2. Remove nuts (17), lock washers (18), and end cover (19).
3. Remove cam button (22), shims (23), piston assembly (10), and spring (7) from body.
4. Remove snap ring (21), piston cup (24), shims (13), spring (12), and shims (11).
5. Remove vee-block seal (9) and "O" ring (8).
6. Remove nut (31), inlet valve (29), exhaust valve (28), spring (4), and "O" rings (2-5) from cage assembly.
7. Remove snap ring (27), cap (26), and screen (25) from body.

Cleaning and Inspection

Wash all metal parts in cleaning fluid. Examine inlet valve seat in cage and exhaust valve seat on lower end of piston; they must be free of nicks or other damage.

Assembly

1. Install spring (4) on exhaust valve (28) and install in cage assembly. Install inlet valve (29) and nut (31); tighten securely.
2. Install new "O" rings (2-5).
3. Install new vee-block seal (9) and "O" ring (8) on piston (10).
4. Install shims (11), spring (12), shims (13), and piston cup (24) in piston and install snap ring (21).
5. Install spring (7) in body (6).
6. Use scratch marks made at disassembly to install cage assembly (3) and body on studs (30).
7. Install shims (23), cam button (14) and end cover (19). Install lock washers (18) and nuts (17), tighten securely.

NOTE: Shims are used as required to maintain a dimension of .030" to .040" between the exhaust valve and seat. This dimension can only be checked by inserting a feeler gauge through the delivery port.

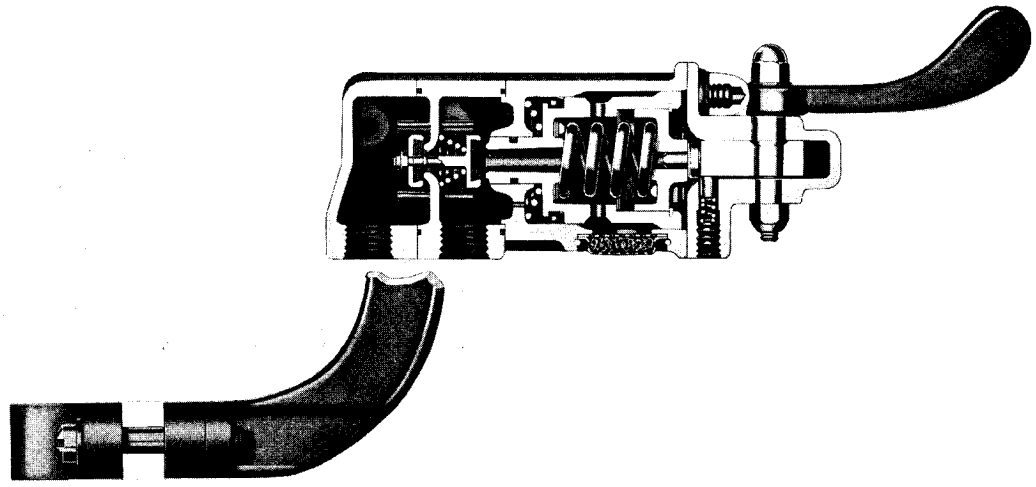


Figure AS-16 Vertical Handle Hand Control Valve (Cross-Sectional View)

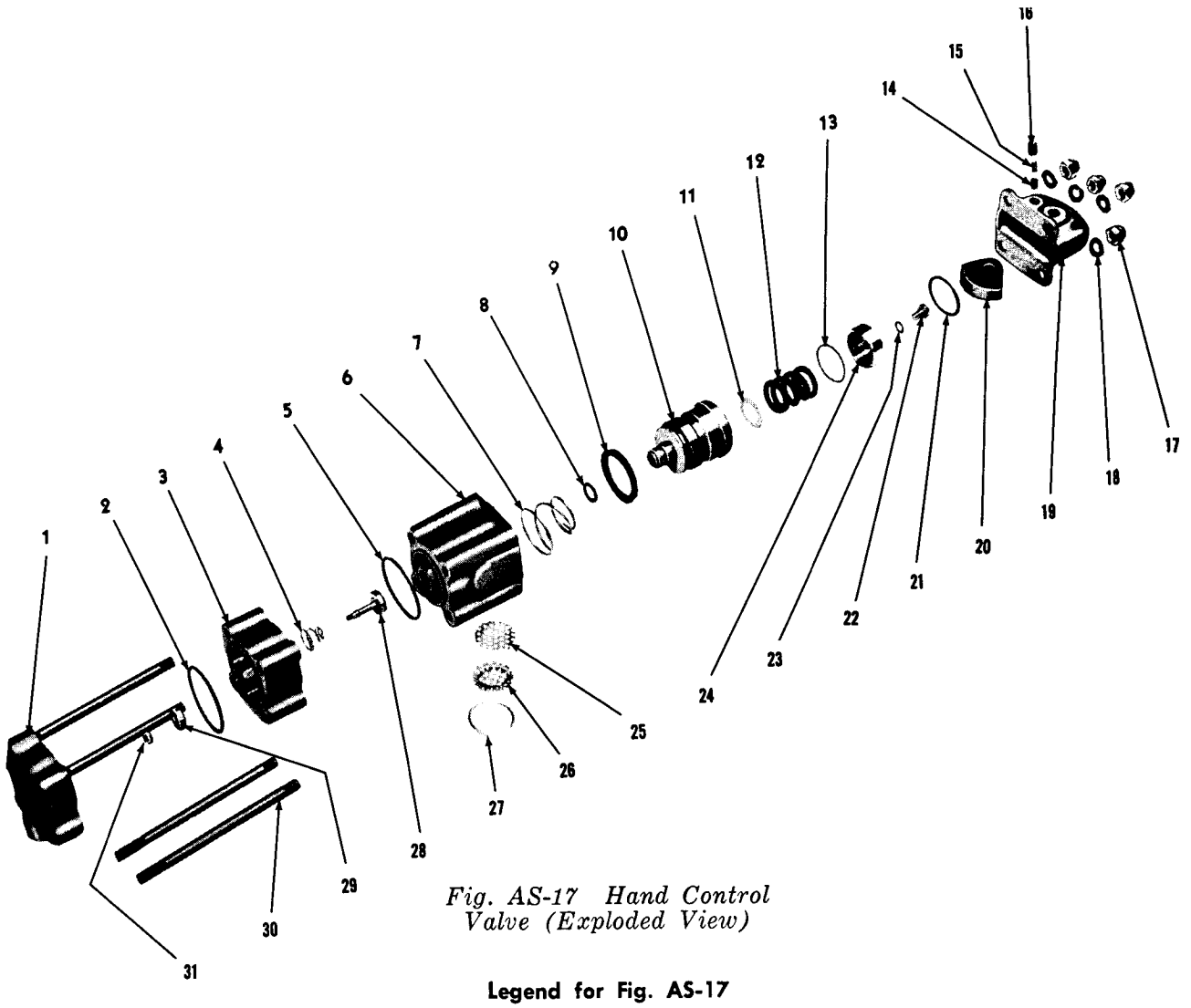


Fig. AS-17 Hand Control Valve (Exploded View)

Legend for Fig. AS-17

KEY	DESCRIPTION	KEY	DESCRIPTION	KEY	DESCRIPTION
1	CAP, END	11	SHIMS	21	RING, SNAP
2	"O"-RING	12	SPRING	22	BUTTON, CAM
3	CAGE, ASSEMBLY	13	SHIMS	23	SHIM
4	SPRING	14	POINT, SET	24	CUP, PISTON
5	"O"-RING	15	SPRING, SET SCREW	25	SCREEN
6	BODY	16	SCREW, SET	26	CAP
7	SPRING	17	NUT, ACORN	27	RING, SNAP
8	"O"-RING	18	WASHER, LOCK	28	VALVE, EXHAUST
9	SEAL, VEE-BLOCK	19	COVER, END	29	VALVE, INLET
10	PISTON	20	CAM	30	STUDS
				31	NUT

Test

Released Position

Plug cylinder port, connect air supply and air gauge to inlet port. Check exhaust port; no leakage allowed.

Applied Position

Connect cylinder port to small reservoir with air-gauge. Apply handle to allow 5 to 10 psi to register at reservoir gauge. Check exhaust port with soapy water; permissible leak is a one inch soap bubble in three seconds.

Apply handle slowly and note that pressure registered at the small reservoir builds up in proportion to handle travel. With handle fully applied both air gauges should register the same.

SPECIFICATIONS

The following specifications apply to current production machines only.

25-B SUPERCRANE WEIGHT BREAKDOWN FOR TRANSPORTING

The approximate working weight of the 25-B Supercrane with a standard 30' alloy steel boom is 68,350#. In some instances it may be possible to transport the machine without stripping for transporting.

The following information should be helpful in determining what should be removed from the complete machine, in order to meet highway load limits when transporting the 25-B Supercrane from job site to job site.

Upper works with truck frame and axles with nominal fuel supply and water in radiator	31,395#
Crawler side frame assembly, std. 30" treads (each)	7,440#
One-piece removable counterweight	17,370#
30' alloy steel angle boom and boom point machinery	2,775#
Ropes and pendants	250#
Mast pendant links and mast links	630#
Bridle complete with sheaves	260#
Boom stop	260#
30 ton hook block	610#

These weights are approximate and are not guaranteed to be exact by the Bucyrus-Erie Company. They will vary slightly depending upon optional equipment and assessory items. These figures should be used as a guide and actual weights verified before requesting permits.

X-2037
Rev. 3-65

MODEL 25-B

ENGINE DATA

Current

KEY:
D - DIESEL
G - GASOLINE

*Hi-Idle - Clutch Disengaged - Throttle Fully Advanced
*No-Load - Clutch Engaged - No Load on Machinery -Throttle Fully Advanced
*Theo. Stall - Clutch Engaged -Throttle Fully Advanced-Machinery Stalled

DIRECT DRIVE

DRUM SHAFT SPEED: NO LOAD
41.5 ± 1/2 R.P.M.

ENGINE	ALTITUDE RANGE 1000 FEET	ENGINE SPROCKET NO. OF TEETH	ENGINE SPROCKET PART NUMBER	CHAIN PITCH STRANDS	FUEL RACK ADJ. OR INJECTORS	ENGINE SPEED NO LOAD	ENGINE SPEED FULL LOAD	TRANSMISSION MAKE	TRANSMISSION LOW	TRANSMISSION DIRECT	TRANSMISSION OVER
D Cat D-330A	0 to 10	22	600814K21	5/8"-5	⁄.020	2290	2125	*See Note	Below		
G IHC U-501	0 to 4	20	600815K21	5/8"-5	Test Stand	1615	1470	-	-	-	-
G IHC U-501	4 to 6.5	18	600978K21	5/8"-5	" "	1800	1635	-	-	-	-
D IHC UD-525	0 to 7.5	22	600814K21	5/8"-5		1465	1395	-	-	-	-
D GM 4-71	0 to 7.5	20	600815K21	5/8"-5	60 MM	1610	1465	-	-	-	-
G IHC U-501	0 to 4	20	600815K21	5/8"-5	Test Stand	1615	1470	FWD	-	1:1	1.55.1
G IHC U-501	0 to 4	20	600815K21	5/8"-5	" "	1615	1470	FWD	1.3:1	1:1	-
D GM 3-71	0 to 7.5	20	600815K21	5/8"-5	60 MM	1610	1465	FWD	-	1:1	1.55.1
D GM 3-71	0 to 7.5	20	600815K21	5/8"-5	60 MM	1610	1465	FWD	1.3:1	1:1	-

*Cat D330A is equipped with reduction gear with 1.56:1 ratio at engine sprocket. The speeds at engine sprocket are 1465 RPM with engine at (full throttle) no load and 1360 RPM with engine at full load.

TORQUE CONVERTER DRIVE

DRUM SHAFT SPEED: NO LOAD
45.3 ± 1/2 R.P.M.

ENGINE	ALTITUDE RANGE 1000 FEET	ENGINE SPROCKET NO. OF TEETH	ENGINE SPROCKET PART NUMBER	CHAIN PITCH STRANDS	FUEL RACK ADJ. OR INJECTORS	ENGINE SPEED Hi Idle	ENGINE SPEED No Load	TORQUE CONVERTOR Theo. Stall	TORQUE CONVERTOR MAKE	TORQUE CONVERTOR MODEL
D GM 4-71	0 to 4	25	614091K21	5/8"-5	60 MM	2150	-	1850	Twin Disc	6CO-1504-1 MS-235
G IHC U-501	0 to 4	24	615788K21	5/8"-5	Test Stand	1980	-	1580	Twin Disc	6CO-1504-1 MS-280
D Cat D-330T	0 to 4	24	615788K21	5/8"-5		2200	-	1875	Twin Disc	6CO-1504-1 MS-235

MODEL	ISSUED	SUPERSEDE	

MODEL

ENGINE DATA

KEY:
D - DIESEL
G - GASOLINE

*Hi-Idle - Clutch Disengaged - Throttle Fully Advanced
*No-Load - Clutch Engaged - No Load on Machinery -Throttle Fully Advanced
*Theo. Stall - Clutch Engaged -Throttle Fully Advanced-Machinery Stalled

DIRECT DRIVE

DRUM SHAFT SPEED: NO LOAD
41.5 ± 1/2 R.P.M.

ENGINE	ALTITUDE RANGE 1000 FEET	ENGINE SPROCKET NO. OF TEETH	ENGINE SPROCKET PART NUMBER	CHAIN PITCH STRANDS	FUEL RACK ADJ. OR INJECTORS	ENGINE SPEED NO LOAD	ENGINE SPEED FULL LOAD	TRANSMISSION MAKE	TRANSMISSION LOW	TRANSMISSION DIRECT	TRANSMISSION OVER
AC. 10,000	0-10	18	-	5/8-4	-	1800		-	-	-	-
Waukesha 135GZU	0-4	18	-	5/8-4	-	1800		-	-	-	-

TORQUE CONVERTER DRIVE X-2037

DRUM SHAFT SPEED: NO LOAD
45.3 ± 1/2 R.P.M.

ENGINE	ALTITUDE RANGE 1000 FEET	ENGINE SPROCKET NO. OF TEETH	ENGINE SPROCKET PART NUMBER	CHAIN PITCH STRANDS	FUEL RACK ADJ. OR INJECTORS	ENGINE SPEED Hi Idle	ENGINE SPEED No Load	TORQUE CONVERTOR Theo. Stall	TORQUE CONVERTOR MAKE	TORQUE CONVERTOR MODEL
Waukesha 135GZU	0-4	20		5/8-4	-	2420	1830	1670	Allison	TCDOA3777

MODEL | ISSUED | SUPERSEDE

LESCHEN
Red-Strand
Technidata
LESCHEN WIRE ROPE COMPANY ST. JOSEPH, MO.
REPORT NO. 107

WIRE ROPE INSPECTION

Periodic inspections of wire ropes in use are necessary for one very important reason: Wire rope is a "consumed" item. It is literally "used up" as it is used, and gradually loses strength during its useful life.

The purpose of an inspection, then, is simply to ascertain – insofar as may be possible – whether a wire rope retains sufficient capability to perform the work to be done before the next scheduled inspection.

That regular inspections are required by certain governmental regulations is, in a sense, of secondary importance – since the need to perform such inspections would exist anyway.

But the government does require machine owners and/or users to conduct regular, proper inspections, and to keep written records of such inspections . . . and the burden of this requirement is upon the owner/user.

Probably the primary rule to follow in conducting a wire rope inspection on any typical machine or piece of equipment is that each wire rope must be considered individually.

This individual treatment is particularly important when inspecting so-called "standing" ropes – those which are primarily supporting, or structrual, members. For example, the pendants which support long crane booms are frequently made up of several sections, each of which is an individual rope and must be examined individually.

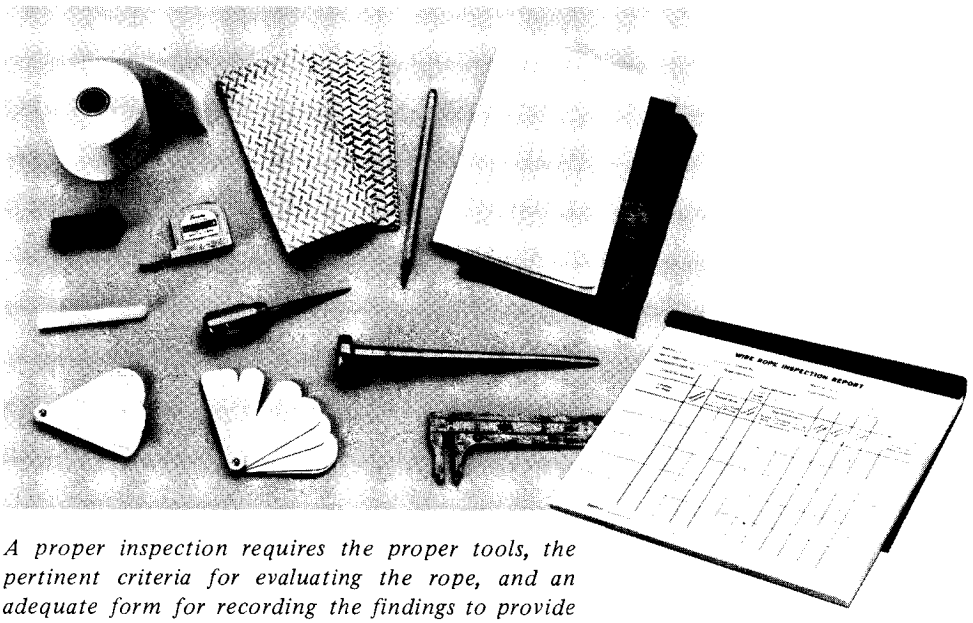
Because different inspection criteria frequently apply, so-called "standing" ropes should be inspected separately from the "running", or operating, ropes on the same machine or installation. Practicalities may dictate that parts of both running and standing ropes be inspected on the same trip to some high or inconvenient location on an installation – but never-the-less, each rope must be given individual attention, and the pertinent information on each rope must be recorded separately.

It should not be necessary to point out, but it must be emphasized, that a proper inspection cannot be made when a wire rope is supporting a load or is in motion. A rope should be "relaxed and at rest" during the inspection. An exception might be certain types of conveyor and tramway ropes.

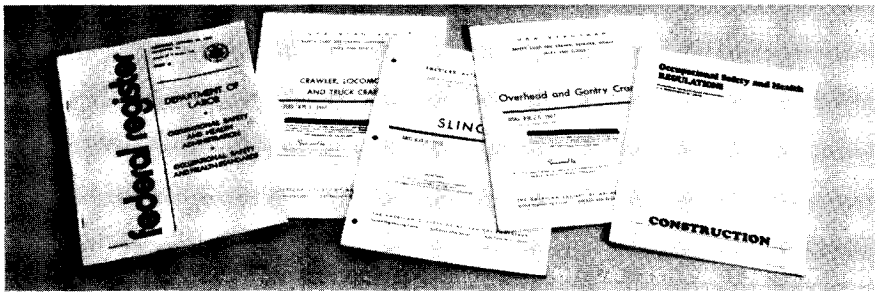
Several tools are useful in inspections. These include:

An awl and a marlin spike.
A caliper.
A steel tape.
Two groove gauges.
Chalk.
Wiping cloths.
Pencil, paper and carbon paper.

The manufacturer's handbook or Operator's Manual for the machine involved, and copies of pertinent governmental and other inspection criteria and specifications are also useful.



A proper inspection requires the proper tools, the pertinent criteria for evaluating the rope, and an adequate form for recording the findings to provide a permanent record.



How Often to Inspect

Quite obviously, the greater the usage a rope receives, the more often inspections would be indicated. Typical Occupational Safety and Health Act (OSHA) regulations state:

> "A thorough inspection of all ropes shall be made at least once a month and a full written, dated, and signed report of rope condition kept on file where readily available."

OSHA Specification 1926.602 refers to Power Crane and Excavator Standards for material handling equipment as follows, regarding wire rope inspections (8.2.1.2):

> "All wire ropes in active service should be visually inspected once each working day. A thorough inspection of such ropes should be made at least once a month and dated records kept as to rope conditions."

The OSHA regulations for overhead and gantry cranes states:

> "Inspection procedure for cranes in regular service is divided into two general classifications based upon the intervals at which inspection should be performed . . . designated as 'frequent' and 'periodic' with respective intervals between inspections . . . (a) Frequent inspection – daily to monthly intervals. (b) Periodic inspection – 1 to 12-month intervals."

The foregoing would seem to underscore the wisdom of many machine users who insist on a daily or work-shift, visual inspection of all the elements in a wire rope system. The OSHA Regulations, however, are specific with reference to written and signed reports on thorough, periodic inspections.

'Critical' Points

There are certain points along any given rope which should receive more attention than others, since some areas will usually be subjected to greater internal stresses, or to greater external forces and hazards.

Carefully select the most critical points for close inspection – points where failure would be most likely to occur. The same critical points on each installation should be compared at each succeeding inspection.

Critical points which should be considered for careful inspection on most installations would include the following:

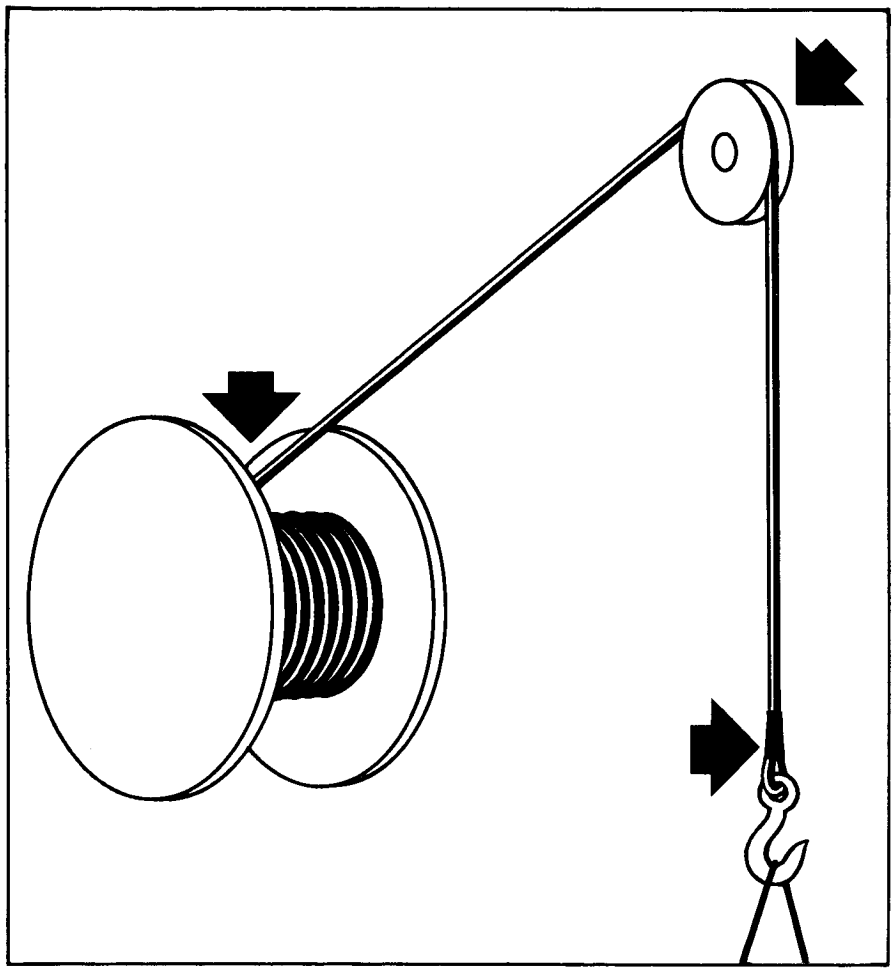
Pick-up Points – These are sections of rope which are repeatedly placed under stress when the initial load of each lift is applied – such as those sections in contact with sheaves.

End Attachments – At each end of the rope, two things must be inspected: the fitting that is attached to the rope, or to which the rope is attached . . . and the condition of the rope itself, where it enters the attachment.

Equalizing Sheaves – The section of a rope which is in contact with and adjacent to such sheaves, as on boom hoist lines, should receive careful inspection.

Drums – The general condition of the drum, and condition of grooves if the drum is grooved, should receive careful inspection – as should the manner in which the rope "spools" onto the drum.

Sheaves – Every sheave in the rope system must be inspected and checked with a groove gauge.

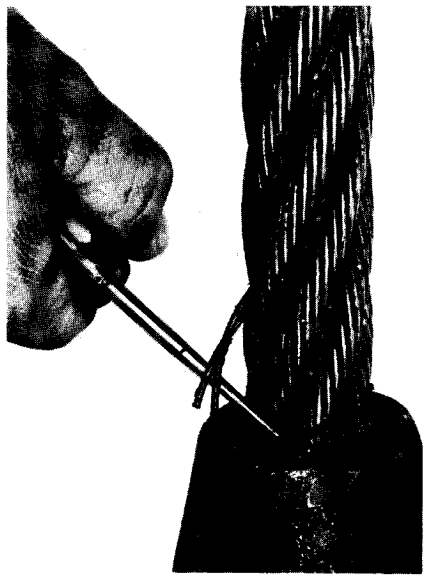


Heat Exposure – Be especially watchful for signs that a rope has been subjected to extreme heat, or to repetitive heat exposure.

Abuse Points – Frequently ropes are subjected to abnormal scuffing and scraping, such as contact with cross-members of a boom. Look for "bright" spots.

It must be kept in mind that minor – and frequently major – differences exist between installations, even on machines of a similar design. Therefore, points on each rope selected for close examination will necessarily require the best judgement of the inspector.

End Attachments



All end attachments have one characteristic in common: all restrict, to some degree, the free movement of wires at the end of the rope. This impairment of the ability of wires to adjust and move at the end can ultimately result in breakage of wires at the point where restriction occurs.

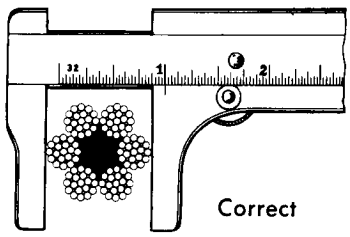
Thus, broken wires are a primary concern when inspecting end attachments on a rope. A single broken wire is usually reason to question continued use of the rope, and more than one is usually sufficient cause for rejection.

Broken wires may be more difficult to locate at end fittings than in other sections of rope. An awl used to pick and probe at the point where strands enter the end attachment can often expose broken wires not otherwise visible.

Another problem frequently encountered at end fittings is corrosion or rust. Such corrosion can easily conceal broken wires, and if left to accumulate can erode the surface of wires to weaken them, or can restrict normal wire movement.

Inspection of rope ends should also include the condition of the actual attachment – worn eyes, missing thimbles, bent or "opened" hooks, worn clevis pins, and so on.

Measuring Diameter



Every periodic inspection must include diameter measurement at critical points – and recording of measurements for future comparsions.

Most inspection standards are specific on permissable reductions in diameter, and the criteria for the installation and industry involved should be known by the inspector before starting to take measurements.

Measurements are proper only when made across the "crowns" of rope strands, so that the true diameter is the widest diameter at any given point on the rope. Always rotate the caliper on the rope – or the rope inside the caliper – to take a measurement.

Reductions in diameter are caused by several factors, including:

Initial "Pull-Down" – All ropes are manufactured larger than nominal diameter. When placed in operation the first time, strands of a new, unused, rope will "seat in", and the diameter will be "pulled down" from its original diameter. Therefore, the first measurements should be made and recorded for future reference after the time of such a rope's initial loading.

Normal Wear – In normal usage, the outer wires, particularly on the crowns of strands, will exhibit wear. Various inspection standards are specific as to the amount of such metal loss permissible.

Internal Rope Damage – When the core of a wire rope has begun to deteriorate, diameter reduction is often the first detectable outward sign. Impending internal breakdown should always be suspected when a sudden or significant diameter reduction is noted, and if possible, an internal rope examination should be made.

Regular Lay

Lang Lay

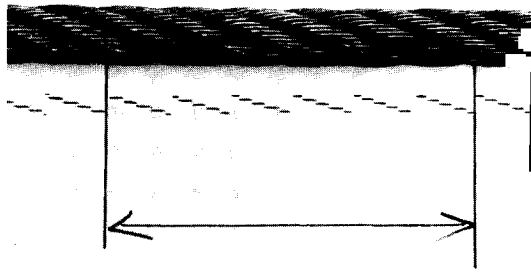
This picture simulates 6x25 fw construction wire ropes with surface wear (only) of 1/3 the outer wire diameter.

Measuring Rope Lay

One rope lay is the length along the rope which a single strand requires to make one complete spiral, or "turn", around the core. It is an engineering factor in the design of a rope, and is carefully controlled during manufacture.

Since there is often some "adjustment" in rope lay during the initial "break-in" stages of a rope's usage, it is recommended that rope lay measurements should be made after the initial loading, for comparison purposes at succeeding periodic inspections.

One method for measuring rope lay is with ordinary carbon paper, blank white paper and a pencil. Firmly hold the paper and carbon on the rope and



"stroke" with the side of the pencil, so the rope's "print" is made on the paper.
By drawing a line through one strand of the "print", counting off the number of strands in the rope and then drawing another line on the print at the place where the same strand appears again, a measurement is established.
Many inspectors have found that a crayon or marking stick and a roll of adding machine tape are ideal for making a "print" at least three rope lays long – so that an average lay length can be determined.
Changes in length of lay are usually gradual throughout the working life of a rope. It is important to compare current lay measurements with previous inspection results to note any sudden changes – for an abrupt change in the pattern can be the signal of an impending problem.

As a rule, if lengthening of lay is noted WITH loss of rope diameter, internal break-up or core destruction should be suspected.

When lengthening of lay is noted WITHOUT loss of rope diameter, the rope is probably "unlaying" for some reason, and further examination should be made for the cause.

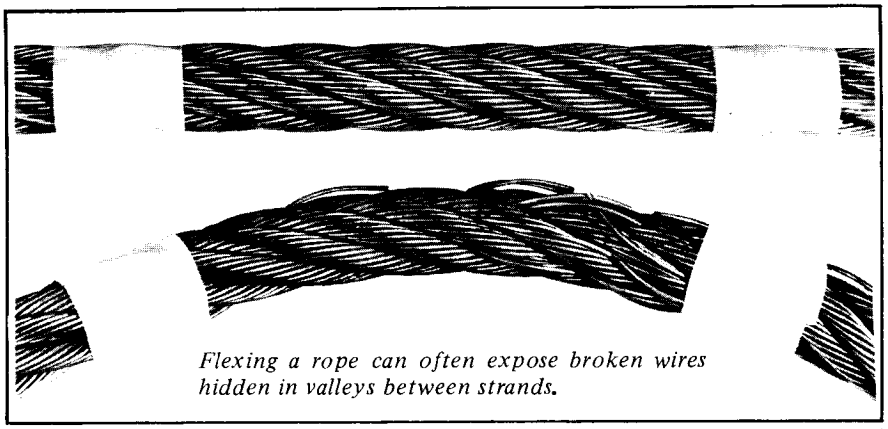
Unlaying sometimes results from operating a rope without having both ends secured to prevent rotation. An end swivel attachment permits such rotation and unlaying.
Another common cause of unlaying is worn sheaves. When the bottom of a sheave groove wears, it can restrict normal movement as the rope enters and leaves the groove; the result can be a build-up of twist which can change the length of lay.
Whatever the cause, unlaying is an abnormality, and should be noted for future reference if the immediate cause cannot be determined.

Finding Broken Wires

Probably the most common sign of rope deterioration and approaching failure is broken wires, and inspection criteria are specific as to the number of broken wires allowable under various circumstances.
It is normal for a properly designed and used "running", or operating, rope to exhibit broken wires as it approaches the end of its useful life. Under ideal conditions, the first wires to break would be the outside wires at the crowns of the strands – where surface wear is expected to occur. On "standing" ropes, wire breakage may not be so easily observed.

It is important that a diligent search be made for broken wires, particularly in critical areas such as "pick-up points" where stresses are concentrated.
The first step in looking for broken wires is to make sure the surface is clean enough that breaks can be seen. Wipe with a cloth. If necessary, scour with a wire brush to clean grease from the valleys between strands.
A thorough search for broken wires cannot be made when a rope is in tension or is supporting a load. Relax the rope, move "pick-up points" off sheaves, and flex the rope as much as possible.

With a sharp awl, pick and probe between wires and strands, lifting any wires which appear loose or move excessively.
If you find a number of broken wires approaching the maximum allowable permitted per strand or per rope lay, extend the search to other sections of the rope, and also take diameter and lay measurements in the area. If internal wire breaks or core damage are suspected, an internal examination should be made, if possible.



Flexing a rope can often expose broken wires hidden in valleys between strands.

One rope lay is the length along the rope which one strand uses to make one complete spiral around the core.

Number of broken wires permitted per strand in one rope lay is specified in inspection criteria for each usage.

Under ideal and normal conditions, wires should break first on the crowns of strands . . . as in this classic example of a worn out rope.

Making an Internal Rope Examination

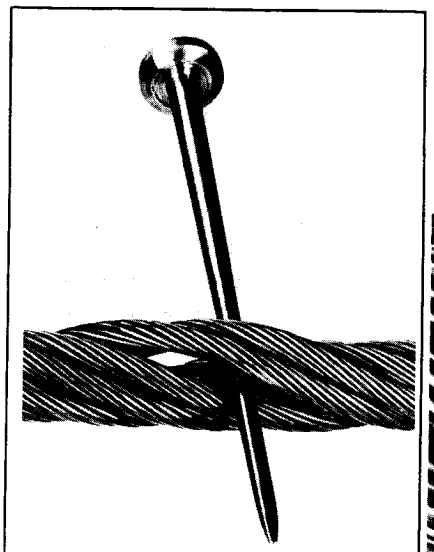
Anytime interior damage, broken wires or core failure may be suspected, a section of rope should be opened for internal examination. This may be accomplished without destroying the rope's future usefulness if due care is exercised and wires are not kinked or notched.

A rope can be opened for internal inspection only when completely relaxed. Using due care, "work" a marlin spike beneath two strands and rotate the spike to expose the core and "under" side of strands. Use an awl to probe for broken wires and examine inner surfaces.

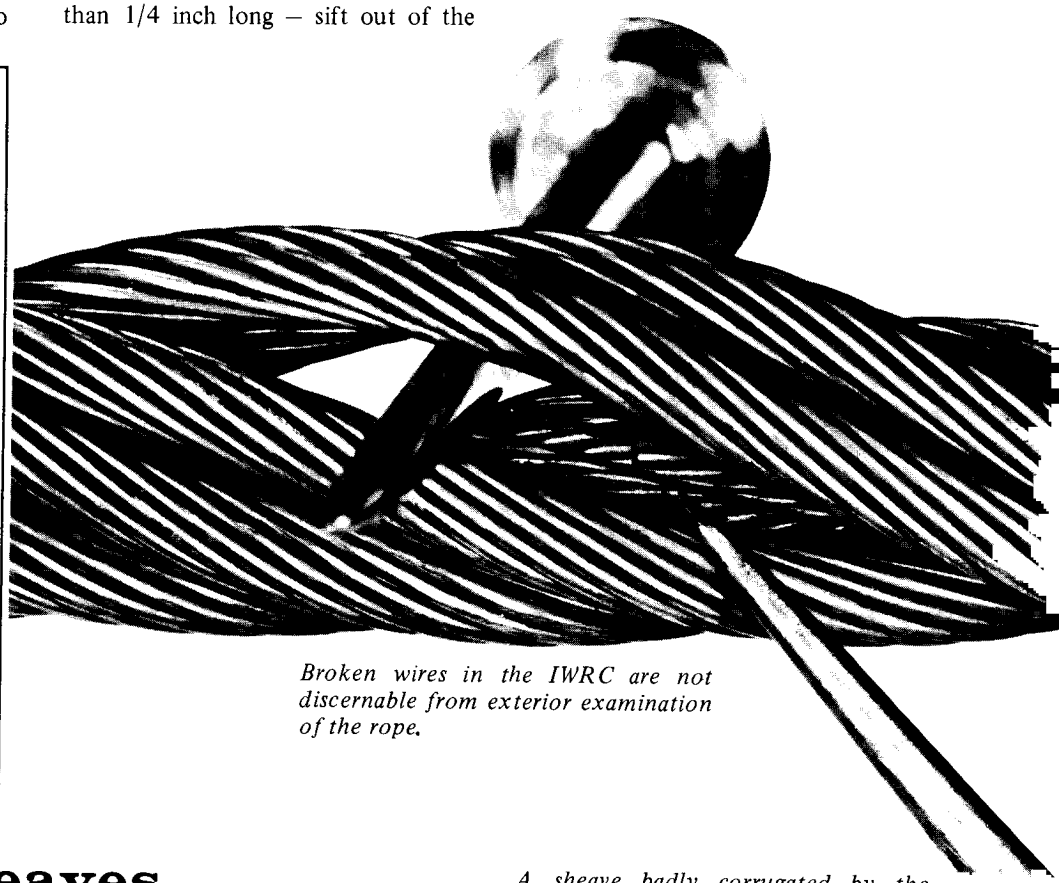
If the rope has an independent wire rope core, look for broken wires on the "under" sides of strands where the strands contact the IWRC. Look for excessive "nicks" or broken wires in the strands caused by contact between adjacent strands or with IWRC. Examine the IWRC for broken wires also.

In the case of fiber core ropes, examine the core for excessive breakage of fibers. If short pieces of fiber – less than 1/4 inch long – sift out of the core, it is breaking up. Such short, broken fibers sometimes indicate the rope is being over-loaded, pinched in tight sheaves, or subjected to other abuse.

If a rope has been opened properly and carefully – and internal condition does not show cause for removal – strands can be returned to their original working positions without distorting the rope or impairing future usefulness.



To open a rope, insert marlin spike beneath two strands and rotate to lift strands and provide view of interior.



Broken wires in the IWRC are not discernable from exterior examination of the rope.

Inspecting Sheaves

Almost every rope installation has one or more sheaves – ranging from traveling blocks with complicated reeving patterns to equalizing sheaves where only minimal rope movement is noticeable. Each sheave should receive an individual examination at periodic inspections.

Each sheave is to be examined for the following:

- Groove depth, width and contour.
- Groove smoothness.
- Broken or chipped flanges.
- Cracks in hubs, spokes, etc.
- Signs of rope contact with guards.
- Sheave bearings and shaft.
- Out-of-round condition.
- Alignment with other sheaves.

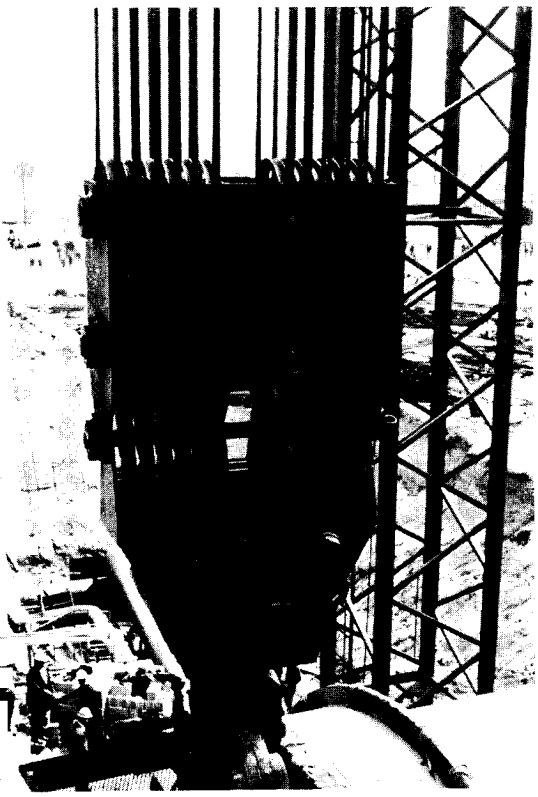
Assessing the general physical condition of a sheave – groove smoothness, freedom from cracks and "knicks", existence of wear on guards, etc. – is a matter of careful, knowledgeable observation.

Properly gauging and evaluating the width, depth and contour of grooves with a groove gauge requires keen observation as well as knowledge of gauge design and use.

A sheave badly corrugated by the rope's "print", a condition which could seriously damage the wire rope.

There are two types of wire rope groove gauges:

1. Those used by manufacturers of sheaves and drums, which make allowance for the maximum allowable oversize for wire rope, and are used to determine the proper contour for NEW grooves.
2. Those used "in the field", which are made to the nominal diameter of the rope PLUS one-half the allowable rope oversize. These are used to determine the MINIMUM condition for WORN grooves.

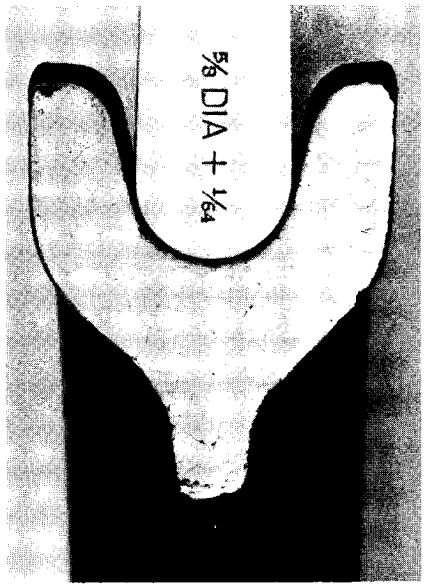


Each sheave in a multiple block is to be examined individually at each periodic inspection.

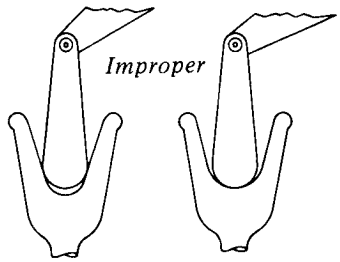
In a field inspection, when the gauge for worn grooves fits perfectly, the groove is at the minimum permissible contour. Anything narrower is unsuitable for use.

It is a good rule to keep in mind that, under normal operating conditions, as a groove wears it tends to become deeper and narrower. Excessive wear in an over-width manner frequently indicates some operating abnormality such as alignment.

Sheave inspection should also include the condition of bearings and shaft. With the rope "relaxed", the sheave should be rotated by hand to determine the "fit" of the bearing and effectiveness of its lubrication . . . whether the sheave runs true, without "wobbling" on its shaft . . . whether the bottom of the groove is still concentric, or "round" in relation to the shaft . . . and whether the sheave and its shaft are in proper alignment with other sheaves or components of the system.

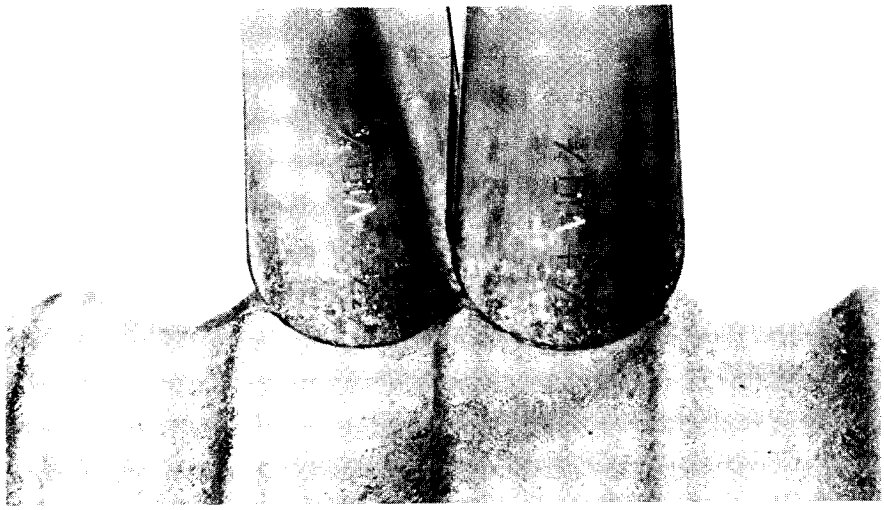


A proper fitting sheave groove should support the rope over 135-150 degrees of rope circumference.



Observe the groove so that it may be clearly seen whether the contour of the gauge matches the contour of the bottom of the groove.

Evaluating Drums



Even though both these gauges properly follow groove contours, when used side-by-side they indicate grooves are too close. Two gauges which overlap in this manner reveal that wraps of rope will scrub when spooling on to or off the drum.

Inspection criteria for drums will usually specify the following:

- Minimum number of dead wraps to remain on the drum.
- Condition of drum grooves, if a grooved drum, and the surface of a smooth drum.
- Condition of flanges at the ends of the drum.
- Rope end attachment.
- Spooling characteristics of the rope.
- Rope condition, particularly at "pick-up points" on the rope.

There is wide acceptance of the following guidelines for checking drums and drum operation.

GROOVES should be of proper contour, and checked with a groove gauge if normal tolerances apply. Bottoms of grooves should be smooth; drums

that become imprinted with the rope's "tread", or excessively roughened, should be corrected or replaced. Grooves should be spaced so one wrap of rope does not "scrub" the next wrap as it spools onto the drum.

SPOOLING is that characteristic of a rope which affects how it wraps onto and off a drum. Spooling is affected by the care and skill with which the first layer of wraps is applied on drums with two or more layers. Wraps should be tight, and a loose condition must be corrected. It is important to examine a rope for kinks or other damage when loose or irregular spooling has been observed.

DRUM CRUSHING is a rope condition sometimes observed which indicates deterioration of the rope. Sometimes crushing is inevitable on a given drum winding, as is deformation of the wires in the rope, usually described as peening. Crushing and peening affect rope performance insofar as these conditions impair adjustment of wires in the rope and damage the wires themselves. When observed, either condition should be noted and careful evaluation of rope made.

How to Use Inspection Forms

These forms were prepared to serve as a guide for making thorough periodic examinations of single wire ropes and serve as a permanent record of the inspection. One form should be used for each rope at each such inspection.

Before beginning an examination of an installation, fill in the blank spaces at the top of the form. These identify the machine or installation, its owner, location, date, etc.

"Rope Application" refers to the specific usage of the rope . . . such as "Main Hoist", or "Boom Pendant", or "Boom Hoist".

After "Rope Description", fill in the diameter, construction, type, etc. . . . such as 1 in. 6x25 FW PRF RLL XIP IWRC.

After "Manufacturer's Ident. No.", insert data which will positively identify this rope . . . preferably the manufacturer's "reel number" which identifies the reel from which the rope was taken. The manufacturer's original purchase invoice or the shipping reel tag

usually carries this number.

The "Applicable Standards" refer to that set of inspection criteria applicable to this installation which can be found in standards and regulations . . . such as ANSI B30.2 for Overhead & Gantry Cranes or Federal Regulations such as OSHA.

It is the inspector's responsibility to obtain the proper inspection criteria for the application to be inspected.

At the column headings to the right of the words "Criteria for Removal", space is provided for the inspector to fill in specific criteria pertaining to each column. Two of these headings are filled in with criteria applicable to all wire rope installations – "1/3 of outside wire diameter" is the maximum wear permissible. One (1) broken wire is the maximum number permissible at end attachments. Fill the other blank spaces with data taken from the proper set of criteria for the machine involved.

A blank column is provided for inspector's use if it is desirable to check any other factor which is not listed on this form.

At the time of each inspection of an installation, refer back to previous inspection records to determine locations on each rope which should be inspected. If the installation has not previously had a thorough inspection, sound judgement should be used in selecting these locations. "Critical Points" should be given first consideration.

The same locations on each rope should be examined carefully at each succeeding inspection so that rope diameter, lay, etc., may be compared to previous measurements in order to detect change in the rope condition. Sudden changes in condition may indicate deterioration.

At each inspection location on a rope, clean the rope sufficiently to be able to find broken wires and to take precise measurements. To be useful, measurements must be accurate.

For each inspection location selected on each rope, describe on the Inspection Report the exact location – such as "Boom point sheave at pick-up". Then, in the order in which columns are established on the Report form, make the indicated observations and write down the information:

1. Measure diameter.
2. Examine for broken wires, (a) in one rope lay, and (b) in one strand of one rope lay. When a broken wire is found, look carefully for others. Record the number of breaks in that rope lay where the most breaks are found.
3. At this same location, inspect for excessive wear.
4. If the examination is being made at a rope dead-end, check for broken wires, corrosion and condition of the fitting.
5. A lay measurement should also be taken at the location selected for inspection.
6. Examine the entire rope end-to-end for evidence of external damage or abuse. Where damage or abuse is noted, proceed to make all the same observations for this location as at any "regular" inspection point. Try to determine the exact cause of any external damage so that "recurring" damage may be prevented.
7. Every sheave should receive a thorough examination and the condition recorded. When the rope "pick-up point" is being examined at a sheave, the data on the sheave can be recorded at that space on the form.
8. Examine and record the drum condition. In a proper inspection, the drum should be observed both in operation and at rest, in order to observe "spooling".

To provide space for all these measurements, five horizontal spaces are provided on each Inspection Report form. Should these not be sufficient for extremely long ropes, or for any other reason, these spaces may be divided with horizontal lines – or a second form used.

When an inspection is completed – or has proceeded far enough for the inspector to decide that rejection is in order – the form should be signed by the inspector. Comments may also be written at the bottom, if desired.

Federal regulations require that signed inspection reports must be maintained on file for all ropes in active service.

NOTICE TO INSTRUCTION MANUAL USERS

1. **This booklet is being provided, not necessarily as an endorsement of Leschen wire rope, but as aid to our customer in performing wire rope inspection.**
2. **Regulations quoted or referred to in this booklet are subject to change and may not be all inclusive; therefore, current and local regulations should be consulted and used in conjunction with this booklet.**
3. **The wire rope inspection form referred to in this booklet may be obtained from the local Leschen wire rope distributor or possibly through a local printer.**

BUCYRUS-ERIE COMPANY