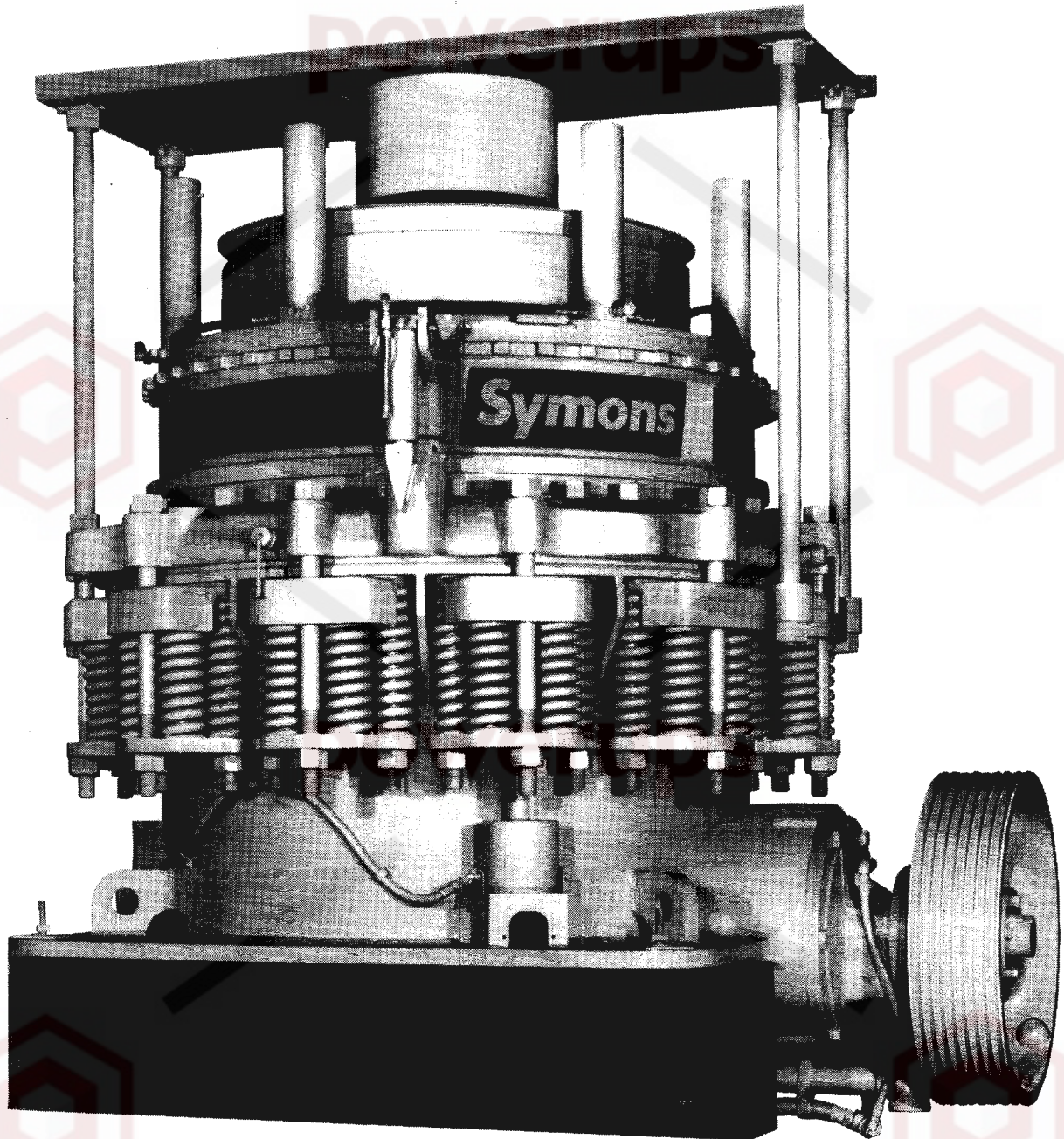


# ***Symons Cone Crusher Instruction Manual***

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SECTION 0

**SAFETY**

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## SECTION 0

# SAFETY

### PERSONNEL SAFETY

This portion of the instruction manual is intended to illustrate only basic safety procedures. Additional precautions may be necessary for the safe operation of a Crusher. The information contained in this manual is not intended to replace safety codes, insurance requirements, federal, state and local laws, rules and regulations.

SAFETY of the operator and maintenance personnel is of prime concern. These paragraphs are presented as a helpful guide to construction equipment personnel, and shows some of the daily work problems which they may encounter.

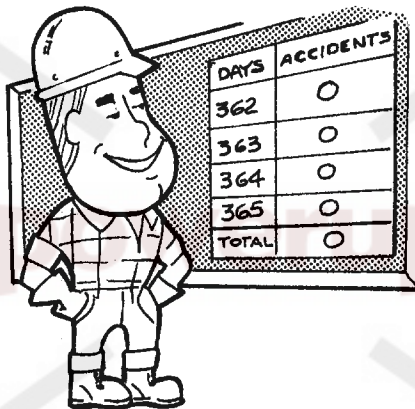
It is the responsibility of the operator to know what specific requirements, precautions and

work area hazards exist, and to discuss them with his supervisor. A common understanding should be reached by all personnel to assure safe performance in operating the equipment.

The operator is the key to safe job performance and should study these safety tips to be aware of basic safety precautions to help prevent serious injury and damage to property.

**STOP ACCIDENTS BEFORE THEY STOP YOU!**

In order to alert you, the user, and those entrusted as operators and maintenance personnel, dangerous or hazardous operations are shown in this instruction manual with **WARNING** notes.



The safest machine must still be operated with care and with knowledge of its performance capabilities. The most comprehensive safety program must still be followed.

Remember that on any job, YOU are the key to safety. Good safety practices not only protect the men around you, they are your own best protection. Study this manual and any manufacturer's operator's manuals covering your specific equipment. Read all warning and caution instructions. Practice safe operation.

**INSIST THAT YOUR FELLOW WORKERS DO, TOO. BE ALERT TO POSSIBLE HAZARDS BEFORE THEY CAUSE TROUBLE, AND REMEMBER . . . . SAFETY IS UP TO YOU!!!**

**DO YOU KNOW YOUR EMPLOYER'S SAFETY PROGRAM?**

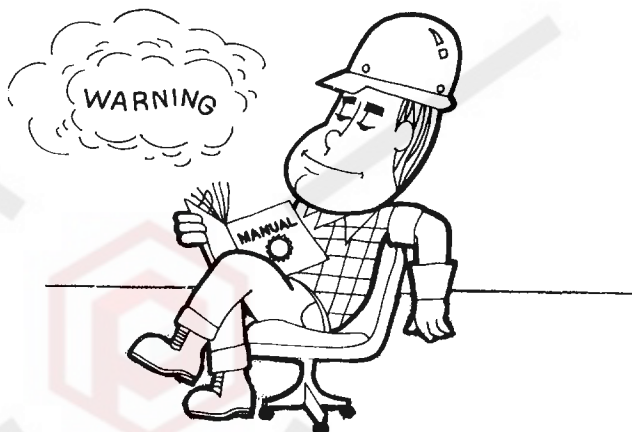
Company safety records show that the greatest percentage of accidents are caused by disregard of simple safety rules. Know-observe!-the overall program . . . and consult your supervisor for specific instructions when starting a job.

**ARE YOU DRESSED PROPERLY FOR THE JOB?**

You may need any number of special items - safety hat, safety shoes, safety glasses, goggles, heavy gloves, ear protective devices, etc., - for your own protection. Find out what items are required and wear them!

Loose clothing can catch in moving parts. Keep sleeves buttoned, jackets belted, and wear your special safety equipment. Keep warm without restricting your movement. Wrist watches and rings can be dangerous. Keep your pockets free of objects which may fall out.

**DO YOU UNDERSTAND YOUR MACHINERY?**



**READ THE MANUAL** furnished with your equipment to learn its operating and maintenance characteristics, capacities and limitations. Learn the location and function of ALL controls, indicators, warning devices and caution instructions. Learn to recognize the machine's warning and safety devices. They will alert you to conditions such as **LOW PRESSURE** or **HIGH TEMPERATURE** that may make it hazardous to continue operating.

**DO YOU HAVE KNOWLEDGE OF WORKING AREAS?**

Learn -- beforehand -- as much about your working area as possible:

Be a good housekeeper . . . keep the floor clean, free of oil, grease, rags, cables, chains, buckets, rocks and other hazards. Keep loose parts in a tool box. Use only non-flammable solutions for cleaning.

Know the weight limitations for any floors on which you will operate.

Know the clearances in the work area. A little time spent checking side and overhead clearances, including power lines, can save a lot of trouble later.

Be careful of dust, smoke or fog, which may obscure your vision.

**ARE YOU PREPARED FOR EMERGENCIES?**

Plan ahead -- stay alert -- operate sensibly -- and you will avoid both having and causing personal injury and accidental equipment damage. If a careless moment does cause an emergency -- react quickly with the tools and skills at hand. Know the location of and how to use a fire extinguisher and a first aid kit.

Know where to get prompt assistance.

An emergency calls for fast action.

**DON'T STOP YOUR SAFETY PROGRAM WITH THESE GENERAL RULES. BE EQUALLY CONSCIOUS THAT SPECIFIC WORKING CONDITIONS - AND YOUR PARTICULAR EQUIPMENT - CAN REQUIRE ADDITIONAL PRECAUTIONS.**

## BEFORE STARTING CHECK

Equipment not properly prepared for operation is unsafe equipment. Run a careful check at the beginning of your shift. If you find something that needs attention, **THINK TWICE** before deciding to "let it go this time". Even minor mechanical defects can lead to personal injury and accidents.

- 1 DO NOT allow unauthorized personnel to operate the Crusher!
- 2 MAKE SURE all guards and other protective devices are in place, secured and not damaged.
- 3 CHECK fluid systems: Are they at the correct level, and completely leak free?
- 4 CHECK every drain cock, valve, and fitting to be sure it is in place and secure.
- 5 LOSS of pressure from low fluid levels may lead to serious hydraulic failures.
- 6 CRUSHER SEIZURE from lack of oil is a problem that may cause accidents.
- 7 NEVER adjust pressure relief valves to get higher operating pressures. The manufacturer's recommended pressures give the safest performance with the longest life.
- 8 NEVER tamper with safety devices.
- 9 CHECK the Crusher thoroughly for visual defects, such as leaks, worn hoses or loose parts.
- 10 INSPECT your machine according to the operator's manual and your supervisor's instructions.
- 11 BEFORE STARTING walk completely around your machine. Make sure there is no one next to, under, or on the machine. Warn any personnel nearby that you are starting up.

REPORT ANY DEFECTS TO YOUR SUPERVISOR.

## START UP SAFELY

- 1 CHECK equipment for warning tags.

- 2 FOLLOW the recommended starting procedure as outlined in Section 11, OPERATING INSTRUCTIONS.
- 3 AFTER Crusher has been started, check all gauges and instruments to be sure that everything is operating properly.
- 4 SHUT DOWN immediately if any improper readings are observed.
- 5 TEST all controls for proper functioning.
- 6 LISTEN for and report any unusual noises.
- 7 RE-CHECK alarms or other warning and safety devices.
- 8 DO NOT stand on the adjustment ring while the Crusher is running.
- 9 DO NOT lean or place your hands on or against the spring clusters while the Crusher is in operation.
- 10 DO NOT take a chance with a defective machine. REPORT IT TO YOUR SUPERVISOR.

## REPORT A DEFECTIVE MACHINE

Inspect your machine daily . . . check for loose, worn or damaged parts. Report or correct any unsafe conditions immediately . . . and do not operate the machine until they have been corrected.

Even a minor defect can become serious . . . report any machine defects to your supervisor.

## STOPPING SAFELY

Be sure Crusher is stopped before . . . cleaning, servicing, lubricating . . . checking belt tension . . . removing housing covers . . . working on hydraulic system . . . making repairs . . . or attempting to clear a plugged cavity. **MAKE NO CHECKS, ADJUSTMENTS OR REPAIRS OF ANY KIND WHILE CRUSHER IS IN OPERATION.**

## TIPS FOR SAFE MAINTENANCE

Perform Maintenance With Care



## READ AND UNDERSTAND

- 1 Instruction manual furnished with the Crusher, especially Section 11, OPERATING INSTRUCTIONS.
- 2 Instructions for inspection and maintenance located at the rear of Section 11, OPERATING INSTRUCTIONS.
- 3 Warning and caution plates provided on the machine.
- 4 Warning and caution notes in the instruction manual.
- 5 Lubrication guides for periodic servicing also at the rear of Section 11.

## WARNING TAGS

Before working inside a Crusher, be sure to tag and lockout the electrical controls so no one else will start it.

Attach warning tags to prevent accidents:

- 1 If Crusher is unsafe for operation
- 2 If controls are being serviced
- 3 If machine is being repaired

## LOCKOUT ELECTRICAL SERVICE

- 1 Always lockout all electrical controls before performing any type of maintenance work on the Crusher.
- 2 When servicing the electrical power unit on those Crushers equipped with hydraulic clamping and adjustment mechanisms, lockout the electrical service to the power unit as depressing the "STOP" button will only stop the motor.
- 3 Provide each maintenance man with his own personal padlock and ONE key.

## CLOTHING - SAFE PRACTICE

- 1 KEEP HANDS AND CLOTHING AWAY FROM MOVING PARTS. Do not take chances by wearing loose sleeves, floppy ties, watches and rings.

- 2 WEAR EYE PROTECTION when handling fuel, cleaning fluid, oil or brake fluid. THESE MATERIALS CAN DAMAGE YOUR EYES.
- 3 WEAR A RESPIRATOR when required.
- 4 WEAR SAFETY GLASSES when drilling, grinding or hammering metal.
- 5 KEEP YOUR POCKETS FREE of objects which can fall out and into machinery.
- 6 WEAR HARD HAT AND SAFETY SHOES, when required.
- 7 WEAR GLOVES to protect your hands when changing cables.
- 8 WEAR SAFETY GLASSES AND PROTECTIVE CLOTHING when using high pressure air.
- 9 WEAR GOGGLES AND PROTECTIVE CLOTHING when handling molten metals; zinc, babbitt, lead, etc.
- 10 WEAR EAR PROTECTIVE DEVICES when required or REDUCE exposure time as required.

## ALCOHOLIC BEVERAGES AND MEDICATION

- 1 DO NOT use alcoholic beverages before coming to work or while on the job.
- 2 BEWARE of medicines, tranquilizers or other drugs which can make you sleepy or less alert.

## WORK AREA

- 1 PROMOTE GOOD HOUSEKEEPING, keep the floor clean and dry, free of debris and tools. Oily and wet floors, steps and hand rails are slippery. In winter watch out for ice and snow. Wet spots, especially near electrical equipment, are dangerous.
- 2 DO NOT let material lay and build up on or around the Crusher.
- 3 STORE dangerous fluids in a suitable place --away from unauthorized personnel. ALLOW NO SMOKING IN THE AREA!

- 4 NEVER start a diesel or gasoline engine within an enclosed area unless there is adequate ventilation. Exhaust fumes can kill!

#### EQUIPMENT

- 1 Use the proper tools; handle tools and heavy parts sensibly.
- 2 Keep all tools and equipment free of dirt, oil and grease. Do not drop or toss them.
- 3 Use hoisting equipment for heavy lifting. Save your back.
- 4 Lower parts, do not drop them.
- 5 To prevent slipping, wipe hand levers and knobs clean of oil or grease.
- 6 Do not use sheaves with cracked rims or spokes.
- 7 Check for missing, cracked or frayed V-belts.
- 8 Check for broken, defective or missing parts and replace them. Keep equipment clean and free of dirt and oil so you can spot loose or defective parts.
- 9 When using cables to move a load, be sure cables are of adequate size and replace any worn, badly frayed, broken or kinked ones. Check end connections for wear.

#### FIRE HAZARDS

- 1 DO NOT smoke while refueling -- or when handling fuel containers.
- 2 SHUT OFF engine when refueling -- and use extra caution if engine is hot.
- 3 WHEN pouring fuel into the tank, ground the funnel or spout against the filler neck to avoid static electric spark.
- 4 DO NOT use gasoline or diesel fuel for cleaning parts. Good commercial, non-flammable solvents are preferred.
- 5 DO NOT smoke while using cleaning solvents.

- 6 DO NOT let greasy, oily rags accumulate in a poorly ventilated area. Store oily rags and other combustible material in a safe place.
- 7 NEVER use an open flame to check fuel, battery electrolyte, or coolant levels . . . or to look for hydraulic leaks anywhere on the equipment. Use a flashlight!
- 8 KNOW where fire extinguishers are kept -- and how they operate -- and for what type of fire. Check regularly -- at least monthly -- to be sure it is in the working area.

#### PRESSURIZED SYSTEMS - HYDRAULIC OR AIR

- 1 Relieve ALL pressure before opening or removing any hydraulic or air pressure lines, valves, fittings, etc.
- 2 Check for worn hoses or damaged lines.
- 3 High pressure oil can be dangerous.

#### USE QUALITY PARTS

A replacement part for any item should always be of comparable SIZE, TYPE AND QUALITY - as the part being discarded.

#### REPORT NECESSARY REPAIRS

If your daily check uncovers any item that needs attention -- repair, replacement or adjustment --REPORT it NOW!

The most minor defect could result in more serious trouble -- IF THE MACHINE IS OPERATED.

Only perform the work you're authorized to do. Do not attempt repairs you do not understand.

Only work on equipment you thoroughly understand -- A pressure-loaded part, if carelessly released, could injure anyone in its path.

Remember you are entrusted with the operation and maintenance of a highly valuable piece of equipment. TREAT IT AS SUCH!

**REMEMBER - SAFETY IS UP TO YOU!**



## PLANT SAFETY

The safety procedures mentioned here do not eliminate all safety hazards found in the area of crushing plants. However, they do highlight some of the procedures which have been found through long experience to improve safety conditions around Crushers, and crushing plants. Nordberg will welcome inquiries regarding other suggested safety procedures for use around their Crushers and related equipment.

### DRIVE GUARDS

Proper safety precautions start with the initial installation of the Crusher. Crushers are driven either by V-belts or by direct couplings to motors. THE BELT DRIVE OR COUPLING SHOULD HAVE A PROTECTIVE GUARD AROUND IT.

Crusher sheaves in particular are designed for maximum rim speeds. If these speeds are exceeded it is possible that the sheave could explode and cause severe injury or even death.

Since the speed of the Crusher is quite important for proper operation, most V-belt drive guards usually have a small opening immediately opposite the center of the crusher drive shaft so that a tachometer can be inserted to occasionally check the speed of the counter-shaft. This opening should be covered with an access door or hatch.

### OPERATORS PLATFORM

Since periodic inspection and maintenance must be performed on each Crusher, IT IS IMPORTANT THAT SOME TYPE OF PLATFORM BE ERECTED AT A LEVEL CONVENIENT FOR THE MAINTENANCE MEN WHO MUST INSPECT AND WORK ON THE CRUSHER. A good operators platform constructed of "solid" floor plate should have hand railings, toe plates and wire mesh or expanded metal between the platform and the top of the hand railing to prevent tools from dropping off the platform and hitting someone working below. Do not fasten the operators platform to the adjustment ring as the entire adjustment ring raises or lifts very quickly when tramp iron passes through the Crusher.

## ELECTRICAL LOCKOUT

THE ELECTRICAL POWER SOURCE FOR THE CRUSHING EQUIPMENT SHOULD BE LOCKED OUT WHENEVER ANYONE IS WORKING ON IT. Each maintenance man who normally works on a Crusher should be provided with his own personal padlock with only one key. When he works on any assembly of the Crusher, he should use this padlock to lock out the electrical controls for the Crusher. It is most important that only one key be provided for the lock and that key must be in the pocket of the person who is working on the Crusher. If more than one person works on the Crusher, each should have his own lock and key at separate lockout stations for the controls of the Crusher. Accidental start-up of crushing equipment with men in the immediate area can be responsible for many accidents on what was supposedly a "clear" machine.

### CRANES

Crushers, like any other type of mechanical equipment, require normal periodic maintenance if the operator is to get the most for his money from the use of the machine. One of the most flagrant crusher safety violations is the use of inadequate and unsafe lifting equipment. Although a Crusher is not a finely tuned piece of equipment such as an automobile engine, the internal parts of a Crusher should be assembled and disassembled with crane facilities that have the capability of gently and slowly lifting and lowering the various parts that make up a Crusher. WHEN USING A CRANE, ALWAYS OPERATE WITHIN THE RATED CAPACITY OF THE CRANE. THE SAFE RATED CAPACITY INCLUDES WEIGHT OF HOOK, BLOCK AND ANY MATERIALS HANDLING DEVICES SUCH AS CABLES, SLINGS, SPREADER BARS ETC. SUBTRACT THE WEIGHT OF ALL THESE TO FIND THE TRUE WEIGHT OF THE LOAD THAT CAN BE HANDLED SAFELY. Chain falls should be considered only as a last resort to assemble and disassemble a Crusher. When it comes to safety, the best should be used.

### MOBILE CRANES

WHEN USING A MOBILE CRANE, ALWAYS OPERATE WITHIN THE RATED CAPACITY OF THE MACHINE TO AVOID BUCKLING THE BOOM OR TIPPING. Safe ratings are based on operating the crane on firm, level ground; outriggers should be properly extended

and/or lowered whenever possible. Avoid fast swings, hoists or sudden braking; these can cause overloads. Do not handle large, heavy loads in strong winds.

When moving your crane, check bridges before crossing, make sure they will support the weight of the machine. Check clearances under bridges, for overhead electrical lines or any overhead obstruction.

Check your hitcher, be sure he's clear before starting lift. Make certain he securely attaches the load.

## WELDING EQUIPMENT

One of the most frequently used tools around the Crusher is the cutting torch. Crushers which are equipped with hydraulic components should have these components depressurized and adequately covered with flame-proof material so that sparks, weld spatter, etc., cannot reach these areas. Ruptured high pressure hydraulic lines will quickly vaporize the hydraulic fluid as it reaches the atmosphere. This vaporized fluid can quickly become a mass of flames, resulting in severe burns for personnel in the immediate area. ALL MAINTENANCE PERSONNEL WHO NORMALLY USE TORCH CUTTING EQUIPMENT SHOULD BE ADVISED IF THERE ARE HYDRAULIC COMPONENTS IN THE IMMEDIATE AREA IN WHICH THEY ARE WORKING. Then adequate precautions be made to avoid contact with these components. Rubber lined hoses are not immune to the torch cutting equipment which is used in normal plant maintenance procedures.

## CONVEYOR BELTS

DO NOT USE CONVEYOR BELTS AS WALKWAYS. Conveyor belts leading to and from the Crusher should be provided with walkways alongside the conveyor. Always provide hand rails along the conveyor belt walkway as an added safety precaution.

## PORTABLE PLANTS

If your crushing plant consists of portable equipment, that is crushing and screening equipment mounted on trailers, trailer footing or cribbing is extremely important for safe operation. Check your footing. Your machine should be on as solid and level a footing as possible.

Use heavy timber mats as needed. Trailers must be raised so that trailer wheels do not touch the ground. Place screw jacks at each corner of the trailer or as near the corner as possible. All four jacks must be an equal distance from each end. Adjust each jack until the unsupported portion of the trailer beams stop vibrating or until vibrations are reduced to a minimum. NEVER leave your trailer in a low spot where rains may wash out your footing. PERIODICALLY RECHECK TRAILER FOOTING FOR STABILITY.

When moving your trailer, check bridges before crossing, make sure they will support the weight of the machine. Check clearances under bridges, for overhead lines, or any overhead obstruction. NEVER TRAVEL WITH NEAR-CAPACITY LOADS, CHECK LOCAL LAWS, ESPECIALLY ON WEIGHT LIMITATIONS. When traveling on the highway make sure all headlights, clearance lights and tail lights are on. Use proper traffic warning flags and signs.

## CRUSHING PLANT "NOISE"

Crushing equipment by its very nature is noisy, and the auxiliary equipment found in and around crushing equipment such as chutes, transfer stations, screens, etc., can at times be noisier than the Crusher itself. EAR PROTECTIVE DEVICES MAY BE REQUIRED IF NOISE LEVELS ARE HIGHER THAN THOSE ALLOWED BY LAW. If ear protective devices are undesirable consideration should be given to reducing the amount of noise exposure that an operator or maintenance man may be subjected to, in other words shorter working hours.

Although alteration of the machinery to change its noise characteristics may be economically impossible, many operators have found that the installation of a relatively inexpensive operator's station can improve noise conditions. The operator can see the equipment in operation and still be protected from the noise through the installation of acoustical tile, double windows, air conditioning equipment, etc. These working conditions will normally result in a more efficient operation and reduce potential injuries from noise.

Many plant operators are finding that an operator's tower erected at an elevation above most of the equipment provides both safety features for the operator and increased efficiency in plant operation.

## NORDBAK VERSUS ZINC

All Crushers require some type of backing when replacing the crushing members. Recent developments of epoxy resins such as NORDBAK Backing Compound have all but eliminated the possibility of workmen being accidentally burned due to molten zinc either spilling or exploding when it comes in contact with wet surfaces. THE ENORMOUS DEGREE OF CONVENIENCE AS WELL AS THE HIGH SAFETY FACTOR INVOLVED WHEN USING PLASTIC BACKING AGENTS HAS MADE THE USE OF MOLTEN ZINC FOR CRUSHER LINER BACKING OBSOLETE!

When epoxy backings are used, care should also be taken when removing the liners with a cutting torch. THE AREA SHOULD BE WELL VENTILATED BECAUSE EPOXY FUMES CAN CAUSE NAUSEA OR POSSIBLE EYE OR SKIN IRRITATION.

## SPRING RING ASSEMBLIES

For those Crushers which use springs as a means of protecting the Crusher from tramp iron overload, it is recommended that the hydraulic jacks used to assemble and disassemble spring clusters be tightly secured to the Crusher itself by means of a chain or cable. IF PROPERLY SECURED, ANY UNEXPECTED AND SUDDEN MOVEMENTS WILL NOT CAUSE THE JACKS TO BE FORCEFULLY EJECTED TOWARD THE PERSONNEL WORKING ON THE CRUSHER. It is also recommended to wrap a cable around the springs themselves to keep them from being ejected away from the Crusher.

## CLEARING A CRUSHER

There are many unforeseen events such as power failures, sudden surge of materials, etc., which can cause a Crusher to become plugged with material and stall. UNPLUGGING THE CRUSHER CAN BECOME A VERY SERIOUS POTENTIAL SOURCE OF ACCIDENTS. In many instances, the only way in which the Crusher can be restarted is to literally dig the material out of the crushing cavity by hand. Sometimes, however, alternate methods may be used which make clearing the machine both easier and safer.

In those machines which are crushing relatively fine material, a plugged Crusher can sometimes be cleared by inserting a high pressure water hose into the crushing chamber and washing away the material which has jammed itself into the cavity. In machines which are crushing a relatively coarse material, some operators have found that a long handled pruning saw can be used to "saw away" the material which is jamming the Crusher.

In some cases, hydraulic jacks have been used on the outside of the Crusher to overcome the spring load holding the jammed material in place in the crushing cavity. Excessive loading from a hydraulic jack on the external parts of a Crusher can cause severe stresses within the Crusher and initiate cracks in some of the more expensive assemblies.

## TRAMP IRON REMOVAL

Without question, the MOST DANGEROUS OPERATION around a Crusher is the REMOVAL OF TRAMP IRON which has jammed in the crushing chamber. Extremely severe injuries, can occur trying to remove tramp iron. ABSOLUTELY NO WORK SHOULD BE DONE IN TRYING TO REMOVE TRAMP IRON LODGED IN THE CRUSHING CAVITY WITHOUT FIRST READING THOROUGHLY THE PARAGRAPH TRAMP IRON REMOVAL IN SECTION 11.

## GENERAL MAINTENANCE WORK

A certain amount of work must be done in the immediate area of the Crusher during the normal course of operations on a day-to-day basis. The following are some of the do's and don'ts to be followed as part of normal crusher operating procedures.

- 1 DO NOT perform maintenance on moving machinery. This includes such items as adding lubricating oil or greasing parts of the Crusher while it is in operation.
- 2 DO NOT put hands or feet on the spring clusters which protect the Crusher from tramp iron overloads while the Crusher is in operation.
- 3 DO check the manufacturer's recommendations for periodic maintenance procedures. These maintenance procedures are

designed to not only avoid damage to the equipment but also avoid harm to the operator as well.

- 4 DO avoid spillage around the Crusher. Crushers seem to attract odd size pieces of rock, gravel, etc. Plant operators should make it a habit to keep the area immedi-

ately adjacent to the Crusher free from this type of spillage which could cause unsuspecting personnel to trip and fall.

- 5 NEVER look into the crushing cavity while the Crusher is in operation without protection from possible flying material.

**Section 1**

**GENERAL CRUSHER INFORMATION**

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## SECTION 1

# GENERAL CRUSHER INFORMATION

### INTRODUCTION

This Instruction Book has been prepared to assist you, the user, and those entrusted as operators, in the installation, operation, and maintenance of the Symons cone crushers, Standard and Short Head.

The information contained herein will serve to acquaint you with the construction of the Crusher and as an aid in gaining the general knowledge necessary for efficient operation and maintenance.

Each Crusher is completely assembled and test run prior to shipment, however, certain safeguards must be taken during use. These precautions are defined in the following instructions, and will help to prevent the problems that arise because of improper operation or maintenance.

It is strongly recommended that the contents of this book be read, understood and put in practice prior to installation and during operation of the Crusher.

### CRUSHER SIZES

These instructions, in general, cover all sizes of Symons cone crushers; which are the 2 Ft., 3 Ft., 4 Ft., 4-1/4 Ft., 5100, 5-1/2 Ft. and 7 Ft. sizes.

### INITIAL INSPECTION

It is recommended that as soon as possible after receipt of the Crusher, a careful check be made for any possible damage which might have been incurred during transit. A careful check should also be made to be sure that nothing has been lost and that all items on the Bill of Lading, Freight Bill or Manifest can be accounted for. If any shortages or damages are discovered, these should immediately be brought to the attention of the respective carrier so that necessary claims can be processed without any undue delay.

### INFORMATION FURNISHED

The following drawings and data for your particular Crusher will be found in a separate book entitled INSTALLATION DRAWINGS.

- 1 Foundation Drawing.
- 2 Oil Piping Drawings for the Crusher and lubricating system.
- 3 Water Piping Drawings when the water seal is furnished.
- 4 Drawings and Auxiliary Bulletins when the hydraulic clamping and adjustment mechanism is furnished.
- 5 All other drawings or informational data that might be required for your specific installation.

A Parts Manual containing the various assembly drawings pertaining to your Crusher will be sent under separate cover at a later date; usually immediately after the Crusher has been shipped. This manual illustrates and identifies each and every part used in the assembly of the machine and is to be used when ordering spare or replacement parts.

### REPAIR PARTS

Nordberg endeavors to carry an ample supply of parts in stock to provide prompt and efficient service on all orders for repairs and replacements.

To avoid delay, and the possibility of incorrect parts being furnished, the following information should be given:

- 1 Crusher Size and Type (Standard or Short Head).
- 2 The Serial Number of the Crusher which is stamped on the crusher name plate as well as on the cover of the Parts Manual.

- 3 Exact quantity of each part ordered.
- 4 Complete name and part code number as shown in the Parts Manual.
- 5 Complete shipping instructions. Advise whether shipment is desired by Mail, Express, Surface or Air Freight.

If your crusher Parts Manuals have been lost, destroyed or misplaced, an additional set will be supplied without charge upon application.

For proper operation, only genuine factory parts should be installed. These are guaranteed as to accuracy, workmanship and material.

## CRUSHER TERMINOLOGY

Throughout this manual certain terms will be used in describing the Crusher and its operation. In order that there will be no possibility of confusion or misunderstanding, these terms are defined as to their usage in the manual.

**FEED:** The raw material that is to be crushed.

**LINERS:** The bowl liner and mantle are the crushing members and are commonly referred to as liners.

**CAVITY:** The internal contour formed by the two crushing members.

**PARALLEL ZONE:** With the liners in their closest relationship during the gyrating cycle, the lower portion of both the bowl liner and mantle, for some distance, will be parallel to each other. This area is known as the parallel zone.

**FEED OPENING (Closed Side):** The smallest distance between the top of the crushing members as measured when the two crushing members are at their closest relationship during their gyrating cycle.

**FEED OPENING (Open Side):** The largest distance between the top of the crushing members as measured when the two crushing members are at their farthest relationship during their gyrating cycle. The feed opening (open side) determines the maximum size of feed.

**DISCHARGE SETTING:** The distance between the bottom of the crushing members as measured at the point where the two crushing members are at their closest relationship during their gyrating cycle. This discharge setting regulates product size.

**MINIMUM DISCHARGE SETTING:** The smallest permissible distance between the bottom of the crushing members as measured when the two crushing members are at their closest relationship during the gyrating cycle.

**DISCHARGE OPENING:** The distance between the bottom of the crushing members as measured at the point where the two crushing members are at their farthest relationship during their gyrating cycle. This wide opening permits rapid discharge of the crushed material.

**PRODUCT SIZE:** The size of the screened material after it has been crushed.

**CAPACITY:** The output of the Crusher computed in tons per hour.

**OPEN CIRCUIT OPERATION:** The type of operation where precise uniformity of product size is not considered to be of prime importance and the feed is run through the Crusher but once.

**CLOSED CIRCUIT OPERATION:** The type of operation where precise uniformity of product size is important and the product is screened as it is being discharged and the material which does not pass through the screen is returned to the Crusher.

## ESTIMATING CRUSHER CAPACITY

Cone crusher capacity charts have been developed for use as an application tool to properly utilize the machine's capabilities. Symons Cone Crushers have three separate and distinct capacities (see the tables STANDARD CONE CRUSHER CAPACITIES or SHORT HEAD CONE CRUSHER CAPACITIES). The difference between these is the point in the circuit at which the measure is taken in either open circuit or closed circuit operation. The crusher is one component of the circuit. As such, its performance is in part dependent on the proper selection and operation of feeders, conveyors, screens, supporting structure, electric motors, drive components and surge bins. Where used, attention to the following factors will enhance crusher capacity and performance.

- 1 Proper selection of crushing chamber for material to be crushed.
- 2 A feed grading containing proper distribution of the particle sizes.
- 3 Controlled feed rate.
- 4 Proper feed distribution 360° around the crushing chamber.
- 5 Discharge conveyor sized to carry maximum crusher capacity.
- 6 Properly sized scalping and closed circuit screens.
- 7 Automation controls.
- 8 Adequate crusher discharge area.

The following factors will detract from crusher capacity and performance.

- 1 Sticky material in crusher feed.
- 2 Fines in crusher feed (smaller than crusher setting) exceeding 10% of crusher capacity.
- 3 Excessive feed moisture.
- 4 Feed segregation in crushing cavity
- 5 Improper feed distribution around circumference of crushing cavity.
- 6 Lack of feed control.

- 7 Inefficient use of recommended connected horsepower.
- 8 Insufficient conveyor capacity.
- 9 Insufficient scalper and closed circuit screen capacities.
- 10 Insufficient crusher discharge area.
- 11 Extremely hard or tough material.
- 12 Operation of crusher at less than recommended full load countershaft speed.

Capacities shown on these tables are neither maximum nor minimum and are based on results secured in actual practice. The figures shown apply to short tons of material weighing 100 pounds per cubic foot and are based on a properly graded feed.

The capacities shown in the tables are based on results obtained from thousands of installations worldwide, crushing the broadest range of ores, rocks and minerals to determine effect of individual conditions.

## SELECTION OF PROPER LINERS

Through extensive research and study, Nordberg has developed a varied line of crushing members covering a wide range of feed and product sizes. Since there are so many variable conditions and types of operation to be considered, it would be difficult to list each type of liner that would be best suited for each individual condition and type of operation.

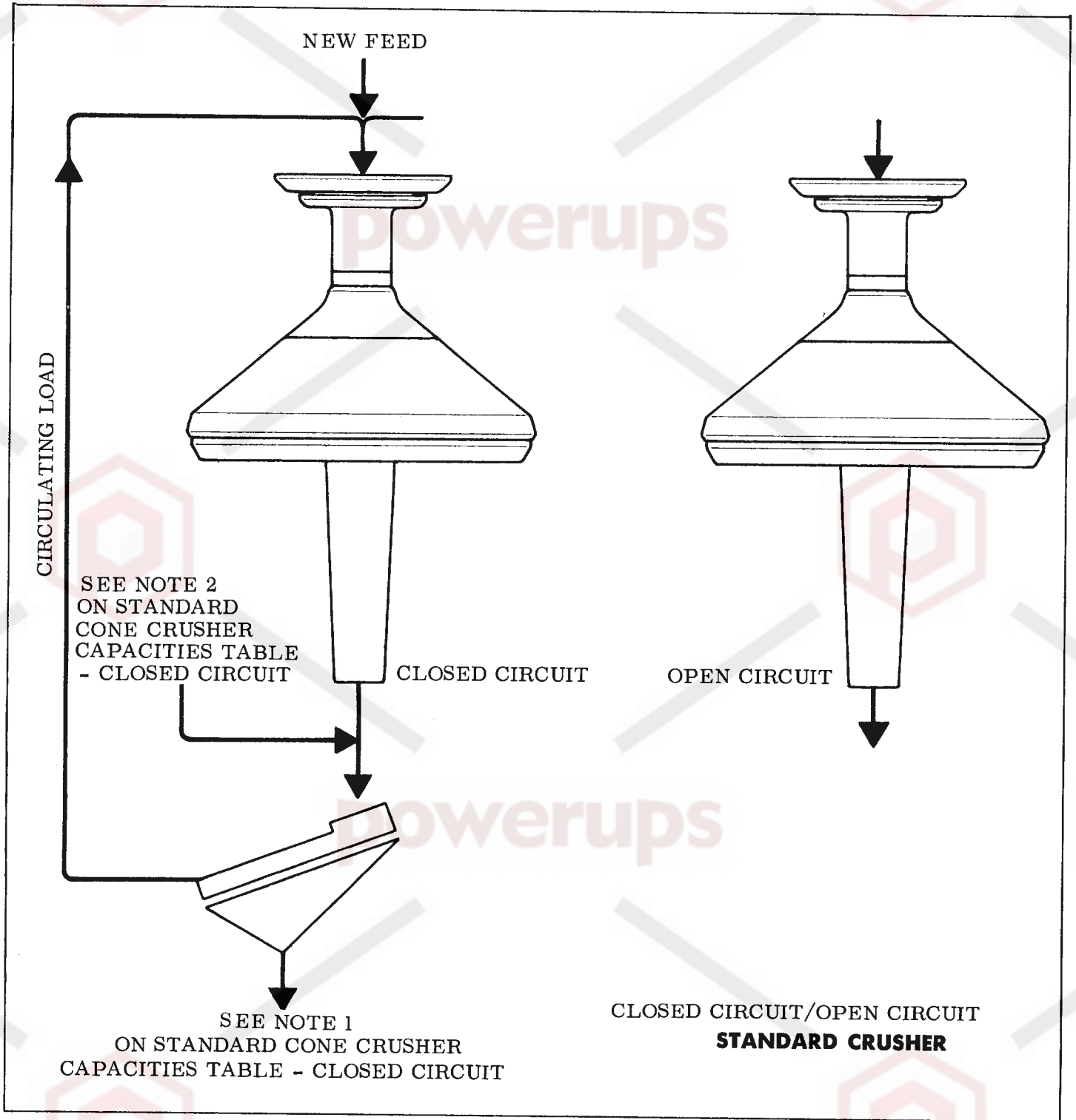
If for any reason, it is felt that unsatisfactory wear life was obtained from the original liners, it is suggested that the bowl liner and mantle be cut open so that the contour of the bowl liner and mantle can be traced onto a sheet of paper and the traced contours sent to the factory, in order that the exact concentration of wear can be determined.

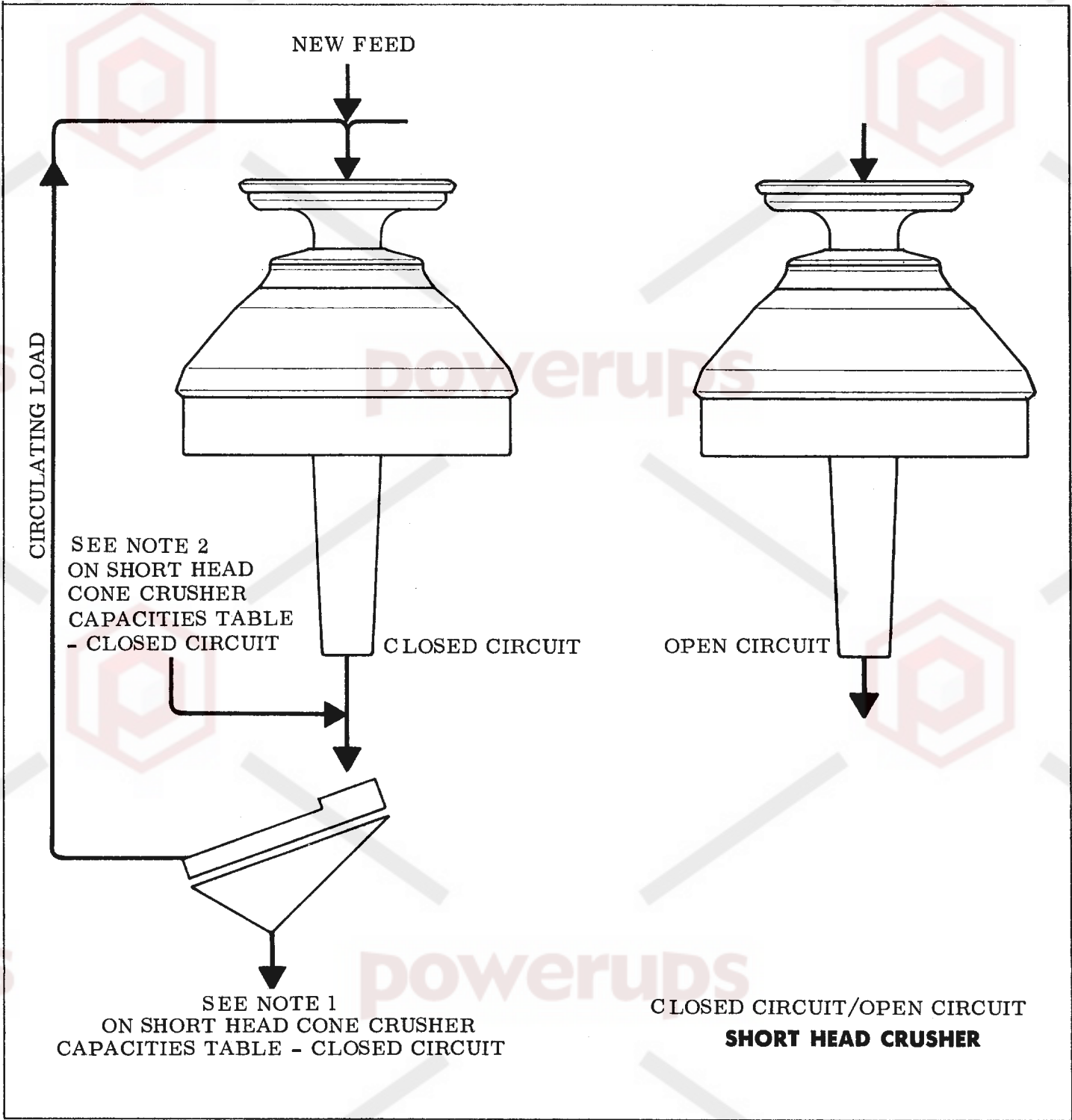
Another bowl liner and mantle can then be recommended which will have a different contour at these wear points.

In order to properly answer any inquiry, it is important that the following information be included:

- 1 Size of Feed.
- 2 Type of Feed.
- 3 Product Size Desired.

To operate continuously with liners having a crushing cavity unsuited to the operation, results in uneconomical wear of the liners, poor crushing efficiency and, in some instances, abuse to the Crusher.





# Standard cone crusher capacity

Standard Symons cone crushers — cavities • feed openings • product sizes

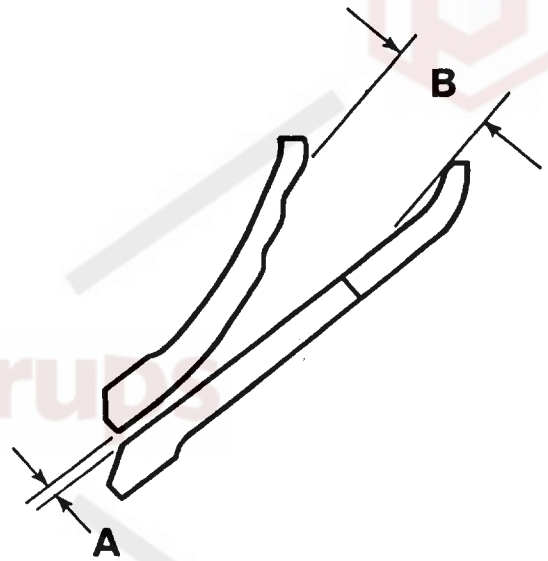
Open circuit — capacities in tons (2000 lb) per hour passing through the crusher at indicated discharge										
Size	Type of cavity	Recommended minimum discharge setting A	Feed opening with min. recommended discharge setting A		1/4" (6mm)	3/8" (9mm)	1/2" (13mm)	5/8" (16mm)	3/4" (19mm)	
			B Closed side	B Open side						
2 Ft. (600mm)	Fine	1/4" (6mm)	2 1/4" (57mm)	2 7/8" (72mm)	18	20	25	30	35	
	Coarse	3/8" (9mm)	3 1/4" (83mm)	4 3/8" (109mm)						
	Extra Coarse	1/2" (13mm)	4" (100mm)	4 3/8" (109mm)						
3 Ft. (900mm)	Fine	3/8" (9mm)	3 9/16" (83mm)	4 1/16" (102mm)	50	65	80	90	100	
	Coarse	1/2" (13mm)	6 3/8" (159mm)	7" (175mm)						
	Extra Coarse	1" (25mm)	6 1/2" (163mm)	7 1/8" (178mm)						
4 Ft. (1200mm)	Fine	3/8" (9mm)	5" (127mm)	5 1/4" (131mm)	70	100	120	140	150	155
	Medium	1/2" (13mm)	6 1/8" (156mm)	6 1/4" (156mm)						
	Coarse	3/4" (19mm)	7 1/8" (178mm)	7 5/8" (191mm)						
4 1/4 Ft. (1275mm)	Fine	1/2" (13mm)	4 3/8" (109mm)	5 3/8" (137mm)	120	140	145	160	175	190
	Medium	3/8" (9mm)	7 1/2" (188mm)	8 1/4" (210mm)						
	Coarse	3/4" (19mm)	8 5/8" (216mm)	9 5/8" (241mm)						
5 1/2 Ft. (1650mm)	Fine	5/8" (16mm)	7 1/2" (188mm)	8 3/8" (209mm)	200	225				
	Medium	3/4" (19mm)	8 1/2" (213mm)	9 5/8" (241mm)						
	Coarse	1" (25mm)	9 5/8" (241mm)	10 3/4" (269mm)						
7 Ft. HD (2100mm)	Fine	3/4" (19mm)	10 1/8" (253mm)	11 1/8" (278mm)	420					
	Medium	1" (25mm)	12 5/8" (303mm)	13 3/8" (334mm)						
	Coarse	1 1/4" (31mm)	13 3/8" (334mm)	14 3/4" (369mm)						
7 Ft. X HD	Extra Coarse	1 1/2" (38mm)	16 3/4" (425mm)	18 1/8" (460mm)	Consult factory for capacities					
10 Ft. (3048mm)	Fine	7/8" (22mm)	12 1/2" (317mm)	14" (356mm)						
	Medium	1" (25mm)	15 1/2" (394mm)	17" (432mm)						
	Coarse	1 1/2" (38mm)	18 1/2" (470mm)	20" (508mm)						
	Extra Coarse	1 1/2" (38mm)	24 1/2" (622mm)	26" (660mm)						

Closed circuit — capacities in tons (2000 lb) per hour based on closed circuit operation										
Size	Type of cavity	Recommended minimum discharge setting A	Feed opening with min. recommended discharge setting A		Effective square opening on circuit screen					
			B Closed side	B Open side	1/4" (6mm)		3/8" (10mm)		1/2" (13mm)	
					1/4" (6mm)	3/8" (10mm)	3/8" (10mm)	3/8" (10mm)	Note 1	Note 2
2 Ft. (600mm)	Fine	1/4" (6mm)	2 1/4" (57mm)	2 7/8" (72mm)	10	20	12	24	16	28
	Coarse	3/8" (9mm)	3 1/4" (83mm)	3 3/4" (95mm)						
	Extra Coarse	1/2" (13mm)	4" (100mm)	4 3/8" (109mm)						
3 Ft. (900mm)	Fine	3/8" (9mm)	3 9/16" (83mm)	4 1/16" (102mm)	35	65	40	70		
	Coarse	1/2" (13mm)	6 3/8" (159mm)	7" (175mm)						
	Extra Coarse	1" (25mm)	6 1/2" (163mm)	7 1/8" (178mm)						
4 Ft. (1200mm)	Fine	3/8" (9mm)	5" (127mm)	5 1/4" (131mm)	50	95	55	95		
	Medium	1/2" (13mm)	6 1/8" (156mm)	6 1/4" (156mm)						
	Coarse	3/4" (19mm)	7 1/8" (178mm)	7 5/8" (191mm)						
4 1/4 Ft. (1275mm)	Fine	1/2" (13mm)	4 3/8" (109mm)	5 3/8" (137mm)						
	Medium	3/8" (9mm)	7 1/2" (188mm)	8 1/4" (210mm)						
	Coarse	3/4" (19mm)	8 5/8" (216mm)	9 5/8" (241mm)						
5 1/2 Ft. (1650mm)	Fine	5/8" (16mm)	7 1/2" (188mm)	8 3/8" (209mm)						
	Medium	3/4" (19mm)	8 1/2" (213mm)	9 5/8" (241mm)						
	Coarse	1" (25mm)	9 5/8" (241mm)	10 3/4" (269mm)						
7 Ft. HD (2100mm)	Fine	3/4" (19mm)	10 1/8" (253mm)	11 1/8" (278mm)	Consult factory for capacities					
	Medium	1" (25mm)	12 5/8" (303mm)	13 3/8" (334mm)						
	Coarse	1 1/4" (31mm)	13 3/8" (334mm)	14 3/4" (369mm)						
7 Ft. X HD	Extra Coarse	1 1/2" (38mm)	16 3/4" (425mm)	18 1/8" (460mm)	Consult factory for capacities					
10 Ft. (3048mm)	Fine	7/8" (22mm)	12 1/2" (317mm)	14" (356mm)	Consult factory for capacities					
	Medium	1" (25mm)	15 1/2" (394mm)	17" (432mm)						
	Coarse	1 1/2" (38mm)	18 1/2" (470mm)	20" (508mm)						
	Extra Coarse	1 1/2" (38mm)	24 1/2" (622mm)	26" (660mm)						

• capacities

setting "A"

7/8" (22mm)	1" (25mm)	1-1/4" (31mm)	1-1/2" (38mm)	2" (51mm)	2-1/2" (64mm)
40 45 50	45 50 55	50 60 70	60 75 80		
100 120	130 130	150 150	180 180		
155 160 170	170 180 200 210	185 200 220 230	220 270 280	340 350	
170 190 215	180 220 240 260	200 250 275 300	280 325 335	385 395	
250 285	285 320 330	325 370 390	360 420 460 475	460 500 525	700 750
450	550 670	680 800 870	800 890 930 970	1100 1200 1300	1400 1500
1030	1300 1570	1620 1800	1800 2000 2100 2200	2500 2700 2900	3150 3400



**Note 1** Net finished product (screen undersize)

**Note 2** Tons per hour passing through crusher (net finished product plus recirculating load)

5/8" (16mm)		3/4" (19mm)		7/8" (22mm)		1" (25mm)		1-1/4" (31mm)		1 1/2" (38mm)		2" (50mm)		2 1/2" (63mm)	
for closed circuit operation															
1/2" (13mm)		5/8" (16mm)		3/4" (19mm)		3/4" (19mm)		7/8" (22mm)		1" (25mm)		1 1/4" (32mm)		1 1/2" (38mm)	
Note 1	Note 2	Note 1	Note 2	Note 1	Note 2	Note 1	Note 2	Note 1	Note 2	Note 1	Note 2	Note 1	Note 2	Note 1	Note 2
20	30	24	35	28	42	32	42	40	50	48	58				
20	30	24	35	28	42	32	42	40	50	48	58				
20	30	24	35	28	42	32	45	40	55	48	65				
45	75	60	90	70	105	80	105	95	120	120	150	145	170		
45	75	60	90	75	110	85	110	100	125	120	150	145	170		
				75	110										
70	105	85	125	100	150	120	155	130	160	165	200	195	235		
70	110	100	145	110	160	125	165	140	170	170	210	195	235		
				115	175	130	175	150	185	170	210	195	235		
				175	175				185						
95	135	105	155	125	185	145	190	175	220	205	205	235	280		
		120	175	135	200	155	205	190	235	215	260	250	295		
				140	210	165	215	190	245	220	270	250	295		
										225	275	260	310		
		160	235	180	265	210	270	240	300	300	360	330	390	400	465
								250	310	310	375	340	400	420	490
									310	315	380	350	410		



# Short Head capacities

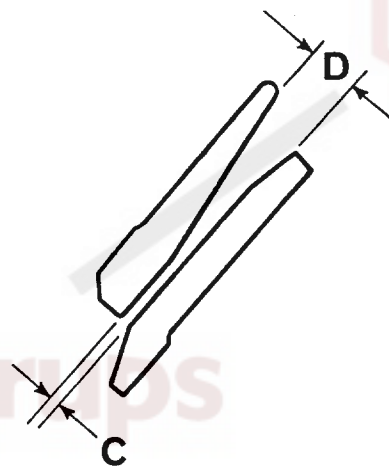
Short Head Symons cone crushers — cavities • feed openings •

Open circuit — capacities in tons (2000 lb) per hour passing through the crusher at indicated discharge									
Size	Type of cavity	Recommended minimum discharge setting C	Feed opening with min. recommended discharge setting C		1/8" (3mm)	3/16" (5mm)	1/4" (6mm)		
			D Closed side	D Open side					
2 Ft. (610mm)	Fine	1/8" (3mm)	3/4" (19mm)	1 3/8" (35mm)	10	18	20		
	Coarse	3/16" (5mm)	1 1/2" (38mm)	2" (51mm)				18	24
3 Ft. (914mm)	Fine	1/8" (3mm)	1/2" (13mm)	1 5/8" (41mm)	30	45	60		
	Medium	1/8" (3mm)	1 3/16" (33mm)	2 3/8" (60mm)				45	60
	Coarse	1/4" (6mm)	2" (51mm)	3" (76mm)				65	85
4 Ft. (1219mm)	Fine	3/16" (5mm)	1 1/8" (29mm)	2 1/4" (57mm)	55	85			
	Medium	5/16" (8mm)	1 3/4" (44mm)	2 5/8" (73mm)					
	Coarse	1/2" (13mm)	2 3/8" (56mm)	3 1/2" (89mm)					
	Extra Coarse	5/8" (16mm)	3 1/2" (89mm)	4 5/8" (117mm)					
4 1/4 Ft. (1295mm)	Fine	1/8" (3mm)	1 1/8" (29mm)	2 1/2" (64mm)	40	65	90		
	Medium	1/4" (6mm)	2 1/8" (54mm)	3 1/2" (89mm)					
	Coarse	5/16" (8mm)	2 3/4" (70mm)	4 1/8" (105mm)					
	Extra Coarse	5/8" (16mm)	3 5/8" (98mm)	5 1/4" (133mm)					
5 1/2 Ft. (1676mm)	Fine	3/16" (5mm)	1 3/8" (35mm)	2 3/4" (70mm)	100	150	150		
	Medium	1/4" (6mm)	2 1/8" (54mm)	3 1/2" (89mm)					
	Coarse	3/8" (10mm)	3 1/8" (98mm)	5 1/4" (133mm)					
	Extra Coarse	1/2" (13mm)	4 3/8" (117mm)	5 1/2" (133mm)					
7 Ft. HD (2134mm)	Fine	3/16" (5mm)	2" (51mm)	4 1/8" (105mm)	210	300			
	Medium	3/8" (10mm)	3 3/4" (95mm)	5 1/4" (133mm)					
	Coarse	1/2" (13mm)	5" (127mm)	7" (178mm)					
	Extra Coarse	5/8" (16mm)	6" (152mm)	8" (203mm)					
7 Ft. X HD <span style="float: right;">Consult factory for capacities</span>									
10 Ft. (3048mm)	Fine	1/4" (6mm)	3" (76mm)	5" (127mm)			700		
	Medium	1/2" (13mm)	4" (102mm)	6" (152mm)					
	Coarse	5/8" (16mm)	7" (178mm)	9" (229mm)					
	Extra Coarse	3/4" (19mm)	8" (203mm)	10" (254mm)					

Closed circuit — capacities in tons (2000 lb) per hour based on closed circuit operation												
Size	Type of cavity	Recommended minimum discharge setting C	Feed opening with min. recommended discharge setting C		Effective square opening on							
			D Closed side	D Open side	1/8" (3mm)		3/16" (5mm)					
					1/8" (3mm)	3/16" (5mm)	1/8" (3mm)	3/16" (5mm)				
Note 1	Note 2	Note 1	Note 2	Recommended closed side								
2 Ft. (610mm)	Fine	1/8" (3mm)	3/4" (19mm)	1 3/8" (35mm)	6	12	10	20				
	Coarse	3/16" (5mm)	1 1/2" (38mm)	2" (51mm)					10	20		
3 Ft. (914mm)	Fine	1/8" (3mm)	1/2" (13mm)	1 5/8" (41mm)	15	30	20	40				
	Medium	1/8" (3mm)	1 3/16" (33mm)	2 3/8" (60mm)					15	30	20	40
	Coarse	1/4" (6mm)	2" (51mm)	3" (76mm)								
4 Ft. (1219mm)	Fine	3/16" (5mm)	1 1/8" (29mm)	2 1/4" (57mm)	20	40	35	70				
	Medium	5/16" (8mm)	1 3/4" (44mm)	2 5/8" (73mm)								
	Coarse	1/2" (13mm)	2 3/8" (56mm)	3 1/2" (89mm)								
	Extra Coarse	5/8" (16mm)	3 1/2" (89mm)	4 5/8" (117mm)								
4 1/4 Ft. (1295mm)	Fine	1/8" (3mm)	1 1/8" (29mm)	2 1/2" (64mm)	20	40	35	70				
	Medium	1/4" (6mm)	2 1/8" (54mm)	3 1/2" (89mm)								
	Coarse	5/16" (8mm)	2 3/4" (70mm)	4 1/8" (105mm)								
	Extra Coarse	5/8" (16mm)	3 5/8" (98mm)	5 1/4" (133mm)								
5 1/2 Ft. (1676mm)	Fine	3/16" (5mm)	1 3/8" (35mm)	2 3/4" (70mm)	65	130						
	Medium	1/4" (6mm)	2 1/8" (54mm)	3 3/8" (89mm)								
	Coarse	3/8" (10mm)	3 1/4" (98mm)	5 1/4" (133mm)								
	Extra Coarse	1/2" (13mm)	4 3/8" (117mm)	5 1/2" (133mm)								
7 Ft. HD (2134mm)	Fine	3/16" (5mm)	2" (51mm)	4 1/8" (105mm)	120	240						
	Medium	3/8" (10mm)	3 3/4" (95mm)	5 1/4" (133mm)								
	Coarse	1/2" (13mm)	5" (127mm)	7" (178mm)								
	Extra Coarse	5/8" (16mm)	6" (152mm)	8" (203mm)								
7 Ft. X HD <span style="float: right;">Consult factory for capacities</span>												
10 Ft. (3048mm)	Fine	1/4" (6mm)	3" (76mm)	5" (127mm)								
	Medium	1/2" (13mm)	4" (102mm)	6" (152mm)								
	Coarse	5/8" (16mm)	7" (178mm)	9" (229mm)								
	Extra Coarse	3/4" (19mm)	8" (203mm)	10" (254mm)								

product sizes • capacities

setting C				
3/8" (10mm)	1/2" (13mm)	5/8" (16mm)	3/4" (19mm)	1" (25mm)
30 32	40 45	55		
75 75 80	100 100 105	110 125	140	
95 100	135 145 155 160	145 160 180 185	200 210	240
115 115 120	150 150 175	180 180 200	220 230	250 260
180 180 210	230 230 280 280	280 310 310	310 340 340	370 370
360 390	400 450 500	450 500 530 560	560 600 650	660 720
810 880	900 1010	1010 1125 1240	1220 1350 1460	1500 1630



**Note 1** Net finished product (screen undersize)

**Note 2** Tons per hour passing through crusher (net finished product plus recirculating load)

closed circuit screen

1/4" (6mm)	3/8" (10mm)	1/2" (13mm)	5/8 (16mm)	3/4" (19mm)	1" (25mm)
------------	-------------	-------------	------------	-------------	-----------

settings for closed circuit operation

3/16' (5mm)		1/4" (6mm)		3/8" (10mm)		1/2" (13mm)		5/8" (16mm)		3/4" (19mm)	
Note 1	Note 2	Note 1	Note 2	Note 1	Note 2	Note 1	Note 2	Note 1	Note 2	Note 1	Note 2
13 13	20 20	15 18	23 27	25 26	32 35	30 35	45 50				
30 30	45 45	50 50 55	65 65 70	70 70 75	85 80 90	80 80 85	110 110 115	95 105	135 145	130	150
40	60	60	95	80 85	105 110	100 100 115	140 140 160	120 145 150	175 210 220	170	205
55	80	75 80	110 120	100 105 110	130 140 150	125 125 140	170 170 200	175 175	250 250	200 200	260 260
90	140	135 135	200 200	175 175 180	220 220 240	210 210 220 220	270 270 280 280	245 250 250	350 360 360	280 320 320	340 385 395
160	230	240	360	315 315	390 420	360 360 380	450 500 540	420 420 450 465	500 550 650 680	500 550 550	600 660 690
		500	750	670 670	850 900	850 850	1200 1300	950 1000 1100	1300 1400 1500	1150 1150 1250 1250	1400 1400 1520 1600



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powerups

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powerups

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**Section 2**  
**GENERAL INSTALLATION INFORMATION**

**GENERAL CRUSHER DATA**

Clearance Dimensions

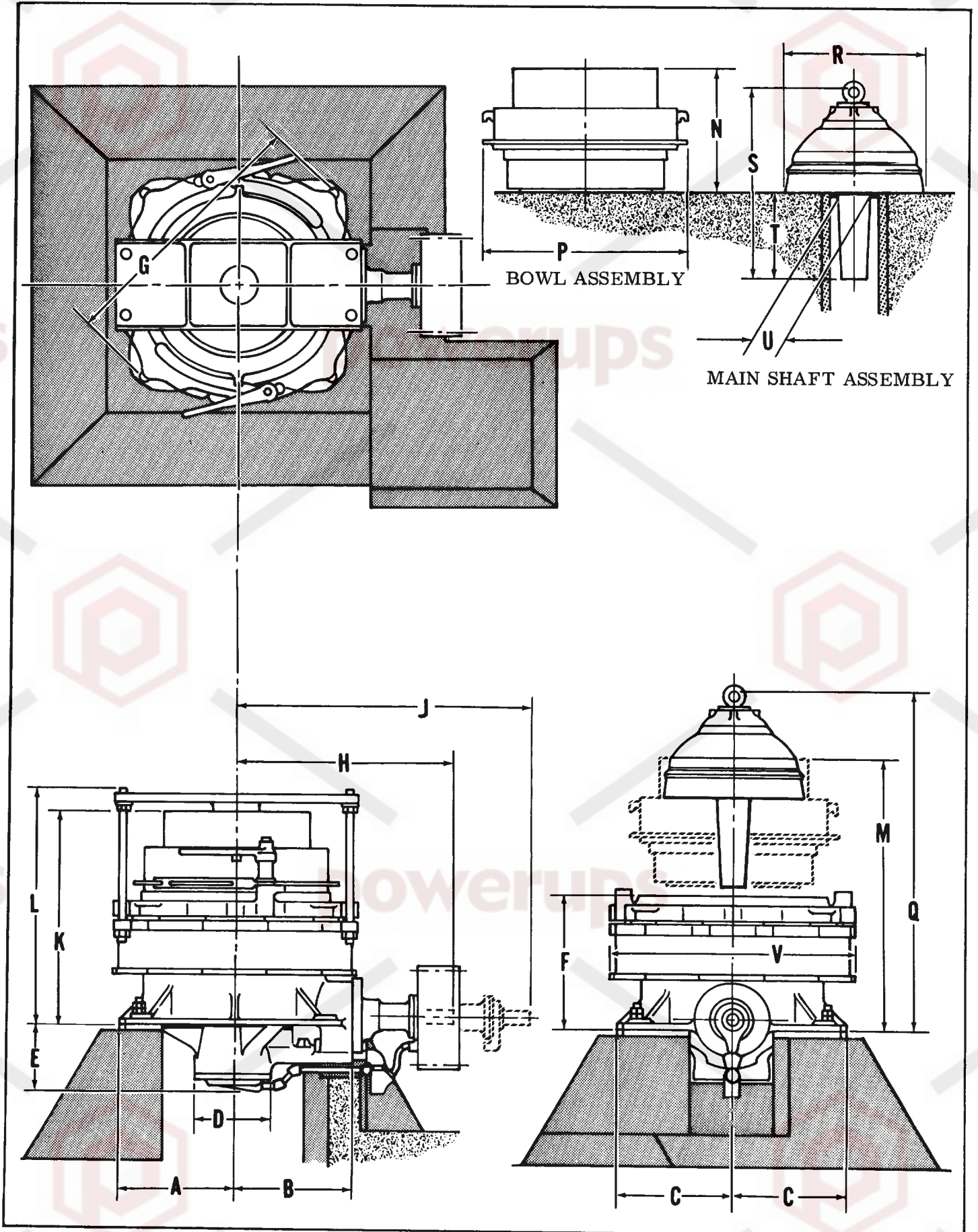
Standard Crusher and Sub-Assembly Weights

Short Head Crusher and Sub-Assembly Weights

Typical Crusher Installations

Typical Foundation Arrangement

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**CLEARANCE DIMENSIONS**

WEIGHT OF COMPLETE CRUSHER AND WEIGHTS OF ASSEMBLIES THAT REQUIRE FREQUENT HANDLING	CRUSHER SIZE						
	2 Ft.	3 Ft.	4 Ft.	4-1/4 Ft.	5-1/2 Ft. HEAVY DUTY	7 Ft. HEAVY DUTY	7 Ft. EXTRA HEAVY DUTY
CRUSHER COMPLETE	9,900	22,000	37,100	49,500	95,400	148,500	191,200
MAIN FRAME, ADJUSTMENT RING, SPRINGS, STEP BEARING PLATES, ECCENTRIC, SOCKET, COUNTERSHAFT BOX, COUNTERSHAFT AND CRUSHER SHEAVE	6,500	14,300	23,000	30,700	56,100	85,000	127,200
MAIN FRAME ADJUSTMENT RING & SPRINGS	4,300	10,500	16,800	24,200	43,400	63,800	106,000
MAIN FRAME, INCLUDING MAIN FRAME CAP, OUTER ECCENTRIC BUSHING AND MAIN FRAME LINER	2,800	5,800	10,300	12,100	25,500	40,000	55,300
BOWL, BOWL LINER AND ADJUSTMENT CAP	2,100	4,000	8,400	10,800	22,600	32,700	33,200
HEAD, MAIN SHAFT, MANTLE AND FEED PLATE	1,300	3,700	5,700	8,000	16,700	30,800	30,800
COUNTERSHAFT BOX, COUNTERSHAFT AND CRUSHER SHEAVE	1,100	2,000	2,700	2,800	4,700	7,000	7,000
ECCENTRIC	600	1,200	2,200	2,300	4,200	7,600	7,600
SOCKET	500	600	1,300	1,400	3,800	6,600	6,600
MANTLE	230	640	1,450	1,700	4,300	6,700	6,700
BOWL LINER	260	800	1,800	2,000	4,500	7,800	7,800

SINCE VARIOUS ASSEMBLY COMBINATIONS ARE AVAILABLE IN EACH CRUSHER SIZE AND BECAUSE OF MANUFACTURING VARIATIONS, THE WEIGHTS SHOWN ABOVE ARE APPROXIMATE  
 ALL WEIGHTS CAN VARY  $\pm$  5%  
 ALL WEIGHTS IN POUNDS

**STANDARD CRUSHER AND SUB-ASSEMBLY WEIGHTS**

WEIGHT OF COMPLETE CRUSHER AND WEIGHTS OF ASSEMBLIES THAT REQUIRE FREQUENT HANDLING	CRUSHER SIZE						
	2 FT	3 FT	4 FT	4-1/4 FT	5-1/2 FT HEAVY DUTY	7 FT HEAVY DUTY	7 FT EXTRA HEAVY DUTY
CRUSHER COMPLETE	10,100	23,200	38,800	49,800	96,700	154,600	197,300
MAIN FRAME, ADJUSTMENT RING, SPRINGS, STEP BEARING PLATES, ECCENTRIC, SOCKET, COUNTERSHAFT BOX, COUNTERSHAFT AND CRUSHER SHEAVE	6,500	14,300	23,000	30,700	56,100	85,000	127,200
MAIN FRAME, ADJUSTMENT RING AND SPRINGS	4,300	10,500	16,800	24,200	43,400	63,800	106,000
MAIN FRAME INCLUDING MAIN FRAME CAP, OUTER ECCENTRIC BUSHING AND MAIN FRAME LINER	2,800	5,800	10,300	12,100	25,500	40,000	55,300
BOWL, BOWL LINER AND ADJUSTMENT CAP	1,900	4,500	8,800	9,600	20,200	31,600	32,100
HEAD, MAIN SHAFT, MANTLE AND FEED DISTRIBUTOR	1,700	4,400	7,000	9,500	20,400	38,000	38,000
COUNTERSHAFT BOX, COUNTERSHAFT AND CRUSHER SHEAVE	1,100	2,000	2,700	2,800	4,700	7,000	7,000
ECCENTRIC	600	1,200	2,200	2,300	4,200	7,600	7,600
SOCKET	500	600	1,300	1,400	3,800	6,600	6,600
MANTLE	250	600	1,300	1,300	3,100	5,000	5,000
BOWL LINER	300	800	1,500	1,500	3,400	6,000	6,000

SINCE VARIOUS ASSEMBLY COMBINATIONS ARE AVAILABLE IN EACH CRUSHER SIZE AND BECAUSE OF MANUFACTURING VARIATIONS, THE WEIGHTS SHOWN ABOVE ARE APPROXIMATE — ALL WEIGHTS CAN VARY  $\pm 5\%$   
ALL WEIGHTS IN POUNDS

**SHORT HEAD CRUSHER AND SUB-ASSEMBLY WEIGHTS**



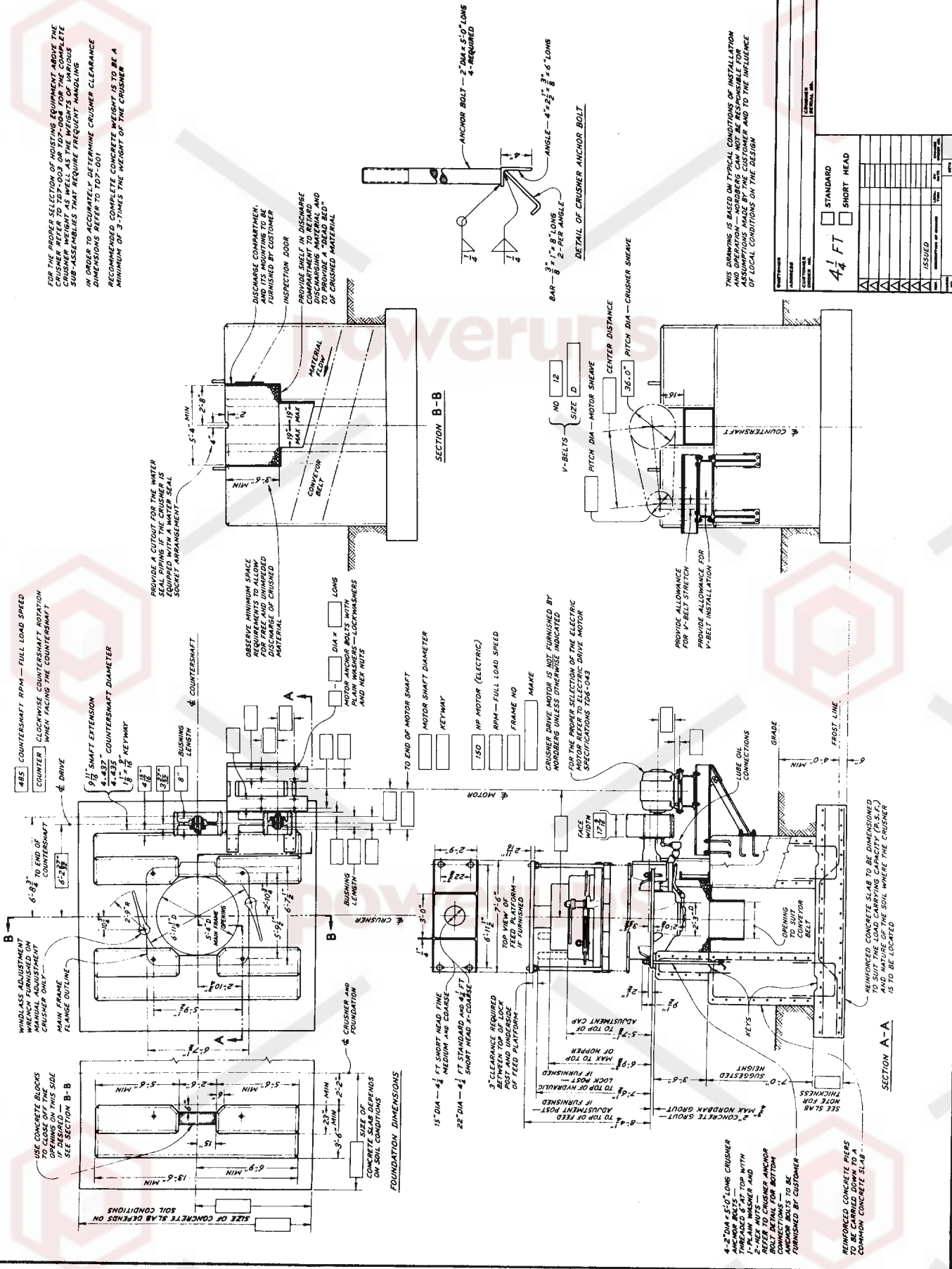
**TYPICAL CRUSHER INSTALLATIONS**





FOR THE PROPER SELECTION OF HOISTING EQUIPMENT ABOVE THE CRUSHER REFER TO TD7-003 OR TD7-004 FOR THE COMPLETE LISTING OF WEIGHTS OF VARIOUS SUB-ASSEMBLIES THAT REQUIRE FREIGHT HANDLING IN ORDER TO ACCURATELY DETERMINE CRUSHER CLEARANCE DIMENSIONS REFER TO TD7-001

RECOMMENDED CONCRETE WEIGHT IS TO BE A MINIMUM OF 3-TIMES THE HEIGHT OF THE CRUSHER



THIS DRAWING IS BASED ON TYPICAL CONDITIONS OF INSTALLATION AND OPERATION - NORBERG CAN NOT BE RESPONSIBLE FOR ASSUMPTIONS MADE BY THE CUSTOMER AND TO THE INFLUENCE OF LOCAL CONDITIONS ON THE DESIGN

DESIGNED BY	DATE	SCALE	REVISED BY	DATE	SCALE
CHECKED BY					
APPROVED BY					
CUSTOMER'S REPRESENTATIVE					
4 1/2 FT					
STANDARD					
SHORT HEAD					
ISSUED					

**TYPICAL FOUNDATION ARRANGEMENT**

SECTION 2  
**GENERAL INSTALLATION INFORMATION**

**FOUNDATION**

The foundation drawing which is furnished will, in most instances, govern the installation of the Crusher. The foundation should conform wherever possible, to the size and type of construction recommended on the drawing. A TYPICAL FOUNDATION ARRANGEMENT is shown at the beginning of this section. A solid level foundation of proper proportion and durability is of utmost importance to the successful operation of the Crusher.

**CRUSHER CLEARANCE DIMENSIONS**

A well planned installation is an absolute necessity for the ultimate success of the Crusher. One of the major considerations to be given the construction of the foundation is crusher clearances. Sufficient head room should be provided above the Crusher for the removal of the main shaft and bowl assemblies. Enough room should be provided at the side of the foundation for the removal of the countershaft box assembly. Consideration should also be given to the additional clearance required for the feeding arrangement,

such as; chuting, feed hopper and other auxiliary equipment. Adequate clearance should also be provided for the discharge compartment, conveyor and related equipment. In order to accurately determine crusher clearances, refer to the table CLEARANCE DIMENSIONS as well as the foundation drawing.

**CRUSHER & SUB-ASSEMBLY WEIGHTS**

Another factor to be considered when designing the foundation and also a factor to be considered when planning overhead lifting equipment is crusher weights. An overhead crane, a rubber or track mounted mobile crane, a chain hoist or other suitable equipment must be provided for handling heavy crusher components during erection or during the replacement of the crushing members or other wornparts. Size requirements for hoisting equipment including cables, slings and hooks can be calculated by referring to the table CRUSHER AND SUB-ASSEMBLY WEIGHTS. This table gives the complete crusher weight as well as the weights of sub-assemblies that require frequent handling.

## **FEED ARRANGEMENT**

The maximum efficiency which can be obtained from the Crusher is directly dependent on the feed arrangement. The Crusher can only reach maximum efficiency if the feed is supplied in the correct amount and is evenly distributed around the entire crushing cavity. By carefully checking the foundation drawing and crusher clearance dimensions, certain precautions can be taken regarding the installation of the feed equipment. The construction should permit the easy removal of this equipment when servicing the Crusher. The feed arrangement, therefore, deserves a great deal of thought in the planning prior to its eventual construction.

Each Crusher can be furnished with a feed platform and spout which should be used whenever conditions permit. The feed platform can be adjusted vertically by turning the feed adjustment nuts which support the platform. On the 7 Ft. Crushers, the feed platform is a rigid structure without feed spout, and is furnished on the large machines due to the type of feed and the wide variation of feeding equipment available for these Crushers. A properly constructed feed box mounted on top of the feed platform provides a backstop for the feed as it comes from the chute so that the feed will rebound and fall vertically through the feed spout. The feed will then drop onto the feed plate in a more uniform manner. The feed box, when correctly fed in conjunction with the feed distributing plate on the Crusher, will

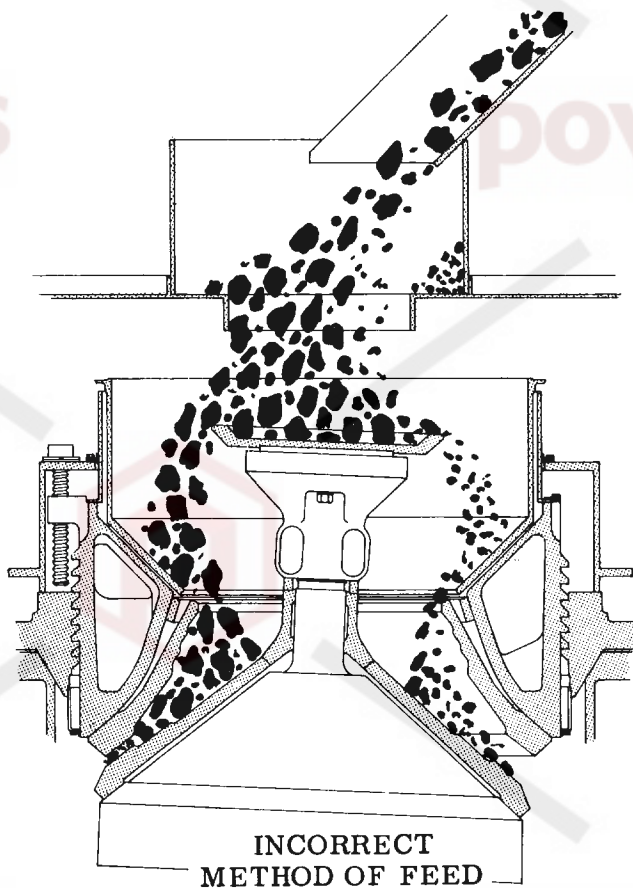
help to assure a uniform distribution of thoroughly mixed feed around the entire crushing cavity. Segregation of fine and coarse material should be kept to a minimum to achieve maximum liner wear. For best results on the "Standard" Crushers the feed should be regulated so that the crushing cavity is not entirely filled and that the feed does not build up under the feed plate. On the "Short Head" Crushers the feed should be regulated so that there is a build-up of material below the feed plate and above the crushing cavity. This bridge of material should extend around the entire cavity and serve as a limiting means to prevent over-feeding. With this type of feeding, a greater output can be realized with a product of a finer and more uniform size and also a substantial reduction in power consumption. A feed box is not furnished with the Crusher, since the type of feed will determine how the feed box is to be constructed and of what material.

**WHENEVER POSSIBLE, IT IS ADVISABLE TO PLACE A SCREEN AHEAD OF THE CRUSHER TO REMOVE FINE OR STICKY MATERIAL FROM THE FEED PRIOR TO CRUSHING. THIS WILL ELIMINATE PACKING, EXCESSIVE SPRING ACTION AND INEFFICIENT OPERATION. A METAL DETECTOR CAN ALSO BE INSTALLED TO REMOVE METALLIC OBJECTS, SUCH AS TRAMP IRON WHICH WOULD CAUSE SPRING ACTION.**

Here the incoming material passes through one side of the feed opening, causing uneven distribution.

Results of uneven distribution:

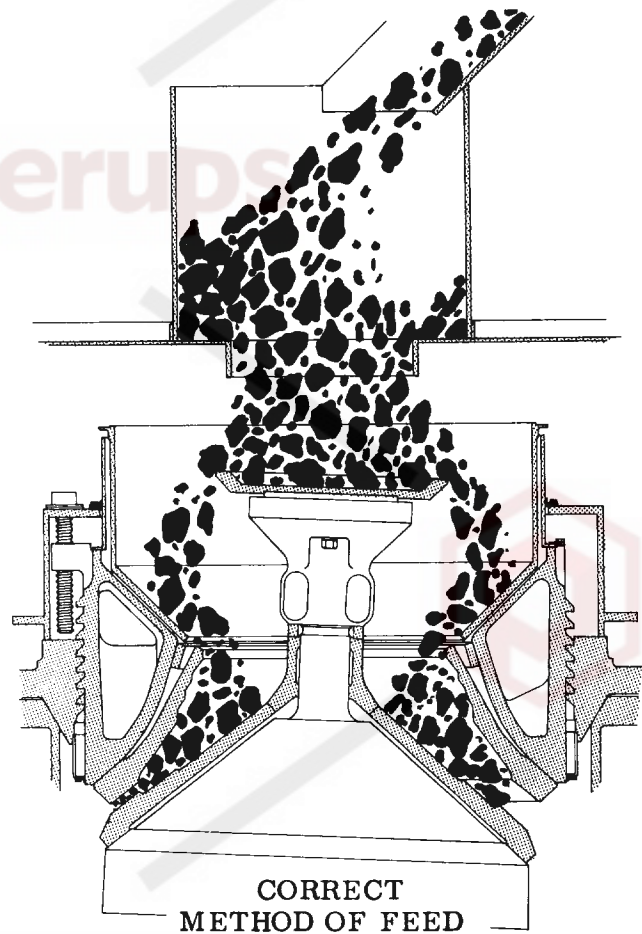
1. Reduced capacity.
2. Oversize product.
3. Excessive spring action.
4. Maximum bearing pressure.
5. Maximum power consumption.



Here the incoming material falls on the feed plate properly.

Results of even distribution:

1. Maximum capacity.
2. Uniform product.
3. Minimum spring action.
4. Minimum bearing pressures.
5. Minimum power consumption.



### FEE ARRANGEMENT

The feeding equipment must be of adequate size so as to maintain maximum feed conditions to the Crusher.

The correct and incorrect method of feed and feed box construction are shown in the illustration FEED ARRANGEMENT.

### DISCHARGE ARRANGEMENT

Since the discharge arrangement varies with each installation, a discharge compartment or chute is not furnished with the Crusher. The construction should, however, follow the recommendations as shown on the foundation

drawing. Either metal or wood may be used for the discharge compartment. An inspection door should be provided in the compartment so that the inside of the compartment is readily accessible for cleaning or inspection. A shelf or ledge should be constructed within the discharge compartment. The shelf will provide a "dead bed" of crushed material on which the falling material will hit. The shelf will absorb much of the impact before the material falls onto the conveying equipment, adding considerable life to such equipment.

If a chute is to be used, the slope of the chute must be more than 45° with the horizontal and,

if material is very sticky, the angle of inclination should be increased.

There should be sufficient clearance, as shown on the foundation drawing, between the main frame cap and the bottom of the discharge compartment and between the discharge opening or chute and the conveying belt or elevator. Adequate clearance at these points will prevent material from clogging the discharge area and causing it to build up under the head and interfere with the operation of the Crusher. This will insure a free unimpeded discharge of crushed material.

### TYPE OF DRIVE

The standard recommendation for driving the Crusher is through a V-belt drive. The V-belt drive is particularly desirable because of, first its feature which prevents Crusher shock loads from being transferred to the crusher motor and, secondly, its ability to carry surge loads without a resultant loss in crusher speed.

The V-belt drive can consist of either conventional ABCDE section belts, narrow 3V, 5V,

8V belts or banded belts. See the illustration BELT CROSS SECTIONS.

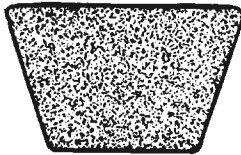
The narrower 3V, 5V, 8V belts are designed for compactness of drive, drive economy and reduced overhung load. Banded belts are single belts unitized with a common cover to prevent belt whip or turnover. Banded belts fit all standard sheaves, however, banded belts should be limited to only 2 or 3 individual belts banded together.

Should the motor sheave be located directly ABOVE the countershaft or within 30° of the crusher vertical centerline, the factory must be informed as to the position of the drive sheave, so that the OUTER countershaft bushing can be properly installed.

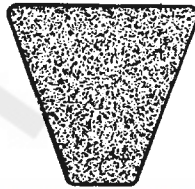
Power may be furnished by either an electric motor or diesel engine.

The Crusher may also be direct driven, that is, coupling connected to a driving motor or engine.

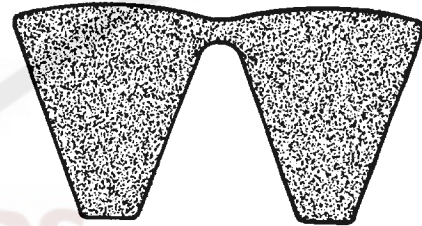
Any problems related to the crusher drive should be submitted to the factory for suggestions.



CONVENTIONAL ABCDE BELTS



NARROW 3V 5V 8V BELTS



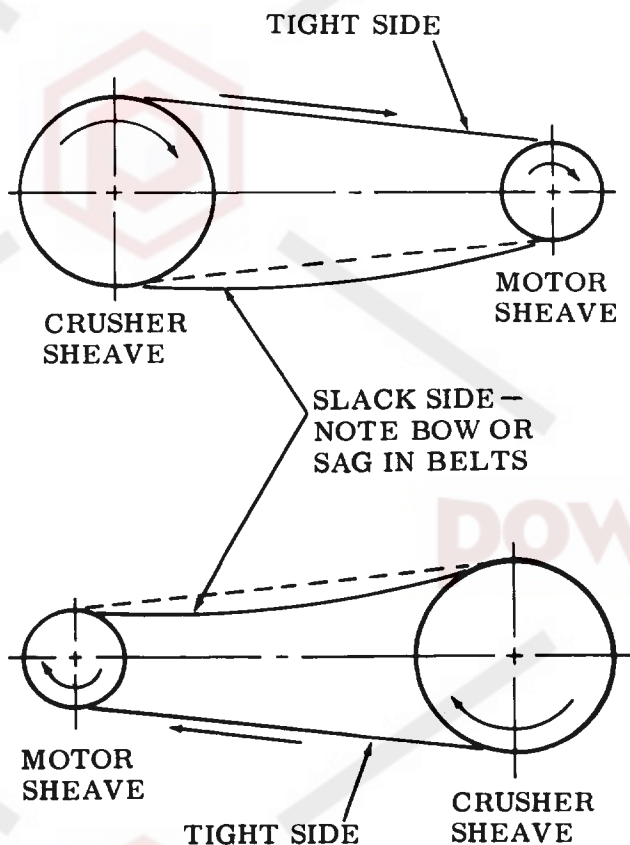
BANDED BELTS

### BELT CROSS SECTIONS

## INITIAL INSTALLATION OF V-BELT DRIVE

For the initial installation or when reassembling the V-belt drive, proceed as follows:

- 1 Clean all oil, grease or rust from the sheave grooves.
- 2 Make certain that the sheaves are correctly aligned and that the shafts are parallel.
- 3 Never force belts onto sheaves. Always shorten the center distance until belts can be slipped on easily. To determine the minimum allowances for shortening or lengthening the center distance between sheaves, see the table V-BELT INSTALLATION AND TAKE-UP ALLOWANCES.
- 4 Always use a matched set of belts and use new belts of the same manufacture. Never mix worn and new belts.



### DETERMINING SLACK SIDE

- 5 Place belts on sheaves and run the drive for a few minutes. Then tension the drive until only a slight bow or sag appears on the slack side of the belts when the drive

is running. An example of tight side and slack side is shown in the illustration DETERMINING SLACK SIDE. The slack side depends both on motor position and rotation of Crusher.

## TENSIONING THE V-BELT DRIVE

Tensioning the drive is a term used when force is applied to the V-belt by some method to provide the wedging action between the V-belt and the sheave. This wedging action provides the ability for a V-belt to transmit power from the motor sheave to the crusher sheave.

Various methods of tensioning V-belts have been established. Two simplified methods will be described in the following paragraphs; Tension-Deflection and Percent (%) of Elongation. Either of these two methods, if followed closely, will provide belt tension such that the drive will operate satisfactorily. Each has certain advantages for a given type of belt.

For tensioning the drive using the TENSION-DEFLECTION method, proceed as follows:

- 1 Place a straight edge across the top of both sheaves. See the illustration TENSION-DEFLECTION METHOD.
- 2 Measure the span length.
- 3 Using a spring scale at right angles to the center of the span length, apply a force to the scale great enough to deflect one of the belts 1/64" per EACH inch of span length.
- 4 The force should approximate the forces shown in the table DEFLECTION FORCES for a properly tensioned drive.

### EXAMPLE

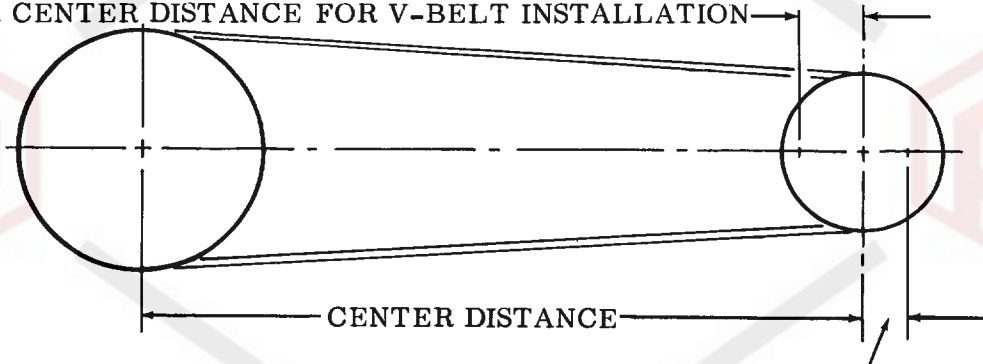
V-belt section = Standard "D" Belt

Span length (Center Distance) = 62"

Deflection Force (From Table) = 20 to 30 pounds

Deflection = 62" Span Length x 1/64" = 62/64" or 31/32"

SHORTER CENTER DISTANCE FOR V-BELT INSTALLATION



LONGER CENTER DISTANCE FOR V-BELT TAKE-UP

After calculating a center distance from a standard pitch length make provision that the centers can be moved closer together by the amount shown in the following table to facilitate installing the belts without injury. Also, the centers should be adjustable over the calculated distance by an amount as shown in last column of the table because of manufacturing tolerance and possible stretch and wear of belt.

CONVENTIONAL "ABCDE" V-BELTS						
Belt Length	Minimum Allowance Below Center Distance for Installation of Belts					Minimum Allowance Above Center Distance for Stretch and Wear All Sections
	A	B	C	D	E	
26 to 38*	3/4	1				1
38 to 60*	3/4	1	1-1/2			1-1/2
60 to 90*	3/4	1-1/4	1-1/2			2
90 to 120*	1	1-1/4	1-1/2			2-1/2
120 to 158*	1	1-1/4	1-1/2	2		3
158 to 195*		1-1/4	2	2	2-1/2	3-1/2
195 to 240*		1-1/2	2	2	2-1/2	4
240 to 270*			2	2-1/2	2-1/2	4-1/2
270 to 330*			2	2-1/2	3	5
330 to 420*			2	2-1/2	3	6
420 and over				3	3-1/2	1.5% of Belt Length
NARROW "3V, 5V, 8V" V-BELTS						
Belt Length	Minimum Allowance Below Center Distance for Installation of Belts			Minimum Allowance Above Center Distance for Stretch and Wear All Sections		
	3V	5V	8V			
25 to 50*	1/2					1
50 to 80*	3/4	1				1-1/4
80 to 112*	3/4	1	1-1/2			1-1/2
112 to 140*	3/4	1	1-1/2			1-3/4
140 to 180*		1	1-1/2			2-1/4
180 to 224*		1	1-3/4			2-1/2
224 to 250*		1-1/4	1-3/4			2-3/4
250 to 280*		1-1/4	1-3/4			3-1/4
280 to 315*		1-1/4	1-3/4			4
315 to 400*		1-1/4	2			4-1/2
400 to 500*			2			5-1/2

\*In each group the range is to, but not including, the second length.  
All dimensions in inches.

**V-BELT INSTALLATION AND TAKE-UP ALLOWANCES**

Therefore on a NEW installation with a "D" section belt and a span length of 62", the belt should deflect 31/32" with a spring force of 20 to 30 pounds for a properly tensioned drive.

- 5 At the end of 2 - 4 hours of operation, the drive should be retensioned to approximately the maximum force.
- 6 After 24 - 48 hours, it is well to check the drive to see if the force on the belts is between the minimum and maximum force shown on the table DEFLECTION FORCES. Retension if necessary. Either excessively low or high tension will affect the life and operation of a V-belt.

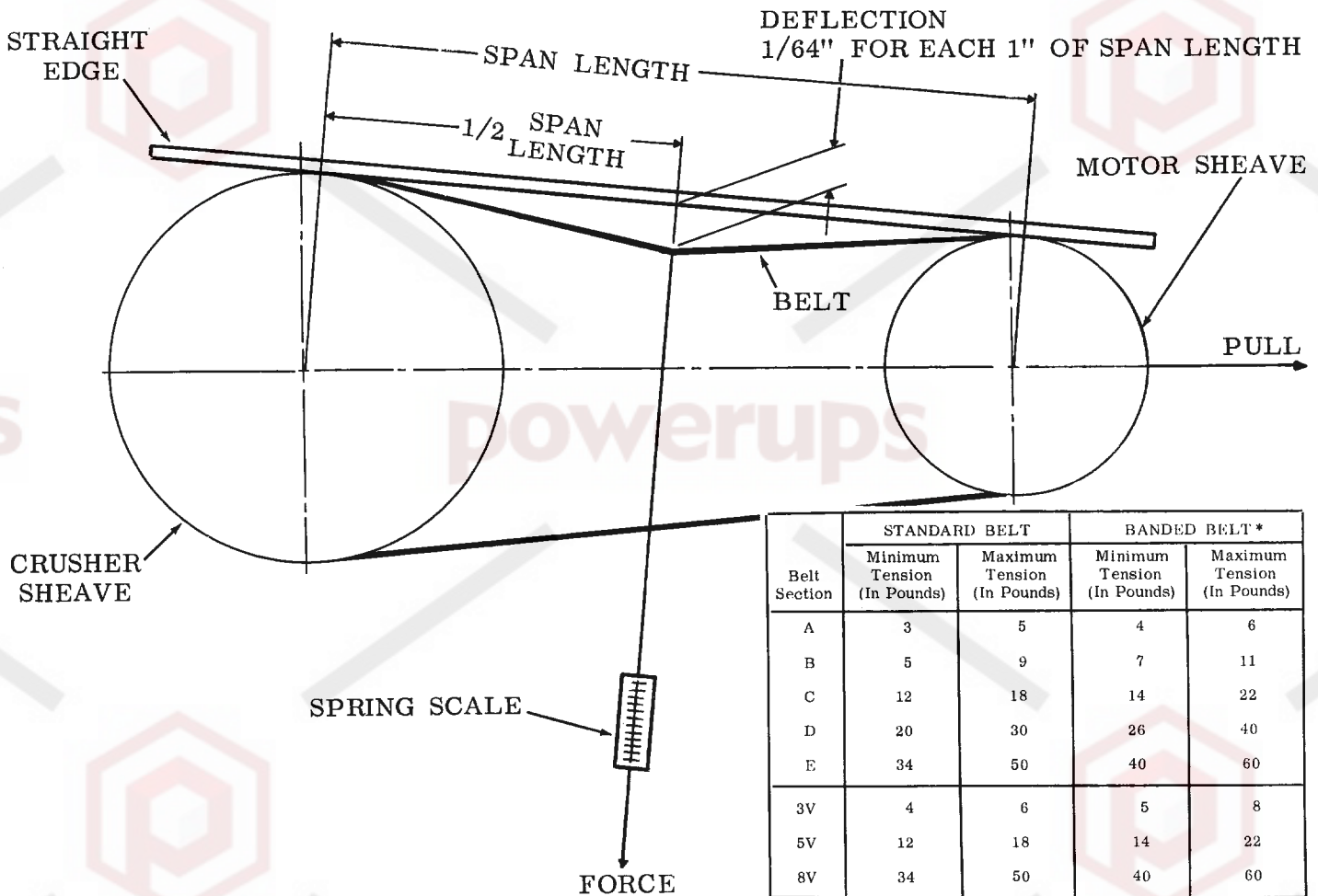
Because of the higher horsepower rating of 3V, 5V, 8V belts, each belt will be required to operate at a higher tension than belts used on a conventional V-belt drive. The total tension, however, will be no higher than that required by a conventional drive. In fact, the bearing load will be less than that for a conventional V-belt drive because

of the narrower width of the sheaves, which results in less overhung load.

WHEN PROPERLY TENSIONED, A 3V, 5V, 8V BELT MAY NOT FEEL AS TIGHT AS ONE MIGHT EXPECT FROM THE TENSION THEY CARRY. THEREFORE, IT IS ADVISABLE TO USE A SPRING SCALE TO CHECK BELT TENSION ON THESE BELTS.

For tensioning the drive using the PERCENT (%) OF ELONGATION method, proceed as follows. This particular method of tensioning V-belt drives was developed primarily for tensioning banded belts.

- 1 Remove the slack from the belts.
- 2 Next, wrap a 50 Ft. steel tape around the outside circumference of the belt and measure to the nearest 1/8". Record this length. See the illustration PERCENT OF ELONGATION METHOD.



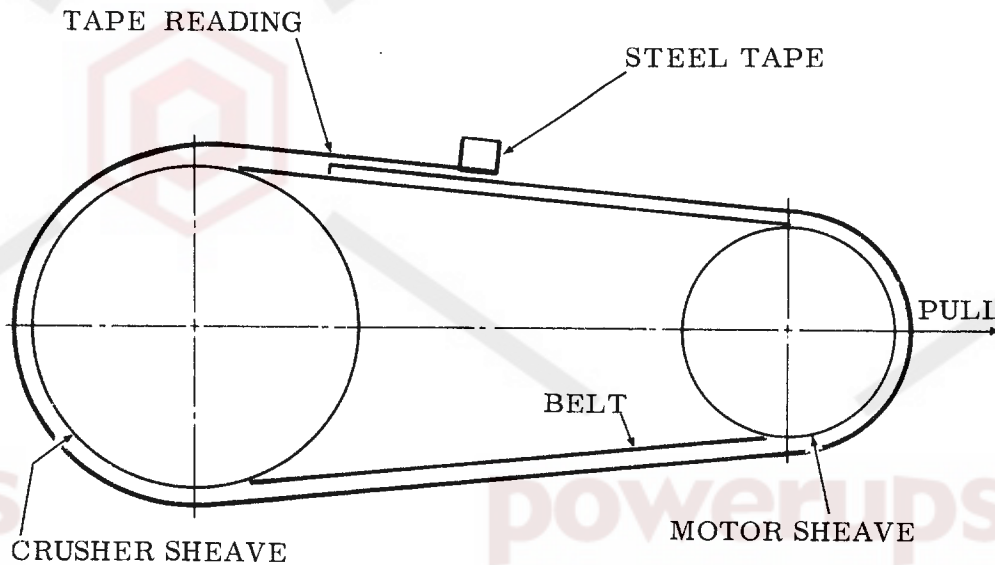
Belt Section	STANDARD BELT		BANDED BELT *	
	Minimum Tension (In Pounds)	Maximum Tension (In Pounds)	Minimum Tension (In Pounds)	Maximum Tension (In Pounds)
A	3	5	4	6
B	5	9	7	11
C	12	18	14	22
D	20	30	26	40
E	34	50	40	60
3V	4	6	5	8
5V	12	18	14	22
8V	34	50	40	60

\* Multiply these values by number of belts in band.

**TENSION - DEFLECTION METHOD**

**DEFLECTION FORCES**





Belt Section*	Multiplier	Percent
A	.010	1.0
B	.009	0.9
C	.008	0.8
D	.007	0.7
E	.006	0.6
3V	Refer to TENSION-DEFLECTION METHOD	
5V	.009	0.9
8V	.009	0.9

\* Standard or banded belts  
ELONGATION FACTORS

### PERCENT OF ELONGATION METHOD

- 3 Multiply this recorded length by a percent of elongation factor which is shown in the table ELONGATION FACTORS and add this amount to the initial measurement.
- 4 Elongate the belt to this new reading.

#### EXAMPLE

V-belt section = Standard or banded "D" belt

Initial tape reading = 120"

Elongation factor (From Table) = .007 (Multiplier) which is 0.7% (Percent)

New length reading = 120" initial reading x .007 elongation factor = 120" initial reading + .840 = 120.8" or 120-7/8"

Therefore on an installation with a "D" section belt and an outside circumference measurement of 120", the motor sheave should be moved away from the crusher sheave until the steel tape reads 120-7/8" for a properly tensioned drive.

- 5 Periodic belt tension checks must be made and if retensioning becomes necessary, the tensioning process just described should be repeated.

It must be pointed out that the TENSION-DEFLECTION METHOD is the preferred method of tensioning V-belts.

Usually the first sign that indicates retensioning is necessary, is belt slippage. This slippage will show up in loss of power and speed at the crusher sheave and in a high rate of belt and sheave groove wear. These conditions are usually accompanied by belt "squeal" and also a heating up of belts and sheaves. These conditions are readily apparent and can be detected by simply looking, listening and feeling.

### V-BELT PRECAUTIONS

Some of the do's and don'ts in connection with proper V-belt drive operation are as follows:

- 1 DO - Check belt tension frequently during the first few days of run-in operation. When the belts have had time to become seated in the sheave groove, re-tension the belts. New belts have a certain amount of initial stretch and will require additional tensioning.
- 2 DON'T - Overtighten belts as too much tension shortens both belt and bearing life. Maintain uniform tension. Idle belts should appear snug or tight; in motion, they have a slight sag on the slack side.
- 3 DO - Keep drives well ventilated as heat build-up over 140° Fahrenheit causes belt life to become shortened. The sides of the belt guard must be designed to allow for adequate circulation of air. Either perforated plate or expanded metal is ideal for this type of application.

- 4 DON'T - Allow any oil or grease to come in contact with the belts as excessive oil causes the rubber to swell and the belts to fail prematurely.
- 5 DO - Make V-belt drive general inspections on a periodic basis. The following points should be checked at each inspection.
  - A. Loss of crusher speed - check tension.
  - B. Unequal stretch - check for internal breaks.
  - C. Excessive elongation - check for over-load.
  - D. Belt softening or swelling - check for oil or grease.
  - E. Belt hardening and cracking - check for excessive heat.

### **INITIAL ALIGNMENT OF FLEXIBLE COUPLING**

For the initial installation or when reassembling the flexible coupling on a direct drive arrangement it is always desirable to align the couplings as accurately as possible for the longest coupling life and minimum vibration. After the coupling halves have been properly installed on the shafts, bring the two halves together and proceed to align the coupling as follows:

- 1 Check the gap and angular alignment by measuring the distance between the coupling halves, at four places, 90° apart, around the circumference of the coupling. See the illustration COUPLING ALIGNMENT. To measure the gap, use a feeler gauge or an inside calipers or a dial indicator with a magnetic base. Coupling halves must be aligned so that all four measured dimensions DO NOT vary more than 0.015 inches.

If any of the four measured dimensions varies more than the 0.015 inch it would indicate excessive angular misalignment.

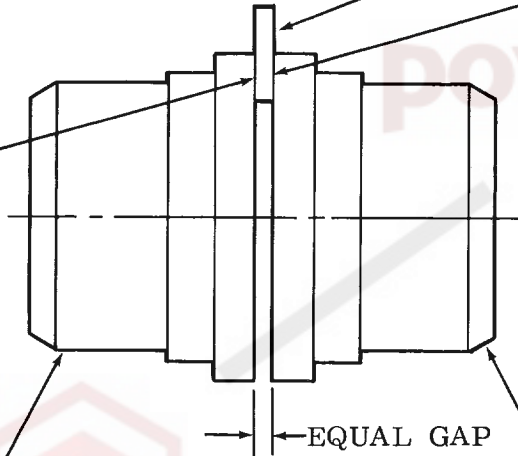
- 2 Check parallel alignment by laying a straight edge across the outside diameter of the coupling halves, at four places, 90° apart, around the circumference of the coupling. See the illustration COUPLING ALIGNMENT. Align so that the straight edge rests squarely on both coupling halves. Check with a feeler gauge or with a dial indicator. Parallel misalignment should NOT exceed 0.015 inches.
- 3 Gap, angular and parallel alignment are important whenever using a flexible coupling to drive a Crusher.
- 4 A safety set collar must be installed on the crusher countershaft to provide the proper countershaft end float or running clearance. Refer to the instructions DIRECT DRIVE in Section 4, for the proper installation of a safety set collar.

CHECK WITH FEELER GAUGE FOR PROPER GAP AND ANGULAR ALIGNMENT ON OTHER COUPLING HALF AT THIS POINT CHECK AT 90° INTERVALS

HOLD KEY STOCK TIGHT AGAINST COUPLING HALF AT THIS POINT

USE KEY STOCK FOR CHECKING GAP

EQUAL GAP

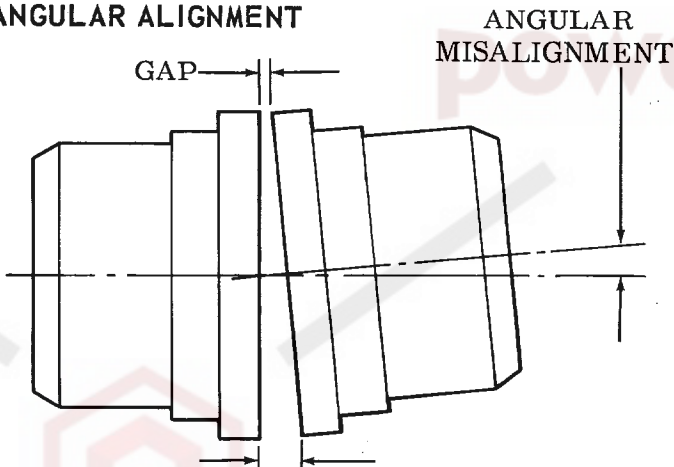


DRIVING HALF OF COUPLING (MOTOR)

DRIVEN HALF OF COUPLING (CRUSHER COUNTERSHAFT)

**CORRECT GAP AND ANGULAR ALIGNMENT**

**INCORRECT GAP AND ANGULAR ALIGNMENT**

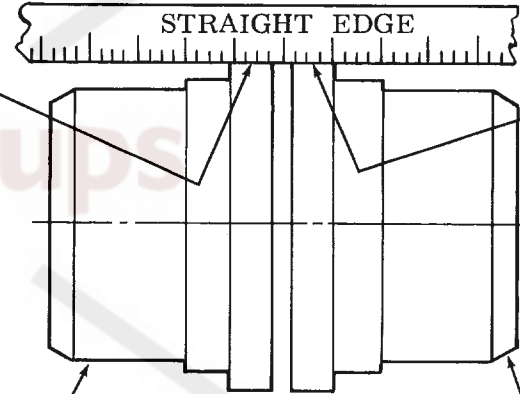


0.015" MAXIMUM GAP AND ANGULAR MISALIGNMENT

CHECK WITH FEELER GAUGE FOR PROPER PARALLEL ALIGNMENT ON OTHER COUPLING HALF AT THIS POINT - CHECK AT 90° INTERVALS

HOLD STRAIGHT EDGE TIGHT AGAINST COUPLING HALF AT THIS POINT

STRAIGHT EDGE

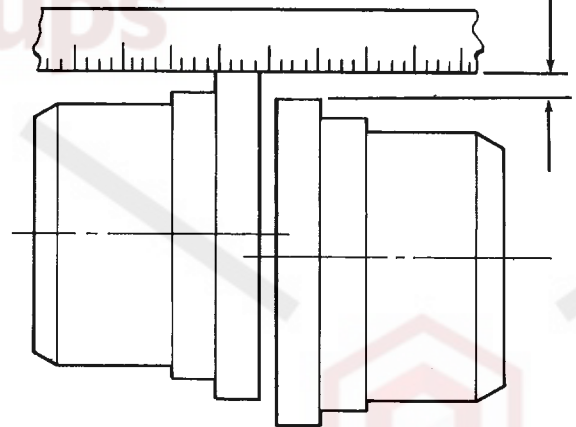


DRIVING HALF OF COUPLING (MOTOR)

DRIVEN HALF OF COUPLING (CRUSHER COUNTERSHAFT)

**CORRECT PARALLEL ALIGNMENT**

0.015" MAXIMUM PARALLEL MISALIGNMENT



**INCORRECT PARALLEL ALIGNMENT**

**COUPLING ALIGNMENT**

## CRUSHER MOTOR

The electrical driving motor is to be a squirrel cage induction motor; continuous rated, with normal starting torque (approximately 125 percent) and normal breakdown torque (approximately 200 percent) with  $\pm 10$  percent acceptable voltage variance.

Abrasive resistant insulation and stator thermostats (an internal protective device) are suggested. The motor can either be open dripproof or totally enclosed fan cooled.

To maintain continuous service of the recommended operating horsepower level shown on the foundation drawing, an electric motor with a 1.15 service factor is required. If a service factor of 1.0 is used, the horsepower rating appearing on the motor's nameplate should be approximately 15 percent higher than the recommended operating horsepower. However, the crusher power draw is to be held to the horsepower shown on the foundation drawing.

If a V-belt drive is used, care should be taken when ordering the motor that the motor bearings are adequately sized for the overhung sheave weight and belt pull. The motor must also have 360° radial belt pull capacity. Motor shaft diameter must be able to withstand peak torque and simultaneous bending due to belt pull and sheave weight. The shaft should be of sufficient length to accommodate the entire length of the motor sheave bushing or hub as well as provide clearance between the motor housing and the rim of the sheave.

With the V-belt drive, slide rails under the motor are required to provide allowance for V-belt take-up due to belt stretch and for belt installation.

If a direct drive is used, care should be taken when ordering the motor, that the motor shaft extension and bearings are adequately sized for a direct drive application. The motor shaft diameter must be able to withstand peak torque.

All horsepower ratings referred to on foundation drawings are based on electric horsepower. Therefore, when using a diesel engine as the driving unit, the engine manufacturer must be contacted in order to find out what diesel horsepower is equivalent to the electric horsepower at the speed (RPM) shown on the foundation drawing.

## PIPELINE INFORMATION

The LUBRICATING SYSTEM, Section 10, describes in detail the proper type of oil, its temperature and regulation, as well as the equipment that is used or could be used in the Crusher lubricating system. It should be noted that the lubricating system for the Crusher is designed for 125 PSI MAXIMUM operating pressure.

Consult piping drawings furnished to show the pipe and pipe fittings supplied with the Crusher and any other lubricating equipment. Pipeline layout will vary to suit local conditions. Two influencing factors should be considered in the layout of both feed and drain lines; the pipeline should be as short and as direct as possible, without dead pockets or other flow obstructions and the drain line should have a minimum pitch of 1" for every 12" of pipe used.

It is necessary that all piping be checked for internal cleanliness, that all chips and cuttings at threaded ends be removed to safeguard the oil pump.

Unions should be installed in suitable locations to facilitate removal of any of the lubricating equipment: oil pump, filter, cooler, etc.

All piping connections should be checked for leaks. It is very important that the oil suction line between the pump and tank be absolutely tight, since any leakage in this line will be reflected in the lowering of pump efficiency, that is, oil capacity and oil pressure will be considerably lower and may endanger the crusher lubrication. Leakage in the suction line is especially dangerous since it does not reveal itself by an oil leakage as would be the case in the oil pressure line.

Attention should be given as to the direction of rotation of the crusher countershaft, as it is important that suction and feed lines be connected properly to the crusher driven integral pump. For the correct arrangement of the integral pump piping consult the piping drawings furnished.

## GENERAL ASSEMBLY AND DISASSEMBLY INFORMATION

Symons cone crushers are shipped either as a complete unit or in sub-assemblies, depending on crusher size. For domestic shipment, the smaller size Crushers are usually shipped as a complete unit, ready to be set on the foundation. In some instances these smaller machines will be dismantled into

sub-assemblies for export shipment or for domestic shipment where shipping or handling restrictions so demand. The larger size Crushers are, in most instances dismantled for shipment.

In succeeding sections detailed instructions will be given covering the assembly and disassembly of the various crusher components. Starting with the main frame, the remaining components are discussed in their normal assembly sequence. Whether the Crusher is shipped as a complete assembled unit or whether it is completely dismantled, the Crusher can be assembled by referring to those sections which apply to the Crusher depending on the extent of dismantling.

Before installing any of these crusher parts, check that the protective coating applied to all machined surfaces for shipment has been removed, and that all parts are clean and free from grit and dirt, especially oil passages and pipes.

All machined surfaces and threads that may have possibly been damaged in shipment must be restored to the proper condition before assembly. After cleaning, lightly oil all bearing surfaces and machined surfaces of mating parts.

## GENERAL MAINTENANCE INFORMATION

When performing any maintenance work on the Crusher, the following general precautions should be observed:

- 1 When removing parts with machined or bearing surfaces which may rust, they should be well oiled or covered with a rust preventative, if they are to be kept out of the Crusher for any length of time.
- 2 Use additional caution when handling any parts which have bearing surfaces or a machined surface that has close tolerances.
- 3 When disassembling any parts with bearing or machined surfaces, protect these surfaces from coming in contact with the ground by using wooden blocking.
- 4 Bronze liners or bushings should be handled with extreme care. Excessive ramming or pounding on this soft material may cause warping or springing of such parts.

- 5 Clean thoroughly and oil, all machined parts before installing them in the Crusher. Do not replace a bearing surface without coating it with oil.
- 6 When assembling two mating parts that require either a press or sliding fit, coat the contacting surfaces with a light coating of oil. This will act as a lubricant and prevent rusting in place. When pressing the main shaft into the head or the pinion onto the countershaft use a white lead and oil mixture.
- 7 Inner and outer eccentric bushings are to be stored vertically, stored in any other position could cause the bushings to become out-of-round or elliptical. Great difficulty could consequently be encountered when installing them in the Crusher. In some instances installation would be impossible.
- 8 All bowl, adjustment ring, main shaft, main shaft nut, locking collar, locking nut and locking nut cover thread surfaces are to be rubbed with a cloth impregnated with powdered molybdenum disulfide and then coated with grease or oil. Again, should this powder be unobtainable, grease applied liberally is a good substitute.

## MINIMUM RECOMMENDED SPARE PARTS LIST

The following is a list of the minimum spare parts which should be on hand at all times to insure a minimum of down time.

1. Bowl liner.
2. Mantle.
3. Integral oil pump (if so equipped).
4. Step bearing plate shims (1 Set).
5. Socket sealing ring springs (1 Set).
6. Socket sealing ring spring housings (1 Set).

SPRINGS AND HOUSINGS ARE USED ONLY ON CRUSHERS EQUIPPED WITH THE STANDARD HEAD SEALING ARRANGEMENT

It is to be understood that this list contains only the minimum compliment of spare parts and if

the crusher installation is either in a remote location or consists of several Crushers, this list should be expanded. Therefore, consult the factory for a suggested list of spare parts for your particular operation.

Before storing any spare parts, check that the protective coating applied before shipment is still intact.

Finally, when replacing any bushings, bearings or major parts and when the Crusher is being started for the first time, it is advisable to "run the parts in". Refer to the information described in the paragraph entitled BREAK-IN PROCEDURE in Section 11.

## **SPECIAL TOOLS**

Only tools which are not readily available through commercial supply houses can be furnished with your Crusher.

These tools consist of all the eyebolts necessary for handling the equipment; a few special wrenches; cables for turning and adjusting the bowl; a mandrel for pouring backing; and special capscrews for installing and removing the countershaft box.

All of the tools are painted the same color as the Crusher for immediate identification and shipped in a separate box.

The illustration SPECIAL TOOLS shows the type of tools usually furnished, but will vary slightly with each size of Crusher.

## **PROTECTING THE CRUSHER AGAINST RUST CORROSION**

Rusting is a specific type of corrosion that occurs on iron and steel surfaces when both water and oxygen are present.

Rusting can occur even if the amount of water present is only a very thin film that may not even be visible. In fact, rusting of iron and steel in humid atmospheres is a common experience. Since air, the normal source of oxygen, usually contains some moisture, and ordinary water contains dissolved air, the elements required for rusting are practically always present. Corrosion of some metals, for example copper and aluminum, results in the formation of a tight oxide film that protects

the surfaces from further corrosion. On the other hand, rust on iron or steel is porous so that water and oxygen can still get at the underlying surface. Therefore, rusting continues and penetrates deeper into the metal.

Rust is dangerous and expensive. Rusting causes industry several billions of dollars annually. In many plants rusting is the major cause of:

- Downtime
- Lost Production
- Wasted Production
- High Maintenance Costs
- Early Replacement of Equipment

Rusting also creates:

- Safety Hazards to Personnel

This cost can be greatly reduced:

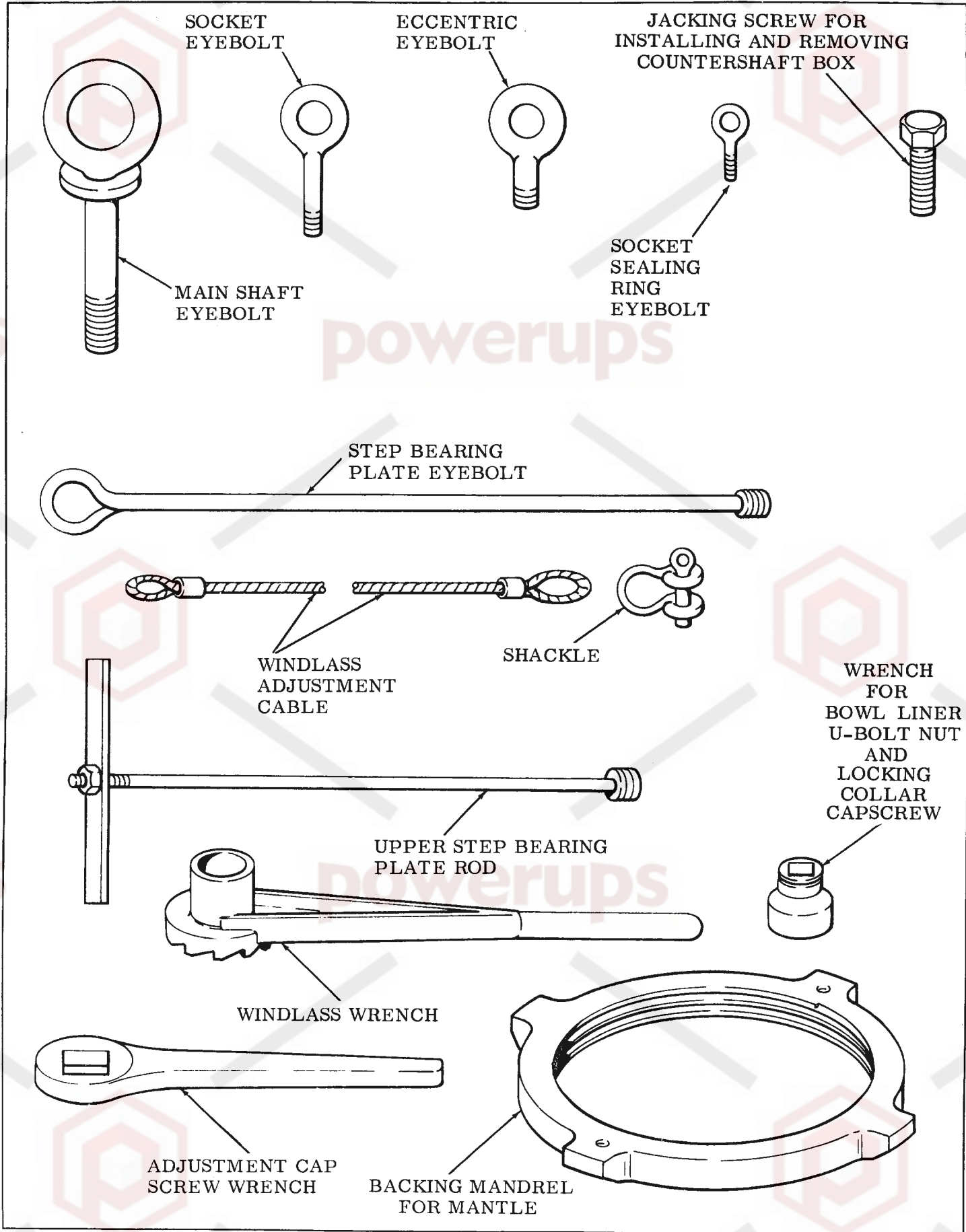
- Through a rust prevention program
- Through proper use of rust preventives

To protect your Crusher from rust corrosion during seasonal shut down or for foreign shipment or for outdoor storage (winter or summer), the following protective measures are recommended:

- 1 Remove the bowl and main shaft assemblies and fill the entire eccentric bore with a rust preventive lubricating oil until the oil is level with the top of the socket liner.

Make sure that all piping and the breather hole in the side of the countershaft box are sealed with pipe plugs to assure that the entire inside of the Crusher can be filled.

Use a lubricating oil which has a rust-preventive blend that is designed for the protection of internal parts of enclosed assemblies such as engines, compressors, pumps, gear sets, and hydraulic assemblies. The rust preventives function by displacing water from metal surfaces, by forming strong water-resistant films on the surfaces, and by absorbing water in the system into a water-in-oil emulsion. These products provide as much as 30 to 40 times the protection against rust as high-quality lubricating oils that have not been especially formulated to prevent rust.



**SPECIAL TOOLS**

In most applications, the residual rust-preventive film left by these products need not be flushed away or otherwise removed when the Crusher is to be filled with lubricating oil and put into normal service.

Generally, one (1) barrel (55 U.S. gallons) is sufficient to coat a Crusher. The viscosity of the oil should be in the 150 to 300 SSU at 100° Fahrenheit range.

- 2 Fill the countershaft box with oil through the 1/2" tapped hole in the top of the box casting. Some leaking will occur from the end of the countershaft box, this is normal.
- 3 Turn the main shaft assembly upside down and fill the lubricating hole in the bottom of the shaft until the oil flows out of the hole in the head, then drain. Brush or spray a light-bodied petroleum solvent containing a substantial amount of a polar rust-preventive additive having strong attraction for metal surfaces, on the entire main shaft and underside of the head.

The additive should have excellent ability to wet metal surfaces in the presence of water; as a result it strongly resists displacement from the surface by water. The solvent should evaporate quickly and leave a thin, transparent, greasy film. The material should be suitable for light and moderate service, for example, protected outdoor storage. It should be applied at plant operating temperature by any convenient means (brushing, rolling, spraying) and the film need not be removed when the Crusher is placed in operation.

- 4 Brush or spray this same greasy solution on the bowl and adjustment ring threads. Then cover the threads with a liberal amount of a lithium base grease NLGI No. 1 containing 5-10% of molybdenum disulfide.
- 5 Pack the socket sealing ring (standard seal only) with this same grease, making sure the wipers are completely covered. If the Crusher has a water sealing arrangement, fill the water chamber with the same oil as used in the rest of the Crusher.
- 6 If the Crusher is equipped with a hydraulic clamping and adjustment mechanism, fill the oil tank on the power unit with a similar rust preventive oil but having a viscosity of 150 SSU at 100° Fahrenheit, 25 U.S.

gallons are required for the entire hydraulic system. Make sure the oil is compatible with such a hydraulic system where neoprene, polyurethane, bronze, nickel, chrome, steel and iron is used.

The hydraulic clamping and adjustment system must be operated to assure that the power unit, lock posts and rams have been thoroughly coated with the rust preventive.

- 7 After the Crusher has been completely filled with the special rust preventive oil, the Crusher is to be drained before placing it in storage, as the remaining film is all that is required for adequate rust protection.

DO NOT USE THIS OIL TO OPERATE THE CRUSHER AS IT IS DESIGNED ONLY FOR RUST PREVENTION.

- 8 Then re-assemble the bowl and main shaft assemblies into the Crusher and cover the entire adjustment cap and bowl hopper with a sheet of 8 mil BLACK polyethylene to prevent water from seeping into the Crusher and corroding the bowl and adjustment ring threads. This sheeting is available in 20 ft. by 100 ft. rolls. Black is recommended as transparent sheeting will deteriorate four (4) times faster than black. The end of the countershaft box and countershaft should also be covered. Steel strapping or banding is an ideal method of holding the polyethylene sheeting in place.

IF THE ABOVE RECOMMENDATIONS ARE FOLLOWED, A CRUSHER STORED OUTDOORS SHOULD HAVE 6-12 MONTHS OF RUST PROTECTION.

Where it is necessary that the Crusher be shipped or stored dismantled, the various sub-assemblies must be protected more thoroughly, as the previously described procedures are for metal surfaces that are NOT directly exposed to the elements; sun, wind, rain, snow, etc.

The following protective measures are recommended in those instances where a Crusher must be shipped or stored dismantled and the various sub-assemblies exposed to the elements:

- 1 Cover the entire top of the socket liner, the adjustment ring, and end of the counter-



shaft box with the black polyethylene sheeting to protect the inside of the Crusher after the Crusher itself was prepared as previously described with a rust preventive oil. The sheeting must be adequately braced to prevent sagging.

- 2 Spray or paint the machined surfaces of the various sub-assemblies; bowl, main shaft and head, etc. with a specially processed asphaltic material that is made fluid by means of a petroleum solvent. It is a medium-body, black liquid that can be applied at room temperature by any convenient method. The solvent evaporates and leaves a hard strong dry acid-resistant film. This coating provides long-time protection under severe conditions such as

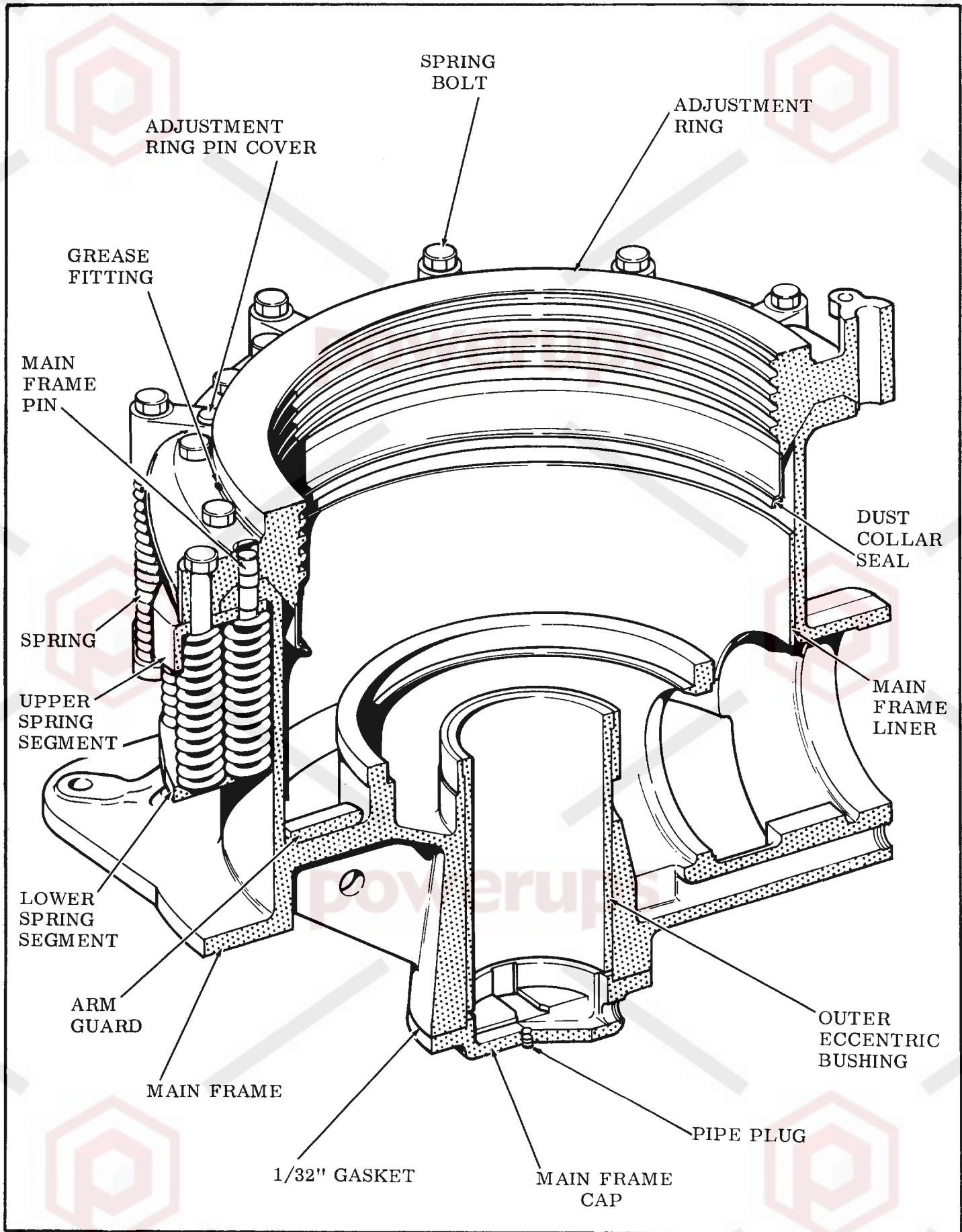
unprotected outdoor storage and presence of corrosive fumes. It is especially suitable for unpainted external surfaces. The treated parts will withstand considerable scuffing and moderately rough handling, but they should be protected against severe physical damage, since the hard, dry film is not self-repairing. The film is somewhat similar to paint and although semi-permanent can be removed even after prolonged aging by vigorous rubbing with solvent soaked rags.

FOR THOSE PARTS STORED OUTDOORS UNPROTECTED, THE ABOVE RECOMMENDATIONS SHOULD PROVIDE 24 MONTHS OF PROTECTION AGAINST RUST CORROSION.

### Section 3

## MAIN FRAME, ADJUSTMENT RING & SPRING RING ASSEMBLIES

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## SECTION 3

# MAIN FRAME, ADJUSTMENT RING & SPRING RING ASSEMBLIES

### DESCRIPTION

This section covers the main frame, adjustment ring and spring assemblies. The main frame, which is securely bolted to a foundation, transmits the crushing force to the foundation and provides a rigid support for the remaining crusher components. A main frame liner welded to the inside of the frame as well as arm guards are replaceable and protect the inside of the frame from wear. An adjustment ring, which seats on a conical machined surface at the top of the main frame is threaded on its inside diameter to provide the means of adjusting the bowl assembly. Heavy duty helical compression springs seating against the underside of the frame and bolted to the adjustment ring allows tramp iron to pass through the crushing cavity without damage to the Crusher. As a non-crushable object enters the crushing cavity and spring pressure is exceeded, the springs compress and permit the adjustment ring to lift, allowing such material to be readily discharged. Main frame pins projecting from the top of the frame prevent the adjustment ring from rotating and serve as a guide to return the ring to its original position when the adjustment ring lifts or tilts. The outer eccentric bushing, which is locked to the frame, provides the bearing surface for the eccentric assembly. A main frame cap bolted to the bottom of the frame gives access to this portion of the Crusher as well as provides the support for the thrust bearing and eccentric assemblies.

### ASSEMBLY INSTRUCTIONS

In most instances, these components will be shipped already assembled, however, in some rare cases, shipping restrictions or space limitations may require that the unit be disassembled. Complete procedures, for assembling the main frame components, are given in the MAINTENANCE portion of this section.

If the main frame assembly or the entire Crusher is to be placed on a concrete foundation,

the main frame must be grouted into place. There are two types of grouting material in usage today; these are concrete and NORDBAK. Concrete has been used almost exclusively as grouting material over the past years, however, more recently concrete grout has been replaced by NORDBAK in most crusher installations.

The preparations, properties of concrete, and equipment involved, in most cases makes NORDBAK a preferable material. NORDBAK is a tough, resilient, vibration resistant epoxy material which is readily available in kit form in various sizes. Each kit consists of an epoxy and a hardener that are mixed together right at the job site; the simple directions are included in each kit. The use of NORDBAK requires no special equipment, preparation or handling. Once mixed, the NORDBAK must be poured without delay, but subsequent mixes can be poured at any convenient time.

To install either the main frame assembly or the entire Crusher on a concrete foundation or to grout a steel structure to a concrete slab proceed as follows:

- 1 Torch cut four large diameter washers from 3/8" plate and place them over the foundation bolts.
- 2 Attach a suitable sling or slings through the holes in the four ribs at the lower corners of the main frame flange. On the 7 Ft. extra heavy duty Crusher lifting hooks near the top of the frame are to be used for this purpose.

#### **WARNING**

Do not use the lifting hooks on the adjustment cap for lifting the entire machine. These hooks are NOT strong enough to lift the entire Crusher. Serious personal injury or severe damage to the Crusher could result.

- 3 Carefully lift the main frame and lightly oil the underside of the frame flange

to prevent adhesion of the NORDBAK to the Crusher.

- 4 Place the main frame in position on the foundation on top of the 3/8" thick washers.

When using concrete grout place the main frame on hardwood blocks positioned beneath each of the four corners of the frame rather than on the steel washers. Wood is used in this instance as concrete grout shrinks when it sets and the wood will shrink with the concrete.

The blocks should support the main frame approximately 2" to 2-1/2" above the top of the concrete foundation to allow for the proper thickness of concrete.

The surface of the foundation where the concrete grouting will be poured, should be left rough and be carefully cleaned before grouting. This surface should be thoroughly saturated with water and kept wet to prevent any rapid absorption of water from the grout mix. However, remove any excess water from the top of the foundation just prior to pouring the grout. Use a grout mixture which contains a non-shrink additive to minimize shrinkage.

- 5 Level the Crusher by inserting "C" shaped shims around the foundation bolts on top of the steel washers. This will give approximately 1/2" to 3/4" grout area between the main frame and the foundation, which is the desired NORDBAK thickness.

- 6 Next, construct a form around the inside and outside of the main frame flange that will contain the NORDBAK during pouring. Use 1" x 2" wood furring strips for the forms. Locate and fasten the furring strips 1/2" from the outside of the crusher flange, on the inside, place the forms against the side of the foundation and the underside of the main frame flange. See the illustration **GROUTING WITH NORDBAK**. All forms must be thoroughly waxed with 3 coats of ordinary paste wax. This will prevent the wood strips from sticking to

the grout. All joints and seams must be sealed with a caulking compound to prevent leakage of the NORDBAK during pouring.

- 7 Mix and pour the NORDBAK following instructions on the kit. When cold temperatures prevail, warm the NORDBAK and crusher flange to 65° - 80° Fahrenheit. For best results the NORDBAK kits should be stored in a warm area before mixing. To prevent air entrapment under the Crusher, pour the NORDBAK from one place at a time, allowing the NORDBAK to cover an area of approximately 2 feet on either side of the pouring spot. Then move to a position where the previous pour flow has stopped and pour again. Continue this procedure until grouting is completed.

**DO NOT POUR NORDBAK INTO MORE THAN ONE AREA AT A TIME.**

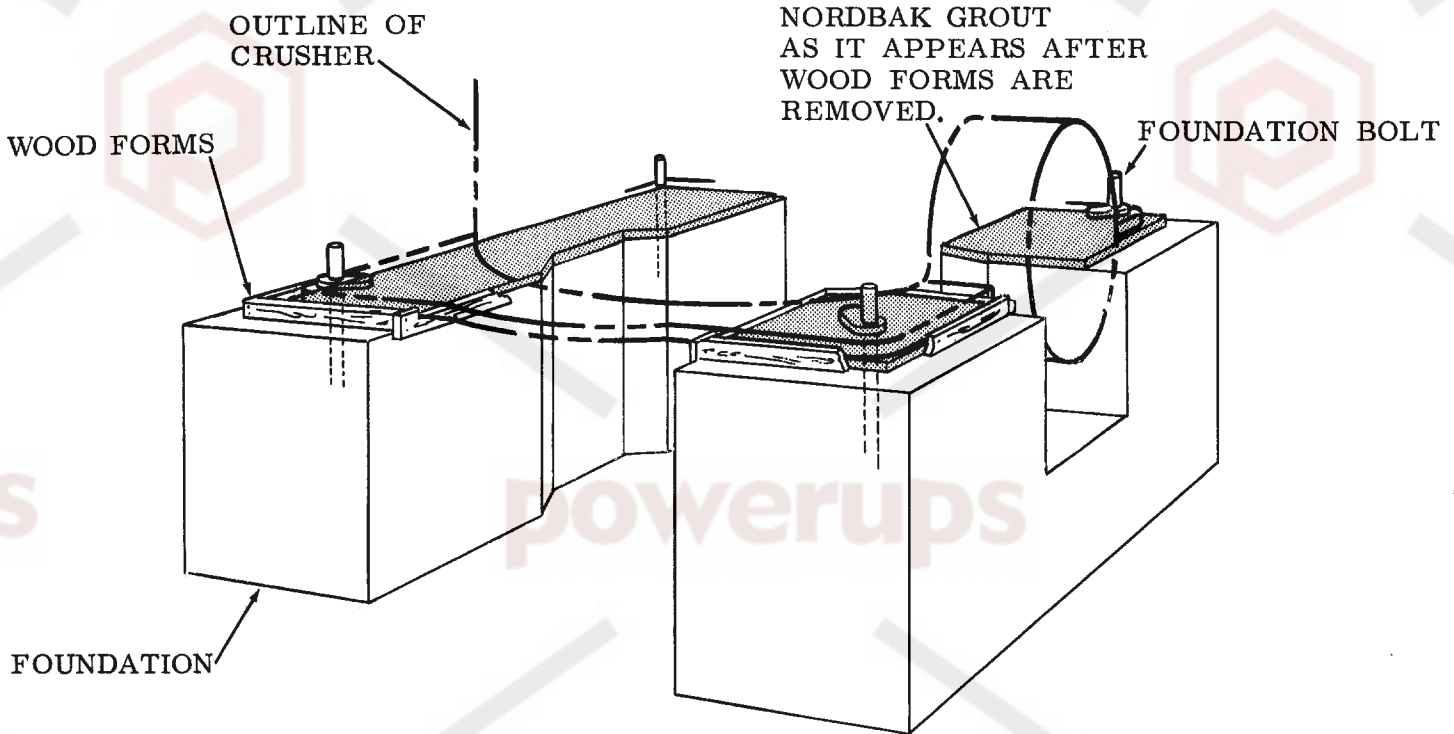
For the average number of pounds required to grout the Crusher with either 1/2" or 3/4" of grout thickness refer to the table **NORDBAK GROUTING REQUIREMENTS**.

CRUSHER SIZE	*Pounds of NORDBAK Required For:	
	1/2" Grout	3/4" Grout
2 Ft.	33	55
3 Ft.	55	99
4 Ft.	99	143
5100 and 4-1/4 Ft.	110	165
5-1/2 Ft.	176	265
7 Ft.	187	286

\*All quantities include enough grout for an extra 1/2" between forms and frame flange. If the foundation is irregular, increase amounts by 10%.

#### **NORDBAK GROUTING REQUIREMENTS**

- 8 NORDBAK will harden sufficiently in 6 hours to permit operation if the foundation, Crusher and NORDBAK are warmed to 70° Fahrenheit when the pour is made.
- 9 After the grouting has hardened, tighten the Crusher firmly to the foundation.
- 10 When a Crusher is mounted on a steel structure the Crusher is simply leveled and tightened firmly to the structure.



### GROUTING WITH NORDBAK

#### MAINTENANCE

**MAIN FRAME LINER AND ARM GUARDS.** When the Crusher is "down" for a liner change, inspect the main frame liner and arm guards for wear.

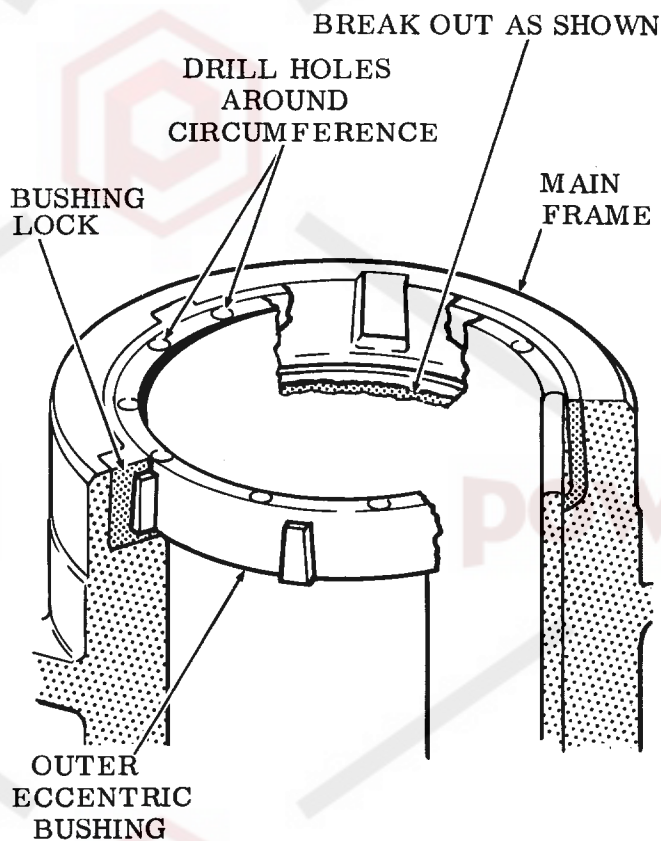
With the head removed from the Crusher, lower the arm guards from the top onto the main frame arms. An arm guard could be slipped in place from beneath the Crusher while the head is in place but with considerable difficulty.

A replacement main frame liner is sometimes shipped in sections, making the installation of the liner a somewhat easier task. Should a liner be received in one piece, the ends of the liner must be overlapped until the liner is smaller in diameter than the adjustment ring threads. Clamp the overlapped ends tightly together with heavy duty "C" clamps, lower the liner in place in the frame and remove the clamps, allowing the liner to spring back to its original shape. The height at which the liner is to be welded inside the frame is readily noticeable by the remaining weld from the old liner.

**OUTER ECCENTRIC BUSHING REMOVAL.** The outer eccentric bushing is held in the main

frame by a bushing lock at the top. This lock must be removed before the bushing can be pressed out. It is by far easier to break out the top of the bushing than it is to remove the lock. Should it be desired to remove a bushing in one piece, the bushing lock must be drilled and chipped out. Even the smallest piece of broken zinc or NORDBAK Locking Compound must be cleaned out before pressing can begin. If the outer eccentric bushing is to be removed for replacement, proceed as follows:

- 1 Drill a series of 3/8" diameter holes, spaced 4" apart, in the wall of the outer eccentric bushing. See the illustration REMOVING BUSHING LOCK. Drill the holes to a depth corresponding to the shoulder width of the replacement bushing.
- 2 Hold a steel bar at a 45° angle against the outside of the bushing and break the top of the bushing into pieces by hitting the steel bar with a sledge hammer.
- 3 Break the top of the bushing away from the bushing lock all around the circumference of the bushing, cleaning out all chips and fragments.
- 4 Remove the main frame cap at the bottom of the frame to give access to the bushing.

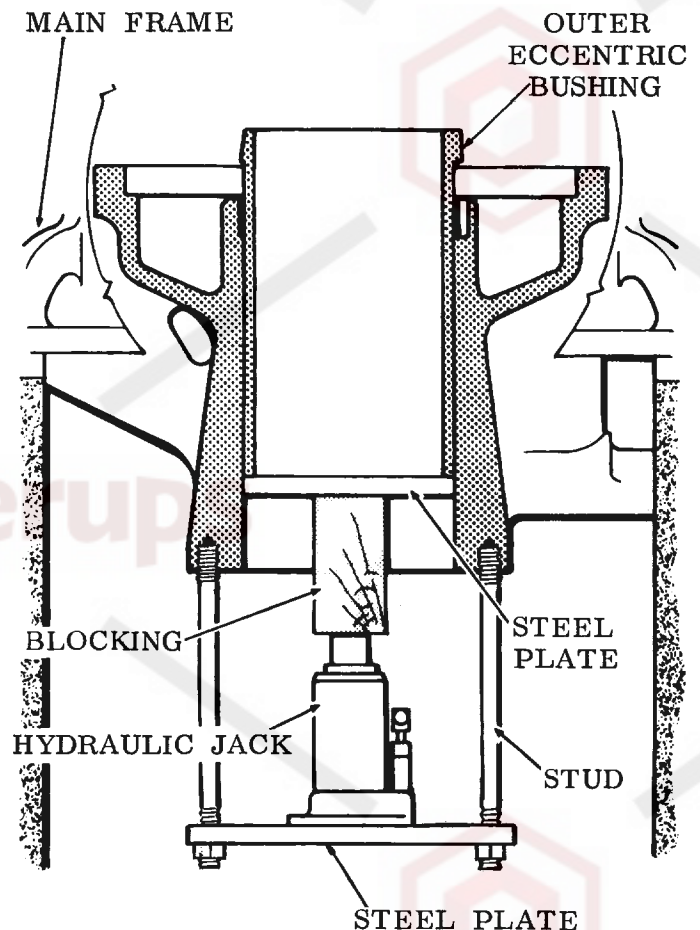


### REMOVING BUSHING LOCK

- 5 Cut a steel plate, to a diameter slightly smaller than the main frame bore. A plate 2" thick is required; several plates of thinner materials can be used to obtain this 2" thickness. Place the plate against the bottom of the bushing as shown in the illustration REMOVING OUTER ECCENTRIC BUSHING.

A HEX NUT CAN BE WELDED TO THE TOP OF THIS PLATE AND WITH AN EYEBOLT THREADED INTO THE NUT, CONNECT THE EYEBOLT TO A CRANE OR SUITABLE HOIST. PULLING FROM THE TOP, WHILE JACKING FROM THE BOTTOM, WILL HELP CONSIDERABLY IN REMOVAL.

- 6 Then cut a plate the same diameter as the main frame cap also from 2" material. Torch cut three holes in the plate the same diameter and on the same bolt circle as those in the main frame cap. The three holes must be spaced 120° apart.
- 7 Suspend the plate from the bottom of the main frame by three long studs. Place a 50 ton hydraulic jack between this plate and the one placed against the bottom of the bushing. A substitute arrangement can be



### REMOVING OUTER ECCENTRIC BUSHING

utilized by placing a steel rail or beam across the discharge compartment to provide a support for the jack.

- 8 Force the bushing from the frame by exerting pressure with the jack and adding blocking whenever necessary.

**INSPECTION OF MAIN FRAME BORE.** Before installing a new outer eccentric bushing, inspect the main frame bore for scoring or rough spots, these must be smoothed out.

Also check the bore to be sure that it has not worn oversize or shrunk undersize, due to the presence of heat. Measure the main frame bore from bottom to top.

Removing the main frame cap will expose an area in the bore that has been unaffected by wear or heat, since the cap projects about 1/2" inside. Using an inside micrometer placed in the bore, about 1/4" to 3/8" from the bottom of the frame, will give the original bore diameter

Once this dimension has been recorded measure the entire length of the bore, checking about

every 6". At the same time check for out-of-roundness by swinging the micrometer 90° to the first measurement and measure this diameter. It must be pointed out that on the 7 Ft. heavy and extra heavy duty Crushers, a stepped outer eccentric bushing is used, making the measuring somewhat complicated. The lower bore is to be measured as mentioned previously. Then add 0.062 inch to the lower bore dimension, this would be the correct dimension for the middle bore. Add 0.125 inch to the lower bore for obtaining the correct upper bore dimension.

THE STEPPED BUSHING ON THESE LARGER MACHINES PERMITS THE BUSHING TO SLIDE TWO-THIRDS OF THE WAY INTO THE FRAME BEFORE COMING INTO ANY POSSIBLE INTERFERENCE, CONSEQUENTLY AIDING IN INSTALLATION.

With a bore that has shrunk unevenly, the high spots can be ground off to the correct diameter. If the bore has pulled in to the extent where hand grinding is no longer practical, the entire main frame bore must be machined out to the original diameter. Also, in case the frame bore has worn out-of-round, it should be remachined concentric, even though the diameter would be increased. Remachining drawings are available showing the correct bore dimensions and their tolerances.

When a bore has either been worn or machined oversize, contact the factory for the purchase of a special oversize bushing, giving remachined bore dimensions so that the bushing can be machined to the proper tolerances.

**OUTER ECCENTRIC BUSHING INSTALLATION**  
Outer eccentric bushings are machined to provide a metal-to-metal or a few thousandths loose fit in the main frame bore. Should a bushing have such a metal-to-metal fit or be out of round because of improper storage or shipment, the following procedure using dry ice is recommended.

To install a replacement outer eccentric bushing, using dry ice proceed as follows:

1 Paint or scribe a line down the side of the bushing starting from one of the cast lugs.

THE OUTER ECCENTRIC BUSHING ON THE 7 FT. CRUSHER HAS CORED POCKETS RATHER THAN CAST LUGS TO FORM THE BUSHING LOCK WITH THE FRAME.

- 2 Pack the bore of the replacement bushing with dry ice to shrink the bushing. The table DRY ICE REQUIREMENTS gives the approximate amount of dry ice necessary to adequately pack the inside of the bushing providing some sort of filler is used in the center of the bushing. As an example, a 6" x 6" wooden timber leaves sufficient area around it in a 4-1/4 Ft. outer eccentric bushing to allow for an adequate amount of dry ice to shrink the bushing.

**WARNING**

Use heavy, well insulated gloves when handling the dry ice. Handling dry ice without protection could result in severe burns.

Cooling time should be approximately two hours on all size bushings.

Wrap the outside of the bushing with several layers of burlap to prevent the external build up of frost which would hinder the installation of the bushing in the main frame. Wrapping also helps to achieve a more thorough cooling.

DO NOT USE THIS METHOD OF INSTALLATION TO OVERCOME A MAIN FRAME BORE THAT HAS CLOSED-IN.

- 3 Measure the outside diameter of the bushing and the bore of the main frame to determine when the bushing has cooled sufficiently.
- 4 Lift the bushing into position and center it in the top of the main frame bore. Use the line on the side of the bushing for aligning the bushing with the cored pockets in the frame.
- 5 Quickly lower the bushing into the main frame.
- 6 The top of the bushing must be flush with the top of the frame when properly installed.
- 7 Pour the bushing lock. Follow the procedure as outlined under POURING THE BUSHING LOCK.



CRUSHER SIZE	QUANTITY OF DRY ICE IN POUNDS
2 Ft.	100
3 Ft.	150
4 Ft.	200
5100 and 4-1/4 Ft.	250
5-1/2 Ft.	400
7 Ft.	600

### DRY ICE REQUIREMENTS

If dry ice is not available an alternate method using ramming can be employed. To install the bushing by ramming, proceed as follows:

- 1 Paint or scribe a line down the side of the bushing starting from one of the cast lugs.

THE OUTER ECCENTRIC BUSHING ON THE 7 FT. CRUSHER HAS CORED POCKETS RATHER THAN CAST LUGS TO FORM THE BUSHING LOCK WITH THE FRAME.

- 2 Lift the bushing into position and center it in the top of the main frame bore. Use the line on the side of the bushing for aligning the bushing with the cored pockets in the frame.
- 3 Place the steel plate used in removal, on top of the bushing and force the bushing into the frame by ramming against the top of the steel plate.
- 4 The top of the bushing must be flush with the top of the frame when properly installed.
- 5 Pour the bushing lock. Follow the procedure as outlined under POURING THE BUSHING LOCK.

**POURING THE BUSHING LOCK.** The cast lugs around the top of the outer eccentric bushing which engage the cored pockets in the main frame are dovetailed to provide a lock when the remaining space between the lugs and the frame is filled with NORDBAK Locking Compound or zinc. This lock prevents the bushing from moving.

THE OUTER ECCENTRIC BUSHING ON THE 7 FT. CRUSHER HAS CORED POCKETS RATHER THAN CAST LUGS TO FORM THE LOCK WITH THE FRAME.

Development of the original NORDBAK non-metallic backing compound eliminated the need to pour molten zinc when crusher liners were replaced. However, it was still necessary to use zinc to lock the inner and outer eccentric bushings. The original formula for NORDBAK resins lacked the high temperature and high impact characteristics needed for such heavy duty applications.

Nordberg has developed a compound which successfully meets those requirements. This new product is called NORDBAK Locking Compound. Now the hazards of molten zinc can be eliminated completely from crusher maintenance procedures.

The NORDBAK Locking Compound comes in a kit containing three ingredients: resin, filler and hardener. The simple directions are included in each kit. Once mixed, the NORDBAK must be poured without delay.

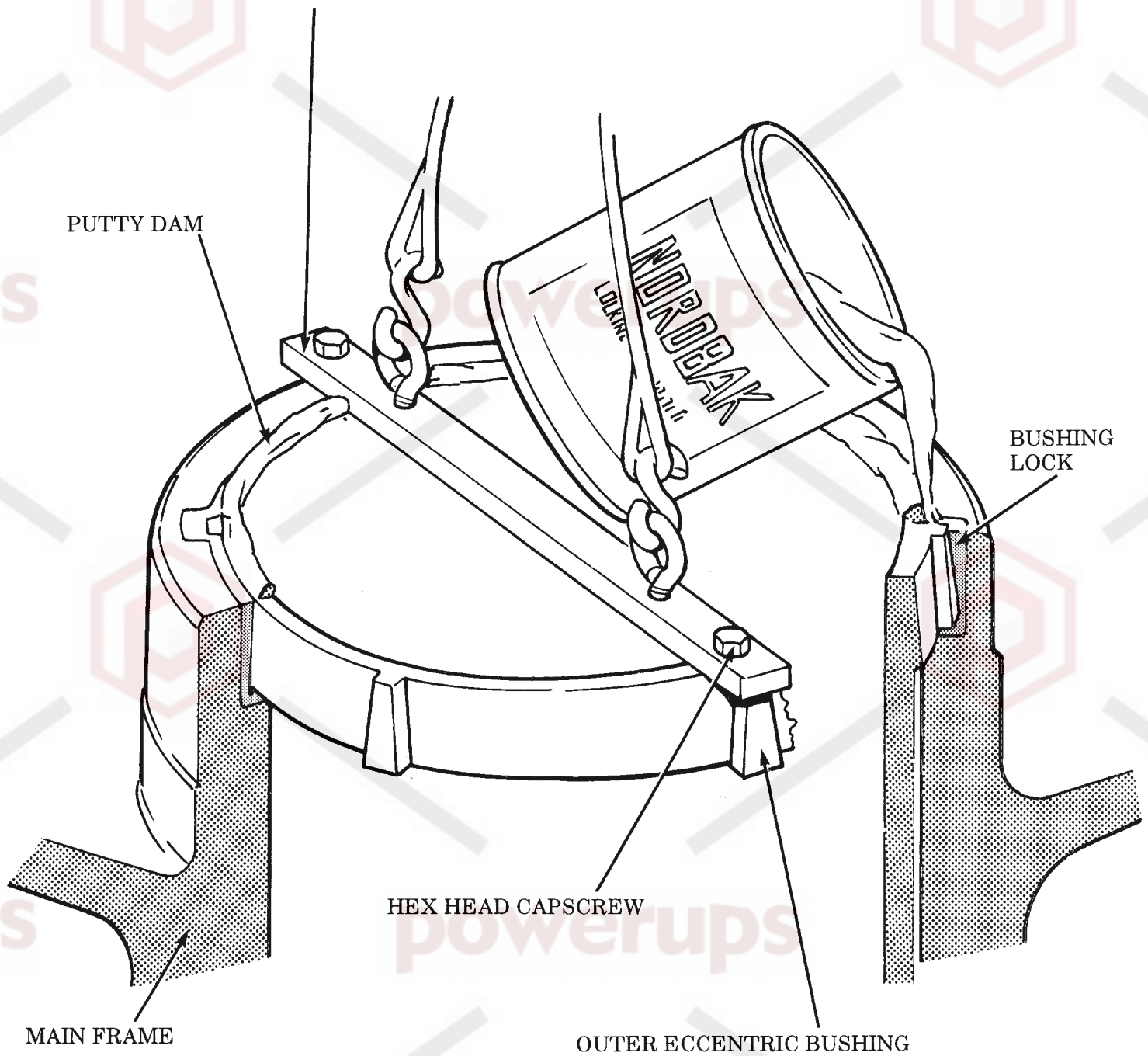
Application of NORDBAK Locking Compound requires no special training or experience. Melting and pouring equipment and special protective gear are eliminated because the Locking Compound is mixed and poured at room temperature.

THE USE OF NORDBAK BACKING MATERIAL IS NOT RECOMMENDED IN THIS APPLICATION.

To pour an outer eccentric bushing lock, proceed as follows:

- 1 The top of the bushing must be flush with the top of the frame when properly installed.
- 2 The bushing and frame and, if used, the NORDBAK Locking Compound should be at room temperature prior to pouring (60° to 90° Fahrenheit).
- 3 When using NORDBAK Locking Compound, the outer eccentric bushing is prepared by

USE A 1" x 2" STEEL BAR BOLTED ACROSS THE TOP OF THE OUTER ECCENTRIC BUSHING TO HOLD THE BUSHING FLUSH WITH THE TOP OF THE FRAME UNTIL THE BUSHING IS LOCKED INTO THE MAIN FRAME.



**POURING NORDBAK LOCK**

forming a dam of putty around the top of the bushing as shown in the illustration POURING NORDBAK LOCK. This putty dam helps direct the flow of the Locking Compound into the opening between the bushing and frame. It also prevents the NORDBAK from spilling down the inside of the bushing.

**WARNING**

Carefully follow the instructions as well as the precautions that are printed on the individual cans of NORDBAK Locking Compound before mixing and pouring.

- 4 Refer to the table, LOCKING MATERIAL REQUIREMENTS for the number of Locking Compound kits or the approximate amount of zinc to prepare.
- 5 Pour the locking material into and fill the entire space between the outer eccentric bushing and the main frame.

**WARNING**

When pouring the bushing lock with 800° Fahrenheit molten zinc, goggles and protective clothing must be worn. Contact with molten zinc will result in serious burns.

- 6 After the locking material has fully hardened, grind off flush any excess material.

**REPLACING THE BUSHING LOCK.** If the outer eccentric bushing ever becomes loose, repouring of the lock is all that is required. Drill,

chip and clean out all the zinc or NORDBAK Locking Compound. Reset the bushing, if necessary and then repour the lock.

**SPRING ASSEMBLIES.** The spring cluster assemblies ordinarily will not require any maintenance, however, it may become necessary to remove the springs in order to maintain other crusher components.

**WARNING**

Spring disassembly/assembly is extremely hazardous. Follow all instructions with care.

There are two different types of spring arrangements over the countershaft box housing, which we will refer to as offset and centered, each of which requires a different procedure for disassembling and assembling. The offset spring arrangement will have a spring cluster on each side of the countershaft box housing. The centered spring arrangement will have one spring cluster, directly over the countershaft box housing. See the illustrations OFFSET SPRING ARRANGEMENT and CENTERED SPRING ARRANGEMENT. Because of the equipment involved, these spring clusters are to be removed last and installed first.

**AFTER REMOVING OR INSTALLING ONE SPRING CLUSTER, THE NEXT CLUSTER TO BE DISASSEMBLED OR ASSEMBLED IS THE ONE DIRECTLY OPPOSITE. STAGGERING IN THIS MANNER WILL ALLOW THE ADJUSTMENT RING TO SEAT EVENLY ON THE MAIN FRAME.**

CRUSHER SIZE		2 Ft.	3 Ft.	4 Ft.	5100 and 4-1/4 Ft.	5-1/2 Ft.	7 Ft. HEAVY DUTY	7 Ft. EXTRA HEAVY DUTY
Quantity of Locking Material Required for Outer Eccentric Bushing	Number of NORDBAK Locking Compound Kits *	1/2	1/2	1	1	1-1/2	1/2	1/2
	Zinc (In Pounds)	6	11	15	20	42	12	12
Volume Required (Cubic Inches)		20	40	55	75	160	45	45
Quantity of Locking Material Required for Inner Eccentric Bushing	Number of NORDBAK Locking Compound Kits *	1/2	1/2	1	1	1	1	1
	Zinc (In Pounds)	7	8	16	18	17	21	21
Volume Required (Cubic Inches)		25	30	60	70	65	80	80

\* When properly mixed, one kit of NORDBAK Locking Compound provides 115 cubic inches of Locking Material (6 lb. 4 oz.).

**LOCKING MATERIAL REQUIREMENTS**

CRUSHER SIZE	2 Ft.	3 Ft.	4 Ft.	5100 and 4-1/4 Ft.	5-1/2 Ft.	7 Ft. HEAVY DUTY	7 Ft. EXTRA HEAVY DUTY
Jack Capacities in Tons (2000 Lbs)	5	15	35	20	30	30	50

### JACK CAPACITIES

The correct jack capacity for lowering or raising one spring cluster can be determined by referring to the table, JACK CAPACITIES.

**OFFSET SPRING ARRANGEMENT DISASSEMBLY.** To remove the springs, spring bolts and spring segments, proceed as follows:

- 1 Place a hydraulic jack on the main frame flange at one side of the countershaft box housing.

#### WARNING

The jack should be shimmed so that it is solid and level. A logging chain or steel cable should be wrapped around the entire circumference of the main frame and jacks to hold the jacks in position. Serious personal injury may result if a jack should slip.

- 2 Place a 2" x 3" x 36" steel bar across the top of the jack and the main frame as shown in the illustration OFFSET SPRING ARRANGEMENT.
- 3 Place a 2" x 3" x 3" steel block on the bar mid-way between the middle spring bolt and the inner bolt and relieve the spring pressure on the bolts by jacking.
- 4 Slowly unscrew the spring bolt nuts while lowering the jack. Do not remove the spring bolt nuts at this point.
- 5 Lower the jack and slide the 2" block on the bar mid-way between the outer spring bolt and the middle spring bolt. Raise the jack to relieve the pressure on the bolts and slowly unscrew the outer spring bolt nut.
- 6 Lower the jack and replace the 2" thick bar with a 1" x 3" x 36" bar, then place a 1" x 3" x 3" block on the bar mid-way between the middle bolt and the inner bolt. Raise the jack to relieve pressure and slowly unscrew the remaining spring bolt nuts.

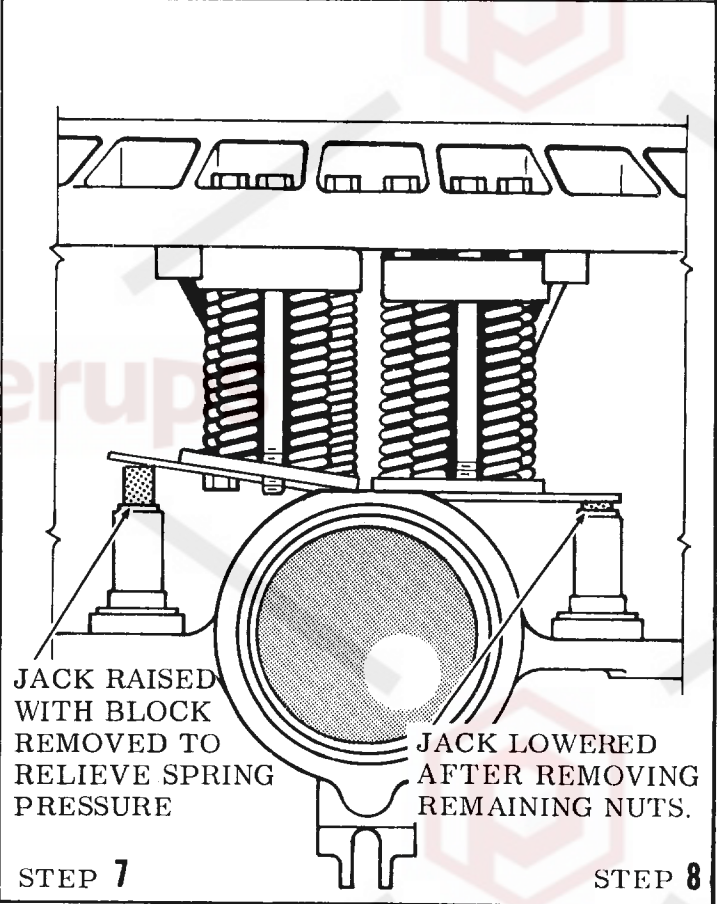
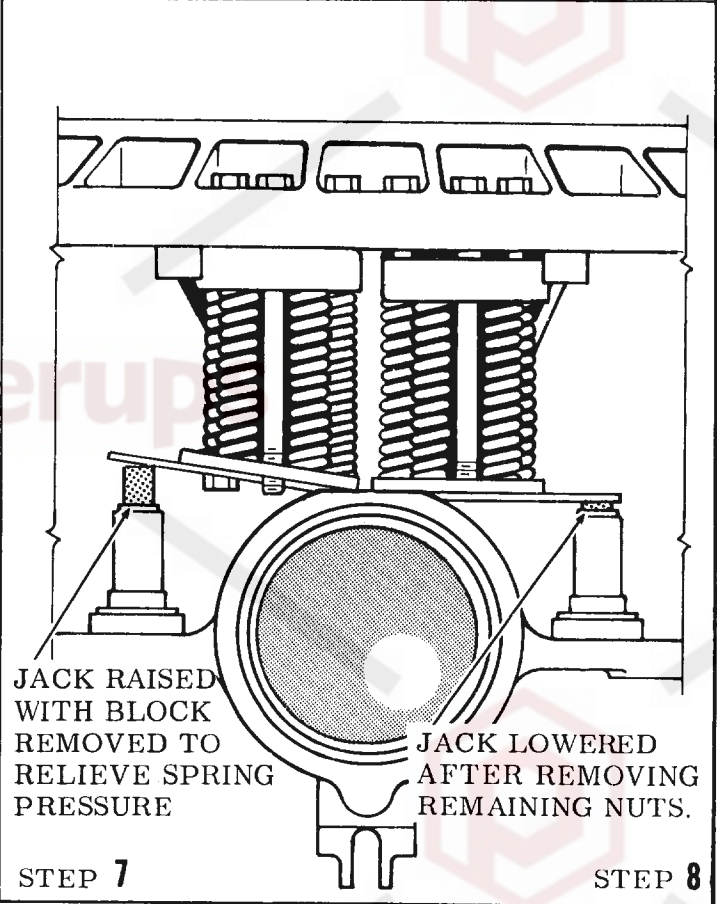
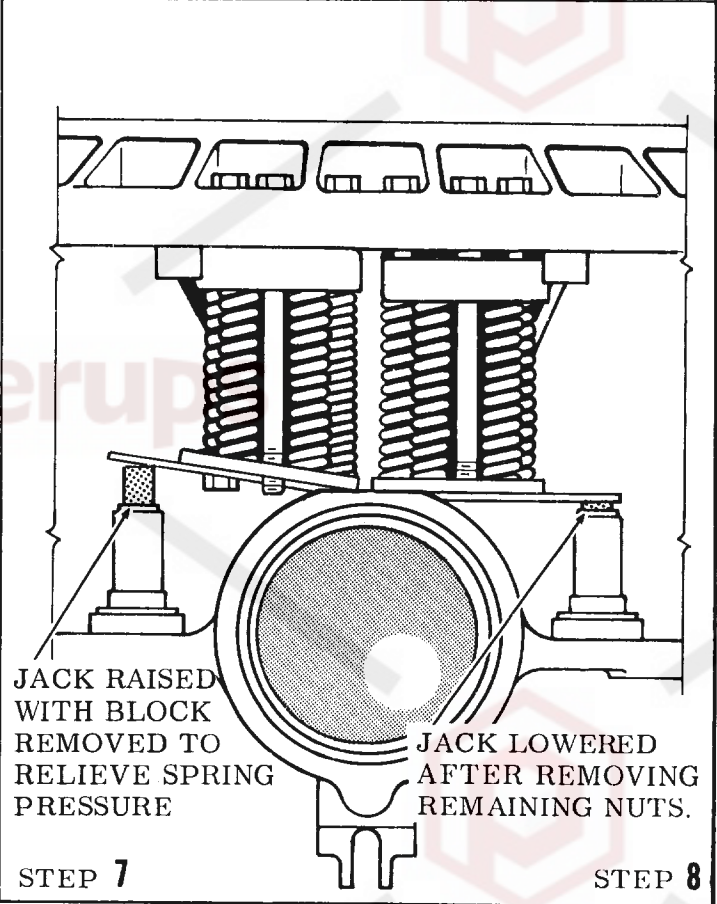
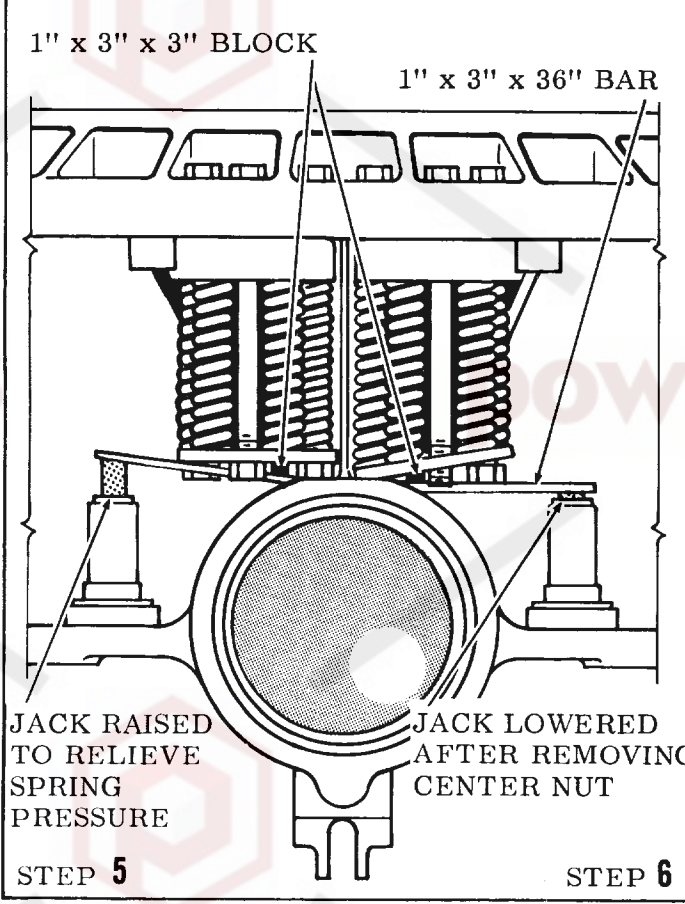
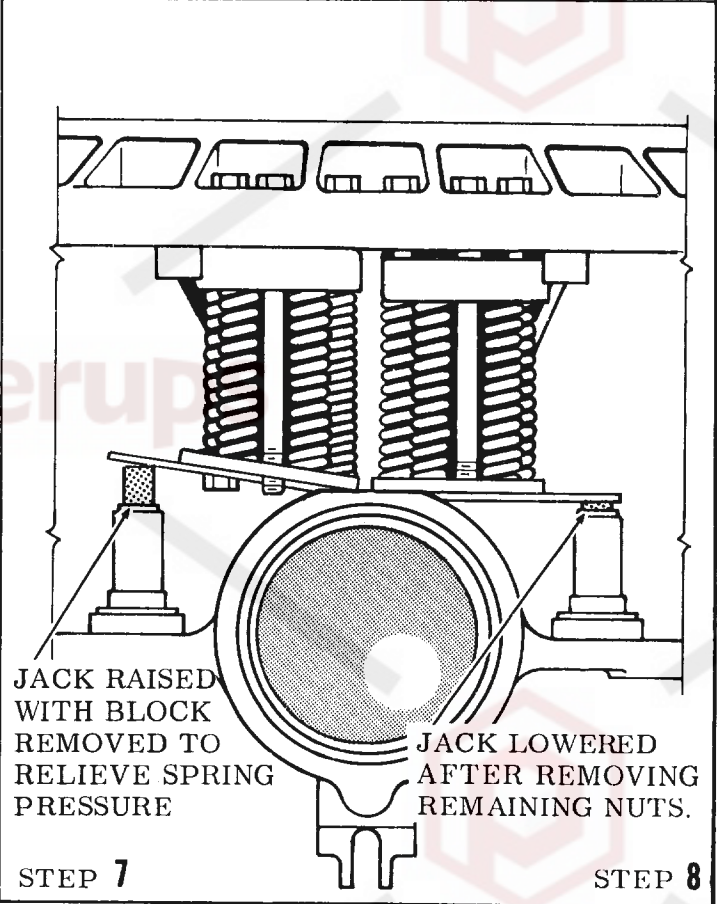
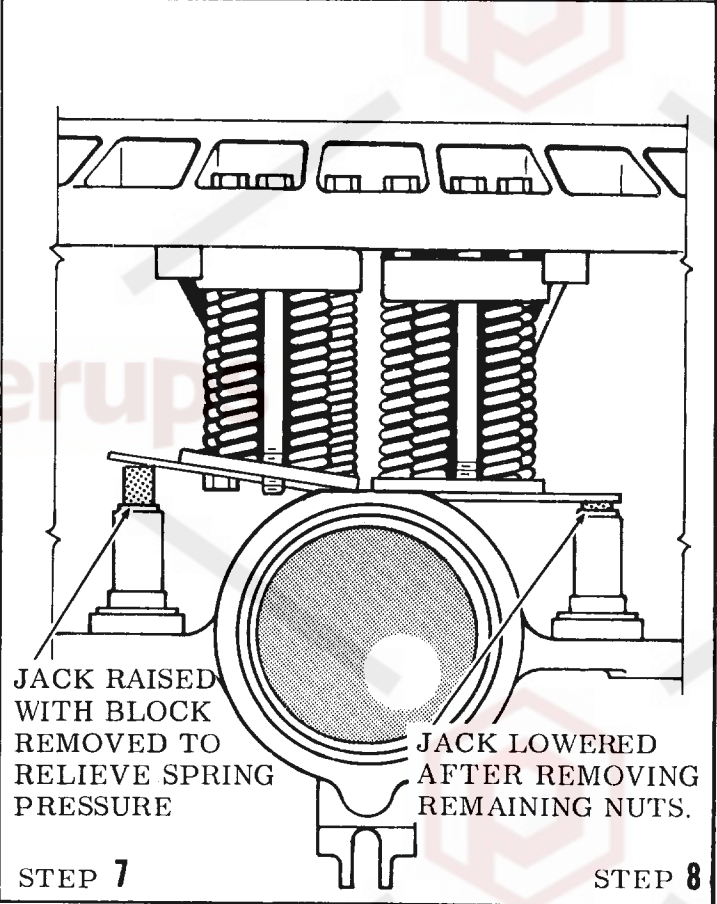
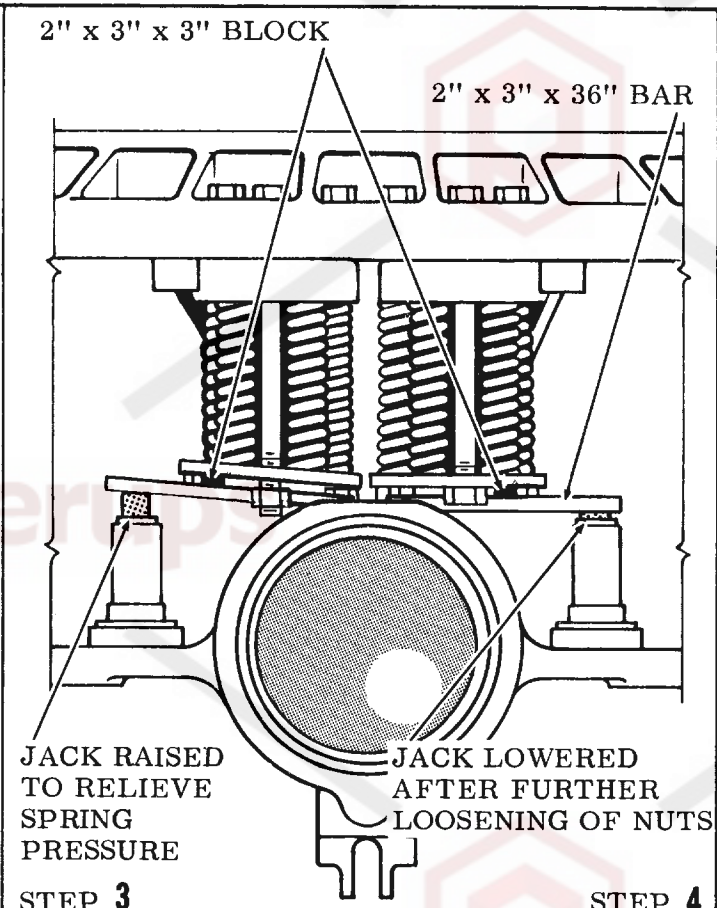
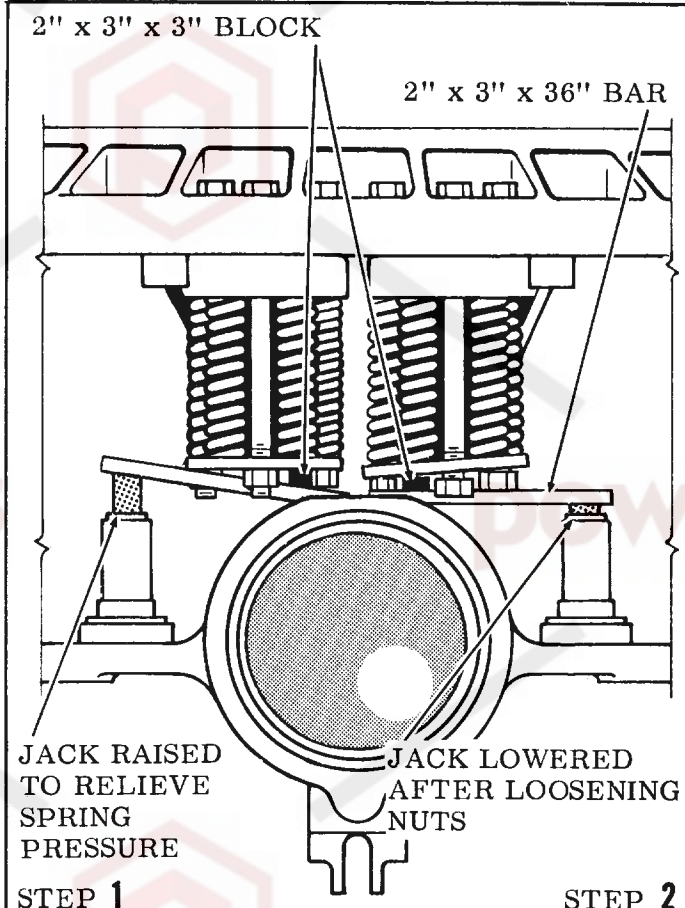
- 7 Lower the jack and remove only the block, then raise the jack once again and remove the spring bolt nuts entirely.
- 8 Slowly lower the jack until all spring pressure has been relieved and remove the spring components.
- 9 Removing the remaining springs around the circumference of the main frame requires the use of two hydraulic jacks, simply to balance the cluster. Place a jack on the frame flange just under each side of the lower spring segment and remove the clusters by unscrewing the spring bolt nuts and lowering the jacks.

**OFFSET SPRING ARRANGEMENT ASSEMBLY.** To install the springs, spring bolts and spring segments, proceed as follows:

- 1 Place a hydraulic jack on the main frame flange and block where necessary to make the jack solid and level.
- 2 Place a 1" x 3" x 36" steel bar across the top of the jack and the main frame. See the illustration OFFSET SPRING ARRANGEMENT.
- 3 Place the lower spring segment on top of the bar in a position so that the spring bolt holes extend on each side of the bar enough to enable the hex nuts to be turned on. Position the springs and upper spring segment on top of the lower spring segment.

THERE ARE NO UPPER SPRING SEGMENTS ON THE 5-1/2 FT. AND 7 FT. FABRICATED MAIN FRAME AND EXTRA HEAVY DUTY CRUSHERS.

- 4 If the Crusher has internal pins, be certain the main frame pin has entered the center rear spring, then carefully lower the spring



**OFFSET SPRING ARRANGEMENT**

bolts through the adjustment ring and spring cluster assembly. Do not drop the bolts in, as the threads could be damaged, making the installation of the nuts difficult.

- 5 Raise the spring cluster by jacking and turn the outer spring bolt nut up tight against the spring segment as the springs are being compressed.
- 6 Lower the jack and insert a 1"x 3" x 3" steel block between the steel bar and the segment, wedge the block mid-way between the middle bolt and the inner bolt.
- 7 Raise the jack until the segment is level, turning up the remaining nuts against the segment as the springs are being compressed.
- 8 Lower the jack and replace the 1" thick bar with a 2" x 3" x 36" bar, then place a 2" x 3" x 3" block on the bar mid-way between the outer spring bolt and the middle spring bolt.
- 9 Raise the jack again and turn the outer spring bolt nut up tight as the springs are compressed.
- 10 Lower the jack and wedge the 2" block on the bar mid-way between the middle bolt and inner bolt.
- 11 Raise the jack until the segment is again level, turning up the remaining nuts tight against the segment. See SPRING ADJUSTMENT TABLE for correct spring installation length.
- 12 Repeat this procedure with the spring cluster on the opposite side of the countershaft box housing.
- 13 The remaining spring assemblies are to be installed by using two jacks to balance the cluster. Place a jack on the frame flange just under each side of the cluster. Alternately compress the springs and tighten the spring bolt nuts until the correct spring installation length is reached.

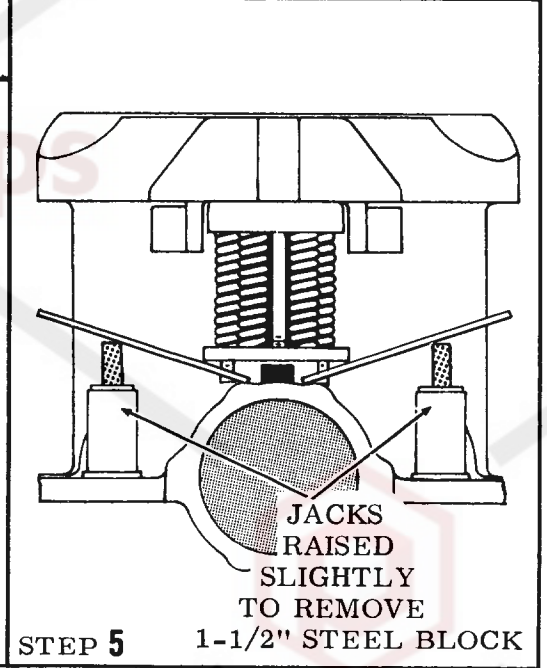
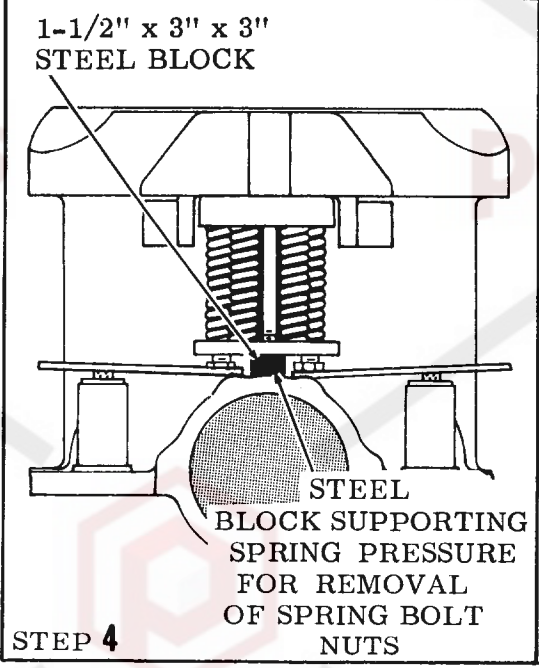
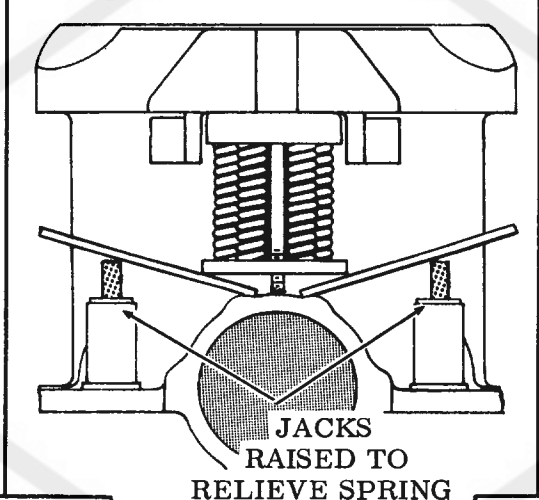
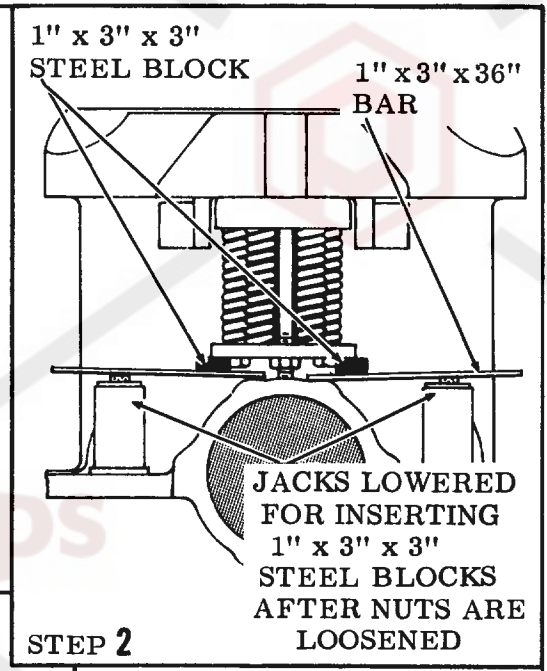
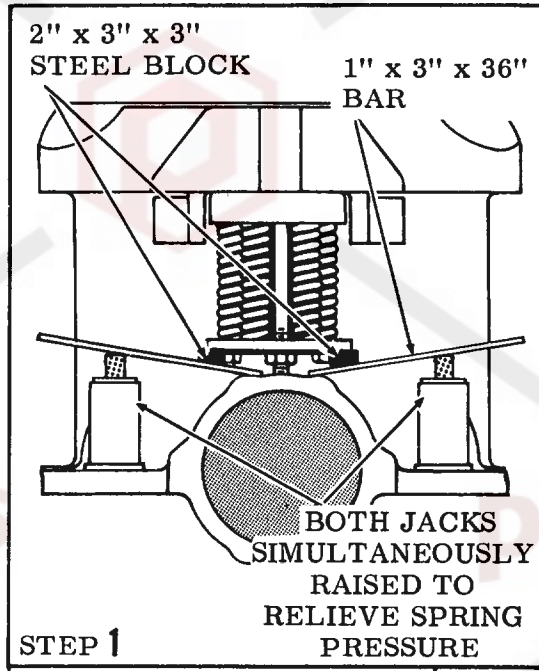
CENTERED SPRING ARRANGEMENT DISASSEMBLY. To remove the springs, spring bolts and spring segments, proceed as follows:

- 1 Place a hydraulic jack on the main frame flange at each side of the countershaft box housing.

**WARNING**

The jack should be shimmed so that it is solid and level. A logging chain or steel cable should be wrapped around the entire circumference of the main frame and jacks to hold the jacks in position. Serious personal injury may result if a jack should slip.

- 2 Place a 1" x 3" x 36" steel bar, tapered or wedge shaped at one end, across the top of the jack and main frame, as shown in the illustration CENTERED SPRING ARRANGEMENT.
- 3 Place a 2" x 3" x 3" steel block on top of each steel bar directly under each edge of the lower spring segment and relieve the spring pressure on the bolts by jacking.
- 4 Alternate unscrewing the spring bolt nuts and lowering the jacks. Lower the cluster about 1/2".
- 5 With the spring bolt nuts supporting the cluster, lower the jacks and replace the 2" steel blocks with 1" x 3" x 3" blocks. Then jack the springs upward to relieve the weight, and slowly unscrew the spring bolt nuts and lower the jacks.
- 6 Insert a 1-1/2" x 3" x 3" steel block between the lower spring segment and the main frame and lower the springs until the entire spring force is held by the 1-1/2" steel block. Remove the 1" steel blocks and the spring bolt nuts at this time.
- 7 Move the steel bars outward slightly. Jack the spring cluster upwards once again and remove the 1-1/2" steel block.
- 8 Lower the jacks and remove the special tapered bars. With all spring pressure relieved, the jacks and the spring assembly can be removed. It may be necessary to pry the cluster outward with a long section of pipe or heavy board in order to free it.
- 9 Removing the remaining springs around the circumference of the main frame requires the use of two hydraulic jacks, simply to balance the cluster. Place a jack on the frame flange just under each side of the lower spring segment and



**CENTERED SPRING ARRANGEMENT**

remove the cluster by alternating unscrewing the spring bolt nuts and lowering the jacks.

**CENTERED SPRING ARRANGEMENT ASSEMBLY.** To assemble the springs, spring bolts and spring segments, proceed as follows:

- 1 If the Crusher is equipped with internal main frame pins, force the main frame pin upward until it is flush with the underside of the main frame, to aid in installing this spring cluster.

THE PIN COVER ON THE ADJUSTMENT RING DIRECTLY OVER THIS MAIN FRAME PIN MUST BE REMOVED BEFORE THE PIN CAN BE FORCED UPWARD.

- 2 Place the spring cluster assembly in position over the countershaft box housing, then carefully lower the spring bolts through the adjustment ring and spring cluster assembly. Do not drop the bolts in, as the threads could be damaged, making the installation of the nuts difficult. See the illustration **CENTERED SPRING ARRANGEMENT**.
- 3 Drive the main frame pin back to its original position by sledging. Check that the pin has entered the center rear spring.
- 4 Place a hydraulic jack on the main frame flange at each side of the countershaft box housing. The jack should be blocked so that it is solid and level. Place the special tapered bars, used in disassembly on top of the jacks.
- 5 Drive the special bars between the lower spring segment and main frame as far as they will go, then raise the spring cluster

by jacking under the ends of the bars until a 1-1/2" x 3" x 3" steel block can be inserted between the lower spring segment and the frame.

- 6 Lower the jacks and thread the spring bolt nuts on the spring bolts.
- 7 Place 1" x 3" x 3" steel blocks on top of the bars under each edge of the lower spring segment and compress the springs by jacking, while at the same time tightening the nuts.
- 8 Lower the jacks and replace the 1" blocks with 2" x 3" x 3" blocks. Continue jacking until the springs are compressed to the correct length. See **SPRING ADJUSTMENT TABLE**.
- 9 The remaining spring assemblies are to be installed by using two jacks to balance the cluster. Place a jack on the frame flange just under each side of the cluster. Alternately compress the springs and tighten the spring bolt nuts until the correct spring installation length is reached.

**DETERMINING CORRECT SPRING LENGTH.** At this point it is advisable to check the spring setting. Refer to the **SPRING ADJUSTMENT TABLE** for correct spring installation length for your particular Crusher.

\* Since only the latest design springs are shown in the table, contact the factory for the correct installed length if your Crusher is more than several years old or if the spring lengths on your Crusher are different than those shown.

Once this length is known, a spring gauge can be made in the following manner: take two welding rods and remove the coating, then cut each rod to one-half (1/2) the spring installed

* CRUSHER SIZE	2 Ft.	3 Ft.		4 Ft.	4-1/4 Ft.	5-1/2 Ft.		7 Ft. HEAVY DUTY		7 Ft. EXTRA HEAVY DUTY	
			**				**	**	**		
Free Length	15	16	14-3/4	17-1/2	17-1/2	23-1/2	20	27-1/4	23-1/2	34-1/8	30-1/2
Installed Length	13-1/4	14-3/8	13-1/4	14-1/2	15-1/16	22	18-3/4	24-1/4	21-3/4	31	28-1/4
Minimum Working Length	13	14-1/8	13	14-3/8	14-13/16	21-3/4	18-1/2	24	21-1/2	30-5/8	28

\*\* For Spring Clusters Over Countershaft Box

(All Dimensions Are In Inches)

**SPRING ADJUSTMENT TABLE**



length. When this has been done, take one of these rods and place one end against the underside of the upper spring segment or the underside of the main frame where applicable. While holding this rod in place, take the other rod and place one end of it against the top of the lower spring segment. Whether or not the correct length has been reached can then be seen at a glance. This method is much more accurate than using a ruled tape measure for checking. Check each spring cluster for the correct spring length at three locations, thereby insuring that the cluster was not installed in a tilted position.

Should the installed length be too great or too small, repeat the previous steps wherever necessary. Once the correct length has been attained, remove the jacking equipment; spring pressure will hold the spring bolt nuts tightly in place. When all of the springs have been hung, recheck each cluster for the correct installation length.

All size Crushers now use shorter springs in the cluster immediately over the countershaft box as a safety measure and for easier installation and removal. The shorter springs can be readily identified by measuring the free length of the spring. Refer to the SPRING ADJUSTMENT TABLE.

**DO NOT USE THE SHORTER SPRINGS IN THE SAME CLUSTER WITH THE LONGER SPRINGS.**

**REMOVING RUSTED OR DAMAGED SPRING BOLTS.** Difficulty can be encountered when there has been a lot of spring action or when the Crusher has been exposed to the weather. The threads on the spring bolts could distort or stretch from continual spring action or corrode when exposed to the elements. If this takes place, torch cutting of the spring bolts might become necessary.

**WARNING**

**EXTREME CARE MUST BE USED WHEN REMOVING THE CLUSTERS BY TORCH CUTTING OF THE SPRING BOLTS.**

The spring clusters are to be raised in the same manner as previously described. Com-

press the cluster about 1/2". This will expose part of the spring bolt below the segment. These are to be torch cut at this point. A logging chain or steel cable wrapped around the entire circumference of the springs and jacks will offer some degree of protection should the jacks begin to slip when the compression on the cluster is removed. Once the bolts have been torch cut, carefully lower the entire cluster still keeping the chain or cable wrapped around them. As each cluster is removed, take up the slack on the chain or cable before lowering the next cluster.

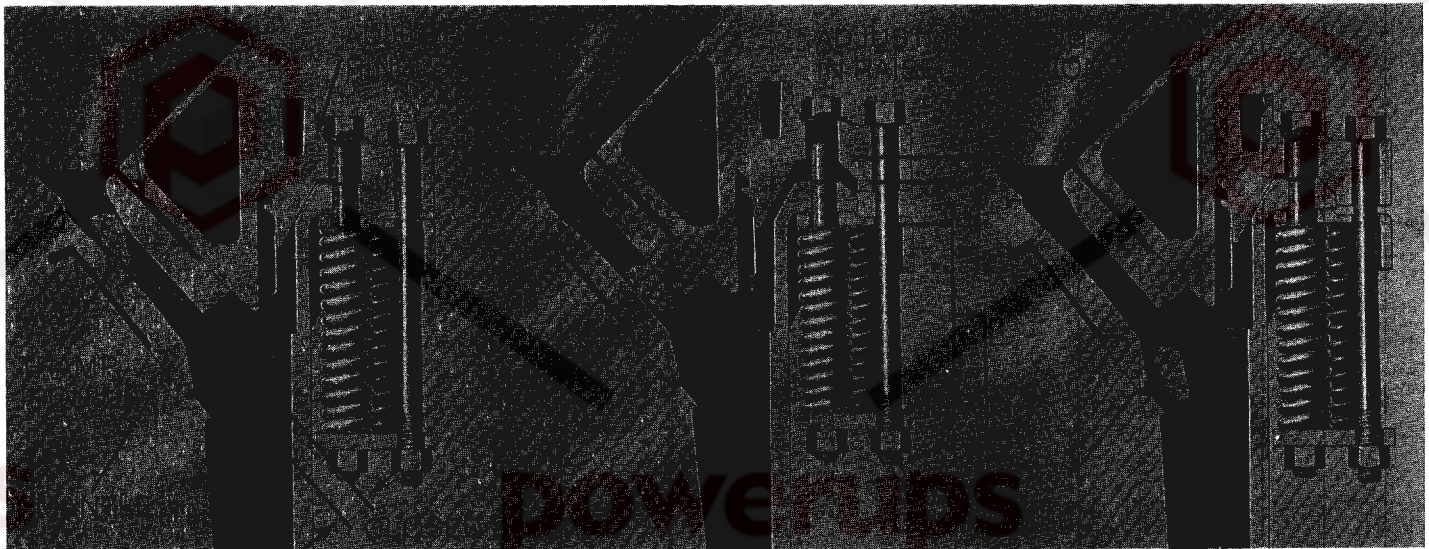
**WARNING**

**USE EXTREME CARE IN REMOVING SPRING ASSEMBLIES IN THIS MANNER. SERIOUS PERSONAL INJURY MAY RESULT.**

**SPRING BOLT INSPECTION.** If the clusters have been taken down in the conventional manner by simply unscrewing the spring bolt nuts, examine the spring bolts for wear, both at the top of the bolt, where they pass through the adjustment ring and frame, and at the threads on the bottom. Smooth out any nicks or burrs or remove any rust which would hinder the turning of the nuts when reassembling the springs. Replace any bolts which are permanently damaged.

**SPRING ADJUSTMENT.** In the crushing of material of ordinary hardness, the springs will not work. If due to abnormal conditions or materials of exceptional hardness, the springs work only occasionally, this action need not cause any alarm. Refer to the illustration SPRING ACTION.

Excessive spring action, such as sustained cyclic or rhythmic action, indicates a faulty crushing condition that should be investigated and corrected before any serious damage is done to the Crusher. Irregular feed, excessive fines in the feed, too close a crusher setting and overloading may be some of the causes of spring action. The springs should never be further compressed to overcome excessive spring action because added compression of these springs will only impose excessive strain on the Crusher without correcting or eliminating the cause of the faulty condition.



As a piece of tramp iron enters the cavity, the springs allow the bowl and the adjustment ring to rise, thus preventing damage. Immediately upon passage of the tramp iron, the springs automatically return the bowl and adjustment ring to the normal operating position.

### SPRING ACTION

Refer to the SPRING ADJUSTMENT TABLE which shows the correct installed length of the springs for the various size Crushers when compressed for normal operation. Shown also is the minimum working length to which the springs can be safely compressed. All springs, when adjusted, should be the same length.

The springs should never be compressed beyond the recommended minimum length. Should any abnormal spring difficulty be encountered, the problem should be submitted to the factory for suggestions and recommendations.

During normal Crusher operation the main frame and adjustment ring seating surfaces will wear; the more the spring action, the more the wear. As the seating surfaces wear, the adjustment ring moves downward which causes each spring cluster to lengthen which in turn means the initial spring force holding the adjustment ring to the main frame has been reduced. Therefore, periodically check the springs for the correct installed length and readjust if necessary. **CORRECT SPRING LENGTH IS IMPORTANT!**

**MAIN FRAME PINS.** There are two kinds of main frame pins, internal and external. A Crusher is equipped with either one or the other. The main frame pins prevent the adjustment ring from rotating in respect to the main frame and also guide the adjustment ring back to its original position, when the ring lifts, due

to tramp iron or packed material. Due to the rotation of the head in respect to the bowl, the adjustment ring will want to rotate in the direction of machine rotation. Since this force will be acting on the adjustment ring in one direction only, the internal main frame pins or the external main frame pin bushings will have a tendency to wear on one side only. Spring action is the main cause of pin or bushing wear.

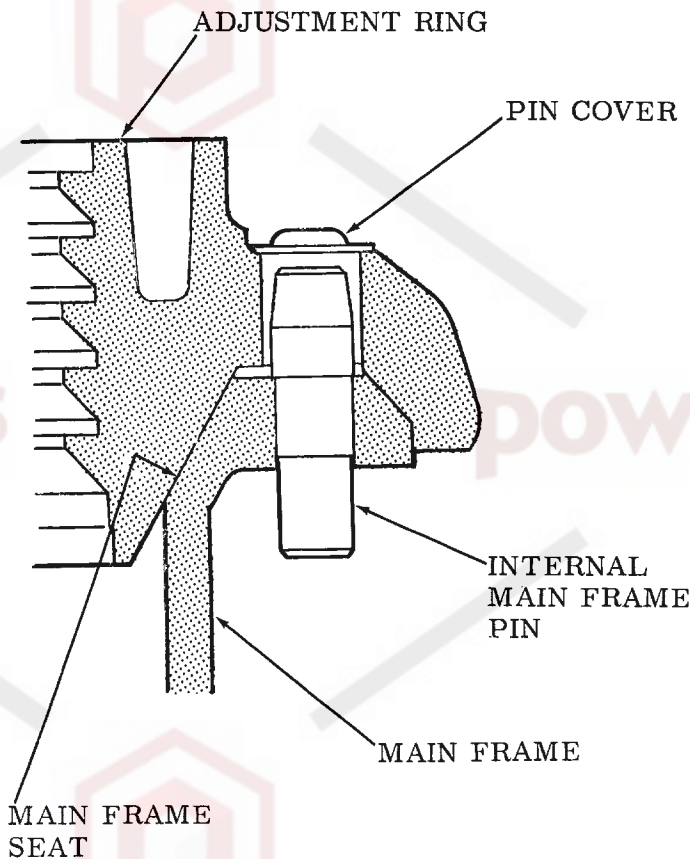
Since the internal pins are concealed beneath a pin cover on the adjustment ring, it will be necessary to remove the cover by chipping off the weld before inspection of the pin is possible.

With external pins, it is the bushing which wears and not the pin itself. Any wear on the external main frame pin bushing is easily checked since the bushings are readily visible at all times.

Excessive pin or bushing wear will result in a concentration of wear on the spring bolts in the area where the bolt passes through the main frame. The internal main frame pins and the external main frame pin bushings should be replaced when they show signs of excessive wear. Since excessive wear is unusual, the main frame pins will rarely require replacement.

**INTERNAL MAIN FRAME PINS.** To replace the internal main frame pins, refer to the

illustration INTERNAL MAIN FRAME PINS and proceed as follows:



#### INTERNAL MAIN FRAME PINS

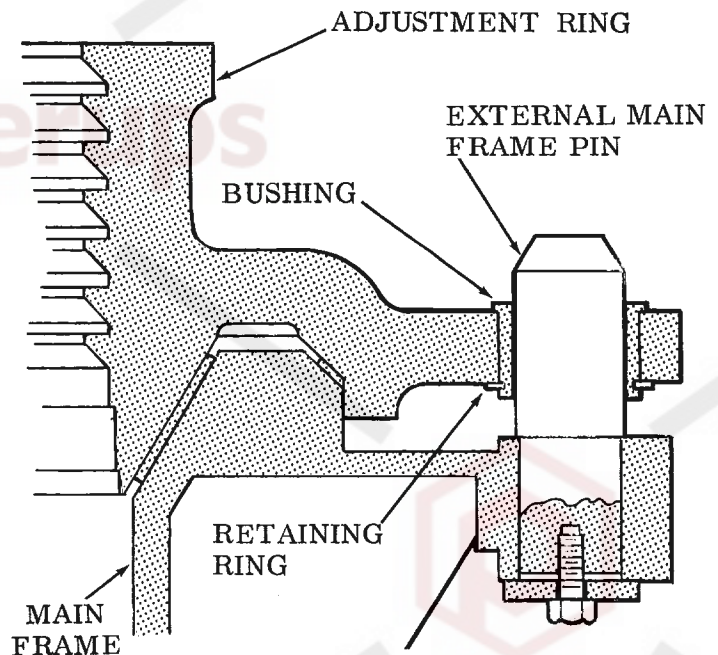
- 1 Remove the spring clusters as described under SPRING ASSEMBLIES.
- 2 Remove the adjustment ring.
- 3 Push the worn pins out using a hydraulic jack centered under the pin.
- 4 Drive the new pins in the frame by sledging.

THE MAIN FRAME PIN, WHICH IS DIRECTLY OVER THE COUNTERSHAFT BOX HOUSING, SHOULD BE SLEDGED ONLY PART WAY IN, THAT IS UNTIL THE BOTTOM OF THE PIN IS FLUSH WITH THE UNDERSIDE OF THE FRAME, SINCE THE CLEARANCE BETWEEN THE UNDERSIDE OF THE FRAME AND COUNTERSHAFT BOX HOUSING IS SO SMALL THAT INSTALLATION OF THE SPRING CLUSTER AFTER THE PIN IS IN PLACE WOULD BE DIFFICULT.

- 5 Coat the main frame seat with a mixture of molybdenum disulfide and lubricating oil to reduce wear.

- 6 Place the adjustment ring on the frame, centering the pins in the adjustment ring holes, and install the spring clusters.
- 7 Weld on new pin covers where required.

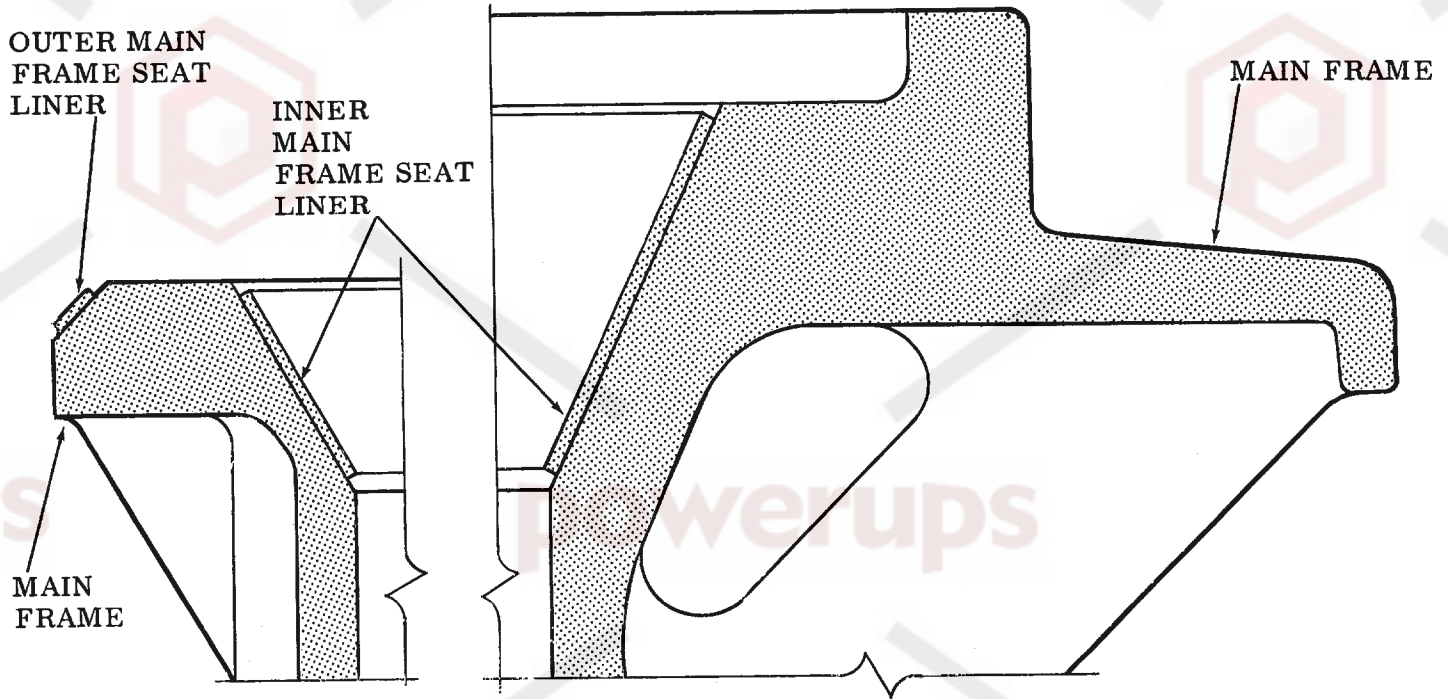
EXTERNAL MAIN FRAME PIN BUSHINGS. To replace the external main frame pin bushings, refer to the illustration EXTERNAL MAIN FRAME PINS and proceed as follows:



#### EXTERNAL MAIN FRAME PINS

- 1 Lower, but do not remove, the spring clusters as described under SPRING ASSEMBLIES.
- 2 Rotate the adjustment ring slightly to center the main frame pin in the bushing.
- 3 Once the pin is centered, remove the bushing by first removing the retaining ring and then prying the bushing out.
- 4 Simply slide the new bushing into the adjustment ring and lock in place with the retaining ring.
- 5 When the bushings have been replaced, raise the springs to the correct length.

MAIN FRAME SEAT. Once the spring ring assemblies have been removed from the Crusher, the adjustment ring can be lifted from



2 FT., 3 FT., 4 FT., 5100,  
4-1/4 FT., 5-1/2 FT. AND  
7 FT. HEAVY DUTY

7 FT. EXTRA HEAVY DUTY

### MAIN FRAME SEAT LINERS

the main frame to inspect the main frame seat for wear. Due to irregularity in feed to a Crusher and the slight rubbing action between the adjustment ring and main frame seat, there is a certain amount of wear. Should there be an excessive amount of spring action, this wear could be increased.

As standard equipment on all 7 Ft. Crushers, a bronze inner main frame seat liner is welded to the frame as shown in the illustration MAIN FRAME SEAT LINERS.

The use of a bronze alloy which forms the seating surface for the adjustment ring of these machines, provides a replaceable wearing surface. The bronze alloy being of a softer metal than either the frame or the ring does the wearing.

Seat liners can be provided on the other size Crushers, but at an additional cost. The smaller size Crushers are not subjected to the same type of hard use, except in extreme cases, as the larger machines, thereby not warranting the need for seat liners.

In conjunction with the bronze inner main frame seat liners, a steel outer seat liner is also added. This outer liner simply fills in the space or void that occurs when the adjustment

ring is raised due to the addition of the inner liner. The outer liner is very important as it permits the adjustment ring to tilt and recenter properly when the ring raises due to a piece of tramp iron passing through the crushing cavity.

Because of the different type of seating on the 7 Ft. Extra Heavy Duty Crusher, no outer seat liner is possible. See the illustration, MAIN FRAME SEAT LINERS.

To determine exactly how much wear is taking place on the seat liners, proceed as follows:

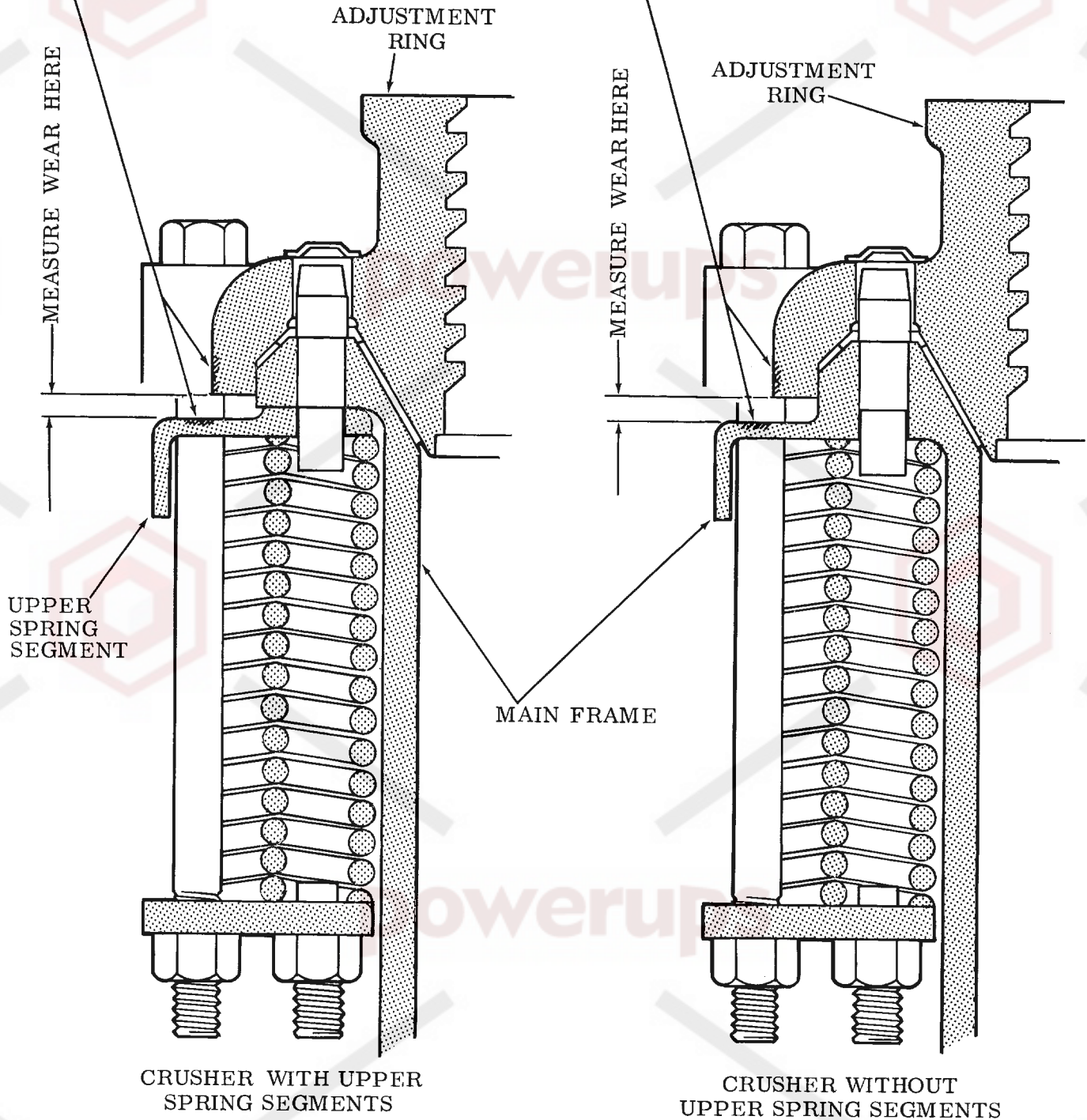
- 1 Starting at the countershaft box, grind four flat areas, 90° apart, on the side of the adjustment ring and on top of the upper spring segment as shown on the illustration, DETERMINING SEATING SURFACE WEAR.

ON CRUSHERS WHICH HAVE NO UPPER SPRING SEGMENTS GRIND THE MATCHING AREAS ON TOP OF THE MAIN FRAME UPPER FLANGE.

The flat areas on the upper spring segments or on the frame must be directly below those on the adjustment ring.

GRIND FLAT AREAS ON SIDE OF ADJUSTMENT RING AND ON TOP OF UPPER SPRING SEGMENT AS SHOWN

GRIND FLAT AREAS ON SIDE OF ADJUSTMENT RING AND ON TOP OF MAIN FRAME AS SHOWN



**DETERMINING SEATING SURFACE WEAR**

- 2 In a clockwise direction, number these areas by stamping or painting 1, 2, 3 and 4 on both the adjustment ring and the spring segments.
- 3 Measure from the bottom of the adjustment ring to the ground areas on the top of the upper spring segment and record the dimensions.
- 4 At periodic intervals remeasure these points and compare them to the original dimensions. Comparing the two sets of dimensions will show at a glance how much wear has taken place and if the wear is even all the way around the Crusher. Due to casting and machining variations this is the only accurate method wear can be determined.
- 5 When any one of the four check dimensions measures less than the initial recorded dimensions by the amount shown on the table SEAT LINER WEAR, the seat liners need replacing. This much vertical wear means that only 1/16" of material is left on the INNER seat liner.

CRUSHER SIZE	MAXIMUM VERTICAL WEAR
All Size Crushers Except 7 Ft. Extra Heavy Duty	3/8"
7 Ft. Extra Heavy Duty	3/4"

**SEAT LINER WEAR**

Example: Crusher Size: 4-1/4 Ft. Short Head

Original recorded measurement	1-1/4"
Periodic dimensional check	1"
Difference	1/4"

The 1/4" difference between the two measurements indicates the seating surface has worn but, according to the table SEAT LINER WEAR the seat liner still has some wear life left. If the difference had been 3/8", the seat liner would have required replacing.

WHENEVER REPLACING WORN SEAT LINERS, BOTH INNER AND OUTER LINERS MUST BE REPLACED AT THE SAME TIME. INSTALLATION AND WELDING PROCEDURES ARE SHOWN ON THE DRAWING FURNISHED WITH EACH SET OF SEAT LINERS. THE DRAWING IS ENTITLED, FIELD WELDING OF MAIN FRAME SEAT LINERS.

The above method can also be used for determining how much wear is taking place between the adjustment ring and main frame if the Crusher is NOT equipped with seat liners.

If, when inspecting the adjustment ring and the main frame for seating surface wear, it is found that the seat is worn or the present liners need replacing, remachining and installation drawings as well as welding procedures can be furnished.

BEFORE A SEAT LINER CAN BE INSTALLED ON AN OLDER CRUSHER THE MAIN FRAME AND ADJUSTMENT RING SEAT MUST BE RESTORED TO ITS ORIGINAL CONDITION.

When assembling the adjustment ring onto new seat liners, contact must be all around on the bronze INNER liner and a clearance of 1/32" must exist at the OUTER liner as shown in the illustration, SEATING SURFACE.

WHEN ASSEMBLING THE ADJUSTMENT RING ONTO A MAIN FRAME WITHOUT SEAT LINERS, CONTACT MUST ALSO BE ALL AROUND ON THE INNER SEATING SURFACE AND A GAP MUST EXIST AT THE OUTER SEATING SURFACE.

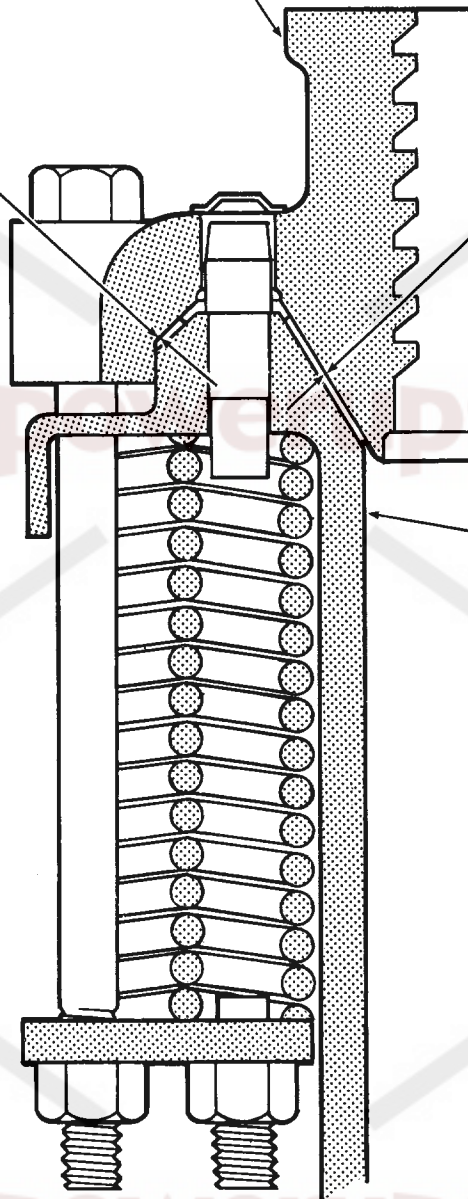
To determine if the adjustment ring is seating properly, place balls of clay or putty on the seat liners, then lower the adjustment ring on the frame. The clay or putty will compress and show where the ring is seating.

SEATING ON THE OUTER SEAT LINER COULD CAUSE PREMATURE FAILURE OF THE ADJUSTMENT RING BY ABNORMAL BENDING OF THE RING AND ALSO SUBJECT THAT PORTION OF THE RING TO EXCESSIVE WEAR.

1/32" CLEARANCE MUST EXIST BETWEEN THE OUTER SEAT LINER AND THE ADJUSTMENT RING

ADJUSTMENT RING

CONTACT MUST BE ALL AROUND ON THE INNER SEAT LINER AND THE ADJUSTMENT RING



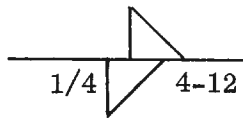
MAIN FRAME

SEATING SURFACE

ORIGINAL OUTLINE OF  
MAIN FRAME

FULCRUM BAR

ADJUSTMENT RING



128-1/2 D.

124-1/2 D.

THICKNESS  
TO SUIT WEAR  
CONDITION

MAIN FRAME WORN  
TO THIS HEIGHT

SEAT LINER

MAIN FRAME

**7 FT. EXTRA HEAVY DUTY CRUSHER SEAT LINER**



Should the seating be on the outer liner, the main frame and/or adjustment ring must be reworked.

7 FT. EXTRA HEAVY DUTY CRUSHER SEAT LINER. Because of the different type of seating on the 7 Ft. Extra Heavy Duty Crusher, no outer seat liner is possible. See the illustration, MAIN FRAME SEAT LINERS.

After installing a new seat liner, a fulcrum bar must also be added to the top of the main frame as shown in the illustration 7 FT. EXTRA HEAVY DUTY SEAT LINER.

The fulcrum bar is required as the top of the main frame and the underside of the adjustment ring wears along with the bronze inner seat liner. The thickness of this fulcrum bar will vary according to seat liner wear.

To determine the proper thickness of the new fulcrum bar, proceed as follows:

- 1 Place balls of clay or putty around the top of the main frame.
- 2 Then lower the adjustment ring on the frame. When the adjustment ring is properly seated the clay or putty will compress, showing the exact amount of clearance remaining between the adjustment ring and the main frame.
- 3 Measure the thickness of the compressed clay or putty, then subtract  $3/16$ " to obtain the correct thickness of the fulcrum bar.

Round off this dimension to a standard plate or bar stock size, such as  $7/8$ " or  $1$ " or  $1-1/8$ ".

- 4 Weld the fulcrum bar to the top of the main frame as shown in the illustration, 7 FT. EXTRA HEAVY DUTY SEAT LINER.
- 5 When assembling the adjustment ring onto the new seat liner, contact must be all around on the seat liner. A clearance of  $1/8$ " to  $3/16$ " between the top of the main frame and the underside of the adjustment ring is required.

SEATING ON TOP OF THE MAIN FRAME COULD CAUSE PREMATURE FAILURE OF THE ADJUSTMENT RING BY ABNORMAL BENDING OF THE RING AND ALSO SUBJECT THAT PORTION OF THE RING TO EXCESSIVE WEAR.

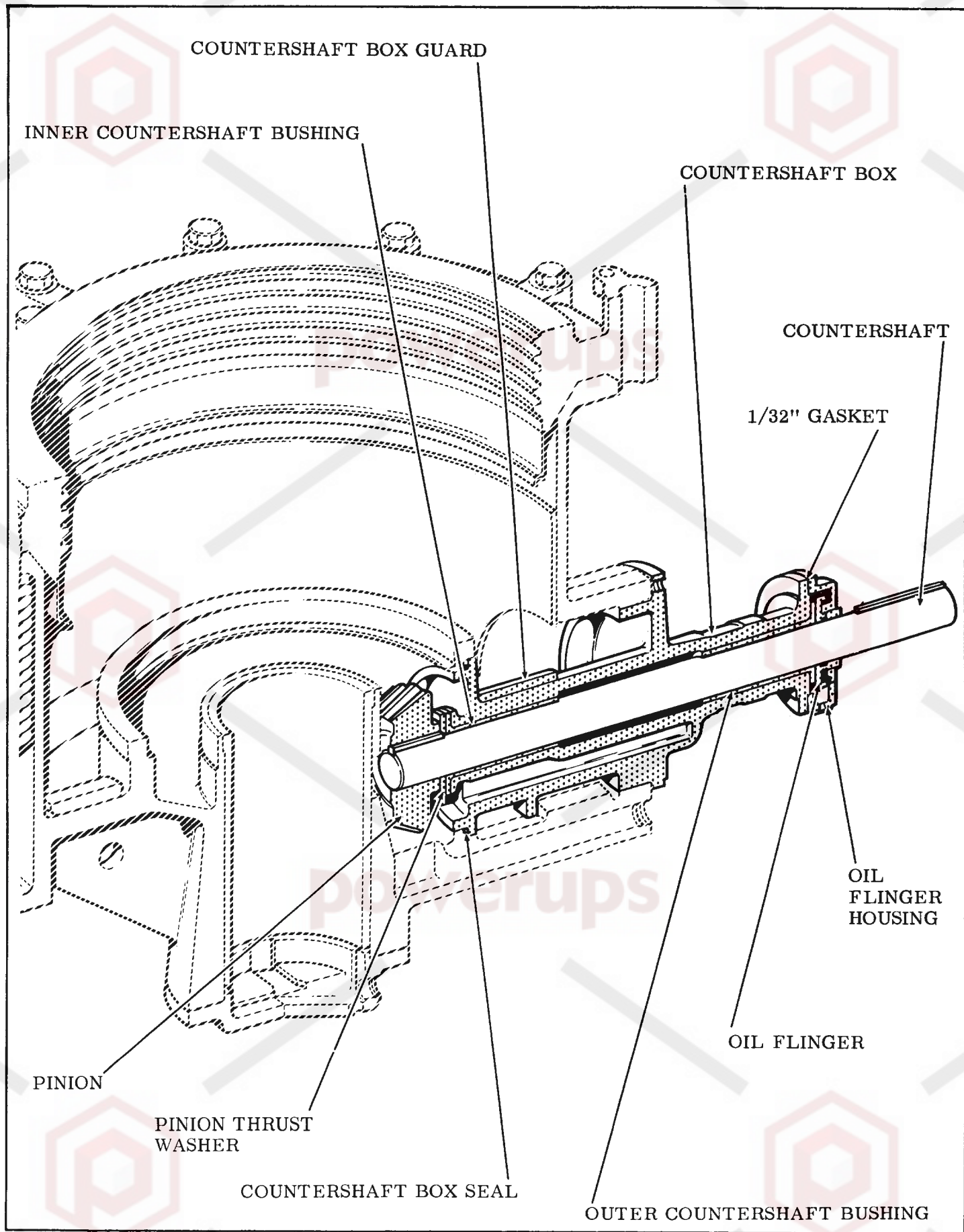
- 6 Should the seating be on top of the main frame, the fulcrum bar must be reworked.

WHENEVER A SEAT LINER IS REPLACED, THE TOP OF THE MAIN FRAME MUST HAVE A FULCRUM BAR ADDED TO THE FRAME. INSTALLATION AND WELDING PROCEDURES ARE SHOWN ON THE DRAWING FURNISHED WITH THE SEAT LINER. THE DRAWING IS ENTITLED, FIELD WELDING OF MAIN FRAME SEAT LINER.

## Section 4

# COUNTERSHAFT BOX, COUNTERSHAFT AND SHEAVE ASSEMBLIES

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## SECTION 4

# COUNTERSHAFT BOX, COUNTERSHAFT AND SHEAVE ASSEMBLIES

### DESCRIPTION

This section covers the countershaft box, countershaft and crusher sheave assemblies. Power is transmitted from the initial power source to the countershaft through a V-belt or a direct drive. The countershaft, which has a bevel pinion pressed and keyed to it, in turn drives the gear on the eccentric assembly. The countershaft is supported within two sleeve bearings or bushings. These bushings are pinned to the countershaft box to prevent any possibility of bearing rotation. The flange on the inner countershaft bushing assumes all thrust wear from the pinion thrust washer. The oil flinger keyed to the other end of the countershaft removes the oil from within the countershaft box by centrifugal force. A housing covering the flinger is so designed as to allow the oil to drain back to the oil tank for re-use. The countershaft box has a force fit in the main frame and is firmly held in place with large diameter cap-screws. An "O" ring between the inner mating surfaces of the box and frame provides an oil tight seal. A box guard protects that portion of the countershaft box which is exposed to wear from falling material.

The assembly just described pertains to the countershaft box and countershaft used with the independently driven oil pump system.

When a crusher driven integral oil pump is furnished as would be the case on most 2 Ft., 3 Ft., 4 Ft., 5100 and 4-1/4 Ft. Crushers, an oil collar gear and gear housing are used in place of the oil flinger and flinger housing.

The oil collar gear is keyed to the countershaft in the same manner as the oil flinger except that the key must be welded to the oil collar gear to hold the key in place. This oil collar gear in turn drives the oil pump gear which is fastened to the rear of the integral oil pump. The pump itself is bolted to the gear housing.

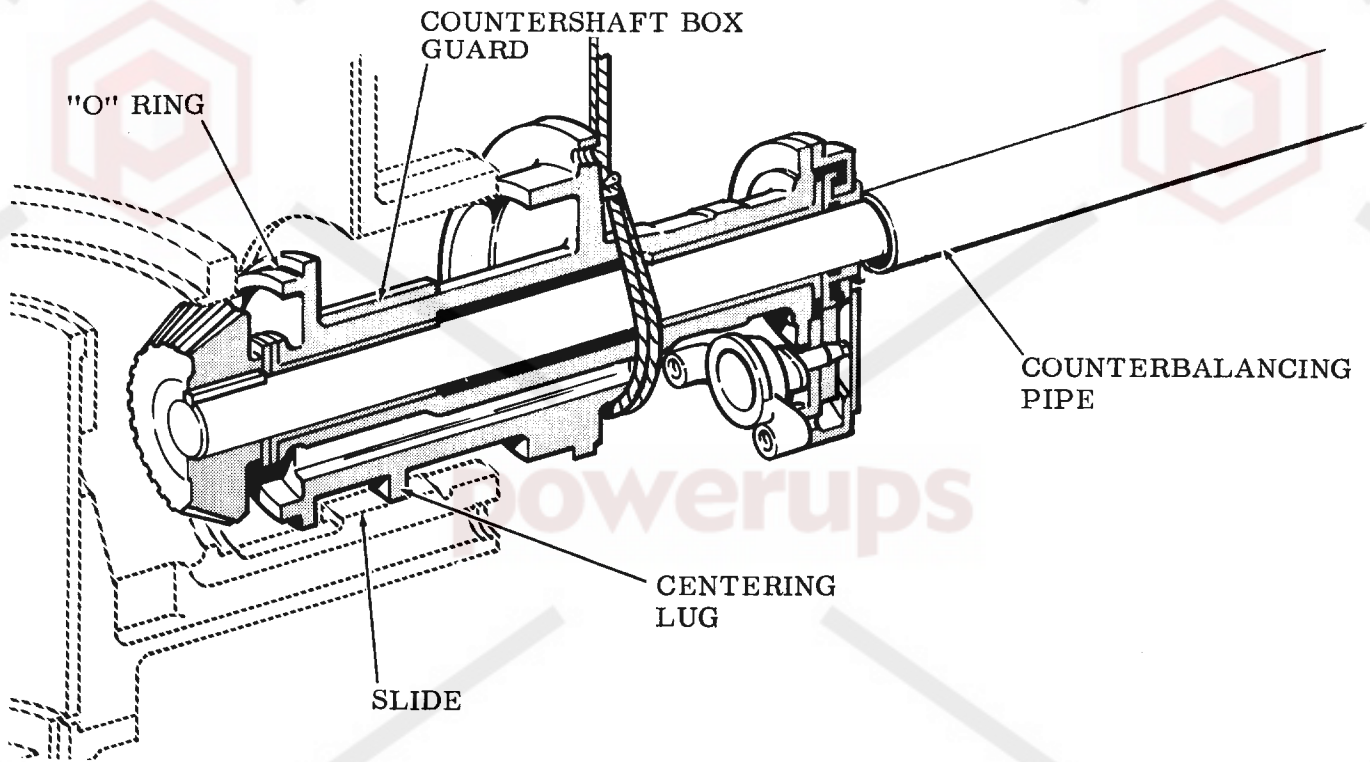
IN ORDER TO SIMPLIFY THE ASSEMBLY AND DISASSEMBLY PROCEDURES USED THROUGHOUT THIS SECTION, ONLY THE DESCRIPTIVE NAMES OIL FLINGER AND FLINGER HOUSING WILL BE USED AND SHOULD BE TAKEN TO ALSO MEAN OIL COLLAR GEAR AND GEAR HOUSING WHEN A CRUSHER IS SO EQUIPPED.

### ASSEMBLY INSTRUCTIONS

Refer to the illustration INSTALLING COUNTERSHAFT BOX ASSEMBLY. A complete procedure for assembling the various components is given in the maintenance portion of this section. If the countershaft box assembly was removed for shipment, the countershaft box is to be installed in the main frame as follows:

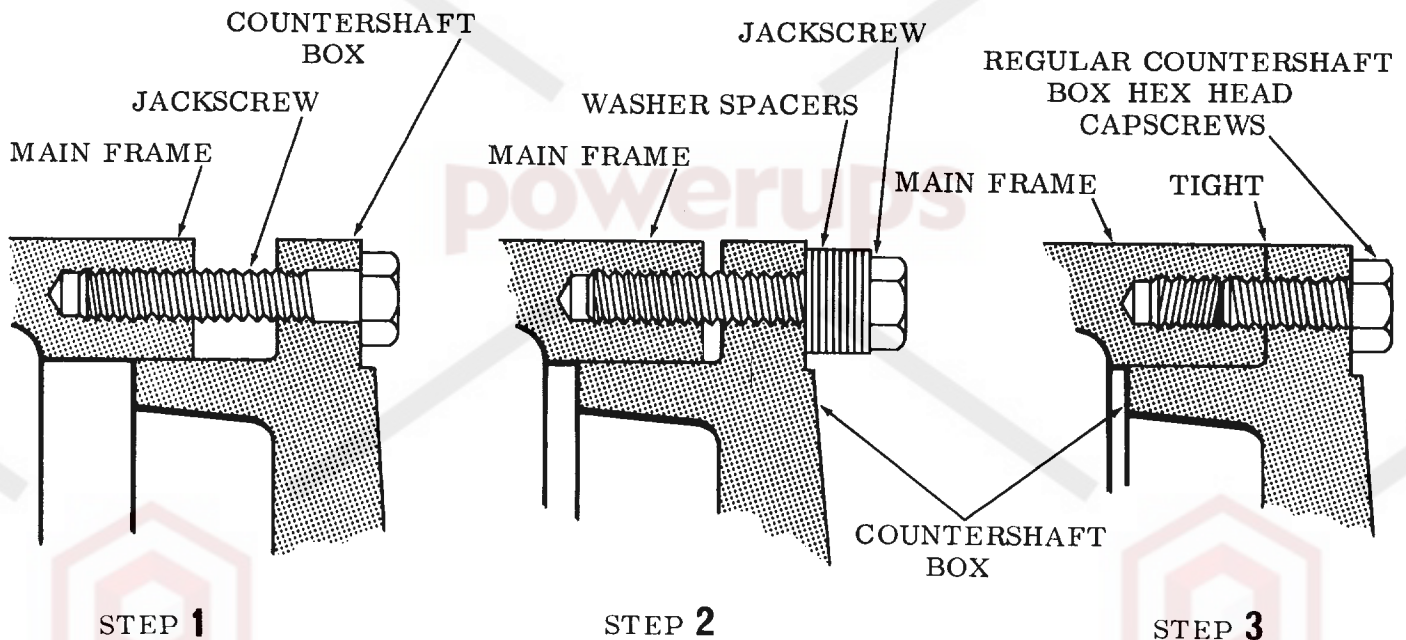
- 1 Carefully stretch the large diameter "O" ring, which can be found in one of the packing boxes, over the machined diameter at the pinion end of the countershaft box. This "O" ring prevents oil leakage from between the countershaft box and main frame.
- 2 Lower the countershaft box guard into position on the pinion end of the box.
- 3 Slide a long section of pipe over the sheave end of the countershaft to offset the much heavier pinion end of the assembly. See the illustration INSTALLING COUNTERSHAFT BOX ASSEMBLY.
- 4 With an overhead crane or other suitable lifting device, carefully position the countershaft box centering lug on the slide within the main frame and slide the assembly in as far as it will go.

THE 2 FT. AND 3 FT. CRUSHERS DO NOT HAVE THIS CENTERING LUG AND SLIDE ARRANGEMENT.



### INSTALLING COUNTERSHAFT BOX ASSEMBLY

- 5 Insert the three special hex head jacking screws, found in the box with the tools, through the holes in the box flange, space 120° apart, and then into the threaded holes in the frame. See the illustration FORCING COUNTERSHAFT BOX INTO MAIN FRAME.
- 6 As the countershaft box has an interference fit on both flanges with the main frame, alternately tighten each jackscrew a small amount, to prevent binding, until they have bottomed in the threaded holes in the frame.
- 7 Remove the jackscrews and install washers or spacers between the head of the jackscrews and the flange as shown. Again

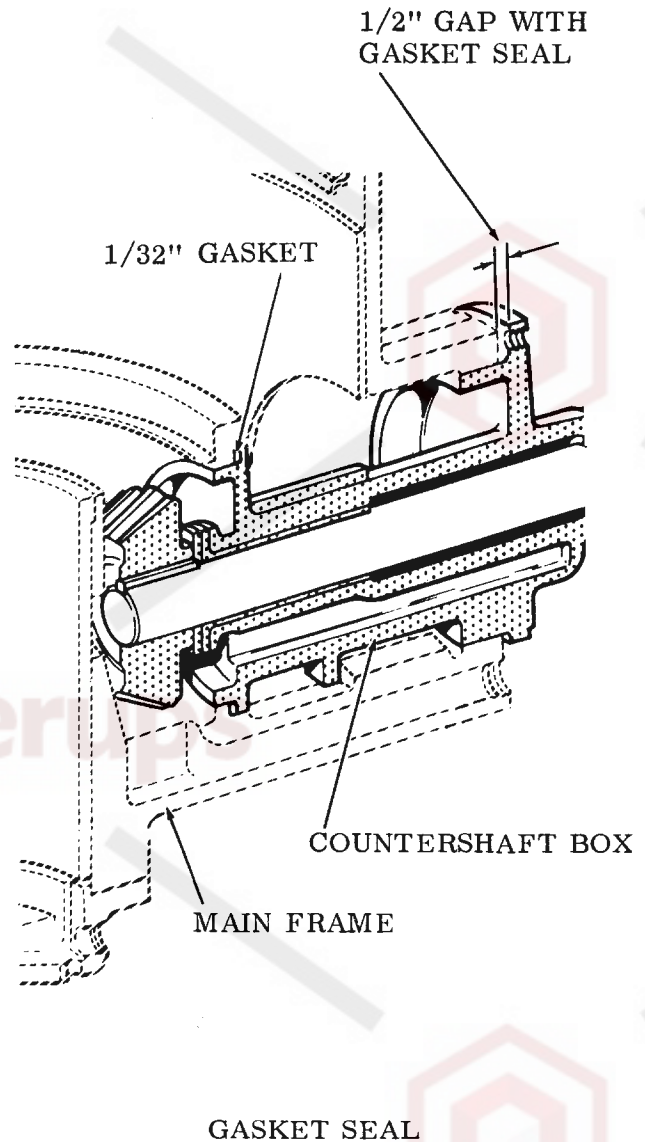
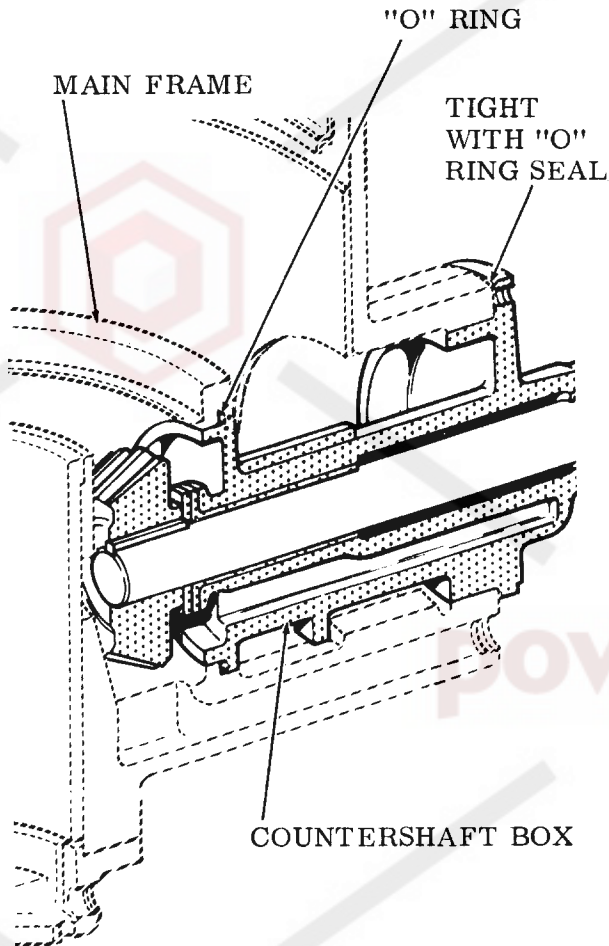


### FORCING COUNTERSHAFT BOX INTO MAIN FRAME

tighten each jackscrew a small amount until they have bottomed in the threaded holes.

- 8 The jackscrews are now removed and replaced with the regular hex head capscrews that will finally hold the box in the frame.
- 9 Continue forcing the countershaft box into the frame by alternately tightening these standard capscrews until the box is tight against the frame at the outer flange. See the illustration COUNTERSHAFT BOX SEALS.

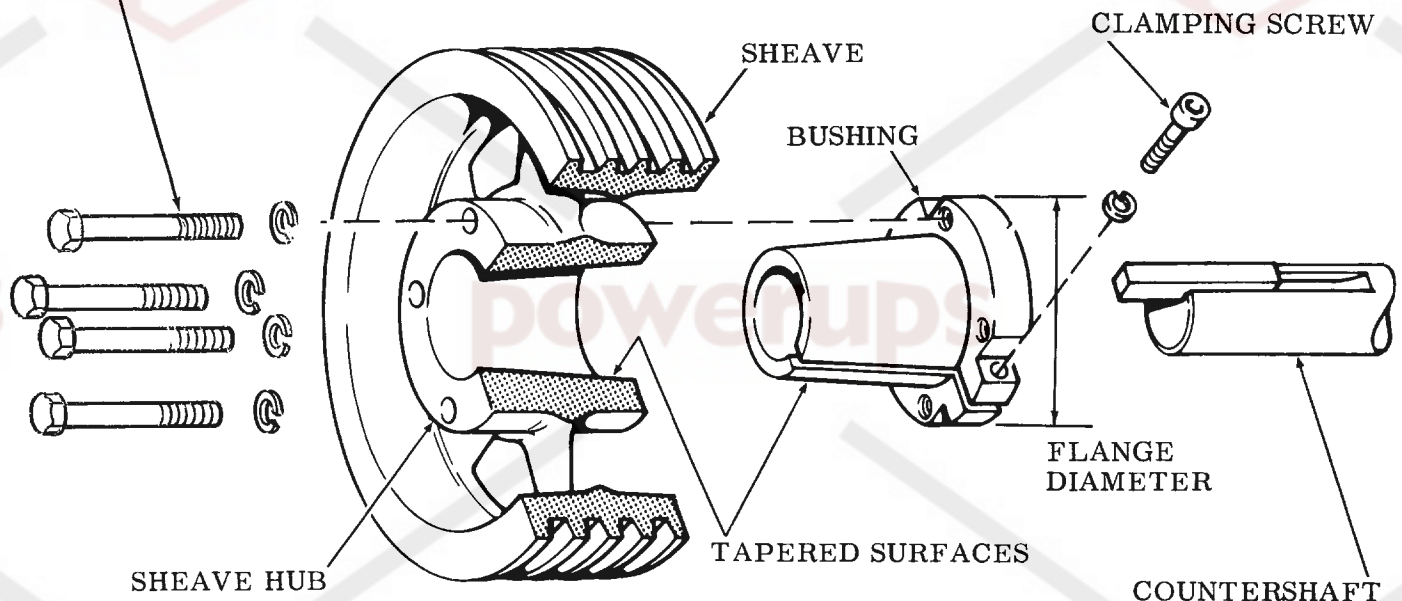
ON "OLDER" MACHINES WHICH HAVE THE GASKET SEAL RATHER THAN THE "O" RING SEAL DESCRIBED HERE, THE COUNTERSHAFT BOX IS PROPERLY INSTALLED WHEN A GAP OF APPROXIMATELY 1/2" REMAINS BETWEEN THE BOX AND FRAME AT THE OUTER FLANGE. NO ATTEMPT SHOULD BE MADE TO CLOSE THIS GAP AS WITH THE GASKET SEAL, THE BOX SEATS TIGHTLY AT THE INNER FLANGE AND COMPRESSES THE 1/32" THICK GASKET. SEE THE ILLUSTRATION COUNTERSHAFT BOX SEALS.



"O" RING SEAL

### COUNTERSHAFT BOX SEALS

## COMBINATION TAKE-UP AND BACK OFF BOLTS



## MOUNTING CRUSHER SHEAVE

To mount a crusher sheave with a removable bushing, proceed as follows; Refer to the illustration, SHEAVE ASSEMBLY.

- 1 Refer to the oil piping drawing and install all oil piping.
- 2 Remove the split tapered bushing from the sheave by unscrewing the combination take-up and back-off bolts.
- 3 Check that the tapered surface and bore of the bushing, the tapered bore of the sheave and the countershaft, are clean and free of burrs, scratches and all foreign matter, such as paint, dirt and lubricants.
- 4 Pull the countershaft toward the drive end until the pinion thrust washer is tight against the INNER countershaft bushing as shown in the illustration END FLOAT - V-BELT DRIVE.
- 5 Bump the oil flinger against the OUTER countershaft bushing using a 4" x 4" block of wood as a ram.
- 6 Check the shaft to be sure that it cannot be moved axially, in or out. If slight movement is still possible, exert a pulling force on the countershaft while simultan-

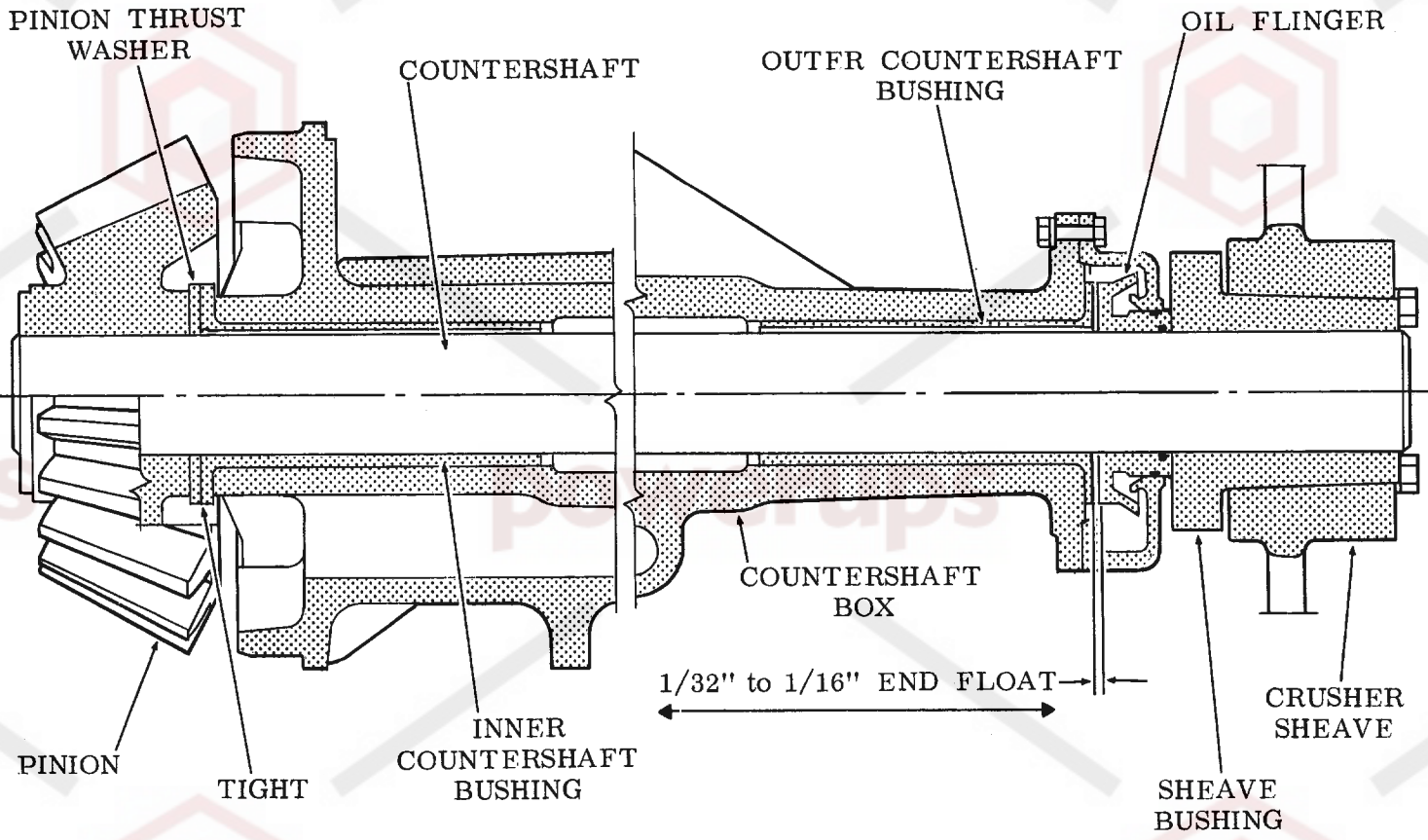
## SHEAVE ASSEMBLY

eously bumping the oil flinger against the outer countershaft bushing.

- 7 Place the sheave key in the countershaft keyway.
- 8 Loosen the clamping screw and setscrew on the sheave bushing sufficiently to permit the bushing to be slid onto the shaft.

DO NOT USE ANY LUBRICANTS DURING THE FOLLOWING ASSEMBLY PROCEDURES.

- 9 Slide the bushing over the end of the shaft, flange first.
- 10 Position the sheave bushing on the shaft so that there is 1/32" to 1/16" clearance between the bushing and the oil flinger. Firmly tighten the clamping screw, however, avoid overtightening.
- 11 Using a wooden 4" x 4" block, ram the countershaft toward the Crusher until the sheave bushing contacts the oil flinger, thereby providing the necessary end float or running clearance. See the illustration END FLOAT - V-BELT DRIVE.



**END FLOAT--V-BELT DRIVE**

RECHECK THE 1/32" TO 1/16" END FLOAT BY MOVING THE COUNTERSHAFT AXIALLY, IN AND OUT.

- 12 Slide the sheave over the bushing being careful to keep the bolt holes lined up with the tapped holes in the bushing flange.
- 13 Insert the take-up bolts through the bolt holes and alternately tighten each bolt a small amount, until all bolts are tight. Refer

to the table, TAKE-UP BOLTS TORQUE REQUIREMENTS. Do not lubricate the bolt threads or the tapped holes. When the sheave is finally positioned, a clearance of 1/8" to 1/4" should exist between the face of the sheave hub and the flange of the bushing. No attempt should be made to take up this clearance as this clearance assures the proper fit and grip between sheave bushing and countershaft. Follow the torque requirements closely: over tightening the take-up bolts will create bursting pressures in the hub of the sheave and could cause the sheave to crack.



IDENTIFYING SIZE OF SHEAVE BUSHING FOR PROPER TORQUE REQUIREMENTS		DO NOT USE ANY LUBRICANTS		
		PROPER TORQUE WHEN USING TORQUE WRENCH (FOOT POUNDS)	PROPER WRENCH PULL WHEN USING OPEN END OR SOCKET WRENCH	
BUSHING FLANGE DIAMETER	SIZE AND THREAD OF TAKE-UP BOLTS			WRENCH LENGTH (INCHES)
2	#10-24	5	4	15
2-11/16	1/4-20	9	4	27
3-3/16	1/4-20	9	4	27
3-3/16	1/4-20	9	4	27
3-7/8	5/16-18	15	6	30
4-5/8	3/8-16	30	6	60
6	1/2-13	60	12	60
6-5/8	9/16-12	75	12	75
7-1/4	5/8-11	135	12	135
9	3/4-10	225	15	180
10	7/8-9	300	15	240
11-3/4	1-8	450	18	300
15	1-1/8-7	600	24	300

### TAKE-UP BOLT TORQUE REQUIREMENTS

### CRUSHER SHEAVE REMOVAL

To remove the crusher sheave proceed as follows:

- 1 Remove the take-up bolts and thread two of them into the tapped holes in the hub of the sheave. Using the two bolts as back-off bolts, exert pressure by tightening the bolts against the flange of the bushing, breaking the sheave grip on the bushing cone.

SHOULD THERE BE DIFFICULTY "BREAKING" THE FIT BETWEEN THE SHEAVE AND BUSHING, TAP THE END OF THE SHAFT OR BUSHING WITH A BABBITT HAMMER WHILE MAINTAINING BACK-OFF BOLT PRESSURE, UNTIL THE SHEAVE IS LOOSE ENOUGH TO REMOVE.

- 2 Loosen the clamping screw and setscrew on the bushing.

- 3 If necessary, insert a wedge such as a screwdriver, into the split in the bushing flange and remove the bushing.

### MOUNTING FLEXIBLE COUPLING

For the initial installation or when reassembling the flexible coupling on a direct drive arrangement, proceed as follows:

- 1 Disassemble the coupling.
- 2 Inspect both the driving and driven shafts and coupling bores, making sure they are free from burrs, scratches and all foreign matter. Be sure the keys fit the shafts and coupling halves properly.

- 3 Since the coupling halves are mounted on both the crusher countershaft and motor or engine shafts with an interference fit, heat the coupling hub to a temperature of approximately 175° Fahrenheit above the ambient temperature and install on the shaft as quickly as possible.

DO NOT HEAT THE COUPLING HUB OVER 275° FAHRENHEIT AS THE FLANGE OR GAP PORTION OF THE COUPLING COULD BECOME DAMAGED FROM EXCESSIVE HEAT. A CHEMICAL MARKING DEVICE, WHICH MELTS AT A PREDETERMINED TEMPERATURE, SHOULD BE USED TO INSURE UNIFORM AND SAFE HEATING.

**WARNING**

Use heavy, well insulated asbestos gloves when handling the heated coupling halves.

- 4 Measure the shaft diameter and the bore of the coupling as it is being heated to be sure the bore is slightly larger than the shaft. If the coupling has been heated properly, no trouble should be encountered in positioning the coupling on the shaft. Make sure the keyways are properly aligned.
- 5 Drive in the keys.
- 6 Pull the countershaft toward the drive end until the pinion thrust washer is tight against the INNER countershaft bushing as shown in the illustration END FLOAT - DIRECT DRIVE.
- 7 Bump the oil flinger against the OUTER countershaft bushing using a 4" x 4" block of wood as a ram.

- 8 Check the shaft to be sure that it cannot be moved axially, in or out. If slight movement is still possible, exert a pulling force on the countershaft while simultaneously bumping the oil flinger against the outer countershaft bushing.
- 9 In order to provide the proper countershaft end float using a direct drive arrangement, a safety set collar must be installed on the countershaft. Since a set collar is usually split in two halves for easier installation, position the halves on the shaft and firmly tighten the two clamping screws, however, avoid overtightening.

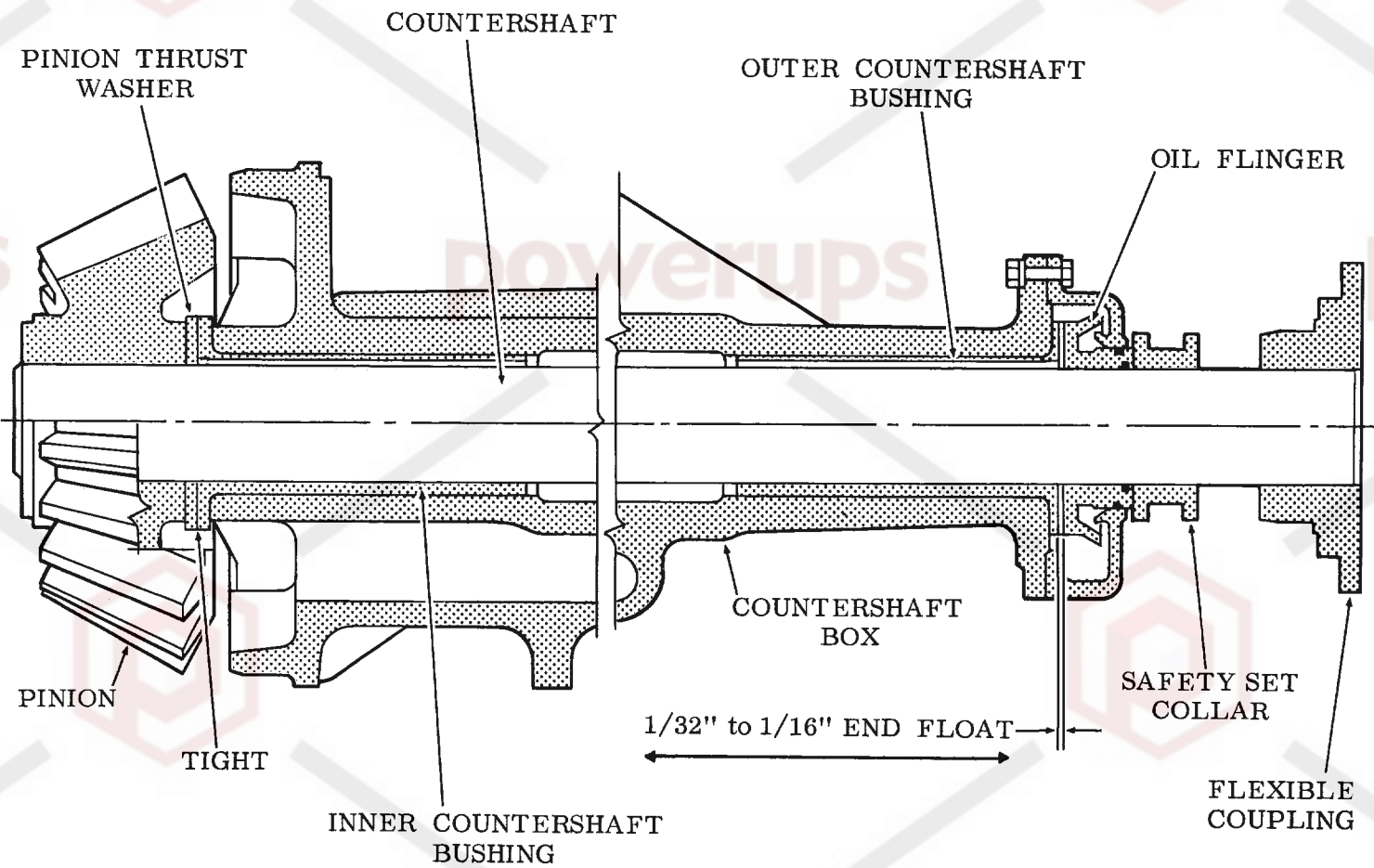
The safety set collar should be positioned so that there is 1/32" to 1/16" clearance between the collar and the oil flinger. Using a wooden 4" x 4" block, ram the countershaft toward the Crusher until the collar contacts the oil flinger, thereby providing the necessary end float or running clearance. See the illustration END FLOAT - DIRECT DRIVE.

RECHECK THE 1/32" TO 1/16" END FLOAT BY MOVING THE COUNTERSHAFT AXIALLY, IN AND OUT.

- 10 Tighten the setscrew in the safety set collar to lock the collar in place.
- 11 Align the coupling as described in Section 2, INITIAL ALIGNMENT OF FLEXIBLE COUPLING.

**CHECKING END FLOAT**

If the Crusher was shipped completely assembled, the end float was set correctly at the factory; but, as it is important for the proper operation of the Crusher, re-check the end float. The countershaft must be free to move in and out 1/32" to 1/16". DO NOT ALLOW END FLOAT TO EXCEED 1/16".



**END FLOAT - DIRECT DRIVE**

## MAINTENANCE

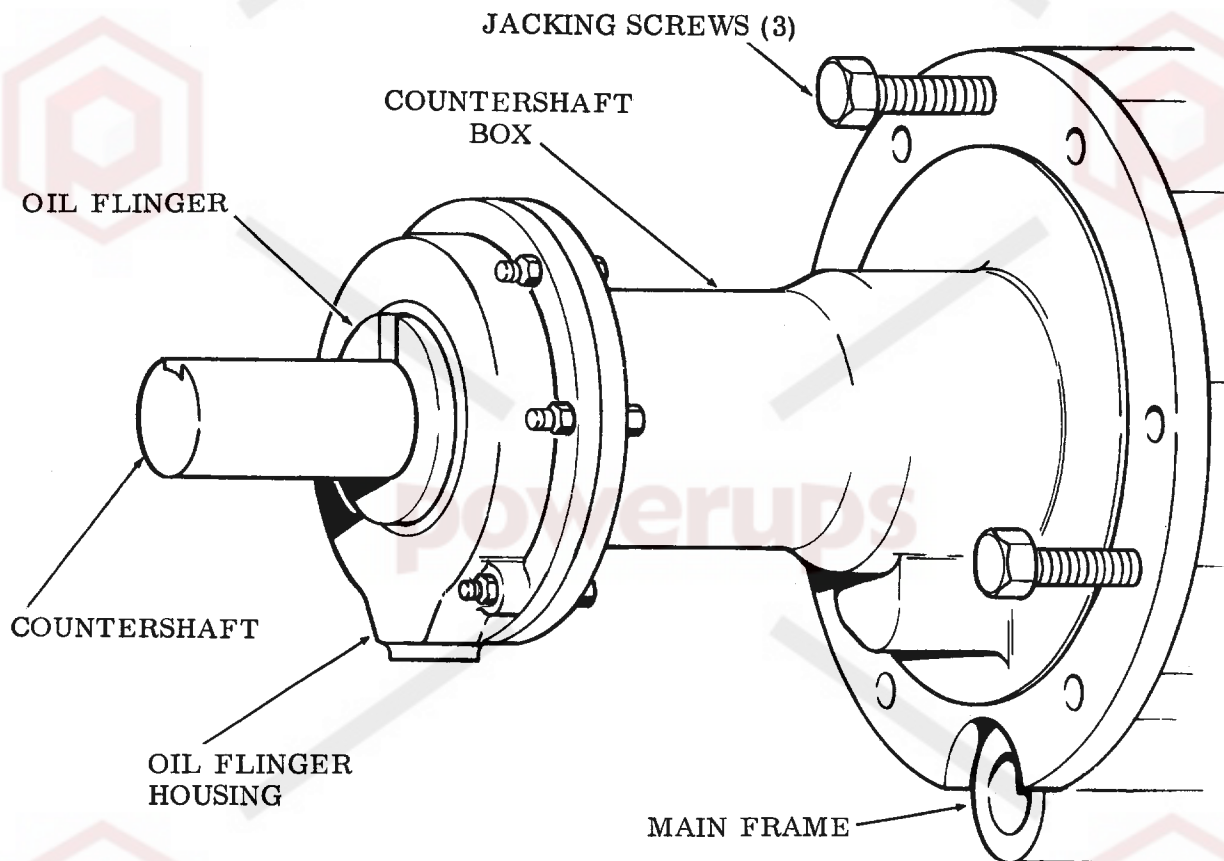
**DISASSEMBLY OF COUNTERSHAFT BOX.** To disassemble the countershaft box and countershaft assembly for replacement of bushings, pinion or other wear parts, proceed as follows:

- 1 Remove all oil piping that would interfere with the removal of the box.
- 2 Remove the crusher sheave at this point, as described under CRUSHER SHEAVE REMOVAL. This is done primarily to prevent damaging or breaking the sheave during box removal.
- 3 Remove the capscrews holding the countershaft box to the main frame.

4 Install the special jacking screws, that are furnished with the machine, into the three equally spaced tapped holes in the outer flange of the box. See the illustration COUNTERSHAFT BOX REMOVAL.

- 5 Alternately tighten each jackscrew a small amount to prevent binding in the frame.

IF THERE IS AN EXCEPTIONALLY TIGHT FIT, HEAT MAY BE APPLIED TO THE MAIN FRAME AT THE OUTER COUNTERSHAFT BOX FIT TO ASSIST IN REMOVAL. HEAT THE FRAME HOUSING TO APPROXIMATELY 100° FAHRENHEIT ABOVE AMBIENT.

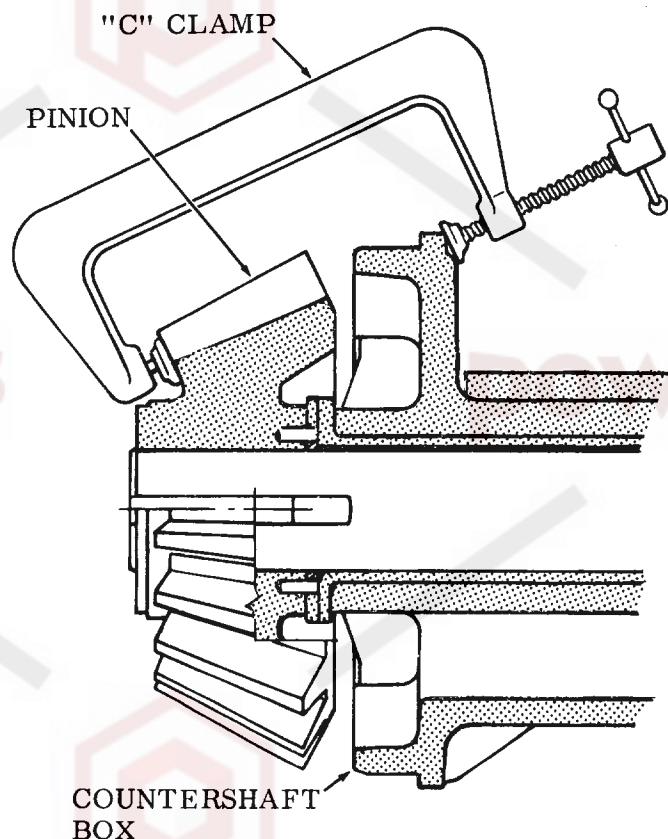


**COUNTERSHAFT BOX REMOVAL**

- 6 Continue tightening them until the box is free of the frame.
- 7 Slide a long section of pipe over the sheave end of the countershaft to counterbalance the assembly and remove the assembly by using an overhead crane or other suitable lifting device. See the illustration INSTALLING COUNTERSHAFT BOX ASSEMBLY.
- 8 Remove the flinger housing.
- 9 Heat the oil flinger to a temperature of approximately 50° Fahrenheit above the ambient temperature.
- 10 Place a pry bar between the flinger and the countershaft box and exert moderate pressure.
- 11 Once the flinger starts to move, grasp each side of the flinger and pull the flinger straight off the shaft.

**WARNING**

Use heavy, well insulated gloves when handling the heated oil flinger.



**HOLDING THE COUNTERSHAFT ASSEMBLY**

INSIDE THE BORE OF SOME OIL FLINGERS IS EITHER AN "O" RING OR A GRAPHITE IMPREGNATED PACKING, WHICH PREVENTS OIL FROM LEAKING OUT ALONG THE COUNTERSHAFT. CARE SHOULD BE TAKEN THAT THIS SEAL IS NOT DAMAGED DURING REMOVAL OF THE FLINGER. IF THE SEAL IS DAMAGED, IT MUST BE REPLACED BEFORE THE UNIT IS REASSEMBLED.

- 12 Pull the countershaft assembly out of the countershaft box.

ASSEMBLING THE COUNTERSHAFT BOX. Assembly is the reverse procedure of disassembly with the following exceptions:

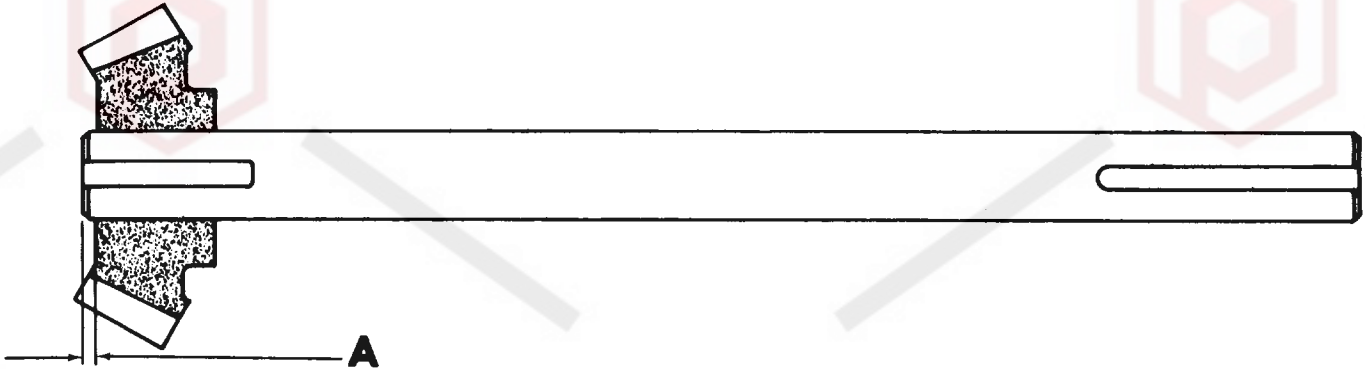
- 1 Insert the countershaft assembly in the countershaft box.
- 2 To hold the countershaft stationary, place a large "C" clamp so that the pinion is clamped to the countershaft box flange. See the illustration HOLDING THE COUNTERSHAFT ASSEMBLY. An alternate method for holding the countershaft would be to place the pinion against a firm bearing wall or similar support.
- 3 Place the oil flinger key in the keyway in the countershaft. In some countershafts the flinger keyway is a small keyway just for the flinger key, while, in other countershafts the flinger key fits in the same keyway as the crusher sheave key.
- 4 Check the condition of the seal inside the oil flinger bore, if the flinger is so equipped. Replace the seal if necessary.
- 5 Heat the oil flinger to a temperature of approximately 50° Fahrenheit above the ambient temperature and install on the countershaft as quickly as possible.

DO NOT APPLY TOO MUCH HEAT TO THE FLINGER AS THE "O" RING OR THE GRAPHITE IMPREGNATED PACKING WHICH PREVENTS OIL FROM LEAKING OUT ALONG THE COUNTERSHAFT, COULD BECOME DAMAGED FROM THE HEAT.

- 6 When resistance is encountered, place a block of wood across the face of the flinger and force the flinger on the shaft by ramming against the timber. The flinger is properly installed when it is tight against the outer countershaft bushing.
- 7 On some countershaft box assemblies the oil flinger key cannot be installed until the oil flinger has been properly installed on the countershaft. In this case the key must be welded to the flinger to hold the key in place. If the flinger being installed already has the key welded to it, check that the weld did not crack during removal of the flinger.
- 8 If the oil flinger is equipped with a piston ring to provide the oil seal between the flinger and the flinger housing, check that the piston ring can be freely turned in the specially machined groove in the flinger. Carefully file off any nicks or burrs that may have formed on the piston ring, causing the piston ring to bind in the flinger. Replace the piston ring if necessary.

- 9 Check the bore inside the flinger housing before assembling the housing to the countershaft box, the bore must be SMOOTH! If a groove is BEGINNING to wear into the bore of the flinger housing from the piston ring, the bore must be machined smooth. A groove worn in the housing can cause the piston ring to "lock" in the flinger housing and make future removal of the flinger housing extremely difficult, if not impossible, without damaging some part on this end of the countershaft box assembly. Replace the flinger housing if the groove worn in the housing is too deep.

**REPLACING THE PINION.** Whenever the countershaft box is out of the Crusher for inspection or replacement of parts, it is advisable to inspect the pinion for wear or broken teeth. Pitting or galling on the face of the teeth are good indications of excessive wear. This can be due to improper tooth contact resulting from an incorrect quantity of shims being placed under the lower step bearing plate, by overloading the Crusher, or by using excessively dirty oil.



CRUSHER SIZE	PINION LOCATION A	PRESS FIT IN TONS (2000 Lbs.)
2 Ft.	1/2" *	12
3 Ft.	1/2"	20
4 Ft.	3/8"	25
5100 and 4-1/4 Ft.	3/8"	25
5-1/2 Ft.	1/2"	40
7 Ft.	1/4"	65

\* Integral Oil Pump Only

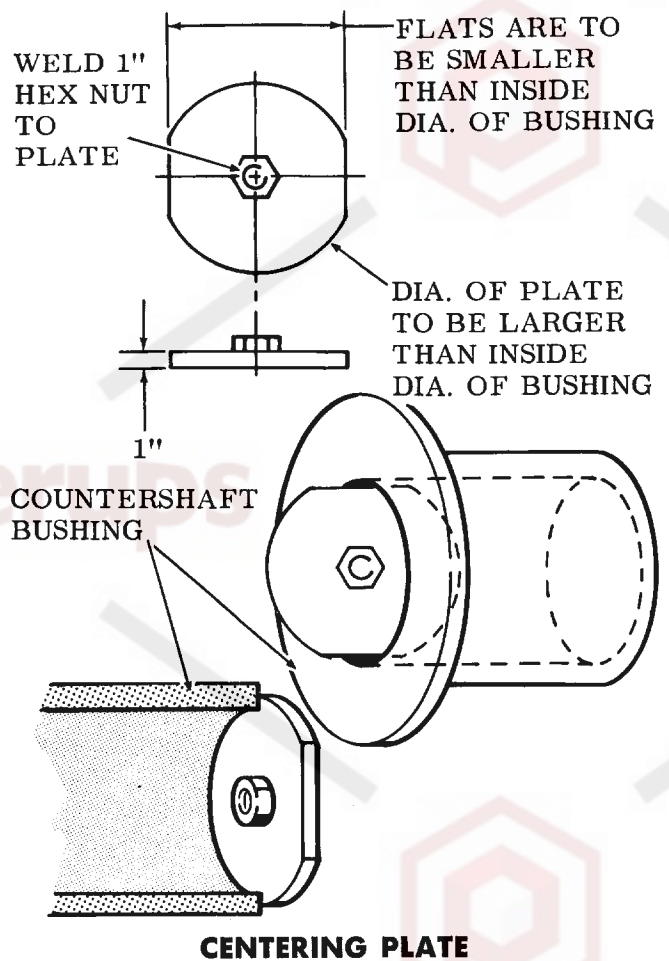
**PINION LOCATION AND PRESS FIT**

Also check the pinion thrust washer for wear or scoring. If the pinion is worn to the point where replacement is necessary, the pinion is to be removed as follows:

- 1 Remove the countershaft assembly from the countershaft box as described under DISASSEMBLY OF COUNTERSHAFT BOX.
- 2 Slide off the pinion thrust washer.
- 3 Drive out the tapered key, from the rear of the pinion.
- 4 Place the pinion and shaft assembly in a suitable hydraulic press and force the pinion free of the shaft. The table, PINION LOCATION AND PRESS FIT lists the capacity of press required for both removal and installation of the pinion.
- 5 Lubricate the end of the shaft and the bore of the new pinion with a suitable pressing lubricant.
- 6 Place the pinion on the end of the shaft and align the keyways.
- 7 Press the new pinion onto the shaft so that the end of the shaft protrudes from the pinion the distance specified in the table PINION LOCATION AND PRESS FIT.

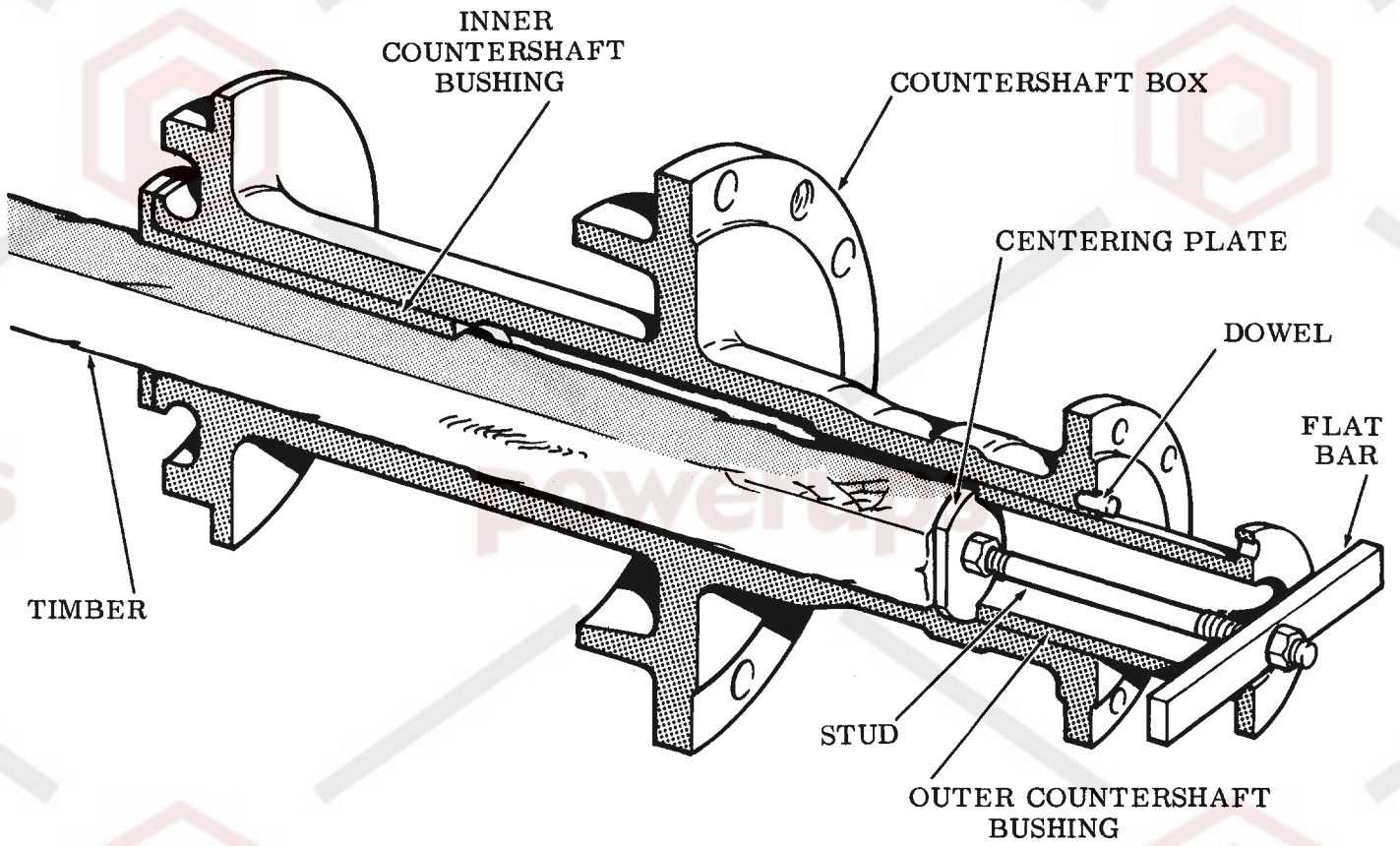
**REMOVAL OF COUNTERSHAFT BUSHINGS.**  
On occasions when a bushing becomes worn and replacement is necessary, the bushing will be loose in the box. In instances such as this, the bushing is simply slid from the box without difficulty. Due to extreme limits of manufacturing tolerances, the countershaft bushings may have had a slight interference fit within the countershaft box. If such is the case, removal will be more difficult. To replace the countershaft bushings, that have such a press fit or those that have "seized" in the box because of a build up of heat due to inadequate lubrication or from overloading the Crusher, proceed as follows:

- 1 Remove the countershaft box from the main frame and the countershaft from the countershaft box as described under DISASSEMBLY OF COUNTERSHAFT BOX.
- 2 Construct a steel centering plate as shown in the illustration, CENTERING PLATE.

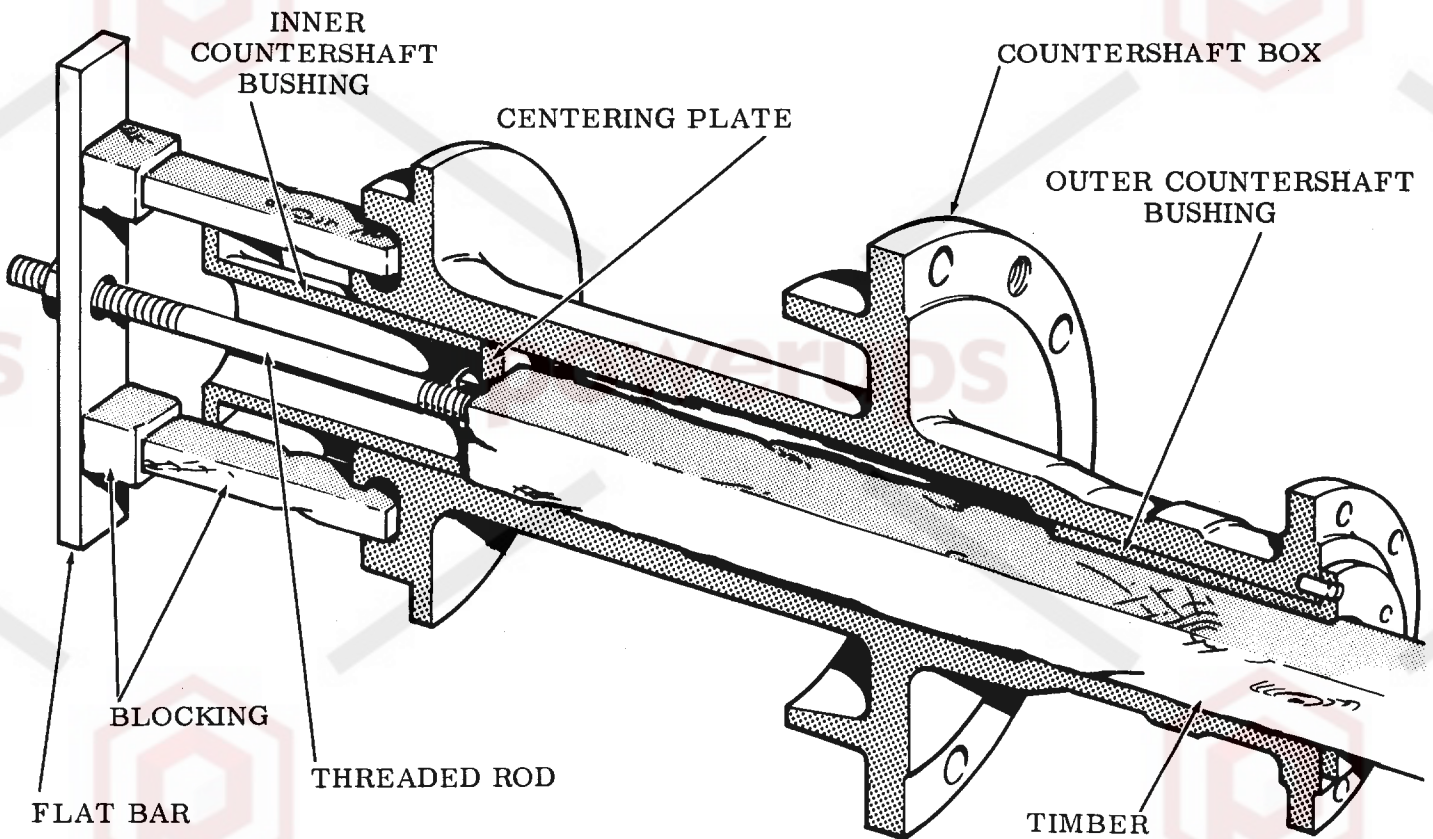


- 3 Slide the narrow portion of the plate horizontally through the bushing until the plate is behind the bushing.
- 4 Turn the centering plate 90° so that the outer edge of the plate will bear against the bushing. See the illustration COUNTERSHAFT BUSHING REMOVAL BY RAMMING.
- 5 While holding the plate in position thread a 1" diameter rod into the nut which is welded to the center of the plate. The rod must be a few inches longer than the bushing and threaded on both ends.
- 6 Place a 1" x 3" x 12" steel bar over the other end of the rod and hold firmly in place with a hex nut.
- 7 Insert a long timber or pipe through the opposite end of the countershaft box and ram against the centering plate.

Should the bushing remain tight within the countershaft box an alternate method utilizing a jacking procedure is suggested to remove

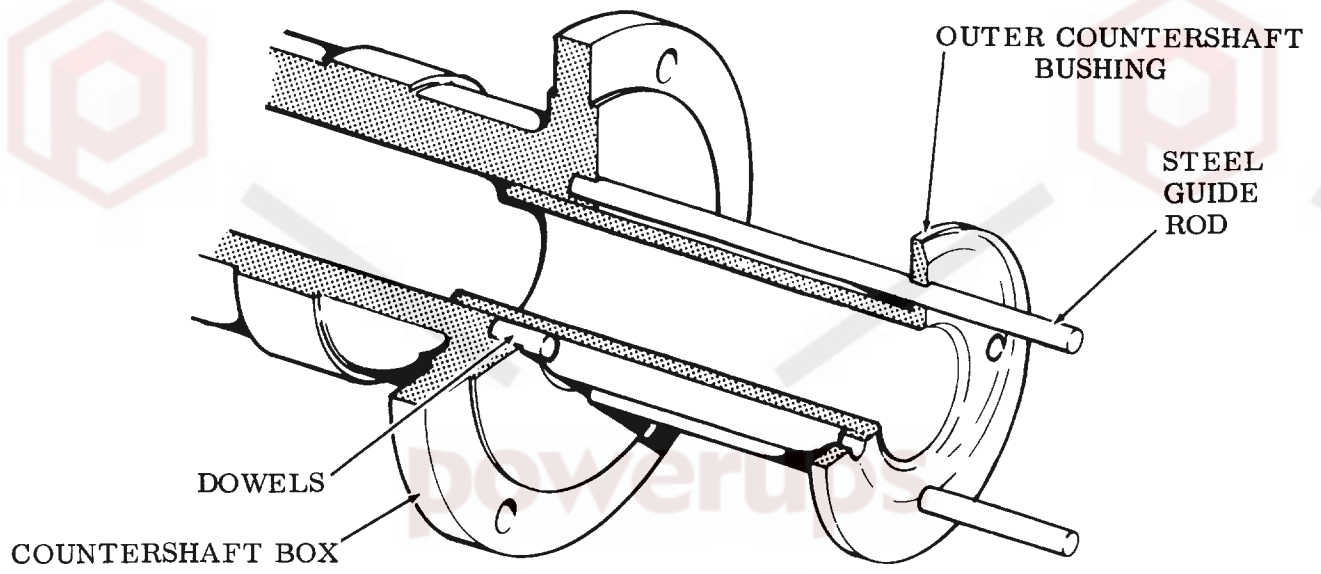


**COUNTERSHAFT BUSHING REMOVAL BY RAMMING**

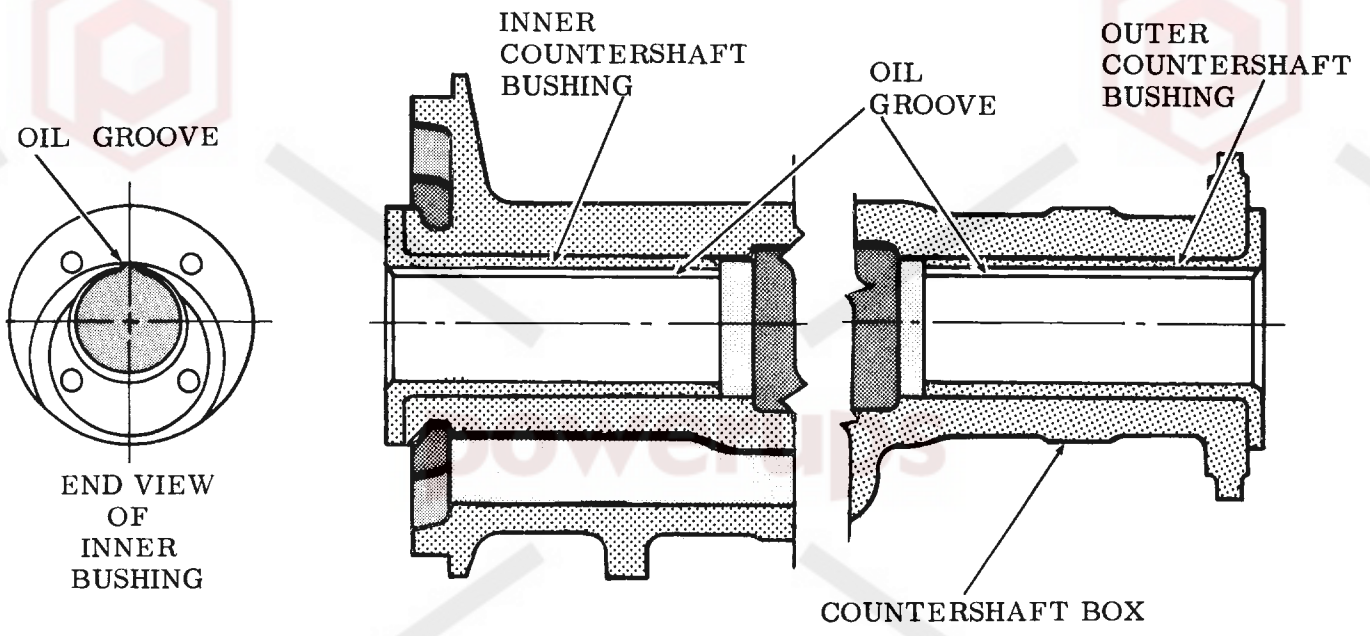


**COUNTERSHAFT BUSHING REMOVAL BY JACKING**





**COUNTERSHAFT BUSHING INSTALLATION**



**LOCATION OF INNER COUNTERSHAFT BUSHING OIL GROOVE**

bushings which are very difficult to remove, proceed as follows:

- 1 Using the same centering device as previously described and in the same manner except for a much longer rod and steel bar, place wooden blocking between the steel bar and the countershaft box flange as shown in the illustration COUNTER-SHAFT BUSHING REMOVAL BY JACKING.
- 2 Using the threaded rod as a jackscrew, tighten the hex nut until the flange of the bushing is pulled against the steel bar.
- 3 Unscrew the nut and place additional blocking under the bar and tighten the hex nut until the bushing is again pulled against the bar.
- 4 Repeat this procedure until the bushing is free.

**INSPECTION PRIOR TO BUSHING INSTALLATION.** As a precautionary measure prior to pressing in a new bushing, check the diameter of the bore in the countershaft box. The bushings are machined to provide a fit of 0.001 inch tight, to 0.002 inch loose. The inside diameter of the bore and the outside diameter of the bushing should be checked to make certain their diameters meet these tolerances. Should the interference be more than the 0.001 inch, the box must be remachined to meet these limits. An excessive interference fit can cause the bushing to collapse or the bushing bore to become smaller thereby reducing the clearance between countershaft and bushing. If the bore is found to be smaller than when originally machined, this bore shrinkage can usually be attributed to extreme heat.

Check the shaft itself for straightness or run out. With the shaft between centers, the run out should not exceed a total of 0.004 inch. If more than 0.004 inch, the countershaft should be replaced.

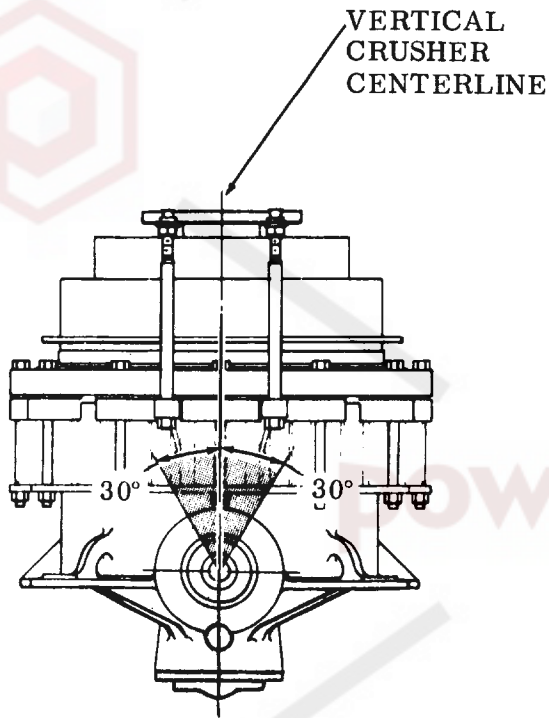
If the bore of the bushing has become smaller from excessive pressure when pressing into an

undersize countershaft box bore or if a bent countershaft is used, the bushing could seize onto the shaft.

Should the shaft be twisted, as indicated by comparison of alignment between keyways, it is to be discarded and a new one installed.

**INSTALLING COUNTERSHAFT BUSHINGS.** When both the countershaft and countershaft box have been thoroughly inspected and found to be satisfactory, the new bushings can be installed. Should the bushings have a loose fit within the box just slide the bushings in, over the dowels, taking care that the oil groove in the bore is positioned as described in Step 3. If an interference fit occurs, proceed as follows:

- 1 Remove two of the four dowels or pins that are in the face of the box flange.
- 2 Insert two rods which are slightly longer than the bushing into these two dowel holes. See the illustration COUNTERSHAFT BUSHING INSTALLATION. These rods will make certain that the holes in the bushing flange line up with the dowels in the box.
- 3 Both countershaft bushings, inner and outer are identical. However, their position in the bore may differ. Determine the proper location of the bushing oil groove in relation to the countershaft box as follows:
  - A. The longitudinal oil groove in the INNER countershaft bushing is properly located at the top of the countershaft. See the illustration, LOCATION OF INNER COUNTERSHAFT BUSHING OIL GROOVE.
  - B. The OUTER countershaft bushing is normally installed with the longitudinal oil groove located at the top, however its position will differ if the motor sheave is located ABOVE the Crusher, either directly over the crusher sheave or within 30° of each side of the crusher vertical centerline. See the illustration VERTICAL DRIVE.

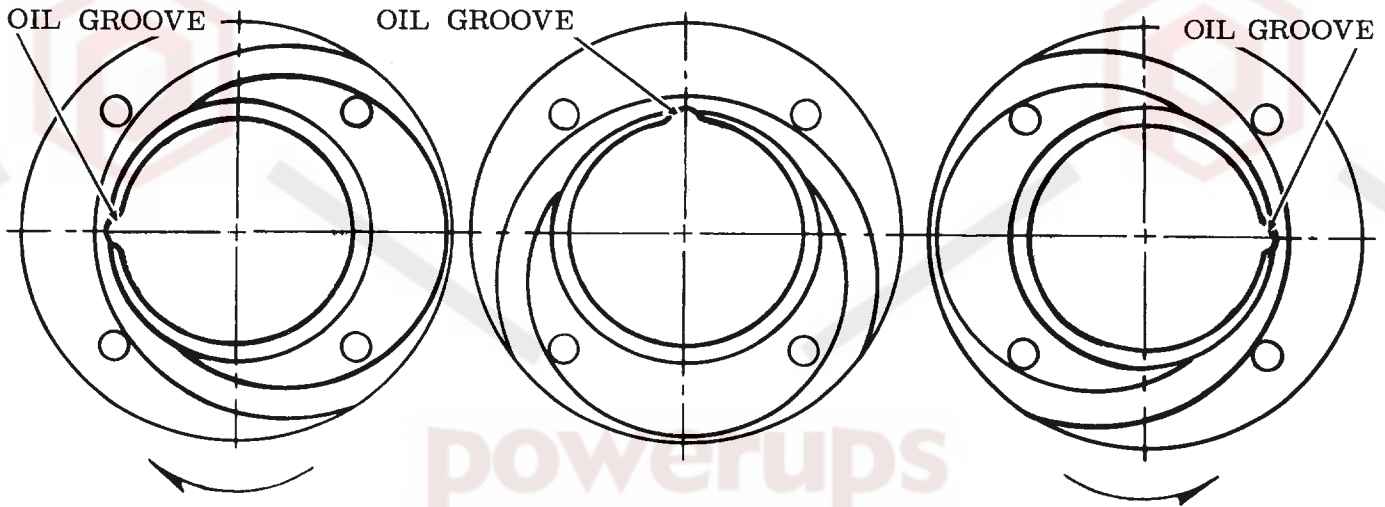


**VERTICAL DRIVE**

The outer countershaft bushing groove must then be rotated 90° from top center in either direction depending on the rotation of the crusher countershaft. See the illustration POSITIONS OF OUTER COUNTERSHAFT BUSHING OIL GROOVE. Rotating the bushing 90° when using such a vertical drive will prevent the pull of the countershaft from slightly closing this groove and restricting the flow of lubricating oil through it.

- 4 Pack the bore of the replacement bushings with dry ice for 2-3 hours to shrink the bushings to permit easy installation into the countershaft box.

Approximately 50 pounds of dry ice will be required for BOTH countershaft bushings on the 2 Ft. through the 4-1/4 Ft. size Crushers, while 100 pounds will be required on the 5-1/2 Ft. and 7 Ft. machines.



9:00 O'CLOCK POSITION FOR CLOCKWISE ROTATION WITH VERTICAL DRIVE OR WITHIN 30° OF VERTICAL

NORMAL OR 12:00 O'CLOCK POSITION

3:00 O'CLOCK POSITION FOR COUNTERCLOCKWISE ROTATION WITH VERTICAL DRIVE OR WITHIN 30° OF VERTICAL

**POSITIONS OF OUTER COUNTERSHAFT BUSHING OIL GROOVE  
(END VIEW OF COUNTERSHAFT BUSHING)**

WRAP THE OUTSIDE OF THE BUSHING IN A FEW LAYERS OF BURLAP TO PREVENT THE EXTERNAL BUILD UP OF FROST WHICH COULD HINDER THE INSTALLATION OF THE BUSHING IN THE COUNTERSHAFT BOX. THIS ALSO HELPS TO ACHIEVE A MORE THOROUGH COOLING.

**WARNING**

Use heavy, well insulated gloves when handling the dry ice. Handling dry ice without protection could result in severe burns.

IF THE COUNTERSHAFT BOX IS AT A TEMPERATURE OF 75° FAHRENHEIT OR HIGHER, PLAIN ICE CAN BE USED AS A SUBSTITUTE. MEASURE THE OUTSIDE DIAMETER OF THE BUSHING AND THE BORE OF THE COUNTERSHAFT BOX TO DETERMINE WHEN THE BUSHING HAS COOLED SUFFICIENTLY.

- 5 Very quickly slide the bushing into the bore of the countershaft box using the rods inserted in the box as guides.
- 6 If installation did not proceed rapidly and the bushing expanded when part way in the bore or if installation by freezing is not available, ram the bushing into place using a block of wood across the face of the bushing to protect it. The guide rods will help considerably in this type of assembly.

DO NOT USE EXCESSIVE FORCE WHEN RAMMING AS THE BUSHING CAN BECOME COCKED IN THE BORE CAUSING GREAT DIFFICULTY.

- 7 Replace the two dowels that were previously removed.

**OIL LEAKAGE FROM DRIVE END OF COUNTERSHAFT BOX**

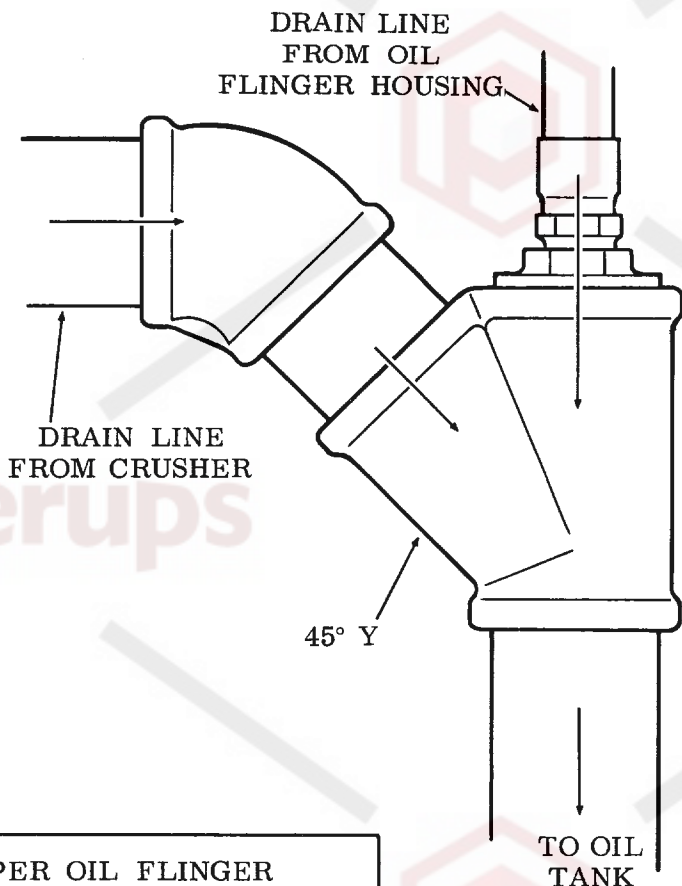
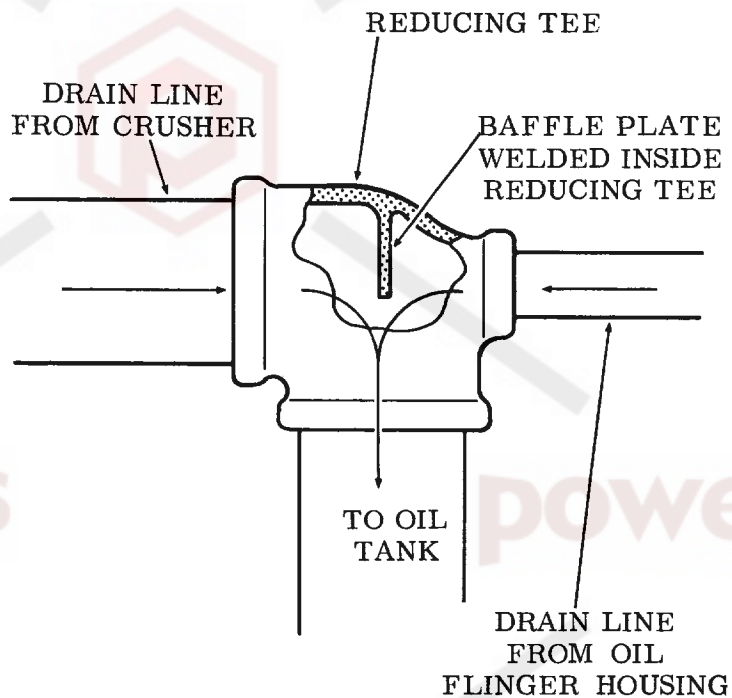
Should oil begin to leak out of the oil flinger housing at the drive end of the countershaft box, it may be that either an "O" ring or a graphite packing inside the oil flinger has become damaged or worn and requires replacing. See the paragraph DISASSEMBLY OF COUNTERSHAFT BOX in this section.

It is also possible that the cause of the oil leakage is the inability of the oil to drain away fast enough from the oil flinger housing, especially when the oil is cold. This type of oil leak is probably due to insufficient pitch in the main drain line or incorrect piping coming from the flinger housing. See the illustration OIL PIPING CONNECTIONS. Minimum pitch is 1" for every 12" of drain pipe used.

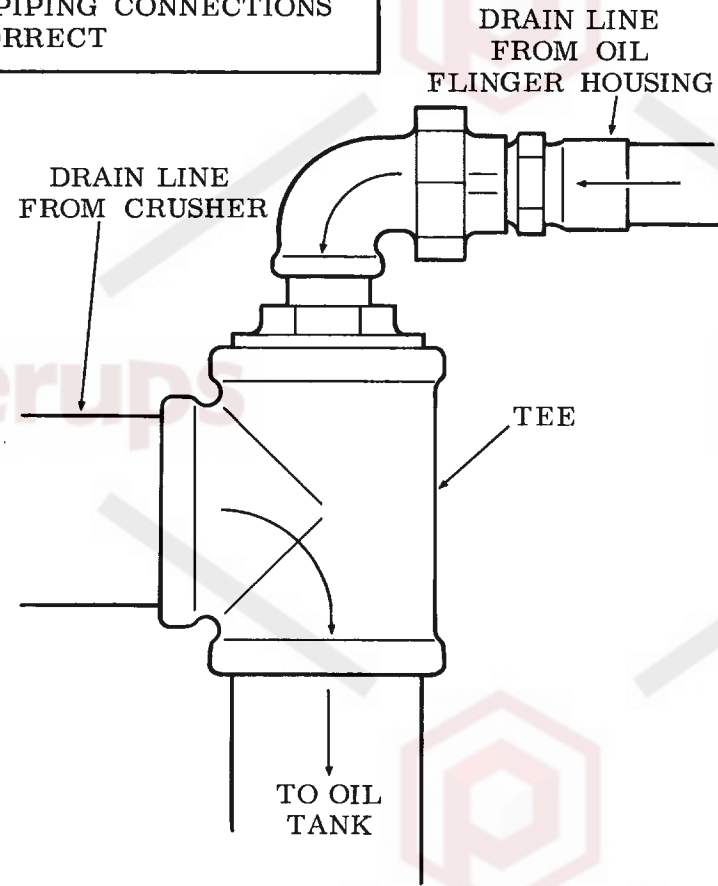
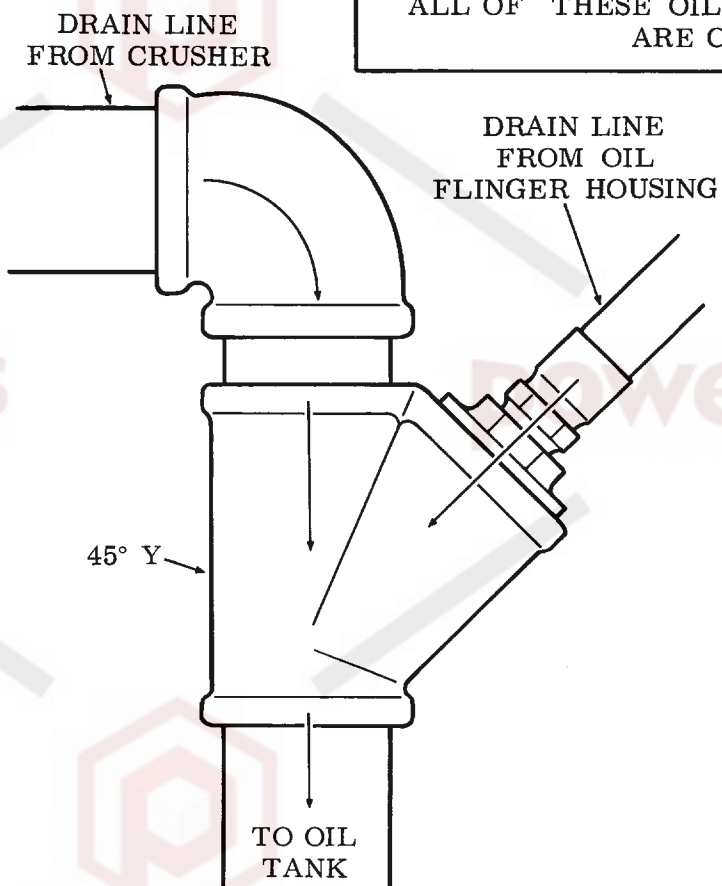
Also check the inside of the hose or piping coming from the oil flinger housing for any obstructions, such as dirt build-up or a collapsed hose that may restrict oil flow. Any of these items just described can cause the oil to back up and leak out of the flinger housing.

Before doing any disassembly work on the countershaft box itself, or any repiping of the main drain line, all of which means considerable down time, it is recommended to "break" the drain line from the flinger housing where it joins the main drain line and run a separate line from this housing directly back to the oil tank. This procedure has eliminated this kind of oil leak in most cases and has resulted in the least amount of down time because of working with small pipe diameters - 3/4" to 1-1/4". See the illustration SEPARATE DRAIN LINE.

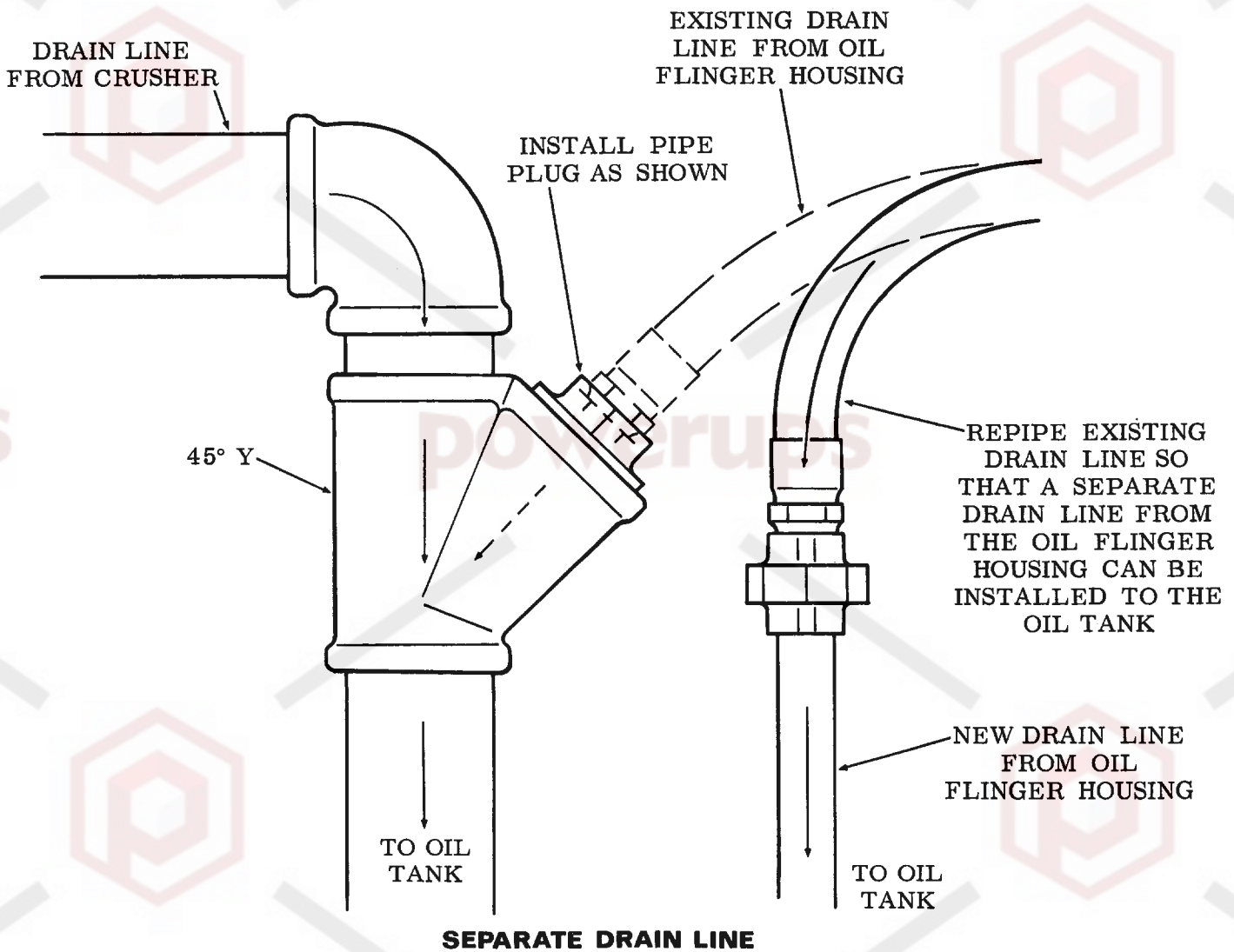
The majority of oil leaks from the drive end of the countershaft box have been on portable plants where drain lines do not have sufficient pitch due to space limitations in such installations.



CHECK FOR PROPER OIL FLINGER HOUSING TO CRUSHER DRAIN LINE PIPING!  
ALL OF THESE OIL PIPING CONNECTIONS ARE CORRECT



**OIL PIPING CONNECTIONS**



#### CONVERTING TO PRESSURE LUBRICATED COUNTERSHAFT BOX

Countershaft boxes, when they were originally designed, were "flood" lubricated from within the Crusher rather than the present pressure lubricated system which uses an external oil feed line to force oil under pressure directly into the countershaft box.

In the original system, oil spilling off the pinion was trapped by a cored pocket cast into the pinion end of the countershaft box, the oil then flowed along a longitudinal groove machined into the bore of the countershaft BOX and into the large cavity inside the box. The oil then flowed out of the drive end of the countershaft box between the countershaft and the countershaft bushing. To prevent the oil from draining out too fast, a babbitt dam was installed in the

oil groove of the outer countershaft bushing and an angle needle valve was used to regulate the amount of oil to the box.

To convert "old style" countershaft boxes to the vastly improved pressure lubricated system presently being used, carefully follow all the directions shown in the illustrations CONVERTING AN "OLD STYLE" COUNTERSHAFT BOX TO THE PRESSURE LUBRICATED SYSTEM.

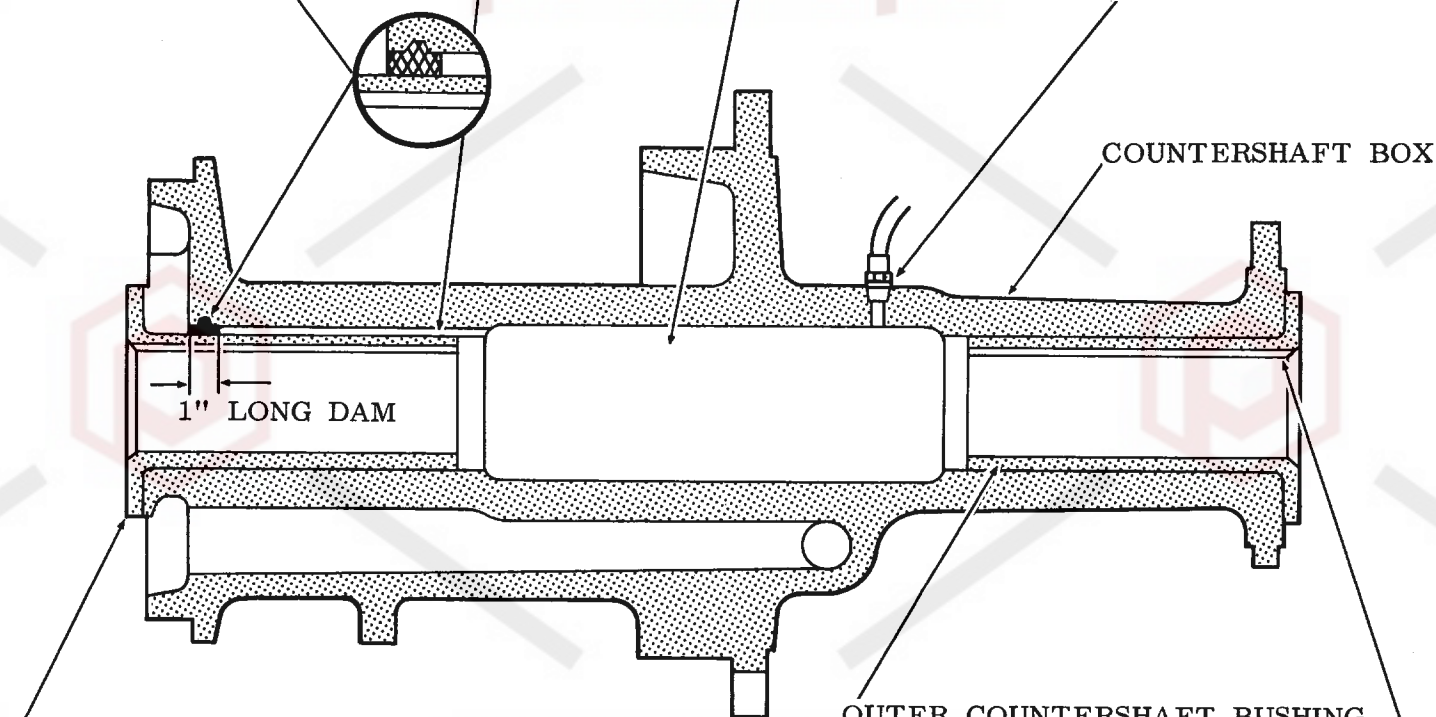
Pressure lubricated countershaft boxes are lubricated through the use of either hose or piping directly connected into the countershaft box near the drive end of the box. All lubrication is done from outside the Crusher.

No countershaft bushing babbitt dams or angle needle valves are used! The countershaft box is always under pressure, thereby assuring complete lubrication of the entire countershaft and countershaft box assembly at all times.

DRILL A 5/16" DIAMETER ANGULAR HOLE INTO THE OIL GROOVE IN THE COUNTERSHAFT BOX TO LOCK THE BABBITT IN THE GROOVE. THE BABBITT MUST BE SCRAPED TO THE CONTOUR OF THE BOX BORE.

THE LONGITUDINAL OIL GROOVE IN THE COUNTERSHAFT BOX MUST BE PLUGGED AS SHOWN IN THE ENCIRCLED AREA. THE 1" LONG BABBITT DAM IN THE GROOVE IS NECESSARY TO PRESSURIZE THIS AREA OF THE BOX.

REMOVE THE ANGLE NEEDLE VALVE FROM THE COUNTERSHAFT BOX AND REPLACE WITH 1/2" HOSE OR PIPING DIRECTLY FROM THE OIL FEED LINE.



INNER COUNTERSHAFT BUSHING

OUTER COUNTERSHAFT BUSHING (WHEN CONVERTING TO THIS PRESSURE LUBRICATED SYSTEM ANY EXISTING BABBITT DAM IN THE BUSHING OIL GROOVE MUST BE REMOVED. A DAM IN THE GROOVE IS NO LONGER NECESSARY IN EITHER COUNTERSHAFT BUSHING.)

**4 Ft., 4¼ Ft. and 5½ Ft. CRUSHERS**  
**CONVERTING AN "OLD STYLE" COUNTERSHAFT**  
**BOX TO THE PRESSURE LUBRICATED SYSTEM**

THE SLANTING OIL HOLE IN THE COUNTERSHAFT BOX MUST BE PLUGGED AS SHOWN IN THE ENCIRCLED AREA. A SHORT LENGTH OF BRASS OR STEEL ROD INSERTED IN THE HOLE AND BRAZED IN PLACE IS ALL THAT IS NECESSARY TO PRESSURIZE THIS AREA OF THE BOX.

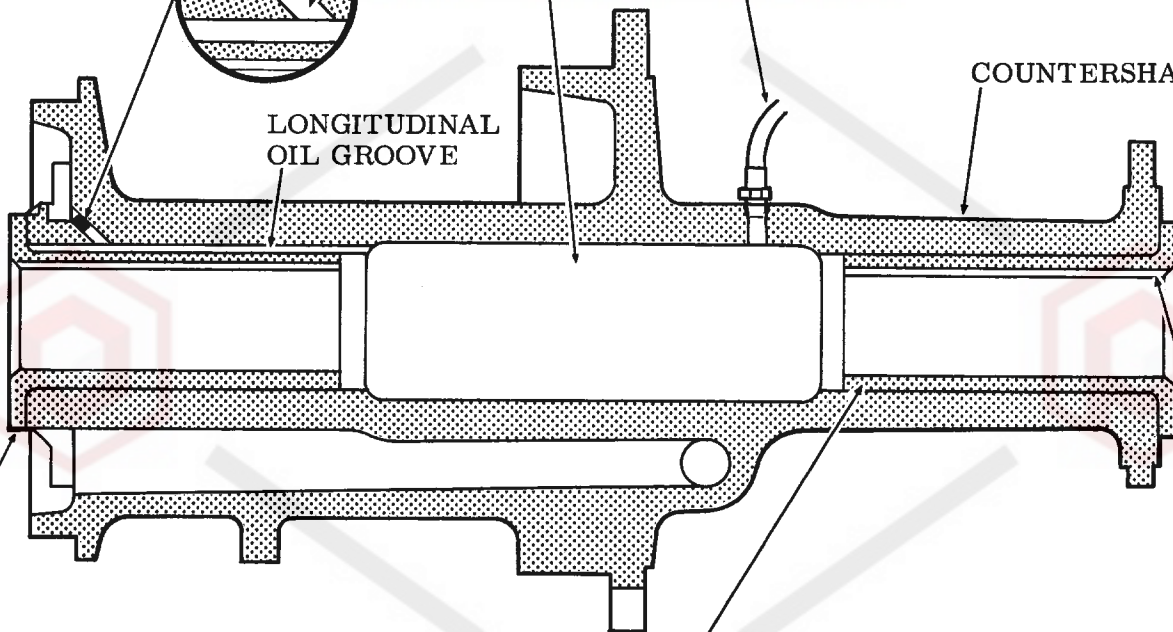
BRASS OR  
STEEL PLUG

SLANTING  
OIL HOLE

REMOVE THE ANGLE NEEDLE VALVE FROM THE COUNTERSHAFT BOX AND REPLACE WITH 1/2" HOSE OR PIPING DIRECTLY FROM THE OIL FEED LINE.

LONGITUDINAL  
OIL GROOVE

COUNTERSHAFT BOX



INNER COUNTERSHAFT BUSHING

OUTER COUNTERSHAFT BUSHING  
(WHEN CONVERTING TO THIS PRESSURE LUBRICATED SYSTEM ANY EXISTING BABBITT DAM IN THE BUSHING OIL GROOVE MUST BE REMOVED. A DAM IN THE GROOVE IS NO LONGER NECESSARY IN EITHER COUNTERSHAFT BUSHING.)

**2 Ft., 3 Ft. and 7 Ft. CRUSHERS**

**CONVERTING AN "OLD STYLE" COUNTERSHAFT  
BOX TO THE PRESSURE LUBRICATED SYSTEM**





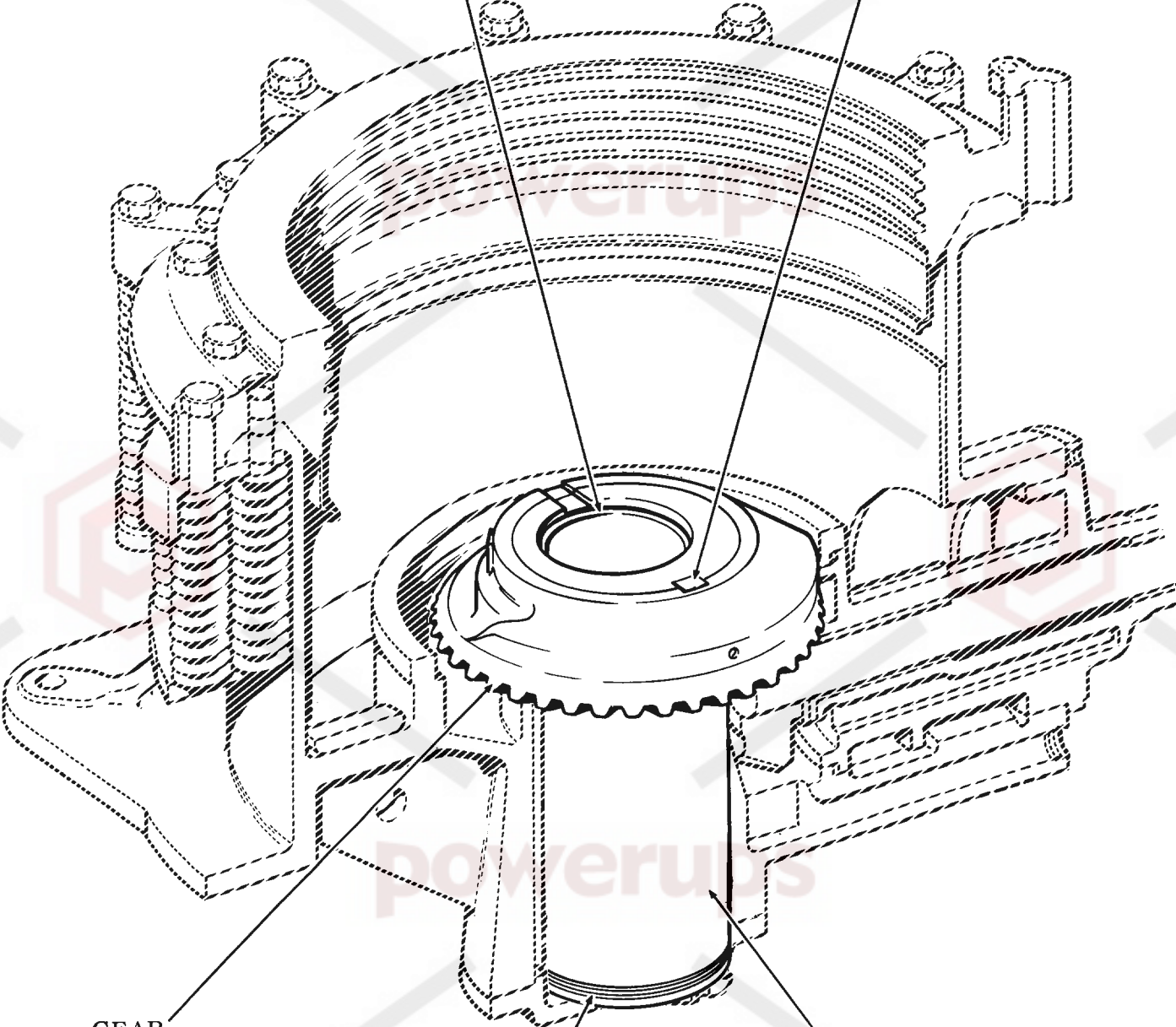
**Section 5**

**THRUST BEARING AND ECCENTRIC ASSEMBLIES**

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ASSEMBLY INSTRUCTIONS . . . . .	5- 1
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INNER ECCENTRIC BUSHING

GEAR KEY



GEAR

STEP BEARING PLATES

ECCENTRIC

## SECTION 5

# THRUST BEARING AND ECCENTRIC ASSEMBLIES

### DESCRIPTION

This section covers the thrust bearing and eccentric assemblies. The eccentric which has a tapered, offset bore provides the means whereby the head and main shaft follows an eccentric path during each cycle of rotation. An inner eccentric bushing locked into the eccentric bore provides the bearing surface for the main shaft. A large bevel gear pressed and keyed to the top of the eccentric is driven by the pinion on the countershaft. The eccentric in turn rotates within the outer eccentric bushing in the main frame bore. The entire assembly is supported by a series of thrust plates which rest on top of the main frame cap. This series of thrust or step bearing plates reduces the frictional wear of the eccentric assembly. Backlash and root clearance between gear and pinion teeth are maintained in this assembly by the addition or subtraction of step bearing plate shims.

### ASSEMBLY INSTRUCTIONS

If the eccentric assembly was removed from the Crusher due to weight limitations, the various parts of this assembly are to be installed as follows:

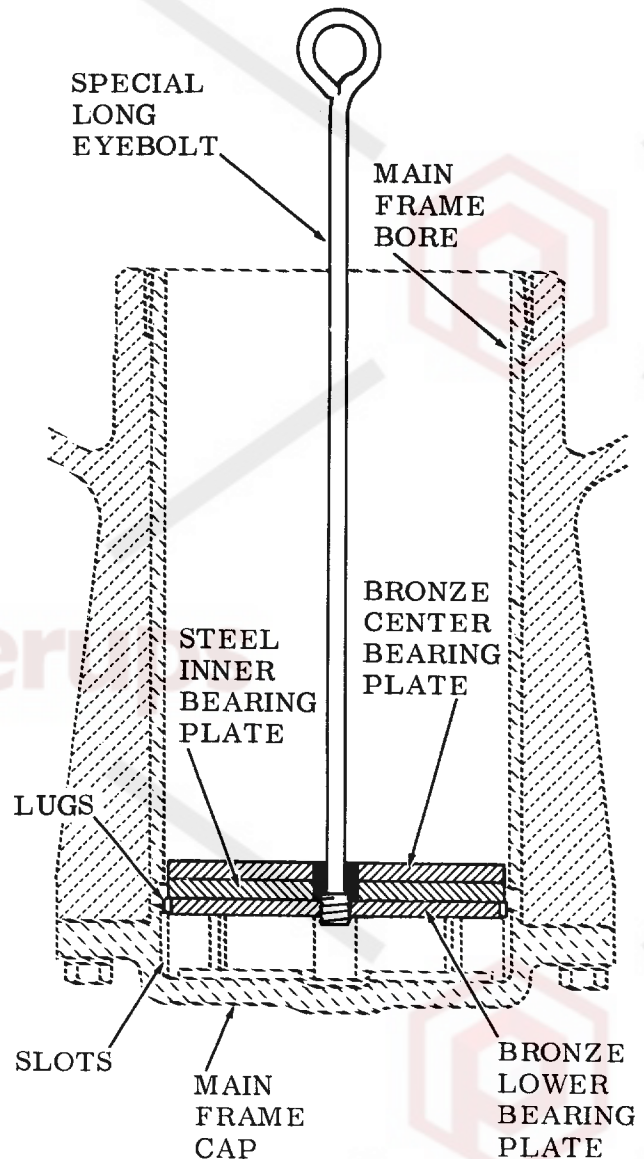
- 1 Stack the step bearing plates with the bronze lower bearing plate at the bottom, the steel inner bearing plate in the middle, and the bronze center bearing plate at the top. See the illustration INSTALLING STEP BEARING PLATES. Apply a light coat of oil to all bearing plates and the eccentric.

ON SOME MACHINES THE STEEL INNER BEARING PLATE AND BRONZE CENTER BEARING PLATE HAVE BEEN OMITTED, THERE ARE ONLY TWO STEP BEARING PLATES; THE BRONZE LOWER AND STEEL UPPER WHICH HAS A PIN PRESSED INTO THE TOP OF THE PLATE AS DESCRIBED IN STEP 3.

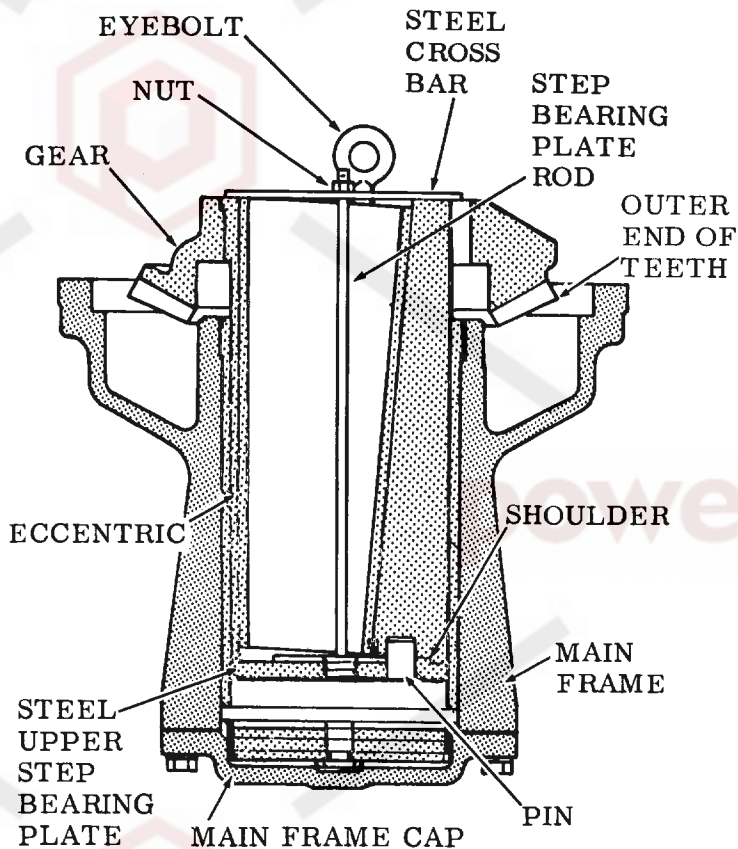
- 2 Thread the special long eyebolt into the bronze lower bearing plate and lower the plates into position in the main frame bore making sure the lugs on the bottom

plate engage the slots in the main frame cap.

- 3 Place the steel upper step bearing plate which has a pin pressed into the top of the plate, against the bottom of the eccentric being sure the pin is fully in the cored hole. Also check that the plate which has a shoulder on it, is centered in the eccentric. Thread the step bearing plate rod into the bearing plate and check to be certain the rod does not protrude beyond the bottom of the plate.



**INSTALLING STEP BEARING PLATES**



### INSTALLING ECCENTRIC ASSEMBLY

- Place the steel cross bar over the other end of the rod and rest the bar across the eccentric. The rod will be held firmly in place by tightening the nut against the cross bar. See the illustration INSTALLING ECCENTRIC ASSEMBLY.

- Install the eyebolts into the top of the eccentric and lower the eccentric assembly into the Crusher.
- Be sure the gear and pinion have properly meshed and are in their correct relationship to each other. The backlash and root clearance should be set in accordance with the specifications listed in the table BACKLASH AND ROOT CLEARANCE MEASUREMENTS. After satisfactory tooth backlash and root clearance has been established, the step bearing plate rod is to be removed.

### CHECKING OR ADJUSTING BACKLASH AND ROOT CLEARANCE

To check or adjust backlash and root clearance, proceed as follows:

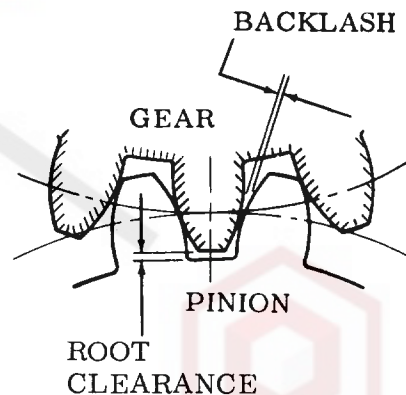
- Position the counterweight or heavy portion of the gear directly over the pinion if possible.

ON SOME OF THE SMALLER SIZE CRUSHERS THERE IS NOT ENOUGH ROOM TO CHECK BACKLASH OR ROOT CLEARANCE WHEN THE COUNTERWEIGHT OF THE GEAR IS DIRECTLY OVER THE PINION. IN THIS CASE, STEP 1 MUST BE OMITTED.

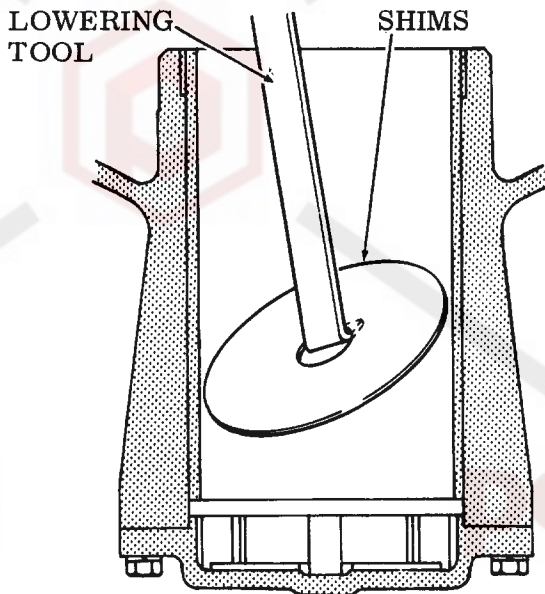
- Pull the countershaft toward the drive end until the pinion thrust washer is tight against the INNER countershaft bushing as shown in the illustration END FLOAT found in Section 4.

BACKLASH & ROOT CLEARANCE MEASUREMENTS

CRUSHER SIZE	BACKLASH	ROOT CLEARANCE		
		Actual	Minimum	Maximum
2 Ft.	.020 .040	.109	.094	.125
3 Ft.	.020 .040	.109	.094	.125
4 Ft.	.020 .040	.125	.094	.156
5100 and 4-1/4 Ft.	.030 .050	.125	.094	.156
5-1/2 Ft.	.040 .060	.156	.125	.188
7 Ft.	.050 .070	.203	.125	.312



All Dimensions In Inches- MEASUREMENTS TO BE TAKEN AT OUTER END OF TEETH ONLY



**INSTALLING SHIMS**

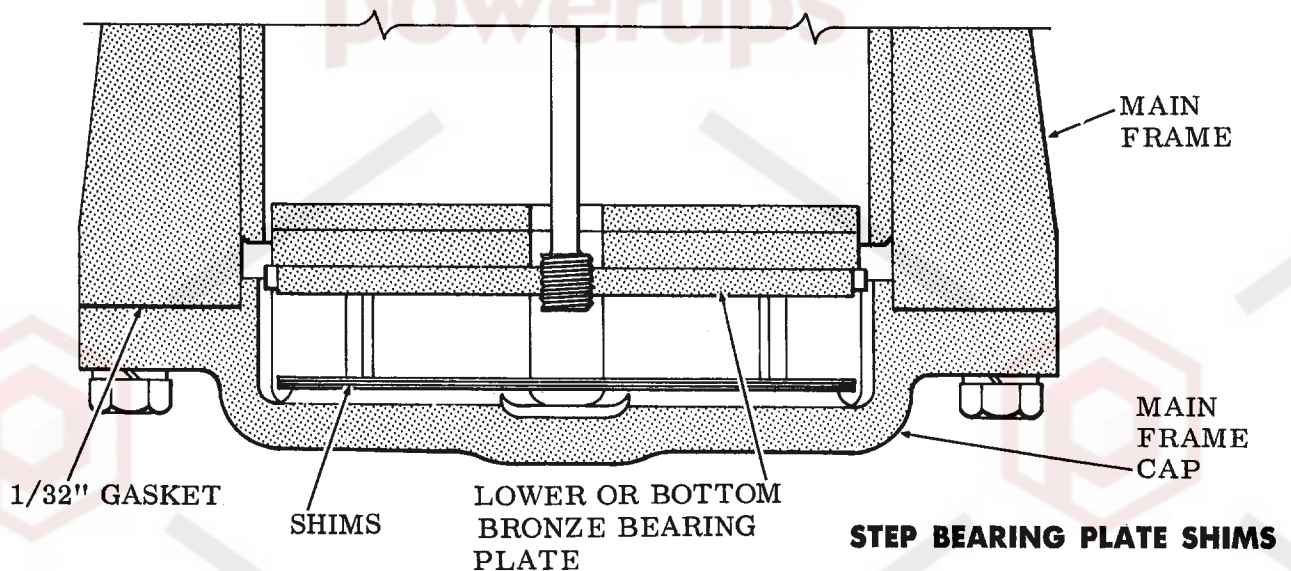
V-BELTS OR FLEXIBLE COUPLING MUST BE "LOOSE" BEFORE PROCEEDING WITH THE MEASUREMENTS.

- 3 Turn the countershaft slightly, until a GEAR tooth is in a vertical position as shown in the illustration BACKLASH AND ROOT CLEARANCE MEASUREMENTS.
- 4 Remove all clearance between the eccentric and the outer eccentric bushing by jacking or prying the eccentric assembly toward the pinion so that the teeth on the gear are in their closest relationship to the pinion. This is best accomplished by jacking the gear horizontally toward the pinion. A pry bar inserted between the socket portion of the frame and the gear can also be used.

Hold the gear in this position while taking the measurements. Use only enough force as is required to slide the eccentric assembly toward the pinion. Using excessive pressure could "tip" the eccentric assembly and give incorrect readings.

- 5 To check the-backlash, rotate the counter-shaft until the pinion tooth just "touches" the gear tooth. Measure the clearance on the opposite side of the teeth with a feeler gauge. Then measure the root clearance as shown in the illustration BACKLASH AND ROOT CLEARANCE MEASUREMENTS.
- 6 Mark the gear where the backlash and root clearance measurements were taken. Rotate the gear by turning the countershaft and check the measurements again with the gear in a different position. Do this several times and find the average readings.
- 7 If the average backlash and root clearance is found to be less than that which is specified in the table, the eccentric assembly is to be removed and metal shims of the proper thickness are to be added. The shims can be lowered in place by using a tool such as shown in the illustration INSTALLING SHIMS.

The shims are to be inserted under the bottom bronze bearing plate and directly on top of the main frame cap as shown in the illustration STEP BEARING PLATE SHIMS. Adding shims will raise the eccentric assembly and move the gear away from the pinion thereby increasing the backlash and root clearance. Should the measurements be more than that specified, metal shims of the proper thickness must be removed.



**STEP BEARING PLATE SHIMS**

Whenever installing shims on top of the main frame cap, always place the thinnest shims on the bottom and the thickest shims on top.

SHIMS PLACED BENEATH THE BEARING PLATES WHEN THE CRUSHER LEFT THE FACTORY ARE OF THE REQUIRED THICKNESS TO PROVIDE PROPER BACKLASH AND ROOT CLEARANCE. THESE SHIMS, WHILE PLACED IN THE CRUSHER INITIALLY FOR BACKLASH ADJUSTMENT ARE PRIMARILY USED FOR WEAR COMPENSATION. REFER TO THE MAINTENANCE PORTION OF THIS SECTION.

Always use a minimum quantity of shims; if two 1/32" shims are required, use one 1/16" shim instead. Do not use shims thinner than 1/32". All shims must be FLAT, without rough edges, kinks or bends.

## MAINTENANCE

**REMOVING ECCENTRIC ASSEMBLY, 3 Ft., 4 Ft., 5100, 4-1/4 Ft., 5-1/2 Ft. and 7 Ft. CRUSHERS.** To remove the eccentric assembly on these Crushers, for servicing or replacement of parts, proceed as follows:

- 1 Thread the eyebolts into the top of the eccentric and lift the eccentric assembly out of the Crusher.

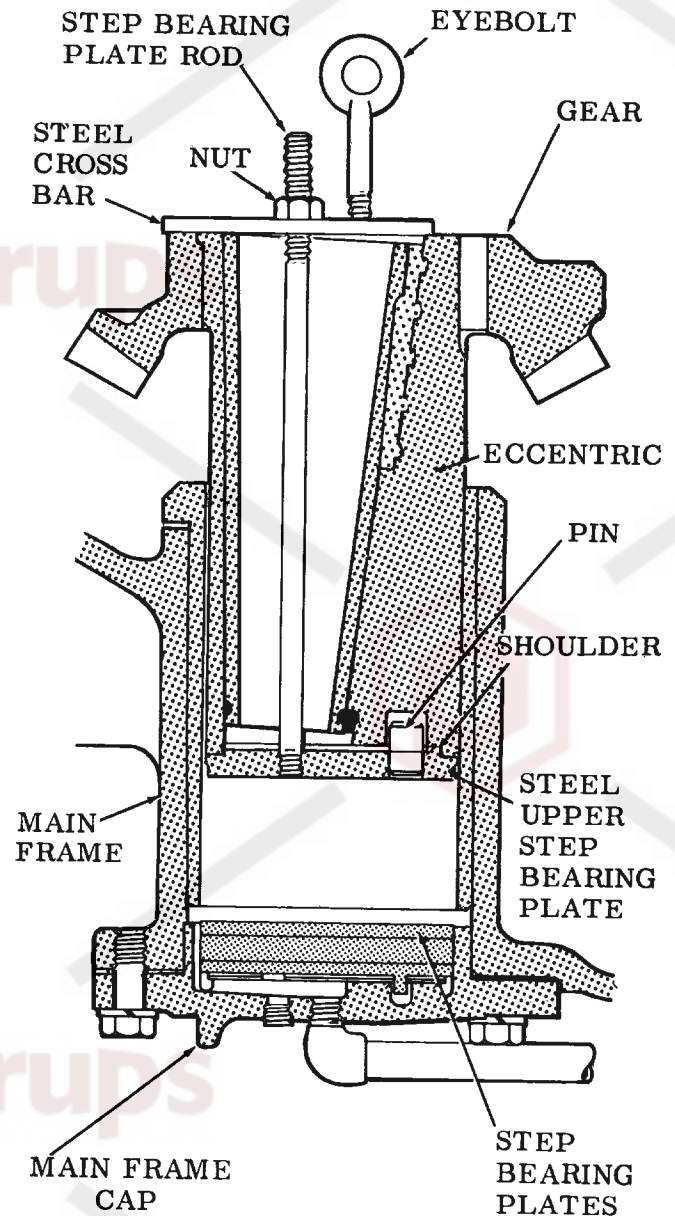
### WARNING

Care should be taken that the step bearing plates do not stick to the bottom of the eccentric during eccentric removal, as these plates could "break" loose from the bottom of the eccentric during the lifting procedure and cause personal injury. Raise the assembly slightly, then push down on the bearing plates with a long pipe or pole to break the plates loose from the eccentric.

- 2 Screw the special long eyebolt into the bottom step bearing plate and remove all the step bearing plates at one time. See the illustration **INSTALLING STEP BEARING PLATES**.

**REMOVING ECCENTRIC ASSEMBLY, 2 Ft. CRUSHER.** To remove the eccentric assembly for servicing or replacement of parts on the 2 Ft. Crusher, proceed as follows:

THE TAPPED HOLE IN THE UPPER STEP BEARING PLATE IS OFFSET FROM THE REMAINING PLATES MAKING THE REMOVAL PROCEDURE DIFFERENT IN THE 2 FT. CRUSHER.



### REMOVING 2 FT. ECCENTRIC ASSEMBLY

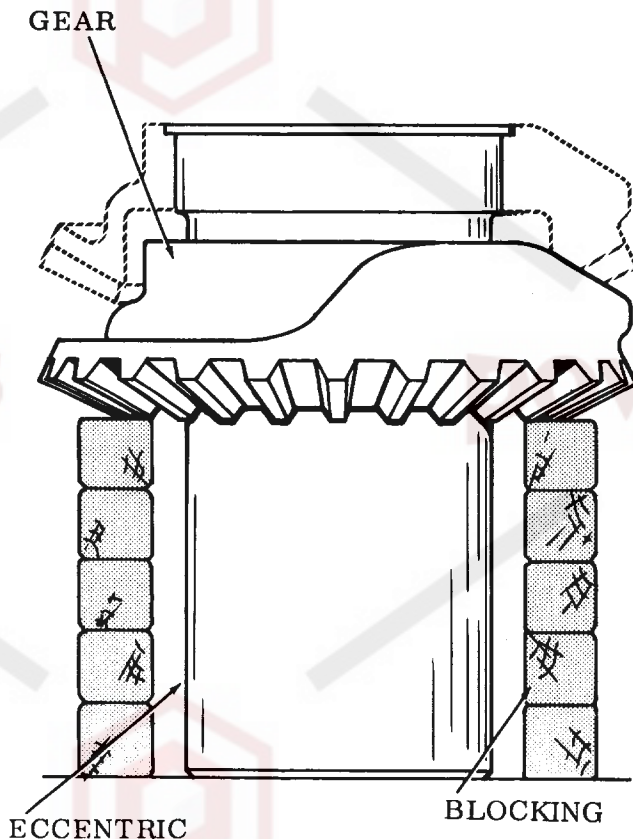
- 1 Screw the step bearing plate rod into the upper step bearing plate.
- 2 Place the steel cross bar over the other end of the rod and rest the bar across the eccentric. The rod will be held firmly in place by tightening the nut against the cross bar. See the illustration **REMOVING 2 Ft. ECCENTRIC ASSEMBLY**.
- 3 Install the eyebolts into the top of the eccentric and lift the assembly clear of the machine.

- 4 Screw the special long eyebolt into the bottom step bearing plate and lift the three remaining plates out of the main frame bore.

**REPLACING GEAR.** The bevel gear which is mounted at the top of the eccentric should be inspected whenever the eccentric is removed for servicing other related parts or if broken or excessively worn teeth are suspected. Pitting or galling on the face of the teeth are a good indication of excessive wear. This can originate from an incorrect quantity of shims being placed under the lower step bearing plate or by overloading the Crusher or by using excessively dirty oil. If it has been determined that the gear is worn to the point where replacement is necessary, removal is best accomplished as follows:

**ONE PIECE GEAR REMOVAL.** To remove the one piece gear for inspection or replacement of parts, proceed as follows:

- 1 Remove the eccentric assembly from the Crusher as described under REMOVING ECCENTRIC ASSEMBLY.



**ONE PIECE GEAR REMOVAL**

- 2 Place blocking under the gear in such a position that the gear will not fall a great distance and possibly damage the outside of the eccentric. The blocking, however, should be low enough to permit the gear to drop clear of the eccentric shoulder to which it was pressed. See the illustration ONE PIECE GEAR REMOVAL.
- 3 Chip off the weld holding the key to the gear and drive the key out from the bottom of the gear.
- 4 Uniformly heat the gear to approximately 200° Fahrenheit above ambient temperature.
- 5 Ram downward on the outer surface of the gear until the gear drops free of the eccentric fit.

**ONE PIECE GEAR INSTALLATION.** When installing a new gear proceed as follows:

- 1 Place the gear on blocking that is high enough to permit the eccentric to be suspended in the gear when the eccentric is lowered into position. Uniformly heat the gear to 200° Fahrenheit above ambient temperature.

IT IS IMPORTANT THAT THE GEAR IS HEATED EVENLY THROUGHOUT AND THE HEAT IS NOT CONCENTRATED IN ONE AREA CREATING A "HOT" SPOT WHICH COULD DESTROY THE HEAT TREATMENT OF THE GEAR. A CHEMICAL MARKING DEVICE, WHICH MELTS AT A PREDETERMINED TEMPERATURE SHOULD BE USED TO INSURE UNIFORM AND SAFE HEATING.

- 2 Measure the outside diameter of the eccentric and the bore of the gear as it is being heated to be sure the bore is slightly larger than the eccentric.
- 3 Align the keyways, and lower the eccentric into place until the eccentric is firmly seated in the gear. If the gear has been heated properly, no trouble should be encountered in lowering the eccentric into position.
- 4 Then drive the key into position, approximately 3/8" below the top of the gear. After the entire assembly has cooled, tack



weld the gear to the key, care being taken that the weld does not project above the top of the eccentric.

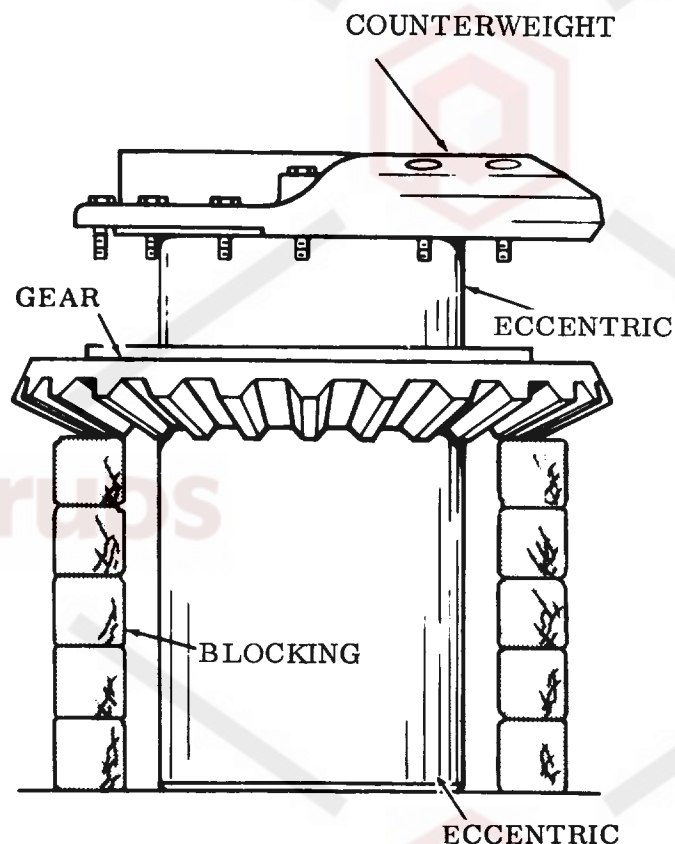
A HYDRAULIC PRESS CAN BE USED FOR REMOVAL OR INSTALLATION OF THE GEAR, HOWEVER, HEAT IS STILL THE PREFERRED METHOD. IN THE EVENT THAT EITHER GEAR OR ECCENTRIC HAS BEEN METAL SPRAYED TO INCREASE THE INTERFERENCE FIT, INSTALLATION WITH HEAT IS TO BE THE ONLY METHOD USED. IF A HYDRAULIC PRESS IS TO BE USED, REFER TO THE TABLE GEAR PRESS FIT FOR THE CAPACITY OF PRESS REQUIRED.

CRUSHER SIZE	PRESS FIT IN TONS (2000 LBS.)
2 Ft.	6
3 Ft.	8
4 Ft.	15
5100 and 4-1/4 Ft.	15
5-1/2 Ft.	20
7 Ft.	25

#### GEAR PRESS FIT

**TWO PIECE GEAR REMOVAL.** This arrangement consists of a separate ring gear bolted to a counterweight. Only the gear needs replacing as the counterweight remains pressed and keyed to the eccentric. For removal of this type of gear, proceed as follows:

- 1 Remove the eccentric assembly from the Crusher as described under REMOVING ECCENTRIC ASSEMBLY.
- 2 Place blocking under the gear in such a position that the gear will not fall a great distance and possibly damage the outside of the eccentric. The blocking however, should be low enough to permit the gear to drop clear of the shoulder on the counterweight. See the illustration TWO PIECE GEAR REMOVAL.
- 3 Remove the hex head capscrews and lockwashers bolting the gear to the counterweight.
- 4 Ram downward on the outer surface of the gear until the gear drops free of the counterweight.



#### TWO PIECE GEAR REMOVAL

**TWO PIECE GEAR INSTALLATION.** When installing a new gear, proceed as follows:

- 1 Remove the tapped dowel from the worn gear and drive it into the dowel hole of the new gear.
- 2 Thoroughly clean the threads on the capscrews that hold the gear to the counterweight and the tapped holes in the gear. It is recommended to use Loctite Locquic Primer T as a cleaning agent. The use of this primer deposits various activating chemicals on the surface of the threads. However xylol or trichloroethylene can also be used.

DO NOT USE GASOLINE, KEROSENE OR ANY OTHER OILY (PETROLEUM BASE) CLEANING AGENTS OR THE EFFECTIVENESS OF THE LOCTITE WILL BE REDUCED CONSIDERABLY.

- 3 Place the gear on blocking and carefully lower the eccentric assembly inside the gear with the dowel projecting inside the dowel hole in the counterweight.

- 4 Liberally coat the capscrew threads with Loctite 277, before assembling the capscrews into the gear.

DO NOT USE ANY LUBRICANT EXCEPT LOCTITE.

- 5 Insert the capscrews and lockwashers into the holes in the counterweight. Turn the capscrews into the tapped holes in the gear and check that the gear is properly centered on the counterweight fit.

THERE ARE TWO DIFFERENT LENGTH CAPSCREWS USED. THE LONGER CAPSCREWS ARE TO BE USED IN THE HEAVIER PORTION OF THE COUNTERWEIGHT.

- 6 Alternately tighten each capscrew a small amount to prevent the gear from binding on the counterweight. Tighten each capscrew to the torque value shown in the table TWO PIECE GEAR TORQUE REQUIREMENTS.

GRADE 5 CAPSCREWS MUST BE USED. THE HEAD OF A GRADE 5 CAPSCREW IS IDENTIFIED WITH THREE RADIAL MARKS AS SHOWN.



- 7 When all capscrews have been tightened, check with a feeler gauge that the gear is tight against the underside of the counterweight. The gear is now properly installed.

REMOVAL OF COUNTERWEIGHT. In the event the counterweight on the two piece gear arrangement must be removed from the eccentric use the same removal and installation method as described in the ONE PIECE GEAR REMOVAL and INSTALLATION procedures.

ADJUSTING GEAR BACKLASH FOR WEAR. When step bearing plate and tooth wear reaches a point where the proper backlash can no longer be maintained, the backlash must be adjusted. This is accomplished by adding or removing the correct combination of shims which will give the proper backlash as specified in the table BACKLASH AND ROOT CLEARANCE MEASUREMENTS under ASSEMBLY INSTRUCTIONS. Adding shims raises the entire assembly, thereby moving the gear and pinion farther apart, while removing shims lowers the assembly to bring the gear and pinion closer together. Be certain the plates and shims are reassembled correctly.

BOTTOMING OF GEAR TEETH SHOULD BE AVOIDED AT ALL TIMES. CLEARANCE MUST BE PROVIDED AT THE BOTTOM OF THE TEETH, REGARDLESS OF TOOTH WEAR. THEREFORE, WHEN TEETH BECOME WORN TO THE EXTENT THAT THE MINIMUM ROOT CLEARANCE AS SHOWN IN THE TABLE CANNOT BE MAINTAINED WITH THE PROPER BACKLASH, THEN BACKLASH FIGURES MUST BE DISREGARDED.

INNER ECCENTRIC BUSHING. Whenever the eccentric is removed, the inner eccentric bushing should be checked for looseness and excessive wear. When the bushing is found to be loose in the eccentric, follow the instructions under REPOURING BUSHING LOCK.

A BUSHING WITH NORMAL USE TENDS TO WEAR MORE AT THE HEAVIEST SIDE OF THE ECCENTRIC. THIS IS NO CAUSE FOR CONCERN SINCE IT IS A NORMAL AND EXPECTED CONDITION. A BUSHING WHICH IS WORN EXCESSIVELY THIN OR CRACKED WILL, OF COURSE, REQUIRE REPLACEMENT.

INNER ECCENTRIC BUSHING REMOVAL, 2 Ft., 3 Ft., 4 Ft., 5100 and 4-1/4 Ft., CRUSHERS. Eccentrics on these Crushers have two integrally cast flat areas that engage similar flats on the bushing for preventing the bushing

CRUSHER SIZE	CAPSCREW SIZE	PROPER TORQUE WHEN USING A TORQUE WRENCH (FOOT POUNDS)
5-1/2 FT.	1"	560 - 610
7 FT.	1-1/4"	1050 - 1150

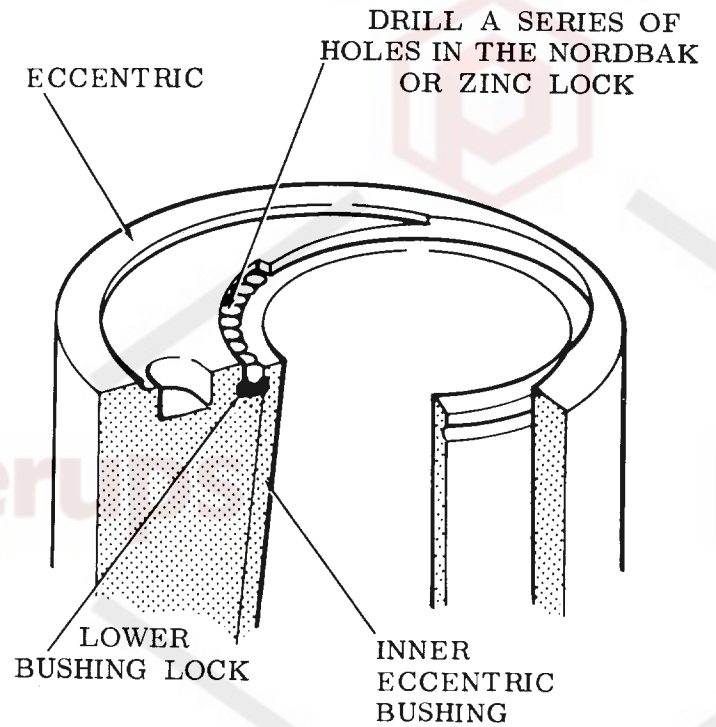
**TWO PIECE GEAR TORQUE REQUIREMENTS**

from turning. Do not disturb these cast flat areas which are located in the upper portion of the eccentric bore unless they are ineffective through wear. See REPOURING BUSHING LOCK.

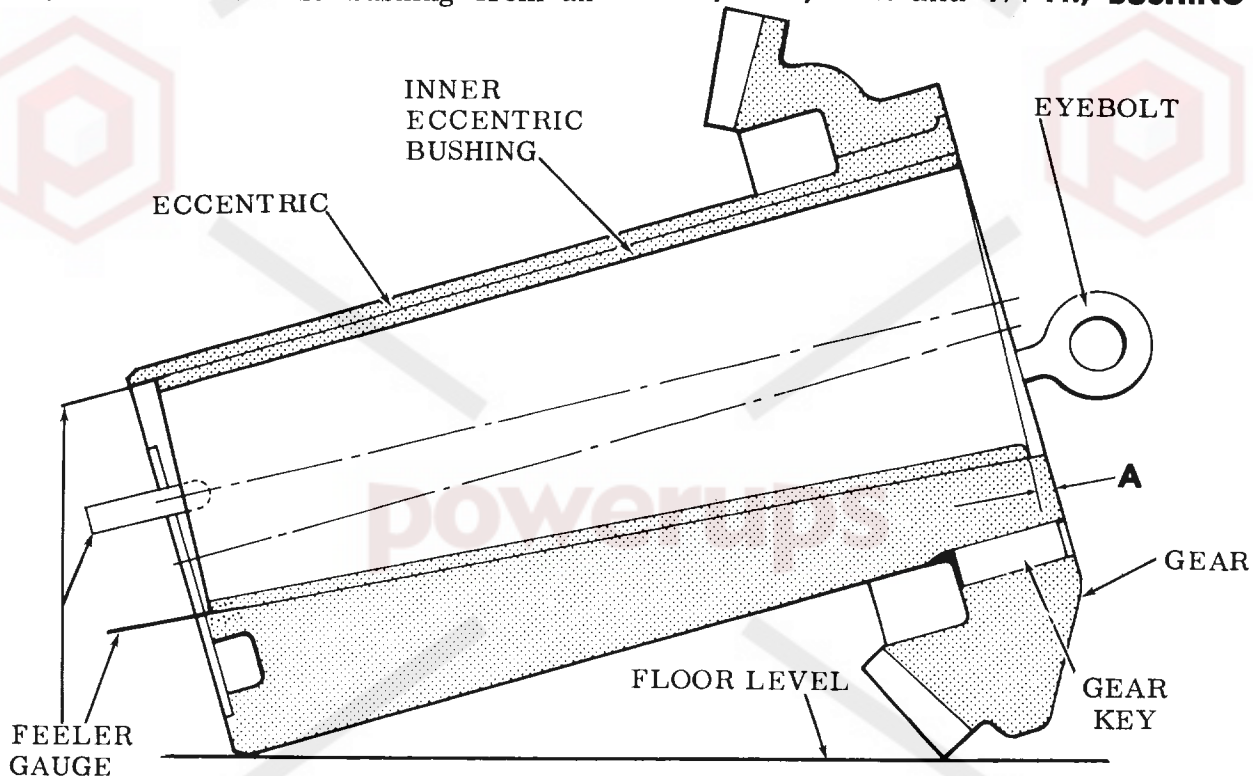
To remove the inner eccentric bushing from the eccentric, simply turn the eccentric upside down, place a steel plate against the bottom of the bushing and jar the bushing free by ramming against the plate.

Position the eccentric on wooden blocking in such a manner so as to enable the bushing to drop free of the eccentric when rammed loose.

In some Crushers a lower bushing lock was used to prevent the bushing from moving vertically. This lower bushing lock is no longer used as field experience has shown that an inner bushing does not require any mechanical means to keep the bushing from moving vertically. However, if the lower lock had been used, the lock must be removed before the inner eccentric bushing can be removed from the eccentric. To remove the bushing from an



**2 Ft., 3 Ft., 4 Ft. and 4 1/4 Ft., BUSHING LOCK**



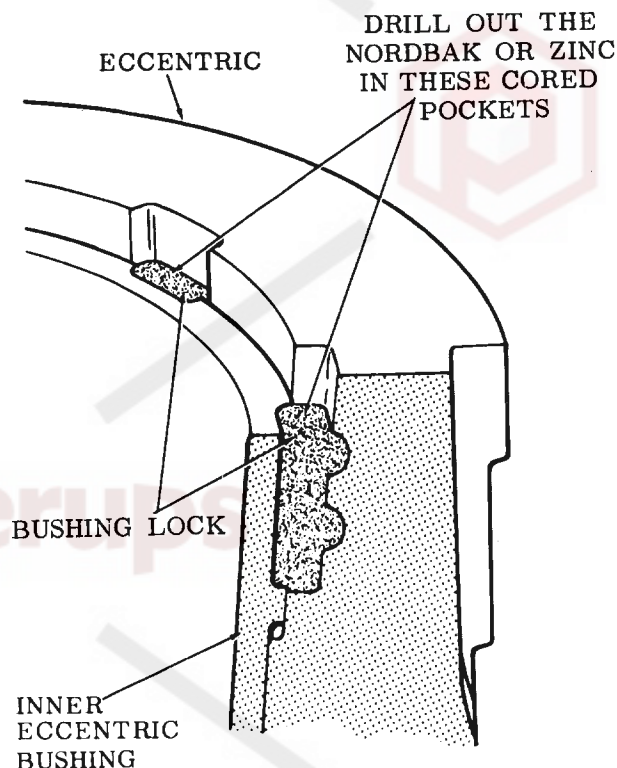
CRUSHER SIZE	2 FT.	3 FT.	4 FT.	5100 AND 4-1/4 FT.	5-1/2 FT.	7 FT.
<b>A</b>	3/8	7/16	15/32	19/32	7/8	1-3/16

ALL DIMENSIONS IN INCHES

**INNER ECCENTRIC BUSHING LOCATION**

eccentric where the lower bushing lock was used on the 2 Ft., 3 Ft., 4 Ft., and 4-1/4 Ft. Crushers proceed as follows:

- 1 Drill a series of holes in the bushing lock found at the bottom of the eccentric, as shown in the illustration, 2 Ft., 3 Ft., 4 Ft., and 4-1/4 Ft. BUSHING LOCK.
- 2 Drive a chisel through the material between each adjoining hole. When the bushing lock was poured, the locking material flowed all around the groove machined into the bushing. However, it only locked with the cored pocket in the eccentric which extended approximately one-third of the way around the circumference. This pocket can be readily seen when the eccentric is turned upside down for drilling. Free the NORDBAK or zinc in this area only.
- 3 Place a steel plate against the bottom of the bushing and jar the bushing free by ramming against the plate.



### 5-1/2 Ft. and 7 Ft. BUSHING LOCK

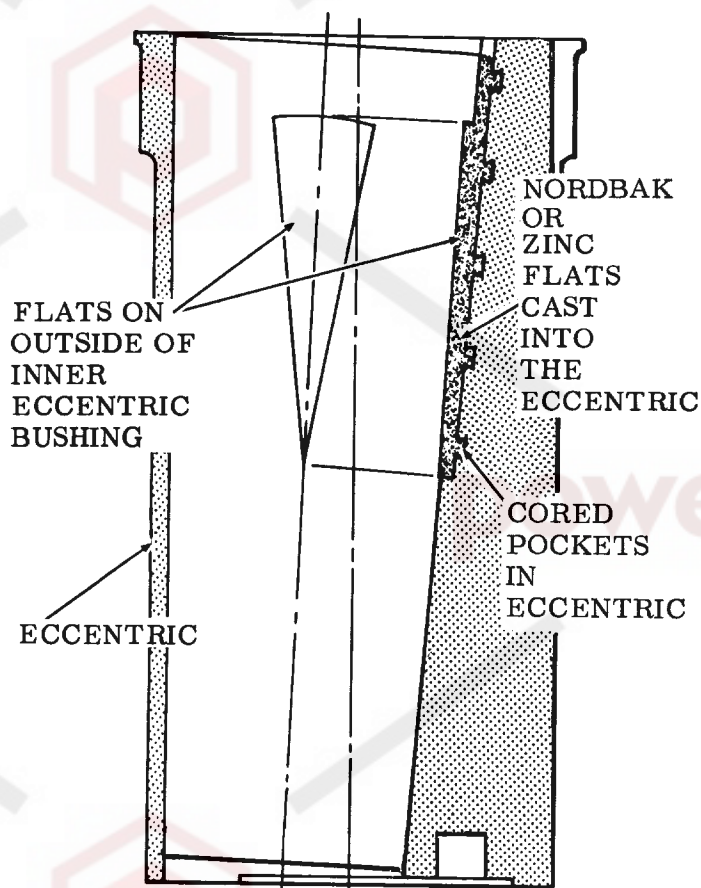
**INSTALLING INNER ECCENTRIC BUSHING.**  
To install a replacement inner eccentric bushing, proceed as follows:

- 1 Chip out any NORDBAK or zinc which might remain in the cored pockets in the eccentric on the 5-1/2 Ft. and 7 Ft. Crushers. Do not disturb the cast flats in the eccentric bore on the 2 Ft., 3 Ft., 4 Ft., 5100 and 4-1/4 Ft. Crushers.
- 2 Check to be sure the flats on the bushings are in alignment with the cast flats in the eccentric or the pockets in the bushings are across from the ones in the eccentric.
- 3 Lower the bushing into the eccentric and, using a wooden timber, ram the bushing down. For the APPROXIMATE location of the bushing within the eccentric, refer to the illustration and table INNER ECCENTRIC BUSHING LOCATION. Measurements are to be taken from the top of the eccentric down to the bushing at the gear key. Ram the bushing down until a feeler gauge of no more than 0.004 inch can be inserted at the bottom, between the outside of the bushing and the bore of the eccentric.

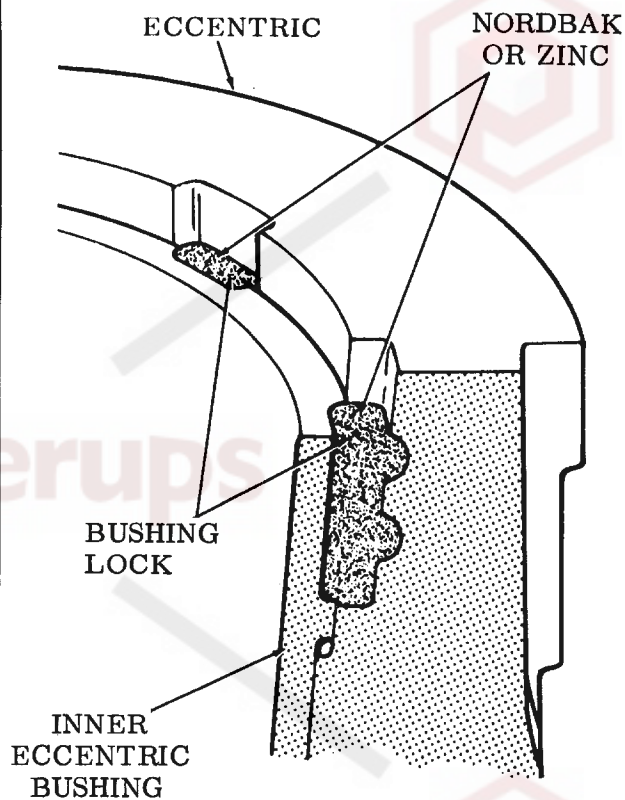
**DO NOT USE DRY ICE TO INSTALL AN INNER ECCENTRIC BUSHING. BOTH BUSHING AND ECCENTRIC MUST BE AT THE SAME TEMPERATURE WHEN INSTALLING THE BUSHING.**

**INNER ECCENTRIC BUSHING REMOVAL, 5-1/2 Ft. AND 7 Ft. CRUSHERS.** On the 5-1/2 Ft. and 7 Ft. machines the bushing lock is found only at the top of the bushing and consists of mating tapered pockets, in both the bushing and eccentric, which are filled with NORDBAK locking compound or zinc, to prevent the bushing from turning. If the inner eccentric bushing requires replacement, proceed as follows:

- 1 Drill a series of holes in the locking material, only in the pockets that are directly across from the cored pockets in the eccentric. See the illustration, 5-1/2 Ft. AND 7 Ft. BUSHING LOCK.
- 2 Chisel through the material adjoining the drilled holes.
- 3 Turn the eccentric upside down positioned on wooden blocking in such a manner so as to enable the bushing to drop free of the eccentric when rammed loose.
- 4 Place a steel plate against the bottom of the bushing and ram against the plate. The bushing should now drop out of the eccentric.



2 Ft., 3 Ft., 4 Ft., 5100 and  
4-1/4 Ft. CRUSHER



5-1/2 Ft. and 7 Ft. CRUSHER

### REPOURING BUSHING LOCKS

- 4 Pour the bushing lock at the top of the eccentric on the 5-1/2 Ft. and 7 Ft. Crushers. On the 2 Ft., 3 Ft., 4 Ft., 5100 and 4-1/4 Ft. Crushers no further bushing locks are required. Refer to the table LOCKING MATERIAL REQUIREMENTS in Section 3 for the approximate amount of locking material to prepare.

USE ONLY NORDBAK LOCKING COMPOUND WHEN REPOURING THE BUSHING LOCKS. DO NOT USE NORDBAK BACKING MATERIAL. NORDBAK LOCKING COMPOUND USES A SPECIAL FILLER WHICH OFFERS MORE STRENGTH AND HEAT TRANSFER PROPERTIES THAN CONVENTIONAL NORDBAK BACKING MATERIAL.

REPOURING BUSHING LOCK. Should a bushing become free to rotate within the eccentric by wearing through the bushing lock, it is then necessary to repour these locks. On the 2 Ft.,

3 Ft., 4 Ft., 5100 and 4-1/4 Ft. Crushers see the illustration REPOURING BUSHING LOCKS. Remove the bushing and chip out the cast flats in the eccentric bore, especially the dovetailing cast into the eccentric. Once this is done, the loosened bushing can be lowered back into position and the NORDBAK locking compound or zinc repoured from the top of the eccentric. Care should be taken when repouring these flats that the flats on the bushing are directly opposite the dovetailing in the eccentric bore. On the 5-1/2 Ft. and 7 Ft. Crushers, just drill, chip and clean out the NORDBAK or zinc from the pockets and pour in an additional quantity, taking care that the bushing pockets are located directly across from the pockets in the eccentric. See the illustration REPOURING BUSHING LOCKS.

BEFORE REPOURING ANY LOCK, CHECK THAT THE BUSHING IS PROPERLY INSTALLED AS DESCRIBED UNDER INSTALLING INNER ECCENTRIC BUSHING.

Refer to the table LOCKING MATERIAL REQUIREMENTS in Section 3 for the approximate amount of locking material to prepare.

#### EMERGENCY REPAIR OF GEAR AND ECCENTRIC INTERFERENCE FIT

To offset downtime during critical operating periods, the use of Loctite is recommended as an emergency "field" repair to correct for the loss of interference fit between the gear and eccentric, until a more appropriate time is available for normal repair or replacement of parts. When using Loctite to hold the gear to the eccentric proceed as follows:

- 1 Measure the outside diameter of the eccentric and the bore of the gear. If the fit is less than 0.010 inch loose on the diameter, Loctite can be used.

IF THE CRUSHER IS EQUIPPED WITH A TWO-PIECE GEAR ARRANGEMENT, THE BORE OF THE COUNTERWEIGHT MUST BE MEASURED INSTEAD OF THE GEAR AS THE COUNTERWEIGHT IS THE PART PRESSED ONTO THE ECCENTRIC.

- 2 Thoroughly clean the outside of the eccentric and the bore of the gear or counterweight. It is recommended to use Loctite Locquic Primer T as a cleaning agent. The use of this primer deposits various activating chemicals on the surface of the gear or counterweight and eccentric. However, xylol or trichloroethylene can also be used.

DO NOT USE GASOLINE, KEROSENE OR ANY OTHER OILY (PETROLEUM BASE) CLEANING AGENTS OR THE EFFECTIVENESS OF THE LOCTITE WILL BE REDUCED CONSIDERABLY.

- 3 Liberally coat the surfaces of both the gear or counterweight and eccentric with Loctite RC/680 (High Strength Retaining Compound) using a CLEAN brush. Make sure the entire fit surfaces are coated with the Loctite.
- 4 If necessary the gear or counterweight can be heated to permit assembly to the eccentric.

DO NOT USE A HYDRAULIC PRESS TO INSTALL THE GEAR OR COUNTERWEIGHT TO THE ECCENTRIC WHEN USING THE LOCTITE REPAIR PROCEDURE.

- 5 After the gear or counterweight has been coated with Loctite and it is properly positioned on the eccentric, allow at least 2 to 3 hours before moving the assembly. Refer to the installation method as described in the ONE-PIECE GEAR INSTALLATION procedure to properly position the gear or counterweight on the eccentric.

PLACE BLOCKING UNDER THE GEAR OR COUNTERWEIGHT IN SUCH A MANNER AS TO HOLD THE ENTIRE ASSEMBLY IN ITS CORRECT RELATIONSHIP WITH EACH OTHER UNTIL THE LOCTITE HAS CURED.

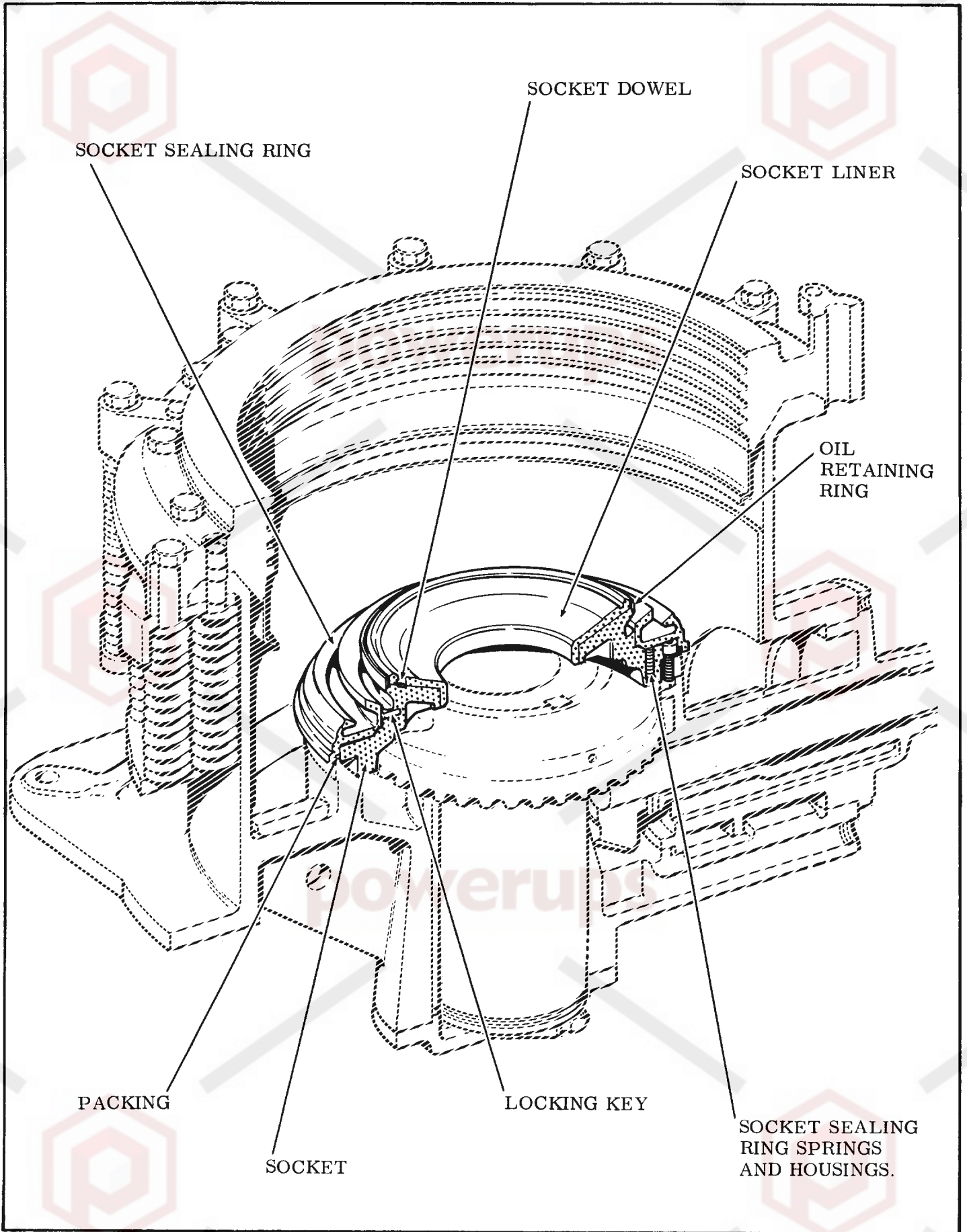
- 6 Curing of the Loctite can be speeded up by heating the gear or counterweight to 200° Fahrenheit. The assembly can then be used immediately after cooling to room temperature.



**Section 6**  
**SOCKET ASSEMBLY**

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## SECTION 6

# SOCKET ASSEMBLY

### DESCRIPTION

This section covers the socket assembly. The socket with the socket liner supports the main shaft assembly and transmits the crushing force to the main frame. The socket is held rigidly in the frame by an interference fit and a series of capscrews installed around the perimeter of the socket.

In the case of a 4-1/4 Ft. or 7 Ft. Crusher equipped with a dowelled socket, an interference fit and a series of dowels provide the means of holding the socket rigidly to the frame.

In the case of the 2 Ft. Crusher, an interference fit and a key provide the means of holding the socket rigidly to the frame.

The socket liner mounted on top of the socket provides the bearing surface for the head. The spherical bearing surface of the socket liner is thoroughly lubricated from an oil passage through the center of the main shaft and through the head. A retaining ring welded to the socket prevents the oil which is circulating on the surface of the socket liner from spilling into the sealing arrangement. An oil groove in the liner and a series of drilled holes in both the liner and socket allows the oil to drain back inside the Crusher.

It is very important that dust and abrasive particles which result from the crushing process be kept from entering the lubricating system or damaging the highly machined internal portions of the Crusher. Since the head moves with an eccentric or gyrating motion a seal must be provided that is flexible in order that continuous contact or sealing is possible.

This flexibility is provided in three types of sealing arrangements; the standard seal, air seal and water seal.

The standard seal utilizes a sealing ring packed with grease, which is constantly held against the head wipers by a series of small helical compression springs. This wiper arrangement allows the dust particles that enter the seal to become trapped and

embedded in the grease. The standard seal is used in most plant installations with average crushing conditions, where the supply of water is limited and on portable plant installations.

For extremely dusty crushing conditions the air seal using a similar type of wiper arrangement as the standard seal is furnished. This seal uses an air blower to pressurize the seal area and force the dust out.

For extremely dusty crushing conditions a water seal which has a water chamber bolted to the socket, in conjunction with a baffle ring welded to the head, uses constantly circulating water as the seal. This baffle arrangement requires that dust particles become trapped and suspended in the water flowing through the chamber.

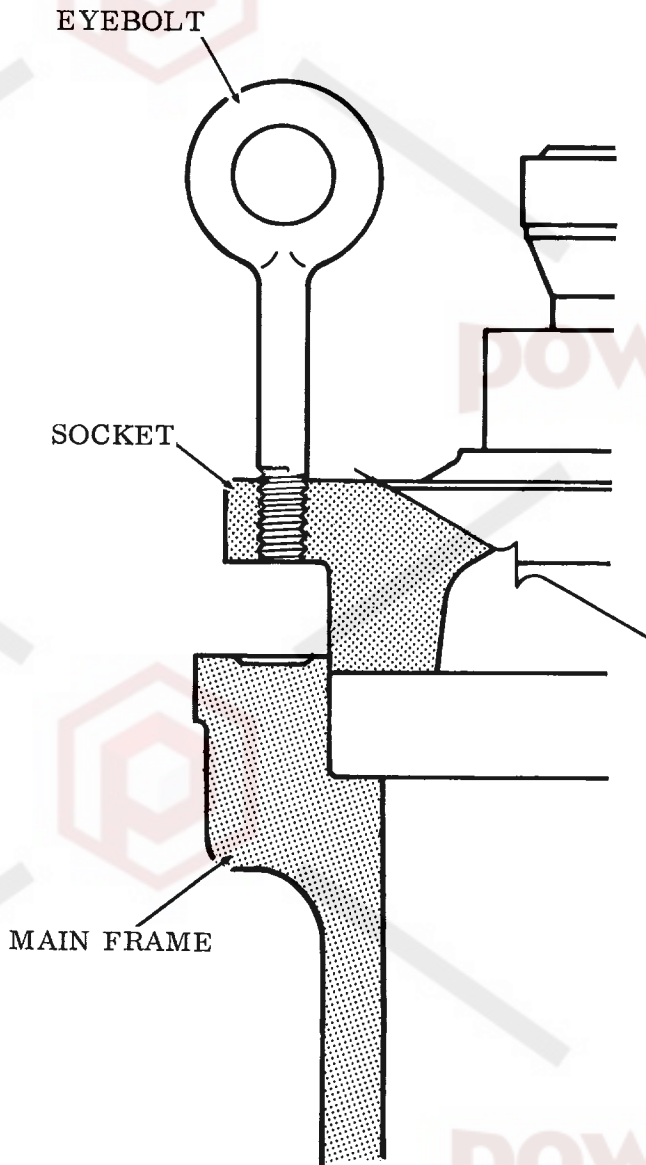
Either of these types of seals provides a very effective seal against dust infiltration.

### ASSEMBLY INSTRUCTIONS

**GENERAL INFORMATION.** Although the socket is usually shipped completely assembled in the main frame, the occasion may arise where weight or shipping restrictions prohibit this degree of assembly. If the socket assembly was removed for shipment, it will be necessary to partially disassemble the unit in order that the tapped holes for the lifting eyebolts and the holes which are used for holding or pulling in the socket are accessible. Remove the sealing ring components (if equipped with the standard seal or air seal arrangement) or the water chamber components (if equipped with the water seal arrangement) as described in the MAINTENANCE portion of this section, then proceed to install the socket.

**INSTALLING THE BOLTED SOCKET.** To install the bolted socket, proceed as follows:

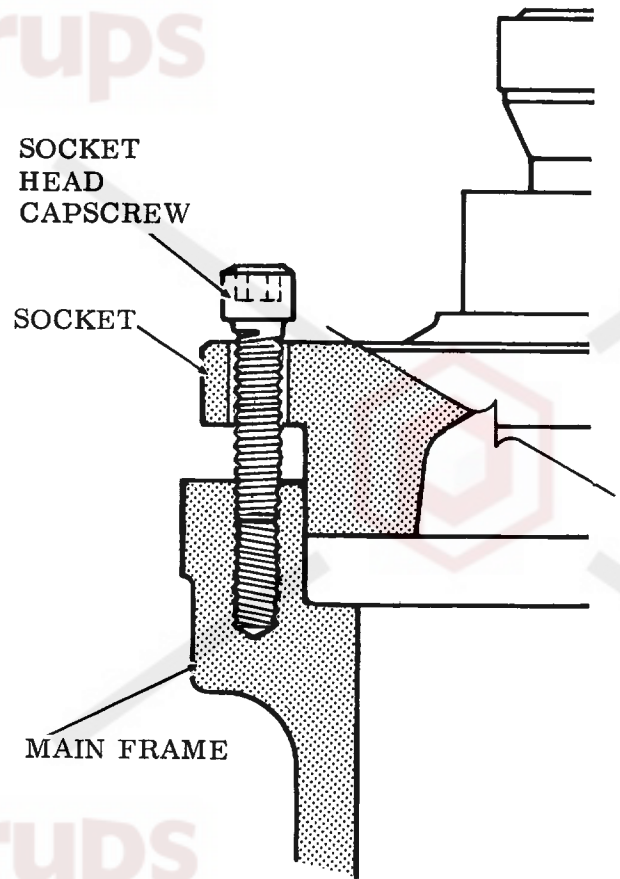
- 1 Lower the socket into the approximate position on the main frame and align the holes in the socket with the tapped holes in the frame. See the illustration LIFTING SOCKET ASSEMBLY.



**LIFTING SOCKET ASSEMBLY**

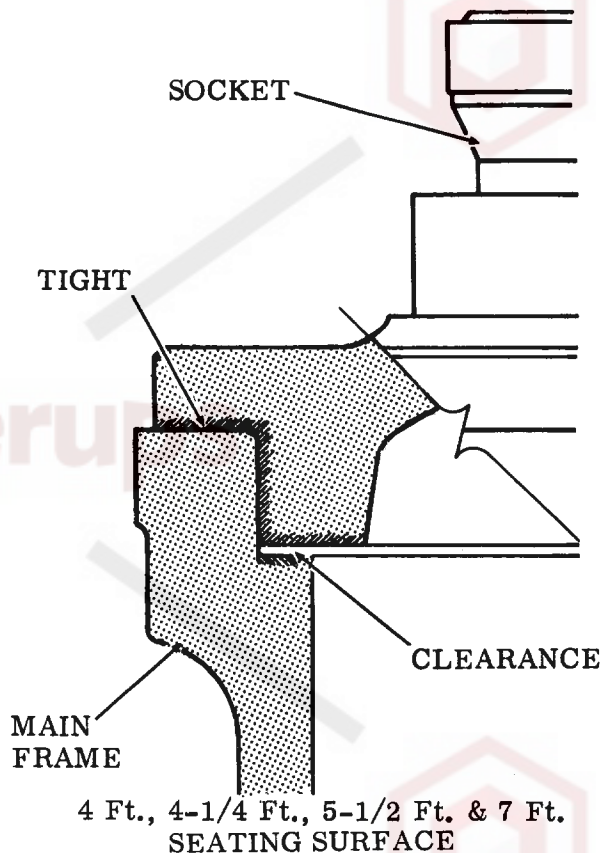
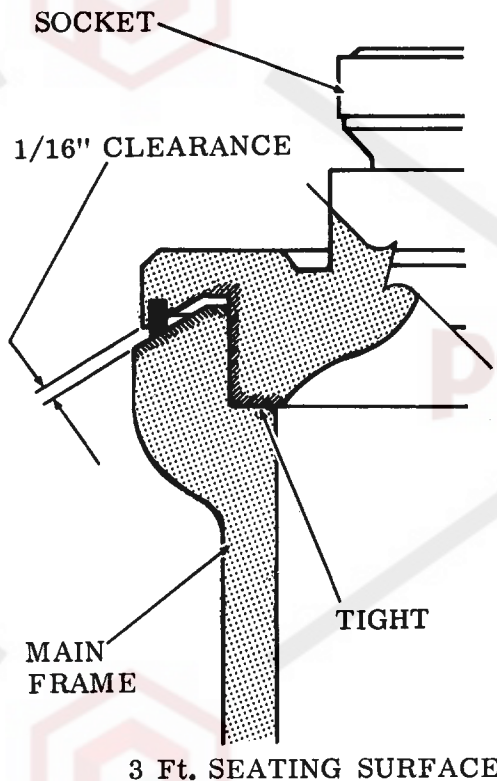
ONE HOLE IN BOTH THE SOCKET AND THE MAIN FRAME IS OFFSET TO INSURE PROPER ASSEMBLY.

- 2 Insert the socket head capscrews through the holes in the socket and then into the tapped holes in the main frame.
- 3 As the socket has an interference fit with the main frame, uniformly heat the frame around the socket fit to 100° Fahrenheit above ambient temperature.



**TIGHTENING SOCKET HEAD CAPSCREWS**

- 4 With a wrench, alternately tighten each cap-screw a small amount to prevent binding. See the illustration TIGHTENING SOCKET HEAD CAPSCREWS.
- 5 Tighten all capscrews until the socket is firmly seated in the main frame. On the 3 Ft. Crusher, the socket must seat with a clearance of 1/16" between the socket and frame, at the outside flange of the socket, as indicated by feeler gauges. On all other size Crushers the socket must seat without any clearance. See the illus-



### BOLTED SOCKET SEATING SURFACES

tration BOLTED SOCKET SEATING SURFACES.

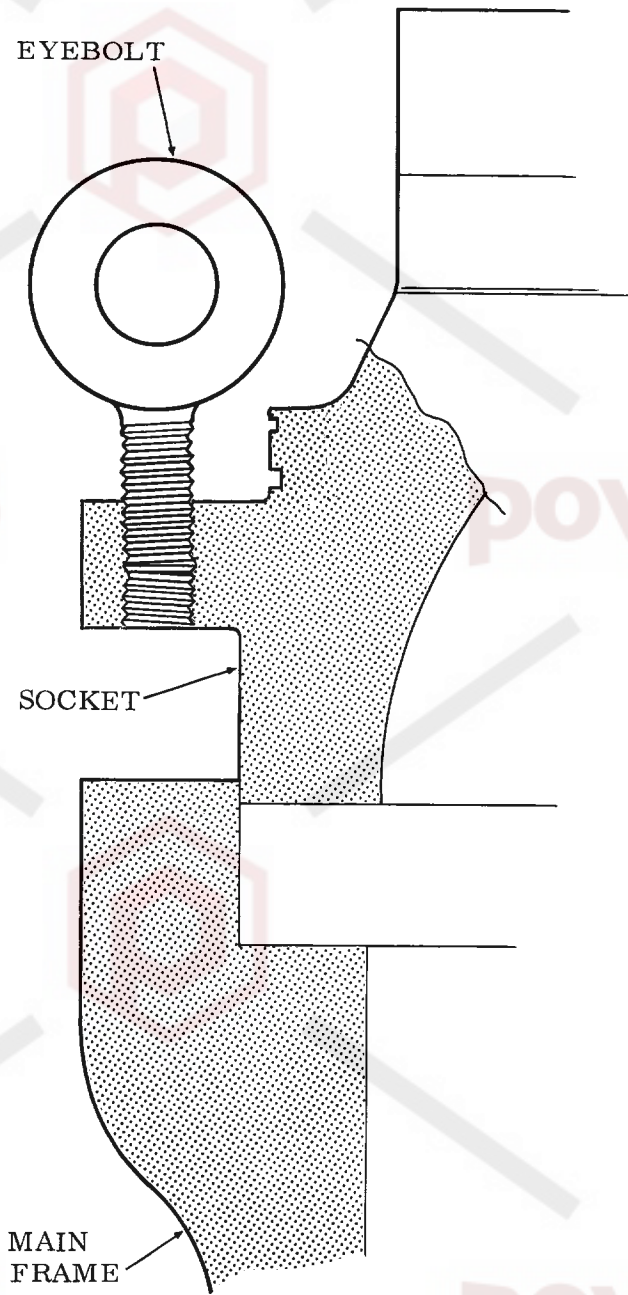
- 6 Clean, lubricate and install the sealing ring or water chamber components, depending on how equipped, as instructed under **SERVICING THE STANDARD SEAL, AIR SEAL or WATER SEAL ARRANGEMENT** in the **MAINTENANCE** portion of this section.

#### INSTALLING THE 4-1/4 FT. DOWELLED SOCKET.

To install the dowelled socket, proceed as follows:

- 1 Lower the socket into the approximate position on the main frame and align the holes in the socket with the four dowels in the frame. See the illustration **LIFTING SOCKET ASSEMBLY — DOWELLED SOCKET**.
- 2 With the socket in the proper position on the main frame insert the four special hex head jacking screws, found in the box with the tools, through the holes in the socket and then into the tapped holes in the main frame.

- 3 As the socket has an interference fit with the main frame, uniformly heat the frame around the socket fit to 100° Fahrenheit above ambient temperature.
- 4 Alternately tighten each jacking screw a small amount to prevent binding. See the illustration **TIGHTENING JACKING SCREWS**.
- 5 Tighten all jacking screws until the socket is firmly seated in the main frame. The socket must seat with a clearance of 1/8" between the socket and frame, at the outside flange of the socket. See the illustration **DOWELLED SOCKET SEATING SURFACE**.
- 6 The jacking screws are then removed. All drilled and tapped holes in the socket are to be sealed with the plastic tapered plugs that are furnished.
- 7 Clean, lubricate and install the sealing ring as instructed under **SERVICING THE STANDARD OR AIR SEAL ARRANGEMENT** in the **MAINTENANCE** portion of this section.

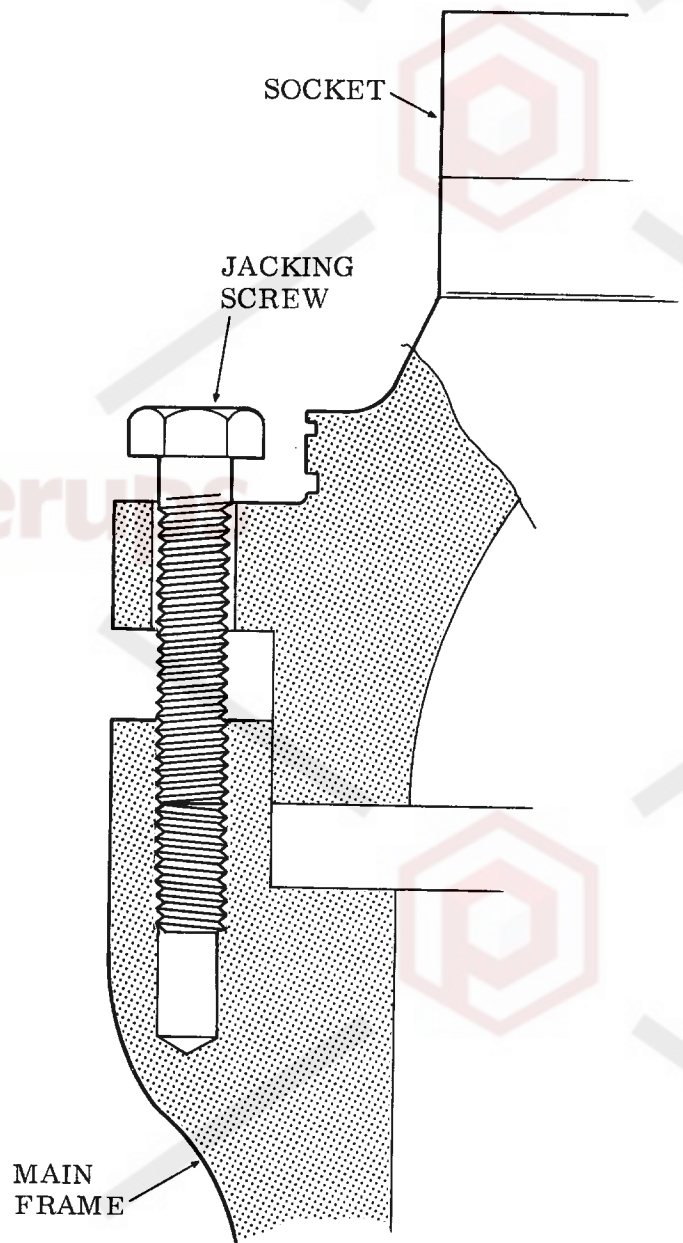


**LIFTING SOCKET ASSEMBLY  
DOWELLED SOCKET**

INSTALLING THE 7 FT. DOWELLED SOCKET.  
To install the doweled socket, proceed as follows:

- 1 Lower the socket into the approximate position on the main frame and align the holes in the socket with the four dowels in the frame. See the illustration LIFTING SOCKET ASSEMBLY - DOWELLED SOCKET.

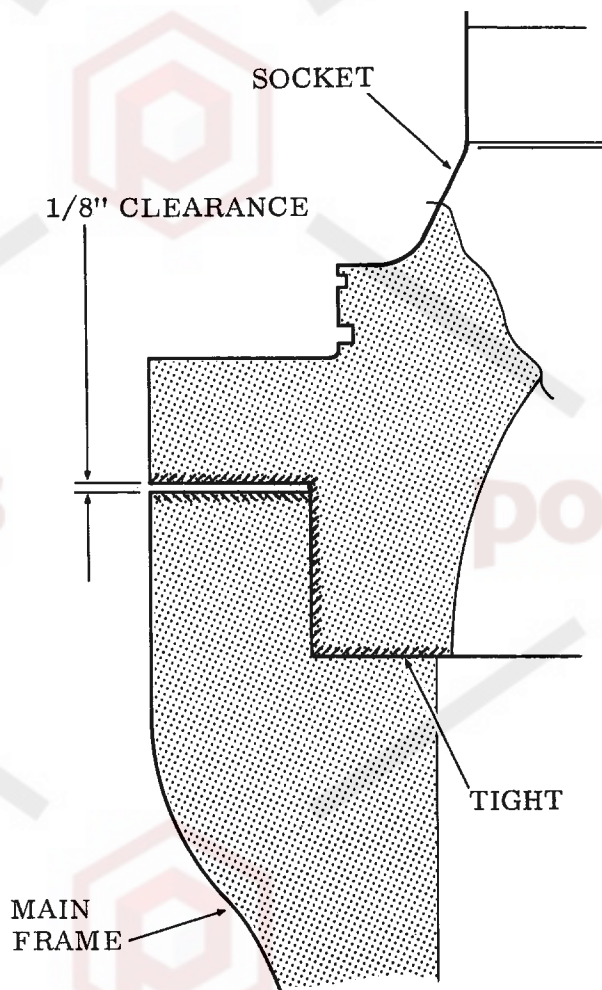
ON THE WATER SEAL DOWELLED SOCKET THERE IS ONE HOLE IN THE



**TIGHTENING JACKING SCREWS**

SOCKET THAT IS TO BE ALIGNED WITH A LOCATING PIN IN THE MAIN FRAME TO INSURE PROPER ASSEMBLY. THIS PIN IS LOCATED OPPOSITE THE COUNTER-SHAFT BOX.

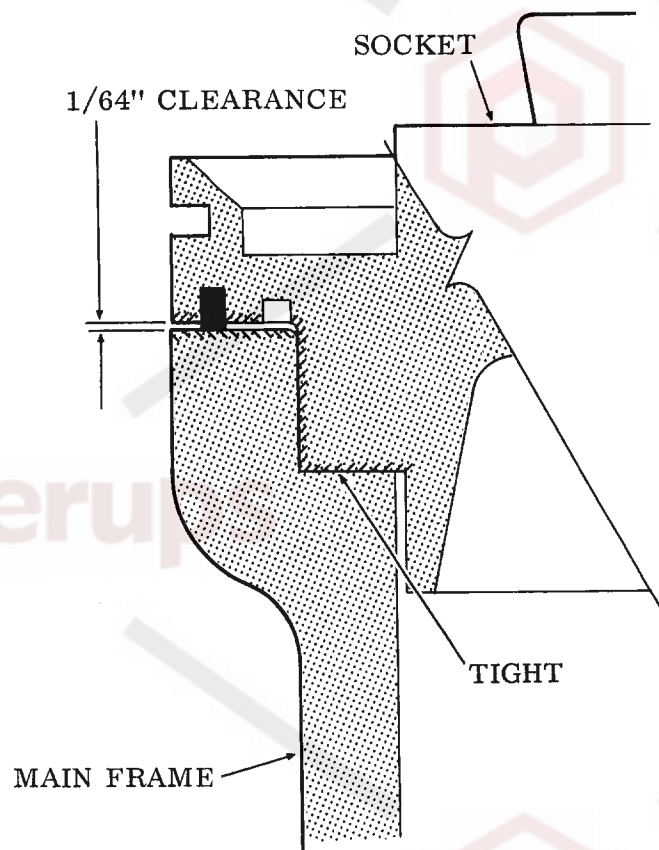
- 2 With the socket in the proper position on the main frame insert the four special hex head jacking screws, found in the box with the tools, through the holes in the socket and then into the tapped holes in the main frame.
- 3 As the socket has an interference fit with the main frame, uniformly heat the frame



### DOWELLED SOCKET SEATING SURFACE

around the socket fit to 100° Fahrenheit above ambient temperature.

- 4 Alternately tighten each jacking screw a small amount to prevent binding. See the illustration TIGHTENING JACKING SCREWS.
- 5 Tighten all jacking screws until the socket is firmly seated in the main frame. The socket must seat with a clearance of 1/8" between the socket and frame, at the outside flange of the socket. See the illustration DOWELLED SOCKET SEATING SURFACE.
- 6 The jacking screws are then removed. The tapped holes are to be sealed with cotton waste saturated with oil or grease.
- 7 Clean, lubricate and install the sealing ring or water chamber components, depending on how equipped, as instructed under SERVICING THE STANDARD, or WATER SEAL ARRANGEMENT in the MAINTEN-



### 2 FT. KEYED SOCKET SEATING SURFACE

ANCE portion of this section.

INSTALLING THE 2 FT. KEYED SOCKET. If this keyed socket assembly was removed for shipment the socket is installed as follows:

- 1 Lower the socket into the approximate position on the main frame and align the flat portion of the socket with the key in the main frame.
- 2 As the socket has an interference fit with the main frame, uniformly heat the frame around the socket fit to 100° Fahrenheit above ambient temperature.
- 3 Place a 4" x 4" hardwood block on the socket directly over the interference fit.
- 4 With a sledge hammer or heavy ram, strike on top of the block to force the socket in place. Do not try to force the socket into the frame too far at one time as the socket may bind, making installation difficult. Alternately ram the socket on one side and then on the opposite side.
- 5 Continue forcing the socket into place by

hitting the block at various points all around the perimeter of the socket until there is a 1/64" clearance between the top of the main frame and the socket as indicated by feeler gauges. See the illustration 2 Ft. KEYED SOCKET SEATING SURFACE.

WHEN DRIVING IN A KEYED SOCKET IN THE MANNER SO DESCRIBED, THE SOCKET LINER MAY HAVE BECOME UNSEATED. IF SO, USE A 4" x 4" TIMBER AS A RAM TO RESEAT THE LINER. BE CERTAIN TO RAM DIRECTLY OVER THE SOCKET LINER INTERFERENCE FIT.

- 6 Clean, lubricate and install the sealing ring components, as instructed under SERVICING THE STANDARD or AIR SEAL ARRANGEMENT in the MAINTENANCE portion of this section.

## AIR SEAL PIPING

GENERAL INFORMATION. The main consideration when deciding on an air type seal, is the amount of dust that is to be kept from entering the internals of the Crusher. The air type seal is an ideal seal where extremely dusty conditions exist. Because of the environment in which the air seal is employed, the air entering the air seal must be relatively clean and free from foreign matter. The quantity and required pressures must be in accordance with the amounts shown in the table PIPING AND AIR REQUIREMENTS. A complete air blower and motor assembly can be purchased from the factory to meet the needs outlined in the table, PIPING AND AIR REQUIREMENTS.

A continuous air supply is provided through the use of the air blower assembly and is connected to the Crusher as shown in the illustration TYPICAL AIR SEAL PIPING. The distance from the blower to the Crusher should not exceed 25 feet. In the event the surroundings about the blower are extremely dusty the filter-silencer should be located outside where a dusty atmosphere is at a minimum. When this type of installation is used, the filter-silencer to blower distance should not exceed 100 feet.

With an air type seal, air is circulated through the seal arrangement and discharged into the atmosphere. The dirt and dust is kept from entering the internals of the Crusher by the slight increase of pressure (1/2 PSI to 1-1/2 PSI) over the atmospheric pressure.

BLOWER DESCRIPTION. The blower used is a rotary type lobe blower. It is a positive displacement type unit, whose pumping capacity is determined by size, operating speed, and pressure conditions. It employs two double-lobe impellers mounted on parallel shafts and rotating in opposite directions within a cylinder closed at the ends by headplates. As the impellers rotate, air is drawn into one side of the cylinder and forced out the opposite side against the pressure existing there. The pressure developed, therefore, depends on the resistance of the discharge system.

Effective sealing of the blower inlet area from the discharge area is accomplished by use of very small operating clearances. Resulting absence of moving contacts eliminates the need for any internal lubrication. Clearances between the impellers during rotation are maintained by a pair of accurately machined timing gears, mounted on the two shafts extended outside the air chamber.

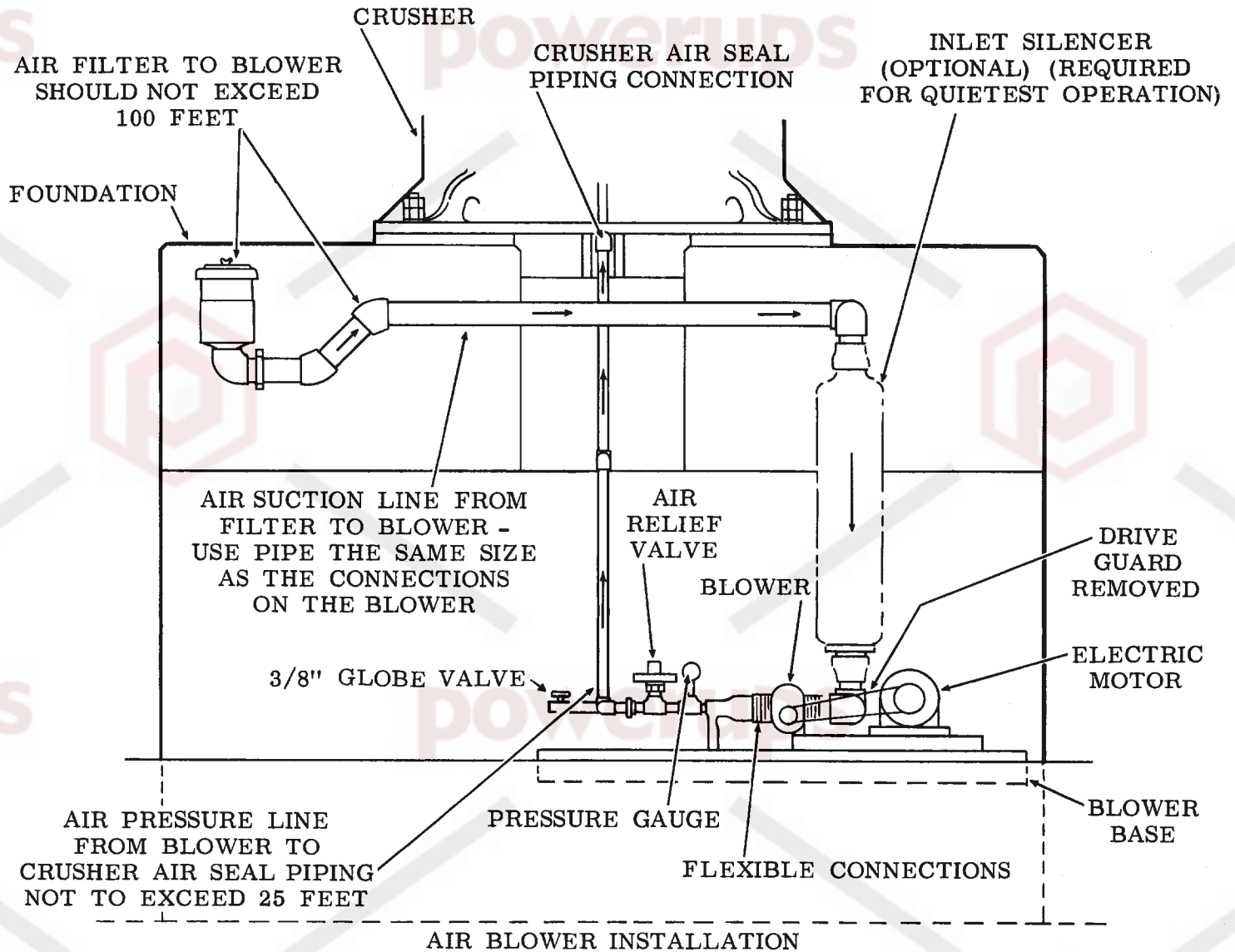
No attempt should ever be made to control capacity by means of a throttle valve in the intake or discharge piping. This will not only increase the power load on the driver, but can also overload and seriously damage the blower. Likewise, if a possibility exists that flow to the blower inlet may be cut-off during normal operation of a process, then an adequate vacuum relief valve must be installed near the blower. A pressure type relief valve in the discharge line near the blower is furnished as standard equipment for protection against cut-off or blocking in this line.

Before making any change in blower capacity, or operating conditions, contact the factory for specific information applying to your particular blower. In all cases, operating conditions must be maintained within the approved range of pressures, temperatures and speeds as shown in the table MAXIMUM BLOWER LIMITATIONS. Also, the blower must not be used to handle air containing liquids or solids. Serious damage to the rotating parts will result.

BLOWER INSTALLATION. The blower when furnished, is completely assembled and mounted on a base. The blowers are internally treated at the factory to protect against normal atmospheric corrosion before

CRUSHER SIZE	Size of Air Supply Pipe Between Blower and Crusher	Size of Suction Pipe Between Air Filter-Silencer and Blower	Quantity of Air to be Circulated in Cubic Feet per Minute *	Discharge Pressure (Pounds per Square Inch Gauge) *	Blower R.P.M.	Motor R.P.M.	Motor H.P.
* Ratings are based on inlet air of 14.7 pounds per square inch absolute (0-2000 Foot elevation), 70° Fahrenheit temperature and a specific gravity of 1.0.							
4-1/4 FT.	1-1/2"	4"	187	4	3000	1750	7-1/2

### PIPING AND AIR REQUIREMENTS



### TYPICAL AIR SEAL PIPING



installation. Maximum period of protection is one year under average conditions, if plugs or seals are not removed. Protection against chemical or salt water atmosphere is not provided. Do not remove seals until ready to start installation, as protection will be lost by evaporation.

Install blower in a protected indoor location, if possible. However, an unprotected outdoor installation will be satisfactory if correct lubrication for expected temperatures is provided. Refer to the section BLOWER LUBRICATION. Just before starting the installation, remove plugs or covers from inlet and discharge connections. Inspect for dirt or foreign objects inside the blower, then turn drive shaft by hand to make sure that it rotates freely.

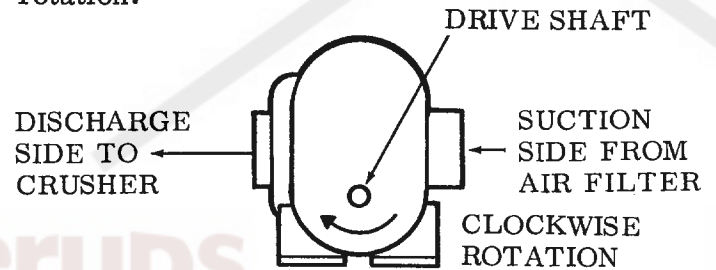
**WARNING**

Do not place hands and fingers in the intake or discharge ports of the blower while turning the drive shaft.

Since the blower is factory mounted on a base very little adjustment will be required. However, the assembly can become twisted during shipping and handling, therefore, it is wise to loosen the foot hold-down bolts to check foot contact with the mounting surface. The base should then be mounted on a relatively level solid foundation or heavy flooring, not in excess of 25 feet from the Crusher. Use shims where necessary at bolting points to prevent warping of the assembly.

Transmission of small operating vibrations to a supporting structure in some cases may be objectionable. Use of vibration isolators, or vibration absorbing materials, can be effective in overcoming this problem. To avoid blower casing distortion, the treatment used should be applied under the motor-blower common mounting plate or base, rather than directly under the blower feet alone.

These blower units must be driven in the proper rotation with respect to the discharge. The proper rotation when viewed from the drive shaft is as shown in the illustration BLOWER ROTATION AND DISCHARGE ARRANGEMENT. An arrow near the shaft indicates the proper rotation.



**BLOWER ROTATION AND DISCHARGE ARRANGEMENT**

Piping should be accurately squared with the blower, supported independently, and sized no smaller than the connections on the blower. Use only clean, new pipe and make certain it is free of scale, cuttings, weld beads, dirt or any other foreign material.

**BLOWER V-BELT DRIVE.** A V-belt drive arrangement is used on the 4-1/4 Ft. machine and comes completely assembled from the factory. However, due to shipping and handling the drive alignment can become misaligned and must be checked prior to starting. Remove the drive guard and check the alignment by placing a long straight edge or tightly drawn string across the faces of the sheaves as shown in the illustration V-BELT DRIVE ALIGNMENT.

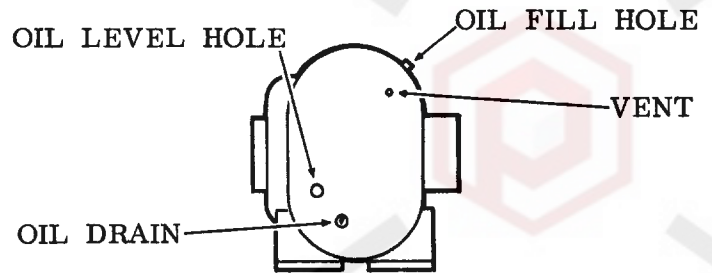
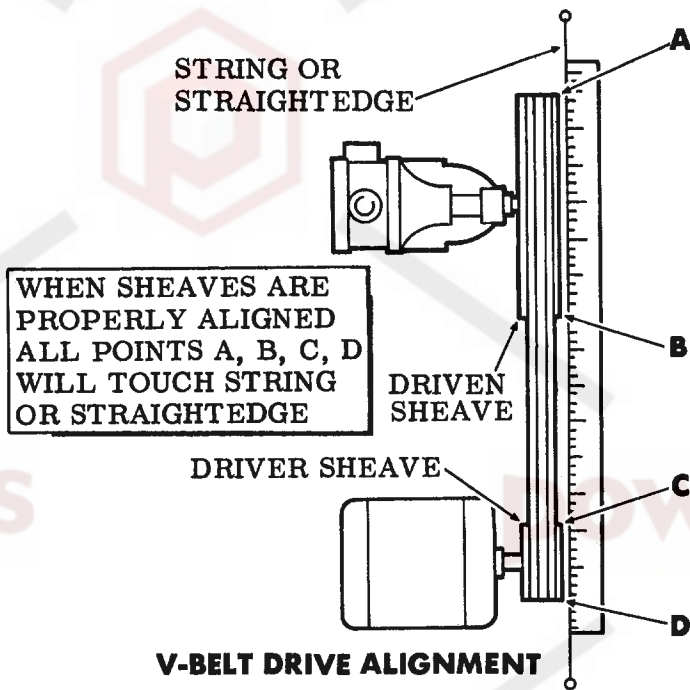
When aligning or replacing a sheave on the blower, the sheave must be mounted not more than 1/4" from the blower housing.

Adjust motor position on its sliding base so that belt tension is in accordance with the drive manufacturer's instructions. Avoid ex-

CRUSHER SIZE	DIFFERENTIAL PRESSURE (PSI)	INLET VACUUM INCHES OF HG.	TEMPERATURE RISE FAHRENHEIT DEGREES*	REVOLUTIONS PER MINUTE
4-1/4 FT.	4	8.5	90	4970

\*Based at 100° Fahrenheit maximum inlet temperatures. If inlet temperature is higher than 100° Fahrenheit, the above allowable temperature rise must be reduced by 2/3 of the difference between ambient (temperature around blower) and the actual measured inlet temperature.

**MAXIMUM BLOWER LIMITATIONS**



### BLOWER GEAR HOUSING OIL FILLING

Recommended oil grades for various operating conditions are listed in the table below.

Ambient Temperature	Discharge Pressure PSIG	Viscosity SSU at 100°F	Approx. SAE No.
Below 90°F	Below 2.0	500-700	30
Over 90°F	Below 2.0	700-1000	40
Below 90°F	Over 2.0	700-1000	40
Over 90°F	Over 2.0	1000-2000	50

For the quantity of oil required to fill the sump in the blower refer to the table BLOWER OIL SUMP CAPACITIES.

CRUSHER SIZE	QUANTITY REQUIRED IN FLUID OUNCES
4-1/4 FT.	7

### BLOWER OIL SUMP CAPACITIES

Check gear housing oil level every week and add oil if needed. Do not check or fill oil while the blower is running. The oil change interval will depend on the oil operating temperature and the type of oil. For a good grade industrial type non-detergent oil with a blower discharge temperature of less than 250° Fahrenheit, oil change should be made every 1,000 operating hours. For blower discharge temperatures of higher than 250° Fahrenheit, more frequent oil changes will be required.

Shaft bearings at drive end of blower are grease lubricated. All blowers have pressure type grease fittings in the bearing housings. Using a good quality grease with high temperature stability and having a consistency of NLGI No. 2, force new lubricant under pressure into each drive end bearing housing until traces of clean grease appear through the holes in the

cessive belt tension at all times. Recheck tension after the first ten hours of operation, and periodically thereafter, to avoid slippage and loss of blower speed.

Check blower after installation, and before applying power, by rotating the drive shaft by hand. If it does not rotate freely, look for uneven mounting, piping strain, excessive belt tension or coupling misalignment. Do not operate the blower at this time because there is no oil supply in the gear housing.

**BLOWER LUBRICATION.** Shaft bearings at the gear end of the blower are splash lubricated by one or more gears dipping into an oil sump formed in the head plate. Before starting the blower, fill this sump as follows:

- 1 Remove oil fill plug from the gear end head plate and the oil level plug from the gear cover. Refer to the illustration BLOWER-EXPLODED VIEW.
- 2 Pour oil through the fill hole slowly until the oil starts to run out of the oil level hole. Refer to the illustration BLOWER GEAR HOUSING OIL FILLING.
- 3 After the oil has stopped running out of the oil level hole, apply Permatex No. 2 to the oil level and oil fill plug threads and replace.

bearing cover. Drive end bearings must be greased prior to initial start-up. The blower should be regularly greased every 700 operating hours after initial start-up.

**BLOWER OPERATION.** Before starting the blower for the first time under power, recheck the installation thoroughly to reduce the likelihood of troubles. Use the following check list as a guide, but also consider any other special conditions in your installation.

- 1 Be certain no bolts, rags or dirt have been left in the blower gear housing.
- 2 Be certain that inlet piping is free of debris.
- 3 If installation is not recent, check blower leveling, drive alignment, belt tension, and tightness of all mounting bolts.
- 4 Be certain the proper quantity of oil is in the gear housing.
- 5 Be certain the driving motor is properly lubricated, and that it is connected through suitable electrical overload devices.
- 6 Rotate blower shaft several times by hand to make sure impellers are free at all points, with no rubbing or bumping.
- 7 Check motor rotation by momentarily pushing the start button. If not in accordance with arrow on blower, reverse the motor connections.

Initial operation should be carried out under "no load" conditions by opening all valves and venting the discharge to atmosphere, if possible. Then start motor briefly, listen for unusual noises, and check that the blower coasts freely to a stop. If no problem appears, repeat this check and let the motor run a little longer. If any questions exist, investigate before proceeding further.

Now operate the unit for about 10 minutes. During this run feel cylinder and headplates for development of hot spots that indicate rubbing contacts. Also listen for knocking sounds (contact between impellers), and watch for any change or increase in vibration. At the end of this run, check the inlet screen near the blower for collected debris.

After above tests are completed and any necessary corrections made, a final check run of at least one hour should be performed under normal operating conditions. Start unloaded as above, and apply the system pressure load gradually by closing the discharge atmospheric vent. Use a mercury monometer connected to the discharge piping to see that the pressure rating of the blower is not exceeded. Also use good thermometers to determine the temperature rise through the blower. Both figures should satisfy the conditions listed in the table **MAXIMUM BLOWER LIMITATIONS**. Check the unit frequently during this run. Shut down immediately if excessive noise or heating develops and refer to the **BLOWER TROUBLE SHOOTING CHECK LIST**.

Assuming all tests are satisfactory, the blower will now be ready for continuous full load operation. During the first several days, make periodic checks to determine that all conditions remain acceptable and steady. These checks may be particularly important if the blower is part of a process system where conditions may vary. At the first opportunity, stop the blower and clean or remove the inlet screen. Also recheck leveling, coupling alignment or belt tension, and mounting bolts for tightness.

If operation proves that blower capacity is a little too high for the actual air requirements, a small excess may be blown off through a 3/8" globe valve. Refer to the illustration **TYPICAL AIR SEAL PIPING**. It is not good practice to use the pressure relief valve as an automatic vent. Such use may cause the discharge pressure to become excessive, and can also result in failure of the valve itself. If the blower capacity is low, it may be possible to increase the drive speed. Before attempting this change, contact the factory for recommendations, based on actual requirements and operating pressure/temperature conditions.

**BLOWER SAFETY PRECAUTIONS.** For equipment covered specifically or indirectly in this section, it is important that all personnel observe safety precautions to minimize the chance of injury. Among many considerations, the following should particularly be noted:

- 1 Blower housing and associated piping or accessories may become hot enough to cause major skin burns on contact.

- 2 Internal and external rotating parts of the blower and driving equipment can produce serious physical injuries. Do not reach into any opening in the blower while it is operating, or while subject to accidental starting. Cover external moving parts with adequate guards.
- 3 Disconnect power before doing any work, and avoid by-passing or rendering inoperative any safety or protective devices.
- 4 Stay clear of the blast from pressure relief valves and the suction area of vacuum relief valves.
- 5 Avoid extended exposure in close proximity to machinery with high intensity noise levels.
- 6 Use proper care and good procedures in handling, lifting, installing, operating and maintaining the equipment.
- 7 Other potential hazards to safety may also be associated with operation of this equipment. All personnel working in or passing through the area should be warned by signs and trained to exercise adequate general safety precautions.

#### BLOWER MAINTENANCE AND REPLACEMENT.

Regular inspection of the blower and its installation, along with complete checks on operating conditions, will pay dividends in added life and usefulness. Particular attention should be paid to lubrication of timing gears and bearings in accordance with comments under BLOWER LUBRICATION. Also service the driver per manufacturer's instructions, and check belt drive tension. By use of thermometers and gauges, make sure that blower operating temperature and pressure remain within allowed limits.

When a blower is taken out of service it may require internal protection against rusting or corrosion. The need for such protection must be a matter of judgement based on existing conditions as well as length of down-time. Under atmospheric conditions producing rapid corrosion, the blower should be protected immediately. Treatment consists of spraying or flushing the interior with a mixture of light oil and kerosene. Before restarting, check internal condition visually and rotate the drive shaft by hand.

Should adjustments or replacements eventually be needed, these can often be performed locally as described in this section, after obtaining required parts. Personnel should have a good background of mechanical experience and be thoroughly familiar with these instructions.

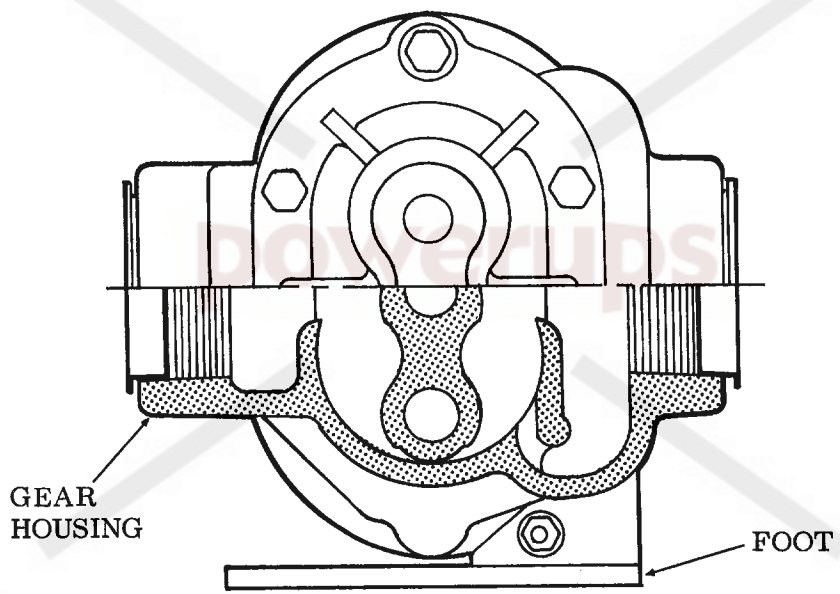
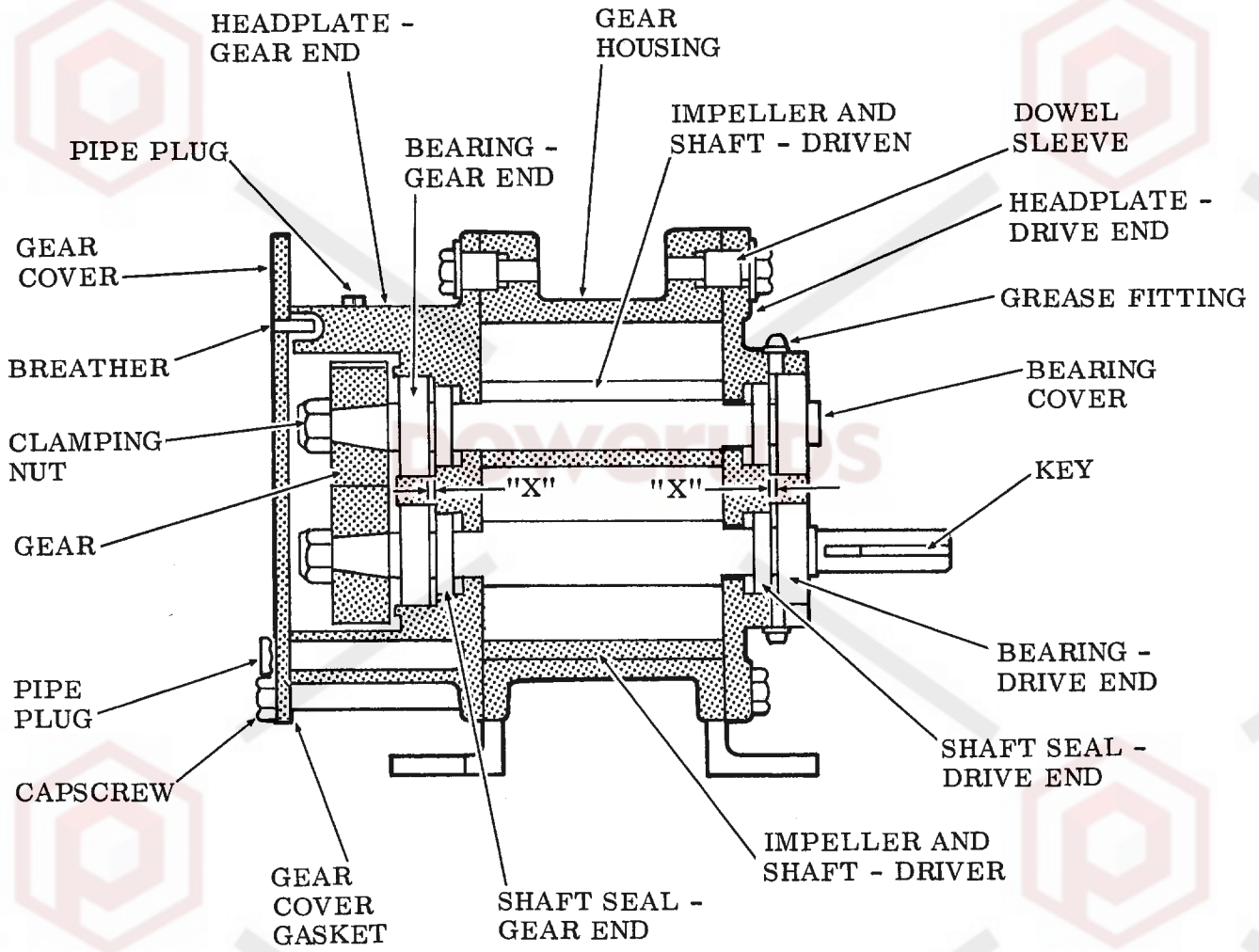
When ordering parts, give all blower name-plate information, plus the Names as taken from the illustration BLOWER-EXPLODED VIEW.

#### REPLACEMENT OF GEARS, BEARINGS, SEALS, IMPELLERS AND SHAFTS.

- 1 Remove sheave or coupling from blower drive shaft.
- 2 Drain oil from gear housing by removing lower pipe plug.
- 3 Remove gear cover, being careful not to damage gasket.
- 4 Remove both gear clamping nuts. Lock impellers by wedging between lobes with wood blocks to prevent rotation while loosening nuts.
- 5 Loosen all capscrews in drive end headplate. Insert jack screws in threaded holes and pull headplate away from housing about 1/4".
- 6 At gear end, drive both impeller shafts toward headplate to loosen gears from taper fits, and remove gears. Avoid damaging shaft threads by using a soft metal, plastic or wood mallet.
- 7 Remove drive end headplate and housing and pull both impellers out of the gear end headplate.
- 8 Remove all bearings from both headplates. They should be easily removable by inserting a finger or an expanding tool in the shaft hole. Bearings at the gear end can be damaged during gear removal, and it is advisable that all four bearings be replaced when a blower is torn down.
- 9 Remove all shaft seals from both headplates by driving out with a wood dowel inserted through the shaft holes from the rear.

TROUBLE	ITEM	POSSIBLE CAUSE	REMEDY
NO AIR FLOW	1	Speed too low	Check by tachometer and compare with speed shown in table Piping and Air Requirements.
	2	Wrong rotation	Compare actual rotation with the illustration Blower Rotation and Discharge Arrangement. Change drive if wrong.
	3	Obstruction in piping	Check piping, valves, silencer, to assure an open flow path.
LOW CAPACITY	4	Speed too low	Repeat remedy for Item 1. If belt drive, check for slippage and readjust tension.
	5	Excessive pressure rise	Check inlet vacuum and discharge pressure, and compare these figures with those specified in table Piping and Air Requirements.
	6	Obstruction in piping	Repeat remedy for Item 3.
	7	Excessive slip	Check inside of casing for worn or eroded surfaces causing excessive clearances.
EXCESSIVE POWER	8	Speed too high	Check speed and compare with speed shown in the table Piping and Air Requirements.
	9	Pressure too high	Repeat remedy for Item 5.
	10	Impellers rubbing	Inspect outside of cylinder and headplates for high temperature areas, then check for impeller contacts at these points. Correct blower mounting, drive alignment.
OVERHEATING OF BEARINGS OR GEARS	11	Inadequate lubrication	Check oil sump level in gearhouse, and try to inject grease in drive end bearings.
	12	Excessive lubrication	Check gear oil level. If correct, drain and refill with clean oil of recommended grade.
	13	Excessive pressure rise	Repeat remedy for Item 5.
	14	Coupling misalignment	Check carefully. Realign if questionable.
	15	Excessive belt tension	Readjust for correct tension.
VIBRATION	16	Misalignment	Repeat remedy for Item 14.
	17	Impellers rubbing	Repeat remedy for Item 10.
	18	Worn bearings/gears	Check gear backlash and condition of bearings; and replace as indicated.
	19	Unbalanced or rubbing impellers	Scale or process material may build up on casing and impellers, or inside impellers. Remove build-up to restore original clearances and impeller balance.

### BLOWER TROUBLE SHOOTING CHECK LIST



**BLOWER — EXPLODED VIEW**

10 Install new replacement seals in one or both headplates, as required by the design. After lubricating the outer edge, position seal over its recess with the shaft sealing lip facing out as shown in assembly drawing. Then press evenly into place until the seal face is even with face of recess. Lubricate seal lip with light grease.

11 Assemble gear end headplate to housing. Make sure dowel sleeves are in place in the two alignment holes in flange ears, then insert short capscrews in these holes and tighten.

12 Set this assembly on a flat surface plate, with the open end of the housing up. Insert both impellers, taper end of shafts first, being careful to avoid damage to seal lips. Make sure the longer (driving) shaft is in the bottom hole in relation to blower feet. Refer to the illustration BLOWER ROTATION AND DISCHARGE ARRANGEMENT.

13 Assemble drive end headplate to the housing over its dowel sleeves. Insert and tighten all capscrews in both headplates.

14 To install bearings correctly in both headplates, first determine how back clearance "X" shown in the BLOWER-EXPLODED VIEW drawing is to be provided. To do this, measure the thickness of the bearing and add dimension "X," 1/32" for the 4-1/4 Ft. Then measure the depth of the headplate recess. Any difference between these two figures will be the amount the bearing face should project beyond the headplate face. If there is no difference, the bearing should be flush. Apply a light film of oil on bearing fits prior to pressing bearings on shafts.

15 Press bearings into the headplates as determined above, using aligning tool that will pass over the shaft and push on both inner and outer races at the same time. This will keep the bearings square with the headplate. Note that open bearings are used only in the gear end headplate. The drive end requires bearings sealed on one side, with the sealed face placed on the outside. Degrease shaft and gear tapers.

16 Install new driven gear. Oil shaft threads lightly and tighten gear clamping nut with a torque wrench to 75 ft.-lbs.

A small hardwood wedge between impeller lobe and housing opening will prevent shaft from turning.

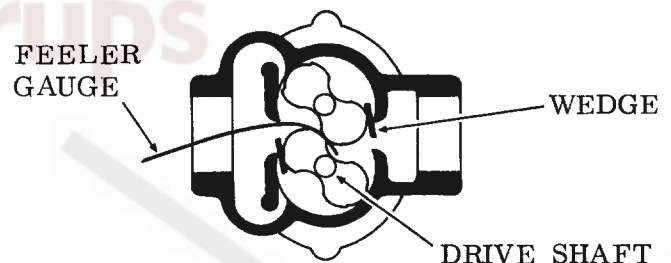
17 Install new driving gear after first positioning impellers correctly in relation to each other as shown in the illustration WEDGING OF IMPELLERS. With both impellers at 45°, insert a long metal feeler gauge between the two adjacent lobes and clamp it there by pushing small hardwood wedges between the back sides of these lobes and the housing openings. Feeler gauge thickness should be a middle value taken from the last column in the table BLOWER CLEARANCES. Now install the gear, observing tooth match marks if present, and tighten the nut lightly.

Crusher Size	Impeller End to Headplate (Total Both Ends)	Impeller Tip to Housing	Impeller Lobes at 45° *
4-1/4 Ft.	0.007" - 0.010"	0.004" - 0.006"	0.008" - 0.010"

\*Refer to illustration Wedging of Impellers

### BLOWER CLEARANCES

CLEARANCES LISTED ABOVE ARE USED IN ASSEMBLY AT THE FACTORY. THEY MAY CHANGE IN SERVICE, BUT SHOULD NEVER BE LESS THAN THE MINIMUM VALUES.



### WEDGING OF IMPELLERS

18 Remove wedges and feeler gauge, then rotate impellers to determine lobe clearances at all four 45° positions. They should be approximately equal, and within the range listed for the blower size. Adjust gear position if necessary, then insert the

corrected feeler and wedges and tighten the gear clamping nut to full torque. Spin the drive shaft by hand to make sure there are no gear tight spots or impeller contacts.

- 19 Install gear cover plate with gasket. Use the original special gasket if in good condition, or a factory replacement, positioning it to match the headplate shape. If it is necessary to make a replacement, be sure to use material of the original thickness and cut it to duplicate the original shape exactly. This will produce the oil metering orifice required between outer and inner sections of the oil sump, without which gears and bearings will run dry.
- 20 Replace oil drain plug and refill gear housing with proper grade of oil as discussed under LUBRICATION.
- 21 Reinstall drive sheave or coupling half, and remount blower in correct alignment with driver. Refer to discussion under INSTALLATION.

## WATER SEAL PIPING

**GENERAL INFORMATION.** The main consideration when deciding on a water type seal, is the quantity and quality of water that will be available. The water should be clean and free from foreign matter and excessive sediment. The quantity of water must be in accordance with the amount specified in the table PIPING AND WATER REQUIREMENTS.

Two types of water systems which can be used, are the CONTINUOUS and the LIMITED. The

merits and requirements for each system are discussed in the following paragraphs.

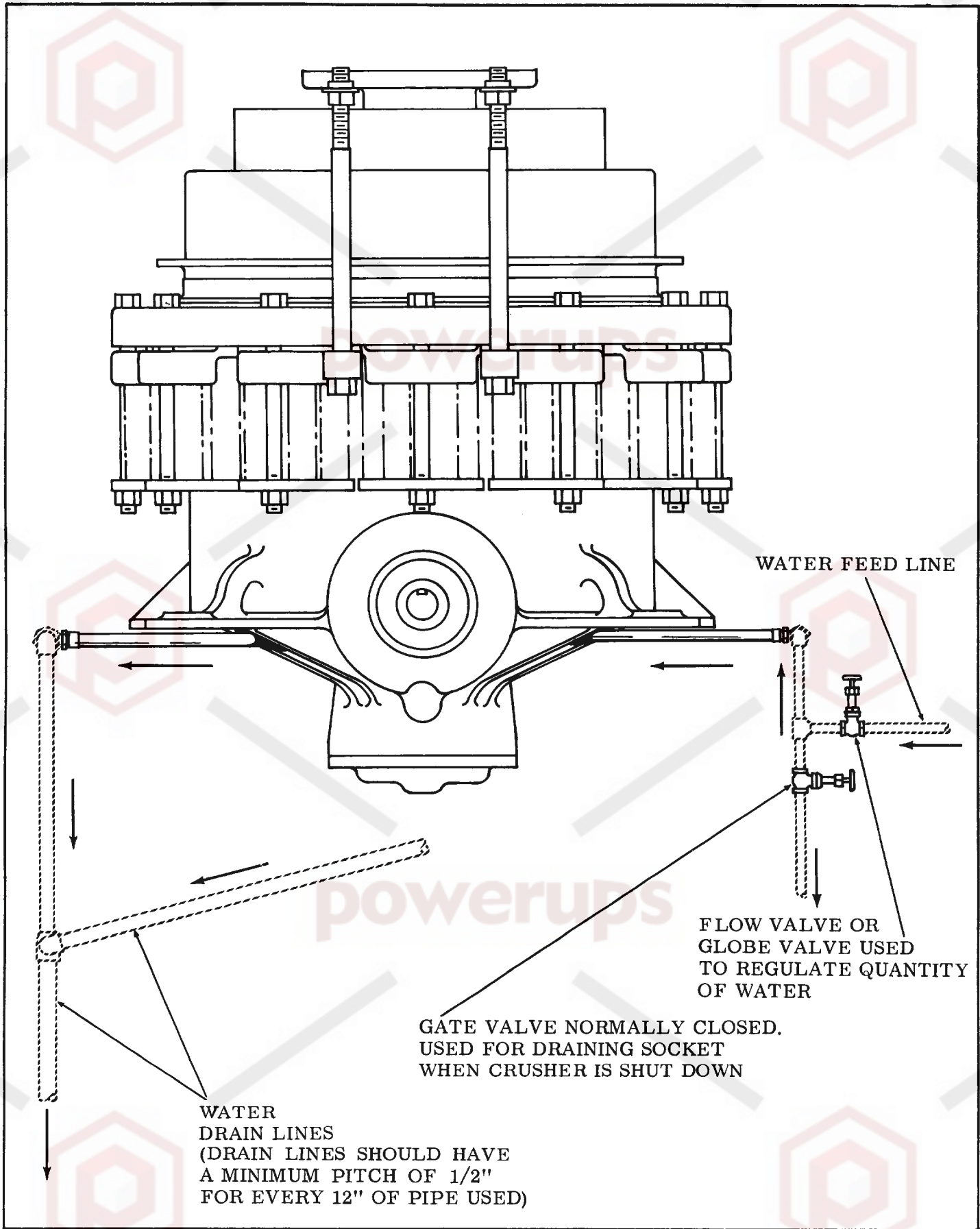
**CONTINUOUS WATER SYSTEM.** A continuous water system is that which can be obtained from a plant water system. With a continuous system, water is simply circulated through the Crusher and discharged. The dirt and dust is collected in the water and washed away and not recirculated through the system. When using a continuous system avoid operating in freezing temperatures unless precautions are taken to prevent the water from freezing. This type of water system is the most popular and is used on most water seal installations. See the illustration CONTINUOUS WATER SYSTEM.

**LIMITED WATER SYSTEM.** If a continuous water supply is not available, a storage settling tank for the water supply can be used. The water in this type of system is continually being circulated from a storage tank to the Crusher and back again. A baffle separates the tank, and the dust contaminated water drains into one side of the baffle while the pump suction line is connected to the other side of the baffle. The heavier particles of dust will settle on the one side of the baffle before mixing with the water on the other side. See the illustration LIMITED WATER SYSTEM, for the location of this baffle. Sediment at the bottom of the settling tank should be drained off periodically and water added to maintain the correct level. Refer to the table PIPING AND WATER REQUIREMENTS for the correct capacity of the tank and the horsepower required for the water pump motor. Since this is a closed system, an anti-freeze solution or a light grade of fuel oil can be substituted in place of the water to keep the system from freezing in cold weather.

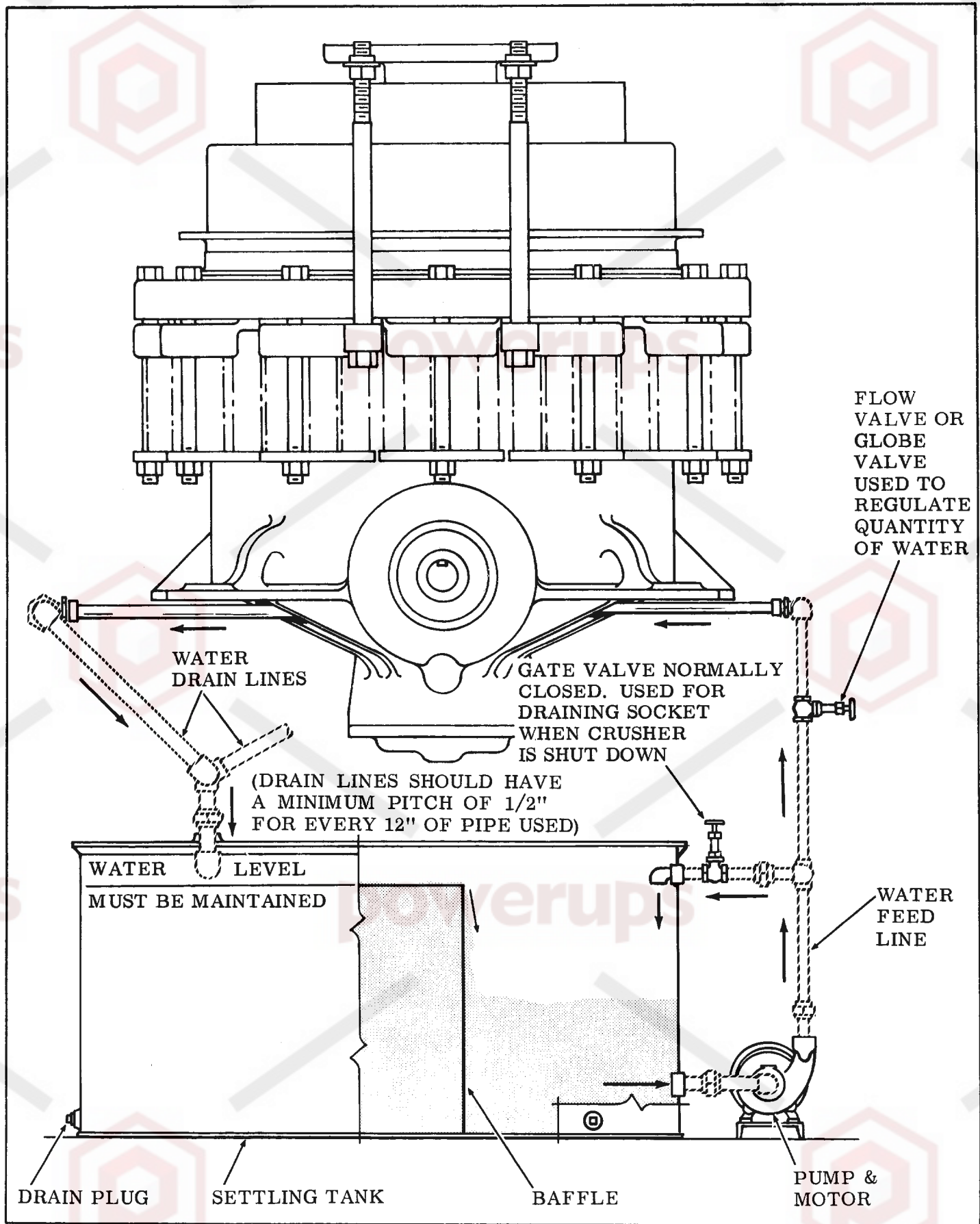
Crusher Size	Size Of Water Drain Pipe	Size Of Water Supply Pipe	Recommended Quantity of Water to be Circulated in Gals. per Minute	Minimum Recommended Settling Tank Capacity in U.S. Gallons	HP Required For Pump Motor When Using Settling Tank
3 Ft.	1"	1"	3-4	300	1/2
4 Ft.	1-1/2"	1"	6-8	300	1/2
4-1/4 Ft.	1-1/2"	1"	6-8	300	1/2
5-1/2 Ft.	1-1/2"	1"	8-10	300	1
7 Ft.	1-1/2"	1"	10-12	500	1

**PIPING AND WATER REQUIREMENTS**





**CONTINUOUS WATER SYSTEM**



**LIMITED WATER SYSTEM**

**WATER PRESSURE REQUIRED.** The amount of water pressure required for the water type seal is dependent upon the quantity (GPM) of water that is necessary to adequately flush out the water chamber, however, the pressure loss within the water chamber is minimal, approximately 10 PSI.

**INSTALLATION.** Whenever a water seal arrangement is furnished with the Crusher, drawings are provided showing hose and pipe fittings, of both the feed and drain lines, which are furnished with the Crusher. A typical arrangement of the continuous and the limited water system is shown in the illustrations CONTINUOUS WATER SYSTEM and LIMITED WATER SYSTEM. Drain lines should have a minimum pitch of 1/2" for every 12" of pipe used.

After the piping has been installed, the system should be tested to determine if the amount of water circulated conforms to that given in the table for the various size Crushers. The flow valve, which is furnished, should be installed in the feed line, to control the amount of water to the Crusher. The quantity of water and the water pressure must remain constant for the proper operation of the water seal arrangement.

All hose and pipe fittings are to be placed directly under the arms of the main frame or counter-shaft box to prevent wear from the crushed material.

**OPERATION.** Do not allow the water level in the overflow trough of the water chamber to become too high. This is caused by either an excessive amount of water being supplied to the chamber, or by the discharge pipe not draining freely due to being frozen or partially clogged. Dirt or other foreign material such as precipitation from hard water may also partially clog the water outlet or drain manifold.

A large concentration of dust will require more water to flush out the seal. Sediment should not be allowed to accumulate in the water chamber or the effectiveness of the seal will be reduced. If this occurs, it may be caused by an insufficient supply of water or an uneven overflow of water, which indicates the Crusher is not level on the foundation. Also check for a dirty water supply or the crushed material could be building up in the discharge chute and interfering with the underside of the head.

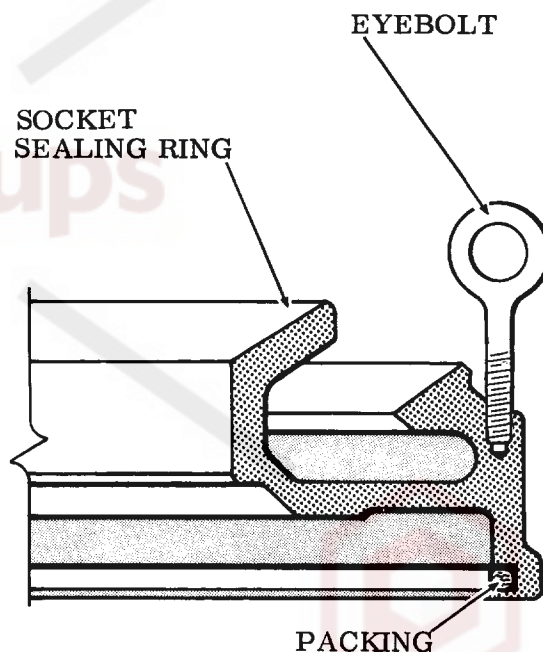
**SEASONAL STORAGE.** At the end of the crushing

season or during any long shutdown period, drain all the water from the Crusher. To assure complete drainage of the water chamber, both the feed and drain lines are to be pitched away from the Crusher and the feed line is to be drained using the valve furnished. It is also advisable to remove the head and main shaft assembly and fill the inner portion of the water chamber with a light grade of oil to prevent the water jet ports from clogging or corroding.

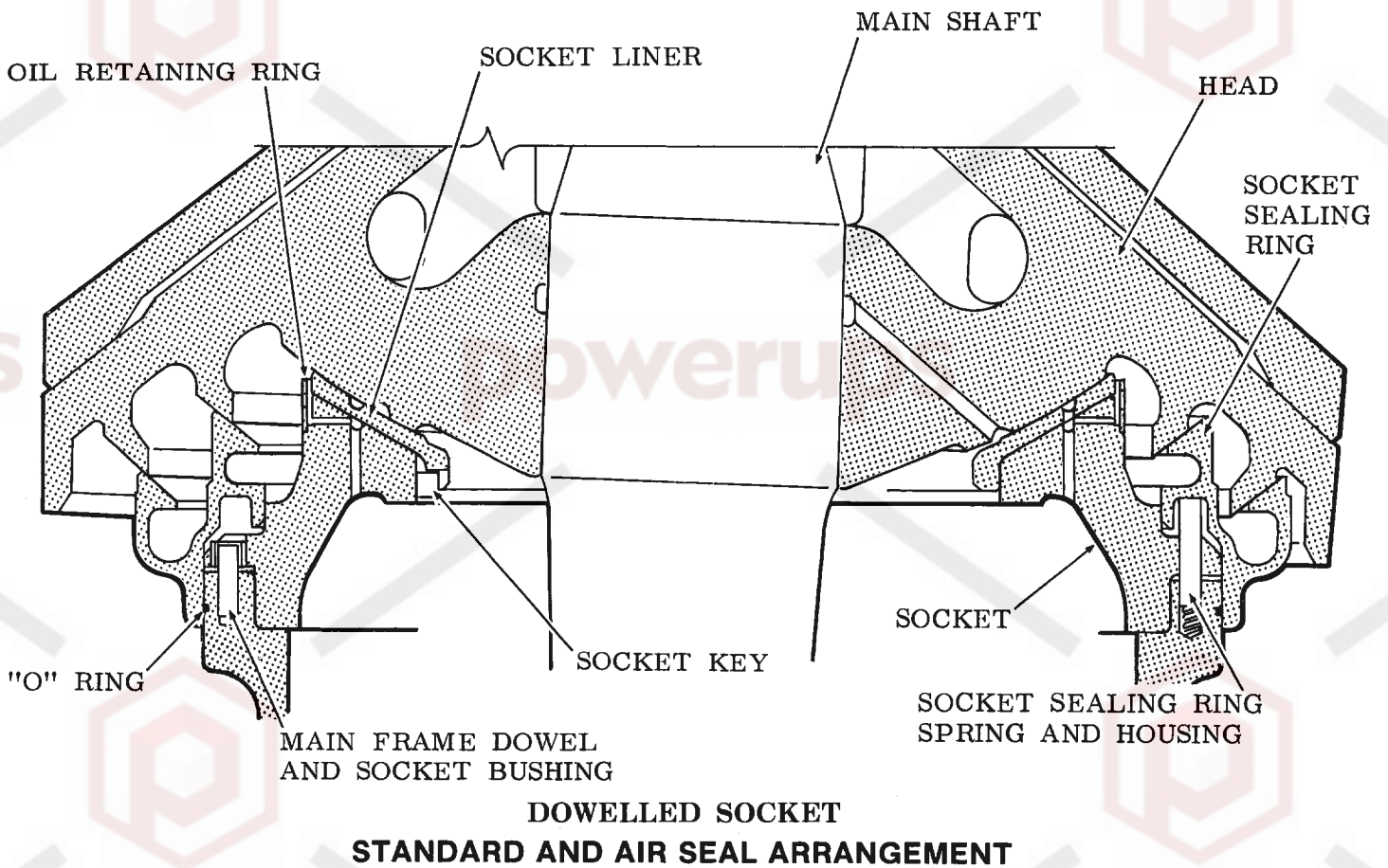
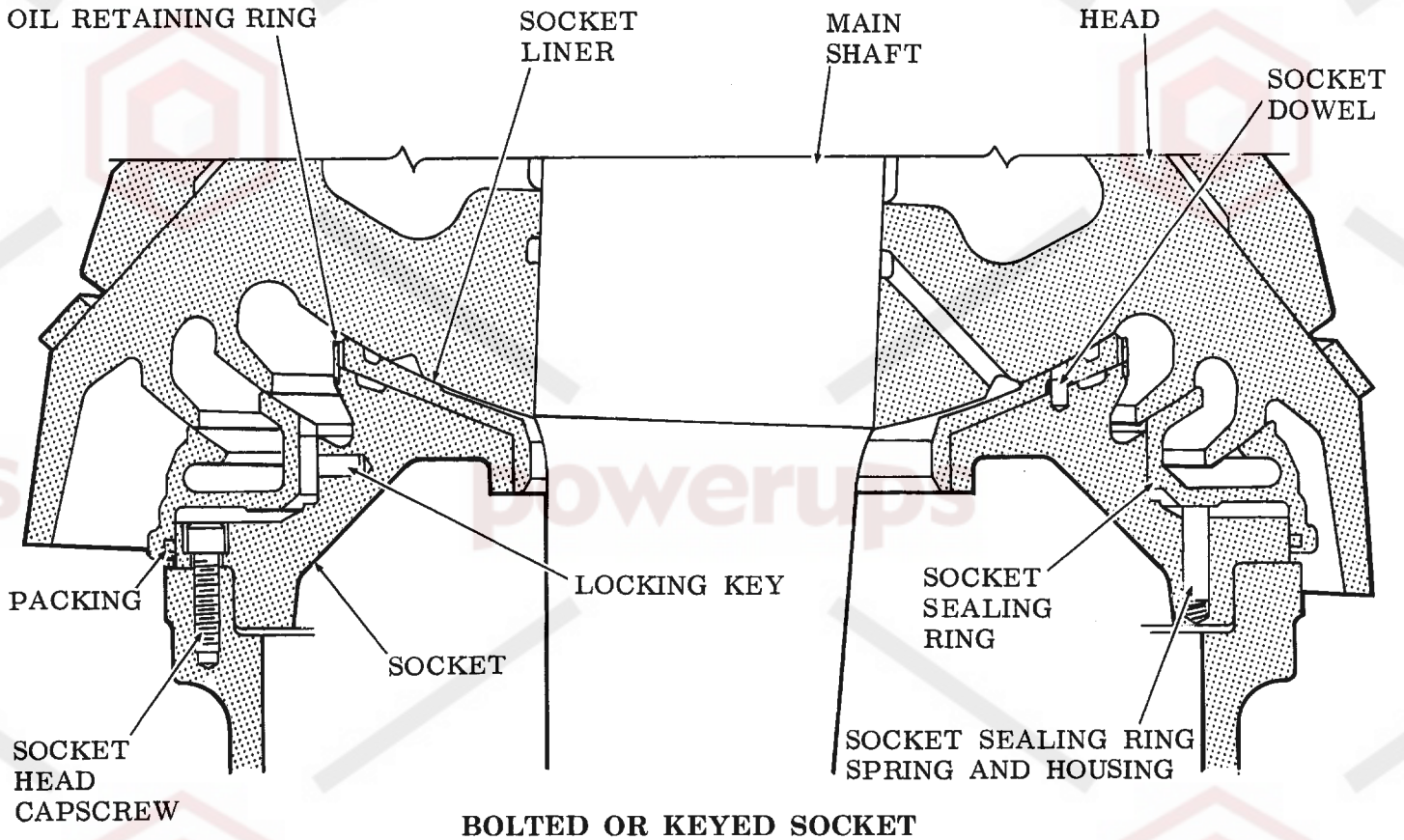
## MAINTENANCE

**SERVICING THE STANDARD OR AIR SEAL ARRANGEMENT.** With the main shaft assembly out of the Crusher for a liner change, it is advisable to replace the grease in the sealing ring chambers and check the socket sealing components for proper operation and wear. If the socket sealing ring is excessively worn to the point where it has lost its effectiveness as a seal, it should be replaced. If any of the springs have become weakened and no longer can exert the necessary pressure to maintain continuous contact between the head wipers and the sealing ring wipers, they also should be replaced. To service or replace the parts on a standard or air seal arrangement, proceed as follows:

- 1 Remove the socket sealing ring, springs, spring housings, and locking keys (If so equipped). See the illustration STANDARD and AIR SEAL ARRANGEMENT and LIFTING SOCKET SEALING RING.



**LIFTING SOCKET SEALING RING**

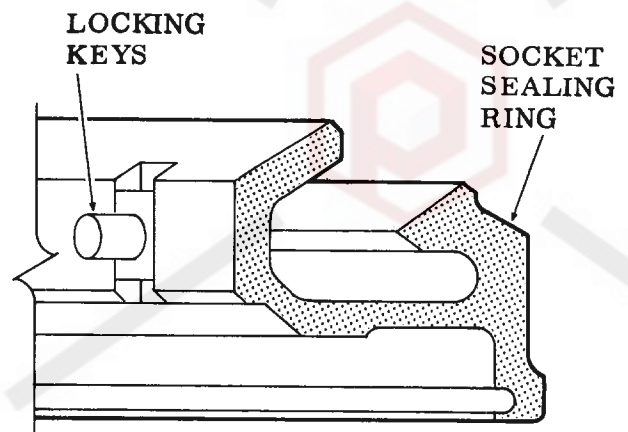


ON THE 7 FT. CRUSHER, CAST LUGS ON THE SIDES OF THE SEALING RING ARE USED FOR LIFTING PURPOSES.

- 2 Thoroughly clean all the components removing all grease and dirt. Check that the drain holes or chipped grooves just beneath the socket liner are open. These holes or grooves permit the excess oil that flows over the socket liner to run down between the socket liner and the oil retaining ring and drain back into the Crusher. See the illustration OIL DRAIN HOLES/GROOVES.
- 3 Inspect the wipers on both the head and sealing ring for wear.
- 4 Inspect the wipers on both the head and sealing ring for possible damage, smooth up any nicks, burrs or rough edges.
- 5 Inspect the springs for possible breakage and weakness due to fatigue. Replace where necessary. Use a new spring as a guide to determine whether a spring has lost its compression.
- 6 Clean the holes in the socket or main frame which accommodate the springs and spring housings.
- 7 Insert the springs in the spring housings and lightly lubricate the housings with oil, then insert them in the holes in the socket or the main frame.
- 8 Check each spring and spring housing to be sure it has adequate freedom of movement within the hole in the socket.
- 9 Install the locking keys at the side of the socket. See the illustration LOCKING KEYS. Check that the locking keys move freely within the hole in the socket.

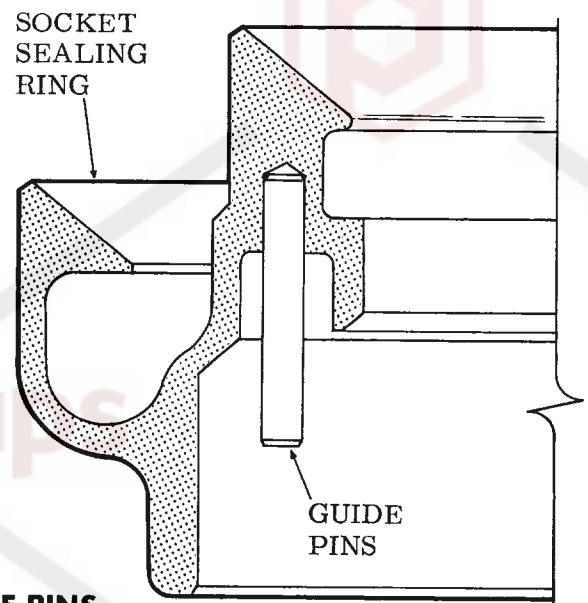
ON THE 7 FT. DOWELLED SOCKET GUIDE PINS ARE USED IN PLACE OF THE LOCKING KEYS. CLEAN THE GUIDE PINS PRESSED INTO THE UNDERSIDE OF THE SOCKET SEALING RING THOROUGHLY. SEE THE ILLUSTRATION GUIDE PINS.

- 10 Remove the felt packing from inside the socket sealing ring flange or on the side of the socket and soak the packing thoroughly in lubricating oil. The felt is then to be reinserted in the groove.



**LOCKING KEYS**

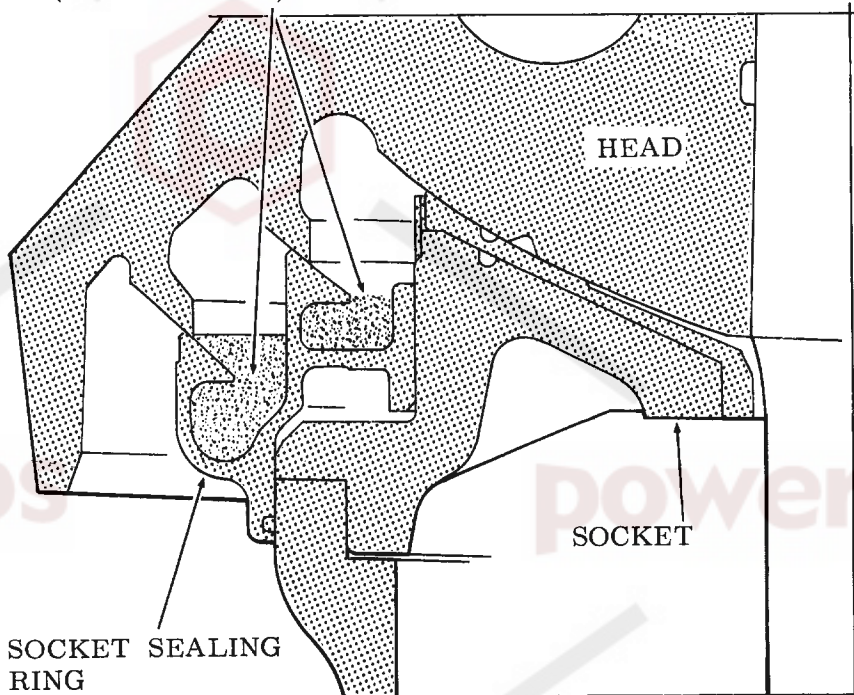
ON THE 7 FT. DOWELLED SOCKET A LARGE DIAMETER "O" RING IS USED IN PLACE OF THE FELT PACKING. REMOVE THE "O" RING FROM THE GROOVE IN THE MAIN FRAME AND CLEAN THE GROOVE THOROUGHLY. LIGHTLY GREASE THE "O" RING AND THEN REINSTALL IN THE GROOVE. IF THE SEAL IS DAMAGED, IT MUST BE REPLACED BEFORE THE SEALING RING IS REASSEMBLED.



**GUIDE PINS**

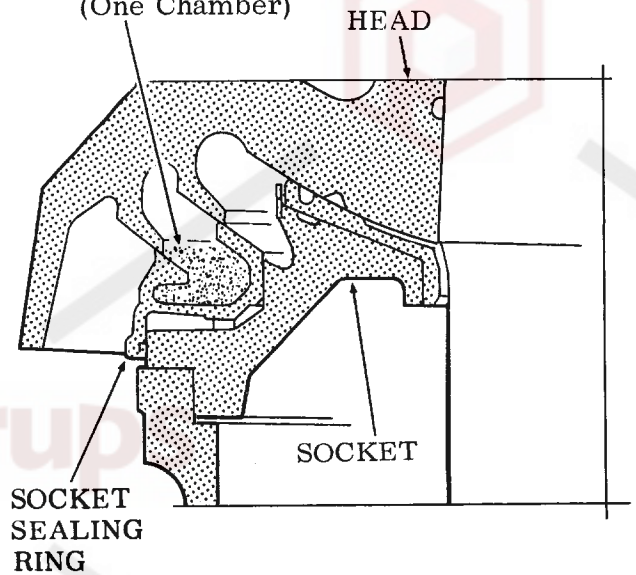
THE FELT PACKING OR "O" RING SEALS AGAINST DUST INFILTRATING BETWEEN SOCKET AND RING. IF DUST IS ALLOWED TO ENTER THIS AREA, FREE MOVEMENT OF THE SEALING RING CAN BE IMPAIRED. THEREFORE, IF THIS PACKING OR "O" RING SHOULD BECOME DAMAGED OR INEFFECTIVE THROUGH LONG USE, REPLACEMENT IS NECESSARY.

GREASE  
(Two Chambers)



**5-1/2 Ft. AND 7 Ft.  
BOLTED SOCKET**

GREASE  
(One Chamber)



**2 Ft., 3 Ft., 4 Ft., 4-1/4 Ft. AND  
7 Ft. DOWELLED SOCKET**

**SOCKET SEALING RING GREASE CHAMBERS**

- 11 Carefully aligning the slots in the sealing ring with the locking keys or the guide pins in the sealing ring with the guide bushings in the socket, lower the ring over the socket onto the spring housings.
- 12 Check to be certain that the ring is free on the socket, that no binding of the seal is evident and that free movement on the springs is possible. If the sealing ring is not "free" on the socket, trim the inside diameter of the felt packing, using a sharp knife.
- 13 Remove the lifting eyebolts and seal the tapped holes with cotton waste saturated in oil or grease.

ON THE 4-1/4 FT. DOWELLED SOCKET ALL DRILLED AND TAPPED HOLES IN THE SOCKET ARE TO BE SEALED WITH THE PLASTIC TAPERED PLUGS THAT ARE FURNISHED.

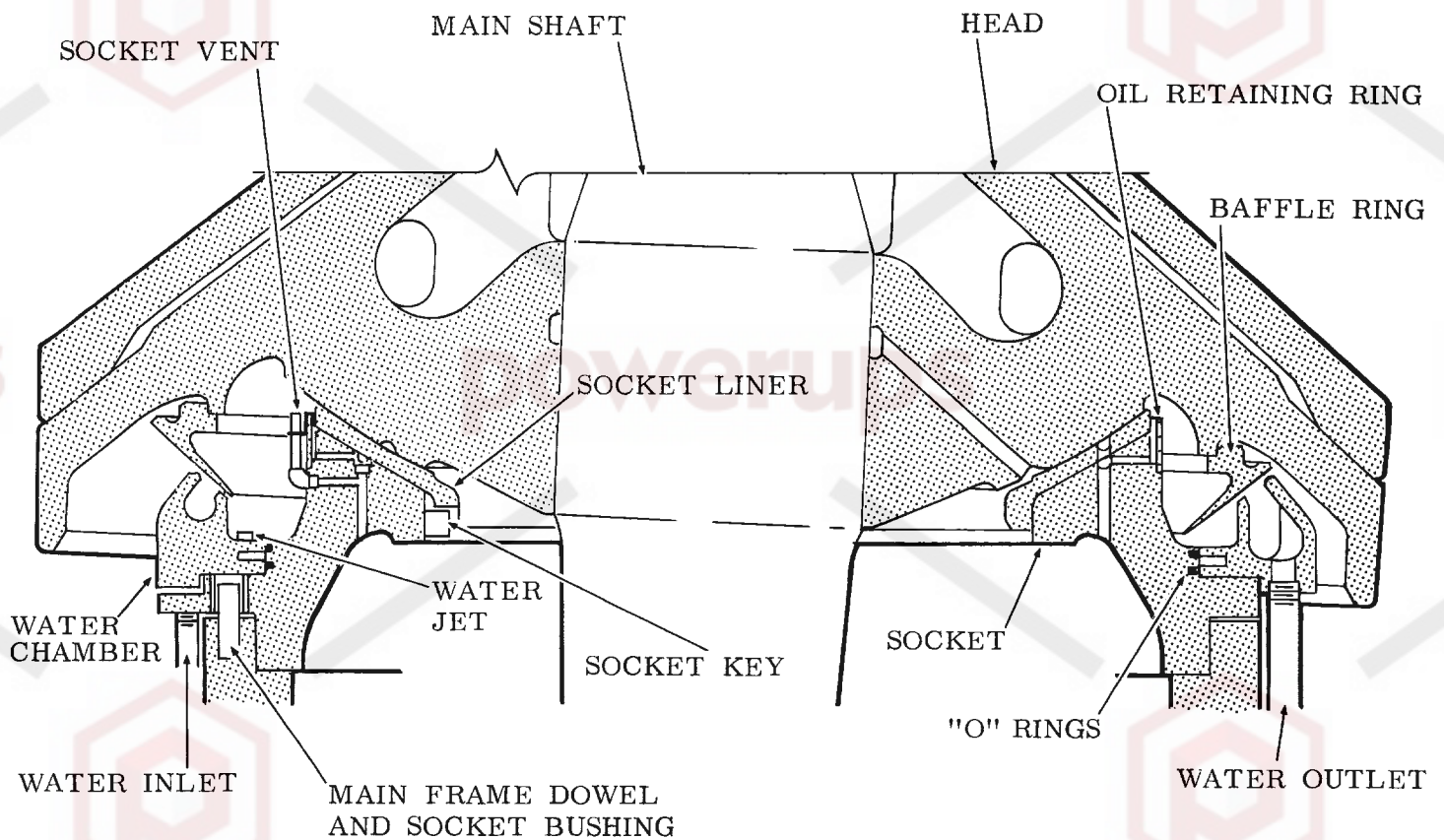
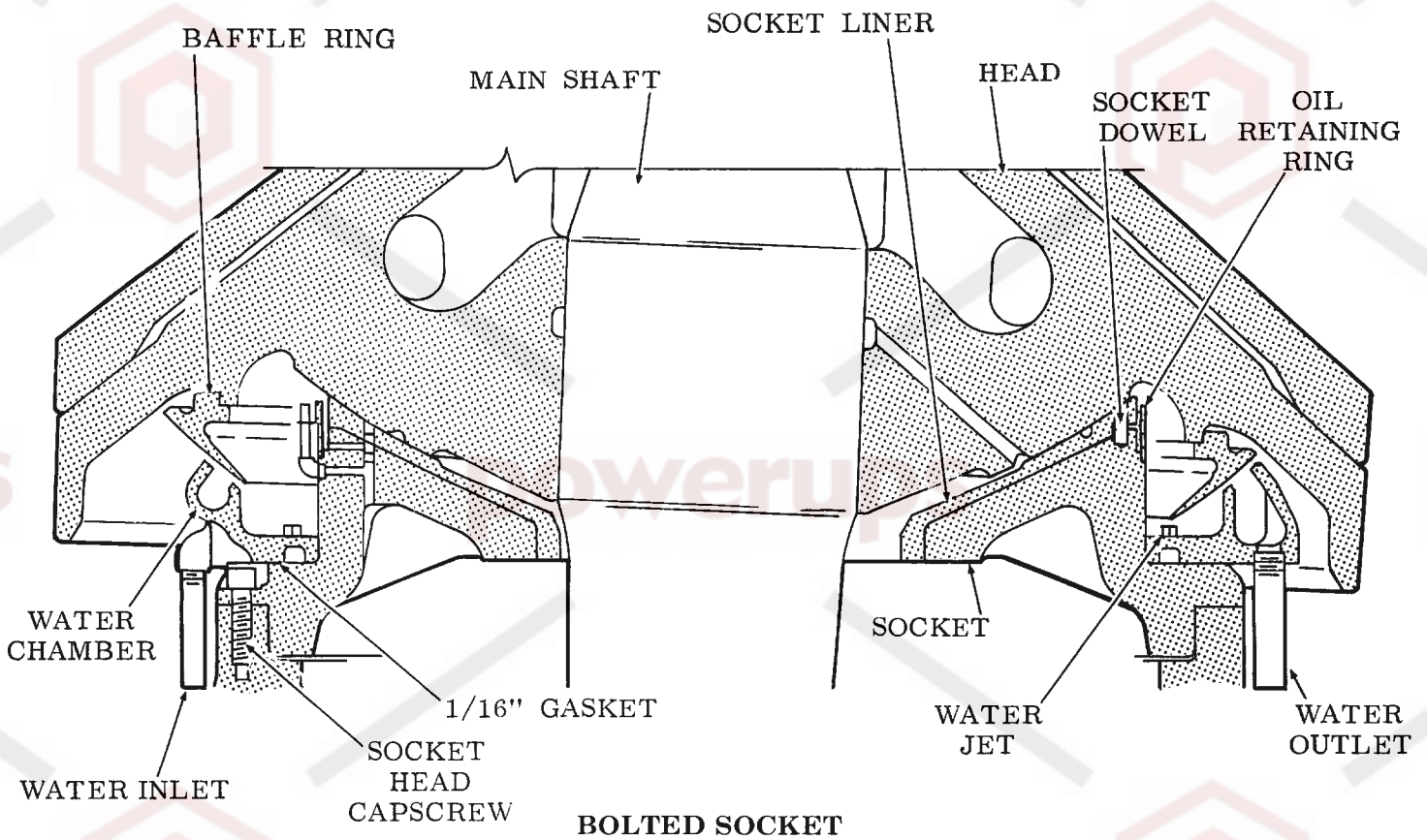
- 14 If this is a STANDARD SEAL ARRANGEMENT pack the sealing ring with a lithium base grease such as NLGI No. 1 or equivalent, to the level shown on the illustration SOCKET SEALING RING GREASE CHAMBERS. The sealing ring on the 2 Ft. through 4-1/4 Ft. and 7 Ft. dowelled socket has only one chamber that has to be filled with grease, while the 5-1/2 Ft. and 7 Ft.

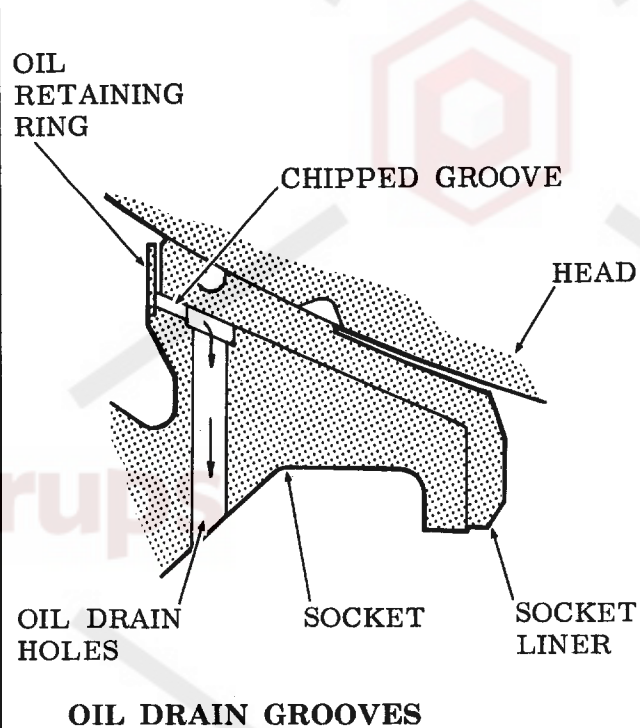
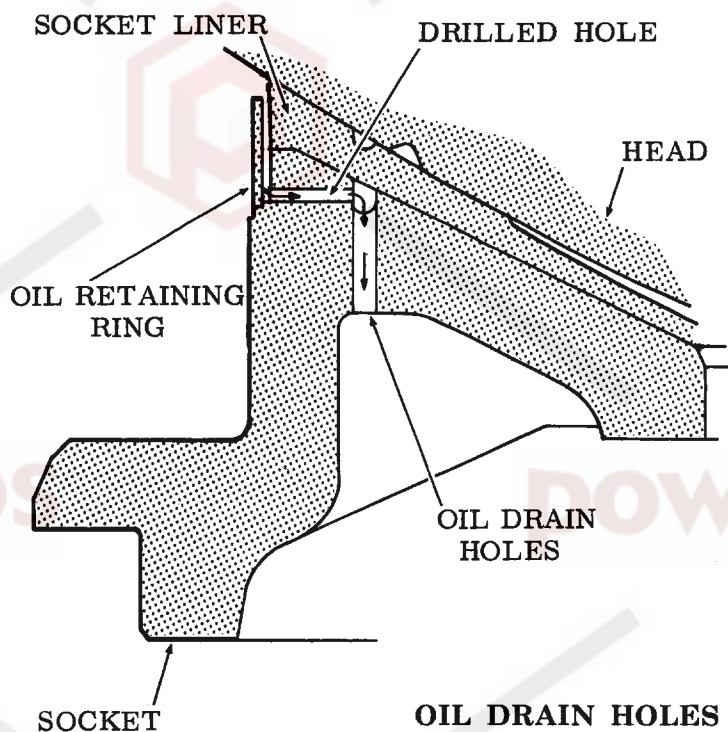
bolted socket has two chambers that are to be filled with grease. If the Crusher has an AIR SEAL ARRANGEMENT do not pack the sealing ring with grease. Proceed to Step 15.

- 15 Lightly oil the surface of the socket liner and coat both ring and head wipers with a liberal amount of grease.
- 16 Install the main shaft assembly in the Crusher and check that the springs lightly force the sealing ring against the wipers on the head.
- 17 After the main shaft assembly is in its proper position, lift the assembly approximately 1/2" and again check that the sealing ring is free to move on the springs.

**SERVICING THE WATER SEAL ARRANGEMENT.** With the main shaft assembly out of the Crusher for a liner change, it is advisable to clean the water chamber and check the socket sealing arrangement for proper operation. For disassembly and replacement of the various socket sealing components refer to the instructions as described under REPLACING THE WATER CHAMBER GASKET OR "O" RINGS.

To service the parts on a water seal arrangement, proceed as follows:





**OIL DRAIN HOLES/GROOVES**

- 1 Thoroughly clean all the parts, removing all grease, dirt and sediment. See the illustration WATER SEAL ARRANGEMENT.
- 2 Clean the slots or holes in the water jets to be sure there will be unrestricted water flow. If necessary, adjust each water jet so that the slots or holes will all point in the same direction so that the water will circulate in a clockwise direction. This will prevent sediment from settling in the chamber. See the illustration ADJUSTING WATER JETS.
- 3 Check that the drain holes or chipped grooves just beneath the socket liner are open. These holes or grooves permit the excess oil that flows over the socket liner to run down between the socket liner and the oil retaining ring and drain back into the Crusher. See the illustration OIL DRAIN HOLES/GROOVES
- 4 On the 7 Ft. Crusher, check that the vent pipes are open thereby allowing the water chamber and baffle ring area to maintain atmospheric pressure. The 4-1/4 Ft. and 5-1/2 Ft. Crushers have similar venting arrangements. These larger machines are equipped with vents because of the large quantity of water being circulated through the water chamber. See the illustration

**WATER SOCKET VENTING.**

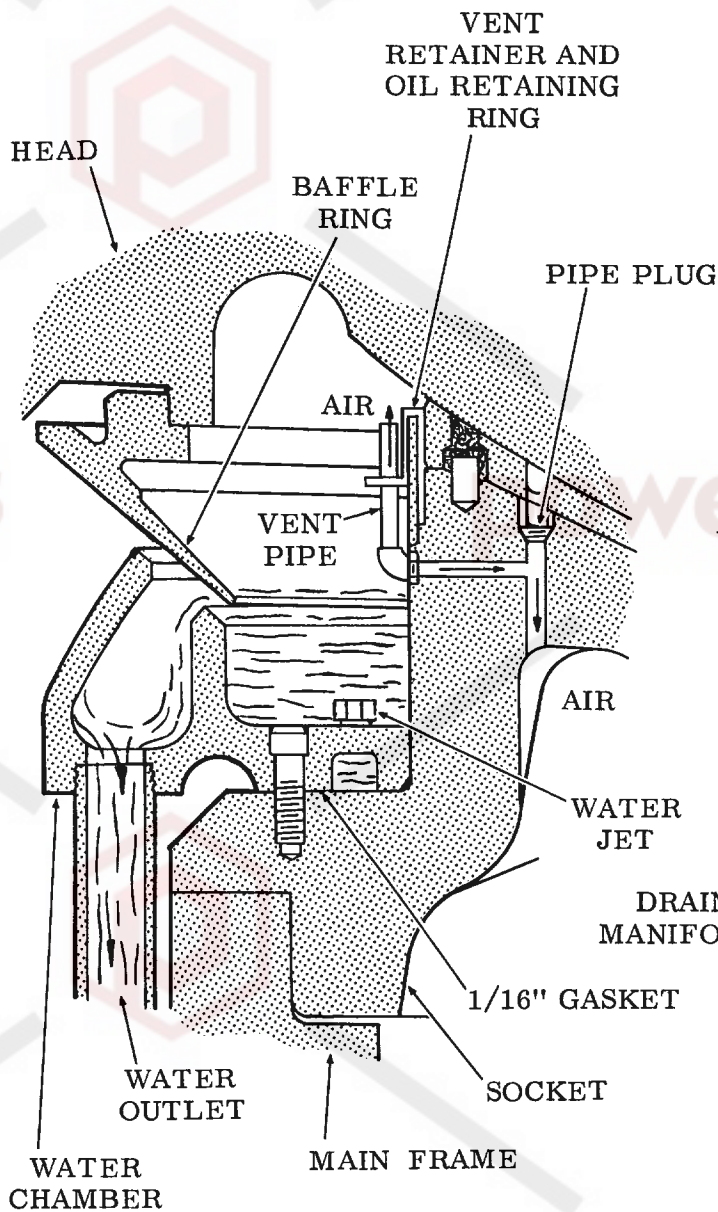
- 5 Fill the chamber with water and test for leaks and proper operation. See the table PIPING AND WATER REQUIREMENTS.
- 6 Install the main shaft assembly in the Crusher.

**WATER PRESENT IN THE LUBRICATING OIL.** There may be occasions when water may be present in the lubricating oil, either from condensation, or a plugged air breather or if the Crusher is so equipped, from a faulty water seal arrangement.

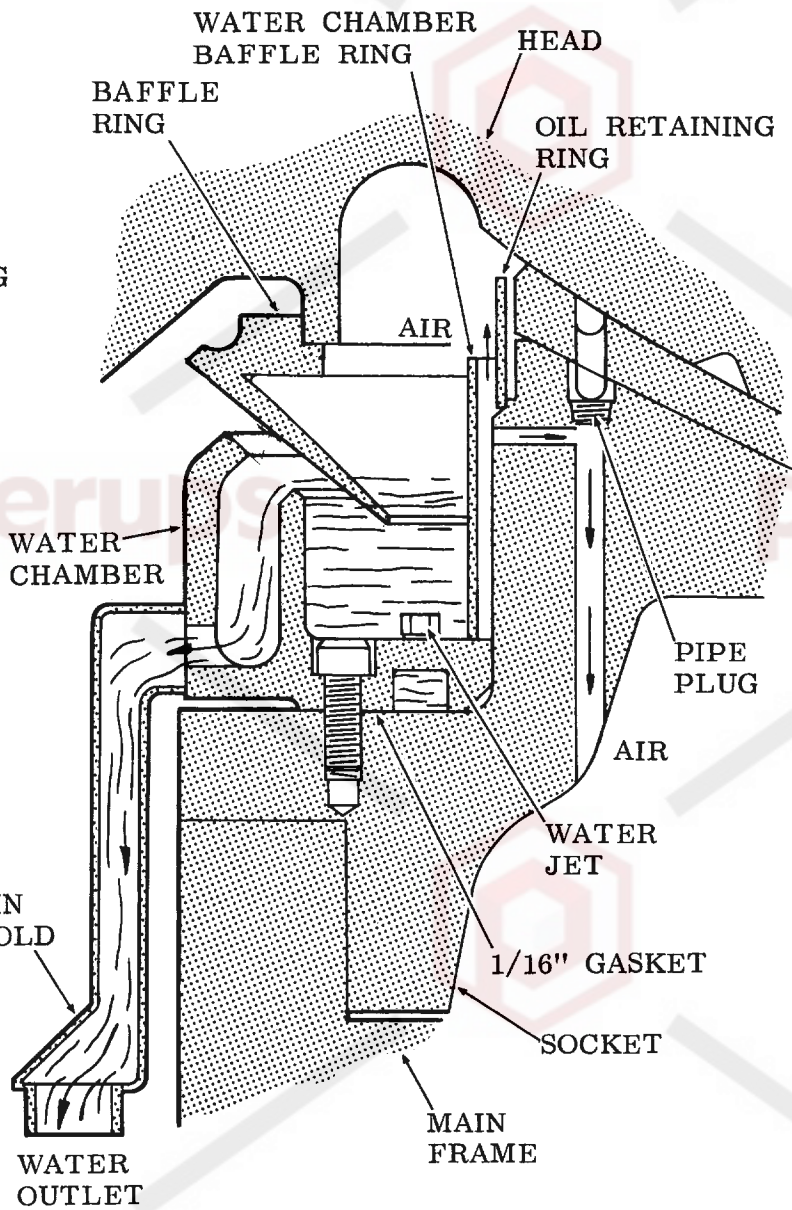
**AN IMPORTANT FACTOR TO CONSIDER IS THAT THE AIR BREATHER CONNECTING INTO THE SIDE OF THE COUNTERSHAFT BOX MUST BE CLEAN TO MAINTAIN ATMOSPHERIC PRESSURE INSIDE THE CRUSHER TO ASSURE FREE DRAINAGE OF THE LUBRICATING OIL AND CIRCULATION OF WATER.**

A natural cause of water in the lubricating oil is condensation, in which case, it need only to be drained off. If the water which is present in the lubricating oil is due to condensation or other natural causes, allow the oil to remain motionless in the tank for a day so that the water will have a chance to settle to the bottom of the tank. Since the water is the heavier liquid, it can now be drained off without losing a great deal of oil. When water is present in the oil in any appreciable amount, the oil will foam. This con-





7 FT. CRUSHER



4 1/4 FT. & 5 1/2 FT. CRUSHER

### WATER SOCKET VENTING

dition is readily visible in the oil level gauge on the oil tank. Insufficient clearance between the water chamber rubber skirt and the baffle ring on the head used on some Crushers can cause water in the oil. See the instructions REPLACING THE WATER CHAMBER GASKET OR "O" RINGS. Another cause of water in the lubricating oil is that water is being supplied in greater amounts than what is recommended. See the table PIPING AND WATER REQUIREMENTS.

**LEAKING WATER.** Should water begin to leak from beneath the Crusher, it could be caused by either an excessive amount of water being supplied to the chamber, or by the discharge pipe not drain-

ing freely due to being frozen or partially clogged. Dirt or other foreign material such as precipitation from hard water may also partially clog the water outlet or drain manifold. See the table PIPING AND WATER REQUIREMENTS. Also check all pipe connections for tightness. Leakage could occur from the gasket joint between the water chamber and socket, see the instructions REPLACING THE WATER CHAMBER GASKET OR "O" RINGS.

**REPLACING THE WATER CHAMBER GASKET OR "O" RINGS.** If there is evidence of water leakage from beneath the Crusher or as indicated by foam in the oil level gauge on the oil tank, the Crusher should be disassembled to determine whether there

is a leaking water chamber gasket or worn "O" rings or the vents and drain holes are plugged.

In some Crushers there was a rubber skirt inserted in a groove in the water chamber to prevent crushed material from bouncing into the water chamber and plugging up the water outlet or drain manifold. This rubber skirt, when it made contact with the baffle ring welded to the head, had a tendency to cause the water flowing in the water chamber to either be pumped out of the Crusher into the discharge compartment or be splashed into the Crusher's lubricating system.

To prevent this pumping action, a clearance of at least 1/8" between the rubber skirt and the baffle ring was required. However, field experience has shown that this clearance was not maintained. Therefore if the Crusher has a rubber skirt, it is recommended the skirt be pulled out of the groove in the water chamber and thrown away.

To replace the gasket or "O" rings or other related parts, proceed as follows:

- 1 With the main shaft assembly removed, thoroughly clean the water chamber, removing any grease or other sealing agent which might be packed around the socket head capscrews.

**ON THE 7 FT. DOWELLED SOCKET THE WATER CHAMBER IS HELD TO THE SOCKET BY HEX HEAD CAPSCREWS BOLTED FROM BENEATH THE SOCKET.**

- 2 Disconnect the pipe couplings in the water piping at the inlet and the drain side of the water chamber. See the illustration WATER SEAL ARRANGEMENT.

- 3 Remove the socket head or hex head capscrews which bolt the water chamber to the socket.

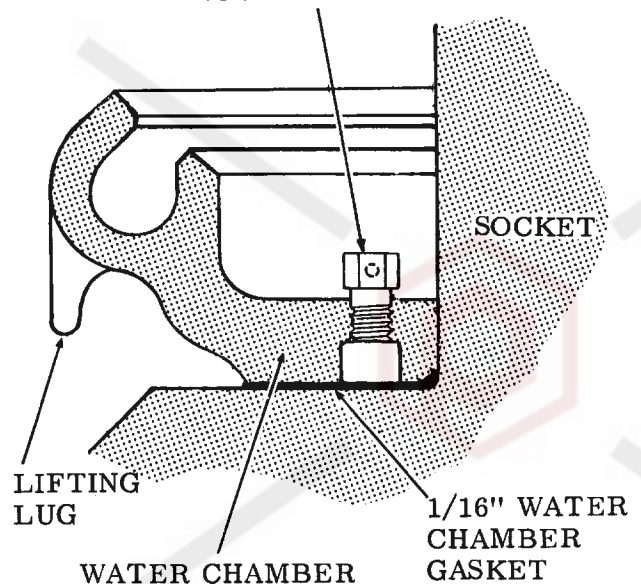
**ON THE 7 FT. MACHINE THE VENTS AND VENT RETAINERS MUST BE UNSCREWED AT THE SIDE OF THE SOCKET BEFORE THE CHAMBER CAN BE LIFTED OFF. SEE THE ILLUSTRATION WATER SOCKET VENTING.**

- 4 Using the lifting lugs or eyebolts, lift the water chamber, together with the short sections of inlet and drain piping, clear of the Crusher.
- 5 With a putty knife or other thin bladed instrument, scrape the old gasket off the socket. Clean the surface of the chamber and the socket thoroughly so that all traces of gasket or gasket cement are removed. Be careful not to damage the gasket surfaces.

On the 7 Ft. dowelled socket there is NO gasket between the water chamber and socket. The water chamber and socket joint is sealed by the use of two large diameter "O" rings inserted into machined grooves in the socket. Therefore, if these "O" rings should become damaged or ineffective through long use, replacement is necessary. Lightly grease the new "O" rings when installing them in the grooves.

- 6 Clean the slots or holes in the water jets to be sure there will be unrestricted water flow. If necessary, adjust each water jet so that the slots or holes will all point in the same direc-

**ADJUST WATER JETS SO THAT WATER FLOWS IN A CLOCKWISE DIRECTION**



**ADJUSTING WATER JETS**

tion so that the water will circulate in a clockwise direction. See the illustration ADJUSTING WATER JETS. This will prevent sediment from settling in the chamber.

- 7 On those Crushers using a water chamber gasket, cement the 1/16" gasket to the socket using a suitable gasket cement such as Permatex No. 2. Do not cement the chamber to the gasket.
- 8 Carefully position the water chamber on the socket so as not to disturb the gasket, or "O" rings, then align the holes in the chamber with the tapped holes in the socket.

**ONE HOLE IN BOTH THE WATER CHAMBER AND THE SOCKET IS OFFSET TO INSURE THE PROPER LOCATION OF**

**WATER INLET AND DRAIN CONNECTIONS.**

- 9 Bolt the water chamber to the socket with the socket head or hex head capscrews. Be sure that each capscrew is tight enough to effect a seal, however, do not overtighten.
- 10 After the capscrews have been tightened securely, the area around the head of the capscrew should be sealed to prevent corrosion. This sealing can be done with a tube of silicone sealant. Any tapped holes are to be sealed with cotton waste saturated with oil or grease.

**INSTALL THE VENTS AND RETAINERS ON THE 7 FT. CRUSHER.**

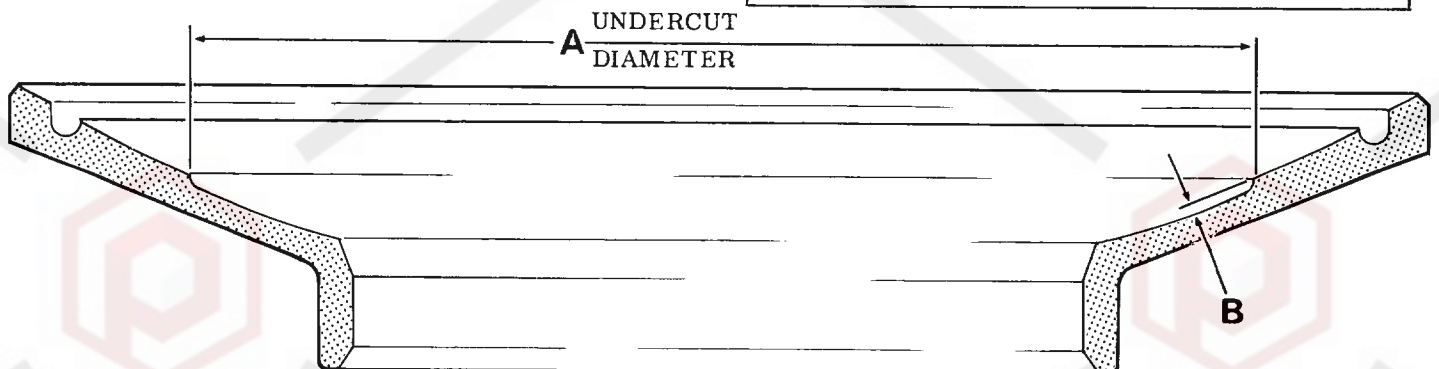
- 11 Connect the water seal piping to the inlet and outlet side of the water chamber by referring to the piping drawings furnished.
- 12 Fill the chamber with water and test for leaks and proper operation. See the table PIPING AND WATER REQUIREMENTS.
- 13 Install the main shaft assembly in the Crusher.

**SOCKET LINER GENERAL INFORMATION**

A portion of the spherical surface of the socket liner is relieved or undercut to a depth of 3/16" or 1/4" depending on crusher size. This undercut is shown in the illustration SOCKET LINER UNDERCUT DIMENSIONS. The socket liner is machined so that normally the outer edges of the socket liner are the only portion which will be in contact with the head. As the socket liner wears, the main shaft assembly slowly drops, causing the running clearance between the main shaft and inner eccentric bushing to be reduced. When this wear occurs it may cause the head to revolve at an abnormally fast rate. (0 to 10 RPM is considered normal with Crusher running empty.) A careful inspection of the socket liner will show if the bearing area has worn away where it is flush with the undercut. In conjunction with the spinning head, there will be a possible loss of oil and an increase in oil temperature. When a spinning head condition is noticed, the socket liner most likely must be replaced.

CRUSHER SIZE	A DIA-METER	B UNDERCUT
2 Ft.	12-5/8	3/16
3 Ft. Standard	16-1/2	3/16
3 Ft. Short Head	17-1/2	3/16
4 Ft.	20	3/16
4-1/4 Ft.	22-1/2	3/16
5-1/2 Ft.	30	3/16
7 Ft.	38	1/4
All Dimensions In Inches		

**SOCKET LINER UNDERCUT DIMENSIONS**



WHEN THE SOCKET LINER WEARS DOWN TO THE UNDERCUT, THIS WILL BE READILY NOTICEABLE BY THE SHALLOW OIL GROOVE, THE LINER MUST BE REPLACED. OTHERWISE DAMAGE TO PARTS OF THE SOCKET SEALING ARRANGEMENT AS WELL AS DAMAGE TO THE CRUSHER ITSELF, MAY OCCUR.

**REPLACING SOCKET LINER.** When the socket liner has worn to a point where replacement is required, proceed as follows:

- 1 Remove the socket from the Crusher as described under REMOVAL OF BOLTED or DOWELLED or KEYED SOCKETS.
- 2 Place the socket upside down on timbers or other suitable supports as shown in the illustration SOCKET LINER REMOVAL.

CARE SHOULD BE TAKEN WHEN SUSPENDING THE SOCKET THAT NO OBSTRUCTIONS WILL INTERFERE WITH THE REMOVAL OF THE WORN LINER.

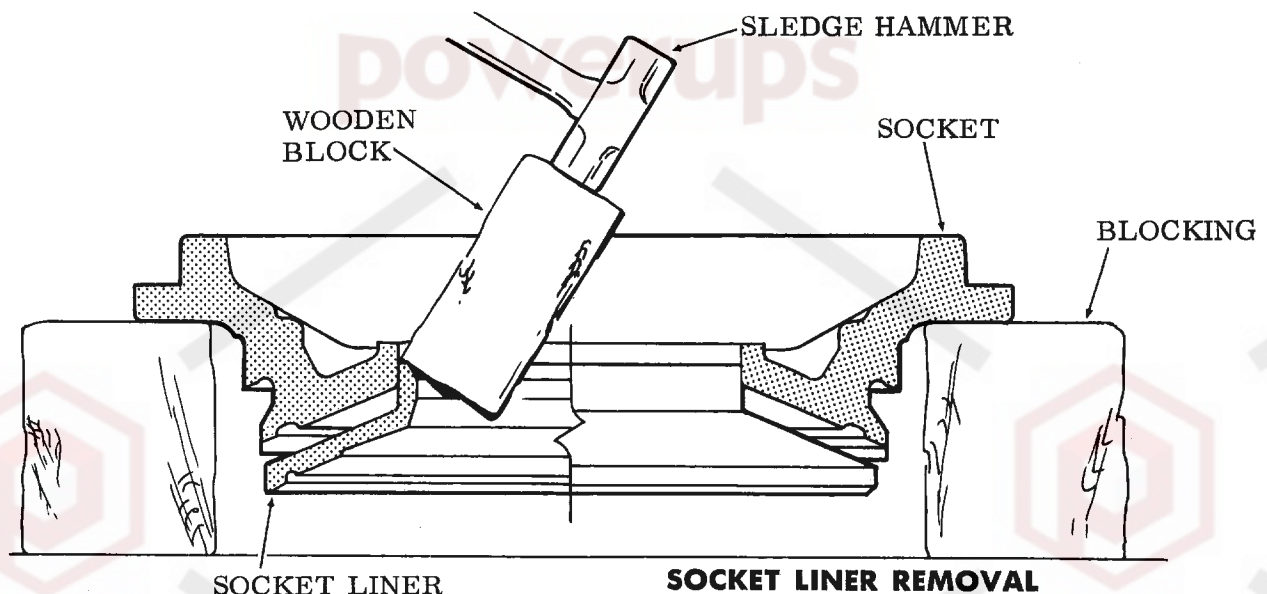
- 3 Place a 4" x 4" wooden block against the socket liner and hit against the wooden block with a heavy hammer. See the illustration SOCKET LINER REMOVAL. Keep hitting the liner moving around the bore

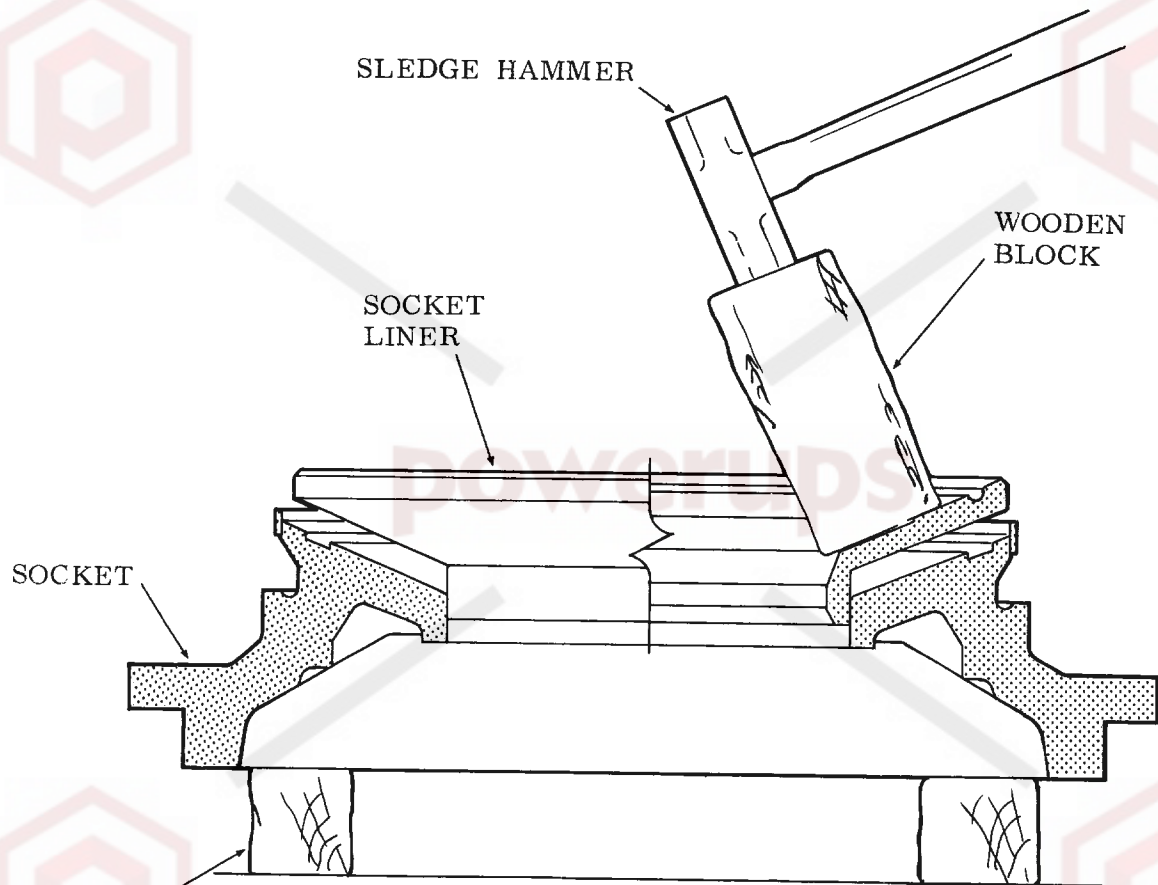
and alternately hitting the liner at one point and then at a point on the opposite side, until the liner drops free.

- 4 Then turn the socket over and center the new liner over the brass dowels in the socket. If necessary, replace any dowels that have become worn. These dowels prevent the socket liner from turning should the liner lose its interference fit. See the table SOCKET LINER INTERFERENCE FIT for the proper amount of interference between socket liner and socket.

ON THE 7 FT. DOWELLED SOCKET, TWO KEYS ARE USED TO PREVENT THE SOCKET LINER FROM TURNING SHOULD THE LINER LOSE ITS INTERFERENCE FIT. IT IS ADVISABLE WHENEVER REPLACING THE SOCKET LINER TO CHECK THE WELDS HOLDING THE KEY TO SEE IF THERE ARE ANY CRACKS, REWELD IF NECESSARY. SEE THE ILLUSTRATION SOCKET LINER KEYS.

- 5 Place a wooden block directly over the top of the socket fit, as the liner has an interference fit with the socket, and hit against the block with a sledge hammer or heavy ram. Force the liner in place a little at a time, moving around the perimeter of the bore and alternately hitting the liner at one point and then at a point on the opposite side. See the illustration SOCKET LINER INSTALLATION.



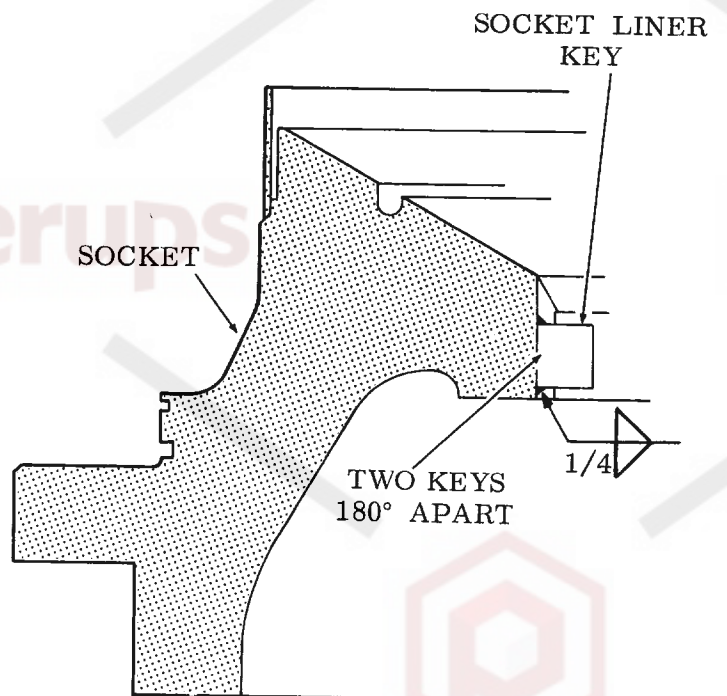


**SOCKET LINER INSTALLATION**

CRUSHER SIZE	SOCKET LINER TO SOCKET INTERFERENCE	
	MINIMUM	MAXIMUM*
2 Ft.	.002	.004
3 Ft.	.000	.003
4 Ft.	.001	.004
4-1/4 Ft.	.001	.004
5-1/2 Ft.	.001	.005
7 Ft. Bolted Socket	.001	.006
7 Ft. Dowelled Socket	.002	.006

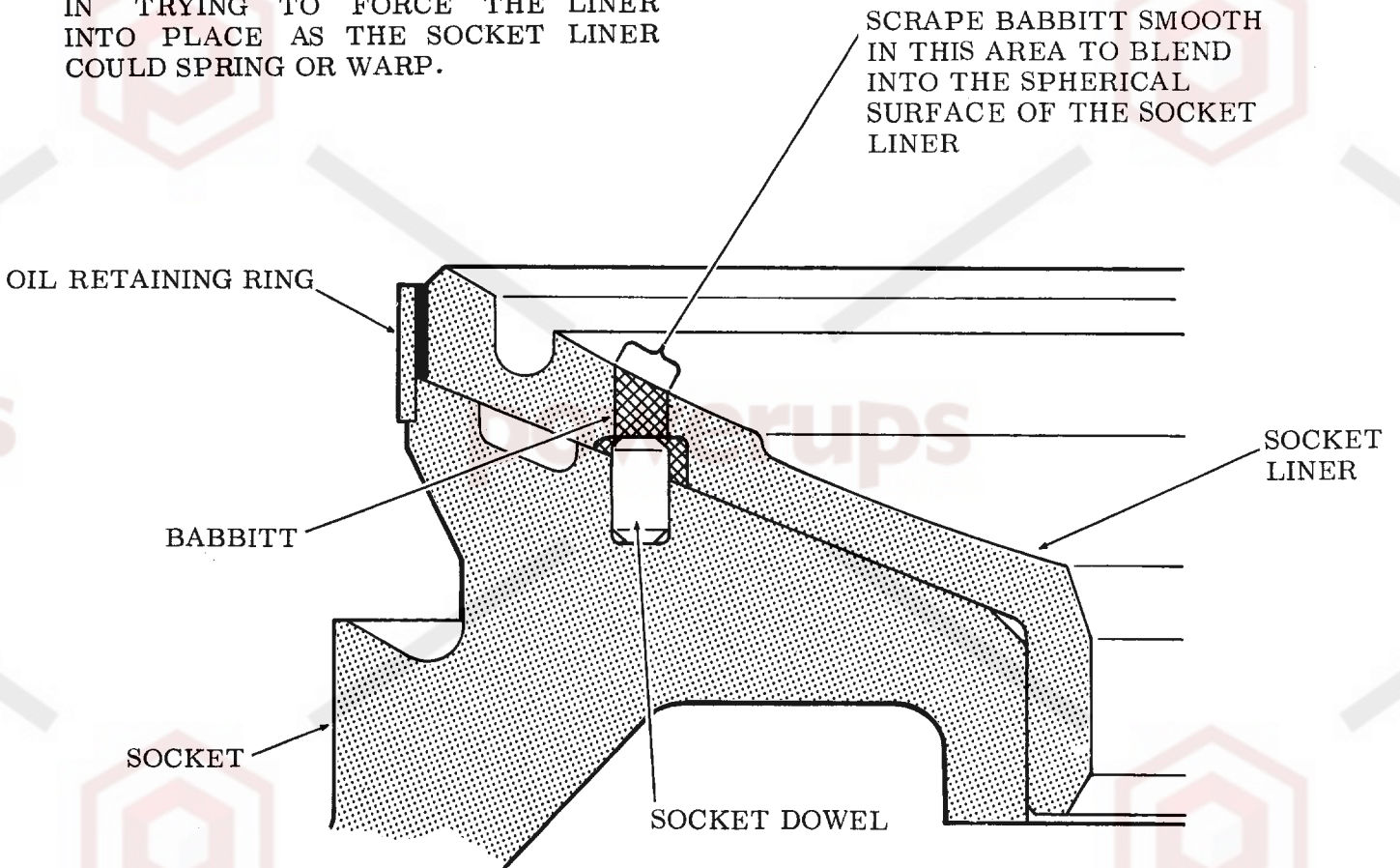
\*Maximum Interference Fit Desired  
All Dimensions In Inches

**SOCKET LINER INTERFERENCE FIT**



**SOCKET LINER KEYS**

DO NOT USE EXCESSIVE FORCE IN TRYING TO FORCE THE LINER INTO PLACE AS THE SOCKET LINER COULD SPRING OR WARP.



**SOCKET DOWELS**

6 Pour babbitt into the counterbored dowel holes, after the liner has been firmly seated.

**WARNING**

When handling the 650° Fahrenheit molten babbitt, goggles and protective clothing must be worn. Contact with molten babbitt will result in serious burns.

7 Once the babbitt has hardened, remove all excess babbitt by scraping, being sure that there are no high spots and that the surface of the babbitted area is smooth and blends into the spherical surface of the liner. See the illustration SOCKET DOWELS.

8 Thoroughly clean and lightly oil the surface of the liner.

THE PROCEDURE AS OUTLINED IN STEPS 6 AND 7 DO NOT APPLY TO THE 7 FT. DOWELLED SOCKET.

REMOVAL OF BOLTED SOCKET. To remove the bolted socket for maintenance or the replacement of related parts, proceed as follows:

- 1 Lift off the socket sealing ring or unbolt the water chamber to give access to the socket head capscrews which bolt the socket to the main frame.
- 2 Using a wrench, remove these capscrews.
- 3 Use four of the capscrews as jacking screws by installing them into the tapped holes provided in the socket.
- 4 Uniformly heat the main frame around the socket fit to 100° Fahrenheit above ambient temperature.
- 5 Using a wrench, alternately tighten each cap-screw a small amount. See the illustration REMOVING BOLTED SOCKET. The socket will be slowly withdrawn from its interference fit in the frame.

- 6 Continue tightening the capscrews until the capscrews bottom in the threaded holes.
- 7 Back out the capscrews far enough to insert a steel block under each capscrew.

ON THE 3 FT. CRUSHER, SPECIAL LONGER JACKING SCREWS ARE FURNISHED FOR REMOVING THE SOCKET AS THE SLANTING SOCKET SURFACE ON THE FRAME PREVENTS THE USE OF STEEL BLOCKS FOR EXTENDING THE LENGTH OF THE REGULAR SOCKET HEAD CAPSCREWS. THESE LONGER CAPSCREWS ARE IN THE PACKING BOX WITH THE TOOLS.

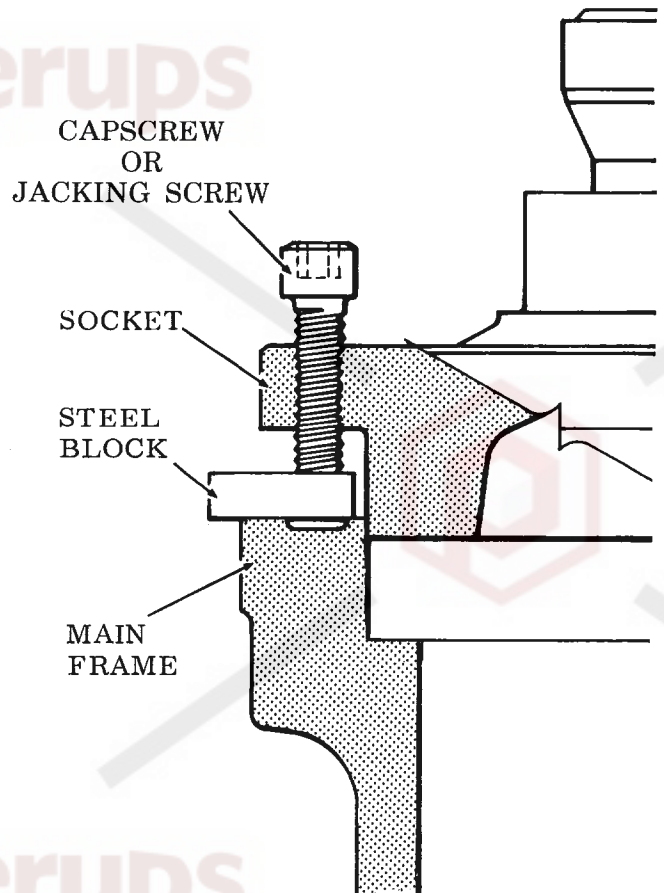
- 8 Again alternately tighten each capscrew a small amount against the steel block until the socket is free of the frame.

THE TAPPED HOLES SHOULD BE FILLED WITH COTTON WASTE SATURATED WITH OIL OR GREASE IMMEDIATELY AFTER USE TO PREVENT CORROSION AND PLUGGING WITH DIRT.

- 9 Screw the lifting eyebolts into the socket and remove the socket from the Crusher.

**REMOVAL OF 4-1/4 FT. AND 7 FT. DOWELLED SOCKET.** To remove the dowelled socket for maintenance or the replacement of related parts, proceed as follows:

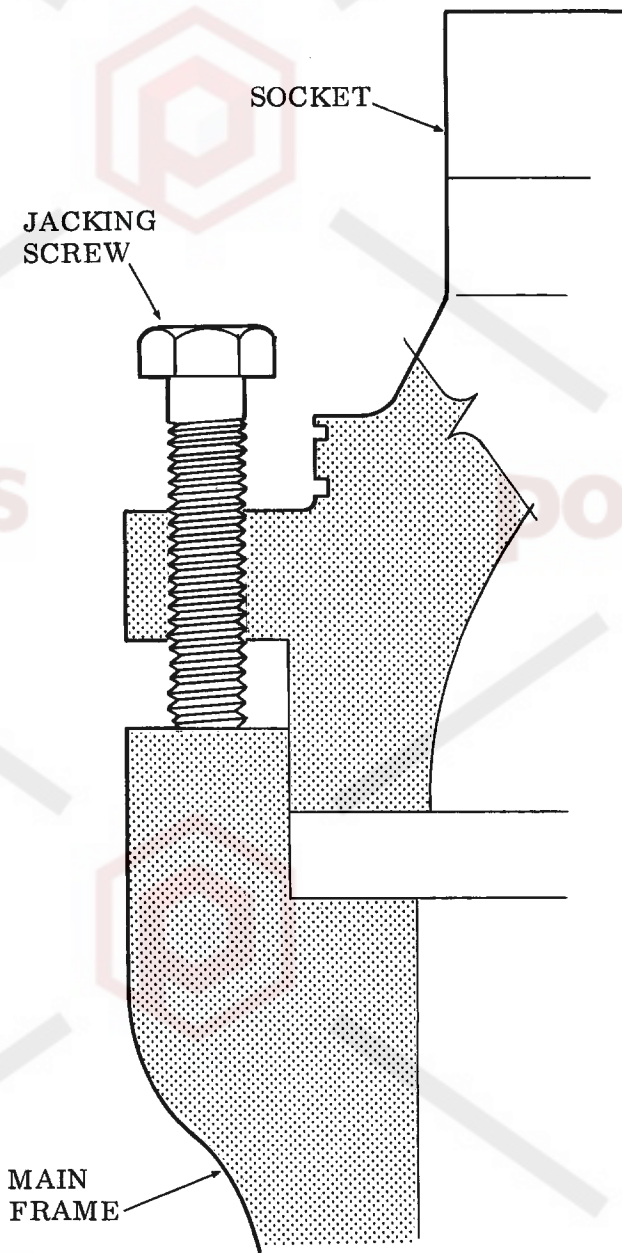
- 1 Lift off the socket sealing ring or unbolt the water chamber to give access to the dowels which prevent the socket from turning in the main frame.
- 2 Use the four special hexhead jacking screws found in the box with the tools by installing them into the tapped holes provided in the socket.
- 3 Uniformly heat the main frame around the socket fit to 100° Fahrenheit above ambient temperature.
- 4 Using a wrench, alternately tighten each jacking screw a small amount. See the



**REMOVING BOLTED SOCKET**

illustration REMOVING DOWELLED SOCKET. The socket will be slowly withdrawn from its interference fit in the frame.

- 5 Tighten each jacking screw a small amount until the socket is free of the frame.
- 6 The tapped holes should be filled with cotton waste saturated with oil or grease immediately after use to prevent corrosion and plugging with dirt.



**REMOVING DOWELLED SOCKET**

- 7 Screw the lifting eyebolts into the socket and remove the socket from the Crusher.

**REMOVAL OF 2 FT. KEYED SOCKET.** To remove the 2 Ft. keyed socket for maintenance or the replacement of related parts, proceed as follows:

- 1 Place three steel wedges 120° apart between the socket and the top of the eccentric. See the illustration REMOVING KEYED SOCKET.

- 2 Uniformly heat the main frame around the socket fit to 100° Fahrenheit above ambient temperature.
- 3 Alternately hitting the wedges with a sledge hammer will slowly force the socket free of the frame.
- 4 Screw the lifting eyebolts into the socket and remove the socket from the Crusher.

**SHIMMING LOOSE SOCKET.** On rare occasions, after prolonged or continuous hard use, it is possible for the socket to become loose from its press or interference fit in the frame. In the case of the bolted socket, if this condition is not discovered and corrected as soon as possible, breakage of the socket head cap-screws may occur. On a keyed socket the continual pounding can cause the key and main frame bore to wear. The correct interference fit between the socket and main frame is extremely important! See the table **SOCKET INTERFERENCE FIT.**

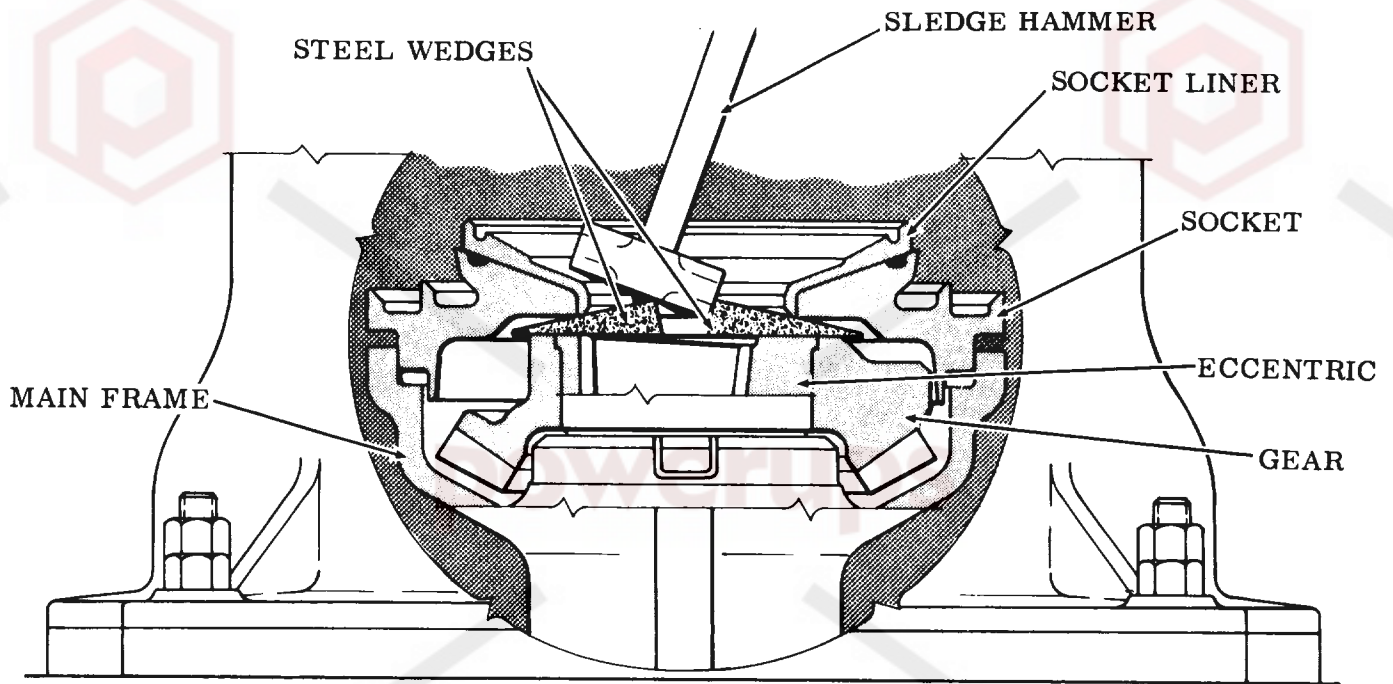
This condition is usually indicated by oil leakage from beneath the Crusher. Other factors can also bring about oil leakage in the same region, such as a worn socket liner or head. Regardless of the cause of the leakage the Crusher should be disassembled to accurately pinpoint where the

CRUSHER SIZE	SOCKET TO MAIN FRAME INTERFERENCE FIT	
	MINIMUM	MAXIMUM*
2 Ft.	.002	.005
3 Ft.	.002	.006
4 Ft.	.003	.007
4-1/4 Ft. Bolted Socket	.003	.007
4-1/4 Ft. Dowelled Socket	.005	.009
5-1/2 Ft.	.003	.008
7 Ft. Bolted Socket	.004	.009
7 Ft. Dowelled Socket	.010	.015

\*Maximum Interference Fit Desired  
All Dimensions In Inches

**SOCKET INTERFERENCE FIT**





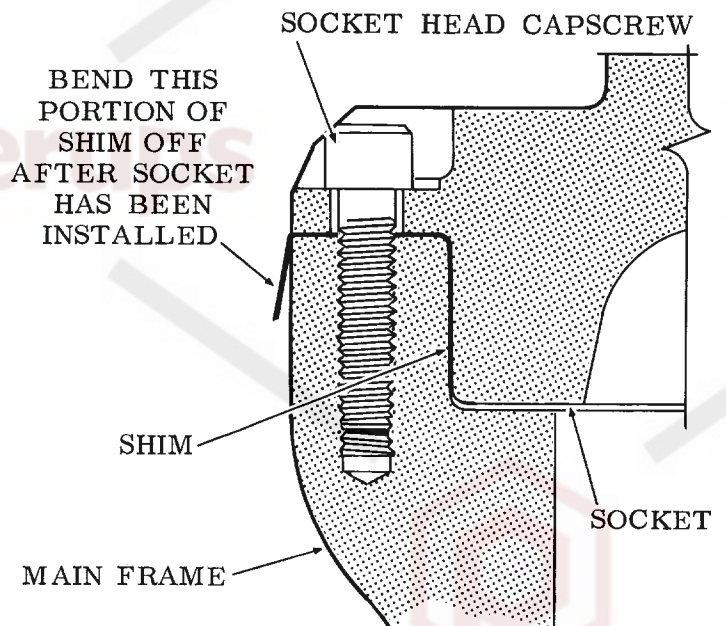
### REMOVING KEYED SOCKET

leakage is occurring. If it is discovered that the leakage is due to a loose socket, the condition can be remedied as follows:

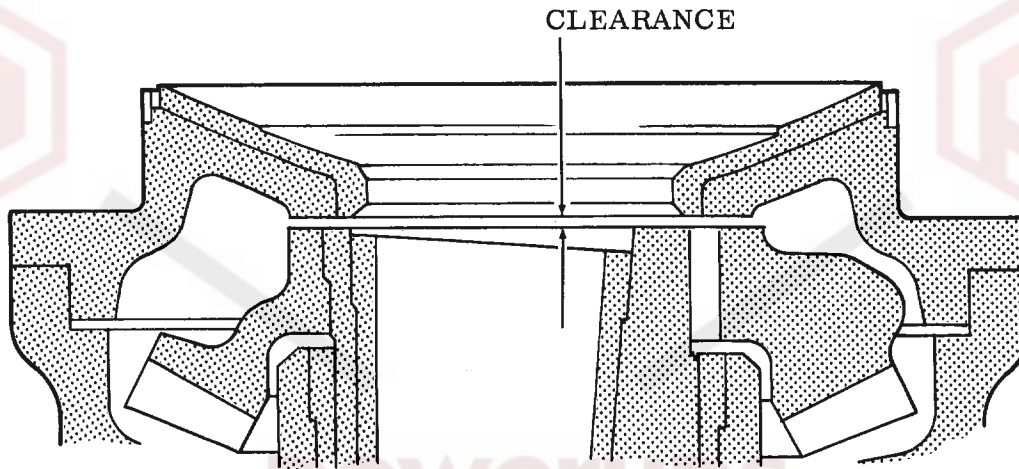
- 1 Match mark the socket and frame at two places, 180° apart. Repeat this procedure four times each time rotating 45°.
- 2 Remove the socket and measure the diameter of the socket and the diameter of the main frame bore at the places indicated by the match marks.
- 3 Compute the average total clearance or interference.
- 4 Make up eight shims of a thickness which will give a total interference fit as specified in the table SOCKET INTERFERENCE FIT. Be sure the shims are long enough to be lapped over the top of the main frame.
- 5 Place the eight shims at the points indicated by match marks. Hold the shims in place by bending the shims around the top of the main frame bore. See the illustration INSTALLING SOCKET SHIMS.

- 6 Force or drive the socket into place in the frame following the procedures under ASSEMBLY INSTRUCTIONS.

**SOCKET AND ECCENTRIC CLEARANCE.** Whenever installing the socket in the Crusher, there must be clearance between the underside



### INSTALLING SOCKET SHIMS



CRUSHER SIZE	ACTUAL CLEARANCE	MINIMUM CLEARANCE	MAXIMUM CLEARANCE
2 Ft.	3/16	3/32	1/4
3 Ft.	3/16	3/32	1/4
4 Ft.	3/16	3/32	1/4
4-1/4 Ft.	1/4	1/8	5/16
5-1/2 Ft.	5/16	3/16	3/8
7 Ft.	5/16	3/16	3/8

All Dimensions In Inches

### SOCKET AND ECCENTRIC CLEARANCES

of the socket and the top of the eccentric and gear as shown in the table SOCKET AND ECCENTRIC CLEARANCES.

Care should be taken when the socket is assembled in the main frame that the minimum clearance between the underside of the socket and the top of the eccentric and gear as shown in the table be carefully observed.

Operating the Crusher without such clearance reduces the running clearance between the inner

eccentric bushing and the main shaft and could cause the Crusher to overheat.

Should little or no clearance exist after the socket is installed, remove the socket and check the table BACKLASH AND ROOT CLEARANCE MEASUREMENTS in Section 5. If these measurements are in accordance with the table, the reduced clearance between the socket and eccentric may be due to wear on the main frame and socket seating surfaces. Reworking the main frame and/or socket to restore the original dimensions is recommended.



## Section 7

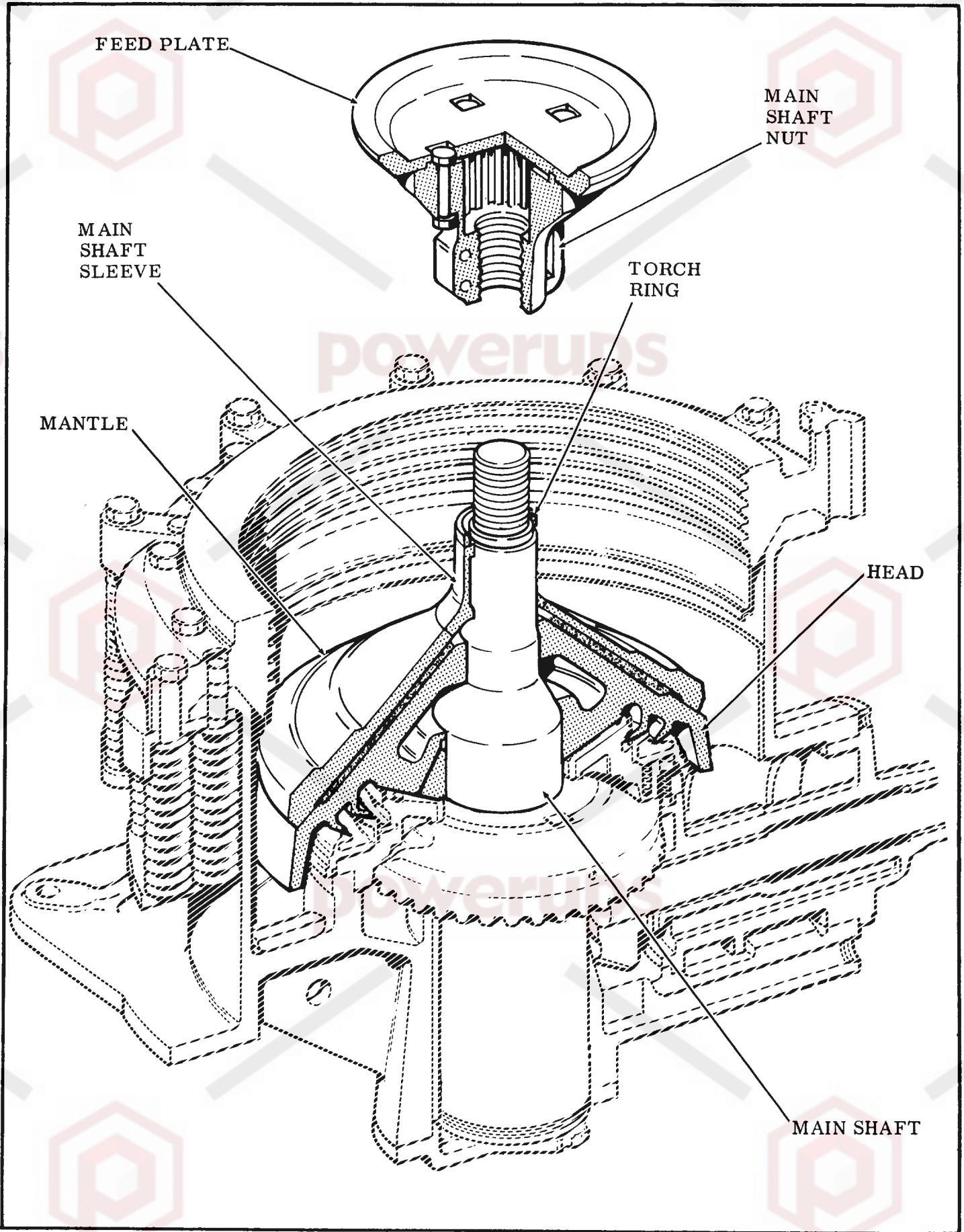
# MAIN SHAFT, MANTLE AND FEED DISTRIBUTOR ASSEMBLIES

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## SECTION 7

# MAIN SHAFT, MANTLE AND FEED DISTRIBUTOR ASSEMBLIES STANDARD CRUSHER

### DESCRIPTION

This section covers the main shaft, mantle and feed distributor assemblies. The head which is assembled to the main shaft by an interference fit is supported by the concave bearing surface of the socket liner. The tapered portion of the main shaft extends down into the inner eccentric bushing and, there only by contact between the main shaft and bushing, is the head driven in its eccentric or gyrating motion. Covering the head is a replaceable mantle which is the rotating or driving crushing member.

On top of the mantle are the main shaft sleeve and torch ring which are all firmly held in place on the head by a main shaft nut threaded directly onto the main shaft. The main shaft nut also provides the support for the feed plate. The feed plate rotates with the main shaft and is responsible for evenly distributing the feed around the feed opening of the crushing members.

### ASSEMBLY INSTRUCTIONS

If the main shaft, mantle and feed distributor assemblies were removed prior to shipment, due to height limitation or weight restrictions, the various parts are to be installed as follows:

- 1 Examine all oil passages to be certain they are thoroughly clean.
- 2 Apply a light coating of oil, not grease, to the main shaft and the spherical surface on the bottom of the head.
- 3 Lift the main shaft assembly by removing the feed plate and inserting the main shaft eyebolt through the main shaft nut and threading it into the main shaft. See the illustration REMOVAL AND INSTALLATION OF MAIN SHAFT ASSEMBLY.

### WARNING

Do not attempt to lift the main shaft assembly by the feed plate. The feed plate bolts are NOT strong enough to lift the entire weight of the main shaft assembly. Serious personal injury or severe damage to the Crusher could result.

- 4 Lower the main shaft assembly into the Crusher, taking certain precautions to prevent damaging the sealing arrangement on the underside of the head and on the socket. This is true regardless of whether the Crusher is equipped with a standard or water seal. See the illustration REMOVAL AND INSTALLATION OF MAIN SHAFT ASSEMBLY. On this illustration, note the points of contact in the encircled areas between the main shaft and inner eccentric bushing as well as the direction of pull on the cable. Tilting the main shaft assembly slightly toward the gear key which is the heavy or thick side of the eccentric will give ample clearance between the sealing arrangement on the head and the socket on the frame.

- 5 Install the bowl as described in ASSEMBLY INSTRUCTIONS in Section 8. Then reassemble the feed plate.

### MAINTENANCE

**MAIN SHAFT ASSEMBLY REMOVAL.** To remove the main shaft assembly for inspection or replacement of parts, proceed as follows:

- 1 Remove the bowl as described in BOWL REMOVAL in Section 8. On some Crushers the feed plate must be removed from the main shaft nut before the bowl can be lifted off.
- 2 Remove the feed plate and insert the main shaft eyebolt through the main shaft nut and thread it into the top of the main shaft. See the illustration REMOVAL AND INSTALLATION OF MAIN SHAFT ASSEMBLY.

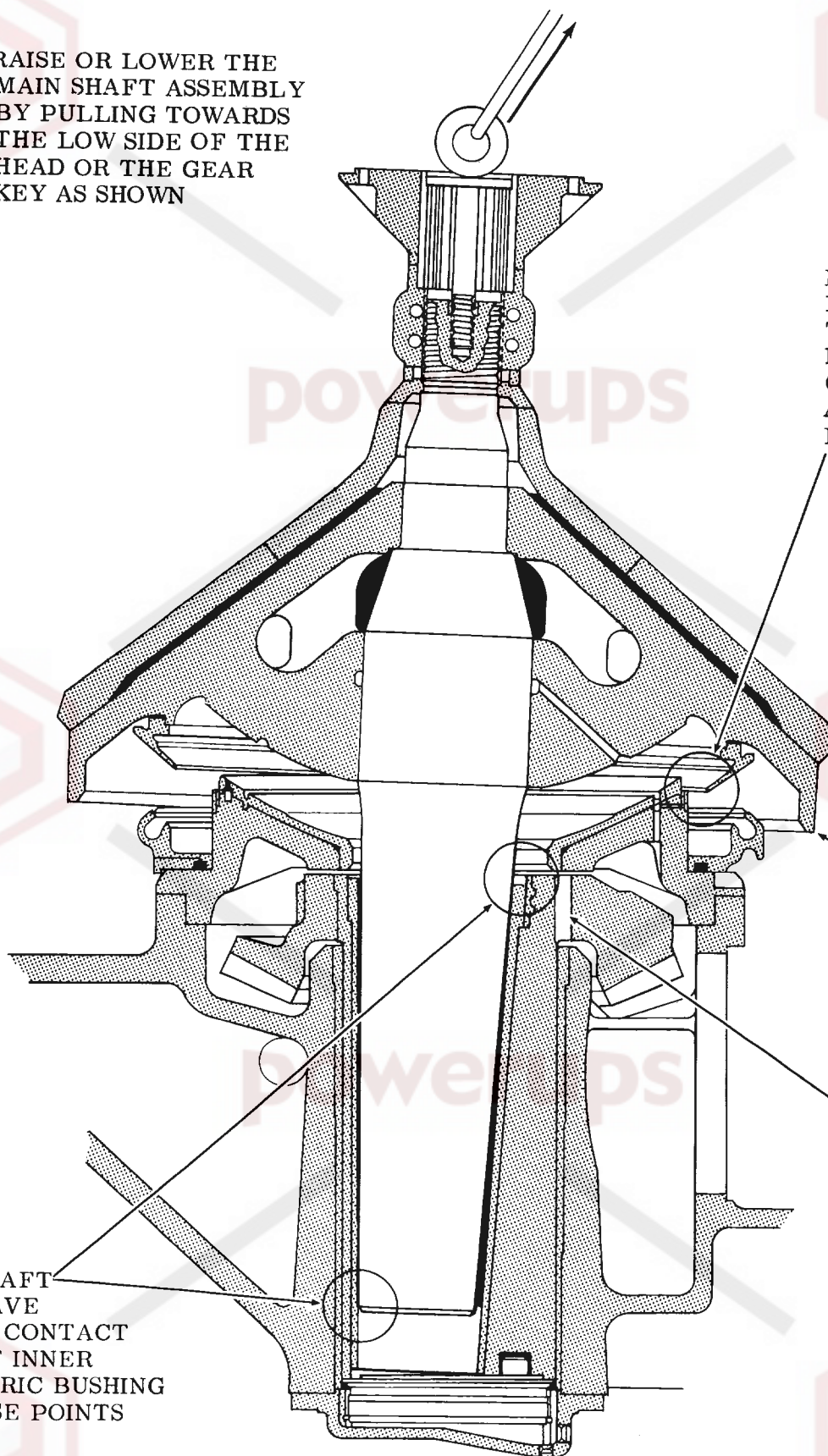
RAISE OR LOWER THE  
MAIN SHAFT ASSEMBLY  
BY PULLING TOWARDS  
THE LOW SIDE OF THE  
HEAD OR THE GEAR  
KEY AS SHOWN

BY LIFTING OR  
LOWERING IN  
THIS MANNER  
NOTE THE  
CLEARANCE  
AT THIS  
POINT

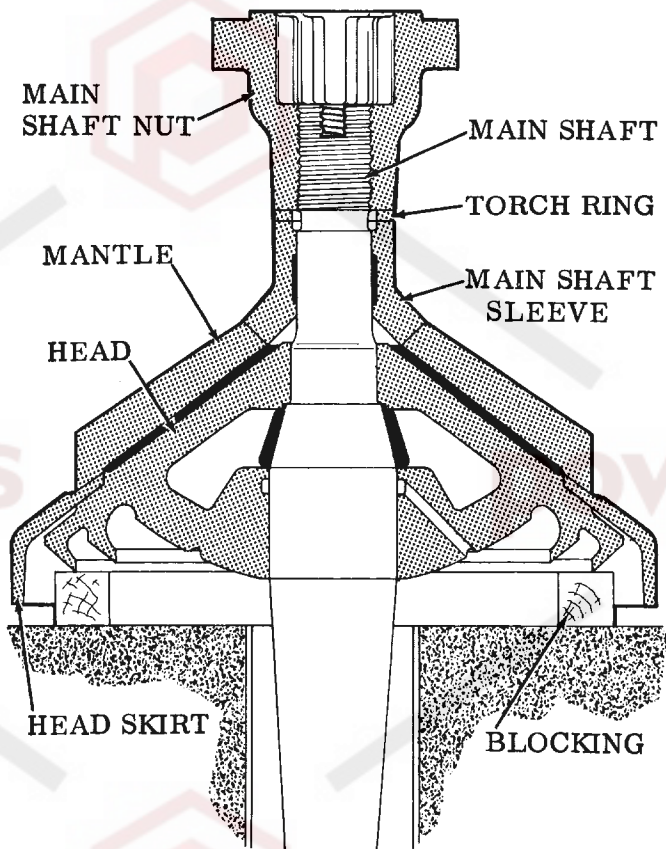
LOW  
SIDE  
OF  
HEAD

GEAR  
KEY

MAIN SHAFT  
IS TO HAVE  
SLIDING CONTACT  
AGAINST INNER  
ECCENTRIC BUSHING  
AT THESE POINTS



**REMOVAL AND INSTALLATION OF MAIN SHAFT ASSEMBLY**

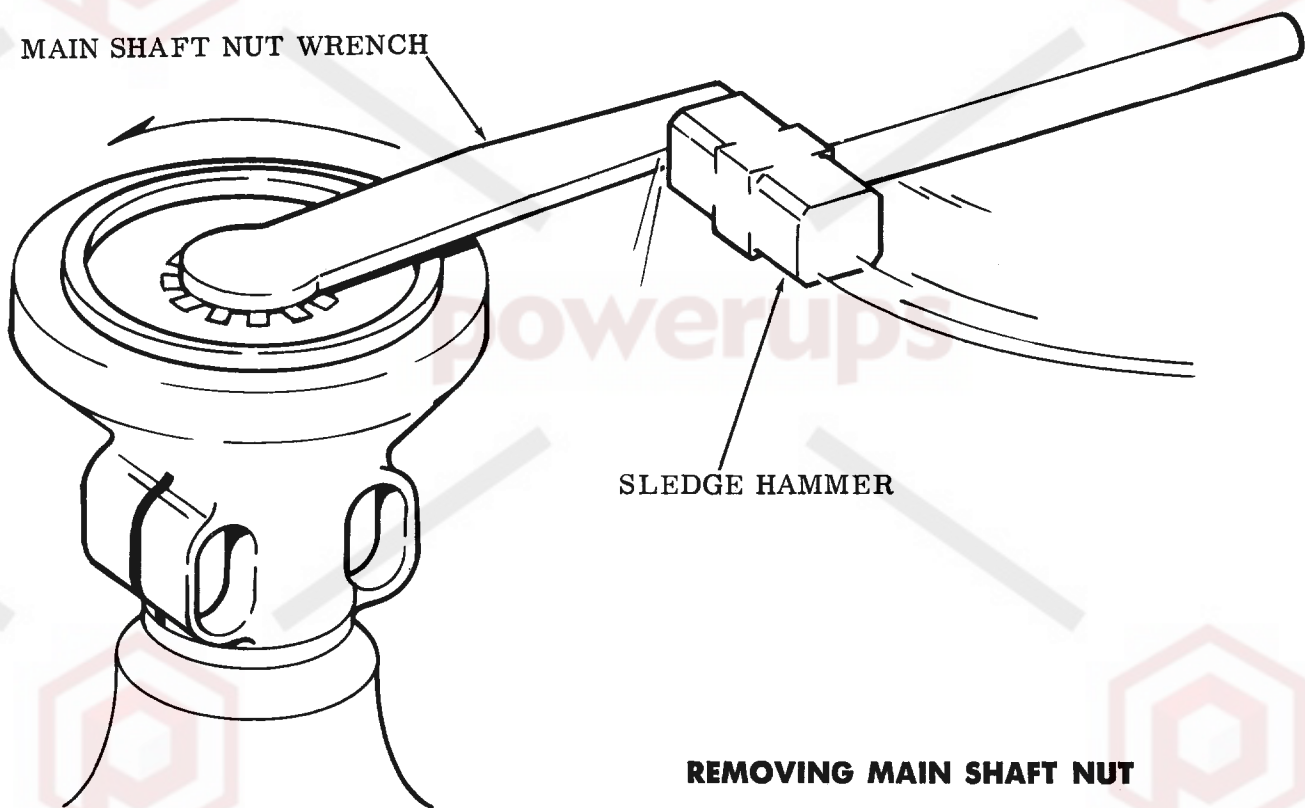


**2 FT. MAIN SHAFT ASSEMBLY**

**WARNING**

Do not attempt to lift the main shaft assembly by the feed plate. The feed plate bolts are NOT strong enough to lift the entire weight of the main shaft assembly. Serious personal injury or severe damage to the Crusher could result.

- Carefully lift the main shaft assembly out of the Crusher by positioning the overhead crane or lifting device so that the cable will be lifting at a slight angle from the vertical with the angle towards the heavy side of the eccentric. See the illustration, REMOVAL AND INSTALLATION OF MAIN SHAFT ASSEMBLY. On this illustration, note the points of contact in the encircled areas between the main shaft and inner eccentric bushing as well as the direction of pull on the cable. Pulling or tilting the main shaft assembly slightly toward the heavy side of the eccentric will give ample clearance between the sealing arrangement on the head and the socket on the frame. Lifting in this manner will prevent damaging the sealing arrangement on the underside of the head and on the socket. This is true regardless of whether the Crusher is equipped with a standard seal or water seal. The heavy or thick side of the eccentric can be determin-



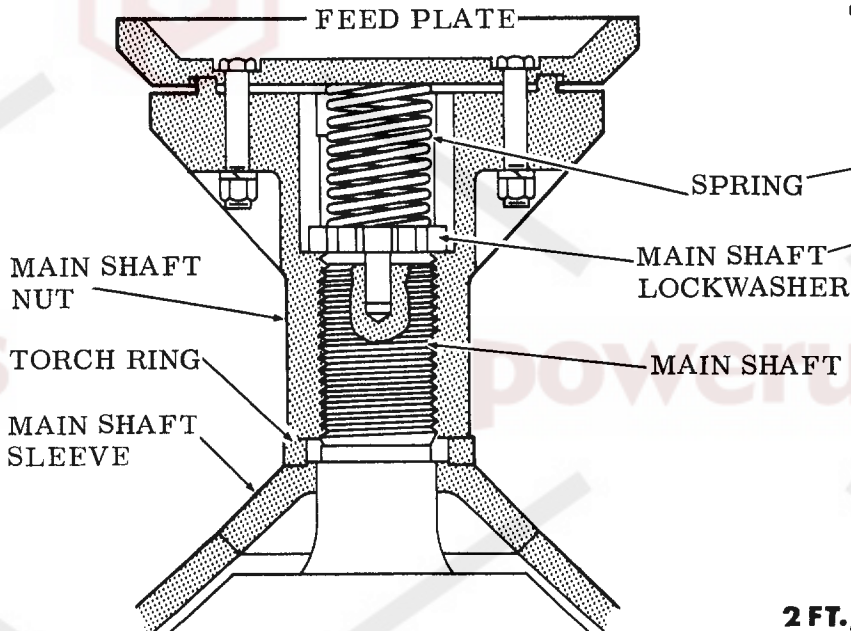
**REMOVING MAIN SHAFT NUT**



ed by noting the position of the discharge opening before the bowl is removed. The low side of the head indicates the heavy side of the eccentric.

ON A CRUSHER EQUIPPED WITH THE STANDARD SEAL SOCKET ARRANGEMENT, CARE SHOULD BE TAKEN THAT THE SOCKET SEALING RING DOES NOT STICK TO THE WIPERS ON THE HEAD DURING REMOVAL. BE CERTAIN THAT THE SEALING RING RESEATS PROPERLY ON THE SOCKET AFTER THE MAIN SHAFT HAS BEEN REMOVED.

- 4 With the main shaft assembly out of the Crusher, examine the polished surfaces of the head and shaft and smooth out any scratches or score marks as well as any rust or pitting.
- 5 In order that the mantle and feed plate assemblies can be worked on at a convenient height when removed from the Crusher, it is suggested that a hole, of adequate depth and diameter to contain the main shaft, be provided in the floor or sunk in the ground. This hole should be provided with adequate drain-



**3 FT. CRUSHER CLOCKWISE COUNTER-SHAFT ROTATION**

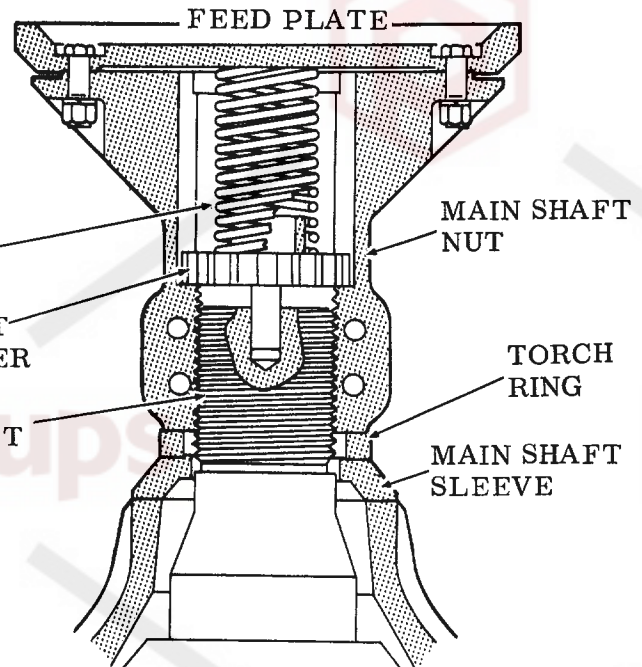
age to avoid any accumulation of water. For the proper size of this hole refer to the table CLEARANCE DIMENSIONS in Section 2. Lower the main shaft assembly into this hole so that the head skirt rests on the floor

or ground. On the 2 Ft. Crusher, support the head by placing blocking under the head wipers as shown in the illustration 2 Ft. MAIN SHAFT ASSEMBLY.

REPLACING MANTLE. To remove the worn mantle and install a replacement mantle, proceed as follows:

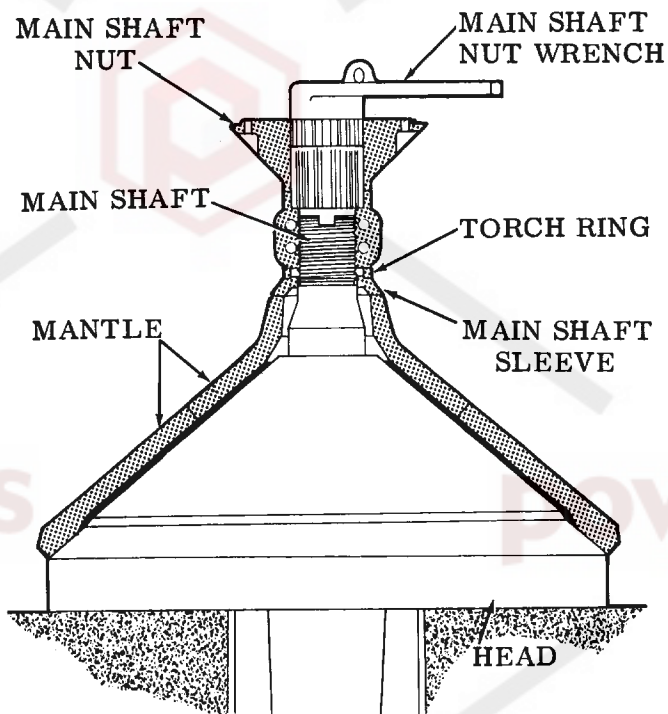
IN SOME SPECIAL CASES A CRUSHER MAY BE ORDERED WITH THE COUNTERSHAFT ROTATING CLOCKWISE. IN THESE CASES, A MAIN SHAFT LOCKWASHER IS FURNISHED AND MUST BE REMOVED PRIOR TO REMOVAL OF THE MAIN SHAFT NUT. THE WASHER LOCKS THE NUT TO THE SHAFT, PREVENTING THE NUT FROM WORKING LOOSE. WITH THIS TYPE OF ARRANGEMENT, THE MAIN SHAFT NUT IS NOT SELF-TIGHTENING. SEE THE ILLUSTRATION CLOCKWISE COUNTERSHAFT ROTATION.

- 1 Place the special wrench provided, into the top of the main shaft nut, as shown in the illustration REMOVING MAIN SHAFT NUT, and sledge in a COUNTERCLOCKWISE direction.



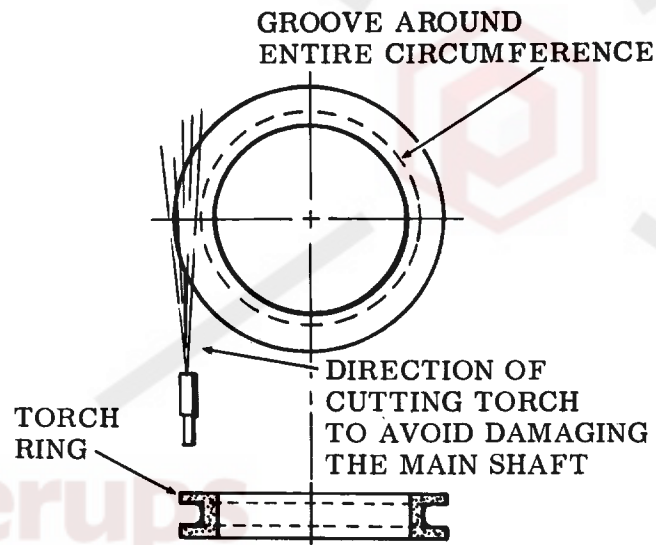
**2 FT., 4 FT., 5100, 4 1/4 FT., 5 1/2 FT. AND 7 FT. CRUSHERS CLOCKWISE COUNTERSHAFT ROTATION**

- 2 Since the main shaft nut automatically tightens during operation and the mantle tends to elongate, difficulty may be experienced in unscrewing the nut. If extreme difficulty is encountered in removing the main shaft nut, the torch ring, located just below the



### REPLACING MANTLE

main shaft nut, may be torch cut to relieve the pressure on the nut. See the illustration REPLACING MANTLE. In most instances it is not necessary to cut through the ring as a groove cut in the ring around the entire circumference will cause the ring to collapse. See the illustration CUTTING GROOVE IN TORCH RING. If cutting the groove does not cause the ring to collapse, the ring may be cut all the way through, being extremely careful not to damage the shaft. See the



### CUTTING GROOVE IN TORCH RING

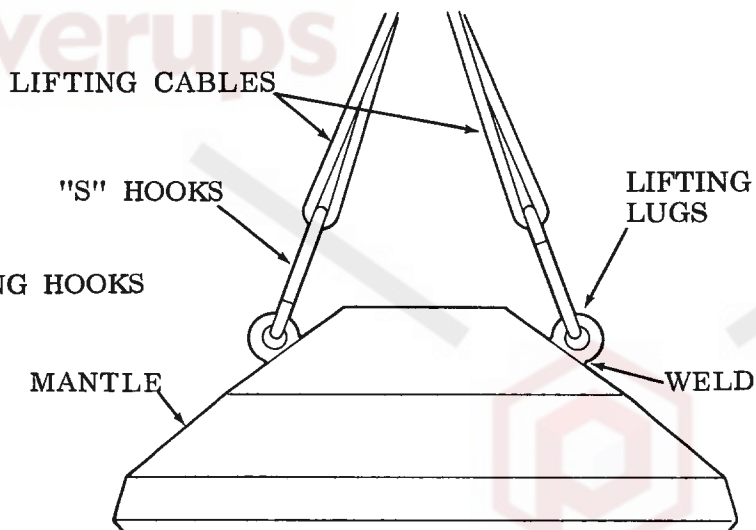
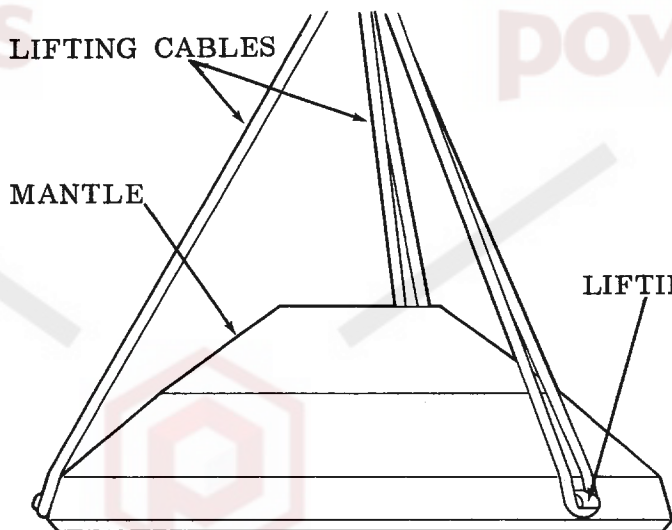
illustration CUTTING GROOVE IN TORCH RING. The main shaft nut should now be free to turn.

### WARNING

When it is necessary to use a cutting torch in removing parts backed by NORDBAK or zinc, provide adequate ventilation. Avoid inhaling fumes. Personnel removing parts should be required to wear air-line respirators to prevent inhalation of fumes (when torch cutting) or dust (when grinding or chipping).

- 3 Remove the main shaft nut and main shaft sleeve.

WHEN LIFTING LUGS HAVE BEEN USED FOR LIFTING A NEW MANTLE, THE LUGS MUST BE KNOCKED OFF AND THE WELD GROUND FLUSH WITH THE SURFACE OF THE MANTLE AFTER THE MANTLE IS IN PLACE ON THE HEAD.



### LIFTING THE MANTLE

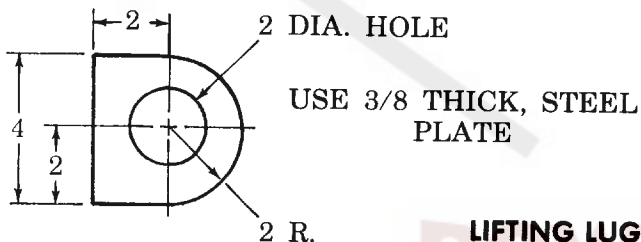
- 4 Lift the worn mantle free of the head using one of the lifting methods shown in the illustration **LIFTING THE MANTLE**. One method uses the three equally spaced lifting hooks cast into the lower edge of the mantle and the other, two equally spaced lifting lugs welded to the upper surface of the mantle.

**WARNING**

WHEN LIFTING THE MANTLE USING WELDED ON LIFTING LUGS, BE CERTAIN THE LUGS ARE STRONG ENOUGH TO CARRY THE LOAD AND THAT A WELDING ROD SUITABLE FOR WELDING ON MANGANESE STEEL IS USED.

Construct the lifting lugs to the dimensions shown in the illustration **LIFTING LUG** and use the following welding procedure for welding the lifting lugs to the mantle.

- 1 Use Nicro Mang (EFe Mn-A) welding electrodes.
- 2 Do NOT pre-heat — mantle to be kept as cool as possible.
- 3 Thoroughly clean the mantle in the area where the lifting lug is to be welded (minimum of wire brushing required).
- 4 A 1/4" fillet weld on BOTH sides of the lifting lug is recommended.
- 5 ANY CRATERS IN THE WELD MUST BE FILLED WITH ADDITIONAL WELD.



**LIFTING LUG**

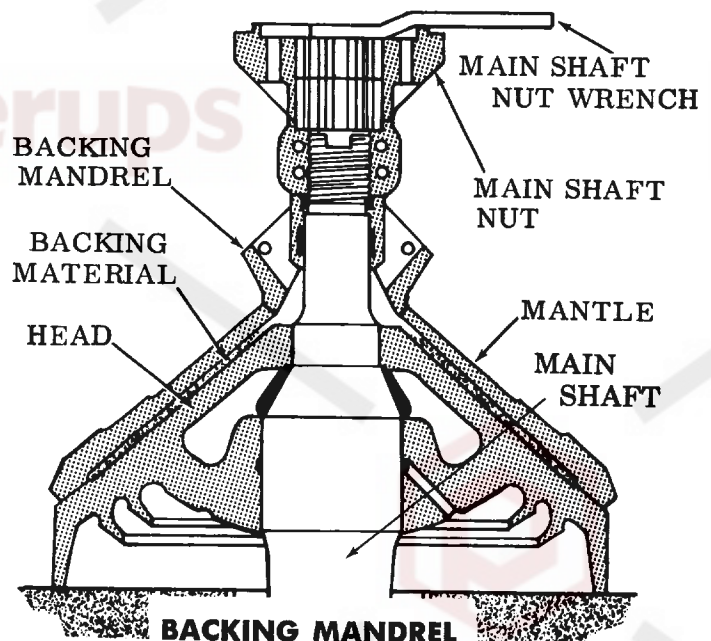
(All dimensions in inches)

- 5 Chip off any backing material which might remain on the head. Usually the backing material will adhere to the mantle and little if any chipping is required on the head.
- 6 If zinc backing is to be used, prepare the mantle and head according to the instructions under **APPLICATION OF ZINC BACKING**.

**APPLICATION OF ZINC BACKING.** Whenever a new set of liners is installed, it is necessary to repour the backing material between the mantle and head and between the bowl liner and bowl. There are two types of backing material in common usage today and these are zinc and

**NORDBAK.** Zinc has been used almost exclusively as backing material over the past years, however, more recently the zinc has been replaced by NORDBAK in most crusher installations. Zinc is a readily available material and approximately 80% of the old material is reclaimable. However, the special precautions, preparations and equipment involved in the use of zinc, in most cases, makes the NORDBAK a preferable material. If it is decided to use zinc, it can be repoured as follows:

- 1 If the crushing members are stored in an area that is exposed to the weather or cold and should zinging operations be carried out under the same conditions, the mantle, head, bowl liner and bowl should be heated evenly to about 100° Fahrenheit to drive out all traces of moisture or sweating. Pre-heating will eliminate the tendency of moisture to vaporize when pouring the zinc, and causing sputtering. Caution must be exercised when heating any of these parts so as not to cause a "hot spot" which would destroy its heat treatment.
- 2 Apply a light coating of lubricating oil to the inside of the mantle, the outside of the head, the outside of the bowl liner and the inside of the bowl. This will prevent the zinc from sticking to either the head or bowl. At the same time this film of oil will remove any surface moisture that might be present.
- 3 Lower the mantle onto the head and slide the backing mandrel down on top of the mantle as shown in the illustration **BACK-**

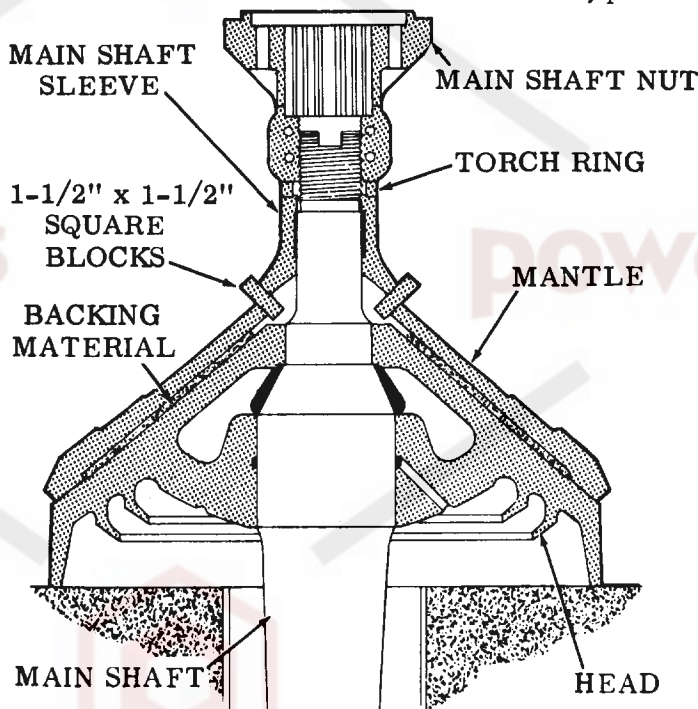


ING MANDREL. It is important that the mantle is seated properly, both for pouring of the zinc and the self-tightening feature. A loose or cocked mantle can result in damage to the mantle or mantle seat on the head.

- 4 Install the main shaft nut using the special wrench. Then sledge the entire arrangement tight. This will draw the backing mandrel down firmly against the mantle, thereby centering and positioning the mantle on the head.

IF, ON THE 2 FT., 3 FT., 4 FT., 5100 AND 4-1/4 FT. CRUSHER NO MANDREL IS AVAILABLE, STEEL BLOCKS CAN BE USED IN ITS PLACE. SLIP THE MAIN SHAFT SLEEVE AND THEN THE TORCH RING, OVER THE SHAFT TO CENTRALIZE THE MANTLE, THEN PLACE FOUR PIECES OF STEEL 1-1/2 INCHES THICK, BETWEEN THE MANTLE AND THE LOWER JOINT OF THE SLEEVE, EQUALLY SPACED 90° APART, AS SHOWN IN THE ILLUSTRATION INSTALLING MANTLE WITHOUT BACKING MANDREL. SLEDGE THE MAIN SHAFT NUT DOWN TIGHT TO POSITION THE MANTLE.

- 5 Check that the mantle bears tightly against the head by using a feeler gauge all around the mantle seat. Should any openings exist due to wear on this area of the head, pack



**INSTALLING MANTLE WITHOUT BACKING MANDREL**

these openings with "Dambabbit" which is a plastic asbestos compound, or clay to keep the backing from leaking out during pouring.

FOR A COMPLETE PROCEDURE ON REPOURING BACKING MATERIAL BETWEEN THE BOWL AND BOWL LINER, REFER TO SECTION 8.

- 6 Refer to the table, BACKING REQUIREMENTS for the approximate amount of zinc to prepare, then pour the zinc without interruption, filling the entire cavity behind the mantle to just below the top of the head.

**WARNING**

When handling the 800° Fahrenheit molten zinc, goggles and protective clothing must be worn. Contact with molten zinc will result in serious burns.

- 7 After the zinc has fully hardened remove the mandrel and any excess zinc that may have seeped onto the top of the head.
- 8 Examine the threads on the main shaft and the main shaft nut and remove any burrs or nicks which might exist and clean the threads thoroughly. Coat the threads with grease or lubricating oil, preferably mixed with 5 - 10% (by volume) of molybdenum disulfide powder.
- 9 Install the main shaft sleeve and the torch ring on the mantle being sure that the sleeve is level so that the torch ring will seat properly.
- 10 Pack the area between the torch ring and the main shaft with loose asbestos or fiberglass to protect the shaft from damage when cutting into the torch ring during mantle replacement.
- 11 Screw the main shaft nut onto the main shaft and tighten the nut securely by sledgeing on the special wrench. It is important that the main shaft nut is absolutely tight. Failure to adequately tighten the nut could cause the mantle to loosen and result in damage to the mantle or the mantle seat on the head.
- 12 Lower the main shaft assembly into the Crusher, remove the eyebolt and bolt the

CRUSHER SIZE*		2 Ft.	3 Ft.	4 Ft.	5100 and 4-1/4 Ft.	5-1/2 Ft.	7 Ft. **
BACKING REQUIRED FOR BOWL LINER (Average Weight In Pounds)	ZINC	65	115	280	370	625	1200
	NORDBAK (See Below)	22	33	77	99	165	330
BACKING REQUIRED FOR MANTLE (Average Weight In Pounds)	ZINC	55	185	260	330	625	950
	NORDBAK (See Below)	22	55	77	88	165	264

\*THIS TABLE ALSO INCLUDES THE BACKING REQUIREMENTS FOR THE 2 FT. AND 4 FT. SHORT HEAD CRUSHERS.

NORDBAK is available in two kit sizes: a large kit containing (after mixing) approximately 22 pounds of backing material, and a small kit containing approximately 11 pounds.

\*\*Specify "High Impact" NORDBAK when ordering NORDBAK backing for a 7 Ft. Crusher.

Where the Crusher is used for crushing gold ore in plants having the cyanide process of recovery, it is recommended that the zinc backing for the mantle and bowl liner be supplanted by some mixture containing no zinc or aluminum. Should the mantle or liner loosen slightly, causing the zinc to powder and be introduced with the ore, a loss in recovery may occur. In place of zinc, use non-metallic NORDBAK backing material for such operations.

### STANDARD CRUSHER BACKING REQUIREMENTS

feed plate in place. On some machines, the feed plate must be installed after the bowl assembly is in the Crusher.

#### APPLICATION OF NORDBAK BACKING

NORDBAK is a tough, resilient, non-metallic backing material which is readily available in kit form in various sizes. Each kit contains a large and small can of NORDBAK and a mixing paddle. The use of NORDBAK requires no special equipment, preparation or handling. The NORDBAK material is not re-usable and therefore, is expendable with the worn mantle or liner. With NORDBAK, the backing can be mixed right at the job site as mixing and pouring requires no special training, the simple directions are included with each kit. Once mixed, the NORDBAK must be poured without delay. Subsequent mixes that may be required to completely fill the cavity, can be poured at any convenient time. To repour NORDBAK backing material, proceed as follows:

- 1 The NORDBAK kits and the parts that require backing should be at room temperature prior to pouring (60° to 90° Fahrenheit).

- 2 Apply a light coating of lubricating oil to the outside of the head and the inside of the bowl. This will prevent the NORDBAK from sticking to either the head or bowl.

- 3 Lower the mantle onto the head and slide the backing mandrel down on top of the mantle as shown in the illustration, BACKING MANDREL. It is important that the mantle is seated properly, both for the pouring of the NORDBAK and the selftightening feature. A loose or cocked mantle can result in damage to the mantle or mantle seat on the head.

IF TOO COLD, NORDBAK WILL HARDEN SLOWLY AND WILL BE TOO VISCOUS TO FILL A SMALL SPACE WITH CERTAINTY. IF TOO HOT, THERE IS THE RISK OF THE MIXTURE SETTING IN THE CAN BEFORE IT CAN ALL BE Poured. SHOULD THIS SITUATION ARISE, THE UNOPENED CANS SHOULD BE IMMERSed IN COOL WATER BEFORE MIXING. DO NOT USE NORDBAK WHERE THE FEED TO THE CRUSHER EXCEEDS 175° FAHRENHEIT.

4 Install the main shaft nut using the special wrench. Then sledge the entire arrangement tight. This will draw the backing mandrel down firmly against the mantle, thereby centering and positioning the mantle on the head.

IF NO MANDREL IS AVAILABLE, THE MAIN SHAFT SLEEVE, TORCH RING AND MAIN SHAFT NUT INSTALLED ON THE MAIN SHAFT CAN BE USED AS A SUBSTITUTE. SLEDGE THE MAIN SHAFT NUT DOWN TIGHT TO POSITION THE MANTLE, THEN PROCEED TO STEP 5.

5 Check that the mantle bears tightly against the head by using a feeler gauge all around the mantle seat. Should any openings exist due to wear on this area of the head, pack these openings with "Dambabbit", which is a plastic asbestos compound, or clay to keep the backing from leaking out during pouring.

6 Remove the main shaft nut and the mandrel and fill the entire cavity behind the mantle with NORDBAK to just below the top of the head. The table BACKING REQUIREMENTS gives the approximate amount of NORDBAK necessary to fill the cavity. Removing the nut and mandrel will simplify pouring the NORDBAK.

**WARNING**

Carefully follow the instructions as well as the precautions that are printed on the individual cans of NORDBAK before mixing and pouring. Skin contact with NORDBAK may cause serious delayed Dermatitis. Avoid inhalation of vapor. Use ventilation, particularly if heated. Prevent all contact with skin. If contact occurs, wash immediately with soap and water.

A POURING SPOUT SHOULD BE FASHIONED OUT OF SHEET STEEL OR HEAVY CARDBOARD TO DIRECT THE NORDBAK FLOW INTO THE BACKING CAVITY, WHICH WILL PREVENT SPILLING AND SPEED UP THE POURING PROCESS. IF THE NORDBAK IS Poured IN AT SEVERAL LOCATIONS AROUND THE TOP OF THE HEAD, THIS ALSO WILL SPEED UP THE POURING PROCESS.

7 After the NORDBAK has fully hardened, remove any excess backing that may have seeped onto the top of the head.

8 Examine the threads on the main shaft and main shaft nut and remove any burrs or nicks which might exist and clean the threads thoroughly. Coat the threads with grease or lubricating oil, preferably mixed with 5 - 10% (by volume) of molybdenum disulfide powder.

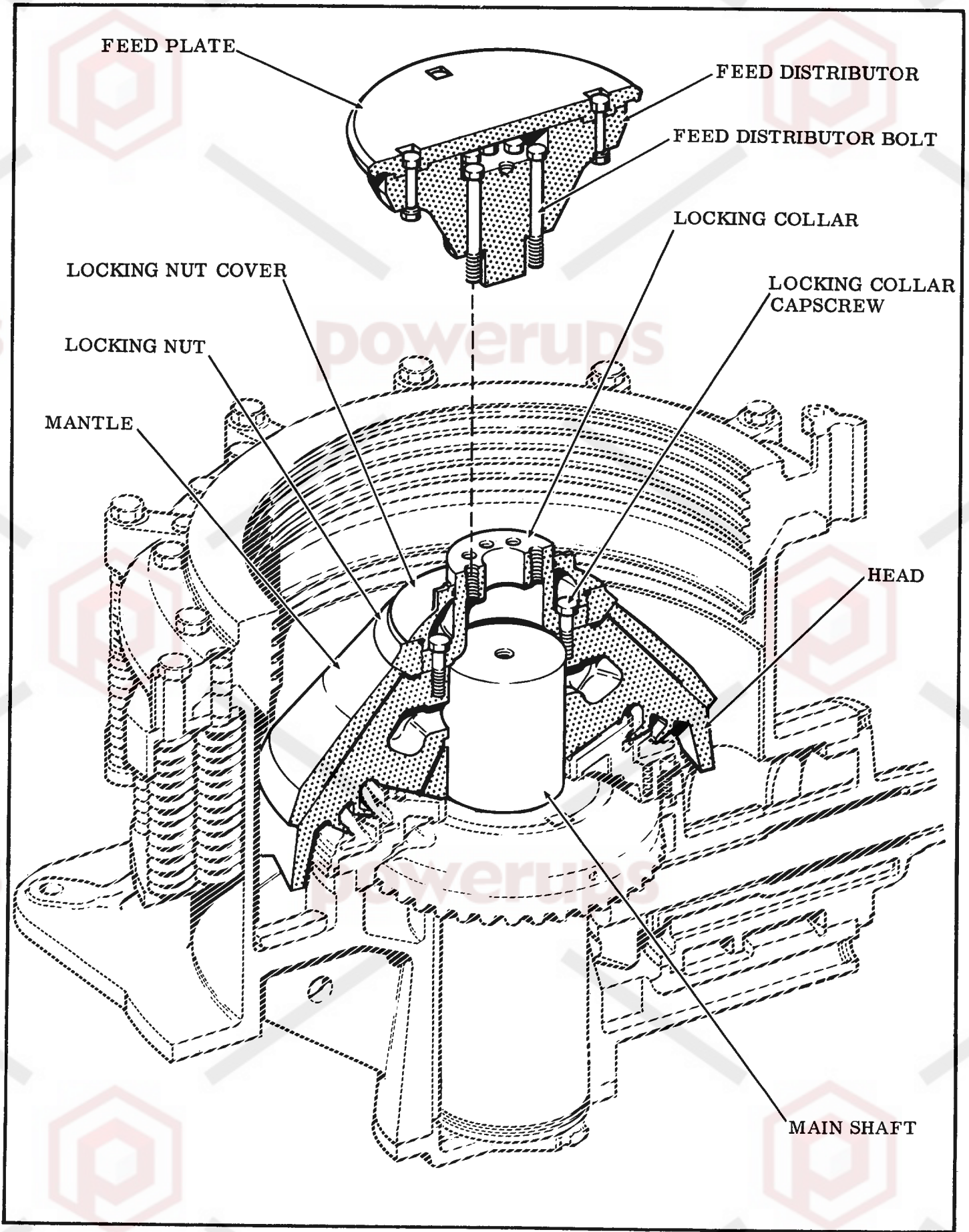
9 Install the main shaft sleeve and the torch ring on the mantle being sure that the sleeve is level so that the torch ring will seat properly.

10 Pack the area between the torch ring and the main shaft with loose asbestos or fiberglass to protect the shaft from damage when cutting into the torch ring during mantle replacement.

11 Screw the main shaft nut onto the main shaft and tighten the nut securely by sledging on the special wrench. It is important that the main shaft nut is absolutely tight. Failure to adequately tighten the nut could cause the mantle to loosen and result in damage to the mantle or the mantle seat on the head.

12 Lower the main shaft assembly into the Crusher, remove the eyebolt and bolt the feed plate in place. On some machines the feed plate must be installed after the bowl assembly is in the Crusher.

REPLACING HEAD OR MAIN SHAFT. Normally it is not necessary to replace the head or main shaft. However, if for any reason, either requires replacement, it is advisable to contact the factory for the proper replacement procedure. This is required, as procedures are different for each Crusher and each particular crusher installation. Some of the differences are: size of hydraulic press required, heating temperatures, headbore size, and shaft size. Remachining information is also available if and when head wipers or baffle rings have become worn.



# MAIN SHAFT, MANTLE AND FEED DISTRIBUTOR ASSEMBLIES

## SHORT HEAD CRUSHER

### DESCRIPTION

This section covers the main shaft, mantle and feed distributor assemblies. The head which is assembled to the main shaft by an interference fit is supported by the concave bearing surface of the socket liner. The tapered portion of the main shaft extends down into the inner eccentric bushing and there only by contact between the main shaft and bushing is the head driven in its eccentric or gyrating motion. Covering the head is a replaceable mantle which is the rotating or driving crushing member. The mantle is firmly held in place on the head by a large locking nut threaded onto the locking collar bolted to the top of the head. Protecting the locking nut and locking collar threads from wear is a locking nut cover. The feed distributor bolted to the locking collar provides the support for the feed plate. The feed plate rotates with the main shaft and is responsible for evenly distributing the feed around the feed opening of the crushing members.

On 2 Ft., 4 Ft., 5100, 4-1/4 Ft. and 5-1/2 Ft. Crushers that are equipped with a standard main shaft (threaded at the top) the main shaft arrangement is somewhat different than the other SHORT HEAD Crushers in that on top of the mantle is a main shaft sleeve and torch ring. The main shaft sleeve and torch ring are firmly held in place on the mantle by a main shaft nut threaded directly onto the main shaft. Use the information outlined in the STANDARD CRUSHER portion of this section, do not use the SHORT HEAD instructions.

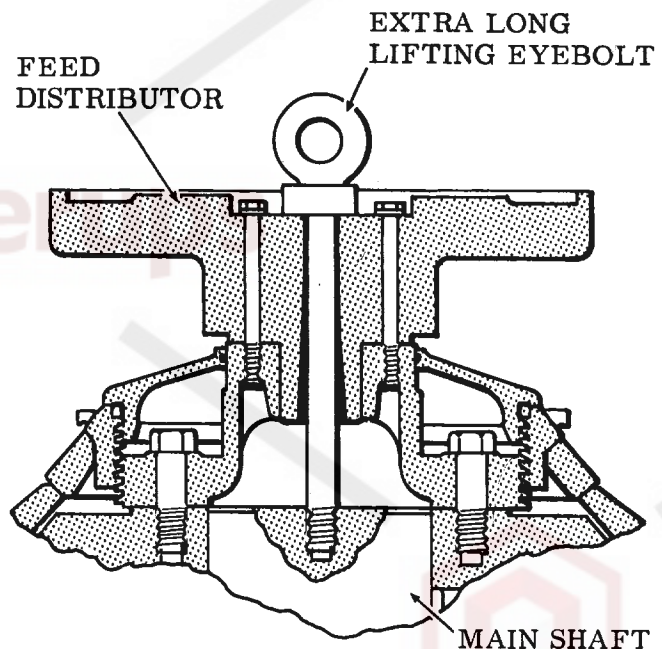
### ASSEMBLY INSTRUCTIONS

If the main shaft, mantle and feed distributor assemblies were removed prior to shipment, due to height limitations or weight restrictions, the various parts are to be installed as follows:

- 1 Examine all oil passages to be certain they are thoroughly clean.
- 2 Apply a light coating of oil, not grease, to the main shaft and the spherical surface on the bottom of the head.

3 Lift the main shaft assembly using one of the following three methods:

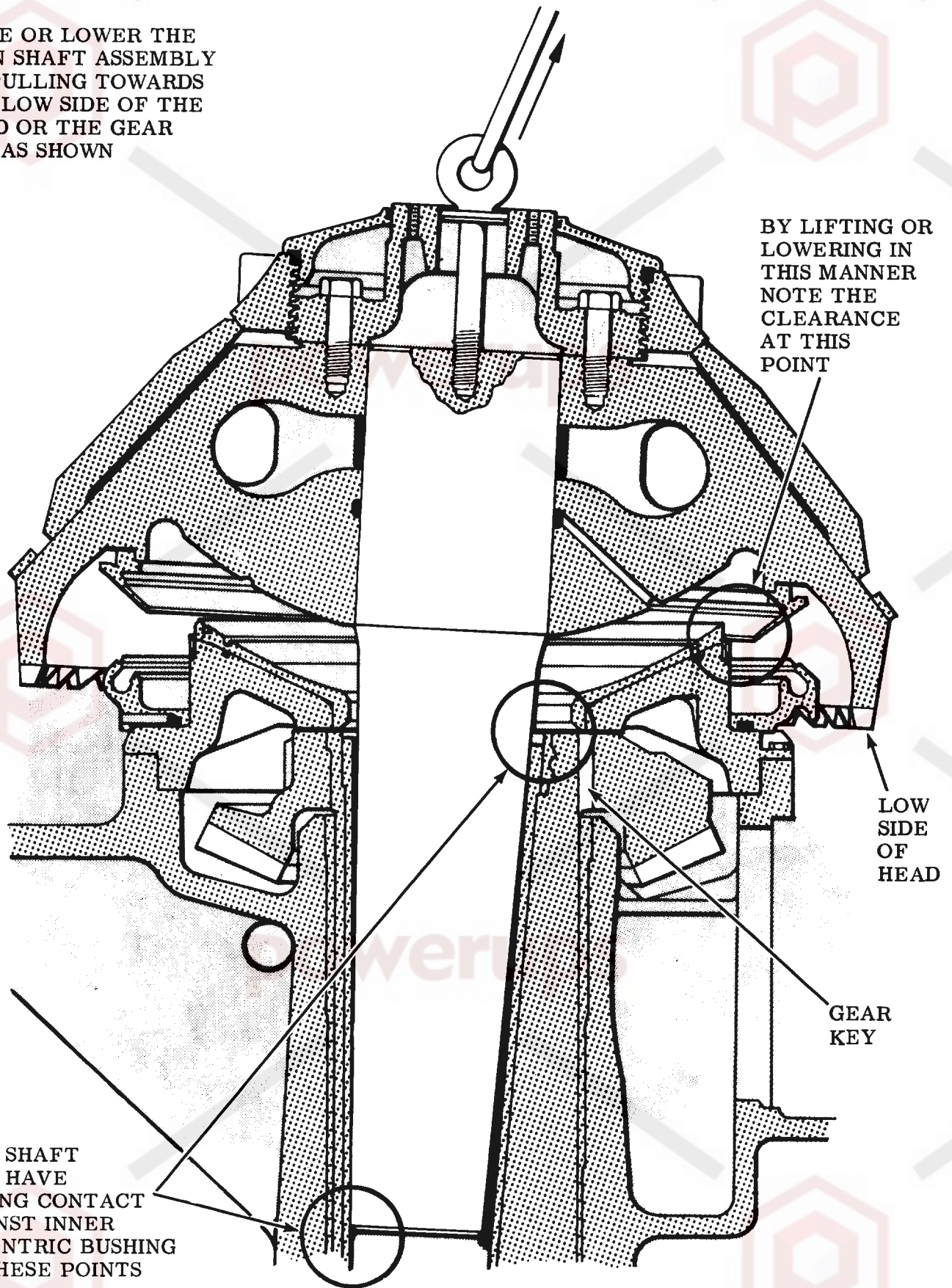
- A. On the 3 Ft., 5100, 4-1/4 Ft. and 5-1/2 Ft. Crusher, remove the feed plate and feed distributor, then insert the main shaft eyebolt through the locking collar and screw it into the top of the main shaft. See the illustration REMOVAL AND INSTALLATION OF 3 Ft., 5100, 4-1/4 Ft. and 5-1/2 Ft. MAIN SHAFT ASSEMBLY.
- B. On the 7 Ft. Crusher, only the feedplate must be removed. The extra long lifting eyebolt is inserted through the cored hole in the feed distributor and threaded into the top of the main shaft. See the illustration REMOVAL AND INSTALLATION OF 7 Ft. MAIN SHAFT ASSEMBLY.



**REMOVAL AND INSTALLATION OF 7 FT. MAIN SHAFT ASSEMBLY**

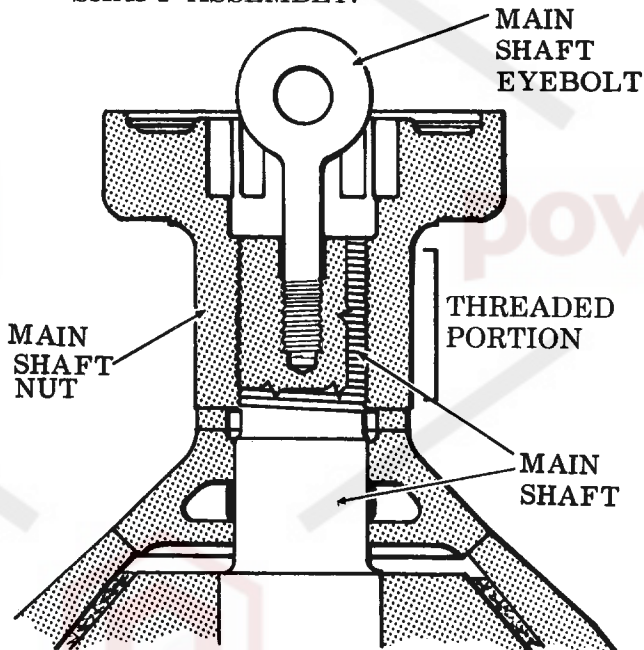


RAISE OR LOWER THE  
MAIN SHAFT ASSEMBLY  
BY PULLING TOWARDS  
THE LOW SIDE OF THE  
HEAD OR THE GEAR  
KEY AS SHOWN



**REMOVAL AND INSTALLATION OF 3 FT., 5100, 4¼ FT., AND 5½ FT. MAIN SHAFT ASSEMBLY**

- C. On the 2 Ft., 4 Ft., 5100 and 4-1/4 Ft. Crushers that are equipped with a standard main shaft (threaded at the top) remove the feed plate and insert the main shaft eyebolt through the main shaft nut and thread it into the main shaft. See the illustration REMOVAL AND INSTALLATION OF 2 FT., 4 FT., 5100 AND 4-1/4 FT. MAIN SHAFT ASSEMBLY.



**REMOVAL AND INSTALLATION OF 2 FT., 4 FT., 5100 AND 4-1/4 FT. MAIN SHAFT ASSEMBLY**

- 4 Lower the main shaft assembly into the Crusher, taking certain precautions to prevent damaging the sealing arrangement on the underside of the head and on the socket. This is true regardless of whether the Crusher is equipped with a standard or water seal. See the illustration REMOVAL AND INSTALLATION OF 3 FT., 5100, 4-1/4 FT. AND 5-1/2 FT. MAIN SHAFT ASSEMBLY. On this illustration, note the points of contact in the encircled areas between the main shaft and inner eccentric bushing as well as the direction of pull on the cable. Tilting the main shaft assembly slightly toward the gear key which is the heavy or thick side of the eccentric will give ample clearance between the sealing arrangement on the head and the socket on the frame.

**WARNING**

Do not attempt to lift the main shaft assembly by the feed plate. The feed plate bolts are NOT strong enough to lift the entire weight of the main shaft assembly. Serious personal injury or severe damage to the Crusher could result.

- 5 Install the bowl as described in ASSEMBLY INSTRUCTIONS in Section 8. Then reassemble the feed plate and, if necessary, the feed distributor.

**MAINTENANCE**

**MAIN SHAFT ASSEMBLY REMOVAL.** To remove the main shaft assembly for inspection or replacement of parts, proceed as follows:

- 1 Remove the feed plate and feed distributor, then insert the main shaft eyebolt through the locking collar and thread it into the top of the main shaft. See the illustration REMOVAL AND INSTALLATION OF 3 FT., 5100, 4-1/4 FT. AND 5-1/2 FT. MAIN SHAFT ASSEMBLY.

ONLY THE FEED PLATE NEED BE REMOVED BEFORE THE ASSEMBLY CAN BE LIFTED OUT OF THE 2 FT., 4 FT. AND 7 FT. CRUSHERS. SEE THE ILLUSTRATIONS REMOVAL AND INSTALLATION OF 7 FT. MAIN SHAFT ASSEMBLY AND REMOVAL AND INSTALLATION OF 2 FT., 4 FT., 5100 AND 4-1/4 FT. MAIN SHAFT ASSEMBLY.

**WARNING**

Do not attempt to lift the main shaft assembly by the feed plate. The feed plate bolts are NOT strong enough to lift the entire weight of the main shaft assembly. Serious personal injury or severe damage to the Crusher could result.

- 2 Remove the bowl as described in BOWL REMOVAL in Section 8.
- 3 Carefully lift the main shaft assembly out of the Crusher by positioning the overhead crane or lifting device so that the cable will be lifting at a slight angle from the vertical with the angle towards the heavy side of the eccentric. See the illustration REMOVAL AND INSTALLATION OF 3 FT., 5100, 4-1/4 FT. AND 5-1/2 FT. MAIN SHAFT ASSEMBLY. On this illustration, note the points of contact in the encircled areas between the main shaft and inner eccentric bushing as well as the direction of pull on the cable. Pulling or tilting the main shaft assembly slightly toward the heavy side of

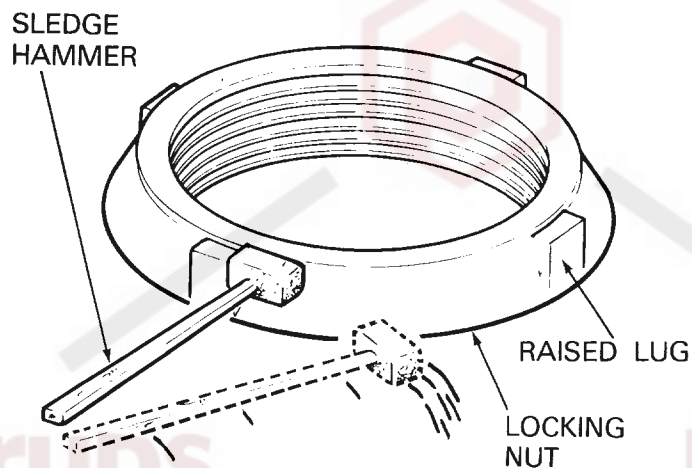
the eccentric will give ample clearance between the sealing arrangement on the head and the socket on the frame. Lifting in this manner will prevent damaging the sealing arrangement on the underside of the head and on the socket. This is true regardless of whether the Crusher is equipped with a standard seal or water seal. The heavy or thick side of the eccentric can be determined by noting the position of the discharge opening before the bowl is removed. The low side of the head indicates the heavy side of the eccentric.

ON A CRUSHER EQUIPPED WITH THE STANDARD SEAL SOCKET ARRANGEMENT CARE SHOULD BE TAKEN THAT THE SOCKET SEALING RING DOES NOT STICK TO THE WIPERS ON THE HEAD DURING REMOVAL. BE CERTAIN THAT THE SEALING RING RESEATS PROPERLY ON THE SOCKET AFTER THE MAIN SHAFT HAS BEEN REMOVED.

- 4 With the main shaft assembly out of the Crusher, examine the polished surfaces of the head and shaft and smooth out any scratches or score marks as well as any rust or pitting.
- 5 In order that the mantle and feed distributor assemblies can be worked on at a convenient height when removed from the Crusher, it is suggested that a hole, of adequate depth and diameter to contain the main shaft, be provided in the floor or sunk in the ground. This hole should be provided with adequate drainage to avoid any accumulation of water. For the proper size of this hole refer to the table CLEARANCE DIMENSIONS in Section 2.

REPLACING MANTLE, 3 FT., 5100, 4-1/4 FT., 5-1/2 FT. AND 7 FT. CRUSHERS. To remove the worn mantle and install a replacement mantle, proceed as follows:

- 1 To remove the locking nut, sledge against the cast lugs on the locking nut. See the illustration SLEDGING METHOD.

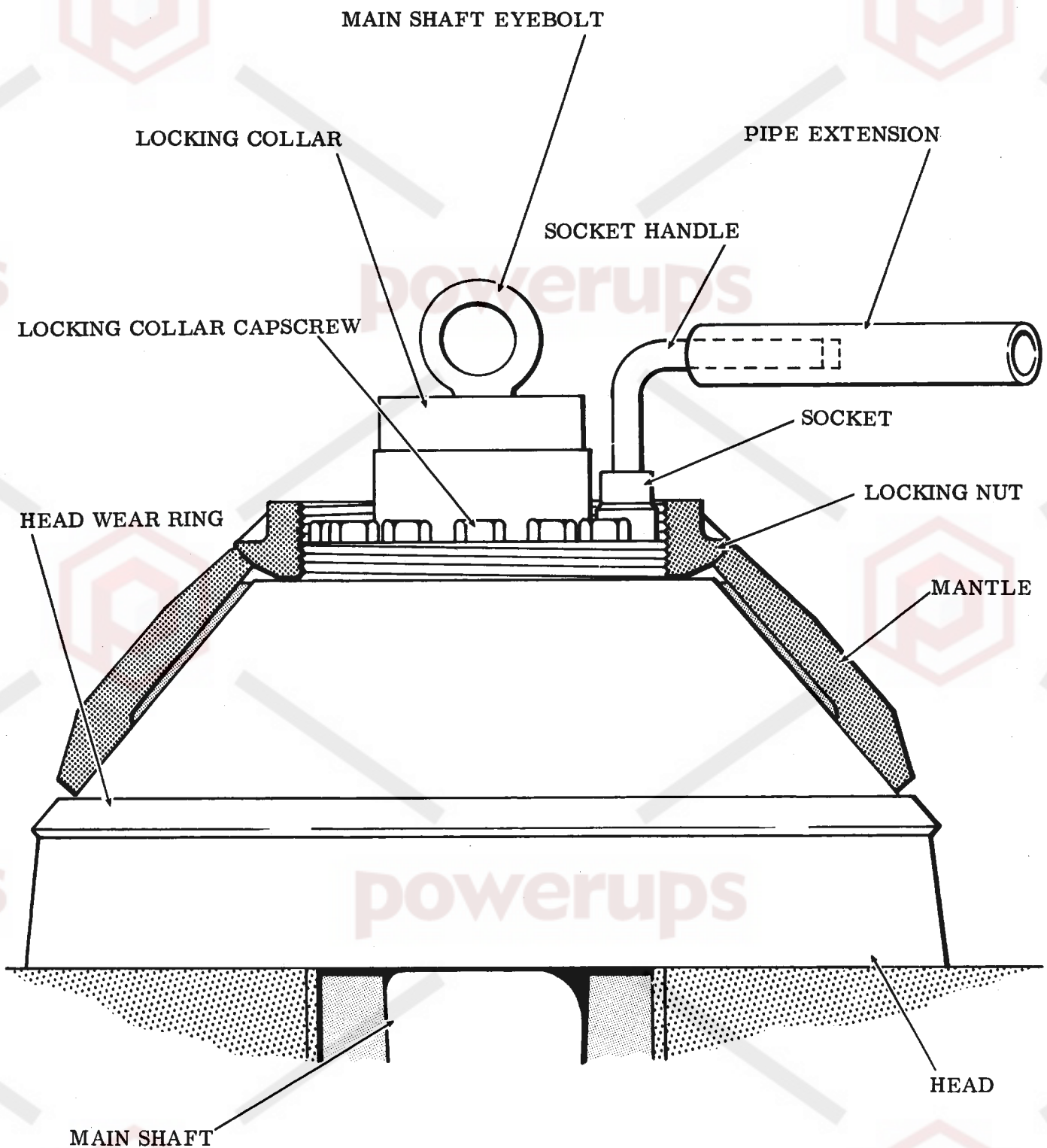


### SLEDGING METHOD

On occasions the cover and the locking nut may come off together.

THE SELF-TIGHTENING LOCKING NUT AND THE LOCKING NUT COVER HAVE EITHER LEFT-HAND OR RIGHT-HAND THREADS DEPENDING ON COUNTERSHAFT ROTATION. THE NUT AND COVER ARE REMOVED BY ROTATING IN A CLOCKWISE DIRECTION ON A CRUSHER WHOSE COUNTERSHAFT ROTATES CLOCKWISE AND IN A COUNTERCLOCKWISE DIRECTION ON A CRUSHER WHOSE COUNTERSHAFT ROTATES COUNTERCLOCKWISE.

- 2 Remove the locking nut in the same manner as described in Step 1. Since the locking nut automatically tightens during operation and the mantle tends to elongate, difficulty may be experienced in unscrewing the nut. If extreme difficulty is encountered in removing the locking nut, the pressure on the nut can be relieved by alternately backing off a slight amount on each locking collar cap-screw. It is important that each capscrew not be loosened more than a quarter of a turn at a time, otherwise a few capscrews will carry all of the mantle pressure, possibly causing capscrew breakage. Loosen these capscrews with the socket and special "L" handle provided. A pipe extension may be required for additional leverage. See the illustration LOOSENING AND TIGHTENING LOCKING COLLAR CAPSCREWS. An alter-



**LOOSENING AND TIGHTENING LOCKING COLLAR CAPSCREWS**

nate method would be to torch cut through the mantle directly beneath the nut or vertically through the mantle to relieve the pressure on the locking nut. When cutting with a torch, extreme caution must be used so as not to damage the head or locking collar.

**WARNING**

When it is necessary to use a cutting torch in removing parts backed by NORDBAK or zinc, provide adequate ventilation. Avoid inhaling fumes. Personnel removing parts should be required to wear air-line respirators to prevent inhalation of fumes (when torch cutting) or dust (when grinding or chipping).

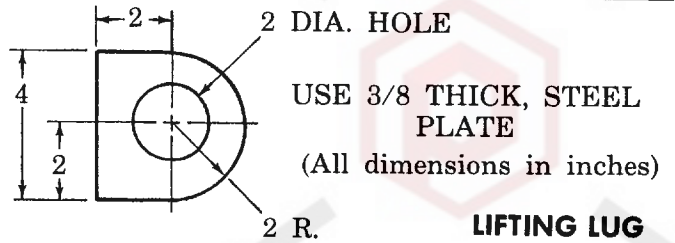
- 3 Tighten the locking collar capscrews if it was necessary to loosen them for removal of the locking nut.
- 4 Lift the worn mantle free of the head using one of the lifting methods shown in the illustration **LIFTING THE MANTLE**. One method uses the three equally spaced lifting hooks cast into the lower edge of the mantle and the other, two equally spaced lifting lugs welded to the upper surface of the mantle.
- 5 Chip off any backing material which might remain on the head. Usually the backing material will adhere to the mantle and little if any, chipping is required on the head.

**WARNING**

WHEN LIFTING THE MANTLE USING WELDED ON LIFTING LUGS, BE CERTAIN THE LUGS ARE STRONG ENOUGH TO CARRY THE LOAD AND THAT A WELDING ROD SUITABLE FOR WELDING ON MANGANESE STEEL IS USED.

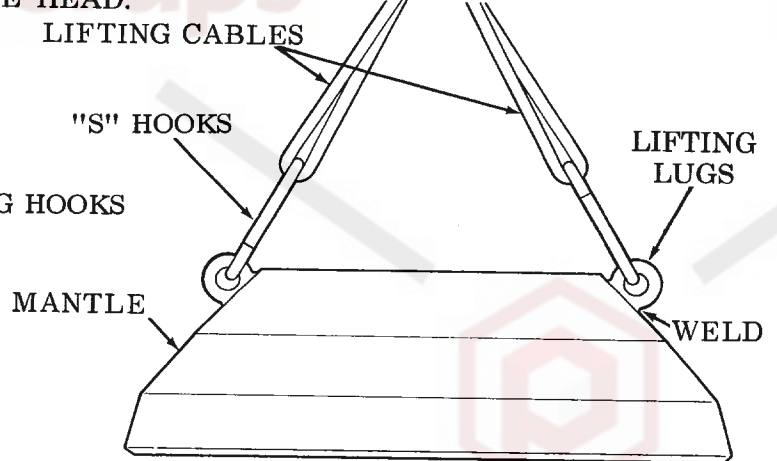
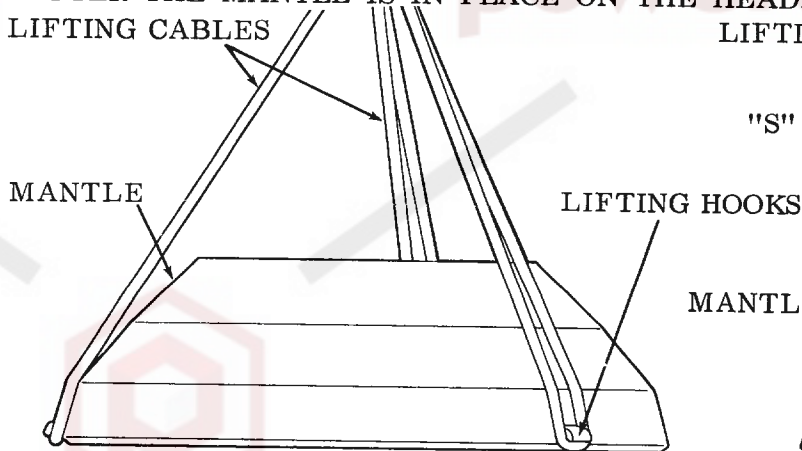
Construct the lifting lugs to the dimensions shown in the illustration **LIFTING LUG** and use the following welding procedure for welding the lifting lugs to the mantle.

- 1 Use Nicro Mang (EFe Mn-A) welding electrodes.
- 2 Do NOT pre-heat — mantle to be kept as cool as possible.
- 3 Thoroughly clean the mantle in the area where the lifting lug is to be welded (minimum of wire brushing required).
- 4 A 1/4" fillet weld on BOTH sides of the lifting lug is recommended.
- 5 ANY CRATERS IN THE WELD MUST BE FILLED WITH ADDITIONAL WELD.



- 6 If zinc backing is to be used, prepare the mantle and head according to the instructions under **APPLICATION OF ZINC BACKING**.

WHEN LIFTING LUGS HAVE BEEN USED FOR LIFTING A NEW MANTLE, THE LUGS MUST BE KNOCKED OFF AND THE WELD GROUND FLUSH WITH THE SURFACE OF THE MANTLE AFTER THE MANTLE IS IN PLACE ON THE HEAD.

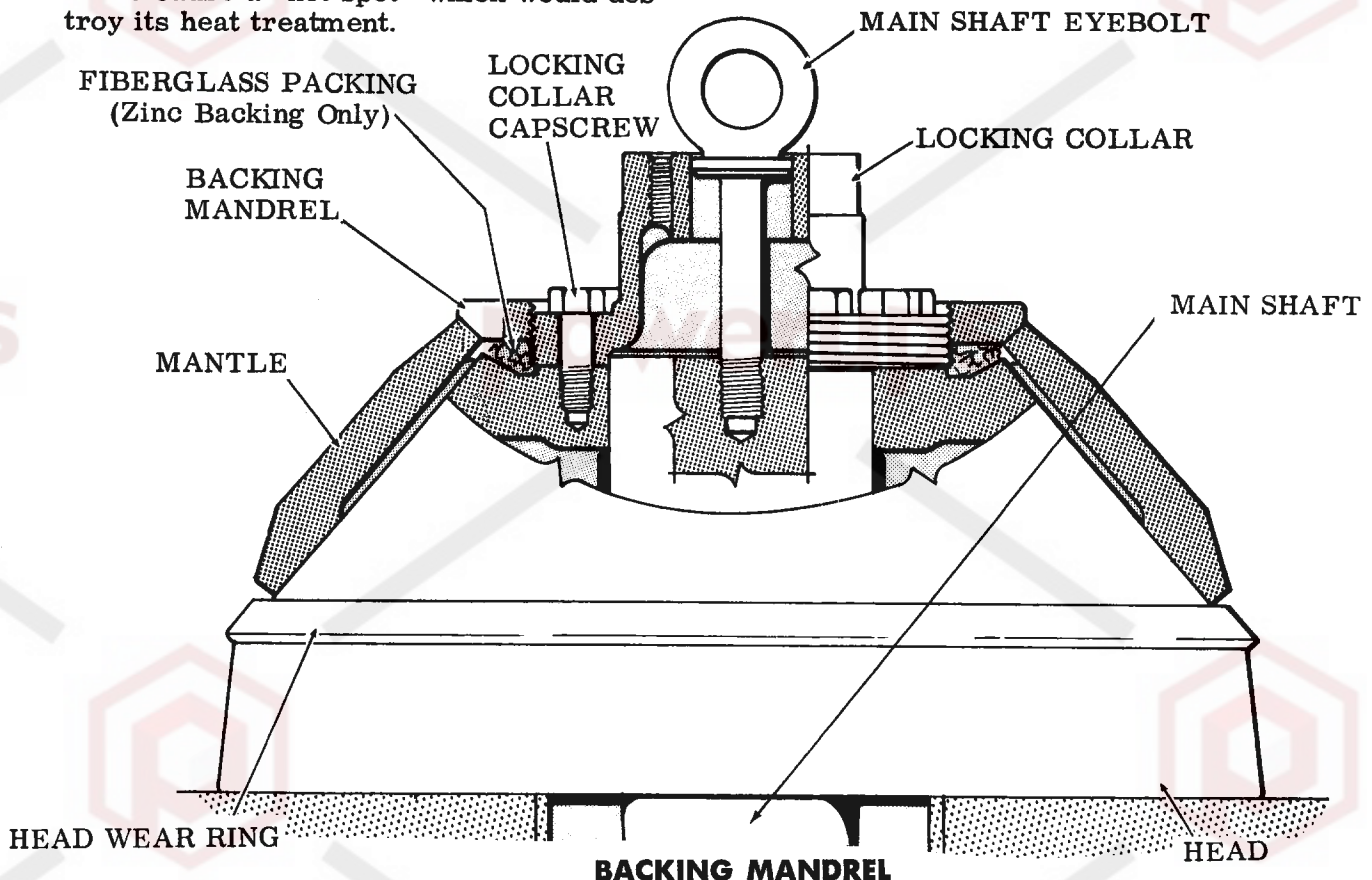


**LIFTING THE MANTLE**

APPLICATION OF ZINC BACKING, 3 FT., 5100, 4-1/4 FT., 5-1/2 FT. AND 7 FT. CRUSHERS. Whenever a new set of liners is installed, it is necessary to repour the backing material between the mantle and head and between the bowl liner and bowl. There are two types of backing material in common usage today and these are zinc and NORDBAK. Zinc has been used almost exclusively as backing material over the past years, however, more recently the zinc has been replaced by NORDBAK in most crusher installations. Zinc is a readily available material and approximately 80% of the old material is reclaimable. However, the special precautions, preparations and equipment involved in the use of zinc, in most cases, makes the NORDBAK a preferable material. If it is decided to use zinc, it can be repoured as follows:

- 1 If the crushing members are stored in an area that is exposed to the weather or cold and should zincing operations be carried out under the same conditions, the mantle, head, bowl liner and bowl should be heated evenly to about 100° Fahrenheit to drive out all traces of moisture or sweating. Pre-heating will eliminate the tendency of moisture to vaporize when pouring the zinc, and causing sputtering. Caution must be exercised when heating any of these parts so as not to cause a "hot spot" which would destroy its heat treatment.

- 2 Apply a light coating of lubricating oil to the inside of the mantle, the outside of the head, the outside of the bowl liner and the inside of the bowl. This will prevent the zinc from sticking to either the head or bowl. At the same time this film of oil will remove any surface moisture that might be present.
- 3 Lower the mantle onto the head and install the backing mandrel on the locking collar as shown in the illustration BACKING MANDREL. Using the double sledge method, sledge the mandrel firmly against the mantle to center and position the mantle on the head. It is important that the mantle is seated properly, both for pouring of the zinc and the self-tightening feature. A loose or cocked mantle can result in damage to the mantle or the mantle seat on the head.
- 4 Check that the mantle bears tightly against the head by using a feeler gauge all around the mantle seat. Should any openings exist due to wear on this area of the head, pack these openings with "Dambabbit" which is a plastic asbestos compound, or clay to keep the backing from leaking out during pouring.



- 5 Pack loose fiberglass, "Dambabbit" or clay beneath the mandrel as shown in the illustration, BACKING MANDREL. This will prevent the zinc from flowing onto the top of the head and becoming interlocked with the locking collar threads.

**WARNING**

When handling the 800° Fahrenheit molten zinc, goggles and protective clothing must be worn. Contact with molten zinc will result in serious burns.

FOR A COMPLETE PROCEDURE ON REPOURING BACKING MATERIAL BETWEEN THE BOWL AND BOWL LINER, REFER TO SECTION 8.

- 6 Refer to the table, BACKING REQUIREMENTS for the approximate amount of zinc to prepare, then pour the zinc without interruption, filling the entire cavity behind the mantle to just below the top of the head.
- 7 After the zinc has fully hardened remove the mandrel and any excess zinc that may have seeped onto the top of the head.
- 8 Examine the locking nut and locking collar threads and remove any burrs or nicks which might exist and clean the threads thoroughly. Coat the threads with grease or lubricating oil, preferably mixed with 5 - 10% (by volume) of molybdenum disulfide powder. Install the locking nut and tighten securely using the double sledge method.

CRUSHER SIZE		3 FT.	5100 AND 4-1/4 FT.	5-1/2 FT.	7 FT.*
BACKING REQUIRED FOR BOWL LINER (Average Weight In Pounds)	ZINC	95	190	470	750
	NORDBAK (See Below)	33	55	132	198
BACKING REQUIRED FOR MANTLE (Average Weight In Pounds)	ZINC	85	150	300	560
	NORDBAK (See Below)	33	44	77	143

NORDBAK is available in two kit sizes: a large kit containing (after mixing) approximately 22 pounds of backing material, and a small kit containing approximately 11 pounds.

\*Specify "High Impact" NORDBAK when ordering NORDBAK backing for a 7 Ft. Crusher.

Where the Crusher is used for crushing gold ore in plants having the cyanide process of recovery, it is recommended that the zinc backing for the mantle and bowl liner be supplanted by some mixture containing no zinc or aluminum. Should the mantle or liner loosen slightly, causing the zinc to powder and be introduced with the ore, a loss in recovery may occur. In place of zinc, use non-metallic NORDBAK backing material for such operations.

**SHORT HEAD CRUSHER BACKING REQUIREMENTS**

- 9 Check that the locking nut cover felt seal, is not worn or damaged, then install the locking nut cover.
- 10 After lowering the main shaft assembly into the Crusher, remove the lifting eyebolt and install the feed distributor and feed plate. On some machines the feed distributor and feed plate must be installed after the bowl assembly is in the Crusher.

**APPLICATION OF NORDBAK BACKING, 3 FT., 5100, 4-1/4 FT., 5-1/2 FT. AND 7 FT. CRUSHERS.** NORDBAK is a tough, resilient, non-metallic backing material which is readily available in kit form in various sizes. Each kit contains a large and small can of NORDBAK and a mixing paddle. The use of NORDBAK requires no special equipment, preparation or handling. The NORDBAK material is not reusable and, therefore is expendable with the worn mantle or liner. With NORDBAK the backing can be mixed right at the job site as mixing and pouring requires no special training, the simple directions are included with each kit. Once mixed, the NORDBAK must be poured without delay. Subsequent mixes that may be required to completely fill the cavity, can be poured at any convenient time. To repour NORDBAK backing material, proceed as follows:

- 1 The NORDBAK kits and the parts that require backing should be at room temperature prior to pouring (60° to 90° Fahrenheit).

IF TOO COLD, NORDBAK WILL HARDEN SLOWLY AND WILL BE TOO VISCOUS TO FILL A SMALL SPACE WITH CERTAINTY. IF TOO HOT, THERE IS THE RISK OF THE MIXTURE SETTING IN THE CAN BEFORE IT CAN ALL BE Poured. SHOULD THIS SITUATION ARISE, THE UNOPENED CANS SHOULD BE IMMERSed IN COOL WATER BEFORE MIXING. DO NOT USE NORDBAK WHERE THE FEED TO THE CRUSHER EXCEEDS 175° FAHRENHEIT.

- 2 Apply a light coating of lubricating oil to the outside of the head and the inside of the bowl. This will prevent the NORDBAK from sticking to either the head or bowl.
- 3 Lower the mantle onto the head and install either the backing mandrel or the locking nut on the locking collar. See the illustration BACKING MANDREL. Using the double

sledge method, sledge the mandrel or nut firmly against the mantle to center and position the mantle on the head. It is important that the mantle is seated properly, both for the pouring of the NORDBAK and the self-tightening feature. A loose or cocked mantle can result in damage to the mantle or mantle seat on the head.

- 4 Check that the mantle bears tightly against the head by using a feeler gauge all around the mantle seat. Should any openings exist due to wear on this area of the head, pack these openings with "Dambabbit" which is a plastic asbestos compound, or clay to keep the backing from leaking out during pouring.
- 5 Remove the mandrel or locking nut and fill the entire cavity behind the mantle with NORDBAK to just below the top of the head. The table BACKING REQUIREMENTS gives the approximate amount of NORDBAK necessary to fill the cavity.

#### WARNING

Carefully follow the instructions as well as the precautions that are printed on the individual cans of NORDBAK before mixing and pouring. Skin contact with NORDBAK may cause serious delayed Dermatitis. Avoid inhalation of vapor. Use ventilation, particularly if heated. Prevent all contact with skin. If contact occurs, wash immediately with soap and water.

A POURING SPOUT SHOULD BE FASHIONED OUT OF SHEET STEEL OR HEAVY CARDBOARD TO DIRECT THE NORDBAK FLOW INTO THE BACKING CAVITY, WHICH WILL PREVENT SPILLING AND SPEED UP THE POURING PROCESS. IF THE NORDBAK IS Poured IN AT SEVERAL LOCATIONS AROUND THE TOP OF THE HEAD, THIS ALSO WILL SPEED UP THE POURING PROCESS.

- 6 Examine the locking nut and locking collar threads and remove any burrs or nicks which might exist and clean the threads thoroughly. Coat the threads with grease or lubricating oil, preferably mixed with 5 - 10% (by volume) of molybdenum disulfide powder. Install the locking nut and tighten securely using the double sledge method.
- 7 Check that the locking nut cover felt seal is not worn or damaged, then install the locking nut cover.



8 After lowering the main shaft assembly into the Crusher, remove the lifting eye-bolt and install the feed distributor and feed plate. On some machines the feed distributor and feed plate must be installed after the bowl assembly is in the Crusher.

REPLACING MANTLE, 2 FT., 4 FT., 5100, 4-1/4 FT. AND 5-1/2 FT. CRUSHERS (STANDARD MAIN SHAFT). On 2 Ft., 4 Ft., 5100, 4-1/4 Ft. and 5-1/2 Ft. Crushers that are equipped with a standard main shaft (threaded at the top ) the main shaft arrangement is somewhat different than the other SHORT HEAD Crushers, therefore an entirely different mantle replacement procedure is necessary. To remove the worn mantle and install a replacement mantle, refer to the STANDARD CRUSHER portion of this section and read thoroughly ALL of the paragraphs under REPLACING MANTLE.

APPLICATION OF ZINC BACKING, 2 FT., 4 FT., 5100, 4-1/4 FT. AND 5-1/2 FT. CRUSHERS (STANDARD MAIN SHAFT). Whenever a new set of liners is installed, it is necessary to repour the backing material between the mantle and head and between the bowl liner and bowl.

To repour zinc backing on the 2 Ft., 4 Ft., 5100, 4-1/4 Ft. and 5-1/2 Ft. Crushers, that are equipped with a standard main shaft, refer to the STANDARD

CRUSHER portion of this section and read thoroughly ALL of the paragraphs under APPLICATION OF ZINC BACKING.

APPLICATION OF NORDBAK BACKING, 2 FT., 4 FT., 5100, 4-1/4 FT. AND 5-1/2 FT. CRUSHERS (STANDARD MAIN SHAFT). As with the zincing method, whenever a new set of liners is installed, it is necessary to repour the backing material between the mantle and head and between the bowl liner and bowl.

To repour NORDBAK backing material on the 2 Ft., 4 Ft., 5100, 4-1/4 Ft. and 5-1/2 Ft. Crushers, that are equipped with a standard main shaft, refer to the STANDARD CRUSHER portion of this section and read thoroughly ALL of the paragraphs under APPLICATION OF NORDBAK BACKING.

REPLACING HEAD OR MAIN SHAFT. Normally, it is not necessary to replace the head or main shaft. However, if for any reason, either requires replacement, it is advisable to contact the factory for the proper replacement procedure. This is required, as procedures are different for each size of Crusher and each particular Crusher installation. Some of the differences are: size of hydraulic press required, heating temperatures, headbore size, and shaft size. Remachining information is also available if and when head wipers or baffle rings have become worn.

Section 8

**BOWL, BOWL LINER AND ADJUSTMENT CAP ASSEMBLIES**

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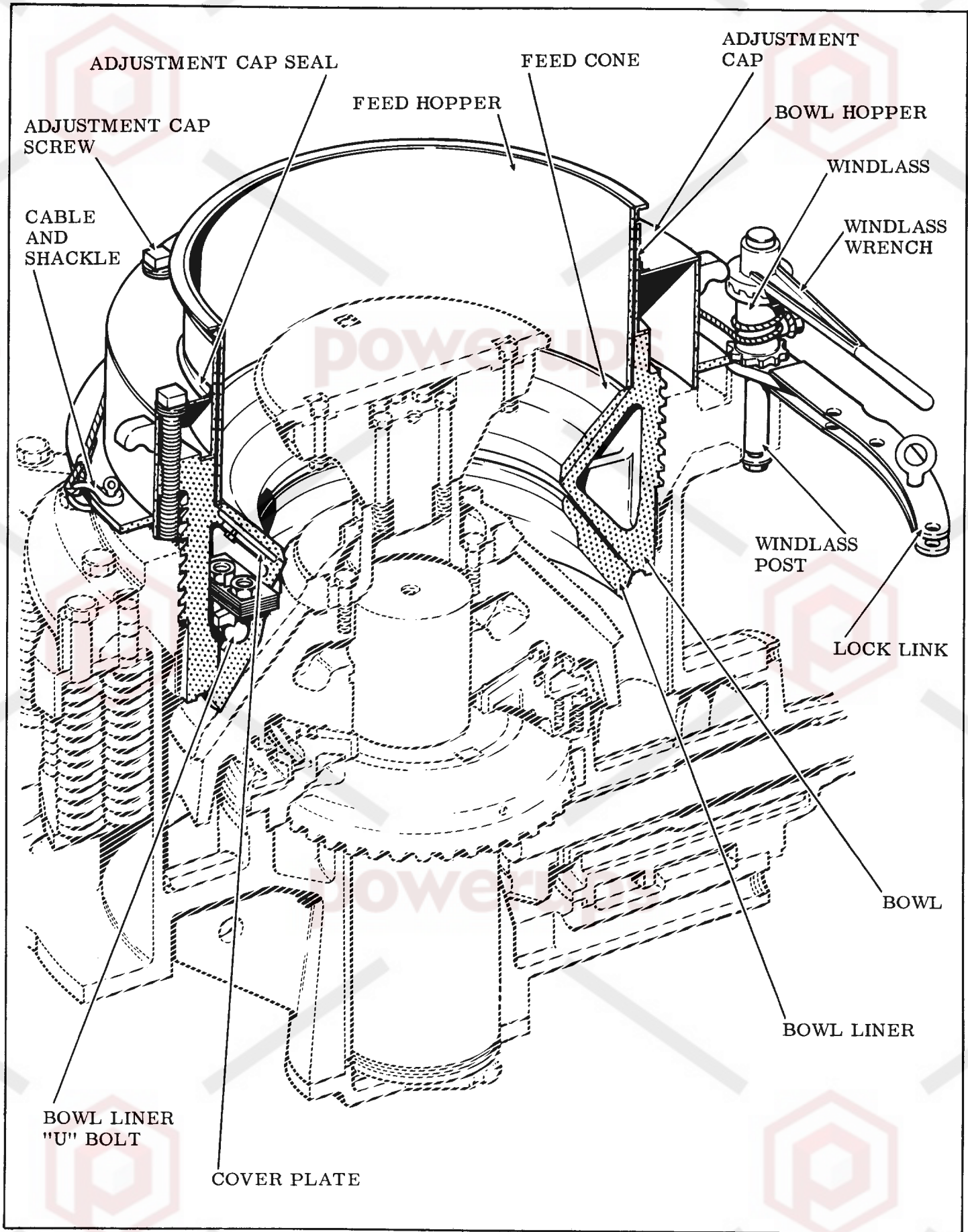
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## SECTION 8

# BOWL, BOWL LINER AND ADJUSTMENT CAP ASSEMBLIES

### DESCRIPTION

This section covers the bowl, bowl liner and adjustment cap assemblies. The bowl which is threaded on its outside diameter is suspended on heavy duty threads inside the adjustment ring. The bowl is adjustable, up or down, by turning the bowl counterclockwise or clockwise within the adjustment ring. Adjusting the bowl controls the size of feed opening and discharge setting. The adjustment cap which fits around the bowl and rests on the adjustment ring is used for raising the bowl into the crushing position in the adjustment ring.

A series of large diameter screws or a lock post arrangement, located around the top of the adjustment cap, project through the cap and into bosses on the bowl. As the adjustment cap rests on top of the adjustment ring, tightening the screws or driving the taper keys in the lock posts will raise the bowl into the crushing position. Lock links bolted to the adjustment ring and connected to the adjustment cap prevent the bowl assembly from rotating during crushing. The bowl turns with the adjustment cap when the cap is rotated by pulling on a cable connecting the cap to a windlass or through a swivel and sheave arrangement to an overhead crane.

Inside the bowl, the feed cone directs the falling feed to the crushing members as it comes from the feed plate. Directly beneath the feed cone and recessed in the bowl are the bowl cover plates. These cover plates are readily opened for removal of the bowl liner bolts for changing the bowl liner. The replaceable bowl liner is held rigidly to the bowl by "U" bolts which attach to hooks on the bowl liner.

In the case of the 4 Ft. short head crusher, directly beneath the feed cone and recessed in the bowl there may be a series of wedges which hold the replaceable bowl liner rigidly to the bowl.

The bowl liner, while it is adjustable, is the stationary crushing member.

### ASSEMBLY INSTRUCTIONS

If the bowl, bowl liner and adjustment cap assemblies have been shipped separately due to weight or shipping restrictions, the various assemblies must be dismantled, cleaned and reassembled prior to installation. To dismantle, clean, reassemble and install the bowl, bowl liner and adjustment cap assemblies, proceed as follows:

- 1 In order to expose the full length of threads on the bowl, it will be necessary to first remove the adjustment cap. The adjustment cap may be removed by employing one of the following two methods depending on whether the Crusher is equipped with adjustment cap screws or with the Duckworth adjustment arrangement.
  - A. If the Crusher is equipped with adjustment cap screws, the screws must be removed by using the special wrench provided or by using an air wrench and socket. See the illustration ADJUSTMENT CAP SCREW ARRANGEMENT.
  - B. If the Crusher is equipped with the Duckworth adjustment arrangement, the taper keys and adjustment lock post washers must be removed. The lock posts can remain in position in the bowl. See the illustration DUCKWORTH ARRANGEMENT. Remove the tapered keys by sledging. The cotter pins inserted through the key prevent the key from flying all the way out and should not be removed until the initial loading has been eliminated. Then remove the cotter pin and continue tapping the key with light blows until the key can be removed by hand.
- 2 Lift off the adjustment cap and thoroughly clean the threads on the bowl and also the threads on the adjustment ring, removing all dirt and rust preventive.

### ADJUSTMENT CAP SCREW ARRANGEMENT

ADJUSTMENT  
CAP SCREW

ADJUSTMENT  
CAP

BOWL

ADJUSTMENT  
CAP

BOWL  
HOPPER

BOWL  
THREADS

### DUCKWORTH ARRANGEMENT

LOCK POST

COTTER PIN

TAPER KEY

ADJUSTMENT  
LOCK POST  
WASHERS

ADJUSTMENT  
CAP

BOWL

ADJUSTMENT  
CAP

BOWL  
HOPPER

LOCK POST

BOWL  
THREADS

- 3 Rub down the thread surfaces of both the bowl and adjustment ring with a cloth impregnated with molybdenum disulfide powder. This procedure bonds a lubricating film to the metal allowing the bowl to rotate more freely. An initial coat of molybdenum disulfide was applied to these threads at the factory.
- 4 Liberally coat the threads with a mixture of grease and 5 - 10% (by volume) of molybdenum disulfide powder.

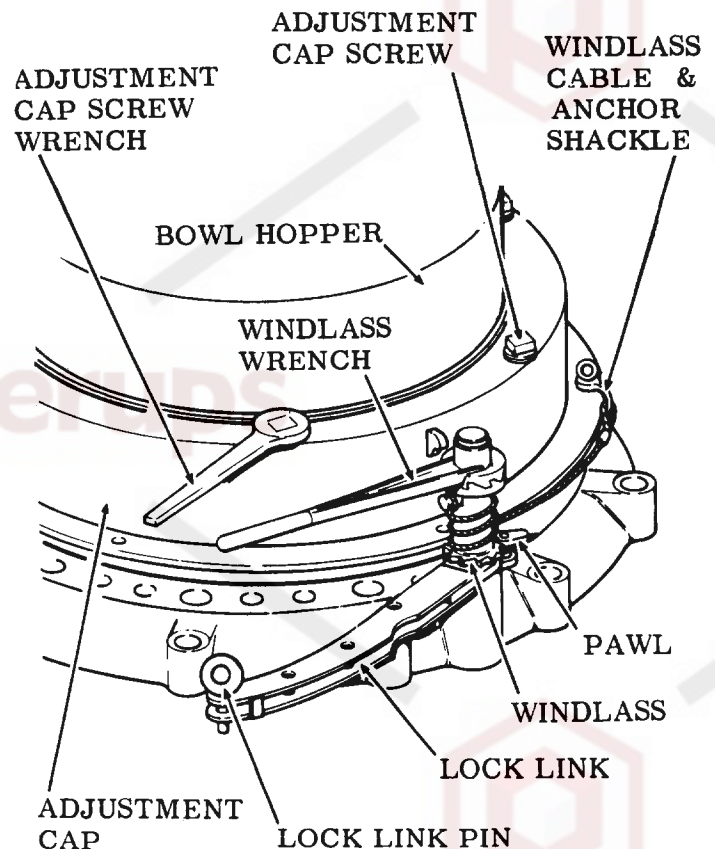
WHEN CRUSHING HOT MATERIAL SUCH AS CLINKERS OR SLAG, A HIGH TEMPERATURE GREASE MIXED WITH 5-10% (BY VOLUME) OF MOLYBDENUM DISULFIDE POWDER SHOULD BE USED. THIS SAME POWDER MIXED WITH LUBRICATING OIL HAS ALSO BEEN FOUND SATISFACTORY FOR SUCH APPLICATIONS.

- 5 Reassemble the adjustment cap and other components to the bowl. If the Crusher has adjustment cap screws, turn them all the way down but do not tighten. If the Crusher is equipped with the Duckworth adjustment arrangement, sledge in the tapered keys but do not drive them in tight, and insert the cotter pin in the hole in the key.
- 6 Lift the entire assembly onto the adjustment ring by rigging slings to the hooks on the adjustment cap. Before the bowl assembly can be lowered into the Crusher, removal of the feed plate and feed distributor might be necessary. For removing these items follow the procedure given in MAIN SHAFT REMOVAL in Section 7.
- 7 The bowl is then threaded into the adjustment ring using one of the two following methods, depending on whether the Crusher is equipped with windlasses or a swivel casting and sheave.

ALL 2 FT., 3 FT., 4 FT., 5100 AND 4-1/4 FT. CRUSHERS ARE FURNISHED WITH THE WINDLASS ADJUSTMENT, FOR TURNING THE BOWL WHILE THE 5-1/2 FT. and 7 FT. USE THE SWIVEL ADJUSTMENT.

- A. If the Crusher is equipped with the windlass adjustment, slide the windlass posts into the bosses on the adjustment ring and fasten in place as shown in the illustration WINDLASS ADJUSTMENT. Lower the lock link over the post and place the windlass on top of the lock link, making sure that the pawl engages the lower portion of the windlass.

The lock links are not to be connected to the adjustment cap at this time. Assemble the windlass cables, which connect the windlass to the adjustment cap, by inserting anchor shackles through the end loops of the cables. Bolt the shackle to the adjustment cap collar and fasten the other end of the cable to the windlass. Attach the windlass cables to the proper side of the adjustment cap to obtain clockwise rotation. Rotate the bowl into the adjustment ring by turning the windlasses with the large cast windlass wrenches provided. Pipe extensions can be used on the wrench handles to minimize the power required for turning.



**WINDLASS ADJUSTMENT**

B. If the Crusher is equipped with the swivel adjustment, place the lock link post spacer, followed by the lock link, on the adjustment ring bosses, one directly opposite the other and hold in this position. Insert the lock link post and fasten the post to the ring as shown in the illustration SWIVEL ADJUSTMENT. In one of the other two bosses, insert the swivel adjustment assembly and bolt in place.

The lock links are not to be connected to the adjustment cap at this time. Place a wooden plug in the boss not being used, to prevent rust or corrosion. Assemble the swivel cable which connects the sheave to the adjustment cap by inserting an anchor shackle through the end loop of the cable. Bolt the shackle to the adjustment cap collar while slipping the cable around the sheave and hooking the other end of

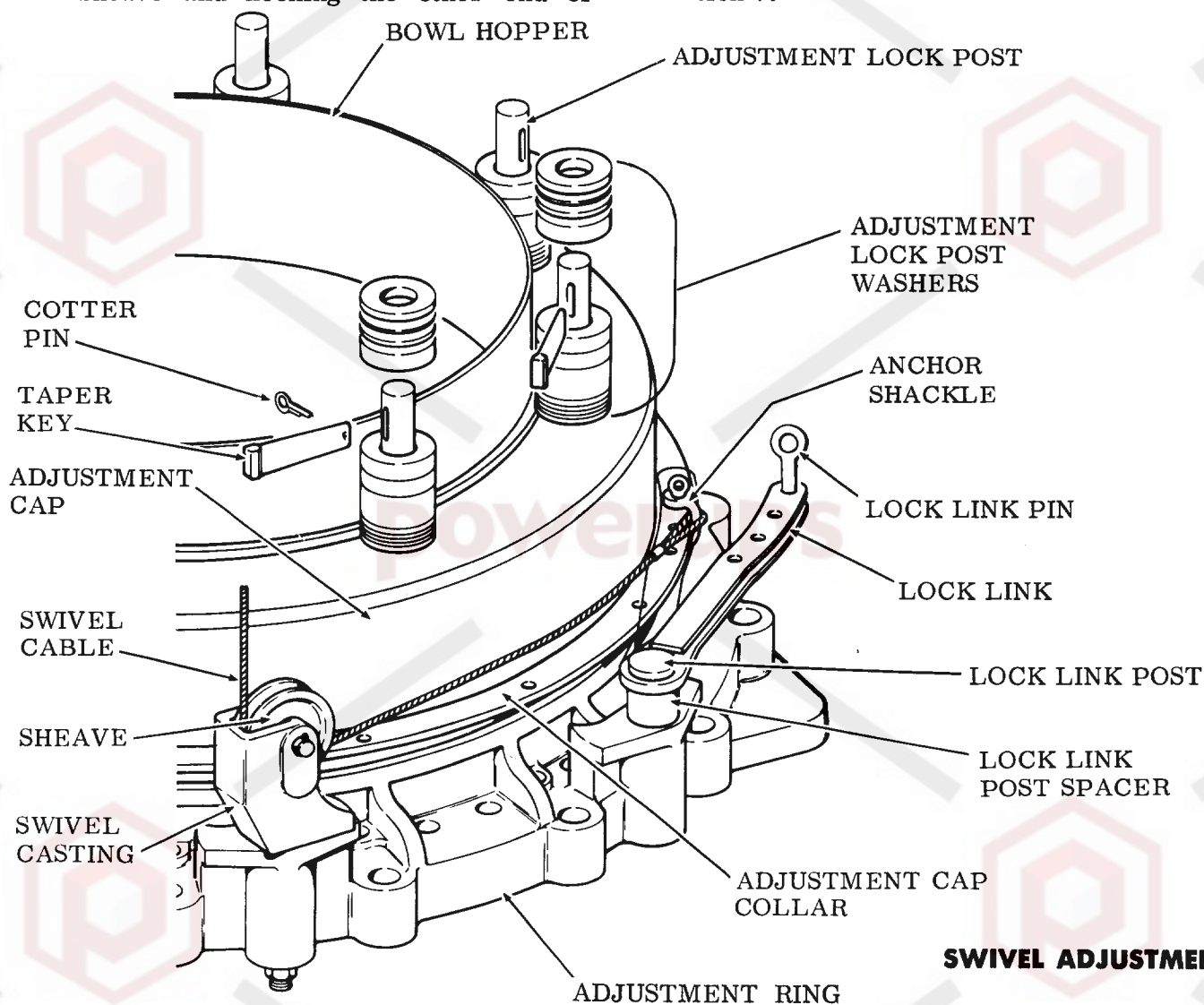
the cable to an overhead crane (10 ton capacity) or hook a suitable block and tackle arrangement to a truck or tractor. Attach the cable to the proper side of the adjustment cap to obtain clockwise rotation, then pull the bowl into the adjustment ring.

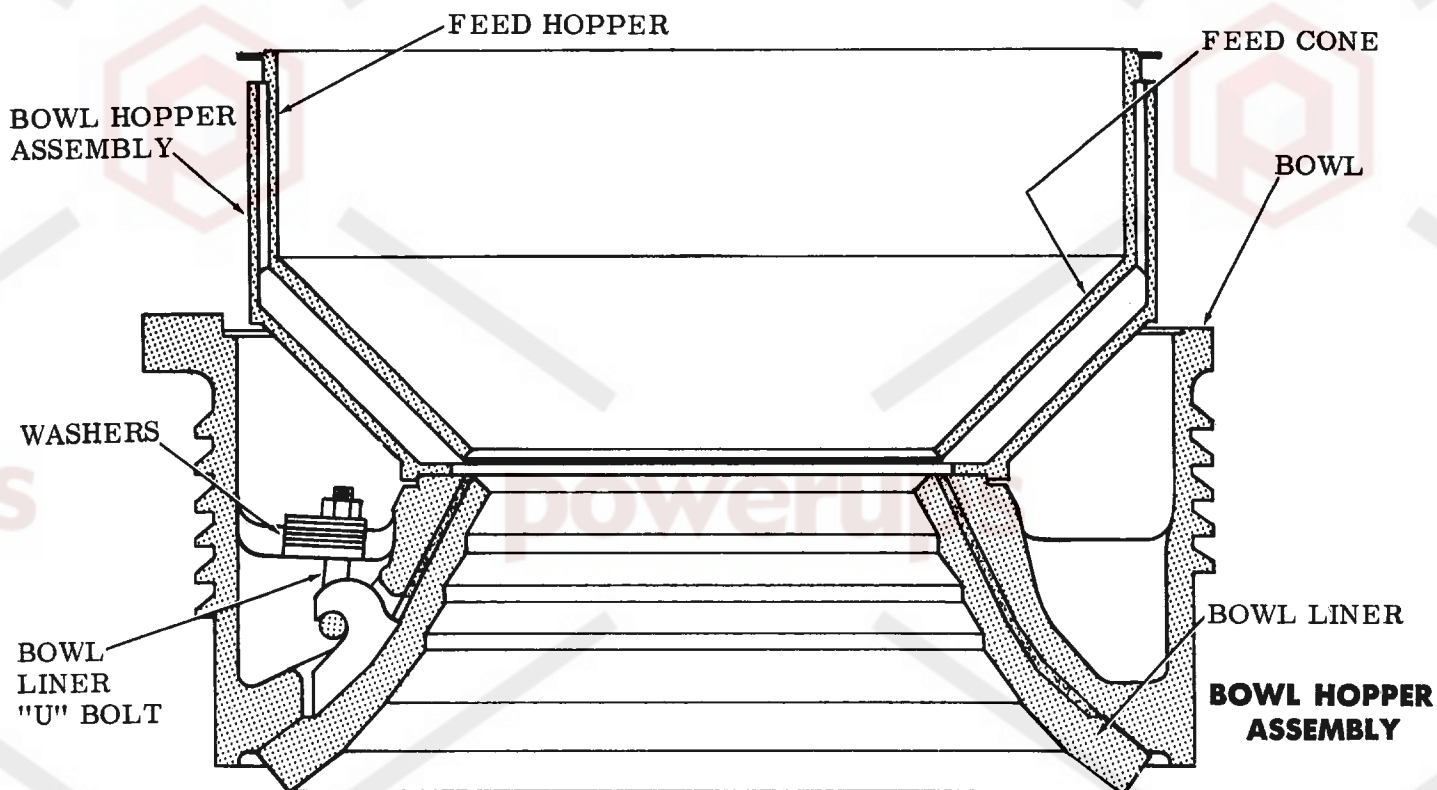
8 Turn the bowl assembly to the desired setting by referring to ADJUSTING THE BOWL in Section 11.

## MAINTENANCE

**BOWL REMOVAL.** To remove the bowl assembly for the inspection and replacement of parts, proceed as follows:

1 If necessary, remove the feed plate and feed distributor, following the procedure given in MAIN SHAFT REMOVAL in Section 7.





- 2 Turn the bowl counterclockwise out of the adjustment ring using one of the methods described in OPERATING INSTRUCTIONS in Section 11.
- 3 Lift the bowl, by rigging slings to the hooks on the adjustment cap, over the main shaft assembly. Then lower it onto wooden blocking, as shown in the illustration BOWL ASSEMBLY. On the 2 Ft. Crusher, place the blocking under the bowl liner rather than under the bowl.

**BEFORE REPLACING THE BOWL LINER, IT IS ADVISABLE TO READ THOROUGHLY THE INSTRUCTIONS UNDER APPLICATION OF ZINC BACKING AND NORDBAK BACKING IN SECTION 7.**

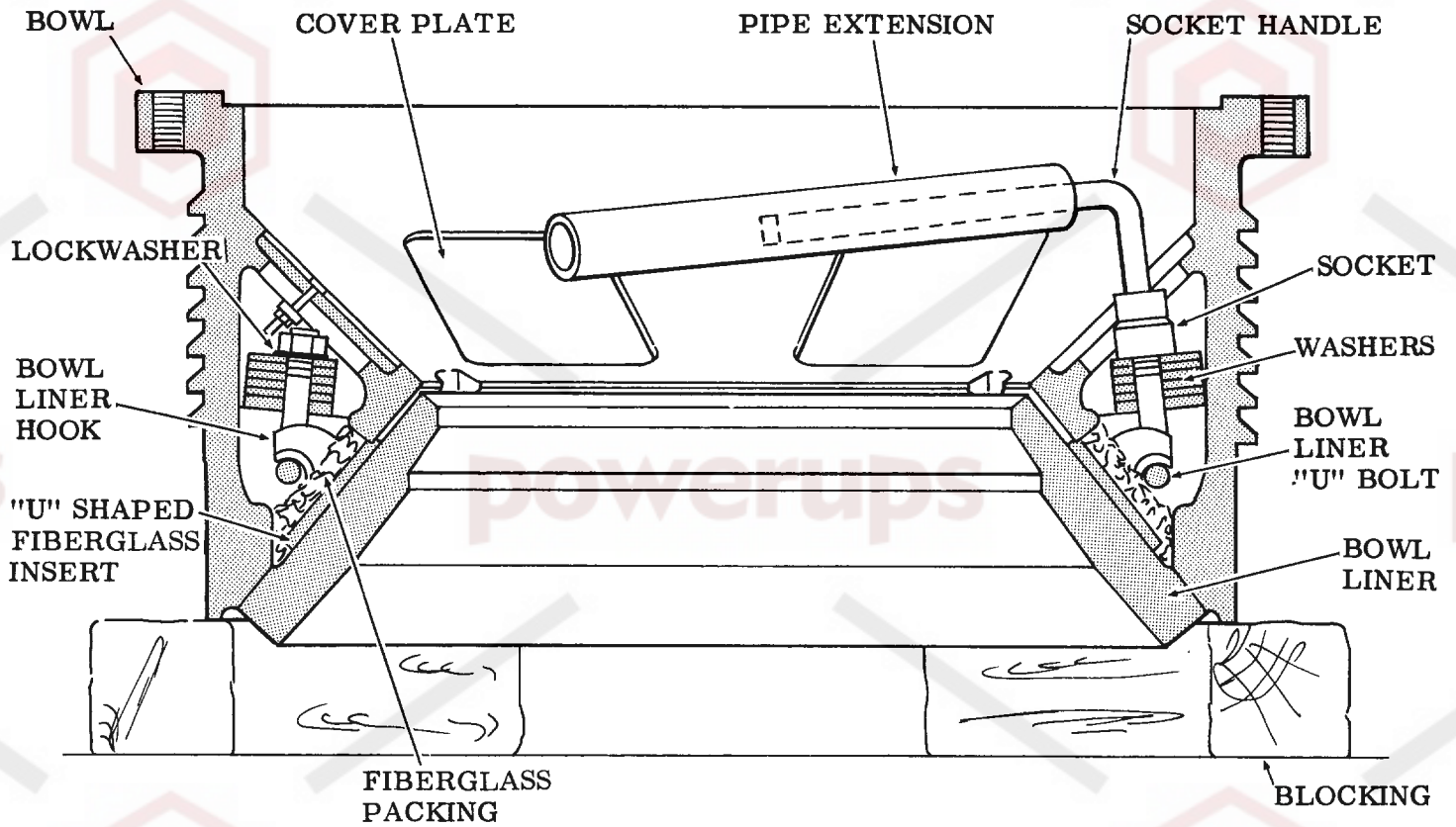
**BOWL LINER REMOVAL, 3 Ft., 4 Ft., 5100, 4-1/4 Ft., 5-1/2 Ft., and 7 Ft. CRUSHERS.** To remove the bowl liner, proceed as follows:

- 1 Remove the adjustment cap screws or the taper keys and washers, depending on how the Crusher is equipped, then lift off the adjustment cap.
- 2 Thoroughly clean the threads on the adjustment ring and bowl, removing all traces of dirt, rust and old grease.

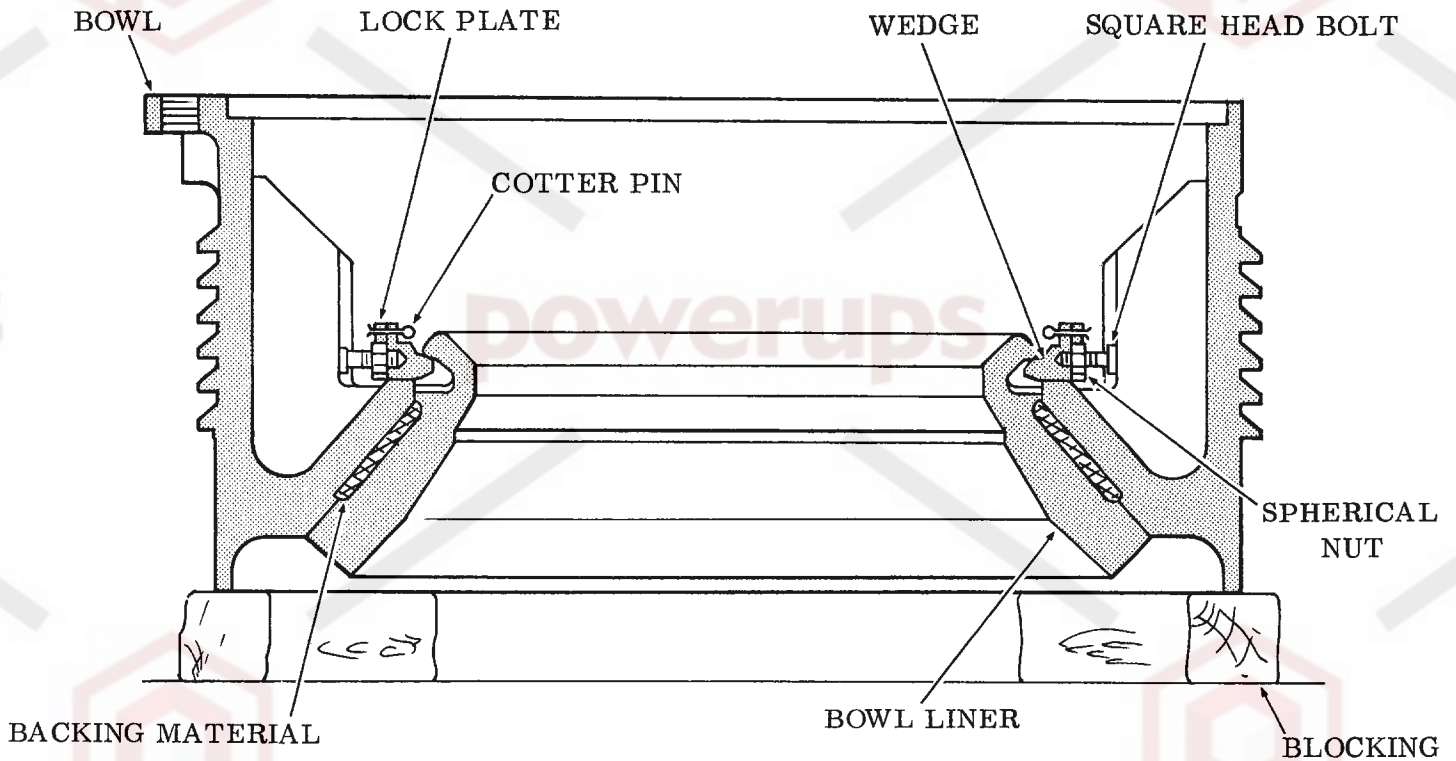
- 3 Lift the feed cone and the feed hopper from within the bowl, then remove the bowl hopper from the top of the bowl. This will reveal the cover plates through which access to the bowl liner "U" bolts is obtained.
- 4 Remove the cover plates. On some of these crusher sizes, there are no cover plates, the entire top of the bowl is open. These bowls have a bowl hopper assembly bolted to the bowl to cover this portion of the bowl. See the illustration BOWL HOPPER ASSEMBLY. With this type of bowl, the feed cone and feed hopper are lifted from within the bowl and then the hopper assembly is unbolted from the bowl, thereby giving access to the bowl liner "U" bolts or to the wedges which hold the bowl liner to the bowl.
- 5 After the rectangular "U" bolt lockwashers have been removed, use the socket and special "L" shaped handle to remove the "U" bolt nuts. Then lift off the washers and remove the "U" bolts. See the illustration BOWL ASSEMBLY.

A pipe extension may be required on the handle for additional leverage. Considerable force might have to be applied as the crushing action can cause the bowl liner to flow or elongate slightly, thereby increasing the tension on these bolts.





3 Ft., 4 Ft., 5100, 4-1/4 Ft., 5-1/2 Ft. and 7 Ft. CRUSHERS



4 Ft. SHORT HEAD CRUSHERS

**BOWL ASSEMBLY**

ON THE 4 FT. SHORT HEAD CRUSHER WHICH HAS NO "U" BOLTS, REMOVE THE COTTER PINS THAT HOLD THE LOCK PLATES TO THE WEDGES. SEE THE ILLUSTRATION BOWL ASSEMBLY. THEN LIFT OUT THE LOCK PLATES, THIS WILL EXPOSE THE SPHERICAL NUTS AND PERMIT THE WEDGES TO BE LOOSENED. USING AN OPEN END WRENCH, UNSCREW THE SPHERICAL NUTS ON THE SQUARE HEAD BOLTS. THESE NUTS HOLD THE WEDGES AGAINST THE BOWL LINER. WITH A HAMMER AND A BLUNT CHISEL, DRIVE THE WEDGES OUT.

- 6 Lift the bowl off the liner. Occasionally the backing material, if the bowl was improperly prepared around the bowl liner hooks, may lock the liner in the bowl. If the bowl sticks to the liner, ram vertically on the top of the liner hooks to break loose the backing material from around the hook openings.

ON THE 4 FT. SHORT HEAD CRUSHER WHICH HAS NO HOOKS, IF THE BOWL STICKS TO THE LINER, RAM VERTICALLY ON THE TOP OF THE LINER TO BREAK LOOSE THE BACKING MATERIAL FROM THE BOWL.

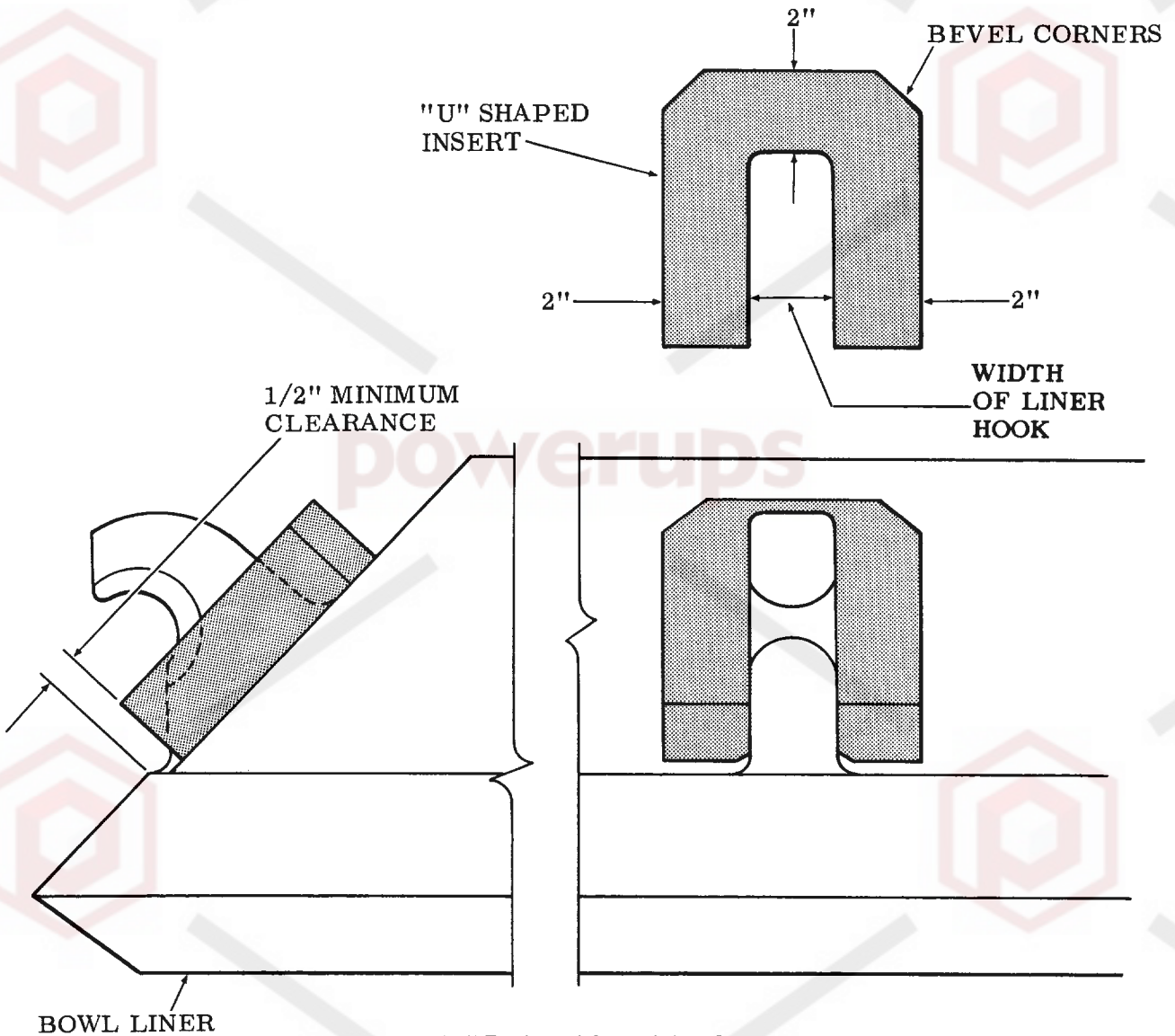
- 7 Chip off any backing material which might remain on the bowl. Usually the backing material will adhere to the liner and little, if any, chipping is required on the bowl.

#### WARNING

When it is necessary to use a cutting torch in removing parts backed by NORDBAK or zinc, provide adequate ventilation. Avoid inhaling fumes. Personnel removing parts should be required to wear air-line respirators to prevent inhalation of fumes (when torch cutting) or dust (when grinding or chipping).

PREPARATION OF BOWL AND BOWL LINER FOR APPLICATION OF BACKING MATERIAL, 3 Ft., 4 Ft., 5100, 4-1/4 Ft., 5-1/2 Ft. and 7 Ft. CRUSHERS. To prepare the bowl and bowl liner for the application of backing material, proceed as follows:

- 1 If zinc backing is to be used, the bowl and bowl liner may have to be heated to remove all trace of moisture.
- 2 Apply a light coating of lubricating oil to the inside of the bowl to prevent the NORDBAK or zinc from sticking to the bowl.
- 3 Cut U-shaped inserts using a shears from fiberglass insulation, as shown in the illustration FIBERGLASS INSERTS. The paper backing should be left on the insulation while cutting and protective non-porous gloves should be used when handling this material. The size of the inserts will vary depending on the particular liner casting used.



### FIBERGLASS INSERTS

THE MATERIAL TO BE USED IS COMMERCIAL FIBERGLASS INSULATION AND CAN BE PURCHASED FROM MOST LUMBER OR BUILDING MATERIAL SUPPLY FIRMS. THIS MATERIAL IS 2" THICK AND IS OBTAINABLE IN ROLLS, EITHER 16" OR 24" WIDE OR FROM THE FACTORY, CUT TO SIZE FOR IMMEDIATE USE.

Cut the length of the insert so as to provide a minimum clearance of 1/2" between the bottom of the insert and the edge of the bowl liner seat as shown in the illustration FIBERGLASS INSERTS. Chamfer the corners of the inserts to allow the backing material to flow easily around the inserts.

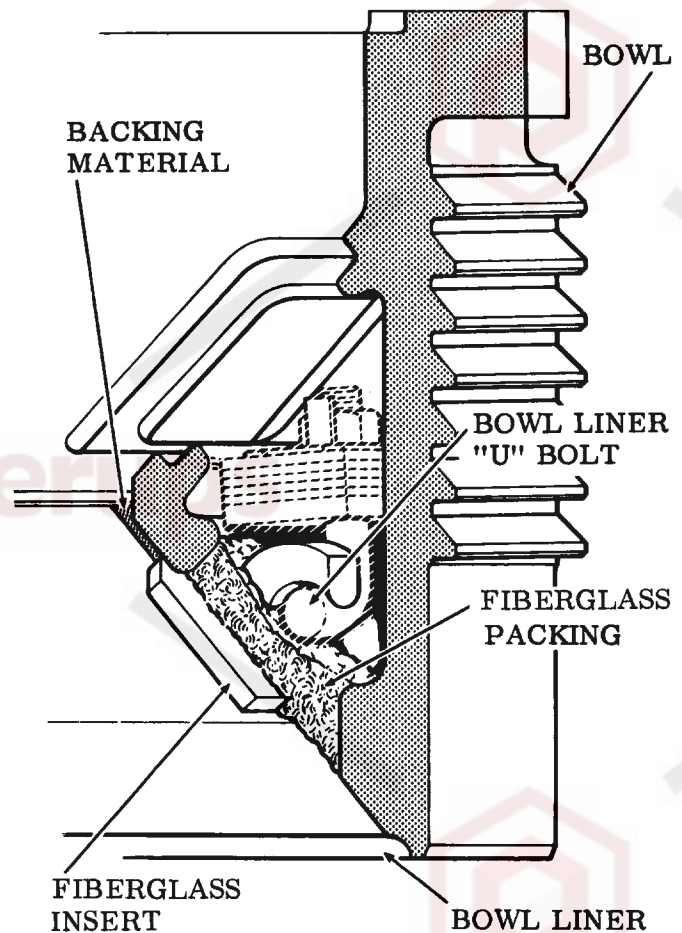
- 4 Remove the paper covering and position the inserts around the liner hooks as shown in the illustration FIBERGLASS INSERTS.

MAKE CERTAIN THAT THERE IS A MINIMUM CLEARANCE OF 1/2" BETWEEN THE BOTTOM OF THE INSERT AND THE LINER SEAT. ANY INSULATION CAUGHT BETWEEN THE BOWL LINER SEAT AND THE BOWL WILL CAUSE IMPROPER SEATING OF THE LINER.

- 5 Lower the bowl in position on the liner, being careful not to disturb any of the inserts. When the bowl is properly located and centered, the fiberglass inserts will be compressed as shown in the illus-

tration **PREPARATION OF BOWL AND BOWL LINER.** Fill all clearances and voids around the hooks with loose fiberglass insulation and pack firmly in place using a wooden wedge or similar tools. Should any backing be allowed to seep in and harden around the liner hooks, difficulty in removing the worn liner will be encountered.

Should fiberglass insulation material be unavailable, clay or plastic asbestos compound known as "Dambabbit" can be used as a substitute. When using either of these two materials, the bowl is placed on the liner as soon as the bowl has been thoroughly cleaned of previous backing material. Fill all the clearances and voids around the hooks, packing this material tightly against the liner. If clay is to be used with zinc backing, care should be taken that the moisture content is kept quite low to prevent the zinc from sputtering. Some dust infiltration into the hook cavities can occur when a new liner is installed in a worn bowl in extremely dusty operations. Additional dust protection is possible by applying an asphaltic rubber solution over the fiberglass packing and the adjacent bowl area.



**PREPARATION OF BOWL AND BOWL LINER**

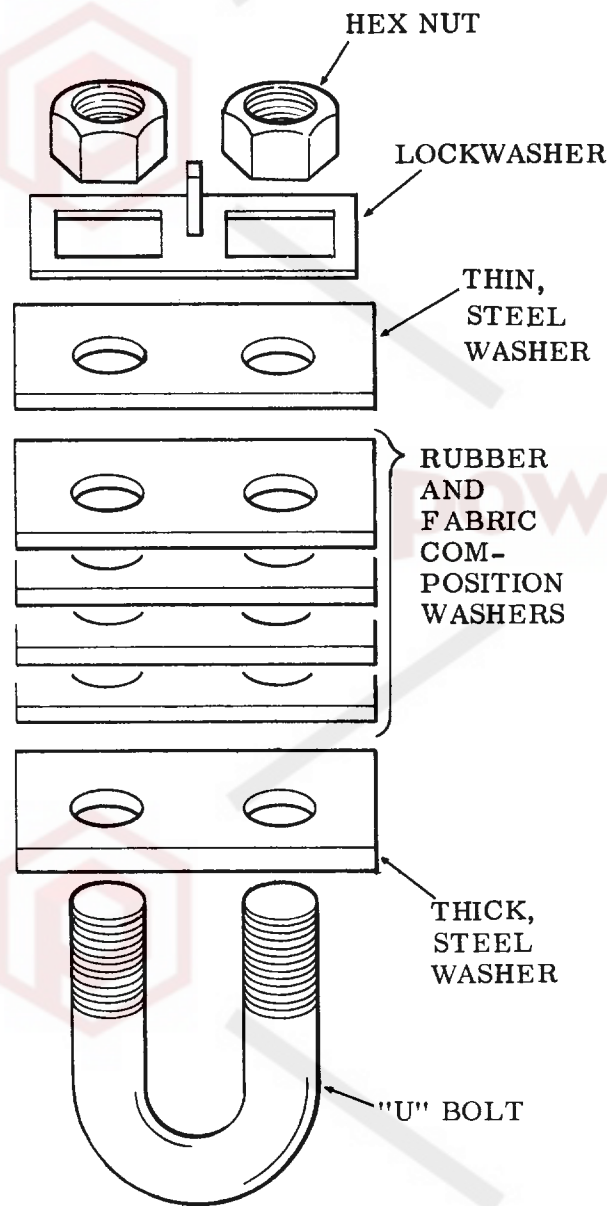
**APPLICATION OF ZINC BACKING, 3 Ft., 4 Ft., 5100, 4-1/4 Ft., 5-1/2 Ft. and 7 Ft. CRUSHERS.** To prepare the Crusher and pour zinc backing, proceed as follows:

- 1 Install and tighten **TWO** of the bowl liner "U" bolts, 180° apart. Installing only two "U" bolts at this time will permit an unobstructed view of the hook openings to see if any leaking is taking place. When these bolts are securely tightened, the "U" bolt washers of rubber and fabric composition must be firmly compressed. See the illustration "U" BOLT ASSEMBLY.
- 2 Check that the bowl liner bears tightly against the bowl by using a feeler gauge all around the liner seat. Should any openings exist due to wear on this area of the bowl, pack these openings with "Dambabbit" or clay to keep the backing from leaking out during pouring.

- 3 Refer to the table **BACKING REQUIREMENTS** in Section 7 for the approximate amount of zinc to prepare. Then carefully pour the zinc and if leaks are apparent, tamp extra fiberglass or a suitable substitute into the leak. This should be done as quickly as possible as the molten zinc will seek out any weak spot in the packing. Hardened zinc becomes very difficult to remove from the inside of the bowl.

**WARNING**

When handling the 800° Fahrenheit molten zinc, goggles and protective clothing must be worn. Contact with molten zinc will result in serious burns.



**"U" BOLT ASSEMBLY**

APPLICATION OF NORDBAK BACKING, 3 Ft., 4 Ft., 5100, 4-1/4 Ft., 5-1/2 Ft. and 7 Ft. CRUSHERS. To repour NORDBAK backing material, proceed as follows:

- 1 Install and tighten ALL the bowl liner "U" bolts as shown in the illustration "U" BOLT ASSEMBLY. When these bolts are securely tightened, the "U" bolt washers of rubber and fabric composition must be firmly compressed.
- 2 Check that the bowl liner bears tightly against the bowl by using a feeler gauge all around the liner seat. Should any openings exist due to wear on this area of the bowl, pack these openings with "Dambabbit" or clay to keep the backing from leaking out during pouring.
- 3 Refer to the table BACKING REQUIREMENTS in Section 7 for the approximate amount of NORDBAK to prepare. Then pour the NORDBAK, filling the entire cavity behind the bowl liner. A quick check at the hook openings will reveal whether any leakage of backing is taking place. Packing additional fiberglass into the openings will remedy any leakage problems. Should some of the NORDBAK leak into the inner chambers of the bowl, it can easily be removed by chipping once it has hardened.

**WARNING**

Carefully follow the instructions as well as the precautions that are printed on the individual cans of NORDBAK before mixing and pouring. Skin contact with NORDBAK may cause serious delayed Dermatitis. Avoid inhalation of vapor. Use ventilation, particularly if heated. Prevent all contact with skin. If contact occurs, wash immediately with soap and water.

- 4 After the zinc has hardened, install and tighten the remaining bowl liner "U" bolts and recheck the first two for tightness. Then place the rectangular lockwashers over the bolt nuts.
- 5 Replace the bowl cover plates or the bowl hopper assembly, lubricate the bowl and adjustment ring threads following the procedure recommended in ASSEMBLY INSTRUCTIONS. This is most important to insure free rotation of the bowl within the adjustment ring. Then reassemble the remaining components.

- 4 Recheck all bowl liner bolts for tightness after the NORDBAK has hardened, then place the rectangular lockwashers over the bolt nuts.
- 5 Replace the bowl cover plates or the bowl hopper assembly, lubricate the bowl and adjustment ring threads following the procedure recommended in ASSEMBLY IN-

**STRUCTIONS.** This is most important to insure free rotation of the bowl within the adjustment ring. Then reassemble the remaining components.

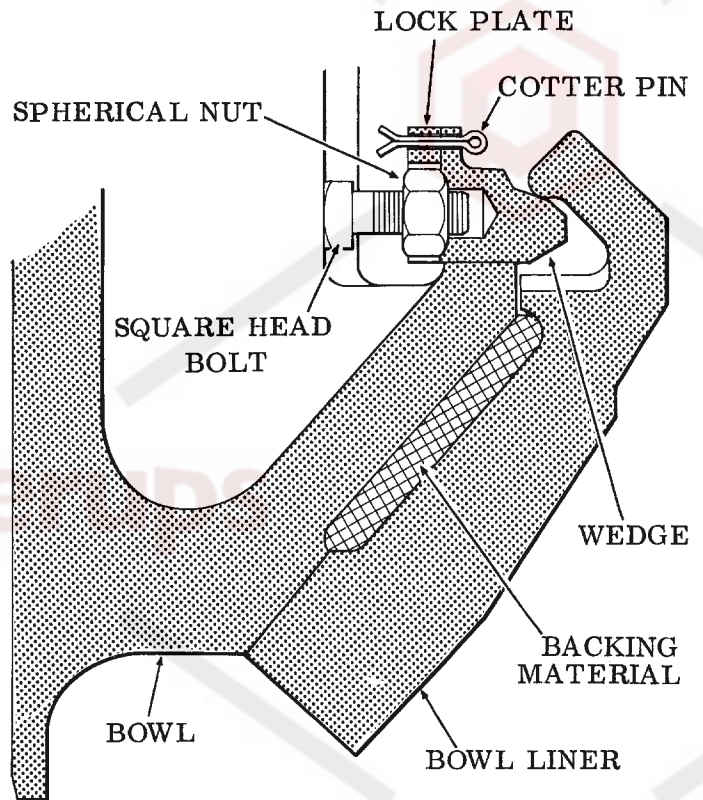
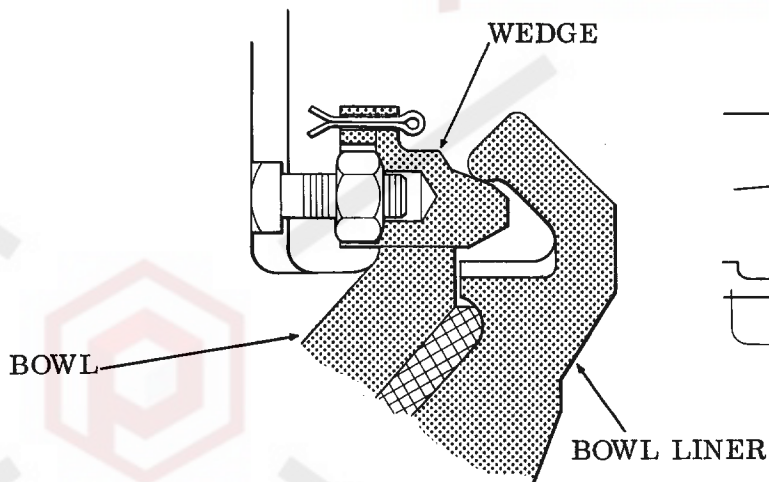
**PREPARATION OF BOWL AND BOWL LINER FOR APPLICATION OF BACKING MATERIAL, 4 FT. SHORT HEAD CRUSHERS.** To prepare the bowl and bowl liner for the application of backing material, proceed as follows:

- 1 If zinc backing is to be used, the bowl and bowl liner may have to be heated to remove all trace of moisture.
- 2 Apply a light coating of lubricating oil to the inside of the bowl to prevent the NORDBAK or zinc from sticking to the bowl.
- 3 Lower the bowl in position on the liner, being careful the bowl liner is positioned correctly as described in **INSTALLING THE BOWL LINER, 4 FT. SHORT HEAD CRUSHERS.**

**INSTALLING THE BOWL LINER, 4 FT. SHORT HEAD CRUSHERS.** To install the bowl liner proceed as follows:

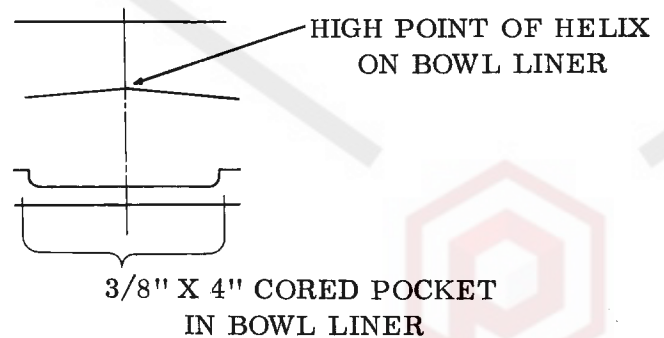
- 1 Lower the bowl in position on the bowl liner. To insure self-tightening, position the bowl liner in the bowl so that the wedges will contact the highest point of the helix on the bowl liner.

The high point of the helix on the bowl liner is identified by 3/8" x 4" long cored pockets cast into the centering ring on the liner. See the illustration **LOCATING HIGH POINT OF HELIX.**

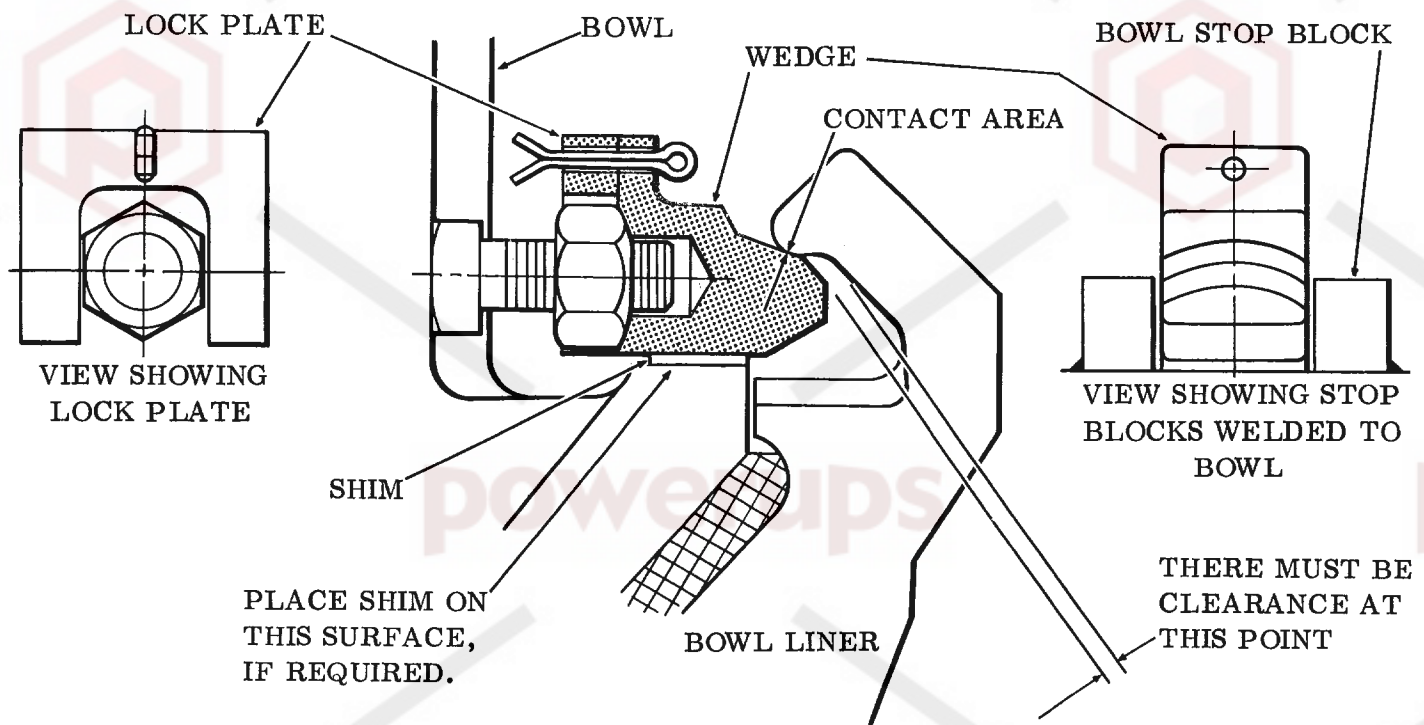


#### **BOWL LINER WEDGE ASSEMBLY**

- 2 Pre-assemble each of the square head bolts, spherical nuts and wedges as shown in the illustration **BOWL LINER WEDGE ASSEMBLY.** Make sure that the spherical surface of the nut is against the wedge.
- 3 Place each wedge assembly into a cored pocket around the inside of the bowl. See the illustration **BOWL ASSEMBLY.**
- 4 Using an open end wrench, turn the spherical nut behind each wedge until the wedge engages the helix on the bowl liner.



#### **LOCATING HIGH POINT OF HELIX**



### SHIMMING BOWL LINER WEDGE

- 5 Alternately tighten each nut, 180° apart, until all the wedges are tight against the helix portion of the bowl liner. The wedges must be securely tightened and properly seated in the bowl.

IN THE EVENT THE "NOSE" PORTION OF THE WEDGE CONTACTS THE SIDE OF THE BOWL LINER DUE TO CASTING VARIATIONS IN THE LINER, A SHIM MUST BE PLACED UNDER THE WEDGE SO THAT CONTACT IS MADE ON THE SLANTED PORTION OF THE WEDGE. SEE THE ILLUSTRATION SHIMMING BOWL LINER WEDGE.

APPLICATION OF BACKING MATERIAL, 4 FT. SHORT HEAD CURSHERS. With the 4 Ft. Short Head bowl liner arrangement no special preparations, such as sealing and packing around hooks, are required. The bowl is simply placed on top of the bowl liner. To repour backing material, proceed as follows:

- 1 Check that the bowl liner bears tightly against the bowl by using a feeler gauge all around the liner seat. Should any openings exist due to wear on this area of the bowl, pack these openings with "Dambabbit" or clay to keep the backing from leaking out during pouring.

- 2 Refer to the table BACKING REQUIREMENTS in Section 7, for the approximate amount of backing material to prepare, then fill the entire cavity behind the bowl liner.

#### WARNING

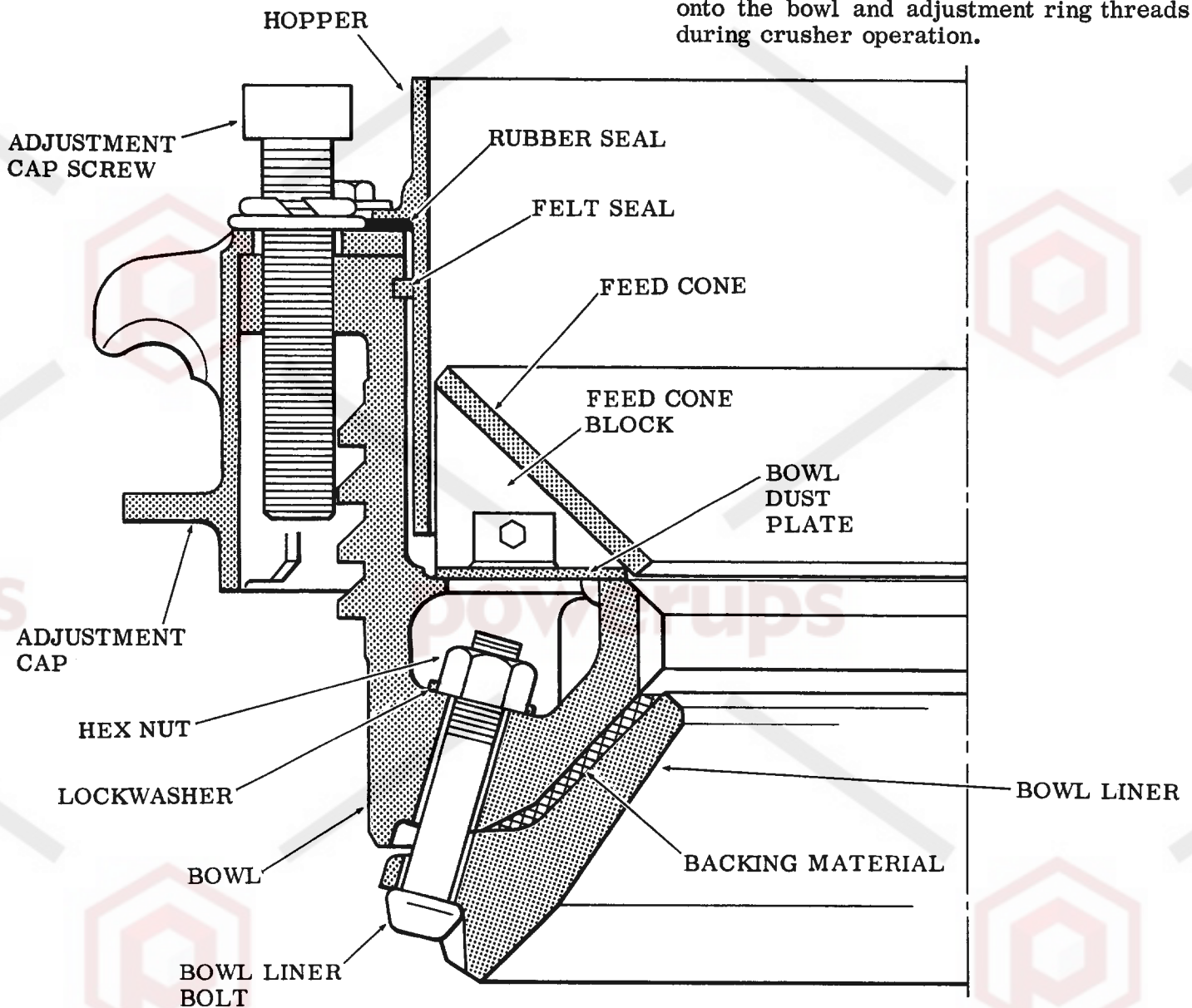
When handling the 800° Fahrenheit molten zinc, goggles and protective clothing must be worn. Contact with molten zinc will result in serious burns.

- 3 Recheck all the wedges and spherical nuts for tightness after the backing has hardened.
- 4 Install the lock plates over the spherical nuts and fasten the lock plates to the wedge using a long cotter pin. The lock plates will keep the spherical nuts from vibrating loose and causing the bowl liner to become loose in the bowl.
- 5 Replace the feed cone and feed hopper, lubricate the bowl and adjustment ring threads following the procedure recommended in ASSEMBLY INSTRUCTIONS. This is most important to insure free rotation of the bowl within the adjustment ring. Then reassemble the remaining components.

**BOWL LINER REMOVAL 2 FT. CRUSHERS.**  
The 2 Ft. bowl arrangement is somewhat different, therefore an entirely different bowl liner replacement procedure is necessary. To remove the worn bowl liner, proceed as follows:

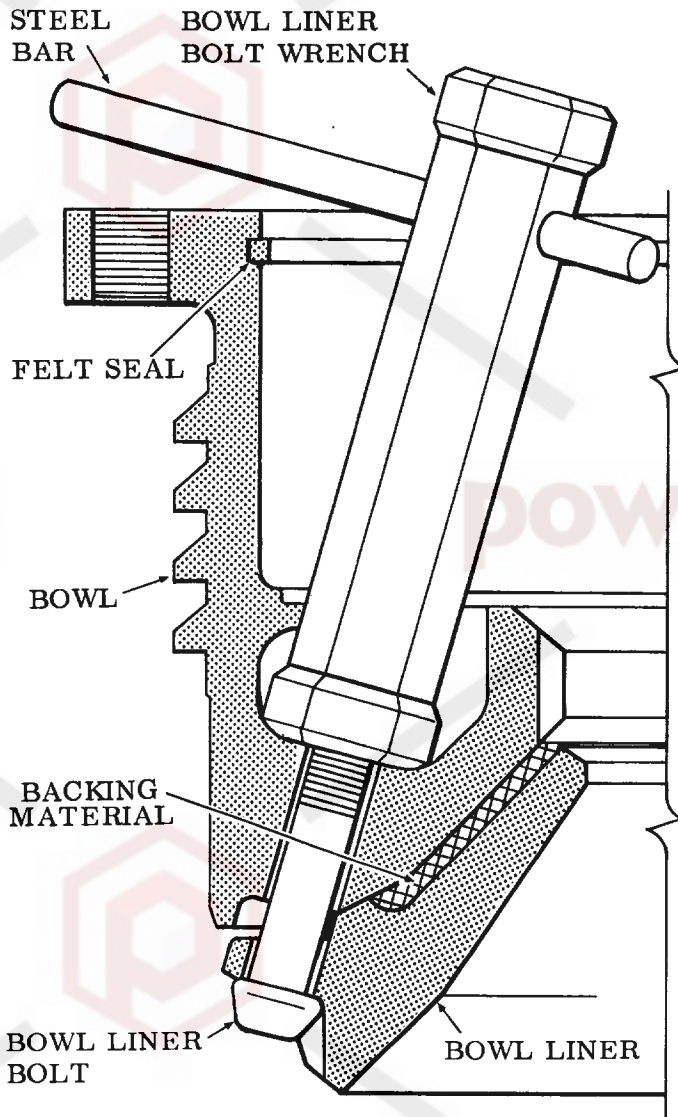
- 1 Remove the adjustment cap screws, then lift off the adjustment cap and hopper. See the illustration 2 FT. BOWL ASSEMBLY.
- 2 Thoroughly clean the threads on the adjustment ring and bowl, removing all traces of dirt, rust, and old grease.
- 3 Lift out the feed cone, feed cone blocks and dust plates. This will give access to the bowl liner bolts.

- 4 Remove the rectangular lockwashers. Using the special cast bowl liner bolt wrench with a steel bar for leverage, remove the bowl liner bolt nuts and then the bolts. Refer to the illustration 2 FT. BOWL LINER BOLT WRENCH.
- 5 Lift the bowl off the liner.
- 6 Chip off any backing material which might remain on the bowl. Usually the backing material will adhere to the liner and little, if any chipping is required on the bowl.
- 7 Check that the felt seal inside the bowl is not worn or damaged, as this is the seal that prevents dust and dirt from seeping onto the bowl and adjustment ring threads during crusher operation.



**2 FT. BOWL ASSEMBLY**





**2 FT. BOWL LINER BOLT WRENCH**

**APPLICATION OF BACKING MATERIAL, 2 FT. CRUSHERS.** The 2 Ft. Crusher was designed with the liner bolting directly into the bowl with straight bowl liner bolts. See the illustration 2 FT. BOWL ASSEMBLY.

With this arrangement, no special preparations such as sealing and packing around hooks are required. The bowl is simply placed on top of the bowl liner. To repour backing material, proceed as follows:

- 1 If zinc backing is to be used, the bowl and bowl liner may have to be heated to remove all trace of moisture.
- 2 Apply a light coating of lubricating oil to the inside of the bowl to prevent the NORDBAK or zinc from sticking to the bowl.
- 3 Lower the bowl into position on the liner.
- 4 Install and tighten ALL the bowl liner bolts securely.
- 5 Check that the bowl liner bears tightly against the bowl by using a feeler gauge all around the liner seat. Should any openings exist due to wear on this area of the bowl, pack these openings with "Dambabbit" or clay to keep the backing from leaking out.
- 6 Refer to the table BACKING REQUIREMENTS in Section 7, for the approximate amount of backing material to prepare, then fill the entire cavity behind the bowl liner.
- 7 Recheck all the bowl liner bolts for tightness after the backing has hardened, then place the lockwashers over the bolt nuts.
- 8 Replace the bowl dust plates and feed cone blocks, lubricate the bowl and adjustment ring threads following the procedure recommended in ASSEMBLY INSTRUCTIONS. This is most important to insure free rotation of the bowl within the adjustment ring. Then reassemble the remaining parts of this assembly.

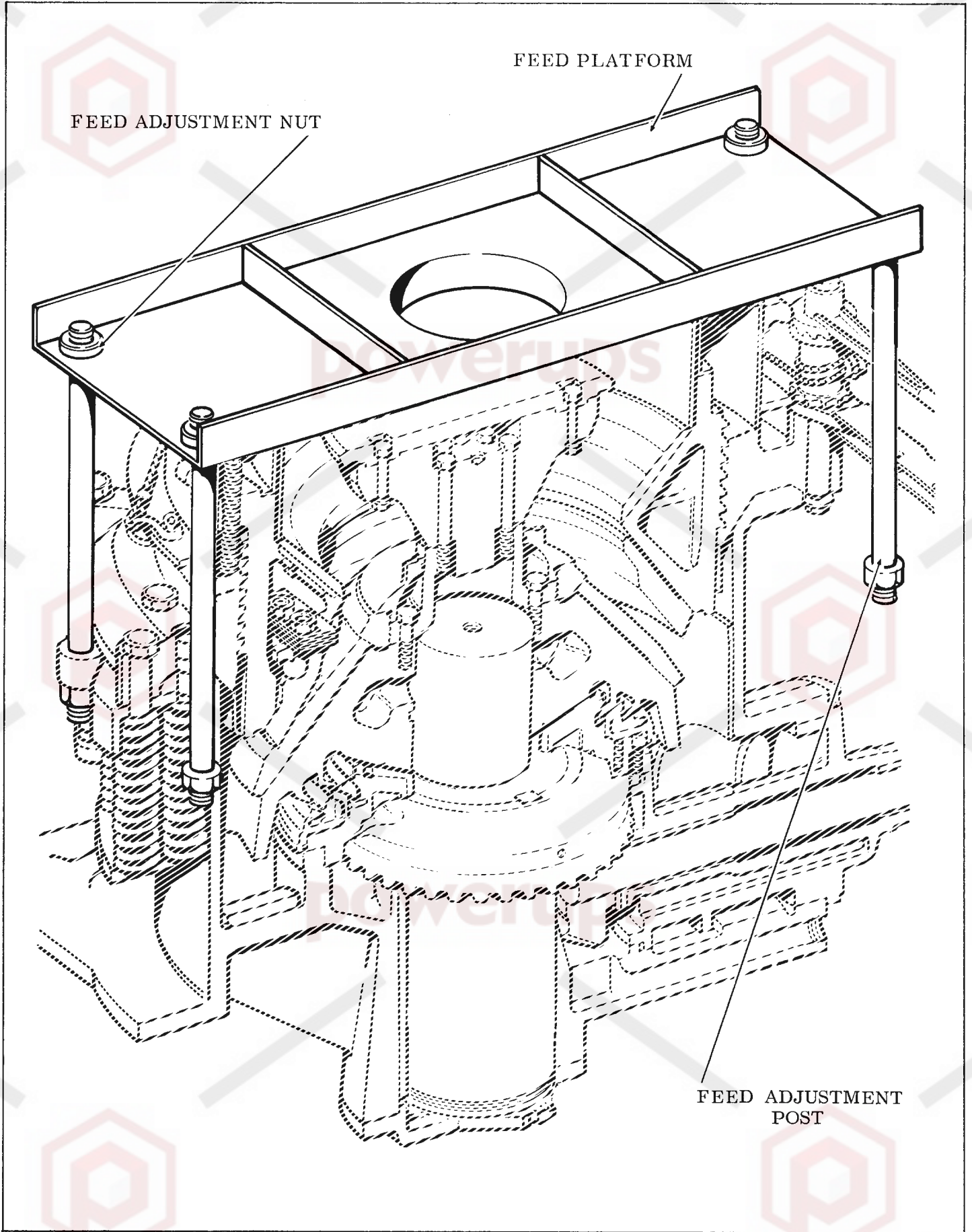
**Section 9**  
**FEED PLATFORM ASSEMBLY**

DESCRIPTION . . . . .	9-1
ASSEMBLY INSTRUCTIONS . . . . .	9-1
MAINTENANCE . . . . .	9-3
FEED ADJUSTMENT POST REMOVAL . . . . .	9-3

FEED PLATFORM

FEED ADJUSTMENT NUT

FEED ADJUSTMENT  
POST

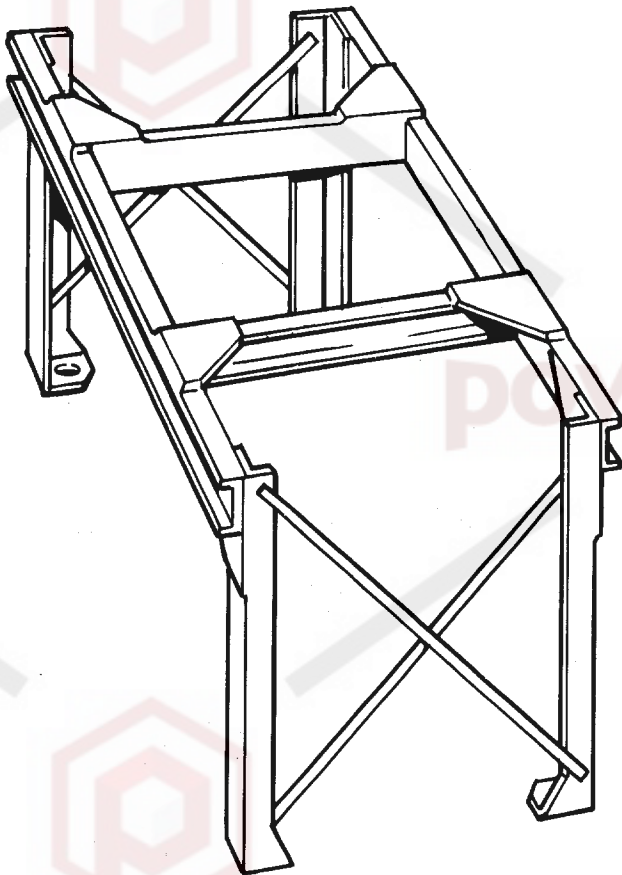


## SECTION 9

# FEED PLATFORM ASSEMBLY

### DESCRIPTION

This section covers the feed platform assembly. The feed platform is suspended by four large diameter feed adjustment posts. The feed platform rests on adjustable feed adjustment nuts which are threaded onto the upper end of each adjustment post. The lower threaded end of each adjustment post is inserted into bosses on the main frame and bolted firmly in place. A feed spout, which is part of the feed platform, directs and confines the flow of incoming feed. The thread on the upper end of each post permits the distance between the feed spout and feed plate to be adjustable.



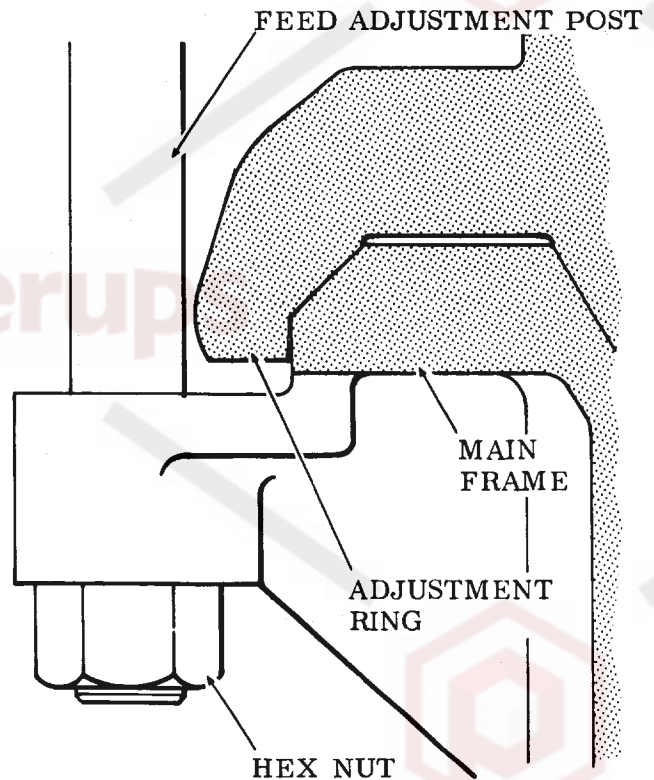
**7 FT. FEED PLATFORM**

On the 7 Ft. Crushers, the feed platform is a rigid structure that cannot be adjusted and is furnished on these larger machines due to the type of feed and the wide variation of feeding equipment available for these Crushers. See the illustration 7 Ft. FEED PLATFORM. However, on the 7 Ft. Short Head Crusher a feed spout is furnished as part of the feed platform.

### ASSEMBLY INSTRUCTIONS

If the feed platform was removed prior to shipment, due to height limitations, it is to be installed on the Crusher as follows:

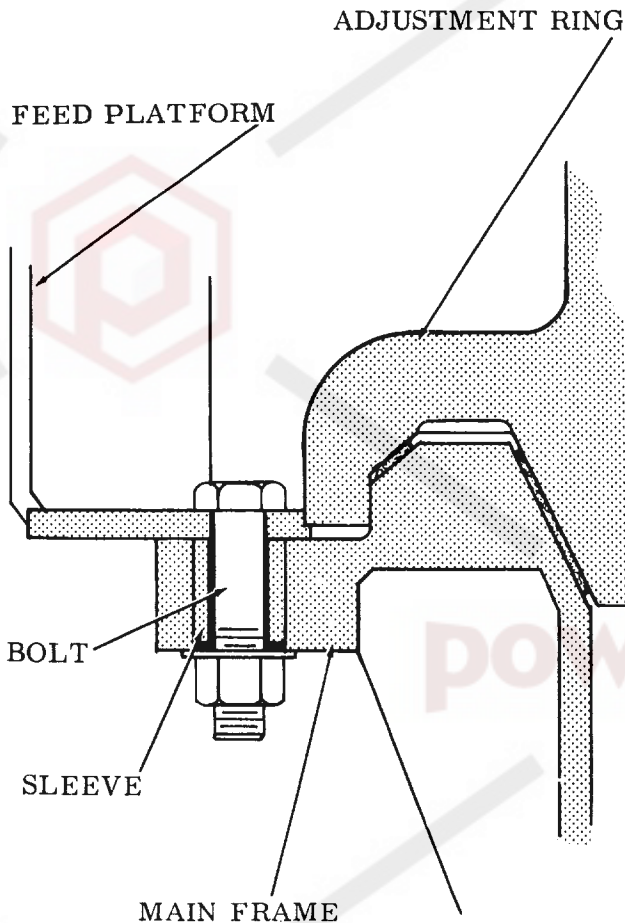
- 1 Insert the four feed adjustment posts into the bosses on the main frame and fasten securely with the standard hex nuts. See the illustration INSTALLING FEED ADJUSTMENT POSTS.



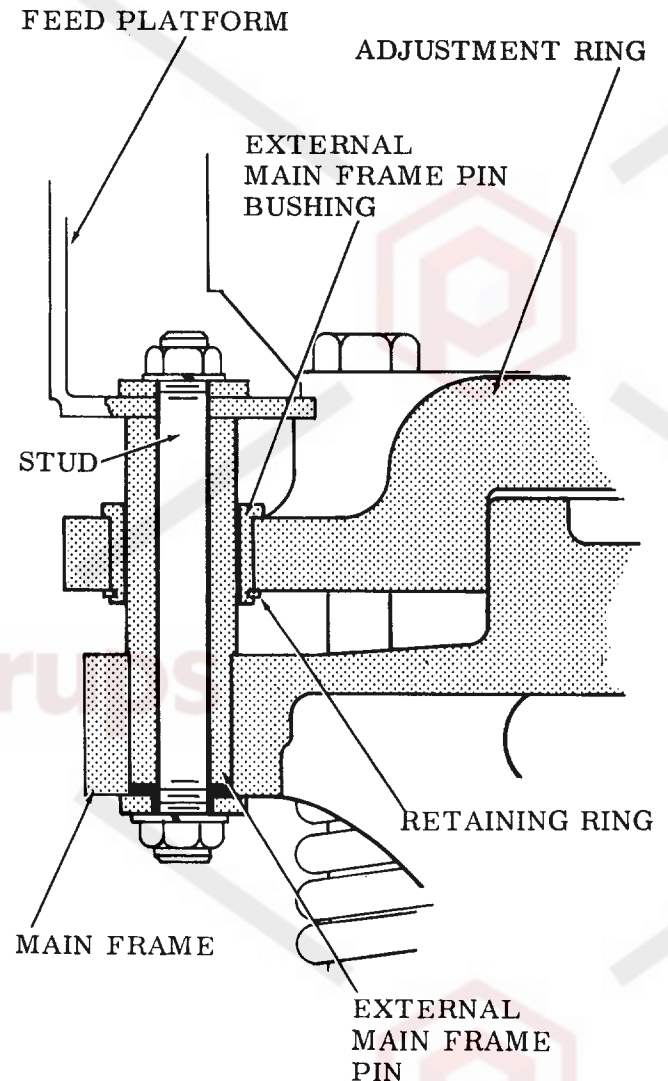
**INSTALLING FEED ADJUSTMENT POSTS**

On the 7 Ft. Heavy Duty Crusher, the entire feed platform is placed on top of the four feed platform bosses on the main frame and then bolted into place. Split sleeves are inserted into these bosses to take up the clearance between the bolt and the hole in the frame. See the illustration INSTALLING FEED PLATFORM, 7 FT. HEAVY DUTY CRUSHER. The 7 Ft. Extra Heavy Duty Crusher feed platform is placed on top of the four external main frame pins which are pressed into these bosses on the main frame and then bolted into place with long studs. See the illustration INSTALLING FEED PLATFORM, 7 FT. EXTRA HEAVY DUTY CRUSHER.

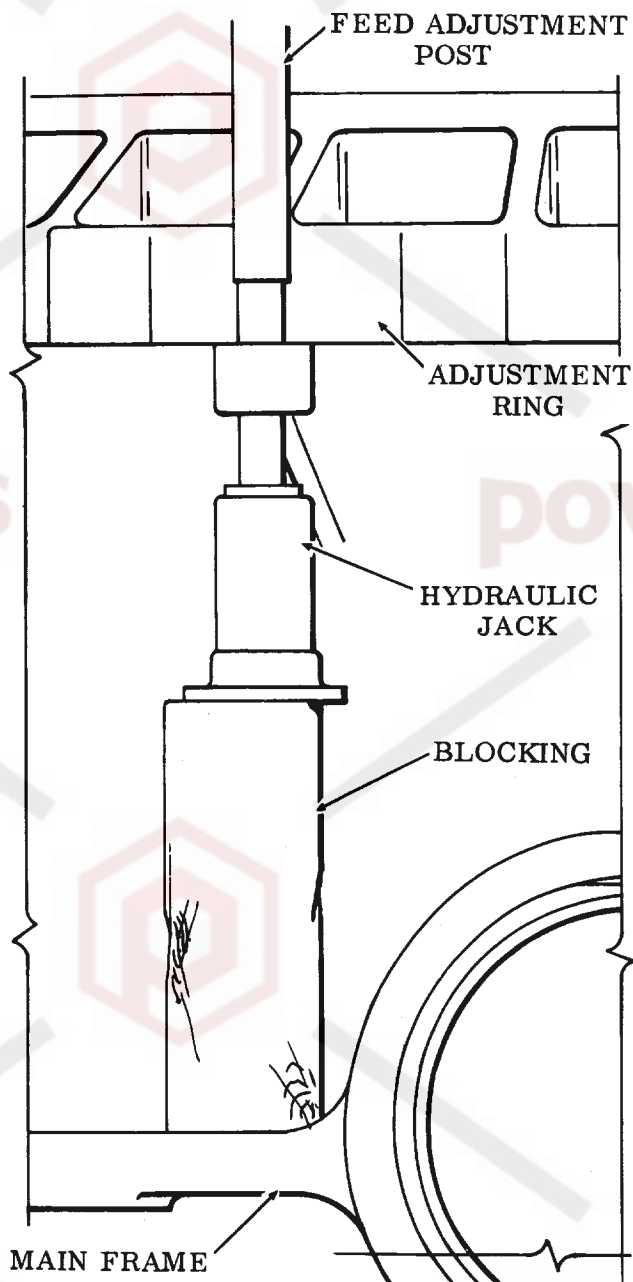
- 2 Thread the feed adjustment nuts on the upper ends of the adjustment posts making certain they are all an equal distance from the top of the posts.
- 3 Lower the feed platform onto the nuts being careful not to damage the post threads.
- 4 Check the distance between the top of the bowl hopper, or the top of the lock posts, whichever is higher, and the underside of the feed platform. This distance must be ample to permit lifting of the adjustment ring when a non-crushable object passes through the crushing cavity.



**INSTALLING FEED PLATFORM  
7 FT. HEAVY DUTY CRUSHER**



**INSTALLING FEED PLATFORM  
7 FT. EXTRA HEAVY DUTY CRUSHER**



**POST REMOVAL**

## **MAINTENANCE**

**FEED ADJUSTMENT POST REMOVAL.** To remove the feed adjustment posts, simply remove the hex nuts bolting the adjustment posts to the frame and lift the posts out. Dirt and corrosion in the threads can be dissolved by using penetrating oil or anti-freeze. It is possible that because of rust, the close tolerances between the hole in the main frame boss and the feed adjustment post itself might cause difficulty in taking out the posts. If difficulty is encountered, proceed as follows:

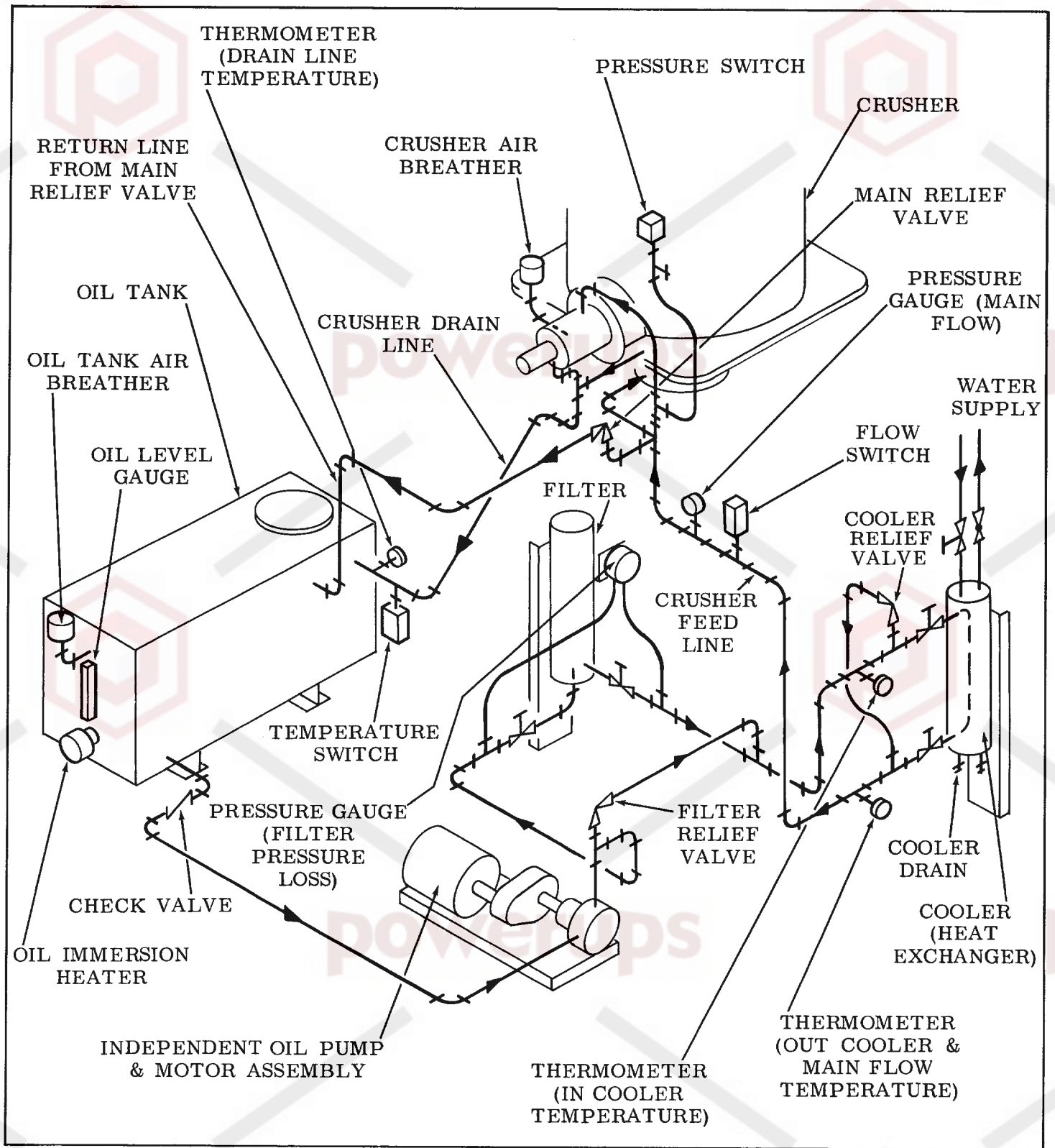
- 1 Remove the hex nuts from the lower ends of the posts.
- 2 Place a hydraulic jack directly beneath the adjustment post and push the post out of the boss. See the illustration POST REMOVAL.
- 3 To assist in removing the post, apply heat to the boss while forcing up on the post with a hydraulic jack.



**Section 10**  
**LUBRICATING SYSTEM**

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**LUBRICATING SYSTEM SCHEMATIC**

## SECTION 10

# LUBRICATING SYSTEM

### DESCRIPTION

The lubricating oil system shown in the illustration LUBRICATING SYSTEM SCHEMATIC is a model system and is not meant to convey the idea that all the equipment shown is standard equipment for all crusher installations. The devices, however, are shown in their correct location and would function in the manner described if such a system were furnished in its entirety. The lubricating system as described in this section and used on these Crushers is designed for 125 PSI maximum operating pressures; both oil and water!

In this system oil is taken from the oil tank where it passes through a check valve to the suction side of the oil pump. The oil pump forces the oil under pressure to the oil filter. A bypass relief valve controls the oil to the filter and will bypass the filter if it becomes clogged. Pressure gauges before and after the filter provide a visual check of the pressure drop across the filter and indicates when the filter should be changed. The oil is then directed through a heat exchanger where the oil is cooled by circulating water. A relief valve will divert the oil around the cooler when the oil is cold and becomes too heavy and causes a pressure build up. Thermometers on each side of the oil cooler provide a visual check of the oil temperature. The main relief valve located at the Crusher, is responsible for preventing oil under excessive pressure from entering the Crusher. When an excessive oil pressure condition exists, the relief valve will open and divert part of the oil back to the tank. The remainder of the oil is then directed to the main frame cap at the bottom of the main frame. The oil under pressure is forced upward between the bearing surfaces of the main shaft and inner eccentric bushing and the bearing surfaces of the eccentric assembly where the oil spills onto the gear and pinion teeth. See the illustration INTERNAL OIL FLOW. At the same time the oil is forced upward through a drilled passage

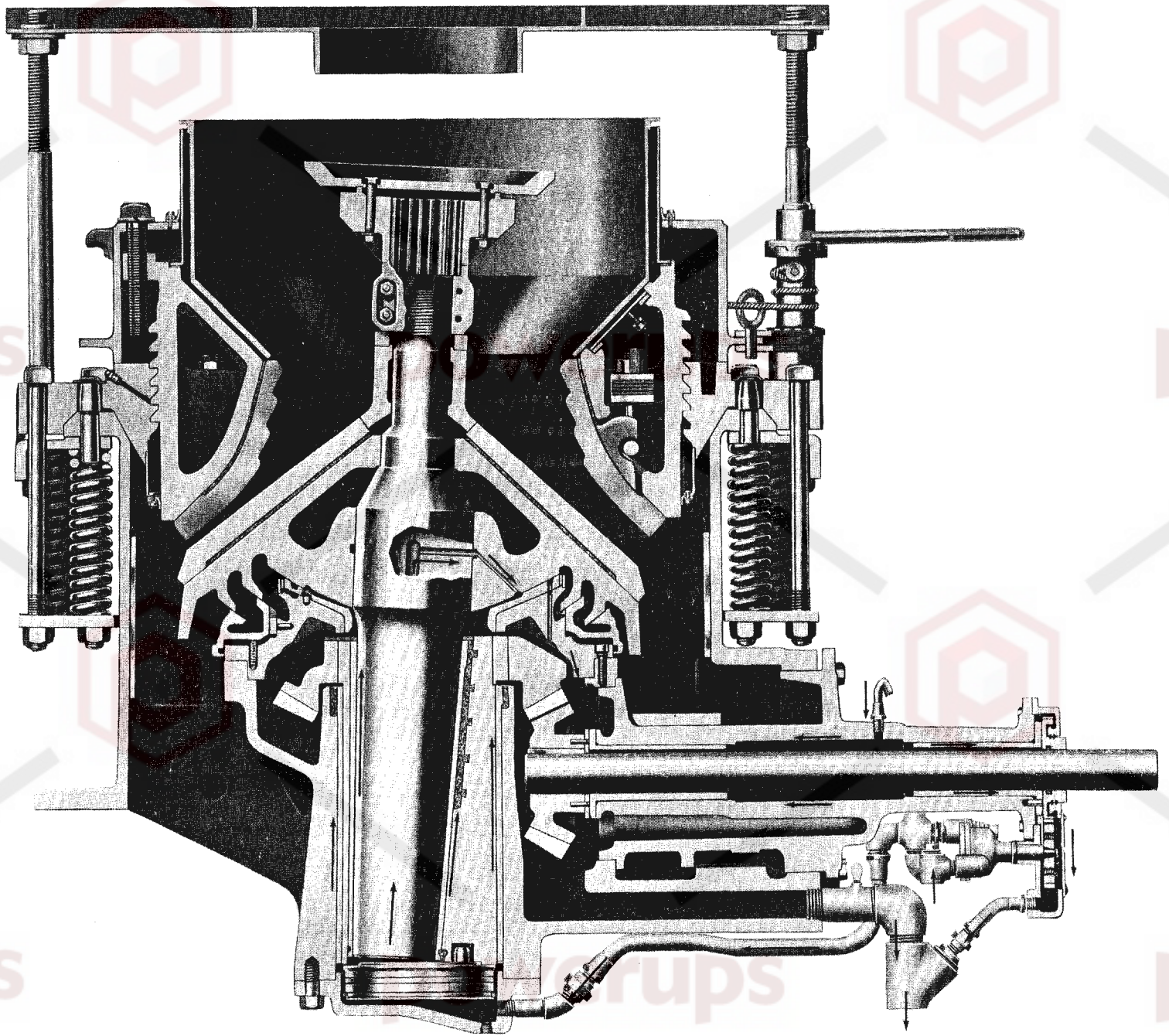
in the main shaft where an angular drilled hole through the head directs the oil to the bearing surface of the socket liner. The overflow of oil from the socket liner is drained off through holes in the socket onto the gear teeth. A separate line simultaneously forces oil through the countershaft box to the countershaft bearings. The oil, which drains off the gear teeth, collects in a sump at the underside of the main frame where drain piping directs the oil back to the tank. The oil from the countershaft box drains out of the housing at the sheave end of the countershaft, also back to the oil tank.

A pressure switch, temperature switch and flow switch can be installed in the lubricating oil system to provide automatic safety devices which when energized will either stop the Crusher or give audible warning of an abnormal condition.

### LUBE OIL SPECIFICATIONS

Use a high grade paraffin (not naphthene) base industrial oil of viscosity specified, having high film strength, having high affinity for and adhesiveness to metal surfaces, having stable chemical and physical properties. Such lubricants should have a high viscosity index, rapid water separation, resist foaming, offer some rust and corrosion protection, resist oxidation and have anti-wear additives.

Extreme pressure (E.P.) lubricants containing sulphur phosphorus, lead naphthenate, or other anti-weld agents, compatible with the metals used in Crushers (bronze, babbitt, cast iron and steel) are particularly suited for heavy duty operations. Such E.P. lubricants have greater oil film strength, greater load bearing ability and, therefore protect working surfaces better than straight industrial oils. E.P. lubricants also have the desirable higher viscosity index values and usually much lower pour points than straight industrial oil and therefore are well worth their slightly higher cost.



**INTERNAL OIL FLOW**

Consult the factory for any special recommendations (supplying full information and data), when operating under abnormal conditions, such as when handling hot materials or when operating in extreme climates or atmospheric conditions or where heating or cooling facilities are not available.

For normal, all year operating conditions, corresponding to oil temperatures leaving the Crusher at below 140° Fahrenheit, but preferably above 80° Fahrenheit, the lubricant should have a viscosity of 300 to 350 SSU (Seconds, Saybolt Universal) at 100° Fahrenheit and a viscosity of 50 to 60 SSU at 210° Fahrenheit, corresponding to a viscosity index of 90 or higher. For such all year operating conditions, lubricants with viscosities higher than 400 SSU at 100° Fahrenheit, or lower than 300 SSU at 100° Fahrenheit are not recommended.

### OIL SPECIFICATIONS

Viscosity at 100° F. - - - - - 300-350 SSU  
 Viscosity at 210° F. - - - - - 50-60 SSU  
 Viscosity Index (V.I.) - - - - - 90 or higher

Correct lubricants meeting the above specifications are essential for the protection of the working parts of our Crushers. They are available from all major oil companies. Improper lubricants can ruin the Crusher and their use will void any warranties pertaining to such Crushers.

### OIL TEMPERATURE

The oil temperature leaving the Crusher should be in the range of 100° and 130° Fahrenheit. However the preferred range is 100° to 115° Fahrenheit. The Crusher should not be operated if this oil temperature reaches 140° Fahrenheit or drops below 60° Fahrenheit.

Higher temperatures warrant investigation as to proper operation or characteristics of the oil. Where ambient temperatures or operating conditions result in oil temperatures leaving the machine between 130° and 140° Fahrenheit, cooling facilities are to be used.

Thermostatically controlled electric heaters are suggested to enable oil flow in cold weather. Heaters are recommended when lubricant temperatures in the oil tank drop below 60° Fahrenheit.

If at any time the Crusher is suspected of overheating, check the temperature difference between the oil going into the Crusher and the oil leaving the Crusher by installing thermometers in the feed and drain lines. The temperature difference should be between 1° and 3° Fahrenheit. If the temperature difference is more than 5° Fahrenheit, most likely the bearings within the Crusher have closed-in due to abnormal operating conditions.

### REGULATING THE OIL SUPPLY

The oil pump capacity, pipe line sizes and bypass relief valve size have been selected and set to provide the Crusher with an ample supply of lubricating oil and to insure cooler operation.

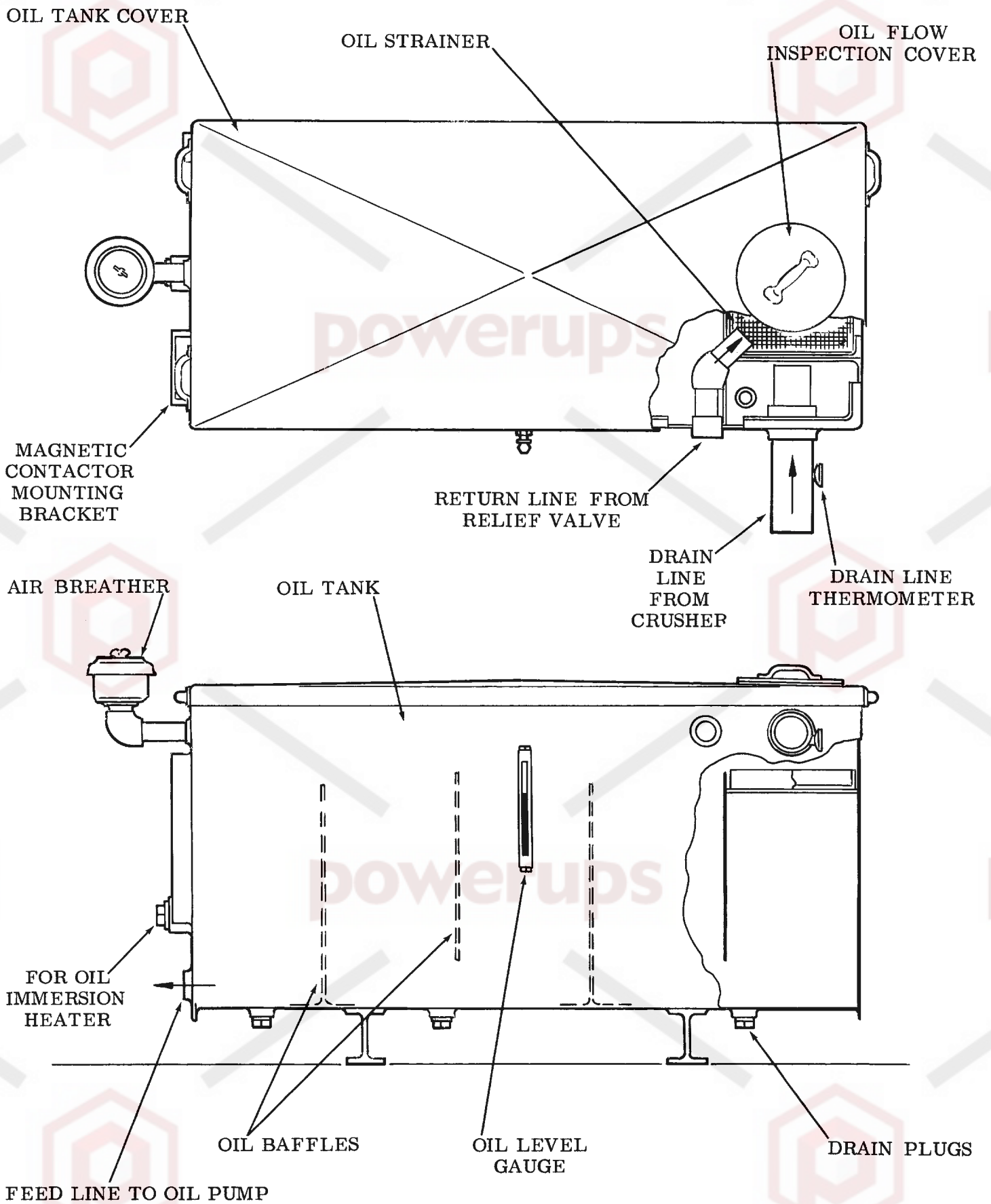
Field adjustments of the lubricating system should, therefore, be unnecessary as long as lubricant selection and crusher operation follow this instruction manual. See the table CRUSHER OIL CAPACITY AND OPERATING PRESSURE.

### OIL TANK

The oil tank is a simple, efficient reservoir for furnishing oil to the crusher lubricating system. Oil returning to the oil tank from the crusher drain line passes through a wire screen which removes any particles of foreign matter, 10 mesh or larger. Then flowing under and over a baffle arrangement for maximum settling of sludge, the oil enters the feed line to the oil pump. Oil piping must be connected to the tank

CRUSHER SIZE	2 Ft.	3 Ft.	4 Ft.	5100 and 4-1/4 Ft.	5-1/2 Ft.	7 Ft.
U.S. Gallons per Minute	9-15	12-15	17-22	30-35	50-55	60-65
Normal Operating Pressure Pounds per Square Inch	3-6	5-10	5-10	5-10	5-15	5-15

**CRUSHER OIL CAPACITY AND OPERATING PRESSURE**



**OIL TANK ARRANGEMENT**

MINIMUM VERTICAL DISTANCE THAT THE OIL TANK BOTTOM CAN BE BELOW THE TOP OF CRUSHER FOUNDATION					
CRUSHER SIZE	2 Ft.	3 Ft.	4 Ft., 5100 and 4-1/4 Ft.	5-1/2 Ft.	7 Ft.
MINIMUM DISTANCE	5'-0" Plus "X"	5'-0" Plus "X"	5'-0" Plus "X"	6' -0" Plus "X"	6'-0" Plus "X"
The variable dimension "X" represents the pitch of drain pipe. See the crusher oil piping drawing for application.					

### OIL TANK LOCATION

as shown in the illustration OIL TANK ARRANGEMENT. The level of oil can be seen on an oil level gauge located on the side of the tank. To assure proper lubrication the oil level must be kept within the range of the oil gauge glass. A thermometer located in the drain line at the oil tank readily provides the operator with the oil temperature leaving the Crusher. As the oil tank is sealed from contamination by dust and moisture, an air breather maintains atmospheric pressure. The illustration OIL TANK ARRANGEMENT shows the relative positions of the oil level gauge, thermometer and breather, which are shipped separately to avoid breakage.

PERIODIC CLEANING OF THE BREATHER IS IMPORTANT, THE FREQUENCY OF WHICH DEPENDS ON THE AMOUNT OF DUST PRESENT. ONCE A WEEK OR OFTENER, IF OPERATIONS ARE UNUSUALLY DUSTY, REMOVE THE FILTER ELEMENT AND CLEAN THE BREATHER AS RECOMMENDED IN THE AIR BREATHER PARAGRAPH IN THIS SECTION.

Locate the oil tank below and as near the Crusher as possible, in any convenient location. For the minimum VERTICAL distance that the oil tank can be below the top of the crusher foundation, refer to the table OIL TANK LOCATION. It is suggested that the tank be raised to provide suitable space

below the oil tank drain plugs to facilitate draining and to assure complete air circulation around the tank.

IN THE CASE OF A CRUSHER DRIVEN INTEGRAL PUMP, THE TANK SHOULD BE KEPT AT AT MINIMUM ELEVATION. UNDER NO CIRCUMSTANCES SHOULD THE HEIGHT FROM THE BOTTOM OF THE TANK TO THE CENTERLINE OF THE OIL PUMP EXCEED 13'-0". THIS IS THE MAXIMUM SAFE LIFT OF THE INTEGRAL PUMP AND IF INCREASED MAY CAUSE FAULTY PUMP ACTION, ESPECIALLY AFTER PUMP PARTS HAVE BECOME WORN.

By removing the inspection cover in the oil tank cover, the oil from both the crusher drain line and the main relief valve by-pass or return line can be readily observed.

Change oil as experience dictates. Avoid operating with an oil that is dirty or gritty, or has lost its body. Sludge should be periodically drained from the tank and the oil screen cleaned. Filling the oil tank with the cover removed is the most convenient method, but it can also be done by removing the inspection cover in the cover. After cleaning the tank, fill with the correct grade of oil using the amount shown in the table OIL TANK CAPACITIES. This is the required amount to adequately lubricate the Crusher and insure

CRUSHER SIZE	2 Ft.	3 Ft.	4 Ft.	5100 and 4-1/4 Ft.	5-1/2 Ft.	7 Ft.
In U.S. Gallons	110	110	110	110	220	220
In U.S. Barrels	2	2	2	2	4	4

### OIL TANK CAPACITIES

cooler operation. An additional 35 to 55 U.S. gallons will be required to fill the Crusher, filter, cooler, pipe line, etc.

### OIL IMMERSION HEATER AND THERMOSTAT

A thermostatically controlled electric heater is suggested to enable oil flow in cold weather. Heaters are recommended when lubricant temperatures in the oil tank drop below 60° Fahrenheit. Oil tanks can either be supplied complete with heaters or the present oil tank can be modified to accommodate almost any type of heater available.

Should an immersion type heater be desired, a heater which is designed specifically for the type of lubricating oil used in a Crusher can be furnished. These heaters have a special watt density of approximately 13 watts per square inch. This special wattage will not allow charring or carbonization of lube oil, whereas, immersion heaters with standard wattage (20 watts per square inch and above) will cause such charring and carbonization. This immersion heater is equipped with a built-in thermostat, 0° to 100° Fahrenheit range, with the heater terminals and thermostat enclosed in a weatherproof housing. As the thermostat is mounted as an integral part of the heater, electrical connections are simplified. The table HEATER CAPACITIES AND LOCATION lists the recommended watts on the various crusher sizes.

The rectangular oil tanks now being furnished with the Crushers have a 2-1/2" pipe coupling welded into the side of the tank, thereby making the installation of an immersion heater a simple operation. Should an existing round oil tank require a modification to install the heater, it becomes necessary to weld a 2-1/2" pipe coupling into the side of the tank midway between the oil baffles "X" inches from the bottom. Refer to the table HEATER CAPACITIES AND LOCATION for the proper height of the pipe coupling.

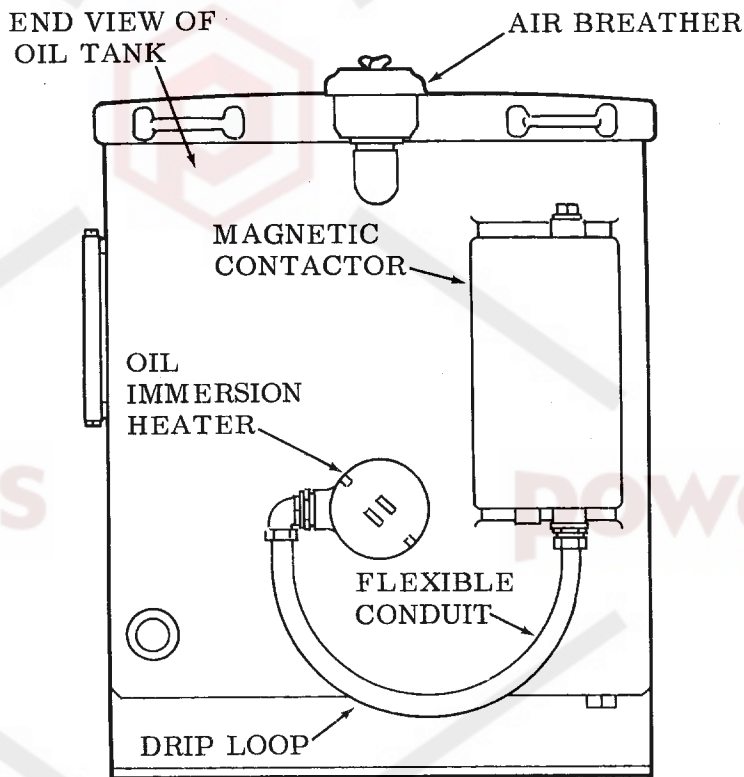
Normally, only one oil immersion heater is required per oil tank.

#### GENERAL INSTALLATION INFORMATION:

- 1 Insert the heater through the pipe coupling in the oil tank.
- 2 Use a pipe sealing compound on the threads.
- 3 Screw the heater into the pipe coupling, tighten sufficiently with a wrench applied to the HEX PORTION of the heater housing.
- 4 Position the electrical conduit opening on the heater housing on the side or at the bottom so that a drip loop can be installed as shown in the illustration IMMERSION HEATER INSTALLATION. A drip loop is recommended to minimize passage of moisture along the wiring onto the heater and/or thermostat terminals. Any moisture will then collect at the bottom of the drip loop and evaporate before seeping onto any terminals and corroding them.
- 5 Wire as shown on the illustration IMMERSION HEATER WIRING DIAGRAM. Use moisture-proof flexible conduit.

#### HEATER CAPACITIES AND LOCATION

CRUSHER SIZE	No. of Watts Recommended	"X" Location from Bottom of Round Oil Tank
2 Ft.	3000	8"
3 Ft.	3000	8"
4 Ft.	3000	8"
5100 and 4-1/4 Ft.	3000	8"
5-1/2 Ft.	4000	10"
7 Ft.	4000	10"



### IMMERSION HEATER INSTALLATION

ALL WIRING SHOULD BE DONE IN ACCORDANCE WITH LOCAL AND NATIONAL ELECTRICAL CODES.

BE SURE THE LINE VOLTAGE IS CONNECTED TO THE HEATER ELEMENT TERMINALS AND NOT TO THE THERMOSTAT TERMINALS, AS THE THERMOSTAT IS ONLY RATED FOR 115/230 VOLTS.

- 6 Do not bend the heating elements.
- 7 Protect the heater terminals from the weather, condensation or from direct spill over.

### OPERATION

- 1 The thermostat should be set at 80° Fahrenheit for the proper operation of the lube system and Crusher.
- 2 An initial heat-up time of the oil for 110 U.S. gallons with the 3000 watt heater could be as high as 6 to 7 hours whereas with 220 U.S. gallons using the 4000 watt heater the heat-up time could be as high as 12 to 14 hours. But once the 80° Fahrenheit

temperature is reached the heater will maintain the thermostat setting.

- 3 It is important that the oil level gauge on the side of the oil tank remains at least partially filled as any portion of the heating elements that are exposed to air will lead to premature burnout of the elements.
- 4 Do not allow excessively thick coatings to form on the heating elements or heater burnouts can occur.
- 5 Disconnect the power to the heater whenever draining the oil tank.

### MAINTENANCE

- 1 Disconnect the power to the heater before removing the heater from the oil tank.
- 2 Remove the immersion heater from the oil tank periodically for inspection; check the heating elements for cracks and scale deposits.
- 3 All standard wattage (20 watts per square inch) immersion type oil heaters should be given a periodic cleaning since the oil that comes in contact with such heating elements tends to vaporize slightly. This causes a layer of carbon to build up on the surfaces of the elements and reduces heating efficiency. Removal of the heater from the oil tank is required for cleaning.
- 4 Remove sludge deposits from the oil tank. Always keep the heating elements above the sludge.
- 5 Clean the terminal ends of the heating elements and thermostat of all contamination. (Disconnect the power supply.)
- 6 Do not kink the thin capillary tubing that connects the heat sensitive bulb to the thermostat. Excess tubing should be coiled not kinked or bent.

### CHECKING THE THERMOSTAT SETTING

Every thermostat was carefully calibrated and tested at the factory before shipment. However, if there is any reason to suspect that the thermostat is no longer operating properly, the thermostat can be checked as follows:



- 1 Remove the thermostat and heat sensitive bulb assembly from within the heater housing. Be sure the power to the heater has been disconnected before removing the thermostat.
- 2 Place the heat sensitive bulb of the thermostat in a pan of water that has been heated to 80° Fahrenheit. Use a separate thermometer to accurately measure the temperature of the water. Take care not to kink the capillary tubing.
- 3 Allow the bulb to adjust to the temperature of the water for a few minutes before checking the thermostat.
- 4 Then turn the thermostat control knob "slowly" until the thermostat "clicks" off. Compare the temperature setting on the knob with the thermometer reading. The two readings should agree, if not, the thermostat requires recalibration or replacement.
- 5 While a thermostat can be recalibrated in the field it is recommended that the thermostat simply be replaced.

**ELECTRICAL RATINGS. Immersion Heater:**  
 460 or 575 volt, 3 phase, 3000 watts (3 kilowatts) heating capacity, 3.8 amps (460 volt) 3.0 amps (575 volt) per heater terminal.

or

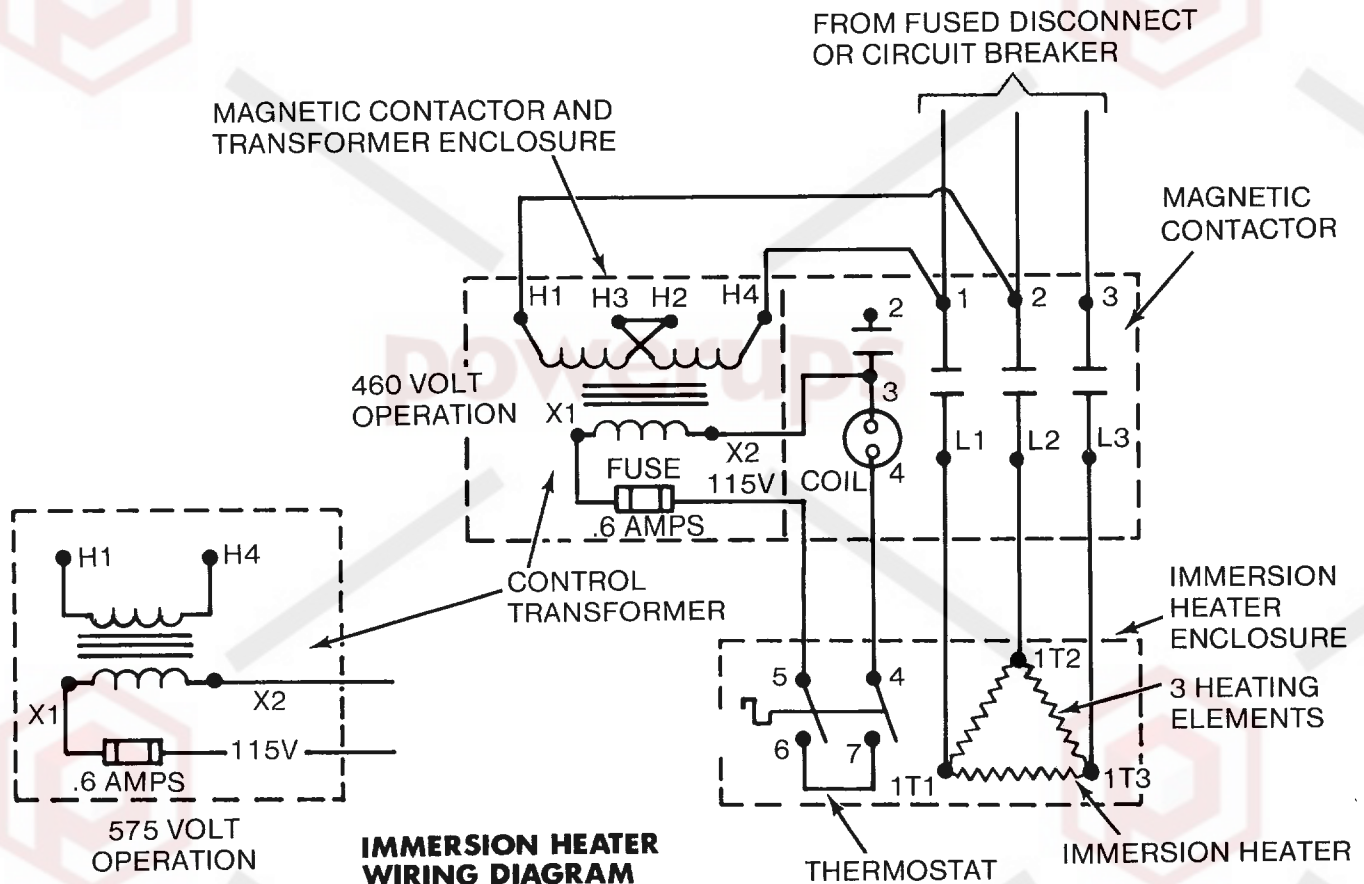
460 or 575 volt, 3 phase, 4000 watts (4 kilowatts) heating capacity, 5.0 amps (460 volt) 4.0 amps (575 volt) per heater terminal.

Thermostat: 115/230 volt, single phase, contacts: double pole, single throw. Contact Maximum A.C. Rating

35 amps at 115 volts  
 25 amps at 230 volts

### MAGNETIC CONTACTOR AND TRANSFORMER

A magnetic contactor electrically connected to the immersion heater is required to switch the load from the thermostat to the heater.



as the operating range of the thermostat is 115/230 volts and the heater elements are for 460 or 575 volts. A magnetic contactor is required to operate all 3 phase wired immersion heaters.

A transformer in the contactor enclosure is wired to the contactor to step down the higher heater voltage to the lower thermostat voltage thereby requiring no additional wiring by the customer except to bring the power source to the contactor. Be sure the line voltage is connected to the heater ELEMENT terminals and NOT to the thermostat terminals.

The magnetic contactor and transformer is in a weather proof enclosure.

**ELECTRICAL RATINGS.** Magnetic Contactor: For 460 volt operation is 3 pole, 27 amps with a 230/460 - 115 volt control transformer; for 575 volt operation is 3 pole, 27 amps with a 600 volt primary and 115 volt secondary control transformer. The transformer is rated and fused for .6 amp.

For the electrical wiring between the contactor and heater see the illustration IMMERSION HEATER WIRING DIAGRAM.

### CHECK VALVE

The main function of a check valve, which should be connected into the oil feed line at the oil tank, is to prevent the draining of the oil in the feed line, back into the tank. This draining back of the oil would cause the loss of the prime on the oil pump if the pump is located above the level of oil in the tank. This is especially important with a Crusher that is furnished with a crusher driven integral oil pump as this pump is located at the crusher countershaft box and is always above the oil tank. Without a check valve the integral pump would have to be primed each time the Crusher is started.

On the independently driven oil pump which is normally placed at the same level as the oil tank, it is not quite as important. A check valve is furnished as standard equipment on all Crushers. Care should be taken when installing the check valve, that the valve is positioned properly in the oil feed line, as the valve only operates in one direction. This direction is clearly marked on the valve itself.

### INDEPENDENT OIL PUMP

The independently driven pump system is preferred in most crusher installations as it permits lubrication before starting the Crusher and is a more flexible and better controlled

system. This pump is a low speed, internal gear, positive displacement pump that can be supplied with all Crushers and is furnished as regular equipment on the 5-1/2 Ft. and 7 Ft. Crushers.

The pump is driven by a totally enclosed electric motor, operating through a gear reducer to provide the correct pump speed. For the correct oil pump speed and electric motor horsepower refer to the table PUMP RPM AND HORSEPOWER REQUIREMENTS.

CRUSHER SIZE	PUMP GPM	PUMP RPM	MOTOR HP*
2 Ft.	12-15	150	3
3 Ft.	12-15	150	3
4 Ft.	17-22	230	3
5 100 and 4-1/4 Ft.	30-35	350	3
5-1/2 Ft.	50-55	230	5
7 Ft.	60-65	280	5

\*Motor horsepower (HP) based on maximum of 25 Ft. vertical head between oil pump and Crusher

### PUMP RPM AND HORSEPOWER REQUIREMENTS

**ELECTRICAL RATING.** Check the motor nameplate for the correct voltage, frequency and phase; electrical connections are also shown on the nameplate. For proper operation and lubrication of the motor refer to the manufacturer's service bulletin.

### ELECTRICAL INFORMATION

All fuse protection equipment is to be furnished by the customer to conform to local electrical codes. The starter for the pump motor, is also to be furnished by the customer to meet the customer's specific needs, location and electrical interconnecting requirements. Attach a No. 8 or larger ground wire to the pump and motor assembly.

### GENERAL PUMP INFORMATION

It must be pointed out that the pump is made especially for this type of lubricating service. Hardened steel and special machining tolerances are used on the internal parts of these pumps to provide trouble free operation and long service. Therefore, should any servicing be necessary, it is imperative that identical parts be used for replacement.

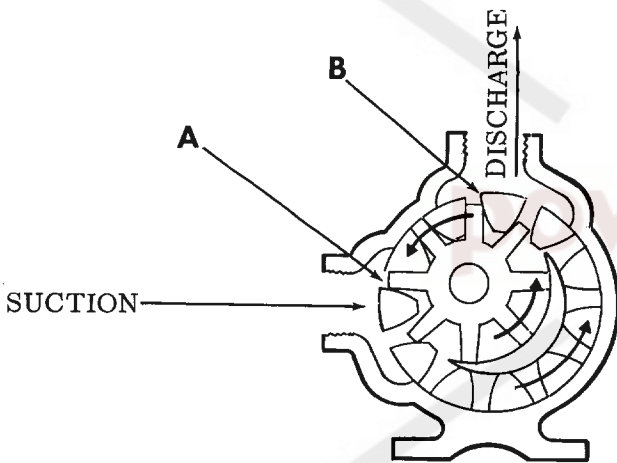
Correct installation of the pump is the most important factor in proper pump operation. The correct pump may be selected to perform

a given task but, if improperly installed, will give unsatisfactory performance.

### GENERAL INSTALLATION INFORMATION

Before installation is started a few items of a general nature should be considered.

- 1 Location - always locate the pump as close as possible to the oil tank. Locate the pump below the oil level in the tank if at all practical. These oil pumps are self priming but the better the suction conditions the better the performance.
- 2 Accessibility - the pump should be located where it is accessible for inspection, maintenance, and repair. Allow room to remove the rotor and shaft without removing the pump from the base.
- 3 Suction/Discharge - shaft rotation will determine which port is suction and which is discharge. A look at the illustration OIL PUMP PORTS will show how rotation determines which port is which; as the pumping gears come out of mesh, point "A" on the illustration, oil is drawn into the suction port; as the gears come into mesh, point "B", the oil is forced out the discharge port. Reversing the rotation reverses the flow through the pump.



**OIL PUMP PORTS**

### FOUNDATION

Every pump should have a good foundation. It may be any structure sufficiently strong to hold the pump base rigid and to absorb any strain or shock that may be encountered. A

concrete foundation built on solid ground is the most satisfactory. If a concrete foundation is provided, make it at least 2" wider and longer than the base of the unit.

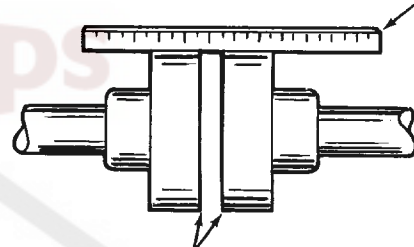
When the unit is placed on the foundation it should be leveled and checked for position against the piping layout and then fastened down.

### ALIGNMENT

The pump and motor was shipped from the factory properly aligned. However, the alignment may have been disturbed in shipment or in mounting. For this reason it should never be taken for granted a unit just received from the factory is perfectly aligned. Therefore, when placing the unit on the foundation, the alignment should be carefully checked after installation as every base is elastic no matter how heavy or well designed it is.

- 1 Check pump ports to be sure they are square and in proper position; shim or move pump as required.
- 2 If the pump is driven by a flexible coupling(s), either direct connected to the motor or through a gear reducer, remove the coupling guards and check alignment of the coupling halves. A straightedge placed across the coupling must rest evenly on both rims at the top, bottom, and sides. See the illustration COUPLING ALIGNMENT.

USE STRAIGHT EDGE. THESE SURFACES MUST BE PARALLEL.



CHECK WIDTH BETWEEN THESE SURFACES WITH INSIDE CALIPERS TO BE CERTAIN THE FACES ARE AN EQUAL DISTANCE APART AND PARALLEL

### COUPLING ALIGNMENT

- 3 If the pump is driven by V-belts, check the alignment by using a long straightedge or tightly drawn string across the face of the sheaves. See the illustration V-BELT DRIVE ALIGNMENT.

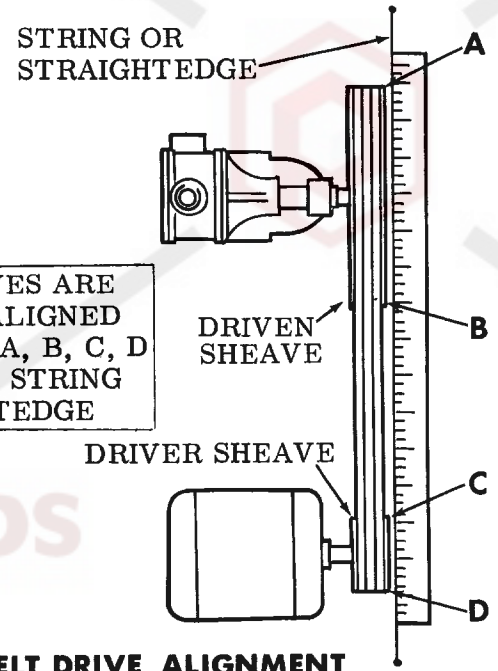
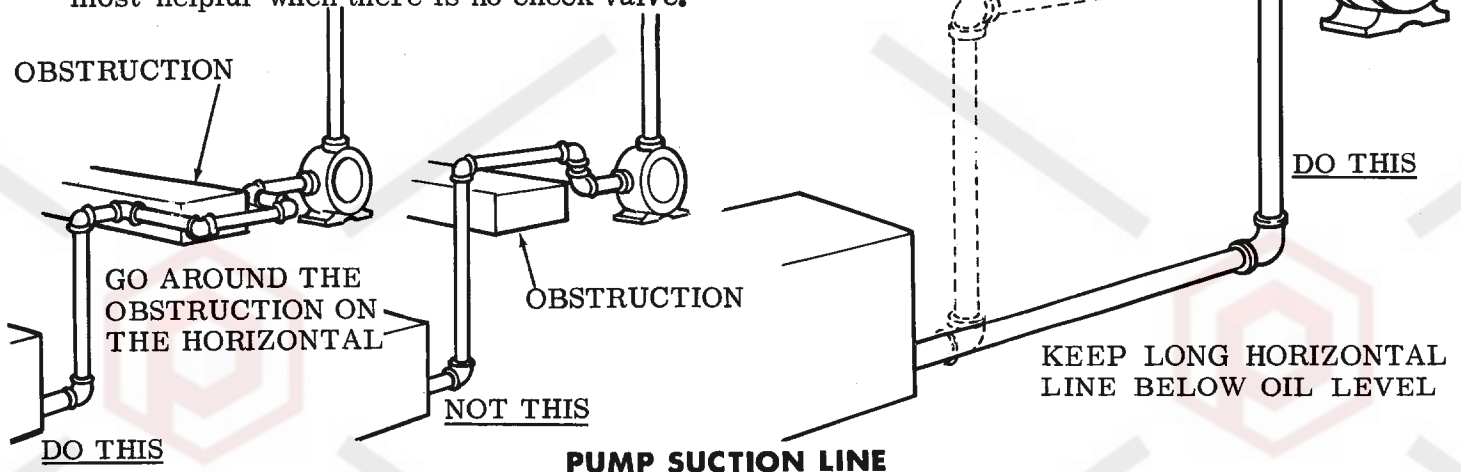
- 4 Make a final check on alignment after piping is hooked up. See ALIGNMENT under PIPING.

### PIPING INFORMATION

The cause of many pumping problems can be traced to the suction piping. It should always be as large and short as practical.

Before starting the layout and installation of the piping system consider the following points:

- 1 Never use piping smaller than the pump port connections.
- 2 Be sure the inside of the pipe is clean before hooking it up.
- 3 Check Valve - When pumping with a suction lift, a check valve installed at the end of the suction piping will hold the oil in the line and make it easier for the pump to prime. Be sure the check valve is big enough so that it doesn't cause excessive line loss.
- 4 When approaching an obstacle in the suction line, go around the obstacle instead of over it. Going over it creates an air pocket. See the illustration PUMP SUCTION LINE.
- 5 Where practical, slope the piping so no air pockets will be formed. Air pockets in the suction line make it hard for the pump to prime.
- 6 For a suction line with a long horizontal run keep the horizontal portion below the liquid level if possible. This keeps the pipe full so the pump does not have to remove so much air when starting; this is most helpful when there is no check valve.

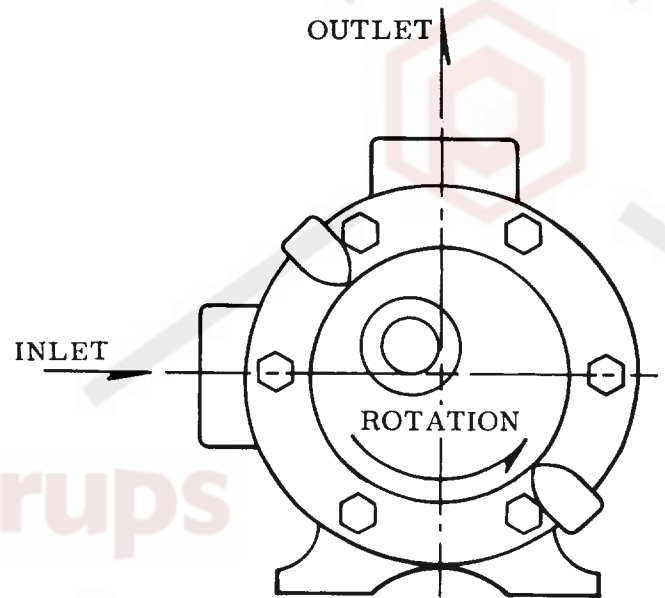


### V-BELT DRIVE ALIGNMENT

- 7 Strainer - A strainer in the oil tank will keep foreign objects from going into the pump; without a strainer some would go through; others would cause a jammed pump, a broken part, or a torn up drive. The strainer basket mesh should be fine enough to protect the pump. Provision should be made for cleaning the strainer. Use of a strainer is particularly important at start up to help clean the system of weld beads, pipe scale, and other foreign objects.

A strainer mounted in the suction line is not recommended as there is the possibility of the strainer becoming plugged with foreign material and cutting off the flow of oil to the pump.

- 8 The pump should not be used to support the piping. The weight of the pipe should be carried by hangers, supports, stands, etc.
- 9 When fastening the piping to the pump do not impose any strain on the pump casing. "Springing" or "drawing" the piping up to the pump will cause distortion, possible misalignment and probable rapid wear of the pump. Do not use the pump to correct errors in piping layout or assembly.
- 10 All joints of the piping system should be tight; pipe sealing compound or teflon tape will help assure leak free threaded joints. Leaks in the suction line permitting air to be drawn in may cause a noisy pump, or a reduction in capacity.
- 11 Alignment - Check the alignment of the drive after the piping is hooked up. As a final check on pump alignment remove the head of the pump and with a feeler gauge determine if there is clearance all the way around between the rotor and casing. Because of manufacturing tolerances, bushing clearances, etc, the rotor may not be centered in the casing, but it should not drag; dragging would indicate unit misalignment or casing distortion from piping strain.
- 12 A gate valve can be installed in the suction line between the oil tank and the pump to permit replacing the oil pump or any of its components without draining the oil tank. However during normal operation the gate valve must be OPEN.
- 5 Check the rotation of the motor to be certain the pump is turning in the correct direction. See the illustration PUMP ROTATION. Jog motor to be sure it is turning in the right direction.
- 6 Check the suction piping to be sure (a) it is all connected and tight, (b) valves are open, and (c) end of pipe is below the oil level.
- 7 Check discharge piping to be sure (a) it is connected and tight, (b) valves are open, and (c) there is a place for the oil to go.
- 8 Check any gear reducer, motor, coupling, etc. for instructions and lubricate as recommended.
- 9 For packed pumps, loosen packing gland nuts so gland can be moved slightly by hand. Adjust gland to reduce leakage only after pump has run long enough to reach constant temperature. Packing should leak a little to keep it cool and lubricated.



**PUMP ROTATION**

### START UP

Before pushing the "start" button, check the following:

- 1 Are there vacuum and pressure gauges on or near the pump? These gauges are the quickest and most accurate way of finding out what is happening in the pump.
- 2 Check alignment.
- 3 Check piping to be sure there is no strain on the pump casing.
- 4 Rotate the pump shaft by hand to be sure it turns freely.
- 10 Do NOT use the pump to flush the system with water. Either remove the pump or run piping around it while flushing. Dirty water and foreign particles going through the pump will do more damage in a few moments than months of actual service.
- 11 Check to be sure all guards are in place.
- 12 Now push the "start" button.

If the pump does not begin to deliver oil within one minute push the "stop" button. Do NOT run the pump longer than one minute without liquid in it. Review the steps just outlined, consider what the suction and discharge gauges, if used, indicate. If everything appears to be in order, put some oil in the pump. This will help it prime.

Push the "start" button again. If nothing is flowing within two minutes, stop the pump. The pump is not a compressor, it will not build up much air pressure; it may be necessary to vent the discharge line until oil begins to flow.

If the pump still does not deliver, the cause may be one or more of the following:

- 1 Suction line air leaks; vacuum gauge reading should help determine if this is the problem.
- 2 End of suction pipe not submerged deep enough in the oil.
- 3 Suction lift is too great or the suction piping is too small.
- 4 Oil is vaporizing in the suction line before it gets to the pump.

If after consideration of these points it still does not pump, review again all points given under START UP; read through TROUBLE-SHOOTING and try again.

#### TROUBLE-SHOOTING

A pump which is properly installed and maintained will give long and satisfactory performance.

If trouble does develop, one of the first steps toward finding the difficulty is to INSTALL A VACUUM GAUGE IN THE SUCTION PORT AND A PRESSURE GAUGE IN THE DISCHARGE PORT. Readings on these gauges often will give a clue as to where to start looking for the trouble.

#### VACUUM GAUGE - SUCTION PORT

- 1 High reading would indicate -
  - A. Suction line blocked - check valve stuck, gate valve closed, strainer plugged.

- B. Oil too viscous to flow through the piping.
- C. Lift too high.
- D. Line too small.

#### 2 Low reading would indicate -

- A. Air leak in suction line.
- B. End of pipe not in the oil.
- C. Pump is worn.
- D. Pump is dry - should be primed.

#### 3 Fluttering, jumping, or erratic reading -

- A. Oil vaporizing.
- B. Oil coming to pump in slugs, possibly an air leak or insufficient oil above the end of the suction pipe.
- C. Vibrating from cavitation, misalignment, or damaged parts.

#### PRESSURE GAUGE - DISCHARGE PORT

##### 1 High reading would indicate -

- A. High viscosity and small and/or long discharge line.
- B. Gate valve partially closed.
- C. Filter plugged.
- D. Line partially plugged from build up on inside of pipe.
- E. Oil in pipe not up to temperature.
- F. Oil in pipe has solidified.

##### 2 Low reading would indicate -

- A. Too much extra clearances inside the pump.
- B. Pump worn.

- 3 Fluttering, jumping, or erratic reading -
- A. Cavitation.
  - B. Oil coming to pump in slugs.
  - C. Air leak in suction line.
  - D. Vibrating from misalignment or mechanical problems.

Some of the following may also help pinpoint the problem:

- 1 Pump does not pump.
- A. Lost its prime - air leak, low oil level in tank, check valve stuck.
  - B. Suction lift too high.
  - C. Rotating in wrong direction.
  - D. Motor does not come up to speed.
  - E. Suction and discharge valves not open.
  - F. Strainer clogged.
  - G. Pump worn out.
  - H. Any changes in the oil or operation that would help explain the trouble, such as new source of supply, added more lines, inexperienced operators, etc.
- 2 Pump starts, then loses its prime.
- A. Oil tank empty.
  - B. Oil vaporizing in the suction line.
  - C. Air leaks or air pockets in the suction line; leaking air through the packing.
  - D. Worn out.
- 3 Pump is noisy.
- A. Pump is being starved (heavy oil cannot get to pump fast enough). Increase suction pipe size or reduce length.
  - B. Pump is cavitating (oil vaporizing in the suction line). Increase suction pipe size or reduce length; if pump is above the oil raise the liquid level closer to the pump; if the oil is above the pump, increase the head of oil.

- C. Check alignment.
- D. May have a bent shaft or rotor tooth. Replace damaged part.
- E. May have to anchor pump base or piping to eliminate or reduce vibration.
- F. May be a foreign object trying to get into the pump through the suction port.

- 4 Pump not up to capacity.
- A. Starving or cavitating - increase suction pipe size or reduce length.
  - B. Strainer partially clogged.
  - C. Air leak in suction piping or along pump shaft.
  - D. Running too slowly; is motor the correct speed and is it wired up correctly.
  - E. Pump worn out.
- 5 Pump takes too much power.
- A. Running too fast - is correct motor speed, reducer ratio, sheave size, etc. being used.
  - B. Is oil more viscous than unit sized to handle; heat the oil, increase the pipe size, slow down the pump, or get a bigger motor.
  - C. Discharge pressure higher than calculated, check with pressure gauge. Increase size or reduce length of pipe, reduce speed (capacity) or get bigger motor.
  - D. Packing gland drawn down too tight.
  - E. Pump misaligned.
  - F. Extra clearance on pumping elements may not be sufficient for operating conditions. Check parts for evidence of drag or contact in pump and increase clearance where necessary.

#### 6 Rapid Wear

On most applications the pump will operate for many months or years before it gradually loses its ability to deliver capacity or pressure. Examination of such a pump

would show a smooth wear pattern on all parts. RAPID WEAR, occurring in a few minutes, hours or days, shows up as heavy grooving, galling, twisting, breaking or similar severe signs of trouble. Some of the causes, evidence and cures are listed here.

#### PREVENTATIVE MAINTENANCE

Performing a few preventative maintenance procedures will extend the life of the pump and reduce the cost per gallon pumped.

- 1 Packing Adjustment - Occasional packing adjustment may be required to keep leakage to a slight leak; if impossible to reduce leakage by gentle tightening, replace packing.
- 2 End Clearance Adjustment - After long service the running clearance between the end of the rotor teeth and the head may have increased through wear to the point where the pump is losing capacity or pressure. Resetting end clearance will normally improve pump performance. See PUMP MAINTENANCE AND REPAIR INSTRUCTIONS - REASSEMBLY.
- 3 Examine Internal Parts - Periodically remove the head, examine idler and bushing and head and pin for wear. Replacing a relatively inexpensive idler bushing and idler pin after only moderate wear will eliminate the need to replace more expensive parts at a later date. Be sure idler does not slide off idler pin as head is removed and drop and hurt someone or damage the part.
- 4 Cleaning the Pump - A clean pump is easier to inspect, adjust, and runs cooler; plus, it looks better.
- 5 Storage - If a pump is to be out of service or stored for a long time, drain it and protect it from rusting inside and out.

#### DO'S AND DON'TS

Do's and don'ts for installation, operation, and maintenance of positive displacement pumps to assure safe, long, trouble-free operation.

#### Installation -

- 1 Do install pump as close to oil tank as possible.

- 2 Do leave working space around the pumping unit.
- 3 Do use large, short, and straight suction piping.
- 4 Do install a strainer in the oil tank.
- 5 Do double-check alignment after the unit is mounted and piping is hooked up.
- 6 Do cut out the center of gaskets used on flanged connections.
- 7 Do record pump model number and serial number and file for future use.

#### Operation -

- 1 Don't run pump at speeds faster than recommended.
- 2 Don't require pump to develop pressures higher than 100 PSI.
- 3 Don't operate pumps without all guards being in place.
- 4 Do have spare parts, pumps or standby units available, particularly if the pump is an essential part of a key operation or process.

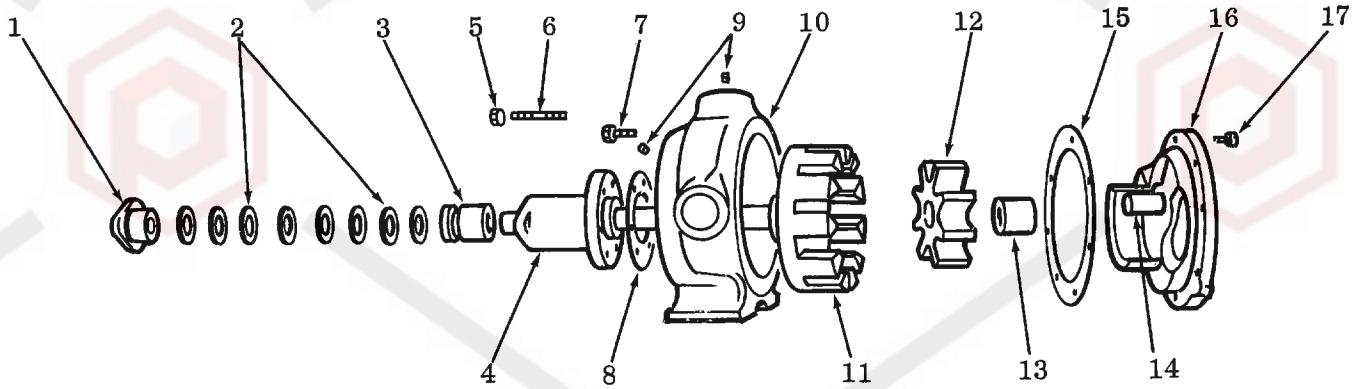
#### Maintenance -

- 1 Don't drop parts during disassembly, such as idler can slip from the pin as the head is removed from the pump; it may drop on someone's foot, plus it may get nicked or gouged.
- 2 Don't stick fingers in the ports of a pump! The close running parts may trim more than fingernails if the pump is rotated.
- 3 Don't spin the idler on the idler pin! Fingers may be jammed between teeth and crescent.
- 4 Do remember that a few simple preventative maintenance procedures such as adjustment of end clearance, examination of internal parts, etc., will extend the service life of the pump.
- 5 Do OBTAIN, read and keep the maintenance instructions furnished with the pump.



## TROUBLE SHOOTING DATA

SYMPTOM	POSSIBLE CAUSE	CORRECTION
Gouges or marks made by large hard particles; a rapid wearing away of bushings from very small abrasives similar to pumice; or anything in between.	Abrasives	Flush the system with the pump removed. Oftentimes after a system has run for a few cycles or a few days the dirt is pretty well cleaned out and if the pump is rebuilt into good condition it will then last for a long time.
Rust, general overall aggressive attack or sloughing off of metal.	Corrosion	Consider whether all of the materials used in pump construction were attacked; consider other materials used in the system to determine how they resisted the oil. Check to see whether or not the oil has been contaminated to make it more corrosive than anticipated.
Noisy operation, broken bushings, twisted shaft, parts show evidence of high heat.	Exceeding operating limits	Contact the factory
Pump may stall. Evidence of heavy contact between end of rotor teeth and head or other parts.	Insufficient end clearance	Increase end clearance
Noisy bearings, localized heating at bearings, smoke, rapid bushing wear.	Lack of lubrication	Be sure all instructions for lubrication of drive equipment are followed.
Wear on only one part of a surface, such as one side of the casing, one side of the packing gland, only a portion of the face of the head.	Misalignment	Double check alignment of drive equipment and piping. Check the alignment under conditions as close to operating conditions as possible.
Pump stalls because parts have uneven expansion caused by frictional heat; galling between surfaces having relative motion; idler pins changing color because of high heat.	Run dry	Be sure there is oil in the system at the time of start up. Provide some kind of automatic alarm or shut-off if oil tank runs dry.



ITEM	NAME OF PART	ITEM	NAME OF PART
1	Packing Gland	10	Casing
2	Packing	11	Rotor and Shaft
3	Rotor Bearing Sleeve Bushing	12	Idler and Bushing
4	Rotor Bearing Sleeve and Bushing	13	Idler Bushing
5	Packing Gland Nuts	14	Idler Pin
6	Packing Gland Studs	15	Head Gasket
7	Capscrews	16	Head and Idler Pin
8	Rotor Bearing Sleeve Gasket	17	Capscrews
9	Pipe Plug		

### OIL PUMP - EXPLODED VIEW

#### PUMP MAINTENANCE AND REPAIR INSTRUCTIONS

**DISASSEMBLY** - Before starting disassembly, study the illustration OIL PUMP - EXPLODED VIEW to determine the parts relationship. The parts are shown in a logical sequence of disassembly and will prove to be a valuable aid in dismantling the pump.

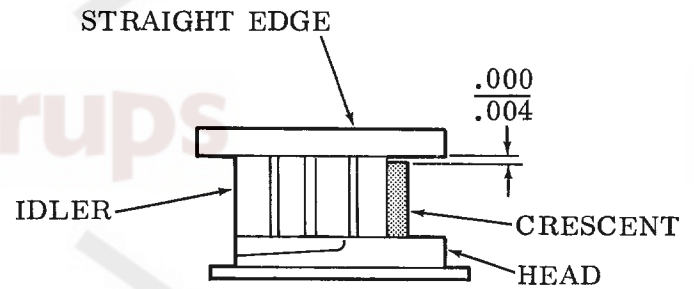
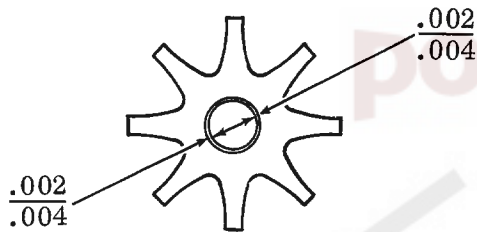
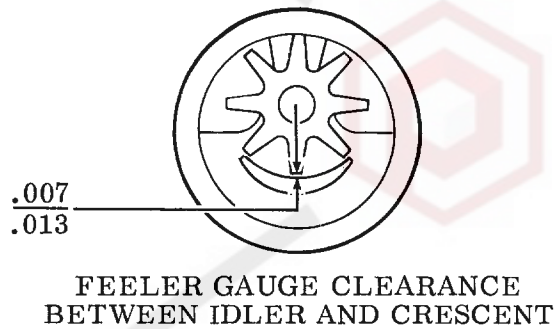
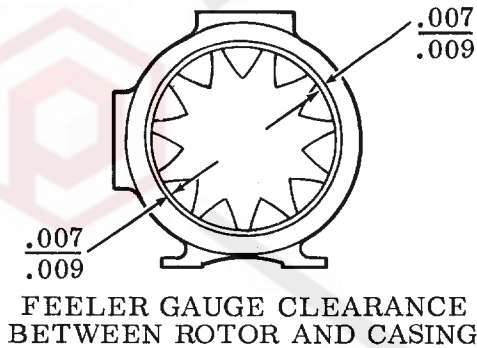
- 1 Remove the head from the pump. When the head is being removed, the idler usually stays on the idler pin in the head, but the idler may fall off if the inside of the head is tilted downward. A fall on a hard surface can damage the idler. If the idler should fall, check carefully and file or stone all nicked or rough places before reassembly.
- 2 Remove the head gaskets. If a new set is not available, the original gaskets may be re-used provided they are not damaged. Coat these gaskets with grease or vaseline to prevent drying and shrinkage if exposed to the atmosphere for any length of time.

With the head removed, the parts can be checked for wear with a feeler gauge. By comparing the actual clearances in the pump with the clearances shown in the following illustrations, the approximate condition of the pump may be determined.

- 3 Remove the idler from the idler pin. If the idler pin is worn, the idler, idler bushing and idler pin should be replaced. Remove the idler pin from the head with an arbor press. When installing a new idler pin be sure it is started straight and pressed into place.

If the idler bushing is worn, a new idler and idler bushing must be installed.

- 4 Remove the packing gland by removing the packing gland nuts.
- 5 Carefully remove the rotor and shaft from the casing. First remove the pipe plug from the drain hole in the back of the casing. This will break the vacuum between the rotor and casing and help in removing the rotor and shaft. Use a hardwood block or piece of soft bronze between the hammer and shaft and drive the rotor from the casing.
- 6 Remove the packing from the rotor bearing sleeve. Be sure to take out all of the packing.
- 7 The rotor bearing sleeve bushing should be inspected and if it shows signs of wear, the bushing should be replaced. This bushing must be removed from the packing gland end of the rotor bearing sleeve.



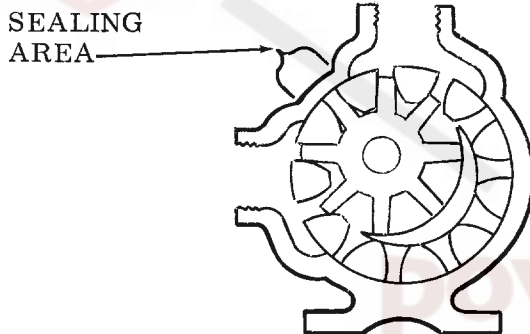
FEELER GAUGE CLEARANCE  
BETWEEN IDLER PIN AND IDLER BUSHING

COMPARISON OF IDLER THICKNESS  
WITH LENGTH OF CRESCENT

### FEELER GAUGE CLEARANCES

- 8 Casing should be examined for wear, particularly at the sealing area between the port openings. See the illustration CASING SEALING AREA. If this surface is in good condition, the casing in all probability may be used. All parts should be checked for

- 1 Install the rotor and shaft. Before placing the rotor and shaft in the casing, carefully check the rotor and shaft and remove all burrs or rough surfaces that could damage the bushing in the casing. Coat the inside of the casing bushing and the rotor shaft with a thin film of grease or oil. Place the end of the shaft in the casing bushing, turn the rotor slowly from right to left, and push the rotor into the casing as far as it will go. Be sure the drain plug is out of the casing; this opening will let the entrapped air escape.



### CASING SEALING AREA

wear before the pump is put together. When making major repairs, such as replacing a rotor and shaft, it is usually considered advisable to also install a new head and idler. When making minor repairs, when only an idler bushing and idler pin are required, other new parts are usually not necessary.

- 2 Place the head gaskets on the head. The proper amount of gaskets should be used to provide the necessary end clearance within the pump so it turns freely with no appreciable end play. The rotor shaft must be free to move axially, in and out, 0.005 to 0.009 inch.
- 3 Put the idler on the idler pin in the head.
- 4 The head can now be assembled on the pump. Tilt the top of the head away from the pump slightly until the crescent enters the inside diameter of the rotor and rotate the idler until its teeth mesh with the rotor teeth. Do not damage the head gaskets. Note correct position of the idler and crescent on the illustration CASING SEALING AREA. Tighten the head capscrews and then check

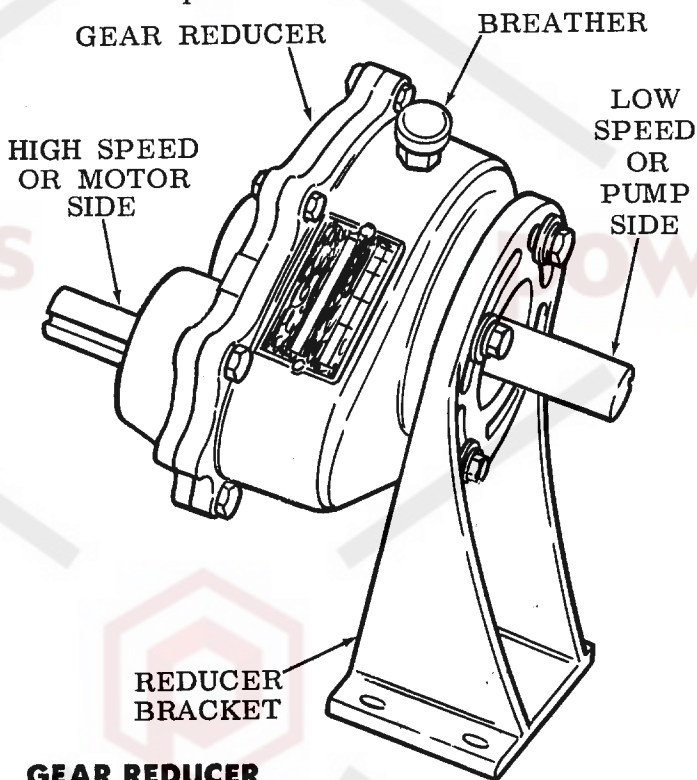
REASSEMBLY - Use the exploded view to determine parts relationship.

the end clearance. If the pump shaft cannot be rotated, more gaskets must be added. If, however, the pump has any noticeable end play, remove enough gaskets so the pump has no appreciable end play but still turns freely.

- 5 Pack the pump. It is good practice to install a set of new packing. Cut the packing into individual rings that wrap exactly around the shaft. Install and seat each ring, one at a time, staggering the ring joints from one side of the shaft to the other. Lubricate the packing rings with oil or grease to aid in assembly. A length of pipe or tubing slid over the end of the rotor shaft will help in seating the packing rings.
- 6 Install the packing gland and nuts. The gland must enter the rotor bearing sleeve at least 1/8" after tightening the packing gland nuts. Be sure the packing does not wedge between the rotor bearing sleeve and the gland, as this may split the sleeve.

#### GEAR REDUCER

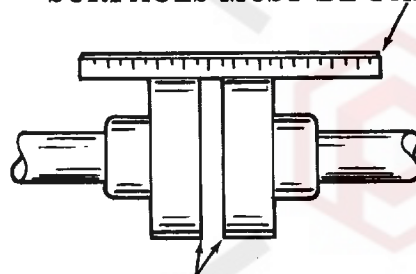
**INSTALLATION** - Gear reducers are shipped completely assembled and ready for installation except for the addition of lubricant. To install the reducer proceed as follows:



#### GEAR REDUCER

- 1 Fasten the oil pump securely to the pump base.
- 2 Mount the reducer in the reducer bracket finger tight. The breather should be located on the top of the reducer and the magnetic drain plug on the bottom. Refer to the illustration GEAR REDUCER.
- 3 Place the coupling halves on both the high and low speed reducer shafts.
- 4 Align the low speed coupling half with the coupling half on the pump. Use a straight edge to align the coupling as shown on the illustration COUPLING ALIGNMENT. A C-clamp, clamped over pieces of keystone, may be used to hold this alignment until the mounting bracket is securely bolted to the pump base. It may be necessary to shim the bracket to the exact center height of the pump.

USE STRAIGHT EDGE. THESE SURFACES MUST BE PARALLEL.



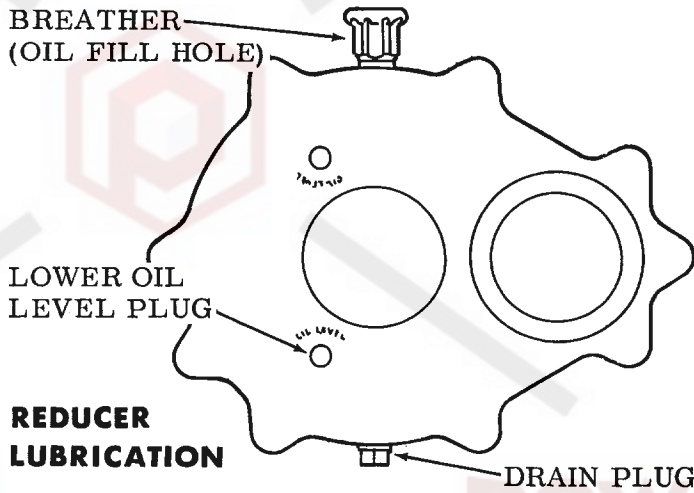
CHECK WIDTH BETWEEN THESE SURFACES WITH INSIDE CALIPERS TO BE CERTAIN THE FACES ARE AN EQUAL DISTANCE APART AND PARALLEL.

#### COUPLING ALIGNMENT

- 5 Rotate the reducer in the "banana" slots of the bracket until the high speed coupling half is at the exact center height of the motor coupling half.
- 6 Tighten the reducer to the reducer bracket securely.
- 7 Align the high speed coupling and fasten the motor tightly to the pump base.

**LUBRICATION** - Before operating the reducer, add lubricant as follows:

- 1 Remove the breather and fill the reducer to the lower oil level hole. See the illustration REDUCER LUBRICATION.
- 2 After the first 100 hours of operation, drain and refill with new lubricant.

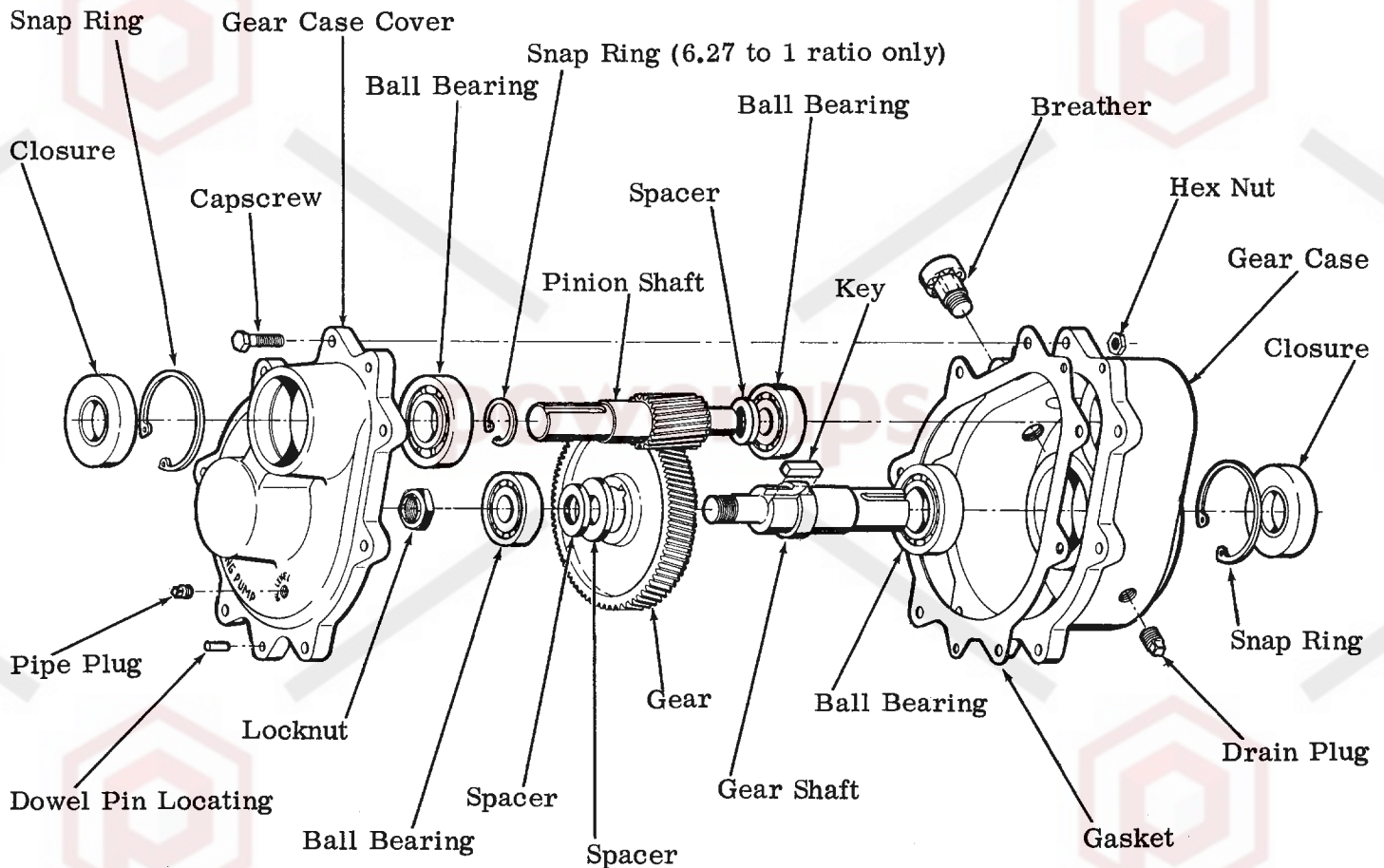


Ambient Temperature	Above 32°F	Below 32°F
Automotive Oil Type	SAE 30	SAE 10
Quantity	1/2 Pint (8 Ounces)	

### REDUCER OIL SPECIFICATIONS

OPERATION - After the first few hours of operation, inspect the reducer for leaks. If leakage between the gear case and cover cannot be stopped by tightening the capscrews, the gasket should be replaced. Leakage around either shaft indicates a damaged closure which should be replaced. The operating temperature on the outside of the reducer case, after a few hours of operation, should not be more than approximately 75° Fahrenheit higher than the surrounding air temperature. The oil within the reducer should never exceed a temperature of 200° Fahrenheit.

- 3 Check the lubricant level every 1000 hours of operation. Add lubricant as necessary.
- 4 Once every 2000 hours drain and refill. If the reducer is outdoors, change to the proper lubricant each spring and fall. See the table REDUCER OIL SPECIFICATIONS.



### GEAR REDUCER - EXPLODED VIEW

**DISASSEMBLY** - Before starting disassembly, study the illustration GEAR REDUCER - EXPLODED VIEW to determine the parts relationship. The parts are shown in a logical sequence of disassembly and will prove to be a valuable aid in dismantling the reducer.

- 1 Disconnect the couplings and remove the capscrews holding the mounting bracket to the base. Remove the coupling halves and bracket from the reducer.
- 2 Remove the breather and drain plugs. Drain all lubricant from the reducer.
- 3 Remove the hex head capscrews holding the cover to the gear case.
- 4 Lightly tap against the protruding ear tabs or drain plug or breather bosses on the cover to loosen it from the gear case. Remove the cover from the gear case by carefully prying alternately at opposite sides with a screw driver. **DO NOT FORCE!** Be careful not to damage the gasket.
- 5 Grasp the pinion and gear shafts and pull both assemblies simultaneously from the case or cover.
- 6 Remove the locknut on the gear shaft. Use a conventional gear or bearing puller to remove the bearings from the gear shaft. Remove the beveled spacer and pull the gear from the shaft. Save the square key.
- 7 Use the puller and remove the bearings from the pinion shaft.
- 8 Remove the closures (oil seals) from the gear case and cover only if they show signs of deterioration or damage. It is not necessary to remove the snap ring in the gear case and cover. Closures must be pressed or driven out from the inside of the case and cover.

**REASSEMBLY** - Use the exploded view to determine parts relationship.

If the gear ratio is to be changed from that of the disassembled reducer, be sure to select a pinion and gear of a common ratio. A pinion from one ratio cannot be used with a gear from a different ratio.

- 1 Be sure all parts are clean, and that gasket surfaces are free from burrs. Install the spacer and the ball bearings on the pinion shaft. Be sure the bearings are seated firmly against the spacer and the shoulder on the pinion shaft.

ON THE 6.27 TO 1 RATIO REDUCERS IT IS NECESSARY FIRST TO INSTALL A SNAP RING IN THE GROOVE ON THE PINION SHAFT BETWEEN THE TEETH AND INNER RACE OF THE BALL BEARING. TWO SPACERS ARE REQUIRED BETWEEN THE INNER RACE OF THE BEARING AND SHOULDER ON THE PINION FOR THE 7.65 TO 1 RATIO. THE BEVELED EDGE IN THE SPACERS SHOULD BE TURNED TOWARD THE BEARING.

- 2 Install the square key in the gear shaft and press the gear into place. Be sure the gear seats against the shoulder on the shaft.
- 3 Place the two spacers on the gear shaft with the beveled edge on the one spacer toward the gear. Install the ball bearings on the gear shaft. Be sure the bearings are seated firmly against the spacer and shaft shoulder. Tighten the locknut securely on the gear shaft.
- 4 If the closures were removed during disassembly, place the gear case and cover, gasket faces down, on a surface which will not mar this face. Be sure the snap rings are in the case and cover. Put gasket sealer on the outside diameter of the new closures. Drive the closures, with lip toward the inside of the reducer, in place against the snap rings. Use a wood block covering the entire closure and drive evenly. Apply a lubricant to the closure seal lips.
- 5 Block the gear case, open side up, to provide at least 3-1/4" clearance between the case and work surface.
- 6 Make certain the pinion and gear shaft keyways are free of burrs and sharp edges to prevent damaging the closure lips. Take the pinion and gear assemblies, mesh the gear teeth, and insert simultaneously into the gear case half. Rotate the gear shaft slightly as it is pushed through the closure. Tap the end of the pinion shaft

and gear shaft with a hardwood block to seat the bearings in the counterbores.

7 Place the gasket on the gear case. If the gasket is the least bit damaged, discard it and use a new gasket.

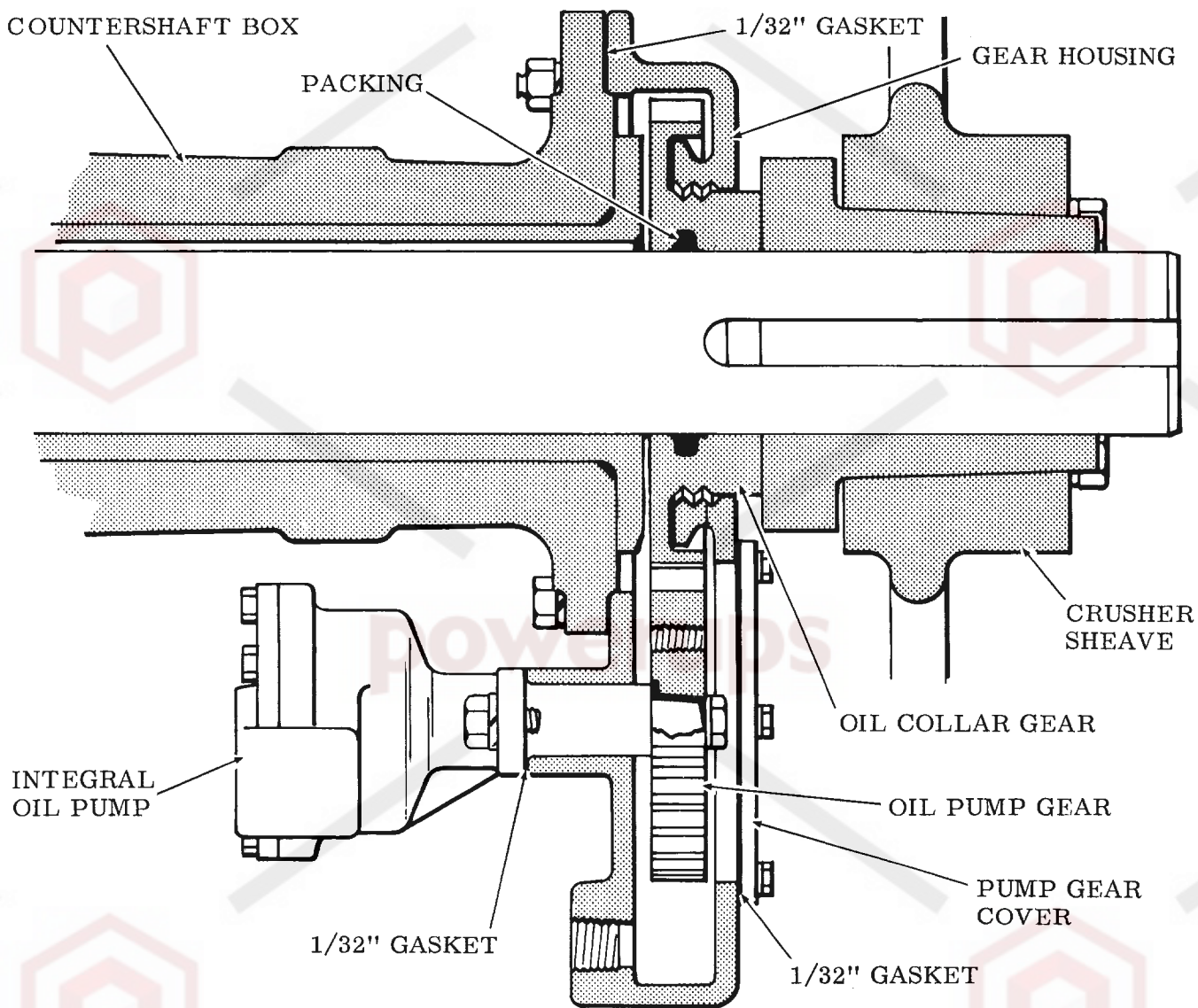
8 Align the gear case cover with the ends of the pinion and gear shafts, and carefully press the cover into place. Rotate pinion shaft during assembly. Tap the cover with a hardwood block to seat the bearings in the cover.

9 Install the capscrews and nuts for the reducer. Tighten securely, alternating around the gear case to prevent distortion.

10 Install the drain plug. Be sure the reducer is filled with the proper lubricant.

### INTEGRAL OIL PUMP

GENERAL INFORMATION. The crusher driven integral pump is a compact, internal gear, positive displacement pump designed and furnished as standard equipment on the 2 Ft. through 4-1/4 Ft. Crushers. This pump is mounted near the countershaft box as an integral part of the Crusher being driven by a gear on the countershaft. Therefore, the Crusher must be operating before the oil pump will circulate the oil through the lubricating system.



**INTEGRAL OIL PUMP**

Even if the Crusher is equipped with an integral oil pump, it is suggested to read thoroughly ALL of the paragraphs under INDEPENDENT OIL PUMP especially trouble shooting and pump maintenance and repair information.

It is important that the Crusher be operated with the proper direction of rotation of the countershaft. Reversing direction can cause the oil trapped in the suction line between the pump and check valve to increase in pressure until the pump ceases to function. If opposite direction of rotation is desired, the piping must then be changed for the reversed rotation. Consult the article on COUNTERSHAFT ROTATION in Section 11 before attempting to reverse the crusher rotation.

#### INTEGRAL OIL PUMP REMOVAL AND INSTALLATION

The following procedure will permit easy removal of the integral pump from the Crusher for servicing, refer to the illustration INTEGRAL OIL PUMP.

- 1 Disconnect all piping that would interfere with pump removal.
- 2 Remove the crusher sheave or rotate the sheave so that the pump is accessible through the ribs of the sheave.
- 3 Remove the pump gear cover and gasket. This will expose the rear of the pump rotor shaft and the oil pump gear.
- 4 Remove the hex nut and lockwasher from the rotor shaft and pull the keyed oil pump gear off the tapered end of the shaft. Be careful not to damage the mating oil collar gear during removal.
- 5 Remove the capscrews holding the pump casing to the rear of the gear housing. The pump is now free to be removed from the Crusher. Do not misplace the gasket which is between the pump casing and gear housing.

Separate drawings found in the Parts Manual are to be used for disassembling the integral pump itself.

Reverse the above procedure when assembling the oil pump to the Crusher, replacing any gaskets that have become damaged.

IT IS IMPORTANT WHEN REASSEMBLING THE PUMP THAT THE PROPER AMOUNT OF HEAD GASKETS ARE USED TO PROVIDE THE NECESSARY CLEARANCE WITHIN THE PUMP SO THAT THE ROTOR SHAFT TURNS FREELY WITH NO APPRECIABLE END PLAY. THE ROTOR SHAFT MUST BE ABLE TO MOVE AXIALLY, IN AND OUT, 0.005 to 0.010 INCH.

The illustration INTEGRAL OIL PUMP shows the integral pump on the 4-1/4 Ft. Crusher. For any of the other crusher sizes, the location of the pump may vary, but the method of removal will be the same.

#### OPERATION

Before starting the Crusher be certain the pump is adequately lubricated or primed. Never operate the pump dry over an extended length of time. Operating a pump without oil for a few minutes will do more damage than many hours of pumping. For priming, refer to the article PREPARATIONS BEFORE STARTING in Section 11.

The crusher driven integral pump lubricating system permits simplified installation and is especially suitable for portable plants and other similar installations.

#### OIL FILTER

An oil filter can be supplied when finer filtration of the lubricating oil is desired, than can be obtained from the 10 wire mesh screen in the oil tank, thereby giving additional life to the crusher bearing parts. Filters with varying degrees of filtration are available in either the replaceable, throw-away cartridge type, or the manually cleanable type. As filters differ in size, construction and performance, reference should be made to the filter manufacturers' instruction bulletin for installation and servicing.

For the most efficient filtering, 50 micron filtration is recommended. The filter selected



must have the proper capacity (GPM) for adequately lubricating the Crusher.

A filter can either be installed utilizing the independently driven pump or the crusher driven integral pump.

The oil strainer inside the oil tank is NOT a filter and is not intended to remove particles of dust and dirt from the oil.

#### FILTER BY-PASS RELIEF VALVE

With the filtering arrangement, a relief valve set at 25 PSI must also be installed. When the oil is cold or if clogging of the filter occurs the relief valve would automatically by-pass the oil around the filter.

#### WHEN TO CLEAN THE FILTER

A definite schedule for cleaning cannot be predetermined, but when there is an excessive amount of oil being by-passed, cleaning is necessary. By-passing of oil can be observed by installing a sight flow indicator immediately after the relief valve. The glass on the flow indicator would provide the operator with a visual means of showing if the oil is being by-passed and that cleaning is required. For a more effective method of determining when cleaning is necessary, pressure gauges can be installed in the oil lines entering and leaving the filter. Differences in pressures between the inlet and outlet side of the filter (pressure loss) can be seen at once. When there is an approximate 25 PSI difference between the "in-filter" and "out-filter" gauges, the filter element needs to be replaced. Example: 45 PSI at the "in-filter" gauge and 20 PSI at the "out-filter" gauge; difference is 25 PSI, therefore filter is dirty!

A differential pressure gauge can be installed to clearly show when the filters require cleaning without remembering any pressures.

**OIL MUST BE AT OPERATING TEMPERATURE WHEN CHECKING FOR PRESSURE LOSS, AS A GREATER AMOUNT OF OIL WILL BE BY-PASSED WHEN USING COLD OIL THEREFORE REGISTERING A LARGE PRESSURE LOSS WITHIN THE FILTER.**

Valves are to be installed at the inlet and outlet of the filter to shut off the flow of oil through the filter, this will keep the lubrication system in operation when servicing the filters.

#### CLEANING THE FILTER

Observe carefully how the filter is assembled when it is taken apart the first time. To clean a typical filter proceed as follows:

- 1 Open the air vent valve on top of the filter, then open the drain valve at the bottom of the filter or filter piping and completely drain the unit.
- 2 Remove the filter cover, then the pressure plate assembly and lift out the dirty element. Use the plastic bag the replacement element is shipped in for disposal of the dirty element.
- 3 Place the new element in the filter shell, making sure it is properly seated on the inlet seat at the bottom of the shell.
- 4 Position the pressure plate assembly on top of the element, being careful that the tube on the pressure plate slides into the hole in the top of the element.
- 5 Place the filter cover over the filter itself. The large spring on the pressure plate will compress as the nuts on the swing bolts are turned down. Tighten all the cover bolts evenly and no tighter than necessary.

#### VENTING

Periodically bleed the air from within the filter by opening the valve at the top of the filter. This will break the trap and allow the oil to flow through the entire filtering surface. A little oil will bleed out with the air, so observe the operation carefully as initially the air and oil mixture will sputter, close the valve when the oil flows out in a steady stream.

If air is continuously forced into the filter with the oil, unscrew the valve and connect a small tube from the top of the filter directly to the oil tank.

By placing your hand against the side of the filter shell you can tell when air is trapped inside the filter; that portion of the filter that contains the air will feel cooler than the rest of the filter as the warm oil cannot penetrate that portion of the filter containing the trapped air.

## COOLER

The lubricating system can be equipped with a cooler which will maintain an oil temperature to the Crusher between 100° and 130° Fahrenheit. There are two types of coolers available, the one which is the most common, uses water circulating through a tubular cooler, this type of cooling is shown in the LUBRICATING SYSTEM SCHEMATIC.

In some areas or locations where water is in short supply, air can be used for cooling the oil. A large radiator, similar to an automobile radiator, through which the warm oil to the Crusher is circulated, is used. Mounted on the radiator is a motor driven fan that forces the surrounding air past the radiator core and fins and cools the oil. As the construction of an air cooler depends on what the highest ambient temperature is, and the size of Crusher, this type of cooler in some cases must be designed to meet the particular Crusher cooling requirements. This kind of cooling system is as efficient as a tube type water cooler, refer to the paragraph in this section entitled AIR COOLER for installing and operating an air cooler. Piping drawings that show the proper method of installing an air cooler are furnished whenever an air cooling system is used.

Since the tube type cooler which uses circulating water as the cooling means is the most common type of cooler used in a crusher installation, this will be the type of cooling covered in the following paragraphs.

## WATER COOLER

The standard 6" diameter cooler normally furnished will maintain an oil temperature of 125° Fahrenheit or below, even with cooling water temperature as high as 80° Fahrenheit. For the quantity of water required to adequately cool the Crusher, refer to the table QUANTITY OF WATER REQUIRED. This cooler is provided as standard equipment on the larger crushers to help in dissipating the heat generated by the large amount of work being done with these Crushers.

A larger size cooler can be supplied to allow 95° Fahrenheit cooling water to maintain an oil temperature of 125° Fahrenheit or below. If a larger size cooler is required for your particular installation, a separate Technical Data sheet will be furnished to show the quantity of water required.

For longer cooler life, it is recommended that the cooler be mounted VERTICALLY in the lubricating system as shown in the illustration COOLER PIPING. Also to provide for longer cooler life a special copper-nickel alloy is used in the tube construction of these coolers to resist any chemical action from using impure water.

## WATER PIPING

Two types of water systems can be used, one is the CONTINUOUS and the other is the LIMITED. The merits and requirements for each system are discussed in the following paragraphs.

**CONTINUOUS WATER SYSTEM.** A continuous water system is that which can be obtained from a plant water system. With a continuous system, water is simply circulated through the cooler and discharged. When using a continuous system avoid operating in freezing temperatures unless precautions are taken to prevent the water from freezing. This type of water system is the most popular and is used on most cooler installations.

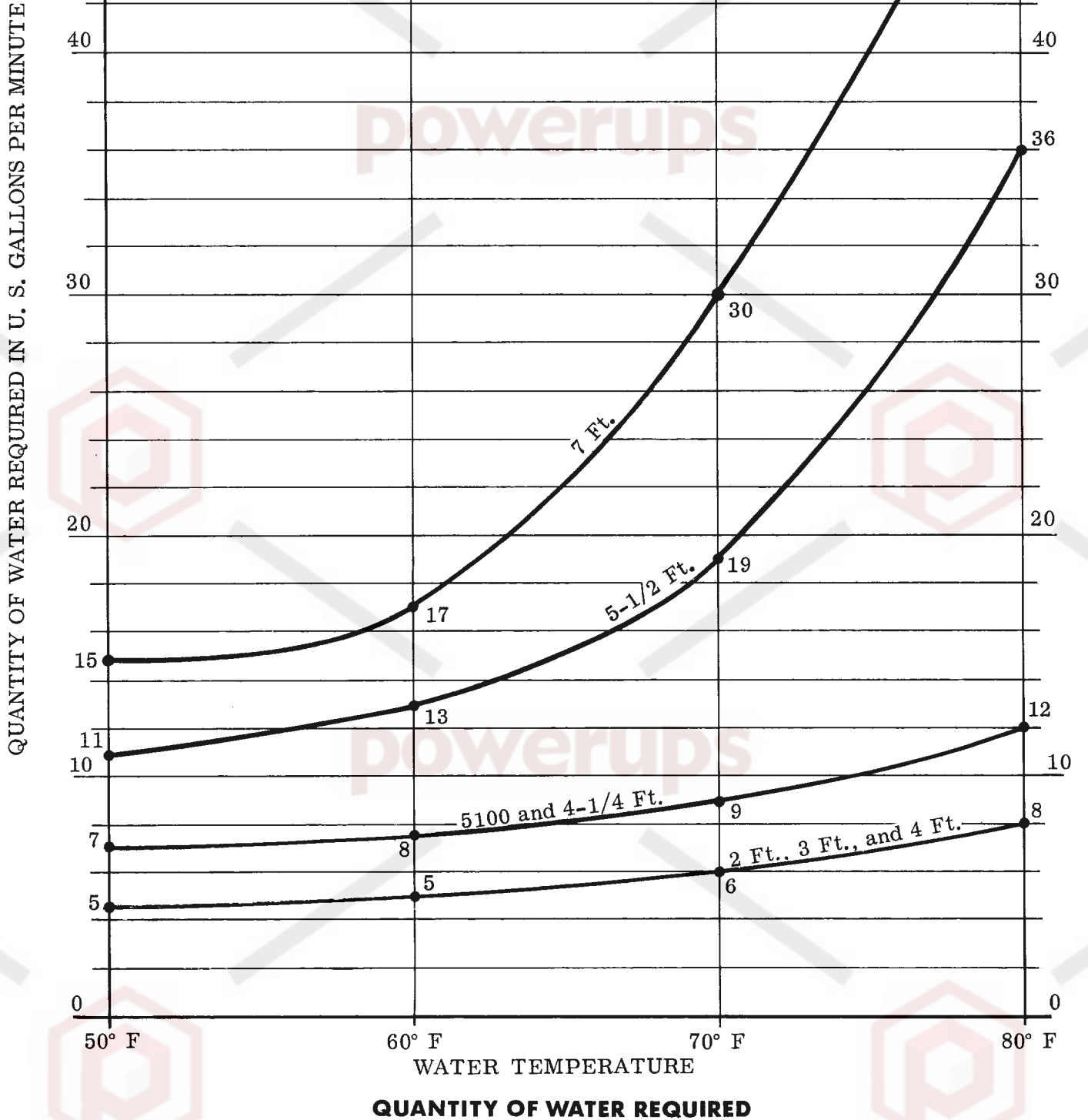
**LIMITED WATER SYSTEM.** If a continuous water supply is not available, a storage settling tank for the water supply can be used. The water in this type of system is continually being circulated from a storage tank to the cooler and back again. Refer to the table STORAGE TANK REQUIREMENTS for the correct capacity of the tank and the horsepower required for the water pump motor. Since

CRUSHER SIZE	Minimum Recommended Storage Tank Capacity in U.S. Gallons	HP Required For Pump Motor When Using Storage Tank
3 Ft.	1000	3
4 Ft.	1000	3
5100 and 4-1/4 Ft.	1000	3
5-1/2 Ft.	2000	5
7 Ft.	2000	5

**STORAGE TANK REQUIREMENTS**

MAXIMUM ALLOWABLE WATER FLOW THRU COOLER

The quantities of water shown on the table are based on 300SSU lubricating oil at 100° F. with the oil being cooled from 140° F. to 125° F. using a 6" diameter by 36" long cooler. This is the standard cooler for all sizes of Crushers.



this is a closed system, an anti-freeze solution can be substituted in place of the water to keep the system from freezing in cold weather.

## CONTROLLING THE WATER

To control the amount of water to the cooler, a globe valve can be installed in the system to manually regulate the amount of water through the cooler or a temperature control valve can be installed in the system to automatically control the cooling water to the cooler. Refer to the illustration COOLER PIPING and install either the globe valve or the temperature control valve in the location as shown.

Manually controlling the water through the cooler means periodic checks by the crusher operator to see that the oil feed line temperature to the Crusher remains fairly constant. Adjustments to the globe valve may be required as water temperatures vary during the period that the Crusher is operating.

Automatic controlling of the water through the cooler is preferred and is the arrangement that is shown in the COOLER PIPING illustration.

## TEMPERATURE CONTROL VALVE

### INSTALLATION

**VALVE LOCATION.** The temperature control valve should be mounted as close to the cooler as possible and should be installed in the cooling water OUTLET line as shown in the illustration COOLER PIPING.

This keeps the cooler filled with water which reduces corrosion of the cooler tubes and prevents the control valve from being affected by extreme variations of cooling water temperature.

Check that the temperature control valve has been installed with the arrow on the valve body in the direction of the water flow.

**VALVE POSITION.** If possible, let the capillary tubing run downward from the valve to the temperature sensitive bulb.

**BULB LOCATION.** This is perhaps the most important factor in a good installation. The entire bulb, not just part of it, must be exposed to the fluid of which the temperature is to be controlled. In this case the fluid to be controlled is the lubricating oil. The temperature

sensitive bulb is to be installed in the oil feed line to the Crusher as shown in the illustration COOLER PIPING.

**TEMPERATURE SETTING.** The valve should be factory set to maintain a feed line temperature to the Crusher of 100° Fahrenheit.

## GENERAL INFORMATION

Temperature control valves are instruments, not pipe fittings. A dent in the body or a sharp bend in the capillary tubing may prevent the valves from operating. Do not subject these controls to water-hammer conditions or excessive pressures.

## TEMPERATURE ADJUSTMENT

To lower the oil temperature turn the adjusting screw counterclockwise; to raise the temperature turn clockwise.

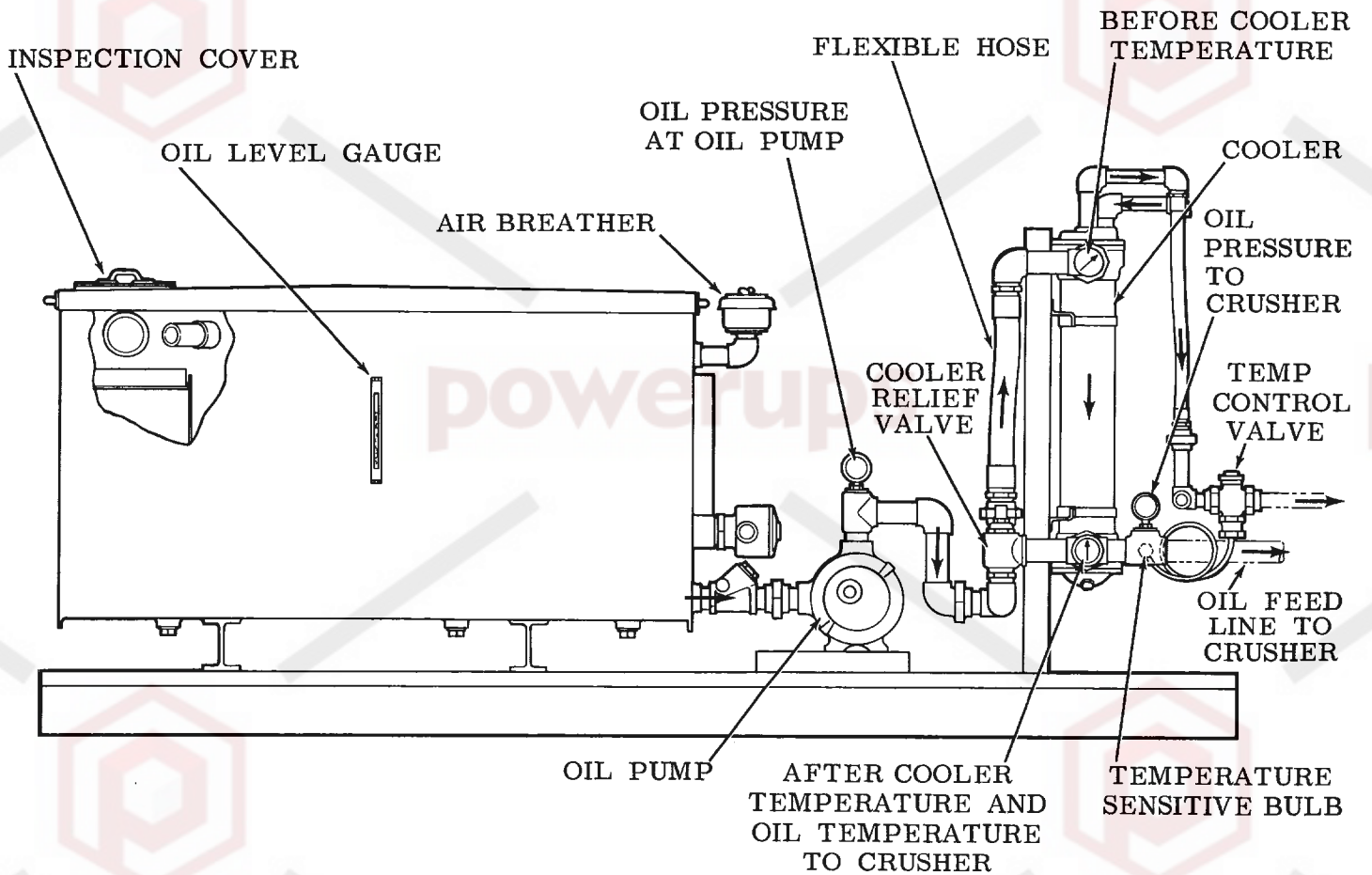
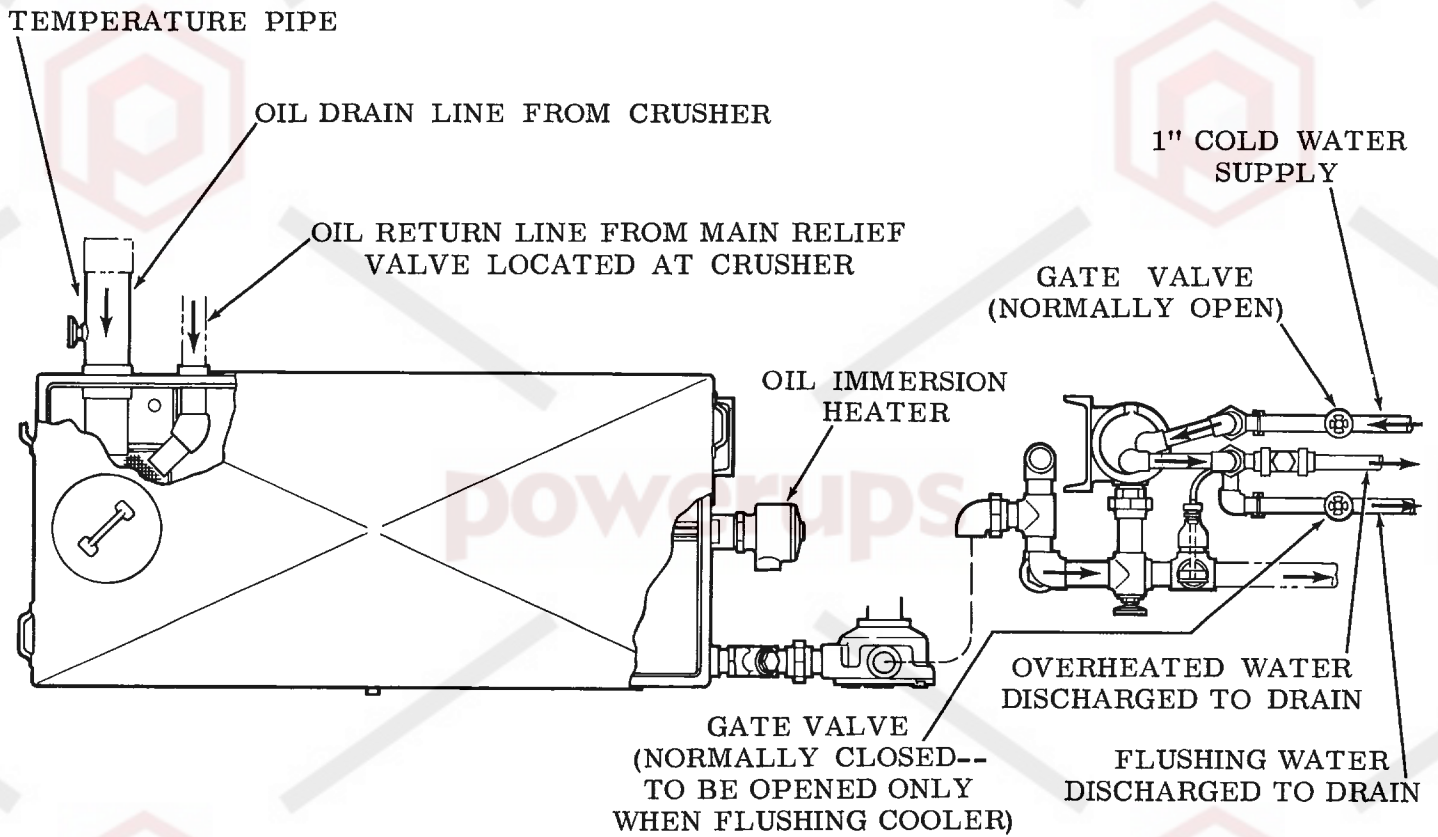
Since the valve controls the water flow through the cooler and the cooler cools the oil to the Crusher, it will probably require 5 to 10 minutes for an adjustment of the valve and water flow to show as a change in oil temperature. Changes in valve settings should therefore be made 1/2 turn at a time with 10 minutes or so between changes.

## OPERATION

Remember that this is a modulating control. It does not alternately open wide and shut tight like an electrical control device. In normal operation, the control valve remains in a constant, partially open position which is automatically adjusted whenever conditions require it.

## MAINTENANCE

The only servicing normally required is to keep the control clean. The valve can be inspected and cleaned by access through the inlet and outlet, without disassembly. The temperature sensitive bulb of the valve should be located where it will be most affected by the temperature changes of the lubricating oil. Accumulations of sludge, or dirt will reduce its sensitivity.



**COOLER PIPING**

The bulb should be examined and cleaned whenever the oil is changed or if the oil temperature increases abnormally.

#### **TROUBLE-SHOOTING**

If the control does not appear to be holding temperatures steady, or if not enough cooling is obtained, first check for external conditions which may prevent the control from operating correctly. Examples are: low or fluctuating water supply pressure; damaged or obstructed valves, strainers or other accessories; supply piping too small; dirty bulb or poor bulb location; kinked or broken capillary tubing.

If the valve will not close, check for dirt or foreign matter under the valve seat. The valve can be inspected through the inlet and outlet openings without disassembly, and can usually be cleaned out with an air hose.

If overheating results because a valve stays closed regardless of the temperature at the bulb, the thermostat may have lost its "fill" and become inoperative. To check this, remove the valve and bulb from the line, set the control at about the middle range, and insert the bulb in water hotter than the maximum of the range. If the control does not open, factory repairs to the thermostat are required.

If water leaks from the valve body, some part may be loose or partially disassembled. Otherwise, a seal bellows may be damaged requiring factory replacement.

If the valve chatters, this usually means a loose or disassembled interior part. Chattering is sometimes caused by other devices near the control, and can sometimes be eliminated by changing piping, arrangements, valve position, or supply pressure.

#### **WATER PRESSURE REQUIRED**

The amount of water pressure required for the cooling system is dependent upon the quantity (GPM) of water that is necessary to adequately

cool the Crusher, however, the pressure loss within the cooler and through a temperature control valve is minimal, approximately 10 PSI.

The maximum water flow that is allowed through the cooler is 50 GPM.

#### **WATER FLUSHING VALVE**

Located adjacent to the cooler should be a water flushing valve (Gate Valve) that is to be opened once a day to flush the sediment that remains within the cooler from the generally slow moving water. The flushing valve water can be simply discharged into a drain.

Opening the flushing valve directs the full force of the water through the cooler, dislodging any sediment or foreign particles that might remain in the cooler and lead to premature failure of the cooler tubes.

Flushing for several minutes each day is all that is required.

Flushing is strongly recommended in those installations where the cooling water cannot or is not strained, before entering the cooler.

#### **GENERAL COOLER INFORMATION**

##### **FREEZE-UP**

If there is a possibility that the water within the cooler will freeze and rupture the cooler, it must be thoroughly drained or an anti-freeze added prior to cold weather.

A most effective method in the prevention of a freeze-up would be the use of a commercially accepted solution of water and anti-freeze. It is recognized that this is not always possible under some of the circumstances in which these coolers are operated.

It is, therefore, important that in case of potential freeze-up, the units are properly drained after use. In addition it is recommended that air pressure be applied to blow out any water which does not drain out normally. To assure that the water will drain out of the tubes of a cooler mounted "horizontally", the cooler must be tipped approximately 2"

toward the inlet and outlet bonnet. This will permit the water held in the tubes by surface tension to flow out of the tubes.

Drain plugs located in the bottom of the cooler bonnet or in the bottom of the cooler piping are to be used for draining the cooler completely during cleaning or in freezing weather.

#### WHEN NOT IN USE

Should the cooler not be in use for a month or more, the cooler must be thoroughly drained of water and allowed to dry. This is done by removing the end bonnets on the cooler and blowing out the tubes. Water in the cooler will stagnate and lead to corrosion of the tubes if water is allowed to stand in the tubes without any movement for a period of time. This procedure should also be followed if there is a seasonal shutdown.

#### GALVANIC CORROSION

Each cooler is furnished with zinc anodes in order to minimize galvanic corrosion. In most fresh water applications, these anodes are not necessary and can be replaced with a pipe plug. In all salt water applications, it is advisable that the anodes be kept in the cooler. Anodes should be checked periodically, as they gradually erode away. How quickly the anodes will erode cannot be predetermined.

#### REPAIR OF COOLER

Should any of the tubes within the cooler tube bundle begin to leak, the individual tube(s) can be repaired as follows; Leaking of the cooler will show up as water in the oil tank. The following procedures are offered only as suggestions in those instances where the cooler cannot be returned to the manufacturer or to an automobile radiator shop specializing in repair of such equipment.

- 1 For a temporary repair drive wooden tapered plugs into each end of the leaking tube and seal the plugs with caulking compound.
- 2 For a more permanent repair, braze each end of the leaking tube shut, using silver solder. Do not use "soft" solder. The

brazing flux must be completely neutralized after the repair has been completed. If the flux has not been completely neutralized, accelerated corrosion of the remaining tubes within the cooler will take place.

- 3 If freezing of the cooler should occur, remove the end bonnets of the cooler and thoroughly inspect the circumferential seam between the tube sheet and the cooler shell for cracks. The tube sheet is the perforated plate of the cooler that the individual tubes are mounted in.

Immerse the cooler in a barrel of water only exposing that area of the cooler that requires repairing. Proceed to repair the cracked seam with silver solder. Immersing the cooler in water removes some of the heat caused by brazing before the thermal expansion can cause additional damage to the cooler.

#### CLEANING

The greatest efficiency, and longest life will be obtained from the cooler if it is kept clean. Periodic cleaning not only improves the heat transfer efficiency of the cooler, but also retards corrosion by removing corrosion-causing deposits and obstructions to smooth flow. Again, a definite schedule for cleaning the cooler cannot be predetermined, but inefficient cooling of the oil will determine when cleaning is necessary. To determine cooler efficiency, thermometers should be installed on the lube oil lines entering and leaving the cooler. The amount of heat transferred can then be seen at a glance. Whenever there is only a slight difference in oil temperature in and out of the cooler, the cooler may have become plugged with sediment or corroded and require cleaning.

If any unusual cooling problems are experienced such as high ambient or water temperatures or highly corrosive water, consult the factory for special recommendations, giving full operating conditions and data.

Regardless of the type of service and whether straining is practiced or required, the majority of all coolers benefit from periodic cleaning. A special alloy is used in the tube construction of these coolers to resist any chemical action when using impure water. The copper alloys, like most metals, depend for their corrosion resistance on a thin protective film of copper

oxide laid down on the metal surface. Any local breaks in this film will leave adjacent areas of protected and unprotected metal, a possible starting point for severe corrosion. Tube cleaning methods used should therefore avoid disturbing this "protective film".

The choice between chemical and mechanical cleaning will usually depend on such factors as nature of the fouling material, construction of the cooler, relative effectiveness and costs.

#### MECHANICAL CLEANING

Mechanical cleaning is particularly adaptable for cleaning the INSIDE of the tube surfaces.

Forcing high pressure water, or water and high pressure air, is effective in many instances. More thorough cleaning consists of forcing fiber brushes, or nylon brushes through the tubes. Water is particularly effective in providing a flushing action to remove the loosened material. Nylon brushes, which retain their stiffness in water, are somewhat more effective in removing more tightly adherent scale and dirt. Wire brushes are NOT recommended for cleaning copper alloys of this type.

#### CHEMICAL CLEANING

On the shell or lube oil side, chemical cleaning provides the only method of cleaning the cooler. The chemicals used are to be selected for their effectiveness in dissolving all or parts of the scale or fouling material. In some cases an additional flushing action is necessary to remove the loosened solids.

The selection of cleaning agent and method depend upon the nature of the scale or fouling material, cooler construction, facilities available, etc. There are hazards involved in using some of the most effective solvents, such as the chlorinated hydrocarbons, inhibited hydrochloric acid and many proprietary compounds. Cleaning of this type should always be done by or under the close supervision of specialists in this type of work.

#### USE OF STRAINERS

Foreign particles permitted to enter a cooler are capable, depending upon their size, nature and quantity of partially or completely blocking

the tubes. Similar objects too small to block the tubes may, by sticking to the tube walls, impair the heat transfer and also lead to that type of corrosion known as "deposit attack". This can occur whether the deposits are organic or inorganic, although the decay of organic matter is frequently an accelerating factor. Therefore, it is strongly recommended that the water to the cooler be strained (100 mesh or finer) of all sediment prior to circulation through the cooler, however, the strainer must be of adequate size to prevent plugging the strainer and cutting off the water flow to the cooler. A 1" strainer is NOT large enough to assure constant water flow to the cooler. If the water supply cannot be strained with a large capacity strainer, it is suggested to operate without one.

Conditions of the particular installation will usually dictate the size of strainer required and whether stationary or revolving strainers should be used.

#### COOLER BY-PASS RELIEF VALVE

When using a cooler, a pressure relief valve is to be installed to automatically by-pass the oil around the cooler when operating with cold oil or if clogging of the cooler occurs. With cold oil, the pressure drop within the cooler increases, thereby forcing the cooler relief valve to open and causing the majority of the oil to by-pass around the cooler rather than go through it.

#### AIR COOLER

An air cooler, which is a large radiator similar to an automobile radiator, through which the warm oil to the Crusher is circulated, is easy to install, since it is practically ready for operation when received. Piping to the radiator should be externally supported and not hung on the radiator itself. Flexible hose connections are recommended when piping to the radiator. The radiator should be installed between the oil pump and the Crusher. Piping drawings that show the proper method of installing an air cooler are furnished whenever an air cooling system is used. Never mount the radiator in an enclosed room as the air cooler depends on a continuing supply of moving air to cool the oil sufficiently. Before bolting the radiator to the foundation make sure that it is level.



Since mounted on the radiator is a large diameter motor driven fan that forces the surrounding air past the radiator core and fins and cools the oil, check the tightness of the fan motor hold down bolts.

When wiring the fan motor, check the motor nameplate for the correct voltage, frequency and phase; electrical connections are also shown on the nameplate. For proper operation and lubrication of the motor, refer to the manufacturer's service bulletin. All fuse protection equipment is to be furnished by the customer to conform to local electrical codes. The starter for the fan motor is also to be furnished by the customer to meet the customer's specific needs, location and electrical interconnecting requirements.

Attach a No. 8 or larger ground wire to the radiator and motor assembly. After the motor is connected to the power supply, check the motor and fan for correct rotation as shown on the cooler piping drawings. The blowing air is to be taken from the fan side of the radiator, forced through the core and out of the front of the radiator.

**WARNING**

To prevent serious bodily injury make sure the FAN GUARD is in place, secured and not damaged before operating the radiator fan.

It is strongly recommended that the radiator be equipped with a core guard in order to protect the radiator core and fins from being damaged by flying rocks.

The greatest efficiency and longest life will be obtained from the cooler if it is kept cleaned. Periodic cleaning improves the heat transfer efficiency of the cooler, therefore, clean the exterior surfaces of the cooling core whenever they become clogged with dust and dirt. Clean the core thoroughly with a fiber brush or blow out with compressed air. At least once a year, drain the oil from within the radiator and clean the radiator tubes thoroughly with either a fiber or wire brush.

Refer to the paragraph in this section entitled TEMPERATURE SWITCH for operating the cooler fan automatically.

**MAIN RELIEF VALVE**

A factory adjusted relief valve located near the countershaft box is provided to protect the Crusher from excessive pressure. If the oil pressure exceeds the valve setting, the excess oil is returned to the oil tank. When starting in cold weather, oil may be returned to the oil tank because of increased oil viscosity resulting in higher oil pressure. Removing the inspection cover in the oil tank cover will show if any oil is being returned to the tank from the relief valve. If the oil entering the main frame cap is too cold and the relief valve cannot bypass enough oil back to the oil tank, the oil entering the cap can raise the entire eccentric assembly until it contacts the underside of the socket. Without clearance between the socket and eccentric, oil will be trapped between the inner eccentric bushing and the main shaft and lead to localized heating at the top of the inner eccentric bushing. Running clearance between the inner eccentric bushing and main shaft will also be reduced causing the Crusher to operate with incorrect geometry, possibly leading to premature main shaft failure or overheating of the inner eccentric bushing. The proper relief valve setting is shown in the table MAIN RELIEF VALVE SETTINGS. This setting is stamped on the body of the relief valve.

CRUSHER SIZE	VALVE SETTINGS
2 Ft.	8 PSI
3 Ft.	10 PSI
4 Ft.	10 PSI
5100 and 4¼ Ft.	10 PSI
5½ Ft.	15 PSI
7 Ft.	15 PSI

**MAIN RELIEF VALVE SETTINGS**

WHEN THE TEMPERATURE OF THE LUBRICATING OIL REACHES 100° FAHRENHEIT THERE SHOULD BE NO OIL BEING BY-PASSED OR RETURNED TO THE OIL TANK FROM THE RELIEF VALVE.

PERIODIC INSPECTIONS OF THE RELIEF VALVE RETURN LINE IN THE OIL TANK SHOULD BE MADE, BOTH WHEN THE OIL IS COLD AND WHEN IT IS WARM, TO DETERMINE WHETHER OR NOT THE VALVE IS FUNCTIONING PROPERLY. IF AT 100° FAHRENHEIT, THE RELIEF VALVE IS BY-PASSING OIL BACK TO THE OIL TANK, THE VALVE MAY REQUIRE CLEANING OR REPLACING, UNDER NO CIRCUMSTANCES ADJUST OR DISMANTLE THE VALVE — REPLACE IT INSTEAD!

**PRESSURE SWITCH- LOW PRESSURE ALARM**

A pressure switch can be provided to protect the Crusher in the event of oil pressure failure. Should the pressure in the oil feed line drop below the minimum safe operating pressure of the Crusher, the pressure switch is activated. An electrical warning signal or machinery shut-down interlocking arrangement connected to the pressure switch, warns the operator against such pressure loss.

The pressure switch is furnished as standard equipment on all Crushers.

Connect the pressure switch into the oil feed line leading to the countershaft box as shown in the illustrations PRESSURE SWITCH CONNECTIONS. The switch should be located in a place where it is protected from dust and vibration. DO NOT ATTACH TO THE CRUSHER.

IF THE CRUSHER IS ALLOWED TO OPERATE LONGER THAN TWO MINUTES AFTER THE LOSS OF OIL PRESSURE OR FLOW SERIOUS DAMAGE CAN RESULT TO THE CRUSHER.

LOSS OF PRESSURE CAN BE CAUSED BY SEVERAL CONDITIONS; INSUFFICIENT OIL IN THE LUBRICATING SYSTEM, BROKEN OIL FEED LINE, OIL PUMP FAILURE OR EXCESSIVE BEARING WEAR IN THE CRUSHER. A CAREFUL INSPECTION WILL DISCLOSE THE TROUBLE.

The pressure switch which has an adjustable range setting, is factory set for the minimum safe operating pressure of the Crusher, refer to the table PRESSURE SWITCH BASE SETTING. This basic pressure setting presumes that the pressure switch is located at the same elevation as the crusher countershaft. Should the pressure switch be located below the countershaft the following adjustment must be made: for every 2-1/2 feet the pressure switch is below the countershaft INCREASE the base setting 1 PSI. Piping leading to the switch must be vented before initial operation by opening the tee at the pressure switch using the pipe plug provided.

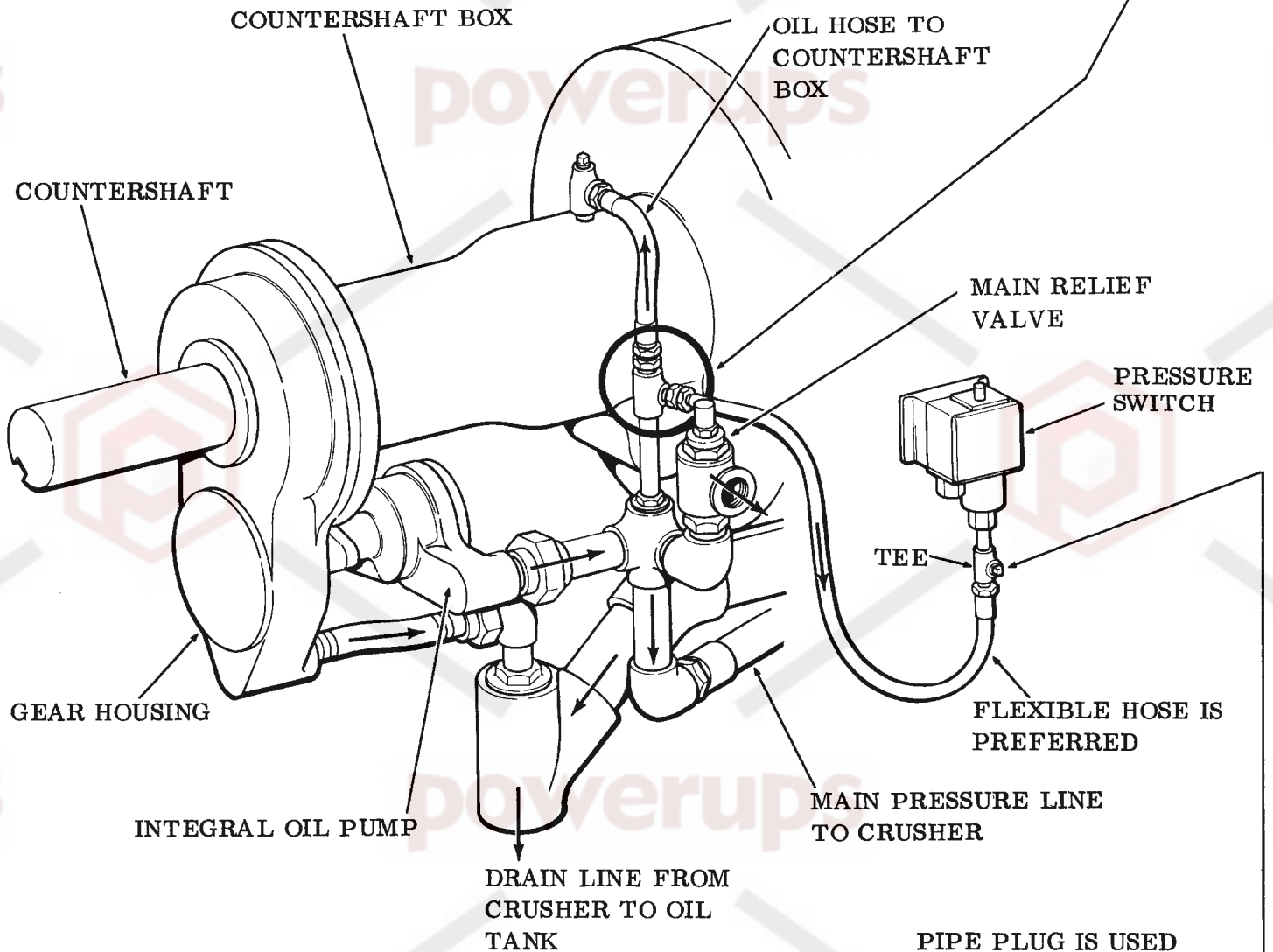
For the proper operation of the pressure switch with either electrical warning signals or machinery shut-down interlocking arrangements, refer to the paragraph entitled INTER-LOCKING SAFETY CONTROLS.

CRUSHER SIZE	CUT-OUT PSI	CUT-IN PSI	DIFFERENTIAL SETTING-PSI
All Size Crushers	3	4	1

\*Increasing the basic, cut-out setting shown in the table will automatically increase the cut-in setting by the same amount as the differential setting remains constant.

**PRESSURE SWITCH BASE SETTING\***

CONNECT PRESSURE SWITCH PIPING INTO THIS AREA OF THE CRUSHER OIL PIPING. NOTE THAT PRESSURE SWITCH MUST BE CONNECTED INTO THE PIPING AS CLOSE TO THE MAIN PRESSURE LINE AS POSSIBLE, BEFORE THE OIL HOSE GOING TO THE COUNTERSHAFT BOX.

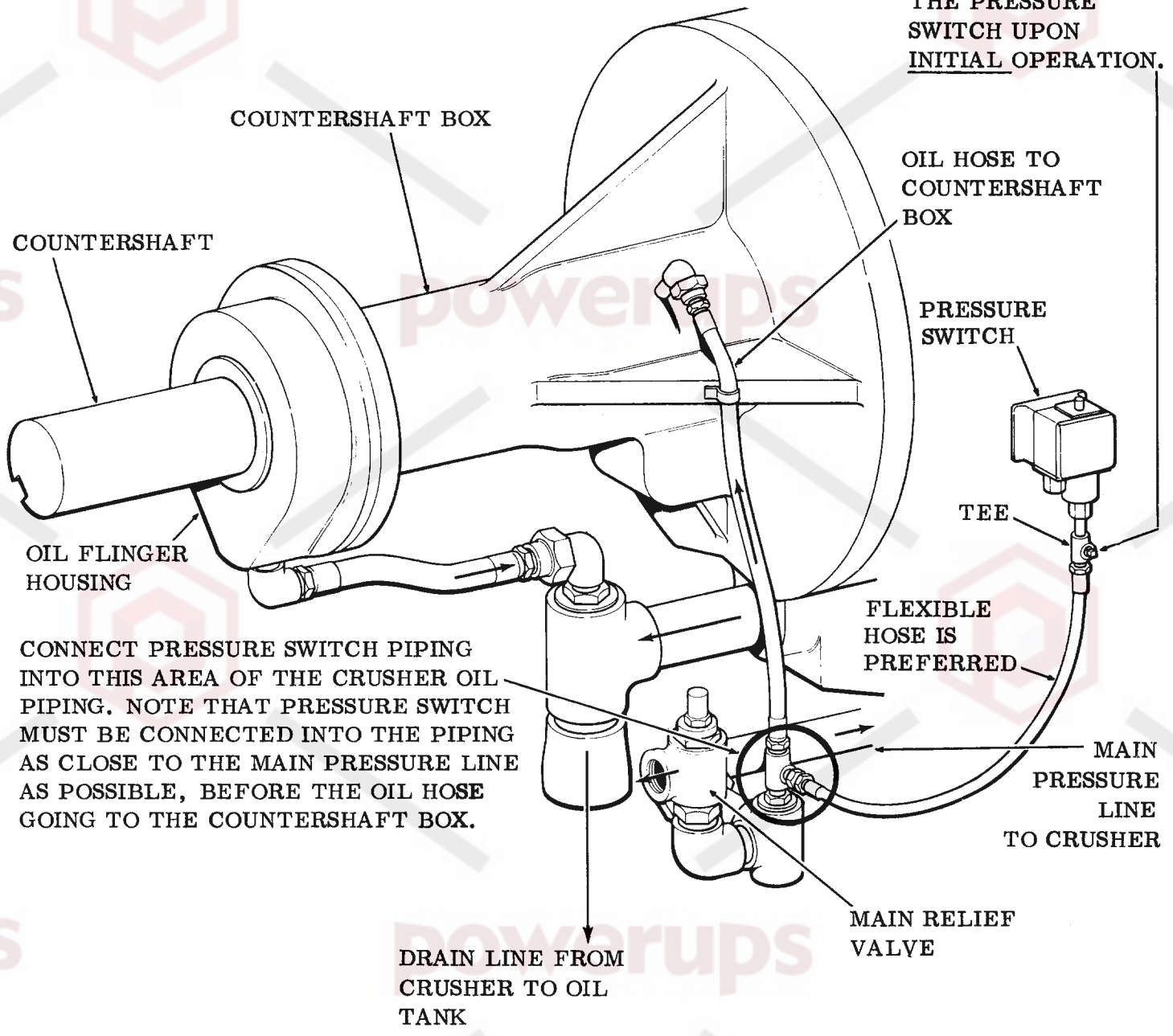


DO NOT ATTACH THE PRESSURE SWITCH TO THE CRUSHER

PIPE PLUG IS USED FOR VENTING THE PIPING LEADING TO THE PRESSURE SWITCH UPON INITIAL OPERATION

**PRESSURE SWITCH CONNECTIONS  
INTEGRAL OIL PUMP ARRANGEMENT**

PIPE PLUG IS USED FOR VENTING THE PIPING LEADING TO THE PRESSURE SWITCH UPON INITIAL OPERATION.



CONNECT PRESSURE SWITCH PIPING INTO THIS AREA OF THE CRUSHER OIL PIPING. NOTE THAT PRESSURE SWITCH MUST BE CONNECTED INTO THE PIPING AS CLOSE TO THE MAIN PRESSURE LINE AS POSSIBLE, BEFORE THE OIL HOSE GOING TO THE COUNTERSHAFT BOX.

DO NOT ATTACH THE PRESSURE SWITCH TO THE CRUSHER

**PRESSURE SWITCH CONNECTIONS  
INDEPENDENT OIL PUMP ARRANGEMENT**

**ELECTRICAL RATINGS.** Pressure Switch:  
Single pole, double throw

Contact Maximum A. C. Rating

10 amps at 230 volt  
5 amps at 575 volt

The switch is mounted in a weather proof enclosure.

## TEMPERATURE SWITCH

**GENERAL INFORMATION.** A temperature switch installed in the oil drain line can serve to do either of two functions. One is to be used as a high temperature alarm, the other is to operate a radiator type oil cooler fan motor automatically if the Crusher has this type of oil cooler. Should both the high temperature alarm and oil cooler operation be desired, two temperature switches would have to be used.

The temperature switch should be mounted in the drain line as near the oil tank as possible. A special pipe, 12" in length, with a 1/2" half coupling welded into it or a regular pipe tee can be used.

It is important to have the heat sensitive bulb of the temperature switch completely covered by the returning oil at all times and since the drain line is normally only half filled with oil, it is recommended that the temperature switch be mounted in the drain line upside down with the heat sensitive bulb entering the drain pipe from the bottom side.

The temperature switch is furnished as standard equipment on all Crushers.

### HIGH TEMPERATURE ALARM OPERATION

Once the switch is installed, it is to be electrically interlocked with either warning signals or machinery shut-down equipment. When the lube oil coming from the Crusher reaches 140° Fahrenheit, the warning signal is activated by the switch, thereby warning of an abnormal crushing condition. The warning signal will continue to operate for either as long as the oil temperature remains above 140° Fahrenheit or until it has been shut off manually. Once the difficulty has been corrected, the oil temperature must drop below 130° Fahrenheit before the temperature switch will again become deactivated.

Though 140° Fahrenheit is the highest setting at which the temperature switch should be set, a lower setting can be used if crushing conditions so dictate.

Install the switch with the factory setting of 140° Fahrenheit. After beginning crushing operations carefully observe and record the temperature in the oil drain line for several days. Once this oil temperature has stabilized, that is, reached a relatively constant temperature, resetting of the switch might be necessary.

Using this recorded temperature, turn the temperature switch range adjustment screw until the switch setting is 10° Fahrenheit above the temperature in the drain line, therefore warning of impending trouble before any damage can result. Turning the range adjustment screw **CLOCKWISE** will **RAISE** the temperature, while turning the screw **COUNTER-CLOCKWISE** will **LOWER** the temperature. No adjustment of the differential screw is required as this is factory set for 10° Fahrenheit.

Crusher oil temperature usually remains constant after operation has begun. At what temperature the lube oil will stabilize depends upon such things as type of crushing, ambient temperature and crusher location.

Where cooling facilities must be used to bring the lubricant into the oil temperature range previously specified, careful regulating of the water supply or the fan motor, depending on type of cooling used, will give an even more constant oil temperature. Therefore, when using a cooler, the re-adjustment of the temperature switch base setting (140° Fahrenheit) is most important as a Crusher with a cooler usually has lower operating temperatures.

The lower the operating temperature the more important it is that the switch be reset to within 10° Fahrenheit of the oil temperature.

High temperature can be caused by several conditions; insufficient oil in the lubricating system, broken oil feed line, oil pump failure or excessive bearing wear in the Crusher. A careful inspection will disclose the trouble.

For the proper operation of the temperature switch with either electrical warning signals or machinery shut-down interlocking arrangements, refer to the paragraph entitled **INTER-LOCKING SAFETY CONTROLS**.

## AIR COOLER OPERATION

When air is used to cool the oil in place of the regular water cooler, a temperature switch can be used to control the fan motor on the oil cooler which would otherwise run unnecessarily. The switch will automatically start the fan motor when the oil temperature in the drain line reaches 110° Fahrenheit and stop the motor when the temperature drops to 100° Fahrenheit. Therefore, the fan motor on this radiator type cooler will only operate when necessary, that is, when the lube oil temperature in the drain line is 110° Fahrenheit and above.

**ELECTRICAL RATINGS.** Temperature Switch:  
Single Pole, double throw

Contact Maximum A. C. Rating

5 amps at 230 volt

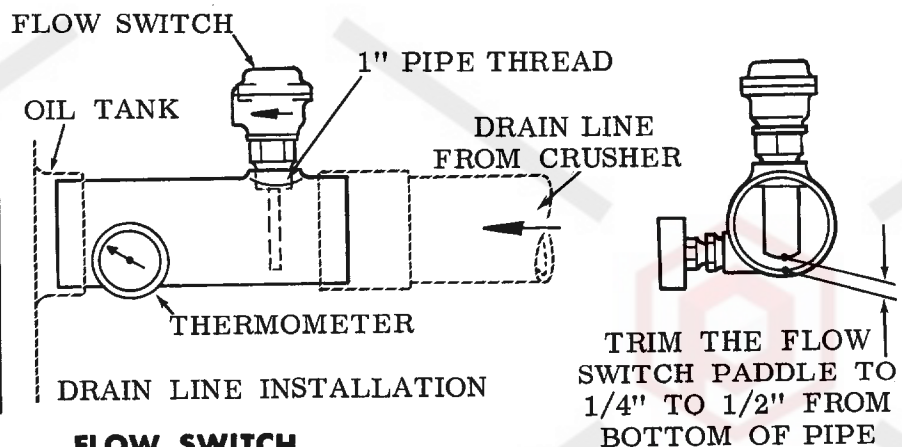
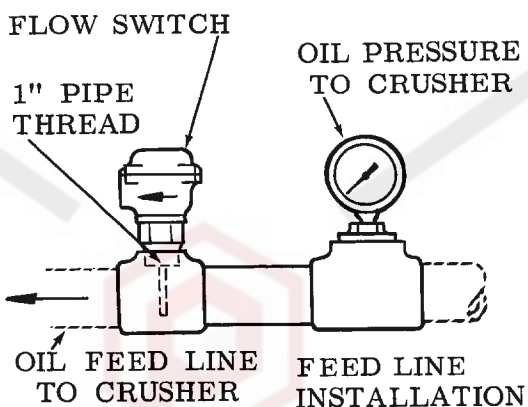
3 amps at 575 volt

The switch is mounted in a weather proof enclosure.

## FLOW SWITCH - NO FLOW ALARM

A flow switch can be installed in the system to protect against possible oil pump failure, oil line breakage or excessive oil leakage. The flow switch will activate upon no oil flow. An electrical warning signal or machinery shut-down interlocking arrangement connected to the switch warns the operator against such loss of oil flow.

The flow switch can be located in either the feed line to the Crusher or in the drain line from the Crusher. If the flow switch is mounted in the drain line it should be located in a relatively horizontal run of drain pipe



## FLOW SWITCH

and should have a minimum of 6" of straight pipe on each side of the switch. Install the LONG paddle on the switch and screw the switch carefully into the special temperature pipe or into a pipe tee until the paddle reaches the bottom of the pipe or tee. The paddle should be trimmed until, when the flow switch is correctly installed, the paddle is approximately 1/4" to 1/2" from the bottom of the pipe or tee.

Should the flow switch be mounted in the smaller feed line to the Crusher install the short paddle on the flow switch and screw the switch into the top of a tee which has been installed in the feed line for that purpose.

Mount the flow switch so that the bronze paddle is at right angles to the oil flow. Check that the arrow on the side of the switch is pointing in the same direction as the oil flow. The flow switch must be installed vertical and upright as shown in the illustration FLOW SWITCH.

The preferred method of installation is to place the flow switch in the OIL FEED LINE to the Crusher, the reason being that the feed line is always filled with pressurized oil while the drain line is only partially filled with returning oil.

Occasionally on the 2 Ft. through the 4-1/4 FT. Crushers a flow switch mounted in the drain line will activate and give a false signal because of the pulsating low flow in the drain line of these size Crushers. If this is the case, remove the flow switch from the drain line and re-install in the feed line, trimming the paddle to suit the smaller pipe size.

Loss of flow can be caused by several conditions; clogged or blocked drain or feed line,

broken pipe or pipe fittings or leakage within the Crusher itself. A careful inspection will disclose the trouble.

Refer to the paragraph entitled INTERLOCKING SAFETY CONTROLS for the proper operation of the flow switch with either electrical warning signals or machinery shut-down interlocking arrangements.

**ELECTRICAL RATINGS.** Flow Switch: Single pole, double throw

Contact Maximum A. C. Rating

7.4 amps at 115 volt  
3.7 amps at 230 volt

The switch is mounted in a weather proof enclosure.

## **PACKAGE LUBE SYSTEM**

For the ultimate in crusher lubrication a package lube system has been developed that combines ALL of the lubricating and protective features previously described in this section.

The Package Lube System is a skid mounted self contained lubricating unit that furnishes a predetermined quantity of filtered oil, under adjustable temperature and pressure to an oil circulating system. Units are built in capacity ranges from 12 to 65 U.S. gallons per minute, based on 350 Seconds Saybolt Universal lubricating oil at 100° Fahrenheit and 100 PSI maximum pump outlet pressure. The Package Lube is suitable for all climates and atmospheric conditions. Incorporated in the Package Lube is an automatic alarm system, that warns against high oil temperature and loss of oil flow.

All phases of operation can be immediately observed by glancing at the indicating gauges mounted on the lube system covering direct readings for temperatures of oil in and out of the cooler, temperature of the returning oil, pressure at the oil pump, pressure of the main flow to the Crusher as well as the pressure loss in the filters.

For the installation, operation and maintenance procedures pertaining to the package lube components see the table of contents at the

beginning of this section for reference to the individual item in the system.

To aid in locating all of the systems components and to follow the path of the oil through the system refer to the Package Lube System General Arrangement drawing which is furnished with the lube system.

## **INTERLOCKING SAFETY CONTROLS**

When interlocking the pressure switch or other such protective devices with warning signals or machinery shut-down protection, three interlocking methods have been suggested. Careful attention should be given as to whether your Crusher is equipped with either the "Independently Driven Oil Pump System" or the "Crusher Driven Integral Oil Pump System" as three alternates for each are illustrated in this section.

The wiring diagrams shown are typical arrangements for across the line and reduced voltage starters. Consult your electrical supplier or contractor for wiring diagrams of the particular type of starter selected.

Should either a high temperature alarm (Temperature Switch) or a low or no-flow alarm (Flow Switch) be used as additional protective devices, they are to be electrically interlocked in exactly the same manner as the Pressure Switch. The use of pilot lights with the various switches will show at a glance which switch has been activated.

## **ELECTRICAL SYMBOLS**

In order that there will be no confusion or misunderstanding of the symbols as they are shown in the various electrical wiring diagrams, the symbols together with a description as to what they represent are given in the illustration ELECTRICAL SYMBOLS.

## **ELECTRICAL CIRCUITS**

**INDEPENDENT PUMP (Warning Signal Only).** This alternate circuit has a warning signal only. When the oil pressure falls below 3 PSI, the warning signal is activated. A warning horn or signal light can be used. The warning signal continues to operate until the crusher motor is stopped, or the oil pressure to the Crusher is again above 4 PSI. The crusher motor and

The crusher motor cannot be started at any time until the oil pump is operating and the oil pressure is above 4 PSI.

#### EQUIPMENT NECESSARY

Pressure Switch  
Motor Starters  
Warning Signal

INDEPENDENT PUMP (Electrical Interlock Between Oil Pump Motor, Crusher Motor, and Warning Signal). This alternate circuit is connected to perform the following functions when the oil pressure falls below 3 PSI. The warning signal is activated and the crusher motor stops but the oil pump motor will continue to run. The warning signal continues to operate until disconnected by an automatically resetting push button. See the typical WIRING DIAGRAM No. 2.

The crusher motor cannot be started at any time until the oil pump is operating and the oil pressure is above 4 PSI.

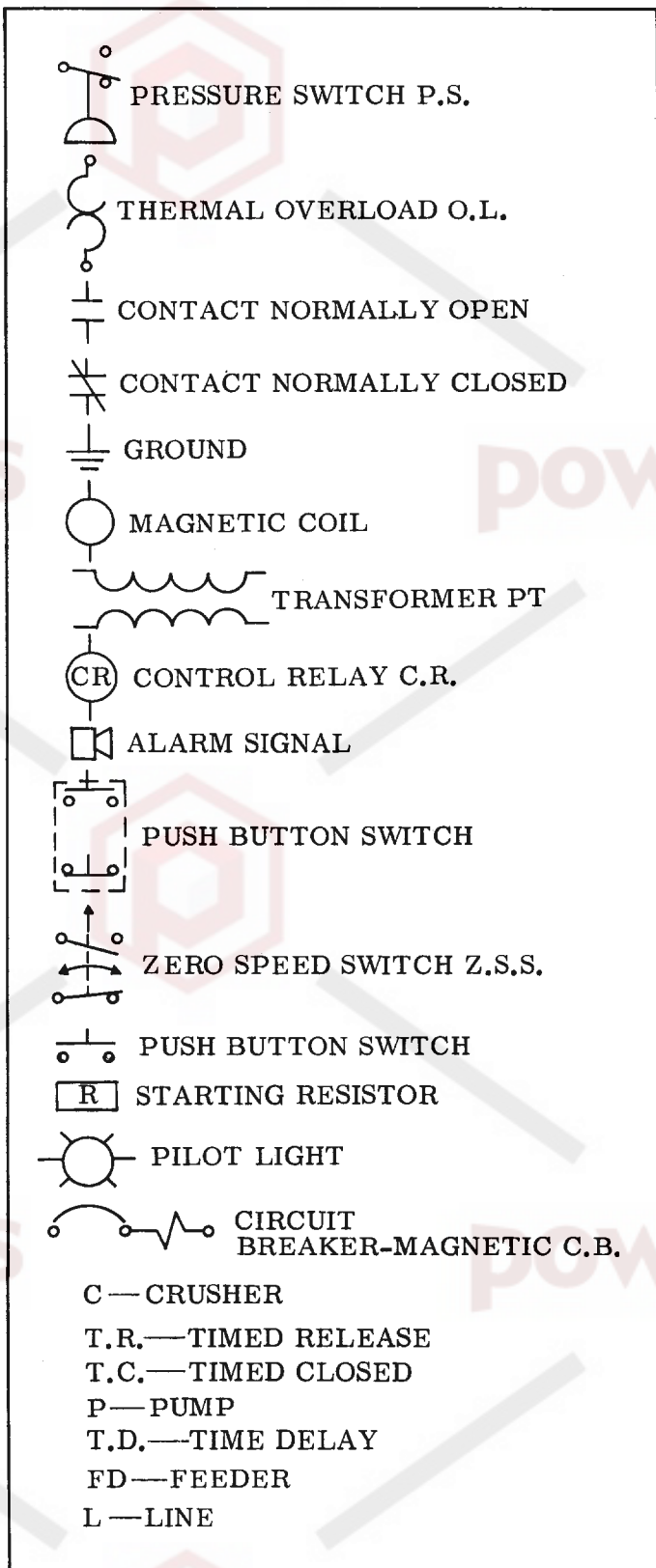
It should be noted that if a crusher feeder is used, the feeder will continue to run after the Crusher has stopped, allowing the Crusher to overflow with material. Should the Crusher fill with material when stopped, cleaning is necessary before restarting the Crusher.

#### EQUIPMENT NECESSARY

Pressure Switch  
Motor Starters  
Warning Signal  
Control Relay

INDEPENDENT PUMP (Electrical Interlock Between Oil Pump Motor, Feeder Motor and Time Delay Interlock to Crusher Motor and Warning Signal). This alternate circuit is connected to perform the following functions when the oil pressure falls below 3 PSI. The warning signal is activated, the crusher feeder motor stops and the crusher motor continues to run for two minutes after loss of pressure and then stops. The warning signal continues to operate until the crusher motor stops. Oil pump motor will continue to operate.

Starting sequence is as follows: Oil pump motor is started first, then discharge conveyor or elevator if used, crusher motor, and finally the feeder. The feeder cannot be started until



#### ELECTRICAL SYMBOLS

oil pump motor will not stop with the loss of pressure. See the typical WIRING DIAGRAM No. 1.



the Crusher is operating. The crusher motor cannot be started at any time until the oil pump is operating and the oil pressure is above 4 PSI.

This alternate circuit has the added protection of a zero speed switch located on the crusher discharge conveyor or elevator that would stop the feeder in the event the conveyor or elevator stops. This would prevent a jam-up of material under the Crusher which would require shutting down of the Crusher for cleaning. With the feeder stopped, the warning signal is activated but the oil pump and Crusher both continue to operate. This option can be adapted to any of the three alternate circuits mentioned. See the typical WIRING DIAGRAM No. 3.

#### EQUIPMENT NECESSARY

- Pressure Switch
- Motor Starters
- Warning Signals
- Time Delay Relay
- Zero Speed Switch

CRUSHER DRIVEN INTEGRAL PUMP (Warning Signal Only). This alternate circuit has a warning signal only. When the oil pressure falls below 3 PSI, the warning signal is activated. A warning horn or signal light can be used. The warning signal continues to operate until the crusher motor is stopped, or the oil pressure to the Crusher is again above 4 PSI. The crusher motor will not stop with the loss of pressure. See the typical WIRING DIAGRAM No. 4.

#### EQUIPMENT NECESSARY

- Pressure Switch
- Motor Starter
- Warning Signal

CRUSHER DRIVEN INTEGRAL PUMP (Electrical Interlock Between Crusher Motor and Warning Signal). This alternate circuit is connected to perform the following functions when oil pressure falls below 3 PSI. The warning signal is activated and the crusher motor stops. The warning signal continues to operate until disconnected by an automatically resetting push button. See the typical WIRING DIAGRAM No. 5.

The start push button to the crusher motor must be held in until 4 PSI oil pressure is reached.

It should be noted that if a crusher feeder is used, the feeder will continue to run after the Crusher has stopped, allowing the Crusher to overflow with material. Should the Crusher fill with material when stopped, cleaning is necessary before restarting the Crusher.

#### EQUIPMENT NECESSARY

- Pressure Switch
- Motor Starter
- Warning Signal
- Control Relay

CRUSHER DRIVEN INTEGRAL PUMP (Electrical Interlock Between Feeder Motor and Time Delay Interlock to Crusher Motor and Warning Signal). This alternate circuit is connected to perform the following functions when the oil pressure falls below 3 PSI. The warning signal is activated, the crusher feeder motor stops and the crusher motor continues to run for two minutes after loss of pressure and then stops. The warning signal continues to operate until the crusher motor stops.

Starting sequence is as follows; Discharge conveyor or elevator, if used, is started first, then crusher motor, and finally the feeder. The feeder cannot be started until, the Crusher is operating. The start push button to the crusher motor must be held in until 4 PSI oil pressure is reached.

This alternate circuit has the added protection of a zero speed switch located on the crusher discharge conveyor or elevator that would stop the feeder in the event the conveyor or elevator stops. This would prevent a jam-up of material under the Crusher which would require shutting down of the Crusher for cleaning. With the feeder stopped, the warning signal is activated but the Crusher continues to operate. This option can be adapted to any of the three alternate circuits mentioned. See the typical WIRING DIAGRAM No. 6.

#### EQUIPMENT NECESSARY

- Pressure Switch
- Motor Starters
- Warning Signal
- Time Delay Relay
- Zero Speed Switch

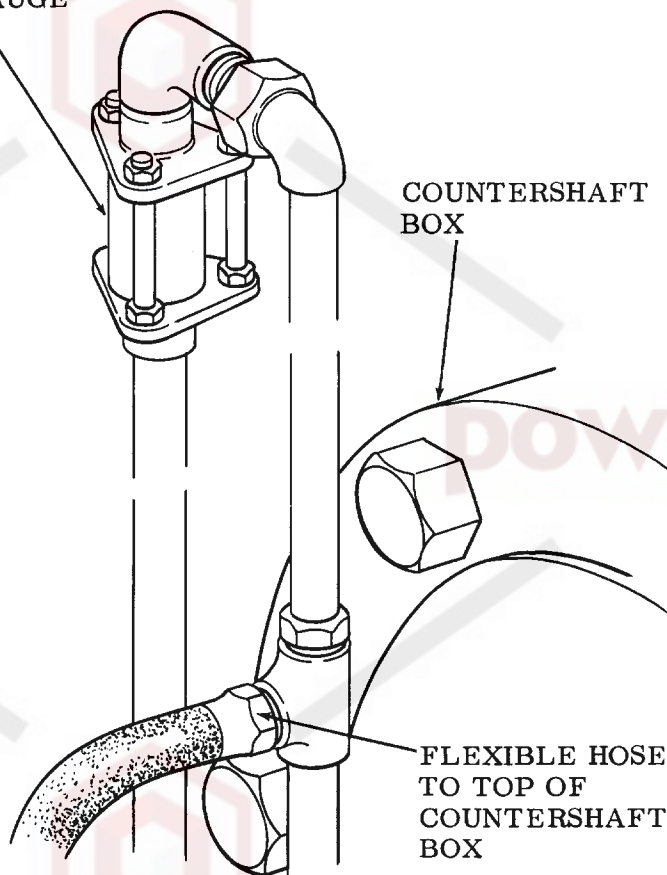
## SIGHT FEED GAUGE

As a visual means of checking the oil flow and minimum operating pressure in the lubricating system, a sight feed gauge could be connected into the crusher piping as shown in the illustration SIGHT FEED GAUGE. To avoid damage in shipment, the gauge and adjacent piping is removed from the Crusher and shipped separately.

Therefore, when connecting the sight feed gauge, reference should be made to the piping drawings furnished. Locate the gauge near the top of the adjustment cap and place so that the oil stream is readily visible. It is also recommended that the gauge be protected from damage by flying rock.

This gauge is factory adjusted for a thin, pencil size oil stream at operating temperature but may need field adjustment of the flow regulating screw at the top of the gauge body to compensate for any change in location of the gauge.

SIGHT FEED GAUGE



SIGHT FEED GAUGE

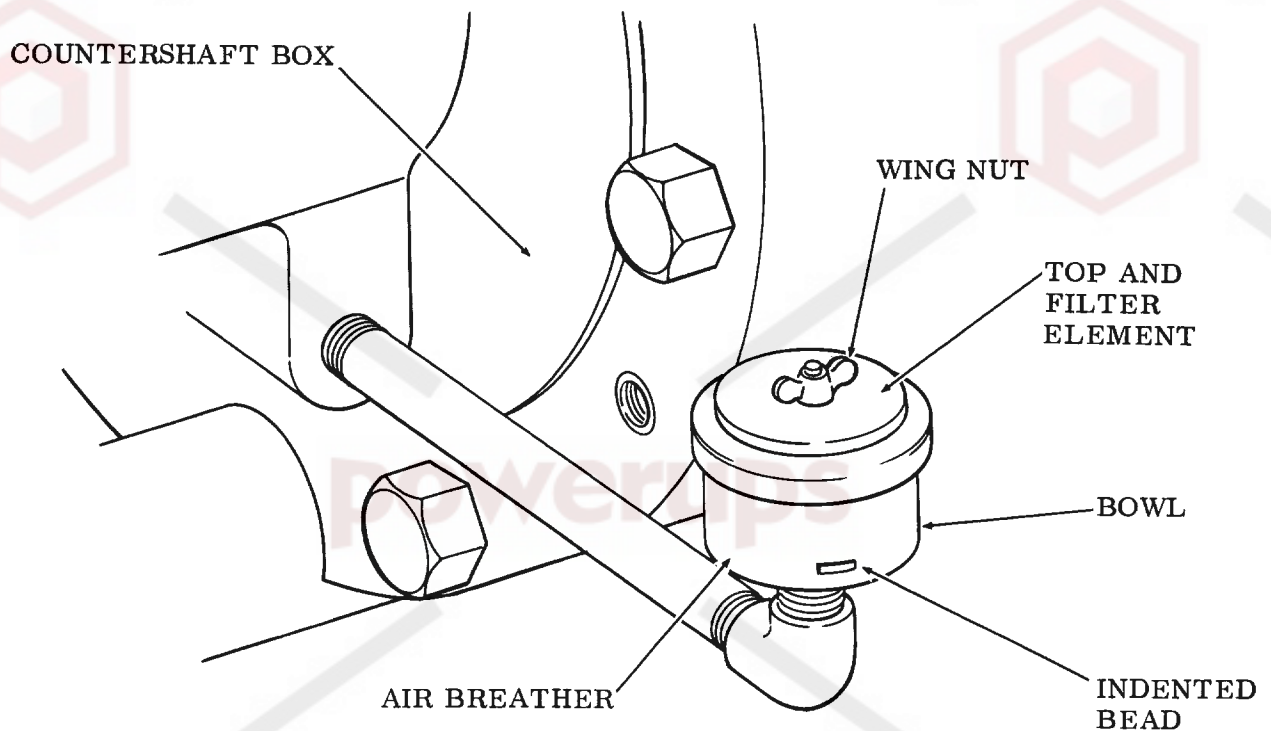
Should the gauge cease to function, it is either from lack of lubrication or most likely dirty oil has clogged the gauge passages. Therefore, cleaning is required and re-adjustment might then be necessary.

Oil flowing through the sight feed gauge shows that there is enough oil pressure to lubricate the head and socket liner area but it does not guarantee that the oil is actually flowing inside the Crusher. The sight feed gauge is considered to be an "old fashioned" method of checking for oil flow; the pressure switch is used in its place.

## AIR BREATHER

The air breather is readily identified by its bright red color. The breather is to be connected into the countershaft box, as shown in the illustration AIR BREATHER INSTALLATION. This air breather maintains atmospheric pressure inside the Crusher to assure free drainage of the lubricating oil. Install the breather away from the crusher sheave, in an area somewhat protected from dust, using either pipe or flexible hose. This arrangement is suggested as the dust turbulence created by the sheave will reduce filter efficiency by clogging.

To check if the Crusher is breathing properly remove the breather completely from its piping and place a piece of thin paper over the elbow the breather was screwed into. The paper should move ever so slightly, in and out. This indicates the Crusher is properly vented. If the paper is either sucked into the piping or blown off, there is a breathing or venting problem inside the Crusher, the paper should pulsate. If the breather ceases to function, it is possible that the long cored hole inside the countershaft box leading to the breather is filled with dirt. Remove the breather and its piping and blow out the hole with compressed air. Usually it is not necessary to remove the countershaft box to clean out any dirt buildup in this hole.



### AIR BREATHER INSTALLATION

As the oil tank is sealed from contamination by dust and moisture, an air breather is also mounted on the oil tank to maintain atmospheric pressure within the tank. A Crusher breathes through two locations; one is from the breather on the side of the countershaft box and the other is through the partially filled drain line going to the oil tank.

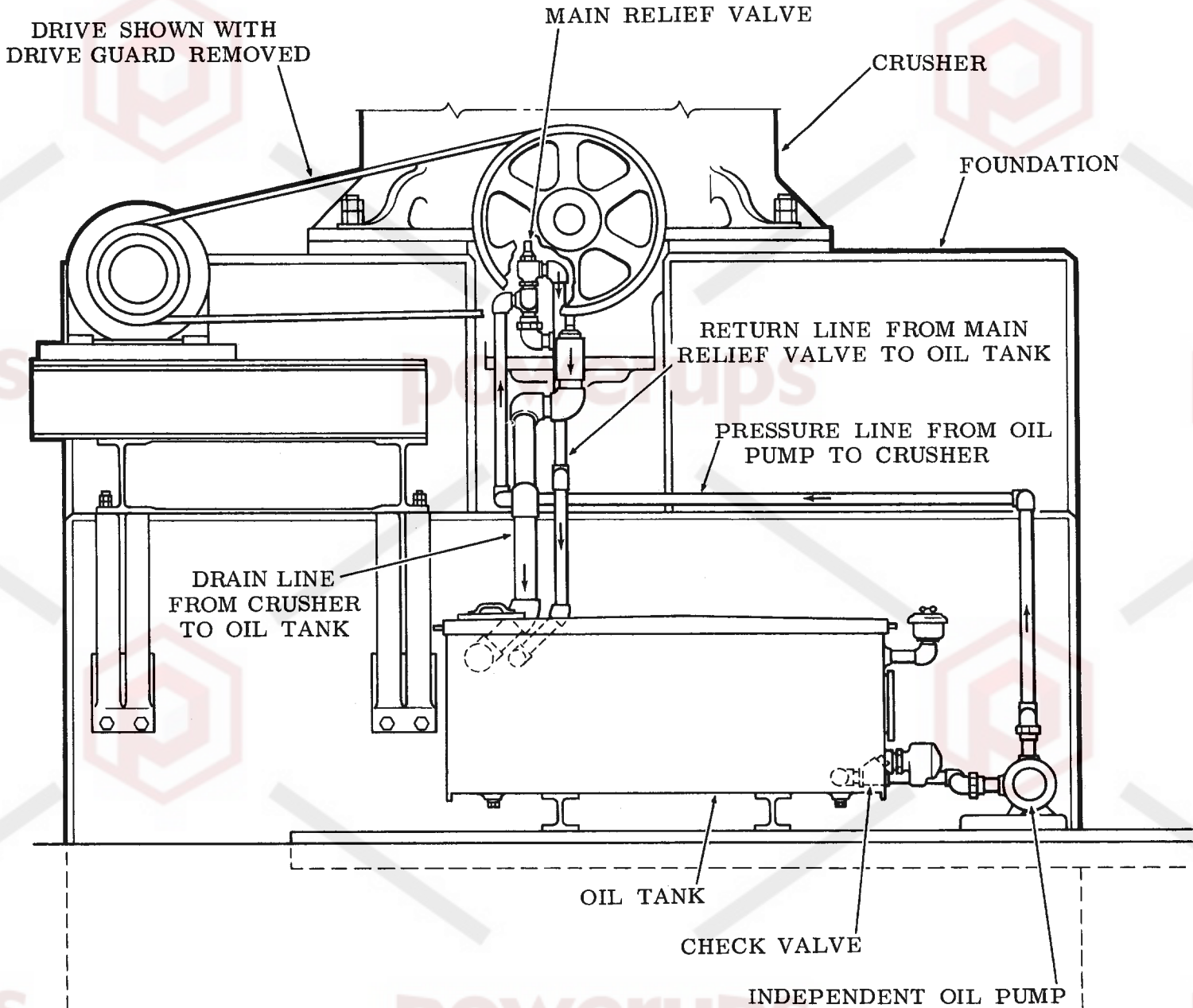
So both breathers are equally important.

Periodic cleaning is important, the frequency of which depends on the amount of dust present. Once a week, or oftener if operations are unusually dusty, remove the filter element and clean.

When servicing the air breather, which is commonly referred to as an "oil bath", observe the following instructions:

- 1 No tools are required to service the breather. Remove the breather from the Crusher by unscrewing the wing nut on top of the breather.

- 2 Lift out top and element assembly. Then empty dirty oil from bowl and wipe out any accumulated sludge.
- 3 Remove screen filter element from top assembly and inspect. Element seldom needs replacing.
- 4 Clean dirty element by agitating in kerosene or some other cleaning solvent.
- 5 Allow element to dry, then dip in clean oil. Refill filter bowl with clean oil (SAE 10-30 in cold weather, SAE 30-50 in hot weather) up to the prescribed level on the side of the breather bowl (Indented Bead). Always install filter element with felt baffle at bottom.
- 6 Reassemble the breather and install on the Crusher.



**INDEPENDENT OIL PUMP WITH OIL TANK ARRANGEMENT**

DRIVE SHOWN WITH  
DRIVE GUARD REMOVED

MAIN RELIEF VALVE

CRUSHER

FOUNDATION

RETURN LINE FROM MAIN  
RELIEF VALVE TO OIL TANK

DRAIN LINE FROM  
CRUSHER TO OIL TANK

PRESSURE LINE FROM  
COOLER TO CRUSHER

WATER  
OUTLET  
LINE

COOLER BY-PASS  
RELIEF VALVE

WATER  
INLET  
LINE

OIL TANK

COOLER  
(WATER)

CHECK VALVE

COOLER  
MOUNTING  
BRACKET

INDEPENDENT OIL PUMP

COOLER BY-PASS LINE

**INDEPENDENT OIL PUMP WITH OIL TANK AND OIL COOLER (WATER) ARRANGEMENT**

DRIVE SHOWN WITH  
DRIVE GUARD REMOVED

MAIN RELIEF VALVE

CRUSHER

FOUNDATION

RETURN LINE FROM MAIN  
RELIEF VALVE TO OIL TANK

PRESSURE LINE FROM  
COOLER TO CRUSHER

COOLER BY-PASS  
RELIEF VALVE

COOLER  
BY-PASS LINE

DRAIN LINE  
FROM CRUSHER  
TO OIL TANK

COOLER  
(AIR)

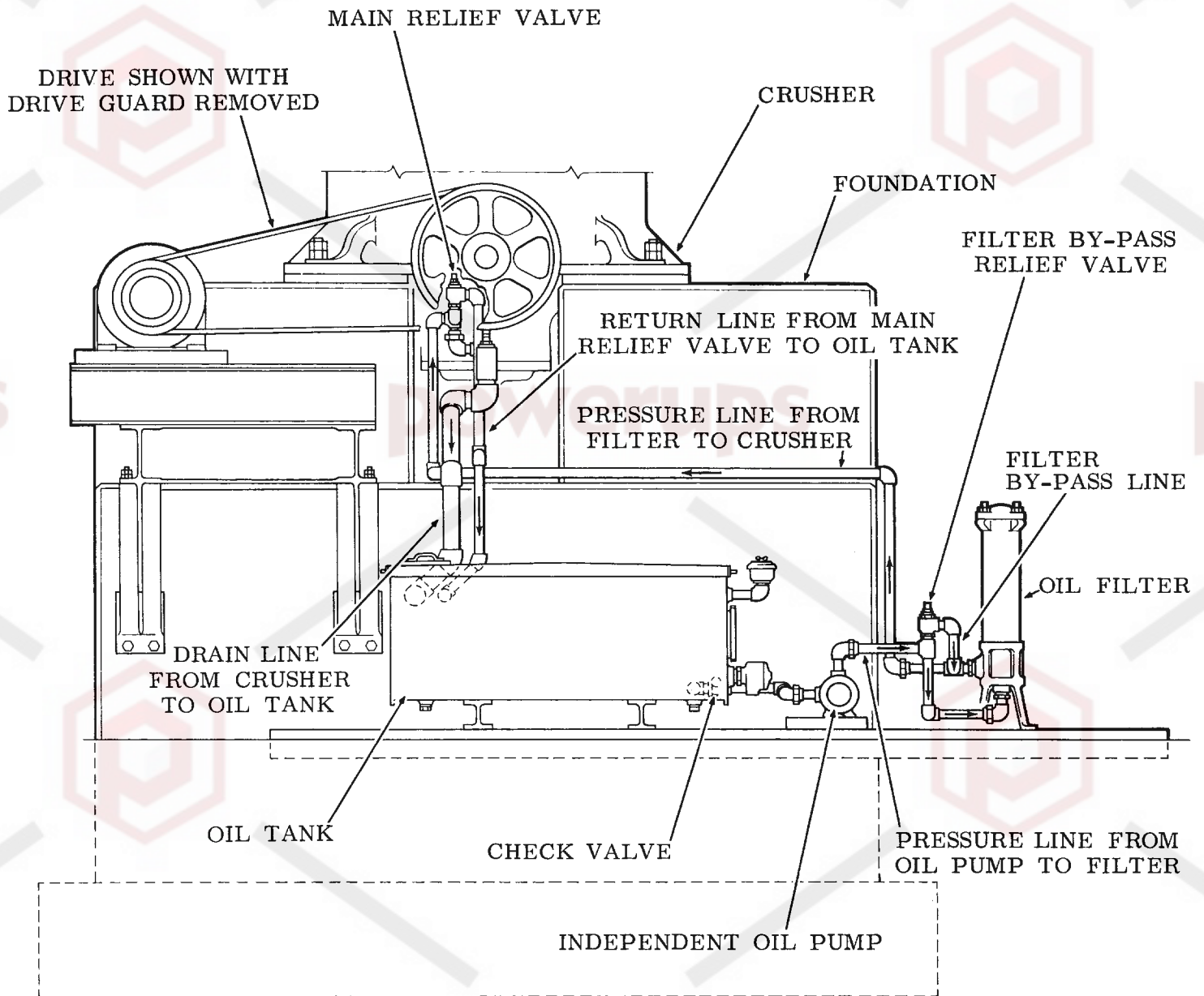
OIL TANK

CHECK VALVE

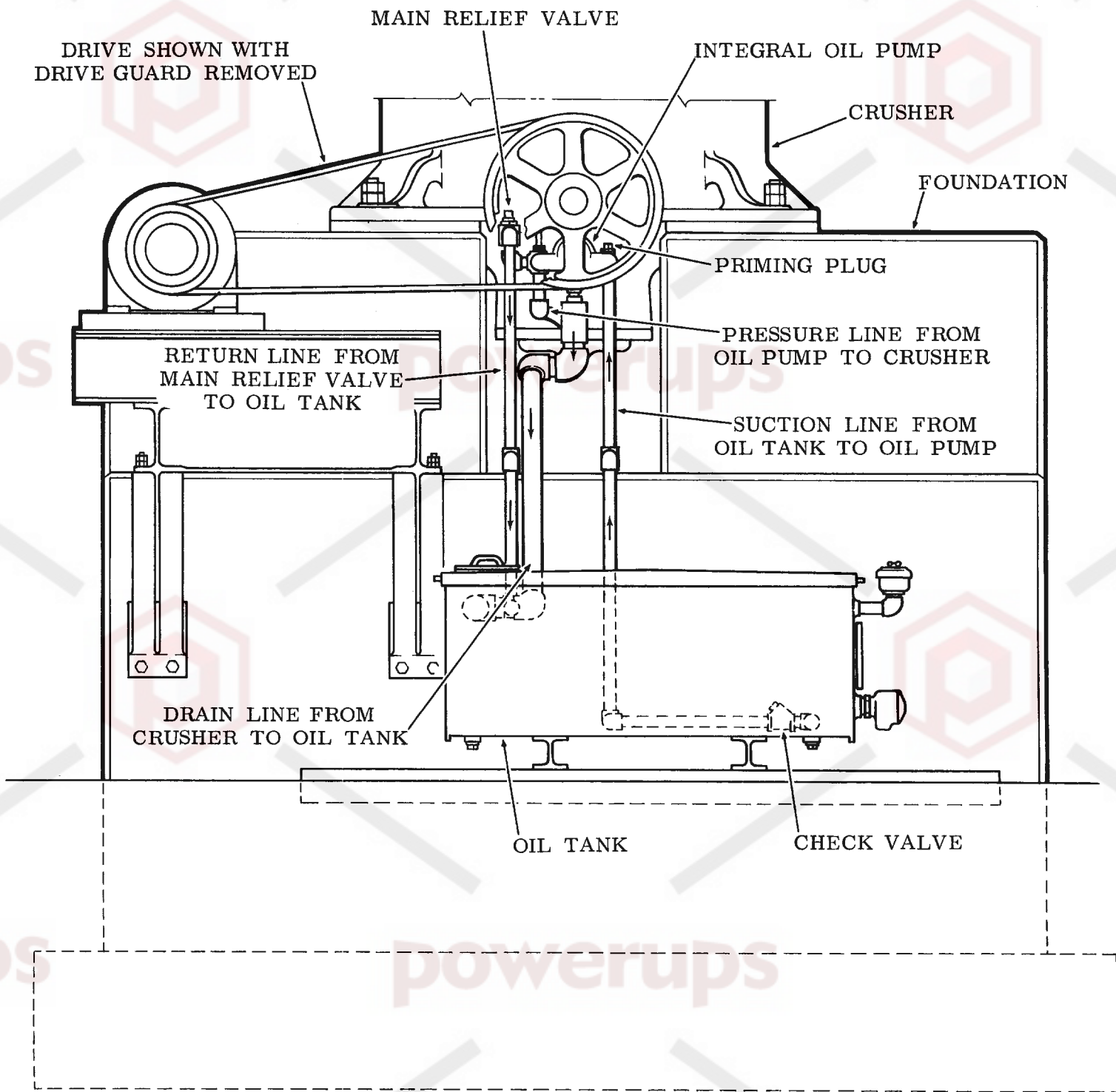
PRESSURE LINE FROM  
OIL PUMP TO COOLER

INDEPENDENT OIL PUMP

**INDEPENDENT OIL PUMP WITH OIL TANK AND OIL COOLER (AIR) ARRANGEMENT**

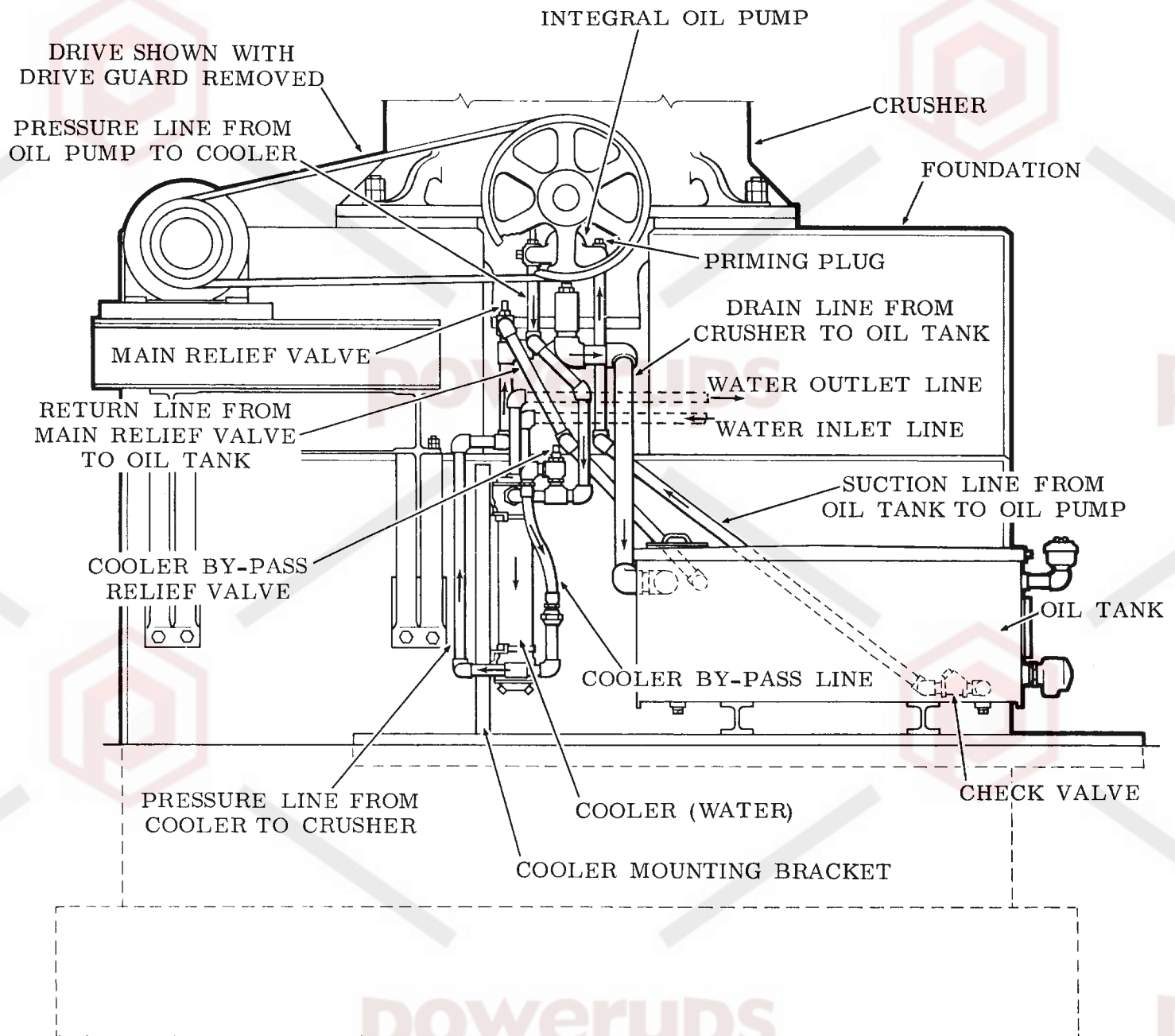


**INDEPENDENT OIL PUMP WITH OIL TANK AND OIL FILTER ARRANGEMENT**

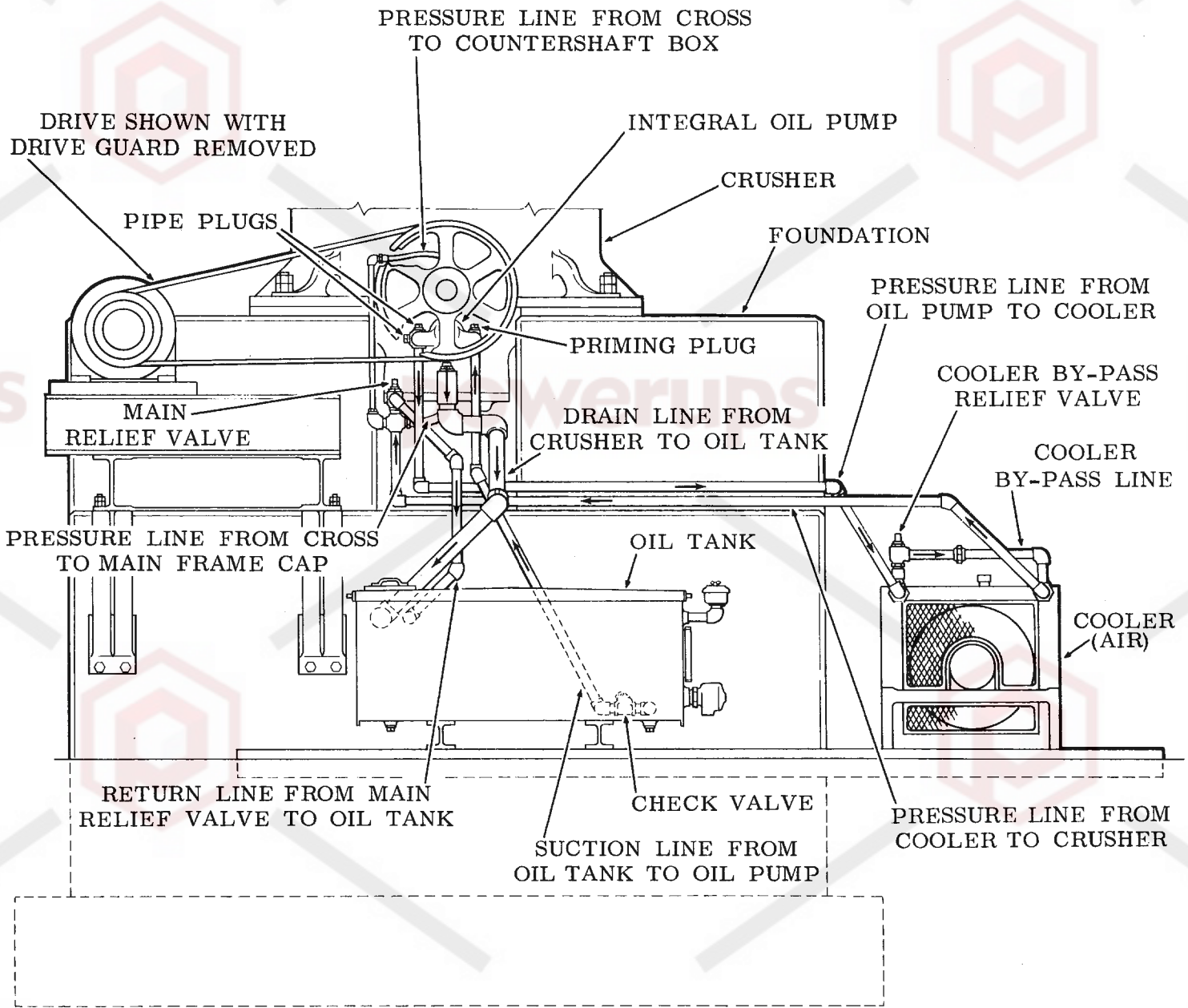


**INTEGRAL OIL PUMP AND OIL TANK ARRANGEMENT**

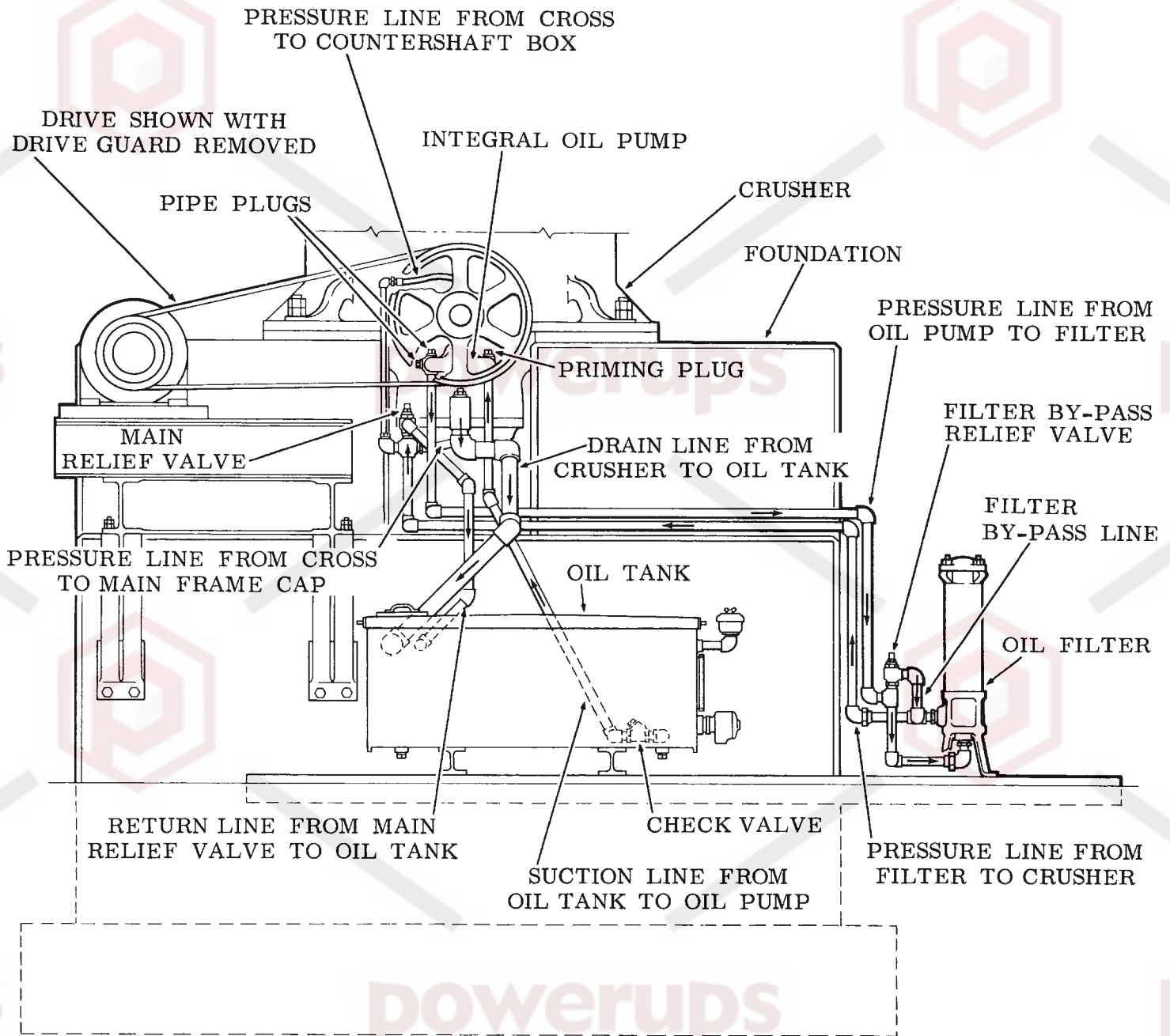




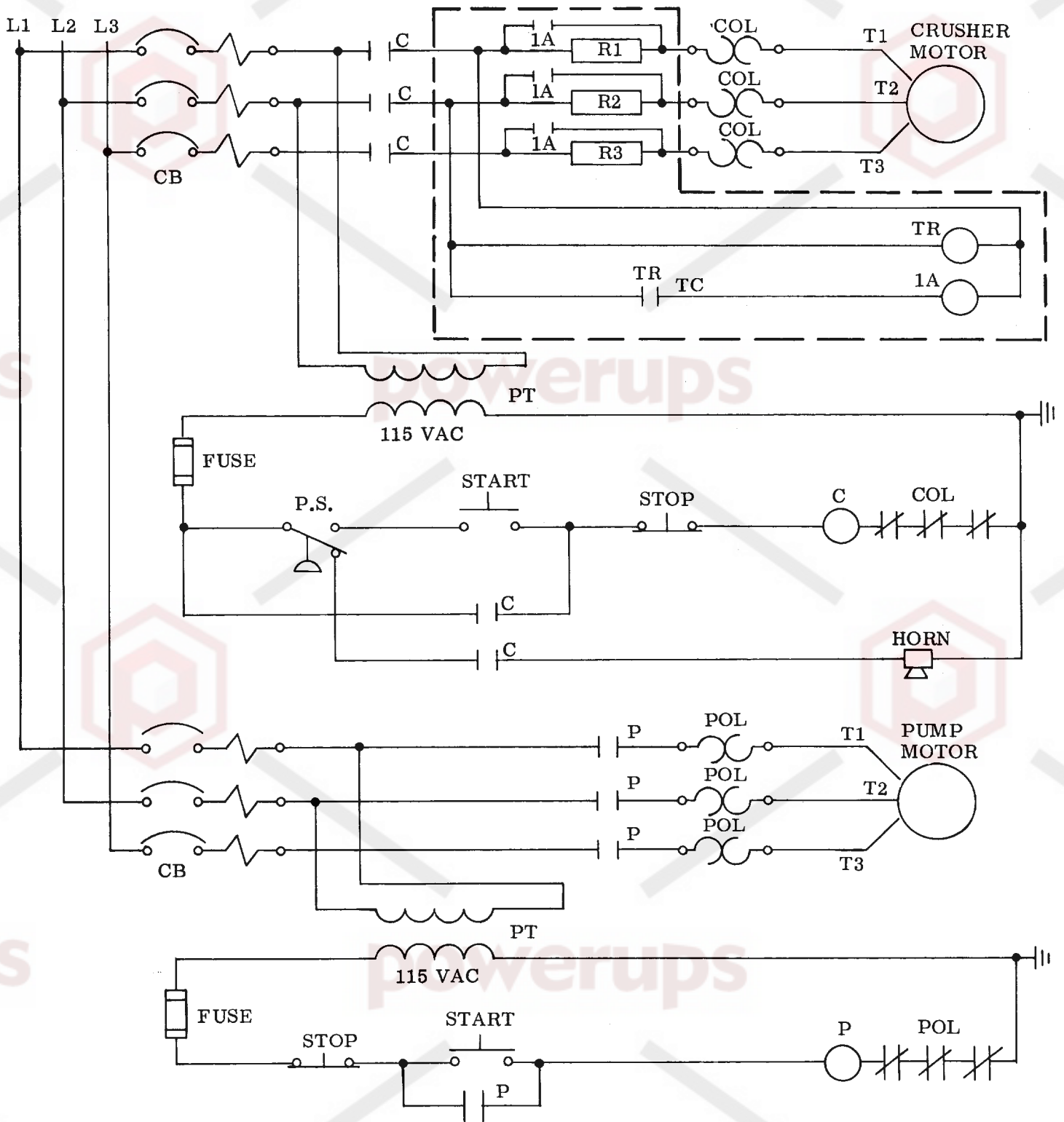
**INTEGRAL OIL PUMP WITH OIL TANK AND OIL COOLER (WATER) ARRANGEMENT**



**INTEGRAL OIL PUMP WITH OIL TANK AND OIL COOLER (AIR) ARRANGEMENT**



**INTEGRAL OIL PUMP WITH OIL TANK AND OIL FILTER ARRANGEMENT**

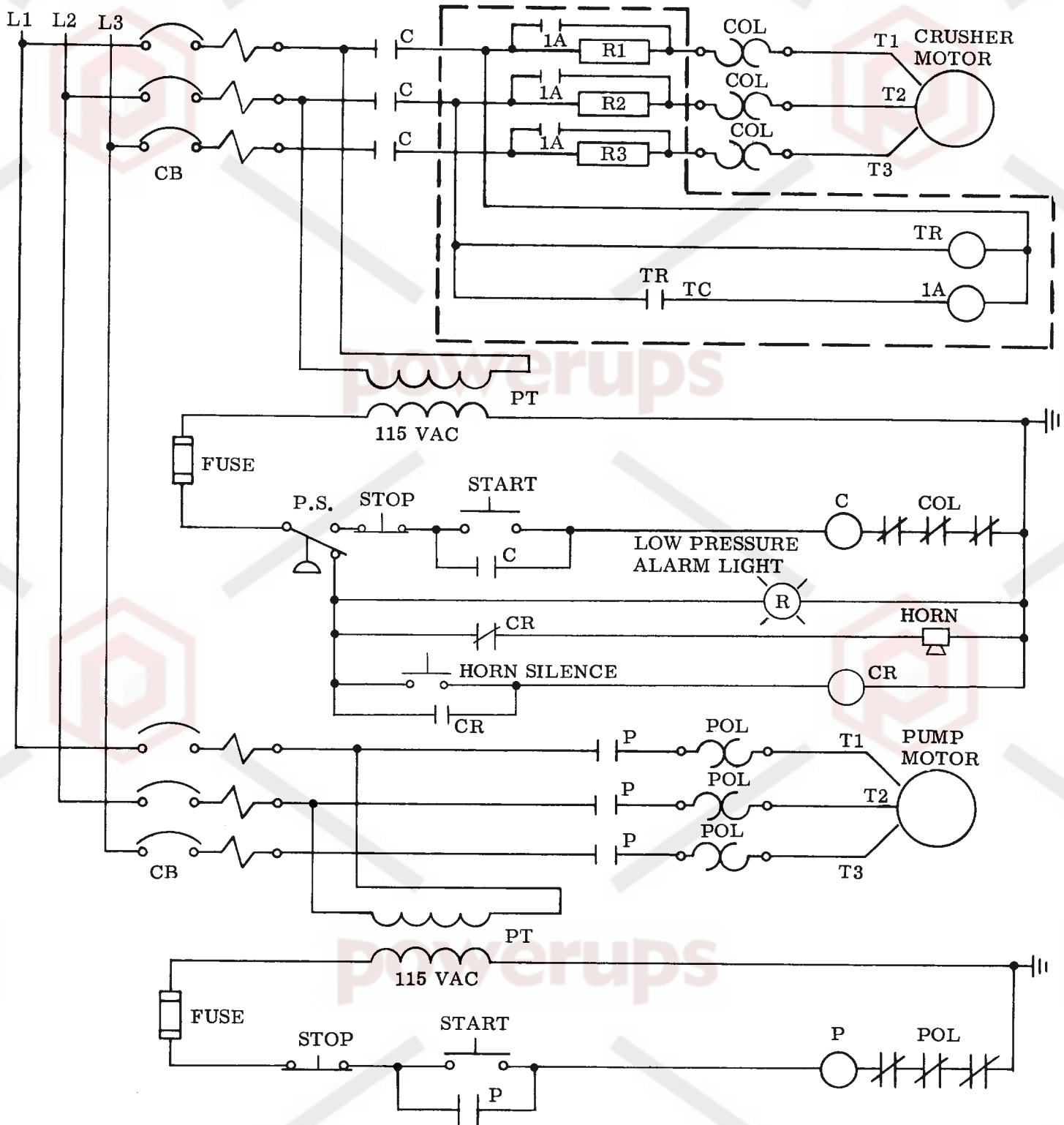


**NOTES:**

1. DASHED LINE INDICATES A TYPICAL REDUCED VOLTAGE SCHEME THAT MAY BE UTILIZED WHERE FULL VOLTAGE STARTING IS NOT DESIRABLE.
2. SIZE OVERLOAD HEATER COILS TO ACTUAL NAMEPLATE FULL LOAD AMPERES TO AVOID NUISANCE TRIPPING.

WIRING DIAGRAM No. 1

**INDEPENDENT PUMP  
(WARNING SIGNAL ONLY)**

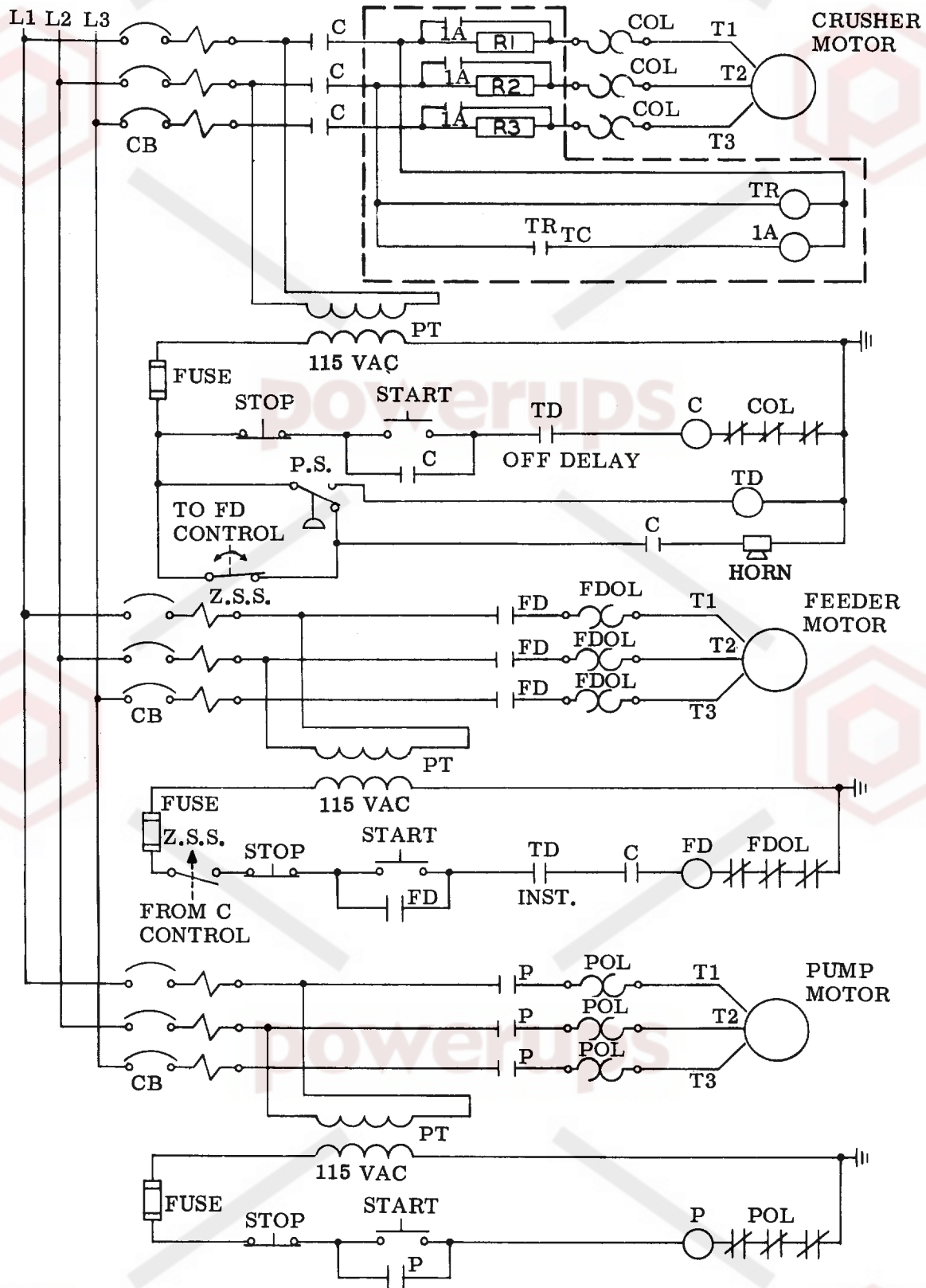


**NOTES:**

1. DASHED LINE INDICATES A TYPICAL REDUCED VOLTAGE SCHEME THAT MAY BE UTILIZED WHERE FULL VOLTAGE STARTING IS NOT DESIRABLE.
2. SIZE OVERLOAD HEATER COILS TO ACTUAL NAMEPLATE FULL LOAD AMPERES TO AVOID NUISANCE TRIPPING.

WIRING DIAGRAM No. 2

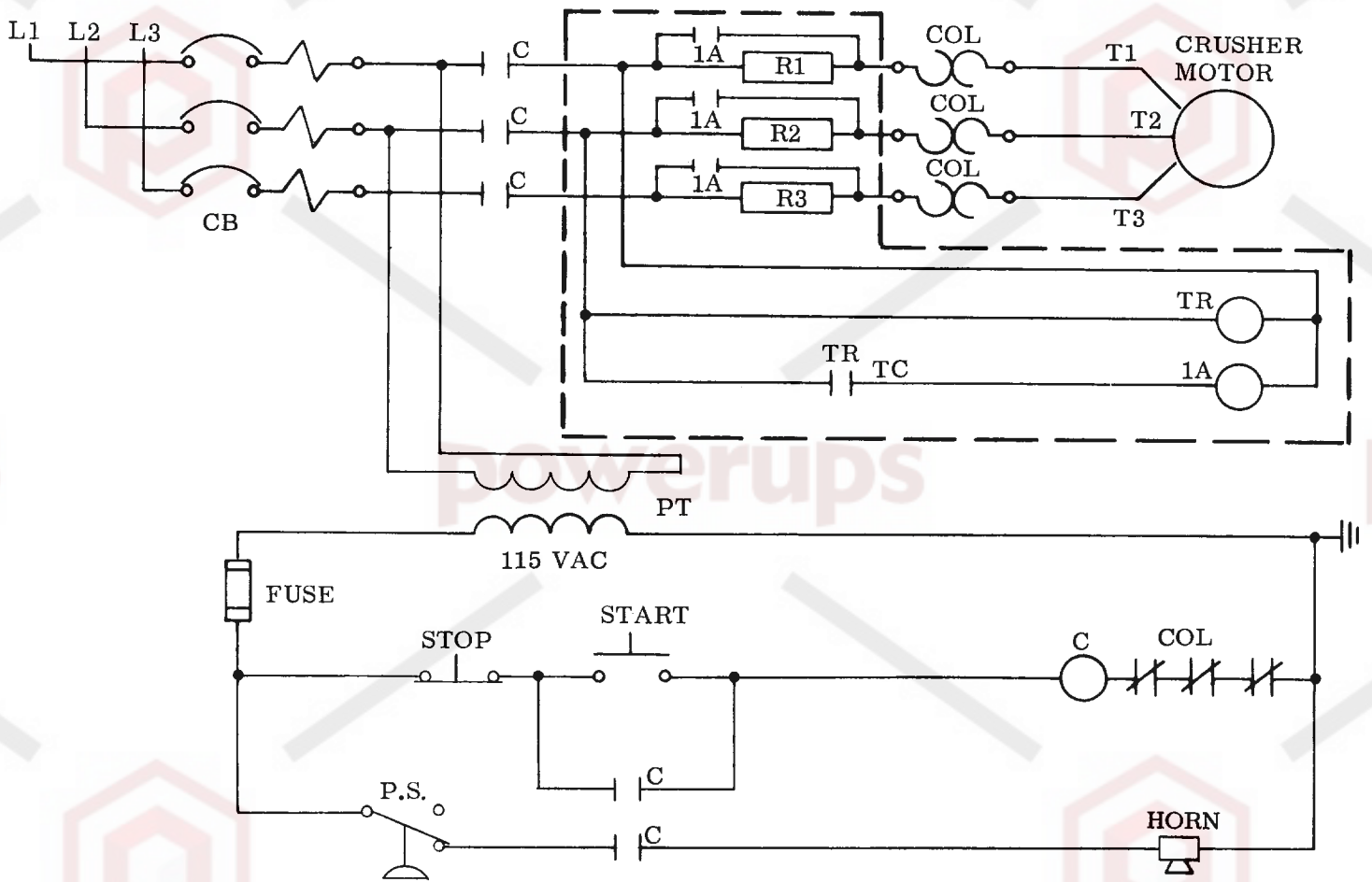
**INDEPENDENT PUMP  
(ELECTRICAL INTERLOCK BETWEEN OIL PUMP MOTOR, CRUSHER MOTOR,  
AND WARNING SIGNAL)**



1. DASHED LINE INDICATES A TYPICAL REDUCED VOLTAGE SCHEME THAT MAY BE UTILIZED WHERE FULL VOLTAGE STARTING IS NOT DESIRABLE.
2. SIZE OVERLOAD HEATER COILS TO ACTUAL NAMEPLATE FULL LOAD AMPERES TO AVOID NUISANCE TRIPPING.

WIRING DIAGRAM No. 3

**INDEPENDENT PUMP  
(ELECTRICAL INTERLOCK BETWEEN OIL PUMP MOTOR, FEEDER MOTOR AND TIME DELAY INTERLOCK TO CRUSHER MOTOR AND WARNING SIGNAL)**

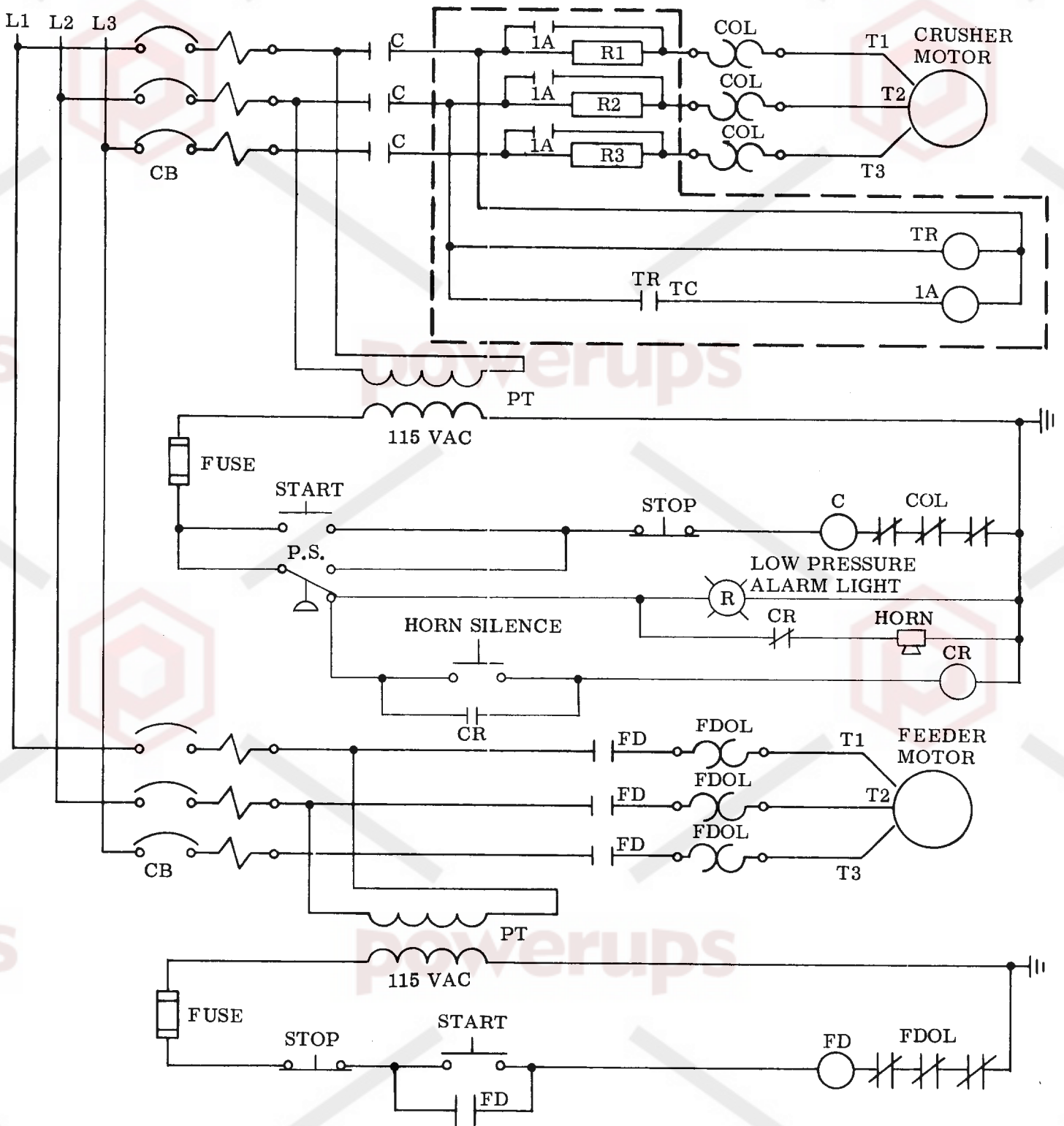


NOTES:

1. DASHED LINE INDICATES A TYPICAL REDUCED VOLTAGE SCHEME THAT MAY BE UTILIZED WHERE FULL VOLTAGE STARTING IS NOT DESIRABLE.
2. SIZE OVERLOAD HEATER COILS TO ACTUAL NAMEPLATE FULL LOAD AMPERES TO AVOID NUISANCE TRIPPING.

WIRING DIAGRAM No. 4

**INTEGRAL PUMP (WARNING SIGNAL ONLY)**



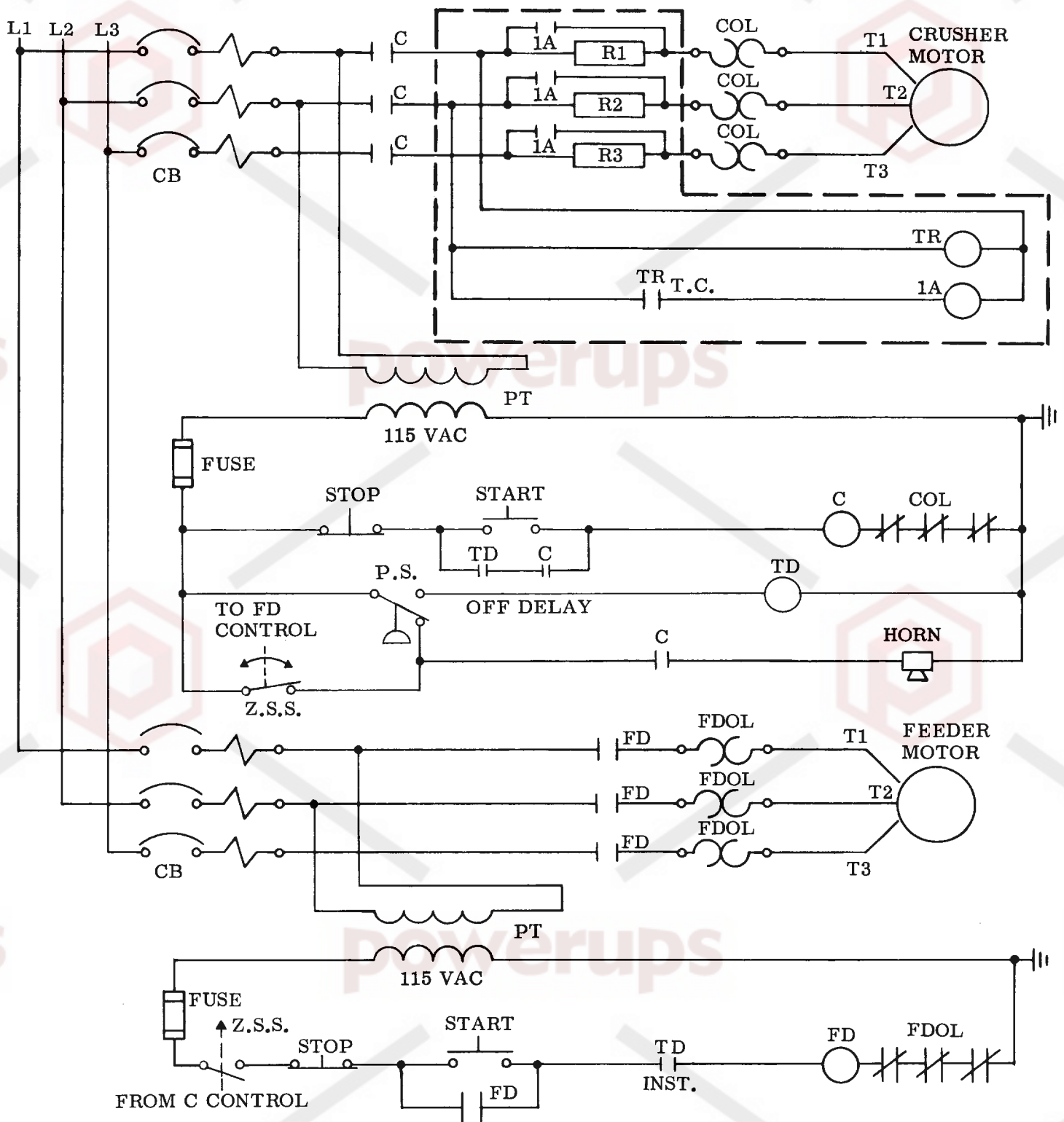
**NOTES:**

1. DASHED LINE INDICATES A TYPICAL REDUCED VOLTAGE SCHEME THAT MAY BE UTILIZED WHERE FULL VOLTAGE STARTING IS NOT DESIRABLE.
2. SIZE OVERLOAD HEATER COILS TO ACTUAL NAMEPLATE FULL LOAD AMPERES TO AVOID NUISANCE TRIPPING.

WIRING DIAGRAM No. 5

**INTEGRAL PUMP  
(ELECTRICAL INTERLOCK BETWEEN CRUSHER MOTOR AND WARNING SIGNAL)**





**NOTES:**

1. DASHED LINE INDICATES A TYPICAL REDUCED VOLTAGE SCHEME THAT MAY BE UTILIZED WHERE FULL VOLTAGE STARTING IS NOT DESIRABLE.
2. SIZE OVERLOAD HEATER COILS TO ACTUAL NAMEPLATE FULL LOAD AMPERES TO AVOID NUISANCE TRIPPING.

WIRING DIAGRAM No. 6

**INTEGRAL PUMP**

**(ELECTRICAL INTERLOCK BETWEEN FEEDER MOTOR AND TIME DELAY INTERLOCK TO CRUSHER MOTOR AND WARNING SIGNAL)**

**Section 11**  
**OPERATING INSTRUCTIONS**

CHECK LIST FOR STARTING NEW CRUSHER

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THREAD LUBRICATION .....	11-12
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## CHECK LIST FOR STARTING NEW CRUSHER

PRIOR TO ACTUAL STARTING OF CRUSHER	SATIS- FACTORY	UNSATIS- FACTORY
1. Wooden shipping wedges have been removed from between mantle and bowl liner	<input type="checkbox"/>	<input type="checkbox"/>
2. Crusher setting has been checked at _____ "	<input type="checkbox"/>	<input type="checkbox"/>
3. V-Belt drive tension and alignment	<input type="checkbox"/>	<input type="checkbox"/>
4. Relationship of countershaft bushing oil groove and drive location	<input type="checkbox"/>	<input type="checkbox"/>
5. Countershaft end float (1/32" to 1/16")	<input type="checkbox"/>	<input type="checkbox"/>
6. Grouting and fastening of Crusher to foundation	<input type="checkbox"/>	<input type="checkbox"/>
7. Foundation design has ample discharge area for material to fall free and prevent build-up from below	<input type="checkbox"/>	<input type="checkbox"/>
8. Lubricating system:		
a) Drain line pitch is ample (Minimum 1" per 12")	<input type="checkbox"/>	<input type="checkbox"/>
b) Brand name and type of oil in oil tank; Specify name and type	<input type="checkbox"/>	<input type="checkbox"/>
c) Piping has been installed per factory drawings	<input type="checkbox"/>	<input type="checkbox"/>
d) Auxiliaries such as filter, cooler, immersion heater, pressure switch, temperature switch, flow switch, have been installed properly	<input type="checkbox"/>	<input type="checkbox"/>
e) Alarm system (Pressure Switch, Temperature Switch, Flow Switch) has been electrically connected according to Wiring Diagram No. _____ as shown in Section 10	<input type="checkbox"/>	<input type="checkbox"/>
f) Location of relief valve and piping is correct	<input type="checkbox"/>	<input type="checkbox"/>
g) Pump is rotating in correct direction	<input type="checkbox"/>	<input type="checkbox"/>
h) Independent oil pump gear reducer lubricant (if furnished)	<input type="checkbox"/>	<input type="checkbox"/>
i) Pump has been primed (if Integral Pump)	<input type="checkbox"/>	<input type="checkbox"/>
j) Piping connections are correct on pump	<input type="checkbox"/>	<input type="checkbox"/>
k) Filters have been vented (if furnished)	<input type="checkbox"/>	<input type="checkbox"/>
l) Countershaft box and oil tank air breathers have been installed properly	<input type="checkbox"/>	<input type="checkbox"/>
9. Sealing ring is free and floating (if Standard Seal)	<input type="checkbox"/>	<input type="checkbox"/>
10. Motorized feeder gear reducer lubricant (if furnished)	<input type="checkbox"/>	<input type="checkbox"/>
11. Recommended grease was forced into all adjustment ring grease fittings	<input type="checkbox"/>	<input type="checkbox"/>
12. Hydraulics (if furnished)		
a) Brand name and type of oil in power unit oil tank Specify name and type	<input type="checkbox"/>	<input type="checkbox"/>

SATIS-  
FACTORY

UNSATIS-  
FACTORY

- b) All hoses from power unit to Crusher have been properly bled
- c) At least one adjustment has been made to assure that bowl adjustment rams and lock posts are operating properly
- d) Bowl lock arm engages notch in adjustment cap properly and has been installed to prevent undesired rotation during crushing
- e) Hose from power unit to lock posts has ample "Play" when bowl is rotated
- f) Air filter-lubricator is full of oil and in proper working condition (if Air Power Unit)

<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>

JOG CRUSHER

- 1. Countershaft rotates in proper direction

START CRUSHER

- 1. Crusher was run no load until drain line temperature was at least 70° F.
- 2. Crusher is running at \_\_\_\_\_ RPM
- 3. Crusher head spin (running no load) is \_\_\_\_\_ RPM
- 4. Crusher has been checked for oil leaks from below Crusher
- 5. Power draw running empty is \_\_\_\_\_ Amps
- 6. Alarm system (Pressure Switch, Temperature Switch, Flow Switch) has been checked
- 7. Pitch of water drain line (if Water Seal) (Minimum 1/2" per 12")
- 8. Water flow from water chamber is \_\_\_\_\_ GPM (if Water Seal)
- 9. Crusher was run at 50% of full power for at least two hours
- 10. Relief valve stopped returning oil to tank at \_\_\_\_\_ °F.
- 11. Feed distribution in crushing cavity

<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
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AFTER SIX HOUR INITIAL OPERATION

- 1. Temperature differential between oil feed line and oil drain line was \_\_\_\_\_ °F.
- 2. Customer has been advised of any recommended changes to his installation

<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>

PORTABLE PLANTS

- 1. Cribbing has been installed properly
- 2. If rubber mounts are used, Crusher is free to move without interference

<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>

## SECTION 11

# OPERATING INSTRUCTIONS

### PREPARATIONS BEFORE STARTING

Good inspection habits will do much to insure years of successful operation of the Crusher. Do not rely on memory alone to regulate required periodic maintenance, keep an accurate written record. Regularly performing prestart and maintenance inspections will pay off in the way of eliminating costly down time and prolonging the life of the Crusher. Before starting the Crusher perform the following operations:

- 1 Check that the correct lubricating oil is being used and that the lubricating system has been installed as described in LUBRICATING SYSTEM, Section 10.
- 2 Start the independently motor driven oil pump (if so equipped). Remove the inspection cover in the oil tank cover and check the oil drain line inside the tank to be certain the oil is circulating. Under normal operating conditions, the oil flowing out of the drain line should at least half fill the pipe.
- 3 If the Crusher is equipped with a crusher driven integral pump, the pump must be primed and the countershaft box filled with oil before starting the Crusher. Remove the pipe plug from the tee at the pump and prime the pump by pouring in a quantity of oil. This is only necessary during initial start up or starting after an extended shutdown. The check valve at the oil tank will maintain prime under ordinary operating conditions.

Fill the countershaft box with oil by disconnecting the flexible oil hose at the top of the countershaft box and filling the box with lubricating oil. Reconnect the hose and securely tighten the connection. Filling the box with oil is necessary to properly lubricate the countershaft bushings with this type of oil pump upon initial start-up.

- 4 Remove the wooden wedges which are driven in between the crushing members for shipping purposes.
- 5 Check the end float, the countershaft must be free to move axially in and out 1/32". See MOUNTING CRUSHER SHEAVE in Section 4.
- 6 Make a final inspection of the Crusher to be certain that no tools or mechanical obstructions are on the Crusher, that all joints and fasteners are properly tightened, that no leaks are apparent, and that there is no other reason why the Crusher should not be started.
- 7 Rotate the countershaft by hand to check that the mantle is not striking the bowl liner and that there are no other mechanical difficulties. Should the mantle strike the bowl liner, refer to the instructions under ADJUSTING THE BOWL, later in this section.
- 8 After all the previous steps have been checked, start the Crusher as instructed under the paragraph STARTING THE CRUSHER.

### COUNTERSHAFT SPEED

The correct speed or revolutions per minute (RPM) is most important for the proper crushing action. The speed for all sizes of Crushers is shown in the table COUNTERSHAFT SPEED. The sheave sizes recommended for driving the Crusher are designed for full load running, therefore, the countershaft speed will be somewhat higher when running under no load. Experience has shown that by operating the Crusher at the correct countershaft speed, maximum output of material can be achieved in conjunction with a uniformly shaped product.

CRUSHER SIZE	2 FT.	3 FT.	4 FT.	5100 AND 4-1/4 FT.	5-1/2 FT.	7 FT.
Revolutions Per Minute (RPM) Full Load	575	580	485	485	485	435

### COUNTERSHAFT SPEED

The speed of the crusher countershaft determines the amount of material and also the number of blows a particle will receive in passing through the crushing cavity. If the Crusher cannot be operated at the correct RPM, a slightly higher RPM is preferred (within 5 percent (%) of the correct RPM) since if the speed of the crusher countershaft is reduced much below the recommended RPM the crushing performance would be adversely affected by over choking the crushing chamber and causing the Crusher to stall.

**EXAMPLE:** A crusher countershaft with a recommended speed of 485 RPM could be driven at any speed between 485 and 510 RPM (485 RPM +5%, - 0%) without affecting crushing performance.

There are certain applications where a higher than normal RPM has been recommended to improve particle size and/or shape without loss of tonnage through the Crusher. This higher RPM is usually used in conjunction with a special "reduced throw" eccentric. In such applications, consult the factory for the correct countershaft speed.

### COUNTERSHAFT ROTATION

All STANDARD Crushers are equipped for COUNTERCLOCKWISE rotation of the countershaft and all SHORT HEAD Crushers are equipped for CLOCKWISE rotation of the countershaft. Direction of rotation is as viewed from the drive end of the countershaft and should not be reversed. Direction is important as the self-tightening main shaft nut or locking nut automatically keeps the mantle tight against the head, relying on the correct rotation of the countershaft to provide this self-tightening feature.

Under SPECIAL conditions STANDARD Crushers can be equipped to rotate clockwise and SHORT HEAD Crushers, counterclockwise.

All 4 Ft., 5100, 4-1/4 Ft. and 5-1/2 Ft. SHORT HEAD Crushers that use a standard main shaft (threaded at the top) are equipped for COUNTERCLOCKWISE rotation of the countershaft. Under SPECIAL conditions these Crushers can be equipped to rotate CLOCKWISE, as described in the instructions shown below for a STANDARD Crusher.

If the rotation on a STANDARD Crusher is changed from counterclockwise to clockwise, such as with a diesel drive, a special lock-washer must be assembled in the main shaft nut as described in the article REPLACING MANTLE in Section 7 as the main shaft and main shaft nut have right hand threads. This locks the main shaft nut to the main shaft and prevents loosening of the assembly but eliminates the self-tightening feature. When using an electric drive motor on a STANDARD Crusher, the motor should be wired to give the Crusher counterclockwise rotation.

If the rotation on a SHORT HEAD Crusher is changed from clockwise to counterclockwise, three parts must also be changed. They are the locking collar, locking nut, and locking nut cover. These parts must all have right hand threads instead of the left hand threads that are used for clockwise rotation. This change will still retain the self-tightening feature; however, replacement parts with right hand threads may be very difficult to obtain, as they are not normally stocked. It is NOT recommended to change rotation on a SHORT HEAD Crusher.

Also, in the case of the crusher driven integral pump, the proper direction of rotation is very important, refer to INTEGRAL OIL PUMP in Section 10.

If a change in rotation is made on a Crusher with a crusher driven integral oil pump, the inlet and outlet piping must also be reversed.

## STARTING THE CRUSHER

The Crusher is driven by an engine or an electric motor. Starting the Crusher merely amounts to starting the engine or motor according to the manufacturers' instruction. Do not introduce any feed to the Crusher during starting. To start the Crusher, proceed as follows:

- 1 Start the engine or motor.
- 2 If the Crusher is equipped with an integral pump which only functions when the Crusher is operating, check to be certain there is oil coming from the drain line in the oil tank. If the pump is operating properly, the oil should flow out of the drain line into the oil tank almost immediately after starting and is readily visible by removing the inspection cover in the oil tank cover.
- 3 Check the rotation of the countershaft.
- 4 Check the speed of the countershaft.

**DO NOT ALLOW THE CRUSHER TO OPERATE LONGER THAN TWO MINUTES IF NO OIL HAS APPEARED AT THE DRAIN LINE INSIDE THE OIL TANK, AS SERIOUS DAMAGE CAN RESULT TO THE CRUSHER. NORMALLY, OIL FLOWING OUT OF THE DRAIN LINE SHOULD BE OF SUFFICIENT VOLUME AS TO HALF FILL THE PIPE. LACK OF OIL FLOW CAN BE CAUSED BY SEVERAL CONDITIONS; INSUFFICIENT OIL IN THE LUBRICATING SYSTEM, OIL PUMP FAILURE, LOSS OF PRIME ON THE PUMP, OBSTRUCTIONS IN THE FEED LINE OR AN INCORRECT SETTING OF THE RELIEF VALVE. REFER TO LUBRICATING SYSTEM, SECTION 10.**

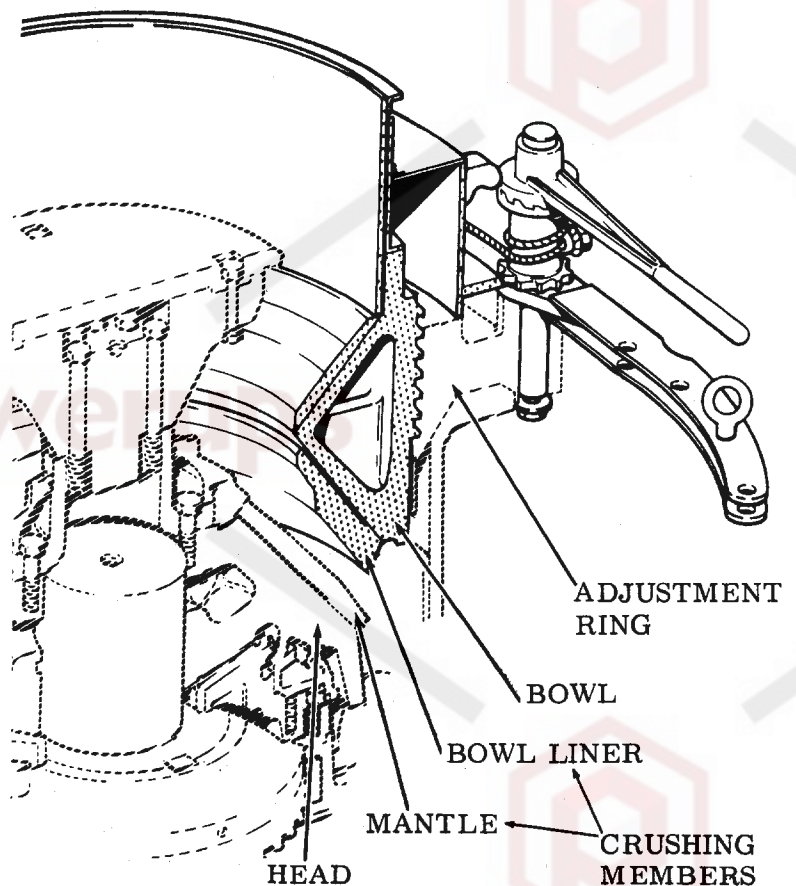
## SETTING THE CRUSHER

## BREAK-IN PROCEDURE

Although the Crusher was test run at the factory, it is advisable after initial start-up or starting after installation of new bearings, to permit the Crusher to run without a load or at reduced load for several hours. This will permit a general running-in of the Crusher and an assurance that all parts are functioning properly as well as being thoroughly lubricated. It is also advisable to check the oil temperature more closely during this time. Refer to the paragraph on OIL TEMPERATURE in Section 10.

## SETTING THE CRUSHER

The crusher setting is dependent on the size of product required. In most instances the bowl should be set so that the opening between the crushing members on the closed side, measures a distance slightly less than the maximum size of product desired. In addition to resetting the bowl when changing the size of the product, it is also necessary to adjust the bowl to compensate for wear on the crushing members.





THE INITIAL SETTING AS DETERMINED BY THE SIZE OF THE PRODUCT DESIRED IS NOT AN ABSOLUTE GUARANTEE THAT THIS IS THE BEST SETTING FOR MAXIMUM PRODUCTION. THIS DEPENDS AT TIMES ON THE CHARACTERISTICS OF THE MATERIAL TO BE CRUSHED, ON THE POWER DRAW OF THE CRUSHER MOTOR OR ENGINE OR ON ADJUSTMENT RING ACTION.

The setting of the Crusher is changed by either lowering or raising the bowl in the adjustment ring, by turning the bowl assembly clockwise to lower and counterclockwise to raise. Lowering the bowl decreases the setting, raising the bowl increases the setting.

## ADJUSTING THE BOWL

ADJUSTING THE BOWL (Windlass and Adjustment Cap Screw Arrangement). This arrangement, normally furnished on the 2 Ft., 3 Ft., 4 Ft., 5100 and 4-1/4 Ft. Crushers, uses windlasses located on the adjustment ring to provide the mechanical advantage to turn the bowl and the adjustment cap screws to raise the bowl into the crushing position. To adjust the bowl with the windlass and adjustment cap screw arrangement, proceed as follows:

- 1 Loosen the adjustment cap screws sufficiently to allow the bowl to be turned into the ring to the desired setting. A special wrench is provided for this purpose or a heavy duty air wrench and socket can be used.
- 2 Connect the windlass cable to the windlass and to the adjustment cap collar as shown in the illustration WINDLASS AND ADJUSTMENT CAP SCREW ARRANGEMENT. Attach the cables to the proper side of the adjustment cap to obtain the desired rotation.
- 3 Pry out the lock link pins and swing the lock links out of the way. Turn the windlasses with the large cast wrenches. If necessary, pipe extensions can be used on the wrench handles for added leverage. Turning the windlasses will wind the cable around the windlass and turn the bowl in the adjustment ring. The pawl, which is

spring loaded, ratchets against the notches in the windlass, thereby keeping the cable from unwinding when the wrench pressure is relaxed. Repeat this procedure until the bowl assembly reaches the desired setting.

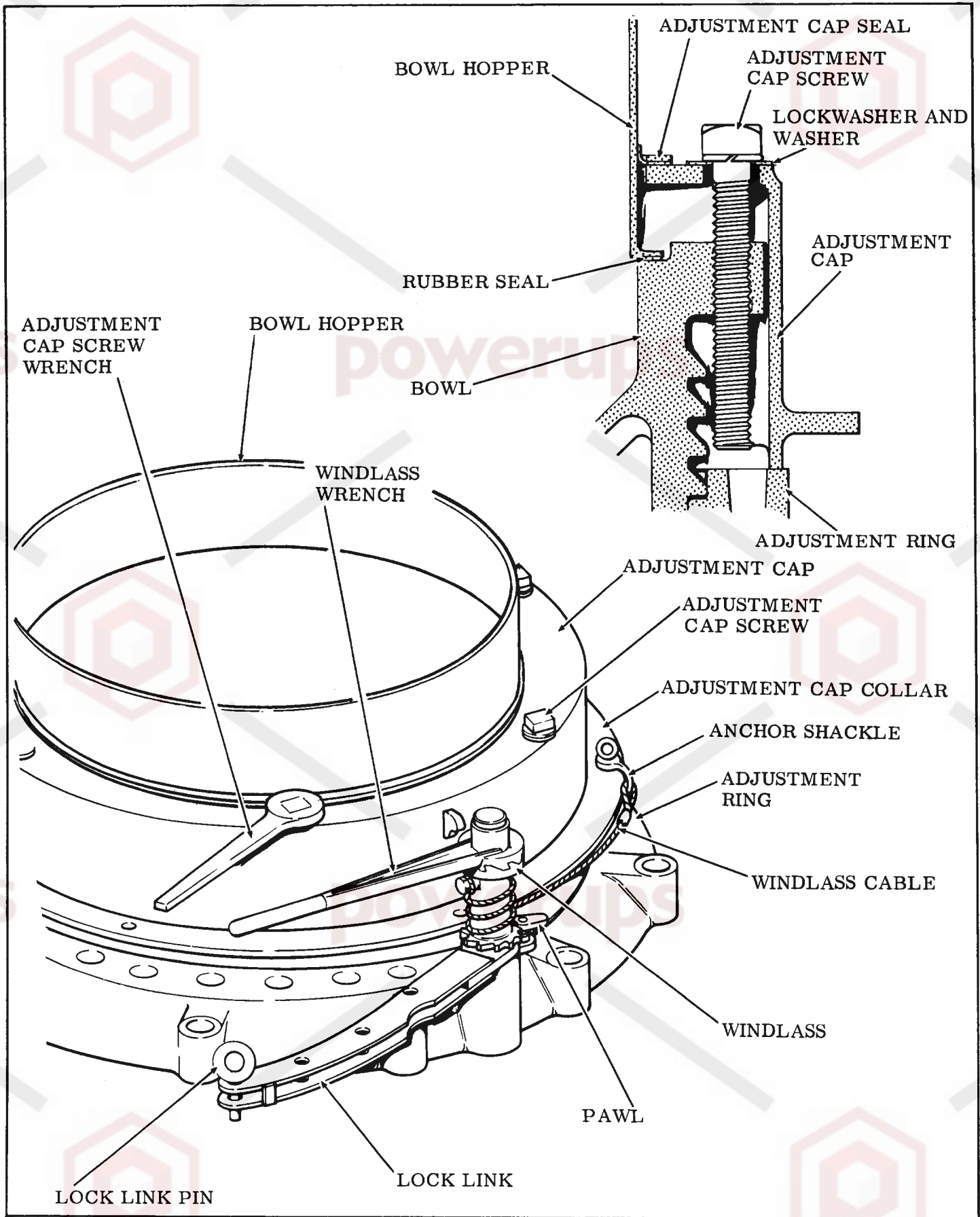
- 4 Swing the lock links in place against the adjustment cap and insert the lock link pin through the lock link and into one of the locking holes in the adjustment cap collar. It may be necessary to slightly rotate the adjustment cap in either direction to align the holes in the lock link and the collar.
- 5 Tighten the adjustment cap screws. Do not tighten the screws in a consecutive order, but alternate 180 degrees so that an even rise of the bowl assembly will be made. This will raise the bowl into the crushing position and prevent the bowl from rotating. See the illustration BOWL THREAD ENGAGEMENT WITH ADJUSTMENT RING (Crushing Position). Sledge the cap screws tight, using a pipe extension on the wrench handles if necessary, to insure maximum tightness. It is important that these screws are absolutely tight to prevent any movement whatsoever in the bowl threads.
- 6 Check the screws for tightness after the Crusher has been in operation for several hours and retighten, if necessary.

FAILURE TO ADEQUATELY TIGHTEN THE ADJUSTMENT CAP SCREWS COULD CAUSE THE BOWL TO LOOSEN AND POSSIBLY BREAK THE ADJUSTMENT CAP SCREWS OR THE BOWL AND ADJUSTMENT RING THREADS COULD WEAR EXCESSIVELY.

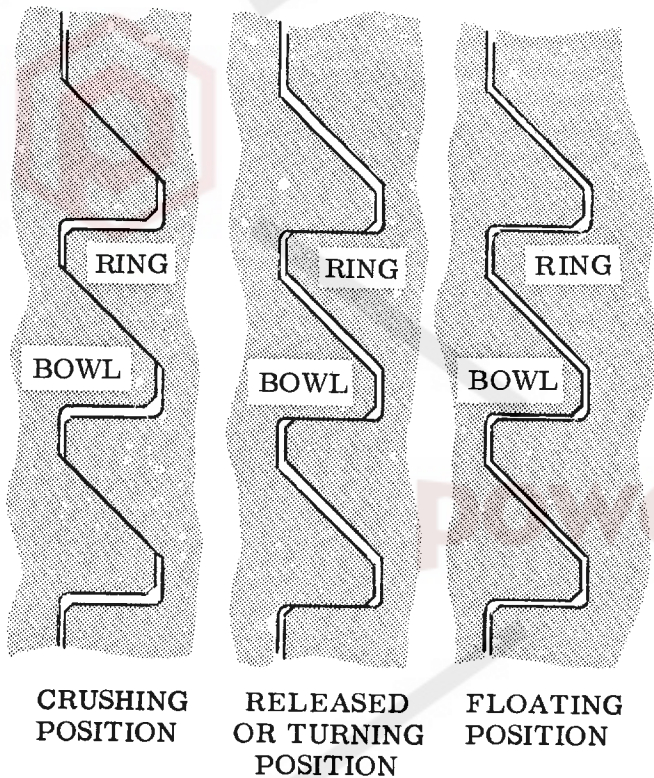
## TURNING THE BOWL USING AN OVERHEAD CRANE

If an overhead crane, or some other lifting means is available, turning the bowl within the adjustment ring requires somewhat more skill but less effort. To turn the bowl assembly using a crane, proceed as follows:

- 1 Rig suitable lifting cables from the crane



**WINDLASS AND ADJUSTMENT CAP SCREW ARRANGEMENT**



### BOWL THREAD ENGAGEMENT WITH ADJUSTMENT RING

to the adjustment cap hooks and lift the entire bowl assembly a very slight amount. By lifting the bowl ever so slightly, the bowl will float in the adjustment ring threads as shown in the illustration BOWL THREAD ENGAGEMENT WITH ADJUSTMENT RING (Floating Position).

- 2 With the bowl suspended in the floating position, two men can walk the bowl down or up within the adjustment ring to the desired setting. With each quarter turn of the bowl, lower or raise the assembly so that the bowl remains free in the adjustment ring.

### ADJUSTING THE BOWL (Windlass and Duckworth Adjustment Arrangement)

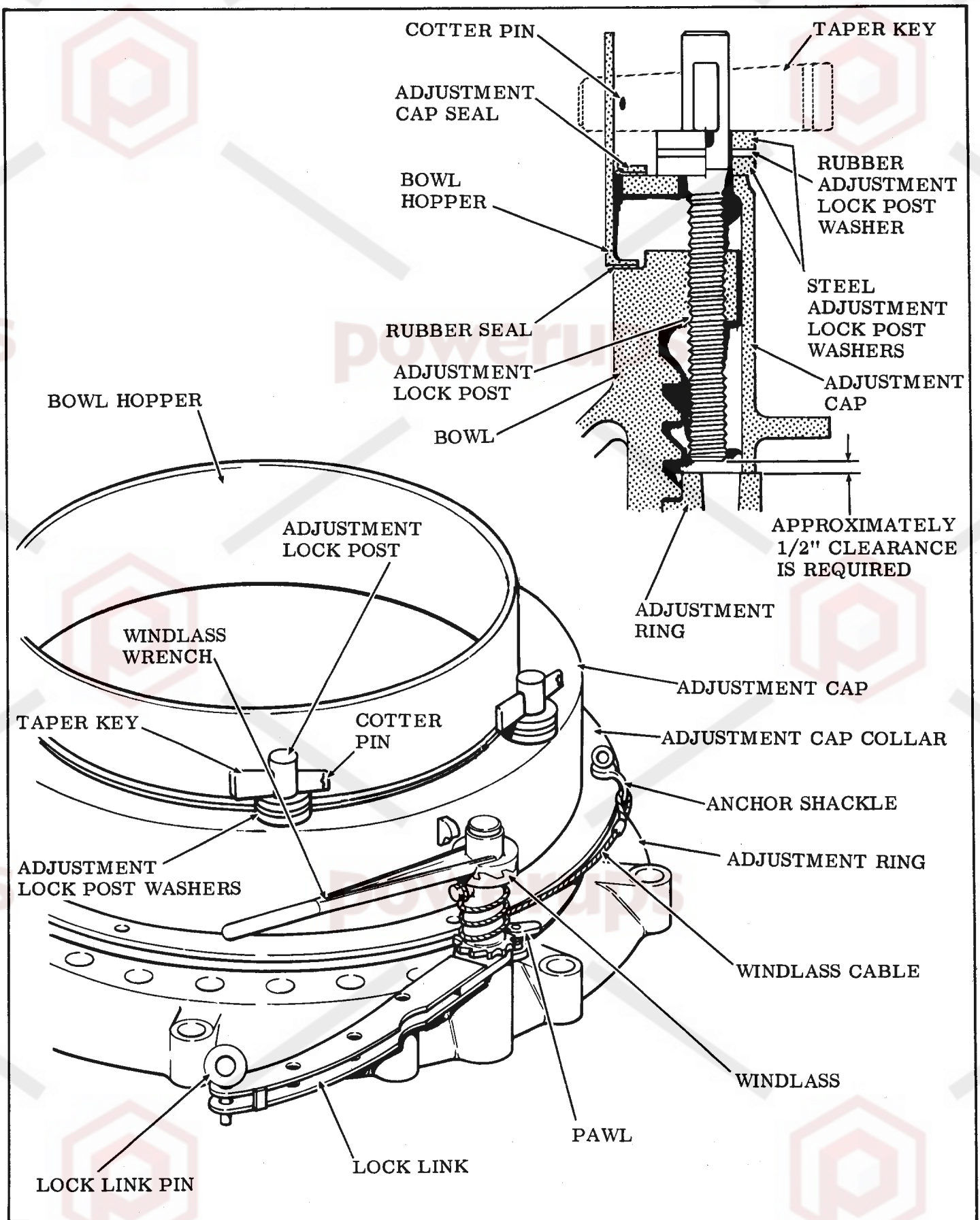
On the 3 Ft., 4 Ft., 5100 and 4-1/4 Ft. Crushers, equipped with a Duckworth arrangement for raising the bowl into the crushing position, proceed as follows:

- 1 Remove the tapered keys by sledging. Do not remove the cotter pins inserted through the keys until after the initial loading has been eliminated from the

keys. This will prevent the keys from flying all the way out. The keys should then be tapped out and removed by hand. See the illustration WINDLASS AND DUCKWORTH ADJUSTMENT ARRANGEMENT.

- 2 Remove the three adjustment lock post washers.
- 3 Adjust the bowl to the desired setting using the windlass or overhead crane as described in previous instructions.
- 4 Swing the lock links in place against the adjustment cap and insert the lock link pin through the lock link and into one of the locking holes in the adjustment cap collar. It may be necessary to slightly rotate the cap in either direction to align the holes in the lock link and the collar.
- 5 Replace the three lock post washers, with the rubber washer in between the metal washers.
- 6 Turn the lock post down until it bottoms on the adjustment ring then back off approximately 1-1/2 turns to allow clearance between the bottom of the post and the top of the adjustment ring.
- 7 Insert the tapered keys into the lock post and using a sledge hammer, drive them securely in place to raise the bowl into the crushing position and prevent the bowl from rotating. Do not sledge the keys in a consecutive order, but alternate 180 degrees so that an even rise of the bowl assembly will be made. It is important that the keys are absolutely tight to prevent any movement what-so-ever in the bowl threads. A clear ringing sound when sledging the keys is evidence that the keys are tightly in place.
- 8 Install the cotter pins in each key.
- 9 Check the keys for tightness after the Crusher has been in operation for several hours and resledge, if necessary.

FAILURE TO TIGHTEN THE TAPERED KEYS SUFFICIENTLY COULD CAUSE THE BOWL AND ADJUSTMENT RING THREADS TO WEAR EXCESSIVELY.



**WINDLASS AND DUCKWORTH ADJUSTMENT ARRANGEMENT**

## ADJUSTING THE BOWL (Adjustment Sheave and Duckworth Adjustment Arrangement)

This arrangement which is furnished on the 5-1/2 Ft. and 7 Ft. machines uses a swivel casting and a sheave located on either of two bosses on the adjustment ring to turn the bowl and the Duckworth arrangement to raise the bowl into the crushing position. To adjust the bowl with the adjustment sheave and Duckworth adjustment arrangement, proceed as follows:

- 1 Remove the tapered keys by sledging. Do not remove the cotter pins inserted through the keys until after the initial loading has been eliminated from the keys. This will prevent the keys from flying all the way out. The keys should then be tapped out and removed by hand.
- 2 Remove a few of the adjustment lock post washers.
- 3 Connect the swivel cable to the adjustment cap collar and around the sheave as shown in the illustration ADJUSTMENT SHEAVE AND DUCKWORTH ADJUSTMENT ARRANGEMENT. Attach the cable to the proper side of the adjustment cap to obtain the desired rotation.
- 4 Connect the opposite end of the cable to an overhead crane (10 ton capacity), if available, or by a block and tackle arrangement connected to a truck or tractor.
- 5 Swing the lock links out of the way and rotate the bowl by pulling on the cable with a crane, truck or tractor. Turn the bowl assembly to the desired setting.
- 6 Swing the lock links in place against the adjustment cap and insert the lock link pin through the lock link and into one of the locking holes in the adjustment cap collar. It may be necessary to slightly rotate the cap in either direction to align the holes in the lock link and the collar.
- 7 Remove or add the correct amount of washers to each lock post so that when the tapered key is driven into place it will protrude an equal amount on each side of the post. Always reassemble the washers so that a heavy washer at least one inch thick is on top to support the pressure of the tapered key without bending the washer.

8 Insert the tapered keys into the lock post and using a sledge hammer drive them securely in place to raise the bowl into the crushing position and prevent the bowl from rotating. Do not sledge the keys in a consecutive order, but alternate 180 degrees so that an even rise of the bowl assembly will be made. It is important that the keys are absolutely tight to prevent any movement what-so-ever in the bowl threads. A clear ringing sound when sledging the keys is evidence that the keys are tightly in place.

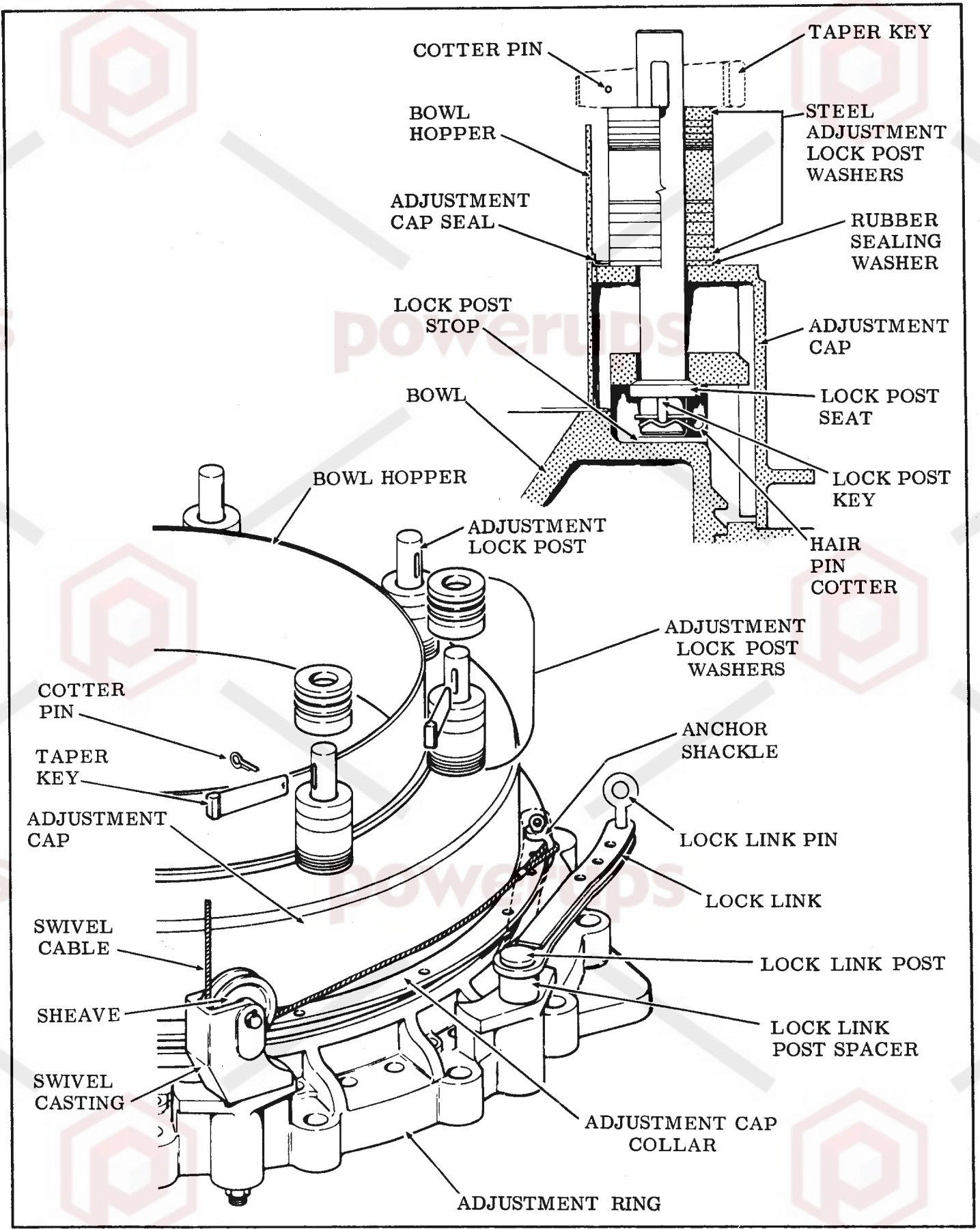
- 9 Install the cotter pins in each key.
- 10 Check the keys for tightness after the Crusher has been in operation for several hours and resledge, if necessary.

FAILURE TO TIGHTEN THE TAPERED KEYS SUFFICIENTLY COULD CAUSE THE BOWL AND ADJUSTMENT RING THREADS TO WEAR EXCESSIVELY.

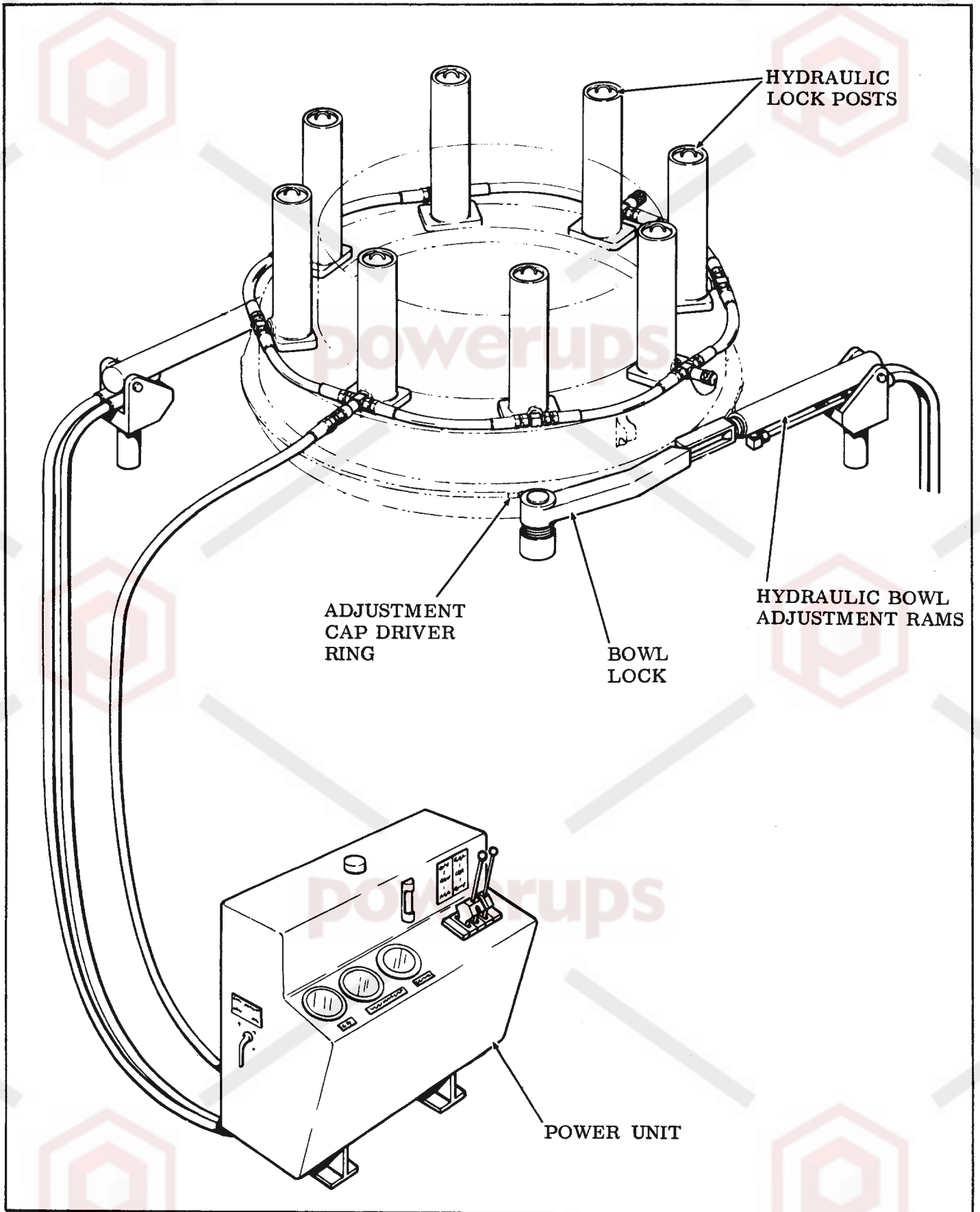
## ADJUSTING THE BOWL (Hydraulic Adjustment Arrangement)

Another arrangement, for rotating and clamping the bowl, which provides all the conveniences of effortless remote control, is the hydraulic adjustment arrangement. This system, although optional, is available on the 4 Ft., 5100, 4-1/4 Ft., 5-1/2 Ft. and 7 Ft. Crushers and can be installed on new machines as well as existing machines now in operation. All the adjustments are made from a power unit, either electrically or air operated. Positive clamping of the bowl assembly is automatically maintained by hydraulic cylinders which replace the standard lock posts or adjustment cap screws.

A lever on the power unit releases clamping pressure on the hydraulic lock posts while adjustments are being made, and when the lever is returned to the clamp position, pressure is automatically re-applied. Hydraulic adjustment rams rotate the bowl to the desired setting by engaging notches on the adjustment cap driver ring. A spring loaded ratchet type bowl lock automatically engages these notches after each retraction of the bowl adjustment rams and positively holds the setting until another change in setting is necessary. Installation, operation



**ADJUSTMENT SHEAVE AND DUCKWORTH ADJUSTMENT ARRANGEMENT**



**HYDRAULIC ADJUSTMENT ARRANGEMENT**

and maintenance of the hydraulic components are completely described in Section 12. See the illustration HYDRAULIC ADJUSTMENT ARRANGEMENT.

SINCE CLAMPING PRESSURE IS UNIFORM AND AUTOMATICALLY SUSTAINED, NO PERIODIC INSPECTIONS FOR BOWL LOOSENESS ARE NECESSARY AND THE POSSIBILITY OF DAMAGE CAUSED BY BOWL MOVEMENT DURING OPERATION HAS BEEN ELIMINATED.

### MINIMUM SETTING

Under no circumstances should the Crusher be set closer than the recommended minimum setting for that particular size of Crusher. Operating with less than the recommended minimum setting causes excessive spring action and produces an unsatisfactory product. This also places an undue strain on the Crusher, resulting in added maintenance expense. The table RECOMMENDED MINIMUM DISCHARGE SETTING shows the minimum discharge settings for the various sizes of Crushers. These settings are in keeping with maximum production and satisfactory Crusher performance.

### CHECKING THE CRUSHER SETTING

Check the crusher setting by fastening a piece of lead to the end of a strong, flexible wire and inserting the lead slowly downward into the crushing cavity with the Crusher running empty. Make sure that the lead passes through the PARALLEL ZONE of the crushing members. In the same motion, quickly withdraw the lead and measure the thickness, this will give the setting of the Crusher. If necessary, reset the bowl assembly to the desired closed side setting. Do not use zinc to check the crusher setting as zinc will not compress easily. Using zinc may cause the adjustment ring to lift slightly and give an incorrect measurement.

To determine if the crusher setting is the same all around the crushing cavity, it is suggested that a piece of lead be inserted into the crushing cavity at four different locations, each 90° apart. Comparing the four thicknesses will show at a glance if the adjustment ring is setting level on top of the main frame or if the adjustment ring is tipped due to wear on one side of the Crusher because of improper feed distribution. See the illustration FEED ARRANGEMENT in Section 2 for the correct method of feed.

Operating with a tipped adjustment ring can reduce tonnage through the Crusher considerably and cause excessive spring action.

CRUSHER SIZE	Type of Cavity	Recommended Minimum Discharge Setting
2 Ft. Standard	Fine	1/4
	Coarse	3/8
	Extra Coarse	1/2
3 Ft. Standard	Fine	3/8
	Medium	1/2
	Extra Coarse	1
4 Ft. Standard	Fine	3/8
	Medium	1/2
	Coarse	3/4
	Extra Coarse	1
5100 and 4-1/4 Ft. Standard	Fine	1/2
	Medium	5/8
	Coarse	3/4
	Extra Coarse	1
5-1/2 Ft. Standard	Fine	5/8
	Medium	7/8
	Coarse	1
	Extra Coarse	1-1/2
7 Ft. Standard	Fine	3/4
	Medium	1
	Coarse	1-1/4
	Extra Coarse	1-1/2
2 Ft. Short Head	Fine	1/8
	Coarse	3/16
3 Ft. Short Head	Fine	1/8
	Medium	1/8
	Coarse	1/4
4 Ft. Short Head	Fine	3/16
	Medium	5/16
	Coarse	1/2
	Extra Coarse	5/8
5100 and 4-1/4 Ft. Short Head	Fine	1/8
	Medium	1/4
	Coarse	5/16
	Extra Coarse	5/8
5-1/2 Ft. Short Head	Fine	3/16
	Medium	1/4
	Coarse	3/8
	Extra Coarse	1/2
7 Ft. Short Head	Fine	3/16
	Medium	3/8
	Coarse	1/2
	Extra Coarse	5/8

### RECOMMENDED MINIMUM DISCHARGE SETTING

(All Dimensions In Inches)

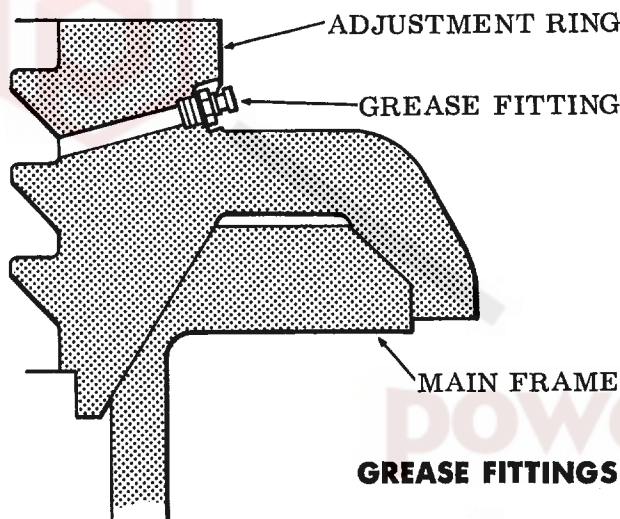


## THREAD LUBRICATION

As the bowl is the adjusting member of the Crusher, it is very important to lubricate the threads on the bowl and adjustment ring periodically to insure free movement of the bowl within the adjustment ring.

Grease fittings evenly distributed around the side or top of the adjustment ring are provided to enable lubrication of the threads while the bowl is in engagement with the adjustment ring. See the illustration GREASE FITTINGS.

Grease should be forced into these fittings when the bowl is both in the crushing position and the released position. Establish a regular maintenance schedule for forcing grease into these fittings. Use a lithium base grease such as NLGI No. 1 or equivalent, preferably mixed with 5 - 10% (by volume) of molybdenum disulfide powder. When crushing hot materials; clinkers, slag, etc., a high temperature grease, preferably mixed with the same 5 - 10% (by volume) of molybdenum disulfide powder should be used. This powder mixed with lubricating oil has also been found satisfactory for such high temperature applications.



## TURNING THE BOWL

If difficulty in turning the bowl is encountered it is probably due to galling or tearing of the thread surfaces on either the bowl or the adjustment ring or both. Such thread damage normally occurs during the initial assembly of the bowl in the adjustment ring when using a SINGLE cable connected to the adjustment cap to "pull" the bowl to the desired setting. The bowl, when turned in this manner, is usually rotated by pulling on the cable with a truck, tractor or front end loader.

If the SINGLE cable pull was used to turn the bowl assembly into the adjustment ring, the bowl tends to tip in the adjustment ring threads. This tipping creates point contact between the outside diameter of the bowl threads and the flat surfaces of the adjustment ring threads in the direction of pull, especially if the pull is not horizontal. When the bowl is pulled "off center" and tipping occurs, thread galling or tearing can take place. This damage is normally limited to the first thread on the bowl and adjustment ring and appears on the flat surfaces of the threads. The metal shavings created by the tearing of the lead thread can damage the remaining threads as this debris is carried along with the thread as the bowl is turned into the adjustment ring. Similar thread damage may occur when removing the bowl in this manner.

If thread galling or tearing has occurred, the following alternate methods of installing and removing the bowl assembly will minimize thread damage.

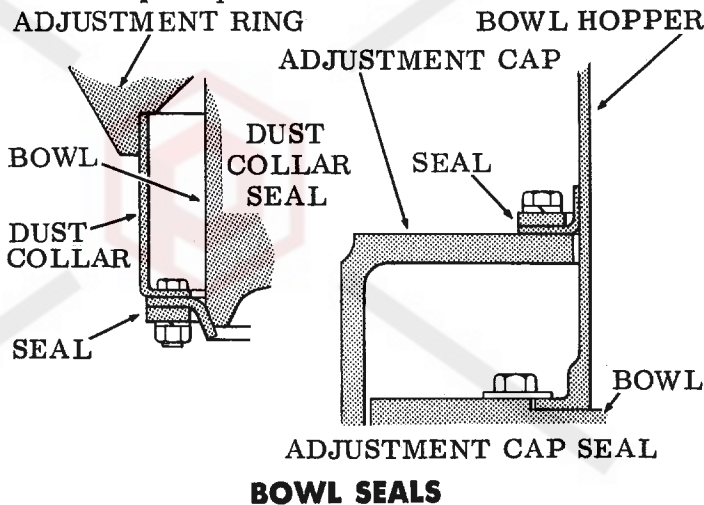
- 1 Turn the bowl, using an overhead crane or some other lifting means to "float" the bowl in the adjustment ring threads as shown in the illustration BOWL THREAD ENGAGEMENT WITH ADJUSTMENT RING. With the bowl suspended in the floating position, two men can walk the bowl down or up within the adjustment ring to the desired setting. With each quarter turn of the bowl, lower or raise the assembly so that the bowl remains free in the adjustment ring. Turn the bowl assembly at least two full revolutions using this method.
- 2 Use a DOUBLE cable pull to turn the bowl assembly in or out.
- 3 If the Crusher is equipped with hydraulic clamping and adjustment use the bowl adjustment rams to turn the bowl until at least two full revolutions of the bowl are made.

After the bowl assembly has been turned into the adjustment ring at least two revolutions, the SINGLE cable pull can be used to turn the bowl in the rest of the way. Make sure the bowl assembly is pulled slowly (approximately ONE revolution per minute). Reverse the procedure when removing the bowl.

Considerable force might possibly have to be exerted in order to "break" the bowl loose in the adjustment ring. One or a combination

of any of the following faulty operating conditions could cause the bowl to become difficult to turn within the adjustment ring.

- 1 Crushing hot materials; slag, clinkers, etc., using unsuitable thread lubricant.
- 2 Not lubricating the bowl and adjustment ring threads at recommended periodic intervals.
- 3 Worn or improperly installed adjustment cap seal. See the illustration BOWL SEALS.
- 4 Worn or improperly installed dust collar seal. See the illustration BOWL SEALS.
- 5 Operating the Crusher at the same setting for too long a period of time.
- 6 Locating the Crusher where it is exposed to the elements, particularly rain, without adequate protection.

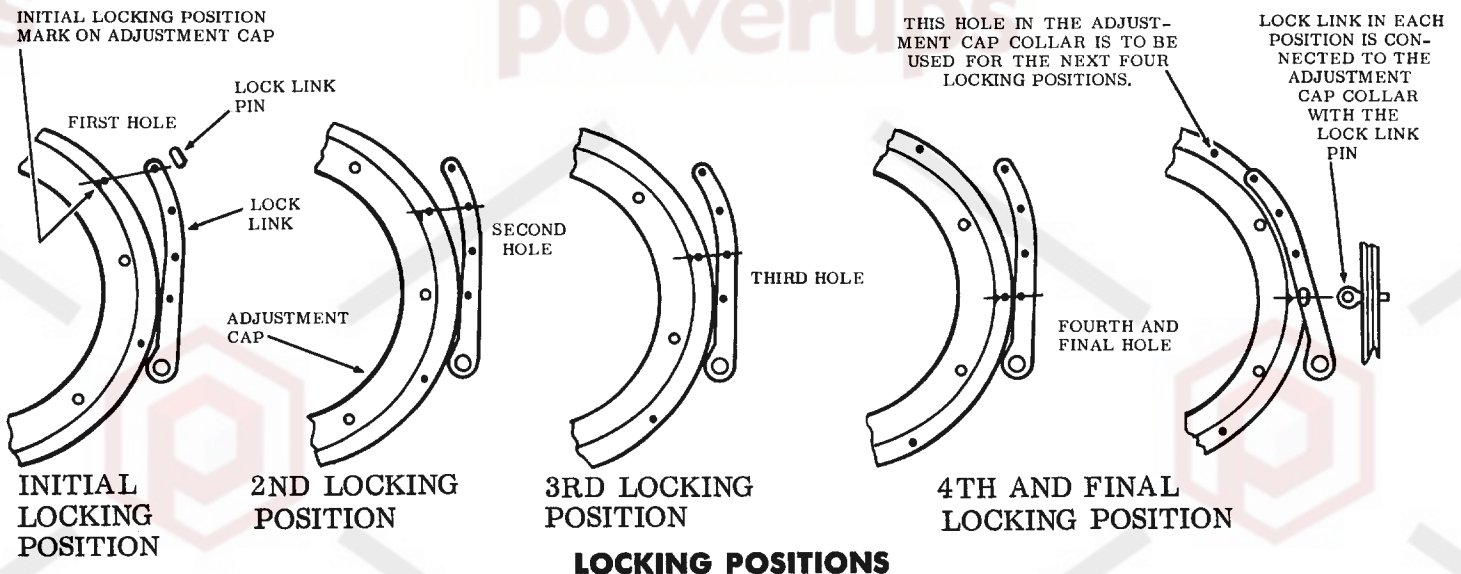


The following suggestions will do much to eliminate the possibility of even experiencing a bowl that is difficult to turn in the adjustment ring.

- 1 Periodically release the bowl from its crushing position and rotate the bowl back and forth.
- 2 Add grease in the grease fittings located around the side or top of the adjustment ring while the bowl is in the adjustment ring. Establish a regular maintenance schedule for servicing these grease fittings. Use a grease as recommended in the THREAD LUBRICATION paragraph found in this section.
- 3 At the time of initial installation or whenever the bowl is removed, clean the threads and coat them with the lubricant recommended in ASSEMBLY INSTRUCTIONS in Section 8 prior to reassembly.
- 4 Check the bowl seals occasionally for wear.

If the bowl does become stuck in the adjustment ring and the bowl cannot be rotated by ordinary means, proceed as follows:

- 1 While the Crusher is operating, feed a quantity of material into the Crusher with the bowl in the released position.
- 2 Pour penetrating oil or antifreeze around the entire circumference of the bowl threads and force these same solutions through the grease fittings on the adjustment ring. The penetrating oil or antifreeze will loosen



any packed dirt that may have filtered into the thread clearances and also loosen any rust that may have formed.

- 3 Using the windlass or swivel arrangement, try turning the bowl by applying as much force as possible.

If this procedure does not get immediate results, let the Crusher stand for several hours while periodically applying penetrating oil or antifreeze around the threads, then repeat the previous steps.

### DETERMINING LINER WEAR

The following information will be extremely helpful when trying to determine when the liners have worn to a point where replacement is necessary. An accurate record can be kept to show the degree of liner wear without stopping operations. On the INITIAL set of liners, keep a record of liner wear as follows:

- 1 After the crusher setting has been reached, swing the lock links inward until they engage the adjustment cap collar. The cap must be rotated slightly in either direction until a hole in the lock link aligns with a hole in the adjustment cap collar. Fasten the lock link to the collar with the lock link pin.
- 2 Place an identifying mark on the adjustment cap at one of the lock link pins. This will indicate the INITIAL locking position. Locking positions are shown in the illustration LOCKING POSITIONS. Rotating the same hole in the adjustment cap collar to the next hole in the lock link will bring the bowl into a new locking position and gives a very fine vertical adjustment of the bowl.

- 3 During regular operation, keep an accurate record on the exact number of locking positions used on this initial set of liners, starting with the first locking position and recording each locking position until the liners have worn out.

AS NO TWO CRUSHING OPERATIONS ARE IDENTICAL AND BECAUSE OF THE WIDE RANGE OF LINER STYLES AND THICKNESSES AVAILABLE AND CASTING VARIATIONS, IT WOULD BE IMPOSSIBLE TO PREDICT IN ADVANCE HOW MANY LOCKING POSITIONS A PARTICULAR SET OF LINERS WILL HAVE TO GO THROUGH BEFORE THEY ARE WORN OUT.

- 4 After the liners have worn out, but before moving the bowl within the adjustment ring, paint a short horizontal line on the bowl hopper just above the adjustment cap seal.
- 5 Install the new liners and by keeping a record of the locking positions, the degree of liner wear can be determined by comparison with the number of locking positions that were required when the initial set of liners was worn out. The mark painted on the bowl hopper will also show when the liners are approaching the wear limit as the hopper moves downward with each change in setting. Follow this procedure several times to establish a fairly accurate average as no two sets of liners will wear exactly alike. As an aid to the operator, the number of locking positions available per each revolution of the bowl as well as the change in vertical height are shown in the table VERTICAL TRAVEL OF BOWL.

CRUSHER SIZE	2 Ft.	3 Ft.	4 Ft.	5100 and 4-1/4 Ft.	5-1/2 Ft.	7 Ft.
Pitch of Bowl Thread	1-1/2"	2"	2"	2"	2"	2"
Number of Locking Positions Available In One Complete Revolution of Bowl	24	24	24	24	32	64
Vertical Travel of Bowl Per Locking Position	1/16"	5/64"	5/64"	5/64"	1/16"	1/32"
All dimensions in inches.						

### VERTICAL TRAVEL OF BOWL

CRUSHER SIZE	4 Ft.	5100 and 4-1/4 Ft.	5-1/2 Ft.	7 Ft. Heavy Duty	7 Ft. Extra Heavy Duty
Pitch of Bowl Thread	2"	2"	2"	2"	2"
Number of Locking Positions Available In One Complete Revolution of Bowl	48	48	48	48	32
Vertical Travel of Bowl Per Locking Position	3/64"	3/64"	3/64"	3/64"	1/16"
All dimensions in inches					

### VERTICAL TRAVEL OF BOWL USING HYDRAULIC ADJUSTMENT

IF YOUR PARTICULAR OPERATION DOES NOT CALL FOR SUCH FINE VERTICAL ADJUSTMENT OF THE LINER, NOT ALL THE LOCKING POSITIONS POSSIBLE WOULD NEED BE USED. THEREFORE, MARK ONE OF THE HOLES IN THE LOCK LINK AND USE ONLY THIS HOLE FOR LOCKING THE LINK TO THE ADJUSTMENT CAP EACH AND EVERY TIME YOU ADJUST THE BOWL SETTING. THIS WILL ALLOW AN ACCURATE RECORD TO BE KEPT WITHOUT USING ALL THE LOCK LINK HOLES.

**DETERMINING LINER WEAR USING HYDRAULIC ADJUSTMENT.** Liner wear can be recorded when using the hydraulic means of adjustment in much the same manner as previously described. To determine liner wear with the hydraulic adjustment, record the number of strokes or extensions made by the bowl adjustment rams on the INITIAL set of liners. Each ram extension rotates the adjustment cap one notch on the driver ring, resulting in a change in the crusher setting. On the next set of liners compare the number of strokes to determine the degree of liner wear. The number of locking positions available per each revolution of the bowl as well as the change in vertical height is shown in the table VERTICAL TRAVEL OF BOWL USING HYDRAULIC ADJUSTMENT.

### CLEARING THE CRUSHER

Should the Crusher stop under load, no attempt should be made to start the Crusher again until the entire crushing cavity has been cleared. Attempting to start the Crusher with the cavity full of material

may result in serious damage to the Crusher and crusher motor.

Some of the reasons a Crusher stops under load are as follows; for example, Crusher drive motor or engine stopped because of power failure or lack of fuel, too much feed entering the crushing cavity causing the Crusher to stall, discharge conveyor stopped allowing discharging material to back up and plug the Crusher or a piece of tramp iron becoming caught in the crushing cavity.

The gyrating crushing action of the head could possibly cause the material caught between the crushing members on the closed side to tip and raise the adjustment ring a small amount. This caught material wedges very tightly between the bowl liner and mantle because of the compression of the spring clusters in that area. See the illustrations CLEARING THE CRUSHER.

ON OCCASION AN OVERSIZE PIECE OF TRAMP IRON CAN BECOME CAUGHT, IMBEDDED OR WEDGED BETWEEN THE CRUSHING MEMBERS AND CAUSE THE CRUSHER TO STALL. IF TRAMP IRON IS SUSPECTED AS THE REASON THAT THE CRUSHER STALLED, READ THOROUGHLY THE PARAGRAPHS TRAMP IRON REMOVAL LOCATED IN THIS SECTION.

One of the MOST DANGEROUS OPERATIONS around a Crusher is the REMOVAL OF TRAMP IRON which has jammed in the crushing chamber. Extremely severe injuries can occur by trying to remove tramp iron in an incorrect manner. ABSOLUTELY NO WORK SHOULD BE DONE IN TRYING TO REMOVE TRAMP IRON LODGED IN THE CRUSHING CAVITY WITHOUT FIRST READING THOROUGHLY THE PARAGRAPHS IN TRAMP IRON REMOVAL.

ON A STANDARD CRUSHER THE  
INCOMING FEED USUALLY FILLS  
THE ENTIRE CRUSHING CAVITY  
WHEN THE CRUSHER  
STOPS UNDER LOAD

ADJUSTMENT RING  
RAISED SLIGHTLY  
IN THIS AREA

COARSER MATERIAL ON  
THIS SIDE OF CRUSHING  
CAVITY

BOWL LINER

ADJUSTMENT RING

OPEN SIDE

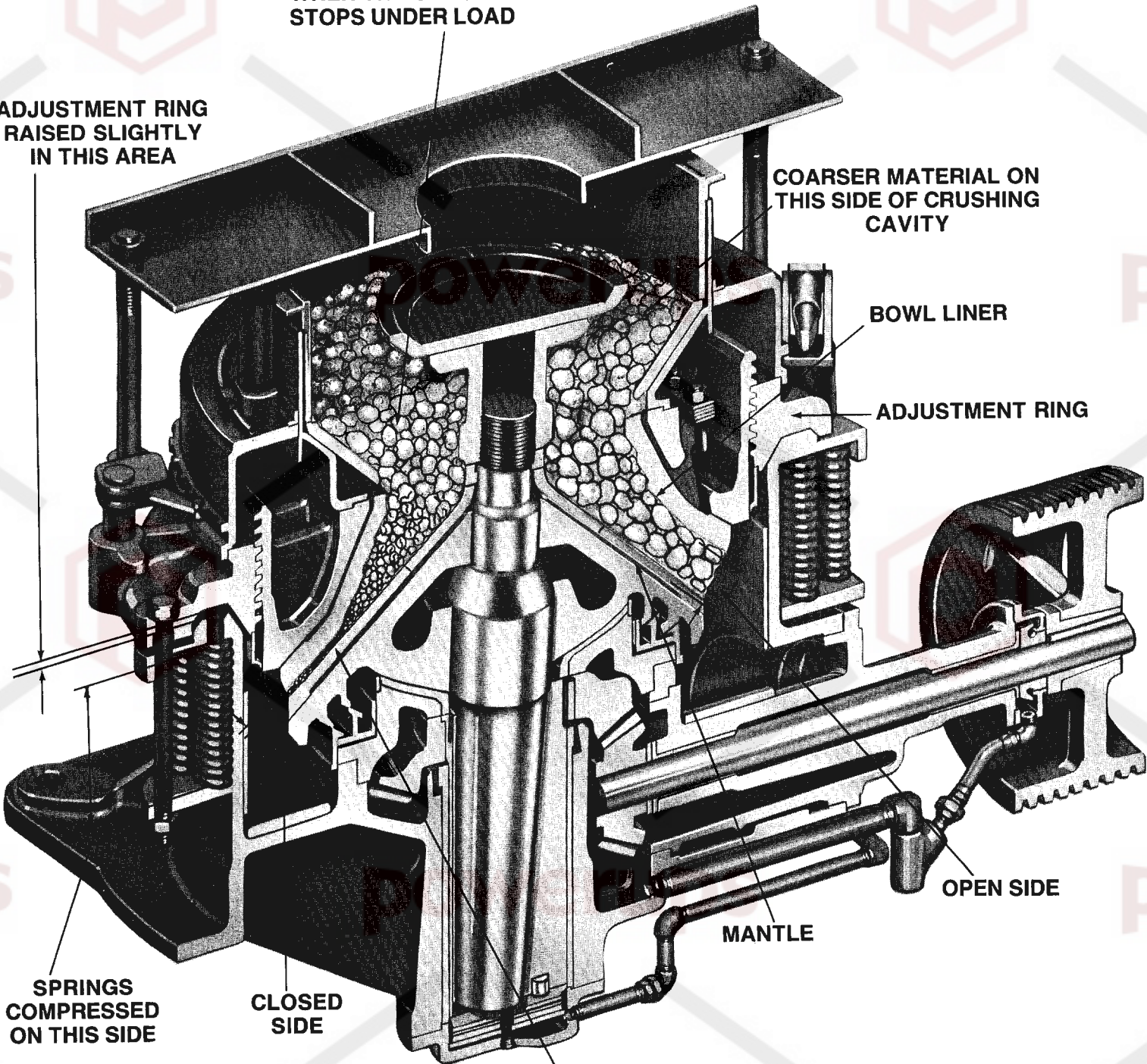
MANTLE

SPRINGS  
COMPRESSED  
ON THIS SIDE

CLOSED  
SIDE

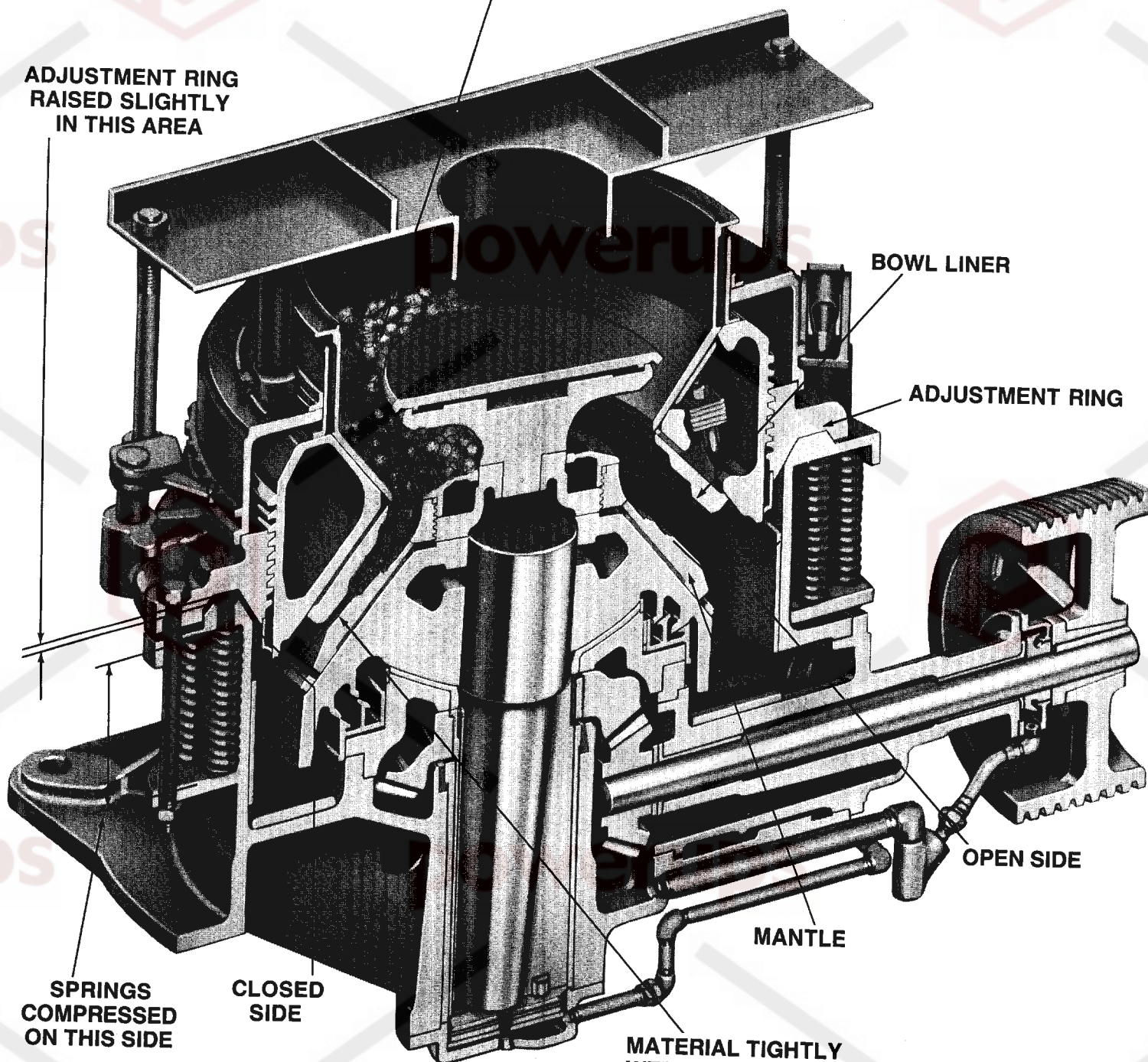
MATERIAL TIGHTLY  
WEDGED BETWEEN  
BOWL LINER AND  
MANTLE ON CLOSED SIDE

**CLEARING THE CRUSHER (STANDARD)**



ON A SHORT HEAD CRUSHER  
THE INCOMING FEED USUALLY  
REMAINS IN ONLY 1/2 OF  
THE CRUSHING CAVITY WHEN  
THE CRUSHER STOPS  
UNDER LOAD

ADJUSTMENT RING  
RAISED SLIGHTLY  
IN THIS AREA



BOWL LINER

ADJUSTMENT RING

OPEN SIDE

MANTLE

MATERIAL TIGHTLY  
WEDGED BETWEEN  
BOWL LINER AND  
MANTLE ON CLOSED SIDE

SPRINGS  
COMPRESSED  
ON THIS SIDE

CLOSED  
SIDE

**CLEARING THE CRUSHER (SHORT HEAD)**

To manually clear the Crusher of material wedged between the bowl liner and mantle, proceed as follows:

- 1 Shut the power OFF to the crusher motor and LOCK OUT the motor.
- 2 Clean out all loose material in the crushing cavity. Always use extreme care when cleaning out the crushing cavity as a piece of tramp iron could be wedged between the bowl liner and mantle but HIDDEN by the loose material in the cavity.
- 3 With the aid of such tools as a sledge hammer, and a long chisel or steel bar which has an end bent into the form of a hook, the wedged or tightly compacted material must be punched or picked out.
- 4 In those machines which are crushing relatively fine material, a plugged Crusher can sometimes be cleared by inserting a high pressure water hose into the crushing cavity and washing away the material.
- 5 In Crushers which are crushing a coarser material, a curved saw with a long handle, such as a pruning saw, can be used to literally "saw" away the wedged material.

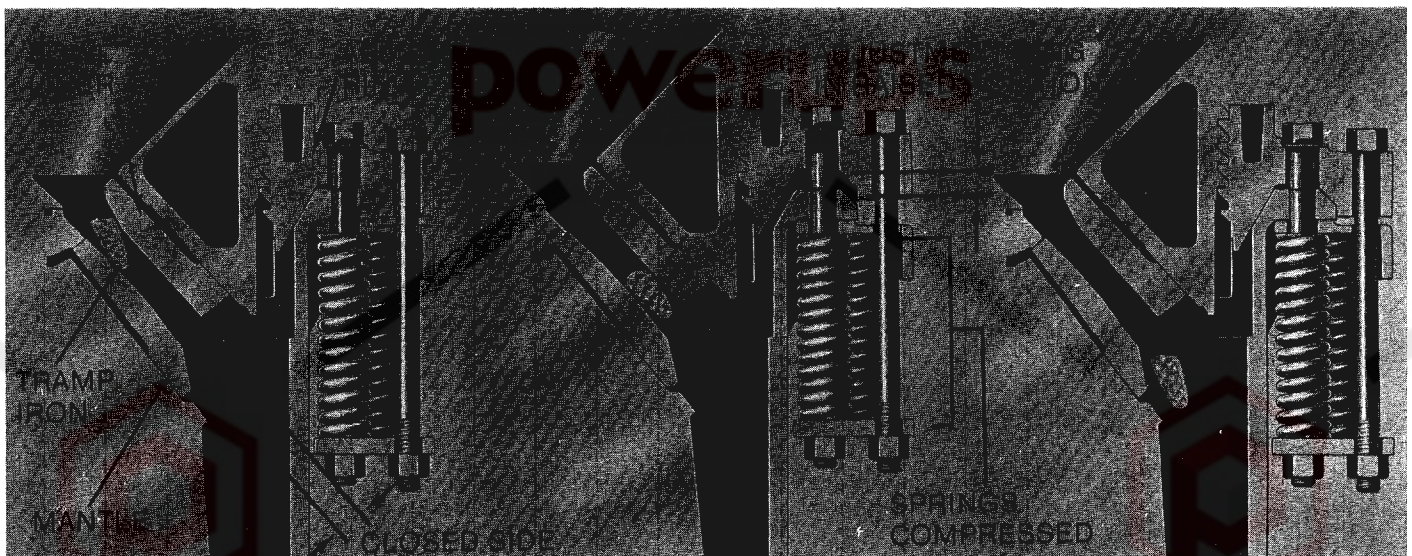
There are many unforeseen events which can cause a Crusher to become plugged with material and stall. UNPLUGGING THE CRUSHER CAN BECOME A VERY SERIOUS POTENTIAL SOURCE OF ACCIDENTS. In many instances, the only way in which the Crusher can be restarted is to literally dig the material out of the crushing cavity.

## WARNING

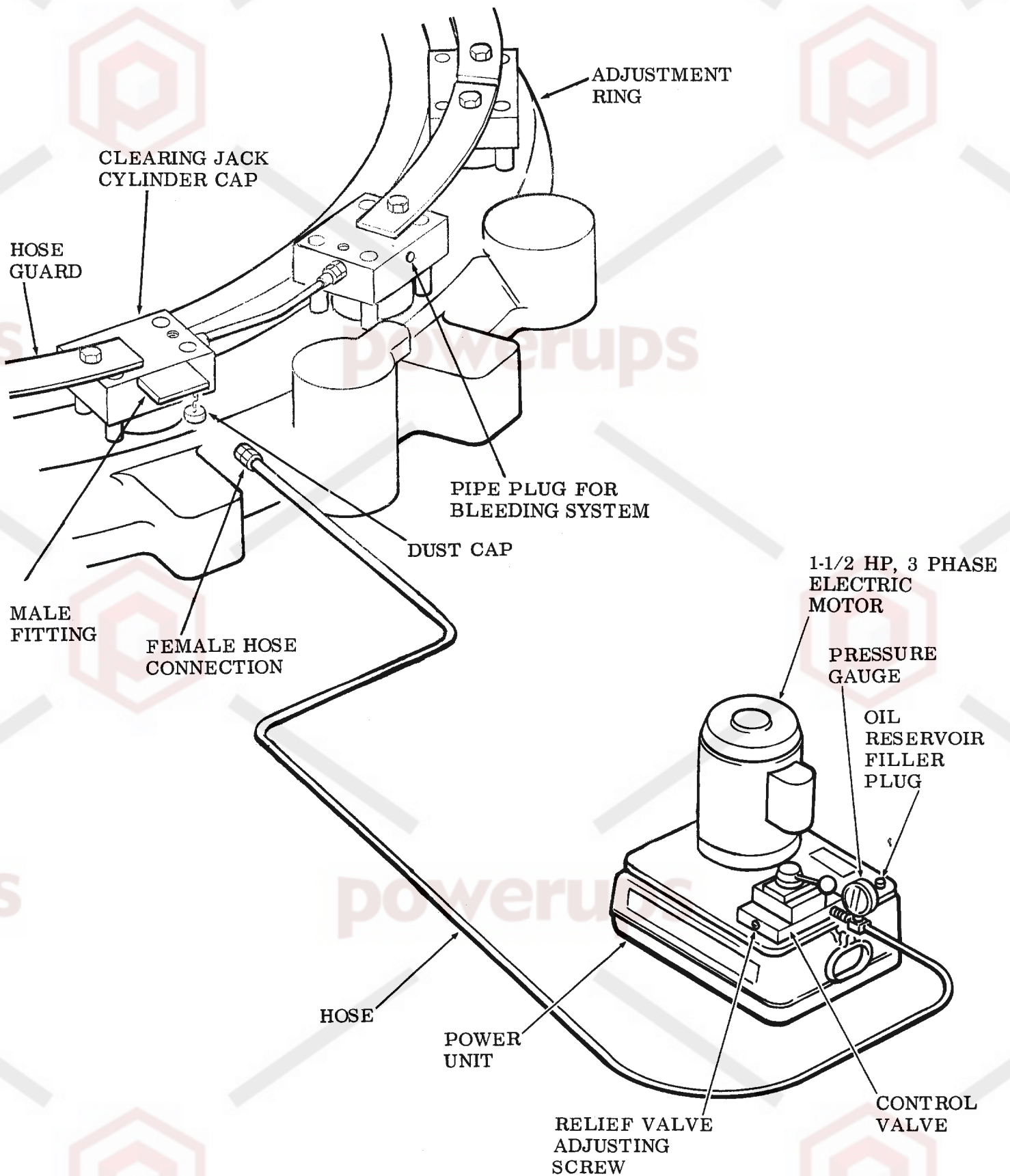
WHEN CLEARING THE CRUSHER IN THIS MANNER, DO NOT PLACE FEET OR HANDS ON THE SPRING CLUSTERS OR IN THE SPACE BETWEEN THE ADJUSTMENT RING AND MAIN FRAME OR ANY PART OF YOUR BODY BETWEEN THE LOWER SPRING SEGMENTS AND THE MAIN FRAME FLANGE. SERIOUS PERSONAL INJURY CAN RESULT.

An arrangement for hydraulically clearing the Crusher is available on the 4 Ft., 5100, 4-1/4 Ft., 5-1/2 Ft. and 7 Ft. Crushers. This hydraulic clearing system will substantially reduce the time and effort which ordinarily would be required to clear a Crusher AND is recommended as the SAFEST way to clear a jammed crushing cavity.

A portable electric power unit, when connected to hydraulic jacks either around the outside of the main frame or on top of the adjustment ring, lifts the entire adjustment ring vertically off its seating surface on the main frame a predetermined distance. See the illustration HYDRAULIC CLEARING SYSTEM. This additional clearance relieves the pressure from the material wedged between the crushing members. The material is now free to pass through the Crusher SAFELY or can now be EASILY CLEARED by manual means. Installation, operation and maintenance of the HYDRAULIC CLEARING SYSTEM are completely described in Section 13.



**SPRING ACTION**



**HYDRAULIC CLEARING SYSTEM**



## TRAMP IRON REMOVAL

As a piece of tramp iron enters the crushing cavity, the springs around the outside of the Crusher allow the bowl and the adjustment ring to rise, thus preventing damage to the Crusher. Immediately upon passage of the tramp iron, the springs automatically return the bowl and adjustment ring to the normal operating position. Refer to the illustration **SPRING ACTION**. On occasion an oversize piece of tramp iron can become caught, imbedded, or wedged between the crushing members and cause the Crusher to stall.

When the tramp iron becomes wedged between the bowl liner and mantle, the tramp material causes the adjustment ring to rise in the area where the tramp iron is caught by overcoming the spring force holding the adjustment ring to the main frame. The spring force pulling down on the adjustment ring and bowl is what makes tramp iron removal extremely dangerous, because in the process of removing the tramp iron, the highly compressed spring clusters pull the adjustment ring back down to its original position on the main frame almost instantaneously.

One of the **MOST DANGEROUS OPERATIONS** around a Crusher is the **REMOVAL OF TRAMP IRON** which has jammed in the crushing chamber. Extremely severe injuries can occur by trying to remove tramp iron in an incorrect manner. **ABSOLUTELY NO WORK SHOULD BE DONE IN TRYING TO REMOVE TRAMP IRON LODGED IN THE CRUSHING CAVITY WITHOUT FIRST READING THOROUGHLY THESE PARAGRAPHS** and the paragraphs in **CLEARING THE CRUSHER**.

The hydraulic clearing system, as previously described in the paragraphs **CLEARING THE CRUSHER**, will substantially reduce the time and effort which ordinarily would be required to clear the Crusher **AND** is recommended, as it will permit the removal of tramp iron **SAFELY**. See the illustration **HYDRAULIC CLEARING SYSTEM**. Installation, operation and maintenance of the **HYDRAULIC CLEARING SYSTEM** are completely described in Section 13.

Should your Crusher not be equipped with a hydraulic clearing system, the use of **THERMAL CUTTING TORCHES** is recommended.

**THERMAL CUTTING TORCHES.** There are various types of thermal cutting torches on the market that operate with much higher temperatures than a conventional oxy-acetylene cutting torch. The thermal type cutting torch is a self-contained tool which consists of a combination of special metal alloy wires inserted inside a long steel pipe which heats to a temperature in excess of 4,500° Fahrenheit when combined with pressurized oxygen forced through the pipe. The intense concentrated heat, generated by such a thermal cutting torch, melts the tramp iron with such speed that there is usually no structural damage to the surrounding materials. A rotary motion to the burning torch is recommended in order to produce a washing action which permits the melted slag from the tramp iron to be blown out as the washing progresses. Its compact size, mobility and low cost should make the thermal torch a most desirable addition to a crushing plant's list of tools.

To remove tramp iron wedged between the bowl liner and mantle using a thermal cutting torch proceed as follows:

- 1 Shut the power **OFF** to the crusher motor and **LOCK OUT** the motor.
- 2 Clean out all loose material in the crushing cavity as described in the paragraphs **CLEARING THE CRUSHER** located in this Section. If the Crusher stalled due to a piece of tramp iron proceed to Step 3.

### **WARNING**

Extreme precautionary safety measures must be taken when removing tramp iron. The reason such caution must be exercised is that it is impossible to know how securely the tramp iron is wedged between the bowl liner and mantle. It is possible to have a piece of tramp iron caught between the crushing members very tightly; it is also possible to have the tramp material wedged between the liners with only a small wedging force so that the slightest jarring of the tramp iron could cause it to be squirted, propelled or ejected rapidly upwards towards the feed opening. Therefore the operator should use great caution whenever attempting to remove a piece of tramp iron from within the crushing cavity. **UNDER NO CIRCUMSTANCES SHOULD ANYONE ENTER THE CRUSHING CAVITY WHEN A PIECE OF TRAMP IRON IS WEDGED BETWEEN THE BOWL LINER AND MANTLE.**

- 3 For safety reasons and to permit a clear view into the crushing cavity, the feed platform should be removed.

IF THE CRUSHER IS EQUIPPED WITH A MAIN SHAFT NUT AND FEED PLATE, SEE THE ILLUSTRATION TRAMP IRON REMOVAL (STANDARD CRUSHER), THE MAIN SHAFT NUT AND FEED PLATE CAN USUALLY BE LEFT IN PLACE AS THE FEED OPENING IS WIDE ENOUGH TO PERMIT A CLEAR VIEW INTO THE LOWER PORTION OF THE CRUSHING CAVITY.

IF THE CRUSHER IS EQUIPPED WITH A FEED DISTRIBUTOR AND FEED PLATE, SEE THE ILLUSTRATION TRAMP IRON REMOVAL (SHORT HEAD CRUSHER), IT IS ADVISABLE TO REMOVE THE FEED DISTRIBUTOR AND FEED PLATE IN ORDER TO OBTAIN A CLEAR VIEW OF THE TRAMP IRON.

- 4 Since a thermal cutting torch is usually a steel pipe approximately 10 ft. long, the operator should stand on an operator's platform surrounding the Crusher on the opposite side from where the tramp iron is wedged, for a clear view of the crushing cavity AND FOR MAXIMUM SAFETY. The "pipe" can easily be bent to permit working in the crushing cavity.
- 5 Connect the cutting torch to an oxygen supply, set the oxygen pressure and permit a small amount of oxygen to flow through the cutting torch. Ignite the cutting end of the torch following the manufacturer's operating instructions very carefully; then open the oxygen regulating valve completely. The thermal cutting torch should now burn vigorously.

**WARNING**

WHEN WORKING WITH TORCH CUTTING EQUIPMENT, USE HEAT RESISTANT PROTECTIVE CLOTHING AND GLOVES, SHADED WELDING GOGGLES, HARD HAT AND FACE SHIELD FOR SAFETY REASONS.

- 6 After the tramp iron has been located, lower the cutting torch into the crushing cavity and proceed to "wash" the tramp iron away. Start at the top of the tramp iron and wash the molten metal downward. It is very important that the molten metal can run out freely and it does not form a puddle on the tramp iron. Use a slight rotary motion to the cutting portion of the torch to speed up the "washing" operation and to keep the tramp iron from rewelding itself.

DO NOT TOUCH THE TRAMP IRON OR PUT ANY PRESSURE ON IT WITH THE TORCH. ALWAYS MAINTAIN A SHORT GAP WHEN CUTTING METALS. ALWAYS KEEP THE TORCH MOVING TO PREVENT IT FROM BEING FUSED TO THE METAL BEING BURNED.

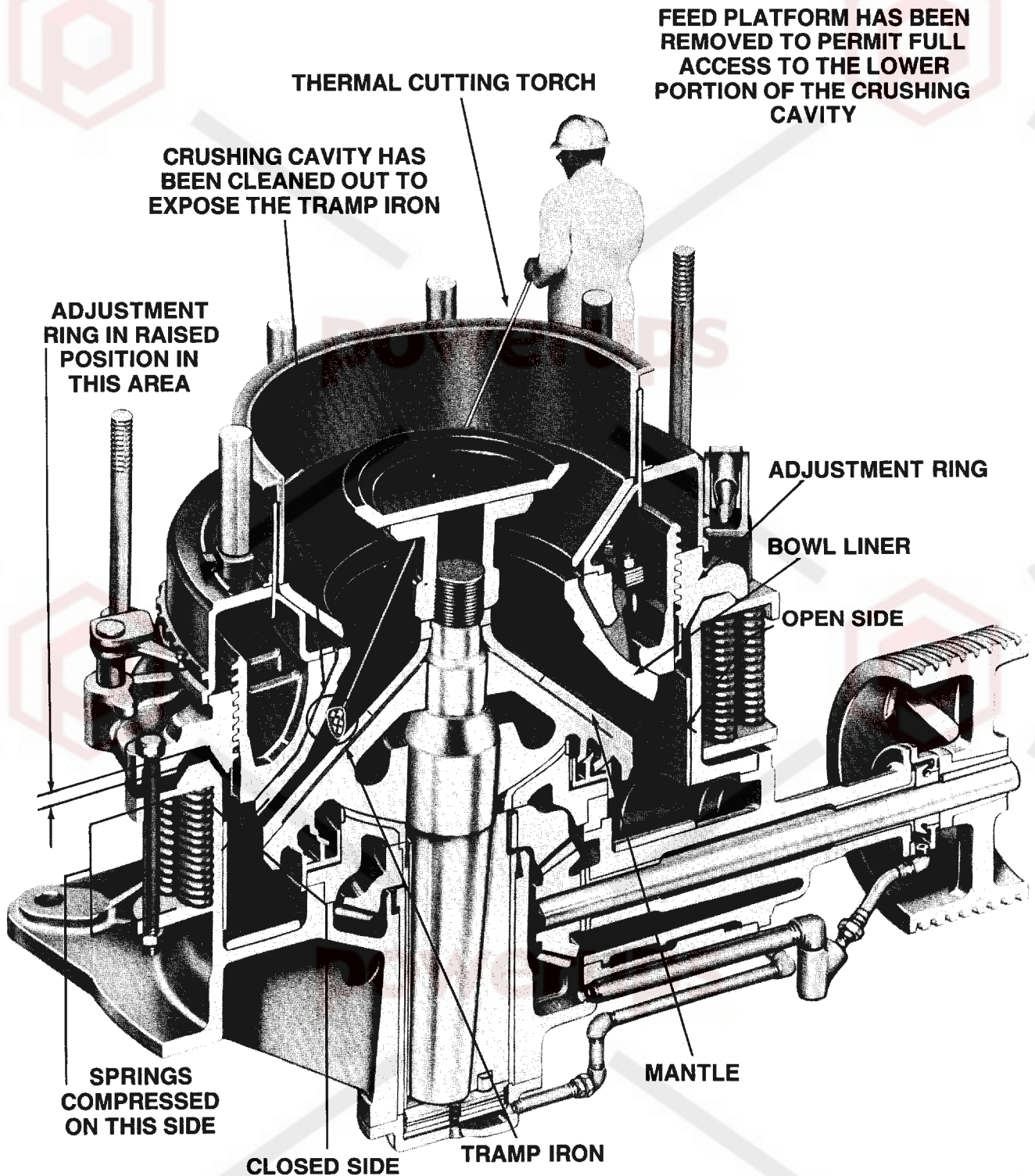
During the cutting operation protect the discharge conveyor and nearby walls or flooring from sparks or hot metal as it is possible for molten slag to drop out of the Crusher onto the conveyor belt.

**WARNING**

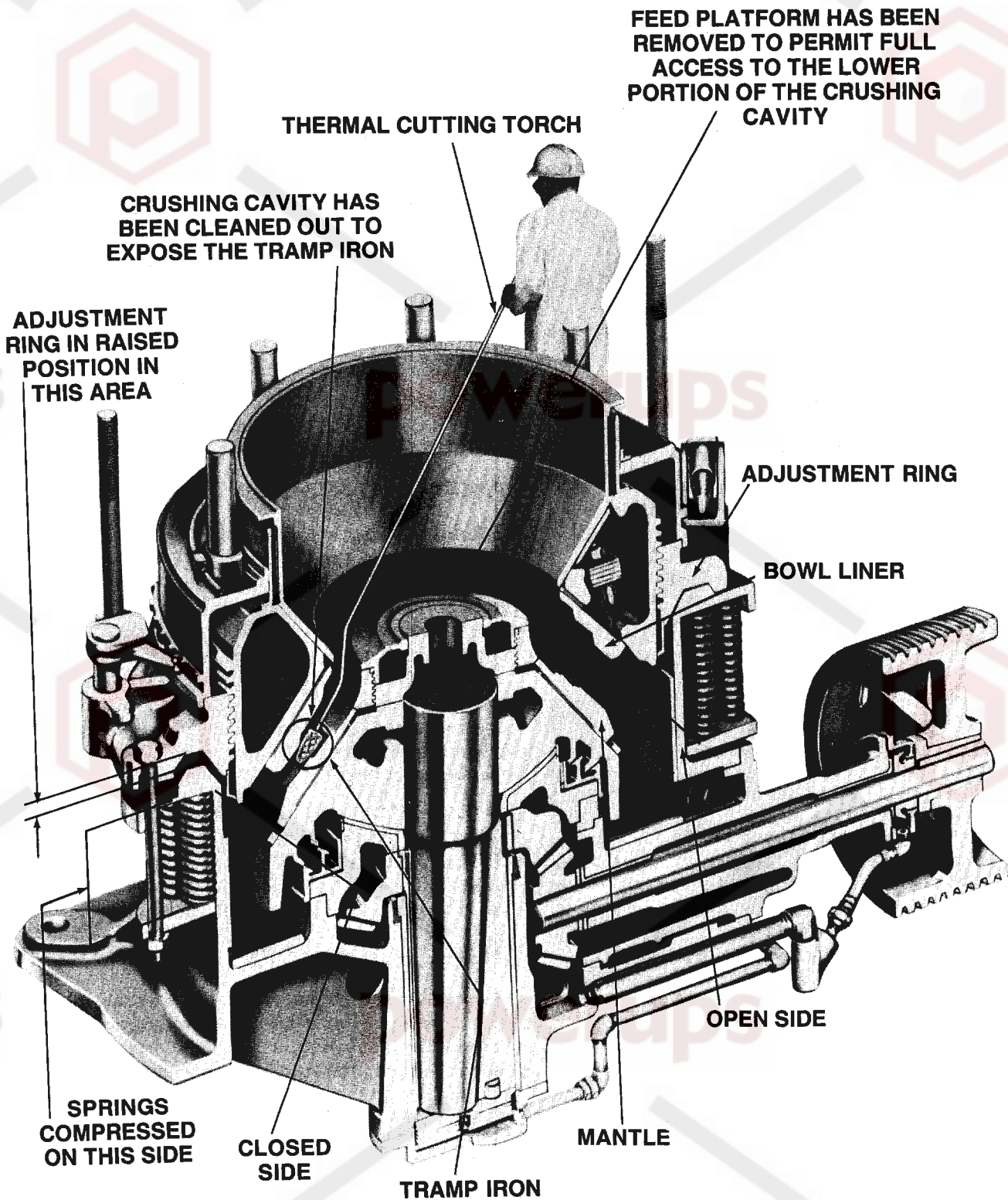
WHEN DOING ANY TORCH CUTTING AROUND A CRUSHER, PERSONNEL SHOULD BE REQUIRED TO WEAR RESPIRATORS, AS THE NOXIOUS FUMES PRODUCED DURING THE CUTTING PROCESS CAN BE HARMFUL IF BREATHED CONTINUOUSLY IN CONCENTRATED FORM. AVOID INHALING FUMES! PROVIDE ADEQUATE VENTILATION!

- 7 Work quickly as the burning time of the 10 ft. long thermal cutting torch is 3 to 5 minutes.

The pipe portion of a thermal cutting torch is similar to a conventional welding electrode in that the entire 10 ft. long pipe is self-consuming or "disappears" during use. THEREFORE FOR MAXIMUM SAFETY DO NOT USE A THERMAL CUTTING TORCH PIPE WHEN THE PIPE LENGTH IS SHORTER THAN 5 FT., EITHER THREAD OR PUSH ON AN ADDITIONAL 10 FT. LENGTH AS THESE CUTTING TORCHES ARE DESIGNED FOR QUICK ATTACHMENT OF PIPE LENGTHS.



**TRAMP IRON REMOVAL  
(STANDARD CRUSHER)**



**TRAMP IRON REMOVAL  
(SHORT HEAD CRUSHER)**

## **WARNING**

DO NOT ATTEMPT TO DISLodge OR "LOOSEN" THE TRAMP MATERIAL WITH A SLEDGE HAMMER, PRY BAR OR LONG PIPE. SERIOUS PERSONAL INJURY COULD RESULT. DO NOT ATTEMPT TO DISLodge OR "LOOSEN" THE TRAMP MATERIAL USING ANY TYPE OF EXPLOSIVE DEVICE. SERIOUS PERSONAL INJURY AND SEVERE DAMAGE TO THE CRUSHER COULD RESULT.

DO NOT PLACE ANY BLOCKING OR WEDGES BETWEEN THE ADJUSTMENT RING, MAIN FRAME OR SPRING CLUSTERS TO HOLD THE ADJUSTMENT RING IN ITS RAISED POSITION WHILE REMOVING TRAMP IRON IN THE CRUSHING CAVITY. ONCE THE TRAMP IRON HAS BEEN REMOVED, THE SPRING FORCE PULLING DOWN ON THE ADJUSTMENT RING AND BOWL MAY CAUSE THE BLOCKING OR WEDGES TO SLIP OR SQUIRT OUT, OR THEY MAY BE PINCHED SO TIGHTLY THAT THEY MUST BE REMOVED IN THE SAME MANNER AS A PIECE OF TRAMP IRON. SERIOUS PERSONAL INJURY COULD RESULT.

- 8 Once the tramp iron has been washed away and the adjustment ring lowers to its original position on the main frame, the cutting torch should be QUICKLY withdrawn. It is possible to occasionally damage a cutting torch with the procedure just described as the torch can become pinched between the bowl liner and mantle if the adjustment ring returns to its seating surface on the main frame before the cutting torch can be withdrawn.

**OXY-ACETYLENE CUTTING TORCHES.** Oxy-acetylene cutting is an operation in which a mixture of pressurized oxygen and acetylene is fed through a conventional welding torch equipped with a cutting attachment. The cutting torch directed towards the tramp iron causes the tramp iron to be cut only in the area directly beneath the cutting tip.

Usually such equipment requires plant personnel to be near the place where the tramp material is caught and does not offer any protection should the tramp iron "slip" during the cutting process.

THEREFORE AN OXY-ACETYLENE CUTTING TORCH IS NOT A SUITABLE METHOD FOR REMOVAL OF TRAMP IRON AND SHOULD NOT BE USED.

**LANCING.** Lancing is an operation in which pressurized oxygen is fed through a long steel pipe by means of a hose and an oxy-acetylene cutting or welding torch is used to pre-heat the surface of the material to be removed. The oxygen lance directed against the pre-heated tramp iron causes the tramp material to burn at a much higher temperature than a conventional cutting torch. However, if the tramp iron is caught in the lower portion of the crushing members pre-heating of the tramp iron would be extremely difficult, if not impossible.

THEREFORE AN OXYGEN LANCE IS NOT A SUITABLE METHOD FOR REMOVAL OF TRAMP IRON AND SHOULD NOT BE USED.

## **FACTORY OVERHAUL**

Special facilities are available for rebuilding complete Crushers or reconditioning parts which may have seen unusual hard service or have become worn after long periods of operation. It may prove advisable and advantageous to return the Crusher to the factory for this work. A complete overhaul at times is more economical than mere replacement of some badly worn parts. Crushers are completely dismantled, all parts are inspected to determine serviceability and worn parts are replaced with factory made parts to assure proper operation.

CHECK WITH THE FACTORY REGARDING THIS SERVICE BEFORE SCRAPPING WORN PARTS SUCH AS HEAD, BOWL, ADJUSTMENT RING, OR MAIN FRAME. Considerable savings may be possible through reconditioning of such parts.

## **INSPECTION PERIODS**

The best method of keeping a Crusher in good operating condition after it has been erected and operating satisfactorily, is regular periodic inspections. It is recommended that the Crusher be inspected regularly and adjustments made and worn parts replaced before a major breakdown develops. The inspections that are required and the intervals of time for each inspection are clearly given on the chart INSPECTION AND MAINTENANCE PERIODS. These inspections are meant only as a guide and some individual judgement will have to be used to determine whether the inspections are to be performed at closer or further intervals. The type of material handled, climate and operating conditions will dictate the frequency of inspections.

Keep the Crusher clean and well painted. A clean machine, as a rule, receives better care, is better maintained and will not depreciate as quickly as one which is neglected or abused.

## INSPECTION AND MAINTENANCE PERIODS

8 HOURS	40 HOURS	200 HOURS	2000 HOURS
<ol style="list-style-type: none"> <li>1. Check the level of oil in the oil tank.</li> <li>2. Check oil temperature</li> <li>3. Check for oil flow in the sight feed gauge or oil pressure if so equipped.</li> <li>4. Check power draw on motor.</li> <li>5. Check adjustment cap screws or tapered keys for tightness.</li> <li>6. Check for loose fasteners or connections.</li> <li>7. Check for unusual noise, indications of wear, or undue strain on crusher parts.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check V-Belts for tension wear or breaks.</li> <li>2. Check for oil leaks in both pipeline and Crusher.</li> <li>3. Check mantle and bowl liner for tightness.</li> <li>4. Check crusher setting.</li> <li>5. Check end float.</li> <li>6. Clean counter-shaft box and oil tank air breathers.</li> <li>7. With bowl in crushing position, grease adjustment ring and bowl threads using grease fittings on the adjustment ring.</li> </ol>	<ol style="list-style-type: none"> <li>1. Release bowl assembly from its crushing position and rotate back and forth.</li> <li>2. Check the lubricating oil for dirt and sludge. Change if necessary.</li> <li>3. Inspect the oil strainer within the oil tank for metal chips. Occasional small metal flakes are normal. A large quantity of chips may indicate excessive pressure on bearing surfaces or possible bearing failure.</li> <li>4. Check mantle and bowl liner for wear.</li> <li>5. Check feed plate and feed cone for wear.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check step bearing plates for wear.</li> <li>2. Check inner and outer eccentric bushing wear.</li> <li>3. Inspect gear and pinion teeth for wear and check backlash and root clearances.</li> <li>4. Check socket liner wear.</li> <li>5. Check socket sealing ring and spring housing for wear. Also check sealing ring springs effective pressure (Standard seal only).</li> <li>6. Inspect main shaft and head for wear.</li> <li>7. Inspect bowl and adjustment ring threads for wear.</li> </ol>

## INSPECTION AND MAINTENANCE PERIODS

8 HOURS	40 HOURS	200 HOURS	2000 HOURS
<p>8. When crushing members approach wear limit check daily.</p> <p>9. Check the oil flow back into the oil tank, both from the Crusher and from the relief valve</p> <p>10. Check that alarm system is functioning</p> <p>11. Check when stopping Crusher that Crusher "floats" to easy stop.</p> <p>12. Check that feed to Crusher is properly distributed.</p> <p>13. Check that Crusher has a free discharge.</p>	<p>8. Check adjustment cap seal for tightness against bowl hopper.</p> <p>9. Check for spring action or movement of adjustment ring.</p> <p>10. Check sheaves for dust accumulation, cracked spokes and tightness on shaft.</p> <p>11. Check feed plate bolts for tightness</p>		<p>8. Check countershaft bushing wear.</p> <p>9. Look for leakage at gaskets, packings, "O" rings, and seals.</p> <p>10. Inspect oil collar gear and oil pump gear tooth wear (Integral pump only).</p> <p>11. Check if rubber skirt around water chamber has clearance between the baffle ring on head and the skirt. (Water seal only).</p> <p>12. Check main frame liner wear.</p> <p>13. Check arm guard and countershaft box guard wear.</p> <p>14. Check for any cracked welds.</p> <p>15. Change oil in oil tank.</p> <p>16. Check the springs around the outside of the Crusher for the proper installed length.</p>

### TYPICAL CRUSHER PROBLEMS

CRUSHER PROBLEMS	POSSIBLE CAUSES	COMMENTS/CORRECTIONS	REFER TO SECTION-PAGE
Crusher Overheating	1. Pump worn—not delivering enough oil.	1. Check for proper oil flow (GPM) in drain line.	10-3
	2. Insufficient running clearances between main shaft and inner eccentric bushing.	2. Check socket liner and ball of head for wear. Use templates to check the socket liner and ball of head for wear. CONSULT THE FACTORY. The socket liner undercut can be used as a guide, the head should be smooth without any noticeable step.	6-26
	3. Oil not draining properly.	3. Check pitch in drain line from crusher to oil tank. (Minimum 1" per 12").	2-11
		Clean air breather on side of countershaft box.	10-39
		Drain line clogged with dirt or other debris.	
	4. Improper crusher liners for application.	4. Too much crushing in lower portion of crushing cavity causing excessive power draw.	1-3
	5. Hot or unusually hard feed causes crusher to generate more heat.	5. Requires installation of oil cooler due to application.	10-25 10-31
	6. Insufficient clearance for oil to flow between top of eccentric and underside of socket.	6. Establish proper socket and eccentric clearance, oil trapped between inner eccentric bushing and main shaft causing local "hot" spot (1/4" to 1/8" clearance required).	6-33
	7. Insufficient oil supply.	7. Check relief valve for malfunctioning due to wear, chips or stuck spring, oil bypassing crusher.	10-32
		Check for the proper oil level in tank.	10-5
8. V-belts tensioned too tight.	8. Retension V-belts.	2-5	
9. Improper oil installed in crusher.	9. Change to proper oil. Extreme Pressure oil recommended.	10-1	
10. No end float	10. Reset end float (1/32" to 1/16").	4-4, 4-6	



CRUSHER PROBLEMS	POSSIBLE CAUSES	COMMENTS/CORRECTIONS	REFER TO SECTION-PAGE
	11. Crusher pulling too much power.	11. Improper feed conditions often involved. Excessive amount of fines in feed, or crusher set too tight for application.  Large amount of tramp material in the feed causing overloads.	1-3
	12. Crusher set too tight.	12. Do not set crusher setting below recommended minimum discharge setting.	11-11
	13. Insufficient clearance between top of outer eccentric bushing and underside of gear.	13. Oil trapped between outer eccentric bushing and eccentric —top of bushing must be flush with top of main frame.	3-5
	14. Too thin of step bearing plate shim between lower step bearing plate and main frame cap can “shift” and close off center oil hole causing reduced lubrication to the inner eccentric bushing.	14. Do not use shims thinner than 1/32”.	5-4
	15. Lubrication hole in the main shaft or head plugged with dirt or other debris.	15. Vertical hole in main shaft, inter-connecting horizontal hole in shaft and angular hole in head must be cleaned using high pressure air.	10-1
	16. Outer eccentric bushing pulled in or collapsed near where the gear well of the main frame joins the eccentric hub of the frame.	16. Main frame bore must be restored to its original diameter either by machining or by hand grinding. Hand grinding can take as many as six to eight hours to complete and is in a confined area. While the “hand ground” bore is somewhat rough and irregular, it is an effective way to remove the pulled-in or collapsed area of the frame.	3-4
	17. Inner eccentric bushing pulled in or collapsed at the TOP of the bushing on the THIN side of the eccentric. That area directly opposite the main gear key.	17. Hand grind the pulled in or collapsed area of the eccentric until the bushing fits in the eccentric so that it is tight at the bottom. Do not force the bushing into position.	5-7 5-8 5-9

CRUSHER PROBLEMS	POSSIBLE CAUSES	COMMENTS/CORRECTIONS	REFER TO SECTION-PAGE
Crusher Throwing Oil	1. Bearing surface of socket liner worn away. (0-10 RPM normal head spin).	1. Usually shows up as excessive head spin. Regrind socket liner or replace socket liner, make sure contact area is at outer edge of socket liner. Use templates to check the socket liner and ball of head for wear. CONSULT THE FACTORY.	6-26
	2. Socket sealing ring jammed in upward position holding head up away from socket liner.	2. Usually due to one of the locking keys in cocked position, dust build-up around sealing ring springs and housings, or build-up of crushed material in discharge compartment lifting up sealing ring. Crusher must be dismantled and thoroughly cleaned in the socket area.	6-20
	3. High oil pressure.	3. Excessive pressure lifts head out of socket liner. Cold weather start-ups often major factor.	10-6
		Oil too cold or incorrect relief valve.	10-32
	4. Closed-in inner eccentric bushing, creating more friction on main shaft due to improper running clearances.	4. Usually shows up as excessive head spin. Head will spin at eccentric speed, usually due to worn socket liner or excessive heat build-up in crusher at some previous time.	6-26
	5. Excessive wear on feed plate or on feed distributor assemblies.	5. Replace feed plate or add weight (welded plates) to top of feed distributor to provide proper balance.	7-1 7-11
	6. Slabby feed being trapped under feed plate and cocking head.	6. Cut down on feed size.	7-1
	7. Oil too cold.	7. Install oil tank immersion heater and heat oil to 80° F.	10-6
8. Crusher lightly loaded.	8. Increase feed to crusher. Under load contact area on socket liner is at outer edge, when crusher is lightly loaded contact area is on inside edge of socket liner. Scrape or replace socket liner, ball of head may require remachining. Use templates to check the socket liner and ball of head for wear. CONSULT THE FACTORY.	6-26	

<b>CRUSHER PROBLEMS</b>	<b>POSSIBLE CAUSES</b>	<b>COMMENTS/CORRECTIONS</b>	<b>REFER TO SECTION-PAGE</b>
	9. Excessive countershaft speed (RPM).	9. Check for correct countershaft speed (RPM).	11-2
	10. Improper oil installed in crusher. Oil too heavy.	10. Change to proper oil.	10-1
	11. Crusher not vented properly.	11. Clean breather on side of countershaft box. Use high pressure air to clean out long cored hole in countershaft box to which the breather is connected.	10-39 10-40
	12. Oil passages or air vents in socket plugged to prevent proper oil drainage.	12. Dismantle and clean all socket and liner oil drain holes and air passages.	6-23
	13. Drain hose from flinger housing kinked or plugged.	13. Replace drain hose and/or eliminate kink or sharp bend in drain piping.	4-18
	14. Oil not draining fast enough, from flinger housing, especially when oil is cold.	14. Run separate drain line back to oil tank.	4-19
	15. Drain line clogged with dirt or other debris.	15. Inspect drain line, clean if necessary.	None
	16. No orifice or too large of a hole in the orifice in the bottom of the main shaft.	16. Consult the factory for correct orifice hole size.	None

CRUSHER PROBLEMS	POSSIBLE CAUSES	COMMENTS/CORRECTIONS	REFER TO SECTION-PAGE
Capacity Falling Off	1. Feed opening in bowl liner has closed-in due to wear restricting feed entry.	1. Replace liners or torch-cut larger feed opening.	1-3
	2. Low operating speed (RPM).	2. Check for correct countershaft speed (RPM).	11-2
	3. Too much moisture in the feed, slowing the movement of the feed in the crushing cavity.	3. Moisture must be less than 5%.	None
	4. Extremely slabby feed causing bridging before the feed opening at the top of the liners.	4. Reduce feed size.	7-1
	5. Large pieces of debris in the feed (wood, tree roots, re-bar, etc.) slowing feed movement.	5. Feed to crusher should be free of this type of material.	2-2
	6. Too large of a feed top size.	6. Reduce feed size.	2-2
	7. Large amount of clay in the feed.	7. Remove clay or sticky material from the feed.	None
	8. Incorrect feed distribution, segregated feed causes fines to be fed in one side of the crushing cavity.	8. Correct feed arrangement.	2-2
	9. Broken or cracked main shaft.	9. Remove main shaft assembly and carefully inspect the area where the main shaft is pressed into the head for possible movement of the shaft within the head bore. If in doubt have the main shaft sonic tested.	None

<b>CRUSHER PROBLEMS</b>	<b>POSSIBLE CAUSES</b>	<b>COMMENTS/CORRECTIONS</b>	<b>REFER TO SECTION-PAGE</b>
Crusher Stalling	1. V-belts too loose.	1. Retension V-belts.	2-5
	2. Electrical problems with drive motor.	2. Check power draw of crusher running empty and compare to power draw of motor running free (without belts). If both readings are close, have electrician check motor.	None
	3. Wet, sticky feed to crusher.	3. Install water jets to flush material through crusher, thus preventing build-up in cavity.	11-16 11-17
	4. Build-up under crusher.	4. Check foundation for ample discharge of crushed material. Install bin indicator and/or zero speed switch on discharge conveyor tail pulley.	2-3
	5. Countershaft speed too low.	5. Check for correct countershaft speed (RPM)	11-2
	6. Oil pressure (PSI) too low.	6. Check for correct operating pressure (PSI)	10-3
	7. Feed level too high in crushing cavity causing excessive power draw.	7. Reduce amount of feed to crusher.	2-2 2-3
	8. Improper electric drive motor or diesel engine.	8. Electric motor or engine horsepower service factor too low.	2-11
	9. Incorrect feed opening (too small) in crushing cavity. Most crushing being done at top of feed opening which increases power draw.	9. Check for correct selection of liners	1-3 thru 1-9
	10. Closed-in outer and/or inner eccentric bushing thereby reducing running clearances.	10. Crusher must be disassembled to inspect condition of the bearings.	3-4 5-7

CRUSHER PROBLEMS	POSSIBLE CAUSES	COMMENTS/CORRECTIONS	REFER TO SECTION-PAGE
Water Getting Into Oil (Water Seal)	1. Vent passages not installed in socket.	1. Dismantle socket and install vents.	6-24
	2. Oil passages and air vents plugged to prevent proper venting of water chamber.	2. Dismantle and clean all socket and liner oil drain holes and air passages.	6-23
	3. Excessive water flow to chamber.	3. Check for proper water GPM and constant water pressure. Fluctuating pressure causes splashing of water.	6-15
		Check that water jets are all pointing in a clockwise direction to permit smooth water flow.	6-25
	4. Inside diameter of baffle ring worn so that it no longer remains in the water circulating in the water chamber as the head gyrates.	4. Consult the factory for the correct dimension.	6-22
5. Dirty water plugging drain lines from the water chamber.	5. Water should be clean and free from foreign matter and excessive sediment.	6-15	

CRUSHER PROBLEMS	POSSIBLE CAUSES	COMMENTS/CORRECTIONS	REFER TO SECTION-PAGE
Frozen or Broken Countershaft	1. V-Belts tensioned too tight.	1. Retension V-belts and check sheave alignment.	2-5
	2. No lubrication or not enough lubrication to countershaft bushings.	2. Check for some type of restriction between main oil supply line and entry hole in countershaft box. Remove any type of valve or some other means of restriction in the supply line.	None
	3. Oil groove in outer countershaft bushing in wrong position.	3. V-belt drive should never pull countershaft into oil groove.	4-16
	4. No end float.	4. Reset end float (1/32" to 1/16").	4-4, 4-6
	5. Bent countershaft. Usually shows up as excessive vibration to end of countershaft or "wobble" to crusher sheave.	5. Replace countershaft.	4-15
	6. Oil groove in outer countershaft bushing plugged with dirt or other debris.	6. Clean oil groove.	4-15
	7. Broken gear or pinion tooth.	7. Replace gear or pinion.	5-5, 4-11
	8. Incorrect backlash and/or root clearance between gear and pinion.	8. Check for correct backlash and root clearance.	5-2

<b>CRUSHER PROBLEMS</b>	<b>POSSIBLE CAUSES</b>	<b>COMMENTS/CORRECTIONS</b>	<b>REFER TO SECTION-PAGE</b>
Stuck Bowl	<p>Accumulation of dirt or rust between threads of adjustment ring and bowl because of:</p> <p>Hot incoming feed (slag).</p> <p>Poor thread lubrication.</p> <p>Worn adjustment cap seal or dust collar seal.</p> <p>No weather protection.</p> <p>Operating too long at one setting.</p> <p>Galled bowl and/or adjustment ring threads.</p> <p>Broken Threads.</p>	<p>Try the following steps in order:</p> <p>Pour anti-freeze into threads.</p> <p>Loosen adjustment cap screws or Duckworth keys or release the pressure in the hydraulic lock posts and run material through crusher.</p> <p>Run pieces of lumber through crusher.</p> <p>Throw small pieces of "soft" steel through crusher.</p> <p>Heat adjustment ring.</p> <p>Heat adjustment ring and cool bowl.</p> <p><b>DO NOT REMOVE ADJUSTMENT RING FROM MAIN FRAME.</b></p>	<p>11-12</p> <p>11-4 11-6 11-8 12-17</p> <p>11-12</p>



<b>CRUSHER PROBLEMS</b>	<b>POSSIBLE CAUSES</b>	<b>COMMENTS/CORRECTIONS</b>	<b>REFER TO SECTION-PAGE</b>
Loose Bowl Liner or Mantle	1. Mantle - Main shaft nut or locking nut does not self-tighten.	1. Check for zinc or NORDBAK poured too high and left in contact with underside of main shaft nut or locking nut.	7-8 7-18
	2. Mantle - Crusher countershaft rotating in wrong direction.	2. Self-tightening feature of mantle will not work if countershaft is rotating in wrong direction.	7-4 7-14
	3. Locking nut on short head crusher bottoming on head.	3. Insufficient clearance between bottom of locking nut and top of head. Minimum clearance should be approximately 3/8".	7-14
	4. Mantle or head seating surfaces worn or not machined correctly.	4. Restore seating surfaces to factory dimensions.	None
	5. Insufficient backing clearance between mantle and head.	5. Backing clearance should be at least 1/4" to 3/8".	7-6, 7-8 7-17, 7-19
	6. Mantle out-of-round.	6. Maximum out-of-round condition should be 1/4".	None
	7. Mantle not centered on head.	7. Check with feeler gauge at bottom of mantle. Clearance should be no more than 0.004 inch.	7-6 7-8 7-17 7-19
	8. Mantle not tight on head during initial installation.	8. See comment No. 7.	7-6, 7-8 7-17, 7-19
	9. Mantle — Operating Crusher without feed for too long of a time.	9. Maximum idle time should be 30 minutes.	None
	10. Mantle too thin.	10. Wear not to exceed 2/3 of mantle thickness.	None
	11. Old backing not completely removed before installing new mantle.	11. Remove all old backing to permit the new mantle to seat correctly on the head.	7-6 7-16
	12. Bowl liner - broken hooks	12. Badly worn bowl liner; thin section flexing.	8-1
	13. Bowl liner - loose or broken U-bolts.	13. Rubber belting washers not installed when bowl liner was replaced.	8-9
	14. Bowl liner too thin.	14. Wear not to exceed 2/3 of bowl liner thickness.	None
	15. Too much tramp iron or sticky material going through the crusher.	15. Too much tramp iron or sticky material will cause adjustment ring to jump.	2-2
	16. Bowl liner or bowl seating surfaces worn or not machined correctly.	16. Restore seating surfaces to factory dimensions.	None

CRUSHER PROBLEMS	POSSIBLE CAUSES	COMMENTS/CORRECTIONS	REFER TO SECTION-PAGE
	17. Old backing not completely removed before installing new bowl liner.	17. Remove all old backing to permit the new bowl liner to seat correctly in the bowl.	8-7
	18. U-shaped fiber glass inserts used around bowl liner hooks caught between bowl liner seat and bowl causing improper seating.	18. Remove bowl liner, trim the inserts to provide a 1/2" minimum clearance between bottom of insert and edge of bowl liner seat.	8-8

CRUSHER PROBLEMS	POSSIBLE CAUSES	COMMENTS/CORRECTIONS	REFER TO SECTION-PAGE
Oil Leak at Sheave End of Countershaft Box	1. Crusher not vented properly.	1. Clean breather on side of countershaft box. Use high pressure air to clean out long cored hole in countershaft box to which the breather is connected.	10-39 4-1
	2. Drain hose from flinger housing kinked or plugged.	2. Replace drain hose and/or eliminate kink or sharp bend in drain piping.	4-18
	3. Oil not draining fast enough, from flinger housing, especially when oil is cold.	3. Run separate drain line back to oil tank.	4-19
	4. Worn piston ring between oil flinger and flinger housing.	4. Replace piston ring and rework housing bore, if necessary.	4-11

CRUSHER PROBLEMS	POSSIBLE CAUSES	COMMENTS/CORRECTIONS	REFER TO SECTION-PAGE
Excessive Vibration	1. Weight change due to worn crusher parts.	1. Excessively worn feed plate or feed distributor parts. Add weight onto feed distributor or replace worn parts.	7-1 7-11
	2. Excessive head spin.	2. Head and main shaft moving with eccentric due to seized inner eccentric bushing.	5-8
	3. Gear and pinion tooth root interference.	3. Improper gear mesh, gear bottoming on pinion. Raise eccentric assembly by shimming.	5-2
	4. Bent countershaft.	4. Replace countershaft.	4-15
	5. Crusher sheave badly out of balance.	5. Remove dirt build-up from spokes and rim of sheave.	4-4
	6. If crusher is mounted on a portable plant, cribbing or soil conditions maybe inadequate.	6. Check cribbing or soil conditions.	0-8
	7. Inadequate foundation and/or soil bearing capacity.	7. Check foundation or soil conditions.	2-1
	8. Loose mantle.	8. Remove mantle and re-install.	7-4, 7-14, 7-20
	9. Countershaft speed (RPM) too high.	9. Check for correct countershaft speed (RPM).	11-2

<b>CRUSHER PROBLEMS</b>	<b>POSSIBLE CAUSES</b>	<b>COMMENTS/CORRECTIONS</b>	<b>REFER TO SECTION-PAGE</b>
Wear on Head or Bowl Seating Surface	1. Crusher operating with loose mantle or bowl liner.	1. Make sure crushing members are seated properly when assembling with related parts and that locking nut or main shaft nut is tightened securely BEFORE operation.	8-8 8-9 7-7 7-9 7-17 7-19
	2. Crusher operating with excessively worn mantle or bowl liner.	2. Thin section of crushing member flexes, accelerating wear on head or bowl seating surfaces.	None
	3. Wearing completely through mantle or bowl liner and crushing on head or bowl.	3. See comment No. 2.	None
	4. Cracked mantle or bowl liner.	4. See comment No. 2.	None

<b>CRUSHER PROBLEMS</b>	<b>POSSIBLE CAUSES</b>	<b>COMMENTS/CORRECTIONS</b>	<b>REFER TO SECTION-PAGE</b>
Dust and Dirt Getting Into Lube System	1. Insufficient grease in socket sealing ring.	1. Fill socket sealing ring with proper quantity of grease.	6-21
	2. Insufficient water in water chamber.	2. Check for proper water GPM and constant water pressure.	6-15
	3. Baffle ring welded to head with intermittent weld.	3. Weld baffle ring to head with a 1/4" continuous fillet weld.	6-24
	4. No air breather on side of countershaft box.	4. Install breather on side of countershaft box.	10-39
	5. Breather on side of countershaft box or oil tank not functioning properly.	5. Clean both breathers; with crusher operating, a piece of paper placed over the breather piping should move in and out.	10-5 10-39
	6. Crusher sheave swirling dust into the countershaft box breather.	6. Using hose, relocate countershaft box breather away from crusher sheave.	10-39
	7. Dust and dirt falling into Crusher when Crusher has been dismantled for servicing or maintenance.	7. Cover socket and eccentric area with canvas tarpaulin or polyethylene (plastic) sheeting when servicing crusher.	None
	8. Vent passages in water seal socket plugged.	8. Check that drain holes or chipped grooves are open.	6-23
	9. Water seal socket not vented.	9. Check that vent pipes or water chamber baffle ring are installed.	6-23 6-24
	10. Worn socket sealing ring or head wiper allowing dust to infiltrate into the crusher.	10. Replace socket sealing ring or build-up with weld and remachine head wiper to original factory dimensions.	6-18 thru 6-21
	11. Socket sealing ring jammed in the downward position or cocked on the socket.	11. Dismantle and thoroughly clean socket sealing ring area and replace socket sealing ring springs and housings.	
	12. Too great of a vertical drop in the crusher drain line between crusher and oil tank.	12. Dust and dirt will be sucked into socket area. Add an additional breather in crusher drain line in vertical pipe just below countershaft box elbow, Y-branch or tee coming from the horizontal pipe. Consult factory.	None
	13. No seals or gaskets between oil tank and oil tank cover.	13. Replace seals or gaskets.	None
	14. Insufficient quantity of air for air sealing arrangement.	14. Check for correct CFM and PSI.	6-6 6-7

<b>CRUSHER PROBLEMS</b>	<b>POSSIBLE CAUSES</b>	<b>COMMENTS/CORRECTIONS</b>	<b>REFER TO SECTION-PAGE</b>
Gear and Pinion Tooth Wear	1. Excessively dirty oil.	1. Replace oil and clean oil tank.	10-1
	2. Tooth wear profile too low.	2. Worn step bearing plates. Raise eccentric assembly by shimming.	5-2
	3. Tooth wear profile too high.	3. Lower eccentric assembly by removing shims beneath the lower step bearing plate.	5-2
	4. Crusher overloaded.	4. Usually shows up as jumping adjustment ring. Reduce feed to crusher.	1-3 3-14
	5. Tooth wear profile on the ends of the teeth.	5. Excessive wear on inner or outer eccentric bushings.	None
	6. Incorrect oil or oil too cold causing eccentric assembly to lift or run in raised position most of the time.	6. Two distinct wear patterns on the gear and pinion. Change to proper oil or install oil tank immersion heater and heat oil to 80°F.	10-1 10-6
	7. Excessive end float.	7. Reset end float (1/32" to 1/16").	4-4, 4-6
	8. Running with "tipped" eccentric assembly.	8. Foreign material caught between lower step bearing plate (or shims) and the top of main frame cap.	5-1 5-3

<b>CRUSHER PROBLEMS</b>	<b>POSSIBLE CAUSES</b>	<b>COMMENTS/CORRECTIONS</b>	<b>REFER TO SECTION-PAGE</b>
Nosiy Gear and Pinion	<ol style="list-style-type: none"> <li>1. Incorrect backlash and/or root clearance.</li> <li>2. Operating crusher with new gear and worn pinion or worn gear and new pinion.</li> <li>3. Mis-matched gear and pinion profile (14-1/2° vs 20° involute).</li> </ol>	<ol style="list-style-type: none"> <li>1. Recheck backlash and/or root clearance.</li> <li>2. None.</li> <li>3. Consult factory.</li> </ol>	<p>5-2</p> <p>None</p> <p>None</p>



CRUSHER PROBLEMS	POSSIBLE CAUSES	COMMENTS/CORRECTIONS	REFER TO SECTION-PAGE
Tilted Adjustment Ring	1. Uneven wear on top of main frame and/or adjustment ring seating surfaces.	1. Improper feed distribution in crushing cavity. Rotate adjustment ring 180°.	3-16
	2. Uneven wear on main frame seat liners.	2. Improper feed distribution in crushing cavity. Replace seat liners.	3-16
	3. Continuous overload or improper liners causing adjustment ring to "pound" on the main frame seating surface.	3. Refer "selection of proper liners" paragraphs and tables.  Reduce feed to crusher.	1-3 thru 1-9 2-2, 2-3
	4. Incorrect spring lengths holding adjustment ring to main frame causing adjustment ring to jump.	4. Recheck spring installed lengths.	3-13 *

\*Spring installed lengths shown in the table refer ONLY to the springs presently being furnished on current machines. For the correct spring installed lengths on older Crushers consult the factory.

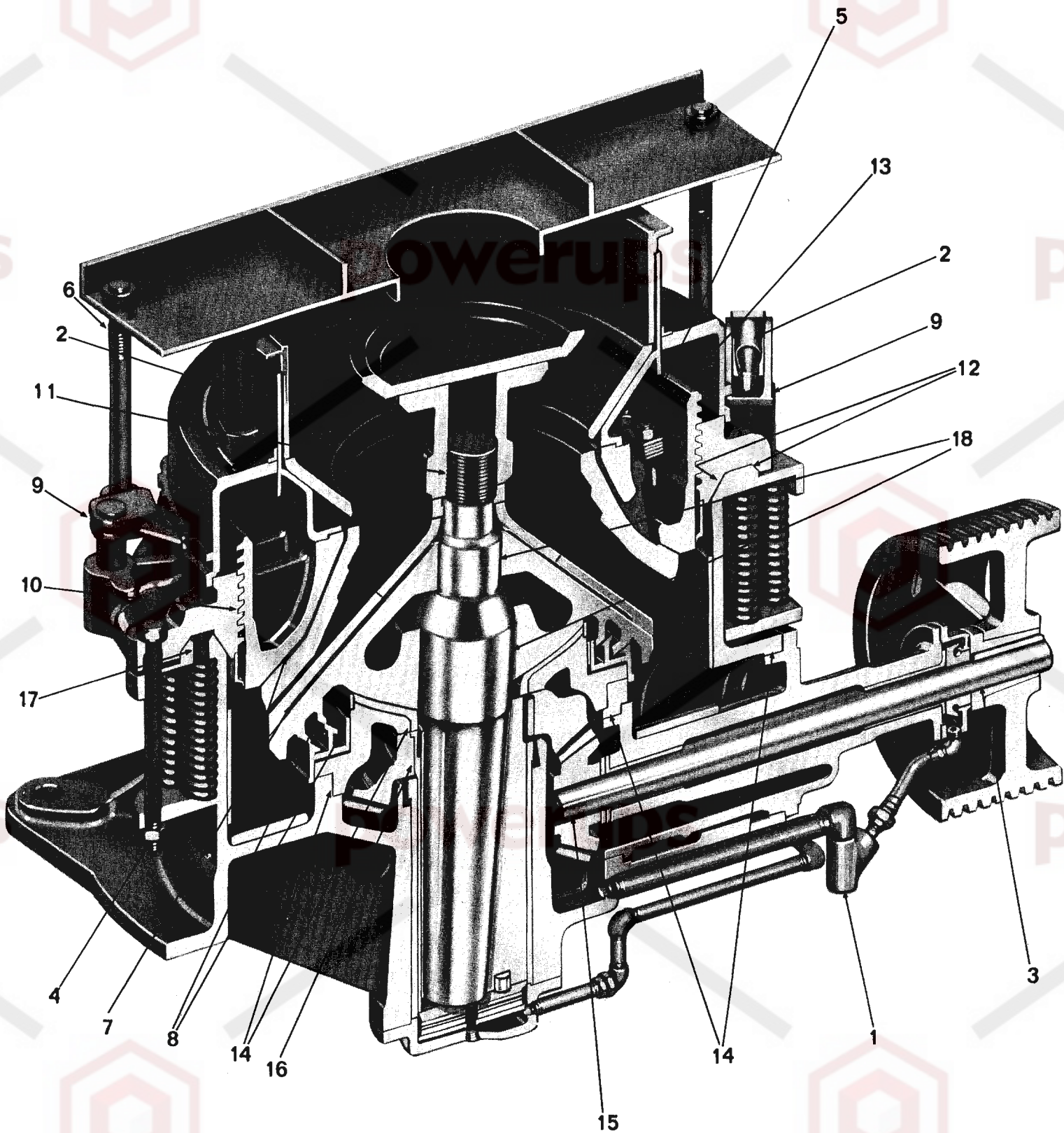
CRUSHER PROBLEMS	POSSIBLE CAUSES	COMMENTS/CORRECTIONS	REFER TO SECTION-PAGE
Loose Bowl	<ol style="list-style-type: none"> <li>1. Worn adjustment ring and bowl threads.</li> <li>2. Operating without tightening adjustment cap screws or Duckworth keys or hydraulic lock posts sufficiently.</li> <li>3. Too close of a crusher setting.</li> <li>4. Using too thick of a mantle and/or bowl liner.</li> <li>5. Operating with broken adjustment cap screws, Duckworth posts or hydraulic lock posts.</li> <li>6. Too large of a crusher setting.</li> <li>7. If Crusher has been furnished with hydraulic clamping and adjustment mechanism check that the hose between power unit and lock posts is properly connected.</li> </ol>	<ol style="list-style-type: none"> <li>1. Remachine 45° surface of threads to provide uniform pitch if threads are not worn too badly.</li> <li>2. Tighten cap screws or Duckworth keys properly or pressurize the hydraulic lock posts to the proper PSI.</li> <li>3. Open crusher setting until bowl stops jumping.</li> <li>4. Adjustment cap does not contact the top of the adjustment ring. Thinner liners or special adjustment cap spacer required.</li> <li>5. Replace adjustment cap screws, Duckworth posts or hydraulic lock post bolt assembly.</li> <li>6. Close crusher setting until adjustment cap makes contact with the top of the adjustment ring.</li> <li>7. When power unit is operating hose between power unit and lock posts should feel somewhat "stiff".</li> </ol>	<p>None</p> <p>11-4 11-6 11-8 12-17</p> <p>3-14 11-11</p> <p>None</p> <p>11-4 11-6 11-8</p> <p>11-11</p> <p>None</p>

<b>CRUSHER PROBLEMS</b>	<b>POSSIBLE CAUSES</b>	<b>COMMENTS/CORRECTIONS</b>	<b>REFER TO SECTION-PAGE</b>
Feed Plate Bolts Breaking	1. Feed too high in crushing cavity.	1. Reduce amount of feed to crusher.	11-16 11-17
	2. Slabby feed.	2. Reduce feed size or increase feed opening by changing liners.	1-3
	3. Feed plate bolts too tight.	3. Do not over tighten bolts.	7-1, 7-11
	4. Worn seating surface between feed plate and feed distributor.	4. Weld and remachine feed distributor seating surface. Replace feed plate.	7-1 7-11
	5. Feed plate bolts too loose.	5. Tighten bolts until they are snug.	None
	6. Too great of a drop of large size feed falling on top of feed plate.	6. This problem is usually restricted to a standard crusher. Reduce height of feed between feed box, chute or conveyor to feed plate.	None

CRUSHER PROBLEMS	POSSIBLE CAUSES	COMMENTS/CORRECTIONS	REFER TO SECTION-PAGE
Wear on Underside of Socket	1. Excessive oil pressure lifts eccentric until eccentric contacts underside of socket.	<p>1. Oil too cold. Install oil tank immersion heater and heat oil to 80°F.</p> <p>Check main relief valve for proper operation.</p> <p>Check for correct viscosity of lubricating oil. Oil may be heavier than that specified.</p>	<p>10-6</p> <p>10-32</p> <p>10-1 10-3</p>

CRUSHER PROBLEMS	POSSIBLE CAUSES	COMMENTS/CORRECTIONS	REFER TO SECTION-PAGE
Broken Main Shaft	<p>1. Frequent tramp iron passing through crusher. SHAFT BREAKS IN HEAD FIT PORTION OF MAIN SHAFT.</p> <p>Shaft may break in either head fit area or lower portion (tapered portion) depending on actual fatigue conditions. When breakage occurs in head fit portion it is usually a short distance above head ball area.</p>	<p>1. Install metal protection device.</p>	<p>11-20</p>
	<p>2. Crusher continually overloaded. SHAFT BREAKS IN HEAD FIT PORTION OF MAIN SHAFT.</p>	<p>2. Usually shows up as jumping adjustment ring. Reduce feed to crusher.</p>	<p>11-16 11-17</p>
	<p>3. Excessive wear on socket liner and/or ball of head allowing main shaft to penetrate too far into inner eccentric bushing, thereby reducing running clearance and causing lubrication failure. SHAFT BREAKS IN LOWER PORTION OF MAIN SHAFT. (TAPERED PORTION)</p>	<p>3. Replace socket liner, weld and remachine ball of head or shim socket to compensate for socket liner AND head ball wear thereby restoring proper geometry within the crusher.</p> <p>Use templates to check the socket liner and ball of head for wear.</p> <p>CONSULT THE FACTORY.</p> <p>The socket liner undercut can be used as a guide, the head should be smooth without any noticeable step.</p>	<p>6-26 5-8 7-1 7-11 5-2</p>
	<p>4. Main shaft bears at top of inner eccentric bushing instead of at bottom of inner bushing. SHAFT BREAKS IN LOWER PORTION OF MAIN SHAFT. (TAPERED PORTION)</p>	<p>4. Incorrect geometry between main shaft, socket liner and inner eccentric bushing. Replace socket liner, weld and remachine ball of head or shim socket to compensate for socket liner AND head ball wear.</p>	<p>6-26 5-8 7-1 7-11 5-2</p>

CRUSHER PROBLEMS	POSSIBLE CAUSES	COMMENTS/CORRECTIONS	REFER TO SECTION-PAGE
High Head Spin	1. Excessive wear on socket liner and/or ball of head allows the main shaft to penetrate too far into inner eccentric bushing, thereby reducing running clearance and increasing contact between shaft and bushing.	1. Replace socket liner, weld and remachine ball of head or shim socket to compensate for socket liner AND head ball wear thereby restoring proper geometry within the crusher.  Use templates to check the socket liner and ball of head for wear.  CONSULT THE FACTORY.  The socket liner undercut can be used as a guide, the head should be smooth without any noticeable step.	6-26 5-8 7-1 7-11 5-2
	2. Ball of head contacting the inside portion of socket liner thereby offering less resistance to spinning.	2. Scrape socket liner spherical bearing surface so that ball of head makes contact on the outer surface of socket liner.	6-26
	3. Scored or burned inner eccentric bushing.	3. Replace inner eccentric bushing or polish out the scores, gouges or burn marks.	5-7 thru 5-10
	4. Excessively worn feed plate or feed distributor parts.	4. Replace worn parts.	7-1 7-11
	5. Head and main shaft moving with eccentric due to seized inner eccentric bushing.	5. Disassemble crusher and replace inner eccentric bushing. Bushing may be "froze" to main shaft.	5-7 thru 5-10
	6. Inner eccentric bushing positioned too high in the eccentric during initial installation or when it was replaced.	6. Remove inner eccentric bushing from eccentric and relocate correctly.	5-8
	7. "Tipped" eccentric assembly thereby increasing contact between shaft and inner eccentric bushing.	7. Foreign material caught between lower step bearing plate (or shims) and the top of main frame cap.	5-1 5-3
	8. Cold oil, incorrectly set main relief valve or using heavier viscosity oil than recommended will raise the eccentric assembly and increase contact between inner eccentric bushing and shaft.	8. Install oil tank immersion heater, replace main relief valve or check for correct oil.	10-6 10-32 10-1 10-3



**LUBRICATION CHART FOR STANDARD SYMONS CONE CRUSHER**

- (1) Location ----- Crusher Circulating Oil  
 Lubricant ----- Oil; 350 SSU @ 100°F, 54 SSU @ 210°F, 90 VI minimum  
 Interval ----- Change every 2000 hours  
 Method ----- Circulation
- (2) Location ----- Hydraulic Power Unit, Lock Posts & Bowl Adj Rams (Hydraulic Crusher Only)  
 Lubricant ----- Oil; 150 SSU @ 100°F, 45 SSU @ 210°F, 90 VI minimum  
 Interval ----- Change every 2000 hours  
 Method ----- Circulation
- (3) Location ----- Countershaft  
 Lubricant ----- Oil; 150 SSU @ 100°F, 45 SSU @ 210°F, 90 VI minimum  
 Interval ----- During Assembly  
 Method ----- Manual, brush
- (4) Location ----- Spring Bolt Threads  
 Lubricant ----- Oil; 150 SSU @ 100°F, 45 SSU @ 210°F, 90 VI minimum  
 Interval ----- 2000 hours  
 Method ----- Manual, brush
- (5) Location ----- U-Bolt Threads  
 Lubricant ----- Oil; 150 SSU @ 100°F, 45 SSU @ 210°F, 90 VI minimum  
 Interval ----- Every liner change  
 Method ----- Manual, brush
- (6) Location ----- Feed Adjustment Post Threads  
 Lubricant ----- Oil; 150 SSU @ 100°F, 45 SSU @ 210°F, 90 VI minimum  
 Interval ----- 1000 hours  
 Method ----- Manual, brush
- (7) Location ----- Bowl & Head Surfaces that contact NORDBAK or Zinc backing  
 Lubricant ----- Oil; 150 SSU @ 100°F, 45 SSU @ 210°F, 90 VI minimum  
 Interval ----- Every liner change  
 Method ----- Manual, brush
- (8) Location ----- Fill Socket Sealing Ring Chamber(s) (Standard Seal Crusher Only)  
 Lubricant ----- Grease; Lithium base NLGI No. 1  
 Interval ----- Every liner change  
 Method ----- Manual, hand packing
- (9) Location ----- Bowl Adjustment Ram & Bowl Lock Torsion Springs (Hydraulic Crusher Only)  
 Lubricant ----- Grease; Lithium base NLGI No. 1  
 Interval ----- 200 hours  
 Method ----- Manual, brush
- (10) Location ----- Bowl & Adjustment Ring Threads  
 Lubricant ----- Grease; Lithium base NLGI No. 1 with 5-10% molybdenum disulfide powder  
 Interval ----- 40 hours; Every liner change (by volume)  
 Method ----- Grease fittings; Manual, brush
- (11) Location ----- Main Shaft & Nut Threads  
 Lubricant ----- Grease; Lithium base NLGI No. 1 with 5-10% molybdenum disulfide powder  
 Interval ----- Every liner change (by volume)  
 Method ----- Manual, brush
- (12) Location ----- Main Frame & Adjustment Ring Seating Surfaces  
 Lubricant ----- Grease; Lithium base NLGI No. 1 with 5-10% molybdenum disulfide powder  
 Interval ----- During Assembly (by volume)  
 Method ----- Manual, brush

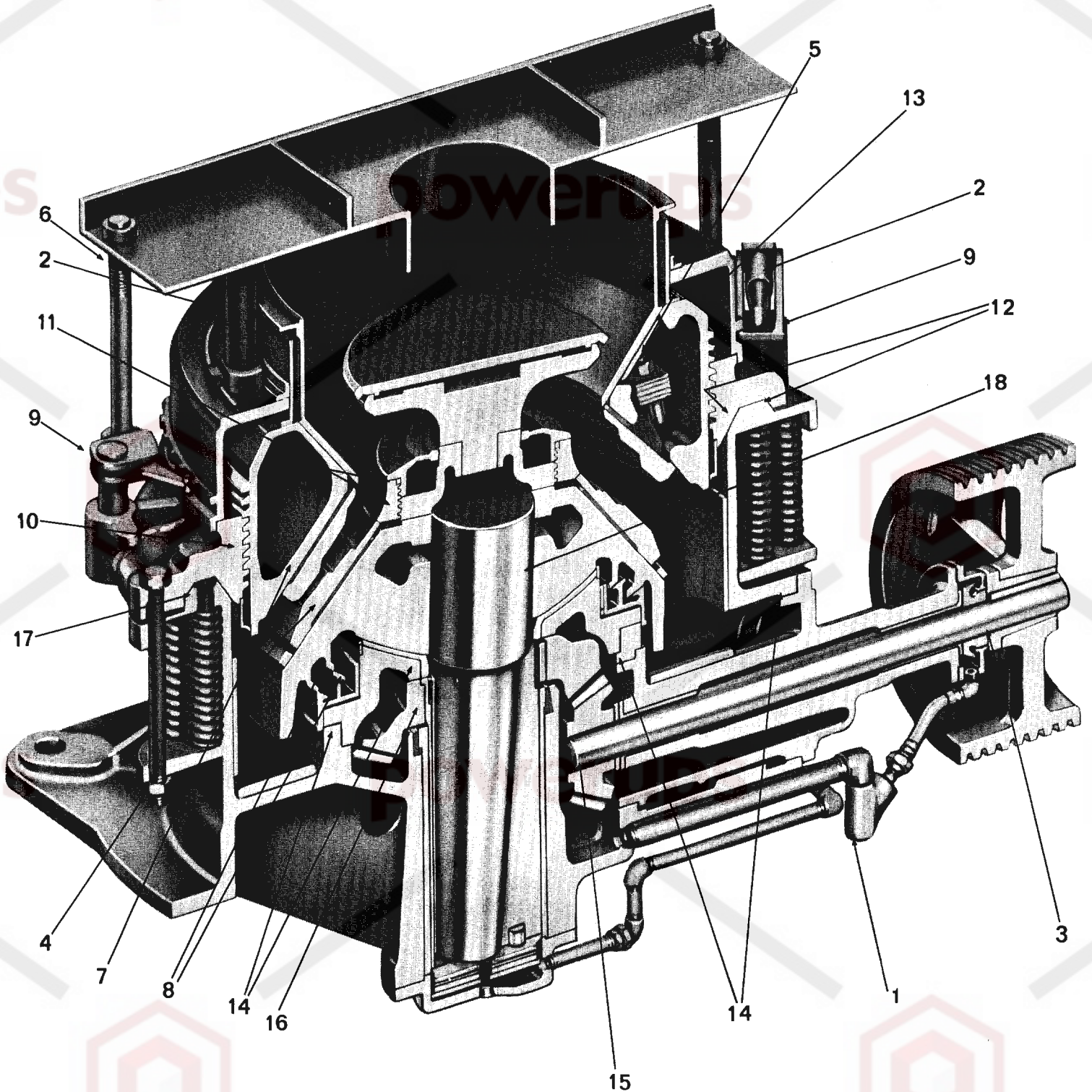


- (13) Location ----- Adjustment Cap Screw Threads (Cap Screw Adjustment Only)    OR  
 Adjustment Lock Post Threads (Duckworth Adjustment Only)  
 Lubricant ----- Grease; Lithium base NLGI No. 1 with 5-10% molybdenum disulfide powder  
 Interval ----- Every liner change (by volume)  
 Method ----- Manual, brush
- (14) Location ----- Socket Liner, Socket & Countershaft Box Interference Fits  
 Lubricant ----- White lead & Oil; 60% white lead, 40% boiled linseed oil  
 Interval ----- During Assembly  
 Method ----- Manual, brush
- (15) Location ----- Pinion & Countershaft Interference Fits  
 Lubricant ----- White lead & Oil; 60% white lead, 40% boiled linseed oil  
 Interval ----- During Assembly  
 Method ----- Manual, brush
- (16) Location ----- Gear or Counterweight & Eccentric Interference Fits  
 Lubricant ----- White lead & Oil; 60% white lead, 40% boiled linseed oil  
 Interval ----- During Assembly  
 Method ----- Manual, brush
- (17) Location ----- Main Frame Pin Interference Fits  
 Lubricant ----- White lead & Oil; 60% white lead, 40% boiled linseed oil  
 Interval ----- During Assembly  
 Method ----- Manual, brush
- (18) Location ----- Head & Main Shaft Interference Fits  
 Lubricant ----- White lead & Oil; 60% white lead, 40% boiled linseed oil  
 Interval ----- During Assembly  
 Method ----- Manual, brush

#### GENERAL LUBRICATION INFORMATION

- 1 All machined surfaces, especially bearing surfaces, are to be lightly coated with oil (150 SSU @ 100°F, 45 SSU @ 210°F, 90 VI minimum) PRIOR to assembly unless otherwise specified.
- 2 All fastener threaded surfaces (capscrews, bolts, nuts, etc.) are to be coated with oil (150 SSU @ 100°F, 45 SSU @ 210°F, 90 VI minimum) PRIOR to assembly unless otherwise specified.
- 3 DO NOT use any lubricant containing molybdenum disulfide or graphite for any assembly procedure unless otherwise specified.

#### LUBRICATION CHART FOR STANDARD SYMONS CONE CRUSHER



**LUBRICATION CHART FOR SHORT HEAD SYMONS CONE CRUSHER**

- (1) Location ---- Crusher Circulating Oil  
Lubricant --- Oil; 350 SSU @ 100°F, 54 SSU @ 210°F, 90 VI minimum  
Interval ---- Change every 2000 hours  
Method ----- Circulation
- (2) Location ---- Hydraulic Power Unit, Lock Posts & Bowl Adj Rams (Hydraulic Crusher Only)  
Lubricant --- Oil; 150 SSU @ 100°F, 45 SSU @ 210°F, 90 VI minimum  
Interval ---- Change every 2000 hours  
Method ----- Circulation
- (3) Location ---- Countershaft  
Lubricant --- Oil; 150 SSU @ 100°F, 45 SSU @ 210°F, 90 VI minimum  
Interval ---- During Assembly  
Method ----- Manual, brush
- (4) Location ---- Spring Bolt Threads  
Lubricant --- Oil; 150 SSU @ 100°F, 45 SSU @ 210°F, 90 VI minimum  
Interval ---- 2000 hours  
Method ----- Manual, brush
- (5) Location ---- U-Bolt Threads  
Lubricant --- Oil; 150 SSU @ 100°F, 45 SSU @ 210°F, 90 VI minimum  
Interval ---- Every liner change  
Method ----- Manual, brush
- (6) Location ---- Feed Adjustment Post Threads  
Lubricant --- Oil; 150 SSU @ 100°F, 45 SSU @ 210°F, 90 VI minimum  
Interval ---- 1000 hours  
Method ----- Manual, brush
- (7) Location ---- Bowl & Head Surfaces that contact NORDBAK or Zinc backing  
Lubricant --- Oil; 150 SSU @ 100°F, 45 SSU @ 210°F, 90 VI minimum  
Interval ---- Every liner change  
Method ----- Manual, brush
- (8) Location ---- Fill Socket Sealing Ring Chamber(s) (Standard Seal Crusher Only)  
Lubricant --- Grease; Lithium base NLGI No. 1  
Interval ---- Every liner change  
Method ----- Manual, hand packing
- (9) Location ---- Bowl Adjustment Ram & Bowl Lock Torsion Springs (Hydraulic Crusher Only)  
Lubricant --- Grease; Lithium base NLGI No. 1  
Interval ---- 200 hours  
Method ----- Manual, brush
- (10) Location ---- Bowl & Adjustment Ring Threads  
Lubricant --- Grease; Lithium base NLGI No. 1 with 5-10% molybdenum disulfide powder (by volume)  
Interval ---- 40 hours; Every liner change  
Method ----- Grease fittings; manual, brush
- (11) Location ---- Locking Collar, Locking Nut & Locking Nut Cover Threads  
Lubricant --- Grease; Lithium base NLGI No. 1 with 5-10% molybdenum disulfide powder (by volume)  
Interval ---- Every liner change  
Method ----- Manual, brush
- (12) Location ---- Main Frame & Adjustment Ring Seating Surfaces  
Lubricant --- Grease; Lithium base NLGI No. 1 with 5-10% molybdenum disulfide powder (by volume)  
Interval ---- During Assembly  
Method ----- Manual, brush

- (13) Location ---- Adjustment Cap Screw Threads (Cap Screw Adjustment Only) OR  
 Adjustment Lock Post Threads (Duckworth Adjustment Only)  
 Lubricant --- Grease; Lithium base NLGI No. 1 with 5-10% molybdenum disulfide powder  
 Interval ---- Every liner change (by volume)  
 Method ----- Manual, brush
- (14) Location ---- Socket Liner, Socket & Countershaft Box Interference Fits  
 Lubricant --- White lead & Oil; 60% white lead, 40% boiled linseed oil  
 Interval ---- During Assembly  
 Method ----- Manual, brush
- (15) Location ---- Pinion & Countershaft Interference Fits  
 Lubricant --- White lead & Oil; 60% white lead, 40% boiled linseed oil  
 Interval ---- During Assembly  
 Method ----- Manual, brush
- (16) Location ---- Gear or Counterweight & Eccentric Interference Fits  
 Lubricant --- White lead & Oil; 60% white lead, 40% boiled linseed oil  
 Interval ---- During Assembly  
 Method ----- Manual, brush
- (17) Location ---- Main Frame Pin Interference Fits  
 Lubricant --- White lead & Oil; 60% white lead, 40% boiled linseed oil  
 Interval ---- During Assembly  
 Method ----- Manual, brush
- (18) Location ---- Head & Main Shaft Interference Fits  
 Lubricant --- White lead & Oil; 60% white lead, 40% boiled linseed oil  
 Interval ---- During Assembly  
 Method ----- Manual, brush

#### GENERAL LUBRICATION INFORMATION

- 1 All machined surfaces, especially bearing surfaces, are to be lightly coated with oil (150 SSU @ 100°F, 45 SSU @ 210°F, 90 VI minimum) PRIOR to assembly unless otherwise specified.
- 2 All fastener threaded surfaces (capscrews, bolts, nuts, etc.) are to be coated with oil (150 SSU @ 100°F, 45 SSU @ 210°F, 90 VI minimum) PRIOR to assembly unless otherwise specified.
- 3 DO NOT use any lubricant containing molybdenum disulfide or graphite for any assembly procedure unless otherwise specified.

#### LUBRICATION CHART FOR SHORT HEAD SYMONS CONE CRUSHER

## Symons cone crusher

WHERE USED	LUBRICANT SPECIFICATIONS	WHEN PERFORMED	FOR APPLI- CATION SEE SECTION	OIL MANUFACTURER'S BRAND NAME
Oil Circulating System	350 SSU at 100°F 54 SSU at 210°F 90 VI minimum	Change every 2000 hours	10*	
Heating required below 60°F lubricant temperature Cooling required above 130°F lubricant temperature				
Hydraulic Clamping and Adjustment System	150 SSU at 100°F 45 SSU at 210°F 90 VI minimum	Change every 2000 hours	12	
Gear Reducer on Independent Oil Pump (Helical Gear Reducer)	0°-40°F ambient 280 to 360 SSU at 100°F 40°-110°F amb. 700 to 1000 SSU at 100°F	Change every 2000 hours	10	
Gear Reducer on Motorized Rotating Feed Distributor (Worm Gear Reducer)	0°-40°F ambient 90 to 125 SSU at 210°F 40°-110°F amb 125 to 190 SSU at 210°F	Change every 1000 hours	None*	
*Extreme Pressure Lubricant Preferred				

### OIL LUBRICATION CHART

## Symons cone crusher

WHERE USED	LUBRICANT SPECIFICATION	WHEN PERFORMED	FOR APPLI- CATION SEE SECTION	OIL MANUFACTURER'S BRAND NAME
Bowl and Adjustment Ring Threads	Lithium Base NLGI No. 1*	Replace every liner change and add every 40 hours	8, 11	
Main Shaft Nut Threads (Standard Crusher only)	Lithium Base NLGI No. 1*	Replace every liner change	7	
Locking Collar, Locking Nut and Locking Nut Cover Threads (Short Head Crusher only)	Lithium Base NLGI No. 1*	Replace every liner change	7	
Ram and Bowl Lock Torsion Springs (Hydraulic Crushers only)	Lithium Base NLGI No. 1*	Add every 200 hours	12	
Socket Sealing Ring Chamber(s) (Standard Seal Crusher only)	Lithium Base NLGI No. 1 Multi-Purpose *Can be used.	Replace every liner change	6	
Motorized Rotating Feed Distributor Bearings and Seals (If used)	Lithium Base NLGI No. 1 Multi-Purpose *Can be used.	Add every 40 hours	None	

\*With molybdenum disulfide additive or extreme pressure characteristics

### GREASE LUBRICATION CHART





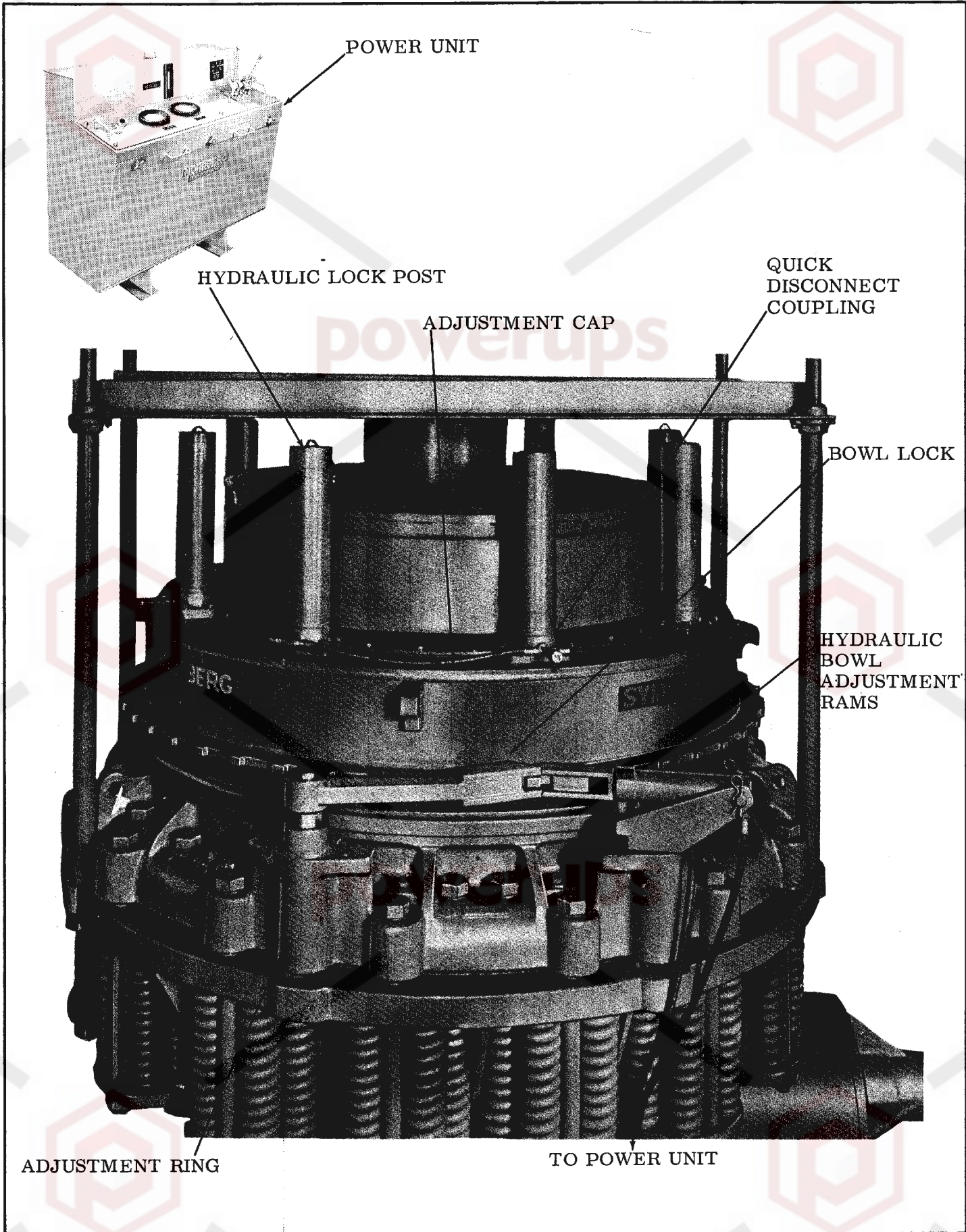




## Section 12

# HYDRAULIC CLAMPING AND ADJUSTMENT MECHANISMS

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POWER UNIT

HYDRAULIC LOCK POST

ADJUSTMENT CAP

QUICK DISCONNECT COUPLING

BOWL LOCK

HYDRAULIC BOWL ADJUSTMENT RAMS

ADJUSTMENT RING

TO POWER UNIT

## SECTION 12

# HYDRAULIC CLAMPING AND ADJUSTMENT MECHANISMS

### DESCRIPTION

Another arrangement, for rotating and clamping the bowl, which provides all the conveniences of effortless remote control, is the hydraulic clamping and adjustment arrangement. This system, although optional, is available on the 4 Ft., 5100, 4-1/4 Ft., 5-1/2 Ft. and 7 Ft. Crushers and can be installed on new machines as well as existing machines now in operation. All the adjustments are made from a power unit, either electrically or air operated. Positive clamping of the bowl assembly is automatically maintained by hydraulic lock posts which replace the standard lock posts or adjustment cap screws.

A lever on the power unit releases clamping pressure on the hydraulic lock posts while adjustments are being made, and when the lever is returned to the clamp position, pressure is automatically re-applied. Hydraulic adjustment rams rotate the bowl to the desired setting by engaging notches on the adjustment cap driver ring. A ratchet type bowl lock automatically engages these notches after each retraction of the bowl adjustment rams and positively holds the setting until another change in setting is necessary.

Installation, operation and maintenance of the hydraulic components are completely described in this section. See the illustration HYDRAULIC ADJUSTMENT ARRANGEMENT.

**SINCE CLAMPING PRESSURE IS UNIFORM AND AUTOMATICALLY SUSTAINED, NO PERIODIC INSPECTIONS FOR BOWL LOOSENESS ARE NECESSARY AND THE POSSIBILITY OF DAMAGE CAUSED BY BOWL MOVEMENT DURING OPERATION HAS BEEN ELIMINATED.**

### GENERAL INFORMATION

These instructions cover only the electric and air hydraulic clamping and adjustment mechanism as installed on these Crushers.

For the convenience of the crusher operators, the maintenance section of this instruction manual has been written to cover only those conditions which may arise during normal operation of the Crusher and hydraulic mechanism.

The installation, operation and maintenance procedures described herein should be followed as closely as possible to insure optimum performance and life of the hydraulic components. Study these instructions thoroughly and make them available to the persons entrusted with the care of the Crusher.

### INFORMATION FURNISHED

The following drawings and data for your particular Crusher will be found in a separate book entitled INSTALLATION DRAWINGS.

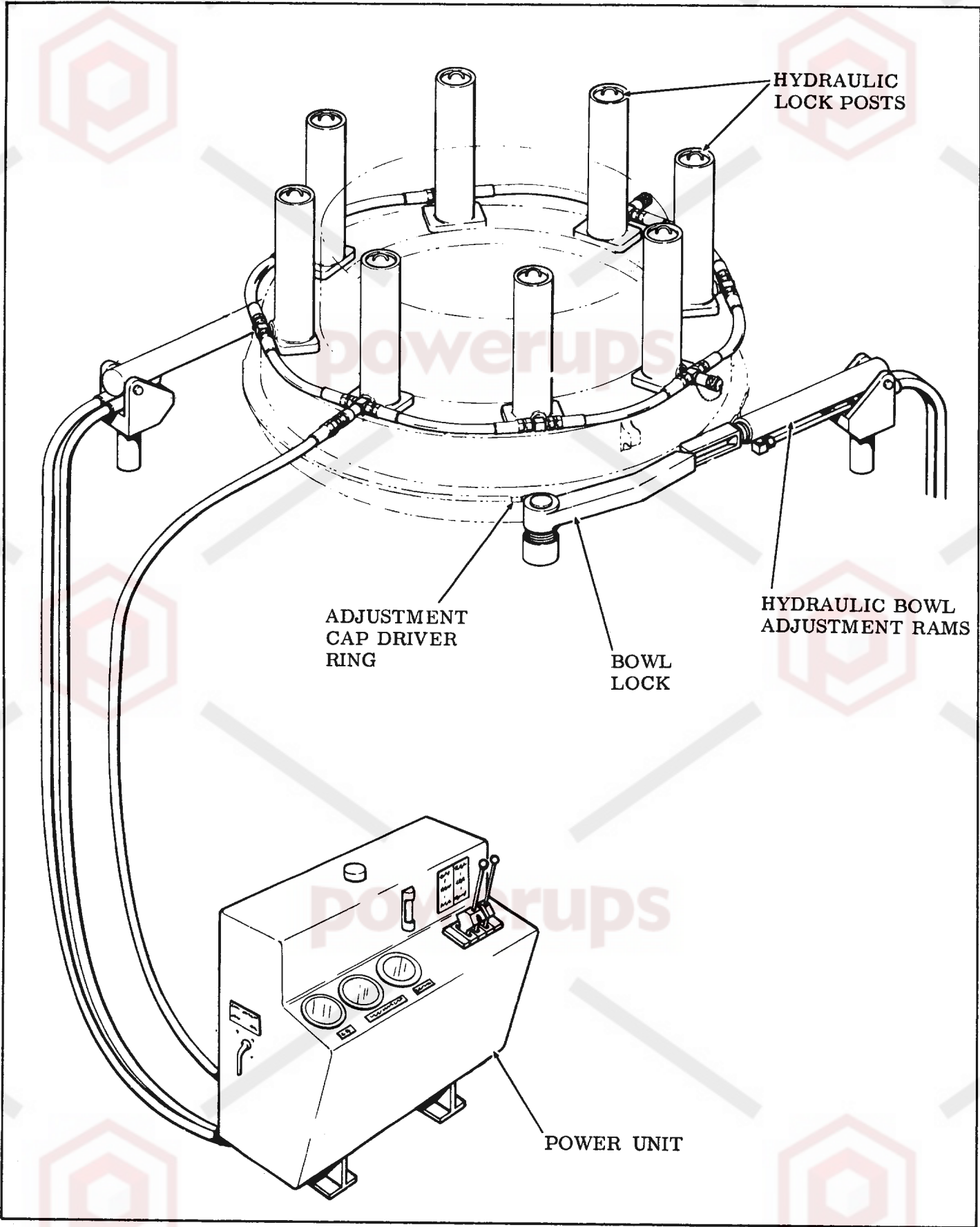
- 1 Hydraulic Circuit Assembly Drawing
- 2 Power Unit Parts List and General Arrangement Drawing
- 3 Schematic and Pictorial of Hydraulic Circuit
- 4 Wiring Diagram for Electric Power Unit.

All other drawings or informational data that might be required for your specific installation are also furnished.

### INSTALLATION

**MODIFY EXISTING ADJUSTMENT CAP: (Field Conversion Only)**

It is strongly recommended that a new adjustment cap be purchased with each hydraulic field conversion due to the extensive amount of welding required on an existing cap. Should it be decided to modify the existing adjustment cap, both the necessary conversion drawing and parts will be furnished.



**HYDRAULIC ADJUSTMENT ARRANGEMENT**

## MODIFY ADJUSTMENT RING AND BOWL: (Field Conversion Only)

The adjustment ring and bowl of the Crusher must be modified to a certain extent by the addition of certain parts; since these parts vary with each crusher installation, modification drawings for each of the various types of installation will be furnished. However, in most installations the modification should not consist of more than the welding on of these various component parts and the drilling of locating and grease lubricating holes.

## LOCATION OF POWER UNIT

### ELECTRIC

The power unit of the hydraulic mechanism which consists of an electric motor, hydraulic pump, accumulator and other electric and hydraulic components, should be placed in a location where the crusher operator has good visibility to both the hydraulic lock posts on top of the adjustment cap and also the bowl adjustment rams. It is recommended that the power unit be placed no farther than 30 feet from the Crusher.

### AIR

The power unit of the hydraulic mechanism which consists of an air-hydraulic booster, filter-lubricator and other hydraulic components, should be placed in a location where the crusher operator has good visibility to both the hydraulic lock posts on top of the adjustment cap and also the bowl adjustment rams. It is recommended that the power unit be placed no farther than 30 feet from the Crusher.

## HYDRAULIC OIL SPECIFICATIONS

For the hydraulic clamping and adjustment mechanism use a high grade paraffin (not naphthene) base industrial oil of viscosity specified, having high film strength, having high affinity for and adhesiveness to metal surfaces, having stable chemical and physical properties. Such lubricants should have a high viscosity index, rapid water separation, resist foaming, offer some rust and corrosion protection, resist oxidation and have anti-wear additives.

For normal, all year operating conditions, the lubricant should have a viscosity of 140 to 160 SSU (Seconds Saybolt Universal) at 100° Fahrenheit and a viscosity of 40 to 50 SSU at 210° Fahrenheit, cor-

responding to a viscosity index of 90 or higher. For such all year operating conditions, lubricants with viscosities higher than 300 SSU at 100° Fahrenheit, or lower than 100 SSU at 100° Fahrenheit are not recommended.

## OIL SPECIFICATIONS

Viscosity at 100°F ..... 140-160 SSU

Viscosity at 210°F ..... 40-50 SSU

Viscosity Index (V.I.) ..... 90 or higher

Correct lubricants meeting the above specifications are essential for the protection of the working parts of our Crushers. They are available from all major oil companies. Improper lubricants can ruin the Crusher and their use will void any warranties pertaining to such Crushers.

**DO NOT USE FIRE RESISTANT HYDRAULIC FLUIDS AS THESE HYDRAULIC SYSTEMS ARE NOT DESIGNED FOR THE USE OF SUCH FLUIDS.**

Fire resistant hydraulic fluids **MAY NOT** be compatible with packings, seals, accumulator bladders, hoses and other components within the hydraulic system. Pump life **MAY** decrease and any paint inside the oil tank **MAY** soften and lift off. Contact the factory before using any fire resistant hydraulic fluids.

Approximately 55 U.S. gallons will be required to fill the power unit reservoir, hydraulic lock posts, bowl adjustment rams and interconnecting hoses.

## ASSEMBLY OF HYDRAULIC LOCK POSTS

4 FT., 5100, 4-1/4 FT., AND 5-1/2 FT. CRUSHERS.

To assemble the lock post to the bowl and adjustment cap proceed as follows:

- 1 Remove one hair pin cotter, and slide out the key. See the illustration HYDRAULIC LOCK POST ASSEMBLY; 4 FT., 5100, 4-1/4 FT. AND 5-1/2 FT. CRUSHERS.
- 2 The upper and lower spherical washers can then be removed from the bolt assembly and should be placed into each boss on the bowl.

- 3 Remove the dust cap and carefully lift the lock post by using the ring located on the cover and place the post in position on top of the adjustment cap.

THE LOCK POSTS SHOULD BE LIFTED WITH A CRANE, SLOWLY AND CAREFULLY AS DURING THE LIFTING STAGE THE BOLT ASSEMBLY MAY SLOWLY SLIDE DOWN OUT OF THE CYLINDER.

- 4 The lock posts should be placed on top of the adjustment cap so that the tapped hole on the side of the cylinder faces the outside of the adjustment cap.
- 5 Fasten the lock posts to the adjustment cap with capscrews as shown.
- 6 Alternately thread the cross and tee fittings as shown on the HYDRAULIC CIRCUIT ASSEMBLY DRAWING into the sides of the cylinders.
- 7 Then interconnect the posts with the hoses also as shown on the circuit drawing. At this point there should be no fittings screwed onto the cross fittings.

## ASSEMBLY OF HYDRAULIC LOCK POSTS

### 7 FT. CRUSHERS.

To assemble the lock post to the bowl and adjustment cap proceed as follows:

- 1 Remove one hair pin cotter, and slide out the key. See the illustration HYDRAULIC LOCK POST ASSEMBLY; 7 FT. CRUSHERS.
- 2 The special nut can then be removed from the bolt assembly and placed into each boss on the bowl.

THE LOCK POSTS SHOULD BE LIFTED WITH A CRANE, SLOWLY AND CAREFULLY AS DURING THE LIFTING STAGE THE BOLT ASSEMBLY MAY SLOWLY SLIDE DOWN OUT OF THE CYLINDER.

- 3 Lift the lock post and place the post in position on top of the adjustment cap. The lock posts should be placed on top of the adjustment cap so that the tapped hole on the side of the cylinder faces the outside of the adjustment cap.
- 4 Fasten the lock posts to the adjustment

cap with capscrews as shown.

- 5 Alternately thread the cross and tee fittings as shown on the HYDRAULIC CIRCUIT ASSEMBLY DRAWING, into the sides of the cylinders.
- 6 Then interconnect the posts with the hoses, also as shown on the circuit drawing. At this point there should be no fittings screwed onto the cross fittings.

## ASSEMBLY OF ADJUSTMENT CAP TO BOWL

- 1 Lift the adjustment cap approximately 4 or 5 feet off the ground and pull down the bolt assembly as far as possible. Follow this procedure for all the lock posts.
- 2 Then lift the cap over the bowl and slowly lower the cap until the bolt assembly drops into the bowl boss far enough so that the key can be inserted with the nut (or spherical washers), against the underside of the bowl boss.

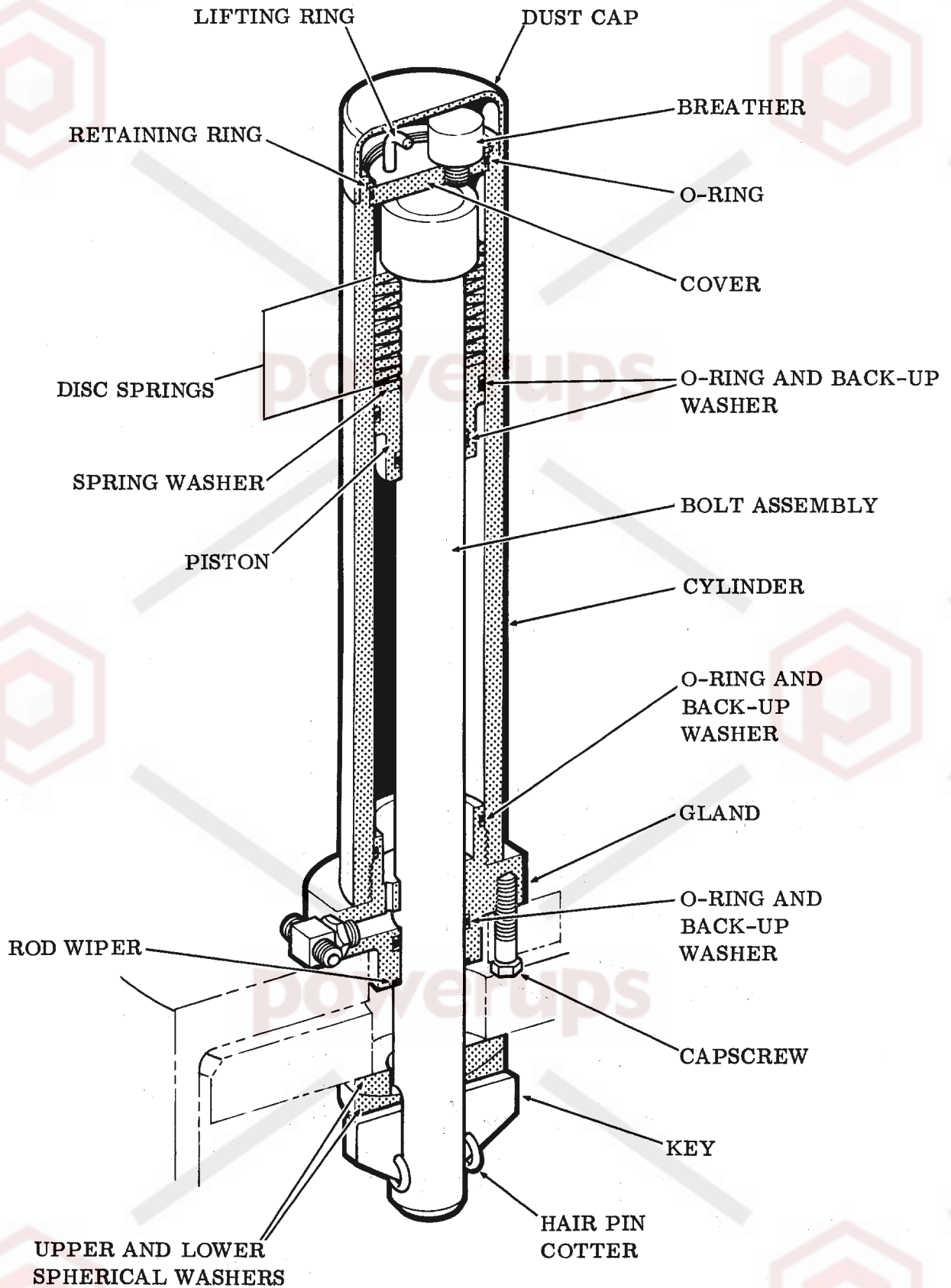
### WARNING

As a safety precaution the adjustment cap should be blocked up in some manner during this operation so that in case of a crane failure the cap would not drop and cause injury to the operator's hands.

- 3 After the keys have all been put in place, re-insert the hair pin cotter.
- 4 Slowly lower the adjustment cap until it bottoms on the bowl bosses. For the initial installation only, it is suggested that the cap be lifted with a crane as soon as the lock posts are connected to the bowl, until the entire assembly is just lifted off the ground.
- 5 Attach the quick-disconnect sockets at this point, this will prevent an air pocket from forming in the cylinders.

## ASSEMBLY OF BOWL ADJUSTMENT RAMS WITH TORSION "SPRING"

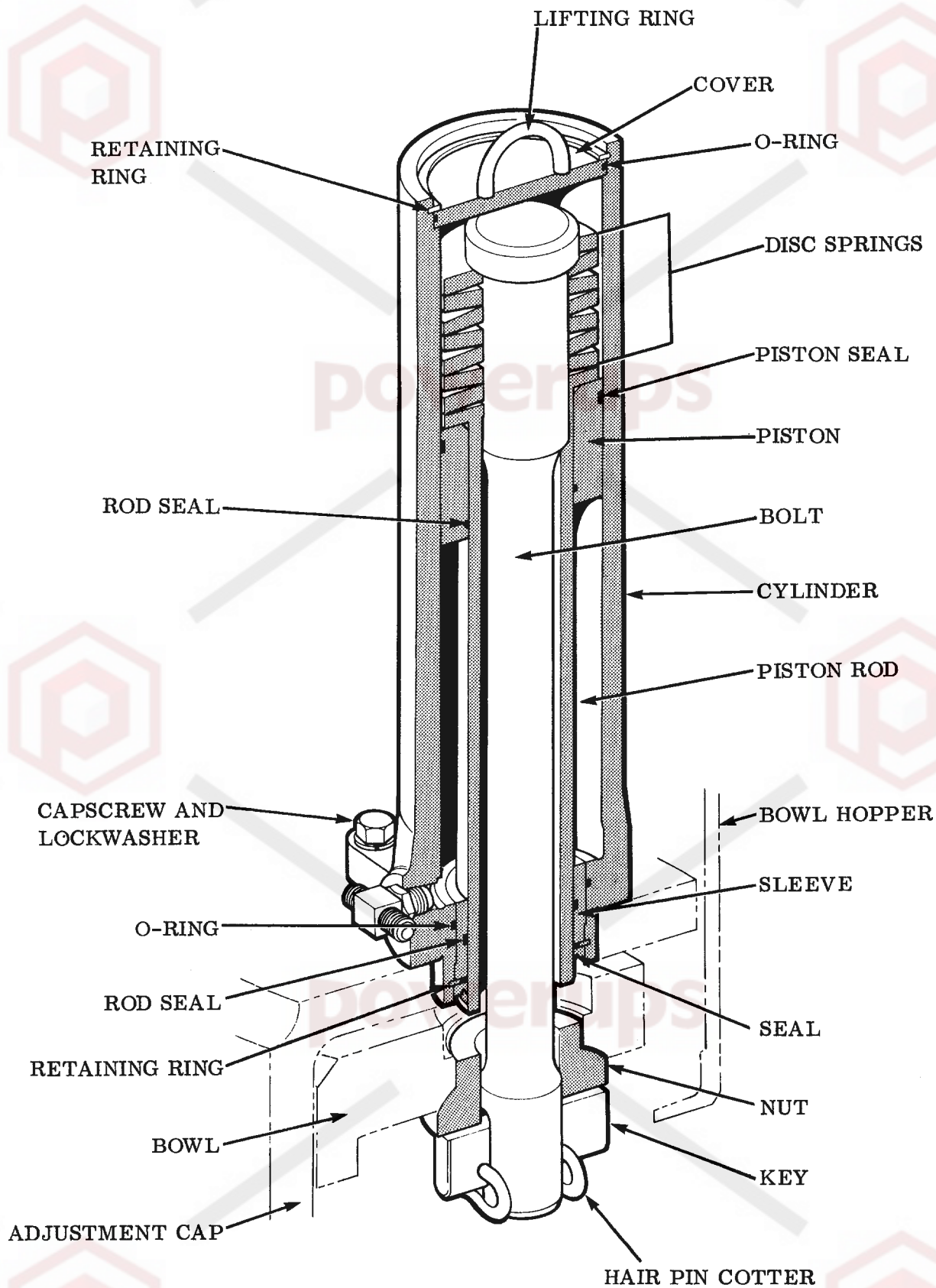
The bowl adjustment ram assemblies should be placed into position on the adjustment ring



**LOCK POST ASSEMBLY**

4 FT., 5100, 4-1/4 FT. AND 5-1/2 FT. CRUSHERS





**LOCK POST ASSEMBLY**  
7 FT. CRUSHERS

before assembling the bowl into the adjustment ring. To assemble the bowl adjustment rams equipped with a torsion "spring" into the adjustment ring proceed as follows:

- Insert one end of the torsion spring into the drilled hole on top of the adjustment ring boss as shown in the illustrations BOWL ADJUSTMENT RAM ASSEMBLY WITH TORSION "SPRING".
- 2 Place the two bowl adjustment rams into position on the adjustment ring bosses 180° apart. Lower the ram so that the other end of the torsion spring enters the cavity on the underside of the ram retainer. This torsion spring will keep constant pressure on the ram to keep it in contact with the notched driver ring on the adjustment cap.
  - 3 Position the rams so that when they extend they will turn the bowl clockwise when looking down into the Crusher.
  - 4 Center the ram fork so that equal clearance exists on top and bottom between the driver ring and the fork. If the fork and driver ring on the adjustment cap are not centered properly, remove the brass plug from the adjustment screw which supports the ram and either raise or lower the adjustment screw to center the fork on the driver ring. On the 7 Ft. Crushers the adjusting screw is called the saddle.

## **ASSEMBLY OF BOWL ADJUSTMENT RAMS WITH TORSION "BAR"**

The bowl adjustment ram assemblies should be placed into position on the adjustment ring before assembling the bowl into the adjustment ring. To assemble the bowl adjustment rams equipped with a torsion "bar" into the adjustment ring proceed as follows:

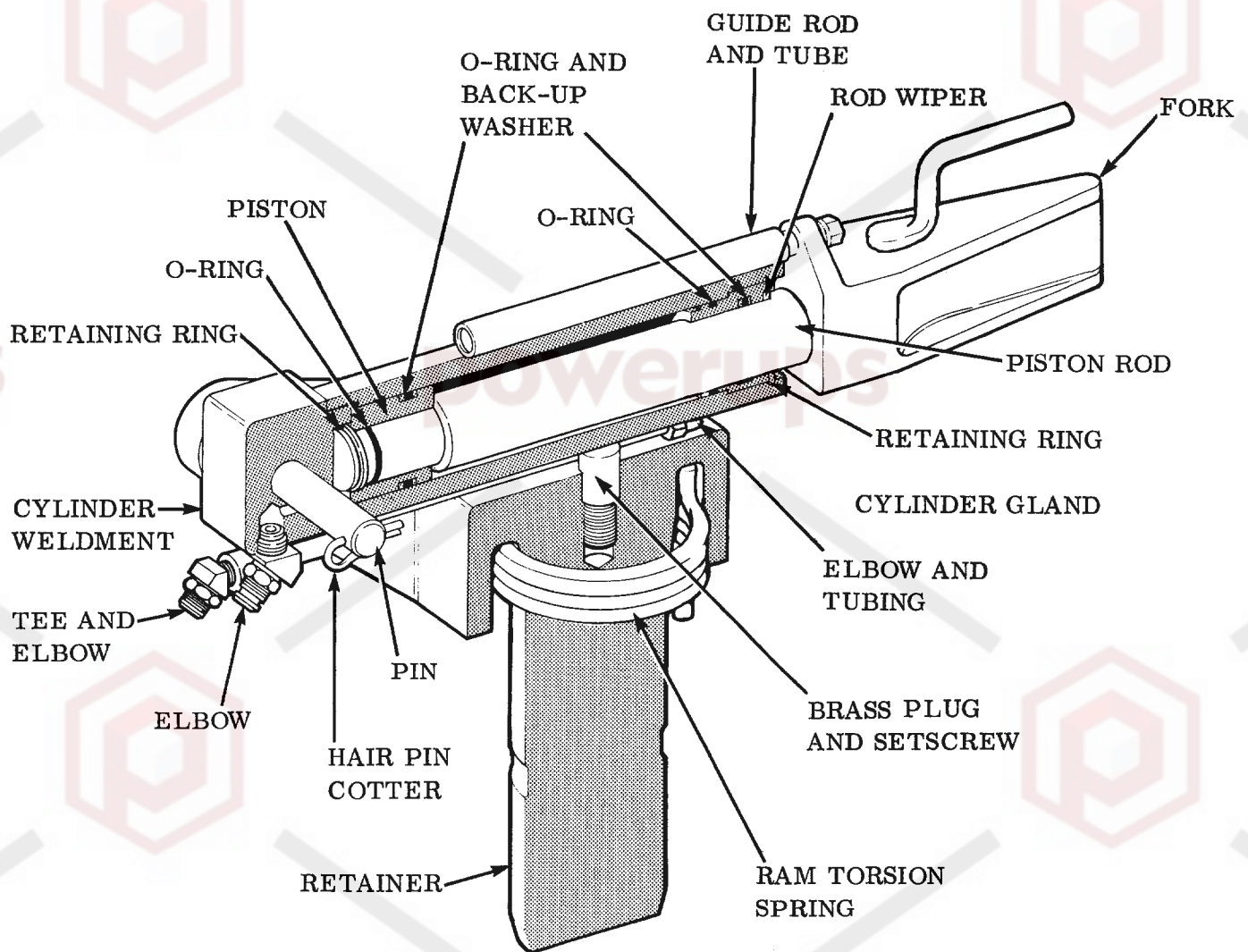
- 1 Remove the torsion bar and ram stop plate from the two ram assemblies, then place each assembly in the adjustment ring bosses located 180° apart. See the illustration BOWL ADJUSTMENT RAM ASSEMBLY WITH TORSION "BAR".
- 2 Swivel the bowl adjustment ram so the fork points toward the center of the Crusher.
- 3 From the bottom side of the adjustment ring insert the torsion bar up through the ram post and into the square hole in the ram retainer so

the top of the bar is even with the top of the ram retainer surface.

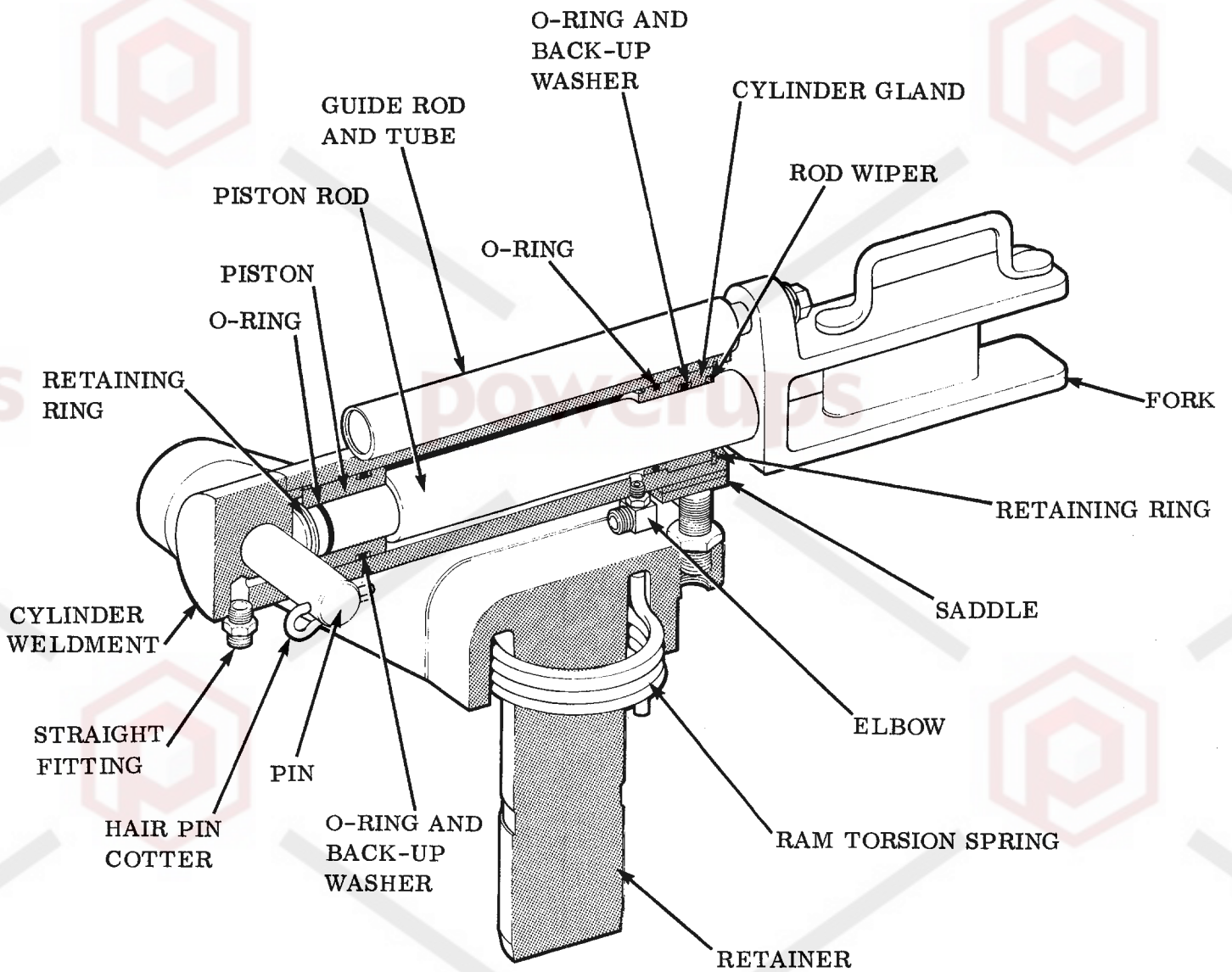
- 4 Slide the ram stop plate with the two dowels pointing down and facing away from the Crusher onto each torsion bar from the bottom of the adjustment ring until the end of the bar is even with the bottom surfaces of the plate.
- 5 Screw the 1/2" × 4" setscrew into and through the side of the adjustment ring boss far enough for the screw to go between the dowels in the ram stop plate and beneath the torsion rod.
- 6 Screw the 3/8" × 1-1/2" setscrew into the ram retainer until it bottoms in the ram post groove then turn the setscrew out, one turn.
- 7 Position the rams so that when they extend they will turn the bowl clockwise when looking down into the Crusher. Then turn the entire ram assembly until contact is made against the ram stop blocks welded to the adjustment ring. Insert a 1/2" diameter steel rod into the hole in the adjustment ring just to the side of the ram stop located on the ram retainer. This will lock the ram away from the adjustment cap when the bowl assembly is being assembled or disassembled from the Crusher.
- 8 After the adjustment cap and bowl is assembled into the Crusher remove the 1/2" diameter rods and allow the rams to come to rest against the driver ring on the adjustment cap.
- 9 Center the ram fork so that equal clearance exists on top and bottom between the driver ring and the fork. If the fork and driver ring on the adjustment cap are not centered properly, either raise or lower the adjustment screw to center the fork on the driver ring.

## **ASSEMBLY OF BOWL INTO ADJUSTMENT RING**

- 1 Coat the threads of the bowl and adjustment ring with grease as per normal operating procedure.
- 2 Lift the bowl assembly by the hooks on the adjustment cap and position it over the adjustment ring on the Crusher. The initial lift on the cap will cause the adjustment cap alone to raise first, after a short rise the entire bowl assembly will be lifted.

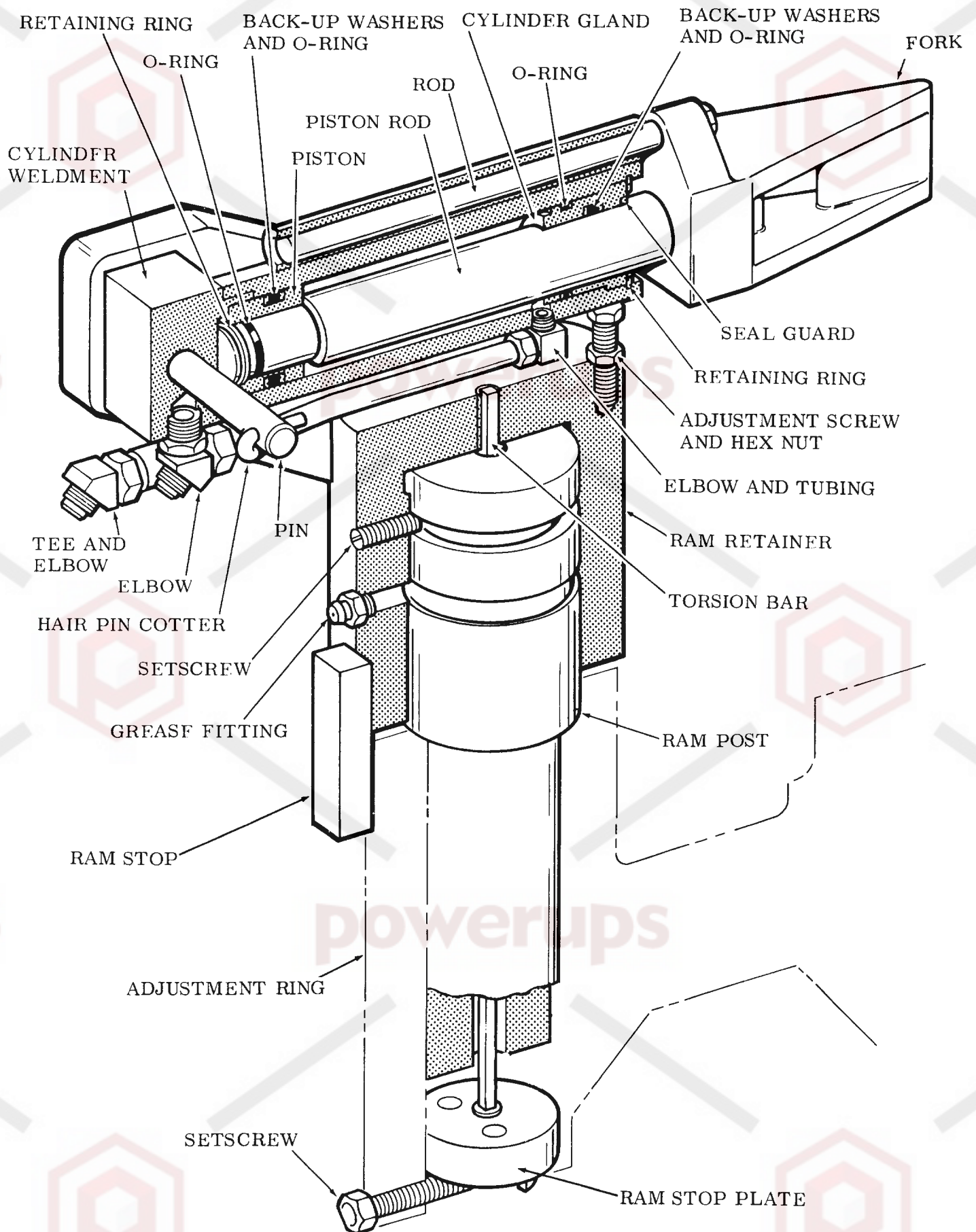


**BOWL ADJUSTMENT RAM ASSEMBLY WITH TORSION "SPRING"**  
 4 FT., 5100, 4-1/4 FT. AND 5-1/2 FT. CRUSHERS



**BOWL ADJUSTMENT RAM ASSEMBLY WITH TORSION "SPRING"**

7 FT. CRUSHERS



**BOWL ADJUSTMENT RAM ASSEMBLY WITH TORSION "BAR"**  
 4-1/4 FT. CRUSHERS

- 3 After the bowl assembly has been placed into the ring, turn down the bowl in the conventional manner until the proper setting of the liners has been reached.

### ASSEMBLY OF BOWL LOCK WITH TORSION "SPRING"

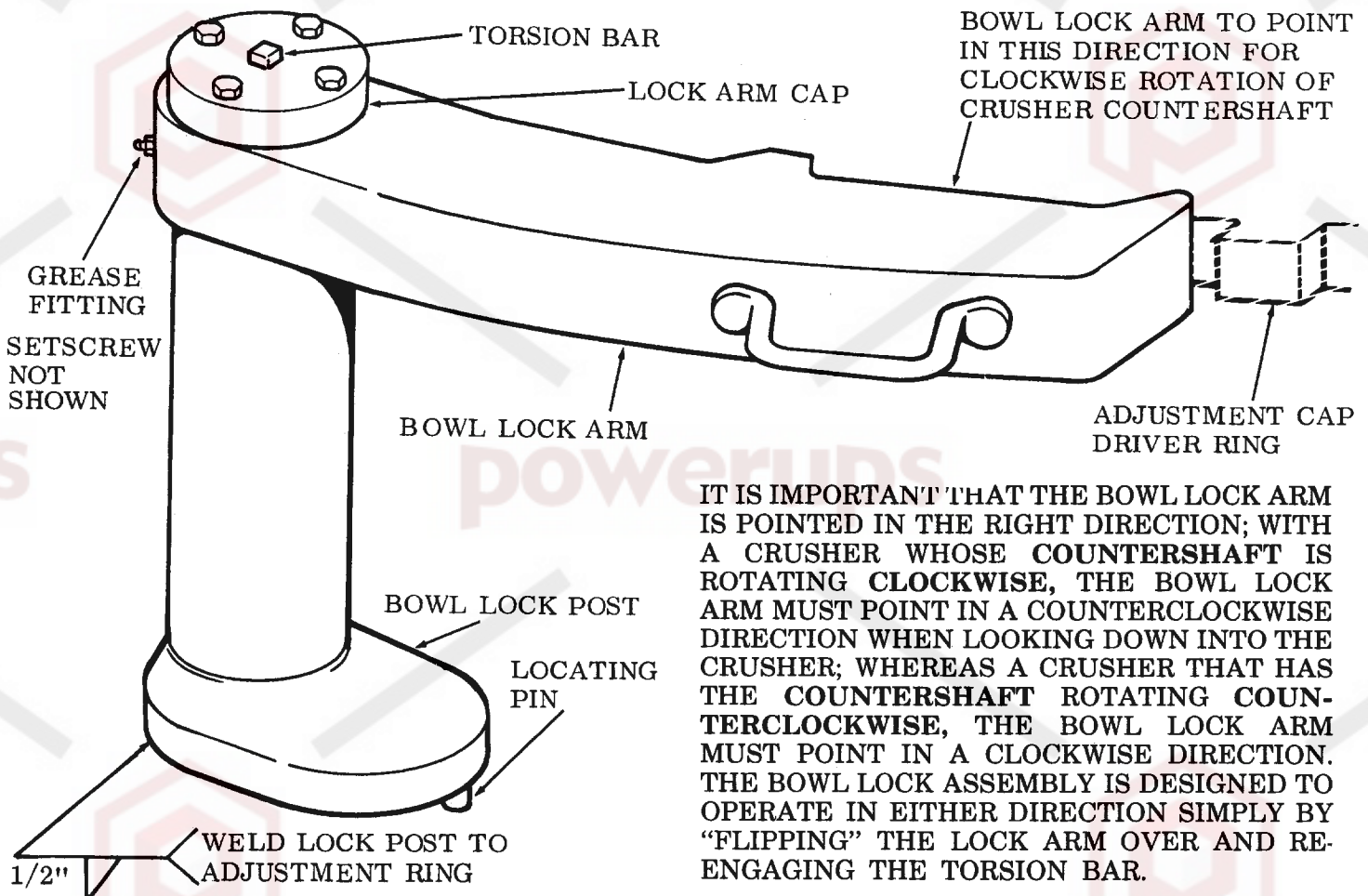
The automatic bowl lock assembly should be placed into position on the adjustment ring after the bowl assembly has been turned into the adjustment ring. To assemble the bowl lock assembly equipped with a torsion "spring" on the adjustment ring proceed as follows:

- 1 The bowl lock arm should be aligned to obtain the proper relationship to the driver ring on the adjustment cap and the fork on the bowl adjustment rams. See the illustrations BOWL LOCK ASSEMBLY WITH TORSION "SPRING".
- 2 Weld the lock post to the adjustment ring.

IT IS IMPORTANT THAT THE BOWL LOCK ARM IS POINTED IN THE RIGHT DIRECTION; WITH A CRUSHER WHOSE COUNTERSHAFT IS ROTATING CLOCKWISE, THE BOWL LOCK ARM MUST POINT IN A COUNTERCLOCKWISE DIRECTION WHEN LOOKING DOWN INTO THE CRUSHER; WHEREAS A CRUSHER THAT HAS THE COUNTERSHAFT ROTATING COUNTERCLOCKWISE, THE BOWL LOCK ARM MUST POINT IN A CLOCKWISE DIRECTION. THE BOWL LOCK ASSEMBLY IS DESIGNED TO OPERATE IN EITHER DIRECTION SIMPLY BY "FLIPPING" THE LOCK ARM OVER AND RE-ENGAGING THE TORSION SPRING.

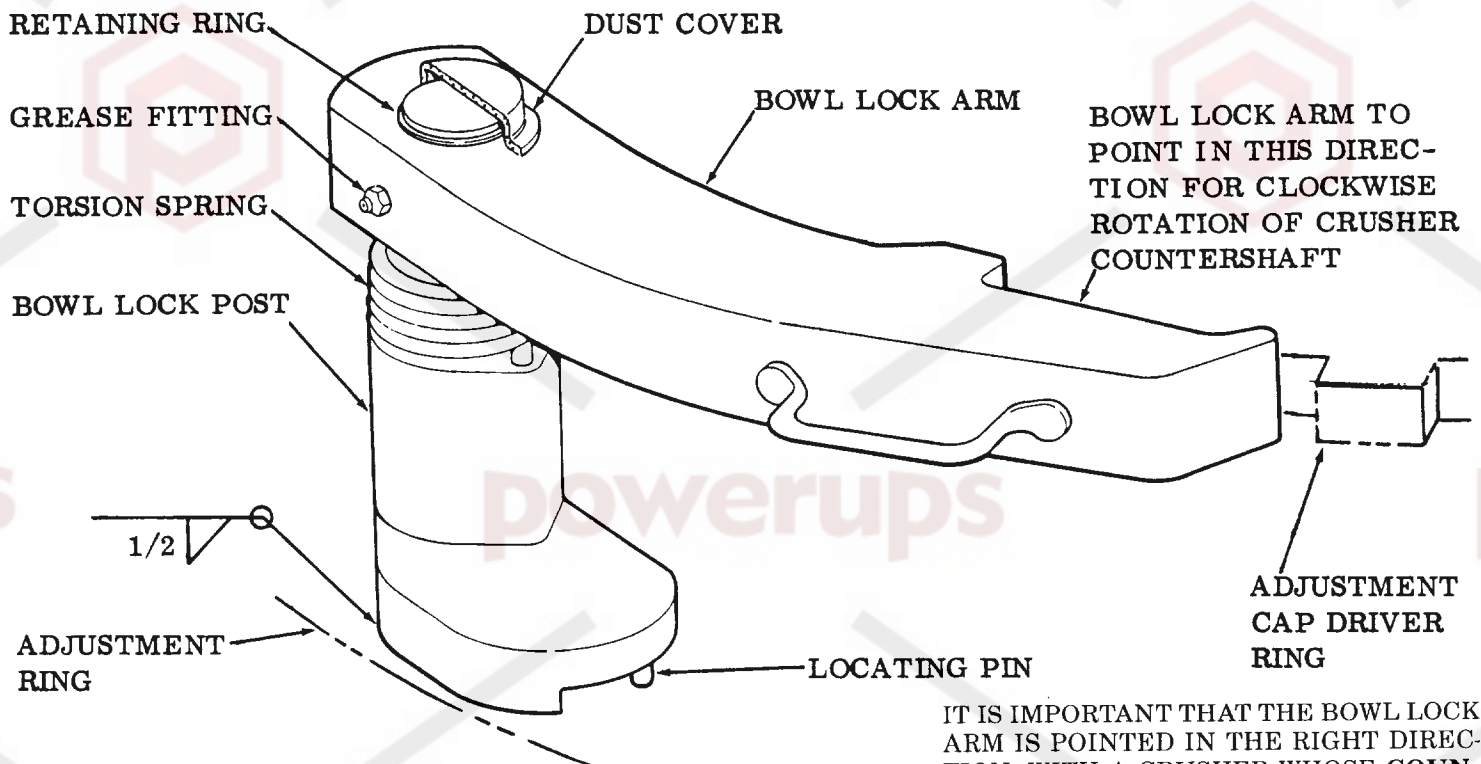
### ASSEMBLY OF BOWL LOCK WITH TORSION "BAR"

The automatic bowl lock assembly should be placed into position on the adjustment ring after the bowl assembly has been turned into the adjustment ring.



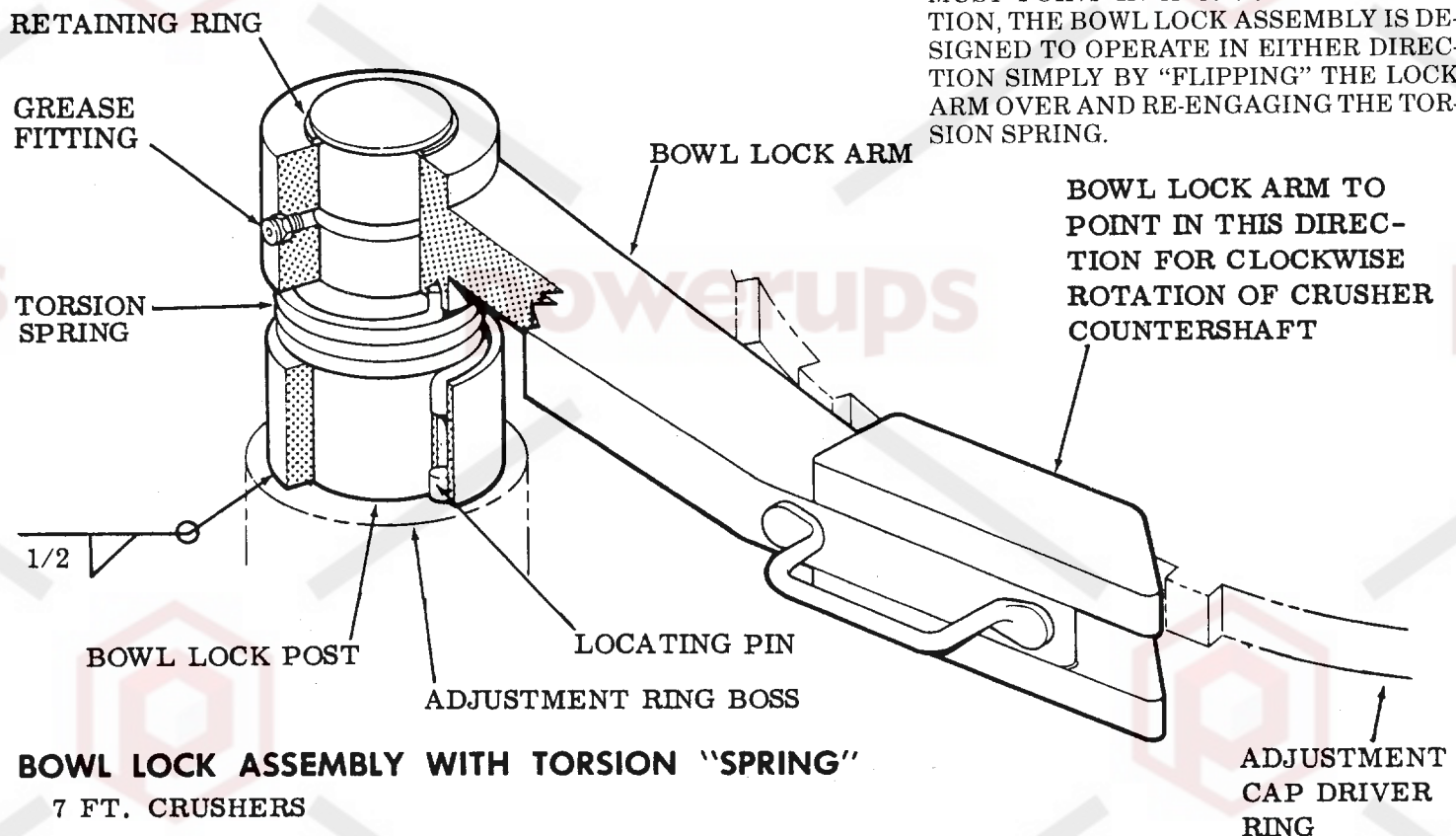
IT IS IMPORTANT THAT THE BOWL LOCK ARM IS POINTED IN THE RIGHT DIRECTION; WITH A CRUSHER WHOSE COUNTERSHAFT IS ROTATING CLOCKWISE, THE BOWL LOCK ARM MUST POINT IN A COUNTERCLOCKWISE DIRECTION WHEN LOOKING DOWN INTO THE CRUSHER; WHEREAS A CRUSHER THAT HAS THE COUNTERSHAFT ROTATING COUNTERCLOCKWISE, THE BOWL LOCK ARM MUST POINT IN A CLOCKWISE DIRECTION. THE BOWL LOCK ASSEMBLY IS DESIGNED TO OPERATE IN EITHER DIRECTION SIMPLY BY "FLIPPING" THE LOCK ARM OVER AND RE-ENGAGING THE TORSION BAR.

**BOWL LOCK ASSEMBLY WITH TORSION "BAR"**  
4-1/4 FT. CRUSHERS

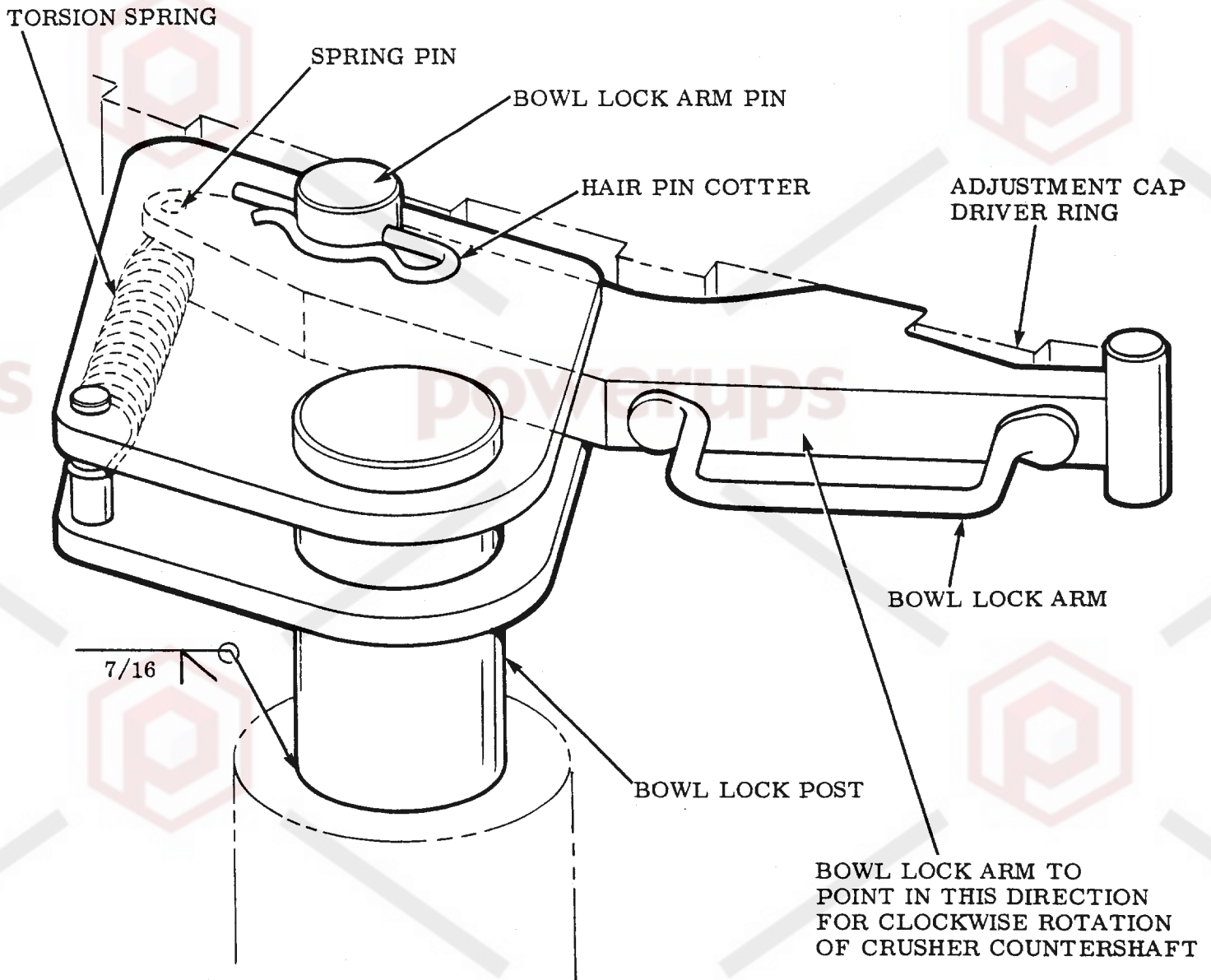


**BOWL LOCK ASSEMBLY WITH TORSION "SPRING"**  
4 FT., 5100 AND 4-1/4 FT. CRUSHERS

IT IS IMPORTANT THAT THE BOWL LOCK ARM IS POINTED IN THE RIGHT DIRECTION; WITH A CRUSHER WHOSE COUNTERSHAFT IS ROTATING CLOCKWISE, THE BOWL LOCK ARM MUST POINT IN A COUNTERCLOCKWISE DIRECTION WHEN LOOKING DOWN INTO THE CRUSHER; WHEREAS A CRUSHER THAT HAS THE COUNTERSHAFT ROTATING COUNTERCLOCKWISE, THE BOWL LOCK ASSEMBLY IS DESIGNED TO OPERATE IN EITHER DIRECTION, THE BOWL LOCK ARM MUST POINT IN A CLOCKWISE DIRECTION, THE BOWL LOCK ASSEMBLY IS DESIGNED TO OPERATE IN EITHER DIRECTION SIMPLY BY "FLIPPING" THE LOCK ARM OVER AND RE-ENGAGING THE TORSION SPRING.



**BOWL LOCK ASSEMBLY WITH TORSION "SPRING"**  
7 FT. CRUSHERS



IT IS IMPORTANT THAT THE BOWL LOCK ARM IS POINTED IN THE RIGHT DIRECTION; WITH A CRUSHER WHOSE COUNTERSHAFT IS ROTATING CLOCKWISE, THE BOWL LOCK ARM MUST POINT IN A COUNTERCLOCKWISE DIRECTION WHEN LOOKING DOWN INTO THE CRUSHER; WHEREAS A CRUSHER THAT HAS THE COUNTERSHAFT ROTATING COUNTERCLOCKWISE, THE BOWL LOCK ASSEMBLY IS DESIGNED TO OPERATE IN EITHER DIRECTION SIMPLY BY "FLIPPING" THE LOCK ARM OVER AND RE-ENGAGING THE TORSION SPRING.

### BOWL LOCK ASSEMBLY WITH TORSION "SPRING"

5-1/2 FT. CRUSHERS

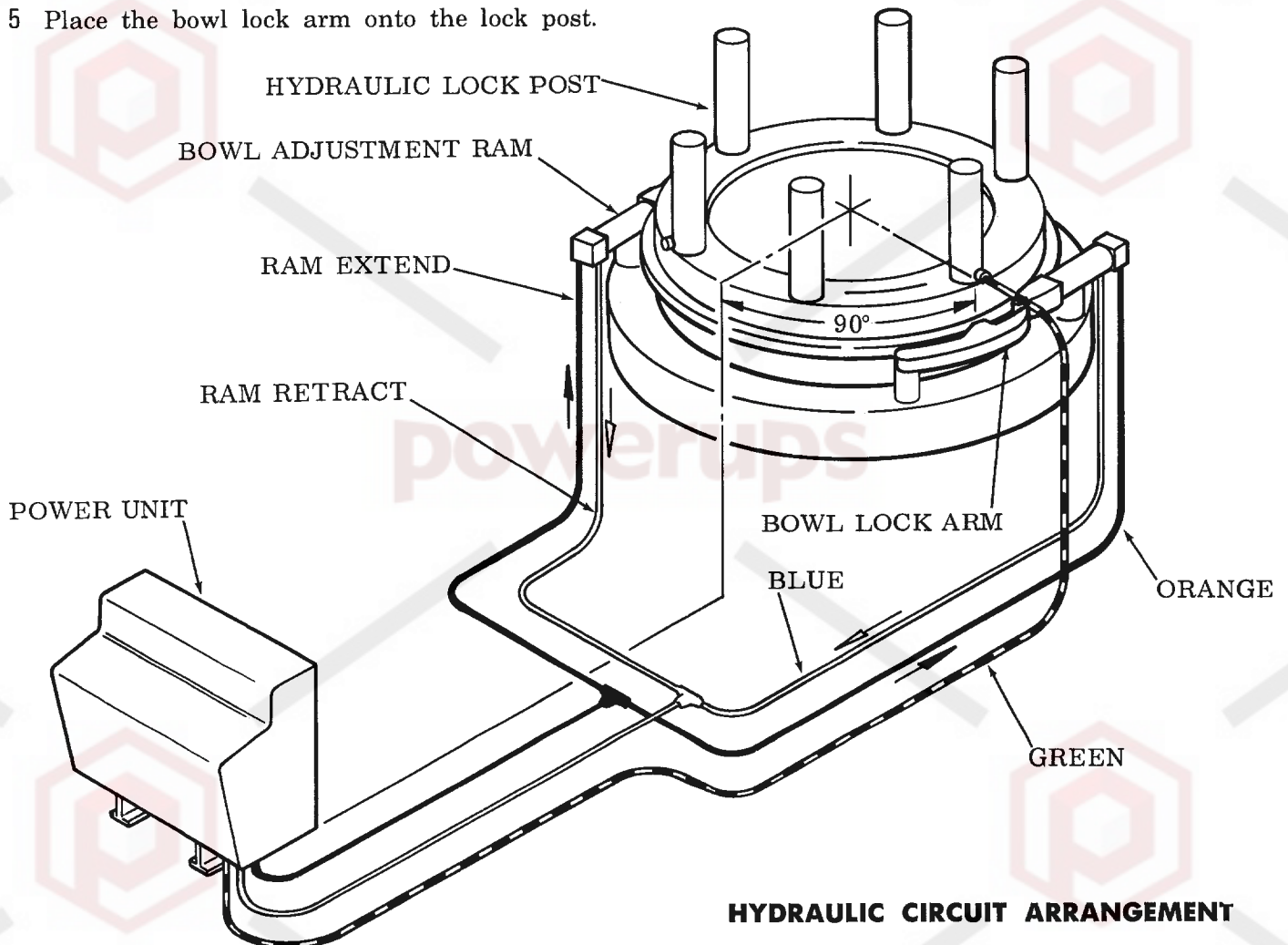


To assemble the bowl lock assembly equipped with a torsion "bar" on the adjustment ring proceed as follows:

- 1 Locate the bowl lock assembly on the flat area on the adjustment ring which has been provided for this purpose. Insert the two 1/2" diameter locating pins in the bottom of the bowl lock post in the drilled holes in the adjustment ring.
- 2 The bowl lock arm should be parallel and aligned to obtain the proper relationship to the driver ring on the adjustment cap and the fork on the bowl adjustment rams. See the illustration BOWL LOCK ASSEMBLY WITH TORSION "BAR". Bowl lock post should be shimmed, if necessary.
- 3 Weld the lock post to the adjustment ring.
- 4 Insert the torsion bar down into the center hole in the lock post and engage it into the square hole located in the bottom of the lock post. After the bar is in the square hole it is to be pushed down until it bottoms.
- 5 Place the bowl lock arm onto the lock post.

- 6 Place the lock arm cap onto the lock arm and engage with the torsion bar.
- 7 Push the lock arm against the adjustment cap making sure the arm is against the inside of the adjustment cap driver ring and not on top of one of the driver ring notches.
- 8 Turn the lock arm cap in the opposite direction the lock arm is pointing until the holes in the cap line up with the tapped holes in the lock arm and bolt the cap to the lock arm.
- 9 Screw the 3/8" x 1-1/2" setscrew into the lock arm until it bottoms in the lock post groove then turn it out, one turn.

TO KEEP THE LOCK ARM FROM CONTACTING THE DRIVER RING WHEN INSTALLING OR REMOVING THE ADJUSTMENT CAP AND BOWL FROM THE CRUSHER, PULL THE LOCK ARM AWAY FROM THE CAP UNTIL THE HOLE IN THE STOP, WELDED TO THE REAR OF THE LOCK ARM, IS LINED UP WITH THE HOLE IN THE LOCK POST. THEN INSERT A 1/2"



DIAMETER STEEL ROD THROUGH THE LOCK ARM STOP AND INTO THE LOCK POST.

## HYDRAULIC CIRCUIT ARRANGEMENT

All piping between the power unit and the Crusher has been provided with quick-disconnect couplings for quick assembly and disassembly.

IT IS MOST IMPORTANT THAT DURING THE ENTIRE PIPING PROCEDURE ALL DIRT AND FOREIGN MATTER BE KEPT OUT OF THE HOSES AND FROM ALL FITTINGS.

It is suggested that all three hoses be first connected to the power unit and just prior to connection to the hydraulic lock posts and rams, all hoses be bled by depressing the needle valve on the quick-disconnect socket and running oil through these lines so as to fill the entire hose.

- 1 Color code the hose between the hydraulic lock posts and the power unit GREEN. See the illustration HYDRAULIC CIRCUIT ARRANGEMENT.
- 2 Connect the GREEN quick-disconnect coupling to the hydraulic lock post which is located approximately 90° to the right of the power unit.
- 3 Color code the hoses from the power unit to the extend side of each ram ORANGE. The extend side of the ram is the right hand fitting on the ram when facing the ram fork.
- 4 Connect the ORANGE coded hose from the power unit to a tee and then from the tee to the extend fitting of each ram.
- 5 Color code the hoses from the power unit to the retract side of each ram BLUE. The retract side of the ram is the left hand fitting on the ram when facing the ram fork.
- 6 Connect the BLUE coded hose from the power unit to a tee and then from the tee to the retract fitting of each ram.

CHECK THE POSITION OF THE HYDRAULIC LINES TO THE BOWL ADJUSTMENT RAMS SO THEY WILL NOT INTERFERE WITH ANY MOVING PARTS.

## HYDRAULIC POWER UNIT

### ELECTRIC POWER UNIT

The hydraulic power unit is composed of a cabinet with the electric motor, hydraulic pump, accumulator, gauges, and other electrical and hydraulic components. The Gauge and Control Valve Sub-Assembly is a complete unit by itself and, if necessary, is readily removable for service of individual units.

The electric motor is a 5 HP motor with electrical characteristics tailored to the individual user. All fuse protection equipment is to be furnished by the customer to conform to local electrical codes. The starter for the power unit motor is also to be furnished by the customer to meet the customer's specific needs, location and electrical interconnecting requirements. Attach a No. 8 or larger ground wire to the power unit. Direction of rotation of the motor and pump can be either clockwise or counterclockwise.

The hydraulic pump is a piston-type pump with a total of six cylinders. The flow from the pump is split into a five cylinder-one cylinder arrangement and regulated by an unloading valve so that all six cylinders are pumping until a pressure of 1,500 PSI is reached. At this point, only one cylinder is actually pumping and the other five cylinders are bypassing oil.

A pressure switch will automatically shut the pump off when a pressure of 2,500 PSI is reached and turn the pump on when the pressure drops to 2,100 PSI.

The green pilot light on the control panel of the power unit indicates that power is available to the power unit motor even though the motor is not running. THIS LIGHT MUST BE ON WHENEVER THE CRUSHER IS RUNNING.

### AIR POWER UNIT

The hydraulic power unit is composed of a cabinet with the booster, gauge and control valve and air filter-lubricator sub-assemblies. Each sub-assembly is a complete unit by itself and, if necessary, is readily removable for service of individual parts.

This power unit is operated by using compressed air. Use an air system which is reasonably DRY. Connect a compressed air line (80 to 100 PSI - 80 PSI minimum) to the valve located on the left side of the power unit cabinet. No electrical connections are required.

The amount of air required for the proper operation of the power unit is 5 standard cubic

feet per minute (SCFM) at 15 PSI, 60° Fahrenheit.

It is possible to keep the Crusher running and still remove one or more of the sub-assemblies for service for a relatively short period of time, such as changing one of the components. The Pictorial Circuit of the Air-Hydraulic Power Unit shows the procedures to be followed. Following these procedures will permit removal of the various sub-assemblies without any loss of pressure in the lock posts.

However, if some trouble should arise which requires considerable time to repair, it is desirable to shut down the Crusher completely.

**REMOVAL OF ONE OR MORE SUB-ASSEMBLIES WILL MAINTAIN PRESSURE IN THE SYSTEM IF THERE ARE NO LEAKS PRESENT.**

### **STARTING THE CRUSHER** (Electric Power Unit)

Before the Crusher is actually started, all hydraulic lines, both at the power unit and at all connections on the Crusher, should be carefully checked for leaks. Pay particular attention to the quick-disconnect coupling to make sure that the plug is properly engaged with the socket so that the hydraulic fluid can pass through.

Check the control valve handles to see that they are in the neutral or middle position. See the illustration, **POWER UNIT CONTROL VALVE HANDLES**. Push the "ON" button on the power unit. At this point the electric motor will start to pump the oil through the valve; however, the oil, with both handles in the neutral position will be by-passing through the valve and will not be doing any actual work at this point. Pull the right handle of the valve back. This procedure will start the automatic clamping cycle on the hydraulic lock posts. When the motor has been initially turned on it will take a few moments before the pump can fill the hydraulic lock posts with oil. The lock posts have been designed to operate at a hydraulic pressure of 2,500 PSI. As the power unit is operating it will continue pumping oil into the cylinders until this pressure has been reached and then stop automatically. If the hydraulic pump should stop at any pressure other than 2,500 PSI, the pressure can be regulated by adjusting the setscrew found on top of the pressure switch. The pressure switch is

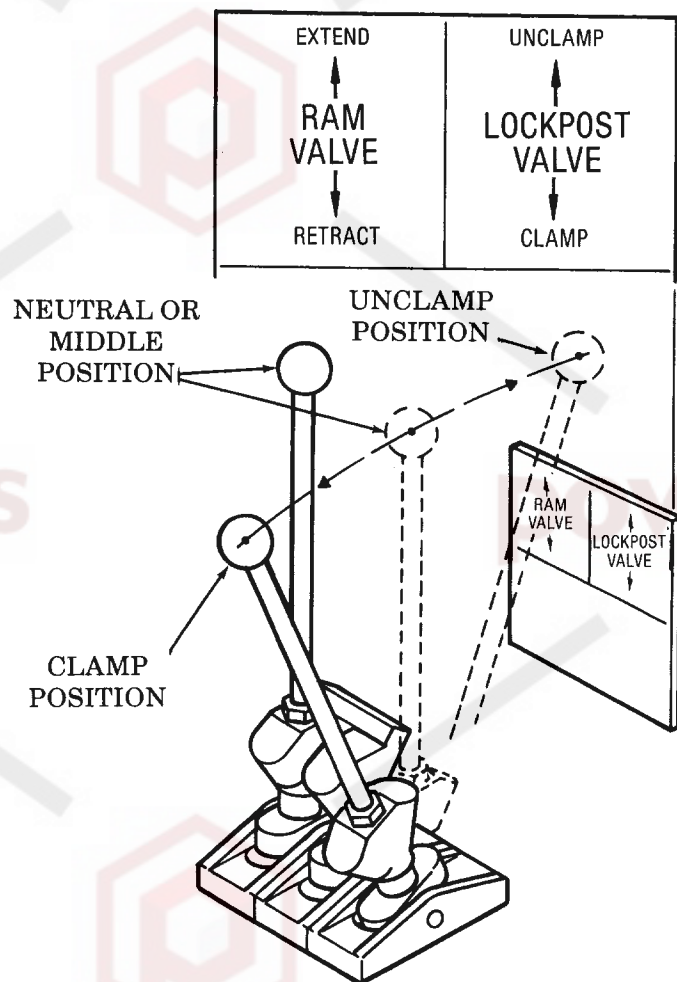
mounted inside the power unit on the left side. The **PRESSURE DIFFERENTIAL SETTING** inside the pressure switch should be maintained at 400 PSI.

The Crusher can now be started. The right handle on the control valve should always remain in the back (handle towards operator) or clamp position during actual crushing operation of the machine. Check that the bowl lock arm is engaging the notched driver ring on the adjustment cap and that it is pointing in the right direction.

### **STARTING THE CRUSHER** (Air Power Unit)

Before the Crusher is actually started, all hydraulic lines, both at the power unit and at all connections on the Crusher, should be carefully checked for leaks. Pay particular attention to the quick-disconnect coupling to make sure that the plug is properly engaged with the socket so that the hydraulic fluid can pass through.

Check the control valve handles to see that they are in the neutral or middle position. See the illustration, **POWER UNIT CONTROL VALVE HANDLES**. Turn the air valve on, this will allow the air to pass into the power unit and activate the air-hydraulic booster. At this point the booster should begin its reciprocating motion and start to pump the oil through the control valve; however, the oil, with both valves in the neutral position, will be bypassing through the valve and will not be doing any actual work. Pull the right handle of the valve back. This procedure will start the automatic clamping cycle on the hydraulic lock posts. When the air has been initially turned on it will take a few moments before the booster can fill the hydraulic lock posts with oil. The lock posts have been designed to operate at a hydraulic pressure of 2,000 PSI. As the power unit is operating it will continue pumping oil into the cylinders until this pressure has been reached and then stop automatically. If the booster should stop at any pressure other than 2,000 PSI, the pressure can be regulated by changing the air pressure going into the power unit.



on the adjustment cap and that it is pointing in the right direction.

### TYPICAL ADJUSTING CYCLE

After the bowl liner and mantle have worn to a condition where the setting must be adjusted, the feed to the Crusher should be stopped (it is preferable to stop the motor on the Crusher). The hydraulic lock posts are then depressurized by pushing the right handle forward (away from the operator) and leaving it in this position. After the lock posts pressure gauge reads zero pull the right hand handle to the neutral or middle position. The next step is to extend the rams by pushing the left handle forward until the rams come to a complete stop. It is advisable to occasionally check the pressure range on the rams during the extending stroke. Normally this pressure during the actual extending should be between 300 to 700 PSI and as the ram comes to a complete stop the pressure should jump up to 2,800 PSI (Electric) or 2,000 PSI (Air).

Ram pressures over 800 PSI while in the extending stroke indicates something abnormal and the Crusher should be inspected to find the cause of the high pressure required to move the bowl. After the ram has been fully extended it can be retracted by pulling the left handle back until the ram again comes to a dead stop in the fully retracted position. It should be noted that there is no gauge which indicates the pressure while the ram is retracting. The rams are then extended and retracted as many times as required to reach the proper setting. Always extend and retract the rams to the limit of their stroke so that the ram comes to a dead stop. After the proper setting has been reached, return the handle to the neutral or middle position. The hydraulic lock posts are now repressurized by pulling the right handle back and LEAVING it in this clamped position. Check the cylinder pressure gauge to make sure that the cylinders have a pressure of 2,500 PSI (Electric) or 2,000 PSI (Air).

It will be found that as the adjustment cap rotates the GREEN hose which is connected to the hydraulic lock posts will turn along with the adjustment cap and gradually move out of position. When this occurs the hose line should be disconnected from its particular quick-disconnect socket and then moved to the next convenient quick-disconnect socket. See the illustration, HYDRAULIC CIRCUIT ARRANGEMENT. This, however, must be done when the pressure to the cylinders is off. It is important that the hose be reconnected immediately.

THE NORMAL OPERATING POSITION OF THE

### POWER UNIT CONTROL VALVE HANDLES

A pressure regulator will be found on the air filter-lubricator inside the power unit. Turning the adjusting screw on this regulator IN will result in an INCREASE in air pressure and turning the screw OUT will DECREASE the air pressure.

The booster is designed to give approximately 25 PSI hydraulic pressure for every one (1) pound of air pressure.

Check the air and hydraulic pressures only after the booster has stopped working and has settled at a constant pressure.

NORMAL OPERATING AIR PRESSURE SHOULD BE APPROXIMATELY 85 PSI AND NORMAL HYDRAULIC PRESSURE OF THE CYLINDERS SHOULD BE APPROXIMATELY 2,000 PSI.

The Crusher can now be started. The right handle on the control valve should always remain in the back (handle towards operator) or clamped position during actual crushing operation of the machine. Check that the bowl lock arm is engaging the notched driver ring

VALVE HANDLES DURING THE CRUSHING CYCLE HAS THE RIGHT HANDLE (HYDRAULIC LOCK POST VALVE) IN THE CLAMP POSITION (PULLED BACK TOWARDS THE OPERATOR) AND THE LEFT HANDLE (RAM VALVE) IN THE NEUTRAL (MIDDLE) POSITION. SEE THE ILLUSTRATION, POWER UNIT CONTROL VALVE HANDLES.

A relief valve set at 2,800 PSI is built into the operating valve. This is a safety feature of the power unit and should never be tampered with or changed.

### REMOVAL OF BOWL FOR LINER CHANGE

After the liners have been worn out, stop the Crusher and depressurize the hydraulic lock posts. Disconnect the green hydraulic hose from the lock posts completely. The bowl lock arm and adjustment rams are to be moved out of the notched driver ring on the adjustment cap and held away from it until the bowl is turned out of the adjustment ring in the conventional manner.

DO NOT WRAP THE CABLE AROUND THE LOCK POSTS WHEN TURNING THE BOWL. THE CABLES SHOULD BE WRAPPED AROUND THE SHELL OF THE ADJUSTMENT CAP.

Lift the entire bowl assembly with the hooks on the adjustment cap. Again it will be found that the cap will rise alone first, then the entire assembly will be lifted. Place the bowl assembly on the ground and block up the adjustment cap. Then remove the hair pin cotter from the keys in the bolts. Remove the keys and the nuts or spherical washers. The entire adjustment cap is now free and can be lifted with the lock posts and hose in place and is ready for re-assembly when the new bowl liner has been installed in the bowl.

### GENERAL INFORMATION ON OPERATION

It is suggested that a mark be painted on the bowl hopper, as described in the paragraph DETERMINING LINER WEAR in Section 11 to indicate to the operator the point at which the liner wear has reached its maximum. As the adjustment cap seal reaches this mark, the operator would then know that the liners are fully worn and ready to be changed.

On the 7 Ft. Extra Heavy Duty Crusher, one full stroke of the ram will change the crusher

setting 1/16", on the 7 Ft. Heavy Duty, 5-1/2 Ft. Heavy Duty, 4-1/4 Ft., 5100 and 4 Ft. Crushers one full stroke of the ram will change the crusher setting 3/64". It has been found, through experience, that optimum crushing operations result from frequent small changes in liner setting rather than a few large changes.

A total of 32 strokes of the bowl adjustment rams are required for one complete revolution of the bowl on the 7 Ft. Extra Heavy Duty Crusher and 48 strokes on the 7 Ft. Heavy Duty, 5-1/2 Ft. Heavy Duty, 4-1/4 Ft., 5100 and 4 Ft. Crushers.

In the event of tramp iron passing through the Crusher, there may be a nominal increase in hydraulic pressure. This has been carefully considered in the design and should result in no damage whatsoever to the hydraulic system.

In the event of the bowl threads becoming stuck, it is possible that the bowl adjustment rams can be turned in the opposite direction and used to turn out the bowl; however, IT SHOULD BE STATED THAT THE RAMS HAVE NOT BEEN DESIGNED TO CLEAR A PLUGGED MACHINE DUE TO EITHER TRAMP IRON OR AN OVERLOAD.

### PERIODIC MAINTENANCE

#### WARNING

Depressing the "Stop" button on top of the power unit cabinet will only turn off the electric motor. When servicing the electric power unit the "MAIN" power supply to the power unit must be shut off. Always lock out ALL electrical controls BEFORE performing any maintenance work on the Crusher.

#### WARNING

When servicing the air power unit the air control valve located on the left side of the power unit cabinet must be in the "OFF" position.

### CHECK OIL LEVEL

The oil level should be checked periodically to insure smooth operation; however, it is suggested that the tank be filled with oil as indicated

on the power unit only when installing new liners and that the cylinders are completely filled in order to prevent an overflow. One inch of oil in the tank is equivalent to 1.7 gallons.

#### STRAINER (Electric Power Unit)

The strainer located between the hydraulic pump and oil tank should be cleaned at regular intervals. The frequency of these intervals must be determined by the individual operator and the dust conditions in the plant.

#### AIR FILTER-LUBRICATOR (Air Power Unit)

**FILTER.** The filter has a quick release bowl, making the filter element readily available for cleaning. Remove the bowl and clean the filter element periodically by washing with kerosene or other similar cleaner and dry with compressed air.

Using the petcock drain at least once per shift or as frequently as possible.

When cleaning or replacing filter element blow off cover assembly louvers with air.

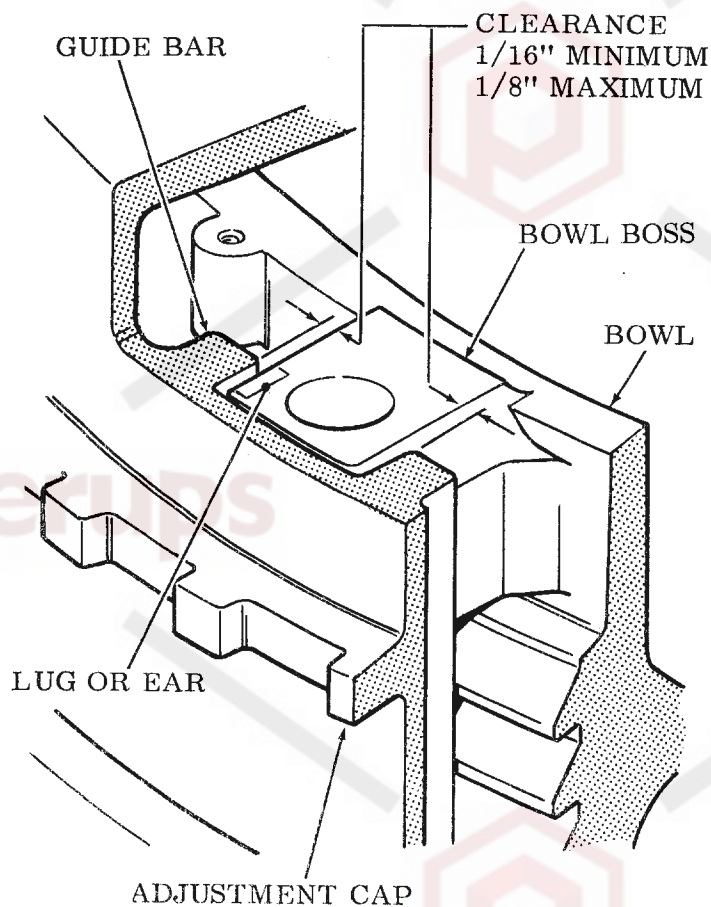
**LUBRICATOR.** To fill the lubricator, turn off the air pressure and remove one of the fill plugs, (the first turn of the fill plug vents the air pressure from the bowl) or remove the bowl and pour the oil into it.

Pour in only clean oil, use the same light oil as is in the oil tank. **DO NOT** fill the bowl above the indicated mark.

This lubricator is unique, in that only particle sizes 2 microns or smaller are permitted to flow from the lubricator; because of this characteristic, only one drop in 20, visible in the sight dome, passes into the system. A count of 40 to 50 drops per minute will result in something over 2 drops per minute output.

Control the rate of oil entering the air stream by turning the adjustment screw in to give less oil and out to give more oil.

Since lubrication in this micro-mist form is very penetrating, only a minimum amount is required. This setting will satisfy the minimum flow requirements of the equipment. If the booster is cycled rapidly, the lubricator will



#### BOWL LUG AND GUIDE BAR CLEARANCES

automatically increase its oil output.

Periodically clean the adjusting screw needle valve and "O" ring and the screen located on the siphon tube inlet by swishing in a solvent and blowing off with air.

Drain off any contaminants or water if they settle in the bottom of the bowl.

#### CHANGING HYDRAULIC OIL

The hydraulic oil in the complete system should be changed **AT LEAST** once a year. During this change, the inside of the oil tank should also be thoroughly cleaned of any sludge accumulation.

#### BOWL

The lugs or "ears" on the bowl bosses should be checked at every second or third liner change for wear. A **MAXIMUM** clearance of 1/8" between the ears and guide bars of the

adjustment cap should be held. If the clearance becomes larger, the ears should be built up with weld and then ground smooth until the clearance is plus 1/16" or minus 1/8". See the illustration, BOWL LUG AND GUIDE BAR CLEARANCES.

### **BOWL ADJUSTMENT RAM AND LOCK**

At least once a month, grease the ram retainer shaft or ram post by using the grease fitting on the side of the adjustment ring boss or ram retainer, also force grease through the fitting on the side of the bowl lock arm.

### **TROUBLE SHOOTING**

Because of the nature of a hydraulic system, most trouble will present itself in the form of an oil leak. The oil leak will create a pressure drop which, in turn, will cause the pump or booster to work more often to return the pressure in the system to its proper setting.

Any abnormal running of the pump or booster means that there is a continuous oil leak at some location in the system. If the leak happens to be past one of the "O" rings in the lock post, it will be very difficult to find the leak because the oil will run down the inside of the cylinder and into the bowl boss. Any other leak will reveal itself in a pool of oil visible to the operator.

In the event of leakage in a hydraulic lock post, it is recommended that the defective lock post be bypassed by using the extra long hose furnished for that purpose. Normal crushing can then be resumed and the defective cylinder repaired during a liner change. Under EXTREME conditions the entire system can operate for a short period on only four lock posts, if it ever becomes necessary.

Any repair work done on a hydraulic component should always be done in relatively clean and dirt-free surroundings.

Possible malfunctions with causes and corrections are shown in TROUBLE SHOOTING DATA found in this Section.

### **ACTUATOR FAILURE IN BOOSTER (AIR POWER UNIT)**

If the oil pressure as shown on the "cylinder" pressure gauge does not go up to the required setting, there could be an actuator failure in the booster. If so, proceed as follows:

- 1 There are two actuator assemblies in the booster, one located at each end of the ram heads. Only the indicating rod of the actuator protrudes out of the booster.
- 2 If there is a pressure failure in the system or if the booster fails to start after the air pressure has been turned off for

## TROUBLE SHOOTING DATA

SYMPTOM	POSSIBLE CAUSE	CORRECTION
Oil pressure does not go up to the required setting. (Electric Power Unit)	Incorrect adjustment of pressure switch.	Readjust setscrew on pressure switch.
Oil pressure does not go up to the required setting. (Air Power Unit)	Insufficient air pressure. Actuator failure in booster.	Check plant air pressure- 80 psi minimum. See Page 10.
Ram fork slipping out of position.	Misalignment of ram in relation to driver ring on adjustment cap.	Reset adjustment screw or saddle located on ram retainer casting directly under ram cylinder.
Ram no longer pushes against the driver ring on the adjustment cap.	Torsion spring or bar beneath retainer plugged with dirt or broken. Torsion spring jumped out of engagement with either adjustment ring or ram retainer. Ram retainer shaft rusty.	Clean torsion spring or bar thoroughly and re-engage with both adjustment ring boss and ram retainer. Clean all rust and pitting from ram retainer shaft and grease thoroughly.
Bowl adjustment ram no longer pushes against the driver ring on the adjustment cap.	Torsion spring or bar clogged with dirt. Rust on bowl lock post.	Clean torsion spring or bar thoroughly. Remove all rust and pitting from bowl lock post and grease thoroughly.
Difficulty in engaging quick-disconnect couplings.	Locked-in pressure either plug or socket caused by disconnecting in pressurized condition.	Depress needle valves at end of plug or socket (with a brass rod and a soft hammer blow, if necessary), until back pressure is relieved.

some time, pull on the indicating rod of the actuator with a pair of pliers. If this does not start the unit, shut off the air pressure and replace the actuator assembly.

- 3 Remove the actuator assembly by removing the retaining ring in the bore of the ram head and pulling on the indicating rod. This will pull out the actuator spacer and the actuator.
- 4 Replace the actuator assembly with a new one. The spacer and retaining ring can be used again as they normally do not require replacement.

### REUSABLE HOSE COUPLINGS

The three 30 Ft. hoses between the power unit and the Crusher can be shortened to suit the location of the power unit since each of these hoses is equipped with one reusable hose coupling. To shorten the 30

Ft. hose proceed as follows:

- 1 Cut the hose with a hacksaw to the required length.
- 2 Strip the hose of its rubber cover before installing the reusable coupling.
- 3 To strip the hose, cut around the entire outside of the hose, down to the wire braid.
- 4 Slit the covering lengthwise, lift the flap and pull off with a pliers.

**BE CAREFUL NOT TO FRAY OR DAMAGE THE WIRE BRAID.**

- 5 The length of hose to be stripped can be determined by placing the coupling shell next to the hose and measuring from the hose end of the shell to the large notch on the shell.



- 6 Place the coupling shell in a vise and screw the hose counter-clockwise into the shell until it is inserted to its full depth.
- 7 Apply oil to the threads on the coupling insert and to the inside of the hose.
- 8 With the coupling shell held firmly in a vise, screw the threaded insert clockwise into the shell until it is tight.

## **CLEANING HYDRAULIC AND CIRCULATION SYSTEMS**

Fluid contamination is the most common cause of hydraulic and circulation oiling systems' poor performance. As contamination in a system builds up, the performance becomes progressively worse. Initially it may be an almost unnoticeable slowing down of actions. Later, as contaminants increase, the system may fail completely.

Interference with a system's operation may be the result of oil oxidation and varnish formation, viscosity change, or additive depletion. It may even be from particles preventing the free flow of oil or the movement of close fitting parts.

In new systems, harmful dirt, sludge, and abrasives may be introduced during manufacture and erection. Slivers or chips of metal from pipe threads and tube cutting, pipe joint sealant, and weld spatters are the most common built-in contaminants that resist initial flushing and cleaning procedures.

In operating systems, abrasive particles are produced as a result of wear of moving parts or erosion within the system. Foreign particles or dust may enter through seals, fluid filler pipes, and breather caps on reservoirs during normal operation. Condensation may occur when a system cools after shutdown and result in a critical amount of water contamination. Oil degradation from additive depletion and oxidation from aeration and high temperatures may cause the formation of varnish and sludge deposits.

### **CLEANLINESS REQUIREMENTS**

Some or all of the previously mentioned contaminants can be found in every hydraulic or circulation system. Even the careful addition of initial fill or make-up oil to the system through 5-micron filters will add some small amount of contamination.

The complete removal of all contaminants is economically not practical. A system's tolerance for contamination must be found and the system then maintained below this contamination level.

As a guide to determine a system's tolerance level, the following general classifications of types of systems may be useful.

### **LOW PRESSURE CIRCULATION OIL SYSTEMS**

Crushing equipment, paper machines, and steel mill circulation oiling systems may operate at pressures up to about 500 PSI. They are usually equipped with suction strainers of 10 to 100 mesh and a main pressure line filter of 75 microns nominal rating. The clearances in pumps, motors, valves, and cylinders in these systems are large enough so that operating efficiency is not impaired by spherical particles up to about 100 microns in diameter--providing the concentration of these particles is low. Even at low concentrations some abrasive wear may take place as a result of particles carried by the fluid scratching against metal surfaces.

### **LOW TO MODERATE PRESSURE HYDRAULIC SYSTEMS**

These are systems operating at pressures up to about 2500 PSI. They are usually equipped with 80 to 100 mesh filters to remove all spherical particles over about 50 microns diameter. Clearances in pumps, motors, valves, and cylinders are so small that large particles of contaminants can cause jamming, or sticking. Abrasive wear of close fitting parts by minute contaminants can be serious in these systems.

### **MEASURING CLEANLINESS**

The surest method of rating a circulation oiling system's cleanliness is the scheduled inspection of key parts of the system (valve removed or piping section disassembled for visual inspection). These regular inspections allow the determination of the rate of contaminant buildup and thus provide a check on filtering efficiency.

Another method is to regularly test samples of the fluid to determine rate of oil deterioration and contaminant buildup. However, this method may not indicate possible deposition of material. If the contaminants are insoluble in oil, they may be deposited in low flow rate areas of the system and not show up in the oil samples. For this reason, periodic checks of the system it-

self should be made. However, when dealing with critical hydraulic systems, opening them up often introduces an intolerable amount of dirt. Therefore, these systems should not be opened periodically for visual inspection.

Analysis of periodic samples will indicate any deterioration of the oil that is taking place through oxidation or other chemical reactions (such as additive depletion etc.). Also if particle sizes of the insoluble contaminants are small enough, and oil flow is high, the rate of formation of these materials may be measured by checking the amounts present in the oil. The gravimetric method gives an accurate quantitative reading on the total amount of insoluble contamination in an oil.

#### CLEANING NEW SYSTEMS

Machine manufacturers exercise great care in cleaning their equipment and preparing it for shipment. Despite the precautions taken, impurities get into hydraulic or circulation systems during shipment and erection. The latter, in particular, offers opportunities for the entrance of foreign materials which interfere with operation, such as dirt, rags, wood blocks, paint flakes, and rust particles. All these materials should be removed from the machines after erection but before placing machines in service.

The following cleaning procedures should be performed before operating machines under load:

- 1 Examine the interior of the reservoir and other accessible interior spaces for contamination or foreign matter. Carefully remove all such materials by manual methods --hand, brushing, wiping with lint-free rags, etc.

If, in a large machine, piping has been assembled or welded on the job, or holes have been drilled and tapped in lines or machines, carefully remove pipe scale, weld spatter, surplus thread compound, gasket cement, metal chips, and debris.

- 2 Where the machine builder recommends flushing with lubricating oil alone but specific instructions are not available, generally follow the procedure outlined in the preceding paragraph, using oil of suitable viscosity without addition of solvent: (1) If the flushing oil is to be circulated by means of the regular pump, use oil sub-

stantially the same viscosity as that to be used in regular operation. During flushing, provide a fine screen of adequate capacity on the pump suction to prevent entrance of abrasive particles. (2) If an independent pump can be used for circulation, the use of a low viscosity flushing oil may be considered. After flushing, drain the system immediately, taking all necessary steps to remove all of the flushing charge.

- 3 Examine filter cartridges and suction screens for cleanliness, and clean or replace them if necessary. Also, clean filter housings.
- 4 After carefully examining and cleaning the system, install the proper grade and quantity of lubricating oil or hydraulic fluid.

#### CLEANING MACHINES IN SERVICE

Inspection may indicate several reasons for cleaning systems that have been in service for some time;

- 1 Deposits in the reservoir or on parts within the system.
- 2 Erratic operation of hydraulic systems or high oil temperatures.
- 3 Poor oil condition as evidenced by dark color, cloudy appearance, a "burned oil" or rancid odor, or the wrong viscosity of oil.
- 4 Presence of emulsions or process fluid contamination.

If the machine is functioning satisfactorily, the last two conditions (poor oil condition or contamination) may be remedied by the procedure outlined under CLEANING DURING SHUTDOWN.

If deposits are found, or if the machine is operating erratically, it may be desirable to clean the machine thoroughly.

#### CLEANING DURING SHUTDOWN.

FIRST STEP - Drain the entire system immediately after shutdown while the oil is still hot. Otherwise, solid contaminants will settle out, and as the oil cools, some soluble oxidation products will become insoluble and also settle out. A sample of the drained oil may be sent to a laboratory for a check on its condition. If the oil is still suitable for continued service, it

can be filtered and used as make up. Otherwise, it may possibly be used for general-purpose lubrication of non-critical machine parts.

In many reservoirs the drain plug is incorrectly located above the bottom, leaving some oil in the machine when it is drained. In hydraulic systems, oil may be left in cylinders, accumulators, and lines when the reservoir is drained. Use special care to drain all of the old oil from such systems as completely as possible. Oil left in the bottom of a reservoir can usually be removed effectively with a hose connected to a suction pump or by mopping with lintless rags.

**SECOND STEP-** After removing all the oil wipe the reservoir clean with lint-free rags. The nature of any dirt found in the reservoir should be determined. Visual inspection should make it possible to identify paint flakes, rust, wear particles, lint, or other similar material. Remove loose paint or rust found on the reservoir surfaces. If metallic wear particles are found, the installation of a magnetic drain plug should be considered. Also, the reasons for the wear should be determined.

**THIRD STEP -** Remove and replace renewable filter cartridges, and clean the elements of

other types of filters and suction strainers in the system. Also clean the filter housings.

**FOURTH STEP -** Recharge the system with the proper grade and quantity of lubricating oil or hydraulic fluid.

#### BENEFITS

The benefits from following a comprehensive program of checking on a system's cleanliness, and acting to maintain the system below its contamination limit, include the following:

- 1 Less machine unscheduled downtime, with loss of production, will result in increased productivity.
- 2 Machines are more responsive, or faster acting, when contamination is maintained at a low level and results in increased productivity.
- 3 Wear of machine is reduced thereby lengthening its service life, which will result in increased productivity.

**Section 13**  
**HYDRAULIC CLEARING SYSTEM**

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## SECTION 13

# HYDRAULIC CLEARING SYSTEM

### DESCRIPTION

For efficient continuous operation of a Crusher, there must be a consistent, uniform flow of material through the crushing cavity.

Should the Crusher stop under load, no attempt should be made to start the Crusher again until the entire crushing cavity has been cleared. Attempting to start the Crusher with the cavity full of material may result in serious damage to the Crusher and crusher motor.

Some of the reasons a Crusher stops under load are as follows; for example, crusher drive motor or engine stopped because of power failure or lack of fuel, too much feed entering the crushing cavity causing the Crusher to stall, discharge conveyor stopped allowing discharging material to back up and plug the Crusher or a piece of tramp iron becoming caught in the crushing cavity.

The hydraulic clearing system, described in this Section, will substantially reduce the time and effort which ordinarily would be required to clear the Crusher and permit the removal of tramp iron SAFELY.

A motor driven two-stage pump provides an oil flow with pressures of **8,000 PSI on the 7 Ft. Extra Heavy Duty** and **9,000 PSI on the 4 Ft., 5100, 4-1/4 Ft., 5-1/2 Ft. and 7 Ft. Heavy Duty Crushers.** See the table **SYSTEM PRESSURE AND ADJUSTMENT RING VERTICAL LIFT USING HYDRAULIC CLEARING.** A three-way, three position control valve directs hydraulic oil to each of three hydraulic jacks, one located at each arm on the main frame flange or four hydraulic jacks equally spaced around the underside of the main frame upper ring or fourteen or sixteen hydraulic jacks equally spaced around the top of the adjustment ring. The piston, within each jack cylinder extends and lifts the adjustment ring upwards off of its seating surface on the main frame a distance of 1" on the 4 Ft., 1-1/2" on the 5100, 4-1/4 Ft., 5-1/2 Ft. and 7 Ft. Heavy Duty and 2" on the 7 Ft. Extra Heavy Duty Crushers. This additional clearance relieves the pressure off the material between the crushing members and the material is free to pass through the Crusher or can now be easily cleared by manual means as described in the paragraphs **CLEARING THE CRUSHER** in Section 11.

CRUSHER SIZE	4 FT.	5100 AND 4-1/4 FT.	5-1/2 FT.	7 FT. HEAVY DUTY	7 FT. EXTRA HEAVY DUTY
NUMBER OF CLEARING JACKS	4	3	14	16	16
SYSTEM AND POWER UNIT PRESSURE (POUNDS PER SQUARE INCH — PSI)	9,000	9,000	9,000	9,000	8,000
ADJUSTMENT RING VERTICAL LIFT (INCHES)	1"	1-1/2"	1-1/2"	1-1/2"	2"

**SYSTEM PRESSURE AND ADJUSTMENT RING VERTICAL LIFT USING HYDRAULIC CLEARING**

## OPERATION

### CONNECTING THE POWER UNIT

When clearing of the Crusher is required, the portable hydraulic power unit is to be placed in a suitable location near the Crusher and close to an electrical power source as shown in the illustrations HYDRAULIC CLEARING SYSTEM. The power unit is connected to the Crusher as follows:

- 1 The power unit, which has a built-in reservoir, is to be filled with oil by removing the filler plug on the top of the power unit. Use a hydraulic oil as described in HYDRAULIC OIL SPECIFICATIONS. Measure from the top of the reservoir to the surface of the hydraulic oil. This distance should be 1" to 1-1/4", when properly filled.
- 2 On the 4 Ft., 5100 and 4-1/4 Ft. Crushers, remove the specially vented dust cap from the male fitting mounted on the side of the manifold block or one of the clearing jacks as shown in the illustrations HYDRAULIC CLEARING SYSTEM, 4 FT., 5100 AND 4-1/4 FT. CRUSHERS. On the 5-1/2 Ft. and 7 Ft. Crushers, remove the dust cap from the male fitting mounted on the front of one of the clearing jacks as shown in the illustrations HYDRAULIC CLEARING SYSTEM, 5-1/2 FT. AND 7 FT. CRUSHERS.
- 3 Then connect the 12 Ft. long hose to the power unit and to the manifold block or clearing jack on the Crusher.

Carefully clean the hydraulic fitting on the manifold block or clearing jack; both ends of the hose and the tee at the pump (power unit).

IT IS MOST IMPORTANT THAT DURING THE ENTIRE PIPING PROCEDURE ALL DIRT AND FOREIGN MATTER BE KEPT OUT OF THE HOSES AND FROM ALL FITTINGS.

- 4 Check the power unit to be certain the control valve handle is in the PRESSURE OFF position.
- 5 Connect the power unit electric motor to a 1-1/2 HP, 3 phase power source. Direction of rotation of the motor is counterclockwise when viewing from the shaft end of the motor. Jog the motor to check for the correct rotation.

Check the motor nameplate for the correct voltage, frequency and phase; electrical connections are also shown on the nameplate. For the proper operation and lubrication of the motor, refer to the manufacturer's service bulletin.

All fuse protection equipment is to be furnished by the customer to conform to local electrical codes. The starter for the power unit motor is also to be furnished by the customer to meet the customer's specific needs, location and electrical interconnecting requirements. Attach a No. 8 or larger ground wire to the power unit.

- 6 Turn the electrical power to the power unit motor OFF.

### HYDRAULIC OIL SPECIFICATIONS

For the hydraulic clearing system use a high grade paraffin (not naphthene) base industrial oil of viscosity specified, having high film strength, having high affinity for an adhesiveness to metal surfaces, having stable chemical and physical properties. Such lubricants should have a high viscosity index, rapid water separation, resist foaming, offer some rust and corrosion protection, resist oxidation and have anti-wear additives.

For normal, all year operating conditions, the lubricant should have a viscosity of 300 to 350 SSU (Seconds Saybolt Universal) at 100° Fahrenheit and a viscosity of 50 to 60 SSU at 210° Fahrenheit, corresponding to a viscosity index of 90 or higher. For such all year operating conditions, lubricants with viscosities higher than 400 SSU at 100° Fahrenheit, or lower than 300 SSU at 100° Fahrenheit are not recommended.

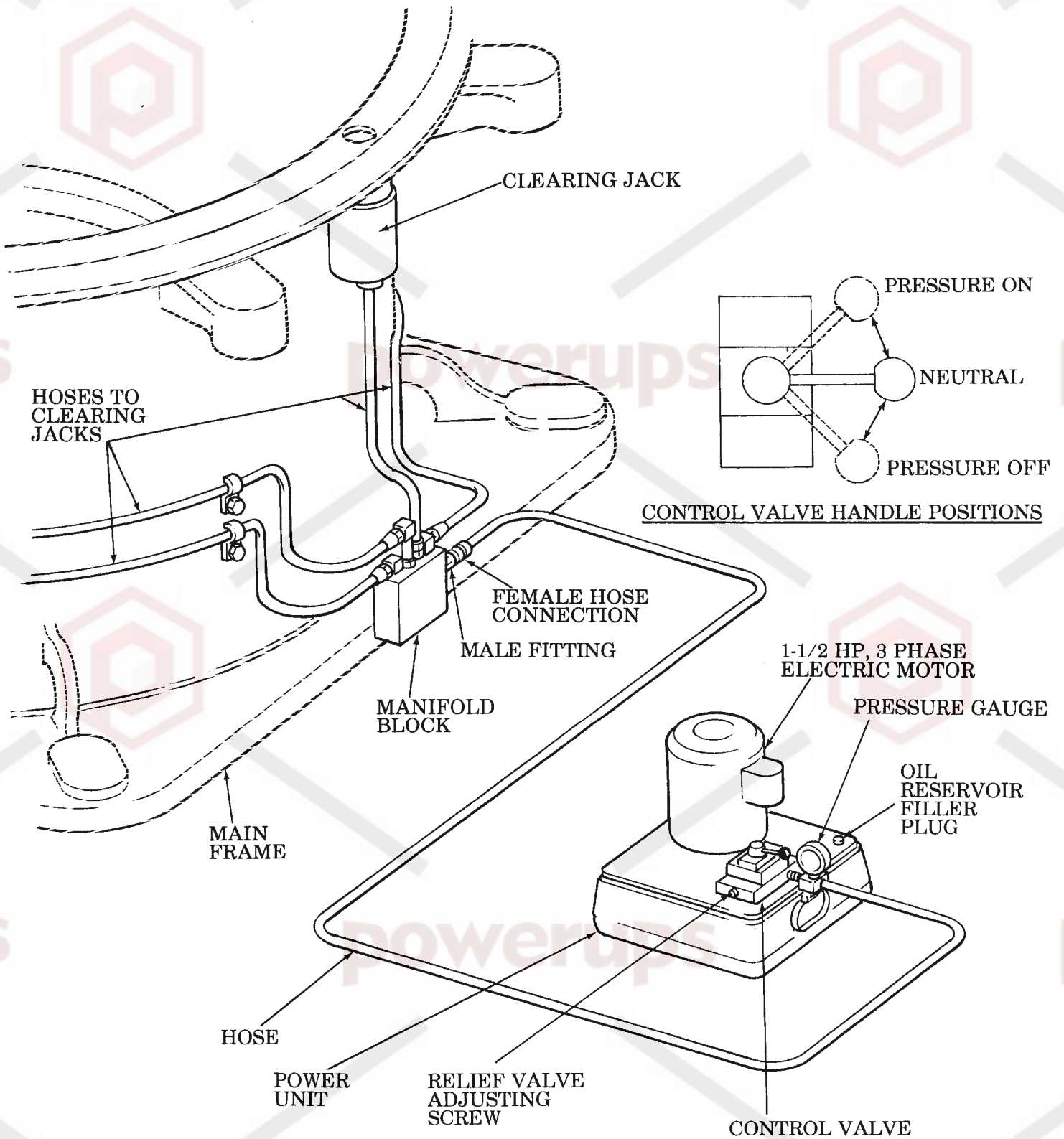
### OIL SPECIFICATIONS

Viscosity at 100°F	300-350 SSU
Viscosity at 210°F	50-60 SSU
Viscosity Index (V.I.)	90 or higher

Correct lubricants meeting the above specifications are essential for the protection of the working parts of our Crushers. They are available from all major oil companies. Improper lubricants can ruin the Crusher and their use will void any warranties pertaining to such Crushers.

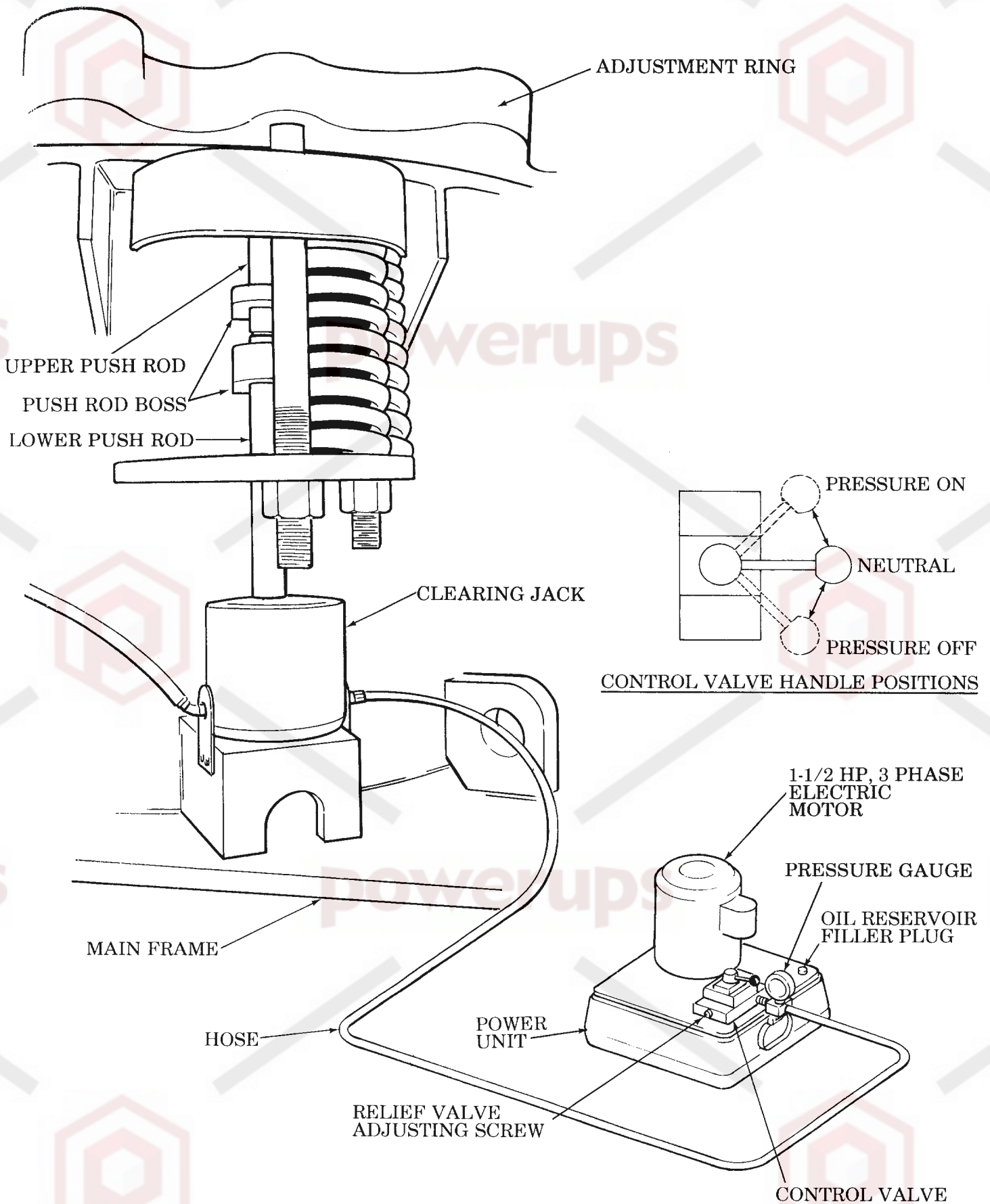
**DO NOT USE FIRE RESISTANT HYDRAULIC FLUIDS AS THESE HYDRAULIC SYSTEMS ARE NOT DESIGNED FOR THE USE OF SUCH FLUIDS.**

Fire resistant hydraulic fluids **MAY NOT** be compatible with packings, seals, hoses and other components within the hydraulic system. Pump life **MAY** decrease and any paint inside of the oil tank **MAY** soften and lift off. Contact the factory before using any fire resistant hydraulic fluids.

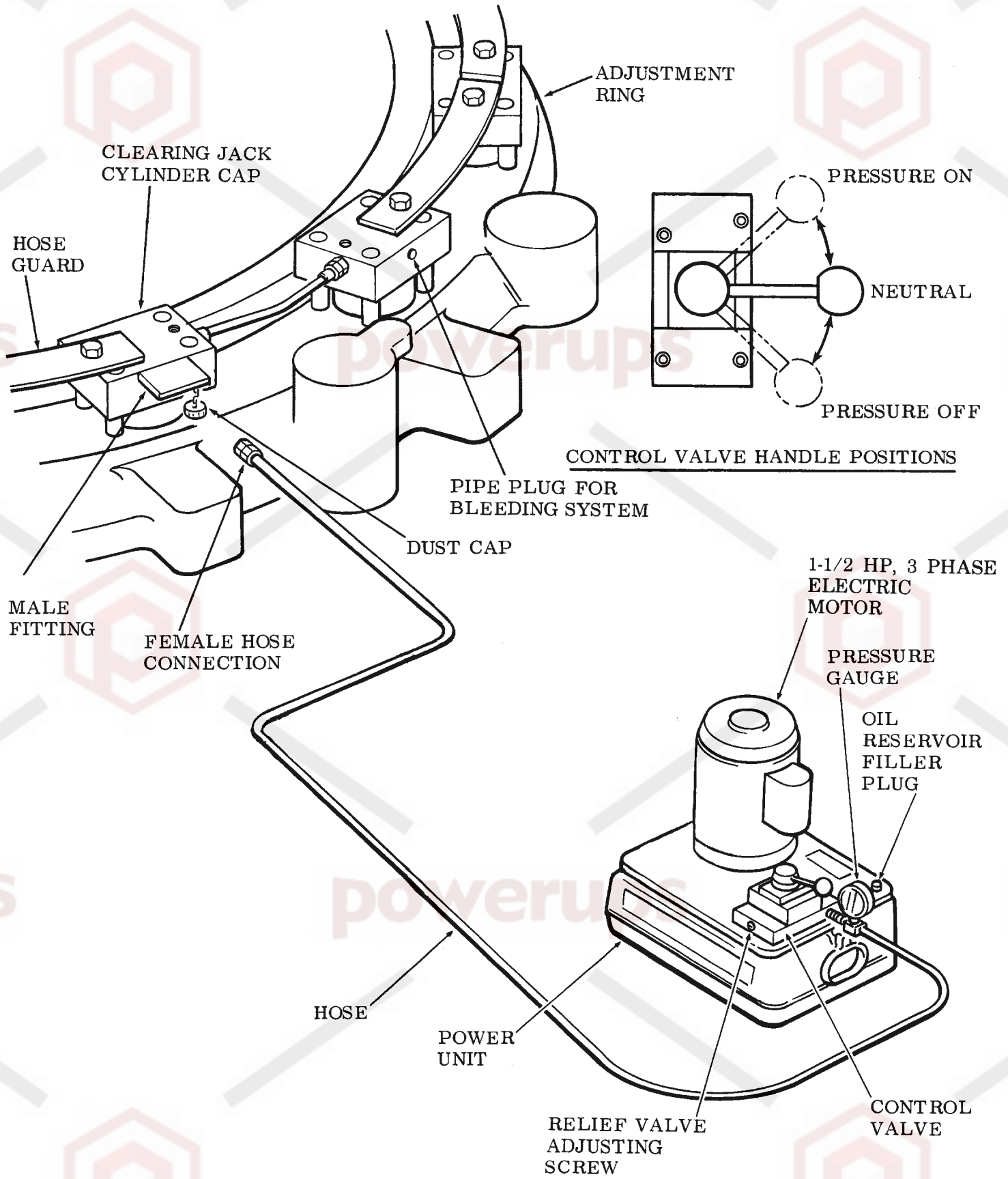


**HYDRAULIC CLEARING SYSTEM**  
4 FT. CRUSHERS

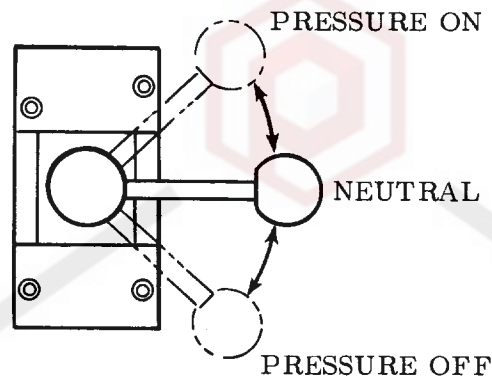




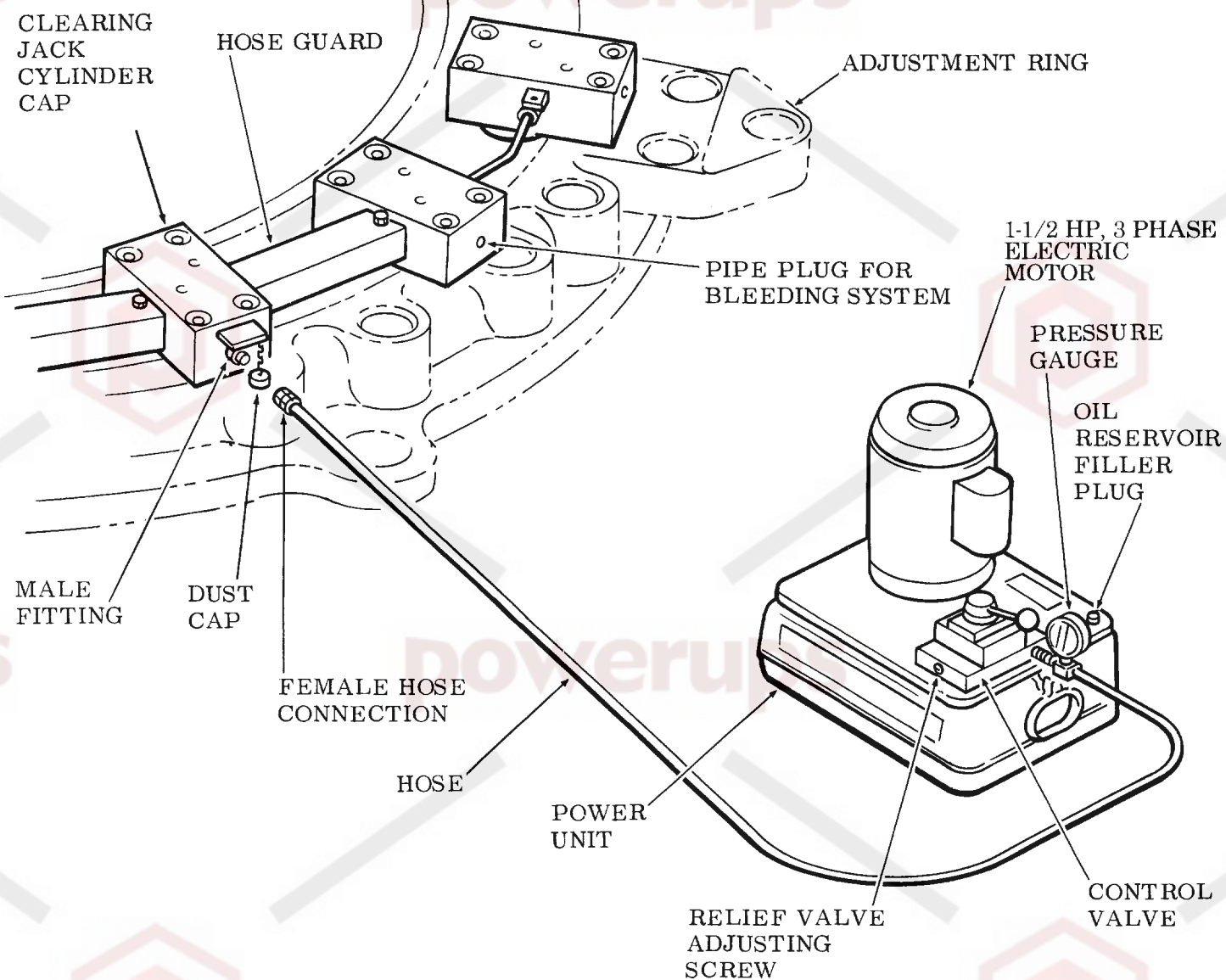
**HYDRAULIC CLEARING SYSTEM**  
5100 AND 4-1/4 FT. CRUSHERS



**HYDRAULIC CLEARING SYSTEM**  
 5-1/2 FT. AND 7 FT. HEAVY DUTY CRUSHERS



CONTROL VALVE HANDLE POSITIONS



**HYDRAULIC CLEARING SYSTEM**  
7 FT. EXTRA HEAVY DUTY CRUSHERS

Approximately 25 U.S. gallons will be required to fill the power unit reservoir, hydraulic clearing jacks and interconnecting hoses.

## DISCONNECTING THE POWER UNIT

During normal crusher operation the power unit is to be disconnected from the Crusher and stored in a readily accessible and clean location as follows:

- 1 Turn the electrical power to the power unit motor OFF and disconnect the motor from the power source.
- 2 Place the control valve handle in the PRESSURE OFF position.
- 3 Observe the pressure gauge at the power unit and wait until the gauge indicates 0 PSI.
- 4 Slowly loosen the female hose connection at the manifold block or clearing jack and relieve any pressure remaining in the system through the loosened connection before removing the hose completely.

### WARNING

Under no circumstances should the hose be disconnected from the manifold block or clearing jack while there is a pressure reading on the pressure gauge. Recheck to be certain the control valve handle is in the PRESSURE OFF position. Disconnecting the hose while under pressure is dangerous due to the high velocity of the escaping oil and to the possibility of being struck by the free end of a whipping hose.

- 5 Disconnect the female hose connection. On the 4 Ft., 5100 and 4-1/4 Ft. Crushers install the special vented dust cap, making certain it is tightened securely on the male fitting at the manifold block or on the end of the elbow on the clearing jack. On the 5-1/2 Ft. and 7 Ft. Crushers install the dust cap, making certain it is tightened securely on the end of the male fitting on the clearing jack cylinder cap.
- 6 Plug the female hose connection to keep the hose and power unit clean during storage.

IT IS IMPORTANT THAT THE HYDRAULIC CIRCUIT BE KEPT FREE OF DIRT, DUST OR ANY OTHER ABRASIVE MATERIAL. THE OIL CLINGING TO THE INTERNAL WALL OF THE HOSE WILL QUICKLY ACCUMULATE ANY DUST OR DIRT SUSPENDED IN THE AIR AROUND THE WORK SITE. WHEN THE POWER UNIT IS NEXT PUT IN USE, THE MATERIAL WOULD BE FLUSHED FROM THE HOSE AND CIRCULATED THROUGH THE SYSTEM, CAUSING DAMAGE TO THE CLOSELY MACHINED SURFACES IN THE CLEARING JACKS, CONTROL VALVE AND PUMP.

- 7 Store the power unit in as clean a location as possible. If nothing else is available, the power unit should, at least, be covered by a suitable protective covering.

## PREPARATIONS BEFORE STARTING

Air entrapped in the empty hose will almost certainly be introduced into the hydraulic circuit when the hose is connected to the Crusher and the hydraulic system is pressurized. To insure satisfactory and safe operation the hydraulic circuit must be bled and the system checked as follows:

- 1 Connect the power unit to the Crusher as instructed under CONNECTING THE POWER UNIT.
- 2 Place the control valve handle in the PRESSURE OFF position.
- 3 Turn the electrical power to the power unit motor ON and let the power unit run depressurized for 2 or 3 minutes.
- 4 Locate the clearing jack that is the farthest from the power unit connection and "crack" open the hose connection or pipe plug 1 to 1-1/2 turns.
- 5 Move the control valve handle to the PRESSURE ON position. Leave the handle in this position until a steady, clear stream of oil flows from the loosened connection.
- 6 Return the control valve handle to the NEUTRAL position, then securely tighten the previously loosened hose connection or pipe plug.
- 7 Place the control valve handle in the PRESSURE ON position and allow the system to build up to 2,000 PSI then return the control valve handle to the NEUTRAL position. The system should remain pressurized while in the neutral position.

- 8 Check the hose connections at the clearing jacks and at the power unit to be certain there are no leaks. Tighten the hose connections if necessary.
  - 9 Move the control valve handle to the **PRESSURE ON** position and watch the pressure gauge to see if system pressure reaches and holds 8,000 PSI or 9,000 PSI depending on the crusher size. See the paragraph **DESCRIPTION** for crusher sizes. If there is a 500 PSI ( $\pm$ 500 PSI) pressure variation from the 8,000 PSI or 9,000 PSI, the relief valve on the power unit will need an adjustment as instructed under **ADJUSTING THE POWER UNIT**.
  - 10 After the system pressure reaches and holds the correct pressure, place the control valve handle in the **PRESSURE OFF** position.
  - 11 Observe the pressure gauge at the power unit and wait until the gauge indicates 0 PSI.
  - 12 Turn the electrical power to the power unit motor **OFF**.
- 2 Connect the hydraulic power unit to the Crusher as instructed under **CONNECTING THE POWER UNIT and PREPARATIONS BEFORE STARTING**. The control valve handle should be in the **PRESSURE OFF** position.
  - 3 Turn the electrical power to the power unit motor **ON**. Place the control valve handle in the **PRESSURE ON** position. When the full system pressure of 8,000 PSI or 9,000 PSI is reached, the adjustment ring is in the raised position. Jog the Crusher by applying short spurts of power to the crusher drive motor to clear the crushing cavity.
  - 4 If the crushing head is free and the cavity is clear of material, place the control valve handle in the **PRESSURE OFF** position and allow the adjustment ring to return to its seating surface on the main frame. **JACK PRESSURE MUST BE RELEASED BEFORE STARTING THE CRUSHER**. Then resume normal crushing operations. If jogging the Crusher a few times does not free the head, proceed to Step 5.
  - 5 Release the jack pressure by moving the control valve handle to the **PRESSURE OFF** position. This will allow the crusher spring pressure to lower the adjustment ring and compress or crush any material that shifted during the time the adjustment ring was lifted.
  - 6 Raise the adjustment ring again, to relieve the spring pressure on the jammed material by moving the control valve handle to the **PRESSURE ON** position. This will allow any material to fall free that was crushed while spring pressure to the adjustment ring was re-applied.
  - 7 Jog the Crusher a few times as instructed in Step 3 and again check for free head movement.
  - 8 If the crushing cavity is cleared, resume normal crushing. If the head is still not free, repeat Steps 3 through 7 several times or as long as material continues to discharge from the crushing cavity.
  - 9 If the crushing cavity still is not cleared after repeated cycling of the clearing system, raise the adjustment ring by moving the control valve handle to the **PRESSURE ON** position. After the full system pressure is reached, swing or slide the safety block assemblies located around the top of the main frame or loosen the hex nut and raise the handle arms on the safety block assemblies located around the outside of the adjustment ring, to the horizontal position as shown in the illustrations **SAFETY BLOCKS**. Move each safety block toward the Crusher as far as possible under the adjustment ring as shown in the illus-

## **CLEARING THE CRUSHER**

Should the Crusher stop under load, no attempt should be made to start the Crusher again until the entire crushing cavity has been cleared. Attempting to start the Crusher with the cavity full of material may result in serious damage to the Crusher and crusher motor.

Some of the reasons a Crusher stops under load are as follows; for example, Crusher drive motor or engine stopped because of power failure or lack of fuel, too much feed entering the crushing cavity causing the Crusher to stall, discharge conveyor stopped allowing discharging material to back up and plug the Crusher or a piece of tramp iron becoming caught in the crushing cavity.

The gyrating crushing action of the head could possibly cause the material caught between the crushing members on the closed side to tip and raise the adjustment ring a small amount. This caught material wedges very tightly between the bowl liner and mantle because of the compression of the spring clusters in that area.

To clear the Crusher or to remove tramp iron wedged between the bowl liner and mantle using the hydraulic clearing system, proceed as follows:

- 1 Shut the power **OFF** to the crusher motor as quickly as possible.

trations SAFETY BLOCK POSITIONS. These blocks, when slid into position, fit between the main frame and adjustment ring and will keep the adjustment ring and bowl in the raised position in case of a sudden loss of pressure due to a hydraulic line, pump, or jack failure.

**WARNING**

THE SAFETY BLOCKS MUST BE SECURELY PLACED BETWEEN THE MAIN FRAME AND THE ADJUSTMENT RING BEFORE ANY MANUAL CLEARING OF THE CRUSHER BEGINS. THIS IS A SAFETY FEATURE TO PROTECT HANDS OR ARMS OR EQUIPMENT FROM BEING CAUGHT BETWEEN THE CRUSHING MEMBERS IN THE EVENT OF A HYDRAULIC FAILURE.

DO NOT PLACE FEET OR HANDS ON THE SPRING CLUSTERS; IN THE SPACE BETWEEN THE ADJUSTMENT RING AND MAIN FRAME; OR ANY PART OF THE BODY BETWEEN THE LOWER SPRING SEGMENTS AND THE MAIN FRAME FLANGE. ALWAYS POSITION THE SAFETY BLOCKS BETWEEN THE MAIN FRAME AND ADJUSTMENT RING WHEN THE ADJUSTMENT RING IS IN THE RAISED POSITION AND TRAMP IRON IS BEING REMOVED.

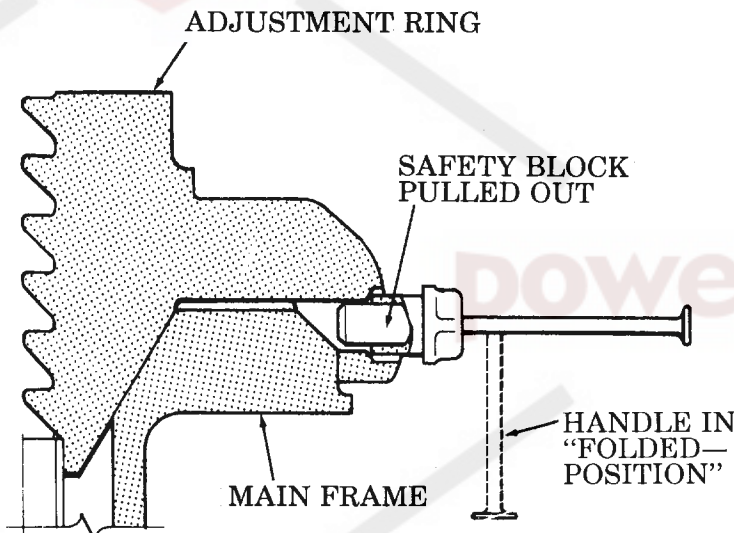
- 10 With the safety blocks inserted, proceed with the manual clearing procedure as described in the paragraphs TRAMP IRON REMOVAL in Section 11.

THE PROBABILITY OF AN UNCRUSHABLE OBJECT LODGING ITSELF WITH ITS MAXIMUM DIAMETER OR SIZE ALIGNED BETWEEN THE CRUSHING MEMBERS IS RARE. IF THIS SHOULD HAPPEN AND THE OBJECT IS LARGE ENOUGH, IT IS POSSIBLE THAT LIFTING THE ADJUSTMENT RING AND JOGGING THE CRUSHER WILL NOT ALLOW THE OBJECT TO DROP OUT OF THE CRUSHER. IF THIS SHOULD OCCUR, IT MAY BE NECESSARY TO "WASH" THE TRAMP IRON PIECE AWAY BY USING A THERMAL CUTTING TORCH AS INSTRUCTED IN TRAMP IRON REMOVAL IN SECTION 11.

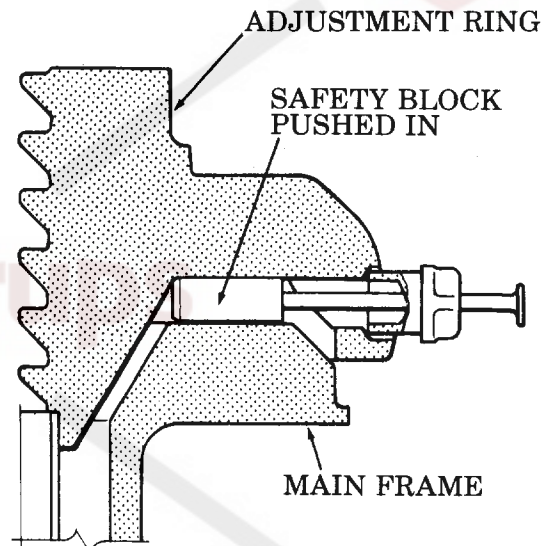
**WARNING**

UNDER NO CIRCUMSTANCES ENTER THE CRUSHING CAVITY WHEN A PIECE OF TRAMP IRON IS WEDGED BETWEEN THE BOWL LINER AND MANTLE.

- 11 When the cavity is cleared, swing or pull the safety blocks outward as shown in the illustration.

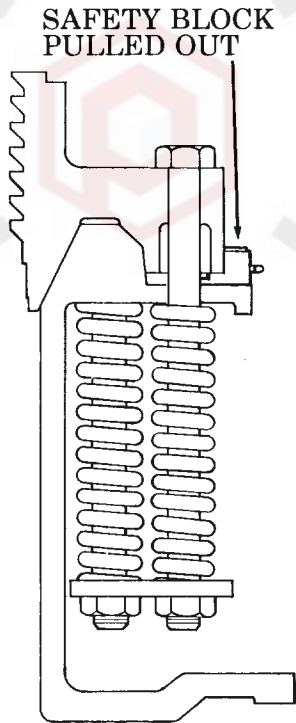


ADJUSTMENT RING IN NORMAL CRUSHING POSITION WITH SAFETY BLOCK PULLED OUT FOR NORMAL CRUSHING



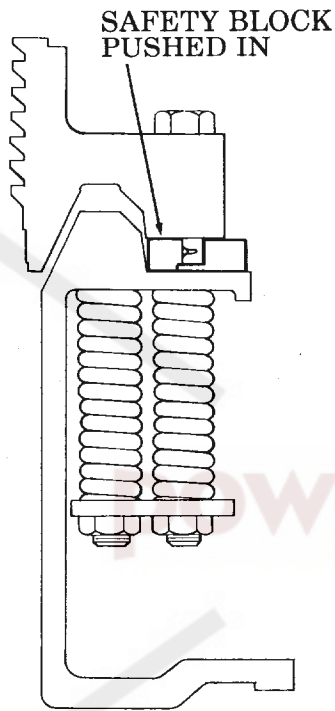
ADJUSTMENT RING IN RAISED POSITION AND SAFETY BLOCK PUSHED IN FOR MANUAL CLEARING OF CRUSHING CAVITY

**SAFETY BLOCK AND SAFETY BLOCK POSITIONS**  
4 FT., 5100 AND 4-1/4 FT. CRUSHERS



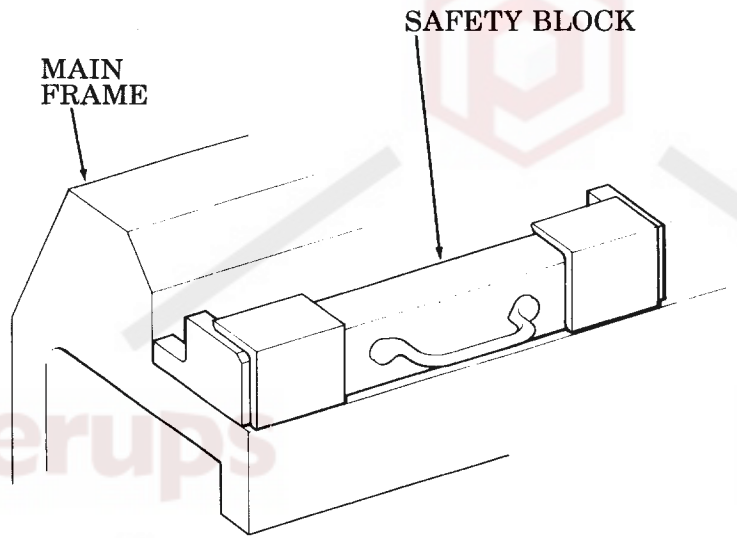
SAFETY BLOCK  
PULLED OUT

SAFETY BLOCK  
PULLED OUT  
FOR NORMAL  
CRUSHING



SAFETY BLOCK  
PUSHED IN

SAFETY BLOCK  
PUSHED IN  
FOR MANUAL  
CLEARING OF  
CRUSHING CAVITY



MAIN  
FRAME

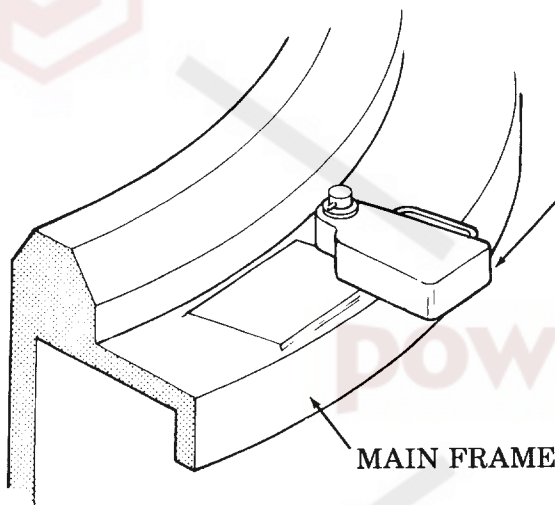
SAFETY BLOCK

**SAFETY BLOCKS**

7 FT. HEAVY DUTY CRUSHERS

**SAFETY BLOCK POSITIONS**

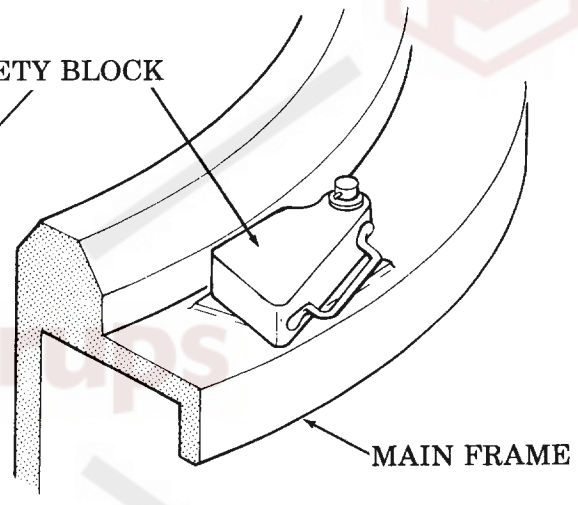
5-1/2 FT. AND 7 FT. HEAVY DUTY CRUSHERS



SAFETY BLOCK

MAIN FRAME

SAFETY BLOCK  
POSITION FOR  
NORMAL CRUSHING

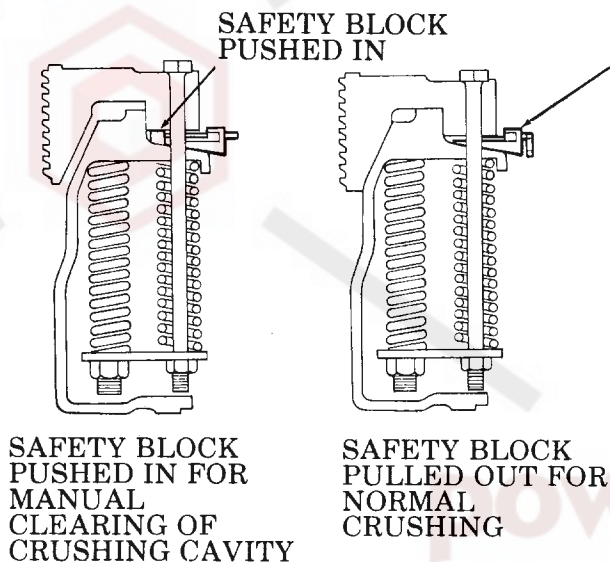


MAIN FRAME

SAFETY BLOCK  
POSITION FOR  
MANUAL CLEARING  
OF CRUSHING CAVITY

**SAFETY BLOCKS**

5-1/2 FT CRUSHERS



### SAFETY BLOCK POSITIONS

7 FT. EXTRA HEAVY DUTY CRUSHERS

tions SAFETY BLOCK POSITIONS. Release the jack pressure by placing the control valve handle in the PRESSURE OFF position. JACK PRESSURE MUST BE RELEASED BEFORE STARTING THE CRUSHER.

- 12 Resume normal crushing.
- 13 Disconnect the power unit as instructed under DISCONNECTING THE POWER UNIT.

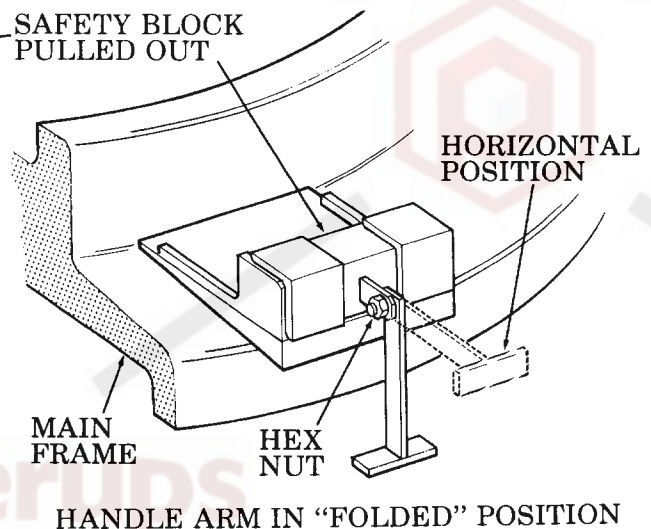
### WARNING

Under no circumstances should the Crusher be started and crushing resumed with the clearing jacks in the RAISED position or in any position other than fully RETRACTED. SERIOUS PERSONAL INJURY AND SEVERE DAMAGE TO THE CRUSHER COULD RESULT. Hydraulic jacks could be torn loose from their mountings and the jacks ejected rapidly outwards or hydraulic hoses could rupture.

### ADJUSTING THE POWER UNIT

If the system pressure varies more than 500 PSI from the specified pressure ( $\pm 500$  PSI), the relief valve on the power unit must be adjusted as follows:

- 1 Place the control valve handle in the PRESSURE ON position and wait until the pressure gauge indicates the maximum, pressure, which should be **8,000 PSI on the 7 Ft. Extra Heavy Duty** and **9,000 PSI on the 4 Ft., 5100, 4-1/4 Ft., 5-1/2 Ft. and 7 Ft. Heavy Duty Crushers.**



### SAFETY BLOCKS

7 FT. EXTRA HEAVY DUTY CRUSHERS

THE POWER UNIT MUST BE TESTED WITH THE CONTROL VALVE HANDLE IN THE "PRESSURE ON" POSITION AND WITH THE HYDRAULIC OIL ACTING AGAINST AN IMMOVABLE RESISTANCE. THIS CAN BE ACCOMPLISHED BY EITHER CONNECTING THE POWER UNIT TO THE CRUSHER AS INSTRUCTED UNDER CONNECTING THE POWER UNIT AND/OR BY REMOVING THE POWER UNIT HOSE AT THE PRESSURE GAUGE AND INSTALLING A THREADED PIPE PLUG IN THE GAUGE ADAPTER FITTING.

- 2 If the hydraulic pressure is more than 500 PSI above 8,000 PSI or 9,000 PSI, proceed as follows:
  - A. Place the control valve handle in the PRESSURE OFF position and turn the electrical power to the power unit motor OFF.
  - B. Turn the relief valve adjusting screw OUT (counterclockwise) two turns as shown on the illustrations HYDRAULIC CLEARING SYSTEM.
  - C. Turn the electrical power to the power unit motor ON and place the control valve handle in the PRESSURE ON position.
  - D. Carefully, and slowly, turn the relief valve adjusting screw IN (clockwise) until the pressure gauge reads and holds 8,000 PSI or 9,000 PSI.

NO ATTEMPT SHOULD BE MADE TO TURN THE RELIEF VALVE ADJUSTING SCREW OUT (COUNTERCLOCKWISE) WHILE THERE IS HYDRAULIC PRESSURE IN THE SYSTEM. IF THE PRESSURE SET POINT OF 8,000 PSI OR 9,000 PSI



IS EXCEEDED WHILE TURNING THE RELIEF VALVE ADJUSTING SCREW IN (CLOCKWISE), THE SYSTEM MUST BE DEPRESSURIZED AND THE PROCESS OF ADJUSTING THE PRESSURE MUST BE STARTED OVER. FOR COMPLETE ACCURACY THE FINAL ADJUSTMENT MUST BE MADE WHILE IN THE PROCESS OF INCREASING PRESSURE BY TURNING THE RELIEF VALVE ADJUSTING SCREW IN (CLOCKWISE).

- 3 If the hydraulic pressure is more than 500 PSI below 8,000 PSI or 9,000 PSI, proceed as follows:

A. Turn the electrical power to the power unit motor ON and place the control valve handle in the PRESSURE ON position.

B. Carefully, and slowly, turn the relief valve adjusting screw IN (clockwise) until the pressure gauge reads and holds 8,000 PSI or 9,000 PSI.

Since the pressure is already below either 8,000 PSI or 9,000 PSI, there is no need to depressurize the system and turn the relief valve adjusting screw OUT (counterclockwise).

## MAINTENANCE

It is important to maintain the clearing jacks in good operating condition. By carrying out simple preventive maintenance procedures, expensive repair costs can be avoided. If hydraulic system pressure cannot be maintained with the control valve in the NEUTRAL position, it is a good indication of oil leakage in the hydraulic circuit. Oil leakage coming from between the piston and the cylinder of the jack is an indication that the clearing jacks will require rebuilding. If after prolonged usage there is oil leakage at one or more of the clearing jacks, it is advisable to rebuild all the jacks rather than just the immediate problem. In addition, from time to time, check the hoses and all connections to insure that they are not leaking. If they are leaking, tighten the fittings and/or replace the fittings and hoses.

## CLEARING JACK REMOVAL, 4 FT. CRUSHERS

To remove one of the clearing jacks for inspection or all the clearing jacks for rebuilding, proceed as follows:

- 1 Disconnect the power unit from the Crusher as instructed under DISCONNECTING THE POWER UNIT.

- 2 Relieve any remaining pressure in the hydraulic circuit by "cracking" open one of the hose connections at any of the clearing jacks, 1 to 1-1/2 turns.
- 3 Remove the hoses from the bottom of the clearing jack, being careful not to damage any of the hydraulic fittings.

DURING THE REBUILDING PROCESS IT IS EXTREMELY IMPORTANT THAT THE HOSES BE PROTECTED AGAINST DIRT AND DUST ENTERING THE HOSE PASSAGES. IMMEDIATELY AFTER REMOVAL, STORE THE HOSES IN A CLEAN, DUST FREE AREA.

- 4 Using a plumber's wrench with a canvas strap, unscrew the clearing jack cylinder from the cylinder head which is located on the underside of the main frame upper ring, see the illustration CLEARING JACK ASSEMBLY, 4 FT. CRUSHERS.

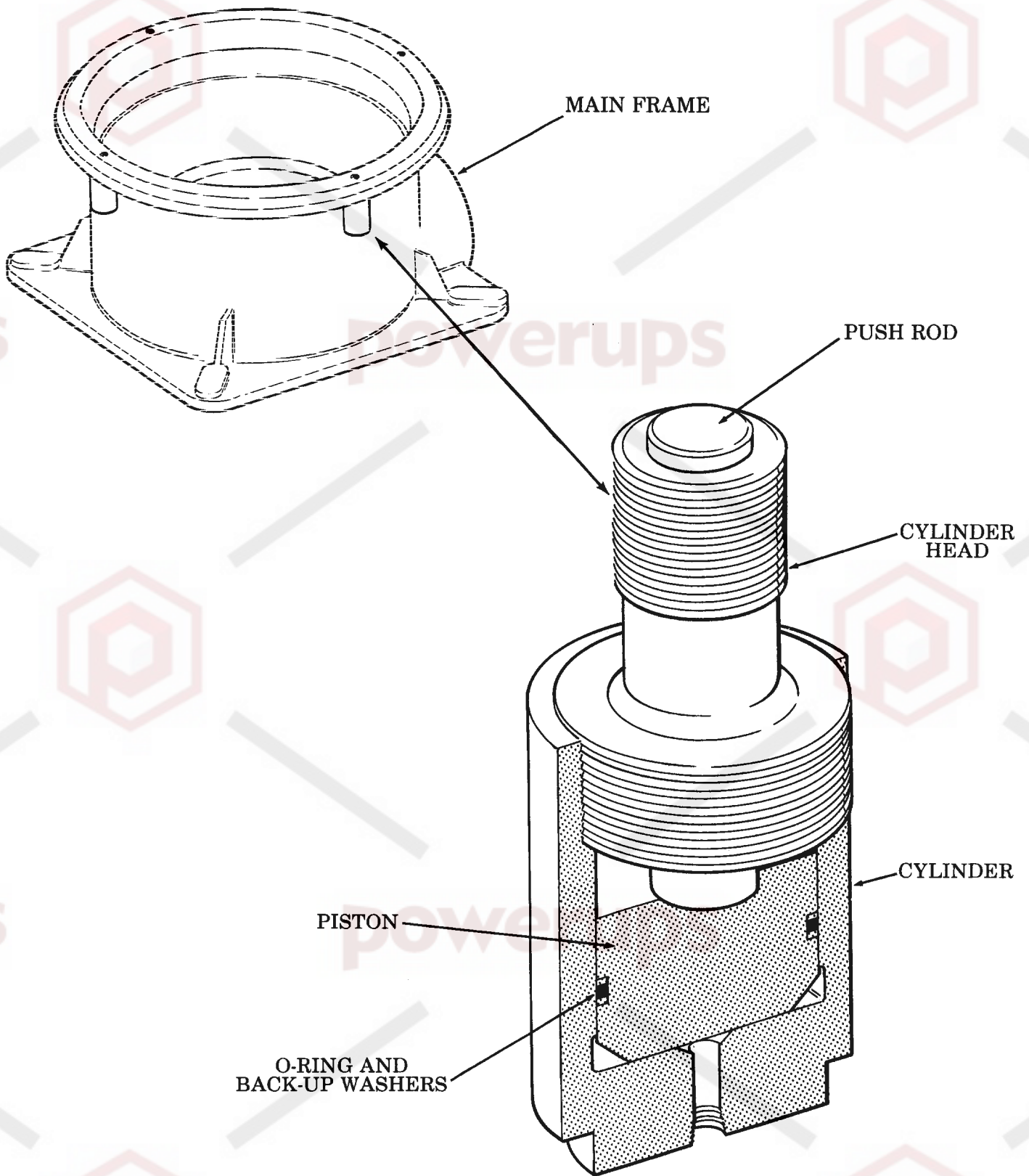
DO NOT USE A PIPE WRENCH TO REMOVE THE CLEARING JACK. INDENTATIONS CREATED FROM THE JAWS OF THE PIPE WRENCH CAN CAUSE THE CLEARING JACK CYLINDER TO FAIL WHEN PRESSURIZED.

Care should be taken when lowering the clearing jack cylinder as the push rod and piston should slide downward with the cylinder. If these parts stick in the cylinder head, care should be taken so that they do not drop accidentally and become damaged.

- 5 Remove the push rod from within the cylinder head by pulling downward on the rod. If the push rod cannot be removed, this is usually a result of the head of the rod being peened over. The cylinder head and push rod will have to be removed from the crusher main frame before the push rod can be removed.

IF THE PUSH ROD IS PEENED OVER AT THE TOP, MACHINE THE PUSH ROD 1/32" SMALLER IN DIAMETER FOR A 1" LENGTH.

- 6 Loosen the cylinder head from the underside of the main frame by using a brass rod and hammer in the holes on the bottom of the cylinder head. Then finish removing by unscrewing the cylinder head completely.
- 7 Inspect the cylinder bore and piston for nicks, scratches or excessively worn spots. If there is excessive wear on any of these parts, they should



**CLEARING JACK ASSEMBLY**  
4 FT. CRUSHERS

be replaced. Excessive wear on the cylinder bore and/or piston will cause the piston to cock.

Check the push rod for rust, galling, bending or peening.

Check the piston O-ring and back-up washers for breaks or flat spots. Check the outside diameter of the piston for galling or peeling of the bronze plating.

## **CLEARING JACK ASSEMBLY, 4 FT. CRUSHERS**

To assemble and install the clearing jacks, proceed as follows:

- 1 All surfaces of the cylinder bore, piston, push rod and cylinder head are to be clean and dust free. Any rust on these surfaces should be removed by buffing with a fine abrasive rubbing compound. **DO NOT FILE OR USE EMERY PAPER. IF RUST IS EXTENSIVE AND CANNOT BE REMOVED WITH RUBBING COMPOUND, THE JACK MUST BE REPLACED.** Closely examine the inside bore for scratches. Any deep scratches or scoring will cause leakage and the jack must be replaced.

**USE LINT-FREE RAGS WHEN CLEANING HYDRAULIC COMPONENTS.**

- 2 Liberally coat the threads on the cylinder head with a mixture of grease and 5-10% (by volume) of molybdenum disulfide powder. Install the cylinder head into the main frame upper ring and tighten, using a brass rod and hammer in the holes on the bottom of the cylinder head. The cylinder head should bear tightly against the underside of the main frame upper ring.
- 3 Install the O-ring and back-up washers in the piston as shown in the illustration **CLEARING JACK ASSEMBLY, 4 FT. CRUSHERS.** Coat the bore of the cylinder with a light oil and install the piston in the cylinder with the chamfered portion of the piston against the bottom of the cylinder.
- 4 Apply a coat of oil to the push rod and insert it into the cylinder head. Hold the push rod up in the cylinder head until the cylinder with the piston installed has been threaded onto the cylinder head.
- 5 To tighten the cylinder on the cylinder head use a plumber's wrench with a canvas strap. The cylinder will have approximately 1/8" clearance with the underside of the main frame upper ring when properly installed.

- 6 Reconnect the hoses to the bottom of the clearing jack.
- 7 Recheck the hose connections to be certain they are tight.
- 8 Test the hydraulic circuit for leaks and bleed the system as instructed under **PREPARATIONS BEFORE STARTING.**

## **CLEARING JACK REMOVAL, 5100 AND 4-1/4 FT. CRUSHERS**

To remove one of the clearing jacks for inspection or all the clearing jacks for rebuilding, proceed as follows:

- 1 Disconnect the power unit from the Crusher as instructed under **DISCONNECTING THE POWER UNIT.**
- 2 Relieve any remaining pressure in the hydraulic circuit by "cracking" open one of the hose connections at any of the clearing jacks, 1 to 1-1/2 turns.
- 3 Remove the hoses from each clearing jack, being careful not to damage any of the hydraulic fittings.

**DURING THE REBUILDING PROCESS IT IS EXTREMELY IMPORTANT THAT THE HOSES BE PROTECTED AGAINST DIRT AND DUST ENTERING THE HOSE PASSAGES. IMMEDIATELY AFTER REMOVAL, STORE THE HOSES IN A CLEAN, DUST FREE AREA.**

- 4 Lift the push rods slightly and slide the jack off the pedestal on the main frame. See the illustration **PUSH ROD INSTALLATION, 5100 AND 4-1/4 FT. CRUSHERS.**
- 5 To remove the piston from within the jack cylinder, connect the jack directly to the pumping unit used to operate the clearing system. Slowly pressurize the jack until the piston is free from the jack cylinder bore.

**TAKING THE JACK APART SHOULD BE DONE IN A DUST FREE AREA SO AS NOT TO CONTAMINATE THE CLOSELY MACHINED INTERNAL PARTS. DIRT WOULD CAUSE EXCESSIVE WEAR AND PREMATURE SEAL FAILURE WHEN THE JACK IS REASSEMBLED.**

- 6 Pour the oil out of the jack cylinder and inspect the cylinder bore and piston for nicks, scratches,

rust or excessively worn spots. If there is excessive wear on any of these parts, they should be replaced. Excessive wear on the cylinder bore and/or piston will cause the piston to cock.

Check the rod wiper and rod seal for breaks or flat spots.

## **CLEARING JACK ASSEMBLY, 5100 AND 4-1/4 FT. CRUSHERS**

To assemble the clearing jacks, proceed as follows:

- 1 All surfaces of the cylinder bore and piston are to be clean and dust free. Any rust on these surfaces should be removed by buffing with a fine abrasive rubbing compound. **DO NOT FILE OR USE EMERY PAPER. IF RUST IS EXTENSIVE AND CANNOT BE REMOVED WITH RUBBING COMPOUND, THE JACK MUST BE REPLACED.** Closely examine the inside bore for scratches. Any deep scratches or scoring will cause leakage and the jack must be replaced.

**USE LINT-FREE RAGS WHEN CLEANING HYDRAULIC COMPONENTS.**

- 2 Install the rod seal in its groove in the cylinder bore. The seal is to be installed with the solid end of the seal toward the top of the jack cylinder as shown in the illustration **CLEARING JACK ASSEMBLY, 5100 AND 4-1/4 FT. CRUSHERS.**
- 3 Install a new rod wiper in its counterbore located at the top of the cylinder bore.
- 4 Coat the jack cylinder bore and piston liberally with a light oil.
- 5 Carefully insert the piston into the cylinder and push it into the cylinder until it bottoms.
- 6 Install the jack on the Crusher as described under **PUSH ROD INSTALLATION, 5100 AND 4-1/4 FT. CRUSHERS.**

## **CLEARING JACK AND PUSH ROD INSTALLATION, 5100 AND 4-1/4 FT. CRUSHERS**

To assemble the clearing jacks and push rods, proceed as follows:

- 1 There are three sets of push rods; each set consists of one upper push rod and one lower push rod, installed at each jack location. Refer to the

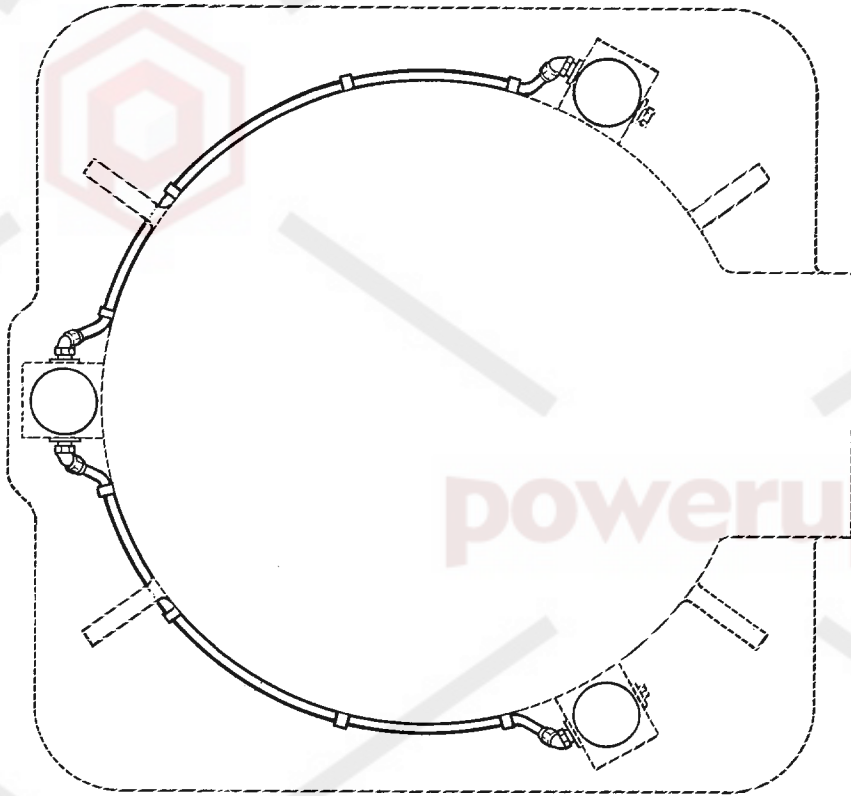
illustration, **PUSH ROD ASSEMBLY, 5100 AND 4-1/4 FT. CRUSHERS.** The upper push rod can be identified by the rounded nose on one end of the rod. This rod is to be inserted, rounded end up, up through the lower and upper push rod bosses, located on the side of the main frame.

- 2 Then insert the lower push rod up under the upper push rod through the same lower push rod boss. The turned end of the lower push rod is to be pointing up when being installed.
- 3 Slide both push rods up far enough to slide the clearing jacks into position under the rods with the jack hydraulic connection pointing out, then allow the push rods to rest on the jack pistons.
- 4 Center each jack under the push rods.
- 5 Connect all the fittings, hoses and pump to the jack as shown in the illustration, **HYDRAULIC CLEARING SYSTEM, 5100 AND 4-1/4 FT. CRUSHERS.**
- 6 Recheck the hose connections to be certain they are tight.
- 7 Test the hydraulic circuit for leaks and bleed the system as instructed under **PREPARATIONS BEFORE STARTING.**

## **CLEARING JACK REMOVAL, 5-1/2 FT. AND 7 FT. CRUSHERS**

To remove one of the clearing jacks for inspection or all the clearing jacks for rebuilding, proceed as follows:

- 1 Disconnect the power unit from the Crusher as instructed under **DISCONNECTING THE POWER UNIT.**
- 2 Relieve any remaining pressure in the hydraulic circuit by "cracking" open one of the pipe plugs at any of the cylinder caps, so equipped, 1 to 1-1/2 turns.
- 3 Remove the hose guards by removing the hose guard capscrews which attach the guards to the cylinder caps. See the illustrations **HYDRAULIC CLEARING SYSTEM, 5-1/2 FT. AND 7 FT. CRUSHERS.**
- 4 Remove the hoses from each of the cylinder caps, being careful not to damage any of the hydraulic fittings.



ADJUSTMENT RING

UPPER PUSH  
ROD BOSS

UPPER  
PUSH ROD

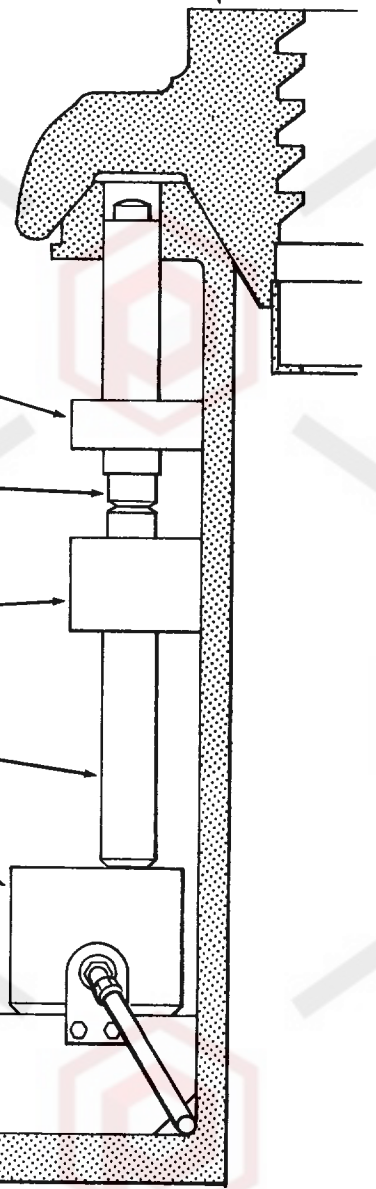
LOWER PUSH  
ROD BOSS

LOWER  
PUSH ROD

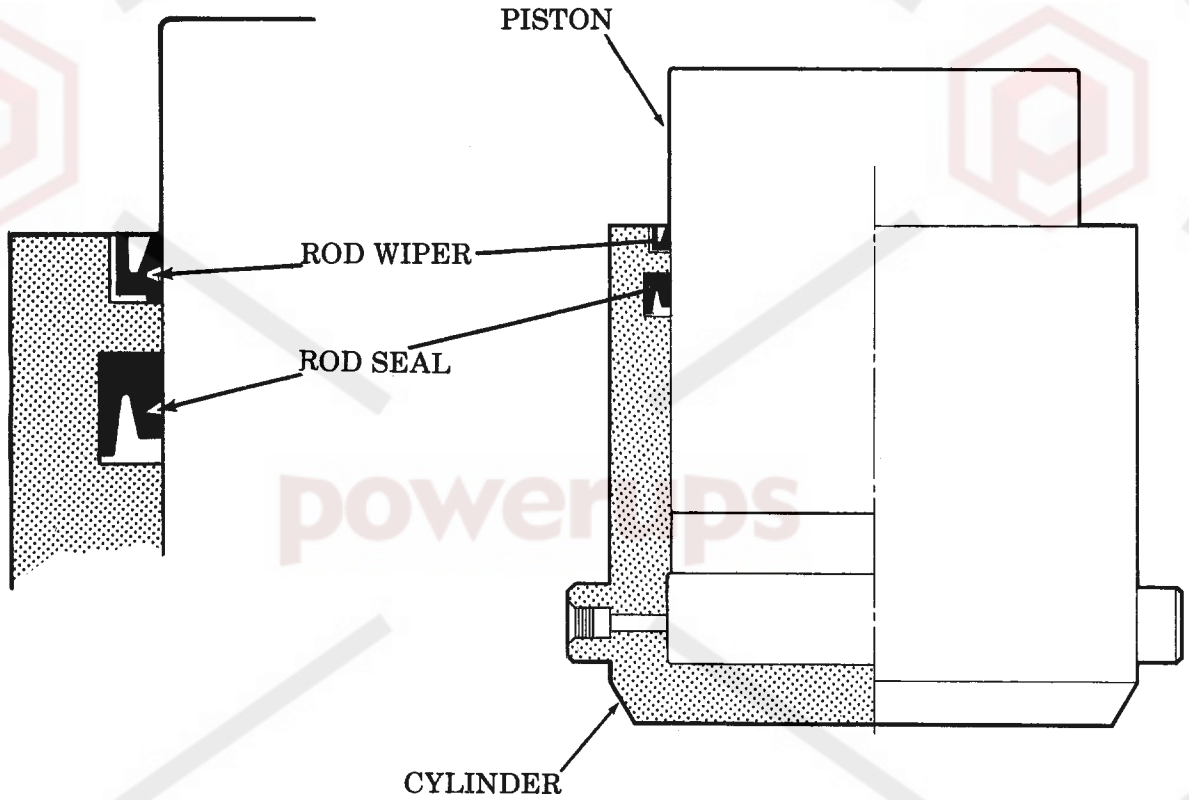
CLEARING JACK

JACK  
PEDESTAL

MAIN  
FRAME



**PUSH ROD INSTALLATION  
5100 AND 4-1/4 CRUSHERS**



**CLEARING JACK ASSEMBLY**  
5100 AND 4-1/4 FT. CRUSHERS

DURING THE REBUILDING PROCESS IT IS EXTREMELY IMPORTANT THAT THE HOSES BE PROTECTED AGAINST DIRT AND DUST ENTERING THE HOSE PASSAGES. IMMEDIATELY AFTER REMOVAL, STORE THE HOSES IN A CLEAN, DUST FREE AREA.

- 5 Remove the clearing jack mounting bolts from each corner of the cylinder cap as shown in the illustrations CLEARING JACK CYLINDER CAP, 5-1/2 FT. AND 7 FT. CRUSHERS.
- 6 Thread two eyebolts into the tapped holes at the top of the cylinder cap. Connect a steel cable to the eyebolts and to a suitable overhead lifting device. Take a slight strain on the cable to determine whether the cylinder is free within the adjustment ring. If the clearing jack assembly is loose, remove the unit from the adjustment ring and proceed with clearing jack rebuilding as instructed under CLEARING JACK REBUILDING, 5-1/2 FT. AND 7 FT. CRUSHERS.
- 7 If the clearing jack is not readily removable, unscrew the two eyebolts and install the two jacking screws in the two tapped holes, in place of the eyebolts. Alternately tighten each jacking screw a small amount until the cylinder assembly is loose. Reinstall the eyebolts and lift the unit free of the adjustment ring.

### **CLEARING JACK REBUILDING, 5-1/2 FT. AND 7 FT. CRUSHERS**

Be sure that a sufficient quantity of O-rings, wear rings, and T-seals or O-rings, Poly-Pak seals and modular bearings, depending on the style of clearing jacks, are on hand before the rebuilding work begins. During the entire rebuilding process it is important that the work is done on a clean surface and in a dust free atmosphere. To disassemble, inspect, rebuild, and reassemble the clearing jacks, proceed as follows:

- 1 Set the clearing jack upright on suitable blocking so that the piston is raised off the work area as shown in the illustration CLEARING JACK BLOCKING.
- 2 Remove the two socket head capscrews which attach the cylinder cap to the cylinder and lift the cap free of the cylinder.
- 3 Thread an eyebolt into the tapped hole in the top of the piston and lift the piston free from the cylinder as shown in the illustrations CLEARING JACK ASSEMBLY.

- 4 Remove the O-ring from the top of the cylinder; on the 7 Ft., also remove the plastic wear ring from the bottom of the cylinder. Thoroughly clean the inside bore of the cylinder. Any rust on the inside surfaces of the cylinder should be removed by buffing with a fine abrasive rubbing compound.

**DO NOT FILE OR USE EMERY PAPER. IF RUST IS EXTENSIVE AND CANNOT BE REMOVED WITH RUBBING COMPOUND, THE CYLINDER MUST BE REPLACED.**

Closely examine the inside bore for scratches. Any deep scratches or scoring will cause cylinder leakage and the cylinder must be replaced.

**ON THE 7 FT. CLEARING JACKS MAKE CERTAIN THE 1/8" VENT HOLE IS FULLY OPEN AND FREE OF ANY DIRT OR GREASE.**

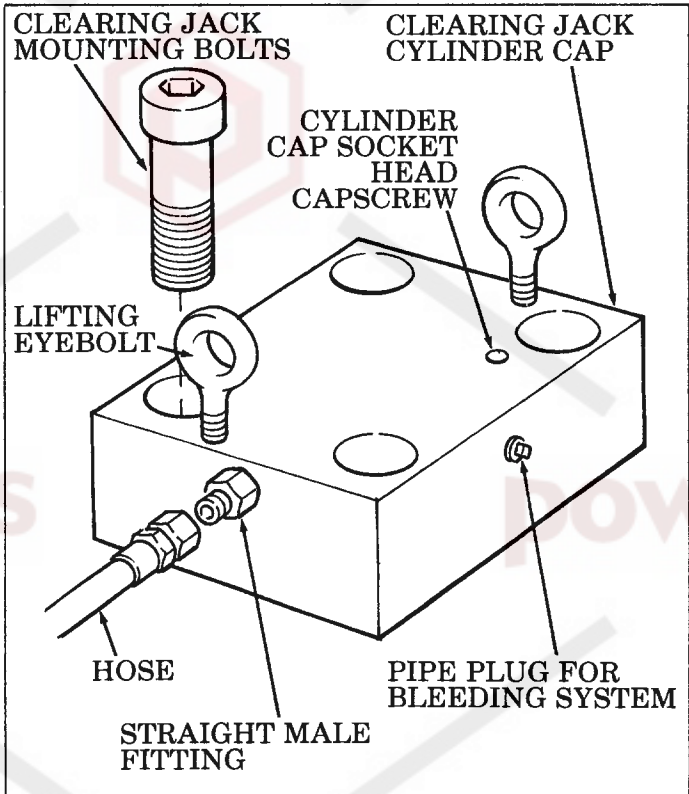
- 5 Place a new wear ring in position inside the cylinder groove. This can be accomplished by overlapping the two ends of the wear ring by exerting finger pressure and inserting it from the bottom of the cylinder until the wear ring snaps into the groove, see the illustration PLASTIC WEAR RING, 7 FT. CRUSHERS.

**THE PROCEDURE DESCRIBED IN STEP 5 DOES NOT APPLY TO THE 5-1/2 FT.**

- 6 Stand the cylinder upright on suitable blocking such as was used during disassembly.
- 7 Remove the Poly-Pak seal and the modular bearing on the 5-1/2 Ft. or the T-seal on the 7 Ft. from the piston and thoroughly clean the piston and the seal groove. Examine the piston for any galling or corrosion. Light scratches or scoring on the large diameter piston surface are not critical since sealing between the piston and cylinder is provided by the Poly-Pak seal or the T-seal. Any roughness on the piston surfaces must be polished out with a rubbing compound.

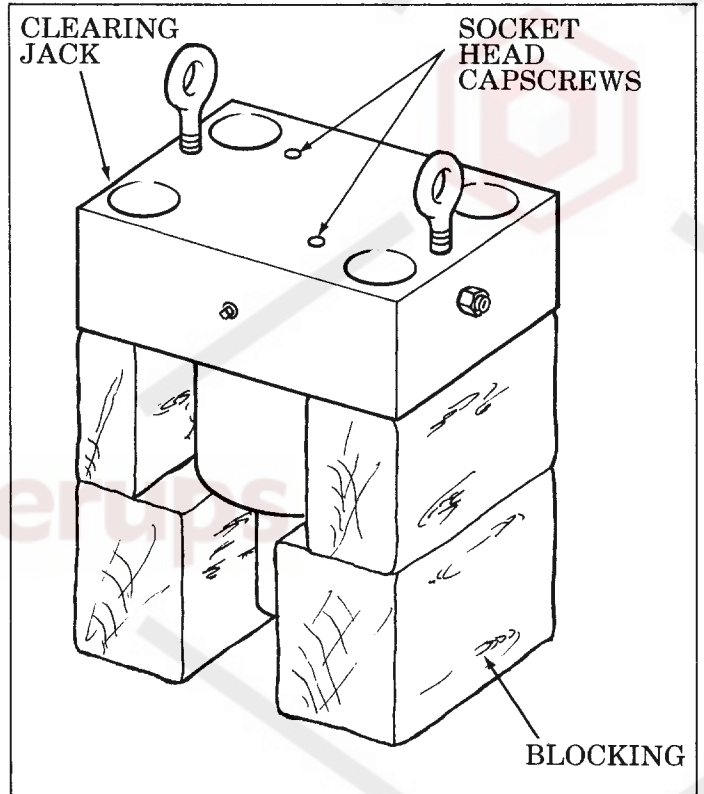
**DO NOT FILE OR USE EMERY PAPER ON THE PISTON.**

- 8 Lightly coat the piston surface with light oil. Position the new Poly-Pak seal and modular bearing at the same time or a new three-piece T-seal in the groove in the side of the piston. See the illustrations CLEARING JACK ASSEMBLY, 5-1/2 FT. AND 7 FT. CRUSHERS. Use just enough force over the top of the piston to clear the outside diameter of the piston. Avoid any undue stretching which will permanently distort the seal.

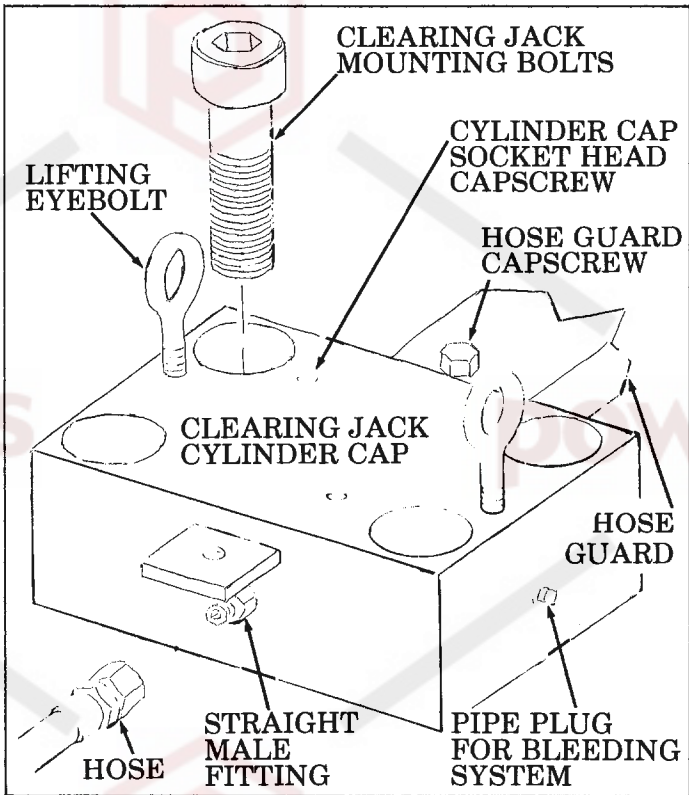


**CLEARING JACK CYLINDER CAP**

5-1/2 FT. AND 7 FT. HEAVY DUTY CRUSHERS

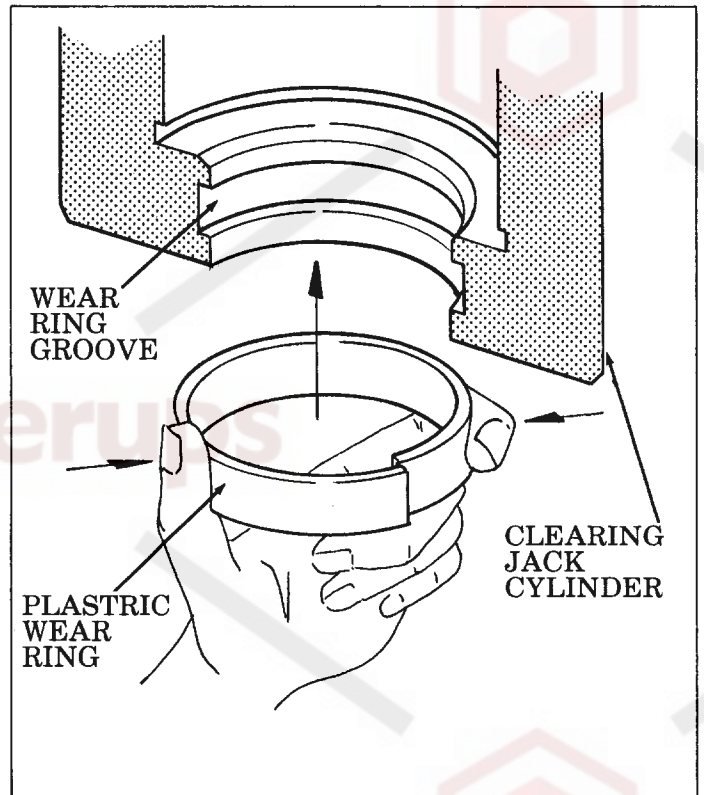


**CLEARING JACK BLOCKING**



**CLEARING JACK CYLINDER CAP**

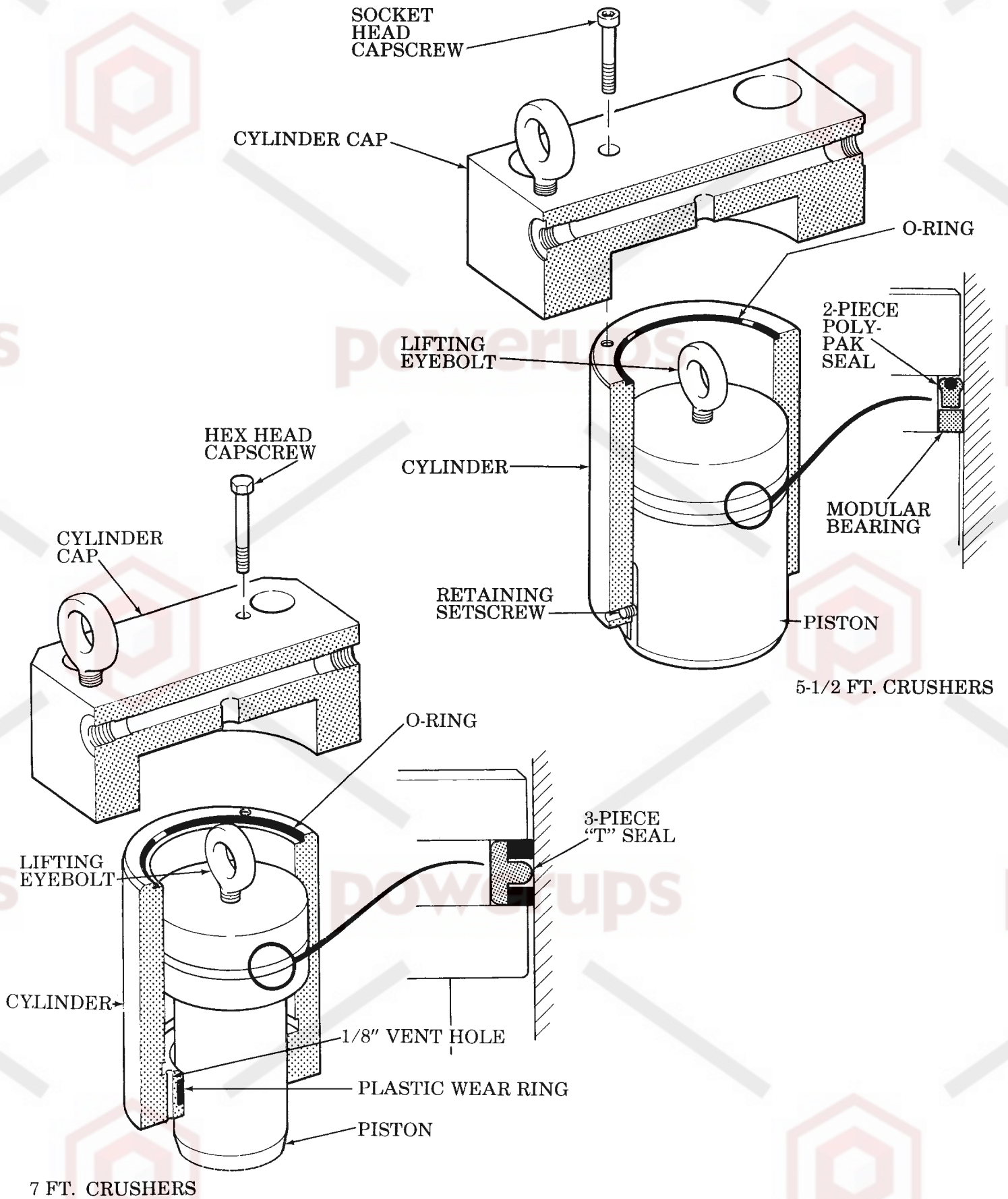
7 FT. EXTRA HEAVY DUTY CRUSHERS



**PLASTIC WEAR RING**

7 FT. CRUSHERS





**CLEARING JACK ASSEMBLY**

IF THE SEAL IS STRETCHED OUT OF SHAPE, IT MUST BE DISCARDED AND A NEW SEAL MUST BE USED.

- 9 Slowly insert the piston into the clean cylinder. When the modular bearing or T-seal is flush with the top of the cylinder bore the piston should be rotated back and forth in a circular motion while exerting slight downward pressure. Once the seal is fully seated in the cylinder bore, the piston can be tapped into place with a wooden hammer handle.

ON THE 5-1/2 FT. CLEARING JACK, MAKE SURE THE SLOT IN THE SIDE OF THE PISTON IS IN LINE WITH THE PISTON RETAINING SCREW. SEE THE ILLUSTRATION CLEARING JACK DISASSEMBLY.

- 10 Place a new O-ring in the ring groove at the top of the cylinder bore.
- 11 Thoroughly clean the cavity in the cylinder cap, then flush and use high pressure air to blow out the internal oil passages. Then plug the straight male fitting with easily removable clean waste material. Coat the entire inside diameter of the cylinder cap with Never-Seez lubricating compound. Carefully place the cap in position on the cylinder being certain to align the two holes in the cylinder cap with the two tapped holes at the top of the cylinder wall. Also be careful not to let the O-ring get pinched when installing the cylinder cap.
- 12 Thoroughly clean the two socket head capscrews and insert them through the two inside diameter holes in the cylinder cap and tighten the capscrews fingertight only. The two cylinder cap socket head capscrews should be tightened to the specified torque value at the time the clearing jacks are reinstalled on the adjustment ring.

### CLEARING JACK INSTALLATION, 5-1/2 FT. AND 7 FT. CRUSHERS

To install the clearing jacks on the crusher adjustment ring proceed as follows:

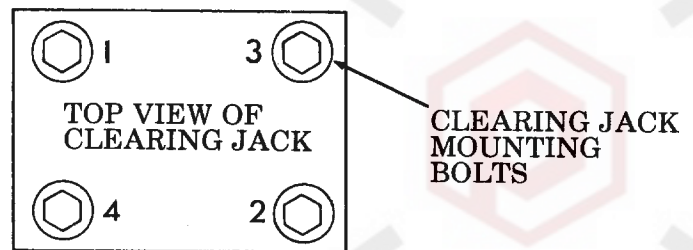
- 1 Wipe off the outside diameter of the jack cylinders and thoroughly clean the bores in the adjustment ring. Coat the adjustment ring bores with Never-Seez lubricating compound to aid assembly

and to prevent jack seizure when the clearing jacks are again removed.

- 2 Lower the jacks into the adjustment ring bores making certain the jack cylinder is fully seated on the bottom of the adjustment ring bore and the holes in the cap are in alignment with the tapped holes in the adjustment ring.

THE TWO JACKS THAT ARE EQUIPPED FOR CONNECTING TO THE POWER UNIT MUST BE POSITIONED 180° APART WITH THE STRAIGHT MALE FITTING AND DUST CAP FACING OUTWARD.

- 3 Coat the threads of the four clearing jack mounting bolts with Never-Seez lubricating compound and install the four bolts at the corners of the cylinder cap. Alternately tighten the bolts on the 5-1/2 Ft. to 250 Ft-Lbs in 50 Ft-Lb increments and the 7 Ft. to 200 Ft-Lbs in 50 Ft-Lb increments following the torquing sequence shown in the illustration CLEARING JACK TORQUE REQUIREMENTS.

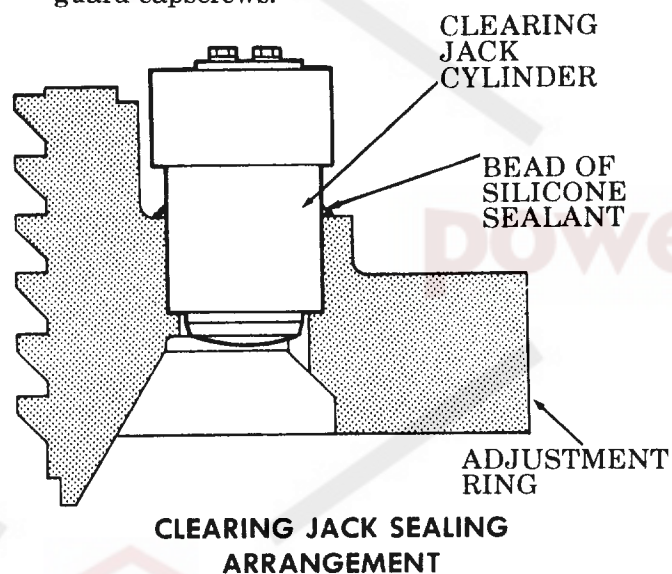


ALTERNATELY TIGHTEN THE BOLTS ON THE 5-1/2 FT. TO 250 FT-LBS IN 50 FT-LB INCREMENTS AND THE 7 FT. TO 200 FT-LBS IN 50 FT-LB INCREMENTS FOLLOWING THE TORQUING SEQUENCE SHOWN.

### CLEARING JACK TORQUE REQUIREMENTS

IF ALL THE CLEARING JACKS HAVE BEEN REMOVED FOR REBUILDING, ONLY EVERY OTHER JACK SHOULD BE TIGHTENED TO THE FULL TORQUE VALUE AT THIS TIME. THE MOUNTING BOLTS ON THE REMAINING JACKS SHOULD BE LEFT LOOSE ENOUGH TO ALLOW SOME MOVEMENT TO ALIGN THE HOSE ASSEMBLIES. IF ONLY ONE CLEARING JACK WAS REMOVED FOR INSPECTION, THE MOUNTING BOLTS SHOULD NOT BE TIGHTENED UNTIL AFTER THE HOSES ARE INSTALLED.

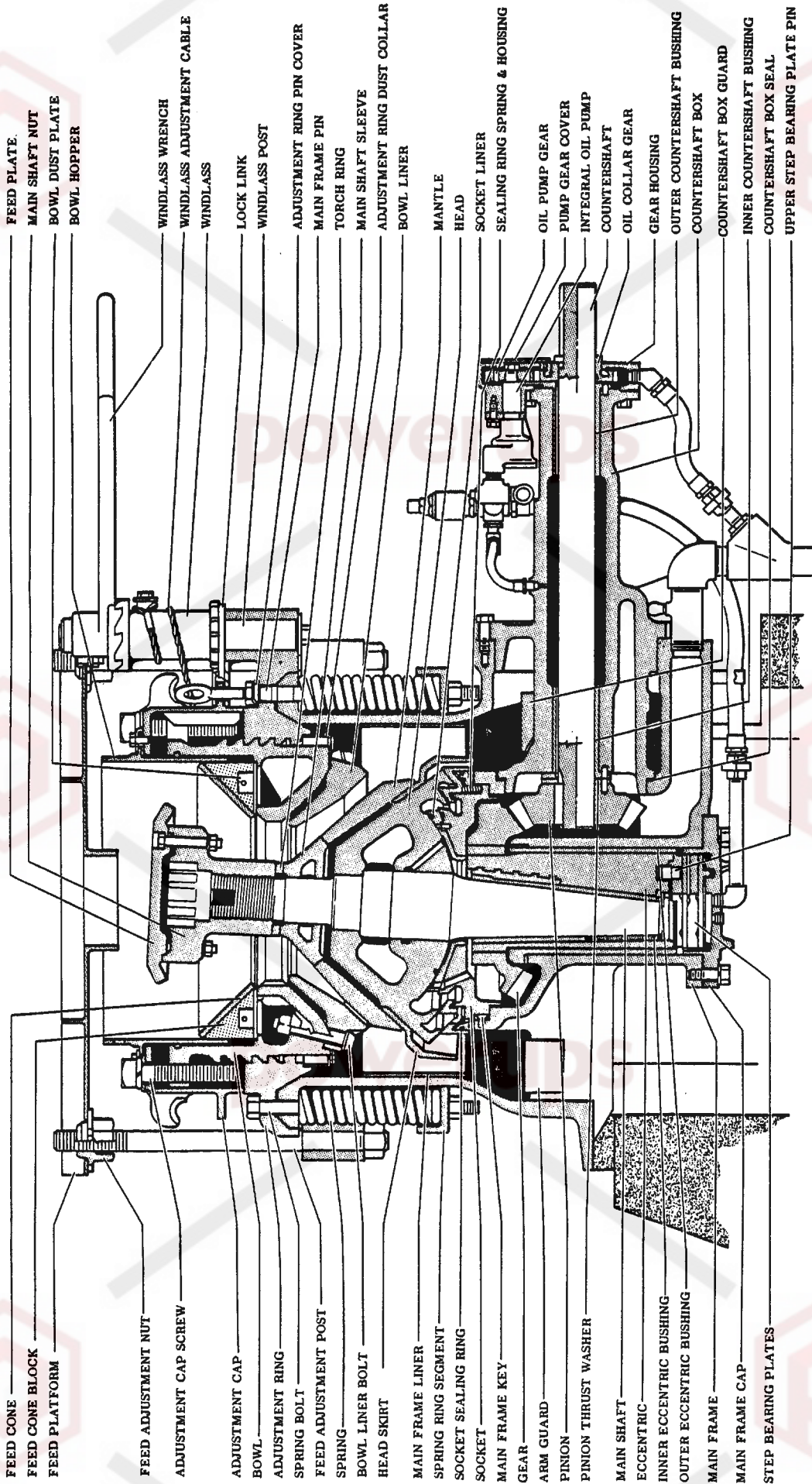
- 4 Torque the cylinder cap socket head capscrews to a torque value of 6 Ft-Lbs on those clearing jacks at which the mounting bolts have been tightened.
- 5 Carefully clean the threads of the straight male fitting and remove the waste material that had been inserted as a plug. Install the clean hoses between the jack assemblies. Position the loose jack assemblies so that the straight male fitting extending out from the cylinder cap will align with the hose fittings. Securely tighten the hose fittings.
- 6 Tighten the clearing jack mounting bolts and the cylinder cap socket head capscrews at those clearing jacks which were not tightened in Steps 3 and 4. Follow the tightening procedure given in Steps 3 and 4.
- 7 Recheck the hose connections to be certain they are tightened securely.
- 8 Apply a bead of silicone sealant around the entire outside diameter of the cylinder where the cylinder contacts the adjustment ring bore as shown in the illustration CLEARING JACK SEALING ARRANGEMENT.
- 9 Test the hydraulic circuit for leaks and bleed the system as instructed under PREPARATIONS BEFORE STARTING.
- 10 Install the hose guards and tighten the hose guard capscrews.



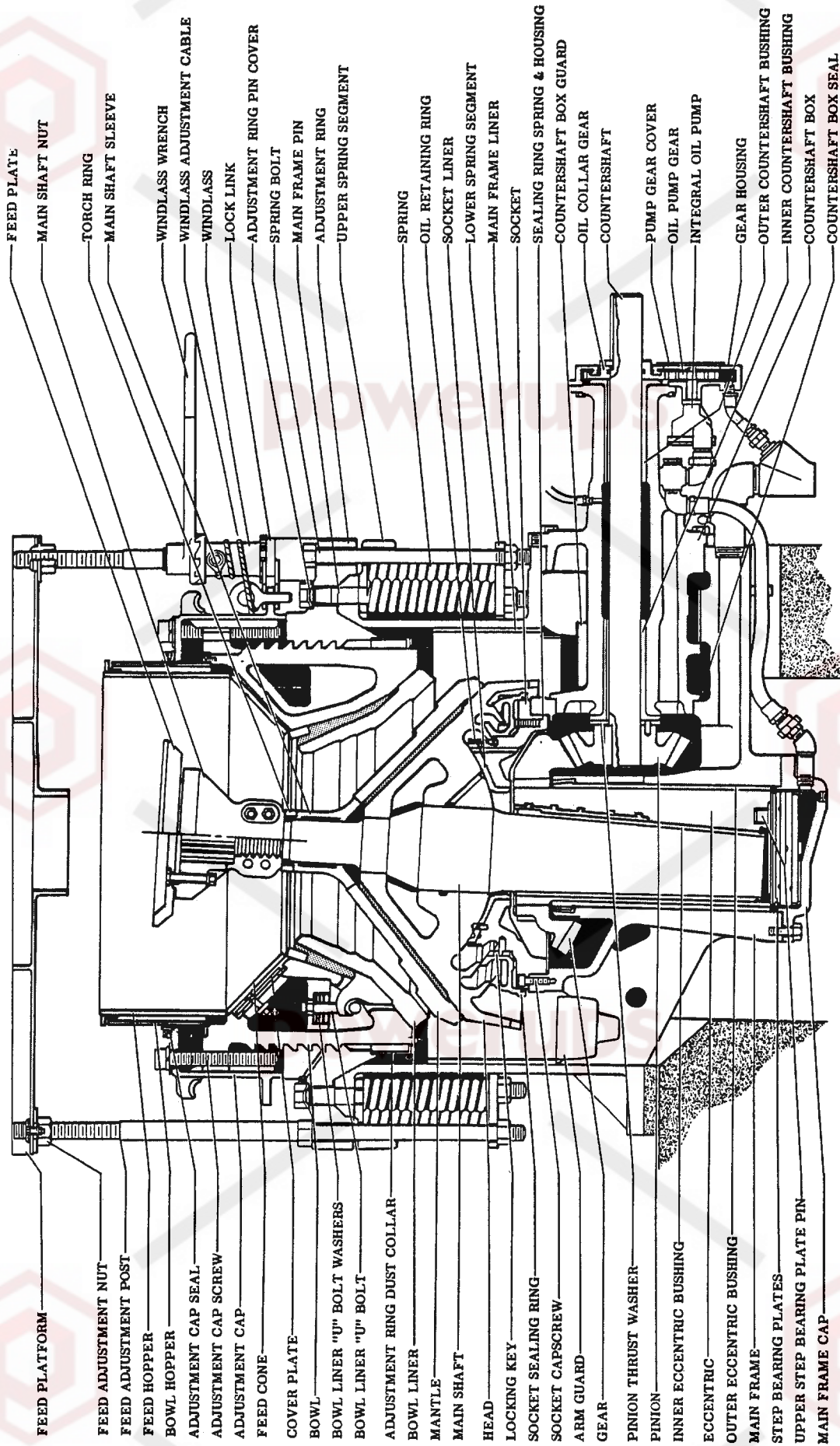
## JAMMED CLEARING JACK REMOVAL, 5-1/2 FT. AND 7 FT. CRUSHERS

If a cylinder rod becomes jammed in the cylinder of a clearing jack, thus preventing the adjustment ring from returning to the main frame seat, proceed as follows:

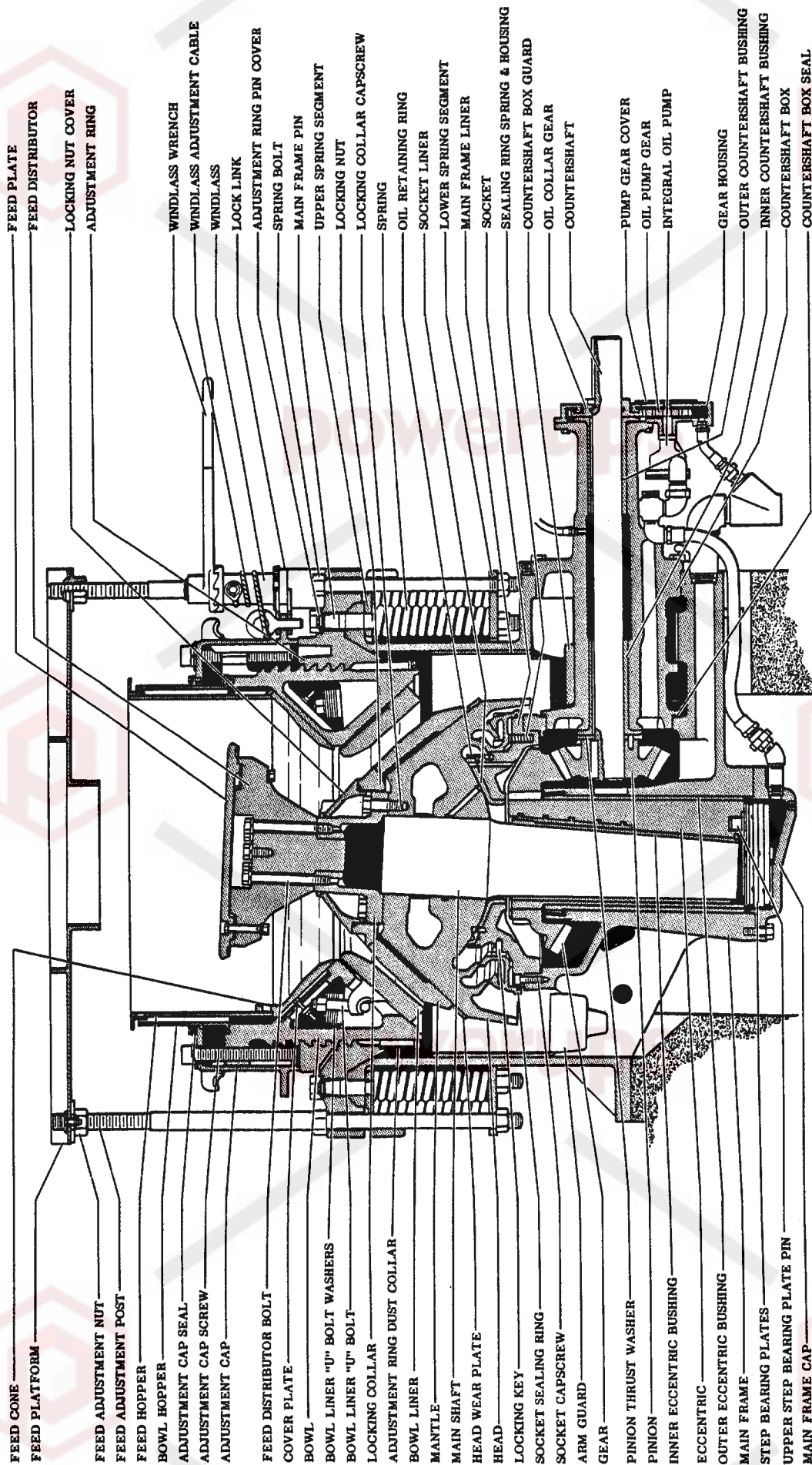
- 1 Release the jack pressure by placing the control valve handle in the PRESSURE OFF position. Disconnect the power unit as instructed under DISCONNECTING THE POWER UNIT. Locate the clearing jack cylinder(s) with the jammed rod. Normally, the adjustment ring section where the jammed cylinder(s) is mounted will remain in a partially raised position after all pressure has been relieved from the system.
  - 2 In order to insure that all hydraulic pressure is relieved from the jammed clearing jack cylinder(s), carefully "crack" open the pipe plug 1 to 1-1/2 turns.
  - 3 Lower all of the spring clusters as instructed in Section 3, MAIN FRAME, ADJUSTMENT RING AND SPRING RING ASSEMBLIES.
  - 4 Remove the clearing jack cylinder(s) as instructed under CLEARING JACK REMOVAL, 5-1/2 FT. AND 7 FT. CRUSHERS.
- IT IS RECOMMENDED THAT AT LEAST FOUR MORE CLEARING JACK CYLINDERS BE REMOVED FOR INSPECTION, TWO ON EACH SIDE OF THE JAMMED CYLINDER(S).
- 5 Reassemble the spring clusters as instructed in Section 3, MAIN FRAME, ADJUSTMENT RING AND SPRING RING ASSEMBLIES.
  - 6 Recondition the removed clearing jack cylinder(s) as instructed under CLEARING JACK REBUILDING, 5-1/2 FT. AND 7 FT. CRUSHERS.
  - 7 Reinstall the clearing jack cylinder(s) onto the adjustment ring as instructed under CLEARING JACK INSTALLATION, 5-1/2 FT. AND 7 FT. CRUSHERS.



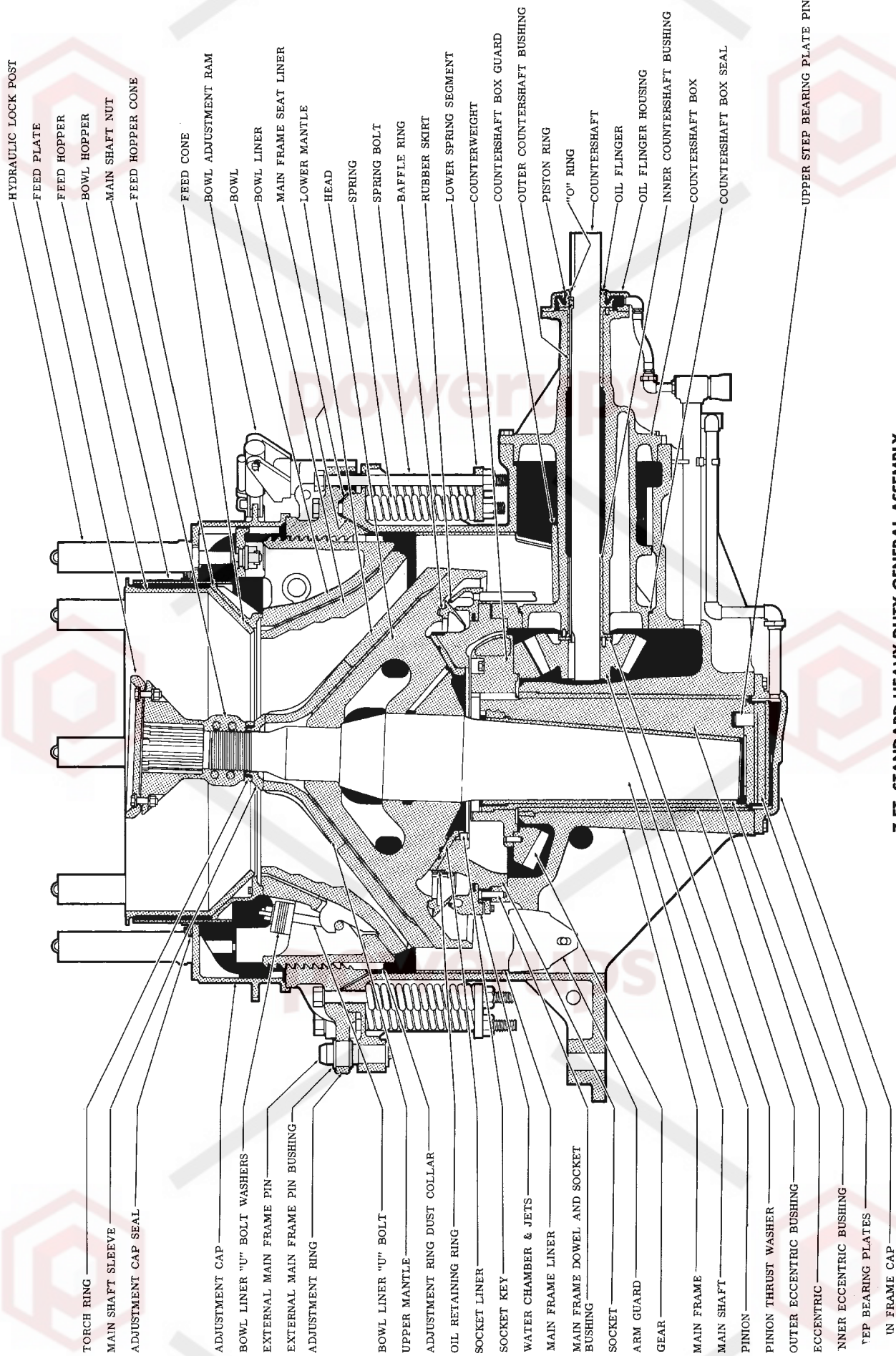
**2 FT. SHORT HEAD GENERAL ASSEMBLY**  
 (standard seal - typical arrangement for 2 ft. standard)



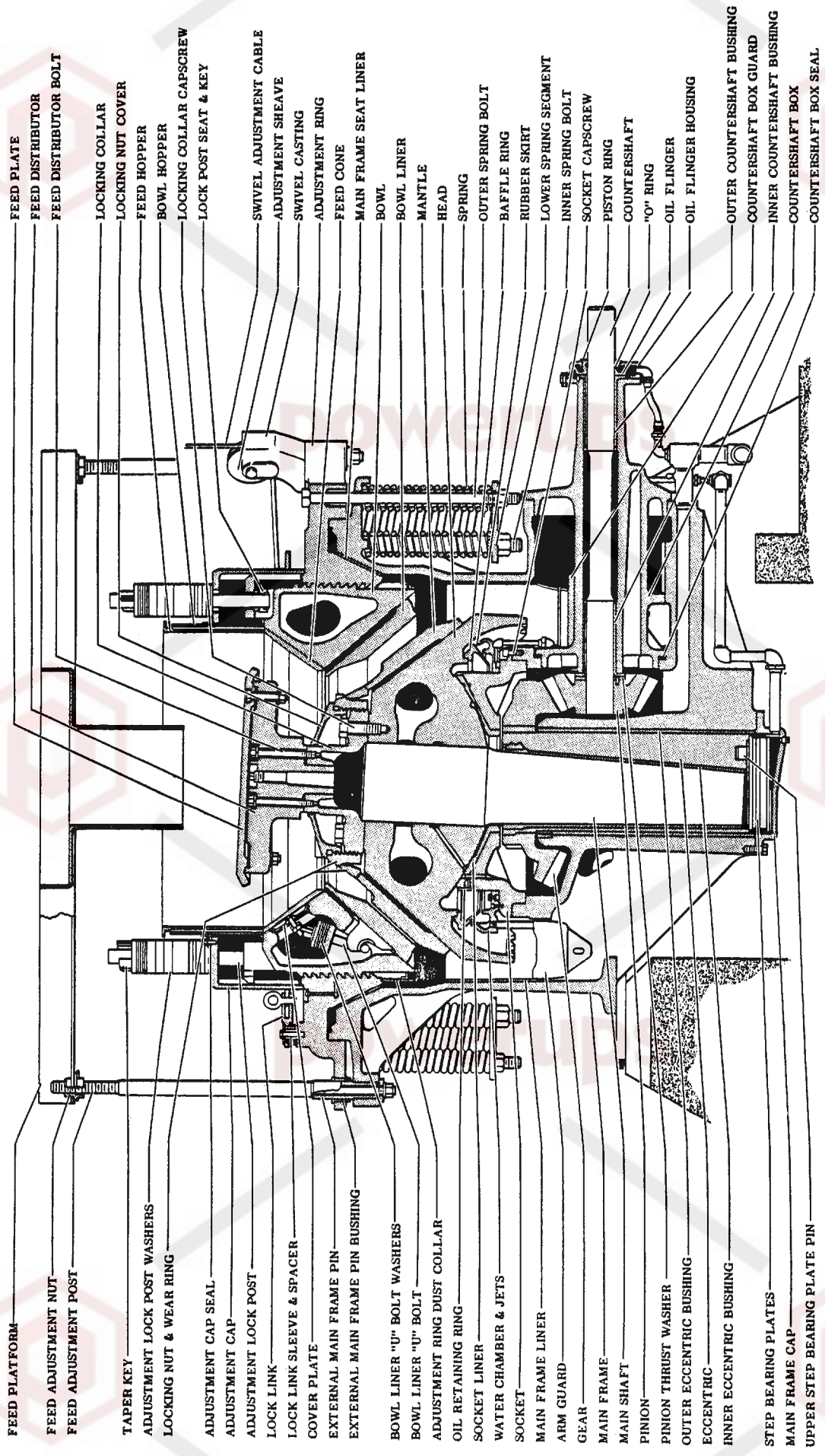
**4 1/4 FT. STANDARD GENERAL ASSEMBLY**  
 (standard seal - typical arrangement for 3 ft. and 4 ft. standards)



**4 1/4 FT. SHORT HEAD GENERAL ASSEMBLY**  
 (standard seal - typical arrangement for 3 ft. short head)



**7 FT. STANDARD HEAVY DUTY GENERAL ASSEMBLY**  
 (water seal-typical arrangement 5½ ft. & 7 ft. extra heavy duty standards)



- FEED PLATFORM
- FEED ADJUSTMENT NUT
- FEED DISTRIBUTOR
- FEED DISTRIBUTOR BOLT
- FEED ADJUSTMENT POST
- TAPER KEY
- LOCKING COLLAR
- LOCKING NUT COVER
- FEED HOPPER
- BOWL HOPPER
- LOCKING COLLAR CAPSCREW
- LOCK POST SEAT & KEY
- ADJUSTMENT LOCK POST WASHERS
- ADJUSTMENT LOCK POST
- ADJUSTMENT CAP SEAL
- ADJUSTMENT CAP
- ADJUSTMENT LOCK POST
- LOCK LINK
- LOCK LINK SLEEVE & SPACER
- COVER PLATE
- EXTERNAL MAIN FRAME PIN
- EXTERNAL MAIN FRAME PIN BUSHING
- BOWL LINER "U" BOLT WASHERS
- BOWL LINER "U" BOLT
- ADJUSTMENT RING DUST COLLAR
- OIL RETAINING RING
- SOCKET LINER
- WATER CHAMBER & JETS
- SOCKET
- MAIN FRAME LINER
- ARM GUARD
- GEAR
- MAIN FRAME
- MAIN SHAFT
- PINION
- PINION THRUST WASHER
- OUTER ECCENTRIC BUSHING
- ECCENTRIC
- INNER ECCENTRIC BUSHING
- STEP BEARING PLATES
- MAIN FRAME CAP
- UPPER STEP BEARING PLATE PIN
- SWIVEL ADJUSTMENT CABLE
- ADJUSTMENT SHEAVE
- SWIVEL CASTING
- ADJUSTMENT RING
- FEED CONE
- MAIN FRAME SEAT LINER
- BOWL
- BOWL LINER
- MANTLE
- HEAD
- SPRING
- OUTER SPRING BOLT
- BAFFLE RING
- RUBBER SKIRT
- LOWER SPRING SEGMENT
- INNER SPRING BOLT
- SOCKET CAPSCREW
- PISTON RING
- COUNTERSHAFT
- "O" RING
- OIL FLINGER
- OIL FLINGER HOUSING
- OUTER COUNTERSHAFT BUSHING
- COUNTERSHAFT BOX GUARD
- INNER COUNTERSHAFT BUSHING
- COUNTERSHAFT BOX
- COUNTERSHAFT BOX SEAL

**7 FT. SHORT HEAD EXTRA HEAVY DUTY GENERAL ASSEMBLY**  
 (water seal - typical arrangement 5 1/2 ft. & 7 ft. heavy duty short heads)