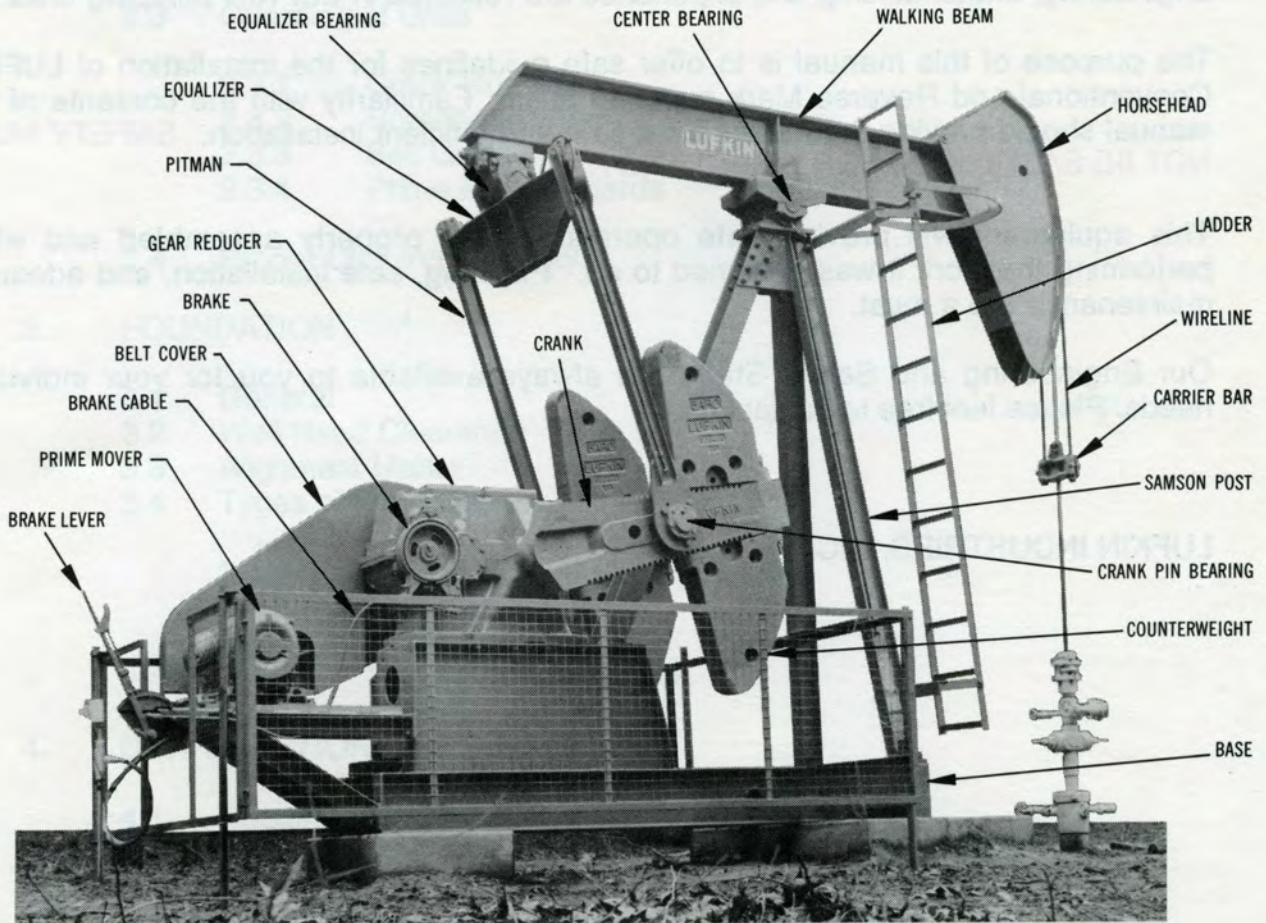


LUFKIN

CONVENTIONAL & REVERSE MARK PUMPING UNITS



OPERATOR'S MANUAL CU-93



INDUSTRIES, INC.

P.O. BOX 849 LUFKIN, TEXAS 75902-0849

PHONE: 409/634-2211

TWX: 910-880-4201, SALES & PURCHASING

Dear Customer:

Thank you for buying LUFKIN products.

It is essential that you read this entire manual before installing, operating, or performing any maintenance on your LUFKIN pumping unit.

LUFKIN INDUSTRIES, INC. is totally committed to the safety and health of the people who make and use our products. Our "PRIORITY ONE" goal is to manufacture quality products that offer the highest degree of safety. Over seven decades of design engineering, craftsmanship and experience are reflected in LUFKIN pumping units.

The purpose of this manual is to offer safe guidelines for the installation of LUFKIN Conventional and Reverse Mark pumping units. Familiarity with the contents of this manual should provide the means for a safe and efficient installation. **SAFETY MUST NOT BE SACRIFICED FOR EXPEDIENCY.**

This equipment will provide safe operation when properly assembled and when performing the work it was designed to do. Planning, safe installation, and adequate maintenance are a must.

Our Engineering and Safety Staffs are always available to you for your individual needs. Please feel free to contact us.

LUFKIN INDUSTRIES, INC.

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OPERATOR'S MANUAL

LUFKIN CONVENTIONAL AND REVERSE MARK PUMPING UNITS

1. INTRODUCTION

1.1 EQUIPMENT DESCRIPTION

The LUFKIN Conventional crank balanced pumping unit is a symmetrical rear mounted geometry Class I lever system having crank counterbalance. LUFKIN's Reverse Mark unit is a conventional style pumping unit with offset geometry and phased counterbalance. It is designed for operation in a clockwise direction of rotation only, when viewing the unit from the side with the well head to the right. The four bar lever system converts rotational motion at the crank to reciprocating motion at the horsehead and in turn to the downhole pump.

These LUFKIN pumping units have been designed to rigid LUFKIN standards and exceed API (American Petroleum Institute) standard requirements for pumping unit design. In addition, all individual components of the unit and the unit as a whole represent the very best engineering design, production facilities, quality control and field experience that over 70 years of LUFKIN INDUSTRIES' experience can bring to you. The unit must be properly installed and maintained for satisfactory service. Your LUFKIN unit will give many years of dependable service when properly maintained and operated within its load and torque ratings.

NOTE: Some of the photographs and illustrations used in this manual may not look exactly like the parts you are working with, but they are representative.

1.2 TERMINOLOGY

To avoid confusion, some of the more common terms used concerning pumping units are defined as follows:

Front: is the well head (horsehead) end.

Rear: is the prime mover end.

Left & Right: are determined by standing at the rear of the pumping unit and facing the well head.

Crank Sweep or Crank Swing: is the circular area centered about the crankshaft where the cranks and counterweights will rotate when in motion.

1.3 TRAINING

It is essential that only properly trained personnel, under competent supervision, be allowed to work with this equipment. Training programs are an important part of safe and correct operation. Training also provides the knowledge necessary to maximize the performance of your equipment. LUFKIN INDUSTRIES, INC. recognizes the importance of training and conducts training schools to educate your personnel in safe operating and maintenance procedures. These training schools are held at corporate headquarters in Lufkin, Texas. There is a small charge for this service. The dates for each school are

available upon request by contacting your nearest LUFKIN sales office (see back cover of this manual).

1.4 HAZARD IDENTIFICATION

This manual employs several hazard identifiers which are used as follows:

DANGER - used to indicate immediate danger and that special precautions are necessary.

WARNING - used where damage could be done to the equipment which may result in personal injury.

CAUTION - used to warn against potential hazards or unsafe practices.

2. SAFETY

DANGER: BEFORE PROCEEDING WITH THE ERECTION, OPERATION, OR MAINTENANCE OF A PUMPING UNIT, YOU MUST FAMILIARIZE YOURSELF WITH FEDERAL, STATE, AND LOCAL LAWS AS WELL AS WITH YOUR COMPANY'S SAFETY REGULATIONS. ALWAYS REVIEW THE SAFETY SECTION OF THIS MANUAL BEFORE PERFORMING ANY TASK ON OR AROUND A PUMPING UNIT. ALL MECHANICAL SUCKER ROD PUMPING UNITS, OF NECESSITY, HAVE LARGE AND HEAVY ROTATING PARTS. EVEN A TEMPORARILY STATIONARY PUMPING UNIT HAS COMPONENTS WHICH CAN START MOVING FROM THE EFFECT OF GRAVITY. IT IS ESSENTIAL THAT ALL PERSONNEL INVOLVED IN THE ERECTION, OPERATION, AND MAINTENANCE OF PUMPING UNITS USE EXTREME CARE AT ALL TIMES WHEN WORKING NEAR THESE HEAVY ROTATING PARTS.

ALL ELECTRICAL WORK MUST BE PERFORMED BY A QUALIFIED ELECTRICIAN. ON PUMPING UNITS THAT HAVE ELECTRIC MOTORS, AUTOMATIC TIMERS, OR ANY OTHER ELECTRICAL DEVICES, THE COMPONENTS MUST BE REGULARLY INSPECTED AND MAINTAINED IN A SAFE OPERATING CONDITION BY A QUALIFIED ELECTRICIAN.

FAILURE TO HEED THESE WARNINGS COULD RESULT IN SEVERE BODILY INJURY OR DEATH TO PERSONNEL.

2.1 TIMES OF PARTICULAR DANGER

LUFKIN does not recommend installation of or maintenance on pumping units during thunderstorms. Exercise extreme caution during icy conditions and other inclement weather.

CAUTION: All personnel must stay clear of the cranks and counterweights or other elements which may start moving.

Times of particular danger from rotating or moving parts are during unit erection, stroke change, counterbalance change, general unit maintenance, well servicing, and while

taking dynamometer card readings. Any time it is necessary to perform maintenance, or work around the pumping unit, be certain that the prime mover can not be started and that the cranks are blocked to prevent rotation.

CAUTION: Be certain of the location of power lines before and during performance of any task on or around pumping units. Be sure you set up your operation in such a manner as to avoid any contact with power lines. Failure to heed this warning could result in severe bodily injury or death to personnel.

2.2 COMMONLY USED SAFETY PROCEDURES

CAUTION: (LOCKOUT/TAG OUT) It is essential to prevent rotation of the cranks for the purpose of service or maintenance of any kind. Do not enter the crank swing area to chain the drum, engage the pawl, or install timbers.

2.2.1 Chaining the Brake Drum (figure 1)

Set the brake with the cranks in the desired position.

WARNING: Abrupt braking may damage the gear teeth in the reducer. A slow, even pull on the brake lever is recommended.

Thread a sturdy (never less than 3/8 high-tensile alloy) chain through the hole in the brake drum nearest the trunnion and then around the trunnion. Snug up the chain and attach the hook end around a link. Be sure the chain is working against the direction of rotation.

CAUTION: All chains and cable slings must have a load test certification tag attached and must not be used for loads beyond that certification. A visual daily inspection of chain and cable slings and a monthly inspection verified by a signed report are required. Faulty chains and slings could cause severe bodily injury or death.



FIGURE 1



FIGURE 2

2.2.2 Installing the Brake Pawl (figure 2)

On units equipped with the positive-stop brake, the pawl must be lowered into a notch in the drum to prevent crank rotation. Engage the pawl only after the unit is stopped. The pawl and the drum should be inspected prior to engagement to be sure they have not been damaged by previous misuse.

WARNING: Do not allow the load to rest on the pawl tooth. If this is done, you will need a crane to lift the load in order to disengage the pawl.

2.2.3 Using Heavy Timbers (figure 3)

The most commonly used safety procedure is to place heavy timbers under the cranks. The brake must also be secured. If the long end of the cranks are straight down, no rotation will start if the carrier bar has not yet been attached to the polished rod, or if the polished rod has been securely clamped at the stuffing box to hold the well load.

CAUTION: Never use the brake alone as a safety stop. Always use the other mentioned methods as back-ups. Timbers should always be used unless the cranks are positioned in such a manner as to prevent doing so.

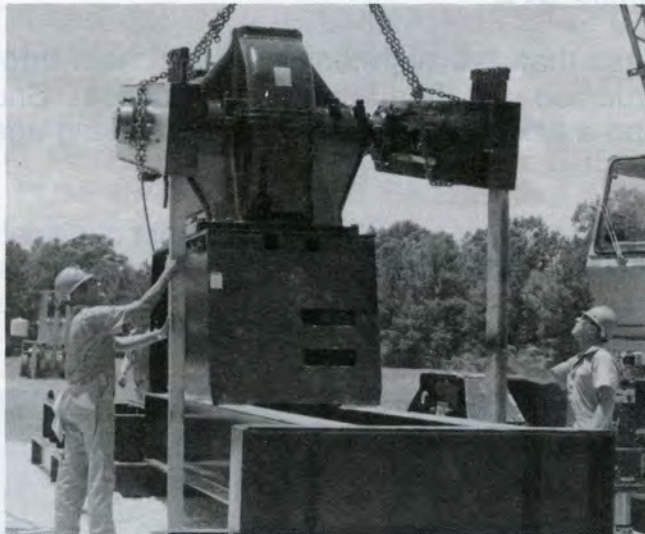


FIGURE 3

2.3 GUARDING OF UNITS

DANGER: DO NOT OPERATE PUMPING UNITS WITHOUT PROPER GUARDS IN PLACE. THE LARGE MOVING PARTS ARE DANGEROUS TO PERSONNEL. THE PURPOSE OF GUARDS IS TO PROVIDE A SAFETY BARRIER BETWEEN THE MOVING PARTS OF THE PUMPING UNIT AND ONLY PEOPLE WHO ARE FAMILIAR WITH THE OPERATION OF PUMPING UNITS. THEY ALSO PROVIDE A BARRIER BETWEEN THE MOVING PARTS AND ANIMALS. WHEN PUMPING UNITS ARE OPERATED WHERE THEY ARE ACCESSIBLE TO THE GENERAL PUBLIC, IT IS NECESSARY TO PLACE

THE PUMPING UNIT WITH GUARDS IN AN ENCLOSED AREA WITH A LOCKED ENTRANCE. THE ENCLOSURE MUST PREVENT ENTRY OF UNAUTHORIZED PERSONS. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN SERIOUS INJURY OR DEATH TO PERSONNEL. FEDERAL, STATE, AND LOCAL REGULATIONS MAY REQUIRE SPECIFIC TYPES OF GUARDING, DEPENDENT UPON THE LOCATION OF YOUR UNIT. THE LOCATION OF THE UNIT, AND THEREFORE THE TYPE OF GUARDING NEEDED, IS KNOWN ONLY BY THE USER WHO MUST CHOOSE THE PROPER GUARDING. IT IS ESSENTIAL THAT THE USER OF THE PUMPING UNIT COMPLY WITH ALL APPLICABLE SAFETY REQUIREMENTS. FOR ADDITIONAL INFORMATION ON GUARDING OF PUMPING UNITS, REFER TO API RP11ER.

2.3.1 Crank Guards

Crank guards are available from LUFKIN (see figures 4 and 5). Under normal operating circumstances, the 42" open and type "W" would be considered minimum guarding for people who are familiar with pumping units and who are accustomed to working around them. Basically, this type guard simply keeps workers from accidentally wandering or falling into the crank sweeps. The 62" and 84" wire mesh guards would normally be considered adequate guarding for people familiar with the operation of pumping units and accustomed to working around them, as well as smaller animals who might be able to move through the guards described above.

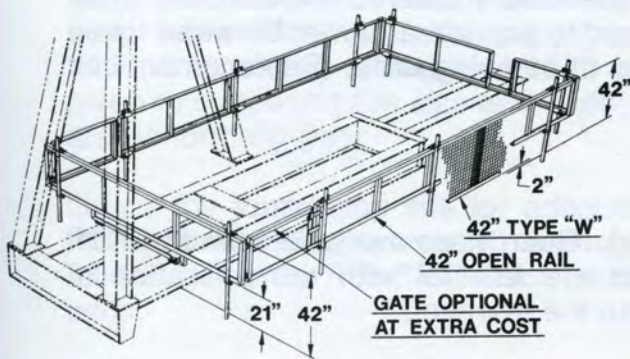


FIGURE 4

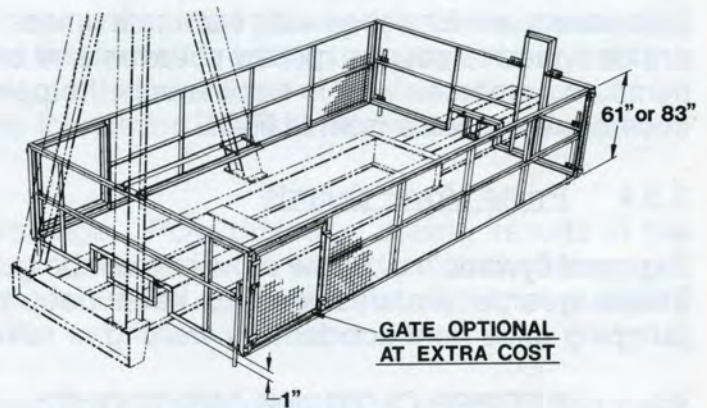


FIGURE 5

2.3.2 Horsehead Guards

Horsehead guards (see figure 6) are available from LUFKIN. This guard is designed to keep people who are familiar with the operation of pumping units from accidentally wandering into the area below the horsehead and carrier bar.

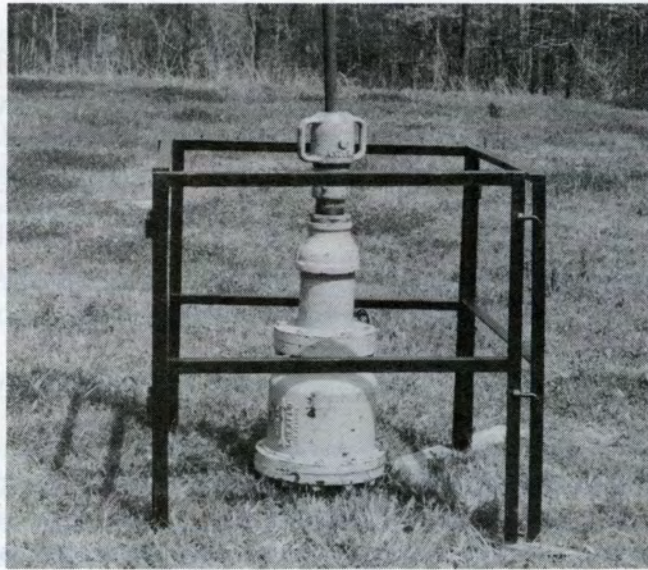


FIGURE 6

2.3.3 Belt Guards

Belt covers are furnished with each unit unless it is specifically ordered without one. They are designed to cover exposed sheaves and belts and to provide a barrier between these items and a person who is familiar with the operation of pumping units. Replacement belt covers are available from LUFKIN.

2.3.4 Prime Mover Guards

Exposed flywheels of prime movers must be guarded. Guards are available from LUFKIN. These guards are designed to keep people who are familiar with the operation of pumping units from accidentally walking or falling into the flywheel.

2.4 PROPER CLOTHING AND TOOLS

Snug fitting clothing is recommended. Remove jewelry. Wear hard hats, safety glasses, and safety shoes (see figure 7).

Use proper tools for the job. Tools are designed for specific purposes. Use them in the way they were intended to be used. Always keep tools clean and in good condition.

Anytime you perform work at such a height that a fall could possibly inflict injury, you should wear a safety belt. When possible, use a manlift or some other type of approved safety basket.

Refer to your company's safety regulations concerning clothing and tools.



FIGURE 7

3. FOUNDATION

3.1 GENERAL

The foundation should be constructed in accordance with a current foundation plan only. A copy of this plan is shipped with the unit in a waterproof package in the miscellaneous parts sack. The foundation plan gives the minimum foundation required for soil with a minimum bearing strength of 1500 pounds per square foot. Consideration should be given to increasing the size and depth of the foundation in areas where the soil conditions are abnormally poor.

Grade the foundation site for adequate drainage. Poor drainage usually results in the foundation settling unevenly, causing undue stresses in the unit base and subsequent failure. Refer to API RP11G for additional information about the installation of pumping units.

WARNING: Poor preparation of the site and/or concrete can cause pumping unit base breakage.

3.2 WELL HEAD CLEARANCE

Carrier bar clearance from the bottom of the pumping unit base is shown on the foundation plan. This should be considered when the grade height of the foundation is established. If clearance to sling a dynamometer beneath the carrier bar is desired, at least 32 inches of clearance is required between the carrier bar and well head stuffing box, with the polished rod at the bottom of the stroke.

The polished rod should be vertical to minimize stuffing box wear and to aid in the alignment of the unit.

3.3 ALIGNMENT MARKS

The pumping unit base has center marks on the edges of the bottom flanges of the front and rear cross-members. The foundation (including poured concrete, precast concrete, and board mat) must also have a center line and a lateral line (or mark) showing the distance between the polished rod and front cross-member on the unit base. Strike a center line from the front to the rear of the foundation by stretching a chalk line from the center of the well head across the top of the block and midway between the anchor nuts (refer to the foundation plan). The initial alignment involves matching the center lines on the base and foundation and placing the base the proper distance from the polished rod.

3.4 TYPES OF FOUNDATIONS

3.4.1 Poured Concrete

WARNING: Poured concrete foundations must set at least 48 hours before setting the unit. The concrete must be completely set before tightening the hold-down clamp bolts.

The foundation print shows the minimum area and depth of concrete, along with the steel requirements needed to support the pumping load, assuming the soil has a minimum bearing strength of 1500 pounds per square foot. Build the form and place steel reinforcing bars and wire mesh to conform to specifications as set forth in API RP11G. After the steel is placed in the form, prepare a wooden template, as shown in figure 8, and drill the template using the foundation plan for anchor nut locations. Screw the hold-down bolts into the anchor nuts and locate the template over the foundation form so that the anchor nuts will be flush with the top of the concrete. A hex nut should be used on the hold-down bolts on the top side of the template to hold the anchor nuts tightly against the template. Plug the bottom of the anchor nuts with paper to prevent the concrete from filling up the cavities.

After the anchor nuts are properly located, pour the foundation and dress off, smooth and level. When this type of foundation is used, it must be allowed to set a sufficient time to attain adequate strength before tightening the foundation bolts (refer to API RP11G). Note the center line and cross mark used to locate the base on the foundation in figure 9.

3.4.2 Precast Concrete

Precast blocks are frequently used for one-piece base units and two-point base units. The site should be graded for proper drainage, and consideration should be given to the size of the block with respect to the bearing strength of the soil. See your foundation print.

3.4.3 Board Mat

A board mat type foundation, as illustrated in figure 10, may be used with a wide-skid base unit. The installation plan (furnished with the unit) gives timber size and spacing in relation to the well head, along with suggested subsoil preparation.

Note the center line and cross mark on the timbers used to locate the unit base. The cross mark is the distance from the well head to the first cross-member of the base. Board mat

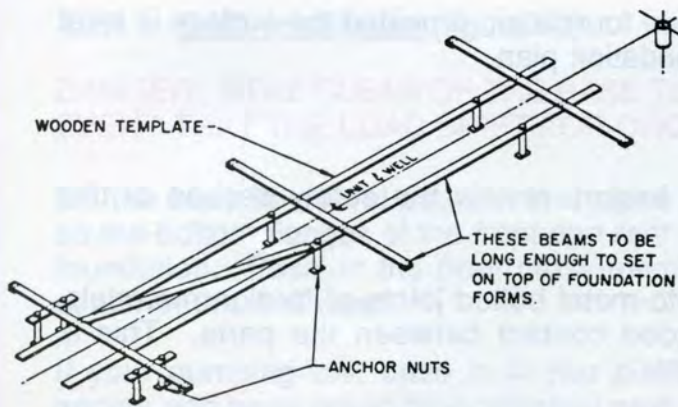


FIGURE 8

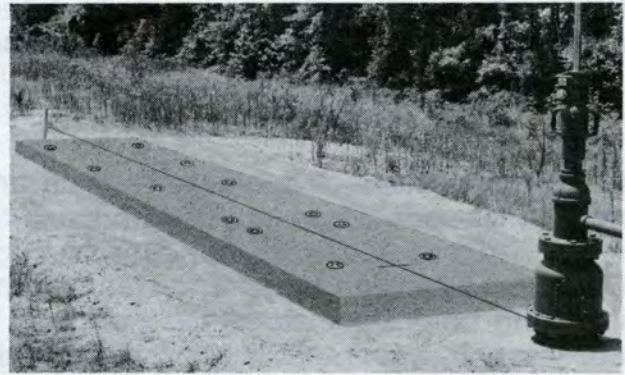


FIGURE 9

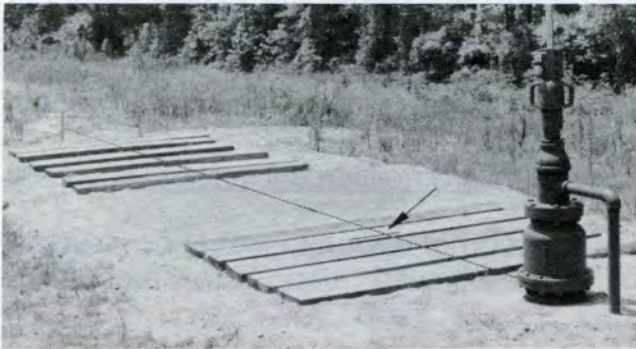


FIGURE 10

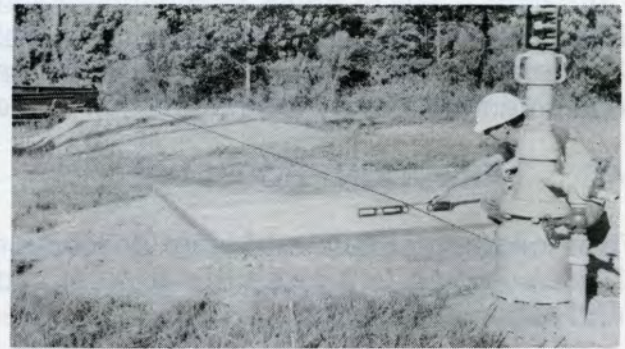


FIGURE 11

foundations may also be used for two-point installations. Refer to the foundation plan of your particular unit for the proper location of the board mat members.

3.4.4 Two-Point Foundation

A specially designed base for the two-point Conventional pumping unit lends the unit to an economical two-point installation. A foundation support is required only at the front and rear of the unit.

WARNING: Only conventional units that are designated as "two-point" are suitable for two-point foundations. Units that are not designated as "two-point" must be used with a foundation that fully supports the steel base. Refer to the foundation print which was shipped with the unit or contact LUFKIN.

Poured concrete, precast concrete, or board mat (for wide-skid base units) type of foundations may be used for two-point installations. In all cases provisions must be made to keep the base from shifting on the foundation. Hold-down clamps are generally used with concrete foundations and earth anchors are used with board mat foundations. See figure 11 for a typical installation. Concrete blocks must be level. A chalk line is shown down the center of the foundation to locate the unit base. Also a cross mark locating the front cross-member of the base is shown. Always use your foundation print to locate your unit.

NOTE: Two-point units can be set on a one-piece foundation provided the surface is level and the unit is tied down as specified on the foundation plan.

4. UNIT ERECTION

CAUTION: Before the erection of the unit is begun, review the safety section of this manual (Section 2).

During unit erection be sure to clean all metal-to-metal bolted joints of foreign materials, including paint, to insure that there will be good contact between the parts. This is necessary to insure that the bolts will remain tight.

4.1 REQUIRED EQUIPMENT

Hook heights required and maximum weights to be lifted are given in the Addendum, Section 11, Table II. This information may be used to select the gin pole or crane equipment necessary for the erection of the unit.

4.2 ERECTION PROCEDURE

The following picture and word description of the erection of a Conventional or Reverse Mark pumping unit gives the general sequence to be followed, along with precautions and alignment checks.

CAUTION: Before proceeding with the erection, servicing, or maintenance of pumping units, be sure you and your crew fully discuss the job to be done. (See figure 12.) Make sure everyone is made aware of the dangers and that they understand the proper hand signals to be used during the job.



FIGURE 12



FIGURE 13

4.2.1 Base Installation (figure 13)

DANGER: STAY CLEAR OF THE BASE TO AVOID SERIOUS INJURY OR DEATH IN THE EVENT THAT THE LOAD SHIFTS OR DROPS.

Lift the base in a level position and place on the foundation. Align the center line marks on the bottom flanges of the front and rear cross-members with the center-line mark on the foundation. Position the front cross-member of the base the correct distance from the center of the well head.

If your pumping unit base is in two pieces, a unit base and an engine end base, the engine end base would be positioned next. Remove the bolts from the joint plates. Clean the joint plates on the unit base and engine base before bolting them together. Tighten the bolts joining the bases according to the recommendations given in the Addendum, Section 10. Locate and install foundation hold-down clamps and bolts. Snug tighten. Final tightening of the foundation bolts will be done after unit alignment. (Procedure 4.2.26.)

4.2.2 Reducer Installation (figure 14)

DANGER: THE REDUCER WITH CRANKS IS AN ASSEMBLY THAT IS MADE UP OF HEAVY ROTATING PARTS. PERSONNEL MUST EXERCISE EXTREME CARE WHEN LIFTING THIS ASSEMBLY TO BE CERTAIN THAT THE CRANKS ARE LOCKED AGAINST ROTATION. (REFER TO SECTION 2.1 THRU 2.2.2 OF THIS MANUAL FOR PROPER PROCEDURES.) PERSONNEL MUST STAY CLEAR OF THE ASSEMBLY SO THAT A SERIOUS INJURY MAY BE PREVENTED IN THE EVENT THAT THE LOAD SHIFTS OR DROPS.

Reducers are shipped from the factory with the brake linings engaged against the brake drum and the positive-stop pawl engaged in the drum. Due to shipping requirements the larger reducers are shipped separate from their bases.

CAUTION: Before attempting to install the reducer, see "Brake Installation and Adjustment" in procedure 4.2.3. Familiarize yourself with the type of brake on your unit, then make sure that the cranks are secured against rotation.

To install the reducer on its sub-base, attach slings to the reducer and both cranks to stabilize the load. Do not allow the sling to bear against the slow speed shaft oil seal or breakage will result. Clean the top of the sub-base and the bottom of the reducer. Chalk the centerline on top of the sub-base and use the centerline marks on the front and rear of the reducer for initial alignment. Place the reducer on the sub-base and install the bolts, but leave them loose so the reducer can be shifted for alignment. See procedure 4.2.5 for final tightening instructions.



FIGURE 14

4.2.3 Brake System Installation and Adjustment

DANGER: THE BRAKE IS NOT INTENDED AS A SAFETY STOP BUT IS INTENDED FOR OPERATIONAL USE ONLY. WHEN OPERATIONS OR MAINTENANCE ARE TO BE CONDUCTED ON OR AROUND THE PUMPING UNIT, THE CRANKS AND COUNTERWEIGHTS MUST BE SECURELY FIXED IN A STATIONARY POSITION. (REFER TO SECTION 2.2 THRU 2.2.3 OF THIS MANUAL.) THIS MACHINERY IS MADE UP OF HEAVY PARTS THAT CAN ROTATE UNEXPECTEDLY. PERSONNEL MUST EXERCISE EXTREME CARE WHEN WORKING AROUND THE SWEEP OF THE CRANKS. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN SERIOUS INJURY OR DEATH TO PERSONNEL.

Most of our units are shipped with the type "B" brake (figure 15). Some of the units have a fabricated trunnion located horizontally from the high speed pinion, while others have the trunnion mounted in the housing and located vertically from the high speed pinion.

Some of our units were shipped with the type "C" brake (figures 16 and 17). This type also had some horizontally and some vertically mounted trunnions. The differences between the type "B" and type "C" are: 1) The stop screw is now called the shipping screw and is used for helping to lock the brake for shipping purposes; 2) There is now an adjusting nut located at the brake release bracket as well as at the end of the adjusting screw; and 3) Now both linings are adjusted independently.

Follow the procedures outlined below for the installation of the brake control lever and brake cable and for the adjustment of the brakes as they pertain to each type:

4.2.3.1 Type "B" (figure 15)

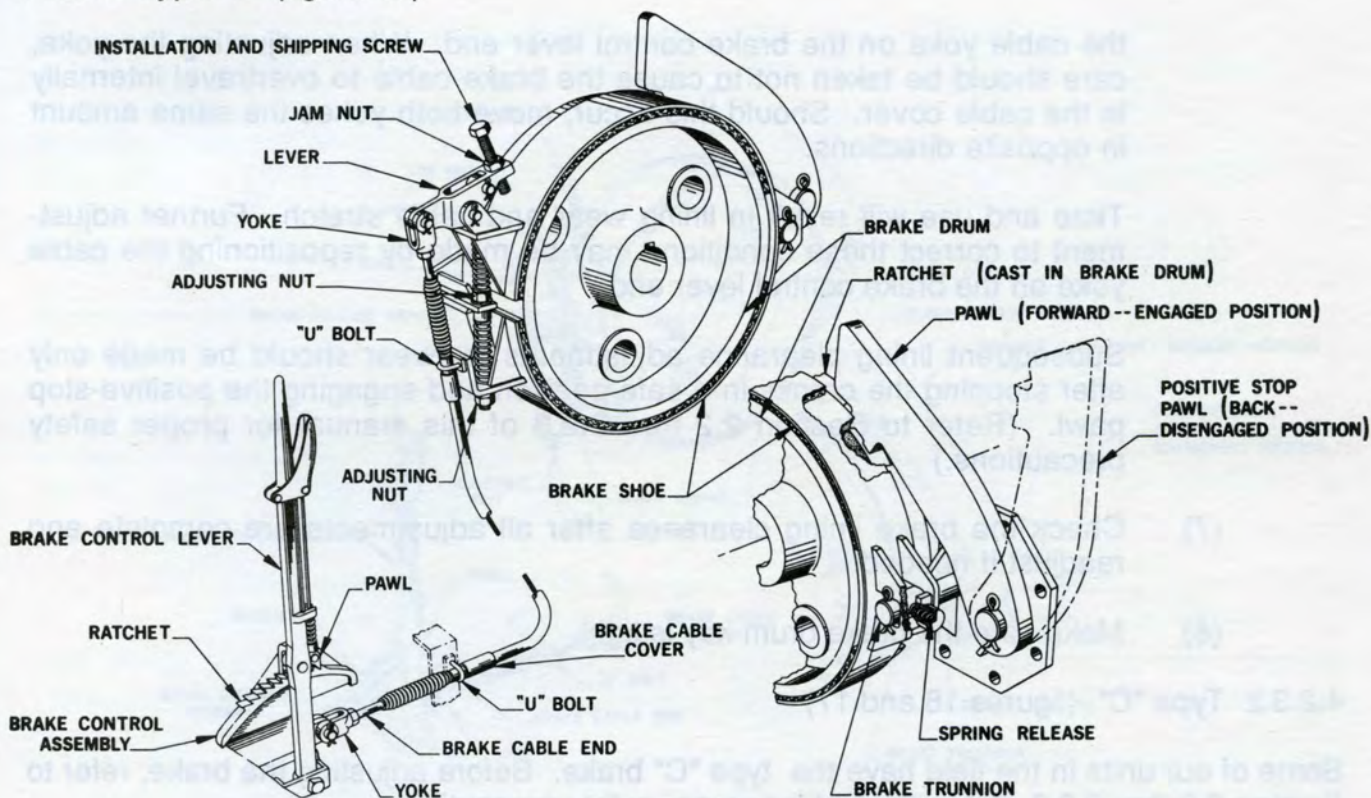


FIGURE 15

- (1) New units are shipped from the factory with the brake linings engaged against the drum and the positive-stop pawl engaged in the drum.
- (2) Attach the brake control lever assembly to the base.
- (3) The adjustment of the brake is set at the factory but may require final adjustment once the brake lever is installed.

With the installation and shipping screw released, adjust the position of both linings with the adjusting nuts until they just clear the drum. The spring release on the trunnion should pull the lining away from the drum near the trunnion.

- (4) Attach the brake cable to the brake lever on the base, using the u-bolt provided.
- (5) Move the brake control lever to the maximum forward position, and position the yoke on the end of the brake cable so that it can be pinned to the brake control lever.
- (6) Using the brake control lever, engage the brake. Full engagement should occur with several notches of the ratchet on the brake assembly still remaining to compensate for subsequent lining wear and cable stretch. Further adjustment to meet this condition may be made by repositioning

the cable yoke on the brake control lever end. When adjusting the yoke, care should be taken not to cause the brake cable to overtravel internally in the cable cover. Should this occur, move both yokes the same amount in opposite directions.

Time and use will result in lining wear and cable stretch. Further adjustment to correct these conditions may be made by repositioning the cable yoke on the brake control lever end.

Subsequent lining clearance adjustments for wear should be made only after stopping the cranks in a safe position and engaging the positive-stop pawl. (Refer to Section 2.2 thru 2.2.3 of this manual for proper safety precautions.)

- (7) Check the brake lining clearance after all adjustments are complete and readjust if needed.
- (8) Make sure the brake drum key is tight.

4.2.3.2 Type "C" (figures 16 and 17)

Some of our units in the field have the type "C" brake. Before adjusting the brake, refer to Section 2.2 thru 2.2.3 of this manual for proper safety precautions.

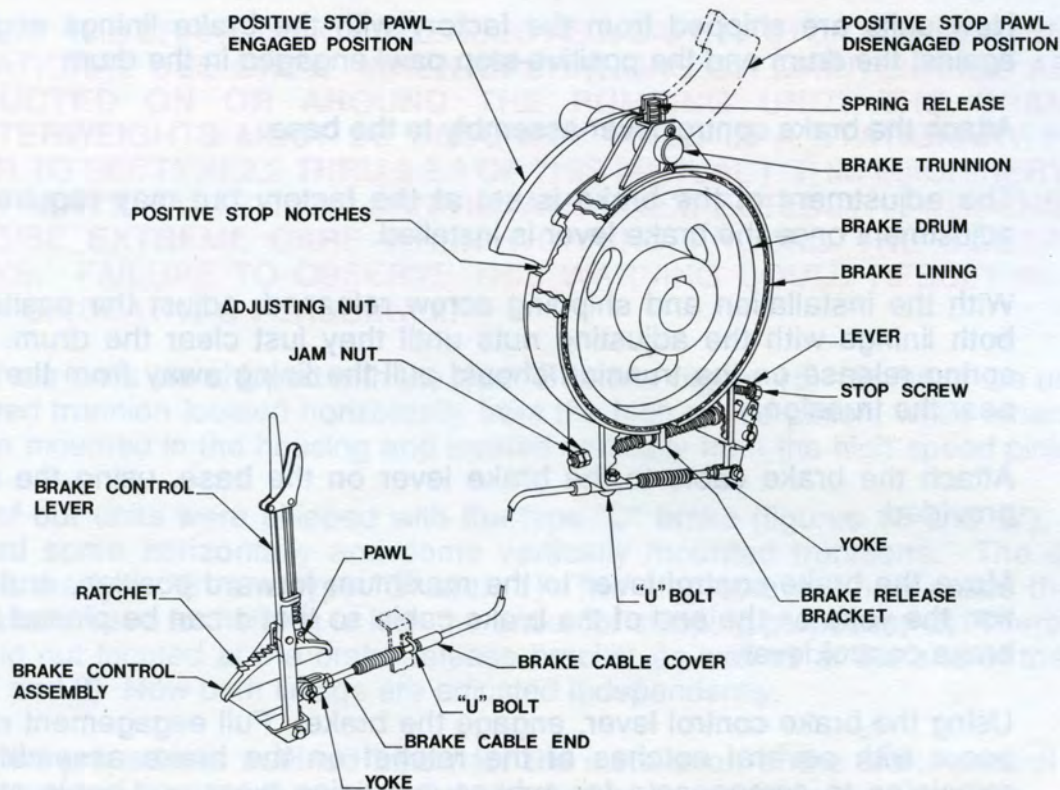


FIGURE 16

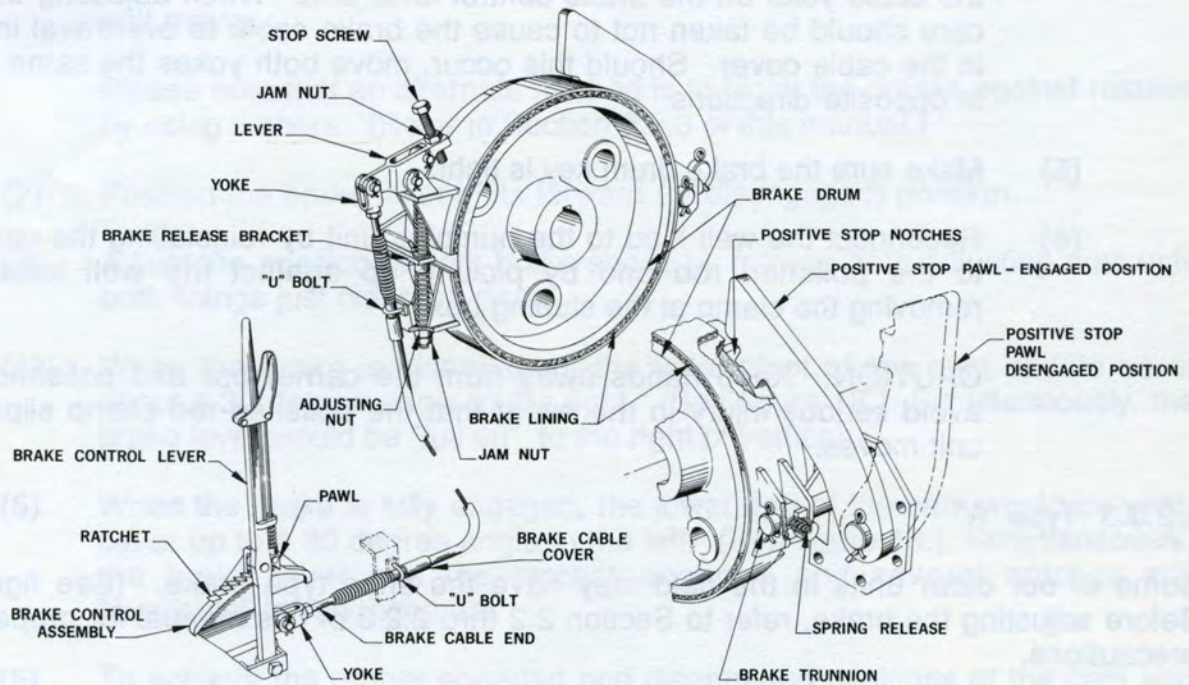


FIGURE 17

- (1) Remove the well load from the pumping unit by clamping the polished rod at the stuffing box and disconnecting the carrier bar. Use a rope to hold the carrier bar clear of the polished rod while positioning cranks. Slowly release the brake to allow the cranks to rotate to a safe position. Do this only after being sure that the crank sweep area is clear.

CAUTION: Keep hands away from the carrier bar and polished rod to avoid serious injury in the event that the polished-rod clamp slips or the unit moves.

Please note that an alternate method is to block the cranks against rotation by using timbers. (Refer to Section 2.2.3 of this manual.)

- (2) Position the brake lever in its forward (or disengaged) position.
- (3) Adjust the position of both brake linings by loosening the jam nut and moving adjusting nut until both linings just clear the drum. Retighten the jam nut.
- (4) Using the brake control lever, engage the brake. Full engagement should occur with several notches of the ratchet on the brake assembly still remaining to compensate for subsequent lining wear and cable stretch.

Further adjustment to meet this condition may be made by repositioning the cable yoke on the brake control lever end. When adjusting the yoke, care should be taken not to cause the brake cable to overtravel internally in the cable cover. Should this occur, move both yokes the same amount in opposite directions.

- (5) Make sure the brake drum key is tight.
- (6) Reconnect the well load to the pumping unit by reinstalling the carrier bar to the polished rod and by picking up against the well load before removing the clamp at the stuffing box.

CAUTION: Keep hands away from the carrier bar and polished rod to avoid serious injury in the event that the polished-rod clamp slips or the unit moves.

4.2.3.3 Type "A"

Some of our older units in the field may have the shoe type brake. (See figure 18.) Before adjusting the brake, refer to Section 2.2 thru 2.2.3 of this manual for proper safety precautions.

- (1) Remove the well load from the pumping unit by clamping the polished rod at the stuffing box and disconnecting the carrier bar. Use a rope to hold the carrier bar clear of the polished rod while positioning cranks. Slowly release the brake to allow the cranks to rotate to a safe position. Do this only after being sure that the crank sweep area is clear.

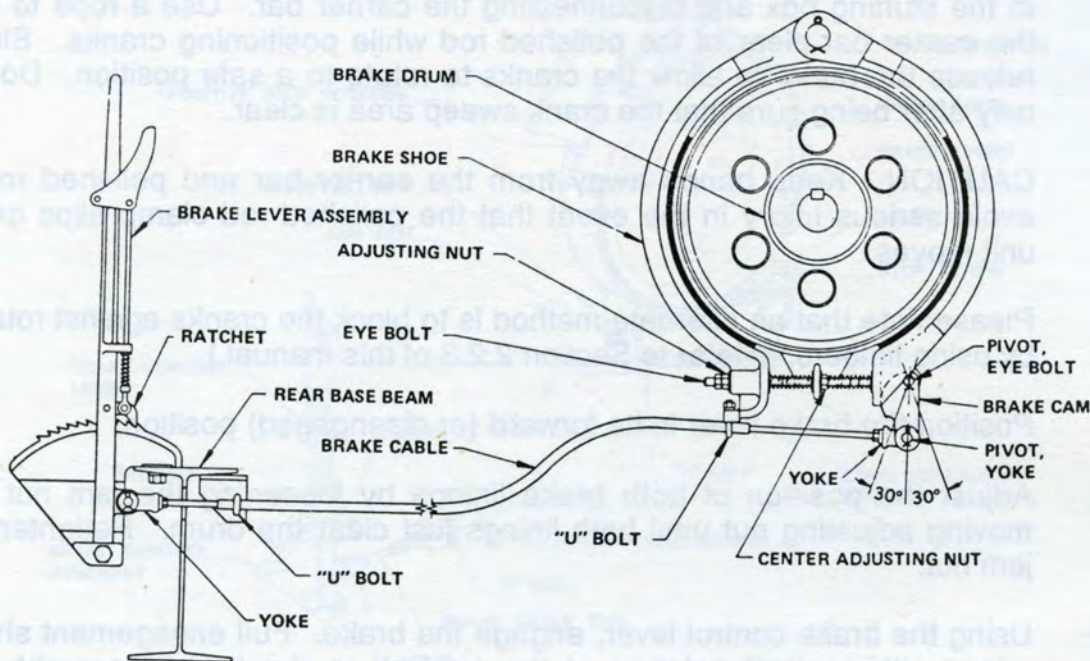


FIGURE 18

CAUTION: Keep hands away from the carrier bar and polished rod to avoid serious injury in the event that the polished-rod clamp slips or the unit moves.

Please note that an alternate method is to block the cranks against rotation by using timbers. (Refer to Section 2.2.3 of this manual.)

- (2) Position the brake lever in its forward (or disengaged) position.
- (3) Adjust the position of both brake shoes by moving both adjusting nuts until both linings just clear the drum.
- (4) When the brake is disengaged, the yoke pivot of the cam should be at about a 30 degree angle to the right. (See figure 18.) Simultaneously, the brake lever would be "full off", to the right of vertical.
- (5) When the brake is fully engaged, the lower end of the cam would be vertical or up to a 30 degree angle to the left. (See figure 18.) Simultaneously, the brake lever has the ratchet engaged and several notches still "available" for engagement.
- (6) To achieve the proper engaged and disengaged positions of the cam and brake lever, either or both yokes can be adjusted in or out on the ends of the brake cable.
- (7) Be certain that the rod end does not bottom out on the cable cover when engaging or disengaging the brake. When the yoke positions are established, tighten the jam nuts against the yokes.
- (8) Make sure the brake drum key is tight.
- (9) Reconnect the well load to the pumping unit by reinstalling the carrier bar to the polished rod and by picking up against the well load before removing the clamp at the stuffing box.

CAUTION: Keep hands away from the carrier bar and polished rod to avoid serious injury in the event that the polished-rod clamp slips or the unit moves.

4.2.4 Crank Rotation

DANGER: THIS MACHINERY IS MADE UP OF HEAVY PARTS THAT CAN ROTATE UNEXPECTEDLY. PERSONNEL MUST EXERCISE EXTREME CARE WHEN WORKING AROUND THE SWEEP OF THE CRANKS. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN SERIOUS INJURY OR DEATH TO PERSONNEL. CLEAR ALL PERSONNEL AND OBJECTS FROM THE CRANK SWEEP AREA BEFORE PROCEEDING. MAKE SURE YOU ARE SAFELY IN BETWEEN THE TWO CRANK SWEEPS DURING THIS OPERATION.

The cranks should now be rotated to a safe position, the long end down. Remove the chains from the reducer but not the cranks. Disengage the positive-stop pawl. The pawl should be locked into the disengaged position, using the locking bolt and nut where provided. Clear the crank sweep area. Gradually release the brake lever to allow the cranks to slowly rotate to bottom dead center. Remove the chains from the cranks.

When it becomes necessary to rotate the cranks to another position, attach chains or cables to both cranks as shown in figure 19. Use a long sling to minimize excessive stress on the sling and cranks. After the cranks are in the desired position, set the brake and engage the positive-stop pawl. Block the cranks against rotation by placing heavy timbers under the cranks.

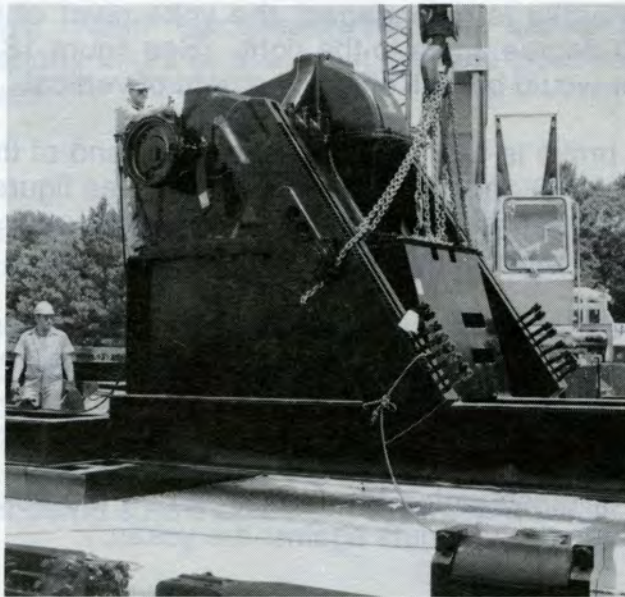


FIGURE 19

DANGER: THE BRAKE IS NOT INTENDED AS A SAFETY STOP BUT IS INTENDED FOR OPERATIONAL USE ONLY. WHEN OPERATIONS OR MAINTENANCE ARE TO BE CONDUCTED ON OR AROUND THE PUMPING UNIT, THE CRANKS AND COUNTERWEIGHTS MUST BE SECURELY FIXED IN A STATIONARY POSITION. (REFER TO SECTION 2.2 THRU 2.2.3 OF THIS MANUAL FOR PROPER PROCEDURES.) FAILURE TO SECURE THE CRANKS AGAINST ROTATION COULD RESULT IN SERIOUS INJURY OR DEATH TO PERSONNEL WORKING AROUND THE PUMPING UNIT.

4.2.5 Reducer Alignment (figure 20)

Shift the reducer on the sub-base until the distance from the crankshaft to the samson post bolt holes on the base is the same on each side of the unit. Tighten the bolts that attach the reducer to the sub-base, following the recommendations given under "Fasteners" in the Addendum, Section 10.

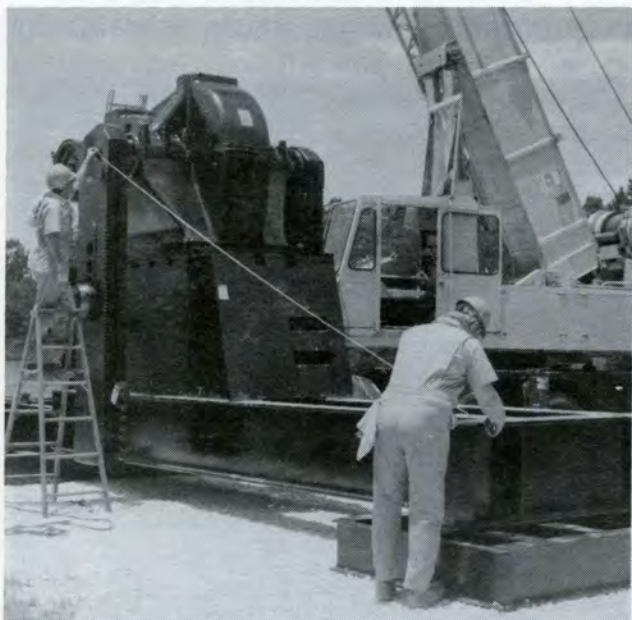


FIGURE 20



FIGURE 21

4.2.6 Master Counterweight Installation

DANGER: THIS MACHINERY IS MADE UP OF HEAVY PARTS THAT CAN ROTATE UNEXPECTEDLY. EXTREME CARE MUST BE EXERCISED WHEN WORKING AROUND THE SWEEP OF THE CRANKS. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN SERIOUS INJURY OR DEATH TO PERSONNEL.

Locate the cranks straight down. Clean the surfaces of the counterweights and cranks of any foreign materials. Units are usually shipped with the counterweight bolts located on the top side of the cranks. Half of these will need to be removed and placed on the opposite side of the cranks. Slide the counterweight bolts into the T-slot of the crank through the opening near the crankshaft. Lift the counterweight with a sling as shown in figure 21.

CAUTION: Do not stand under any part of the load while installing counterweights; serious injury or death could occur in the event the load shifts or drops. To avoid injury to fingers and hands, hold the bolts with large channel lock pliers or other suitable tool so the hands and fingers are not placed in jeopardy.

On symmetrical weights, the recess for the adjusting pinion should be located toward the long end of the crank. On counterweights with two bolts, the curved side must be located toward the long end of the crank. (See figure 22.) Line the counterweight bolts up with the holes in the weights and swing the weight into position against the face of the crank. Install the counterweight bolt nuts and tighten according to the recommendations given in the Addendum, Section 10. Install a second nut as a jam nut.

CAUTION: Improperly tightened counterweight bolts can allow the counterweights to move on the crank. Impact movement of the counterweights could break through the stop

on the crank end and damage the unit or cause possible serious injury or death to personnel.

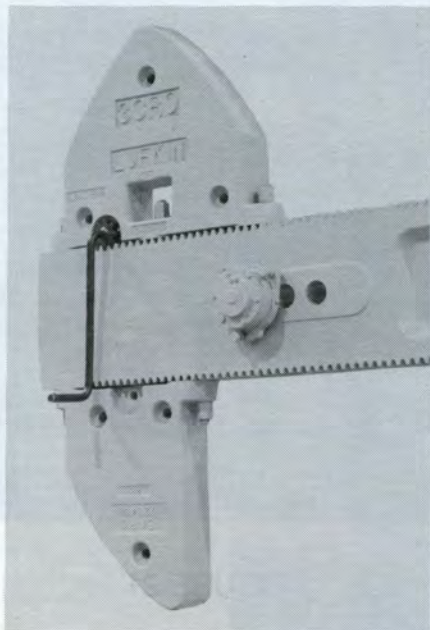


FIGURE 22



FIGURE 23

4.2.7 Auxiliary Weight Installation

CAUTION: Do not stand under any part of the load while installing the auxiliary weights; serious injury or death could occur in the event that the load shifts or drops.

Install auxiliary weights as shown in figure 23. Using the technique shown, support the weight through one of the mounting bolt holes, then lower the weight until the "pivot hole" lines up with the corresponding hole in the master counterweight. Insert a pivot-rod and lower the weight until the other two holes line up with the remaining holes in the master counterweight. Install two bolts. Remove the pivot rod and install the last bolt in the pivot-rod hole. Tighten all bolts according to the recommendations given under "Fasteners" in the Addendum, Section 10.

4.2.8 Samson Post Installation

CAUTION: Do not stand under any part of the load; serious injury or death could occur if the load shifts or drops.



FIGURE 24

Clean the surfaces between the front and rear leg connection plates. Also, clean the surfaces between the unit base and foot plates of the samson post.

To reduce the probability of losing bolts, the post and brace assembly is shipped with the bolts in the holes. The exception to this is the bolts used to mount the rear leg to the sub-base, which use elastic stop nuts. Remove all the bolts (figure 24). Align the holes in the rear leg with the holes in the connection plates and reinstall these bolts. It is best to install the bolts so that the nuts will be on the outside, which makes it easier to tighten later. Leave the bolts loose as they will be tightened after the center bearing plate is leveled (procedure 4.2.9).

Lift the post assembly with a sling attached near the top of the assembly. This will hang the post in a near level position for easy attachment to the base, as shown in figure 25. Install the bolts attaching the front and rear post members to the base. The bolts and elastic stop nuts for the rear leg are located in a sack attached to the rear leg. Install the bolts from the bottom so the elastic stop nuts will be on the top side. Initially, the post feet to base bolts are snug tightened. Final tightening will be done after the center bearing plate is leveled (procedure 4.2.9).



FIGURE 25

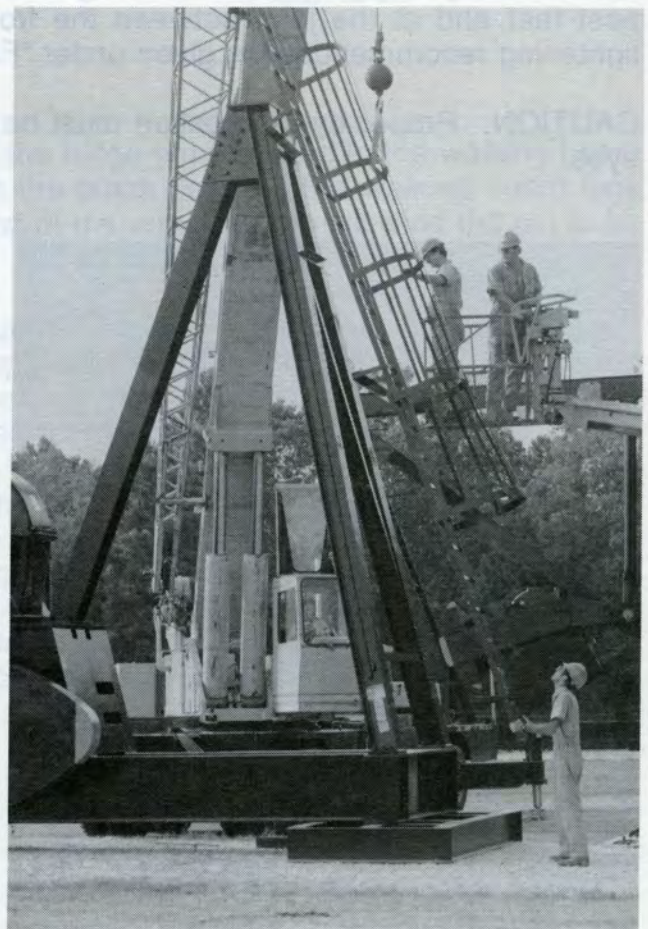


FIGURE 26

4.2.9 Ladder Installation

CAUTION: Do not stand under any part of the load; serious injury or death could occur if the load shifts or drops.

The ladder attaches directly to the samson post or to brackets attached to the post leg as shown in figure 26. Install the bolts and tighten, following the recommendations given under "Fasteners" in the Addendum, Section 10.

CAUTION: It is not intended for the ladder to be used while the unit is in operation. The loop furnished with our ladders (figure 27) is the clamp-on type. The purpose of the loop is to provide support for a person when working in the area of the center bearing. The loop must be located in such a position to insure maximum safety to personnel. Extreme care must be exercised during unit installation and/or maintenance to avoid becoming trapped between the walking beam and the loop.

Check the level of the center bearing seat plate as shown in figure 28. If necessary, shim up under one of the front post legs to achieve a level center bearing seat plate. Shimming is not usually required. After leveling is achieved, hammer-tighten the bolts at all three post feet and at the joint between the front and rear samson post legs, following the tightening recommendations given under "Fasteners" in the Addendum, Section 10.

CAUTION: Proper eye protection must be worn; flying metal may cause damage to the eyes.



FIGURE 27

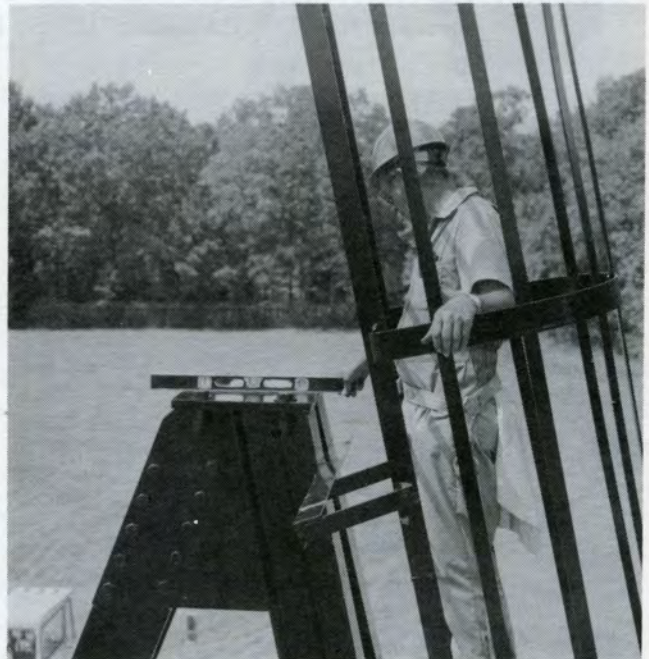


FIGURE 28

4.2.10 Center Bearing to Beam Assembly (figure 29)

CAUTION: Do not stand under any part of the load; serious injury or death could occur if the load shifts or drops.

Clean the surfaces between the center bearing and walking beam. Be sure these contacting surfaces are metal-to-metal. Position the center bearing assembly in place on the walking beam or position the beam over the center bearing assembly. Align the bolt holes. Install the bolts and snug tighten. Final tightening of these bolts is described in procedure 4.2.13.



FIGURE 29

4.2.11 Equalizer Bearing to Beam Assembly

CAUTION: Do not stand under any part of the load; serious injury or death could occur if the load shifts or drops.

Your new pumping unit is shipped to you with the hinge pin mounted in the walking beam lugs. To remove the pin for cleaning, loosen the pinch bolts on the walking beam lugs and remove the elastic stop nut on the rear end of the equalizer pin allowing the pin to be moved toward the front of the beam.

Lift the walking beam so the equalizer and equalizer bearing assembly will fit between the two lugs welded to the rear end of the walking beam, as shown in figure 30. Clean the hinge pin and all of its contacting surfaces of any rust preventive material. Carefully inspect the hinge pin and its contact surfaces for any burrs or foreign material, which should be carefully removed with a file or a safe solvent (per your company's safety regulations) prior to assembling. After cleaning the surfaces, recoat them with a light oil to ease the assembly process. Install the hinge pin from the front end of the beam, passing it through the frontmost lug first, then the equalizer bearing box, and finally the rearmost lug on the walking beam. (On some of the smaller pumping units, the hinge pin is installed from the rear toward the front.) Next, slide the endcap onto the hinge pin stud and install the elastic stop nut. Snug tighten the hinge pin nut and the pinch bolts. Final tightening will be done after rotation of the unit (procedure 5.1.3).



FIGURE 30



FIGURE 31

4.2.12 Equalizer Bearing Hinge Pin Lubrication

Using a grease recommended in Section 8.3, lubricate the equalizer bearing hinge pin as shown in figure 31.

4.2.13 Center Bearing/Equalizer Bearing Alignment (figure 32)

After assembling the center bearing assembly and the equalizer bearing assembly to the walking beam, carefully measure the distance between the end of the center bearing shaft and the end of the equalizer bearing shaft on both sides. For proper alignment, these distances should be the same. If necessary, loosen the center bearing saddle bolts so the center bearing assembly can be rotated until the shaft centers are the same on both sides. After securing the alignment, hammer-tighten the bolts between the center bearing saddle and the walking beam, per the Addendum, Section 10. Tighten the pusher screws on the walking beam against the center bearing and use the jam nuts to lock them in place.

CAUTION: Proper eye protection must be worn; flying metal may cause damage to the eyes.

WARNING: Improper tightening of the center bearing to walking beam bolts can result in broken bolts which in turn will cause severe damage to the pumping unit.



FIGURE 32



FIGURE 33

4.2.14 Pitman/Equalizer, Assembly (figure 33)

Clean the surfaces between the pitman upper connections and the equalizer. Bolt the upper end of the pitmans to the equalizer. The lubrication line grommet must be located under one of the mounting bolts of the pitman that has the lubrication line attached to it. Snug tighten. Final tightening will be done after unit alignment (procedure 4.2.26).

4.2.15 Equalizer Bearing Lubrication Hose Installation

Attach the lubrication hose to the lubrication line on the pitman and fill with grease as specified in Section 8.3. Then attach the hose to the equalizer bearing housing (figure 34). Only one line is needed for equalizer bearing lubrication.

4.2.16 Pitman Box Lubrication

Using a grease recommended in Section 8.3, lubricate the upper pitman boxes as shown in figure 35.



FIGURE 34



FIGURE 35



FIGURE 36

4.2.17 Pitman Parallelism

CAUTION: Do not stand under any part of the load; serious injury or death could occur if the load shifts or drops.

Attach slings to the walking beam so that it can be lifted in a horizontal position; then lift the assembly until the pitmans are off the ground. View the walking beam/pitman assembly from the side and sight from one pitman arm to the other to check for pitman parallelism (figure 36). In the event that the pitman arms do not line up, you should contact your nearest LUFKIN representative who will determine the cause of the non-parallelism and the disposition of the problem.

4.2.18 Center Bearing/Post Installation

CAUTION: Do not stand under any part of the load; serious injury or death could occur if the load shifts or drops.

Clean the surfaces between the center bearing and the samson post for foreign materials. Lift the walking beam/pitman assembly in a level configuration and position the center bearing over the top of the samson post. The center bearing has a male boss which fits into the hole in the top plate of the samson post to aid in rough alignment of the center bearing to the samson post. Install the samson post to center bearing bolts and snug-tighten. These bolts will be thoroughly tightened later, after pitman alignment is checked. Note the sling arrangement in figure 37--it helps to stabilize the beam during "lift".



FIGURE 37

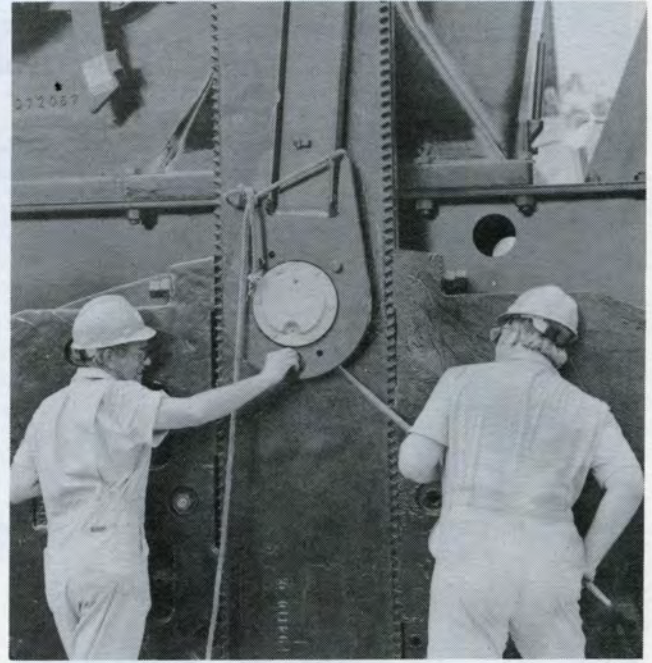


FIGURE 38

4.2.19 Pitman/Crankpin Connection (figure 38)

Some of the larger pumping units are shipped without the crank pins mounted in the cranks. In the event that the crank pins are not mounted, refer to Section 5.3.3 for the proper installation of the crank pins. After the crank pins are mounted in the cranks, carefully clean the contact surfaces between the pitman lower connection and the crank pin bearing box. The pitman ends should fit easily on the crank pin bearing boxes.

WARNING: Do not hammer the pitman lower connection onto the crank pin bearing box. This could result in damage to the crank pin bearings.

If the pitman does not fit the crank pin squarely, the upper pitman bolts may need to be loosened to get the proper alignment. Align the capscrew holes and install the capscrews, tightening them per the Addendum, Section 10, Table I.

4.2.20 Pitman Alignment

Using a tape, carefully measure the distance between the end of the crankshaft and the nearest part of the pitman on both sides of the gearbox, as shown in figure 39. The two distances should be within 1/8 of an inch of each other. In the event the pitman to crankshaft distances are not equal, the walking beam should be rotated by turning the center bearing on the post until the alignment between the pitman and the crankshaft end is satisfactory. Hammer-tighten the center bearing to the samson post bolts.

CAUTION: Proper eye protection must be worn; flying metal may cause damage to the eyes.

WARNING: Failure to properly align the pitman to the crankshaft causes undue stresses on the structural components, which will lead to a shortened life of the pumping unit.



FIGURE 39



FIGURE 40

4.2.21 Center Bearing Lubrication Lines Installation

Attach the lubrication hoses to the lubrication lines, which are located on both front legs of the samson post, and fill the hose/line assemblies with a grease recommended in Section 8.3. Attach the hose to the center bearing (both sides).

4.2.22 Wireline Installation

The procedure illustrated in figure 40 involves forming a loop around the wireline seat, which is located at the top of the horsehead. The wireline retainer is then placed over the seat and the wireline. Tighten the bolt that secures the wireline retainer to the horsehead, then pull the carrier bar downward to insure the wireline is against the seat. See Addendum, Section 10, for bolt tightening recommendations.

4.2.23 Wireline Bail Installation (figure 41)

A wireline bail is furnished on 120" stroke and larger Conventional and on all Reverse Mark pumping units. The purpose of the bail is to prevent the wireline from sliding off of the side of the horsehead in the event slack occurs in the wireline. To install the wireline bail, simply insert the pins on the bail into the pipe sockets on the side of the horsehead.



FIGURE 41



FIGURE 42

4.2.24 Horsehead Installation

CAUTION: Do not stand under any part of the load while positioning the horsehead; serious injury or death could occur in the event that the load shifts or drops. Do not place hands or fingers inside of the horsehead during installation.

Before lifting the horsehead, make sure the adjusting screws are flush with the inside of the side plates (figure 42). Lift the horsehead and clean the wireline track of any foreign material. Place the horsehead on the beam, making sure that the rocker plate on the inside of the horsehead fits behind the seat bar and against the angle iron spacer on the top flange of the walking beam (figure 43). Some of the smaller units are shipped with a hinge pin, which needs to be installed at this time. Insert the pin through the side plate and the hinge pipe that is located on top of the walking beam. Add the washers and the cotter pins to hold the hinge pin in place. Allow the horsehead to swing down so that the bumper plate inside the horsehead contacts the front plate of the walking beam. Be sure that the rocker plate inside the upper portion of the horsehead fits firmly against the top flange of the beam and is between the seat bar and the angle spacer.

Most of the larger stroke length units are equipped with a horsehead safety bar. (See figure 44.) Install the bar through the slot in the side of the head and through the angle welded to the front plate of the beam. The roll pin, which is part of the bar, must go through the slot on the side plate and then rotated 90° to bear against the inside of the side plate to keep the bar from sliding out.

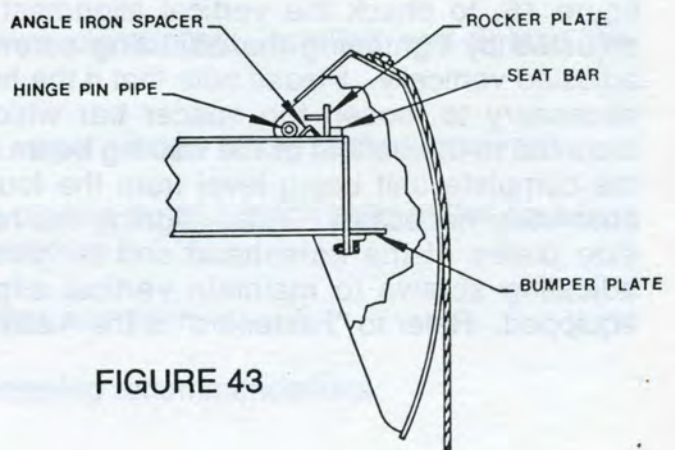


FIGURE 43

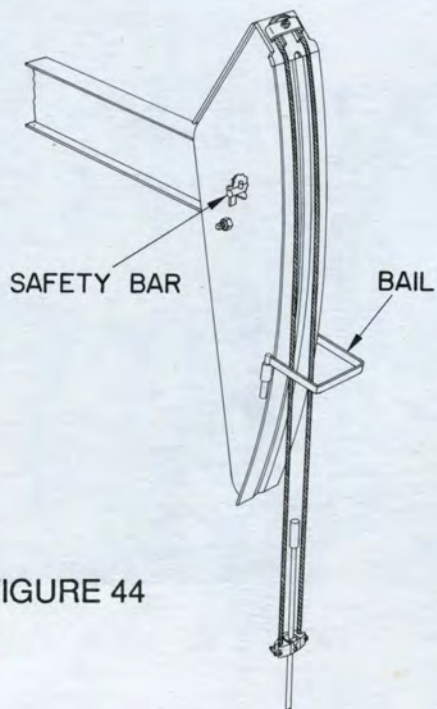


FIGURE 44

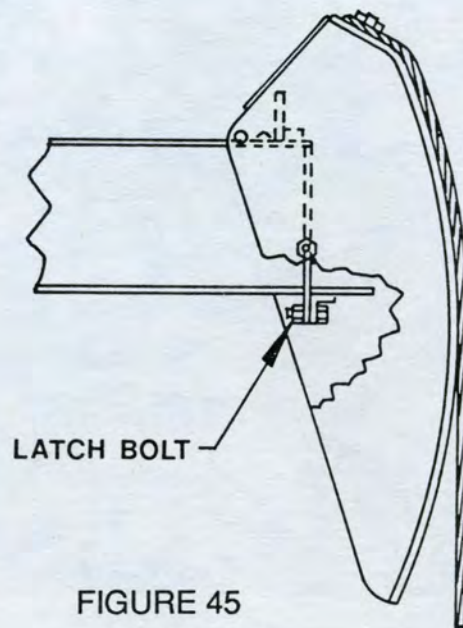


FIGURE 45

The units with shorter stroke lengths are equipped with a latch bolt. (See figure 45.) These size units are normally shipped from the factory with the horsehead mounted to the walking beam. At this time, be sure that the latch bolt is installed. If the horsehead alignment is incorrect (procedure 4.2.25), then the latch bolt will need to be loosened until the adjustments are made.

DANGER: BE SURE THAT THE SAFETY BAR, HINGE PIN, AND/OR THE LATCH BOLT IS INSTALLED AND TIGHTENED AT ALL TIMES EXCEPT DURING HORSEHEAD REMOVAL. ALSO, BE CERTAIN TO REMOVE THE SAFETY BAR, HINGE PIN, AND/OR THE LATCH BOLT BEFORE ATTEMPTING TO REMOVE THE HORSEHEAD. FAILURE TO OBSERVE THESE WARNINGS COULD RESULT IN SERIOUS INJURY OR DEATH TO PERSONNEL.

4.2.25 Horsehead Adjustment

With the walking beam in a horizontal position, use a level or a plumb bob, as shown in figure 46, to check the vertical alignment of the horsehead. The horse-head may be adjusted by tightening the adjusting screws on either side of the horsehead until it is adjusted vertically. Please note that if the horsehead is out of vertical alignment, it may be necessary to loosen the spacer bar which is located just inside the horsehead and mounted to the bottom of the walking beam. The spacer bar is set at the factory, based on the complete unit being level from the foundation up and should not be moved unless absolutely necessary. After aligning the horsehead, center the spacer bar between the side plates of the horsehead and retighten the bolts. Tighten the jam nuts on the adjusting screws to maintain vertical alignment. Tighten the latch bolt on units so equipped. Refer to "Fasteners" in the Addendum, Section 10.

CAUTION: It is essential that the user of the pumping unit comply with all applicable safety requirements concerning the guarding of horseheads. Guards are available from LUFKIN.

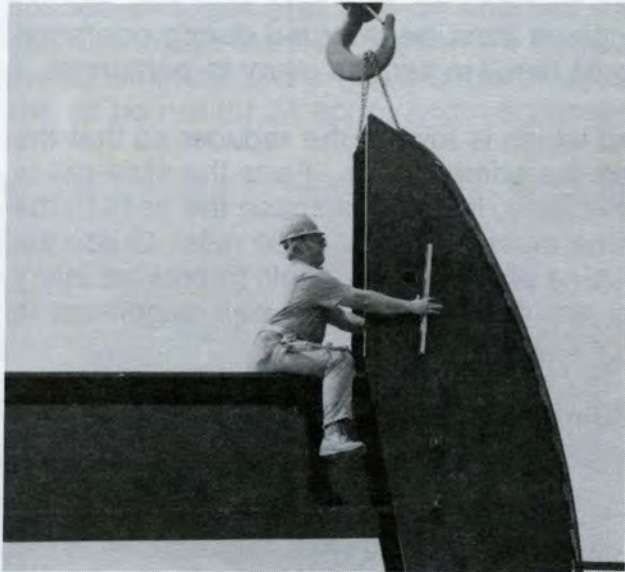


FIGURE 46

4.2.26 Unit Alignment (figure 47)

While holding the carrier bar away from the polished rod, lower a plumb bob from the center of the top of the horsehead down to the polished rod. Establish the distance from the string to the center of the wireline rope and account for this when checking the alignment from the polished rod. Move the entire pumping unit on its foundation if adjustment is required.



FIGURE 47

After establishing the final alignment of the unit to the well:

- (1) Be sure all foundation hold-down clamps are installed and tighten the bolts.
- (2) Tighten the bolts connecting the upper pitman boxes to the equalizer.

NOTE: Do not tighten the hinge pin bolt nor the pinch bolts at the equalizer until after rotation of the unit (procedure 5.1.3).

- (3) Check all other bolts to be sure they are tight.

Refer to the Addendum, Section 10, for bolt tightening recommendations.

4.2.27 Prime Mover Installation

CAUTION: Do not stand under any part of the load while installing the prime mover; serious injury or death could occur in the event that the load shifts or drops.

CAUTION: Exposed flywheels of slow-speed engines must be guarded during operation of the engine. Failure to observe this warning could result in serious injury to personnel.

Position the slide rails on the T-slots near the end which is toward the reducer so that the belts can more easily be installed after positioning the prime mover. Face the slide rail to match the mounting holes on the prime mover. Similarly, install and space the bolts in the T-slots on the slide rails. Carefully lower the prime mover onto the slide rails. Guide the bolts into the holes in the prime mover feet by using pliers or other tools to prevent injury to fingers and hands. Install the nuts but do not tighten until the belt alignment is completed.

Some bases are tailor-made for a particular engine. These do not use slide rails, but instead the engine feet mount directly to the T-slots on the base.

CAUTION: Do not place fingers and hands between the prime mover and the slide rails as serious injury could occur should the prime mover be suddenly dropped.

4.2.28 "V-belts" Installation and Alignment

DANGER: STAY CLEAR OF THE CRANK SWING AREA WHILE INSTALLING BELTS AS SERIOUS INJURY OR DEATH COULD OCCUR. BE SURE THAT THE PRIME MOVER CANNOT BE STARTED DURING THIS PROCEDURE.



FIGURE 48



FIGURE 49

Install a matched set of belts. Use the inside grooves if either sheave has an excess number of grooves. Use a string to line up the inside faces of the sheaves as shown in figure 48. Shift the prime mover as required and then tighten the bolts that attach the prime mover to the slide rails. Tighten the belts by using the adjustment screws. A few pounds of finger pressure on one belt midway between the sheaves should deflect the belt one to two inches. Tighten the bolts attaching the slide rails to the T-slots, following the recommendations given under "Fasteners" in the Addendum, Section 10. New belts should be run for 24 hours and retightened.



FIGURE 50

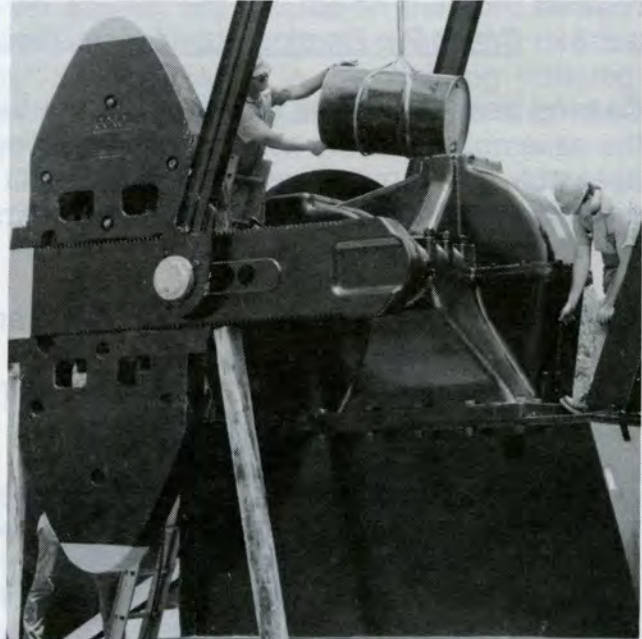


FIGURE 51

4.2.29 Belt Cover Installation

DANGER: STAY CLEAR OF THE CRANK SWING AREA WHILE INSTALLING THE BELT COVER AS SERIOUS INJURY OR DEATH COULD OCCUR. BE SURE THAT THE PRIME MOVER CANNOT BE STARTED DURING THIS PROCEDURE.

Remove the bottom pan (figure 49) from the belt cover and install the cover (figure 50). The front support fits over two slow-speed shaft studs on the reducer and is retained by the jam nuts that are located on the reducer studs. The rear belt cover support fits on the base. Check inside the cover to be sure the sheaves and belts have adequate clearance. The cover can be shifted sideways to adjust clearance. Replace the bottom pan. Some belt covers are equipped with a center support or a wind brace, which should be attached at this time. Tighten all bolts following the recommendations given under "Fasteners" in the Addendum, Section 10.

CAUTION: It is essential that the user of the pumping unit comply with all applicable safety requirements concerning the guarding of belts and sheaves. For additional information concerning belt guards, see API RP11ER.

4.2.30 Reducer Lubrication (figure 51)

See Section 8.1 for the lubrication specifications and the amount required. Check the oil level with the dip stick located at the front of the reducer. If the oil level is low, remove the inspection cover and add oil to the proper level.

WARNING: Damage will occur to the reducer if it is operated with the improper amount or type of lubricant.

4.2.31 Crank Pin Bearing Lubrication (figure 52)

Bearing assemblies are lubricated at the factory; however, it is a good practice to check the assemblies. Using a grease as specified in Section 8.3, pump grease into the bearing assembly until it overflows through the relief fitting located in the upper part of the end cap or on the back side of the bearing housing. Pump grease in slowly to avoid damage to the seals.

WARNING: Damage will occur to the crank pin bearings if they are operated with the improper amount or type of lubricant.



FIGURE 52



FIGURE 53

4.2.32 Equalizer Bearing Lubrication (figure 53)

Bearing assemblies are lubricated at the factory; however, it is a good practice to check the assemblies. The grease fitting for the equalizer bearing is located on one of the pitman arms. Using a grease as specified in Section 8.3, pump grease into the bearing assembly until it overflows through the relief fitting located in the bearing housing.

Lubrication lines are prelubricated; therefore, only a small amount of grease should be required for this check. Pump the grease in slowly to avoid damage to the seals.

WARNING: Damage will occur to the equalizer bearing if the unit is operated with the improper amount or type of lubricant in the equalizer bearing.

4.2.33 Center Bearing Lubrication (figure 54)

Bearing assemblies are lubricated at the factory; however, it is a good practice to check the assemblies. The grease fittings for the center bearing are located on the front samson post legs. Using a grease as specified in Section 8.3, pump grease into the bearing assembly until it overflows through the relief fitting located in the bearing housing. Lubrication lines are prelubricated; therefore, only a small amount of grease should be required for this check. Pump grease in slowly to avoid damage to the seals.

WARNING: Damage will occur to the center bearing if it is operated with the improper amount or type of lubricant.

4.2.34 Crank Guard Installation (figure 55)

Never operate pumping units without guards in place. Guards are available from LUFKIN. Refer to Section 2.3 thru 2.3.4 of this manual.

When you choose to purchase crank guards from LUFKIN, a crank guard installation schematic, which shows the panel part numbers and their location relative to each other and to the well head, is shipped with the unit. The front panel, located beneath the samson post, heel-clamps to the base beam flanges where possible. Other than hi-prime units, the rear panel has an opening for the belt cover and is heel-clamped to the engine base beam flanges where possible. The side panel is attached to the front and rear panels with hinges consisting of stationary hooks on the side panels and vertical pipe receptacles on the front and rear panels.



FIGURE 54



FIGURE 55

4.2.35 Carrier Bar/Polished Rod Connection

Position the unit in the same stroke position as the bottom-hole pump. (This is usually at the bottom of the stroke position.) Remove the gate from the carrier bar and position the slot in the carrier bar around the polished rod. Replace the gate and secure the gate latch in the notch provided. Install the rod clamp at the carrier bar and tighten the bolts according to the clamp manufacturer's torque recommendations. Remove the rod clamp at the well stuffing box.

CAUTION: Keep hands away from the polished rod and carrier bar to avoid serious injury in the event that the polished-rod clamp slips or the unit moves.

5. OPERATION

DANGER: BEFORE OPERATING ANY UNIT, REVIEW THE SAFETY SECTION (SECTION 2) OF THIS MANUAL. EXERCISE EXTREME CAUTION TO REMAIN CLEAR OF THE CRANK SWEEP AND OTHER MOVING PARTS WHILE PERFORMING ANY OF THE FOLLOWING TASKS. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN SERIOUS INJURY OR DEATH TO PERSONNEL WORKING AROUND THE PUMPING UNIT.

5.1 STARTING THE UNIT FOR THE FIRST TIME

5.1.1 Before Starting Checks

Some of these items have been covered in the erection procedure; however, some time may have elapsed since the erection of the unit and other work may have been done on or around the unit; therefore, these items should be rechecked.

- (1) Check the oil in the reducer.

WARNING: Running the reducer without oil at the proper level will result in severe damage to the unit.

- (2) Check the lubrication of all structural bearings.

- (3) Clear the crank swing area. Remove all tools, timbers or any other obstruction left on the unit and foundation that is in the path of the cranks.

WARNING: Failure to clear the crank swing area can result in damage to the unit.

- (4) Make sure all guards are in place.

CAUTION: It is essential that the user of the pumping unit comply with all federal, state, and local regulations which may require specific types of guarding. Guards are available from LUFKIN. Refer to API RP11ER "Guarding Of Pumping Units" for additional information.

Safety rules mandate that all guards must be in place before operating the unit.

- (5) Disengage the positive-stop brake pawl.

DANGER: CHECK TO BE SURE THAT ALL PERSONNEL ARE CLEAR OF THE CRANK SWING AREA BEFORE DISENGAGING THE PAWL AS SERIOUS INJURY OR DEATH COULD OCCUR.

The pawl must be disengaged from the brake drum before attempting to start the unit.

5.1.2 Direction of Rotation

The LUFKIN Reverse Mark pumping unit must rotate clockwise only. This is determined by looking at the unit from the side with the horsehead located to your right.

The LUFKIN Conventional pumping unit can operate equally well with the rotation in either direction. Whenever evidence of excessive wear or pitting of the gear teeth is noticed, it might be to your advantage to change the direction of rotation. Reversing the rotation causes different involute surfaces of the gear teeth to be exposed to the load, which extends the life of the gear elements. If your prime mover is a three-phase electric motor, this can easily be done by reversing the leads on the motor.

DANGER: ELECTRICAL POWER MUST BE LOCKED OUT PRIOR TO PERFORMING ANY WORK ON THE ELECTRIC MOTOR. ALL ELECTRICAL WORK MUST BE PERFORMED BY A QUALIFIED ELECTRICIAN.

5.1.3 First Crank Revolution

DANGER: STAY CLEAR OF THE CRANK SWING AREA AS SERIOUS INJURY OR DEATH COULD OCCUR.

The first revolution of the crank should be as slow as possible. Check for proper clearance between the cranks and the belt cover, crank guards and pitman side members. Bottom-hole-pump spacing should also be checked during the first revolution.

After slowly rotating the unit through several revolutions, stop the unit with the horsehead at the top of the upstroke. Tighten the hinge pin to remove the end play between the equalizer bearing housing and the beam lugs.

WARNING: Failure to remove the end play between the equalizer bearing housing and the beam lugs will cause damage to the equipment.

Tighten the pinch bolts on the beam lugs.

Refer to the Addendum, Section 10, for bolt tightening recommendations.

NOTE: After one week of operation, all bolts must be retightened.

5.2 COUNTERBALANCE ADJUSTMENT

5.2.1 Determining the Required Counterbalance

Efficient operation, minimum torque loading, and maximum life of a pumping unit are all a result of proper counterbalance. Counterbalance requirements can be determined very accurately or estimated by several methods.

CAUTION: Do not enter the crank swing area to perform any of the following tasks. Failure to observe this warning could result in serious injury or death.

(1) Polished-rod dynamometer

A dynamometer card analysis is the most accurate method for determining loading and counterbalance. This involves using a dynamometer to record the well load through a stroke cycle and then using torque factors to determine the reducer torque and counterbalance required for balanced conditions.

(2) Ammeter

A clip-on ammeter may be used to compare the upstroke and downstroke current on electrically powered units. When the counterbalance is adjusted so that the current peaks are equal, the unit will be approximately in balance.

(3) Vacuum gauge

A vacuum gauge may be used to compare torque peaks on engine driven units much like the ammeter is used on electrically driven units. Vacuum pressure decreases as engine output increases.

(4) Sound of the prime mover

A rough estimate of balance can be made by listening to the characteristic sound of the prime mover as it drives the unit. Some speed change will occur as the peak loads are approached; this speed change will cause the sound of the prime mover to change.

(5) Tension in the belts

Belt tension and consequently belt stretch increases with load which causes an apportionable amount of slack in the belts on the side opposite the direction of rotation of the prime mover. A visual comparison of the belt slack or sag on the upstroke and downstroke can be used to estimate counterbalance.

5.2.2 Counterweight Adjustment (figure 56)

DANGER: STAY CLEAR OF THE CRANK SWING AREA WHILE MOVING COUNTERWEIGHTS AS SERIOUS INJURY OR DEATH COULD OCCUR.

Rotate the unit and apply the brake so that the crank is slightly downhill in the direction that the weights are to be moved. Set the brake, engage the pawl, and secure the cranks against rotation. (Refer to Section 2 of this manual for proper procedures.) Loosen the counterweight bolts just enough to allow the weights to be moved. Use the pinion adjusting tool, as shown in figure 56, to move the weights to the desired position. Please note that some of the larger weights may have to be moved with the aid of a crane or a pry bar. The weight on the bottom of the crank may be moved in a like manner. After positioning the weights in the desired location, tighten the counterweight bolts, following the recommendations given under "Fasteners" in the Addendum, Section 10, and install a second nut as a jam nut.

CAUTION: Improperly tightened counterweight bolts can allow the counterweights to move on the crank. Impact movement of the counterweights could break through the stop on the crank end and damage the unit or cause serious injury or death to personnel.



FIGURE 56

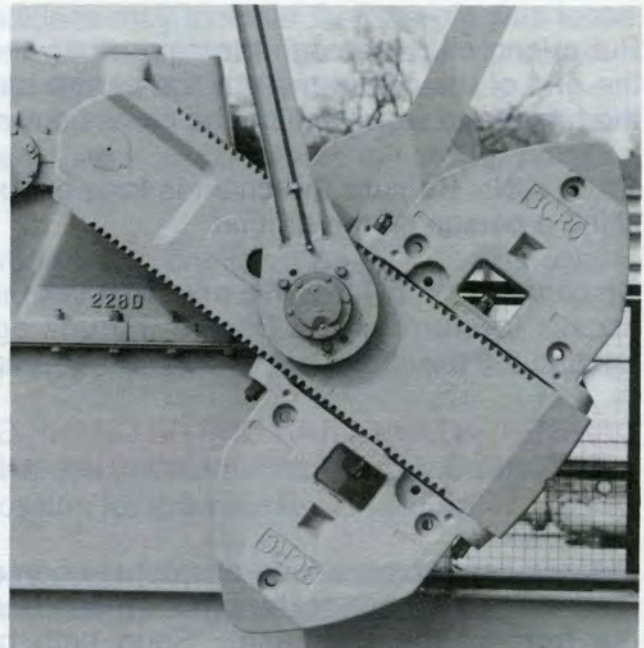


FIGURE 57

5.3 STROKE CHANGE

CAUTION: Extreme caution must be exercised during the following procedure to prevent serious personal injury. Before performing a stroke change, review Section 2 (the Safety Section) of this manual.

The following description of a stroke change is given while viewing the pumping unit from the side with the well head located to the right:

5.3.1 Preparation

Locate the cranks at about the 2 o'clock position and set the brake.

WARNING: Abrupt braking may damage the gear teeth in the reducer. A slow, even pull on the brake lever is recommended.

Place a polished-rod clamp at the stuffing box and tighten according to the clamp manufacturer's torque recommendations.

Using the prime mover (or crane), relocate the cranks to the 12 o'clock position and set the brake.

Disconnect the carrier bar from the polished rod.

CAUTION: Keep hands away from the polished rod and carrier bar to avoid serious injury in the event that the polished-rod clamp slips or the unit moves.

Put a long chain through the carrier bar and put the gate back into the carrier bar. Hold the end of the chain and pull the carrier bar away from the polished rod while easing off the brake and slowly letting the cranks down to the 4 o'clock position (figure 57).

CAUTION: Be sure the chain is long enough so that the carrier bar can be held without lifting a person off the ground.

Disconnect or lockout the prime mover. Remove the crank guard side panel to gain access to crank area. Secure the unit against rotation. Engage the pawl. (Refer to Section 2.2 thru 2.2.3 of this manual for proper procedures.)

DANGER: STAY CLEAR OF THE CRANK SWING AREA WHILE POSITIONING TIMBERS, ATTACHING THE CHAIN, AND ENGAGING THE PAWL AS SERIOUS INJURY OR DEATH COULD OCCUR.

Place a safe come-a-long or ratchet-boomer (1-1/2 ton) between the carrier bar and the front cross-member of the base. Place another between the equalizer and the holes on the front of the sub-base. Snug both come-a-longs or ratchet-boomers to restrain possible movement or tilting of the walking beam which would occur once the crank pins are removed from the cranks.

5.3.2 Crank Pin Removal

Remove the cotter pin. Remove the crank pin nut using the box-end hammer-wrench, which is furnished with a set of wrenches as an option, and a 14 pound sledge hammer with a full length handle.

CAUTION: Proper eye protection must be worn; flying metal may cause damage to the eyes.

Drive out the crank pin. The best procedure is to use a drive nut and the sledge hammer previously mentioned. The drive nut, which is also furnished as an option, is screwed on until it bottoms on the end of the pin. Hammer against the head of the drive nut until the pin is loose. When a drive nut is not available, hammer as squarely as possible against the end of the pin. When the pin becomes loose, do not remove it from the hole. Remove the drive nut and install the original nut three or four threads deep. Follow the same procedure on the opposite crank pin. Check the crank pin clearance in the hole and adjust come-a-longs accordingly so that when the pins are removed they will not fall nor pull up in a sudden motion. Remove the nuts and pull the crank pins out of the holes. The pitman side member will support the crank pin bearing assembly until the pin is installed into another hole. Apply rust preventive to the crank pin bore after the pin is removed.

5.3.3 Crank Pin Installation

Use a safe solvent (per your company's safety regulations) to clean the crank pin, crank pin hole, nut, and the surface of the crank against which the nut will seat. Also remove paint, burrs, and other foreign matter from these areas. Inspect the crank pin and hole surfaces for fretting, rust, or wear. These conditions may indicate that the pin was loose. Using spot bluing, check the contact between the pins and the new holes. If contact is less than 90% of the length of the fit, consult the nearest LUFKIN sales office.

Adjust come-a-longs or ratchet-boomers to line up the crank pins with the proper holes for the stroke length desired.

Apply a coat of light oil on the tapered pin, threads, and crank pin hole. Wipe off excess oil with a clean, lint-free cloth. Insert the pin into the pin hole and install the nut.

WARNING: Do not install the crank pin without properly applying oil film to the pin and the hole.

Using the box-end hammer-wrench, tighten the crank pin nut as tight as possible by hand. This establishes the zero or "metal-to-metal" position for the subsequent steps.

Using a sledge hammer on the wrench, turn the nut two cotter pin notches past the hole in the pin, then watching carefully, line up the hole in the pin with the third cotter pin notch.

CAUTION: Proper eye protection must be worn; flying metal may cause damage to the eyes.

Install the cotter pin. Never back the nut off to insert the cotter pin. If you have turned the nut too far, remove the crank pin and repeat all of the installation procedures.

WARNING: Improper cleaning of the crank pin and crank pin hole, as well as improper tightening of the crank pin, can cause damage to the pumping unit.

5.3.4 Putting the Unit into Operation

With the brake engaged, remove the come-a-longs or ratchet-boomers. Unchain the drum and disengage the pawl. Remove timbers with a sledge hammer.

DANGER: STAY CLEAR OF THE CRANK SWING AREA WHILE REMOVING TIMBERS, REMOVING THE CHAIN, AND DISENGAGING THE PAWL AS SERIOUS INJURY OR DEATH COULD OCCUR.

Reinstall the crank guard panel or panels.

Hold the carrier bar away from the polished rod with the chain and slowly release the brake to let the cranks go to the bottom. Engage the prime mover (or use a crane) to slowly reposition the cranks at 12 o'clock while holding the carrier bar away from the polished rod. Remove the chain from the carrier bar and attach the carrier bar to the polished rod.

Please note that the bottom-hole-pump spacing will need to be checked and the polished-rod clamp may have to be repositioned to accommodate the new stroke length.

CAUTION: Keep hands away from the carrier bar and polished rod to avoid serious injury in the event that the polished-rod clamp slips or the unit moves.

Slowly release the brake to transfer the well load back to the carrier bar. Be sure that the load is not on the polished-rod clamp at the stuffing box. If necessary, use the prime mover to pick up the load.

Remove the polished-rod clamp which was used at the stuffing box to clamp off the well load.

After a stroke length change, the counterbalance should be checked and the weights repositioned as required for proper balancing.

5.4 WELL SERVICING

DANGER: BEFORE PERFORMING ANY TASK AROUND A PUMPING UNIT, REFER TO THE SAFETY SECTION OF THIS MANUAL (SECTION 2). ALL MECHANICAL SUCKER ROD PUMPING UNITS, OF NECESSITY, HAVE LARGE AND HEAVY ROTATING PARTS. EVEN A TEMPORARILY STATIONARY PUMPING UNIT HAS COMPONENTS WHICH CAN START MOVING FROM THE EFFECT OF GRAVITY. IT IS ESSENTIAL THAT ALL PERSONNEL EXERCISE EXTREME CARE AT ALL TIMES WHEN WORKING NEAR THESE HEAVY ROTATING PARTS. FAILURE TO DO SO CAN RESULT IN SEVERE BODILY INJURY OR DEATH.

5.4.1 Preparation

Place the walking beam in a near-level position and set the brake.

WARNING: Abrupt braking may damage the gear teeth in the reducer. A slow, even pull on the brake lever is recommended.

Place a polished-rod clamp at the stuffing box and tighten according to the clamp manufacturer's torque recommendations.

Using the prime mover (or crane), slowly rotate the unit to release the well load from the carrier bar and set the brake.

Disconnect or lockout the prime mover. Remove the crank guard side panel to gain access to crank area. Secure the unit by chaining the drum and by using heavy timbers under the cranks. Engage the pawl. (Refer to Section 2.2 thru 2.2.3 of this manual for proper procedures.)

CAUTION: It is essential to prevent rotation of the cranks stopped in any position for the purpose of service or maintenance of any kind. Do not enter the crank swing area to chain the drum, engage the pawl, or install timbers.

Disconnect the carrier bar from the polished rod.

CAUTION: Keep hands away from the polished rod and carrier bar to avoid serious injury in the event that the polished-rod clamp slips or the unit moves.

Put a long chain through the carrier bar and put the gate back into the carrier bar.

CAUTION: Be sure the chain is long enough so that the carrier bar can be held without lifting a person off the ground.

5.4.2 Horsehead Removal

DANGER: UNDER NO CIRCUMSTANCES SHOULD WELL SERVICING BE ATTEMPTED WITHOUT REMOVING THE HORSEHEAD. BE CERTAIN TO REMOVE THE LATCH BOLT, SAFETY BAR, AND/OR THE HINGE PIN BEFORE ATTEMPTING TO REMOVE THE HORSEHEAD. FAILURE TO OBSERVE THESE WARNINGS COULD RESULT IN SERIOUS INJURY OR DEATH TO PERSONNEL.

Slowly lift the horsehead while holding the end of the chain to keep the carrier bar away from the polished rod.

CAUTION: Do not stand under any part of the load; serious injury or death could occur if the load shifts or drops.

Lower the cranks to the 6 o'clock position and secure the unit against rotation before well servicing.

5.4.3 Horsehead Installation

After well servicing is completed, reinstall and check the alignment of the horsehead as described in Procedure 4.2.24 and 4.2.25 of this manual.

DANGER: BE SURE THAT THE SAFETY BAR, HINGE PIN, AND/OR THE LATCH BOLT IS INSTALLED AND TIGHTENED AT ALL TIMES EXCEPT DURING HORSEHEAD REMOVAL. ALSO BE CERTAIN TO REMOVE THE SAFETY BAR, HINGE PIN, AND/OR THE LATCH BOLT BEFORE ATTEMPTING TO REMOVE THE HORSEHEAD. FAILURE TO OBSERVE THESE WARNINGS COULD RESULT IN SERIOUS INJURY OR DEATH TO PERSONNEL.

5.4.4 Putting the Unit into Operation

With the brake engaged, unchain the drum and disengage the pawl. Remove the timbers with a sledge hammer.

DANGER: STAY CLEAR OF THE CRANK SWING AREA WHILE REMOVING TIMBERS, REMOVING THE CHAIN, AND DISENGAGING THE PAWL AS SERIOUS INJURY OR DEATH COULD OCCUR.

Reinstall the crank guard panel or panels. Remove the chain from the carrier bar and attach the carrier bar to the polished rod.

CAUTION: Keep hands away from the carrier bar and polished rod to avoid serious injury in the event that the polished-rod clamp slips or the unit moves.

Transfer the well load back to the carrier bar. Be sure that the load is not on the polished-rod clamp at the stuffing box. If necessary, use the prime mover to pick up the load.

DANGER: DO NOT ATTEMPT TO LIFT THE ROD STRING WITH WELL SERVICING EQUIPMENT WITHOUT FIRST REMOVING THE HORSEHEAD. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN SERIOUS INJURY OR DEATH TO PERSONNEL WORKING AROUND THE PUMPING UNIT.

Remove the polished-rod clamp which was used at the stuffing box to clamp off the well load.

Check the bottom-hole-pump spacing before attempting to operate the pumping unit.

6. PREVENTIVE MAINTENANCE

Preventive maintenance is essential to prolong the life of the unit and to prevent expensive failures. Many items can be checked by visual inspection and by listening for unusual noises. These items should be checked each time you go to the unit.

CAUTION: Never approach a pumping unit assuming that everything is alright. With time, some components could have worked loose and could present a potentially dangerous situation.

The following visual inspections are recommended before approaching the unit:

- (1) Look at both crank pins to see if they may have worked loose.
- (2) On units which are driven by slow-speed engines, look to see if the flywheel is loose.
- (3) Look at the counterweights to be sure they are tight.
- (4) Look at the center bearing to be sure it has not worked loose.
- (5) Inspect the vertical alignment of the unit with the well. See if the polished rod is working to one side of the stuffing box. Also, visually compare the distance between the pitman side-members and the cranks on each side of the unit. Check to see that the wireline is tracking properly on the horsehead. Also look for obvious broken strands of wire fraying from the wireline. A change in alignment can be caused if the base shifts on the foundation due to loose hold-down bolts. Misalignment can also result from a foundation that has settled to an unlevel position.
- (6) Look for any obviously loose or missing bolts. Loose bolts will eventually fail in fatigue. This is the major cause of most pumping unit failures. Loose bolts can usually be located by looking for rust at the bolted joint and by checking for visual movement.

If any of the above conditions exist, the unit must be shut down immediately and the problem corrected.

DANGER: DO NOT PERFORM ANY TASK ON THE UNIT UNTIL YOU REVIEW THE SAFETY SECTION OF THIS MANUAL (SECTION 2). THE CRANKS AND COUNTERWEIGHTS MUST BE SECURED AGAINST ROTATION. FAILURE TO COMPLY WITH THIS WARNING COULD RESULT IN SERIOUS INJURY OR DEATH TO PERSONNEL WORKING AROUND THE UNIT.

7. SCHEDULED MAINTENANCE

There are several items that need checking on a regular basis to help extend the life of your pumping unit.

DANGER: BEFORE PERFORMING ANY MAINTENANCE, REVIEW THE SAFETY SECTION OF THIS MANUAL. WHEN MAINTENANCE IS BEING CONDUCTED ON OR AROUND THE PUMPING UNIT, THE CRANKS, AND COUNTERWEIGHTS MUST BE SECURELY FIXED IN A STATIONARY POSITION BY CHAINING AND USING HEAVY TIMBERS UNDER THE CRANKS. (REFER TO SECTION 2.2 THRU 2.2.3 OF THIS MANUAL FOR PROPER PROCEDURES.) DO NOT USE ONLY THE BRAKE AS A SAFETY STOP. THE BRAKE IS INTENDED FOR OPERATIONAL USE ONLY. FAILURE TO SECURE THE CRANKS AGAINST ROTATION OR MOVEMENT COULD RESULT IN SERIOUS INJURY OR DEATH TO PERSONNEL WORKING AROUND THE PUMPING UNIT.

7.1 MONTHLY

7.1.1 Reducer

The reducer oil level should be checked. Remove the dipstick located at the front of the reducer. The oil level should be between the low and full mark on the dipstick. Loss of oil from the reducer is usually caused by seal leakage at the shafts or leakage at the parting line. If the oil level is low, remove the inspection cover and add oil to the proper level. (Refer to Section 8.1 for lubricant specifications.)

7.1.2 Structural Bearings

Visually check the structural bearings for oil seal leaks. This includes the crank pin bearings, equalizer bearing and center bearing. Do not confuse grease discharge from the bearing housing vents with seal leakage.

7.2 QUARTERLY

7.2.1 Belts and Sheaves

Belt alignment and tension should be checked and adjusted to prolong belt life. Under normal use belts will stretch and wear. Belts need replacing once they have exceeded their allowable stretch. Belt manufacturers suggest running new belts 24 hours and then retightening. (Consult your belt supplier.) Refer to procedure 4.2.28.

Also check the sheaves for wear, chips and cracks. Replace them if any of these conditions exist. Keeping sheaves in good condition will prolong belt life.

7.2.2 Brake, Drum and Brake Cable

The brake lining should be inspected for wear and clearance adjustment. When the brake control lever is fully engaged, there should be several notches left on the ratchet. If adjustment is required, follow the instructions in Procedure 4.2.3.

Inspect the brake drum for cracks around the hub and key area. Also look at the brake pawl notches to see if any of them have been chipped, cracked, or broken out. Replace the drum if any of these conditions exist.

Inspect the condition of the brake cable. If the rubber coverings at the ends of the cable are cracked, moisture will get into the cable and possibly freeze up its movement. Make sure the brake rods are not bent. Replace the cable if any of these conditions exist.

7.2.3 Crank Phase Marks

On the end of the crankshaft, there is a match mark placed partially on the shaft and partially on the crank. These should remain lined up. If for any reason they are not lined up, you should contact LUFKIN.

7.3 BI-ANNUALLY

7.3.1 Reducer

The gear tooth condition should be checked for abnormal wear. There are many modes of gear tooth failures. Only the most common are included in this section. The following is paraphrased from ANSI/AGMA 110.04, Nomenclature of Gear Tooth Failure Modes:

- (1) Score marks on the teeth are an indication that the film thickness of the oil is insufficient for the loads imposed. Score marks are vertical marks on the teeth from the top of the teeth to the root (see figure 58).
- (2) Pitting is a type of surface fatigue which occurs when the endurance limit of the material is exceeded. It shows up as small cavities along the surface of the teeth. The type of pitting shown in figure 59 is usually caused by torque overload. Continued overload may result in gear tooth failures.

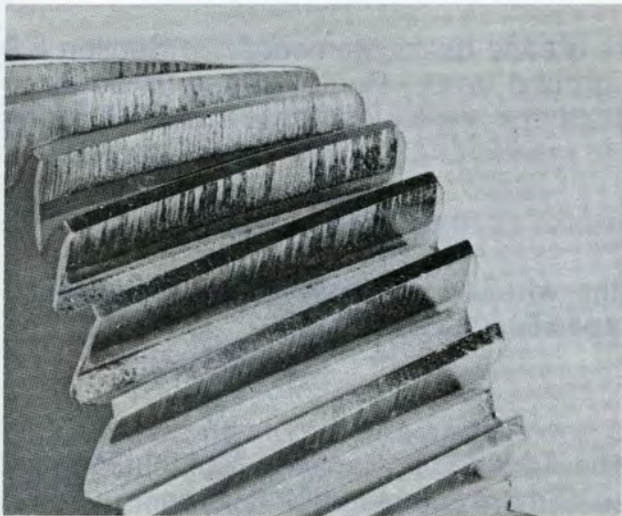


FIGURE 58

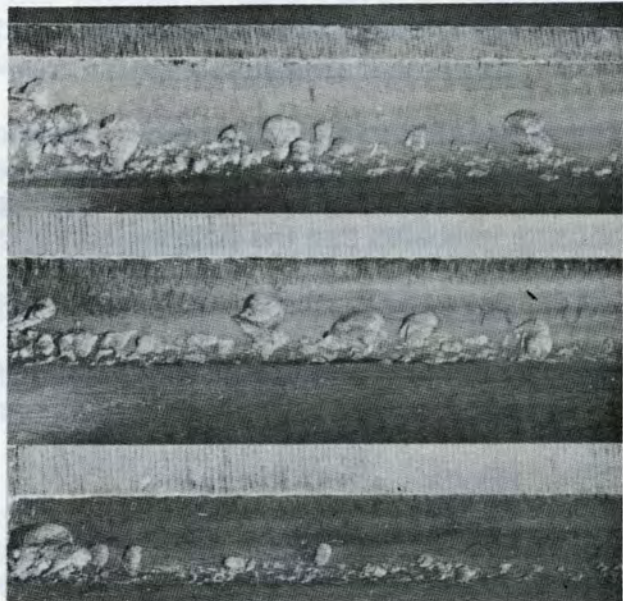


FIGURE 59

For more detailed descriptions, illustrations, causes, and remedies, see ANSI/AGMA Standard 110.04. Note also that figures 58 and 59 were extracted from "AGMA Standard Nomenclature of Gear Tooth Failure Modes (AGMA 110.04), with the permission of the publisher, The American Gear Manufacturer's Association, Suite 1000, 1901 North Fort Myer Drive, Arlington, Virginia 22209."

Collect a typical sample (about a pint) of the reducer oil in a transparent container. A visual inspection will expose possible dirt, sludge, water emulsion, or other forms of contamination. Also keep a sample of new oil for comparisons. If the lubricant has any of the following conditions, check with your oil supplier about replacement:

- (1) An acid or burnt odor would indicate oxidation of the oil to the point that it should be replaced.
- (2) If sludge is observed in the used sample, the oil should either be replaced or filtered to remove the sludge. Sludge is usually found in gear units that have not had their lubricants changed in a long time.
- (3) If water is found in the sample, the water should be completely drained from the sump. The presence of water in used oil can be detected by placing a drop or two on a heated metal surface. Bubbling and spattering will occur with as little as 0.1% of water present in the oil. More than approximately 0.2% water by volume suggests an oil change.

If a rigorous laboratory test of the oil is not practical, then the oil should be replaced every 18 months as a precaution against a change in viscosity, a loss of the additive package, or an increase in the acidic condition of the oil.

For lubricant specifications, see Section 8.1 of this manual.

7.3.2 Structural Bearings

The structural bearings should be lubricated with grease as recommended in Section 8.3 of this manual. Grease fittings are located at ground level. Pump grease in slowly to avoid pushing out the oil seals. Discharge from the vents located on each bearing housing indicates that the housing is full.

7.3.3 Wireline

Look for broken strands of wire fraying from the wireline. A rusty wireline should be cleaned and coated with a wireline lubricant as specified in Section 8.4.

7.3.4 Bolts

Check all bolts. Retighten as recommended in the Addendum, Section 10 of this manual. Loose bolts will eventually fail, which is the cause of most pumping unit failures.

8. LUBRICANT SPECIFICATIONS

8.1 REDUCER

For temperatures down to 0°F. use an AGMA No. 5 EP (ISO VG220) premium mild, extreme-pressure lubricant (preferably a sulphur-phosphorous type) with rust and oxidation inhibitors and an anti-foam agent. The pour point of the oil should be 5°F. or lower. For temperatures down to -30°F. use an AGMA No. 4 EP (ISO VG150) premium mild, extreme-pressure lubricant (preferably sulphur-phosphorous type) with rust and oxidation inhibitors and an anti-foam agent. The pour point of the oil should be -15°F. or less.

8.2 REDUCER OIL CAPACITY

<u>MODEL</u>	<u>CAPACITY</u>	<u>MODEL</u>	<u>CAPACITY</u>
1280D	120 GAL.	160D	22 GAL.
912D	107 GAL.	114D	17 GAL.
640D	70 GAL.	80D	17 GAL.
456D	55 GAL.	57D	13 GAL.
320D	50 GAL.	40D	7 GAL.
228D	34 GAL.		

8.3 STRUCTURAL BEARINGS

WARNING: Do not use soda-soap grease.

For temperatures down to 0°F., use a premium NLGI No. 1 lithium, soap-base grease with an extreme-pressure additive. The oil in the grease should have a viscosity of approximately 1000 SSU at 100°F. For temperatures down to -30°F., use a premium NLGI No. 0 lithium, soap-base grease with an extreme-pressure additive.

8.4 WIRELINE

Clean the wire rope by wire brushing; do not use solvent. Apply a good wire rope lubricant that will penetrate and adhere to the rope.

WARNING: Do not use crude oil or lubricants that may be injurious to steel.

9. LUFKIN SERVICE

9.1 PERSONNEL

LUFKIN has capable sales and service personnel throughout the oil producing areas of the world. These people are competent and experienced not only in the proper sizing of surface pumping units but also in any service that may be needed. Contact the LUFKIN Sales Office nearest you to inquire about the availability of LUFKIN service.

9.2 REPAIR AND REPLACEMENT PARTS

WARNING: For repair or modification to a LUFKIN pumping unit, use only parts that meet LUFKIN specifications. (Consult your nearest LUFKIN sales office.) Failure to do so could result in equipment failure and possibly serious injury to personnel.

A complete line of repair and replacement parts are available from several warehouse locations as well as the manufacturing plant in Lufkin, Texas. A parts list is available for each pumping unit assembly. When parts are needed, furnish the complete unit designation, serial number and LUFKIN's shipping order number for the particular unit on which the part is to be used.

ADDENDUM

10. FASTENERS

10.1 "METAL-TO-METAL" GRIP

Bolting is a vital part of an oil field pumping unit. The surfaces under the bolt head and nut, and the contacting surfaces must be flat, clean, and free of burrs so that the bolted members join in "metal-to-metal" contact. Bolts which are properly tightened during erection and retightened about a week later will retain their grip under normal operating conditions. Improperly tightened bolts will break in fatigue and may cause serious failures and injury to personnel. Table I gives recommended tightening torques.

Since high-capacity torque wrenches are not commonly available, the larger size bolts are usually hammered tight. Use a box-end wrench with a striking face and tighten the bolts until the hammer blows feel solid. Bolts will fail in fatigue from inadequate tightening rather than from being pulled in two from excessive tightening torque.

CAUTION: Proper eye protection must be worn; flying metal may cause damage to the eyes.

TABLE I

Proper Tightening Torques

Nuts and Cap Screws with "Metal-to-Metal" Grip

3/8 - 16 NC	15	to	24 ft.lb.
1/2 - 13 NC	32	to	44 ft.lb.
5/8 - 11 NC	59	to	74 ft.lb.
3/4 - 10 NC	99	to	116 ft.lb.
7/8 - 9 NC	153	to	175 ft.lb.
1 - 8 NC	225	to	256 ft.lb.
1 1/8 - 7 NC	320	to	360 ft.lb.
1 1/4 - 7 NC	452	to	510 ft.lb.
1 1/2 - 6 NC	780	to	880 ft.lb.

10.2 "ELASTIC" GRIP

The grip is not always "metal-to-metal". In applications such as foundation bolts, heel-clamp bolts, and bolts used on various brackets, the fasteners will be subjected to cyclic loading. The tightening torques needed in these applications are extremely variable; however, they should be about one-half of the values given in Table I. Bolts should always be overtightened rather than undertightened.

11. ERECTION EQUIPMENT SIZING CHARTS

The following charts are a general guide to assist in selecting the proper equipment for erecting your LUFKIN pumping unit. An example for using the charts would be as follows:

What are my needs to set a C-228D-213-86 pumping unit?

- (1) In the top section of Table II, go to the 86" stroke to see that the minimum hook height needed would be 23'-7". Also account for any additional height needed due to the height that the bottom of the pumping unit base is set above ground level.
- (2) Also in this section of Table II notice the weight of the unit base is 8,390 lbs. Go to the reducer size in the lower section of Table II and see that a 228D reducer with cranks weighs 11,820 lbs. Since 228D and smaller reducers are normally shipped mounted to the unit base, you must add (8,390 + 11,820 = 20,210 lbs.) to get the heaviest total lift needed.

Table II

Approximate Weight and Hook Data for Erection Purposes

<u>MAXIMUM STROKE</u>	<u>+MINIMUM HOOK HEIGHT</u>	<u>APPROXIMATE WT.(LBS) PORTABLE GAS ENGINE BASE</u>
192"	33' - 2"	15,000
168"	29' - 7"	12,035
144"	28' - 7"	12,035
120"	27' - 6"	11,885
100"	24' - 2"	8,710
86"	23' - 7"	8,390
74"	20' - 0"	6,205
64"	17' - 2"	4,990
54"	14' - 10"	3,810
48"	13' - 1"	3,000
42"	11' - 1"	2,740
36"	10' - 10"	2,165

+ Bottom of the unit base to the top of the horsehead with the beam horizontal

REDUCER SIZE *WEIGHT W/CRANKS (LBS)

1280D	28,800
912D	21,760
640D	20,460
456D	18,440
320D	16,510
228D	11,820
160D	8,630
114D	7,350
80D	4,930
57D	3,700
40D	2,710

*** LARGEST CRANK USED WITH REDUCER**

NOTE: NORMALLY 228D REDUCERS AND SMALLER ARE SHIPPED MOUNTED ON THE BASE; ADD REDUCER WITH CRANK WEIGHT TO THE BASE WEIGHT FOR TOTAL LIFT.

Approximate Weight and Hook Data for Erection Purposes

REDUCER SIZE (LBS)	MINIMUM HOOK	MAXIMUM STROKE
1280D	10"	10"
912D	10"	10"
640D	10"	10"
456D	10"	10"
320D	10"	10"
228D	10"	10"
160D	10"	10"
114D	10"	10"
80D	10"	10"
57D	10"	10"
40D	10"	10"

Bottom of the unit base to the top of the hoisthead with the...
 The grip is not always...
 head clamp bolts, and used on various brackets...
 cyclic loading. The lifting torque needed in these applications are extremely...
 variable, however, they should be about one-half of the values given in Table 1. Sides...
 should always be overlightened rather than underlightened.

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