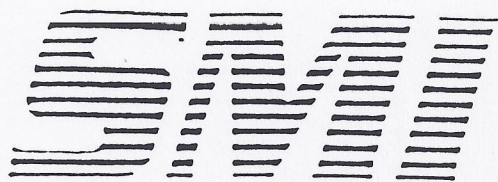


**SMI PUMPING UNIT
OPERATOR'S MANUAL
AND
TROUBLE SHOOTING GUIDE**



SM INDUSTRIES, INC.

Operator's Manual

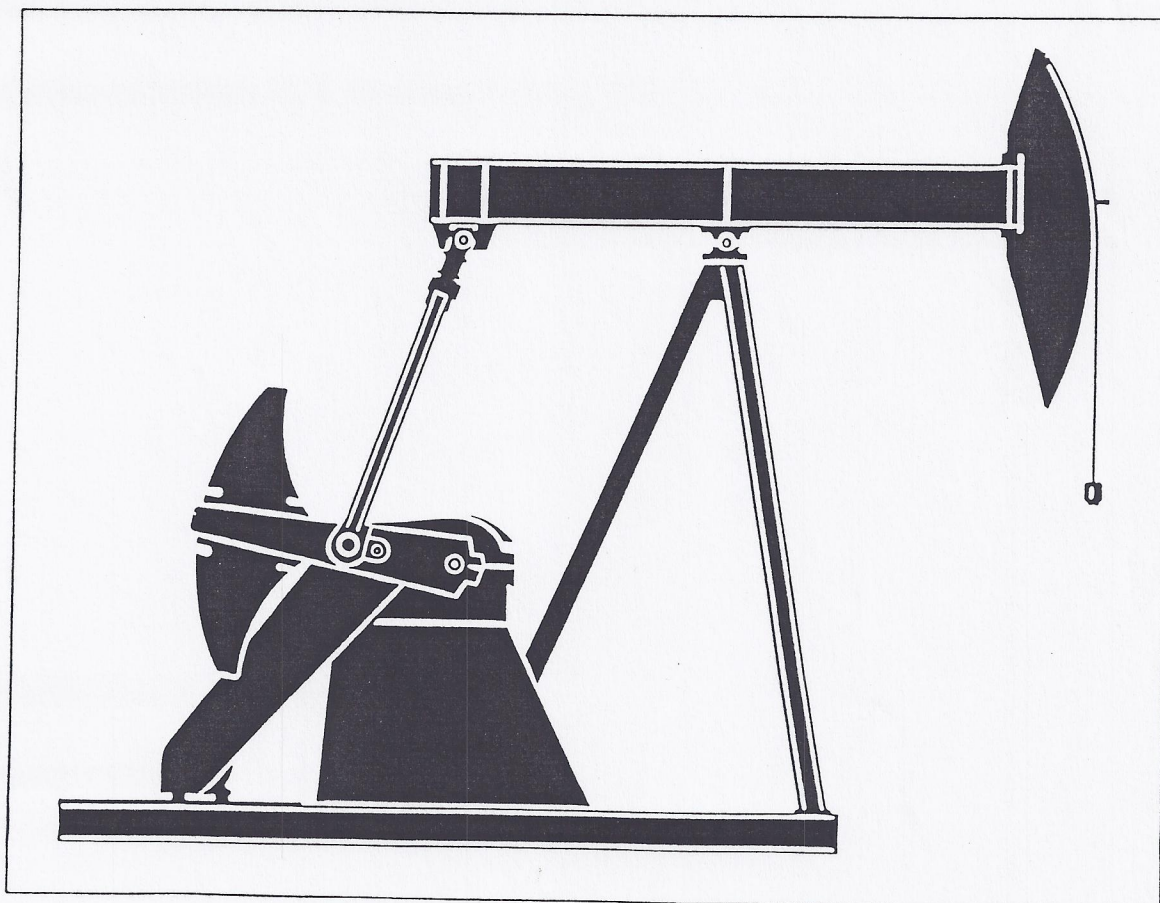


Table of Contents

		Page
1 Introduction	1-1. Safety Precautions	2
	1-2. Features	2
2 Foundation, Unit Alignment, and Base Installation	2-1. General	3
	2-2. Types	3
	2-3. Alignment	3
	2-4. Tie-Downs	3
	2-5. Poured Concrete Foundation	3
	2-6. Precast Concrete Portable Foundation	3
	2-7. Timber Mat	3
3 Installation and Erection of the Pumping Unit	3-1. Basic Data	4
	3-2. Installation of Cranks	4
	3-3. Installation of Gear Reducer	5
	3-4. Installation of Crankpins	6
	3-5. Installation of Brake Assembly	6
	3-6. Installation of Counterweights	8
	3-7. Installation of Samson Post	9
	3-8. Assembly of Walking Beam, Equalizer and Bearing Assembly, Center Bearing Assembly and Pitman Arms and Bearings	10
	3-9. Installation of Walking Beam Assembly on Samson Post	12
	3-10. Installation of Horsehead and Wire Line Assembly	14
	3-11. Final Alignment	14
	3-12. Installation of V-Belt Drive and Prime Mover	15
	3-13. Lubrication	15
	3-14. Final Installation Steps	16
	3-15. After One Week of Operation	16
	3-16. Adjustment of Counterweights	16
4 Maintenance	4-1. Checks	17
	4-2. Brake	17
	4-3. Lubrication of Bearings	17
	4-4. Lubrication of Gear Reducer	17
5 Charts	5. Charts	18-22

1 Introduction

The SMI pumping unit is designed in accordance with API standards. It is manufactured and sold in the United States by SM INDUSTRIES, INC. (**SMI**) of Louviers (near Denver), Colorado. It is backed by many years of manufacturing experience. The basic design of the SMI pumping unit has proven itself for many years in the oilfields of most oil producing countries. **SMI** brings its experienced personnel to bear on design, product quality, performance and service.

To assure customers of proper unit size for given well conditions, **SMI** can assist with sizing calculations. To assure customers of product quality and reliability, **SMI** provides a written warranty.

1-1. Safety Precautions

Pumping units are manufactured of structural steel and steel castings and therefore have heavy moving parts. Times of particular danger from rotating or moving parts are during installation, maintenance, lubrication, stroke or counter-balance change, wellhead activities, and dynamometer testing. It is extremely important to stop and/or secure parts for installation, adjustment, or maintenance activities, and to support these parts with strong timbers or with a crane.

Warning: Nonadherence to the specified working procedures may cause injuries or fatal accidents.

Caution: Nonadherence to the specified working procedures may cause damage to the equipment.

1-2. Features

SMI pumping units are equipped with swing-away horseheads. This hinge-type connection uses four lock pins, two on each side, to fasten the horsehead to the walking beam. The horsehead may be swung to either side of the walking beam. This swing-away feature allows safe and easy access to the well.

Each basic type unit can be provided with the next larger or smaller size gear reducer. No modification of the equalizer is necessary because the upper pitman bearings are interchangeable. Differences in heights of gear boxes are compensated for by means of plates between gear box and base, also between center bearing and samson post.

The slow-speed and high-speed gears are connected to their respective shafts by means of a shrinking process. No keys are used. Through hydraulic pressure, the fit is loosened and the gears become adjustable to another stress point in case of excessive wear. This also allows for easy removal for repair work.

Sheaves and belts have been engineered to transmit the required horsepower on each size of pumping unit.

Prime mover bases are available for any type prime mover.

2 Foundation, Unit Alignment, and Base Installation

2-1. General

No attempt has been made to recommend the type of foundation to be used. This depends upon the unit base used and local soil conditions. A local contractor should be consulted about local soil conditions and to recommend the shape and depth of foundation required.

2-2. Types

There are several types of foundations used for pumping units: poured concrete, precast concrete and timbers placed crosswise to unit base resting on an adequately prepared foundation of gravel or sand. The latter type foundation should only be used with a long base (portable base).

2-3. Alignment

Regardless of the type of foundation used, precautions should be taken to assure that the foundation is perfectly level in all directions.

2-4. Tie-Downs

With poured concrete, the method of securing the unit to the foundation is generally determined beforehand and the necessary pipe, bolts or anchor nuts are installed at the time of pouring the concrete. With precast concrete, the method for securing the unit is provided at the time the concrete is precast. Timbers should only be used in conjunction with a portable-type pumping unit base, and the method of securing the unit to the ground should be provided at time of installation.

2-5. Poured Concrete Foundation

When this type of foundation is used, the setting time for cement must be strictly observed.

- a. SMI pumping units have center marks on the front and rear cross members of the unit base. Attach a chalk line to the wellhead and stretch it along the center of the foundation to establish a center line. Cross mark a line at right angles to the center line to indicate where the front of the unit base will rest with respect to the center of the well. Obtain this dimension from Chart No. 1. At this time, the unit base should be installed on the foundation in accordance with the lines marked on the foundation.
- b. If the base is to be grouted, an allowance must be made at this time for the thickness of the grout, generally about one inch. Tapered hardwood wedges are an ideal substance for this purpose as they facilitate leveling the pumping unit across the base both to and from the well.
- c. The prime mover base should be installed at this time. Align and level in the same manner as the unit base.

Note: Prior to erection of the unit, it is recommended that the unit base be adequately anchored to the foundation.

2-6. Precast Concrete Portable Foundation

- a. Unit alignment and base installation should be accomplished as detailed in 2-5a, b, and c where applicable.

2-7. Timber Mat

- a. Unit alignment and base installation should be accomplished as detailed in 2-5a where applicable. Prime mover base is an integral part of the unit base as recommended for this type of foundation.

3 Installation and Erection of the Pumping Unit

3-1. Basic Data

We recommend using a crane with a lifting capacity of at least $2\frac{1}{2}$ times the gear reducer weight. If the base is to be installed with the gear reducer mounted, the crane lifting capacity must be at least $3\frac{1}{2}$ to 4 times the gear reducer weight. Refer to Chart No. 2 for the weights of gear reducers.

Metal-to-metal grip is of the utmost importance for all parts bolted together. All bolts should be hammer-tightened or torque-tightened with a torque wrench. Refer to Chart No. 3 for torque loads of all bolts.

During the installation, erection and assembly of pumping units, all bore and contact surfaces must be cleaned of all cosmoline, dirt, paint or burrs to allow metal-to-metal contact.

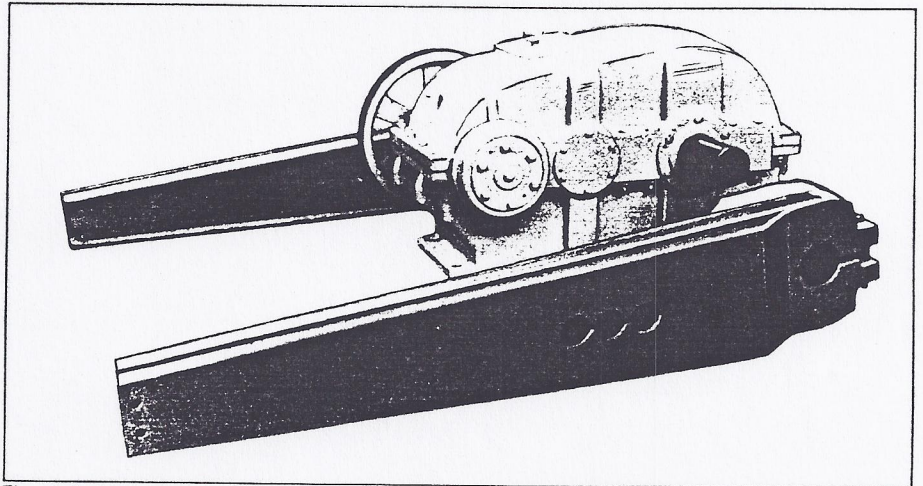


Figure 1

3-2. Installation of Cranks

Note: Occasionally the cranks are shipped loose. If so, the following procedures should be followed to install the cranks.

- a. Remove corrosion-preventing agent from crank bore and surface of the main shaft.
- b. Turn the drive shaft until the fitting key is positioned towards the brake. Push the cranks onto the shaft, making sure that the fitting key is positioned. Care must be taken to be sure crank hub is snugged against shaft shoulder. See illustration in Figure 1.

Note: For easier installation, the hole for the main shaft may be widened slightly by means of bolts, lock nuts and steel plate. See illustration in Figure 2.

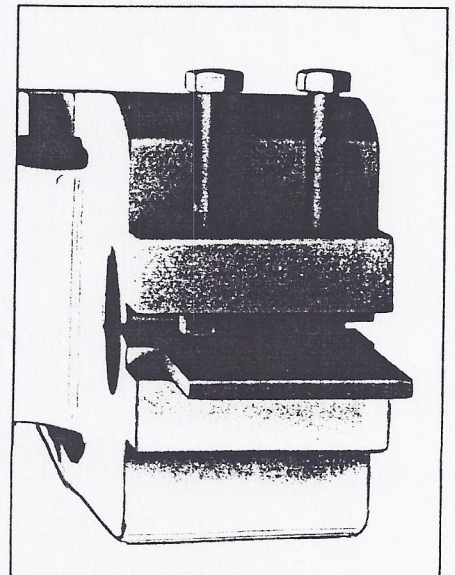


Figure 2

3-3. Installation of Gear Reducer

- c. Remove auxiliary means for installation, install lock bolts and nuts, and tighten nuts securely.
- a. Lift the gear reducer with cranks attached, using two or four lifting slings attached to the front and rear lifting eyes located on the bottom half of the gear reducer.

Caution: The two lifting eyes located on the cover (top half of gear reducer) must not be used, they are for lifting the cover only.

Warning: During lifting, the crank ends will remain on the ground and the main shaft will start to rotate. Stand clear of crank sweep during this operation to avoid serious injury.

- b. Slide the gear reducer over the unit base from the front or rear and position it on the subbase. See illustration in Figure 3. Be sure bottom of gear reducer and top of subbase surfaces are properly cleaned and that all spacers are in position.
- c. Using a steel tape measure, measure the left and right distances between main shaft and front mounting holes of samson post. The distances must be the same for the left and right sides. Shift gear reducer accordingly if required. See illustration in Figure 4.
- d. Tighten all bolts to secure gear box. Cranks may have to be lifted with a crane to tighten bolts on sides of gear reducers. Support cranks on the outer edge.

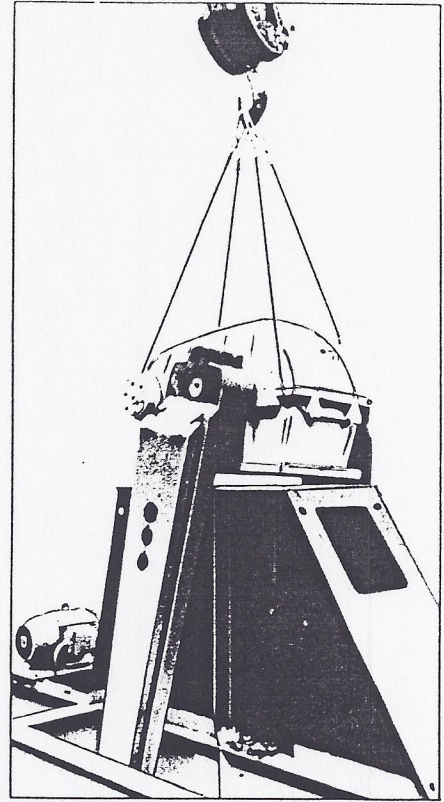


Figure 3

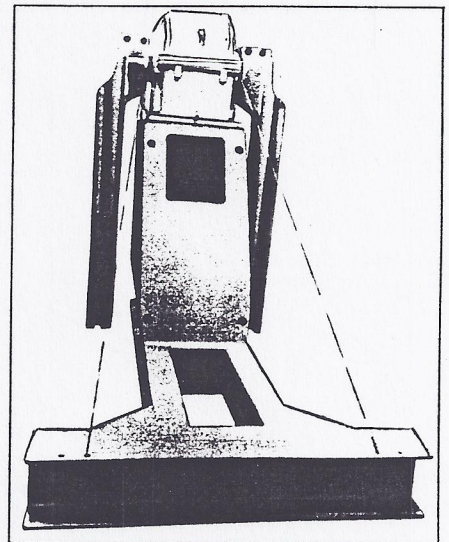


Figure 4

Note: Bars or filler plates are required between the subbase and gear reducer on various size units. These are provided with threaded holes. First, attach the plates to the subbase from the bottom by means of cap screws, leaving the cap screws loose. Then attach the gear reducer from the top with cap screws, also leaving these loose. Follow alignment procedure as described in 3-3c and d

above. Tighten cap screws in a crisscross pattern, making sure top and bottom cap screws are tightened simultaneously. See illustration in Figure 5.

- e. Remove plastic plug located at center bottom of gear reducer at wellhead end. Screw in drain cock tightly, using pipe dope on threads.
- f. Install sheave on gear reducer. Be sure key is fitted properly and tighten all bolts as needed.

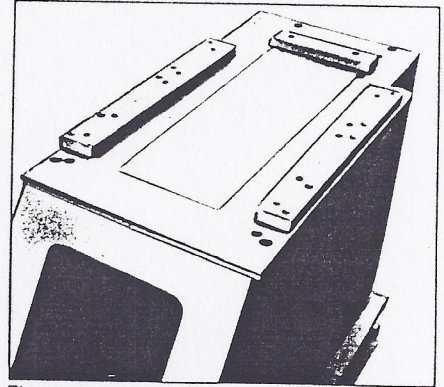


Figure 5

3-4. Installation of Crankpins

- a. Clean hole in cranks that crankpins are to be mounted in and apply a thin coat of light oil in them.

Caution: Too thick an oil film causes loosening of the crankpin in the crank during operation. Wipe any excess oil with a clean, dry cloth.

Protect the other holes against corrosion by using a suitable corrosion-preventing agent.

- b. Clean crankpins and install them dry in the crankpin holes. Be sure that the thrust pin of the crankpin is engaged in the groove provided in the crank. See illustration in Figure 6.

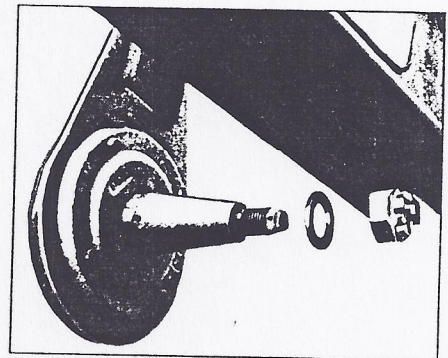


Figure 6

- c. Clean and oil threads of castellated nuts and install washer and nut onto the crankpin from the gear reducer side of the crank. Hand-tighten nut with wrench until there is metal-to-metal contact between crank, washer and nut.
- d. Tighten the castellated nut one or two additional slots with a hammer wrench and insert cotter pin.

Caution: Watch alignment of slots and cotter hole. NEVER BACK NUT OFF TO INSERT COTTER. Remove crankpin and go through same procedure again.

3-5. Installation of Brake Assembly

- a. Attach brake cable at top of subbase just below gear reducer and attach brake cable through angular bracket to be located at top of subbase and below gear reducer. Bracket to be bolted through holes as provided. Other end of cable to be attached through bracket welded to prime mover base. Be sure cable as attached at upper bracket is lined up with brake actuating arm. See illustration in Figure 7 and 8.

Note: If sucker rod string is disconnected from pumping unit when cranks are in the horizontal position with maximum counterweights mounted at the long end of the crank, the brake is designed to allow the cranks to gently rotate to the lower position, thus protecting gears and pinions from damage.

- b. Mount brake lever on bracket mounted at prime mover base.
- c. Attach brake cable to brake actuating arm and brake lever by means of clevises as provided.

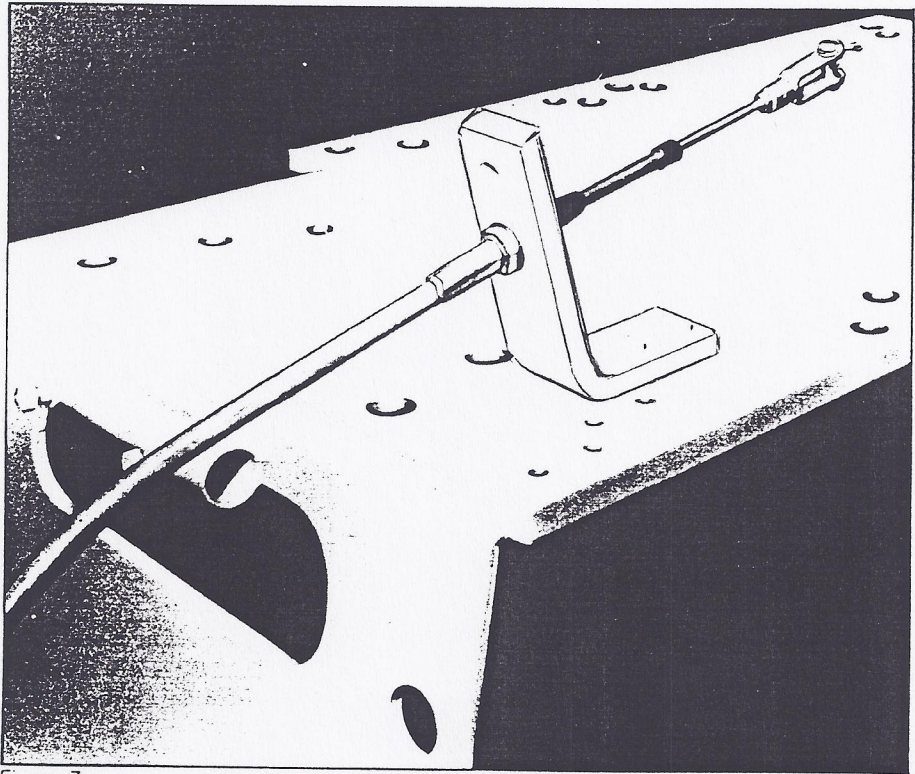


Figure 7

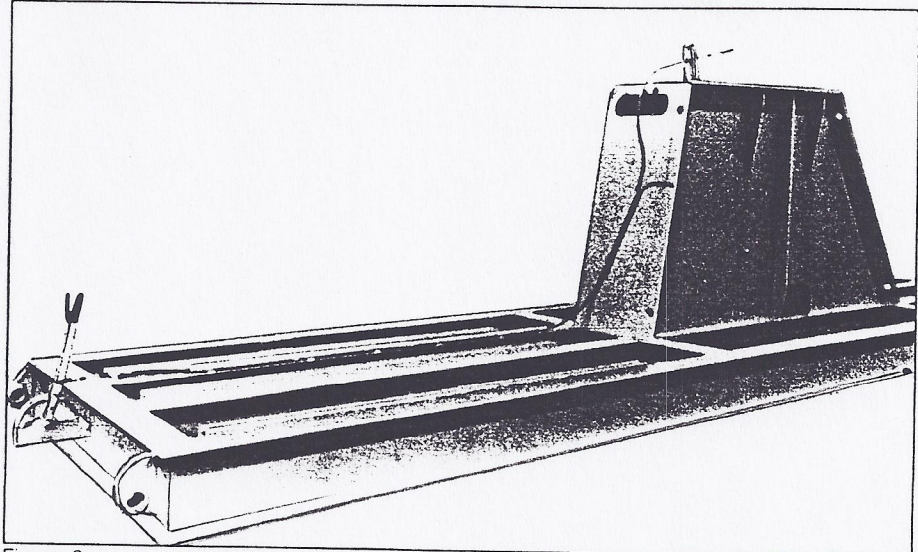


Figure 8

Note: Make sure brake cable shows same length for travel at both ends.

3-6. Installation of Counterweights

- d. Set brake using brake lever.
- a. With cranks hanging in vertical position, install roll pins in holes at the bottom of each side of cranks. Insert counterweight bolts in slots of each side of cranks from the top and then install roll pins in the upper holes on each side of cranks.
- b. Clean surfaces between cranks and counterweights and be sure bolts and nuts have clean surfaces.
- c. Lift each master weight in a vertical position by means of a lifting sling and attach to position on the cranks for desired counterbalance effect. See illustration in Figure 9.
- d. Tighten counterweight bolts securely. Improperly tightened

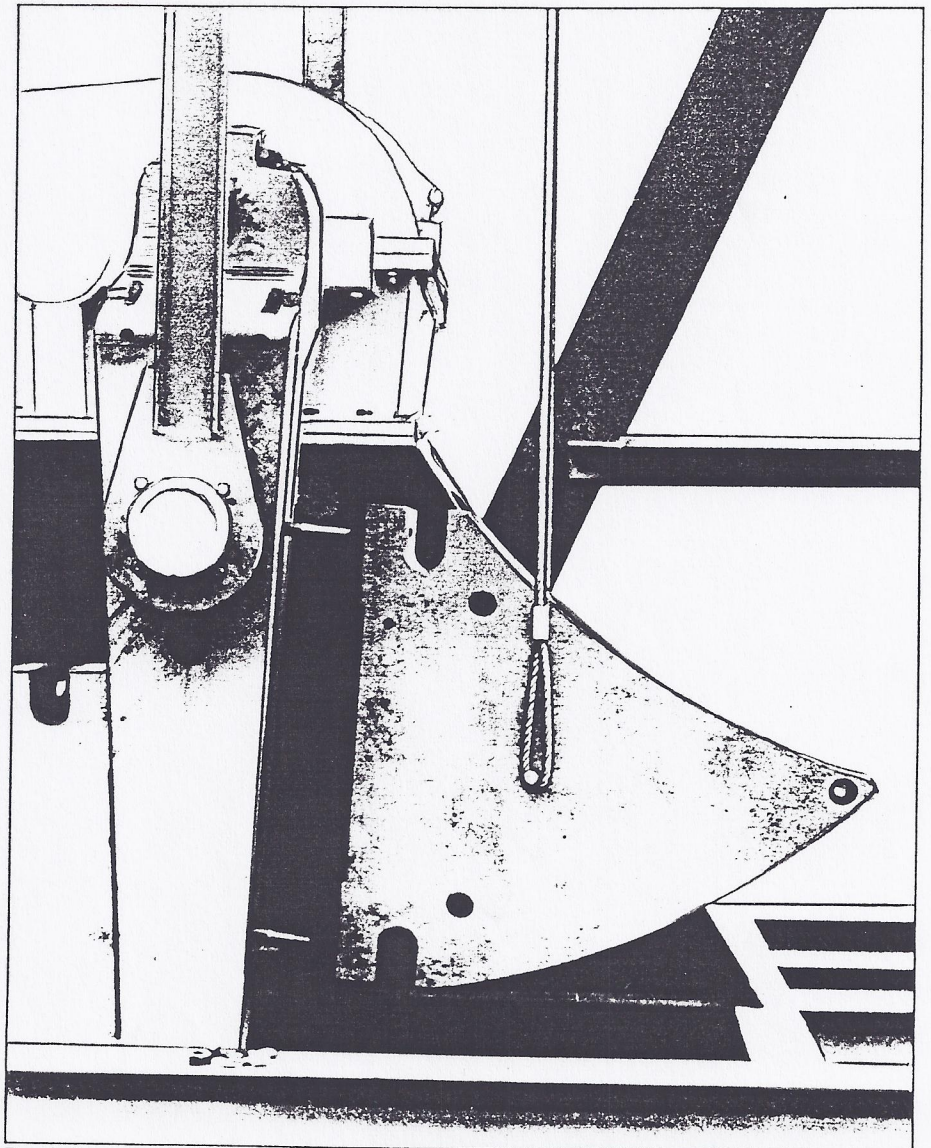


Figure 9

counterweight bolts can allow counterweights to move on the cranks. COUNTERWEIGHT BOLTS SHOULD BE HAMMER-TIGHTENED. Be sure lock nuts are securely tightened. COUNTERWEIGHT BOLTS ARE GRADE 5, HIGH TENSILE STRENGTH.

- e. Auxiliary counterweights must be installed on the gear reducer side of master counterweights. Two auxiliary counterweights can be attached to each master counterweight.

Note: Normally four master counterweights are installed. If less balancing effect is required, two master counterweights may be used.

In order to maintain an equilibrium in rotating forces, the two master counterweights are to be installed with one counterweight pointing up on one crank, the other one pointing down on the other crank.

See illustration in Figure 10 for mounting counterweights and auxiliaries.

3-7. Installation of Samson Post

- a. Place front legs of samson post on ground and insert rear post leg between fastening plates. Install bolts for samson post, nuts sticking out, and leave bolts loose. Ladder may also be installed at this time.
- b. Attach sling around top of samson post and lift in vertical position. Guide rear post leg through opening in the gear base and position post onto the unit base.

Warning: Care must be taken so lifting sling does not slip.

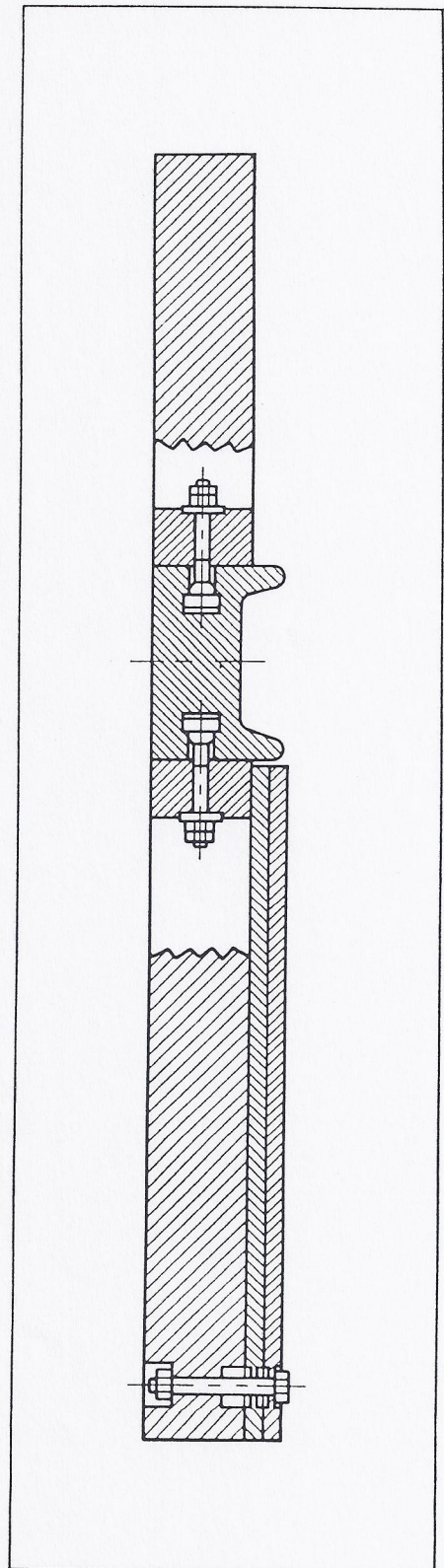


Figure 10

- c. Tighten all bolts on base and post.
- d. If ladder was not installed before, it should be installed at this time.

Warning: For safety reasons, during erection work, auxiliary ladder should be used.

See illustration in Figure 11 and 12.

3-8. Assembly of Walking Beam, Equalizer and Bearing Assembly, and Pitman Arms and Bearings

- a. Place walking beam on the ground with bottom of beam (side with mounting holes) pointing up.

Note: Clean both plates on bottom of walking beam, bottoms of equalizer, and center bearing assemblies of all cosmoline, dirt and paint and be sure there are no burrs of any kind.

- b. Attach the equalizer bearing to the beam with bolts as provided and hand-tighten only. Be sure centering thrust disc is correctly installed.
- c. Align the equalizer bearing with the walking beam. Bolt holes provide some play, move bearing to extreme right or left and mark extreme position at corner. Then move bearing to extreme other side and mark same corner. Divide distance of marked points, and center bearing accordingly. See illustration in Figure 13.
- d. Tighten equalizer bearing bolts at this time.
- e. Check the clearance of the longitudinal bearing of the equalizer bearing assembly. If there is a clearance in this bearing in the longitudinal direction of the walking beam, the elastic stop nut must be tightened until there

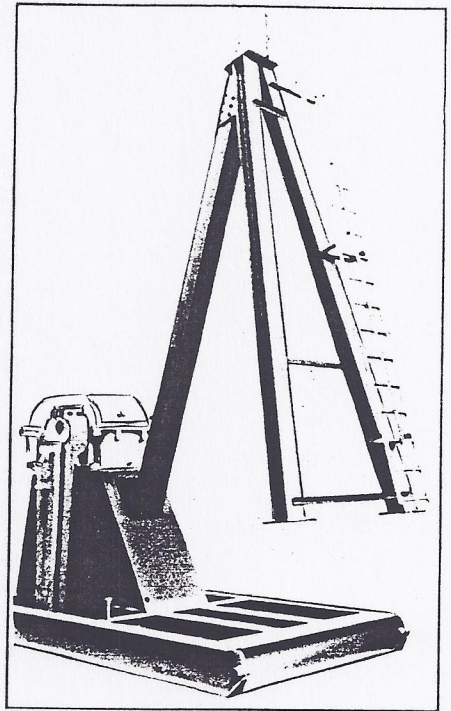


Figure 11

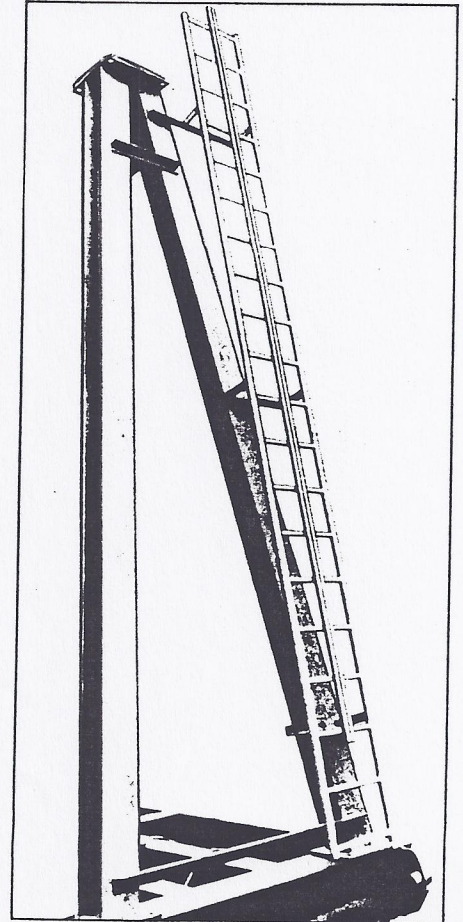


Figure 12

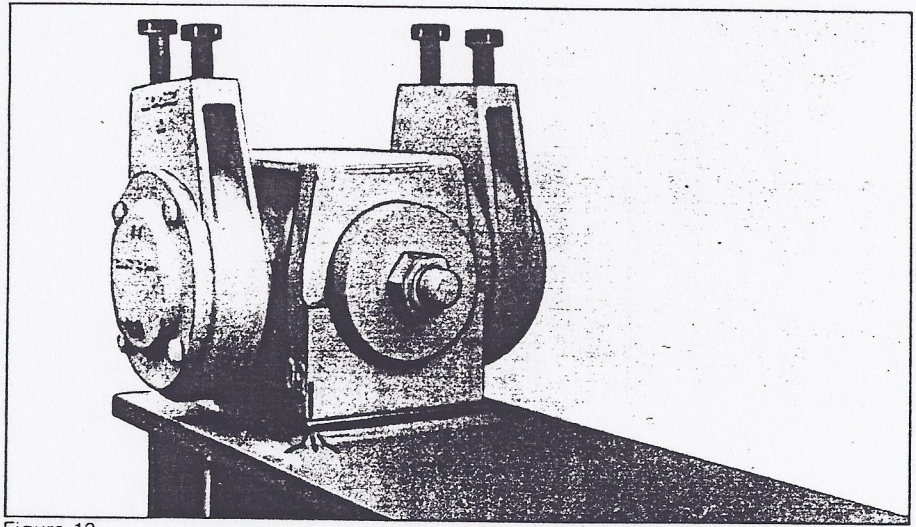


Figure 13

is no longer any clearance. Be sure the equalizer bearing can be tilted to the top and the bottom.

- f. Place center bearing assembly right side up on wooden timbers and drive roll pins into housing of center bearing until bottom of roll pin is flush with bottom of housing.
- g. Place center bearing assembly upside down on walking beam and align the assembly in accordance with 3-8b and c as shown above. Only hand-tighten bolts at this time.
- h. Place equalizer on timbers with outer holes pointing up.
- i. Clean contact surfaces of equalizer and pitman upper bearings as well as connecting bolts from cosmoline, dirt, paint or burrs and lightly grease them. Attach upper pitman bearings, align and tighten. See illustration in Figure 14.

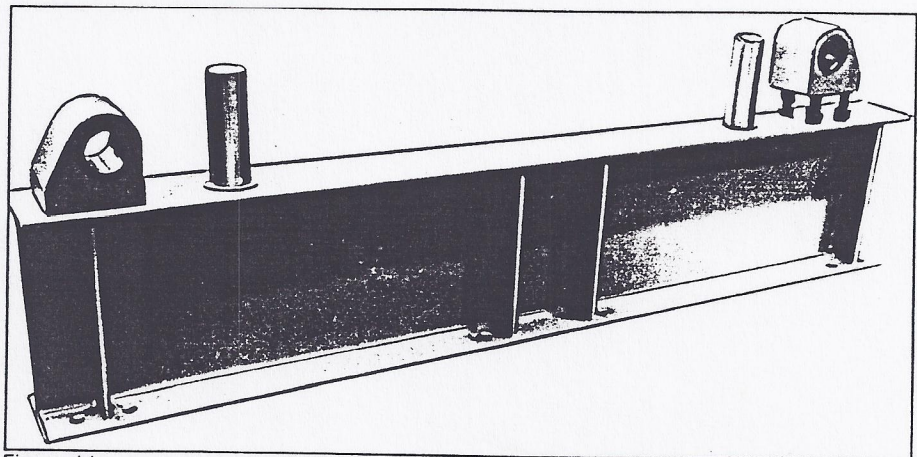


Figure 14

Note: The upper pitman bearings may be installed with the inclined faces pointing inward or outward. See Chart No. 6.

- j. Turn equalizer over so that the four center holes are pointing up.
- k. Turn walking beam over so both bearing assemblies point downward. Attach equalizer bearing assembly to walking beam with bolts and hand-tighten at this time.

- i. Equalizer alignment is accomplished by checking the dimension between the outer front bolts of the upper pitman bearings and the two bottom mounting holes for the horsehead. These dimensions must be the same. See illustration in Figure 15.

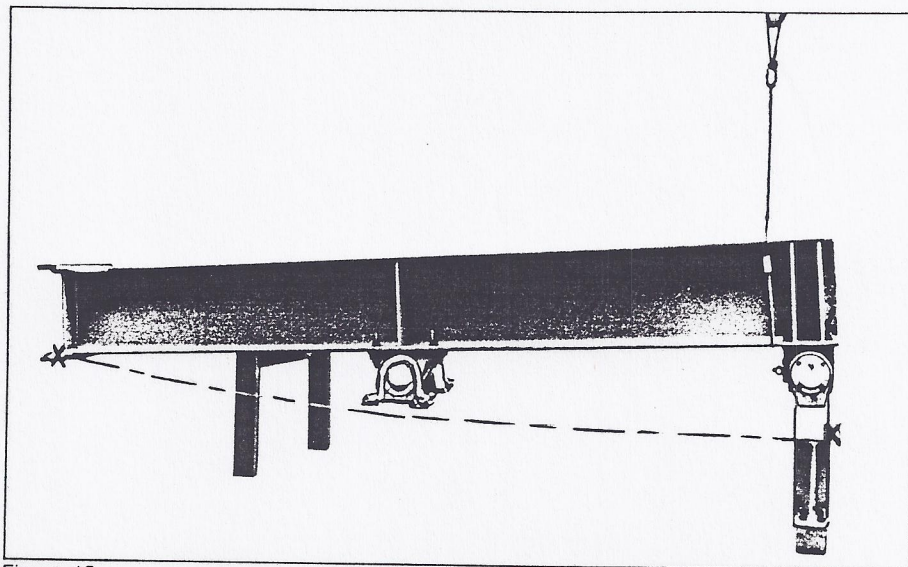


Figure 15

- m. Tighten equalizer bearing bolts at this time and swivel equalizer until it is in a horizontal position.
- n. Remove caps from the upper pitman bearings and push pitman forkhead over these bearings. Install shaft through forkhead and upper bearings and tighten clamping bolts. To eliminate play between forkhead and bearing housing, laminated shims are to be used. These can be peeled to size with a pocketknife. See illustration in Figure 16.

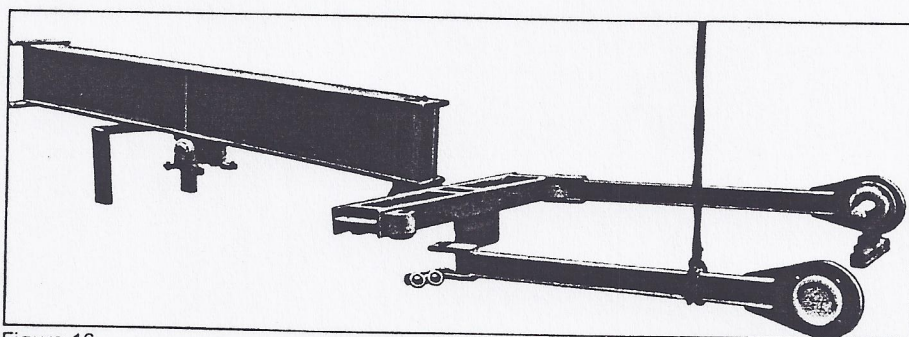


Figure 16

Note: Pitmans must be positioned parallel to the walking beam in such a way that the non-machined surfaces of the lower pitman connections point outwards.

3-9. Installation of Walking Beam Assembly on Samson Post

- a. Using two slings placed around walking beam in such a manner that when the beam is lifted it will be in level position, lift walking beam assembly and place center bearing on top of samson post. Be sure bottom surface of housing and top of samson post plate are free of any cosmoline, dirt, paint or burrs to ensure metal-to-metal contact. See illustration in Figure 17.

Warning: When lifting this assembly, the pitman arms will rotate slowly until they are in a vertically suspended position. Stand clear of all moving parts and away from dropping range.

Make sure that slings will not slip.

Caution: When lifting walking beam assembly, care must be taken to ensure that pitman arms do not get caught.

Note: Some units require filler plates between samson post and walking beam. These should be installed at this time. Refer to Chart No. 5.

- b. Align bolt holes of center bearing housing and top plate of samson post and hammer roll pins firmly into top plate of samson post. See illustration in Figure 18.

Note: If roll pins cannot be fully hammered in, they can be pulled flush with bolts.

- c. Install and tighten the bolts.
- d. Lower walking beam towards rear until lower pitman connection is aligned with crankpin bearing housing.
- e. Remove all cosmoline, paint, dirt or burrs from all machined surfaces of lower pitman connection and crankpin bearing housing.
- f. Slide pitman arms onto crankpin bearing housing and insert and tighten bolts.

Note: Bolt one pitman to crankpin bearing housing at a time.

- g. If ground lubrication system is furnished, install it at this time. See illustration in Figure 19.

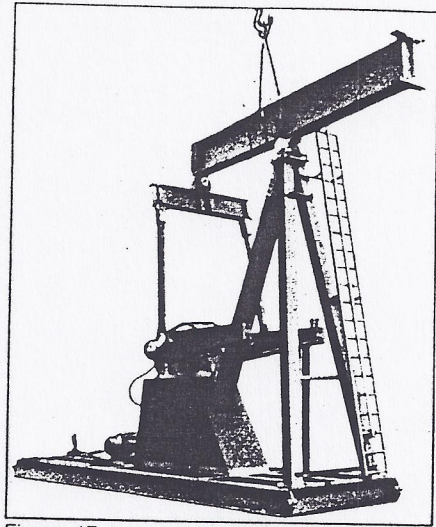


Figure 17

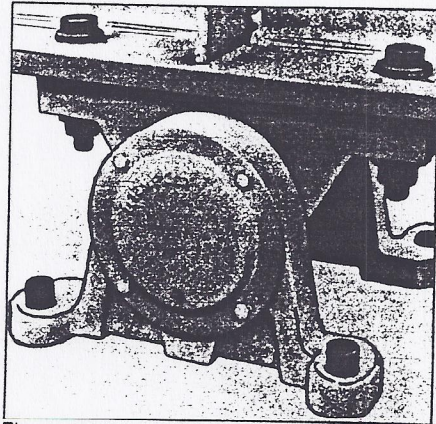


Figure 18

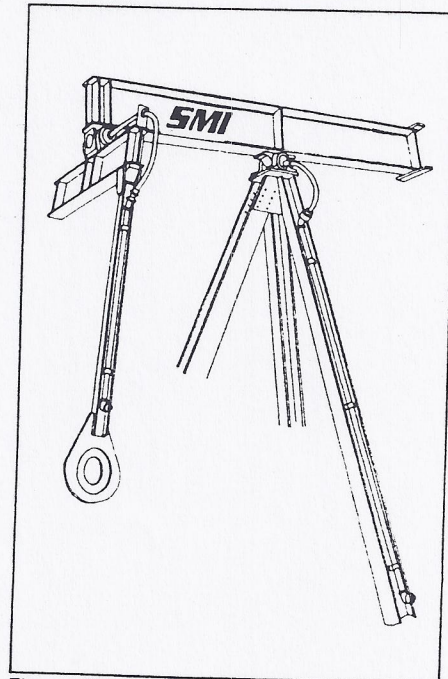


Figure 19

3-10. Installation of Horsehead and Wire Line Assembly

- a. Using a crane, horizontally position the walking beam and apply the brake.

Warning: For safety reasons, the horizontally positioned cranks should be supported by suitable means other than the brake. A commonly used safety procedure is to place heavy timbers under the cranks.

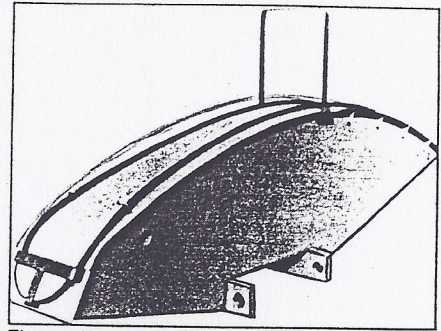


Figure 20

- b. Place wire line assembly with carrier bar over pulley at top of horsehead and bolt wire line retainer plate into position. Equalize wire line so that carrier bar will hang level.
- c. Attach wire line bail to horsehead. See illustration in Figure 20.
- d. Attach lifting sling to the top side holes of horsehead and raise until it can be aligned with the mounting holes in the front of the walking beam. Be sure all cosmoline, dirt, paint and burrs are removed from holes. See illustration in Figure 21.
- e. Knock in hinge pins and lock them with spring pins.

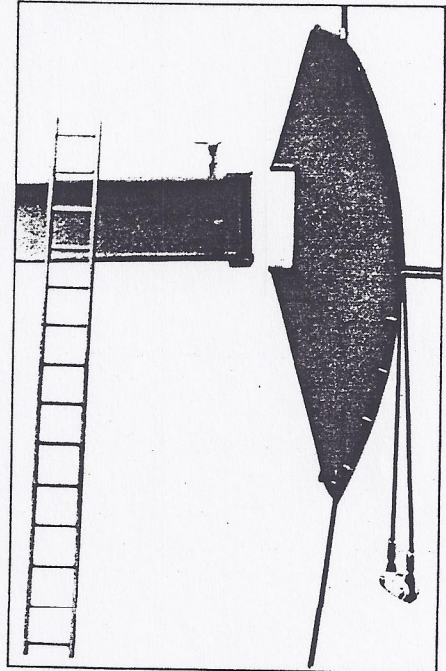


Figure 21

3-11. Final Alignment

- a. Check distance between end of crankshaft and pitman arm and be sure it is the same on both sides; if not, move walking beam to equalize this distance. Tighten bolts, beam to center bearing. See illustration in Figure 22.
- b. By use of a plumb bob, check alignment of the pumping unit with the center of the well. In determining this position, take into account half of the wire line. Check alignment, center of samson post top to center line drawn on top of foundation.
- c. If the unit is not properly positioned when viewed from the side, the entire pumping

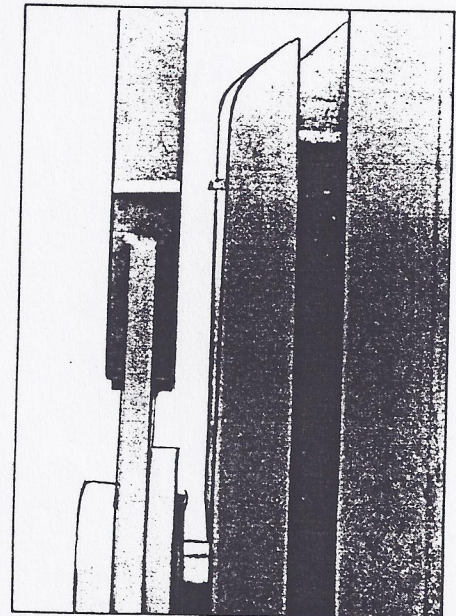


Figure 22

- unit must be shifted accordingly.
- d. If the unit is not properly positioned when viewed from the front, the horsehead can be aligned by lateral motion of walking beam or by shifting the entire unit from side-to-side.
- e. Attach carrier bar to polished rod and install polished rod clamp.
- f. Uniformly hammer-tighten all bolts, including tie-down bolts.

3-12. Installation of V-Belt Drive and Prime Mover

- a. Position prime mover rails close enough to the gear reducer so V-belts will slip over sheaves. Center prime mover rails so foundation holes in prime mover frame will match the rail centers. Install prime mover on rails, insert bolts and hand-tighten nuts.
- b. Install prime mover sheave, position as close to prime mover housing as possible to minimize overhung load on bearing. Tighten cap screws in QD hub and check for proper fit of key.
- c. Install V-belts, using taut string to align driven and driver sheaves. Shift prime mover as required. Check belt tightness in accordance with V-belt manufacturer's recommendations. Secure prime mover to rails and rails to base with hammer wrench.

Note: Prime mover should be installed in accordance with manufacturer's instructions.

- d. Install V-belt guard if required.

Note: Depending on size of the guard, it will be attached at two or three attachment points. Every guard must be mounted at the top and bottom. On larger units, the guard may also be attached in the middle. See illustration in Figure 23.

Note: When using a gas engine, a flywheel guard may have to be installed.

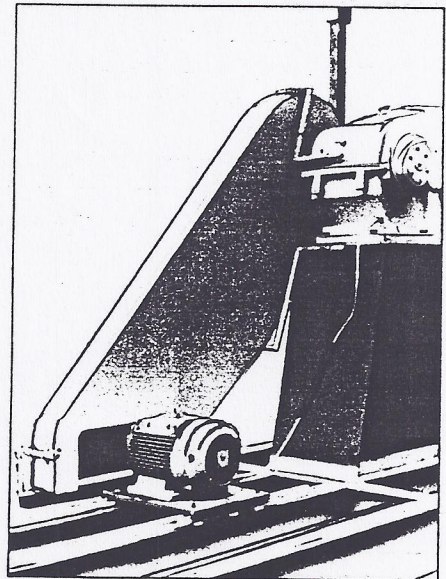


Figure 23

- a. Fill gear reducer with quantity and type of oil as specified in lubrication Chart No. 4. Oil level must always come up to mark on the dipstick. See illustration in Figure 24.
- b. The structural bearings have been adequately lubricated at the factory with grease for temperatures down to -30°F .

Note: At temperatures below -30°F or when mainly used in

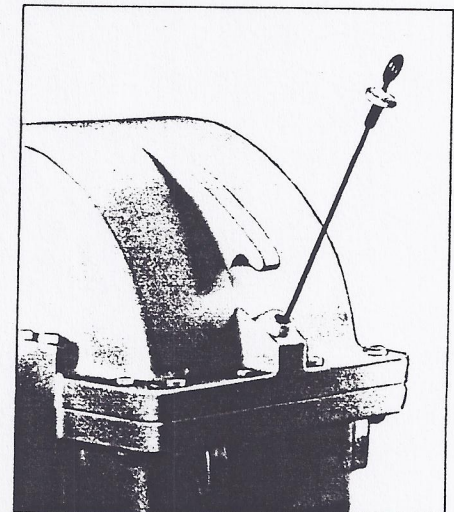


Figure 24

3-13. Lubrication

this temperature range, the bearings must be flushed and refilled with suitable type of grease prior to assembly.

3-14. Final Installation Steps

- a. If the unit is to be grouted, recheck base for level and adjust accordingly. Grout unit and allow sufficient curing time for grout before starting unit.
- b. If crank guard is furnished, install it at this time.
- c. Unit is now ready for start-up.

Warning: Do not operate unit until all guards are in place.

3-15. After One Week of Operation

- a. Re-tighten all bolted connections, including counterweight bolts.
- b. Check oil level in gear reducer.
- c. Check gear reducer and structural bearing assemblies for abnormal leaks.
- d. Check V-belt tension and adjust if necessary.

Warning: Before working around pumping unit, shut off prime mover, allow cranks to rotate to vertical position, and set hand brake securely.

3-16. Adjustment of Counterweights

Warning: When adjusting counterweights, always fully apply the brake. For safety reasons, one of the horizontally positioned cranks must be supported by heavy timbers or with a crane.

SMI pumping units are crank-balanced units with easily adjustable counterweights.

Counterweights may be adjusted in two ways: First, position cranks in a horizontal position, loosen counterweight bolts and, by use of the adjusting mechanism, move counterweights in either direction as needed. See illustration in Figure 25. Second method would be to position cranks in the vertical position by moving counterweights up or down with a crane or come-along to desired position. See illustration in Figure 9 (on page 8). In using either method, be sure counterweight bolts are hammer-tightened and lock nuts are secure.

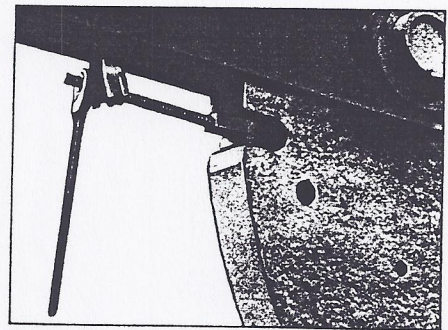


Figure 25

4 Maintenance

4-1. Checks

Proper servicing and maintenance of the SMI pumping unit, early detection, and elimination of malfunctions and damage provide for long, trouble-free operation. Check periodically that there are no abnormalities in the gear reducer or bearings. Listen for abnormal sounds in the structure, gear reducer and bearings. Look for misalignments in V-belts and wire lines.

4-2. Brake

Before the prime mover is shut off, the brake should be checked for proper operation and position of brake lever.

4-3. Lubrication of Bearings

Bearings used in SMI pumping units are designed for long life with little maintenance required.

The crankpin bearings, center bearings and equalizer bearings are antifriction bearings and are equipped with grease fittings. These should be re-lubricated every six months or as required. Grease should be pumped into the bearings until fresh grease emerges from the sealing ring. **Note bulletin regarding Perma Lube Lubricators below!**

4-4. Lubrication of Gear Reducer

Collect a sample of the gear reducer oil every six months and check oil for dirt and water emulsion. Subsequently, evaluate oil for further usability. Change oil if required.

Intermittent operation in areas with high humidity tends to emulsify oil, which leads to corrosion and premature wear of gears and bearings. For this reason, condensed water in the gear reducer must be drained from time-to-time.

```
*****
*
*   S M I   S E R V I C E   B U L L E T I N   *
*
*****
```

To: ALL CUSTOMERS USING SMI PUMPING UNITS WITH PERMA LUBE LUBRICATORS INSTEAD OF A GROUND LUBE SYSTEM

The PERMA LUBE lubricators, installed on both sides of center and tail bearings, need replacement at regular intervals.

Timing depends on operating conditions and temperature. However, a normal maintenance schedule would suggest:

```
*****
*
*   R E P L A C E M E N T   E V E R Y   6   M O N T H S   *
*
*           M A N D A T O R Y   T O   A V O I D   B E A R I N G   F A I L U R E S   *
*
*****
```

Please make sure this information is available to all personnel performing maintenance on your SMI pumping units which use PERMA LUBE lubricators instead of a ground lube system.

We hope this bulletin helps you maintain your SMI pumping unit in good operating condition.

SMI Sales and Service Department

PHONE (303) 794-9864

5 Charts

Chart No. 1

Dimension from Center of Well to Front of Unit Base Crossrail

912-365-168 — 12'1¼"	320-305-120 — 7'8¼"	160-143- 86 — 5'4"
912-305-168 — 12'1¼"	320-256-120 — 8'0¾"	160-119- 86 — 5'4"
912-427-144 — 9'9¾"	320-213-120 — 8'0¾"	160-200- 74 — 50¼"
912-365-144 — 9'9¾"	320-305-100 — 6'1¾"	160-173- 74 — 50¼"
640-365-168 — 12'1¼"	320-256-100 — 6'1¾"	160-143- 74 — 53¾"
640-305-168 — 12'1¼"	320-213-100 — 6'5½"	160-173- 64 — 42¼"
640-427-144 — 9'9¾"	320-173-100 — 6'5½"	160-143- 64 — 42¼"
640-365-144 — 9'9¾"	320-246- 86 — 5'1"	114-173- 86 — 5'4"
640-305-144 — 9'11¾"	320-213- 86 — 5'1"	114-143- 86 — 5'4"
640-256-144 — 9'11¾"	228-256-120 — 8'0¾"	114-119- 86 — 5'4"
640-365-120 — 7'8¼"	228-213-120 — 8'0¾"	114-200- 74 — 50¼"
640-305-120 — 7'8¼"	228-305-100 — 6'1¾"	114-173- 74 — 50¼"
456-365-168 — 12'1¼"	228-256-100 — 6'1¾"	114-143- 74 — 53¾"
456-305-168 — 12'1¼"	228-213-100 — 6'5½"	114-173- 64 — 42¼"
456-427-144 — 9'9¾"	228-173-100 — 6'5½"	114-143- 64 — 42¼"
456-365-144 — 9'9¾"	228-246- 86 — 5'1"	114-119- 64 — 51"
456-305-144 — 9'11¾"	228-213- 86 — 5'1"	114-133- 54 — 39¼"
456-256-144 — 9'11¾"	228-173- 86 — 5'4"	114-119- 54 — 39¼"
456-365-120 — 7'8¼"	228-143- 86 — 5'4"	80-143- 74 — 53¾"
456-305-120 — 7'8¼"	228-119- 86 — 5'4"	80-173- 64 — 42¼"
456-256-120 — 8'0¾"	228-200- 74 — 50¼"	80-143- 64 — 42¼"
456-213-120 — 8'0¾"	228-173- 74 — 50¼"	80-119- 64 — 51"
456-305-100 — 6'1¾"	160-213-100 — 6'5½"	80-133- 54 — 39¼"
456-256-100 — 6'1¾"	160-173-100 — 6'5½"	80-119- 54 — 39¼"
320-305-144 — 9'11¾"	160-246- 86 — 5'1"	57-119- 64 — 51"
320-256-144 — 9'11¾"	160-213- 86 — 5'1"	57-133- 54 — 39¼"
320-365-120 — 7'8¼"	160-173- 86 — 5'4"	57-119- 54 — 39¼"

Chart No. 2 Gear Reducer Weights

Gear Reducer with Brake but LESS: V-belts, Oil and Cranks

912 — 12,870 lbs.	320 — 4,840 lbs.	114 — 2,090 lbs.
640 — 9,240 lbs.	228 — 3,520 lbs.	80 — 1,632 lbs.
456 — 7,040 lbs.	160 — 2,970 lbs.	57 — 1,250 lbs.

Additional Weights

Counterweight and Crank Size	Cranks (2)	Master Cwts. (4)	Auxiliary Counterweights (4)
10	8,800 lbs.	19,826 lbs.	3,766 lbs.
20	6,600 lbs.	14,942 lbs.	2,790 lbs.
30	5,192 lbs.	11,114 lbs.	1,918 lbs.
40	3,972 lbs.	8,536 lbs.	1,600 lbs.
50	2,662 lbs.	6,292 lbs.	1,258 lbs.
60	2,134 lbs.	5,262 lbs.	950 lbs.
70	1,632 lbs.	—	—

**Chart No. 3
Proper Tightening Torques
of all Bolts and Cap Screws**

For oil lubricated bolts, nuts and cap screws Grade 5, providing they can be easily turned and they do not jam because of bad threading or misaligned holes.

Thread Size (Metric)	Torque Load (Ft.-Lbs.)	Thread Size (Inches)	Torque Load (Ft.-Lbs.)
M10	28 — 32	3/8 — 16 UNC	22 — 25
M12	49 — 56	1/2 — 13 UNC	52 — 59
M16	122 — 140	5/8 — 11 UNC	110 — 125
M20	238 — 273	3/4 — 10 UNC	195 — 225
M24	410 — 470	7/8 — 9 UNC	315 — 360
M27	600 — 690	1 — 8 UNC	480 — 545
M30	820 — 935	1 1/8 — 7 UNC	710 — 810
M33	1,125 — 1,290	1 1/4 — 7 UNC	960 — 1,100
M36	1,440 — 1,645	1 1/2 — 6 UNC	1,680 — 1,920

**Chart No. 4
Lubrication Information**

**Oil Capacity Gear
Reducers**

912 - 162 gal.	320 - 66 gal.	114 - 25 gal.
640 - 122 gal.	228 - 48 gal.	80 - 21 gal.
456 - 91 gal.	160 - 31 gal.	57 - 17 gal.

**Recommended Lubrication
Gear Reducer**

For temperatures between 0°F and 212°F, use an SAE 90 extreme pressure or AGMA 6 EP gear lubricant with rust and oxidation inhibitors and an antifoam agent.

For temperatures down to -30°F, use an SAE 80 extreme pressure or AGMA 3 EP gear lubricant with rust and oxidation inhibitors and an antifoam agent.

Lubricant should have a pour point sufficiently low to flow at all extreme temperatures.

Structural Bearings

For temperatures down to 0°F, use a premium NLGI No. 1 multipurpose lithium soap base grease with extreme pressure characteristics.

For temperatures down to -30°F, use a premium NLGI No. 0 multipurpose lithium soap base grease with extreme pressure characteristics.

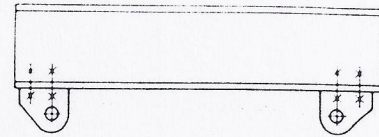
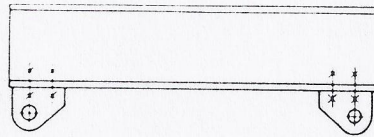
**Chart No. 5
Hints for Installation for
Footrests, Intermediate
Plates, Brake Lever
Assembly**

Pumping Unit Designation	Footrests with Screws for Fastening Gear	Intermediate Plate with Screws for Center Bearing	Brake Lever Cable Position A	Assembly Cable Position B
912	365-168	—	X	—
	305-168	—	X	—
	427-144	—	X	—
	365-144	—	X	—
640	365-168	—	—	X
	305-168	—	—	X
	427-144	—	—	X
	365-144	—	—	X
	305-144	—	X	—
	256-144	—	X	—
	365-120	—	X	—
	305-120	—	X	—
456	365-168	X	—	X
	305-168	X	—	X
	427-144	X	—	X
	365-144	X	—	X
	305-144	—	—	X
	256-144	—	—	X
	365-120	—	—	X
	305-120	—	—	X
	256-120	—	X	—
	213-120	—	X	—
	305-100	—	X	—
	256-100	—	X	—
	320	305-144	X	—
256-144		X	—	X
365-120		X	—	X
305-120		X	—	X
256-120		—	X	—
213-120		—	X	—
305-100		—	X	—
256-100		—	X	—
213-100		—	X	—
173-100		—	X	X
246- 86		—	X	X
213- 86		—	X	X

Chart No. 5 continued

Pumping Unit Designation	Footrests with Screws for Fastening Gear	Intermediate Plate with Screws for Center Bearing	Brake Lever Cable Position A	Assembly Cable Position B
256-120	X	—	—	—
213-120	X	—	—	—
305-100	X	—	—	—
256-100	X	—	—	—
228 213-100	—	X	X	—
173-100	—	X	X	—
246- 86	—	—	—	X
213- 86	—	—	—	X
173- 86	—	X	X	—
143- 86	—	X	X	—
119- 86	—	X	X	—
200- 74	—	X	X	—
173- 74	—	X	X	—
213-100	X	—	—	X
173-100	X	—	—	X
246- 86	—	—	—	X
213- 86	X	—	—	X
173- 86	—	—	—	X
160 143- 86	—	X	X	—
119- 86	—	X	X	—
200- 74	—	X	X	—
173- 74	—	X	X	—
143- 74	—	X	—	—
173- 64	—	X	—	—
143- 64	—	X	—	—
173- 86	X	—	—	X
143- 86	X	—	—	X
119- 86	X	—	—	X
200- 74	X	—	—	X
114 173- 74	X	—	—	X
143- 74	—	—	—	—
173- 64	—	—	—	—
143- 64	—	—	—	—
119- 64	—	X	—	—
133- 54	—	X	—	—
119- 54	—	X	—	—
143- 74	X	—	—	—
173- 64	X	—	—	—
80 143- 64	X	—	—	—
119- 64	—	—	—	—
133- 54	—	—	—	—
119- 54	—	—	—	—

Chart No. 6
Position of the Inclined
Surface of Pitman Bearing
at Equalizer



Pumping Unit Designation	Basic Structure Type	Pumping Unit Designation	Basic Structure Type	
912	365-168	1	365-168	1
	305-168	1	305-168	1
	427-144	1	427-144	1
	365-144	1	365-144	1
640	305-144	2	365-168	1
	256-144	2	305-168	1
	365-120	2	427-144	1
	305-120	2	365-144	1
456	256-120	3	305-144	2
	213-120	3	256-144	2
	305-100	3	365-120	2
	256-100	3	305-120	2
320	213-100	4	305-144	2
	173-100	4	256-144	2
	246- 86	4	365-120	2
	213- 86	4	305-120	2
228	213-100	4	256-120	3
	173-100	4	213-120	3
	246- 86	4	305-100	3
	213- 86	4	256-100	3
	173- 86	5	256-120	3
	143- 86	5	213-120	3
	119- 86	5	305-100	3
	200- 74	5	256-100	3
160	143- 74	6	213-100	4
	173- 64	6	173-100	4
	143- 64	6	246- 86	4
114	143- 74	6	213- 86	4
	173- 64	6	173- 86	5
	143- 64	6	143- 86	5
	119- 64	7	119- 86	5
	133- 54	7	200- 74	5
	119- 54	7	173- 74	5
	80	173- 86	5	173- 86
143- 86		5	143- 86	5
119- 86		5	119- 86	5
200- 74		5	200- 74	5
173- 74		5	173- 74	5
143- 74		6	143- 74	6
173- 64		6	173- 64	6



SM INDUSTRIES, INC.

P. O. Drawer 8
Louviers, CO 80131

Phone: (303) 794-9864 Toll free: 800-826-3905 Telex: 910-935-0155

This information does not cover all possible problems, causes, solutions, hazards and warnings. Not all of the information applies equally to all unit sizes. SMI reserves the right to make changes in this information just as it reserves the right to make changes in design without furnishing notice thereof. SMI does not take responsibility for the correctness and use of this information. This information is not to be duplicated.

TROUBLE SHOOTING GUIDE

INDEX

<u>COMPONENT</u>	<u>TYPE OF PROBLEM</u>	<u>PAGE NO.</u>
CENTER BEARING	VISIBLE	2
	NOISE	3
	LEAKS	4
EQUALIZER BEARING	VISIBLE	5
	NOISE	6
	LEAKS	7
PITMAN BEARING	VISIBLE	8
	NOISE	9
CRANKPIN BEARING	VISIBLE	10
	NOISE	11
	LEAKS	12
CRANK	VISIBLE	13
GEAR REDUCER	VISIBLE	14
	NOISE	15
	LEAKS	16
	TEMPERATURE	17

T R O U B L E S H O O T I N G G U I D E

FOR SMI PUMPING UNITS / 1-9-86 / PAGE 2

*
* CENTER BEARING *
*
* VISIBLE PROBLEM *
*

P
R
O
B
L
E
M

- P-1 | Loose bolted connection.
- P-2 | Sand or dirt in ground lube system if ground lube system is used.
- P-3 | Perma-Lube lubricator reservoir is empty when Perma-Lube is used.

C
A
U
S
E

- C-1 | Neglected proper tightening during unit assembly and/or during recommended retightening after unit assembly.
- C-2 | Careless handling during installation and/or use of dirty grease gun tip or contaminated grease during regreasing.
- C-3 | Normal 6-month time for replacement of Perma-Lube lubricators has been exceeded, or operating and ambient conditions require more frequent replacement of lubricators.

S
O
L
U
T
I
O
N

- S-1 | Tighten the bolted connection properly.
- S-2 | Free the ground lube system of sand and dirt. Check if sand and dirt particles got into the lube lines or into the bearing. If contaminated, disassemble the lube system and if necessary the bearing and clean with good grade solvent. Assemble the lube system and fill it with lithium grease, also do the same with the bearing if it had to be cleaned. Then connect lube system to bearing.
- S-3 | Check grease reservoirs of Perma-Lube lubricators frequently. Be sure to replace lubricators at least at the normal 6-month interval. SMI can supply you with replacement lubricators.

T R O U B L E S H O O T I N G G U I D E

FOR SMI PUMPING UNITS / 1-9-86 / PAGE 3

```
*****  
*                                     *  
*   CENTER_BEARING                   *  
*                                     *  
*   NOISE                             *  
*                                     *  
*****
```

P
R
O
B
L
E
M

P-1 Cracking noise in center bearing.

C
A
U
S
E

C-1 Damaged self aligning center roller bearing.

S
O
L
U
T
I
O
N

S-1 Replace the whole center bearing assembly. Send the damaged center bearing to SMI for repair service or replacement.

TROUBLE SHOOTING GUIDE
FOR SMI PUMPING UNITS / 1-9-86 / PAGE 4

*
* CENTER BEARING *
*
* LEAKS *
*

P
R
O
B
L
E
M

- P-1 : Grease leaks from bearing housing or cover.
- P-2 : Discolored grease (rust brown pigments in grease) coming out through shaft seal lip.
- P-3 : Leak in lube system when ground lube system is used.

C
A
U
S
E

- C-1 : Damage or breakage of seal and/or roller bearing due to mishandling during transport or installation.
- C-2a : Water entering bearing due to a bad seal lip.
- C-2b : Damaged self aligning roller bearing.
- C-2b : Water entering bearing due to a crack in bearing housing or cover.
- C-3a : Remaining fragments of grease nipple and or damaged thread.
- C-3b : Damaged lube pipes, hoses, or connections.

S
O
L
U
T
I
O
N

- S-1&2 : Replace complete center bearing assembly and send to SMI for re-repair service or replacement.
- S-3 : Replace damaged components, clean repaired section before re-filling with recommended lithium based grease.

TROUBLE SHOOTING GUIDE
FOR SMI PUMPING UNITS / 1-9-86 / PAGE 5

*
* EQUALIZER BEARING *
*
* VISIBLE PROBLEM *
*

- P
R P-1 : Loose bolted connection if equalizer bearing is bolted on.
O
B P-2 : Sand or dirt in ground lube system if ground lube system is used.
L
E P-3 : Perma-Lube lubricator reservoir is empty when Perma-Lube is used.
M

- C-1 : Neglected proper tightening during unit assembly and/or during
recommended retightening after unit assembly.
C
A C-2 : Careless handling during installation and/or use of dirty grease
U gun tip or contaminated grease during regreasing.
S
E C-3 : Normal 6-month time for replacement of Perma-Lube lubricators has
been exceeded, or operating and ambient conditions require more
frequent replacement of lubricators.

- S-1 : Tighten the bolted connection properly.
S-2 : Free the ground lube system of sand and dirt. Check if sand and
dirt particles got into the lube lines or into the bearing. If
contaminated, disassemble the lube system and if necessary the
bearing and clean with good grade solvent. Assemble the lube
system and fill it with lithium grease, also do the same with the
bearing if it had to be cleaned. Then connect lube system to
bearing.
S
O : Keep grease gun tip clean and protected between uses. Keep
L grease container clean and protected between uses.
U
T
I
O
N
S-3 : Check grease reservoirs of Perma-Lube lubricators frequently.
Be sure to replace lubricators at least at the normal 6-month
interval. SMI can supply you with replacement lubricators.

T R O U B L E S H O O T I N G G U I D E

FOR SMI PUMPING UNITS / 1-9-86 / PAGE 6

*
* EQUALIZER BEARING *
*
* NOISE *
*

P
R P-1 : Knocking noise (SMI Units with bolted on equalizer bearing)
O
B P-2 : Cracking noise
L
E P-3 : Squeaking noise (SMI Units with bolted on equalizer bearing)
M

C
A C-1a : Improperly tightened elastic stop (in longitudinal direction of
U walking beam).
S C-1b : Loose stud bolts connecting bearing to walking beam. DANGER!
E C-1&2 : Damaged bearing.
C-3 : Bearing or bearing surface running dry, worn out multi component
friction bearing, or improper tightness of elastic stop nut.

S-1a : Check the clearance of the longitudinal bearing in the equalizer
bearing assembly. If there is clearance, the elastic stop nut
must be tightened until there is no more clearance.
: To set up for checking and adjusting the elastic stop nut, based
: on clockwise rotation, stop the cranks in approx. horizontal po-
: sition (pointing away from wellhead if stop nut is in rear, or
: pointing toward wellhead if stop nut is in front of bearing
: assembly). The walking beam should be horizontal and the elas-
: tic stop should be load free. If these conditions can not be
: obtained, free the load from the wireline hanger.
S-1b : In case of a loose stud bolt connection, remove the old stud
S bolts. Check the thread in the housing. If damaged, order a
O new housing. Check the shearpin in housing and shearpin bore
L in walking beam for wear. If worn, repair shearpin seat with
U high grade liquid steel and allow at least 2 days to harden.
T
I : Remove burrs and rough edges on the matching surfaces and fill
O dents with liquid steel. Always use new studbolts. Use Loctite
N #271 on the thread and apply the recommended torque.
: Use self locking nuts to fasten equalizer bearing to beam.
: Hand tighten and let connection harden for at least 2 days
: before tightening with proper torque.
S-1&2 : Send bad bearing to SMI for repair or replace with new bearing.
S-3 : Apply oil from both sides where the bearing housing adjoins the
crosshead. Check the elastic stop nut seat at the same time.
: If the squeaking noise continues, send bearing to SMI.

T R O U B L E S H O O T I N G G U I D E

F O R S M I P U M P I N G U N I T S / 1 - 9 - 8 6 / P A G E 7

*
* EQUALIZER BEARING *
*
* L E A K S *
*

- P
R
O
B
L
E
M
- P-1 Grease leaks from bearing housing or cover.
 - P-2 Discolored grease (rust brown pigments in grease) coming out through shaft seal lip.
 - P-3 Leak in lube system when ground lube system is used.

- C
A
U
S
E
- C-1 Damage or breakage of seal and/or roller bearing due to mishandling during transport or installation.
 - C-2a Water entering bearing due to a bad seal lip.
 Damaged self aligning roller bearing.
 - C-2b Water entering bearing due to a crack in bearing housing or cover.
 - C-3a Remaining fragments of grease nipple and or damaged thread.
 - C-3b Damaged lube pipes, hoses, or connections.

- S
O
L
U
T
I
O
N
- S-1&2 If bolted on equalizer bearing assembly, replace complete bearing assembly and send to SMI for repair service or replacement.
 - S-3 Replace damaged components, clean repaired section before refilling with recommended lithium based grease.

TROUBLE SHOOTING GUIDE
FOR SMI PUMPING UNITS / 1-9-86 / PAGE 8

*
* PITMAN BEARING *
*
* VISIBLE PROBLEM *
*

P
R
O
B
L
E
M

- P-1 Loose pitman bearing to pitman arm bolted connection.
- P-2 Pitman bearing shaft is working its way out.
- P-3 Loose pitman bearing to equalizer beam connection when this is a bolted connection.

C
A
U
S
E

- C-1 Pitman bearing was not sufficiently tightened or retightened.
- C-2 Pitman bearing to pitman arm bolted connection was not sufficiently tightened or retightened.
- C-3 Neglected assembly procedure or not sufficiently retightened.

S
O
L
U
T
I
O
N

- S-1 Tighten the bolted connection properly.
- S-2 Check pitman bearing and pitman arm for visible damage.
 - If there is no visible damage, disconnect the pitman arm banjo, align forkend of pitman arm with pitman arm bearing and drive the pitman bearing shaft into position. Tighten bolted connection properly.
 - If there is visible damage, replace the damaged part.
- S-3 Send the damaged part to SMI for repair service or replacement.
- S-3 Replace the stud bolts in pitman bearing housing and tighten bolted connection properly.

TROUBLE SHOOTING GUIDE
FOR SMI PUMPING UNITS / 1-9-86 / PAGE 9

*
* PITMAN_BEARING *
*
* NOISE *
*

P
R
O
B
L
E
M

P-1 : Knocking noise.

C
A
U
S
E

C-1a : Worn out multi-component friction bearing if multi-component friction bearing is used.
C-1b : Worn out shaft.

S
O
L
U
T
I
O
N

S-1 : Replace the pitman bearing and/or shaft.

NOTE: * Units with serial numbers up to x-999-0 x-999-1
Replace pitman bearing and send old bearing to SMI for repair.
* Units with serial numbers up to x-999-2
Replace pitman bearing/equalizer bearing unit and send old unit to SMI for repair.
* After 5 years of operation the multi-component friction bearings should be replaced on a preventive maintenance basis.

TROUBLE SHOOTING GUIDE
FOR SMI PUMPING UNITS / 1-9-86 / PAGE 10

*
* CRANKPIN BEARING *
*
* VISIBLE PROBLEM *
*

P
R
O
B
L
E
M

P-1 : Metal flakes on grease collar of crankpin.
P-2 : Shining surface area where crankpin bearing adjoins inside surface of crankarm. This shining or polished surface could occur either where the castle nut is seated on the washer or where the washer is seated on the crank.
: Check if the crankpin is turning in the crankpin hole or if the rollpin which prevents turning has sheared off.

C
A
U
S
E

C-1a : Loose crankpin.
C-1b : Damaged self aligning roller bearing.
C-2 : Loose crankpin.

S
O
L
U
T
I
O
N

S-1a : Since the crankpin and crankpin hole could be damaged, no field repair is possible.
: Call SMI service department!
: Under no circumstances should a shortcut be attempted by just replacing the crankpin bearing. This will not solve the problem and in cases where the parts are still under warranty, it will void the warranty.
S-1b : Replace the crankpin bearing. Send the damaged crankpin bearing to SMI for repair service or replacement.
S-2 : See S-1a above. Call SMI service department!

TROUBLE SHOOTING GUIDE
FOR SMI PUMPING UNITS / 1-9-86 / PAGE 11

*
* CRANKPIN BEARING *
*
* NOISE *
*

P
R
O
B
L
E
M

P-1 Cracking noise.

C
A
U
S
E

C-1 Damaged self aligning roller bearing.

S
O
L
U
T
I
O
N

S-1 Replace the complete crankpin bearing assembly. Send crankpin bearing assembly to SMI for repair service.

NOTE: Before crankpin bearing is installed into the crank, check taper of crankpin and crankpin bore in crank for proper fit.

WARNING: Do not install a new crankpin bearing into a crankpin hole which shows wear, deformation or mismatch in taper between crankpin and crankpin bore.

T R O U B L E S H O O T I N G G U I D E

FOR SMI PUMPING UNITS / 1-9-86 / PAGE 12

*
* C R A N K P I N B E A R I N G *
*
* L E A K S *
*

P
R
O
B
L
E
M

- P-1 Grease leaks from bearing housing or cover.
- P-2 Discolored grease (rust brown pigments in grease) coming out through shaft seal lip.

C
A
U
S
E

- C-1 Damage or breakage of seal and/or roller bearing due to mishandling during transport or installation.
- C-2a Water entering bearing due to a bad seal lip.
- C-2b Water entering bearing due to a crack in bearing housing or cover.

S
O
L
U
T
I
O
N

S-1&2 Replace the complete crankpin bearing assembly. Send crankpin bearing assembly to SMI for repair service.

NOTE: Before crankpin bearing is installed into the crank, check taper of crankpin and crankpin bore in crank for proper fit.

WARNING: Do not install a new crankpin bearing into a crankpin hole which shows wear, deformation or mismatch in taper between crankpin and crankpin bore.

TROUBLE SHOOTING GUIDE
FOR SMI PUMPING UNITS / 1-9-86 / PAGE 13

* CRANK *
* VISIBLE PROBLEM *

- P R O B L E M P-1 : Loose key. (Key is working it's way out).
- P-2 : Repeated key movement.
- P-3 : Cracks in casting, such as near the T-slots for counterweight bolts.
- P-4 : Hairline cracks in the hub near the keyway.

- C A U S E C-1 : Loose bolts in clamping head of crank.
- C-2 : Key or keyway in crank hub or slow speed shaft is worn.
- C-3 : Mishandling during pumping unit setup.
- C-3 : Hub of crank has been over expanded during crank installation.

- S O L U T I O N S-1 : Push the key back into proper position. Tighten the clamping bolts by tightening the nuts. Do not forget to tighten the locknuts.
- S-2,3,4 : Since field repair is not possible, call SMI service department for assessment of problem, repair service or replacement parts.

TROUBLE SHOOTING GUIDE
FOR SMI PUMPING UNITS / 1-9-86 / PAGE 14

*
* GEAR_REDUCER *
*
* VISIBLE PROBLEM *
*

- P
R
O
B
L
E
M
- P-1 : Missing or loose nuts and bolts.
 - P-2 : Missing oil dipstick.
 - P-3 : Discoloration of brake drum.
 - P-4 : Cracks in housing.

- C
A
U
S
E
- C-1a : Insufficient tightening of bolts.
 - C-1b : Vibration.
 - C-2 : Lost during transportation or careless handling.
 - C-3 : Brake was or is running too tight.
 - C-4 : Mishandling during transportation or installation.

- S
O
L
U
T
I
O
N
- S-1 : Replace missing nuts and bolts. Tighten replaced bolts using proper torque. Check rest of the bolts and tighten as needed using proper torque.
 - S-2 : Check oil. If necessary, drain water and refill. Plug hole for dipstick with a cork until replacement dipstick is received.
 - S-3 : Check brake for wear. If necessary, replace brake shoes and/or readjust brake. Do not forget to adjust the set screw for the brake lever on the drum.
 - S-4 : Contact SMI service department to determine possible solution.

T R O U B L E S H O O T I N G G U I D E

FOR SMI PUMPING UNITS / 1-9-86 / PAGE 15

```
*****
*
*   GEAR_REDUCER
*
*   NOISE
*
*****
```

- P P-1 : Knocking noise combined with gear backlash.
- R P-2 : Very deep knocking noise.
- O P-3 : Cracking noise.
- B P-4 : Squeaking noise.
- L P-5 : Screaming noise.
- E P-6 : Grinding and rumbling noise.
- M P-7 : Continuous grinding noise.

- C-1a : Wrong position of counterweights.
- C-1b : A very small gear reducer torque load.
- C C-2 : The resonance effect of the gear reducer support (plate base).
- A C-3&4 : Worn out our damaged roller bearing(s).
- U C-5 : Shaft seal(s) running dry. (Most likely of low speed shaft).
- S C-6 : Gear tooth or teeth damaged. Check if pitting is visible,
E : either equally distributed over all gear teeth or limited to
: certain areas of slow speed gear (bullgear).
- C-7a : Grinding brake. (Brake shoes in contact with brake drum).
- C-7b : Grinding belts. (Belts in contact with beltguard).

- S-1a : Check required CBE. Reposition counterweights if necessary.
- S-1b : Check and/or change pumping speed and/or plunger diameter.
- S-2 : Use sound dampening materials, such as sand in gear reducer sup-
: port (plate base), if required to reduce noise.
- S-3&4 : Listen with hearing aid, such as a stethoscope, for presence and
: location of worn or damaged bearing(s). Replace as required.
- S-5 : Determine reason for dryness. Check shaft seals for wear and
: tear and replace if necessary. Apply grease between dust and
S : seal lips of seal. In dusty areas apply additional grease or
O : oil from the outside to lubricate and protect seal.
- L S-6a : Check where and when noise occurs. Check if the teeth are deep-
U : ly pitted. If necessary, index the slow speed gear on the
T : slow speed shaft to engage different teeth when peak torque
I : occurs. Indexing should be done in a shop using an oil pres-
O : sure procedure recommended by SMI.
- N S-6b : If only leading or only trailing tooth side is pitted, change
: direction of rotation.
- S-6c : Clean dirt and metal deposits from gear reducer. Change or fil-
: ter gear reducer lube oil.
- S-6d : Do a dynamometer test and establish actual well conditions and
: proper CBE. (SMI can assist with RP11L calculations if given
: well data).
- S-7a : Readjust brake.
- S-7b : Check clearance between belts, sheave and beltguard. Also check
: for proper belt tension. If necessary, make adjustments.

- P-1 : Leakage from shaft seals.
- P-2 : Leakage from bearing covers.
- P-3 : Leakage from between lower housing and gear reducer cover.
- P-4 : Leakage from oil drain.
- P-5 : Leakage from inspection cover

- C-1a : Oil back flow grooves closed off by misapplied gearbox sealant.
- C-1b : Shaft seals damaged.
- C-2 : Loose screw connections.
- C-3 : Loose bolt connections.
- C-4 : Loose oil drain assembly.
- C-5a : Loose screws.
- C-5b : Damaged rubber seal

- S-1a : Take preventive action immediately in order to save the shaft seals: Clean off dirt and varnish, remove rust with fine emery cloth, clean again and apply a thin coat of oil. Loosen bearing covers and pull them back. Clean oil back flow grooves with small flexible wire, check sealant on bearing covers and if necessary, clean and apply sealant and reassemble.
- S-1b : Replace damaged seals.
NOTE: Seal lip (coilspring loaded) should face the inside, the dust lip should face the outside of the gear reducer. The seal lips of both shaft seals on the brake side of the gear reducer should face the inside of the gear reducer.
- S-2&3 : Sometimes leakage can be stopped by simply tightening screws. If leakage does not stop, check sealant film. If necessary clean and apply new sealant and tighten screws. (See S-1a).
- S-4 : Seal and tighten oil drain assembly.
- S-5 : Tighten screws.
- S-6 : Replace rubber seal, no sealant required.

TROUBLE SHOOTING GUIDE
FOR SMI PUMPING UNITS / 1-9-86 / PAGE 17

*
* GEAR REDUCER *
*
* TEMPERATURE *
*

- *****
- | | | |
|---------------------------------|-----|---|
| P
R
O
B
L
E
M | P-1 | High temperature of bearing covers and adjoining areas. |
| | P-2 | High temperature of brake. |
| | P-3 | High temperature of whole gear reducer assembly. |
- *****

- *****
- | | | |
|-----------------------|-----|---|
| C
A
U
S
E | C-1 | Bearings damaged or running dry. |
| | C-2 | Misadjusted brake is running too tight. |
| | C-3 | Possible effect of ambient conditions, such as exposure to sun. |
- *****

- *****
- | | | |
|--------------------------------------|-----|--|
| S
O
L
U
T
I
O
N | S-1 | Replace damaged bearings. |
| | S-2 | Readjust the brake for brake shoes to run free. |
| | S-3 | Temperature not to exceed 200 degrees Fahrenheit during peak summer months. Keep an eye on the lube oil. |
- *****