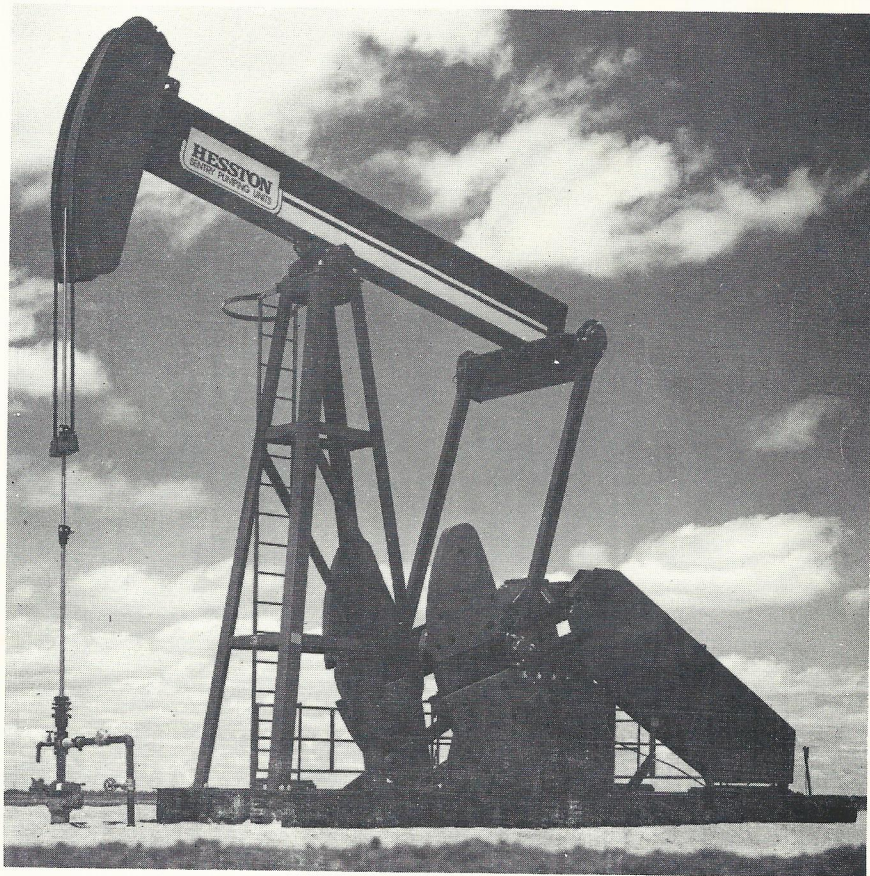


HESSTON[®]

SENTRY PUMPING UNITS

Model 228



PUMPING UNIT

OWNER'S MANUAL

FORM 700 703 954

HESSTON SENTRY PUMPING UNITS

Model 228 **GEAR DRIVE** **PUMPING UNIT**



This Manual is Applicable to:

Model 228 Pumping Unit, Serial No. P228-00001 and on.

This Manual supersedes Form No. 1713130

WARRANTY AND SERVICE POLICY

Hesston pumping units are guaranteed by Hesston Corporation to be free from defective material and workmanship for a period of 12 months after installation or 18 months from shipping date, whichever occurs first. Intermittant service is considered continuous for computing the period of operation. This warranty is void if the equipment is operated above rated capacity, is abused or improperly installed. Any part or parts proving defective due to faulty materials or workmanship will be replaced "NO CHARGE," FOB Hesston, Kansas, customer to pay the freight from Hesston to location. Hesston shall have the right to claim any defective part or parts for return to Hesston for factory inspection. When a Hesston service man is used, and it is found that the breakdown is due to defective materials or workmanship, no charge will be made for services within the warranty period. This warranty is void if work is done or parts replaced without specific authorization from Hesston or a Hesston representative. For warranty service contact the supply company from whom the unit was purchased or the Hesston Corporation, Hesston, Kansas. IN MEETING THIS WARRANTY, IT IS THE INTENT OF HESSTON TO BE COMPLETELY RESPONSIBLE FOR THE REPLACEMENT OF ANY PARTS OR COMPONENTS WHICH ARE DETERMINED TO BE DEFECTIVE DURING THE WARRANTY PERIOD. HESSTON DOES NOT INTEND TO BE RESPONSIBLE FOR ANY COSTS ASSOCIATED WITH "DOWN TIME," LOSS OF PROFITS OR PRODUCTION, RENTAL OF SUBSTITUTE EQUIPMENT, OR OTHER SIMILAR ITEMS, AND, WHERE PERMITTED BY LAW, THERE ARE NO REPRESENTATIONS OR WARRANTIES, EXPRESS OR IMPLIED, EXCEPT AS SET OUT ABOVE. IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS, AND LIABILITY FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES ARE EXPRESSLY EXCLUDED.

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SPECIFICATIONS

Unit Designation Number - G228-246-86
 *G228-213-100

Dimensions:

A — 18'	H — 16' 3-3/8"	S — 10'
B — 8' 10-7/8"	J — 27' 9-3/4"	T — 16-1/4"
*8' 2"	K — 14"	U — 7' 4"
C — 3' 7"	L — 14"	V — 6' 2-3/8"
*4' 2"	M — 27"	W — 7' 2-1/2"
D — 3' 9"	N — 7' 2"	X — 3' 1"
E — 9' 3"	P — 2' 6"	Y — 7' 9-1/2"
*10' 9"	Q — 11' 3-1/8"	Z — 6' 11-3/4"
F — 9' 5"	R — 7' 1/2"	UU — 5' 2-1/2"
G — 3' 1-3/8"		YY — 6' 1"

**SPECIFICATIONS:
 REDUCER DATA**

Peak Torque, inch-pounds	228,000
Reduction Ratio	28:45:1
Std. Sheave P.D. Grooves	36" 4C
Maximum Sheave P.D.	41"

STRUCTURE DATA

Weight, Approx. Shipping	31,080
Beam Capacity, lb.	24,600 *21,300
Structural Unbalance, lb.	+760 *+280
Stroke Lengths, in.	50, 62, 74, 86 *57, 72, 86, 100

Working Centers:

Well End	9' 3" (E)	*10' 9" (E)
Pitman End	9' 5" (F)	

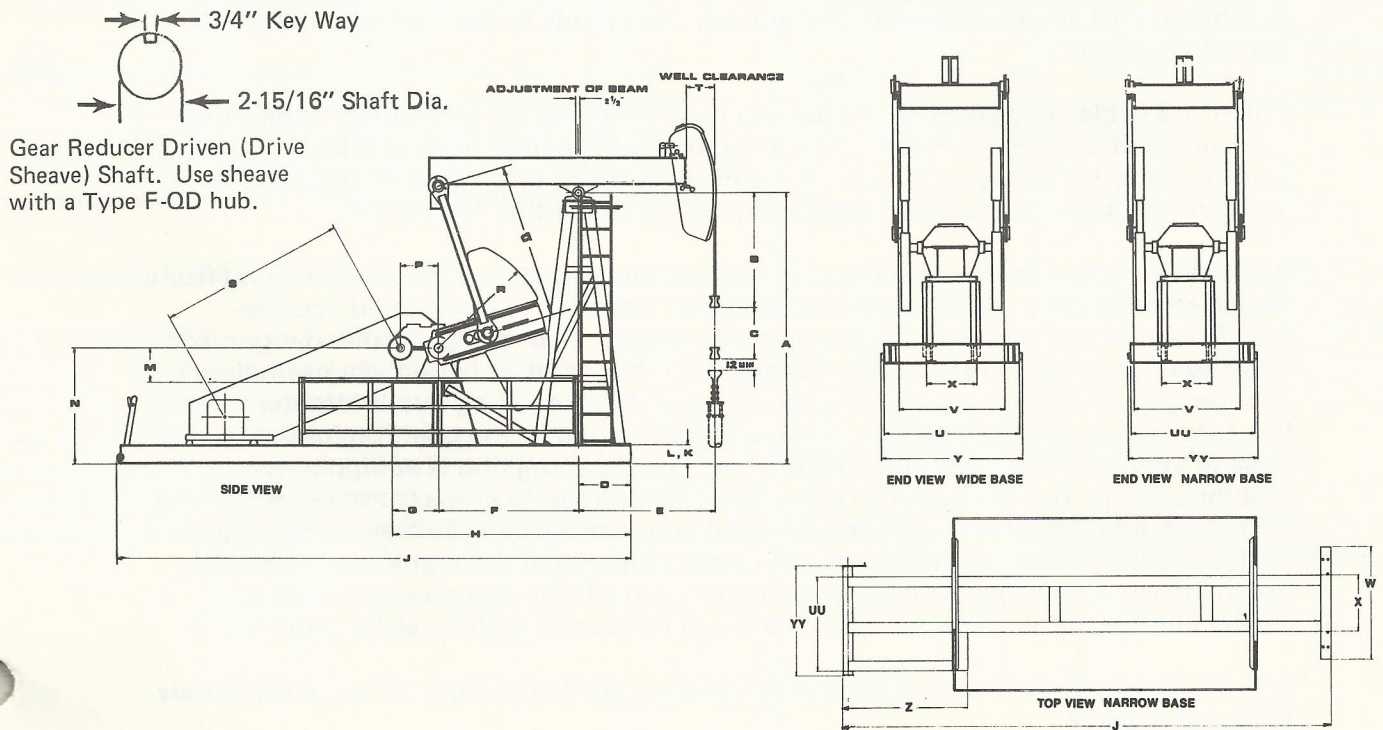
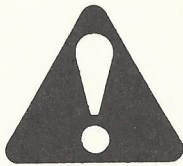


Figure 1.

SAFETY PRECAUTIONS



WATCH OUT!

for this symbol throughout the book. It will direct your attention to information that involves your safety!

Read and understand all assembly and operating instructions and precautions before attempting to assemble and operate the pumping unit.

PRACTICE SAFETY FIRST

Avoid the possibility of fire when working in the vicinity of an oilwell. Be prepared for an emergency, fire or mechanical failure, in the event that an accident does happen.

Most oilwell pumping units are constructed of large and heavy rotating parts. When working around these machines, it is essential that all personnel involved with the installation, assembly, operation and maintenance of the pumping unit use extreme care and good safety practices at all times. Failure to use extreme care when working with them can cause severe bodily injury or death.

During assembly of the pumping unit, a hoisting supervisor should give direction for all hoisting operations and be located where he is readily visible to hoist/crane operator and can view all of the hoisting operations. All persons should exercise extreme caution and stay clear of all objects being hoisted. When working on ladders or work stands, insure adequate footing and hand holds to securely assemble the large components.

Chain and cable slings used in the assembly of the pumping unit should have a load test certification tag and must not be used for loads beyond that certification to be safe. A visual daily inspection of chain and cable slings and a periodic inspection verified by a signed report are required by OSHA regulation 1910.184.

It should be noted that a pumping unit has components which can start moving from the effect of gravity. All personnel should stay clear of the cranks and counterweights or other elements which may start moving. Times of particular danger from rotating or moving parts would be during assembly, stroke change, counterbalance change, general maintenance, well servicing, and while taking dynamometer tests. It is essential to prevent rotation of the cranks stopped in any position for the purpose of service or maintenance of any kind. The pumping unit is equipped with a braking system, but the operator should also devise safety stops from heavy timbers or metal tubing/channels that can be placed under or against the cranks. See figure 35 for possible safetying methods. When the long end of the crank arm is straight down, no rotation will start when the power source is disengaged, provided the carrier bar has not yet been attached to the polished rod or the well is clamped off.


Do not operate the pumping unit unless all safety shields and guard rails are securely fastened in place.

GENERAL INFORMATION

INTRODUCTION

The purpose of this manual is to provide instruction on the installation, assembly, operation and maintenance of a Sentry Pumping Unit. Become familiar with the contents of this manual. It will provide the means for a safe and efficient installation and operation. Due to the size of the pumping unit and its components, safety must be stressed during assembly, at start up and any time that maintenance is performed. Safety must not be sacrificed for expediency. Before beginning assembly, operation or maintenance, review the Safety Precautions section.

The data presented in this manual was current at the time of printing. The photos and illustrations used in this manual may not look exactly like your pumping unit but are representative and specify the correct parts and instructions required to properly assembly, maintain and operate your particular pumping unit.

 **WARNING:** Some pictures in this manual show the pumping unit with safety shields removed for assembly or for a better view of the subject. The pumping unit should never be operated with any of the safety shields removed.

THE MODEL 228 PUMPING UNIT

The Model 228 Pumping Unit is furnished with a gear reducer. The mainframe is furnished in several different configurations, depending on requirements of the site requiring either a narrow base or a wide base and provisions for powering it with either an electric motor or a gas engine. When required, a high prime mover mounting is available for the electric motor.

UNIT DESIGNATION NUMBERS

The Sentry Pumping Unit, Model 228 designation numbers found on the pumping unit structure data plate are defined as follows:

G — Gear Drive

228 — 228,000 inch-pounds peak torque rating

D — Double Reduction

213 — 21,300 pounds of walking beam capacity

246 — 24,600 pounds of walking beam capacity

86 — 86-inch maximum stroke

100 — 100-inch maximum stroke

A.P.I. RATING AND DESIGNATION

Sentry Pumping Units are designed and rated according to A.P.I. (American Petroleum Institute) specifications. This design and specification calls for the unit to operate at 20 strokes per minute and with proper counterbalance adjustment. If unit is operated in excess of this, or without proper counterbalance adjustment, the unit's ratings may be exceeded, thereby relieving Hesston of their obligation under the warranty and Service Policy.

FRONT, REAR, RIGHT AND LEFT

The front of the pumping unit as used in this manual is considered the well head end. The opposite end from the well head is the rear end. Right and left are determined by facing the well head with the pumping unit behind your back.

SERIAL NUMBER AND DATA PLATES

The pumping unit has two serial number and data plates located as shown in figure 2. The pumping unit

GENERAL INFORMATION



Figure 2. Serial Number and Data Plates

structure plate furnishes the pumping unit serial number, unit designation, number and length of strokes and the structure rating. The pumping unit gear reducer serial number and data plate is located on the rear of the gear reducer and also furnishes the pumping unit serial number as well as the gear reducer type, size and ratio. Th quantity of lubricant is also specified.

PLATED GRADE 5 BOLTS

Bolt Diameter	Three Radial Dashes
	*Foot-Pounds
5/16-18	13
3/8 - 16	23
7/16 - 14	37
1/2 - 13	57
9/16 - 12	82
5/8 - 11	110
3/4 - 10	200
7/8 - 9	320
1 - 8	485
1-1/8 - 7	595
1-1/4 - 7	840
2-1/2 - 4	4400

Figure 3. Torque Values Table

*Torque values are less for plated bolts than for unplated. Do not use these values on unplated bolts.

BOLT TIGHTENING TORQUE VALUES

All bolts used on the pumping unit are plated Grade 5. The larger bolts used on the pumping unit are classified as "heavy structural" (A325 stamped on head), but all are tightened to the following torque values. The bolts should be properly tightened during assembly of the pumping unit and retightened approximately 24 hours after operation has begun. On final tightening of all bolts, refer to figure 3 for the correct tightening torque.

ASSEMBLY

The following assembly instructions specifies the site requirements, specifications and alignment data, as well as providing a step-by-step illustrated procedure for assembling the pumping unit. The site and foundation for the pumping unit must be properly prepared before setting the pumping unit in place. These instructions do not provide a foundation plan. It is recommended that the owner have a qualified person prepare a foundation plan according to the particular conditions of the site. For purposes of this assembly, a compacted earthen base with wood planks was used.

NOTE: Foundation requirements and anchor instructions are provided with the anchor kit that is available for this pumping unit.

WELL HEAD CLEARANCE

The pumping unit should be set on a foundation with a height that will provide a 12-inch minimum clearance between the top of the well head (stuffing box) and the bottom of the carrier bar with the polish rod at the bottom of the stroke.

SITE PREPARATION

The site must be prepared to provide proper drainage away from the site with a satisfactory foundation for the pumping unit and a height that will assure proper well head clearance. To obtain the proper well head clearance, the site should be prepared so the top of the foundation (surface that pumping unit mainframe will occupy) will be no more than 55-inches below the top of the well head (stuffing box). See figure 4 for dimensions for site preparation.

ALIGNMENT WITH WELL HEAD

The pumping unit mainframe has alignment marks which are used to align it longitudinally with the well head. An alignment mark in the forward edge of the front cross member of the mainframe and another alignment mark at the top of the end plate of the gear reducer base must align with the centerline of the well head stuffing box as shown in figure 5. Also, the mainframe has two alignment marks on the two inner

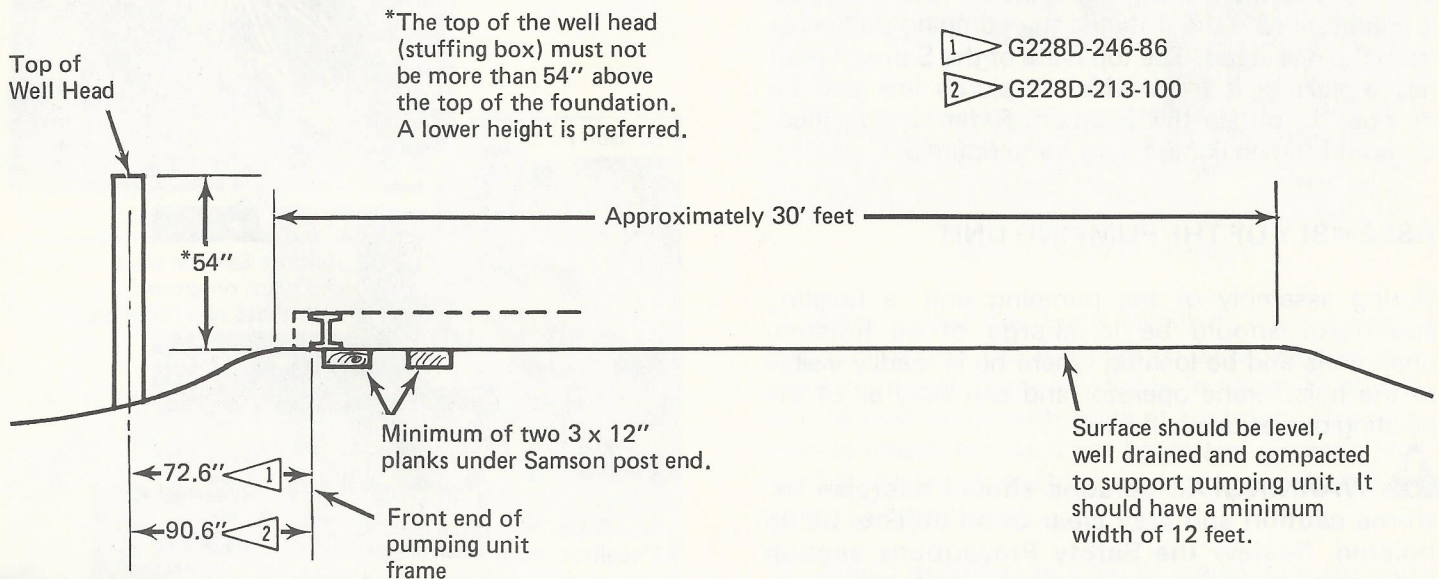


Figure 4. Preparation of Site

ASSEMBLY

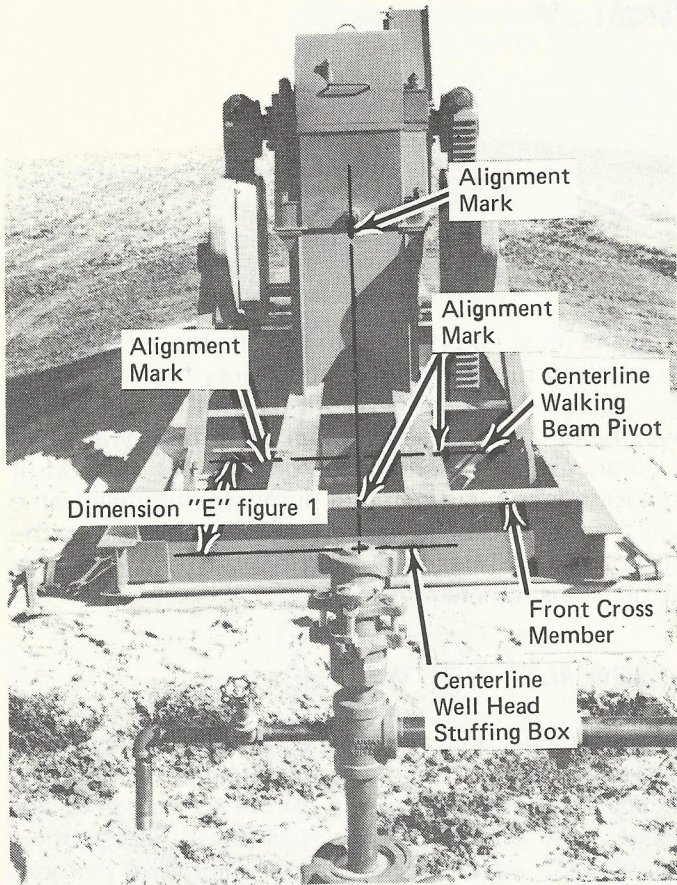


Figure 5. Alignment of Pumping Unit

frame members (shown in figure 5) that locates the centerline of the walking beam pivot. This centerline is used to locate the distance the pumping unit is set from the well head. The top plate of the Samson post has a hole in it from which a plumb line can be dropped to obtain this location. Refer to Specifications and Dimensions, figure 1 and figure 5.

ASSEMBLY OF THE PUMPING UNIT

During assembly of the pumping unit, a hoisting supervisor should be in charge of all hoisting operations and be located where he is readily visible to the hoist/crane operator and can view all of the hoisting operations.

! WARNING! All persons should exercise extreme caution and stay clear of all objects being hoisted. Review the Safety Precautions section before assembling the pumping unit. When uncrating the pumping unit, **DO NOT** remove ALL shipping retainers (wire, bolts) at one time from

all parts. To remove all shipping retainers at one time may cause some parts to shift and fall while lifting another part and could injure nearby personnel. Remove the retainers only prior to lifting each individual part from it's shipping position.

NOTE: Bolts for attaching the ladder and the pitman are installed in the attaching holes of these parts. Bolts for attaching the other parts are shipped in the boxes of parts.

NOTICE: When making the final tightening of bolts, refer to figure 3 for the specified torque values.

1. Remove shipping bolts and wire from only the part to be lifted from its shipping position. Remove parts in the following order: Samson post (weight 2000 lbs.), equalizer beam (weight 875 lbs.), box of parts, pitmans (weight 200 lbs.), ladder (weight 122 lbs.) and guard rails. The six shipping bolts shown in figure 6 are Samson post attachment bolts. Save them for future use. Lift equalizer beam to a location preparatory to attaching it to the walking beam.

! WARNING! When hoisting, make sure that hoisting sling is securely attached and the load is balanced.

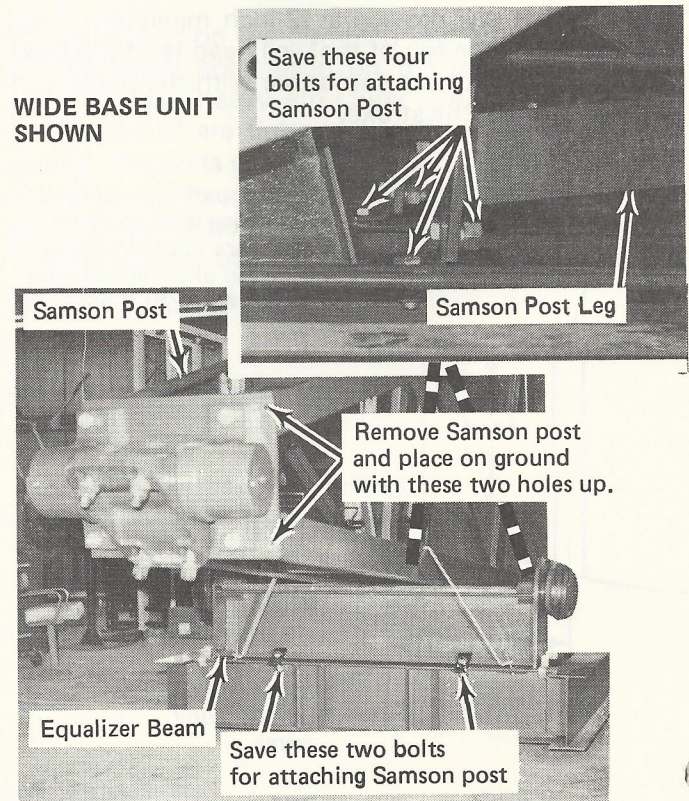


Figure 6

2. Attach hoist to each of the crated parts, remove shipping fasteners, then lift part from mainframe and place in a position suitable for assembly.

3. The walking beam is shipped as a separate unit with the horsehead installed backwards. Disconnect horsehead and reinstall it on the walking beam as shown in figure 7, supporting it with a piece of pipe. Remove shipping skids and hoist walking beam (approximately 3400 pounds) into position for attachment to equalizer beam.

4. Hoist walking beam into position over equalizer beam as shown in figure 8 and attach with bolts

called out. Use a square to position equalizer beam at right angles to walking beam.

5. Hoist pumping unit into a level position on the foundation and align it with the well head, positioning unit the correct distance from well head using alignment marks and measurements shown in figure 5.

6. To install ladder on Samson post, loosen safety loop attachment bolts and extend it. Then attach ladder to top of Samson post with two bolts shown in figure 9. Raise bottom end of ladder and install two braces between ladder and Samson post. Angles attached to bottom of ladder should be repositioned in towards Samson post.

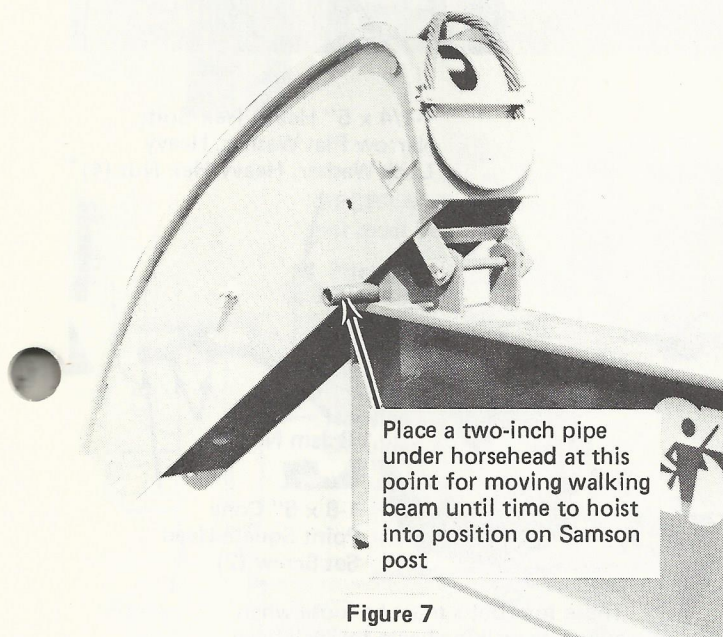


Figure 7

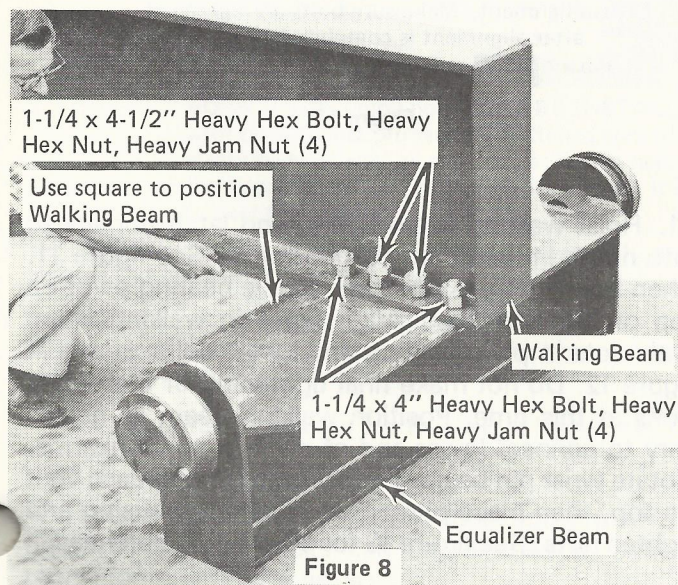


Figure 8

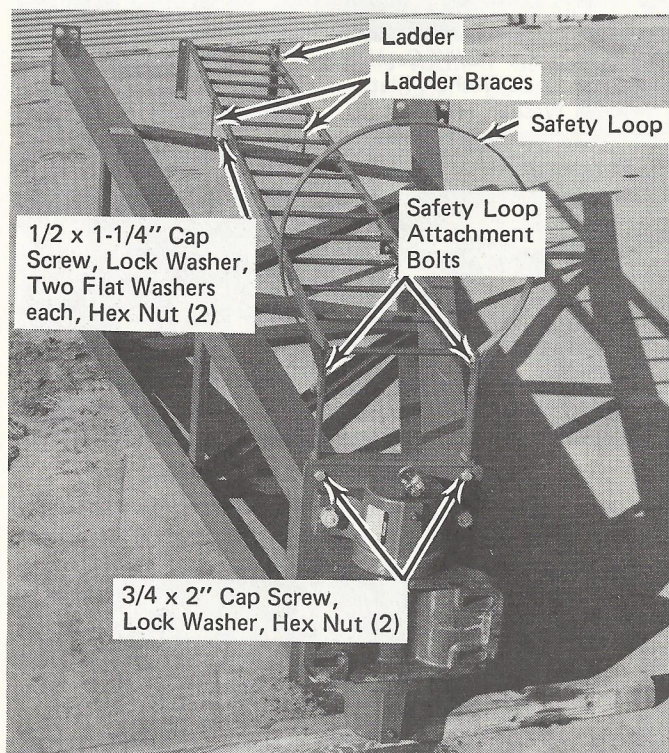


Figure 9. Ladder Installation

7. After ladder has been installed, hoist Samson post with ladder (total weight of 2122 pounds) into position on mainframe as shown in figure 10 and attach to mainframe with bolts at each leg. The bolts used to attach the equalizer beam and Samson post legs for shipment must be used to complete attachment of Samson post.

8. Attach angles at bottom of ladder to mainframe with bolts shown in figure 10. Tighten all ladder attachment bolts.

ASSEMBLY

9. Remove wrist pins from shipping box, remove cotter pin and nut. Install wrist pin in crank arms as shown in figure 38.

10. Attach pitmans to equalizer bearing housings. End of pitman with short hose attaches to equalizer. Position bearing housing so grease vent will be on top. Rotate clamping bolt heads to grasp housing and tighten nuts. See figure 13 for positioning bolt head. Remove grease fitting or pipe plug from center of equalizer housing and attach short hose on pitman.

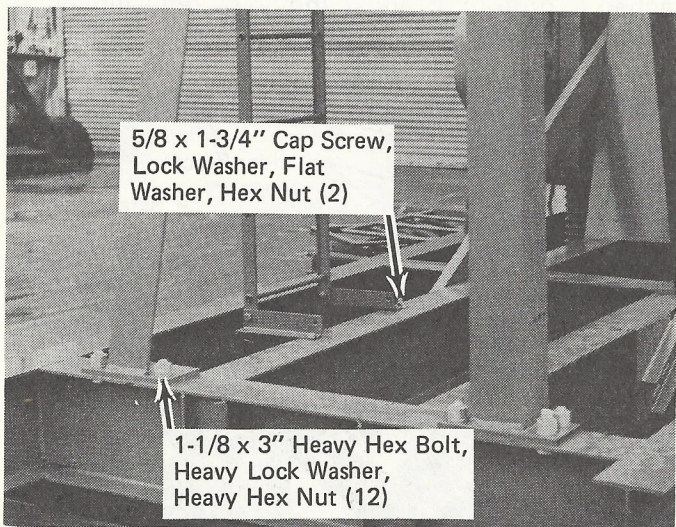


Figure 10. Installation of Samson Post

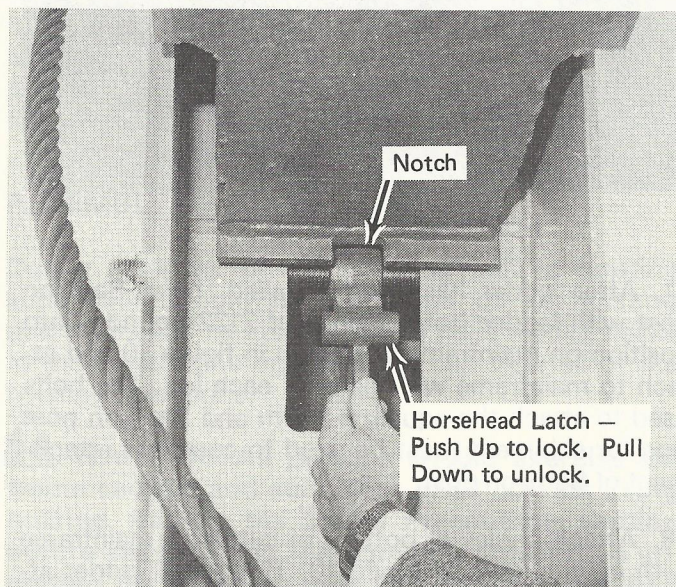


Figure 11. Locking Horsehead into Position

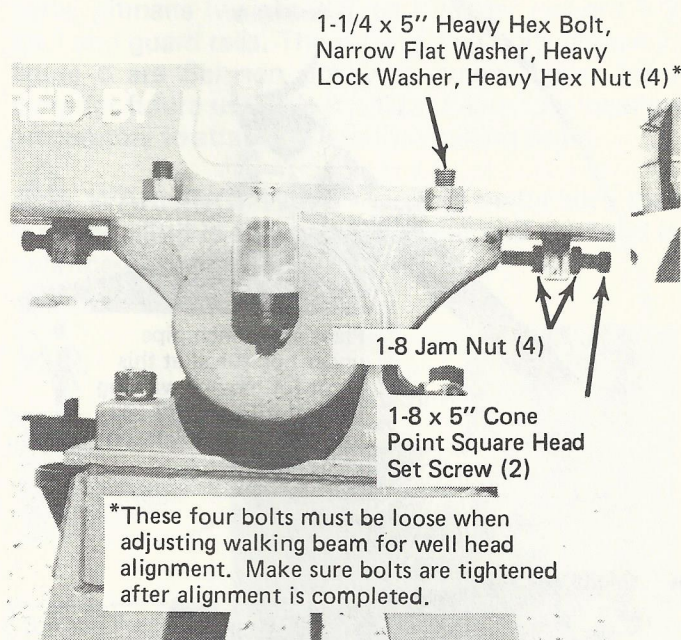
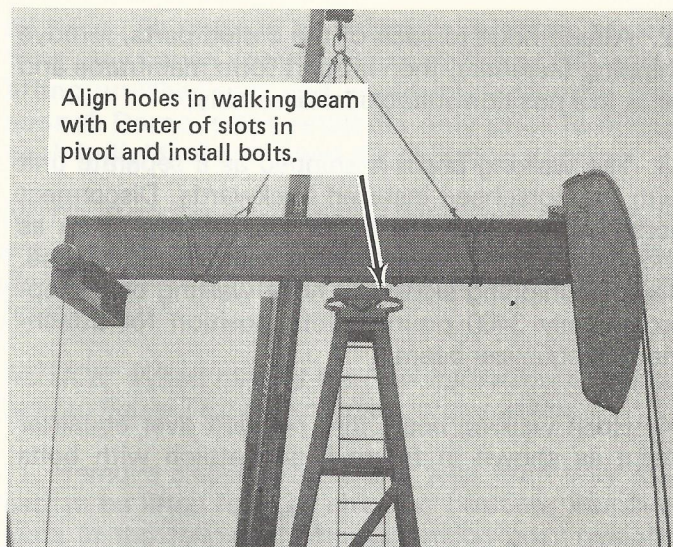
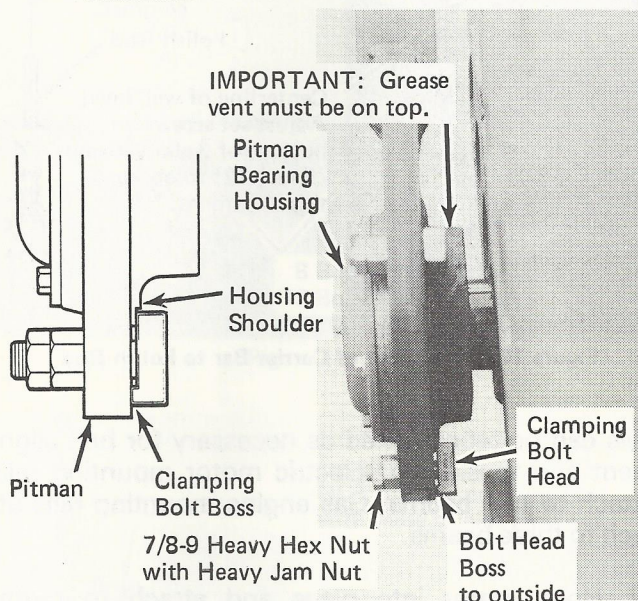
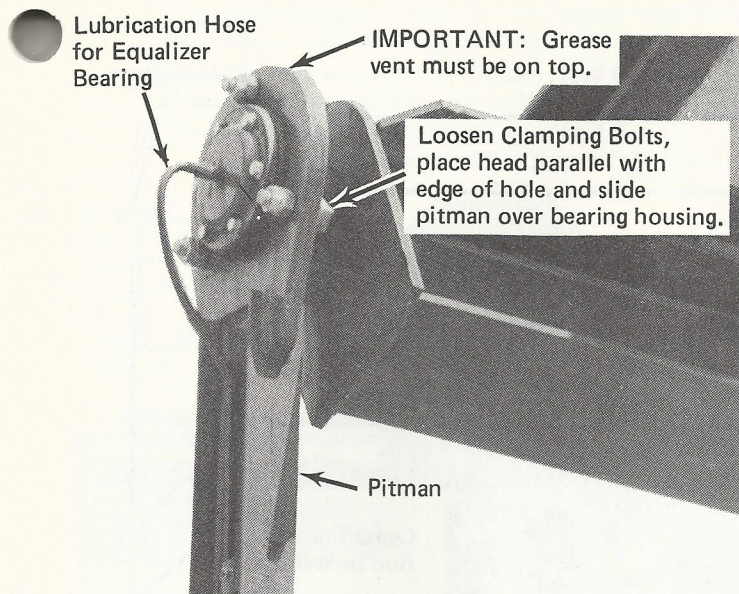


Figure 12

11. Hoist walking beam slowly and latch horsehead into notch in flange of walking beam. See figure 11. Then hoist into position over saddle bearing pivot on top of Samson post. Align holes in walking beam with slots in pivot casting and install bolts shown in figure 12. Do not make final tightening of these four bolts at this time. Position walking beam as necessary to connect lower end of pitmans to crankarms. Rotate wrist pin bearing housing to place grease vent on top, then place pitman over bearing housing and tighten nuts. See figure 13 for positioning bolt head.



NOTICE: Clamping bolt **MUST BE INSTALLED** with boss against pitman and flattened area of clamping bolt head on shoulder as shown here. If the clamping bolt is not installed as shown, it is subject to breaking.

TO REMOVE: Loosen nut, rotate clamping head away from housing and pull pitman free of housing.

TO INSTALL: Rotate clamping head away from hole in pitman, place pitman over housing, then rotate clamping head to engage housing. Tighten nuts.

Figure 13. Installation and Removal of Pitman

12. Loosen and back off brake lock bolt shown in figure 41 so that brake can be released to permit repositioning of crank arms.

13. To align horsehead and walking beam with well head, take safety precautions to assure that all personnel and debris are free of crank sweep and all other moving parts. Rotate cranks until walking beam is in a horizontal position. Engage brake and provide a positive lock for the unit. See paragraph "Safety Stops" and figure 35.

14. For alignment of horsehead with well head (or polish rod), attach a plumb line at top of horsehead and centered in groove of cable track as shown in figure 14. Using adjusting bolt per Detail A of figure 14, adjust horsehead for vertical alignment.

15. For alignment of carrier bar with polish rod or centerline of well head, drop a plumbline through centerline of carrier bar and align plumbline with centerline of well head as shown in Detail A of figure 15 or with centerline of polish rod. If adjustment is required (2-1/2-inch adjustment), loosen bolts in slotted holes of walking beam pivot (figure 12) and engage one of the adjusting bolts located at either end of the pivot casting and move the required distance. When alignment has been completed, re-tighten all bolts. After connecting polish rod to carrier bar and full weight of pump is hanging on walking beam, make a final alignment adjustment to assure that wireline is properly tracking the wire track and there is no side pull on the polish rod.

NARROW BASE FRAMES

For narrow base frames using a frame extension (straight or ell), proceed to and accomplish steps 31 through 37 to complete the set up on those units. For narrow base frames with a high prime mover electric motor mounting, proceed to and accomplish steps 38 through 49 to complete set up of those units.

WIDE BASE FRAMES

To complete the assembly of the wide base frame, accomplish the following steps 16 through 30.

NOTE: These instructions show the installation of a 60 hp electric motor. A gas engine would be installed similarly, using the bolts specified.

•On wide base frames that will have the high prime mover electric motor installed, accomplish steps 38 through 49 instead of steps 16 through 30.

16. Install motor mounting rails with clamping plates and bolts shown in figure 16. Install bolts loosely so

ASSEMBLY

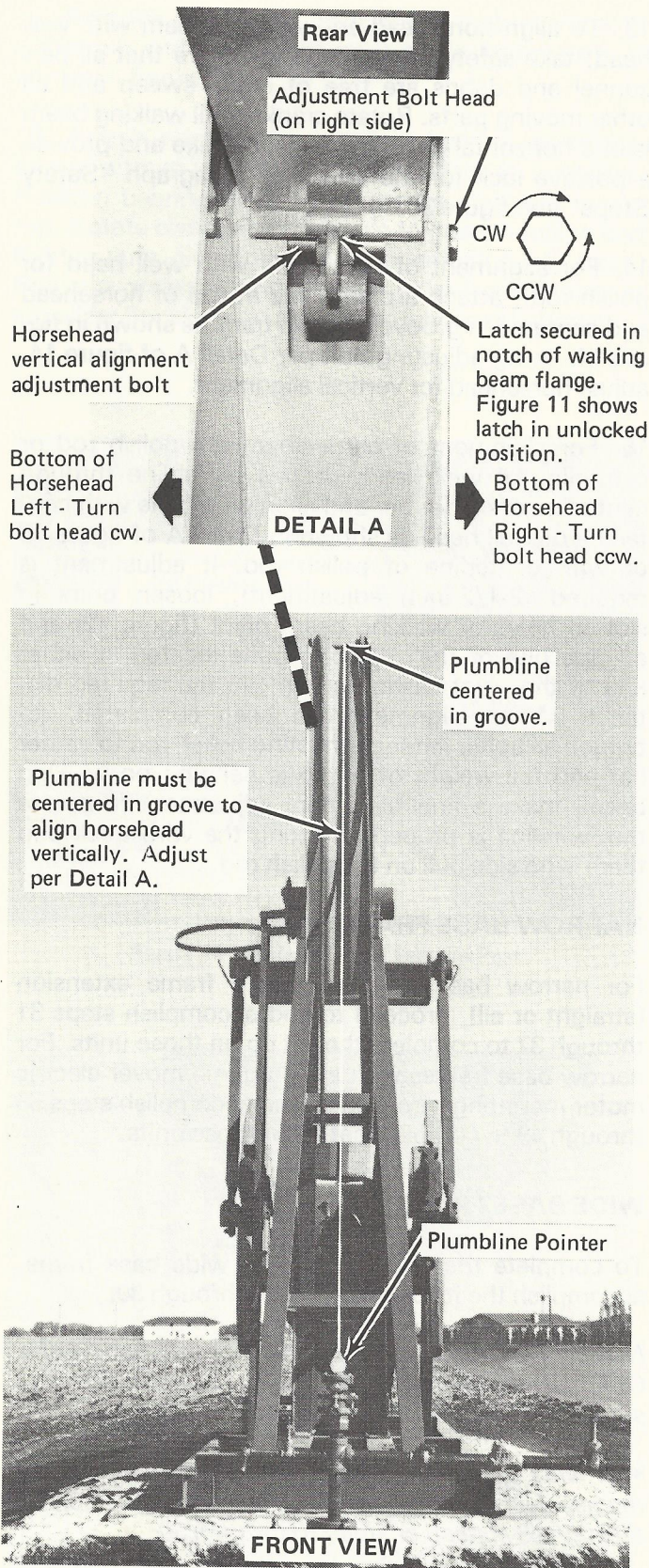


Figure 14. Horsehead Alignment

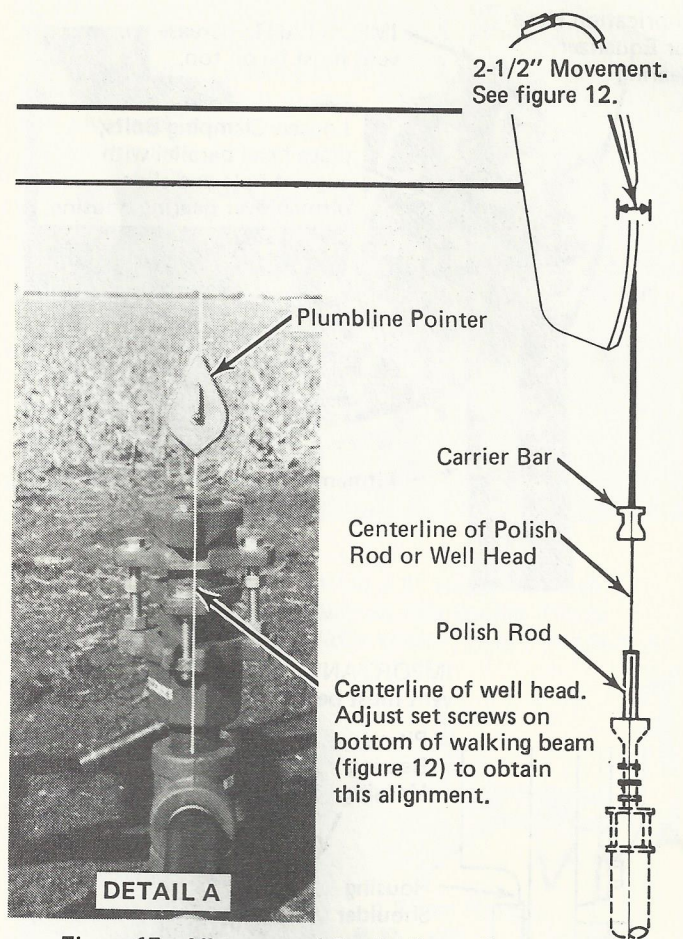


Figure 15. Alignment of Carrier Bar to Polish Rod

rails can be repositioned as necessary for belt alignment and tensioning. Electric motor mounting rails attach to two beams. Gas engine mounting rails attach to three beams.

17. Hoist motor into place and attach to motor mounting rails with square headed bolts specified in figure 16. Do not tighten these bolts at this time.

18. Install appropriate size sheave on motor shaft if not already installed. Position motor so belt grooves on motor sheave align with belt grooves on drive sheave on the gear reducer (figure 17). Install four matched Type C-section V-belts and pull motor rearward to snug up belts.

19. With motor and belts approximately aligned, install drawbolt and drawbolt support as shown in figure 18. Adjust jam nuts on drawbolts to tension belts as specified by the belt manufacturer. Take deflection and force reading in mid-span of belt. During belt tensioning, make final sheave alignment: grooves of

- 1 Electric Motor – 5/8 x 2-1/2" Square Head Bolt, Heavy Lock Washer, Heavy Hex Nut (12)
- 2 Gas Engine – 3/4 x 3" Square Head Bolt, Heavy Lock Washer, Heavy Hex Nut (16)
- 3 Gas Engine – 7/8 x 4" Square Head Bolt, Lock Washer, Hex Nut (6). Optional to 2.

- 1 2 4 Bolts
- 3 6 Bolts with Narrow Flat Washer each

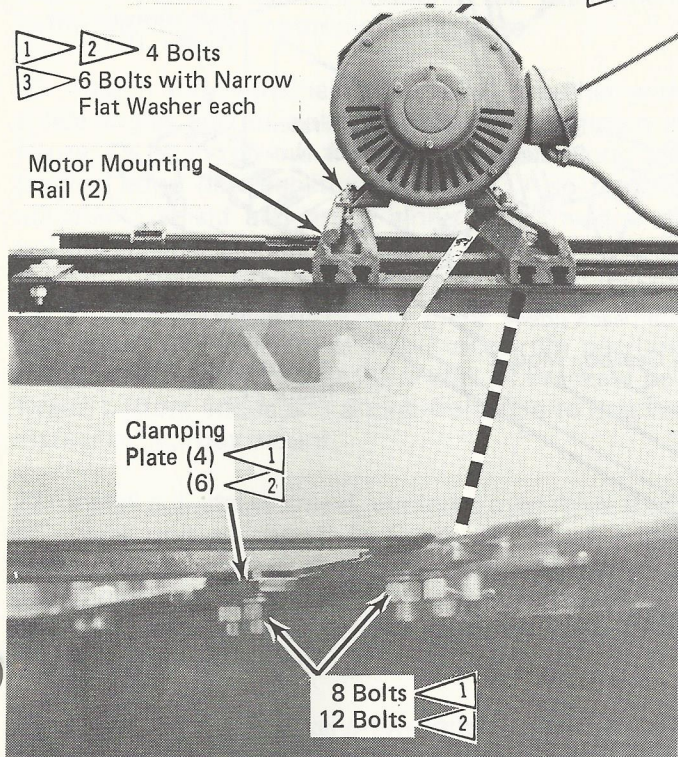


Figure 16.

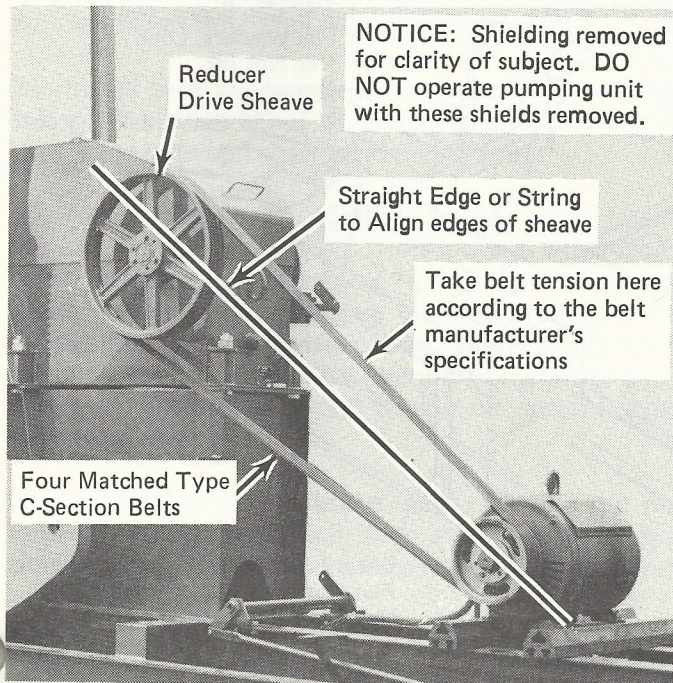


Figure 17

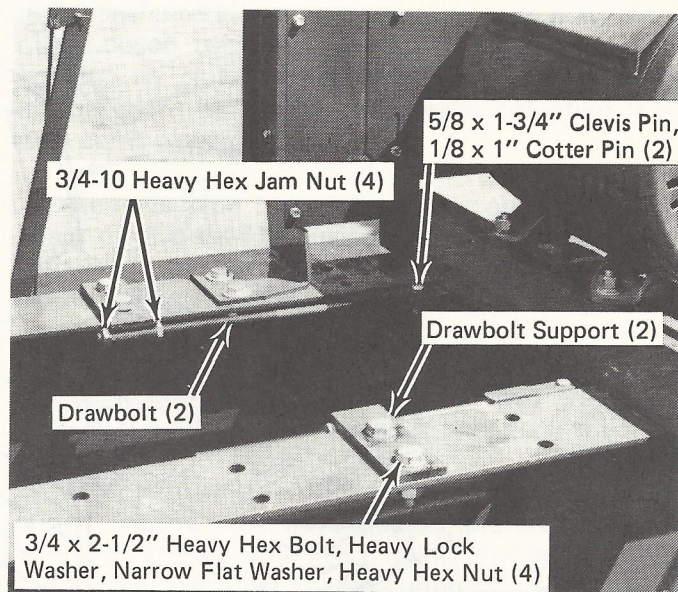


Figure 18

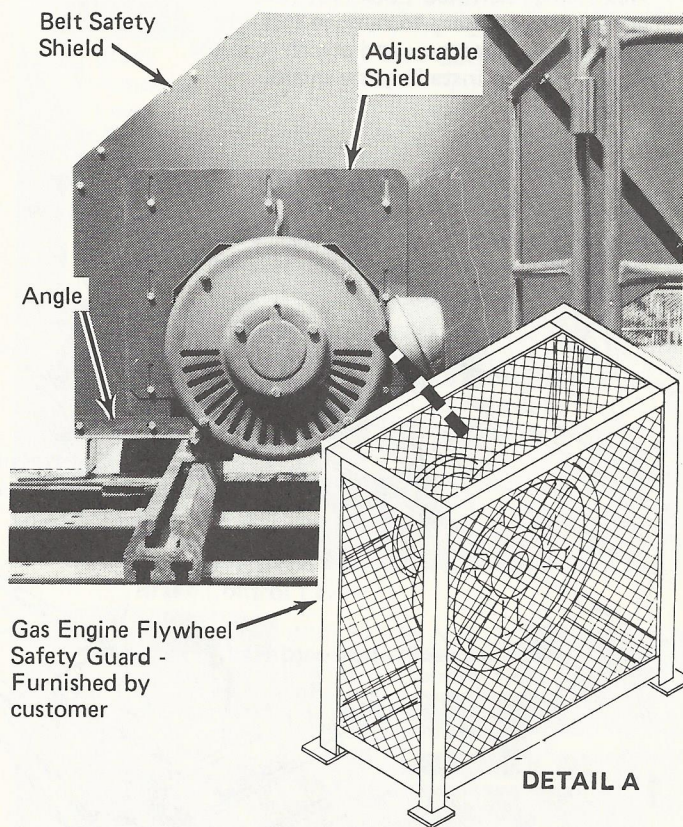


Figure 19

SAFETY NOTE: Flywheels on gas engines for pumping units should be guarded by enclosures. The design of this enclosure should permit temporary access to the flywheel when necessary for engine starting. See detail A of figure 19 for an example.

ASSEMBLY

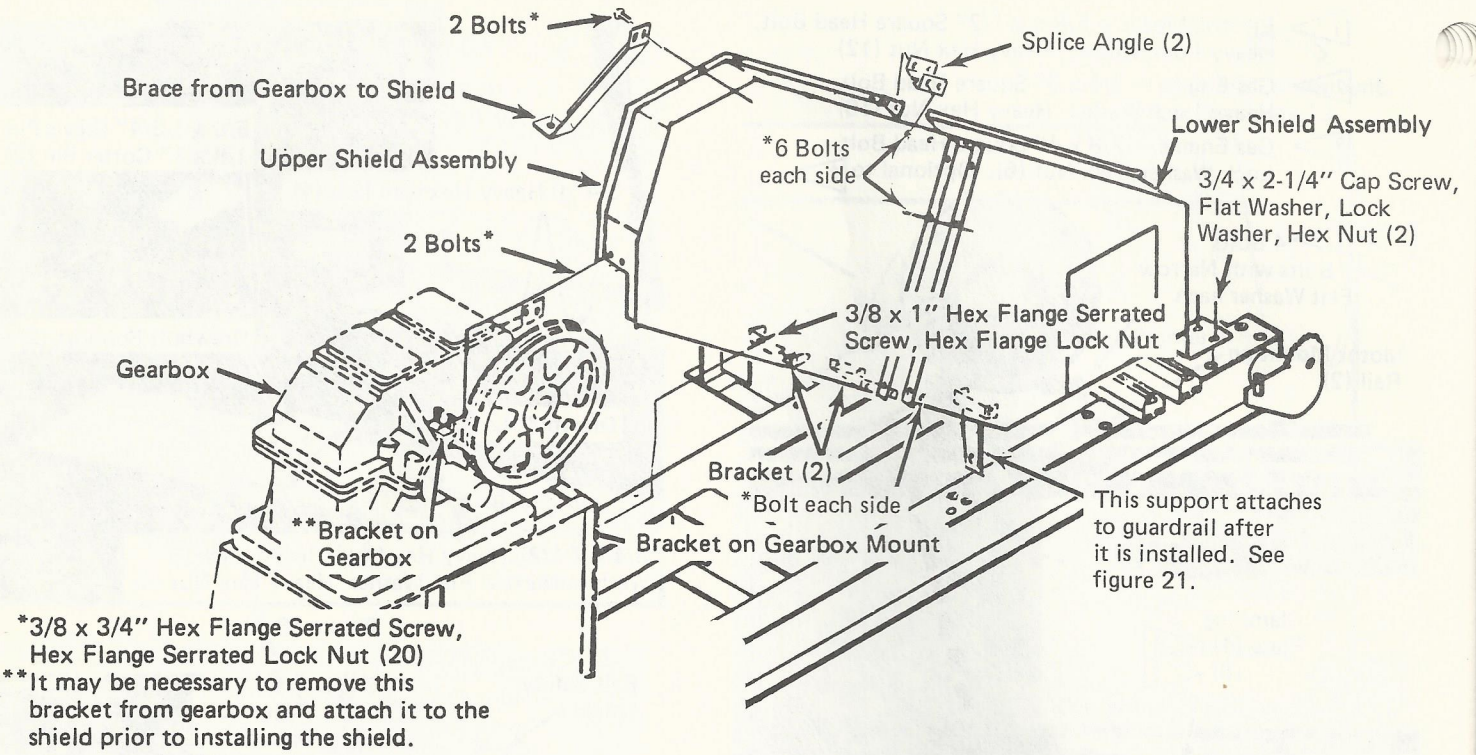


Figure 20

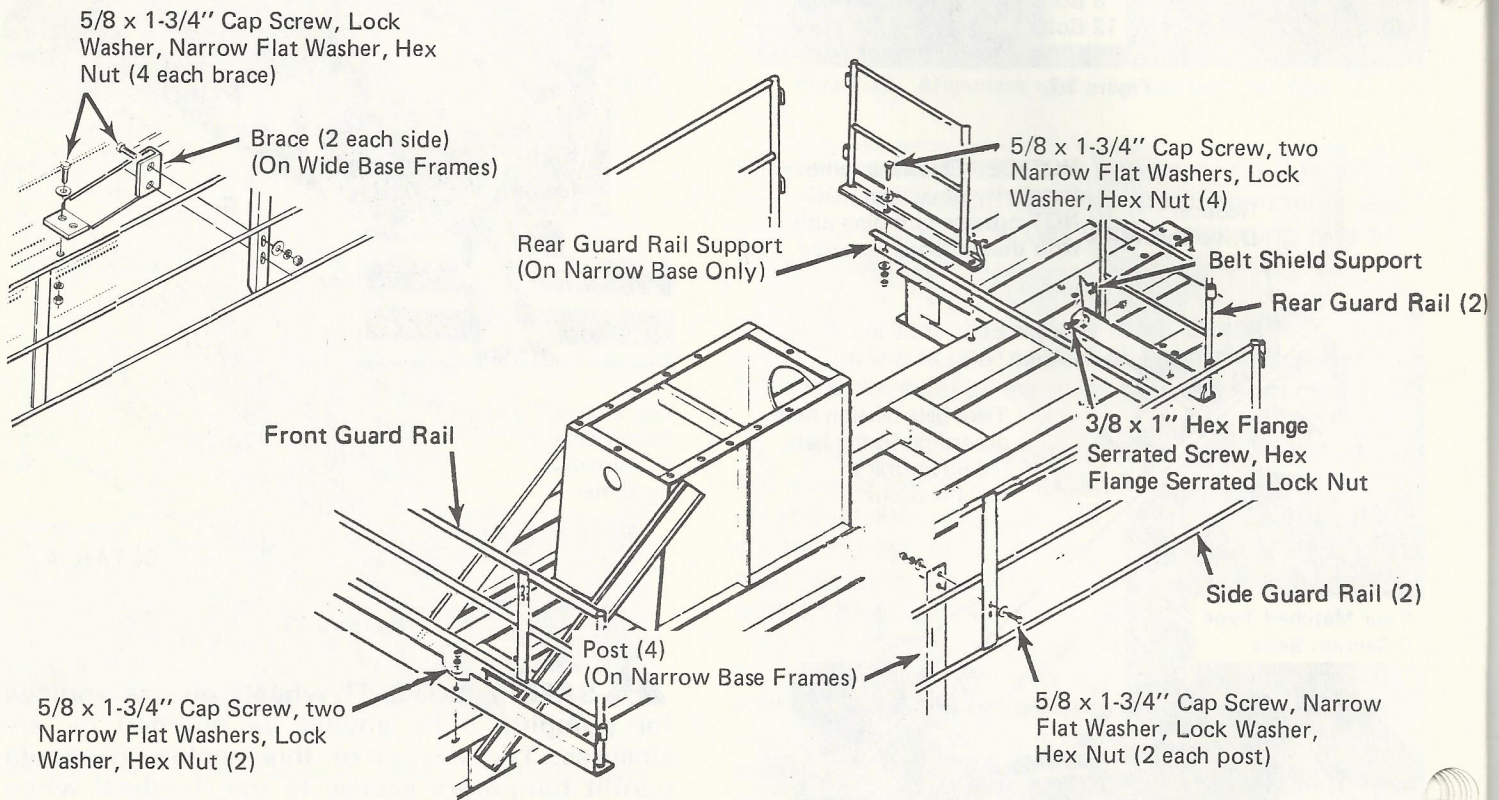


Figure 21

both sheaves must align and motor shaft must be parallel with drive sheave shaft. A straight edge or string stretched across the edges of the sheaves can be used to align the sheaves. Check that belt grooves are in alignment. With belts properly tensioned and aligned, tighten motor mounting rail attachment bolts, then tighten motor mounting bolts.

20. Attach the two shield assemblies together with splice angles and six bolts on each side as shown in figure 20. Then remove the three brackets along the bottom edge between the two sides. Also remove adjustable shield and angle along bottom edge of bottom shield assembly.

21. Hoist shield assembly into place over the belts and attach at each end and to brace from gearbox with bolts shown in figure 20. Install all brackets between bottom edges and attach front one to bracket on rear of gearbox mount.

22. Install adjustable shield, centered over drive shaft of power unit as shown in figure 19. Install angle along bottom edge of shielding if removed. When a gas engine has been installed, customer should furnish safety shielding to enclose an exposed flywheel and other moving parts.

23. Install front guard rail on mainframe near centerline of Samson post with two bolts and two rear guard rails at rear end of mainframe with two bolts each as shown in figure 21. Attach lower belt shield support to left guard rail with one bolt shown.

24. Install side guard rail on each side by inserting railing pins into socket of end railings. Then install side brace between railing and mainframe.

25. Attach brake control lever to ratchet with a bushing and bolt. See figure 22. Route brake cable from brake assembly on gearbox, under belt shield to brake control lever. Remove one nut from end of cable housing at control lever end. Then insert end of cable through holes in cable support bracket and install nut. Attach cable pull to link on control lever with two nuts.

26. On gearbox end of brake cable, install a nut on threaded end of cable pull, then attach cable extension and lock it with nut. Install a nut on threaded end

of extension and attach clevis and lock it with the nut. Loosen cable housing nuts and attach cable housing to slot in brake assembly. Tighten nuts against slot. Attach clevis to brake actuating lever with clevis pin and cotter pin.

27. Remove pipe plug from either end of walking beam pivot bearing housing and install pipe nipple, elbow and oil level gauge shown in figure 23. Fill pivot bearing housing with lubricant per Lubrication section.

28. Lubricate both pitmans through two grease fittings near the bottom end. See Lubrication section.

29. Gear reducer is shipped from the factory with the correct lubricant. Remove dipstick and check that oil level is at or above the FULL mark. If oil is below the LOW mark, add lubricant per Lubrication section.

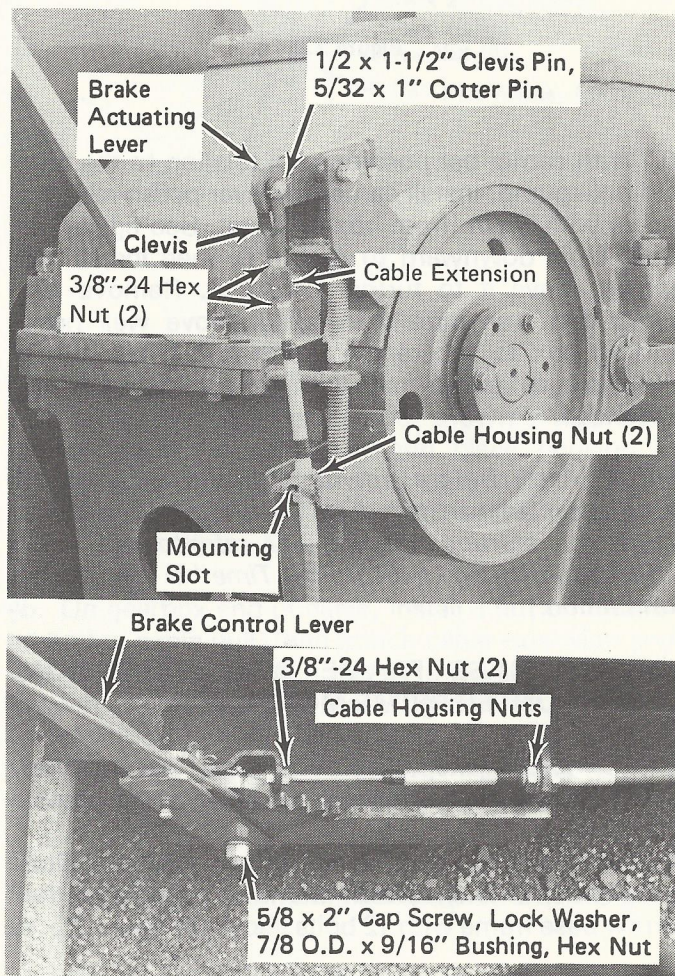


Figure 22

ASSEMBLY

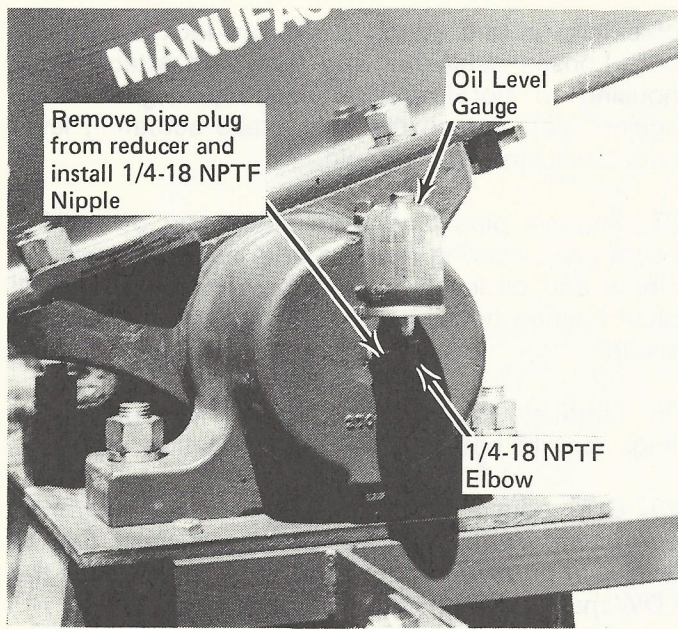


Figure 23

30. With carrier bar positioned in relation to the bottom hole pump, install carrier bar over polish rod and secure with T-pin (from box of parts). See figure 24. Drive T-pin downward to secure it, then install rod clamps above it to further secure it. Remove rod clamp that was initially installed above well head stuffing box to secure the pump rod. Then check alignment of polish rod with wireline track over horsehead.

IMPORTANT: Before operating pumping unit, remove rod clamp installed above well head stuffing box. Before starting pumping unit, refer to paragraph "Starting Pumping Unit for First Time" in the Operation section.

NARROW BASE FRAME WITH EXTENSION (LOW MOUNTED PRIME MOVERS)

After completing steps 1 through 15 of "Assembly of the Pumping Unit," proceed with the following steps.

31. Remove all items bundled to the frame extension for shipment. Then attach frame extension to the narrow base frame with 12 bolts shown in figure 25.

32. Remove shipping bolts securing engine or motor mounting rails to frame extension. Then accomplish assembly steps 16 through 19 as applicable to a gas engine or electric motor. Check that belts are in align-

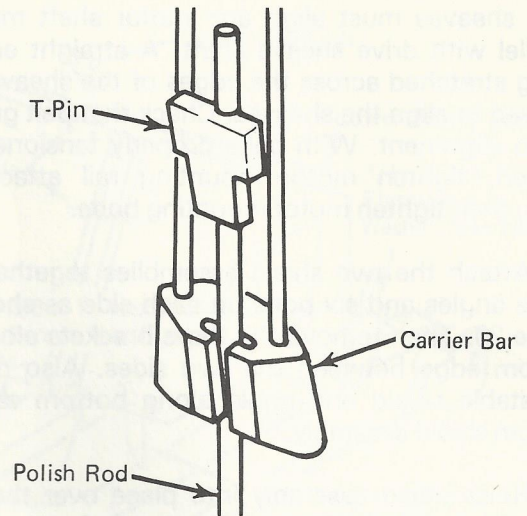


Figure 24

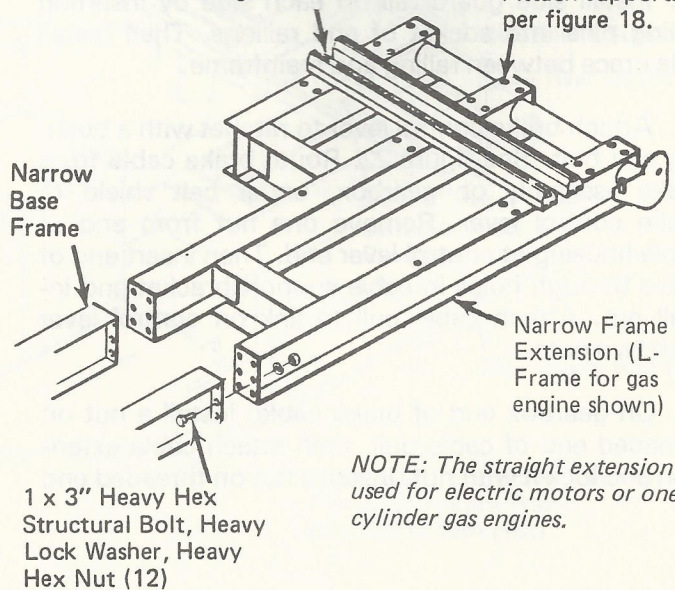
ment and properly tensioned before proceeding to the following step.

33. Install belt shields per steps 20 through 22.

34. Place rear guard rail support under belt shield and install two rear guard rails as shown in figure 21. Attach lower belt shield support to left guard rail with one bolt shown. Install front guard rail near centerline of Samson post with two bolts.

Prime Mover Mounting Rails - Attach with clamping plates and bolts shown in figure 16.

Drawbolt Support Attachment Holes Attach supports per figure 18.



NOTE: The straight extension is used for electric motors or one-cylinder gas engines.

Figure 25

35. Install side guard rail on each side by inserting pins on each end into sockets of end guard rails as shown in figure 21. Install two posts on each side of unit to support side guard rails. Attach with two bolts each.

36. Install brake control lever and cable per steps 25 and 26.

37. Complete assembly steps 27 through 30.

NARROW BASE FRAME WITH HIGH PRIME MOVER ELETRIC MOTOR

After completing steps 1 through 15 of "Assembly of the Pumping Unit" proceed with the following steps.

38. Remove all items from the high prime mover frame shipping bundle. Then attach the right and left high prime mover frames to the holes in the flange on each side of the gearbox mounting stand with bolts shown in figure 26. Tighten bolts to torque values specified in figure 3.

39. Attach high prime mover frame cross member to ends of left and right high prime mover frames with bolts specified in figure 26.

40. Place motor mounting rails on high prime mover frame as shown in figure 26 and attach loosely with clamping plates hooked under the flanges of the high prime mover frame. Refer to steps 16 through 19 of "Assembly of the Pumping Unit" as applicable for an electric motor for bolts and parts used except that drawbolt supports are not used to anchor the drawbolts on the high prime mover configuration. The drawbolts anchor to the high prime mover frame cross member as shown in figure 26. Check that belts are in alignment and properly tensioned before proceeding to the following step.

41. Attach shield support bracket to top of left high prime mover frame with bolt shown in figure 27.

42. Remove bracket from between bottom lower edges of belt shield shown in figure 27. Then hoist belt shield into position over belts and attach to high prime mover frame and gearbox with bolts called out in figure 27. Install bracket and attach to support bracket on top of left high prime mover frame.

43. Attach brake control lever to ratchet with bolt and bushing per figure 28.

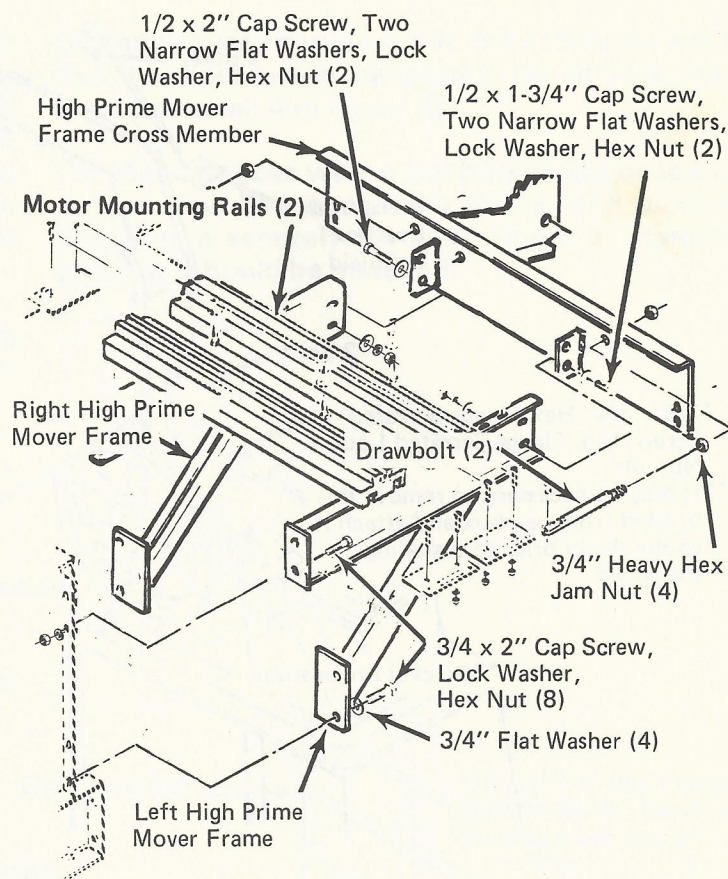


Figure 26

44. Insert brake cable from front side through hole in high prime mover cross member shown in figure 28. Loosen cable housing nuts and place housing in mounting slot, then tighten nuts against slot. Install a nut on end of cable pull and attach to link on control lever with another nut.

45. On gearbox end of cable, install a nut on threaded end of cable pull, then attach cable extension and lock it with nut. Install a nut on threaded end of extension; then attach clevis and tighten nut against it. Loosen housing nuts and install housing in mounting slot on brake assembly. Tighten nuts against slot. Attach cable clevis to brake actuating lever.

46. Attach an end guard rail to high prime mover frame cross member with four bolts shown in figure 29.

47. Install the other end guard rail near the centerline of the Samson post with two bolts.

ASSEMBLY

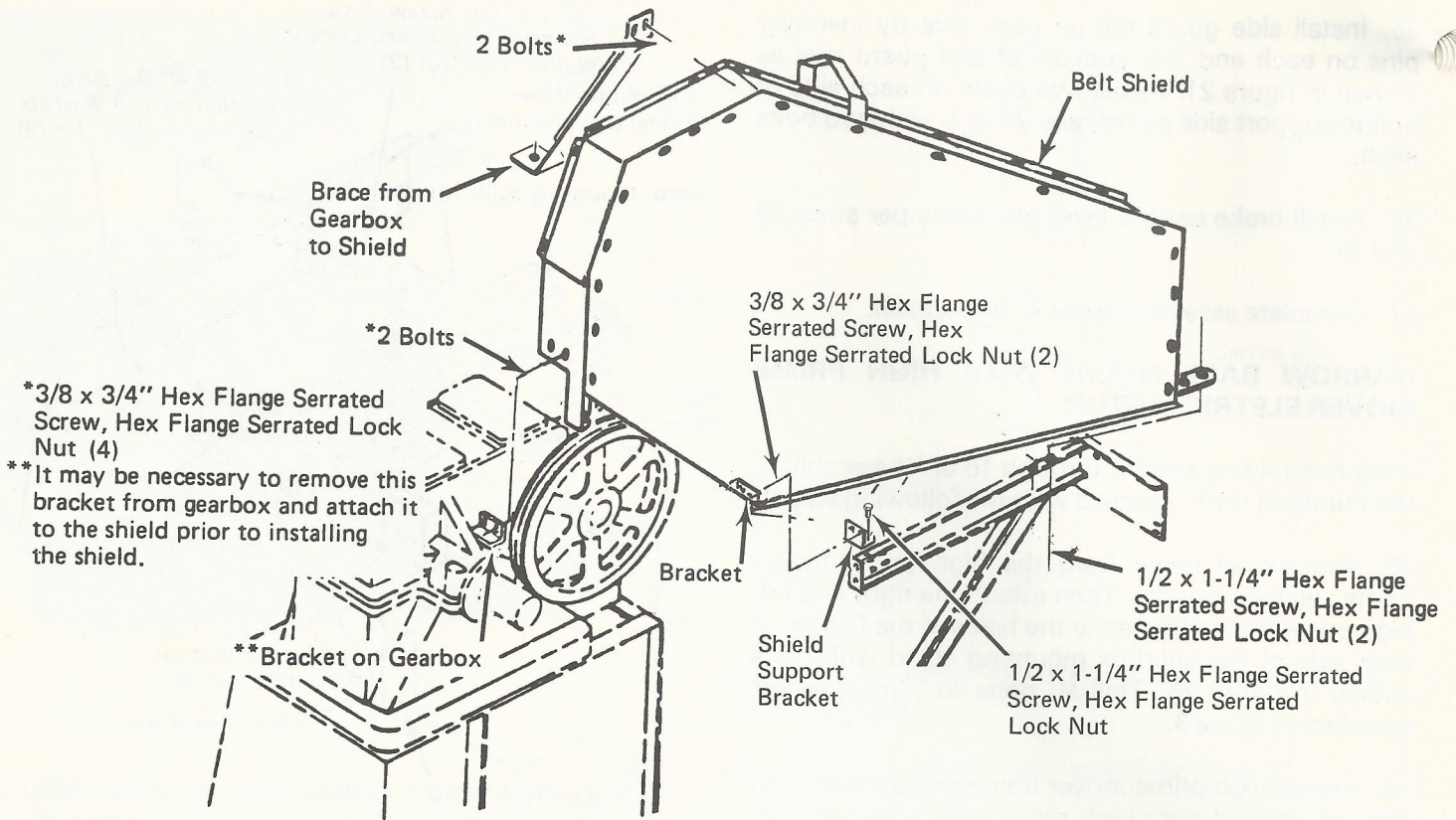


Figure 27

48. Install side guard rail on each side by inserting pins on each end into sockets of end guard rails as shown in figure 29. On narrow base frames, install two posts on each side of unit to support side rail. Attach with two bolts each. On wide base frames, install braces between frame and side guard rails.

49. Complete assembly steps 27 through 30.

GUARDING THE PUMPING UNIT

The pumping unit was designed to comply with the API safety standards, Guarding of Pumping Units, API RP11ER existing at that time. Due to conditions prevalent at the pumping site, it is recommended that the owner of the pumping unit comply with the following safety requirements:

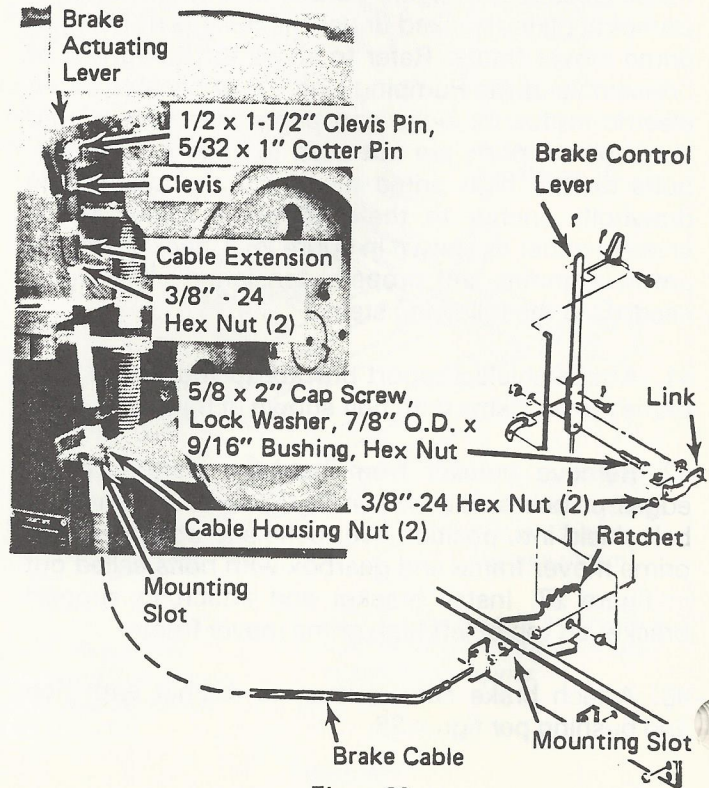


Figure 28

"Where unattended locations present close exposure to a community of people, safety barriers, such as provided by a totally enclosed and locked perimeter, may be required. Equipment may be considered to be guarded by location when in an enclosed area with a locked entrance. The area should have either walls or a fence of a minimum height of 96 inches."

this enclosure should permit temporary access to the flywheel when necessary for engine starting." See detail A of figure 19.

"In the instances where the horsehead descends to less than 84-inches from the ground or work platform, a securely fastened single or standard guardrail should be installed."

"Flywheels on gas engines for pumping units should be guarded by enclosures. The design of

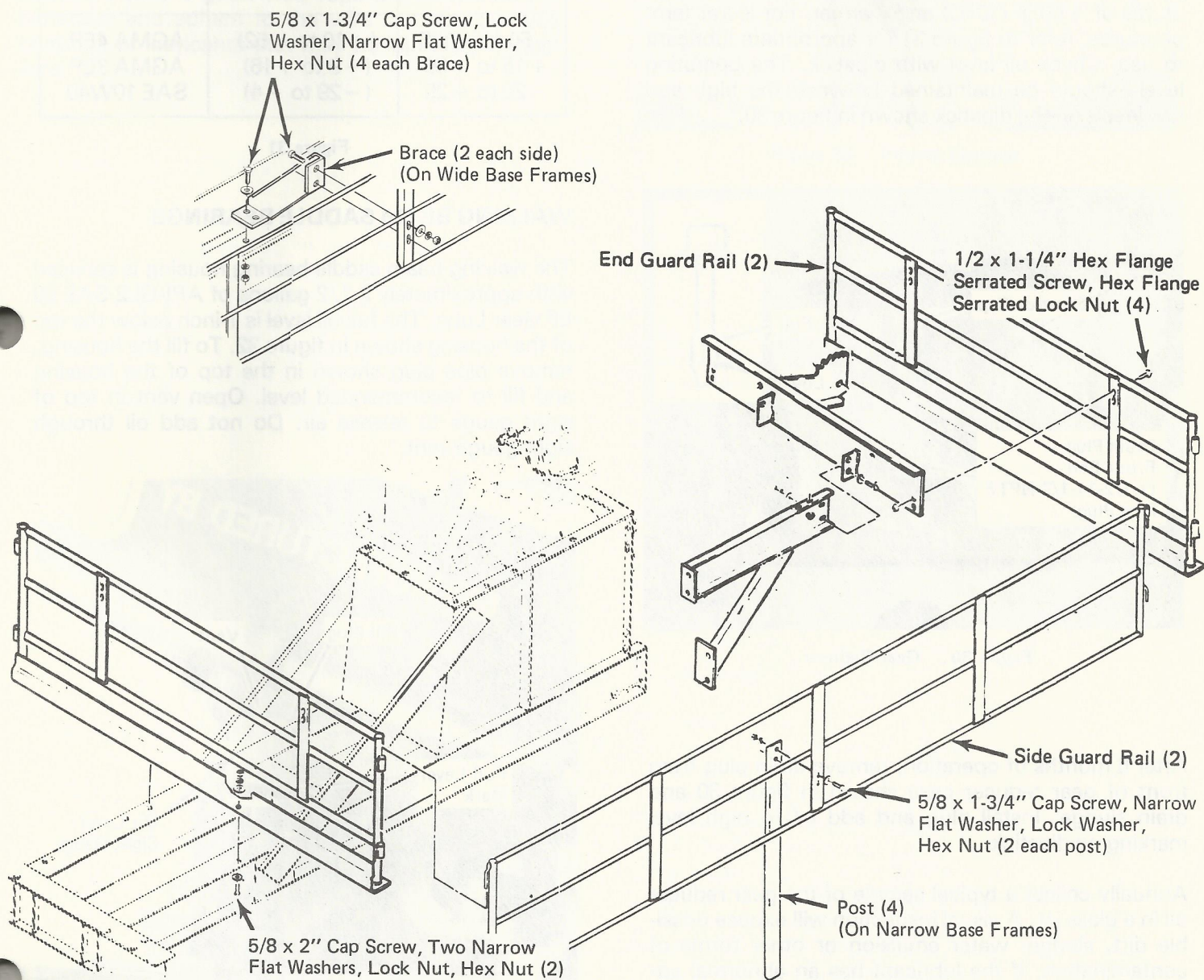


Figure 29

LUBRICATION

GEAR REDUCER

The gear reducer is serviced at the factory with 34 gallons of AGMA 4EP oil suitable for ambient temperatures of +50°F (10°C) and warmer. For lower temperatures, refer to figure 31 for appropriate lubricant to use. Check oil level with dipstick. The operating level should be maintained between the high and low levels on the dipstick shown in figure 30.

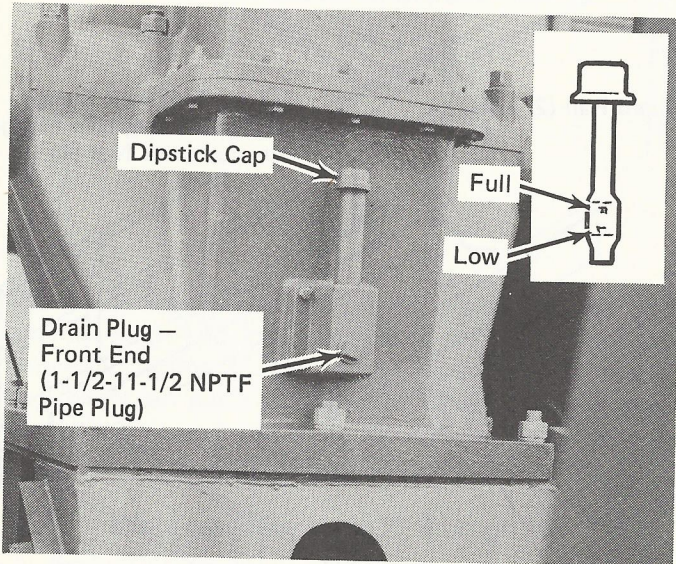


Figure 30. Gear Reducer

After 6 months of operation, remove drain plug from front of gear reducer case shown in figure 30 and drain sludge. Install plug and add oil to high level marking on dipstick.

Annually collect a typical sample of the gear reducer oil in a glass jar. A visual inspection will expose possible dirt, sludge, water emulsion or other forms of contamination. If the lubricant has an abnormal appearance or smell, check with oil supplier about replacement.

RECOMMENDED LUBRICANT FOR VARIOUS SURROUNDING TEMPERATURES		
Degrees ° F	(Degrees ° C)	Use Oil Grade
+ 50 to + 125	(+ 10 to + 52)	AGMA 4EP
+ 15 to + 60	(- 9 to + 16)	AGMA 3EP
- 20 to + 25	(- 29 to - 4)	SAE 10W40

Figure 31

WALKING BEAM SADDLE BEARINGS

The walking beam saddle bearing housing is serviced with approximately 2-1/2 gallons of API-GL2 SAE 90 EP Gear Lube. The full oil level is 1-inch below the top of the housing shown in figure 32. To fill the housing, remove pipe plug shown in the top of the housing and fill to recommended level. Open vent in top of sight gauge to release air. Do not add oil through sight gauge vent.

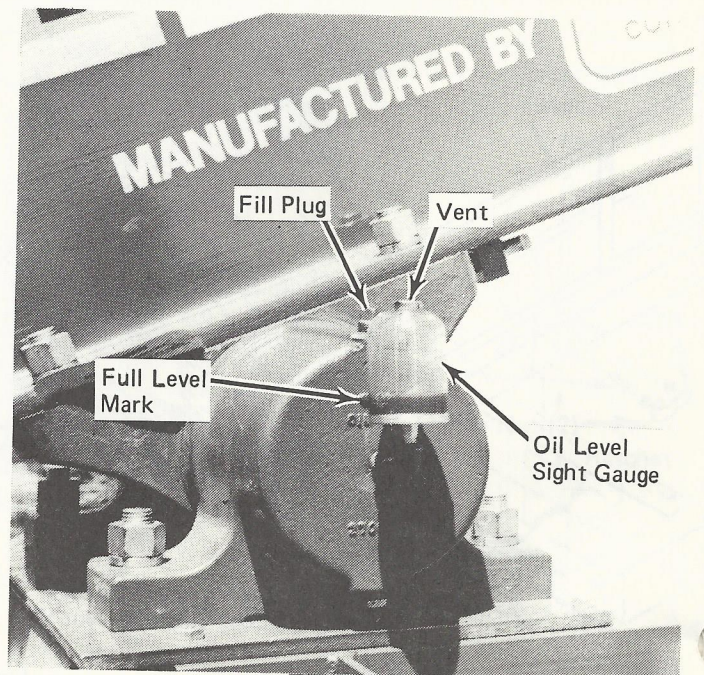


Figure 32

PITMAN BEARINGS

Lubricate pitman bearings weekly through two grease fittings on each side of the pumping unit. Use grease called out in figure 33. Surplus grease will be expelled through a vent on the inside of the bearing housing. Should grease discharge around the bearing shaft, disassemble bearing and housing, clean vent and install new seals.

WIRE LINE

Clean the wire line by wire brushing; do not use a solvent. Apply a good wire rope lubricant that will penetrate and adhere to the wire line. Do not use crude oil or lubricants that may be injurious to steel wire.

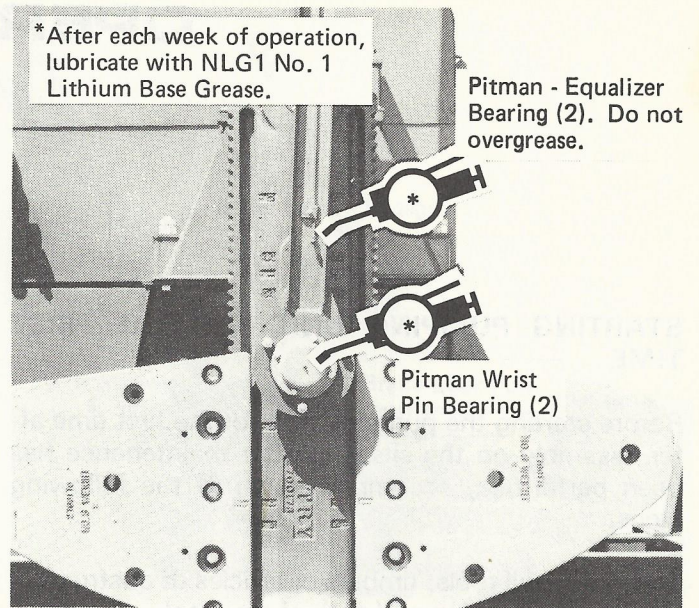


Figure 33. Pitman Bearings


OPERATION

STARTING PUMPING UNIT FOR THE FIRST TIME

Before starting the pumping unit for the first time after assembly on the site and after maintenance has been performed, accomplish each of the following steps.

1. Remove all tools, timbers or articles of obstruction from the foundation and path of the cranks.
2. Check to be certain that all safety guards, shields and railings are properly installed. Safety rules state that all guards and safety devices must be in place before operation begins. See paragraph "Guarding the Pumping Unit."
3. Check for proper lubricant levels in the gear reducer and walking beam saddle bearing pivot. See Lubrication section.
4. Check that bearings at both ends of pitman are lubricated. See Lubrication section.
5. Check that power unit is properly installed and that belts are in alignment and properly tensioned.
6. Check that all bolts have been properly tightened per figure 3. All bolts should be checked and retightened after the first 24 hours of operation.
7. Check counterbalance adjustment. Refer to "Counterbalance Adjustment" under Maintenance to determine an acceptable method of performing this adjustment.
8. Before attempting to start the pumping unit, disengage brake and remove all safety stops. Check that shipping bolt in brake assembly is disengaged and permits proper operation of brake.
9. Make first revolution of crank arms as slow as possible in order to properly check clearance between cranks, belt guards, pitmans, railings and any safety structure installed around the pumping unit. Also,

during first stroke, the bottom hole spacing should be checked. Then check alignment of polish rod with wireline track. Readjust as necessary per figure 15.

 **WARNING!** Stay clear of rotating cranks and counterweights and parts that may start moving, otherwise serious personal injury may occur.

CHECKLIST PRIOR TO STARTING PUMPING UNIT EACH TIME

- _____ Check oil level of gear reducer per Lubrication section.
- _____ Check saddle bearing for leakage.
- _____ Check pitman and equalizer for proper installation. Lubricate bearings per Lubrication section.
- _____ Check tension of drive belts.
- _____ Visually check for loose bolts, parts and any excessive wear areas.
- _____ Check drive belt safety shields, safety railings and other safety devices for proper installation.
- _____ Check that appropriate items under "Preventive Maintenance" and "Scheduled Maintenance" have been performed.
- _____ Visually check wire line for wear and tracking. Correct as necessary.
- _____ Make a visual alignment check of pumping unit with well head. Correct as necessary.

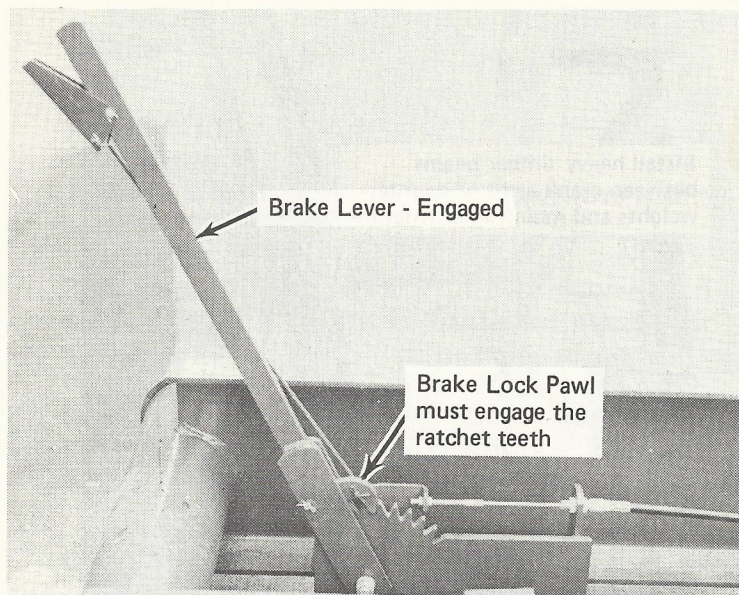
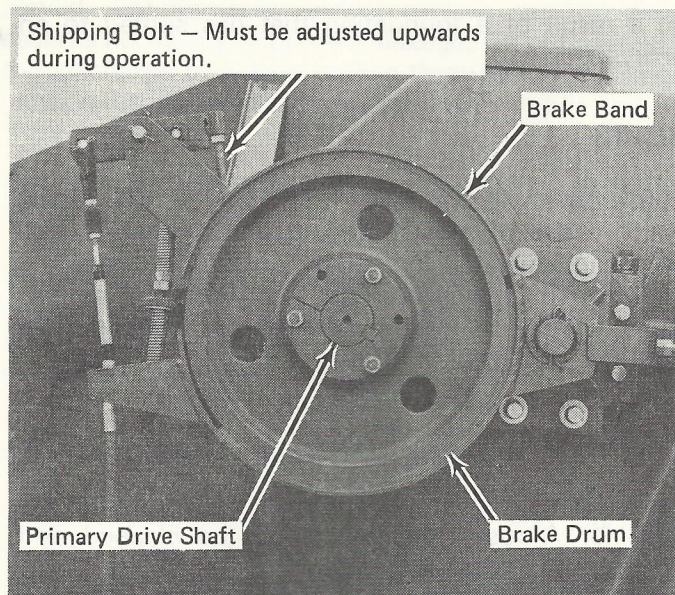


Figure 34

BRAKE SYSTEM

The brake system consists of a drum and brake band on the right end of the primary drive shaft of the gear reducer and a control lever and linkage. Any time the pumping unit is stopped, the brake should be engaged by placing the brake lever in the engaged position

shown in figure 34 and engaging the brake lock located at the bottom of the lever.

! WARNING! When checking, servicing or performing maintenance, install safety stops per figure 35 to prevent injury due to accidental rotation of the crank arms. DO NOT depend on the brake as a safety device.

MAINTENANCE

SAFETY STOPS

! WARNING! To prevent accidental injury to nearby persons, install safety devices to prevent movement of crankarms or walking beam.

American Petroleum Institute's publication, API RP11ER section on Equivalent Safety states that: "The pumping unit brake is not intended as a safety stop but is intended for operational stops only. When

operations or maintenance are to be conducted on or around a pumping unit, the position of the crankarms and counterweights should be securely fixed in a stationary position by chaining or other acceptable means." (All statements with reference to the American Petroleum Institute are reprinted by permission from the American Petroleum Institute "Guarding of Pumping Units" API RP11ER, first edition March 1976.)

MAINTENANCE

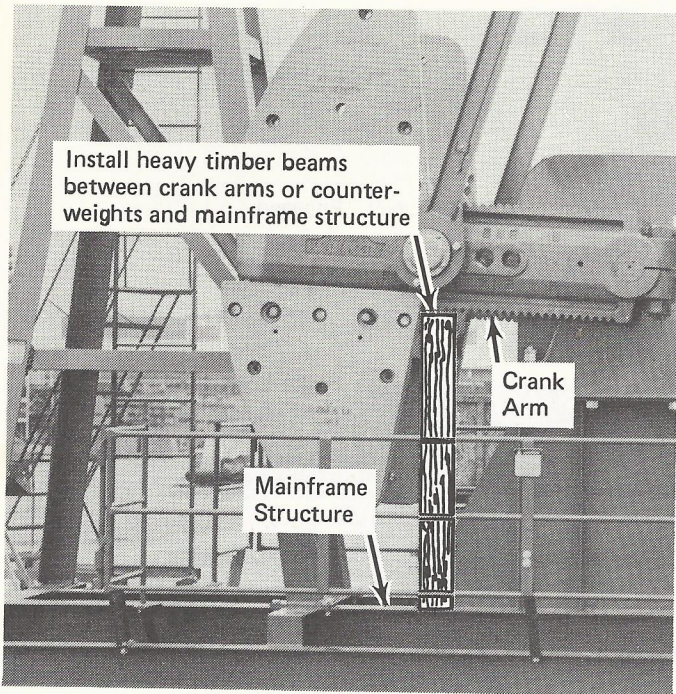


Figure 35

Safety stops such as heavy timbers should be placed between the crank arms and a structural member of the mainframe as shown in figure 35 to prevent rotation any time personnel are in the vicinity of moving parts. Due to the large size of the parts involved, it must be pointed out that the safety devices must be securely installed against an adequate retainer and of sufficient size and strength to retain the weight and force. Chains or cables may be used, provided they can be securely attached and in a manner that will not result in damage to the securing part.

PREVENTIVE MAINTENANCE

With periodical preventive maintenance according to the recommended schedule, the life of the unit will be prolonged and costly down time will be prevented. Visual and audio inspections can be made on any of the items routinely.

ALIGNMENT

Alignment of the unit can be checked visually by comparing the distance between the pitman and cranks on each side of the unit. Also, check to see that the wireline is tracking in the center of the horse-head. A change in alignment can be caused if the base shifts on the foundation. Misalignment can also

be a result of a foundation that has settled to an unlevel position.

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. Bolts should be retightened as recommended in figure 3 at the front of this manual.

WIRELINE

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

BELTS

Belt alignment and tension should be checked and adjusted to prolong belt life per belt manufacturer's recommendation.

BRAKE

Brake lining should be inspected for wear and clearance adjustment. When the brake control lever is fully engaged, there should be several teeth left on the ratchet. If adjustment is required, refer to "Brake Adjustment" in the Maintenance section.

GEAR REDUCER

The gear tooth condition should be checked periodically for abnormal wear. Score marks on the teeth are an indication that the film thickness of the oil is not sufficient for the loads imposed. Score marks are vertical marks on the teeth from the top of the teeth to the root. A frequent visual inspection for oil leakage from the gear reducer should be made. When leakage occurs, check oil level and add oil as necessary. Make necessary corrections to prevent leakage.

PITMAN BEARINGS

Visually inspect bearing housings at both ends of pitman for grease leakage around the shaft. Also observe bolts and cap on the outside for looseness and grease leakage. When leakage or looseness is ob-

served, tighten bolts and/or replace gaskets and seals as necessary to prevent leakage. Do not mistake the discharge of excess grease through the housing vent on the inside surface as seal leakage.

WALKING BEAM SADDLE BEARING RESERVOIR

Visually inspect for oil leakage between the walking beam pivot and the bearing housings on each side. Any leakage will indicate the need for seal replacement in the bearing housing.

CRANK ARMS AND COUNTERWEIGHTS

Check that crank arm clamping bolt and key are secure. There should not be any evidence of movement between drive shaft and crank arm and key. Check security of counterweight attachment bolts and that counterweight movement pinions are securely locked. Pinion locking bolts are screwed in (CW) to lock. Also check security of crank pin nut and cotter pin.

SCHEDULED MAINTENANCE

The following daily, weekly, monthly and annual schedules are provided as an aid to the serviceman as a reminder of the items to check and the type of discrepancy to look for.

DAILY CHECKS

1. Visually check bolts for looseness. If evidence is apparent, tighten per figure 3 torque values.
2. Visually check pumping unit for proper operation, installation and adjustment.
3. Visually check all lubrication points.

WEEKLY CHECKS

1. Lubricate pitman bearings. See Lubrication section.
2. Review all items under "Checklist Prior to Starting Pumping Unit Each Time."

MONTHLY CHECKS

1. Review all items listed under "Preventive Maintenance."

2. Perform all lubrication items listed in the Lubrication section.

ANNUALLY

1. Review all items listed under "Preventive Maintenance."
2. Collect a typical sample of the gear reducer oil in a glass jar. A visual inspection will expose possible dirt, sludge, water emulsion or other forms of contamination. If the lubricant has an abnormal appearance or smell, check with oil supplier about replacement. It may be desirable to submit this sample to a laboratory for further analysis.

COUNTERBALANCE ADJUSTMENT

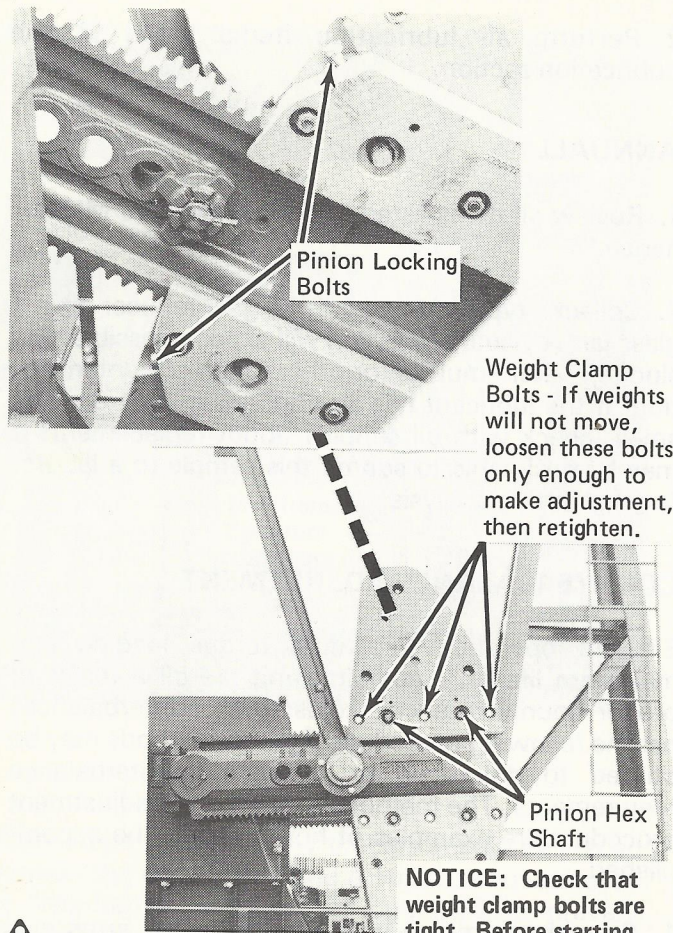
Efficient operation, minimum torque loading and maximum life of a pumping unit are all a result of proper counterbalance. Adjust the counterbalances per the following procedure. Several methods may be utilized to determine or estimate counterbalance requirements. The methods following the adjustment procedure are examples of how this may be accomplished.

1. Stop the pumping unit with the crank arms in a horizontal position or slightly downhill in the direction the weights are to be moved.
2. Set brake and install safety devices per figure 35.
3. Loosen pinion locking bolts shown in figure 36. Each counterweight has two pinions for moving it. Both pinions must be unlocked.
4. Install socket wrench (furnished with pumping unit) on hex pinion shaft. Rotate pinion to move counterweight to desired position. Then tighten pinion locking bolt to a minimum of 350 foot-pounds torque. Recheck torque on bolts after 24 hours of operation and again after 40 hours of operation.

NOTE: Should the counterbalance weights refuse to move due to insufficient clearance between the two castings, loosen the weight clamp bolts only enough to permit movement of the weights. Be sure to retighten these bolts after adjustment.

5. Remove safety devices, release brake and start power unit to check for proper operation.

MAINTENANCE



Pinion Locking Bolts

Weight Clamp Bolts - If weights will not move, loosen these bolts only enough to make adjustment, then retighten.

Pinion Hex Shaft

NOTICE: Check that weight clamp bolts are tight. Before starting pumping unit, **BE SURE** pinion locking bolts are tight. Check after 24 hours of operation and at 40 hours of operation.

WARNING! Brake must be engaged and other appropriate safety stops installed to prevent injury due to accidental rotation of crankarms.

Pinion locked to support weight of counterbalance.

Pinion unlocked for moving counterbalance

Pinion Brake Pad
Pinion Locking Bolt - Rotate clockwise to tighten.

DETAIL A

Figure 36

AMMETER

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

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.

SOUND OF THE POWER UNIT

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

STROKE CHANGE

WARNING! In order to safely perform stroke change, extreme caution must be exercised to prevent serious personal injury.

WARNING! While accomplishing stroke change, install safety devices to secure walking beam and crank arms in a stationary position.

WARNING! Prior to disconnecting the pitmans, refer to Specifications for Structural Unbalance weight and make arrangement to counteract the unbalance.

Stroke change is accomplished by moving the wrist pin assembly to the desired stroke hole location in the crank arm (see figure 37). This requires disconnecting pitmans from wrist pin bearing housings. To accomplish stroke change, the following procedures need to be followed:

1. Stop pumping unit with crank arms slightly forward of gear reducer base. Allowing for access to the wrist pin nut.
2. Set brake and install all safety devices.
3. Disconnect pitmans from wrist pin bearing hous-

POLISHED ROD DYNAMOMETER TEST

Dynamometer card analysis is the most accurate method used to determine 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 gear reducer torque and counterbalance required for balanced conditions.

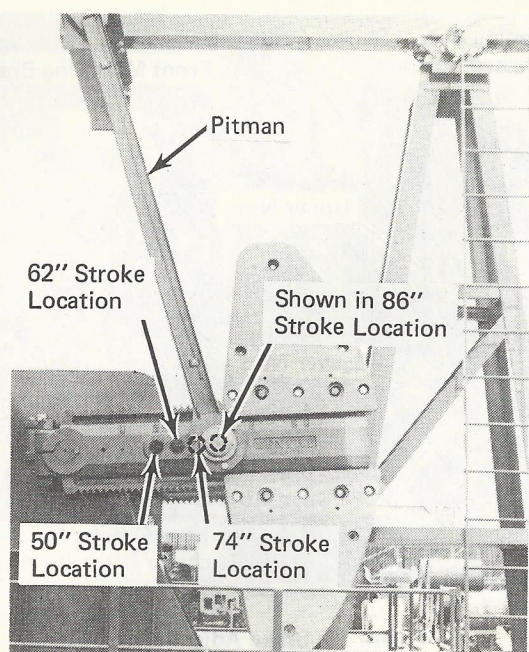


Figure 37. Stroke Change

ing per figure 13. Move pitmans out of working area and secure.

4. Remove cotter pin and wrist pin nut shown in figure 38.

5. Remove cover from wrist pin bearing housing and clean grease from end of pin.

6. Install a puller shaft into threaded hole at end of wrist pin per detail AA, figure 38.

7. Install a piece of tubing or similar support over crank pin housing and against crank arm to support a cross bar for pulling pin. Place bar with a hole in it across support and over puller shaft and install a nut.

8. Tighten nut on puller shaft and tap on inside end of crank pin with a soft drift pin and hammer to loosen. Continue to tighten puller nut and tap on pin until pin is free.

9. After wrist pin is removed, clean and inspect pin and bearing; repack bearing with grease per Lubrication section and reinstall cap.

To install:

10. Clean wrist pin and hole in crank arm that will receive wrist pin. Wrist pin and hole must be clean and dry for assembly.

11. Place the wrist pin in hole and install nut by hammer tightening (4000 foot-pounds torque). **NOTICE!** DO NOT back off nut to install cotter pins. Continue tightening to next hole. Install the cotter pin.

WARNING! Walking beam must be repositioned to connect pitmans to wrist pin. Use gin pole, crane or some type of hoist to reposition it safely.

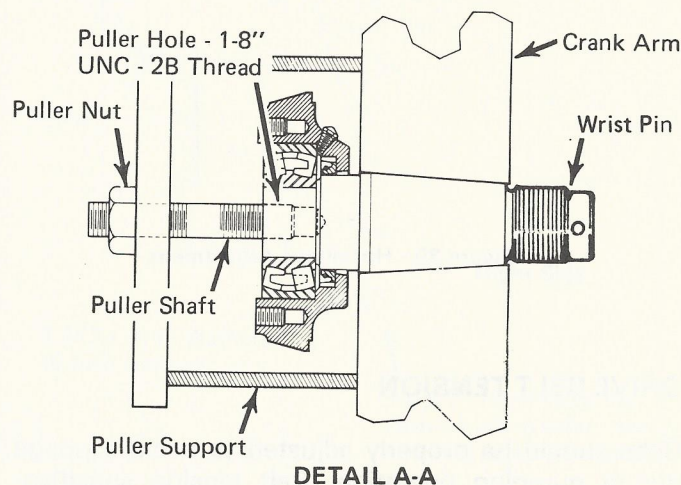
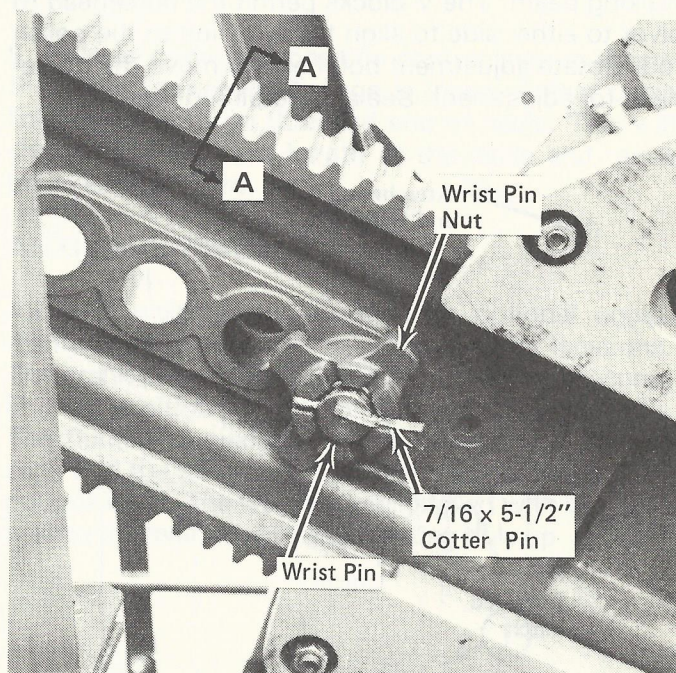


Figure 38. Wrist Pin Removal and Installation

12. Reposition walking beam as necessary to connect pitmans to wrist pin housing. See figure 13. Be sure grease vents in bearing housing are on top.

13. Remove all tools, work stands and safety devices from pumping unit and prepare for operation.

MAINTENANCE

HORSEHEAD ADJUSTMENT

The horsehead is attached to the walking beam with a pin and secured in place with a weight operated latch. See figure 39. By releasing the latch, the horsehead can be folded back over on top of the walking beam. The weight of the horsehead and associated parts are carried by a round bar near the top of the horsehead resting in two V-blocks on top of the walking beam. The V-blocks permit the horsehead to pivot to either side to align the wire line to the polish rod. Rotate adjustment bolt head to move the horsehead for adjustment. See also detail A of figure 14.

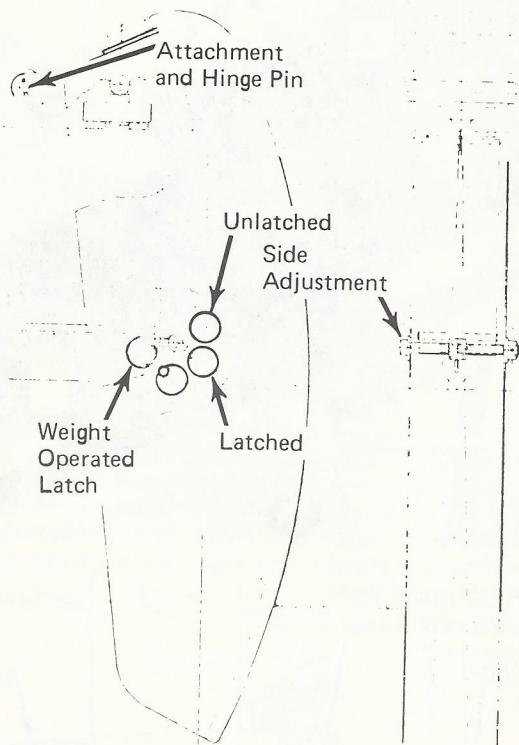


Figure 39. Horsehead Adjustment

DRIVE BELT TENSION

Belts should be properly adjusted to avoid slippage during pumping operation. Belt tension specifications should be obtained from belt manufacturer.

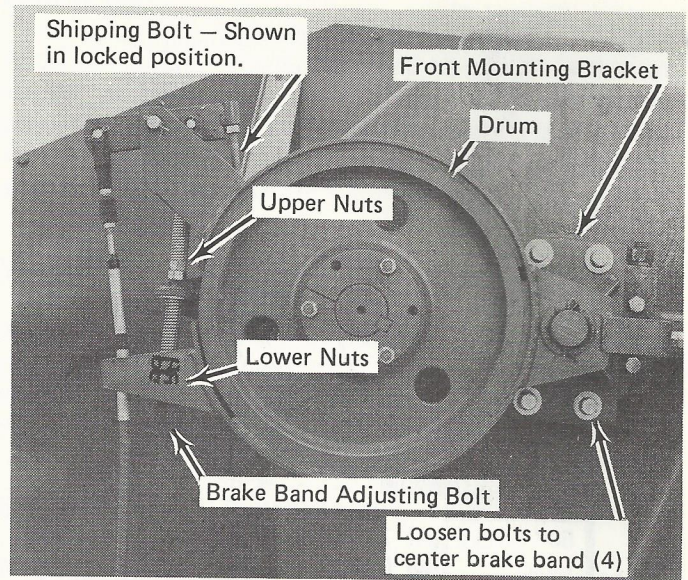


Figure 40. Brake Adjustment

BRAKE ADJUSTMENT

The brake system uses a band type brake consisting of a drum mounted on the gear reducer's primary shaft, a brake band and a control lever with a ratchet type lock shown in figures 40 and 41. A shipping bolt is provided for locking the brakes during shipment. Whenever the pumping unit is transported by hauling, the brakes should be engaged and the shipping bolt tightened down against the bracket. Prior to operation of the pumping unit, the shipping bolt must be backed out completely to permit full operation of the brake shoes. Minor adjustments may be necessary to compensate for brake lining wear, cable stretch and worn linkage. Check out the system and make necessary adjustments by the following procedure:

1. When performing brake inspection and maintenance, release the brake and permit the crank arms to coast to a stop a bottom dead center.
2. Check that drum is centered between the front and rear ends of the brake lining as shown in figure 40. If the brake lining contacts the drum at either the front or rear, loosen the front mounting bracket attachment bolts and move the bracket to center the drum in the lining.

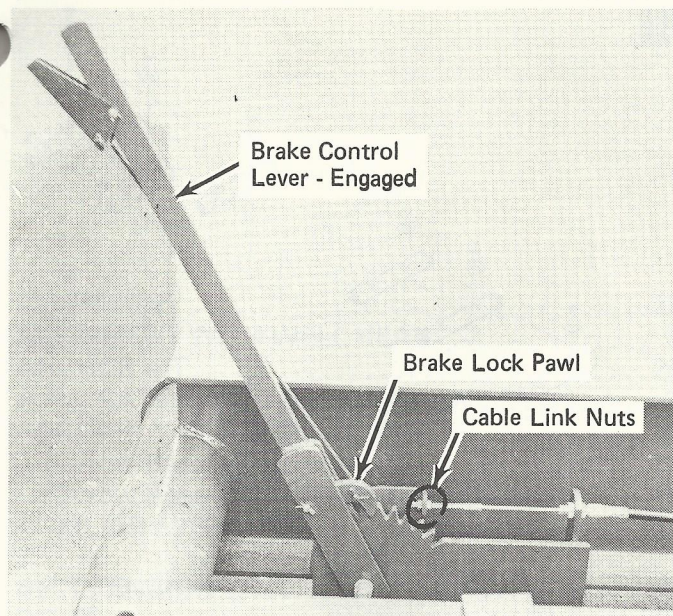


Figure 41

3. Check for excessive clearance between the drum and the clamping ends of the band as shown in figure 40. Adjust jam nuts upwards on adjusting bolt to reduce clearance between band and drum. Brake lining should not touch the drum. The upper nuts

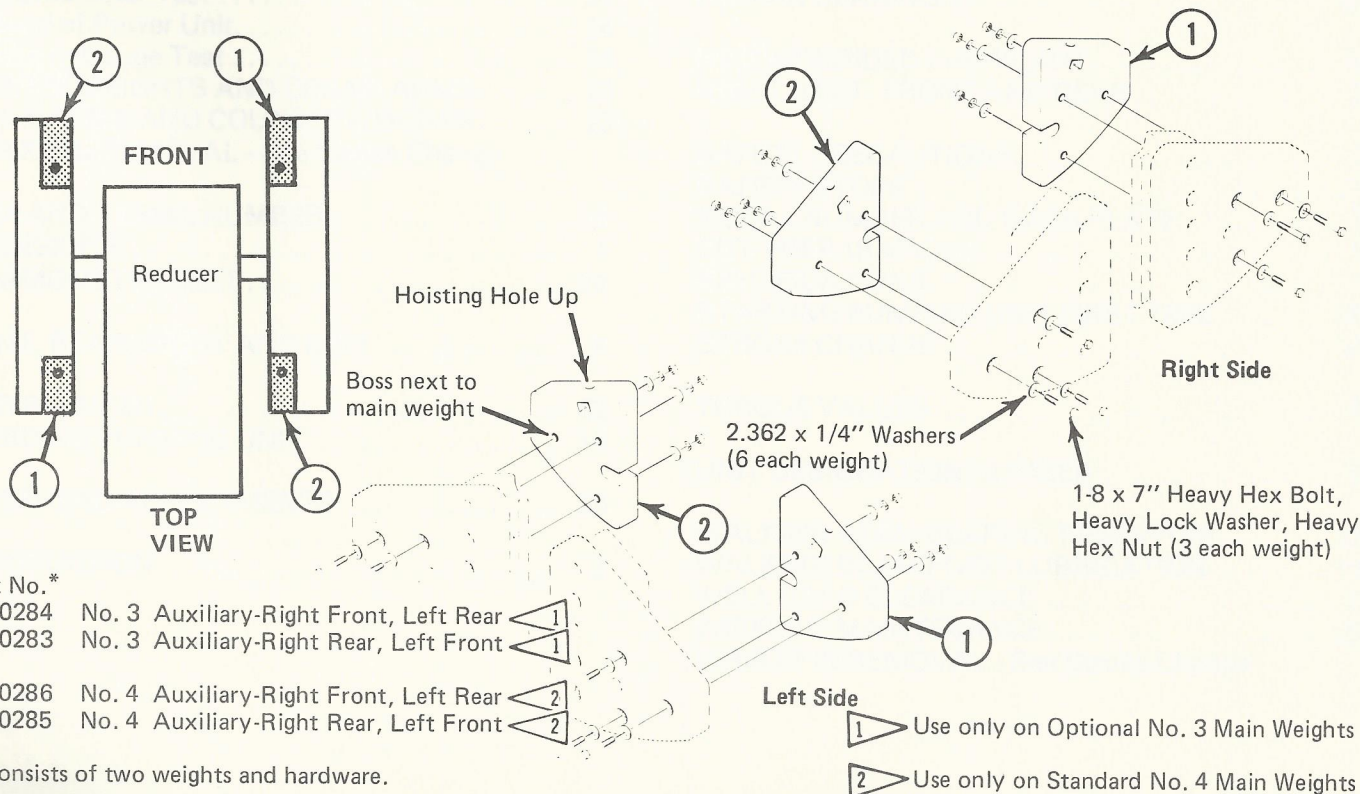
control clearance for upper end of brake band and lower nuts control clearance of lower end of band.

4. Engage brake control lever. See figure 41. Full engagement should occur with several teeth remaining on the ratchet to compensate for subsequent lining wear and cable stretch. When there is not sufficient teeth left on the ratchet to completely set the brake, adjust brake control linkage per following step 5.

5. Release brake and position control lever to where the cable connection linkage is loose. Adjust cable link nut forward on threaded end of cable. This will shorten the effective length of the cable and move brake lever forward.

AUXILIARY WEIGHTS

Auxiliary weights are available as optional equipment. See top view shown in figure 42 for locations. The crank arms must be pointing down and secured in that position when installing auxiliary weights. The number 3 auxiliary weights weigh 750 pounds each and the number 4 auxiliary weights weigh 1135 pounds each. The weights are installed with the boss next to the main weight and hoisting hole up.



- Kit No.*
- | | | |
|-----------|--|---|
| 1. K00284 | No. 3 Auxiliary-Right Front, Left Rear | 1 |
| 2. K00283 | No. 3 Auxiliary-Right Rear, Left Front | 1 |
| 1. K00286 | No. 4 Auxiliary-Right Front, Left Rear | 2 |
| 2. K00285 | No. 4 Auxiliary-Right Rear, Left Front | 2 |

*Kit consists of two weights and hardware.

Figure 42. Auxiliary Weights

MAINTENANCE

ANCHOR KIT P/N 700 900 674

This kit furnishes anchor bolts and holddown tubes for anchoring the pumping unit to a concrete foundation. Included in the kit are instructions furnishing foundation requirements, alignment specifications and drawings showing locations for installation of the anchor bolts.

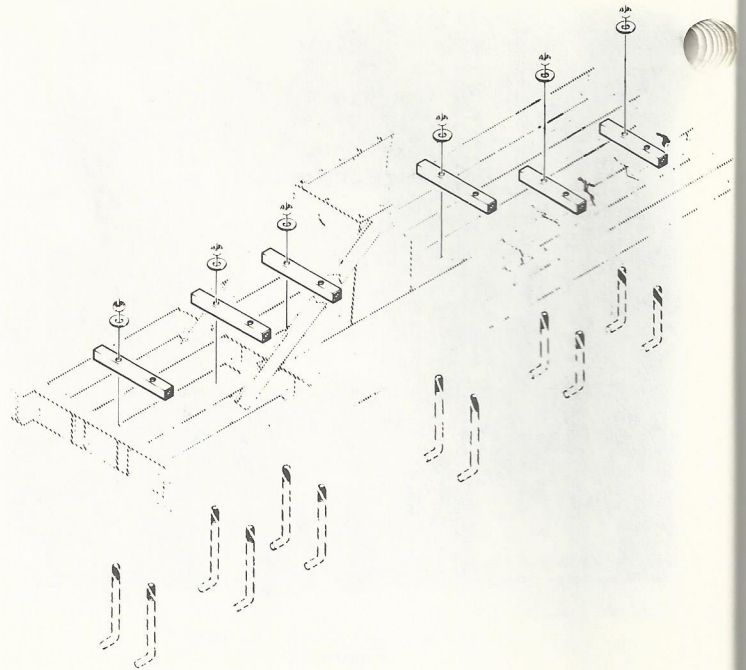


Figure 43. Anchor Kit

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