

OPERATING - MAINTENANCE - PARTS
MANUAL
McKIERNAN-TERRY MODEL V-14
VIBRATORY PILE DRIVER/EXTRACTOR
AND
MODEL HP-210 HYDRAULIC POWER PACK



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FIG. 1

This manual contains description maintenance and troubleshooting instructions and parts on your McKiernan-Terry Model V-14 Vibratory Pile Driver/Extractor with Hydraulic Power Pack. Sufficient descriptive material, together with numerous photographs, schematics and line drawings are included to enable the operator to understand the basic construction of the vibrator and how the principles by which the hydraulic system functions.

Upon receipt of the hydraulic power pack, the local engine dealer should be notified immediately. The local dealer should be advised of the particular make and model of engine and a serviceman requested to administer the initial start-up.

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I. GENERAL DESCRIPTION

A. VIBRATOR

The V-14 Vibrator is hydraulically powered, meaning hydraulic oil is pumped to hydraulic piston type motors. The hydraulic motors are directly coupled to four eccentric shafts that have their vertical dynamic forces additive causing a downward and upward movement and cancelling all horizontal dynamic forces. These vibratory dynamic forces are transmitted to a pile section through clamping jaws that are hydraulically powered. The Vibrator has a unique spring suspension system that isolates the vibratory force from the holding device.

There are four rotating eccentrics stacked in a vertical plane and mounted in special heavy duty spherical roller bearings. The two inner eccentrics are directly connected by chain couplings to two flange mounted, fixed displacement, piston type hydraulic motors. To maintain proper relationship, the two inner eccentrics are gear connected. The top and bottom eccentrics are driven through a spur gear set by the inner eccentrics. Forced oil lubrication is furnished to the eccentric bearings and gears by a Gerotor Pump and driven off the lower eccentric. The two hydraulic motors, Lucas 1M1000, are supplied with pressurized oil through a manifold that is attached to the input port of each motor and likewise a manifold attached to the discharge ports of the motors. Similarly, the required motor case drain is manifolded for a common return-to-tank line.

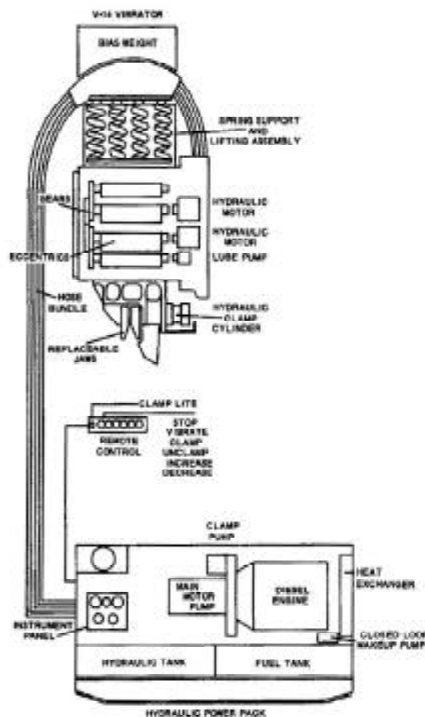


FIG. 2

I. GENERAL DESCRIPTION

A. VIBRATOR - Continued

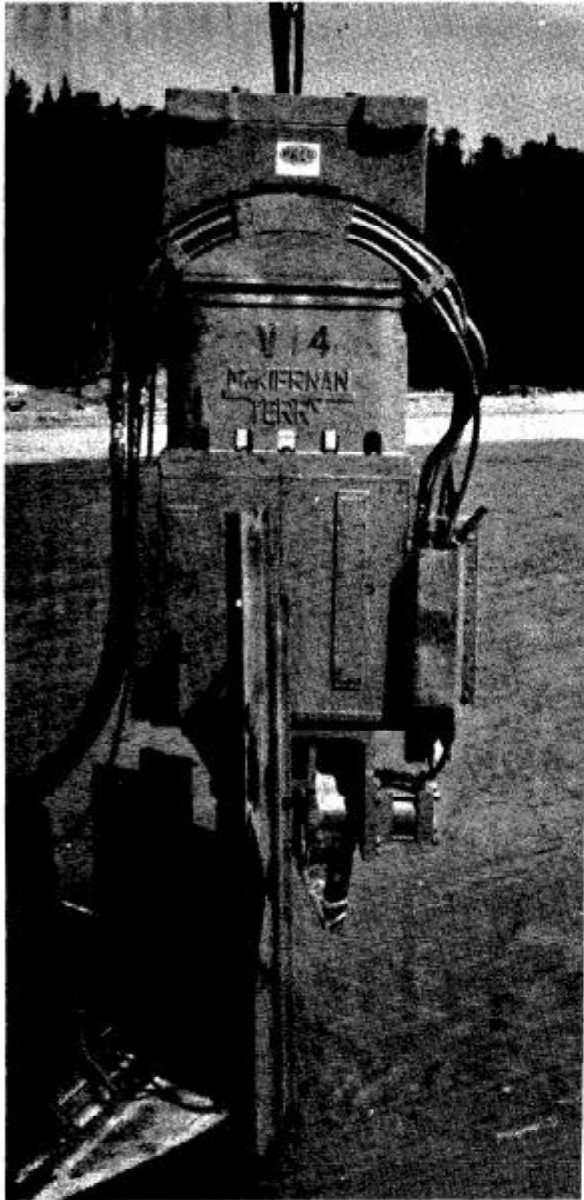


FIG. 3

The V-14's operating frequency of 1500 to 1850 cycles per minute provides a maximum rate of pile penetration or extraction in the broadest range of soil structures. The amplitude depends on the total mass that is being vibrated and the resistance of the soil. Under normal conditions of driving or extracting piling, the amplitude will be within the range of 1/4 to 5/16 inch. The clamp housing contains an 8" hydraulic cylinder with 1 1/2 inch of travel developing 70 tons of clamping force at 2800 psi. There are two jaws, one fixed and one movable. The movable jaw articulates to compensate for minor deformations in pile head sections. Clamping or unclamping is accomplished within one to two seconds.

A pre-loaded, spring type suspension system effectively isolates most of the vibrations from the crane boom. The standard suspension assembly is designed for a maximum 20 ton line pull when extracting. A 40 ton line pull is obtainable when equipped with the larger suspension system. When tough driving is encountered, the 20 ton suspension assembly is designed to accept 1-1/2 tons of bias weight, still retaining its effectiveness in isolating most of the vibrations from the crane boom.

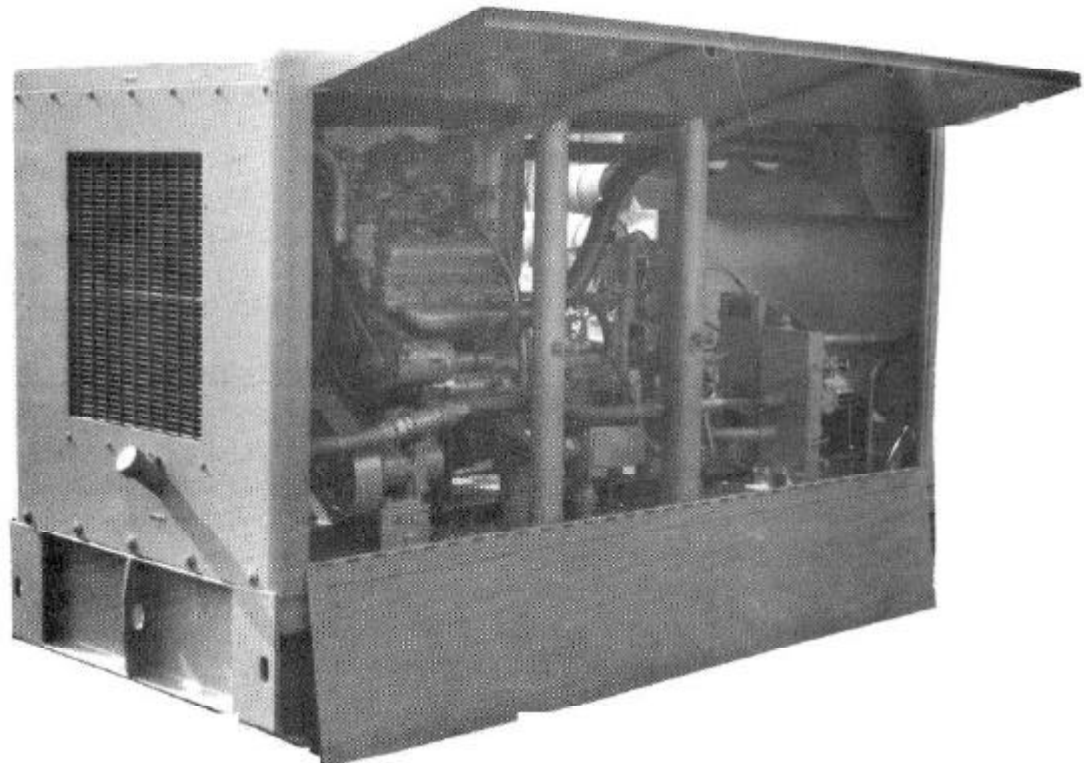
The remote control pendent has six push buttons and an indicator light. The buttons actuate 24-volt controls in the power pack to start or stop vibration, clamp or unclamp and increase or decrease operation frequency. All push buttons are interlocked for maximum safety when operating the vibrator.

I. GENERAL DESCRIPTION

B. HYDRAULIC POWER PACK

A portable type hydraulic power package is used to develop the hydraulic energy to rotate the eccentrics at vibratory frequency. The skid mounted, totally enclosed power package covered by this manual consists of two independent hydraulic circuits. Each circuit has its own high pressure pump driven by the diesel engine. This allows the vibrator clamp to operate independently of the vibrator drive and maintain clamp pressure at all times.

The drive circuit powers the vibrator by supplying oil under pressure through the hoses, which are connected to the power unit, to the hydraulic motors in the vibrator.



The maximum operating pressure is limited by a high pressure relief valve. The operating pressure for vibrator exciter and clamp can be read on the instrument panel pressure gage. The drive circuit is closed-loop meaning that the oil from the hydraulic motors returns to the inlet of the hydraulic drive pump. The boost (charge or make-up) pump is belt-driven from the engine and operates whenever the engine is running to assure positive inlet pressure to the drive and clamp pumps and to supplement drain losses from the pump and motors in the closed loop system.

I. GENERAL DESCRIPTION

B. HYDRAULIC POWER PACK - Continued

The vibrator is controlled by the operator from a hand-held, remote push button station. The operator need only push the proper buttons in the correct sequence. The frequency of vibration can be adjusted from the operator's push button station. The control system will automatically stop the vibrator if the boost pressure falls, if the clamp pressure drops too low or if the electrical power fails.

The clamp circuit is an open-loop circuit. The clamp pump operates the jaws to open and close from the pile, and supplies oil to operate other controls. The pump is equipped with a pressure compensator which destrokes the pump when the clamp cylinder moves full travel and pressure increases. A high pressure clamp relief valve is also provided as an excessive pressure safety device.

All oil passes through and/or around the hydraulic oil cooler. The radiator is designed to dissipate the heat generated in the hydraulic system, utilizing air drawn through it by the engine fan. The flow of hydraulic oil through the cooler is automatically controlled by a thermostatically operated valve.

All the pumps are protected with full-flow filters two of which have dirt indicators. The differential pressure drop caused by a dirty filter element causes the indicators to move and to show when the elements need changing. It is important that maintenance of these filters be performed regularly because a clean system is necessary for long life of the hydraulic equipment.

The motor drain line, back-to-tank, has a "blow off" safety valve located in the line on the vibrator. The relief valve setting recommended is 40 psi but pressure settings to 50 psi are permissible without damage to the motor seal or interior components. If this pressure is surpassed by a kink in the line or incorrect connection at the tank, oil will spill. This protection is necessary to limit the case pressure of the motors (max. 40 psi).

The safety relief valve is positioned adjacent to the motor drain manifold to assure maximum safety to the hydraulic motors. Refer to Page 37 for normal drain flows from motors.

II. OPERATING INSTRUCTIONS

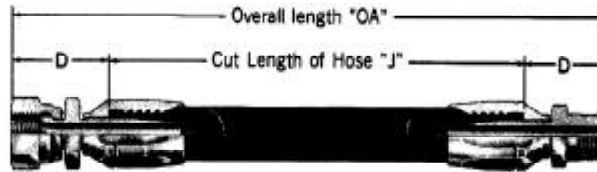
A. CONNECTION OF HOSES

All V-14 Vibrators are thoroughly tested at the factory and consequently filled with hydraulic fluid. Generally, the hose bundle assembly filled with oil, is disconnected from the hydraulic power pack and the vibrator for shipment. Therefore, it is necessary to make the correct hose connections to the vibrator and power pack. There are five hoses in the bundle, each 150 ft. long. Two 1 1/4 I.D. lines for the hydraulic motors, two 3/4 I.D. lines for the hydraulic clamp cylinder and one 3/4 I.D. line for the hydraulic motors case drain. Hose connections at the hydraulic power pack are made easily by quick disconnects with double checks. At the vibrator, it is important to connect the correct hoses which are originally color coded.

IT IS MOST IMPORTANT that great care be made to have all connections FREE from ALL contamination especially the high pressure hydraulic motor line. All hydraulic line connectors and quick disconnects, when disconnected, should be capped or plugged immediately to assure against contamination.

When the hoses are attached to the Vibrator, care should be made to have the bundle hang free and the larger hoses evenly supporting the load. Extreme care should be made at all times not to kink any of the hoses. As an example, the 1 1/4" I.D., 2" O.D. hose has a minimum bending radius of 18 inches. Even though these hoses have a minimum bursting pressure of 12,000 psi, a kink will weaken the hose multiple spiral wire wrap reinforcement and rupture will result at high operating pressures.

The hose lines between the vibrator and the hydraulic power pack are 150 ft. long, made up of 50 ft. lengths. A damaged hose section of 50 ft. can be replaced or a repair connector inserted in the 3/4 I.D., 1 1/4 O.D. hydraulic clamp lines and drain line. Refer to Fig. 5. The 1 1/4 I.D., 2 O.D. motor lines cannot be repaired in the field without special tooling.



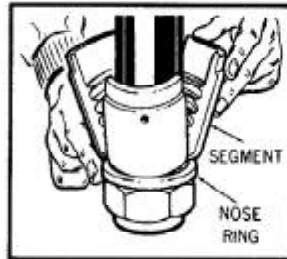
Hose assembly length

To determine "J" length: (cut length of Hose): From "OA" (overall length) deduct "D" dimensions of both end fittings.

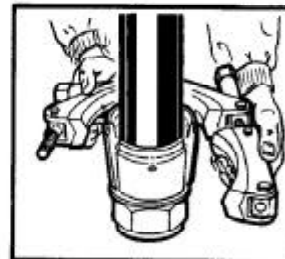
Segmented reusable fittings with 4-spiral wire hose



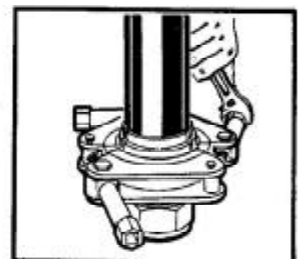
Step 1
Cut hose to length. Clean hose bore. Slip flat retaining ring on hose. Place nose ring over nipple and insert nipple into hose until bottomed on nipple shoulder.



Step 2
Hook the three segments under nose ring and space them evenly around hose.

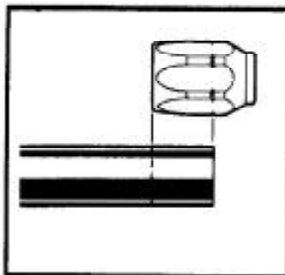


Step 3
Open 1583 Assembly Tool. Attach tool over the segments by inserting the locating pins into hole in each segment. CAUTION: Be careful not to damage or shear off locator pins.



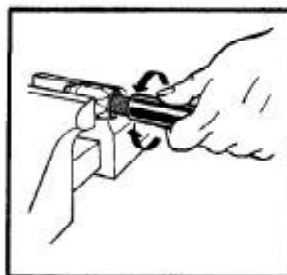
Step 4
Wrench tighten the Assembly Tool sections uniformly around the fitting. Slide the retaining ring over the compressed segments. Loosen Assembly Tool and remove. Use reverse procedure to remove fittings from hose.

Standard reusable fittings with 4-spiral wire hose



Step 1
Cut hose to length required using a fine-tooth hacksaw or cut-off wheel. Clean hose bore. Hose must be stripped of its rubber cover before inserting in socket. Locate stripping point by putting hose end next to socket as shown. Measure from hose end of socket to notch on socket.

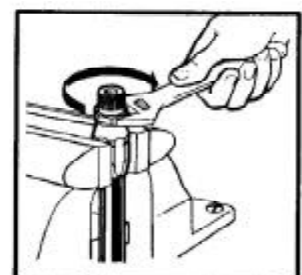
Step 1 A
After cutting around rubber cover, raise flap and pull cover off, working clockwise around the hose (looking at end of hose). Clean excess rubber off hose, working with "lay" of wire to avoid fraying or unraveling.



Step 2
Sockets for hose fittings are furnished with internal annular grooved design. Install socket by pushing hose into socket with a back and forth rocking and twisting motion until hose bottoms on shoulder of socket.



Step 3
Oil nipple threads and inside of hose liberally. No assembly mandrel is needed for 4-spiral wire hose. Use heavy oil or Aeroquip Lube Oil.



Step 4
Screw nipple clockwise into socket and hose. Leave $\frac{1}{32}$ " to $\frac{1}{16}$ " clearance between nipple hex and socket.

FIG. 5

II. OPERATING INSTRUCTIONS

B. HIGH-LOW FLOW OR DRIVE PUMP

The main Drive Pump is rotary, parallel, multi-piston whose camplate is servo controlled to provide variable displacement. The camplate minimum angle of inclination is set for a low flow of about 10 GPM. The camplate maximum angle of inclination is set for a maximum flow of about 80 GPM but is remotely adjustable down to about 70 GPM. Whenever the "STOP" button of the remote control pendant is pushed, the main camplate is stroked to the low flow position. As long as the position of the jaws are maintained open, the pump camplate will never stroke to high flow condition.

C. FILL THE HYDRAULIC LINES

1. Be sure the jaws are open so that the drive pump camplate is automatically stroked to the low flow position.
2. After initially connecting hoses, or replacing a broken 2" O.D. hydraulic motor line and before running the vibrator, hold the "Fill" button depressed and simultaneously push the "START" button on the hand-held push button station to start the filling process.
3. Continue to hold the "Fill" push button for one to five minutes until the lines are full of oil.
4. If the clamp jaws are closed and the diesel engine speed set very low (1000 RPM), the drive pump will stroke to high flow position when the "START" push button is depressed and the vibrator will vibrate. However, even at the high flow position, the low engine speed will only result in a relatively low pump volume flow and a low vibrating frequency. With caution, this method could be used in the event the "FILL" system above is not functioning.

WARNING: FAILURE TO FOLLOW A FILL PROCEDURE CAN CAUSE PUMP DAMAGE.

II. OPERATING INSTRUCTIONS

D. START AND WARM-UP ENGINE

1. Before starting the engine, read the engine manufacturer's operating and maintenance instructions carefully. Follow the engine starting, operating and maintenance procedures detailed in the manual.
2. Be sure enclosure doors are open and all pre-start-up checks (detailed in III-B-1) have been made and completed satisfactorily. While the engine is warming up at engine speeds of 900-1200 RPM, turn the selector switch on the electrical control system to the "ON" position. The green lamp on the enclosure indicates "POWER ON".
3. Set the engine speed at operating speed of 1900-1950 RPM. The boost pressure should read about 90 psi \pm 5 psi as indicated on the instrument panel. The clutch can remain engaged on starting engine since the only load will be the compensated clamp pump. Under very cold conditions, less strain will be put on the engine if it is started with the clutch disengaged.

E. REMOTE CONTROL PENDENT OPERATING



The remote control pendant, Figure 6, has 100 feet of electrical conduit that connects to the hydraulic power pack through a quick disconnect connector. The conduit is multiconductor with 3 spare wires.

The pendant has 6 push buttons and one green indicator light. The jaw clamping or unclamping is designated as "close" or "open". The vibrate start or stop is designated "START" and "STOP". The change requirement of frequency, varied from 1500 cpm to 1850 cpm is designated as FAST or SLOW. The green light will go on when the jaw is fully clamped or closed. Once the pumps are engaged and the hoses filled, all operations of the vibrator are controlled from the remote electrical push button station.

FIG. 6

II. OPERATING INSTRUCTIONS

E. REMOTE CONTROL PENDENT OPERATING - Continued

1. To Clamp on the Pile:

Press the "CLAMP" button.

The green lamp on the push button station indicates when there is adequate pressure in the hydraulic line to the clamp cylinder.

2. To Vibrate:

Press the "VIBRATE" button.

The running time meter is activated to record driving time. The vibrator will not operate unless there is adequate pressure in the line to the clamp cylinder and adequate boost pressure at the main drive pump inlets.

Wait for the clamp closed green light to go on before depressing the "VIBRATE" button.

3. To Stop Vibrator:

Press "STOP" button.

The vibrator will decelerate to a stop in approximately two seconds. The vibrator will stop automatically during operation if the boost pressure to the pumps or clamp pressure falls, if the electrical system loses power, or if the tank level falls too low. The running time meter is deactivated as the motors stop.

If for some reason the "STOP" push button does not bring the vibrator to a halt, declutch the pump drive or stop the engine.

II. OPERATING INSTRUCTIONS

E. REMOTE CONTROL PENDENT OPERATING - Continued

4. To Adjust Vibrator Frequency:

To increase the vibration frequency, hold the "FAST" button until the desired frequency is obtained. The maximum frequency of the vibrator is limited to approximately 1850 cpm.

To decrease the vibration frequency, hold the "SLOW" button until the desired frequency is obtained. The minimum frequency of the vibrator is set to approximately 1500 cpm though it may be set lower. Refer to Fig. 7 for the theoretical dynamic forces and horsepowers of the V-14 with varying frequencies.

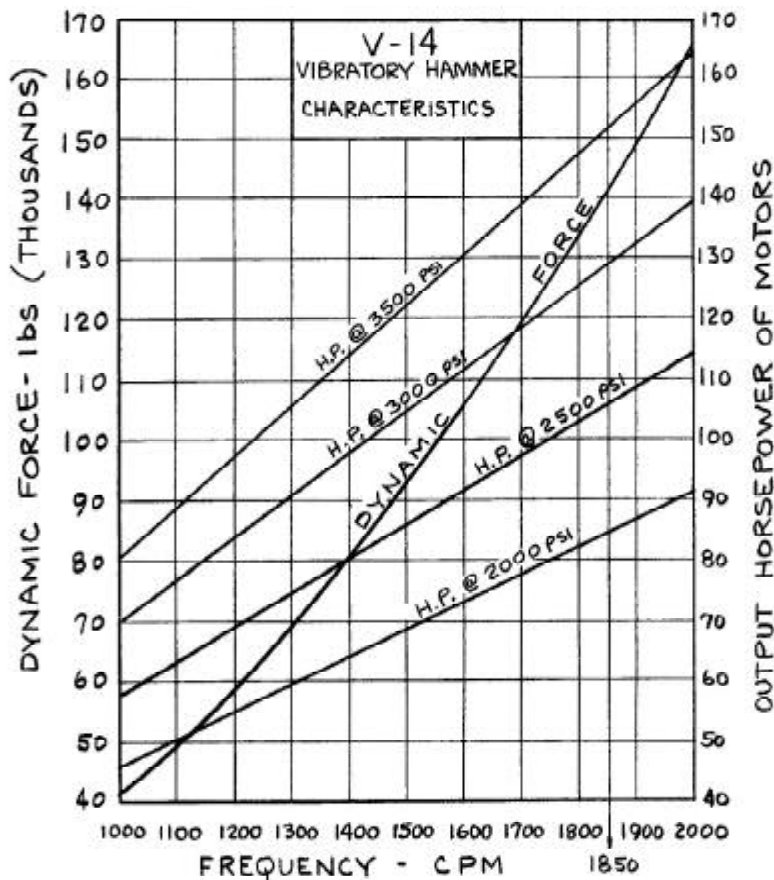


FIG. 7

II. OPERATING INSTRUCTIONS

E. REMOTE CONTROL PENDENT OPERATING - Continued

4. To Adjust Vibrator Frequency - Continued

The maximum frequency of the vibrator is set at 1850 CPM with an engine speed of 1900-1950 RPM with the hydraulic motor pressure reading 1000-1500 psi (no load). This initial setting is made at the factory with the vibrator free hanging in a test rack. The vibrator, when used on actual driving or extracting, will experience heavier resisting loads and the hydraulic motor pressure readings will increase to the maximum drive relief pressure setting of 3200 psi. At the maximum operating pressure, the engine speed may lower a very smaller amount with a resulting maximum vibrator frequency from 1850 to 1800 CPM. Increasing the maximum vibrator frequency will cause excessive eccentric speeds that will drastically lower the vibrator bearing life. Vibrator frequency can easily be checked with a strobe light or photo tachometer.

5. To Unclamp from the Pile:

WARNING: The operator must wait for a visual check that the vibrator has stopped.

Press the "OPEN" button and the jaws will open so that the vibrator can be removed from the pile. The green lamp on the remote electrical push button station will go out, indicating that the pressure in the line to clamp cylinder has been released.

NOTE: The vibrator cannot be unclamped when the electrical system is in the "VIBRATE" mode. The "STOP" button must always be pushed prior to the "OPEN" button.

II. OPERATING INSTRUCTIONS

F. SHUT DOWN

1. Stop the vibrator and open jaws.
2. Reduce diesel engine speed to 700-1000 RPM and allow to idle for a few minutes. Shut down the engine following the procedure in the engine operator's manual.
3. If the vibrator is shut down while clamped to a pile, the clamp cylinder will maintain its pressure. The built-in check valve on the clamp cylinder will hold adequate clamp pressure for days if required. However, if the vibrator is stored clamped to a pile, a crane cable line to the vibrator is still recommended.

CAUTION: DO NOT SHUT DOWN DIESEL ENGINE WITH VIBRATOR RUNNING BECAUSE IT MAY PUT A STRAIN ON THE ENGINE.

III. MAINTENANCE AND ADJUSTMENTS

A. GENERAL:

The V-14 Vibrator and HP-210 Hydraulic Power Pack should be inspected regularly to help keep it in good operating condition. The time interval between necessary adjustments and repairs depends primarily on how much and how hard the machine has been used. Repair or replace broken or damaged parts as soon as they are discovered. Periodic cleaning and repainting will help keep all parts in better working order and prolong the machine's life.

The diesel-driven, hydraulic power pack has been designed to minimize field downtime by making most components replaceable as units. Field maintenance will generally be limited to the regular preventative maintenance procedures following and possibly the replacement of seals and gaskets when the equipment is initially used and some minor checks may have to be performed because of contamination in the closed loop system. Small particles may become dislodged after the vibrator is used at maximum flow and pressure conditions.

The vibrator is run-in and checked thoroughly at the factory for leaks and possible malfunctions. The vibrator bearing-gear enclosure is completely sealed with a closed forced lubrication system requiring a minimum of checking.

Occasional inspection of the vibrator is encouraged. Removal of the side cover opens to view the motor and pump couplings, the end of the gears and an end view of the bearings. Always assure that the couplings are fixed securely and the gear line-up is correct.

Refer to Page 131 at the rear of this manual for fit tolerances of bearings in the vibrator. If bearing or cartridge replacements are required, these clearance and interference fits will be helpful.

III. MAINTENANCE AND ADJUSTMENTS

B. DAILY CHECK LIST

CHECK THE ENTIRE UNIT PRIOR TO AND DURING START-UP AT EACH SHIFT.

1. Prior to starting the engine at each shift, check as follows:
 - a. Make all daily lubrication and preventative maintenance checks indicated in the engine manufacturer's operating and maintenance manuals.
 - b. Check the oil level in the pump drive transmission. Do not operate the unit with low oil level in this transmission.
 - c. Check the hydraulic oil level before starting the engine. The dial indicator should indicate $3/4$ to full. Recheck this level after filling the lines to be sure it remains in the safe operating range. DO NOT operate the unit with the hydraulic oil level below $3/4$.
 - d. Visually check all hoses for signs of damage or cuts that might cause hose failure during operation. Be sure all connections are tight, especially the quick disconnects.
 - e. Check the belt tension on the DeLaval-IMO boost pump (See Page 42) before starting. The belt may need adjustment frequently when new.
 - f. Be sure all doors on the enclosure are open before starting the engine.
 - g. Look for any damage to the unit in general that might cause it to fail when put into operation.
 - h. Check tightness of screws on hydraulic motor, lube pump, spring shields, etc. Look for cracks at stressed areas.

III. MAINTENANCE AND ADJUSTMENTS

B. DAILY CHECK LIST - Continued

1. Prior to starting the engine - Continued
 - i. Check spacing under lifting head. Should be fairly equal distance. Unequal spacing could be a sign one of the springs or spring containers is broken.
 - j. Be sure there is fuel in tank.
 - k. Be sure there is cooling fluid in radiator.
 1. WARNING: DO NOT start any of the pumps, (Boost No. 22, Fig. 14, Clamp No. 12, Fig. 9 and Drive No. 13, Fig. 16) initially or after the pumps have been inoperative for a long time without first checking to be sure the pumps are primed, i.e., the pump cases full of oil. This will prevent starting the pumps without lubrication which can cause pump damage. To check, remove the drain hose and visually determine the case is full of oil.
2. After start-up, check as follows:
 - a. Inspect the hydraulic lines for leaks.
 - b. Inspect the Pumps No. 12, No. 13 and No. 22 for leaks, excessive vibration or temperature. If anything appears to be wrong, shut down and refer to the pump instruction books for Lucas and IMO.
 - c. Inspect the oil seal areas in the pump drive and control valves for leaks.

III. MAINTENANCE AND ADJUSTMENTS

B. DAILY CHECK LIST - Continued

2. After start-up - Continued

- d. Inspect the indicators on the filters, (No. 28 Fig. 19, No. 24 Fig. 39, No. 27 Fig. 19 and No. 30 Fig. 39) with oil at operating temperature to be sure the elements do not need changing. Keeping the system clean is essential for long life of the hydraulic equipment.
- e. After starting engine and bringing to operating speed, be sure boost (or make-up) pressure is up to 90 ± 5 psi., the open or close clamp pressure is up to 2750 min. psi and the main drive pressure is at 300-350 psi.
- f. Allow hydraulic oil temperature to come up slightly above the oil pour temperature preferably to 30° F. before starting vibrator.
- g. Before attaching to pile, open and close clamp jaws to verify fast and positive action.
- h. Be sure there are no kinks in the lines and that they hang uniformly.
- i. Once the vibrator has been started, be sure lube oil is pumping. Lube oil will pour against the site glass on the vibrator.
- j. Always maintain close check on the lifting cable to assure no fraying has occurred.
- k. Oil the lifting shafts and grease the guide bushings generously. Check for overheated bearing housings.
- l. Be sure clamp jaws open and close.

III. MAINTENANCE AND ADJUSTMENTS

C. LUBRICATION

1. Diesel Engine

Follow the engine manufacturer's operating and maintenance instructions. The crankcase oil can be drained on the side from the extended pipe. Recommended oils for crankcase:

Exxon Lube D-3 SAE 30
Mobil Delvac 1230
or equivalent

RECOMMENDED FUEL

NO. 2 DIESEL
FUEL OIL

FUEL OIL FILL

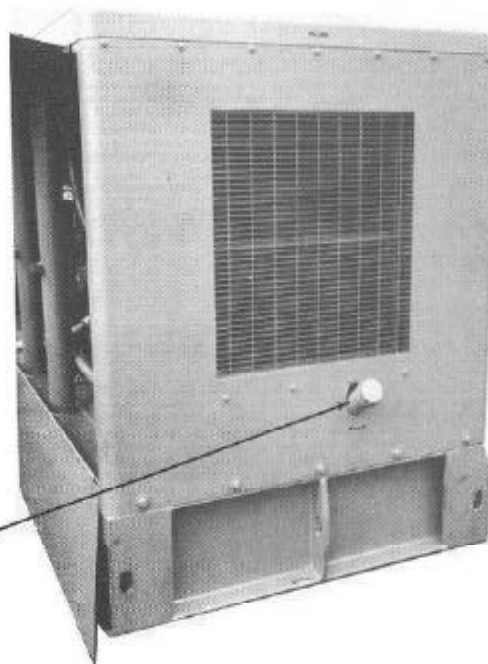


FIG. 8

III. MAINTENANCE AND ADJUSTMENTS

C. LUBRICATION - Continued

2. Pump Drive (Federal Gear Transmission)

Fill the gear case through the filler plug until the oil level reaches the level plug. Maintain the oil level at the level plug.

- (1) The oil to be used is as follows:
 - (a) Summer - SAE 140, non-corrosive, non-foaming, with EP additives per MIL-L-2105.
 - (b) Winter - SAE 90, non-corrosive, non-foaming, with EP additives per MIL-L-2105.
- (2) Drain, flush and refill the pump drive every 1000 hours (as read from the engine running time meter, not driving time meter) with the proper oil.

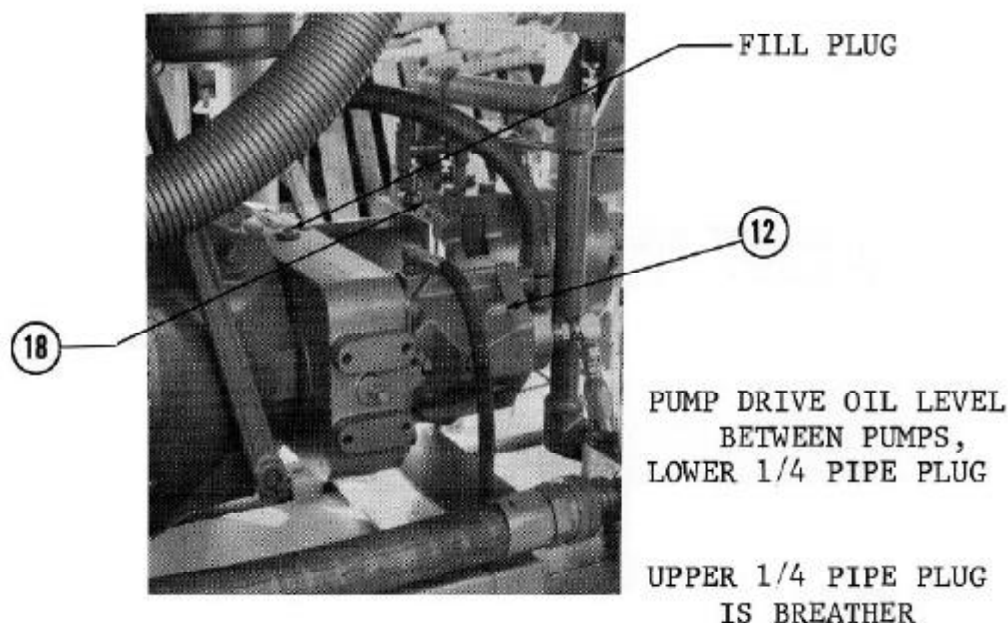


FIG. 9

III. MAINTENANCE AND ADJUSTMENTS

C. LUBRICATION - Continued

3. Hydraulic Oils

The hydraulic system in the HP-210 power unit requires highly dependable fluids to provide maximum efficiency and continuity of operation. The fluid must operate over wide temperature ranges, keep the system free from rust, separate quickly from water encountered from either contamination or condensation, and protect all parts from wear over extended periods of service.

- a. When adding or changing hydraulic oil, use high quality hydraulic oil with the following specifications:

Viscosity: 150 ssu @ 100° F.
Viscosity Index: 100 minimum
Pour Point: -20° F. (Dependent on Ambient)
Additives: Rust inhibitor, defoamant,
and oxidation inhibitor

WARNING: DO NOT use any of the following types of oils in this hydraulic system:

- Antiwear or EP Additives
- Synthetic hydraulic fluids
- Napthenic base oils
- Hydraulic brake fluid
- Aircraft hydraulic fluid
- Automatic transmission fluid
- MS or motor oils

(Recommended Hydraulic Oils, see Page 30)

III. MAINTENANCE AND ADJUSTMENTS

C. LUBRICATION - Continued

3. Hydraulic Oil - Continued

b. RECOMMENDED HYDRAULIC OILS:

MANUFACTURER	TYPE	POUR POINT	VISCOSITY INDEX	VISCOSITY @ 100° F.
*Texaco	Regal A	-30°F.	100	153ssu
	Rando A (Do not use Rando HDA)	-20°F.	100	158ssu
*Mobil	DTE Light or DTE 797 (Do not use DTE 24, 25, 26)	+20°F.	95	150ssu
*Exxon	Teresso 43 or Teresso 47	+15°F.	110	150ssu
*Shell	Tellus 27	-25°F.	110	160ssu
Citgo	Pacemaker T-15	-30°F.	95	150ssu
Conoco	Turbine Oil 15	+5°F.	100	150ssu
	Dectol R & O 15 (Do not use G P Dectol R & O or Super Hydraulic Oils)	-20°F.	100	155ssu
Gulf	Harmony 44 (Hydraulic)	+5°F.	102	150ssu
Pure	Puroturbine Light or Puropale Light (Do not use Puropale RX)	-20°F.	100	150ssu

*Primary Recommendation

III. MAINTENANCE AND ADJUSTMENTS

C. LUBRICATION - Continued

3. Hydraulic Oil - Continued

- c. NOTE: If cold ambient temperatures are anticipated, it may be necessary to use a lighter weight oil for winter service. Consult MKT for details.

It is recommended that the hydraulic oil be drained and changed at least once a year. It may be necessary to change it more frequently, depending on the operating conditions and/or whether summer and winter weight oils are used.

WARNING: When replacing or adding oil, be extremely careful to keep foreign matter from entering the oil and the system. Dirt, dust, etc., will harm or interfere with the operation of the pumps and valves.

- d. Mixing different manufacturer's hydraulic oils can be done if they are miscible, (same base and additives). Check with factory or oil supplier.
- e. Maintain hydraulic oil in tank to full reading. Dropping below 3/4 full may cut out Boost Pump delivery.

The hydraulic motor on the vibrator requires a drain line to relieve case pressure inside the motor. The motor drain line back-to-tank has a "blow off" safety valve located in the line on the vibrator. The "blow off" relief valve setting recommended is 40-50 psi to protect the motor seals and interior components. If this pressure is surpassed by a kink in the line or incorrect connection at the power unit tank or any resistance of flow to tank, oil will spill at the valve.

III. MAINTENANCE AND ADJUSTMENTS

C. LUBRICATION - Continued

4. Vibrator

Vibrator lubrication is basically automatic and an occasional look at the outside side glass for flow and a check on the level is all that should be required. The gear-bearing-eccentric housing is sealed and the oil level should not change.

The lube oil supplied by the factory is Shell Tellus 33, SAE 30. The basic requirement for this oil is good lubricating qualities, that is: an EP oil (extreme pressure), a high viscosity index (100) and a relatively low pour point.

A check on the lube oil level is made by removing the lower pipe plug on the heavy end cover. The oil level should be to the bottom of this pipe plug hole when the vibrator is level. After the vibrator is used and this plug removed, it is not unusual for a hissing of air since a vacuum or a pressurizing of the housing has occurred due to the action of the hydraulic motors when operating above or below the height of the hydraulic power pack respectively.

If the level of oil is above this pipe plug opening or lube oil volume increasing this will indicate that the hydraulic motors are leaking hydraulic fluid through the motor drive shaft seals. The seal leakage must be corrected immediately. The mixture of hydraulic oil and lube oil is not a lube problem but the increased level will add load to the rotating eccentrics and cause excessive foaming. The side cover, closest to the hydraulic motor housing, can be removed and an inspection of the oil and coupling connectors to the lube pump and eccentrics can be made.

III. MAINTENANCE AND ADJUSTMENTS

C. LUBRICATION - Continued

4. Vibrator - Continued

Periodic removal of the three magnetic plugs at the bottom of the exciter housing (one covered by the clamp housing) for inspection would be advisable to remove any loose metallic particles and give indication of possible internal wear of bearings.

The lube strainer and lube filter must be checked periodically. The strainer is located at the suction end of the lube pump in the bottom transfer block of the motor housing. The end pipe plug has the strainer soldered to it. The lube filter assembly is located at the pressure end of the lube pump. See Fig. 43, Page 83.

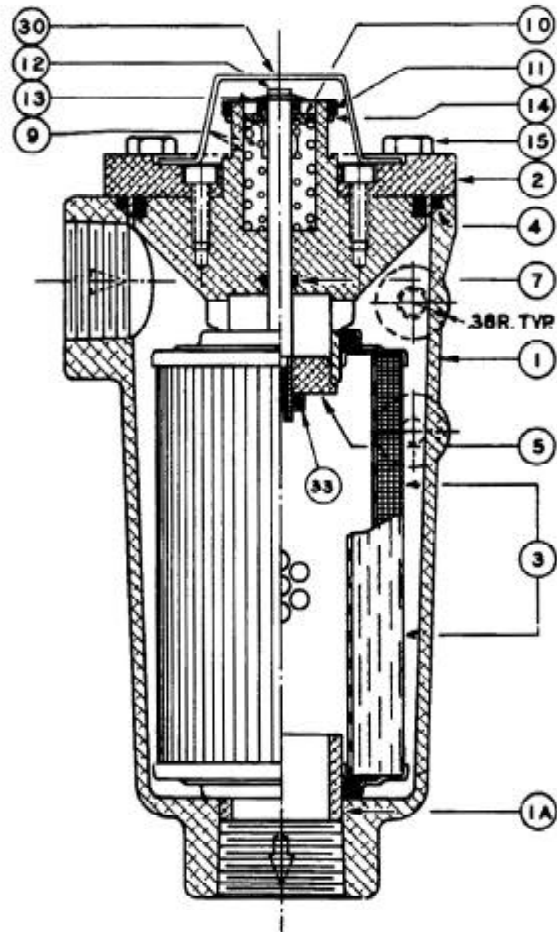


FIG. 10

III. MAINTENANCE AND ADJUSTMENTS

C. LUBRICATION - Continued

4. Vibrator - Continued

The paper filter element, Marvel 629206-5140, is replaceable and provides 40 micron filtration. The indicating ring exposed at the end of the filter will return to its original position when stopped but an O-Ring will indicate its last position. If the O-Ring is in the red, the filter must be replaced. After replacing the filter element, be sure to return the O-Ring back to the green area.

The clamping assembly moving jaw slide is not lubricated. If desired, a coating of "Moly-Kote" could be applied, but do not use oils or grease since they will pick up dirt and grit. The suspension assembly has four grease fittings, located on the lower bushing holders. These bushings are to be greased regularly. Also, oil the suspension upper bushings freely.

D. HYDRAULIC SYSTEM

1. How to Drain the Hydraulic System

- a. Remove the oil cap in the base of the tank to drain it. The easiest way to drain the entire system, not just the tank, is to disconnect the many hoses at their adapters and allow the oil to drain into a suitable container.
- b. Manually operate the control valves to drain them.
- c. After the tank has been thoroughly cleaned, suction filters No. 30 and tank screen No. 38 cleaned and the filters No. 27 Fig. 19, No. 28 Fig. 19 and No. 24 Fig. 39 elements changed, replace the hoses and tighten all connections.

III. MAINTENANCE AND ADJUSTMENTS

D. HYDRAULIC SYSTEM - Continued

1. How to Drain the Hydraulic System - Continued

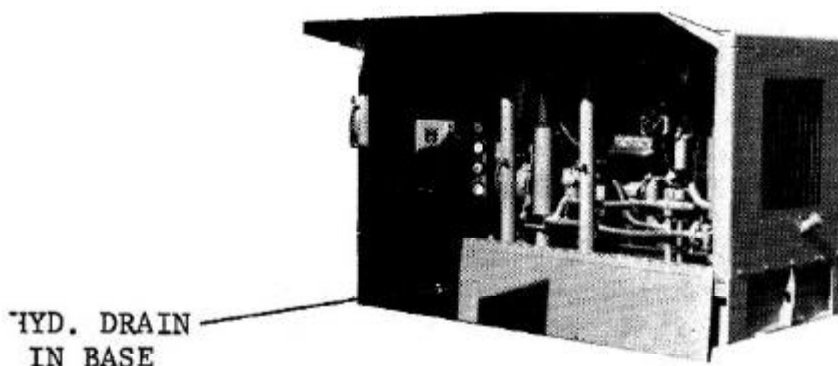


FIG. 11

WARNING: Before start-up, after draining the system, be sure all pumps (No. 13 Fig. 16, No. 12 Fig. 9 and No. 22 Fig. 14) are primed and their cases full of oil. Follow the normal start-up and filling procedures. Be sure the Boost Pump (No. 22, Fig. 14) is allowed to run until the entire system is pressurized to 85-95 psi.

2. Pumps

The hydraulic pumps (No. 13 Fig. 16 and No. 12 Fig. 9) in the clamp and drive circuits are high-pressure axial-piston pumps. The belt-driven boost pump (No. 22 Fig. 14) is an IMO, rotary-screw pump.

NOTE: No major field repairs of these units should be attempted. Replace the pumps with a complete new unit.

For more detailed information on the pumps, refer to the instruction manuals in the rear of this manual.

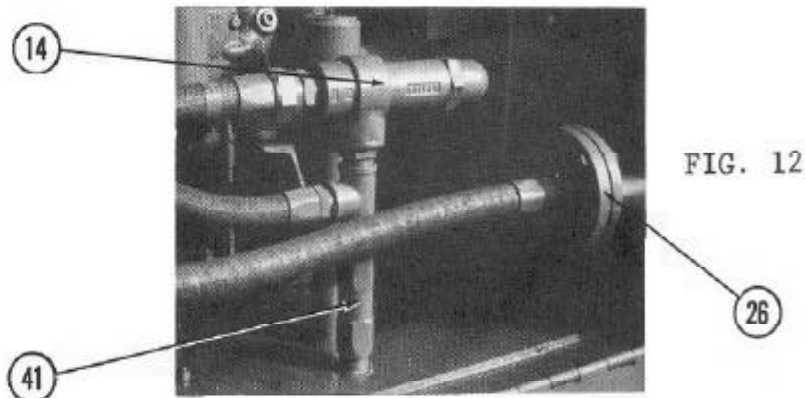
III. MAINTENANCE AND ADJUSTMENTS

D. HYDRAULIC SYSTEM - Continued

2. Pumps - Continued

All pumps used on this hydraulic power pack require priming. If the hydraulic power unit has not been used for a few weeks, it would be safe to check the prime of each pump before starting. Priming the charge pump is done by disconnecting the IMO input line and pouring in maximum volume of hydraulic fluid, or disconnecting the drain line on the piston pumps and filling the pump case.

The clamp pump, a Rivett Piston, has its input feed supercharged with pressures of 5 to 10 psi. This input feed pressure will assure pump prime. The input feed pressure is the result of the check valve No. 41 cracking pressure, positioned past the charge line relief valve No. 14.



In the event it becomes necessary to clean the orifice plug in the large Lucas pump (see Fig. 16) per the troubleshooting instructions, unscrew the plug carefully, trying not to damage the shaft O-Ring.

At all times, there must be free flow to tank from both piston pumps and motor drain lines. If there is an obstruction in the piston pump drains, the case pressure could rise (normal 7-15 psi) above the maximum 60 psi of the seals and cause seal and retainer damage, or destroy the motors.

III. MAINTENANCE AND ADJUSTMENTS

D. HYDRAULIC SYSTEM - Continued

2. Pumps - Continued

The motor drain line has a safety blow-off relief that will protect the hydraulic motors in the vibrator. Full dependence should not be put on this blow-off.

The following tabulation of pump flows and piston pump/motor drains will be helpful in evaluating specifications and establishing service requirements:

Pump Flows

a. Lube Pump in Vibrator	@ 1850 RPM -	7 1/2 GPM
(Gerotor)	@ 1525 RPM -	6 GPM
b. Boost Pump	@ 100 psi -	36 GPM
(IMO)	@ 50 psi -	38 GPM
c. Clamp Pump	@ 2800 psi -	17 GPM
(Rivett)	1900 RPM	
d. Drive Pump	@ 1900 RPM -	110 GPM
(Lucas)	3000 psi	
	Trimmed to	70-80 GPM

Piston Pump/Motor Drains

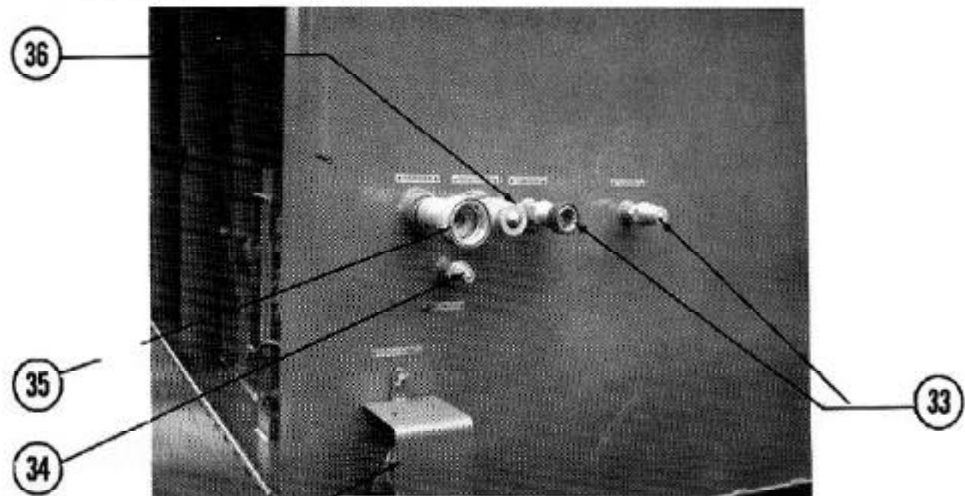
a. Clamp Pump	Average drain @ 2750 psi -	3/4 - 1 1/2 GPM
(Rivett)	Requiring service @ 2750 psi -	over 3 GPM
b. Drive Pump	Average drain @ 3200 psi -	2-3 GPM
(Lucas)	Requiring service @ 3200 psi -	over 6 GPM
c. Exciter Motors(2).	Average drain @ 3200 psi -	2 GPM
(Lucas)	Requiring service @ 3200 psi -	over 4 GPM

III. MAINTENANCE AND ADJUSTMENTS

D. HYDRAULIC SYSTEM - Continued

3. Adding Oil and Venting Air

- a. Inspect all connections to be sure they are tight.
- b. Remove the cover (Fig. 13) over the hydraulic oil filter and add the oil. Fill the tank until the dial indicator shows the tank to be full.
- c. Small amounts of air are automatically removed from the drive circuit, provided the filling procedure is followed. To remove the air from the clamp cylinder system, operate the clamp cylinder and bleed at the hose connection existing from vibrator on the low pressure side or drain side, never at the high pressure side. Repeat a few times until no escaping air is noticed.



HYD.OIL SPOUT

FIG. 13

- d. After filling the system, recheck the oil level and refill the tank if necessary.

WARNING: WHEN ADDING OIL, USE ONLY HYDRAULIC OIL AS DESCRIBED IN SECTION III-C-3.

III. MAINTENANCE AND ADJUSTMENTS

D. HYDRAULIC SYSTEM - Continued

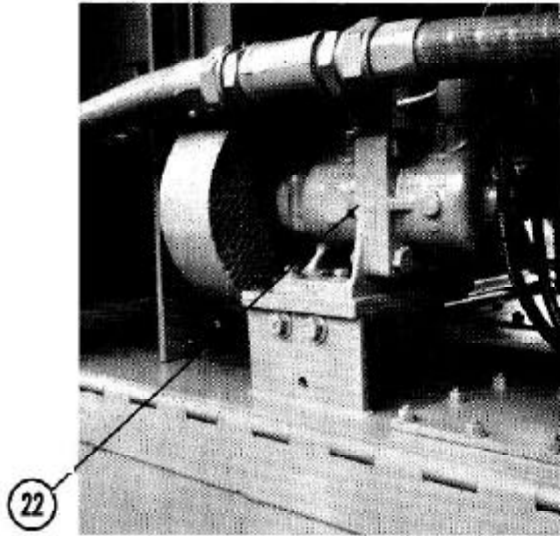


FIG. 14

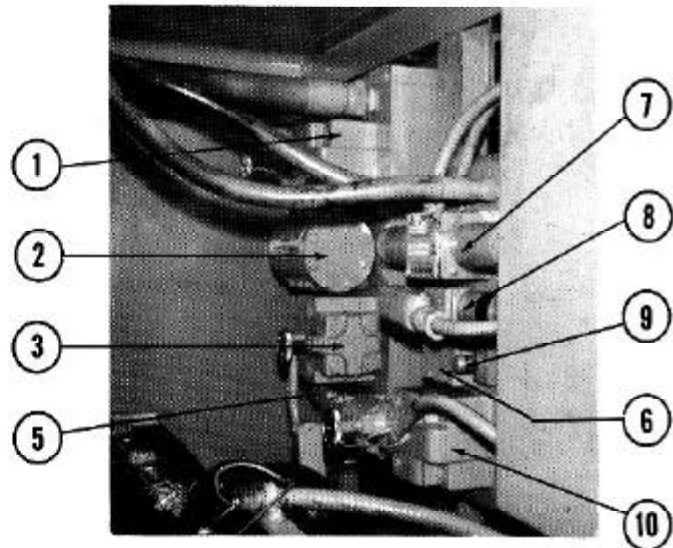
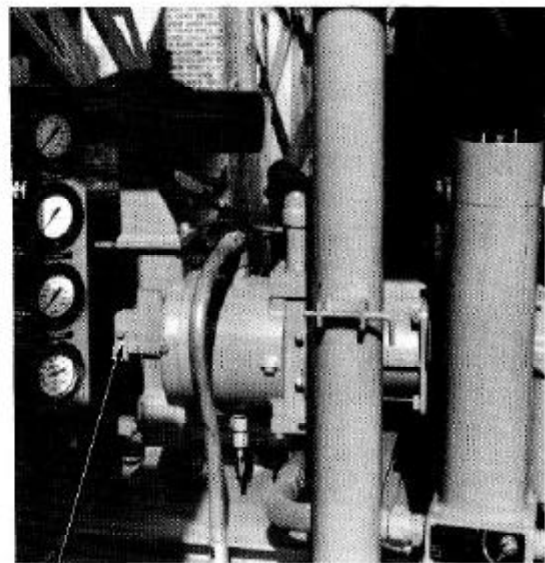


FIG. 15

4. Control Valves

Repairs on valves should be limited to the replacement of oil seals and solenoid coils.

Pressure adjustments are all that might be required on the relief valves (Parts 1, 3, 10 and 14) and the pressure compensator on the small piston pump (clamp circuit) Part 12 on Fig. 9.



ORIFICE
PLUG

FIG. 16

III. MAINTENANCE AND ADJUSTMENTS

D. HYDRAULIC SYSTEM - Continued

4. Control Valves - Continued

To make the relief valve adjustments, loosen the locknut and slowly adjust the pressure setting while simultaneously watching the appropriate pressure gage. Turn the adjusting knob IN, in small increments, to increase pressure and OUT, to decrease pressure. Adjustments to the relief valves and pressure compensation must be approved by manufacturer or owner of equipment so that warranties are not affected.

The following pressure settings should be obtained with the oil at operating temperatures:

- a. Drive circuit relief valve (Part 3, Fig. 17)
(Over Relief) 3200-3500 psi
- b. Clamp circuit relief valve (Part 10, Fig. 15)
(Over Relief) 3200-3300 psi
- c. Clamp pump pressure compensator (Part 12,
Fig. 9) 2700-2800 psi

NOTE: To make the compensator adjustment, it is necessary for the clamp pressure relief valve to be set first, raising the compensator pressure very high (screwing adjusting screw in), setting the relief at approximately 3300 and then lowering the compensator to approximately 2750 psi.

- d. Boost pressure relief valve Part 14, Fig. 12
85-90 psig, set without load on the power pack.
- e. Brake valve (Part 1, Fig. 17). Adjust this valve until the desired stopping time of the vibrator is obtained. To adjust, a pressure gage must be connected to the gage port of the brake valve setting the stopping pressure approximately 1200-1400 psi.
- f. Pilot or back pressure relief valve No. 4, Fig. 17, setting should be 350-400 psi.

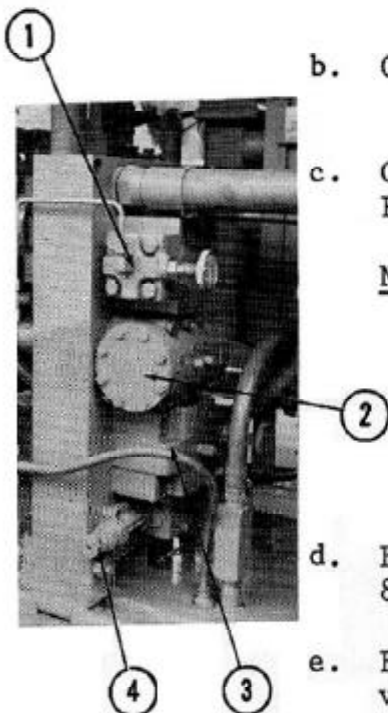


FIG. 17

III. MAINTENANCE AND ADJUSTMENTS

D. HYDRAULIC SYSTEM - Continued

4. Control Valves - Continued

- g. The boost pressure switch (Item 17) electrical interlock is a protection against too low a boost or make-up pressure in the closed loop circuit. Generally, when starting the main pump from low flow to maximum flow and the two vibrator motors from a stop, pump and motor internal pressure increase causing their drains to increase. This added drain for the pump and motors at the initial start may cause an instant boost pressure drop since it takes an instant for the boost relief valve (Item 14) to open. This instant drop in pressure may open the boost pressure switch and return the main pump back to low flow. The needle valve (Item 40) will slow down the drop in pressure in the boost pressure switch. Close this needle valve and crack open about 1/8 turn.

Pressure switch settings are made at the factory. With switch contact on rising pressure, the pressure switch settings are as follows:

PRESSURE SWITCH #	PRESSURE SWITCH	PSI SETTING
17	Boost	40 ± 05
15	Drive	700 ± 100
16	Clamp	1900 ± 100

III. MAINTENANCE AND ADJUSTMENTS

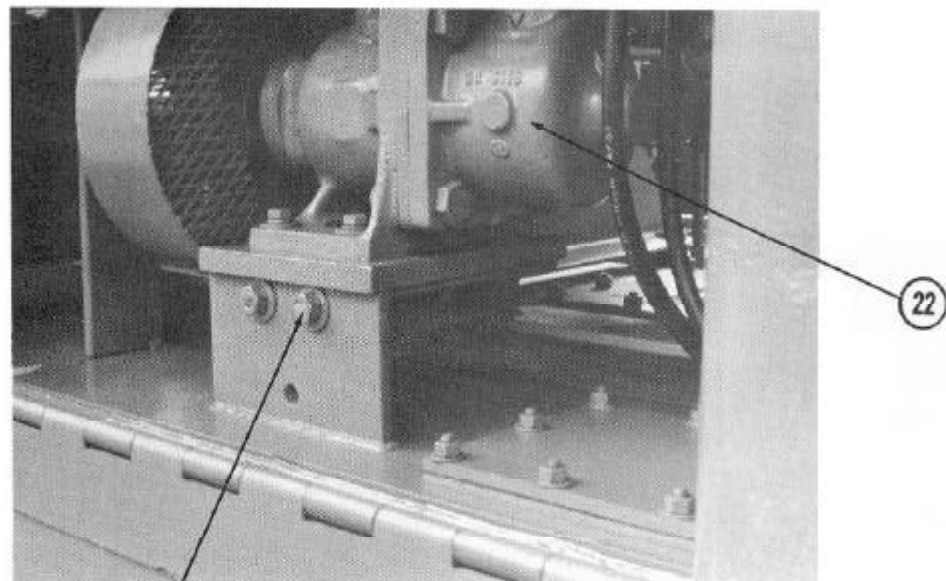
D. HYDRAULIC SYSTEM - Continued

5. Boost Pump Belt Drive

Adjust the belt tension by moving the slide base, with the two adjusting screws under the IMO boost pump (Part 12) until a force of approximately 5 pounds, applied perpendicular to the belt at the center of its span, is required to deflect the belt 3/8 inch. It may be necessary to adjust a new belt's tension several times. A straight edge should be used to insure the sheaves are in the same plane.

To change the belt, loosen the slide base under the pump until the belt will come off the sheaves.

The belt and sheaves must be clean and oil-free to prevent slippage.



ADJUSTING SCREWS

FIG. 18

III. MAINTENANCE AND ADJUSTMENTS

D. HYDRAULIC SYSTEM - Continued

6. Oil Temperature

The hydraulic oil temperature is maintained automatically by a thermostatically operated temperature control valve (Part 26, Fig. 12) at the discharge of the cooler (Part 25, Fig. 8). No adjustment of this valve is required. The normal operating temperature should be approximately 115° F., as read on the dial thermometer on the instrument panel, and should not exceed 145° F., even on the hottest summer day. If these temperature limits are not met, or the temperature fails to stabilize, it may be necessary to replace the thermostatic elements.

WARNING: DO NOT OPERATE THE UNIT IF OIL TEMPERATURE EXCEEDS 160° F., AS PUMP DAMAGE MAY RESULT.

7. Filters

All filters in the hydraulic system are on the suction side of the pumps. There is a tank strainer before the 40 micron, cleanable filter, No. 30. The indicator on top of filter No. 30 will show when cleaning of the element is required. Filter No. 24, located close to the drive manifold, is 25 micron with two K25 elements. Filter No. 28 is 10 micron on the suction side of the large Lucas Pump, filter No. 28 has two K10 elements. Filter No. 27 is 10 micron on the suction side of the clamp pump. Filter No. 27 has a single K10 element.

III. MAINTENANCE AND ADJUSTMENTS

D. HYDRAULIC SYSTEM - Continued

7. Filters - Continued

Change the filter (No. 24 Fig. 16 and No. 28 Fig. 15) elements when the indicator on the filter housing indicates the need for a change. The position of the indicator should be checked daily when the hydraulic oil is warm and the pumps are operating. It is suggested that regular element-change intervals be established, based on operating experience especially for No. 27, the clamp pump filter. Keeping the system and oil clean is essential for good equipment life.

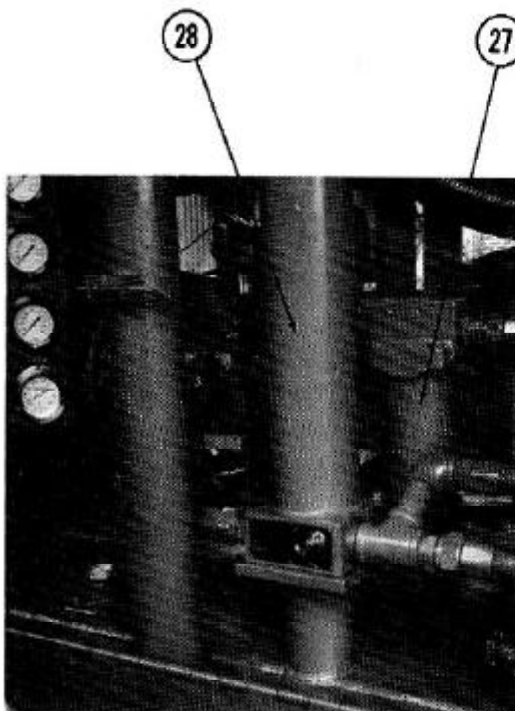


FIG. 19

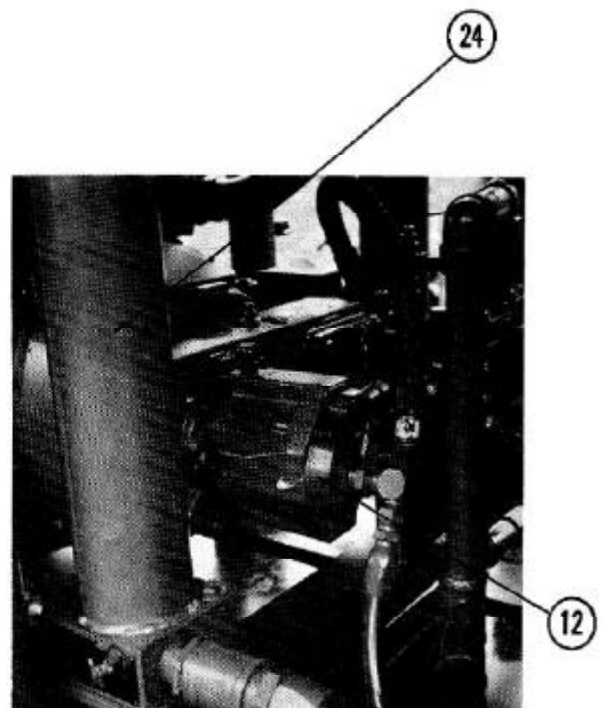


FIG. 20

III. MAINTENANCE AND ADJUSTMENTS

E. ELECTRICAL CONTROL SYSTEM

1. The electrical control system is powered by two 12 volt batteries in series, or 24VDC. The schematic and connection diagrams, Fig. 20, Page 43 show the circuit and general arrangement.
2. Automatic controls or interlock adjustments are made at the pressure switches (15, 16, 17 on Fig. 18) located on the back of the gage panel. Since these switches are used for protective control purposes, the following regular maintenance checks are recommended.
 - a. Remove the cover and visually inspect for evidence of shorting, corrosion or loosening of screws. Vibration of panel could cause internal switches to be nonoperative.

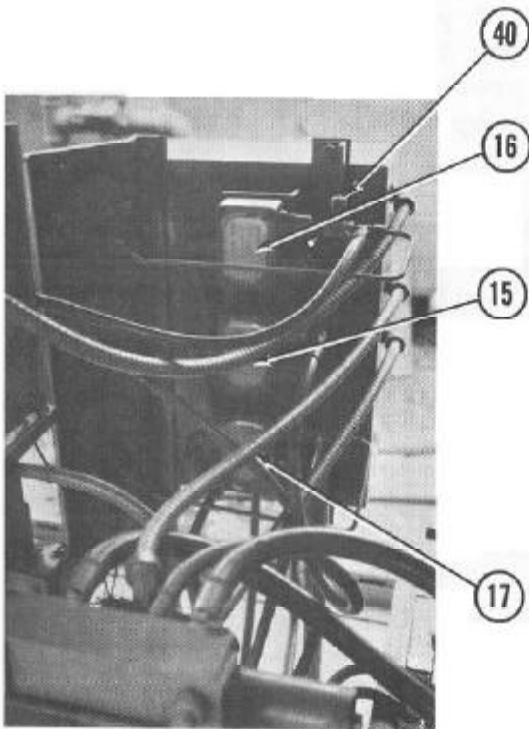


FIG. 21

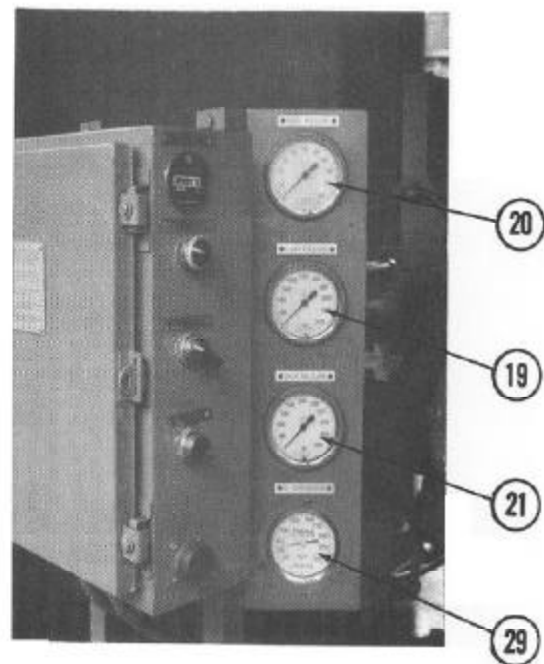


FIG. 22

III. MAINTENANCE AND ADJUSTMENTS

E. ELECTRICAL CONTROL SYSTEM - Continued

2. Automatic control adjustments - Continued

b. The pressure switch settings have been tested at the factory. Do not change spring compression of hydraulic cylinder or the original setting will be altered. The settings of the switches are as follows:

- (1) Boost pressure switch (No. 16 on Fig. 21 or PS-1 on Fig. 35, Page 73) 40 ± 05 psi.
- (2) Clamp pressure switch (No. 15 on Fig. 21 or PS-2 on Fig. 35) 1900 ± 100 psi.
- (3) Drive pressure switch (No. 17 on Fig. 25 or PS-3 on Fig. 35) 700 ± 100 psi.

Readjustments of pressure settings can only be done by removing the switch assembly and with an auxiliary pressure source with gage, set switch contact by adjusting spring compression in cylinder.

3. All relays are the plug-in type. If a malfunction should occur, remove the defective relay and insert a new unit. The 5 relays are identical and interchanging of relays can be done.
4. A separate fuse, inside the control box, is supplied for the main system (15 amps.) and for the main pump actuator motor (4 amps.). The upper fuse is the 15 amp. Jumping the fuse or adding higher amps. could cause serious damage.
5. The timer will run when the drive pressure switch contact is closed or when drive pressure is above the 700 psi setting.

III. MAINTENANCE AND ADJUSTMENTS

F. REPAIR AND REASSEMBLY

1. Exciter Assembly

The disassembly of a portion of the exciter, such as the replacement of hydraulic motors or a major disassembly such as the replacement of eccentric bearings determines how and where the work must be done. The replacement of the hydraulic motors, the lube pump or the lube filter assembly can be done cautiously in the field and not necessitate the convenience of a shop with suitable lifting and handling equipment. In all cases of disassembly and reassembly, the exciter assembly drawings, Fig. 48 and 49, Pages 106 and 107 should be used. The machined components, such as gears, eccentrics, covers, retainers, etc., have their respective part numbers stamped on the part as a seven digit number.

The lube filter has a filter element, Item 86, which provides a 40 micron filtration. Replacement of the filter element can easily be made by removing the exposed filter end cover. The plastic cover over the visual indicator is not watertight. If this cover is damaged or if the V-14 is submerged in water, the lack of seal is not important and will not affect the filter indicator or filter operation. Two tightly fitted shear blocks, Item 84, are positioned against the body of the filter housing, Item 85, Page 106. If a filter housing is replaced, be sure the shear blocks are tightly fitted against the filter housing body.

All cap screws, Grade 5, 8 or 9 should be torqued as follows:

3/8" - 30 ft. lbs.	5/8" - 160 ft. lbs.
1/2" - 80 ft. lbs.	3/4" - 250 ft. lbs.

III. MAINTENANCE AND ADJUSTMENTS

F. REPAIR AND REASSEMBLY - Continued

1. Exciter Assembly - Continued

- (a) Replacement of a Hydraulic Motor (Ref. Figs. 48 and 49, Pages 106 and 107)

The replacement of a hydraulic motor, Item 24, should be done with utmost care. Remove the motor housing cover, Item 4, side cover, Item 19 (nearest the motor housing), the two large manifolds, Items 20 and 21, and the drain motor manifold, Items 42, 37, 39 and 40. Be careful of the manifold O-Rings, Item 74. The set screw on the motor coupling, Item 53, should be loosened on the eccentric end only so that the coupling stays with the motor. Remove the 4 screws, Item 68, on each hydraulic motor. Note these screws are removed from the inside, threading into the crescent-like steel nut on the outside of the hydraulic motor. When removing the hydraulic motor, be extra careful not to drop or lose the eccentric coupling key, Item 54. Replace the coupling on to the new hydraulic motor approximately the same location on the motor shaft. The new hydraulic motor must have the port cover blocks located exactly the same as was on the hydraulic motor removed. Reassemble the hydraulic motor with a new motor gasket, Item 59, and use Loctite screw lock to the hydraulic motor screws, Item 68. The effectiveness of Loctite can only be assured if it is allowed to dry for 12 hours or more. Reassemble the two large manifolds, Items 20 and 21, be assured the O-Rings, Item 74, are not damaged and that they are properly seated. Tighten the coupling set screws, Item 53, securely.

CAUTION: These piston type motors are very susceptible to damage as a result of contamination. Take every precaution to keep the open hydraulic motor parts clean and free from dust or foreign particles.

III. MAINTENANCE AND ADJUSTMENTS

F. REPAIR AND REASSEMBLY - Continued

1. Exciter Assembly - Continued

- (b) Replacement of Eccentric Bearings (Ref. Figs. 48 and 49)

The removal of eccentric bearings requires an almost complete disassembly of the exciter assembly. Removal of the suspension assembly and the clamp assembly is recommended. Be sure to drain the lube oil. Removal of the motor housing assembly is necessary but it is not necessary to disassemble the hydraulic motors, pumps, manifolds, etc., on the motor housing assembly. Loosen the motor coupling set screws, and the lube pump set screws on the eccentric end only and loosen the pipe union, Item 55, and lift off the entire motor housing. Remove the large heavy end cover, Item 3. The gears are exposed on the one end and the bearings exposed on the other end. Remove the two timing gears, Item 10 and 11, and the 4 drive gears, Items 8 and 9. The timing gears will be pinned to the two center drive gears and may be difficult separating or sliding off the eccentric shafts. The gear keys are tightly fitted at assembly and may have been hammered into place. The pinned gears can be removed as a pair. Be sure to record location of gears to assure reassembly will be the same.

The eccentric shafts will have a slip fit in the bearing inner races and an interference fit between the bearing outer race and the respective housings, either in the exciter housing or in the bearing cartridges, Item 44, 61 and 78.

Reference the chart of fit tolerances on Page 131.

III. MAINTENANCE AND ADJUSTMENTS

F. REPAIR AND REASSEMBLY - Continued

1. Exciter Assembly - Continued

(b) Replacement of Eccentric Bearings - Continued

Freeze the new bearings and position full depth into the cartridge, until the bearing seats against the shoulder. Freeze the new bearings and position into the exciter housing to within 1/8" of full depth with bearing cover, Item 13 or Item 12. Assemble eccentrics and bearing cartridge fully. Using the covers, Item 12 and 13, jack in the bearings but be sure there will be a .040 total end clearance between the bearing inner race and the eccentric shoulder. Machining the pilot protrusion of the covers, Item 12 and 13, may be necessary. When reassembling the gears, be sure they are seated tightly against the eccentric shoulders, the keys are hammered tightly in place and the locknuts are hammered tight before bending lockwasher flaps.

Position the eccentrics up or down accurately by correct meshing of gear teeth. Note the relationship between gear tooth and keyway, in mating gears, the keyway lines up with the center line of the tooth with one and the other it lines up between teeth. The keyway on the eccentrics are accurately positioned with the highest point.

Wherever possible, cement new gaskets to covers with 3M cement and apply a thin coat of Permatex to the other side of the gasket. Apply Loctite screw lock to all cap screws and set screws.

Before installing new bearings, be sure the bearing number is correct and don't rely on box markings. The small bearing is Torrington No. 70SD23W33F4 and the large bearing No. 110SD23W33F4. The W33 designates the lubrication groove and oil holes. The holes are a must. The F4 designates bearing roller clearance and F4 must be used.

III. MAINTENANCE AND ADJUSTMENTS

F. REPAIR AND REASSEMBLY - Continued

1. Exciter Assembly - Continued

(b) Replacement of Eccentric Bearings - Continued

Remove the cartridges with bearings, first, using jack screws in the threaded holes provided. Lift the two large eccentrics out of the bearings remaining in the exciter housing with eye bolts screwed into the eccentrics. The two small eccentrics with the 3/4 extension shaft requires a special clamp for lifting.

The removal of the bearings from the cartridges and exciter housing will be difficult. Remove the bearing from the cartridges in an arbor press. The smaller cartridges will be more difficult because a small area of the bearing inner race is exposed through the cartridge opening. Use a 2 3/4 O.D. pipe to press out the small bearing from the cartridge. If the bearing separates its inner race from the outer race, it will be necessary to drill a few holes through the cartridge to the outer race and hammer out this race. The bearings in the exciter housing can be pressed out into the exciter housing if a large enough arbor press is available or they may be hammered out using a rod and hammer.

Reassembling new bearings into the cartridges and exciter housing will require sub-freezing the bearings. Use of dry ice will not be satisfactory. Sub-freezing the bearings to - 150° F. in a low temperature freezer or placing the bearing over liquid nitrogen is most desirable. If facilities only permit an immersing of the bearing into the liquid nitrogen (-300° F.), this will do the job quickly, but this may risk damaging the bearing by the sudden thermal shock. Freezing the bearings to this low temperature is not damaging but the suddenness from room temperature to -300° F. is potentially dangerous.

III. MAINTENANCE AND ADJUSTMENTS

F. REPAIR AND REASSEMBLY - Continued

2. Clamp Assembly

The standard clamp assembly, Fig. 50, Page 108 may require a replacement of the slide, Item 2 and/or a clamp cylinder, Item 8. The cylinder shaft is threaded into the slide until the slide seats against the cylinder shaft shoulder. If the slide is damaged, it may not slide easily and require considerable force to remove it. Utilization of the hydraulic cylinder to remove the slide is possible by using successingly larger spacer blocks between the clamp housing and the cylinder flange and extending and retracting the hydraulic cylinder piston. Removal of the slide key, Item 7, is not necessary for disassembly.

Similarly, the above slide-hydraulic cylinder removal pertains to the Z-pile clamp assembly, Fig. 66, Page 122, caisson clamp assembly, Fig. 69, Page 125 and the pipe clamp assembly, Fig. 68, Page 124.

Loctite should be used on all screws when assembling. Smear Moly-Kote (or equivalent Molybdenum Disulphide) generously onto the slide, Item 2, before reassembling.

III. MAINTENANCE AND ADJUSTMENTS

F. REPAIR AND REASSEMBLY - Continued

3. 20 TON SUSPENSION ASSEMBLY

The 20 ton suspension assembly may require bushing replacement after long and hard use. The four vertical shafts of the suspension assembly are guided in six bronze bushings, four at the lower end and two at the upper end. Referencing the 20 ton suspension assembly drawing, Fig. 55, Page 113, and Fig. 56-58, Page 114, it can be seen that on each outer shaft there is a smaller, upper spring in a container. These two upper springs, Item 8, actually preload the 4 large lower springs, Item 6, and the two inner small springs, Item 7. It is this very high preload of springs that make the disassembly and assembly difficult.

There is a separate lower bushing holder, Item 13, that guides the lower end of the shafts. When the suspension assembly is removed from the exciter, this lower bushing holder will have to be removed from the exciter separately. Remove the grease fittings from the lower bushing holder to prevent their breakage when lifting.

The full spring preload of the assembly is maintained by the 4 top nuts, Item 17. DO NOT TORQUE THESE 4 TOP NUTS TO START DISASSEMBLY.

After the hydraulic hoses are disconnected from the lifting head, Item 2, immediately cap all quick disconnects to prevent contamination. To start disassembly, set the lower bushing holder, Item 13, onto a wood spacer about 3" thick and 6" wide, lower the suspension assembly over the lower bushing holder and jack down the top lifting head uniformly so that the 4 nuts with washers can be hand-screwed. Two "come-alongs" can be used on opposite sides of the suspension assembly, hooked into the middle openings at the bottom of each side of the spring suspension housing and over the mid-point of each side of the top lifting head. Tighten the "come-alongs" equally. (See Fig. 23). Do not allow the

III. MAINTENANCE AND ADJUSTMENTS

F. REPAIR AND REASSEMBLY - Continued

3. 20 TON SUSPENSION ASSEMBLY - Continued

top lifting head to cock or it will seize on the spring lifting shafts, preventing further movement. At the factory, this jacking down is done by setting the suspension assembly in a fixture (See Fig. 24). Important! The hex slotted nuts must not be removed until all spring pressure has been removed from the nuts. If the threads of the spring lifting shafts, Fig. 57, Page 114, are damaged, a 5/8 Dia. rod may be inserted into the catch holes of the appropriate bottom nut, Item 2, Fig. 57 to hold the spring lifting shaft while the hex slotted nut is wrenched off. On disassembly, be sure the 5/16 roll pin, Item 3, Fig. 57, hasn't sheared. Release the "come-alongs" equally after the nuts and washers are removed.

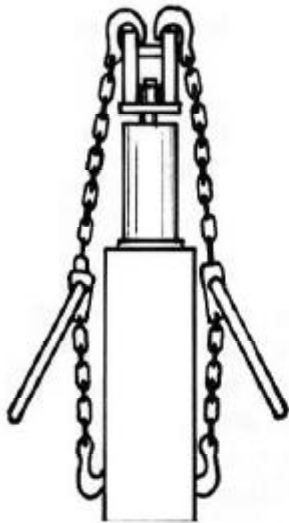


FIG. 23

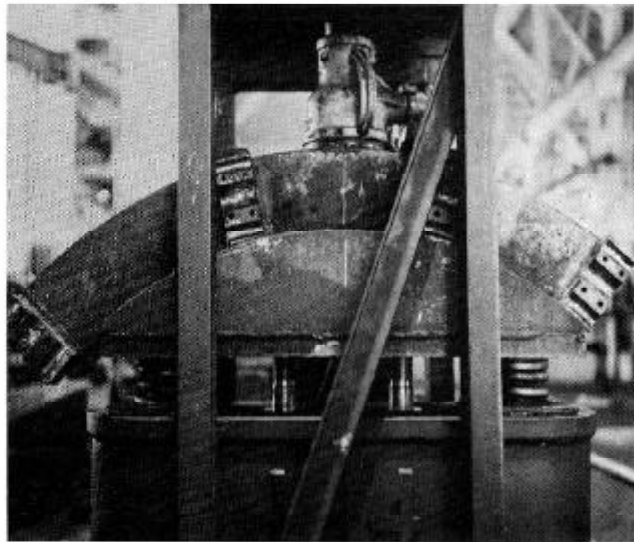


FIG. 24

III. MAINTENANCE AND ADJUSTMENTS

F. REPAIR AND REASSEMBLY - Continued

3. 20 TON SUSPENSION ASSEMBLY - Continued

Replace all worn, broken or fatigue-cracked parts with genuine MKT replacement parts, available from your factory authorized MKT Distributor. MKT's standard warranty against defective material and labor is applicable to new MKT parts providing they are interfaced only with other genuine MKT parts.

The installation of bushings into the upper bushing holders, Item 11, and into the lower bushing holder, Item 13, should be done on an arbor press. The following tolerances will be helpful in establishing diameters and fits for the bushings:

Upper bushing bore	- - - -	2.994/2.996
Upper bushing O.D.	- - - -	3.000/2.998
Upper bushing I.D.	- - - -	2.270/2.265
Lifting shaft dia.	- - - -	2.250/2.245
Lower bushing bore	- - - -	2.494/2.496
Lower bushing O.D.	- - - -	2.500/2.4985
Lower bushing I.D.	- - - -	1.760/1.755
Lifting shaft dia.	- - - -	1.740/1.735

After the bushings have been pressed into place, two diametrically opposite locking set screws are used on each bushing to assure the bushings won't slip in their respective hangings. Drill and tap four 3/8 brass set screws x 1/2" long, half diameter in the bushing and half diameter into the bushing holder.

III. MAINTENANCE AND ADJUSTMENTS

F. REPAIR AND REASSEMBLY - Continued

3. 20 TON SUSPENSION ASSEMBLY - Continued

When replacing a spring lifting shaft, the bottom nut, Item 2, Fig. 57, must be accurately located on and pinned to the shaft as follows:

- (1) Screw the nut onto the shaft to the point where the dimension from the top of the nut to the center of the cotter pin hole at the top of the shaft is a nominal $22 \frac{3}{4}$ inches. See Fig. 25.
- (2) Using the hole in the bottom nut as a pilot, drill a .28" hole through the shaft and insert a $\frac{5}{16} \times 4$ " roll pin, Item 3, Fig. 57.
- (3) Assure that all shaft threads are clear and that the hex slotted nuts, Item 17, can be run by hand.

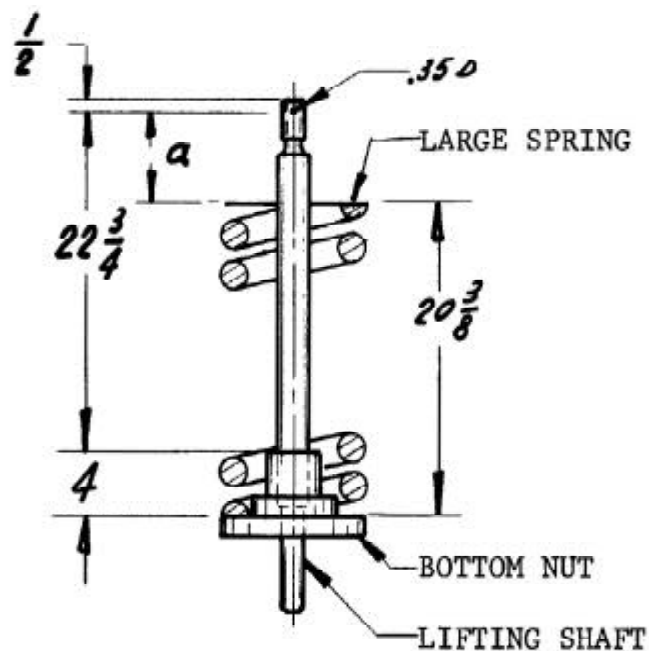


FIG. 25

III. MAINTENANCE AND ADJUSTMENTS

F. REPAIR AND REASSEMBLY - Continued

3. 20 TON SUSPENSION ASSEMBLY - Continued

The nominal dimension internally of the support spring housing, Item 25, from the top of the flange to the bottom seat of the support spring is $13 \frac{3}{8} \pm \frac{1}{8}$. Variations in excess can and should be corrected by inserting $\frac{1}{8}$ shims on the seat (See Fig. 26).

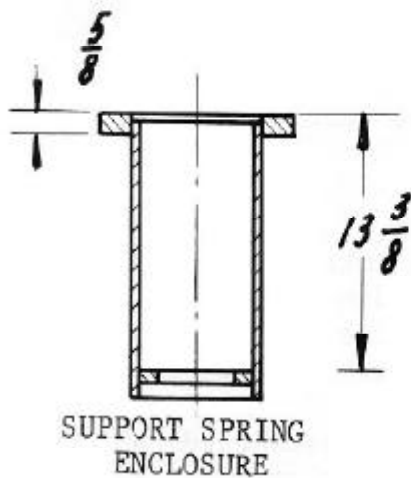


FIG. 26

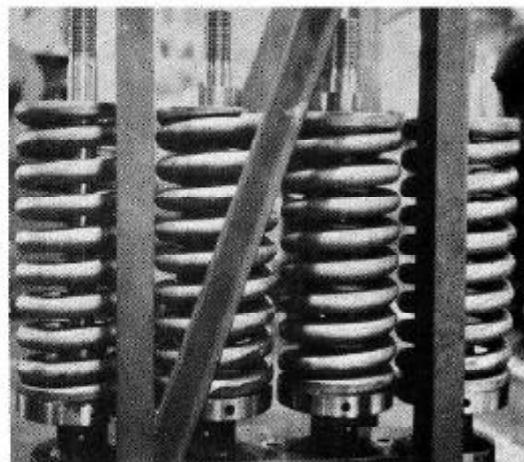


FIG. 27

The nominal free spring lengths are:

Support Spring, Item 8	- - -	18 inches
Inner Spring, Item 7	- - -	$18 \frac{3}{8}$ inches
Outer Spring, Item 6	- - -	$20 \frac{3}{8}$ inches

Do not interchange the support and inner springs. The inner springs will not fit into the support spring enclosures. It is important to properly match spring lifting shafts, Item 1, Fig. 57 and outer support springs, Item 8, Fig. 55 for rattle-proof, longest wear operation of the suspension assembly.

- (1) Select the two Spring Lifting Shafts, with Bottom Nuts attached, having the closest to a nominal $26\text{-}\frac{3}{4}$ " dimension from the top of the bottom land of the Bottom Nut to the center line of the top cotter pin hole (See Fig. 25).

III. MAINTENANCE AND ADJUSTMENTS

F. REPAIR AND REASSEMBLY - Continued

3. 20 TON SUSPENSION ASSEMBLY - Continued

- (2) Select a pair of, and preferably the longest, most equal length (± 0.03 ") Outer Springs.
- (3) Mount the shafts and springs (selected per Paragraphs 1 & 2 preceding) in the outer bushings of the lower bushing holder.
- (4) Mount the remaining two shafts and outer springs in the inner bushings of the lower bushing holder.
- (5) Measure from the top of each spring to the center line of each cotter pin hole to determine a nominal dimension "a" (See Fig. 25, Page 56. This "a" dimension must be within 1/8" for all four shaft/spring sets.
 - (a) Correction of a substandard "a" dimension can be made by making a 1/8" or larger spacer to make up the difference, as necessary, which will be inserted between the appropriate, corresponding hex slotted nut and washer when they are reassembled.

Reassemble the suspension assembly in the reverse of its disassembly. With the top lifting head, Item 2, drawn down adequately, position the four flatwashers, Item 22, over the four spring lifting shafts. Important! Install any spacer required to correct dimension "a" variation just determined. Screw on the four hex slotted nuts, Item 17. Important! These nuts should be run on by hand. Bring each nut down to the point where the cotter pin hole in the corresponding shaft is just clear at the bottom of one of the slots in the nut for insertion of a cotter pin. CAUTION! Do not wrench the nuts for a final draw-down of the top lifting head. Bring the top lifting head down with the "come-alongs" so that the

III. MAINTENANCE AND ADJUSTMENTS

F. REPAIR AND ASSEMBLY - Continued

3. 20 TON SUSPENSION ASSEMBLY - Continued

nuts can be run to their final position by hand. Insert and fix four 3/8" x 4" cotter pins, Item 19. Release the "come-alongs" evenly and equally to keep the top lifting head parallel to the spring suspension housing. IMPORTANT! NEVER REMOVE FROM OR INSTALL AN INDIVIDUAL HEX SLOTTED NUT ON A SPRING LIFTING SHAFT BY WRENCHING THE NUT AND HOLDING THE SHAFT AT THE CATCH HOLE IN THE BOTTOM NUT! This improper procedure can easily over-stress the 5/16" x 4" roll pin, Item 3, Fig. 57, shearing it, and permit the bottom nut, Item 2, Fig. 57 to run off the lifting shaft during subsequent operation of the vibrator. Major damage to the lower bushing holder, the bottom nuts, lifting shafts, springs, the support spring housings and/or the spring suspension housing can be the result. Bolt the lower bushing holder to the exciter, being sure to replace the 2 grease fittings, Fig. 56, Page 114. Lower the suspension assembly to the exciter, reseating the lifting shafts in the lower bushings.



FIG. 28

III. MAINTENANCE AND ADJUSTMENTS

F. REPAIR AND REASSEMBLY - Continued

4. 40 TON SUSPENSION ASSEMBLY

The 40 Ton Suspension Assembly, Reference Fig. 61, Page 117, and Fig. 62-64, Page 118, consists of a complex system of springs, preloaded, to provide an isolation of the massive lifting head and provide a means of lifting and relaxing while the assembly is vibrated. The four long lifting shafts are each guided in bushings, one at the top and one at the bottom of the shaft. It is these bushings that may require disassembly for replacement after long and hard use. Or, if the system is abused by over pulling and a shaft requires replacement, disassembly will be necessary. It is the spring preloads that make the disassembly and assembly difficult. Observing the cross section on Fig. 61, it can be seen that there are two separate spring assemblies, one in the lower housing and one in the upper housing. The assemblies of the lower and upper housings are independent when it comes to disassembly or assembly though they work together, when used together. The total preload in each shaft is about 3600 lbs. The large spring in the lower housing and the large and small spring in the upper housing is opposed or preloaded by the small spring (support spring) in the enclosure of the lower housing. Each shaft assembly is the same.

The lifting head can easily be removed by loosening the top four hex slotted nuts after the hoses are removed. If a fixture similar to Fig. 73, on Page 129 is not available, the disassembly of the 40 ton suspension assembly can be made while it is fastened to the exciter and the V-14 clamped onto a driven pile. The preloaded forces from the springs in the upper housing are held by the 14 - 1" cap screws, Item 19. Remove 10 of the cap screws, leaving two on each end. Jack up the top housing slowly and evenly with the four remaining screws. Remove the top housing, and upper small and large springs. The center nut, Item 3, on Fig. 63, Page 118, is removed after the spring forces in the lower housing are made small against the middle nut.

III. MAINTENANCE AND ADJUSTMENTS

F. REPAIR AND REASSEMBLY - Continued

4. 40 TON SUSPENSION ASSEMBLY - Continued

Be sure to remove the two set screws in the middle nut as shown on Fig. 63, Page 118. The middle nut can easily be screwed off by pulling up the shaft about 3-4 inches, either one at a time with a crane line or two at a time as shown by the fixture assembly, Fig. 73, Page 129. Once the middle nuts are removed, the lower housing can be lifted off.

The following dimension tolerances for the bushings and shafts will be helpful for reassembly:

Upper bushing holder I.D. - -	3.499/3.497
Upper bushing O.D. - - - - -	3.503/3.501
Upper bushing I.D. - - - - -	3.018/3.013
Shaft Dia. - - - - -	2.998/2.995
Lower Bushing Holder - - - -	3.493/3.491
Lower Bushing O.D. - - - - -	3.497/3.495
Lower Bushing I.D. - - - - -	2.520/2.515
Shaft Dia. - - - - -	2.493/2.490

After the bushings have been pressed into place, two diametrically opposite set screws are used on each bushing to assure the bushings won't slip in their respective housings. Drill and tap for 3/8 brass set screws x 1/2 lg., half dia. in the bushing and half diameter in the bushing holder.

The sequence of assembly is as follows:

- (a) Remove the middle nut, Item 3, on Fig. 63, if this is a new lifting shaft assembly. Position the four shafts (with nut, Item 5, Fig. 63) into the lower bushing holder, (4990134) Fig. 62, Page 118.

III. MAINTENANCE AND ADJUSTMENTS

F. REPAIR AND REASSEMBLY - Continued

4. 40 TON SUSPENSION ASSEMBLY - Continued

- (b) Position springs, Item 12, and lower bottom housing, Item 1, down onto the large springs.
- (c) Position springs, Item 14, and set nut, Item 6, onto threads. Pull up on shafts, Item 4, with lift fixture, Fig. 73, Page 129, or if the vibrator is clamped to a pile and the lower suspension housing, Item 1, is bolted to the exciter, lift up each shaft separately with a crane line and screw nut, Item 3, Fig. 63, to obtain the 24 5/16 shaft extension (Ref. Fig. 63, Page 118). This 24 5/16 should position the middle nut for aligning the 3/8 threaded hole in the middle nut with the pre-spotted hole in the shaft. Screw in the set screws per Fig. 63 using Loctite.
- (d) After all four middle nuts are fixed, position upper springs, Item 12 and 13, upper bushing assembly, Item 7, and top housing, Item 2, onto springs.
- (e) Jack down top housing, Item 2, with bolts, Item 19.
- (f) Assemble lifting head, Item 15, and tighten top nuts, Item 10, firmly. If the locking set screw in the top nuts are no longer satisfactory, drill and tap for 1/2" staking set screws, Item 17, using Loctite on both top nut, Item 10, and set screws, Item 17.

III. MAINTENANCE AND ADJUSTMENTS

F. REPAIR AND REASSEMBLY - Continued

5. Hydraulic Power Pack

(a) General

The V-14 Hydraulic Power Pack, designated HP-210, develops hydraulic drive power for the V-14 vibrator hydraulic motors and hydraulic clamp cylinder using a separate pump for each function. The more probable repair may involve replacement or removal of the large Lucas Pump or the smaller Rivett Pump. A malfunctioning pump should be returned to the respective pump manufacturer for repair. The listing of piston pump and motor drains on Page 37, will assist the user when it may be necessary to service the pumps. The pressure settings for the relief valves have been discussed in the text in the Hydraulic System, Page 40. As a reference, these pressure settings are as follows:

VALVE NO.	RELIEF VALVE	PSI SETTING
14	BOOST (@ NO LOAD)	85-90
10	CLAMP (OVER RELIEF)	3200-3500
12	CLAMP COMPENSATING	2700-2800
4	PILOT OR BACK PRES.	350-400
3	DRIVE (OVER RELIEF)	3200-3500
1	CUSHIONING	1200-1400

(b) Hoses

The replacement of hoses may be necessary after accidental damage may have caused leaks or danger of bursting. The hose line materials listed on Page 59 are made by Aeroquip though equivalent manufactured hoses are satisfactory. The short

III. MAINTENANCE AND ADJUSTMENTS

F. REPAIR AND REASSEMBLY - Continued

5. Hydraulic Power Pack - Continued

(b) Hoses - Continued

length hoses, draping over the lifting head of the vibrator, are tightly clamped and if substitute hoses are used, check the hose diameters. Smaller hose diameters may require a wrapping of tape.

HOSE NO.	I.D.	O.D.	MIN. BEND RAD.	MIN. BURST PSI	RECOM. WORKING PSI
2786-20 (Super High Pres.) Motor Line FC136-12	1.250	2.000	18	12,000	3,000
(Super High Pres.) Clamp Line 2651-12	.750	1.266	11	16,000	4,000
(Medium Pres.) Drain Line	.625	1.078	6.5	6,000	1,500

The following tabulation will be helpful when making up new hoses or replacing connectors and fittings:

DASH NO.	NPT	JIC (37° FLARE)	SAE (45° FLARE)	SAE W/O-RING BOSS
2	1/8-27			
4	1/4-18	7/16-20	7/16-20	7/16-20
5		1/2-20	1/2-20	1/2-20
6	3/8-18	9/16-18	5/8-18	9/16-18
8	1/2-14	3/4-16	3/4-16	3/4-16
10		7/8-14	7/8-14	7/8-14
12	3/4-14	1 1/16-12	1 1/6-14	1 1/16-12
14				1 3/16-12
16	1-11 1/2	1 5/16-12		1 5/16-12
20	1 1/2-11 1/2	1 5/8-12		1 5/8-12
24	1 1/2-11 1/2	1 7/8-12		1 7/8-12
32	2-11 1/2	2 1/8-12		2 1/2-12
40	2 1/2-8	3-12		
48	3-8	3 1/2-12		

III. MAINTENANCE AND ADJUSTMENTS

F. REPAIR AND REASSEMBLY - Continued

5. Hydraulic Power Pack - Continued

(c) Oil Heat Exchanger

The oil heat exchanger on the V-14 Power Pack is subject to moisture condensation and eventually internal corrosion if not used for prolonged periods of time. The V-14 Power Packs should be started every two to three weeks when not in service. This start-up run should be long enough to get the oil temperature up to 100^{±0} F. to assure the temperature control valve, Item 26, Fig. 12, Page 36, will open and allow oil to pass to the oil cooler. This procedure, if followed, will help prevent internal corrosion.

Replacement of the oil heat exchanger, MKT No. 34110301, can be made by first removing the front cowling with grill. The front cowling is removable by unfastening the screws along the top and the bottom and screwing out the fuel fill pipe and possibly lifting the roof section about 1/16 to remove the front cowling. The heat exchanger, now exposed, is easily disconnected. Before installing the new heat exchanger, it will be necessary to remove a bottom deflector plate with a slight angle which is bolted to the heat exchanger. The side baffles, which bolt to the oil heat exchanger may require elongating of holes to match the threaded holes in the heat exchanger.

(d) Large Lucas Pump or PTO Pump Drive

The large Lucas Pump and PTO can be removed with the aid of a lift truck. The bolting of the pump with adapter to the PTO is accessible as is the bolting of the pump drive to the clutch housing. The difficulty is with handling of the heavy components. On reassembly, be sure all hydraulic piping connections are firmly tightened and be sure to prime the pump if it was disconnected or replaced.

III. MAINTENANCE AND ADJUSTMENTS

F. REPAIR AND REASSEMBLY - Continued

5. Hydraulic Power Pack - Continued

(e) Brake Valve

The V-14 Power Pack Brake Valve, Double A No. QB-10-12A2, Valve No. 1 on the Hydraulic Schematic, Fig. 37, Page 77 has an internal spool-stop sleeve pressed into position. This pressed-in sleeve has a tendency to slip out of position when pressurized in the V-14 hydraulic circuit and cause an erratic V-14 operation. The sleeve, Item 1, Fig. 29, normally protrudes the housing about 1/8" whereas, if the sleeve has slipped, it will protrude about 3/8", visible through the port opening.

The correction made at the factory was to stake the sleeve in two places through the sides of the housing, diametrically opposite, at dimensions approximately as shown in Fig. 29. The procedure was as follows:

Drill 5/16" to the sleeve, followed by spotting a point into the sleeve plus 1/32" deep with a 5/16 carbide mason drill. Tap for 3/8 set screw x 1" long with dog point (5/16 D. x 3/16) and counter tapping for 1/4 pipe plug. (Refer to Fig. 30).

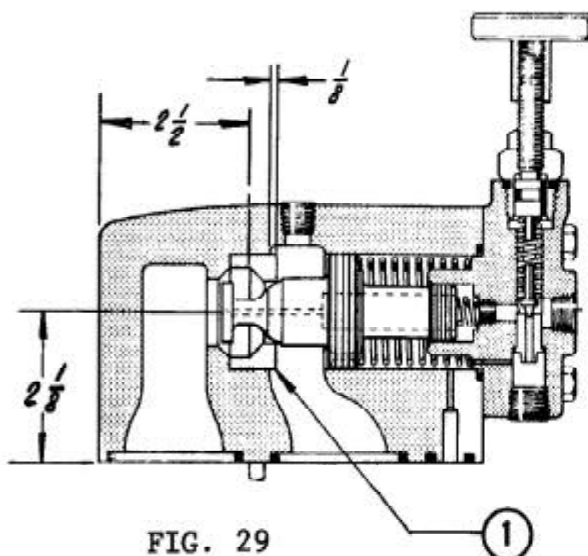


FIG. 29

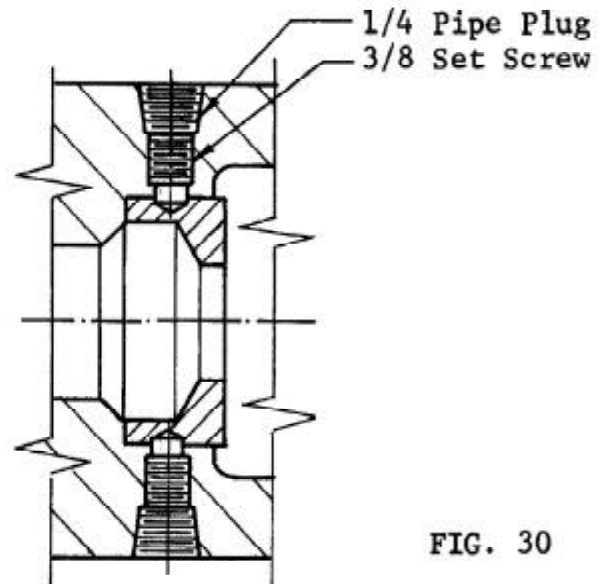


FIG. 30

III. MAINTENANCE AND ADJUSTMENTS

F. REPAIR AND REASSEMBLY - Continued

5. Hydraulic Power Pack - Continued

f. Overspeed Protection

The V-14 Hydraulic Power Pack has a Jordan Actuator that controls the position of the high flow stroke servo valve. The total movement of this valve and stem assembly is about $5/16"$ for V-14 Vibrator frequencies of 1500 cpm to 1850 cpm. The highest V-14 Vibrator frequency has the valve stem in the lowest position. To prevent the actuator control stem from moving too far below the highest vibrator frequency setting, a stop spacer has been added under the washer on the stem. The distance under the washer is approximately $7/16"$. All V-14 Hydraulic Power Packs should have this safety over-speed spacer added to the large pump servo stem. The height of the spacer is $3/8"$. Refer to Fig. 31 and Fig. 32 below for the sizing detail and positioning of this spacer.

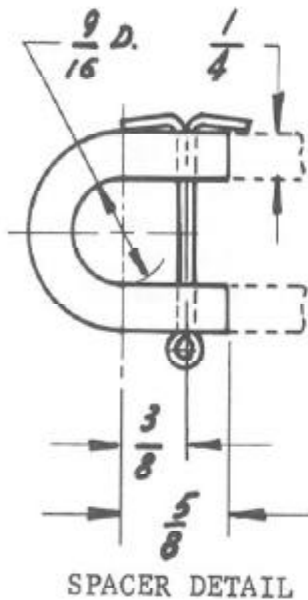


FIG. 31

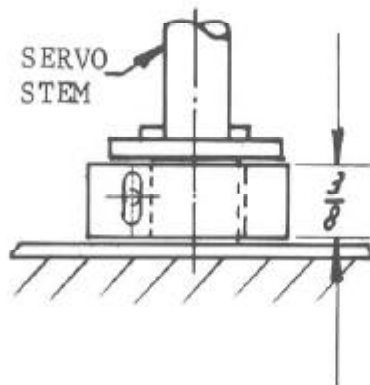


FIG. 32



FIG. 33

SPACER

III. MAINTENANCE AND ADJUSTMENTS

F. REPAIR AND REASSEMBLY - Continued

5. Hydraulic Power Pack - Continued

(g) Test Pendent

The miniature pendent, 9330203, is a test device that duplicates the V-14 Remote Cable Pendent Assembly. The miniature pendent has the same positioning of all the push buttons and light and is 1 5/8" x 2" x 12".

The miniature pendent has an amphenol plug on one end, which will thread to the amphenol socket of the control box. For use with those V-14 Control Boxes with a Crouse-Hinds Socket, use Adapter, 4990092, which is fitted with a Crouse-Hinds plug on one end and an amphenol socket on the other end.

This test pendent will assist field personnel in isolating a pendent line or push button malfunction. In the event there is a malfunction with the standard control cable assembly, this test pendent can be used to run the V-14 until the standard control pendent can be repaired.

(h) 6V71 Engine

The Detroit Diesel 6V71 Engine can be removed only by first removing the roof of the enclosure. The water and oil heat exchangers must be disconnected and the exhaust manifolds must be dropped. The doors should be removed to prevent their damage.

IV. ELECTRICAL CIRCUITRY

A. SEQUENCE OF OPERATION

1. Start-Up

1. Start and warm engine following engine manufacturers' procedures. Activate electrical control system by turning selector switch (SS-1) to "on". Green light indicates electrical power (24V) is on. With engine running, boost pump (No. 22, Fig. 14) immediately pumps hydraulic fluid maintained at a pressure of 85-90 psi by the relief valve (No. 14, Fig. 12) and Pressure Switch PS-1 will close contacts. Engage clutch and bring to maximum (1900 RPM) engine speed. After initial engagement of clutch, it is not necessary to disengage the clutch. Clamp cylinder pressure will come up with jaws open or closed. Clamp pressure switch will close contacts and green light will come on if jaws are closed. On starting, ALWAYS be sure jaws are open. If boost pressure is not up or over 40 psi, the pressure switch contacts will not close.

2. Operate Vibrator

To understand the electrical sequencing and why certain relays, solenoids, etc., are energized, it is most important to relate to both the Electrical Schematic Diagram (Fig. 35) and the Hydraulic Schematic Diagram (Fig. 37).

With the jaws "open", push button depressed, clutch engaged and engine at about 1900 RPM, relay CR-2 is the only relay energized thus energizing Sol B to throw clamping valve No. 7 to the "unclamp or open" position. All other contactors remain open. Pushing the "start or vibrate" button, nothing will happen.

IV. ELECTRICAL CIRCUITRY

A. SEQUENCE OF OPERATION - Continued

2. Operate Vibrator - Continued

By pushing the "close or clamp" button, PB-1, relay CR-2 is deenergized and CR-1 relay is energized. Note that push buttons, PB-1, 2, 3, 4 have holding contacts that do not require a hold on the push button to maintain the position. CR-1 energized, Sol A is energized thus throwing the clamping valve No. 7 to the "clamp on close" position. To this point, no other relays are energized. Now that the clamping pressure switch PS-2 contacts and boost pressure switch PS-1 are closed, the pendent green light will go on.

If at this point, the "start or vibrate" button is depressed (PB-2), CR-3 relay becomes energized, energizing Sol C, which closes valve No. 11, Fig. 39 to stroke the main pump for full pump flow. At the same time, Sol E on Part 5 and Sol D on Part 8 are energized, Sol D passing high pressure to the main two-way pilot operated valve No. 2, Fig. 15, allowing flow through the vibrator hydraulic motors. Sol E energized, closes valve No. 5 which shuts off the vent of relief valve No. 3, Fig. 17, causing this drive safety relief valve to function. The V-14 will vibrate. PS-3 will be pressurized and close its contacts to start timer. An interlock contactor of CR-3 is used to jump across the PB-4 so that the jaws couldn't be opened if the "open" push button is depressed with V-14 vibrating and another safety contactor held open to prevent CR-2 relay being energized resulting in Sol B being energized to open clamp.

IV. ELECTRICAL CIRCUITRY

A. SEQUENCE OF OPERATION - Continued

2. Operate Vibrator - Continued

To stop the vibrator, depress the "Stop" button which deenergizes CR-3 relay resulting in destrok- ing the drive pump No. 13, Fig. 16, by deenergizing Sol C, Valve No. 11, venting pump, and deenergizes Sol D to cut off pilot pressure for the two-way valve 2, preventing closed loop flow. Deenergized relay CR-3 deenergizes Sol E to vent the main relief valve No. 3 and pass low flow through relief valve No. 4, Fig. 17. PS-3 drive pressure switch will open and stop timer.

B. VIBRATOR FREQUENCY CHANGE

To change vibratory frequency, the high flow position of the drive pump cam plate is changed or trimmed by an electric motor moving a linear servo control shaft through a gear train. The total distance of linear travel for an operating frequency range of 1500 CPM to 1850 CPM is about 5/16 inch. By depressing push button PB-5 for "increase", relay CR-4 is energized, closing contacts to rotate motor in such a direction to increase drive pump flow. Push button PB-5 must be held to continue "increase", maximum setting controlled by set limit switch LS-2. By depressing push button PB-6 for "decrease" relay CR-5 is ener- gized, closing contacts to rotate motor in such a direction to "decrease" minimum setting controlled by set limit switch LS-1. Push button PB-6 must be held to continue "decrease".

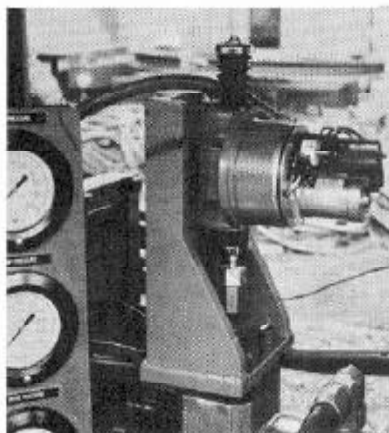


FIG. 34

IV. ELECTRICAL CIRCUITRY

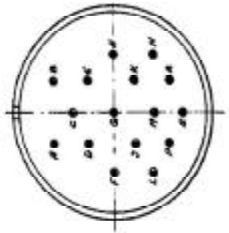
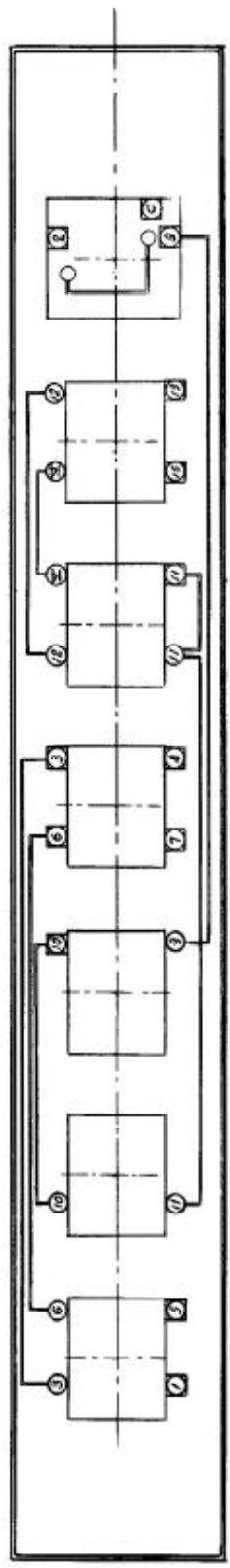
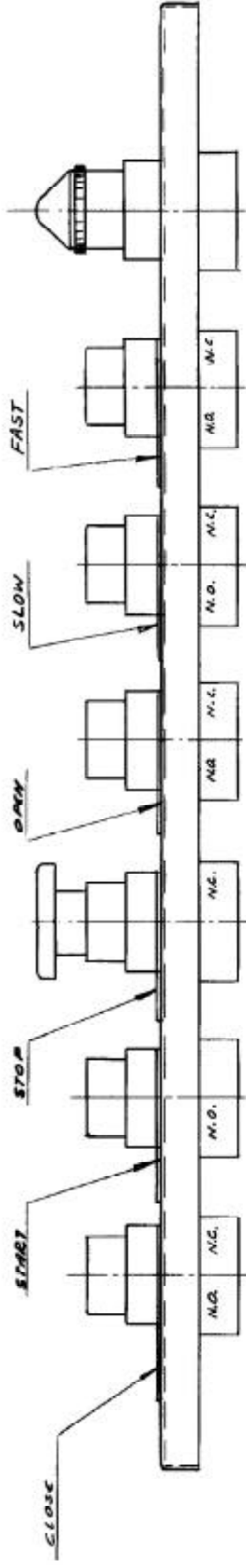
C. ELECTRICAL LEGEND

PB-1	=	Push Button "Close"
PB-2	=	Push Button "Start"
PB-3	=	Push Button "Stop"
PB-4	=	Push Button "Open"
PB-5	=	Push Button "Fast"
PB-6	=	Push Button "Slow"
PB-7	=	Push Button "Fill"
PS-1	=	Boost Pressure Switch (No. 17)
PS-2	=	Clamp or Close Pressure Switch (No. 15)
PS-3	=	Drive Pressure Switch (No. 16)
Sol A	=	Energized Puts Valve (No. 7) into "Clamp or Close" Position
Sol B	=	Energized Puts Valve (No. 7) into "Unclamp or Open" Position
Sol C	=	Energized Closes Valve (No. 11) to Stroke Main Pump
Sol D	=	Energized Directs Valve (No. 8) to Pilot Two-Way Valve (No. 2)
Sol E	=	Energized Closes Valve (No. 5) Shuts Down Vent of Pilot Control Relief Valve (No. 3)
T	=	Timer
LS-2)	=	Limit Switches in Hydraulic Drive Pump
LS-1)	=	Actuator
SS-1	=	Selector Switch, on-off

CABLE WIRE LETTER	TERMINAL NO.	COLOR
H	1	ORANGE/BLACK
K	2	BLACK
E	3	GREEN/BLACK
L	4	BLUE/WHITE
F	5	BLACK/RED
S	6	RED/WHITE
D	7	BLUE/RED
J	8	GREEN
A	9	WHITE/BLACK
N	10	BLK/BLACK
P	11	GREEN/WHITE
R	12	BLACK/WHITE
C	13	RED
X 1-17	SPARE	ORANGE
X 2-B	SPARE	RED/BLACK
X 3-G	SPARE	WHITE

FIG. 36

PENDENT-CABLE ASSEMBLY



V. HYDRAULIC CIRCUITRY

A. GENERAL

There are basically two independent hydraulic circuits in the hydraulic power pack. Refer to Fig. 37, Page 77. The upper open loop circuit for the clamping and the lower closed loop circuit for drive or vibrate. There are two manifolds, one for the clamping circuit and one for the drive circuit, the components of each enclosed by the heavy enclosed broken line on Fig. 37. The hydraulic power pack description in Paragraph I-B explains the general hydraulic arrangement. The following description will explain in more detail how and why each component functions in the circuit, referencing Fig. 37 or similarly Figs. 44, Page 102, or Fig. 45, Page 103, with color coding of pressures.

The diesel engine powers three pumps, the boost or charge pump No. 22, the clamping pump No. 12 and the drive pump No. 13.

The drive Lucas Pump No. 13 and the two vibrator hydraulic motors in the closed loop circuit have case drain leakages that return to tank besides overflow through relief valves No. 3 and purge valve No. 23. In stopped non-vibrating position, relief valve No. 4 also goes to drain. These losses in the closed loop are made up by the boost pump No. 22. The boost also provides flow for the clamping Lucas Pump No. 12 and its drain loss and pressure to stroke the drive pump No. 13 for low to high flow. Excess make-up flow passes to drain through relief valve No. 14. The quick disconnects 33, 34, 35, and 36 have their checks open when they are engaged. Any one disconnected will check closed both sides of the line. Flow in the drive circuit is from the drive pump No. 13 through Q.D. No. 35/36 to the hydraulic motors in the vibrator back through Q.D. 35/36, through the heat exchanger No. 25 and temperature controller No. 26 and filter Nos. 24 and 28 and back to pump No. 13.

V. HYDRAULIC CIRCUITRY

B. SEQUENCE OF OPERATION

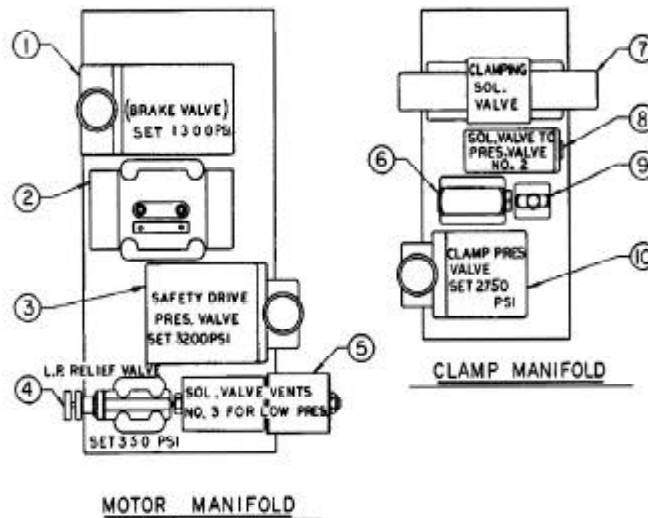
In conjunction with what is explained in the electrical control system, Paragraph III-E, the sequence of operation hydraulically is as follows:

1. Start-Up

The start-up has been made, the jaws are open and the drive pump No. 13 is de-stroked to low flow because Sol C on Valve 11 (Refer to IV-C) is not energized leaving Valve No. 11 open to tank. Refer to Fig. 38, Page 78, which is a line drawing of the pump and external Servo for stroking the camplate. The electrical actuator, used on the drive pump, changes the position of the pump volume controller. Sol E on Valve 5 is deenergized allowing relief Valve No. 3 to vent at pressure setting (350-400 psi) of relief Valve No. 4. Flow cannot pass through the hydraulic motors in the vibrator because the two-way Valve No. 2 is closed; there is no flow pressure from Valve 8 since its Sol D has not been energized in stopped condition. Boost Pump No. 2 supplies about 37 GPM of hydraulic fluid, the pressure relieved at Valve No. 14 at 85-90 psi. Flow control Valve No. 18 is used to limit flow to the drive pump case, or about 2 GPM for cooling.

2. Operating Sequence

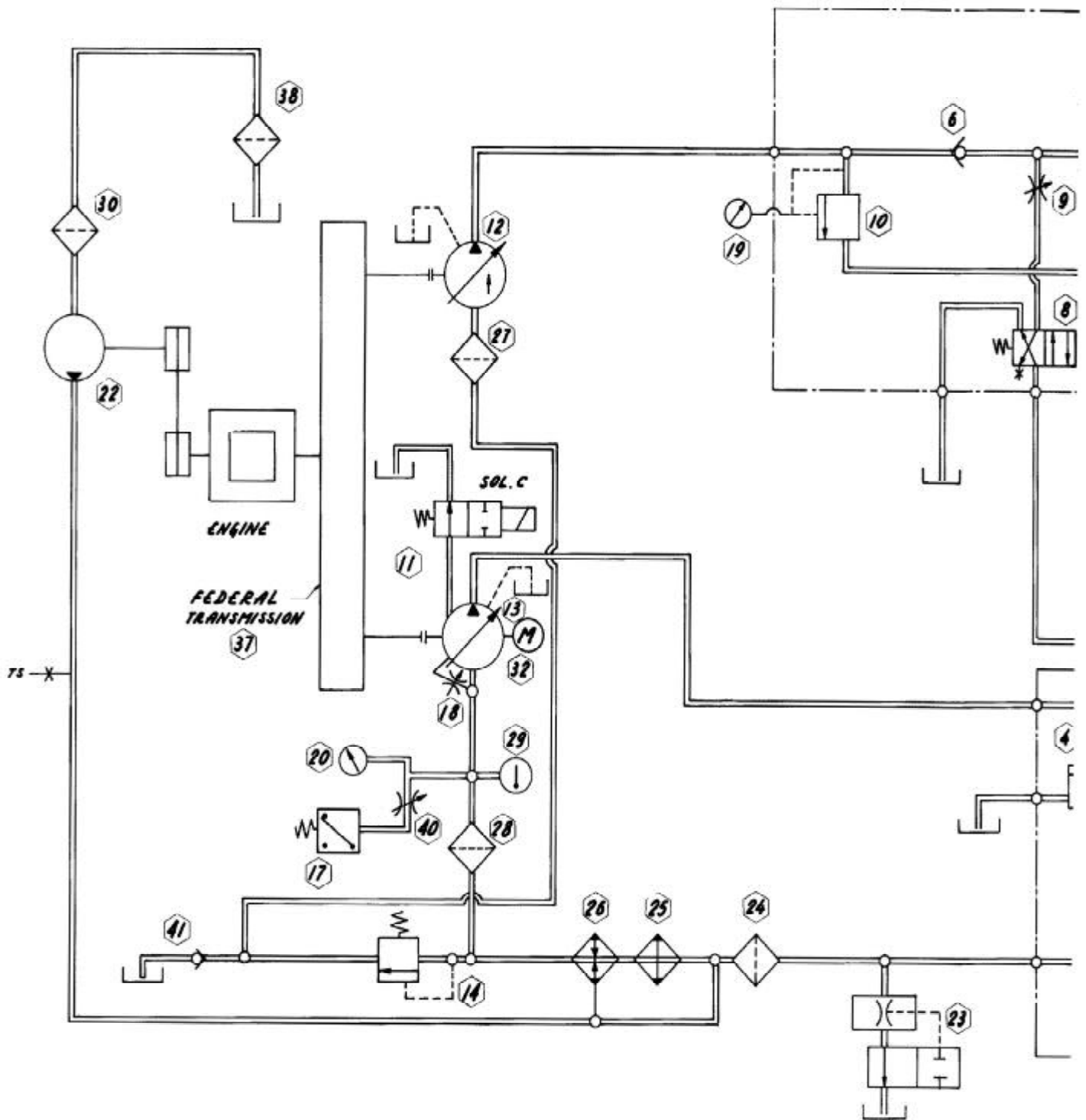
The Operating Sequence is to clamp on to a pile and start vibrating. With jaws closed, and the "start or vibrate" push button depressed, Sol D on Valve 8, Sol C on Valve 11 and Sol E on Valve 5 are energized. Sol C closes Valve 11 to stroke the drive pump No. 13 to high flow. Sol E closes to devent relief valve No. 3 and have it in position to relieve at drive pressure (about 3200 psi).



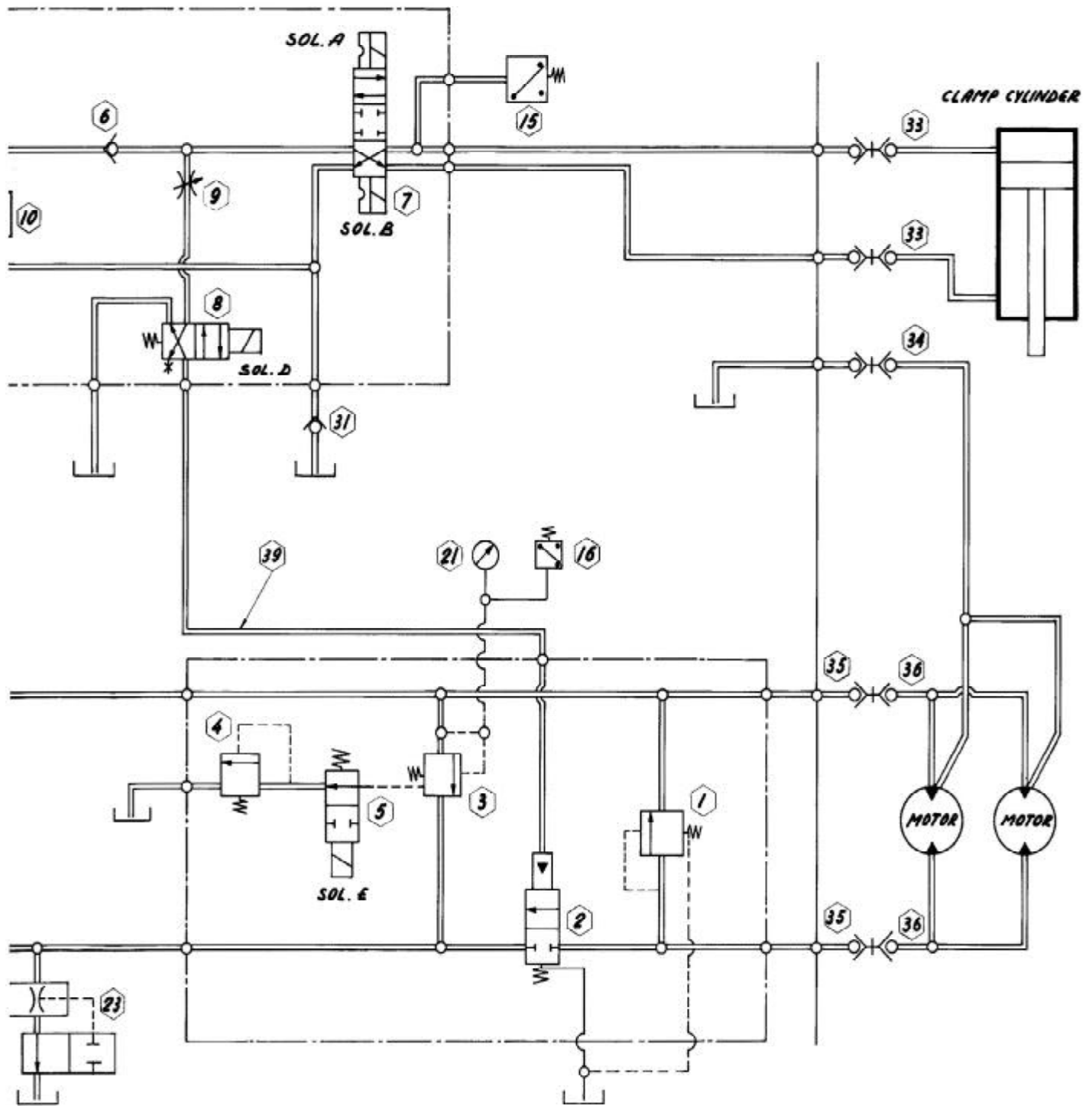
ITEM NO.	PART NO.	DESCRIPTION	MFG.	MODEL NO.
1	0 9310009	Brake Relief Valve	Double A	QB-10-12A2
2	0 9310027	Pilot Oper. 2-Way Valve	Rivett	P4810-10
3	0 9310007	Main Drive Relief Valve	Double A	QB-10-10A2
4	0 9310010	Back Pres. Relief Valve	HPM	H-1846D
5	0 9310011	Sol. Valve	Saville	37-1-24D
6	0 9310012	Check Valve	Manatrol	CS-800-S
7	0 9310085	Sol. Dir. Valve	Double A	QM-01-C-10D3-24VDC
8	0 9310048	Sol. Valve	Double A	QJ-01-C-10D3-24VDC
9	0 9310015	Needle Valve	Manatrol	NS-200-S
10	0 9310016	Clamp Relief Valve	Double A	BQB-06-10A1
11	0 9310017	Sol. Valve	Saville	36-1-12P-24VDC
12	0 9110068	Clamp Pump	Rivett	PV-2024-2447-L-C-S
13	0 9110003	Main Drive Pump	Lucas	LU-94017
14	0 9310028	Boost Relief Valve	Ful Flo	VJ-7-XS
15	0 9310025	Clamp Pres. Switch	Barksdale	9048-5
16	0 9310025	Drive Pres. Switch	Barksdale	9048-5
17	0 9310024	Boost Pres. Switch	Barksdale	9048-1
18	0 9310018	Needle Valve	Manatrol	NS-400-S
19	0 9310136	Clamp Pres. Gage	Marshalltown	No. 51F 0-5000 PSI
20	0 9310137	Boost Pres. Gage	Marshalltown	No. 24F 0-250 PSI
21	0 9310136	Drive Pres. Gage	Marshalltown	No. 51F 0-5000 PSI
22	0 9110002	Boost Pump	IMO	A313A-187
23	0 9310019	Purge Valve	Waterman	250-8-4-.5
24	0 9310115	Drive-25 Micron Filter	Schroeder	LF-8-2R25-P-D
25	3 4110301	Oil Heat Exchanger	Perfex	Spec. 09990103
26	0 9310111	Temperature Controller	AMOT	2 1/2 BOC-110
27	0 9310232	Clamp-10 Micron Filter	Schroeder	LF1-1K10-P
28	0 9310117	Drive-10 Micron Filter	Schroeder	LF-20-2K10-P-D
29	0 9310040	Temperature Gage	Trerice	V-80040 Bulb 4-3D1, 2 1/2
30	0 9310118	Drive-40 Micron Filter	Mich. Dyn.	MS50F2BB2
31	0 9310020	Check Valve	Manatrol	CA-1200-5-20
32	0 9110007	Main Pump Actuator	Jordon	LA-1140
33	0 9270005	Quick Disconnect-Clamp	Aeroquip	5600-12-12S
34	0 9270010	Quick Disconnect-Drain	Aeroquip	5600-12-10S
35	0 9270001	Quick Disconnect-Motor-Fem.	Bruning	1001S-20F-E2
36	0 9270002	Quick Disconnect-Motor-Male	Bruning	1002S-20F-E2
37	0 9440020	PTO-Pump Drive	Federal	Type 752C
38	0 9310023	Tank Screen Filter	Marvel	350-100
39	-	Pilot Line Between Manifolds	-	-
40	0 9310049	Needle Valve	Manatrol	N-200-S-10
41	0 9310205	Check Valve	Comontrol	350-10-1 1/4 5PSI

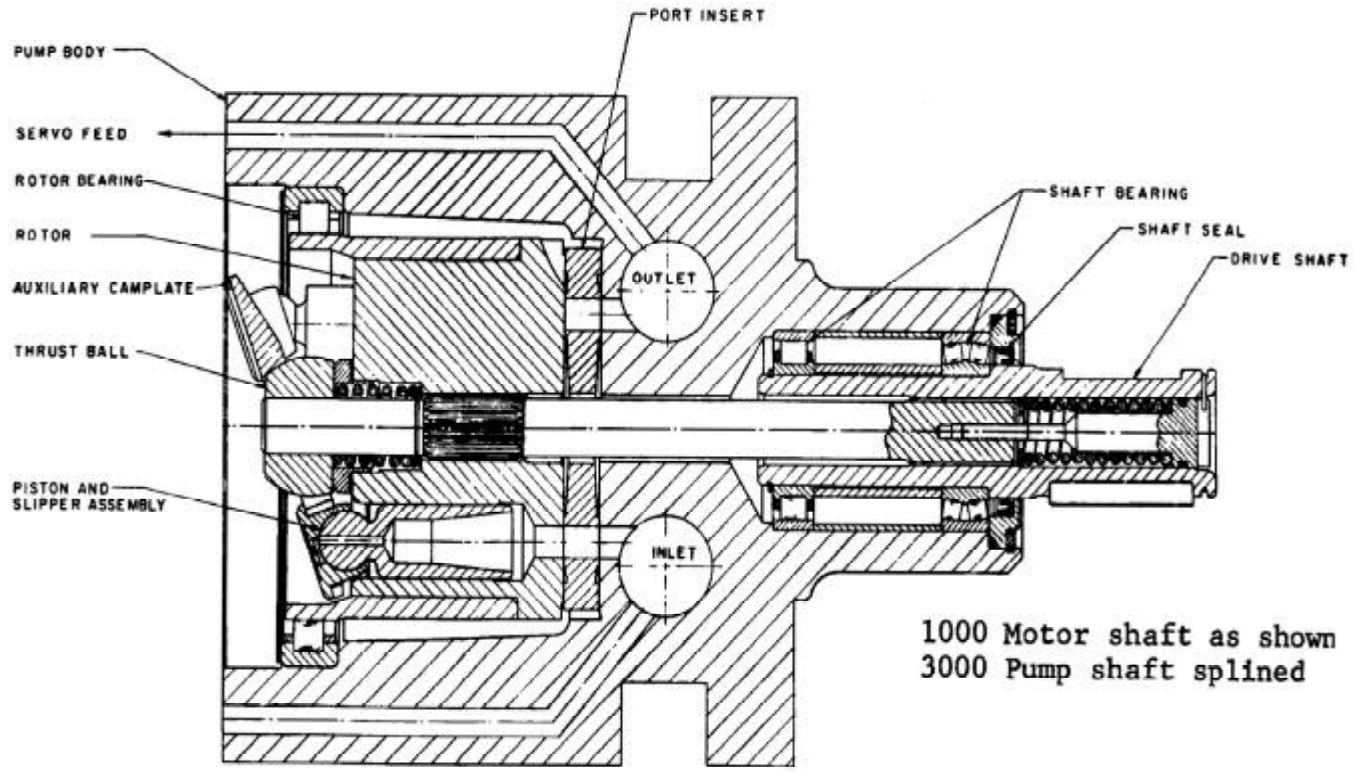
HYDRAULIC SCHEMATIC

FIG. 37



CONTINUED





1000 Motor shaft as shown
 3000 Pump shaft splined

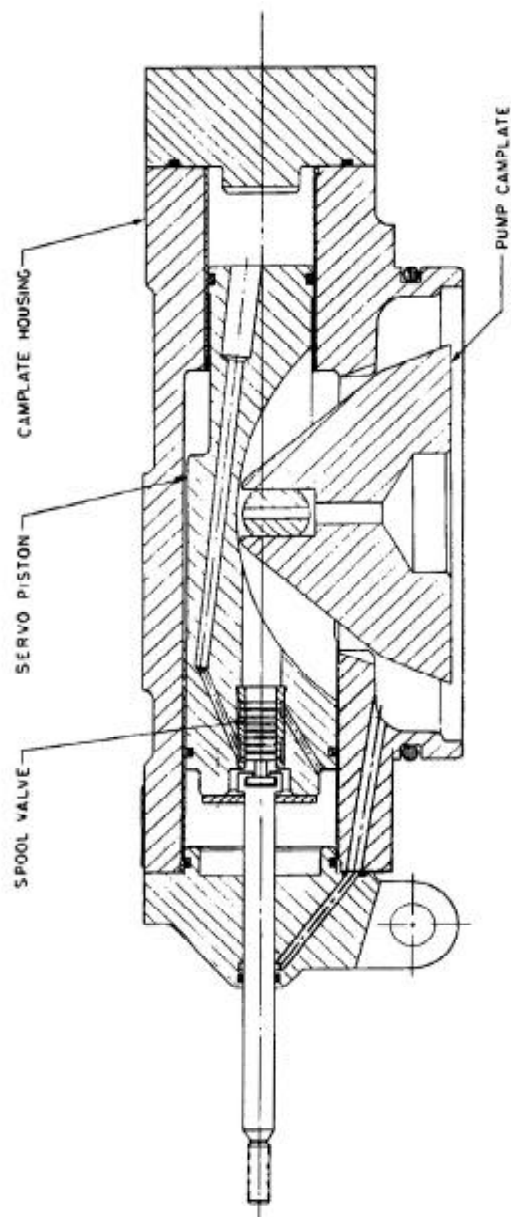
PUMP OR MOTOR UNIT

V-14 LUCAS
 MOTOR NO. LU-93018
 (24100129)

- MOTOR SEAL NO. 88163461 (09100006)
- MOTOR RETAINER NO. 88244103 (09100007)
- MOTOR REAR PLATE NO. 88244107 (09100008)
- MOTOR SNAP RING NO. 8928281 (09100009)

SECTION VIEW OF LUCAS PUMP OR MOTOR

FIG. 38



MANUAL SERVO, TYPE MS

POWER PACK LUCAS
PUMP NO. LU-94017
(09110003)

PUMP JORDAN ACTUATOR
NO. LA-1140
(09110007)

JORDAN 24VCD MOTOR
FOR LA-1140
(09120001)

V. HYDRAULIC CIRCUITRY

B. SEQUENCE OF OPERATION - Continued

2. Operating Sequence - Continued

Sol D on Valve 8 switches flow through flow control Valve No. 9, from blocked position, to pressurize the pilot operated two-way Valve No. 2 to open it and permit flow through the hydraulic motors in the vibrator. During the vibrating position, hydraulic fluid losses from the motor pump drains are made up by the boost pump No. 22. Any time there is a drop in clamp pressure or a drop in boost pressure (low level hydraulic fluid will cut out boost flow and drop pressure), the vibrator will stop vibrating caused by the destroking of the main (deenergizing Sol C on Valve No. 11) and closing of the two-way Valve No. 2 (deenergizing Sol D of Valve 8).

3. Stopping the Vibrator

Stopping the vibrator is done by depressing the "stop" push button which deenergizes Sol C of Valve No. 11, Sol D of Valve No. 8 and Sol E of Valve No. 5. The force to stop or slow down the eccentrics and hydraulic motors is a result of oil pressure built up at the discharges of the motors and the motors now become Pumps. To control the deacceleration of the hydraulic motors, a relief Valve No. 1, set at approximately 1200 psi will relieve the excess hydraulic fluid to the input side of the hydraulic motors. This stopping Valve No. 1 is

V. HYDRAULIC CIRCUITRY

B. SEQUENCE OF OPERATION - Continued

3. Stopping the Vibrator - Continued

set to stop the hydraulic motors as quickly as possible (about 2 seconds with the V-14) and still not reverse cycle the hydraulic motors from over-pressure built-up by the stopping action. To maintain a positive supply of hydraulic fluid to the hydraulic motors on the suction side when stopping, a back pressure as low pressure setting by relief Valve No. 4 is maintained at 300-350 psi. Without this back pressure, the hydraulic motors in the vibrator will cavitate (suck air if hydraulic fluid is absent) and this can damage the motors.

On "unclamping or opening" the jaws, Sol B of Valve No. 7 is energized, reversing flow to the clamp cylinder on the vibrator. Note that the clamp cylinder is powered both directions and the reading on the clamp gage No. 19 (See Fig. 22, Page 45) will show a pressure reading (set about 2750 psi).

4. Fail Safe for Clamping Pile

The clamping hydraulic cylinder is powered both directions. With the jaws closed and pressure in the cylinder, the danger of a pile slipping out when lifting vibrator and pile is almost impossible. If, however, a clamp hose is damaged, ruptured or leaks and/or the hydraulic power source fails while the pile is clamped, a built-in check valve system on the cylinder will hold the pressure.

V. HYDRAULIC CIRCUITRY

C. PART NO. vs., FIGURE REFERENCE

Reference the hydraulic schematic, Fig. 21 for all descriptions and explanations of component operation in the hydraulic power pack. The following tabulation of parts number identification with the actual part located in a photograph or line drawing figure will be helpful.

PART NO.	LOCATED FIG.	PAGE NO.	PART NO.	LOCATED FIG.	PAGE NO.
1.	17	40	21.	22	45
2.	15	39	22.	14	39
3.	17	40	23.	39	82
4.	17	40	24.	39	82
5.	15	39	25.	8	27
6.	15	39	26.	12	36
7.	15	39	27.	19	44
8.	15	39	28.	19	44
9.	15	39	29.	22	45
10.	15	39	30.	39	82
11.	39	82	31.	39	82
12.	9	28	32.	34	71
13.	16	39	33.	13	38
14.	12	36	34.	13	38
15.	21	45	35.	13	38
16.	21	45	36.	13	38
17.	21	45	37.	13	38
18.	9	28	38.	39	82
19.	22	45	39.	39	82
20.	22	45	40.	21	45
			41.	12	36

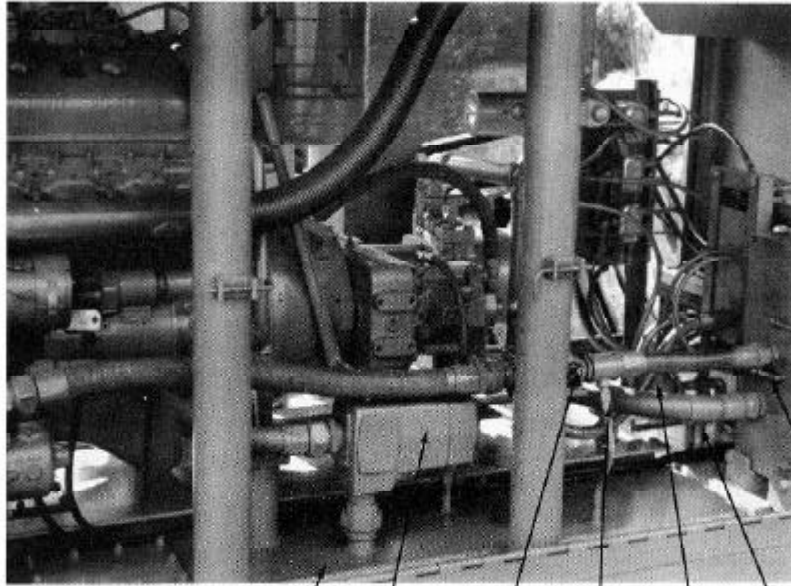
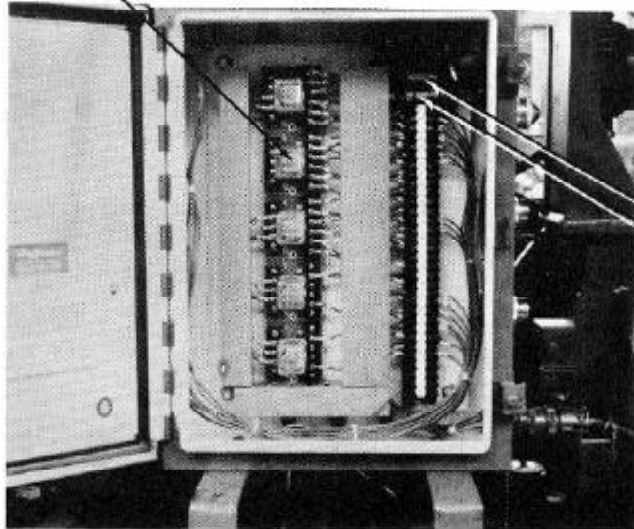


FIG. 39

- 38
- 30
- 24
- 23
- 11
- 31
- 39

RELAYS



15 AMP. FUSE
4 AMP. FUSE

FIG. 40

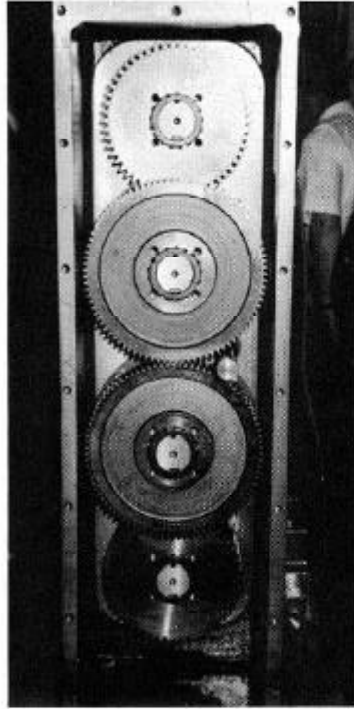


FIG. 41

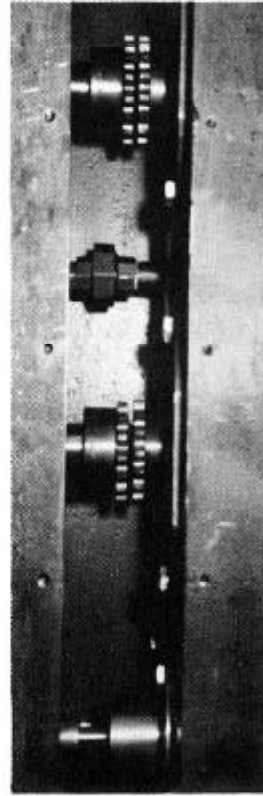


FIG. 42

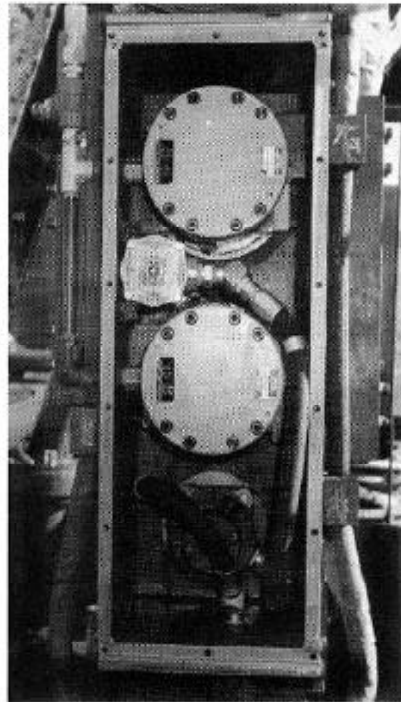


FIG. 43

VI. TROUBLESHOOTING

The first step in troubleshooting is to isolate the problem - Is it mechanical, hydraulic or electrical? Generally, the mechanical part can be checked by observation. If test light checking the electrical control system does not indicate an electrical problem, a hydraulic problem is indicated. Alternatively, if manual operation of the solenoid valves permits normal operation of the hydraulic circuit and all pressure levels are satisfactory, the problem is probably electrical.

If an electrical problem exists, trace the sequence of operation with a 24V test light, using the electrical schematic diagrams, Fig. 35, Page 73. The pressure switches and solenoids should also be checked to determine if they are damaged or malfunctioning.

Generally, the repair of hydraulic pumps and hydraulic motors is not to be done in the field, reference Page 58. Any malfunctioning hydraulic pumps or hydraulic motors should be replaced. However, under direction of the factory representatives, shaft seals could be replaced in the field if the down time of the equipment warrants the emergency repair.

Because the identification of hydraulic components and their location is important, a duplicate tabulation is added on Page No. 81 for your convenience. Also, the hydraulic schematic is illustrated in two modes, one with Jaws Open, the Vibrator not operating, Fig. 44, Page 102, and the other with Jaws Closed, the Vibrator operating, Fig. 45, Page 103.

HYDRAULIC COMPONENTS

ITEM NO.	DESCRIPTION	LOCATED ON	
		FIG.	PAGE
1	Brake Relief Valve	17	40
2	2-Way Valve, Pilot Operated	15	39
3	Main Drive Relief Valve	17	40
4	Back Pressure Relief Valve	17	40
5	Sol. Valve	15	39
6	Check Valve	15	39
7	Sol. Directional Valve	15	39
8	Sol. Valve	15	39
9	Needle Valve	15	39
10	Clamp Relief Valve	15	39
11	Solenoid Valve	39	82
12	Clamp Pump	9	28
13	Main Drive Pump	16	39
14	Relief Valve (Boost)	12	36
15	Pressure Switch (Clamp)	21	45
16	Pressure Switch (Drive)	21	45
17	Pressure Switch (Boost)	21	45
18	Needle Valve	9	28
19	Clamp Pressure Gage	22	45
20	Boost Pressure Gage	22	45
21	Drive Pressure Gage	22	45
22	IMO Boost Pump	14	39
23	Purge Valve	39	82
24	Drive Filter (25 Micron)	39	82
25	Oil Heat Exchanger	8	27
26	Temperature Controller	12	36
27	Clamp Filter (10 Micron)	19	44
28	Drive Filter (10 Micron)	19	44
29	Temperature Gage	22	45
30	Drive Filter (40 Micron)	39	82
31	Check Valve	39	82
32	Drive Motor Actuator	34	71
33	Quick Disconnect - Clamp	13	38
34	Quick Disconnect - Drain	13	38
35	Quick Disconnect - Motor-Fem.	13	38
36	Quick Disconnect - Motor-Male	13	38
37	PTO - Pump Drive	13	38
38	Tank Screen Filter	39	82
39	Pilot Line Between Manifolds	82	82
40	Needle Valve	21	45
41	Check Valve	12	36

VI. TROUBLESHOOTING CHART

A. HYDRAULIC DRIVE CIRCUIT - VIBRATOR NOT OPERATING PROPERLY

TROUBLE	PROBABLE CAUSE	REMEDY
A-1 Increase of lube fluid in pump drive causing seepage into the clutch bell housing	a) Overfilled or expansion with heat.	Drain off at level plug.
	b) Leakage of hydraulic fluid through Pump Seals.	a) A small leakage may stop after a week or two of operation. b) Check pump seals and replace, if necessary.
A-2 Pump Drive fluid seeping into the dry clutch bell housing without pump drive overfill	Pump Drive seal leakage	Replace Pump Drive Seal. Consult factory.
A-3 No boost pressure	a) Boost Pump No. 22, Fig.14 requires priming.	Prime Boost Pump by removing input hose line and filling with hydraulic fluid.
	b) Boost Pump drive V-belt slipping or broken.	Tighten V-belt by moving pump on slide base. Refer to III - D-5.
	c) Loose hose intake connection.	Tighten all hose lines leading to and from boost pump especially the intake to be sure air is not sucked in.
	d) Boost Pump No.22, Fig.14 broken.	Replace boost pump.
	e) Oil level too low.	If hydraulic oil level goes below 3/4, it is possible Boost suction will not be in oil. Fill up to full level.
Continued		

VI. TROUBLESHOOTING CHART

A. HYDRAULIC DRIVE CIRCUIT - VIBRATOR NOT OPERATING PROPERLY

A-3 Continued No boost pressure	f) Possible boost pressure gage No.20, Fig.22 is broken.	If broken or damaged, replace gage.
A-4 Drop in boost pressure when "start" push button is depressed, and V-14 not vibrating	a) Boost pump No.22, Fig.14 sucking air.	Tighten boost pump flange and all hose lines leading to and from boost pump.
	b) Boost pressure relief valve No.14, Fig.12 stuck open.	Dismantle relief valve to assure plunger is not stuck. Be sure to maintain exact position of locking screw or 85-90 psi on boost gage No.20, Fig.22. If the valve is broken, replace.
	c) Excess motor or pump drains.	Check all pump and motor drains if excess, Ref. Page 37, have pump or motor serviced.
	d) Sol Valve No.5, Fig.15 may not operate when energized.	Check Solenoid Valve No. 5 to assure spool moves to closed position when Start button is depressed. If malfunctioning, replace.
	e) Boost pump input filter No.28, Fig.19 clogged or not sealed.	Boost pump input filter No. 28 should be cleaned often. Be sure No. 28 filter housing is tightly closed and sealed.
	f) Boost Pump damaged.	Check the screw pump by dismantling to assure there is no galling. If galled, replace pump.
	g) Boost line Sump Filter No. 38, Fig.39	Open cover on tank to expose boost pump input line and check to see if pump filter No. 38, is clogged.
	h) Boost pump V-belt slipping.	Tighten V-belt.

VI. TROUBLESHOOTING CHART

A. HYDRAULIC DRIVE CIRCUIT - VIBRATOR NOT OPERATING PROPERLY

TROUBLE	PROBABLE CAUSE	REMEDY
A-5 Loss of boost pressure when operating Vibrator	a) Tank leak and hydraulic oil level dropped.	Correct leak and refill hydraulic oil tank
	b) V-belt slipping.	Tighten V-belt.
	c) Hyd. fluid contaminated with water and sludge.	Drain, flush and replace Hyd. fluid.
	d) Clogged Filter No.28, Fig.19	Clean filter element.
	e) If hydraulic power pack is tilted on ground.	If the hydraulic power pack is tilted and the oil level is borderline, the boost pump suction line may be out of the hydraulic fluid.
	f) Excess motor or pump drain	Check all pumps and motor drains. If excess, have pump or motor serviced.
	g) Blocked input or discharge line.	Check boost input and discharge lines for blockage by disconnecting and checking flow. Remove blockage.
A-6 Press "Start" and nothing happens	a) Boost pressure not up above or dipping below 40 psi.	Check boost pressure circuit.
	b) Clamp "close" pressure not up (above 1900 psi)	Check clamp pressure circuit.
	c) Boost pressure switch No. 17, Fig. 21 or clamp pressure switch No. 15, Fig. 21 malfunctioning.	a) Check to see pressure limit switch actuated by internal arm. b) Check to see pressure switch plunger moving. c) Replace pressure switch if malfunctioning.
Continued		

VI. TROUBLESHOOTING CHART

A. HYDRAULIC DRIVE CIRCUIT - VIBRATOR NOT OPERATING PROPERLY

TROUBLE	PROBABLE CAUSE	REMEDY
A-6 Continued Press "Start" and nothing happens	d) CR-3 relay, (See Fig. 35) malfunctioning.	If malfunctioning, replace. Try substituting relays.
	e) Clamp jaws are not "closed".	Clamp jaws must be closed to vibrate.
	f) Power "on" switch not put on.	Check that power is on and green light on panel is on.
	g) Malfunctioning push buttons or electrical contact block.	Use test pendent to assure pendent problem. Malfunctioning push buttons or contact blocks should be replaced.
	h) Electrical multiconductor broken.	If the electrical multiconductor had been damaged or sheared, cut to fit and rewire. Use test pendent to assure conductor problem.
	i) Sol C, Part No.11, Fig.39 may be stuck or malfunctioning.	If Sol C is not operating, the drive pump No. 13, Fig. 16 will not go into high flow but low flow will go to vibrator and a pulse of vibrator movement noticed.
	j) The orifice plug, on the drive pump No. 13, Fig.16 may be clogged.	If the drive pump orifice plug is clogged, the pump will not go into high flow.
	k) Brake valve, No.1, Fig.17 may be stuck or malfunctioning.	Ref. III. F. 5e, Page 66, correct if possible or replace valve.
	l) Quick Disconnects incorrectly connected or damaged.	Check Connections or replace.

VI. TROUBLESHOOTING CHART

A. HYDRAULIC DRIVE CIRCUIT - VIBRATOR NOT OPERATING PROPERLY

TROUBLE	PROBABLE CAUSE	REMEDY
A-7 Press "start" push button. Motor lines pulse, but no vibration	a) Loss of boost pressure.	Check out Section A-4
	b) Drive Pump No.13, Fig.16 not going into high flow.	a) Clean orifice plug. b) Check Sol C on Valve 11 to be sure valve closes when energized.
	c) Quick-disconnects incorrectly connected or damaged.	Check connections or replace.
	d) Valve No. 2 not opening.	a) Valve No. 2 may be stuck; clean and check; may have to replace valve. b) Valve No. 8, Sol D not operating. Check to see it opens when energized.
	e) Brake Valve No. 1 may not be functioning correctly.	Difficult to check without exchanging valve. Check Section III.F.5e, Page 66.
	f) Needle Valve No. 9 not open.	Check to be sure oil pressure in line between manifolds, Item 39 when put in Vibrate mode.
A-8 Press "Stop" push button, and Vibrator doesn't stop Continued	a) Malfunction push button or contacts.	Replace if malfunctioning. Check with Test Pendant.
	b) Relief Valve No.4, Fig.17 may be set very high and not at 350-400 psi.	If No. 4 relief valve is set high, (500-2000 psi) the vibrator will stop and repeat vibrating when "stop" push button is depressed. Set Relief Valve No. 4 to 250-300 psi.

VI. TROUBLESHOOTING CHART

A. HYDRAULIC DRIVE CIRCUIT - VIBRATOR NOT OPERATING PROPERLY

TROUBLE	PROBABLE CAUSE	REMEDY
A-8 Continued Press "Stop" push button and Vibrator doesn't stop	c) CR-3 relay, (see electrical Diagram Fig. 35) may be stuck.	If this relay malfunctions, replace or exchange with one of the others.
	d) Valve No. 8, Fig. 15, may be stuck in its energized position maintaining pressure on Valve No.2, Fig.15 keeping it open	Poke Sol D in Valve No. 8, Fig. 15 to determine if it is stuck. If Valve No. 2 is left open, low flow position of drive pump could keep vibrator going. If Valve No. 8 malfunctions, replace it.
A-9 Drive Pump not stroking to high flow.	a) Drive Pump No. 13 orifice plug--see Fig. 16 may be clogged.	Remove orifice plug and blow out.
	b) Boost pressure not high enough.	Check through Sections A-3, A-4 and A-5.
	c) Drive Pump No. 13 Servo Piston seized.	Have Pump No. 13 serviced.
	d) Sol C on Valve No. 11, Fig. 39 malfunctioning.	Refer to Section A-6-i or A-7-b. Also, disconnect union leading to tank; in drive mode, no oil should pour from pump vent line through Valve 11.
	e) Electrical malfunction.	Any possible cause in Section A-6. Use test pendent.
A-10 Drive Pump not de-stroking to low flow. Continued	a) Drive Pump No. 13 Servo piston seized.	Have Drive Pump No. 13 serviced.

VI. TROUBLESHOOTING CHART

A. HYDRAULIC DRIVE CIRCUIT - VIBRATOR NOT OPERATING PROPERLY

TROUBLE	PROBABLE CAUSE	REMEDY
A-10 Continued Drive Pump not de-stroking to low flow.	b) CR-3 relay on electrical schematic Fig.35 stuck.	If CR-3 is stuck, Sol C of Valve 11 will remain energized. If CR-3 is malfunctioning, replace it or exchange for check.
	c) Sol C of Valve 11, Fig. 39 could be stuck and when de-energized will not return to open position.	If Sol C of Valve 11 is malfunctioning, replace it.
A-11 Braking too slow or too fast.	Valve No. 1 not set correctly	Install pressure gage on Valve No. 1 set for braking pressure 1200-1500 psi. See III.D.4.e, Page 40.
A-12 "Increase" or "Decrease" control doesn't work	a) Electrical Malfunction.	First use test pendent to isolate possible pendent or cable problem. Check wiring at actuator.
	b) Fuse burned.	Change fuse. Must be 4 amp.
	c) Motor burned out.	Replace motor.
	d) Limit Switches in actuator out of adjustment.	First check sequencing of limit switch contacts. If switches are malfunctioning, replace. Possibly limit switch holder came loose.
	e) Servo valve stem over-traveled	Reposition Servo valve. Check stop device, see Fig. 31 & 32, Page 67.
	f) Relays CR-4 or CR-5 malfunctioning.	Substitute relays or replace.
	g) Cams in actuator came loose and switch sequencing in-operative.	Reposition cams.

VI. TROUBLESHOOTING CHART

A. HYDRAULIC DRIVE CIRCUIT - VIBRATOR NOT OPERATING PROPERLY

TROUBLE	PROBABLE CAUSE	REMEDY
A-13 Overheating Hydraulic fluid temp.	a) Thermostatic "Amot" valve No.26, Fig.12 malfunction.	Replace thermostatic elements in valve. Contact factory.
	b) Excessive sludge or contaminant forming in oil Cooler No.25, Fig. 8.	Disconnect, drain and flush clean.
	c) Malfunction temperature gage No. 29, Fig. 22 or capillary wire.	Temperature gage on capillary may be damaged. Replace where required.
	d) Engine fan may not be turning.	Correct engine fan malfunction.
	e) Radiator front end opening blocked or heated air from radiator recirculated.	Check that there is no radiator blockage. Also check air circulation--heated air may be restricted from escaping.
A-14 Too high vibrating frequency	a) Too much flow reaching hydraulic motors.	a) Adjust maximum limit switch setting in actuator. Check stop device Fig. 31 & 32, Page 67. b) Maximum engine speed may have been changed.
A-15 Hydraulic heat exchanger leaking oil	a) Fatigue breakage.	Have radiator re-soldered
	b) Boost pressure too high.	Repair radiator and be sure boost relief setting 85-90 psi.

VI. TROUBLESHOOTING CHART

B. HYDRAULIC CLAMP CIRCUIT - CLAMP NOT OPERATING PROPERLY

TROUBLE	PROBABLE CAUSE	REMEDY
B-1 No clamp or unclamp movement when push button is depressed	a) Pendent or cable	Use test pendent to isolate pendent or cable problems.
	b) Electrical push button malfunction.	Check push button and contactor for malfunction.
	c) Sol A or Sol B on Valve No.7, Fig. 15 malfunctioning.	a) Check by depressing solenoid plunger. If solenoids stick or operate erratic, replace Valve No. 7.
	d) Blocked line leading to clamp cylinder.	a) Check for quick disconnect malfunction.
	e) No Power.	Turn on electric switch.
	f) Clamp Pump No.12, Fig.9 malfunction.	a) Possible clamp pump requires service. b) Possible pump drive gear damaged. Contact factory.
	g) Relief valve No.10, Fig.15 set too low.	Adjust relief valve No. 10 per III-D-4B and C, Page 40.
	h) Electrical Control System malfunction.	Check relays CR-1 and CR-2 (see Fig. 35) for malfunction exchange or replace if required. Also check wire connections to relays.
	i) Clamp cylinder malfunctioning.	Assure oil pressure going to clamp cylinder.

VI. TROUBLESHOOTING CHART

B. HYDRAULIC CLAMP CIRCUIT - CLAMP NOT OPERATING PROPERLY

TROUBLE	PROBABLE CAUSE	REMEDY
B-1 Continued No clamp or unclamp movement when push button is depressed.	i) If clamp slide attached to hydraulic cylinder is stuck.	a) The clamp slide stuck has to be corrected by forcefully removing and correcting diameters.
B-2 Clamp pressure dropping off.	a) Line leakage	a) Check clamp lines leading from hydraulic power unit to clamp cylinder and connection at clamp cylinder.
	b) Malfunction Sol Valve No.7	Recheck B-1-b, B-1-c and B-1-h for probable causes.
	c) Clamp Pump Malfunction.	Recheck B-1-f.
	d) Clamp Pump Compensator stuck.	Crack Compensator Adjusting Nut. Have serviced if required.
	e) Input flow to pump inadequate.	Check Filter No. 27 possible check valve No. 41 malfunctioning.
B-3 Clamp operates but green light on pendant doesn't light.	a) Green light broken.	Replace lamp. If light isn't broken, check wire connections.
	b) Relief valve No.10 set too low or pressure switch No. 15 set too high.	Adjust relief valve No. 10 and clamp pump compensator per III-D-4 B and C, Page 40 and pressure switch setting, Page 41.

VI. TROUBLESHOOTING CHART

C. VIBRATOR SUSPENSION ASSEMBLY - REFERENCE 20 TON
FIG. 55, PAGE 113, or 40 TON FIG. 61, PAGE 117

TROUBLE	PROBABLE CAUSE	REMEDY
C-1 Excessive bronze filings	Wearing bushing guides. Poor lifting shaft surface finish.	Add excess oil to bushings. Correct finish of shafts when unit is disassembled.
	Bent lifting shafts.	Bent shafts should be replaced, unless bushings open up satisfactorily.
C-2 Erratic Suspension bounce on driving	Broken spring.	If spring(s) is broken - replace as soon as possible.
	Uneven spring load, such as an unwinding of a lower nut or upper nut.	Check each shaft nut spacing on shaft and correct if necessary.
	Soil condition.	May be soil causing unusual rebound. Try changing frequencies.
C-3 Loose lifting head. Unusual noise.	a) Broken spring or broken shaft.	Make necessary correction.
	b) Top or bottom nuts may be loose.	Check out each shaft nut spacing and correct if necessary.
	c) Overspeed of vibrator.	Be sure maximum frequency is 1850 cpm.

VI. TROUBLESHOOTING CHART

D. VIBRATOR EXCITER ASSEMBLY -

REFERENCE FIG. 48 and FIG. 49, PAGES 106 and 107.

TROUBLE	PROBABLE CAUSE	REMEDY
D-1 Vibrator losing lube oil (Level should be at pipe plug height (Item 60))	a) Leakages at covers.	Tighten covers and if that doesn't correct problem, new cover gaskets should be installed.
	b) Leakages at hydraulic motor mounting flange or lube pump flange.	Check tightness of bolts holding hydraulic motors and lube pump (Item 27) to exciter housing. Check the gasket and replace if damaged.
	c) Leakages thru lube filter and piping or past the large end gaskets.	Tighten fittings and mounting screws. Replace gaskets where required.
D-2 Vibrator exciter housing gaining oil level	a) Hydraulic motor shaft seal leaking hydraulic fluid.	Replace hydraulic motor shaft seal. Check hydraulic motor drain for blockages. Relief in drain line set at 40 psi.
	b) If submerged under water, could possibly have filled with water.	Check all covers and gaskets for tightness.
D-3 No vibration but Drive Pump pressure up	a) Hydraulic motors damaged and locked.	Replace hydraulic motors.
	b) Bearing(s) damaged or frozen.	Determine which bearings are faulty and replace. Check lube system.
	c) Eccentrics out of phase.	Determine damage and make corrections.
	d) Broken eccentric coupling(s) or keys.	Determine damage and repair or replace.

VI. TROUBLESHOOTING CHART

D. VIBRATOR EXCITER ASSEMBLY -

REFERENCE FIG. 48 and FIG. 49, PAGES 106 and 107

TROUBLE	PROBABLE CAUSE	REMEDY
D-3 Continued No vibration but Drive Pump pressure up	e) Obstruction in hydraulic hose lines.	Check hose quick disconnects.
D-4 No lube oil pumping to bearings (not visible at sight glass)	a) Lube pump Item 27, faulty.	Replace lube pump.
	b) Obstruction in suction strainer before lube filter.	Check oil passage by removing strainer No. 60. Remove side cover Item 19 (nearest hydraulic motors) and check for foreign material blockage.
	c) Obstruction small orifice leading to sight glass.	Remove sight glass and clear opening.
	d) No lube oil.	a) Check oil level in vibrator. b) Hydraulic motor direction reversed. Change hydraulic hose lines. c) Check lube pump coupling.
	e) Lube filter clogged.	Replace filter element.
D-5 Oil leak from motor housing	a) Leakage at flange mounting surface of hydraulic motors or lube pump.	Check tightness of screws and for gasket damage.
	b) Leakage at manifold mounting.	Check tightness of manifold screws, Item 73 and check O-Rings Item 74 for damage.
	c) Leakages at lube hose connections.	Check and tighten all lube hose connections.

VI. TROUBLESHOOTING CHART

D. VIBRATOR EXCITER ASSEMBLY -

REFERENCE FIG. 48 and FIG. 49, PAGES 106 and 107

TROUBLE	PROBABLE CAUSE	REMEDY
D-6 Vibrator overheating	a) Bearing damage	a) Check bearings for damage or excessive wear. b) Check after cooled off--may be inadequate allowance for eccentric shaft thermal expansion.
	b) No lubrication to bearings.	Check lube system. Be sure lube level is correct.
D-7 Vibrator internal noise	a) Damaged bearings.	Follow D-6.
	b) Hydraulic motor or lube pump damaged or loosely connected.	Check by testing for excessive heat. Remove motor housing cover (Item 4). Make necessary corrections.
	c) Damage eccentric coupling Item 53 or lube pump coupling Item 50.	Determine damage of coupling and replace.
	d) Damaged gear(s)	Remove heavy cover, Item 3 being careful of gasket. Check gears. Replace if required. May be loose gear retaining nuts or damaged keys.
	e) Loose bearing retainers, Item 78,61,44	Tighten all bearing retainer bolts. Access through side cover closest to hydraulic motor.
D-8 Vibrating erratic	a) Eccentrics out-of-phase.	Check bearings: may have dropped shaft and gears jumped a tooth.
	b) Timing Gears loose on eccentric shafts.	Reassemble timing gears.

VI. TROUBLESHOOTING CHART

D. VIBRATOR EXCITER ASSEMBLY -
 REFERENCE FIG. 48 and FIG. 49, PAGES 106 and 107

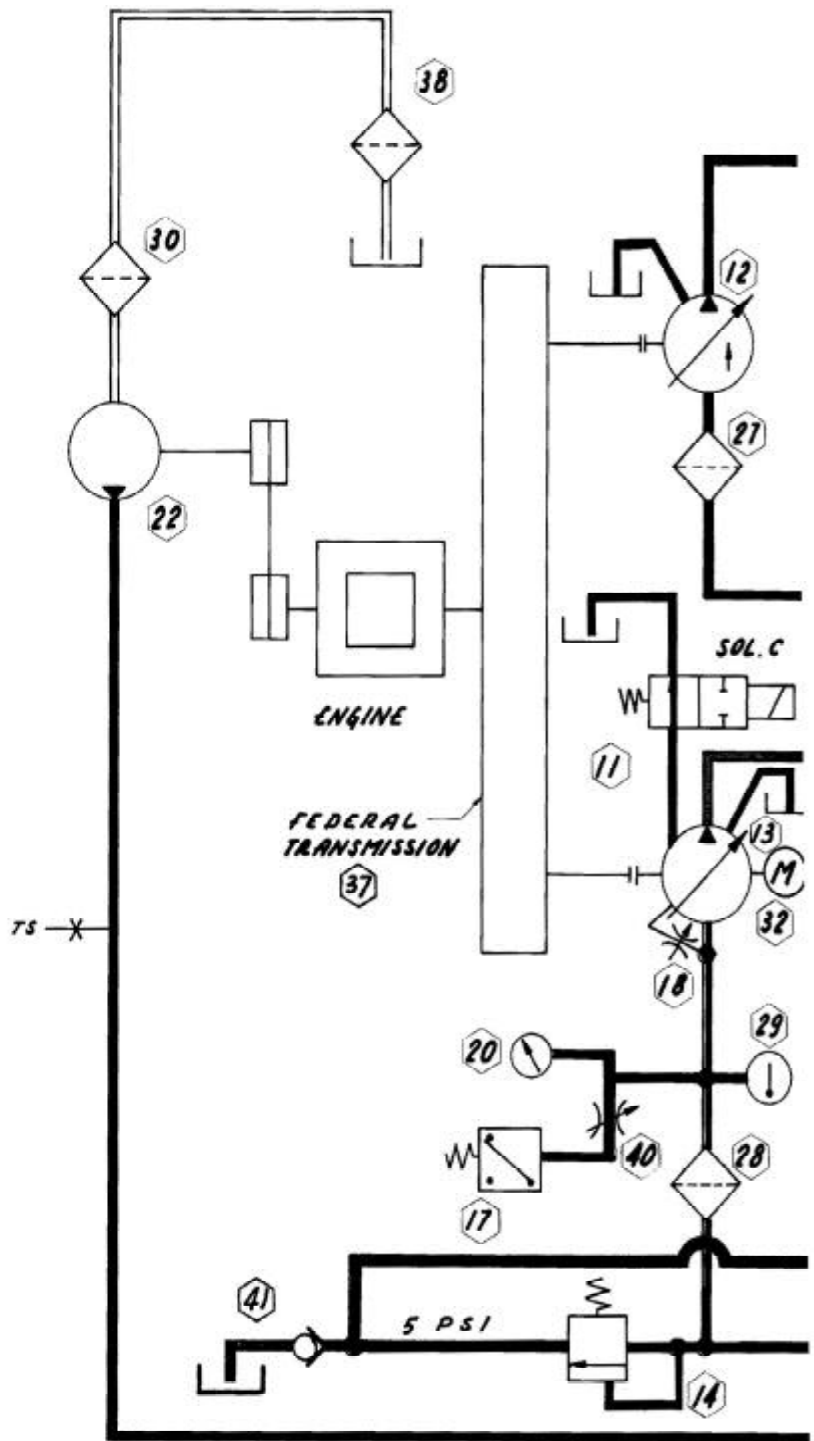
TROUBLE	PROBABLE CAUSE	REMEDY
D-9 Vibrator loss of frequency on hard driving	Overloading Vibrator	The V-14 is limited to a hydraulic drive pressure setting. The motors are constant torque not constant horsepower. If the hydraulic motors call for more torque, (more pressure), limited by relief valve No. 3, this relief valve will open more and the motor will drop speed rapidly.
D-10 Drain blow-off valve opening	a) Drain line blockage.	a) Check Quick Disconnect. b) Check drain hose.
	b) Excess motor drain.	Motors may require servicing. Ref. Page 36.
	c) Relief setting too low	Should be 40 psi. Screw in spider of valve a little to increase pressure setting.
	d) Cold hyd. fluid.	Warming of oil will help.

VI. TROUBLESHOOTING CHART

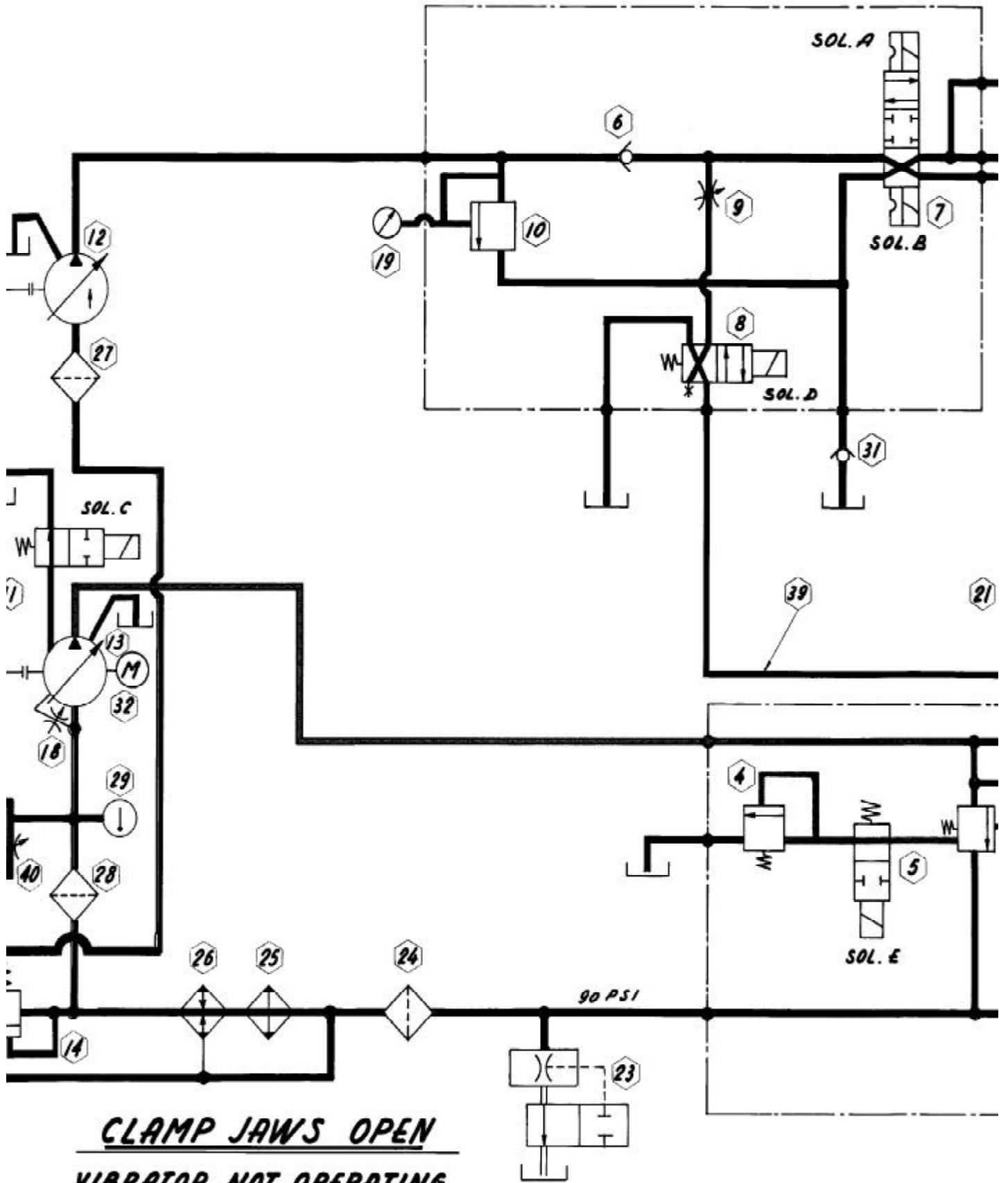
E. VIBRATOR CLAMP ASSEMBLY - REFERENCE FIG. 50, PAGE 108

TROUBLE	PROBABLE CAUSE	REMEDY
E-1 Clamp Pressure but no clamp movement	a) Damaged slide, Item 2.	Disassemble and correct slide diameter.
	b) Hydraulic hose.	Check quick disconnects and hose for kinks.
	c) Damaged hydraulic cylinder Item 8.	Replace hydraulic cylinder Item 8.
E-2 Jaws slipping on pile	a) Loss of clamping pressure.	Malfunction of clamp pump or pressure compensator. Might require readjustments.
	b) Lack of clamping overtravel.	Check for full hydraulic cylinder travel (1 1/2"). Jaws may be worn minimizing clamping overtravel.
E-3 Excessive looseness of movable jaw (Item 18 or Item 4)	a) Slide jaw keyway opened from damage or wear.	All that can be done is replace the slide, Item 2.
	b) Jaw key damaged or worn.	a) If not too much damage, add weld and grind to size (risk of damaging slide, Item 2, keyway). b) Replace jaw.
	c) Captivating shoulder jaw screws, Item 9, damaged.	Replace with new shoulder jaw screws. Be sure the shoulder is tight against the slide, Item 2, face. Recommend using Loctite and welding small steel strip to head of each shoulder bolt (Item 9) to keep from unscrewing.

- 1 RELIEF VALVE - 1200 P.S.I.
 - 2 2 WAY, N.C. PILOT OPER. DIR. VALVE
 - 3 RELIEF VALVE - 3200 TO 3500 P.S.I.
 - 4 RELIEF VALVE - 350 P.S.I.
 - 5 2 WAY N.O. SINGLE SOL. DIR. VALVE
 - 6 CHECK VALVE
 - 7 4 WAY, 3 POS. DOUBLE SOL. DIR. VALVE
 - 8 4 WAY, 2 POS. SINGLE SOL. DIR. VALVE
 - 9 NEEDLE FLOW CONTROL VALVE
 - 10 RELIEF VALVE - 3300 PSI
 - 11 2 WAY, N.O., SINGLE SOL. DIR. VALVE
 - 12 CLAMP PUMP
 - 13 MAIN PUMP
 - 14 RELIEF VALVE - 90 P.S.I.
 - 15 PRES. SWITCH - CLAMP
 - 16 PRES. SWITCH - DRIVE
 - 17 PRES. SWITCH - BOOST
 - 18 NEEDLE FLOW CONTROL VALVE
 - 19 PRES. GAGE - CLAMP
 - 20 PRES. GAGE - BOOST
 - 21 PRES. GAGE - DRIVE
 - 22 BOOST PUMP
 - 23 PURGE VALVE
 - 24 25 MICRON FILTER - MAIN
 - 25 HEAT EXCHANGER
 - 26 TEMPERATURE CONTROLLER
 - 27 10 MICRON FILTER - CLAMP
 - 28 10 MICRON FILTER - MAIN
 - 29 TEMPERATURE GAGE
 - 30 40 MICRON FILTER - BOOST
 - 31 CHECK VALVE
 - 32 PUMP ACTUATOR
 - 33-36 QUICK DISCONNECTS
 - 38 SUMP FILTER
 - 39 PILOT LINE BETWEEN MANIFOLDS
 - 40 NEEDLE FLOW CONTROL VALVE
 - 41 CHECK VALVE
- OPERATING PRES. 3200 P.S.I.
 DRAIN
 SUCTION OIL
 PILOT PRES. 350 P.S.I.
 CHARGE PRES. 90 P.S.I.

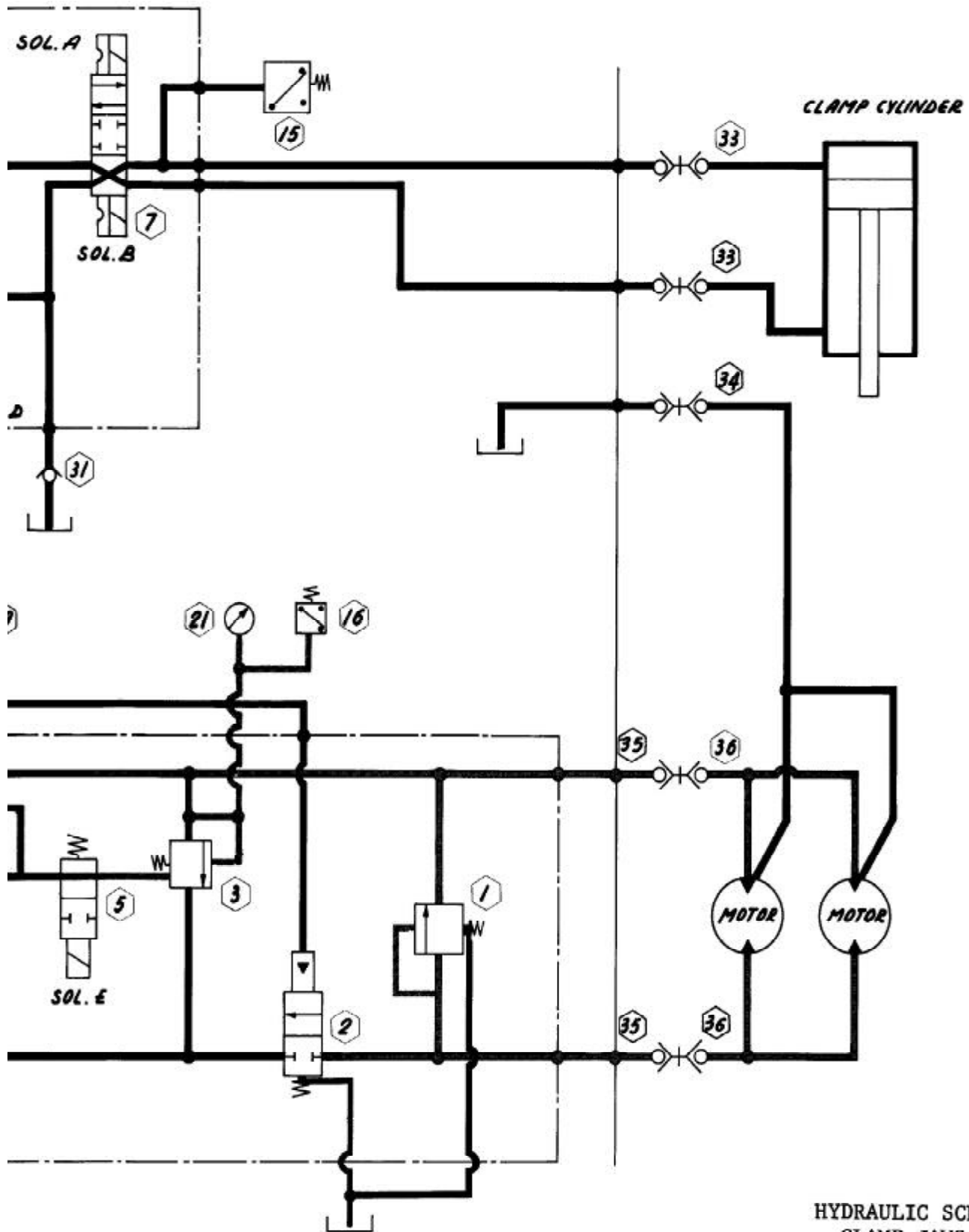


CL+
VIBRA



CLAMP JAWS OPEN
VIBRATOR NOT OPERATING
(LOW FLOW)

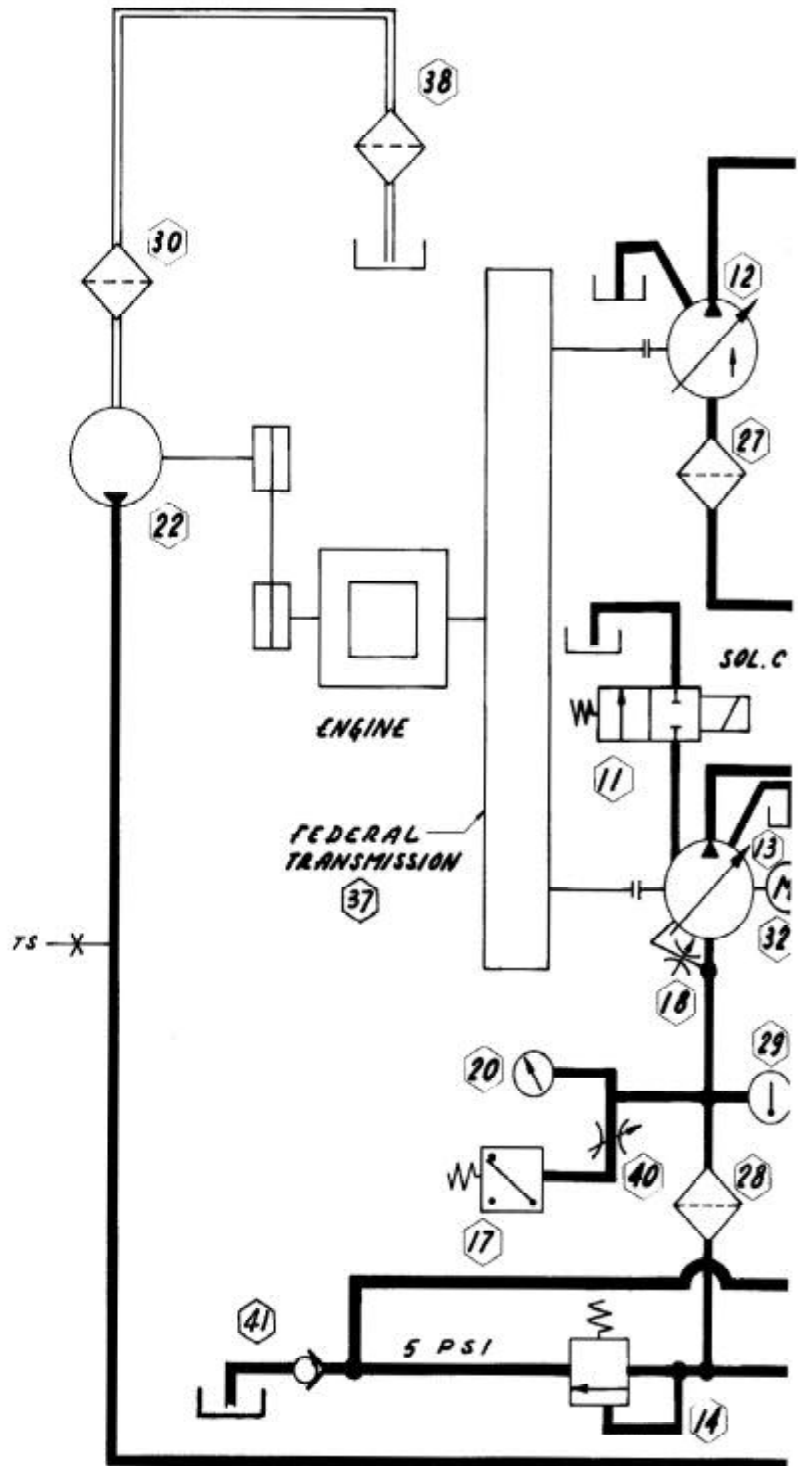
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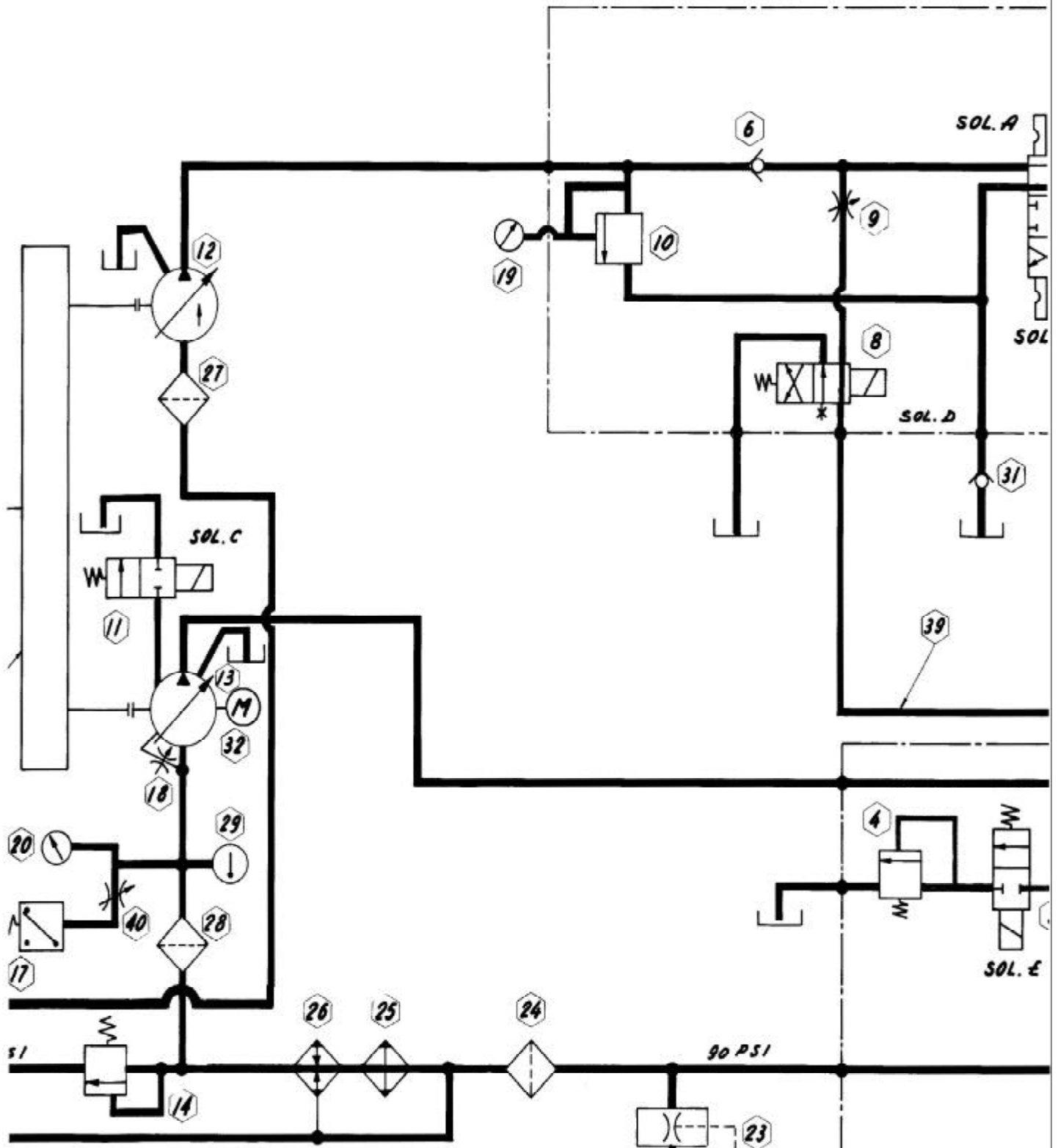
HYDRAULIC SCHEMATIC
CLAMP JAWS OPEN

FIG. 44

- 1 RELIEF VALVE - 1200 P.S.I.
 - 2 2 WAY, N.C. PILOT OPER. DIR. VALVE
 - 3 RELIEF VALVE - 3200 TO 3500 P.S.I.
 - 4 RELIEF VALVE - 350 P.S.I.
 - 5 2 WAY N.O. SINGLE SOL. DIR. VALVE
 - 6 CHECK VALVE
 - 7 4 WAY, 3 POS. DOUBLE SOL. DIR. VALVE
 - 8 4 WAY, 2 POS. SINGLE SOL. DIR. VALVE
 - 9 NEEDLE FLOW CONTROL VALVE
 - 10 RELIEF VALVE - 3300 PSI
 - 11 2 WAY, N.O., SINGLE SOL. DIR. VALVE
 - 12 CLAMP PUMP
 - 13 MAIN PUMP
 - 14 RELIEF VALVE - 90 P.S.I.
 - 15 PRES. SWITCH - CLAMP
 - 16 PRES. SWITCH - DRIVE
 - 17 PRES. SWITCH - BOOST
 - 18 NEEDLE FLOW CONTROL VALVE
 - 19 PRES. GAGE - CLAMP
 - 20 PRES. GAGE - BOOST
 - 21 PRES. GAGE - DRIVE
 - 22 BOOST PUMP
 - 23 PURGE VALVE
 - 24 25 MICRON FILTER - MAIN
 - 25 HEAT EXCHANGER
 - 26 TEMPERATURE CONTROLLER
 - 27 10 MICRON FILTER - CLAMP
 - 28 10 MICRON FILTER - MAIN
 - 29 TEMPERATURE GAGE
 - 30 40 MICRON FILTER - BOOST
 - 31 CHECK VALVE
 - 32 PUMP ACTUATOR
 - 33-36 QUICK DISCONNECTS
 - 38 SUMP FILTER
 - 39 PILOT LINE BETWEEN MANHOLDS
 - 40 NEEDLE FLOW CONTROL VALVE
 - 41 CHECK VALVE
- OPERATING PRES. 3200 P.S.I.
 DRAIN
 SUCTION OIL
 PILOT PRES. 350 P.S.I.
 CHARGE PRES.

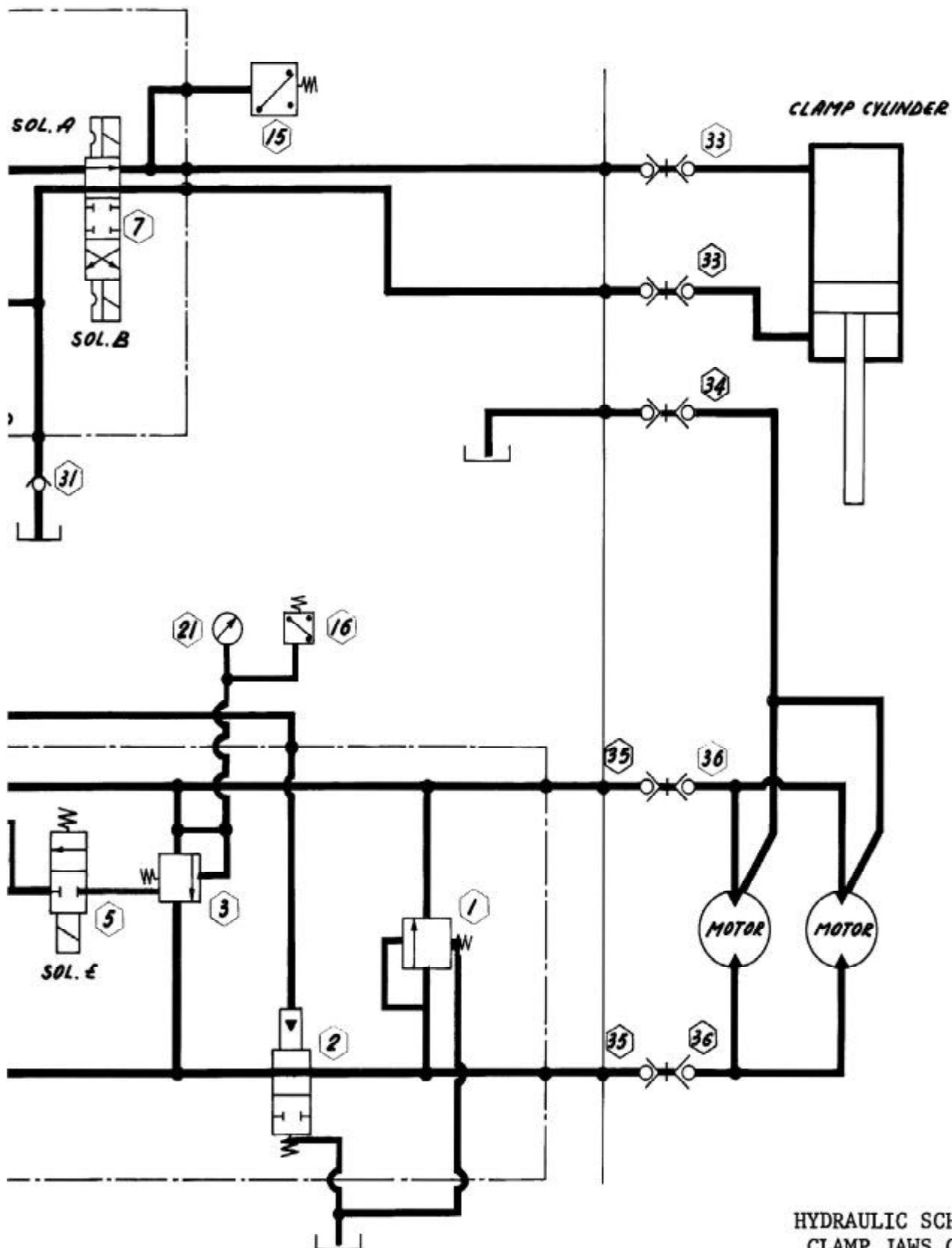


CL₁
VIB



CLAMP JAWS CLOSED
VIBRATOR OPERATING
(HIGH FLOW)

CONTINUED



HYDRAULIC SCHEMATIC
CLAMP JAWS CLOSED

FIG. 45

VII. PARTS IDENTIFICATION OF THE V-14 VIBRATOR

The component parts of each assembly drawing are identified by a balloon with a number inserted called an item number. When ordering a component part, use only the seven digit number to the right of the vertical line through the part number block.

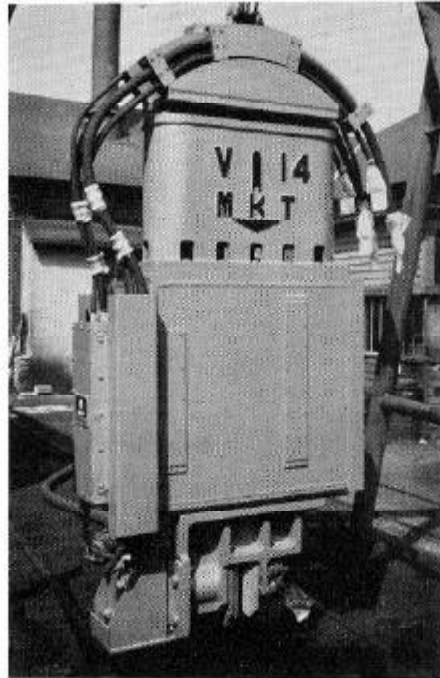


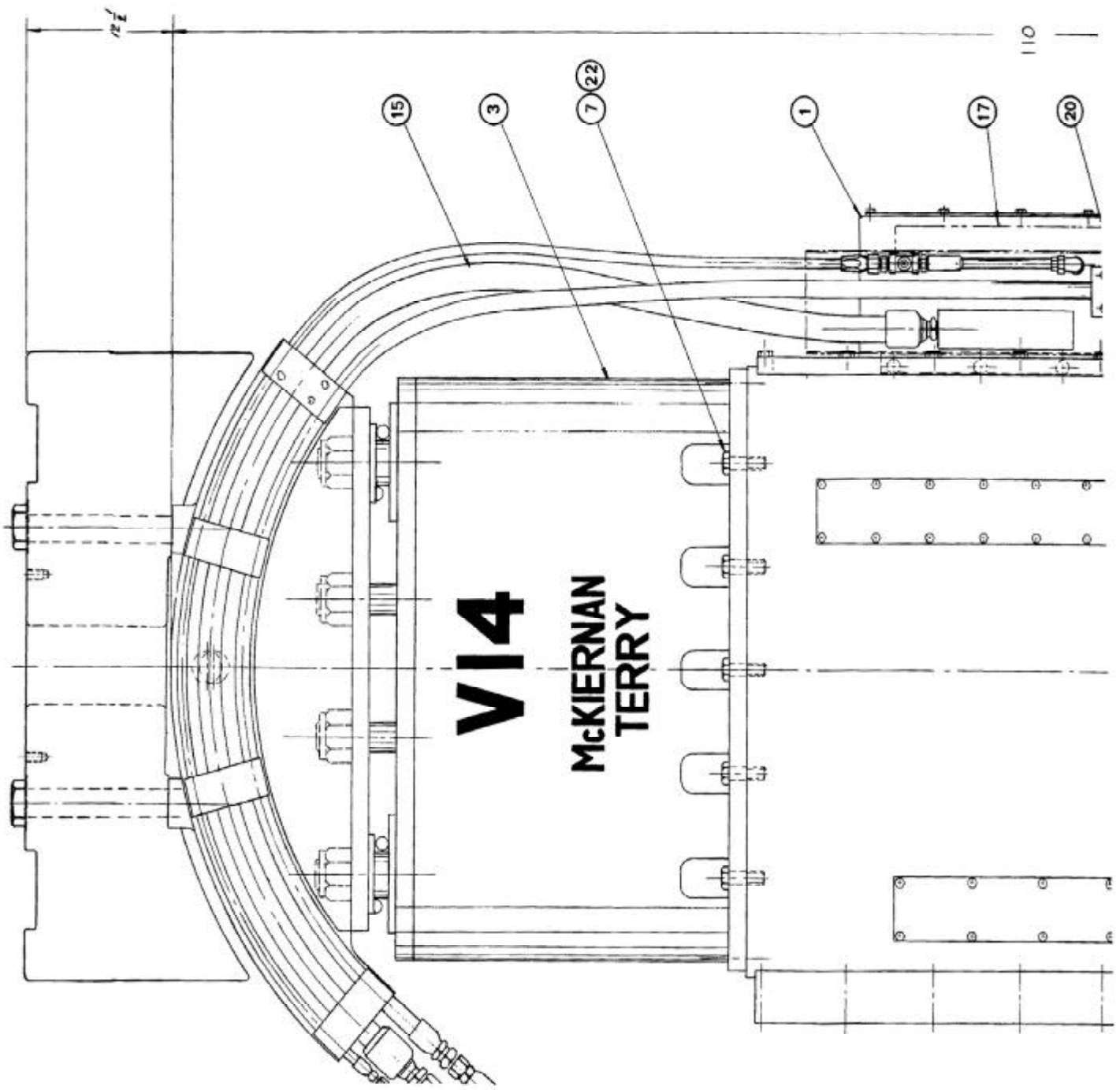
FIG. 46

VII. A.

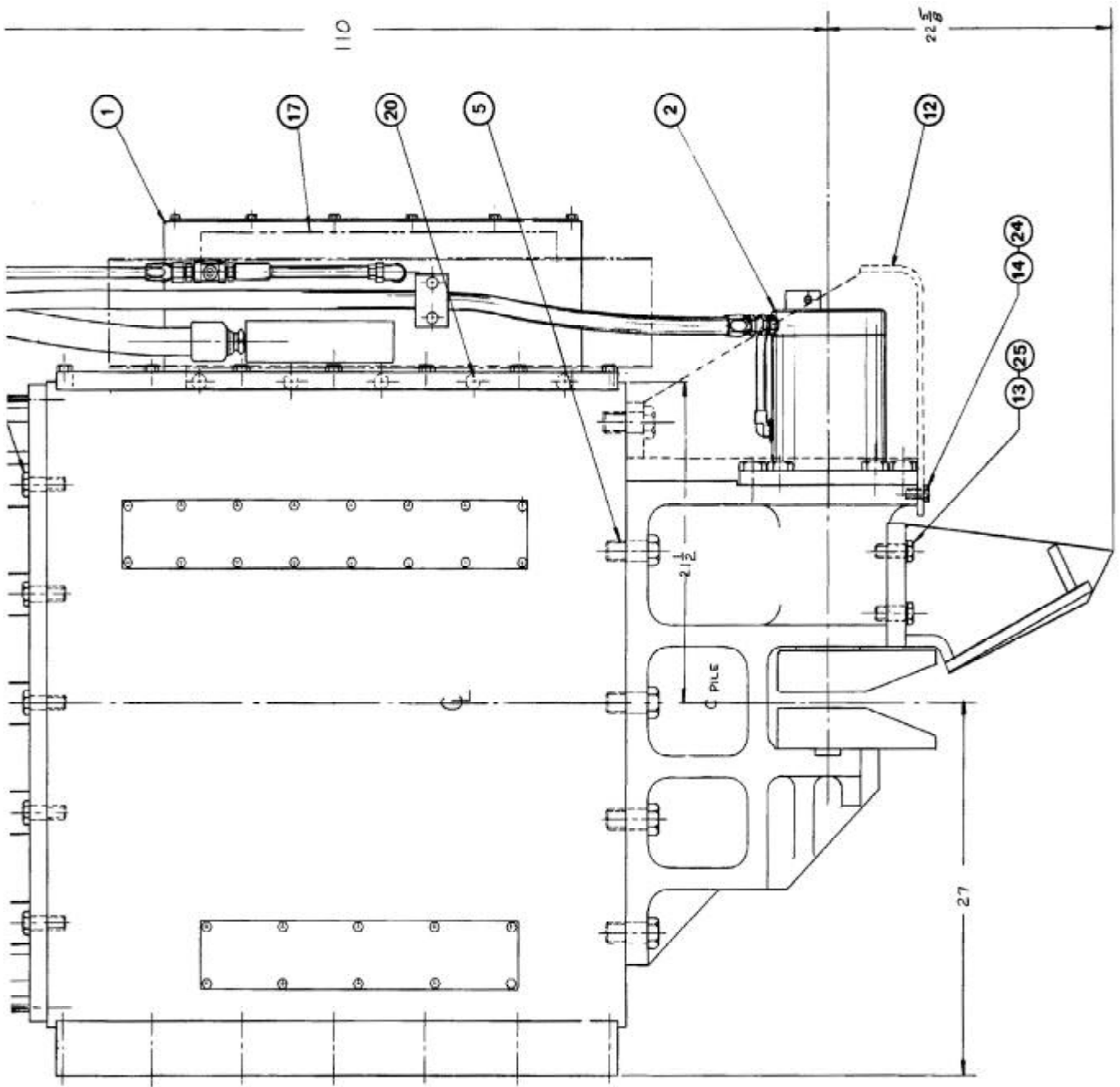
GENERAL ASSEMBLY

ITEM NO.	PART NO.	DESCRIPTION	QUAN. REQ'D.
1	6 4100100	Exciter Assembly	1
2	6 4100200	Hydraulic Clamp Assembly	1
3	6 4100325	Suspension Assembly	1
5	0 9016311	1 1/2-6 Hex Hd. Cap Screw x 3 1/4	10
7	0 9190010	1-8 Hex Head Cap Screw x 2 3/4	15
12	4 4100005	Clamp Cylinder Shield	1
14	0 9010913	3/4 x 10 Hex Hd. Cap Screw x 1 1/2	4
15	3 4100400	Hydraulic Hose Assembly	1
17	4 4990053	Protective Shield	2
20	0 9190012	1/2-13 Hex Head Cap Screw x 7/8	20
22	0 9240003	1" Dowel Pin x 1 3/4	4
24	0 9030117	3/4 Lockwasher	4

FIG. 47



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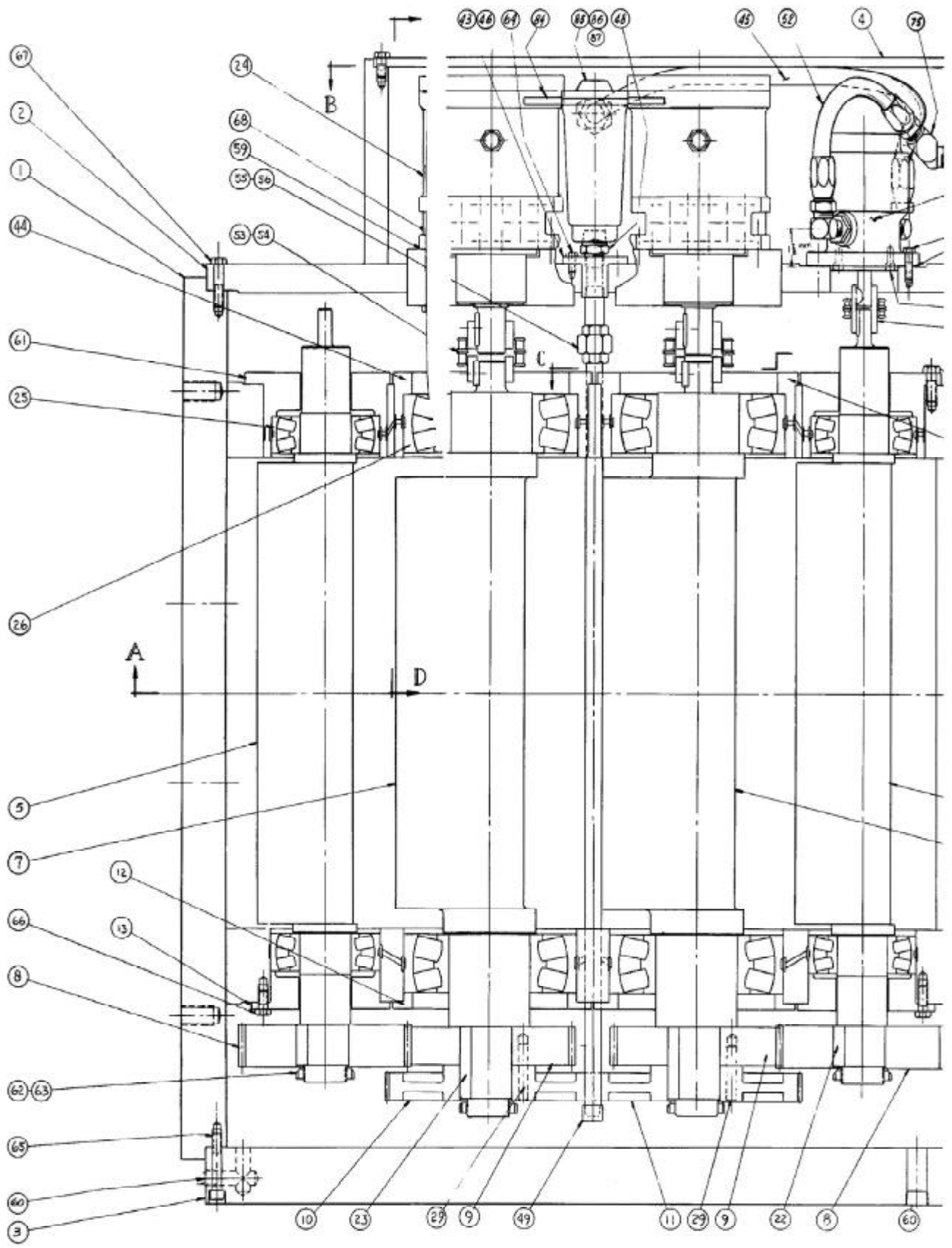


VII. B.

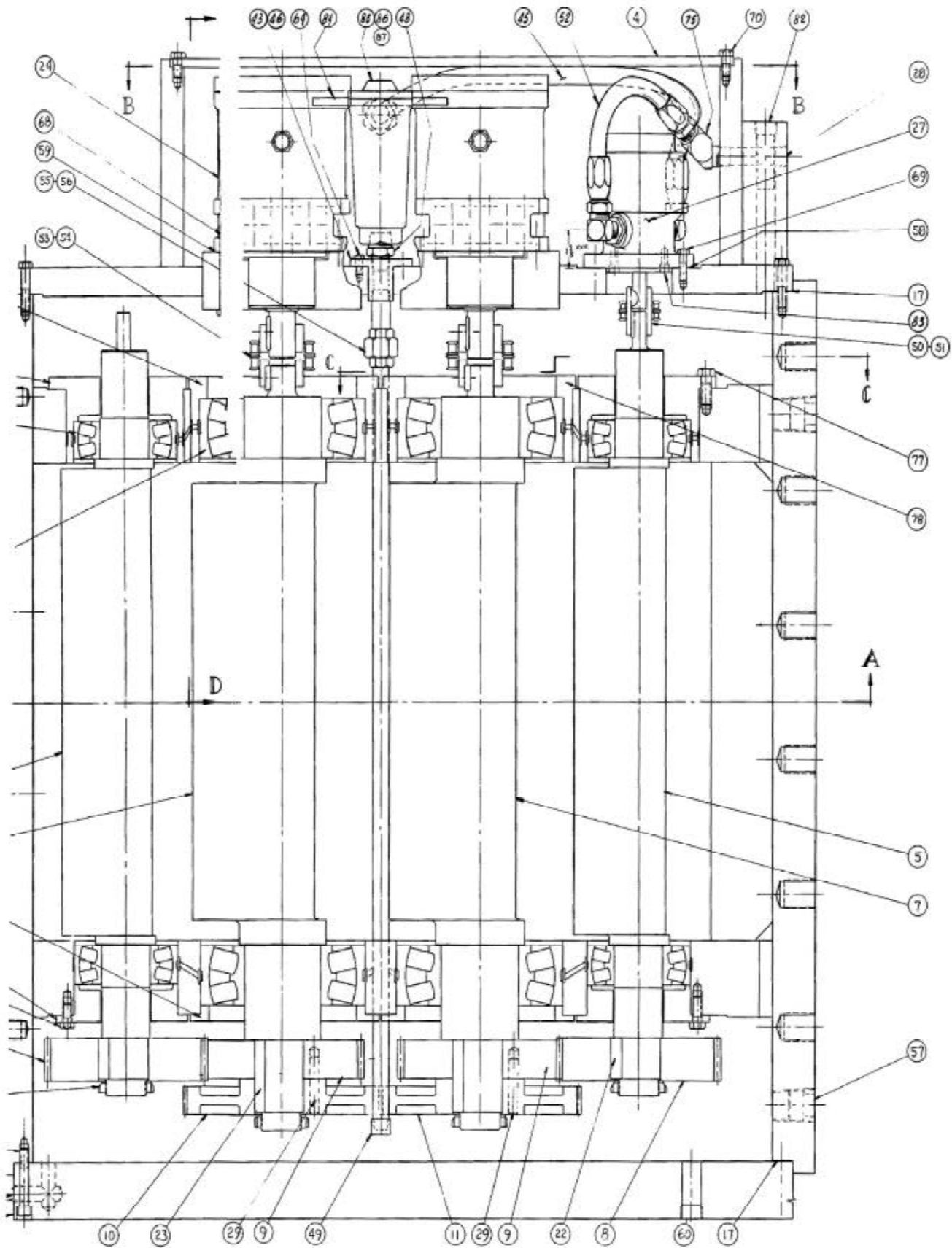
EXCITER ASSEMBLY - V-14
Sheet 1 of 2

ITEM NO.	PART NO.	DESCRIPTION	QUAN. REQ'D.	
1	6	4100101	Exciter Housing	1
2	6	4100102	Exciter Motor Housing	1
3	4	4100109	Exciter Housing Cover	1
4	4	4100110	Motor Housing Cover	1
5	4	4100144	Eccentric-Outer	2
7	4	4100142	Eccentric-Inner	2
8	3	4100114	Gear	2
9	3	4100115	Pinion	2
10	3	4100116	Timing Pinion	1
11	3	4100117	Timing Gear	1
12	3	4100118	Large Bearing Cover	2
13	3	4100119	Small Bearing Cover	2
14	3	4100120	Exciter Side Cover	2
15	3	4100121	Gasket, Side Cover	2
16	3	4100122	Gasket, Side Cover	2
17	3	4100123	Gasket, Motor Housing	2
18	0	9240001	Dowel Pin, 3/4 D. x 2 1/4	2
19	3	4100124	Exciter Side Cover	2
20	4	4100125	Motor Manifold - Outer	1
21	3	4100126	Motor Manifold - Inner	1
22	2	4100127	Key, Gear	2
23	2	4100128	Key, Gear	2
24	2	4100129	Hydraulic Motor	2
25	0	9140001	Bearing	4
26	0	9140002	Bearing	4
27	0	9110001	Lube Pump	1
28	0	9300342	Pipe Plug, 3/4"	1
29	0	9240015	1/2 Dowel x 3	4
30	0	9230015	Swivel Fitting, 2045-20-20S	2
34	0	9230016	Pipe Reducer, 2081-16-12S	3
35	0	9230017	Pipe Adapter, 2024-12-12S	2
37	0	9300002	90° Elbow - Union Fitting	1
38	0	9300003	Pipe	1
39	0	9230018	Pipe Tee, 2090-8-8S	1
40	0	9230001	Male Pipe to Male 2083-12-8S	1
42	0	9300004	Pipe Nipple	2
43	2	4100133	Tube Adapter Gasket	1
44	3	4100134	Large Bearing Cartridge	1
45	2	4100135	Lube Pump Hose Assembly	1
46	2	4100137	Lube Line Adapter	1

FIG. 48

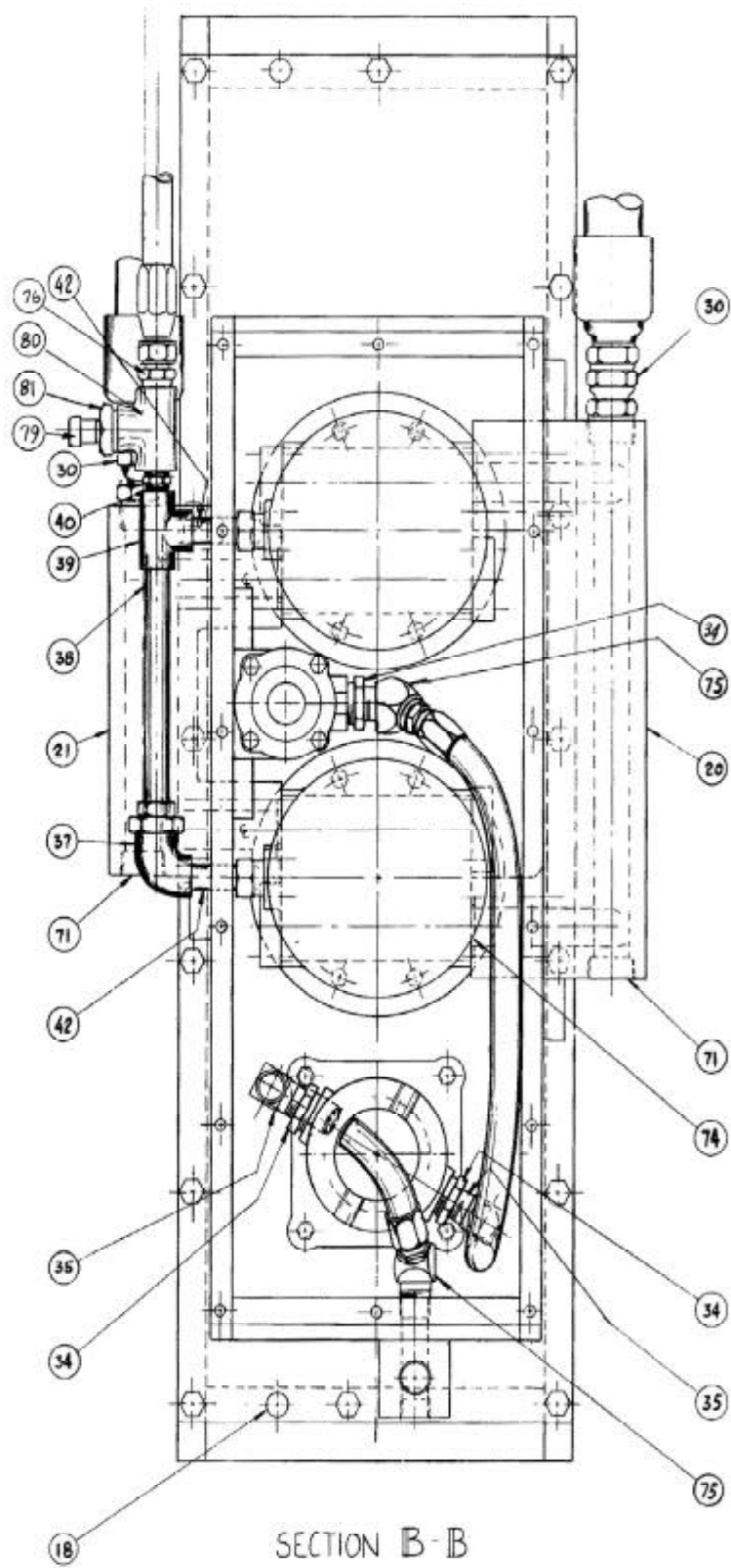


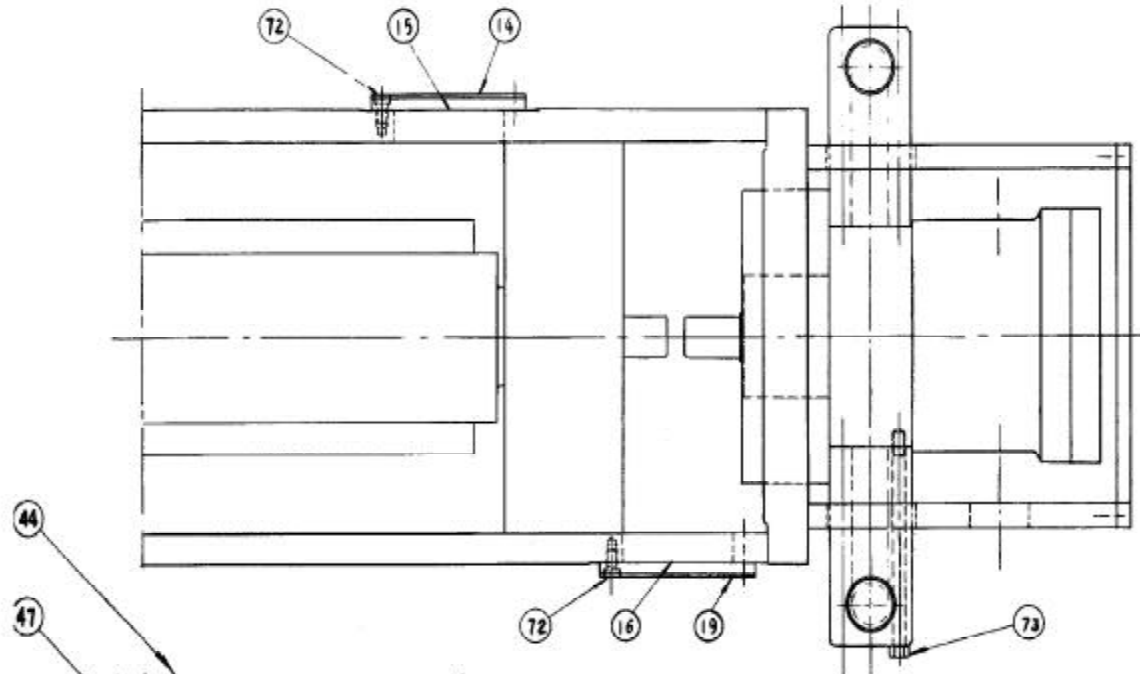
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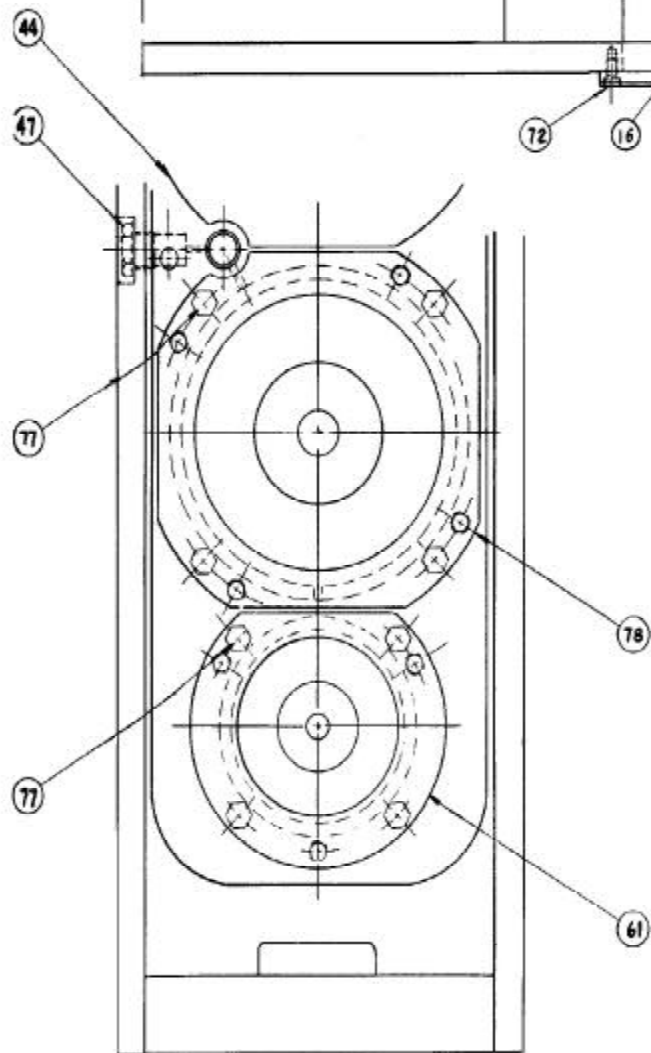
ITEM NO.	PART NO.	DESCRIPTION	QUAN. REQ'D.
47	0 9310053	Sight Window	1
48	0 9230374	Aeroquip 2083-16-12S	1
49	0 9300006	Pipe Cap	1
50	0 9160001	Coupling	1
51	0 9180001	Key	1
52	2 4100136	Lube Pump Hose Assembly	1
53	0 9160002	Coupling	2
54	0 9180002	Key	2
55	0 9300007	Pipe Union, 3/4"	1
56	0 9300354	Pipe Nipple	2
57	0 9310002	Magnetic Plug	3
58	2 4100138	Gasket, Lube Pump	1
59	2 4100139	Gasket, Hyd. Motor	2
60	0 9300352	Pipe Plug	1
61	3 4100140	Small Bearing Cartridge	2
62	0 9210018	Locknut	4
63	0 9210019	Lockwasher	4
64	0 9190001	Hex Head Cap Screw	2
65	0 9190002	Socket Head Cap Screw	16
66	0 9190003	Hex Head Cap Screw	16
67	0 9190004	Hex Head Cap Screw	16
68	0 9190005	Hex Head Cap Screw	8
69	0 9190006	Hex Head Cap Screw	4
70	0 9190007	Hex Head Cap Screw	14
71	0 9300076	Pipe Plug, 1 1/4	2
72	0 9190008	Socket Head Cap Screw	52
73	0 9050646	Socket Head Cap Screw	16
74	0 9130001	O-Ring - 224	4
75	0 9230019	45° Elbow, 2088-12-12S	2
76	0 9230020	Pipe Nipple, 2021-12-12S	1
77	0 9190050	Hex Head Cap Screw	16
78	3 4100141	Large Bearing Cartridge	1
79	0 9310006	Relief Valve	1
80	0 9300092	Tee	1
81	0 9230060	Pipe Reducer	1
82	1 4100148	Lube Suction Filter	1
83	0 9190045	Soc.Hd. Cap Screw	6
84	1 4990122	Shear Block	2
85	0 9310198	Marvel Filter 85116E1500	1
86	0 9310199	Marvel Element 629206-5140	1
87	0 9130113	O-Ring 2-120	1

FIG. 49





SECTION D-D



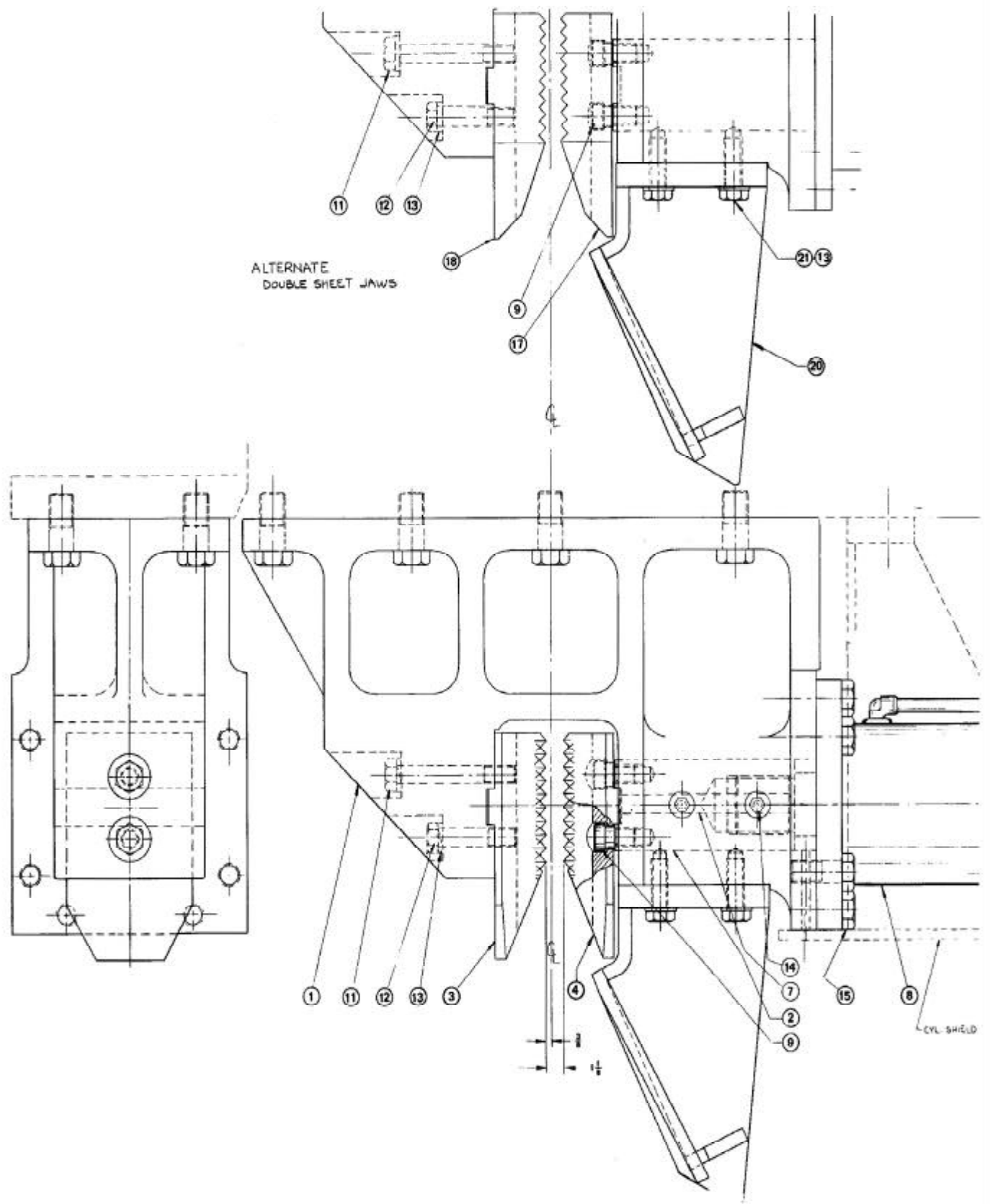
SECTION C-C

VII. D.

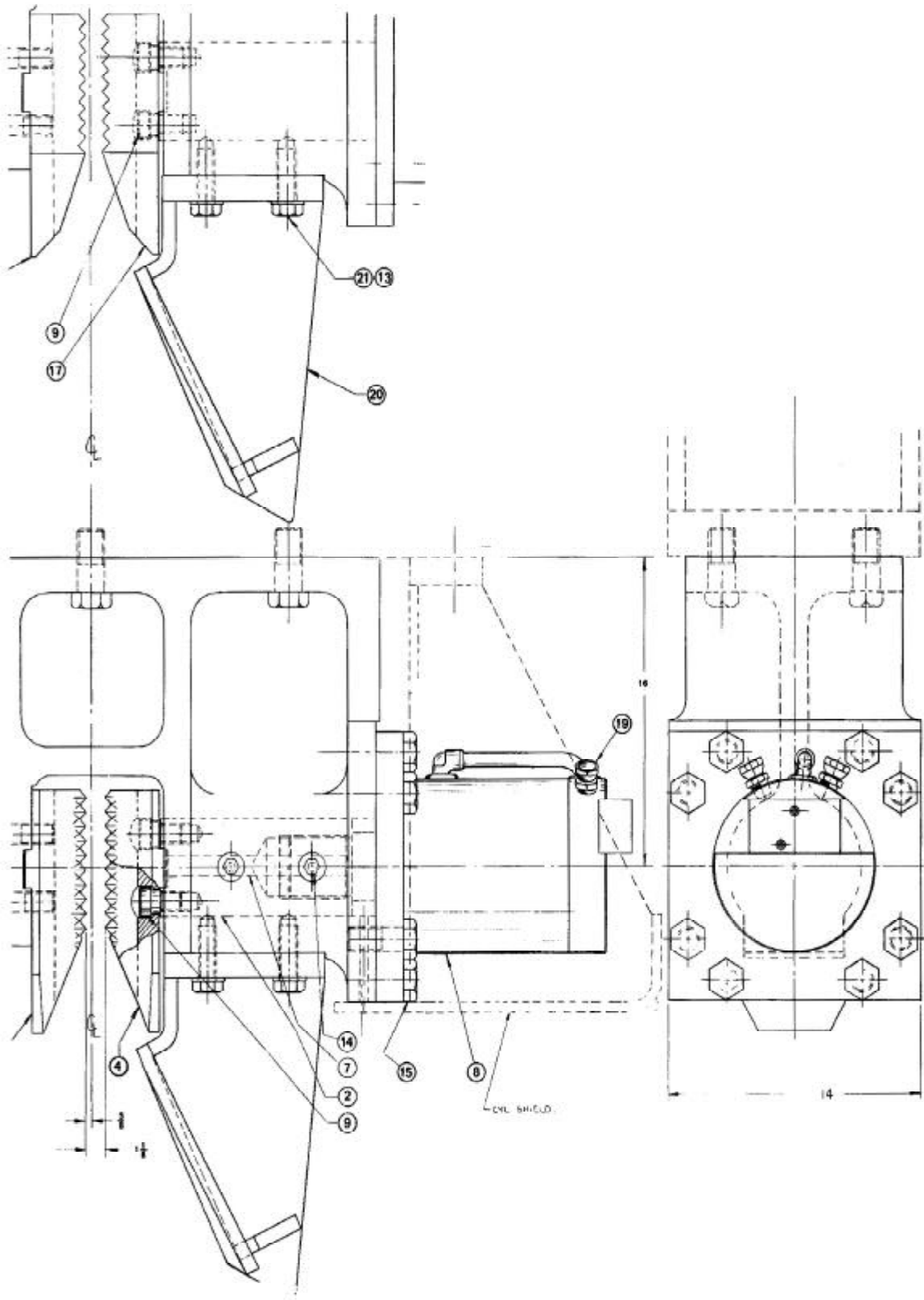
HYDRAULIC CLAMP ASSEMBLY

ITEM NO.	PART NO.	DESCRIPTION	QUAN. REQ'D.
1	6 4100201	Clamp Housing	1
2	3 4100202	Clamp Slide	1
3	3 4990101	Clamp Jaw-Fixed -Universal Type	1
4	3 4990099	Clamp Jaw-Movable-Universal Type	1
7	2 4100209	Slide Key	1
8	0 9220018	Hydraulic Cylinder	1
9	1 4990051	Jaw Screw	2
11	0 9016135	Hex Hd.Cap Screw, 1"-8 x 7 GR8	1
12	0 9016125	Hex Hd.Cap Scr.1"-8 x 4 1/2 GR8	1
13	0 9030121	Lockwasher	6
14	0 9190013	Hex Head Cap Screw	2
15	0 9016218	Hex Hd.Cap Scr. 1½-12 x 3 GR8	8
17	3 4990094	Clamp Jaw-Mov.-Double Pile Type	1
18	3 4990096	Clamp Jaw-Fixed-Double Pile Type	1
19	0 9230041	Adapter-Swivel	2
20	4 4100004	Jaw Shield	1
21	0 9016113	Hex Head Cap Screw	4

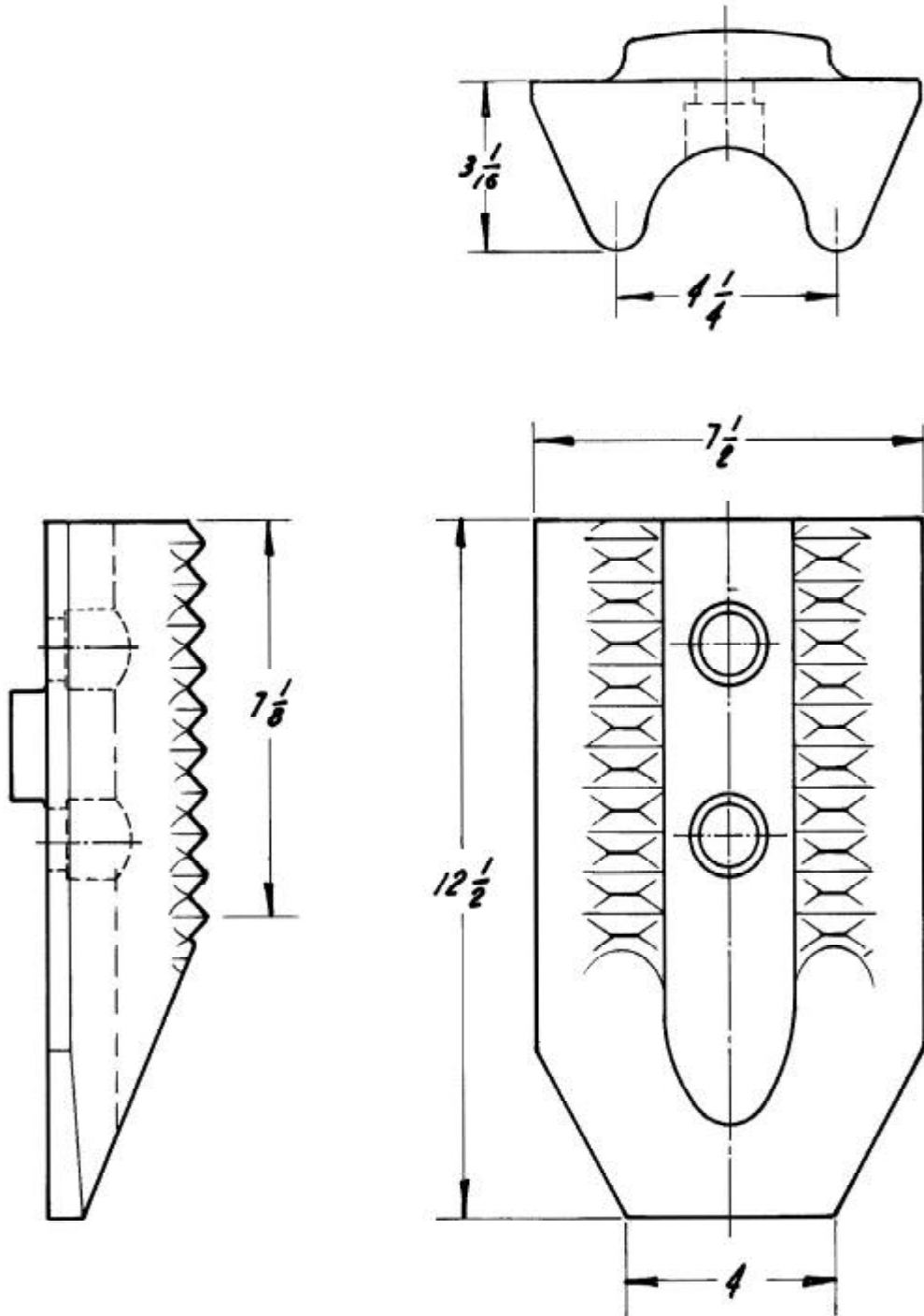
FIG. 50



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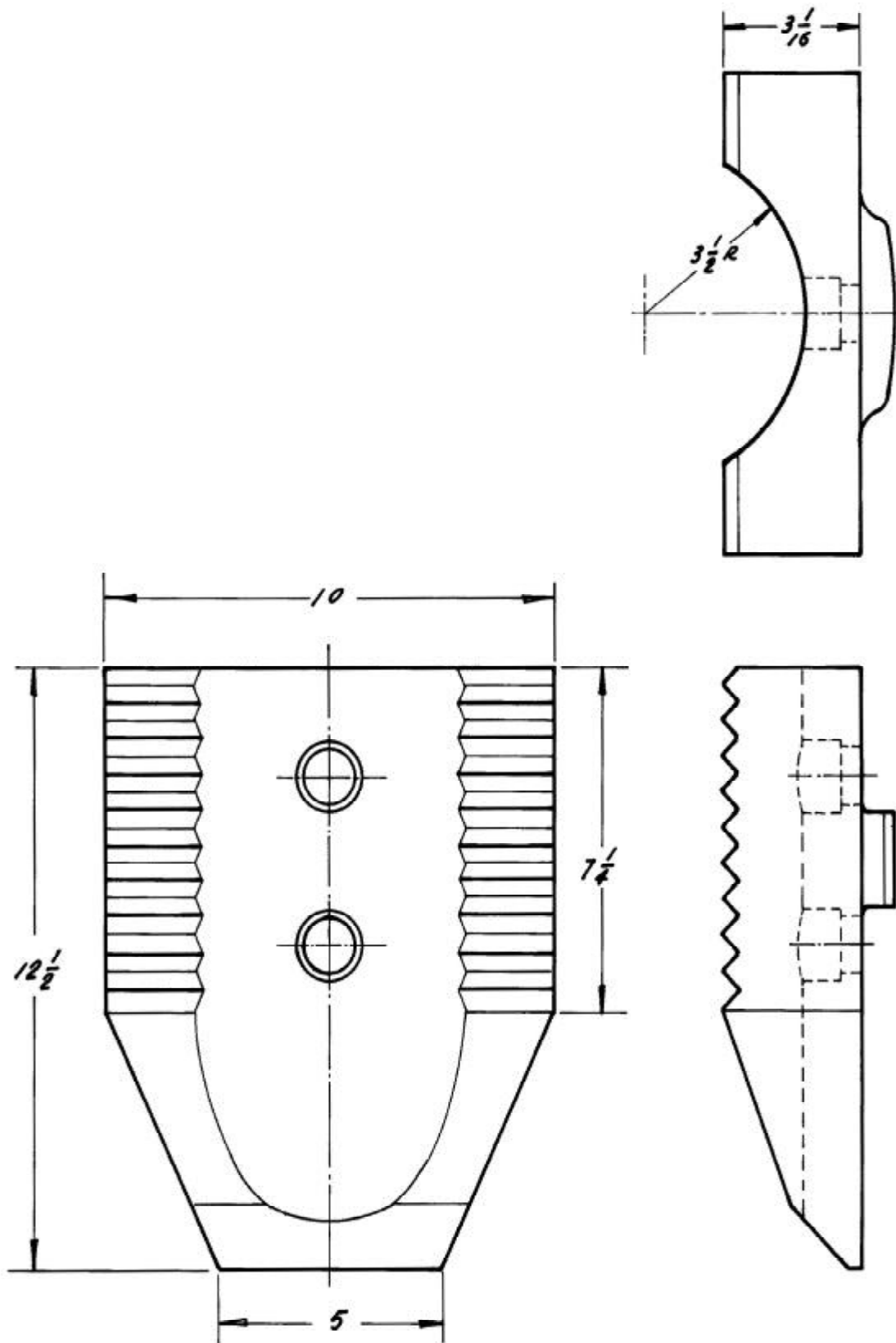


JAW CONFIGURATIONS

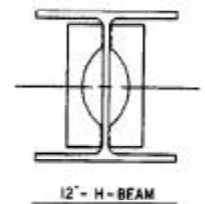
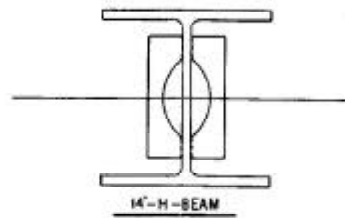
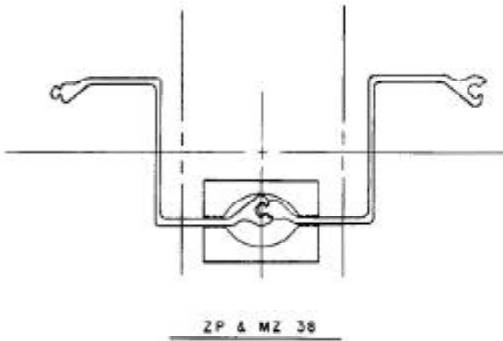
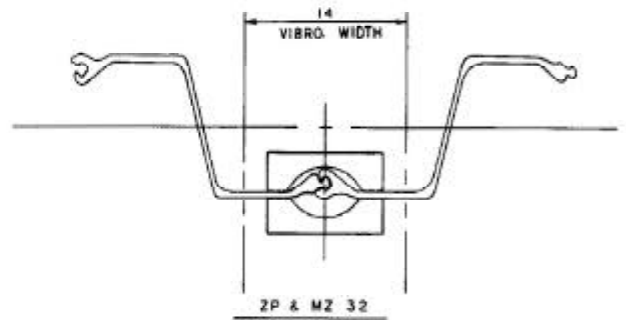
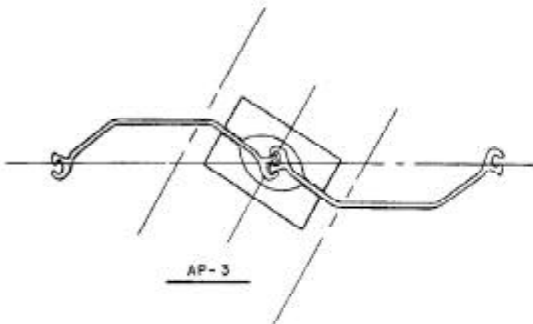
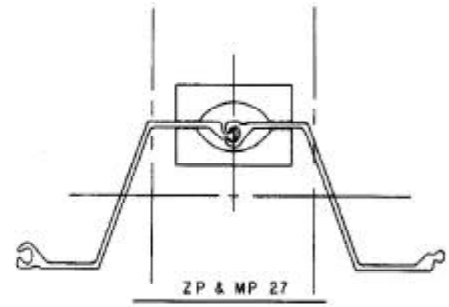
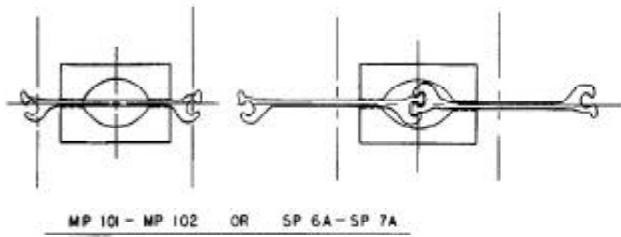


UNIVERSAL SCREW JAW

FIG. 51

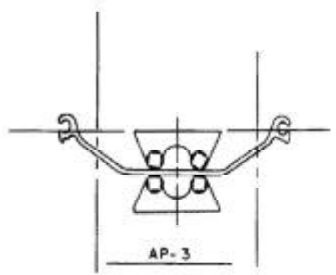
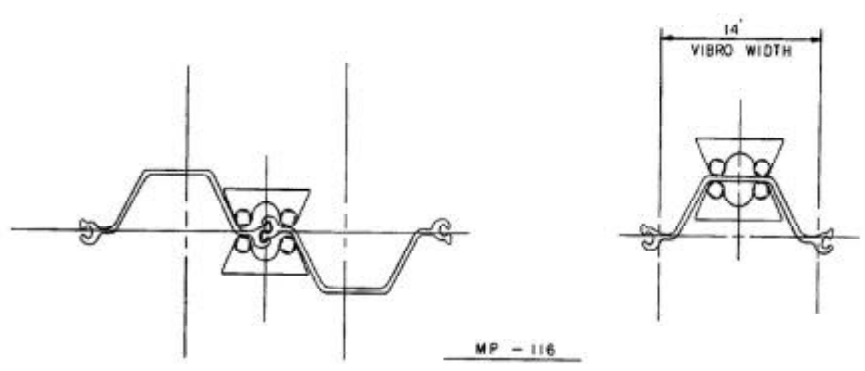
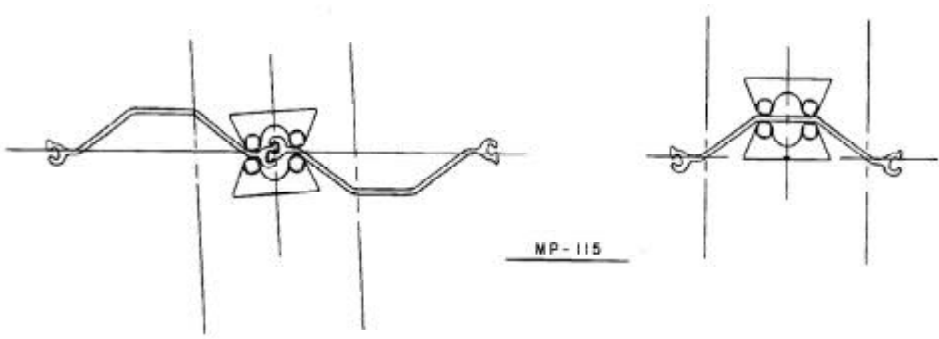
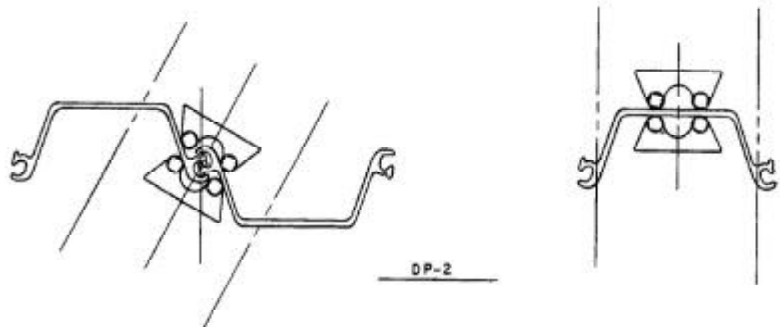


DOUBLE SHEET JAW



DOUBLE SHEET JAWS

FIG. 52
CLAMP JAWS FOR
PILE CONFIGURATIONS



UNIVERSAL TYPE JAWS



FIG. 53

V-14 WITH 20 TON SUSPENSION ASSEMBLY



FIG. 54

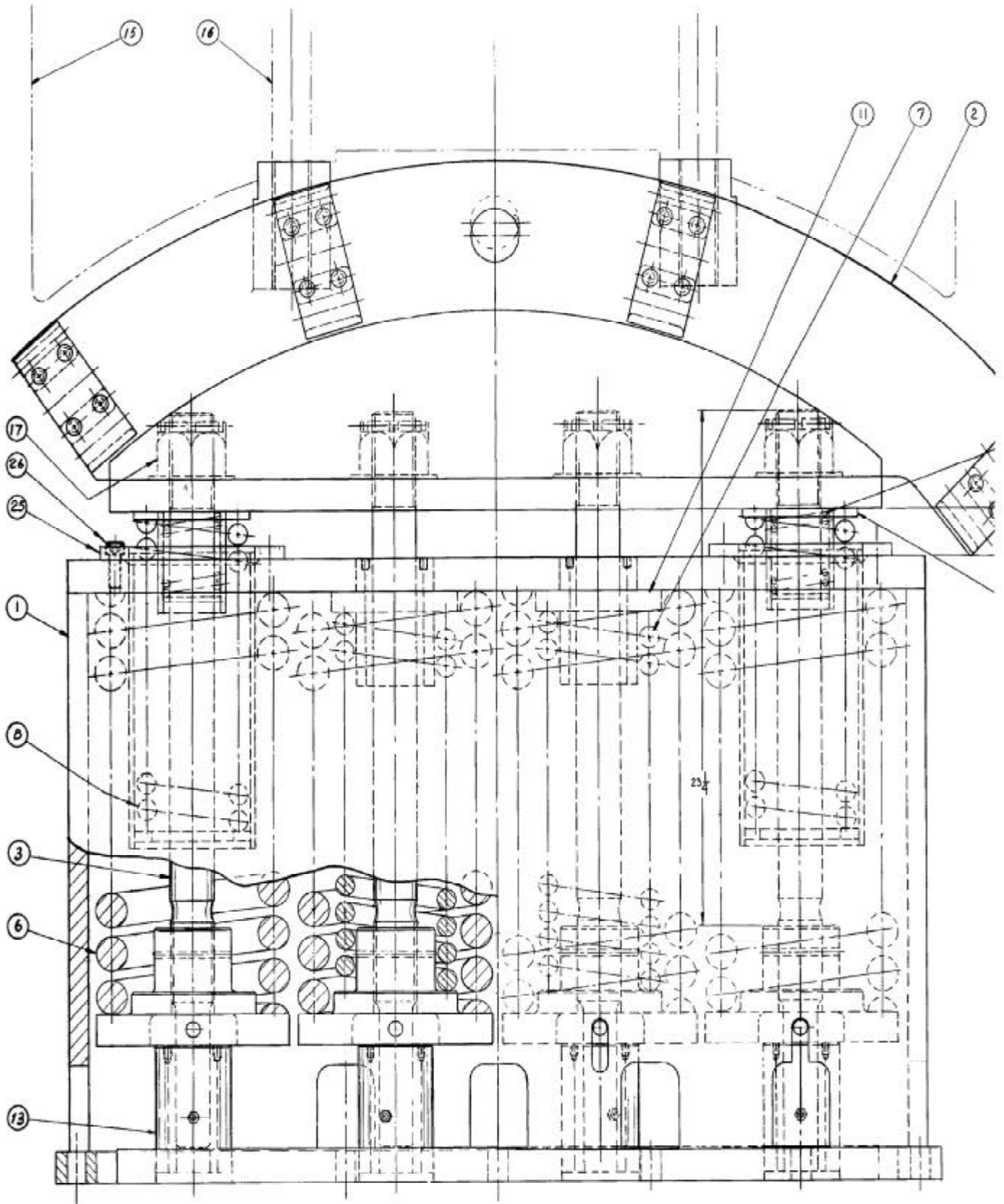
V-14 WITH 20 TON SUSPENSION ASSEMBLY PLUS WEIGHTS

VII. E.

SUSPENSION ASSEMBLY - 20 TON
Sheet 1 of 2

ITEM NO.	PART NO.	DESCRIPTION	QUAN. REQ'D.
1	6 4100301	Spring Suspension Housing	1
2	6 4100303	Top Lifting Head	1
3	3 4100334	Spring Lifting Shaft Assembly	4
6	3 4100309	Spring - Outer	4
7	3 4100310	Spring - Inner	2
8	3 4100311	Spring - Support	2
9	2 4100312	Spring Tension Cup	2
10	2 4100313	Cup Spring	2
11	1 4100335	Upper Bushing Holder Assembly	2
13	4 4100336	Lower Bushing Holder Assembly	1
15	3 4100319	1 Ton Driving Wt.	1
16	2 4950012	Hex Hd. Cap Scr.-for 1 Ton Wt.	2
17	2 4100320	Hex Slotted Nut	4
19	0 9040001	Cotter Pin	4
22	1 4100332	Flat Washer	4
23	3 4950002	1/2 Ton Driving Wt.	1
24	2 4950003	Hex Hd.Cap Scr.-for 1 & 1/2 Ton Wt.	2
25	3 4100333	Support Spring Enclosure	2
26	0 9050811	Soc. Head Cap Screws	8
27	0 9190014	1/2-13 Soc.Hd. Cap Scr. x 1 3/4	32

FIG. 55



CONTINUED

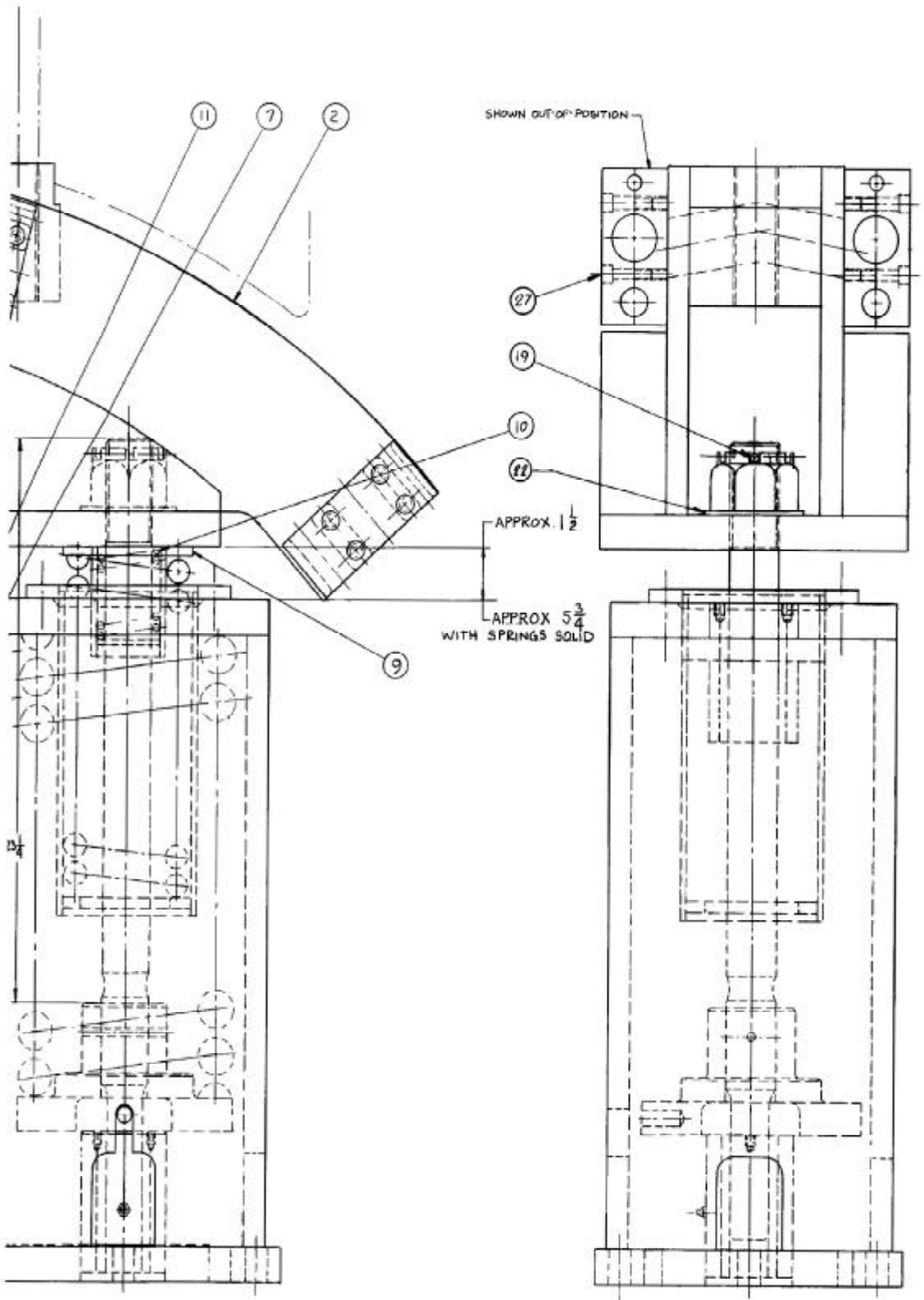


FIG. 56 - LOWER BUSHING HOLDER ASSEMBLY

ITEM NO.	PART NO.	DESCRIPTION	QUAN. REQ'D.
1	4 4100329	Lower Bushing Holder	1
2	2 4100316	Lower Bushing	4
3	0 9420008	Grease Fitting - 1/8"	4
4	0 9430017	3/8-16 x 1/2 Brass Set Screw	8

FIG. 57 - SPRING LIFTING SHAFT ASSEMBLY

ITEM NO.	PART NO.	DESCRIPTION	QUAN. REQ'D.
1	3 4100307	Spring Lifting Shaft	1
2	3 4990128	Bottom Nut	1
3	0 9240022	5/16 Roll Pin x 4	1

FIG. 58 - UPPER BUSHING HOLDER ASSEMBLY

ITEM NO.	PART NO.	DESCRIPTION	QUAN. REQ'D.
1	0 9430017	3/8-16 x 1/2 Brass Set Screw	2
2	2 4990127	Upper Bushing Holder	1
3	2 4100328	Upper Bushing	1

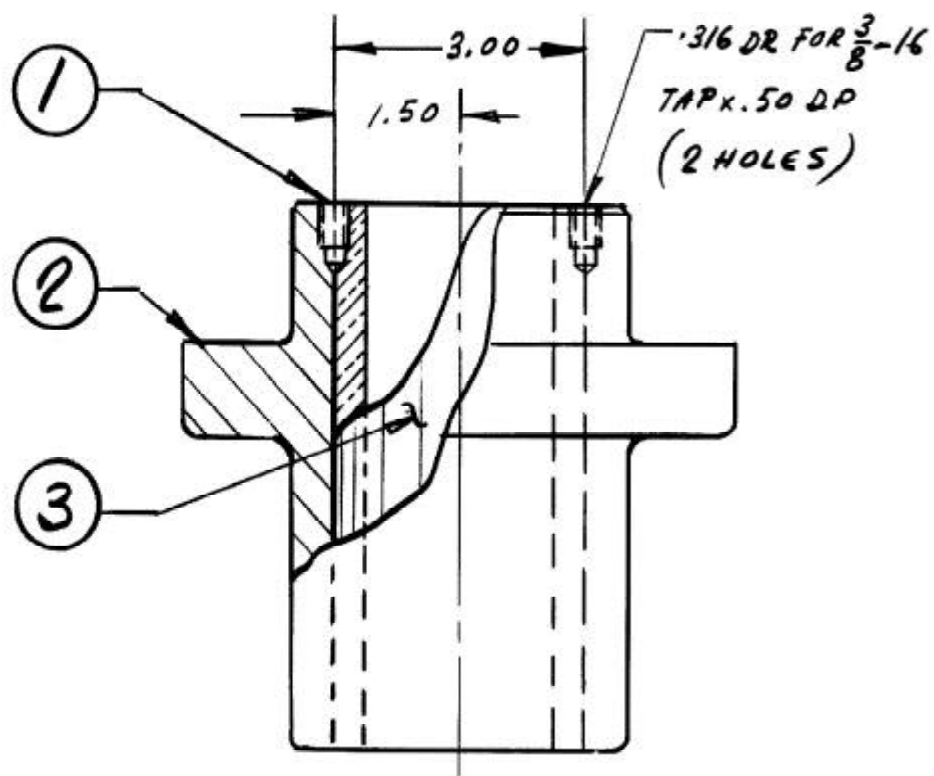


FIG. 58

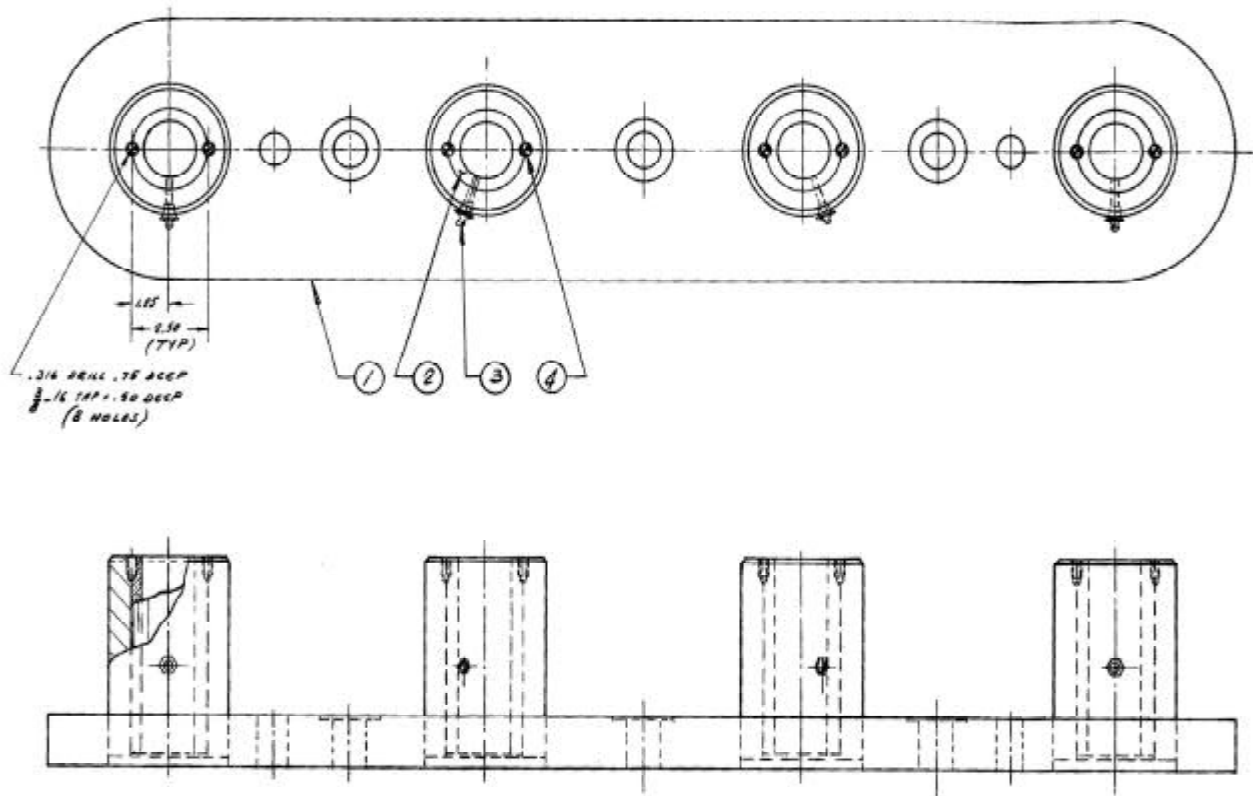


FIG. 56

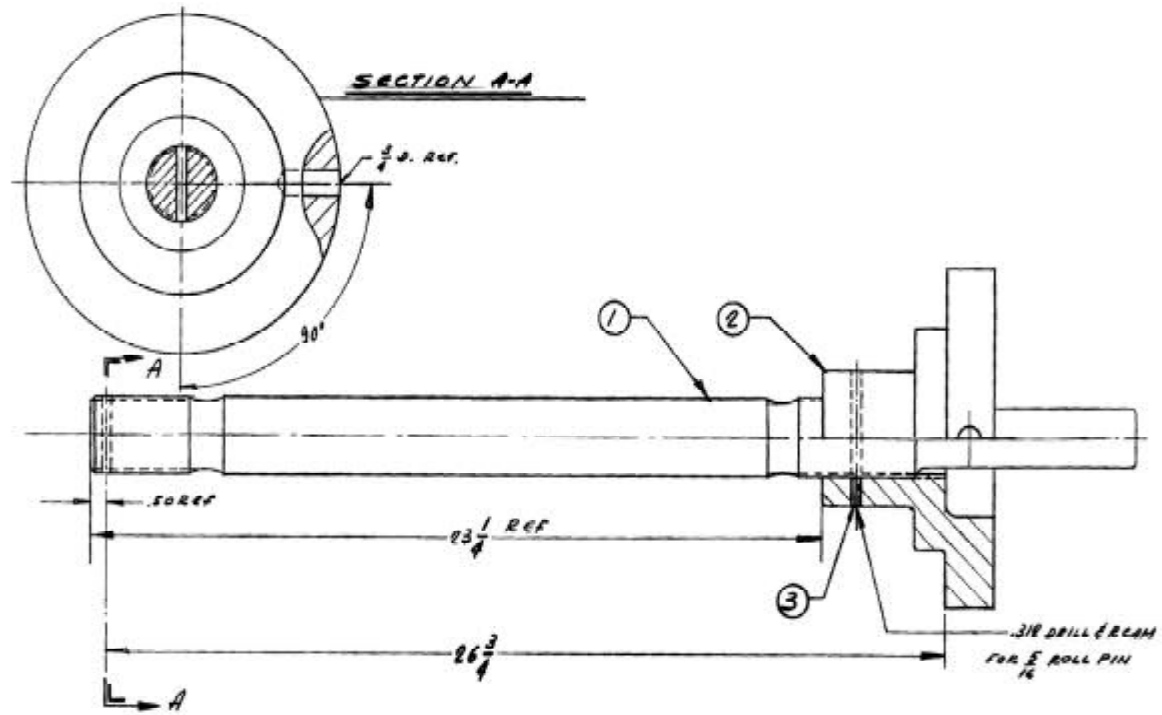


FIG. 57



FIG. 59

V-14 WITH 40 TON SUSPENSION ASSEMBLY



FIG. 60

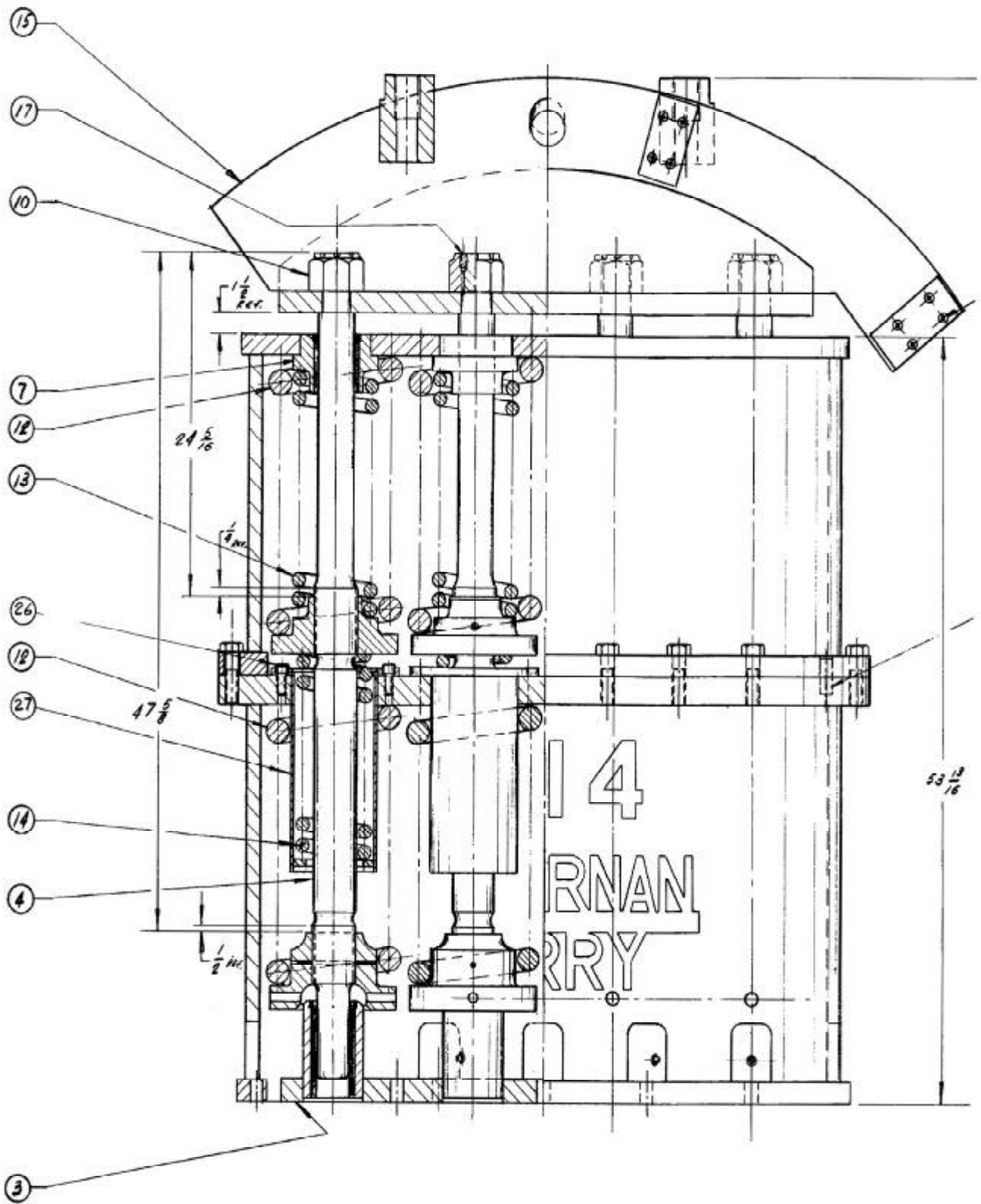
V-14 WITH 40 TON SUSPENSION ASSEMBLY

VII. G.

40 TON SUSPENSION ASSEMBLY
Sheet 1 of 2

ITEM NO.	PART NO.	DESCRIPTION	QUAN. REQ'D.
1	5 4990023	Bottom Housing	1
2	5 4990024	Top Housing	1
3	4 4990134	Lower Bushing Holder Assembly	1
4	3 4990131	Lifting Shaft Assembly	4
7	3 4990135	Top Bushing Holder Assembly	4
10	2 4100320	2 1/4-4 Nut	4
11	0 9240002	1" Dowel x 2 1/2	2
12	3 4100309	Spring - Outer	8
13	3 4100310	Spring - Inner	4
14	3 4100311	Spring - Support	4
15	6 4990035	Top Lifting Head	1
17	0 9250717	1/2-13 x 1 Soc. Set Screw	4
19	0 9016121	1"-8 x 3 1/2 Cap Screw	14
20	2 4100419	Clamp Line Hose Ext.-16 Ft.	2
21	2 4100432	Motor Drain Hose Ext.-13 1/2 Ft.	1
22	2 4100407	Motor Line Hose Ext.-13 1/2 Ft.	2
26	0 9050811	5/8-11 x 1 1/4 Soc.Hd. Cap Scr.	16
27	3 4990030	Support Spring Enclosure	4
28	0 9190014	1/2-13 Soc.Hd. Cap Scr. x 1 3/4	32

FIG. 61



CONTINUED

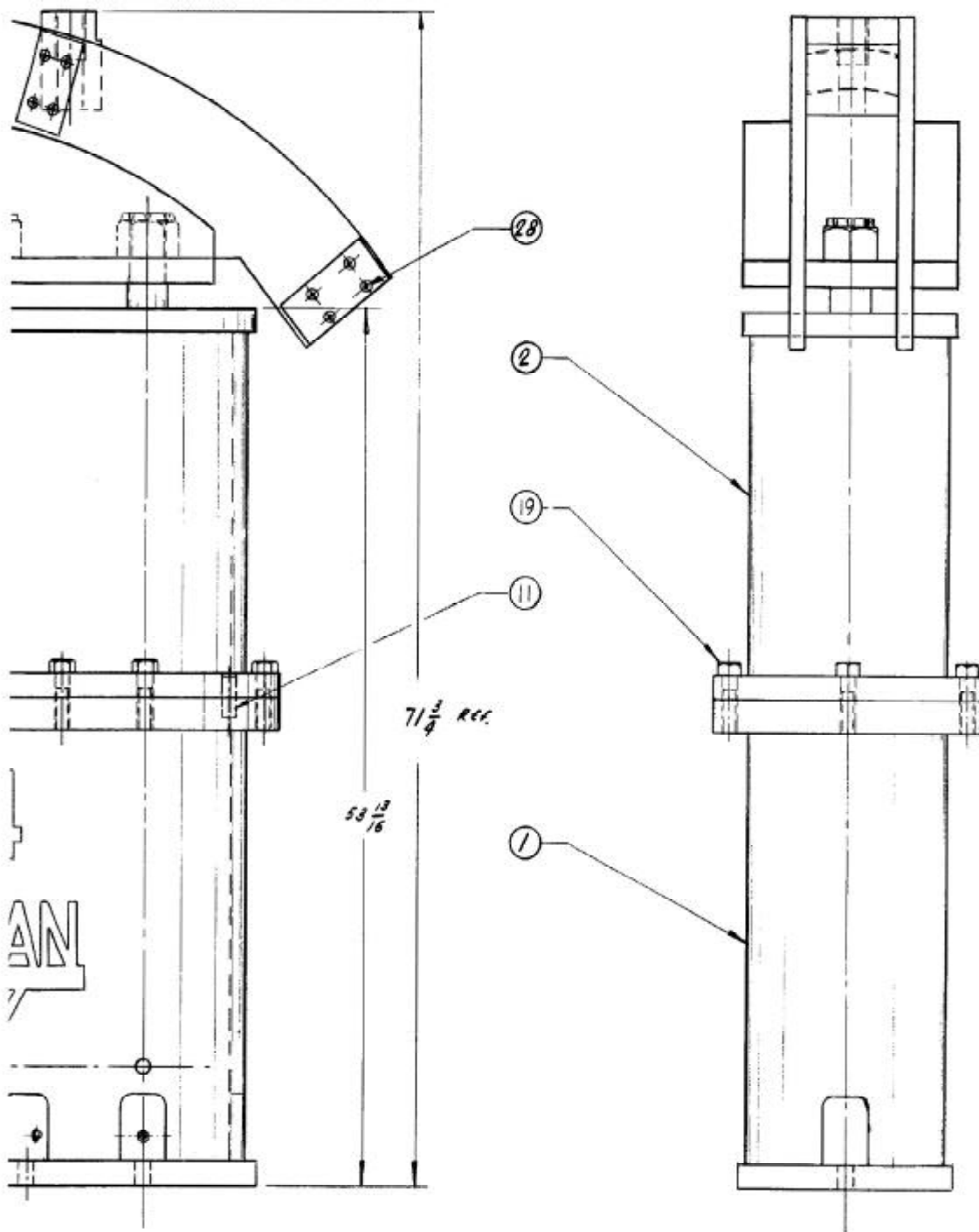


FIG. 62 - LOWER BUSHING HOLDER ASSEMBLY

ITEM NO.	PART NO.	DESCRIPTION	QUAN. REQ'D.
1	4 4990025	Lower Bushing Holder	1
2	2 4990031	Lower Bushing	4
3	0 9430017	3/8-16 x 1/2 Brass Set Screw	8
4	0 9420008	Grease Fitting - 1/8	4

FIG. 63 - LIFTING SHAFT ASSEMBLY

ITEM NO.	PART NO.	DESCRIPTION	QUAN. REQ'D.
1	0 9430146	3/8-16 x 5/8 Soc. Set Scr.Fl.Pt.	1
2	0 9430147	3/8-16 x 5/8 Soc.Set Scr.Cone Pt.	1
3	3 4990028	Middle Nut	1
4	3 4990026	Lifting Shaft	1
5	3 4990027	Bottom Nut	1
6	0 9240024	1/2 Dowel x 6	1

FIG. 64 - TOP BUSHING HOLDER ASSEMBLY

ITEM NO.	PART NO.	DESCRIPTION	QUAN. REQ'D.
1	0 9430017	3/8-16 x 1/2 Brass Set Screw	2
2	3 4990029	Top Bushing Holder	1
3	2 4990032	Upper Bushing	1

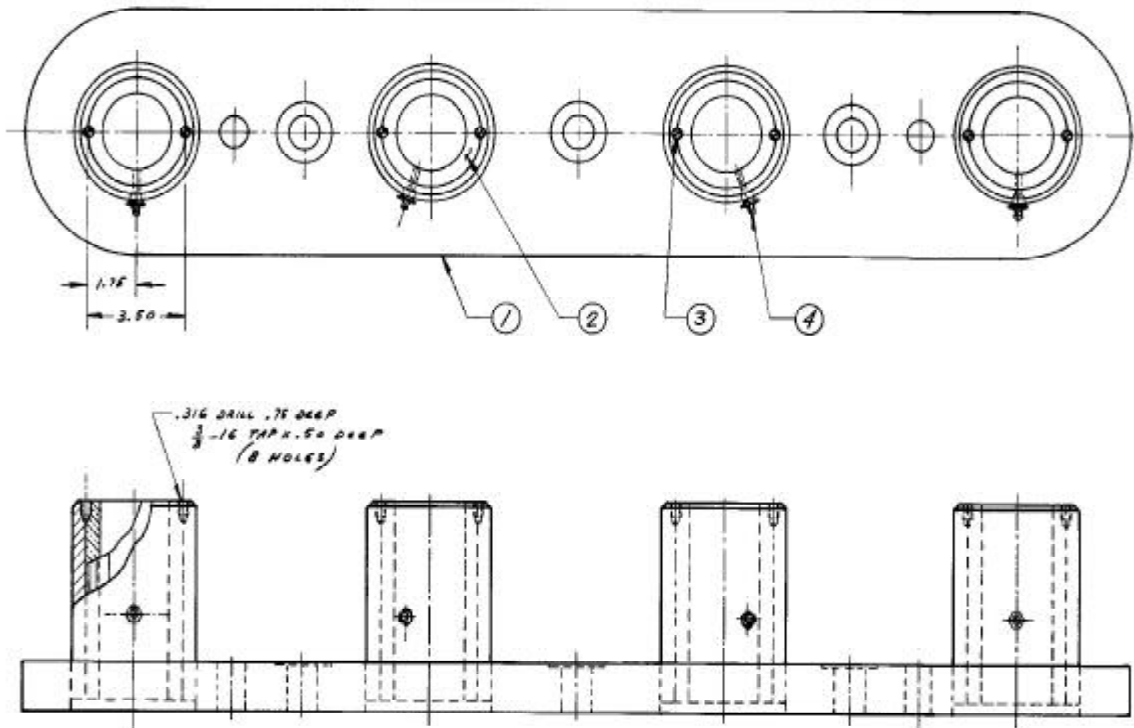


FIG. 62

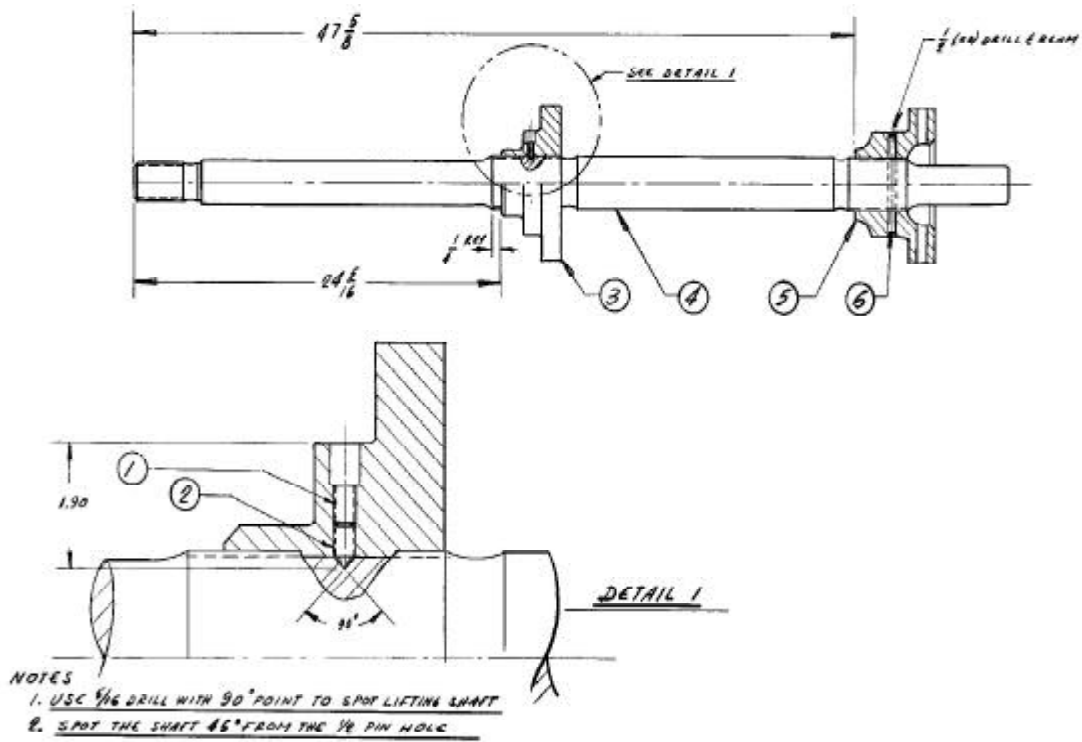


FIG. 63

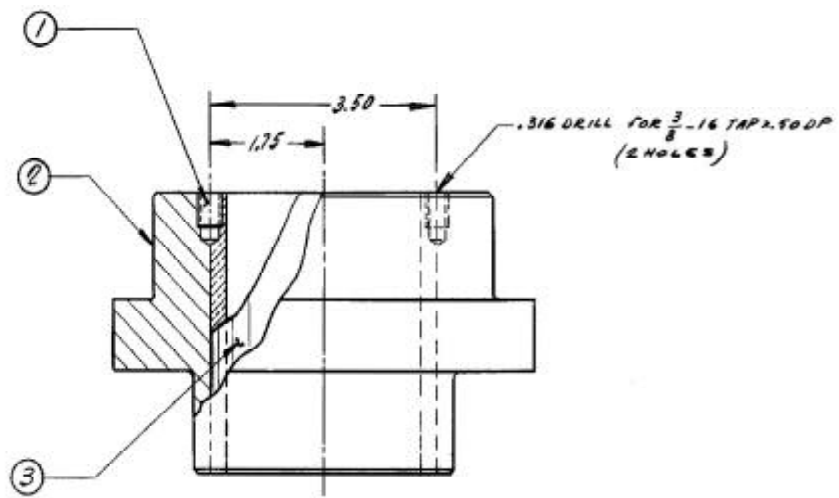


FIG. 64

VII. I. STANDARD CHEST OF SPARES - W/20 TON SUSPENSION

ITEM NO.	PART NO.	DESCRIPTION	QUAN. REQ'D.
1	0 9280001	General Mechanics Tool Kit	1
2	0 9016311	1 1/2-6 Hx.Hd. Cap Screw x 3 1/4	4
3	0 9016214	1 1/4-12 Hx. Hd. Cap Screw x 2 1/2	4
4	0 9016135	1"-8 Hx. Hd. Cap Screw x 7"	1
5	0 9016125	1"-8 Hx.Hd. Cap Screw x 4 1/2	1
6	0 9030121	1" Spring Lockwasher	6
7	1 4990051	Jaw Screw	2
8	0 9016113	1"-8 x 2 1/2 Hx. Hd. Cap Screw	2
9	0 9050646	7/16-20 Soc. Hd. Cap Screw x 7	8
10	0 9190008	5/16-18 Soc.Hd.Cap Scr. x 5/8, Insert	8
11	0 9300004	1/2" Pipe Nipple x 2 3/4	2
12	2 4100320	2 1/4-4 Hex Slotted Nut	1
13	0 9040001	3/8 Am. Std. Cotter Pin x 4	4
14	0 9190010	1"-8 Hx.Hd. Cap Scr. x 2 3/4, Insert	2
15	0 9190011	1/2-13 Hx.Hd.Cap Scr.x 1 3/8, Insert	4
16	0 9190012	1/2-13 Hx.Hd.Cap Scr. x 7/8, Insert	6
17	0 9230035	Aeroquip 412-12-12S	1
18	0 9200001	1/2-13 Nut, Esna 52NE-083	2
19	0 9190014	1/2-13 Soc.Hd.Cap Scr.x 1 3/4, Insert	10
20	0 9230021	No. 12 Swivel Hose Fitting	2
21	0 9230022	No. 12 Pipe Hose Fitting	2
22	0 9130076	O-Ring No. 2-122-Viton	4
23	0 9130025	O-Ring No. 2-225-Viton	4
24	0 9230007	No. 12 - JIC - Pipe Adapter	3
25	0 9230034	Aeroquip 411-12S	1
26	0 9130024	O-Ring No. 2-128-Viton	4
27	0 9260001	Loctite Screw Lock	1
28	0 9280002	3 1/2 Socket 1" Sq. Drive	1
29	0 9280003	Impact Ext. Bar - 13" Lg.	1
30	0 9280004	Adapter 3/4 Female 1" Male	1
31	2 4100426	50 Ft. Motor Drain Hose Ext.	1
32	2 4100431	11 1/2 Ft. Motor Drain Hose Ext.	1
33	2 4100404	50 Ft. Motor Hose Ext.	1
34	2 4100406	11 1/2 Ft. Motor Hose Ext.	1
35	2 4100415	50 Ft. Hyd. Clamp Hose Ext.	2
36	2 4100418	14 Ft. Hyd. Clamp Hose Ext.	1
37	0 9310003	Filter Element A10	1
38	0 9310004	Filter Element K10	2
39	0 9310005	Filter Element K25	2
40	0 9320001	1" Eye Bolts	2
41	0 9330001	FNM 15 Fuse, 15 Amp.	2
42	0 9330187	FNM 4 Fuse, 4 Amp.	2
43	0 9330007	24 ^V Light Bulb	2

VII. J. STANDARD CHEST OF SPARES - W/40 TON SUSPENSION

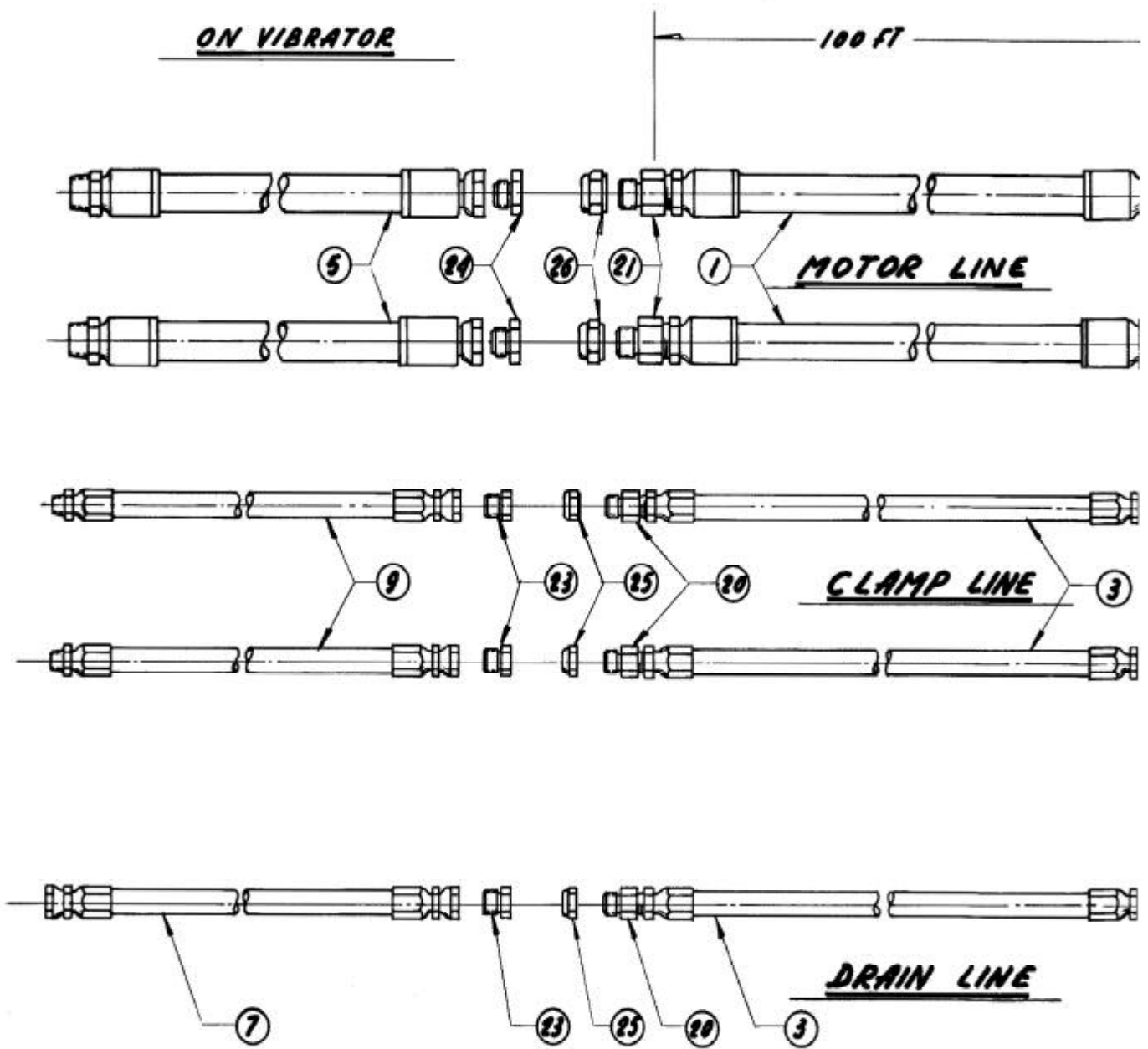
ITEM NO.	PART NO.	DESCRIPTION	QUAN. REQ'D.
1	0 9280001	General Mechanics Tool Kit	1
2	0 9016311	1 1/2-6 Hx.Hd. Cap Screw x 3 1/4	4
3	0 9016214	1 1/4-12 Hx.Hd. Cap Screw x 2 1/2	4
4	0 9016135	1"-8 Hx. Hd. Cap Screw x 7"	1
5	0 9016125	1"-8 Hx. Hd. Cap Screw x 4 1/2	1
6	0 9030121	1" Spring Lockwasher	6
7	1 4990051	Jaw Screw	2
8	0 9016113	1"-8 Hx. Hd. Capscrew x 2 1/2	2
9	0 9050646	7/16-20 Soc. Hd. Cap Screw x 7	8
10	0 9190008	5/16-18 Soc.Hd.Cap Scr. x 5/8, Insert	8
11	0 9300004	1/2" Pipe Nipple x 2 3/4	2
12	2 4100320	2 1/4-4 Hex Slotted Nut	1
13	0 9040001	3/8 Am. Std. Cotter Pin x 4	4
14	0 9190010	1"-8 Hx.Hd.Cap Scr. x 2 3/4, Insert	2
15	0 9190011	1/2-13 Hx.Hd.Cap Scr. x 1 3/8, Insert	4
16	0 9190012	1/2-13 Hx.Hd.Cap Scr. x 7/8, Insert	6
17	0 9230034	Aeroquip 411-12S	1
18	0 9200001	1/2-13 Nut, Esna 52NE-083	2
19	0 9190014	1/2-13 Soc.Hd.Cap Scr.x 1 3/4, Insert	10
20	0 9230021	No. 12 Swivel Hose Fitting	2
21	0 9230022	No. 12 Pipe Hose Fitting	2
22	0 9130076	O-Ring No. 2-122-Viton	4
23	0 9130024	O-Ring No. 2-128-Viton	4
24	0 9230007	No. 12 - JIC - Pipe Adapter	3
25	0 9230035	Aeroquip 412-12-12S	1
26	0 9130025	O-Ring No. 2-225 - Viton	4
27	0 9260001	Loctite Screw Lock	1
28	0 9280002	3 1/2 Socket 1" Sq. Drive	1
29	0 9280003	Impact Ext. Bar - 13" Lg.	1
30	0 9280004	Adapter 3/4 Female 1" Male	1
31	2 4100426	50 Ft. Motor Drain Hose Ext.	1
32	2 4100432	13 1/2 Ft. Motor Drain Hose Ext.	1
33	2 4100404	50 Ft. Motor Hose Ext.	1
34	2 4100407	13 1/2 Ft. Motor Hose Ext.	1
35	2 4100415	50 Ft. Hyd. Clamp Hose Ext.	2
36	2 4100419	16 Ft. Hyd. Clamp Hose Ext.	1
37	0 9310003	Filter Element A10	1
38	0 9310004	Filter Element K10	2
39	0 9310005	Filter Element K25	2
40	0 9320001	1" Eye Bolt	2
41	0 9330001	FNM 15 Fuse, 15 Amp.	2
42	0 9330187	FNM 4 Fuse, 4 Amp.	2
43	0 9330007	24 ^v Light Bulb	2

VII. K.

HYDRAULIC HOSE ASSEMBLY

ITEM NO.	PART NO.	DESCRIPTION	QUAN. REQ'D.
1	3 4100401	100 Ft. Motor Line Hose Ass'y.	2
3	3 4100403	100 Ft. Clamp and Drain Hose Ass'y.	3
4	2 4100404	Motor Line Hose Ext. - 50 Ft.	2
5	2 4100407	Motor Line Hose Ext. - 13 1/2 Ft.	2
7	2 4100434	Motor Drain Hose Ext. - 13 1/2 Ft.	1
8	2 4100415	Hyd. Clamp & Drain Hose Ass'y.-50 Ft.	3
9	2 4100419	Hyd. Clamp Hose Ext. - 16 Ft.	2
10	0 9270001	Quick Disconnect Female	2
11	0 9270002	Quick Disconnect Male	2
12	0 9270003	Cap	2
13	0 9270004	Plug	2
14	0 9230002	Dust Plug	2
16	0 9230003	Dust Cap	2
17	0 9230062	Dust Plug	1
18	0 9230063	Dust Cap	1
20	0 9230007	JIC-Pipe Adapter	6
21	0 9230008	JIC-Pipe Adapter	4
23	0 9230010	JIC Plug	3
24	0 9230413	Cap Nut	2
25	0 9230012	Cap Nut	3
26	0 9230013	Cap Nut	2
28	0 9300012	1 1/4 Nipple - Sch. 80	2
29	0 9300013	3/4 Nipple - Sch. 80	3
32	0 9270010	Quick Disconnect - Drain	1
33	0 9270005	Quick Disconnect - Clamp	2

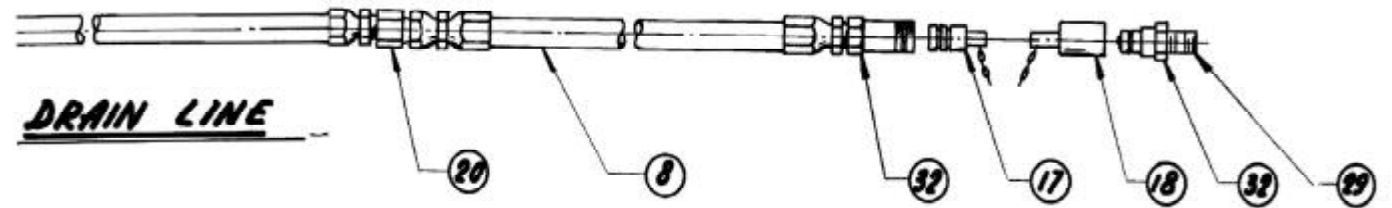
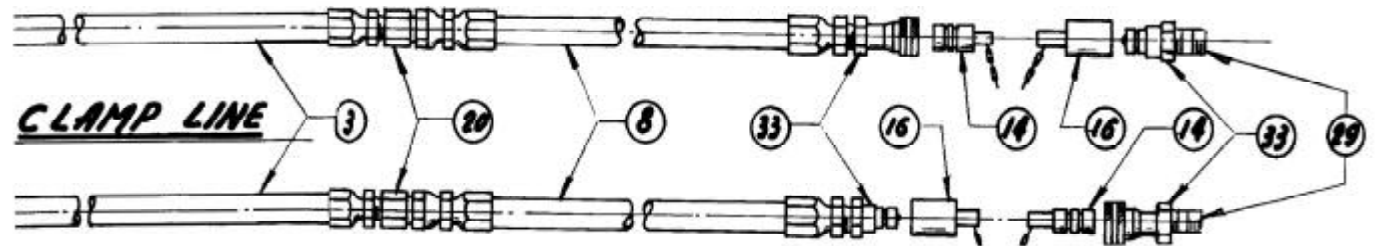
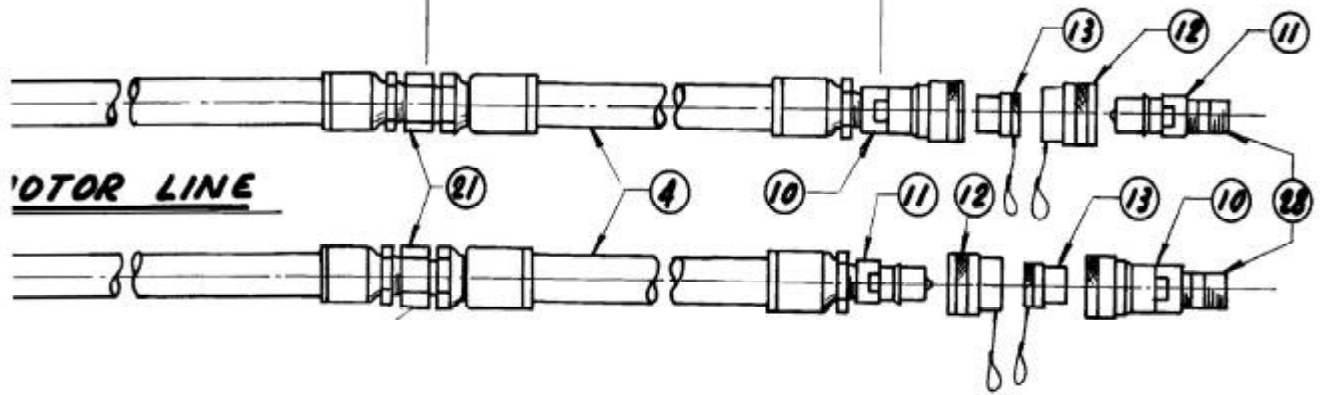
FIG. 65



CONTINUED

100 FT

50 FT

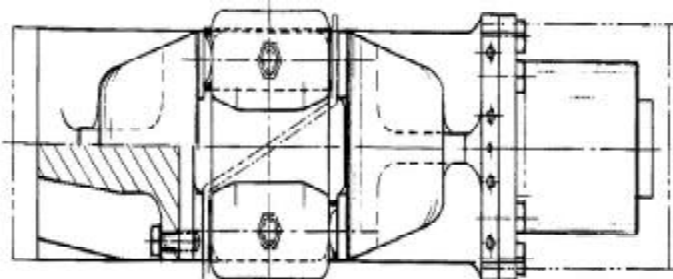
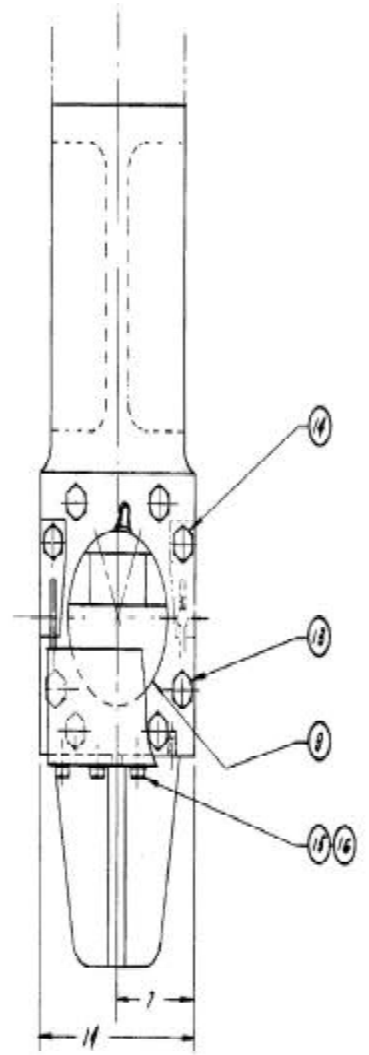
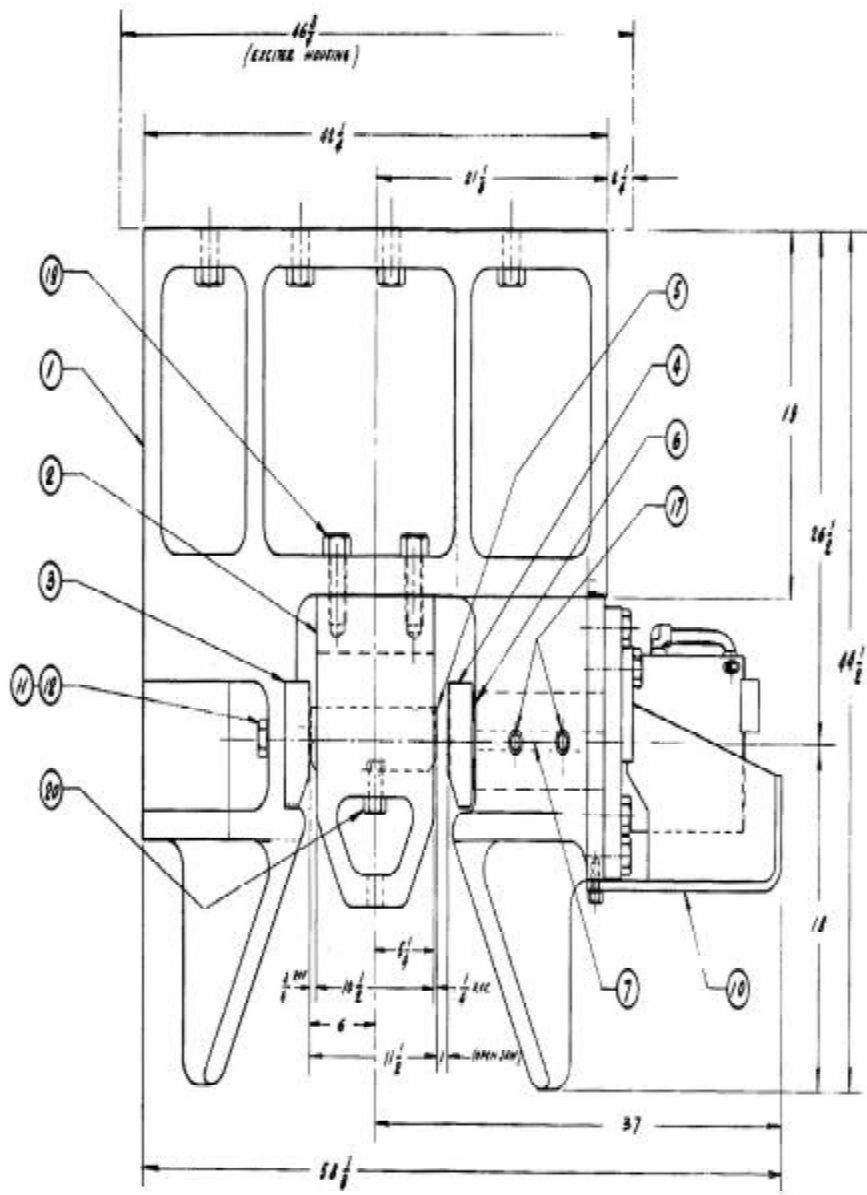


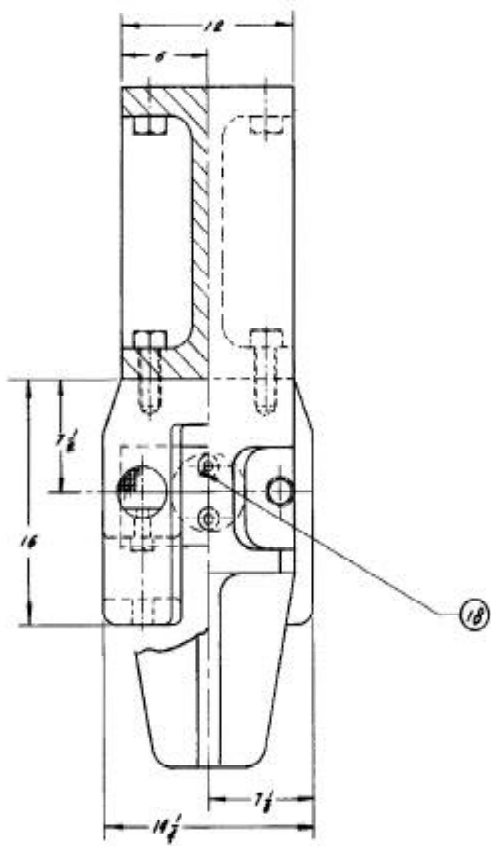
VII. L.

Z PILE CLAMP ASSEMBLY

ITEM NO.	PART NO.	DESCRIPTION	QUAN. REQ'D.
1	6 4950301	Clamp Housing	1
2	4 4950303	Jaw Slide Housing	1
3	3 4950305	Clamp Jaw Fixed	1
4	3 4950307	Clamp Jaw Movable	1
5	3 4950309	Jaw Sliding	2
6	3 4100202	Clamp Slide	1
7	2 4100209	Slide Key	1
9	0 9220018	Hyd. Cyl. 8" Bore 1 1/2" Stroke	1
10	4 4950311	Cylinder Shield	1
11	0 9030121	1" L.W.	2
12	0 9016117	1"-8 x 3 HHCS GR8	2
13	0 9016219	1 1/4-7 x 3 1/4 HHCS GR8	6
14	0 9016223	1 1/4-7 x 4 HHCS GR8	2
15	0 9010913	3/4-10 x 1 1/2 HHCS	4
16	0 9030117	3/4 Lockwasher	4
17	0 9190013	1/2-13 Hex Hd. Cap Screw x 1 1/4	2
18	1 4990110	Jaw Screw	2
19	0 9016313	1 1/2-6 x 3 1/2 HHCS GR8	4
20	1 4950312	1" Full Dog Screw	2
21	2 4100417	Clamp Hose Ext. (10")	2
22	0 9230007	Aeroquip 2022-12-12S	2
23	0 9016313	1 1/2-6 x 3 1/2 HHCS GR8	8

FIG. 66





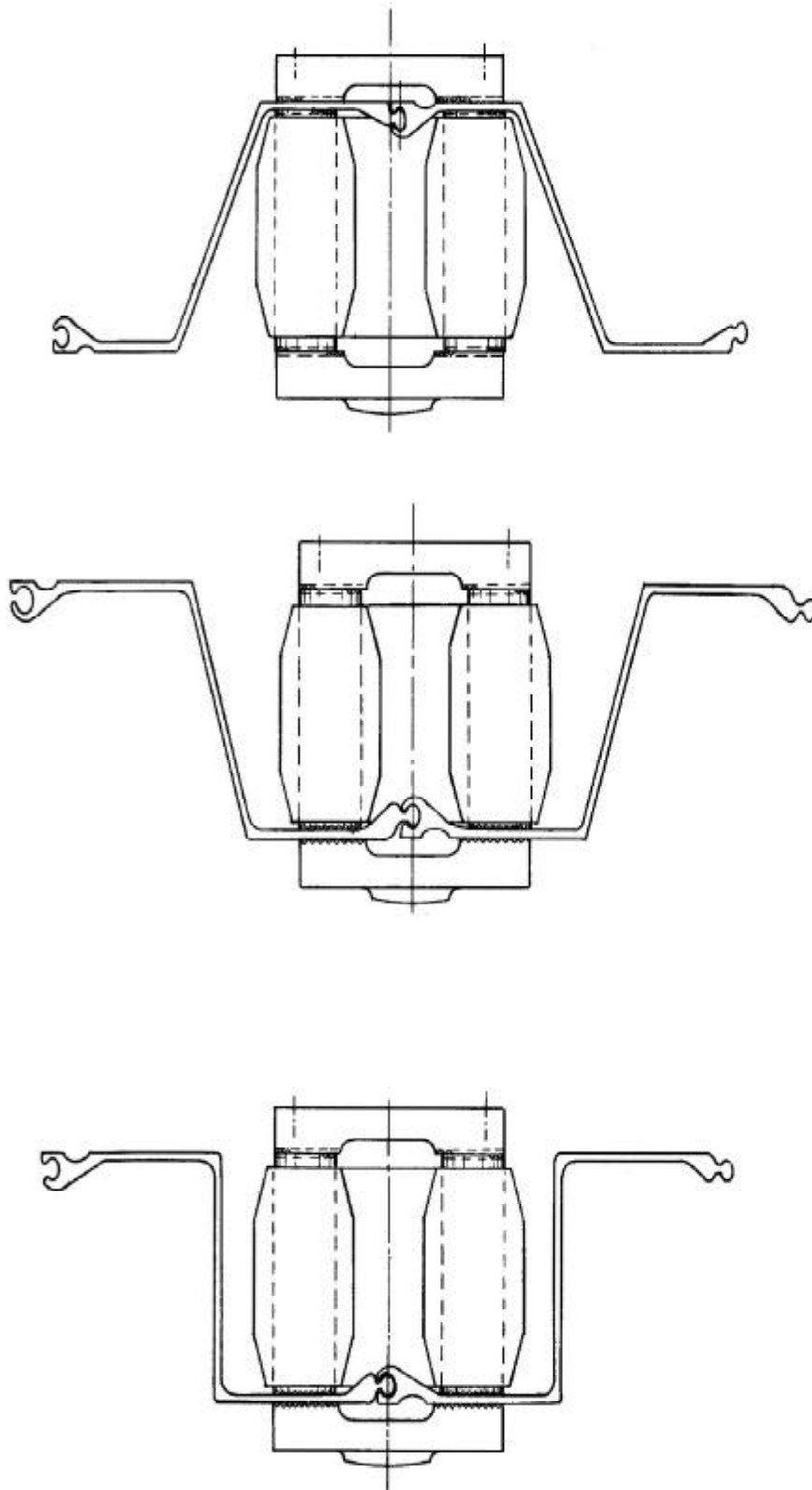
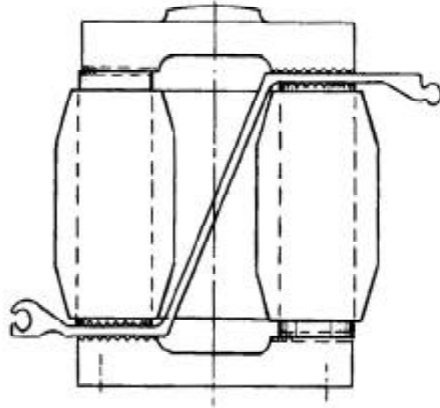
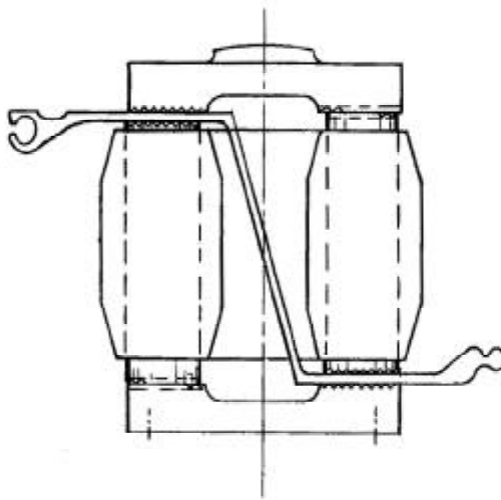


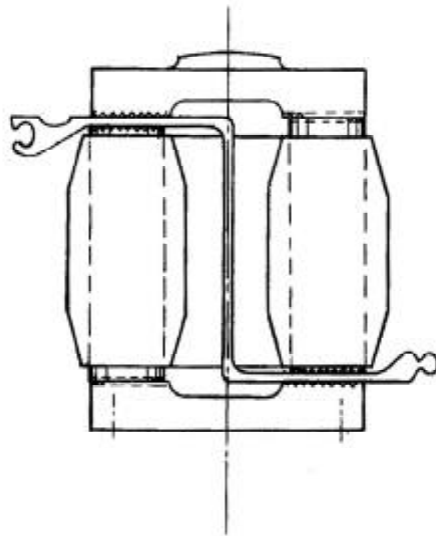
FIG. 67
Z-PILE CLAMPING
ON Z-PILE SECTIONS



ZP&MZ 27



ZP&MZ 32



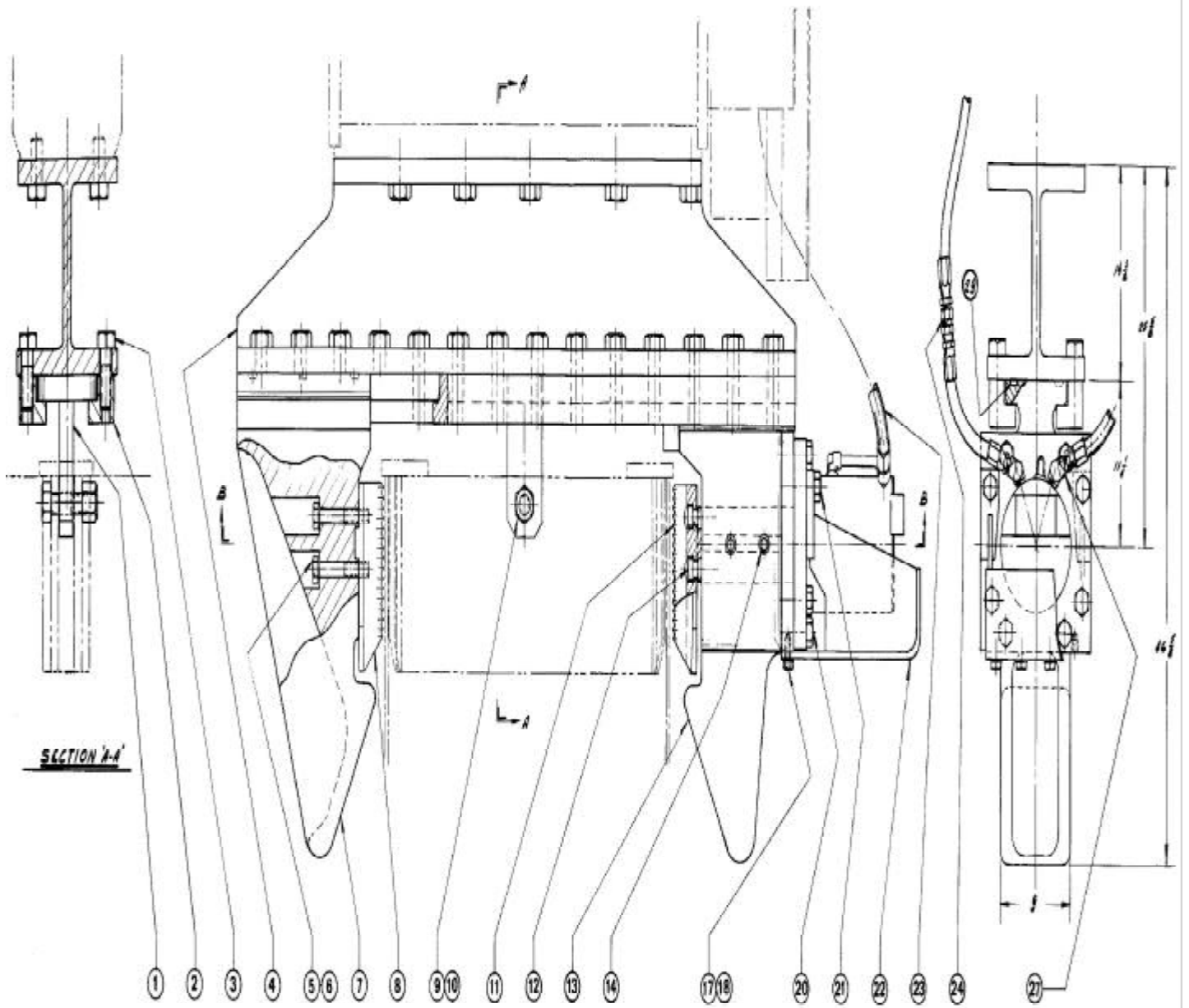
ZP&MZ 38

VII. M.

10-36" PIPE CLAMP ASSEMBLY

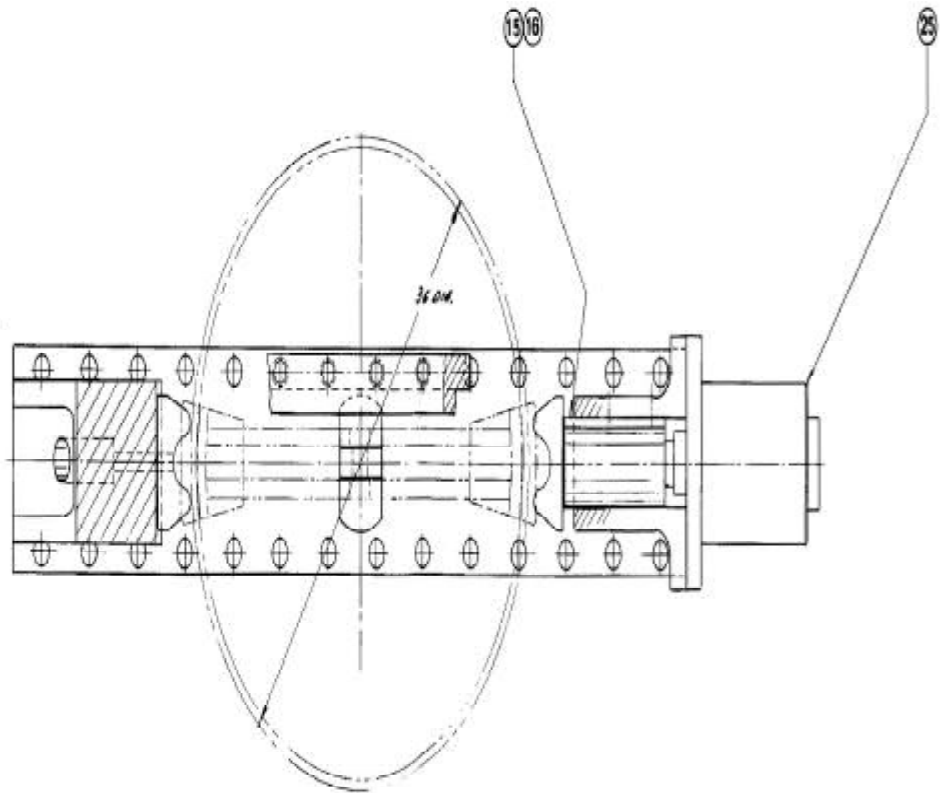
ITEM NO.	PART NO.	DESCRIPTION	QUAN. REQ'D.
1	3 4950109	Mandrel Support Block	1
2	3 4950105	Clamp Bar	2
3	0 9016315	1 1/2-6 HHCS x 4 Gr.8	28
4	4 4950101	Adapter	1
5	0 9016135	1"-8 HHCS x 7" Gr. 8	2
6	0 9030121	1" Lockwasher	2
7	4 4950110	Backup End Housing	1
8	3 4990101	Universal Jaw-Fixed End	1
9	0 9011323	1 1/2-6 HHCS x 6	1
10	0 9200002	Esna Nut 49NU-246 (1 1/2)	1
11	3 4990099	Universal Jaw-Movable End	1
12	1 4990051	Jaw Screw	2
13	4 4950112	Cyl. End Housing	1
14	0 9190013	1/2-13 HHCS x 1 1/4	2
15	3 4100202	Clamp Slide	1
16	2 4100209	Slide Key	1
17	0 9010913	3/4-10 HHCS x 1 1/2	4
18	0 9030117	3/4 Lockwasher	4
19	0 9240002	1" Dowel x 2 1/2	2
20	0 9016218	1 1/4-12 HHCS x 3	6
21	0 9016224	1 1/4-12 HHCS x 4	2
22	4 4950311	Cylinder Guard	1
23	2 4100420	Hose Ext. (15")	2
24	0 9230007	Aeroquip 2022-12-12S	2
25	0 9220018	Hyd. Cyl.	1
27	0 9230077	Aeroquip 2088-12-12S	2
29	0 9430229	Steel Grippers	12

FIG. 68



NOTES:

1. THE TWO END ASSEMBLIES ARE MOUNTED BY LOOSENING THE CLAMP BARS (15) AND SETTING THE CLAMPING ASSEMBLY TO THE PROPER LEVEL OF CLAMPING. AFTER CLAMPING OF BOTH ENDS, IN MOST CASES, THE 10-10 TYP CLAMPING STAKE WILL COLLAPSE THE PIPE TO THE NEARLY CORRECT POSITION. THE 10-10 TYP CLAMPING STAKE WILL BE LIFTED FROM THE PIPE BY A BARRER OF THE CLAMPING AND LIFT THE COLLARING OF THE PIPE. A SPECIAL FORMER IS REQUIRED FOR EACH PIPE SIZE. NOTE, THE POSITION OF THE MANUAL SUPPORT (25) CAN ALSO BE ADJUSTED.
2. BEYOND OF THE MANUAL SUPPORT WILL BE AN END ASSEMBLY TO CLAMP FOR CLAMPING BARRER PLING.



SECTION B-B

VII. N.

6 FT. DIA. CAISSON CLAMP ASSEMBLY

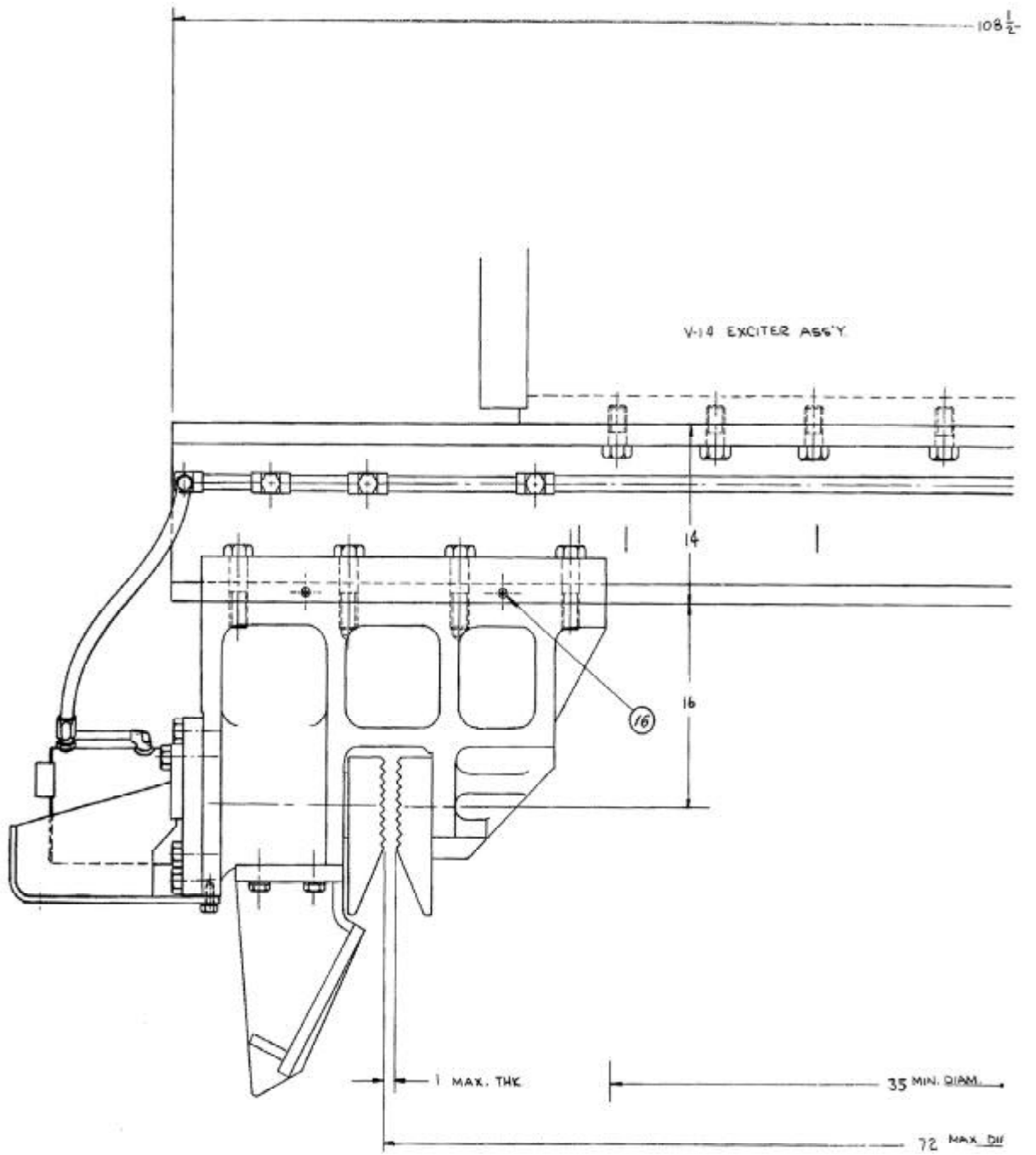
ITEM NO.	PART NO.	DESCRIPTION	QUAN. REQ'D.
1	5 4950005	Clamp Beam	1
2	3 4950007	Clamp Bar	4
3	3 4950008	Hole Pattern	1
4	4 4950311	Cylinder Guard	2
6	2 4950013	Clamp Hose	4
7	0 9010913	3/4-10 x 1 1/2 HHCS	8
8	0 9016224	1 1/4-12 x 4 HHCS GR8	4
9	0 9230072	Aeroquip - 2021-16-12S	4
10	0 9230071	Aeroquip - 2082-16S	12
11	0 9016323	1 1/2-6 x 5 1/2 HHCS GR8	16
12	0 9030117	3/4 L.W.	8
13	0 9230016	Aeroquip 2081-16-12S	2
14	0 9230041	Aeroquip 2045-12-12S	2
16	0 9430211	3/4-10 x 2 1/2 Set Screw-Cup	8
17	0 9230372	Aeroquip 2089-12-12S	2

9 FT. DIA. CAISSON CLAMP ASSEMBLY

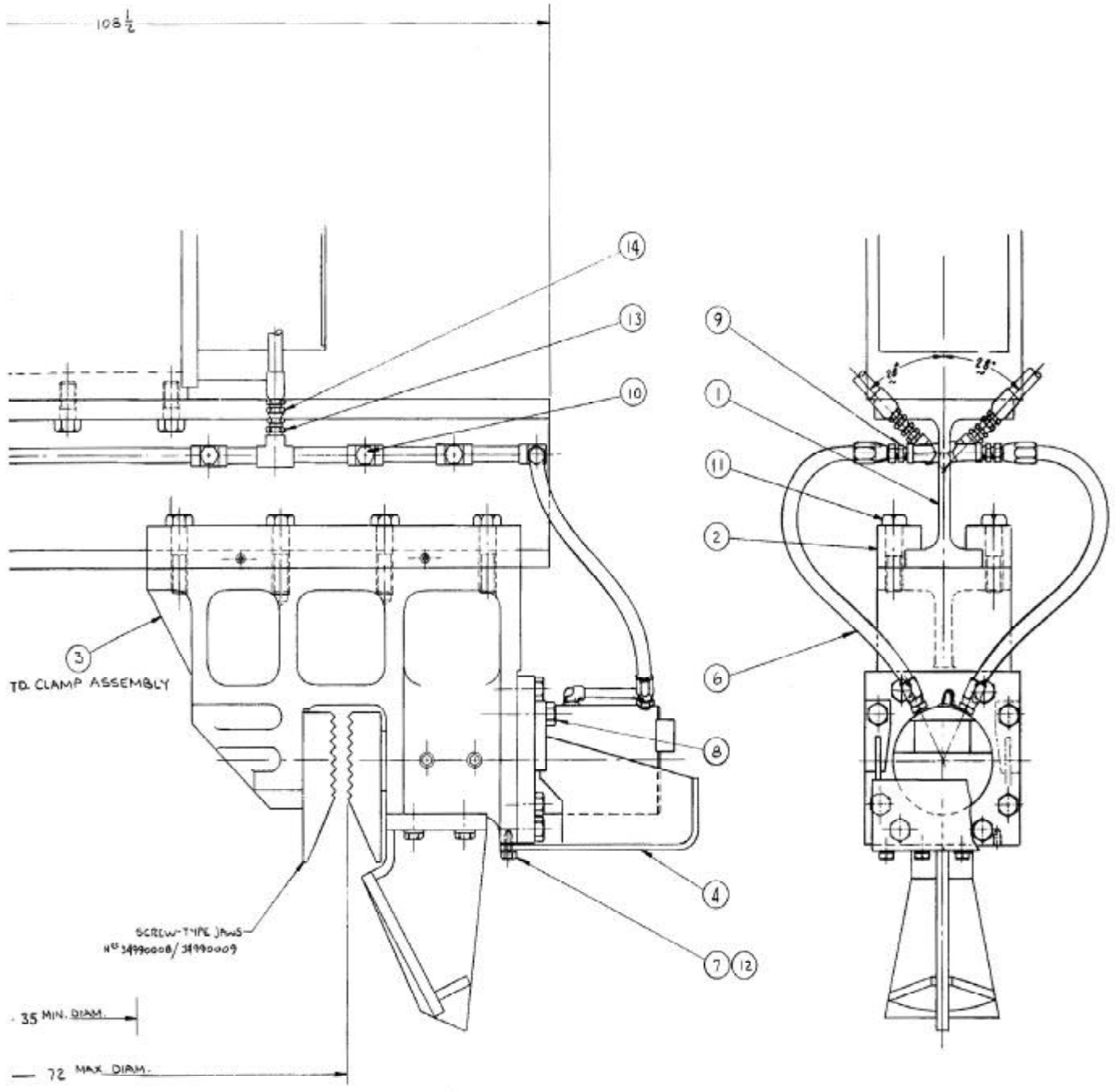
All Part Nos. same as 6 Ft. Dia. except for the following:

ITEM NO.	PART NO.	DESCRIPTION	QUAN. REQ'D.
1	5 4950010	Clamp Beam	1
10	0 9230071	Fitting - 2082-16S	16

FIG. 69



CONTINUED



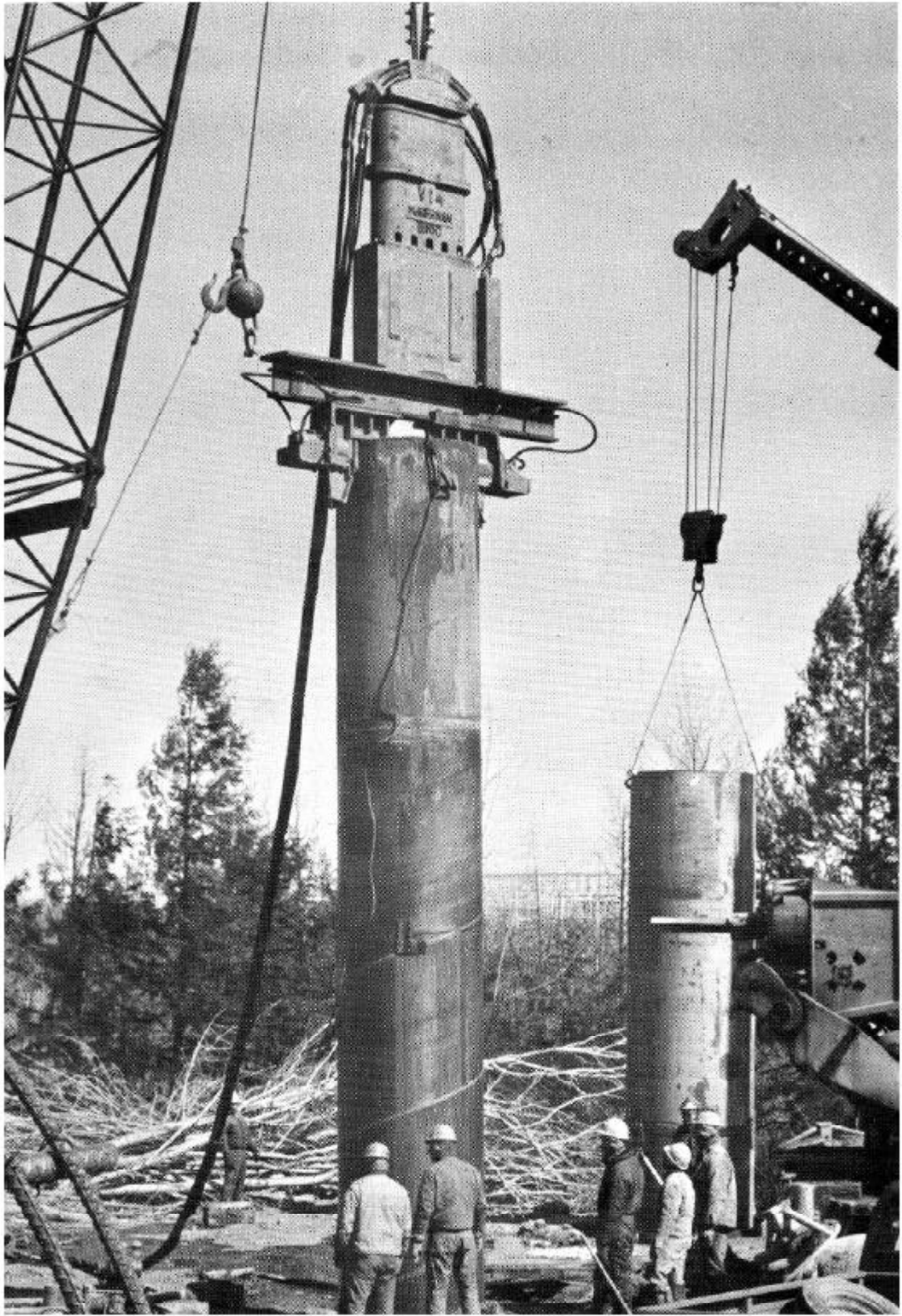


FIG. 70

V-14 WITH CAISSON BEAM

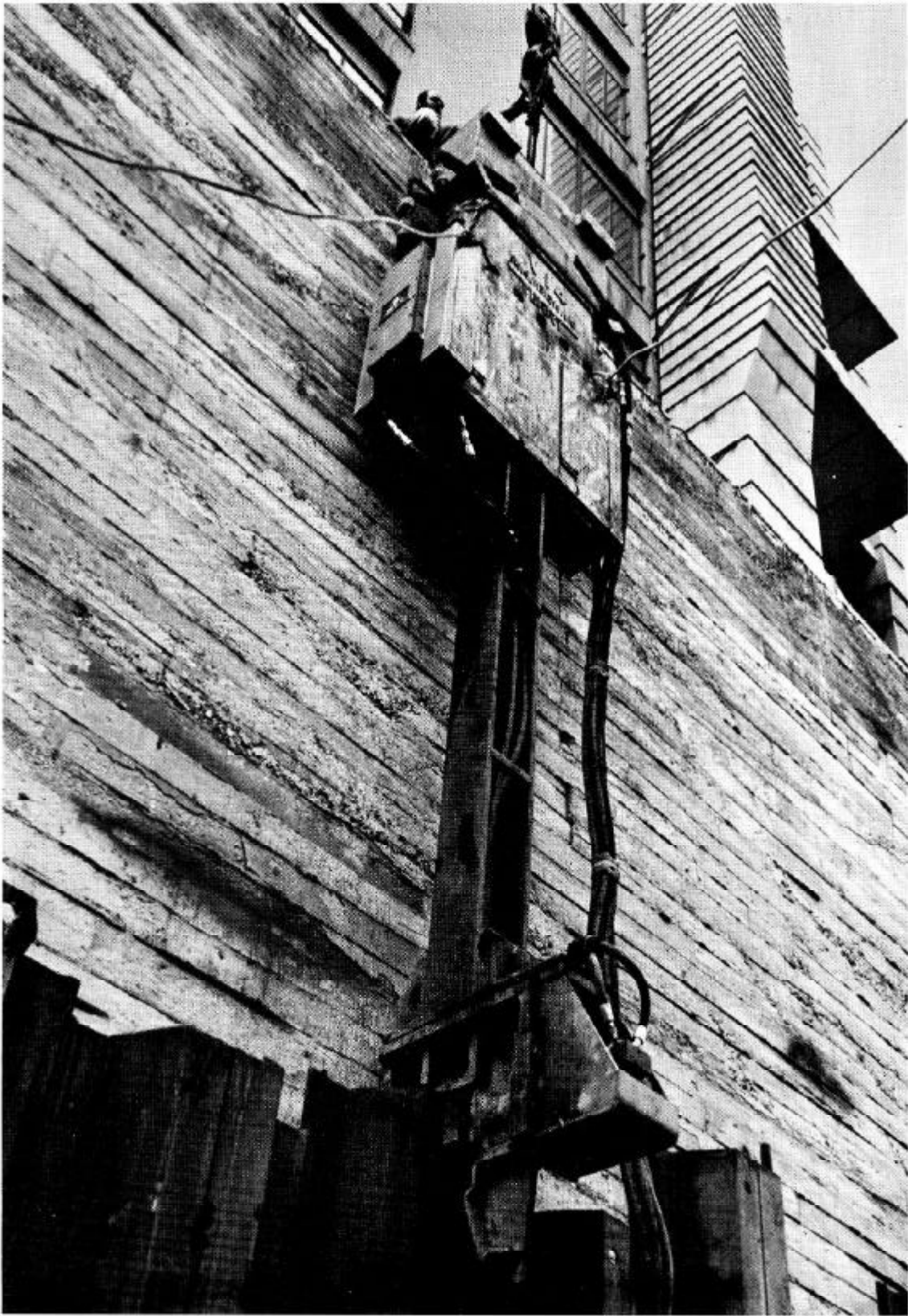
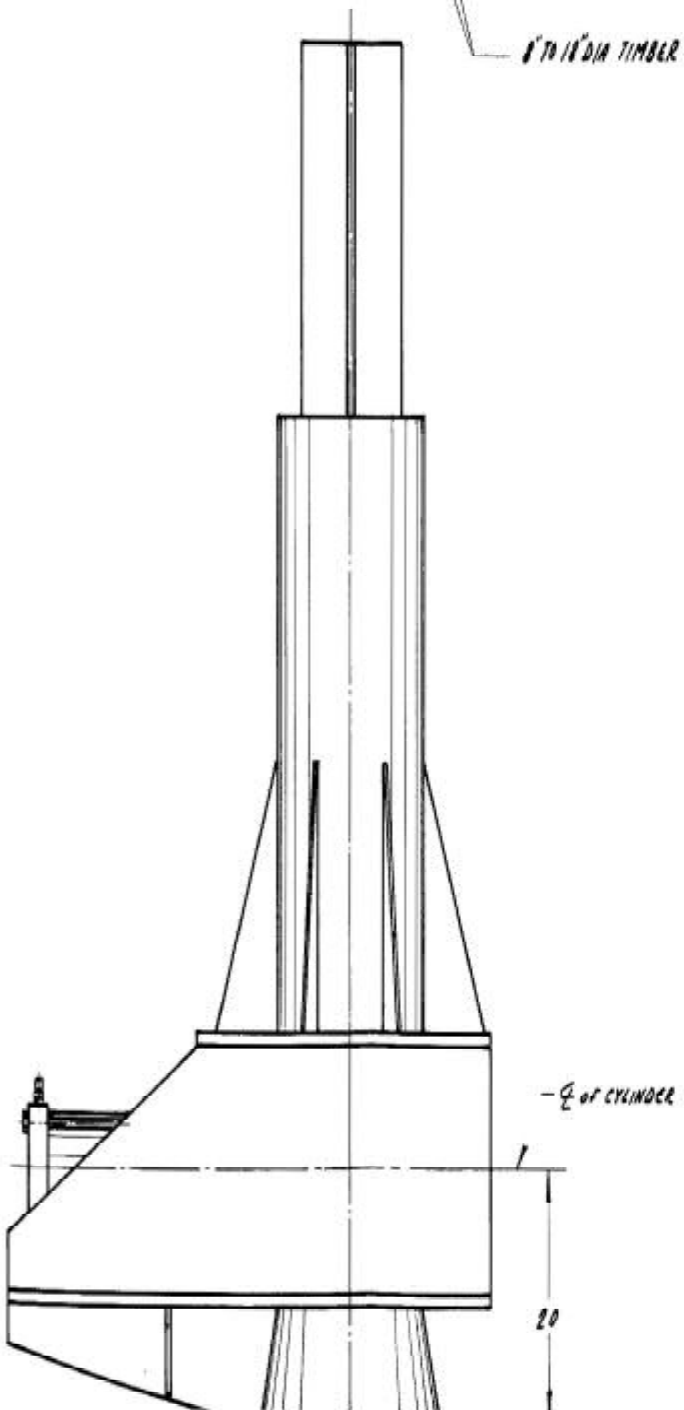
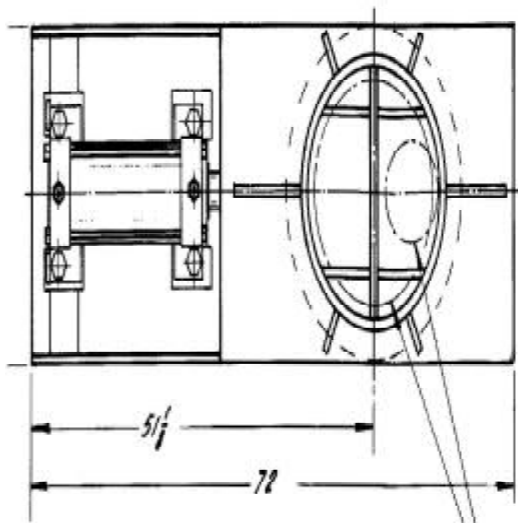


FIG. 71

10 FT. CLAMP EXTENSION "CALIFORNIA STINGER"

HYDRAULIC TIMBER
PULLER/DRIVER

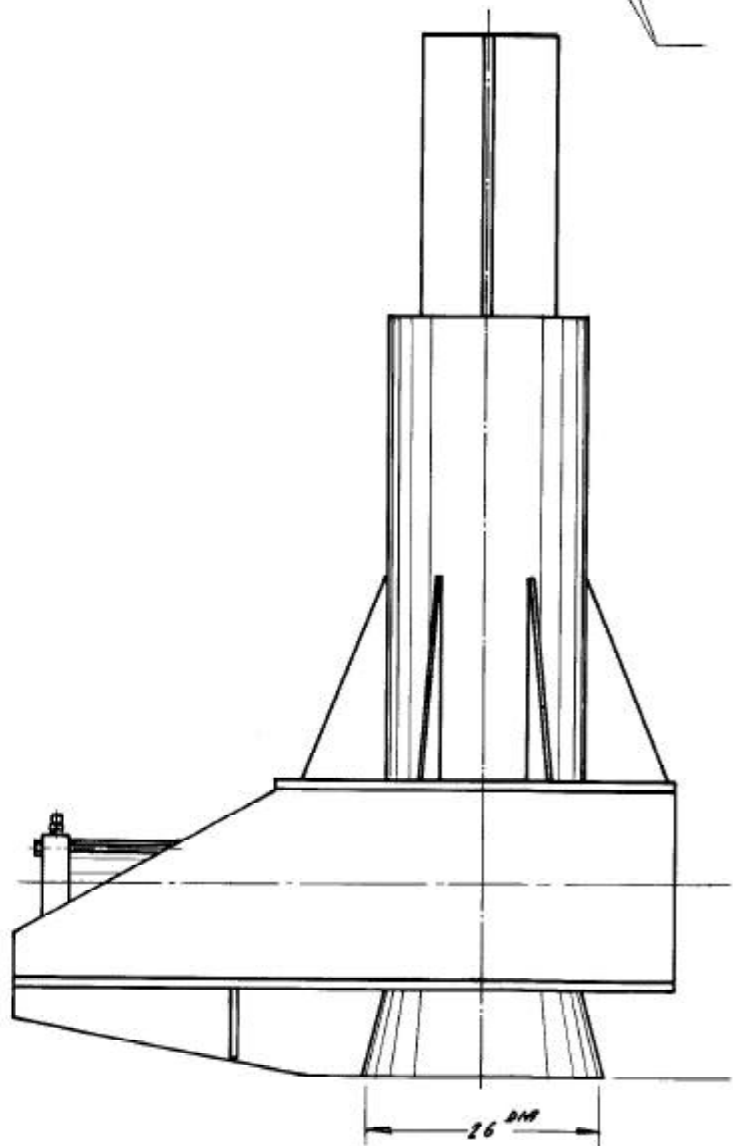
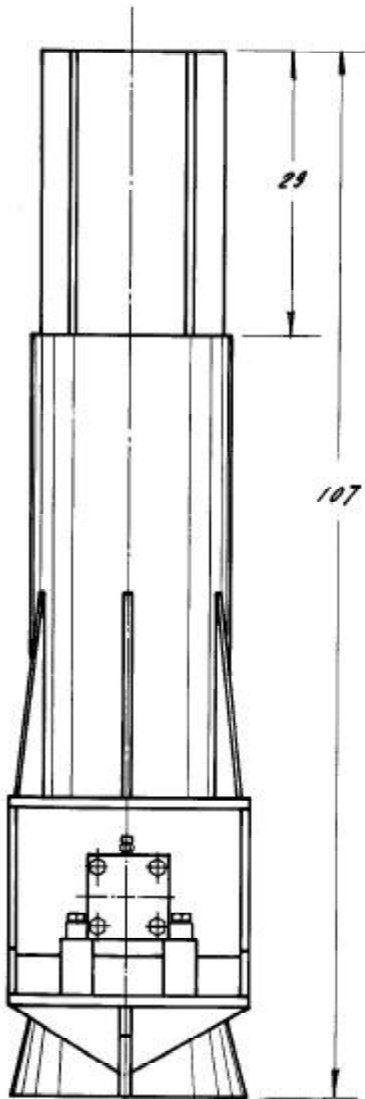
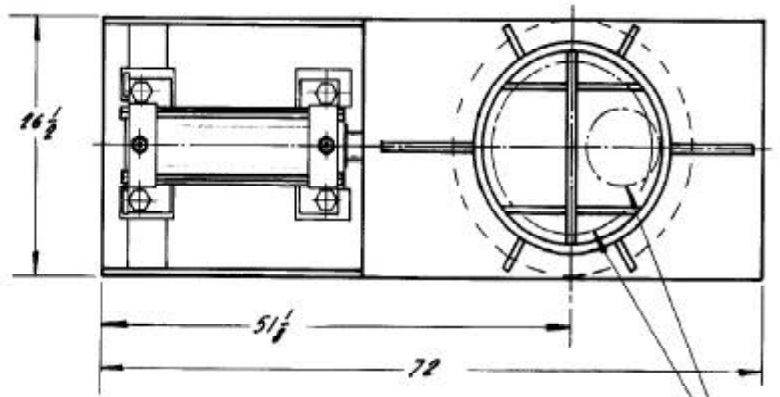


8" TO 18" DIA TIMBER

SPECIFICATIONS

- CLAMP FORCE @ 2700 P.S.I. 63 TONS
- CLAMPING CYLINDER 7" DIA.
- CLAMP CYLINDER MAX PRESSURE 5000 P.S.I.
- CLAMPING RANGE 8" TO 18" DIA.

CONTINUED



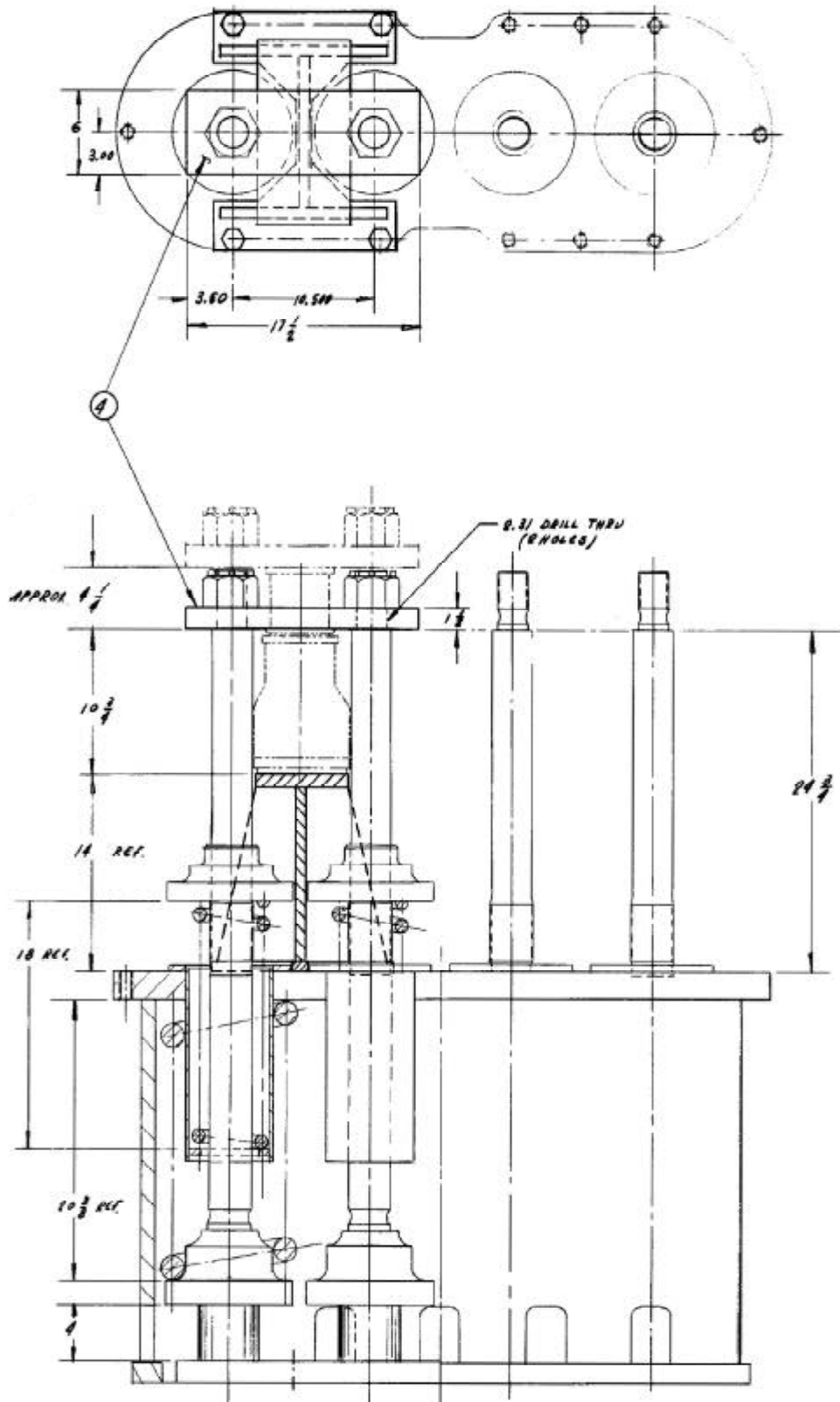


FIG. 73

ASSEMBLY FIXTURE
40 TON SUSPENSION ASSEMBLY

VIII. BIAS WEIGHTS

A. ON SUSPENSION ASSEMBLY

1a. 2000 lb. weight	34100319	1 Req'd.
1b. Bolts for 2000 lb. wt.	09011543	2 Req'd.
2a. 1000 lb. weight	34950001	1 Req'd.
2b. Bolts for 3000 lb. wt.	24950003	2 Req'd.

B. BETWEEN EXCITER AND CLAMP ASSEMBLY

1. 666 lb. weight	34990059	3 Req'd.
2. Clamp Hose Assembly	24990058	2 Req'd.
3. Bias Weight Studs	24990062	10 Req'd.
4. Fitting, 2046-12-12S	09230216	2 Req'd.
5. Esna 49NU-246 Nut	09200002	10 Req'd.

IX. EXCITER BEARING-FIT TOLERANCES

<u>SMALL ECC. SHAFT</u>	<u>SMALL BR'G. I.D.</u>	
<u>2.7549</u>	<u>2.7559</u>	+ .0004
2.7541	2.7553	+ .0018
<u>LARGE ECC. SHAFT</u>	<u>LARGE BR'G. I.D.</u>	
<u>4.3294</u>	<u>4.3307</u>	+ .0005
4.3286	4.3299	+ .0021
<u>SMALL BORE-HOUSING</u>	<u>SMALL BR'G. O.D.</u>	
<u>5.9040</u>	<u>5.9055</u>	- .0010
5.9030	5.9050	- .0025
<u>LARGE BORE-HOUSING</u>	<u>LARGE BR'G. O.D.</u>	
<u>9.4472</u>	<u>9.4488</u>	- .0010
9.4460	9.4482	- .0028
<u>SMALL CARTRIDGE I.D.</u>	<u>SMALL BR'G. O.D.</u>	
<u>5.9040</u>	<u>5.9055</u>	- .0010
5.9030	5.9050	- .0025
<u>LARGE CARTRIDGE I.D.</u>	<u>LARGE BR'G. O.D.</u>	
<u>9.4472</u>	<u>9.4488</u>	- .0010
9.4460	9.4482	- .0028
<u>SMALL CARTRIDGE O.D.</u>	<u>HOUSING BORE-SM.</u>	
<u>6.749</u>	<u>6.750</u>	+ .0020
6.748	6.749	+ .0000
<u>LARGE CARTRIDGE O.D.</u>	<u>HOUSING BORE-LG.</u>	
<u>10.249</u>	<u>10.250</u>	+ .0020
10.248	10.249	+ .0000

SMALL BR'G.: 70SD23W33F4
DIAMETRAL CLEARANCE: .0041-.0051

LARGE BR'G.: 110SD23W33F4
DIAMETRAL CLEARANCE: .0047-.0060