SPECIALIZED EQUIPMENT
CHEMICAL PLANTS & REFINERIES
ENGINEERS, DESIGNERS & FABRICATORS
PHONES (409) 769-7470 AND 769-9426
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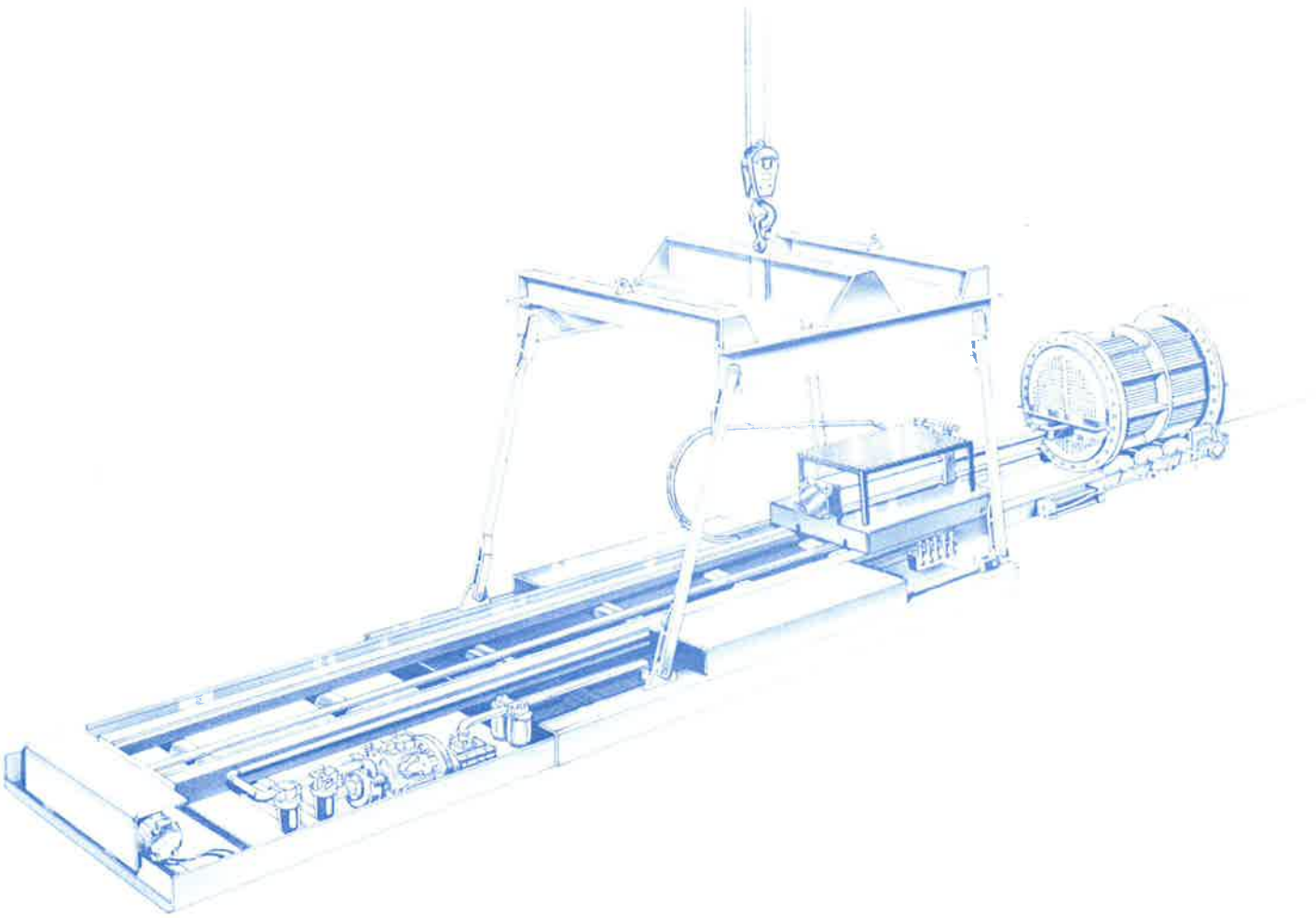
HYDRO-EXTRACTORS, INC.

P.O. BOX 1287 BEAUMONT, TEXAS 77704



OPERATING AND MAINTENANCE MANUAL

Revised 1992

OPERATING INSTRUCTIONS

MODEL 504 & 504S (SPECIAL)

First we should acquaint ourselves with the Extractor and it's various parts and what functions they perform during operations. Refer to Drawing 4-93-1 for Model 504s.

504s - Nomenclature - Drawing 4-93-1

ITEM	DESCRIPTION	COMMENTS
1.	Main Frame	Contains Butt Plates 1A
2.	Extension Frame	Uses on Exchangers longer than 24'.
3.	Main Superstructure	Used with four tension arms 3A
4.	Extension Superstructure	Used with extension frame
4A.	Tension Arms	2 Short Arms used with 2, 3A & 4
5.	Balance Lug Connector	Used with 2 & 2 frames
6.	Main Car	Contains Main Cylinder & Chain Motors
7.	Main Cylinder	Primary Force Applicator
8.	Drive Chain	Secondary Force Applicator
9.	Flange Clamp	Secures Front by Clamping shell flange or flange lugs
10.	Sling Cylinders w/cable sings	Positions front butt plates
11.	Hydraulic Control Valves	
12.	Hydraulic Oil Distributor Blocks	
13.	Hydraulic Oil Lock Valves	
14.	Hydraulic Oil Flow Control Compensators	
15.	Balance Cylinders	
16.	Clamp Cylinders	
17.	Drive & Idler Sprockets	
18.	Reaction Lugs	Air Cylinder operated by air valve 26A
19.	Opposed Hydraulic Motors	Car positioner & secondary force applicator
20.	Suction Line Filters	
21.	Tandem Pumps	
22.	Integral Reduction Gear w/ Vane Motors only	
23.	18 H. P. Piston Motor	
24.	Air Line Lubricator	
25.	Air Line Filter	
26.	Air Cylinder for Reaction Lugs - Under Car 6	
26A.	Air Valve for Control of Lugs Under Car	
28.	Trolley Cars with adjustable slide plates	

DISCUSSION OF PRIMARY PARTS

AIR MOTOR (23) -The air motor is powered by the plant air system or air compressor w/90 PSI continuous working air pressure. A rubber hose is to be connected from the plant air system to the Extractor air piping at a connection located next to the operating valves.

HYDRAULIC PUMPS (21) - The hydraulic pumps are powered by the air motor. The first pump from the air motor has a capacity of 22 G.P.M. and a pressure output of 1000 P.S.I. The second pump has a capacity of 7 G.P.M. and a pressure output of 3000 P.S.I. When pumping at a pressure of less than 1000 P.S.I., both pumps are operating with a capacity of 29 G.P.M. When the pressure exceeds 1000 P.S.I., the first pump (or volume pump) is relieved to the oil reservoir tank by means of a pressure unloading valve located in the discharge line. Once the pressure has exceeded 1000 P.S.I., the check valve located in the discharge manifold piping from the tandem pumps seats and manifold piping from the tandem pumps seats and maintains the pressure to the operating valves. It is easy to see that all hydraulic cylinders will operate faster with a pressure of less than 1000 P.S.I. since the speed of the cylinders depend on how fast their volume can be displaced.

OPERATING VALVES (11) - This block of valves operate all the hydraulic cylinders on the Extractor. These are three position spring-return valves. Pushing forward and pulling backward opens the ports on the valve. Once released they are spring-returned to the neutral position which allows the oil to return to the oil reservoir. Each valve will be labeled as to which cylinders they control on the Extractor.

MAIN CYLINDER (7) - The Main cylinder is located on the main car 6 and is the cylinder used when pulling or pushing a bundle. The cylinder has a pulling force of 113, 400 pounds with a hydraulic pressure of 3000 P.S.I. applied to the rod end of the piston and a pushing force of 150,000 pounds when a hydraulic pressure of 3000 P.S.I. is applied to the piston end. The ratio of hydraulic pressure to pulling force is 37.8 to 1. (Example - If we have 1000 P.S.I. on the hydraulic gauge, then we have a pulling force of 37,800 pounds being exerted by the main cylinder.)

REACTION LUG-LIFTING CYLINDERS (26) - The lifting cylinders are air operated and are located under the main car 6 of the main cylinder. The cylinders are operated by a two-position hand level valve located near the block of operating valves. The cylinders are piped so that when the front lugs are down, the rear lugs are up and visa versa. The front lugs must be in the down position when pulling with the main cylinder and at anytime the main care 6 is to be moved toward the back of the Extractor. The back lugs must be down to push with the main cylinder and at anytime the main car is to be moved toward the front of the Extractor. Particular attention should be taken as to what position the lugs are in before moving the main car.

MAIN CAR (6) - The main car is located on top of the main members of the Extractor and carries the main cylinder, and is equipped with air operated lugs on the underside. The main car can be moved the length of the Extractor by means of the main cylinder pushing the main car back after the bundle has been pulled the length of the rod and by means of the chain connected to the hydraulic motors under the car.

FRONT CLAMPS & CYLINDERS (9) - The front clamp cylinders are located inside the 8" x 6" tubing that are the main members of the Extractor. The cylinders are connected to the front clamps that grip the shell flange of the exchanger during pulling and installing bundles. The two cylinders are operated by two common valves in the block of operating valves. The cylinders are capable of extending the front clamps out a distance of approximately 40 inches. Special attention of handling clamps should be taken, and not let hand or fingers interfere with clamping to shell flange.

BALANCE CYLINDERS (15) - The balance cylinders are located on the outer members of the Extractor. These cylinders, too, are controlled by one common valve in the block of operating valves. The purpose of the balance cylinders is to balance the Extractor and bundle after it has been pulled, or to balance the Extractor and bundle before lifting to install a bundle. The cylinders are connected to a member with lugs that pin the overhead structure. By moving the balance members toward the heavy end of the Extractor, it can be brought to the level position before the load is raised or lowered.

HYDRAULIC MOTORS (19) - The hydraulic motors are located at the rear of the Extractor and are controlled by one common valve in the block of operating valves. The motors are capable of rotating in both directions. The motors pull the chain that is connected to the underside of the main car. The main car is moved forward and backward by the use of the hydraulic motors. Small and easily pulled bundles can be pulled with the hydraulic motors; however, it is recommended that the first pull be made with the main cylinder until the rod has made its full stroke and it is determined the pull pressure required is 1000 P.S.I. or less on the hydraulic gauge.

SLING OR SECURING CYLINDERS (10) - The securing cylinders are located at the front on the main members of the Extractor. The cylinders are equipped with a cable sling and are used to secure the front of the Extractor to the shell of the exchanger by placing a bolt through the eye of the sling and through one of the bolt holes in the shell flange. The front of the Extractor can be pulled up firmly against the tube sheet of the bundle before pulling operations begin. The slings are loosened after the bundle has been pulled but not completely removed or until the Extractor has been brought to balance. Caution should be taken not to connect slings too far out of center of cable shive. Hands and fingers should be clear when tightening cables.

OPERATING INSTRUCTIONS

Now that we are familiar with the parts of the Extractor, we shall move on to the operation of the equipment.

First, the hook on the crane should be connected through the shackle on top of the superstructure. Have the crane operator lift the Extractor about a foot. Connect air hose and move the balance cylinders until the lugs connecting to the superstructure are at about their mid-point of travel. The extractor will be heavy on the end that the main car is on. To bring the Extractor in balance, move the main car toward the end that is high. This is done with the hydraulic motors, but be sure the lugs under the main car are in the right position before trying to move the main car. Once the Extractor is level, it is ready to be lifted up to the bundle. If the bundle is above ground level, attention should be given to the air supply hose. A tag line should be attached to the unit when lifting Extractor.

Now that the Extractor is balanced, move it with the crane to the bundle to be pulled. The first alignment objective is to place the front butt plates (1A) against the shell flange or against the lugs that are welded or bolted to the flange. When the butt plates are in contact or very near the shell flange, the sloping surface of the butt plates should be under the tube sheet and approximately centered. During this positioning, the clamping lugs have been rotated down or to the side to reduce any interference.

The next step is to extend the sling cylinders (10) approximately 3 to 4 inches and attach eye of the cable slings to the back side of the shell flange by inserting two flange bolts through the sling eye and a convenient bolt hole in the flange. Shackles or other rigging tools may be used to accomplish the same results. Use the sling cylinders to make the final adjustments for centering, up and down corrections and pulling the entire unit into contact with the shell flange or lug projections. Each sling cylinder is individually controlled by its own hydraulic valve. Caution should be used to keep hands clear when tightening sling.

The Extractor is now ready to be clamped to the shell flange or lugs by rotating the clamps to a position that will contact the back side of the flange or lugs. Caution: Keep hands clear when clamping to shell flange.

When the clamping lugs are rotated to the proper position, actuate the clamp control valve to pull the jaws against the shell flange. This action causes the flange to be held hydraulically between the front butt plates and the jaws on the clamping lugs similar to a piece being held in a mechanical vise.

At this point observe the Extractor for being level and the crane cable for being vertically over the lifting shackle. Make any corrections that may be necessary.

The next step is to move the main car (6) to the front of the Extractor to engage the reaction lugs against the frame lugs blocks. The movement of the main car is accomplished as follows:

1. Open air supply valve to start hydraulic pump and supply air to lug air cylinder (26).

2. If the main car is to be moved forward, operate air valve 26A until front lugs are up. Main air valve may have to be opened more to obtain sufficient air pressure.

3. To move the main car by **chain** drive motors, operate the chain control valve to move the car to the desired position. If the car stops abruptly, the main car lugs are in the wrong position. Move the air valve 26A to the opposite position.

4. When front main car lugs approach lug blocks, operate the air valve to let reaction lugs drop to engage against the frame blocks.

CONNECTION OF MAIN CYLINDER TO EXCHANGER BUNDLE

There are numerous methods and adapter plates that may be employed to fasten the rod end of the main cylinder to the tube sheet or channel flange. The precautions that are to be followed are that the connection should not cause bending of the main cylinder rod. Several methods used are as follows:

1. Pull plate bolted to drilled and tapped holes in the tube sheet and pinned to rod eye or clevis.

2. Pull plate fastened to bundle by inserting tension rods through tubes and bolted on front and floating head of bundle.

3. Same as Item 2 except cable is threaded through tubes.

4. Main car is positioned at second set of lug blocks and cable is fastened to eye bolts in the tube sheet to make the initial break. Then a pull-bar* with adjustable clamps is fastened to the back side of the tube sheet to continue the exchanger removal. (See sketch IIB detail A in rear of manual.)

5. A plate is bolted through flange bolt holes of an integral channel exchanger to make the connection.

The above list is only a few ways for attaching the main cylinder to the bundle. The points of caution must be that no connection **causes severe bending** of the rod and that each type of connection must have a minimum of slack. The amount of slack in the connection may cause the cylinder to stroke short when the fluid is reversed, which prevents the lugs from engaging on the next set of lug blocks. Should this occur, the list of corrective actions covers several methods for getting out of the problem. (Item 7, Pg. 11)

The Extractor is in position to begin removal of the tube bundle. The following steps have been completed:

1. Extractor lifted and leveled.

2. Butt plates positioned on shell flange.

3. Sling cylinders are connected to shell flange and Extractor is centered.

4. Extractor is clamped to shell flange.

5. Main car is moved forward and front lugs are engaged on lug blocks.

6. Main Cylinder rod is extended and secured to tube sheet.

7. Extractor is level and crane cables are vertical over load.

We are now ready to exert a pulling force on the tube bundle. There are two methods used to apply the force slowly to break the bundle loose from the shell. One method is to just pull the main cylinder valve handle **slowly** and gradually apply the force while the air motor is running full speed. The other method is to **reduce the speed of the air motor**, pull the main cylinder valve open, then gradually increase the speed of the air motor. Either methods is satisfactory, but it should be "emphasized" that during the initial break the force should be applied slowly. Once the tube sheet is free of the shell flange, any speed desired may be used to move the bundle onto the Extractor. When the main cylinder is completely retracted, the adjustable "V" blocks (or commonly called slide plates) are jacked inward to take the load of the tube sheet. During the initial pull the tube sheet passes over the trolley cars until it can be loaded onto the trolley car nearest the main cylinder car, making sure slide plates with welded bead stays nearest to main car for pulling.

At this point further extraction of the bundle may be accomplished by the method of backstepping the main car or by engaging the chain motors. If the bundle has moved relatively freely, the force of the chain motors may be sufficient to continue movement. To engage the motors actuate the proper control handle to try to continue extraction of the bundle. Since the chains are a continuous motion and much faster, it is desirable to use this method as much as possible.

If the bundle has required over 1000 P. S. I. for the complete stroke, the main car will probably have to be backstepped to continue extraction. This is accomplished by reversing the fluid in the main cylinder which pushes the main car back to the next set of lug blocks.

When the front lugs are engaged on the lug blocks, the cycle may be repeated. The fluid to the main cylinder is reversed to the rod end and the bundle is pulled another stroke length. When the middle baffle passes over the middle trolley car, wooden blocks are wedged under the baffle for support. The bundle is extracted until the next to last baffle can be supported by the trolley car. When support is complete, the bundle can then be completely removed from the shell.

The next step is to determine the balance point of the unit. This is done by releasing **gradually** the front clamps until they are free and can be rolled down or out. CAUTION: DO NOT AT ANY TIME: disconnect cable slings from shell flange until the unit is in balance. When the flange clamps are released, notice whether the front of the Extractor tries to move up or down. If it moves down and puts additional tension on the cable slings, the balance arms need to be brought forward. If the front tries to go up, this indicates the back is heavy; therefore, the balance arms need to be moved back. This entire operation of balancing is performed with the cable slings attached to the shell flange. CAUTION: DO NOT disconnect the cable slings until the front end of the Extractor can be moved freely by one man. This step is a safety procedure that prevents the sudden shifting of the front of the Extractor. When the front can be moved freely, disconnect the cable slings; and the unit is ready to set on the ground for unloading.

Unloading the bundle may be accomplished in several ways. The three ways used most often are as follows:

1. The superstructure may be removed by pulling the pins at the balance lugs. Then the pull plate must be disconnected before the bundle is lifted off. Slings are secured around the tubes and the bundle moved to the desired location.

2. Another method for removing the bundle is to push it forward with the main cylinder until the trolley approaches the back side of the butt plate. In this the center of the bundle is forward of the main superstructure cross member which allows a sling to be secured and the bundle lifted and moved from under the structure. This works very well on the bundles in the 48-inch diameter range and twenty feet long.

3. Another excellent way to remover a bundle off the unit is to pull the pins at the balance lugs and lift the tension arms above the balance lugs so that you may place two lifting slings (steel or nylon) under the bundle. These lifting slings will be pinned to the front two tension arms and back two tension arms by using the same pins that were removed from the balance lugs. It's a good idea to place these lifting slings beneath the baffles. By using this method, you are using the superstructure as a lifting device to set the bundle at a desired location.

INSTALLING THE EXCHANGER BUNDLE

The Extractor is sitting on the ground or a platform. Move the main cylinder car to the back of the Extractor to permit placing the bundle on the trolley cars. Locate the trolley cars along the Extractor to support the front tube sheet, a middle baffle on large bundles and the next to the end baffle. Since the baffles are a smaller diameter than the tube sheet, place pieces of wooden 2" X 4" or 4" X 4" blocks to raise the floating tube sheet or first baffle above the butt plate "V" shapes on the frame. The floating head or first baffle should clear the top[of the "V" shapes at least the width of the gasket. In most instances a safe dimension is 1". Next, fasten the pull bar to the tube sheet to prevent the bundle from rolling off the Extractor should the front end go down for any reason. The unit is ready to balance by lifting slowly and moving the balance arms until the unit is level. Now, lift the unit to the shell and fasten the sling cables to the shell flange. Do not extend the sling cylinders more than 6" or half their stroke. When the slings are connected, actuate the main cylinder to start the floating head or first baffle into the shell. Once the bundle is started, then the front clamps can be rolled up and pulled against the back side to the shell flange to clamp the unit in position.

At this point, the chain drive units should be capable of pushing the bundle into the shell. Make sure the front main car lugs are up before activating the chain drive motors. As the bundle is being installed, the crane may have to raise or lower the unit and move it sideways as the baffles enter the shell. If the chain motors will not install the bundle, the main cylinder is used to step it into the shell. When the bundle is in place, the same procedure is used in unclamping, balancing and then removing the sling cables.

TROUBLE SHOOTING PROBLEMS

	PROBLEM	POSSIBLE CAUSE
1.	Pump will not put up pressure	1A - Air motor not running fast enough because of low air pressure & volume - Air pressure min. 90 PSIG - Air volume min. 450 CFM - Pump shaft speed design 900 to 1000 RPM 1B - Suction line filter dirty. 1C - Suction line is sucking air through broken nipple, plug, etc. 1D - Oil level too low in reservoir - minimum level is 4 in. from bottom 1E - Volume unloader valve is bypassing to oil reservoir -set valve to bypass at 1000 P.S.I. 1F - Gauge is stuck or improperly calibrated 1G - Pump gears or O-rings are worn and causing accessible bypassing
2.	Main car lugs will not stay up	2A - Insufficient air pressure, opening main air valve to air motor may correct problem
3.	When backstepping main car, bundle goes back into shell	3A - The bundle does not offer enough resistance force to push the main car back. In this case the chain motors should be engaged to pull or push the main car and the bundle 3B - Rear lugs are down under main car and engaging on lug blocks. Open air valve
4.	The tube sheet begins slipping off the trolley car	4A - Have crane operator pick up to load the trolley enough to prevent slippage. 4B - If the tube sheet slips off the dolly, lower the Extractor enough to get the trolley car back under the tube sheet
5.	Bundle diameter	5A - Use 4" X 4" timbers or wide flange beams to lay across clamp rectangular tubing. Lay one piece in front to butt against shell flange and one piece in back to clamp flange, then proceed as normal

PROBLEM (cont'd)	POSSIBLE CAUSE (cont'd)
6. 3000 PSI. on Main cylinder will not move bundle	6A - Disconnect both hoses from main cylinder and connect a 5000 P.S.I. test pump to rod end of cylinder using absolutely clean hydraulic oil and apply up to 5000 P.S.I. if necessary. This is a force of 37.8 sq. in. X 5000 lbs. per sq. in. -189,000 lbs. CAUTION: The back or piston end or the main cylinder must be vented or piped to an oil drum to prevent back pressure on the piston and control valves. Secure back of main car by chaining to main runners to prevent bending of 1" X 4" Flat Bar under main car.
7. When backstepping the main car, the lugs lack 1" or less of dropping behind the lug blocks	7A - Try to move the main car and bundle back with the chain drive motors. 7B - Pull cylinder rod in and add shim material to take the slack out of the connection to the tube sheet. 7C - Have crane operator lift the frame and pull the cylinder rod in at the same time, then hold the frame at a 5 to 10 degree angle and reverse the fluid to push the car back. Once the lugs are locked, let the frame back down to level position and proceed to pull the bundle. 7D - Use a 4" X 4" or 6" X 6" timber and place between a solid part of the main car and one of the cross members. Actuate control valve to pull main car against the timber which will pull the bundle out far enough to let the lugs lock when the car is back stepped.

MODEL 504 SPECIAL

The word "special signifies that the base unit has been designed for a specific application above the normal requirements of the standard model. Some variations are listed below:

1. Base frame runners are larger and/or longer than standard.
2. Base frame runners are spaced wider to accommodate flanges.
3. Bolt on sections are provided for pulling bundles longer than 24 feet.
4. Special superstructures are provided for extra long and/or extra large diameter exchangers.
5. Additional trolley cars may be supplied to raise the center line of the bundle when integral channel bundles are being pulled.

When special units are supplied with extension sections, the following procedure should be followed:

1. The extension has large guide pins to join the rear section of the Extractor by insertion into pipe sockets. Push the mating flanges together, drive 1 1/2" dowel pin through flanges, then install and tighten 1 1/2" hex head bolts.
2. Use 3" pipe sections to connect sliding balance lugs in extension section to balance lugs on base unit
3. Move long superstructure to its position over Extractor with the four tension bars (3A) pinned to the superstructure. Start at one end and connect tension arms to base frame balance lugs. Make sure that each pin installed has a safety pin retainer installed and locked. The long superstructure must always have the six tension bars installed.
4. When the extension is installed, disconnect chain holding block and pull extra chain from the trough and stretch it to the anchor point at the end of the extension. Pull chain tight and anchor in place with the holding block.
5. Disconnect the spring steel hose support and move it to the clip provided near the hose trough. This will permit the spring and hose to travel the full length of the unit. When the extension is removed, the spring steel should be rebolted to the forward clip.
6. When pulling integral channel bundles, it will be necessary to use the 4-inch wide flange dollies with the sliding wedges. Since the bottom nozzle of the channel passes between the main runners, all but one trolley must be removed from the Extractor. The trolley remaining will support the channel flange next to the main car. As the bundle is removed from the shell, the 4-inch wide flange dollies are put in place on top of the main runners and under the bundle baffles. An elevated wedge block is slid into place from each side of the exchanger and locked with the bolts. Wooden blocks and wedges may be necessary for additional cribbing under the baffles for proper support.

MAINTENANCE & SPARE PARTS

The maintenance required to keep the unit in top operating condition is normal cleanliness and lubrication. The single most critical item is to keep clean hydraulic oil in the main oil reservoir and change the filters as necessary to be assured of dirt-free oil circulation through the system.

Lubrication Recommendations:

Hydraulic Oil - Use a good grade of lube oil that is rated at 180/220 S.U.S. viscosity @ 100 degree F. with anti foaming agents. SAE10 or equivalent wt.

Grease - Any general purpose grease is satisfactory for bearings and air motor. See air motor manual for lubrication of piston motor.

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MOBIL EQUIVALENT
RECOMMENDED HYDRAULIC & LUBRICATING OIL
FOR OPERATING TEMPERATURES SHOWN BELOW

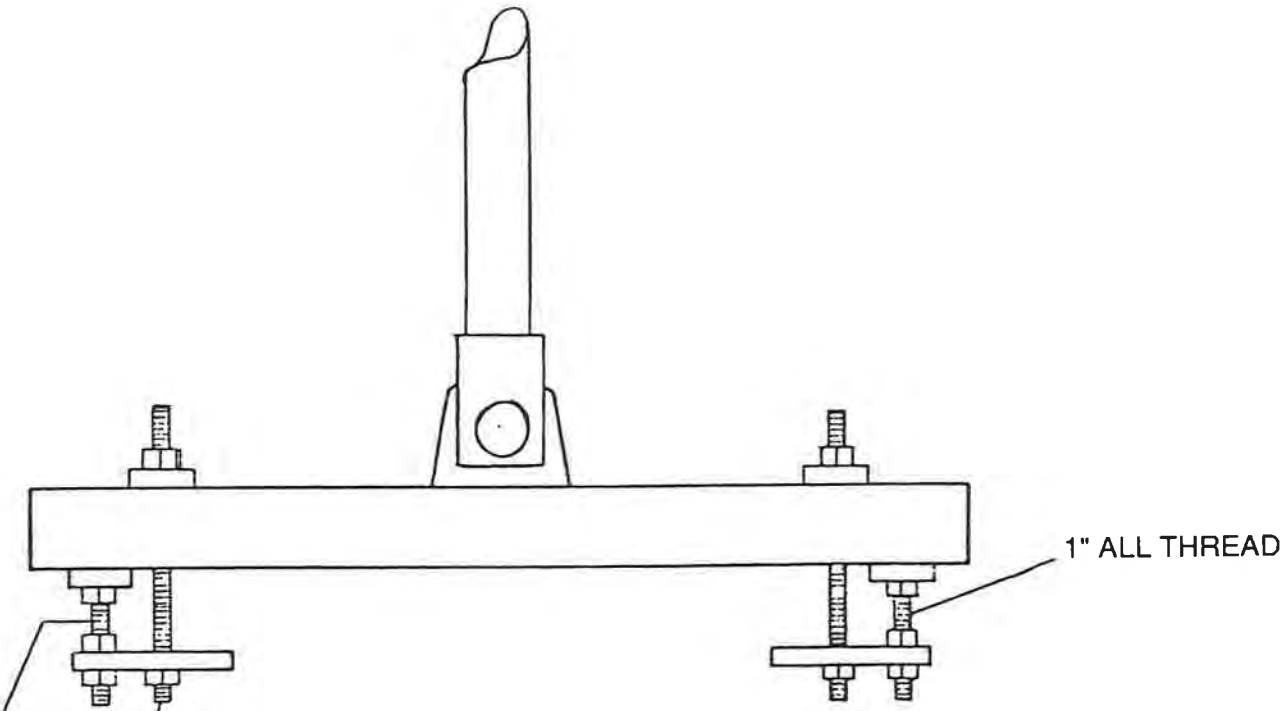
AMBIENT TEMP.	PRODUCT	VISCOSITY SUS 100F	REFINING LOCATION
-85F TO 35F	MOBIL AERO HFA	73.8	PAULSBORO, N.J.
-20 & ABOVE	MOBIL DTE 11	89	PAULSBORO, N.J.
-10F & ABOVE	MOBIL DTE 13	146	ST. LOUIS, MO
0F & ABOVE	MOBIL DTE 15	204	AUGUSTA, KANSAS
15F & ABOVE	MOBIL DTE 18	484	AUGUSTA, KANSAS
-25F & ABOVE	MOBIL FLUID 423	198	CHICAGO, ILL
10F & ABOVE	MOBIL ATF 220	181/193	BEAUMONT, TEXAS
0F & ABOVE	MOBIL ATF 210	207	BEAUMONT, TEXAS
10F & ABOVE	MOBIL DTE 24	145/160	BEAUMONT, TEXAS
15F & ABOVE	MOBIL DTE 25	220/235	BEAUMONT, TEXAS

SHELL EQUIVALENT

HYDRAULIC & LUBRICATING OIL

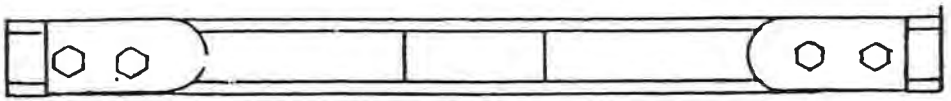
MOBIL PRODUCT	SHELL PRODUCT
MOBIL AERO HFA	NOT AVAILABLE
MOBIL DTE 11	AERO SHELL FLUID 4
MOBIL DTE 13	TELLUS NO. 23
MOBIL DTE 15	TELLUS NO. 32
MOBIL DTE 18	TELLUS NO. 68
MOBIL FLUID 423	DONAX TD
MOBIL ATF 220	EONAX TG
MOBIL ATF 210	DONAX TF
MOBIL DTE 24	TELLUS NO. 32
MOBIL DTE 25	TELLUS NO. 46

Any good grade hydraulic oil equivalent to SAE 10 W. that contains anti-foaming and water dispersant agents.

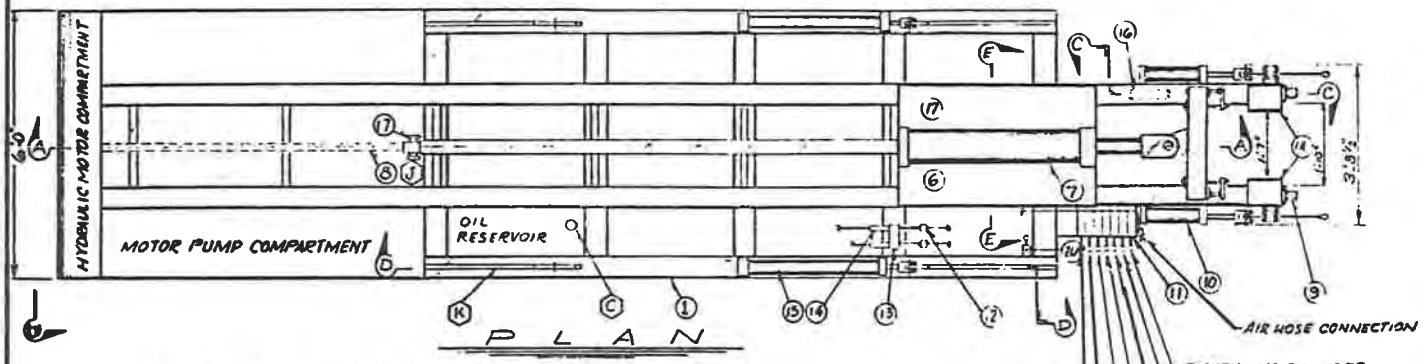


PULL-BAR

ADJUST OUTSIDE ALL THREAD TO THE THICKNESS OF THE TUBE SHEET, THEN TIGHTEN INSIDE ALL THREAD TO CLAMP ONTO TUBE SHEET



SKETCH II B DETAIL "A"
HYDRO-EXTRACTORS 11/14/84



PLAN

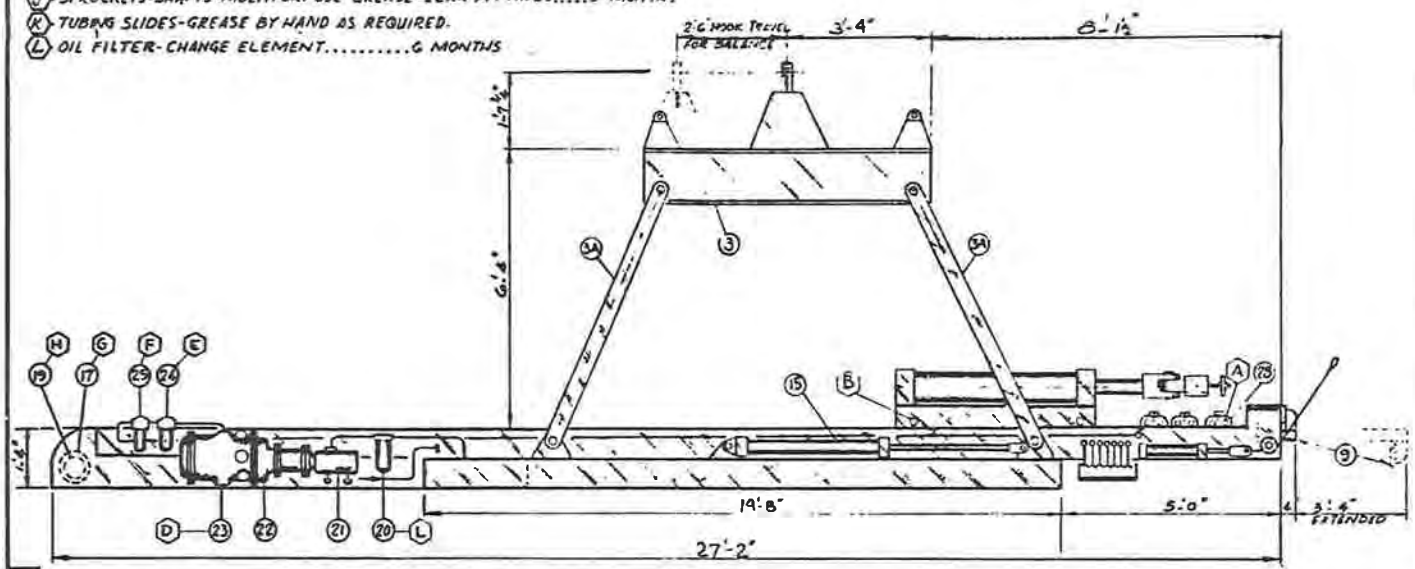
* MOTOR SPOOL VALVE.

LUBRICATION-⬡

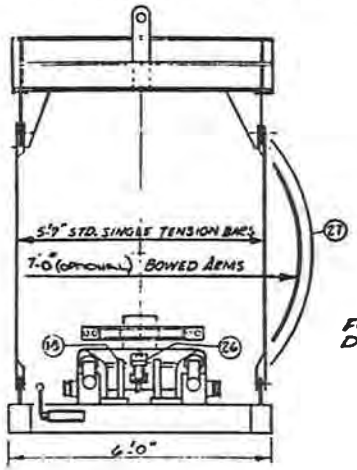
- (A) ROLLERS-MULTIPURPOSE GREASE-ZERK FITTINGS..... 3 MONTHS.
- (B) ROLLERS-UNDER CAR - MULTIPURPOSE GREASE-ZERK FITTINGS, 3 MONTHS.
- (C) RESERVOIR-LIGHT TURBINE BEARING OIL - SAE-10W @100°F..CHK. EA. USE.
- (D) AIR MOTOR-SAE-10W OIL-FILL TO TOP PET COCK VALVE.....CHK. EA. USE.
- (E) AIR LINE LUBRICATOR-SAE 30W OIL-10-20 DROPS/MIN..... CHK. EA. USE.
- (F) AIR LINE FILTER-WASH BRONZE ELEMENT -/SOLVENT..CHK EA. USE.
- (G) SHAFT BEARINGS-MULTIPURPOSE GREASE-ZERK FITTINGS.....3 MONTHS
- (H) HYD. MOTOR REDUCTION GEARS-90 W. OIL-FILL THRU SOCKET HD. SCREW.
- (J) SPROCKETS-SHAFTS-MULTIPURPOSE GREASE-ZERK FITTINGS.....3 MONTHS
- (K) TUBING SLIDES-GREASE BY HAND AS REQUIRED.
- (L) OIL FILTER-CHANGE ELEMENT.....6 MONTHS

LEGEND-( )

ITEM	DESCRIPTION
1	MAIN FRAME -/BUTT PLATES (4)
3	MAIN SUPERSTRUCTURE.
3A	TENSION BARS
5	BALANCE LUG CONNECTOR
6	CYLINDER - MAIN CAR
7	MAIN CYLINDER
8	DRIVE CHAIN. CONNECTS TO CAR & MOTORS.
9	FLANGE CLAMPS FOR CLAMPING SHELL FLG.
10	SLING CYLINDERS -/CABLE SLINGS
11	HYD. CONTROL VALVES
12	HYD. DISTRIBUTION BLOCK
13	HYD. LOCK VALVES.
14	HYD. FLOW COMPENSATORS.
15	BALANCE HYD. CYLINDERS.
16	CLAMP CYLINDERS INSIDE TUBING
17	DRIVE & IDLER SPROCKETS.
18	REACTION LUGS-UNDER CAR-AIR OPERATED
19	HYD. MOTORS-MTD. UNDER CAR ON MOD. 504 S.W
20	OIL SUCTION FILTER.
21	TANDEM PUMPS.
22	REDUCTION GEAR - VANE TYPE MOTORS ONLY.
23	AIR MOTOR - PISTON TYPE.
24	AIR LINE LUBRICATOR.
25	AIR LINE FILTER
26	AIR CYLINDER-FOR RET. LUGS UNDER CAR.
26A	AIR VALVE - FOR CONTROL OF LUGS UNDER CAR.
27	BOWED TENSION ARMS FOR BUFFALO 84" DIA. (OPTIONAL)
28	DOLLY CARS -/ADJUSTABLE "V" SLIDE PLATES
29	REMOTE CONTROL FOR MAIN CYLINDER (OPTIONAL)



ELEVATION



END ELEV.

NOTE.
FOR SECTIONS SEE DWG. Nº 4-93-1B

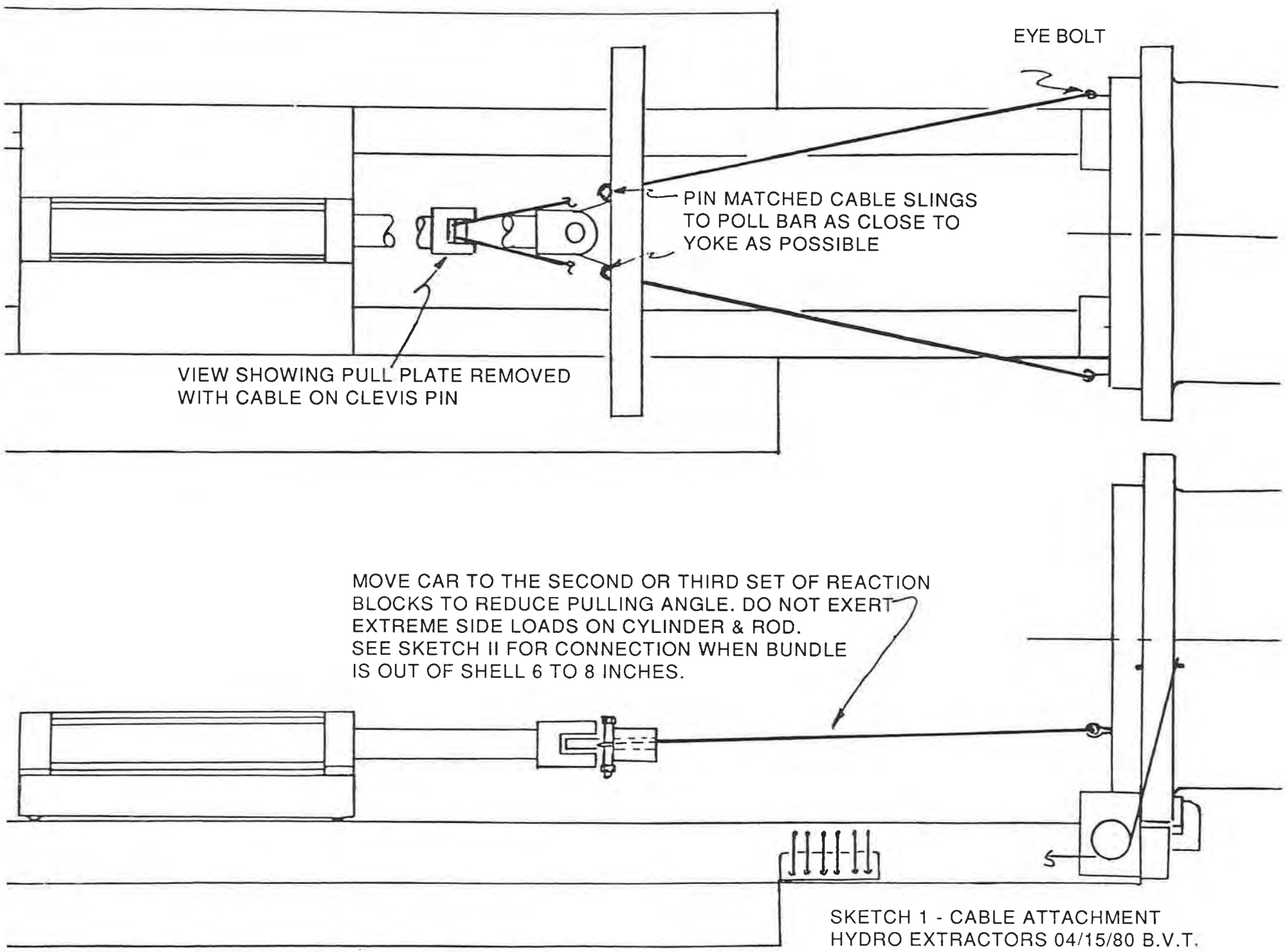
CERTIFIED DWG.
3/13/81

HYDRO-EXTRACTORS, INC.

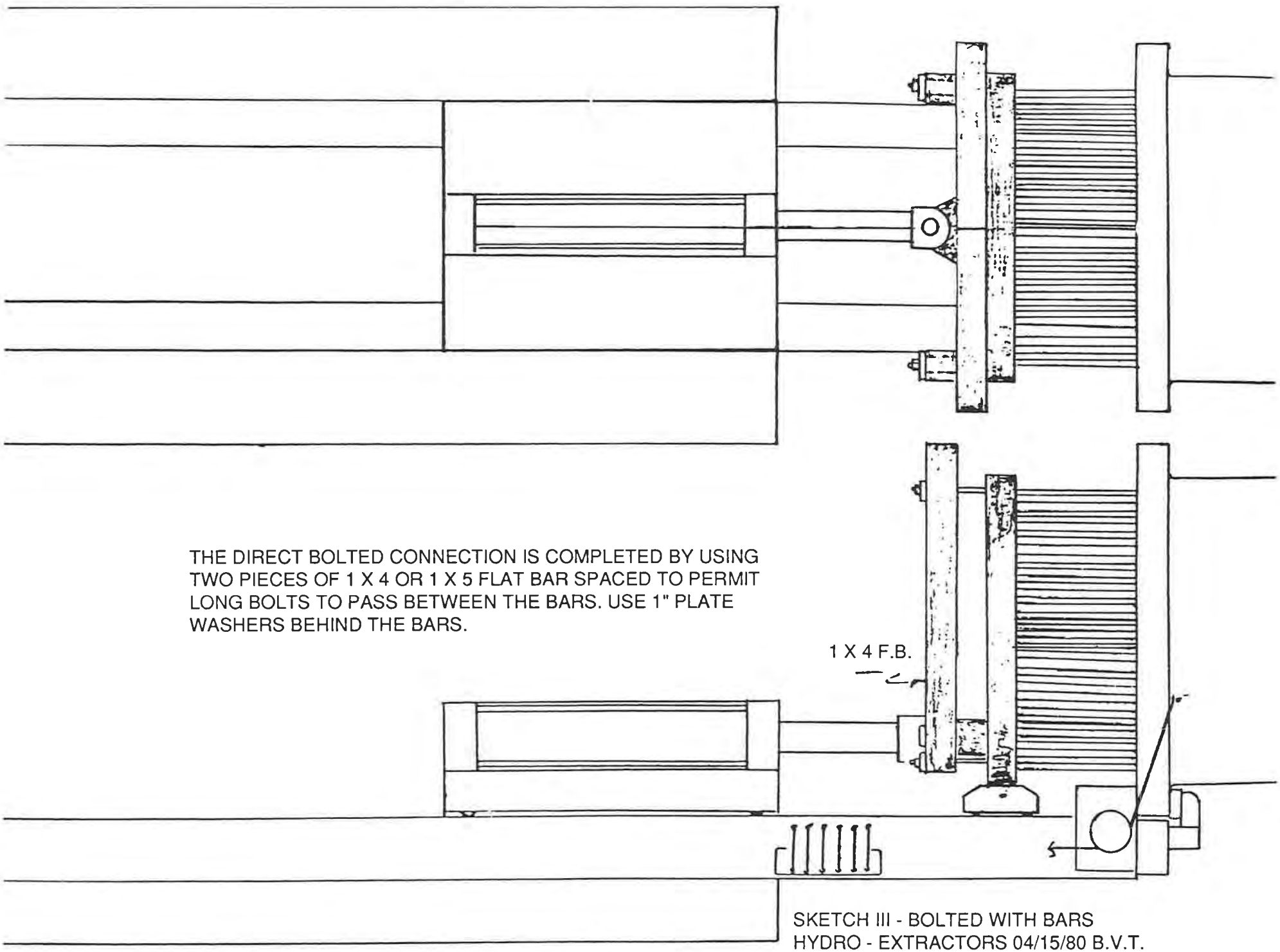
MODEL 504 ASSEMBLY DRAWING

DWN. J. JOHNSON | DATE: 3-17-81

SCALE: ½" = 1'-0" | DWG Nº 4-93-1 A

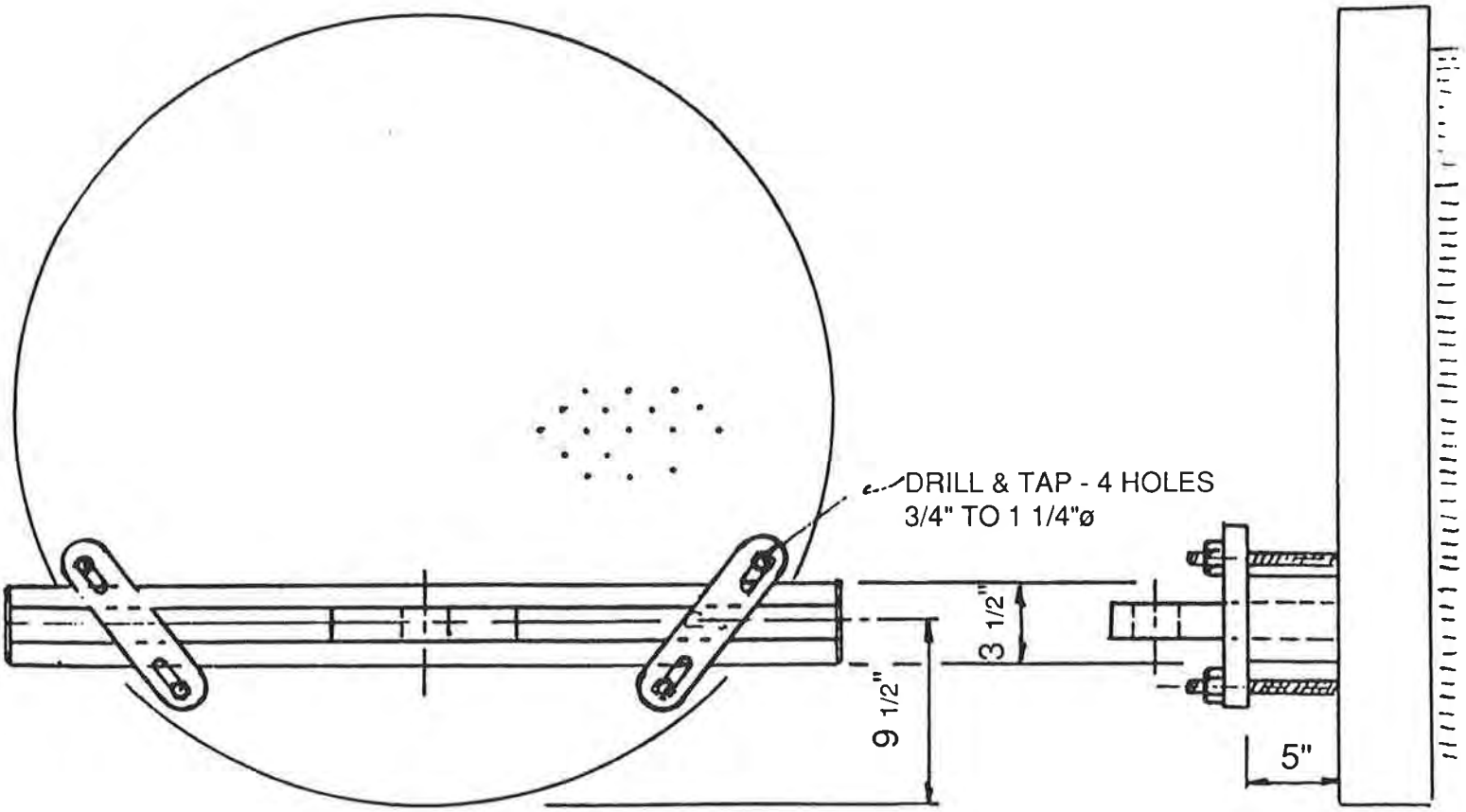


SKETCH 1 - CABLE ATTACHMENT
HYDRO EXTRACTORS 04/15/80 B.V.T.



THE DIRECT BOLTED CONNECTION IS COMPLETED BY USING TWO PIECES OF 1 X 4 OR 1 X 5 FLAT BAR SPACED TO PERMIT LONG BOLTS TO PASS BETWEEN THE BARS. USE 1" PLATE WASHERS BEHIND THE BARS.

SKETCH III - BOLTED WITH BARS
HYDRO - EXTRACTORS 04/15/80 B.V.T.



NOTE: THE CENTER LINE OF THE PULL BAR IS APPROXIMATELY 10 1/2" FROM THE BOTTOM OF TUBE SHEETS FROM 24" IN DIAMETER TO 66" IN DIAMETER. DRILL & TAP 4 HOLES ON THE OUTER PERIPHERY OF THE TUBE SHEET THAT WILL CLEAR THE 3 1/2" WIDE PULL BAR. HOLE SIZES SHOULD BE FROM 3/4" IN DIA. TO 1 1/4" IN DIA. DEPENDING ON THE DIAMETER OF TUBE SHEET AND THE ANTICIPATED FOULING CONDITIONS ON THE SHELL SIDE.

SKETCH IV - DRILLING FOR PULL BAR
HYDRO - EXTRACTORS 04/15/80 B.V.T.

Use sufficient shims under cap to avoid preloading roller bearings, then tap cap into place on housing cover. Tighten capscrews uniformly, then hand rotate the main shaft to test for drag and also check for end play. Progressively remove shims until a slight drag is noticed when the shaft is rotated. At this point, remove bearing cap, install oil seal, then replace cap and tighten securely. NOTE: The proper preloading of a shaft bearing is reached when no end play can be detected and the shaft can be turned by hand.

Assemble the motor unit to the gear housing as explained on page 7 and service the unit with oil and grease before operating.

PREVENTIVE MAINTENANCE TIPS

Regular attention to lubrication and elimination of moisture in air lines are the two most important factors governing part replacements and length of service between overhauls. Observe the follow suggestions:

1. Drain off accumulated water daily, then level check the oil supply. Water which accumulates in the motor crankcase will raise the oil level and anything above the normal oil level will be blown out through the filler cap during operation. Conceivably, this can replace all of the motor oil completely with water, resulting in wear and damage to motor parts.

2. Drain the air receiver at least once a day. Air laden with moisture will condense into water in the air receiver and should be drained off frequently. Moisture traps installed at low points in the transmission lines also aid in reducing the amount of water which may reach the motor.

3. Keep the strainer in the filler cap open. This should be checked each time the motor is serviced with oil. If the screen becomes plugged, air pressure will build up in the crankcase and will cause a reduction in power and may even rupture oil seals and allow to escape into the gear case or to the atmosphere.

4. Always use a line oiler with motors on continuous duty. This assures that the rotary valve and bushings will receive adequate lubrication and the oil vapor carried into the motor will help to lubricate cylinder walls.

5. In some installations, due to atmospheric conditions or because moisture has not been eliminated in supply lines, can be corrected by attaching a length of hose or pipe to the rotary valve exhaust port to carry the exhaust air away from the motor. Freezing can generally be eliminated by insuring that the air supply is as dry as possible before it is used by the motor.

MAXIMUM CLEARANCES RECOMMENDED BEFORE REPLACEMENT ON JOY MOTORS.

a. Maximum compression ring gap recommended.

AMP 38,94	.020
AMP 115, 125, 180, 190,200	.035

b. Rotary valve clearance in bronze bushing:
.010 total clearance

c. Clearance between bushing and connecting rods on crankshaft assembly:
.035 total clearance

d. Torque values for air motor crankshaft:

	Setscrew	Capscrew
AMP-38,94	40-45 ft.lbs.	20-25ft. lbs.
AM-115 thru 200	120-130 ft.lbs.	50-60ft. lbs.

SPECIAL INSTRUCTIONS - JOY AIR MOTORS
e. Installing bearing crankshaft

If a bearing is to be installed on the splined end of the crankshaft of an assembled air motor, the following precaution should be taken:
Insert a washer or spacer ring between the valve cover plate and the rotary valve. This will force the rotary valve against the inner ring of the ball bearing mounted on the opposite end of the crankshaft. The bearing being installed over the splined end of the crankshaft can now be driven into place without fear of damage to the internal bearings of motor.

ORDERING PARTS AND SERVICE

When you need a serviceman or wish to place an order for parts, always include the following information in you inquiry:

Serial Number and Model Number of Machine. These will be found stamped on the cylinder of the machine.

Part Number and Name of Part. The part number will usually be found cast or stamped on the part itself. If not, refer to the illustrated parts list.

WHERE TO ORDER PARTS

Parts should be ordered through your authorized Joy Manufacturing Company Distributor. Orders will not be accepted at the factor since your distributor is equipped and located to provide you with the best possible service.