宝鸡市盟泰石油机械有限公司
BAOJI MENGTAI PETROLEUM MACHINERY CO.,LTD

F-1600 Drilling Pump

Operation & Maintence Manual

Model: F-1300/1600 Mud Pump

BAOJI MENGTAI PETROLEUM MACHINERY CO.,LTD

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/min					180		170		160		150		140		130	
	F-1300				18.7	2720	21.0	3050	23.7	3440	27.0	3915	31.0	4495	34.5	5000
	F-1600				23.1	3345	25.9	3750	29.2	4235	33.2	4820	34.5	5000	34.5	5000
	Rated power				Discharging L/S (GPM)											
	F-1300		F-1600													
	kW	HP	kW	HP												
130	1050	1408	1293	1733	50.42 (799)		44.97 (713)		39.83 (631)		35.01 (555)		30.50 (483)		26.30 (417)	
*120	969	1300	1193	1600	46.54 (737)		41.51 (658)		36.77 (583)		32.32 (512)		28.15 (446)		24.27 (385)	
110	889	1192	1094	1467	42.66 (676)		38.05 (603)		33.71 (534)		29.62 (469)		25.81 (409)		22.25 (352)	
100	808	1083	994	1333	38.78 (614)		34.59 (548)		30.64 (485)		26.93 (427)		23.46 (372)		20.23 (320)	
90	727	975	895	1200	34.90 (553)		31.13 (493)		27.58 (437)		24.24 (384)		21.11 (334)		18.21 (288)	
1					0.3878 (6.147)		0.3459 (5.483)		0.3064 (4.857)		0.2693 (4.269)		0.2346 (3.719)		0.2023 (3.206)	

Note:

1. Based on 100% volumetric efficiency and 90% mechanical efficiency.

2. Recommended strokes and Input power when mud pump runs continually.

Table 1B F-1300/1600 Drilling Mud Pump's performance parameter

stroke /min	Liner diameter, inand rated pressure, MPa（Psi）															
					7		6 3/4		6 1/2		6 1/4		6		5 1/2		5	
	F-1300				19.2	2785	20.7	2995	22.3	3230	24.1	3495	26.2	3795	31.1	4515	34.5	5000
	F-1600				23.6	3430	25.4	3690	27.4	3980	29.7	4305	32.2	4670	34.5	5000	34.5	5000
	Rated power				Discharging L/S (GPM)													
	F-1300		F-1600															
	kW	HP	kW	HP														
130	1050	1408	1293	1733	49.19 (779)		45.74 (725)		42.41 (672)		39.21 (621)		36.14 (573)		36.36 (481)		25.10 (398)	
*120	969	1300	1193	1600	45.40 (719)		42.22 (669)		39.15 (620)		36.20 (573)		33.36 (529)		28.03 (444)		23.16 (367)	
110	889	1192	1094	1467	41.62 (659)		38.70 (613)		35.89 (569)		33.18 (526)		30.58 (484)		25.69 (407)		21.23 (336)	
100	808	1083	994	1333	37.84 (599)		35.18 (557)		32.62 (517)		30.16 (478)		27.80 (440)		23.36 (370)		19.30 (306)	
90	727	975	895	1200	34.05 (540)		31.66 (502)		29.36 (465)		27.15 (430)		25.02 (396)		21.02 (333)		17.37 (275)	
1					0.3784 (5.997)		0.3518 (5.577)		0.3262 (5.171)		0.3016 (4.781)		0.2780 (4.406)		0.2336 (3.702)		0.1930 (3.060)	

Note:

1. Based on 100% volumetric efficiency and 90% mechanical efficiency.

2. Recommended strokes and Input power when mud pump runs continually.

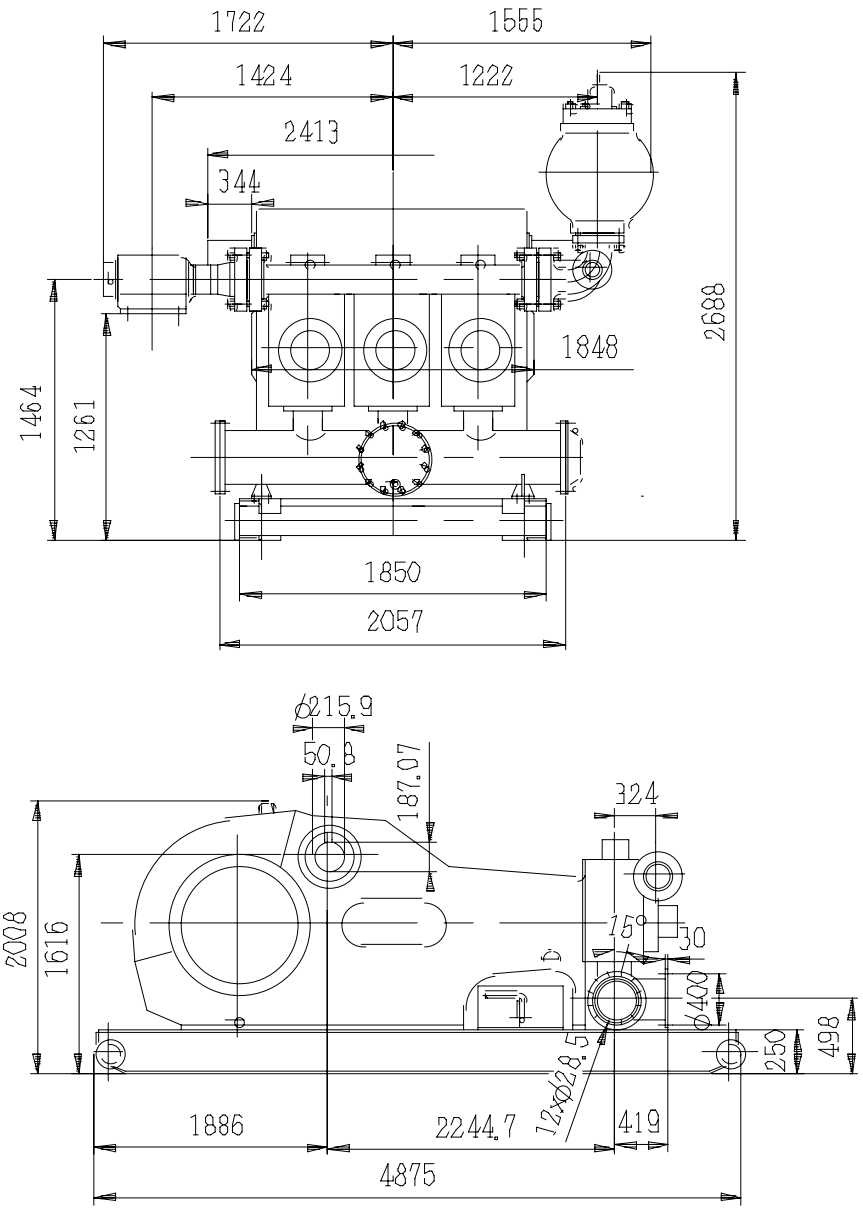


Fig. 1 F—1300/1600 drilling mud pump'soverall dimension

1.2 Installation of New Pump

F-1300/1600 Drilling mud pump has been completely assembled and test operated under pressure before being shipped to the field. Unless otherwise instructed, the lubrication is drained from the power end. Before putting the pump into service, the following precautions and operations must be performed or checked: In order to prevent personal injury during the performance of any maintenance or inspection procedures, this equipment MUST BE SHUT DOWN AND NOT OPERATING, and all safety devices on

prime movers, drives, etc, MUST BE IN THE SAFE POSITION.

The skids under the F-1300/1600 mud pumps are suitable for most any type of installation. The support under the pump must be level and adequate to support the weight and operating forces exerted by the pump.

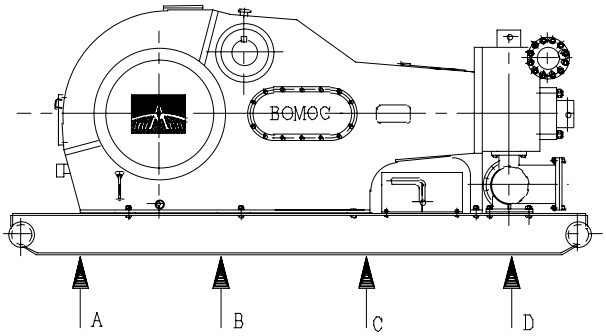


Fig 2

1.2.1 Land Installation

In land installations, 8 piece of 76mm×305mm boards laid side crosswise to the pump skids for the entire length, or at a minimum, at the points indicated in Fig.2,is usually sufficient .The boards should be a 300mm wider than the width of the pump skid runners. Wet or marshy locations may require a more stable foundation.

1.2.2 Permanent Installations

On permanent installations such as barge, platform, structural base, or concrete slab, where pump skids are bolted down, it is essential that the skids be properly shimmed to prevent possibility of twisting or distorting the power frame. The pump skids must sit solid on all shim points with bolts loose.On barge installations, the pump skids are generally bolted down to T-beams running parallel and in line with the pump skids. Install shims at points shown in Fig, 2 and 3 and observe caution of proper shimming to prevent twist or distortion. The shims on all installations should extend the full width of the skid beam flanges and have a minimum length of 12”(305mm) .

On installations where the power unit or electric motor is mounted integrally with the pump skids, the preferred installation would be to set the pump package on the T-beam skids and provide retention blocks rather than bolts to hold it in place. This will allow the pump to “float” and minimize the transfer of barge deck or platform distortion into the frame.

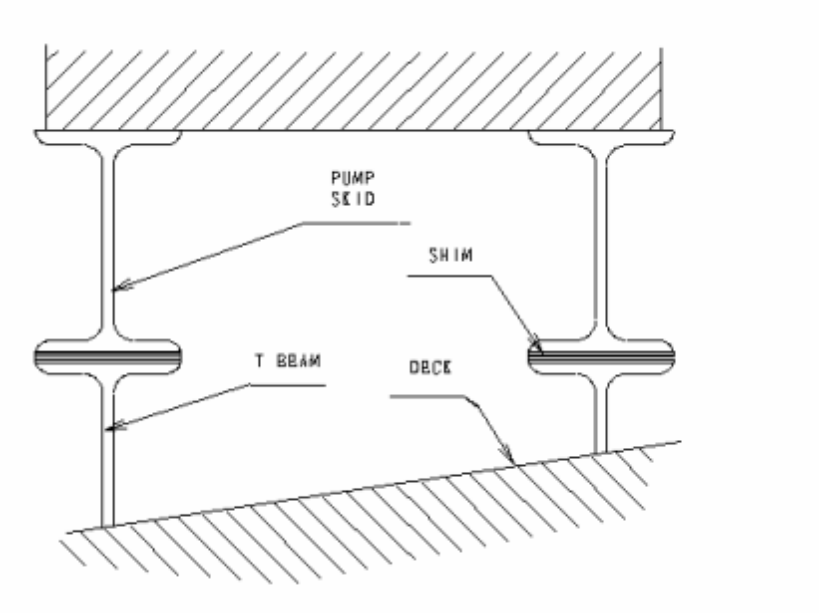


Fig. 3

1.2.3 Installations of Driving Device

The drive between the mud pumps and the power source, whether V-belts or multi-width chains, should be installed with the greatest care to assure maximum operating life with minimum of unexpected or undesirable shutdowns due to drive failures.

When installing the drive sheave of sprocket, make sure all grease or rust preventative is removed from the shaft and the bore of the drive. Remove all burrs or rough spots from the shaft, key, and keyway. Fit key to the keyways in both the shaft and drive and install key into shaft keyway.

Coat pinion shaft with a light coating of anti-seize compound or light oil and install the drive sheave or sprocket hub. Tighten hub bolts as indicated below:

When a wrench or length of pipe is used to increase leverage in tightening draw-up bolts, it is imperative to adhere to the wrench torque values given in the chart below. This adherence is important, because in mounting the hub, the tightening force on the bolts is multiplied many times by the wedging action of the tapered surface. This action compresses the hub for a snug fit on the shaft. If the bolt-tightening forces are extreme, bursting pressure is created in the hub of the mounted pulley; this pressure may cause the pulley to crack. The hub bolts should always be tightened alternately and progressively.

Wrench Torque N.m	Wrench Length mm	Wrench pull N
810	900	900

1.2.3.1 V-Belt Drives

1) Check sheaves groove condition

Before installing the v-belts, check sheave grooves for wear. Worn or rounded grooves will destroy V-belts rapidly. The sidewalls must be straight. Sheave grooves must be free of dirt, rust or other extrusions, which could damage the V-belts.

2) Check line to centre of lelt.

3) Adjust V-belt for proper tension

Adjust the belt tension by moving the sheaves apart until all of the sag has just been eliminated from the tight side of the belt and some of the belts on the slack side. Then increase the given center distance. For example: on 2540mm(100") Center distance, after adjusted center distance then increase additional 13mm(1/2"). On 3180mm(150")center distance, after adjusted center distance then increase additional 19 mm(3/4").

DO NOT OBTAIN BELT TENSION BY PICKING UP END OF PUMP AND ALLOWING BELTS TO TIGHTEN UNDER WEIGHT OF PUMP AS END IS BEING LOWERED TO THE GROUND.

1.2.3.2 Chain Drive

1) Installation

Proper installation and maintenance of the sprocket and chain drives are essential if good service life is to be obtained. Since many factors, such as chain width, center distances, speeds, and loads must be considered when determining the allowable tolerance for sprocket alignment; no good "rule of thumb" can be applied. The chain alignment must simply be held as nearly perfect as possible. A more precise alignment can be made by stretching two steel wires (piano wire) along one face of the two sprockets, one above and one below the centerline, and moving one of the sprockets until the wires touch at four points. This will determine that the centerlines of the drives are parallel and the faces of the sprockets are square.

2) Drive chain lubrication

The pump drive chain lubrication system on the majority of F series of pumps is an independent system having its own oil pump, reservoir and drive. Fill chain case to the indicated level with a non-detergent oil. Lubricant brand is as follows:

Ambient temperature above 32º F(0ºC) SAE-30/N100

Ambient temperature above 32º F(0ºC) SAE-20/N68

For temperatures below 0ºF, consult a reputable lubrication dealer for recommendations.

The usage's lubricant should match to lubricate relevant specification or lubrication manual established according to the specification.

Since this is an independent system, it will require the same maintenance or service attention employed on any other piece of machinery, including:

- Daily check of oil level.
- Daily check on condition of oil.
- Frequent check on oil pressure. (5-15psi) (0.352-1.06kg .cm2).
- Volume of oil being applied to chain.
- Condition of nozzles in spray tube.
- Condition of oil pump drive (V-belts or chain)

NOTE: 1. Oil pressure may be adjusted with the pressure relief adjusting screw on the rear of the pump housing.

2. Pressure drops may also indicate suction and discharge filter screens need cleaning.

1.3 Suction System Requirements

Individual installation conditions will dictate the design of the suction system. The suction of the F-series pumps must have a positive head (pressure) for satisfactory performance. The optimum suction manifold pressure is 20~30 psi (0.14~0. 21Mpa) for maximum volumetric efficiency and expendable parts life. A 5 x 6 centrifugal pump with 40h.p 1150-rpm electric motor best supplies this head pressure. This type of drive requires a device to automatically start and stop the centrifugal pump motor simultaneously with the triplex pump. On DC electric powered a signal can usually be supplied from the DC control panel to energize a magnetic starter when the mud pump clutch airline will provide a set of contacts for energizing the magnetic starter when clutch is engaged.

The suction lines should be piped with valve arrangements so the charging pump can be by-passed so operation can be continued in event of charging pump failure or for maintenance. Operation without a charging pump can be improved by replacing the suction valve spring with a weaker spring.

Suction dampener is a very effective aid for complete filling of the liners and dampening pulsations in the suction line,which results in a smoother flow in the discharge line.

CAUTION:

Do not pipe the return line from the shear relief valve back into the suction system as a relief valve operation will cause a sudden pressure rise in the system vastly greater than the system pressure ratings, resulting in damage to manifold, suction dampener and centrifugal pump.

1.4 The Preparation of Power End

F-series mud pump has been completely assembled and test operated before being shipped to the field. Unless otherwise instructed, the lubrication is drained from the power end. Before operating the pump, the following must be performed or checked.

1.4.1 Power End Lubrication

Before installing lubricant, open inspection door in cover and check oil reservoir for possible accumulation of condensation, etc, and drain and flush by removing the pipe plugs on each side of the pump. Refer Item 2.Fig.7. Add the proper type and quantity of lubrication in the power end. Refer to lubrication plate on pump frame for type and quantity required.

Recheck oil level after pump has operated for a period of 15 minutes. Shut pump down and allow approximately five minutes for the oil level to equalize, Check at oil level gauge, Item 1, Fig 7.It is usually necessary for 3 gallons (10L) of oil to be added due to a certain amount being retained in the crosshead area and frame cavities.

1.4.2 Installation of Crosshead Extension Rods and Diaphragm Stuffing Box Seals

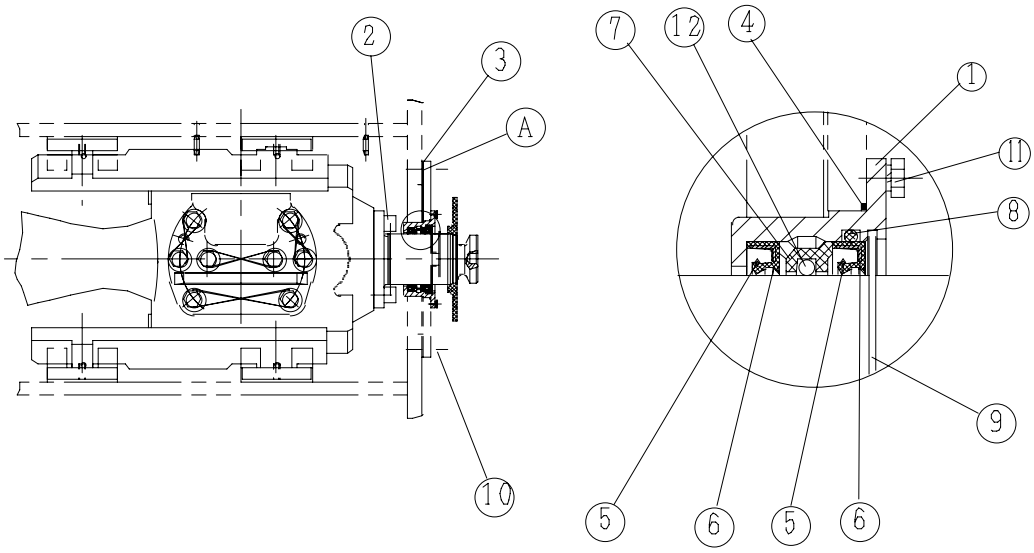


Fig. 4

⑴diaphragm stuffing box and mud apron (2) Bolt (3) Shim (4) Sealing ring (5) Spring (6) two-lip seal (7) Sealing ring (8)O-ring (9) Locking spring (10) Bolt (11) Bolt (12) O-ring

With reference to Figure 4, remove the diaphragm stuffing box and mud apron (1) and rotate pump so that crosshead is at the front of the stroke, Thoroughly clean the front of the crosshead and the face of the crosshead extension rod. Insert alignment boss on crosshead extension rod into the crosshead bore and tighten the retainer bolts (2) to the following torque, 350~370ft.lbs(475~500N.m), at last tightened with iron wire. Thoroughly clean mud apron and the face of frame, on the "A" place Fig. 4 is with the shim ③and tighten bolt⑩to the following torque, 90~120ft.lbs(120~160N.m)

Thoroughly clean the hole and the end face of diaphragm stuffing box plate, exterior surface of diaphragm stuffing box and surface of flange. Coating the exterior surface of diaphragm stuffing box with light oil and install O-ring seal (4). Install diaphragm stuffing box on the diaphragm stuffing box plate then tighten bolt (11) to the following torque: 12~18 ft .lbs (16~24N.m).

The diaphragm stuffing box packing assembly consists of two double lip oil seal (6), an oil seal ring (7), an O-ring (12) O-ring (8)and a lock spring (9). Install the assembly as follows:

a) Remove left pressure spring (5) from double lip oil seal (6) and place seal in the inner (power end) position on the crosshead extension rod, with lip toward power end. Replace the pressure spring in theseal lip and slide the seal into position in the stuffing box.

SEE NOTE BELOW

b) Install the O-ring (12) into Oil Seal ring (7). Insert O-ring (12) and oil seal ring (7) over rod and slide it into stuffing box bore.

c) Install the O-ring (8)in groove in stuffing box bore.

d) Installation procedure of left right double lip seal in the Fig.4 is the same as step a).

CAUTION: The double lip seal can be used in the inner, or power end, power end, position to replace the single lip seal, but DO NOT use the single lip seal in the outer position.

e) Install the locking spring (9)

CAUTION: must be taken to assure the pressure spring (5) does not slip out of the groove in the oil seal lip, as severe scoring of the crosshead extension rod can occur. Coat extension rod with a light oil to facilitate installation of the packing assembly.

1.5 Spray Pump Assembly

Spray pump assembly consists of spray pump, water tank and spray nozzle etc. it is used for flushing and cooling piston and linear during pump operated.

Proper attention must be paid at all times to assure adequate cooling fluid is being applied to the piston and liner assembly. Stoppage of the cooling fluid will result in almost instant failure of the piston rubbers and possibly extensive damage to the liner bore.

Stationary spray type have been used on F-series pumps Ref. Fig 5.It consists of a fixture (1), a pipe (2) and a spray nozzle (3), it make cooling fluid spray to piston and linear. Adjust cooling water supply to the manifold and inspect spray nozzle operation very often making sure the nozzle is pointed directly at the piston.

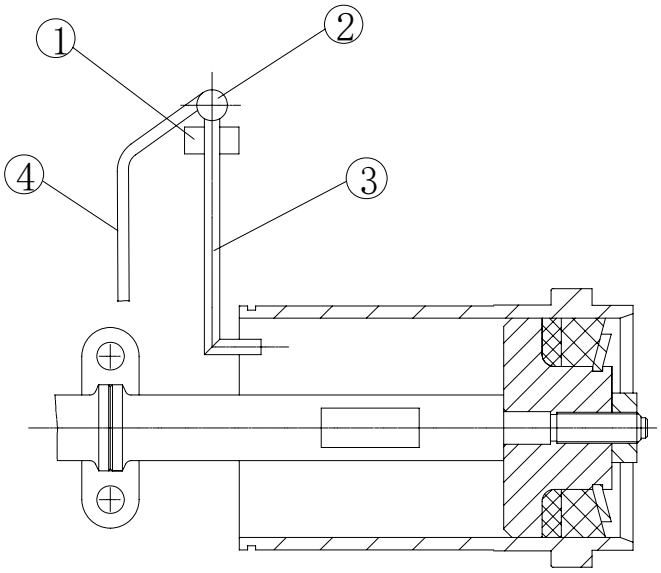


Fig. 5

(1) Fixing frame (2) Steel pipe (3) Spray Nozzle (4) Soft pipe

Cooling fluid be transfused from pump (Item 3 Fig .7) and Water tank (Item 5. Fig. 7) to the manifold on the frame. Adjust regulating valve (Item 4 Fig .7) to apply as much water as possible to the liners without splashing back on the crosshead extension rods and diaphragm stuffing box plate. If water is allowed to splash on the crosshead extension rods, some of the water will work back into the power end to contaminate the lubrication oil.

The cooling fluid is returned from the crosshead extension rod compartment to the setting chamber, and as the fluid overflows through the filter screen between the two sections of the tank, the solids are allowed to settle out. The filter screen will catch much of the foreign material floating in the fluid. With reference to Fig .67

Check condition of the cooling fluid at frequent intervals and CLEAN and FLUSH reservoir as required and replace the cooling fluid. Increasing Sand grain in Contaminated fluid will cause premature liner and piston wears from abrasion or stoppage of the spray nozzle or spray tube.

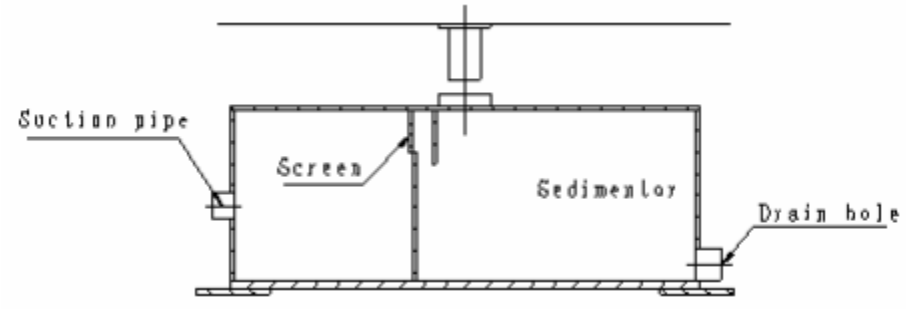


Fig 6

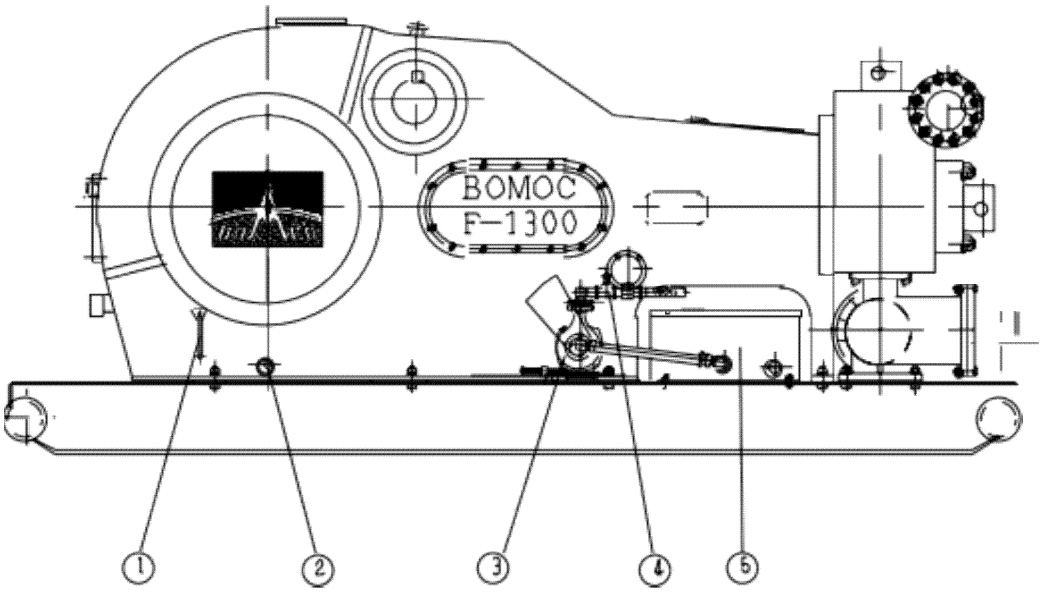


Fig. 7

(1)Oil level indicator (2)Plug (3)Spray pump (4)Regulating valve (5)Water tank

1.6 The assembly of Fluid End Parts

A cross-section through the fluid end for F-1300/1600 is shown in Fig, 8. With reference to Fig 8, clean and assemble the fluid end parts in the following manner:

Note: All of the parts in this fluid end assembly are designed with metal to metal seating to alleviate friction wear from breathing action encountered in modern high pressure pump operation. For this reason it is essential that all parts be clean and free of rust, nicks and burrs before being assembled.

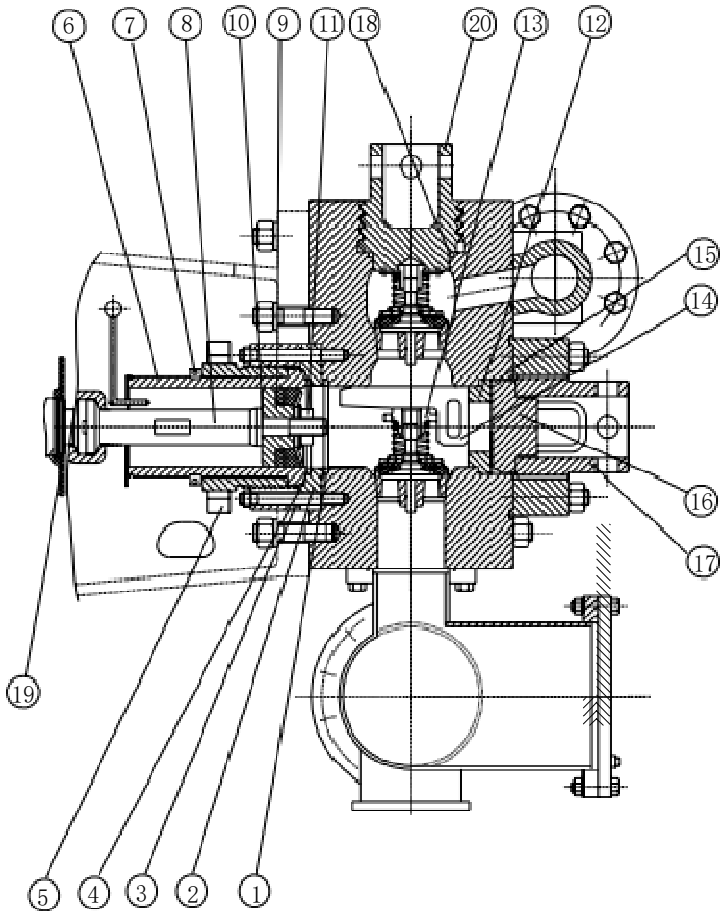


Fig. 8 F—1300/1600Fluid end assembly

(1)Wear plate seal (2)Wear plate (3)linear flange (4)linear sealing ring (5)linear lock (6)Linear (7)linear locking ring (8)piston rod (9)piston (10)piston sealing (11)nut (12)Allocation disc (13)valve rod guider (14)plug board (15)cylinder head sealing ring (16)Cylinder head plug (17)cylinder head

(18)valve cover sealing ring (19)mud apron (20)Valve cover

1.6.1 Valves and Seats

Remove all three discharge valve pot covers (1), and the three cylinder heads (2) and plugs (10), and thoroughly clean all machined surfaces in the fluid end with a good cleaning solvent.

Make sure all valve seat bores are VERY CLEAN AND DRY (no dirt, grease, anti-rust compound, etc). THOROUGHLY CLEAN AND DRY the valve seats and installs suction and discharge valve seats into the valve pot bores. Drive seats firmly into place with a bar and hammer to ensure contact closely. Install valves and springs and the other parts.

1.6.2 Liners

Installs wear plate seal (1) in counter bore of fluid end (see Fig. 8). Slide wear plate (2) over studs until it seats against fluid end. Slide liner flange (3) over studs with the starting thread at the 5 o'clock position and tighten bolts to470~510ft.lbs (640~690N.m) torque.

Note: Placing the starting thread at 5 o'clock position makes engaging the liner lock threads][much easier.

Place liner seal (4) in counter bore of wear plate (2). Apply thin coat of grease to ID of liner lock (5) and slide over rear of liner (6). Install two-piece liner lock ring (7) in liner groove and O-ring to hold them in position. Slide liner-handling tool over liner up against liner lock ring and tighten setscrew to secure it in place. Hoist liner assembly into position with jib hoist. Apply liberal coat of grease to liner lock threads. Align the starting thread of the liner lock (5) to the 7 o'clock position and insert the liner into the liner thread ring (3) screw liner lock in until liner seats in position. Tighten with sledgehammer on hammer lugs.

1.6.3 Piston Rod

Clean piston (9) and piston rod (8), making sure they are free of nicks and burrs. Install "O" ring seal (10) in groove in piston head. Slide piston head (9) on rod while observing that O-ring does not fall out of groove. Tighten piston rod nut (11) to 1625~2165 N.m (1200~1600ft.lbs.)

Coating liner I.D. and piston O.D. with grease. Check ends of piston rod and extension rod to be sure they are clean and free of burrs. Insert piston rod into liner through cylinder head opening holding piston rod centered at the rear of the liner. Drive the piston into the liner with a driving tool or a piece of hardwood and sledgehammer. Use caution as the piston rod approaches the crosshead extension rod that the dowel on the end of the piston rod is not damaged. The piston rod must be supported and the dowel guided into the pilot bore

1.6.4 Piston Rod Clamps

The piston rod clamps are machined as one piece and then sawed in half. The two pieces are with matching numbers on each half and connected by chain. The two pieces with the same matching numbers should always be kept together as a set. Install the clamp around the rod end flanges. Tighten bolt to the following torque values: 330N.m (245ft.ls). before the clamps are installed, mud apron (19) should be installed on the end of crosshead rod.

When rods and rod clamp are new a gap in excess of 5.5mm could be present between the two halves of the clamp, This is satisfactory provided the faces of the rods are seating metal to metal. As wear occurs, the halves will pull closer together. Clamping action will be lost when a gap no longer exists. At this time clamps must be replaced. Install splash plate on rear of liner.

1.6.5 Lower valve Guide and Cylinder Head

Insert the lower valve guide (13) through the alignment ring and position the guide over the valve stem. Start the lock plate (14) and draw it down, compressing the valve spring and seating the valve guide in the tapered slot. Insert allocation disc (12) into pump head hole and Install head seal (15) on cylinder head plug (16). Coat seal and O.D. of plug with light oil. Screw a 1 M length of pipe into the threaded opening on the plug. Using the pipe to balance the plug slide it straight into the fluid end opening. Apply a liberal coat of grease to the cylinder head threads and screw the cylinder head (17) in against the plug (16). Tighten cylinder head with wrench provided and sledge hammer.

Fluid leakage through the weep hole will indicate a defective seal or loose cylinder head. Should on time Replace seal or tighten cylinder head. DO NOT plug weep hole as this can result in severe damage to cylinder head threads, thread rings, etc, in event of a liner seal failure.

1.6.6 Valve Cover

Install valve cover (18) into bore, and after liberal application of grease or tool joint compound to the gasket and thread area, tighten the valve covers into place, using a sledge hammer and bar.

1.6.7 Discharge Manifold

A 5"（127mm）5000psi flange connection is provided on the discharge manifold. Remove flange and protect gasket area before welding (customer's option) to the discharge piping. Tighten discharge flange connection bolts to 1625-2165 N.m (1200~1600ft.lbs.)Torque. To insure uniform make-up of the ring joint connection, tighten flange bolt nuts in a cross-criss order. If a blind flange is installed on the opposite end of the discharge manifold, check flange bolts and tighten to same specification as noted above.

1.6.8 Suction Manifold Flange

The suction flange has a standard thread connection 12"（305mm）and is custom made to match the companion flange on the pump suction manifold. An O-ring seal seals off the connection. Thoroughly clean O-ring groove and face of flanges before making up connection. Tighten flange bolts to 490~665N.m.

1.6.9 Accessory Manifold

An accessory manifold Fig .9.is available for installation on the discharge manifold opposite the discharge end, The manifold will accommodate a KB-75 pulsation dampener (1) and provides a 3"NPT and a 2″NPT side outlet connections for such items as a shear relief valve (3) and a pressure gauge (2).

Note: when pressure gauge connection is R 1 1/2″, a transition joint should be used.

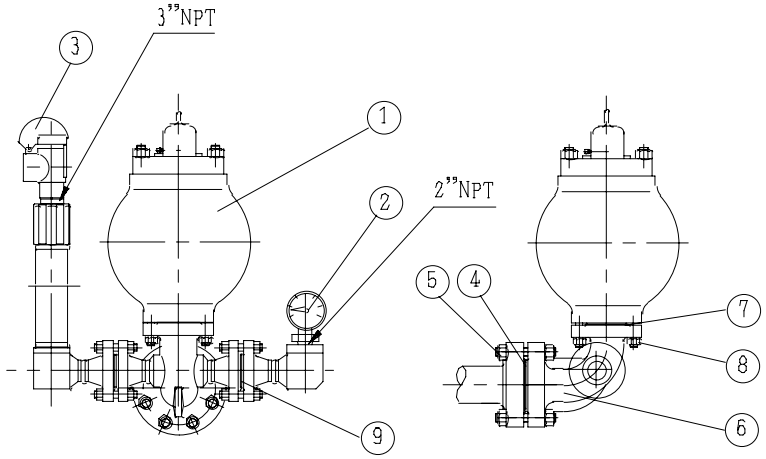


Fig. 9

(1) Pulsation dampener (2) pressure gauge (3) shear relief valve (4) ring (5) flange bolt (6) Discharge spool (7)-gasket ring (8)nut

An accessory manifold connect with discharge manifold by flange. Before assembly thoroughly clean ring joint groove, install ring (4) and tighten the flange bolts (5) to 1625N.m. torque. To assure uniform make-up of the ring joint connection, tighten the nuts in a criss-cross order.

The shear relief valve (3) is installed on the discharge manifold for the purpose of protecting the pump from excessively high-pressure overloads. The relief valve must be installed so that is will be directly exposed to the mud. DO NOT PUT ANY TYPE OF SHUT OFF VALAE between the relief valve and the manifold. Pipe the discharge side of the relief valve directly into the mud pit with as few turns

in the line as possible. If the turn must be made, the elbow should be over120º. IT IS NOT RECOMMENDED for the discharge side of the relief valve to be piped into the suction line of the pump.

The mounting for KB-75 pulsation dampener (1) is a flange with R-39 ring gasket. Before installing dampener, thoroughly clean ring groove and ring, and after setting dampener into place, tighten the nut (8)to 1020N.M torque. to insure uniform make-up, tighten nuts in a crisscross order.

Precharge dampener before starting up pump. Precharge pressure should not be more than maximum of 4.5Mpa. Dampener should be charged with nitrogen or air. Do not charge with inflammable and explosive gas such as oxygen and hydrogen etc. (with reference this instruction manual"dampener")

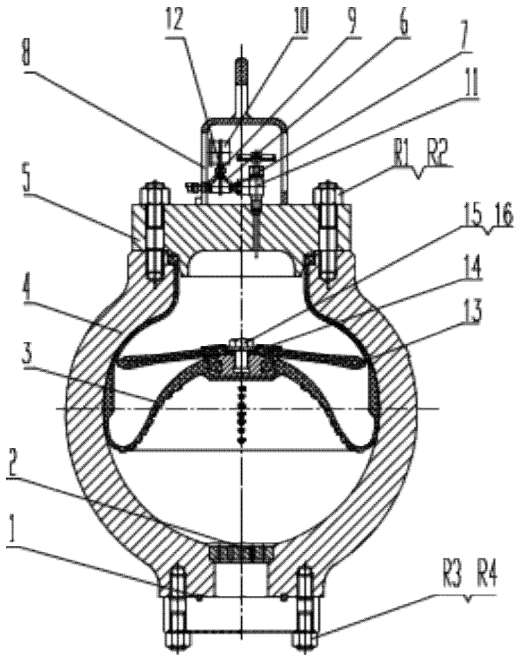


Fig. 10 KB-75 dampener assembly

(1) Gasket ring (2) bottom blug (3) bladder (4) shell assembly (5) cover (6) tee joint (7) Joint (8) shield of pressure gauge (9) exhaust valve (10) pressure gauge (11) stop valve (12) Gasket (R_1) stud (R_2) nut (R_3) stud (R_4) nut

1.7 Dampener Assembly

Proper installation and usage of dampener can availably reduce the pressure fluctuation of discharge system therefore obtaining more smooth fluid. For the sake of acquiring long life span of dampener, usually make pressure of pump and Precharge pressure of bladder to keep the suggestion proportion.

(Precharge pressure should not be more than 2/3 of the pump discharge pressure, or a maximum of 4.5Mpa.）

1.7.1 Installation

The lifting lug installed on the shield of pressure gauge is used for lifting dampener assembly. Before assembly thoroughly clean gasket ring and groove of mating flange and coat with grease.

Lifting the dampener to the corresponding position of mud pump discharge line, rotate nut (R4) to 1085N.m (800ft.lbs) torque. Assure the connection part is flat and aligned by alternantly tightening the nuts.

1.7.2 Gas charging

a set of gas charging device is attendant when equipment leave factory（gas charging hose assembly of dampener）please Operate as following procedure: (See Fig. 11)

1. Remove shield of pressure gauge of dampener, rotate valve cover of exhaust about 1/4-1/2 turn to release the air pressure existed in pressure gauge area, then remove the exhaust valve.

2. Connect hose to the nitrogen cylinder valve and charge valve of dampener.

3. Open the charge valve of dampener.

4. Slowly open the nitrogen cylinder valve, use this valve to adjust incoming gas of dampener.

5. When the pressure gauge of dampener indicates pressure required then shut the nitrogen cylinder valve.

6. Shut the charge valve of dampener.

7. Remove hose, cover the shield of pressure gauge, then install the exhaust valve.

For getting best result, Precharge pressure should not be more than 2/3 of the pump discharge pressure, or a maximum of 4.5 Mpa. (650psi)

Warning:

1. Only charge with compressed nitrogen or air. Do not charge with inflammable and explosive gas such as oxygen and hydrogen etc.

2. When make maintenance to the dampener, insure both the dampener pressure gangue and the pump pressure gangue indications is zero. Low pressure can't be exactly shown by the dampener pressure gangue, which may cause an accident.

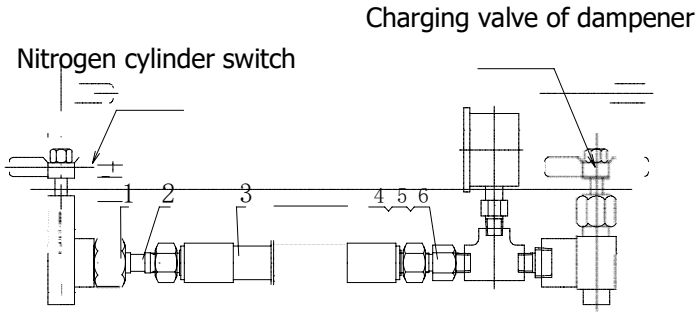


Fig. 11

(1)Nut C5/8″ (2)Seal connector (3)Connector type C-type ⑷Seal connector (5)Gasket (6)Pipe plug

1.8 Safety Valve

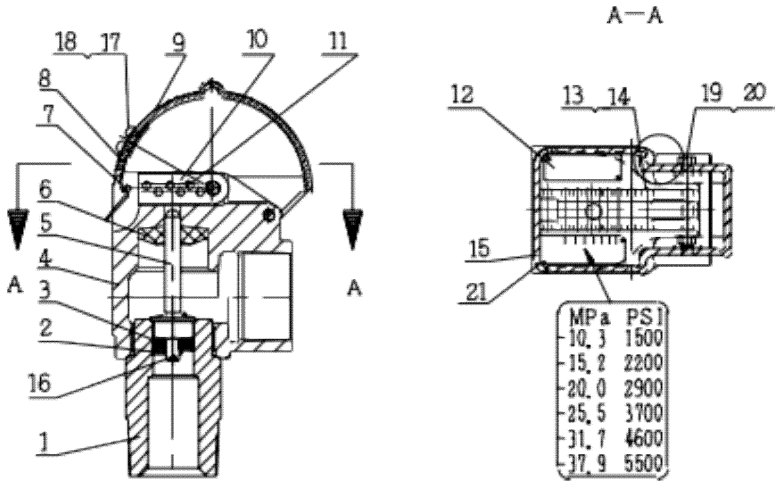


Fig 12

(1)Connector (2)Retainer Ring (3)Piston Assy. (4)Body (5Piston Rod (6)Bumper (7)Pin (8)Spring (9)Safety Cap (10)Shear Bar (11)Shear Pin (12)Warning Plate (13)Shear Bar Pin (14) Retainer Ring (15)Name Plate (16)Cotter Pin 4×26 (17)NutM4 (18) Screw M4×16 (19)Bole M10×110 (20)Nut M10 （21）Screw

JA-3shear pin safety valve constructer refers to Fig 12. When the pump charging pressure exceeds the rating pressure under a given liner, the piston moves up until attach the shear bar and power it raise up, and finally the bar breaks the shear pin and high pressure mudflow quickly.

Change the position of shear pin can adjust the release pressure value. The operation is simple and reliable.

Each classification work pressure is marked on the shear bar. When adjust the pressure, just to do is put the shear pin in the relevant hole according to the given pressure.

Note: There must be only one shear pin in the shear bar one time! Adjust the pressure with the liner changes.（Refer to Section 1.1.2）。Wire, arc welding or other alternative material are strictly forbidden, otherwise the valve pressure is affected which maybe a reverse accident.

2. Lubrication

Proper lubrication of the moving parts in any piece of machinery is the most important single factor affecting its ultimate life. To obtain maximum trouble-free service life from the power end of pump, it is necessary to perform routine maintenance care and an inspection to insure the proper amount of CLEAN lubricant is being provided on the fiction surface of moving parts.

2.1 Minimum Operating Speeds

The F-Series pumps utilize the controlled flow oil bath splash and pressure system to lubricate the entire power end. The type of pressure system provided in each individual pump will govern the minimum SPM at which the pump can be operated, F-1300/1600 mud pump have the pressure lubrication system, and which can be operated at 25 SPM (at oil pressure of 0.035 Mpa)

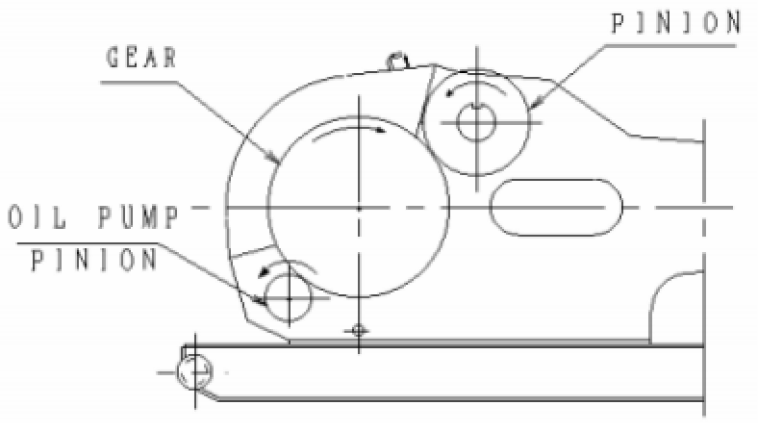


Fig. 13

CAUTION: The pressure lubricating system can be provided with an externally mounted oil pump driven through V-belts or an internally mounted oil pump driven from the main gear. When an internally mounted oil pump is used, the direction of rotation of the pinion shaft must be as shown in Fig. 13.

2.2 Controlled Flow Splash System

The controlled flow splash lubrication system is the same for all F-Series pumps, regardless of the type of oil pump drive provided for the pressure system In the controlled flow splash system, the main gear picks oil up from the reservoir, and when the teeth mesh with the pinion, the oil is displaced into various troughs and compartments in the frame. With reference to Figure 15, the oil thrown into oil trough (7) is directed through the oil tube (8) to the two pinion bearings.

Oil passage from the of the crosshead guide compartment to the crosshead bearing is shown in Figure 14, Oil accumulates in the compartment over the crossheads. The oil runs through the nipple (1) into the crosshead retainer to the oil passages (5) and on to the crosshead pin bearing. As noted, the duplicate set of oil passages (5) in the crosshead pin permits the crosshead pins to be rotated without having to give attention to hole alignment. This permits the installation of crosshead pins from either direction.

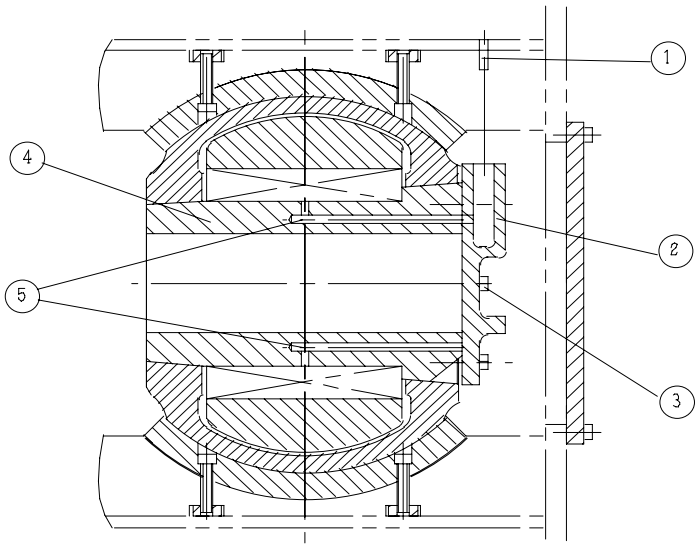


Fig. 14

(1) Nipple (2) retainer (3) bolt (4) crosshead pin (5) oil passage

2.3 Pressure Lubrication System

The pressure lubrication system, incorporating the oil pump for the F-series pumps, is shown in Figure 15: In this system, filtered oil is supplied to the pump through the suction filter (1) and is discharged from the pump into the manifold block (2) and nozzle (3A). Oil is distributed to the main bearing oil line (4) and the crosshead compartment manifold block (4A) located above the crosshead

(1)Filter (2) manifold block (3) oil line (3A) spray nozzle (4) main bearing oil line (4A) Manifold block (5) pressure gauge (6) relief valve (7) oil trough (8) oil tube (9) Lubrication pump

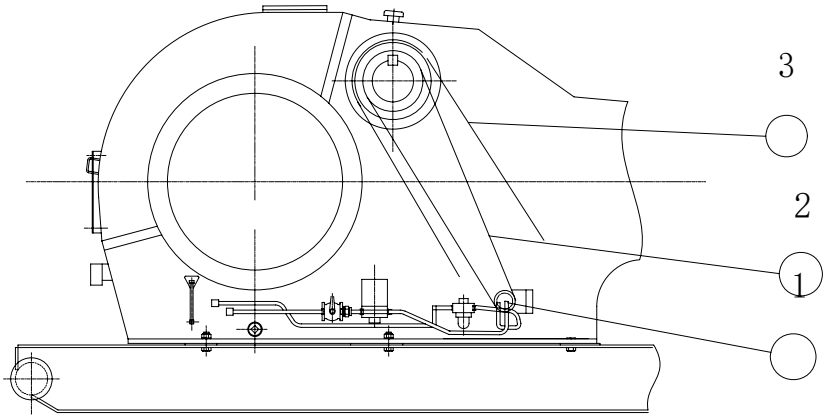


Fig. 16

(1) Oil pump (2) V-belt (3) guard

A typical layout for the pinion shaft driven oil pump is shown in Fig. 16.The oil pump (1) is piped into the oil system through the suction and pressure connections on the bottom inside wall of the power frame. Do not adjust V-belt drive (2) too tight. Over tightening can cause premature failure of the pump. To prevent possible injury, always install guard (3) over V-belts before putting pump into service.

2.4 Maintenance of Lubrication System

Adequate lubrication of the moving parts is, as stated, the most important single factor affecting the ultimate service life of the pump, CARE AND MAINTENANCE of the system is the sole responsibility of the operator or crew to which it has been assigned, and the extent to which this is applied will determine the amount of trouble – free service life that will be obtained.

2.4.1 Lubrication specifications

The lubricant recommendations shown below, on the nameplate on the side of the pump, are the result of extensive long-term field tests and can validate to wear away (include gear, bearing and guild cross head). Substitutions should be made only in extreme emergencies.

2.4.2 Oil reservoir capacity

Oil reservoir capacity: 379 liters (100 U.S . Gallons)

2.4.3 Routine inspection

ONCE EACH TOUR, check and maintain oil level at the FULL mark on the bayonet gauge. PUMP MUST BE SHUT DOWN and allowed to stand idle for approximately five minutes to allow oil level to equalize. ONCE EACH SIX MONTHS, or more often if oil becomes contaminated with abrasive particles or corrosive compounds, drain and flush the oil reservoir then fill in new lubricant. Oil drains are located on either side of the pump frame. During the flushing procedure, thoroughly clean the oil troughs and the compartment in top of the crosshead guide. Also clean or replace the filter element in the air breather cap and clean suction screen. Remove covers from settling chamber and purge out contaminants before adding new oil.

Routine inspection on condition of oil should be made as condensation of moisture in the air, intrusion of mud, water or dirt, can necessitate a more frequent oil change.

Contamination should be drained out of the pump through the clean out covers located on the frame wall underneath the crosshead inspection doors.

Once each month, remove clean out covers on both sides of pump to drain contaminated oil from setting chamber. Approximately 15-gallons of oil be lost; replenish the main reservoir to compensate for the amount drained out.

Once each week, remove one of the lower 1/2" cap screws that secure the clean out cover to the frame to drain off water condensate.

ONCE EACH TOUR, check oil level in main reservoir. Maintain at full mark on dipstick to the manifold block. If loss of pressure occurs, check for:

- Clogged suction screen
- Low oil level
- Slipping V-belt drive
- Broken or loose connections
- Damaged or worn oil pump
- Defective Relief valve

For an abnormal increase in oil pressure, check for:

- Plugged oil lines
- Contamination causing oil to be viscous
- Relief valve inoperative

- Defective pressure gauge
- Other conditions

3. Maintenance

3.1 Power End

Routine inspection of the power end is the most important form of preventive maintenance and will result in considerable savings by detecting any major trouble that might be developing and allowing the necessary repairs to be made on a planned or transport rig-down time.

3.1.1 Check tightness of the main bearing bolts.

Bolts must be tightened to the following torque: 13210 N.m (9750ft.lbs)

3.1.2 Safety wires

Check safety wires on all bolts including the main bearing hold-down bolts and eccentric bearing retainer bolts. Replace any broken wires after retightening the bolts. Refer to crankshaft assembly section for bolt requirements .

3.1.3 Oil lines

Check all oil lines to insure they are intact and free of obstructions. Check oil pump suction hose for damage or flat areas.

3.1.4 Suction filter

Check condition of suction filter. Clean and replace as required.

3.1.5 Main bearing cover

Remove the main bearing cover and check tightness of main bearing retainer blots, condition of the bearing rollers, etc. Clean and remove any sludge or foreign substance that might have accumulated at the bottom of the bearing area.

3.1.6 Main gear and pinion teeth

Inspect the condition of the main gear teeth and pinion gear teeth for any indications of abnormal wear. During the initial break-in period there will be some pitting on the face of the gear teeth. This is referred to as" initial pitting "and is not harmful to the life of the gear. However, if routine inspection indicates the degree of pitting continues to increase, immediately contact the pump manufacturer for a more thorough inspection of the gear.

3.1.7 Crosshead pin bolts and crosshead guides

Remove cover and check condition of the crosshead pin bolts and safety wires. (Center crosshead pin bolts can be reached by removing back cover and placing eccentric on outer top dead center). Tighten

crosshead bolts M24X70(Item 3 Fig .14) to the torque: 225-240 N.m (165-175ft.lbs)

3.1.8 Oil and oil reservoir

Check condition of the oil and cleanliness of the oil reservoir. Service oil system as described in the Lubrication Section of this manual.

3.2 Roller Bearings

Anti-frication bearings are adopted by MTPM-F series mud pumps.

A roller bearing is a precisely built machine within itself; therefore, careful handling is required in order to obtain the long service life and high load carrying characteristics associated with anti-frication bearings.

The main bearings are self-aligning spherical roller bearings. The pinion shaft is mounted on straight roller bearings. The eccentric bearings are straight roller with thrust plates on each side to keep the eccentric straps in line, and the crosshead pin bearings are straight needle roller bearings. None of the bearings require special adjustments.

All inner and outer races are assembled by means of very accurate fits. This accuracy is necessary; therefore, if the bearings are to be used again, he inner and outer races and the roller assemblies of each bearing must be kept together, and reinstalled exactly as they came off.

It is always necessary to completely replace any roller bearing that fails, even though only one part of the bearing damages. Since the running clearances of these bearings are extremely small, excessive clearances, worn or grooved raceways, and any pitting or flaking of the parts is indication of failure and the entire bearing should be changed as soon as possible.

All roller bearings are assembled to their shafts by means of shrink fits. (Ref. To bearing fit data under each shaft assembly.) Damaged or worn bearings and raceways can be removed by driving them off the shaft with a bar and hammer. They also can be cut off from the shaft with a burning torch, but care must be taken not to burn into the shaft. Bearings should always be heated in an oil bath ,the temperature of which should not exceed 149℃ .(300°F). Be certain that both the oil and the container are very clean. If the oil container is indirect contact with the fire, place a rack into the container so that the bearings will not rest on the bottom. Do not leave the bearings in the oil bath longer than three minutes.

Do not heat the bearings with a torch unless it is the only possible means available. When it is

necessary to use a torch, it should be used only by an experienced welder or mechanic. Hold the torch at least 150mm (6 inches) away from the bearing and keep the torch moving at all times. Use a Tempil stick. **DO NOT OVERHEAT THE BEARING**. Overheating draws the temper of the metal and soften bearing .

Once the heated bearing is in place on the shaft, hold it in place until it cools naturally. **NEVER USE WATER OR ANY OTHER LIQUID TO COOL A HOT BEARING**. Rapid cooling will cause the surfaces of the races and rollers to "check" or crack and the bearing will fail immediately.

Never strike a roller bearing with a steel hammer. If the bearing must be driven into position, use wood or a soft hammer and strike lightly.

Always coat the shaft or housing with grease before installing the bearing. Clean white lead, that is an anti-seize compound, is the best lubricant for this purpose.

Do not remove a new bearing from the box or wrapping until it is to be installed. Protect it from dirt and other foreign matter at all times. If a bearing must be cleaned, use clean kerosene or other solvent.

3.3 Pinion Shaft Assembly

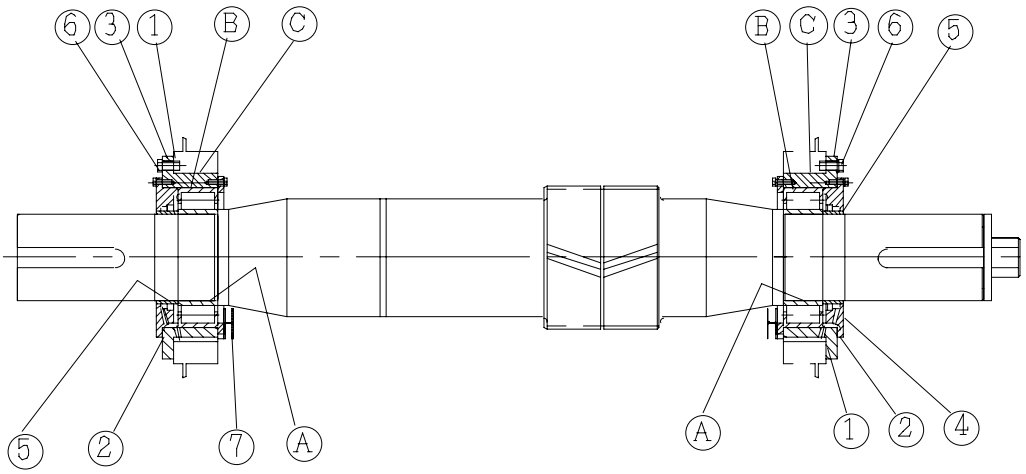


Fig.17

(1) washer (2) end cover washer (3) bearing sleeve (4) end cover washer (5) anti-abrasion sleeve (6) bolt

GHART II **(mm)**

Description	Inner Race. to Shaft	Outer Race. to Bore	Carrier to frame Bore
Position	A	B	C
Data	T0.050～T0.109	T0.115～L0.018	L0.203～L0.076

Note: T-shrink range L-space range

The pinion is an integral part of the shaft leaving only the installation of the bearings and oil seal spacer to complete the assembly.

The running clearances of the bearings are predetermined by their precision fit to the shaft and the bearing carrier. When performing maintenance or overhaul, make sure the fits show in chart II is obtained.

When installing the pinion shaft assembly in the pump observe the following precautions:

1) Insure pinion bearing carrier gasket (1) and oil seal carrier gasket (2) are in place and in good condition.

2) When installing the pinion bearing carrier (3) and the oil seal carrier MAKE SURE THE CARRIERS ARE INSTALLED WITH DRAIN HOLES AT THE TOP to correctly position oil troughs and align drain holes.

3) Remove burrs, dents or gouges from the OD of the oil seal spacer (5) before sliding oil seal carrier (4) into place. Exercise care when sliding lip of seal over end of shaft to prevent it from being damaged by the sharp edge of the keyway. Also pay particular attention to insure oil seal lip IS NOT TURNED UNDER by edge of spacer when sliding seal onto the spacer.

4) Tighten pinion bearing carrier bolts (6) to the approximate torque 110～215N.m (80-165ft .lbs)

5) Check condition of the pinion bearing inner and outer race and rollers. If there is any indication of galling, flaking or grooving , or if diametral clearance exceeds 0.20～0.25mm, it is recommended the entire bearing be replaced.

3.4 Crankshaft Assembly

The crankshaft assembly consists of the crankshaft, eccentric ring gear, eccentric strap with bearings, and the main bearings.

The running clearances of the bearings are predetermined by their precision fit to the shaft and their respective bores, When performing any maintenance or overhaul, make sure the fit shown in chart III

are obtained.

Instruction	Inner ring and shaft neck	Out ring and hole	Inner ring and shaft	Out ring and hole
position	A	B	C	D
Data mm	T0.098～T0.165	L0.095～0	T0.175～T0.300	T0.100～L0.050

Instruction	Gear ring and flange	Bearing seat and frame hole	Out ring and hole	Inner ring and pin
position	E	F	G	H
Data mm	L0.025～L0.127	L0.051～T0.051	T0.015～T0.075	T0.031～T0.090

Note: T-shrink range L-space range

Assemble the crankshaft in the following manner:(Refer to Fig.18)

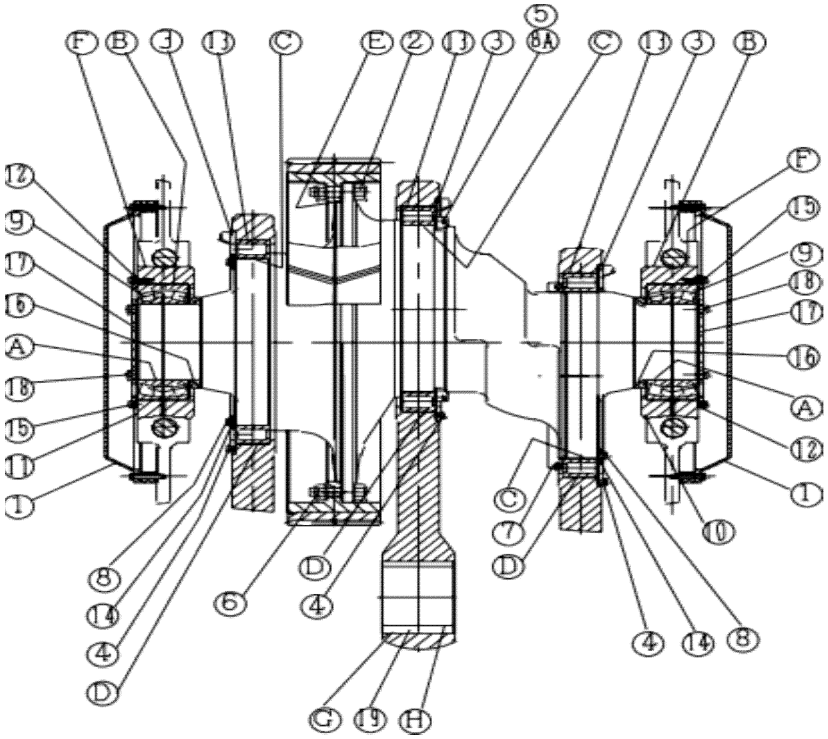


Fig.18

1. end cover 2. bolt 3. baffle ring 4. bolt 5. bearing baffle ring 7. baffle ring 8. bolt 9. main bearing 10. right bearing sleeve 11. left bearing sleeve 12. out baffle ring 13. connect rod

bearing 14. inner baffle ring 15. bolt 16. main bearing baffle ring 17. inner ring baffle blate 18 bolt 19. crosshead bearing

1) Mount gear ring and check jumping

Thoroughly clean mating faces of ring gear and flange and bolt flange into position. Tighten flange bolts (2) to the torque: 2455 N.m (1810ft .lbs)

2) Install the outer races of the eccentric bearings (13) and the outer race retainer ring (3) in the three eccentric straps. Outer race retainer ring must be positioned so that oil scoop is at the bottom when pump is at mid-stroke. Tighten retainer bolts (4) to the torque 60～90 N.m (44～66ft .lbs) : safety wire heads.

NOTE: The inner and outer races of the eccentric bearings are matched and must not be intermixed.

3) Install the outer race of the crosshead bearings in the three eccentric straps .It is preferred that the outer race assembly be "pressed" into position of frozen in "dry ice" or a deep freeze until it can be inserted into the bore. Under emergency circumstances, the outer race assembly can be installed by using a large torch and heating the eye of the eccentric strap . DO NOT EXCEED 149℃(300°F) (Use Temil Stick) and DO OT USE WATER to cool the strap.

NOTE: The inner and outer races of the crosshead bearings are matched and should not be intermixed.

4) Install the inner race of the crosshead bearing on the crosshead pin and marks according to their respective eccentric strap positions (such as 1, 2, 3 or left, middle, right). Remove all nicks and burrs before shrinking race into place. Refer to bearing fit Position H Chart III.

5) Install inner race of the center eccentric bearing on the shaft. Slide center strap into position and install inner race clamp (5). Tighten socket head screws (8A) in clamp to the torque 60～90 N.m (44～66ft .lbs) .

6) Install snap ring (7) in the groove on RH eccentric and shrink inner race of eccentric bearing on shaft. After sliding the RH eccentric strap into position, install inner bearing retainer (14).Tighten inner race retainer bolts (8) to the torque 60～90 N.m (44～66ft .lbs)

7) Install the LH eccentric bearing (other than for snap ring) and eccentric strap under the same procedure outlined in step 6 above.

8) Place main bearings (9) in the main bearing carriers (10 RH and 11 LH) and install outer race retainer (12) and retainer bolts (15). Tighten bolts to the torque 60～90 N.m (44～66ft .lbs):

9) After installing the two main bearing spacers (16), shrink main bearings (9) on each end of the shaft. Install inner race retainers (17) and retainer bolts (18) .Tighten retainer bolts to the torque: 60～90 N.m (44～66ft .lbs)

3.5 Installing Crankshaft Assembly in Frame

In order to obtain a more precise fit between the main bearing housing and the frame bore on MTPM F-Series pumps, the installation procedures outlined below are to be followed (Refer to Fig. 19)

1) Place a piece of wood between eye of eccentric strap and crosshead guide (as shown in Fig. 20) to protect guide from scoring or gouging as the straps are sliding into position.

2) Rotate the main bearing carrier so that the two flat spots (180° apart) are parallel with the main bearing bolt holes, and slowly lower the crankshaft into position. (The flat spot provides clearance for the main bearing bolts.)

3) After placing crankshaft in the frame, and before installing the main bearing covers, check the roller is in the main bearings to assure that each row of rollers in each bearing is equally loaded. Equal loading is obtained by positioning the floating bearing carrier. Assure the number of inner and outer rollers supporting the weight of the crankshaft in each bearing is same, and then tight the bearing covers. Because of tolerances, etc., the total number of tight rollers could very slightly different between individual bearings. The preload pressure on the main bearing carrier is obtained by placing the correct amount of shims under the main bearing cap.

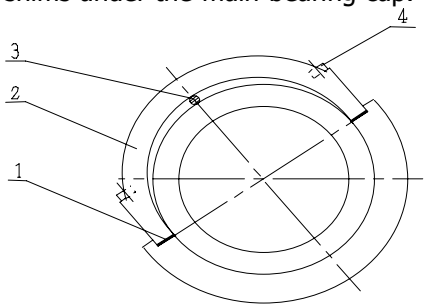


Fig. 19

1. washer 2. bearing cover 3. lead wire 4. main bearing bolt

4) Install 0.50mm (0.02") shims under both ends of the main bearing cover to get pre-tighten. Total thickness is as following:

- Place a piece of lead wire (approximately 0.8mm diameter) or plastic gage between OD of

bearing carrier and ID of bearing cap, as near center of bearing cap as can be determined, and tighten main bearing bolts

- Remove main bearing cap and determine clearance between bore of cap and OD of bearing carrier by either measuring thickness of compressed lead or measuring compressed dimension of plastic gage.

- Using this dimension, calculate the required thickness of shims as follows:

Subtract thickness of compressed lead or plastic gage from the original 0.50mm shim thickness. Then subtract 0. 1mm for preload. The result is the correct shim thickness required.

Example:

1.00 mm Original shims thickness	or	0.040 〃
-0.63mm plat lead wire thickness		—0.025 〃
0.37mm		0.015 〃
—0.06-0.10mm tighten interference		—0.0024-0.0040 〃
0.31-0.27mm the correct shim total thickness		0.0126-0.0110 〃

NOTE: Machining tolerances make it necessary to determine individual shim requirements for each (right hand and left hand) main bearing cover.

5) Install main bearing caps with the correct amount of shims as determined above, and tighten main bearing bolts to torque values IV.

6) Again check inner and outer row of rollers on each bearing as previously outlined to assure equal loading is still present on each bearing.

CHART IV

Instruction	Torque		Thread Size	Wrench Size	
	N.m	ft.lbs		mm	in
Data	13210	9750	3”-8UN	92.0	3 5/8”

3.6 Installing of Crosshead Guides

When installing crosshead guides observe the following procedures and precautions:

1) Thoroughly clean all dirt or contamination and remove all burrs or rough edges from both sides of the guides and the frame bore where the guides fit.

2) If old guides are to be reused, inspect the wearing surfaces for wear and scoring streaks.

NOTE: For F-1300/F-1600 upper and lower crosshead guides are NOT interchangeable. The guides are machined so that the lower guide places the crosshead on frame centerline, and upper guides are machined to afford proper clearance between crosshead and upper guide.

1) Install upper and lower guides, Torque guide screws to 200～270N.m (150～200ft.lbs)

2) Check between frame and guides at points A, Fig. 21A, with 0.05mm (0.002") feeler gauge to make sure guides fit into bore.

3.7 Installing of Crosshead

The crossheads in the pumps can be installed through the front (fluid end) or back end of the crosshead guide .

Refer to Fig.20 When installing crossheads, and observe the following precautions:

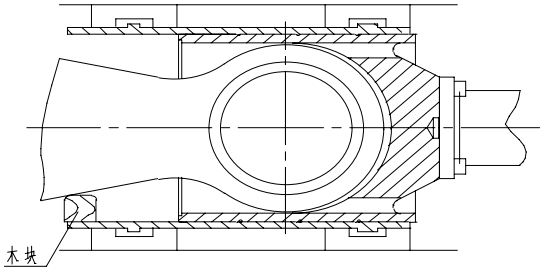


Fig.20

1) Thoroughly clean all dirt or contamination and remove all burrs or rough edges from OD of the crosshead, crosshead pin bores, and inner bore of crosshead guide. Dry crosshead pin bore so taper bore connection will make up metal to metal See Note.

2) Position "eye" of eccentric at the opening in the side of the crosshead guide. Block eccentric strap so that crosshead will clear the "eye" as it is sliding into position to where the crosshead pin holes are in alignment. Refer. Fig 20.

3) Install the left hand crossheadfirst, rotate eccentric assembly to make "eye" into center crosshead and right hand eccentric strap "eye" back, affording clearance to install center pin through right hand

crosshead inspection door. Remove diaphragm stuffing box plate (1,Fig.21) and install right hand crosshead through this bore. Slide into place and install crosshead pin.

4) Install crosshead pin retainer (2) and retainer bolts (3) and rotate pin until the four crosshead retainer holes with crosshead bolt holes (4) are in an alignment. Install the crosshead retainer bolts and tight by hand. Ref. Fig 21.21A

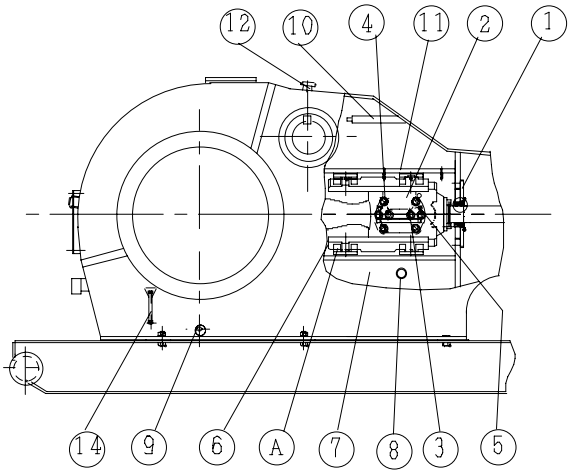


Fig.21

1. mud baffle disc 2. crosshead pin baffle plate 3. bolt 4. bolt 5. hole 6. lower guide plate 7. frame 8. limber hole 9. pipeplug 10. oil box 11. upper guide plate 12. vent cover 14. oil level

Seat crosshead pin in tapper bore by bumping large end with a light blow, and add adjusting shims between crosshead and crosshead pin retainer (individualshims required for each matched crosshead and retainer). Tighten retainer bolts (3 and 4,Fig.21,21A) to the following torque and safety wire:225～240 N.m (165～175ft. 1bs)

DO NOT EXCEED THESE VALUES. USE TORQUE WRENCH.

NOTE: To pull the crosshead pin, remove the four crosshead retainer bolts (4) and screw two of the bolts into the "jack screw" holes (5). Tighten the two jack screw bolts until the pin breaks loose. Complete removal of crosshead pin retainer plate (2) and slide pin out of bore.

5) Check running clearance of crosshead by sliding long "feeler" gauges between crosshead and upper guide bore. The clearance should not be less than 0.508mm (0.020"). Check with long feeler gauge over entire surface of crosshead.

NOTE: Less running clearance at center of crosshead can be caused by "swelling" from over tighting the crosshead pin retainer bolts (4). If present, loosen pin and retighten into place by using the make-up torques shown in paragraph 4.

3.8 Checking Crosshead Alignment

In order for the pistons to run normally in the liners, the crosshead must travel in a straight line along the horizontal centerline of the frame bore. To check and adjust crosshead alignment, proceed as follows:

1) Remove diaphragm stuffing box from the diaphragm plate, (Fig,21).Do not remove the plate.

2) Position crosshead at the extreme front of its stroke. With inside calipers or telescoping gauges, accurately measure the distance from the diaphragm plate bore to the crosshead extension rod at the top and bottom. Compare the two measurements to determine the position of the rod relative to the centerline of the bore.

3) Rotate pump to extreme rear of stroke and take measurement again at the same place. Compare these measurements to the ones taken at the front of the stroke to determine if crosshead is running horizontally.

4) If the centerline of the extension rod is more than 0.381mm (0.015") low in the diaphragm plate bore, shims should be inserted under the lower guide to bring the extension rod back to center, provided there is ample clearance between the top of crosshead and upper crosshead guide. It is normal for the lower guide to wear more at the rear due to heavier loading at this point because of the angle of the eccentric strap. It is permissible to shim the guides on a taper if is done accurately to provide firm support for the guide.

Note: the pump must reverse due to power reason, the pressure will act on the upper guide plate, so the clearance of guide plate should be controlled in 0.25-0.40mm (0.010-0.016)

5) Do not shim guides to less than 0.50mm (0.020") clearance between upper guide and crosshead. The large crosshead clearances are acceptable due to characteristics of triplex pump operation, the crosshead pressure is always on the lower guide.

Cut shims from steel shim stock long enough to reach completely across the guides. Cut tabs on the side to bend down over frame supports to hold them in place. Refer to items 3 and 4 under

Installation of Crosshead Guides.

3.9 Fluid End Maintenance

For many years, the fluid end of a pump was considered a non-wearing part which did not cause any concern other than possible infrequent repairs or replacements resulting from fluid cuts or washouts. However, the higher pressures of the present-day drilling requirements have resulted in higher stresses being imposed on the fluid end which, when combined with the corrosive characteristics of the drilling fluid, have resulted in the demand that more and better maintenance be given to the fluid end parts and pieces if a reasonable operating life is to be obtained. A view of the obvious points is as follows:

1) Make sure all valves on the discharge side of pump are opened before pump is put into operation. Kicking pump in against a closed valve can often be the start of a fatigue crack. An open crack may not necessarily occur at the precise moment, however, a small crack could occur and start the process of "corrosion fatigue failure"

2) Do not engage pump clutch when prime mover is running at a high rate of speed. Which can cause undesirable shock loads against both power end and fluid end.

3) Properly maintain pressure relief valve to assure it is set for the pressure rating on the liner size being used. Refer to the description about the relief valve.

4) Do not operate the pump for an extended period of time if a severe fluid knock is present.

Properly prepare fluid end for storage. When pump is to be shut down or not operated for a period of ten days or more, it is recommended that the fluid end parts such as liners, pistons, rods, etc, be removed from the pump and the fluid end be flushed out completely with fresh water, After a thorough flushing, apply grease or a rust preventative to all of the machined surfaces such as valve pot cover threads, valve pot cover gasket surfaces, valve seats, liner bores, etc. The parts removed from the pump including liner, piston rods, etc., should of course be protected correctly. This will not only extend the life of the fluid end through resistance to corrosion,but will also protect the expendable parts still left in the pump and maintain them in good condition for installation in the pump at the next start-up period.

The fluid end assembly for these triplex pumps consists of three forged cylinder blocks, complete with valve pot covers and cylinder heads, a suction manifold, and a discharge manifold.

3.9.1 Fluid Cylinder blocks

The three separate fluid cylinder blocks (1) bolt metal –to-metal to the power end frame through retainer studs (2), Alignment with the power end frame bores is obtained through the "pilot" boss on fluid end. However, to obtain accurate alignment, all nicks or burrs must be removed from "pilot" boss and frame bore and all dirt and foreign matter cleaned from the mating surfaces; otherwise cylinder blocks could make up in a "cocked" or misaligned position.

Chart V

Position	Size （mm）	Size （in）
A	209.55-209.68	8.250-8.255
B	180.97-181.10	7.125-7.130
C	209.60-209.68	8.252-8.255
D	368.27-368.32	14.499-14.501
E	6.35×45°	0.250×45°
F	76.07-76.20	2.995-3.000
G	15.87-16.00	0.625-0.630
H	28.45-28.70	1.120-1.130
J	149.10-149.35	5.870-5.880
K	158.67-158.90	6.247-6.252
L	168.40-168.53	6.630-6.635
M	187.32-187.45	7.375-7.380
N	12.57-12.83	0.495-0.505
P	Conicity 1：6	2″Taper per ft. on dia.

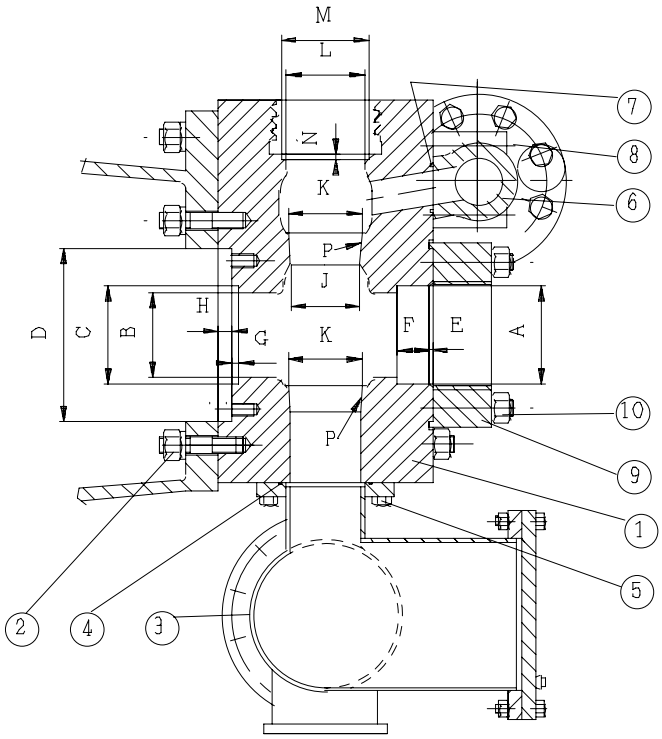


Fig.22

1.hydraulic cylinder 2.bolt 3.suction pipe 4.O-ring 5.bolt 6.discharging pipe 7. O-ring 8. bolt 9.cylinder cover flange 10.bolt

3.9.2 Suction Manifold

The suction manifold (3) bolts to each cylinder block and is sealed through the 0-ring in the connection flange. Thoroughly clean o-ring groove, the 0-ring sealing surface on bottom of the cylinder block, and replace o-ring seal before bolting manifold into position. The flange connection MUST make up metal-to-metal to retain the o-ring seal, therefore any nicks, grooves or washouts on the sealing surface must be repaired before installation. Ref. Welding and Repair Section in this manual for repair procedures.

Screw all suction manifold bolts (5) in the three cylinder blocks before tightening. Tighten to torque values shown in Chart VI.

3.9.3 Discharge Manifold

The discharge manifold bolts to each cylinder block and is sealed through the 0-ring in the connection flange. Thoroughly clean the 0-ring groove, the 0-ring sealing surface on face of the cylinder block before bolting the manifold into position. The flange connection MUST make up metal-to-metal to retain the 0-ring seal, therefore any nicks, grooves, or washouts on this sealing surface must be repaired before installation. Ref. Welding and Repair Section in this manual for repair procedures.

Start all discharge manifold bolts (8) in the three cylinder blocks before tightening. Tighten to torque values shown in Chart VI. Tight cylinder block to power frame with stud nuts to torque values shown in Chart VI.

3.9.4 Cylinder Head Thread Ring

A replaceable cylinder head thread ring (9) is screwed on to the face of the cylinder blocks. The thread ring must make up metal-to-metal with face of cylinder blocks in order for the axis of the threads to be perfectly square with the cylinder block bore. Therefore, make sure all burrs, extrusions, or foreign matter have been removed from the mating faces before installing.

NOTE: Install thread ring so that the "bleed hole" is in the down position. Tighten the cylinder head thread ring stud nuts (10) to the torque values shown in Chart VI.

Chart VI

Position	ITEM	TORQUE N.m	TORQUE ft. lbs
CYL BLOCK TO POWER END	2	2170	1600
SUCTION MANIFOLD	5	325	240
DISCHARGE MANIFOLD	8	1355	1000
THREAD RING	10	2170	1600

3.10 Welding and Repairs

On occasion where washouts or normal wear cause repairs to be made to the fluid end bores, the following welding procedures and precautions should be closely followed. Machine bore all dimensions to those shown in applicable chart V and in all case maintain the shoulders (where liners, covers, etc.) seat 90°to the axis of the bore.

3.10.1 Welding Procedures

Weld repairs can usually be separated into two categories:

(1) Washes, and (2) Cracks. Listed below is the basis information for the repairs:

1) Washouts:

- Weld as 30# carbon Steel
- Clean area by grinding or Arc-air
- Before starting any welding procedure, make sure the electrodes are dry of moisture, and if necessary, put in oven and bring up to temperature required to drive out moisture.

- Spot heat area to 120°-180°F(250°-350°C) out in all directions for a minimum of 75mm(3")
- Use AWS-ASTM E-60-7018 low hydrogen rods. Example:ADAM-Arc 7018.
- Temperatures should be brought back to 120°-180°F(250°-350°C) after each pass and maintained throughout the welding. After welding is completed and area cleaned, heat to 120°-180°F(250°-350°C) and allow to cool naturally.

2) Cracks:

- Grind out all of crack .Any attempt to burn out a crack will only result in the crack progressing faster than the material can be burned.
- Preheating:
- The purpose of preheating is to expand the area being repaired so that as the cooling process takes place, the welded area and the preheated area will cool more uniformly. Preheating also prevents hard spots from forming between the base metal and the welding by eliminating a thermal shock as the weld is being applied. This hard spot will, of course, be a good place for fatigue cracks to occur.
- The welding procedure is as same as that mentioned above.

3.11 Repair to Valve Pot Cover Bore

When making repairs to washouts in the valve pot cover bore, it is extremely important that the surface where the valve cover seats is either "machined" or "ground" perfectly flat and 90°to the axis of the threads. As shown in Fig. 23, the valve pot cover gasket (1) seats into the counterbore at top of valve cover deck, and as the cover makes up metal to the valve deck, the gasket is confined within its counterbore obviously, any high spots on the valve cover deck from weld repairs, or any low spot from over-grinding of the repairs can result in a gap between top of the valve cover deck and bottom of the valve cover, through which the valve cover gasket can be extruded under pressure and cause damage to valve cover .

The high or low spot can also cause valve covers to make up in a "cocked" position and result in severe thread damage (cracks) due to the axis of the two mating threads being out of square.

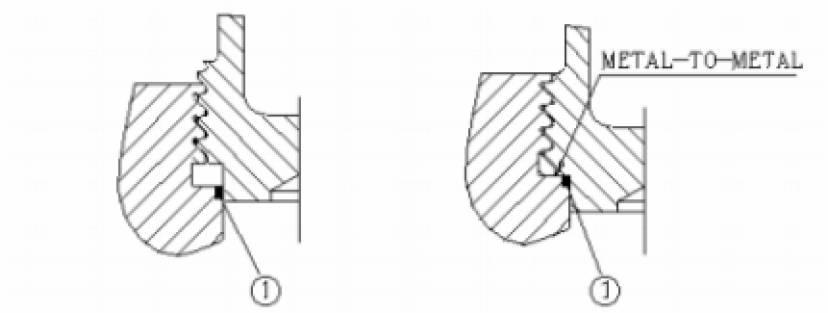


Fig .23

3.12 Change of Dampener Bladder

Procedures of change for dampener bladder (Refer to Fig 10):

1) Sure that the gas in the system has been drained out completely.
2) Disassemble the cover by screwing two bolts into the "jack screw" holes. If the stud is demounted from studded assembly, clean the studs and screw holes after the nuts have been taken down. Screwing the studs using special wrench or normal wrench with two nuts at the same time, tightening them to the torque 800N.m(580ft-lbs).
3) Take off the bladder

   Insert a bar into the gap between bladder and shell, then stave it with pressure and takes it off from the top hole.
4) Check the bladder if there is any damage. If the bladder is destroyed by piercing, check if there are some blow-ups or impurities, clean them thoroughly at once.
5) Check the bottom plug (Item2) situation, and assure every edge is smooth. Putting the new one vertically when change the pierced or worn-out bladder; the shrink range is 0.076～0.152mm(0.003～0.006").
6) Assembly new bladder

   Staving it and rolling up like a screw, and then put it into through the top hole. Release and adjust in order to match with the shell; Seat neck seal of bladder on shell port; meantime coat grease on neck inside.
7) Assembly the cover (Item 5); prevent the bladder from being deforming and pressured.

8) Tighten nuts(Item R2) to the torque 1100N.m(800ft.lbs).

9) Charge following Item1.7.2.

3.13 Approximate Weights of Pump Assemblies

NAME / UNIT		Pinion shaft assy.	Crank shaft assy.	Crosshead	Crosshead pin and guide	Rear cover	Suction pipe	Discharge pipe	1/3Fluid end connection part
F－1300	lbs	2,356	14,564	431	201	379	704	740	2,724
F－1600		2,373	15,179						
F－1300	Kg	1,069	6,606	196	91	172	319	336	1,236
F－1600		1,077	6,885						
Note: each pump includes three fluid ends, and 1/3 fluid end is any one of them.									

4. Maintenance of Pump

Proper maintenance of the pump in time is the necessary measure to assure the pump working and prolong the service life. For using any pump, maintenance should be paid more attention to.

4.1 Daily Maintenance

1) After stopping the pump, check the oil level of power end, at least once a day. If chain drive is used, the oil level of chain box should be checked.

2) Check the working situation of liner and piston, it's normal that a little mud is taken out with piston. If there is leakage, the piston should be changed. Check the abrasion of liner inner bore, if the abrasion is severe, the liner should be changed in time.

3) Check the liner compartments of the frame. The mud and contamination should be cleaned.

4) Check the water tank of spray pump. The water or oil should be supplied if there is not enough. The polluted water should be changed and the water tank should be cleaned.

5) Check if the pressure of discharge pulsation dampener meets the requirements.

6) Check the reliability of relief valves, if necessary, they should be changed.

7) Check the lubricating oil pump for the variation of pressure gauge, if the pressure is very low (lower than 0.035Mpa) or no pressure, check if the suction and discharging filter screen are plugged.

8) Loose the coupling of piston rod every day, check if the pyramidal face of coupling and the junction face of piston rod and extension rod are clean, rotate the piston rod a quarter round and tighten. The purpose of doing that is to make the wearing face evenly and prolong the service life of liner and piston.

9) Before tightening the valve cover, the lubricating grease should be coated on the threads and be checked once four hours for loosing.

10) Check the alarm bore of valve covert seal and liner seal (including the seal between the wearing plate and cylinder), if the mud discharges, the relative seal ring should be changed.

4.2 Weekly Maintenance

1) Disassemble the valve cover and clean them every week, meanwhile coat the molybdenum disulfide complex calcium base grease.

2) Check the inner sleeve of valve guide, if there is sharp abrasion (that means the clearance between the valve guide pole and guide exceeded 3mm), it should be changed to avoid the guide failing to guide the valve motion in the right way and accelerating the abrasion of valve.

3) Check the valve and valve seat, change the worn or pierced valve body, valve rubber and valve seat (when changing the valve seat, the valve body should be changed at the same time). Check the spring and change the broken or inelastic spring.

4) Check the locknuts of piston. The corrosive or damaged locknuts should be changed. (The seal rings in the locknuts will fail after the locknuts are tightened three times.)

5) Drain water one time from the plug of drain flange until oil comes out.

6) Check and clean the filter screen in the lubricating oil line.

4.3 Monthly Maintenance

1) Check all the stud bolts and nuts of fluid end. For example: nuts among cylinders, nuts connecting the cylinder to frame,the bolts and nuts on the suction and discharge manifold. If they are loose, they should be tightened to the specified torque value.

2) Check the seal rings in the packing box of extension rod. The worn one should be changed. Usually, change it at least once every three months. Attention should be taken to the oil seal position when changing (the lip should be inward).

3) Remove and clean the filter installed in the discharge manifold.

4) Change the dirty oil in the oil pool of power end and the oil groove of crosshead every six months. Clean these oil grooves at the same time.

4.4 Yearly Maintenance

1) Check if the crosshead guide is loose, if the crosshead running clearance conforms to requirements. The clearance can be adjusted by adding shim under the guide or rotating the crosshead 180°.

2) Check the whole pump completely every two years or three years, check if the main bearing, connecting rod bearing, crosshead bearing, input shaft bearing are worn or outworn. They should be changed if they can't be used any more.

3) Check the wear of gears, if they are worn sharply, the drive shaft and the driven shaft should be turnaround installed to use the face that isn't worn.

For the convenience of maintenance, checkpoints are listed in chartVII and Fig.24.

4.5 Cares should be Taken for the Following in Maintenance

1) Before tightening the coupling connecting the extension rod and piston rod, the 25°taper face should be cleaned.

2) When changing the liner, the liner seal ring should be changed as well.

3) After stopping the pump in winter, the mud in the valve compartment and liner should be discharged and cleaned completely.

4) Cover each inspection hole to avoid the sand dropping into the lubricating oil.

5) The discharge pulsation dampener is only allowed to charge inert gas (such as nitrogen) or air. No inflammable and explosive gases are allowed such as oxygen, hydrogen etc.

Chart VII Maintenance List

Period	No	Maintenance
Daily	1	Check the oil level after stopping the pump, if it is too low, it should be added to required level.
Daily	2	Check if the readings of pressure gauge of lubricating oil pump are normal. When the pressure is too low, the cause should be found at once.
Daily	3	Check if the dampener works normally
Daily	4	Fill the cooling lubricant up to the spray pump water tank when it's not enough.

Yearly	28	Check the seal of rear cover and crank shaft end cover, if the seal is not good, it should be changed.

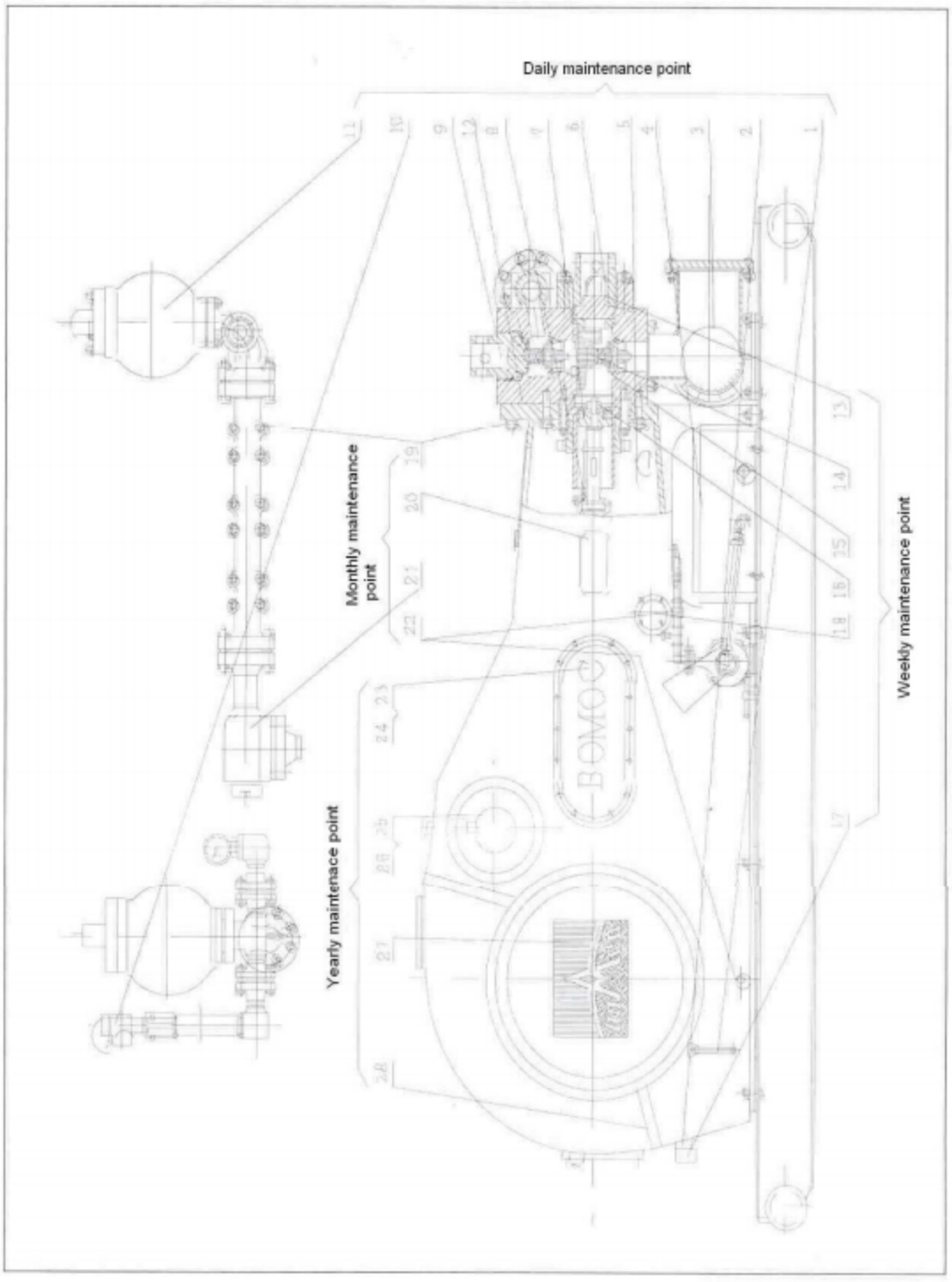


Fig.24 Check point for usual maintenance

	4.The lubricating oil is too much or too little.	
8. There is slap on the power end.	1. The crosshead guide is worn out sharply. 2. The bearing is worn out. 3. The guide is loose. 4. There is water hammer on the fluid end.	1. Adjust the clearance or change the worn guide. 2. Change the bearing. 3. Tighten the bolts of guide. 4.Improve the suction performance.

Note: Besides the above estimated trouble, if other abnormal phenomena are found, the reasons should be found according to the trouble spot. After troubleshooting, the pump can run normally.

6. Storage

1. When the pumps are not used for a long time, they should be stored.
2. Before storing, clean it carefully, empty each part of fluid end and clean it with water.
3. Discharge the engine oil in the bottom of gear box of power end completely and remove the deposits.
4. Coat viscous lubricants on the finished surface of all bearings, crossheads, gears, piston rods, extension rods etc.
5. Coat grease on the machined surface of each parts of fluid end.
6. Cover the suction inlet and discharging outlet with blind flange.
7. The nose end cover, rear cover and the inspection hole cover of crosshead should be covered.

7. Explains for Order

7.1 Provided range of mud pump

Completely MUD PUMP basic parts; spray pump; pulsation dampener; safety value; tools; spare parts for one time change of rubber seals. Not including sprocket and big skid.

If not be special required by users, spray pump is droved by belt for English system pump and the spray pump is droved by motor for metric system pump, and lubrication pump is inner droved style by big gear.

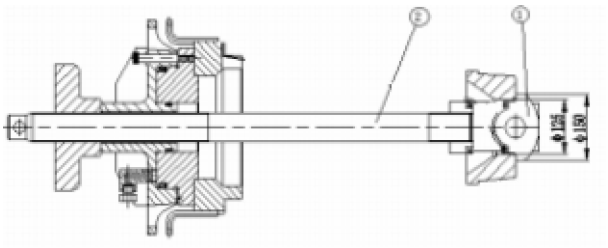
Normally, 170liners and pistons are assembled in the pump when it is transported to users.

7.2 The metric system and English system products

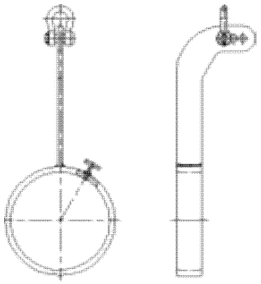
F-series mud pumps divided into two basic styles, one is metric screws pump, the other is American style screws pump. Users choose it due to their own demands and declare when ordering.

8. Usage of Special Tool

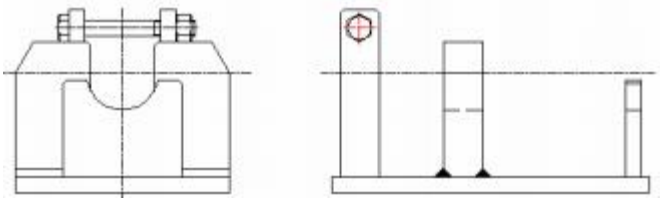
1. The valve extractor for common valve seat-hook type



2. Sling tool for liner

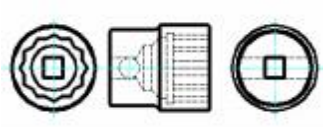


3. Disassembly frame of piston nut

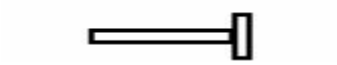


4. change joint AH1001012113
Disassemble change joint of middle pull rod and connection bolt of crosshead

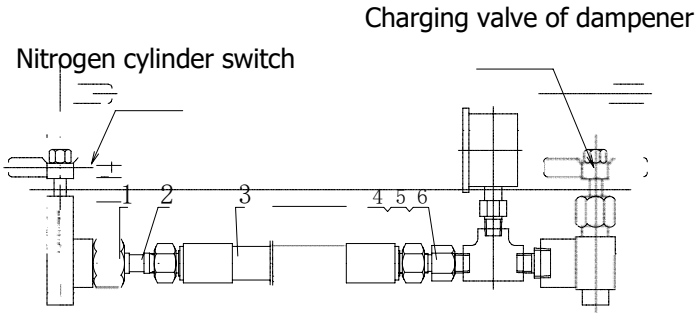
5. Sleeve- disassembly tool for fluid end nut



6. Valve cover rod



7. Charging hose of air dampener



9. Lubrication Manual

Name	Lubrication position	Ambient temp.	Lube specification	Recommended lubrication	
				Mobilgear	Spartan
F-1300 F-1600 Mud Pump	Gear box of drilling pump (Note: The oil includes rust-resistant, corrosion-resistant, foam-proof and damage-proof sulphur-phosphorus concentrated additive.)	+10℃~+68℃	AGMA Mild EP # 7*L-CKD 460 Gear oil, API GL-5，SAE 85W-140 Gear oil	Mobilgear 634	Spartan EP 460
		-7℃~+38℃	AGMA Mild EP# 6* L-CKD 320 Gear oil, API GL-5，SAE 85W-90 Gear oil	Mobilgear 632	Spartan EP 320
		-29℃~+16℃	AGMA Mild EP#2* API GL -5，SAE 80W-90 Gear oil	Mobilgear 626	Spartan EP 68
		-40℃~+27℃	API GL -5，SAE 75W-90 Gear oil	Mobilgear SHC 220	
	Bearings of grease lubrication (for spraying pump, drive axle, universal axle) Hydraulic thread of valve cover, thread of end cover, thread of releasing filter net cove, etc.	0℃~+50℃	NLGI 2 Concentrated lithium-chloro grease	Mobilux EP 2	Beacon EP 2
		-30℃~+5℃	NLGI 0 Concentrated lithium-chloro grease	Mobilux EP 0	Beacon EP 0
		-40℃~+50℃	NLGI 2 Concentrated and composite lithium-chloro grease	Mobilgear SHC 220	