中国石油

BOMCO F-1300/1600 Mud Pump

Instruction Manual

AH13010200SM

AH16010200SM

宝鸡石油机械有限责任公司

BAOJI OILFIELD MACHINERY CO., LTD

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Contents

Preface

Thanks for using F series mud pumps produced by Baoji Oilfield Machinery Co., Ltd.

The outline dimension, frame, and fluid end of F-1300 and 1600 mud pump are the same, only the bearing and gear pair of power end are different. For convenience of customer, this manual introduces these two kinds mud pumps at the same time.

Instruction manual of F1300/1600 mud pump is a complete document for customers. This manual offers a plenty of accurate and concise data and operation procedure for reference of operator, maintenance personnel, and technologists.

It is not intended, nor would it be possible in such limited space, to cover every possible condition which may be encountered. Strictly operating according to specification and regulation can not only minimize down-time of mud pump but also prolong service life of equipments.

All specifications and data are in accordance with engineering designs specification and should be strictly abided during operation, maintenance and repair. For the matching equipments, user should operate and repair in reference to the documents supplied by original manufacturer.

If this manual has some defects, please present your suggestion and opinion.

BOMCO F-1300/1600 is key equipment matched to drilling rig for petroleum well. It is used for transporting drilling fluid to well bottom by high-pressure manifolds of circulating system in order to cool off the drill bit, flush the well bottom, crush and take out the rock, and balance the formation pressure.

The design and manufacture of F series mud pump is in compliance with API Spec. 7K. The module size of fluid end conforms to API Spec. 7.

1. Use of new mud pump

1.1 Technical Specification and Performance Parameter

1.1.1. Technical Specification

Model	F—1300	F—1600
Type	Triplex single acting piston pump	
Max. Liner size mm	180	180
Rated Power kW	960	1180
Rated stroke spm	120	120
Stroke length mm	305	305
Gear ratio	4.206	4.206
Valve pots	API 7#	API 7#
Weight kg	24572	24971

1.1.2. Performance data

Performance data of F-1300/1600 Mud Pump data sees table 1A. When imperial system liner is adopted, the performance data sees table 1B.

1.1.3. Overall Dimension

Overall dimension of F-1300/1600 Mud Pump sees Fig.1.

Table 1A Performance data of F-1300/1600 Mud Pump

Stroke/minute	Liner Diameter, mm & Rating pressure, MPa（Psi）													
					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
	Rating power				Displacement 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 for continuous service.

Table 1B Performance data of F-1300/1600 Mud Pump

Stroke/ minute	Liner Diameter, in & Rating 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
	Rating power				Displacement 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 for continuous service.

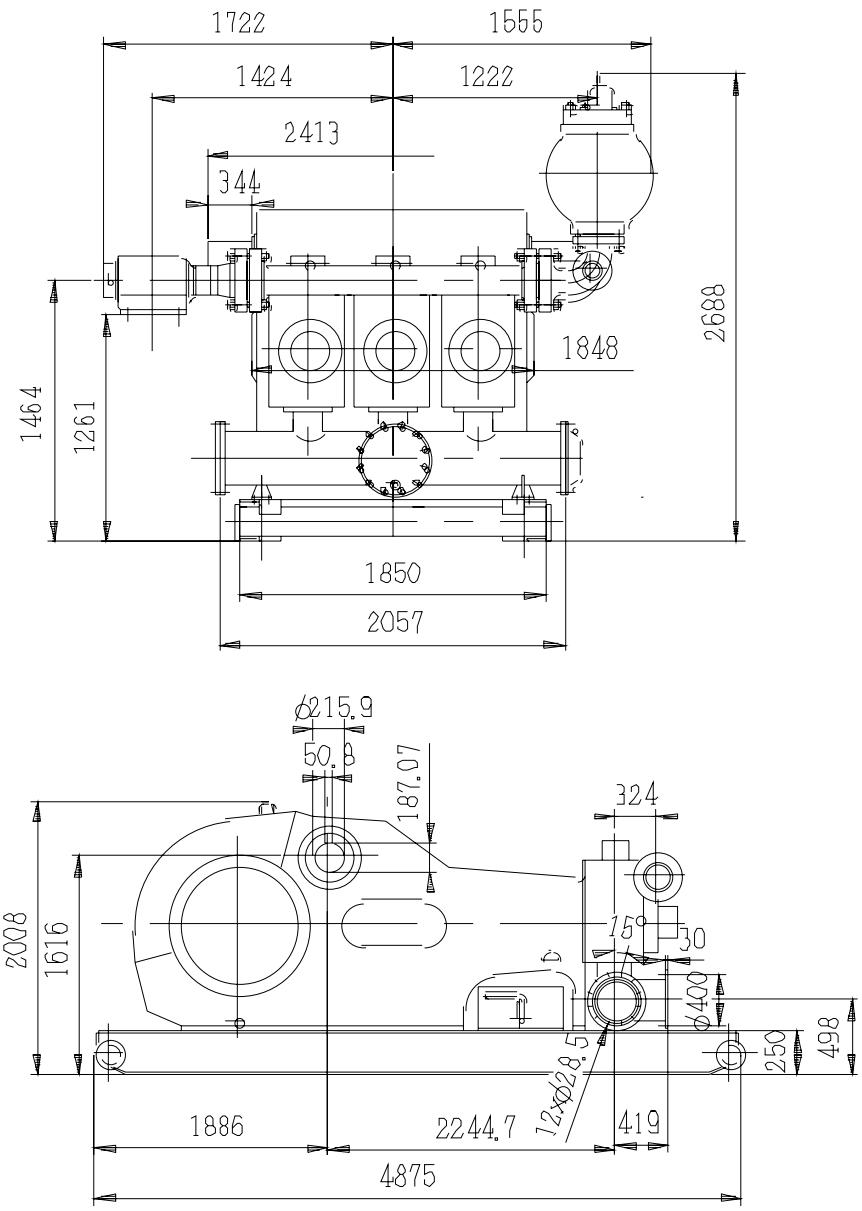


Fig.1 Overall dimension of 1300/1600 mud pump

1.2. Installation of New Pump

F-1300/1600 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 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 and drive devices MUST BE IN THE SAFE POSITION.

The skid under the F-1300/1600 mud pumps is suitable for any type of installation. However, the support under the pump must be level and adequate to support the self-weight and operating forces exerted by the pump.

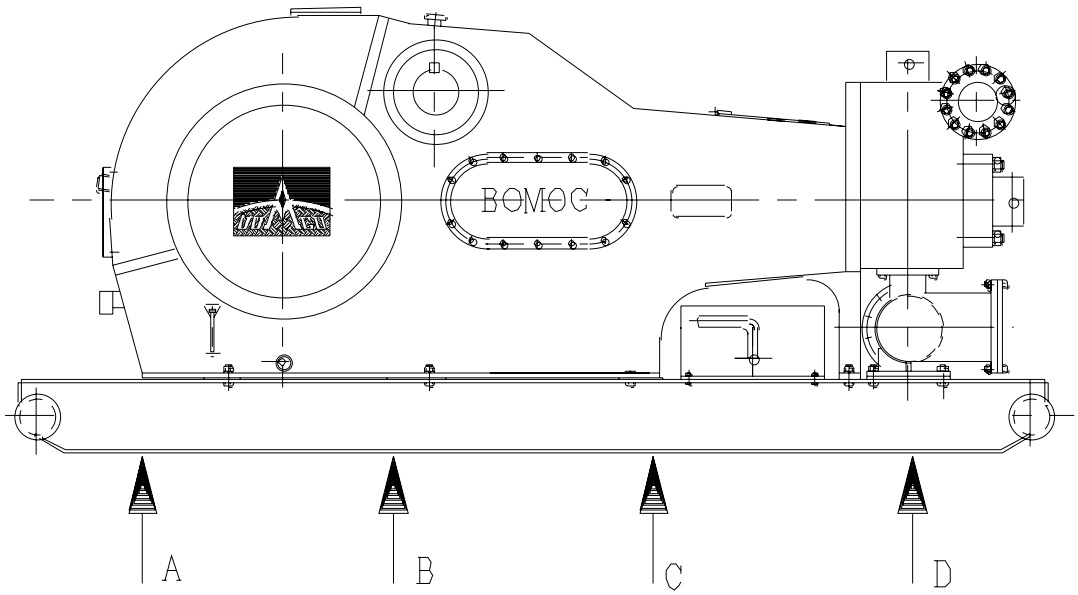


Fig. 2

1.2.1. Ground Installation

When ground installation is going on, 8 pieces of 76mm×305mm boards is cushioned in the direction of pump skid, as indicated in Fig.2. The base of boards should be 300mm wider than that of pump skid beam. In the wet or moist circumstance, need solider base.

1.2.2. Permanent Installation

When installing mud pump on the structural base or concrete slab of drilling barge and platform, fix pump skid with bolts, it is essential that the skid should 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. 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).

When prime mover, drive device are installed 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.

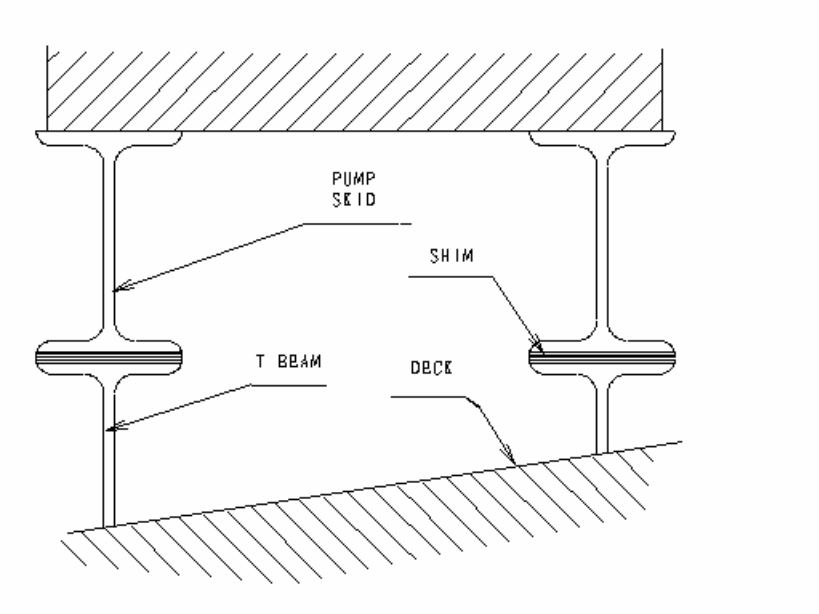


Fig. 3

1.2.3. Installations of Driving Device

The drive between the mud pumps and prime mover should be adopted V-belts or multi-row chains drive, which is installed with precision to assure longest service life and minimum possibility of unexpected or undesirable shutdowns due to drive failures.

When installing the drive sheave or sprocket, make sure all grease or rust preventative is removed clearly from the shaft end and the matched bore. 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 light grease of anti-adhesive compound or light oil and install the drive sheave or sprocket hub. Tighten hub bolts as indicated below:

Use of wrench or lengthening bar to tighten bolt may lead to increase of torque, so it is necessary and important to tighten bolt according to the following torque values, 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 hub to crack. The hub bolts should always be tightened alternately, progressively and gradually.

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

Note：N=0.1kgf

1.2.3.1. V-Belt Drives

1. Check sheaves groove condition

Before installing the v-belts, check if sheave grooves is worn or rounded for wearing, worn grooves will destroy V-belts rapidly. The sidewalls must be straight. In sheave grooves there is no dirt, rust or other extrusions, which could damage the V-belts.

2. Check alignment of belt pulley

3. Adjust V-belt for previous tension

Adjust the belt tension by moving the belt pulley center distance 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 adjust center distance then increase additional 13mm(1/2"). On 3180mm (150") center distance, after adjust center distance then increase additional 19.5mm (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.

1.2.3.1 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 the other 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 lube grease. Lubricant brand can refer to "Lubrication oil guide of BOMCO products".

If temperature is below 0ºF, consult department of lube grease supplier for recommendations.

Lube grease should be in accordance to relevant specification and lubrication manual based on specification.

Chain lubricating system is an independent one, which requires the same maintenance or service attention employed on any other piece of machinery, includes:

- Daily check of grease level.
- Daily check on condition of lube grease.
- Check oil pressure. (5-15psi) (0.35-0.103Mpa).
- Supply a volume of grease to chain.
- Check nozzles in spray tube.
- Check 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. Requirements for Suction System

For design of suction system of mud pump, individual installation is needed. The suction of the F-series pumps must have a positive head (pressure) for satisfactory performance. When the optimum pressures of suction manifold is 0.14~0. 21Mpa (20~30 psi), mud pump has maximum volumetric efficiency and expendable parts life, which is required with 6 x 8 centrifugal pump (with 45kw,

1450-rpm electric motor). The centrifugal pump should be started or stopped automatically and simultaneously with the drilling pump. On DC electric drilling rig, generally a sign got from DC control disc excites magnetic starter.

Centrifugal pump also can be driven by belt and the force comes from pinion shaft of pump.

When arranging suction lines, charging pump is adopted by-passed connection, so operation can be continued even if pump is failed or repaired. Operation without a charging pump, soft suction valve spring can be used to improve suction performance.

Suction dampener is a very effective aid for improving suction performance and eliminating fluid pulsations in the suction line, which results in a smoother flow in the discharge line.

Attention: Do not connect the return line of the shear relief valve with suction pipelines since when relive valve is open, which will cause a sudden risen pressure; when the pressure is higher than rating pressure value, manifold、suction dampener and centrifugal pump will be damaged.

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 injecting lubricant, open inspection door of cover, check if oil in power end reservoir goes bad, remove the pipe plugs (No. 2 in Fig.7) on each side of the pump, drain all the remaining lubrication oil and flush. Add the proper type and quantity of lubrication in the power end (Refer to nameplate on pump frame for type and quantity required).

Recheck oil level after pump has operated for 15 minutes. Shut pump down and allow approximately five minutes for the oil level to equalize, Check oil level gauge, (No. 1 in Fig. 7). It is usually necessary to refill about 10L (3 gallons) oil since a certain amount is retained in the crosshead area and frame cavities.

1.4.2. Installation of Crosshead Extension Rods and Stuffing Box Seals

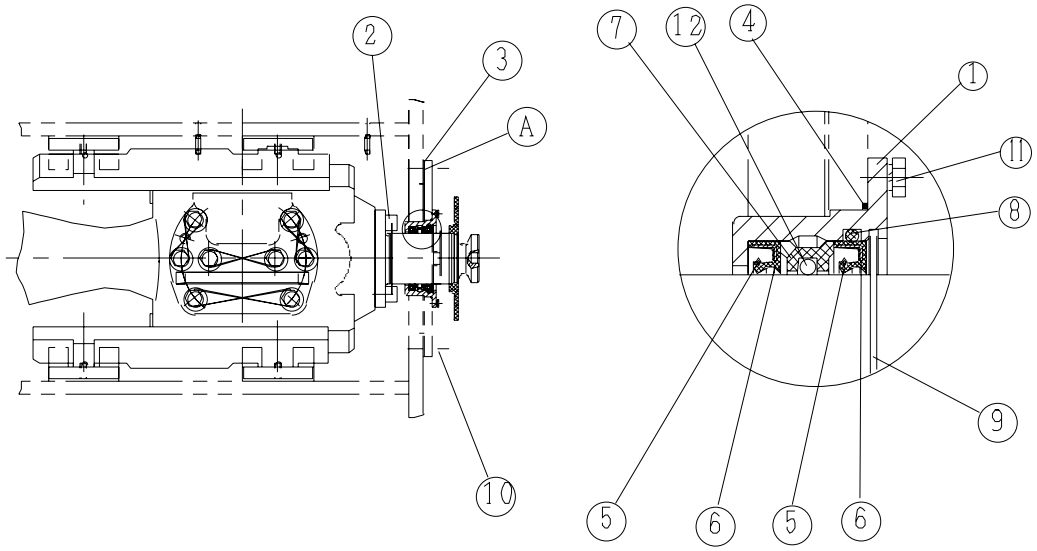


Fig. 4

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

Refer to Figure 4, remove the stuffing box① and mud apron 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. Mount position boss of extension rod to the crosshead and tighten the retainer bolts②, the torque is 475~500N.m (350~370ft.lbs), at last tighten with iron wire. Thoroughly clean mud apron and the face of frame, on the "A" place in Fig. 4 mount washer ③ and bolt ⑩, tighten it and the torque is 120~160N.m (90~120ft.lbs).

Thoroughly clean the hole and the end face, and meanwhile clean exterior surface of stuffing box and surface of flange stuffing box plate. Coat the exterior surface of stuffing box with light oil and install O-ring ④. Install stuffing box on the mud guard packing then tighten bolts as the following torque: 16~24N.m (12~18 ft .lbs).

The stuffing box packing assembly consists of two lip oil seal⑥, oil seal ring⑦, O-ring⑫, O-ring⑧ and lock spring⑨. Install the assembly as follows:

Method A:

a) Remove spring⑤ from two lip oil seal⑥ and mount it on the exterior of the crosshead extension rod with lip toward power end. Then install spring ⑤ on the oil seal lip, and slide them into the stuffing box. See the following notes.

b) Put the O-ring⑫ into Oil Seal ring⑦. Install O-ring⑫ and oil seal ring⑦ on the extension rod and then put it into stuffing box bore.

c) Install the O-ring⑧ in groove of stuffing box.

d) Installation left/right double lip seal ⑥ in the Fig.4 as a).

Note: The double lip seal near power end can be replaced by single lip oil seal, but DO NOT use the single lip seal in the outer position (fluid end).

e) Install the locking spring⑨

a) Take down the stuffing box ① from pump frame. Assemble two lip oil seal, oil seal ring⑦, O-ring⑫, O-ring⑧ and lock spring⑨ in the stuffing box as per Fig. 4 of partial enlargement, and then hook O-ring ④ over the cylindrical outside surface of the stuffing box ①.

b) Install the guide sleeve on the front end of Crosshead tension rod as per Fig.4, and coat light lubricant on the outside surfaces of Crosshead tension rod and the guide sleeve.

c) Mount the stuffing box assembly on Crosshead tension rod through the guide sleeve, pull it into position by hand, and then fix the stuffing box ① on the mud guard packing with spring washer and bolt (11).

Note: must ensure 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 light lubricant on extension rod for easy installation of the stuffing box assembly.

1.5. Spray Pump Assembly

Spray pump assembly consists of spray pump, water tank and spray nozzle etc. It functions 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.

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

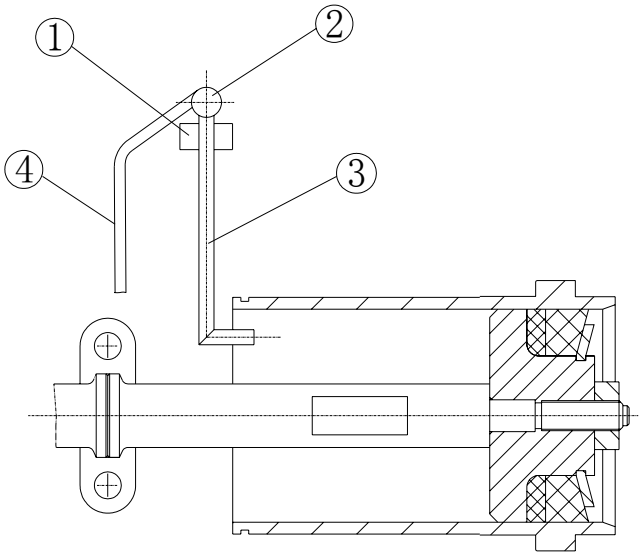


Fig. 5

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

Cooling fluid is transfused from spray pump (No.3 in Fig .7) through Water tank (No.5. in Fig. 7) to the manifold on left/right wall plate of the frame. Adjust regulating valve (No.4 in Fig .7) to supply as much water as possible to the liners without splashing back on the crosshead extension rods. Avoid some water will work back into the power end to contaminate the lubrication oil.

The cooling fluid returns to the setting chamber from the crosshead extension rod compartment, 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 in the fluid. Refer to Fig .6.

Check cleanliness of the cooling fluid at frequent intervals and CLEAN and FLUSH reservoir and replace the cooling fluid as required. Increasing sand grain in contaminated fluid will cause premature abrasion of liner and piston or stoppage of the spray nozzle or spray tube.

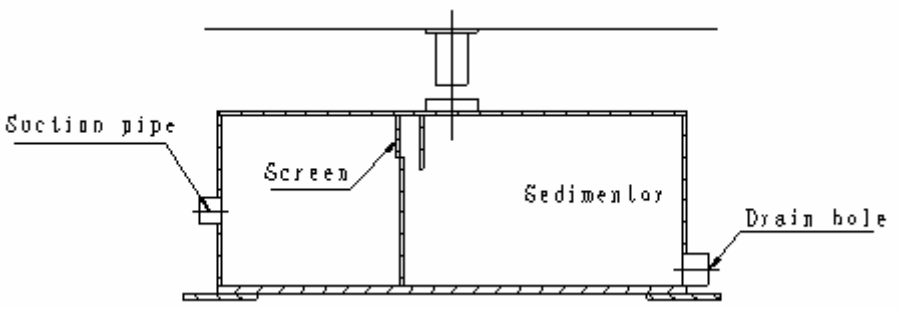


Fig. 6

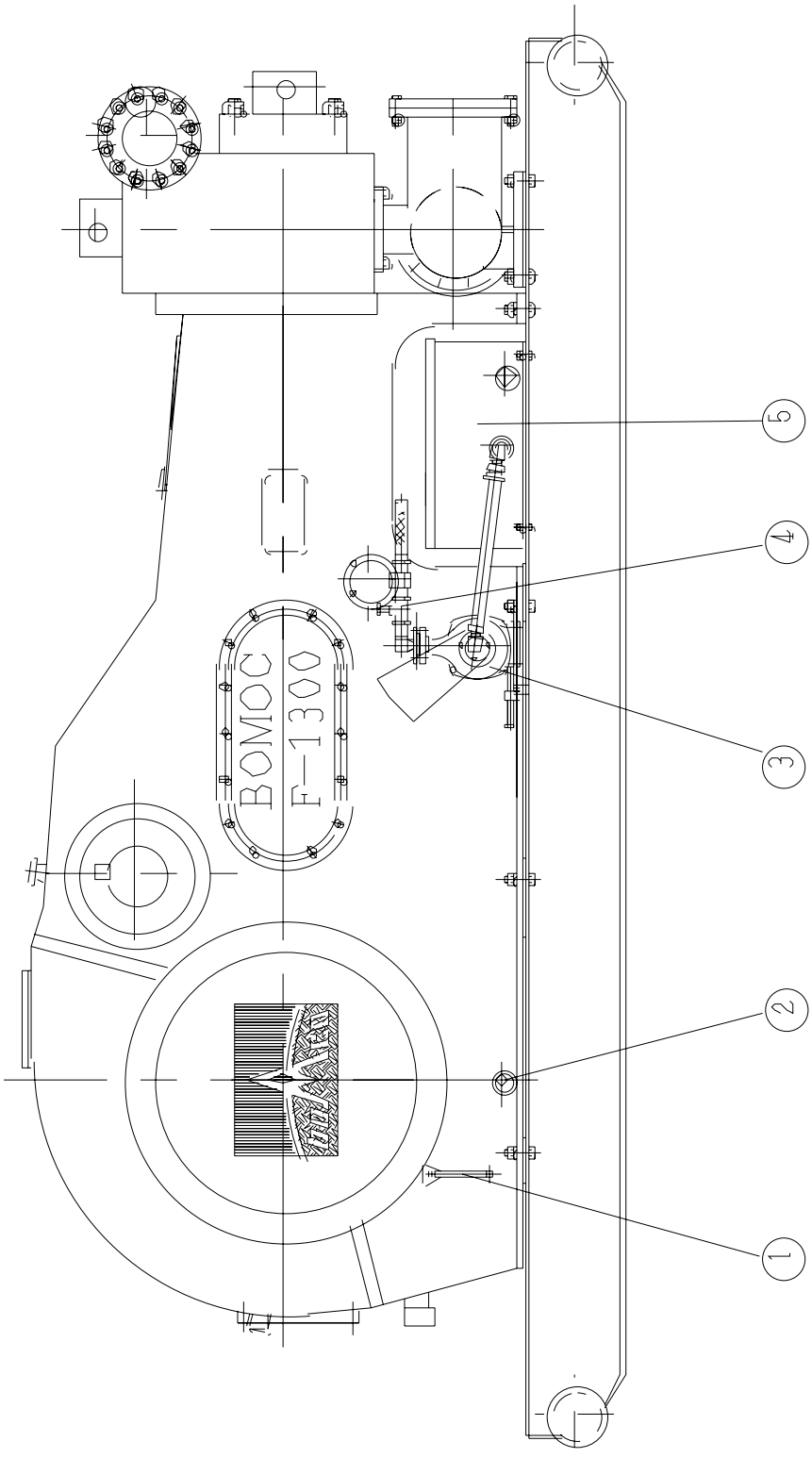


Fig. 7

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

1.6. The assembly of Fluid End Parts

A profile of the fluid end for F-1300/1600 is shown in Fig, 8. Refer to Fig. 8, clean and assemble the

fluid end parts as following:

Note: Most of the parts in fluid end 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 should be clean and free of rust, nicks and burrs to ensure reliable seal before being assembled.

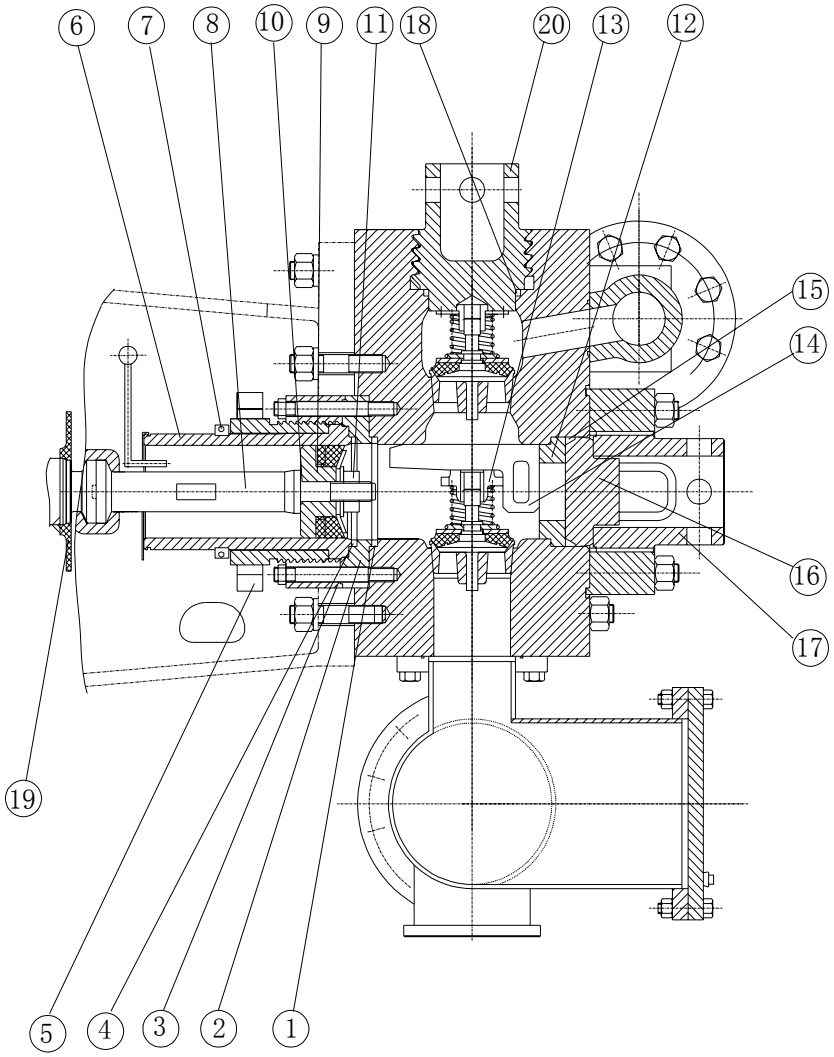


Fig. 8 F—1300/1600 Fluid end assembly

1. Wear-resisting plate seal; 2. Wear-resisting plate; 3. Liner flange; 4. Liner seal ring; 5. Liner press cover; 6. Liner; 7. Liner locking ring; 8. Piston rod; 9. Piston; 10. Piston seal; 11. Nut; 12. Locating plate; 13. Valve rod guide; 14. Plug plate; 15. Cylinder head seal ring; 16. Cylinder head plug; 17. Cylinder head; 18. Valve cap seal ring; 19. Mud guard packing; 20. Valve cap

1.6.1. Valves and Seats

Remove three valve caps (20), three cylinder heads (17), and plugs (16) as shown in Fig.8. 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 (free of 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-resisting plate seal (1) in counter bore of fluid end (see Fig. 8). Install wear-resisting plate (2) through studs until it seats against fluid end. Mount liner flange (3) over studs with the starting thread at the 5 o'clock position and tighten bolts with 640~690N.m (470~510ft.lbs) torque.

Note: Placing the starting thread at 5 o'clock position to make the liner gland threads meshing much easier.

Place liner seal (4) in counter bore of wear-resisting 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 piston seal ring (10) in groove of piston head. Slide piston head (9) on rod while observing that O-ring does not fall out of groove. Tighten piston rod nut (11) with 1625~2165 N.m (1200~1600ft.lbs.)

Coat grease on liner I.D. and piston O.D. 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 with the following torque values: 330N.m (245ft.ls). before the clamps are installed, mud guard packing (19) should be installed on the end of crosshead rod.

When piston 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), hook it around the stem, insert plug (14) into the locating groove of valve guide. Mount locating plate (12) in pump head bore, meanwhile install cylinder seal ring (15) on cylinder plug (16)Start the lock plate (14) and draw it down, compressing the valve spring and seating Coat seal ring and O.D. of plug with light lubricant. Push cylinder plug into the opening of fluid end. Grease the cylinder head threads; screw the cylinder head (17) in against the plug (16). Tighten cylinder head with wrench provided and sledge hammer.

Fluid leakage through the discharge hole indicates a defective seal or loose cylinder head. Should replace seal or tighten cylinder head in time. DO NOT plug the discharge hole since this can result in severe damage to cylinder head threads.

1.6.6. Valve Cover

Install valve cover seal ring (18) into bore, and after grease the valve cover seal area and threads area, tighten the valve covers into place using a sledge hammer and bar.

1.6.7 Discharge Manifold

API 5"（127mm）5000psi flanges are provided on the discharge manifold. Remove discharge flange and seal gasket area before welding (customer's option for the welding methods) flange on the discharge piping. Tighten flange connection bolts with 1625-2165 N.m (1200~1600ft.lbs.) torque. Tighten nuts in a cross-criss order.

1.6.8 Suction Manifold Flange

The suction flange has 3 12" (305mm） connection flanges. Generally they are installed as per oilfield condition: one is connected with suction manifold inlet, one with suction dampener, and one is plugged by blankoff flange. An O-ring seals off the connection. Thoroughly clean O-ring groove and face of flanges before making up connection. Tighten flange bolts with 490~665N.m (360~490ft.lbs).

1.6.9 Auxiliary Manifold

An auxiliary manifold is shown in Fig.9. It can be installed on the discharge manifold opposite the discharge end. The manifold can connect with KB-75 pulsation dampener (1), shear relief pin (3) and pressure gauge (2).

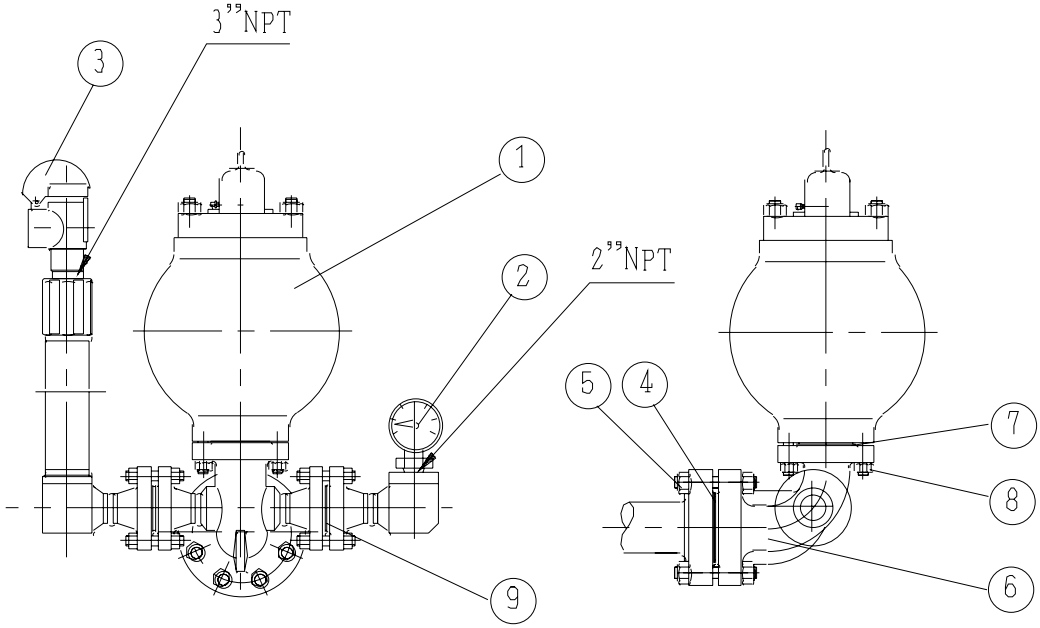


Fig. 9

(1) Pulsation dampener (2) pressure gauge (3) shear relief valve (4) Seal washer (5) flange bolt (6) Discharge four-way joint (7) Seal washer (8)nut (9) Seal washer

An auxiliary manifold connects with discharge manifold by flange. Before assembly thoroughly clean joint groove of flange, install seal washer (4) and tighten the flange bolts (5) with 1625-2165N.m. (1200-1600ft.lbs) torque. To assure uniform make-up of seal washer connection, the clearance between flange end faces should be even, tighten the nuts in a criss-cross order.

The shear relief valve (3) is installed on the auxiliary manifold for the purpose of protecting the pump from excessively high-pressure overloads. The relief valve must be installed correctly so that is will be directly contacted with the mud pump. DO NOT PUT ANY TYPE OF SHUT OFF VALAE between the

relief valve and the manifold. Pipe the discharge end of the relief valve directly into the mud pit with seamless steel pipe 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 end 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 seal washer. Before installing dampener, thoroughly clean ring groove and ring, and after setting dampener into place, tighten the nut (8) with 950-1265N.m (700-935ft.lbs) torque. Tighten nuts in a criss-cross order.

Both sides of discharge four-way joint are R-27 seal washer flange. Before installing, thoroughly clean gasket and groove. Connect the bolt and the nut with 495-660N.m （365-490ft.lbs）torque, tighten nuts in a criss-cross order.

Precharge air or N2 to dampener before starting up pump. See details in "Dampener assembly" section.

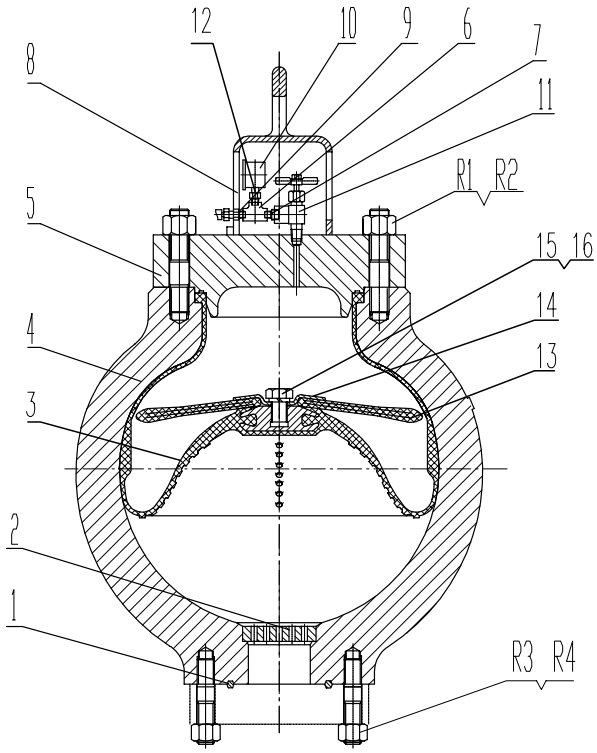


Fig.10 KB-75 Dampener assembly

(1) Gasket ring (2) bottom plug (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) Washer (13)Balance disc (14)Press plate (15)Spring washer (R_1) stud (R_2) nut (R_3) stud (R_4) nut

1.7. Dampener Assembly

Correct installation and usage of dampener can availably reduce the pressure fluctuation of discharge system therefore obtaining smoother 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. It should not be more than 2/3 of the pump discharge pressure, or a maximum of 4.5Mpa. (650psi).

1.7.1 Installation (see Fig.10)

The structure of KB-75 dampener is shown in Fig.10. The pad eyes installed on the pressure gauge

shield ⑧ is used for lifting dampener assembly. Before assembly thoroughly clean ring groove, gasket ring ① and groove of mating flange and coat with grease.

Lifting the dampener to the corresponding position of mud pump discharge line, screw nut (R4) with 950~1265N.m (700~935ft.lbs) torque. Assure the connection part is flat and aligned by alternately tightening the nuts.

1.7.2 Air charging

A set of air charging device is attached when equipment leaves factory（air charging hose assembly of dampener）please Operate as following procedure: (See Fig. 11)

a) 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.

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

c) Open the charge valve of dampener.

d) Slowly open the nitrogen cylinder valve, use this valve to adjust incoming N_2 of dampener.

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

f) Shut the charge valve of dampener.

g) Remove hose, cover the shield of pressure gauge, and 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.

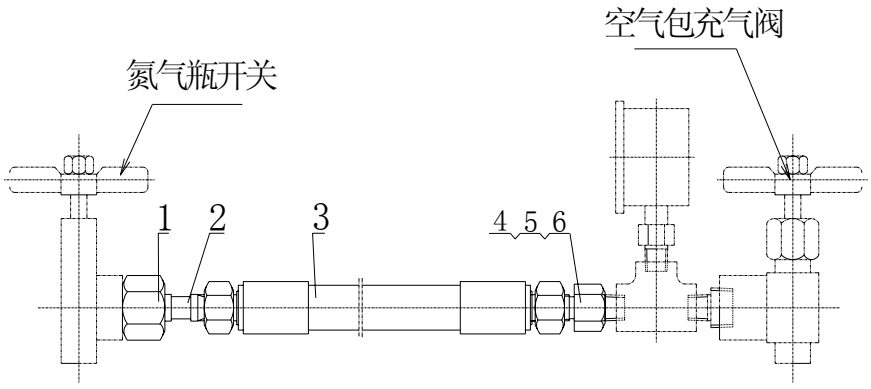


Fig. 11

(1) Nut C5/8″ (2) Seal connector (3) C-type connector hose (4) Joint (5) Gasket (6)Pipe plug

1.8 Shear safety Valve

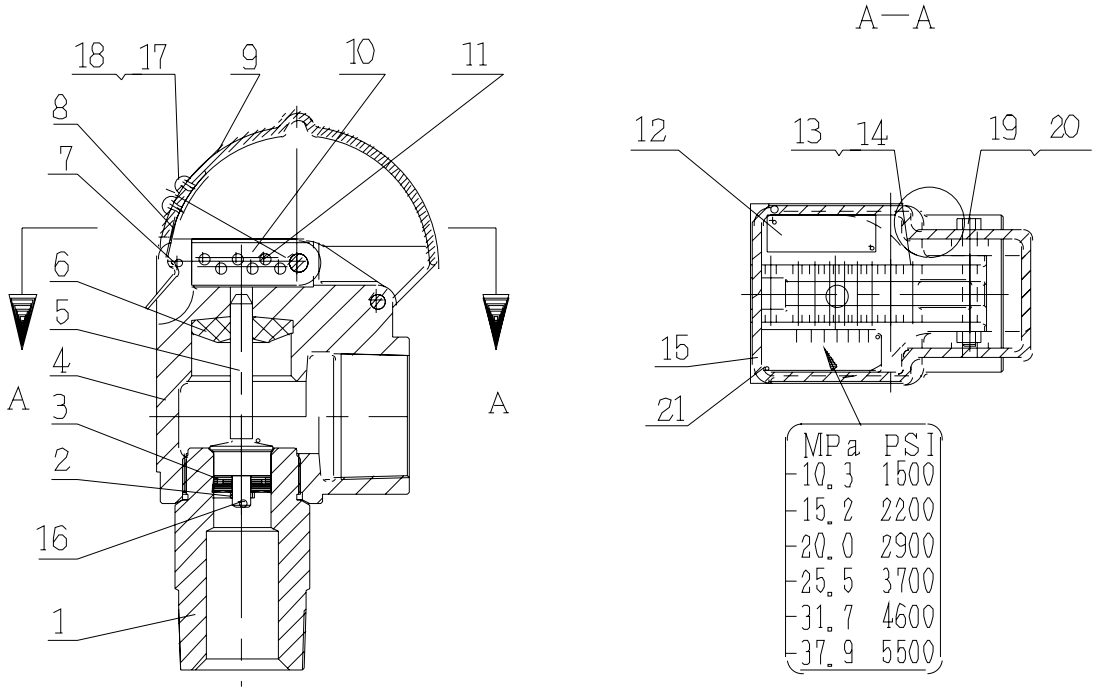


Fig 12

(1)Connector (2)Retainer Ring (3)Piston Assy. (4)Body (5)Piston Rod (6)Bumper (7)Pin (8)Spring (9)Safety Cap (10)Shear Bar (11)Shear Pin (12)Warning Plate (13)Pin shaft (14) Retainer Ring (15)Name Plate (16)Cotter Pin (17)Nut (18)Cap screw (19)Bolt (20)Nut（21）Cap screw

JA-3 shear pin safety valve structure refers to Fig 12. When the pump pressure exceeds the rating pressure, the force of piston (3) will jack up shear pin plate (10), which will cause the shear pin (11) broken and the fluid emptying fast.

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, what to do is just to 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 since this directly affects 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 stroke at which the pump can be operated. The pressure lubricating system of F-1300/1600 mud pump is shown in Fig.13, which can be operated at 25 strokes/minute (oil pressure is 0.035 Mpa; 5psi)

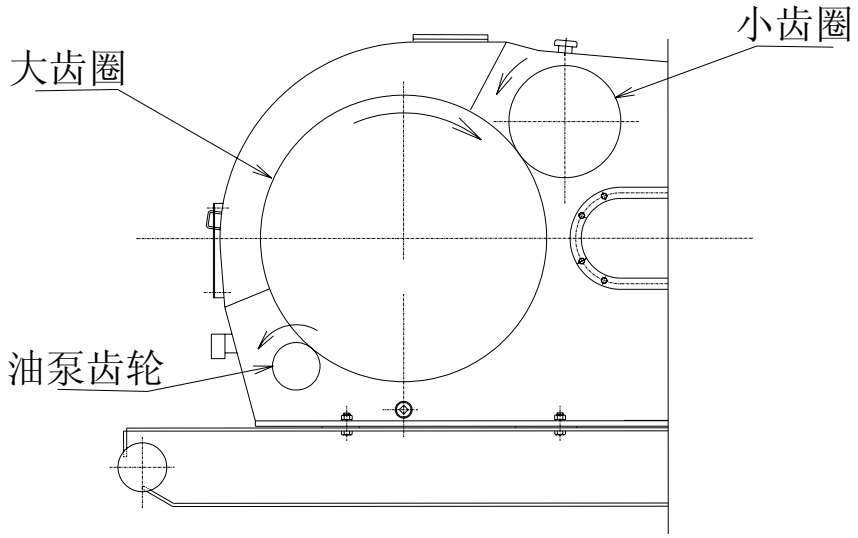


Fig. 13

NOTE: The pressure lubricating oil pump can be mounted on the external of drilling pump and driven by V-belt; or install the oil pump in the drilling pump driven by the gear ring. When an internally mounted oil pump is used, the direction of pinion shaft rotation should be as shown in Fig. 13; when reversing the pump, the inlet/outlet of lubricating pump must be reversed.

2.2 Controlled Flow Splash System

The controlled flow splash lubrication system is the same on 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 top 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.

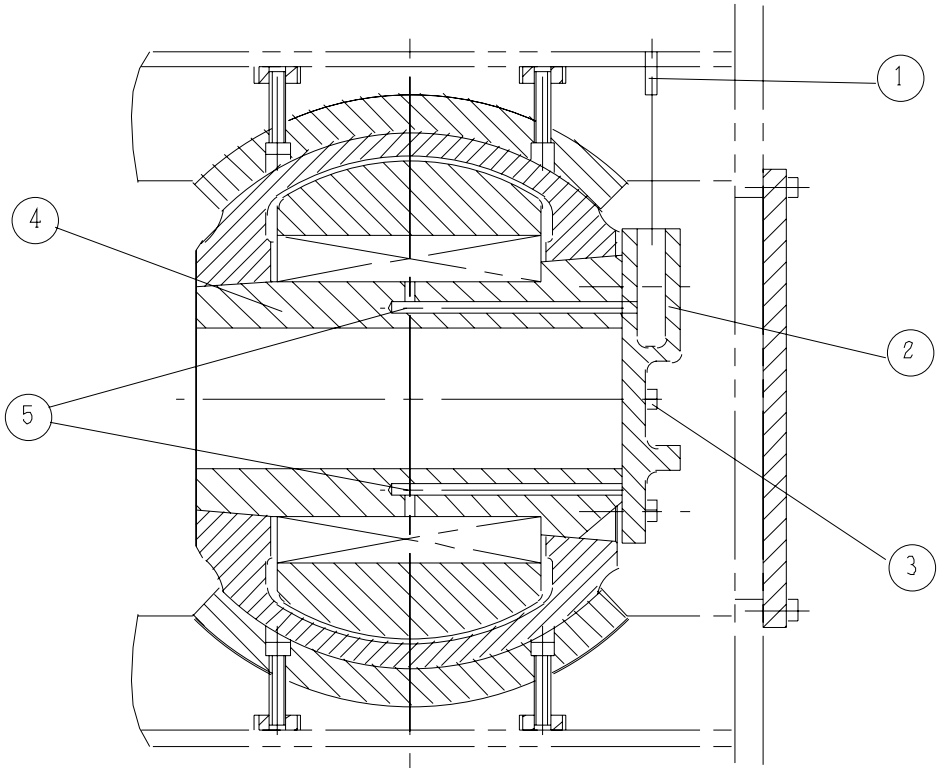


Fig. 14

(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 into the main bearing oil line (4) and the crosshead compartment oil distributor (4A) located above the crosshead compartment. The crosshead compartment oil distributor (4A) distributes oil to the crosshead, crosshead bearings and extension rods.

A pressure gauge (5) is mounted on the back wall of the frame to show oil pressure being maintained in the oil distributor. The oil pressure will, of course, vary with the speed of the main pump, however if a sudden pressure drop or increase occurs, refer to the section on maintenance of lubrication system for possible cause.

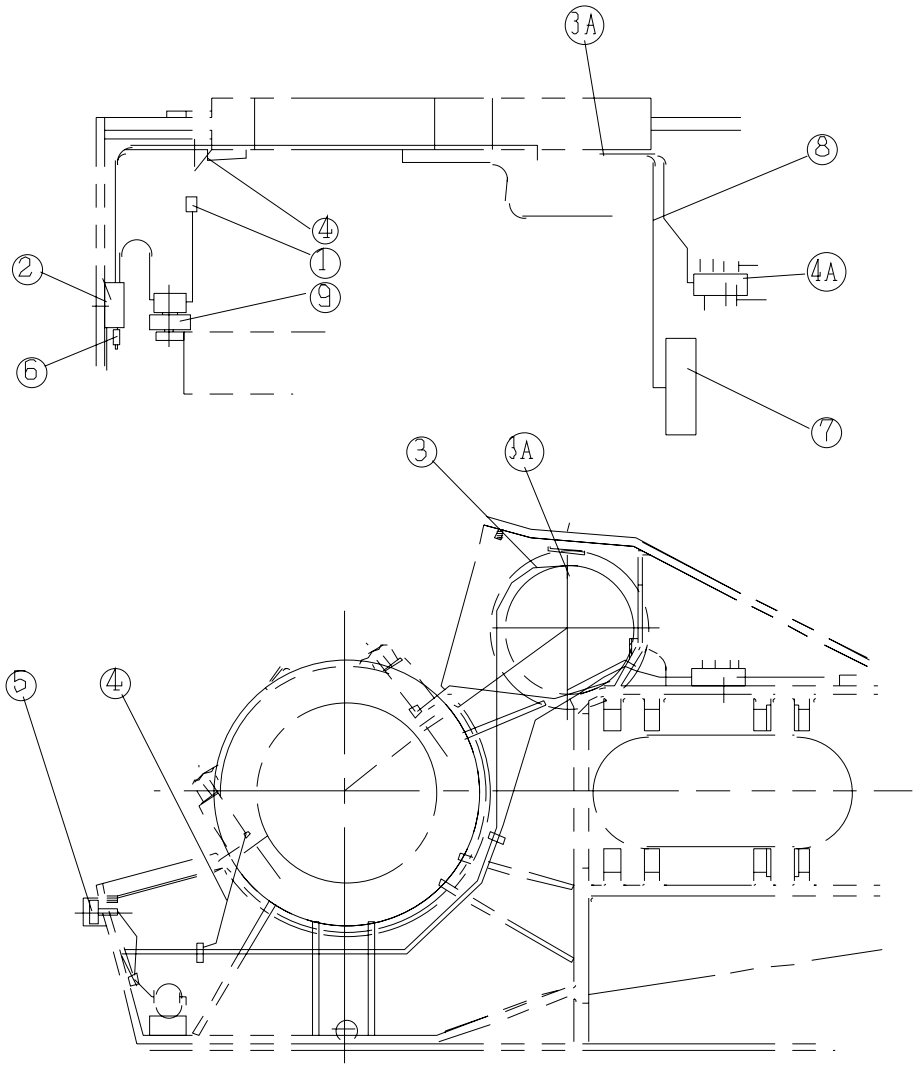


Fig.15

(1) Filter (2) Oil distributor (3) Oil line (3A) Spray nozzle (4) Main bearing oil line (4A) Oil distributor

(5)Pressure gauge (6) Relief valve (7) Oil trough (8) Oil tube (9) Lubrication pump

A pressure relief valve (6) is mounted to the oil distributor (2) to prevent excess pressure from damaging oil pump and drive. The relief valve is preset at 0.27Mpa (40 PSI) and must be tighten (to prevent adjusted pressure change).

When installing the internally mounted oil pump (9 Fig .15), position pump so that the back face of the drive gear is flush and parallel with the edge of the main gear, and gear teeth have 0.60~0.90mm clearance.

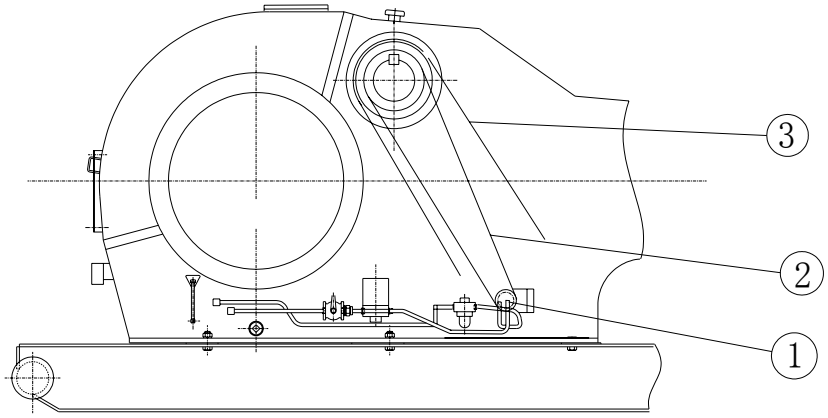


Fig. 16

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

A typical outside mounted oil pump is shown in Fig. 16.The oil pump (1) is piped into the oil system through the suction and discharge joints at the bottom of power end left/right wall plates. 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 refers to the nameplate on the side of the pump or "BOMCO Products Lubricant Use Guide". These lubricants 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, if oil becomes contaminated with abrasive particles or corrosive compounds, drain and clean 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 on top of the crosshead guide. Also clean or replace the filter element in the air breather cap and clean suction screen. Remove covers of 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.

Sludge should be drained out of the pump in setting chamber located on the frame wall underneath the crosshead inspection doors.

Check once each month; remove clean out covers on both sides of pump to drain oil with sludge from setting chamber. Approximately 15-gallons of oil are lost; replenish the main reservoir to compensate for the amount drained out.

Check 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.

Check 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 as follow:

- 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
- Sludge 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 as the following torque: 13210 N.m (9750ft.lbs)

3.1.2 Lock wires

Check lock 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 the cover of crosshead bore and check condition of the crosshead pin bolts and lock 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) with the torque: 225-240 N.m (165-175ft.lbs). Do not exceed these valves above when using torque wrench.

If the crosshead or guide shows abnormal wear or scoring, replace immediately because it can cause damage to the bearings, etc; Excess wear can also cause rapid wear to the piston and liner.

3.1.8 Oil and oil reservoir

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

3.2 Roller Bearings

Roller bearings are adopted by 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 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 double straight needle roller bearings. None of the bearings require special adjustments.

All inner and outer races of bearings are matched by means of very accurate fits with bores and shafts. Inner and outer races of bearings are installed one–to-one with matched number. Therefore, when the bearings are to be installed again, the inner and outer races must be matched correctly.

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 be careful 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 in direct 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 Tempilstick. **DO NOT OVERHEAT THE BEARING**. Overheating draws the temper of the metal and softens 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. Clean anti-corrosion grease for packing before assembly. If a bearing must be cleaned, use clean kerosene or other solvent.

3.3 Pinion Shaft Assembly

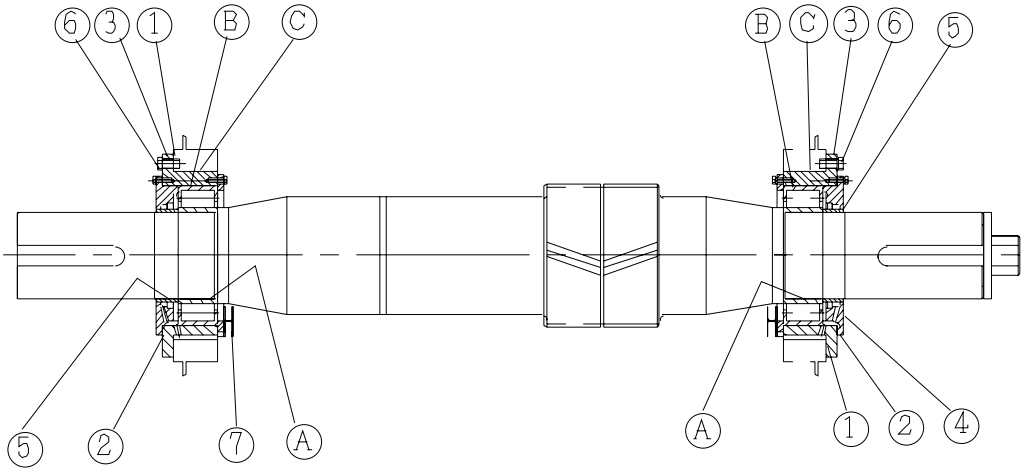


Fig.17

(1) Washer (2) Cover washer (3) Bearing sleeve (4) Cover (5) Wear-resisting sleeve (6) Bolt

Table 2 (mm)

Description	Inner Race to shaft journal	Outer Race to Bore	Bearing sleeve to frame Bore
Position	A	B	C
Data mm	T0.050～T0.109	T0.115～L0.018	L0.203～L0.076

Note: T-shrink range L-Clearance range

Since the pinion is an integral part of the shaft, only install the bearings and oil seal anti-wear sleeve to complete the assembly (See Fig.17).

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 Table 2 is obtained.

When installing the pinion shaft assembly on the pump, observe the following precautions:

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

b) When installing the bearing sleeve (3) and the cover (4), make oil collecting groove face to (7) and correctly align with oil return bore.

c) Remove burrs, dents or gouges from the outer surface of the anti-wear sleeve (5) before sliding cover (4) into place. When sliding lip of seal over end of shaft exercise care 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 by edge of the sleeve when sliding seal into the anti-wear sleeve.

d) Tighten bearing bolts (6) with the approximate torque 110～215N.m (80-160ft .lbs)

e) Check condition of the pinion bearing inner and outer races and rollers. If there is any indication of galling, flaking or grooving, or if diametric clearance exceeds 0.3mm, it is recommended the entire bearing be replaced.

3.4 Crankshaft Assembly

The crankshaft assembly consists of the crankshaft, gear ring, connecting rod 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 Table 3 are obtained.

Table 3 (mm)

Description	Inner Race. to Shaft journal	Outer Race. to Bore	Inner Race. to Shaft	Outer Race. to Bore
Position	A	B	C	D
Data mm	T0.098～T0.165	L0.095～0	T0.175～T0.300	T0.100～L0.050
Description	Gear ring to Flange	Carrier to Frame Bore	Outer Race. to Bore	Inner Race. to 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-Clearance range

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

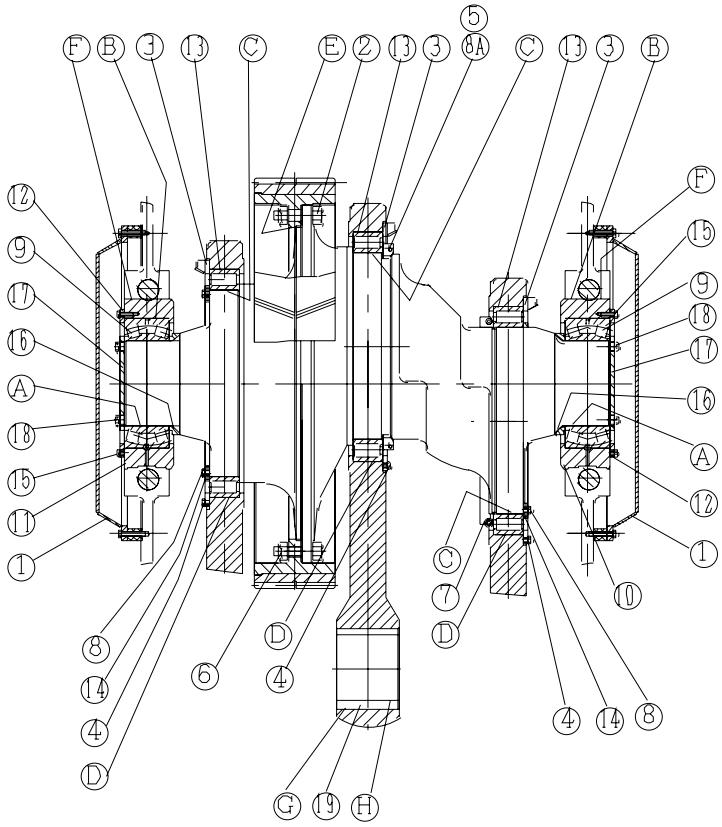


Fig.18

(1) Cover (2) Bolt (3) Retainer ring (4) Bolt (5) Bearing retainer ring (7) Retainer ring (8) Bolt (8A) Inner hex bolts (9) Main bearing (10) Right bearing sleeve (11) Left bearing sleeve (12) Outer retainer ring (13) Connecting rod bearing (14) Inner retainer ring (15) Bolt (16) Main bearing retainer (17) Inner race retainer (18) Bolt (19) Crosshead bearing

1) Install gear ring and check run-out.

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

Install a set of roller bearing on both ends of crankshaft, and measure gear ring face run-out with dial indicator. Because of the effect of roller bearing clearance, it is required to measure synchronously on shaft end and gear end face with dial indicator; the real run-out on any position is the D-valve of the two readings. When the run-out exceeds 0.224mm (0.0088in), take down gear ring and check the reason of over D-valve.

2) Install the outer races of the connecting rod bearings (13) and the outer race retainer ring (3) in the three connecting rods separately. Outer retainer ring should be installed as following: when the pump is at the middle strokes, oil collecting ring should be at the bottom; tighten bearing retainer bolts (4) with the torque 75 N.m (55ft .lbs) and lock with wires. NOTE: The inner/outer races and rollers of the connecting rod bearings are matched by group and must not be intermixed.

3) Install the outer race of the crosshead bearings (19) into three connecting rod small ends .It is preferred that the outer race assembly be "pressed" into position of frozen in "dry ice" (CO2) 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 connecting rod. DO NOT EXCEED 149℃ (300°F) (Use TemilStick) and DO OT USE WATER to cool the strap.

NOTE: The inner and outer races of the crosshead bearings are matched by group and

should not be intermixed.

4）Install the inner race of the crosshead bearing on the crosshead pin and mark respective items (like 1,2,3 or left/mid/right) according to their positions. Remove all nicks and burrs before shrinking race into place. Refer to bearing fit Position H Table 3.

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 with the torque 60～90 N.m (44～66ft .lbs).

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

7) Install the LH eccentric bearing and connecting rod etc.(refer to item 6) above).

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

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

3.5 Installing Crankshaft Assembly in the Frame

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

1) Place a piece of wood between small end of connecting rod and crosshead guide (as shown in Fig. 20) to protect guide from scoring or gouging as the connecting rod are sliding into position.

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

3) After placing crankshaft in the frame, and before installing the main bearing covers, check the rollers in the main bearings to assure that each row of rollers in each bearing is equally loaded. The exact method to check is: drive each row roller by hands, there should be 4-6 rollers seized because of the gravity, while it is not allowed that some row can be driven by hands. The two sides of floating bearing outer race should have roughly equivalent axial clearance. Check out and then install main bearing covers.

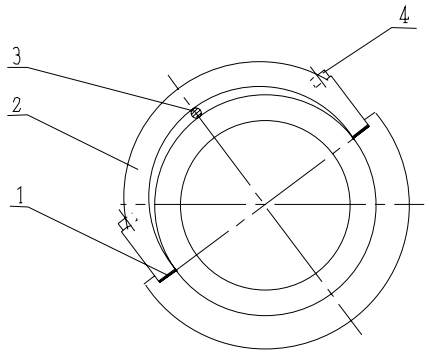


Fig.19

(1) Washer (2) Bearing cover (3) Wire (4) Main bearing bolt

4) Install shims under bearing press covers to obtain 0.06-0.10mm (0.0024-0.0040in) clamp to get preload pressure. The preload pressure is obtained by placing the correct amount of shims under the bearing cap. The required amount of shims is determined as follows:

- Place a piece of wire（about 0.8mm diameter）or plastic clearance gauge between the bearing sleeve outer race and bearing press cover inner race, press it at the middle place of bearing press cover so far as possible. Fasten main bearing bolt, and see the table 4 for torque.
- Remove bearing press cover and determine clearance between bore of cap and OD of bearing carrier by either measuring thickness of compressed lead or measuring compressed dimension (Max. size) of plastic gage.
- Use this dimension to calculate the required thickness of shims as follows:

Shims thickness required = original shim thickness (here 1mm) – wire compressed thickness- clamp shrink range (0.06~0.10) mm.

Example:

0.040″ Original shims – 0.025″ Lead Thickness – (0.0024~0.0040″) Clamp shrink range =0.0126~0.0110″ Shim Thickness requires

NOTE: The tolerances on left/right sides are not be all the same after machining, which makes it necessary to measure and calculate individual shim requirements for each (right hand and left hand) main bearing cover.

5) Place the correct amount of shims as stated above under main bearing press cover, and tighten main bearing bolt with torque values in table 4..

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.

Table 4

Description	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

1) Thoroughly clean all dirt or contamination and remove all burrs or rough edges from the surface of the guides and in the frame compartment.

2) If old guides are to be reused, inspect the friction surfaces for wear and scoring streaks. Otherwise it should be replaced.

NOTE: For F-1300/F-1600 upper and lower crosshead guides are NOT interchangeable. The lower guide places the crosshead on frame centerline, and upper guides are machined to afford proper clearance between crosshead and upper guide. Upper guide is thinner, a big chamber is at its rear part and oil bore at the middle.

3) Install upper and lower guides, torque guide screws with 205～270N.m (150～200ft.lbs)

4) Check compactness between frame and guides at points A (Fig. 21); it is appropriate that 0.05mm (0.002″) feeler can not press into.

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:

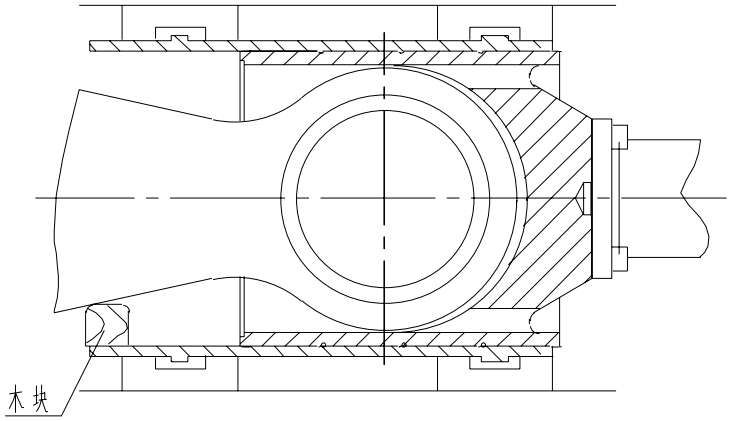


Fig.20

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 crosshead first, rotate crankshaft assembly to make "eye" into center crosshead and right hand eccentric strap "eye" back, take down mud guard (1 in Fig.21), and push right crosshead to the frame for enough space to install Mid-crosshead and then right crosshead.

Note: If an old crosshead is reused again, do check the sliding surface for wear or score. If necessary, the crosshead can be switched to opposite sides of pumps, that is L/R crossheads interchange their positions, and turn it 180° to make the smooth surface at the bottom of crosshead. Mid-crosshead also can be rotated by 180° ,and at this time crosshead pin should be inserted from opposite side of original side. Do not insert crosshead pin into cone bore until crosshead pin retainer has been installed.

4) Install crosshead pin retainer (2) and 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. to Fig 21. The oil groove of crosshead pin retainer should be upward.

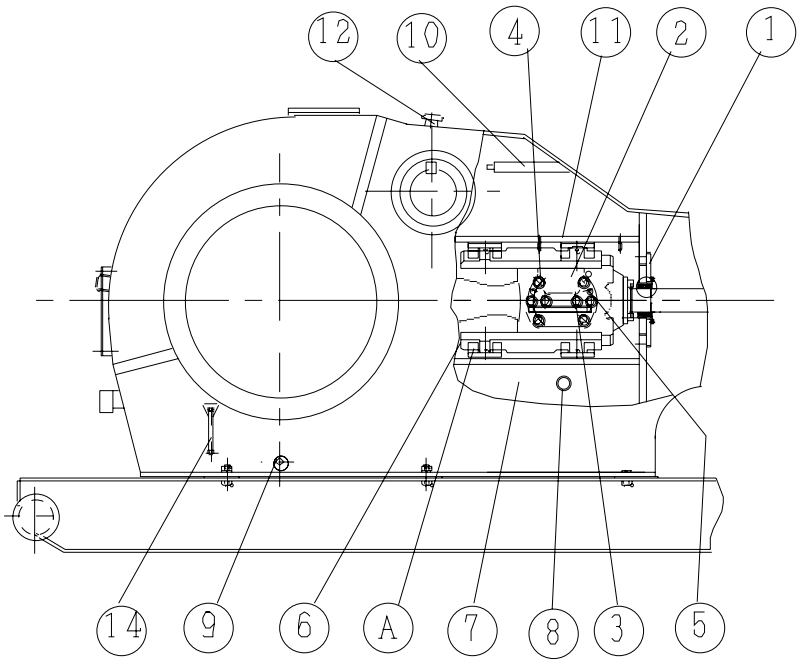


Fig.21

(1) Mud guard (2) Crosshead pin retainer (3) Bolt (4) Bolt (5) Jack screw bore (6) Lower guide (7) Frame (8) Dirt discharge bore (9) Pipe plug (10) Oil accumulating box (11) Upper guide (12) Air shield (14) Oil level gauge

Strike gently the crosshead large end into cone bore, fasten retainer bolt (3) and (4) (see Fig.21) with torque 225～240 N.m (165～175ft. 1bs) and wire.

USE TORQUE WRENCH AND DO NOT EXCEED THE SETTING VALUES..

NOTE: To pull out the crosshead pin, first 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 upper surface and guide. The clearance should be in 0.45-0.56mm (0.018-0.022in). Check with long feeler gauge over entire surface of crosshead.

NOTE: Over tightening the crosshead pin retainer bolts (4) will cause crosshead outer race contact circular arc deformation and increase the possibility of worn. Now loosen pin and retighten into place by using the make-up torques shown in item 4) above.

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.

Do not shim guides to make the clearance less than 0.50mm (0.020″) 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 when forward-rotating.

Note: When the mud pump must run in reverse situation because of power, the crosshead pressure is on the upper guide; now guide clearance must be controlled in 0.25~0.40mm (0.010-0.016in).

5) 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 main maintenance 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 seal area, liner flange threads, valve pot cover threads, cylinder cover threads, valve seats, 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 removed from 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, complete with liner, valve pot covers and cylinder heads, a suction manifold, and a discharge manifold.

3.9.1 Fluid Cylinder

See Fig.22 for the structure of cylinder and dimension data in table 5.
The three separate fluid cylinders (1) connect metal –to-metal with the power end frame through retainer studs (2); alignment of the power end and cylinder is realized through power end frame bores and 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 it could make up in a "cocked" or misaligned position after the two parts connecting.

The fit between "pilot" boss and frame bore (Position A) is as follows:

Table 5

Position	Dimension（mm）	Dimension（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	Taper 1：6	2"Taper per ft. on dia.

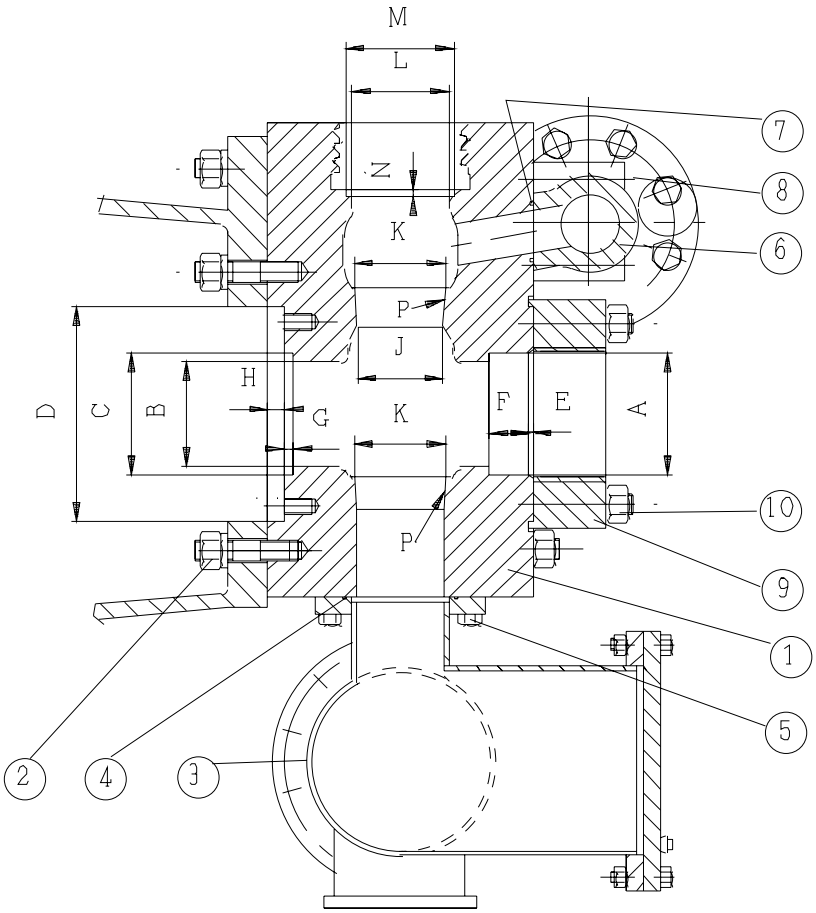


Fig.22

(1) Cylinder (2) Bolt (3) Suction pipe (4) O ring (5) Bolt (6) Discharge pipe (7) O ring (8) Bolt (9) Cylinder head flange (10) Bolt

3.9.2 Suction Manifold

The suction manifold (3) bolts to each cylinder block and seal the flange connection face through the 0-ring. Thoroughly clean o-ring groove, the 0-ring sealing surface at bottom of the cylinder block. Put o-ring in before bolting suction manifold into position; the flange connection MUST make up metal-to-metal to ensure the o-ring seal, therefore any nicks, grooves or washouts on the sealing surface must be repaired before installation. Ref. Welding and Repair Section (3.10) in this manual for repair procedures.

Screw the three cylinder blocks bolts (loose and no fasten) before tightening suction manifold bolts (5), and then tighten with torque values shown in table 6.

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 3.10 in this manual for repair procedures.

Screw the three cylinder blocks bolts (8) (loose and no fasten) before tightening discharge manifold bolts (5), and then tighten the connecting bolts of cylinder and frame with torque wrench values shown in table 6.

3.9.4 Cylinder Head flange

A replaceable cylinder head flange (9) is screwed on the face of the cylinder blocks. The flange must make up metal-to-metal with face of cylinder blocks in order for the axis vertical of the end face and cylinder. Therefore, make sure all burrs, extrusions, or foreign matter removed from the mating faces before installing.

NOTE: When install the flange, make sure the "bleed hole" is in the down position. Tighten the nuts (10) with the torque values shown in table 6.

Table 6

Position	ITEM	TORQUE N.m	TORQUE ft. lbs
TO THE FRAME	2	2170	1600
SUCTION MANIFOLD	5	325	240
DISCHARGE MANIFOLD	8	1355	1000
CYLINDER HEAD FLANGE	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 table 5 and in any case maintains the shoulders (install liners, valve covers, and cylinder head etc.) seat 90°to the axis of the bore.

3.10.1 Welding Procedures

Weld repairs can usually be separated into two categories: (1) Washouts, (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 dry it.
- Spot heat area to 120°-180°C (250°-350°F) 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°C (250°-350°F) and allow cooling naturally.

2) Cracks:

- Grind out all of cracks by mechanical method. Any attempt to eliminate a crack using air cut 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. Heat cracking during eliminating weld 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 the same as that mentioned above.

3.11 Repair Valve 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 clearance between top of the valve cover deck and bottom of the valve cover, through which the valve cover gasket can be extruded and washout under pressure. 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.

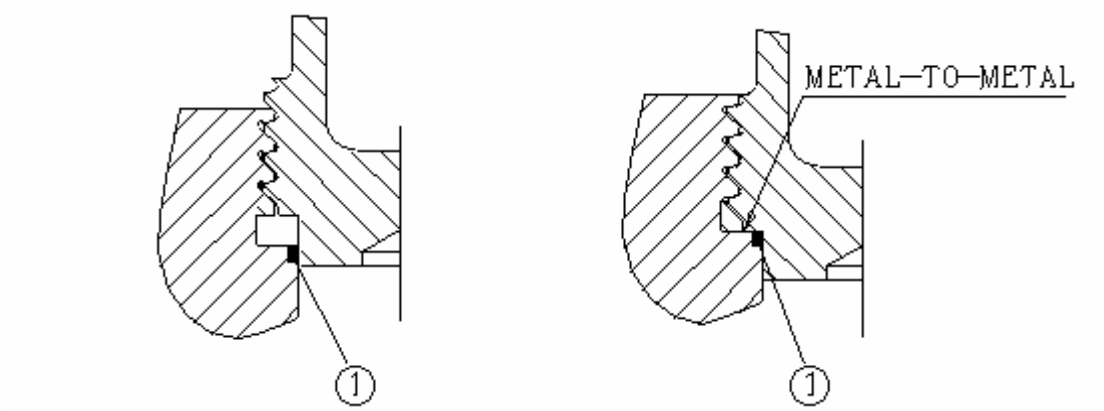


Fig .23

3.12 Change of Dampener Bladder

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

1) Sure that the pressure in the system has been drained out completely (see 1.7 Dampener assembly).

2) Disassemble the cover (5) by screwing three 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 with the torque 800N.m (580ft-lbs).

3) Take off the bladder.

Insert a bar without edges and burrs into the gap between bladder and shell, then compress it flat 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.

Compressing it flat 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).

8) Tighten nuts (Item R2) with the torque 1625-2170N.m (1200-1600ft.lbs).

9) Charge following Item1.7.2.

3.13 Approximate Weights of F-1300/1600 Pump Assemblies

NAME / UNIT		Pinion shaft assy.	Crank shaft assy.	Cross-head	Crosshead pin and guide	Rear cover	Suction pipe	Discharge pipe	1/3 Fluid end connection part
F—1300	lbs	2,356	14,564	431	201	379	704	740	2,724
F—1600		2,374	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 cylinders 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 change of lubricating oil pump. If the pressure is very low (less than 0.035MPa) or zero, check if there is any block in suction manifold and discharge filter in time.

3) Check that suction dampener works normally.

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

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

6) 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.

7) Check the front compartment of the frame, clean thoroughly if there is a lot of mud, oil dirt setting.

8) Check water tank of spray pump; clean the tank, refill water in time, change water contaminated.

9) Loose piston bar clamp every day and check if clamp conical face, piston bar and mid tension bar connecting face are clean, then rotate the piston bar a quarter of one circle to tighten, which makes the wear face of piston bar evenly distributed and prolongs the service life of piston and liner.

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

11) Check often 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、liner and clean them every week, meanwhile coat extreme pressure lithium base grease.

2) Check the inner sleeve of valve rod 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 heavy 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: cylinder head flange nuts, 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 stuffing 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.

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

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

4.4 Yearly Maintenance

1) Check the wear of crosshead and guide plate faces; 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° (now change the crosshead position for easy operation).

2) It is recommended check the whole pump completely every two 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 gear pair, 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 consulters, checkpoints are listed in table 7 and Fig.24.

4.5 Matters need attention in Maintenance

1) Before tightening the mid extension rod and piston rod, the matched taper face should be cleaned.

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

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

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

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

Table 7 Daily Maintenance List

Interval	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 suction dampener works normally
Daily	4	Fill the cooling lubricant up to the spray pump water tank when it's not enough. Change it when it deteriorates.
Daily	5	Check the front compartment of the frame. Clean it if there are a plenty of mud and dirty oil settling.
Daily	6	Check if the cylinder cover is loose every four hours. Coat the grease on the threads when installing.
Daily	7	Check the piston and liner for leakage, change them when necessary.
Daily	8	Loose the clamp of piston rod one time daily, rotate the piston rod a quarter turn and then tighten the clamp back again.
Daily	9	Check if the valve bonnets are loose every four hours. Coat lubricant on the thread when tightening.
Daily	10	Check if the safety valves are reliable.
Daily	11	When stopping the pump check if the pre-charging pressure of discharge pulsation dampener meets the operational requirements.
Daily	12	Observe the alarm bore, if the mud is discharged, the related seal ring should be changed.
Weekly	13	Disassemble cylinder cover and valve cover, clean and coat with extreme pressure lithium base grease.
Weekly	14	Check the inner sleeve of valve guide, if it's heavy worn, it should be changed.
Weekly	15	Check the suction and discharge valve body, valve seat, valve rubber and

		valve spring, change the damaged one.
Weekly	16	Check if the locknuts of piston are corrosive or damaged. Change if they are damaged (normally, change after using three times).
Weekly	17	Check the filter screen of lubricating system. Clean it if it is plugged.
Weekly	18	Loosen the plug of drain flange, discharge the dirt and water in the oil pool.
Monthly	19	Check bolts and nuts of fluid end, the loose or damaged bolts should be tightened or changed.
Monthly	20	Check the seal ring in the packing box, the worn one should be changed at least once every three months
Monthly	21	Check the filter in the discharge pipe. Clean it if it is plugged.
Monthly	22	Change the dirty oil in the oil pool of power end and crosshead oil groove and clean them every six months.
Yearly	23	Check the wear of crosshead; if necessary use the crosshead after rotating 180°.
Yearly	24	Check if the guide is loose, check if the crosshead clearance conforms to requirements, otherwise, they should be adjusted.
Yearly	25	Check the wear of gear pair, if necessary, use them reverse face.
Yearly	26	Check if the pinion shaft and crankshaft are all right. Measures should be taken when there is any abnormal phenomenon.
Yearly	27	Check the bearing of power end. The damaged one should be changed.
Yearly	28	Check the seal of rear cover and crank shaft end cover, if the seal is not good, it should be changed.

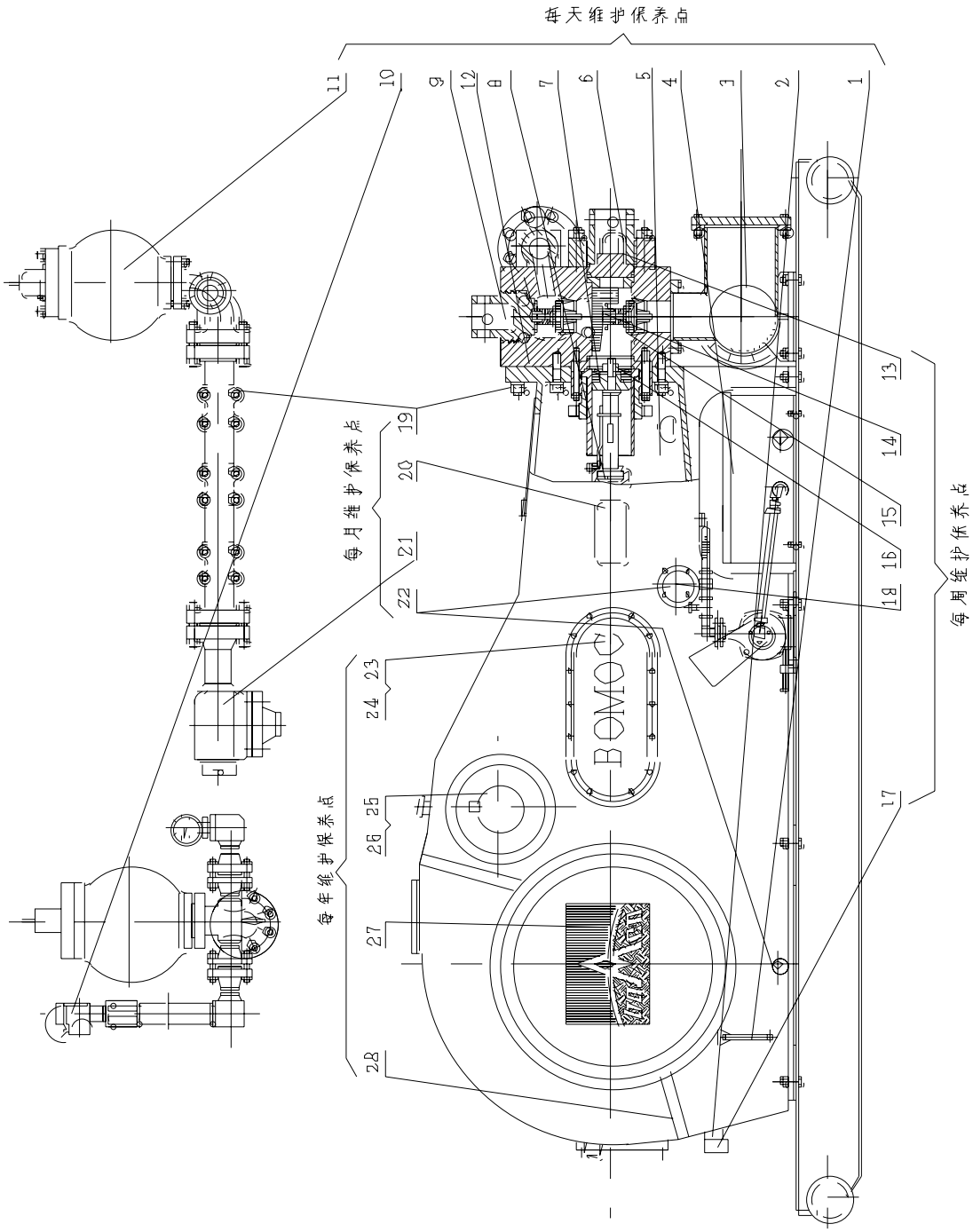


Fig.24 Maintenance checkpoints

Note: Daily Maintenance: 1-12
Weekly Maintenance: 13-18
Monthly Maintenance: 19-22
Yearly Maintenance: 23-28

5. Troubleshooting

During the running of the pump, if there are troubles, the reason should be found and the trouble should be solved in time, otherwise, they will affect the normal working of the pump.

Trouble	Cause	Troubleshooting
1. The pressure readings	1. The charging piping is not	1. Tighten the flange bolts of

become low and the discharge reduces or no mud discharged.	sealed off and the air gets into the pump. 2. The suction filter screen is plugged.	charging piping or change the gasket. 2. Stop the pump and clean the suction filter screen.
2. Uneven discharge. The pressure gauge fluctuates. The charging piping has abnormal noise.	1. A piston or a valve is worn out or damaged. 2. There is air in the pump cylinder.	1. Change the damaged piston and check the valve to find if it's damaged or plugged. 2. Check if the charging piping and valve cap are sealed off.
3. There is severe knock in the liner.	1. The piston nuts are loose. 2. The liner cover is loose. 3. The suction is not good caused water dash.	1. Tighten the piston nuts. 2. Tighten the liner cover. 3. Check the reason of improper suction.
4. The mud leakage from the alarm bore of valve cap, cylinder and liner seal.	1. The valve cap and the cylinder cover are not tightened. 2. The seal ring is damaged.	1. Tighten the valve cap and the cylinder cover. 2. Change the seal ring.
5. The discharge pulsation dampener can't be charged or it leaks soon after charging.	1. The charging connector is plugged. 2. The bladder of the pulsation dampener is broken. 3. The needle valve is not sealed.	1. Clean the connector. 2. Change the bladder. 3. Repair or change the needle valve.
6. The diesel is overloaded.	The discharge filter drum is plugged.	Remove the filter screen and clean it.
7. Abnormal temperature on running friction parts like power end, crosshead etc.	1. The oil pipe or oil port is plugged. 2. The lubricating oil is too dirty or deteriorated. 3. The rolling bearing is worn or damaged. 4. The lubricating oil is too much or too little.	1. Clean the oil pipe or oil port. 2. Change new oil. 3. Repair or change bearing. 4. Add proper amount of oil.
8. Abnormal knock sound on power end, bearing, crosshead etc.	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 troubles, if other abnormal phenomena are found, the

reasons should be found according to the trouble spot. After troubleshooting, the pump can run normally.

6. Matters need attention for 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 lubricant 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

One mud pump consists of pump main body; spray pump; pulsation dampener; safety value; tools; spare parts for one time change of rubber seals.

Belt pulley and big skid are not included.

If there is not special required by users, spray pump is droved by belt and lubrication pump of power end is inner droved style.

Normally, Φ170 liners and pistons are assembled in the pump when it is transported to users.

7.2 Metric system and British system

1) F-series mud pumps are divided into two basic styles: metric and British. Users choose it due to their own demands and declare when ordering.

2) Metric pump adopts metric threads and British pump adopts American threads.

7.3 Drive rotation direction

If drilling rigs require the mud pumps reverse rotation, please order F-1300R/1600R reverse pump. Follow characters belong to F-1300R/1600R the reverse pump:

1. The clearance between guides is 0.25-0.40mm (0.010~0.016in).
2. Upper guide and lower guide can exchange.
3. Connecting the oil pump oppositely.

8. Lube Application Guide

Description	Lubricating position and description	Ambient Temp.	Oil Spec.	Recommended oil	
				Mobile	Esso
Mud pump (Drilling pump)	Gear box (Note: the oil includes the rust-proof, the non-corrosive, anti-foaming, and sulfur-phospho rus series EP anti-wear additive)	+10°C ～ +68°C	AGMA Mild EP # 7 * L-CKD 460 gear oil API GL-5 , SAE 85W-140 gear oil	Gear oil 634	Spartan EP 460
		-7°C～+38°C	AGMA Mild EP # 6 * L-CKD 320 gear oil API GL-5 , SAE 85W-90 gear oil	Gear oil 632	Spartan EP 320
		-29°C ～ +16°C	AGMA Mild EP #2 * API GL -5 , SAE 80W-90 gear oil	Gear oil 626	Spartan EP 68
		-40°C ～ +27°C	API GL -5 , SAE 75W-90 gear oil	Gear oil SHC 220	
	Bearings lubricated by grease (spraying pump, drive shaft and Cardan shaft)	0°C～+50°C	NLGI 2 EP lithium base grease	Grease EP 2	Beacon EP 2
		-30°C～+5°C	NLGI 0 EP lithium base grease	Grease EP 0	Beacon EP 0
		-40°C ～ +50°C	NLGI 2 EP complex lithium base grease	Grease SHC 220	

* IADC（International Association of Drilling Contractor）recommend to use.

9. F-1300/1600 Mud Pump Parts Content

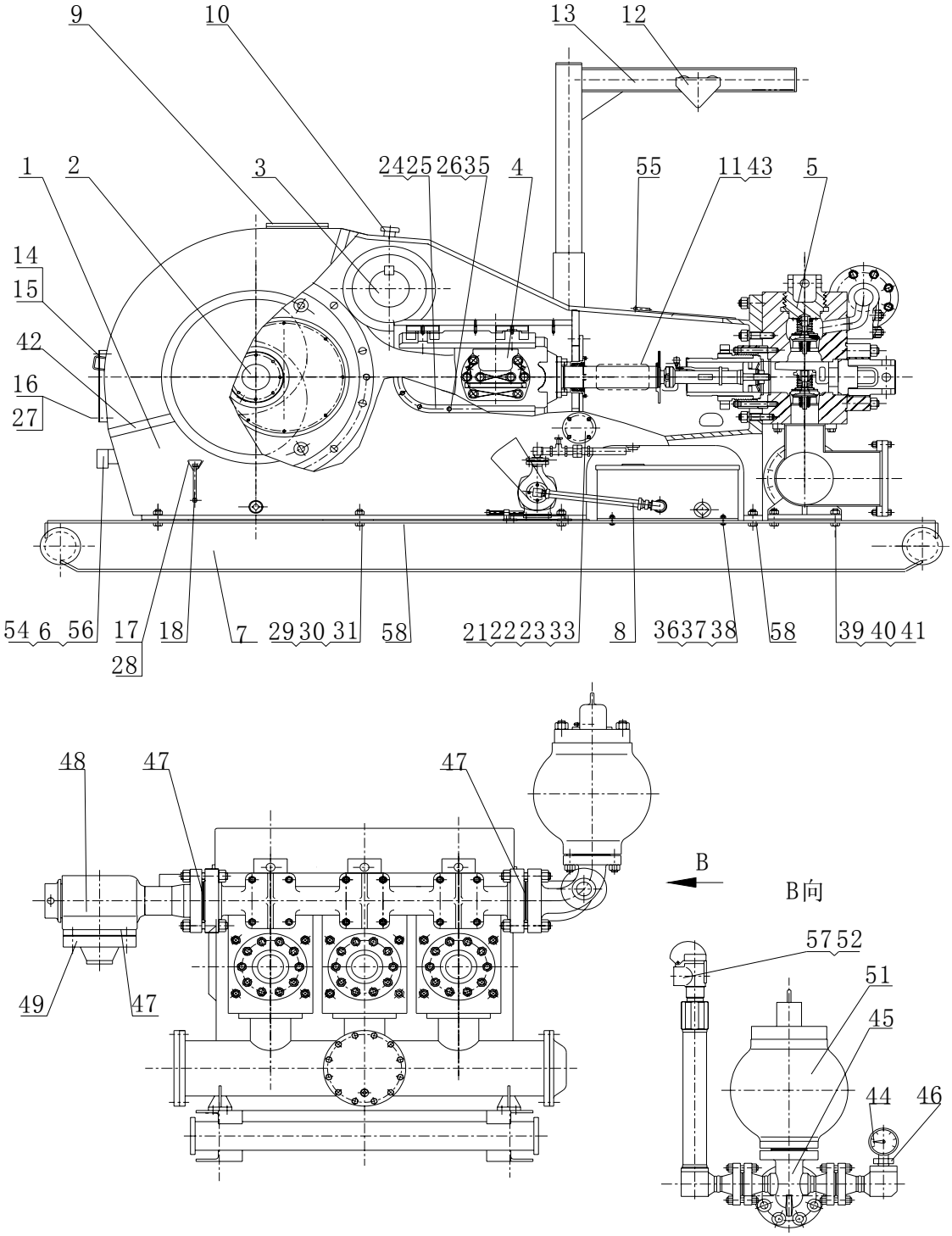
Parts Content Drawing List

Drawing description	Drawing No. or Part No.
F-1300/1600 General Assembly	AH13010200 / AH16010200
F-1300/1600 Crankshaft Assembly	H1301020200 / AH1601020100
F-1300/1600 Pinion Shaft Assembly	AH1301020300 / AH1601020200
F-1300/1600 Crosshead Assembly	AH1301020400
F-1300/1600 Fluid End Assembly A	AH1301020500
F-1300/1600 Power End Lubrication Assembly	AH1301020600
F-1300/1600 Spray Pump Assembly	AH1301020800
F-1300/1600 Suction Dampener	AH0000050100
F-1300/1600 Discharge Strainer Assembly	
KB-75 Pulsation Dampener	AK75350200
Pulsation Dampener Charging Hose Assembly	AH100102130100
JA-3 Shear Relief Valve	AH0000060200

F-1300/1600 Spare Parts List

F-1300/1600 Tool List

F-1300/1600 Mud Pump General Assembly

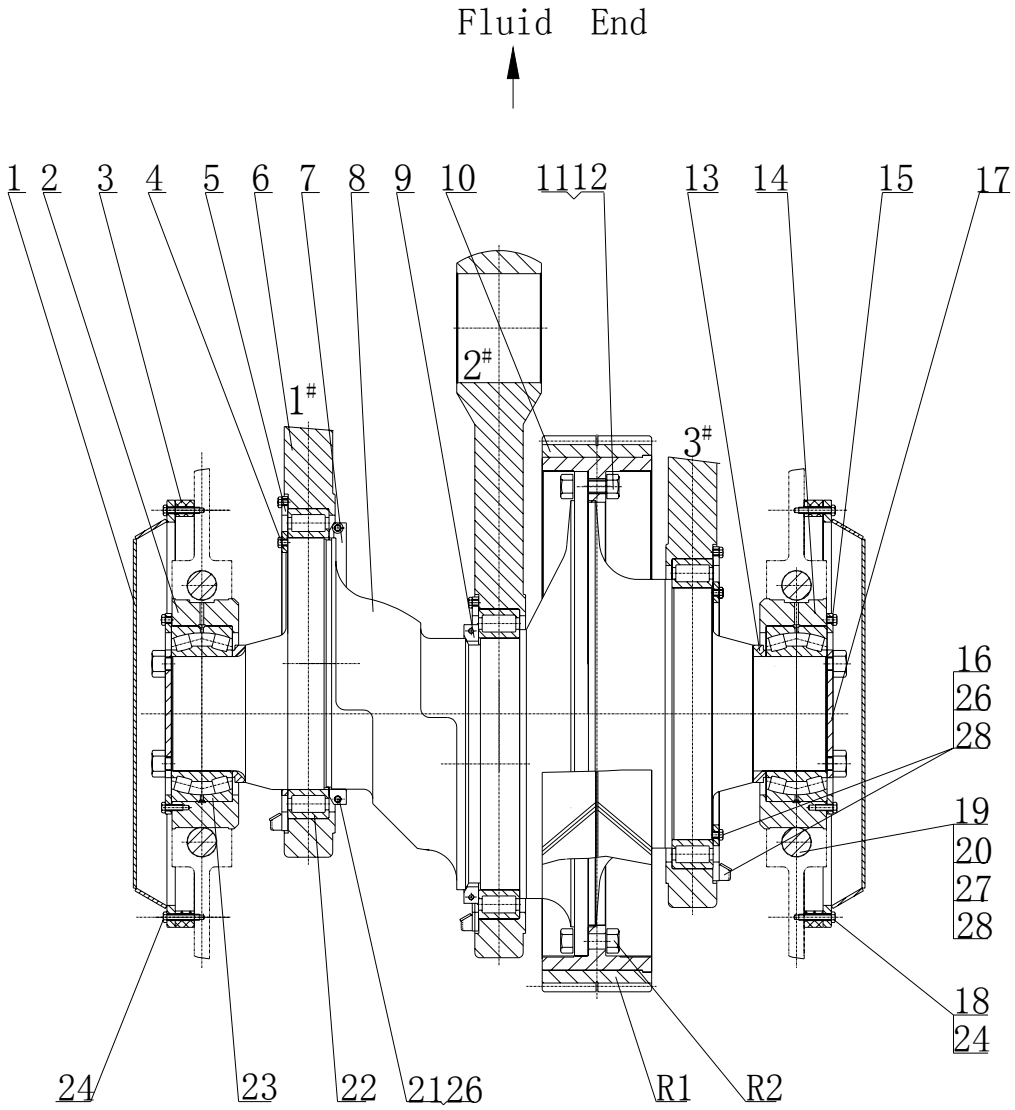


F-1300/1600 Drilling Mud Pump

Item	Qty	Description	Drawing No.	
			F-1300	F-1600
1	1	Frame assembly	AH1301020100	AH1301020100
2	1	Crank shaft assembly	AH1301020200	AH1601020100
3	1	Pinion shaft assembly	AH1301020300	AH1601020200
4	3	Crosshead assembly	AH1301020400	AH1301020400
5	1	Fluid end assembly	AH1301020500	AH1301020500
6	1	Power end lubrication assembly	AH1301020600	AH1301020600
7	1	Skid	AH1301020700	AH1301020700
8	1	Spray pump assembly	AH1301020800	AH1301020800
9	2	BS Nameplate	AH13010209	AH16010203
10	1	Tools	AH1301021000	AH1301021000
11	1	Spare parts	AH1301021100	AH1301021100
12	1	Discharge filter assembly	AH1001021100	AH1001021100
13	2	Seal washer	AH10010109	AH10010109
14	1	Ventilation shield	T515-101.00	T515-101.00
15	1	Small crane	AH1301011000	AH1301011000
16	1	Lifting frame	AH1301011100	AH1301011100
17	1	Cover plate	AH1301011200	AH1301011200
18	1	Gasket	AH13010113	AH13010113
19	2	Indicator	AH10010113	AH10010210
20	2	Oil level assembly	AH1001011400	AH1001011400
22	2	Drain cover（Ⅲ）	AH1001011500	AH1001011500
23	2	Seal washer	AH10010116	AH10010116
24	2	Crosshead pore cover	AH13010114	AH16010104
25	2	Gasket	AH13010115	AH13010115
26	1	Transition joint	T512-1002	T512-1002
27	1	Elbow	AH10010212	AH10010212
28	1	Gasket ring R44	T508-1002	T508-1002

Item	Qty	Description	Drawing No.	
			F-1300	F-1600
29	1	Flange	T508-1002	T508-1002
30	1	KB-75 Dampener	AK75350200	AK75350200
31	1	JA-3 Shear relieve valve	AH0000060200	AH0000060200
32	2	Connection tube	T510-1002	T510-1002
33	1	Cover plate	AH1301011800	AH1301011800
34	2	Right-angle joint	T511-1002	T511-1002
35	14	Bolt 1/2-13UNCX1	T500-1001	T500-1001
36	8	Bolt 1/2-13UNCX1 1/2	T500-1017	T500-1017
37	28	Bolt 5/8-11UNCX1 5/8	T500-1010	T500-1010
38	16	Bolt 1-8UNCX3 1/4	T500-1013	T500-1013
39	16	Nut 1-8UNC-2B	T501-1003	T501-1003
40	4	Bolt 5/8-11UNCX1 3/4	T500-1008	T500-1008
41	4	Nut 5/8-11UNC-2B	T501-1002	T501-1002
42	6	Pin for index tag	420999050603001000	420999050603001000
43	16	Spring washer 27 (GB93)	420503011271600000	420503011271600000
44	22	Washer 12 (GB848)	420501036120200000	420501036120200000
45	28	Washer 16 (GB848)	420501036160200000	420501036160200000
46	4	Spring washer 16 (GB93)	420503010161600000	420503010161600000
47	8	Cruciform slot panhead screw M4x16 (GB818)	420101050704001606	420101050704001606
48	1	Rubber strip	140601061000000000	140601061000000000
49	1	Dual dial anti-knock pressure gauge	380207192602511514	380207192602511514
50	10ml	Threads anaerobic lock glue	170506010100243000	170506010100243000
51	On demand	Adjustable washer	AH13010119	AH13010119
52	8	Plain cushion	420501060270100000	420501060270100000

Crankshaft Assembly

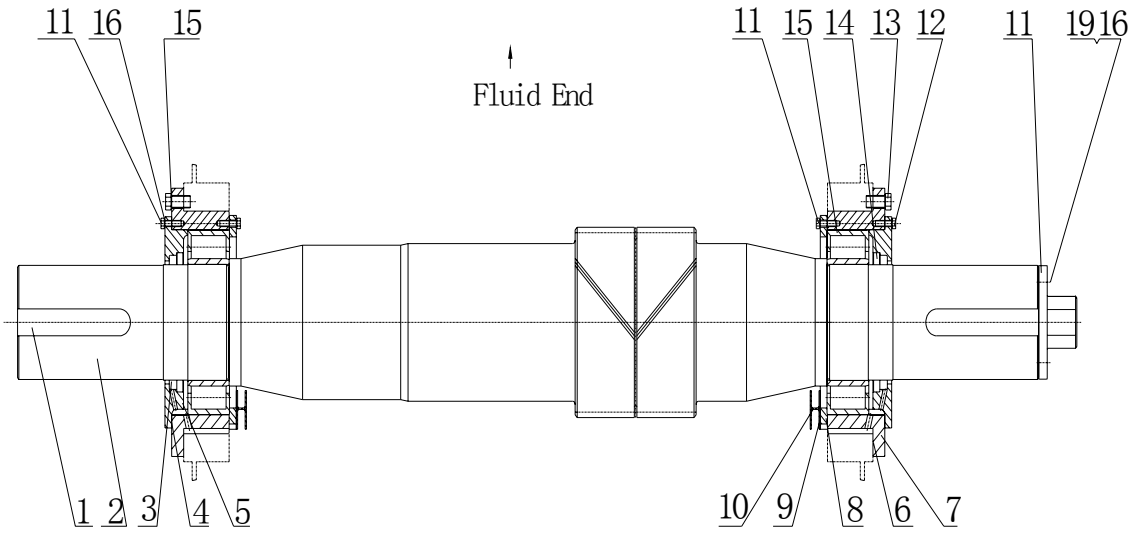


Item	Qty	Description	Drawing No.	
			F-1300	F-1600
1	2	Main bearing cover	AH130101020100	AH130101020100
2	1	Bearing sleeve, right	AH1301010202	AH1601020101
3	2	Gasket	AH1301010203	AH1301010203
4	2	Inner race retainer	AH1301010204	AH1301010204
5	3	Outer race retainer	AH130101020500	AH160101010200
6	3	Connecting rod	AH1301020202	AH1601020102

Item	Qty	Description	Drawing No.	
			F-1300	F-1600
7	1	Locating ring (I)	AH130101020100	AH130101020100
8	1	Hollow crankshaft	AH1301020201	AH1601020101
9	1	Locating ring (II)	AH1301010203	AH1301010203
10	1	Gear ring	AH1301010204	AH1301010204
11	12	Piston nut 1 1/2-8UN	AH130101020500	AH160101010200
12	12	Bolt 1 1/2-8UNx5 1/2	AH1301020202	AH1601020102
13	2	Spacer ring,	AH1301020203	AH1301020203
14	1	Main bearing sleeve (left)	AH130102020400	AH130102020400
15	2	Retainer ring	AH1301020205	AH1301020205
16	72	Bolt 5/8-11UNCx1 1/2	AH130101021000	AH160101010400
17	2	Retainer plate	T501-303.0	T501-303.0
18	28	Bolt 5/8-11UNCx1 3/4	T500-2023	T500-2023
19	4	Main bearing bolt	AH1301010211	AH1301010211
20	On demand	Shim set	AH1301020206	AH1601020103
21	2	Screw 5/8-11UNC ×4	AH1301010213	AH1601010106
22	3	Eccentric bearing	T500-1018K	T500-1018K
23	2	Main bearing	AH1301010214	AH1301010214
24	28	Washer 16 (GB848)	T500-1008	T500-1008
25	2	Screw 5/8-11UNC ×4 3/4	AH1301010215	AH1301010215
26	40m	Lock wire φ1.5 (GB343)	AH130101021600	AH130101021600
27	3m	Lock wire φ3 (GB343)	T500-3004K	T500-3004K
28	90ml	Threads anaerobic lock glue 243	AH1301010217	AH1601010107

Item	Qty	Description	Drawing No.	
			F-1300	F-1600
R1	1	Gear ring (split one)	AH1301010218	AH1601010108
R2	12	Bolt 1 1/2-8UN× 7	420501036160200000	420501036160200000

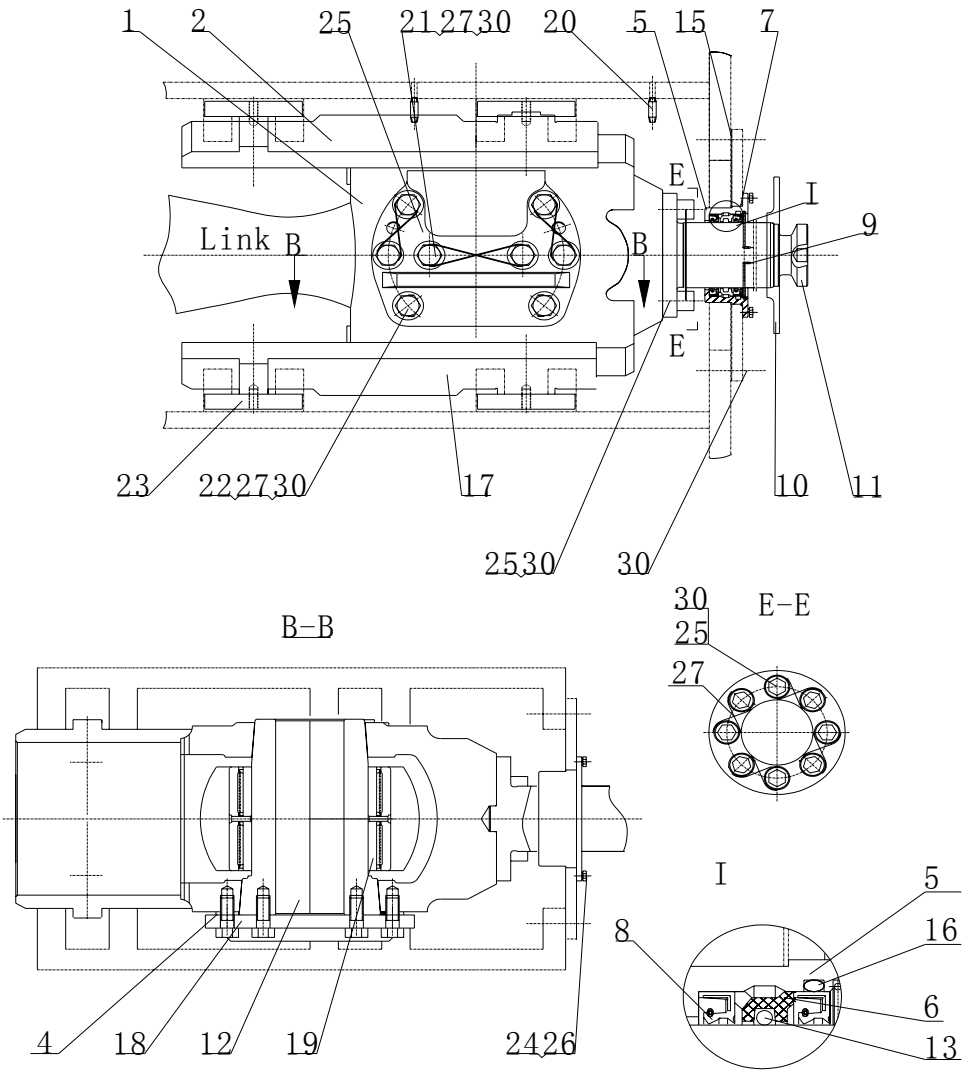
F-1300/1600 Pinion Shaft Assembly



Item	Qty	Description	Drawing No.	
			F-1300	F-1600
1	1	Key 2″×2″×11 3/8″	AH1301020301	AH1301020301
2	1	Pinion shaft	AH1301020302	AH1601020201
3	2	Wear-resisting sleeve	AH1301010303	AH1301010303
4	2	End cover	AH1301020303	AH1301020303
5	2	Gasket	AH1301010305	AH1301010305
6	2	Gasket	AH1301010306	AH1301010306
7	2	Pinion bearing carrier	AH1301010306	AH1301010306
8	2	Retainer ring	AH1301020305	AH1301020305
9	2	Gasket	AH1301010309	AH1301010309
10	2	Oil box	AH130101031000	AH130101031000
11	24	Bolt 1/2-13UNCX1 3/8	T500-1019	T500-1019

Item	Qty	Description	Drawing No.	
			F-1300	F-1600
12	16	Bolt 7/8-9UNCX2	T500-1027	T500-1027
13	2	Oil seal 9.125"X10.375"X0.625"	AH1301010311	AH1301010311
14	2	Bearing 4G32844H	AH1301010312	AH1301010312
15	16	Spring washer 22 (GB93)	420503011221600000	420503011221600000
16	24	Spring washer 14 (GB93)	420503011141600000	420503011141600000
17	1	Flange	AH1301010313	AH1301010313
18	3	Bolt 5/8-11UNCX1 3/4	T500-2003	T500-2003
19	3	Spring washer 16 (GB93)	420503011161600000	420503011161600000

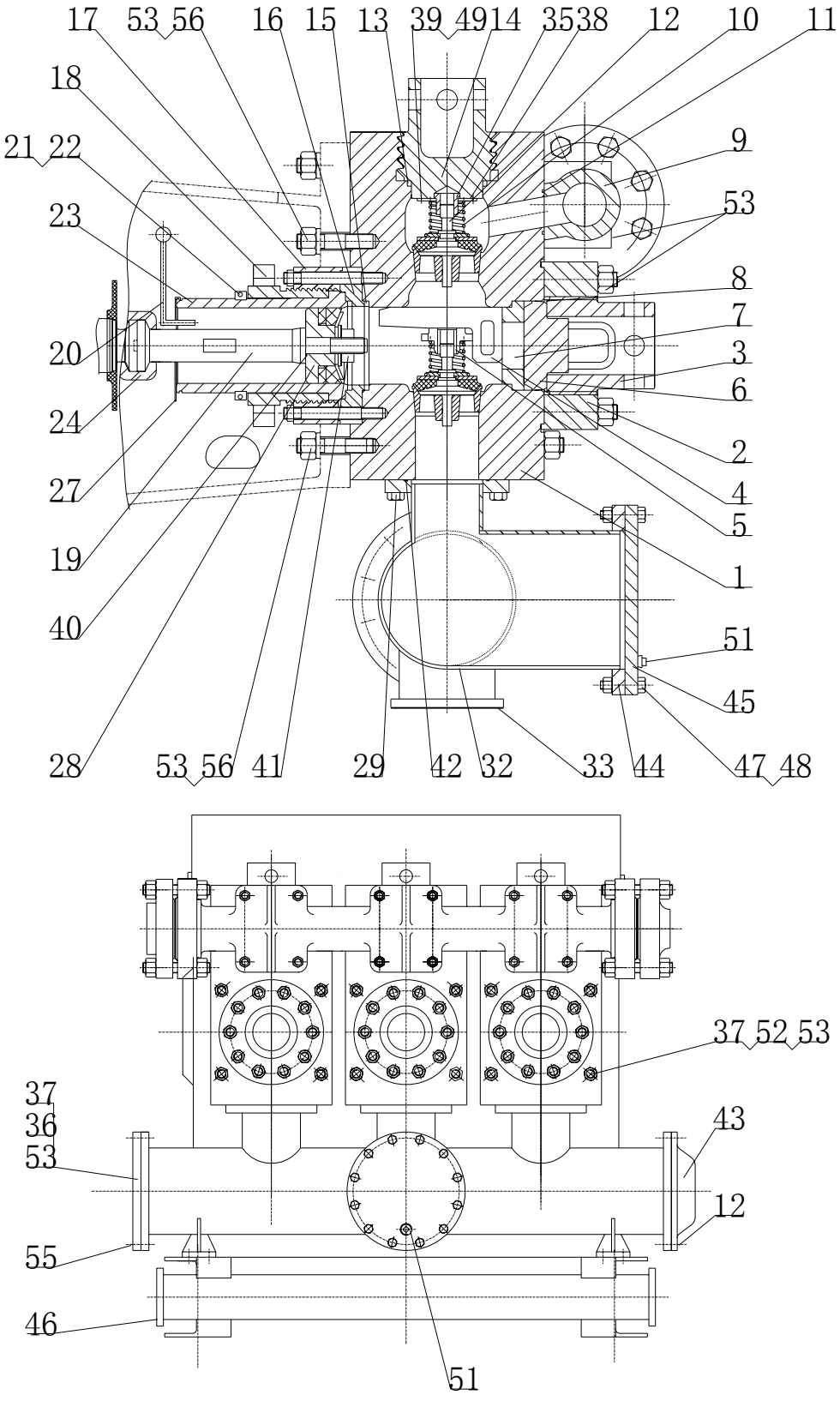
F-1300/1600 Crosshead Assembly



Item No.	Qty.	Description	Drawing No.
1	1	Crosshead	AH1301020401
2	1	Crosshead guide (upper)	AH1301010402
3	8	Shim set	AH100101041700
4	2	Shim	AH1301010403
5	1	Stuffing box	AH1301010404
6	1	Sealing ring	AH1301010405
7	1	O-ring φ190×3.55 (GB3452.1)	530301011900035507

Item No.	Qty.	Description	Drawing No.
8	2	Double lip seal 5"X6.25"X0.625"	AH1301010406
9	1	Locking spring	AH1301010407
10	1	Mud guard plate	AH1301010408
11	1	Crosshead extension rod	AH1301010409
12	1	Crosshead pin	AH1301020403
13	1	O-ring φ125×7 (GB3452.1)	530301011250070007
14	8	Bolt 3/4-10UNCX2 1/2	T500-3010
15	1	Plate gasket	AH1301010411
16	1	O-ring φ160×7 (GB3452.1)	530301011600070007
17	1	Crosshead guide (lower)	AH1301010412
18	1	Crosshead pin retainer	AH1301020404
19	1	Crosshead bearing	AH1301010414
20	2	Pipe connector NPT3/8″×2	AH1301010414
21	2	Bolt 1-8UNCX2 1/4	T500-2018K
22	6	Bolt 1-8UNCX2 1/2	T500-2019K
23	8	Locking plate	AH1301020402
24	4	Bolt 3/8-16UNCX1	T500-1021
25	8	Screw 1-8UNCX2 1/2	T500-3013K
26	4	Spring washer 10 (GB93)	420503011101600000
27	On demand	Galvanized wire φ1.6 (GB4240)	040104030160000800
30		Threads anaerobic lock glue 243	170506010100243000

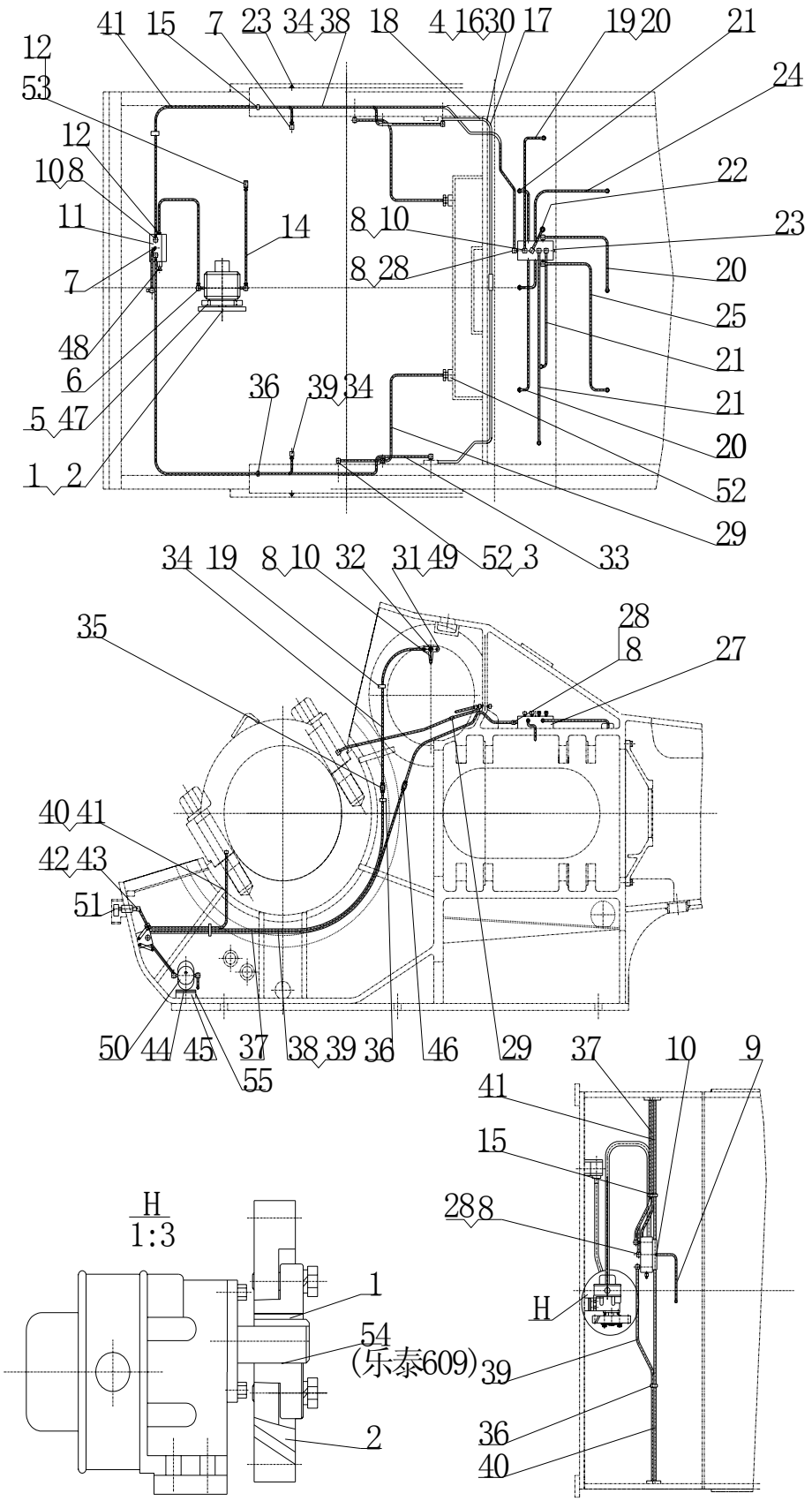
F-1300/1600 Fluid End Assembly



Item No.	Qty.	Description	Drawing No.
1	3	Fluid end Assembly	AH130102050100
2	3	Cylinder head flange	AH1301010502
3	3	Cylinder head	AH1301010503
4	3	Plug assembly	AH130101050400
5	3	Valve rod guide (lower)	AH130101050500
6	3	Cylinder head plug	AH130101050600
7	3	Locating plate	AH1301010507
8	3	Cylinder head seal ring	AH1301010508
9	1	Discharge manifold	AH1301010509
10	6	Valve spring	AH00000101
11	3	O-ring φ95×5.3 (GB3452.1)	530301010950053007
12	6	Valve Assembly API 7 pylome	AH0000020300
13	3	Valve cover seal ring	AH1301010510
14	3	Valve pot cover	AH1301020502
15	6	Liner seal ring	AH1301010512
16	3	Wear plate	AH1301020503
17	3	Liner flange	AH1301010514
18	3	Liner press cover	AH130101051500
19	3	Piston rod	AH1301020504
20	3	Connector tube	AH130102050500
21	3	O-ring φ200×7 (GB3452.1)	530301012000070007
22	3	Liner lock ring	AH1301010518
23	3	Bi-metal liner	AH130102051200
24	3	Clamp assembly	AH130102050600
26	3	Elbow NPT3/8-M22X1.5	AH1301020507
27	3	Liner end cover	AH1301010520
28	3	British piston	AH130102050800
29	18	Bolt 7/8-9UNCX2	T500-1027
30	3	Joint NPT1/2-M22X1.5	AH1301020509
31	3	Right joint NPT1-NPT1/2	AH1301020509
32	1	Suction pipe	AH130102051100

Item No.	Qty.	Description	Drawing No.
33	4	Shim set	AH130101052300
34	30	Gasket 39	AH1001010527
35	3	Valve rod guide	AH1001010510
36	16	Stud bolt 1 1/2-8UNCX10 1/2	T500-7002
37	44	Nut 1 1/2-8UN	T501-2001
38	3	Retainer	AH1001010512
39	12	Bolt 3/8-16UNCX3/4	AH0501020509
40	3	O-ring 41.2x3.55 （GB3452.1）	530301010412035507
41	3	Piston nut 1 1/2-8UN	T501-303.0
42	3	O-ring φ185x7 (GB3452.1)	530301011850070007
43	1	Suction baffle plate	T505-1006
44	3	O-ring φ345x7 (GB3452.1)	530301013450070007
45	2	Suction flange (Ⅰ)	AH1001010525
46	1	Suction flange (Ⅱ)	AH1001020509
47	36	Nut 1-8UNC	T501-1003
48	24	Bolt 1-8uncx3 1/2	T500-1023
49	1	Stainless steel wireφ1.6×1830 （GB4240）	040104030160001900
50	3	Hose assembly C-13X1W-850 （JB1887）	140507011301008530
51	2	Plug NPT 1 1/2	T506-1007
52	12	Stud bolt 1 1/2-8UNX22 1/4	AH1301020513
53		Loktite glue 243	170506010100243000
54	12	Bolt 1-8UNCX4 1/4	T500-1024
55	3	Hose clamp 3 （Q/ZB251）	061401030750000000
56	2	Discharge baffle plate	T505-1008
57		Suction dampener	AH0000050100

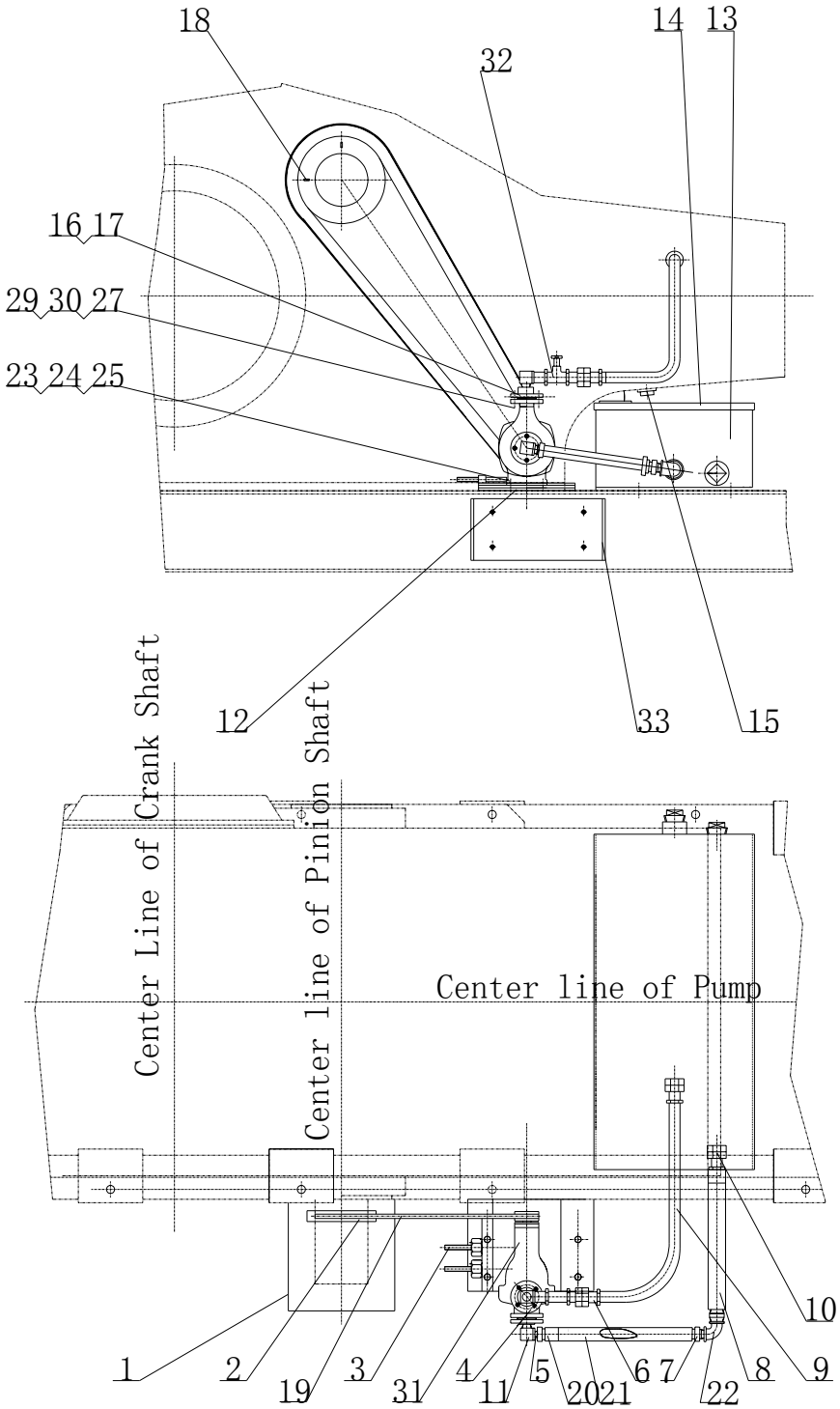
F-1300/1600 Power End Lubrication Assembly



Item No.	Qty	Description	Drawing No.
1	1	Key 3/16×3/16×1	T516-2001
2	1	Oil pump gear assembly	AH080102060100
3	2	90° elbow NPT1/4×NPT 3/8	T001-2204
4	2	Bolt A12（GB5650）	520902540320120100
5	8	Inner hexagon screw 5/16-18UNCX1 5/8	T500-3003
6	2	Connector A16 （JB/ZQ4410）	520901010350040040
7	3	Connector A8 （JB/ZQ4410）	520901010350050050
8	14	90° elbow NPT1/4×NPT1/4	T001-2203
9	1	Copper tube Φ8×305（GB1572）	051102010080010002
10	17	Connector A8 （JB/ZQ4408）	520901010330050050
11	1	Joint seat	AH1001010611
12	2	Connector A16 （JB/ZQ4408）	520901010330040040
13	1	Copper tube Φ16×686 （GB1527）	051102010160015002
14	1	Copper tube Φ16×331 （GB1527）	051102010160015002
15	2	Pipe clamp	AH080102060200
16	2	Connector 45°	AH1001010608
17	1	Copper tube Φ10×838 （GB1527）	051102010100010002
18	1	Copper tube Φ12×305 （GB1527）	051102010120010002
19	13	Pipe clamp Φ8	AH050102060400
20	3	Copper tube Φ8×762 （GB1527）	051102010080010002
21	2	Copper tube Φ8×508 （GB1527）	051102010080010002
22	2	Copper tube Φ8×229 （GB1527）	051102010080010002
23	5	Pipe plug NPT1/4"	T506-1002
24	1	Copper tube Φ8×915 （GB1527）	051102010080010002
25	1	Copper tube Φ8×1194 （GB1527）	051102010080010002
26	1	Copper tube Φ8×1016 （GB1527）	051102010080010002
27	1	Joint seat (I)	AH1001010607
28	2	Connector A10 （JB/ZQ4408）	520901010330010010
29	4	Pipe clamp〈I〉	AH050102060100

Item No.	Qty	Description	Drawing No.
30	2	Washer A12 （GB5651）	520902551280120100
31	4	Bolt 1/4-20UNCX3/4	T500-1007
32	2	Oil jet	AH1301010601
33	2	Copper tube Φ12×610 （GB1527）	051102010012010002
34	2	Copper tube Φ8×813 （GB1527）	051102010080010002
35	2	Connector A8 （GB5628.1）	520901010050050050
36	3	Pipe clamp-double Φ8	AH050102060200
37	1	Copper tube Φ10×1956 （GB1527）	051102010010010002
38	1	Copper tube Φ8×1956 （GB1527）	051102010080010002
39	1	Copper tube Φ8×2311 （GB1527）	051102010080010002
40	1	Copper tube Φ8×1600 （GB1527）	051102010080010002
41	1	Copper tube Φ8×1245 （GB1527）	051102010080010002
42	1	Connector NPT1/4-NPT1/4	T001-0401
44	1	Shim set	AH100101060400
45	1	Bracket	AH130102060200
46	1	Connector A10 （GB5628.1）	520901010050010010
47	8	Spring washer 8（GB93）	420503011081600000
48	1	Relief valve（YYFJ-L120）	512604900000032002
49	4	Spring washer 8（GB93）	420503011081600000
50	1	Oil pump, 2S	512601010031000000
51	1	Pressure gauge, M14×1.5(Y-60Z）	380202051160006021
52	4	Connector A12（JB/ZQ4408）	520901010330020020
53	1	Oil filter Assembly	AH100101061000
54		Loctite	170506010100609000
55	2	Locating plate	AH1001010613

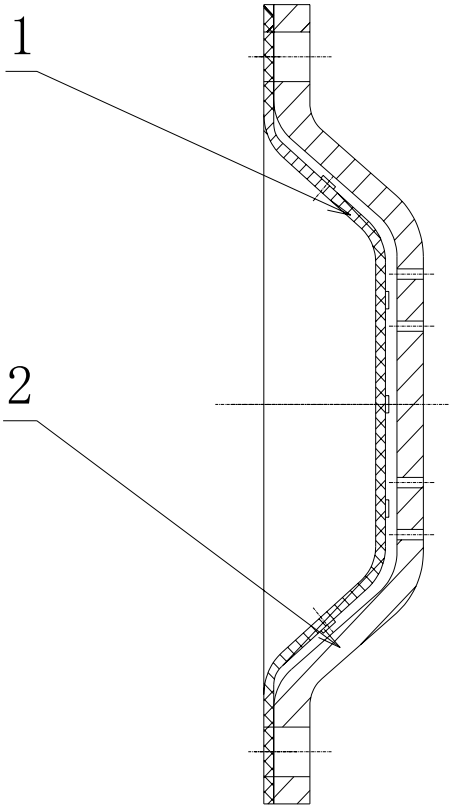
F-1300/1600 Spray pump assembly



Item No.	Qty	Description	Drawing No.

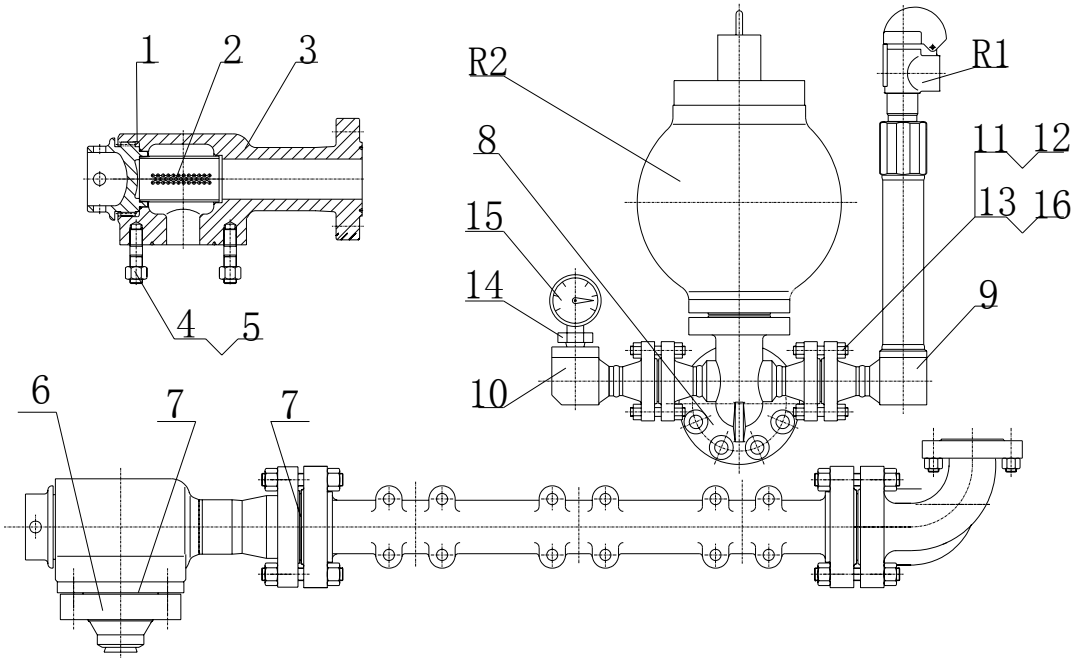
1	1	Guard	AH130102080100 AH130102080300
2	1	Sheave	AH1301010802
3	1	Support Assembly	AH100102080200
4	1	Connector Z1″-G1″	AH1001010804
5	1	Connector Z1″	AH1001010805
6	1	Connector G1″-M33×2	AH1001010806
7	1	Connector ZG2-1/2″	AH1001010807
8	1	Connector ZG2 1/2″-Z2 1/2	AH1001010808
9	1	Hose Φ22×Φ37	140501010220100000
10	2	Hose connector Φ22×Φ37	AH100101080900
11	3	Elbow 90° Z1"	AH1001010810
12	2	Connection plate	AH1001020803
13	1	Water tank	AH130101080400
14	1	Tank cover	AH100101081300
15	1	Connector NPT2 1/2″	T513-1004
16	2	Shim	AH1001010814
17	2	Flange Z1″	AH1001010815
18	2	Locking screw M8×25 （GB73）	420103028308002500
19	2	V-belt A-3708 （GB1171）	140301012037080000
20	2	Pipe clamp NO：3	061401010380000000
21	1	Hose Φ38×Φ53	140501010380305300
22	1	Elbow 90° ZG2 1/2″	520207050400650002
23	4	Bolt 5/8-11UNCX1 1/8	T500-1029
24	4	Spring washer 16 （GB93）	420503011161600000
25	4	Washer 16（GB96）	420501046160100000
26	4	Bolt 1/2-13UNCX1 5/8	T500-1004
27	12	Spring washer 14 （GB93）	420503011141600000
28	4	Washer 14 （GB96）	420501046140100000
29	8	Bolt 1/2-13UNCX2 1/4	T500-1005
30	8	Nut 1/2-13UNC	T501-1001
31	1	Spraying pump	AH100101081600
32	1	Ball valve G1″	441305011104164025
33	1	Pump support	AH130102080200

F-1300/1600 Suction Dampener



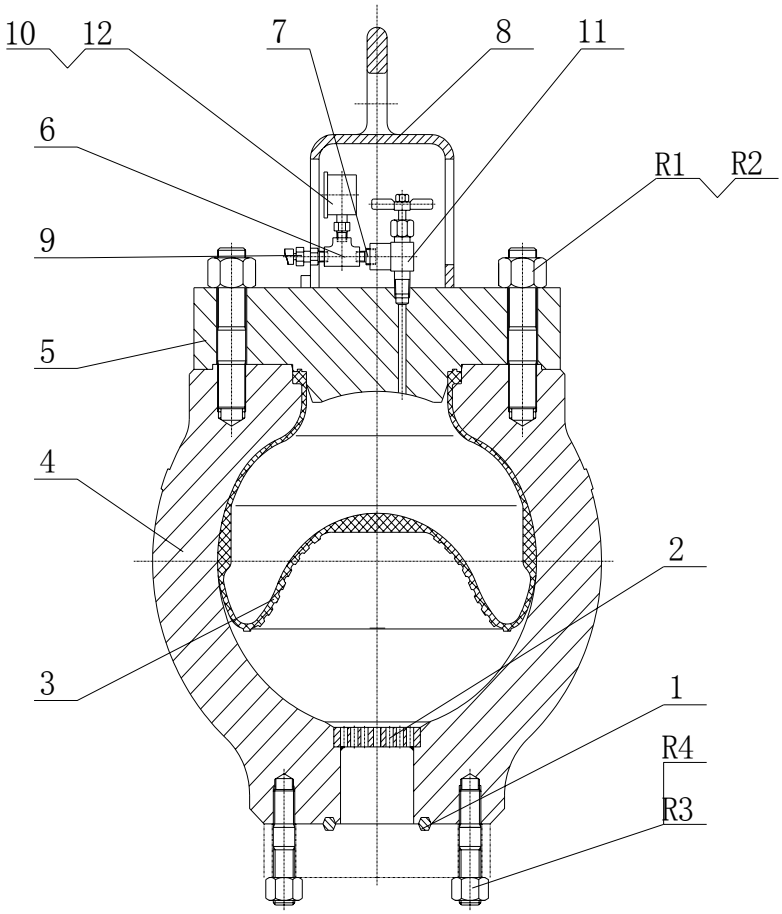
Item No.	Qty	Description	Drawing No.
		Suction dampener assembly	AH0000050100
1	1	Bladder	AH0000050101
2	1	Cover	AH0000050102

F-1300/1600 Discharge Strainer Assembly



Item	Qty	Description	Part No.
1	1	O-ring φ165×7	530301011650070007
2	1	Strainer Assembly	AH100101190200
3	1	Housing	AH1001011901
4	8	Stud M39×2-M39×3×135	T503-4007
5	8	Nut M39×3	T507-2011
6	1	Flange 5 1/8×35MPa	T508-1002
7	3	Gasket ring R44	T508-5002
8	1	Discharge cross joint	AH100101200300
9	1	Relieve valve connector	AH100101200200
10	1	Pressure gauge seat	AH100101200100
11	16	Stud M27×170	T503-1004
12	16	Nut M27	T507-2005
13	On demands	Loctite	170506010100277000
14	1	Transition joint R 1 1/2×NPT2″	T512-1001
15	1	Pressure gauge (NPT2″ or R 1 1/2″)	380207192602500514
16	3	Gasket ring R27	T508-5003
R1	1	JA-3 Shear relief valve	AH0000060100
R2	1	Pulsation dampener	AK75350100

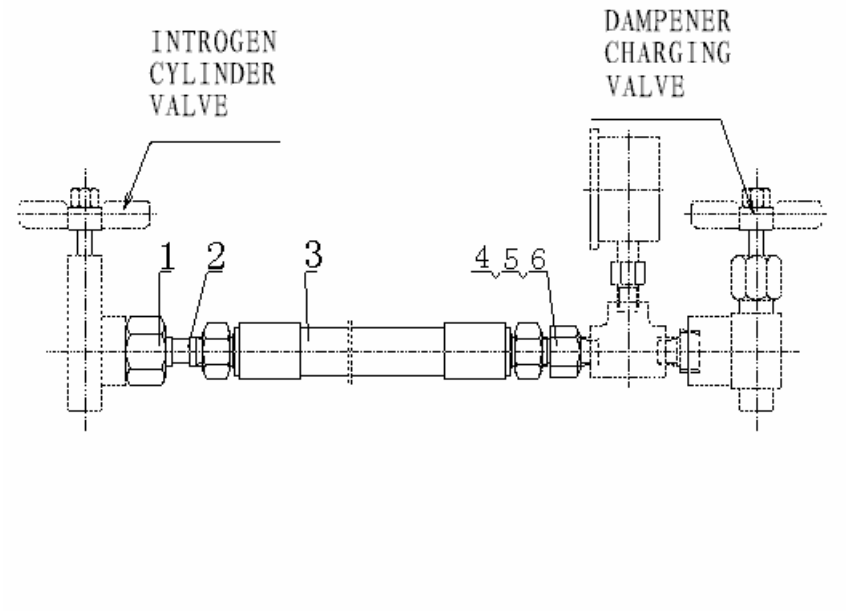
KB-75 Pulsation Dampener



Item No.	Qty	Description	Drawing No.
		General drawing	AK75350200
1	1	Gasket ring R39	T508-5001
2	1	Bottom plug	AK75350101
3	1	Bladder	AK7535010200
4	1	Housing assembly	AK7535020100
5	1	Cover	AK75350202
6	1	Tee joint NPT 1/4″	T511-2001
7	1	Joint NPT 1/4″	AK75350106
8	1	Pressure gauge guard assembly	AK7535020300
9	1	Air discharge valve	AK7535010001
10	1	Pressure gauge 0-25MPa NPT1/4	380202052250006020
11	1	Shutoff valve	AK7535010002

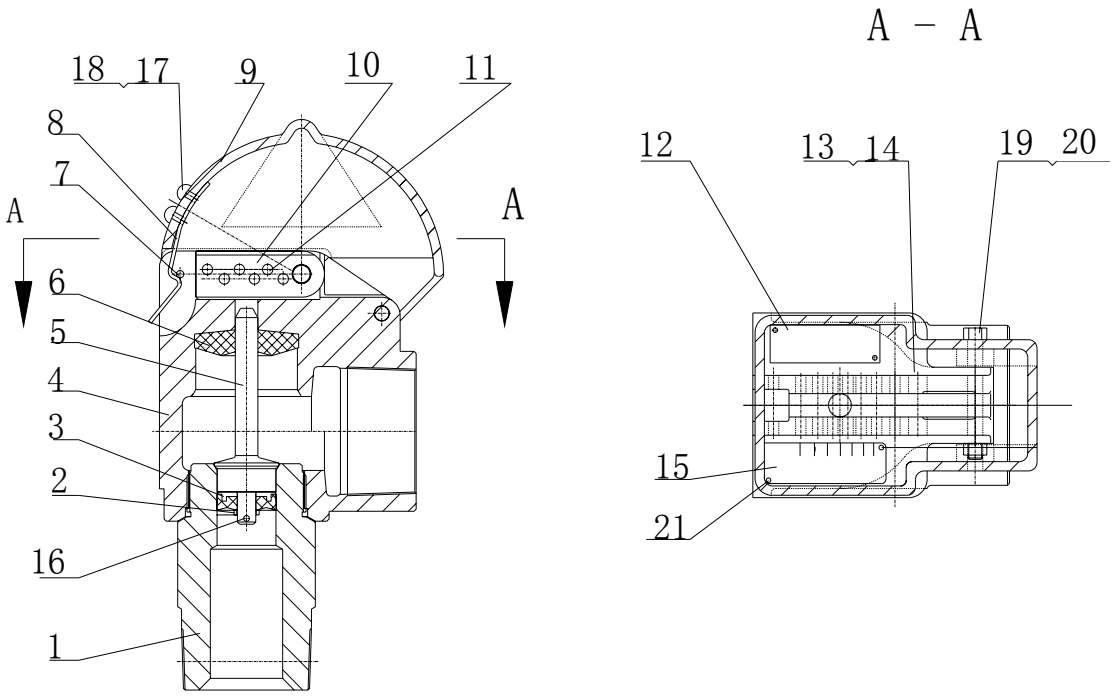
12	1	Gasket	T514-1001
R1	12	Stud bolt 1 1/2X4 3/4	T500-6002
R2	12	Nut 1 1/2-8UN	T501-2001
R3	8	Stud nut 1 1/4X4 1/4	T500-6003
R4	8	Nut 1 1/4-8UN	T500-2002

Pulsation Dampener Charging Hose Assembly



Item No.	Qty	Description	Drawing No.
		Pulsation dampener charging hose assembly	AH100102130100
1	1	Nut G5/8"	AH100102120101
2	1	Sealing connector	AH100102120102
3	1	Hose, C-type, M14×1.5	520901050030080084
4	1	Connector	AH100101210703
5	1	Gasket	AH100101210704
6	1	Pipe plug	AH100101210705

JA-3 Shear Relief Valve



Item No.	Qty	Description	Part No.
		JA-3 Shear relief valve	AH0000060200
1	1	Joint	AH0000060101
2	1	Retainer ring	AH0000060102
3	1	Plunger assembly	AH000006010300
4	1	Valve body	AH0000060104
5	1	Plunger stem	AH0000060105
6	1	Bumper	AH0000060106
7	1	Roll pin	AH0000060107
8	1	Locking spring	AH0000060108
9	1	Guard	AH0000060109
10	1	Shear plate	AH0000060110
11	1	Shear pin	AH0000060111
12	1	Warning nameplate	AH0000060201
13	1	Pin shaft	AH0000060113
14	2	Retainer ring	AH0000060114
15	1	Nameplate	AH0000060202
16	1	Cotter pin 4×26	420703020504002600
17	2	Nut M4	420402080040200000

18	2	Screw M4×16	420101021104001600
19	1	Bolt 3/8-16UNCX4 1/4	T500-1016
20	1	Nut 3/8-16UNC	T501-1005
21	4	Screw M3×8	420101020703000800

F-1300/1600 Spare Parts List

Item No.	Qty	Description	Drawing No.
		Spare parts	AH1301021100
1	2	Oil seal 9.125″×10.375″×0.625″	AH1301010311
2	3	O-ring Φ190×3.55（GB3452.1）	530301011900035000
3	3	O-ring Φ160×7（GB3452.1）	530301011600070007
4	6	Double lip oil seal 5″×6.25″×0.625″	AH1301010406
5	3	O-ring Φ95×5.3 (GB3452.1）	530301010950053007
6	3	Valve cover seal ring	AH1301010510
7	6	Liner seal	AH1301010512
8	3	Cylinder head seal	AH1301010508
9	3	O-ring Φ200×7 （GB3452.1）	530301012000070007
10	3	O-ring Φ41.2x3.55（GB3452.1）	530301010412035507
11	3	O-ring Φ185×7 （GB3452.1）	530301011850070007
12	3	O-ring Φ345×7（GB3452.1）	530301013450070007
13	3	Rubber 6 1/2L	T504-132.00
14	6	Valve rubber	AH000002030103
15	3	Gasket ring R44	T508-5002
16	1	Gasket ring R39	T508-5001
17	1	Buffer washer	AH0000060106
18	1	Piston assembly	AH000006010300
19	1	Bladder	AK7535010200
20	10	Shear pin	AH0000060111
21	2	Seal washer	AH10010109
22	3	Oil seal ring	AH1301010405
23	3	O-ring Φ1250×7 （GB3452.1）	530301011250070007
24	1	Capsule	AH0000050101

F-1300/1600 Tool List

Item No.	Qty	Description	Drawing No.
		Attachment tools	AH1301021000
1	1	Liner lifting tool	AH130102100100
2	1	Cylinder head rod	AH100101210100
3	1	Sleeve 2 3/8″	AH1001012108
4	1	Sleeve 2″	AH1001012109
5	1	Sleeve 3 5/8″	AH1301011602
6	1	Sleeve 1 1/2″	AH1301011603
7	1	Connector	AH1301011604
8	1	19 5/8″ Extension bar	AH1301011605
9	1	8″ Extension bar	AH1001012110
10	1	Connector 1″	AH1001012111
11	1	24″ Extension bar	AH1001012112
12	1	SH 1/2 Ratchet hoist	390101010100500000
13	1	Manual hydraulic pump 70MPa	512605040000117000
14	1	Dampener charging hose assembly	AH100102130100
15	1	Hydraulic valve seat puller	AH130101160600
16	1	Packing guide sleeve	AH1301011607
17	1	Taper sleeve	AH1301011608
18	1	Press sleeve	AH1301011609
19	1	Long sleeve	AH130101161000
20	1	Plugboard puller	AH130101161200
21	1	Short lead screw	AH1301011613
22	1	Hang receptacle	AH1301011614