



## **DSL85 Power Swivel**

# **Use and Maintenance Manual**

DSL85-SM

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## Foreword

DSL85 power swivel is the swivel the central tube of which is driven by constant displacement hydraulic motor through gear reduction system. With a compact structure and a design weight of only 750 kg, it applies to most of drilling derricks or workover derricks.

DSL85 power swivel can provide steady and non-impact torque. Its maximum static load at zero speed is 850 kN and it can bear dynamic load of 450 kN at 100 rpm.

DSL85 power swivel can be used to connect long single drill stems and oil tubes without using spinning chain, pipe tongs and kelly spinner. The using of power swivel can reduce the rig stop/start frequency, and thus improving rig efficiency and reducing the wear of pump, drawwork and other drilling equipment.

DSL85 power swivel is provided with closed circuit hydraulic system that controls the flow and direction of hydraulic oil by controlling the closed adjustable hydraulic pump with electric handle. In the whole operating range, the central tube of power swivel can realize step-less speed variation. The torque limit of power swivel can be set on the touch screen, so that the risk of drill column twisting and expansion is eliminated.

DSL85 power swivel also has the functions the same as ordinary swivels. When the central tube is in rotating or stationary state, the drilling fluid enters inside drill stem through gooseneck, wash pipe and central tube and circulates.

A complete set of DSL85 power swivel consists of swivel, diesel engine- hydraulic pump set, control cabinet, control cable, auxiliary towing machine and pipe winch. All these parts are installed on skid to form a fixed device.

Characteristics of DSL85 power swivel are as below:

- 1) Provide steady and non-impact torque and reduce the damages to drill column;
- 2) Applicable to most of drilling and workover derricks;
- 3) Long drill columns can be used;
- 4) The torque limit of power swivel can be set;
- 5) Replaceable to traditional swiveling faucets;
- 6) Installed on the skid as a whole to facilitate transportation.

DSL85 power swivel can be applied in the following aspects:

- 1) It is specially applicable to fishing and workover: for example, cutting of external casing, oil tube or drill stem; the drilling away of blockage, filler or cement; the milling or scraping of metal casing – self-controlled torque used in this aspect is free from impact, so that twisting off and tool damages are reduced.
- 2) Drilling operations: this swivel of compact structure and light weight can be used in light and medium scale drilling operations. In addition to oil well and gas well drilling, it can also be used in water well drilling, pier piling and foundation laying.
- 3) Sampling: DSL85 power swivel can also be used in sampling. Its reasonable and steady torque prevents coring tools or pipe strings from damages and make it possible to drill cores of any length.

## 1. Safety Precautions

Before installing and using power swivel, please read and obey following safety precautions and steps:

1. Customers all provide their minimum temperatures while ordering this product if their normal working temperature is lower than -20°C.
2. Determine the structure and strength of derrick in order to ensure that it can bear the load applied by power swivel.
3. DSL85 power swivel must be provided with reactive torque cable to bear the reactive torque generated by it during work. The reactive torque cable, passing through the reactive torque arm, shall be fixed on derrick top by one side and on the well countertop by the other end. If reactive torque arm fails, the reactive torque cable can prevent it from falling down on the well countertop.
4. Before operation, derrick height and the stroke of travelling block shall be carefully inspected, and the reactive torque cable shall be installed vertically as far as possible, so that the swivel will be able to move upward and downward freely in the effect of torque. If the installation angle of reactive torque cable is more than 5%, the load on swivel will be made eccentric and its operation will be thus affected.
5. NDT for main bearing parts (lifting bail, shell, lifting bail pin, central tube and its joint) of power swivel must be carried out after using the swivel for 2 years. The power swivel can only be used if they are tested conforming.
6. Understand and get familiar with the working principle and working process of power swivel and the function of its handle and buttons.
7. Operators shall be trained qualified and provided with normal safety supplies.

Warning: Operators or floormen may be injured physically if not adopting these safety measures.

## 2. Main Technical Parameters

Table 1: Main Technical Parameters of DSL85 Power Swivel

Item	Technical Parameters	
	The Metric System	British System
Maximum static load	850 kN	94 US ton
Rated dynamic load (100 rpm)	450 kN	50 US ton
Maximum torque	5400 N.m	3980 ft.lbf
Maximum speed	155 rpm	
Maximum circulating pressure	35 MPa	5000 psi
Gooseneck connection	NPT2 <sup>1</sup> / <sub>2</sub>	
Joint of central tube	2 <sup>7</sup> / <sub>8</sub> IF	
Model of diesel engine	Cummins 4BTA-C125	
Rated power/speed of diesel engine	90 kW/2,000 rpm	120 H.P./2,000 rpm
Volume of hydraulic line	30.5 m	100 ft
Maximum working pressure of hydraulic system	31.5 MPa	4,568 psi
Maximum work flow of hydraulic system	180 L/min	47.5 gal/min
Effective volume of hydraulic oil tank	360 L	95 gal
Effective volume of diesel tank	250 L/min	66 gal
Dimensions	5,050×5,000×2,090 mm	16.6×9.8×6.9 ft
Total weight	4,500 kg	9,920 lb

### 3. Working Principle and Product Structure

#### 3.1 Product Composition

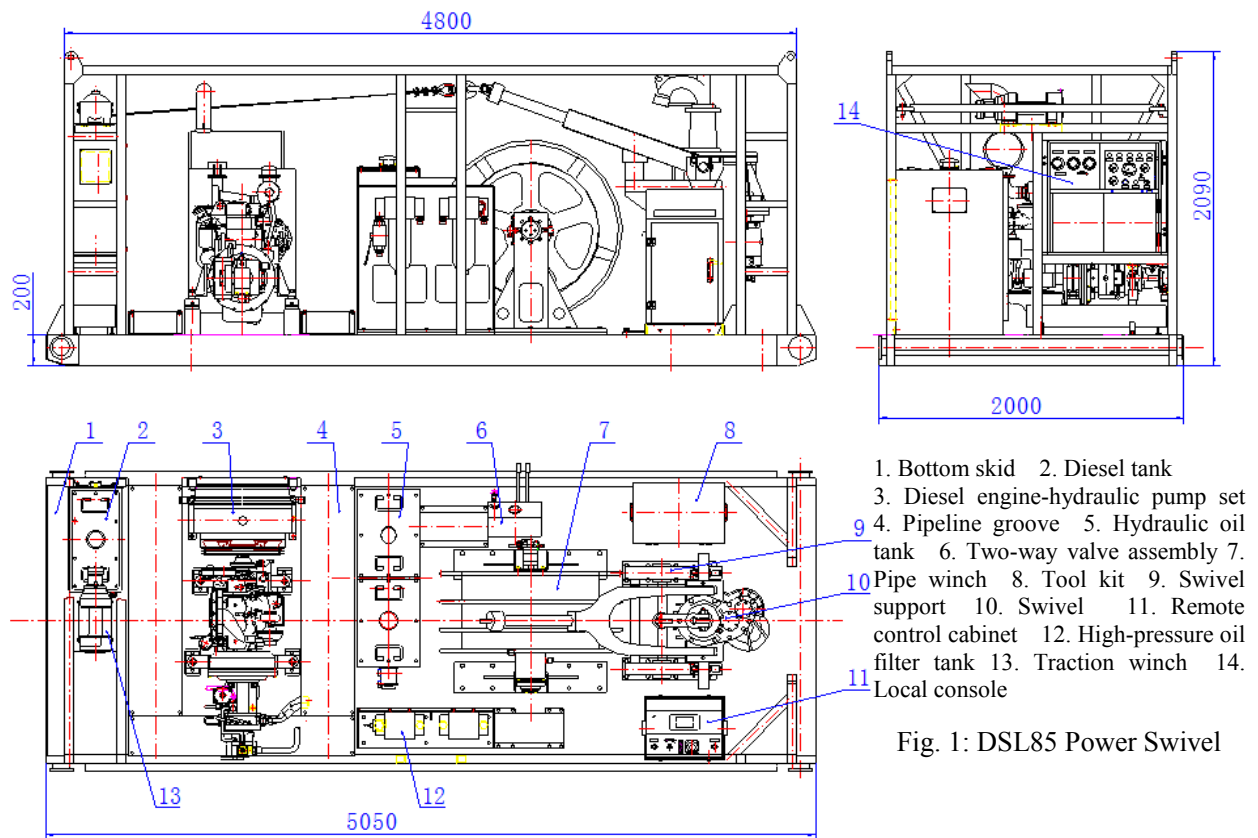


Fig. 1: DSL85 Power Swivel

Fig. 1 is the overall structure diagram of DSL85 power swivel, which is composed of power control device and hydraulic swivel set. Hydraulic swivel is installed on workover derrick, and its hydraulic motor on the swivel is driven by the hydraulic fluid output by power control device and its central tube is driven by gear reduction in order to complete fishing, workover, drilling and sampling. The hydraulic power control device is placed beside derrick and the hydraulic pump is driven by the diesel engine to output hydraulic fluid. The control cabinet, hydraulic oil tank, diesel oil tank, winch and pipe drawwork are all installed on the skid.



### 3.2 Hydraulic Principles

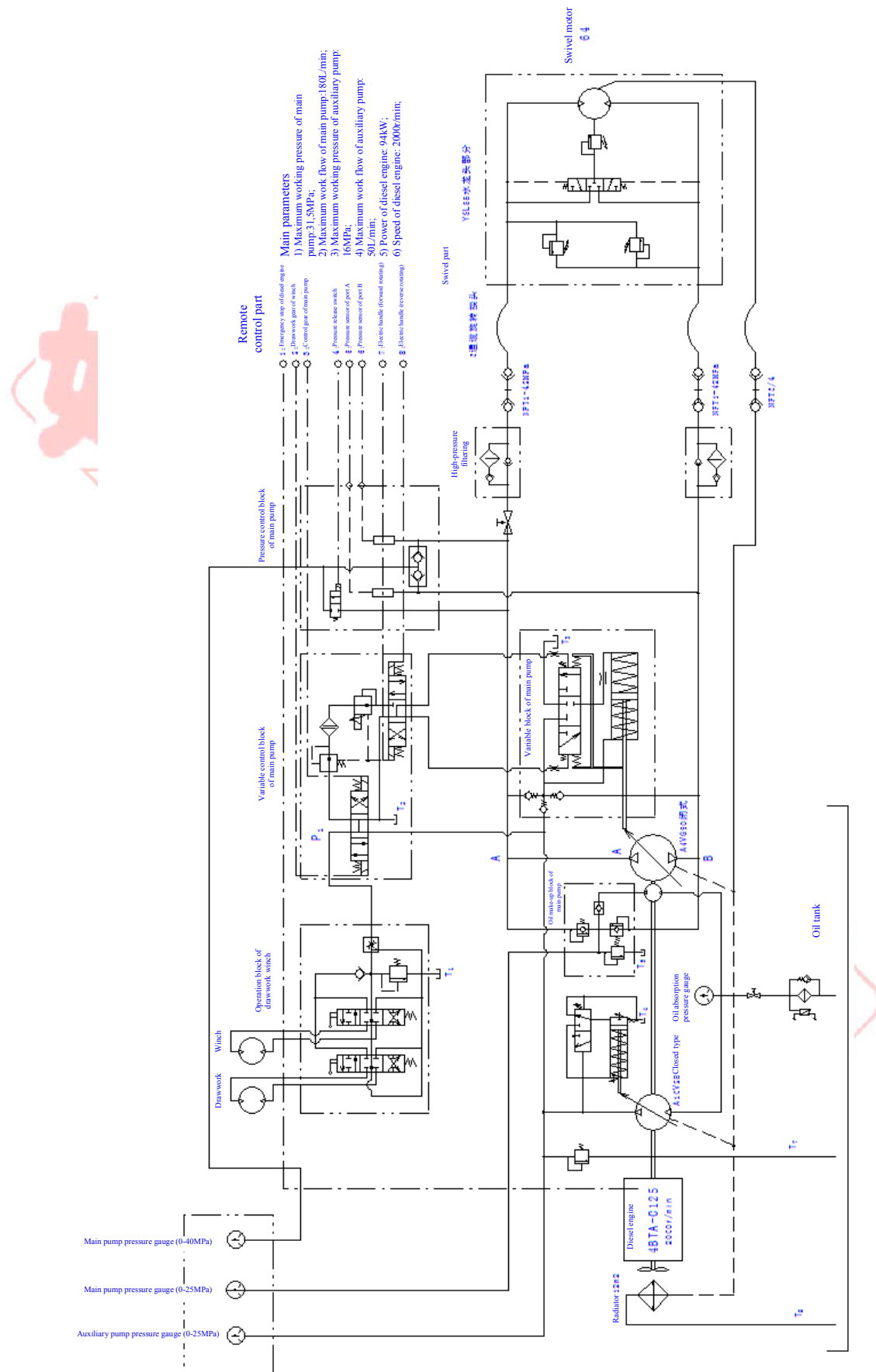


Fig. 2: Hydraulic Schematic Diagram of DSL85 Power Swivel

Fig. 2 is the schematic pressure diagram of DSL85 power swivel, and its main pump (closed pump), control pump and the coaxial device of slippage pump are installed in the output end of diesel engine; the main pump is used to output the hydraulic pressure, the maximum flow of which is 180L/min and the maximum pressure is 31.5 MPa, to drive the hydraulic motor of swivel. The control pump outputs pressure of 30 L/min and hydraulic of 16 MPa to control the adjustment of the delivery of main pump and drive the towing machine and hydraulic winch. The slippage pump is integrated inside main pump, with a pressure of 1.6 MPa, to supply oil and make up oil to the low-pressure port of main pump. The drain oil of main pump flows back to oil tank after cooled in air cooler.

The control pump switches through solenoid value. After switching to towing machine and hydraulic winch, the pump controls the operation of them through the 2-way console, and changes their speed by adjusting the fluid flow rate with 3-way flow valve.

There are overflow valves provided at the pressure oil ports of all pumps and their maximum pressure can be set separately to protect the safety and reliability of hydraulic system.

The hydraulic oil output by main pump is connected to the hydraulic motor of swivel by the 3-channel rotary joint and quick coupler after filtered in high-pressure oil filter to drive the motor to operate. The hydraulic oil in the low pressure side of hydraulic motor, together with the flushing oil of control pump, flows back to hydraulic oil tank after cooled in the cooler, so as to cool the system down.

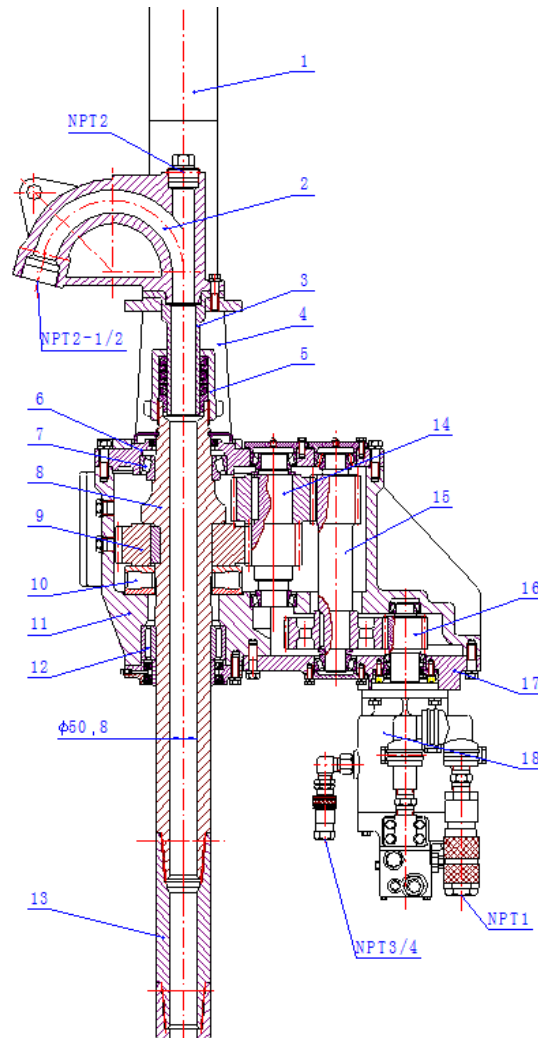
The flow and direction of the hydraulic oil in main pump is controlled by electrical handle, and displayed on the touch screen through signal conversion in sensor and also displayed on the pressure gauge.

### 3.3 Hydraulic Swivel

Hydraulic swivel is the main component installed on derrick for rotating and drilling in. As shown in Fig. 3, hydraulic swivel is driven by hydraulic motor (18), which is installed at the lower swivel part and protected by a steel frame. 2 high-pressure hydraulic hoses and 1 motor fluid tube are linked out from the bottom of power swivel to connect to the pipe winch on skid. High-pressure hydraulic hoses are connected to the motor through universal joint and quick coupler. The high-pressure joint is NPT1 joint and drain joint is NPT3/4 joint.

Gooseneck (2) is made from alloy steel through inblock cast. The top of gooseneck is sealed with NPT2 plug screws so that cables and small tools can be used in downhole operation with the swivel. Gooseneck and swivel packing (5) both have passed the hydrostatic pressure test and their test pressure is up to 5,000 psi.

Main bearing parts - lifting bail (1), lifting bail pin, shell (11) and central tube (8) on the swivel are manufactured



1: Lifting bail 2: Gooseneck 3: Wash pipe 4: Support 5: Packing assembly 6: Upper cover 7: Bearing 8: Central pipe 9: Output gear 10: Main bearing 11: Shell 12: Lower stabilizing bearing 13: Short connector 14: Double-reduction gear shaft 15: One-stage reduce gear shaft 16: Motor output gear 17: Motor mounting plate 18: Hydraulic motor

Fig. 3: Structural Diagram of Hydraulic Swivel



through standard thermal treatment and according to strict inspection and process procedures; therefore, they all comply with API regulations.

Hydraulic motor is driven by hydraulic oil and the power will be transmitted to the central tube after driven by 3-stage gear. Drive gears are all helical gears that can lead to better gear contact and steadier driving.

There is magnetic plug screw installed on the lower cover plate (17) of swivel shell. The magnetic plug screw can absorb the fine iron chips generated by gear meshing inside shell so as to guarantee clean gear oil inside the shell. There are 2 oil levels installed on the side of shell for the observation of gear oil level inside the shell. The oil level shall be between the 2 oil levelers.

### 3.4 Skid-mounted Unit

Since the hydraulic power part of DSL85 power swivel is installed on it, the skid (3), made from square tubes through welding, is solid and durable. The lifting eyes (6) on both ends of skid can either be used for lifting or to drag the skid on the ground through steel wire ropes. In order to facilitate dragging, both ends of the skid are made circular arcs. The skid plane is covered by insert tread to provide a solid anti-skid floor for operators. The upper part of skid is welded into a frame structure with square tubes to prevent the equipment from damages in storage and transportation process.

The battery compartment (1) is in the left side of skid, and the 2 sets of 12 V batteries are put inside it to provide power for the starting of diesel engine, PLC control and touch screen display.

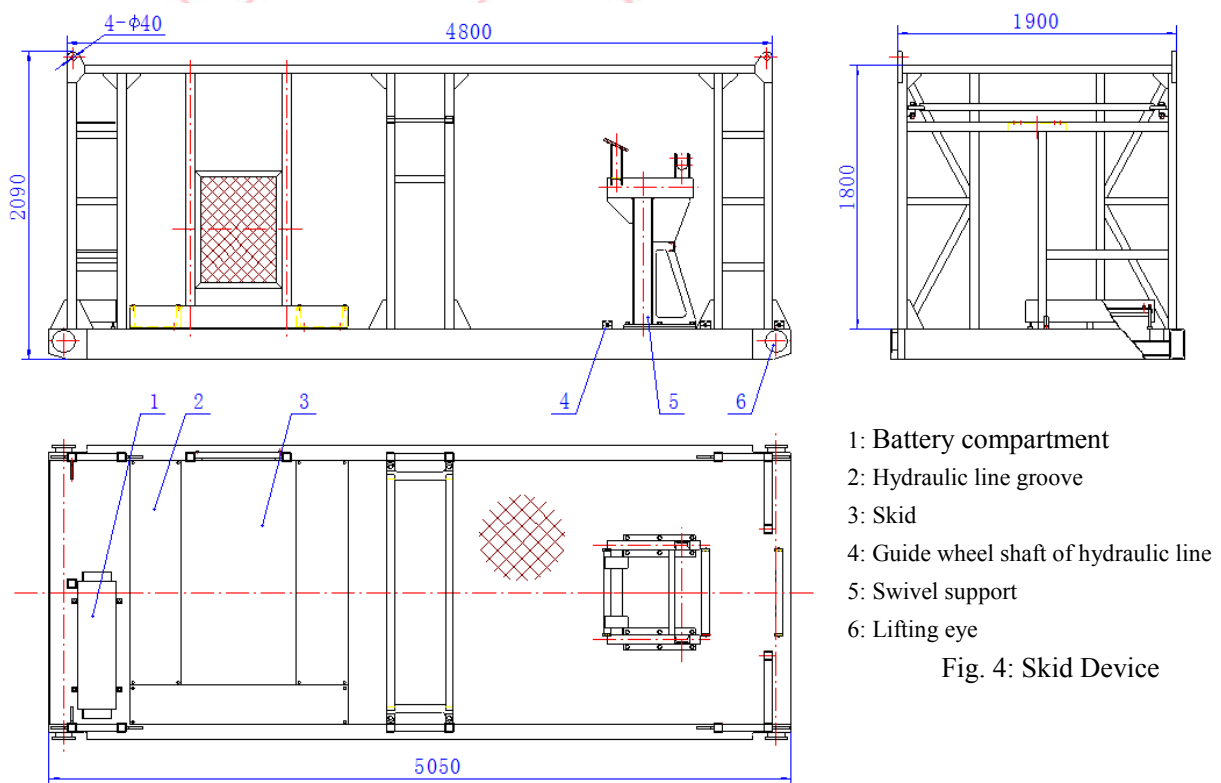


Fig. 4: Skid Device

The swivel mounting support (5) is in the right side of skid, and the swivel is put on it when it is not used. The 3 guide wheel shafts generate rolling friction when contacting with hydraulic line when it is pulled out or back to protect pipelines.

There is also hydraulic line groove (2) on the bottom skid where most of hydraulic lines of power swivel are placed to protect and lengthen the service life of hydraulic lines.

### 3.5 Diesel Engine – Hydraulic Pump Assembly

Diesel engine – hydraulic pump assembly, consisting of diesel engine (4) and dual hydraulic oil pump, is the device that provides hydraulic power to the whole DSL85 power swivel. As shown in the figure, the dual pump is



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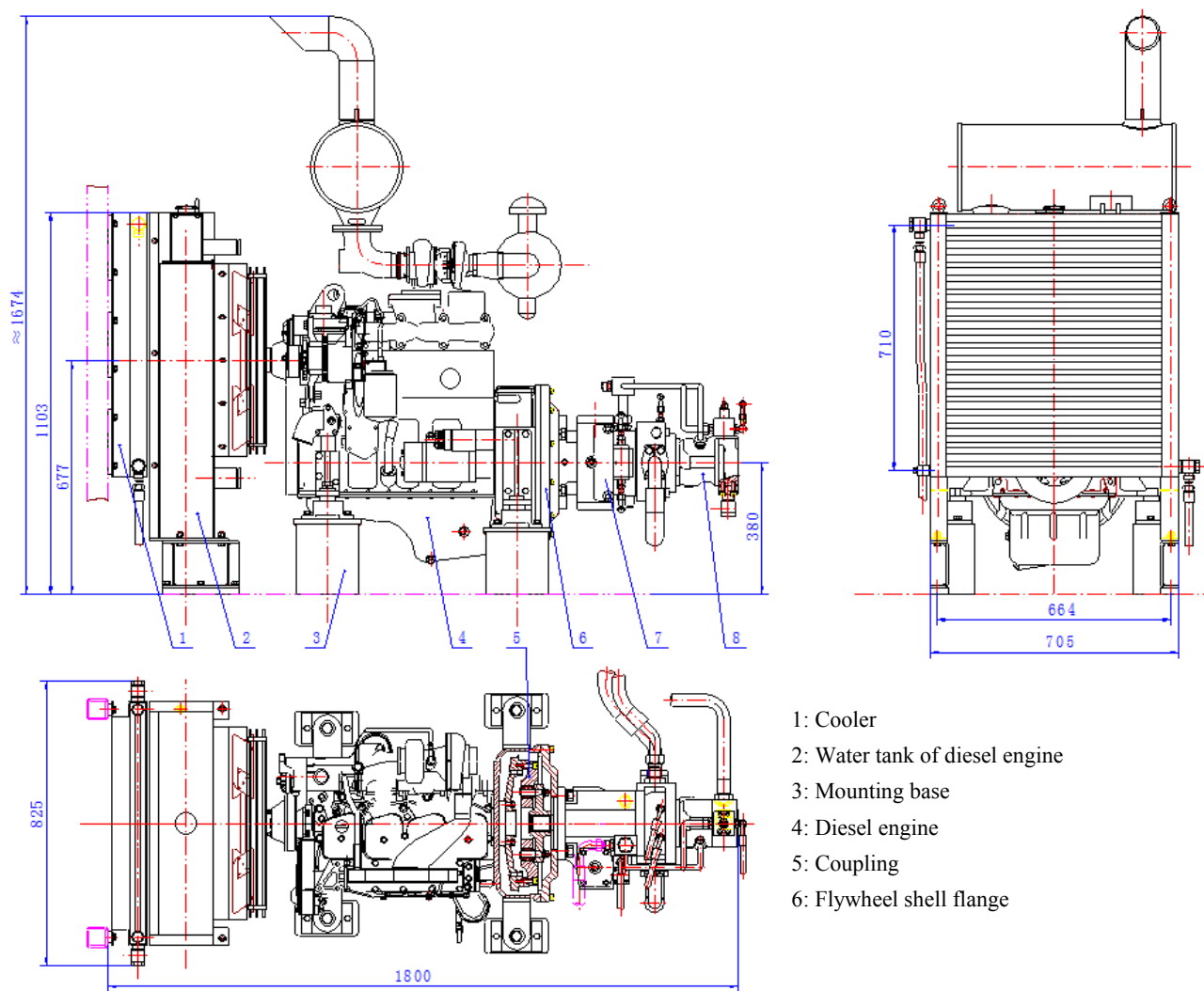
installed and fixed on the flywheel flange (6) after cascading them. The input shaft of pump assembly and the flywheel of diesel engine are connected inside flywheel shell through coupling (5).

There are rubber bumper blocks fixed among the 4 legs and mounting base (3) of diesel engine to absorb the energy generated by impact and vibration in its starting or operation process;

Pump unit is manufactured by the main pump (closed) (7) and control pump (8) through cascading. The main pump is a closed oil pump, the 2 oil ports on it are directly connected to hydraulic motor, forming a closed circuit. Moreover, there is proportional solenoid directional control valve installed on the main pump, and pump flow can be adjusted by changing its voltage and current. When the voltage and current are changed to negative from positive, the pressure direction of oil port, i.e. the rotation direction of hydraulic motor, can be changed; when the voltage or current is zero, there is no flow at the 2 oil ports.

Control pump is used to provide pressure oil to main pump, hydraulic winch and towing machine. There is solenoid directional control valve installed on the control pump, when the main pump needs to work, disconnect the electromagnet to make oil fluid flow into the control valve of main pump; when the main pump needs not while the winch and towing machine need to work, rotate the knob to energize the electromagnet and reverse the solenoid valve; then the oil fluid will flow to the multi-way valve unit for towing machine and hydraulic winch operation.

The flow control of main pump is realized by the step-less speed regulating of hydraulic motor completed by the forward and backward shaking of electric handle of remote console. There are safety pumps installed on both of the 2 oil ports of main pump to prevent oil pump overload, and also 2 pressure sensors provided to further protect the main pump by unloading after the pressure of the 2 oil ports reaches maximum set pressure. Main pump control and unloading are controlled by PLC program and displayed on the touch screen. The switching of control pump (7) is controlled locally and remotely by 2 knobs. See the remote control cabinet and local console for pump control details.

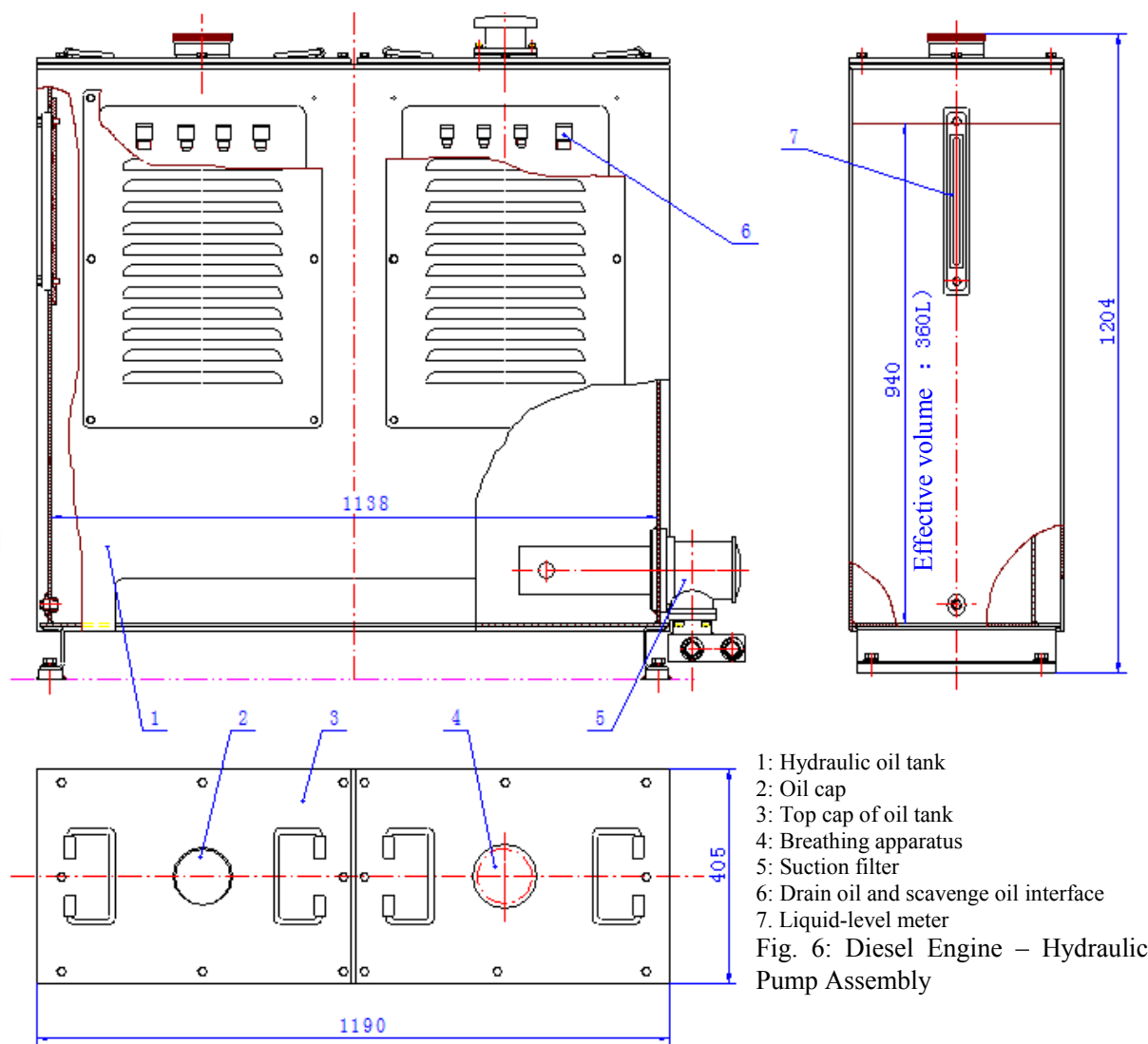


### 3.5 Hydraulic Oil Tank and High-pressure Filter

As shown in Fig. 6, the oil tank capacity is 360 L; oil is filled in from the hole on oil cap (2) of top cap of oil tank (3), and oil level is displayed on liquid level gauge (7); hydraulic oil is output to slippage pump and control pump after rough filtering in suction filter (5).

Suction filter (5) is installed on oil tank (1) to prevent the impurities of oil inside oil tank from being sucked into pipeline and slippage pump. There is an indicating pressure gauge on the suction filter, and when it points at the green area, the filter works normally; when it points at the red area, the filter needs to be washed or its filter element needs to be replaced.

There are 8 drain oil interfaces and spill port (6) installed on the front side of hydraulic oil tank. The flushing oil of hydraulic motor and the flushing oil of hydraulic oil pump will flow back to oil tank after cooling, and the drain oil of hydraulic pump and hydraulic motor will flow back to hydraulic oil tank directly.

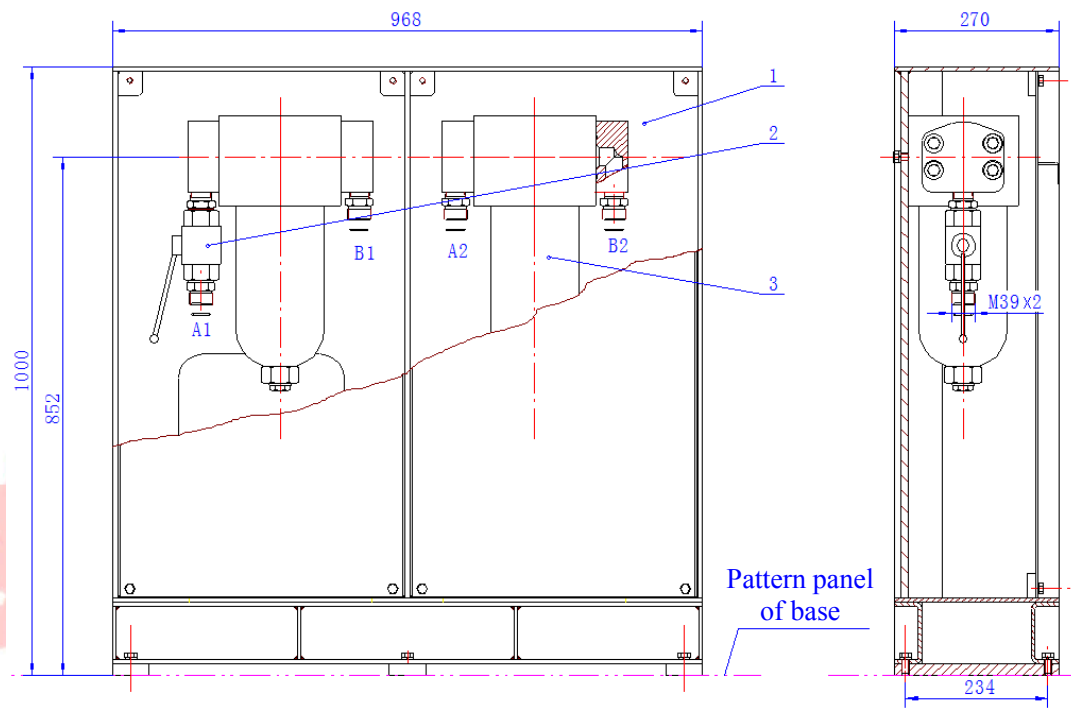


1: Hydraulic oil tank  
 2: Oil cap  
 3: Top cap of oil tank  
 4: Breathing apparatus  
 5: Suction filter  
 6: Drain oil and scavenge oil interface  
 7: Liquid-level meter  
 Fig. 6: Diesel Engine – Hydraulic Pump Assembly

High-pressure filter is installed on oil filter mounting rack in the side opposite to the hydraulic oil tank. High-pressure filter is a dual flow filter of high filtering accuracy and installed inside pipeline. It can further filter the hydraulic oil output from pump assembly to prevent fine particles generated by mechanical wear from entering pump assembly and hydraulic motor together with oil, and improve the service life of pump assembly and hydraulic motor.

There is a high-pressure ball valve installed at the input end of high-pressure filter. The ball valve shall be closed in order to adjust the overflow valve of main pump when the working pressure of power swivel needs to be adjusted, and be opened in normal operation.

As shown in the figure, the A1 and A2 oil ports are connected to the A and B oil port lines of main pump; B1 and B2 oil ports are connected to the 2 high-pressure rubber hoses on hydraulic winch (2 M39×2A clamp joints on winch);



1: Filter mounting rack 2: High-pressure ball valve 3: High-pressure filter

Fig. 7. High-pressure Filter Assembly

### 3.6 2-way Control Valve Unit, Towing Machine and Hydraulic Winch

3.6.1 2-way console is used to control the forward and reverse rotation of towing machine and hydraulic winch. As shown in Fig. 8, there are multi-way reversing valve, pressure gauge (1) and 3-way flow valve installed inside the box (5); the positive or negative rotation of towing machine and hydraulic winch can be realized by pulling up or pushing down the operation handle (4) of towing machine or the operation handle (2) of hydraulic winch. When the output speed of towing machine and winch are too slow or too quick, the rotation speed can be adjusted by rotating flow control handle (3). The working pressure of auxiliary operating console can be adjusted by the overflow valve on control pump or the overflow valve of multi-way reversing valve; however, it must be lower than the pressure of the overflow valve of control pump.

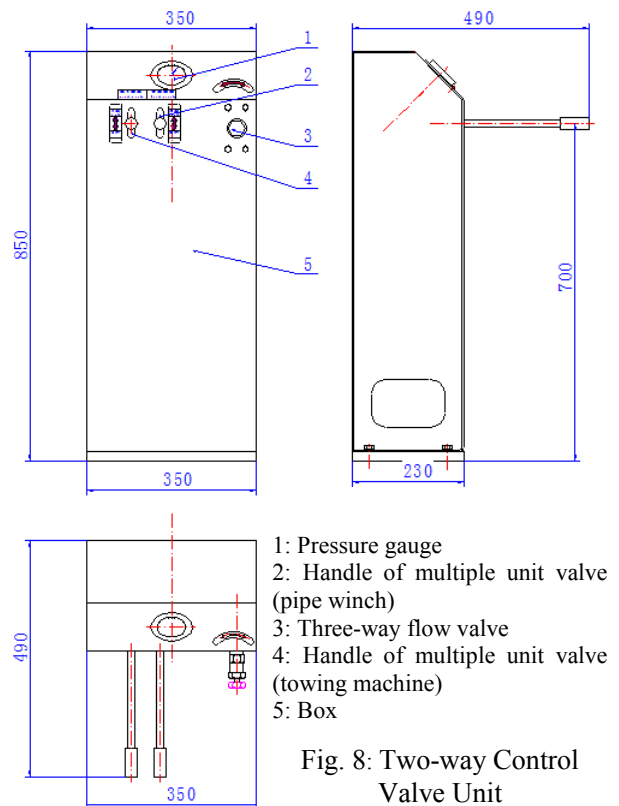


Fig. 8: Two-way Control Valve Unit

3.6.2 Towing machine: it is a kind of auxiliary equipment to power device used as the traction rope for swivel installation and removal. As shown in Fig. 9, there are steel wire ropes wound on the reel, and cord hook (3) buckled in the rings at the top of the lifting bail fixed at its free end of towing machine (1), so that it can tow the upper and lower drill blocks of swivel by taking back or releasing steel wire ropes, and prevent the swivel from damages or from colliding with other

parts during unsteady inclined pulling.

The towing machine is installed on the winch mounting rack at one end of the skid.

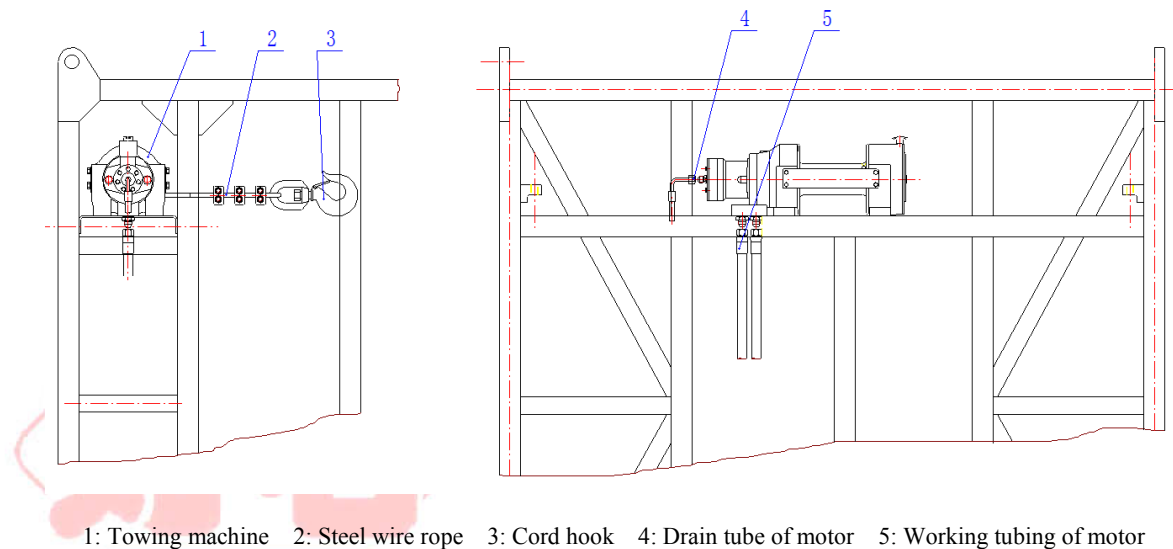


Fig. 9: Towing Machine

3.6.3 Hydraulic winch: it is an auxiliary equipment to power swivel used to wind and store the hydraulic hoses connected to swivel, as shown in Fig. 10. Hydraulic winch consists of winch bracket (2), winch driving motor (3), pipe winch (1) and rotary joint (6).

The 3 winch grooves are wound by three 30.5 m hydraulic hoses respectively, and one ends of the hoses are connected to the 3 output joints of the hydraulic rotary joints inside winch and the other ends are provided with corresponding high-pressure quick couplers and connected to corresponding swivel interfaces to form a closed hydraulic circuit. The input interfaces of hydraulic rotary joints are connected to high-pressure filter and the return port of oil tank respectively.

Hydraulic winch releases and retracts the high-pressure hoses (5) and drain hoses (4) wound on winch through the hydraulic motor driving winch; when the swivel is lifted up to the drill block for installation or sent to the storage area (swivel mounting rack) from the drill block, it is needed to rotate the winch to release or retract pipeline. Before rota

valve switching knobs on local operating console and remote operating console shall both be switched to “multi-way valve” and then operation handle on 2-way console can be operated.

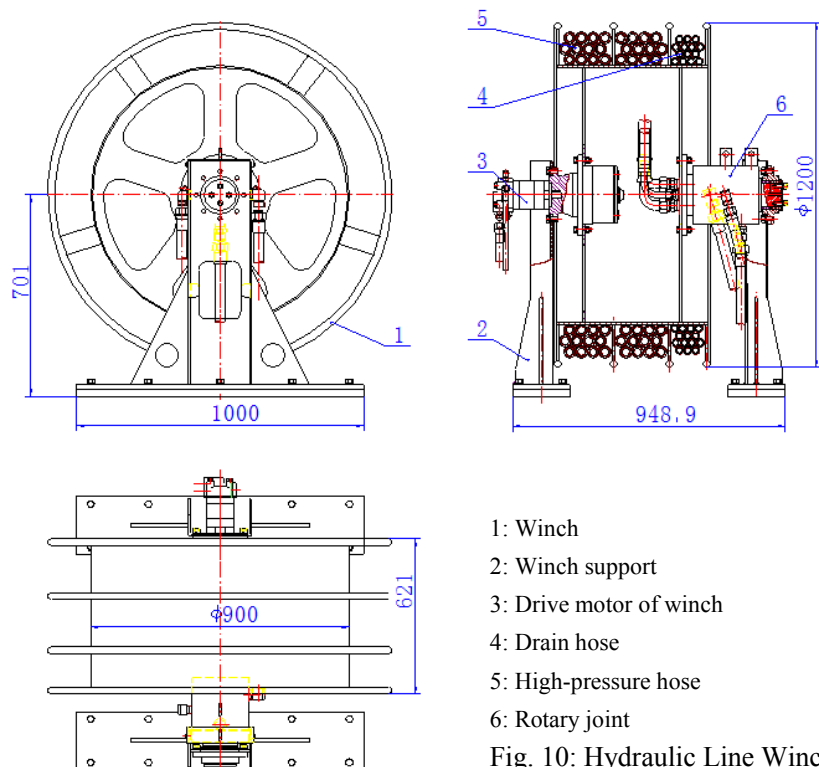


Fig. 10: Hydraulic Line Winch

### 3.7 Control Device

DSL85 power swivel is controlled by electric handle and displayed with a touch screen. In order to facilitate operators and protect their safety, the control cabinet can be put on the skid or the skid can be moved out before operating the control cabinet remotely with cables within certain distance.

The control panel of removable control cabinet consists of electric handle, touch screen, pump control valve switching knob, emergency stop button and status indicator (see Fig. 11). The rotation direction and speed of central tube are controlled by electric handle and its current rotation speed and output torque are displayed on the touch screen. Moreover, the maximum working pressure can be set on touch screen. When the torque and working pressure of hydraulic system exceed the set value for downhole abnormalities, the hydraulic pump will stop outputting hydraulic oil and the electric handle will fail in order to protect equipment and drilling tool.

The pump control valve switching knob can control the flowing direction of the hydraulic oil output from hydraulic control pump. When the switching knob points at “pump control valve”, the hydraulic oil output from control pump will flow into the flow control mechanism of main pump. At this moment, the swing angle of electric handle can be adjusted to control the displacement of main pump and thus controlling the rotation speed and direction of central tube. When switching knob points at “multi-way valve”, the hydraulic oil output from control pump will flow into the 2-way operating console, and at this moment, the 2-way valve can be adjusted to control the action of the auxiliary mini hoist and pipe winch.

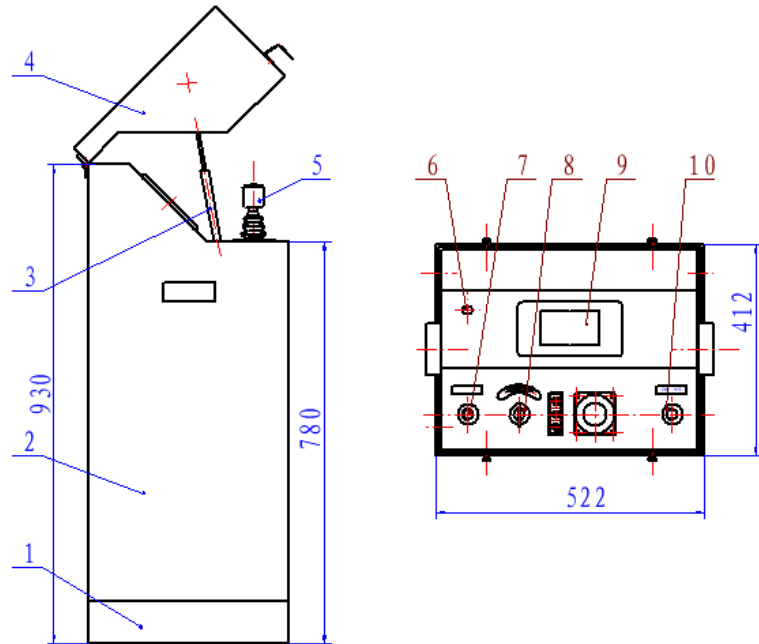
There is also local operating console installed in the left side of skid. As shown in Fig. 12, local operating console consists of the box (9), battery switch (2), oil make-up pressure gauge, control pressure gauge and system pressure gauge (6, 7, 8) and diesel engine monitor (10). Moreover, the pressure sensor (3) and pressure release valve at the oil port of main pump are installed inside local operating console.

There is electrical wiring box, to or from which the solenoid valve cable, sensor cable, cable of pressure release valve, the switching solenoid valve cable of control oil pump and power switch are all connected, inside the box of local operating console. Interfaces of the electrical connectors inside local operating console are connected to the electrical connectors of remote operating console to realize the transmission of control data.

The start/stop of diesel engine can be operated through the instrument of diesel engine, and water temperature, oil temperature, oil pressure and rotation speed of diesel engine can all be shown on this instrument.

Residual oil inside the pipeline of pressure gauge can be released by pressing pressure release button (5) and pressure display can thus be made return to zero.

Control oil can be made flow to main pump direction or operating console direction by rotating the switching

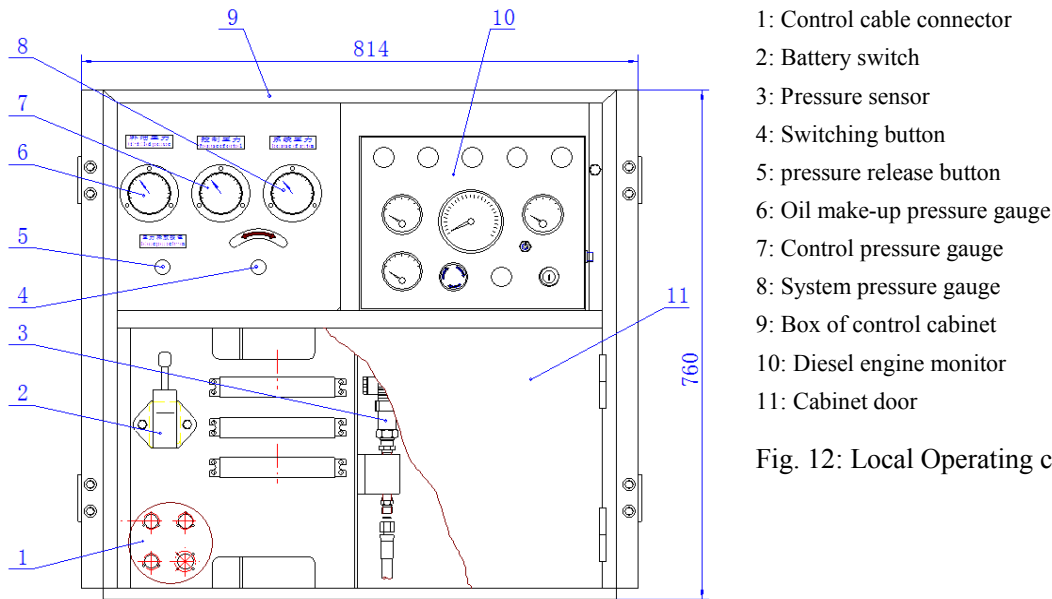


1: Base of control cabinet 2: Box of control cabinet 3: Gas spring 4: Cabinet cover  
5: Operating electric handle 6: Indicator 7: Pressure release button  
8: Switching knob 9: Touch screen 10: Emergency stop button

Fig. 11: Removable Control Cabinet

knob.

Note: When the switching knob (4) is controlled, i.e. “pump control valve” is switched to “multi-way valve” and then switched back, the 2 indicators shall be consistent.



1: Control cable connector

2: Battery switch

3: Pressure sensor

4: Switching button

5: pressure release button

6: Oil make-up pressure gauge

7: Control pressure gauge

8: System pressure gauge

9: Box of control cabinet

10: Diesel engine monitor

11: Cabinet door

Fig. 12: Local Operating console

## 4. Equipment Installation and Test Run

### 4.1 Preparation before Installation

- 1) Inspect all parts before installation to make sure that the equipment is intact and all accessories and spare parts are prepared;
- 2) Put the skid on a flat and solid ground beside derrick; the skid shall be kept in a horizontal position and all skid corners shall be supported;
- 3) Fill engine oil in the diesel engine according to *Diesel Engine Operation Instructions* and fill water in its water tank.
- 4) Remove remote control console from the base, and then connect it with the instrument panel with control cables taken from the tool kit in a position that is 10 m from the host or nearer.
- 5) Fill hydraulic oil inside oil tank to a degree within oil leveler display range; the filling amount shall be about 360 L;
- 6) Fill diesel oil inside diesel oil tank to the top of oil leveler
- 7) Flip the battery power switch (Fig. 12, part 2) to establish power;
- 8) Flip the switching knobs of local console and remote console to “multi-way valve” direction;
- 9) Inspect if the self-inspection of diesel engine instrument is normal;
- 10) Inspect the display of the touch screen of remote console and set the maximum pressure;
- 11) Before hydraulic pump assembly is started, the shells of main pump and control pump shall both be filled up with oil by loosening the oil drain joint on pump; moreover, they shall be maintained up during work.

Note: The diesel engine must not be started until oil is filled according to Article 10.



## 4.2 Installation of Power Swivel

- 1) Start the diesel engine and adjust its speed to 1,800 r/min (switch speed switch from “idling” to “rating”)
- 2) Hook the lifting bail of swivel with the mini hoist of drill block and hook the lifting bail clip with the cord hook of towing machine (Fig. 9, part 3);
- 3) Operate the mini hoist to lift it up, operate the towing machine to release rope slowly, and operate the hydraulic winch interactively to release hydraulic hose until the swivel is lifted to wellhead. Then, unhook the cord hook of towing machine from the lifting bail of swivel, operate the control valve of towing machine to make the towing machine rotate negatively and wind steel wire rope around its reel;
- 4) Continue to release winch hose and lift the swivel to the maximum height of derrick, and then inspect the hydraulic hose of swivel. The hose shall be free and with no additional load, and shall not collide with other parts of the derrick. Fix winch hose on the derrick and reserve enough length for the upward and downward moving of swivel.
- 5) According to Fig. 10 and Table 2 and install the 2 reactive torque steel wire ropes randomly provided on the service rig, tighten them and make them pass through the reactive torque arms at both sides of swivel. The installment center distance of steel wire rope shall be between 2,222 mm-2,322 mm.
- 6) Move the swivel upward and downward, and the reactive torque arms shall be able to slide on the reactive torque steel wire rope freely;
- 7) Flip the switching knobs of local console and remote console to “pump control valve” direction;
- 8) Inspect if the control pressure gauge and the oil make-up pressure gauge of instrument panel are normal;

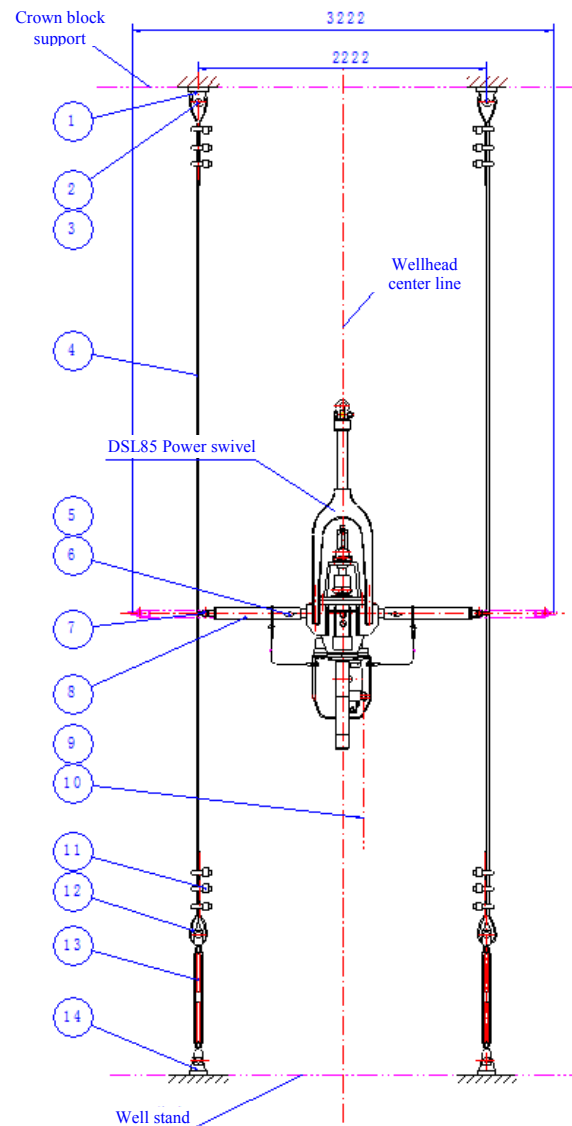


Fig. 13: DSL85 Power Swivel Installation Diagram

Table 2: List of Accessories for Installation of DSL85 Power Swivel

No.	Code	Name	Qty.
1	71.191.00A	Pedestal	2
2	36.01-01 I	Pin	2
3	GB/T91-2000	Pin 6×40	2
4	GB/T20118-2006	Steel wire rope φ16×40m	2
5	RS171.120-01	Set pin	2
6	19.500-05	Bobby pin	2
7	JB/T8112-1999	Shackle S-BX5	2
8	RS171.120.00	Reactive torque assembly	2
9		High-pressure hose 32 IV-30500	2
10		Hose 25 II-30500	1

11	GB/T5976-2006	Rope clamp 16	12
12	GB/T33-1999	Loop end WT16	4
13	GB/T3818-1999	Turnbuckle KUUD-M30	2
14	71.192.00A	Support	2

### 4.3 Test Run

- 1) Push the handle of remote control console forward (CW) gently, the central tube of swivel will rotate clockwise; observe the speed of central tube displayed on the touch screen;
- 2) Reset the handle to neutral position after operating for 3-5 min, then the central tube of swivel will stop rotating;
- 3) Pull the handle of remote control console backward (CCW) gently, the central tube of swivel will rotate counterclockwise; the central tube will stop after operating for 3-5 min;
- 4) Operate the handle to adjust the speed from the minimum to the maximum in the CW direction; observe the value displayed on the touch screen;
- 5) Operate the handle to adjust the speed from the minimum to the maximum in the CCW direction; observe the value displayed on the touch screen;

Note: The high-pressure ball valve of high-pressure oil filter shall not be closed during work;

## 5. Operating Procedure for DSL85 Power Swivel

The power swivel shall start loading or operating after the test run status of all parts, oil temperature, and the liquid level of oil tank after hydraulic oil circulation are inspected, the skid is placed flatly in well site and the power head is hung on derrick and tested.

Operating procedure:

### 5.1 Pressure Regulating and Torque Setting:

- 1) Setting-up of oil make-up pressure: oil make-up pressure can be adjusted by increasing or decreasing the oil make-up overflow valve (on the valve block in the opposite of the oil port of main pump) and is displayed on the oil make-up pressure gauge on instrument panel; the general oil make-up pressure is: 1.6 MPa. The oil make-up pressure is set and locked before leaving factory.
- 2) Setting-up of system pressure: system pressure can be adjusted by adjusting the A and B ports and overflow valve; in general, the oilway of high-pressure ball valve is the CW (drilling) direction of swivel; the high-pressure ball valve can be closed during adjustment and be opened after setting-up. System pressure can be displayed on the system pressure gauge (Fig. 10, Part 8) of local operating console; system pressure shall not be larger than 31.5 MPa and is adjusted to 25~27 MPa in most cases.
- 3) Setting-up of control pressure: control pressure is obtained by adjusting the overflow valve of control pump (oil outlet valve block of control oil pump), and its value can be displayed on the control pressure gauge of instrument panel. The control pressure is set and locked at 16 MPa before leaving factory;
- 4) Torque setting-up: input the maximum system pressure, which is set as 24 MPa in general, manually according to the input requirements of touch screen. The display is corresponding to the maximum output torque, and if the torque is too large, the maximum pressure set can be reduced correspondingly. In the case of electric control, the flow of main pump will become zero automatically when system pressure reaches the set value for overload protection.

### 5.2 Speed Adjustment and Forward and Reverse Operation

In normal operation:

- 1) When the electric handle is in neutral position, there is no flow in either the A port or B port of main pump,

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the swivel is stopped and the speed displayed on touch screen becomes zero;

- 2) Flip the electric handle to “CW” direction, and then the swivel starts to rotate (CW); the larger the flipping degree is, the higher the speed is; the speed will be the largest when the handle is flipped to the end, vice versa.
- 3) Flip the electric handle to “CCW” direction, and then the swivel starts to rotate (CCW); the larger the flipping degree is, the higher the speed is; the speed will be the largest when the handle is flipped to the end, vice versa.
- 4) Forward and reverse direction switching: when the handle is flipped over the neutral position, the rotation speed of swivel will change. When directions are switched, the handle shall be pushed or pulled back to the neutral position first and then be flipped after the swivel stops steadily, in order to avoid impact vibration.

### **5.3 Control Switching:**

If the towing machine and hydraulic winch need to be operated, the control knob shall be rotated to “multi-way valve” direction (the direction will be switched at the same time under local or remote control), then the main pump will stop operating automatically, which is equivalent to the condition that the electrical handle is in the neutral position. At this moment, only the 2-way control valve unit acts effectively.

Note: When the switching knob is operated, i.e. “pump control valve” is switched to “multi-way valve” and then switched back, the local control and remote control shall be switched to the same position.

### **5.4 Emergency Handling**

When emergency occurs, such as broken hose or swivel jam, or faults caused by unknown reasons, the “emergency stop” button (locally or remotely) shall be pressed immediately to make the diesel engine stop, and the machine can be restarted after finding out reasons and eliminating faults.

## **6. Maintenance**

The purpose of obeying following regulations is to ensure the longest service life of DSL85 power swivel. DSL85 power swivel is used under extremely high load, and the change of temperature or other factors will affect its working time.

### **6.1 Maintenance of Power Swivel**

#### **6.1.1 Lubrication**

- 1) Inspect gear lubricating oil in side swivel shell before using the power swivel. The level of lubricating oil shall be maintained between the 2 oil levers all the time. If necessary, gear lubricating oil can be added to make the lubricating oil maintained at a suitable oil level.
- 2) Gear lubricating oil shall be replaced after the swivel operates for 100 h for the first time. The magnetic oil drain plug at shell bottom shall be inspected and metal chips on plug shall be eliminated when replacing lubricating oil.

Note: The oil capacity of power swivel is 15 L.

- 3) After the first oil replacement that is executed after the swivel operates for 100 h for the first time, gear lubricating oil shall be replaced every 1,000 h, or after the device stops operating for certain period. The magnetic oil drain plug at shell bottom shall be inspected and metal chips on plug shall be eliminated when replacing lubricating oil.
- 4) Magnetic particle testing for lifting bail, lifting bail pin, central tube and protection joint shall be executed frequently.

### 6.1.2 Preheating before Application

During the initial trial run or the application after being left unused for a long time, the power swivel shall be preheated to normal operating temperature range, 48-93°C (120-200°F), with a relatively low speed and under a small load. The temperature of swivel shall be increased gradually. If it is used in a very hot environment, higher operating temperature is allowed, but the temperature of swivel shell shall not be higher than 100°C.

### 6.1.3 Storage

If the power swivel is no longer used and will be saved in the long run, add full gear oil to avoid oxidation; the central tube or lower end of central tube joint should be provided with screw protection cap to avoid screw damage. Before the central tube joint is connected with central tube and before the screw protection cap is connected with central tube (central tube joint), the thread should be provided with thread oil.

Prior to transportation, the joints of all hydraulic pipelines should be sealed by packaging them with thick and tidy kraft paper.

### 6.1.4 Change of pipe washing parts

If there is any sign indicating that leakage happens to packing device during the working process, i.e., the packing sealing effect becomes a failure, change the wash pipe and packing according to the following steps by referring to Diagram 12 and Table 3.

- 1) Dismantle bolt and washer (Piece 4 and Piece 5), take out of gooseneck (Piece 2), wash pipe (Piece 6) and sealing ring (Piece 3).
- 2) Unscrew packing box (Piece 8) from the central tube (Piece 14) to make the whole packing assembly separate from the central tube totally;
- 3) Dismantle the set screw on packing box and fasten it again after changing new packing (Piece 16) and O-ring (Piece 10);
- 4) Fasten the new packing assembly on the central tube again.
- 5) Assemble new wash pipe on the support (Piece 17) with bolt and washer (Piece 4 and Piece 5) according to the sequence of wash pipe (Piece 6), O-ring (Piece 3) and gooseneck (Piece 2).
- 6) Add lubricating grease to packing.

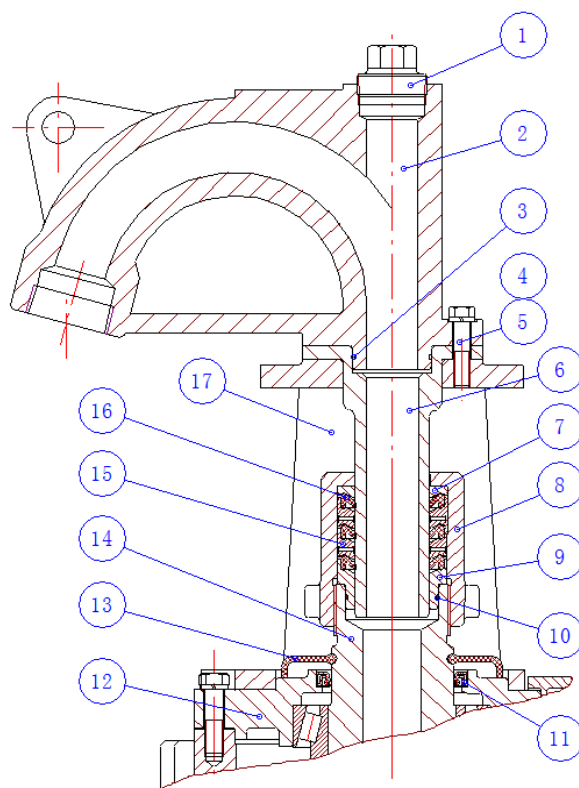


Fig. 14: Wash pipe Packing Assembly of DSL85 Power Swivel

Table 3: Detailed List of Mud Pipe Assembly of DSL85 Power Swivel

No.	Code	Name	Qty.
1	RS171.100-02	Gooseneck	1
2	GB/T32.1-88	Bolt M18×45	6
3	GB/T93-87	Washer 18	6
4		O-ring OR-NBR90 81.92×5.33	1
5	71.100-24B	Wash pipe	1
6	71.100-15B	Support	1

7	71.140-02B	Backing ring	1
8		Oil cup NPT1/8	2
9	71.140-03A	Packing	3
10	71.140-04A	Retainer	2
11	71.140-05A	Junk ring	1
12	RS171.100-06	Central tube	1
13		Framework oil seal 139.7×177.8×16.6	1
14	71.100-20A	Rubber umbrella	1
15		O-ring OR-NBR90 101.19×3.53	1
16	71.140-01A	Packing box	1

### 6.1.5 Wearing limit

The lifting ring whose upper journal connection size is  $\phi 69.85\text{mm}$  and is worn to  $\phi 66\text{mm}$  should be changed accordingly.

If the intermediate diameter of joint thread between central tube and short joint and 27/8I.F. screw tooth at the lower end of short joint is worn to 1.5mm on average, the central tube and short joint then need changing.

## 6.2 Maintenance of Hydraulic Power Device

The power device is composed of diesel engine, pipe, filter, oil tank, hose, hose reel, rigging and electric components.

### 6.2.1 Maintenance of diesel engine

Please refer to the maintenance guide of diesel engine in the data attached.

### 6.2.2 Hydraulic oil tank and filter

Always make sure the oil level in hydraulic oil tank remains in a proper height. The oil level should be observed from oil pointer if the hydraulic oil is cooled.

If the pointer of pressure gauge on oil suction filter is in red region, clean or change the filter element of oil filter.

### 6.2.3 Pipe winch and hydraulic hose

Add lubricating grease to the hydraulic swivel joint of pipe winch on a monthly basis in order to prevent dusts, water or other sundries from contaminating hydraulic oil and hydraulic system.

The hydraulic hose should be evenly distributed in the pipe winch slot; pipe distorting, knotting or unnecessary pulling force should be avoided by pipeline. Never put something sharp or heavy articles on hose, in order to avoid damaging the hoses.

If the equipment is not used, they should be saved in dry warehouses.

If the temperature is very low, keep hydraulic system away from condensate water or moisture of hydraulic oil with water pollution.

### 6.2.4 Local operating console, mobile operating console and control cable

If the cable used for connecting local and mobile operating consoles is not used temporarily, save them through winding and then cover them with dustproof shield. Never make cables tie a knot or tighten them excessively. Never grind cables with any heavy articles.

Open and clean local operating console and mobile operating console once a year at least (more times if they are in humid environment). Clean and dry all the exposed electric terminals and then apply silicon resin or varnish to them.

Power off battery switch prior to cleaning.



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## 7. Swivel Disassembly and Assembly

Swivel should be disassembled and assembled and main parts should be repaired indoors where the environment is clean and the equipment is intact. Keep checking to ensure no sundries enter the inside of swivel. Prior to disassembly and assembly again, please read the list of swivel parts and drawings carefully.

### 7.1 Swivel Disassembly

- 1) Dismantle all hydraulic hoses on swivel. Pack both ends of hose with clean kraft paper to prevent any sundries from entering the pipe.

Note: If hydraulic hoses are not used temporarily, wind them to avoid knotting or other damages. Hose damage will lead to blockage or other problems that affect normal operation.

- 2) Put power head on the proper support frame.
- 3) Dismantle hydraulic motor shield.
- 4) Put the open vessel below magnetic drain plug and unscrew magnetic oil drain plug screw to drain gear oil and other sundries in power swivel shell thoroughly.
- 5) Dismantle M12 nut and lifting bail pin roll on both sides of shell.
- 6) Insert round steel whose diameter is slightly shorter than 25 mm and length is larger than 150 mm inside  $\phi 25$  hole of lifting bail ring and knock round steel outside in order to pull haul ring pin from shell and remove haul ring.
- 7) Disassemble gooseneck and take out of wash pipe.
- 8) Take out of set screw, loosen packing box and disassemble packing assembly.
- 9) Dismantle the support of swivel in order to take out of rubber umbrella.
- 10) Put the swivel upside down. Dismantle the fixed bolt of hydraulic motor in order to take out of hydraulic motor. Note: Hydraulic motor cannot be dismantled. If you believe there is a fault happened to hydraulic motor, please block oil port and send motor to us for inspection and further treatment.
- 11) Take out of lower end cover. If necessary, use soft hammer to knock the matters attached on washer. Put the lower end cover aside and take out of washer; always ensure both sealing surfaces are clean.
- 12) Take out of check ring and two lower oil seals from the lower end cover.
- 13) Dismantle the fixed bolt of motor mounting plate in order to dismantle motor mounting plate. Remove the residues on the sealing surface of motor mounting plate.
- 14) Take out of motor output gear, Level 1 reduction gear, bearing and space ring;
- 15) Put power swivel correctly again and dismantle the fixed bolt on upper cover plate.
- 16) Dismantle the end cover of reduction gear shaft and bearing excircle together with cover plate from shell. Always make sure the two sealing surfaces of adjustable pad of upper cover and sealing ring have been cleaned thoroughly.
- 17) Take out of oil seal from upper cover plate.
- 18) Take out of central tube, inner ring of stabilizing bearing, main bearing, output gear and gear shaft from inside the shell;
- 19) Take out of all bearings from these shafts.

Note: All these parts that are taken out of during the dismantling process should be cleaned thoroughly. The best way is to clean meta parts with steam or jetting machine or high grade solvent and new brush. After finishing

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cleaning each part, check if it needs repairing or changing. After cleaning is finished, all parts should be dried via compressed air or clean soft cloth and coated with lubricating oil externally. Parts without protection oil cannot be saved overnight.

## 7.2 Reassembly of Swivel

All parts should be thoroughly cleaned and fueled before assembly. Never use the lubricating oil discharged from swivel again. Instead, please do use the new lubricating oil of the same type and grade recommended.

- 1) Put the shell of swivel on the swivel support which is properly supported.
- 2) Install key, output gear, main bearing and strengthen bearing inner ring and sealing wear-proof casing with thermal matching in sequence along the swivel central tube. Install bearing inner ring on the upper end of central tube;
- 3) Install parts on two gear shafts;
  - a. Install Level 2 driven pulley and bearing of both ends on Level 2 gear shaft;
  - b. Install upper end bearing on Level 1 gear shaft;
- 4) Install the central tube and reduction gear shaft of gear and bearing inside the shell;
- 5) Check the upper plane of shell to ensure it is clean and free from burrs;
- 6) Put sealer and adjustable pad on the upper plane of shell;
- 7) Install upper bearing excircle and upper oil seal on the upper cover plate;
- 8) Install upper cover plate on the shell of swivel and fasten it with bolt and washer;
- 9) Install a small hydraulic jack on the position below the lower end surface of central tube and make dial indicator lean against the top of central tube. In this way, the axial clearance of central tube could be checked and measured. When enhancing the central tube with jack, records its movement data via dial indicator; record its total movement volume when it stops.
- 10) Take out of jack dial indicator and upper cover plate, take out of adjustable pad and change its quantity and thickness and the newly changed gasket unit should be able to make the axial displacement of central tube reach 0.1 mm- 0.2 mm.
- 11) Install the upper shaft end cover of two reduction gears and small adjusting pad on the upper cover plate;
- 12) Install the lower bearing of Level 1 reduction gear shaft and the lower bearing of motor output gear inside the bearing hole of lower cover plate;
- 13) Fix Level 1 reduction gear and install both Level 1 reduction gear and bearing spacer of Level 1 reduction gear on the body of swivel;
- 13) Put the shell of swivel upside down and install it on the support;
- 15) Install the upper bearing of motor output bearing shaft inside shell and install Level 1 reduction gear shaft, isolation ring and inner ring of lower bearing in the lower end of Level 1 reduction gear shaft;
- 16) Fix motor mounting plate and gasket on the shell by bolt and then fasten the bolt;
- 17) Install the lower stabilizing bearing inside the shell of swivel;
- 18) Install two framework oil seals and spring collar inside the alignment gland and connect the alignment gland with the shell of swivel by making the lubricating cup outward after assembly is finished;
- 19) Install the lower bearing of input gear shaft inside the mounting plate hole of motor; install framework oil seal inside the cover which is then installed in the mounting plate of motor;



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- 20) Install the lower end cover, gasket and adjustable pad of Level 1 reduction gear on the mounting plate of motor;
  - 21) Install hydraulic motor, oil port flange, joint, universal joint, etc.;
  - 22) Overturn swivel to make the shell align on the support, install rubber umbrella on the central tube and knob the well installed packing assembly on the upper thread of central tube;
  - 23) Install swivel support on the upper cover plate;
  - 24) Connect wash pipe and swivel support and insert them inside packing assembly. Screw packing box and set screw accordingly;
  - 25) Connect gooseneck, sealing ring, support and wash pipe and fix them with bolt; pay attention to the installation direction of gooseneck;
  - 26) Install lifting bail in the corresponding position of the shell of swivel and align lifting bail pin with the lifting bail pinhole on the shell; Knock at the lifting bail pinhole with rubber hammer and copper bar to fix the lifting bail. If the lifting bail is aligned, make the lifting bail pin roll inside pin hole and fix it with nut.
  - 27) Install motor lath crib, purge cock, breathing apparatus and other accessories;
  - 28) Fix all the bolts with holes on their head with steel wires in pairs;
  - 29) Add gear oil to the shell from upper cover plate and the oil level should remain between two oil pointers.



### 8.1 Plan View of Swivel



Table 4: Details of Parts of Plan View of Power Swivel

No.	Code	Name	Qty.
1	JB/T8112-1999	Shackle T-BX6.3	1
2	RS145.100-01	Lifting bail	1
3	RS145.100-02	Plug screw	1
4	RS145.100-03	Gooseneck	1
5	GB/T32.1-2000	Bolt M14×60	5
6	GB/T93-87	Washer 14	5
7	RS145.100-04	Wash pipe	1
8	RS145.100-34	Support	1
9	RS145.110.00	Packing assembly	1
10	GB/T79-2000	Bolt M12×25	1
11	RS145.100-37	Lifting bail pin	2
12	RS145.120.00	Reaction torque arm assembly	2
13	FB231-05	Steel oil pointer GY20	2
14	RS145.100-22	Shell	1
15	GB/T32.1-2000	Bolt M14×30	5
16	GB/T93-87	Washer 14	5
17	RS145.130.00	Motor guardrail	1
18	RS145.100-15	Central tube	1
19	RS145.100-16	Central tube joint	1
20	RS145.100-39	Screw protector	1
21	FHV16 1NPT F/M	Quick coupling NPT1	2
22	04.240-01B	Straight joint NPT1-NPT1	4
23	CEAC25 (NPT1)	Universal joint	2
24	RS145.100-36	Lifting bail pin roll	2
25	GB/T6170-2000	Nut M12	2
26	GB/T32.1-2000	Bolt M16×80	4
27	GB/T93-87	Washer 16	4

## 8.2 Side View of Swivel

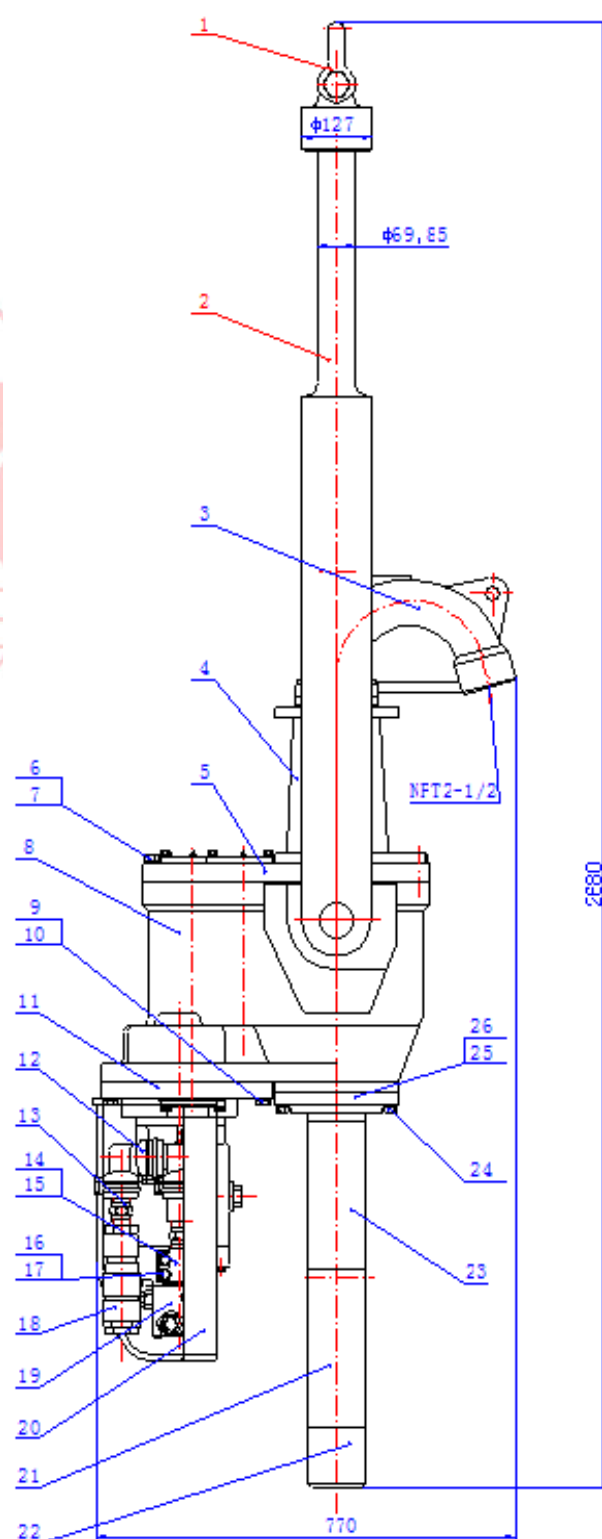


Table 5: Details of Parts of Side View of Power Swivel

No.	Code	Name	Qty.
1	JB/T8112-1999	Shackle T-BX6.3	1
2	RS145.100-01	Lifting bail	1
3	RS145.100-03	Gooseneck	1
4	RS145.100-34	Support	1
5	RS145.100-35	Upper gland	1
6	GB/T32.1-2000	Bolt M16×80	4
7	GB/T93-87	Washer 16	4
8	RS145.100-22	Shell	1
9	GB/T32.1-2000	Bolt M16×55	8
10	GB/T93-87	Washer 16	8
11	RS145.100-13	Motor mounting plate	1
12	CEAC25 (NPT1)	Universal joint	2
13	04.240-01B	Straight joint NPT1-NPT1	4
14	RS171.140-04	Flange of motor oil port	2
15	JB/ZQ4224-97	O-ring45×3.1	2
16	ASME	Outer hexagon bolt with hole on its head $\frac{7}{16}$ -14UNC-1 $\frac{3}{8}$	8
17	ASME	Spring washer 7/16	8
18	FHV16 1NPT F/M	Quick coupling NPT1	2
19	HHD64	Quantitative piston motor	1
20	RS145.130.00	Motor guardrail	1
21	RS145.100-15	Central tube	1
22	RS145.100-39	Screw protector	1
23	RS145.100-16	Central tube joint	1
24	GB/T32.1-2000	Bolt M14×45	8
25	RS145.100-38	Alignment gland	1
26	RS145.100-11	Gasket of lower cover	1

8.3 Vertical View of Swivel

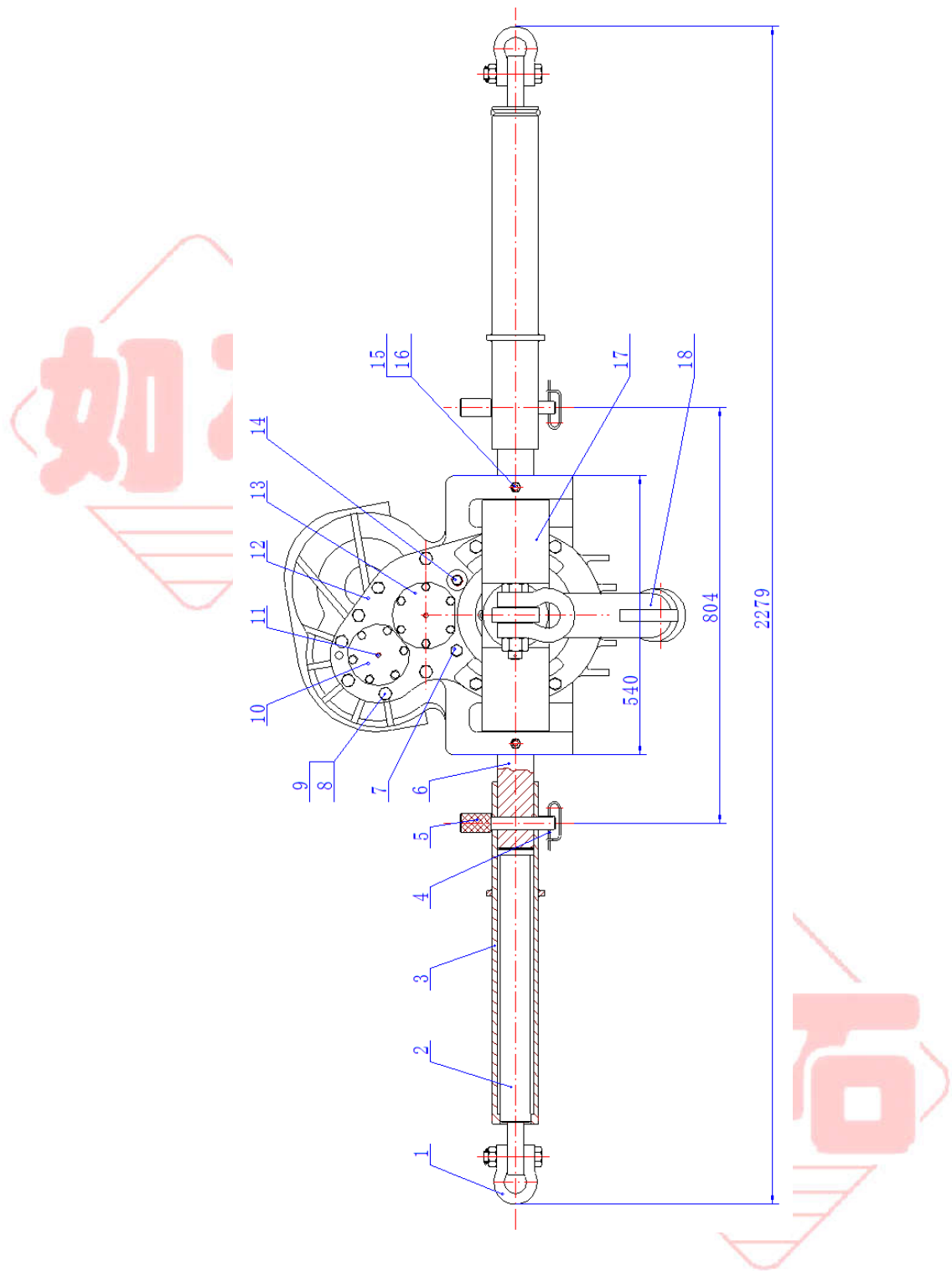


Table 6: Details of Parts of Vertical View of Power Swivel

No.	Code	Name	Qty.
1	JB/T8112-1999	Shackle S-BX5	2
2	RS145.120-01	Slide bar	2
3	RS145.121.00	Sliding sleeve	2
4	19.500-05	Small pin	2
5	RS145.120-02	Fixed pin	2
6	RS145.100-37	Lifting bail pin	2
7	JB/ZQ4444-97	Plug screw M33×2	1
8	GB/T32.1-2000	Bolt M16×60	12
9	GB/T93-87	Washer 16	12
10	RS145.100-29	Gland III	1
11	JB/T7940.1-95	Oil cup M10×1	2
12	RS145.100-35	Upper gland	1
13	RS145.100-25	Gland II	1
14	05.180.00	Breathing apparatus	1
15	RS145.100-36	Lifting bail pin roll	2
16	GB/T6170-2000	Nut M12	2
17	RS145.100-01	Lifting bail	1
18	RS145.100-03	Gooseneck	1



## 8.5 Swivel Drive System Diagram

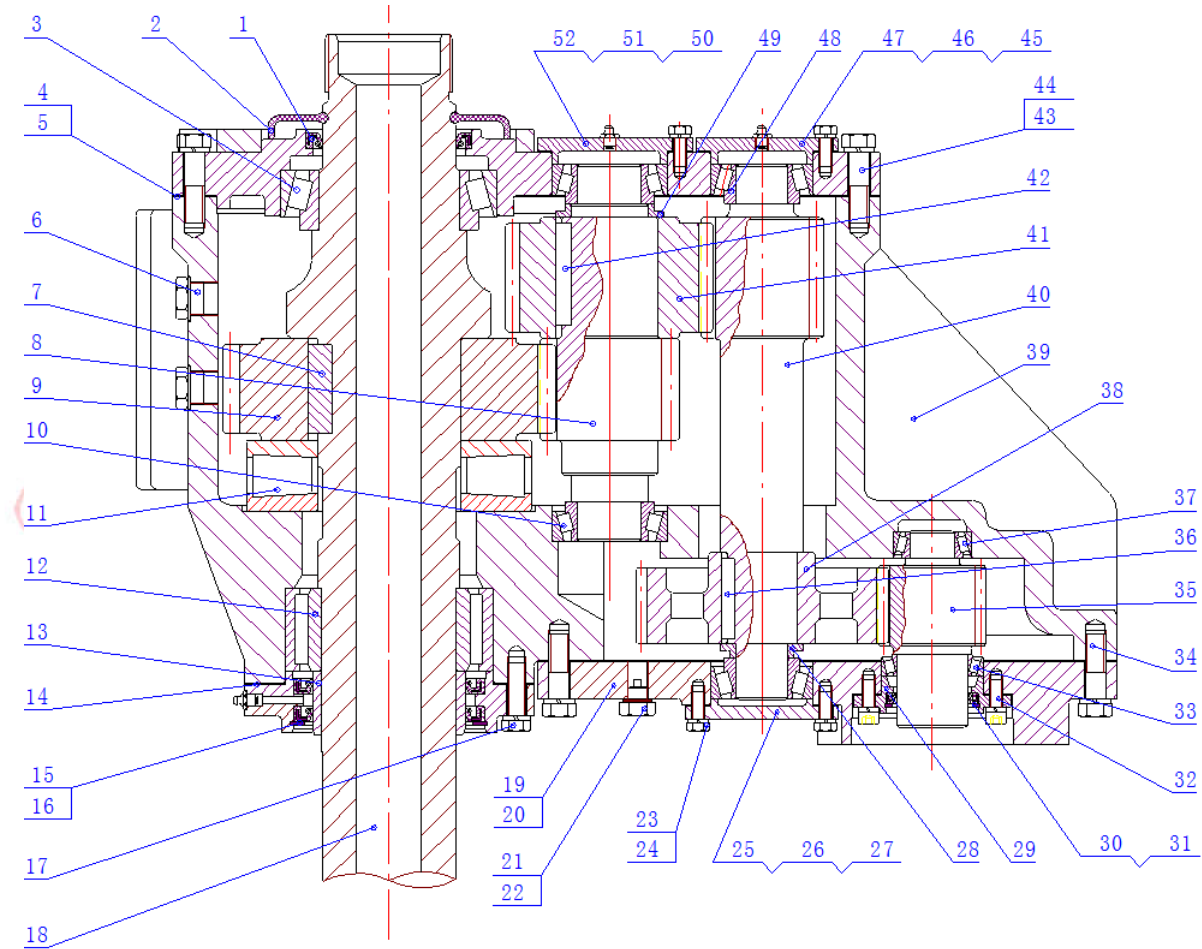


Table 7: Details of Parts of Swivel Drive System

No.	Code	Name	Qty.
1	GB9877.1-88	Lip-type packing FB105×130×12	1
2	RS145.100-05	Rubber umbrella	1
3	GB/T297-1994	Bearing 33022 (110×170×47)	1
4	RS145.100-06	Gasket of upper cover	1
5	RS145.100-07	Adjustable pad of upper cover	1
6	FB231-05	Steel oil pointer GY20	2
7	GB/T1096-2003	Key 32×18×70	1
8	RS145.100-09	Level 2 gear shaft	1
9	RS145.100-08	Output gear	1
10	GB/T297-1994	Bearing 33210 (50×90×32)	1
11	T441	Bearing 111.76×223.52×55.88	1
12	RS145.100-10	Needle bearing	1
13	RS145.100-12	Sealing wear-proof casing	1
14	RS145.100-11	Gasket of lower cover	1
15	GB9877.1-88	Lip-type packing FB120×150×12	2
16	GB893.1-86	Check ring 120	1
17	GB/T32.1-2000	Bolt M14×45	6
18	RS145.100-15	Central tube	1
19	RS145.100-13	Motor mounting plate	1
20	RS145.100-14	Gasket	1

No.	Code	Name	Qty.
21	35.04.00	Magnetic purge cock	1
22	JB982-77	Washer 16	1
23	GB/T32.1-2000	Bolt M10×25	18
24	GB/T93-87	Washer 10	22
25	RS145.100-18	Gland I	1
26	RS145.100-19	Gasket I	1
27	RS145.100-20	Adjustable pad I	1
28	RS145.100-17	Check ring I	1
29	RS145.100-32	Cover	1
30	GB/T893.1-86	Check ring 72	1
31	GB9877.1-88	Lip-type packing FB55×72×8	1
32	GB/T70.1-2000	Bolt M10×50	4
33	GB/T279-1994	Bearing 32911 (55×80×17)	1
34	GB/T32.1-2000	Bolt M16×55	8
35	RS145.100-33	Input gear shaft	1
36	GB/T1096-2003	Key 16×10×63	1
37	GB/T279-1994	Bearing 33007 (35×62×21)	1
38	RS145.100-21	Level 1 driven pulley	1
39	RS145.100-22	Shell	1
40	RS145.100-23	Shaft of Gear I	1
41	RS145.100-24	Level 2 driven pulley	1
42	GB/T1096-79	Key 20×12×80	1
43	GB/T32.1-2000	Bolt M16×60	12
44	GB/T93-87	Washer 16	20
45	RS145.100-25	Gland II	1
46	RS145.100-26	Gasket II	1
47	RS145.100-27	Adjustable pad II	1
48	GB/T279-1994	Bearing 33208 (40×80×32)	2
49	RS145.100-28	Check ring II	1
50	RS145.100-29	Gland III	1
51	RS145.100-30	Gasket III	1
52	RS145.100-31	Adjustable pad III	1

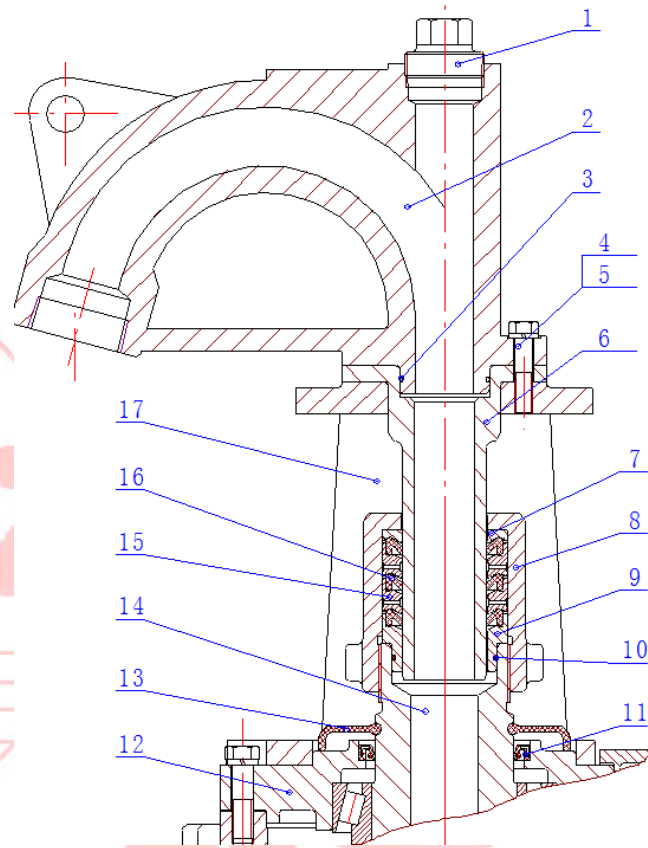


Table 8: Details of Parts of Swivel Wash pipe-Packing

No.	Code	Name	Qty.
1	RS145.100-02	Plug screw NPT2	1
2	RS145.100-03	Gooseneck	1
3	JB/ZQ4224-97	O-ring68×3.1	1
4	GB/T32.1-2000	Bolt M14×60	5
5	GB/T93-87	Washer 14	5
6	RS145.100-04	Wash pipe	1
7	RS145.110-02	Bushing ring	1
8	RS145.110-01	Packing box	1
9	RS145.110-05	Junk ring	1
10	JB/ZQ4224-97	O-ring 80×3.1	1
11	GB9877.1-88	Lip-type packing FB105×130×12	1
12	RS145.100-35	Upper gland	1
13	RS145.100-05	Rubber umbrella	1
14	RS145.100-15	Central tube	1
15	RS145.110-03	Retainer	2
16	RS145.110-04	Packing	3
17	RS145.100-34	Support	1

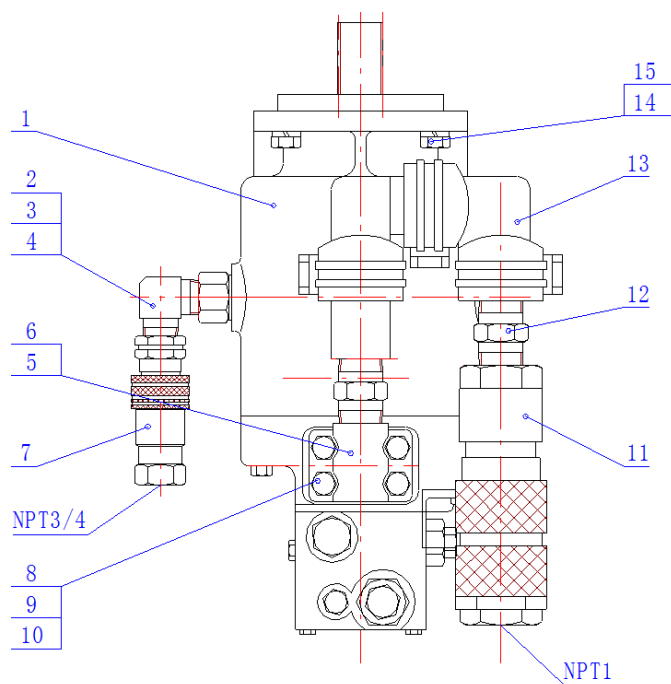


Table 9: Details of Hydraulic Motor Parts

No.	Code	Name	Qty.
1	HHD64	Quantitative piston motor	1
2	JZN12C-U17	Straight joint NPT3/4 (inner) -11/16UN	1
3	JB982-77	Washer 27	1
4	07.700-06	Right-angle coupling NPT3/4-NPT3/4	1
5	PAV1-NPT3/4	Quick coupling NPT1	1
6	RS171.140-04	Flange of motor oil port	2
7	JB/ZQ4224-97	O-ring 45×3.1	2
8	ASME	Outer hexagon bolt with hole on its head $\frac{7}{16}$ -14UNC-1 $\frac{3}{8}$	8
9	ASME	Spring washer 7/16	8
10	GB3081-82	Steel wire 1.5	As required
11	FHV16 1NPT F/M	Quick coupling NPT1	2
12	04.340-01B	Straight joint NPT1-NPT1	4
13	CEAC25 (NPT1)	Universal joint NPT1	2
14	ASME	Outer hexagon bolt with hole on its head $\frac{1}{2}$ -13UNC-1 $\frac{3}{8}$	8
15	ASME	Spring washer 1/2	8

## 9. Troubleshooting

No.	Fault	Phenomenon	Cause/troubleshooting
1	Boosting pressure is consumed when main pump is in neutral position.	The pressure gauge does not indicate boosting pressure	Check if fault happens to pressure gauge and if slippage pump is damaged.
2	Boosting pressure is consumed when main pump is in working status.	The boosting pressure is lower than 0.4 MPa when the power swivel rotates at the highest speed.	Fault happens to pump or motor. Close the high-pressure ball valve at the high-pressure oil filter to make main pump under working status; if the boosting pressure is normal, there must be something wrong with motor; if boosting pressure is abnormal, fault may happen to slippage pump.
3	Hydraulic oil is too hot	The liquid level and temperature indicator on hydraulic oil tank displays a temperature higher than 87°C	If milk white is found via checking hydraulic oil, it means air is mixed inside hydraulic oil; check if air leaks in the suction inlet of slippage pump or the oil suction oil filter interface of the hydraulic oil tank; check if the oil liquid level inside oil tank is too low.
4	The rotation speed of central tube is lower	Observed by eyes	Faults happen to variable resistor and the voltage transmitted to proportional valve should be 0-10 V. Change it if it is faulty.
5	Direction control function lost	Observed by eyes	Change electric handle if it is faulty.
6	The rotation speed of central tube is lower	Observed by eyes	The element of proportional valve is pasted or blocked. Operate handle forward or backward very quickly to loosen the pasted element.
7	Swivel still rotates when it is in neutral position	Observed by eyes	Alignment adjustment controlled by main pump displacement is in maladjustment.
8	Leakage of packing assembly	Observed by eyes	Change aged packing or worn packing and wash pipe.