

DKYC320/31.5D II
Hydraulic Power Control Unit

Operation Manual
DKYC320/31.5D II -SM

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I. Safety Notices:

1. Personal Safety Protection Requirements during Operation and Maintenance of Hydraulic Power Control Unit

1) Prior to operation of the hydraulic power control unit, it is firstly required to understand its structure and performance, as well as installation at the well site.

2) Prior to operation and maintenance of the hydraulic power control unit, it is firstly required to examine whether or not installation of the unit is firm and reliable, and whether or not the respective parts have been properly connected, such as whether or not the connection of hydraulic line and its quick joint and the connection of the cables are correct, etc.

3) Understand and know well the operation principle and the operating process of the hydraulic power control unit, and the functions of respective operating buttons and handles, and know well the display items of the LCD touch screen and the setting of the highest pressure, etc.

4) It is strictly prohibited for many operators to operate and control the unit at the same time, when no instruction is received. The remote control box is for priority operation generally, and it is strictly prohibited to operate the local instrument panel at the same time when remote control box is being operated.

5) It is required to disconnect power supply, when operation of the hydraulic power control unit is completed or stopped or the unit is being maintained, to prevent personal injury arising from misoperation.

6) It is not allowed to adjust or dismantle any part when the unit is being used, and it is not allowed to examine and maintain the unit when it is under operation.

2. Equipment Safety Requirements during Operation and Maintenance of Hydraulic Power Control Unit

1) Confirm that the hydraulic power control unit has been installed and placed steadily and firmly, and it is strictly prohibited to place it on soft and loose surface.

2) Confirm that the oil level position of the hydraulic power control unit is within the range of oil pointer.

3) Prior to start of the hydraulic oil pump, it is required to fill up hydraulic oil manually inside the pump case, to prevent damage of hydraulic pump unit.

4) It is strictly prohibited to impact, knock, and smash the hydraulic power control unit, to damage respective parts.

5) Protect respective hydraulic pipelines and cable lines, to prevent bending and compression injury.

II. Main Technical Parameters of Hydraulic Power Control Unit

1) Max. Operating Pressure: 31.5MPa

2) Rated Operating pressure: 24MPa

3) Max. Operating Flow Rate: 320L/min

4) Rated Operating Flow Rate: 280L/min

5) Diesel Engine Parameters:

1. Model: Dongfeng Cummins 6CTA8.3-C260

2. Bore×Stroke 114×135mm

3. Displacement-liter 8.3L

4. Number of Cylinders: 6
 5. Firing Order: 1-5-3-6-2-4
 6. Rated 194kW at 2200 r/min
 7. Max. Torque : 1135N.m/1500 r/min
 8. Low Idle Speed : 900 ± 100 r/min
 9. Fuel Consumption: ≤230g/kW.h
 10. Steady-state speed regulation : ≤10%
 11. Rotation: Counterclockwise (viewed from the front of the engine Aspiration)
 12. Compression Ratio :16.5:1
 13. Lubricating Oil Capacity: 18.9L
 14. Coolant capacity (Engine Only) : 10.9L
 15. Startup Mode: Electric Startup
 16. Start Voltage : DC24V
 17. Type : after cooled
 18. Fan : Suction type
 19. Flywheel Housing : SET1#
 20. Emission Standard : Notional 1
 21. Starting Performance : No need to use any cold weather start device for success start when environment temperature is over -12℃
 22. Other Performance : To meet Dongfeng Cummins Standard
 23. Fuel : No.0 Diesel or NO.10 Diesel (Depend on environment temperature)
 24. Oil : Use 15W40CF-4 or above level lubricating oil
 25. Coolant : Rust-proof antifreeze
 26. Engine Body Color : Black
- 6) Closed Circuit Plunger Variable Pump:
1. Model: QLA4VG180HD/32R-NSD02F021S
 2. Delivery Capacity: 180mL/r
 3. Max. Speed: 2500r/min
 4. Rated Pressure: 40MPa
 5. Flush Pump Flow Rate: 32L/min
 6. Constant Power Variance: Automatic Overload Speed Reduction
 7. Provided with Flush Pump Overflow Valve: A/ B Port as Output Overflow Valve and A/B Port as Pressure Joint
 8. Power Supply Voltage: DC24V
 9. Speed Regulating Mode: Electric Handle Stepless Speed Regulation
 10. Display Mode: LCD Touch Screen TK6070IP – Display of Current Rotating Speed (Flow) and Pressure Value
- 7) Auxiliary Pump: (Main Pump Control or Oil Compensation for Wire Winch and Hose Winch) :
1. Model: QLAA10V028DR/31R-VSC12K01
 2. Rated Operating Pressure: 28MPa
 3. Max. Flow Rate: 28L/min
- 8) Hydraulic Hose Winch:
1. Rated Operating Pressure: 16MPa
 2. Max. Hose Winch Speed: 7r/min
 3. Max. Hose Winch Torque: 5000N.m

3. Hose Capacity 30.5 m X3 (32 IV, 2 Pieces; 25 II, 1 Piece)
- 9) Hydraulic Wire Winch:
1. Max. Hauling Force: 3600kg
 2. Operating Pressure: 15MPa
 3. Operating Flow Rate: 15-30L/min
 4. Winding Speed: 12-19m/min
 5. Steel Cable Diameter: 10mm
 6. Max. Cable Capacity: 70m
 7. Installation Height: 2000mm
- 10) Hydraulic Oil Tank:
1. Exterior: 550X1000X1000mm
 2. Effective Capacity: 450L
 3. Suction Filter: TF400X100
 4. HP Oil Filter: BR-660X10P (Two-way Reversible Filter) Pressure: 42MPa
- 11) Diesel Fuel Tank:
1. Exterior: 400X1000X1000mm
 2. Effective Capacity: 320L
- 12) Two-way Operation Panel (For Operation of Both Hose Winch and Wire Winch) :
1. Operating Pressure: 20MPa
 2. Max Flow Rate: 30L/min
 3. Adjustable Flow Rate: 15-30L/min
- 13) Instrument Panel:
1. Main Pump Operating Pressure Display: 0-40MPa
 2. Control Pump Oil Pressure Display: 0-20MPa
 3. Compensation Oil Pressure Display: 0-2.5MPa
 4. Diesel Engine Instrument Installation and Operation
 5. Control Oil and Operation Panel Oil Circuit Switch (Electric Control)
 6. Pressure Gauge Pressure Release Button (Electric Control)
 7. Power Supply DC24V (Battery)
- 14) Air Cooler:
- 1) Plate Air Cooler: 15m²
 - 2) Diesel Engine Fan: Suction
 - 3) Rated Flow Rate: 75L/min
 - 4) Back Pressure: Not Larger than 0.2MPa
- 15) Remote Operating Control Panel:
1. Pressure Display and Corresponding Torque Display (Touch Screen)
 2. Rotating Speed (Flow Rate) Display (Touch Screen)
 3. Setting of Max Unloading Pressure (Touch Screen)
 4. Electric Handle Speed Regulation
 5. High and low gear switching (Electric Control and Remote Control)
 6. Control Oil and Operation Panel Oil Circuit Switching (Electric Control and Remote Control)
 7. Pressure Gauge Pressure Release Button (Electric Control and Remote Control)
 8. Emergency Stop (Diesel Engine) Button
- 16) Tool Kit:
1. Remote Control Electric Cable

2. Other Tools

17) Exterior Dimension of Power Unit: 5300X2100X2000mm:

18) Weight: ~5500kg:

III. Scope of Operation for Hydraulic Power Control Unit

This power control unit is applicable to well workover operation, to provide hydraulic power for power swivel, and to take automatic control over limit value of the purveyed hydraulic pressure, as well as to perform random operating control over the output hydraulic flow rate, from maximum flow rate in positive direction to maximum flow rate in negative direction, able to cater to stepless setting for the output rotating speed of power swivel, to change the rotating direction for the output of the power swivel central tube.

IV. Structure of Main Parts for Hydraulic Power Control Unit

According to Fig 1 Hydraulic Schematic Diagram for Power Control Unit, this unit has the main pump (closed pump), the control pump, and the oil compensation pump coaxially installed and mounted on the output terminal of diesel engine. The maximum flow rate of the main pump used for output is 320L/min and the maximum pressure of hydraulic power is 31.5MPa, to be provided to drive the hydraulic motor of swivel. The flow rate for output of control pump is 30L/min and the pressure of hydraulic power is 16MPa, used to control the regulation on the flow rate of main pump on one hand, and to drive the wire winch and hydraulic hose winch on another. The pressure of oil compensation pump is 1.6Mpa, used for oil supply and compensation to the LP port of the main pump. The oil discharged from main pump returns to oil tank through air cooler.

The control valve is switched through solenoid valve, to take operating control respectively over wire winch and hydraulic hose winch, through two-way operation panel, after wire winch and hydraulic hose winch are switched over, and to change the rotating speeds of wire winch and hydraulic hose winch respectively through three-way flow throttling valve for changing the flow rate of the adjustable liquid circuit.

The pressure oil ports of respective pumps are all set with overflow valves, able to set their maximum pressure values, respective, to protect the safety and reliability of the hydraulic system.

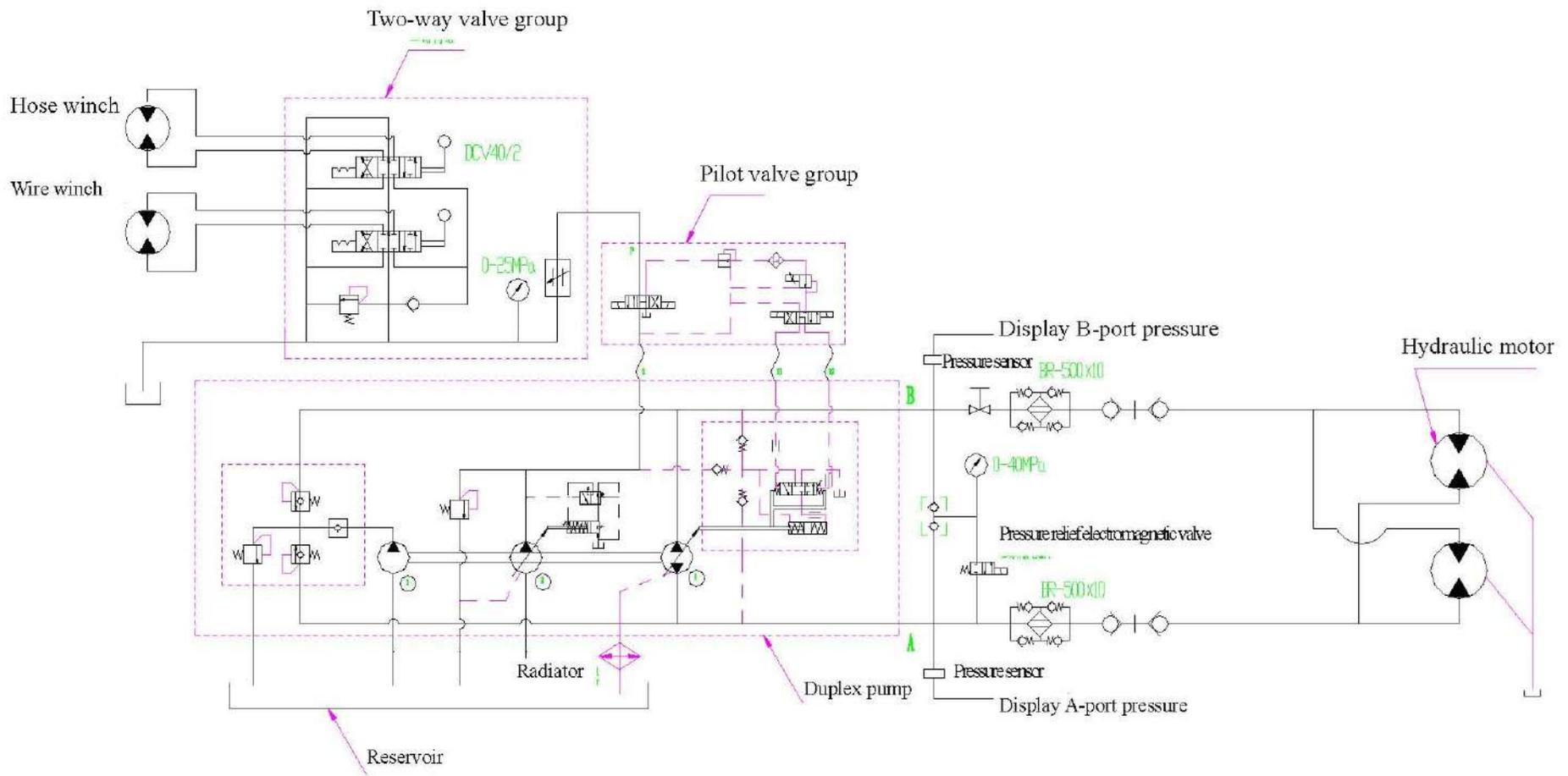


Fig 1. Hydraulic Schematic Drawing for DKYC320/31.5D II Power Control Unit

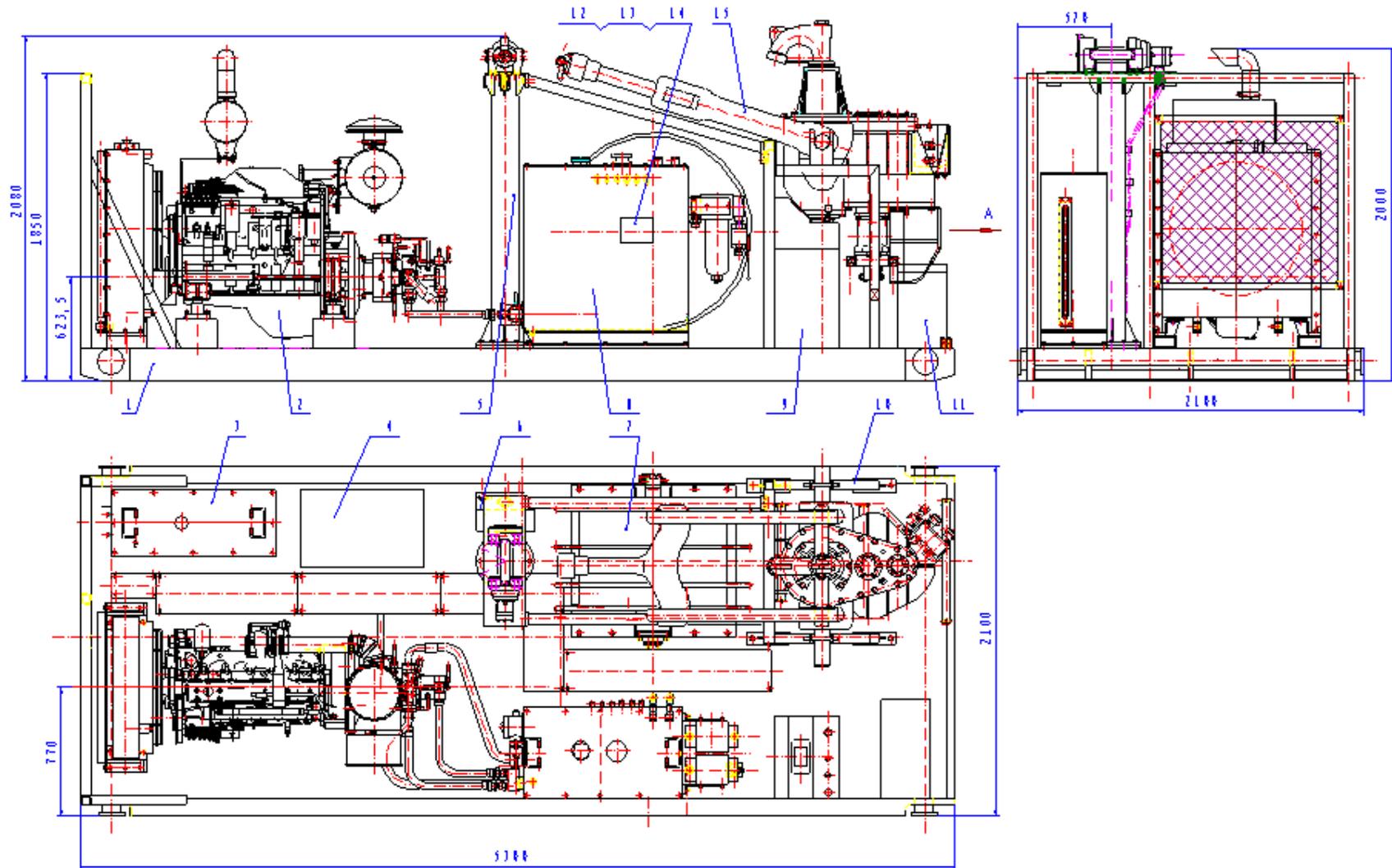


Fig 2 Outside Drawing for Power Control Unit

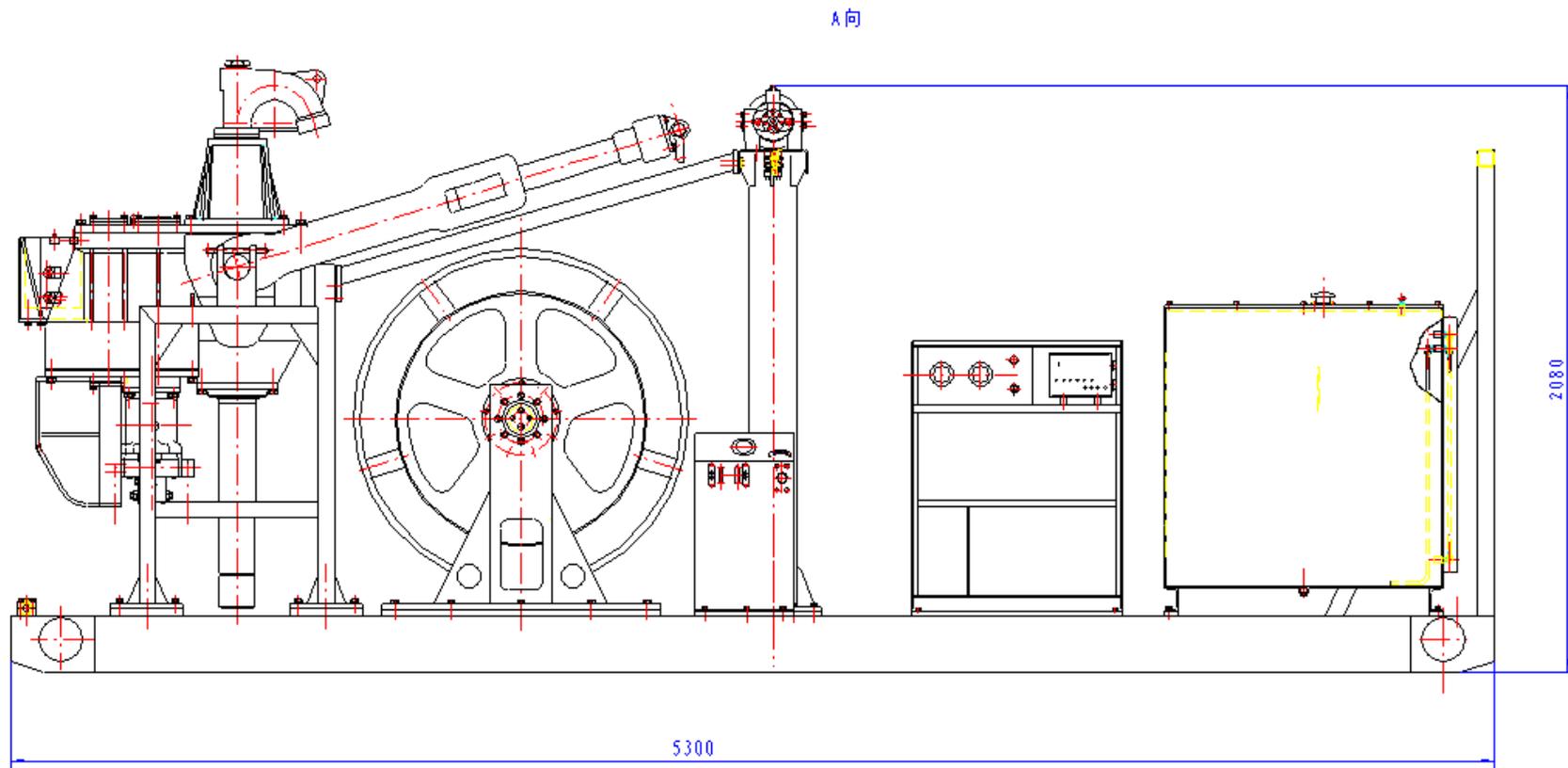


Fig. 2 Outside Drawing for Power Control Unit

- 1: Chassis 2: Diesel engine-pump set 3: Fuel tank 4: Local control console 5: Wire winch 6: Two-way control valve group
 7: Hose winch 8: Reservoir 9: Remote control console 10: Swivel support 11: Tool kit 12: Nameplate mounting plate
 13: Nameplate 14: Screw 15: Power swivel

As indicated in Fig 2, the power control unit is mainly composed of following parts:

Chassis (1), Diesel Engine-pump set (2), Fuel Tank (3), Local console (4), two-way control valve block (5), hose winch (6), Hydraulic Oil Tank (7), reservoir(8), remote console (9), swivel support(10), tool kit(11), power swivel (15), etc.

1.Chassis: All the parts are installed and fixed or put on the Chassis (1), and the chassis is welded using shaped square tube, as indicated in Fig 2-1:

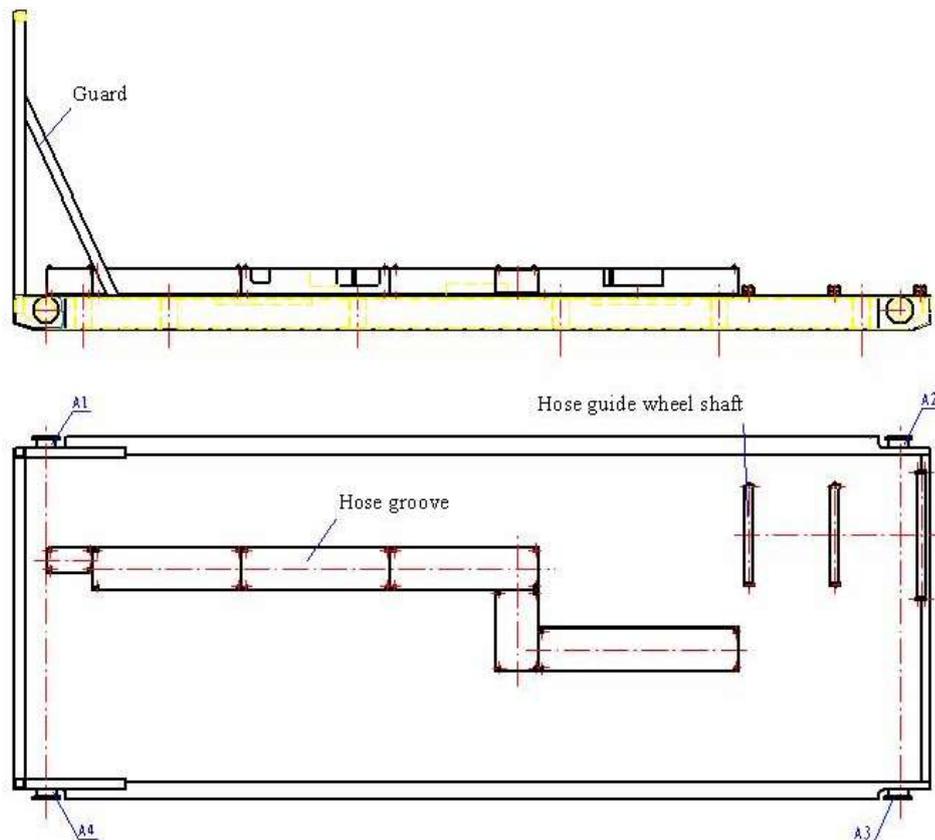


Fig 2-1 Chassis

The chassis is in the skid-mounted type, and A1, A2, A3, and A4 on the four corners are the hanging places for lifting slings. The piping guide wheel shaft is in B area on the right side, namely when the hydraulic line is pulled out or retracted, it gets into rolling friction with guide wheel shaft, to protect pipeline. The guardrail for air cooler is located in the area C on the left side.

2. Diesel-Pump Unit: The pump unit comprises of diesel engine and hydraulic oil pump unit, as indicated in Fig 2-2. The double pump is installed and fixed on the Flywheel Housing Flange (3) after being connected in series, and the input shaft of the pump unit is connected with the flywheel of diesel engine inside the flywheel housing through coupler.

Shock Absorption Block is fixed between the four mounting outriggers of the diesel engine and the Mounting base (1), to absorb the energies generated from impact vibration during startup or operation of diesel engine.

2. Diesel-Pump Unit: The pump unit comprises of diesel engine and hydraulic oil pump unit, as indicated in Fig 2-2. The double pump is installed and fixed on the Flywheel Housing Flange (3) after being connected in series, and the input shaft of the pump unit is connected with the flywheel of diesel engine inside the flywheel housing through coupler.

Shock Absorption Block (cushion) is fixed between the four mounting outriggers of the diesel engine and the Mounting base (1), to absorb the energies generated from impact vibration during startup or operation of diesel engine.

The pump unit is composed of the double pump including the Main Pump (Closed Type) (6), and the Control Pump (7). The Main Pump (6) is a closed oil pump, on which the two oil ports are directly connected with hydraulic motor to form closed circuit. Proportional electromagnetic reversing valve is installed on the Main Pump (6), able to adjust the flow rate of pump at discretion through changing size of voltage or current, and it is able to change the pressure direction of oil port, namely change the rotating direction of the hydraulic motor, when voltage or current is changed from positive to negative. No flow rates are available with the two oil ports, when the value of voltage or current is zero.

The Control Pump (7) is used to provide control pressure signals for the Main Pump (6). Two-position three-way electromagnetic reversing valve is mounted on the Control Pump (7). When the Main Pump (6) is under operation, the electromagnet is disengaged, and the oil liquid is the control pressure signal, while the Main Pump (6) is not under operation, the electromagnet is powered on through knob switch, it is reversed, and the oil liquid supplies oil to operation box, used for operating hydraulic hose winch and wire winch.

The stepless speed regulation is achieved through turning electric handle on the remote control operation panel for the control over flow rate of the Main Pump (6), and safety valves are installed in the areas of both two oil ports for the Main Pump (6), to prevent overload of oil pump, while two pressure sensors are mounted, to control the pressure relief respectively for the two oil ports after the maximum setting is reached, to further protect the Main Pump (6). All the operations for control and relief of the Main Pump (6) are achieved using PLC program and displayed on touch screen. The switch of the Control Pump (7) is controlled in local and remote two places, respective, using two knobs. Refer to the instrument panel and remote control operation panel under mentioned for pump control.

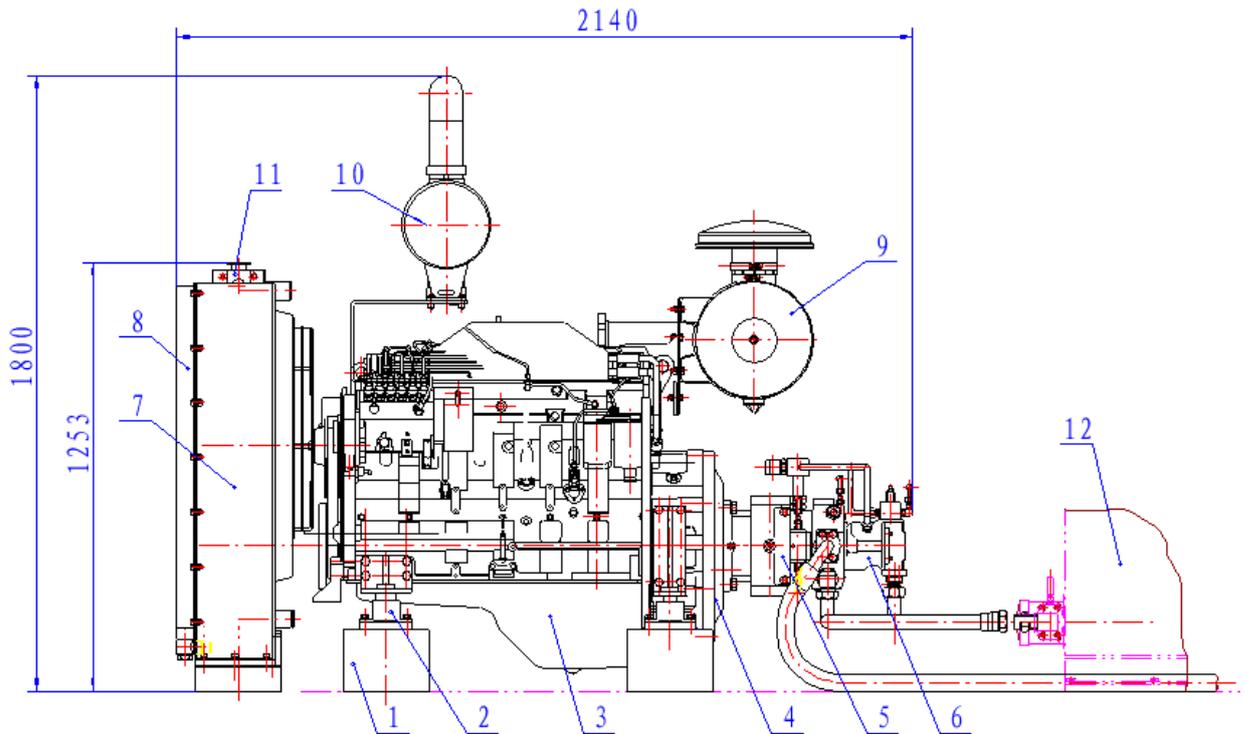


Fig.2-2: Motor-pump set

- 1: diesel engine seat 2: cushion 3: diesel engine 4: flywheel housing flange
 5: main pump(closed type) 6: control pump 7: suction fan 8: cooler
 9: suction pipe 10: exhaust pipe 11: water tank 12: oil reservoir

3. Oil Tank and Pipeline Filter:

As indicated in Fig 2-3, the pipeline filters (suction filter and HP oil filter) are both installed on the Oil Tank (1). The oil storage level inside the Oil Tank (1) is 450L. The oil liquid is filled in through the Oil Filler Cap (3) on the top cover of oil tank, and the height of liquid level can be displayed from the Liquid Level Gauge (10). The hydraulic oil is exported to the oil compensation pump and the control pump through Suction Filter (13) after coarse filtration, and the sealing performance of pipeline may be observed from the Pressure Gauge (11).

The A1 and A2 oil ports indicated in the figure are connected with the lines for A and B oil ports of the main pump, while the B1 and B2 oil ports are connected with the two HP hoses on hydraulic hose winch (The Two NPT1 on Hose Winch = 1/4 HP Quick Joint). The O1 oil return port is connected with oil discharge pipe of hydraulic hose winch (NPT1 quick joint), and the O2 oil return port is connected with oil return pipe of cooler. Totally 6 oil ports are available for the Oil Discharge Port (9), separately connected with respective

pumps and valve units as well as overflow valves.

The Suction Filter (13) is used to prevent the suction of impurities in oil liquid inside the Oil Tank (1) into pipeline and oil compensation pump. The HP Oil Filter (6) is a two-way filter, typical of high filtration precision, fitted in the pipeline, to prevent the entry of micro-particles into pump unit and hydraulic motor along with oil liquid due to mechanical abrasion, to extend the service lives of pump unit and hydraulic motor.

LP ball valve (12) is to shut off oil out line when checking or repairing pump set.

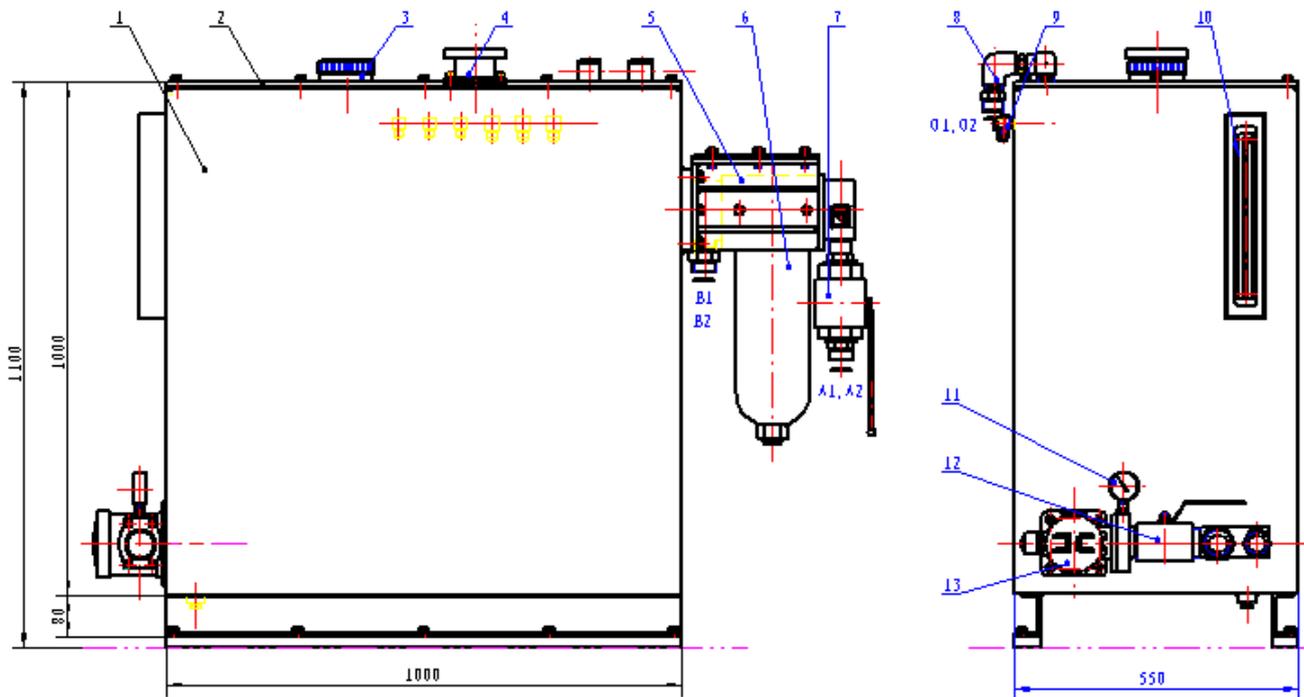


Fig 2-3 Oil Tank and Pipeline Filter

1. Hydraulic oil tank 2. Tank cover 3. Oil Filler Cap 4. Breathing Apparatus 5. Filter holder
 6. HP Oil Filter 7. HP Ball Valve 8. Oil Return Manifold 9. Oil Discharge Manifold
 10. Liquid Level Fluid Temperature Gauge 11. Pressure Gauge 12. LP ball valve 13. Oil Suction Filter

A1 and A2: Oil Filter Inlet Ports

B1 and B2: Oil Filter Outlet Ports

O1 and O2: Oil Return Ports

4. Attached Drawing for Auxiliary Operation Panel, Wire Winch, and Hydraulic Hose Winch:

1) The auxiliary operation panel is a two-way operation panel, used to control over operation of positive/negative rotations for both wire winch and hydraulic hose winch, as indicated in Fig 2-4-1. The Multi-way Reversing Valve (1), the Pressure Gauge (2), the Three-way Flow Rate Valve (6), and other parts are installed inside the Case Body (3), to achieve the positive/negative rotation of wire winch and hydraulic hose winch, by turning the Operating Handle (4) of wire winch or the Operating Handle (5) of hydraulic hose winch up and down. When the output speeds of wire winch and hose winch are too fast or too slow, the speed may be adjusted through turning the Flow Rate Adjusting Handle (7). The operating pressure of auxiliary

operation panel may be adjusted through overflow valve on the control pump in pump unit, and at the same time it may be adjusted through the Multi-way Reversing Valve (1), but it must be lower than the pressure value of the overflow valve for control pump.

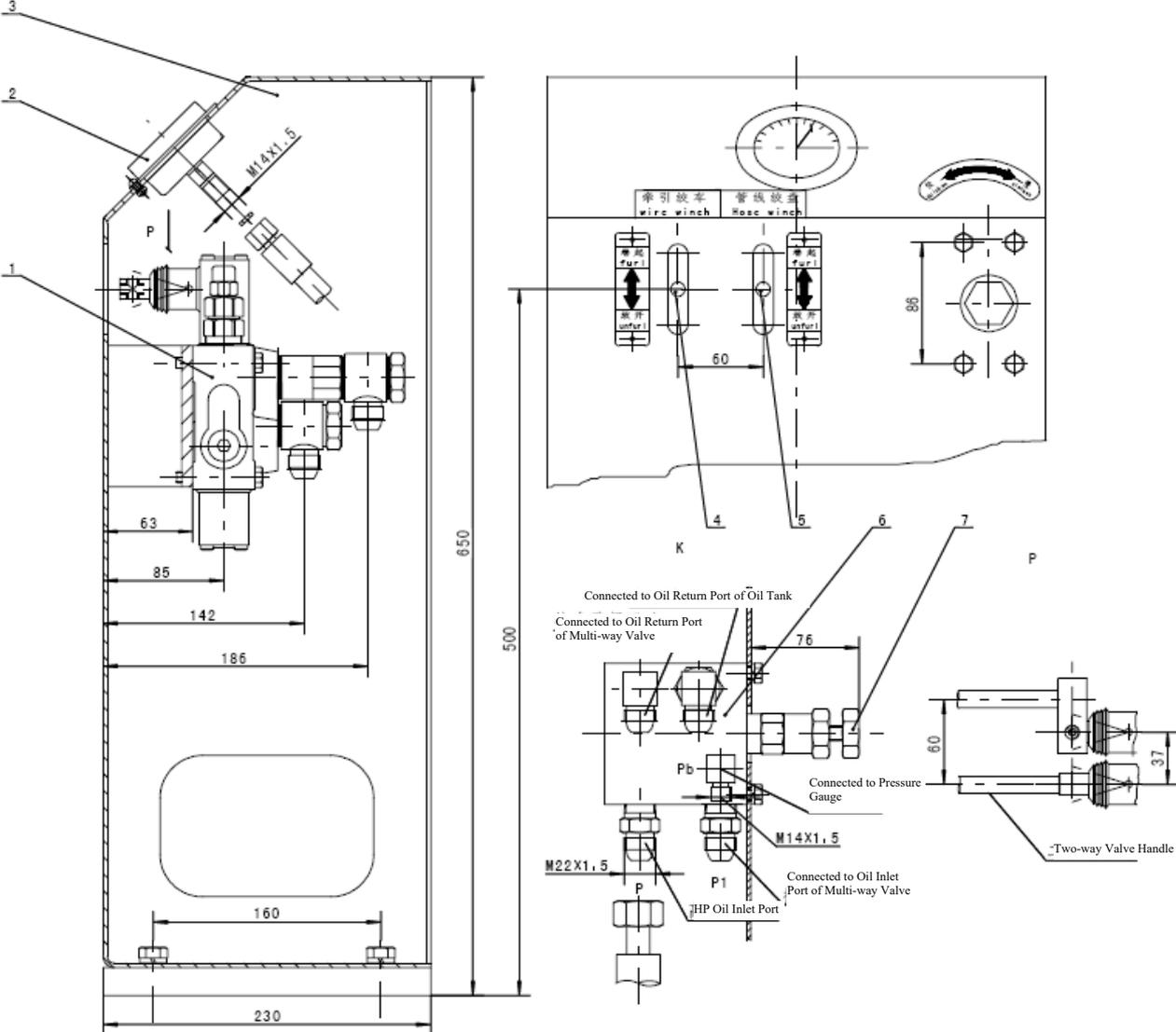


Fig 2-4-1 Auxiliary Operation Panel

- 1. Multi-way Reversing Valve 2. Pressure Gauge 3. Case Body 4. Wire Winch Operating Handle 5. Hydraulic Hose Winch Operating Handle 6. Three-way Flow Rate Valve 7. Flow Rate Adjusting Handle

2) The wire winch is an auxiliary function of the power unit, and serves as the towing pull rope for up and down the drill floor during installation or demounting of the swivel. As indicated in Fig 2-4-2, Steel Cable (2) is wound on the winding drum of the Wire Winch (1), the Cable Hook (4) is fixed on the moving end buckled on the lug on the top of bail of swivel, to achieve the traction function of swivel for up and down the drill floor, through wire winch retraction/extension of Steel Cable (2), to prevent bruise of swivel or other parts arising from instability during inclined pull.

The Wire Winch (1) is installed on the top of Bracket (3).

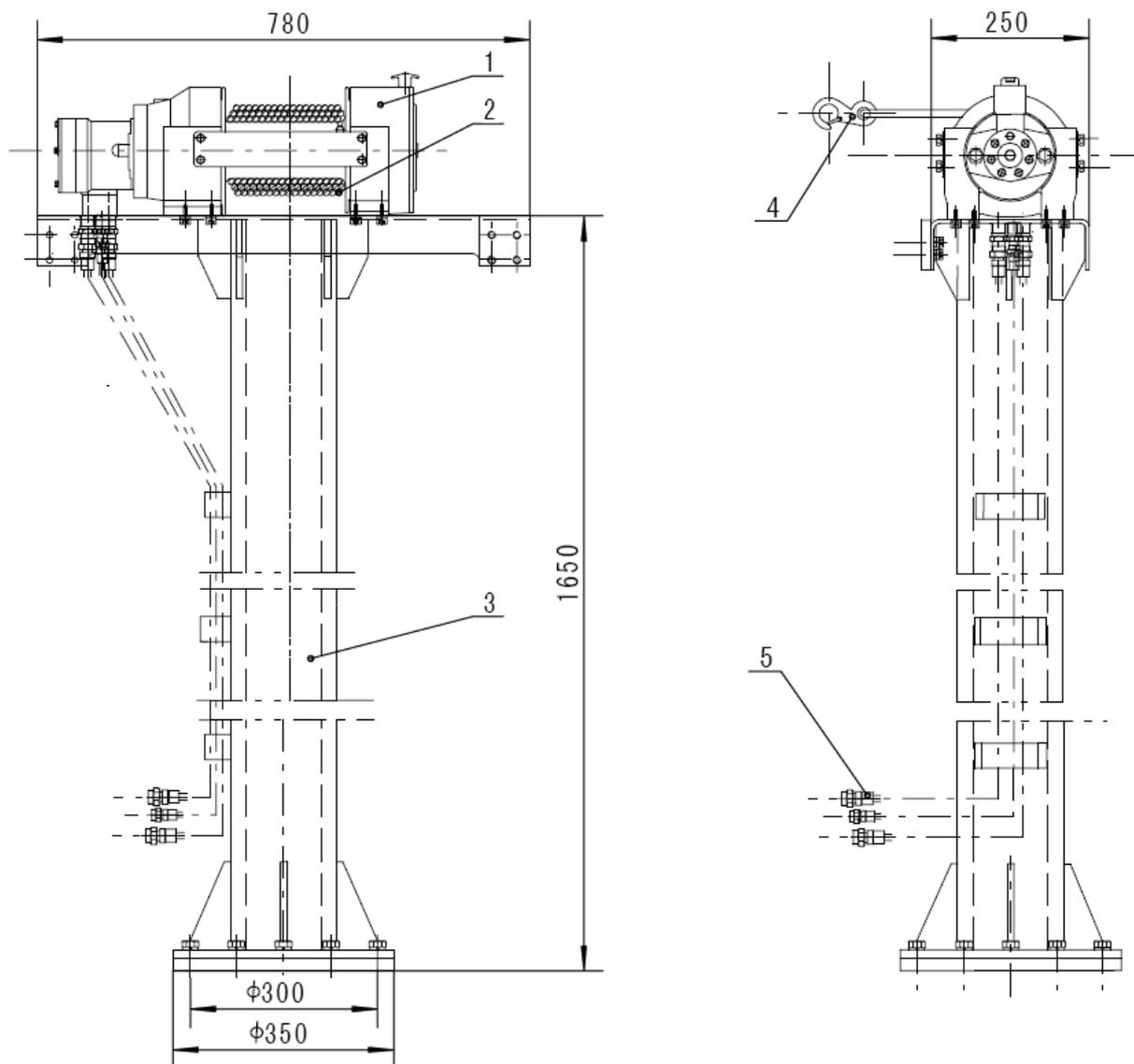


Fig 2-4-2 Wire Winch

1. Wire Winch 2. Steel Cable 3. Bracket 4. Cable Hook 5. Hose Joint

3) Hydraulic Hose Winch: The hydraulic hose winch is an auxiliary function of the power unit, used for winding and storing hydraulic hose connected with swivel, as indicated in Fig 2-4-3. The hydraulic hose winch is composed of the Winch Bracket (1), the Hose Winch (2), the Hydraulic Motor (3), the Running Speed Reducer (4) and other main parts.

Three pieces of hydraulic hoses are wound respectively inside the 2 slots of the Hose Winch (2), the lengths of hoses are all 30.5m, one end of the hose is connected with 3 joints on the inner side of spoke for the Hose Winch (2), and HP quick joints are all mounted on the outer side of spoke for the 3 joints of A1, A2, and O1, respectively, connected with the 3 pipelines from the oil tank (two HP oil filters and oil return port). The other ends of the 3 pipelines are also fitted with corresponding HP quick joints, directly connected with the corresponding joints of swivel, to form a closed hydraulic circuit.

Retraction/extension of 3 hydraulic hoses wound and stored on the Hose Winch (2) is performed by Hydraulic Motor (3) for the Hydraulic hose winch by driving the Hose Winch (2) for rotation through Running Speed Reducer (4). The Hose Winch (2) shall be turned for extension and retraction of lines, in both cases when swivel is lifted to drill floor for installation or conveyed to the storage place (the chassis of the power unit) from the drill floor), and at this point it is required to pick off the line quick joint connected with oil tank on the outer side of spoke for the Hose Winch (2), so that the hose winch is able to turn smoothly, while the quick joints shall be connected again, when fixation (installation or storage) of swivel is completed. Generally, it is not required to pick off the quick joints at the connecting part of swivel motor and the line

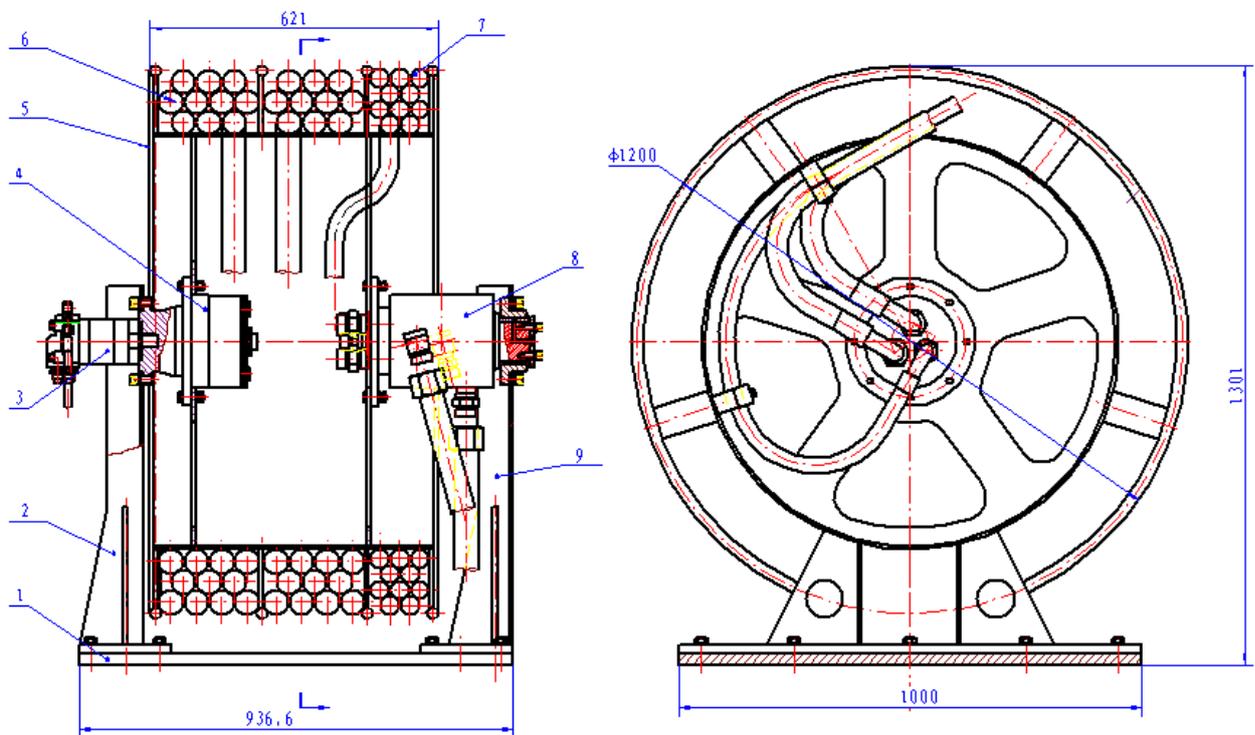


Fig 2-4-3 Hydraulic Hose Winch

1. Winch mounting plate 2.. Winch left Bracket 3. Hydraulic Motor 4. Running Speed Reducer 5. Hose winch 6. HP Hose 7. Oil Return Hose 8. Hydraulic return hose 9. Winch right bracket

5. Outside Drawing for Air-cooling Device

The function of air-cooling device is to cool down the discharged oil from the main pump (closed type) before it returns to oil tank, and its structure is indicated as in Fig 2-5: composed of two parts including Cooler Bracket (1) and Cooler (2).

The air cooler is installed on the front end of water tank for diesel engine, tightly close to water tank, sharing one same diesel engine fan with water tank. The discharge oil of the main pump enters from Oa oil inlet port, flows out from the Ob oil return port of oil tank, through the Cooler (2) and returns into the oil tank.

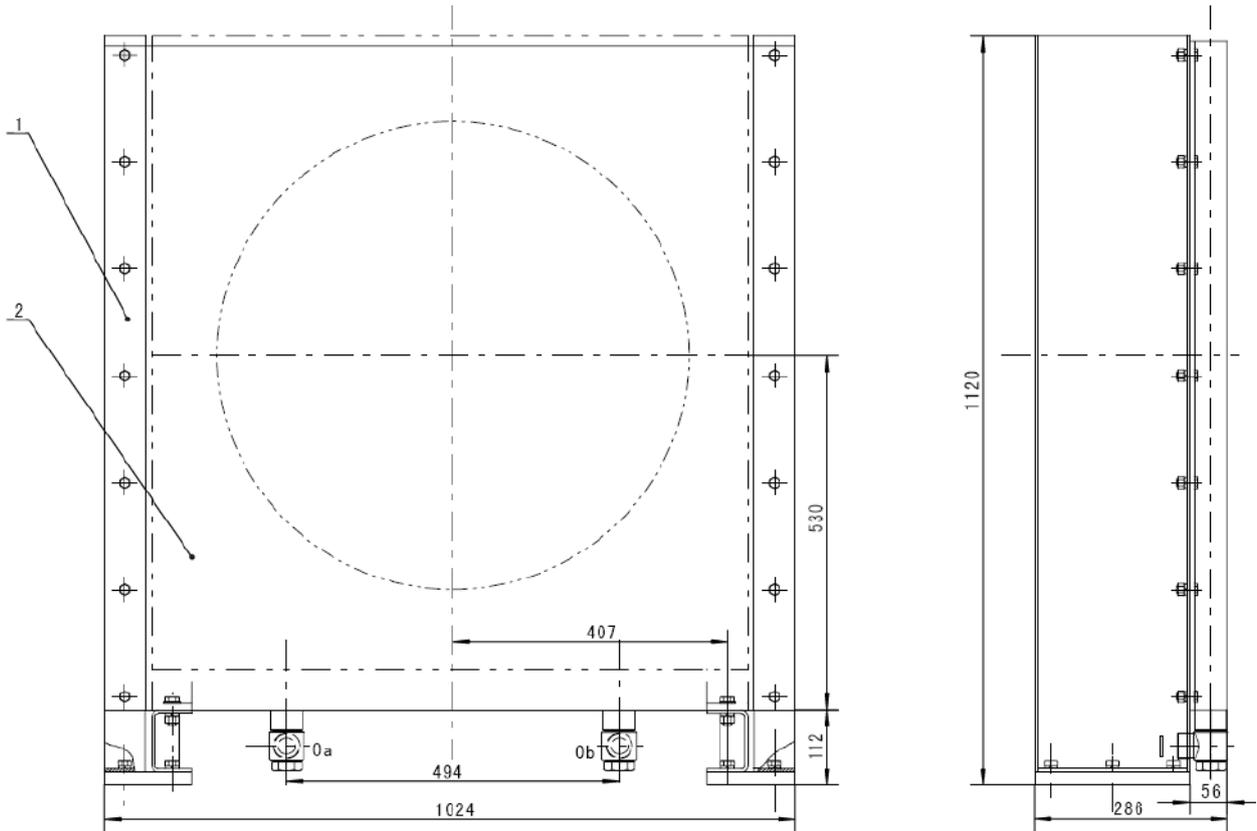


Fig 2-5 Outside Drawing for Air-cooling Device

1. Cooler Bracket 2. Cooler

Oa as Oil Inlet Port Ob as Oil Outlet Port

6. Local console

The shape of instrument panel is indicated as in Fig 2-6, mainly composed of box body (7), the Power Supply (Battery Pack) (15), oil compensation, control, and system pressure gauges (4, 5, and 6), and the Diesel Engine Instrument (8), pump control valve set (12), etc. , and the Pressure Sensor (10) and the Pressure Release Valve (11) for the oil port of main pump are installed inside the instrument panel.

The electrical junction box is located inside the middle cabinet in the case body of instrument panel, and the cables for solenoid valve, sensor, and pressure release valve of main pump, the switching solenoid valve of control oil pump, and power supply switch, etc are all connected into or out from the junction box.

The startup and shutdown of diesel engine may be operated through the instrument of diesel engine. The water temperature, oil temperature, oil pressure, rotating speed, and other parameters during operation of diesel engine can all be displayed on this instrument.

Two sensors are used to measure the pressure values of the two oil ports for main pump, to be amplified and transformed into values of voltage or current for transmission, control, and display through PLC.

The pressure release valve (11) is used to release the remaining oil inside the pipeline of pressure gauge,

through pushing and pressing the Pressure Release Button (3), for the display of pressure to reset to the status of zero position.

The Control Switching Knob (2) is used to control the oil liquid towards the direction of main pump or the direction of operation panel, by turning the knob.

Note: When control switching knob (2) is operated, namely when “Control Pump” is switched to “Operation Panel” and then switched to “Control Valve”, it can be operated only in one same place, namely local operation or remote control.

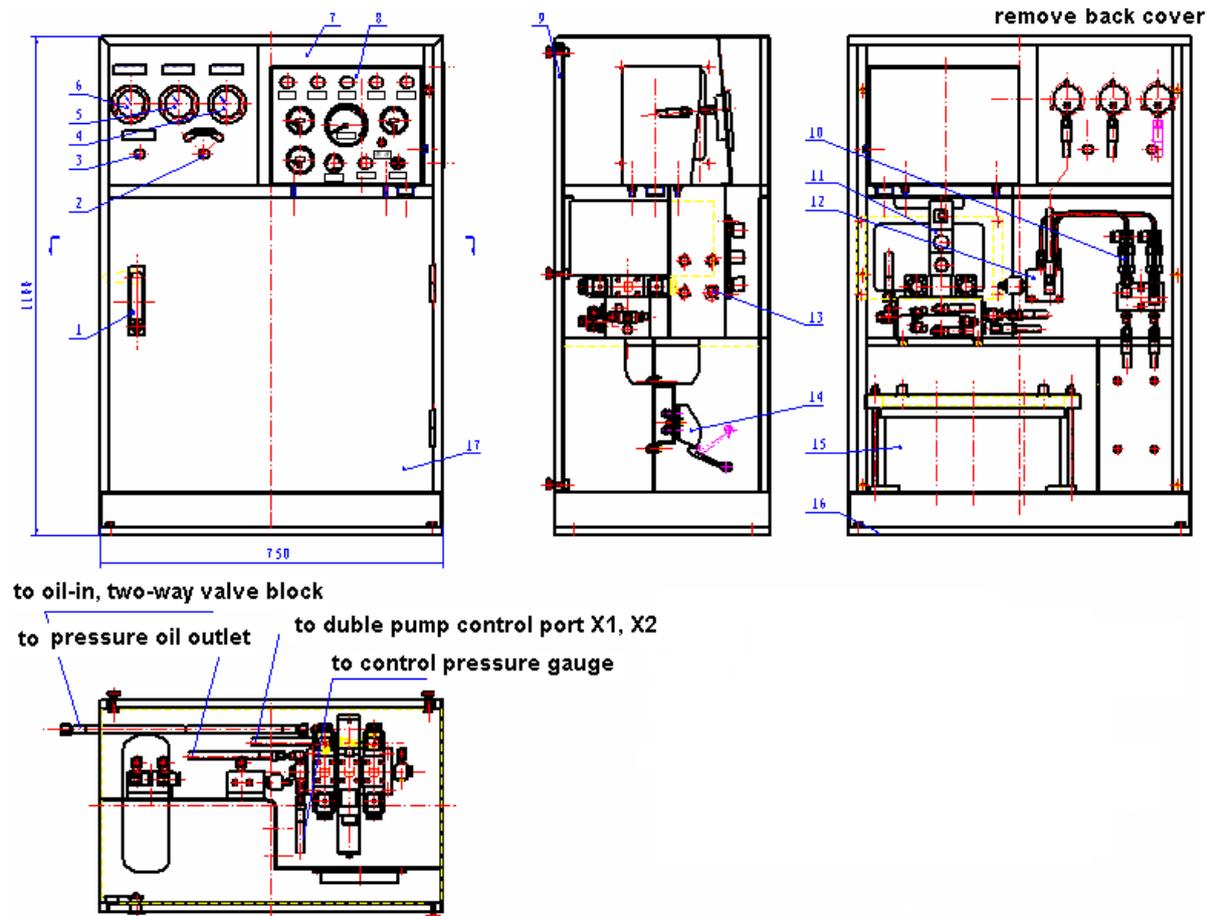


Fig 2-6 Local Control Console

- 1.Door lock 2.Shifting switch 3. Pressure release button 4. System Pressure Gauge
 5. Control Pressure Gauge 6. Oil Compensation Pressure Gauge 7.Box body 8. Diesel Engine Instrument
 9.Back cover 10. Pressure Sensor 11. Pressure Release Valve 12.Pilot valve 13.Cable interface
 14.Battery switch 15. Power Supply (Battery Pack) 16. Base plate 17.Front door

7. Remote Control Operation Panel

The remote control operation panel is connected with the electrical box of instrument panel through one shielded cable, for forward and backward movement of the Electric Handle (5), to achieve the change in main

pump flow rate and direction, thus to achieve the fast/slow output rotating speed and positive/negative-direction rotation of the swivel.

The remote control operation panel is mainly composed of Electric Handle (5), Touch Screen (9), and PLC Electrical Box (2), etc.

The items displayed on Touch Screen (9) are:

- The current pressure value and the torque value showing functional relationship with pressure
- The current swivel output rotating speed (functional relationship with flow rate)
- The set maximum pressure value (lower than 2-3MPa for overflow valve of main pump)

When system pressure value reaches the set maximum pressure value, the electric handle will turn to be ineffective automatically, and the flow rate of main pump will reset automatically, to prevent damage of parts for main pump arising from overload of the main pump.

The Emergency Stop Button (10) is set on the operation panel as well, and it is able to directly shut down the diesel engine, in the case of failure or emergency status, by pushing down the Emergency Stop Button.

The operation panel is also fitted with Pressure Release Button (7) and the Control Switching Knob (8), to facilitate operation.

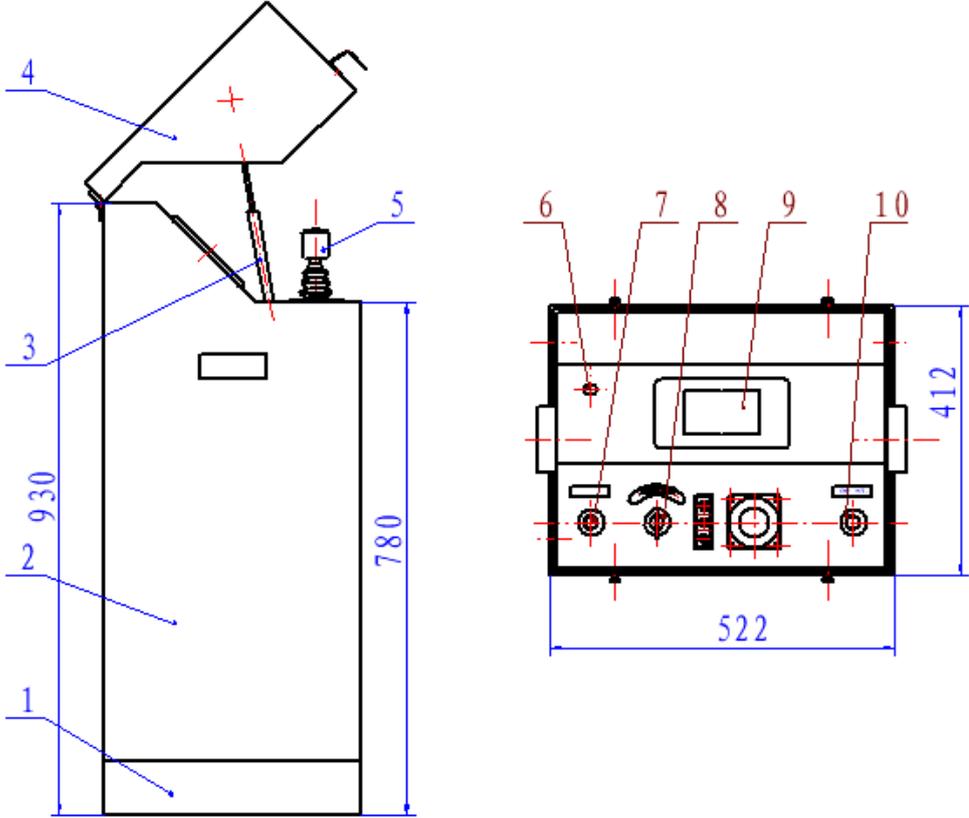


Fig 2-7 Remote Control Operation Panel

- 1.Console base seat 2. Box body 3.Air spring 4.Box cover 5 Electric Handle. 6.Indication light
- 7.Pressure Release Button 8. Control Switching Knob 9.Touch Screen 10. Emergency Stop Button

V. Installation and Test Run of Hydraulic Power Control Unit

It is required to perform installation and test run for the power control unit, after its principle, structure, parameters, and performance are understood and well known.

I. Preparation for Installation of Power Control Unit

1) Refill about 19L machine oil (lubricating oil) into diesel engine, and fill water into the water tank of diesel engine.

2) Move out the remote control operation panel from on the chassis, within a range of 10m from the main unit, and take out 10m cable from the tool kit, to be connected with the instrument panel and the remote control operation panel.

3) Refill hydraulic oil into the oil tank until the oil pointer is within the range of display, and refuel for about 440-480L .

4) Refill diesel fuel into the diesel fuel tank, until the top part of oil pointer is displayed.

5) Turn the battery power supply switch (No.14, Fig.2-6) and switch on power supply.

6) Turn the control switching knob of local and remote to the direction of “multi-way valve” .

7) Examine whether or not the self inspection of diesel engine instrument is normal.

8) Examine the touch screen of remote control operation panel and set the maximum pressure value.

9) It is required to fill up the pump housings of main pump and control pump with oil liquid manually prior to startup of hydraulic pump unit, fill in the oil liquid by loosening the oil discharge joint on the pump, and maintain it under the full status during operation.

Note: Oil must be refilled according to the requirement of Item 9) before diesel engine can be started.

II. Installation

1) Start up diesel engine and adjust the speed to 1800r/min. (speed regulation switch to be switched from “Idle” to “Rated”)

2) Hook up the bail of swivel using the small winch for drill floor, and hook up the bail buckle of swivel using the hook of wire winch.

3) Use the small winch to lift up slowly, and operate the hydraulic hose winch to unwind hydraulic hose, until the swivel reaches the normal hanging height of drill floor. Further extend the winch hose, fix the winch hose on the derrick, and leave enough length for up and down movement of swivel.

4) Lower the swivel.

5) Mount the reaction torque cable for swivel, and pull tight the cable.

6) Turn the control switching knob of instrument panel to the control direction of “pump control valve”.

7) Examine whether or not the conditions of pressure on control pressure gauge of the instrument panel and the pressure gauge of oil compensation pump are normal.

III. Test Run

1) Operate the handle for remote control operation panel, gently push it forward (clockwise) (when voltage value is 1V), and the central tube of swivel will rotate clockwise. Observe the number counting status displayed on screen.

2) Turn back the handle to the neutral position after operation for 3-5 minutes, and the central tube of swivel will stop rotation.

3) Gently pull the operating handle backwards (counterclockwise), and the central tube of swivel will rotate counterclockwise. Stop after running for 3-5 minutes.

4) Operate the handle for speed regulation clockwise from the minimum to the maximum, and observe the number counting status displayed on screen.

5) Operate the handle for speed regulation counterclockwise from the minimum to the maximum, and observe the number counting status displayed on screen.

Note: It is prohibited for the high-pressure ball valve on HP oil filter to be placed under the closed status under operation.

VI. Operation Rules for Hydraulic Power Control Unit

After the power control unit has been installed and applied to test run, examine the running status of respective parts, examine the oil liquid temperature, the liquid level of oil tank after circulation of hydraulic oil, and other conditions, and carry out loading or operation after the operation has been confirmed to be normal.

Operation Rules

1. Operation for Pressure Regulation and Torque Setting:

1) Setting of Oil Compensation Pressure: It is able to adjust the pressure for oil compensation by enlarging or diminishing the oil compensation overflow valve (on the valve block opposite the oil port of main pump, and its value may be displayed from the oil compensation pressure gauge of instrument panel. The pressure for oil compensation is generally 1.6MPa, and it has been set and locked up at delivery from factory.

2) Setting of System Pressure: It is able to adjust the size of system pressure by regulating the overflow valves on A and B ports of main pump, and generally the oil circuit with HP ball valve is in the counterclockwise direction (drilling) of swivel. The HP ball valve may be closed during regulation, to be re-opened after the pressure has been set. The size of system pressure may be displayed from the system pressure gauge of instrument panel. System pressure shall not be larger than 31.5MPa, and it is proper when adjusted to 25~27MPa on general.

3) Setting of Control Pressure: Control pressure is achieved by adjusting the overflow valve of control pump (the valve block at the oil outlet port of control oil pump), and its value may be displayed from the control pressure gauge of instrument panel. It has been set and locked up at 16MPa at delivery from

factory.

4) Operation for Setting of Torque: Manually enter the numerical value for system maximum pressure, through the input requirement of touch display screen, and the maximum setting is 24MPa generally. The screen display outputs the maximum torque value correspondingly, and the setting for maximum pressure value shall be correspondingly lowered, if the entered maximum torque value is too large. The flow rate of main pump is automatically reset to zero when system pressure reaches the set value, during operation of electric control.

2. Operation for Speed Regulation and Operation for Positive/Negative Direction

Under Normal Operation:

1) When electric handle is located on neutral position, no flow rate is available for A or B port of main pump, the swivel is kept under stopped status, and the rotating speed displayed on screen is zero.

2) Turn the electric handle in the “clockwise” direction, the swivel begins rotation (clockwise). The larger the turning range is, the super-faster the rotating speed will be. The rotation is at the maximum speed when the handle is turned to the extreme point, while it slows down gradually until stops rotation on the contrary.

3) Turn the electric handle in the “counterclockwise” direction, and the swivel will begin rotation (counterclockwise). The larger the turning range, the super-faster the rotating speed. The rotation is at the maximum speed when the handle is turned to the extreme point, while it slows down gradually and stops rotation on the contrary.

4) Operation for Reversal of Positive/Negative Rotation: When handle is turned beyond the neutral position, change takes place in turning direction of swivel. It is required to place the handle to the neutral position during reversal, to be restarted after swivel has stopped steadily, to avoid generation of impact vibration.

3. Operation for Control Switching:

When it is required to operate wire winch and hydraulic hose winch, the main pump will turn to be ineffective automatically, after the control knob is turned to the direction of “operation panel” (allowable for both local and remote controls), equivalent to the time when handle is placed on neutral position. Only the action of operation panel is effective at this point.

Note: When control switch is operated, namely when “Control Pump” is switched to “Operation Panel” and then switched to “Control Pump”, it can be operated only in one same place, namely local operation or remote control.

4. Operation for Emergency Disposal:

In the case of emergency accident, such as the breakage of hose or lockup of swivel, etc, or unknown causes, and other failures, it is required to press the “Emergency Stop” button (allowable for both local

and remote controls), and the diesel engine will shut down, for it to be recovered after the cause has been found out and the failure has been removed.

VII. Maintenance and Service of Hydraulic Power Control Unit

The power control unit is the power control core for swivel to generate torque force and rotation speed, and it is under operation in all weathers around the clock. Once the power control unit is out of service, the swivel will stop due to power loss, and the entire well workover operation will be affected. On this account, it is quite important to implement routine maintenance and service for the power control unit. Its main maintenance and service part is indicated as follows:

The chassis shall be kept flatly for the placement of the power control unit, with the four corners on the bottom free from suspension, to be steadily placed. It shall also be put in a place far away from liable shock or impact, as well as contamination of oil stain or mud or where it is combustible or flammable, while the CBU shall be maintained clean and neat.

1. Maintenance and Service of Diesel Engine:

Refer to “Diesel Engine Operation and Maintenance Manual” for maintenance and service of diesel engine.

2. Maintenance and Service of Duplex Pump Unit

1) Frequently examine whether or not the connection between respective pumps of the duplex pump unit is reliable.

2) Examine whether or not leak exists with respective pump oil ports. Observe the vacuum pressure gauge at the suction port of oil tank and examine the oil suction status of pump, and determine whether or not the pump operating status is normal through displays of control pressure gauge and oil compensation pressure gauge.

3) The electromagnetic proportional valve, the solenoid valve, and other electrical parts of pump shall be prevented from impact and mud contamination. Drench shall be prevented using protection cover, etc.

4) It is strictly prohibited to maintain or replace the line or the sealing member or the filter gauze, etc to the pump unit during operation, to prevent unexpected accidents.

3. Maintenance and Service of Diesel Fuel Tank and Oil Tank

1) The oil liquids for diesel fuel tank and oil tank must be sufficient. Frequently examine and view the position of liquid level, and it is required to supply oil liquid as soon as possible if the oil level is found to be inadequate.

2) Frequently examine the temperature status for the oil liquid of oil tank, over-heated and too cold oil liquid may both affect the normal operation of pump.

3) Examine and view whether or not the filter core of oil filter for oil tank is operating inside the normal area, and the unit shall be shut down and the filter core shall be replaced timely, when it is found to be blocked.

The unit shall also be shut down to examine the condition of filter core, when the vacuum degree of vacuum pressure gauge in the area of suction filter is higher than 50kP.

4) It shall be replaced with corresponding hydraulic oil along with the change in ambient temperature, and UB-N32# anti-wear hydraulic oil and YB-N46# anti-wear hydraulic oil are recommended as the hydraulic oils to be used in oil tank. YC-N32 and YC-N46 low-freezing hydraulic oils may be selected for use, when ambient temperature is below -25°C.

4. Maintenance and Service of Wire Winch and Hydraulic Hose Winch:

1) The wire winch shall be installed at a certain height, impact of other workpieces shall be prevented, and lubricating oil shall be periodically filled to the gear case of winch.

2) Lubricating oil shall be periodically applied to the support area and the speed reducer of hydraulic hose winch.

3) Attention shall be paid to align the piping joint during assembly and disassembly of HP quick joint on hydraulic hose winch, to prevent damage of screw thread. Ensure that the line shall be removed prior to turning of hose winch.

4) Protective caps shall be set on the two ends of joint after the piping joint is demounted, to prevent entry of impurities into the oil circuit of pipeline.

5. Maintenance and Service of Hydraulic Hose:

The line of hose winch is relatively long, and the operating pressure is high. The pipeline shall be winded or stretched under the free status, and neatly winded.

2) The hose surface shall keep clean, and damage of hose arising from friction with workpiece shall be prevented.

3) Compression and smash with weights are strictly prohibited, and it is strictly prohibited for hose to be abruptly bent.

4) The joints on two ends of hose shall be removed when it is not to be used for a long time, the oil stain and extraneous matter inside the pipe shall be blown out using compressed air, and the joint on the two ends shall then be sealed up.

6. Maintenance and Service of Operation Panel, Instrument Panel, and Remote Control Panel

1) The operation panel, instrument panel, and remote control panel, etc are all composed of instruments, electrical components, sensors, hydraulic valve fittings, and operating handles, etc, under heavy stress and the workpieces are fairly fragile. Impact with weights is strictly prohibited, and it is strictly prohibited to operate the handle too forcibly and violently.

2) The operating buttons or knobs with surface insulation materials dropped out shall be timely replaced, to prevent the accident of electric shock.

3) It is strictly prohibited to disassemble pipeline or cable line in the cases of unknown causes, and it is prohibited to connect pipeline or cable at discretion or randomly.

VIII. Diagnosis and Removal of General Failures

NO.	Failure	Effect	Cause/Solution
1	Loss of Oil Compensation Pressure, when main pump is under the neutral gear status	1) No oil filling pressure is available with indication of pressure gauge. 2) Reading of vacuum pressure is too high.	1) Examine the pressure gauge whether or not pump is out of service, and examine whether or not the connecting sleeve between oil compensation pump and control pump is damaged. 2) Filter core of suction filter is blocked – Filter core to be replaced
2	Loss of Oil Compensation Pressure, when main pump is under the operating status	Oil compensation pressure is lower than 0.4MPa, when power swivel is rotating at highest speed.	Pump or motor is out of service. Close the ball valve for high-pressure pipeline, for main pump to be under operating status: Motor is out of service if oil compensation pressure is normal, while oil compensation pump is out of service if oil compensation pressure is anomalous.

3	Overheated Hydraulic Oil	Reading of liquid level fluid temperature gauge exceeds 87°C.	Milky white color shows up through examination of hydraulic oil, indicating air has blended (air existing in the oil). Examine whether or not air leak exists in the connecting part of oil compensation pump, and examine the liquid level position of oil fluid in oil tank.
4	Reduced Speed	Visible	Variable resistor is out of service, and the voltage entering into the proportional valve shall be between 0-10V – To be replaced if any failure exists
5	Loss of Direction Control	Visible	Electric handle is out of service – To be replaced with a new handle
6	Reduced Speed	Visible	Valve core of proportional valve is adhered or locked. It is advisable to operate the handle quickly forward and backward, for the slide valve adhered to disengage.
7	Swivel still Rotating when it is at neutral gear	Visible	The alignment regulation for control over main pump delivery capacity is maladjusted.

IX. List of Recommended Spare Parts

1) Wearing Parts

NO.	Code	Name	QTY	Installation Position	Remarks
1	TFX-400X100	Filter Core	1	Suction Filter	
2	LH0660D*BH3HC	Filter Core	2	HP Oil Filter	
3	YJ20-H40N	HP Ball Valve	1	HP Oil Filter	
4	VFP21P-F-1 1/4NPT	Quick Joint NPT1 1/4	4	HP Hose 32 IV	
5	PAV1-NPT1	Quick Joint NPT1	2	Oil Discharge Hose 25 II	
6	YN60-III	Shock-proof Pressure Gauge (0-2.5Mpa)	1	Instrument Panel	
7	YN60-III	Shock-proof Pressure Gauge (0-25Mpa)	1	Instrument Panel	
8	YN60-III	Shock-proof Pressure Gauge (0-40Mpa)	1	Instrument Panel	
9	YK-60 I	Pressure Gauge (-0.1-+2Mpa)	1	Oil Tank	
10	JB/ZQ4224	O-Ring 32*3.1	6		
11	JB/ZQ4224	O-Ring 38*3.1	7		
12	JB/ZQ4224	O-Ring 55*3.1	1		
13	JB/ZQ4224	O-Ring 70*3.1	4		
14	JB/ZQ4224	O-Ring 80*3.1	2		

2) List of Pipelines for DKYC-320/31.5D Hydraulic Power Unit

NO.	Hose Code	From	Port 1	To	Port 2	Hose Code	QTY	Remarks
1	DKYC-01	Main Pump A (SAE Split Flange)	45°	HP Oil Filter (Right Outer Side)	Straight Connection	32 IV-2800	1	PA 532 SF6A -M45X2A
		Main Pump B (SAE Split Flange)	45°	HP Ball Valve (Left Outer Side)	Straight Connection	32 IV-3100	1	
2	DKYC-02	Main Pump Pressure Measuring Port A	90°	Instrument Panel Three-way Valve Block A1 Port	Straight Connection	A6 II-2400	1	2-M14X1.5A
3	DKYC-03	Main Pump Pressure Measuring Port B	90°	Instrument Panel Three-way Valve Block B1 Port	Straight Connection	A6 II-2000	1	
4	DKYC-04	Main Pump Oil Discharge Port T2	90°	Cooler A Port (Oil Inlet Port)	Straight Connection	A25 I-2500	1	2-M39X2A
5	DKYC-05	Auxiliary Pump Oil Suction Port	90°	Oil Tank Suction Filter External Port	Straight Connection	A32 I-1050	1	2-M45X2A
6	DKYC-06	Auxiliary Pump Pressure Measuring Port	90°	Instrument Panel Control Pressure Gauge	Straight Connection	A6 I-2400	1	2-M14X1.5A
7	DKYC-07	Auxiliary Pump Subsystem P Port	90°	Operation Panel Throttling Valve P Port	Straight Connection	C13 II-1800	1	2-M22X1.5C
8	DKYC-08	Auxiliary Pump Overflow Port T3	90°	Oil Tank Discharge Port O4	Straight Connection	C10 I-2100	1	2-M18X1.5C
9	DKYC-09	Auxiliary Pump Oil Discharge Port T6	90°	Oil Tank Discharge Port O1	Straight Connection	C13 I-2600	1	2-M22X1.5C
10	DKYC-10	Gear Pump Oil Suction Port	90°	Oil Tank Suction Filter Internal Port	Straight Connection	A38 I-1050	1	2-M52X2A
11	DKYC-11	Gear Pump Pressure Measuring Port	90°	Instrument Panel Oil Compensation Pressure	Straight Connection	A6 I-2300	1	2-M14X1.5A

				Gauge				
12	DKYC-12	Gear Pump Overflow Port T4	90°	Oil Tank Discharge Port O5	Straight Connection	C10 I-2800	1	2-M18X1.5C
13	DKYC-13	HP Oil Filter (M45X2A)	Straight Connection	Hose Winch HP Quick Joint NPT	90°	32 IV-2700	1	M45X2A-NPT1-1/4
14	DKYC-14	HP Oil Filter (M45X2A)	Straight Connection	Hose Winch HP Quick Joint NPT	90°	32 IV-2500	1	M45X2A-NPT1-1/4
15	DKYC-15	Oil Tank Oil Return T1	Straight Connection	Hose Winch Oil Discharge Quick Joint	90°	A25 I-2500	1	M39X2A-NPT1
16	DKYC-16	Hydraulic Hose Winch High Pressure A	90°	Hydraulic Motor Quick Joint A Port	Straight Connection	32 IV-30500	2	M45X2A(90°)-NPT1-1/4
		Hydraulic Hose Winch High Pressure B		Hydraulic Motor Quick Joint B Port				
17	DKYC-17	Hydraulic Hose Winch Oil Discharge	90°	Hydraulic Motor Oil Discharge Joint	Straight Connection	25 II-30500	1	M39X2A-NPT1
18	DKYC-18	Hydraulic Hose Winch Motor A	Straight Connection	Operation Panel Multi-way Valve A1	Straight Connection	C13 II-1900	2	2-M22X1.5C
		Hydraulic Hose Winch Motor B		Operation Panel Multi-way Valve B1				
19	DKYC-19	Hydraulic Hose Winch Motor Oil Discharge Port	90°	Oil Tank Discharge Port O6	Straight Connection	C10 I-4000	1	2-M18X1.5C
20	DKYC-20	Wire Winch Motor A	Straight Connection	Operation Panel Multi-way Valve A2	Straight Connection	C13 II-1850	2	2-M22X1.5C
		Wire Winch Motor B		Operation Panel Multi-way Valve B2				
21	DKYC-21	Wire Winch Motor Oil Discharge Port	90°	Oil Tank Discharge Port O3	Straight Connection	C10 I-3100	1	2-M18X1.5C

22	DKYC-22	Operation Panel Throttling Valve P1 Port	Straight Connection	Operation Panel Multi-way Valve P	Straight Connection	C13 II-900	1	2-M22X1.5C
23	DKYC-23	Operation Panel Multi-way Valve Oil Return T	Straight Connection	Operation Panel Throttling Valve T1	Straight Connection	C13 I-600	1	2-M22X1.5C
24	DKYC-24	Operation Panel Throttling Valve T	Straight Connection	Oil Tank Discharge Port O2	Straight Connection	C13 I -3200	1	2-M22X1.5C
25	DKYC-25	Throttling Valve Block Pressure Gauge Port Pb	Straight Connection	Operation Panel Pressure Gauge	Straight Connection	A6 I-700	1	2-M14X1.5A
26	DKYC-26	Cooler Oil Outlet Port B	Straight Connection	Oil Tank Oil Return T2	Straight Connection	A25 I-4800	1	2-M39X2A
27	DKYC-27	Instrument Panel Three-way Valve Block A Port	Straight Connection	Instrument Shuttle Valve A Port	Straight Connection	Pressure Measuring Line L=380	2	2-M14X1.5A
		Instrument Panel Three-way Valve Block B Port		Instrument Panel Shuttle Valve B Port				
28	DKYC-28	Instrument Panel Shuttle Valve Pb Port	Straight Connection	Instrument Panel System Pressure Gauge	Straight Connection	A6 I-750	1	2-M14X1.5A