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ZQ127 - 25
DRILL PIPE POWER TONG

OPERATION MANUAL

ZQ127-25-SM

STANDARD:SY/T5074-2004

7K-0048

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Contents

1.Summary

ZQ127-25 drill pipe power tong is used to make up and break out oil tubing and small drill pipe in well repairing operation. Open throat design. It is a combination of spinning tong and torque tong.

ZQ127-25 power tong is a kind of mini power tong to meet the need of well repairing in our country. It can substitute physical labor. Features of design are as follows:

1. Convenient power source. Compressed air is the source except for hydraulic motor.

2. Float body of the tong head makes suspending installation simpler.

3. Adoption of low speed high torque hydraulic motor, planet mechanism of air tyre clutch, two gear shifts, and convenient to control.

4. Auto-aligning and clamping mechanism secures reliable clamping and no sliding.

5. Advanced notch-restoring mechanism.

6. Easy and convenient replacement of dies.

7.Torque and speed can be controlled. And maximum torque and speed will be obtained in both forward and reverse direction.

2.Main Properties And Parameters

1. Hydraulic system

   Rated flow 180L/min

   Max. Working pressure 14MPa

2. Pressure system

   Working pressure 0.5-1MPa

3. RPM

   High gear 65 r/min

   Low gear 10.5 r/min

4. Under different pressure, torque is as follows:

Table 1. Comparison of pressure and torque

Hydraulic system Pressure (MPa)	Torque (N.m)	
	High gear	Low gear
12	4000	25000

10.5	3200	20000
8.5	2700	17000
7	2100	13000
5	1500	9500

5. Size range of pipe: ϕ 65- ϕ 127
   Drill pipe: 2-7/8in, 3-1/2in
   Tubing:2-3/8in, 2-7/8in, 3-1/2in
6. Overall dimensions (mm)
   Length X Width X Height 1110x735x815
7. Weigh 620 kg

3. Main Structure And Working Principle

ZQ127-25 power tong mainly consists of tong head, planet gearbox, speed reduction device, air passage, and hydraulic system, while tong head comprises clamping mechanism, floating mechanism, brake mechanism and position-restoring mechanism.

1. Two-speed planet gearbox

In order to achieve low torque spinning at high speed and high torque make-up or break-out at low speed, ZQ127-25 drill pipe power tong is provided with a two-speed planet shift gear and unique braking mechanism for shifting the gear without stopping the tongs. The efficiency of the tongs is therefore raised.

See fig.1, high speed is obtained as hydraulic motor drives planet gear Z3 on the frame to rotate, power comes from the sun gear Z1 when internal gear Z2 is braked. For low speed, the sequence is reverse, hydraulic motor drives the sun gear Z6 to rotate, power comes from the frame of the planet gear Z5 when the internal gear Z4 is braked.

2. Reducer assembly

Refer to fig.1, the output shaft of the two-speed planet gear box is the input shaft of the two-speed gear reducer assembly, the notched gear Z11 is driven to rotate through the first step deceleration (Z7-Z8) and the second step deceleration (Z9-Z10-Z11). The function of two idle gears Z10 is to keep the notched gear Z11 rotation continuously by Z9. This is necessary for “padding the notch”.

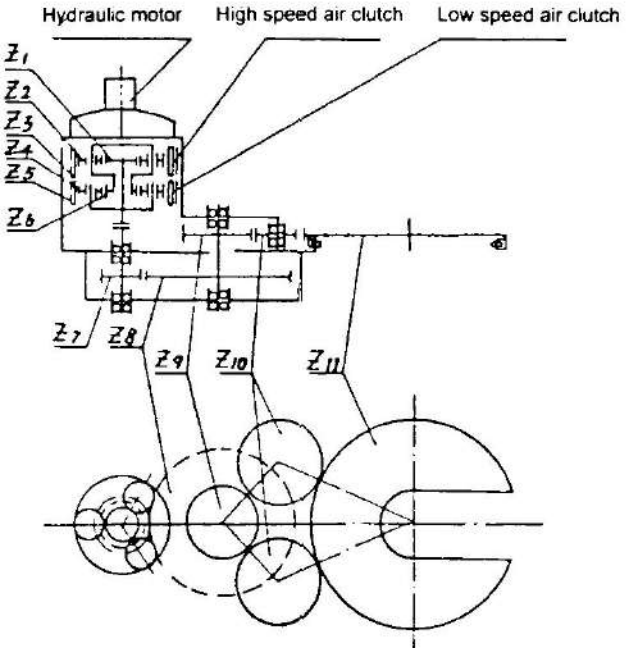


Fig.1 Transmission illustration

3. Tongs Head

3.1 Gripping mechanism: The notched gear of transmission drives the floating body to rotate through three pins. If brake band continuously prevents the brake disc from rotating with about 1 kN.m torque and the jaw rack with jaws is connected with brake disc by screws, when the floating body begins to rotate, both brake disc and the jaw rack is braked to stop because disc is not in notch with the tool joint. But the cam with affixed slope rotates along with the rotation of the float body, the rollers located at the back of the jaw will go up along the spiral surface and comes close to the center along the groove and at last grip against the drill string joint. Meanwhile, the notched gear will drive the brake disc, the jaw rack and jaws on the floating body and drill string to rotate for the operation of making-up and breaking-out.

3.2 The floating body: Owing to the relative position between the upper tongs and lower tongs is variable; it is necessary that upper tongs can float relatively to the lower tongs.

3.3 The brake mechanism: In order to cause relative motion between roller and cam.

Two brake bands, connection rod and band adjusting sleeve make up brake mechanism. Turning the adjusting sleeve will adjust the force of spring in the sleeve, so as to change the value of brake torque. The brake mechanism has the function of guide for floating body and fit for joint deviation as well.

3.4 Restoration mechanism: There are three restorations for aligning notched to power tongs of open head, the aligning of floating body with the case body, the aligning

of jaws rack if the upper tongs with the floating body, and the aligning of jaws rack of the low tongs with the case body.

First, align approximately with high speed, and then align accurately with low speed , by this way the floating body can by aligned exactly with the case body.

The aligning of jaw rack of the upper tongs with floating body is just the same as the aligning of jaw rack of the lower tongs with case body.

During restoration, use restoring turning pin to align notch. Screw pins into the floating body, and install restoring turning pin into the brake disc. Align the floating body with jaw rack by turning the restoring turning pin. The restoration of the lower tongs in the same as that of the upper tong.

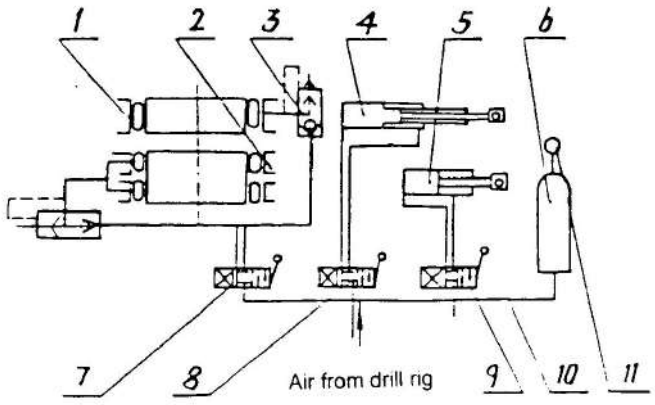
4. Pneumatic system

As shown in fig.2, compressed air from drill rig is used as the air source. In order to avoid long-distance pipeline affecting flow the power tong features inner cavity of suspension rod to reserve compressed air. So the inner cavity is just the air reservoir.

Pneumatic system contains two QF501B bi-directional air valves, which control high and low gear tyres and gripping cylinder respectively.

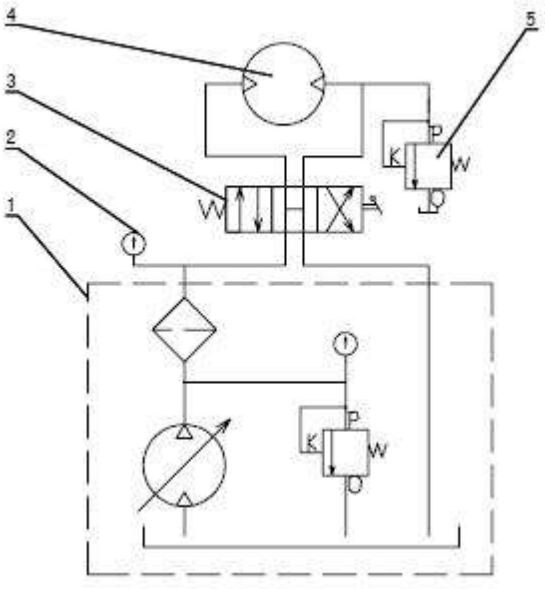
5. Hydraulic system

See fig.3, hydraulic oil from hydraulic source of well repairing machine goes through oil hose to hand-reversing valve (3). The hydraulic motor can rotate for ward and backward by controlling the hand-reversing valve (3). Pressure gauge (2) indicates the pressure reading. By looking up the comparison of pressure and torque the torque valve comes out.



1. High gear air tyre
2. Low gear air tyre
3. Quick release valve
4. Gripping cylinder
5. Air reservoir
6. Reversing valve for gripping cylinder
7. Reversing valve for high and low gear

Fig.2 Pneumatic system



1. Hydraulic power unit
2. Pressure gauge
3. Hand-reversing valve
4. Hydraulic motor
5. Relief valve for making-up

Fig.3 Hydraulic system

4. Installation And Commission

1. Leveling the tongs:

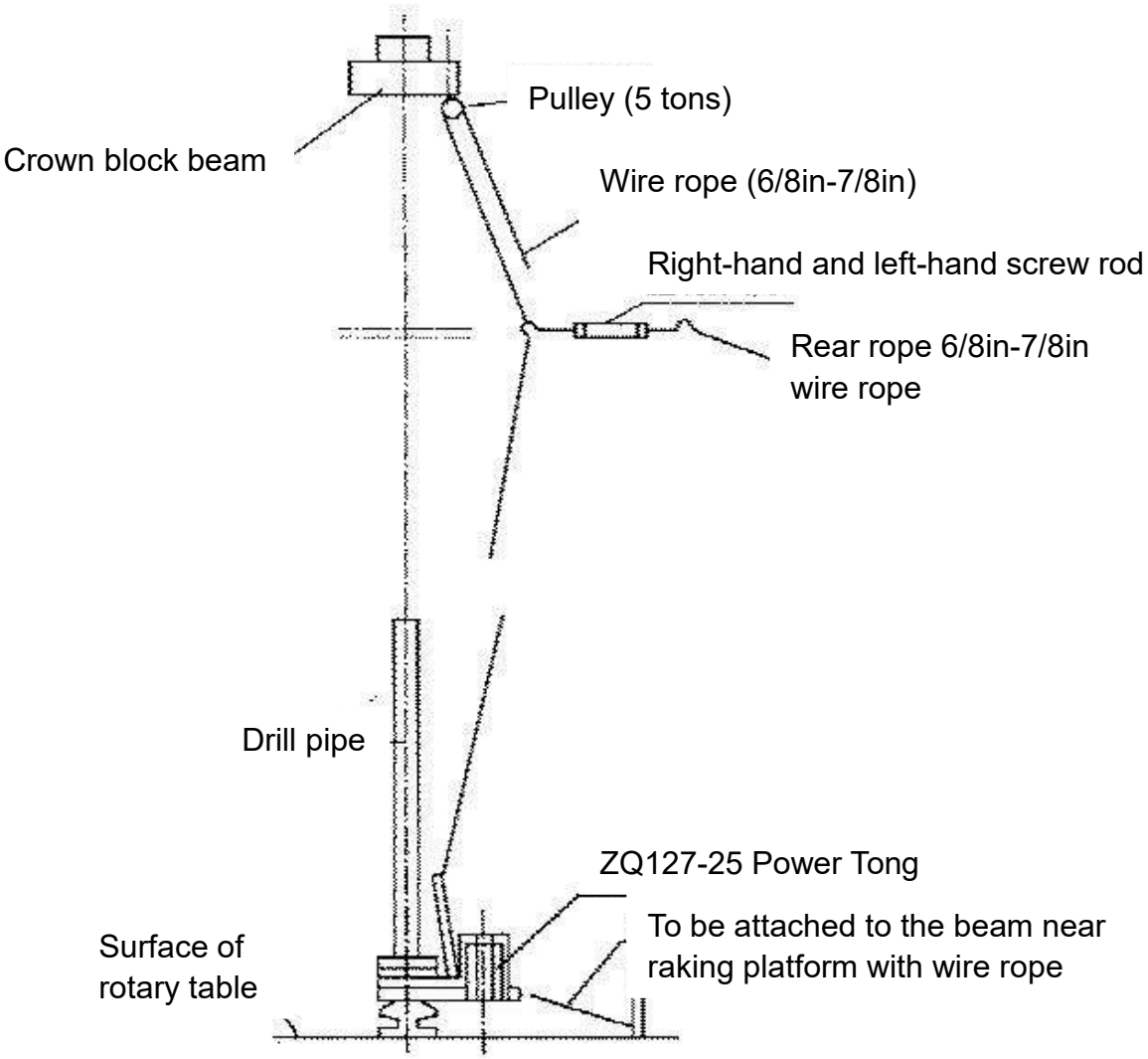
Refer to fig.4, push the tongs to well surface, and adjust the height of the tongs. Hang the tongs to the derrick through pulley and fix it under proper height. Turn the screw rod on the top part of the suspension rod to level the tongs horizontally. Adjust the adjusting bolt on the bottom of the suspension rod to make the pin and box of drill pipe contact closely to the two plug screws of the upper and lower tongs respectively. Generally, it is all right when the top surface of the tongs is parallel to the rotary table.

2. Installation of rear rope

Push the tongs to well head, and clamp drill pipe or tubing . attach one end of the two wire ropes (6/8in-7/8in) to the tail or shifting cylinder of the tongs, and herringbone the other end of them to the derrick. Secure the wire ropes never loose during operation.

3. Commission

Make the tongs idle run in forward and reverse direction for 2 minutes at high and low gear respectively. And test restoration mechanism to see if reliable.



Installation on 8085 Drill Rig

Fdig.4 Installation illustration

5. Adjustment of Torque and Speed

1. The speed of the tongs: The speed of the tongs head is proportional to the flow of oil pump supply. When the flow is adjusted to 180 L/min, required RPM will be obtained.

2. The torque of the tongs head: the torque of the tongs head is proportional to the pressure of hydraulic system. Its adjusting way is : Shift the tongs onto well head to hold the joint, operate the tongs with high gear to make up until the tongs head stop rotating, turn off the relief valve for making up. First, adjust the relief valve of hydraulic unit to maximum pressure, and then adjust the relief valve for making up to the specified pressure, so as to obtain torque needed.

6. Operation Regulations

6.1 Turn on the valve of air pipeline from drilling rig to the tongs.

6.2 Put through the line of hydraulic source.

6.3 Push steadily the tongs onto well head and adjust it by hand hoist if its height is not proper.

6.4 After the tongs embraces drill pipe or tubing, observe if the two plug screws are contacting closely with pin and box of drill pipe respectively, then operate the bi-directional air valve of gripping cylinder to make the lower tong clamp the joint or tubular.

6.5 According to the need of making up and breaking out, put the handle of the bi-directional air valve to relevant position, there is no necessary to shut down in changing speed.

6.6 Forward and reverse rotation of the motor is completed by H-type hand-reversing valve. Change the position of handle according to the need of making up and breaking out.

6.7 Restoration: This is the procedure that the notches of the tongs head are aligned with each other. Having finished one make up or break out, it is necessary to operate the H-type hand-reversing valve to make the tongs head rotate against the working direction of the tongs head. In restoration, choose high or lower gear bi-direction air valve according to the actual distance between notches.

6.8 When pin is entirely screwed out for box, restore the bi-directional valve at making up direction.

It is permitted to stop the tongs and lift the string when the upper tongs has loosened drill string and the notch aligning is not done.

6.9 Before the pin has not screwed out of the box completely and the upper tongs has not loosened the drill string, don’t hoist the drill string upward.

6.10 Operate the handle of the bi-directional air air valve of gripping air cylinder to the position opposite the working position to make the lower tongs restore “O” position and align the lower notches.

6.11 Steadily move the tongs away for the working position.

6.12 Have finished whole trip, restore all hydraulic and air valves to “O” position, and shut off hydraulic source and well repairing machine.

6.13 Seal all the joints of hydraulic and air pipeline against dirty during moving.

6.14 Before changing the position of locating pin, all the notches should be aligned.

7. Maintenance

7.1 After finishing every trip, the tongs head should be washed clean with water, and be blown dry with compressed air. In winter, blow with steam. After the cam and roller parts are cleaned up, coat their surface with grease. The cam should be clean and the roller pin should be able to rotate freely. Maintenance requirement of the bearings in transmission system is the same as bearings in air compressor.

7.2 After every trip, clean the gripping air cylinder with clean water, and wipe the piston rod with cotton yarn and coat its surface with grease, and its extended parts should be drawn into its liner.

8. Common Troubleshooting

Trouble	Probable Cause	Correcting Action
Upper tongs or low tongs fail to grip in making up or breaking out	1. Long time service of the dies, worm and torn, blunt.	1. Replace dies.
	2. Die groove being filled with dirt.	2. Clean dirt with wire brush.
	3. Too loose for large brake band to make the upper tongs jaws not able to follow the cam.	3. Fasten the adjusting tube of the brake band or replace spring of the tube.
	4. Dirty brake disc and brake band fails to stop the tongs.	4. Clean brake disc and brake band.
	5. Tongs not leveled.	5. Level the tongs.
	6. Tongs not moving exactly to wellhead.	6. Move tongs to well head exactly and grip drill pipe.
	7. Air cylinder or air line leaking to cause air pressure dropping below 0.5 MPa.	7. Turn the angle coupling tight, check up sealing condition of gripping air cylinder, replace sealing ring.
	8. Dirty tongs and much filth in law rack to cause roller difficult to roll, but slip.	8. Clean jaw rack, law and roller, smear grease on their surface.
	9. When jaws replaced relevant plug screw not replaced.	9. Replace relevant plug screw.
	10. Drill pipe joint worn badly to make jaw fail to grip.	10. Replace under size jaw.
	11. The direction of locating pin of the upper tongs is not in correspondence with the low tongs.	11. According to making up and breaking out, put the locating pin correspond with the nameplate indication.
	12. The notches of the upper and low tongs are not aligned each other, their locating pin fail to work.	12. The locating pin must be reversed after the notches have beer aligned .
High speed without low speed or low speed without high	1. Air line leaking	1. Replace the airline leaking.
	2. Dirty slide of bi - directional or wear cause air valve leaking.	2. Clean and polish the slide or replace valve.
	3. Airs clutch leaking or brake band	3. Replace air tyre of clutch or

speed	lining worn excessively. 4. Air leaking of quick release valve.	brake band lining. 4. Replace the core of the valve.
Shift gear slow	1. Quick release valve blocked up. 2. Too small clearance between air clutch and internal gear.	1. Clean or replace quick release valve. 2. Adjust the clearance to proper condition.
The pressure for high speed is not high enough	The pressure of the relief for making up is not high enough.	Adjust he relief of making up to proper pressure.
The pressure for low speed is not high enough to make breaking out fail.	1. Friction slice worn excessively, not able to hold the internal gear of the gear box, causing sliding. 2. Damage of oil motor.	1. Replace the friction slice of air tyre clutch (low gear). 2. Repair the motor.

9. Some Explanations

1. The tongs is suitable for drill string of different size. Five sizes for jaw, and seven sizes for plug screw. Jaw and plug match as following.

Applicable pipe		3-1/2 Drill pipe	3-1/2″ Tubing	2-7/8 Drill pipe	2-7/8″ Tubing	2-3/8″ Tubing
Upper tong	Jaw	φ127	φ94	φ105	φ78	φ65
	Plug	7	24	18	32	38
	Roller	φ65	φ80	φ72	φ80	φ80
Lower tong	Jaw	φ127	φ115	φ105	φ94	φ78
	Plug	7	13	18	24	32
	Roller	φ65	φ65	φ72	φ80	φ80

2. Maximum pressure of hydraulic system should be below 14MPa.

3. Maximum limit of drill pipe joint for the tongs is 8mm.