Mechanized Discharge of Tubing in Oil Workover Operation

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Abstract: Oil exploitation is basically in underground operation. In order to improve the mechanization degree and work efficiency of underground operation, it is very important to select and design the tubing pulling and discharging form. It is necessary to design a pipe arranging machine with the characteristics of reliable operation and stable operation, which can automatically loosen and discharge the tubing in the process of tripping, and can have a suitable pipe arranging machine to work in different workover environments to realize the mechanization of wellhead operation.

Keywords: workover operation, pipe arranging machine, mechanise

1 INTRODUCTION

Workover is an indispensable work to ensure the normal production of the oilfield. During workover, all tools in the well account for more than 80% of the whole workover workload, and the labor intensity is relatively high[1]. In recent years, China's investment in the main industry of petroleum machinery has been increasing. At the same time, the attention paid to the peripheral equipment of oil rigs is seriously insufficient, and the investment is relatively small, which leads to the research level of drill pipe automatic operating system falling behind that of developed countries, and it is still in its infancy on the whole[2], but the market demand is very strong. Therefore, it is necessary to speed up the research of drill pipe automatic operation system. Figure 1 shows an automatic tubing rod arrangement device in offshore oilfield exploitation.

Figure 1 Automatic rod arranging device

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2 PRESENT SITUATION AND EXISTING PROBLEMS OF WORKOVER TRIPPING EQUIPMENT

2.1 Foreign research status

Since 1950s, various mechanized tripping devices have been popularized and applied abroad, and today, they have reached a certain scale. For example, Russia and the United States have developed comprehensive mechanized devices and workover rigs respectively. Their common feature is that they use the least manpower to realize the full set of mechanized operations of lifting, unloading and arranging, and have a high lifting speed. The drill pipe automatic operating system is a mature technology system in countries with advanced petroleum equipment development, such as the United States, Canada, Norway, etc. It started early and its technical level has been improved many times. Many operating systems designed and produced by many countries have been put into use, and the full automation of drill pipe operation has become the operating standard of petroleum industry in western developed countries[3].

2.2 Domestic research status

China has made some achievements in this field since 1960s, but there is a big gap with foreign countries in general. For example, the problem of high labor intensity of tubing discharge in workover operation has not been solved. Although some achievements have been made in recent years, there is still a big gap compared with foreign advanced level, and the automation operation level of a large number of drilling platforms still stays at the level of the 1960 s; In contrast, the automation level of offshore oil drilling rig is relatively high, but it basically depends on imports, which seriously restricts the normal development and the improvement of economic benefits. Therefore, it is of practical significance to study the mechanization of drainage tubing[4].

2.3 Feasibility analysis

There are many reasons why tubing drainage has not been mechanized. First of all, it is technically difficult. From the perspective of tubing discharge action, tubing or rods should be arranged one by one when lifting tubing, and tubing should be discharged in sequence when lowering tubing, which should be accurate, reliable, continuous and coordinated. Secondly, the working environment is harsh, and the field working environment is tough. Moreover, the topography and road conditions of most well sites are different, so it is difficult to make the developed equipment not only complete the specified pipe arrangement, but also adapt to the harsh requirements of various well site environments[5].

From the above, it can be seen that the difficulty in realizing mechanized tubing discharge is to use simple equipment to complete complex actions, and at the same time, it must adapt to various well site environments[6]. Therefore, in the design and research, we must carefully analyze every problem, make full use of the latest design results, and pay attention to the actual situation of production, find out the corresponding solutions and put forward reasonable plans.

3 Introduction of Mechanized Drawing and Arrangement of Tubing

Generally speaking, the forms of tubing pulling and discharging can be divided into vertical row and horizontal row. The advantages of vertical row are small floor space and high efficiency. The disadvantage is that the stability is poor and it is not easy to match with the existing working machine. If the degree of mechanization is not high, it is necessary to increase the operators on the second floor platform, which has certain danger; Horizontal row has the characteristics of safety and stability, consistent with the working mode of the existing working machine, and easy to be accepted manually. At present, the oil pipes are basically discharged horizontally. According to the well site area and the number of oil pipes, double-layer or multi-layer drainage is adopted, and the layers are separated by cross arms. In view of this pipe arrangement, the following mechanical devices are designed.

3.1Simple lifting type

Figure 2 shows a simple lifting tubing discharge device.

In this device, two rotatable beams are arranged on the existing derrick (one of which is selected according to the orientation of the well site), a miniature electric rope winder is installed on the beams, and a pipe grasping manipulator is arranged at the end of the rope, and the rope winder can move freely along the beams[7]. During operation, the operator only needs to clamp the pipe grasping manipulator near the center of the oil pipe, press the lifting button to lift the oil pipe to a certain height, and then move it to the required position. When the operation is finished, the whole set of machinery can be put back to its original position and transported together with the derrick without adding other handling equipment.

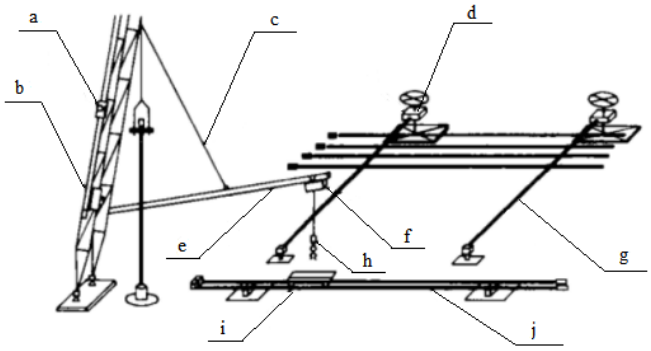

Figure 2. Simple lifting tubing discharge device

a-Rotating beam fixer; b-rotating the beam; c-Hanging rope; d-lifting mechanism; e-Turn the beam; f-miniature electric rope winder; g-pipe bridge; h-pipe grasping manipulator; i-car; j-Sliding guide rail

3.2 Automatic discharge type

Figure 3 shows the automatic drainage tubing drainage device.

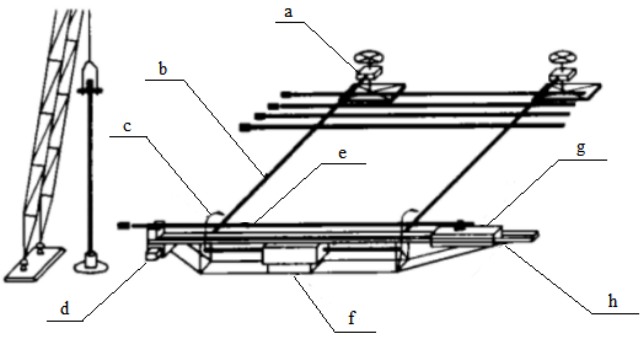

Figure 3. Automatic drain tubing drain device

a-Lifting mechanism; b-pipe bridge; c-transmission mechanism; d-console; e-in charge of institutions; f-Power box; g-pick-up agency; h-Guide rail

The device consists of three main parts: delivery, transfer and discharge of tubing. When lifting, the oil pipes are from vertical state to horizontal state under the joint action of the hook and the shuttle mechanism, and then the transfer mechanism transfers the flat oil pipes to the pipe arranging mechanism, which arranges the oil pipes neatly, The order of pipe laying is the opposite[8].

3.3 Split combined type

Figure 4 shows the split combined tubing discharge device.

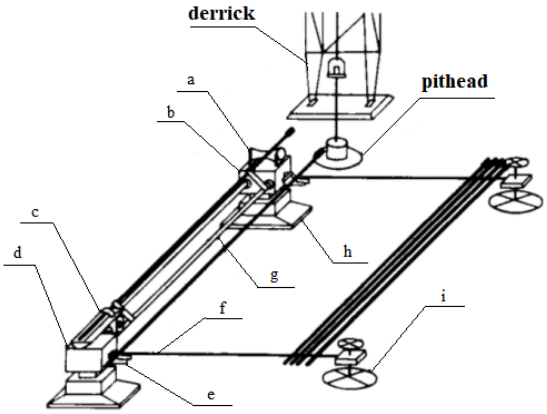

Figure 4. Split combined tubing discharge device

a-Power roller; b-pipe moving manipulator; c-inertial car; d-Power box; e-tubing separation mechanism; f-pipe bridge; j-Turn the guide rail; h-Lifting support; i-Lifting mechanism

In this device, a pair of rotating guide rails are installed on two lifting supports to combine them into a main structure, and the two lifting supports are respectively provided with branch management mechanisms, which can be connected with the pipe bridge during operation[9]. One side of the rotating guide rail is provided with a pipe moving manipulator to complete the oil pipe transfer task (when necessary, it can be adjusted to the other side to realize pipe arrangement on both sides). Its design idea is to change the whole handling into decentralized transportation and on-site assembly. The device has a simple structure, and two small motors are placed in two lifting supports respectively, so the protection performance is good[10].

3.4 Multilayer discharge type

Figure 5 shows the multi-layer drainage tubing drainage device.

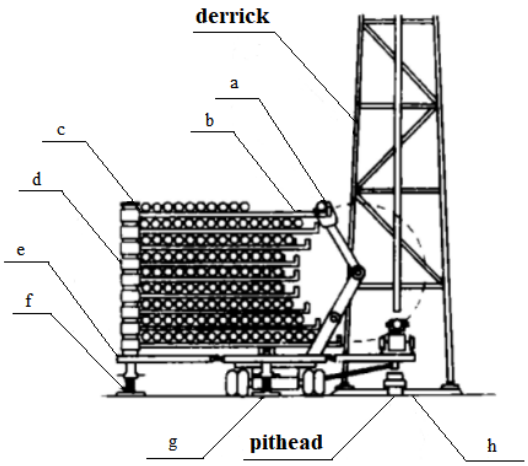

Figure 5. Multi-layer drain tubing drain device

a-tubing transfer manipulator; b-limit switch for tubing; c-guide pillow rotating shaft; d-layer arrangement device; e-Folding flat plate; f-Lifting mechanism; g-adjustable support; h-Tubing Shuttle

The device is similar to the automatic discharge type, which changes the single-layer to multi-layer discharge, and the end of each layer is provided with an oil pipe limit switch to ensure that the oil pipe is discharged and discharged in layers in order. The three aspects of oil pipe transportation, transmission and discharge are integrated into a whole, and a folding structure is adopted to be combined on a tractor[11].

4.CONCLUSIONS

The mechanized tubing tripping device in workover and tripping operations in oil fields is reliable and stable, which greatly reduces the labor intensity of workers and improves the working environment. Horizontal drainage is the best way to arrange pipes, and the mechanism used by it can be easily matched with the widely used tractor at present without major changes. Considering the different working environment, the automatic drainage tubing

drainage device has more advantages in overhaul well operation; In minor workover operations, the multi-layer drainage tubing drainage device has more advantages. In order to realize the mechanized discharge of tubing as soon as possible, a truck-mounted comprehensive mechanized workover rig with excellent performance and high mechanization degree should be developed to form a complete mechanized operation system.

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