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Hydraulic Structure Design of Multi-function Light-load Hydraulic Conveyor

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ABSTRACT

Transportation is one of the necessary conditions for social material production, and the hydraulic principle occupies an important role in transportation, it is reflected in all aspects of our life. Hydraulic module vehicle is one of the main equipment for the transportation of large heavy cargo in the world, especially suitable for the transportation of petrochemical, energy, steel and other heavy industries and super large equipment. With the continuous improvement of China's living standards, the cost of small and medium-sized cargo transportation in the overall operation transportation costs is increasing, and the development of China's small and medium-sized cargo transport tools is relatively backward, especially the heavy hydraulic equipment, on the whole presents a very big disadvantage. Most of our small and medium-sized goods are handled by the combination of manpower and trolley. This traditional way is time-consuming, laborious and low efficiency, which urgently needs the research and development of small and medium-sized goods handling hydraulic equipment. Therefore, we designed this multi-functional light load hydraulic transport machine.

KEYWORDS

Hydraulic Pressure; Conveyor.

1. INTRODUCTION

Hydraulic transmission is the liquid as the working medium, in the original mechanical energy into hydraulic energy, in the execution of the original hydraulic energy into mechanical energy, to achieve stable energy transmission and smooth movement of machinery. [1] First, the mechanical energy of the prime motor is converted into liquid hydraulic energy through hydraulic pump, and then the pressure energy in the pipe is controlled through the sealing pipe, oil filter, hydraulic control valve, etc., the hydraulic energy is converted into mechanical energy at the original (hydraulic cylinder). Compared with mechanical transmission, hydraulic transmission has many advantages. Hydraulic drive control is convenient, can achieve a wide range of stepless speed regulation, but also can be adjusted in the process of movement, speed regulation is convenient. Hydraulic transmission has a small size, light weight, high efficiency, reliable work, low energy consumption advantages [2]. And the system is filled with oil, for each hydraulic component has lubrication and cooling functions, so it is not easy to wear, so the service life is long. Hydraulic mechanical arm is widely used in production practice, which can support continuous and stable operation, improve production automation level and production efficiency.[3]

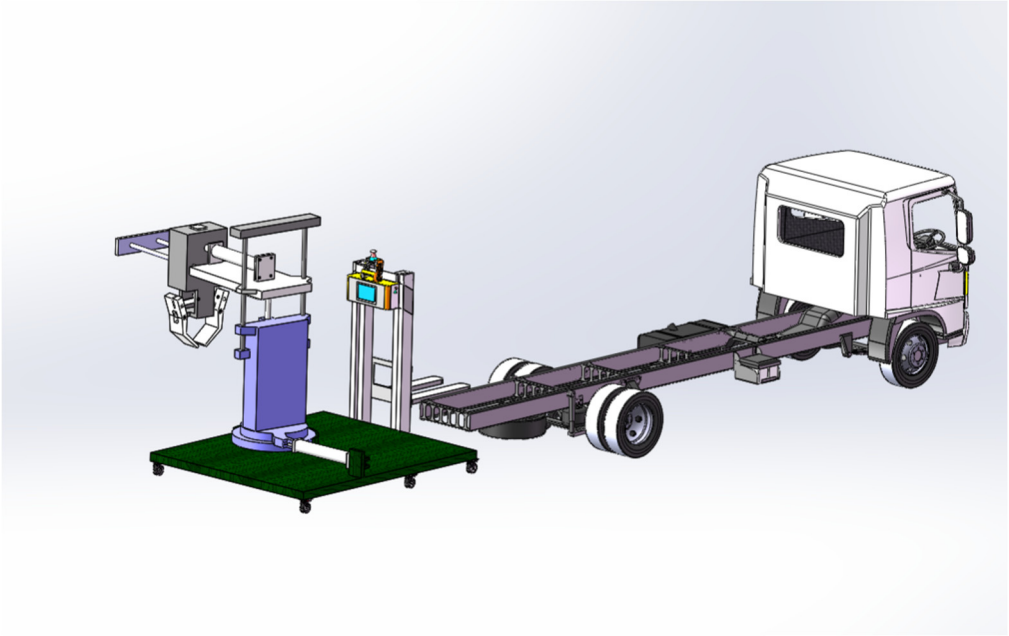

Figure 1. Cargo handling crane

2. HYDRAULIC MECHANISM DESIGN

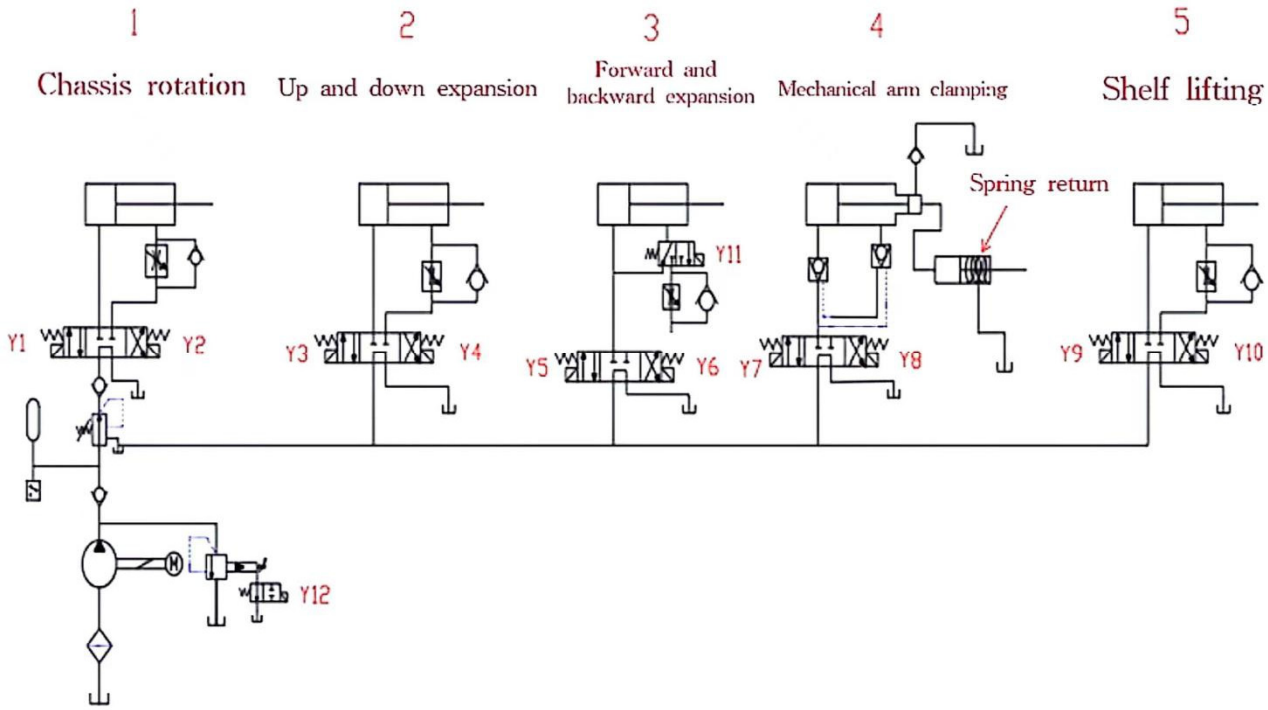

Figure 2. Schematic diagram of hydraulic mechanism

The circuit on the hydraulic structure diagram, valve 1,2,3,4 and 5, respectively correspond to valve 1-2-3-4-5 on the physical diagram, which can realize the chassis rotation, hydraulic rod expansion up and down, front and back, mechanical arm clamping and relaxation, and front fork lifting. There are five hydraulic circuits for the whole device, which control four hydraulic cylinders 1,2,3,4 and 5 respectively. After the oil supply by the oil filter, the hydraulic pump transforms the mechanical energy of the motor into hydraulic energy into the hydraulic system. The pilot overflow valve and the

two-position two-way return valve are filled on the main line of the high-pressure oil circuit. When the working parts are temporarily stopped working, the pump works at low pressure, reduce the power consumption and prolong the life. The accumulator plays the role of maintaining the system pressure. Since the 1 loop achieves the mechanical arm rotation without excessive liquid pressure, the pressure reduction valve is added. The 4 loop realizes the clamping and relaxation of the mechanical arm, which requires large liquid pressure, which can be realized by the pressurized loop. The 4 loop also adds the locking loop, which can make the mechanical arm continuously clamping. Due to the length of the truck car is slightly longer, the 3 loop specially added two-bit two-way return valve, with three-bit four-way solenoid valve can achieve differential connection, realize the front and back of the mechanical arm, in line with the actual 1 production requirements.1,2,3,5 Return oil throttle speed regulation system, the return oil circuit has back pressure, can be used for high load, high speed operation. In the figure, the electromagnetic differential connection loop can realize fast forward-advance-fast retreat-stop multiple movements. Three-bit four-way solenoid valve controls the "in-back-stop" of each hydraulic cylinder two-way solenoid valve controls the "fast-slow" movement of each cylinder.

2.1. Mechanical Chassis Rotation Control

The rotation of the mechanical chassis is mainly controlled by valve 1, taking the three processes of advancing, quick retreat and stopping as examples:

Access —— 1 road three four-way solenoid valve Y1 charged on, no rod cavity oil, to achieve access. Suitable for the smooth rotation of the chassis to the specified orientation angle process when the mechanical arm is loaded.

Fast retreat —— 1 road three four-way solenoid valve Y2 charged on, a rod cavity into oil, to achieve fast retreat. It is suitable for the process of rapid rotating reset of the base of the robotic arm to grab cargo.

When the three-way four-way solenoid valves on stop —— 1 are not charged, the oil circuit 1 is not connected and the hydraulic cylinder does not act. Applicable when the goods have been transported to the specified location.

If other oil roads are not connected, the oil will flow through the discharge circuit composed of pilot overflow valve and two-way solenoid valve and flow into the oil tank to protect the oil circuit.

2.2. The Mechanical Arm Hydraulic Rod is Extended up and Down

The expansion and expansion of the hydraulic rod of the mechanical arm is mainly controlled by valve 2, taking the three processes of advancing, fast retreat and stopping as examples:

Access —— 2 road three four-way solenoid valve Y3 charged on, no rod cavity oil, to achieve access. It is suitable for the process of smoothly extending the telescopic rod after grasping the load and placing the cargo at the specified height.

Fast retreat —— 2 road three four-way solenoid valve Y4 charged on, there is a rod cavity into the oil, to achieve fast retreat. It is suitable for the process of rapid downward contraction and reduction to grab cargo without load.

Stop the three four-way solenoid valves Y3 and Y4 on —— 2 road are not charged, the oil circuit 2 is not connected and the hydraulic cylinder does not act. Suitable when the goods are transported to the same altitude as the designated location.

If other oil roads are not connected, the oil will flow through the discharge circuit composed of pilot overflow valve and two-way solenoid valve and flow into the oil tank to protect the oil circuit.

2.3. Extend the Mechanical Arm hydraulic Rod in Front and Back

The front and back expansion of the hydraulic rod of the mechanical arm is mainly controlled by valve 3, taking the four strokes of fast forward, advance, fast retreat and stop as examples:

Fast forward —— 3 road three four-way solenoid valve Y5 charged on, two two-way solenoid valve Y11 is not charged, differential connection, to achieve fast operation. It is suitable for the process of extending forward horizontally to grab the cargo under the mechanical arm,

When the front and rear length of the carriage is long, the fast forward is convenient for the mechanical arm to quickly reach into the carriage to arrange the goods.

Work into —— 3 road three four-way solenoid valve Y5 live connected, two two-way solenoid valve Y11 live connected, no rod cavity oil, to achieve work into. It is suitable for the process of extending the expansion rod after grasping the load to place the cargo in the specified position.

Fast back —— 3 road three four-way solenoid valve Y6 charged connected, two two-way solenoid valve Y11 charged connected, there is a rod cavity oil, to achieve fast back, suitable for the mechanical arm under the state of fast inward horizontal contraction to grab the cargo process.

Stop the three four-way solenoid valves Y5 and Y6 on —— 3 road are not charged, the oil circuit 3 is not connected and the hydraulic cylinder does not act. Apply when the goods are transported to the same position in the vertical direction of the specified position.

If other oil roads are not connected, the oil will flow through the discharge circuit composed of pilot overflow valve and two-way solenoid valve and flow into the oil tank to protect the oil circuit.

2.4. Strengthen and Relax the Hydraulic Rod of the Mechanical Arm

The tightening and relaxation of the hydraulic rod of the mechanical arm are jointly controlled by valve 4 and valve 2:

Work into -- 4 road three four-way solenoid valve Y7 charged on, no rod cavity oil, to achieve work into. It is suitable for the mechanical claw to quickly adjust the spacing between the claws in the unloaded state, to grab the goods of different widths.

Execadd the spring in the cylinder. Suitable for natural reset by spring after unloading.

Stop the three four-way solenoid valves Y7 and Y8 on —— 2 road are not charged, the oil circuit 4 is not connected and the hydraulic cylinder does not act. Suitable for the state of the mechanical claw before grasping the cargo.

If other oil roads are not connected, the oil will flow through the discharge circuit composed of pilot overflow valve and two-way solenoid valve and flow into the oil tank to protect the oil circuit.

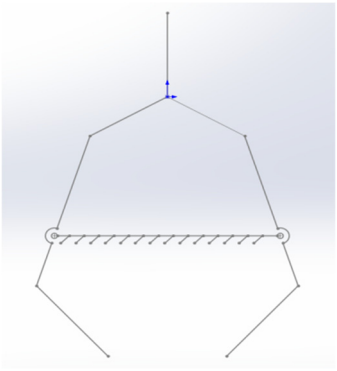

Figure 3. Mechanical arm diagram

2.5. Shelf Hydraulic Rod up and Down

The expansion is controlled by valve 2, valve 4 and valve 5:

Access —— 4 road three four-way solenoid valve Y9 charged on, no rod cavity oil, to achieve access. Suitable for the fork under load.

Fast retreat —— 2 road three four-way solenoid valve Y10 charged on, a rod cavity into the oil, to achieve fast retreat. Suitable for the downward contraction of the fork without load.

When the three four-way solenoid valves Y9 and Y10 are not charged, the oil circuit 5 is not connected and the hydraulic cylinder does not act. The fork is at the lowest point (and at the same height as the chassis).

If other oil roads are not connected, the oil will flow through the discharge circuit composed of pilot overflow valve and two-way solenoid valve and flow into the oil tank to protect the oil circuit.

3. RESEARCH METHODS

The methods used in this design are mainly divided into survey method, interdisciplinary research method and experience summary method.

Before the design, we carried out a purposeful, systematic investigation of the small and medium-sized goods handling device in the vegetable market, small logistics companies, department stores, goods moving, agricultural products transportation operation problems, with the problem as the background design function;

Comprehensive mechanical design, mechanical modeling, PLC control, motion simulation and other discipline knowledge, the use of interdisciplinary research methods, so that each mechanical structure and hydraulic components form an organic coordination, to achieve efficient completion of cargo handling and other tasks;

Through the induction of the specific situation in practical activities, make it systematized, theoretical, rise to experience. We can also collect the experience and lessons of our predecessors to avoid the previous lessons.

4. CONCLUSION

Hydraulic device is widely used in all kinds of transportation industry, can realize a wide range of stepless speed regulation, but also can be adjusted in the process of movement, convenient speed regulation, hydraulic components have the function of lubrication and cooling, so not easy to wear, so the hydraulic device long service life, at the same time, also has the right size, easy installation, easy to use, etc. This paper describes the multifunctional light carrier of hydraulic structure design, the device integrated hydraulic device advantages, can be a lot of express logistics company, market, department store, pull moving, agricultural transportation market, can easily carry goods to the truck car, effectively reduce the pressure of human handling goods and improve the work efficiency

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