

Research on the application and development of hydraulic transmission and control technology in agricultural machinery

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Abstract: The practical application of modern agricultural machinery can effectively save labor, but also enhance the efficiency of agricultural production and further promote the development of China's agricultural field. Therefore, the quality of modern agricultural machinery is crucial. The application of hydraulic transmission and control technology in agricultural machinery can help improve the quality of agricultural products, continuously enhance the market competitiveness of enterprises, shorten the gap with developed countries, and further expand the overseas market. In addition, it can effectively alleviate the intensity of farmers' field work and continuously increase farmers' economic income, which plays a very important role in the development of agriculture in China.

Key words: hydraulic transmission and control technology; Agricultural machinery; application

With the continuous development of the new era and the acceleration of new rural construction, agricultural machinery production is facing new development opportunities. In order to increase its own advantages in the fierce market competition, it is necessary to continuously enhance the level of agricultural machinery and maintenance, so as to ensure the quality of agricultural machinery. This paper mainly explores the application of hydraulic transmission and control technology in agricultural machinery.

1. Overview of hydraulic transmission and control technology

The application of hydraulic transmission and control technology in agricultural machinery is mainly carried out with the help of hydraulic system. The perfect hydraulic system includes many components, namely, hydraulic oil, auxiliary components, control components, power components and so on. Hydraulic transmission and control technology can ensure the normal operation of agricultural machinery in the work. Therefore, the rational use of hydraulic transmission and control technology plays a very important role in agricultural machinery.

2. Application status of hydraulic transmission and control technology in domestic agricultural machinery

2.1 Basic application of hydraulic transmission and control technology

How to effectively integrate hydraulic transmission and control technology with other agricultural machinery is the focus of current research. The emergence of hydraulic transmission and control technology can alleviate this problem and make the integration of the two more harmonious and stable. The application of hydraulic transmission and control technology in the combine can effectively reduce the loss rate in the operation process of the combine. The application of stepless speed change will greatly increase the working efficiency of the combine, and the structure of agricultural machinery will be more simplified. At the same time, it also has strong practical value. The practice of hydraulic transmission and control technology is mostly suspension operation, and the common operation is joint operation or compound operation.

2.2 Deep application of hydraulic transmission and control technology

The practice opportunity of hydraulic transmission and control technology in modern agricultural machinery is deepening, which helps to improve the efficiency of agricultural production and reduce the pressure on Farmers' production. Taking the combine harvester as an example, it uses hydraulic transmission and control technology to realize the control of the harvester's travel speed with the help of the function of self-regulation, and it can also be controlled away from the drum speed to meet the needs of different agricultural production. This practical application will be of great significance to the creation of good working conditions for agricultural machinery.

3. Application of electro hydraulic proportional control technology in agricultural machinery

3.1 Principle and characteristics of electro hydraulic proportional control technology

With the rapid development of hydraulic technology and the organic integration of microelectronics technology and computer technology, the electro-hydraulic control system has developed rapidly. The electro-hydraulic servo control technology mainly used in the military field has been gradually transformed into the electro-hydraulic proportional control technology applied in basic industrial equipment. This control system is mainly connected with microelectronic technology and engineering power interface. It inputs the working signal in the system, changes according to the general rule set, and continuously adjusts the controlled working machinery force or torque according to the proportion. The round-trip speed or speed, displacement and other parameters of agricultural machinery are also considered. The concrete embodiment of hydraulic integration. From the perspective of engineering application, electro-hydraulic proportional control technology has several advantages: first, it has simple structure and flexible layout. The electro-hydraulic proportional control system removes the complex hydraulic system framework, and uses the electro-hydraulic integrated structure composed of standard proportional valve, overlapping multi-functional control components, electromagnet and proportional valve to greatly simplify the design system. The use of components is much less than the traditional control valve circuit, which brings many convenience to the system design and operation. Second, the control

function is powerful and has a wide range of applications: it can combine the fast flexibility of electricity with the large output force of hydraulic transmission, and continuously and proportionally control the force, direction, speed and other outputs of the hydraulic actuator according to the value of the input electrical signal, which is easy to realize stepless speed change. Third, the electric signal control realizes remote control or remote control: the electric proportional control system has changed the problems of long hydraulic circuit, large pipeline loss and complex system of multi-channel valve control, and remote wired or wireless control can be realized through the electric signal.

3.2 Application of electro hydraulic proportional control technology in agricultural machinery

1. Application of electro-hydraulic proportional control technology in fertilizer planter

Due to the irrational situation of fertilizer utilization in agriculture, the problem of excessive fertilization is serious, which not only leads to the decline of crop nutrition level, fertilizer utilization rate, the increase of cost and the decline of economic benefits, but also increases the pollution of land and water, resulting in the damage to the natural environment. However, due to the fact that the current fertilizing and seeding machines on the market mainly use mechanical transmission, it is unable to carry out real-time variable fertilization, and variable rate fertilization technology is still in the primary stage of application research and development, but some equipment have completed the demand adjustment of fertilizing and seeding amount of various crops by replacing mechanical transmission parts, and the action is complex, the change range is small, and stepless speed regulation is not possible. The research and development of variable fertilization technology in foreign countries is relatively fast. The large-scale fertilization and seeding machines manufactured by international famous agricultural machinery enterprises such as case in Canada, John Deere and armazon in Italy can be used for manual variable fertilization after the control system compares the field data and the application rate requirements. Variable fertilization control methods are usually divided into three types: electric control hydraulic motor regulation, electric control machine stepless transmission control, and stepper motor vertical drive control. The first two control methods have been widely used in foreign variable fertilization planters, while the third control method has more requirements on electricity, And the on-board power of ordinary tractors can not meet the requirements, so the actual use range is relatively small. Variable fertilization control mode of electric hydraulic motor is the most widely used method at present. Variable control driver can be used to control the speed of DC servo motor, and then drive the hydraulic motor to control the fertilizer discharge shaft for variable regulation and fertilization. With the development of electro-hydraulic ratio control, people can use the electronic proportional valve to control the current of the hydraulic device, so as to adjust the generator speed output, so as to achieve variable rate fertilization. Many universities and scientific research institutions at home and abroad have carried out corresponding research and exploration according to this hot spot. The current principle of variable fertilization controller is generally to use the GPS on the device to get the current positioning data, then call out the fertilization prescription map of the current area, and transmit the information to the variable fertilization controller, so as to adjust the amount of fertilizer discharge.

2. Application of electro hydraulic proportional control technology in tractor suspension system

The main executive component of the traditional hydraulic suspension system is the distributor. By using the mechanical push rod device to adjust the position of the distributor, the flow and direction of the oil can be adjusted, so that the farm implement can reach different working positions. Due to the increasing demand for agricultural machinery operation position and power control system, the traditional mechanical hydraulic suspension system has been unable to meet the demand, and there is an urgent need for mechanical hydraulic suspension system. With its flexible spatial structure and good mechanical characteristics, the electro-hydraulic control system can easily complete the functions of displacement adjustment, force position comprehensive adjustment, lifting limit height adjustment, speed reduction adjustment, transportation locking, etc., with accurate control and fast response. In recent years, many researchers have carried out the research and development of the electro-hydraulic control system for tractor suspension. The core technology is to upgrade the original mechanical hydraulic control system to the electro-hydraulic control system by using the electro-hydraulic proportional directional valve as the main controller of the original mechanical hydraulic control system. The electro-hydraulic proportional valve is a key component of the tractor suspension system. The controller adjusts the number and direction of hydraulic devices according to the current information sent by the displacement, speed, traction force and other data required by the system. Xuhuang et al. Developed the tractor electro-hydraulic suspension device with standby force position compound control technology, which carried out the force control of tillage depth displacement adjustment; Li Li et al. Selected two electro-hydraulic proportional valves as the main controller to carry out force position compound control and displacement adjustment in the operation state.

3. Application of electro hydraulic proportional control technology in other agricultural machinery

The electro-hydraulic proportional control technology is relatively early used in modern construction machinery, because of its advantages of good stability, high accuracy, fast response and so on, the scope of application is increasingly broad, and mature application products have appeared; However, the research on the application of agricultural machinery is still in the period of exploration and development. At this stage, there are more research on the application of variable rate fertilizer applicator, precision seeder and tractor hitch system, and the research and application of some agricultural machinery is still in the initial stage. Zhujian, yangyinhui, etc. applied the electro-hydraulic proportional controller technology to the height controller of the combine header, measured the header elevation on site by using the ultrasonic sensor, adjusted the flow of the electro-hydraulic proportional directional control valve by using the output information of the controller, determined the actual elevation of the header, and kept the header elevation of the harvester near the set value, But their software system principles are different.

4. Development prospect of hydraulic transmission and control technology in agricultural machinery

(1) No leakage development trend the wide application of hydraulic equipment in modern agricultural machinery has effectively improved the efficiency of agricultural production, but there are still some problems in the current actual use environment, such as noise pollution and water leakage, which are concerned by farmers, and not only affect the daily production activities of farmers, It also interferes with the normal operation efficiency of modern agricultural machinery to a certain extent. Therefore, it is urgent to reduce noise and leakage. According to this, we can also carry out innovative research on the interface components, invent new interface components, and realize screw type assembly of cartridge valves, so as to make the closed hydraulic control system composite combination, which can more effectively reduce the noise of agricultural machinery and reduce the problem of leakage. (2) Energy saving development trend the wide application of hydraulic technology in agricultural machinery has not only improved the efficiency of agricultural output, but also created a number of new problems, such as the pollution of the agricultural ecological environment and the high consumption of energy resources. The total power of China's agricultural machinery has exceeded 1.144 billion kilowatts. Therefore, The realization of energy saving and emission reduction of China's agricultural machinery has become the most important key issue in the application of hydraulic technology, and it is also the inevitable requirement of the construction of a harmonious socialist society in China. If we want to realize the electricity saving of hydraulic equipment, we also need to do the following: first, the load sensing technology can effectively reduce the temperature rise response of the mechanical system through this method, and then reduce the energy consumption, so the electricity saving effect is more prominent; Secondly, the electronic hydraulic joint commissioning technology, the application of this technology can greatly improve the fuel economy, and improve the operation stability of the main engine, so as to achieve the goal of energy saving. (3) Development trend of hydrostatic drive hydrostatic drive technology mainly uses the pressure difference of liquid to do work, but different from mechanical drive technology, hydrostatic drive technology has very prominent advantages, including: first, hydrostatic drive technology is widely used. In agricultural production, various agricultural machinery with complex structure and slow action are everywhere, Moreover, the hydrostatic drive technology has a wide range of speed regulation, which can realize stepless speed change, and has good stability at low speed, high specific power, and easy layout, making it able to be widely and flexibly applied, which is of great help to the improvement of production efficiency. Second, compared with mechanical drive, the maintenance cost of hydrostatic drive is lower, the probability of failure in operation is also greatly reduced, and because of its simple operation, it is more conducive to maintenance and repair. Therefore, hydrostatic drive technology is also the main trend of current development.

Concluding remarks

To sum up, with the continuous development of China's rural economy, farmers' purchasing power has also been greatly improved

Many farmers will buy agricultural machinery with good performance, high efficiency, convenient operation and comfort, which provides convenient conditions for the application of hydraulic transmission and control technology. The application of hydraulic transmission and control technology can effectively reduce farmers' labor intensity, improve production efficiency and increase farmers' economic benefits.

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