Application of Hydraulic Transmission Technology in Mechanical Manufacturing and Practice of Leakage Control

Shiying Shen
Shandong Xie He University, Jinan, Shandong, 250109
2008xiehe@dlvtc.edu.cn

Abstract—With the continuous development of the machinery manufacturing industry, people's application requirements and standards for technology are gradually increasing. Many researchers have begun to pay attention to hydraulic transmission technology in machinery manufacturing to avoid new troubles for the development of the entire industry. This article summarizes the application content of hydraulic transmission technology in machinery manufacturing based on previous work experience. The author discusses the leakage control measures of the hydraulic transmission system from four aspects: controlling the leakage of the hydraulic system, strengthening the control of the original seal, controlling the oil pollution, and reducing the shock and vibration probability of the equipment.

1. INTRODUCTION
In actual industrial production, hydraulic transmission technology is more common. When this technology is applied, it mainly uses hydraulic pressure to realize energy transfer, and finally demonstrates the characteristics of flexibility and convenience. This is also one of the key content of relevant enterprises in the new era. At the same time, hydraulic transmission technology can show good application characteristics, and its development prospects are very broad. Especially after the mutual integration with computer control technology, it can provide more comprehensive services for industrial production, and the effect is very obvious.

2. THE PRINCIPLE AND SYSTEM COMPOSITION OF HYDRAULIC TRADITIONAL TECHNOLOGY

2.1. Fundamental
When using traditional hydraulic technology, pressure oil is used as the medium, and the closed container is used as the carrier to ensure better energy transfer and conversion. Among them, oil mainly acts as a medium. Generally speaking, mineral oil is the main application, which can show the role of transmission elements in mechanical transmission. Specific forms include belts, gears, and so on. At the same time, in hydraulic transmission, Pascal's principle is the main basis. The specific content is as follows: In the actual closed type container, force is applied to the liquid. At this time, the liquid will transfer the power to different directions. In daily life, Pascal's principle has also been fully applied to help people lift heavy objects. The hydraulic transmission system involves two energy transfers during operation. First, the system converts mechanical energy into hydraulic energy, and then converts hydraulic energy into mechanical energy to complete the external output work. From the perspective of industrial production, machine tools, cranes, etc. will all be applied to hydraulic transmission technology. The relevant schematic diagrams are shown in Figure 1 and Figure 2.
2.2. Hydraulic Drive System Composition

Many elements such as auxiliary devices, control systems, etc. are involved in the hydraulic transmission system. These devices can play a huge role in actual operation. The first is the power plant. The core component of the device is the hydraulic pump. It can convert the mechanical energy in the prime mover into hydraulic energy, so that the hydraulic energy is always at full load. The second is the control device. It can effectively control the entire hydraulic transmission system such as pressure conditions and medium direction. Meanwhile, it can also control various device types, and the effect is very obvious. The third is the working medium. When the system is running, the most common medium is mineral oil, which can provide more energy for the hydraulic transmission system. Because the hydraulic components have high power and are easy to control, they can work under long-term harsh conditions, and the time under high-power conditions is longer. Therefore, the application of hydraulic transmission system to harvesting machinery can strengthen the operating performance of this type of machinery and demonstrate a higher level of intelligence [1].
3. APPLICATION ADVANTAGES OF HYDRAULIC TRANSMISSION TECHNOLOGY IN MACHINERY MANUFACTURING

In traditional machinery manufacturing, manual operation mode can increase the investment cost of enterprises to a certain extent. Moreover, problems are prone to occur in human operation or inspection work, which has an impact on the economic benefits of the enterprise. In recent years, with the application of hydraulic transmission technology, its technical value has gradually shown itself. This allows the chemical machinery manufacturing industry to develop in the direction of intelligence and science.

3.1. Avoid the Overload of the Power Transmission Device

The combination of hydraulic transmission technology and mechanical manufacturing process can not only realize the torque converter to replace the clutch in the traditional mechanical equipment, give the mechanical equipment stronger stepless speed regulation performance, but also make the hyperbolic output characteristics more obvious. In other words, in the application of mechanical equipment, in addition to reasonable load distribution, the system should also reasonably avoid the overload problem in the power transmission device and strengthen the stability of the mechanical device operation.

3.2. Full Control of Motion Parameters and Dynamic Parameters

It can be seen from the current construction machinery manufacturing process that hydraulic transmission technology has a wide range of applications. This is not only due to the high transmission efficiency of this technology, but also the control of constant power output to maintain the system structure in a simple state under. It can also operate in both positive and negative directions when in use, presenting better load characteristics. In addition, from the perspective of mechanical manufacturing, relevant manufacturing staff can control internal motion and power parameters with the help of hydraulic transmission technology. This can better complete the company's manufacturing goals [2].

3.3. It has the Advantages of Convenience of Adjustment and Flexibility of Layout

The advantages of the entire hydraulic transmission system are the convenient adjustment and flexible layout of the actual hydraulic transmission technology in application. The relevant staff can install the hydraulic transmission system on the engine according to the specific construction machinery form and construction situation. In this way, the traction of the system can be improved, and the transmission system can be maintained in a good operating condition. In addition, when the speed changes in time, the hydraulic transmission technology can also keep the mechanical power acquisition unaffected, making it suitable for application in various operating loads.

4. APPLICATION CONTENT OF HYDRAULIC TRANSMISSION TECHNOLOGY IN MACHINERY MANUFACTURING

4.1. Application in Cyclic Action Level

Generally speaking, the most important core devices in the work of a single bucket hydraulic excavator include walking mechanism, slewing mechanism and so on. In some working devices, sticks and booms are also built-in, and the staff can replace the devices according to the actual situation. Besides, hydraulic excavators can also perform internal backhoe operations. The core actions of the common operating cycle are as follows. Firstly, excavation. The excavator's digging action is mainly based on the action of the stick cylinder, and the adjustment operation of the cutting angle is carried out through the bucket cylinder. If you need to perform a special excavation action, people can use bucket action, stick action and boom action to ensure that the two cylinders produce a compound action and ensure that the bucket can run in accordance with the set trajectory. Secondly, lifting and rotating bucket movements. When the excavation task is over, the staff will push the bucket cylinder out, and then top-start the boom cylinder, start the swing motor, and the turntable rotates in the direction of unloading soil. Thirdly, loading and unloading actions. When the excavator rotates to the unloading point, the
entire turntable will be transformed into a braking mode. At this time, intelligent use of the stick to carry out the adjustment and control of the unloading radius. If there are special requirements for the unloading height and position, people need to adjust the boom to provide cooperation for the development of related actions. Fourth, return to the action. When all unloading work is over, the turntable will rotate in the opposite direction. At this time, the stick cylinder and the boom cylinder will cooperate to ensure that the empty bucket can be lowered smoothly, and new excavation tasks can be started in the follow-up.

4.2. Application in Different Occasions
In recent years, the continuous advancement of computer information technology has given hydraulic transmission technology more opportunities for improvement. On this basis, the development goals set by the technology are also constantly updated. Hydraulic transmission technology can present good power parameters and motion control parameters when applied. From the perspective of structural application, the content of hydraulic transmission technology is relatively simple, which can control the transmission speed and transmission quality of constant power in the output process. Otherwise, hydraulic transmission technology has also been introduced into many construction machinery and equipment at this stage. Since the operating direction of the hydraulic drive system is not restricted, the steel core in the equipment also runs in both positive and negative directions. As a result, this technology can better meet the actual operation requirements in practical applications [3].

4.3. Application at the Level of Diagnosing Technical Problems
First of all, the sealing problem is one of the important influencing factors in the entire hydraulic transmission science and technology. The problems at other levels mostly come from the practical operation of hydraulic transmission science and technology such as spool problems, no pressure, and so on. At this time, the staff need to take effective measures to determine the cause of the problem. People can use the simple diagnosis of faults and the basic content of hydraulic transmission science and technology to ensure that the hydraulic transmission science and technology system can be fully tested. For example, when diagnosing the hydraulic transmission science and technology system of a single bucket excavator, people need to combine easy fault diagnosis with schematic diagrams. In contrast, the easy-to-diagnose method has a wider range of applications. The staff can fully understand the internal situation of the system by virtue of their own work experience and instrument cooperation. When the analysis work is over, the location and cause of the fault can be determined, and people can carry out targeted maintenance operations. However, in the specific operation process, technicians need to have a solid hydraulic knowledge, proficiently master the functions and characteristics of the components in the hydraulic system, and perform comparative analysis with related actions. Only in this way can the specific cause of the problem be determined.

4.4. Application in CNC Lathe
Among CNC machine tools, the application of hydraulic transmission technology is mainly embodied in oil pump devices, tightening system devices and pressure gauges. For example, when applied in an oil pump device, the control effect is mainly achieved through the hydraulic oil tank and the oil pump motor. Generally speaking, the hydraulic oil level control in the hydraulic oil tank is generally around 40L, and the pressure in the oil pump motor is 4Pa. If the pressure in the hydraulic oil tank is lower than 2Pa, the system will also automatically alarm. At this time, the staff can use the electromagnetic steering valve and the pressure reducing valve to achieve full control of the pressure reducing disc and maintain the normal operation of the system. During this process, the pressure adjustment range of the pressure reducing valve is between 0.15 and 3.5 MPa. The tailstock system device is similar to the tightening system device in the application process, they are all controlled by electromagnetic steering valve and pressure reducing valve. But here will also be applied to the ejection and retraction speed control of the tailstock sleeve to control the pressure of the pressure reducing valve, so that the equipment can always be in normal operation. It can be seen from the work of the machine tool that
there are three types of the most common pressure gauges, namely the total pressure gauge, the chuck pressure gauge and the tailstock pressure gauge. The total value is generally based on 7 MPa.

5. TYPES AND CAUSES OF LEAKAGE IN HYDRAULIC TRANSMISSION SYSTEM

5.1. Types of Hydraulic System Leakage
There are many forms of hydraulic system leakage, as shown in Figure 3. It can be seen from the figure that the oil flows from 2 to 1. This form is called internal leakage. If the oil flows from 2 to 3, it is called external leakage.

![Figure 3. Schematic Diagram of Hydraulic System Leakage](image)

5.2. Analysis of the Cause of Leakage
Generally speaking, there are many reasons for system leakage, mainly in the operating phase of the hydraulic system. Especially in the processing of sealing components and contamination of assembly components, it will cause leakage problems in the hydraulic system. In this process, the most common is the hydraulic leakage caused by the sealing element. If the sealing element is unreasonable in the design, it will have a direct impact on the degree of sealing. At this time, it is necessary to consider the compatible form of hydraulic oil and sealing material in the design of the sealing structure to see if it meets the relevant standards. In addition, the length of time the sealing element is used will also affect the leakage of the hydraulic system. If the sealing material is used for a long time, problems such as insufficient compression are likely to occur, resulting in leakage of the hydraulic system [4].

5.2.1. Design Factors
In the operation of hydraulic system, design work is an important part. This also determines the safety and stability of the entire hydraulic system. Once the hydraulic system design is unreasonable, it will inevitably lead to hydraulic problems. In order to keep the hydraulic system running smoothly, the staff should ensure that the hydraulic oil and the sealing components are in a state of mutual cooperation, and they are used in a reasonable manner. When in use, the staff must pay special attention to the pressure limits and load conditions of each component.
5.2.2. Manufacturing and Assembly Factors
In the operation of a hydraulic system, the most important component is the seal. If the quality of the seal is high, the sealing characteristics of the hydraulic system can be strengthened. In contrast, the production process of seals is more complex and technical, and it can produce components with corresponding specifications according to specific needs. However, if the seals used in the hydraulic system are mixed in specifications, the safety of the entire system will be affected and the probability of leakage problems will increase.

5.3. Hydraulic Leakage and Damage Caused by Shock and Vibration
In the actual production and application process, the hydraulic system will be tested by various situations. In application, some vibrations and shocks can enhance the overall operating efficiency of the hydraulic system, but most vibrations and shocks are prone to produce bad effects. For example, the use of mechanical equipment pressure pumps often produces strong shocks and vibrations, which will eventually cause the stability of the welding bracket to be affected and collapse. It is precisely because of the existence of this situation that the hydraulic system is destroyed and a leakage event is triggered. If this problem cannot be dealt with in time, the use time limit of the system will also be greatly reduced [5].

6. CONTROL MEASURES FOR LEAKAGE OF HYDRAULIC TRANSMISSION SYSTEM

6.1. Control the Leakage of the Hydraulic System
In this work, the first thing the staff needs to do is to determine the specific influencing factors of hydraulic system leakage. In order to strengthen the work effect, people should ensure the effectiveness of control measures. Only in this way can it be ensured that the hydraulic system is always in a stable operating state. In other words, only by fully understanding the prevention and treatment strategies of hydraulic system leakage can the effect of hydraulic transmission technology be fully demonstrated. There are many factors that cause hydraulic system leakage, and the current technological capabilities are still unable to avoid all of these factors. However, the staff can analyze the causes of leakage problems in the hydraulic system and work out more targeted prevention measures. This is also one of the effective means to control the leakage problem of the system.

6.2. Strengthen the Control of the Original Seal
Through the comprehensive control of the sealing element, a full understanding of the structure of the sealing element can be ensured, and the effective design of the groove structure of the subsequent sealing element can be ensured to meet various design requirements. Related staff can also hear the piston rod analyze the groove shape and processing content to ensure that the design quality is in a high state and reduce the probability of leakage problems. This can keep the oil seal in a non-damaging state, otherwise it will easily affect the entire sealing effect. At the same time, the staff should also check the shape and size of the sealing element and other parameters. This can make it meet specific standards and regulations, and avoid causing bigger problems. In fact, it is easy to be squeezed by other devices when the seal is applied, which may cause deformation problems. At this time, the designer should focus on improving the compressive resistance of the seal to achieve a rational design. This also has positive significance for the control of leakage problems.

6.3. Do A Good Job in Oil Pollution Control
The actual implementation of oil pollution control operations mainly involves the following aspects. Firstly, reduce the chance of external pollution. Relevant staff should regularly clean the hydraulic device, install a suitable air filter device to disassemble and repair the system. Meanwhile, these tasks need to be carried out in a pollution-free environment. Secondly, the precision filter should be used in the system's impurity filtration operation. When adding new oil, the staff should also filter out the impurities in the oil in advance. Thirdly, related workers to ensure the constant temperature control of
the hydraulic oil. If the hydraulic oil temperature is too high, it is easy to cause system leakage problems. Generally speaking, the best working temperature of hydraulic oil is below 65°C. Fourth, related workers need to carry out regular inspections of hydraulic oil. Through sampling and testing, if any deterioration is found, the staff should immediately replace the hydraulic oil [6].

6.4. Reduce the Chance of Shock and Vibration of the Equipment
In the operation process of the hydraulic system, it can show obvious integral characteristics, which is the so-called "moving the whole body with one engine". The main goal of the hydraulic system is to strengthen the seismic performance and avoid obvious vibration during transportation. For this reason, the staff often fix the hydraulic system pipes to the shock-absorbing instruments. In order to control the number of brackets, people often choose welding methods to connect them together. In this way, the effect of the bracket can be fully exerted, and the effect of shock-proof and decompression can be achieved. It can also be seen from this that if we want to achieve comprehensive control of hydraulic system leakage, we need to start from the source of the problem and formulate protective countermeasures based on the cause of the leakage.

7. Conclusion
In summary, the traditional mechanical process is gradually replaced in mechanical design and manufacturing technology. However, it can be seen from the application of hydraulic system that its role is difficult to be replaced. Although the hydraulic system is prone to many problems in operation, through the in-depth research and analysis of researchers, the technology will become more and more perfect. A higher level of technology is brought into play in practical work, and finally it has been widely used in the field of machinery manufacturing.

References
[1] Song Mengmeng, Li Juntao. Application of hydraulic mechanical transmission control system in mechanical design and manufacture[J]. South Agricultural Machinery, 2021, 52(02): 110-111.
[2] Jia Pengcheng. Application and Leakage Control of Hydraulic Transmission Technology in Machinery Manufacturing[J]. Internal Combustion Engines and Accessories, 2020(18): 98-99.
[3] Zhao Jianqiang. The application of hydraulic transmission technology in machinery manufacturing[J]. Modern Manufacturing Technology and Equipment, 2020, 56(09): 100-101.
[4] Hu Mengen. Discussion on the application of hydraulic transmission technology in machinery manufacturing[J]. Journal of Science & Technology Economics, 2020, 28(20): 50.
[5] Wang Wangfeng. Application analysis of hydraulic machinery transmission control system in mechanical design and manufacture[J]. Hubei Agricultural Mechanization, 2020(09): 68-69.
[6] Wang Shiliang. Application and technical analysis of hydraulic machinery transmission control system in mechanical design and manufacture[J]. Leisure, 2019(07): 239.