

# Design and Control Strategies for Mechanical Hydraulic Transmission Systems

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**Abstract:** With the development of social and economic development, all walks of life are progressing rapidly, and mechanical hydraulic transmission technology has been widely used. Mechanical hydraulic transmission technology is a widely used, high efficiency, energy-saving and environmentally friendly transmission technology, mainly using liquid as the medium, relying on the pressure of the liquid to transmit power. Due to the strong mobility of the liquid, the pressure and flow of the liquid can be changed at will, therefore, it is widely used in mechanical hydraulic transmission systems. This paper takes the design of mechanical hydraulic transmission system as content, combined with the analysis of contemporary problems in the design and control of mechanical hydraulic transmission system, and explores the common problems and solutions in the design process of mechanical hydraulic transmission system. This paper discusses the design and control methods of mechanical hydraulic transmission system control strategy, and hopes to provide some reference for colleagues.

**Keywords:** Mechanical hydraulics, Drive train, Control.

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## 1. Introduction

Mechanical-hydraulic transmission system is a kind of transmission method combining mechanical and hydraulic technology, which has the advantages of high transmission efficiency, high reliability and wide adaptability. It is widely used in mechanical manufacturing, engineering machinery, aerospace, military equipment and other fields. However, the design and control strategy of mechanical hydraulic transmission systems have a crucial impact on their performance and service life. Therefore, this paper will discuss in depth the design and control strategies of mechanical hydraulic transmission systems, aiming to provide useful guidance and reference for researchers and engineers in related fields.

## 2. Definition and Role of Mechanical Hydraulic Transmission System

Mechanical hydraulic transmission system is a kind of transmission system that transmits power through the pressure on the liquid. According to the liquid in the closed container flow speed is different, can be divided into: low-speed hydraulic transmission system, medium-speed hydraulic transmission system and high-speed hydraulic transmission system. Low-speed hydraulic transmission system is mainly through the common action of the pump and motor to transmit power, the output power is small, usually for some small mechanical equipment; medium-speed hydraulic transmission system is mainly relying on the cooperation between the circuit, through different components to transmit power, the output power is larger, usually for some large mechanical equipment; high-speed hydraulic transmission system is mainly with motor, motor, hydraulic rod as the main components[1]. Through high-speed movement to transmit power. The role of the mechanical hydraulic transmission system is to be able to convert the mechanical energy output of the engine into liquid pressure energy, and then through the hydraulic pump to

convert the liquid pressure energy into mechanical energy. Due to the influence of external factors such as temperature and vibration during the working process, the mechanical-hydraulic transmission system can be affected. Therefore, it is necessary to strengthen the design of the mechanical hydraulic transmission system and the study of control strategies to improve the stability and safety of the operation of the mechanical hydraulic transmission system, to ensure that the mechanical hydraulic transmission system can operate safely and reliably[2].

## 3. The Components of The Mechanical Hydraulic Transmission System

Mechanical hydraulic transmission systems are mainly composed of power components, execution components and control components. Power components include engines, hydraulic pumps, etc. Actuating elements include hydraulic cylinders, hydraulic motors, etc. Control elements mainly include hydraulic valves, pumps and flow control valves, etc. Power and control elements constitute the main part of the mechanical hydraulic transmission system, the two together constitute the mechanical hydraulic transmission system[3]. Mechanical hydraulic transmission system can be transformed into a variety of forms according to the need, therefore, in the practical application need to choose the appropriate control mode and power type according to the specific needs.

1. Power components: mainly composed of engines, pumps, valves, etc., where the engine is the core part of the power and the pumps and valves are used as the executive part of the power.

2. Execution components: mainly composed of hydraulic cylinders, motors, etc., of which the motor as an actuator, in the actual work according to the different needs to choose the type and power of the motor.

3. Control elements: mainly include temperature sensors, pressure sensors, etc., which are used to collect external environmental parameters as well as internal parameters of

the control system.

4. Control circuit: mainly composed of oil tank, relief valve, etc., used to control the working state of the mechanical hydraulic transmission system and the pressure size, etc.

5. Other: mainly including pipelines, fittings and other auxiliary parts, such as safety valves, filters, etc. In short, the mechanical hydraulic transmission system consists of a variety of components, which need to be selected according to the actual needs of the corresponding control methods.

#### **4. Problems in the Design of Hydraulic Systems**

1. The choice of hydraulic oil is not reasonable. Because of the viscosity of the hydraulic oil, so in its selection, must take into account the temperature of the working environment of the mechanical hydraulic system, pressure and working frequency and other factors, in order to meet the working requirements of the mechanical hydraulic system, under the premise of selecting the appropriate fluid. If the viscosity of the hydraulic oil is too large, then it will lead to poor liquidity, increased resistance to flow, and even lead to blockage of the system; if the viscosity of the hydraulic oil is too small, then it will lead to poor liquidity, the fluid in the flow process is subject to great resistance, the system can not operate normally.

2. The pipeline design is not reasonable. In the design of hydraulic system, the working condition of the system needs to be analyzed and calculated. As the designer does not have a good planning and design of the pipeline, which leads to the hydraulic system can not work normally. For example, in the design process, there is a certain amount of flow loss and pressure loss in the pipeline. If the pressure loss is too large, it will lead to poor liquid flow or even overflow phenomenon; if the flow loss is too small, it will lead to the system can not work properly. Therefore, when designing a hydraulic system, you should plan the flow rate of the pipeline in a reasonable way to minimise pressure loss and flow loss.

3. Improper selection of hydraulic components. In the selection of hydraulic components must be based on the actual working conditions to determine the model and specifications of the components. For example: in the design of hydraulic systems need to choose the appropriate pressure valve, safety valve and other components, but some designers do not select the component model according to the actual working conditions, but in accordance with past experience to select the component model, resulting in the design of the hydraulic system performance can not meet the actual work requirements. Therefore, in the selection of hydraulic components to pay attention to the selected components and the actual working conditions combined, in order to effectively ensure that the performance of the hydraulic system to achieve the desired goal.

#### **5. The Design of The Hydraulic Transmission System Should Pay Attention to Matters**

1. In the design of mechanical hydraulic transmission system, to minimize the number of hydraulic components, control the size and shape of the components, improve the reliability and stability of hydraulic components. In order to reduce the wear and tear of hydraulic components, high-quality materials should be used for production, especially to

pay attention to the design and selection of sealing devices. At the same time, we should choose high quality hydraulic oil as far as possible to avoid the poor quality of the oil and cause the mechanical hydraulic transmission system to run abnormally[4].

2, in the design of the hydraulic transmission system, to take into account the coordination and interchangeability between the various systems. In the mechanical hydraulic transmission system operation process, each system affects each other, mutual constraints, if a link failure or problems, will lead to the entire system operation is not normal. Therefore, in the design, to strengthen the coordination between the systems to consider, to avoid the situation of mutual influence or constraints.

3, in the mechanical hydraulic transmission system design, to take into account a variety of factors on the mechanical hydraulic transmission system in the operation process of the analysis and processing of factors affecting. In the mechanical hydraulic transmission system operation process will produce some vibration and noise, if these vibrations and noise are not effectively solved and controlled in a timely manner, it will reduce the stability and reliability of the entire mechanical hydraulic transmission system operation. According to the emergence of the problem in a timely manner to take effective measures to deal with and solve, so as to improve the stability and reliability of the operation of the mechanical hydraulic transmission system[5].

#### **6. Principles and Applications of Traditional Control Strategies**

The traditional control strategy is mainly based on the feedback signal of the hydraulic components to adjust the mechanical hydraulic transmission system, so that the system can achieve the maximum degree of automatic control. The traditional control strategy is to use sensors and actuators to obtain feedback signals, according to the changes in the feedback signal to adjust the parameters of the hydraulic components, so that the mechanical hydraulic transmission system to achieve automatic control. The traditional control strategy has many shortcomings in the practical application process, such as the inability to achieve effective processing of non-linear, time-varying and uncertain factors. In order to solve these problems, many new control strategies have been proposed. With the rapid development of modern science and technology, electronic information technology, computer technology and network communication technology, the traditional control strategy is also constantly developing and improving, so as to better achieve the automatic control of mechanical hydraulic transmission system.

#### **7. Conclusion**

The design and control strategy of a mechanical hydraulic transmission system is a complex and critical issue that is important for improving the performance and service life of the mechanical system. The design of a mechanical hydraulic transmission system should start from the whole, considering the coordination and optimisation between the various parts to ensure the stability and reliability of the system. In the choice of control strategy, the most suitable control method should be selected according to the actual situation and needs of the system, and continuously optimised and improved. Finally, future research and development of mechanical hydraulic transmission systems will require more

interdisciplinary cooperation and innovation in order to adapt to changing market demands and technical challenges.

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