HYDRAULIC SERVO-PROPORTIONAL VALVES AND INDUSTRIAL APPLICATIONS

HİDROLİK SERVO ORANSAL VALFLER VE ENDÜSTRİYEL UYGULAMALARI

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Özet

Hidrolik Servo Valfler, bir tür makine veya cihazdaki (genellikle bir piston veya silindir yoluyla) konumu, hızı, basıncı veya kuvveti kontrol etmek için bir elektrik giriş sinyaline veya komutuna yanıt olarak hidrolik yağ akışını ölçen bir cihazlardır. Servo oransal valfler tek kademeli, iki kademeli veya üç kademeli tasarımlara sahip kapalı çevrim kontrol cihazlarıdır. Servovalf'lar ve Servo-Orantılı Valfler, değişen analog veya dijital giriş sinyalini kademesiz bir hidrolik çıkışa (akış veya basınç) dönüştüren elektrohidrolik olarak sürekli çalışan valf türleridir. Oransal valfler genellikle bir silindire veya hidrolik motora giden basıncı kontrol etmek için kullanılır. Sonsuz makara konumlandırması ve dolayısıyla kademesiz olarak ayarlanabilir akış hacimleri sağlarlar. Ortaya çıkan akış veya basınç çıkışı, giriş değişikliğiyle orantılıdır, yani girişin üç katı, çıkışın üç katını üretirler. Servo valfler çok yüksek doğruluk, çok yüksek tekrarlanabilirlik, çok düşük histerezis ve çok yüksek frekans tepkisi ile çalışırlar. Servo valfler tek kademeli, iki kademeli veya üç kademeli tasarımlara sahiptir. Servo valfin temel çalışma prensibi, sistem kontrolünde değişken düşük gerilimden çok, değişken düşük akım kullanılmaktadır. Kontrol sinyali bir kuvvetlendiriciye iletilir. Kuvvetlendiriciye gelen kontrol sinyali daha da kuvvetlendirilerek, valfin istenen pozisyona gitmesini sağlar. Bu sayede aktüatöre istenen miktarda hidrolik güç aktarılır. Bir pozisyon algılayıcısı ile aktüatörün konum bilgisi elektriksel sinyale dönüştürülür ve geri besleme olarak kullanılır. Bu geri besleme kuvvetlendiriciye gönderilir ve servo valfi kontrol etmek için üretilen gerilimin kontrolü bu şekilde sağlanır. Valf, kontrol sinyallerine hızlı ve hassas yanıt vererek uygulamanızda doğru ve verimli çalışmayı sağlamalıdır.

Anahtar kelimeler: Hidrolik Servo Valfler, Oransal Valfler, Endüstriyel Uygulamalar, Makine Mühendisliği

Abstract

Servo Hydraulic Valves are devices that detect oil flow in response to an electrical input signal or instruction in order to regulate position, speed, pressure, or force in a machine or device (often via a piston or cylinder). Servo proportional valves are closed-loop control devices that come in single, two, or three stages. Servovalves and Servo-Proportional Valves are electrohydraulically continuously functioning valves that transform a variable analog or digital input signal into a stepless hydraulic output (flow or pressure). Proportional valves are frequently used to regulate the pressure on a cylinder or hydraulic motor. They allow for limitless roller placement and hence indefinitely variable flow volumes. The output flow or pressure is proportionate to the change in inlet, thus three times the inlet generates three times the output. Servo valves provide extremely high precision, repeatability, minimal hysteresis,

and high frequency responsiveness. Servo valves are available in single-stage, two-stage, and three-stage configurations. The servo valve's main operating concept is that variable low current rather than variable low voltage is employed in system control. An amplifier receives the control signal. The control signal to the amplifier is boosted even further, allowing the valve to move to the proper position. The desired quantity of hydraulic power is therefore supplied to the actuator. The position information of the actuator is translated into an electrical signal and used as feedback by a position sensor. This feedback is provided to the amplifier, which controls the voltage produced to regulate the servo valve. The valve should respond to control signals promptly and precisely, guaranteeing proper and efficient performance in your application.

Keywords: Hydraulic Servo Valves, Proportional Valves, Industrial Applications, Mechanical Engineering

1. INTRODUCTION

The ability of modern technology to manage a wider range of actuation systems, including pneumatic and hydraulic systems in process industries, has naturally boosted interest in servo and proportional valves. These electrohydraulic and electro-pneumatic continuously acting servo valves and servo proportional valves convert fluctuating analog or digital input signals into step-less output signals. This signal might be a pressure or flow signal. These electrohydraulic valves are servo valves and servo-proportional valves. A valve design with a bushing spool assembly and highly precise metering edges is referred to as a servovalve. We refer to valves with a spool-in-body configuration as servo-proportional. Precise control over location, velocity, force, and pressure is possible with valves. Controlling the pressure to a hydraulic motor or cylinder is a frequent application for proportional valves. They offer endlessly changeable flow levels due to their infinite spool location. Triple the input yields triple the output, meaning that the flow or pressure output that results is proportionate to the input variation. In order to manage position, velocity, pressure, or force in a machine or other equipment, a hydraulic servo valve measures the flow of oil in response to an electrical input signal or instruction (typically through a piston or cylinder).

2. METHOD

All fluid-related operations can have pressure, temperature, and flow control thanks to proportional control valves. It enables direction changes as needed and adjustments to the fluid's flow rate and pressure as it passes through the system. These valves may be utilized against hot water and oil, nitrogen, acid, etc. since they are resistant to high temperature and pressure values. It is employed in the movement and management of fluids. Proportional control valves come in a wide variety of varieties, based on factors like the environment in which they will be utilized and the impacts they will be subjected to.

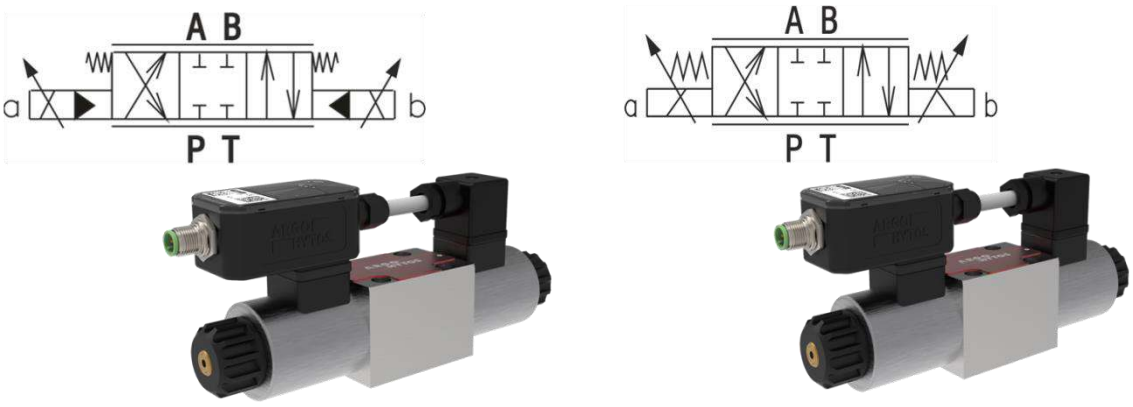


Figure 1. Proportional Directional Control Valves, pilot operated on the left (argo-hytos.com, 2023).

A servo valve is essentially a directional control valve with an infinite range of placement options. In this manner, the fluid's direction and amount are both managed by the servo valve. Servo on valve: A transducer and a mixer, whose feedback is sent on command, measure the regulated output parameter (Doddannavar et al., 2005). Servo, or closed loop, control systems are very efficient in controlling position, flow, and actuator acceleration. They may also be used to repair sensitive circuits while sending out notifications. Generally speaking, servo systems need continuous pressure support. Hydraulic actuators or hydraulic motors can be controlled by servo valves. The servo valve has several significant benefits, one of which being among these is its ability to use a small electrical signal to precisely position the actuator and motor.

The fact that the intricate pieces are made to exact tolerances is a drawback. Its construction is therefore expensive and intricate. Generally speaking, hydraulic servo valves offer precise placement or are utilized as industrial hydraulic equipment when proportioning is necessary. Depending on their design, they might be plate nozzles (also known as flapper or leaf nozzles), jet nozzles, or direct drive servo valves. It was created (Yazıcı, 2003).

3. FINDINGS

The ability of servo valves to control flow using an electrical input signal is its most crucial characteristic. It offers a very tiny input signal and a fully linear connection between the flow rate and the output signal. Its output signal is large. extremely low, around 0.08 W, when using valves for electro-hydraulic control With strong electrical impulses, it is possible to accurately produce hydraulic powers more than 100 kW by auditing. However, because solenoid control is used to drive proportional valves, servo. We see that it seems to be a substitute for valves. These days, proportional valves are different since hydraulic fluids may be utilized with them. Majdic et al.'s investigation used water-based hydraulic a 4/3 proportional directional control valve with distilled clean water as the hydraulic fluid was utilized in the systems (Majdic, 2011). A single-phase open-loop hydraulic proportional valve was also utilized by Amirante et al. The supplying control with their systems, they made a comparison with closed loop systems (Amirante, 2008). Accordingly, proportional valves may be employed with various hydraulic fluids and with both open and closed cycles (Özcan, 1999). The feeding signal is unavailable in open loop systems, which is the only distinction between them and closed loop systems (Kocabas, 1999).

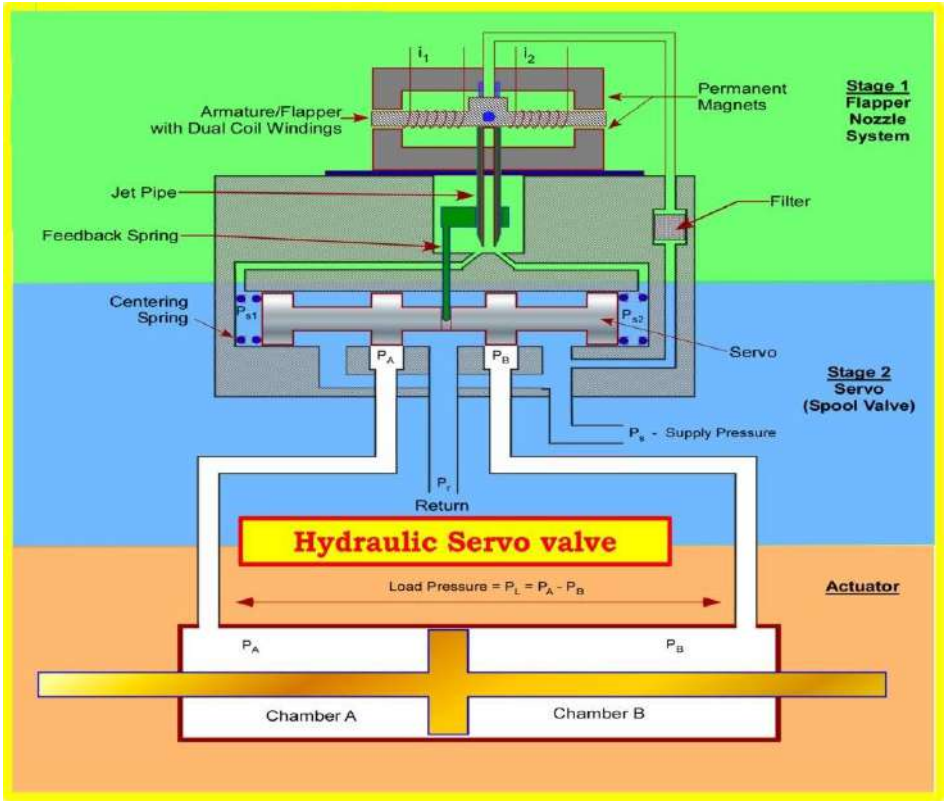


Figure 2. Hydraulic servo valve working principle schematic illustration (Automationforum.com, 2023; DesignAerospace LLC, 2013).

Delivering the necessary flow rate to the system is the most fundamental method of ensuring hydraulic system efficiency in the sector, regardless of the significance of controls or the type of valve that best suits demands (Calışkan, 2008). This servo valve has been chosen based on the proper circumstances and is acceptable for locations demanding a high degree of accuracy. Servo-valve operates with great accuracy, excellent timing, and speed to transport big loads without shock. Alone is insufficient to do this. In addition to servo valves, these systems also require control components, closed loop controls, measurement technologies, and auxiliary function elements (Yiğit et al. 2008; Yazıcı, 2003).

The following factors make proportional control valves the preferred option: Their performance in sealing is high. They offer accurate flow management. They can be used in places with high pressure and temperature levels. Proportional control valves do have certain drawbacks, though. These valve types have the potential to endure pressure losses. Furthermore, sludge or debris may collect inside the valve owing to its construction. Generally speaking, they cannot be utilized for applications requiring bidirectional flow and are only appropriate for unidirectional flow. In essence, valves provide two purposes: With the on/off control type of the first kind of valves, the valve fully opens or closes, cutting off or releasing the fluid. With the second kind of valves, the fluid flow rate may be adjusted proportionately to offer the needed or desired flow rate. These valve types are known as proportional control valves because they allow for regulated fluid transmission

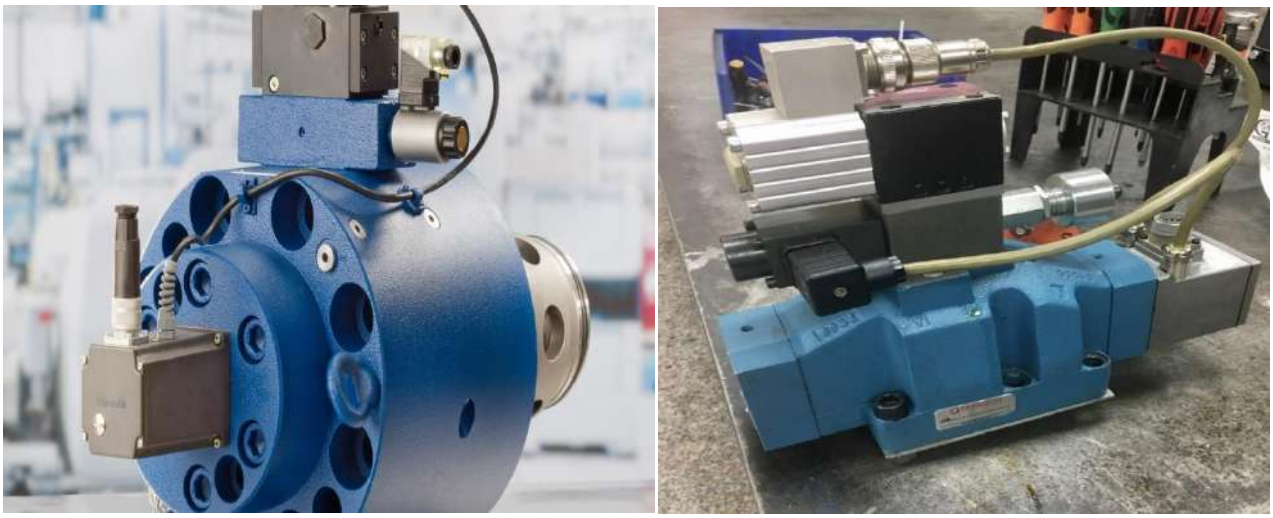


Figure 3. Some examples of industrial applications of Servo Hydraulic Valves

A proportionate electrical input signal can be used to regulate the pressure, flow, and direction of hydraulic proportional valves. The valve can be controlled by electronic cards that are either externally controlled or built within the valve itself. Certain valves require feedback because the industrial or mobile application in question may call for varying valve sensitivity and speed. The reaction time is impacted by the valve's feedback mechanism. Without feedback, the proportional valve response time is around 105 ms. The reaction time of the feedback proportional valve is around 30 milliseconds.

In hydraulic circuits, directional control valves govern the direction and timing of the fluid's flow. When desired, they open and close the flow route and alter its course accordingly. Servovalves got the chance to be employed in the industrial sector after being first employed in the military for precise control. These days, servovalves are employed in both military and commercial aircraft as well as spacecraft. High dynamic performance testing machines are one of the most significant application areas in the industrial world. Fast proportional solenoid valves and other fast valve types have started to replace servo valves in the industrial industry in recent years due to their extremely high prices (Trinkel, B., 2008).

4. RESULT, CONCLUSION AND SUGGESTIONS

An electro-hydraulic servo valve system's hydro-mechanical components interface with the hydraulic system's electronics to generate movement. A signal produced by electrical current is used to carry out this communication. When electrical impulses are present in movement systems, precise control becomes evident. As a result, computer, software, electrical, and mechanical technologies form the foundation of a servo valve. It is a driving equipment with several uses. Because of its various field applications. They are advantageous in a variety of ways. To generate movement in the hydraulic system, the hydraulic servo valve communicates with the hydro-mechanical and electrical components. Electrical current serves as a signal for this communication. In movement systems with electrical impulses, precise control is crucial. Because they have a variety of field applications, they provide benefits in many sectors.

Servo valves are now widely used in industrial control applications for ground-moving vehicles, including cranes used in cargo transportation, mobile vehicles, wind turbines, ships, the iron

and steel industry, lifting vehicles, tree cutting equipment and agricultural machinery, articulated arm circuits, and precision control elements for military use.

In response to rising demand, the sector is seeing a daily increase in the necessity for quick and economical manufacturing. The use of servo valves with intricate operational structures is further increased by current technical advancements and the rise in the number of skilled workers. The industry's growing need for these valves will also make it possible for hydraulic servo valves to advance technologically.

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