ELECTROHYDRAULIC PROPORTIONAL SERVO VALVES – ELECTROHYDRAULIC SERVO DISTRIBUTORS

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ABSTRACT: *Electrohydraulic servo (SVEH) as interface elements in hydraulic machines are actually operated proportional hydraulic distributors, which are used in automatic control systems using full response elements placed in the operated mechanism. Electrohydraulic servovalve is at the interface between control electric type and Hydraulic actuation. The output (flow, pressure) is adjusted according to the size of the control signal (current, voltage), with a related reaction (mechanical, hydraulic, electrical) [1], [27], [28]*
Servo valves have a quick reply, low mass per unit power output, reliability and a wide frequency band. Analysis and synthesis SVEH requires the use of methods from the theory automatic systems, generally resorting to an analysis linearized around the operating point.

KEYWORDS: *Electro hydraulic servo valves, floor nozzle flap, drawer floor distributor, servovalve electrohydraulic floor, reaction mechanical, electrical and special reactions, feature static and dynamic position control, speed and pressure.*

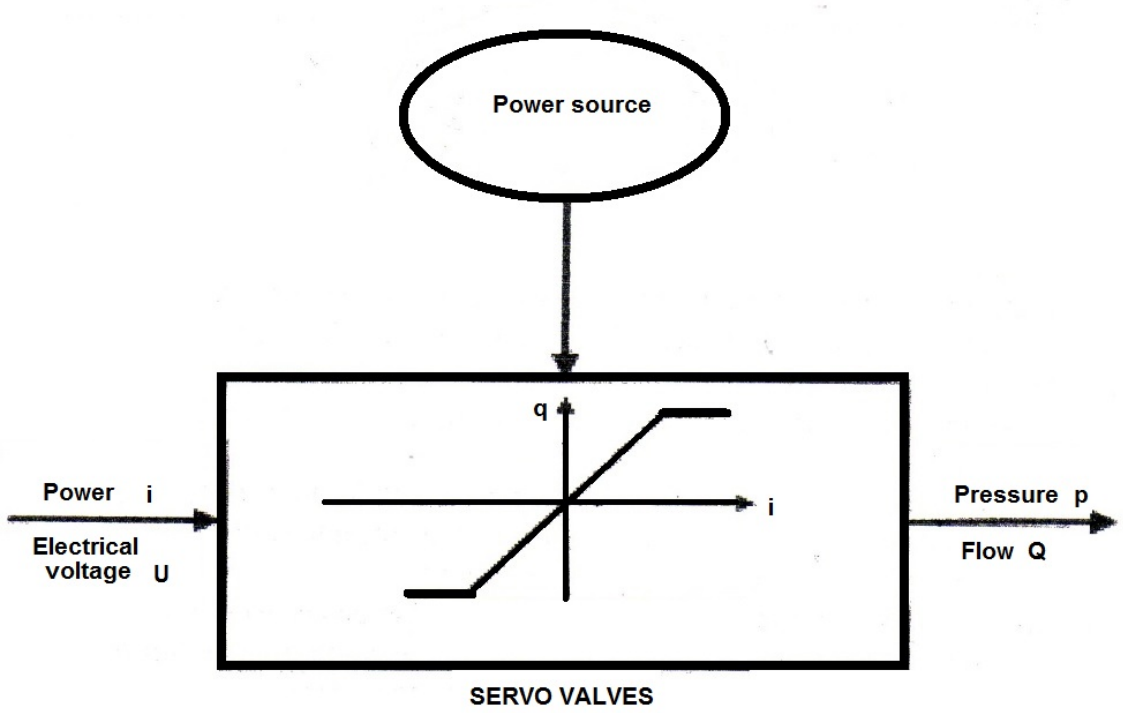
1. Introduction. Distributors and electrohydraulic proportional servo valves

Electrohydraulic control equipment containing devices and systems which ensure control hydraulic parameters such as pressure or flow, with electric controls electric - electronic. Type hydraulic components are proportional flow control devices or pressure by a law of proportionality between the size of the input electric type (current) and output size type hydrostatic (flow or pressure). Derived from classical construction equipment distribution and pressure control or flow control element have the electromechanical converter [1], [3], [8], [9], [11], [13], [25], [27], [28].
Electromechanical hydraulics proportional to convert an electrical signal, typically a current, at a flow rate or a pressure proportional to the input signal. By proper control of hydraulic parameters, ensure a controlled variation of the physical parameters of the mechanical system, such as speed, acceleration, speed, position, force, torque, etc. Two large groups of electrohydraulic control devices appeared in the last half century have revolutionized the automation domain automatization hydraulic proportional hydraulics and electrohydraulic proportional servo valves. Electrohydraulic Proportional distributor is an electrohydraulic amplifier that provides a link between current proportional and flow control adjustment. In practice, there is a formal distinction between distribution electrohydraulic proportional and servo valves, depending on the dynamic behavior because these amps steady state fulfilling the same function. Significant differences between the two groups appear only in relation to response time and static precision.

2. Electrohydraulic proportional servo valves (SVEH) – classification

Electrohydraulic servovalve is a circuit element that converts electrical input signal (current or voltage) to a hydraulic output signal (pressure or flow), while achieving a power amplifier. Electrohydraulic servovalve is a body control and a flow proportional control or hydraulic pressure through an electrical control signal. Electrohydraulic servo valves in the same system combines the advantages of electron order - power (convenience and speed signal processing) with the

hydraulics (small gauge per unit of power and can continue to adjust the set value). Constitute the interface between the electrical equipment and the hydraulic actuator. A conversion signal (electrical flow and / or pressure) and an amplifier (0.030 to 0.200 W, the power of up to 200 kW). As such, electrohydraulic servovalve is a power modulator for the relationship between power control and power command is very high (at $10.^4$ - ... 5.10^5), thus the function of power amplifier. Servo valves as part of automatic hydraulic interface converts the electrical signal into a low power motion hydraulics, which acts to control flow and servo valves called the "flow" or control pressure actuating unit acted servo in this case is called the "pressure". In other words, it can be said that a servovalve increases the amount of input energy consumption corresponding to the output size obtaining a controlled and regulated by the size of the entry (Fig.1) [1], [9], [11], [29].



Controlled power 22.5 mW Output control 50 – 100kW

Fig. 1 Structural diagram of an electrohydraulic servo valves

Servo valves, as equipment control electro, performed, besides selecting hydraulic circuits and droselization their strict proportional the size of current control. The emergence servovalve appearance was required by industrial development whose complexity and performance of aircraft hydraulic systems, machine tools, military equipment and automated production lines, led to the design and manufacture of special products that combine electronics, precision mechanics and hydraulics. Electrohydraulic servovalve combines fast and accurate processing of data by electronic means of transmission power amplified by hydraulic methods.
As such, the modern trend of the development of hydraulic servo and proportional dispensers integrated electronics is the construction. Specifying and selecting servovalve is important for the system designer. Servovalve determine the dynamic response speed and accuracy of the system, as servovalve configuration and determine system requirements. Servo responded quickly, low mass per unit power output, reliability and a broadband power. However, servovalve is characterized by instability of the working fluid temperature change or the environment and the need to filter the working fluid. At the same time, it requires high precision in the fabrication of execution, a perfect seal between the moving and immovable, and operation is accompanied by high energy losses, specific adjustment resistors. Ever since the advent servo (around the 50 s), they were constantly improved in terms of construction, leading to relatively simple solutions, but high performance [1], [12], [13].
Servovalve essentially constitutes an adjustment to the size of the output (flow or pressure) is adjusted according to the value of the control signal (current, voltage), with a touch response

(mechanical, hydraulic, electrical). SVEH are elements with superior static and dynamic characteristics, and performance characteristics of which are presented in [1], [3], as follows:
-power amplifier 10^6 and frequency up to 200 Hz work;
- electro-mechanical converter, in most cases, polarized type torque motor, the motor is used in rare cases electrodynamic transducers pneumatic - mechanical, piezo-electric torque motor, etc;
- first stage hydraulic amplifier is in most cases the nozzle-valve type, but there are special distributor drawer longitudinal tube amplifier - jet, etc;
- the degree of coverage of the control edges of the second stage hydraulic amplifier is in mostly zero;
- reaction tray position of the second stage will be like: barometric, hydraulic, mechanical, electrical, constant reaction pressure, reaction pressure transient or special effects feed back;
- for flow control, pressure control, control flow and pressure:
- very high fineness of the filter (1...5 μm);
- with one, two, or three hydraulic amplification stages.

In Fig. 2 presents a general classification (overall architecture) of electrohydraulic servo, removing into evidence a general classification, the number of floors, type of reaction and control structure floor. Role of hydraulic floor getting progressively proportionality flow or pressure with control current size. I adopted the following solutions:
- floor with spool distributor;
- floor nozzle – damper flap;
- floor oscillating jet;
- floor with jet deflection.

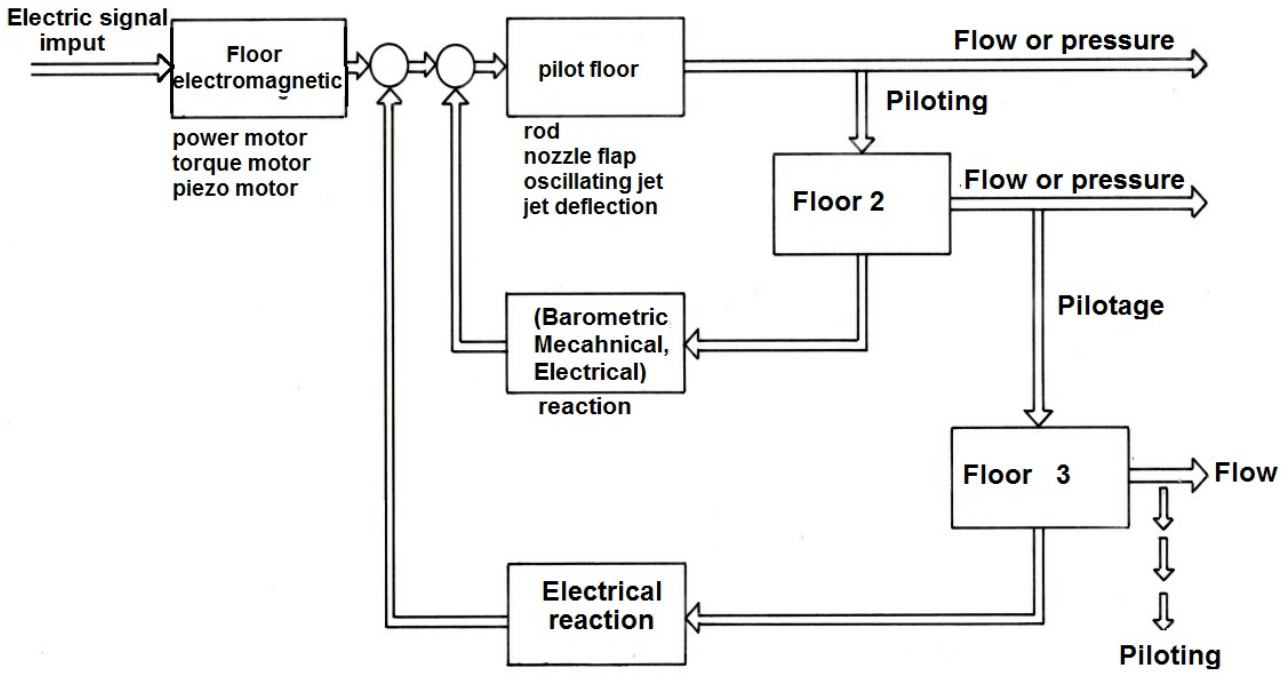


Fig. 2 The general architecture of electro hydraulic servo

The last three design solutions operate at flow rates of 1.5 – 2 l / min for the control pressure of 7 Mpa. In turn, distributors spool valve is classified into:
- spool valve;
- drawer plan;
- drawer conical (conical valve);
- drawer ball (ball valve).

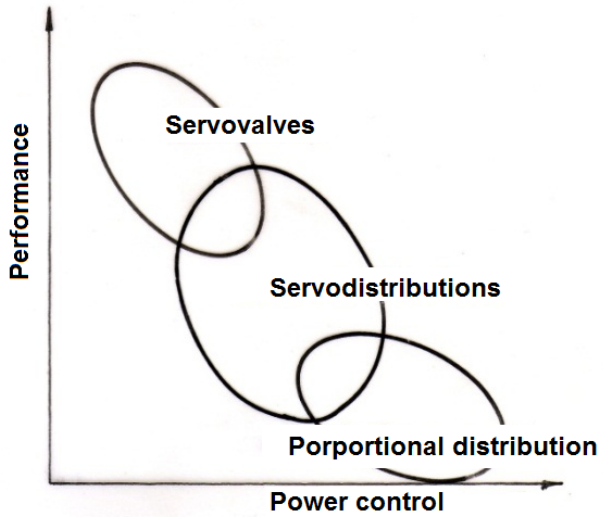
Depending on the number of hydraulic floors, they are as follows:
- servo valves with hydraulic floor (body control motor direct-floor distributor);
- servo valves with two floors: one floor and a hydraulic floor of principle distribution;
- servo valves with three or more floors: each floor is piloting floor to the next floor.

Since, pilot spool is provided by the pressure difference at the ends of the tray to ensure a stable position of the device it is necessary to introduce a reaction, so achieving a position adjustment of the drawer. The reaction may be: barometers, mechanical and electrical. The line on the controlled power and performance is shown in Fig. 3 [1], [3], [7], [13].

2.1. Electrohydraulic servo valves with hydraulic amplifier block

are intended to regulate low flow (Q ≤ 20l/min) and consist of engine torque and amplifier nozzle – clamshell fluidic amplifier, jet fixed or mobile jet with deflector or distributor who supplies drawer execution element. EHSV are characterized as having outstanding distinct dynamic performance [Fig.4] [1], [9], [11], [13], [29],.

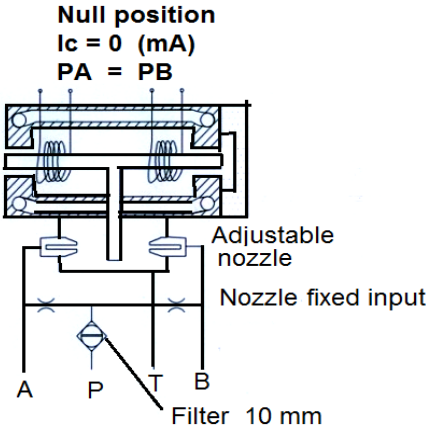
Direct drive drawers distribution was made possible by progress in permanent magnet technology electromechanical converters, high energy (rare earth magnets). By using these materials was possible to make small converters and high output torque. Typically, a servovalve with such a converter, operation forces have values from 1-50 daN, especially in the case of jamming tendencies of the tray.

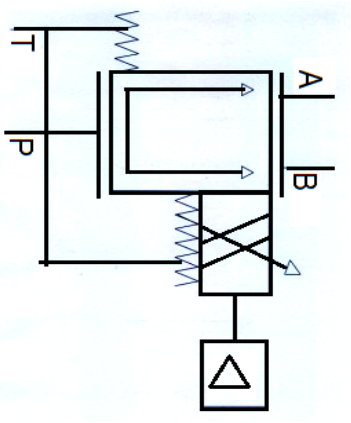


An electromechanical converter for direct conversion done a couple current value is a function of command. This can be done by using a spring element integral with the spool, or by providing a closed loop flow control. Choosing a solution or the other depends on the particular system. In most applications using a brushless motor, the angular displacement of the output shaft [± 20 º] and confined to a lever operated cam to make linear movement required.

Improving performance and reducing power servovalve dynamic electromechanical converter can be obtained by minimizing the moving masses and Colombian friction.

Fig.3. Performance feature – power control unit.





a) functional diagram – operating principle b) symbolic representation

Fig.4. Pressure valve, floor nozzle – damper [1], [3], [13], [14], [15], [16], [20], [27]

The reduction in friction is provided by radial forces balance and the use of special spring does not introduce any radial component.

For very low flow rates (Q < 2 l / min) hydraulic drawer can be replaced by a nozzle - valve, single or differential. Nozzle - valve system ensures small response time due to small parts in motion is frictionless, but the yield is lower due to flow through the nozzles drained 4 is final. Servo valves with direct conversion are less sensitive to fluid contamination or small deviations and deviations of input electricity because electric power control values are much higher. Gate servovalve plan consists of drawers opening that connect distribution.

SVEH torque motor and nozzle - valve resistance (fig. 4) is a combination of half bridge B - B and control flow rates (Q < 1 l / min) , acting as pressure SVEH that carried out the A and B pressure difference Δ proportional with current BC ± Δ p = pA ± pB) = f (ΔiC) (fig.4. a, b). These servo valves are typically used for command and control proportional dispensers, adjustment shelves and servo valves proportional pressure.

Engine electric motor of torque forces acting against the flow up to a certain value, the tray is in turn returned to the central position at a certain pressure drop , even at maximum input signal.

Consequently, the window area is reduced and the flow distribution decreases, this effect has a positive influence on the dynamics. Stroke is less servovalve is faster and there is a reduction in the amplitude due to the limited dynamic function of the pressure drop ΔP

The electrohydraulic systems used in aviation there is a new electrohydraulic servovalve model with direct electrical conversion , which is made up of two identical electromechanical converters.

The rotor of such a converter is made up of four alloy magnets samarium - cobalt. At such a servovalve frequency band can be up to 100 Hz, the limit being the size of the angle of rotation of electromechanical converter.

In Fig. 5 shows a sectional view of a servovalve controlled by an electromagnet directly proportional to the force and electromechanical transformer. For the position control using an inductive transducer LVDT and pressure control of Integrated pressure transducer. Dispenser coupled to the axis of joint control with proportional solenoid valve connecting force between holes progressive working spool [16], [17], [18], [19], [20], [21], [22], [26], [27], [29].

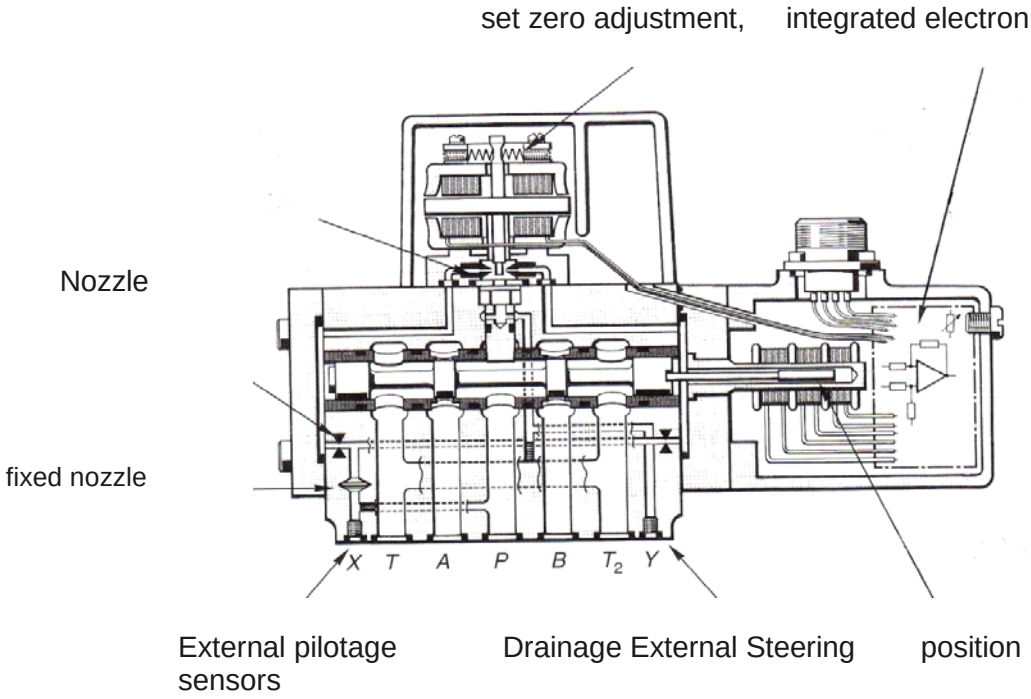
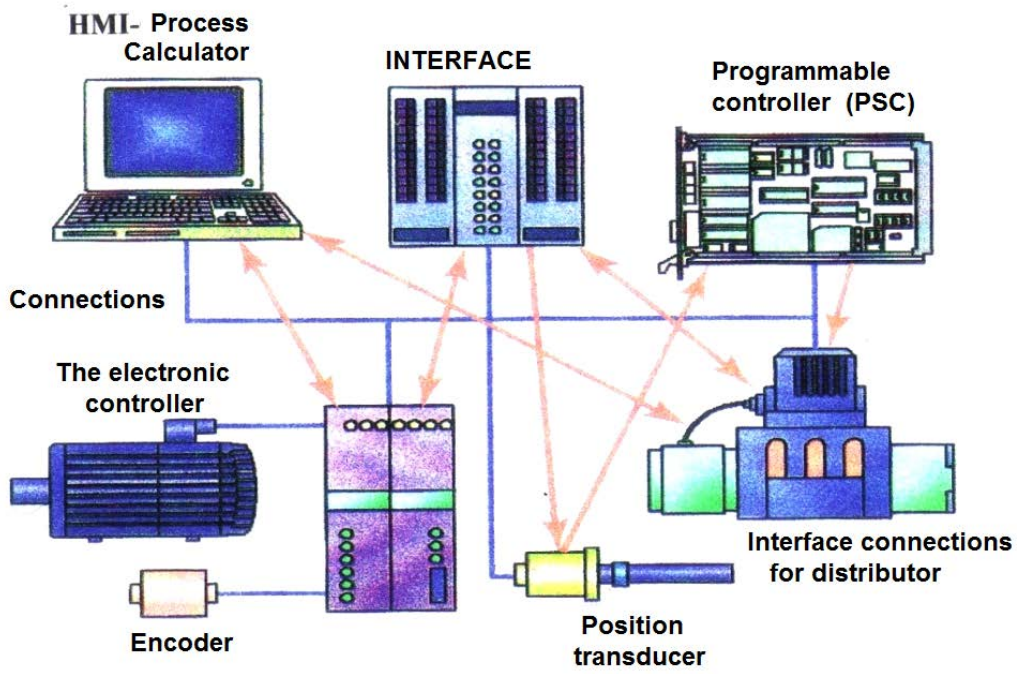


Fig. 5 Electrohydraulic servo valves two floors piloted ordering system with nozzle - valve with integrated electronics and inductive position transducer (after MOOG) [1], [13], [18], [19], [21], [22]

Reduced engine power hysteresis and linearity improvement between the control and spool displacement is achieved through the servo - control integrated servovalve spool position.
For the direct control servo valves , solenoid control system works in wet , thus reducing the friction forces that could impair performance servovalve. Leakage laminar rolling drawer area levels are removed through the drainage system of servovalve. The electronic circuit consists of an integrated circuit in conjunction with a converter μP to direct and control DSP control parameters, displacement and pressure. An analog interface - allows digital finally servovalve communication with the electronic management of the servovalve.



b) decentralized electronic control electrohydraulic servovalve
Fig .6. Electrohydraulic servovalve floor with jet cell (command - piloted s) (by MOOG)

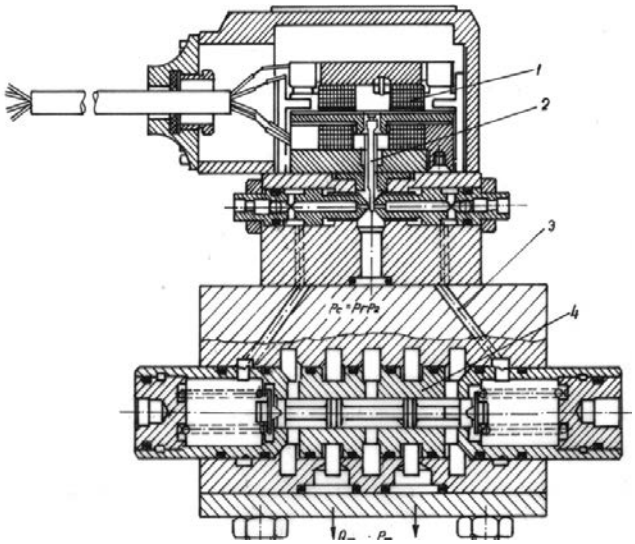
In Fig. 6 presents an electrohydraulic servovalve with drawer and electrical response, the microcontroller and other components incorporated to monitor and control the servovalve flow. Servovalve spool control system is via nozzle - valves amplifier (Fig. 5) or inkjet phone [1], [3], [13], [20], [21], [22], [29].

2.2. ELECTROHYDRAULIC SERVO FLOOR (GUIDED) were imposed in controlling the condition of higher flow rates, which are presented SVEH storey single stage control for moving the main spool. Main spool displacement achieved by creating a pressure difference at the ends of his need automatic position adjustment reaction pressure, reaction force - displacement reaction displacement mechanical, hydraulic jet, jet power and special constructions.
Piloting or preorder main hydraulic spool can be achieved by: drawer hydraulic piloting jet - flap system (fig. 5) and mobile nozzle. Piloting servo slide is rarely used because of disadvantages: higher response time and higher power of command, determined by moving the tray table, and loss of flow, where the drawer is negative coverage.
The nozzle - valve (Fig.4 and 5). The pilot stage, were imposed mainly due to its low inertia, its mobile element (valve) is very easy. The nozzle - valve embodiments can run - functional single and double nozzle. Nozzle system - wide plain nozzle contains a single final nozzle that allows execution order items in one sense, because it is associated with a single hydraulic motor rooms.
The nozzle - dual range (Fig.5) allows command execution element in both directions of travel. Bold servo valves with nozzle phone use exclusively in the preorder stage servo amplifier with two floors , the main disadvantage of loss due to relatively high energy. Mobile nozzle system is less

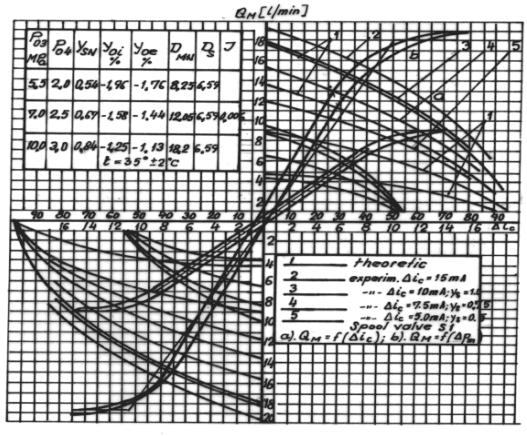
sensitive to oil contamination due to final nozzle diameter and larger gap X0 as the nozzle valve system. In addition, the system is free of very high precision requirements of a nozzle system - wide double nozzle.

Servo valves with mechanical balancing. The simplest version is the reaction SVEH so-called pressure. Balancing the main drawer is secured by force -induced deflection of compression springs (Fig. 7). Using compression springs drawer balance lead to shortcomings like: flow rates and high pressures are required rigid arches sometimes impossible constructive: it requires special precision springs, elastic constants for ensuring identity: compression coil springs inserted radial components that increase friction in the drawer.

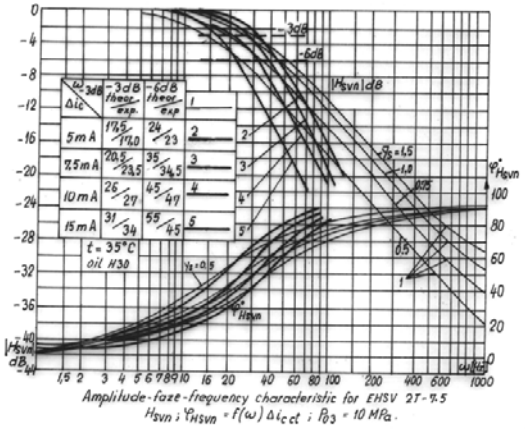
For example, in Fig. 7 a is the whole floor control - reaction pressure spool to achieve SC Electrotimiş Timisoara static and dynamic characteristics of the experimentally obtained experimental static and dynamic characteristics (Fig. 7 , b , c) [1], [2], [3], [4], [5] reveals the following : microgeometry control assembly has an influence quantity and quality of static and dynamic characteristics of SVEH by changing parameters characteristic, linearity, resolution, hysteresis, symmetry and zero current, is frequency response - 3dB response time. Use of swivel disc coil spring support (fig.7.a) or some special springs that does not introduce radial components, reduces radial components, reducing friction forces.



a) Feedback electrohydraulic pressure servo valves SVEH -2T (manufacturing SC Electrotimiş - 1986 to 1990). 1. SV 00 engine torque 2. Hydraulic potentiometer (nozzle - clamshell) 3. Control distributor 4. Whole drawer – distributor



b) Static characteristic Qn = f (p, Δic) for servovalve SVEH 2T - Electrotimiş



c) Feature servovalve frequency SVEH 2T - Electrotimiş

Fig.7 Electrohydraulic servovalve reaction barometric SVEH 2T -SC Electrotimiş (1986-1990)

Servo valves with hydraulic balancing. Hydraulic balancing drawer can be obtained in two ways [1], [9], [11]:

- by creating a hydraulic system tracking the drawer and wide format;
- by changing the value of hydraulic resistance circuit arranged resistors associated with hydraulic pilot and integral with hydraulic drawer so went with it.

Servovalve in Fig. 8 is a hydraulic follow-up. Features of these servo valves is placing the final nozzle 8 Df, in the absence of hydraulic spool centering springs. As a result, the position depends exclusively drawer flow forces the blade and hydraulic drawer. Hydraulic 4 drawers zero coverage will handle the zero position, the position where its strangulation slots are closed and the final nozzles and hence Df hydraulic drawer are symmetrical in relation to three of the engine torque range (1, 2). For the zero position, the two pilot pressure are equal, respectively: PP1 = PP2 = 0.5.P0.

Rotating the blade 3 occurs disrupting the pilot pressures PP1 and PP2 as a result of its displacement in relation to the final eight nozzles arranged in the hydraulic spool 4. The emergence of a differential pressure differential pressure piloting appearance Pp = PP1 - PP2, which will move to the hydraulic compartment will be restored when the initial distance between the blade and the final nozzles (nozzles palette symmetrical to the final). Return to the equality of the two pressures, the time to be restored to the initial distance between the blade and the nozzle end. Hydraulic dispenser aims largest movement direction and blade direction.

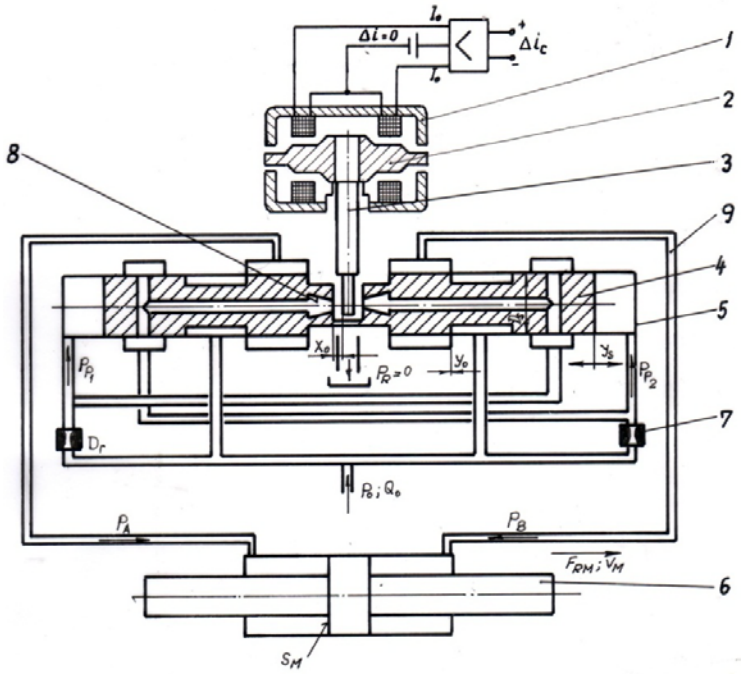


Fig.8. Servo valves with hydraulic balancing - Functional scheme
1. Torque motor; 2. Support flap; 3.tab 4. Drawer; 5. Control room drawer
6. Linear hydraulic motor; 7. Fixed nozzle; 8. Adjustable nozzle; 9. Control circuit

In Fig. 9 show a servovalve with tracking system (hydraulic balancing) Pegasus type. Rotating the blade 7 of the pilot pressure imbalance occurs as a result of its displacement in relation to the two end nozzles 9 arranged within the main tray 8. Main tray 8 will move to will be restored when the initial distance between the nozzles and blades. High accuracy positioning is ensured by achieving a very high amplifications system nozzle - wide. [1], [3], [9], [11]

Electrohydraulic servo valves with special reactions [1], [11], [13], [29]. Within this group are summarized in whose structure falls servo internal or external reactions received from controlled hydraulic motor , from which it provides balance drawer , achieving performance improvement while stationary and / or dynamic servovalve and hydraulic motor.

The most common ones are SVEH mechanical- hydraulic reaction force, the structure of which are internal reactions on which drawer provides balance , achieving improved performance both static as well as dynamic ones.

If **mechanical servo force feedback**, in addition to compulsory pilot, they contain a hydraulic amplifier block, spool type. Here centering springs Figure 10) are replaced by a spring reaction (1) tapered, willing to continue palette (5) (fig. 10). Engine electric torque (3) - EMC provides polarization final nozzle relative to the blade (2). The reaction is collected from the compartment (7) by means of the spring (1) whose spherical end is guided without play in a circular groove of the drawer. Reaction to position the drawer is felt in response to engine torque force as drawer movement relative to the position of the leaf spring deforms zero reaction, leading to the emergence of a resistant torque, torque balance involved 8 sintered filter provides filtration fineness δ < 10 mm, protecting the pilot circuit and especially preliminary nozzles 9 very small diameter. The eccentric 10 zeroing the servovalve, the change in the relative position of the intermediate sleeve 6 and 7 hydraulic drawer.

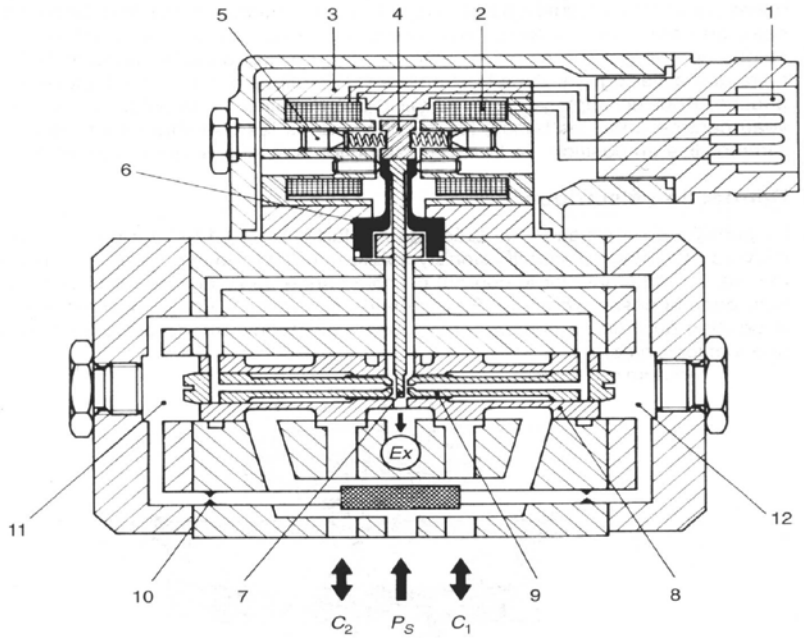


Fig.10. Electrohydraulic servo valve action force (after Orsta - Rexroth)
1. Elastic rod; 2. Final nozzles; 3. Control coils; 4. Reinforcement;
5. Throttle; 6. Bush drawer; 7. Spool; 8. Filter; 9. Preliminary nozzle; 10. Zero adjustment bolt

A detailed structure is shown in Fig. 11 position reaction is converted into reaction force as drawer movement relative to the zero position spring deforms reaction , introducing a resistant torque that balances torque.

The filter sinter (8) (Fig. 10) has a filter fineness of 5 ... 10 μm, protecting the pilot circuit and especially preliminary nozzles. The eccentric 10 (fig. 10) SVEH zeroing on change of relative position of the sleeve 6 and 7 drawer.

A detailed structure is shown in Fig. 11. Position reaction is converted into reaction force as drawer movement relative to the zero position spring deforms reaction, introducing a resistant torque that balances torque.

For servo valve with electrical position feedback (Fig. 12) link reaction is carried out through a transducer position (4, 5), type differential transformer whose rod is rigidly connected to the spool (6). Feedback signal obtained from the sensor is transmitted electronic equipment that controls the operation confirmed the main spool position. It is also used as transducers and generators Hall.

Figure 12 shows a two-story industrial servovalve and electrical position feedback. First floor nozzle - flap is separated from the main distribution floor by a device located in SVEH body. Flight and drainage are built in version control and external drain. They are characterized by high working

pressures (p_n = 15.0 ... 21 MPa) and high static and dynamic performance. In general electrical response of servo valves allow higher performance and static (linearity, resolution and hysteresis). The electronic control circuit can be separate from or integral construction, and this servovalve, to improve static and dynamic performance can be obtained by placing electrical and mechanical response of the position.

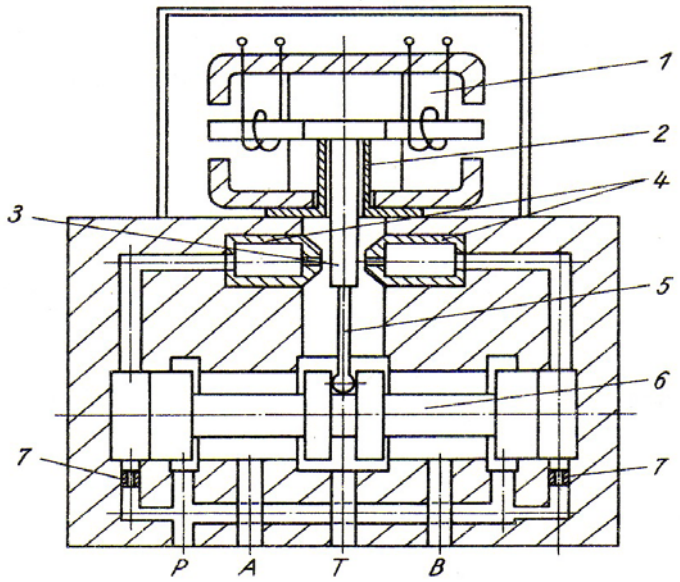


Fig.11 Servo valves with mechanical feedback functional two-story, functional principle

1. Torque motor; 2. Elastic tube ;3. valve; 4. Nozzle (adjustable nozzle);
5. Elastic rod; 6. Dispenser drawer; 7. Fixed nozzles

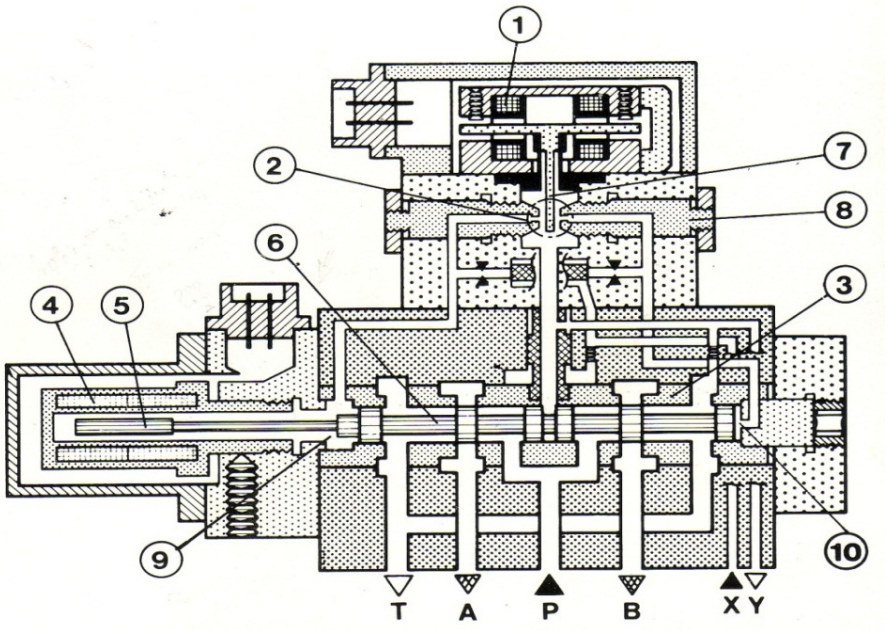


Fig.12 Two-stage servovalve with electrical amplification reaction 4WS2EE 16 ... 20 mm (after Rexroth) [1], [13], [14], [15], [20], [23], [26], [27].

1. Torque motor; 2; Nozzle final; 3. Bush - drawer; 4. Inductive displacement transducer;
5. Rod displacement sensor; 6 drawer distributor; 7. flap ; 8. floor nozzle - damper;
9, 10. Hydraulic control rooms

For the amplification with higher power (flow up to 3000 l/min) is used SVEH with three -stage amplifier, which control the position of the tray end is electrically and setting the position of the intermediate tray by the reaction force - displacement (Fig. 12 , Bosch- Rexroth). Superior natural setting was imposed because the two-story classical servo can not meet the challenges of control of flow rates. Hydraulic flow amplification floors having limited unsuitable for obtaining some dynamic features reasonable. This have won three floors using servo valves.
For such servo valves piloted with three floors, the first two levels are kept normal preamp valve and jet nozzle - floor cell and force that stage I and stage II, and the main gear. Pilot - stage III - is a distributor of drawer whose electrical response possess a connection, enabled by a displacement sensor and an electronic amplifier integrated into the servovalve.
Three floors servovalve controlling a flow rate of 1000 l / min at a pressure of 7 MPa and a control response time of the order of 14 ms . Floor distributor is serviced electrical distributor in place and piloted by a servovalve with two floors. Following a control voltage to the input stage differential pressure ensures principal drawer heads, providing flow control servovalve crossing.
Finally tray position is measured by inductive transducer so that the signal at the output of the power will be proportional to the "is" of the tray. This signal, processed electrical signal will be compared with "shall", the error is canceled electronically by the engine control torque. This type of reaction involves general composition servo controller an electronic module type that can provide internal loop closure. Floor final force can be considered as a linear element execution, driven by a servovalve (pilot) and controlled with a position transmitter. Final electronic amplifier compares the electrical signal input signal from the displacement transducer, the difference being the correction for electromechanical converter (engine torque) (fig.12). The introduction of electric reaction force floor position increases both performance static and dynamic ones, but it also increases the product price (fig.12, poz.4; 5.) [1], [3], [13], [15], [16], [17], [20], [26], [27].
Position reaction can be determined mainly drawer or drawer intermediate floor control and main tray A modern solution is the reaction through a magnetoelectric transducer (6) in the gaps two polarized magnetic circuits. Magnetoelectric transducer is integrated by a preamplifier so that the voltage supplied to the high-level output.
In the hydraulic servo used in aviation routinely using electrohydraulic servo valves to control the injector tube (nozzle phone, spout mobil) such first servo valves have been the family of Air - Equipment, type 30465 is presented in [1] . Servovalve Air Equipment 30465 is a servovalve flow, 4-way and two-story hydraulics. The range control stage is in equilibrium under the action of the pressure forces occurring in the flow of fluid through the holes, Q_2 and Q''_2 the elastic force acting on the blades is opposed to couple electrical current that occurs due to torque through the motor windings .
Spool position is a function of the size of the control current engine torque. Finally, it is worth mentioning that the flow is directly based on pressure drop and geometrical parameters Δp servovalve put out by KS coefficient form :

$$Q = K_S \cdot \sqrt{\Delta p} \qquad (1)$$

Where Δp varies with changes in supply pressure and load on the engine.
A building used a lot is the servovalve pneumohydraulic whose basic principle is similar to the electrohydraulic servo. Here, however, electromechanical converter (engine torque) is replaced by a pneumatic driver. Achieving the required control pressure is achieved by special pneumatic equipment.
Permanently reaction pressure and hydraulic balance (negative reaction pressure) main drawer, collected directly from the hydraulic motor rooms, apply hydraulic spool ends (fig. 13). It is noted that such a servovalve ensure maintenance of a constant differential pressure of the load. The position of the differential spool ends (4, 5) is a function of the differential pressure directly to the engine load PL = pA - pB Δ affixed to the end of the circular areas of the tray, and a differential pressure of the pilot, p = PP1 - PP2 Δ - ensured the movement of the throttle 3 engine torque 1-2, and applied areas of drawer ring S0 4. The position of the drawer, so the hydraulic flow to the engine, depending on the instantaneous value of the pressure p Δ which moves to the right side of

the spool 4. The limits are determined by adjusting only the saturation of the hydraulic spool (parabola dotted line to achieve maximum flow through the servovalve supplied to the load conditions [1], [9], [11], [13].
But the drawer movement occurs in the sense of decreasing opening slots contraction is the drawer, so reducing the flow of hydraulic motor supplied 6. The effect is a reduction in the pressure increase from the engine, or in the presence of the oscillatory disturbance, mitigation. Servovalve in response to pressure and spring constant of the cross (Fig. 15) is a servovalve to control simultaneous flow and pressure. Constant reaction pressure improves the dynamic stability, especially in terms of inertia damping. Flow is determined both by the current control and differential pressure load and servovalve is servovalve flow and pressure. Constant load pressure to a control amount required is achieved by negative feedback of the load pressure on the spool. Constant reaction pressure improves the dynamic stability, especially in terms of inertia damping.

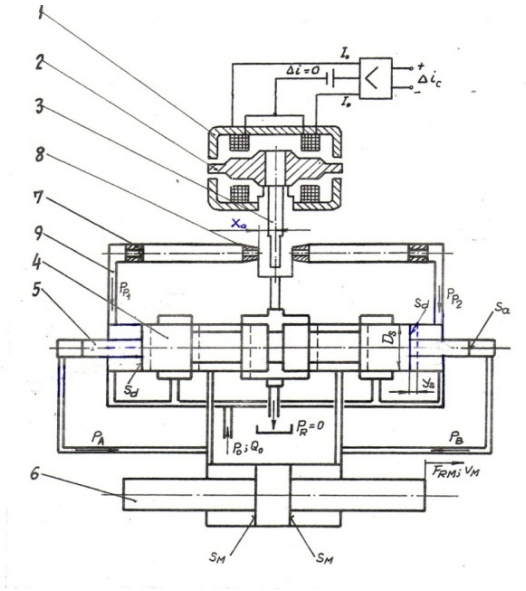


Fig. 13. Permanent jet servovalve pressure. functional diagram

1. Torque motor; 2. Mobile reinforcement; 3. Range; 4. Spool; 5. Extension rod; 6. Linear motor; 7. Fixed nozzle; 8. Adjustable nozzle; 9. Control circuit

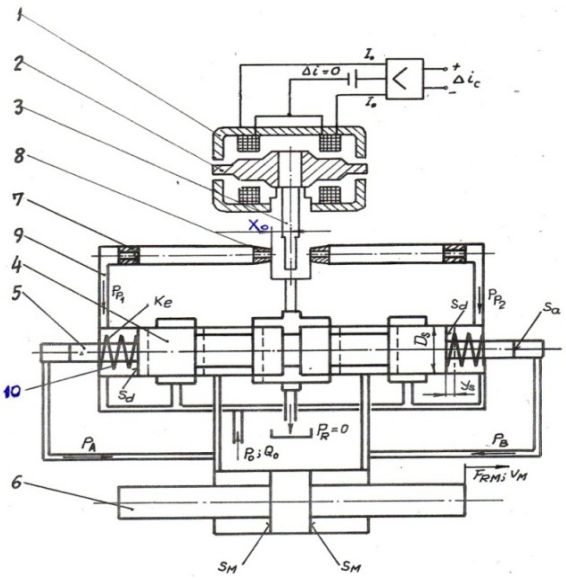


Fig. 14. Permanent jet servovalve pressure and centering springs. functional diagram

1. Torque motor; 2. Mobile reinforcement; 3. Range; 4. Spool; 5. Extension rod; 6. Linear motor; 7. Fixed nozzle; 8. Adjustable nozzle; 9. Control circuit

Specific **modern servo pressure transient** response drawer is that the reaction pressure received from the hydraulic motor only operates in phase with and affixed to the tray main hydraulic motor or torque range.
Spring centering **servo valves and pressure transient response in steady work** as a centering spring servovalve, which gives a great stiffness and transient work as a permanent jet servovalve pressure , ensuring good stabilization inertial loads .
If the servovalve centering spring and bypass network, operating selectively based on the frequency, is determined by the presence in the structure of a filter servovalve " high pass" produced by mechanical and hydraulic elements, made from the damping piston, the center of two compression springs and a hydraulic filter resistor Rh, connected parallel.
The reaction is carried out at pressure spool only transient. Differential pressure load variations are alleviated by amending flow to the engine. Increasing the differential pressure of the load moves up the damping piston, which has the effect of increasing the reaction pressure P from the left end of

the tray, followed by moving to the right of the tray hydraulics. Resulting decrease the engine output, and therefore the change of differential pressure in the opposite direction of the load. If **the servovalve spring centering network and the external leakage derivative**, the reaction of the two pressures P3 and P4 of the hydraulic motor room is taken up by means of two symmetrical damping piston. Alongside each cylinder damping are placed on the input and output filtering hydraulic resistors 13. 4, the hydraulic servovalve tray is in equilibrium under the action of the differential pilot pressure Pp = PP1 - PP2 determined by the position of the blade 3 side of the differential pressure Pr = Pr1, Pr2, and the force induced deformation of the centering spring of the tray .

The pilot pressure is applied to the annular section of the Sd, and the reaction pressure is applied to the areas of the tray Ss tail end 4. In the parking position of the reaction pressure are the same. In phase characterized by variations in load pressure, the pressure differential becomes zero Pr reaction and movement drawer flow generated by the difference leads to attenuation of the initial disturbance. External leakage network has the disadvantage of complexity and size of a larger energy loss with the presence of the resistors located to the outside. For transient -response servovalve pressure range, transient pressure response of the hydraulic motor is applied to the blade by means of the reaction piston 10 and a conical spring which is continuous range.

In order to obtain the servovalve in response to flow, it is ensured by means of a hydraulic resistance evidenced by a sharp-edged valve seating cone and whose rod is connected directly to the floor of the control range. Stationary feature race x1 - QM flow of the valve cone is linear if failure to maintain a constant pressure. These valves are arranged on the branches linear feature that connects servovalve circuit to the hydraulic motor. Of their tapered mushroom cams are connected with valve servovalve torque of the engine by means of leaf springs (fig.15) [1], [11], [13].

Using a stepper motor instead of the couple ensure servovalve can be controlled by discrete signals, obtained from a digital computer solution applied especially automatic controls of planes. A technical solution for digital servovalve shown in Fig. 15 is composed of the spool (1), the ends of which are cross springs (2) and (3) the filter element (4) two preliminary nozzle (5) and (6) and two end nozzles (7) and (8) , which is located in front plate (10), jointly with the stepper motor shaft (11). Disc (10) may have different configurations thus ensuring differential pressure spool ends (1) [1], [9], [13],

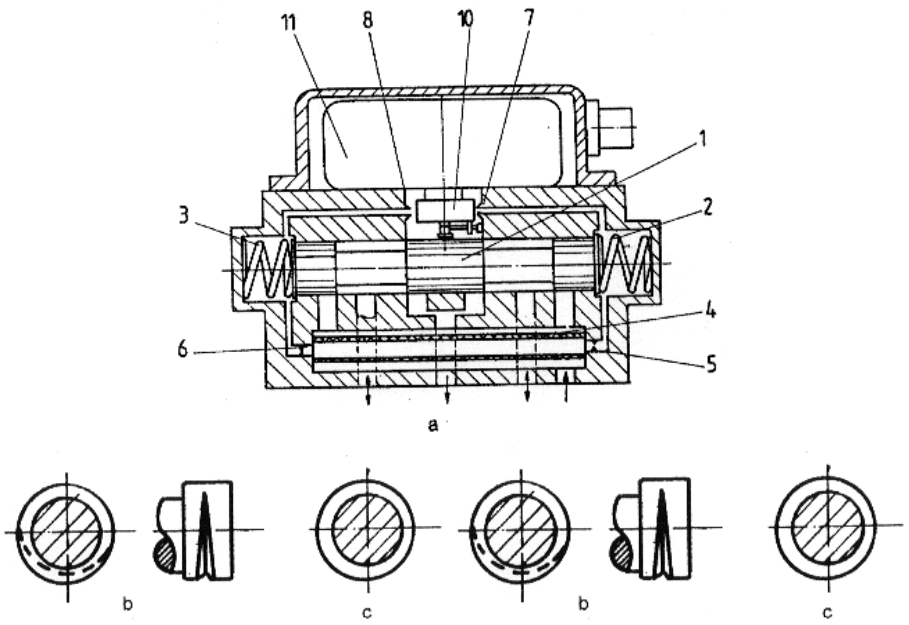


Fig.15 Technical solution for digital servovalve
1. Dispenser drawer; 2, 3. Centering spring; 4. Fine filter; 5, 6. Fixed nozzle;
7, 8. Adjustable nozzle; 10. Flap- disc; 11. Torque motor

.
In Figure 15 the lateral surface of the disc is smooth, but eccentric to the axis of rotation, and as a result, the rotation in one direction or the other causes change the distances between it and the nozzles. In fig.15.b, the disc has a series of notches of varying depth. They are arranged around the periphery of the disc, so that every step of the motor, one slotted nozzles will be right and produce a differential pressure heads compartment (1). The disc (10) is brought into position spring centering median, (2 and 3), (Fig. 15).
At the digital servo, stepper motor can be made up to 1000 steps/second, thus the time constant low response presence of a separate element, which measures the position of the rotary disk (10).
Servo stepper motor are integrated into digital electronics, for which developed lately. However, it is difficult to say whether analog servo will be removed in the future. You will see a hybrid solution with digital input signals, and the reverse link (feedback). It is necessary to remove the " Accidental steps" to the engine.
The structure is the supply pressure of zero, in which case the spool is moved to the right. A modern building is servovalve three amplification stages, which integrated electronic connection is made between components servovalve.
The current aviation use two-story jet servo valves electric type Messier 25 565 through external electronic link is confirmed electronically internal control servovalve. Currently serving aircraft actuators.

3. CONCLUSIONS

Electrohydraulic servo valves (EHSV) as interface elements in hydraulic machines are actually operated proportional hydraulic distributors, which are used in automatic control systems using full response elements placed in the operated mechanism. Electrohydraulic servovalve is at the interface between control electric type and Hydraulic actuation [1], [3], [11], [9], [13]. The output (flow, pressure) is adjusted according to the size of the control signal (current, voltage), with a related reaction (mechanical, hydraulic, electrical). Electrohydraulic servo system solves the requirements of high-tech machines being used in military equipment, aviation, etc.
To control blood flow through the flow section dispenser drawer-body, it is necessary that at every point of the race, so the whole race, the resultant forces drive the drawer (hydrodynamic forces, frictional forces, viscous friction forces lateral forces of inertia, the elastic force and weight of mobile equipment to be in equilibrium with the operating force given by the size of the input torque of the electric motor, the control current proportional to the intensity. therefore, the function of continuously variable control of the electric current, establishing a continuously variable function of proportional flow and pressure at the outlet of SVEH. Servo valves have a quick, low mass per unit power output, reliability and a wide frequency band. Analysis and synthesis SVEH requires the use of methods from the theory automatic systems, generally resorting to an analysis linearized around the operating point [1], [2], [3], [5], [11], [12], [13].
An electrohydraulic servo valve (EHSV) is an electrically operated valve that controls how hydraulic fluid is ported to an actuator. Servo valves and servo-proportional valves are operated by transforming a changing analogue or digital input signal into a smooth set of movements in a hydraulic cylinder [1], [3], [25]. Servo valves can provide precise control of position, velocity, pressure and force with good post movement damping characteristics. An electric command signal (flow rate set point) is applied to the integrated position controller which drives the pilot stage [1], [25]. Proportional hydraulics occurred for economic reasons due to expansion hydraulic automation in all technical areas, both military and especially civilian, industrial applications that do not require a special dynamic. Future follow-up automatic hydraulic self is the systems to be used in electrohydraulic servo valves with direct conversion as electrically Feedback pezinta opportunity to optimize amplification loop flow control or pressure.
Hydraulics are proportional distribution provide continuous electrical circuit elements. That flow direction and adjust control parameters, flow and pressure.
This paper summarizes the main types of electro hydraulic servo valves used mainly in proportional hydraulic equipment.

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