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HYDRAULIC SERVO-MOTOR

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Fig.1

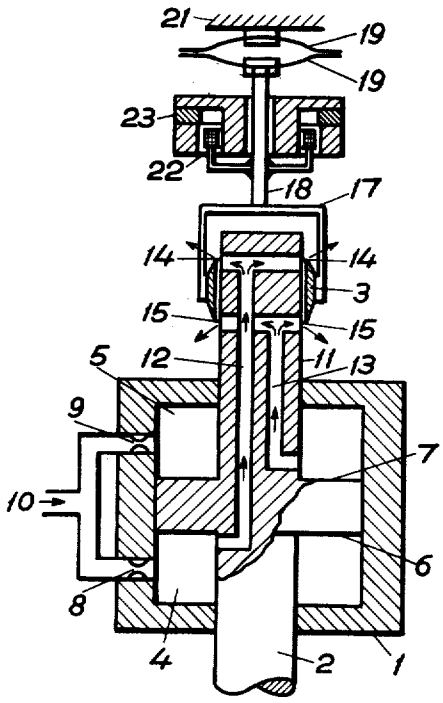
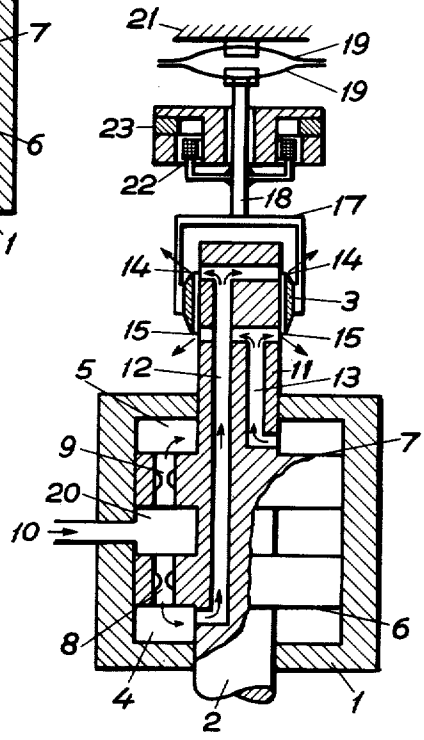


Fig.2



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HYDRAULIC SERVO-MOTOR

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2 Claims. (Cl. 121—41)

This invention relates to a hydraulic servo-motor of the sort comprising a main piston reciprocally movable in a cylinder under the influence of a pressure medium like oil, and obtaining a position determined by the position of a control means. Servo-motors of this sort are often encountered in control and regulation applications, where they are used for amplifying the force from an electromagnetically operated control device so that valves or the like may be operated therefrom.

It is the main object of this invention to provide a servo-motor of the sort described having a very accurate relation between movement of the main piston and the control means.

Another object of the invention is to provide a servo-motor in which the control means is not influenced by the load upon the main piston.

A further object is to make the position of the main piston independent of normal variations in temperature and pressure of the pressure fluid.

Also among the objects is the provision of a servo-motor of the sort described being of simple construction and readily serviceable.

According to the invention the main piston is a double-acting piston with two substantially equal and opposite areas, which are influenced by the pressure medium in two different chambers, which chambers through ducts having a substantial flow resistance is communicating with the source of the pressure medium, and through other ducts is communicating with each one group of openings in the envelope surface of a cylindrical body connected to the main piston, said cylindrical body being surrounded by a sleeve connected to the control means, and the openings in the envelope of said cylindrical body being so arranged, that the sleeve by its movements in relation to the cylindrical body closes one group of openings and opens for the other, so that the two pressures acting on the main piston become different, and the pressure difference influences the main piston in the direction in which the sleeve is moving.

The features of this invention which are believed to be novel are set forth with particularity in the appended claims. The invention itself, however, may best be understood by reference to the following description and the accompanying drawing, in which:

Fig. 1 is a section through a servo-motor according to the invention, and

Fig. 2 is a section through another servo-motor according to the invention, differing from the first only in the arrangement of the ducts connecting the pressure source with the chambers in which the pressure fluid acts upon the piston.

In Fig. 1 the numeral **2** designates a main piston being movable in a cylinder **1**. The main piston **2** is double-acting and its two opposite areas **6** and **7** are influenced by a pressure medium in chambers **4** and **5** respectively. The chambers **4** and **5** are communicating with the source **10** for the pressure medium through

each one restricted duct **8** and **9**, and is further through ducts **12** and **13** communicating with each one group of openings **14** and **15** in the envelope surface of a cylindrical body **11** connected to the main piston **2**. A sleeve **3** with small clearance surrounds the cylindrical body **11** and is connected to a coil **22**, which is movable in the field from a magnet **23**, and is suspended in springs **19**. The openings **14**, **15** in the envelope surface of the cylindrical body **11** are so arranged that the sleeve **3** simultaneously may cover the openings **14** and the openings **15** to about 50 percent.

If the sleeve **3** chokes the openings **14** and the openings **15** to the same degree, the pressure in the chambers **4** and **5** will have the same value, because the restrictions **8** and **9** have the same flow resistance, and this pressure is somewhat lower than the pressure at the source **10**, suitably about half this pressure. The two opposite piston areas **6** and **7** of the main piston are equal, and thus no resulting force influences the main piston in the described case.

If the coil **22** is fed by a current with such polarity that the coil is lifted against the force of the springs **19**, the sleeve **3** moves away from the cylinder **1**. Hereby it opens for the openings **15** and chokes the openings **14** more than previously, so that the pressure decreases in the chamber **5** and increases in the chamber **4**. The main piston **2** is then influenced by a resulting force, which is proportional to the pressure difference in the chambers **4** and **5**, and which is acting in the same direction as the sleeve **3** moved. The main piston **2** thus follows the sleeve **3** and does not stop until a new equilibrium is obtained when the openings **14** and **15** again are equally choked.

When the main piston **2** is loaded, it will be displaced to a new position of equilibrium, where the holes **14** and **15** are choked to a different degree, so that the pressure medium acts upon the main piston **2** with a force which is equal to and counteracting the load. This displacement of the position of equilibrium by loading is equivalent to a certain elasticity in the servo-motor.

When the pressure medium passes an edge of the sleeve **3** at the outlet from one of the openings **14** and **15**, it influences the sleeve with an axial force, the magnitude of which may be reduced by making the edge sharp and knife-like, but never can be entirely eliminated. Because the sleeve **3** is influenced by two counteracting axial forces of this sort, one at the openings **14** and one at the openings **15**, the resulting axial force of the sleeve becomes, however, negligible. Even though each of the said axial forces are pressure- and temperature-dependent, the force with which the servo-motor reacts on the sleeve thus becomes practically constant and equal to zero.

As the ducts **8** and **9** may be made identically equal, their flow resistances become not only equal, but obtain even the same pressure- and temperature-dependence. The same is true for the openings **14** and **15** with appurtenant choking edges of the sleeve **3**. This symmetry provides for a compensation of a change in pressure in the chamber **4**, caused by a change in temperature of pressure at the source **10**, by an equal pressure change in the chamber **5**. The resulting force on the main piston **2** and the position of the main piston in relation to the sleeve **3** thus becomes independent of pressure and temperature.

In Fig. 2 is shown another form of the invention, which differs from the form shown in Fig. 1 only in the arrangement of the restricted ducts **8** and **9**. The main piston **2** is in Fig. 2 provided with an annular groove between the piston areas **6** and **7**, so that a chamber **20** is obtained, which is directly connected to

the source 10 for the pressure medium. The restricted ducts 8 and 9 are arranged in the main piston 2 itself, and connects the chambers 4 and 5 with the chamber 20. This form of the invention has certain manufacturing advantages over the form shown in Fig. 1, but the manner of operation is entirely identical for the two forms.

The openings 14 and 15 are of course always arranged symmetrically around the axis of the cylindrical body 11, so that the sleeve 3 is not influenced by any resulting radial force which may give rise to friction between the sleeve 3 and the cylindrical body 11. In order to eliminate such friction entirely, symmetrically arranged openings may be provided, discharging behind the inner surface of the sleeve 3, and in a known manner communicating through restricted ducts with one of the chambers 4 or 5, or better the chamber 20 in Fig. 2.

We claim as our invention:

1. Hydraulic servo-motor comprising a cylinder, and a double-acting piston reciprocatably movable in said cylinder and dividing the interior of said cylinder into two main chambers, means including a restricted passage for connecting each of said main chambers to a source of pressure fluid, a cylindrical body connected to said piston and protruding from said cylinder openings located in the peripheral surface of said cylindrical body and arranged in two axially displaced groups of openings, means for connecting each of said groups of openings to one of said main chambers, a sleeve fitting with small clearance on said cylindrical body and serving to cover and uncover said openings, said sleeve having

an axial length substantially equal to the axial distance between said two groups of openings, and means for axially displacing said sleeve in dependence on a control magnitude.

2. Hydraulic servo-motor comprising a cylinder, and a double-acting piston having two substantially equal and counteracting working areas being reciprocatably movable in said cylinder and dividing the interior of said cylinder into two main chambers, an annular groove in said piston between said working areas, means for connecting said annular groove to a source of pressure fluid, restricted ducts connecting said annular groove and said main chambers, a cylindrical body connected to said piston and protruding from said cylinder, openings located in the peripheral surface of said cylindrical body and arranged in two axially displaced groups of openings, means for connecting each of said groups of openings to one of said main chambers, a sleeve fitting with small clearance on said cylindrical body and serving to cover and uncover said openings, said sleeve having an axial length substantially equal to the axial distance between said two groups of openings, and means for axially displacing said sleeve in dependence on a control magnitude.

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