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(54) Servomotor piston movable to three predetermined positions

(57) In the position of valve 28 shown pressure fluid from line 22 passes to working chambers 3, 4 on either side of piston 11 while chamber outlets 15, 16 are connected to reservoir 20. Thus the piston moves to a central position in which it closes outlets 15, 16. When valve 28 is moved to either of its other two positions outlets 15,16 are shut, a chamber on one side of the piston is connected to the pressure source while the chamber on the other side is connected to reservoir 20. Thus the piston moves to one or other of its end positions.

Fig. 1

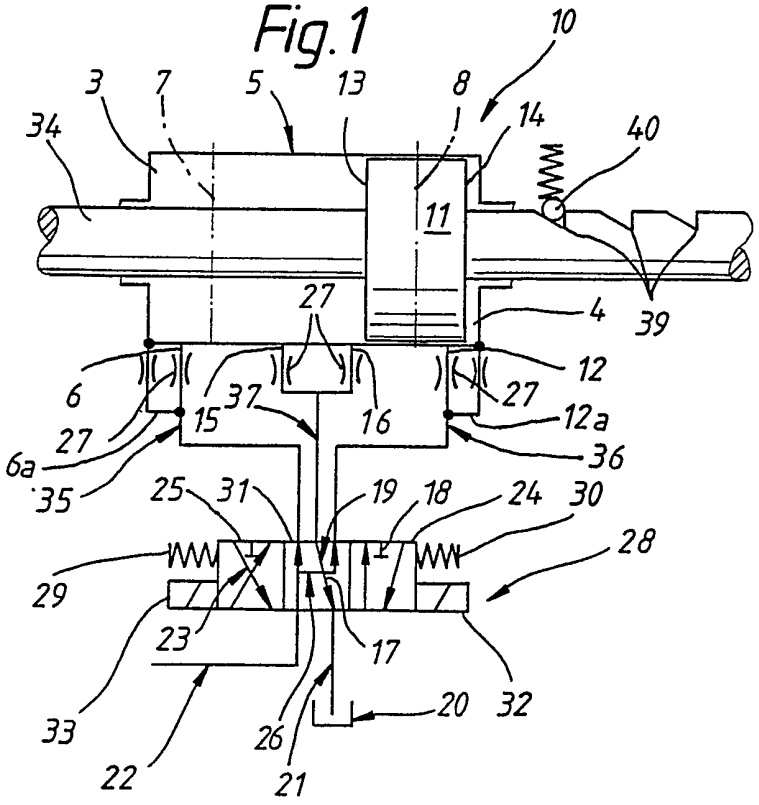

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Fig. 1

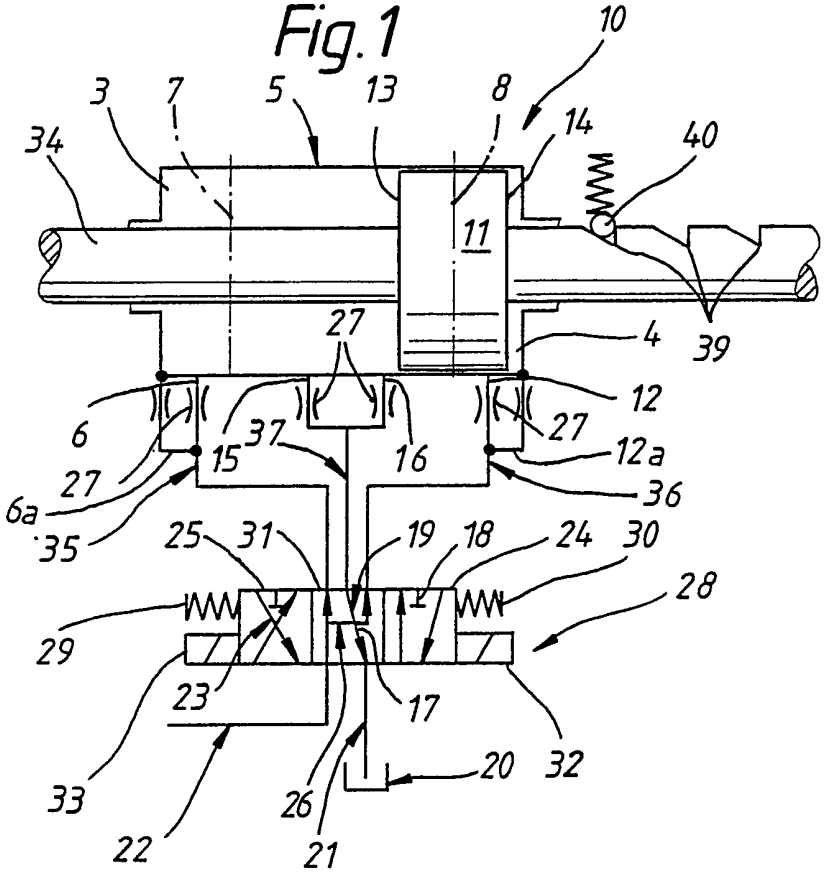
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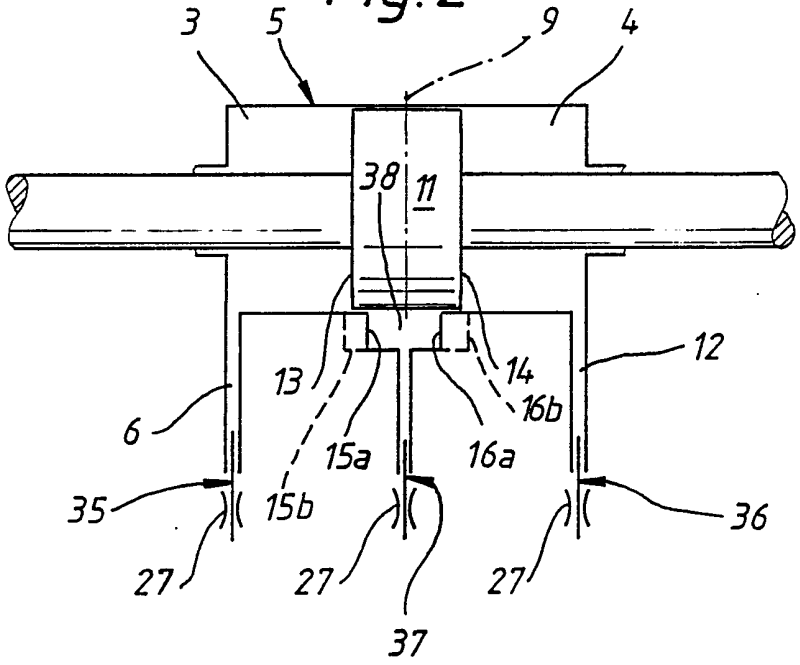
Fig. 2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A device for controlling a pressure medium servomotor

The invention concerns a device for controlling the stroke position of a pressure medium servomotor of the axial piston type, having

- a working cylinder subdivided by a double-acting working piston into a first working pressure chamber and a second working pressure chamber,
- a first end position control connection provided on the working cylinder, this connection entering the first working pressure chamber in the region of the associated first end-of-stroke position of the working piston,
- a second end position control connection provided on the working cylinder, this connection entering the second working pressure chamber in the region of the associated second end-of-stroke position of the working piston,
- a first control edge provided on the periphery of the working piston, this control edge being located in the first working pressure chamber,
- a second control edge provided on the periphery of the working piston, this control edge being located in the second working pressure chamber,
- two central position control connections provided on the working cylinder at an axial distance relative to one another and in the region of a stroke central position of the working piston, these control connections interacting with the control edges,
- a shut-off valve controllable between a first and a second position, by means of which shut-off valve the two central position control connections are connected, to a common pressure conduit leading to a pressure medium container, in such a way that a central position control connection is connected to the pressure conduit in the first valve position of the shut-off valve whereas, in the second valve position of the shut-off valve, it is shut off

relative to the pressure conduit,

- a pressure source and a pressure conduit used as the return to a pressure-relieved reservoir,
- having selector valve means for the end-of-stroke positions of the working piston, to which means are connected the two end position control connections and the pressure source as well as the pressure conduit used as the return,
- a first selector position of the selector valve means, in which position the first end position control connection is connected to the pressure source and the second end position control connection is connected to the pressure conduit used as the return, and
- a second selector position of the selector valve means, in which position the first end position control connection is connected to the pressure conduit used as the return and the second end position control connection is connected to the pressure source.

In a known device of this type for a servomotor driven by compressed air (FR-PS 13 97 486), the two central position control connections are located at a greater distance from one another than the control edges so that, in the central stroke position of the working piston, the control connections are each connected openly to an associated working pressure chamber. On the other hand, the two central position control connections are connected via a selector shut-off valve to an intrinsically closed expansion vessel in such a way that, in the central stroke position of the working piston, the working pressure chamber connected to the pressure source is connected openly to the expansion vessel, whereas the other working pressure chamber is shut off relative to the selector shut-off valve. A catch must be used in order to be able to position the working piston in the central stroke position and this also has to fulfil a braking function for the working piston - in addition to the retention function in the unpressurised

condition - because braking cannot be achieved by the working pressure alone. In this known device, it is also necessary to switch off the working pressure in good time on reaching the central stroke position before the expansion vessel is filled because otherwise the working piston starts moving again and leaves the central stroke position. An expansion vessel with an infinitely large volume or the relief of the associated pressure conduit to atmosphere would have the result that the working piston could no longer leave the central stroke position.

In a known device of a different generic type (DE-PS 712 340) for controlling a pressure medium servomotor of the axial piston type, two axially adjacent annular control chambers concentric with the piston axis are formed at the periphery of the working piston to position it in two different central stroke positions, each of which is connected via a control hole in the working piston to the respective working pressure chamber adjacent to the other control chamber. In consequence, the design of the working piston and the pressure supply to the working cylinder are complicated, as is the design of the valve controlling the pressure supply.

A device of a different generic type for controlling the stroke position of a pressure medium servomotor of the axial piston type is known from US-PS 3,312,146. In this device, the working piston is additionally fixed in its stroke central position by two auxiliary pistons which are respectively located in one of the two working pressure chambers through which the through piston rod of the working piston passes. The auxiliary pistons are located so as to be displaceable relative to both the working cylinder and relative to the working piston in such a way that the working piston is supported on the working cylinder in its end-of-stroke positions by the respectively associated auxiliary piston (pressure-relieved by means of a 5/3-way control valve) whereas it is supported in its stroke central position by the auxiliary piston then

subjected to pressure via the control valve. The other auxiliary piston located in the end-of-stroke positions in the respective working pressure chamber subjected to working pressure is in contact, decoupled from the working piston, with a housing stop fixing the stroke central position, a control edge on the auxiliary piston shutting off relative to its working pressure chamber the associated central position control connection of the working cylinder, this connection being continually connected to the pressure-relieved return conduit and bypassing the control valve. The auxiliary pistons increase the design complexity and reduce the useful stroke of the working piston and the useful cross-section of the working cylinder.

The present invention seeks to design a device for controlling the hub position of a pressure medium servomotor of the type mentioned at the beginning in such a way that a servomotor of the axial piston type driven by hydraulic working medium can be positioned in a central stroke position by simple but functionally reliable means.

According to the present invention there is provided a device for controlling the stroke position of a pressure medium servomotor of the axial piston type, having

- a working cylinder subdivided by a double-acting working piston into a first working pressure chamber and a second working pressure chamber,
- a first end position control connection provided on the working cylinder, this connection entering the first working pressure chamber in the region of the associated first end-of-stroke position of the working piston,
- a second end position control connection provided on the working cylinder, this connection entering the second working pressure chamber in the region of the associated second end-of-stroke position of the working piston,
- a first control edge provided on the periphery of the working piston, this control edge being located in the

first working pressure chamber,

- a second control edge provided on the periphery of the working piston, this control edge being located in the second working pressure chamber,
- two central position control connections provided on the working cylinder at an axial distance relative to one another and in the region of a stroke central position of the working piston, these control connections interacting with the control edges,
- a shut-off valve controllable between a first and a second position, by means of which shut-off valve the two central position control connections are connected, to a common pressure conduit leading to a pressure medium container, in such a way that a central position control connection is connected to the pressure conduit in the first valve position of the shut-off valve whereas, in the second valve position of the shut-off valve, it is shut off relative to the pressure conduit,
- a pressure source and a pressure conduit used as the return to a pressure-relieved reservoir,
- having selector valve means for the end-of-stroke positions of the working piston, to which means are connected the two end position control connections and the pressure source as well as the pressure conduit used as the return,
- a first selector position of the selector valve means, in which position the first end position control connection is connected to the pressure source and the second end position control connection is connected to the pressure conduit used as the return, and
- a second selector position of the selector valve means, in which position the first end position control connection is connected to the pressure conduit used as the return and the second end position control connection is connected to the pressure source,

wherein

- the arrangement of the control edges of the working piston relative to the central position control connections is such that in the stroke central position of the working piston both central position control connections are shut off or throttled relative to the working pressure chambers,
- the pressure conduit used as the return to the pressure-relieved reservoir is connected to the shut-off valve as the common pressure conduit leading to a pressure-medium vessel,
- in the first valve position of the shut-off valve, both central position control connections are connected to the pressure conduit used as the return,
- in the second valve position of the shut-off valve, both central position control connections are shut off relative to the pressure conduit used as the return, and
- selector valve means are provided for the stroke central position and these means make it possible to connect both end position control connections synchronously to the pressure source.

The device according to the invention is particularly characterised by a simple and functionally reliable control with respect to the approach to and retention of the stroke central position by the working piston. In the device according to the invention, the two end position control connections are synchronously subjected to pressure while both central position control connections are opened to atmospheric pressure. If the working piston is located in one of the end-of-stroke positions, pressurised oil supplied via the end position control connection associated with the other end-of-stroke position is led off via one or both central position control connections to the pressure-relieved return. Because of the resulting pressure difference in the two working pressure chambers acting on the working piston, the latter is

displaced until it closes the two central position control connections by means of its control edges and pressure equilibrium occurs at the working piston. The pressure forces of the two working pressure chambers hold the working piston in its stroke central position.

The throttle resistances located in the region of the control connections in the pressure conduits are matched for the stroke motions of the working piston between the three positions at which it can be located.

The pressure at the end position control connections can be switched off after an arbitrary period because of the catch arrangement on the working piston. This has the advantage that the complete system controlled by the device, which may be a gear-change control system, is unpressurised and therefore has no leaks.

In the device according to the invention, only three pressure conduits between the working cylinder and the selector valve have to be controlled because the two central position control connections can be connected by a common pressure conduit which leads to the selector valve. In the device according to the invention no special control chambers are necessary on the working piston to locate the stroke central position.

Details of the invention are provided by the following description of two illustrative examples shown diagrammatically in the drawing, in which:-

Figure 1 shows a device according to a first embodiment, in the form of a hydraulic block circuit diagram, and

Figure 2 shows, on its own, the servomotor of the device of Figure 1 with a variant of the design of the central position control connections.

A servomotor 10 of the axial piston type has a working cylinder 5 in which, in the conventional manner, a working piston 11 (fastened to a through piston rod 34) is accommodated so that it can be axially displaced. The working piston 11

subdivides the cylinder internal space into two working pressure chambers 3 and 4; it can be driven into two end-of-stroke positions 7 and 8 and into a stroke central position 9 by means of a 5/3-way valve 28.

In the region of the first end-of-stroke position 7, a first end position control connection 6 of the working cylinder 5 enters the working pressure chamber 3, this end position control connection 6 being shut off by an associated first control edge 13 at the periphery of the working piston 11 shortly before the working piston can make metallic contact with the relevant end of the cylinder. The first end position control connection 6 is connected to a valve connection of the 5/3-way valve 28 by means of a pressure conduit 35.

In the region of the second end position 8, a second end position control connection 12 of the working cylinder 5 enters the other working pressure chamber 4, this end position control connection 12 being shut off by an associated second control edge 14 at the periphery of the working piston 11 shortly before the working piston can make metallic contact with the relevant other end of the cylinder. The second end position control connection 12 is connected to a valve connection of the 5/3-way valve 28 by a pressure conduit 36.

In the region of the stroke central position 9, two central position control connections 15 and 16 enter the internal space of the working cylinder 5, these central position control connections 15 and 16 being connected to a common pressure conduit 37 which leads to a valve connection of the 5/3-way valve 28. The two central position control connections 15 and 16 are arranged relative to one another and also relative to the control edges 13 and 14 in such a way that the working piston 11 shuts off both central position control connections 15 and 16 relative to the working pressure chambers 3 and 4 in its stroke central position 9 but, when it is displaced out of the stroke central position 9, it connects one of the two control connections 15 or 16 to the respective

expanding working pressure chamber even after a small stroke movement.

A throttle resistance 27 provided in the associated pressure conduit is located so as to exert its effect between each of the control connections 6, 12, 15 and 16, on the one hand, and the 5/3-way valve 28, on the other.

Whereas in the embodiment of Figure 1, two individual connections 15 and 16, each with a throttle resistance 27, are used for the central position control connections, an axial control groove 38 on the inner wall of the working cylinder 5 is provided in the embodiment of Figure 2. The two radial boundaries at the end of the axial control groove 38 interact, as control edges 15a and 16a, with the control edges 13 and 14 in the same way as the individual connections 15 and 16 in Figure 1.

Otherwise, the two embodiments of Figures 1 and 2 are identical.

The piston rod 34 is provided with a catch 39 for each of the piston positions 7 to 9 and a spring-loaded ball 40 engages in the catches 39.

A return conduit 21 leading to a pressure-relieved reservoir 20 and a pressure conduit 32 supplied from a pressure source, which is not shown, are also connected to the 5/3-way valve 28.

The 5/3-way valve 28 can be actuated by means of electromagnetic actuators 32 and 33, respectively, into two valve positions 24 and 25 and by spring means 29 and 30 into a central valve position 31.

A shut-off valve function in the form of an inner valve passage 19 is integrated into the 5/3-way valve 28 and this valve passage 19 opens the common pressure conduit 37 of the central position control connections 15 and 16, or 15a and 16a, relative to the return conduit 21 in a first valve position 17 - and shuts them off in a second valve position 18.

A selector valve function for the stroke central position

9 of the working piston 11 is also integrated into the 5/3-way valve 28 in the form of an inner valve passage 26 which, in a first valve position - which coincides with the valve position 31 of the 5/3-way valve 28 - produces an open connection between the pressure conduits 22, 35 and 36, i.e. it connects the end position control connections 6 and 12 to the pressure source. This selector valve function in the form of the valve passage 26 is, however, switched off in a still possible second valve position which is taken up by the valve passage 26 in the valve positions 24 and 25 of the 5/3-way valve 28.

Finally, the usual selector valve function 23 for the two end-of-stroke positions of the working piston 11 is also integrated in the 5/3-way valve 28. In the first valve position 24 of the selector valve means 23 for the end-of-stroke position 8 selected by the electromagnetic actuator 32, the pressure conduit 22 of the pressure source is connected to the pressure conduit 35 of the working pressure chamber 3 and the return conduit 21 is connected to the pressure conduit 36 of the working pressure chamber 4. In the valve position 25 of the selector valve means 23 selected by the electromagnet 33, the pressure conduit 22 of the pressure source is connected with the pressure conduit 36 of the working pressure chamber 4 and the return conduit 21 is connected to the pressure conduit 35 of the working pressure chamber 3.

In the two valve positions 24 and 25 last mentioned, the valve passage 19 (shut-off function) is shut off (valve position 18) as well as the valve passage 26 (stroke central position 9 selection function).

The device according to the invention has, therefore, the following mode of operation:

When both electromagnets 32 and 33 are without current, the 5/3-way valve 28 is in its central valve position 31 due to the action of the spring means 29 and 30. Because both end position control connections 6 and 12 are connected to the pressure source (pressure conduit 22) and both central position

control connections 15 and 16 are connected to the return conduit 21, there is an equilibrium of pressure at the working piston 11 and the latter is set to the stroke central position 9.

When one of the electromagnets 32, 33 is excited, the central position control connections 15 and 16 are shut off by means of the common pressure conduit 37 and the working piston 11 is driven, in known manner, into its appropriate end-of-stroke position 7 or 8 by means of the end position control connections 6 and 12.

If the working piston 11 is located in one of its end-of-stroke positions, for example in the end-of-stroke position 8 of Figure 1, and the excitation of the associated electromagnet 32 is switched off, both end position control connections 6 and 12 are connected to the pressure source (pressure conduit 22) and both central position control connections 15 and 16 are connected to the return conduit 21, as determined by the valve position 31. By this means, the working pressure chamber 3 is also connected to the return conduit 21 at least via the one central position control connection 15 so that there is a pressure difference at the working piston 11 resulting from the higher pressure of the working pressure chamber 4 not connected to the return conduit 21 and the lower pressure of the working chamber 3, this pressure difference actuating the working piston 11 into its stroke central position 9.

The three valve functions 19 (shut-off), 23 (end position control) and 26 (stroke central position control) could also be achieved by means of separate selector valves if the resulting increase in control complexity were justified.

The end position control connections 6 and 12 are each connected by a throttled bypass control connection 6a and 12a to the end of the associated working pressure chamber 3 and 4, respectively, so as to make it possible to subject the working piston to pressure even in the end-of-stroke positions for return to the central position 9.

A variant is also shown dotted in Figure 2 in which, in the central position 9, the interacting control edge pairs 13/15b and 14/16b also permit a throttled connection between the respective working pressure chamber 3 and 4, respectively, and the common pressure conduit 37.

Claims

1. A device for controlling the stroke position of a pressure medium servomotor of the axial piston type, having

- a working cylinder subdivided by a double-acting working piston into a first working pressure chamber and a second working pressure chamber,
- a first end position control connection provided on the working cylinder, this connection entering the first working pressure chamber in the region of the associated first end-of-stroke position of the working piston,
- a second end position control connection provided on the working cylinder, this connection entering the second working pressure chamber in the region of the associated second end-of-stroke position of the working piston,
- a first control edge provided on the periphery of the working piston, this control edge being located in the first working pressure chamber,
- a second control edge provided on the periphery of the working piston, this control edge being located in the second working pressure chamber,
- two central position control connections provided on the working cylinder at an axial distance relative to one another and in the region of a stroke central position of the working piston, these control connections interacting with the control edges,
- a shut-off valve controllable between a first and a second position, by means of which shut-off valve the two central position control connections are connected, to a common pressure conduit leading to a pressure medium container, in such a way that a central position control connection is connected to the pressure conduit in the first valve position of the shut-off valve whereas, in the second valve position of the shut-off valve, it is shut off relative to the pressure conduit,
- a pressure source and a pressure conduit used as the

return to a pressure-relieved reservoir,

- having selector valve means for the end-of-stroke positions of the working piston, to which means are connected the two end position control connections and the pressure source as well as the pressure conduit used as the return,
- a first selector position of the selector valve means, in which position the first end position control connection is connected to the pressure source and the second end position control connection is connected to the pressure conduit used as the return, and
- a second selector position of the selector valve means, in which position the first end position control connection is connected to the pressure conduit used as the return and the second end position control connection is connected to the pressure source,

wherein

- the arrangement of the control edges of the working piston relative to the central position control connections is such that in the stroke central position of the working piston both central position control connections are shut off or throttled relative to the working pressure chambers,
- the pressure conduit used as the return to the pressure-relieved reservoir is connected to the shut-off valve as the common pressure conduit leading to a pressure-medium vessel,
- in the first valve position of the shut-off valve, both central position control connections are connected to the pressure conduit used as the return,
- in the second valve position of the shut-off valve, both central position control connections are shut off relative to the pressure conduit used as the return, and
- selector valve means are provided for the stroke central position and these means make it possible to connect both

end position control connections synchronously to the pressure source.

2. A device according to Claim 1,wherein the shut-off valve and the selector valve means for the stroke central position interact in such a way that both end position control connections can only be synchronously connected to the pressure source when both central position control connections are connected to the pressure conduit used as the return.

3. A device according to Claim 1 or 2, wherein the shut-off valve and the selector valve means for the end-of-stroke positions interact in such a way that when only one of the end position control connections is connected to the pressure source, both central position control connections are shut off relative to the pressure conduit used as the return.

4. A device according to any one of Claims 1 to 3, wherein throttle resistances are located between the end and central position control connections and the shut-off and selector valve means.

5. A device according to any one of Claims 1 to 4, wherein the stroke positions of the working piston have catches.

6. A device according to any one of Claims 1 to 5, wherein the selector valve means for the stroke positions of the working piston and the shut-off valve are combined in a 5/3-way valve with a central valve position for the hub central position of the working piston selected by spring means.

7. A device according to Claim 6, wherein the 5/3-way valve ia adapted to be actuated into its two other valve positions by an auxiliary control force.

8. A device according to claim 7, wherein said auxiliary control force is derived from electromagnetic.

9. A device for controlling the stroke position of a pressure medium servomotor of the axial piston type, substantially as described herein, with reference to, and as illustrated in, the accompanying drawings.

Examiner's report to the Comptroller under Section 17 (The Search Report)

9210242.5

Relevant Technical fields

(i) UK Cl (Edition K) F1D

(ii) Int Cl (Edition 5) F15B

Search Examiner

J GRAHAM

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search

7 AUGUST 1992

Documents considered relevant following a search in respect of claims 1 TO 9

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
	NONE	1

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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