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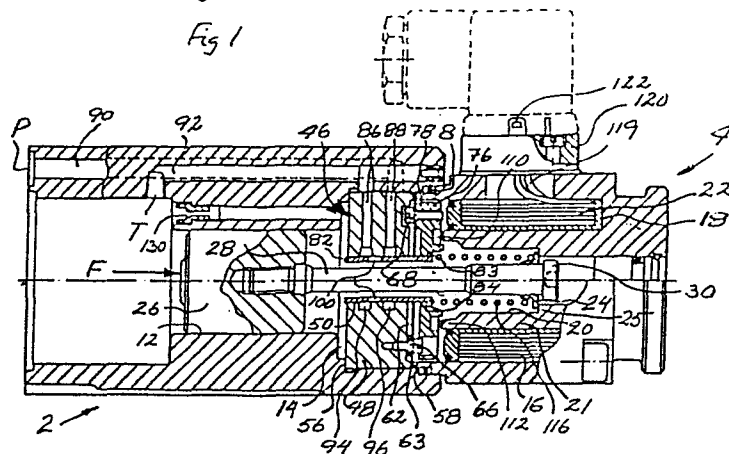
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(54) An electro-hydraulic set device.

(57) Electro-hydraulic set device comprising in a housing a piston (26) which is operable by means of hydraulic pressure that is fed to the working side of the piston via a valve passage (96, 100). The valve passage is opened or closed by an electromagnetically operated control slide (82), a return spring (116) acting between said control slide and said piston and tending to move the slide against the action of the electromagnet (22) in a direction for closing the valve

passage. The control slide is sleeve shaped and arranged in a bore (50) open at both ends in a housing portion (48), located between the piston and an annular electromagnet armature (76) which is drivably engaged with the control slide (82) and freely suspended in the housing by means of a spring means (62). A rod (28) connected to the piston passes through said bore (50) and said sleeve shaped control slide (82).



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The present invention relates to an electro-hydraulic set device comprising in a housing a piston which is operable by means of hydraulic pressure that is fed to the working side of the piston via a valve passage that is opened or closed by an electromagnetically operated
5 control slide, a return spring acting between said control slide and said piston and tending to move the slide against the action of the electromagnet in a direction that closes the valve passage, and said control slide being arranged in a bore open at both ends in a housing portion, located between the piston and an annular electromagnet armature
10 which is drivably engaged with the control slide and a rod connected to the piston passing through said housing portion and the electromagnet armature

One area of use for such set devices is electric control of hydraulic valves used for controlling the hydraulic liquid feed to the
15 drive motors for the different movements of hydraulically operated implements such as cranes, different types of gripping arms and the like. By means of the pistons of a number of electro-hydraulic set devices the valve slides of the hydraulic valves are operated.

An electro-hydraulic set device of the kind stated by means of
20 introduction is described in the PCT publication WO 81/02185. From said publication it appears that this set device has a number of important advantages, i.a. a simple, little space-requiring construction that implies comparably small manufacturing costs.

The object of the present invention is to simplify a set device
25 of the kind indicated and reduce the manufacturing costs thereof further.

This has been attained in that according to the invention in that the control slide consists of a sleeve shaped element, and that said piston rod passes through said bore and said sleeve shaped element.

30 The invention will now be described more closely below with reference to the attached drawings, on which:

Figs. 1 and 3 illustrate each its embodiment of a set device according to the invention in axial section,

Fig. 4 in an enlarged scale serves to show details included in
35 Fig. 3 and also in Fig. 1 insofar as such details are common to both embodiments,

Figs. 2 and 5 in plan views illustrate one detail included in the embodiments according to Figs. 1 and 3, respectively, and

Fig. 6 in axial section shows a detail of a modification of the embodiment according to Fig. 3.

The housing of the set device according to Fig. 1 is composed of two portions 2, 4. The housing portions 2, 4 are sealingly connected to each other essentially end to end via an O-ring seal 8. More particularly, the connections consist of axial bolt joints through outer extensions of the walls of the two housing portions.

The housing portion 2 along a part of its length has a central bore 12 and along the rest of its length a cylindric chamber 14 widening from the bore 12. The chamber 14 is open towards the inner of the housing portion 4, said inner being composed of an outer cylinder shaped space 16 closed by means of a wall 18 at the other end of the housing portion 4, and a centrally extending through bore 20. The space 16 and the bore 20 are separated by means of a cylinder shaped portion 21 of the housing portion 4. The space 16 encloses an embedded electromagnetic coil 22. A follower sleeve 24 is also arranged in the central bore 20 in a way to be described more closely below. The bore 20 at its end remote from the housing portion 2 has a stop abutment 25 for the sleeve 24.

The bore 12 of the housing portion 2 forms a cylinder bore for a piston 26 with a piston rod 28, on which the follower sleeve 24 is glidably guided. The piston 26 acts against a force F originating for example from a centering spring of a hydraulic valve slide not shown. At its end remote from the piston 26 the piston rod 28 has a head 30.

The chamber 14 contains a control slide and armature unit 46. This unit includes a cylindric body 48, the outer peripheral surface of which abutting the inner cylindric wall of the chamber 14 and which has a great axial through hole 50 for the piston rod 28.

The body 48 is clamped between an annular abutment 56 in the chamber 14 and an annular end edge 58 of the housing portion 4, with a spring disc 62 introduced on one side of the body 48. The spring disc 62 is shown more closely in Fig. 2. More particularly, the spring disc 62 has an annular peripheral edge 63 clamped between the body 48 and the end edge 58. In the embodiment shown the spring disc 62 can be attached to the body 48 by means of three screw bolts 66 passing through three holes 67 (Fig. 2) in the spring disc.

Three bolts 68 are screwed into an electromagnetic armature 76 which will be described more closely below, so that a spacer projection

0172150

78 of the armature 76 and the heads of the bolts 68 between them clamp corresponding parts 75 (Fig. 2) of the spring disc 62. The portions 75 of the spring disc 62 are located on tongues 79 which are resiliently carried with respect to the annular clamped edge 62 of the spring disc.

5 The tongues 79 are so shaped that the armature 76 is limitedly freely resiliently movable in the axial direction with respect to the body 48.

In the hole or bore 50 a cylinder shaped control slide 82 extends through the body 48. An end flange 83 of the control slide 82 engages behind an edge 84 of the armature 76 of the electromagnet. The cylinder

10 bore 50 has two radial holes 86 and 88 leading to the periphery thereof and ending in axially extending channels 90, 92 in the body 2 at one end and in annular grooves 94, 96 in the wall of the bore 50 at the other end.

The control slide 82 has a number of through holes 100. The

15 diameter of the holes 100 is somewhat less than the distance between grooves 94, 96.

The area between grooves 94, 96 thus has a width just overlapping the width of the holes 100, i.e. in one position the slide 82 can completely cut off the connection between the holes 86, 88 and the inner

20 of the house portions 2 and 4. The slide 82 has, however, a zero position in which one side edge of the hole 100 just overlaps the edge of the groove 96 and the opposite side edge of the holes 100 leaves a connection between the groove 96 and the inner of the house portions 2, 4.

The armature 76 is disc-shaped with a central hole for the piston

25 rod 28. An annular groove 110 is arranged coaxially with respect to the central hole and broader than and located in front of an annular protrusion 112 from the inner cylinder shaped portion 21 of the house portion 4. The portion 21 with the protrusion 112 serves as a core for the electromagnet. The shape of the details 110 and 112 then of course

30 serves to control and concentrate the magnetic force lines. Between a central seat of the armature 76 and an opposite seat of the drive sleeve 24 a pressure coil spring 116 acts to keep the slide 82 in its abovementioned zero position.

Electric connections 119 to the coil 22 can be led via a

35 connection bushing 120. One of the flat-pin shaped contacts is shown at 122. These contacts are preferably embedded in a resin that fills a portion of the bushing 120 and gives an effective sealing to the inner of the device.

For operation of the set device the channel 90 is connected to an input line P for hydraulic fluid and the channel 92 is connected to a return line T. At excitation of the electro-magnetic coil 22 by means of a drive current the armature 76 is attracted against the initially weak action of the spring 116 and draws the control slide 82 till this element opens the connection to the inner of the set device via holes 100. This attains the result that hydraulic fluid flows into the inner of the set device and its pressure forces the piston 26 towards the left in Fig. 1. During a short initial period the piston rod 28 moves freely until the head 30 comes into abutment against the end surface of the drive sleeve 24.

Thereupon the sleeve 24 is brought to follow the movements of the piston and via the spring 116 moves the armature 76 and thereby the sleeve 82 to a position in which the connection between the hydraulic source and the inner of the set device is cut off, i.e. the control slide 82 covers the groove 96. Due to a small leak flow via a leak passage 130 the piston 26 attains a tendency to move inwardly in the set device so that the force of the spring 116 becomes weaker and thereby the armature 76 obtains a corresponding tendency to move in the same direction. This in turn, however, means that the control slide 82 opens the connection to the groove 96.

The piston 26 thereby takes a position of equilibrium determined by the magnitude of the coil current. The reaction of the coil 26 on a set current level in the electro-magnetic coil in fact is very fast and the movement of the piston to the position determined by said current level takes place practically immediately. The shift of the piston varies linearly with the current.

Stabilization of the drive current for compensating the heating of the coil 22 can be obtained via an outer circuit in a way easily conceivable by the man of the art.

The embodiment according to Figs. 3 and 4 is double acting. It comprises principally two set devices according to Fig. 1, the respective piston rods 28 and 28' of which being interconnected by means of a piston 140. The piston 140 acts in a cylinder bore 142. The portions of the cylinder bore 142 separated by the piston 140 communicate directly with the inner of the respective set device and accordingly correspond to the inner of the set device to the right of the piston 26 in the embodiment according to Fig. 1. The ends of the piston rods 28 and 28', respectively, faced away from the piston 140 are interconnected by means

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of a shaft pivot 144 and 144', respectively, extending out of the housing of the set device via a bore having hydraulic fluid sealings. To the right in Figs. 3 and 4 one of said hydraulic fluid sealings is indicated at 146.

5 The differences further appearing in each set device in Figs. 3 and 4 with regard to the design, with respect to the embodiment according to Fig. 1, are mainly only intended to illustrate possible alternative embodiments of certain details. Thus, in the set devices according to Figs. 3 and 4 the spring disc has the appearance shown in
10 Fig. 5, where bolt holes 67 are missing. This implies that the spring disc according to Fig. 5 lacks the screw connection to the block 48 appearing in Fig. 1. The leak passage 130 in the embodiment according to Fig. 1 has in Figs. 3 and 4 been replaced by a leak passage 148 through the block 48. For the rest details in Figs. 3 and 4 which are identical
15 or similarly acting as details in Fig. 1, have the same reference numerals as in the last mentioned Figure.

 The double acting embodiment according to Fig. 3 can be used for controlling the valve slide of a hydraulic valve in the same way as is described in the abovementioned PCT-publication with reference to Fig.
20 4 in said publication. More particularly, the two single acting set devices of this known arrangement acting against each its end of the valve slide are replaced by a single double acting set device according to Fig. 3. This set device is arranged at one end of the valve slide, one of the shaft pivots 144, 144' being in a suitable way connected for
25 driving the valve slide. This connection can either be direct abutment end to end, but can also be obtained via any desirable connection arrangement, for example a linkage, if a location of the set device close to the hydraulic valve is undesirable for some reason. It should be easily conceived that the double acting set device according to Fig. 3
30 has a great area of use that besides control of the valve slide of hydraulic valves can also include control of the movement of a movable element of other apparatus. As was indicated above it can then be arranged on the most suitable location that must not necessarily be in direct abutment with the apparatus in question.

35 An example of use of the two shaft pivots 144, 144' in a certain application is the case where the double acting set device is used for operating a hydraulic valve slide, as has been described above, whereby the shaft pivot which does not directly act upon the valve slide can be

used for centering the valve slide in its zero position. In this case the shaft pivot 144' can e.g. in the way shown in Fig. 6 be built into a housing 160 attached to the end of the housing of a corresponding set device by means of screws 162. In the end of the shaft pivot 144' a screw 166 provided with a head 164 is screwed. On the shaft pivot 144' a spring 5 seat 168 in the form of a sleeve provided with an end flange 170 is arranged. A corresponding sleeve shaped spring seat 172 with an end flange 174 is provided on the head 164. Between the end flanges 170 and 174 a pressure coil spring 176 acts. Fig. 6 shows the state of this device implying centering of a slide valve, operated by the set device 10 but not shown, to the zero position, the spring 176 then having its smallest tension and pressing the end flange 170 against the end of the set device housing and the end flange 174 against an end wall portion of the housing 160. Regardless of whether the shaft pivot 144' moves to the right or to the left in Fig. 6 as a result of feeding current to one or 15 the other of the magnet coils of the double acting set device, the spring 176 will be compressed since such movement involves a decrease of the distance between the flanges 170 and 174. On the other hand this implies that when the action upon the set device stops the shaft pivot 144' will return automatically to the position shown in Fig. 6 due to the action of 20 the spring 176.

The invention is of course not limited to the embodiments described above and shown on the drawings. In connection with the description above of the embodiment according to Fig. 1 it is stated that 25 the diameter of the holes 100 is somewhat less than the distance between the grooves 94, 96. This gives, as well as the corresponding although differently formed arrangement in the set device according to the abovementioned PCT-publication, the great advantage that no oil is consumed when the set device is inactive.

30 While abandoning this advantage it is, however, possible to choose the diameter of the holes, or the corresponding dimension of another arbitrary passage somewhat greater than the distance between the grooves 94, 96. This would give a faster set device, which may be desirable in certain connections.

Claims.

1. Electro-hydraulic set device comprising in a housing a piston (26) which is operable by means of hydraulic pressure that is fed to the working side of the piston via a valve passage (96,100), that is opened or closed by an electromagnetically operated control slide (82), a return
5 spring (116) acting between said control slide and said piston and tending to move the slide against the action of the electromagnet (22) in a direction closing the valve passage, and said control slide being arranged in a bore (50) open at both ends in a housing portion (48), located between the piston and an annular electromagnet armature (76)
10 which is drivably engaged with the control slide (82) and a rod (28) connected to the piston passing through said housing portion (48) and the electromagnet armature (76), characterized in that the control slide (82) consists of a sleeve shaped element, and that said piston rod (28) passes through said bore (50) and said sleeve shaped element (82).

15 2. A device according to claim 1, characterized in that the sleeve shaped element (82) extends through the armature (76) and is in engagement with the side thereof remote from the piston (26).

3. A device according to claim 2, characterized in that said engagement allows limited mutual movement of the armature (76) and the
20 sleeve shaped element transversely to the length direction of the later.

4. A device according to any of the preceding claims, characterized in that the sleeve shaped element (82) in its wall has valve holes (100) forming said valve passage and extending angularly about said sleeve shaped element.

25 5. A double acting electro-hydraulic set device including in a bore in a housing a piston (140) that is drivable on both sides by means of hydraulic pressure from two set devices acting on each its side of the piston, said set devices each including:

a valve passage (96,100), through which hydraulic pressure is fed
30 to the corresponding working side of the piston (140) and that is opened or closed by an electromagnetically controlled control slide (82), a return spring (116) acting between said control slide and the piston (140) and tending to move the slide against the action of the electromagnet (22) in a direction closing the valve passage (96,100),
35 said control slide (82) being arranged in a bore (50) opened at both ends

in a housing portion (48) located between the piston (140) and an annular electromagnetic armature (76) which is in drivable engagement with the control slide (82), a rod (28,28') connected to the corresponding side of the piston passing through said electromagnetic armature (76), said
5 housing portion (48) and protruding at the end of the set device (28,28') remote from said piston (140) for forming at said end an output set element (144,144').

6. A set device according to claim 5, characterized in that the control slides consist of sleeve shaped elements (82) and that the piston
10 rods (28,28') pass through corresponding bores (50) and sleeves (82).

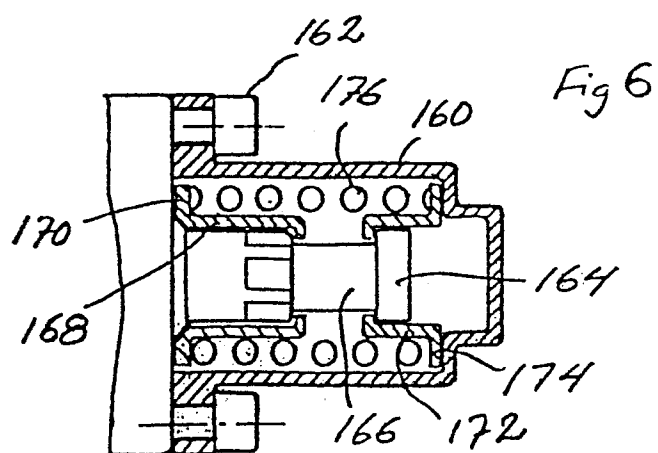
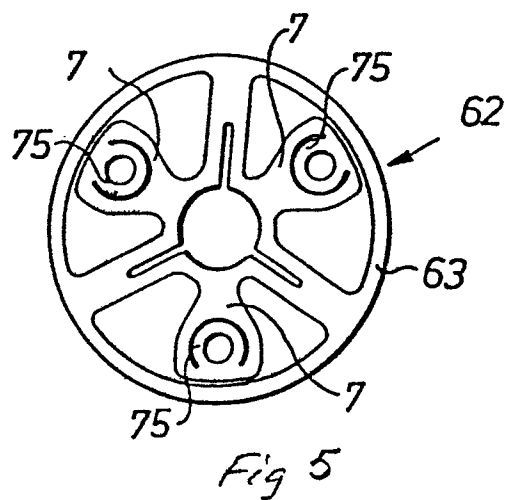
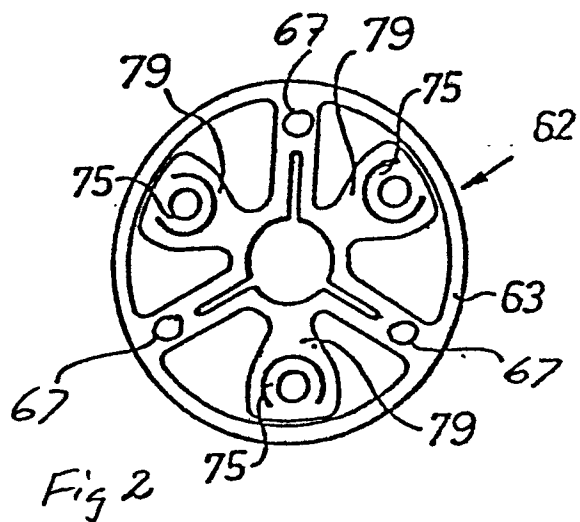
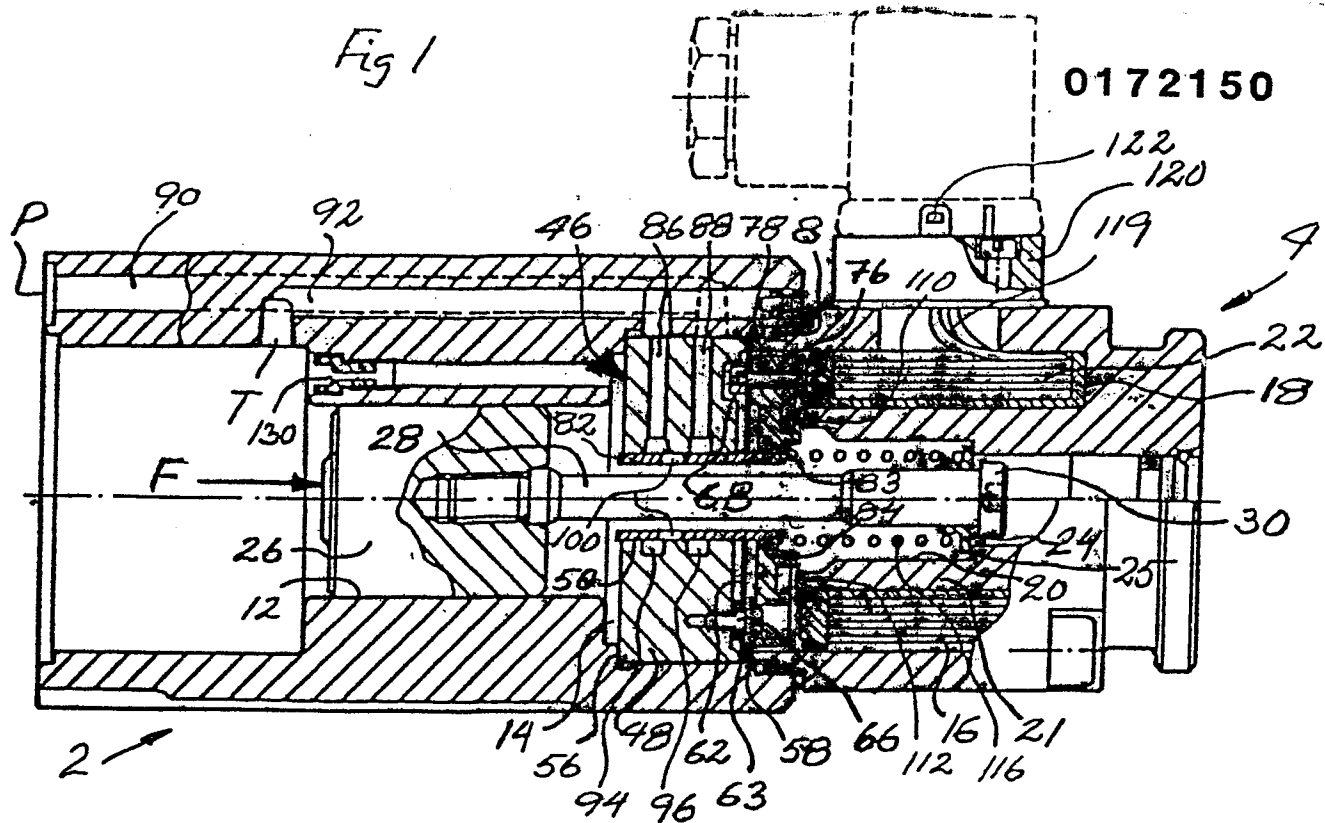
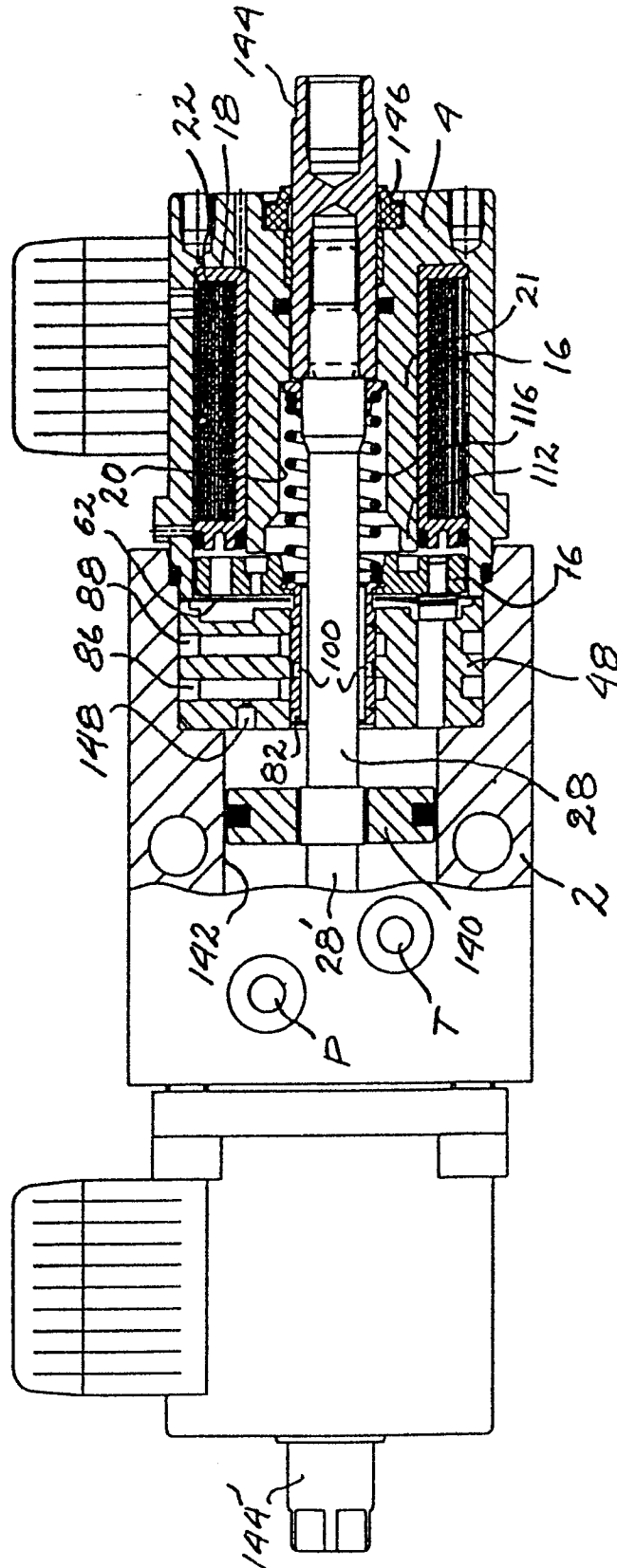


Fig 3





DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 4)
D,A	WO-A-8 102 185 (OLSBERGS HYDRAULIC) * complete document *	1-5	F 15 B 9/09 F 15 B 13/043
A	US-A-3 131 608 (S. YANDO) * complete document *	1-3	
A	GB-A-2 000 883 (THE CESSNA AIRCRAFT CO.) * complete document *	5	
A	US-A-2 915 045 (E.K. MACKENZIE) -----		
			TECHNICAL FIELDS SEARCHED (Int. Cl. 4)
			F 15 B 9/00 F 15 B 13/00
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 30-09-1985	Examiner LEMBLE Y.A.F.M.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			