United States Patent

[11] 3,599,673

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[21] Appl. No. 800,323
[22] Filed Jan. 15, 1969
[45] Patented Aug. 17, 1971
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Paris, France
[32] Priority Jan. 15, 1968, Dec. 23, 1968
[33] France
[31] 135,940 and 179,987

[54] **ELECTRIC PRESSURE-REDUCING VALVE**
6 Claims, 12 Drawing Figs.

[52] **U.S. Cl.** **137/625.61,** 251/65
[51] **Int. Cl.** **F16k 11/07,** F16k 31/08
[50] **Field of Search** 137/625.61, 625.62, 625.64; 251/65

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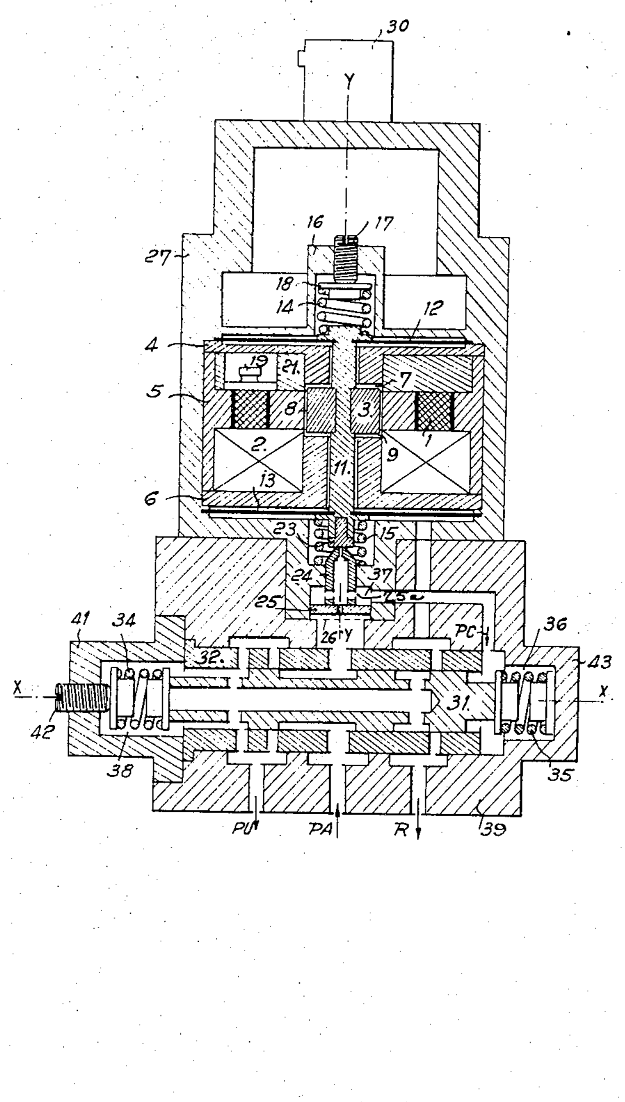
Attorney—Waters, Roditi, Schwartz & Nissen

ABSTRACT: An electric pressure-reducing valve is provided for regulating a hydraulic utilization pressure by means of a low electric control current and comprises two stages, i.e., a primary stage constituted by a magnetic force motor and a stop-valve and jet-nozzle system, and a secondary stage constituted by a hydraulic slide valve servo-controlled by the pressure regulated in the primary stage. The primary stage is wholly constructed along a single axis of revolution: the power developed by the magnetic force motor is directed along this axis, the movement of the stop-valve is a movement of translation along this axis, the jet-nozzle is mounted on this axis; the primary stage is mounted on the body of the electric pressure-reducing valve so as to form an independent unit which is readily removable along said axis without any risk of upsetting the adjustments.



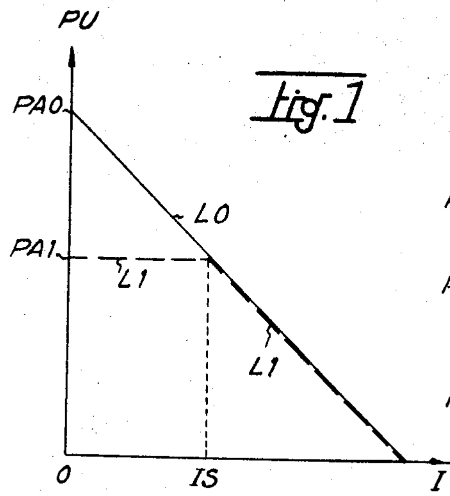


Fig. 1

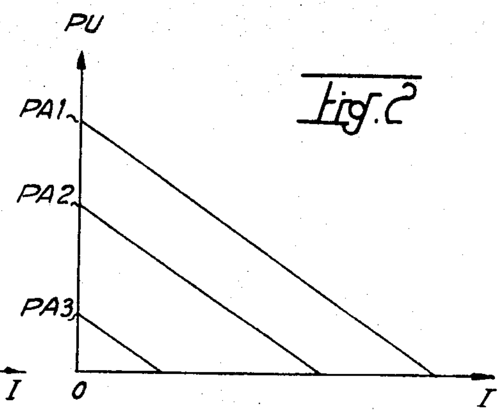


Fig. 2

Fig. 4

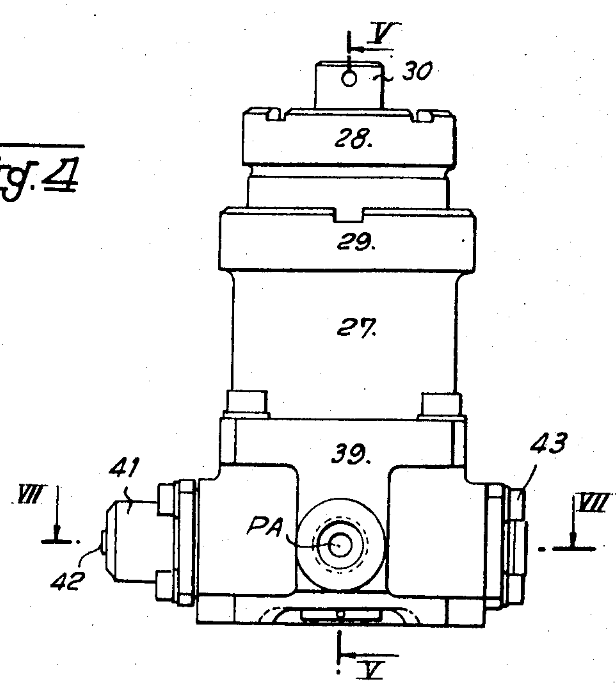
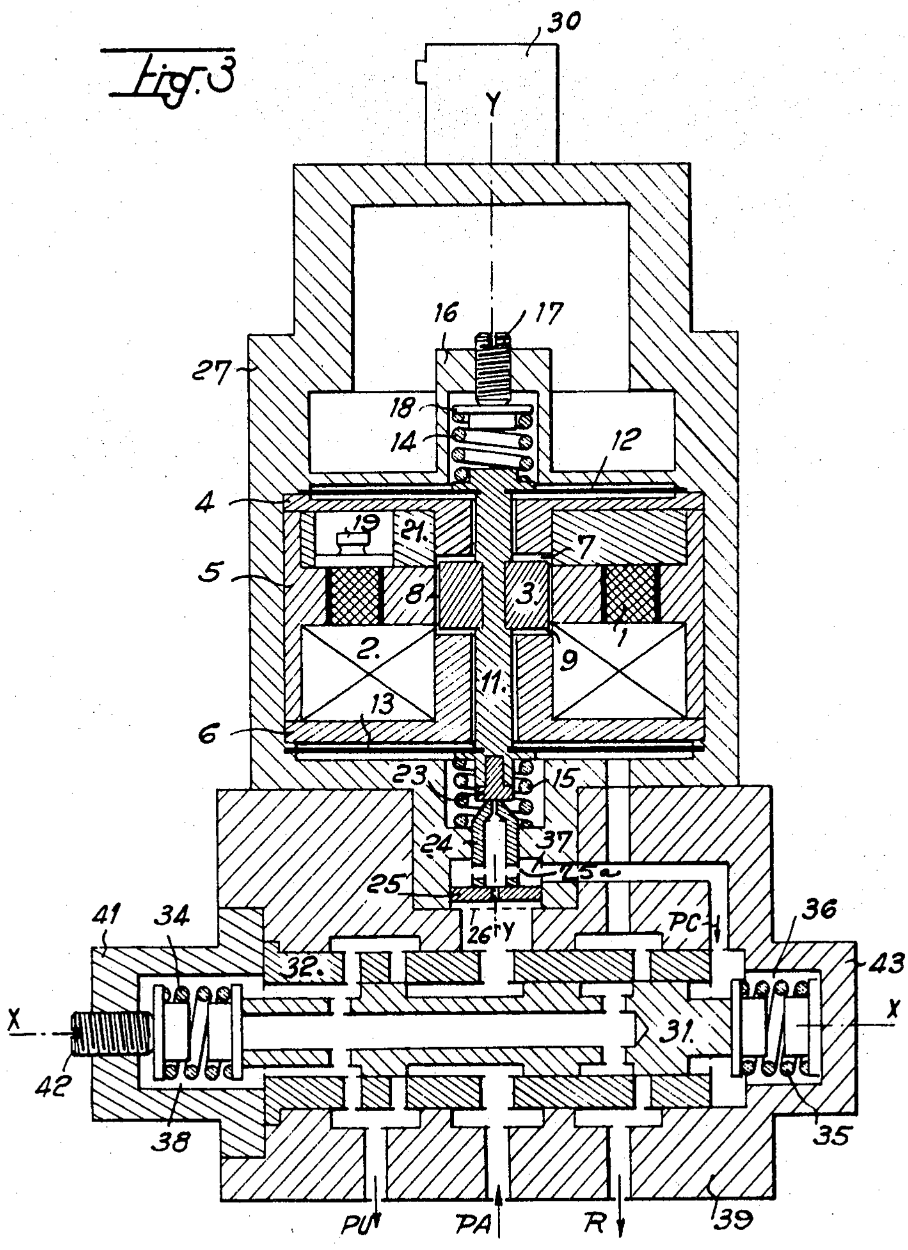


Fig. 3


30
Y
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18
14
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21
7
5
8
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11
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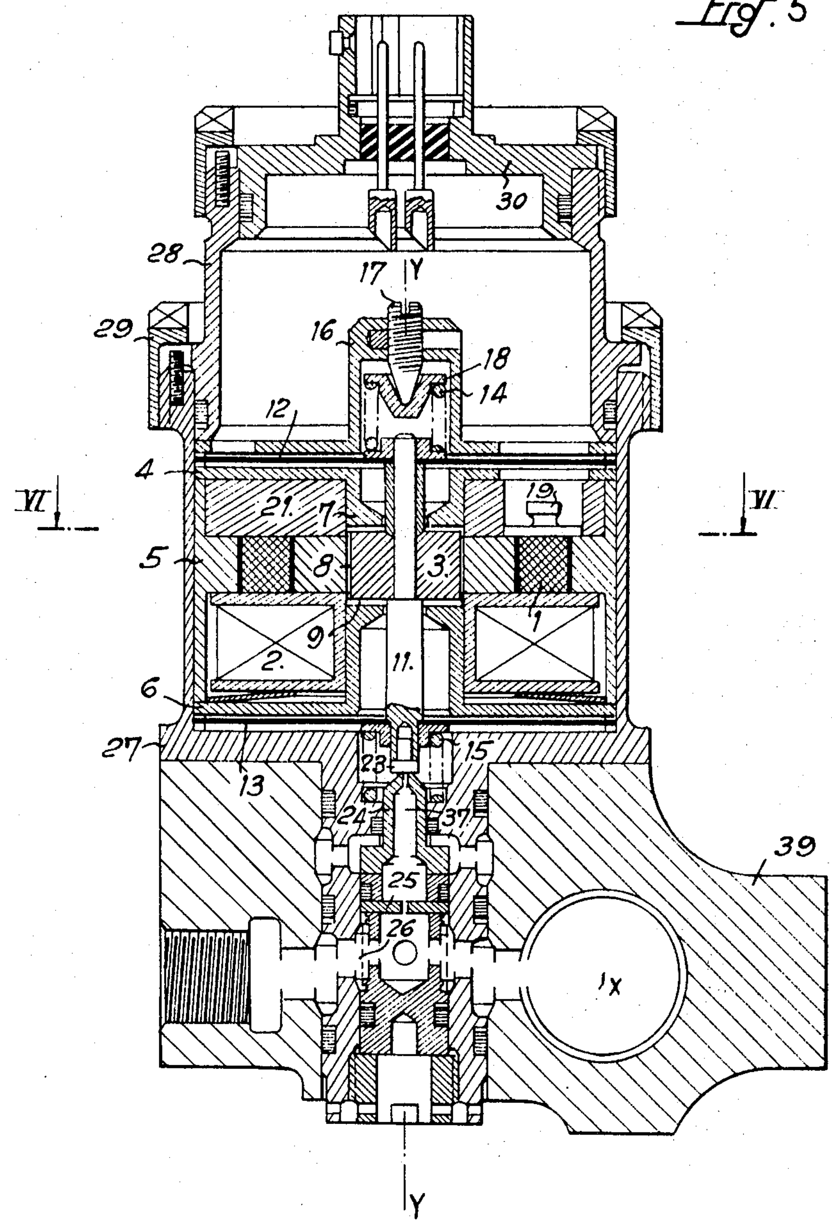
6
23
15
24
37
25
25a
26
Y
41
34
PC
36
43
32
X
31
X
42
38
35
PU
PA
R
39

Fig. 5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X
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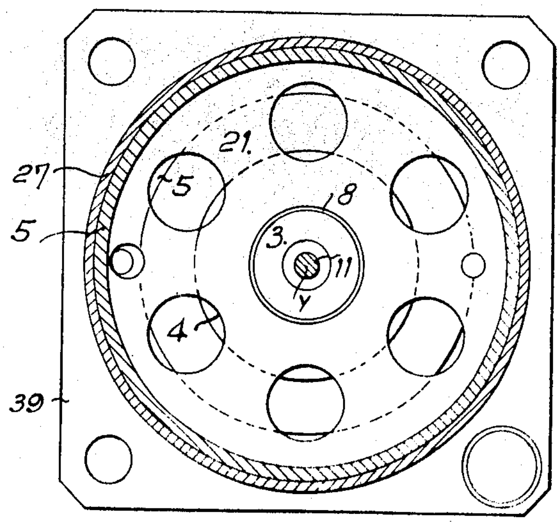


Fig. 6

Fig. 8

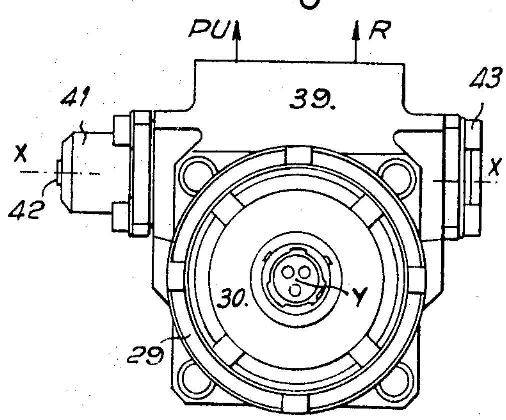


Fig. 7

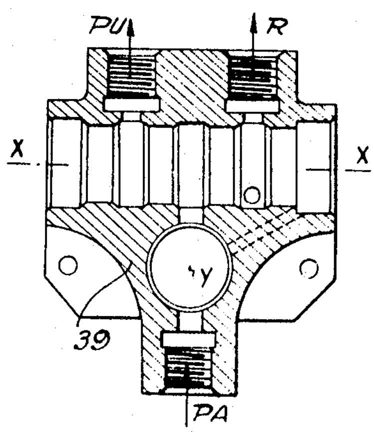


Fig. 9

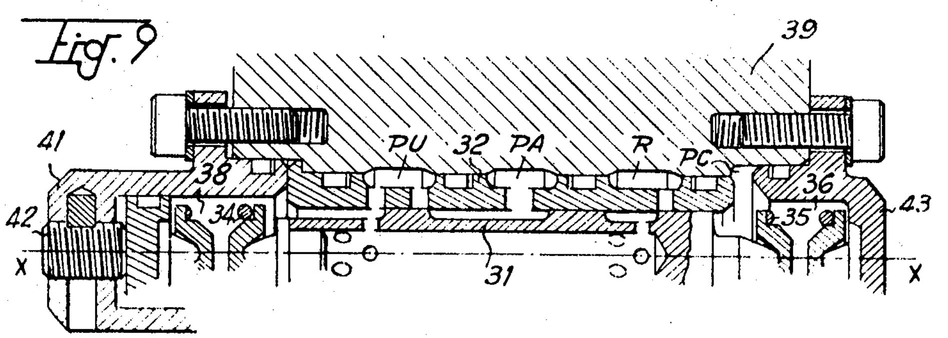
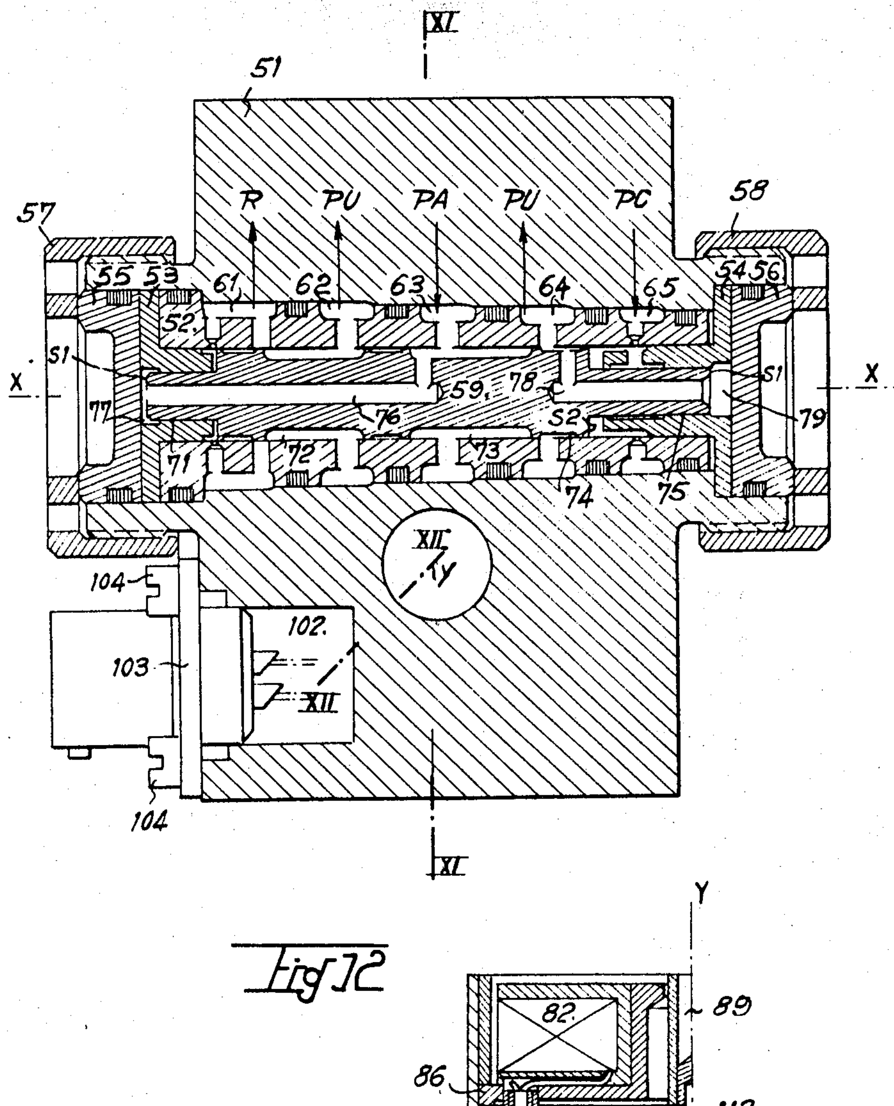


Fig. 10


XI
51
R
PU
PA
PU
PC
57
58
55
53
61
62
63
64
65
54
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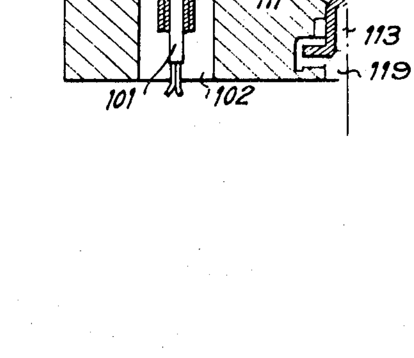
52
S1
X
59
78
S1
X
77
76
79
S2
71
72
73
74
75
XII
Y
104
102
103
XII
104
XI

Fig. 12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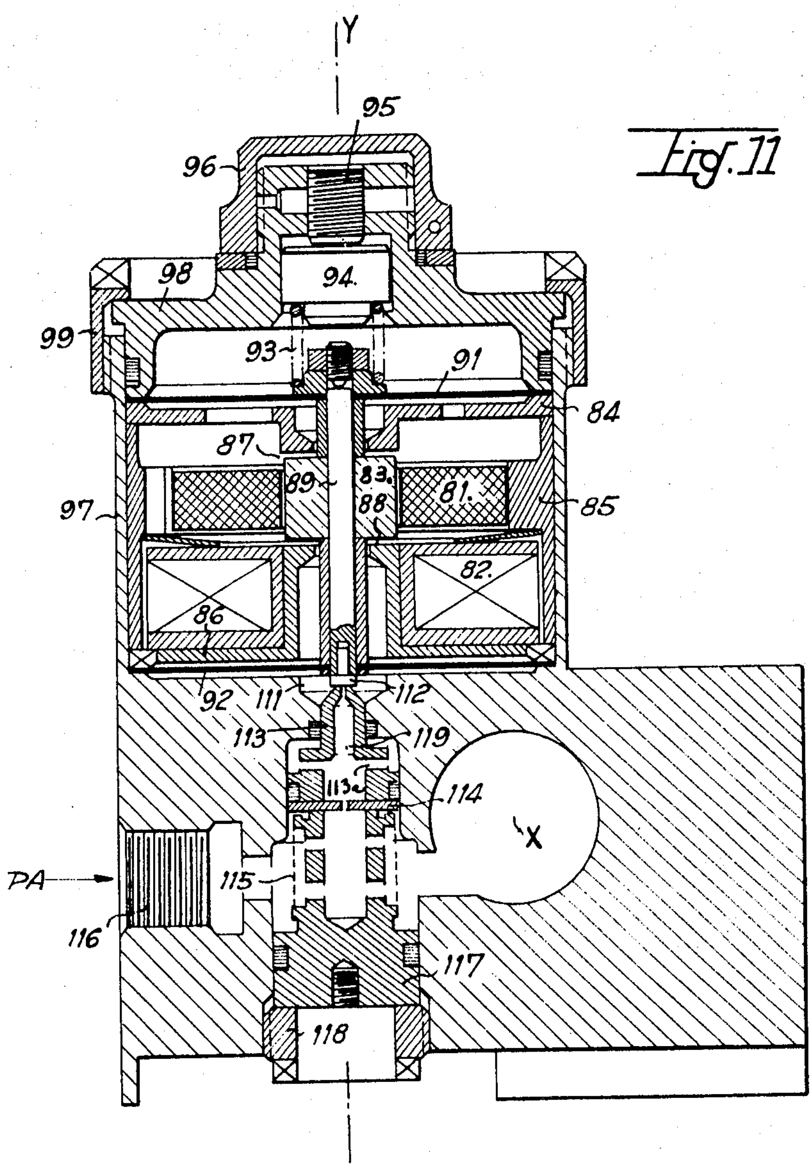
Y
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83a
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111
112
113
119
113a
114
X
PA
115
116
117
118

Fig. 11

ELECTRIC PRESSURE-REDUCING VALVE

The present invention has for its object an apparatus known as an electric pressure-reducing valve, the function of which is to permit the control of a hydraulic pressure by means of a small electric control current.

For the same purpose, it is generally known to utilize servo distributors. This kind of apparatus usually gives satisfactory results, but it has the disadvantage of a high production cost.

The electric pressure-reducing valve according to the invention presents the advantage of having a much simpler construction and, consequently, being substantially less costly than its predecessors.

The electric pressure-reducing valve according to the invention comprises two stages, a primary stage constituted by a magnetic force motor and by a stop-valve and nozzle system, and a secondary stage constituted by a hydraulic slide valve servo controlled by the pressure regulated by the primary stage.

The electric pressure-reducing valve in accordance with the invention is especially characterized in that:

a. The primary stage is wholly constructed along an axis of revolution: the power developed by the force-motor is directed along this axis, the movement of the stop-valve is a translation along this axis, the nozzle or jet is placed on this axis; the primary stage is mounted on the body of the electric pressure-reducing valve as an independent unit which is readily removable by dismantling along the said axis, without risk of interfering with the adjustment;

b. For a constant supply pressure, and in the absence of hydraulic flow, the law of operation which associates the output pressure of the electric pressure-reducing valve with its control current is substantially linear;

c. In addition, if desired but not necessarily, the slope of the said law of operation is independent of the supply pressure; in other words, the same variation of intensity of the control current always produces the same variation of the utilization pressure, and these variations are proportional, over the range between the maximum supply pressure and zero pressure, which are physical limits of the utilization pressure.

In a more detailed manner, the law specified in (b) will be defined by referring to the curves shown in FIG. 1, given by way of nonlimitative example, in which the intensity I of the electric control current is plotted on the abscissa and the utilization pressure PU delivered by the secondary stage is plotted on the ordinate. With the electric pressure-reducing valve according to the invention, the law of current-pressure is linear (the straight line LO in FIG. 1) for the value of the supply pressure PAO at which the primary stage has been adjusted. On the other hand, when the supply pressure falls to a value PA1, less than PA0, the law of current-pressure has a level portion (the broken line L1 of FIG. 1). The utilization pressure PU first remains substantially constant and equal to PA1 as long as the control current has not reached a value IS, which value increases as the supply pressure PA1 becomes lower.

This characteristic with a flat-topped portion is obviously not troublesome in applications in which the supply pressure PA is approximately constant, and it still remains permissible in other applications. However, there exist applications in which the supply pressure is variable and in which furthermore the said flat portion may represent a disadvantage.

The invention enables this disadvantage to be eliminated when so desired. According to a further arrangement of the invention, the electric pressure-reducing valve can, according to paragraph (c) above, provide a law of current-pressure which is always linear and of constant slope, in spite of variations of supply pressure. This law according to (c) will be defined by referring to the curves given in FIG. 2 by way of nonlimitative example, these curves also having the intensity I of the electric control current plotted on the abscissa and the utilization pressure PU on the ordinate.

With this other arrangement according to the invention, for different values of PA, for example PA1, PA2, PA3, there is obtained a system of parallel straight lines, all characterized by a constant ratio between the variation of the control current intensity I and the variation of the utilization pressure PU. It will be observed that the level pressure zones such as that shown in FIG. 1 have been eliminated.

Briefly, following an arrangement in accordance with the invention, in the electric pressure-reducing valve comprising a primary stage and a secondary stage, the primary stage comprising a magnetic force motor, a moving stop-valve displaced by the said motor, a nozzle placed in front of the said stop-valve, and an orifice plate mounted upstream of the said nozzle and supplied under pressure by a hydraulic source, the secondary stage comprising a hydraulic slide valve controlled by the control pressure established by the primary stage between the said orifice plate and the said nozzle and regulating the said utilization pressure, with zero hydraulic flow, following a law as a function of the electric control current which is substantially linear for a constant supply pressure, the said primary stage is wholly constructed along an axis of revolution Y–Y, the power developed by the said force-motor being directed along the said axis Y–Y, the movement of the said stop-valve is in translation along the said axis Y–Y, the said nozzle is a body of revolution about the said axis Y–Y, the whole of the primary stage being capable of removal as a unit along the said axis Y–Y, and the said hydraulic slide valve is acted upon in opposite directions, over two equal sections, on the one hand by the said control pressure and on the other hand by the said utilization pressure, the said hydraulic slide valve having a neutral position in which it does not modify the said utilization pressure, on one side of which it is displaced if the utilization pressure becomes less than the prescribed value and in which it connects the said utilization pressure to exhaust.

Briefly, following another arrangement according to the invention, in the electric pressure-reducing valve comprising a primary stage and a secondary stage, the primary stage comprising a magnetic force-motor, a movable stop-valve displaced by the said motor, a nozzle placed in front of the said stop-valve, and an orifice plate mounted upstream of the said nozzle and supplied under pressure by a hydraulic source, the secondary stage comprising a hydraulic slide valve controlled by the control pressure established by the primary stage between the said orifice plate and the said nozzle and regulating the said utilization pressure, at zero hydraulic flow, following a law as a function of the electric control current which is substantially linear for a constant supply pressure and has a substantially constant slope for a variable supply pressure, the said primary stage is wholly constructed along an axis of revolution Y–Y, the power developed by the said force-motor is directed along the said axis Y–Y, the movement of the said stop-valve is in translation along the said axis Y–Y, the said nozzle is a body of revolution about the said axis Y–Y, the whole of the primary motor can be removed as a unit along the said axis Y–Y, and the said hydraulic slide valve is acted upon in opposite directions, on the one hand over a first section by the said control pressure and over a second section by the said utilization pressure, and on the other hand over a third section equal to the said second section by the said supply pressure, the said hydraulic slide valve having a neutral position in which it does not modify the said utilization pressure, on one side of which it is displaced if the utilization pressure becomes less than the prescribed value and at which it supplies the said utilization pressure from the said supply pressure, and on the other side of which it is displaced if the utilization pressure becomes greater than the prescribed value and at which it connects the said utilization pressure to exhaust.

The invention, and two embodiments of the electric pressure-reducing valve according to the invention, will now be described with reference to the accompanying drawings, given by way of nonlimitative examples. In these drawings:

FIG. 3 is a diagrammatic view in axial section of an electric pressure-reducing valve according to the invention, providing the law of current-pressure shown in FIG. 1;

FIG. 4 is the view in elevation corresponding to FIG. 3;

FIG. 5 is a view in axial section taken along the line V–V of FIG. 4, but to twice the scale;

FIG. 6 is a view in cross section taken along the line VI–VI of FIG. 5;

FIG. 7 is a view in cross section along the line VII–VII of FIG. 4;

FIG. 8 is a view in plan looking from above, of FIG. 4;

FIG. 9 is a view in half-longitudinal section of the secondary stage;

FIG. 10 shows a further electric pressure-reducing valve according to the invention, in cross section passing through the axis X–X of the slide valve of the secondary stage and normal to the axis Y–Y of the primary stage;

FIG. 11 is a cross section passing through the axis Y–Y of the primary stage and normal to the axis X–X of the slide valve of the secondary stage, taken along the line XI–XI of FIG. 10;

FIG. 12 is a detail, in cross section through the axis Y–Y of the primary stage, along the line XII–XII of FIG. 10, showing the electrical connections of the operating coil.

With reference to FIGS. 3 and 5, there will be described below the structure of the primary stage of this electric pressure-reducing valve according to the invention.

The magnetic motor, of the polarized type, comprises a permanent magnet **1** with radial magnetization, a coil **2**, a moving core **3** and a magnetic circuit consisting of the parts **4**, **5** and **6**. The airgap **7** is determined by the space comprised between the core **3** and the part **4**. The airgap **8** corresponds to the space comprised between the said core **3** and the part **5**, and the airgap **9** to the space comprised between the said core **3** and the part **6**.

The core **3** is rigidly fixed to a rod **11**, the two extremities of which are respectively suspended from two fine metallic diaphragms **12** and **13**. The core **3** can thus move without frictional contact on any other member. Two springs **14** and **15** ensure its return to its mean position. The support **6** on which the spring **14** is indirectly supported, comprises a screw **17** which, by acting on the cup **18** of this spring enables the position of the core **3** to be adjusted.

Magnetic shunts **19** arranged in holes formed in a spacing member **21** of the magnetic circuit **4** permit the adjustment of the gain of the force-current law. A closure member or stop-valve **23**, fixed to the extremity of the rod **11** opposite to the screw **17** is mounted facing a jet-nozzle **24** with lateral outlets **25*a***, the whole being arranged, as already stated, along the general axis Y–Y. This primary stage finally comprises an orifice plate **25** protected by a filter **26**.

All the elements of this primary stage are contained in a body **27** and thus constitute an independent unit, which can be extracted from the remainder of the apparatus without risk of putting it out of adjustment. This body **27** is extended by an endpiece **28** fixed on the body **27** by a nut **29** (see FIG. 5). This endpiece **18** is in turn closed by the base of the fluidtight electric socket **30**.

The secondary stage having an axis X–X (see FIGS. 3, 7, 8 and 9), comprises a slide valve **31** moving inside a casing **32** and acted upon by two restoring springs **34** and **35**. The chamber **36** (FIGS. 3 and 9), located at one of the extremities of the slide valve, communicates continuously with the chamber **37** comprised between the nozzle jet **24** and the orifice plate **25** (FIGS. 3 and 5), in which the primary stage regulates the control pressure PC. At the opposite extremity of the slide valve **31**, the chamber **38** communicates with the utilization orifice (pressure PU). The elements of this secondary stage are mounted in a body **39** on which the primary stage is fixed in a removable manner.

The casing **32** is held in position by the endpiece **41**, which comprises a screw **42** by means of which the law of current-pressure can be adjusted. An endpiece **43** closes the chamber **36**. Finally, on the body **39** are provided the three hydraulic connections for supply (pressure PA), utilization (pressure PU) and return R (FIGS. 3, 4, 7 and 8), together with the fixing lugs (not shown).

The operation of this electric pressure-reducing valve is effected as follows:

According to the shape of the current-pressure characteristic which it is desired to obtain, the utilization pressure PU is a substantially linear function, increasing or decreasing, of the current I passing through the coil **2**, on the assumption that the supply pressure PA is constant.

There is considered for example the case in which the pressure PU is a decreasing function of I. When the current I is zero, the stop-valve or closure member **23** occupies a position very close to the jet nozzle **24**, at a distance which can be adjusted by means of the screw **17** in order to obtain the desired maximum pressure of PU. In fact, this distance determines the pressure in the chamber **37**. As long as the pressure PU is less than the pressure PC existing at **37**, the slide valve **31** moves towards the left (FIG. 5) and it delivers from PA towards PU. In consequence, the pressure PU progressively increases; the slide valve **31** closes its passages when an equilibrium of the pressures is reached.

When the current I is not zero, the magnetic motor applies to the moving core **3** a force which, acting in opposition to that applied by the springs **14** and **15**, moves the closure member **23** away from the jet nozzle **24**, which has the effect of reducing the pressure in the chamber **37**. The result is that the slide valve **31** is displaced towards the right and puts the utilization PU in communication with the return R, up to the moment when an equilibrium of the pressures is again obtained, but at a lower value.

It is clear that the force applied on the core by the magnetic motor has for its origin the combination in the airgaps **7** and **9**, of the flux generated by the coil **2**, with the flux created by the permanent magnet of the groove **64** of the casing, a groove **74** which can come opposite passages **64** of the latter flux being distributed between the airgaps **7** and **9**, after having passed across the airgap **8**.

It will be understood that the particular constructional features of the electric pressure-reducing valve described above are not of any limitative nature.

Another electric pressure-reducing valve according to the invention, which ensures the current-pressure law shown in FIG. 2, will now be described with reference to FIGS. 10 to 12.

Referring to FIG. 10, the secondary stage of this embodiment comprises, housed in a body **51** in a fluidtight manner, as shown, a cylindrical casing **52** having an axis X–X mounted between two sockets **53** and **54** forming abutments and two fluidtight plugs **55** and **56** held by threaded nuts **57** and **58** screwed on the body **51**. A cylindrical slide valve **59** having an axis X–X slides freely between the socket-abutments **53** and **54**.

The casing **52** is provided with a plurality of external grooves, each communicating with radial passages, namely, going from left to right in FIG. 10: a groove **61** which is connected (in a manner not shown), to the return to the tank and therefore under pressure; a groove **62** connected to the utilization conduit and therefore under the utilization pressure PU; a groove **63** coupled to the supply conduit and therefore under the supply pressure PA; a groove **64** which is also under the utilization pressure PU; and a groove **65** connected to the output of the primary stage and therefore under the control pressure PC.

The slide valve **59** is provided externally with a plurality of external grooves, separated from each other by three shoulders, namely, going from left to right in FIG. 10: an endpiece **71** of reduced diameter, a groove **72** which can come opposite passages of the groove **61** of the casing and which faces passages of the groove **62** of the casing, a groove **73** which is facing the groove **63** of the casing and which can come opposite passages **64** of the casing, and an endpiece **75** of reduced diameter.

An axial and then radial passage **76** provides a continuous communication between the chamber **77** on the left-hand side of the slide valve and the groove **73**, and a radial then axial passage **78** forms a continuous communication between the groove **74** and the chamber **79** on the right-hand side of the slide valve.

To sum-up, to the left of a central position, the slide valve puts its groove **72** into communication with the grooves **61** and **62** of the casing **52** and thus connects the utilization conduit to the return to the tank, which reduces the utilization pressure PU, and to the right of this central position, the groove **73** of the slide valve **59** puts into communication the grooves **63** and **64** of the casing **52**, and therefore puts the supply conduit into communication with the utilization conduit, which increases the utilization pressure PU.

Now, the slide valve **59** slides freely in the casing **62** under the action of the hydraulic pressures which are applied to it, and which are: on the one hand in the left-hand chamber **77**, the supply pressure PA arriving through the groove **63**, the groove **73** and the axial passage **76**, and acting towards the right on the annular section S1 of the endpiece **71**, on the other hand, in the right-hand chamber **79**, the utilization pressure PU coming in through the groove **64**, the groove **74** and the axial passage **78**, and acting towards the left on the annular section of the endpiece **75**, which has the same annular section S1 as the endpiece **71**, and finally the control pressure PC, coming in through the groove **65** and acting towards the left on the annular section S2. In consequence, the slide valve **59** will be in equilibrium if:

1. $(PA)(S1)=(PU)(S1)+(PC)(S2)$

therefore:

1. $(PU)=(PA)-(PC)\cdot(S2)/(S1)$

With reference to FIG. **11**, the magnetic motor of the polarized type comprises a permanent magnet **81** with radial magnetization, a coil **82**, a moving core **83** and a magnetic circuit composed of the members **84**, **85** and **86**. The working airgaps **87** and **88** correspond respectively to the space comprised between the core **83** and the member **84**, and to the space comprised between the said core and the member **86**. The core **83** is rigidly fixed to a rod **89**, the two extremities of which are suspended respectively from two thin metallic diaphragms **91** and **92**; the core **83** is thus able to move without rubbing contact with any other part. The elastic return of the moving system **83—89** is ensured by the two diaphragms **91** and **92** which are notched and tend to lift this moving system, and by a helicoidal spring **93** which tends to pull it down. This spring **93** works in compression and its supporting point **94** can be displaced by an adjustment screw **95**, accessible through a threaded plug **96**.

The above members of the primary stage are housed in a cylindrical chimney **97**, having an axis Y–Y, of the body **51**, closed by an endplate **98** and a nut **99**.

The two connection wires **101** of the coil **82** (see FIG. **12**) pass into a recess **102** formed in the body **51** and are connected to an electric socket **103** which is removable by means of screws **104** (see FIG. **10**).

In the body **51** and again along the axis Y–Y is formed a chamber **111**, in which a closure member **112**, fixed to the lower extremity of the rod **89** and therefore movable in translation parallel to the axis Y–Y, moves in front of a jet nozzle **113** mounted in a fixed position along the axis Y–Y and with fluidtight sealing in the body **51**. This jet nozzle **113** is fed through the intermediary of an orifice plate **114** and a cylindrical filter **115** from the supply conduit **116**. The jet nozzle **113** and its associated parts are held by a plug **117** and a screw **118** and are thus easily accessible.

When the action of the magnetic motor brings the closure member **112** closer to the jet nozzle **113**, the pressure in the chamber **119** upstream of the jet nozzle increases. This pressure is the control pressure PC and is sent via lateral openings **113a** in nozzle **113** into the groove **65** of the secondary stage through a conduit system (not shown).

It will be noted that, with the arrangements described above, on the one hand the hydraulic portion of the primary stage is readily accessible, for example in order to clean the filter or the jet nozzle, and on the other hand, its electrical portion is easily accessible. In addition, these parts are interchangeable by means of the adjustment alone of the spring **93** by its screw **95**. These advantages are obviously associated with the systematically axial structure (with an axis Y–Y) given to the two hydraulic and electrical portions of the primary stage of the electrodistributor.

On the other hand, the direction of the current I in its coil **82** is such that it produces a control pressure PC at the output of the primary stage which is an increasing function of the current:

3. $(PC)=kI$

in which k is a positive constant. A combination of the equations (2) and (3) shows that:

4. $(PU)=(PA)-aI$

in which a is a constant equal to $(S2/S1)\cdot k$. In other words, the slope a of the straight line representing the current-pressure law is independent of the supply pressure PA. This is what is shown in FIG. **2**.

From the technological point of view, the construction of the second stage shown in FIG. **10** should be noted. The two endpieces **71** and **75** are machined on the slide valve **59** in a concentric manner with respect to the three bearing surfaces which slide in the bore of the casing. The two sockets **53** and **54** are centered in the bore of the casing **52**, these sockets each comprising a bore in which is allowed to slide one of the endpieces **71** and **75**. It can thus be seen that as a result of the centering of the sockets **53** and **54** in the casing **52**, there are only two concentricities to be observed: that of the end pieces **71** and **75** with the three bearing surfaces of the slide valve, and that of the bore and the external machining of the sockets **53** and **54**. These two concentricities can furthermore be obtained with a high degree of accuracy by a single machining operation. In fact, by means of an appropriate jig, the sockets **53** and **54** can be held on the endpieces **71** and **75**, and in a single operation it is possible to grind the three bearing surfaces of the slide valve and the external diameters of the sockets **53** and **54**.

In this way it is possible to obtain almost perfect concentricities and in consequence to provide a frictionless sliding movement of the slide valve, at the same time having very small clearances (between the slide valve **59** and the casing **52**, between the endpieces **71** and **75** and between the sockets **53** and **54** and finally between the sockets **53** and **54** and the casing). These small clearances enable very small friction to be obtained at the level of the second stage.

In addition, it will be observed that the two passages **76** and **78** in the interior of the slide valve **59**, which on the one hand bring the pressure PA into the chamber **77** and on the other hand lead the pressure PU into the chamber **79** permit the machining of the body **51** to be simplified.

What I claim is:

1. An electric pressure-reducing valve for regulating a hydraulic utilization pressure as a function of a low electric control current, comprising a primary stage and a secondary stage, the primary stage comprising a magnetic force motor, a movable closure member coupled to and displaced by said motor, a jet-nozzle placed in front of said closure member, and an orifice plate mounted upstream of said jet-nozzle and supplied under pressure by a hydraulic source, the secondary stage comprising a hydraulic slide valve controlled by the control pressure established by the primary stage between said orifice plate and said jet-nozzle and regulating said utilization pressure with zero hydraulic flow as a function of the electric control current which is substantially linear for a constant supply pressure, said primary stage being wholly constructed along an axis of revolution Y–Y, the power developed by said force-motor being directed along said axis Y–Y, the movement of said closure member by said motor being in translation along said axis Y–Y, said jet-nozzle being a body of

revolution about said axis Y–Y, means supporting the whole of the primary stage as a removable unit along said axis Y–Y, means for supplying said hydraulic slide valve in opposite directions, on two equal sections, on the one hand with said control pressure and on the other with said utilization pressure, and means providing said hydraulic slide valve with a neutral position in which it does not modify said utilization pressure, on one side of which it is displaced if the utilization pressure becomes less than the prescribed value and in which it supplies said utilization pressure from said supply pressure, and on the other side of which it is displaced if said utilization pressure becomes higher than the prescribed value and in which it causes said utilization pressure to escape.

2. An electric pressure-reducing valve as claimed in claim 1, in which said motor of said primary stage comprises a permanent magnet with an axis Y–Y, with radial magnetization, a coil on the axis Y–Y, a movable core on the axis Y–Y, a magnetic circuit comprising two end plates, a yoke with its axis Y–Y with a spacing member and adjustable magnetic shunt means in said spacing member, a rod with its axis Y–Y rigidly fixed to said movable core, two thin metal diaphragms supporting said rod, an adjustable spring with its axis Y–Y at one extremity of said rod, said closure member with its axis Y–Y being at the other extremity of said rod, said means supporting the primary stage as a removable unit comprising a body on the axis Y–Y housing all said members of the primary stage.

3. An electric pressure-reducing valve as claimed in claim 1 wherein said means providing the slide valve with its neutral position comprises a casing slidably receiving said hydraulic slide valve therein, and two opposing springs, one of which includes adjustable means, said springs acting on said slide valve for restoring said slide valve to its neutral position, said means for supplying the hydraulic slide valve with the utilization and control pressures comprising at one extremity of said casing an endpiece closing a first chamber connected to and subjected to said utilization pressure, at the other extremity of said casing, an endpiece closing a second chamber connected to and subjected to said control pressure, said slide valve being provided with a blind axial bore and grooves positioned to cooperate with grooves in said casing for supplying said utilization pressure from said supply pressure when the slide valve is displaced towards the first said chamber, and in causing said utilization pressure to escape when said slide valve is displaced towards said second chamber.

4. An electric pressure-reducing valve for regulating a hydraulic utilization pressure as a function of a low electric control current, comprising a primary stage and a secondary stage, said primary stage comprising a magnetic force motor, a movable closure member coupled to and displaced by said motor, a jet-nozzle placed in front of said closure member, and an orifice plate mounted upstream of said jet-nozzle and supplied under pressure by a hydraulic source, said secondary stage comprising a hydraulic slide valve controlled by the control pressure established by the primary stage between said orifice plate and said jet-nozzle and regulating said utilization pressure, at zero hydraulic flow as a function of the electric control current which is substantially linear for a constant supply pressure and substantially of constant slope for a variable supply pressure, said primary stage being wholly constructed following an axis of revolution, the power developed by said force-motor being directed along said axis, the movement of said closure member by said motor being in translation along said axis, said jet-nozzle being a body of revolution about said axis, means supporting the whole of the primary motor as a removable unit along said axis, means for supplying said hydraulic slide valve in opposite directions, on the one hand on a first section by said control pressure and on a second section by said utilization pressure and on the other hand on a third section equal to said second section by said supply pressure, and means providing said hydraulic slide valve with a neutral position in which it does not modify said utilization pressure, on one side of which it is displaced if the utilization pressure becomes less than the prescribed value and in which it supplies said utilization pressure from said supply pressure, and on the other side of which it is displaced if the utilization pressure becomes greater than the value prescribed and in which it causes said utilization pressure to escape.

5. An electric pressure-reducing valve as claimed in claim 4, in which said motor of said primary stage comprises a permanent magnet having an axis Y–Y, with radial magnetization, a coil on the axis Y–Y, a movable core on the axis Y–Y, and a magnetic circuit comprising two end plates and a yoke having the axis Y–Y, a rod on axis Y–Y rigidly fixed to said core, two thin metal diaphragms supporting said rod, an adjustable spring means on the axis Y–Y, at one extremity of said rod, said closure member being on the axis Y–Y, at the other extremity of said rod, said means supporting the primary stage as a removable unit comprising a cylindrical chimney with the axis Y–Y housing all said members of the primary stage.

6. An electric pressure-reducing valve as claimed in claim 4 further comprising a casing slidably receiving said hydraulic slide valve, said means for supplying the hydraulic slide valve with the utilization and control pressures comprising at one extremity of said casing a socket-abutment and a plug defining a first chamber having a determined section on which is applied said supply pressure, at the other extremity of said casing, a socket-abutment and a plug defining a second chamber having the same section as said first chamber, on which is applied said utilization pressure, an intermediate shoulder of said slide valve forming therein an annular surface constituting said first section on which said control pressure is applied in the direction which pushes the slide valve towards said first chamber, said slide valve being provided with two blind axial bores and with grooves positioned to cooperate with grooves of said casing in supplying said utilization pressure from the supply pressure when the slide valve is displaced towards said second chamber and in causing said utilization pressure to escape with said slide valve is displaced towards said first chamber.