

(21) Application No 8624763

(22) Date of filing **15 Oct 1986**

(30) Priority data

(31) 3538120 (32) 26 Oct 1985 (33) DE

(51) INT CL⁴
F15B 1/02

(52) Domestic classification (Edition I)
F1P 11X
U1S 1820 2013 F1P

(56) Documents cited
None

(58) Field of search
F1P
Selected US specifications from IPC sub-class F15B

(71) Applicants
Alfred Teves GmbH

(Incorporated in FR Germany)

**7 Guerickestrasse, 6000 Frankfurt am Main, Federal
Republic of Germany**

(72) Inventors
Hans-Dieter Reinartz
Helmut Steffes
Franz Latka

(74) Agent and/or Address for Service
J. C. Vaufrourd, ITT Patent Department UK, Maidstone
Road, Foots Cray, Sidcup DA14 5HT

(54) Pressure supply system, especially for brake systems of motor vehicles

(57) A pressure supply system, particularly for the generation of an auxiliary pressure of a hydraulic brake system for motor vehicles, comprises an accumulator, a hydraulic pump driven by a motor and a pressure switch (1) controlling the turning on and off of the hydraulic pump. The said pressure switch (1) includes a switch piston (2) having a piston rod (5) mechanically actuating in pressure-responsive manner, successively, two or three switches (8, 9, 10). The pump motor, by way of these switches, via a relay, is turned on when a bottom pressure limit value (P_U) is reached, and turned off when the upper pressure limit value (P_O) is reached and exceeded. A holding circuit is connected in the electric circuit in which are provided the switches (8, 9, 10) which holding circuit acting when the pressure slowly approaches (p) the limit values (P_U , P_O) slowly to prevent fluttering of the relay contacts and thereby ensures an abrupt switch-over of the relay into the other switching position.

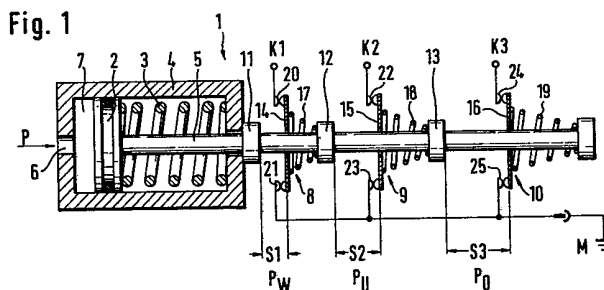


Fig. 1

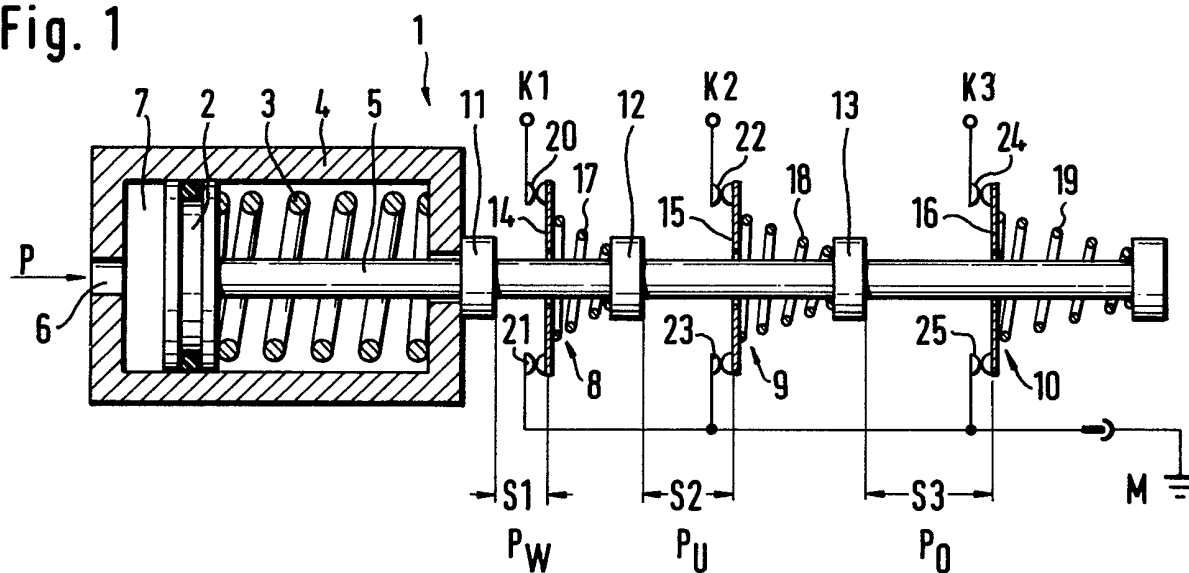


Fig. 2

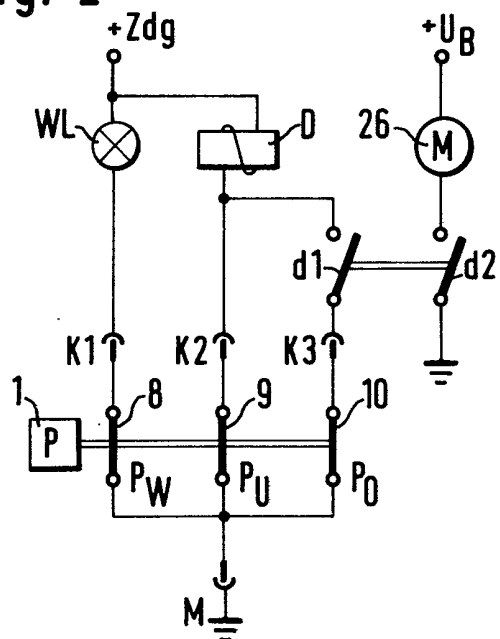


Fig. 3

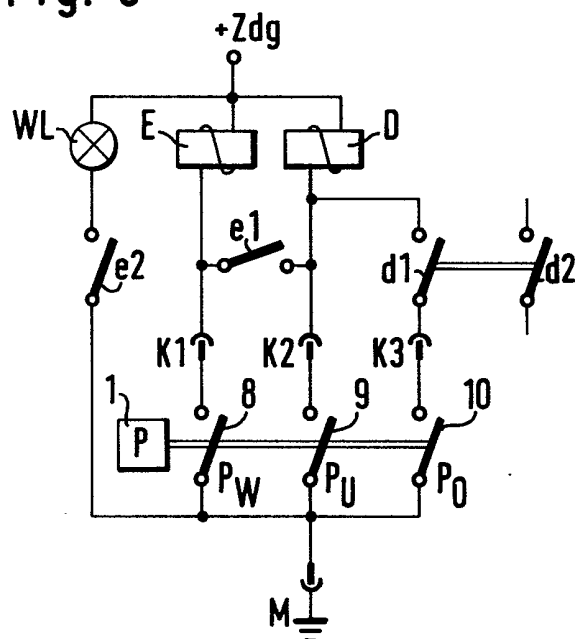
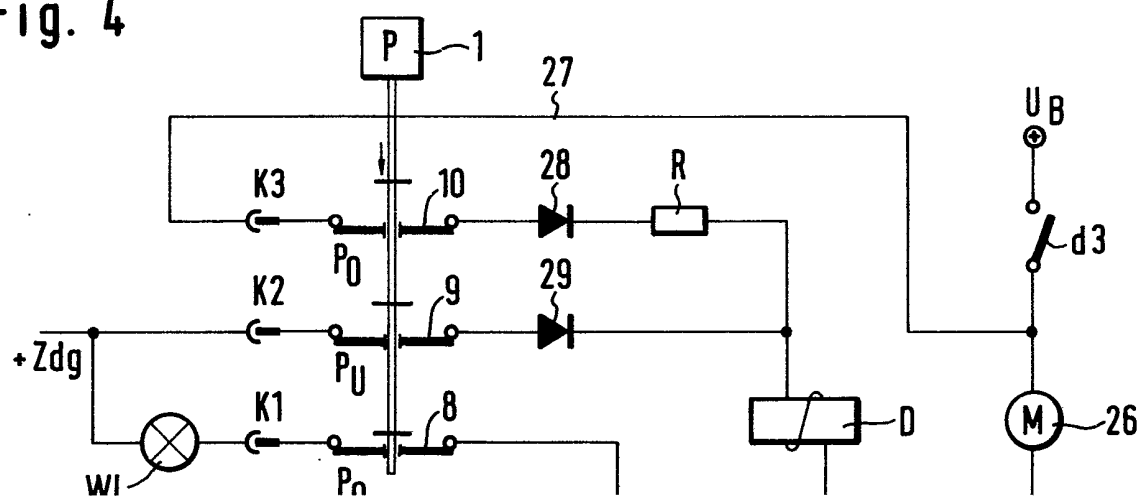


Fig. 4



SPECIFICATION

Pressure supply system, especially for brake systems of motor vehicles

5

This invention relates to a pressure supply system, in particular for generating an auxiliary pressure for a hydraulic brake system for motor vehicles, the pressure supply system comprising an accumulator, an

10

hydraulic pump driven by a motor, and a pressure switch which, via an interconnected motor relay, at a predetermined lower pressure limit, turns on the pump motor and at a predetermined upper limit, turns off the pump motor.

15

It is already known in the art to automatically control the pressure in an auxiliary pressure supply system of a hydraulic brake system with the aid of a pressure switch and to maintain such pressure within an operating pressure range. Such a system, for example, is formed by an hydraulic reservoir charged and recharged with the aid of an hydraulic pump actuated by electromotive force (a motor). The pressure switch monitors at least two or, when combined with a pressure warning system, three switch points. In a system initially non-pressurised, first a warning lamp will flash until the lowest pressure value is reached. Thereafter, loading of the reservoir is continued until the upper switch point or an upper pressure limit value is reached. The pump, thereupon is reswitched only when, due to unloading of the reservoir, the pressure has dropped to a lower pressure limit value which is clearly below the upper threshold value. By this "hysteresis", a frequent turning on and off of the pump is avoided. It will only have to be safeguarded that the pressure remains within the limits and, hence, within the operating pressure range.

35

In conventional pressure switches and pressure warning switches of this type, the pump driving motor is turned on and off via a relay. However, in practice, substantial difficulties are encountered because, during the charging and discharging operation, the pressure slowly approaches the switch point. Although efforts have been taken to obtain, by mechanical means, an abrupt-change characteristic or an abrupt change-type switch-over from one switching position into another switching position, frequently, when the switch point is approached, an unstable or indifferent state of equilibrium occurs. If defective conditions, such as mechanical shocks, are added, which cannot be precluded in a motor vehicle, this will result in a fluttering of the switches or in an excitation of vibrations involving highly disadvantageous effects, with the consequence of increased wear. In vehicles including electronic systems, electromagnetic interference waves are generated. All measures taken to improve the switch characteristic, involve substantial mechanical efforts.

55

It is, therefore, an object of the present invention to overcome the shortcomings involved with conventional pressure supply systems as described and to develop a pressure switch suitable for such systems, which is easy to manufacture and which, also with a very slow change in the auxiliary pressure, safeguards that the pump motor is turned on and off in an abrupt change-type manner.

65

According to the present invention there is provided a pressure supply system, comprising an accumulator, an hydraulic pump driven by a motor, and a pressure switch which, via an interconnected motor relay, turns on the pump motor at a predetermined lower pressure limit value, and turns off the same at a predetermined upper pressure limit value, characterised in that the pressure switch comprises a switch piston axially displaceable against spring force by the pressure to be controlled, which switch piston, upon displacement thereof, mechanically actuates successively at least two switches, one switch of the two being associated with the lower pressure limit value (P_U) and the other switch of the two being associated with the upper pressure limit (P_O), the switches turning on a motor relay (D) and a relay holding circuit when the pressure drops below the lower limit value (P_U), and interrupting the holding circuit when the pressure rises beyond the upper limit value (P_O).

70

75

80

85

90

95

100

105

110

115

120

125

130

135

It has thus been found that the above problem can be solved in an amazingly simple and technically progressive manner.

In the practice of the invention, hence, the desired abrupt-change characteristic is achieved with the aid of a pressure switch realisable by a piston displaceable in proportion to the pressure, and by a number of switches of extremely simple construction in conjunction with the motor relay and an electrical holding relay. The high mechanical efforts hitherto required for achieving an abrupt-change characteristic are thereby eliminated.

According to an advantageous form of embodiment of the invention, the pressure switch is combined with a pressure warning switch, which is realised in that the pressure switch is furnished with a third switch actuated by the switch piston at a predetermined minimum pressure below the lower pressure limit value.

105

110

115

120

125

130

Another form of embodiment of the invention resides in that the switch piston of the pressure switch is connected to an axial piston rod having radial cams to thereby successively actuate the individual switches in response to the pressure acting upon the piston and, hence, in response to the axial displacement. For that purpose, the switches can be in the form of simple contact springs which, upon an axial displacement of the piston rod, can be removed by mechanical engagement of the cams, from the appertaining contact counterparts. The switching pressure can be adjusted by selecting and/or adjusting the spaces, in the rest position, between the contact springs and the appertaining actuating cams. Moreover, in a multiplicity of cases it is of advantage if, in the practice of the invention, a working contact of the motor relay is inserted into the holding circuit in series with a contact closed in the resting position of the switch associated to the upper pressure limit value, with both the pump motor and the holding circuit of the motor relay, advantageously, being turned on and off via a common work contact of the motor relay and with, moreover, the switch associated to the upper pressure limit value and a resistance limiting the current to the value required for holding the relay being inserted into the holding circuit.

Embodiments of the invention will now be de-

scribed with reference to the accompanying drawings, in which:

Figure 1 schematically, shows a simplified illustration of a switch piston displaceable in response to pressure along with the appertaining electrical switches according to one form of embodiment;

Figure 2 shows an electric circuit for the arrangement according to Figure 1;

Figure 3 shows a circuit extended over the one according to Figure 2 for the arrangement according to Figure 1, and

Figure 4 shows an alternative form of embodiment of the electric circuit for the arrangement according to Figure 1.

Referring to the drawings, Figure 1 shows one form of embodiment of a pressure switch of a pressure supply system. The said pressure switch 1, substantially, is composed of a switch piston 2 disposed in a manner axially displaceable against the force of a spring 3 in a cylindrical housing 4. The said piston 2 comprises a piston rod 5 which, upon axial displacement of the switch piston 2, actuates a number of switches.

A pressure p to be regulated or controlled, is transferred via an inlet opening 6, into a front chamber 7 in the interior of the housing 4 and applied to the neighbouring front face of the switch piston 2 thereby permitting an axial displacement of piston 2 against the force of spring 3 in proportion to the pressure p .

In the example as shown, three switches 8, 9, 10 are provided which, upon displacement of the switch piston 2, are successively actuated by piston rod 5. For, piston rod 5 carries switch cams 11, 12, 13 in the form of radial extensions which actuate the appertaining switch 8, 9 or 10 as soon as the respective face of engagement gets into engagement with switch 8, 9, or 10. In Figure 1 of the drawings, the switches are symbolised by contact springs 14, 15, 16 which, in the rest position as shown, at both sides are forced by the force of the closure springs 17, 18, 19 to the contact-counterparts 20 to 25, thereby closing the appertaining current circuits, see Figures 2 to 4.

The spaces between the engagement face of the individual switch cams 11 and 12 or 13, respectively, and the individual contact springs 14 and 15 or 16, respectively, are different thereby successively actuating the switches upon axial displacement of switch piston 2 and, hence, of piston rod 5.

In the example as shown, the said spaces S_1 , S_2 and S_3 are enlarged from left to right so that with an increasing pressure and an axial displacement to the right, the switches 8, 9 and 10 are successively actuated from the left to right. When the pressure is relieved and the switch piston 2 restored into the position as shown, switches 8, 9 and 10 are re-closed in the reverse order.

Pressure switch 1 according to Figure 1, hence, includes three switch points, with the one associated with the lowest pressure value P_W releasing upon displacement S_1 and actuating a warning light WL. With a further pressure rise, path S_2 is traversed and, as soon as the lower pressure limit value P_U is reached, switch 9 is opened. When the upper pressure limit value P_O is reached, switch 10 is actuated thereby turning off the pump of the pressure supply system.

The three switches 8, 9 and 10 with one terminal lead to a common base connection M and with the other terminal respectively lead to connections K1, K2 and K3.

Figure 2 shows one form of embodiment of a circuit capable of controlling, in conjunction with pressure switch 1 according to Figure 1, the pressure supply system. In the rest position of the pressure switch 1, as shown, the current paths are closed via switches 8, 9 and 10. The pressure in the system hence, has not yet reached the bottom limit value P_W —the so-called warning threshold. After turning on the ignition via terminal + Zdg, a warning light WL will light up. A motor relay D, via switch 9 and terminal K2, is turned on to pull up and, via the appertaining working contact d1, to close a holding circuit leading over terminal K3 and switch 10. During a (temporary) opening of switch 9, relay D, hence, continues to be in the pulled-up position.

The driving motor 26 of the hydraulic pump of the pressure supply system is turned on via contact d2 switched simultaneously with contact d1. U_B symbolises the supply battery voltage of the motor vehicle.

When a rise in the pressure occurs, first the warning threshold P_W is reached, with switch 8 opening and warning lamp WL going out. As soon as the lower pressure limit P_U is reached, switch 9 opens. However, relay D, via the holding branch, continues to be in the pulled-up condition. It is only when the upper pressure limit value P_O is reached that also the third switch, viz. switch 10, is actuated, with relay D dropping out to render the pump driving motor 26 inoperative.

When the pressure decreases, only the closure of switch 9 causes the motor 26 to be turned on because owing to the opened contact or switch d1, the closure of switch 10, during a pressure drop to below the upper limit value P_O first will remain ineffective.

Figure 3 shows another version of the circuit by way of which, in conjunction with the pressure switch 1 according to Figure 1, the pressure can be controlled in the supply system. For illustration purposes, the switch position was selected here at a pressure above the upper limit value P_O .

As opposed to the circuit according to Figure 2, in the example of embodiment according to Figure 3, a second relay E was inserted by way of which, in conjunction with the contacts e1, e2, the warning light WL was turned on by switch 8 when the pressure dropped below the pressure threshold P_W . The holding circuit, via contact e1 and switch 9, precludes a scorching of the contacts of switch 8, which would be likely to occur if the pressure very slowly approached the warning threshold P_W thereby causing an unstable switch position. For, the floating of the pressure about the warning threshold P_W could result in a fluttering of the switch 8.

Finally, the form of embodiment of the circuit according to Figure 4 permits a particularly simple construction comprising only one motor relay working contact d3. For, in that arrangement, via contact d3, electrical conduit 27, switch 10 of pressure switch 1, via a diode 28 and an ohmic resistance R, a holding circuit for relay D is formed. Resistance R restricts the current of the holding circuit to a value which is

sufficient only for holding relay D in the pulled-up condition rather than for pulling up the relay D. Hence, relay D via the holding circuit, is held at a pressure rising beyond the bottom pressure limit value P_U until the upper pressure limit value P_O is reached and switch 10 opened.

At the same time, the pump motor 26, via contact d3, is turned on and off. After the upper threshold P_O has been exceeded and motor 26 turned off, in view of switch 10, also the holding circuit is opened via line 27. Motor 26 is, therefore, turned on again only after the pressure has dropped to the bottom pressure limit value P_U and switch 9 closed.

Diodes 28 and 29 serve to decouple the current paths via switches 9 and 10 to ground.

The circuit according to Figure 4 is identical with the circuits as described with reference to Figures 2 and 3, for which reason identical reference characters have been employed.

CLAIMS

1. A pressure supply system, comprising an accumulator, an hydraulic pump driven by a motor, and a pressure switch which, via an interconnected motor relay, turns on the pump motor at a predetermined lower pressure limit value, and turns off the same at a predetermined upper pressure limit value, characterised in that the pressure switch (1) comprises a switch piston (2) axially displaceable against spring force by the pressure to be controlled, which switch piston, upon displacement thereof, mechanically actuates successively at least two switches (8, 9, 10), one switch (9) of the two being associated with the lower pressure limit value (P_U) and the other switch (10) of the two being associated with the upper pressure limit (P_O), the switches turning on a motor relay (D) and a relay holding circuit when the pressure drops below the lower limit value (P_U), and interrupting the holding circuit when the pressure rises beyond the upper limit value (P_O).

2. A pressure supply system according to claim 1, characterised in that the pressure switch (1) is equipped with a third switch (8) actuated by the switch piston (2) at a predetermined minimum pressure (p_W) below the lower limit value (P_U), and turning on and off a warning signal.

3. A pressure supply system according to the claim 1 or claim 2, characterised in that the switch piston (2) of the pressure switch (1) is connected to an axial piston rod (5) having radial cams (11, 12, 13) to thereby successively actuate the individual switches (8, 9, 10) in response to the pressure (p) acting on the switch piston (2) and, hence, in response to the axial displacement.

4. A pressure supply system according to claim 3, characterised in that the switches (8, 9, 10) are in the form of simple contact spring (14, 15, 16) which, upon axial displacement of the piston rod (5), by mechanical engagement of the cams (11, 12, 13), can be removed from the appertaining contact counterpart (20, 21, 22, 23, 24, 25).

5. A pressure supply system according to claim 4, characterised in that, by selecting and/or adjusting the spaces (S_1, S_2, S_3), in the rest position, between the contact spring (14, 15, 16) and the appertaining actuating cam (11, 12, 13), the switch pressure or the

pressure limit value (P_W, P_U, P_O), respectively, is adjustable.

6. A pressure supply system according to any one of claims 1 to 5, characterised in that inserted into the holding circuit is a working contact (d1, d3) of the motor relay (D) in series with a contact closed in the rest position, of the switch (10) associated with the upper pressure limit value (P_O).

7. A pressure supply system according to claim 6, characterised in that both the pump motor (26) and the holding circuit of the motor relay (D) can be turned on and off via a common working contact (d3) of the motor relay (D), with the switch (10) associated with the upper pressure limit value (P_O) and a resistance (R) limiting the current to the value required for holding the relay (D) also being inserted into the holding circuit (27).

8. A pressure supply system according to claim 2, characterised in that the third switch (8) generates the warning signal via a relay (E) equipped with an additional working contact (e1) in series with the switch (9) associated with the lower pressure limit (P_U) to form a respective holding circuit for the warning signal relay (E).

9. A pressure supply system substantially as herein described with reference to and as illustrated in the accompanying drawings.

Printed in the United Kingdom for Her Majesty's Stationery Office by the Tweeddale Press Group, 8991685, 5/87 18996. Published at the Patent Office, 25 Southampton Buildings, London WC2A 1AY, from which copies may be obtained.