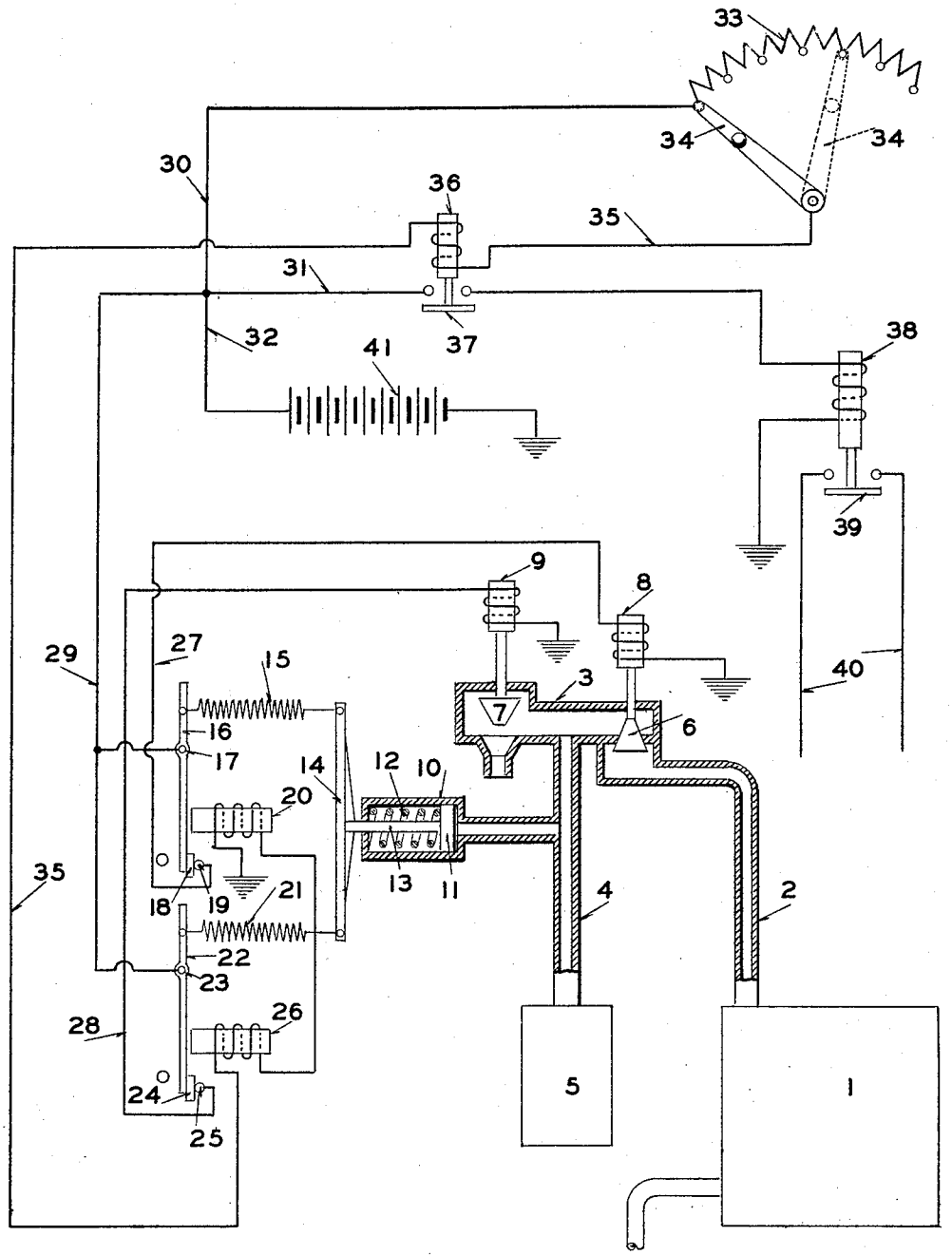
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ELECTRICAL CONTROL OF FLUID PRESSURE

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ELECTRICAL CONTROL OF FLUID PRESSURE

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My invention relates to means for the control of pressure in a pressure chamber, such for example as the cylinder of a car brake, by electromagnetic devices responsive to variations in the strength of the actuating current produced by a rheostat or other variable resistance in the circuit when direct current is used, or by variable reluctance when alternating current is used. By means of this system the current varying means may be located at any desired distance from the chamber in which the pressure is to be controlled, a number of chambers may be controlled simultaneously, and the construction of the device is simplified.

In the accompanying drawing I have illustrated one form of control mechanism adapted to be actuated from a direct current source of supply.

Air or other fluid under pressure is supplied from a tank or reservoir 1 which is connected by pipe 2 with a valve casing 3 which, in turn, is connected by pipe 4 with a pressure chamber 5. This pressure chamber may be the cylinder of a brake system or any other fluid container in which pressure is to be regulated. In the valve casing in an application valve 6 and a release valve 7. The application valve is biased toward open position and is closed by the action of an electromagnet 8. The release valve is biased toward closed position and is opened by the action of an electromagnet 9. Communicating with the pressure chamber is a control chamber 10, the piston 11 of which bears against a compression spring 12 so that its movement is proportional to the pressure in the chamber 5. The piston rod 13 of the piston 12 carries a yoke 14.

One end of the yoke 14 is connected by coil spring 15 with one end of a lever 16 pivoted at 17 and carrying at its other end a movable contact 18 cooperating with a fixed contact 19. The lever 16 forms the armature of an electro-magnet 20 so that the movement of the lever to make and break the circuit between contacts 18 and 19 depends upon the relative tension of spring 15 and the pull of the electromagnet. The other end of the yoke is connected by a spring 21 with a lever 22 pivoted at 23 and carrying a movable contact 24 cooperating with a fixed contact 25. This lever forms the armature of an electromagnet 26. The magnet 20 and armature 16 form a relay and the magnet 26 and armature 22 form a second relay. Both of these relays are of the sensitive type,—that is, they are so designed that they will open and close at approximately the same current strength. It will be evident that the tension of the springs 15 and 21 will be simultaneously varied by the movement of the piston 11 in inverse ratio to the pressure in the pressure chamber 5. When there is no pressure above atmospheric in chamber 5, spring 15 and 21 will be at their maximum tension. The maximum tension of spring 15 should be such that it will be overcome by the pull of magnet 20 with maximum current flowing therethrough. Also, the maximum tension of spring 21 should be such that it will be overcome by the pull of magnet 20 when energized by the maximum current. The tension of the two springs is not, however, the same, that of spring 15 being slightly less than that of spring 21, so that under varying spring tension or magnet pull the levers will not operate simultaneously but successively.

Fixed contact 19 is connected to ground by line 27, including the energizing coil of magnet 8, and fixed contact 25 is connected to ground by line 28, including the energizing coil of magnet 9. The movable contacts 18 and 24 are connected, preferably through their levers, with a line 29 having three branches 30, 31 and 32, respectively. Branch 30 is connected to a rheostat 33, the contact arm 34 of which is connected by line 35 to ground after passing through the energizing coils of magnets 26 and 20. Included in the line 35 is a third electromagnet 36 operating contact bar 37 and so forming a relay to open and close the circuit through the branch 31. The magnet 36 is biased to hold the switch 37 in open position, and the biasing means is so adjusted that the switch 37 will not be closed until the current, supplied through line 35 to magnets 20 and 26 and controlled by rheostat 33, has reached a certain predetermined

amount. This relay is so designed that it will close upon the flow of a predetermined strength of current through line 35 and will open at a predetermined lower current strength. I thus provide an auxiliary circuit, the opening and closing of which bears a certain predetermined relation to the opening and closing of the valves governing the pressure in the chamber 5. In the drawing I have shown this auxiliary circuit as including the actuating coil of an electromagnet 38 operating a switch 39 to make and break a circuit 40. This may be any circuit requiring control having a definite relation to the pressure in the pressure chamber. In case the system is used for the control of a car brake, such as that disclosed in my co-pending application No. 536,104 filed May 9, 1931, the relay 36—37 may perform the function of the mechanically operated interlock switch 26 therein described. Current is supplied to the system by a battery 41, or other source of E. M. F. in the branch 32.

The operation is as follows: If rheostat arm 34 is moved to position shown in full lines to cut out all resistance the maximum current from battery 41 will flow through lines 32, 30, arm 34 and line 35 to ground, energizing magnets 20 and 26 to the maximum extent. Under these conditions the pull of magnets 20 and 26 will be sufficient to overcome the tension of springs 15 and 21, regardless of the position of the piston 11 in the chamber 10, so that circuits 27 and 28 will be closed, energizing magnets 8 and 9 to close valve 6 and open valve 7. This will place chamber 5 at atmospheric pressure. To admit pressure from the reservoir 1 to chamber 5, arm 34 is moved along the rheostat to introduce resistance into the circuit, including line 35. This will reduce the pull of magnets 20 and 26. As springs 15 and 21 are at their maximum tension, due to the position of piston 10, a slight movement of the arm will result in the pull of magnet 26 being overcome by the tension of spring 21 so that contact 24 will be moved away from contact 25, breaking the circuit 28 through magnet 9 and allowing valve 7 to close. A slight further movement of the arm will reduce the current through line 35 to such an extent that the pull of magnet 20 will be overcome by the tension of spring 15 which, as heretofore stated, is somewhat less than spring 21, thus breaking circuit 27 and allowing valve 6 to open and admit fluid under pressure from reservoir 1 to chamber 5. Arm 34 is moved to any selected point on the rheostat (as shown in dotted lines) to secure the desired pressure in chamber 5. When this predetermined pressure is reached piston 11 will have been moved against the tension of spring 12 to such a point that the tension of spring 15 will be reduced by such an amount that magnet 20 will close circuit 27 with resultant closing of valve 6. The pressure in chamber 5 will remain at this value as long as arm 34 is left at the selected point on the rheostat. Should fluid leak out of or be drawn from the chamber 5, thus reducing its pressure, piston 11 will move toward the right, increasing the tension of spring 15 and opening circuit 27 to allow valve 6 to open and supply the loss. The pressure in chamber 5 may be increased by moving arm 34 toward the right, or decreased by moving it toward the left. When the pressure in the chamber 5 is below that which can be supplied by the reservoir 1, increase of resistance in the control circuit will cause an increase of pressure in the chamber, that is, within the operative range of pressures increase of current in the control circuit will cause decrease of pressure in the pressure chamber.

While I have shown the control circuit and the valve actuating circuit as both supplied from the battery 41, it will be evident that separate sources of E. M. F. may be used for these circuits if desired. Further, while I have shown a resistance for varying the current strength in the control circuit, an impedance may be substituted therefor in case alternating current is used, and wherever, in the specification or claims, I have used the term "resistance", I wish to be understood as including an impedance as the equivalent thereof.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. In a device of the class described, the combination with a source of fluid supply, of a pressure chamber communicating therewith, application and release valves, actuating mechanism for said valves independently movable adapted to maintain a variable pressure in said chamber, said mechanism including a control circuit and a pair of valve actuating circuits and means for varying the current strength in said control circuit to influence the opening and closing of said valve actuating circuits.

2. In a device of the class described, the combination with a source of fluid supply, of a pressure chamber communicating therewith, application and release valves, actuating mechanism for said valves adapted to maintain a variable pressure in said chamber, said mechanism including a relay, a control circuit for the magnet of said relay, means for varying the current strength in said relay, and means for applying to the armature of said relay a counter-influence varying with the pressure in said chamber.

3. In a device of the class described, the combination with a source of fluid supply, of a pressure chamber communicating therewith,

application and release valves, actuating mechanism for said valves adapted to maintain a variable pressure in said chamber, said mechanism including a pair of relays, a control circuit for the magnets of said relays, means for varying the current strength in said relays, and means for applying to the armature of said relays a counter-influence varying with the pressure in said chamber.

4. In a device of the class described, the combination with a source of fluid supply, of a pressure chamber communicating therewith, application and release valves, actuating mechanism for said valves adapted to maintain a variable pressure in said chamber, said mechanism including a pair of relays, a control circuit for the magnets of said relays, means for varying the current strength in said relays, and means for applying to the armature of said relays a counter-influence varying in inverse ratio to the pressure in said chamber.

5. In a device of the class described, the combination with a source of fluid supply, of a pressure chamber communicating therewith, application and release valves, actuating mechanism for said valves adapted to maintain a variable pressure in said chamber, a relay governing the movement of said application valve, a second relay governing the movement of said release valve, a circuit including the magnets of both said relays, means for varying the current strength in said circuit, and means for applying to the armatures of each of said relays a counter-influence varying in inverse ratio to the pressure in said chamber, the counter-influence applied to the armature of said first named relay being less than that applied to the armature of said second named relay.

6. In a device of the class described, the combination with a source of fluid supply, of a pressure chamber communicating therewith, application and release valves, actuating mechanism for said valves adapted to maintain a variable pressure in said chamber, said mechanism including a control circuit, means for varying the current strength in said circuit, an auxiliary circuit, and a relay in said control circuit closing said auxiliary circuit at a predetermined current strength, said relay opening said auxiliary circuit at a lower current strength.

7. In a device of the class described, the combination with a source of fluid supply, of a pressure chamber communicating therewith, an electrically operated application valve, an electrically operated release valve a relay the armature of which makes and breaks the circuit actuating said application valve, a second relay the armature of which makes and breaks the circuit actuating said release valve, a member movable proportionally to the pressure in said chamber, a pair of springs carried by said member and each attached to one of said armatures, a circuit supplying circuit to both said relays, and a variable resistance in said last named circuit.

8. In a device of the class described, the combination with a source of fluid supply, of a pressure chamber communicating therewith, an electrically operated application valve, an electrically operated release valve, a relay the armature of which makes and breaks the circuit actuating said application valve, a second relay the armature of which makes and breaks the circuit actuating said release valve, a member movable proportionally to the pressure in said chamber, a pair of springs carried by said member and each attached to one of said armatures, a circuit supplying circuit to both said relays, a variable resistance in said last named circuit, an auxiliary circuit, and a relay in circuit with said variable resistance for opening and closing said auxiliary circuit.

In testimony whereof, I hereunto affix my signature, this 7th day of July, 1931.

ORVILLE C. WRIGHT.