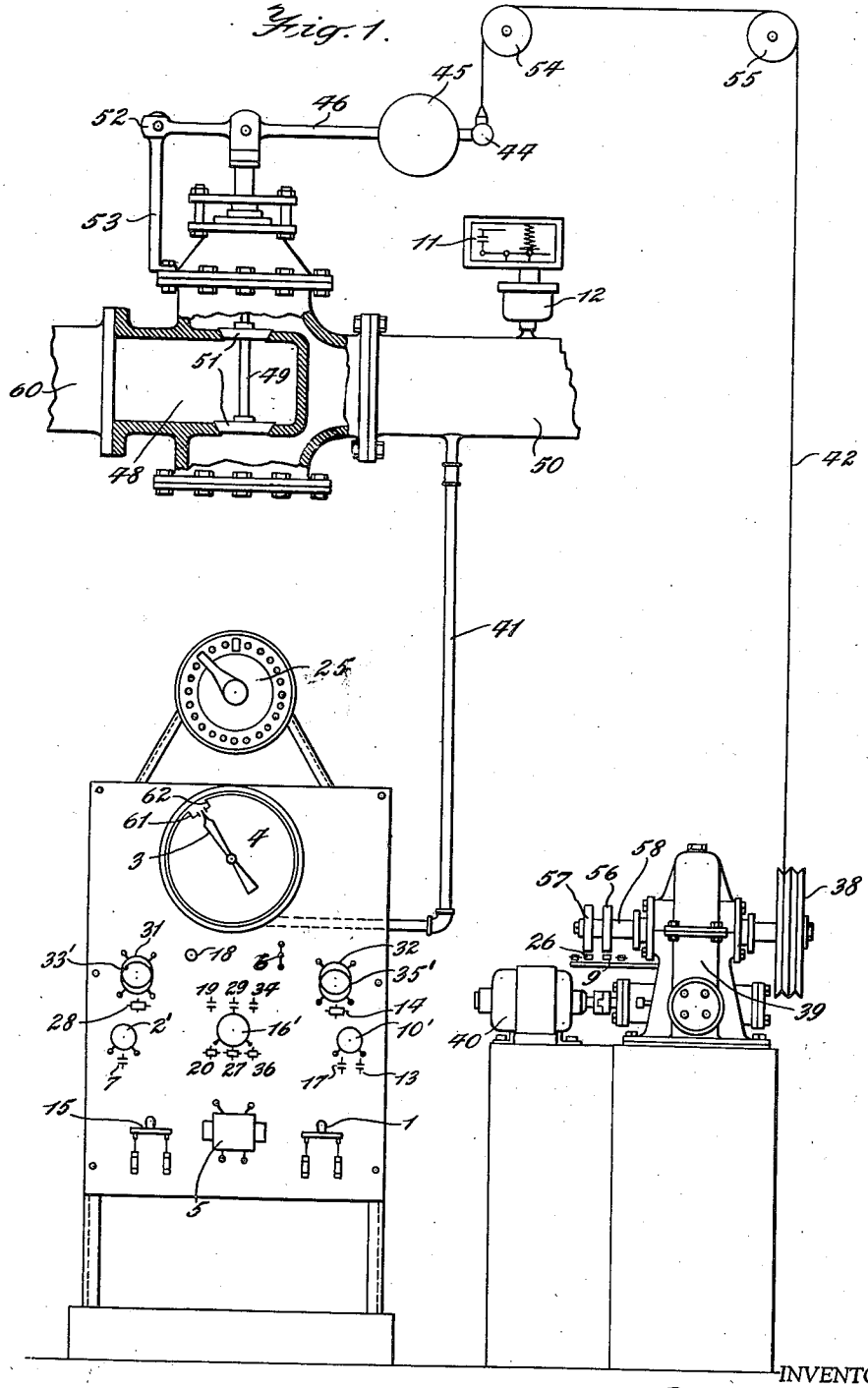
April 16, 1940. P. J. DUGAN 2,197,176

FLUID PRESSURE REGULATOR

Filed April 15, 1937 2 Sheets-Sheet 1

Fig. 1.



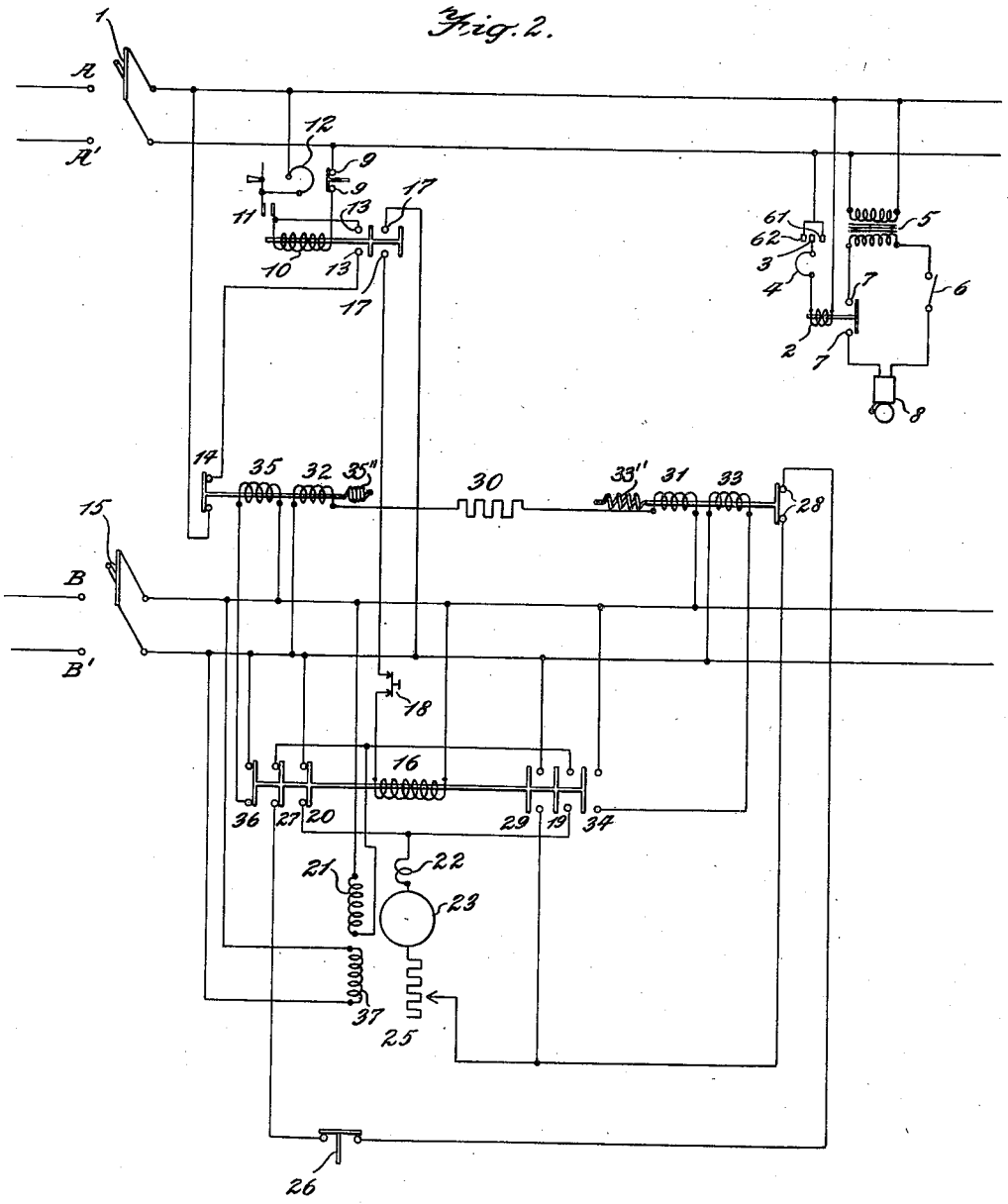
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Fig. 2.



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2,197,176

FLUID PRESSURE REGULATOR

Peter J. Dugan, Crestwood, N. Y.

Application April 15, 1937, Serial No. 136,991

8 Claims. (Cl. 50—10)

My invention relates to fluid pressure regulation and improvements in the methods and apparatus for carrying out said regulation.

An object of my invention is to provide a method of maintaining practically constant the pressure in a fluid distribution system under varying conditions of consumption and demand on said system.

Another object is to provide a method whereby a predetermined pressure may be maintained substantially constant at a given point in a distribution system.

Another object is to provide a pressure-regulating apparatus which is sensitive to minute variation in pressure, permitting the maintenance of an extremely low pressure without interruption in the supply of fluid to the distribution system.

Another object is to provide a method of pressure regulation which may be carried out by a relatively simple form of apparatus.

Other objects, features and advantages of my invention will appear from the following description:

Fig. 1 illustrates the apparatus used in this invention and its layout in general; and

Fig. 2 illustrates schematically the electric circuit for the operation of the pressure regulating apparatus.

Referring to the drawings in detail, there is a pressure-reducing valve 48 through which fluid under pressure flows from a supply pipe 60 to a distribution pipe 50 leading ultimately to a general distributing system.

The pressure-reducing valve 48 effects a reduction in the pressure of the fluid as it flows from the supply pipe 60 to the distribution pipe 50 and said valve is adjustable so that this reduction in pressure may be varied to maintain the fluid pressure at a given point in the distribution system substantially constant under varying conditions of load or demand on the system. The valve 48 is a well-known type of reducing valve, its adjustment being effected by opening or closing valves 51. These valves 51 are carried on a valve rod 49 which extends through the top of the valve 48, being secured to and movable by a lever 46. The lever 46 is pivoted at one end 52 on a supporting bracket 53, and movement of the lever about this pivotal point carries the valve rod 49 up or down, opening or closing the valves 51 correspondingly.

To control the movement of the lever 46, there is a counterbalancing weight 45 and a cable 42 secured to the lever's free end 44. The weight 45 is a constant force tending to hold the lever 46 as far down as permitted by the cable 42. The lever 46' is raised against the action of the weight 45 by means of the cable 42.

The cable 42 is carried over pulleys 54 and 55 to a winding drum 38 to which it is secured and on which a portion of the cable is wound, thus, when additional cable is wound on the drum, it will raise the lever 46 opening the valves 51 correspondingly, and when part of the cable is unwound, it will permit the weight 45 to carry the lever 46 down, closing the valves 51 correspondingly. An electric motor 40 drives the winding drum 38 through reducing gears 39 by which the revolutions of the motor are reduced in the ratio of about 1800 to 1.

The electric motor 40 is connected by a double pole knife switch 15 to a source of direct current B—B' on which it operates. This motor is a well-known type of compound wound reversing motor having an armature circuit comprised of a series field coil 21, an interpolar field coil 22, a non-inductive speed governing rheostat 25, and an armature winding 23 connected in series to the source of direct current B—B', and a shunt field coil 37 also connected to the source of direct current B—B'.

The direction of the motor's rotation is reversed by reversing the flow of current in the armature winding 23 and for this purpose the flow of current is reversed in the circuit comprised of the armature winding, the interpolar field coil and the speed governing rheostat. For this purpose, one end of this circuit is connected in series with a switch 19 and the series field coil to one side of the power supply and is also connected in series with a switch 20 to the other side of the power supply. The other end of said circuit is connected in series with a control button 26, a switch 28, a switch 27 and the series field coil to one side of the power supply and is also connected in series with a switch 29 to the other side of the power supply. When the switches 19 and 29 are closed, the switches 28, 27 and 20 are open and vice versa.

For controlling the operation of these switches and of the electric motor 40, a pressure responsive device 12 located at a given point in the distribution pipe 50 is adjusted so that, when the pressure at the given point falls below a predetermined value, it will close pressure gauge contacts 11 connecting a coil 10 of a pilot relay 10' to a source of alternating current A—A' causing the relay to operate and close contacts 17 and 13.

The contacts 13 are holding contacts in a parallel circuit with the pressure gauge contacts 11 and insure the connection of the coil 10 to the source of energy preventing chattering of the relay 10'.

The closing of the contacts 17 connects a coil 16 of a motor control relay 16' to the source of direct current B—B', causing said relay to operate to close contacts 19, 29 and 34 and to open contacts 20, 27 and 36.

As previously described, the closing of the contacts 19 and 29 permits current to flow in the armature circuit and it will flow in a direction to cause the motor to rotate so as to drive the winding drum 38 to take up a portion of the cable 42 and, consequently, permit an increase in the fluid pressure. The opening of contacts 20 and 27 interrupts the opposite flow of current in the motor armature.

The closing of the contacts 34 connects a coil 33 of a relay 33' to the source of direct current B—B', causing that relay to operate to open contacts 28 in the motor armature circuit in series with the contacts 27 as previously stated.

The opening of contacts 36 disconnects the coil 35 of a relay 35' from the source of direct current B—B' causing that relay to operate to open contacts 14 which are connected in series with the holding contacts 13.

The operation of the last-mentioned relay 35' on opening the contacts 14 is slightly delayed. This delay may be obtained in a number of well-known ways. The relay used here in particular is a relay having spring tension acting in addition to the relay coil 35 to keep the contacts 14 closed, and a supplementary coil 32 opposing this action. The spring 35'' is arranged to provide such spring tension. The supplementary coil 32 is connected in series with a current fixing resistance 30, and another supplementary coil 31 to the source of direct current B—B'. When the relay coil 35 is deenergized, its residual magnetic effect and the spring tension keep the relay from operating at once, but as soon as this residual magnetic effect drops to a point where the effect of coil 32 will overcome it and the spring tension, the relay will operate to open the contacts 14.

The timing out of said relay may be set at a fixed value by adjusting the spring tension on the relay or the current in the supplementary coil 32. This time may be from ½ to 3 seconds as the operation of the apparatus may require.

After the contacts 14 have been opened and when the fluid pressure in the distribution pipe 50 has increased to the predetermined value, the pressure device 12 will permit the pressure gauge contacts 11 to open, disconnecting the coil 10 of the pilot relay 10' from the source of alternating current A—A', causing the pilot relay to operate to open its contacts 17 and 13.

Opening contacts 17 opens the connection of the motor operating relay 16' to the source of direct current B—B', causing said relay's operation to open the contacts 19, 29 and 34 and to close the contacts 20, 27 and 36.

The opening of contacts 19 and 29 opens the motor armature circuit from the source of direct current B—B', causing the motor 40 to stop and thereby stopping the rotation of the winding drum 38. However, the contacts 20 and 27 in the motor armature circuit are closed and the motor 40 is now connected to the source of direct current B—B' but for the contacts 28 in the armature circuit.

The opening of the contacts 34 disconnects a coil 33 of a time delay relay 33' from the source of direct current B—B', causing this relay to operate to close the contacts 28 which are still open in the motor armature circuit. The operation of this relay 33' is delayed similarly to that of the time delay relay 35' previously described and it has the other supplementary coil 31 on it. The spring 33'' on this relay is similar to spring 35'' in effecting the delayed action. The delay is sufficient to permit the motor 40 to come to a full stop before the contacts 28 are closed.

The motor now will rotate in a direction to drive the winding drum 38 in a direction to release a portion of the cable 42, permitting the weight 45 to carry the lever 46 down and close the valves 51 in accordance with the amount of cable released, thus decreasing the fluid pressure in the distribution pipe 50.

The closing of contacts 36 connects the coil 35 of the time delay relay 35' to the source of direct current B—B', causing the relay to operate, closing contacts 14 in the holding circuit now open which is not operating at this time as the contacts 13 controlled by the pilot relay 10' have been already opened.

When the fluid pressure in the distribution pipe 50 drops below the predetermined value, the pressure responsive device 12 will again close its contacts 11 and the cycle of operations will be repeated.

In conjunction with the winding drum 38, there are limit controlling switches 9, in the pilot relay circuit and 26 in the motor armature circuit which are operated by cams 56 and 57, respectively, mounted on shaft 58 which carries the winding drum 38. Thus if the winding drum is driven too far in a direction releasing the cable 42, the cam 57 will open the switch 26 in the motor armature circuit and stop the motor, or if the drum is driven too far in a direction winding cable 42 on it, the cam 56 will open the switch 9 in the pilot relay circuit and thereby cause the reversal of the motor's operation.

In series with the coil 16 of the motor reversing relay 16' and its contacts 17 controlled by the pilot relay there is an operating button switch 18 by which the operation of the apparatus may be controlled to secure the proper sequence of operations.

A warning of any extreme changes in pressure in the distribution pipe 50 is provided by a bell circuit connected to the source of alternating current A—A'. This circuit has a transformer 5, the primary of which is connected to the source of alternating current A—A' and the secondary of which has a single pole knife switch 6, a bell 8, and contacts 7 in series with it.

When the knife switch 6 is closed, the warning circuit is placed in operation and a warning will be sounded by a bell 8 on the closing of the contacts 7 which are controlled by a relay 2'.

The relay 2' has a coil 2 connected at one end to one side of the source of alternating current A—A' and connected at its other end to an indicating hand 3 of a pressure gauge 4. On the face of the pressure gauge 4 contact members 61 and 62 may be set at desired limits and these contact members are connected to the other side of the source of alternating current so that when the pressure exceeds the set limits, the indicating hand will close on one of the contact members connecting the relay coil 2 to the source of alternating current causing the relay 2' to

operate and close the contacts 7 in the bell circuit.

It is to be understood that it is possible to operate this apparatus from a single source of electrical energy either of the alternating or direct type by making suitable modification in the apparatus. While I have illustrated and described certain embodiments of my invention, it will be apparent that other types of mechanism may be used to obtain the same results, and it is understood that by so illustrating and describing preferred embodiments, I have not limited the invention other than as disclosed in the claims in view of the prior art.

I claim:

1. In a fluid pressure regulating system, the combination of a supply pipe, a distribution pipe, and an adjustable pressure reducing valve connecting said pipes, a reversible electric motor operatively connected to said valve and in substantially continuous operation to open or close the valve, a pressure responsive device in said distribution pipe, means controlled by said pressure responsive device to operate the motor in one direction to open the valve upon decrease in pressure in the distribution pipe, and means likewise controlled by said device to substantially immediately reverse said motor to cause it to start to close said valve when the pressure in said distribution pipe has increased to a predetermined point.

2. In a fluid pressure regulating system, the combination of a supply pipe, a distribution pipe, and an adjustable pressure reducing valve connecting said pipes, said valve comprising a stem, a lever having one end pivoted to a fixed pivot and pivotally connected to said stem intermediate the ends of the lever, a cable secured to the other end of said lever, a drum upon which said cable is wound, a substantially continuously operating reversible electric motor operatively connected to said drum through reduction gearing, a pressure responsive device in said distribution pipe, and means controlled by said pressure responsive device to operate said motor in either direction as the pressure in said distribution pipe increases and decreases.

3. In a fluid pressure regulating system, the combination of a supply pipe, a distribution pipe, and an adjustable pressure reducing valve connecting said pipes, a reversible electric motor operatively connected to said valve and in substantially continuous operation to open or close the valve, a pressure responsive device in said distribution pipe, circuits associated with said motor and adapted to operate it in either direction, a motor reversing relay controlling switches in said circuits and adapted to open and close them to reverse the motor, a pilot relay controlling said motor reversing relay, and a circuit controlling said pilot relay and having a switch therein adapted to be closed by said pressure responsive device upon decrease of pressure in said distribution pipe and to be opened by said device upon increase of pressure.

4. In a fluid pressure regulating system, the combination of a supply pipe, a distribution pipe, and an adjustable pressure reducing valve connecting said pipes, a reversible electric motor operatively connected to said valve and in substantially continuous operation to open or close the valve, a pressure responsive device in said distribution pipe, circuits associated with said motor and adapted to operate it in either direction, a motor reversing relay controlling switches in said circuits and adapted to open and close them to reverse the motor, a pilot relay controlling said motor reversing relay, a circuit controlling said pilot relay and having a switch therein adapted to be closed by said pressure responsive device upon decrease of pressure in said distribution pipe and to be opened by said device upon increase of pressure, a holding circuit to maintain said pilot relay in position to energize said motor reversing relay, and means to open said holding circuit after a predetermined interval.

5. In a fluid pressure regulating system, the combination of a supply pipe, a distribution pipe, and an adjustable pressure reducing valve connecting said pipes, a reversible electric motor operatively connected to said valve and in substantially continuous operation to open or close said valve, a pressure responsive device in said distribution pipe, circuits associated with said motor and adapted to operate it in either direction, a motor reversing relay controlling switches in said circuits and adapted to open or close them to reverse the motor, a pilot relay controlling said motor reversing relay, a circuit controlling said pilot relay and having a switch therein, means operated by said pressure responsive device to close said switch upon decrease in pressure in said distribution pipe and to open it upon increase of pressure therein, and a time delay relay controlled by said motor reversing relay and adapted to close a switch in the motor circuit after a predetermined interval when the pilot relay has caused the operation of the motor reversing relay by deenergizing it.

6. In a fluid pressure regulating system, the combination of a supply pipe, a distribution pipe, and an adjustable pressure reducing valve connecting said pipes, a reversible electric motor operatively connected to said valve and in substantialy continuous operation to open or close said valve, a pressure responsive device in said distribution pipe, circuits associated with said motor and adapted to operate it in either direction, a motor reversing relay controlling switches in said circuits and adapted to open or close them to reverse the motor, a pilot relay controlling said motor reversing relay, a circuit controlling said pilot relay and having a switch therein, means operated by said pressure responsive device to close said switch upon decrease in pressure in said distribution pipe and to open it upon increase of pressure therein, and a holding circuit adapted to keep said pilot relay energized for a definite predetermined period when said pressure responsive device has closed the switch energizing said pilot relay causing it to operate the motor reversing relay comprising a circuit adapted to energize said pilot relay, a time delay relay adapted to interrupt said holding circuit after a predetermined period, a circuit associated with said time delay relay having a switch therein controlled by said motor reversing relay and a switch in the holding circuit controlled by said pilot relay and adapted to be closed by the operation of said pilot relay in response to the pressure responsive device.

7. In a fluid pressure regulating system, the combination of a supply pipe, a distribution pipe, and an adjustable pressure reducing valve connecting said pipes, a reversible electric motor operatively connected to said valve and in substantially continuous operation to open or close said valve, a pressure responsive device in said distribution pipe, circuits associated with said motor and adapted to operate it in either direction, a

motor reversing relay controlling switches in said circuits and adapted to open or close them to reverse the motor, a pilot relay controlling said motor reversing relay, a circuit controlling said pilot relay and having a switch therein, means operated by said pressure responsive device to close said switch upon decrease in pressure in said distribution pipe and to open it upon increase of pressure therein, and a time delay relay controlled by said motor reversing relay and adapted to close a switch in the motor circuit after a predetermined interval when the pilot relay has caused the operation of the motor reversing relay by deenergizing it and a holding circuit adapted to keep said pilot relay energized for a definite predetermined period when said pressure responsive device has closed the switch energizing said pilot relay causing it to operate the motor reversing relay comprising a circuit adapted to energize said pilot relay, a time delay relay adapted to interrupt said holding circuit after a predetermined period, a circuit associated with said time delay relay having a switch therein controlled by the motor reversing relay and a switch in the holding circuit controlled by said pilot relay and adapted to be closed by the operation of said pilot relay in response to the pressure responsive device.

8. In a fluid pressure regulating system, the combination of a supply pipe, a distribution pipe, and an adjustable pressure reducing valve connecting said pipes, said valve comprising a stem, a lever having one end pivoted to a fixed pivot and pivotally connected to said stem intermediate the ends of the lever, a cable secured to the other end of said lever, a drum upon which said cable is wound, a substantially continuously operating reversible electric motor operatively connected to said drum through reduction gearing, a pressure responsive device in said distribution pipe, and means controlled by said pressure responsive device to operate said motor in either direction as the pressure in said distribution pipe increases and decreases, a time delay relay controlled by said motor reversing relay and adapted to close a switch in the motor circuit after a predetermined interval when the pilot relay has caused the operation of the motor reversing relay by deenergizing it and a holding circuit adapted to keep said pilot relay energized for a definite predetermined period when said pressure responsive device has closed the switch energizing said pilot relay causing it to operate the motor reversing relay comprising a circuit adapted to energize said pilot relay, a time delay relay adapted to interrupt said holding circuit after a predetermined period, a circuit associated with said time delay relay having a switch therein controlled by said motor and a switch in the reversing relay holding circuit controlled by said pilot relay and adapted to be closed by the operation of said pilot relay caused in response to the pressure responsive device.

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