United States Patent

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[31] **136,766**

[54] **TIME-LAG PRESSURE RESPONSIVE SWITCHES**
4 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **200/83**
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[50] **Field of Search** 200/16.1, 83, 83.9

[56] **References Cited**

UNITED STATES PATENTS

3,106,623	10/1963	Lynn	200/83(.9)
2,827,526	3/1958	Clason	200/83(.4)
2,961,506	11/1960	Kendall	200/83X
2,990,705	7/1961	Bochan	200/83X
3,272,929	9/1966	Hacker	200/16(.1)X
3,304,381	2/1967	McAnespey	200/83
3,352,984	11/1967	Reuter	200/83

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ABSTRACT: A timelag pressure responsive switch comprising a pressure chamber closed by a flexible diaphragm of which the movable portion is displaceable against the resistance of an antagonistic spring for actuating a rod controlling a back contact, characterized in that it comprises a timelag device for retarding the opening of said contact and adjusting the rate of delivery of the fluid under pressure to said chamber for actuating said pressure responsive switch, the timelag characteristic of this device increasing with the fluid viscosity while preserving the fast opening contact characteristic.

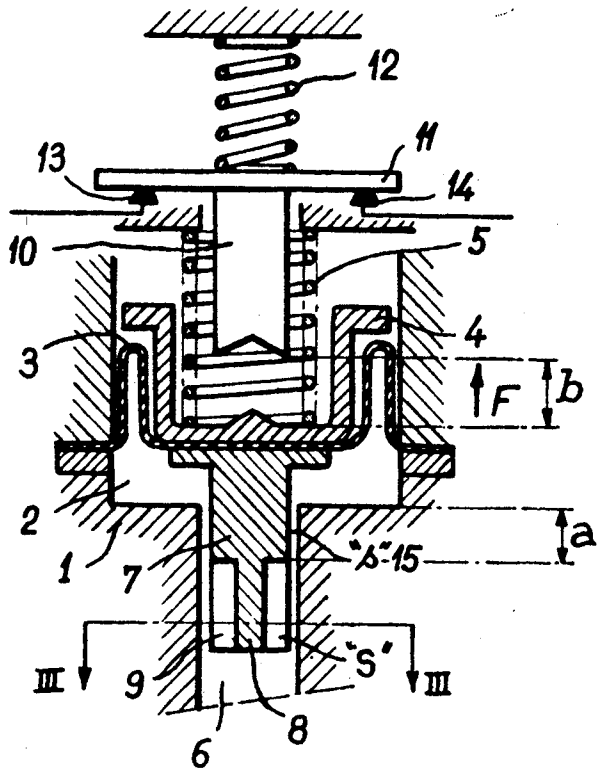

Fig. 1

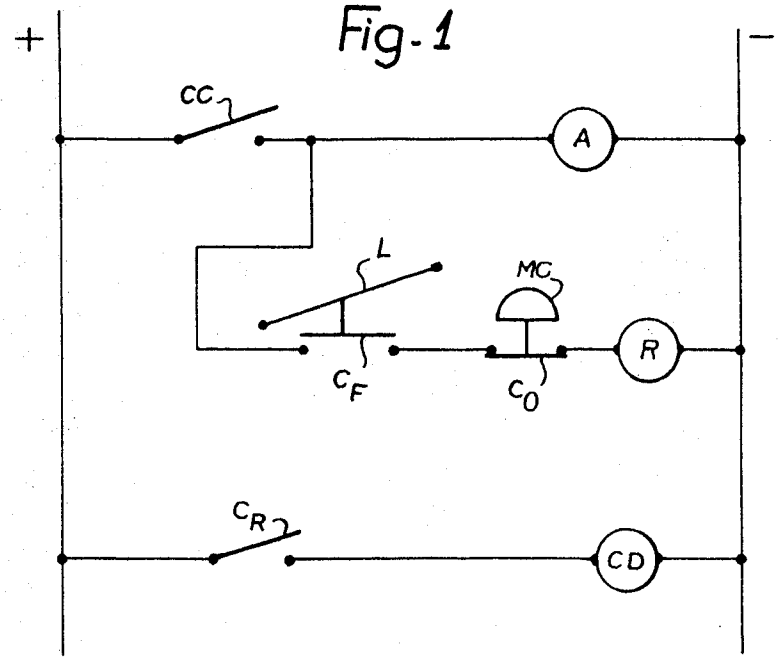

Fig. 2

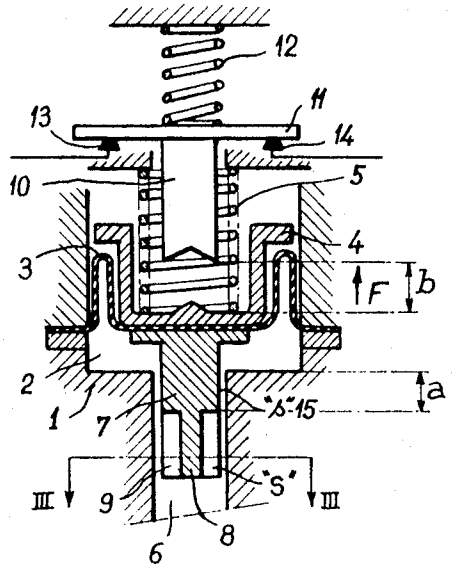

Fig. 3

TIME-LAG PRESSURE RESPONSIVE SWITCHES

This invention relates to a timelag pressure responsive switch.

Pressure responsive switches are already known which comprise a flexible diaphragm responsive to the pressure of the fluid in the circuit to be controlled, the movement of this diaphragm controlling to this end the opening of closing of an electric contact.

As a rule these pressure responsive switches are used for controlling either the ignition of a pilot lamp or an electrical circuit supplying energizing current to a plurality of relays or apparatus to be protected.

A known application of this type of pressure responsive switch, for example of the oil-pressure type, consists in placing its contacts in series with the control of the starter motor of an internal combustion engine of a vehicle or else with a view to prevent the starter pinions from being damaged as a consequence of an untimely closing of said contacts when the engine is running.

Although as a whole this mounting is satisfactory, it was observed however that, especially in cold weather, when the oil viscosity is abnormally high, the starter motor energization was cut off prematurely by the pressure responsive switch.

It is the object of the present invention to provide a pressure responsive switch of the timelag type whereby this inconvenience can be avoided.

This pressure responsive switch, comprising a pressure chamber closed by a flexible diaphragm acting against the resistance of an antagonistic spring on a rod controlling a back contact, is characterized in that it comprises timelag means adapted to retard the contact opening and adjust the rate of delivery of the pressure fluid to the pressure chamber for actuating the pressure responsive switch, the effect of said timelag means increasing with the fluid viscosity while maintaining a quick opening contact characteristic.

Other features and advantages of this invention will appear as the following description proceeds with reference to the attached drawing illustrating diagrammatically, by way of example, a typical form of embodiment of a pressure responsive switch with timelag means according to this invention. In the drawing:

FIG. 1 is a wiring diagram of the pressure responsive switch used as a safety device for protecting a starter motor;

FIG. 2 is a sectional view showing the timelag pressure responsive switch according to this invention; and

FIG. 3 is a section taken along the line III–III of FIG. 2.

Referring first to FIG. 1 it will be seen that the ignition key switch CC of an internal combustion engine (not shown) controls on the one hand the distributor A and on the other hand a circuit comprising in series a front contact CF actuated by the selector lever L of the change speed transmission, the back contact CO of a pressure responsive switch MC and a relay R controlling in turn a contact CR inserted in the circuit for energizing the starter motor CD.

When the ignition key switch CC controlling the supply of current to distributor A is closed, it permits the energization of the circuit of relay R which is controlled by the selector lever L. The contact CR of relay R will thus supply energizing current to the starter motor CD, for driving and therefore starting the vehicle engine.

It will be seen that this electrical circuit will prevent the energization of the starter motor in case:

i. the ignition contact is not closed (i.e. when the ignition key switch remains open);

ii. the starter motor contact is not closed;

iii. the engine is running (the pressure responsive switch remains open).

The engine rotation causes the pressure of the engine lubricating oil or of the hydraulic circuit controlling the change speed transmission, or in a separate hydraulic transmission circuit, to actuate the pressure responsive switch MC to open the energizing circuit of relay R, thus preventing the energization of this relay and therefore of the starter motor when the engine is running.

To avoid in cold weather the premature opening of the energizing circuit of the starter motor as a consequence of the pressure increment at very low engine speed, due to the high viscosity of the oil or other hydraulic fluid a low temperatures, a timelag pressure responsive switch is provided according to this invention in the above-described circuit.

FIG. 2 illustrates a typical constructional example of a timelag pressure responsive switch comprising a body 1 enclosing a pressure chamber 2 closed by a flexible diaphragm 3 secured by its outer peripheral or marginal portions to the body 1. This diaphragm 3 is urged, through the medium of a cup-shaped piston 4 by an antagonistic spring 5, towards a port 6 communicating with the proper fluid circuit.

Thus, the fluid under pressure, for example the oil circulating in the lubricating system of the engine, flows into chamber 2 via said port 6 in which a push member 7 having an outer diameter slightly inferior to that of said port slidably mounted. This push member projects into the chamber 2 and engages the diaphragm 3. The lower portion of push member 7 constitutes a shank 8 formed with longitudinal peripheral channels or grooves 9 having the shape illustrated in cross-sectional view in FIG. 3.

The flexible diaphragm 3 is adapted to actuate a sliding control rod 10 solid with a movable contact bridge 11 urged by a spring 12 to a position in which it closes a pair of contacts 13, 14.

Under these conditions the torque developed by the energized starter motor assists the starting of the internal combustion engine during the transitory initial starting phase thereof.

The timelag characteristic of the pressure responsive switch increases with the oil viscosity, thus increasing the time during which the starter motor assists the engine during its starting period in cold weather.

This pressure responsive switch operates as follows:

As the oil pressure rises in the line connected to port 6, this pressure urges the push member 7 and the central portion of diaphragm 3 to move upwards, i.e. in the direction of the arrow F, against the resistance of spring 5 (the forces due to the oil pressure and urging the push member 7 upwards being superior to the force of spring 5). The rate of this displacement is therefore proportional to the low oil input throttled by the passage 15 having a cross-sectional area *s*. Throughout the stroke *a* the movement takes place at a very low speed. However, when this strobe *a* is completed, the passage area *s* is replaced by a considerably larger cross-sectional area S, but since *a* is definitely smaller than the distance *b* measured from the bottom of the cup-shaped piston 4 to the end of control rod 10, when this piston 4 contacts this rod 10 the piston speed is already much greater than its initial speed for it has already been moved through a distance *b–a* at a relatively high speed.

Under these conditions, the contacts 13, 14 open quickly (in order to extend their useful life) immediately as the piston 4 engages the rod 10 (the force of spring 12 being negligible in comparison with the forces resulting from the oil pressure and the inertia of piston 4).

When the engine is stopped, the oil pressure in port 6 drops and the spring 5 tends to restore the diaphragm 3 to its initial position, the oil then flowing through the large-sectioned passage S while spring 12 quickly restores the bridge member 11 against contacts 13, 14. Then the hydraulic timelag system resumes slowly its initial condition.

Of course, an electrical circuit operating in conjunction with a pressure responsive switch of the front contact type could be combined with the above-mentioned means without departing from the spirit and scope of the invention as set forth in the appended claims.

I claim:

1. A timelag pressure responsive switch comprising a body having a pressure chamber and a port communicating with said chamber, a source of pressurized fluid connected to said port, a flexible diaphragm mounted in said chamber responsive to said pressurized fluid, spring means biasing said

diaphragm against the pressure of said fluid, electrical contact means,

2. A time-lag pressure responsive switch according to claim 1 wherein the end of said push member remote from said diaphragm has at least one longitudinal groove having a total cross section considerably larger than the cross section of said annular passage.

3. A time-lag pressure responsive switch according to claim 1 further comprising a cup-shaped piston interposed between said diaphragm and said contact control means and transmits the displacement of said diaphragm to said contact control means.

4. A time-lag pressure responsive switch according to claim 1 wherein said contact control means is spaced from said diaphragm a distance greater than the length of the smaller annular passage. contact control means responsive to movement of said diaphragm to actuate said contact means, and timelag

means to adjust the rate of delivery of said pressure fluid to said chamber for retarding the actuating of said switch means, said timelag mean s comprising a push member moving freely in said port under the pressure of said fluid, the inner diameter of said port being greater than the outer diameter of said push member forming an annular passage therebetween, said passage having a throttling effect reducing the rate of fluid delivery to said chamber, said contacts being actuated only after the conjugate pressures exerted by the fluid against said push member and said diaphragm have overcome the bias of said spring and said push member clears a considerably larger passage for said fluid to said chamber thus permitting rapid movement of the contact control member whereby the timelag characteristics increase with the fluid viscosity while preserving the snap opening of said contact means.