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PRESSURE-RESPONSIVE SWITCH

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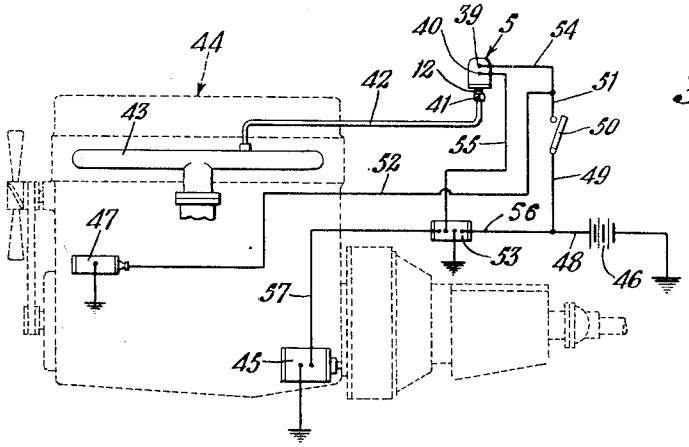


Fig:1.

Fig:2.

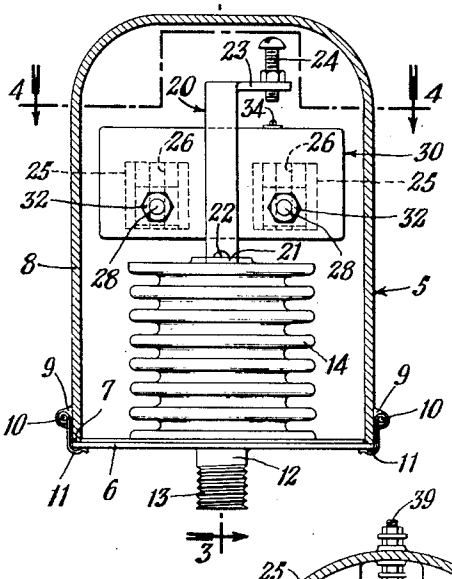


Fig:3.

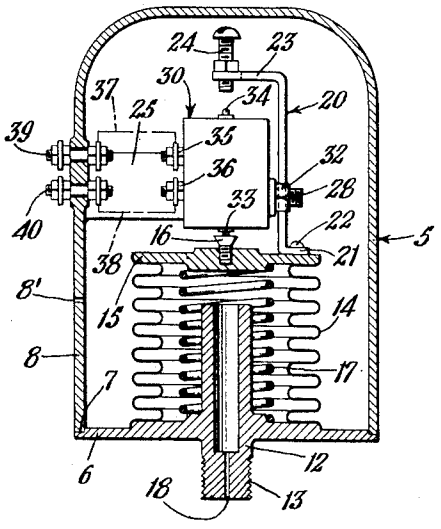
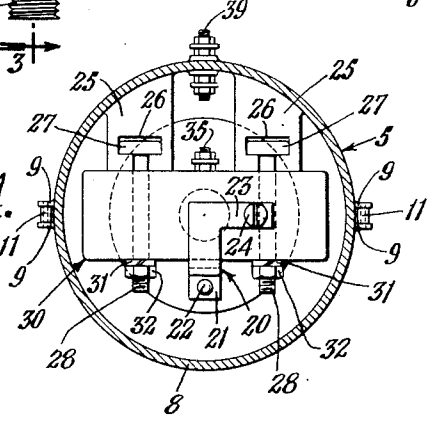


Fig:4.



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PRESSURE-RESPONSIVE SWITCH

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6 Claims. (Cl. 200—83)

This invention relates to a switch mechanism, and more particularly to a pressure-responsive switch mechanism for use in automatically starting an internal combustion engine.

While the mechanism of this invention may be advantageously employed in various locales, it is especially useful in starter systems of automobile internal combustion engines. Accordingly, and by way of example, a preferred and recommended form of the mechanism is described in the ensuing description and illustrated in the accompanying drawing in connection with a starter arrangement for an automobile engine.

A switching mechanism constructed in accordance with this invention preferably comprises a housing consisting of a horizontal base plate and a hollow closure or dome mounted on the base plate and removably secured thereto by a pair of spring clips. Integral with the base plate is a centrally disposed vertical conduit. The conduit includes an upper portion extending into the housing and a lower portion extending below the housing and adapted to be connected to the intake manifold of an automobile engine. A vertically expansible bellows contained in the housing is coaxial with the conduit, the upper end of which terminates therein. The bellows is hermetically sealed at its lower end to the base plate and at its upper end to a head plate carried by the bellows. The bellows may be made of springy material or if preferred, may be provided with a compression spring which bears at its opposite ends against the base plate and the head plate to normally and yieldingly urge the head plate upwardly, thereby expanding the bellows.

The closure is provided with a pair of inwardly projecting lugs having vertical T-slots for receiving the heads of bolts by which a switch is adjustably positioned within the housing above the bellows with the aid of bolts or the like. The switch is preferably of the type having separate on and off actuators, although a single actuator switch may be used if opening and closing occur in different positions of the actuator. Excellent results have been achieved by the use of a reset "micro-switch" having first and second plungers for respectively closing and opening the switch. The first plunger projects downwardly toward the head plate, while the second plunger extends upwardly beyond the confines of the switch. The first plunger is aligned with a first adjustable actuating member or screw carried by the head plate. The second plunger is aligned with a second adjustable actuating member or screw carried by a bracket secured to the head plate in spaced relation to the first member. The parts are so arranged that the compression spring normally moves the head plate and the first member upwardly to actuate the first element so as to close the switch, thereby placing the switch in active service.

The bellows is contracted, whereby the head plate moves downwardly against the action of the compression spring, in response to sufficient vacuum created in the conduit by operation of the engine, thereby moving the first member out of engagement with the first plunger and then causing the second member to engage and actuate the second plunger so as to open the switch. This places the switch out of active service.

It is a primary object of the invention to provide an improved fluid pressure-responsive switch mechanism which will open at one pressure and will close at another pressure.

It is a further object to provide an improved pressure-responsive switch mechanism for use in the starting system of an internal combustion engine.

Another object of the invention is to provide a starting mechanism of the character indicated that automatically places the starter of an automobile engine in service if the engine becomes stalled.

A further object of the invention is to provide a pressure-responsive starter mechanism that is simple, sturdy and compact in design and that is reasonable in manufacturing and installation costs.

A still further object of the invention is to provide a mechanism of the character described that is adapted to perform its intended functions in an effective and trouble-free manner.

The enumerated objects, as well as additional objects, together with the advantages obtainable by the practice of this invention, will be readily apparent to persons skilled in the art upon reference to the following detailed description, taken in conjunction with the annexed drawing, which respectively describe and illustrate a mechanism constructed in accordance with the invention.

In the drawing:

Figure 1 is a view partly diagrammatic and illustrating a switch mechanism embodying this invention, operatively associated with an automobile internal combustion engine and a combined ignition and starter system for the engine;

Figure 2 is a view of the switch mechanism partly in central vertical cross section;

Figure 3 is a view taken along line 3—3 of Figure 2; and

Figure 4 is a view taken along staggered line 4—4 of Figure 2.

Referring now to the drawing wherein like reference numerals denote corresponding parts throughout the several views, a preferred and recommended switch mechanism construction is generally indicated by numeral **5** and comprises a housing consisting of a circular support or base plate **6** having an annular peripheral recess **7** and a hollow closure or dome **8** having an open end that registers with the annular recess. The closure **8** may be provided with a small bleeder opening **8'** to expose the interior thereof to the atmosphere. The closure **8** is provided with pairs of oppositely disposed bosses **9** that support pins **10**. Pivotally connected to each pin is a spring clip **11** for readily securing the closure to the base plate and permitting speedy removal of the closure, as required. Integral with base plate **6** and extending thereabove and therebelow is a vertical conduit **12** externally threaded at its lower end, as indicated at **13**. The conduit **12** is provided with a port **18** of small diameter for a purpose to be described.

A bellows **14** is coaxial with conduit **12** and is hermetically sealed at its lower end to the base plate. The bellows includes a hermetically sealed head plate **15** which is tapped centrally to receive an adjustable actuating member or screw **16**. At the time of assembly, screw **16** is adjusted as required and may, if desired, be maintained in adjusted position by soldering. Within the bellows and also coaxial with the conduit there may be provided a compression spring **17** which, as shown in Figure 3, bears at its opposite ends against the base plate and the head plate to normally and yieldingly urge the bellows into expanded position (Figure 3) in the event the bellows are made of a material having insufficient inherent springiness. The upper extension of conduit **12** may be made of such length as to serve as a stop for the head plate **15**, to prevent excessive collapse of the bellows. An upstanding bracket **20** has a flange **21** for attachment to head plate **15** by a rivet **22** or other means known to the art. The bracket is formed at its upper end with a laterally disposed L-shaped arm **23** that carries a second adjustable actuating member or screw **24** at its free end.

A pair of spaced lugs **25** is formed integral with and projects laterally inwardly of closure **8** (Figure 4). These lugs are provided with vertical T-slots **26** that are parallel to each other and adapted to receive the head **27** and a portion of the shank of corresponding bolts **28** for adjustably securing a switch **30** to the lugs with the aid of lock washers **31** and nuts **32**. As illustrated, switch **30** is positioned above bellows **14** and intermediate actuating members **16** and **24**. The switch is of the reset "micro-switch" type and includes a pair

of plungers, namely, a reset or "on" plunger 33 aligned with member 16 and adapted, upon actuation, to close the switch, and an "off" plunger 34 aligned with member 24 and adapted, upon actuation by member 24, to open the switch. The "micro-switch" is provided with a pair of binding posts 35 and 36 which are respectively connected by conductors 37 and 38 to corresponding posts 39 and 40 that are carried by closure 8.

As is indicated in Figure 1, conduit 12 is adapted to be connected by a union 41 to a conduit 42 that communicates with an intake manifold 43 of an internal combustion engine 44, which, for purposes of illustration, may be of the type employed in automotive vehicles. The engine is provided with a conventional starter device 45.

The arrangement shown in Figure 1 includes an electrical system that consists of a plurality of series circuits, all energized by a battery 46. Current furnished by the battery is transmitted to an induction coil 47 by way of conductors 48 and 49, an ignition switch 50, and conductors 51 and 52, in the order named. Battery current is supplied to a standard starter relay 53 through conductors 48 and 49, switch 50, conductors 51 and 54, binding post 39, conductor 37 (Figure 3), "micro-switch" 30, conductor 38, binding post 40, and conductor 55. At such times as relay 53 is in active service, battery 46 energizes starter 45 through a circuit comprising conductors 48 and 56, relay 53, and conductor 57.

For the purpose of briefly outlining the mode of operation of the illustrated embodiment of the invention, it is first assumed that the parts are in the relative position shown in the drawing with ignition switch 50 open and engine 44 at rest. Under these conditions, bellows 14 is expanded due to the action of compression spring 17, head plate 15 being at its elevated position so that screw 16 has urged plunger 33 upwardly to "on" position, closing "micro-switch" 30.

To start the engine, ignition switch 50 is closed. This permits battery current to flow through conductors 48 and 49, ignition switch 50, conductors 51 and 54, "micro-switch" 30 and conductor 55 to relay 53, actuating the relay so that battery current flows through conductors 48 and 56, relay 53 and conductor 57 to starter 45, thereby energizing the starter and turning the engine to start the same. In the course of engine starting and continued operation of the engine, vacuum is created in manifold 43. This causes contraction of the bellows, moving head plate 15 and screw 16 downwardly out of engagement with plunger 33 against the action of spring 17. Inasmuch as the "micro-switch" is of the reset type, it remains closed until such time as screw 24 moves downwardly so as to actuate plunger 34 to open the switch. At such time as the engine is operating at idling speed, sufficient vacuum is created in the bellows to move head plate 15 and, therefore, bracket 20 downwardly to an extent that screw 24 contacts and moves plunger 34 downwardly, thereby opening switch 30 to place the same out of service.

When ignition switch 50 is again opened, cutting off the engine, the degree of vacuum in the bellows is reduced permitting compression spring 17 to return head plate 15 and screw 16 to the position shown in Figure 3, thereby resetting the "micro-switch" to closed position. In the event that the engine becomes stalled during operation, the reduction in vacuum in the intake manifold and in the bellows also permits spring 17 to actuate plunger 33 and if the ignition switch 50 is still closed, to restart the engine. The small diameter port 18 introduces a delay in the expansion of the bellows to avoid instantaneous closing of the "micro-switch" which might be caused by a backfire or sudden excessive loading of the engine in operation. Also, the delay thus caused will permit the starter motor to come to rest in case of false starting of the engine.

It will be apparent that screw 33 may be so adjusted that high manifold pressures incident to heavy loading of the engine will not accidentally energize the starter. The starter in the illustrated construction is energized only when the manifold pressure is atmospheric, but once it is actuated, it remains in operation until the manifold pressure drops to a point indicating normal operation of the engine.

Among the outstanding advantages and features of the present invention when adapted to a starting system are: the elimination of conventional starter buttons as the engine is started by merely closing the ignition switch; prompt and automatic restarting of the engine in the event of stalling; prevention of accidental operation of the starter prior to closing the ignition switch or while the engine is in normal operation.

In the starter system, herein described, the parts are so arranged that "micro-switch" 30 is opened at low fluid pressure and closed at high pressure. It is recognized that my switch mechanism may be used in systems that may require reversal of opening and closing of the "micro-switch." In such cases, the "micro-switch" may be of the type that closes when the bellows is contracted and is reset into open position when the bellows is expanded.

From the foregoing, it is believed that the construction, operation, and advantages of my present invention will be readily comprehended by persons skilled in the art. It is to be clearly understood, however, that various changes in the apparatus set forth above may be made without departing from the scope of the invention, it being intended that all matter contained in the description or shown in the drawing shall be interpreted as illustrative only and not in a limiting sense.

I claim:

1. In a mechanism of the character described, a support, an electric switch mounted on the support and including first and second movable elements for respectively closing and opening the same, actuating means for alternately placing the switch in closed and open positions, said actuating means comprising a first member aligned with and independent of the first element for moving the same in a direction to close the switch and a second member spaced from the first member, said second member being aligned with and independent of the second element for moving the same in a direction to open the switch, resilient means normally biasing the actuating means in one direction to place the switch in one of said positions, a conduit secured to the support, and pressure-sensitive means biasing the actuating means in a reverse direction against the action of the resilient means in response to variations in fluid pressure in the conduit to place the switch in the other of said positions.

2. In a mechanism of the character described, a support, an electric switch mounted on the support, a bellows carried by the support and including a movable head plate, first and second members secured to and movable with the head plate for actuating the switch to respectively close and open the same, said bellows including resilient means normally urging the head plate in one direction to move the first member to switch-closing position, and a conduit communicating with the interior of the bellows, said head plate being movable in a reverse direction against the action of the resilient means in response to variations in fluid pressure in the conduit to correspondingly move the second member to switch-opening position.

3. In a mechanism of the character described, a support, an electric switch mounted on the support, a bellows carried by the support and including a movable head plate, first and second members secured to and movable with the head plate for actuating the switch to alternately place the same in closed and open positions, said bellows including resilient means normally urging the head plate in one direction to expand the bellows and move the first member to actuate the switch to one of said positions, and a conduit communicating with the interior of the bellows, said bellows being contracted and the head plate being movable in a reverse direction against the action of the resilient means thereof in response to a drop in fluid pressure in the conduit to move the second member to actuate the switch into the other of said positions.

4. In a mechanism of the character described, a support, an electric switch mounted on the support, a bellows carried by the support and including a movable head plate, first and second members secured to and movable with the head plate for actuating the switch to alternately place the same in closed and open positions, said bellows including resilient means normally urging the head plate in one direction to expand the bellows and move the first member to actuate the switch to one of said positions, and a conduit communicating with the interior of the bellows, said bellows being contracted and the head plate being movable in a reverse direction against the action of the resilient means thereof in response to a

drop in fluid pressure in the conduit to move the second member to actuate the switch into the other of said positions, said switch including first and second plungers aligned respectively with the first and second members and adapted to be actuated by the members to alternately close and open the switch, the first plunger being disposed to the side of the switch adjacent the head plate and the second plunger being disposed to the side of the switch remote from the head plate, the first and second members being spaced from each other and adjustable relative to the head plate.

5. In a mechanism of the character described, a housing comprising a base and a closure attached to the base, a bellows secured to the base and positioned within the housing, said bellows including a movable head plate, a first member secured to and projecting beyond the exterior of the head plate, a second member mounted on and positioned exterior the head plate in spaced relation to the first member, an electric switch supported in the housing in spaced relation to the bellows, said switch being adjustable relative to the bellows and including a first plunger aligned with the first member for effecting closing of the switch and a second plunger aligned with the second member for effecting opening of the switch, said bellows including resilient means normally urging the head plate in one direction to expand the bellows and move the first member into engagement with the first plunger to actuate the switch into closing position, and a conduit communicating with the interior

of the bellows, said bellows being contracted and the head plate being movable in a reverse direction against the action of the resilient means in response to variations in fluid pressure in the conduit to move the first member out of engagement with the first plunger and the second member into engagement with the second plunger to open the switch.

6. A mechanism in accordance with claim 5 wherein the switch is secured to the closure, the resilient means comprises a compression spring wholly within the bellows and bearing at its opposite ends against the base and the head plate, the first member and first plunger being disposed to the side of the switch adjacent the head plate, and the second plunger and second member being disposed to the side of the switch remote from the head plate.

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