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SWITCH

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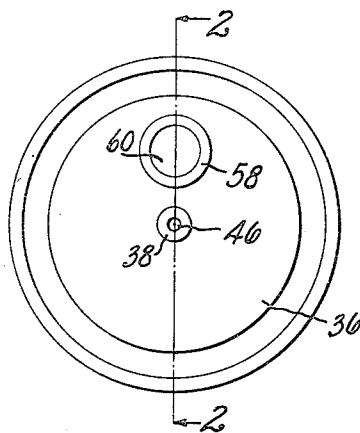


Fig. 1.

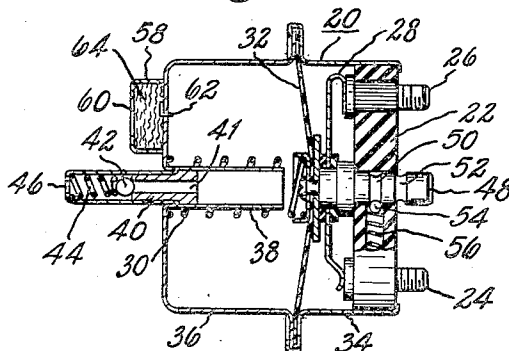


Fig. 2.

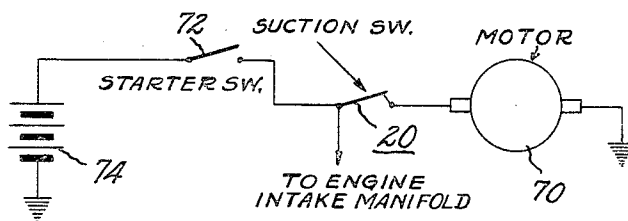


Fig. 3.

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2,773,958

SWITCH

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2 Claims. (Cl. 200—83)

This invention relates to electric switches and is particularly concerned with vacuum actuated electric switches.

An object of the invention is to provide a vacuum operated electric switch which is biased to closed circuit position under a predetermined load and which includes a vacuum operated device capable of overcoming the bias and opening the switch under predetermined conditions of vacuum, means being provided for reestablishing the switch in closed circuit position after a predetermined time delay upon the elimination of the vacuum.

A further object of the invention is to provide a switch for use in an electrical system of an automotive vehicle wherein a safety switch is provided in the starter circuit, which switch is normally closed and which is opened by a vacuum actuator upon starting of the engine, said switch being designed so as to provide a time delay for preventing restarting of the engine until such time that the engine has ceased to rotate.

In automotive starting systems, a starter switch is generally provided which, upon closure, energizes the starter. Engine starters of conventional design include means for engaging the starting motor with the flywheel of the engine through suitable gears and disengaging the motor from the flywheel of the engine after the engine has been started. In many instances, when false starts are encountered, the engine ceases to function shortly after starting and the operator of the vehicle may reclose the starter switch prior to the time that the engine has stopped rotating. Under these conditions, the starter motor is again thrown into engagement with the flywheel. This condition frequently causes breaking of some of the flywheel teeth, since the flywheel is still moving at the time the starter is energized and proper engagement of the gears is thus prevented. It is, therefore, highly desirable to prevent energization of the starting motor prior to the time that the engine has stopped rotating.

Not only is this provision useful in case of false starts but it is also useful during operation of the engine, when, due to silent operation, the operator closes the starter circuit when the engine is running thereby causing engagement of the starter motor gears with the flywheel gear at the time the flywheel is in rotation which again creates a condition where gear teeth may be broken off. Therefore, it is particularly desirable in engine starting systems to provide means for preventing energization of the starting motor during any period that the engine is rotating. The present invention is specifically directed to solving this problem in an inexpensive and highly effective manner through the use of a novel vacuum operated switch placed in series with the starter motor, or device which actuates the starting motor.

Further objects and advantages of the present invention will be apparent from the following description reference being had to the accompanying drawings wherein a preferred embodiment of the present invention is clearly shown.

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In the drawing:

Fig. 1 is a plan view of a vacuum switch.

Fig. 2 is a section taken on line 2—2 of Fig. 1, showing the internal structure of the switch.

Fig. 3 is a diagrammatic electrical hookup of a starter motor used in connection with an internal combustion engine.

Referring specifically to Fig. 2, a switch 20 is shown which includes a base plate 22 of insulating material having two contacts 24 and 26 carried thereby. These contacts are bridged by a spring bridging member 28 spring-pressed against the contacts by means of a spring 30. Interposed between the spring 30 and the contact member 28 is a flexible diaphragm 32 held peripherally between two casing members 34 and 36 which are also engaged with the base plate 22. The spring 30 surrounds and is carried by a downwardly extending tube 38 attached to the upper casing member 36. Within the tube 38 is a ferrule 40 having a passage 41 therethrough which is closed by a ball 42 that is spring-pressed against the aperture at the end of passage 41 in the ferrule 40 by a small spring 44. The outer end of the tube 38 is apertured as at 46.

The spring bridging member 28 is insulatedly carried by a centrally located plunger 48 which passes through and is journaled in the base plate 22 and which includes a pair of grooves 50 and 52 therearound. These grooves are adapted to be engaged by a ball 54 spring-pressed by spring 56 into engagement with one or the other of the grooves 50 or 52. The ball and spring are held within a transverse cavity in the base plate 22. This structure acts as a yieldable detent for the plunger 48 spring contact member 28 whereby the spring contact member is maintained in either open or closed position under a certain predetermined resisting pressure as determined by the detent.

In the upper casing member 36 is placed a vent 58 which is opened to the atmosphere at 60 and opened to the inside of the casing member 36 through a small aperture 62. Within the vent 58 is fibrous material 64 which acts as a filter and restrictor to prevent ingress of dirt and clogging of the small aperture 62.

In operation of the device, a flexible tube (not shown) is attached to the upper end of the tube 38 so as to communicate with the aperture 46 therein. The spring 30 normally presses the diaphragm 32 in the position shown in Fig. 2, and thereby maintains the spring bridging member 28 in closed circuit position with respect to contacts 24 and 26. The flexible tube, not shown attached to the tube 38, is attached at its opposite end to an intake manifold and upon creation of vacuum therein, causes the ball 42, which in reality is a check valve, to open and thereby draws air out of the upper chamber of the casing 36 above the diaphragm. When the vacuum within the chamber 36 is sufficient, the diaphragm 32 is drawn upwardly to cause the bridging member 28 to open circuit contacts 24 and 26. The vacuum in the intake manifold is sufficient to overcome the slight leakage into the chamber 36 through the reduced diameter orifice 62 so that as long as the engine is in operation, the diaphragm 32 is held under vacuum in a position to maintain the bridging member 28 in switch opening position. The detent 52 aids in yieldably maintaining the switch in open position.

When the engine ceases to operate, the vacuum in the intake manifold drops off rapidly and when the engine stops, there is no vacuum within the intake manifold which is then at atmospheric pressure. The switch, however, does not close until the interior of casing 36 is reestablished at substantially atmospheric pressure due to bleeding in of outside air through the reduced orifice 62. The size of the orifice determines the time delay. Thus,

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after a predetermined time delay, the pressure within the casing 36 is built up so that the spring 30 overcomes the detent 52 to again close the switch by closing the bridging member 28 to engage both contacts 24 and 26.

In the installation of this switch, a hookup as shown in Fig. 3 may be used wherein 70 is a starter motor, 72 is a starter switch and 74 is a battery. The battery 74 and the motor 70 are both grounded at one side thereof. The switch 20 is placed in series with the starting switch and is normally closed. When the starter switch 72 is closed, current is immediately impressed upon the motor 70 to cause the same to rotate and cause the starter driving mechanism to engage the flywheel of the engine. As soon as the engine is started, vacuum is established within the manifold which effects the pressure conditions within the casing 36 of the switch 20. After a very short time delay as caused by building up vacuum in the casing 36 sufficient to overcome the resistance of the detent 50 and spring 30 whereupon switch 20 opens to cause the starter motor to become deenergized. After the engine fails to continue to operate due to a false start, it is impossible to reclose the starter motor circuit through switch 72 until such time as the vacuum within the chamber 36 is substantially destroyed due to air being admitted through the metering orifice 62. Since this orifice is small sufficient time delay is created before the switch 20 is reclosed to assure that the engine has stopped rotating whereupon the starter switch 72 may be reclosed and the cycle repeated.

The system also prevents the engagement of the starter with the flywheel during normal operation of the system since the switch 20 is in open circuit position at all times during normal operation of the internal combustion engine.

It will thus be seen that the switch 20 acts as a safeguard against injury to the flywheel or starter motor drive gear since it prevents engagement of the starter motor gear with the flywheel gear during any time that the internal combustion engine is rotating. This action is assured by the definite and predetermined time delay before the switch 20 is placed in closed circuit position after the engine ceases to operate. It is manifest that this switch is of an inexpensive design, yet is fully capable of controlling the circuit as outlined. The switch is simple in construction and has a minimum of moving parts.

The description of the vacuum switch in a starter system, as noted herein, relates to a simplified hookup. In many instances, the starter motor is placed in circuit through a relay or solenoid switch wherein the starter switch per se actually closes the circuit to the solenoid which, in turn, closes a switch for the starter motor circuit. Obviously, the vacuum switch, as noted herein, is capable of use in such a circuit wherein its operation determines the opening or closing of the circuit to the solenoid coil rather than to the starter per se. Such a solenoid setup is clearly shown in Dyer Patent #2,167,646.

It is apparent that the switch may also be used in any application wherein vacuum is created during operation of a device and wherein time delay is desired before a circuit can be energized after the destruction of the vacuum.

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While the embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. A vacuum switch comprising, in combination, a pair of contacts, a bridging member, a chamber closed by a diaphragm, a spring within said chamber normally causing said diaphragm to be moved to one position, means connecting the diaphragm to the bridging member whereby the bridging member is held in closed circuit position when said diaphragm is in said one position, a normally closed check valve communicating with said closed chamber means adapted to connect the closed chamber with a vacuum source through said check valve whereby the check valve is opened only under predetermined conditions of vacuum and the diaphragm is moved to another position for causing said bridging member to be moved to open circuit position when said predetermined vacuum is applied, and detent means associated with said bridging member for and an independent bleed valve connecting said closed chamber to the atmosphere for permitting the spring to re-establish the bridging member in closed circuit position after the vacuum has been destroyed and only after a predetermined time delay as determined by the bleed valve.

2. A vacuum switch comprising in combination; a closed chamber, a diaphragm disposed in said chamber so as to divide the chamber into two independent compartments, switch means in one of said compartments, a slidable support for said switch means operatively connected to said diaphragm and movable to two extreme positions whereby said switch means are caused to be moved to open or closed position, means for yieldably resisting movement of said support from either of said two positions, means in the other of said compartments for normally biasing said diaphragm and said support in one direction, a normally closed check valve providing an entry in said other compartment and adapted to be connected to a source of vacuum whereby said valve is opened said other compartment is evacuated only upon a predetermined vacuum being impressed upon said valve for causing said diaphragm and support to move against the biasing means and to overcome the means for yieldably resisting movement for actuating the switch means, a second valve means in said compartment including a restricted opening independent of said valve for permitting reestablishment of the diaphragm and support to a position in said one position after the vacuum has been destroyed through the action of said biasing means and only after a predetermined time delay as determined by the size of said opening.

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