Nov. 29, 1949 C. H. ANGUS 2,489,736

AUTOMOBILE CIRCUIT CONTROL

Filed March 14, 1946

Fig. 1

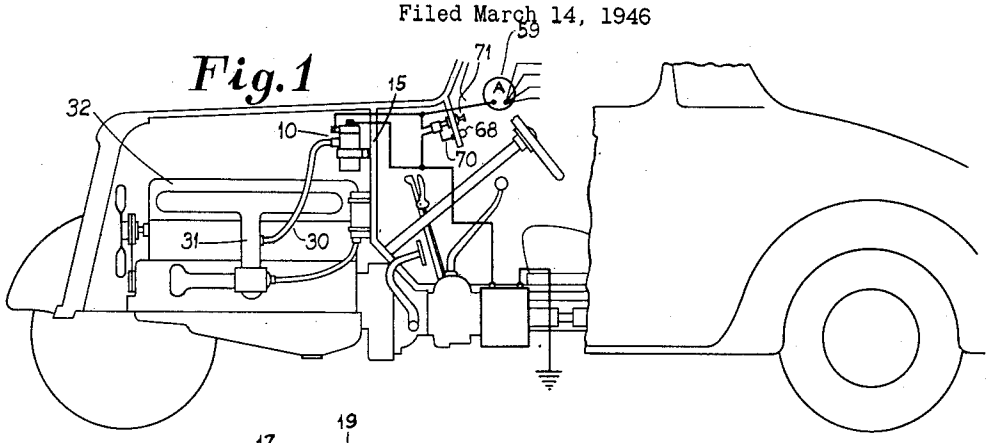


Fig. 3

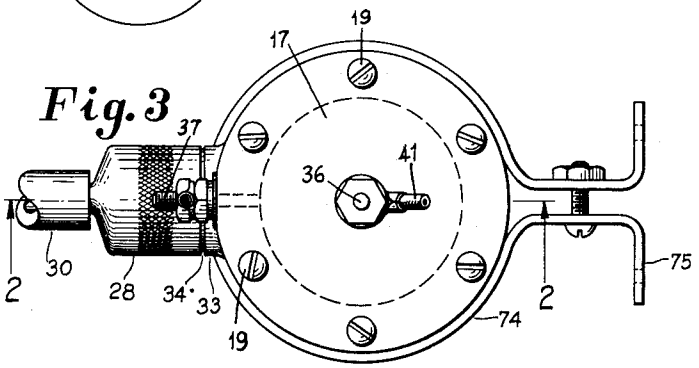


Fig. 2

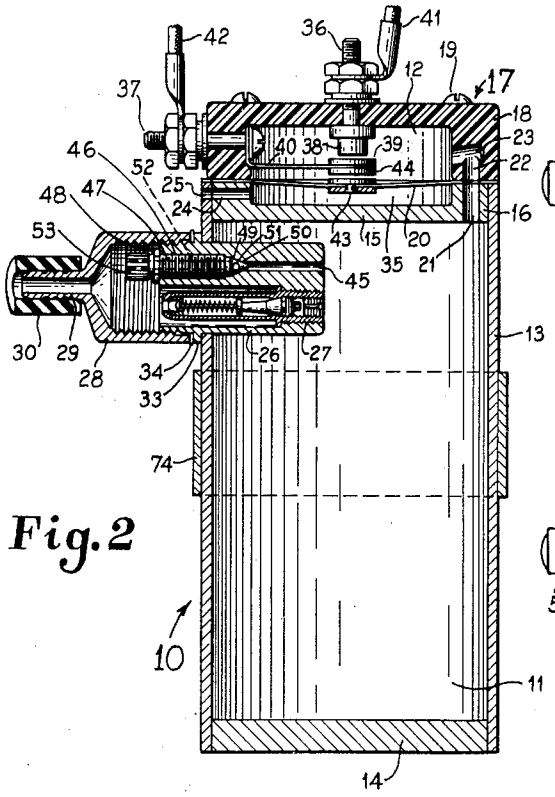
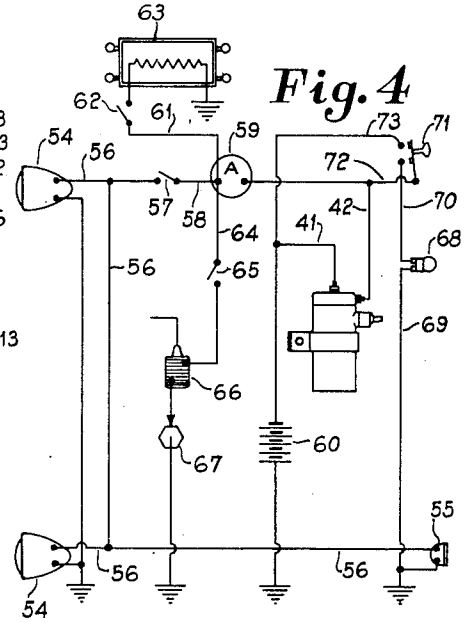


Fig. 4



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AUTOMOBILE CIRCUIT CONTROL

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13 Claims. (Cl. 200—83)

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This invention relates to automatic controlling devices for electrical circuits of automotive conveyances.

The present invention is more particularly concerned with an automatic circuit control having the same general purpose of, but representing an improvement over that illustrated and described in my Patent No. 2,143,906, issued January 17, 1939, and this application is a continuation in part of my copending application, Serial No. 618,611, filed September 26, 1945, now abandoned.

In the circuit controlling device of the above-referred-to patent, switch contacts were operated by an air-operated member which was in turn actuated as a result of the vacuum built up in the intake of the engine, the switch contacts being connected so as to automatically open the electrical circuits of the car immediately upon the engine coming to a standstill and thereby prevent waste of the battery current shouud any of the electrical devices of the car be inadvertently left connected. In this device, a dashpot effect was obtainable as a consequence of making the air-operated member in the form of a pivotally-mounted vane; therefore fluttering of the vane and undesired opening of the circuit was prevented during momentary variations or reductions of the vacuum in the engine intake, such as are occasioned when the car was proceeding up a hill, under heavy load. This device operated satisfactorily, but required care in use, and was somewhat costly in manufacture due to the packing required about the vane.

According to the present invention an improved automatic pneumatic-operated switch device is provided wherein no packing, between moving parts is required, so that the manufacturing and maintenance costs are reduced, and yet the device operates to prevent fluctuations and breaking of the automotive circuits during the short periods that the engine-intake vacuum is reduced while the engine is running, or cut off if the engine should stall. This is accomplished by the provision of a unitary device having structure forming a pair of separate, air-tight, intercennected chambers of different size, one being larger relatively and functioning as a ballast, and the smaller chamber having a simple pressure-responsive or air-operated member, comprising a diaphragm in the embodiment of the invention illustrated herein, which requires no costly air-tight packing, and has a long, useful, trouble-free life. The diaphragm is extremely economical to fabricate, simple to mount without danger of air leakage, and simple to adapt for switch operation.

By the use of the large ballast chamber, together with a vacuum maintaining valve, fluttering of the diaphragm and switch means, which would undesirably open the circuit, is eliminated,

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and also short-lived loss of vacuum from the engine, as for instance when the engine stalls, will not open the circuit, since a substantial interval of time is required, on the order of two or three minutes, to reduce the vacuum in the ballast chamber because of its large size and the substantially tight joints employed.

A novel means is provided for varying and adjusting the rate of air admission into the ballast chamber when the engine is shut off, thereby to adjust the time required by the device to open the circuit. This means comprises an adjustable needle valve interposed between the ballast chamber and the vacuum line, the valve being located, together with the air exhaust valve of the chamber, in a fitting secured to the chamber. The fitting carrying the valve has a removable combination cap and nipple, the nipple connecting with a vacuum hose leading from the car intake, and the cap serving to enclose both the needle valve and the air exhaust valve. The organization as above set forth has the advantage that the same fitting can be used for both valves, eliminating the use of an extra fitting, and that there is eliminated the possibility of dirt or other foreign matter reaching the valves and impairing their operation. In addition, there is no admission of air whatsoever through the needle valve into the ballast chamber when the engine is running, since the needle valve does not communicate with the outside atmosphere, but instead communicates with the car intake. Also, the adjustable needle valve is readily accessible after the device is completely assembled except for the nipple cap, so that the valve can be conveniently adjusted at the factory to properly set each device, yet tampering with the valve after the device leaves the factory is discouraged, due to its being covered and hidden by the cap.

In conjunction with the improved switch device of this invention, a manually operable switch and signal means are provided so that the automatic-controlling device may be rendered inoperative at will, thereby becoming ineffective to open the car circuits, and so that an operator will be apprised of such condition, and will not inadverently leave the car with the device in the inoperative state unless so desired.

Other features and advantages will hereinafter appear.

In the accompanying drawings:

Figure 1 is a schematic view of an automobile having the improved circuit-controlling device of the invention installed therein.

Fig. 2 is an axial section through the automatic pneumatic circuit-controlling device of the invention.

Fig. 3 is a top view of the circuit-controlling device, and

Fig. 4 is a diagrammatic view of the automobile

electrical circuits and the circuit-controlling device of the invention connected therewith.

Referring to Figs. 2 and 3, the pneumatic circuit-control device of the present invention comprises a housing 10 which is so constructed as to form a pair of separate, air-tight, interconnected chambers 11 and 12 of different size, the chamber 11 being relatively larger and functioning as a ballast, and the smaller chamber 12 being associated with a simple, leak-proof pressure-responsive means coupled with switch means, all for reliably controlling the car circuits in a particular and advantageous manner.

In the specific structure at present preferred and shown herein as illustrative of the invention, the housing 10 comprises a body 13 in the form of a cylinder having a bottom closure 14 and a top closure 15, the latter having the shape of a shallow cup with thick side walls 16.

The ballast chamber 11 is thus defined by the closures 14 and 15, and embraces substantially the entire interior of the body 13.

The housing 10 also comprises a cap portion 17 in the form of a shallow cup having thick side walls 18, the cap being inverted and secured to and over the closure 15 by means of screws 19 passing through the side walls of the cap and closure.

Interposed and clamped between the cap 17 and the closure 15 is a pressure operable diaphragm 20 which may be formed of any suitable air-tight material which will yield or flex under air pressure. I have found that a rubberized fabric material may be advantageously used for making the diaphragm 20, since this material serves as an air-tight seal or gasket where it is clamped between the walls 16 and 18 of the closure and cap, as well as being impervious to air and extremely flexible itself.

The side walls 16 and 18 of the closure 15 and cap 17 have aligned channels 21 and 22 respectively, and the diaphragm 20 has an aperture where the said channels meet, to enable these to communicate with each other.

The channel 22 has an angularly extended portion 23 opening into the chamber 12, and thus the latter is connected with the ballast chamber 11.

Also, the side wall 16 of the closure 15 has a channel 24 aligned with an aperture 25 in the wall of the body 13, the said channel and aperture constituting a vent to the atmosphere.

By this construction variations of pressure in the ballast chamber 11 will result in corresponding pressure variations in the chamber 12, causing movement of the diaphragm 20 either upward or downward.

As shown in Fig. 2, the side wall of the body 13 is provided with an air outlet fitting 26 which may be soldered to the said wall to form an air-tight seal thereto. A spring-urged valve 27 which may comprise a standard tire valve is mounted within the fitting 26, the valve being so constructed that it permits air to be removed from the chamber 11, but prevents the intake of air into said chamber.

The fitting 26 is externally threaded to removably carry a cap 28 formed at its end into a nipple 29 which is connected by a flexible hose 30 with the intake 31 of the automobile engine 32. The fitting 26 has an exterior flange or shoulder 33, and a gasket washer 34 is provided between the shoulder 33 and the end of the cap 28 to seal the latter to the fitting. Thus when the engine 32 is operating, air will be sucked out of the ballast chamber 11 and a partial vacuum will be created therein. This vacuum will be sustained regardless of momentary fluctuations of the suction or intermittent cessation of suction, due to the substantial size of the chamber and to the provision of the spring-urged valve 27.

The ballast chamber 11 being in communication with the chamber 12 will cause a partial vacuum to exist within the latter. Since the chamber 35 between the diaphragm 20 and the closure 15 is vented to the atmosphere, atmospheric pressure is brought to bear aaginst the underside of the diaphragm 20 so that the latter is moved upward when the partial vacuum exists in the chamber 12.

For the purpose of controlling the automobile circuits, the cap 17 of the casing 10 is provided with contact-carrying means in the form of studs 36 and 37 which extend through apertures in the walls of said cap, the studs being insulated from each other by making the cap of Bakelite or other insulating material. The stud 36 passes through the center of the cap 17, and at its inner end is provided with a stationary contact 38 adapted to engage a movable contact 39 secured to the end of a resilient arm 40 mounted on the inner end of the stud 37. Connections may be made to the studs 36 and 37 by wires 41 and 42 respectively in the usual manner as shown.

Normally the resilient arm 40 is biased so as to maintain the contact 39 separated from the stationary contact 38. However, when the diaphragm 20 is forced upward, due to a vacuum existing in the chambers 11 and 12, it causes the arm 40 to flex so as to bring the contacts 38 and 39 together.

Preferably the diaphragm 20 at its center is provided with a button 43 riveted thereto and adapted to engage a rivet head 44 on the arm 40, so as to prevent wearing away of the material of the diaphragm.

Because of the structure and arrangement of the chambers 11 and 12, valve 27 and diaphragm 20 and with the particular sealing means employed therewith, the partial vacuum in the said chambers will be maintained at a level which is sufficient to hold the switch contacts 38 and 39 closed over a period of time normally in excess of five minutes after the car engine has stopped, and this is an important advantage of the circuit control since it prevents immediate opening of the car circuits if, for example, the engine should stall before the car when being halted is finally brought to a standstill. Therefore, in a sense, the automatic switch of this invention functions as a time-delay switch, although no clockwork or other movable timing means is employed.

According to the present invention novel means are provided for enabling reliable adjustment of the switch to be made so that the time delay may be in the order of two to three minutes. This adjustment means is extremely simple and fool proof, and is so organized that dirt and other foreign matter cannot reach it. Therefore, after initially adjusting the said means to attain the desired time delay of two to three minutes, it is not necessary at any later date to readjust it due to impairment in its functioning.

The adjustment means comprises an adjustable valve which is constructed to minutely admit air into the ballast chamber 11 after the car engine has ceased to turn over, and the intake vacuum has ceased. Preferably, according to the invention, the adjustment valve is so located as to bypass the one-way valve 27 in the fitting 26, and for this purpose the fitting is made of comparatively large diameter.

Referring to Fig. 2, the fitting 26 has a bore 45 having an enlarged threaded portion 46 which carries a screw 47 adjustable in the bore and locked to the fitting by a lock nut 48. The screw 47 has a conical end 49 fitting a conical seat 50 of the bore 45, and the tip 49 of the screw has apertures 51 communicating with a central bore 52 passing through the screw and through the head 53 thereof.

The screw 47 may be so adjusted that when a vacuum exists in the ballast chamber 11 but no vacuum exists within the cap 28, air may pass through the bore 45 into the chamber 11 at a minute rate, this rate being such that in a period of approximately two to three minutes the vacuum in the chamber 11 is broken sufficiently to release the diaphragm 20 and allow the contact points 38 and 39 to separate from each other.

It will be noted that the valve screw 47 is entirely enclosed within the cap 28 of the fitting 26 and also by the body 13. Since the ballast chamber 11 has no exposed outlet to the atmosphere, no dirt can get into the chamber, and since suction only is applied through the housing 30 to the cap 28 and fitting 26, dirt is prevented from entering the cap and impairing the operation of either the valve 27 or the valve 49, 50. When the engine 32 is shut off, the vacuum in the intake 31 and in the housing 30 and cap 28 ceases, and since air is present within these parts as a result, a small quantity of this air will be sucked through the screw 47 and bore 45 into the ballast chamber 11 to break the vacuum therein.

The locating of the valve screw 47 in the fitting 26 has the advantage that the time delay of the device may be adjusted at the factory after the entire assembly has been completed, since it is a very simple matter to quickly remove the cap 28 and adjust the screw 47. However, since the screw is completely covered and concealed by the cap 28, the danger of tampering with the screw is minimized after the device leaves the factory. Also, by locating the screw 47 in the fitting 26, the necessity of having a second fitting solely for the adjusting valve of the device is eliminated.

When the engine 32 is operating and suction is being applied to the cap 28 the adjusting valve does not function to admit air into the ballast chamber 11 since the valve does not communicate with the atmosphere but instead with the interior of the cap.

Referring to Fig. 4, the circuit diagram of the automobile includes head lamps 54 and a tail lamp 55, all having a common wire 56 connected to the light switch 57 of the car. The other terminals of the head and tail lights are connected to the ground as indicated. The light switch 57 is connected by a wire 58 to the ammeter 59 whose other terminal is connected to the wire 42 leading from the terminal stud 37 of the automatic switch. The wire 41 from the terminal stud 36 of the automatic switch is connected with the battery 60, whose other terminal is grounded.

From the ammeter 59 a wire 61 may lead through a switch 62 to a windshield heater 63, and a wire 64 may lead through an ignition switch 65 to an ignition coil 66 whose other terminal is connected through the distributor rotor 67 to the ground.

According to the present invention the automatic control system for the car is provided with a manually operable switch and signal means, the manual switch being connected in parallel with the automatic switch, and the signaling means operating to indicate when the manual switch is

closed, for which condition the automatic switch is rendered ineffective. As shown in Figs. 1 and 4, a signal bulb 68 is provided, the bulb being connected by a wire 69 to the ground, and by a wire 70 to one terminal of a manually operable switch 71 the other terminal of which is connected by a wire 72 to the wire 42. Also, a third terminal of the switch 71 is connected by a wire 73 to the wire 41.

When the handle of the switch 71 is depressed, the wires 70 and 73 are simultaneously connected with the wire 72, thereby shunting the contacts 38 and 39 of the automatic switch and connecting the signal bulb 68 so that the latter is energized from the battery 60.

The operation of the control of this invention is as follows: Normally the manually-operative switch 71 is left open, in the position shown in Fig. 4. When the engine 37 is to be started, the ignition switch 65 is closed, and the engine turned over by the starter. The suction thus created in the intake 31 will create a partial vacuum in the ballast chamber 11 of the housing 10, and a vacuum in the chamber 12. This will immediately move the diaphragm 20 upward, causing it to flex the resilient arm 40 and bring together the contacts 38 and 39. Thus the battery 60 will be connected through the ammeter 59 to the ignition circuit, so that the engine will receive spark for starting. Also, the other circuits of the car including the lighting, defrosting circuits, etc., will be available for use, and may be energized if their individual switches are closed. It will thus be seen that in starting the engine the ignition switch is closed by the operator inserting the key in the car in the usual manner, and upon the engine being turned over by the starter the automatic switch of the invention will immediately connect the battery 60 to the ammeter 59 so as to render the car circuits available for use.

Therefore, an operator proceeds in running and operating the car just as if the automatic switch were not present, since its operation is entirely automatic. However, when an operator is ready to leave the car and the engine is shut off, or even if the engine should stop without being shut off, the switch will automatically operate after a short period of time on the order of two to three minutes to disconnect all the circuits of the car from the battery by the contacts 38 and 39 separating as the arm 40 moves the diaphragm 20 downward in consequence of the vacuum in the chambers 11 and 12 ceasing.

Thus it will be seen that if the operator has left connected any of the devices such as the defroster 63, etc., these will be automatically disconnected and will not cause a drain on the battery 60 when the car is left parked. Also, the head and tail lights of the car will automatically shut off.

If for some reason, it is desired to leave the head lights and tail lights burning, the manually operable switch 71 may be closed upon leaving the car to bridge the automatic switch and thereby render the latter ineffectual in disconnecting the battery, and an operator will be apprised of the fact that the switch 71 is closed by the signal bulb 68 becoming illuminated for such condition.

According to the above structure as provided by the invention, when the car is in operation fluctuations in the suction of the intake 31 will not result in the car circuits being inadvertently opened, since a substantial reserve vacuum is carried in the ballast chamber 11 of the housing.

For instance, if the car is being driven up a long hill the reduced vacuum in the intake 31, which is prolonged in accordance with the length of the hill, would not result in the diaphragm 20 being released causing undesired separation of the contacts 38 and 39, and opening the car circuits. Also, since the vacuum in the ballast chamber 11 and the vacuum chamber 12 is maintained for a period of approximately two or three minutes after the engine stops, delaying the release of the diaphragm 20 and disconnecting of the car circuits, no trouble would be experienced if, for instance, the engine stalled during parking and before the car came to a complete standstill.

It will be seen that a simple and compact, stabilized or non-fluttering automatic switch device is thus provided by the invention without resorting to a dashpot effect, and to pressure-responsive or air-operated means requiring packings, etc., as with pistons, vanes and the like, and that the effect of a time delay is obtained through the use of the ballast chamber 11, such delay being appreciable to the extent of overcoming, for instance, the reduced intake-vacuum encountered when the car is made to climb hills.

For the purpose of mounting the automatic switch of the invention a bracket is provided in the form of a strap 74 which encircles the body 11, the end portions of the straps being secured together by a screw and having apertured ears 75 for receiving suitable mounting screws (not shown).

Variations and modifications may be made within the scope of this invention and portions of the improvements may be used without others.

I claim:

1. In a pneumatic-operated circuit controller for use with the intake of an internal combustion engine, an air-tight chamber; a substantially leak-proof pressure-operable member connected with the chamber and preventing leakage of air into the latter, said member responding to changes of pressure in the chamber; switch means operated by the pressure-operable member; an air fitting connected to the chamber; a removable cap for said fitting, the said cap having a nipple for connection with the intake of the engine to produce a vacuum in the chamber; a one-way valve in the air fitting, passing air solely out of the chamber; and an adjustable valve in the air fitting, bypassing the one-way valve and minutely admitting air into the chamber to break the vacuum therein within a predetermined time after the engine is shut off, thereby to cause operation of the said switch means, the said valves being enclosed and concealed by the said chamber and removable cap and nipple, and the adjustable valve having a manually operable part contained within the cap and exposed only when the cap is removed from the fitting, thereby to minimize the likelihood of tampering with the adjustment of the valve.

2. In a pneumatic-operated circuit controller for use with the intake of an internal combustion engine, a unitary assembly comprising a relatively large air-tight chamber; means including a leak-proof pressure-operable diaphragm, forming a relatively small air-tight chamber located exteriorly of the large chamber, said large and small chambers permanently communicating with each other and the small chamber having a volume which is a small fraction of the large chamber, and the said pressure-operable diaphragm responding to changes of pressure in the small chamber; biased switch means located in the small chamber and operated by the diaphragm; an air outlet connected to the large chamber, for connecting the latter with the intake of the engine to produce a vacuum in the chambers; a one-way valve in the air outlet, passing air solely out of the large chamber; and a second valve in the air outlet, bypassing the one-way valve and minutely admitting air into the large chamber to break the vacuum in the chambers within a predetermined time after the engine is shut off, thereby to cause operation of the said switch means.

3. A pneumatic-operated circuit controller for use with the intake of an internal combustion engine, comprising a housing having a substantially air-tight ballast chamber; a pressure operable member mounted externally of the chamber; means, forming with the operable member a second substantially air-tight chamber; means forming an air passage between the said chamber; switch means in said second chamber, controlled by the pressure-operable member; an air outlet for the ballast chamber, for connection with the intake of the engine to produce a vacuum in said chamber and operate the pressure-responsive member; and means associated with said air outlet for maintaining the latter closed against flow in the direction to prevent passage of air into the chamber, the vacuum in the latter being sustained during periods of no suction or reduced suction in the engine intake, and holding the pressure-responsive member and switch means steady.

4. A pneumatic-operated circuit controller for use with the intake of an internal combustion engine, comprising a housing having a substantially air-tight ballast chamber; a pressure operable member mounted externally of the chamber; mean, forming with the operable member a second substantially air-tight chamber; means forming an air passage between the said chambers; switch means located within said second chamber, controlled by the pressure-operable member; an air outlet for the ballast chamber, for connection with the intake of the engine to produce a vacuum in said chamber and operate the pressure-responsive member; means associated with said air outlet for maintaining the latter closed against flow in the direction to prevent passage of air into the chamber, the vacuum in the latter being sustained during periods of no suction or reduced suction in the engine intake, and holding the pressure-responsive member and switch means steady; and adjustable means for minutely admitting air into the said ballast chamber to break the vacuum therein within a predetermined time after the engine is shut off, thereby to cause the said switch means to be operated.

5. A pneumatic-operated circuit controller for use with the intake of an internal combustion engine, comprising a housing having a substantially air-tight ballast chamber; a pressure operable member mounted externally of the chamber; means, forming with the operable member a second substantially air-tight chamber; means forming an air passage between the said chambers; switch means controlled by the pressure-operable member; an air outlet fitting for the ballast chamber, including a removable cap on said fitting for connection with the intake of the engine to produce a vacuum in said chamber and operate the pressure-responsive member; means

associated with said air outlet for maintaining the latter closed against flow in the direction to prevent passage of air into the chamber, the vacuum in the latter being sustained during periods of no suction or reduced suction in the engine intake, and holding the pressure-responsive member and switch means steady; and adjustable means located in the said air outlet, and including a manually operable part within said cap, for minutely admitting air into the said ballast chamber after the engine is shut off, thereby to break the vacuum in the chamber within a predetermined time and cause operation of the said switch means, said part being exposed for adjustment when the cap is removed from the fitting.

6. A pneumatic operated circuit controller for use with the intake manifold of an internal combustion engine, comprising a housing having a substantially air-tight ballast chamber; a pressure-operable member mounted on the housing exteriorly of the chamber; means, mounted on the housing, forming with the pressure operable member a second substantially air-tight chamber; means forming an air passage between the said chambers; switch means in said second chamber, controlled by the pressure-operable member; an air outlet for the ballast chamber, for connection to the intake manifold of the engine to produce a vacuum in said chamber; and a valve associated with said air outlet for preventing passage of air from the intake manifold into the chamber, the vacuum in the latter being sustained during periods of no suction or reduced suction in the manifold, and holding the pressure-responsive member and switch means steady.

7. In a suction-controlled circuit controller for automobiles, a switch having fixed and movable contacts; a chamber; a diaphragm dividing said chamber into a high pressure side which communicates with the atmosphere, and a low pressure side in which said contacts are disposed, said diaphragm causing the movable contact of the switch to engage the fixed contact when a partial vacuum exists in the low pressure side; and a ballast chamber of large capacity communicating with the low pressure side of the switch chamber, said ballast chamber having an exhaust opening and an exhaust conduit adapted to be connected to the engine intake whereby a partial vacuum is created in said ballast chamber, and having a spring valve in the exhaust opening preventing air from entering the ballast chamber, whereby the vacuum causing the switch to remain closed is sustained for a predetermined time when suction from the engine is reduced or ceases as by laboring or stopping of the engine.

8. A pneumatic-operated circuit controller for use with the intake manifold of an internal combustion engine, comprising a housing having a substantially air-tight ballast chamber; a diaphragm mounted in the housing exteriorly of the chamber, said diaphragm and housing forming a second substantially air-tight chamber between them having a volume which is a small fraction of the ballast chamber; means forming a permanent air passage between the chambers; switch means operable by the diaphragm; and means for connecting the ballast chamber to the intake manifold of the engine to produce a vacuum in said chamber, said means including a valve for preventing passage of air from the intake manifold into the chamber, the vacuum in the latter being sustained during periods of reduction of the vacuum in the manifold and holding the diaphragm and switch means steady.

9. A pneumatic-operated circuit controller for use with the intake manifold of an internal combustion engine, comprising a housing having a substantially air-tight ballast chamber; a diaphragm mounted in the housing exteriorly of the chamber, said diaphragm and housing forming a second substantially air-tight chamber between them; means forming an air passage between the chambers; switch means disposed in the second chamber, operable by the diaphragm; means for connecting the ballast chamber to the intake manifold of the engine to produce a vacuum in said chamber, said means including a valve for preventing passage of air from the intake manifold into the chamber, the vacuum in the latter being sustained during periods of reduction of the vacuum in the manifold and holding the diaphragm and switch means steady; and a second valve bypassing the first-mentioned valve, said second valve minutely admitting air into the ballast chamber after the engine is shut off, and breaking the vacuum in the chamber within a predetermined time to cause operation of the said switch means.

10. A pneumatic-operated circuit controller for use with the intake manifold of an internal combustion engine in an automobile, comprising an elongate housing for mounting on a supporting surface of the automobile, said housing having a transverse wall dividing it into a relatively small air chamber and a relatively large air chamber; a diaphragm extending transversely across the small chamber and dividing the latter into two parts, one of said parts adjacent the said transverse wall of the housing communicating with the atmosphere and the other part communicating with the relatively large chamber of the housing; switch means located in the said other part of the small chamber and controlled by the said diaphragm; an air outlet communicating with the large chamber of the housing, said outlet being adapted for connection with the engine intake to produce a vacuum in the said large chamber; and a valve associated with the air outlet, preventing air from entering the said large chamber and sustaining the vacuum in the chamber during periods of no suction or reduced suction in the engine intake, thereby to hold the diaphragm and switch means steady.

11. A pneumatic-operated circuit controller for use with the intake manifold of an internal combustion engine in an automobile, comprising an elongate housing for mounting on a supporting surface of the automobile, said housing having a transverse wall dividing it into a relatively small air chamber and a relatively large air chamber; a diaphragm extending transversely across the small chamber and dividing the latter into two parts, one of said parts adjacent the said transverse wall of the housing communicating with the atmosphere and the other part communicating with the relatively large chamber of the housing; switch means located in the said other part of the small chamber and controlled by the said diaphragm; an air outlet communicating with the large chamber of the housing, said outlet being adapted for connection with the engine intake to produce a vacuum in the said large chamber; a valve associated with the air outlet, preventing air from entering the said large chamber and sustaining the vacuum in the chamber during periods of no suction or reduced

suction in the engine intake, thereby to hold the diaphragm and switch means steady; and an adjustable valve bypassing the first-mentioned valve and minutely admitting air into the large chamber to break the vacuum therein within a predetermined time after the engine is shut off, thereby to cause operation of the said switch means.

12. A pneumatic-operated circuit controller for use in an automobile with the intake of an internal combustion engine, comprising an elongate cylindrical housing for mounting on a supporting surface of the automobile; a pair of shallow circular cups secured together at their lips to form a closed chamber, one of said cups being mounted on the end of the housing to seal the latter, and having a vent to the atmosphere; a diaphragm mounted between the lips of the cups, dividing the said chamber into two parts; electrical switch means mounted in the unvented cup, operable by the diaphragm, the said cups having aligned channels connecting the interiors of the unvented cup and housing; an air outlet communicating with the interior of the housing, for connection with the engine intake to produce a vacuum in the said housing; and a spring-urged valve located in said air outlet for preventing passage of air into the housing, the vacuum in the latter being thereby sustained during periods of no suction or reduced suction in the engine intake, thereby to hold the diaphragm and switch means steady.

13. A pneumatic-operated circuit controller for use in an automobile with the intake of an internal combustion engine, comprising a cylindrical, elongate housing adapted to be mounted on a supporting surface of the automobile; a closed cylindrical casing secured with one end closing an end of the housing to seal the latter, the said casing projecting from the end of the

housing; a circular diaphragm stretched across the interior of the cylindrical casing, dividing the latter into a posterior cylindrical chamber and an anterior cylindrical chamber, said posterior chamber having a vent to the atmosphere; electrical terminal studs insulatedly mounted in the walls of the cylindrical casing, said studs extending into the anterior chamber; contacts secured to the studs within the chamber, one of said contacts being movable and adapted to be operated by the said diaphragm; a fitting secured in a wall of the said housing, for connection with the intake manifold of the engine, said fitting having a valve for preventing the passage of air into the housing; and means forming an air passage between the anterior chamber of the cylindrical casing and the chamber of the housing, the volumetric size of the latter, and the said valve operating to maintain the diaphragm and movable contact steady during fluctuations of the suction in the intake of the engine.

CHARLES H. ANGUS.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,628,209	Wilcox	May 10, 1927
1,866,068	West et al.	July 5, 1932
1,984,736	Garoutte	Dec. 18, 1934
2,061,079	Lacoe	Nov. 17, 1936
2,143,906	Angus	Jan. 17, 1939
2,182,816	Moffett	Dec. 12, 1939

FOREIGN PATENTS

Number	Country	Date
593,677	Germany	Mar. 3, 1934