March 2, 1948. L. W. GILBERT 2,437,023

AUTOMATIC STARTING SWITCH

Filed Oct. 13, 1931

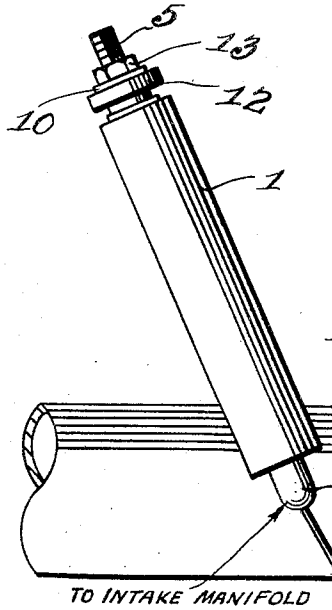



Fig. 2

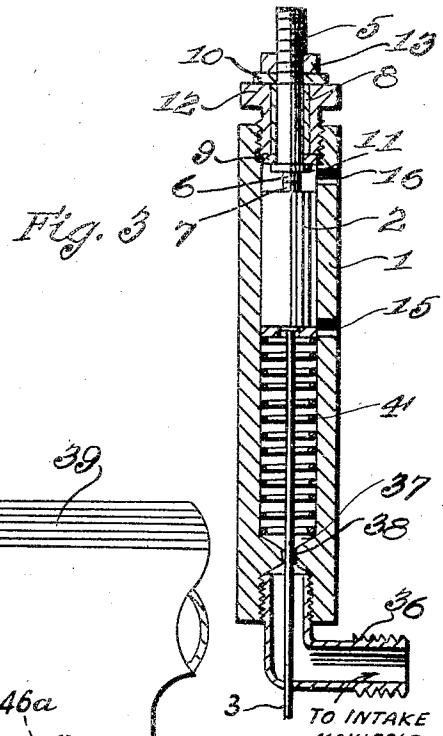



Fig. 3

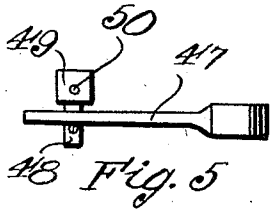



Fig. 5

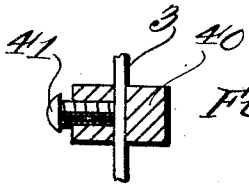



Fig. 4

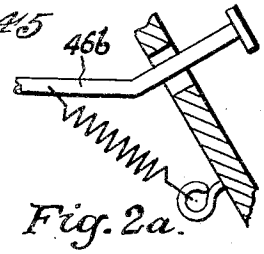



Fig. 2a.

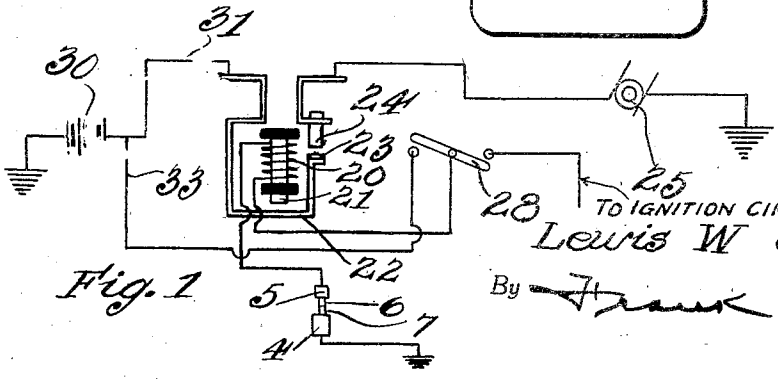



Fig. 1

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## AUTOMATIC STARTING SWITCH

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Application October 13, 1931, Serial No. 568,572

18 Claims. (Cl. 123—179)

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The object of this invention is to provide means for completing a circuit through the self starting motor of an internal combustion engine on the turning of the ignition key, and breaking the circuit after the motor starts.

A further object is to provide for automatically closing this circuit again when the engine stalls.

A further object is to provide an automatic switch connected to the suction of the manifold, which switch is a circuit closing device, which acts to complete the circuit through the magnetic switch or relay and a magnetic switch in combination, the automatic switch being on the self starter when starting the engine, thereby eliminating the floor switch that heretofore has been operated by the foot. This automatic switch automatically opens this circuit through the magnetic switch and through the motor circuit when the engine is running, the movement to open position being due to the suction in the intake manifold, the switch being held in open position by that suction.

Another object is to warn the driver of the danger of unduly taxing the battery if he leaves the ignition switch closed when the car is at rest, sufficient noise being made thereby in cranking the engine to attract the driver's attention.

Another object of the invention is to prevent the closing of the switch of the self starter when the throttle valve is open.

These and other objects of my invention will be illustrated in the drawings, described in the specification and pointed out in the claims at the end thereof.

In the drawings:

Figure 1 is a diagrammatic view of the circuit with which my invention is used.

Figure 2 is a side elevation of the carburetor and intake manifold, partly broken away, with my automatic switch mounted thereon.

Figure 2a is a detail view of the floor board of an automobile, partly broken away, and showing the extension of the accelerator rod and pedal.

Figure 3 is a longitudinal section through the automatic switch.

Figure 4 is a sectional view through the lower collar shown on Figure 2.

Figure 5 is a top plan view showing the arm of the butterfly valve of the carburetor and the collar mounted on said arm.

In the drawings, like reference numerals indicate like parts.

The invention herein described is an improvement on that shown in my prior Patent 1,635,078, issued July 5, 1927, to which reference is made.

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In the drawings, reference numeral 1 indicates an elongated cylinder having a piston 2 mounted to slide therein. In the lower part of the cylinder is a helical spring 4 which normally holds the piston in raised position, that is, in a position where it makes contact with the insulated screw 5 holding together the tungsten points 6 and 7, through which a circuit is formed. The piston has a rod 3 connected thereto which moves up and down or to and fro with it.

This rod makes a loose connection with the throttle valve by which the closing of the contacts 6 and 7 is prevented while the throttle valve is open, as will presently be described.

The screw 5 is inclosed in an insulating sleeve 8, which sleeve is inclosed between insulating washers 9 and 10. The screw 5 is provided with a flange 11 on the bottom thereof, by which its upward movement is limited. The screw 5 passes through a screw plug 12, which is threaded in the upper end of the cylinder 1, and by which the assembly is held in place therein, and in which it can be adjusted up and down. A nut 13 is provided on the screw 5, by which it is clamped in place.

In the side of the cylinder is provided a port opening 15 which is half closed by the lower end of the piston when the piston is in its normally raised position. The piston 2 can be accurately stopped with reference to this port opening by turning the screw plug 12 up or down. The object of this port opening is to permit air to pass therethrough and down through the cylinder into the manifold without moving the piston when the engine is at rest and when the engine is being turned over at cranking speed. A port 16 is provided above the piston to permit air to enter and leave the cylinder as the piston moves down or up.

As soon as the engine is turning on its own power, or above cranking speed, the suction in the manifold is sufficient to draw the piston 2 down and close the port 15. This breaks the circuit through the contacts 6 and 7, it being understood that the contact 7 is grounded on the piston 2 and the piston 2 is grounded on the cylinder 1, which in turn is grounded on the manifold and the frame of the car. It will also be understood that the contact 6 is directly connected to the screw 5, which is in circuit with the magnetic coil or relay 20, which energizes an iron core 21 and attracts the resilient armature 22. This armature carries a contact 23 and

moves the contact into contact with the contact 24, which is in series with the starting motor 25. The circuit of the magnetic coil or relay 20 is controlled by the ignition switch 28, which is turned by the key which locks and unlocks the car. The current flows from the battery 30, through the lead 31, and armature 22, etc. as above described, to the starting motor 25, which cranks the engine. The current also flows from the battery 30 through the lead 33 and the ignition switch 28 through the magnetic coil 20, screw 5, and contacts 6 and 7.

On the bottom of the cylinder 1, is an elbow 36, one end of which is threaded into or connected to the intake manifold of the engine, and the other end of which is threaded into the lower end of the cylinder 1. The lower end of the cylinder 1 is choked, as indicated at 37, to form a base on which the spring 4 can rest, and to restrict the opening that connects the cylinder 1 with the elbow 36 and manifold 39. It will be understood that the opening 38 and the opening 15 should be approximately of the same size, and that both openings should be small, as the small openings make the movement of the piston less sensitive at cranking speed and makes it easy to adjust the normal position of the piston with reference to the opening 15.

The rod or stem 3 is ordinarily made of wire and carries on its lower end a fixed collar or stop 40, which is fastened thereon by the set screw 41. This collar moves up and down with the rod 3 and piston 2. The rod or wire 3 is somewhat flexible and is rigidly fastened to the piston 2, so that it moves with it.

In the carburetor is provided the usual butterfly valve 45, mounted to turn with a shaft 46 which passes through the carburetor. On one end of this shaft is keyed an arm 46*a*, shown in dotted lines. To the arm 46*a* is connected one end of the rod 46*b*. The other end carries the accelerator pedal, not shown, by which the valve is operated. This is the ordinary construction of the carburetor and accelerator rod.

On the other end of the shaft 46 is keyed an arm 47. Both of these arms are outside of the carburetor. On the arm 47 is provided a pin 48, having a head or sleeve 49 swiveled thereon. This sleeve has a hole 50 therein through which the rod 3 can move freely with a sliding motion. The sleeve 49 can slide on this rod when the rod is stationary.

The fixed collar 40 will normally be spaced from the sliding sleeve 49 a short distance, so that the butterfly valve in the carburetor can be moved a short distance by either the accelerator rod and pedal or by hand to open the intake to give it sufficient gas for all practical starting purposes, without moving the piston 2 from its normal position and without opening the contacts 6 and 7 in starting circuit. Before starting, the contacts 6 and 7 are normally held together by the spring 4 in the position shown in Figure 3 and the valve 45 is in the position shown in Figure 2.

Two circuits 20 and 31 are provided, for reasons that will now be explained. These circuits draw from the same battery with the same voltage. To crank the motor several hundred amperes must be drawn from the battery. Because such a heavy current is needed, the battery and the starting motor must be placed close together and connected with heavy conductors, which should be as short as possible to reduce the electrical resistance. The general practice in car construction is to place the intake manifold and carburetor on one side of the engine and the battery and the starting motor on the other side. If only one circuit is provided, the solenoid or magnetic switch would be unnecessary and the heavy starting current would have to pass through the contacts 6 and 7 on one side of the engine and through the starting motor and battery on the other side of the engine. This would give an exceedingly long circuit with considerable resistance through which the heavy current would have to pass.

The solenoid switch is used to close the short circuit through which the heavy current passes, and must be placed close to the battery and starting motor. It can be operated from the vacuum control switch 6 and 7 on the other side of the engine by a long circuit carrying only a few amperes of current.

In starting, it will be understood that the driver merely turns the key in the lock on the dashboard. This closes the circuit 20, which has high resistance, and can be long, and carries only a small current of a few amperes in contrast with the circuit 31, which has low resistance and carries a heavy current of several hundred amperes. The circuit 20 magnetizes the core 21, which in turn draws up the armature 22 and closes the contacts 23 and 24, which are part of the low resistance circuit and carries the heavy current to the starting motor. It is desirable that the vacuum switch shown in Figure 3 be placed directly in connection with the intake manifold 39, so that the vacuum in the intake manifold has the best effect in drawing down the piston 2 and overcoming the force of the spring 4. The rod 3 must also be connected to the accelerator rod so that the spring 4 can not close the contacts 6 and 7 as long as the accelerator pedal is depressed.

The contacts 6 and 7 are normally closed as shown in Figure 3 and will be held closed by the spring 4 while the engine is being cranked, for until the engine operates on its own power the vacuum of the intake manifold caused by cranking the engine will be only a few inches of mercury, which is not sufficient to overcome the force of the spring 4. As soon as the engine fires this vacuum increases to 12 inches or more, which overcomes the force of the spring and pulls down the piston 2.

As long as the contacts 6 and 7 are closed the solenoid 20 and 21 is energized by this circuit and holds the contacts 23 and 24 closed, which causes the starting motor to crank the engine. As soon as the engine fires and is driven on its own power it develops a vacuum in the intake manifold sufficient to pull down the piston 2 opening the circuit 20 so that it no longer attracts the armature 22, and then the armature springs away from the core 21, pulling the contact 23 away from the contact 24, cutting out the starting motor and allowing the engine to run independently thereof on its own power.

When the vacuum in the intake manifold pulls down the piston 2, the piston in turn pushes down on the rod 3 and moves the collar 40 down away from the sleeve 49, and the rod and piston remain in this position while the engine is running. If the driver then steps on the accelerator or moves the hand throttle, he moves the accelerator rod 46*b*, which in turn swings the crank 46*a* and moves the butterfly valve 45 in the carburetor, which valve is carried on the shaft 46. The arm 47 carries the sleeve 49, which swings

down when the driver steps on the accelerator pedal, the sleeve **49** merely traveling along the wire idly. When the engine stalls and the vacuum in the manifold **39** is destroyed, the piston **2** is moved up by the spring **4** and closes the contacts **6** and **7**, unless the rod **3** and collar **40** is otherwise held down by the sleeve **49** and the accelerator rod **46***b*. As soon as the driver takes his foot off the accelerator pedal the parts resume their positions shown in Figures 2 and 3, so that the throttle valve **45** is closed or nearly closed and the contacts **6** and **7** are closed. This causes the contacts **23** and **24** to close at once and starts the cranking of the engine over again, as explained above.

A small space is left between the fixed collar **40** and the sliding sleeve **49** when the throttle **45** is closed, so that the throttle **45** can be opened far enough to permit the engine to be started by the starting motor and without moving the collar **40**, which will remain stationary while the ignition switch is closed and before the contact **7** is pulled away from the contact **6** by the vacuum caused by the engine working on its own power. When the contact **7** moves down, the rod **3** and the fixed collar **40** will move down with it. The starting of the engine on its own power will create the vacuum that will move the contact **7** down and will hold it down as long as the strength of the vacuum exceeds the strength or pressure of the spring **4**. When the contact **7** moves down, this will open the circuit and make the starting motor idle if it has been active previously in cranking the engine. When the accelerator is depressed far enough, it will of itself cause the contact **7** to be moved away from the contact **6** because the sleeve **49** will bear against the fixed collar **40** and draw the collar **40**, rod **3**, piston **2**, contact **7** down with it and compress the spring **4** as long as the accelerator is depressed. While the parts are in this position the circuit will be open and the starter will be idle. As soon as the contacts **6** and **7** close again, the cranking of the engine by the electric starter will begin. After the engine has started on its own power, it creates a vacuum in the intake manifold, and this vacuum pulls down the piston **2**, and pulls the contact **7** away from the contact, cutting off the self-starter. Then the driver can step on the accelerator pedal, and open the throttle valve **45** wide without disturbing the starting motor, which will be idle. Until the engine starts on its own power, the throttle valve should be kept nearly closed, so as to produce a high vacuum. Any appreciable use of the accelerator after the engine fires will reduce the vacuum in the intake manifold so that the spring can move the contact **7** up to the contact **6**, but as long as the accelerator is depressed, the sleeve **49** will hold down the fixed collar **40** mechanically and keep the contacts apart, preventing the unnecessary operation of the starting motor.

It will also be understood that if the car is climbing a hill and the throttle valve **45** is opened wide, the vacuum in the intake manifold will drop and in the absence of the collar **40** and sleeve **49** restrained by the accelerator rod, the piston **2** would be moved up by the spring **4**, closing the contacts **6** and **7**, which is not desirable because it would start the self-starter while the engine is running. To prevent this, the arm **47** which is down when the throttle is open pushes the sleeve **49** down against the fixed collar **40** and holds it down, and thereby holds the piston **2**



down and compresses the spring and thus holds the contact **7** away from the contact **6**.

If the throttle is suddenly opened to racing position when the engine is running idle, the vacuum in the intake manifold will also drop suddenly, permitting the piston **2** to close the contacts **6** and **7** except for the restraint provided in the arm **47** and collar **40** and sleeve **49**, as above explained.

The operation of this invention may be pointed out as follows: In the standard automobiles as made before the filing of this application (and without this invention) there are four foot pedals. These pedals control the brake, the clutch, the accelerator, and the starter. The operator has but two feet with which to operate them. If the engine stalls while the car is going uphill, the driver must keep one foot on the brake pedal to keep the car from going back downhill while he keeps the other foot on the starter pedal trying to start the engine. With the two feet thus engaged he cannot operate either the clutch or the accelerator, and yet the clutch must be released in order to crank the engine. This device, with is electrical connections and vacuum control, automatically throws in the switch to start the starter as soon as the vacuum in the intake manifold drops, and as soon as the driver takes his foot from the accelerator pedal, permitting the operator to use both feet for the brake and clutch pedals, it being understood that the starting pedal can be omitted. The mechanical connection between the switch and the accelerator pedal prevents the device from starting the starter as long as the accelerator pedal is depressed beyond a certain point. This device will cause the starter to automatically spring into action when the engine stops, as soon as the driver releases the accelerator pedal, and will prevent the starter from operating when the accelerator pedal is pushed down; that is to say, when the engine stops and the vacuum drops the driver can start the engine again by simply releasing the accelerator pedal, upon which the spring will close the contacts **6** and **7**, and the driver will prevent the starter from operating as long as he keeps his foot on the accelerator pedal because this compresses the spring **4** and holds the points **6** and **7** apart. The engine will keep the starter from operating as long as it produces a vacuum in the intake manifold that is stronger than the spring.

It will also be understood that while I have described the movement of the piston **2** as being up or down, this is merely relative, as the cylinder **1** can be placed in any position other than vertical, and the piston will work with the same effect as when the cylinder is placed in vertical position.

I claim:

1. In an electric starter system for an internal combustion engine, pressure and vacuum responsive switch means, means connected to the pressure and vacuum responsive switch means to provide unbalanced pressure therein whereby said switch may be opened, and means connected to the vacuum and pressure responsive device to open said switch mechanically by the accelerator rod independent of said unbalanced pressure.

2. A vacuum controlled starter switch for internal combustion engines comprising a switch, a cylinder having a fixed contact and a piston therein carrying a contact thereon, said piston being moved in one direction by the vacuum of

the intake manifold to open the switch, a spring for moving said piston in the other direction to close the switch, a wire connected to said piston, a valve in the carburetor, an accelerator rod for opening and closing the valve, said wire being connected to the accelerator rod by which the piston and switch are held open while the accelerator rod holds the valve open.

3. A vacuum controlled starter switch for internal combustion engines comprising a switch, a cylinder having a fixed contact and a piston therein carrying a contact thereon, said piston being moved in one direction by the vacuum of the intake manifold to open the switch, a spring for moving said piston in the other direction to close the switch, a wire connected to said piston, a valve in the carburetor, an accelerator rod for opening and closing the valve, said wire being connected to the accelerator rod by which the piston and switch are held open while the accelerator rod holds the valve open, said wire having a loose connection with said accelerator rod which permits the valve to be partially opened without moving the piston to open the switch.

4. A vacuum controlled starter switch for internal combustion engines, comprising the combination of a cylinder, an electrical contact fixed in one end thereof, a piston in said cylinder carrying a contact thereon, said piston being moved in one direction by the vacuum of the intake manifold away from said contact to open the switch, a spring for moving said piston in the other direction to close the switch, a wire connected to said piston and extending outside of the cylinder, an accelerator rod, a valve in the carburetor moved thereby, connections between said accelerator rod and said wire by which the piston and switch are held open while the accelerator rod holds the valve open.

5. A vacuum controlled starter switch for internal combustion engines, comprising a cylinder with an electrical contact fixed in one end thereof and insulated therefrom, a piston moving in said cylinder making contact with the fixed contact mounted in the cylinder, said piston being moved in one direction by the vacuum of the intake manifold to separate the contacts, a spring in said cylinder for moving said piston in the other direction to close the contacts, a wire connected to said piston and extending outside of the cylinder, an accelerator rod, a valve in the carburetor moved thereby, connections between said accelerator rod and said wire by which the piston and switch are held open while the accelerator rod holds the valve open.

6. A vacuum controlled starter switch for internal combustion engines, comprising a switch, a cylinder connected with the intake manifold of the engine said cylinder having a fixed contact at one end thereof and insulated therefrom, a piston therein carrying a contact thereon, said piston being moved in one direction by the vacuum of the intake manifold to open the switch, a spring for moving said piston in the other direction to close the switch, a wire connected to said piston and moving therewith, a collar fastened on said wire, a sleeve sliding on said wire, an accelerator rod, connections between said sleeve and said accelerator rod by which the sleeve is moved down against the collar on the initial movement of the rod without opening the switch and by which the sleeve, collar, wire and piston are moved down together on the further movement of the accelerator rod to open the switch.



7. A vacuum controlled starter switch for internal combustion engines, comprising a switch, a cylinder connecting with the intake manifold of the engine said cylinder having a fixed contact at one end thereof and insulated therefrom, a piston therein carrying a contact thereon, said piston being moved in one direction by the vacuum of the intake manifold to open the switch, a spring for moving the piston in the other direction to close the switch, a circuit in which said switch is included, a solenoid in said circuit, a second circuit closed by said solenoid, a motor in said second circuit for cranking the engine, said motor operating only when both circuits are closed, an accelerator pedal and means connecting the accelerator pedal with the piston and switch for holding the switch open when the accelerator pedal is depressed, thereby preventing the operation of the motor to crank the engine.

8. In an automobile, the combination of an engine, fuel intake, a throttle therein capable of being positioned to furnish an idling fuel supply, and an accelerator pedal in control of the throttle, a cranking motor, control circuit and switch therein, means to hold it closed after the throttle has been partially opened by the pedal, and a piston moved by the vacuum created by the operation of the engine for de-energizing said circuit in immediate response to self-operation of the engine and prior to the return of the said pedal to throttle closing position, whereby the increased fuel supply is automatically continued after the termination of the cranking of the engine, a connection between the piston and the accelerator pedal for holding the piston in switch-open position while the throttle remains open.

9. A starter switch for internal combustion engines comprising a circuit opening and closing means, pressure responsive means connected with the circuit opening and closing means for operating said circuit opening and closing means, an accelerator pedal and control means for said pressure-responsive means operatively connected with said accelerator pedal for controlling said pressure-responsive means to hold the circuit opening and closing means in circuit opening condition said control means operating in line with the movement of the circuit opening and closing means.

10. A starter switch for internal combustion engines comprising a circuit opening and closing means, pressure responsive means moved in one direction by the vacuum of the intake manifold to open the circuit opening and closing means, a spring for moving said pressure responsive means in the other direction to close the circuit opening and closing means, an accelerator pedal and means connecting the accelerator pedal with the circuit opening and closing means for holding the opening and closing means open when the accelerator pedal is pressed down said connecting means operating in line with the movement of the circuit opening and closing means.

11. A starter switch for internal combustion engines comprising a circuit opening and closing means, pressure responsive means moved in one direction by the vacuum of the intake manifold to open the circuit opening and closing means, a spring for moving said pressure responsive means in the other direction to close the circuit opening and closing means, an accelerator pedal

and means connecting the accelerator pedal with the circuit opening and closing means for pulling the circuit opening and closing means open and holding it open when the accelerator pedal is pressed down.

12. In an electric starter system for an internal combustion engine having an intake manifold, a throttle, and an accelerator rod, a switch having a movable member and a fixed member, the movable member being normally held in contact with the fixed member and being moved out of contact by a vacuum, means connected to the intake manifold to operate said movable member by a vacuum, and means connected to the engine throttle and accelerator rod to move said movable member mechanically out of contact independent of its operation by a vacuum.

13. A starter switch for an internal combustion engine comprising a circuit opening and closing means having a fixed contact and a moving contact, a spring for normally holding the moving contact in the same plane with the fixed contact, a pressure responsive means connected with the circuit opening and closing means, an accelerator pedal and means connecting the moving contact directly with the accelerator pedal by which the accelerator pedal can move directly the moving contact of the circuit opening and closing means.

14. A starter switch for an internal combustion engine comprising a circuit opening and closing means having a fixed contact and a moving contact, a spring for normally holding the moving contact in the same plane with the fixed contact, a pressure responsive means connected with the circuit opening and closing means, an accelerator pedal and means connecting the moving contact directly with the accelerator pedal by which the accelerator pedal can move directly the moving contact of the circuit opening and closing means, to open the circuit and hold the circuit opening and closing means in circuit opening condition.

15. A starter switch for an internal combustion engine comprising a circuit opening and closing means having a fixed contact and a moving contact, a spring for normally holding the moving contact in the same plane with the fixed contact, a pressure responsive means connected with the circuit opening and closing means, an accelerator pedal and means connecting the moving contact directly with the accelerator pedal by which the accelerator pedal can move directly the moving contact of the circuit opening and closing means and hold the moving contact of the circuit opening and closing means in circuit opening condition.

16. A starter switch for an internal combustion engine comprising a circuit opening and



closing means having a fixed contact and a moving contact, a spring for normally holding the moving contact in the same plane with the fixed contact, a pressure responsive means connected with the circuit opening and closing means, that varies the pressure between the contacts, an accelerator pedal and means connected to the accelerator pedal for directly opening the circuit opening and closing means by and with the pedal by which the accelerator pedal can directly move the circuit opening and closing means.

17. A starter switch for an internal combustion engine comprising a circuit opening and closing means having contacts, pressure responsive means connected with the circuit opening and closing means said pressure responsive means being adapted to vary the pressure between the contacts, an accelerator pedal and means connected with the accelerator pedal by which the accelerator pedal can move the circuit opening and closing means to open the circuit and hold the circuit opening and closing means in circuit opening condition.

18. A starter switch for internal combustion engine comprising a circuit opening and closing means, pressure responsive means connected with the circuit opening and closing means by which the movement of the circuit opening and closing means is controlled, an accelerator pedal and means connecting the accelerator pedal directly with the circuit opening and closing means by which the circuit opening and closing means is moved by and with the pedal and through which the accelerator pedal can hold the circuit opening and closing means in circuit opening condition.

LEWIS W. GILBERT.


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