

Sept. 1, 1936.

C. E. MARKHAM

2,053,094

AUTOMATIC STARTING DEVICE

Filed Nov. 13, 1935

2 Sheets-Sheet 1

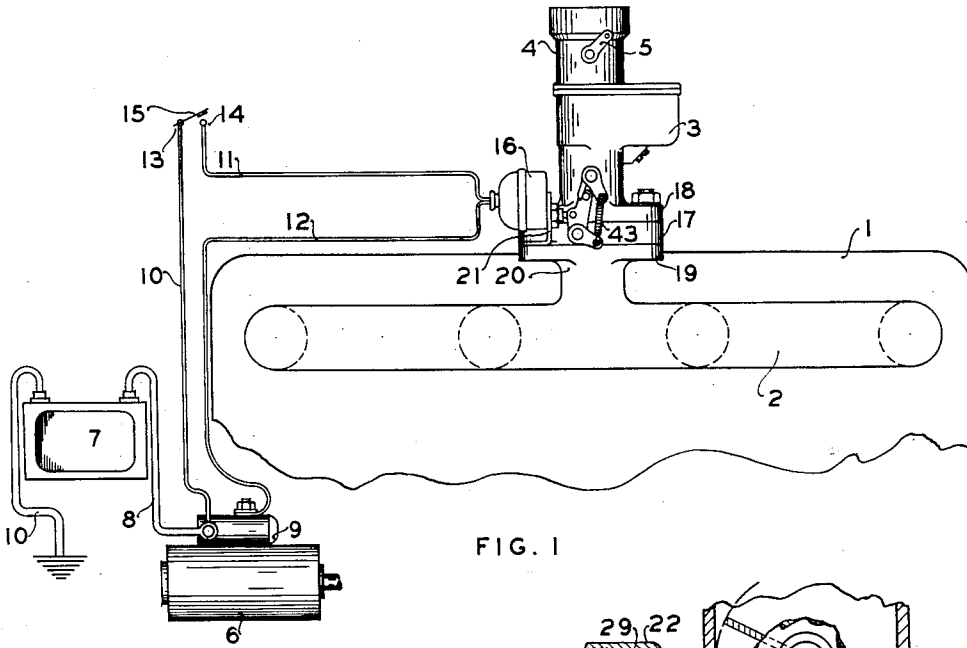


FIG. 1

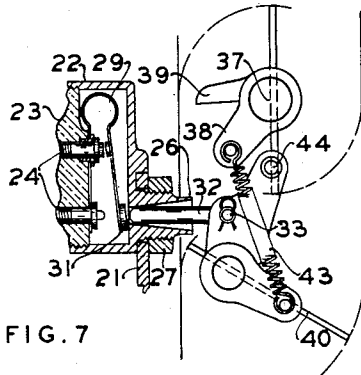


FIG. 7

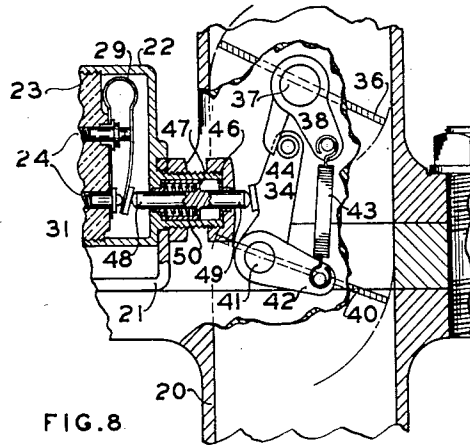


FIG. 8

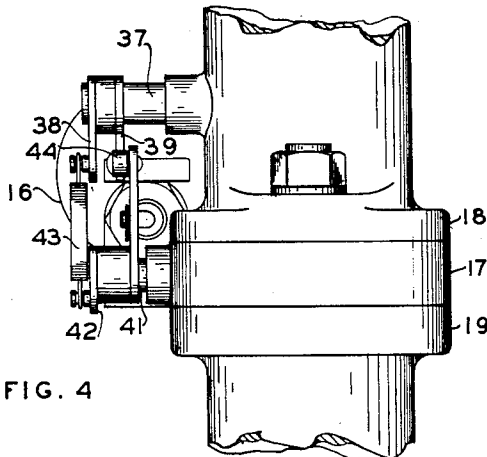


FIG. 4

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2 Sheets-Sheet 2

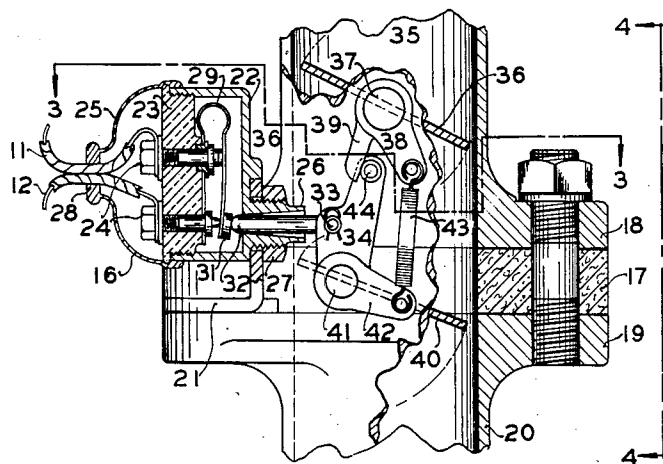


FIG. 2

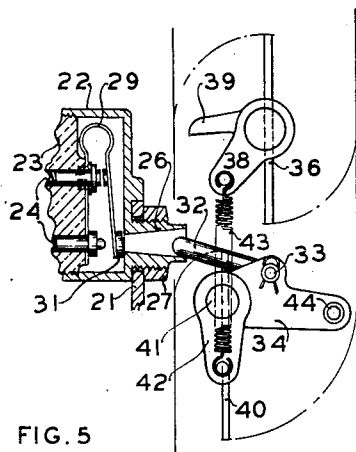


FIG. 5

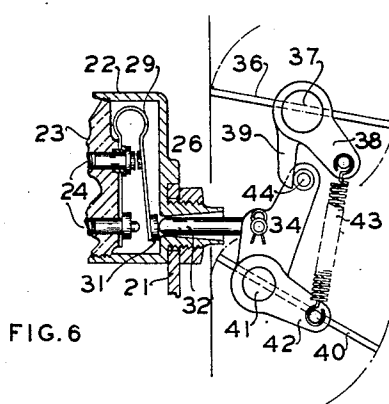


FIG. 6

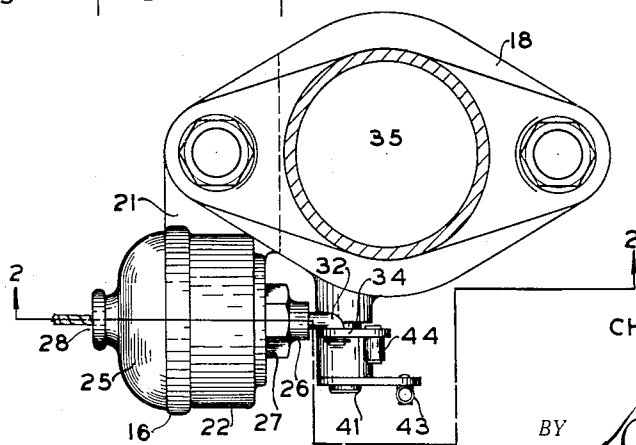


FIG. 3

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2,053,094

AUTOMATIC STARTING DEVICE

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Application November 13, 1935, Serial No. 49,459

16 Claims. (Cl. 123—179)

This invention relates to starting means for internal combustion engines and consists in a device particularly adapted for automatically starting automobile engines, more specifically the invention is an improvement of the device shown in a copending application, Serial No. 48,815 filed November 8th, 1935, in the name of G. R. Ericson.

These devices include means for energizing a "self starter" motor for an internal combustion engine, said means comprising a starter controlling circuit (whether connected direct or through a relay) controlled by a manual switch, conveniently the usual key or lever operated engine ignition switch, and an automatic switch device including a flow responsive means inside the fuel intake conduit and arranged to open the automatic switch when the engine starts to run under its own power.

The present invention has substantially the same general objects as expressed in said copending application, including the provision of a device which insures energizing of the starter circuit when the ignition key is turned on, provided that there is no such flow in the fuel intake passage as would be caused by the operation of the engine under its own power, and provided that the throttle be at least partly open. It is, of course, necessary that the device shall function positively and rapidly to open the starter circuit as soon as the engine starts to run under its own power. An incidental object is to provide a device of the above type including spring means for urging a flow responsive switch actuating element towards its switch closing position, the force exerted by said spring means being at least in part dependent upon the position of the throttle valve.

Another object is to provide a flow responsive switch actuating device which is relatively more sensitive to flow in the fuel intake passage when the throttle is open than when the throttle is closed.

Another object is to positively prevent closing of the automatic switch device when the throttle is closed or very nearly so.

Still another object is to provide simple means for mounting an automatic device of the above type in intimate association with the fuel intake conduit between the engine proper and the carburetor, said device embodying means for resisting transmission of heat along the conduit from the engine to the carburetor.

These objects and other more detailed objects hereafter appearing are attained substantially

by the structure illustrated in the accompanying drawings, in which:

Figure 1 is a side view showing a portion of an automobile engine and equipment.

Figure 2 is a side view and vertical section taken on the line 2—2 of Figure 3, portions being broken away for clearer illustration.

Figure 3 is a top view and horizontal section taken substantially on the broken line 3—3 of Figure 2, certain parts being omitted.

Figure 4 is a partial side view taken at 90° to Figure 2.

Figures 5, 6 and 7 are detail views similar to Figure 2 but showing the operating parts in different positions, and with certain portions being illustrated diagrammatically.

Figure 8 is a view similar to Figures 5, 6 and 7, but showing a modification.

Figure 1 illustrates a portion of an automobile engine 1, having an intake manifold 2 upon which is mounted a carburetor of any suitable design indicated generally at 3. The carburetor may include an air horn 4, having a choke valve (not shown) which may be manually operated by means of the crank 5 and a connection with the dash (not shown) or which may be automatic. It should be noted that while this invention is shown as applied between the carburetor and the intake manifold, it may also be located in the air inlet anterior to the carburetor if desired, or even in the exhaust.

Suitably mounted adjacent the engine are a self-starter motor 6 and a storage battery 7, the motor and battery being connected together through the heavy wire or cable 8, a solenoid or other type of magnetic switch 9, and ground connections as at 10. Connected with the coils of the magnetic switch 9 is an auxiliary circuit including wires 10, 11 and 12. The wires 10 and 11 are connected to the terminals 13 and 14 of a manual switch 15, which, conveniently, may be the usual ignition switch or lever, and the wires 11 and 12 are connected to the terminals of an automatic switch device 16 (see Figure 2).

A collar member 17 formed of heat resisting material such as bakelite or a compressed asbestos substance, is bolted between the opposing flanges 18 and 19 on the carburetor and the riser portion 20 of the intake manifold, respectively. Formed as a rigid part of collar member 17 is a laterally and upwardly extending bracket 21 which mounts the automatic switch device generally indicated at 16. The switch device comprises a housing 22, a backing 23 of insulating material, switch terminals 24, and a cover 25.

Projecting rearwardly from housing 22 is a tubular element 26 extending through an aperture in the upstanding portion of bracket 21 and threaded for receiving a nut 27, securing the switch device to the bracket.

At the center of the cover 25 is an outlet portion 28 receiving the wires 11 and 12 of the auxiliary circuit. A spring contact element 29 of hair pin shape has one leg secured to the rear portions of switch terminals 24 and has abutments 30 and 31 on its free leg. The portion of element 29 secured to the backing member 23 makes electrical contact with the lower terminal 24 (Figure 3) and is insulated from the upper terminal. Slidably received in the tubular portion 26 is a switch actuating reach pin 32 which at one end engages the abutment 31 on element 29 and at the other end has a right angle offset pivoted at 33 to an arm or crank 34.

Mounted inside the mixing chamber portion 35 of the carburetor rigid with pin 37 pivoted in the wall of chamber 35 is a throttle valve 36, a crank or lever 38 and dog 39 on the outside of chamber member 35, are rigid with one end of pin 37 and form a bell crank. Mounted in the intake conduit posterior to the throttle valve, although not necessarily so, is an unbalanced butterfly valve 40 having a shaft 41 rigid therewith and pivoted in the collar member 17. Crank arm 34 and arm 42 constitute a bell crank formed rigid with the end of pin 41 adjacent the lever 38 and dog 39. A tension spring 43 connects the extremities of lever 38 and 42. Crank 34 at its upper extremity has an offset finger 44 for cooperating with the dog 39.

The operation of the device is as follows:

Spring 43 extending between the levers 38 and 42, normally urges the bell crank formed by arms 42 and 34 in a counter-clockwise direction and through reach pin 32 urges the free portion of switch element 29 against the terminals 24 so as to electrically connect the auxiliary circuit wires 11 and 12 (Figure 2). In this position of the parts all that is necessary to energize the starter motor 6 is to close the manual switch 15, which closes the magnetic switch device 9 and completes the starter primary circuit in a manner well known in the art, and slightly depress the throttle pedal. As soon as the engine starts to run under its own power, suction created in the intake manifold and the conduit members 20 and 35 will cause the unbalanced valve 40 to rotate in a clockwise direction withdrawing the reach pin 32 from switch abutment 31 and permitting opening of the switch due to the inherent resistance of the hair pin element 29. In case the engine stalls while the manual switch remains closed, the absence of flow in the intake conduit will permit the spring 43 to move valve 40 and crank arms 34 and 42 in a counter-clockwise direction, again causing the automatic switch device to close without further operation of the switch 15 or the throttle.

Figures 5, 6 and 7 diagrammatically illustrate the operative parts of the automatic switch device in various positions and, particularly show the means for preventing closing of the automatic switch while the engine is running, which would endanger the engine and starter gears.

Figure 5 illustrates a condition in which the throttle valve is wide open and the engine is running at a rapid rate. The substantial flow of mixed fuel and air in the intake conduit holds the unbalanced valve 40 in a position substantially aligned with the axis of the conduit where-

by this valve constitutes a minimum restriction in the conduit.

Figure 6 illustrates the throttle valve in the closed position, as for idling in which case the flow in the intake conduit is substantially reduced. The dog 39 engages crank arm 34, in this case, to positively prevent closing of the automatic switch. Thus it is apparent that the auxiliary circuit cannot be closed through the automatic switch device when the throttle valve is closed as in Figure 6, or as long as dog 39 interferes with finger 44, Figure 2 showing the position of the parts when the throttle is only partly open as in starting. This is a desirable condition since it necessitates opening the throttle valve to a substantial degree before the starter can be operated.

Figure 7 illustrates the position of the parts under flow conditions in the intake conduit, produced when the throttle valve is fully open and the piston speed is relatively slow due to a heavy load on the engine. It is characteristic of springs, such as the coil spring 43, that the force exerted thereby increases as the spring is stretched. In order to avoid a substantial part of such additional resistance to movement of the valve 40 in the clockwise direction, due to elongation of spring 43, the spring, at its upper end, is secured eccentrically to the throttle valve through crank 38. As the throttle valve opens the upper end of spring 43 is lowered reducing the tension on the spring relative to a given position of valve 40 and facilitating the opening of valve 40 by the intake flow. This reduction of the force exerted by the spring 43 is important, since when the throttle valve is fully opened, dog 39 is out of position to limit the movement of crank arm 34 and pin 32 in the switch closing direction.

Figure 2 illustrates the throttle valve partly open as in starting, the unbalanced valve 40 being closed as far as possible and the auxiliary switch device being held closed thereby. The spring 43 is substantially shorter in this position and thus exerts less force upon valve 40 in opposition to the intake flow than when the valve 40 is open. When the engine starts to run under its own power the valve 40 is immediately rotated clockwise so as to open the automatic switch and deenergize the starter. The action of spring 43 on the unbalanced valve 40 is preferably not sufficiently strong to offer substantial resistance to the draft in the intake conduit while the engine is running.

Figure 8 illustrates a modified form of the invention embodying means for stabilizing the flow controlled switch device. Pivotally mounted inside the intake conduit are the throttle valve 36 and unbalanced switch controlling valve 40 connected together by coil spring 43, and cranks 38 and 42. The switch housing 22 includes a rearwardly extending chambered portion 46 receiving a piston 47. The left hand portion 48 of the piston stem extends adjacent abutment 31 on resilient switch contact element 29. The right hand portion 49 of the piston stem abuts crank arm 34.

The piston is constantly urged to the right by a coil spring 50 within chamber 46. Piston 47 and chamber 46 function as a dash pot arrangement to retard both opening and closing movements of the free leg of control element 29. Thus fluttering or momentary movements of unbalanced valve 40 are not transmitted to the switch and a stable condition of the switch is assured

particularly under minimum flow conditions in the intake conduit, as when the engine is being cranked or is idling or laboring under a heavy pull. Preferably, the dash pot action is provided during movement of the piston in both directions but this may be limited to either the switch opening or closing movements.

The device is arranged to positively energize the starter auxiliary circuit when the manual switch 15 is turned on and the throttle pedal depressed and also functions effectively to prevent reenergizing of the starter circuit under practical operating conditions of the engine. In case of stalling, the operator need merely hold the throttle partly open to insure re-starting.

The strength of spring 43, the eccentricity of pivot pin 41 and the relationship between dog 39 and its cooperating element 44 in practice, are properly adjusted to accomplish to best advantage the purposes and functions as expressed above.

While the carburetor illustrated is of the downdraft type, this is not essential and any suitable carburetor may be utilized. The automatic switch device conveniently controls an auxiliary circuit due to the high amperage of the current drawn through the starter primary. It will be understood that the particular wiring arrangement of the starter circuit is likewise variable. Also it may be possible to actuate an engine auxiliary other than a "self starter" motor by the automatic actuating means illustrated, and such use is contemplated.

I claim:

1. A starter control device comprising a conduit, a flow control valve mounted in said conduit, a flow responsive device mounted in said conduit, a switch, and means for operating said switch in response to movements of said control valve and said flow responsive device.

2. A starter control device comprising a conduit, a flow control valve for said conduit, a flow responsive device mounted in said conduit, a control switch, connections between said flow responsive device and said control switch, and means for limiting the action of said control switch when said flow control valve is in a predetermined position.

3. In a device of the class described, means forming a conduit, a flow control valve for said conduit, a flow responsive device in said conduit, spring connections between said flow control valve and said flow responsive device, a control switch, and an operating connection between said flow responsive device and said control switch.

4. In combination, an internal combustion engine intake conduit, a throttle valve therein, an actuating element for an engine auxiliary, a flow responsive device in said conduit and operatively associated with said element, and spring means associated with said throttle valve and said device for urging said device towards a predetermined position, the force exerted by said means being dependent at least in part upon the position of said valve.

5. In a device of the class described, an internal combustion engine intake conduit, a throttle valve therein, a flow responsive element in said conduit, an electric circuit controlling switch operatively connected to said element, and spring means connecting said element and said valve for urging said element towards its switch closing position.

6. The combination of elements specified in claim 2 in which said throttle valve is provided with a shaft extending through the wall of said

conduit and said spring means is secured to a lever mounted on said shaft.

7. The combination of elements specified in claim 2, and further including an element for resisting closing of said switch when said throttle valve is substantially closed.

8. In a device of the class described, an internal combustion engine intake conduit, a throttle valve therein, an electric circuit controlling switch, a flow responsive valve in said conduit, an operative connection between said flow responsive valve and said switch, and spring means connecting said valves and secured eccentrically thereto.

9. In a device of the class described, an internal combustion engine intake conduit, a throttle valve therein, an electric circuit controlling switch, an unbalanced pivoted valve in said conduit, an operating connection between said unbalanced valve and said switch, said valves each having a shaft extending through the wall of said conduit, levers on said shafts outside said conduit, and spring means connecting said levers, whereby said spring means urges said unbalanced valve towards its switch closing position and the force exerted by said spring means is dependent upon the position of said throttle valve.

10. In a device of the class described, an internal combustion engine intake conduit, a pair of valves in said conduit and spaced longitudinally thereof, one of said valves being a throttle and the other being unbalanced, an electric circuit controlling switch device including an actuating element, a lever connected to each of said valves, the lever on said unbalanced valve being operatively associated with said actuating element, and spring means urging said unbalanced valve towards its switch closing position.

11. In a device of the class described, an internal combustion engine intake conduit, an electric circuit controlling switch, means responsive to flow in said conduit for actuating said switch, a throttle valve in said conduit, and means associated with said throttle valve for modifying the extent of actuation of said flow responsive means.

12. The combination of elements specified in claim 11, and further including spring means for urging said flow controlled element towards its starter actuating position.

13. The combination of elements specified in claim 11, and further including spring means for urging said flow controlled element towards its starter actuating position, said spring means being associated with said throttle valve, whereby the force exerted by said means depends at least in part upon the position of said valve.

14. In a device of the class described, an internal combustion engine intake conduit, a throttle valve in said conduit, an electric circuit controlling switch, a flow responsive element in said conduit, an operating connection between said element and said switch, means for urging said element towards its switch closing position, and means associated with said throttle valve for preventing movement of said element to said switch closing position when said throttle valve is in a predetermined position.

15. In a device of the class described, an intake conduit for an internal combustion engine, a throttle valve therein, a flow responsive pivoted element in said conduit, a starter switch device including a reciprocating actuating element, a crank on said suction responsive element and operatively associated with said actuating ele-

ment, and spring means eccentrically connected to said throttle valve and said crank and urging said crank towards its switch closing position, said flow responsive element being constructed
5 and arranged to be affected by a difference to pressure on opposite sides thereof to move said crank to its switch operating position.

16. In a device of the class described, an intake conduit for an internal combustion engine,
10 a throttle valve therein, a flow responsive device in said conduit, a starter switch operatively associated with said device, a spring urging said

device towards its switch closing position, said spring being eccentrically connected to said throttle valve whereby the force exerted thereby is less for a given position of said element when said valve is open than when said valve is closed, 5 said element being constructed and arranged to be moved to its switch opening position when said throttle valve is at least partly open and the engine is running, and structure on said throttle valve for preventing closing of said 10 switch when said valve is substantially closed.

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