

Nov. 17, 1936.

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2,060,955

AUTOMATIC STARTING MEANS FOR HYDROCARBON ENGINES

Filed Nov. 11, 1932

2 Sheets-Sheet 1

Fig. 1.

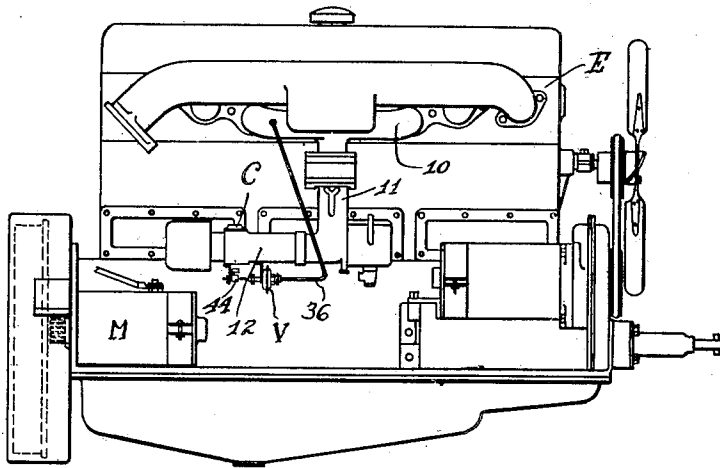


Fig. 5.

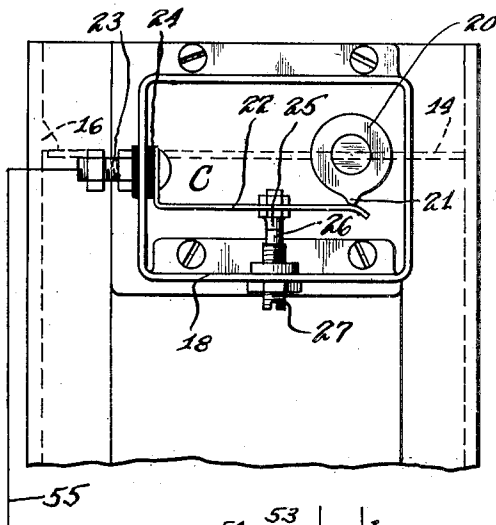
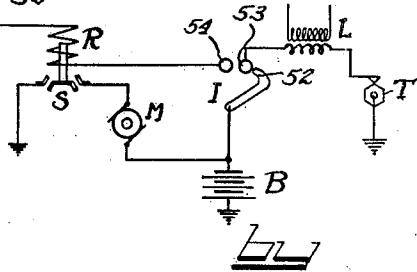
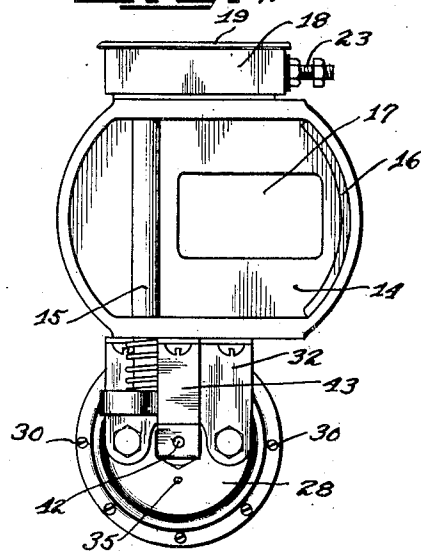


Fig. 4.



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2 Sheets-Sheet 2

FIG. 2.

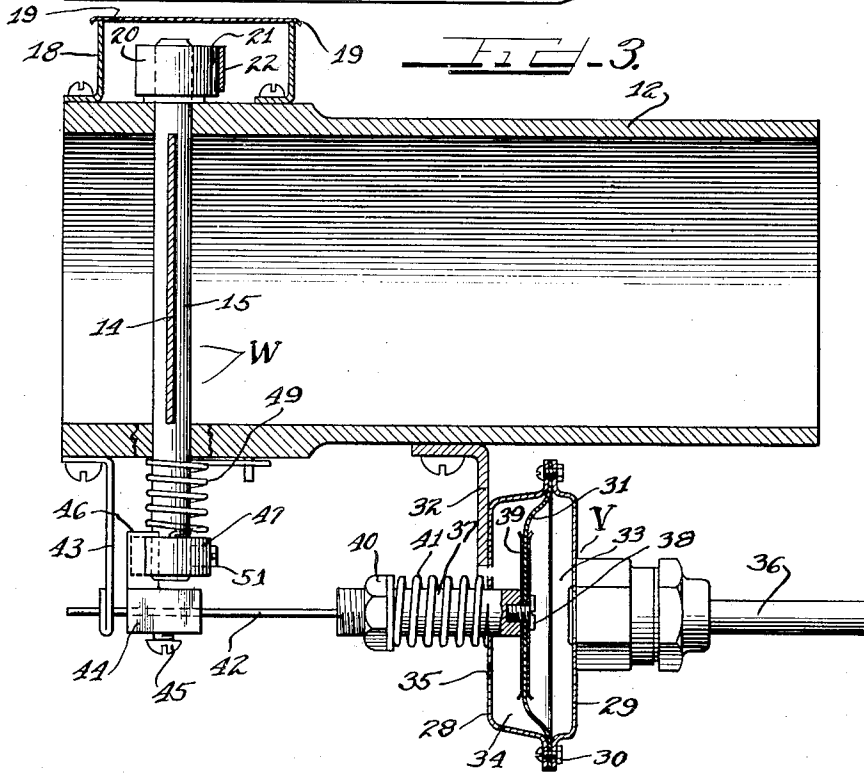
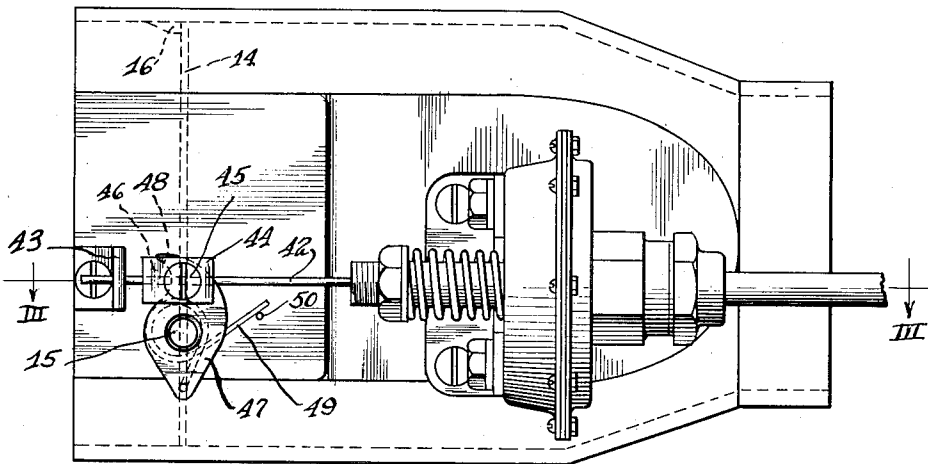


FIG. 3.

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BL

Att. 5.

UNITED STATES PATENT OFFICE

2,060,955

AUTOMATIC STARTING MEANS FOR
HYDROCARBON ENGINESBenjamin A. Swennes, Rockford, Ill., assignor to
Borg-Warner Corporation, Chicago, Ill., a cor-
poration of Illinois

Application November 11, 1932, Serial No. 642,173

2 Claims. (Cl. 290—38)

This invention relates to the automatic start-
ing and restarting of hydrocarbon engines for
automotive vehicles and in general the object is
to provide improved means for automatically
controlling the connection of the starting motor
for starting service upon closure of a switch,
usually the ignition switch, and the automatic re-
starting of the engine upon accidental stalling
or stopping thereof.

More in detail, an important object of the in-
vention is to provide improved suction responsive
means controlled by the suction or vacuum in
the engine intake manifold for controlling the
switch, the suction responsive device remaining
inert and unresponsive to the low degree of suc-
tion or vacuum in the manifold while the engine
is being started, so that the switch will remain
closed, but which device will immediately respond
to the higher suction or vacuum in the manifold
when the engine has been started and is self-
operating and will then cause opening of the
switch for disconnection of the starting motor
from circuit; the suction responsive device being
released should the engine stall or accidentally
fail to operate so that the switch may be closed
for reconnection of the starting motor in circuit.

A further object is to provide improved means
for preventing closure of the switch and connec-
tion of the starting motor with the engine under
conditions where the engine is self operating but
the vacuum or suction in its intake manifold is
insufficient to hold the suction responsive device
in condition for holding the switch open, as for
example, during a period when the throttle valve
is wide open for rapid acceleration of the engine
under which condition it would be detrimental to
the starting motor should it be suddenly geared
to the engine. My improved safety means for
preventing connection of the starting motor with
the engine during the conditions referred to is
preferably controlled by the flow of air for sup-
plying the carburetor, means being provided, re-
sponsive to such air flow, for preventing closure
of the switch until the manifold suction again be-
comes sufficient for effective response of the suc-
tion responsive device.

The invention also includes improved switch
structure and operation and other features all of
which are incorporated in the structure disclosed
on the drawings, in which drawings

Figure 1 is a side elevation of an engine show-
ing the location and connection of the controlling
elements;

Figure 2 is an enlarged side elevation of the

carburetor air intake duct with control elements
mounted thereon;

Figure 3 is a section on plane III—III of Fig-
ure 2;

Figure 4 is an end view, to reduced scale, of the
structure shown in Figure 2; and

Figure 5 is a plan view of the left end of Fig-
ure 3 with the cover removed from the switch
casing.

On Figure 1 I have shown an engine E having
the fuel intake manifold 10 connected with a car-
buretor 11 having the air intake duct 12. The
starting motor M is mounted adjacent the engine
frame for meshing its pinion with the engine gear
in a manner well known in the art.

The automatic control for the starting motor
comprises a controlling switch C, and a suction
responsive device V and an air flow responsive
device W which devices cooperate to determine
the opening or closing of the controlling switch
C. The device W is shown as comprising a plate
14 adapted to fit within the passageway formed
by the carburetor air intake duct 12 so as to form
an impediment or pressure surface for the air
drawn into the passageway. Near one of its
ends the plate 14 is secured to a shaft 15 extend-
ing through and journaled in the opposite wall
of the duct 12 so that the plate will respond to
the pressure of the air thereagainst to swing and
to rotate the shaft, a stop abutment 16 being
provided within the duct 12 against which the
plate is held when it is in full closing position
which, as shown, is in a diametral plane. The
plate has the bypass or opening 17 therethrough
so that the air flow through the duct is never
entirely shut off.

The elements for the switch C are within a
housing 18 secured to one side of the duct 12 and
around one end of the shaft 15, and has a de-
tachable cover 19. A cam 20 is secured to the
projecting end of the shaft in the housing and
the cam shown is cylindrical and with the cam
projection 21 thereon, the cam being preferably
of some insulating material such as fiber, baka-
lite or other suitable material. Secured to one
side of the housing 18 but insulated therefrom
is a contact spring 22. As shown the spring is
secured by a terminal post 23 and insulated from
the housing by suitable insulation 24. The free
end of the spring extends into the path of the
cam projection 21, and, when the spring is en-
gaged by the projection, a contact point 25 car-
ried by the spring is held in electrical engage-
ment with a stationary contact point 26 secured
to the side wall of the housing 18. As shown, 55

the contact point 26 is at the end of a screw 27 so that this contact point may be adjusted. The screw 27 is in electrical engagement with the metallic housing 18 and in service it will be grounded to the framework of the vehicle. When the plate 14 is swung from its closed position the shaft and the cam thereon will be rotated to cause withdrawal of the cam point 21 from the contact spring so that the spring may relax and separate its contact 25 from the contact 26 to thus open a circuit which is controlled by the switch.

The suction or vacuum responsive device V comprises a housing formed of the two opposed sheet metal frames 28 and 29 having peripheral flanges secured together by bolts 30 and clamping between them around its edge a diaphragm 31, the housing being secured to the duct 12 by a bracket 32. The diaphragm divides its supporting housing into the two chambers 33 and 34, the chamber 34 being vented to atmosphere through a suitable vent opening 35. The chamber 33 is closed except for its connection through tubing 36 with the intake manifold 10 of the engine, so that this chamber and the diaphragm will be subjected to the suction or vacuum existing in the manifold.

A bar or plunger 37 extends into the chamber 34 concentric therewith and is secured to the diaphragm by a screw 38, washer plates 39 being preferably applied on opposite sides of the diaphragm for stiffening and strengthening purposes. The outer end of the bar 37 is threaded for reception of an abutment nut 40 between which and the adjacent wall of the diaphragm housing is a compression spring 41 which encircles the bar, this spring tending to hold the bar and the diaphragm in an outer position and to resist movement of the diaphragm inwardly by the suction.

A rod 42 extends from the bar 37 and is slidably supported at its outer end in the end of a bracket 43 extending from the duct 12 adjacent to the projecting end of the shaft 15, the pressure responsive device V being secured to the duct 12 on the side thereof opposite to that on which the switch housing 18 is mounted. The rod has a block 44 adjustably secured thereto as by a set screw 45 and this block has an abutment arm 46 extending laterally therefrom. On the end of the shaft 15 adjacent to the block is secured a lever 47 having a concave recess 48 for receiving the rounded face of the arm 46. A coil spring 49 on the shaft end has one end anchored to the lever 47 and its other end abutting a post 50 on the duct 12, this spring tending to hold the shaft in position with the plate 14 thereon against the stop 16, and with the recess of the lever 47 engaged by or in the path of the arm 46 on the block 44. By means of a set screw 51 the lever may be accurately adjusted on the shaft.

On Figure 5 I have diagrammatically shown the circuit arrangement and control for the system. The positive side of the battery B is connected with the lever or blade I of a switch, usually the ignition switch, the blade being shown as having the extended contact end 52. In the path of the switch blade end are the contact buttons 53 and 54, the button 53 being connected with one terminal of the primary winding of the ignition coil L, the other terminal of the winding being connected through the ignition circuit breaker T to ground. The terminal button 54 is connected through a conductor 55 with the terminal post 23 of the switch C and this conductor

55 includes the winding of a relay R which controls a switch S for closing the circuit for the starting motor M, this circuit extending from the battery through the motor and switch to ground.

Describing now the operation, when the ignition switch is opened and the engine is at rest, the spring 49 by its action on the shaft 15 holds the plate 14 in its closed position and the cam 20 with its point 21 in engagement with the contact spring 22 for engagement of the contacts 25 and 26, the arm 46 on the block 44 being within the recess 48 of the lever 47 on the shaft. If it is desired to run the engine the switch I is swung to bring its end 52 in engagement with the terminal buttons 53 and 54 to close the ignition circuit and also to close the energizing circuit for the relay R, this circuit being then from the battery through the switch I, the winding of the relay R, the conductor 55, switch spring 22, and contact points 25 and 26 to ground. Upon energization of the relay R its armature is attracted to close the switch S and therefore closure of the circuit for the starting motor M and the engine will then be turned by the starting motor. During the slow rotation of the engine by the starting motor the suction within the engine intake manifold will not be strong enough to move the diaphragm 31 against the resistance of the springs 41 and 49, and the pressure of the air flowing through the duct 12 to the carburetor will also be insufficient to swing the plate 14 against the resistance of the spring 49, and consequently the point of the cam 20 will remain in engagement with the contact spring 22 and the energizing circuit for the relay R will remain closed.

The suction responsive device V is adjusted to respond to all speeds above starting speed and therefore as soon as the engine has been started and is self-operating the greatly increased suction will pull in the diaphragm and then by the engagement of the arm 46 on the block 44 with the lever 47 the shaft 15 will be rotated to turn the cam 20 for disengagement of its cam point 21 from the contact spring 22 and the contact points 25 and 26 are separated and the energizing circuit for the relay R is opened and consequently the starting motor circuit is opened by the switch S, and while the engine is self-operating normally these conditions will be maintained. Should the engine stall or accidentally stop while the switch I is closed, the diaphragm, on account of the drop in manifold suction, will be released and its spring 41 will shift the rod 42 outwardly to release the arm 46 from the lever 47 so that the spring 49 may rotate the shaft 15 and the cam 20 for re-engagement with the cam point 21 with the contact spring 22 and reclosure of the switch C and of the energizing circuit for the relay R so that the motor circuit is reclosed for restarting of the engine by the motor.

Under normal conditions of operation of the engine, the suction responsive device V will control the automatic starting and restarting of the engine. Under certain abnormal conditions of operation, as for example sudden wide opening of the carburetor throttle for rapid acceleration of the engine, the sudden drop in the suction in the engine manifold would result in release of the diaphragm and closure of the controlling switch C, and unless this were prevented the starting motor would be coupled to the engine while the engine is running at a high speed. The plate 14 on the shaft 15 has been provided to guard against such untimely closure of the controlling switch. During

ing starting and during normal running of the engine, the bypassage 17 through the plate 14 will be adequate for sufficient supply of air to the carburetor and the plate will not be swung by the air flow to turn the shaft 15 away from its normal position during which the switch C is closed. However, when the throttle of the carburetor is suddenly opened wide the resulting inrush of air in the intake duct 12 will exert sufficient pressure against the plate 14 to swing this plate to rotate the shaft 15 and the cam 20 for opening of the switch C so that, when the diaphragm of the device V is released by the sudden drop of manifold suction, and the lever 47 is released, the spring 49 is prevented by the air pressure against the plate 14 from rotating the shaft 15 to close the switch C and the starting motor will therefore be prevented from reconnection with the engine. As soon as the abnormal conditions have been abated and the engine manifold suction comes back to normal the device V will shift the arm 45 back into engagement with the lever 47 to hold the switch C open and prevent closure thereof by the force of the spring 49 while the pressure against the plate 14 is released as the air flow into the duct 12 returns to normal. This air flow responsive plate 14 thus acts as a safeguard to prevent connection of the starting motor with the engine during periods of suction or vacuum failure in the engine manifold while the engine is self-operating.

To stop the engine the ignition switch I is opened to cut off the ignition and to open the energizing circuit for the relay R and then the springs 41 and 49 will release the shaft 15 for return thereof to its normal position with the switch C closed and with the plate 14 against its stop 16.

The plate 14 may be considered as performing the function of a valve for the air-flow into the duct 12. During starting of the engine the valve will be closed and the air supply for the carburetor will be through the valve bypass 17. During normal self-operation of the engine the suction responsive device V is effective to hold the shaft 15 with the valve plate in inclined or open position so that the carburetor will receive adequate air supply during normal operation and acceleration of the engine. Upon abnormal acceleration, as by sudden wide opening of the throttle, and consequent demand for more air flow through the carburetor, the valve plate may be opened wider and independently of the suction-responsive device V for the required supply of air to the carburetor, the swing of the valve being then resisted only by the spring 49. As the engine responds and the suction in the manifold comes back to normal, the suction responsive device brings its arm 46 back to receive and hold

the lever 47 as the valve plate is swung back by the spring 49 upon diminishing of the air flow into the duct 12 and the switch C will be kept opened.

I thus produce simple and efficient means and operation for automatically starting and restarting the engine of an automotive vehicle when the ignition switch is closed and for preventing application of the starting motor to the engine when it is self-operating. In my system only a single controlling switch is necessary, such a switch being under the control of the engine manifold vacuum and the air flow to the carburetor.

I do not desire to be limited to the exact construction, arrangement and operation shown and described, as changes and modifications may be made without departing from the scope and spirit of the invention as defined in the appended claims.

I claim as follows:

1. For use with a hydrocarbon engine having a fuel intake passage and adapted to be started by an electric motor controlled by means of an electric circuit, switch control means for a switch adapted to open and close such circuit, said switch control means including a movable switch operating member, a vane in operative connection with said operating member and disposed in said fuel intake passage in a manner providing for its movement in said passage by impetus of fuel therethrough, a pressure energized actuator device responsive to variations in pressure in said fuel intake passage, and an operative connection between said device and said switch operating member, the vane tending under such impetus of fuel to effect opening of said switch and the pressure device tending to effect opening of said switch in accordance with a decrease of pressure in said passage.
2. Control means for an electric circuit switch and comprising a passage wherein gas is adapted to move at variable velocities and pressure, an operating member movable to open and close said switch, actuator means responsive to changes in gas velocity through such passage, an operative connection between said operating member and said actuator means, a pressure energized actuator device responsive to variations in pressure in said fuel intake passage, and an operative connection between said device and said switch operating member, said actuator means responsive to fuel velocity and said pressure energized actuator being operative complementally through their respective connections with said switch operating member to cause switch operative movement thereof.

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