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BOOSTER PUMP AND SUCTION SWITCH

Filed March 14, 1941

2 Sheets-Sheet 1

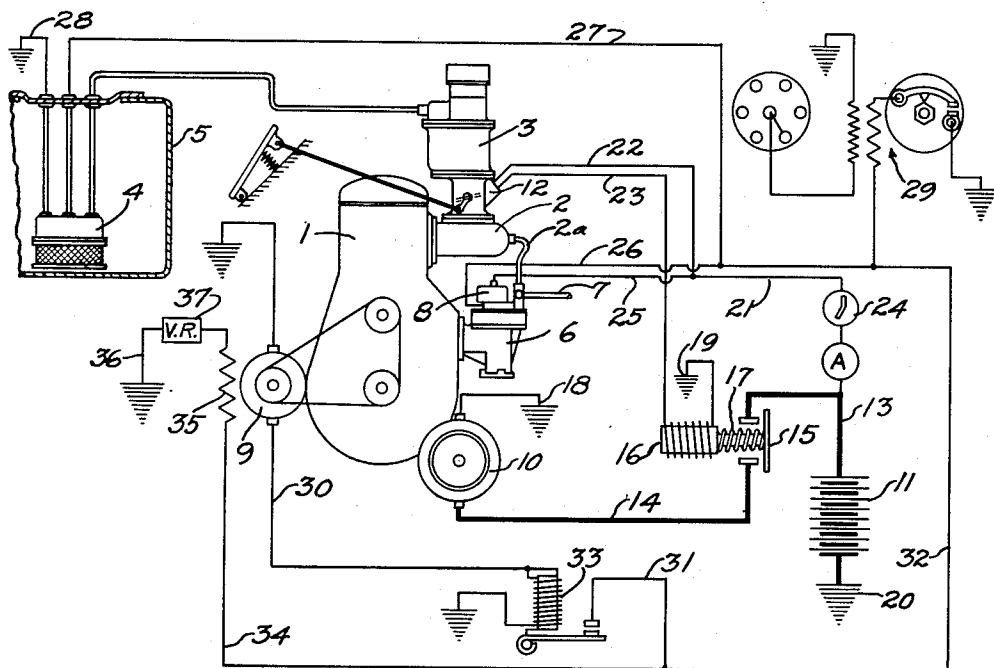


FIG. 1

INVENTOR
FORREST T. FLINT
Donald U. Rice
ATTORNEY

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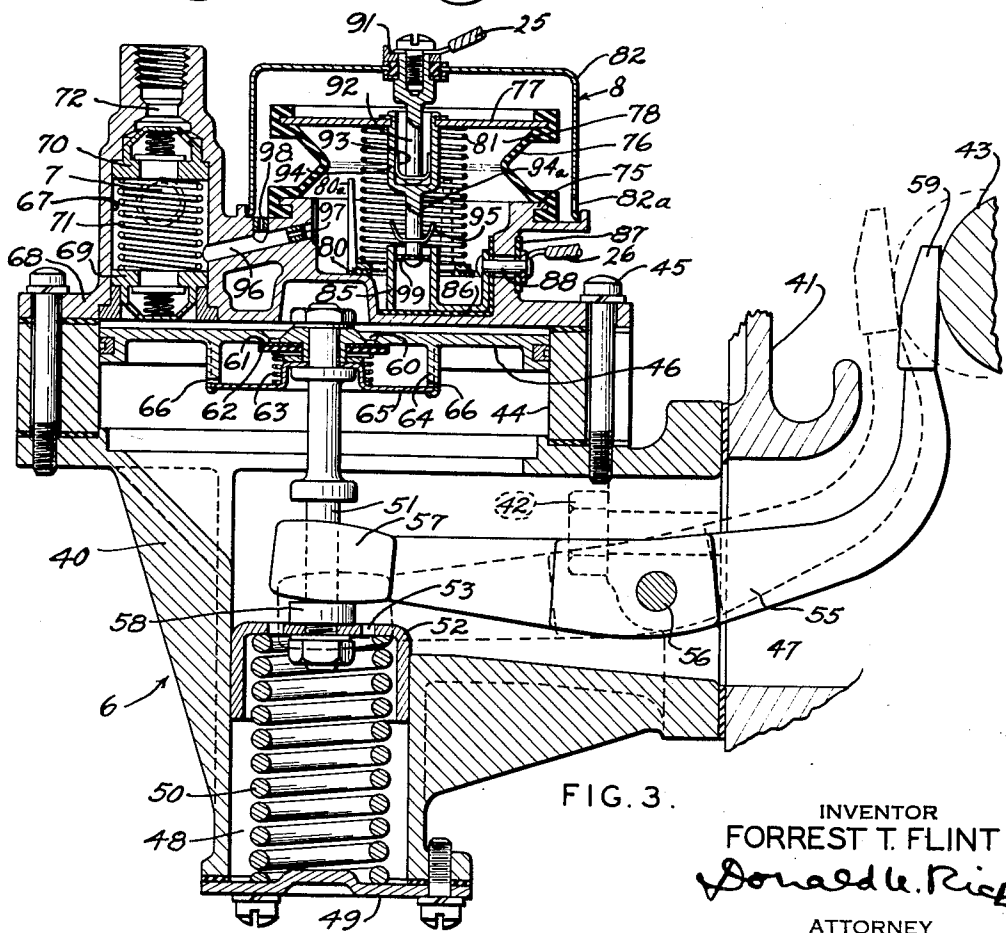
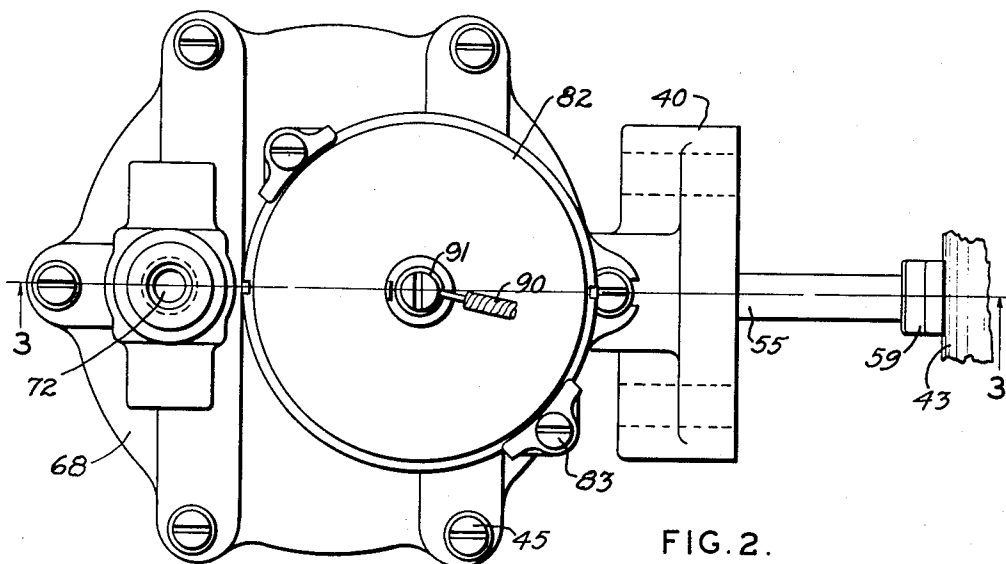
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2 Sheets-Sheet 2



INVENTOR
FORREST T. FLINT
Donald K. Rice
ATTORNEY

UNITED STATES PATENT OFFICE

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BOOSTER PUMP AND SUCTION SWITCH

Forrest T. Flint, Florissant, Mo., assignor to
Carter Carburetor Corporation, St. Louis, Mo.,
a corporation of Delaware

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14 Claims. (Cl. 123—139)

This invention relates to mechanism associated with an internal combustion engine for producing a stabilized pressure differential and utilizing the same for controlling the fuel supply and ignition system.

Many accessories and adjuncts on motor vehicles, such as fuel feed pumps, windshield wipers, oil pumps, and fans may be operated by the vacuum or pressure differential between the sub-atmospheric pressure in the intake manifold and the atmosphere. While it has been found highly desirable to use such motive power, certain operating conditions such as rapid acceleration and low speed operation under a heavy load, decrease the pressure difference between the intake manifold and the atmosphere to a degree where it is of little or no use as a motive power. This very wide fluctuation of the pressure differential renders it undesirable as a motive power for some adjuncts such as a vacuum switch constructed to operate within fairly close pressure limits.

Where an electric fuel pump is used, it is desirably rendered operative to supply fuel concurrently with energizing of the ignition system, but since a driver may neglect to cut off the ignition switch after the engine starts, means should be provided to prevent the pumping of fuel at such times.

An object of this invention is to provide a positively driven air pump for supplying a pressure differential for operating accessories and adjuncts on a motor vehicle.

Another object of the invention is to provide a positively driven air pump for closing a vacuum operated switch when the engine is being started.

Another object of the invention is to provide a novel vacuum operated switch for controlling electrical system of an internal combustion engine.

Still another object is to provide a fuel pump control switch device including automatic means to maintain the switch stably closed during cranking and, at other times, when the engine is operating slowly, while, at the same time, insuring prompt stopping of the pump when the engine stops.

These objects and other more detailed objects hereafter appearing are attained substantially by the device indicated in the accompanying drawings in which:

Fig. 1 is a diagrammatical view illustrating an application of the invention to an internal combustion engine and its associated electrical system.

Fig. 2 is a plan view of the automatic switch device.

Fig. 3 is a vertical section taken substantially on line 3—3 of Fig. 2.

Reference numeral 1 indicates an internal combustion engine having an intake manifold 2 on which is mounted a carburetor 3 supplied with fuel by an electric fuel pump 4 located in the conventional storage tank 5. A fluid pressure pump 6, in the present instance, a suction pump, is attached to and driven by engine 1 and is connected to the intake manifold 2 by the fluid pressure line 2a. Fluid pressure from the pump for actuating various accessories or adjuncts (not shown) is supplied through the pressure line 7. A fluid pressure switch 8 actuated by the pump 6 is used for controlling the electrical circuits shown in Fig. 1. A generator 9 is arranged to be driven by the engine in the usual manner and a starting motor 10 is arranged to crank the engine. A storage battery is indicated at 11. A throttle actuated starting switch 12 may be of any suitable construction as the details thereof form no part of the invention.

To energize the starting motor, a lead 13—14 from the battery is provided having interposed therein a switch 15 operated by a solenoid 16. The switch 15 is normally held open in the position shown by the spring 17. The starting motor is grounded at 18, solenoid 16 is grounded at 19, pump motor 4 is grounded at 28, and storage battery 11 is grounded at 20.

To energize solenoid 16, there is provided a circuit including battery 11, lead 13, ammeter A, key switch 24, leads 21 and 22, manual starter switch 12, and lead 23.

A second circuit for operating the fuel pump includes the battery, leads 13, 21, and 25, fluid pressure switch 8, and leads 26 and 27. This circuit is connected in multiple to the general ignition system as indicated at 29.

The charging circuit includes generator 9, lead 30, reverse current relay 33, leads 31, 32 and 26, pressure switch 8, leads 25, 21 and 13, and the battery.

The generator field 35, grounded at 36, is separately excited by means of the circuit 34, 32, 26, pressure switch 8, leads 25, 21, 13, and battery 11. The field winding 35 is grounded through a conventional voltage regulator indicated at 37 which functions to control the generator output voltage in a well known manner.

By having the elements arranged as above described, fuel pump 4 and the ignition circuit 29 are not energized until pressure pump 6 builds up

sufficient pressure to cause fluid pressure switch 8 to close, and by this arrangement the circuit is opened in event the engine ceases operation.

To better understand the construction and operation of pressure pump 6 and pressure switch 8, reference is made to Figures 2 and 3. The pump 6 comprises a pump housing 40 secured to the motor housing 41 by the bolts 42 in the vicinity of a rotating cam 43 driven by the motor. A vertical pump cylinder 44, secured to the top of pump housing 40 by bolts 45, is divided into two chambers by a ring sealed piston 46. The lower chamber formed by piston 46 is in open communication with the interior of motor housing 41 through the hollow interior of the pump housing and the opening 47 in the motor housing. In the lower portion of pump housing 40 a vertical oil well 48 is formed with its lower end closed by the plate 49 which forms an abutment for one end of compression spring 50.

A piston rod 51 is rigidly secured to and extends downwardly from piston 46 and on its lower end has a guide plunger 52 for reciprocating in oil well 48 and also seating the upper end of spring 50. Openings 53 in the guide member 52 provide a means for the escape of oil from the well as the guide plunger is reciprocated. A lever 55, pivoted at 56, has one end 57 bearing on a collar 58 formed on piston rod 51, while the other end 59 of the lever is held against cam 43 by the upward thrust of spring 50.

Piston 46 is provided with a circularly arranged series of openings 60 for the passage of fluid downwardly through the piston and a valve disk 61, backed by a sound deadening material 62, is normally urged against the under surface of piston 46 by a spring 63 to close the openings 60. Surrounding the valve disk, a sound deadening chamber is formed by a circular wall 64 depending from the under side of piston 46 and a bottom plate 65. Wall 64 is provided with small openings 66 arranged thereabout for distributing and retarding the speed of air passing through the chamber. This chamber also acts as a condensing and collecting chamber for crank case oil sucked upwardly around piston 46 and drawn back through the ports 60. Oil thus collected finds its way through the openings 66 to the crank case of the engine.

A distributing chamber 67 formed in the cylinder cover 68, is provided with a pair of valve units 69 and 70, respectively, positioned by the spring 71. Lower valve unit 69 serves as an inlet check for the suction pump and has a downwardly opening resiliently seated valve arranged to permit the drawing of fluid from chamber 67 and accessory connection 7 to the pumping chamber above the piston 46. Upper valve unit 70 has an upwardly opening resiliently seated valve permitting the flow of fluid to the intake manifold 2, when a sufficient depression exists therein, through the passageway 72 and fluid pressure line 2a. Fluid pressure line 1 is in open communication with the distributing chamber 67 and fluid entering chamber through line 1 is distributed to the pressure pump or to the intake manifold according to the relative depressions therein.

An upwardly projecting cup 75 on pump cover 68 has the lower end of a bellows 76 stretched thereover, the other end of the bellows being stretched over a plate 77 thereby forming the expansible and contractible fluid tight chamber 78. A ring 80 resting on cover 68 within cup 75 has upwardly projecting abutment pin 80a for limiting the downward movement of plate 77. A com-

pression spring 81 is seated between ring 80 and plate 77 for extending the bellows. A cover 82 placed over the bellows is secured to cylinder cover 68 by the bolts 83.

A vertical cylinder 85 in chamber 78 forms one electrical contact of the pressure switch and is insulated from the cylinder cover 68 by the dielectric members 86 and 87. Cylinder 85 is held in place by the binding post 88 to which is connected electrical conductor 26. Electrical conductor 25 is connected to the binding post 91 which is supported by and insulated from the cover 82. Binding post 91 has a downwardly extending portion 92 on the end of which is secured outwardly and upwardly projecting spring contact fingers 93 slidably contacting the inner wall of a cup 94 secured to bellows top plate 77. Cup 94 has a depending finger 94a provided with outwardly and upwardly projecting spring contact fingers 95 for slidably contacting cylinder 85 when bellows 76 is collapsed. Dielectric washer 99 secured to the end of finger 94 reciprocates in cylinder 85 and acts as a guide for member 94.

Distributing chamber 67 and expansible chamber 78 are in communication through passageway 96 having a calibrated restriction 97. The calibrated restriction 98 vents passageway 96 to the atmosphere by way of opening 82a in cover 82.

Restriction 97 retards the inflow of air to chamber 78 on the upstroke of piston 46 while restriction 98 retards the inflow of air when the engine ceases operation.

The operation of the device is as follows:

To start the engine key switch 24 is closed and upon closing manually operated switch 12, solenoid 16 closes the starter circuit thereby causing starting motor 10 to crank the internal combustion engine 1. Cranking speed varies from 9 to 20 R. P. M. and at this low speed 2 to 4 revolutions is sufficient for the pump piston 46 to reduce the air pressure in distributing chamber 67, pressure line 7 and chamber 78 to a point where bellows 76 will partially collapse and switch contact fingers 95 makes contact with the vertical sidewalls of chamber 85 thereby closing the circuit energizing fuel pump 4 and the general ignition system 29.

The small volume of air in chamber 67, pressure line 7 and chamber 78 is exhausted very quickly by the large pressure pump 6 and by the same token a leakage of air in an appreciable amount will cause bellows 76 to extend tending to break the contact between the switch contacts.

It is, therefore, necessary that there be a calibrated passageway to chamber 78 from distributing chamber 67 so that the time required for air to fill chamber 78 is greater than the time required for the upward stroke of pressure pump 6 during its slowest operation, that is, during cranking of the engine.

Bellows 76 will pulsate during low speed operation of pump 6 but not sufficiently to break the switch contacts because of restrictions 97 and 98.

When pump 6 ceases operation calibrated vent 98 admits air to chamber 78 slowly so that in from 4 to 6 seconds the switch contacts are broken.

If, for any reason, pump 6 fails to operate and the engine is running, the subatmospheric pressure in the intake manifold 2 will operate the switch by way of line 2a, passage 72 and valve unit 70. Valve unit 7, also, may open when high

suction exists in the engine intake and pump 6 is operating slowly, as during idling.

In the event that pump piston 46 or its seal is broken and the engine continues operation, intake suction maintains the fuel pump and ignition in operation, except under the most adverse suction conditions, but valve unit 69 remains closed and suction in the intake manifold cannot remove the oil vapor from the crank case.

The detailed drawings and description are intended to be illustrative, not limiting, and the use of all modifications within the scope of the appended claims is contemplated.

I claim:

1. In an electrical circuit control for an internal combustion engine, a pressure chamber having a resiliently movable wall, an electrical switch constructed and arranged to be actuated by said movable wall, a reciprocating fluid pressure pump actuated by said engine, and a restricted passageway from said pressure chamber to said pressure pump for retarding the movement of said wall.

2. In a device for controlling an electrical circuit of an internal combustion engine comprising a suction pump actuated by said engine, a fluid chamber having a movable wall, an electrical switch constructed and arranged to be actuated by said movable wall, a passageway from said pump to said chamber and an atmospheric vent to said passageway.

3. In a device for controlling an electrical circuit of an internal combustion engine, a suction pump actuated by said engine, a fluid chamber having a movable wall, a passageway connecting said pump and said chamber, an electrical switch constructed and arranged to be actuated by the movement of said wall, and an atmospheric vent for said chamber.

4. In a device of the class described having a suction pump actuated by an internal combustion engine, a fluid distributing chamber interposed between fluid actuated devices and said pump, a fluid connection between said chamber and the intake manifold of said engine, and a valve in said fluid connection, said pump being constructed and arranged to develop suction sufficient to hold said valve closed throughout most of the normal operating range of said engine.

5. In a device of the class described having a suction pump actuated by an internal combustion engine, a fluid distributing chamber interposed between fluid actuated devices and said pump, a fluid connection between said chamber and the intake manifold of said engine, and a valve in said fluid connection, said valve being constructed and arranged to be closed by the suction of said pump and opened by the suction of said intake manifold in the event of failure of said pump to function.

6. In combination, an internal combustion engine, a suction pump actuated by said engine, an

electrical fuel pump for supplying fuel to said engine, an electrical circuit for energizing said fuel pump, a fluid chamber in communication with said pump, said chamber having a wall movable in one direction by said pump, a switch interposed in said circuit and actuated by said wall, and means for moving said wall in the opposite direction for interrupting said circuit when said engine ceases to operate.

7. In combination, an internal combustion engine having an ignition system, a suction pump, an electric fuel pump, an electrical circuit for said pump, and means for breaking said electrical circuit when the suction in the pump falls below a predetermined point.

8. In combination, an internal combustion engine having an ignition system, a suction pump, an electric fuel pump, an incomplete electrical circuit for said fuel pump, and means for completing said circuit when suction in said pump reaches a predetermined point.

9. In combination, an internal combustion engine having an ignition system, a suction pump actuated by said engine, and means for opening said ignition system when the suction in said pump falls below a predetermined point for a period of time.

10. In combination, an internal combustion engine having an ignition system, a suction pump actuated by said engine, an electric fuel pump, and means for energizing said fuel pump and ignition system when suction in said pump reaches a predetermined point.

11. In combination, an internal combustion engine having an ignition system, a suction pump actuated by said engine, an electric fuel pump, an electrical circuit for said fuel pump and said ignition system, and means for breaking said circuit when the suction in said pump falls below a predetermined point.

12. A control device for an internal combustion engine comprising a chamber having a movable wall, an actuating connection between said wall and the control, an engine operated pump having a fluid connection to said chamber for actuating said wall in one direction, means yieldingly urging said wall in the opposite direction, a restricted atmospheric port in a wall of said passage to relieve pressure differential in said chamber, and a restriction in said fluid connection to retard the response of said movable wall to variations in pump pressure.

13. A control as specified in claim 12 in which said atmospheric port is between said pump and the restriction in said fluid connection.

14. A control as specified in claim 12 in which said pump includes a reciprocating pumping member, said restriction retarding recovery of said chamber during the return stroke of said member under low speed pumping conditions.

FORREST T. FLINT.