July 2, 1935. P. H. MAURER 2,007,058

AUTOMATIC STARTING MECHANISM

Filed March 25, 1933

Fig. 1

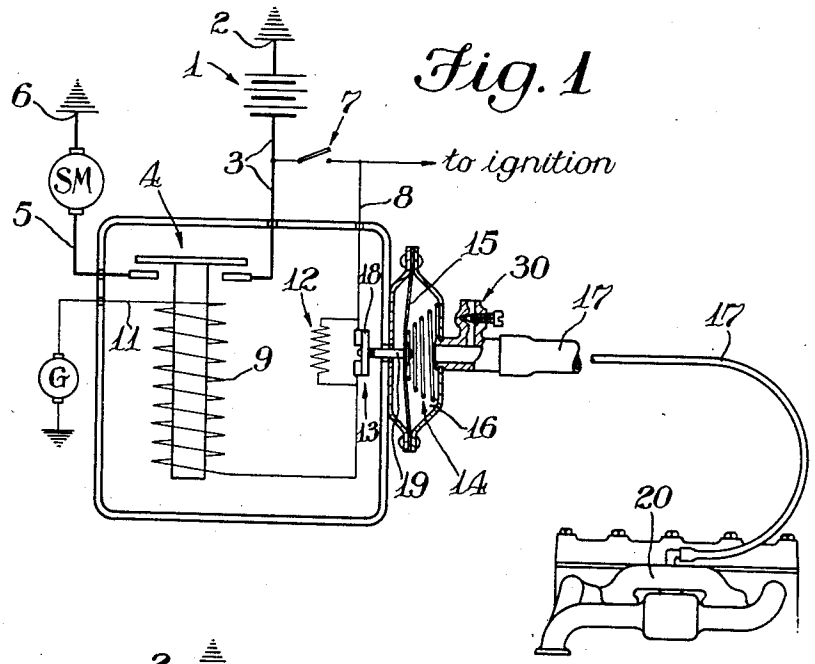
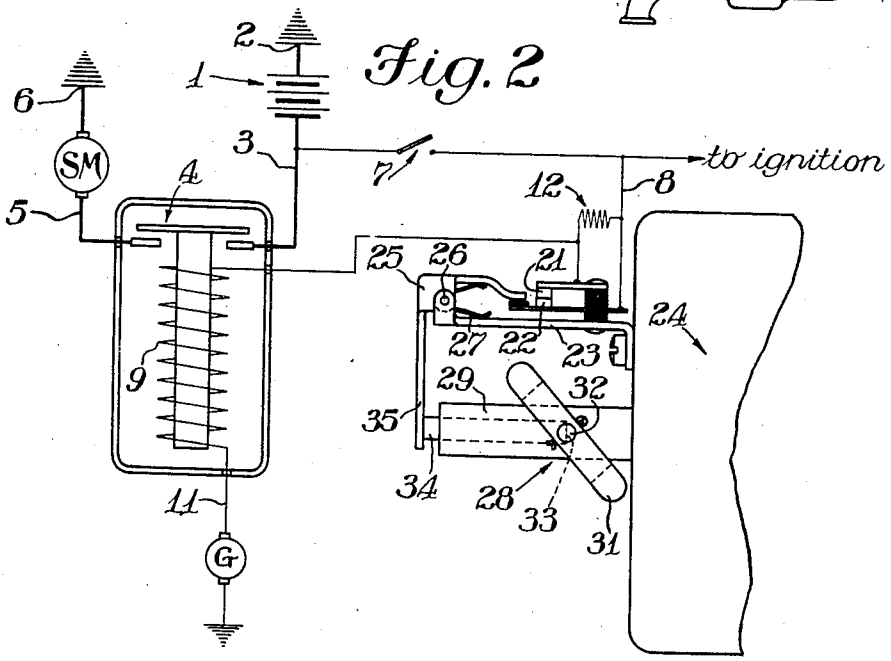


Fig. 2



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Patented July 2, 1935 2,007,058

UNITED STATES PATENT OFFICE

2,007,058

AUTOMATIC STARTING MECHANISM

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Application March 25, 1933, Serial No. 662,757

8 Claims. (Cl. 290—37)

This invention relates to automatic starting mechanism for internal combustion engines and more particularly to a device for actuating the starting mechanism upon closure of a manual control switch such as the ignition switch of the engine to be started, and for automatically restarting the engine in case of stall.

It is an object of the present invention to provide an automatic starting mechanism which is efficient and reliable in operation but simple and economical to manufacture and install.

It is another object to provide such a device which provides for steady and continuous cranking until the engine starts.

It is another object to provide such a device which embodies double safe guards to prevent reactuation of the starter while the engine is self-operative.

Further objects and advantage will be apparent from the following description taken in connection with the accompanying drawing in which:

Fig. 1 is a semi-diagrammatic illustration of a preferred embodiment of the invention; and

Fig. 2 is a similar view of a second embodiment thereof.

Referring first to Fig. 1 of the drawing, there is illustrated a starting system for an internal combustion engine comprising a battery 1 grounded at 2 and connected by a lead 3 to an electro-magnetic starting switch indicated generally by numeral 4, which in turn is connected by a lead 5 to a starting motor SM which is grounded at 6 to complete the starting circuit.

A control circuit for the electro-magnetic starting switch 4 is provided comprising battery 1, lead 3, manual switch 7, which may preferably be the ignition switch of the engine to be started, lead 8 connected to solenoid 9 of the starting switch, and lead 11 which is grounded through the usual engine driven generator indicated at G.

Means are provided for preventing undesired closure of the starting switch by introducing into the control circuit a resistance sufficient to reduce the current flow therethrough to a mere holding value for the solenoid 9 of starting switch 4. As here illustrated, this means is in the form of a conducting element 12 having a suitable resistance, and normally bridged by a set of contacts 13 which are biased toward closed position by means such as a spring 14. Means are provided for opening the contacts 13, and thus introducing the resistance 12 into the control circuit, responsive to a running function of the engine. As here shown, this means comprises an elastic diaphragm 15 forming one wall of a chamber 16 housing the spring 14 and connected as by means of a conduit 17 to the intake manifold 20 of the engine.

The diaphragm 15 is connected to the movable contact 18 of contacts 13 as by means of a rod 19 whereby flexure of diaphragm 15 in response to intake vacuum caused by engine rotation opens the contacts 13 and cuts the resistance 12 into the control circuit.

Since the control circuit is grounded through generator G, it will be understood that the generator constitutes a means responsive to a second running function of the engine for de-energizing the starting switch by preventing the flow of current therethrough when the generator is driven by the engine at sufficient speed to produce a voltage equal to that of the battery.

In the operation of this embodiment of the invention and starting with the parts in the positions illustrated, closure of the ignition switch 7 completes a circuit through the battery 1, leads 3 and 8, contacts 13, solenoid 9, lead 11 and generator G to the ground whereby the solenoid 9 is energized to close the starting switch 4. The starting circuit is thereby closed, causing the starting motor to become energized and crank the engine in the usual manner.

As soon as any substantial vacuum is generated in the intake manifold of the engine, the diaphragm 15 is deflected thereby thus opening contacts 13 and placing resistance 12 in the control circuit. The starting switch 4 is not affected, however, since sufficient current flows through the resistance 12 to hold the starting switch closed so that cranking is not interrupted by the opening of contacts 13.

When the engine becomes self-operative, however, the generator G builds up sufficient counter E. M. F. to prevent the flow of current through the control circuit whereby the solenoid 9 is de-energized and the starting switch opened. Thereafter during the running of the engine, it will be necessary for contacts 13 to be closed and generator G to be substantially deenergized at the same time, before the starting switch will be re-closed, since neither the closure of contacts 13 nor the failure of the generator to function can singly cause such action to take place. It will be understood that during the running of the engine at idling speeds when the generator is weak, the intake vacuum will ordinarily be high, whereas when the engine throttle is opened widely so as to reduce the intake vacuum, the engine will

ordinarily be rotating at sufficient speed to cause the generator to develop sufficient electro-motive force to prevent the starting switch from closing. The two running functions of the engine, namely intake vacuum and generator voltage are therefore complementary to each other in their controlling action on the starting mechanism.

Means are preferably provided for preventing closure of contacts 13 until a predetermined time after the dissipation of the intake vacuum, in order to allow the engine to come completely to rest before actuation of the starting mechanism. As here illustrated, this means is in the form of an adjustable valve 30 in the conduit 17 to restrict the flow of air therethrough.

Referring to the embodiment of the invention shown in Fig. 2, the elements of the starting circuit and control circuit are substantially similar to those illustrated in Fig. 1 and are similarly numbered. However, in place of the vacuum controlled contacts 13 in Fig. 1, a set of contacts 21 and 22 are provided which are arranged to be normally closed and are opened by a centrifugal element mounted on some member which is rotated from the engine such as the generator shaft. As here illustrated, the contacts 21, 22 are mounted on a bracket 23 fixed to the generator frame 24, and are arranged to be opened by a bell crank lever 25 pivoted at 26 on the bracket 23. Lever 25 is normally positioned so as to permit contacts 21, 22 to close by suitable means such as a spring 27, and is arranged to be operated to open said contacts by means of a centrifugal device indicated generally at 28 which is mounted on the end of the generator shaft 29. The centrifugal device may be of any desired type, but as here shown comprises a weighted ring 31 surrounding the generator shaft 29 and loosely pivoted thereto as by means of an axle 32. Axle 32 is provided with a central cut-away portion providing a flat surface 33 arranged substantially at 45° to the plane of the ring, and the generator shaft 29 is axially drilled to receive a plunger 34 in position to bear on the flat surface 33 and to project into engagement with one arm 35 of the bell crank lever 25. It will thus be seen that the spring 27, acting on the plunger 34 through the bell crank lever 25 tends to maintain the ring 31 inclined to the axis of the generator shaft, and rotation of the generator shaft will tend to make the ring assume a position with its axis coinciding with the axis of the generator shaft whereby the plunger 34 will be thrust out of the generator shaft, swinging the bell crank lever 25 to open contacts 21, 22.

In the operation of this embodiment of the invention closure of the ignition switch 7 causes cranking to take place as described in connection with the embodiment illustrated in Fig. 1. However, as soon as substantial rotation of the engine has been instituted, the centrifugal device 28 will open contacts 21, 22 thus introducing resistance 12 into the control circuit. Cranking continues, however, as above described until the counter E. M. F. of the generator deenergizes the starting switch solenoid 9 causing the starting switch to open. Thereafter during the operation of the engine, so long as the engine is rotating sufficiently to maintain contacts 21, 22 open or to cause the generator G to prevent the flow of current through the control circuit, the operation of the starting mechanism is prevented.

Although certain embodiments of the invention have been shown and described in detail, it will be understood that other embodiments are possible and that various changes may be made in the design and arrangements of the parts without departing from the spirit of the invention as defined in the claims appended hereto.

What is claimed is:

1. A starter control for internal combustion engines including a magnetic starting switch, and a control circuit therefor including means responsive to a running function of the engine for reducing the current flow therethrough to a predetermined amount constituting a holding value for the switch.

2. A starter control for internal combustion engines including a magnetic starting switch, a control circuit therefor including means responsive to a running function of the engine for reducing the current flow therethrough to a holding value for said switch, and means for deenergizing said switch.

3. A starter control for internal combustion engines including a magnetic starting switch, a control circuit therefor including means responsive to a running function of the engine for reducing the current flow therethrough to a holding value for said switch but ineffective to open said switch, and means responsive to a second running function of the engine for preventing the flow of current through the control circuit.

4. A starter control for internal combustion engines including a starting switch, means responsive to intake vacuum of the engine for preventing closure of said switch while the engine is rotating but ineffective to cause opening thereof irrespective of the operative condition of the engine, and means responsive to another running function of the engine to open said switch when the engine becomes self-operative.

5. A starter control for internal combustion engines including a magnetic starting switch, a control circuit therefor, means responsive to a running function of the engine for introducing a predetermined resistance in said circuit effective to prevent closure of the switch, and means responsive to a complementary running function of the engine for preventing the flow of current through the control circuit.

6. An electrical system for internal combustion engines including a battery, an engine driven generator connected to charge the battery, a starting circuit including said battery, a starting motor and an electro-magnetic starting switch, a control circuit for the starting switch including said battery and generator and a set of normally closed contacts, a conducting element bridged across said contacts having a resistance designed to cut down the current in the control circuit to a holding value for the electro-magnetic starting switch, and means responsive to a running function of the engine for opening said contacts.

7. An electrical system for internal combustion engines including a battery, an engine driven generator connected to charge the battery, a starting circuit including said battery, a starting motor and an electro-magnetic starting switch, a control circuit for the starting switch including said battery and generator and a set of normally closed contacts, a conducting element bridged across said contacts having a resistance designed to cut down the current in the control circuit to a mere holding value for the electro-magnetic starting switch, and means responsive to intake vacuum of the engine for opening said contacts.

8. An electrical system for internal combustion engines including a battery, an engine driven

generator connected to charge the battery, a starting circuit including said battery, a starting motor and an electro-magnetic starting switch, a control circuit for the starting switch including said battery and generator and a set of normally closed contacts, a conducting element bridged across said contacts having a resistance designed to cut down the current in the control circuit to a holding value for the electro-magnetic starting switch, means responsive to intake vacuum of the engine for opening said contacts, and means for relaying the reclosure of said contacts for a predetermined time after the dissipation of such vacuum.

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