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BACKFIRE RELEASE FOR INTERNAL COMBUSTION ENGINES

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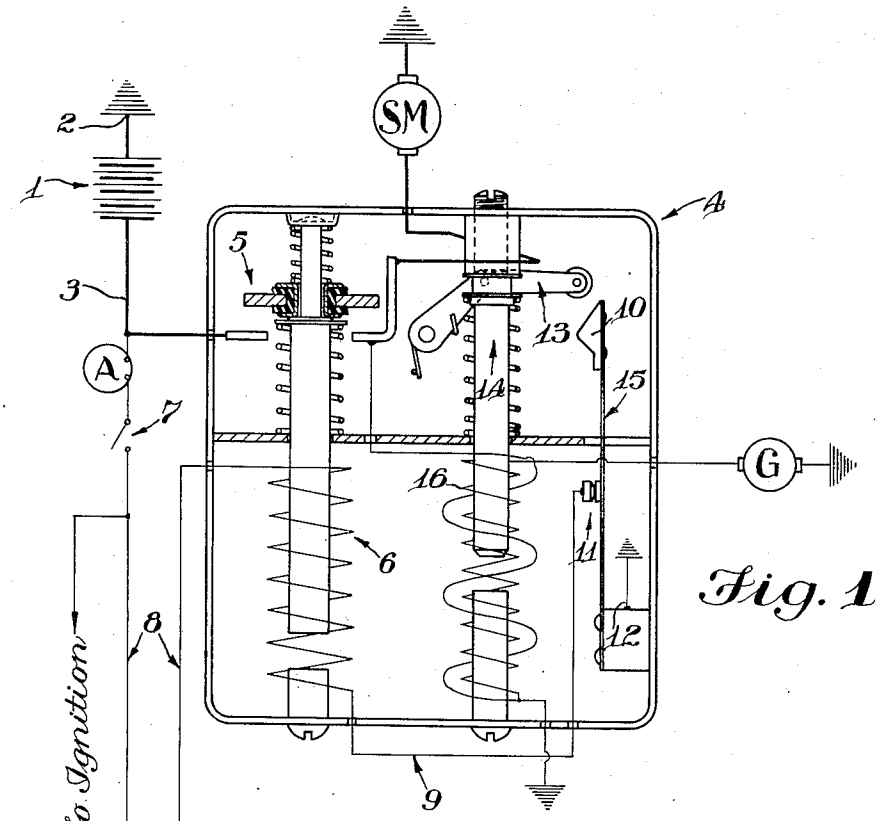


Fig. 1

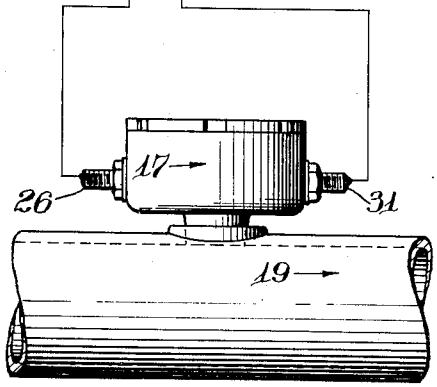
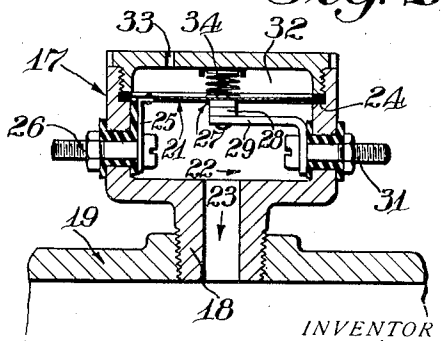


Fig. 2



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BACKFIRE RELEASE FOR INTERNAL COMBUSTION ENGINES

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This invention relates to a back-fire release for internal combustion engines and more particularly a device for minimizing the effect of backward rotation of an internal combustion engine on the auxiliary mechanism thereof and especially on the starting mechanism therefor.

It is well known that the accidental actuation of the starting mechanism when an internal combustion engine is rotating backward causes heavy stresses to be developed which may cause failure of the parts. When an automatic starting mechanism is employed for causing the engine to be cranked repeatedly until a successful start is secured, it therefore becomes important to prevent the operation thereof during backward rotation of the engine.

It is an object of this invention to provide novel means to prevent actuation of a starting mechanism during reverse rotation of the internal combustion engine.

Another object of the invention is to provide an automatic starting mechanism having novel means to maintain the starting mechanism inoperative while the engine is rotating backward.

A further object is to provide a novel device for use in connection with automatic starting mechanism for rendering such starting mechanism inoperative during reverse rotation of the engine, but automatically restoring the starting mechanism to operative condition when the reverse rotation ceases.

Further objects and advantages will be apparent to those skilled in this art from the following description taken in connection with the accompanying drawing in which:

Fig. 1 is a semi-diagrammatic view of a preferred embodiment of the invention shown in connection with an automatic starting mechanism of known type; and

Fig. 2 is an enlarged mid-sectional view of the back-fire releasing device.

Referring to the drawing, an electrical starting system for an internal combustion engine (not shown) is illustrated comprising a battery 1 grounded at 2 and connected to a starting motor SM through a lead 3 and an automatic controlling device indicated generally at 4 and comprising a starting switch 5 adapted to be closed by energization of a solenoid 6. Solenoid 6 is embodied in a control circuit including the ignition switch 7 of the engine, lead 8, lead 9, contacts 11 and ground connection 12. Contacts 11 are arranged to be opened by the action of a lever 13 which is moved by a solenoid plunger 14 to bend back the spring strip 15 carrying one of the contacts 11 when the engine starts. The plunger 14 is maintained in its lower position by means of a coil 16 energized from the generator G while the engine is in normal operation.

The device so far described and the operation thereof are known in the art, but it has been found that the generator coil 16 as usually constructed is not energized by the generator G sufficiently to retain the plunger 14 in its retracted position when the engine is rotating backward such as occasionally occurs for instance in the case of back-fire.

The present invention provides means to prevent the reactuation of the starting mechanism during back-fire conditions in spite of the de-energization of the generator coil 16, and the present embodiment employs for this purpose a device for breaking the control circuit of the solenoid 6 during backward rotation of the engine. As best shown in Fig. 2, this device comprises a casing 17 connected to the intake system of the engine as by means of an extension 18 threaded into the intake manifold of the engine, a portion of which is indicated at 19. A metallic diaphragm 21 is rigidly mounted in the casing 17 in a manner to form a closed chamber 22 in such casing, which chamber is in communication with the gases in the intake manifold through a passage 23 in the threaded extension 18. The diaphragm 21 is insulated from the casing as indicated at 24 and is connected as by means of a lead 25 to an insulated binding post 26 in the side of the casing. A contact 27 is carried by the diaphragm in position to normally engage a fixed contact 28 mounted on a bracket 29 connected to a second insulated binding post 31 in the side of the casing. The space 32 above the diaphragm is preferably vented to the atmosphere as indicated at 33, and a spring 34 is preferably provided for insuring the normal engagement of contacts 27 and 28.

The back-fire releasing device is placed in the control circuit of solenoid 6, and, as shown in Fig. 1, is preferably inserted in the lead 8 of the control circuit, the ends thereof being attached to the binding posts 26 and 31 whereby the contacts 27 and 28 are placed in series in the controlling circuit, and opening of said contacts renders solenoid 6 inoperative.

In operation, and starting with the parts in the positions illustrated, closure of the ignition switch 7 causes energization of the solenoid 6 to close the starting switch 5 and cause the engine, not illustrated, to be cranked. If the engine starts properly, the control plunger 14 is moved to open

contacts 11 and is held in its retracted position by the generator coil 16 as long as the engine is running. However, if the engine should give one or two explosions sufficient to disconnect the starting gearing and thereafter should back-fire, the generator coil 16 is deenergized and the contacts 11 allowed to close. The immediate operation of the starting mechanism is prevented, however, since the backward rotation of the engine operates as a pump to force gas back into the intake system, thus creating a pressure therein which is increased by the back-firing explosions. This pressure in the intake system is transmitted through the passage 23 to the diaphragm 21 causing the contact 27 to be moved away from contact 28, thus breaking the control circuit for the solenoid 6 and preventing closing of the starting switch as long as the pressure in the intake manifold persists. When the backward rotation ceases, the pressure in the intake system is dissipated and the diaphragm 21, assisted if necessary by the spring 34, returns the contact 27 into engagement with fixed contact 28, thus completing the control circuit and causing the cranking operation to be repeated.

In order to provide sufficient time delay to ensure the opening of contacts 27, 28 by the intake pressure before effective closure of contacts 11, the spring strip 15 is provided at its free end with a weight 18 which, when released by the lever 13, vibrates the spring strip for a suitable time before coming to rest and permitting effective closure of contacts 11.

It will thus be seen that there is here provided a device which automatically prevents the actuation of the starting mechanism while the engine is rotating rearwardly, but which restores the parts to operative condition when the rearward rotation ceases. It will be understood that the invention is not restricted to the details of the embodiment illustrated, since other embodiments utilizing the principles of the invention will readily suggest themselves to those skilled in the art, and since various changes may be made in the arrangements and methods of cooperation of the parts without departing from the spirit of the invention as defined in the claims appended hereto.

What is claimed is:—

1. In combination with an internal combustion engine having a fuel intake system and starting mechanism therefor, means actuated by positive pressure in the intake system of the engine greater than atmospheric pressure for preventing actuation of the starting mechanism.

2. In combination an internal combustion engine having an intake system functioning at subatmospheric pressure during normal operation of the engine, starting mechanism therefor including a starting switch, manually controllable means for actuating said starting switch, and means responsive to positive pressure in said intake system for preventing the actuation of said starting switch.

3. In combination with an internal combustion engine having a fuel intake system, a starting mechanism therefor including a starting switch, means including a control circuit for actuating said starting switch, and means responsive to positive pressure in the intake system of the engine above atmospheric pressure for preventing actuation of the control circuit to close the starting switch.

4. In combination with an internal combustion engine having a fuel intake system, an automatic starting mechanism therefor including manually controllable means for cranking said engine whenever forward rotation thereof ceases, and means actuated by positive pressure in the intake system of the engine above atmospheric pressure for preventing such cranking, said latter means being arranged to cause cranking to take place automatically as soon as the positive pressure in the intake system of the engine is dissipated.

5. An automatic controller for internal combustion engine starters comprising with an internal combustion engine, a starting motor circuit, an electro-magnetic switch in said circuit for controlling energizing of the motor, a relay controlling the energizing of said electro-magnetic switch and including contacts, and means actuated by pressure above atmosphere in the intake manifold for maintaining said contacts separated.

6. An automatic controller for internal combustion engine starters comprising with an internal combustion engine, a starting motor circuit, an electro-magnetic switch in said circuit for controlling energizing of the motor, a relay controlling the energizing of said electro-magnetic switch and including contacts, and means actuated by pressure above atmosphere in the intake manifold for maintaining said contacts separated, said means including a flexible diaphragm.

7. An automatic controller for internal combustion engine starters comprising with an internal combustion engine, a starting motor circuit, an electro-magnetic switch in said circuit for controlling energizing of the motor, a relay controlling the energizing of said electro-magnetic switch and including contacts, and means actuated by pressure above atmosphere in the intake manifold for maintaining said contacts separated, said means including a movable member subjected to such pressure.

8. In an automatic controller for internal combustion engine starters, an ignition circuit, a starting motor circuit, and means comprising a pressure-operated device for maintaining said starting motor circuit open after ignition occurs when pressure above atmosphere exists in the engine manifold.

9. In an automatic controller for internal combustion engine starters, an ignition circuit, a starting motor circuit, and means for maintaining said starting motor circuit open after ignition occurs when pressure above atmosphere exists in the engine manifold, comprising a pair of contacts and a pressure-operated device for opening said contacts.

10. In combination with an engine rotatable in opposite directions but operable in only one direction, and automatic starter operating mechanism, said mechanism being effective upon the cessation of operation of said engine, of fluid pressure means associated with said mechanism and said engine to render the mechanism inoperative while said engine is rotating in a reverse direction.

11. In combination with an engine having a manifold and an automatic starter operating mechanism, of fluid pressure controlling means associated with said mechanism, said means being associated with the manifold to render said mechanism inoperative while reverse engine rotation is occurring, and operative thereafter.

12. In combination, an engine, a starter, and an automatic starter actuating system opera-

tive, upon stalling of the engine, to actuate the starter, means associated with said system tending to render it inoperative during back-firing of the engine, and automatic means associated with said system tending to render it operative upon final stopping of the engine.

13. In an engine, the combination with an engine starting system including a starter device having automatic energizing control means associated therewith effective upon stopping of the engine, of fluid pressure means associated with said system automatically to render said control means inoperative when the engine back-fires and automatically to render said control means operative when the engine stops after back-firing.

14. In an automatic controller for internal combustion engine starters, a starting motor circuit, and means comprising a pressure-operated device for maintaining said starting motor circuit open when pressure above atmospheric exists in the engine intake manifold.

15. In an automatic control for internal combustion engine starters, a starting motor circuit, and means for maintaining said starting motor circuit open when pressure above atmospheric exists in the engine intake manifold comprising a pair of contacts, and a pressure-operated device for opening said contacts.

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