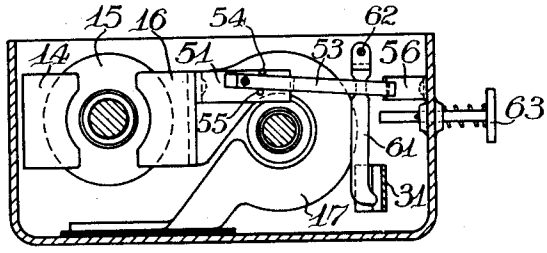
Jan. 9, 1934. F. T. CHRISTIAN 1,942,591

AUTOMATIC STARTING MECHANISM

Filed April 24, 1931

Fig. 2



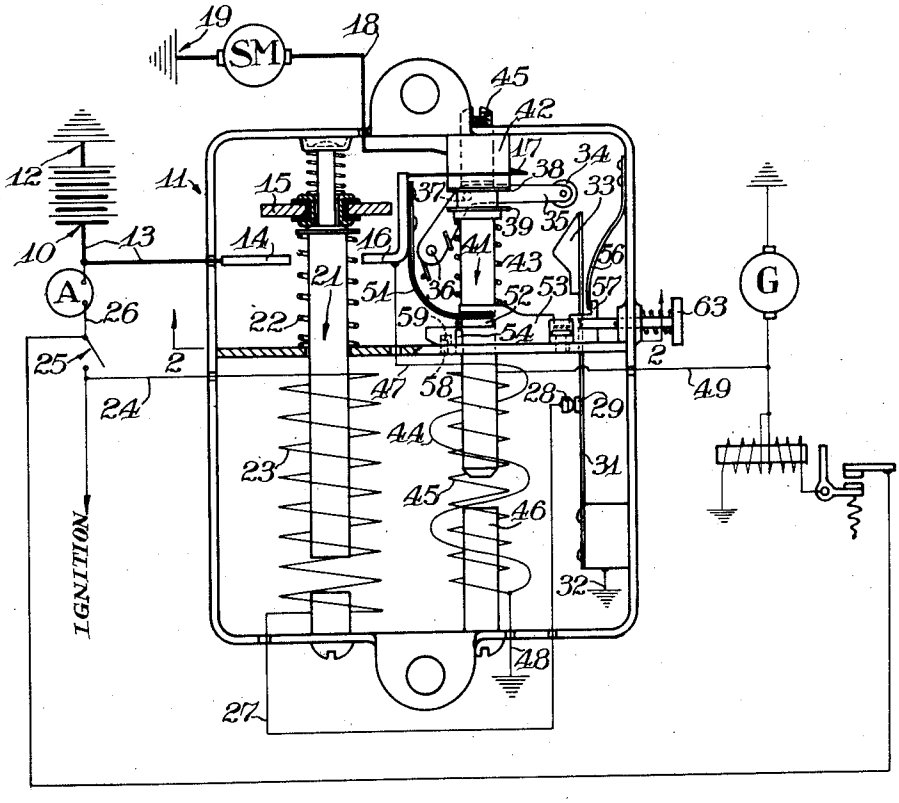


Fig. 1

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AUTOMATIC STARTING MECHANISM

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5 Claims. (Cl. 290—38)

This invention relates to automatic starting mechanism for internal combustion engines and more particularly to a device for protecting the starting mechanism and conserving the source of power in case the engine fails to start after a predetermined amount of cranking.

It is an object of the present invention to provide an automatic starting mechanism embodying novel means for causing the starting circuit to be opened after an expenditure of a predetermined amount of energy therethrough.

Another object is to provide such a device in which a rise in temperature of the starting circuit is caused to trip a circuit-breaking device.

A further object is to provide such a device in which the circuit-breaking mechanism operates by thermal conductivity from an element of the starting circuit which becomes heated by an unduly prolonged or excessive energization of the starting circuit.

Another object is to provide a device of the above character in which the circuit-breaking mechanism retains the starting circuit open until said mechanism is reset by the operator.

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 illustration of a preferred embodiment of the invention, the parts of the automatic starting mechanism being shown in elevation and partly in section; and

Fig. 2 is a section taken substantially on the line 2—2 of Fig. 1.

In Fig. 1 of the drawing there is illustrated an electrical system for an internal combustion engine including a source of electrical energy in the form of a battery 10, a generator G driven from the engine for charging said battery, a starting motor SM for cranking the engine, and an automatic starting switch mechanism indicated generally by the numeral 11 for controlling the starting motor.

The starting motor SM is included in a starting circuit comprising the battery 10 which is grounded at one terminal as indicated at 12, and which is connected by a lead 13 to a stationary element 14 of an automatic starting switch. An insulated movable bridging element 15 is adapted to connect the stationary element 14 with a second stationary element 16 which latter is connected through a single turn coil 17 and a lead 18 to the starting motor SM, the latter being grounded at 19 to complete the starting circuit.

The bridging element 15 of the starting switch is mounted as illustrated on a magnetic plunger 21 which is normally maintained in its upper position by suitable means such as a spring 22 and which is adapted to be moved downwardly to close the starting switch by means of a solenoid 23. Solenoid 23 is included in a control circuit which is adapted to be automatically closed when the engine stalls and to be opened when the engine starts. For this purpose one end of solenoid 23 is connected to the battery 10 through lead 24, manual switch 25, lead 26 in which an ammeter A may be inserted, and the battery lead 13. The manual switch 25 is preferably the ignition switch for the internal combustion engine as illustrated. The opposite end of solenoid 23 is connected by a lead 27 to a stationary contact 28 which is normally engaged by a movable contact 29 mounted on a spring strip 31 which is grounded as indicated at 32, thereby completing the control circuit.

The automatic operation of the control circuit is secured by suitable actuation of the movable contact 29. For this purpose, a wedge-shaped weight member 33 is mounted on the free end of the spring strip 31 in position to be engaged by a roller 34 which is carried by a lever 35 pivoted at 36 and carrying at an intermediate point a laterally extending pin 37. Pin 37 is adapted to be engaged by flanges 38 and 39 carried by a magnetic relay plunger 41. This relay plunger is normally retained in its upper position as illustrated against a spacing sleeve 42 by suitable means such as a spring 43 but is arranged to be attracted and held down in order to cause the roller 34 to engage the weight member 33 and move contact 29 out of engagement with contact 28. For this purpose, a voltage coil 44 and a generator coil 45 are arranged to surround the lower end of plunger 41 and when energized attract said plunger downward into engagement with a fixed magnetic pole piece 46. One end of voltage coil 44 is connected by a lead 47 to the stationary element 16 of the starting switch, and the other end is grounded as indicated at 48. One end of the generator coil 45 is connected to the generator through a lead 49 and is also grounded at 48.

According to the present invention, means are provided for moving the spring strip 31 backward to break the control circuit upon overheating of an element of the starting circuit such as would be caused by unduly prolonged cranking or by an attempt to start the engine when parts thereof were locked or jammed in a way to pre-

vent the cranking operation. For this purpose, a bi-metallic heat-responsive member or thermostat 51 is mounted at one end directly in contact with the fixed element 16 of the starting switch. The free end of the heat-responsive member 51 is arranged to engage in a notch 52 in a slidable latch member 53. This latch member is adapted to be guided for longitudinal movement in any suitable manner as by means of a pair of pins 54, 55 (Fig. 2) and is drawn toward the right in Fig. 1 by yielding means such as a spring strip 56 engaging a projection 57 on the end thereof. Latch member 53 is retained in its retracted position as illustrated in Fig. 1 by suitable restraining means such as a pin 58 which engages in a notch 59 and thus prevents motion of the latch member to the right under the influence of spring 56. A lever 61 (Fig. 2) pivoted at 62 is formed, as shown, to articulate with the latch 53 at an intermediate point thereof, and is arranged, when actuated by the latch 53, to engage at its free end the spring strip 31 and bend said strip backwardly, moving contact 29 away from contact 28.

The heat-responsive member 51 is arranged so that a rise in temperature thereof causes its free end to be deflected upwardly, thus raising the latch member 53 out of engagement with the retaining pin 58 and allowing the spring 56 to move the latch 53 and actuate the lever 61 to open contacts 29, 28. A manual resetting means for the device is provided in the form of a push button 63 the shaft if which is arranged in position to engage lever 61 and move it backwardly until the latch 53 reengages the pin 58.

In the normal operation of the device closure of the ignition switch 25 causes the control circuit to be completed whereby the solenoid 23 is energized to close the starting switch and cause the energization of the starting motor. At this time the voltage coil 44 is energized by reason of its connection with the element 16 of the starting switch but the heavy current traversing the single turn coil 17 magnetizes the adjustable core 45 therein sufficiently to prevent the retraction of the relay plunger 41.

When the engine starts, the reduction in current through the single turn coil 17 and the increase in voltage drop through the voltage coil 44 cause the latter to overcome the effect of the single turn coil 17 and attract the relay plunger 41 downwardly, thus causing the roller 34 to engage the weight member 33 and bend the spring strip 31 backwardly to open contacts 29, 28. The solenoid 23 is thereby deenergized and the starting switch is allowed to open. The voltage coil is not completely deenergized by the opening of the starter switch, however, but retains the relay plunger 41 in its lower position by reason of a small amount of current generated by the starting motor spinning by momentum in its residual field and traversing the voltage coil by reason of its ground connection at 48. Before the starting motor comes completely to rest, the generator G which is driven from the engine builds up sufficient voltage to energize the generator coil 45 and thus retain the relay plunger in its lower position as long as the engine is self-operative.

Should the engine fail to start for any reason after the cranking operation has been continued for a predetermined length of time, or should the cranking operation be prevented by a locking or jamming of the engine, the unduly prolonged or excessive amount of current flowing through the starting circuit causes heating of the elements of the starting switch including the element 16, and this heat is imparted by conduction to the heat-responsive member 51. The consequent deflection of the free end of the heat-responsive member causes the latch 53 to be lifted from the retaining pin 58 enabling the spring 56 to move the latch to the right and swing the lever 61 in a direction to engage the spring strip 31 and open contacts 29, 28. The control circuit is thus broken and maintained open by the spring 56. When the operator has corrected the inoperative conditon of the engine, the parts of the automatic starting mechanism are reset by pressing the push button 63 until the latch 53 reengages the pin 58. Thereupon, the ignition switch 25 being closed, the starting operation takes place in the normal manner.

Although but one form of the invention has been shown and described in detail, it will be understoood that various other embodiments are possible and certain changes may be made in the constructions 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. In automatic starting mechanism for internal combustion engines, a starting circuit including a source of electrical energy, a starting motor and a switch for controlling said motor; a control circuit for said switch including said source of energy, electro-magnetic means for actuating said starting switch and a pair of contacts; means for opening said contacts when the engine starts and for closing the same when the engine stalls, means for moving and maintaining said contacts in open position and means responsive to a predetermined rise in temperature in the starting circuit for initiating the action of said moving means.

2. In automatic starting mechanism for internal combustion engines, a starting circuit including a source of electrical energy; a starting motor and a switch for controlling said motor; a control circuit for said switch including said source of energy, electro-magnetic means for actuating said starting switch and a pair of contacts; means for opening said contacts when the engine starts and for closing the same when the engine stalls, means for moving and maintaining said contacts in open position and a heat-responsive member thermally connected to an element of said switch for causing said moving means to function at a predetermined temperature of said switch element.

3. Automatic starting mechanism for internal combustion engines including a starting motor circuit, a control circuit therefor including a pair of contacts, closure of which causes the control circuit to close the starting circuit, means for closing said contacts if the engine stalls and for opening the same when the engine starts, a second opening means for said contacts, means for restraining said second opening means, and means responsive to an overload on said starting circuit for tripping said restraining means.

4. Automatic starting mechanism for internal combustion engines including a starting motor circuit, a control circuit therefor including a pair of contacts, closure of which causes the control circuit to close the starting circuit, means for closing said contacts if the engine stalls and for opening the same when the engine starts, a second opening means for said contacts, means for restraining said second opening means, and a heat-responsive member thermally connected to

an element of the starting circuit for tripping said restraining means.

5. In an automatic starting mechanism for internal combustion engines, a starting circuit including a source of electrical energy and a magnetic starting switch, a control circuit for said switch including a pair of contacts, means for closing said contacts if the engine stalls and for opening the same when the engine starts, a second opening means for said contacts, means for restraining said second opening means, and means including a heat-responsive element thermally connected to an element of the starting switch for releasing said restraining means.

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