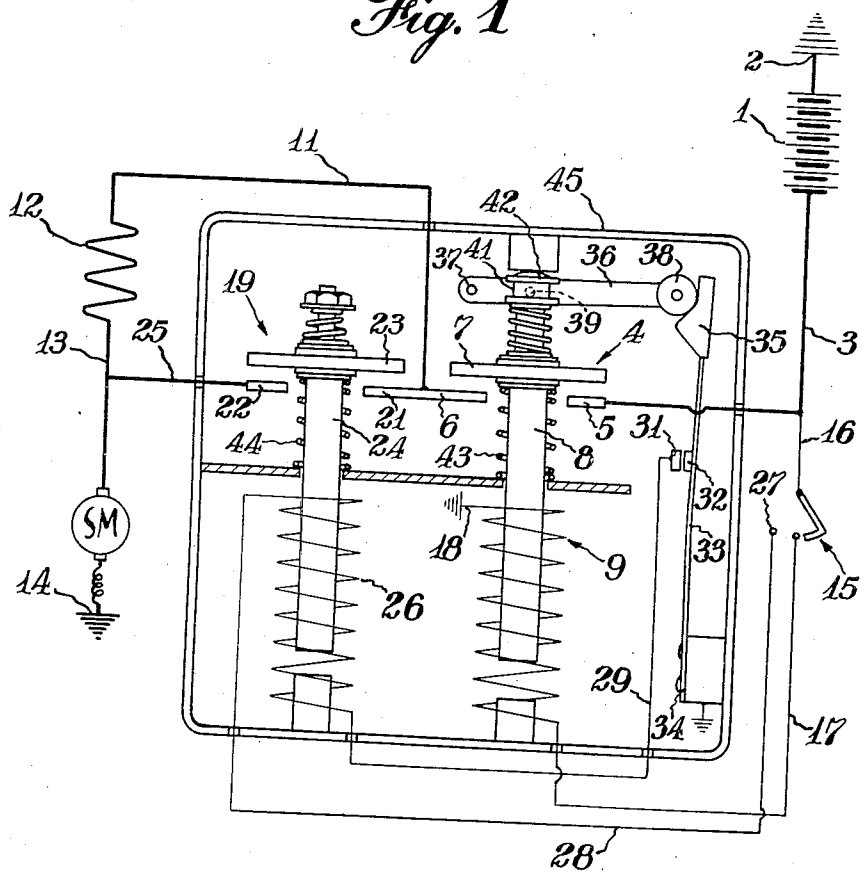
Aug. 27, 1940. M. H. ELKIN 2,213,160

ENGINE STARTER CONTROL

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Fig. 1



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Fig. 2

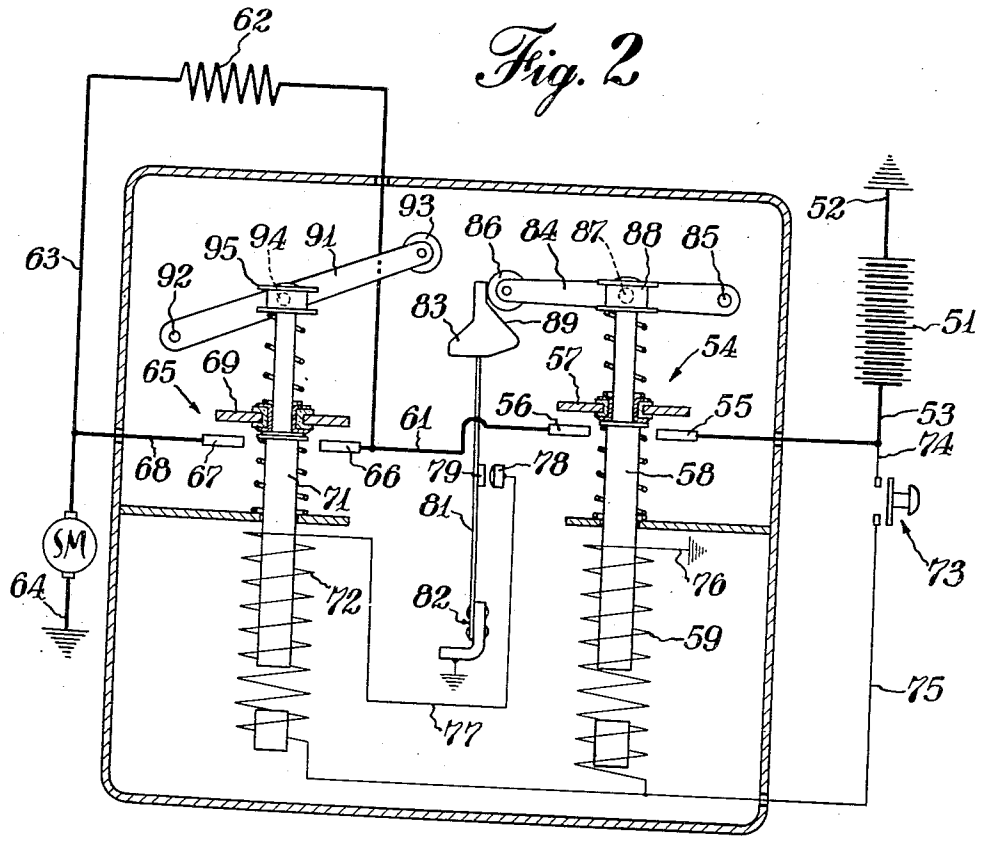
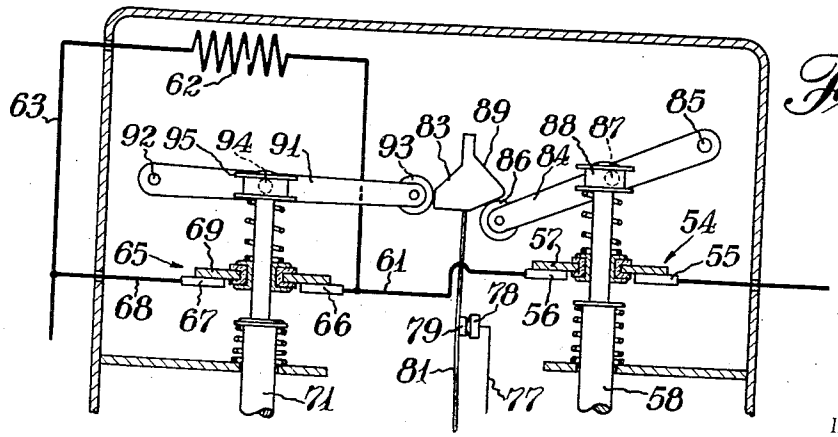


Fig. 3



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ENGINE STARTER CONTROL

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9 Claims. (Cl. 290—38)

The present invention relates to engine starter controls and more particularly to a two-stage starting system in which reduced voltage from a battery is initially applied to a starting motor to effect engagement of the starting gearing, after which the full battery voltage is utilized to crank the engine.

It is an object of the present invention to provide a novel two-stage starter control embodying a device for delaying the application of full battery voltage to the starting motor until a predetermined time after the initial energization thereof.

It is another object to provide such a device which is adapted for remote control as by means of a push button switch on a control board or instrument panel.

It is a further object to provide such a device in which the battery voltage initially applied to the starting motor by closure of the starting switch is reduced by a resistor in the starting circuit, which resistor is shunted by a switch to energize the starting motor from the full battery voltage after a predetermined time.

A further object is to provide such a device in which closure of the shunting switch is automatically delayed for a predetermined time after closure of the starting switch.

Another object is to provide such a device in which the shunting switch is arranged to open prior to the opening of the starting switch to reduce the current flow to be broken by the opening of the starting switch.

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

Fig. 1 is a semi-diagrammatic illustration of a starting system embodying a preferred form of the invention;

Fig. 2 is a similar view of a second embodiment; and

Fig. 3 is a detail of the mechanical interlocking switch control of Fig. 2 showing the parts in cranking position.

In Fig. 1 of the drawings there is illustrated a starting circuit including a battery 1 grounded at 2 and connected by a lead 3 to a magnetic starting switch indicated generally by numeral 4. Starting switch 4 comprises fixed contacts 5 and 6 and a movable contact 7 mounted on a magnetic plunger 8 which is arranged to be actuated by a solenoid 9 to effect closure of the starting switch. Contact 6 is connected by a lead 11 to a resistor 12 having a suitable value for reducing the voltage of the battery during the initial energization of the starting circuit. Resistor 12 is connected by a lead 13 to the starting motor SM which is grounded at 14 to complete the starting circuit.

It will be understood that the starting motor is provided with suitable gearing of conventional type for engaging and actuating a member of the engine to be started, and since these parts are in the usual form, it is deemed unnecessary to illustrate them in detail.

A control circuit for the solenoid 9 of the starting switch is provided comprising a manually operable switch 15 which may be in the form of a push button mounted on an instrument panel or control board. Switch 15 is connected by a lead 16 to the battery lead 3 and by a lead 17 to one end of the solenoid 9, the opposite end of which is grounded at 18 to complete the control circuit.

Means for bridging the resistor 12 to apply the full battery voltage to the starting motor, is provided comprising a bridging switch indicated generally by numeral 19. Bridging switch 19 comprises a fixed contact 21 which is connected to and may be formed integrally with the fixed contact 6 of the starting switch, a second fixed contact 22 and a movable contact 23 mounted on a magnetic plunger 24. Contact 22 is connected by a lead 25 to the starting circuit lead 13.

A solenoid 26 is provided for actuating the plunger 24 to close the bridging switch 19, and a control circuit for the solenoid 26 is provided including a second contact 27 on the manual switch 15, which contact is connected by a lead 29 to one end of the solenoid 26. The opposite end of solenoid 26 is connected by a lead 29 to a fixed contact 31. A movable contact 32 is mounted on a pendulous spring strip 33 which is anchored and grounded at one end as indicated at 34 and carries at its free end a weight or bob 35.

Means are provided for normally holding contacts 31, 32 open and for causing closure thereof a predetermined time after closure of the starting switch. As here shown, this actuating means comprises a lever 36 pivoted at 37 and provided with a roller 38 adapted to engage the bob 35 of the vibrator time delay and bend the pendulous strip 33 to hold open contacts 31, 32. A pin 39 fixed in the side of the lever 36 is arranged to engage in a channel 41 in a collar 42 fixed in any suitable way on the end of the plunger 8 of the starting switch whereby closure of the starting switch swings the lever 36 downward,

causing it to move out of engagement with the bob 35 The pendulous strip 33 is thus set in vibration, and after a predetermined time delay, contacts 31, 32 close and complete the control circuit for the bridging switch 19.

Springs 43 and 44 are provided for normally maintaining the switches 4 and 19 open as illustrated, and the assembly of the two magnetic switches with the vibrator time delay is preferably enclosed in a suitable box 45 on which the resistor 12 may be mounted if so desired in order to form a self-contained commercial unit.

In the operation of this device, closure of the manual switch 15 first effects closure of the control circuit for the starting switch 4 whereby the plunger 8 is actuated to close the starting switch and to release and set in vibration the time delay reed 33. Further pressure on the manual switch 15 causes engagement of contact 27 thereof whereby the control circuit for the bridging switch is completed up to the contact 31. Closure of the starting switch 4 causes initial energization of the starting motor at a voltage reduced by the resistor 12 to a suitable value for effecting engagement of the starter gearing. After a predetermined time delay, contact 32 comes to rest against contact 31, thus completing the control circuit for the bridging switch 19, causing closure thereof. Resistor 12 is thereby shunted out and the full battery voltage applied to the starting motor for cranking purposes.

When the engine starts, release of the manual switch 15 first breaks the control circuit for the bridging switch 19 at contact 27. Switch 19 thus opens and re-introduces the resistor 12 into the starting circuit, thus reducing the flow of current therethrough. Complete release of the manual switch 15 opens the control circuit for the starting switch 4, which then opens and interrupts the starting circuit. It will be noted that inasmuch as the starting switch is not required to break the full cranking current of the circuit, it may be made of lighter and more economical construction than would otherwise be possible, and the entire unit may be made of comparatively small dimensions and light weight.

In Fig. 2 of the drawings there is illustrated an embodiment of the invention in which a mechanical control is provided for ensuring that the bridging switch closes last and opens first. As there illustrated, a starting circuit is provided including a battery 51 grounded at 52 and connected by a lead 53 to a starting switch 54 comprising fixed contacts 55 and 56 and a movable contact 57 carried by a magnetic plunger 58 actuated by a solenoid 59. Contact 56 is connected by a lead 61 to a resistor 62 which is connected by a lead 63 to the starting motor SM which is grounded at 64 to complete the starting circuit.

Means are provided for bridging the resistor 62 to cause full energization of the starting motor comprising a bridging switch 65 having a fixed contact 66 connected to the starting circuit lead 61, a fixed contact 67 connected by a lead 68 to the starting circuit lead 63, and a bridging contact 69 mounted on magnetic plunger 71 which is actuated by solenoid 72.

A control circuit for solenoids 59 and 72 is provided comprising a manual switch such as a push button 73 connected by a lead 74 to the battery lead 53 and by a lead 75 to solenoids 59 and 72. Solenoid 59 is grounded at 76 to complete the control circuit therefor. Solenoid 72 is connected by a lead 77 to a fixed contact 78. A contact 79 is mounted adjacent contact 78 on a pendulous elastic reed 81 anchored and grounded at one end as indicated at 82 and having a weight or bob 83 on its free end.

Means are provided for normally holding contacts 78, 79 open so as to open the control circuit for solenoid 72 of the bridging switch, in the form of a lever 84 pivotally mounted at one end as indicated at 85 and provided at its free end with a roller 86 arranged to engage the bob 83 and hold open said contacts. Lever 84 is provided with a pin 87 arranged to engage in a channeled collar 88 fixed on the end of magnetic plunger 58 whereby operation of the plunger to close the starting switch 54 swings the lever 84, causing the roller 86 to roll down the inclined portion 89 of the bob and disengage therefrom, thus setting the reed 81 in vibration and permitting contacts 78, 79 to close after the vibration has ceased. Effective energization of the solenoid 72 is thus delayed for a predetermined time after closure of the starting switch 54.

According to the present invention, means are provided for holding the starting switch 54 closed until after the bridging switch 65 has opened. As here shown, this means comprises a lever 91 pivoted at one end as indicated at 92 and provided at its free end with a roller 93 adapted when the bridging switch 65 is closed to engage the bob 83 as shown in Fig. 3 and prevent backward motion thereof in a direction to open contacts 78, 79. The lever 84 is then held in its lower position by the bob 83, thereby locking the starting switch 54 closed. Means for actuating lever 91 from the bridging switch plunger 71 is provided in the form of a pin 94 on the lever engaging in a flanged collar 95 fixed to plunger 71.

In the operation of this embodiment of the invention, closure of the push button 73 causes energization of solenoid 59 whereby starting switch 54 is closed and the pendulous reed 81 set in vibration. Closure of the starting switch completes the starting circuit through resistor 62 whereby the starting motor is energized at a reduced voltage to cause engagement of the starter gearing. After a predetermined time of vibration, contacts 78, 79 close, thus causing energization of solenoid 72 which closes the bridging switch 65 and applies the full battery voltage to the starting motor to crank the engine.

When the engine starts, opening of the push button 73 by the operator deenergizes solenoids 59 and 72, whereby the bridging switch 65 is permitted to open, thus re-introducing the resistor 62 in the starting circuit and thereby cutting down the flow of current therethrough. The starting switch 54 is momentarily held closed by reason of the engagement of the roller 86 of lever 84 beneath the bob 83. When the bridging switch 65 opens, however, lever 91 is raised out of engagement with the bob 83, thus permitting the starting switch 54 to open. Switch 54, therefore, never breaks the starting circuit until after the resistor 62 has been replaced in said circuit whereby arcing and burning of the contacts of the starting switch are prevented. Since the proper sequence of operation of the starting and bridging switches is mechanically controlled in a positive manner, it is obvious that there is no possibility of overloading the starting switch by premature opening thereof, so that a much smaller and less expensive construction may be employed than would otherwise be required.

Although but certain embodiments of the invention have been shown and described in detail, it will be understood that other embodiments

are possible and various changes may be made in the design and arrangement of the parts without departing from the spirit of the invention as defined in the claims appended hereto.

What is claimed is:

1. In an engine starter control, a starting circuit including a battery, a starting motor, a starting switch and a resistor, a control circuit for the starting switch including a manual switch, a magnetic switch in shunt with the resistor, a control circuit for the shunt switch including said manual switch and a pair of normally open contacts, means operated by closure of the starting switch for causing closure of said contacts, and means for vibrating said contacts a predetermined time before effective closure thereof.

2. In an engine starter, a starting circuit including a battery, a motor, a starting switch and a resistor for reducing the voltage of the battery initially applied to the motor, means including a magnetic switch for providing a bridging circuit around said resistor to apply full battery voltage to the starting motor, manually controllable means for causing closure of the starting switch, a control circuit for said bridging switch including contacts closed by closure of the starting switch, and means for deenergizing said control circuit while the starting switch remains closed.

3. In combination with an engine starter including a battery, a starting motor and means responsive to energization of the starting motor for establishing a driving connection from the starting motor to a member of the engine to be started, a two-stage starter control therefor including a magnetic starting switch, closure of which energizes the starting motor sufficiently to establish said driving connection, and a shunt switch, closure of which causes the full battery voltage to be applied to the starting motor, said starting switch comprising a movable member, a control circuit for the shunt switch including a pair of contacts, one of which is pendulously mounted, and means operated by the movable member of the starting switch for holding the contacts open when the starting switch is open and for releasing and setting in vibration the pendulous contact when the starting switch closes.

4. In an engine starter, a battery, a starting motor, means including a magnetic starting switch and a resistor for applying reduced voltage from the battery to the motor, means including a magnetic switch for bridging the resistor to apply full battery voltage to the motor, and control circuits for said magnetic switches including a manual switch, closure of which causes energization first of the starting switch, then of the bridging switch, and opening of which causes deenergization first of the bridging switch and then of the starting switch.

5. In an engine starter, a battery, a starting motor, means including a magnetic starting switch and a resistor for applying reduced voltage from the battery to the motor, means including a magnetic switch for bridging the resistor to apply full battery voltage to the motor, control circuits for said magnetic switches including a manual switch, closure of which causes energization first of the starting switch, then of the bridging switch, and opening of which causes deenergization first of the bridging switch and then of the starting switch, the control circuit for the bridging switch also including a pair of normally open contacts, and means actuated by closure of the starting switch for effecting closure of said contacts.

6. In an engine starter control, a starting circuit including a magnetic starting switch and a resistor, a control circuit for the magnetic switch including a manual switch, a magnetic switch for bridging said resistor, a control circuit for the bridging switch including said manual switch, and means actuated by closure of the bridging switch for holding the starting switch closed.

7. In an engine starter control, a starting circuit including a magnetic starting switch and a resistor, a control circuit for the magnetic switch including a manual switch, a magnetic switch for bridging said resistor, a control circuit for the bridging switch incuding said manual switch and a pair of contacts, means actuated by closure of the starting switch for closing said contacts, and means actuated by closure of the bridging switch for holding the starting switch closed.

8. In an engine starter control, a starting circuit including a magnetic starting switch and a resistor, a control circuit for the magnetic switch including a manual switch, a magnetic switch for bridging said resistor, a control circuit for the bridging switch including said manual switch and a pair of contacts, one of which is pendulously mounted, means actuated by the starting switch for holding the pendulously mounted contact open when the starting switch is open and for setting the pendulous contact in vibration when the starting switch closes, and means actuated by closure of the bridging switch for so confining the contact controlling device as to prevent opening of the starting switch.

9. In a two-stage starter control for internal combustion engines, a starting switch, a resistor in series therewith, a shunt switch arranged to bridge the resistor, means actuated by the closing movement of the starting switch for causing closure of the shunt switch a predetermined time after closure of the starting switch, and manually operable means for opening first the shunt switch and then the starting switch.

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