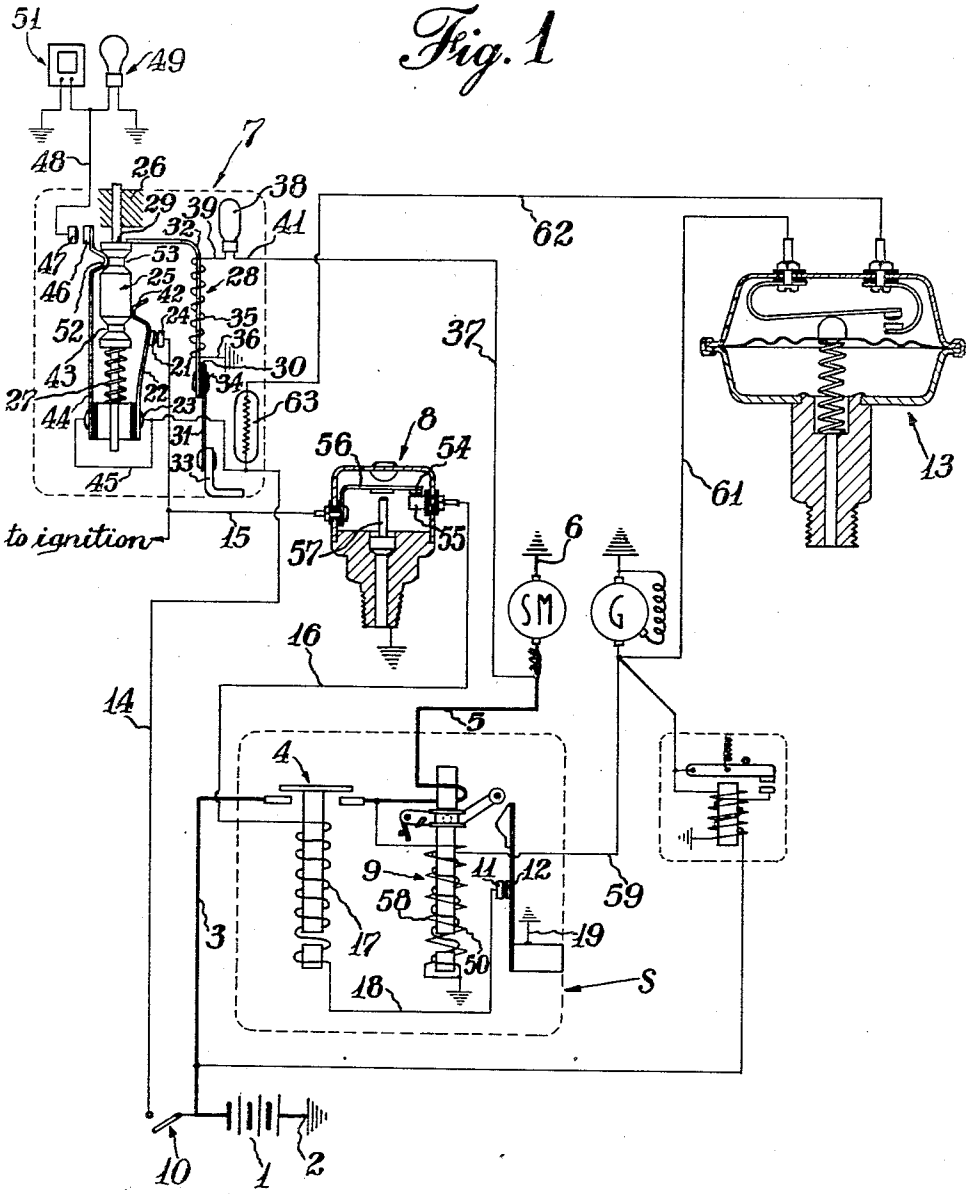
May 28, 1940. M. H. ELKIN 2,202,550

ENGINE STARTER CONTROL

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Fig. 1



Witness:
Burr W. Jones

INVENTOR.
BY Manuel H. Elkin
Clinton L. Jones
ATTORNEY.

May 28, 1940. M. H. ELKIN 2,202,550

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Fig. 2

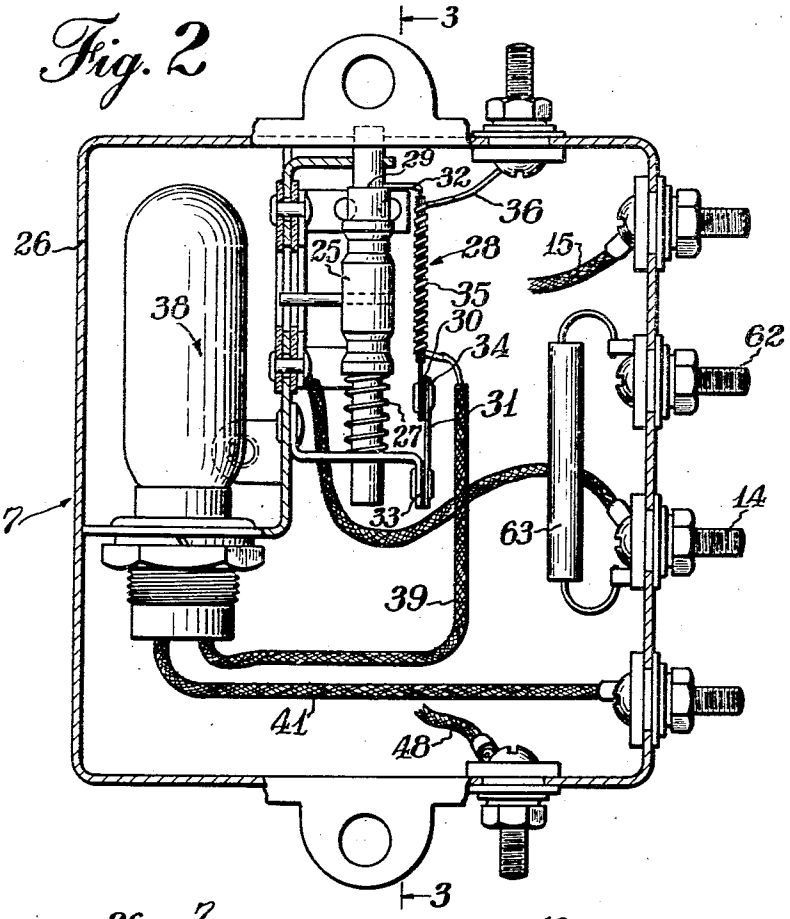
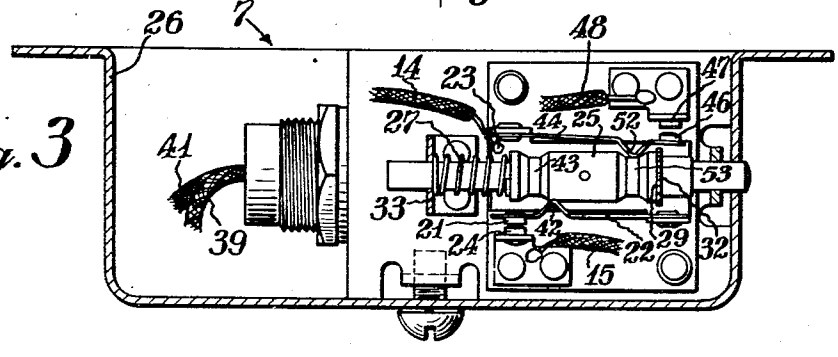


Fig. 3



Witness:
Bure W. Jones

INVENTOR.
Manuel H. Elkin
BY
Clinton S. Jones.
ATTORNEY.

Patented May 28, 1940 2,202,550

UNITED STATES PATENT OFFICE

2,202,550

ENGINE STARTER CONTROL

Manuel H. Elkin, Elmira Heights, N. Y., assignor, by mesne assignments, to Bendix Aviation Corporation, South Bend, Ind., a corporation of Delaware

Application June 29, 1938, Serial No. 216,554

4 Claims. (Cl. 290—37)

The present invention relates to automatic engine starter controls and more particularly to a device for automatically opening the circuit of an electrical starter if the engine fails to start for any reason after a predetermined time of cranking.

Various types of so-called cranking time limiters have heretofore been proposed and used to a considerable extent, most of which have depended on some form of thermostatic device which gradually heats up during cranking and breaks the starting circuit when a predetermined temperature is exceeded. Devices of this character as heretofore constructed have had the disadvantage that they are affected by the ambient temperature and are therefore not uniform in action. Moreover, since the battery which supplies power for heating the thermostat is usually the source of power for cranking the engine, a low battery and a cold engine may reduce the available voltage to a point where the thermostat will not heat up sufficiently to function, and abortive cranking may continue until the battery is completely discharged.

It is an object of the present invention to provide a novel cranking time limiter for automatic starter controls which is efficient and reliable in action while being simple and economical in construction.

It is another object to provide such a device which is substantially unaffected in its action by the prevailing ambient temperature.

It is another object to provide such a device which is substantially uniform in action irrespective of variations in the state of charge of the cranking battery or the comparative stiffness of the engine to be cranked.

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 an electrical system for an internal combustion engine including automatic starter controlling means embodying a preferred form of the present invention;

Fig. 2 is an enlarged detail in elevation and partly in section of the cranking time limiter device; and

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

In Fig. 1 of the drawings an electrical system is illustrated comprising a starting circuit including a battery 1 grounded at 2 and connected by a lead 3 to a commercial form of starter control device S including an electromagnetic starting switch 4 which is connected by a lead 5 to a starting motor SM grounded at 6 to complete the starting circuit.

A control circuit for the magnetic starting switch 4 is provided which includes battery 1, a thermostatic cranking time limiter device indicated generally by numeral 7, a backfire protective device 8 and the relay 9 of the starter control device S. Relay 9 includes contacts 11 and 12 which are maintained open during self-operation of the engine either by an engine-driven generator G or by an intake vacuum operated device 13. In greater detail, this control circuit comprises a lead 14 connected to the battery lead 3 by a manual ignition switch 10, and to the cranking time limiter 7, a lead 15 connecting the cranking time limiter to the backfire circuit breaker 8, a lead 16 connecting the circuit breaker to the coil 17 of the starting switch, and a lead 18 connecting said coil to contact 11, contact 12 being grounded as indicated at 19.

The cranking time limiter 7 comprises a contact 21 mounted on a spring arm 22 to which the power supply lead 14 is connected as indicated at 23. A fixed contact 24 to which the lead 15 is connected is arranged to cooperate with the contact 21. Contacts 21 and 24 are normally held in engagement by an actuating member in the form of a spring-pressed plunger 25 which is slidably mounted in the casing 26 of the cranking time limiter and is held in normal position against the action of a spring 27 by means of a latch 28 engaging a shoulder 29 on the plunger.

According to the present invention, the latch 28 is composed of two strips of thermostatic material 31 and 32, the strip 31 being rigidly mounted on the casing 26 in any suitable way as indicated at 33, and the strip 32 being attached at one end to the free end of the strip 31 as indicated at 34. A sheet of insulating material 30 such as mica is interposed between the attached ends of the thermostatic strips in order to oppose the transfer of heat by conduction from strip 32 to strip 31.

The thermostatic strip 31 is arranged with its high coefficient side away from the plunger 25 so that a rise in temperature of this strip tends to make it bend toward the plunger. The thermostatic strip 32, however, is oppositely arranged so that a rise in temperature thereof tends to make it bend away from the plunger 25 in a direction to unlatch the plunger. By this means, the latch 28 of such composite structure is substantially unaffected by changes in ambient tem-

perature since the reactions of the parts 31 and 32 to changes in ambient temperature substantially cancel each other.

Means are provided for applying heat to the thermostatic element 32 only of the latch 28 during the cranking operation including a heater coil 35 grounded at one end by means of a flexible lead 36, the other end being connected to a lead 37 attached to the starting motor lead 5 so as to be energized from the battery 1 during the cranking operation. In order that the heating effect of the coil 35 may be substantially uniform irrespective of variations in the condition of charge of the battery 1 and the stiffness of the engine to be cranked, means are provided for maintaining a substantially constant flow of current through the heater coil under all conditions. As here shown, this means is in the form of a ballast tube 38 connected by a lead 39 to the heater coil 35 and by a lead 41 to the supply lead 37.

The spring arm 22 carrying contact 21 is provided with a terminal loop 42 bearing on the surface of plunger 25 so as to maintain contacts 21, 24 closed while the plunger is retained in its normal position, as illustrated, by the latch 28. Plunger 25 is provided with a groove 43 which is moved by the spring 27 into registry with the loop 42 of spring arm 22 when the plunger is released by the latch, so as to permit contacts 21, 24 to open.

The contact actuating plunger 25 may also be arranged to operate a signal or alarm of any preferred type, and for this purpose a spring arm 44 is provided which is connected by a lead 45 to the supply lead 14 and carries a contact 46 adapted to cooperate with a fixed contact 47 connected by a lead 48 to one or more alarm devices such as a lamp 49 or a buzzer 51. The spring arm 44 is provided with a loop 52 normally resting in a groove 53 in plunger 25 so as to permit contacts 46, 47 to be open. Release of the plunger 25 by latch 28 causes the cylindrical portion of the plunger to engage the loop 52 of spring arm 44 and close contacts 46, 47.

The backfire circuit breaker 8 comprises a pair of contacts 54 and 55, contact 54 being mounted on a spring arm 56 connected to lead 16, and contact 55 being connected to lead 16. A plunger 57 is arranged to be actuated by intake pressure of the engine to be cranked in any suitable way, not illustrated, so as to engage the spring arm 56 and open contacts 54, 55. In order to secure a time delay prior to reclosure of these contacts, spring arm 56 is preferably made of thermostatic material and the plunger 57 is permitted to ground the circuit whereby a heavy flow of current through the thermostatic arm 56 heats it and causes it to expand away from contact 55.

The relay 9 of starter control S comprises a coil 58 energized from the starting circuit for opening the relay contacts when the engine starts, in the manner set forth in the patent to Loehr and Burdick No. 1,912,904. In order to hold open contacts 11, 12 during self-operation of the engine, relay 9 is provided with a coil 58 connected by a lead 59 to the engine-driven generator G. For isolated installations, the generator lockout is preferably supplemented by an intake vacuum lockout, here shown in the form of the vacuum switch 13 operated from engine intake vacuum by means of any suitable connections, not illustrated, and connected by the lead 61 to the generator coil lead 59, and by a lead 62 to the power supply lead 14 of the control circuit. Since the coil 58 of relay 9 is designed to operate on quite low voltage in order to perform its lockout function at low speeds of the generator, energization thereof by full battery voltage is unnecessary and might cause premature opening of contacts 11, 12 if the vacuum switch 13 is closed during cranking. It is preferred, therefore, to insert a resistance in the lead 62 to cut down the battery voltage to a suitable value. As here illustrated, this resistor is conveniently arranged in the casing 26 of the cranking time limiter as indicated at 63.

In the operation of the device, closure of the ignition switch 10 completes the control circuit from battery 1 through lead 14 to the cranking time limiter, through contacts 21, 24 thereof and lead 15 to the backfire circuit breaker 8, through contacts 54, 55 thereof and lead 16 to the coil 17 of the magnetic starting switch 4, and through lead 18 and contacts 11, 12 to the ground at 19. Consequent closure of the starting switch 4 completes the starting circuit through leads 3 and 5 to the starting motor which is thereupon energized to crank the engine. Upon closure of the starting circuit, current flows through leads 37, 41, ballast tube 38 and lead 39 to the heater coil 35 of the thermostatic latch 28, causing it to gradually heat up. If the engine becomes self-operative before the latch heats up sufficiently to release the plunger 25, the relay 9 opens contacts 11, 12, breaking the control circuit and opening the starting switch 4. Thereafter, contacts 11, 12 are held open by the coil 58 of the relay 9 as long as generator G is effective or there is sufficient vacuum in the engine intake to actuate the vacuum lockout device 13.

If, however, for some reason the engine should not start within a suitable predetermined time limit, the thermostatic element 32 of latch 28 becomes heated sufficiently to release the plunger 25. Contacts 21, 24 are thereupon opened, breaking the control circuit and causing the starting switch 4 to open, and contacts 46, 47 are closed to operate the signal devices 49, 51. When the starting switch 4 opens, the circuit for the heating coil 35 is also broken so that the coil cools off. It is merely necessary, therefore, for the attendant when summoned by the signal device to press the plunger 25 back to its normal position after correcting the condition of the engine which prevented it from starting, whereupon the starting operation will be resumed.

Although but one form of the invention has 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 magnetic starting switch, a control circuit therefor including a pair of contacts, means for holding the contacts normally closed including a slidable plunger, a latch holding the plunger in contact-closing position comprising two oppositely arranged thermostatic blades connected end to end, and a heating coil for one of said blades energized from the starting circuit to cause the latch to release the plunger and permit the contacts to open after a predetermined time of cranking.

2. In an engine starter, a starting circuit including a battery, a starting motor and a magnetic starting switch, a control circuit for the starting switch including a cranking time limiter having thermostatically opened contacts, and

contacts opened when the engine starts, an engine-driven generator, means energized thereby for holding open said last-mentioned contacts during self-operation of the engine, and means responsive to intake vacuum of the engine for energizing said holding means from the battery.

3. In an engine starter, a starting circuit including a battery, a starting motor and a magnetic starting switch, a control circuit for the starting switch including two sets of contacts in series, thermostatic means for opening one set of contacts after a predetermined time of closure of the starting switch, means for opening the second set of contacts responsive to self-operation of the engine, a generator driven by the engine to be started, a solenoid energized thereby to hold open the second set of contacts, a circuit from the battery through said solenoid including a resistor and a pair of normally open contacts, and means responsive to intake vacuum of the engine for closing said last-mentioned contacts.

4. An engine starter control as set forth in claim 1 characterized in that connecting means for energizing the heating coil for the thermostat are provided which include means for maintaining a substantially constant flow of current therethrough irrespective of variations in voltage.

MANUEL H. ELKIN.