May 14, 1946. A. J. SMITH 2,400,216

STARTING CONTROL CIRCUIT FOR ENGINES

Filed Aug. 14, 1944

Fig. 1

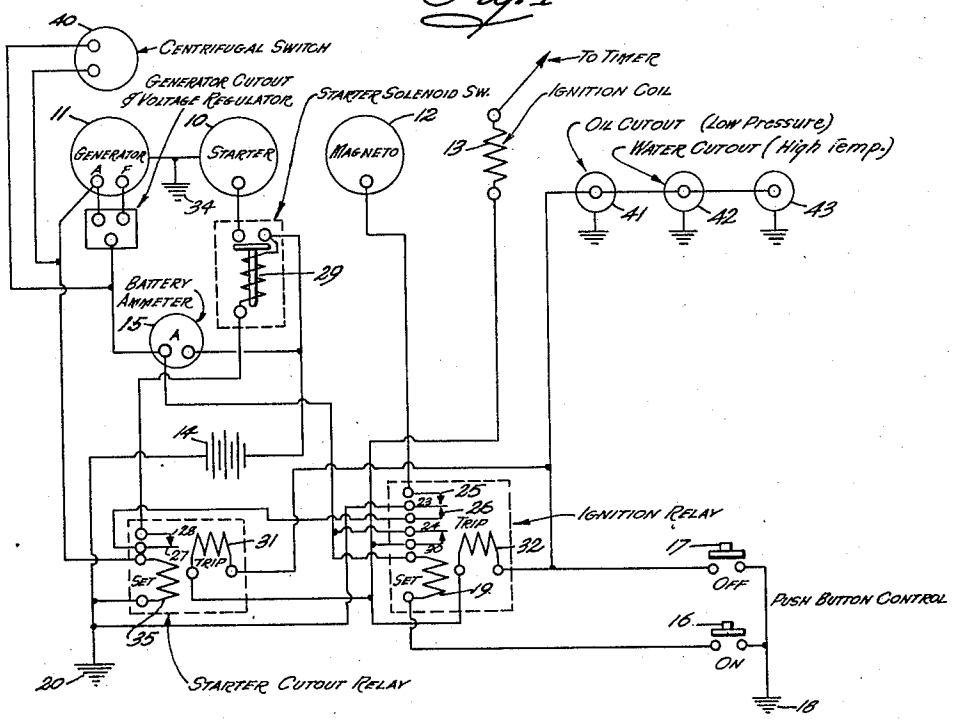
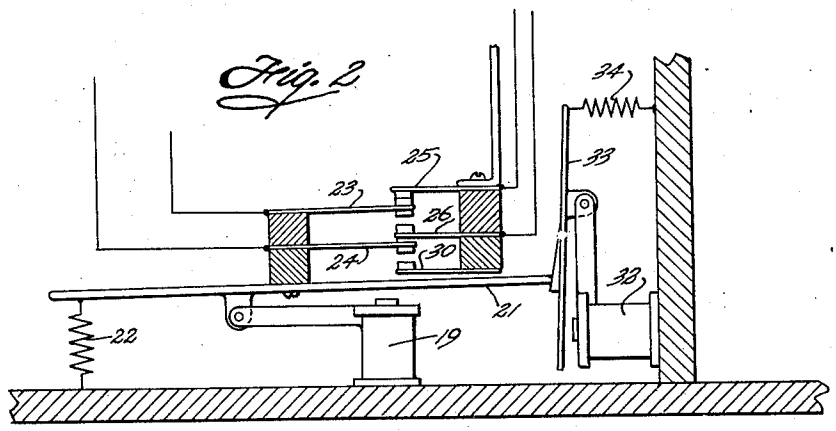


Fig. 2



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Patented May 14, 1946 2,400,216

UNITED STATES PATENT OFFICE

2,400,216

STARTING CONTROL CIRCUIT FOR ENGINES

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Application August 14, 1944, Serial No. 549,374

6 Claims. (Cl. 290—37)

This invention relates to a starting control circuit for engines.

Where engines are remotely located from switches controlling the circuit of the starting mechanism of the engine and in situations where engines have automatic starting devices, the build-up voltage of the charging generator of the engine has been commonly employed to actuate a relay that will open the starter circuit so that the starter cannot be operated while the engine is running. When the engine stops and the voltage of the charging generator drops, the starter control circuit is again closed to be ready for a subsequent operation upon the closing of the starter control switch.

A serious objection to the conventional control of the starter circuit by the build-up voltage of the charging generator resides in the fact that a failure of the generator, allowing its voltage to drop, allows the starter control circuit to again be restored so that on closing the starter switch the starter may operate even though the engine is still running despite the generator failure. If the starter is thus caused to operate while the engine is running there is danger of causing serious damage to the starter drive and the fly wheel of the engine.

An object of the present invention is to provide an improved starting control circuit for engines that are remotely operated or which have automatic starting mechanisms wherein the starter control circuit is opened by the starting of the engine and remains open regardless of the failure of the generator. In this way if the generator should fail, such as for example by its belt breaking, the starter control circuit will still be latched in open position so that it is impossible to operate the starter until after the engine has been deliberately stopped either by a manual or automatic control.

Another object of the invention is to provide an improved starting control circuit for engines wherein latch-type relays are used in the starter control circuit and in the magneto and/or ignition circuits which serve to latch open the starter control circuit when the engine has been started to latch open the magneto ground wire to latch closed the ignition circuit and to latch closed trip coils associated with the latch-type relays that serve to release the latches of the latch-type relay when manual or automatic control switches are closed.

With the foregoing and other objects in view which will be manifest in the following detailed description and specifically pointed out in the appended claims, reference is had to the accompanying drawing, wherein:

Figure 1 is a wiring diagram of the starter control circuit embodying the present invention, illustrating the circuit in somewhat simplified form; and

Fig. 2 is a view illustrating one of the latch-type relays that are employed as part of the starter control circuit embodying the present invention.

Referring to the accompanying drawing wherein similar reference characters designate similar parts throughout, the present invention relates to the starter control circuit of an internal combustion engine, not shown, which may have an electrically operated starter indicated at 10, a charging generator 11, a magneto 12, an ignition coil 13, a battery 14, and an ammeter 15. The starter may have its control circuit energized by the closing of a manual or automatic switch 16 which may be remotely located from the engine. A similar switch indicated at 17 which also may be remotely located is intended to effect a shutting off of the engine.

In carrying out the present invention one side of switch 16 may be grounded as indicated at 18, and the other side of this switch is connected through a set coil 19 of a latch-type relay through the ammeter 15 to the ungrounded side of battery 14. The other side of the battery is grounded as indicated at 20. The set coil 19 serves to attract an armature 21 against the action of its spring 22. This armature carries contacts 23 and 24. In the normal position of the armature 21 contact 23 engages contact 25 which is in the circuit connecting magneto 12 to ground 20. Contact 23 is normally spaced from contact 26 which is in circuit with a contact 27 that is normally electrically connected by its engagement with contact 28 with the starter solenoid switch 29. The contact 24 is normally out of engagement with contact 30 which, in turn, is electrically connected to one side of each of two trip coils 31 and 32. Contact 24 is connected through ammeter 15 to the ungrounded side of battery 14 and contact 23 which is connected to ground 20 will ground contacts 25 or 26, depending on which of these contacts it engages.

Adjacent the armature 21 there is a pivoted latch 33 actuated by a spring 34 into latching position to hold the armature in the position to which it may have been moved by the attraction of the set coil 19.

The starter circuit includes ground 34, the solenoid switch 29, and battery 14. The coil of

the solenoid switch is connected to contact 28 which is normally engaged by contact 27 of the starter cut-out relay which has a set coil 35 and a trip coil 31. The starter cut-out relay is also a latch-type relay similar to that illustrated in Fig. 2, except that its armature carries only contact 27. When the set coil 35 is energized movement of the armature of this latch-type relay causes contact 27 to disengage contact 28 and to be latched in open position until such time as its trip coil 31 is energized which attracts its latch corresponding to latch 33 and allows contact 27 to reengage contact 28 and thus again close the circuit from contact 26 through the coil of the starter solenoid switch. The set coil 35 has one side connected to ground 20 and the other side connected to the armature of generator 11. The generator is connected through a cut-out and voltage regulator to the ammeter 15 and thence to the battery 14.

The operation and advantages of the above-described construction are as follows: Assuming that the engine is stopped, on closing switch 16 set coil 19 is energized attracting armature 21 and causing contact 23 to disengage contact 25 which opens the ground on the primary of magneto 12. Simultaneously contact 23 will engage contact 26 which closes the circuit through contacts 27 and 28 to the starter solenoid switch 29. When the starter solenoid switch is thus actuated battery 14 is connected through the starter 10 to ground 34 and the starter operates to start the engine. Acuation of armature 21 also causes contact 24 to engage contact 30, thus closing the circuit to the ignition coil 13. It will be understood that the engine may either have battery ignition or magneto ignition or as frequently occurs, the same engine may be equipped with both magneto and battery ignition.

When the engine starts, generator 11 builds up voltage and when this voltage is sufficient to correspond to normal running conditions it causes the set coil 35 of the starter cut-out relay to be energized. This attracts its armature causing contact 27 to disengage contact 28. The armature of the starter cut-out relay is latched in this attracted position and remains so latched until trip coil 31 is energized. In this manner after the engine has started, the starter control circuit which includes the starter solenoid switch 29 is opened and held open until trip coil 31 is energized. Consequently, if generator 11 should fail for any reason, such as for example by its belt breaking, set coil 35 may no longer be energized but as its armature is held in latched position, contacts 27 and 28 are held open. Consequently, even if switch 16 should again be closed, the starter control circuit which includes starter solenoid switch 29 can not be closed due to contacts 27 and 28 still being open. In this manner, it is impossible to actuate the starter 11 while the engine is running even though the generator may have failed. In order to re-establish the starting control circuit it is necessary to either deliberately or automatically energize trip coil 31. Thus, if switch 17 is closed, this causes trip coils 31 and 32 to both be energized to actuate their respective latches and release their respective armatures. When the trip coil 32 is energized and armature 21 is released, the magneto is grounded by contact 23 engaging contact 25. The ignition coil circuit is opened by contact 24 disengaging contact 30 and the trip coil circuits are themselves opened by the opening of these same contacts 24 and 30. Contact 23 on disengaging contact 26 also opens the starter control circuit, preventing operation of the starter with the ignition relay in the trip position, even though contacts 27 and 28 may be closed. Energizing of trip coil 31 enables contact 27 to reengage contact 28, thus making the starter control circuit ready for operation again by re-closure of the ignition relay or closing switch 16. With the engine having thus been shut down by the closing of switch 17, the starter control circuit is thus restored and the starter may then be operated by closing switch 16.

In lieu of or in addition to employing the generator 11 to energize set coil 35 a centrifugal switch 30 may be connected between the ammeter 15 and one side of the set coil of the starter cutout relay. This centrifugal switch is designed to close when the engine has been brought up to a predetermined speed. When it closes it, of course, energizes the set coil 35 opening contacts 27 and 28, thus opening the starter control circuit as previously described.

In the event of failure of the centrifugal switch while operating so that set coil 35 is no longer energized, contacts 27 and 28 do not immediately close but are held open until trip coil 31 is energized, such as by closing of switch 17.

The engine may have various automatic control devices indicated at 41, 42 and 43. For example, 41 may be an oil cutout operating upon a serious drop in lubricating oil pressure, 42 a high water temperature cutout and 43 an overspeed cutout. Other automatic controls may be employed if desired to automatically energize trip coils 31 and 32 in the event of various contingencies. The details of these various cutouts are not illustrated other than to indicate that in the event of their respective contingencies they close the circuit through the trip coils to ground. Thus in the event that the oil pressure of the engine is low or the level of oil in the crankcase is low, or the temperature of the engine cooling water becomes excessively high or the engine speed rises above a predetermined value, these cutouts may serve to actuate the trip coils 31 and 32 to automatically stop the engine. Their effect upon the trip coils and upon the starter control circuit is the same as if switch 17 were closed, thus shutting down the engine. If one of the cutouts 41, 42 or 43 are closed, to shut down the engine, the engine may thereafter be momentarily started on closing switch 16, but as soon as this switch is opened, these cutouts will immediately energize the trip coils 31 and 32 to again shut the engine down.

While switch 16 is illustrated as being a manually operated remote switch, it will be appreciated that this switch may be an automatic cycling switch such as that illustrated in the copending application of John H. Wallace, Serial No. 488,199, filed May 24, 1943, or it may be any other automatic switch designed to start the engine at predetermined times. In the event that the engine protective cutouts such as 41, 42 or 43 are not employed for engine protection and the engine stops without switch 17 having been closed, such as for example by the exhaustion of fuel in the fuel supply, then in order to restart the engine it is necessary to first close said switch 17 which closes the circuit to the trip coils of both relays.

From the above-described construction it will be appreciated that an improved starter control circuit is provided which protects the engine against operation of the starter by switch 16, even in the event that the generator 11 or cen-

trifugal switch 40 should fail while the engine is running. By the improved construction it is impossible to operate the starter 10 unless the engine has been deliberately or automatically shut down by the closing of switch 17 or the equivalent thereof occasioned by operation of the cutouts 41, 42 or 43. Consequently danger of damage to the starter mechanism is largely eliminated inasmuch as the starter mechanism cannot ordinarily be operated while the engine is running.

Various changes may be made in the details of construction without departing from the spirit and scope of the invention as defined by the appended claims.

I claim:

1. In combination with an engine having an electrically operated starter, a set coil adapted to be energized upon the starting of the engine, a pair of contacts in circuit with the starter normally urged into engagement so as to ready the starter circuit but adapted to be opened when the set coil is energized to render the starter circuit inoperative, means for latching said contacts out of engagement when the set coil has been energized, and a trip coil adapted when energized to cause said latch means to release the contacts for reengagement, and means for energizing the trip coil.

2. In combination with an engine having an electrically operated starter, a set coil adapted to be energized upon the starting of the engine, a pair of contacts in circuit with the starter normally urged into engagement so as to ready the starter circuit but adapted to be opened when the set coil is energized to render the starter circuit inoperative, means for mechanically latching said contacts out of engagement when the set coil has been energized, and a trip coil adapted when energized to cause said latch means to release the contacts for reengagement, and means for energizing the trip coil.

3. In combination with an engine having an electrically operated starter, a set coil adapted to be energized upon the starting of the engine, a pair of contacts normally urged into engagement to ready the starter circuit but adapted to be opened when the set coil is energized to render the starter circuit inoperative, means for mechanically holding said contacts open after having been opened by the set coil, and a relay having contacts arranged to close the starter circuit through the mentioned contacts and to close the ignition circuit of the engine.

4. In combination with an engine having an electrically operated starter, a set coil adapted to be energized upon the starting of the engine, a pair of contacts normally urged into engagement to ready the starter circuit but adapted to be opened when the set coil is energized to render the starter circuit inoperative, means for mechanically holding said contacts open after having been opened by the set coil, and an ignition relay having a set coil and normally open contacts adapted to be actuated by the set coil to close the starter circuit through the first-mentioned pair of contacts when they are closed and to also close the ignition circuit of the engine, means for energizing the set coil of the ignition relay, means for mechanically latching the contacts of the ignition relay in the position they are moved to by the energizing of the set coil of the ignition relay, a trip coil for causing said latch means to release the contacts of the ignition relay to allow them to open, and means for energizing the last-mentioned trip coil.

5. In combination with an engine having an electric starter, a starter cutout relay having a set coil adapted to be energized when the engine is started and normally closed contacts controlling the starter circuit adapted to be opened when the set coil is energized, means for mechanically latching said contacts in open position, a trip coil for causing the latch means to release, an ignition relay having a set coil adapted to be energized, normally open contacts adapted to be actuated thereby to close the starter circuit through the first-mentioned contacts when they are closed, and to close the ignition circuit of the engine, means for mechanically latching the contacts of the ignition relay in closed position, an ignition relay trip coil adapted to release the latch means of the ignition relay, means for energizing the set coil of the ignition relay, and means for energizing both trip coils.

6. In combination with an internal combustion engine having an electric starter, a starter cutout relay having normally closed contacts in the starter circuit, an ignition relay having normally open contacts in the starter circuit, set coils for both of said relays adapted to open the contacts of the starter cutout relay and close the contacts of the ignition relay, means for energizing the set coil of the starter cutout relay when the engine has been started, means for energizing the set coil of the ignition relay, latch means for latching the contacts of both of said relays in the positions assumed when their set coils have been energized, trip coil means for releasing the latch means of both of said relays, and means for energizing the trip coil means to allow the contacts of both relays to return to their normal positions.

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