

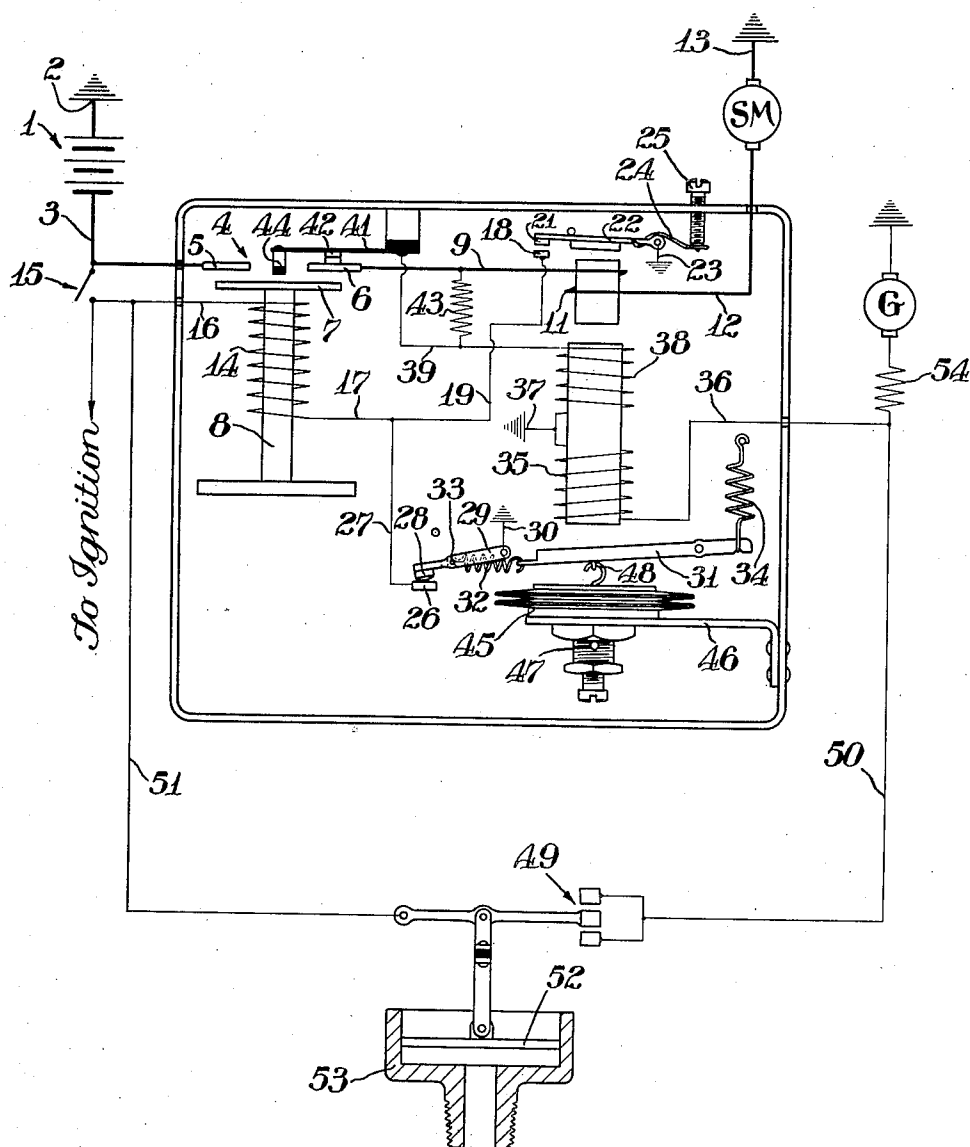
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AUTOMATIC STARTING MECHANISM

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Witness:

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AUTOMATIC STARTING MECHANISM

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This invention relates to automatic starting mechanism for internal combustion engines and more particularly to controlling devices for operating a starting mechanism in case of engine stall and for preventing actuation thereof during self-operation of the engine.

In controlling mechanism of this character including an automatic starter drive it is desirable among other features that provision be made to take care of false starting conditions, that is, situations in which the engine starts sufficiently to disconnect the starter drive as by throwing out the driving pinion, and then dies. If the starting motor is still spinning rapidly by momentum when this happens, immediate reclosure of the starting switch may fail to cause reengagement of the starter drive because the automatic engagement thereof is usually dependent on the acceleration of the starting motor.

Structure has heretofore been provided for preventing reclosure of the starting switch while the starting motor is spinning by utilizing the small amount of current then generated by the starting motor, and the present invention relates particularly to a motor-spin hold-out device of this type.

It is an object of the present invention to provide a novel automatic control device for starting mechanism including a motor-spin hold-out which is effective and reliable under all conditions of service.

It is another object to provide such a device which utilizes the counter electro-motive force of the starting motor to prevent reactivation of the starting mechanism while the motor is spinning by momentum.

It is a further object to provide such a device including structure arranged to cooperate with the motor-spin hold-out structure to cause release of the starting mechanism when the engine starts.

It is another object of the invention to provide such a device which includes instrumentalities for insuring steady and continuous cranking of the engine.

Further objects and advantages will be apparent to those skilled in this art from the following description taken in connection

with the accompanying drawing which illustrates semi-diagrammatically a preferred embodiment of the invention.

Referring to the drawing, there is illustrated a starting system for an internal combustion engine, not shown, including a battery 1, grounded at 2 and connected by a lead 3 to a magnetic starting switch indicated generally at 4 and comprising stationary electrodes 5 and 6 adapted to be bridged by a movable electrode 7 mounted on a magnetic plunger 8. Electrode 6 is connected by a lead 9 to a single turn coil 11 which is connected in turn by a lead 12 to a starting motor SM which is grounded at 13 to complete the starting circuit. Starting switch 4 is controlled by a solenoid 14 which is energized from battery 1 by a control circuit including a manual switch 15, lead 16, lead 17, and two sets of control relay contacts in parallel arranged when closed to ground the lead 17 and complete the control circuit.

One set of these contacts comprises a fixed contact 18 connected by a lead 19 to the lead 17 and a movable contact 21 mounted on a pivoted armature 22 which is grounded at 23. Contacts 18 and 21 are arranged to be closed by the action of the single turn coil 11 on armatures 22, and are arranged to be opened by suitable means such as a spring 24 having a tension adjustment 25.

The other set of contacts comprises a fixed contact 26 connected by a lead 27 to the lead 17, and a movable contact 28 mounted on a pivoted arm 29 which is arranged to be operated by a pivoted armature 31 by means of a yielding element such as a spring 32 pivoted to the arm 29 at 33. Contacts 26, 28 are normally held closed by suitable means such as a spring 34 acting on the armature 31. Means are provided for holding contacts 26, 28 open during self-operation of the engine in the form of a coil 35 connected by a lead 36 to an engine driven generator G, and grounded as indicated at 37 whereby actuation of the generator serves to maintain the armature 31 in its contact-open position.

According to the present invention, means are provided for holding the armature 31 in its contact-open position in case of a false

start until after the starting motor has come substantially to rest. As here illustrated, this means includes a coil 38 grounded at one end at 37 and connected by a lead 39 to a spring strip 41 carrying a contact 42 which is normally in engagement with the starting switch electrode 6. It will thus be seen that when the starting motor SM is spinning by momentum, the coil 38 is connected directly to the starting motor lead 9 whereby said coil will be energized by the current then generated by the starting motor. Said coil is so designed as to efficiently utilize the current so generated in holding the armature 31 in its attracted position during the spinning of the starting motor.

The coil 38 is also utilized to open contacts 26, 28 when the engine starts. For this purpose, the lead 39 is connected to the starting circuit lead 9 through a suitable resistance 43, and means are provided for withdrawing contact 42 from engagement with electrode 6 while the starting circuit is energized from the battery 1, in order that a suitable portion only of the effective voltage of the battery 1 shall be applied to energize the coil 38. As here shown the disconnecting means is in the form of a block of insulating material 44 mounted on the end of the spring strip 41 in position to be engaged by the movable electrode 7 of the starting switch and to be moved thereby so as to disengage contact 42 from electrode 6 when the starting switch is closed. It will thus be seen that when the starting switch is open, the coil 38 is connected directly to the motor side of the starting switch, but when the starting switch is closed, said coil will be energized from the starting circuit through the resistance 43.

Suitable means for delaying the actuation of the armature 31 is preferably provided and is here shown in the form of a collapsible bellows 45 having one end mounted on a fixed bracket 46 and having an adjustable bleeder opening 47, the free end of said bellows being universally connected to the armature 31 as indicated at 48.

Means are preferably provided for supplementing the generator G in energizing the coil 35 to retain the contacts 26, 28 open during self-operation of the engine. As here shown, such means comprises a set of contacts 49 arranged to connect the coil 36 through leads 50 and 51 to the battery lead 16 whenever piston 52 is moved in either direction from its normal position by positive or negative pressure within cylinder 53. It will be understood that cylinder 53 is connected to an engine-operated source of fluid pressure not illustrated such as the intake manifold of the engine. A resistance 54 is preferably provided between the generator G and the lead 50 in order to prevent discharge of the battery through the generator at times when the

generator is ineffective such as during back-fire of the engine.

In operation, starting with the parts in the positions illustrated, closure of the manual switch 15 completes the control circuit through contacts 26, 28 to the ground at 30 whereby solenoid 14 is energized to attract plunger 8 and move the bridging electrode 7 into engagement with electrodes 5 and 6. Prior to engaging the fixed electrodes, electrode 7 engages the block 44, moving contact 42 out of engagement with electrode 6. Closure of the starting switch 4 causes energization of the starting motor SM to crank the engine and also energizes the single turn coil 11 to close contacts 18, 21. At this time, coil 38 is also energized from battery 1 through the resistance 43, whereby armature 31 is attracted to cause opening of contacts 26, 28. The toggle connection formed by the spring 32 and pivoted arm 29 in conjunction with the time delay bellows 45 is effective to prevent opening of contacts 26, 28 until after closure of contacts 18, 21 whereby the control circuit for the solenoid 14 is maintained closed and steady cranking is obtained until the engine starts.

When the engine starts, the reduction in the load on the starting motor causes the single turn coil 11 to be weakened to allow spring 24 to open contacts 18, 21 thus breaking the control circuit through solenoid 14 and allowing the starting switch 4 to open. Contact 42 is thus allowed to engage electrode 6 thereby shorting out the resistance 43 and connecting the coil 38 directly to the starting motor lead 9. Coil 38 is thus maintained energized by the current generated by the starting motor while it is spinning by momentum, thereby retaining armature 31 in its retracted position until the starting motor comes substantially to rest. If it should happen therefore that the engine should die after the first explosion or so, reclosure of the starting switch is delayed sufficiently to insure reengagement of the starter drive.

It will be understood that the current generated by the starting motor while it is spinning by momentum is comparatively feeble, and the coil 38 is designed primarily to make the most efficient use thereof. For this reason it is desirable to prevent the application of the full battery voltage to said coil. The resistance 43 is therefore utilized to cut down the battery voltage to a suitable value to be applied to the coil 38, and the contact 42 and the operating means therefor is provided for shorting out this resistance when the starting motor lead 9 is disconnected from the battery.

Although but one embodiment of the invention has been shown and described in detail, it will be understood that other embodiments are possible and that various changes may be made in the design 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 an automatic starting mechanism for internal combustion engines, a starting system including a battery, a motor and a starting switch, means energized by a portion of the effective voltage of the battery for causing said starting switch to open when the engine starts, and means responsive to opening of said starting switch for disconnecting said opening means from the battery and connecting it directly to said starting motor.
2. In an automatic starting mechanism for internal combustion engines, a starting system including a battery, a motor and a starting switch, a coil energized by a portion of the effective voltage of the battery for causing said starting switch to open when the engine starts, and means responsive to opening of said starting switch for disconnecting said coil from the battery and connecting it to be energized directly by the starting motor during spinning thereof.
3. In an electrical system for internal combustion engines, a starting system including a battery, a starting motor and a starting switch, a control relay for said starting switch including a pair of contacts, means including a coil energized by the starting motor for preventing closure of said contacts during motor spin, and means including said starting switch and a resistance in series therewith for energizing said coil from the battery during cranking of the engine.
4. In an electrical system for internal combustion engines, a starting system including a battery, a starting motor and a starting switch, a control relay for said starting switch including an electro-magnetic coil, a resistance in series with said coil, connections for energizing said coil from the battery through the resistance during cranking of the engine, and means for connecting said coil directly to said motor responsive to opening of said starting switch.
5. An automatic starting mechanism for internal combustion engines including a battery, a motor, and a magnetic starting switch, a control circuit for said magnetic switch including a pair of contacts, means including a coil arranged when energized to open said contacts, means for energizing said coil by a portion of the battery voltage when the starting switch is closed and means responsive to opening of the starting switch for connecting said coil directly to the starting motor.
6. An automatic starting mechanism for internal combustion engines including a battery, a motor, and a magnetic starting switch, a control circuit for said magnetic switch including a pair of contacts, means including a coil arranged when energized to open said contacts, a resistance in series with the coil,

means for energizing said coil from the starting motor circuit through said resistance when the starting switch is closed, and means for shorting said resistance when the starting switch is opened.

In testimony whereof, I have hereunto signed my name.

PAUL MAURER.