

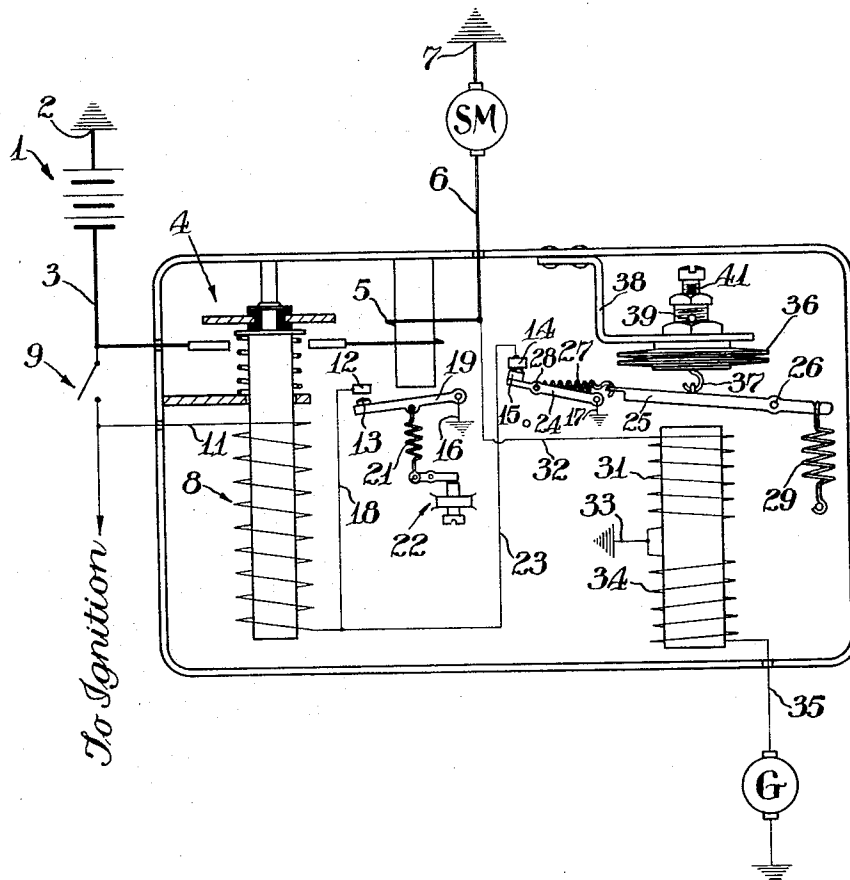
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P. MAURER

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AUTOMATIC STARTING MECHANISM

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Burr W. Jones

INVENTOR

BY *Paul Maurer*
Clinton S. Carr
ATTORNEY

Clinton S. Jones
ATTORNEY

ATTORNEY

UNITED STATES PATENT OFFICE

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AUTOMATIC STARTING MECHANISM

Paul Maurer, Clifton, N. J., assignor to Eclipse Machine Company, Elmira, N. Y., a corporation of New York

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This invention relates to automatic starting mechanism for internal combustion engines and more particularly to controlling devices for causing automatic operation of the starting mechanism in case of engine stall.

In mechanism of this character it is desirable that some device be incorporated for introducing a delay between the time the engine stops rotating and the actuation of the starting mechanism. The engine is thus allowed to come completely to rest before actuation of the starting mechanism, thus avoiding the possibility of throwing unnecessary stresses on the starting mechanism by engagement thereof when the engine is rocking backward.

It is further desirable that provision be made to prevent the relay from "kicking in" at slow idling speeds when an engine is apt to run unevenly or "roll", even though the engine may be substantially stationary at intervals between such rolls.

It is an object of the present invention to provide a controlling device for automatic starting mechanism having a novel time delay arrangement which is efficient and reliable under all conditions of service.

It is another object to provide such a device in which the time delay is effective to prevent the relay from actuating the starting mechanism at slow idling speeds and during engine roll.

It is a further object to provide such a device in which the time delay assists in insuring steady and continuous cranking of the engine.

Further objects and advantages will be apparent 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 an electrical starting system for an internal combustion engine, not shown, including a battery 1 grounded at 2 and connected by a lead 3 to a magnetically operated starting switch 4. The switch 4 is connected through a single turn solenoid 5 and lead 6 to a starting motor SM which is grounded at 7 to complete the starting circuit.

The starting switch 4 is arranged to be operated by a solenoid 8 which is energized from battery 1 through a control circuit comprising battery lead 3, a manual switch 9, lead 11, and two sets of contacts 12, 13 and 14, 15 arranged in parallel and grounded as indicated at 16 and 17 to complete the control circuit. Contact 12 is connected to solenoid 8 by a lead 18 and contact 13 is mounted on a pivoted armature 19 and normally maintained out of engagement with contact 12 by means of a spring 21. Armature 19 is arranged to be attracted by solenoid 5 to close contacts 12, 13 during the cranking operation, but the tension of spring 21 is set by suitable adjusting means such as indicated at 22 so that these contacts will open as soon as the current through the solenoid 5 is reduced by the relief of the load on the starting motor when the engine starts. Contact 14 is connected to solenoid 8 by lead 23 and contact 15 is mounted on a pivoted lever 24 the position of which is controlled by an operating member in the form of an armature 25 pivoted at 26 and connected by a spring 27 to a pin 28 on the lever 24 in such manner as to form an elastic toggle lost motion connection between armature 25 and lever 24. Armature 25 is normally maintained in position to close contacts 14, 15 by suitable means such as a spring 29 and is arranged to be moved to open said contacts by a solenoid 31 connected by a lead 32 to the starting motor lead 6, the opposite end of said solenoid being grounded at 33. Means are provided for maintaining the armature 25 in its attracted position in the form of a solenoid 34 connected by a lead 35 to an engine driven generator G and also grounded at 33.

According to the present invention means are provided for retarding the motion of the armature 25 in both directions, the retardation of its downward movement, in connection with the lost motion connection between the armature 25 and lever 24 being effective to delay the opening of contacts 14, 15 and the retardation of the return movement of armature 25 delaying the closing movement of said contacts. As here illustrated, this delaying device is in the form of a flexible chamber or bellows 36 one end of which is provided with a universal connection to the armature as indicated at 37 and the other end of which is anchored in a bracket 38 and is provided with a bleeder opening 39 which may be adjusted by suitable means such as a needle valve indicated at 41. It will thus be seen that motion of armature 25 to open or to close contacts 14, 15 will cause deformation of the bellows 36, which deformation will be retarded in accordance with the adjustment of the bleeder opening 39. The bellows 36 may be formed of resilient material and biased toward collapsed position, in which case the spring 29 may be dispensed with.

In the operation of the device, starting with the parts in the positions illustrated, closure of the manual switch 9 completes the control circuit through contacts 14, 15 to the ground at 17, 110

thus energizing solenoid 8 and causing closure of the starting switch 4 and initiating the cranking operation. Solenoid 5 being energized by the cranking current causes the armature 19 to close contacts 12, 13 and hold them closed during the cranking operation. Completion of the starting circuit causes energization of solenoid 31 which attracts the armature 25 and causes contacts 14, 15 to be opened. Since, however, the armature 25 must move sufficiently to pass beyond a dead center position with respect to the toggle formed by lever 24 and spring 27 and since the motion of the armature 25 is retarded by the bellows 36 as above pointed out, it is clear that contacts 14, 15 will not be opened until after contacts 12, 13 have had ample time to close, whereby the possibility of interrupted cranking due to premature opening of the contacts 14, 15 is effectively prevented.

As soon as the engine becomes self-operative, the weakening of solenoid 5 by the reduction in the current through the starting circuit allows spring 21 to open contacts 12, 13 thereby opening the control circuit and causing the starting switch 4 to be opened. Solenoid 31 is disconnected from the battery 1 by the opening of starting switch 4, but is not thus completely deenergized since it is traversed by a slight amount of current generated by the armature of the starting motor spinning in its residual field. Meanwhile, the generator G, being driven by the engine, energizes solenoid 34 which maintains armature 25 in its switch open position as long as the engine is self-operative.

If the generator G should be slow in picking up, the armature 25 might be partially released and move upward to some extent under the action of the releasing spring 29 or the contraction of bellows 36. However, this motion is retarded by the bellows 36 under the control of the bleeder opening 39, which is adjusted to delay closure of contacts 14, 15 for a period of time sufficient to allow the generator G to energize solenoid 34 and retract the armature 25. Likewise, during slow idling of the engine, should the engine run unevenly or roll, the generator G might be rotated at intervals so slowly that the solenoid 34 would be ineffective to retain the armature 25. However, the time delay mechanism including the lost motion connection to the lever 24 is effective to prevent closing of contacts 14, 15 during the intervals of slow rotation.

Should the engine stall, the consequent deenergization of the generator solenoid 34 allows contacts 14, 15 to close, but the time delay mechanism prevents such closure until a predetermined time after the deenergization of said solenoid, as determined by the adjustment of the needle valve 41 whereby the engine is given sufficient time to come completely to rest before reactivation of the starting motor.

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 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 electric system for internal combustion engines, a starting system including a magnetic starting switch, a control circuit therefor including two sets of contacts in parallel, means responsive to the initiation of the cranking operation for opening one set of contacts, means

for opening the other set of contacts when the engine starts, and means for delaying the reclosure of the first set of contacts until a predetermined time after the engine comes substantially to rest.

2. In an electric system for internal combustion engines, a starting system including a magnetic starting switch, a control circuit therefor including two sets of contacts in parallel, means responsive to the initiation of the cranking operation for opening one set of contacts, means for opening the other set of contacts when the engine starts, means for delaying the reclosure of the first set of contacts including a chamber having a flexible wall and a bleeder opening, and means whereby opening and closing of said contacts causes deformation of said chamber.

3. In an electrical system for internal combustion engines, a starting system including a magnetic starting switch, a control circuit therefor including a set of normally open contacts and a set of normally closed contacts in parallel, means responsive to the initiation of the cranking operation for closing the normally open contacts and opening the normally closed contacts and means for delaying the opening of the normally closed contacts for a predetermined time.

4. In an electrical system for internal combustion engines, a starting system including a magnetic starting switch, a control circuit therefor including a set of normally open contacts and a set of normally closed contacts in parallel, means responsive to the initiation of the cranking operation for closing the normally open contacts and opening the normally closed contacts, means responsive to self-operation of the engine for opening the normally open contacts and holding open said normally closed contacts, and means for delaying reclosure of the normally closed contacts for a predetermined time after the engine stops.

5. In an electrical system for internal combustion engines, a starting system including a magnetic starting switch, a control circuit therefor including a set of normally open contacts and a set of normally closed contacts in parallel, means responsive to the initiation of the cranking operation for closing the normally open contacts and opening the normally closed contacts, means responsive to self-operation of the engine for opening the normally open contacts and holding open said normally closed contacts, said means including an operating member; and means for delaying the action of said operating member including a chamber having a flexible wall operatively connected thereto and having a bleeder opening therein.

6. Automatic starting mechanism for internal combustion engines including a magnetic starting switch, a control circuit for said switch including a pair of contacts, means for holding said contacts open during the self-operation of the engine including an operating member including a chamber having a flexible wall and a bleeder opening and connections whereby motion of the operating member deforms said chamber; and a toggle lost motion connection between the operating member and said contacts whereby initial and partial movements of the operating member are not transmitted to said contacts.

7. Automatic starting mechanism for internal combustion engines including a magnetic starting switch, a control circuit for said switch, including a pair of contacts; an operating member for said contacts, yielding means normally bias-

ing said operating member toward closed position, means responsive to self-operation of the engine for holding said operating member in open position and a lost motion connection between said operating member and said contacts whereby partial closing movements of the operating member due to fluctuations in idling speed of the engine do not affect said contacts.

8. Automatic starting mechanism for internal combustion engines including a magnetic starting switch, a control circuit for said switch including a pair of contacts, an operating member for said contacts, yielding means normally biasing said operating member toward closed position, means responsive to self-operation of the engine for holding said operating member in open position, a lost motion connection between said operating member and said contacts whereby partial closing movements of the operating member due to fluctuations in the idling speed of the engine do not affect said contacts, and an adjustable means for

retarding the motion of said operating member.

9. Automatic starting mechanism for internal combustion engines including a magnetic starting switch, a control circuit for said switch including a pair of contacts, an operating member for said contacts, yielding means normally biasing said operating member toward closed position, means responsive to self-operation of the engine for holding said operating member in open position, a lost motion connection between said operating member and said contacts whereby partial closing movements of the operating member due to fluctuations in the idling speed of the engine do not affect said contacts, and means for retarding motion of the operating member in both directions including a chamber having a flexible wall and an adjustable bleeder opening and connections whereby the motion of the operating member causes deformation of said chamber.

PAUL MAURER.

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