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SEMIAUTOMATIC STARTING MECHANISM

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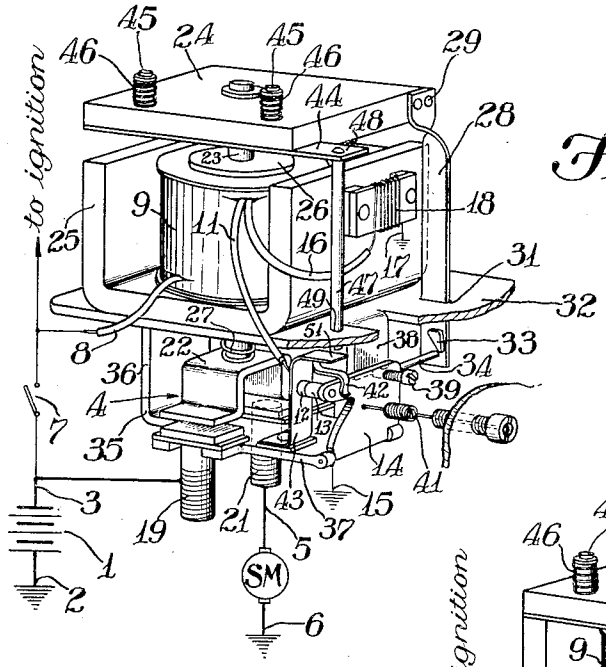


Fig. 1

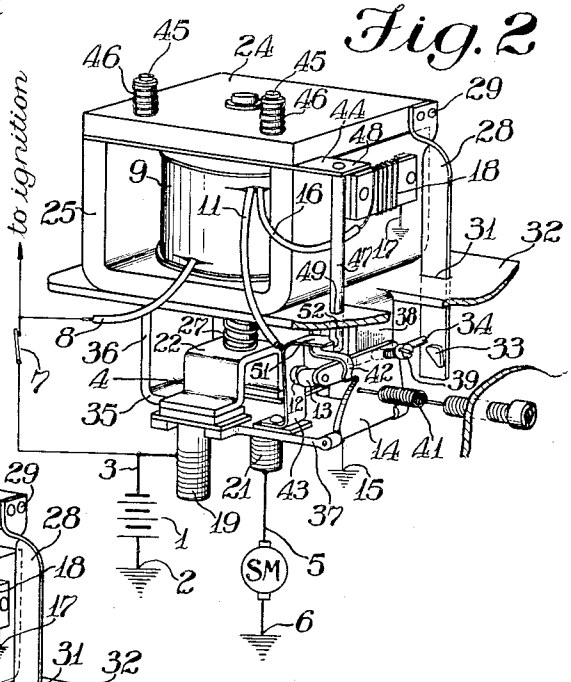
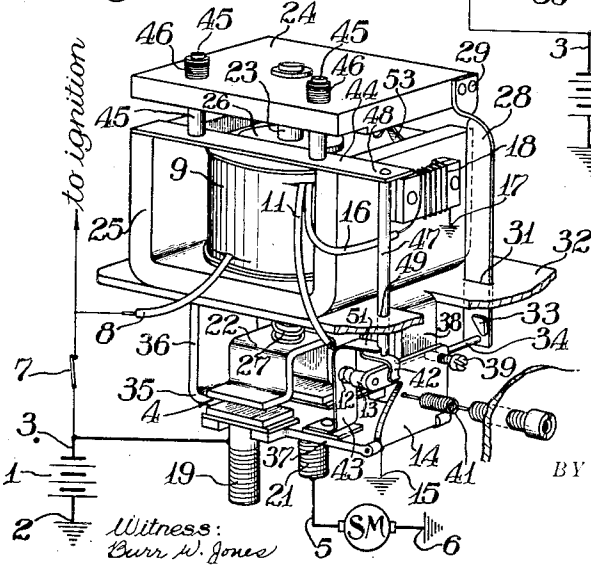


Fig. 2

Fig. 3



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SEMIAUTOMATIC STARTING MECHANISM

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9 Claims. (Cl. 290—38)

This invention relates to a semi-automatic starting mechanism for internal combustion engines and more particularly to a controlling relay for a starting system so arranged that manipulation of a manual switch such as the ignition switch of the engine initiates the cranking operation, the cranking being automatically interrupted when the engine starts, and the starting system being maintained inoperative until the ignition switch is opened and reclosed.

It is an object of the present invention to provide a semi-automatic starting mechanism of the above type which is efficient and reliable while simple and economical in construction.

It is another object to provide such a device which is independent of any running function of the engine for its operation.

It is a further object to provide such a device which uses a function of the starting motor to cause disconnection of the starting mechanism when the engine starts.

It is another object to provide such a device which is easily installed by means of simple wiring connections.

Further objects and advantages will be apparent from the following description in conjunction with the accompanying drawing in which:

Fig. 1 is a semi-diagrammatic view showing in perspective a preferred embodiment of the invention, the parts being shown in normal or idle position and some thereof being cut away for the sake of clarity;

Fig. 2 is a similar view showing the parts in the positions assumed during the cranking operation; and

Fig. 3 is a similar view showing the parts in the positions assumed during the self-operation of the engine.

Referring first to Fig. 1 of 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 starter controlling device including a magnetic starting switch, indicated generally by numeral 4, the starting switch being connected by a lead 5 to a starting motor SM which is grounded at 6 to complete the starting circuit.

A control circuit for the magnetic starting switch is provided comprising the battery 1, lead 3, a manual switch 7 which is preferably the ignition switch for the engine, lead 8 and electromagnet 9. The control circuit is normally completed from electromagnet 9 through lead 11, contact 12, contact 13 normally in engagement therewith, and swinging armature 14 carrying the contact 13, which armature is grounded to complete the control circuit as indicated at 15.

An alternative ground connection for the electromagnet 9 is provided in the form of a lead 16 which is grounded as indicated at 17 through an element 18 having sufficient resistance to substantially weaken the electromagnet 9 when the contacts 12, 13 are open.

The starting switch 4 comprises stationary contact members 19 and 21 and a bridging conductor 22 mounted on a rod 23 traversing the electromagnet 9 and provided at its upper end with an armature 24 arranged to cooperate with a U-shaped field member 25 and a central pole piece 26 which are magnetized by the electromagnet 9. The bridging element 22 of the switch is mounted for limited sliding movement on the lower end of the rod 23 against the compression of a spring 27 whereby the armature 24 is permitted to engage the pole 26 and field 25 by a slight additional movement after the switch element 22 has engaged the contacts 19, 21.

Contacts 12, 13 are arranged to be normally closed so as to cause energization of electromagnet 9 when the ignition switch 7 is closed, but according to the present invention, means are provided for causing the contacts to be opened when the engine starts and to be held open as long as the operator-controlled ignition switch 7 remains closed. This is accomplished by providing means actuated by the closing of the starting switch for displacing the contacts 12, 13 in unison to cause them to be tensioned toward open position, means for holding said contacts together in displaced position during the cranking operation, which means releases the contacts when the engine starts, and means for holding the contact 12 in displaced position as long as the ignition switch is closed, whereby the release of the contact 13 when the engine starts causes the contacts to open and remain open.

The means for displacing the contacts 12, 13 as here shown comprises an actuating element in the form of a bar 28 attached at its upper end to the armature 24 as indicated at 29 and arranged to slide through a guide opening 31 in a frame member 32. The lower end of the bar 28 carries a triangular shaped cam 33 arranged to engage with a pin 34 projecting from the pivoted armature 14. The cam member 33 is approximately in the form of a right triangle the side forming the hypotenuse of which is arranged as illustrated in Fig. 1 to move the pin 34 in a direction to swing the armature 14 toward the starting switch 4

when the bar 28 is moved downward by the main armature 24. The altitude of the right triangle is slightly less than the total travel of the bar 28 whereby when the armature 24 is in its fully closed position, the cam 33 has passed slightly below the pin 34, as shown in Fig. 2, leaving the armature 14 free to return to idle position.

The means for holding the contacts 12, 13 in displaced position comprises an L-shaped member 35 of magnetic material, one arm 36 of which is arranged to contact the frame plate 32 which is also of magnetic material and the other arm of which forms the support 37 for the swinging armature 14. The member 35 thus traverses the U-shaped loop formed by the elements 19, 22, 21 of the starting switch and is accordingly magnetized by cranking current traversing said switch elements. A fixed pole piece for the armature 14 is provided as here illustrated by bending down a tongue 38 from the frame plate 32 into close proximity to the upper end of the armature 14, means such as a non-magnetic adjusting screw 39 being preferably provided for regulating the minimum air gap between the armature and pole piece and thereby regulating the retaining force exerted by the cranking current. Adjustable yielding means in the form of a spring 41 is provided for normally holding the armature 14 against a suitable back stop 42.

In order that the contact 12 may be normally retained in engagement with the contact 13 and may be moved by said contact 13 when the armature 14 is displaced, the contact 12 is mounted on a spring strip 43 insulated from the member 35.

The means for retaining the contact 12 in displaced position comprises a small auxiliary armature 44 yieldably retained in a recess in the main armature 24 as by means of guides 45 and compression springs 46. A rod 47 is suitably attached to an extended portion of said armature 44 as indicated at 48, and is arranged to slide through an opening 49 in the frame plate 32 into proximity with the end 51 of the spring strip 43. The end 51 of said strip is preferably bent at right angles in order to provide vertical resiliency, and the end of the rod 47 is notched as shown more particularly at 52 in Fig. 2 to engage and retain the end of the spring strip when the armature 44 is in its lower position. The springs 46 are made so delicate that the armature 44 is retained in its lower position by a very slight amount of magnetism in the electromagnet 9, whereas a spring 53 is provided for normally retaining the armature 24 in open position, which spring is of sufficient strength to cause the opening of the starting switch in response to the reduction in the strength of electromagnet 9 caused by the insertion of the resistance 18 in its control circuit.

In the operation of this device and starting with the parts in the positions shown in Fig. 1, closure of the ignition switch 7 completes the circuit from the battery 1 through leads 3 and 8 to electromagnet 9 and from thence through lead 11, contacts 12 and 13 to the ground at 15. The consequent energization of electromagnet 9 attracts armatures 24 and 44 causing the bridging member 22 to engage the main switch contacts 19, 21, while the bar 28 causes cam 33 to swing armature 14 inwardly and displace contacts 12, 13 while the lower end of rod 47 slides into the return path of the end 51 of spring strip 43. As soon as the starting switch 4 is closed, cranking is initiated and a heavy current traverses the elements 19, 22, 21 of the switch, causing the magnetization of the magnetic circuit formed by elements 14, 37, 36, 32 and 38 whereby the armature 14 is retained in its inner position although the cam 33 has passed below the rod 34. This is the cranking position of the parts as illustrated in Fig. 2. When the engine starts, the reduction in the current traversing the starting circuit due to the release of the cranking load causes the flux between the pole piece 38 and armature 14 to be reduced sufficiently to permit spring 41 to swing the armature 14 back to its idle position. At this time, however, the contact 12 is prevented from following the contact 13 by reason of the latching engagement of the rod 47 with the end 51 of the spring strip whereby contacts 12, 13 are opened.

Opening contacts 12, 13 break the direct ground connection of the electromagnet 9 whereby it is connected to the ground only by lead 16 and resistance 18. Resistance 18 causes the electromagnet 9 to be so weakened as to release the main armature 24 which is moved to idle position by the spring 53, thereby opening the starting switch. Auxiliary armature 44, however, is retained by the weak magnetization of electromagnet 9 whereby contacts 12, 13 are held open during the self-operation of the engine as illustrated in Fig. 3. When the engine is stopped by the opening of ignition switch 7, the electromagnet 9 is completely deenergized and the auxiliary armature 44 permitted to return to its idle position as illustrated in Fig. 1 under the action of springs 46.

Although but one form 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 details of construction 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 a starter controlling device, a magnetic starting switch including a movable armature, a control circuit therefor including normally closed switch means, means connected to be moved by said armature for tensioning said switch means toward open position, means responsive to cranking current for holding said switch means closed during cranking but arranged to allow said switch means to open when the cranking load is relieved and means under the control of the operator for holding said switch means open.

2. In a starter controlling device, a magnetic starfing switch, a control circuit therefor including normally closed contacts and a manual switch, means actuated by the closing movement of the starting switch for biasing said contacts to open position, means energized by the cranking current for holding said contacts closed during cranking, and means directly under the control of said manual switch for locking said contacts open.

3. In a semi-automatic starter control for internal combustion engines, a starting circuit including a starting switch, a control circuit therefor including a manual switch and make and break means, means whereby closure of the starting switch displaces the elements of the make and break device in unison and holds one only thereof in displaced position, and means responsive to cranking current for holding said elements in displaced position.

4. In a semi-automatic starter control for internal combustion engines, a starting circuit including a starting switch, a control circuit there-

for including a manual switch and make and break means, means whereby closure of the starting switch displaces the elements of the make and break device in unison and holds one only thereof in displaced position, means responsive to cranking current for holding said elements in displaced position, and means including said manual switch for controlling said first holding means.

5. In a semi-automatic starter control for internal combustion engines, a starting switch, a set of yieldably mounted control contacts, means actuated by closure of the starting switch for displacing said contacts in unison and means responsive to the relief of the cranking load for releasing one only of said contacts.

6. In a semi-automatic starter control for internal combustion engines, a starting switch, a set of yieldably mounted control contacts, means actuated by closure of the starting switch for displacing said contacts in unison, means responsive to cranking current for holding said contacts displaced, and means under the control of the operator for holding one only of said contacts in displaced position.

7. A semi-automatic starting system for internal combustion engines including a magnetic starting switch having main switch contacts and control contacts, a main armature for controlling the main contacts, means operated by said main armature for displacing the control contacts in unison, an auxiliary armature and means operated by said auxiliary armature for holding one only of said control contacts in displaced position.

8. A semi-automatic starting system for internal combustion engines including a magnetic starting switch having main switch contacts and control contacts, a main armature for controlling the main contacts, means operated by said main armature for displacing the control contacts in unison, means responsive to cranking current for holding the control contacts displaced, an auxiliary armature, and means operated by said auxiliary armature for holding one only of said control contacts in displaced position.

9. A semi-automatic starting system for internal combustion engines including a magnetic starting switch having main switch contacts and control contacts, a main armature for controlling the main contacts, means operated by said main armature for displacing the control contacts in unison, an auxiliary armature and means operated by said auxiliary armature for holding one only of said control contacts in displaced position, and means under the control of the operator for controlling said auxiliary armature.

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