March 13, 1945. L. B. HARRIS 2,371,167

SWITCHING MECHANISM

Filed Dec. 1, 1931 2 Sheets-Sheet 1

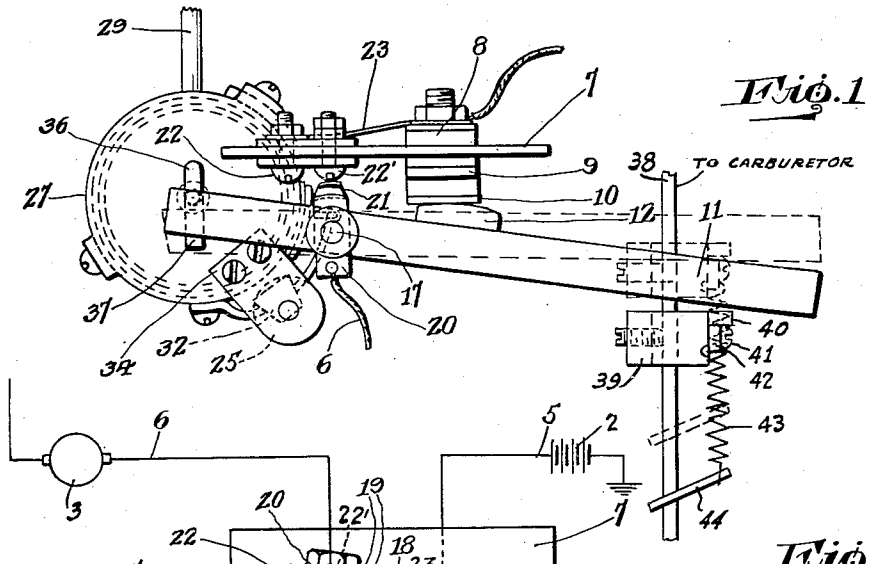


Fig. 1.

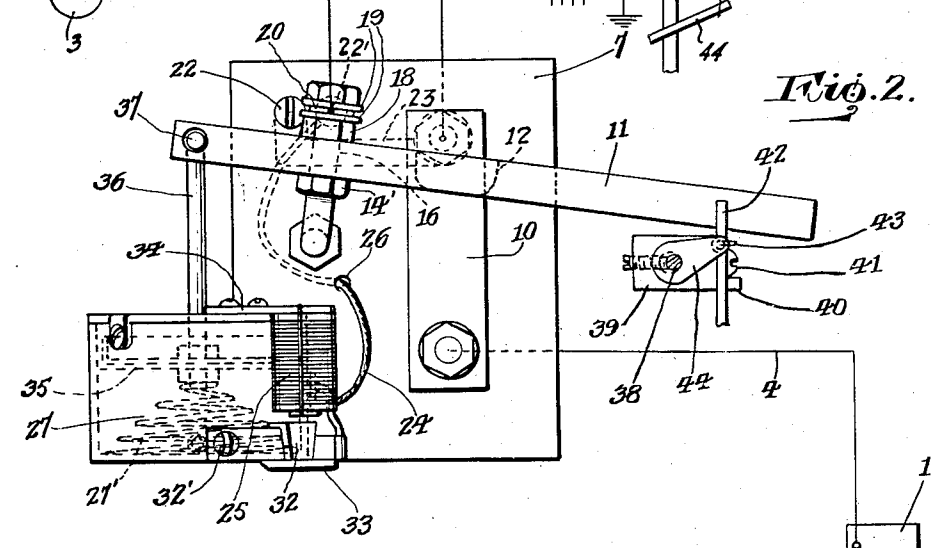


Fig. 2.

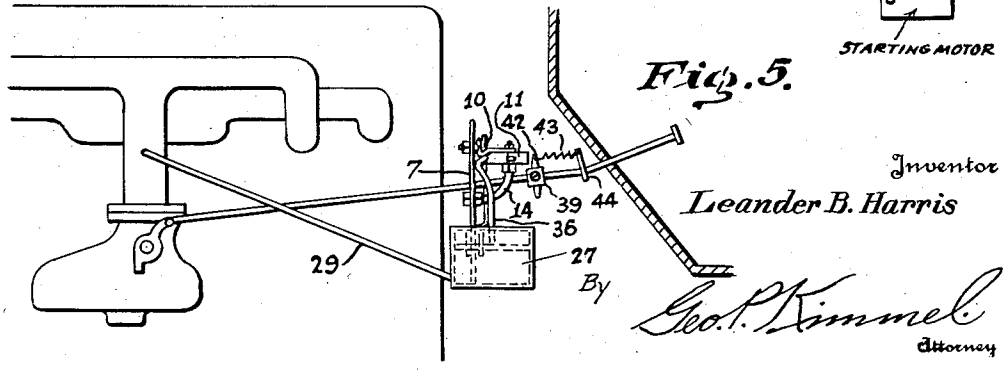


Fig. 5.

Inventor

Leander B. Harris

Geo. P. Kimmel

Attorney

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SWITCHING MECHANISM

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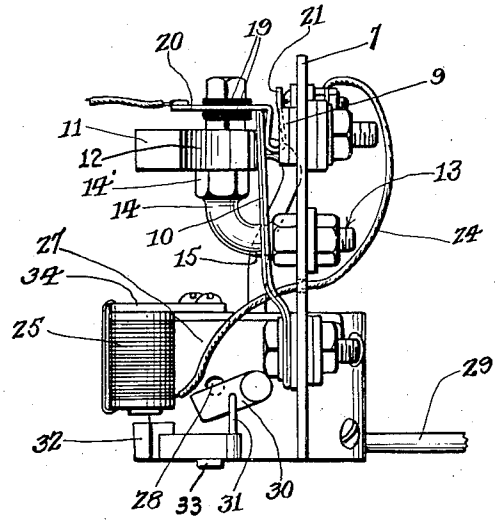


Fig. 3.

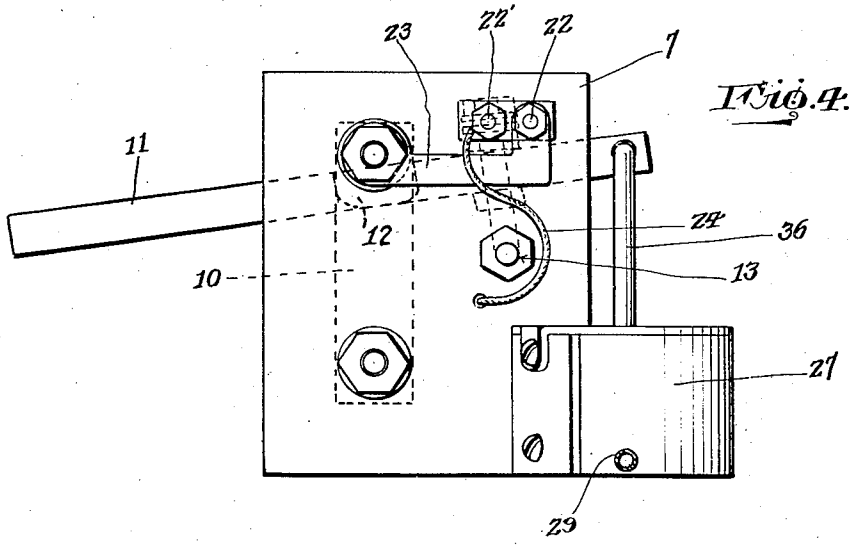


Fig. 4.

Inventor

Leander B. Harris

By Geo. P. Kimmel

Attorney

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UNITED STATES PATENT OFFICE

2,371,167

SWITCHING MECHANISM

Leander B. Harris, Mount Vernon, Ill., assignor, by mesne assignments, to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Application December 1, 1931, Serial No. 578,370

34 Claims. (Cl. 290—38)

My invention relates to a switching mechanism for use in connection with automotive vehicles.

The essential objects of my invention are to provide a mechanism of the class referred to for automatically setting in motion the starter for the engine of the vehicle by use of the foot accelerator in lieu of the starter switch now generally employed for such purpose, thereby eliminating loss of time when the engine of the vehicle is dead; for automatically cutting out the engine starter on the operation of the generator of the vehicle; for advantageous use on a free wheeling type of vehicle when the operation of the engine of the vehicle is discontinued while the latter is coasting; and preventing the setting in action of the engine starter when the engine is running thus preventing damage to the fly wheel, ring gear and starting mechanism; and to attain these ends in a simple, compact, durable, thoroughly efficient, readily installed, expeditiously operated and comparatively inexpensive structure.

To the above ends essentially and others which may hereinafter appear, my invention consists of such part and combination of parts as fall within the scope of the invention as claimed.

In the drawings:

Figure 1 is a top plan view of the mechanism.

Figure 2 is an elevation looking towards one side of the mechanism.

Figure 3 is an end elevation.

Figure 4 is an elevation looking towards the other side of the mechanism.

Figure 5 is a diagrammatical view of an internal combustion engine showing the adaptation therewith of the switching mechanism.

Referring to the drawings, 1 indicates the starter, 2 the battery and 3 the generator of an automotive vehicle. Circuit connections 4, 5 and 6 extend respectively from starter 1, battery 2 and generator 3.

A supporting plate is designated at 7 which has secured thereto by a binding post 8 a contact 9. The circuit connection 5 is attached to post 8. Secured at one end to plate 7 is a resilient contact member 10 normally clear of contact 9. The circuit connection 4 is attached to contact member 10.

Paralleling the plate 7 is an operating lever 11 having a lug 12 on one side thereof. The lever 11 is rotatable to provide for lug 12 to abut the free end of member 10 for the purpose of moving such end to engage contact 9 to close the circuit between battery 2 and starter 1. Pivotally carried by plate 7 is an angle shaped support 13 for lever 11, the former including a vertical and a horizontal part 14, 15 respectively. The part 14 extends through an opening 16 formed in lever 11 between the transverse median and one end of the latter. The lever 11 is rotatable about an axis provided by the part 14 of the support 13. The part 15 is journaled in plate 7. The part 14 is shouldered as at 14' forming a support for lever 11.

The part 14 extends as at 17 from lever 11. The extended portion 17 is threaded. A spacer nut 18 is secured to portion 17 and seats on lever 11. Superposed insulation elements 19 are arranged on portion 17. Interposed between elements 19 and mounted on portion 17 is a contact member 20 having an angularly disposed U-shaped resilient end 21 for successive engagement with contacts 22, 22' respectively carried by plate 7. To contact 22 has attached thereto a circuit connection 23 extended from binding post 8. The circuit connection 6 is attached to contact member 20. Extending from contact 22' is a circuit connection 24 which leads to the coil of a magnet 25. An opening 26 is provided in plate 7 for the passage of connection 24.

Supported from plate 7 is a cylinder 27 provided with an opening 28 in its side. Leading from the cylinder 27 to the intake manifold of the engine is a suction pipe 29 arranged below opening 28. The latter is capable of being closed by a valve 30 hinged to cylinder 27 and having attached thereto a shifting rod 31 carried by one end of the armature 32 of the magnet 25. The armature 32 at its other end is hinged as at 32' to cylinder 27. A stop 33 is provided for limiting the downward shift of armature 32. The normal position of valve 30 is as shown in Figure 3. The cylinder 27 carries a suspension arm 34 for magnet 25. Within cylinder 27 is arranged piston 35 provided with a rod 36 which is pivotally attached, as at 37 to one end of lever 11. Within the cylinder 27 is a tapered coiled spring 27' upon which bears against the bottom of the piston 35.

Carried by the foot operated accelerator 38 of the engine is a shifting device for lever 11 which acts to move the latter so that lug 12 will cause contact member 10 to engage contact 9. The said device comprises a clamp 39 having a stop 40 and a headed pivot 41 which extends through and pivotally supports a spring controlled dog 42 capable of contact with the lever 11 for shifting it horizontally to have lug 12 move member 10 to engage contact 9. The controlling spring for dog 42 is indicated at 43, has one end attached to dog 42 and its other end to an apertured tilting plate

44 mounted on the accelerator rod. The dog 42 when shifted to engage lever 11 abuts one side of the latter.

When the accelerator is depressed to actuate the starting motor, dog 42 through its connection with the accelerator rod moves lever 11 horizontally, causing lug 12 to close the circuit from battery to starter by establishing a contact with contact 9 through the intervening member 10. On the operation of the engine, the generator 3 builds up voltage and energizes magnet 25, thus moving valve 30 in a direction to close opening 28 thereby providing for the formation of a vacuum in cylinder 27 by suction pipe 29, which opens into the intake manifold of the engine. When the vacuum is formed piston 35 is drawn downwardly lifting lever 11 out of engagement with dog 42. The path of the movement of lug 12 then swings outwardly away from contact 9 to open the circuit from battery to starter as soon as lever 11 to which it is attached is disengaged from dog 42. At the same time end 21 of member 20 is moved from contact 22' to engage contact 22 to open the circuit for the magnet and to maintain the circuit closed from the generator to the battery.

Member 10 is not dependent solely upon the downward movement of piston 35 to release it from contact 9. The accelerator connection pushes lug 12 through its attachment to lever 11 against the resilient member 10, holding it in contact with contact 9 until the downward movement of piston 35 has released lever 11 from contact with dog 42. When lever 11 is thus entirely freed from contact with dog 42, member 10 rebounds to its normal position shown in Figure 3, causing lug 12 with lever 11 to move away from contact 9.

This action of lever 11 is made possible through its method of attachment, it being hinged on pivot 14 at opening 16 to allow side play and the opening in the end of lever 11 being of a size to permit it being loosely pivoted on piston rod 36 at point 37.

The mechanism thus includes pressure operated means for closing the battery starter and generator-magnet circuits and electrically operated means for opening the battery-starter and generator-magnet circuits and maintaining a generator-battery circuit closed during the operation of the engine.

The suction operated means is maintained active during the operation of the engine and holds the lever in a position to maintain end 21 of member 20 in engagement with contact 22. When the engine ceases operation, the lever 11 moves in a direction to position it in the path of the dog 42, at the same time the end 21 of contact member 20 is moved to engage contact 22'. During the operation of the engine the piston 35 is below opening 28. When the generator-magnet circuit is opened the armature 32 falls and moves valve 30 from closing position with respect to opening 28. When the engine ceases operation, the piston 35 will be relieved of suction whereby the spring 27' will expand and move the piston 35 upwardly to above the opening 28. On the upward movement of the piston 35 that end of lever 11 attached to the piston will be elevated and the other end of lever 11 will go back to a position relative to the dog 42 for the purpose of positioning the lug 12 parallel to the contact member 10.

With reference to Figure 5, the switching mechanism is generally indicated at A, the engine at B, the carburetor at C, the intake manifold of the engine B at D and the accelerator connections at E.

What I claim is:

1. In a switching mechanism for the circuits of the starter, battery and generator of internal combustion engines, a normally open generator-battery circuit, a normally open battery-starter circuit, a circuit closer for the generator battery-circuit, a circuit closer for the battery-starter circuit, a pressure operated element for operating the circuit closer for the battery-starter circuit in a direction to close the latter, said circuit closer for the generator-battery circuit being operated from said element subsequent to the closing of the battery-starter circuit, and means under the control of suction from the engine for moving said element in a direction to open the battery-starter circuit and to provide for said element shifting the circuit closer for the generator-battery circuit in a direction to close the latter.

2. In an electrical switching mechanism for internal combustion engines, in combination, a normally open generator-battery circuit, a normally open battery-starter circuit, a normally inactive magnet operated closing device, a circuit closer for the generator-battery circuit, the magnet of said device being normally in circuit through said closer with the generator, a circuit closer for the battery-starter circuit, a pressure operated element for operating the circuit closer for the battery-starter circuit in a direction to close the latter and to provide for the activity of said device, the said circuit closer for the generator-battery circuit being operated to circuit closing position from said element subsequent to the closing of the battery-starter circuit, and means under the control of suction from the engine for moving said element in a direction to release the circuit closer for the battery-starter circuit to open the latter and to provide for said element shifting the circuit closer for the generator-battery circuit in a direction to close the latter and to open the magnet circuit, said means formed with a port normally open to the atmosphere and said device when active, on the close of the battery-starter circuit, closing said port.

3. In an electrical switching mechanism for internal combustion engines, in combination, a normally open generator-battery circuit, a normally open battery-starter circuit, a circuit closer for the latter, a manually operated element for shifting said closer to circuit closing position to provide for the running of the engine, a circuit closer for the generator-battery circuit operated from said element subsequent to the shifting thereby of the circuit closer for the battery-starter circuit to close the latter, and means under control of the suction from the engine for moving said element in a direction to release the circuit closer for the battery-starter circuit to open the latter and to provide for said element shifting the circuit closer for the generator-battery circuit in a direction to close the latter.

4. In an electrical switching mechanism for internal combustion engines, in combination, a normally open generator-battery circuit, a normally open battery-starter circuit, a circuit closer for the latter, a manually operated element for shifting said closer to circuit closing position to provide for the running of the engine, a circuit closer for the generator-battery circuit operated from said element subsequent to the shifting thereby of the circuit closer for the battery-starter circuit to close the latter, means under

control of the suction from the engine for moving said element in a direction to release the circuit closer for the battery-starter circuit to open the latter and to provide for said element shifting the circuit closer for the generator-battery circuit in a direction to close the latter, and said means including a structure for shifting said element in a direction to provide for the opening of the generator-battery circuit on the discontinuing of the running of the engine and to position said element parallel to the circuit closer for the battery-starter circuit.

5. In an electrical switching mechanism for internal combustion engines, means under control of the suction from the engine having a port normally open to the atmosphere and a normally inactive magnet operated closure for said port, a normally open generator-battery circuit, a normally open battery-starter circuit, a generator-magnet circuit, a circuit closer for the battery-starter circuit, a circuit closer common to said generator-battery and generator-magnet circuit, a pressure operated element for shifting the circuit closer for the battery-starter circuit to close the latter to provide for the running of the engine and for the activity of said magnet operated closer, said circuit closer for the generator-battery circuit being operated from said element subsequent to the closing of the battery-starter circuit, and said means being coupled with said element to provide, on the running of the engine for said element being moved in a direction to release the circuit closer for the battery-starter circuit to open the latter and for said element shifting the circuit closer common to the generator-battery and generator-magnet circuits to close the former and open the latter.

6. In an electrical switching mechanism for internal combustion engines, means under control of the suction from the engine having a port normally open to the atmosphere and a normally inactive magnet operated closure for said port, a normally open generator-battery circuit, a normally open battery-starter circuit, a generator-magnet circuit, a circuit closer for the battery-starter circuit, a circuit closer common to said generator-battery and generator-magnet circuit, a pressure operated element for shifting the circuit closer for the battery-starter circuit to close the latter to provide for the running of the engine and for the activity of said magnet operated closer, said circuit closer for the generator-battery circuit being operated from said element subsequent to the closing of the battery-starter circuit, said means being coupled with said element to provide, on the running of the engine for said element being moved in a direction to release the circuit closer for the battery-starter circuit to open the latter and for said element shifting the circuit closer common to the generator-battery and generator-magnet circuit to close the former and open the latter, and said means including a structure for shifting said element in a direction to provide for the opening of the generator-battery circuit on the discontinuing of the running of the engine, to close the generator-magnet circuit and to position said element in parallel relation with respect to the circuit closer for the battery-starter circuit.

7. In an electrical switching mechanism for internal combustion engines, the combination with the electric starting motor, storage battery, generator, normally open circuit connections between the battery and motor and normally open circuit connections between the generator and battery, of a primary and a secondary controlling element, said primary element being manually shiftable to close the battery starter circuit to provide for the running of the engine, the said secondary element being shifted from the primary element for closing the generator-battery circuit subsequent to the closing of the battery-starter circuit, and structure under control of suction from the engine and connected to the primary element for shifting the latter when the engine is running in a direction to open the battery-starter circuit and to provide for the primary element shifting the secondary element to close the generator-battery circuit.

8. In an electrical switching mechanism for internal combustion engines, the combination with the electric starting motor, storage battery, generator, normally open circuit connections between the battery and motor and normally open circuit connections between the generator and battery, of a primary and a secondary controlling element, said primary element being manually shiftable to close the battery starter circuit to provide for the running of the engine, the said secondary element being shifted from the primary element for closing the generator-battery circuit subsequent to the closing of the battery-starter circuit, structure under control of suction from the engine and connected to the primary element for shifting the latter when the engine is running in a direction to open the battery-starter circuit and to provide for the primary element shifting the secondary element to close the generator-battery circuit, and said structure including means acting on the discontinuing of the running of the engine for shifting said primary element in a direction to move the secondary element to open the battery-generator circuit.

9. In a starting mechanism for internal combustion engines, the combination with the fuel control mechanism and starter switch, the latter having means for normally urging it to open position, of means for closing said starter switch, said second means being so positioned as to be engaged and actuated by said fuel control mechanism when the engine is not running, and means under control of suction from the engine for moving said second means from such position when the engine is running.

10. In a controlling mechanism for the starting motor of an internal combustion engine having a fuel control mechanism and a starter circuit switch having means for normally urging it to open position, the combination of a pivoted lever switch closing device operatively connecting said switch and said fuel control mechanism when the engine is not running, whereby actuation of said fuel control mechanism will cause said lever device to close said switch and actuate the starting motor, and means under control of suction from the engine for moving said lever device to sever its operative connection with the fuel control mechanism and allow the starter switch to be moved to open position when the engine is running.

11. Starting apparatus for internal combustion engines having in combination, a current source, a starting motor in circuit with said current source and operable by current supplied thereby, a starter switch for controlling the circuit between said starting motor and the current source, means for controlling the quantity of combustible mixture supplied to the engine, means operable by the mixture controlling means for closing said starter switch, means operable by

engine suction for causing said starter switch to be opened when the engine becomes self-operative, a generator, and means operable in response to operation of said generator for causing said suction operated means to become effective.

12. Starting apparatus for internal combustion engines having, in combination, a current source, a starting motor in circuit with said current source and operable by current supplied thereby, a starter switch for controlling the circuit between said starting motor and the current source, means for controlling the quantity of combustible mixture supplied to the engine, means operable by the mixture controlling means for closing said starter switch, means operable by engine suction for causing said starter switch to be opened, means for normally preventing the suction effective on said suction operated means from coming sufficient to operate said means when the engine starts to operate under its own power, a generator, and means responsive to the operation of said generator for increasing the suction effective on said suction operated means sufficiently to operate said means.

13. Starting apparatus for internal combustion engines having, in combination, a current source, a starting motor in circuit with said current source and operable by current supplied thereby, a starter switch for controlling the circuit between said starting motor and the current source, means for controlling the quantity of combustible mixture supplied to the engine, a member operable by the mixture controlling means for closing said starter switch, a suction operated member subject to the manifold vacuum and movable thereby when a predetermined degree of vacuum is reached, to disable the operating connection between said first named member and the mixture controlling means, a generator, and means operable in response to operation of the generator to cause the vacuum effective on the suction operated member to become sufficient to operate such member.

14. Starting apparatus for internal combustion engines having, in combination, a current source, a starting motor in circuit with said current source and operable by current supplied thereby, a starter switch for controlling the circuit between said starting motor and the current source, means for controlling the quantity of combustible mixture supplied to the engine, a member operable by the mixture controlling means for closing said starter switch, a suction operated member subject to the manifold vacuum and movable thereby when a predetermined degree of vacuum is reached, to disable the operating connection between said first named member and the mixture controlling means, a generator, and means operable in response to operation of the generator at a predetermined speed to cause the vacuum effective on the suction operated member to become sufficient to operate such member.

15. Starting apparatus for internal combustion engines having, in combination, a current source, a starting motor in circuit with said current supplied thereby, a starter switch for controlling the circuit between said starting motor and the current source, means for controlling the quantity of combustible mixture supplied to the engine, means operable by the mixture controlling means for closing said starter switch, means operable by engine suction for causing said starter switch to be opened, a generator, and means operable in response to operation of the generator after the engine has become self-operative to cause said suction operated means to become effective to bring about opening of the starter switch.

16. Starting apparatus for internal combustion engines having, in combination, a current source, a starting motor in circuit with said current source and operable by current supplied thereby, a starter switch for controlling the circuit between said starting motor and the current source, means for controlling the quantity of combustible mixture supplied to the engine, means operable by the mixture controlling means for closing said starter switch, means operable by engine suction for causing said starter switch to be opened when the engine is operating under its own power at a predetermined speed, a generator, and means operable in response to operation of the generator when the engine is operating at said predetermined speed to cause said suction operated means to become effective.

17. Starting apparatus for internal combustion engines having, in combination, a current source, a starting motor in circuit with said current source and operable by current supplied thereby, a starter switch for controlling the circuit between said starting motor and the current source, means for controlling the quantity of combustible mixture supplied to the engine, means operable by the mixture controlling means for closing said starter switch, means operable by engine suction for causing said starter switch to be opened when the engine becomes self-operative and the suction effective on said last named means reaches a predetermined amount, a generator and means operable in response to operation of the generator for controlling the amount of suction effective on said suction operated means.

18. Starting apparatus for internal combustion engines having, in combination, a current source, a starting motor in circuit with said current source and operable by current supplied thereby, a starter switch for controlling the circuit between said starting motor and the current source, means for controlling the quantity of combustible mixture supplied to the engine, means operable by the mixture controlling means for closing said starter switch, means operable by engine suction for causing said starter switch to be opened when the engine becomes self-operative and the suction effective on said last named means reaches a predetermined amount, a valve for controlling the effective suction, a generator and means operable in response to operation of said generator for operating said valve.

19. Starting apparatus for internal combustion engines having, in combination, a current source, a starting motor in circuit with said current source and operable by current supplied thereby, a starter switch for controlling the circuit between said starting motor and the current source, means for controlling the quantity of combustible mixture supplied to the engine, means operable by the mixture controlling means for closing said starter switch, means operable by engine suction for causing said starter switch to be opened when the engine becomes self-operative and the suction effective on said last named means reaches a predetermined amount, a valve for controlling the effective

suction, a generator and a magnet operable in response to operation of the generator for operating said valve.

20. Starting apparatus for internal combustion engines having, in combination, a current source, a starting motor in circuit with said current source and operable by current supplied thereby, a starter switch for controlling the circuit between said starting motor and the current source, means for controlling the quantity of combustible mixture supplied to the engine, means operable by the mixture controlling means for closing said starter switch, a suction operated member for causing the starter switch to be opened when the engine becomes self-operative and the suction effective on said member reaches a predetermined amount, a conduit for communicating the engine suction to said member, a valve for controlling admission of air to said conduit to variably regulate the suction effective on said member and means operable in response to operation of the generator for operating said valve.

21. Starting apparatus for internal combustion engines having, in combination, a current source, a starting motor in circuit with said current source and operable by current supplied thereby, a starter switch for controlling the circuit between said starting motor and the current source, means for controlling the quantity of combustible mixture supplied to the engine, means operable by the mixture controlling means for closing said starter switch, a suction operated member for causing the starter switch to be opened when the engine becomes self-operative and the suction effective on said member reaches a predetermined amount, a conduit for communicating the engine suction to said member, a valve for controlling admission of air to said conduit to variably regulate the suction effective on said member, means for maintaining the valve in open position when the engine is being operated by the starting motor and for closing the valve after the engine becomes self-operative.

22. Starting apparatus for internal combustion engines having, in combination, a current source, a starting motor in circuit with said current source and operable by current supplied thereby, a starter switch for controlling the circuit between said starting motor and the current source, means for controlling the quantity of combustible mixture supplied to the engine, means operable by the mixture controlling means for closing said starter switch, a suction operated member for causing the starter switch to be opened when the engine becomes self-operative and the suction effective on said member reaches a predetermined amount, a conduit for communicating the engine suction to said member, a valve for controlling admission of air to said conduit to variably regulate the suction effective on said member, said valve being normally open during operation of the engine by the starting motor so as to prevent the suction effective on said member from becoming sufficient to cause opening of the starter switch and means operable in response to operation of the generator after the engine becomes self operative to effect the closing of said valve so as to cause opening of the starter switch.

23. Starting apparatus for internal combustion engines having, in combination, a current source, a starting motor in circuit with said current source and operable by current supplied thereby, a starter switch for controlling the circuit between said starting motor and the current source, means for controlling the quantity of combustible mixture supplied to the engine, means operable by the mixture controlling means for closing said starter switch, a suction operated member for causing the starter switch to be opened when the engine becomes self-operative and the suction effective on said member reaches a predetermined amount, a conduit for communicating the engine suction to said member, means effective to prevent the engine suction from becoming sufficient to operate said member when the engine is being operated by the starting motor, and means operable in response to self-operation of the engine for operating said last named means to bring about a sufficient increase in the suction effective on said member to operate the latter and cause the starter switch to be opened.

24. Starting apparatus for internal combustion engines having, in combination, a current source, a starting motor in circuit with said current source and operable by current supplied thereby, a starter switch for controlling the circuit between said starting motor and the current source, means for controlling the quantity of combustible mixture supplied to the engine, means operable by the mixture controlling means for closing said starter switch, a suction operated member for causing the starter switch to be opened when the engine becomes self-operative and the suction effective on said member reaches a predetermined amount, a conduit for communicating the engine suction to said member, means effective to prevent the engine suction from becoming sufficient to operate said member when the engine is being operated by the starting motor, and means operable in response to self-operation of the engine at a predetermined speed for operating said last named means to bring about a sufficient increase in the suction effective on said member to operate the latter and cause the starter switch to be opened.

25. Starting apparatus for internal combustion engines having, in combination, a current source, a starting motor in circuit with said current source and operable by current supplied thereby, a starter switch for controlling the circuit between said starting motor and the current source, means for controlling the quantity of combustible mixture supplied to the engine, means operable by the mixture controlling means for closing said starter switch, a suction operated member for causing the starter switch to be opened when the engine becomes self-operative and the suction effective on said member reaches a predetermined amount, a conduit for communicating the engine suction to said member, means effective to prevent the engine suction from becoming sufficient to operate said member when the engine is being operated by the starting motor, a generator and means operable in response to operation of the generator when the engine is operating under its own power for operating said last named means to bring about a sufficient increase in the suction effective on said member to operate the latter and cause the starter switch to be opened.

26. Starting apparatus for internal combustion engines having, in combination, a current source, a starting motor in circuit with said current source and operable by current supplied thereby, a starter switch for controlling the circuit between said starting motor and the current source, means for controlling the quantity of combustible mixture supplied to the engine, an arm engageable and movable by the mixture controlling means to a position to close the starter switch as the mixture controlling means is moved to vari-

ably regulate the mixture supply, and suction operated means for moving said arm in a direction substantially normal to the path of movement of the mixture controlling means to disengage said arm from the mixture controlling means and cause the opening of the starter switch.

27. Starting apparatus for internal combustion engines having, in combination, a current source, a starting motor in circuit with said current source and operable by current supplied thereby, a starter switch for controlling the circuit between said starting motor and the current source, means for controlling the quantity of combustible mixture supplied to the engine, an arm engageable and movable by the mixture controlling means to a position to close the starter switch as the mixture controlling means is moved to variably regulate the mixture supply, normally ineffective suction operated means for moving said arm in a direction substantially normal to the path of movement of the mixture controlling means to disengage said arm from the mixture controlling means and cause the opening of the starter switch, a generator, means operable in response to operation of the generator for causing the suction operated means to become effective and a second switch operable by said arm as it is moved by the mixture controlling means to cause said generator operated means to be operated.

28. Starting apparatus for internal combustion engines having, in combination, a current source, a starting motor in circuit with said current source and operable by current supplied thereby, a starter switch for controlling the circuit between said starting motor and the current source, means for controlling the quantity of combustible mixture supplied to the engine, means operable by the mixture controlling means for closing said starter switch, means operable by engine suction for causing said starter switch to be opened when the engine becomes self-operative and the suction effective on said last named means reaches a predetermined amount, a valve for controlling the effective suction, a generator, a magnet operable in response to operation of the generator for operating said valve, and a second switch for controlling the operation of said magnet and operable by the operating means for the starter switch as said operating means is moved by the mixture controlling means.

29. Starting apparatus for internal combustion engines having, in combination, a current source, a starting motor in circuit with said current source and operable by current supplied thereby, a starter switch for controlling the circuit between said starting motor and the current source, means for controlling the quantity of combustible mixture supplied to the engine, means operable by the mixture controlling means for closing said starter switch, means operable by engine suction for causing said starter switch to be opened when the engine becomes self-operative and the suction effective on said last named means reaches a predetermined amount, a valve for controlling the effective suction, a generator, a magnet operable in response to operation of the generator for operating said valve, and a second switch for controlling the operation of said magnet and adapted to be closed by the operating means for the starter switch as said operating means is moved by the mixture controlling means, said second switch being opened by said suction operated means when the latter becomes effective to open the starter circuit.

30. In a starter control mechanism for internal combustion engines having a current source and a starting motor adapted to be operated by current from said source, a normally open starter switch, a pivoted oscillatable support member, a lever pivotally mounted on the support member and adapted to be moved about its pivot to close said starter switch, said lever being pivoted on the support member at an angle to the axis of oscillation of the support member, means for moving said lever on its pivot to close the starter switch independently of any movement of the support member, suction operated means for moving the pivoted support member to disengage said lever from its operating means to permit opening of the switch, and means for communicating the suction of the engine to said suction operated member.

31. In a starter control mechanism for internal combustion engines having a current source and a starting motor adapted to be operated by current from said source, a normally open starter switch, a pivoted oscillatable support member, a lever pivotally mounted on the support member and adapted to be moved about its pivot to close said starter switch, said lever being pivoted on the support member at an angle to the axis of oscillation of the support member, means for moving said lever on its pivot to close the starter switch independently of any movement of the support member, suction operated means for moving the pivoted support member to disengage said lever from its operating means to permit opening of the switch, means for communicating the suction of the engine to said suction operated member, and means effective when the engine stops to reversely rotate the pivoted support member to bring said lever in the path of movement of its operating means, so as to be engaged by such operating means when it is again operated.

32. In a starter control mechanism for internal combustion engines having a current source and a starting motor adapted to be operated by current from said source, a normally open starter switch having a resilient contact member, a pivoted oscillatable support member, a lever pivotally mounted on the support member and adapted to be moved about its pivot to engage said resilient contact member and close said starter switch, said lever being pivoted on the support member at an angle to the axis of oscillation of the support member, means for moving said lever on its pivot to close the starter switch independently of any movement of the support member, suction operated means for moving the pivoted support member to disengage said lever from its operating means to permit opening of the switch and means for communicating the suction of the engine to said suction operated member.

33. In a starter control mechanism for internal combustion engines having a current source and a starting motor adapted to be operated by current from said source, a normally open starter switch, a pivoted support member adapted to oscillate about a substantially horizontal axis and having a substantially vertical arm when the parts are in normal position, a lever pivotally mounted on said arm and adapted to oscillate in a plane substantially 90 degrees from the axis of said arm, operating means for moving said lever about its pivot to close the starter switch, a suction operated member connected to one end of the lever, and effective when operated to move the pivoted support member about its horizontal axis, thereby moving the lever in a substantially

vertical plane to disengage the lever from its operating means and permit opening of the starter switch, and means for communicating the engine suction to said suction operated member.

34. In a starter control mechanism for internal combustion engines having a current source and a starting motor adapted to be operated by current from said source, a normally open starter switch, a pivoted support member adapted to oscillate about a substantially horizontal axis and having a substantially vertical arm when the parts are in normal position, a lever pivotally mounted on said arm and adapted to oscillate in a plane substantially 90 degrees from the axis of said arm, operating means for moving said lever about its pivot to close the starter switch, a suction operated member connected to one end of the lever, and effective when operated to move the pivoted support member about its horizontal axis, thereby moving the lever in a substantially vertical plane to disengage the lever from its operating means and permit opening of the starter switch, means for communicating the engine suction to said suction operated member while the engine is in operation and means effective when the engine ceases to operate to move the support member in a reverse direction in order to again place the lever in position to be engaged by its operating means.

LEANDER B. HARRIS.