June 5, 1956 D. D. STOLTMAN 2,748,760

ENGINE STARTER CONTROL APPARATUS

Filed June 22, 1953 3 Sheets-Sheet 1

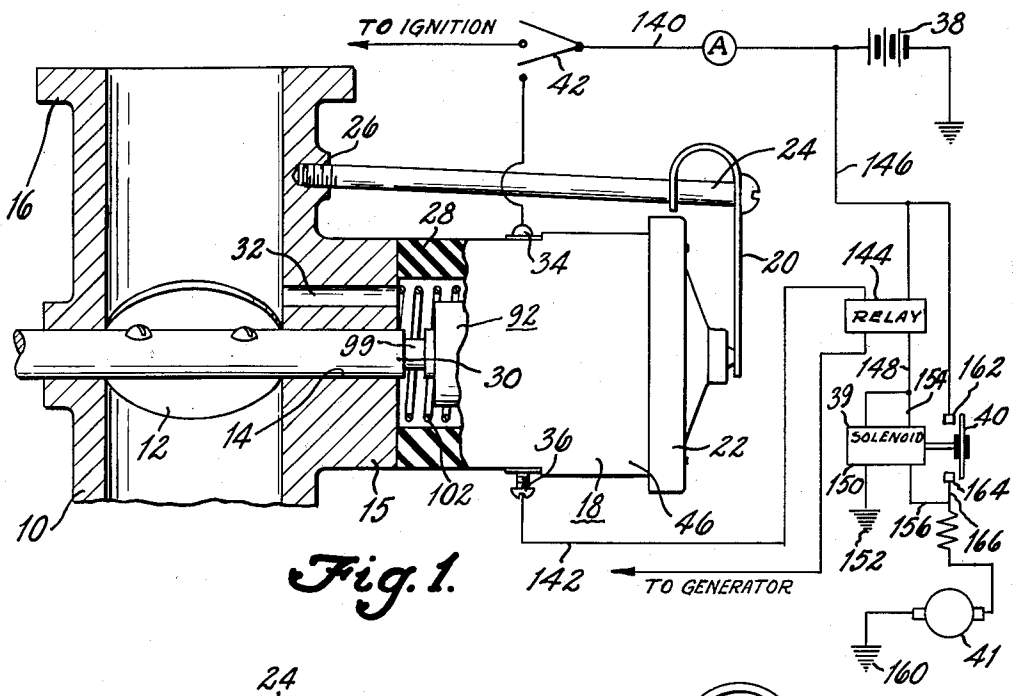


Fig. 1.

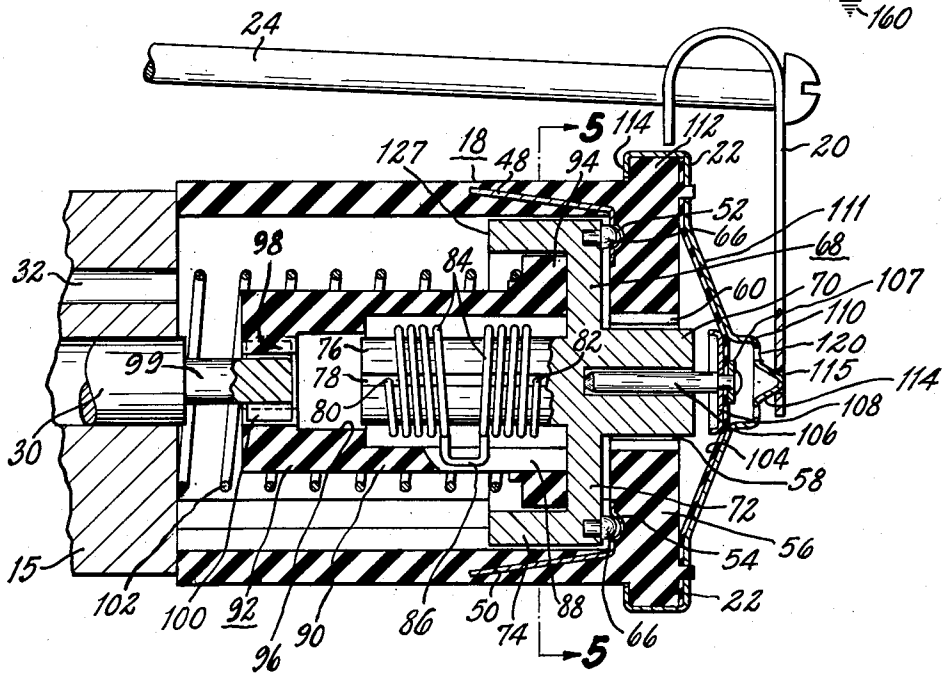


Fig. 2.

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ENGINE STARTER CONTROL APPARATUS

Filed June 22, 1953 3 Sheets-Sheet 2

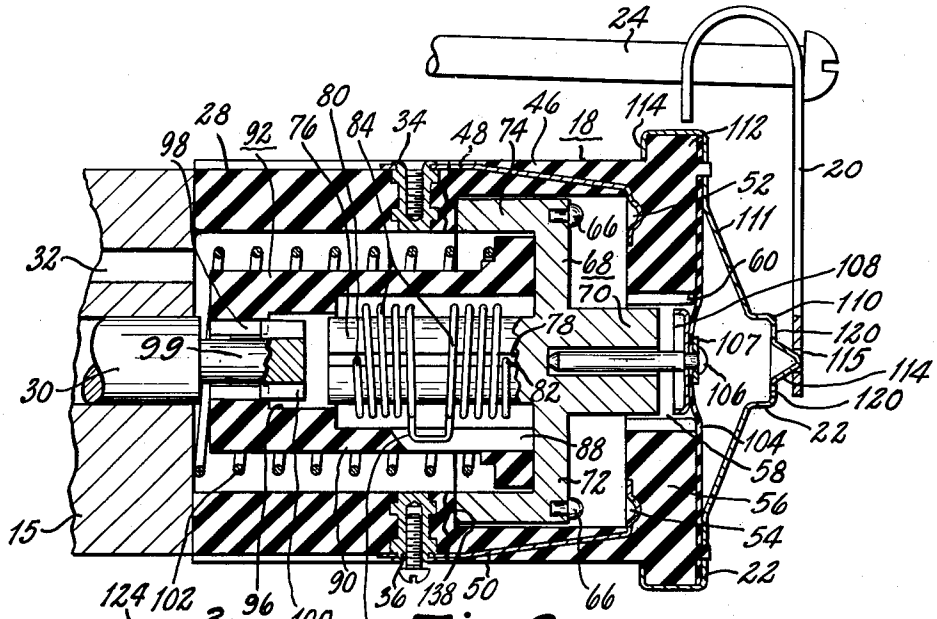


Fig. 3.

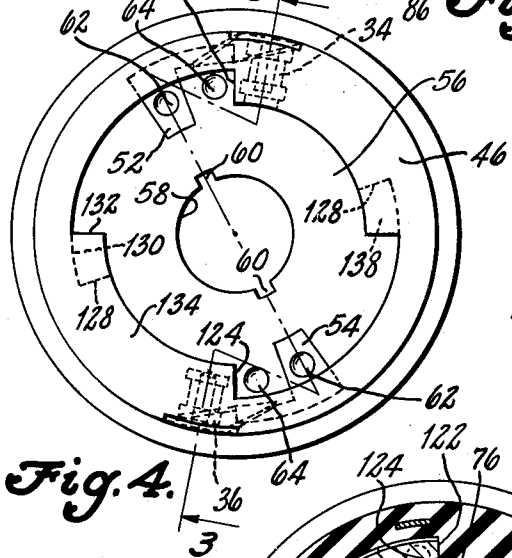


Fig. 4.

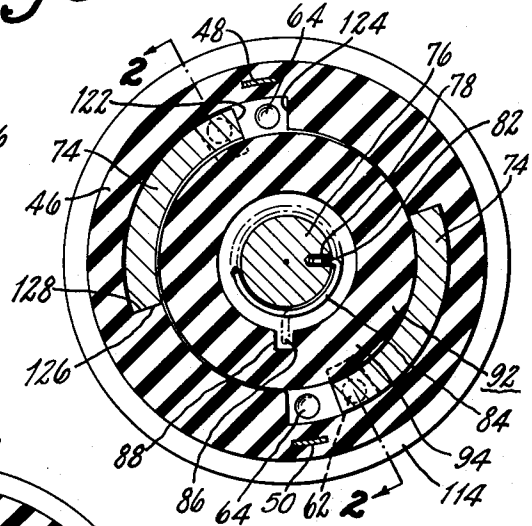


Fig. 5.

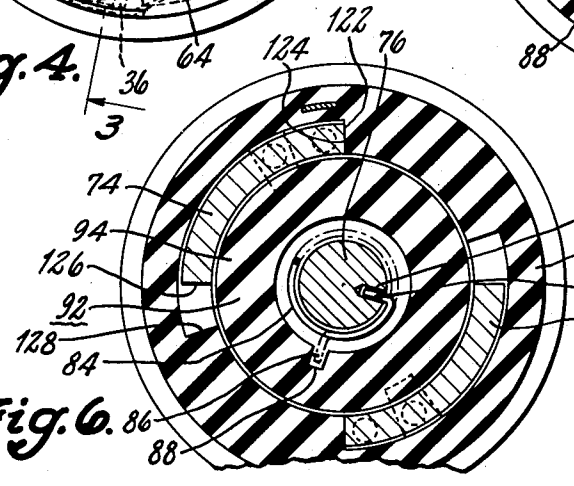


Fig. 6.

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ENGINE STARTER CONTROL APPARATUS

Filed June 22, 1953 3 Sheets-Sheet 3

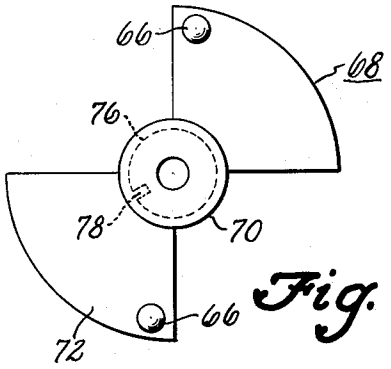


Fig. 7.

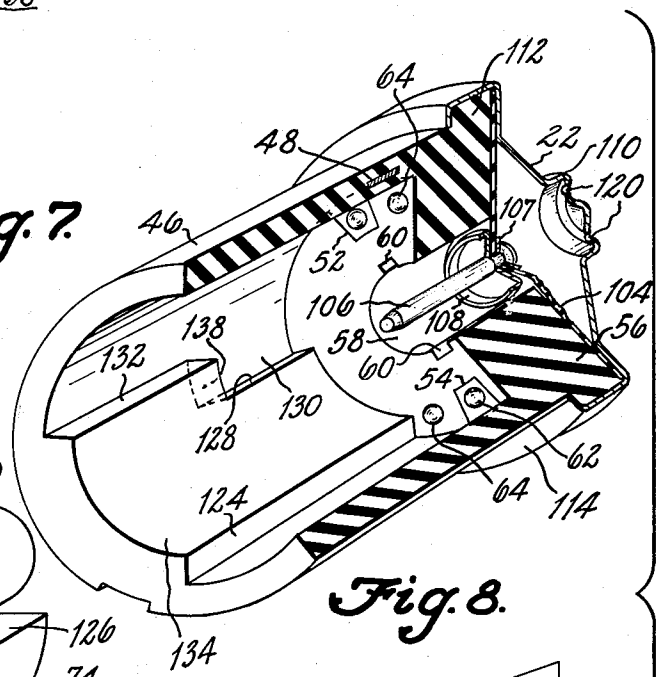
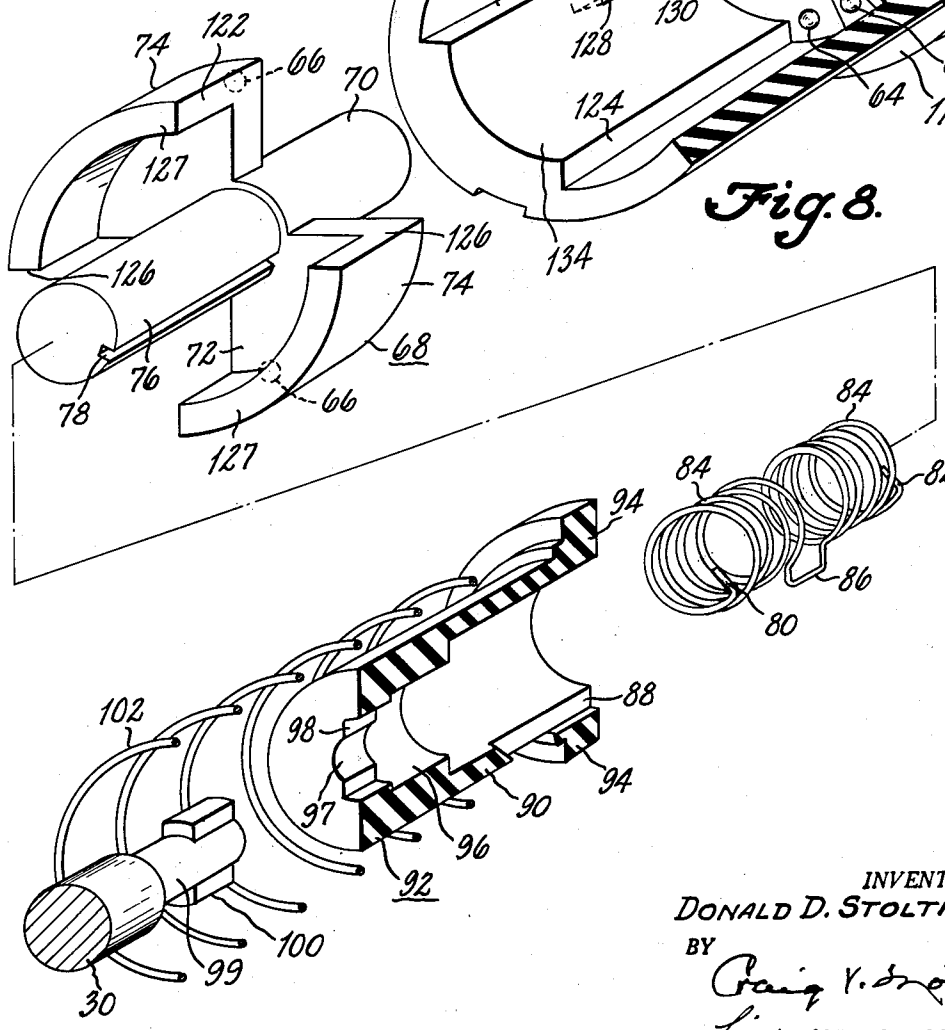


Fig. 8.



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United States Patent Office 2,748,760 Patented June 5, 1956

2,748,760

ENGINE STARTER CONTROL APPARATUS

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Application June 22, 1953, Serial No. 363,325

13 Claims. (Cl. 123—179)

This invention relates to starting apparatus for internal combustion engines of the semi-automatic type in which a control circuit for the starting motor is automatically closed by operation of one of the control members for controlling operation of the engine, such, for example, as the carburetor throttle valve.

In any engine starting apparatus it is particularly desirable to effect starting as quickly as possible after closing of the starting motor circuit in order to prevent unnecessary drain upon the battery. Also, where the starting apparatus is controlled by operation of the carburetor throttle, it is essential that when the engine is self-operative the means through which the control switch for the starting apparatus is actuated by the carburetor throttle operating means must be in some way rendered inoperative so that the normal operation of the throttle to variably control the engine speed will not effect closing of the starter circuit.

It has been customary in starting apparatus of this type to provide a control switch operated in conjunction with the throttle which is so constructed that it is closed when the throttle is opened to that extent which is best for starting in order to minimize the cranking period and when the engine begins to operate under its own power, engine suction becomes effective to open this control switch and the suction is utilized to hold the switch open while the engine continues to operate. It has also been found that under some engine operating conditions as, for example, when an automotive vehicle is ascending a steep grade, with wide open throttle, the engine suction drops to such an extent that such suction is no greater than that which is maintained during cranking of the engine. In fact, under somewhat extreme conditions, the suction during running of the engine becomes actually less than that maintained during cranking when the engine is hot. It has therefore been found difficult to design a starting device of this type having a control switch operated by engine suction in which suction will always be effective to prevent closing of the switch during self-operation of the engine but which will never be effective to open the control switch during the cranking period.

It is accordingly the principal object of the present invention to provide an engine starting apparatus of the type referred to having a control switch of novel construction which is closed by the throttle after the latter has made a predetermined movement of the desired extent toward open position and in which the control switch is opened by engine suction when the engine becomes self-operative and which is provided with means to cause a greater pressure differential to be effective to hold the switch open during all self-operation of the engine under the most extreme possible operating conditions than is ever effective to move the control switch to its open position during engine cranking.

A further object of the invention is to provide an engine starting apparatus having a control switch and means for operating it in the manner described which is simple

in construction, is positive in action, easy to manufacture and inexpensive.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of the present invention is clearly shown.

In the drawings:

Figure 1 is a diagrammatic view of a starter circuit and throttle control switch constructed in accordance with the present invention;

Figure 2 is a vertical section through the starter switch on line 2—2 of Figure 5, with the parts in circuit closing position;

Figure 3 is a composite section with the parts in the circuit open position, and on line 3—3 of Figure 4;

Figure 4 is an end elevation of the switch housing as seen from the left in Figure 1;

Figure 5 is a section on line 5—5 of Figure 2;

Figure 6 is a fragmentary section on the same line but with certain of the parts shown in different positions;

Figure 7 is an end elevation of the contact member 68; and

Figure 8 is an exploded view of the switch showing the parts in perspective and some of the parts in longitudinal section.

As shown in the drawings, 10 indicates the mixture passage of the carburetor for an internal combustion engine in which a throttle valve 12 is rotatably mounted in suitable bearings 14 to variably control the quantity of mixture supplied to the engine in the usual way. As usual, the carburetor is provided with a flange 16 for attachment to the intake manifold. A starter switch indicated generally by the numeral 18 is mounted on a boss 15 projecting from the wall of passage 10 where as shown, it is held in adjusted position by a spring 20 pressing against a cap 22 and a bolt 24 extends through the spring and is threaded into the wall of the mixture passage at 26. However, it will be understood that the manner of securing the switch 18 in position is not material and it may be held in position in any suitable manner.

As shown in Fig. 1, the base 28 of switch 18 is held against the boss 15 and surrounds the end 30 of the throttle shaft while the interior of the switch 18 is connected with the mixture passage 10 posterior to the throttle by a passage 32 in the boss 15. The specific means for mounting the switch 18 which is disclosed permits easy rotary adjustment with respect to the boss 15 and also permits easy removal of the switch by merely lifting and rotating the spring member 20.

Switch 18 has electrical terminals 34 and 36 for connection with a current source 38 and with a control circuit which will be described in detail later. When the switch 18 is closed, a solenoid 39 is energized and this effects the closing of a switch 40 to connect the starting motor 41 directly with the current source. The ignition switch 42 is in series with the terminals 34 and 36 so that both the ignition switch and the switch 18 can be closed to cause the starting motor to become operative. Closing of the switch 18 is effected by a predetermined opening movement of the throttle valve 12 and the extent of this opening movement can be varied by rotating the switch 18 on the boss 15. This adjustment will be more particularly discussed later.

The switch 18 comprises a cylindrical housing 46 of some suitable insulating material in the walls of which are embedded the terminals 34 and 36 previously referred to and these connect, respectively, with metal strips 48 and 50 which terminate, respectively, in contacts 52 and 54 which are suitably positioned in the solid head member 56 of the cylindrical housing 46. This head

member 56 has an axial bore 58 in which notches 60 are situated diametrically opposite each other and these notches form passageways which extend through the head member for a purpose later set forth. The contacts 52 and 54 previously referred to are in the form of semi-spherical depressions 62 and the head member 56 is provided with recesses 64 of semi-spherical shape which are spaced from each other and are the same distance from the center of the head member. These semi-spherical depressions 62 are engageable by the rounded heads of contact members 66 carried by a rotatable member 68 which is rotatable within the housing 46 by rotation of the throttle shaft.

The rotatable member 68 is provided with a stem or shaft 70 which is both rotatable and slidable in the bore 58 of the head member 56. This rotatable member 68 has oppositely extending segments 72 each of which supports one of the contact members 66 and has a projecting flange 74 extending through an arc of about 90° with respect to the axis of the shaft 70. Also, the member 68 on the side opposite the stem 70 has a second and somewhat longer stem 76 in alignment with the stem 70. This stem 76 has a groove 78 in which are anchored the ends 80 and 82 of a helical spring 84 which is provided with a central loop 86 that engages in a groove 88 which is formed in the cylindrical wall of a rotatable driving sleeve 92 which has a projecting flange 94 that fits within the projecting flanges 74 of the rotatable members 68. At its other end the sleeve 92 has a somewhat smaller inner diameter into which the stem 76 extends so that such stem is both slidable and rotatable in this portion of the sleeve 92. The left end of the sleeve 92 is closed except for a cylindrical opening 97 which is provided with keyways 98. At the right end the throttle shaft 30 is of reduced size, as indicated at 99 so that it can extend into the opening 97 and has splines 100 on its outer surface which will engage the keyways 98 when the sleeve 92 is in the position shown in Fig. 2. When the parts are so engaged, rotation of the throttle shaft will rotate the sleeve 92 as the throttle is moved toward open or closed position.

When the switch 18 is held in position on the boss 15, as shown in the drawing, a spring 102 which is positioned within the housing 46 around the sleeve 92 has one end engaging the boss 15 and its other end engages the flange 94 on sleeve 92 so as to force the sleeve 92 into engagement with the rotatable member 68 and exerts a pressure on such member which tends to force the member 68 into engagement with the head member 56 and to hold the sleeve in the Fig. 2 position where it is engageable by the splines 100 formed on the throttle shaft. When the parts are in this position, the contact members 66 will normally engage either the depressions 64 formed in the head member 56 when the switch 18 is opened or the depressions 62 in the contact elements 54 when the switch is closed.

As already indicated, the splines 100 and keyways 98 comprise a driving connection between the end of the throttle shaft 30 and the sleeve 92 to effect rotation of the latter when the throttle shaft is moved. Rotation of the sleeve 92 will, through the medium of spring 84 effect rotation of the rotatable member 68 to close the switch 18 in a manner more fully described later. Opening movement of the switch when the engine begins to run under its own power is effected by axial movement of the member 68 and that movement is accomplished by a device operable in response to increase in engine suction and which will now be described.

A flexible diaphragm 104 is subject to engine suction and carries a pin 106 which extends into an axial recess in the stem 70. The pin has a reduced portion which extends through the diaphragm and clamped between a shoulder 107 of the pin and the diaphgram on one side of the latter is a disc 108 while on the opposite side, the pin is riveted over a washer to hold the diaphragm assembly together. The outer edge of the diaphragm is held against the outer edge of head 66 with sufficient force to form an air-tight joint by crimping the outer edge of the cap 22 around the peripherally extending flange 112 of the member 56. The main portion of the cap 22 which is designated 111 is generally conical in shape, while at the central part of the cap, which is in alignment with the stem 70, there is provided a dome-shaped part 110, for a purpose to be later described. Extending from the part 110 is a pointed projection 114 which engages an opening 115 in the spring clip 20 when the switch is held in position on the boss 115. Openings 120 connect the space between the cap 22 and the head 56 with the atmosphere.

When the parts are in the normal position, that is, when the engine is not running, and is being cranked by the starting motor, they are as shown in Fig. 2, the diaphragm 104 is in contact with the surface of cap 22 at all parts of the surface of the latter except at the dome 110, being held in this position by the force of the spring 102. The only part of the diaphragm which is subject to atmospheric pressure with the parts in this position is the small central portion of the diaphragm which lies opposite the dome portion 110 of cap 22, due to the fact that a seal is effected between the balance of the diaphragm and the conical part of the cap 22. When the engine is cranked by the starting motor, the suction which is maintained in the mixture passage 10 posterior to the throttle is communicated through passage 32, through the small space around the member 68 between it and the inner wall of housing 46 and through passages 60 to the space between the diaphragm and the head 56. During cranking, this suction is very low and the small pressure differential created across that part of the diaphragm which is subject to atmospheric pressure is never sufficient to overcome the force of spring 102 and move the diaphragm to the left, which is necessary to effect opening of the switch.

However, when the engine begins to operate under its own power the suction in passage 10 between the throttle and the engine is very greatly increased, becoming as much as 18 inches of mercury. This will create a pressure differential across the small part of the diaphragm which is subject to atmospheric pressure that is great enough to move the diaphragm and member 68 to the left and open the switch. After the engine is running and the switch is open, the parts are in the position shown in Fig. 3 and the entire diaphragm is subject to atmospheric pressure. Under such conditions, the pressure differential across the whole diaphragm is always great enough even if the engine suction which is communicated to the diaphragm becomes actually less than that which is communicated thereto during cranking, to prevent movement of the diaphragm to the right far enough to effect closing of the control switch.

As already stated, the switch is closed by manual movement of the throttle 12 from its closed position toward open position. When the engine is not running and the throttle is closed, the switch 18 is open and the parts are in the Fig. 6 position. In this position, the contact members 66 engage the recesses 64 and the segments 74 are in a position where the edges 122 of such segments engage stops 124 formed on the housing 46. With the parts in this position, if the throttle is opened, the sleeve 92 is moved counter-clockwise, as seen in Fig. 6. Due to engagement of the bent part of spring 84 in groove 88, this rotation of the sleeve will rotate the element 68 after the spring is put under sufficient tension to disengage the members 66 from the recesses 64. In order to effect this disengagement, the spring 84 is put under sufficient tension to move the member 68 with a snap action to the position shown in Fig. 5 in which the opposite edge 126 of such segment 74 is in engagement with a stop shoulder 128 formed on housing 46 and contact members 66 have been moved into engagement with the contacts 62. This will effect closing of the switch 18 and, if the switch 42

is closed, will effect closing of the control circuit of the starting motor and energization thereof.

When the engine is in operation, if the member **68** can be, under any circumstances, rotated with the throttle as the latter is moved toward open or closed position, it will be moved without opposition because contact members **66** are not in engagement with either recesses **64** or contacts, and member **68** can rotate entirely freely.

Obviously, the rotational movement of member **68** is limited by stops **124** and **128** but the sleeve **92** and the throttle shaft can continue to rotate after movement of member **68** is stopped because of the yielding spring connection **84** between sleeve **92** and member **68**.

The abutment or stop **128** on housing **46** is formed by an undercut **130** from the edge **132** of a rib **134** formed on the inner surface of housing **46**. In forming this abutment, a shoulder **138** is also formed which limits the maximum movement of member **68** to the left when the switch is opened by the effect of engine suction.

When the switch is opened by the effect of high suction, the shoulder **138** permits enough movement of member **68** to move the sleeve **92** far enough to the left to disengage the contacts but not far enough to disengage the keyways **98** from splines **100** so as to uncouple the driving connection between the throttle shaft and sleeve **92**. To accomplish this the throttle must be permitted to close. This will disengage the segment **68** from shoulder **138** and when this occurs the segment and sleeve **92** will move far enough to the left to uncouple the driving connection and sleeve **92** and segment **68** will have been moved substantially back to their normal position with the contact members **66** in alignment with recesses **64**, in which position such elements are held by spring **84** until the driving connection with the throttle shaft is reestablished. Therefore, even if the suction in passage **10** posterior to the throttle dropped enough to permit movement of the member **68** far enough to the right to engage the contact members **66** with the head of housing **46**, this movement could not take place because of the engagement of the end of sleeve **92** with the splines **100** which would not be in alignment with the keyways **98** when the suction drops on open throttle. This mechanism constitutes a positively operating means for preventing any closure of the control switch **18** when the engine is in operation.

Due to the selective mounting of the housing **46** on the boss **15** concentric with the shaft **30**, it is possible to adjust the angular relation of the contacts with respect to the throttle shaft so that completion of the circuit will be made only when the opening of the throttle valve **12** is best suited for engine starting. Such indexing of the switch can be accomplished by setting the throttle position which is determined to be best suitable for engine starting, and thence rotating the switch on the boss until the contactor snaps from the open circuit relation to the closed circuit relation. When secured in that relation, starting is accomplished by movement of the accelerator lever until the throttle reaches the position it occupied when the switch was indexed, and when this position is reached, the control switch will be closed.

The control circuit of the starting apparatus in which this control switch is used is not material and it may be exactly like that shown in the patent to Dermond, 2,326,125, of August 10, 1943. The principal elements of this circuit are shown herein and comprise a wire **140** leading from the battery **38** to switch **42** which connects the battery with the ignition and with terminal **34** of the switch **18**. A wire **142** leads from the terminal **36** of switch **18** to the winding of a relay switch **144** and thence to ground through the generator, so that closing of the switch **18** merely energizes the winding of the relay switch. A wire **146** leads from the battery to one of the contacts of the relay switch, while the cooperating contact of such switch is connected by a wire **148** to one coil of a two-coil magnet **150** grounded at **152**. The wire **148** is also connected by wire **154** to the second coil of the magnet which is connected by wire **156** to a wire leading to the starting motor **41** and to ground at **160**.

The wire **146** also leads to a fixed contact **162** and another fixed contact **164** is connected by a wire **166** with the starting motor, this wire also connecting with the wire **156** previously referred to. The movable contact **40**, previously referred to, is moved by the magnet **150** into engagement with contacts **162** and **164** to close the starting motor circuit and cause operation of the starting motor. When the switch **18** is closed, the contacts of the relay switch are closed and both coils of the magnet **150** are energized to close the switch **40**. When this takes place, one of the coils of the magnet is short-circuited and the switch **40** is held closed until the engine is started. When switch **18** is opened, magnet **150** is entirely deenergized and switch **40** is opened.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. In a starting apparatus for internal combustion engines having a starting motor, a current source, a circuit for connecting said motor and current source, a control switch for controlling said circuit having a plurality of contacts adapted to be electrically connected to close said circuit, a member rotatably movable to connect said contacts and axially movable by engine suction to a position to prevent closing of the switch during engine operation, and means opposing a predetermined resistance to movement of said suction operated member to switch closing position, operating means for moving said rotatable member to switch closing position, a resilient operatng connection between said means and the rotatable member, said resilient operating connection being effective to exert sufficient force to overcome the means opposing movement of said rotatable member only after a predetermined movement of said operating means.

2. In a starting apparatus for an internal combustion engine having a carburetor provided with a mixture passage for supplying combustible mixture to the engine and a throttle valve for controlling the quantity of mixture supplied thereby, a current source, a starting motor operable by current from said source and a circuit for connecting said starting motor with the current source; a control switch for controlling said circuit comprising a housing mounted on the carburetor, a rotatable contact member having contacts mounted thereon, said member being normally in switch open position and rotatable to a position to close said switch to cause operation of the starting motor, means normally connecting said rotatable member with the throttle valve for operation thereby, means operable when the engine is self-operative for disabling the connection between the throttle valve and said rotating member and for moving said rotatable member to a position to open the control switch, and means effective under all operating conditions to prevent movement of the rotatable member to a position to open the switch while the engine is being operated by the starting motor.

3. In a starting apparatus for an internal combustion engine having a carburetor provided with a mixture passage for supplying combustible mixture to the engine and a throttle valve for controlling the quantity of mixture supplied thereby, a current source, a starting motor operable by current from said source, and a circuit for connecting said starting motor with the current source; a control switch for controlling said circuit comprising a housing mounted on the carburetor, a rotatable contact member having contacts mounted thereon, said member being normally in switch open position and rotatable to a position to close said switch to cause operation of the starting motor, means normally connecting said rotatable member with the throttle valve for operation thereby, suction operated means for disabling the operating connection between the throttle valve and the rotating member, said suction operated means being so constructed that

it is effective to disable said operating connection under all possible conditions of self-operation of the engine and is never effective to disable said operating connection during operation of the engine by the starting motor.

4. In a starting apparatus for an internal combustion engine having a carburetor provided with a mixture passage for supplying combustible mixture to the engine and a throttle valve for controlling the quantity of mixture supplied thereby, a current source, a starting motor operable by current from said source and a circuit for connecting said starting motor with the current source; a control switch for controlling said circuit comprising a housing mounted on the carburetor, a rotatable member within the housing and having contacts mounted thereon, an operating member resiliently connected to said rotatable member, means for operatively connecting said operating member with the throttle valve for operation therewith, means operable by engine suction when the engine is self-operative to disable the connection between the operating member and throttle shaft and means under all operating conditions preventing the disabling of this connection when the engine is being operated by the starting motor.

5. In a starting apparatus for an internal combustion engine having a carburetor provided with a mixture passage for supplying combustible mixture to the engine and a throttle valve for controlling the quantity of mixture supplied thereby, a current source, a starting motor operable by current from said source, and a circuit for connecting said starting motor with the current source; a control switch for controlling said circuit comprising a housing mounted on the carburetor, a rotatable contact member having contacts mounted thereon, said member being normally in switch open position and rotatable to a position to close said switch to cause operation of the starting motor, means normally connecting said rotatable member with the throttle valve for operation thereby, and means for adjustably securing the switch housing to the carburetor, said means being constructed to permit rotary adjustment of the switch housing relative to the throttle in order to vary the movement of the throttle required to move said rotatable member to its switch closing position.

6. In a starting apparatus for an internal combustion engine having a carburetor provided with a mixture passage for supplying combustible mixture to the engine and a throttle valve for controlling the quantity of mixture supplied thereby, a current source, a starting motor operable by current from said source and a circuit for connecting said starting motor with the current source; a control switch for controlling said circuit comprising a housing mounted on the carburetor, a rotatable member within the housing and having contacts mounted thereon, an operating member resiliently connected to said rotatable member, suction operated means for disabling the operating connection between the throttle valve and the rotating member, said suction operated means being so constructed that it is effective to disable said operating connection under all possible conditions of self operation of the engine, and is never effective to disable said operating connection during operation of the engine by the starting motor.

7. In a starting apparatus for an internal combustion engine having a carburetor provided with a mixture passage for supplying combustible mixture to the engine and a throttle valve controlling the quantity of mixture supplied thereby, a current source, a starting motor operable by current from said source and a circuit for connecting the starting motor with the current source; a control switch for controlling said circuit comprising a housing mounted on the carburetor, a rotatable member normally operatively connected to the throttle and rotatable thereby to a position to effect closing of the control switch, said member being movable axially with respect to the throttle to effect opening of the switch and disconnection of said member from the throttle, a suction operated member operable to move said rotatable member axially, means for communicating the suction of the mixture passage posterior to said throttle to said suction operated member, and means whereby the same degree of suction creates a greater pressure differential across said suction operated member when the engine is self operative than when the engine is being operated by the starting motor.

8. In a starting apparatus for an internal combustion engine having a carburetor provided with a mixture passage for supplying combustible mixture to the engine and a throttle valve controlling the quantity of mixture supplied thereby, a current source, a starting motor operable by current from said source and a circuit for connecting the starting motor with the current source; a control switch for controlling said circuit comprising a housing mounted on the carburetor, a rotatable member normally operatively connected to the throttle and rotatable thereby to a position to effect closing of the control switch, said member being movable axially with respect to the throttle to effect opening of the switch and disconnection of said member from the throttle, a suction operated member operable to move said rotatable member axially, means for communicating the suction of the mixture passage to the entire area of one side of said suction operated member, means operable when the engine is being operated by the starting motor for communicating atmospheric pressure to a part only of the opposite side of said suction operated member, whereby the pressure differential effective on said member is insufficient to effect movement thereof and opening of the switch while the engine is being operated by the starting motor.

9. In a starting apparatus for an internal combustion engine having a carburetor provided with a mixture passage for supplying combustible mixture to the engine and a throttle valve controlling the quantity of mixture supplied thereby, a current source, a starting motor operable by current from said source and a circuit for connecting the starting motor with the current source; a control switch for controlling said circuit comprising a housing mounted on the carburetor, a rotatable member normally operatively connected to the throttle and rotatable thereby to a position to effect closing of the control switch, said member being movable axially with respect to the throttle to effect opening of the switch and disconnection of said member from the throttle, a suction operated member operable to move said rotatable member axially, means for communicating the suction of the mixture passage to the entire area of one side of said suction operated member, means operable when the engine is being operated by the starting motor for communicating atmospheric pressure to a part only of the opposite side of said suction operated member, said means being operable when the engine is self operative to communicate atmospheric pressure to the entire area of the opposite side of said suction operated member, whereby the pressure differential effective on said member is insufficient to effect opening of the switch during operation of the engine by the starting motor but is always sufficient during self operation of the engine to prevent closing of said control switch.

10. In a starting apparatus for an internal combustion engine having a carburetor provided with a mixture passage for supplying combustible mixture to the engine and a throttle valve controlling the quantity of mixture supplied thereby, a current source, a starting motor operable by current from said source and a circuit for connecting the starting motor with the current source; a control switch for controlling said circuit comprising a housing mounted on the carburetor, a rotatable member normally operatively connected to the throttle and rotatable thereby to a position to effect closing of the control switch, said member being movable axially with respect to the throttle to effect opening of the switch and disconnec-

tion of said member from the throttle, a flexible diaphragm movable by engine suction and operable to move said rotatable member axially to open said control, and means whereby the same degree of engine suction creates a greater pressure differential across said diaphragm when the engine is self operative than when the engine is being operated by the starting motor, so that a degree of suction which is sufficient to hold the switch open during self operation of the engine is not sufficient to open the switch while the engine is being operated by the starting motor.

11. In a starting apparatus for an internal combustion engine having a carburetor provided with a mixture passage for supplying combustible mixture to the engine and a throttle valve controlling the quantity of mixture supplied thereby, a current source, a starting motor operable by current from said source and a circuit for connecting the starting motor with the current source; a control switch for controlling said circuit comprising a housing mounted on the carburetor, a rotatable member normally operatively connected to the throttle and rotatable thereby to a position to effect closing of the control switch, said member being movable axially with respect to the throttle to effect opening of the switch and disconnection of said member from the throttle, a suction operated diaphragm effective to move said rotatable member axially to open the switch and to disable the operating connection between the rotatable member and the throttle means whereby a given degree of engine suction will create a sufficient pressure differential across the diaphragm to open the switch and disable the driving connection when the engine is self operative, and means for preventing the same degree of engine suction from operating the diaphragm when the engine is being operated by the starting motor.

12. In a starting apparatus for internal combustion engines having a starting motor, a current source, a control switch for controlling said circuit having a plurality of contacts adapted to be electrically connected to close said circuit, a member rotatably movable to connect said contacts and axially movable by engine suction to a position to prevent closing of the switch during engine operation, a housing surrounding said rotatable member and in which the member is rotatably and axially movable, and abutments formed on the inner wall of said housing for limiting the rotating and axial movements of said rotatable member.

13. In a starting apparatus for an internal combustion engine having a carburetor provided with a mixture passage for supplying combustible mixture to the engine and a throttle valve controlling the quantity of mixture supplied thereby, a current source, a starting motor operable by current from said source and a circuit for connecting the starting motor with the current source; a control switch for controlling said circuit comprising a housing mounted on the carburetor, a plurality of fixed contacts supported by the housing, a rotatable member supporting a plurality of contacts and movable to engage said contacts with the fixed contacts in order to close the control switch, said housing having a plurality of depressions formed therein normally engaged by the contacts on said rotatable member and acting as a detent means to oppose movement of the rotatable member to switch closing position, a resilient operating connection between the throttle valve and said rotatable member, and effective after a predetermined opening movement of the throttle to overcome the resistance of the detent means and move said rotatable member to switch closing position.

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