

Aug. 2, 1938.

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2,125,399

AUTOMATIC CONTROLLER FOR INTERNAL COMBUSTION ENGINE STARTERS

Filed Dec. 26, 1931

2 Sheets-Sheet 1

FIG. 6.

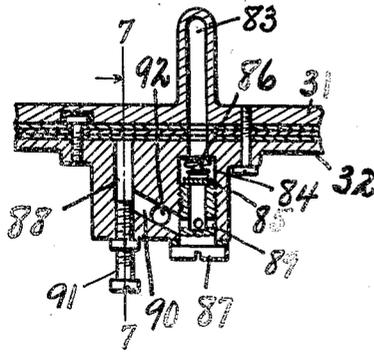


FIG. 7.

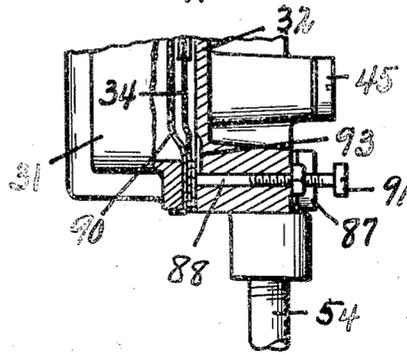
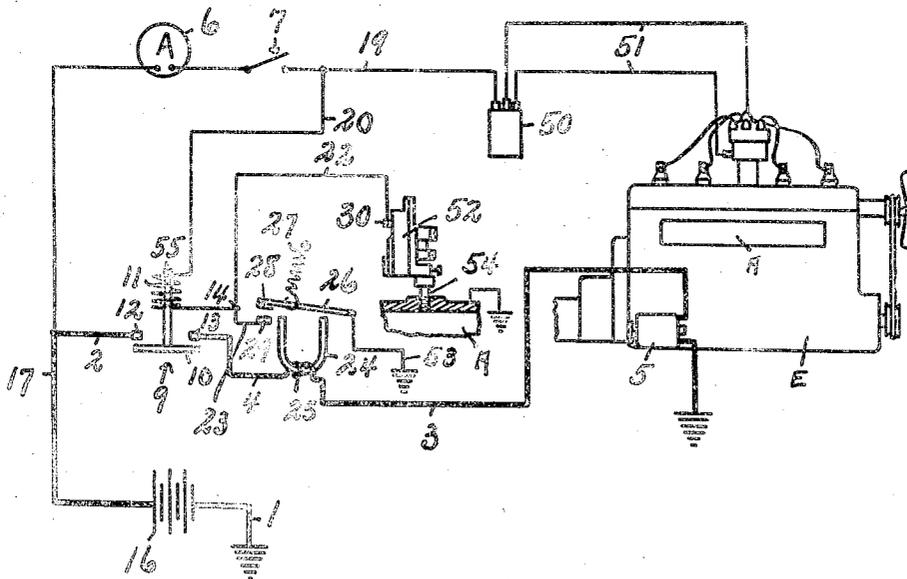


FIG. 1.



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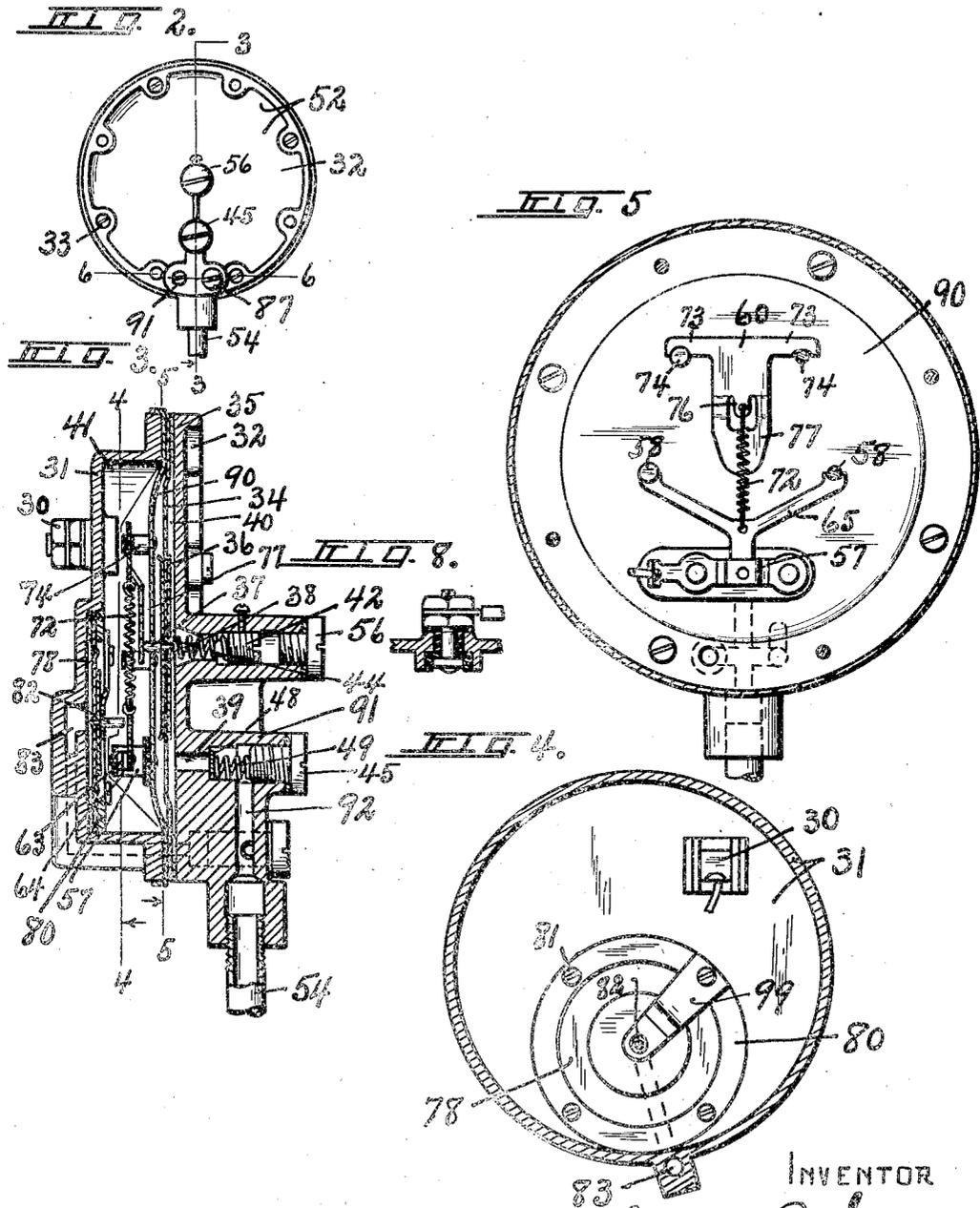
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2,125,399

AUTOMATIC CONTROLLER FOR INTERNAL COMBUSTION ENGINE STARTERS

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Application December 26, 1931, Serial No. 583,355

5 Claims. (Cl. 290—38)

This invention relates to certain new and useful improvements in automatic controllers for internal combustion engine starters, and reference is hereby made to my co-pending applica-
 5 tions, Serial Nos. 548,617 and 576,319, filed July 3rd, 1931 and November 20th, 1931, respectively, of which this application is a continuation in part, the latter application having issued on March
 10 30, 1937 as Patent Number 2,075,305.

The main object of the invention is to provide an automatic means of going through the proper cycle for starting an internal combustion engine when the ignition switch is turned on and to provide a means for restarting such engine in case
 15 the engine stalls with the ignition switch turned on.

Further, with the system of vacuum relay control as illustrated in my said co-pending applications, as well as a system of control using the
 20 voltage produced by the generator to lock out the starting motor, it has become evident that should the engine backfire and start to rotate in a reverse direction and the starting motor becomes engaged with the fly wheel, it will injure the
 25 fly wheel or the Bendix drive or break the Bendix drive support or possibly break the crank case where it supports the starting motor.

To eliminate the possibility of this condition existing, this invention provides in the combina-
 30 tion, an additional control unit which will operate when the intake manifold reaches a pressure above atmosphere due to the reverse operation of the engine. When this pressure condition exists in the manifold, a pair of contacts are
 35 opened in the starting switch circuit which will prevent the engagement of the starting motor as long as this manifold pressure exists.

In the particular embodiment of the invention herein illustrated, there is added an additional
 40 diaphragm to the vacuum relay disclosed in my said co-pending application Serial No. 576,319, and which additional diaphragm has a pin or projecting member which prevents the closing of the main relay contacts when pressure exists in the
 45 intake manifold. This diaphragm is in communication with the intake manifold through a check valve which will open when pressure is created in the manifold. This valve will immediately seal itself sufficiently to retain the pressure
 50 back of the auxiliary diaphragm, holding the contacts open against the diaphragm spring until the air gradually leaks from behind the diaphragm. This leak through the check valve may be caused by a slight distortion of the valve
 55 seat.

It is not necessary with this construction to provide a definite control on this leak time period, due to the fact that when the engine comes to rest and rocks, vacuum is again induced in the manifold which causes the switch to open in its
 5 normal way with the vacuum diaphragm. The only object in retarding the pressure diaphragm is to give the vacuum diaphragm a chance to open the contacts before the pressure diaphragm permits them to close. This positively prevents
 10 the engagement of the starting motor while the fly wheel is rocking.

Other objects and advantages relate to the details of the structure and the form and relation of the parts thereof, all as will more fully appear
 15 from the following description taken in connection with the accompanying drawings in which:

Figure 1 is a diagrammatic illustration of an embodiment of this invention.

Figure 2 is an elevation of the vacuum pressure
 20 relay.

Figure 3 is a section taken on line 3—3, Figure 2.

Figure 4 is a section taken on line 4—4, Figure 3.

Figure 5 is a section taken on line 5—5, Figure 3.

Figure 6 is a section taken on line 6—6, Figure 2.

Figure 7 is a section taken on line 7—7, Figure 6.

Figure 8 is a section through the terminal.

The apparatus as diagrammatically illustrated in Figure 1 is generally the same in circuit arrangement as the apparatus shown in my co-
 35 pending application, Serial No. 576,319, and comprises a battery 16 having one terminal grounded through wire 1. The opposite terminal of the battery is connected by wire 17 to ammeter 6, ignition switch 7, wire 19 to ignition coil 50 which,
 40 in turn, is connected in the usual manner as by wires 51 to the timer and spark plugs of an internal combustion engine E.

The usual starting motor 5 is provided geared or connected by the usual Bendix drive to the fly
 45 wheel of the engine E. A starting motor circuit normally broken, is provided from battery 16 through wire 17, wire 2, terminal 12, terminal 13, wire 4, coil 25, wire 3 to the starting motor 5. Terminals 12 and 13 are spaced apart so that
 50 this circuit is normally broken. Means are provided for closing the starting motor circuit in the form of an electro-magnetic starting switch indicated generally by the arrow 9 and having a coil 11 in circuit with the switch 7. This electro-
 55

magnetic switch comprises the coil 11 and armature 55, the latter carrying a disk or switch member 10 adapted to bridge and electrically connect the contacts 12 and 13 for closing the starting motor circuit.

A primary relay circuit for the coil 11 is provided by wire 20 leading from one terminal of the coil 11 and connected through the ignition switch 7 with wire 17 to one side of battery 16. The other terminal 14 of coil 11 is connected by wire 22 with the terminal 30 of the pressure-operated relay 52. This relay, as hereinafter described, is normally actuated by sub-atmospheric pressure, but also includes means actuated by pressure above atmosphere for also actuating the relay as, for instance, when the engine backfires and pressure exists in the intake manifold thereof. A relay 52, as shown, is preferably in metallic contact with the engine E which, through ground, completes the primary circuit for the coil 11.

For the present, it will be sufficient to say that the contacts of relay 52 are normally closed when engine E is not operating, and atmospheric pressure exists in the intake manifold thereof. The instant the primary circuit of coil 11 closes as by closing ignition switch 7, the disk or switch member 10 is actuated to close the starting motor circuit through contacts 12 and 13 whereupon the starting motor 5 acts to rotate the fly wheel and crank shaft of engine E in the usual manner.

The instant the crank shaft of engine E starts rotating, sufficient sub-atmospheric pressure is produced in the intake manifold A of the engine to actuate relay 52, separating its contacts and thereby opening the primary circuit of coil 11 as hereinafter described in detail. To effect this result, relay 52 may be connected by tube 54 threaded into the intake manifold A of engine E or may be connected to any line leading therefrom in which substantially the same vacuum exists as in the engine manifold, or may be connected to any other source in which sub-atmospheric pressure is produced when the crank shaft of the engine starts rotating. The details of construction of the relay by which this operation is effected will be later described.

The opening of the contacts of relay 52 and the breaking of the primary circuit of coil 11 will not act to open switch 9 since a secondary circuit is provided for coil 11 from battery 16 through wires 17 and 20, coil 11, terminal 14, wire 23, contact 29, and armature 26 carrying contact 28 adapted for electrical connection with contact 29, the former contact being grounded through wire 53. The armature 26, contacts 28 and 29 and wire 53 taken in conjunction with core 24 and coil 25 in the starting motor circuit constitute a current-controlled relay.

Spring 27 is provided for normally holding the armature 26 in such a position that contacts 28 and 29 are electrically disconnected. The tension of spring 27 is so determined or adjusted that the necessary current to crank the automobile engine when flowing through coil 25 to the starting motor will magnetize core 24 sufficiently to close the contacts 28 and 29 and maintain them closed. However, when the starting motor 5 is relieved of the load of cranking the engine, there is a decided reduction of current flowing through coil 25 and, under this condition, spring 27 is sufficiently strong to separate contacts 28 and 29, thereby breaking the secondary circuit of the relay 9, releasing armature 55 and permitting movement of the disk or switch 10 to break the starting motor circuit.

With this understanding of the general arrangement of the circuit and relay, the detailed construction and operation of the pressure controlled relay 52 is as follows: As illustrated, the relay 52 comprises a cup-shaped cylindrical body 31 provided with a removable head 32 secured thereto as by means of screws 33. Clamped between head 32 and body 31 and sealed as by suitable gaskets 35 is a flexible diaphragm 34 and a partition wall 90, the latter of which may be formed of suitable material as thin metal. The flexible diaphragm may also be formed of any suitable material such as silk impregnated with a water impervious compound, leather, thin metal, rubber, materials known as Fabrikoid composition and the like. This flexible diaphragm divides the chamber within the relay casing into two chambers 40 and 41 on opposite sides of the diaphragm.

In order to have the central portion of the diaphragm 34 move at a positive and substantially parallel relation with respect to head 32, the diaphragm is stiffened by two coaxial circular disks 36 perhaps preferably formed of thin metal placed one on each side thereof and secured together and to the diaphragm in that position in any suitable and well-known manner not herein necessary to further illustrate and describe except to say that such connecting means, as illustrated, includes pins 37 and 38 projecting in opposite directions from the diaphragm and extending in a direction substantially normal to the plane of the diaphragm.

Head 32 of the relay casing is provided with a passage or port 39 leading from chamber 40 through the interior of a hollow boss 91 formed on the head 32 to a lateral passageway 92 in communication with tube 54 penetrating the engine intake manifold as hereinbefore described. The interior wall of the boss 91 is shouldered so as to form a seat for a valve 40 closing inwardly toward the chamber 40 and normally held closed as by means of spring 49 having one end in contact with the valve and the opposite end in contact with the headed plug 45 threaded into the outer end of boss 91 preferably with a gasket disposed between the head of the plug and the end of the boss. The head 32 is further provided with a second boss 43 within which is positioned an adjustable threaded plug 42, and spring 44 is positioned between the adjustable plug 42 and the adjacent side of diaphragm 34 with pin 38 extending within the convolutions of the spring to maintain the spring centered. Further, plug 42 may be provided with a reduced extension extending within the adjacent spring convolution to assist in maintaining the spring in proper position. Boss 43 may have its outer end closed airtight by means of screw plug 56 and a gasket interposed between the head of the plug and the adjacent end of the boss. The partition wall 90 is provided with an opening through which the stud or projection 37 extends for engagement with the movable contact actuating member.

Further, the partition 90, as shown, supports a U-shaped contact-carrying member 57 secured thereto and insulated therefrom in any suitable manner and carrying a contact 63. The cooperating contact 64 is carried by a substantially Y-shaped switch arm 65. The extremities of the two symmetrical legs of the switch arm are provided with recesses for seating engagement against respective pins 58, which pins 58 are provided with recesses for receiving the ends of the legs. The contact 64 is carried by the upright leg of the Y switch arm so as to lie opposite the

contact 63. Movement of the switch arm 65 is effected through the medium of spring 72 having one end connected to the switch arm at the meeting point of the legs thereof and its opposite end connected to a tongue 76 formed on a switch-actuating member 60.

This switch-actuating member 60 is mounted for rocking movement, and for that purpose, is formed with two lateral projections 73, each provided with a recess facing the recess in the legs of the Y switch arm 65, and these recesses in the projecting parts 73 seat in recesses formed in respective pins 74 shown in Figure 3 as 58, so as to permit rocking movement of the actuating arm 60 to carry the end of the spring connected to the tongue 76 to opposite sides of the plane of that portion of the Y arm 65 to which the other end of the spring is connected, whereby contact member 64 by movement of actuating arm 60 is snapped into and out of contact with the co-operating contact 63. It would be apparent that the tension of spring 72 maintains the switch-actuating arm 60 and the switch-carrying arm 65 in tight engagement with the respective posts 74 and 58.

For the purpose of causing movement of actuating arm 60 in accordance with movement of pin 37 carried by diaphragm 34, the actuating member 60 is formed with an extension 77 offset in a direction toward pin 37 and overlying the same. The construction and arrangement of the parts is such that when the diaphragm is in its normal position with the absence of vacuum in line 54, pin 37 is so positioned as to contact with the extension 77, moving the actuating member 60 to a position where the contacts 63 and 64 are closed. Upon the production of vacuum in line 54, valve 48 will be opened against the action of the spring 49 and air will be drawn from chamber 40, retracting diaphragm 34 and pin 37 so as to permit spring 72 to separate contacts 63 and 64 whereupon the primary circuit to the starting motor 5 will be broken. However, as hereinbefore described, the secondary circuit including the current-controlled relay will maintain the switch 9 in the starting motor circuit closed until such time as the current reduces in the starting motor circuit to a value which permits opening of the current-controlled relay.

The operation of the apparatus so far described is substantially the same as that of the apparatus described in my said co-pending application Serial No. 576,319.

It will be apparent that with the construction so far described, should the engine backfire producing pressure above atmosphere in the intake manifold to which conduit 54 is connected, that diaphragm 34 relieved from the effect of suction in chamber 40 would immediately move to a position closing contacts 63 and 64, whereupon the starting motor circuit would be closed through switch 9 and the starting motor would be energized to engage the flywheel of the engine while the latter was running backwards or rocking which might result in the disastrous effects heretofore described.

In order to eliminate this possibility, the cup-shaped head 31 is provided with a second or supplementary diaphragm 78 which, although smaller, may be of the same general form and material as diaphragm 34 and is here shown as clamped by washer 80 against a gasket which rests in contact with the interior surface of the head 31, the gasket acting to space the diaphragm a short distance from the casing.

Washer 80, diaphragm 78 and the interposed

gasket may be secured to the head 31 in any suitable manner as by screws 81. Diaphragm 78 is provided at its central portion with a pin or stud 82 projecting toward the switch arm 65 but out of contact therewith when diaphragm 78 lies in its normal plane.

For the purpose of moving the diaphragm 78 to a position where stud 82 will contact with arm 65 to maintain contacts 63 and 64 open, a conduit 83 is provided leading from the chamber at the rear of diaphragm 78 through the wall of the head 31 through the edge of partition wall 90 and diaphragm 34 where they overlie each other in clamped relation, and to a passageway 84 extending through the head 32. This passageway is closed at its outer end by a hollow screw stud 87 threaded into the wall of the passageway and forming at its inner end a seat for a valve 85 opening under pressure against the action of spring 86. Within the head 32, the hollow stud 87 is provided with radial passageways 89 leading to a cross conduit 90 which extends from passageway 84 to a second passageway 93 formed in the head 32. The passageway 90 leads into and intersects the passageway 92 so as to be subjected to the pressure above atmosphere or below atmosphere existing in the passageway 92. When pressure exists in tube 54, valve 48 will be closed thereby as hereinbefore described, to prevent diaphragm 34 to cause the closing of contacts 63 and 64, but the existence of such pressure causes air to pass through conduit 90 into the passageway 84 through the opening of valve 85 and this air under pressure passes through conduit 83 to the chamber at the rear of diaphragm 78, bowing the diaphragm inwardly and causing stud 82 to move into the path of movement of the contact-carrying arm 65, thereby preventing closing of the contacts. Therefore, when either sub-atmospheric pressure or pressure above atmosphere exists in tube 54, this pressure relay will act to maintain contacts 63 and 64 separated, thereby preventing closing of the starting motor circuit until atmospheric pressure has been reached and the engine parts have ceased their movement, whereupon the contacts will again be closed and the starting motor 5 exerted to again start the engine.

For the purpose of providing a time period after the internal combustion engine has stopped running before contacts 63 and 64 will be closed to excite the starting motor, the conduit 88 is provided for permitting slow entrance of air into the chamber 40 to relieve the sub-atmospheric pressure existing therein by reason of the closing of valve 48 through lack of sufficient suction in pipe 54 to maintain said valve open, and to adjust the length of this time period, a valve screw 91 is threaded into the outer end of conduit 88 so that by adjustment, communication between conduit 88 and conduit 90 may be regulated to prevent the entrance of air to chamber 40 at the rate required to provide the desired time period. Conduit 88 communicates with the chamber 40 through a recess 93 formed in the inner surface of the head 32. Spring 99 is provided for holding the diaphragm with stud 82 out of the path of the contact-carrying member 65. The end of the spring may have an opening through which the stud 82 projects. The other end may be mounted on a screw 81.

It will be apparent that with this construction, operation and arrangement of the relay, that when the engine is running under normal conditions, contacts 63 and 64 will be opened to break

the starting motor circuit through switch 9, but should the engine backfire and start to run backwards, producing pressure in the intake manifold and in pipe 54, the contacts will not be closed but will be maintained open by operation of the secondary diaphragm 78 moving stud 82 into the path of the switch-carrying member 65. This provides a construction and method of operation where the starting motor cannot be excited to engage engine parts until substantially atmospheric pressure exists in the engine manifold and the conduit 54.

Although I have shown and described a specific construction and arrangement of the parts as constituting an illustrative embodiment of this invention, I do not desire to restrict myself to the details of form, construction, arrangement or operation of the same, as various changes and modifications may be made within the scope of the appended claims.

I claim:

1. An automatic controller for internal combustion engine starters comprising with an internal combustion engine, a starting motor circuit, an electro-magnetic switch in said circuit for controlling energizing of the motor, a relay controlling the energizing of said electro-magnetic switch and including contacts, means for maintaining said contacts separated when vacuum exists in the intake manifold, and means for maintaining said contacts separated when pressure above atmosphere exists in the intake manifold.

2. An automatic controller for internal combustion engine starters comprising with an internal combustion engine, a starting motor circuit, an electro-magnetic switch in said circuit for controlling energizing of the motor, a relay controlling the energizing of said electro-magnetic switch and including contacts, means for maintaining said contacts separated when vacuum exists in the intake manifold, and means for maintaining said contacts separated when pressure above atmosphere exists in the intake manifold, said latter means including a movable member subjected to such pressure.

3. An automatic controller for internal combustion engine starters comprising with an internal combustion engine, a starting motor circuit, an electro-magnetic switch in said circuit for controlling energizing of the motor, a relay controlling the energizing of said electro-magnetic switch and including contacts, means for maintaining said contacts separated when sub-atmospheric pressure exists in the intake manifold, and means actuated by the pressure above atmosphere in the intake manifold for maintaining said contacts separated, said latter means including a flexible diaphragm.

4. In an automatic controller for internal combustion engine starters, an ignition circuit, a starting motor circuit, and means for maintaining said starting motor circuit open after ignition occurs when pressure other than atmospheric pressure exists in the engine manifold, comprising a pair of contacts in said starting motor circuit and a pair of pressure-operated devices, one of said pressure-operated devices being operable to maintain said contacts separated when a pressure above atmospheric exists in the engine manifold, and the other of said pressure-operated devices operable to maintain said contacts separated when a pressure below atmospheric pressure exists in said engine manifold.

5. In an automatic controller for internal combustion engine starters, a starting motor circuit and means for maintaining said starting motor circuit open when pressure other than atmospheric exists in the engine intake manifold, comprising a pair of contacts in said starting motor circuit, and a pair of pressure-operated devices, one of said pressure operated devices being operable to maintain said contacts separated when a pressure above atmospheric exists in the engine intake manifold, and the other of said pressure-operated devices operable to maintain said contacts separated when a pressure below atmospheric pressure exists in said engine intake manifold.

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