Nov. 27, 1934. G. B. SAYRE 1,981,880

AUTOMATIC CONTROLLER FOR INTERNAL COMBUSTION ENGINE STARTERS

Filed Dec. 26, 1931 2 Sheets-Sheet 1

Fig-1.

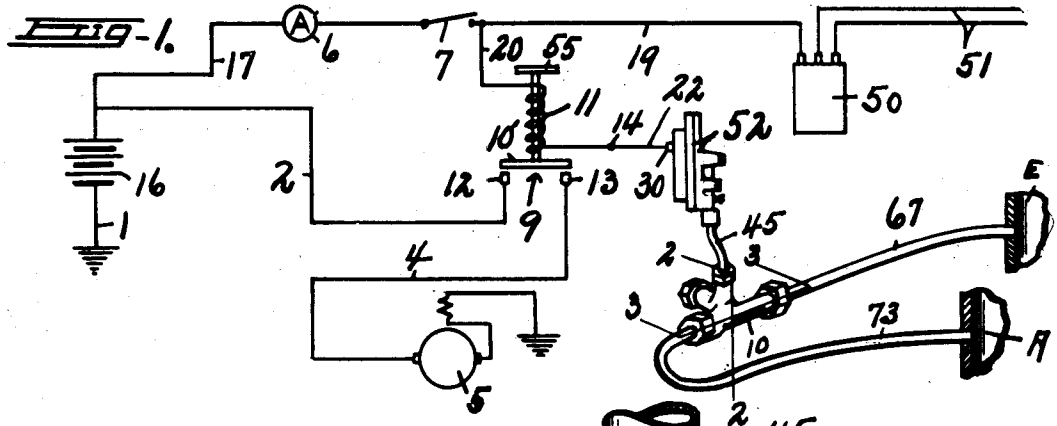


Fig-2.

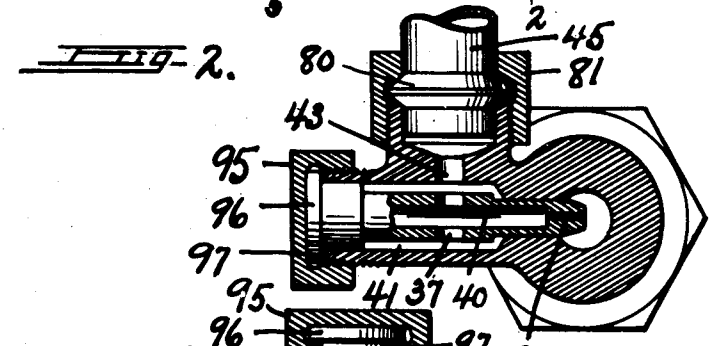


Fig-3.

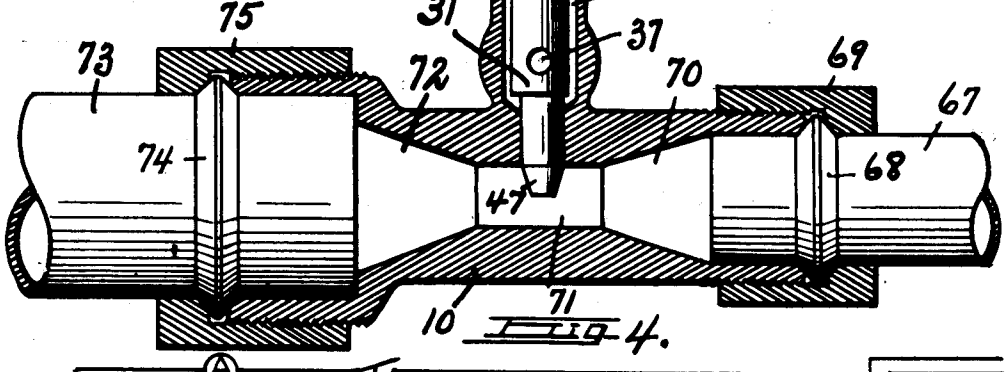
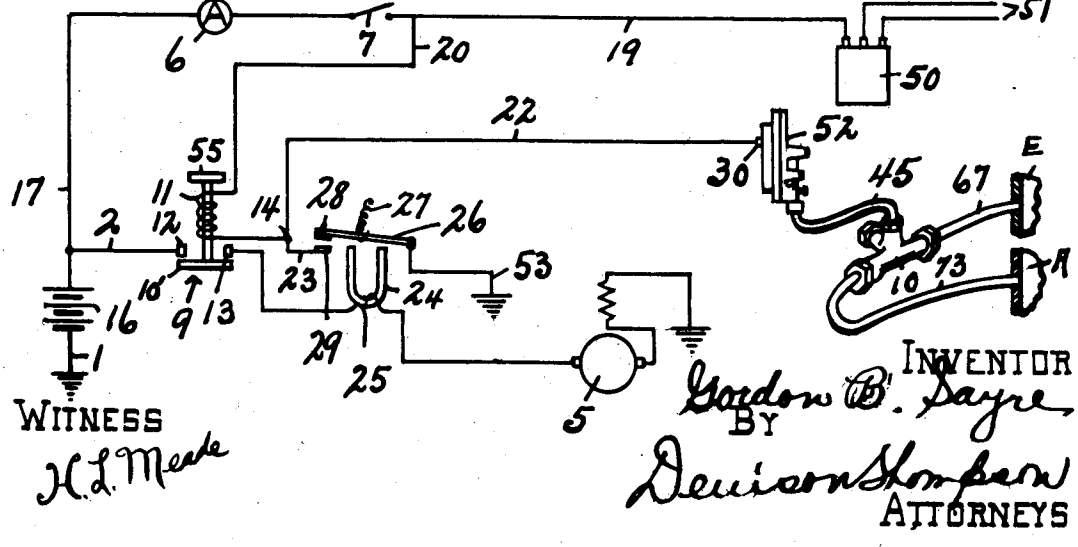


Fig-4.



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Fig. 5.

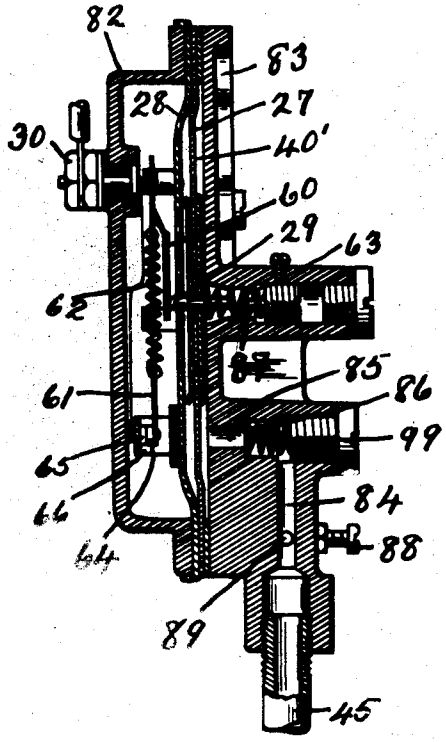


Fig. 6.

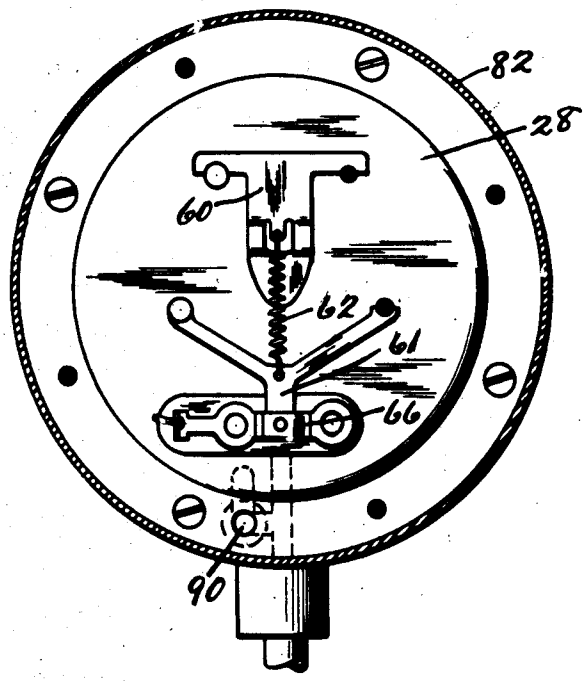


Fig. 7.

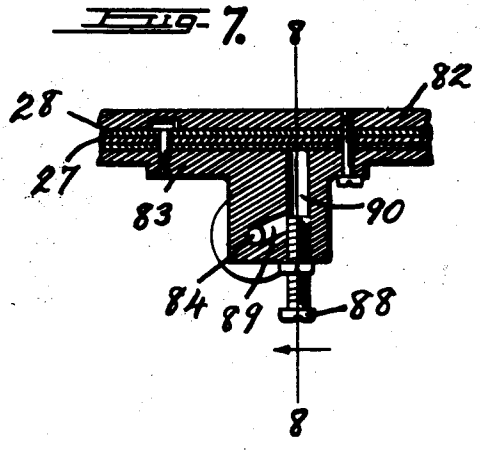
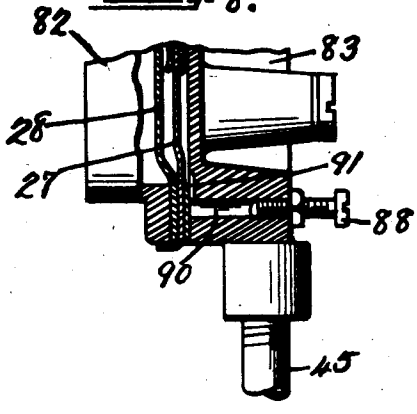


Fig. 8.



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UNITED STATES PATENT OFFICE

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AUTOMATIC CONTROLLER FOR INTERNAL COMBUSTION ENGINE STARTERS

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Application December 26, 1931, Serial No. 583,357

7 Claims. (Cl. 290—38)

This invention relates to certain new and useful improvements in apparatus and method of obtaining or producing vacuums, and the invention is illustrated in connection with an automatic controller for internal combustion engines although it is generally applicable for use in any association with an internal combustion engine, such as the operation of vacuum windshield wipers, vacuum tanks for elevating fuel, etc.

The intake manifold of an internal combustion engine is a known and generally used but highly variable source of suction or vacuum and, in many cases, the vacuum existing in the intake manifold of the engine is at a minimum when most needed at its maximum as, for instance, when the engine is running with the throttle wide open.

I have found that the use of an aspirator incorporated in a conduit or pipe leading from the exhaust manifold is a perhaps more effective means for producing maximum or comparatively high vacuum when most needed, and is peculiarly adapted for use in connection with the operation of a vacuum relay constituting a portion of an automatic starting device for internal combustion engines, and this discovery constitutes the subject matter of an application co-pending herewith Serial No. 583,356.

However, I have discovered that in operation, a markedly improved structure is produced as to degree, consistency and uniformity of desired vacuum when the outlet pipe of the exhaust manifold aspirator is connected to the intake manifold of the internal combustion engine or some other source of suction associated therewith. With this construction, the value of the vacuum in the intake manifold is added to the value of the pressure in the exhaust manifold, and these two values acting jointly produce a resultant suction or vacuum having a value which is a product of their added values. Further, with this arrangement, it is immaterial in which direction the air or gas is drawn or forced through the aspirator restriction past the jet, as in both cases, suction or vacuum is produced in the pipe leading from the jet and under general internal combustion operating conditions, a materially higher more constant and uniform vacuum is produced and maintained in said pipe.

Further, it is immaterial whether, as under normal operating conditions, vacuum exists in the intake manifold and pressure exists in the exhaust manifold or reversely, as when the engine backfires and runs backward, pressure exists in the intake manifold and vacuum exists in the exhaust manifold for, under either condition the effect accomplished by the aspirator in producing suction or vacuum is the same, and in the relationship here shown, the contacts of the vacuum relay will be maintained electrically unconnected.

Other objects and advantages will appear from the following description, taken in connection with the accompanying drawings in which:—

Figure 1 is a diagrammatic illustration of one embodiment of the invention.

Figure 2 is a section on line 2—2, Figure 1.

Figure 3 is a section on line 3—3, Figure 1.

Figure 4 illustrates a modified embodiment of the invention which, in certain cases, is preferable.

Figure 5 is a section through a vacuum relay suitable for the purpose at hand.

Figure 6 is a section taken on line 6—6, Figure 5.

Figure 7 is a sectional view illustrating the adjustable bleed for the chamber at the rear of the diaphragm.

Figure 8 is a section on line 8—8, Figure 7.

The apparatus, as diagrammatically illustrated in Figure 1, comprises a battery 16 having one terminal grounded through wire 1. The opposite terminal of the battery is connected by wire 17 to an ammeter 6, ignition switch 7, wire 19 to ignition coil 50 which, in turn, is connected in the usual manner, as by wires 51 to the timer and spark plugs of an internal combustion engine, the exhaust manifold of which is illustrated at —E— and the intake manifold at —A—.

The usual starting motor 5 is provided, geared or connected in any usual or well-known manner to the fly wheel or crank shaft of the engine. A starting motor circuit normally broken, is provided from battery 16 through wire 17, wire 2, terminal 12, terminal 13, wire 4 to the starting motor 5, the other terminal of the starting motor being grounded, as diagrammatically illustrated.

Terminals 12 and 13 are spaced apart so that 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. This electro-magnetic switch comprises a coil 11 and an 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 vacuum relay circuit is provided for coil 11 as 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 sub-atmospheric pressure operated relay 52.

For the present, it is sufficient to state that the contacts of relay 52 are normally closed when the engine —E— is not operating. The instant the circuit of coil 11 closes, disk or switch 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 of the engine —E— in the usual and well-known manner.

The sub-atmospheric pressure relay 52 may take various forms, but the one illustrated is suitable for the purpose and comprises a cup-shaped body 82 with a head 83 secured thereto as by screws or the like, to provide an internal chamber. The edge of flexible diaphragm 27 and preferably the edge of a partition wall 28 formed of metal or the like, are clamped between the body 82 and head 83.

Diaphragm 27 carries a stud 29 fixed to the center thereof which extends through an opening in the partition 28 and normally engages the actuating arm 60 for the snap switch mechanism which includes a contact-carrying arm 61 and a spring 62 connecting the contact-carrying arm 61 with the actuating arm 60. Spring 63 normally urges the diaphragm in a direction to cause stud 29 to engage the actuating arm 60 and move it in a direction which will cause spring 62 to move the contact-carrying arm 61 in a direction to bring contact 64 carried thereby into contact with the co-operating contact 65 secured to the U-shaped member 66 which is mounted upon but insulated from the partition 28.

Contact 65 is electrically connected to terminal 30, while contact 64 is grounded as through the engine —E—. The detailed construction of a relay of this type is disclosed in certain of my copending applications, and it should be sufficient herein to describe its general operation, as the operation of this relay is not the subject-matter of the claims of this application.

It will be apparent that under normal conditions, spring 63 holds diaphragm 27 in a position so that stud 29 engages actuating arm 60 so that the contacts are normally closed.

When sub-atmospheric pressure is produced in chamber 40' at the rear of diaphragm 27, the diaphragm will be retracted carrying stud 29 away from actuating arm 60 and permitting spring 62 to move contact 64 away from contact 65, thereby breaking the circuit for energizing the coil 11, whereupon switch 9 opens to break the starting motor circuit.

This invention provides a peculiarly advantageous apparatus and method for producing vacuum of the required degree and at the desired time to separate, for instance, the contacts of the vacuum relay to break the energizing circuit for coil 11. This vacuum-producing apparatus takes advantage of the fact that sub-atmospheric pressure exists in the manifold and that the gases exist in and pass through the exhaust manifold —E— of the engine under pressure and that this pressure exists immediately upon firing of the engine.

The apparatus herein disclosed for utilizing a combination of vacuum existing in the intake manifold and pressure existing in the exhaust manifold, comprises a body 10 connected to a pipe 67 which penetrates the exhaust manifold —E—. The connection of tube or pipe 67 to body 10 may be made in any usual manner, as, for instance, by tubing sleeve 68 and tubing nut 69. The apparatus utilized for producing the required vacuum, as herein illustrated, may be generally defined as an aspirator, and the body 10 of the aspirator is provided with a conduit therethrough which at the section 70, is tapered or substantially conical and leads to a restricted passage 71, in this instance arranged at substantially the center portion of the body 10.

On the side of the restricted passage 71 opposite the tapered section 70 is a second section 72 flaring outwardly or widening as it extends from the passage 71, and is preferably a counterpart of the section 70.

A pipe or tube 73 which normally acts as the outlet tube is connected to the end of the body 10 at a point beyond the cone section 72 as by means of tubing sleeve 74 and tubing nut 75.

Although in the drawings the tube 73 is shown as of greater diameter than the tube 67, this is not an essential feature of the invention of this application, and the tubes 67 and 73 may be of the same size or of different sizes as the necessities or advantages of different installations may require.

The restricted passage 71 constitutes a choke between the contracting passage 70 and the expanding passage 72, and acts to produce high velocity of gases through passage 71. Gas enters normally through tube 67, is caused to be reduced in volume by the choke 70, passes through 71 at high velocity and is again relieved at 72 to pass out through the exhaust passage 73 into the intake manifold —A—.

Entering passage 71, as by penetrating the wall of body 10, is a jet 31 which has preferably a conical end 47 entering in and disposed within the passage 71. The jet 31 is preferably in the form of a tube for a considerable portion of its length, and at the end, which extends within the passageway 71, the interior diameter of the jet as illustrated at 30, is quite small and leads to a passageway 40 of enlarged diameter, the wall of which is provided with diametrical passageways or holes 37 leading to chamber 41 formed within an extension of the body 10 and surrounding the adjacent portion of the jet 31.

The wall of the chamber 41 is provided with a hole or passageway 43 leading to and in communication with tube 45, which tube is connected to the body 10 as by tubing sleeve 80 and tubing nut 81. The tube 45 leads to and is connected to the head 83 in any suitable manner and communicates through passageway 84 and passageway 85 with the chamber 40' at the rear of diaphragm 27.

Valve 86 is provided in passage 85 which opens when suction exists in line 45 but is closed by a spring 99 when the engine is not operating so as to maintain sub-atmospheric pressure in chamber 40' for a short time period which may be adjusted by moving screw 88 which controls communication of passageway 89 leading from passageway 84 to the passageway 90 which is in communication with chamber 40' as through recess 91 formed in the head 83.

The period of time required for producing atmospheric pressure in chamber 40' after valve 86 closes, can be adjusted by the regulating screw 88 adapted to obstruct more or less the passage of air through conduit 89. This time period assures stopping of the engine before contacts 64 and 65 close.

It will be apparent that when the velocity of gas or fluid in passage 71 is sufficiently rapid, air is drawn from chamber 40' through tube 45, passageway 43, chamber 41, passageways 37 and jet 30. This air joins the main stream of gas flowing through passageways 70, 71 and 72 and flows into

the intake manifold —A—. The jet 31 is disposed and projects into passageway 71 at substantially right angles to the direction of movement of fluid through body 10, and the projection 94 which surrounds the jet member may be closed air-tight as by a screw cap 95 and gasket interposed between head 96 upon the jet and the outer end of the extension 94.

It is important that the end of the jet which projects into the passage 71 shall extend into the passage a substantially exact distance. Therefore, calibrating washers 97 may be applied under the head of jet 31 to cause the jet end to extend to the exact distance within passageway 71, which produces the most effective operation. As suggestive of particular relations between certain of the elements of the structure, the tube 67 which connects with the exhaust manifold of the engine is of sufficient diameter to carry approximately four times the volume of gas that would pass through restricted conduit 71.

It will be apparent that with this construction and arrangement of vacuum-producing apparatus, it is of no importance in which direction through body 10 that the gas or fluid moves in order to produce suction or vacuum in chamber 40. Therefore, this apparatus operates with equal efficiency whether pressure or vacuum exists in the exhaust manifold or in the intake manifold as the conditions in the two manifolds are in operation always opposed. Under either condition, with this apparatus, the sub-atmospheric relay contacts are maintained open so that the electric starter will not operate to engage engine parts until substantial atmospheric pressure exists in the exhaust and intake manifolds.

The structure diagrammatically illustrated in Figure 4, differs from that illustrated in Figure 1, solely in the provision of a secondary relay of the current operated type. The use of this secondary relay is, in many cases, advantageous in that the opening of the contacts of relay 52 and the breaking of the primary circuit of coil 11 will not cause switch 9 to open since a secondary circuit is provided for coil 11 from battery 16 through wires 17 and 20, coil 11, terminal 14, wires 23, contact 29, armature 26 carrying contact 28 adapted for electrical connection with contact 29, the former contact being grounded through wire 53.

The armature 26, the contacts 28 and 29 and wire 53 taken in conjunction with core 24 and coil 25 which is positioned in the starting motor circuit, constitutes a current controller 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, will magnetize core 24 sufficiently to keep contacts 28 and 29 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 switch 10' to break the starting motor circuit. This secondary circuit for the coil 11 assures starting of the engine before the starting motor circuit is broken, as might result in cases where the vacuum relay alone is used in connection with a primary circuit for coil 11.

It will be apparent from the above that the apparatus for producing vacuum or suction, as herein described, takes advantage of the opposed atmospheric conditions existing in the intake manifold and the exhaust manifold of an internal combustion engine, and makes use of a combination of values, one pressure above atmospheric and the other sub-atmospheric pressure to produce a substantially higher, more constant and uniform vacuum than results from the use of either alone.

It will be apparent that the gases under pressure existing in the exhaust manifold, are forced through restricted passageway 71, and that their movement is assisted and accelerated by the sub-atmospheric pressure existing in the intake manifold and the pipe 73 connected thereto. As the atmospheric conditions in these two manifolds are always in opposition, applicant utilizes a connection between them including an aspirator, the resultant suction produced in the line leading from the jet having a value equal to the added value of the pressure above atmosphere existing in the exhaust manifold and the pressure below atmosphere existing in the intake manifold.

I claim:

1. An automatic controller for internal combustion engine starters comprising an internal combustion engine having intake and exhaust manifolds, an ignition circuit therefor comprising a switch, a starting motor, means including a switch having an actuating coil in circuit with the first switch for controlling the operation of the motor, a pressure-operated relay for controlling the energizing of said coil, a conduit receiving fluid under pressure at one end from the exhaust manifold of the engine and subjected at its opposite end to the sub-atmospheric pressure existing in the intake manifold, and an aspirating device in said conduit and connected to said pressure-operated relay.

2. In an automatic controller for internal combustion engine starters, an internal combustion engine having intake and exhaust manifolds, a starting motor, a normally broken starting motor circuit, means for closing said starting motor circuit comprising a pressure-operated device, conduit means connecting said pressure-operated device with the intake and exhaust manifolds of the engine, and a venturi in said conduit means whereby the velocity of gases through said conduit means is increased to cause a reduction in pressure in said pressure-operated device.

3. In an automatic controller for internal combustion engine starters, an internal combustion engine having intake and exhaust manifolds, a starting motor, a normally broken starting motor circuit, means comprising a pressure-operated device for closing said starting motor circuit, means for controlling said pressure-operated device responsive to the differential in pressure existing between the exhaust and intake manifolds of the engine, and means comprising a venturi for increasing the effect of said differential in pressure.

4. The combination with an internal combustion engine having intake and exhaust manifolds and a starting motor, of an automatic controller for said starting motor comprising a normally broken starting motor circuit including an electro-magnetic switch, a control circuit for said electro-magnetic switch including a pressure operated relay having contacts normally closed, and means for controlling said pressure operated relay in accordance with the

flow of gas between the intake and exhaust manifolds of said engine.

5. In an automatic controller for internal combustion engine starters, an internal combustion engine having intake and exhaust manifolds, a starting motor, a normally broken starting motor circuit, means for closing said starting motor circuit comprising a pressure-operated device, and conduit means connecting said intake and said exhaust manifolds operably associated with said pressure-operated device, said pressure-operated device being responsive to the flow of gas between said manifolds.

6. In an automatic controller for internal combustion engine starters, an internal combustion engine having intake and exhaust manifolds, a starting motor, a normally broken starting motor circuit, electro-magnetic means for closing said starting motor circuit, a control circuit associated with said electro-magnetic means, a pressure-operated device for opening and closing said control circuit, and conduit means connecting said intake and said exhaust manifolds operatively associated with said pressure-operated device, said pressure-operated device being responsive to the flow of gas between said manifolds.

7. In an automatic controller for internal combustion engine starters, an internal combustion engine having intake and exhaust manifolds, an ignition circuit for said engine including a switch, a starting motor, a normally broken starting motor circuit, means including an electro-magnetic switch having a coil for closing said starting motor circuit, said coil being connected in circuit with said first switch, a pressure-operated relay for controlling the energization of said coil, a conduit for conducting fluid between said manifolds, and an aspirating device in said conduit connected to said pressure-operated relay.

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