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AUXILIARY CARBURETOR CONTROL FOR INTERNAL COMBUSTION ENGINES

Filed Nov. 13, 1939

2 Sheets-Sheet 1

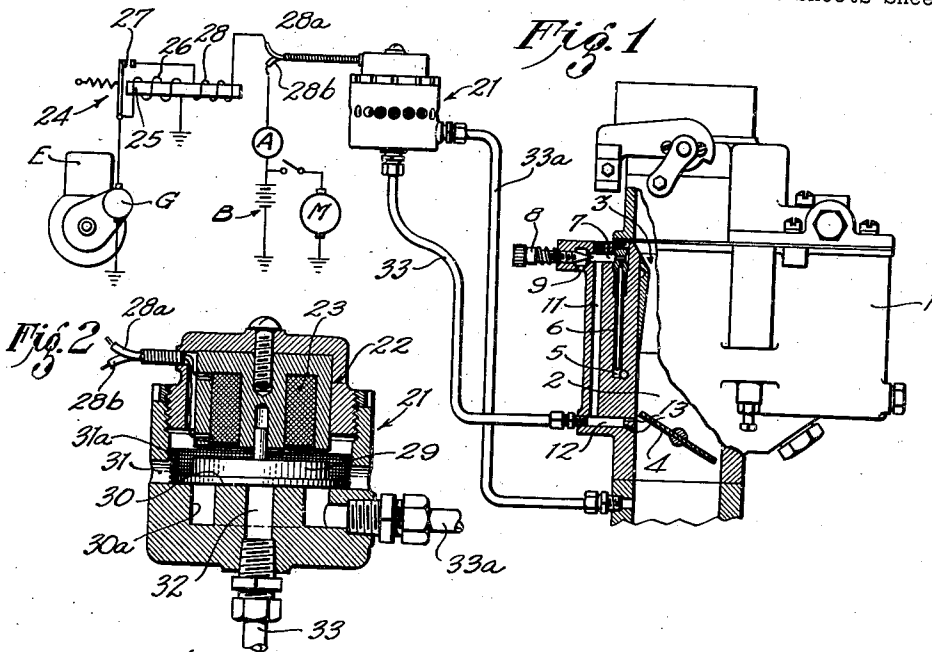


Fig. 4

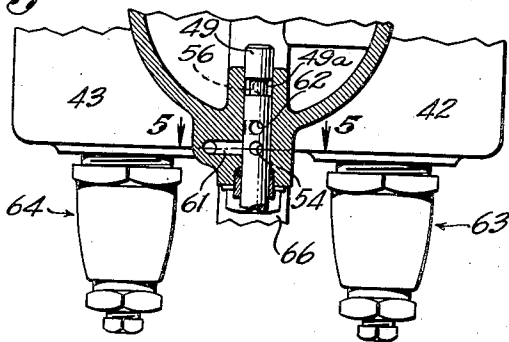


Fig. 5

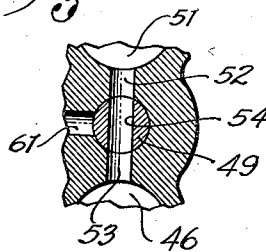


Fig. 6

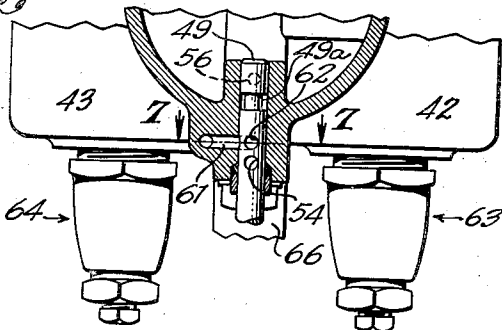
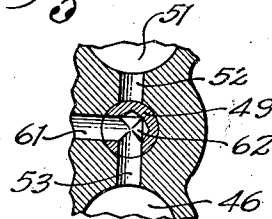


Fig. 7



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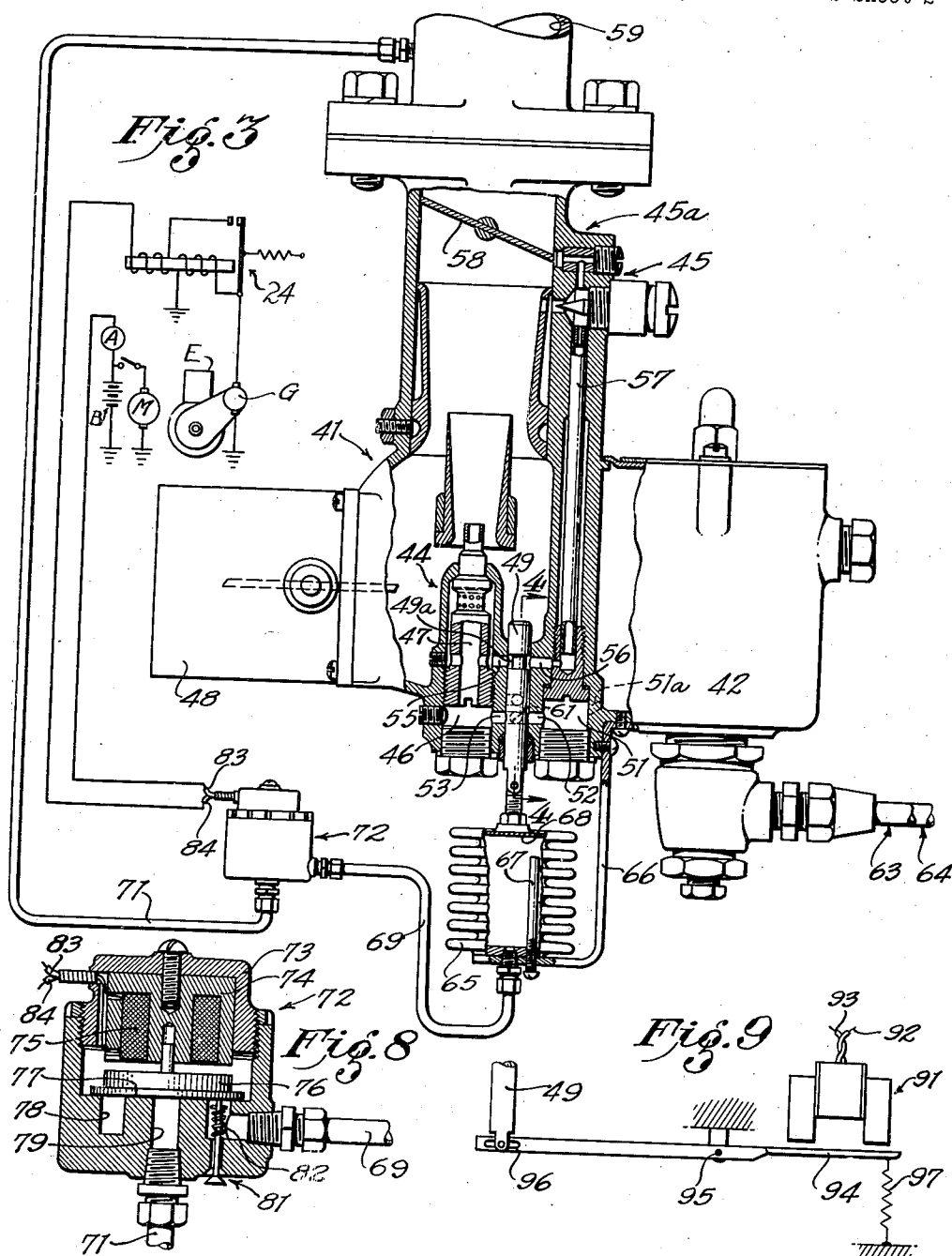
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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AUXILIARY CARBURETOR CONTROL FOR
INTERNAL COMBUSTION ENGINES

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2 Claims. (Cl. 123—127)

This invention relates to control devices for internal combustion engines of the type provided with a carburetor and operating on liquid fuel, and pertains particularly to an economizer control device adapted to provide advantageous operating conditions in fuel supply to an internal combustion engine at both "idling" and power development speeds.

One of the particular objects of the invention is to provide a fully automatic device adapted to provide the customary flow of combustible fluid to the intake manifold of an internal combustion engine during idling conditions, and to completely interrupt such flow during the time which the engine is operating under load or at a speed significantly higher than "idling" speed, wherefore the supply of combustible fluid to the engine may be shut off completely when the engine is operating "under compression" (as when the engine is used as a brake).

A further object of the invention is to provide a device which will cut off the supply of "idling" fluid when the internal combustion engine is operating under compression, and which will at the same time supply a quantity of air to the engine for the purpose of decreasing the "oil pumping" when the engine is operating under compression.

A further object of the invention is to provide a dual carburetor assembly which is automatically responsive to change in engine speed, wherefore it will operate with a high test fuel under idling conditions and with a lower test fuel under power producing conditions, preferably together with a considerable saving in fuel consumption when the engine is operating under compression and at above idling speed.

A further object of the invention is to provide a fully automatic carburetor control mechanism adapted to function as a fuel economizer, which is controlled by the voltage generated by the conventional battery charging generator which is provided for the internal combustion engine.

The device of the present invention is particularly adapted to heavy-duty vehicles such as trucks, in the operation of which it is customary to employ the internal combustion engine as a brake to the greatest possible extent, and under such conditions the carbureting device is constantly metering a quantity of the motive fuel to the engine which is at least sufficient to keep the engine operating under idling conditions (it being appreciated that under "braking" conditions the throttle is substantially closed, in which case the idling jets supply a maximum amount of fuel). In view of the fact that a considerable proportion of the operation of a truck constitutes operation of the engine under compression, particularly in mountainous countries, the fuel consumption when the engine is operating as a brake repre-

sents a very significant proportion of the total fuel consumption.

According to the present invention, when the internal combustion engine is operating at idling speeds, the conventional supply of idling fuel is furnished for the engine, but when the throttle is opened and the engine comes up to power producing speed, particularly as indicated by the charging rate of the generator associated with such engine, the supply of idling fuel is discontinued and reliance for power is placed entirely on the main jets of the carburetor. In this manner, when the throttle is released (closed or partially closed) to place the engine under compression, the speed of the engine remaining considerably higher than "idling" speed, the main jets of the carburetor are substantially shut off due to the throttling action of the butterfly valve associated with the intake manifold structure, and, in distinction to the common practice, the supply of idling fuel remains shut off until the speed of the engine has dropped to a value in the neighborhood of idling speed, at which time the supply of idling fuel is reestablished.

The present invention, in one embodiment, is also directed to the control of the supply of different types of fuel to the engine under different operating conditions, and is particularly adapted to the use of a low test fuel such as distillate or fuel oil for such time as the engine is operating under load, and a high test fuel such as a good grade of gasoline when the engine is operating under idling conditions. This dual control of the fuel supply may conveniently be arranged to provide a substantially complete shut-off of fuel to the engine when the engine is operating under compression, as above described, wherefore a further economy results.

According to the present invention, an electrically controlled valve means is associated with the carburetor of an internal combustion engine in such manner as to cut off the supply of idling fluid (as by closing or venting the idling jet suction line to the atmosphere) whenever the engine is operating above a minimum speed of rotation. The electrically controlled valve device is conveniently associated with the electrical generator with which the vehicle is ordinarily provided, and is adapted to function to provide the above-mentioned venting when the voltage of the generator has reached a substantially predetermined value, for example, a value such as to cause a predetermined battery charging rate. The electrical control device is also useful to obtain the above-mentioned change from high test to low test fuel, the high test fuel being supplied to the engine when the generator is operating below such predetermined charging rate, and the low test fuel being supplied to the engine when the generator is

operating above such predetermined charging rate.

Other objects and features of the present invention will be brought out in the following description of certain preferred embodiments thereof, or will be apparent therefrom. The accompanying drawings illustrate such embodiments, and referring thereto:

Fig. 1 is a partly schematic and partly broken-away side elevation of a carburetor construction, showing how the device of the present invention is utilized;

Fig. 2 is a vertical section of an electrically controlled valve device which may be utilized according to the arrangement shown in Fig. 1;

Fig. 3 is a partly broken-away side elevation of a modified form of carburetor provided with fuel supply control means according to this invention;

Fig. 4 is a sectional detail thereof, taken on line 4—4 of Fig. 3, showing the control means in one operating position;

Fig. 5 is a sectional detail taken on line 5—5 in Fig. 4, illustrating the connections established when the control means is in the position shown in Fig. 4;

Fig. 6 is a view corresponding to Fig. 4, showing the control means in another operating position;

Fig. 7 is a sectional detail taken on line 7—7 in Fig. 6, illustrating the connections established when the control means is in the position shown in Fig. 6;

Fig. 8 is a view corresponding to Fig. 2, showing a modified form of electrically controlled valve device useful in the arrangement shown in Fig. 3; and

Fig. 9 is a partly diagrammatic, partly elevational view showing an alternative arrangement for obtaining the automatic selection of fuel used in the carburetor illustrated in Fig. 3.

Referring to the drawings, in Fig. 1 I have illustrated a down-draft carburetor of a conventional type, comprising a bowl portion 1 and a duct 2 provided with a Venturi throat 3 and a butterfly throttle valve 4. The supply of fuel for the engine with which the carburetor is associated is provided by means of a duct 5 communicating at one end with the bowl 1 and having a vertical passage portion 6 adapted to conduct the fuel to an air-mixing zone 7 provided with a needle valve air inlet means 8 adapted to meter air into the zone 7 through a small opening 9. The mixture of liquid fuel and air passes downwardly through a passage 11 to a position adjacent the butterfly valve 4, as at 12, two or more discharge passages 13 being provided through the walls of the duct 2, the passages being preferably arranged so that at least one is open into the duct 2 when the butterfly valve 4 is completely closed and another passage 13 being adapted to open into the duct 2 just as the butterfly valve 4 is opened to accelerate the engine.

In accordance with this invention, when the feed of the engine, which is fed by the carburetor device, is above idling speed and the butterfly valve 4 is closed, as would occur when the engine is being operated "under compression," the fuel supply passage for the idling jet 13 is vented to the atmosphere to break the suction which draws the liquid fuel through the passages, and supply of fuel to the engine through the "idling" fuel supply is completely cut off. This is conveniently accomplished by providing an electri-

cally controlled valve member 21 (shown more particularly in Fig. 2) to establish the desired venting. The device 21 is provided with an electromagnet 22 having a winding 23 which is adapted to be energized when the speed of the engine has reached a predetermined rate, which may conveniently be accomplished by placing the winding 23 in series with the battery B and the charging generator G, whose speed varies with the speed of the engine E, which is supplied with fuel by the carburetor. A conventional cut-out or charging circuit relay is provided as at 24, comprising a core 25 provided with a winding 26 connected to ground and to the charging pole of the generator G, and adapted, when the voltage of the generator G reaches a predetermined value, to close a contact 27 which is customarily connected through a supplemental coil 28 and thence directly to the battery B. According to this invention, the winding 23 of the valve device 21 has its leads 28a and 28b placed in the lead from the coil 28 to the battery B, whereupon the electromagnet 22 will be energized when the voltage of the generator G is high enough to cause a predetermined flow of charging current to the battery B. Upon energization of the electromagnet 22, a valve disc 29 is raised from a seat 30, admitting air from the atmosphere through ports 31 provided in the side wall of the valve device 21 and into a central passage 32 which communicates through a tube 33 to the passage 12 aforesaid.

In actual operation, when the motor is being started the valve member 29 will be in position upon its seat 30 wherefore the passages 5, 6, 11, and 12 will be sealed from the atmosphere in the customary manner, and adequate supply of fuel through the opening 13 will be had. When the engine is started and is fed by the main fuel supply jet (not shown) it is immaterial whether the jets 13 are supplied with idling fuel or not, but when the feed of the engine is in the neighborhood of "idling speed," the substantially sole supply of fuel to the engine is through the aforesaid jets 13. As the speed of the engine is increased, by opening the butterfly valve 4 and drawing more fuel through the duct 2, the generator G will build up sufficient voltage to cause the cut-out 24 to close, at which time the winding 23 will be energized, and when the speed of the generator has reached a point such that the current in the windings 23 will be sufficient to energize the electromagnet 22 and lift the valve member 29 from the seat 30, the passage 12 will be vented to the atmosphere through the tube 33, passage 32, and apertures 31, thus interrupting the suction which lifts the fuel from the passage 5 and causes it to discharge through the openings 13.

When the engine E with which the carburetor 1 is associated is operated "under compression," as when the engine is caused to continue to rotate above idling speed after the butterfly valve has been closed, the passage 12 will remain vented to the atmosphere until the speed of rotation of the engine has dropped to a point such that the cut-out 24 opens and the generator G is disconnected from the battery circuit. At this time the valve member 29 will drop into position upon the seat 30, closing the passage 32, and allowing the suction to be reestablished in the passage 12 and its associated passages, for the continued supply of idling fluid to the engine.

I also find it advisable, although not essential, when the engine is running under compression and no fuel is being supplied by the idling jets

13, to supply air to the engine in that it tends to maintain a higher average pressure within the cylinders and decreases the tendency for oil pumping. The intaken air to some extent also acts as load, since the engine is an imperfect pump. Thus I may provide the seat 30 with an annular recess 30a which may encircle the bleeder outlet 32 and communicates with the carburetor inlet conduit 2 at a point below the butterfly 4 through a tube 33a. Thus, when the valve plate 29 is seated as it is during the idling condition, the annular recess 30a is closed and no air is admitted to the carburetor through the pipe 33a. When the motor is operating under compression, the valve plate 29 is lifted and the recess 30a is in substantially uninterrupted communication with the atmosphere through the openings 31 so that air is supplied to the conduit 2 through the pipe 33a. In order to prevent the entrance of foreign objects with the air taken in through the openings 31, I may provide a screen member therefor, such as shown at 31a. (It will be appreciated that when it is desired that the supply of air at 33a not interfere with the air-fuel ratio of the carburetor under power-producing conditions of operation, a shut-off valve may be placed in the line 33a, operatively associated with the butterfly valve 4, if desired, whereby supply of air through the line 33a will be had only when the butterfly 4 is closed.)

The form of carburetor device illustrated in Figs. 3 through 8 illustrates the application of the invention to the alternative supply of highest and low-test fuel to an internal combustion engine under idling and power-producing operations, respectively. Referring to these figures, a carburetor is indicated at 41 and is provided with a gasoline bowl 42 and a fuel oil bowl 43. The carburetor is further provided with a main jet assembly 44 and with idling jet assembly 45. In accordance with certain operating conditions, which will be described more fully hereinafter, either gasoline or fuel oil is supplied to a small chamber 46 located below the main jet 44. The fuel supplied to the chamber 46 flows upwardly through a passage 47 and into the main jet 44, where it is mixed with the air arising from intake opening 48. The carburetor is further provided with valve means which includes a valve plunger 49 for effecting the alternative supply of gasoline or fuel oil to the chamber 46 and for interrupting the flow of fuel to the idling jet assembly 45 when fuel oil is being supplied to the chamber 46.

The gasoline bowl 42 is provided with a suitable passage 51a which leads into a chamber 51 which communicates with the chamber 46 through passages 52 and 53. Communication between these passages is established through a passage 54 in the valve plunger 49 when this plunger is in the position shown in Figs. 3, 4, and 5. Part of the gasoline flowing upwardly through the passage 47 is supplied to idling jet 45a, which forms part of the idling jet assembly 45, through passages 55 and 56 which communicate with one another when the plunger 49 is in the position shown in Figs. 3, 4, and 5. To provide for this communication, the valve plunger 49 may be necked down as at 49a. Gasoline from the passage 56 then flows upwardly through passage 57, where it is mixed with air in the idling assembly and discharged through idling jet 45a past butterfly throttle valve 58 where the mixture then flows into intake manifold 59. The relation of the idling jet assembly and butterfly

is all in accordance with conventional practice.

The valve plunger 49 is movable between an upper or first position, such as shown in Figs. 3, 4, and 5, to a lower or second position, such as shown in Figs. 6 and 7. In this lower position the plunger 49 interrupts the flow between the passages 55 and 56 and also interrupts the flow between the passages 52 and 53 so that the supply of gasoline is cut off from the main jets and the supply of fuel to the idling jet assembly 45 is interrupted. In this position fuel oil from the fuel oil bowl 43 flows from the passage 61 communicating with this bowl into the passage 53 which leads to the chamber 46 and the main jet 44. Communication between the passages 61 and 53 is established through an L-shaped passage 62 (Figs. 6 and 7) provided in the plunger 49. Suitable supply lines 63 and 64 are shown leading to the gasoline and fuel oil bowls 42 and 43 respectively, for supplying liquid fuel thereto.

The valve plunger 49 may be moved between its first and second positions through the action of suitable automatically operated means such as a "Sylphon" bellows 65, which is shown mounted below the plunger 49 on a bracket 66 which is attached to the carburetor assembly 41. The "Sylphon" bellows 65 is shown in its expanded position in Fig. 3 and is operable upon a reduction in pressure in the interior thereof to collapse and move the valve plunger 49 into its second position to establish the necessary connections for supplying fuel oil to chamber 46 and the main jet 44. An adjustable stop 67 is preferably provided in the "Sylphon" so that upon engagement of the stop with upper wall 68 of the "Sylphon" the valve plunger 49 is brought to rest in its second position with the L-shaped passage 62 establishing connection between the passages 61 and 53. The reduction in pressure in the interior of the "Sylphon" 65 is produced by vacuum lines 69 and 71 which lead to the intake manifold 59. An operative connection between these vacuum lines is established through the agency of an electrically operated valve 72, which is illustrated in greater detail in Fig. 8.

Valve 72 is shown as comprising a casing 73 within which is positioned a magnetic core 74 provided with an energizing coil 75. The valve is further provided with an armature 76, which also acts as a valve plate, and which rests on a valve seat 77 within which there is an annular channel 78 connected to the vacuum line 69 leading to the "Sylphon." The seat 77 is also provided with a central opening 79 which is operatively connected to the vacuum line 71 which leads to the intake manifold 59. When the valve plate and armature 76 is resting on the seat 77, as shown in Fig. 8, communication between the lines 69 and 71 is interrupted, since the valve plate seals the opening 78 from the opening 79. In order to provide for a supply of atmospheric air to the "Sylphon" when the valve plate 76 is in the position shown in Fig. 8 I have provided a bleeder valve 81 which communicates with the opening 78 and is held in its open position by the plate 76 when this plate is in its passage-closing rest position as shown in Fig. 8. A biasing spring 82 is provided for closing the valve 81 when the plate 76 is moved away from the seat 77.

The coil 75 is shown provided with leads 83 and 84 for connection to a source of electric current. When sufficient current is flowing through

these leads the plate 76 is attracted to the core 74 and a connection is established between the intake manifold 59 and the "Sylphon" bellows 65 through vacuum lines 71 and 69. At the same time the valve 81 is closed to prevent the entrance of outside air into the system. The coil 75 may be connected into the electrical system of the vehicle in exactly the same manner as the coil 23 illustrated in Fig. 2. Thus leads 83 and 84 may be substituted for leads 28a and 28b shown in the wiring diagram of Fig. 1. For convenience the wiring diagram of Fig. 1 is reproduced in Fig. 8 with the above substitution of leads.

Assuming now that the motor has just been started and is operating under idling conditions, the flow of charging current to the battery B is either nil if the contacts 27 are open, or is insufficient, even if contacts 27 are closed, to energize the coil 75 sufficiently to raise the valve plate 76, in which case the "Sylphon" 65 is in its expanded condition as shown in Fig. 3 and gasoline is being supplied to the carburetor through the main jet 44 and the idling jet 45a. As soon as the speed of the motor has increased sufficiently to produce a predetermined charging current, the coil 75 is energized sufficiently to raise the valve plate 76 from its seat 77 and connect the "Sylphon" with the intake manifold, causing the "Sylphon" to contract and move the valve plunger 49 to its second or lower position. This cuts off the supply of fuel at the idling jet and starts the supply of fuel oil to the main jet in the place of gasoline. The motor is then operated on fuel oil without any fuel being supplied to the idling jet, since this is not necessary during running operation of the motor when the butterfly valve 58 is open any substantial amount.

Assuming the motor to be running at a relatively high speed on fuel oil with the butterfly valve 58 substantially opened, compression braking is greatly increased when the butterfly is moved to its substantially closed position as shown in Fig. 3, since there is no fuel supplied to the idling jet 45a and the flow of air past the main jet is ordinarily insufficient to cause the atomization of any substantial amount of fuel oil. As the motor slows down to a speed approaching idling speed, the charging rate decreases to a point where the flux produced by the coil 75 is insufficient to hold the armature 76 against the core 74. At that time the plate will drop to the position shown in Fig. 8 and will interrupt communication between the vacuum lines 69 and 71. When the motor speed is low enough, cut-out 24 operates to open contact 27 and interrupt the charging current completely. At the same time the movement of plate 76 to its lowered position opens valve 81 and supplies atmospheric air to the "Sylphon" 65, causing the bellows to expand to the position shown in Fig. 3 and move the valve plunger from its second position to its first or upper position so that gasoline will be supplied to the main jet and also to the idling jet, and satisfactory idling and low speed operation will be obtained.

Referring to Fig. 9, an arrangement is illustrated for directly obtaining the movement of the valve plunger 49 in response to the flow of the battery charging current without the use of the vacuum operated means illustrated in Fig. 3. In Fig. 9 an electromagnet 91 is shown provided with leads 92 and 93 which may be substituted for the

leads 83 and 84 illustrated in Fig. 3. Upon energization by a predetermined charging current the electromagnet 91 draws armature 94 upwardly and causes movement of lever 94a of which the armature forms a part, about fixed pivot 95. The lever 94a is slidingly pivoted at 96 to the plunger 49. Movement of the armature 94 toward the electromagnet 91 causes the plunger to move vertically to its second or upper position. Partial or total deenergization of the electromagnet causes the armature to move downward due to the action of a biasing spring 97 and causes the plunger to move to its first or upper position.

In each of the above-described embodiments of my invention the supply of fuel to the idling jets is interrupted as soon as the motor reaches a predetermined speed, and this interruption is conveniently obtained by utilizing the charging current supplied to the battery as a criterion of the speed of the motor and as a means of automatically bringing about the desired operation. In both cases the interruption of the supply of fuel to the idling jets produces a more efficient braking operation during the time the motor is used as a brake and the butterfly throttle valve is substantially closed. Less fuel is consumed by the engine during this period than is ordinarily the case and considerably less power (tending to decrease the braking effect of the engine) is produced in the engine during this period. In one embodiment of my invention, additional air is supplied to the intake manifold during the braking operation, which supply of air tends to increase the braking effect and to a certain extent decrease the amount of fuel supplied by the main jet during this period by decreasing the amount of air flowing past the main jet. A similar form of economy is obtained in the other embodiment of my invention, since fuel oil is supplied during the braking operation and the flow of air past the main jet is insufficient to produce any substantial atomization of the fuel oil during the braking period.

My invention is obviously subject to considerable modification, and hence I do not choose to be restricted to the illustrative forms shown and described herein, but rather to the scope of the appended claims.

I claim:

1. An economizer device for an internal combustion engine provided with carburetor means for effecting operation of said engine on either high-test or low-test fuel and provided with a storage battery and a generator operated by said engine for charging said battery, said device comprising: carburetor valve means associated with said carburetor means and operable between a first position to supply high-test fuel to said engine and a second position to supply low-test fuel to said engine; vacuum operated means for moving said carburetor valve means from its first to its second position; and electrically operated valve means associated with said generator for causing operation of said vacuum operated means when the charging current produced by said generator reaches a predetermined value.

2. A device as set forth in claim 1, said valve means operating to cause said vacuum operated means to move said carburetor valve means from its first to its second position when said charging current rises to a predetermined value.

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