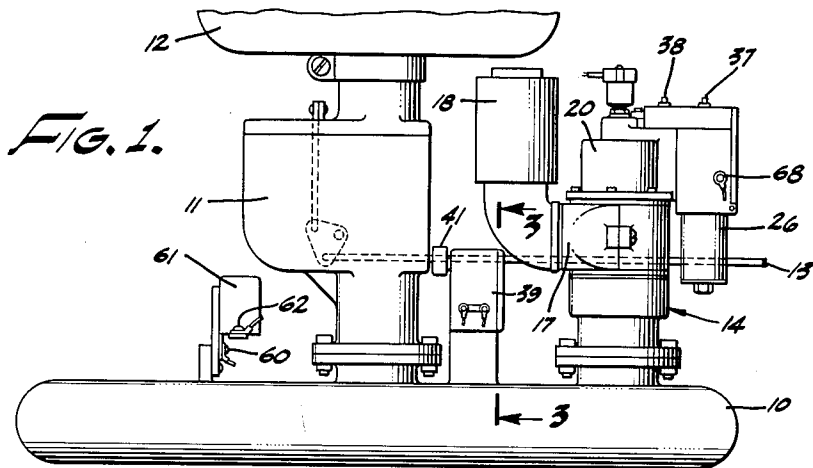
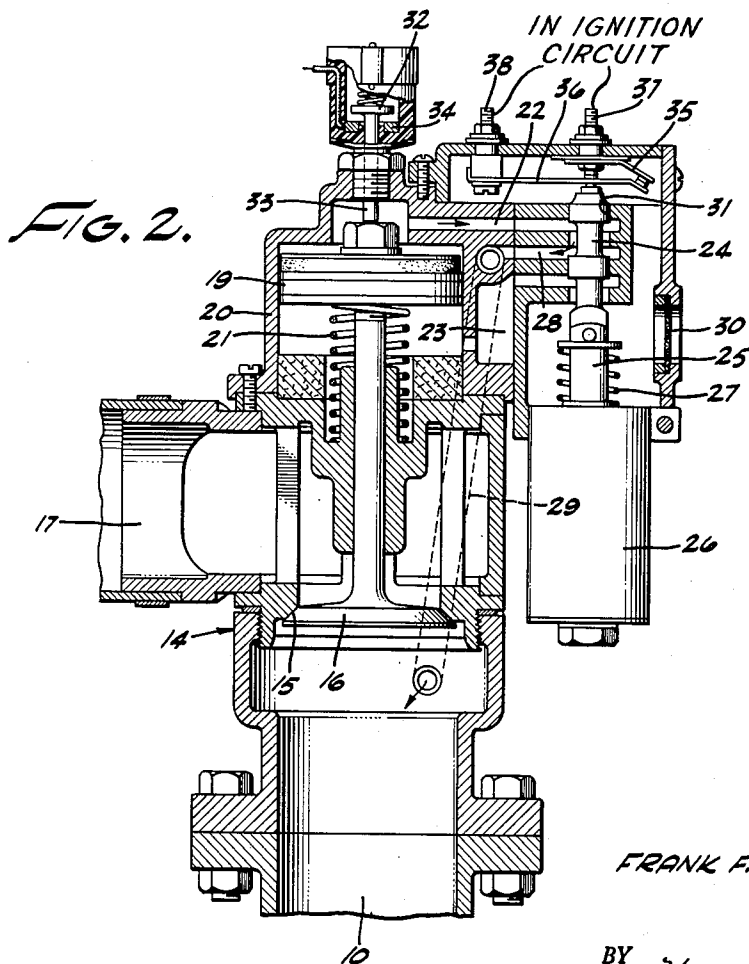


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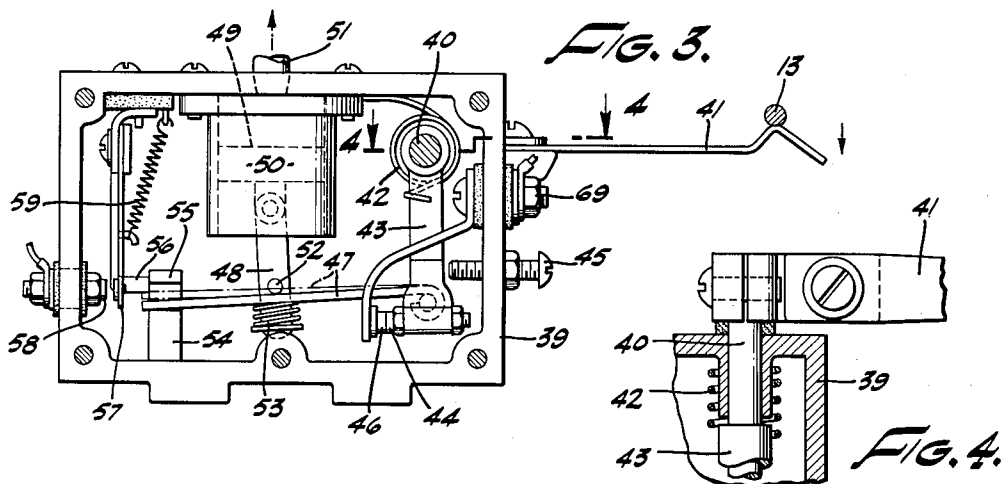
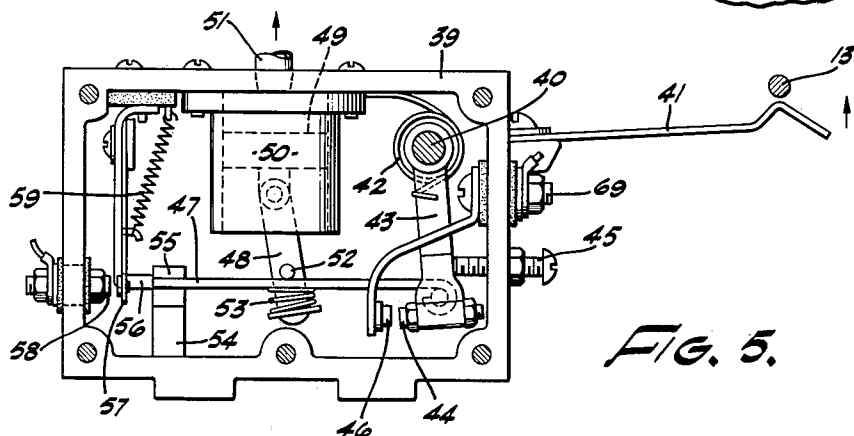
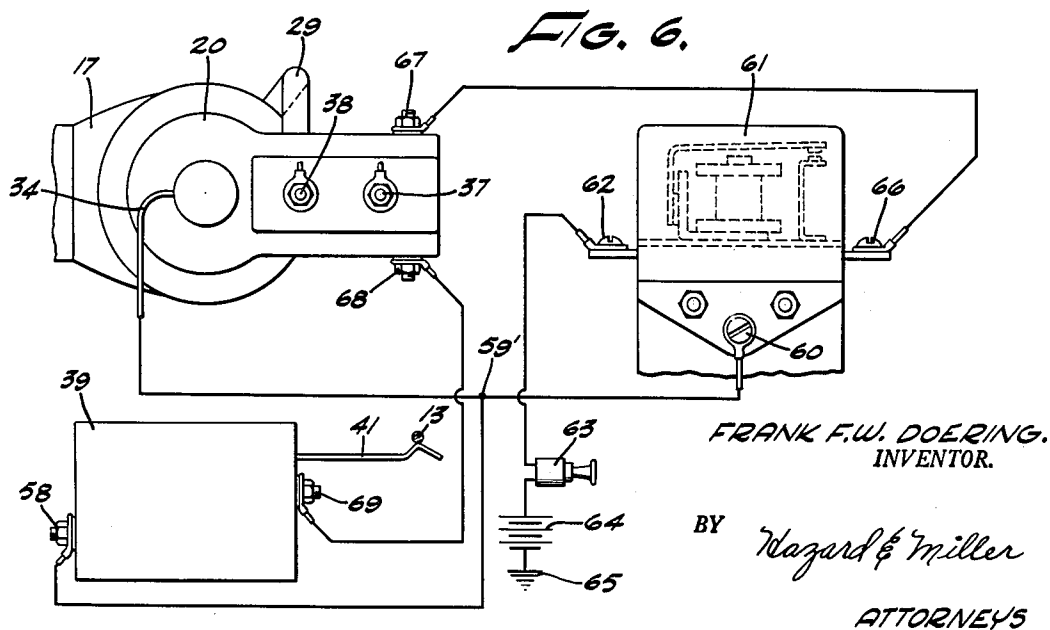
July 24, 1956

F. F. W. DOERING
ELECTRICAL CONTROL FOR INTERNAL
COMBUSTION ENGINE NEUTRALIZERS

2,755,786

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July 24, 1956

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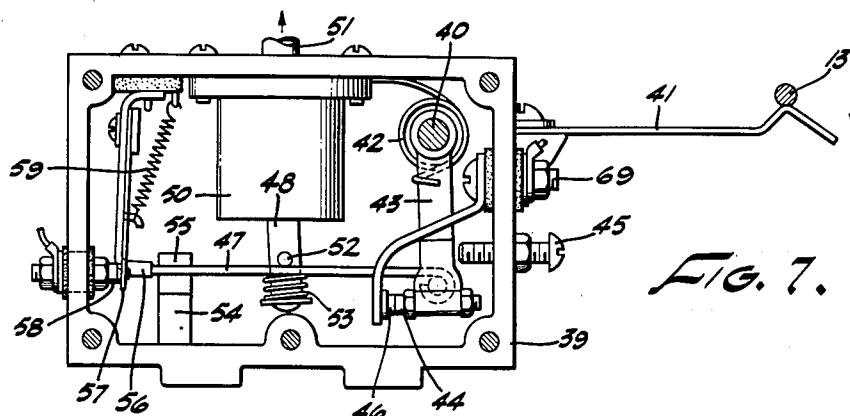


FIG. 7.

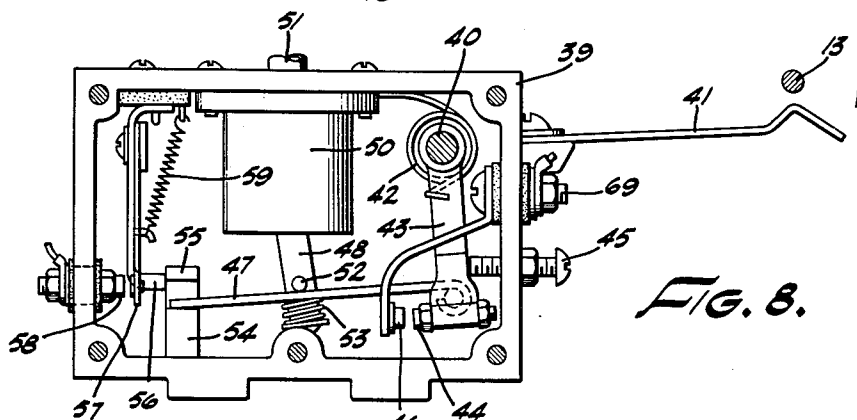


FIG. 8.

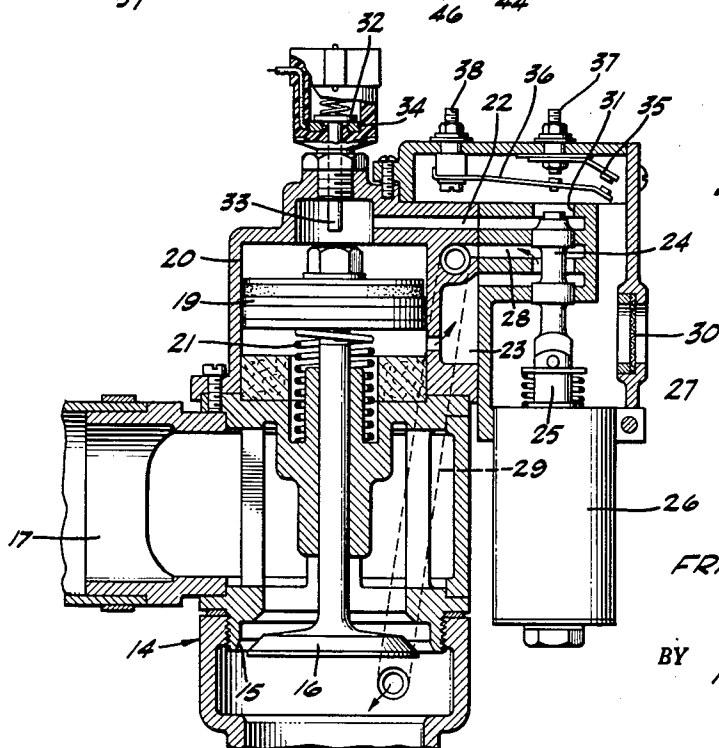


FIG. 9.

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ELECTRICAL CONTROL FOR INTERNAL COMBUSTION ENGINE NEUTRALIZERS

Frank F. W. Doering, Los Angeles, Calif.

Application October 25, 1954, Serial No. 464,250

10 Claims. (Cl. 123—124)

This invention relates to an attachment for the manifold of an internal combustion engine, and may be regarded as an improvement over the construction disclosed in my prior United States Letters Patent No. 1,998,494, issued April 23, 1935.

At the time that the invention disclosed in my prior patent was developed the conventional internal combustion engine used on automobiles was equipped with a generator which generated electric current to charge the storage battery. In such constructions the generator was continuously driven and continuously supplied current. However, there was associated therewith an automatic cutout which was effective to disconnect the generator from the storage battery whenever the engine and consequently the generator was operating at low or idling speeds. The construction disclosed in my prior patent enabled fresh or auxiliary air to be drawn into the manifold of the engine whenever the throttle valve that controlled the supply of fuel from the carburetor to the manifold was closed and the engine was decelerating from a high speed. In such construction the cutout entered into the electric circuit employed and performed an important function in the operation of the device.

At the present time internal combustion engines which are conventionally employed on automobiles are similarly equipped with an electric generator which is utilized to charge the storage battery. However, in order to prevent overcharging of the storage battery the generator from time to time may be caused to stop functioning or to deliver a current of such a low magnitude that it cannot be utilized to operate the manifold attachment. Consequently, there may be prolonged periods of time when the generator is automatically discontinued in its operation due to the fact that the storage battery is completely charged. The device disclosed in my prior patent is unsuitable for use on internal combustion engines having generators which do not function whenever the engine is operating.

A primary object of the present invention is to provide a manifold attachment which will admit fresh or auxiliary air to the intake manifold of the engine whenever the engine is decelerating and which is operable from the current obtainable from the storage battery. In the present construction, inasmuch as the generator of the engine may not be functioning during the periods when the storage battery is fully charged, the generator cutout is not employed and does not participate in the functioning of the present attachment. Consequently, the present device is completely independent in its operation of whether the generator may be functioning or not, or whether the generator is even equipped with a cutout.

In a device of this character it will be appreciated that vacuum conditions in the manifold at idling speeds are highly analogous to those conditions existing when the engine is decelerating. It is desirable, however, that when the engine is operating at idling speed that the manifold be closed against ingress of fresh or auxiliary air and

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that a limited amount of fuel be continuously supplied to the manifold to keep the engine idling. It is only when the engine has been operating at a relatively high speed and is in the process of decelerating that it is desired to open the manifold of the engine for the admission of auxiliary air, thus scavenging the cylinders and in effect cutting off the supply of fuel thus conserving fuel. The admission of the auxiliary air under these circumstances has the additional effect of reducing the discharge through the exhaust manifold of partially burned fuels during the period of deceleration, thus reducing the contamination of the atmosphere therewith.

With the foregoing and other objects in view, which will be made manifest in the following detailed description and specifically pointed out in the appended claims, reference is had to the accompanying drawings for an illustrative embodiment of the invention, wherein:

Figure 1 is a view in side elevation of the manifold of an internal combustion engine illustrating the carburetor as having been attached thereto and the attachment embodying the present invention as having been attached thereto;

Fig. 2 is a longitudinal vertical section through the structure embodying the present attachment;

Fig. 3 is a vertical section taken substantially upon the line 3—3 upon Fig. 1, illustrating the parts in full lines in the position when the engine is stopped and illustrating in dotted lines the position assumed by the parts after the engine has been started but is still idling;

Fig. 4 is a horizontal section taken substantially upon the line 4—4 upon Fig. 3;

Fig. 5 is a view similar to Fig. 3, but illustrating the position assumed by the parts when the throttle valve has been opened and the engine is in the process of accelerating or operating at higher than idling speed and under load;

Fig. 6 is a wiring diagram of the attachment;

Fig. 7 is a view similar to Fig. 3, but illustrating the parts in the position assumed after the throttle valve has been closed following a period during which the engine has been accelerated or has been operating at higher than idling speed;

Fig. 8 is a view similar to Fig. 3, but illustrating the position assumed by the parts in the event that the throttle valve is again opened after the engine has started decelerating but before it has returned to idling speed; and

Fig. 9 is a view similar to Fig. 2, but illustrating the position assumed by the valve when the valve is opened to admit auxiliary air to the manifold.

Referring to the accompanying drawings wherein similar reference characters designate similar parts throughout, the manifold of the internal combustion engine is indicated at 10 and the carburetor which supplies fuel thereto is generally indicated at 11. This carburetor is usually equipped with an air cleaner 12 and has a throttle valve operable by linkage 13 that is connected to a foot pedal in the driver's compartment of the automobile. Depression of this foot pedal will operate the linkage 13 to open the throttle valve of the carburetor in the conventional manner and conversely, when pressure is relieved from the foot pedal the throttle valve will be automatically closed to a position where only sufficient fuel will be supplied to the manifold 10 to maintain the engine in idling condition.

The attachment embodying the present invention comprises a valve housing generally indicated at 14 having a valve seat 15 on which a valve closure 16 is adapted to seat. This valve housing has a lateral inlet indicated at 17 through which fresh air is supplied after passing through an air cleaner 18. When the valve closure 16 is

closed against its seat 15 ingress of auxiliary air to the manifold 10 is prevented and the engine functions in the conventional manner. However, when the engine is in the process of decelerating the closure 16 opens, admitting fresh air to the manifold through the air cleaner 18 and the inlet 17, thus reducing the vacuum in the manifold with the result that fuel supplied from the carburetor 11 is effectively stopped. This fresh air, which is admitted to the manifold, passes through the cylinder and is discharged therefrom into the exhaust manifold, not shown. In this manner the cylinders are effectively scavenged, a useless waste of fuel is avoided, and the discharge into the atmosphere of the products of combustion of partially burned fuel is avoided.

The stem of the valve closure 16 is connected to a piston 19 that is reciprocable in a cylinder 20. This piston is urged into its uppermost position wherein the valve closure 16 is closed by a compression spring 21. The cylinder 20 has ports 22 and 23 which are connected to a slide valve, generally indicated at 24. This slide valve is in turn connected to the armature or core 25 of a solenoid 26, and is urged into its uppermost position by a compression spring 27. The central port 28 of the slide valve is connected by a tube 29 to the valve housing 14 below the seat 15 so that the partial vacuum existing in the manifold 10 will be transmitted through the tubing 29 to the port 28 and transmitted through either the port 22 or the port 23 to the top or bottom of the cylinder 20, depending upon the position of the slide valve. Thus, in the position shown in Fig. 2, the partial vacuum is transmitted to the top of the cylinder 20 so that the piston 19 is urged into its uppermost position by the negative pressure on the upper side of the piston, positive pressure or atmospheric pressure being supplied to the under side of the piston through the port 23 and through a screened inlet 30. When the slide valve is in its lowermost position, as shown in Fig. 9, whatever negative pressure still exists in the manifold despite the admission of auxiliary air is transmitted through the tube 29 and port 23 to the under side of the piston 19, atmospheric pressure being supplied to the port 22 through the opening 31. It will be observed that the area of the piston 19 is somewhat greater than the area of closure 16, and although the closure 16 when open permits auxiliary air to enter the manifold, materially reducing the vacuum therein, some small degree of vacuum still persists. This degree of vacuum is sufficient to maintain the piston 19 depressed against the action of the spring 21 due to the inequality in areas of the piston and valve closure.

On top of the cylinder 20 there is a switch, the movable contact of which is indicated at 32. This contact has a stem 33 which is engaged by and lifted by the piston 19 when the piston is in its uppermost position so that it is out of contact with its stationary contact 34. However, when the piston 19 is depressed, as shown in Fig. 9, and the valve closure 16 is consequently open the movable contact 32 is allowed to lower and engage its contact 34. The housing within which the contacts 32 and 34 are disposed is adjustable relatively to the cylinder 20 by having a threaded connection therewith equipped with a locknut so that the exact position at which the contacts 32 and 34 engage and disengage with relation to the position of piston 19 may be varied.

On the housing surrounding the slide valve there are likewise two mutually engageable contacts 35 and 36 which are connected to terminals 37 and 38 respectively. The terminals 37 and 38 are connected between the primary coil and the breaker arms of the distributor of the ignition apparatus of the engine. Consequently, when the slide valve is in the position shown in Fig. 2, and the valve closure 16 is closed the electric circuit between the primary coil and the distributor is completed. However, when the slide valve 24 is in its lowermost position as shown in Fig. 9, causing the valve closure 16

to open and admit auxiliary air the circuit between the primary coil and the distributor is broken so that the ignition system stops functioning and no spark is created in the cylinders of the engine during the periods that auxiliary air is being admitted to the manifold 10.

A switch box 39 is mounted on the manifold and has a rocker shaft 40 rotatably mounted on a wall thereof. This rocker shaft carries an arm 41 on the exterior of the switch box which is arranged adjacent the linkage 13 in such a manner as to be engageable thereby. Thus, as illustrated in Fig. 3, when the throttle valve of the carburetor 11 is closed, the linkage 13 is effective to depress the arm 41. However, when the throttle valve of the carburetor is open and the engine is either accelerating or operating under load, the linkage 13 moves upwardly to disengage or release the arm 41. The rocker shaft 40 is urged into a position which will swing the arm 41 upwardly by a torsion spring 42. It carries an arm 43 within the switch box that is equipped with a movable contact 44. This arm is engageable by an adjusting screw 45 which limits the rotation of the rocker shaft 40 under the influence of the torsion spring 42. The movable contact 44 is engageable with a stationary contact 46 within the switch box and these contacts mutually engage each other whenever the arm 41 is depressed by the linkage 13, see Figs. 3 and 7. Whenever the arm 41 is disengaged by the linkage 13 in the course of opening the throttle valve of the carburetor the contacts 44 and 46 disengage, see Figs. 5 and 8. On the arm 43 there is pivotally mounted an actuator 47. This actuator extends across a pitman 48 that is pivotally attached to a piston 49 that is reciprocable in a cylinder 50. The bottom of the piston 49 is exposed to atmosphere in the switch box but the upper side of the piston is connected by a tubing 51 to the intake manifold. The piston 49 is urged downwardly by a compression spring within the cylinder so that it is only when vacuum exceeding a predetermined degree exists in the manifold that the piston 49 is elevated. The pitman 48 carries a pin 52 engageable with the top of the actuator and the actuator is urged against the pin by means of a coil compression spring 53. When the piston 49 is in its lowermost position the pin 52 presses the end of the actuator against a lower stop 54, but when the piston is in its uppermost position it may be effective to lift the end of the actuator against an upper stop 55 as shown in Fig. 5. In this position the end of the actuator is disposed opposite the end of an abutment 56 on a movable contact 57 that is urged out of engagement with its stationary contact 58 by means of a tension spring 59. When the actuator 47 is in its uppermost position against the upper stop 55 as depicted in Fig. 5, and is opposite the abutment 56, a depression of the arm 41 by the linkage 13 is effective to cause the crank 43 to push the actuator 47 from right to left and to cause the contacts 57 and 58 to mutually engage as illustrated in Fig. 7. However, when the linkage 13 disengages the arm 41 allowing the crank 43 to be retracted by the torsion spring 42 and the vacuum in the manifold 10 falls below a predetermined degree the spring within the cylinder 50 depresses the piston 49 and consequently the actuator causing the actuator to drop against the lower stop 54, see Fig. 8, in which situation the abutment 56 merely engages the upper stop 55. When the abutment 56 is in engagement with the upper stop 55 and the arm 41 is depressed by the linkage 13, as shown in Fig. 3, it will be observed that the end of the actuator 47 projects beneath the abutment, and in this position, even though a high degree of vacuum exists in the top of the cylinder 50 the actuator cannot be pulled upwardly into a position opposite the end of the abutment 56. In other words, as shown by dotted lines on Fig. 3, under these circumstances the actuator 47 can merely be lifted into the dotted line position shown.

Referring now to Fig. 6, the stationary contact 58

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and the stationary contact 34 are connected together as at 59' to a terminal 60 of a relay 61. One of the terminals of the relay indicated at 62 is connected through a manually operable switch 63 to the storage battery 64, one side of which is grounded as indicated at 65. The other terminal of the relay indicated at 66 is connected to one terminal 67 of the solenoid 26. The other terminal 68 of the solenoid is connected to the terminal 69 to which the stationary contact 46 is connected.

Operation

The operation of the device as above described is substantially as follows:

When the engine is not operating the throttle valve of the carburetor 11 may be assumed to be closed and the linkage 13 is depressing the arm 41, as shown in Fig. 3. As the engine is not operating there will be no vacuum in the cylinder 50 and the piston 49 will consequently be in its lowermost position and the actuator 47 will be in full line position shown in Fig. 3. If the engine is started the throttle valve may be assumed to be allowed to remain closed and the arm 41 may be assumed to continue to be depressed. However, when the engine is started and commences idling a high degree of vacuum is created within the manifold 10 which is transmitted to cylinder 50. This urges the piston 49 upwardly but due to the overlapping relationship between the actuator and the abutment 56, the actuator can only be lifted to the position shown in dotted lines on Fig. 3. Consequently, in this position, even though contacts 44 and 46 mutually engage these functions merely to connect the terminal 68 of the solenoid 26 to ground, it being understood that the contact 44 being mounted on the crank 43 on the rocker shaft 40 is constantly grounded. Under these circumstances, the solenoid 26 will not be energized and the slide valve 24 will remain in the position shown in Fig. 2. Valve closure 16 will remain closed and the engine will continue to idle as long as the throttle valve of the carburetor remains closed. If the operator then depresses the foot pedal controlling the throttle valve to accelerate the engine the linkage 13 will disengage arm 41 and the parts will assume the position shown in Fig. 5. In this position, it will be noted that the arm 41 is allowed to lift as far as is permitted by the adjusting screw 45 and the contact 44 will have disengaged the stationary contact 46. The actuator 47 will have been retracted sufficiently so that the piston 49 can elevate it into engagement with the upper stop 55 or into a position opposite the end of the abutment 56. As long as the parts remain in this position the valve closure 16 remains closed and the engine may accelerate or operate under load.

If the operator then releases the foot pedal to close the throttle valve of the carburetor 11, causing the engine to decelerate, the linkage 13 returns to its engagement with the arm 41 as shown on Fig. 7. This causes the crank 43 to cause the contacts 44 and 46 to re-engage and the actuator 47 to engage the abutment 56 and push the contact 57 into engagement with contact 58. The engagement of contacts 57 and 58 connects ground to the terminals 60 of the relay 61, thus actuating the relays and causing the relay to close. Battery current can then flow from the battery through the manual switch 63 which is assumed to be closed, through the relay to the terminal 67 of the solenoid 24, through the solenoid to terminal 68 and to ground due to the fact that contacts 44 and 46 are then engaged. When the solenoid 26 is thus energized it attracts the core or armature 25 downwardly, shifting the slide valve 24 from the position shown in Fig. 2 to the position shown in Fig. 9. Vacuum in the manifold is thus made effective on the under side of the piston 19 so that the piston is urged downwardly, causing the closure 16 to open. Downward movement of the piston allows contact 32 to engage contact 34 but at the same time enables fresh air to be drawn

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into the manifold and the vacuum within the manifold to be materially reduced. Consequently vacuum in the cylinder 50 instantly falls below the predetermined degree required to hold the piston 49 in its uppermost position. The spring in the cylinder is consequently effective to lower the piston, causing the actuator to immediately drop from the position shown in Fig. 7 into the position shown in Fig. 8. This allows contact 57 to disengage contact 58. However, the opening of these contacts does not cause the relay 61 to open and the solenoid 26 to be deenergized. This is because of the fact that the lowering of the piston 19 allows grounded contact 36 to engage contact 34 and consequently ground is still connected to terminal 60 even though contacts 57 and 58 have been opened. Valve 16 will consequently be held open until the engine virtually returns to idling speed and the draft through the manifold is virtually entirely supplied by the auxiliary air entering past the valve 16. As the degree of vacuum in the manifold is thus gradually reduced by the engine returning to idling speed the effect of the vacuum on the under side of piston 19 becomes less and less and the piston slowly rises. When it reaches its uppermost position it disengages contact 32 from contact 34 and the supply of ground to the terminal 60 is broken. Relay 61 is consequently opened and solenoid 26 deenergized. This allows the slide valve 24 to return to the position shown in Fig. 2 with the result that the valve 16 is held tightly closed.

If the driver again depresses the pedal to open the throttle valve of the carburetor before the engine has completely decelerated to idling speed or in other words, before valve 16 has seated and contact 32 has disengaged contact 34, this has the effect of opening contacts 44 and 46, see Fig. 8. The opening of these contacts breaks the circuit from terminal 68 through the solenoid 26 and consequently the parts will instantly return to the position shown in Fig. 2 so that ingress of air to the manifold is effectively cut off and fuel from the carburetor will be immediately supplied to the manifold. In this manner, closing of the manifold against the entry of air is possible whenever the throttle valve is opened to accelerate the engine or to place the engine under load. Ingress of air on the other hand only occurs when the engine is decelerating from a speed higher than idling speed.

It will be appreciated from the above-described construction that the improved attachment is operable directly from the battery and its operation is independent of whether the generator of the engine is functioning or not. The cutout associated with the generator forms no part of the present apparatus. If at any time it is desired to cause the attachment to discontinue functioning such as in situations where there is a cold engine, the manual switch 63 can be opened to discontinue the supply of current to the relay, and consequently to the solenoid 26. Under such circumstances, it is impossible to energize the solenoid and the valve closure 16 consequently remains closed and all parts remain in the position shown in Fig. 2. Whenever air is being admitted to the manifold the slide valve 24 automatically causes the ignition to be disconnected so that no sparking in the cylinders occurs during this period.

In effect, the solenoid 26 which actuates the slide valve 24 is controlled by three switches, these being the switch made up of contacts 44 and 46 which close whenever the throttle is closed and opened whenever the throttle is opened, the switch made up of the contacts 32 and 34 which is opened whenever the valve 16 is closed and closed whenever the valve 16 is opened, and the third switch made up of the contacts 57 and 58. This switch is adapted to be actuated by the closing of the throttle valve, but this only occurs when there is vacuum in the cylinder 50 of a sufficient magnitude to elevate the actuator 47 and it only occurs after the throttle valve has once been opened which causes the actuator to clear the

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abutment 56 and assume a position opposite the end of the abutment, as shown in Fig. 5. When this latter switch is closed the solenoid 26 is energized, causing the valve 16 to open and while the opening of this valve instantly reduces the vacuum in the cylinder 50 allowing the actuator to drop and the switch 57—58 to open, the switch made up of the contacts 32 and 34 immediately takes over to keep the solenoid 26 energized until the engine either returns to idling speed or the throttle valve is again opened.

Various changes may be made in the details of construction without departing from the spirit and scope of the invention as defined by the appended claims.

I claim:

1. In an attachment for an intake manifold of an internal combustion engine having a throttle valve controlling the supply of fuel thereto, a solenoid, means operable by the solenoid when energized for opening the manifold behind the throttle valve for the ingress of air and closing the manifold against ingress when the solenoid is no longer energized, a switch which when closed causes one side of the solenoid to be electrically connected to a source of current, actuating means operable by the opening and closing of the throttle valve for urging the switch to close when the throttle valve is closed, a vacuum-operated controller operable by the vacuum in the manifold for causing the actuating means to close the switch only when vacuum in the manifold exceeds a predetermined degree, a second switch for causing the mentioned side of the solenoid to be supplied with current only when the manifold is open for ingress of air, and a third switch for opening the circuit through the solenoid when the throttle valve is open and closing circuit through the solenoid when the throttle valve is closed.

2. In an attachment for the intake manifold of an internal combustion engine having a throttle valve controlling the supply of fuel thereto, an electrically operated valve for admitting air to the manifold when the valve is open and preventing its admission when the valve is closed, two switches, both of which are closable by the closing of the throttle valve for causing an electric circuit to be completed through the electrically operated valve to cause it to open, means requiring a vacuum exceeding a predetermined degree to exist in the manifold to cause one of said switches to be closed when the throttle valve is closed, and a third switch closable by the opening of a throttle valve for causing the circuit through the electrically operated valve to be continued after the valve opens and thus reducing the vacuum in the manifold until the valve is again closed.

3. In an attachment for the intake manifold of an internal combustion engine having a throttle valve controlling the supply of fuel thereto, an electrically operated valve for admitting air to the manifold when the valve is open and preventing its admission when the valve is closed, two switches, both of which are closable by the closing of the throttle valve for causing an electric circuit to be completed through the electrically operated valve to cause it to open, means requiring a vacuum exceeding a predetermined degree to exist in the manifold to cause one of said switches to be closed when the throttle valve is closed, means requiring the throttle valve to have been opened once while vacuum is present in the manifold before the last-mentioned switch can be closed by the closing of the throttle valve, and a third switch closable by the opening of a throttle valve for causing the circuit through the electrically operated valve to be continued after the valve opens and thus reducing the vacuum in the manifold until the valve is again closed.

4. An attachment for the intake manifold of an internal combustion engine having a throttle valve controlling the supply of fuel thereto and actuating means therefor comprising a manifold valve for opening the manifold for the ingress of air, electrically operable means for

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opening said valve, a first switch openable and closable by the throttle-valve actuating means to close when the throttle valve is closed and open when the throttle valve is opened, a second switch operable by the throttle-valve actuating means to close when the throttle valve is closed, means requiring a vacuum in the manifold in excess of a predetermined value and a previous opening of the throttle valve before the second switch may be closed by the throttle-valve actuating means, and a third switch operatively connected to the manifold valve to close when the valve is opened and open when the valve is closed, all of said switches being electrically connected to the electrically operable means.

5. An attachment for the intake manifold of an internal combustion engine having a throttle valve controlling the supply of fuel thereto and actuating means therefor comprising a manifold valve for opening the manifold for the ingress of air, electrically operable means for opening said valve, a first switch openable and closable by the throttle-valve actuating means to close when the throttle valve is closed and open when the throttle valve is opened, a second switch operable by the throttle-valve actuating means to close when the throttle valve is closed, means requiring a vacuum in the manifold in excess of a predetermined value and a previous opening of the throttle valve before the second switch may be closed by the throttle-valve actuating means, and a third switch operatively connected to the manifold valve to close when the valve is opened and open when the valve is closed, a relay, a source of electric current connected thereto, the second and third switches being connected to the relay to close and supply current to the electrically operable means when either of the second or third switches are closed, the first switch being connected to the electrically operable means to break the circuit there-through whenever the throttle valve is opened.

6. An attachment for the intake manifold of an internal combustion engine having a throttle valve controlling the supply of fuel thereto and actuating means therefor comprising a manifold valve for opening the manifold for the ingress of air, electrically operable means for opening said valve, a first switch openable and closable by the throttle-valve actuating means to close when the throttle valve is closed and open when the throttle valve is opened, a second switch operable by the throttle-valve actuating means to close when the throttle valve is closed, means requiring a vacuum in the manifold in excess of a predetermined value and a previous opening of the throttle valve before the second switch may be closed by the throttle-valve actuating means, a third switch operatively connected to the manifold valve to close when the valve is opened and open when the valve is closed, a relay, a source of electric current connected thereto, the second and third switches being connected to the relay to close and supply current to the electrically operable means when either of the second or third switches are closed, the first switch being connected to the electrically operable means to break the circuit therethrough whenever the throttle valve is opened, and means for breaking the ignition circuit of the engine whenever the manifold valve is opened.

7. An attachment for an internal combustion engine having an intake manifold, a throttle valve controlling the supply of fuel thereto and actuating means therefor, comprising a manifold valve controlling ingress of air to the manifold, a piston and cylinder for actuating the manifold valve, a solenoid, a core therefor, a slide valve controlling a connection between the manifold and the cylinder connected to the core so as to be shifted thereby when the solenoid is energized, a source of electric current, a relay between the source of current and the solenoid, a first switch connected to the relay for causing the relay to close whenever vacuum exceeding a predetermined degree exists in the manifold and the throttle valve has once been opened but is again closed, a second switch con-

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ected to the relay to close the relay when the manifold valve is opened, and a third switch connected to open the circuit through the solenoid whenever the throttle valve is opened.

8. An attachment for an internal combustion engine having an intake manifold, a throttle valve controlling the supply of fuel thereto and actuating means therefor comprising a manifold valve controlling ingress of air to the manifold, a piston and cylinder for actuating the manifold valve, a solenoid, a core therefor, a slide valve controlling a connection between the manifold and the cylinder connected to the core so as to be shifted thereby when the solenoid is energized, a source of electric current, a relay between the source of current and the solenoid, a first switch connected to the relay for causing the relay to close whenever vacuum exceeding a predetermined degree exists in the manifold and the throttle valve has once been opened but is again closed, a second switch connected to the relay to close the relay when the manifold valve is opened, a third switch connected to open the circuit through the solenoid whenever the throttle valve is opened, and means operable by the slide valve for opening the ignition circuit for the engine whenever the manifold valve is opened.

9. An attachment for an internal combustion engine having an intake manifold, a throttle valve controlling the supply of fuel thereto and actuating means for the throttle valve comprising a manifold valve controlling ingress of air to the manifold, a piston and cylinder for actuating the manifold valve, a solenoid, a core for the solenoid, a slide valve connected to the core controlling a connection between the manifold and the cylinder, a source of electric current, a relay between the source of current and the solenoid, a first switch connected to the relay, an actuator connected to the throttle-valve actuating means, a cylinder connected to the manifold, a piston in the cylinder connected to the actuator, an abutment on the first switch engageable by the actuator when vacuum exists in the second-mentioned cylinder but the throttle valve has not been previously opened, said abutment being arranged to be cleared by the actuator when the

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throttle valve is opened and engaged thereby to close the first switch when the throttle valve is again closed, a second switch connected to the relay for causing the relay to close whenever the manifold valve is opened, and a third switch connected to the throttle-valve actuating means to be opened and closed thereby and electrically connected to the solenoid to open the circuit through the solenoid whenever the throttle valve is opened and to close the circuit through the solenoid whenever the throttle valve is closed.

10. An attachment for an internal combustion engine having an intake manifold, a throttle valve controlling the supply of fuel thereto and actuating means for the throttle valve comprising a manifold valve controlling ingress of air to the manifold, a piston and cylinder for actuating the manifold valve, a solenoid, a core for the solenoid, a slide valve connected to the core controlling a connection between the manifold and the cylinder, a source of electric current, a relay between the source of current and the solenoid, a first switch connected to the relay, an actuator connected to the throttle-valve actuating means, a cylinder connected to the manifold, a piston in the cylinder connected to the actuator, an abutment on the first switch engageable by the actuator when vacuum exists in the second-mentioned cylinder but the throttle valve has not been previously opened, said abutment being arranged to be cleared by the actuator when the throttle valve is opened and engaged thereby to close the first switch when the throttle valve is again closed, a second switch connected to the relay for causing the relay to close whenever the manifold valve is opened, a third switch connected to the throttle-valve actuating means to be opened and closed thereby and electrically connected to the solenoid to open the circuit through the solenoid whenever the throttle valve is opened and to close the circuit through the solenoid whenever the throttle valve is closed, and means operable by the slide valve for opening the ignition circuit whenever the manifold valve is opened.

No references cited.