

March 29, 1966

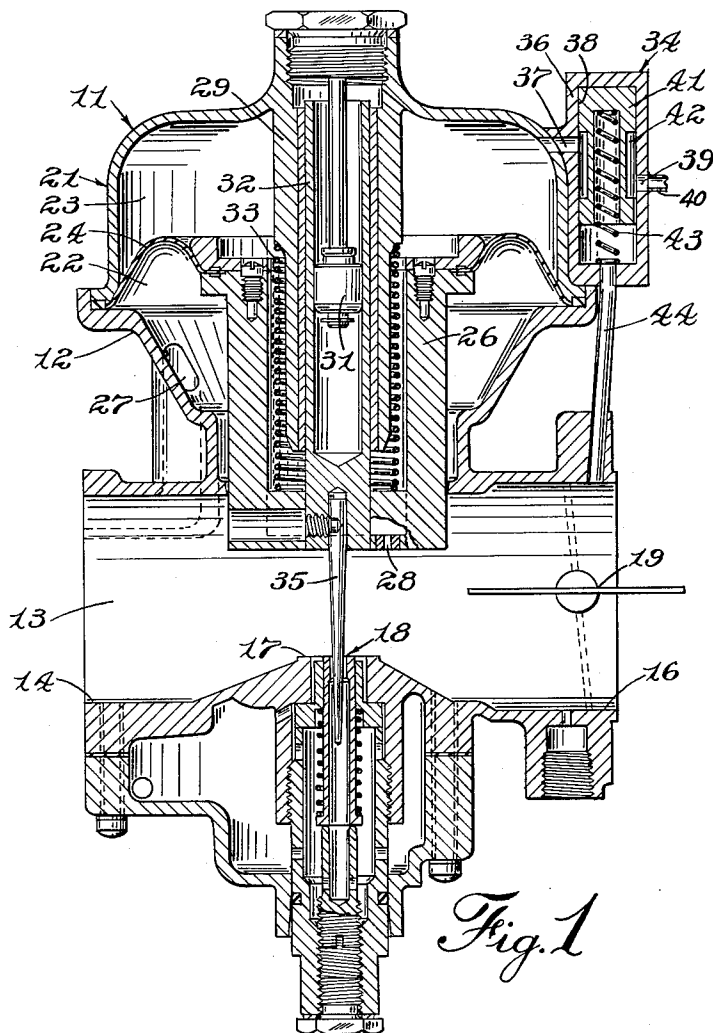
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3,243,167

CONSTANT VACUUM TYPE CARBURETOR

Filed June 4, 1962

3 Sheets-Sheet 1



WITNESS:

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CONSTANT VACUUM TYPE CARBURETOR

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3 Sheets-Sheet 2

Fig. 2

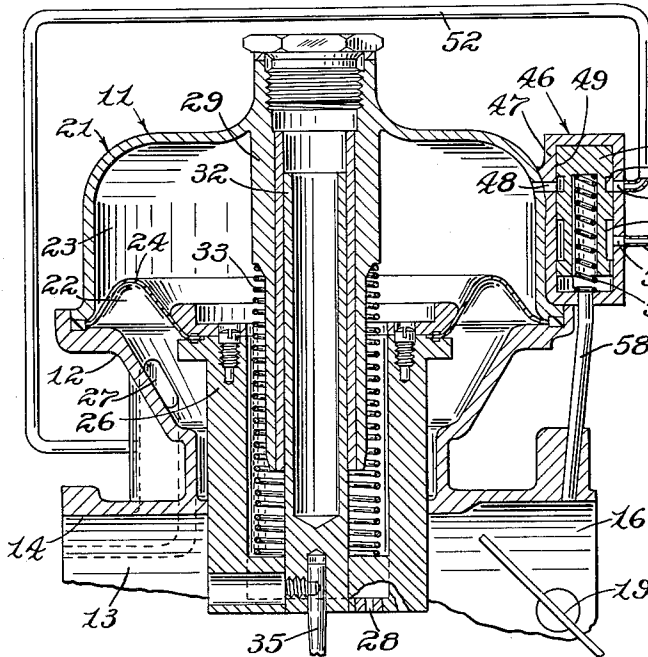


Fig. 3

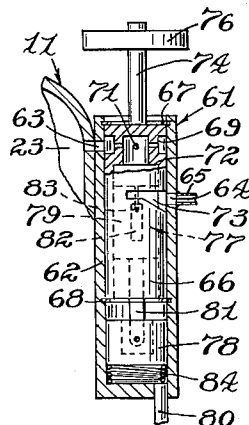
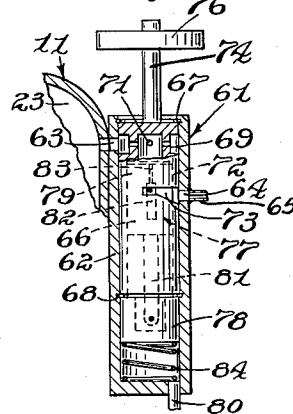


Fig. 4

Fig. 5

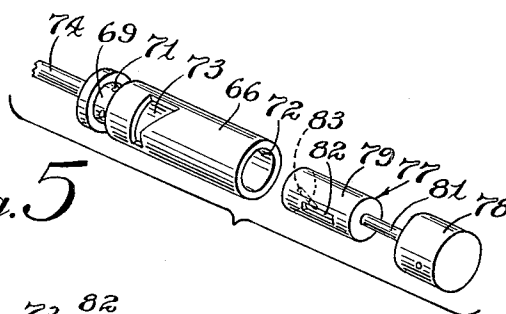
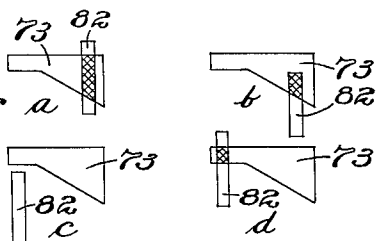


Fig. 6



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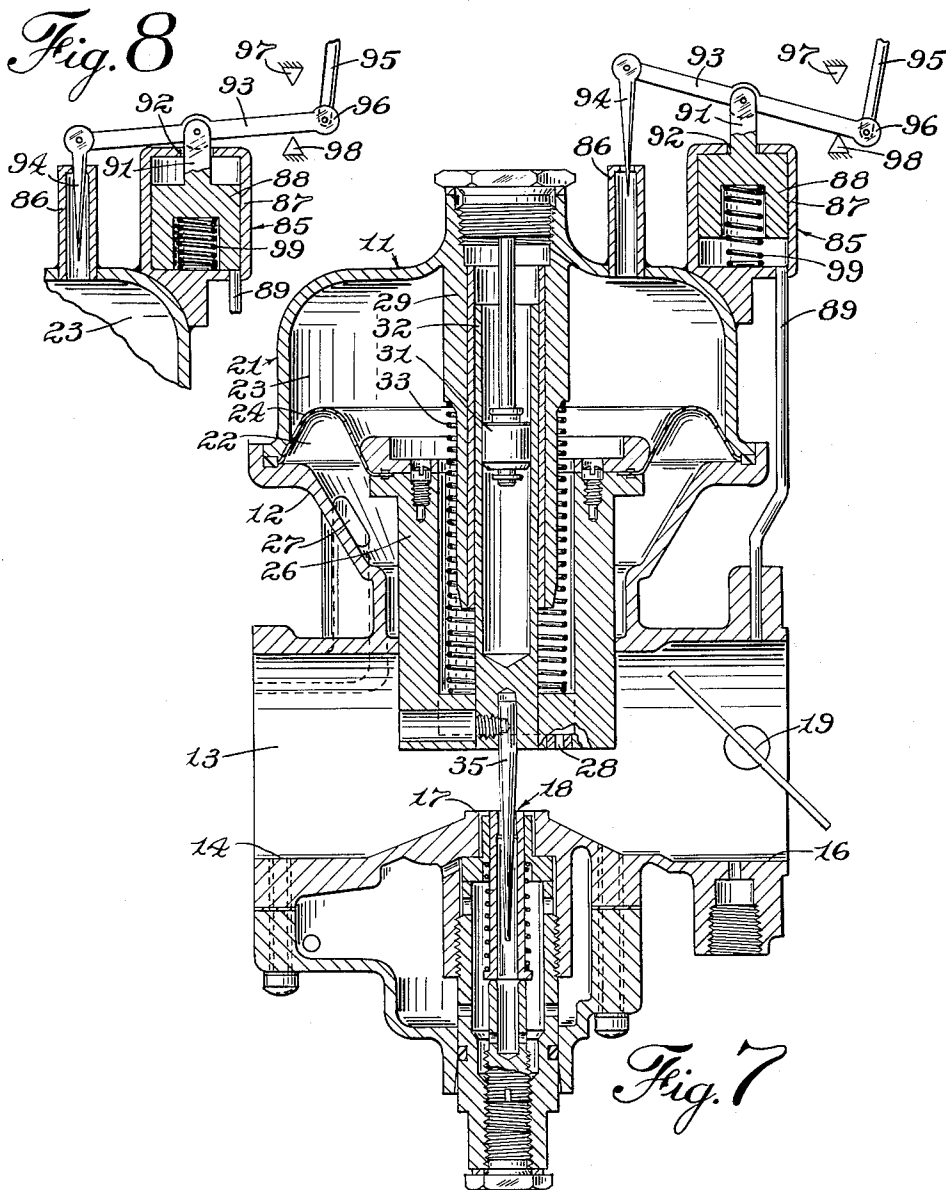
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CONSTANT VACUUM TYPE CARBURETOR

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3 Sheets-Sheet 3



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3,243,167

CONSTANT VACUUM TYPE CARBURETOR
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7 Claims. (Cl. 261-44)

The present invention relates to an air valve or constant vacuum type of carburetor and more particularly relates to a carburetor of the aforesaid type which includes means for providing power enrichment.

In the known construction of carburetors of the type to which the present invention relates, the air supply and the fuel commingled therewith are controlled by an adjustable choke piston to which movement is imparted by the suction of the engine. The choke piston generally is supported by the carburetor body at approximately right angles to the axis of an induction passage. A tapered needle valve is carried by the choke piston and variably engages a fuel metering orifice or jet disposed in the choked portion of the induction passage coaxial of the choke piston. The choke piston and associated needle valve are often broadly referred to in combination as the air valve. A throttle valve is rotatably supported in the induction passage posterior of the air valve for controlling the admission of the fuel-air mixture to the engine.

The suction imparting movement to the air valve is drawn from the induction passage posterior of the air valve and anterior of the throttle valve into the suction side of a split chamber of an air valve adjusting means. The two sides of the chamber are separated in various ways, as by a flexible diaphragm, thereby defining a first chamber maintained at substantially atmospheric pressure or carburetor air inlet pressure and a second chamber maintained during engine operation at sub-atmospheric pressures. When the engine is inoperative, no pressure differential exists in the chamber and the choke piston is allowed to obstruct the induction passage and concomitantly cause the tapered needle valve to substantially close the fuel metering orifice. After the engine operation is initiated a portion of the suction therefrom is directed into the second chamber creating a partial vacuum which establishes a pressure differential between the separated chambers. The pressure differential causes the choke piston to be lifted allowing air to be drawn toward the engine manifold. Movement of the air valve changes the relationship between the needle valve-fuel orifice allowing the fuel to be drawn in definite proportions into the passing mass of air. Admission of resultant fuel-air mixture to the engine manifold is controlled by appropriate throttle valve movements. The two-part chamber which adjusts the air valve is responsive to changes in the directed vacuum or suction and acts in such a way as to maintain the induction passage between the choke piston and the throttle valve in a constant or substantially constant vacuum condition for given operating structures and condition, irrespective of the engine speed or throttle setting.

This type of carburetor has an inherent disadvantage in that the relationship between the choke area and the needle valve-fuel orifice are fixedly established and the mixture strength or characteristics are strictly determined by the mass of air flow through the induction passage irrespective of whether the particular mass flow is produced by a high manifold vacuum and a small throttle

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valve opening (part throttle or cruising operation) or by a low manifold vacuum and a large throttle valve opening (wide open throttle or full power operation). As a result the fuel mixture characteristics are such as to provide a mixture which is generally suitable for one particular operating range but the mixture will be either too rich or too lean for other operating ranges.

On some installations I have found it advantageous to have a relatively lean mixture characteristic during part throttle operation without affecting the normal or preset mixture characteristics during power operation. On still other installations I have found the reverse situation to be desirable, i.e., not affecting the normal or present characteristics at part throttle operation but providing a lean mixture during power operation which is, in effect, obtaining a relatively rich part throttle mixture. To accomplish the desired objects I propose to bleed down the suction in the upper side or second chamber of the air valve adjusting means during the period of operation when enrichment is desired. Bleeding down the suction will reduce the pressure differential within the air valve adjusting means allowing the choke piston to partially obstruct the induction passage. Obstruction of the passage can change the engine's mass air requirements for a given throttle position and the change of air requirements will cause an increase in the vacuum condition posterior of the choke piston. The change of the vacuum condition will be accompanied by an increase in the air velocity across the bridge with the consequential effect of an increase in the amount of fuel being drawn into the volume of air. The effect of the change in the relationship between the needle valve and the fuel orifice will be more than offset by the added static and velocity pressure effects on the fuel discharge orifice. In this fashion a rich mixture is attained. It is, therefore, an object of the present invention to provide a carburetor of the air valve or substantially constant vacuum type with power enrichment means which is facile, reliable, efficient and positive in operation, and relatively inexpensive.

It is another object of the present invention to provide a carburetor which can discriminate between variations of engine vacuum and throttle settings even when unaccompanied by changes in the mass air flow whereby the mixture characteristics can be automatically varied to provide a suitable and proper mixture characteristic for the engine range of operations.

It is still another object of the present invention to provide an air valve carburetor having pressure responsive means adapted to be controlled by the engine manifold vacuum taken on the manifold side of the throttle for bleeding down the suction chamber of the air valve adjusting means for varying the pressure differential therein, and for changing the position of the choke piston relative to the induction passage to provide a richer fuel-air mixture to the engine.

It is a further object of the present invention to provide vacuum economizer means actuable so as to bleed the suction side of an air valve carburetor for obtaining a desired fuel mixture characteristic.

It is a still further object of the present invention to provide valve means for shutting off or reducing the magnitude of the air bleed during periods of engine operation when a normal or preset mixture characteristic is desired.

A still further object of the present invention is to provide economizer means actuable by engine manifold

vacuum and other motivating means for obtaining a desired fuel mixture characteristic from an air valve carburetor during predetermined periods of engine operation.

Lastly, it is an object of the present invention to provide economizer means actuable by vacuum and/or a thermostatic element for controlling bleeding of a suction chamber of an air valve carburetor.

The accompanying drawings will serve to illustrate several specific embodiments of the present invention, in order that its utility and functioning will be thoroughly understood and appreciated. It will be understood, however, that these illustrations are not to be taken as limiting the invention in any way. In the drawings:

FIGURE 1 is a side elevational view of an air valve carburetor, partly in section and broken away, embodying the present invention;

FIGURE 2 is a partial side elevational view of an air valve carburetor, partly in section and broken away, illustrating a second embodiment of the present invention;

FIGURE 3 is a fragmentary view of a valve structure for carburetor enrichment means, partly in section and broken away, the view comprising a third embodiment of the present invention and illustrating the valve position after the utilizing engine has been warmed up and is operating at low engine manifold vacuum;

FIGURE 4 is a view similar to FIGURE 3 illustrating the valve position after the utilizing engine has been warmed up and is operating at high engine manifold vacuum;

FIGURE 5 is an exploded perspective view of the internal elements of the valve illustrated in FIGURES 3 and 4;

FIGURE 6 is a series of diagrammatic illustrations of the relative positions of the valve sleeve and piston elements of FIGURES 3, 4 and 5 under various engine operating conditions; FIGURE 6a represents valve element settings for a cold engine and low engine vacuum such as at the time of starting; FIGURE 6b represents valve element settings for a cold engine and high engine vacuum such as immediately after initiating engine operation; FIGURE 6c represents valve element settings for a warm engine and high engine vacuum such as at cruising or part throttle operation; and, FIGURE 6d represents valve element settings for a warm engine and low engine vacuum such as at wide open throttle or full power operation;

FIGURE 7 is a view similar to FIGURE 1 illustrating a fourth embodiment of the present invention, the bleed valve structure of the enrichment means being shown when the lever member is actuated by an external motivating force and the engine is operating at low vacuum; and

FIGURE 8 is a fragmentary view of the valve structure of FIGURE 7 illustrating the bleed valve structure when the lever is actuated by an external motivating force and the engine is operating at high vacuum.

Referring now to the drawings, wherein like reference characters designate like or corresponding parts throughout the several views, in FIGURE 1 the numeral 11 generally designates a substantially constant vacuum or air valve type of carburetor. The body 12 has an air induction or mixture passage 13 formed therein. The inlet extremity 14 of the induction passage is adapted for connection to a source of air while the outlet extremity 16 of the induction passage is adapted for connection to engine manifold (not shown). A bridge 17 is formed intermediate the inlet and outlet extremities of the induction passage and has formed therein a fuel metering orifice or outlet generally designated as 18. A throttle valve 19, for controlling the admission of the fuel-air mixture to the engine, is rotatably supported in the passage adjacent the induction passage outlet.

The body 12 supports an air valve adjusting means which consists of a two-part chamber generally designated as 21. The lower side 22 and the upper side 23 of the

chamber 21 are separated by a flexible diaphragm 24 and a variable choke piston 26. The lower side or first chamber 22 is in communication with a source of air at substantially atmospheric pressure of air from filter means at filter pressures. Generally and preferably the air is communicated to the chamber from an air filter (not shown) by conduit 27. The upper side or second chamber 23 is in communication with a source of air at sub-atmospheric pressures. The subatmospheric pressures are communicated to the upper chamber by a metering orifice 28 opening between the hollow interior of the choke piston and the induction passage. Changes in the pressure differential existing between the first and second chamber parts during engine operation cause reciprocal movements of the choke piston to occur. The piston is guided in its movements by a support 29 depending from the top of the chamber 21 which houses therein a dashpot member 31 coaxing with a hollow sleeve member 32 of the choke piston. A calibrated spring 33 and/or the weight of the assembly normally biases the piston toward a choked position.

The choke piston 26 is adapted to extend into the induction passage opposite the bridge 17 for controlling the mass air flow through the induction passage. The choke piston being responsive to pressure differentials normally maintains a substantially constant vacuum in the passage between the choke valve and the throttle valve irrespective of the engine speed and/or degree of throttle opening. A calibrated needle valve 35 is supported by the piston and is adapted to extend into the fuel orifice 18 for regulating the admission of fuel into the passage responsive to the mass of air passing through the choked area between the bottom of the choke piston and the top of the bridge. Engine requirements as determined by engine manifold vacuum and by the throttle valve opening determine the mass air flow, and the position of the choke valve and needle valve in the passage controls the air flow and the amount of fuel drawn into the air flow. When the throttle valve is in the closed position, indicated by dotted lines, the choke piston will close off the induction passage and no air will flow across the bridge. When the throttle valve assumes a wide open position or full power position, as illustrated, the pressure differential in the air valve adjusting means 21 will cause the choke piston to be retracted the maximum amount into the chamber thereby allowing the greatest mass air flow to take place and concomitantly the fuel orifice will be restricted by the needle valve to the least degree.

As is well known, when the engine operates at wide open throttle or full power the engine manifold vacuum will be at its lowest value, and when the engine operates at idle or off idle then the engine manifold vacuum will be at its greatest value.

The carburetor 11, as so far described, is of a known construction. My inventive improvements follow. On many installations it is a desirable object to provide either a leaner or relatively richer mixture at part throttle operation. To accomplish this object I propose to bleed down the suction or vacuum in the upper chamber 23 of the valve adjusting means 21. In FIGURE 1 the object is attained by means of an enrichment device generally designated as 34. A closed housing 36 is supported externally of the chamber 21 and has calibrated port means 37 communicating between the interior 38 of the housing and the upper chamber 23. A second port 39 communicates between the interior 38 of the housing and source of air at substantially atmospheric pressure through vent conduit 40. A piston 41 having an annular recess or channel 42 is slidably disposed in the housing. A spring 43 biases the piston upwardly causing the recess 42 to communicate between the ports 37 and 39 and when the piston is in this position a calibrated amount of bleed air is admitted into the upper chamber to diminish the existing pressure differential. The diminished pressure

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differential allows the choke piston to drop into the induction passage a predetermined amount. When the choke piston reduces the area of the induction passage between the bottom of the choke piston and the bridge the amount of vacuum in the induction passage immediately posterior of the air valve will increase. The increased vacuum will exert a static pressure on the fuel orifice. Naturally there will be an increase in the air velocity in the reduced area portion of the induction passage which will cause a velocity induced suction to be exerted on the fuel orifice. The sum of the two suctions has a cumulative effect which is greater than and offsets the reduced area of the fuel orifice due to the enlarged needle valve diameter. The result is the accomplishment of the desired object to provide an enriched fuel-air mixture. The action thus acts to enrich the fuel-air mixture during engine operating conditions when the engine manifold vacuum is below a predetermined value and conversely provides a relatively leaner mixture during engine operating conditions when the engine manifold vacuum is at or above the predetermined value. When the engine is operated at high engine manifold vacuum the vacuum will be communicated by conduit means 44 from a point posterior to the throttle valve to the housing interior 38. The action of the engine manifold vacuum at and above the predetermined values will cause the enrichment piston 41 to be drawn downwardly to close off the port 37, and in so doing, cut off the bleed. The pressure differential in chamber 21 will return to its normal value and the choke piston will operate in a standard preset fashion providing a fuel-air mixture of relatively leaner proportions. The recess 42 is of sufficient axial extent that it continuously communicates with the port 39. Should any engine vacuum leak past the piston 41 it will immediately draw air from the source at port 39 rather than undesirably draw air from the upper chamber 23.

The embodiment of FIGURE 2 is intended to illustrate a carburetor wherein the enrichment device generally designated as 46 acts to provide an air bleed during engine operating conditions when the engine manifold vacuum is at or above a predetermined value. In this manner an enriched fuel-air mixture is provided during these engine operating conditions and a relatively leaner mixture is provided during engine operating conditions when the engine manifold vacuum is below the predetermined value. The device 46 comprises a hollow cylindrical housing 47 having calibrated port means 48 communicating between the upper chamber 23 and the interior 49 of the housing. A second port 51 communicates by means of conduit 52 between the conduit 27 and the interior 49 of the housing. An annular recess or channel 53 is formed adjacent the upper extremity of the piston 54 which is slidably disposed in the housing. The recess is adapted, when the piston is subjected to engine manifold vacuum, to communicate between the ports 48 and 51 to allow a calibrated bleed action to occur and thereby reduce the pressure differential in chamber 21. A second recess or channel 56 formed in the piston 54 is in constant communication with a port 57 and conduit 60 connected to the atmosphere to provide a vacuum or suction break bleed and prevent the engine manifold vacuum from detrimentally affecting the pressure differential of the air valve adjusting means. A conduit 58 communicates engine manifold vacuum to the housing to actuate the piston. When the engine manifold vacuum is low, the bleed action will be accomplished and the choke piston caused to drop a predetermined amount into the induction passage. When the choke piston reduces the area of the induction passage between the bottom of the choke piston and the bridge the amount of vacuum in the induction passage immediately posterior of the air valve will increase. The increased vacuum will exert a static pressure on the fuel orifice. Naturally there will be an increase in the air velocity in the reduced area portion of the induction passage which will cause a velocity induced

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suction to be exerted on the fuel orifice. The sum of the two suctions has a cumulative effect which is greater than and offsets the reduced area of the fuel orifice due to the enlarged needle valve diameter. The result is the accomplishment of the desired object to provide an enriched fuel-air mixture. When the bleed is closed by manifold vacuum, the carburetor will operate in a normal preset fashion which has the effect of producing a leaner fuel-air mixture at the wide open throttle or power portion of its operating curve.

In many installations it is desirable to control the enriched carburetor operation by means of both engine vacuum and engine temperature. The embodiments in FIGURES 3-8, inclusive, disclose improvements for attaining this objective.

In FIGURES 3-5 an enrichment device generally designated as 61 has been illustrated comprising a hollow cylindrical housing 62 closed at one extremity. The housing is provided with a calibrated port 63 communicating with the second chamber of the air valve adjusting means and a port 64 communicating with a source of air at atmospheric pressure through conduit 65. A tubular sleeve member 66 closing off the open extremity of the housing is journaled therein and restrained against axial movements by lock ring means 67 and 68. An annular recess 69 is formed in the exterior surface of the sleeve adjacent the housing port opening 63. A plurality of calibrated openings 71 communicates between the recess and the innermost hollow portion 72 of the sleeve. A contoured opening 73 is formed in the sleeve adjacent the housing port opening 64. A shaft 74 is connected to the sleeve and actuator means 76 is connected thereto. The actuator means are preferably thermostatic but other means can be utilized. Additionally, the actuator means will include a deflooding or wide-open-kick mechanism to return the enrichment device to its normal operating condition. A slidable but non-rotatable piston member generally designated 77 is utilized and consists of an actuator 78 disposed in the housing and a piston plug 79 disposed in the hollow portion 72 of the sleeve 66. A connecting member 81 interconnects the actuator and the piston plug member. An axial slit 82 in the plug communicates via a passage 83 to the inner portion 72 of the sleeve. A spring 84 coacts with the housing and actuator to bias the piston member upwardly as is best illustrated in FIGURE 3. Engine manifold vacuum is communicated to the closed extremity of the housing 62 by conduit 80 and when the engine manifold vacuum is above a predetermined value, the piston member is sucked downwardly to the position illustrated in FIGURE 4.

The object of the particular embodiment of the invention illustrated in FIGURES 3-6, inclusive, is to provide a controlled degree of air bleed. This object is attained by the enrichment device 61 through the vacuum motor force exerted on the piston member 77 and the thermostatic force exerted on the tubular sleeve 66. When the slit 82 and the contoured opening 73 are in proper alignment the object is attained. In FIGURE 6 the relative positions of the slit 82 and the contoured opening 73 under various engine operating conditions are diagrammatically illustrated. In FIGURE 6a the maximum overlap exists when the engine is cold and no engine manifold vacuum exists. This maximum overlap allows a maximum amount of air bleed causing the pressure differential to approach zero and any fuel-air mixture admitted to the engine at this setting will be enriched to the highest degree. At the initiation of engine operation engine manifold vacuum will be created and the piston member 77 will move downwardly in the housing 62 thereby changing the relative positions of the slit 82 and the contoured opening 73 to the positions shown in FIGURE 6b. The resultant fuel-air mixture will continue to be rich but to a lesser degree. As the engine warms up, the thermostatic element 76 will rotate the tubular sleeve 66 in a counter-clock-

wise direction and move the contoured opening 73 to the right in FIGURE 6 relative to the piston slit 82. At normal engine operating temperatures and at and above a predetermined engine manifold vacuum the slit 82 and the contoured opening 73 will not overlap and will assume the relative positions illustrated in FIGURE 6c. No air bleed will occur under these conditions and the carburetor will function in its normal preset manner. When the engine is operated at normal engine temperatures and the engine manifold vacuum drops below the predetermined value, the piston 77 will be biased by the spring 84 causing the slit 82 and the contoured opening 73 to assume the relative positions illustrated in FIGURE 6d. During engine operations below the predetermined engine vacuum the air bleed to the upper chamber will be operative to a limited degree and the resulting fuel-air mixture will be enriched a proportional but limited amount.

The embodiment illustrated in FIGURES 7 and 8 provides an enrichment device generally designated 85 which also operates by reason of a combination vacuum motor and an ancillary motivating force. A bleed 86 opens into the second chamber 23. The housing 87, closed at one extremity, is secured adjacent the chamber 21 and has a slidably disposed piston 88 contained therein. A conduit 89 communicates engine manifold vacuum to the closed extremity of the housing to provide vacuum actuator means for the piston member. A depending arm 91 extends upwardly from the piston through the opening 92 of the housing to provide a pivot point or fulcrum for a lever member 93. A needle valve 94 is pivotally supported by the lever to cooperate with the air bleed 86. Actuator means 95 (not shown but either (1) manually controlled or (2) heat controlled) are secured to the opposite extremity of the lever at 96. Pin members 97 and 98 are provided as travel limiting means for the lever member 93. The operation of the device is similar to the operation described for the enrichment device 61. When the engine is about to be started, no engine manifold vacuum will exist and the piston 88 will assume a position adjacent the uppermost portion of the housing 87 with the depending arm 91 extending to its maximum by reason of a biasing spring 99. The actuator means 95, secured to the extremity 96 of the lever, will urge the lever 93 against the travel limiting pin 98 causing the needle valve 94 to be withdrawn a maximum amount from the bleed passage 86. An enriched mixture is thus provided for starting. The described position is best illustrated in FIGURE 7. When the engine starts, engine manifold vacuum will draw the piston 88 into the housing causing the fulcrum to be displaced downwardly and, in turn, will cause the needle valve to reduce, but not entirely close off, the idle bleed 86. The mixture thus provided is rich but not to the same degree as the starting mixture. When the engine warms up, the actuator means 95 will move toward the travel limiting pin 97 and cause the lever to pivot the needle valve to a positive cut-off of the air bleed. This would be the position assumed during engine operating conditions when the engine manifold vacuum is at or above a predetermined value. When the engine is operated at normal temperatures and the engine manifold vacuum is below the predetermined value, the piston again will be urged upwardly by the spring 99 due to the lack of sufficient engine manifold vacuum. The arm 93 will be lifted by the combination of the fulcrum 91 and the travel limiting pin 97 to lift the needle valve out of the air bleed 86 a predetermined amount, thereby reducing the pressure differential in the chamber 23 and causing the choke piston to drop into the induction passage with a resulting enrichment of the fuel-air mixture being supplied to the utilizing engine.

The foregoing embodiments are considered illustrative only on the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in this art, it is not desired to limit the invention to the exact constructions shown and described, and

accordingly, all suitable modifications and equivalents may be resorted to falling within the scope of the invention as claimed.

I claim:

1. A charge forming device for internal combustion engines comprising, in combination:

a body having an induction passage providing an air intake and a mixture outlet connectable to engine manifold;

an air valve, including a variable choke piston and a needle valve, slidably positioned on the body in the induction passage for controlling a supply of fuel and air to the engine;

a fuel metering orifice disposed in said induction passage opposite said needle valve to cooperate therewith;

a throttle valve rotatably supported in the induction passage anterior of the air valve for controlling the introduction of a fuel-air mixture to the engine;

a flexible diaphragm member separating said body into a first chamber and a second chamber, means maintaining said first chamber at a reference pressure, means maintaining said second chamber during engine operation at a pressure substantially equal to that in the passage intermediate of the needle valve and the throttle valve;

a hollow closed housing;

first conduit means interconnecting the housing and the second chamber;

second conduit means interconnecting the housing to reference pressure;

a bleed piston slidably disposed for reciprocal movement within the housing, said bleed piston having a first and a second position;

a channel disposed in the bleed piston to interconnect the first and second conduit means when the bleed piston is in its first position;

third conduit means communicating pressure downstream of the throttle valve to the housing for moving the bleed piston to its second position;

resiliently yieldable means cooperating with the cylindrical housing and the bleed piston for biasing the bleed piston to its first position when the engine manifold vacuum reaches a predetermined value.

2. The charge forming device set forth in claim 1 wherein: the channel disposed in the bleed piston provides a suction break for preventing the engine manifold vacuum from communicating with the second chamber.

3. The charge forming device set forth in claim 1 further comprising:

a second channel disposed in the bleed piston intermediate the first channel and the third conduit means preventing the manifold vacuum from communicating with the second chamber.

4. A substantially-constant vacuum charge forming device for internal combustion engines comprising in combination:

a body having an induction passage adapted to be connected between an air intake and engine manifold;

an air valve including a variable choke piston slidably positioned in the body and cooperating with the induction passage for controlling a supply of air to the engine;

a fuel metering orifice disposed in said induction passage opposite said choke piston, means moving said piston toward and away from said fuel metering orifice;

a needle valve connected to said choke piston for movement therewith and operative with said fuel metering orifice to control the supply of fuel to said engine;

a throttle valve in the induction passage located on the manifold side of the air valve for controlling the introduction of a fuel-air mixture to the engine;

air valve adjusting means including a diaphragm member separating a first and second chamber;
 first passage means supplying air intake pressure to said first chamber;
 second passage means connecting said second chamber to said induction passage intermediate said air valve and said throttle valve;
 bleed means including a piston having an annular recess connected to said second chamber and the atmosphere operative on actuation to bleed a limited quantity of air into said second chamber to modify the pressure acting on said diaphragm member such that said piston is moved toward said fuel metering orifice; and
 means for controlling said bleed means responsive to manifold vacuum posterior of the throttle valve operative to selectively actuate said bleed means in response to manifold vacuum.

5. A constant-vacuum charge forming device for internal combustion engines comprising in combination:
 a body having an induction passage adapted to be connected between an air intake and engine manifold;
 an air valve including a variable choke piston slidably positioned in the body and cooperating with the induction passage for controlling a supply of air to the engine;
 a fuel metering orifice disposed in said induction passage opposite said variable choke piston;
 a needle valve connected to said choke piston for movement therewith and operative with said fuel metering orifice to control the supply of fuel to the engine;
 a throttle valve in the induction passage located on the manifold side of the air valve for controlling the introduction of a fuel-air mixture to the engine;
 air valve adjusting means including a diaphragm member separating a first and second chamber;
 vacuum actuated means including a piston having an annular recess responsive to manifold vacuum posterior to said throttle valve to reduce the pressure differential between the first and second chambers operative to change the choke piston position in the passage in response to manifold vacuum.

6. A substantially-constant vacuum charge forming device for internal combustion engines comprising in combination:
 a body having an induction passage adapted to be connected between an air intake and engine manifold;
 an air valve including a variable choke piston slidably positioned in the body and cooperating with the induction passage for controlling a supply of air to the engine;
 a fuel metering orifice disposed in said induction passage opposite said choke piston;
 a needle valve connected to said choke piston for movement therewith and operative with said fuel metering orifice to control the supply of fuel to said engine;
 a throttle valve in the induction passage located on the manifold side of the air valve for controlling the introduction of a fuel-air mixture to the engine;
 air valve adjusting means including a diaphragm member separating a first and second chamber;
 first passage means supplying air intake pressure to said first chamber;
 second passage means connecting said second chamber to said induction passage intermediate said air valve and said throttle valve;
 bleed means connected to said second chamber and the atmosphere operative on actuation to bleed a limited quantity of air into said second chamber to modify the pressure acting on said diaphragm member;
 means for controlling said bleed means responsive to manifold vacuum posterior of the throttle valve operative to selectively actuate said bleed means in response to manifold vacuum;

a hollow cylindrical housing closed at its extremities; port means opening into the housing intermediate its extremities, one of said port means communicating between the interior of the housing and the bleed means, other of said port means communicating between the interior of the housing and a source of air at a pressure greater than the air pressure in said second chamber;
 piston means having a recessed means formed therein being slidably positioned for reciprocal movement within the housing, said piston adapted when in a first position to cause the recess means to interconnect said port means for allowing a bleed action to occur and adapted when in a second position to close off the port communicating with the bleed means;
 conduit means interconnecting the interior of the housing and the induction passage for communicating engine manifold vacuum to the housing for actuating the piston to one of its positions; and
 resiliently-yieldable means cooperating with the piston member for biasing the piston to its other position when the communicated manifold vacuum reaches a predetermined value.

7. A constant vacuum charge forming device for internal combustion engines comprising in combination:
 a body having an induction passage adapted to be connected between an air intake and engine manifold;
 an air valve including a variable choke piston slidably positioned in the body and cooperating with the induction passage for controlling a supply of air to the engine;
 a fuel metering orifice disposed in said induction passage opposite said variable choke piston;
 a needle valve connected to said choke piston for movement therewith and operative with said fuel metering orifice to control the supply of fuel to the engine;
 a throttle valve in the induction passage located on the manifold side of the air valve for controlling the introduction of fuel-air mixture to the engine;
 air valve adjusting means including a pressure responsive diaphragm for controlling said choke piston and maintaining a substantially-constant vacuum in the induction passage between the choke piston and the throttle valve irrespective of the engine speed and throttle valve opening;
 vacuum-actuated means responsive to manifold vacuum posterior to said throttle valve operative to control the pressure acting on one side of said pressure responsive diaphragm for changing the choke piston position relative to the induction passage in response to manifold vacuum;
 a hollow closed cylindrical housing, said vacuum-actuated means being housed within the cylindrical housing and comprising a piston slidably disposed for reciprocal movement within the housing, said piston having a first and a second position;
 a pair of ports opening into the housing at axially-separated points, one of said ports communicating between the interior of the housing and the air valve adjusting means, the other of said ports communicating between the interior of the housing and a source of air;
 recess means formed in the piston adapted to interconnect the ports when the piston assumes one of its positions and adapted to close off at least one of the ports when the piston assumes the other of its positions;
 conduit means interconnecting the interior of the housing and induction passage for communicating engine manifold vacuum to the housing for actuating the piston to one of its positions; and
 resiliently-yieldable means cooperating with the piston for urging the piston to the other of its positions

when the communicated manifold vacuum reaches
the predetermined value.

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5 HARRY B. THORNTON, *Primary Examiner*.
ROBERT F. BURNETT, RONALD R. WEAVER,
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