

June 6, 1972

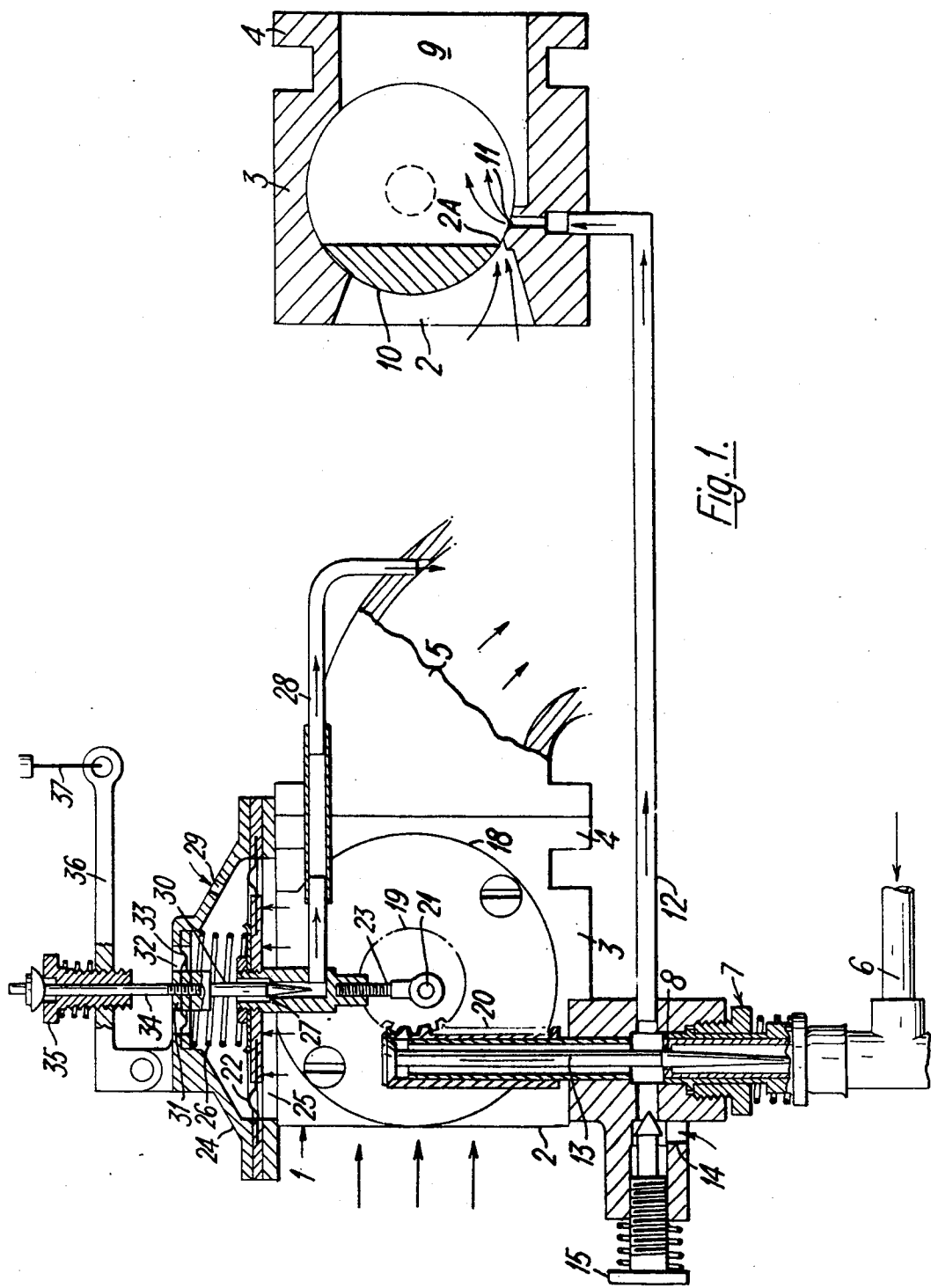
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3,667,741

CARBURETTERS FOR INTERNAL COMBUSTION ENGINES

Original Filed Jan. 15, 1969

4 Sheets-Sheet 1



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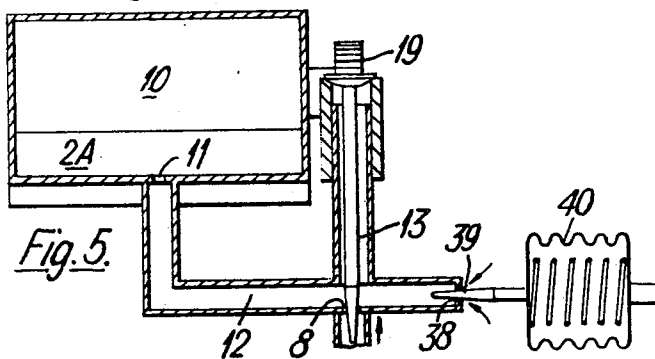
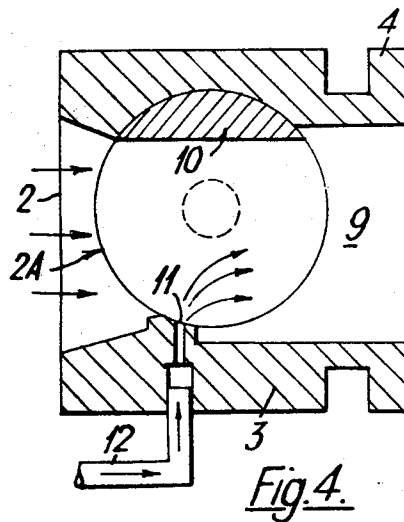
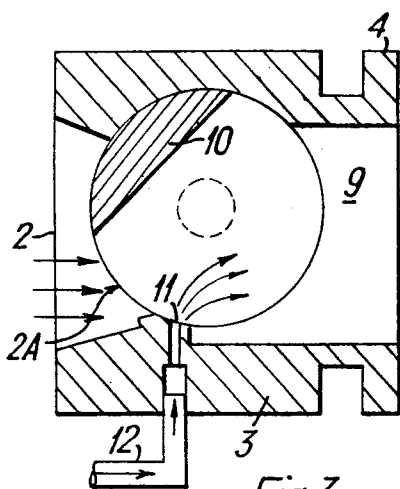
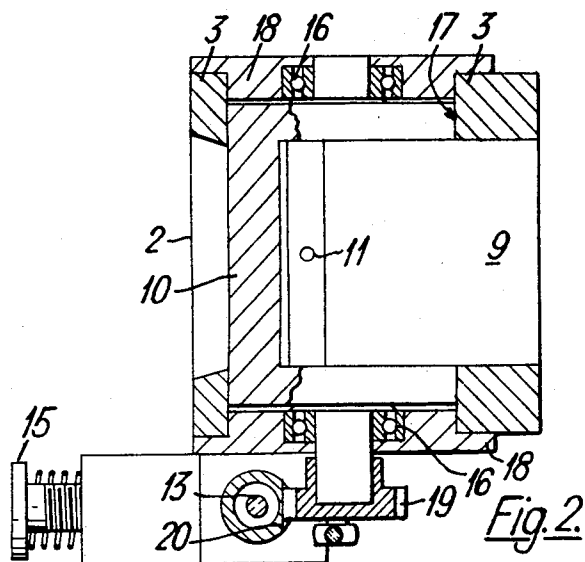
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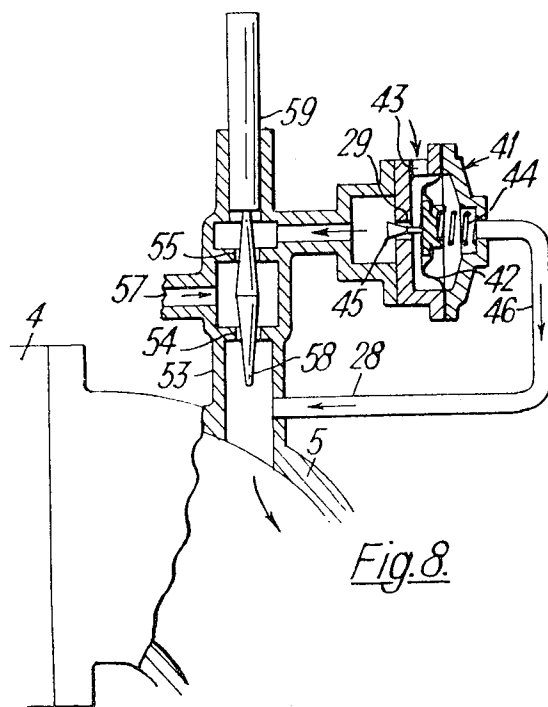
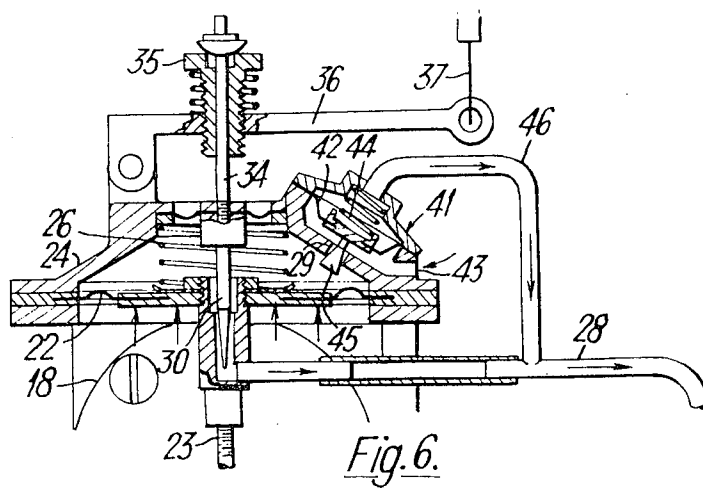
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CARBURETTORS FOR INTERNAL COMBUSTION ENGINES

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4 Sheets-Sheet 3



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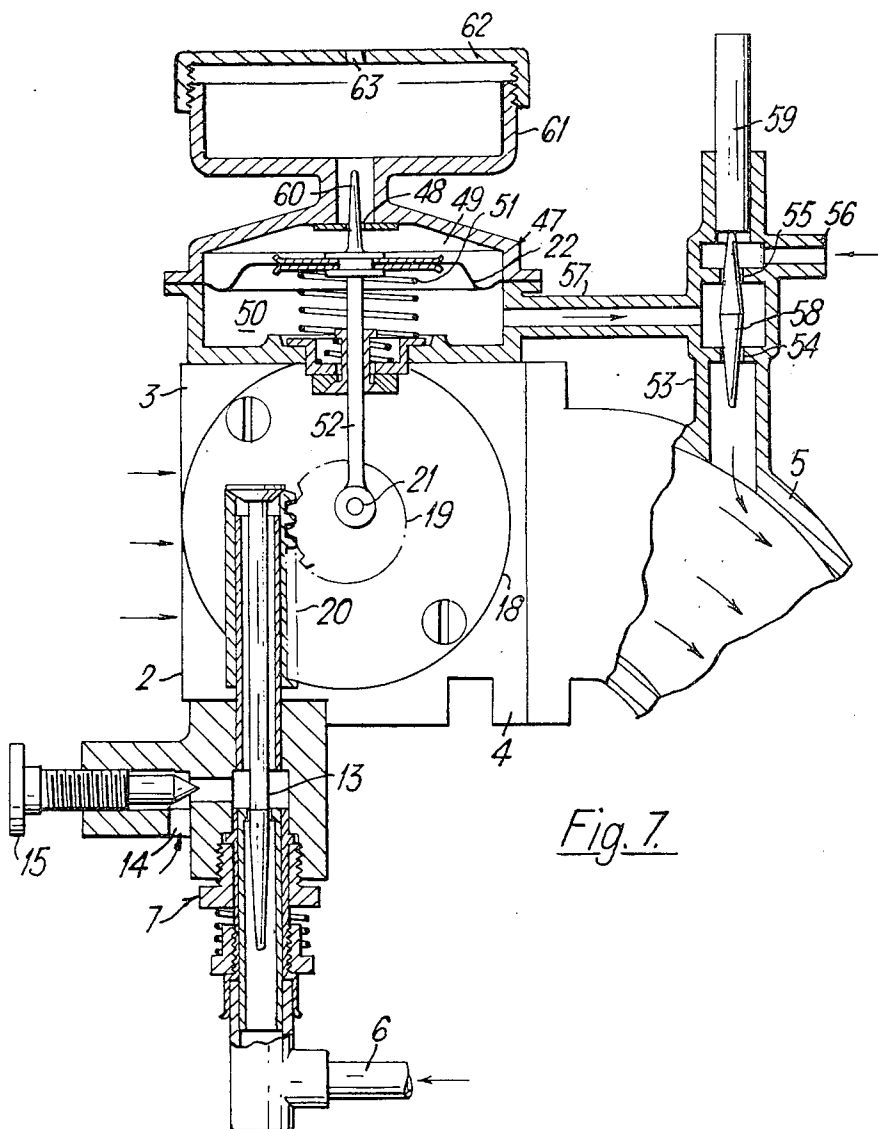
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CARBURETTORS FOR INTERNAL COMBUSTION ENGINES

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CARBURETTERS FOR INTERNAL COMBUSTION ENGINES

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Continuation of application Ser. No. 791,399, Jan. 15, 1969. This application Aug. 28, 1970, Ser. No. 67,988

Claims priority, application Great Britain, Jan. 25, 1968, 3,856/68; May 9, 1968, 21,917/68

Int. Cl. F02m 7/04

U.S. Cl. 261—50 A

8 Claims

ABSTRACT OF THE DISCLOSURE

A carburetter of the controllable jet, automatic variable-choke type has a single main control member (e.g. a rotatable shutter) which regulates the effective cross-sectional area of the choke and also supplants the usual throttle disc.

This application is a continuation of my prior application Ser. No. 791,399, filed Jan. 15, 1969, now abandoned.

This invention relates to carburetters for internal combustion engines, of the controllable jet, automatic variable-choke type having a fuel-metering jet the effective cross-sectional area of which is controlled by a contoured metering needle in dependence upon the instantaneous position of a suction-operated member that controls the effective cross-sectional area of a choke in the main air passage of the carburetter.

The normal automatic variable-choke carburetter is fitted with a throttle disc downstream of the jet discharge to vary the volume of fuel/air mixture entering the engine and thus control the engine power output or load. The pressure-drop across the jet is normally automatically controlled in the region of $\frac{1}{4}$ p.s.i., irrespective of the depression existing in the engine manifold. This practice, under part-load conditions, results in employing only part of the manifold depression and, therefore, having only a limited air velocity through the open area of the choke to break up the fuel. Subsequently the mixture stream strikes the partially opened throttle disc, which causes fuel droplets to be segregated from the air and deposited on the walls of the inlet manifold. This occurrence gives rise to maldistribution of the fuel/air mixture to the various engine cylinders.

According to this invention a carburetter of the type specified above has a single main control member which regulates the effective cross-sectional area of the choke and also supplants the usual throttle disc, and this control member is situated upstream of, or at, the point at which the fuel issues from a fuel-discharge orifice; and means for effecting movement of the control member so as to ensure that the depression across the fuel-metering jet is never less than a predetermined minimum. With this arrangement, for the engine power required, the maximum available air-pressure drop occurs across the fuel-discharge orifice for the formation of the best possible homogeneous mixture; and, as the usual throttle disc is eliminated, this mixture can pass through the inlet manifold without having to meet any obstruction likely to cause maldistribution.

The improved carburetter functions as the constant-depression type on full load, and as a variable-depression instrument when the engine is operating on part load.

The above-mentioned main control member, which it will now be more convenient to designate a shutter, is so shaped as to be as free as possible from bias that could result from air-pressure and air-velocity effects, and is

rotatably mounted (in a manner which provides a good pneumatic seal) on anti-friction bearings. Movement of this shutter is effected by a pressure-responsive means such as a piston, diaphragm or bellows which, has an orifice therein controlled by a needle valve and through which the diaphragm, piston or bellows is subjected to a controlled amount of the manifold depression. This pressure responsive means on full load, controls the maximum pressure-drop across the choke and hence across the fuel-metering jet to the normally used value of approximately $\frac{1}{4}$ p.s.i. During part-load conditions the shutter is positioned to provide only the necessary air flow for the engine power required, which means that it can have a pressure-drop across it varying from approximately $10\frac{1}{2}$ p.s.i. to the full-load condition of approximately $\frac{1}{4}$ p.s.i.

Referring to the accompanying drawings:

FIG. 1 is a schematic side view, partly in section, of a carburetter embodying the invention;

FIG. 2 is a plan view, partly in section, of a shutter that forms part of the carburetter shown in FIG. 1;

FIGS. 3 and 4 are schematic sectional side views illustrating different operating positions of the shutter;

FIG. 5 is a schematic sectional front view of a fuel flow correction means intended for incorporation in the carburetter shown in FIG. 1;

FIG. 6 is a sectional view of part of the arrangement shown in FIG. 1, modified by the inclusion of an over-run control;

FIG. 7 is a schematic side view, partly in section, of an alternative arrangement of the control and pressure-responsive means for operating the shutter; and

FIG. 8 is a sectional view of part of the arrangement shown in FIG. 7, modified by the inclusion of an over-run control.

In the arrangement depicted in FIG. 1, a carburetter 1 of the controllable-area jet, automatic variable-choke type has an air intake 2, and its body 3 has a flange 4 by which it is mounted on the induction manifold 5 of the engine (not shown). Fuel is supplied from a float chamber (not shown), by way of a flexible pipe 6, to a jet assembly 7 which includes a fuel-metering jet 8. The jet assembly 7 is of the well-known construction employed in carburetters of the type to which the invention relates, and therefore needs no further description.

The body 3 of the carburetter has a main fuel/air passage 9 into which the air intake 2 leads (through an intervening variable-size choke 2A), the effective cross-sectional area of which is controlled by a rotatable shutter 10 situated upstream of a fuel emulsion-discharge orifice 11 located substantially at the zone of the choke 2A having the minimum cross-sectional area. The fuel discharge orifice 11 is supplied, via a duct 12, from the fuel-metering jet 8. The effective cross-sectional area of this jet is controlled by a contoured metering needle 13.

In FIG. 1 the shutter 10 is shown in the position which it assumes at small air flows, such as when the engine is idling. Air is bled into the duct 12 via an orifice 14 (the effective area of which is adjustable by a screw 15) to form a fuel/air emulsion.

The shutter 10 is shown forming an approximately half-open condition of the choke 2A in FIG. 3, and the fully open condition of the choke 2A in FIG. 4. The shutter is in the form of a lightweight cylindrical segment, and its rotational axis is at right angles to the axis of the fuel-metering needle 13. The shutter 10 is mounted on ball-bearings 16 (FIG. 2) and rotates in a closely fitting cylindrical housing 17 formed in the body 3. The ball-bearings 16 are mounted in end flanges 18 which permit the rotational axis of the shutter to be moved slightly relatively to the cylindrical housing 17, thus providing

adjustment of the working clearance of the shutter so that a minimum clearance can be set for a good pneumatic seal without rubbing contact and without imposing very fine manufacturing tolerances on the shutter and bore of the housing 17

One the shutter 10 is mounted coaxially a segment of a gear wheel 19 which engages with a rack 20 to which is attached the fuel-metering needle 13, so that the axial movement of this needle relative to the fuel-metering jet 8 is precisely related to the shutter movement and hence to the effective cross-sectional area of the choke 2A (also see FIG. 5). The needle 13 may be attached to the rack 20 through an interposed temperature-responsive bimetallic strip (not shown) capable of causing small movements of the needle relative to a given datum; so that the resultant effective area of the fuel-metering jet 8 is slightly reduced or increased with increased or diminished air temperature and, therefore, fuel temperature respectively, thus providing some correction for changes in fuel viscosity which occur with changes in temperature.

Rotational movement of the shutter 10 is achieved by linking an eccentric pin 21 (FIG. 1), mounted on the segmental gear wheel 19, to a diaphragm 22 through an adjustable link 23; this arrangement enabling the diaphragm 22, which has a relatively small movement, to rotate the shutter 10 through approximately 90° to provide the full choke area. The diaphragm 22 is mounted immediately over, and to one side of, the shutter 10 to provide a compact configuration.

The diaphragm 22 (FIG. 1) is clamped in a chamber or housing 24 open at 25 to atmospheric pressure on one side of the diaphragm, and the latter is acted upon by a spring 26 which loads it against atmospheric pressure so as to balance the effective area of the diaphragm to the full-load inlet manifold depression or the required pressure-drop across the choke 2A. The arrangement is such that the spring 26 of the diaphragm 22 tends to close the shutter 10. The movable portion of the diaphragm has an orifice 27 connected by a flexible pipe 28 to manifold depression; and there is a small air-bleed orifice 29, open to atmosphere, which pertains to the diaphragm-chamber 24, i.e. the space at the spring-loaded side of the diaphragm 22. Acting on the orifice 27 of the diaphragm 22 is a needle valve 30, movement of which can regulate the effective cross-sectional area of the orifice 27. When this valve 30 is lifted fully, virtually full manifold depression is free to act on the effective area of the diaphragm 22 (as the ratio of the effective area of the resultant orifice 27 to the area of the air-bleed orifice 29 is large), causing the shutter 10 to move so as to establish and maintain the pressure-drop across the choke 2A at its predetermined full-load value of approximately ¼ p.s.i. But when the valve 30 is partly lifted, the diaphragm 22 will move until its orifice 27 is reduced in area by the needle valve 30 so as to produce a state of equilibrium with the air-bleed orifice 29 for the pressures prevailing, and the shutter 10 will move a corresponding amount. Movement of the valve 30 controls the engine load, and the shutter 10 will follow the movement of the valve in the opening direction until the full-load condition obtains, when the carburetter becomes a constant-depression instrument. The controlling effect of the diaphragm 22 on the movement of the shutter 10 is such that the depression across the fuel-discharge orifice 11, under full-load conditions, is never less than a predetermined minimum.

The needle valve 30 is mounted on a block 31 located, at the upper part of the housing 24, in an aperture 32 which is sealed by a flexible diaphragm 33. The block 31 is carried by a rod 34 which, by means of a spring-loaded screw 35, is adjustably mounted on a lever 36 operable by a control cable 37 (which corresponds to the throttle-control cable of a conventional carburetter).

For a given choke area, i.e. that area of the choke 2A which, at any time, is uncovered by the shutter 10, the mass of air per unit time passing the shutter 10 will de-

pend on the pressure-drop across it, but is compressible. The mass of fuel issuing from the fuel-metering jet 8 per unit time also depends on the pressure-drop, but is not compressible. If the fuel-metering jet 8 were subject to the same pressure-drop as the air across the shutter 10, it would follow that, starting from a given pressure-drop and fuel-metering jet size, if the pressure-drop be increased, the fuel flow would be proportionately greater, and if the pressure-drop be diminished the fuel flow would be proportionately less, than the air flow.

A manual means for effecting the necessary fuel flow correction is incorporated in the arrangement shown in FIG. 1, and an automatic means is depicted schematically in FIG. 5. There is an orifice 38 which admits air to the fuel duct 12, and the effective cross-sectional area of this orifice is variable by a contoured needle 39 moved relatively to it by a pressure-responsive device 40 (comprising a spring-loaded hermetically-sealed capsule) subject to manifold depression. The effect of this device is such that admission of air to the fuel duct 12 is greatest when the manifold depression is highest, and is lowest at full-load conditions. This admission of air varies the pressure-drop across the fuel-metering jet 8, and hence the fuel flow may be controlled to match the air passing the choke 2A controlled by the shutter 10.

During overrun conditions, when induction manifold depressions are higher than at idling, the fuel/air mixture entering the engine combustion chambers can be so rarefied and diluted with exhaust gas as to cause incomplete combustion. If, however, additional fuel/air mixture is admitted during these conditions, combustion will be more complete. To this end, during overrun operation, the area of the air-bleed orifice 29 of the diaphragm-chamber 24 is varied by a pressure-sensitive device 41 (FIG. 6) so arranged that the air bleed through it is diminished or stopped. The pressure-sensitive device 41 comprises a diaphragm 42, loaded against atmospheric pressure (which has access to the lower side of the diaphragm through an orifice 43) by a spring 44, and a conical valve 45 (carried by the diaphragm 42) which controls the effective cross-sectional area of the orifice 29. The space above the diaphragm 42, and sealed by it, is connected by a pipe 46 to the pipe 28 which, as shown in FIG. 1, leads into the induction manifold 5 of the engine. As previously described, the area of the manifold depression orifice 27 in the diaphragm 22 is controlled by the tapered needle valve 30. Diminishing or obstructing the atmospheric air-bleed to the diaphragm-chamber 24 has the effect of disturbing the pressure equilibrium in this chamber by increasing the depression acting on the diaphragm 22. The latter consequently moves, causing the shutter 10 to rotate so as to increase the effective cross-sectional area of the choke 2A. As the choke area is increased, so the manifold depression is reduced until it reaches a value which, acting on the area of the diaphragm 42, produces a force insufficient to overcome the load of the spring 44; and so the diaphragm 42 moves the valve 45 to increase the effective area of the orifice 29. This reduces the depression acting in the diaphragm-chamber 24, with the result that the shutter 10 (under the influence of the spring 26) will then move towards a closed condition of the choke 2A, until the manifold depression again reaches a value sufficient to move the diaphragm 42; whereupon the cycle restarts. The arrangement described with reference to FIG. 5 thus ensures that the depression in the manifold during overrun conditions never exceeds a value set by the load of the spring 44 (FIG. 6) acting on the effective area of the diaphragm 42. Matters are so arranged that the effective cross-sectional area of the air-bleed orifice 29 is reduced by movement of the diaphragm 42 under a manifold depression slightly greater than that existing under "fast" idle conditions.

Referring now to the alternative arrangement of the control means illustrated schematically in FIG. 7, the same reference numerals identify those components of

5

this design that have already been described with reference to FIG. 1.

The diaphragm 22 in this embodiment is clamped in a housing 47 open to atmospheric pressure, via an orifice 48, on one side (which will be designated diaphragm-chamber 49) and to manifold depression on the other side (which will be designated diaphragm-chamber 50). The housing 47 is mounted on top, and to one side, of the body 3, and the diaphragm 22 is acted upon by a spring 51 which loads it so as to balance its effective area to the full-load inlet manifold depression or the required pressure-drop across the choke 2A. Also, the diaphragm 22 is coupled by a link 52 to the eccentric pin 21 on the gear segment 19, and the arrangement is such that the spring 51 of the diaphragm 22 tends to rotate the shutter 10 (which, as in the first embodiment described, is mounted in a cylindrical housing within the body 3) so as to reduce the effective area of the choke 2A.

A duct 53, connecting the manifold depression to the diaphragm-chamber 50, contains an orifice 54 and a further orifice 55 open to atmospheric pressure at 56, the space between the orifices being connected by a duct 57 to the diaphragm-chamber 50. The two orifices 54 and 55 are coaxial, and their effective cross-sectional areas are controlled by the respective portions of a double-tapered needle 58 which is attached to the inner member of a throttle-control cable 59. Movement of the needle 58 increases the effective cross-sectional area of one of the orifices 54, 55 and reduces that of the other, the middle portion of the needle being capable of virtually obturating the respective orifices. The assembly formed by the needle 58 and its associated orifices is equivalent to, and replaces, the normal carburettor throttle control, and it may be situated either on the carburettor or in the driving compartment of a motor vehicle (in which case the connections to the carburettor are made by flexible tubing).

The effective cross-sectional area of the atmospheric orifice 48 of the diaphragm-chamber 49 is controlled by a contoured needle 60 fixed to the diaphragm 22. This arrangement effects fuel/air ratio enrichment during acceleration, by imposing a variable degree of pneumatic damping upon movement of the diaphragm 22, and hence increasing the pressure-drop across the fuel-metering jet 8. Alternatively, oil damping can be employed by the provision of an oil reservoir 61 so that the diaphragm-chamber 49 is permanently filled with oil; this reservoir being fitted with a detachable cover 62 having an atmospheric vent hole 63.

Engine load control is achieved in the following manner:

When the area of the atmospheric orifice 55 is virtually sealed by the needle 58, virtually full manifold depression will act on the diaphragm 22 and a full-load condition will obtain.

When the area of the manifold depression orifice 54 is virtually sealed by the needle 58, practically full atmospheric pressure will act on each side of the diaphragm 22 which will move under the influence of its spring 51 and cause the shutter 10 to rotate so as to reduce the effective area of the choke 2A, and thus provide a no-load condition.

When the respective effective areas of the two orifices 54 and 55 are controlled between these two extremes, a depression will be applied to the diaphragm 22 somewhat less than that existing in the manifold 5, and the shutter 10 will move to establish a part-load engine condition.

As in the case of the embodiment described with reference to FIGS. 1 and 6, it is desirable (in order to reduce exhaust emissions) for the embodiment shown in FIG. 7 to include provision for dealing with overrun conditions. To this end the pressure-sensitive device 41, which has already been described with reference to FIG. 6, is incorporated as shown in FIG. 8. During overrun opera-

6

tion, the pressure-sensitive diaphragm 42, one side of which is subject to manifold depression (through the piping 28, 46) and the other side to atmospheric pressure through the orifice 43, closes the valve 45, with the result that full manifold depression is admitted via the duct 57 to the diaphragm-chamber 50 (FIG. 7) as the air-bleed through the orifice 29 has ceased. Increasing the depression in this diaphragm-chamber causes the diaphragm 22 to move to increase the effective area of the choke 2A, and the cycle of operations engendered by this movement is identical to that already described with reference to FIG. 6; matters being so arranged that the manifold depression, during overrun conditions, never exceeds the value which is set by the load of the spring 44 acting on the effective area of the diaphragm 42, and which is chosen slightly greater than the value of the manifold depression existing under "fast" idle conditions.

What is claimed is:

1. In a variable-choke carburettor, for an engine having an inlet manifold, said carburettor having a fuel-metering jet, and a contoured fuel-metering needle axially movable in said jet, the improvement which comprises

a choke controlling at least the main flow of air through said carburettor, said choke being provided with a single main control member which is at least partially open and regulates the effective cross-sectional area of the choke and acts as a throttle, in all conditions of operation of the carburettor, said choke having a fuel discharge orifice located substantially at the zone of the choke having the minimum cross-sectional area,

pressure responsive means connected to operate said main control member through a range ensuring that the depression across the fuel discharge orifice is always equal to at least a predetermined minimum and comprising a movable part subjected on one side to substantially atmospheric pressure,

said carburettor being provided with an orifice through which the other side of said movable part is subjected to the depression in the inlet manifold at full load and to a controlled amount of said depression at part load, and

load controlling means comprising a manually adjustable needle valve mounted to regulate the effective cross-sectional area of said orifice so as to regulate the amount of the depression in said inlet manifold to which said movable part is subjected and thereby regulate the movement of said movable part and main control member under less than full load conditions to provide a pressure drop across said choke responsive to said manifold depression,

and resilient means biasing said movable means against said atmospheric pressure and urging it under full load conditions into a position in which the main control member connected thereto provides a minimum pressure-drop across said choke which is substantially constant for all engine speeds.

2. A variable-choke carburettor as claimed in claim 1, in which said pressure-responsive means is connected to effect axial movement of said contoured fuel-metering needle relative to the fuel-metering jet so that said axial movement is precisely related to the movement of the main control member and hence to the effective cross-sectional area of the choke.

3. A carburettor according to claim 1, in which the main control member comprises a shutter in the form of a cylindrical segment which is rotatably mounted, in a manner providing a good pneumatic seal, on anti-friction bearings.

4. A carburettor according to claim 3, in which the rotational axis of the shutter is at right angles to the axis of the fuel-metering needle, and the axial movement of this needle is effected by a rack which is actuated by a segmental gear mounted coaxially on the shutter.

7

5. A carburettor according to claim 1, in which the fuel-metering jet supplies the fuel-discharge orifice through a duct having an air admission orifice of which the effective cross-sectional area is variable by a contoured needle movable relatively to the air admission orifice by a pressure-responsive device subject to manifold depression. 5

6. A carburettor according to claim 1, in which said movable part is located in a chamber that has an air-bleed orifice of which the effective area is varied by a pressure-sensitive device so arranged that, during overrun operation, the air-bleed is diminished or stopped. 10

7. A carburettor according to claim 1, in which the movable part separates two chambers of which one has controlled communication with atmospheric pressure, and the other has communication with a space located between two coaxial orifices the effective cross-sectional areas of which are controlled by the respective portions of a double-tapered needle, one of these orifices being normally open to atmospheric pressure and the other to the inlet manifold depression. 15 20

8. A carburettor according to claim 7, in which a pressure-sensitive device is incorporated between the inlet

8

manifold and that orifice which is normally open to atmospheric pressure, this pressure-sensitive device being effective, during overrun operation, to close a valve controlling admission of air to the atmospheric orifice.

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