

May 17, 1949.

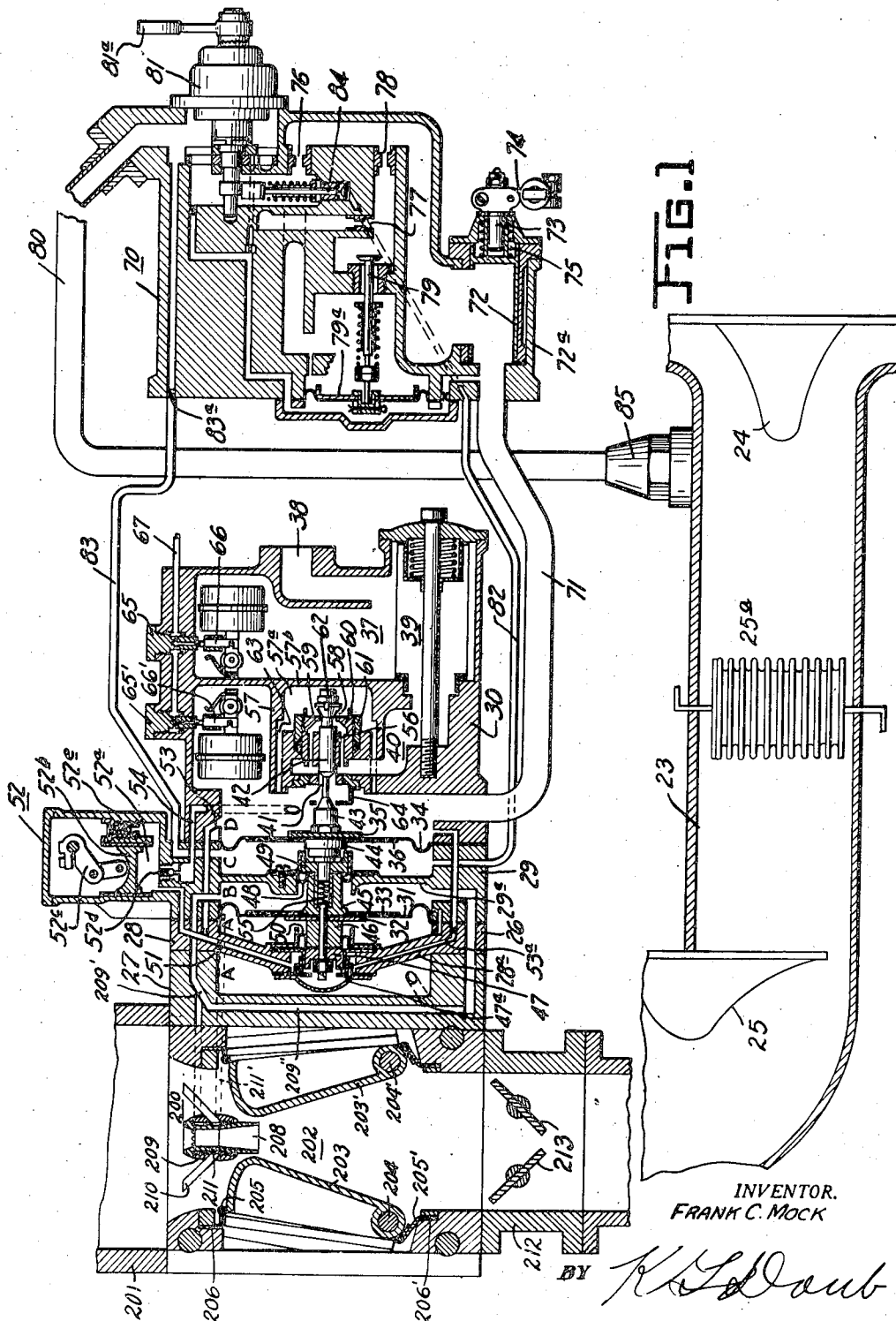
F. C. MOCK

2,470,098

CHARGE FORMING DEVICE

Filed Nov. 20, 1944

4 Sheets-Sheet 1



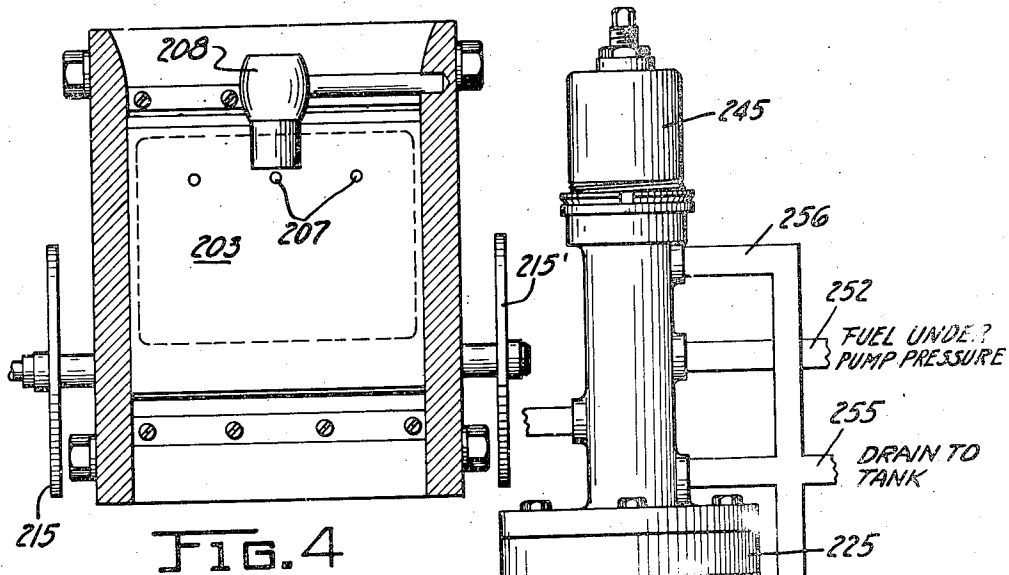
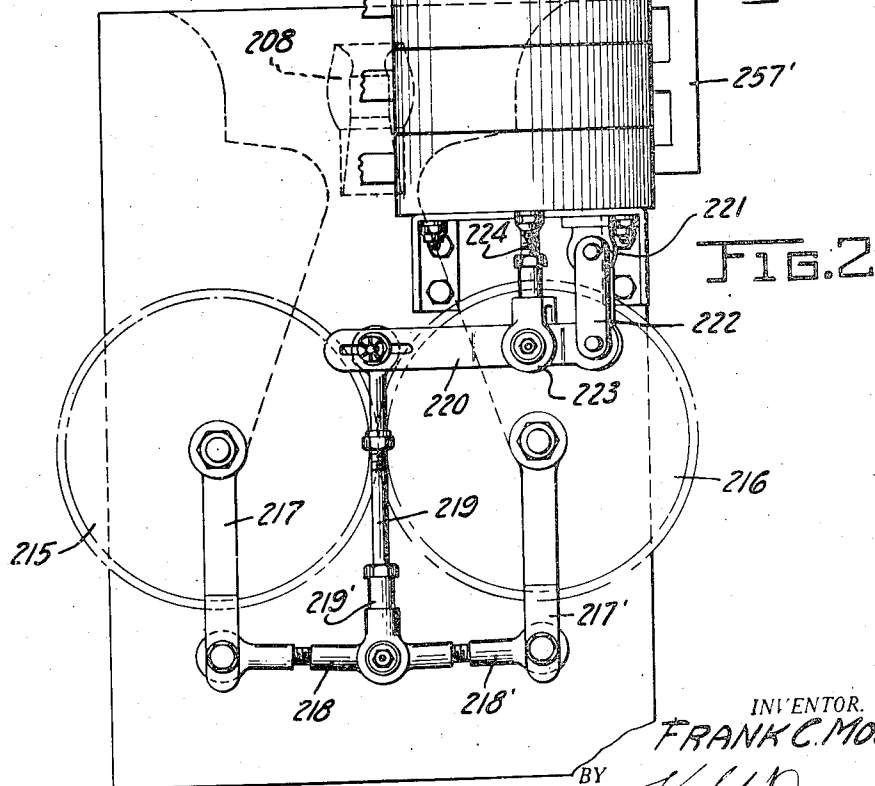
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4 Sheets-Sheet 2



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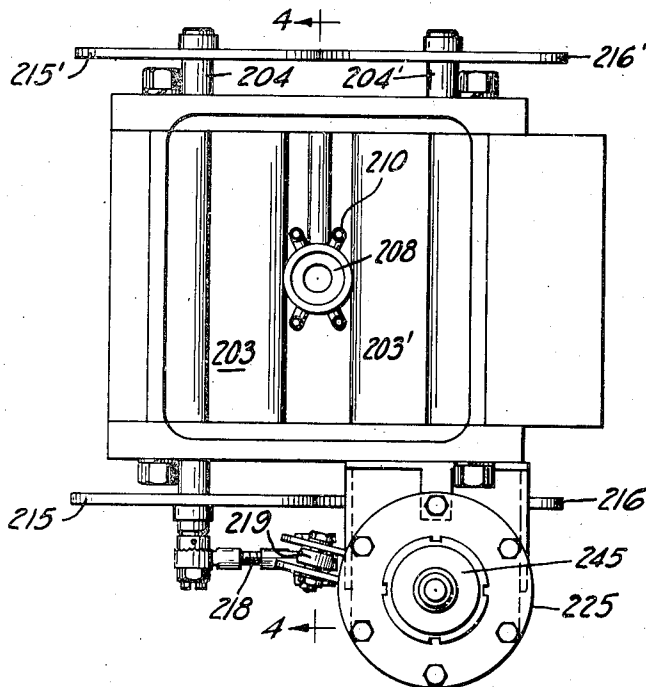


FIG. 3

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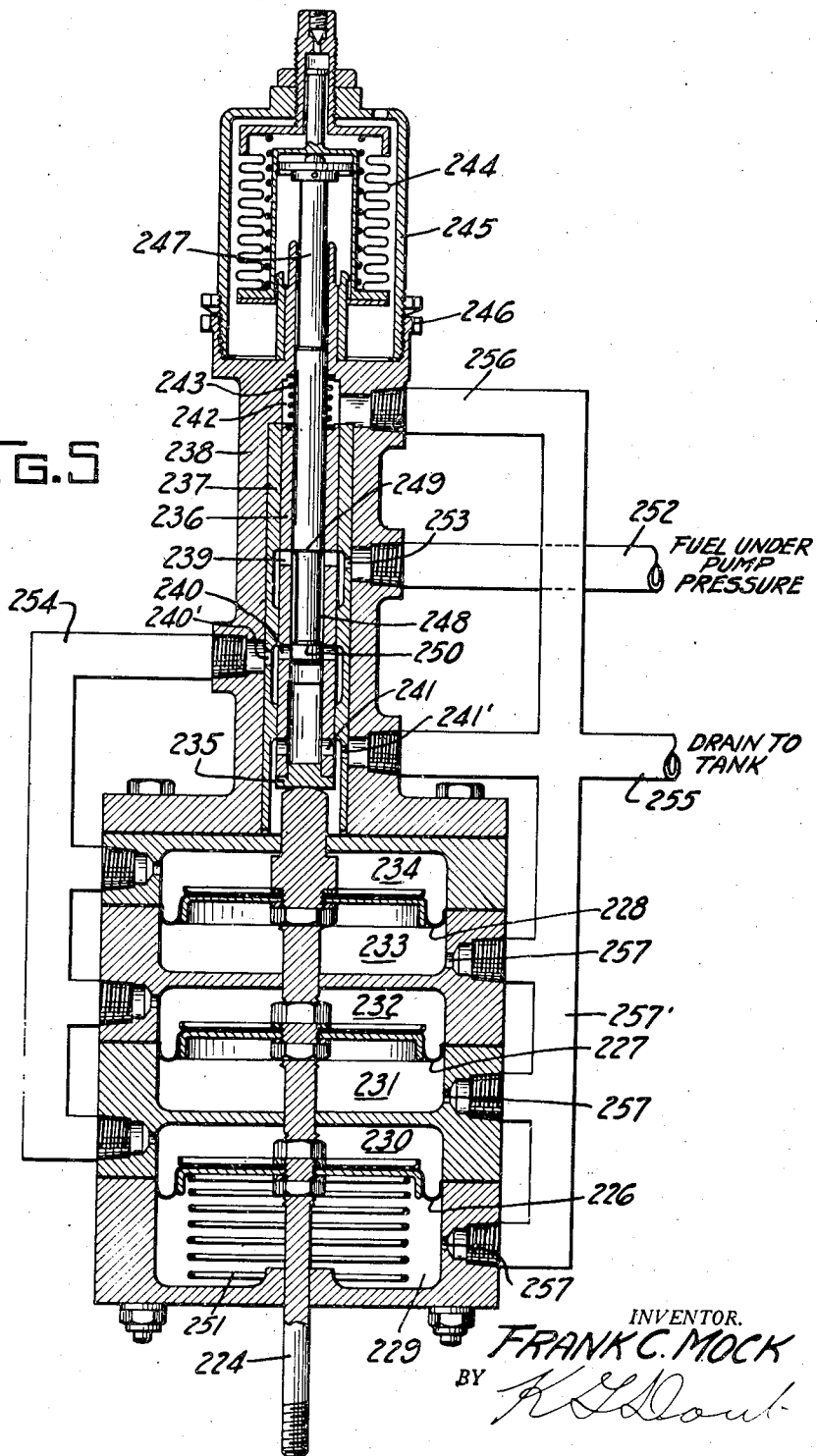
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FIG. 5



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UNITED STATES PATENT OFFICE

2,470,098

CHARGE FORMING DEVICE

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Application November 20, 1944, Serial No. 564,287

3 Claims. (Cl. 261—39)

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This invention relates to charge forming devices or carburetors for internal combustion engines, and includes among its objects: to provide a carburetor particularly adapted for aircraft engines which will supply fuel to an engine in a predetermined fuel/air ratio over a wide range of air densities and under varying operating conditions; a carburetor wherein Venturi suction may be maintained substantially constant with increasing altitude for any given air flow; a carburetor wherein the loss or pressure drop resulting from air flow through the carburetor at high velocities is reduced to a minimum; a carburetor which will meter fuel accurately irrespective of changes in air density and hence velocity of flow through the air-intake system; to adapt a variable Venturi air-intake system to carburetors for aircraft engines and especially carburetors of the injection type utilizing a measure of mass air flow to control the fuel flow; to eliminate or modify the effects of so-called "velocity enrichment" in injection carburetors; to adapt a variable Venturi type air-intake to the fuel-regulating and control units of fixed or plain tube injection carburetors without requiring material changes in the metering system and related parts; to provide a carburetor capable of handling wide variations or extremes of intake air density and thereby, among other advantages, adapt it for mounting on the atmospheric side of a two-stage or multiple supercharger system; and otherwise improve the metering or fuel-feeding characteristics of charge-forming devices.

One of the factors which adversely influence accurate metering in injection carburetors for high-altitude aircraft engines is the increase in velocity of the air flowing through the carburetor resulting from a decrease in density as an airplane ascends to high altitudes. In a carburetor of the type with which the present invention is particularly concerned, the fuel valve which admits fuel to the carburetor and hence controls the fuel metering head is regulated by imposing Venturi differential pressure which constitutes a measure of air flow, commonly termed the "air metering force" on an air diaphragm which tends to open the valve and is balanced for a given air flow by the differential between metered and unmeted fuel, or "fuel metering force" imposed on a fuel diaphragm, which tends to close the valve, the air metering force controlling the fuel metering force. A charge is thus delivered to the engine having a predetermined weight or measure of air and a predeter-

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mined weight or measure of fuel. The controlling or actuating force on the air diaphragm is obtained by taking a measure of scoop pressure and conducting same to a pressure chamber located at one side of the air diaphragm and applying Venturi suction to a suction chamber located at the other side of said diaphragm. The suction is usually obtained by means of a small or boost venturi located in a position with respect to the main venturi such that the air leaves the boost venturi at a point of maximum pressure drop in the main venturi, thereby materially increasing the pressure drop at the throat of the boost venturi. The pressure and suction chambers are connected by one or more calibrated mixture control bleeds which permit a predetermined flow of air through the air diaphragm system; and by regulating this flow of air by means of an altitude aneroid, the air metering force is automatically controlled in accordance with air density and hence mass air flow.

The accuracy of metering with such system of carburetion depends on the air flowing through the carburetor following the laws which govern air flow. Assuming an air venturi of constant area, the depression or suction developed at the throat of the venturi varies as the velocity squared times the density. Thus as altitude is gained, for a given air weight flow, the metering suction and also the resistance to flow (carburetor loss) vary inversely as the air density, the metering pressure head (inches of water) varies inversely as the air density, and the fuel/air ratio varies inversely as the square root of the air density. However, there is a limit to the velocity of flow through the venturi above which the laws governing air flow do not hold true due to so-called "compressibility effects" in the air stream. This limit may, for a given size venturi, be 400 to 450 feet per second and beyond this limit the Venturi differential pressure which governs the air metering force increases at a rate greater than the square of the air velocity, causing enrichment of the fuel charge.

Again, with a fixed venturi there is a loss in power resulting from friction as the velocity increases with decrease in density. If a carburetor loss of say .8 inch of mercury be assumed at ground level, the air charge to the engine will be approximately in the proportion of 29.2/30, but at 30,000 feet altitude where the air density is .37 of that at ground level, the pressure drop through the carburetor will be from 8.9" Hg to 6.6" Hg, a loss of approximately 30 per cent of the power.

The ability of a carburetor to handle wide variations of air intake density also adapts it for mounting on the atmospheric side of a two-stage supercharger system and use of the carburetor throttle as the power control irrespective of whether the main or both the main and auxiliary superchargers are active, thereby simplifying the control mechanism, giving added space between the superchargers for an intercooler and at the same time injecting fuel into the main stage supercharger; as contrasted with mounting of the carburetor between stages with the intercooler placed beyond the main stage or engine-driven supercharger where it may condense fuel already vaporized by the supercharger.

Many and varied types of variable venturi and methods of controlling same have been proposed to regulate the fuel charge and avoid frictional losses due to Venturi restriction and thus improve the volumetric efficiency of the engine. The majority of these systems are concerned with automotive engines for ground vehicles, where widely varying air densities are not encountered and hence are not important factors to be considered. Certain types of aircraft engine carburetors utilize variable venturis wherein the Venturi sections function as throttle valves, but here the venturi is regulated in relation to power requirements and not in direct relation to density. The present invention is concerned primarily with regulation of a variable Venturi type of air-intake system for pressure-feed carburetors to maintain air-flow velocity within a certain predetermined range consistent with accurate fuel metering as well as to reduce carburetor loss, and means coacting therewith for metering the fuel in relation to and as a function of mass air flow; although features of novelty and advantage applicable to carburetors generally will become apparent in view of the following description taken in conjunction with the drawings, wherein:

Figure 1 is a sectional diagram of a charge forming device or carburetor in accordance with the invention;

Figure 2 is a view in elevation of the carburetor of Figure 1, the throttle body, regulator and fuel control units being omitted;

Figure 3 is a top plan view of Figure 2;

Figure 4 is a sectional view taken substantially on the line 4-4, Figure 3;

Figure 5 is a longitudinal sectional view of the servo-motor for actuating the movable Venturi sections of the carburetor of Figures 1 to 4, inclusive;

The carburetor illustrated comprises an air-intake section or body 200 which is preferably rectangular in interior cross-section, the said body being mounted on the discharge end of an air scoop 201 generally opening in the direction of travel and defining an air-intake passage which directs air into the carburetor.

Within the body 200 is a main venturi 202 defined by a pair of movable sections 203 and 203' secured at their downstream extremities on pivot pins or shafts 204 and 204' journaled in suitable bearings in opposite sides of the body 200 and projecting beyond the latter for a purpose to be described. To reduce leakage, sealing members 205, 205' are provided and are carried by resilient brackets 206, 206' which maintain the said members in sealing contact with the contiguous surfaces of the Venturi sections. To prevent formation of an air cushion in rear of

the Venturi sections, they are vented as indicated at 207, Figure 4.

A boost venturi 208 is supported with its downstream or discharge extremity terminating in the throat of the main venturi, or at a point of maximum pressure drop in the latter, the said boost venturi being provided with an annular suction chamber 209 in pressure communication with chamber B of the regulator 26 by way of ducts or passages 209' and 209''; and a measure of impact pressure is received by impact tubes 210 and communicated to impact chamber 211 and thence to chamber A of the regulator by way of duct or passage 211'.

The manner in which the Venturi sections are shifted from one position to another and the operating mechanism therefor will be hereinafter described.

Beyond the body 200 and suitably connected thereto is a throttle body and adapter 212 having rotatably mounted therein a pair of coacting throttle valves 213; and beyond the throttle body is a fuel and air duct or conduit 23 having mounted therein a first stage supercharger 24 and a second stage or auxiliary supercharger 25, an intercooler 25a being mounted between the superchargers.

A fuel regulator unit is generally indicated at 26 (Figure 1) and is adapted to be removably mounted to the barrel 200 and throttle body 212; the said unit being in the form of a series of castings 27, 28, 29 and 30 detachably connected to one another for convenience in assembly and repair and defining air pressure chamber A, air depression or suction chamber B, metered fuel chamber C, and unmetered fuel chamber D; also a relatively large fuel chamber housing a fuel strainer, vapor separator assembly and fuel valve head assembly. Casting 28 is in the form of a spider ring having a hub portion 28a, and casting 29 is provided with a partition wall 29a.

Chambers A and B are separated by a flexible diaphragm 31 which is securely anchored at its outer edge between the castings 28 and 29 and is engaged centrally on one side by a rigid plate 32 and on the opposite side by a thin backing plate 33; while chambers C and D are separated by a flexible diaphragm 34 which is securely anchored at its outer edge between the castings 29 and 30 and is engaged centrally on one side by a plate 35 and on the other side by a thin backing plate 36. Chambers B and C are separated by the rigid walls 29a and the hub assembly supported thereby.

The casting 30 defines a main fuel chamber 37 to which fuel is supplied under pump pressure through inlet port 38 and thence passes through strainer 39 to valve-inlet chamber 40 and from the latter through valve ports 41 and 58 to chamber D of the regulator. Port 41 is controlled by fuel valve 42 forming part of a valve assembly which is shown and described in detail in the copending application of Frank C. Mock Serial No. 538,153, filed May 31, 1944. In general, it consists of a plurality of bushings 43, 44, 45, 46, 47 and adjustable stop 47a, the fuel diaphragm being clamped at its center between plate 35 and bushing 44 and the air diaphragm between plate 32 and bushing 45. A sealing diaphragm 48 is secured at its outer edge to the wall 29a and at its center between bushing 45 and a hollow tie rod and guide bushing 49; and a sealing and balance diaphragm 50 of equal area to diaphragm 48 is secured at its outer edge to hub 28a and at its center between bushings 46 and 47. A passage 51

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places diaphragm 50 in pressure-communication with piston chamber 52a of an accelerator pump generally indicated at 52 and including a piston 52b provided with operating linkage 52c, (which is preferably throttle-actuated) a check valve 52d and a pressure-relief valve 52e. A balance channel 53 having a restriction therein communicates passage 51 with fuel chamber D, and another channel 53a, also having a restriction therein, vents the chamber of diaphragm 50 to said fuel chamber. When the piston 52b is actuated by the throttle or other means, on its upstroke fuel is drawn into chamber 52a from the fuel chamber through passage 54 past valve 52d, and on its downstroke pressure is applied to diaphragm 50 and the fuel valve is opened to correspondingly increase the metering pressure.

An idle spring 55 is located in a chamber defined by the tie rod and guide bushing 49 and functions to maintain a substantially constant metering head when the air metering force acting on diaphragm 31 falls below a certain predetermined value. To permit this spring to so act, the fuel diaphragm 34, fuel valve 42 and bushing 44 are assembled to move in unison as a single unit; and likewise the air diaphragm 31, bushings 45, 46 and 47, guide stem and bushing 49, sealing diaphragms 48 and 50 and associated parts are also assembled to move as a single unit. As long as the air metering force (differential between scoop and Venturi pressures) is above a certain value, or above the idling range, both the air and fuel diaphragms act as a unit on valve 42, but when said force drops below such value, the air diaphragm moves to the left until bushing 47 contacts adjustable stop 47a, whereupon the fuel valve is held open by spring 55 sufficiently to produce a metering head consistent with the desired idling mixture. For a more comprehensive description of the operation of the idling system, reference should be had to application Serial No. 538,153 above noted.

A feature of the fuel valve assembly and coacting parts is that means are provided for neutralizing unbalanced forces or load stresses on the fuel and air diaphragms. These unbalanced forces may result from a number of causes. Theoretically, the diaphragms should exactly balance one another in their action on the fuel valve, but there are certain mechanical forces to be reckoned with. Thus, there is a certain amount of elasticity or spring effect in the diaphragm material which tends to resist movement from a neutral position; the area of each diaphragm changes slightly as it unfolds, and there is a suction effect through the discharge orifice as the fuel valve opens which tends to resist opening movement. In the present instance, two fuel discharge orifices and valve members therefor are provided which are so constructed and arranged as to oppose one another and balance out or neutralize these unbalanced forces. The head assembly for the fuel valve 42 is supported and guided by a sleeve 56 formed integrally with a housing 57 defining a chamber 57a, said housing in turn being formed integrally with a partition wall 57b. In addition to the orifice 41, there is fuel-discharge orifice 58 provided by a seat 59 carried by a mounting ring or sleeve 60 adjustably threaded into a hardened steel bushing 61. The right-hand extremity of the fuel valve 42 is provided with a tapered valve member 62 adapted to control the orifice 58. Fuel discharged through orifice 58 flows into chamber 57a and thence by way of channels or ducts 63

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into chamber D of the regulator. The respective areas of the discharge orifices 41 and 58 and the tapers of the valve members coacting therewith are correlated in a manner such as to balance the fuel valve and parts coacting therewith throughout the range of movement of the valve. Fuel flowing into chamber 40 is under pump pressure which is always higher than the pressure in chamber D of the regulator, but as the fuel flows through the discharge orifices 41 and 58, there is a suction action which tends to draw their valve members towards closed position, and primarily the balancing is by way of regulating this suction effect so that the force tending to open one valve member is opposed by an equal force tending to close the other valve member, although other factors must be considered, such as pressure differential on opposite sides of the orifices, surface areas exposed to pressure and the flow capacity of the ducts 63.

A baffle 64 serves to diffuse the fuel discharged through orifice 41 and reduce the tendency to form vapor in the system, while the multiple flow channels or ducts 63 act as diffusers for fuel discharged through orifice 58.

The chamber 37 in which fuel is received from the fuel pump (not shown) and unmeasured fuel chamber D are provided with vapor-separating systems including vent plugs 65 and 65' respectively, having vents therein controlled by float valves 66 and 66' which open the vents when vapor collects sufficiently to lower the fuel level adjacent the float to a point where the float opens the valve. Vapor so vented flows through line or conduit 67 back to the fuel tank (also not shown).

The fuel control unit, generally indicated at 70, receives unmeasured fuel from the regulator 26 by means of fuel passage or conduit 71; it contains idle valve 72 rotatably mounted in a casing 72a and provided with a stem or shaft 73 and arm 74 having a connection with the throttle linkage (not shown), a spring 75 preventing play in the valve mounting. The valve is shown in open position; it receives the initial flow of fuel from conduit 71 and the fuel passes therethrough to the metering jets, three in number in the present instance, viz: automatic lean jet 76, automatic rich jet 77 and power jet 78. A power enrichment valve 79 is provided and is operated by a diaphragm 79a subjected to the differential between unmeasured and metered fuel pressure and arranged to open valve 79 when the fuel metering force attains a certain value, the valve 79 constituting the metering element during the early part of the power enrichment range and the jet 78 taking over at higher power flows.

The metering jets are located in flow channels which open into fuel discharge conduit 80 through ports controlled by a manual mixture control valve 81 provided with a handle 81a.

Metered fuel pressure is communicated back to C by means of duct or conduit 82, and said latter chamber is relieved of air or vapor by means of duct or conduit 83 discharging into conduit 80 and having a suitable restriction 83a therein. A regulator fill valve 84 operated by a cam on the shaft of the valve 81 allows chamber C to fill with fuel when the carburetor has been empty; it is held open in all positions of said valve except idle cut-off. This construction is more particularly shown and described in U. S. Patent No. 2,361,227.

The conduit 80 conducts metered fuel under pressure to a discharge nozzle 85 located in the

conduit 23 and arranged to discharge fuel into the eye of the main stage supercharger 24. Nozzle 85 may be set to open under a predetermined pressure, for example, five to fifteen pounds per square inch.

The fuel regulator unit 26 and the fuel control unit 70 as shown and described herein incorporate certain features disclosed and claimed in the following commonly owned copending applications: Serial No. 202,206, filed April 15, 1938, now Patent No. 2,390,658; Serial No. 362,572, filed October 24, 1940, now Patent No. 2,447,261, and Serial No. 255,676, filed February 10, 1939, now Patent No. 2,447,264.

The opposite ends of the shafts 204, 204' which project beyond the Venturi housing or body 200 have secured thereon intermeshing gears 215, 215' and 216, 216', and beyond said gears 215 and 216 said shafts have fixed thereon toggle arms 217 and 217' which are yoke-shaped and slotted at their lower ends to provide a pivotal connection for the outer ends of a pair of adjustable toggle links 218, 218', the inner ends of the latter being pivotally connected to a yoke 219' adjustably threaded on the one end of a link 219. At its opposite end, link 219 is provided with another yoke which is adjustably pivoted to the one end of a lever 220, the opposite end of the said lever being pivotally anchored to a relatively stationary supporting bracket 221 by means of links 222. At an intermediate point along its length, lever 220 is provided with a fulcrum connection in the form of a yoke 223 which is adjustably threaded on the one end of a servo-motor pitman or connecting rod 224 constituting part of a servo-motor generally indicated at 225 and shown more or less in detail in Figure 5.

The servo-motor 225 consists of a series of castings which when assembled with diaphragms 226, 227 and 228 provide a plurality of chambers 229, 230, 231, 232, 233 and 234. The diaphragms are clamped between reinforcing plates which at their centers are secured to the rod 224, which projects through and is guided by a series of rigid partitions, and at its upper or left-hand end (depending upon whether the servo is used in a vertical or horizontal position) abuts a cap 235 closing the adjacent end of a valve sleeve 236 slidable in a tubular bearing 237 fixed in an elongated tubular housing 238 which is flanged at its lower end and secured to the servo body. The sliding valve sleeve 236 is provided with an inlet port 239, a discharge port 240 adapted to register with a like port 240' formed in the bearing 237, and a drain or exhaust port 241 adapted to register with a like port 241' formed in said bearing. A chamber 242 is formed in the housing 238 at the upper end of sleeve 236 and therein is disposed a relatively weak spring 243 which urges the sleeve downwardly and maintains the cap 235 against the adjacent end of rod 224.

A spring-loaded bellows 244, responsive to changes in pressure and temperature and therefore density, constitutes part of a control unit including bellows housing 245 which is threaded into a bushing 246 in turn threaded into the upper end of the elongated housing or column 238. The bellows housing 245 is vented to the atmosphere or to the air scoop; and connected to the movable end of the bellows assembly is a valve rod 247 which is relatively slidable with respect to sleeve 236; it has a relieved portion 248 and valve portions or lands 249 and 250, the

valve portion 250 functioning as a gradual bleed as the valve rod moves downwardly.

Within the chamber 229 is a return spring 251 which urges the rod 224 upwardly against the controlling pressure in chambers 230, 232 and 234 and which latter pressure is governed by the action of the bellows 244 and the valve rod 247.

The servo is particularly adapted for fluids of low viscosity such as gasoline or like motor fuels. In operation, fuel under pump pressure of, for example, fifteen to seventeen pounds is conducted to inlet port 239 by means of pipe or tube 252 and enters by way of inlet port 253. As shown in Figure 5, the parts are in low-altitude position, the valve portion 250 substantially closing discharge port 240, the bellows 244 is collapsed and the rod 224 retracted. As air density lowers, as by increase in altitude, and the pressure surrounding bellows 244 decreases, the latter tends to elongate, moving valve rod 247 downwardly and bleeding fluid under pressure through ports 240, 240' into pipe or tube 254 which branches off into servo chambers 230, 232 and 234, causing pressure to build up in these chambers and move rod 224 downwardly against the resistance of spring 251, the valve sleeve 236 also moving downwardly due to pressure of spring 243 with rod 224 until land 250 sufficiently laps port 240. Due to the low viscosity of the fluid and the necessity of maintaining free action of moving parts, and particularly the bellows-controlled valve rod 247, there is a leakage of fluid between the valve sleeve 236 and bearing 237 and between the valve rod 247 and said sleeve. Part of this leakage or drain fluid escapes by way of ports 241, 241' and out through pipe 255, and part by way of chamber 242 and out through pipe 256 and thence to pipe 255. There may also be leakage past the diaphragm connections from servo chambers 230, 232 and 234 into chambers 229, 231 and 233, and hence these latter chambers are connected by way of exhaust ports 257 and pipe 257' with drain or exhaust pipe 255.

Pipe 255 may be connected to the fuel discharge nozzle, in which event the leakage fluid would be maintained at a pressure of say five pounds and this pressure would be additive with respect to the pressure generated by spring 251; or as here shown said pipe may lead back to the fuel tank, in which event the leakage fluid would be at substantially zero gage pressure. In practice, the leakage has been conducted to the fuel discharge line with satisfactory results, although there may be some objection to the slight variation in the regulated fuel feed occasioned by the additional fuel. If so, the line 255 may be connected to the supply tank or any other point where the pressure is of proper value with respect to the supply pressure.

Should there be an increase in density, as where a plane moves from a high to a lower altitude, the bellows 244 will contract, thereby retracting valve rod 247. As land 250 moves above port 240, pressure fluid from chambers 230, 232 and 234 can escape through drain port 241 and pipe 255 until the spring 251 has moved the rod 224 and sleeve 236 upwardly until land 250 again laps port 240. The sleeve 236 is thus made to follow the movements of the aneroid and its stem 247.

When the engine is in operation, air is drawn into the air scoop and thence through the boost venturi 208 and the main venturi 202, and a differential pressure is created between the throat of the boost venturi and the air inlet, which at

constant entering air density, is proportional to the square of the quantity of air flowing. These respective pressures are transmitted to chambers A and B of the regulator unit (note Figure 1) and create a net force on the air diaphragm tending to open the fuel valve 42. When the valve opens, fuel under pressure flows into the unmetered fuel chamber and thence to the fuel control body or unit, where it flows through any one or more of the respective metering orifices, depending upon the position of the manual control valve, and thence through the discharge nozzle 85 from which it is discharged under nozzle pressure to the air stream flowing to the engine. The differential between metered and unmetered fuel, the "fuel metering force," opposes the air metering force and acts in a direction to close the fuel valve, the latter being thus caused to adjust itself to a point of equilibrium such that the differential pressure across the fuel metering orifices is equal to the differential between the air inlet and the venturi, whereby constant fuel/air proportioning is maintained. As engine speed is decreased, the rate of air flow through the venturi is decreased, thereby decreasing the differential pressure acting on the air diaphragm, causing the fuel valve to move towards closed position and thus decrease the fuel flow to compensate for decreased rate of air flow. Thus the air metering force controls the fuel metering force.

As heretofore noted, to obtain proper altitude compensation, the area of the main venturi should vary inversely as the square root of the density; and the bellows 244 which controls the servo motor 225 is loaded and calibrated to move the Venturi sections in this ratio. In regard to the connecting linkage or motion-transmitting mechanism between the servo and Venturi sections, here again the design should be in accord with the above formula. Thus should the density decrease, as by a gain in altitude, the bellows 244 will tend to elongate, thereby moving the rod 224 downwardly which in turn acts through the linkage 220, 219, 218 and 217 to rotate the gear wheels 216 in a direction such as to cause the sections 203 of the venturi to move apart and increase the area of the venturi sufficiently to maintain the metering suction substantially constant irrespective of the decrease in density. In the position shown in Figure 2, the toggle linkage 218 is in the position it will assume when the Venturi sections are in their minimum throat area or high density position. Such density need not necessarily be that obtaining at ground level, since the density may be higher due to ramming and temperature effects. When the linkage moves downwardly, it will cause the arms 217' to move inwardly, thereby rotating gear 215 in a counterclockwise direction and gear 216 in a clockwise direction, imparting an opening movement to the Venturi sections. Thus for a given mass air flow, the differential pressure in chambers A and B will remain constant, and automatic altitude compensation is obtained.

The servomotor of Figure 5 is particularly adapted for pressure-feed carburetor service in that it is capable of functioning with the carburetor as a self-contained unit. However, other power devices could be utilized. For example, it may be desired to use an electric circuit incorporating suitable resistances and relays capable of transmitting a gradual opening and closing movement to the Venturi sections in relation to the travel of the bellows 244. Also, it will be obvious that the mechanism for actuating the

Venturi sections may be modified, as for example, by using the toggle linkage of the plural stage type of carburetor first described.

Although the invention has been described in connection with a carburetor wherein the fuel is delivered into the induction passage leading to the engine, it will be obvious that it is equally applicable for use in systems wherein the fuel is introduced directly into the engine cylinders or into the manifold adjacent the intake valves of the engine, or into the induction passage at any desired point, either anterior or posterior to the throttle.

It will be understood that the foregoing and other changes in construction and arrangement of the parts of the carburetor as well as in the controls therefor may be adopted without departing from the spirit and scope of the invention as defined by the appended claims.

I claim:

1. In a pressure-feed carburetor having a throttle-controlled air-inlet provided with a main venturi and a boost venturi coacting therewith, said main venturi being comprised of movable sections adapted to be opened and closed to vary the air-intake area of the venturi, a discharge nozzle adapted to open under predetermined pressure and discharge fuel into the air stream posterior the throttle, a fuel-supply passage having a metering restriction therein and receiving fuel under pressure at its intake end and terminating at the said nozzle, a fuel valve controlling the flow of fuel through said passage, means regulating said fuel valve including an air diaphragm having on one side thereof a pressure chamber to which a measure of impact pressure is communicated from the air intake and a depression chamber on the opposite side thereof subjected to metering suction from the boost venturi, there being a mixture-control bleed between said chambers which determines the differential pressure on said diaphragm for a given mass air flow, a fuel diaphragm opposing the air diaphragm and subjected on one side thereof to metered fuel pressure and on the other side thereof to unmetered fuel pressure; a hydraulic servomotor operatively connected to said movable sections for imparting opening and closing movement thereto, a servo valve controlling flow of hydraulic fluid to said servomotor, and means responsive to changes in density of the atmospheric air for controlling said servo valve.

2. In a pressure-feed carburetor having an air-intake passage provided with a main venturi made up of movable sections and a fixed boost venturi coacting with the main venturi, a fuel flow passage provided with a fuel valve for admitting unmetered fuel to said flow passage, metering means in said fuel flow passage, means for conducting fuel under pressure to said fuel valve, means for controlling said fuel valve including an air diaphragm subjected to the differential between impact pressure at the air inlet and boost Venturi suction and a fuel diaphragm subjected to the differential between metered and unmetered fuel flowing through said fuel flow passage, a servomotor operatively connected to said Venturi sections for actuating the latter to vary the area of the venturi as a function of air density, said servomotor being powered by fuel under pressure, a valve controlling the admission of fuel to said servomotor, and means responsive to changes in density of the atmospheric air for controlling said latter valve.

3. A pressure-feed carburetor having an air-

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intake passage provided with a main venturi made up of movable sections and a fixed boost venturi coacting with the main venturi, a fuel flow passage having a metering restriction therein, means for supplying fuel under pressure to said passage, a fuel valve controlling the admission of fuel to said passage to thereby regulate the metering head, means for regulating said valve including an air diaphragm subjected to the differential between air-intake pressure and Venturi suction and a fuel diaphragm subjected to the differential between metered and unmetered fuel, a pair of rotatable shafts mounting said Venturi sections, power means operatively connected to said shafts including an hydraulic servomotor having a pressure connection with the fuel passage anterior said valve, a servo valve for regulating the flow of fuel to said servomotor, and means responsive to changes in density of the ambient air for controlling said latter valve.

FRANK C. MOCK.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,269,294	Udale	Jan. 6, 1942
2,303,640	Hogg	Dec. 1, 1942
2,361,227	Mock	Oct. 24, 1944
2,361,993	Chandler	Nov. 7, 1944

FOREIGN PATENTS

Number	Country	Date
363,339	Great Britain	June 13, 1930
493,174	France	Aug. 1, 1919

OTHER REFERENCES

Mennesson (APC Application), 328,115, July 13, 1943.