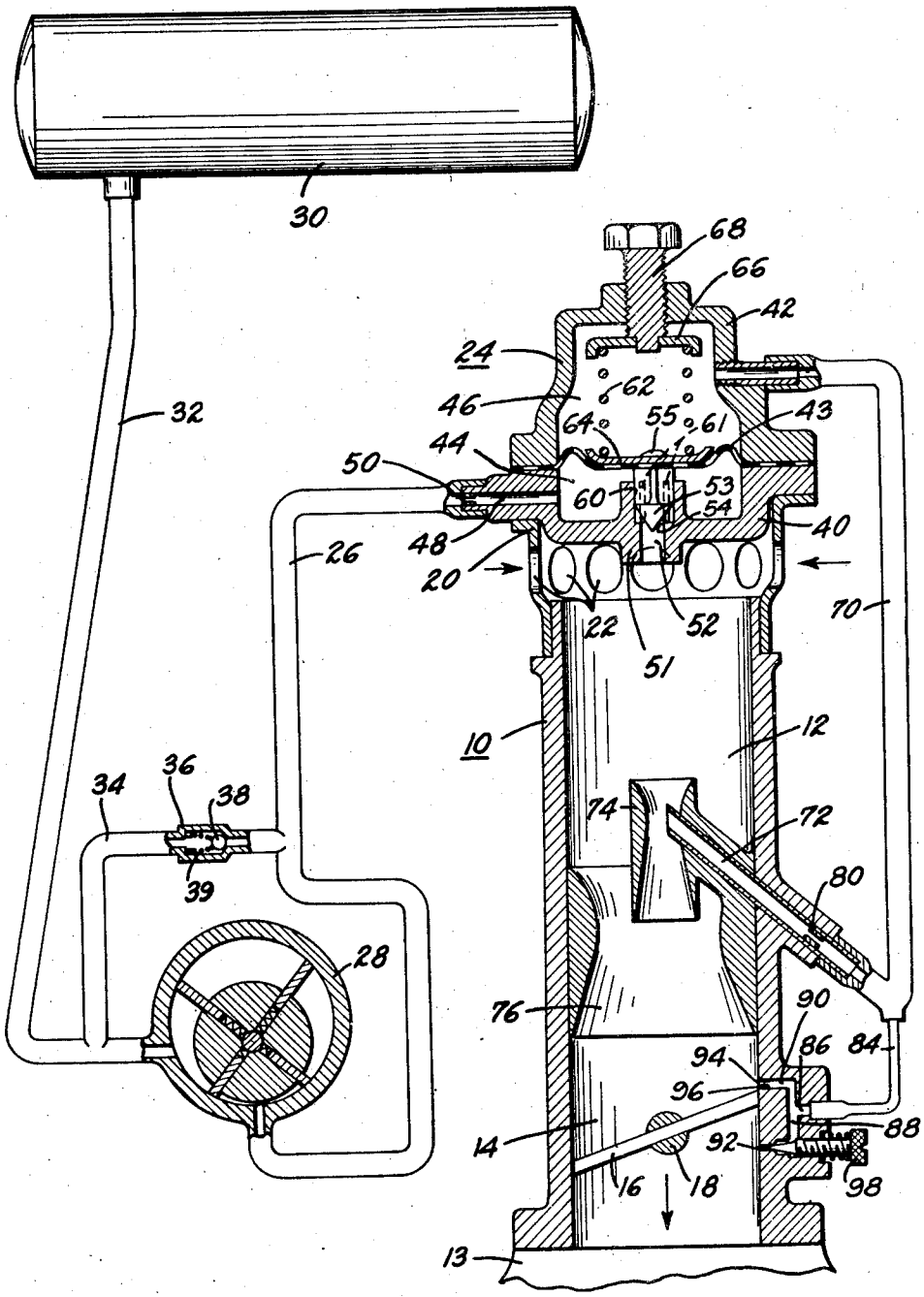
Aug. 24, 1948. F. BARFOD 2,447,791

CARBURETOR

Filed Aug. 25, 1943



INVENTOR

BY FREDERIK BARFOD

J. L. Baisch

Patented Aug. 24, 1948

2,447,791

UNITED STATES PATENT OFFICE

2,447,791

CARBURETOR

Frederik Barfod, South Bend, Ind., assignor to Bendix Aviation Corporation, South Bend, Ind., a corporation of Delaware

Application August 25, 1943, Serial No. 499,987

3 Claims. (Cl. 261—69)

1

This invention relates to fuel feeding systems for internal combustion engines and more particularly to devices or systems in which liquid fuel is supplied thereto under super-atmospheric pressure.

One of the principal objects of the invention is to provide a simplified device of this character which may be built at reasonable cost and which is capable of accurately regulating the fuel supply to maintain a proper fuel to air ratio through wide ranges of engine load and speed.

Another object of the invention is to eliminate boiling of the fuel under high temperature or altitude conditions, such as are experienced with an aircraft engine, to thereby insure accurate metering. This is accomplished by maintaining the fuel under positive pressure until it is discharged into the air supply to form a combustible mixture for the engine.

Still another object of the invention is to finely atomize the fuel discharged into the air stream to produce an improved mixture capable of being readily ignited even though the engine is cold.

A further object of the invention is to provide a device of this character adapted to improve the fuel distribution in the air stream. This is effected by directing the air entering the induction passage radially toward the discharge end of the fuel nozzle from a plurality of sides thereof.

It is a further object of the invention to provide a fuel feeding device or system which will operate properly in any position so that when installed on an aircraft engine the latter will be properly supplied with fuel regardless of the position of flight.

A still further object of the invention is to provide a device or system of this character wherein the fuel is supplied to the nozzle at a substantially constant superatmospheric pressure, and the metering of the fuel is controlled by said fuel pressure, a counterbalancing pressure and by suction resulting from operation of the engine.

A further object of the invention is to provide a device of this character wherein a fluid control valve is urged in opposite directions by normally substantially balanced pressure exerting means of substantially constant pressures and the opening of said valve is controlled by variable fluid pressure means adapted to vary the pressure of one of said balanced pressure means.

Another object of the invention is to provide a device of this character wherein the variable pressure controlling the fuel valve is derived from induction passage suction which may be anterior to the throttle valve.

Still another object of the invention is to provide a device of this character wherein there is a suction connection to a venturi and an idling connection may be included in the system which may include a port or ports adjacent the edge of the valve when closed, said ports, if desired, being on opposite sides of the closed throttle valve.

2

Other objects and advantages of the invention will be readily apparent to one skilled in the art from the following description taken in connection with the accompanying drawing, which represents a preferred embodiment. After considering this embodiment skilled persons will understand that many variations may be made without departing from the principles disclosed; and I contemplate the employment of any structures, arrangements, or modes of operation that are properly within the scope of the appended claims.

The drawing diagrammatically illustrates a fuel feeding system embodying the present invention, parts of said system being in section.

Referring more particularly to the drawing there is shown a downdraft carburetor indicated generally at 10 and including an induction passage 12 attached to the intake manifold 13 of an internal combustion engine (not shown), said induction passage having a mixture outlet 14 controlled by a throttle valve 16 of well known character mounted on a throttle shaft 18. Attached to the upper end of the induction passage 12 is a riser member 20 having a plurality of circumferentially spaced air inlet openings 22. Secured to the upper end of the riser member is a fuel nozzle unit indicated generally at 24 having a fuel connection 26 with a fuel pump 28 which may be of any commercial type adapted to deliver fuel at substantially a constant pressure, said fuel pump being driven by any suitable means, such as the engine equipped with the present invention, and said pump is connected with a fuel tank 30 by means of a fuel conduit 32. Although any type of constant pressure pump may be used, the one shown is of the sliding vane type utilizing a bypass 34 from the outlet or discharge side of the pump to the inlet side for bypassing fuel from said outlet side of the pump to the inlet side to maintain a constant outlet pressure. This is effected by a valve 36 having a movable valve member 38 urged to the closed position by a spring 39, the tension of said spring 39 being predetermined and so calibrated that when the discharge pressure of the pump rises above said predetermined value the valve will open to permit passage of fuel from the outlet side of the pump to the inlet side thereby pre-

venting the pressure at said outlet side from rising above the desired value.

The nozzle unit 24 comprises a pair of hollow casing members 40 and 42 which are secured together by any suitable means such as bolts, not shown. A flexible diaphragm 43 is marginally secured between the casing members and separates the hollow interior of the nozzle unit into a fuel chamber 44 and an air or suction chamber 46. The fuel conduit 26 is connected with the fuel chamber 44 by a passage 48 having a calibrated metering jet means illustrated diagrammatically by the restriction or jet 50. Although but a single restriction 50 is shown for illustrative purposes, it will be understood that a varable orifice or a plurality of orifices may be used whereby the total effective area of the metering jet means may be varied to provide a lean or rich mixture or power enrichment, an increase in the area resulting in an increase in richness as will be apparent hereinafter.

Fuel is discharged from chamber 44 through a nozzle 51 having a discharge passage 52 substantially axially arranged with respect to the induction passage 12 and the discharge end of said passage 52 is in substantially the same plane as that of the air inlets 22 so that the fuel discharged is broken up or atomized by the streams of entering air from a plurality of sides. Discharge of fuel from passage 52 is controlled by a valve comprising a movable valve member 53 cooperating with a valve seat 54. The valve member 53 is secured to the diaphragm 43 by any suitable means such as riveting at 55 and said valve member 53 is slidable within a valve guide 60. The valve member 53 is of the flat-sided type or otherwise arranged to permit passage of fuel therepast; however, if desired, the guide 60 may be provided with a plurality of slots 61 extending longitudinally relative to the valve and spaced circumferentially about the same to permit the passage of fuel through the guide 60 and into the fuel discharge passage 52 when the valve 53 is off its seat.

Within the chamber 46 is a spring 62 which reacts between a spring cup 64 secured to the diaphragm by the riveted portion 55 and a spring cup 66 secured to a screw 68 threadably received in a wall of the casing member 42 whereby the cup 66 may be manually adjusted to vary the tension or pressure of spring 62 on the diaphragm 43. The chamber 46 has a priming connection with the induction passage 12 which comprises a conduit 70, with a tube 72 having a calibrated restriction 80 therein, said tube 72 being connected with the interior of a small venturi 74 disposed within the induction passage 12, the downstream end of the small venturi 74 being disposed within the restricted portion of a large venturi 76. It is to be noted that the venturis are disposed beneath the fuel discharge nozzle 51 and in the line of discharge thereof so that fuel sprayed from said nozzle 51 is uniformly directed toward said venturis. If desired, there may be included in the system means for providing a supply of idling fuel for the engine including at least one connection from the chamber 46 to the induction passage at a point adjacent the throttle valve when closed. This connection preferably includes a passage 86 having branches 88 and 90 terminating in ports 92 and 94 respectively on opposite sides of the leading edge of the throttle valve 16 when closed. The passage 86 may be connected by a conduit 84 with the conduit 70 between the calibrated restriction 80 and the chamber 46; and if desired there may be a restriction 96 of fixed size in the branch passage 94 and an adjustable needle valve 98 for the branch passage 92.

Operation

Fuel is supplied to the fuel conduit 26, leading to the chamber 44 of the nozzle unit 24, under substantially constant superatmospheric pressure and the tension or pressure of spring 62 on the diaphragm 43 is adjusted by means of the screw 68 so that said spring tension or force urging the valve toward closed position is substantially equal in value to the force created by fuel at pump pressure in chamber 44 on the opposite side of said diaphragm urging the valve toward open position; and it is to be understood that the effective pressures of the spring and the fuel on the diaphragm normally counterbalance each other when the air pressure in chamber 46 is atmospheric, at which time the fuel valve 53 is maintained closed.

During operation, the air flow through the induction passage will create a suction in venturi 74 which will vary in accordance with the quantity of air being supplied to the engine. This suction is transmitted through passage 70 to chamber 46 and opens valve 53 until the rate of fuel flow is such that the pressure of the fuel in chamber 44 is reduced, by virtue of the metering jet means 50, an amount equal to the decrease in pressure in chamber 46. The differential in the fuel pressures on opposite sides of the metering jet 50 thus varies directly in accordance with the suction in chamber 46, and consequently the quantity of fuel supplied to the engine will be controlled in constant proportion to the quantity of air, unless the suction in chamber 46 is further modified by means such as the idle ports 92, 94 whose function will now be described.

During idling, it is of course desirable to provide a somewhat enriched mixture. This is accomplished by the ports 92 and 94 which, due to the high suction prevailing posterior to the throttle during idling, tend to increase the suction in passage 70 above that which would normally exist due to the flow of air through the venturi 74. The ports 92 and 94 thus increase the suction in chamber 46 and therefore increase the quantity of fuel being supplied at idling, to thereby enrich the mixture.

By the use of idling suction ports positioned on opposite sides of the throttle when closed, and by properly proportioning their relative sizes and the size of restriction 80, any desired enrichment characteristic may be obtained at idling and through the near-idling range. It will be readily apparent that instead of two idling ports, three or more ports, or a slot of constant or varying width extending longitudinally of the induction passage and adjacent the leading edge of the throttle when in idling position, could be used.

It will be understood that the effective area of the fuel metering jet system determines the quantity of fuel which will be supplied to the engine for any given suction in chamber 46. As a consequence, by increasing or decreasing the effective area of the metering jet system the richness of the mixture will be correspondingly increased or decreased. Various types of metering jet system may therefore be used with the device of the instant invention to automatically vary the richness of the mixture to produce a rich mixture during high power operation, or a lean mixture during light load operation, or to otherwise vary the

richness of the mixture under particular conditions of operation of the engine.

It will be apparent from the foregoing that a very simple inexpensive pressure type carburetor has been provided utilizing but a single diaphragm and valve but capable of accurate fuel-to-air proportioning. It is thought that the invention and many of its other attendant advantages will be understood from the foregoing description and though said invention has been illustrated in connection with but one modification thereof it will be apparent that various changes may be made in the form, construction and arrangement of the parts without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the form hereinbefore described being merely a preferred embodiment.

I claim:

1. In a fuel supply system for an internal combustion engine: a downdraft induction passage having a plurality of circumferentially arranged air inlets in the upper end thereof; a throttle valve adjacent the opposite end of said induction passage; a plurality of venturis anterior to the throttle valve; a nozzle unit disposed adjacent the upper end of the induction passage and having a chamber therein; a diaphragm separating the chamber into a fuel compartment and an air compartment; a discharge nozzle connected with the fuel compartments so positioned that fuel discharged therefrom receives the impact of the air entering the induction passage from the air inlets; a fuel control valve connected with the diaphragm and controlling the discharge passage of the nozzle anterior to the discharge end thereof, said discharge end being unobstructed posterior to the valve; an engine driven means for supplying fuel at substantially a constant pressure; a conduit connecting said means with the fuel chamber; a metering jet system in said conduit anterior to the fuel chamber, the diaphragm being urged in a direction tending to open the fuel valve by pressure of fuel in said fuel chamber; a spring disposed in the air chamber and urging the diaphragm in a direction tending to close the fuel valve with a force substantially equal to the full pressure of said means; means for manually adjusting the tension of the spring; means including a conduit for connecting the air chamber with the small venturi; a restriction in the last mentioned conduit; means for connecting said air chamber with the induction pasage adjacent to and on opposite sides of the leading edge of the throttle valve; a restriction of fixed size in the connection adjacent to and anterior to the throttle valve; and an adjustable restriction in the connection posterior to the throttle valve.

2. In a fuel supply system for an internal combustion engine, a charge forming device having an induction passage provided with a plurality of annularly spaced air inlets, a fuel discharge nozzle having its discharge end located in substantially the same plane as the air inlets, a fuel metering device anterior to said nozzle, engine driven means for supplying fuel to the metering device at substantially a constant super-atmospheric pressure, a valve controlling the discharge of fuel from said nozzle, a pressure-responsive element connected to said valve and urged in a valve-opening direction by the pressure of fuel posterior to the metering device, said nozzle being open at all times beyond the valve, a spring operatively associated with said pressure-responsive means and urging the valve toward closed position with a force substantially equal to that of the full pressure of said engine-driven means, and means for exerting suction on said pressure-responsive means to vary the force of the yielding means, the suction being derived from a pressure varying with variations in the flow of air to the engine.

3. In a fuel supply system for an internal combustion engine having an air induction passage and a fuel conduit for supplying fuel under pressure to said passage, a metering restriction in said conduit, means for maintaining the fuel in said conduit anterior to said restriction at a substantially constant pressure, a chamber for metered fuel in said conduit posterior to said restriction, said conduit terminating in a fuel discharge nozzle connecting said chamber with the induction passage, a plurality of air inlets in the induction passage adapted to direct air into the passage in converging streams adjacent the point of discharge of said nozzle, a valve controlling said nozzle, a diaphragm connected to said valve and forming a movable wall of said chamber, the pressure of fuel on said diaphragm posterior to said restriction tending to open said valve, a spring tending to close said valve with a pressure substantially equal to the fuel pressure to be maintained in said fuel conduit anterior to said restriction, and means for modifying the action of said spring by a pressure decreasing with an increase in air flow to the engine.

FREDERIK BARFOD.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
705,314	Blake	July 22, 1902
715,574	Haarman	Dec. 9, 1902
1,208,196	Pembroke	Dec. 12, 1916
1,228,157	Wyand	May 29, 1917
2,283,021	Udale	May 12, 1942
2,316,300	Udale	Apr. 13, 1943
2,316,327	Garretson	Apr. 13, 1943
2,323,984	Ericson	July 13, 1943

FOREIGN PATENTS

Number	Country	Date
536,861	France	May 11, 1922
846,774	France	Sept. 26, 1939