Jan. 19, 1932. J. MacK. MILLER 1,841,663

AIRCRAFT CARBURETOR AND FUEL SUPPLY SYSTEM

Filed May 23, 1929

Fig. 1.

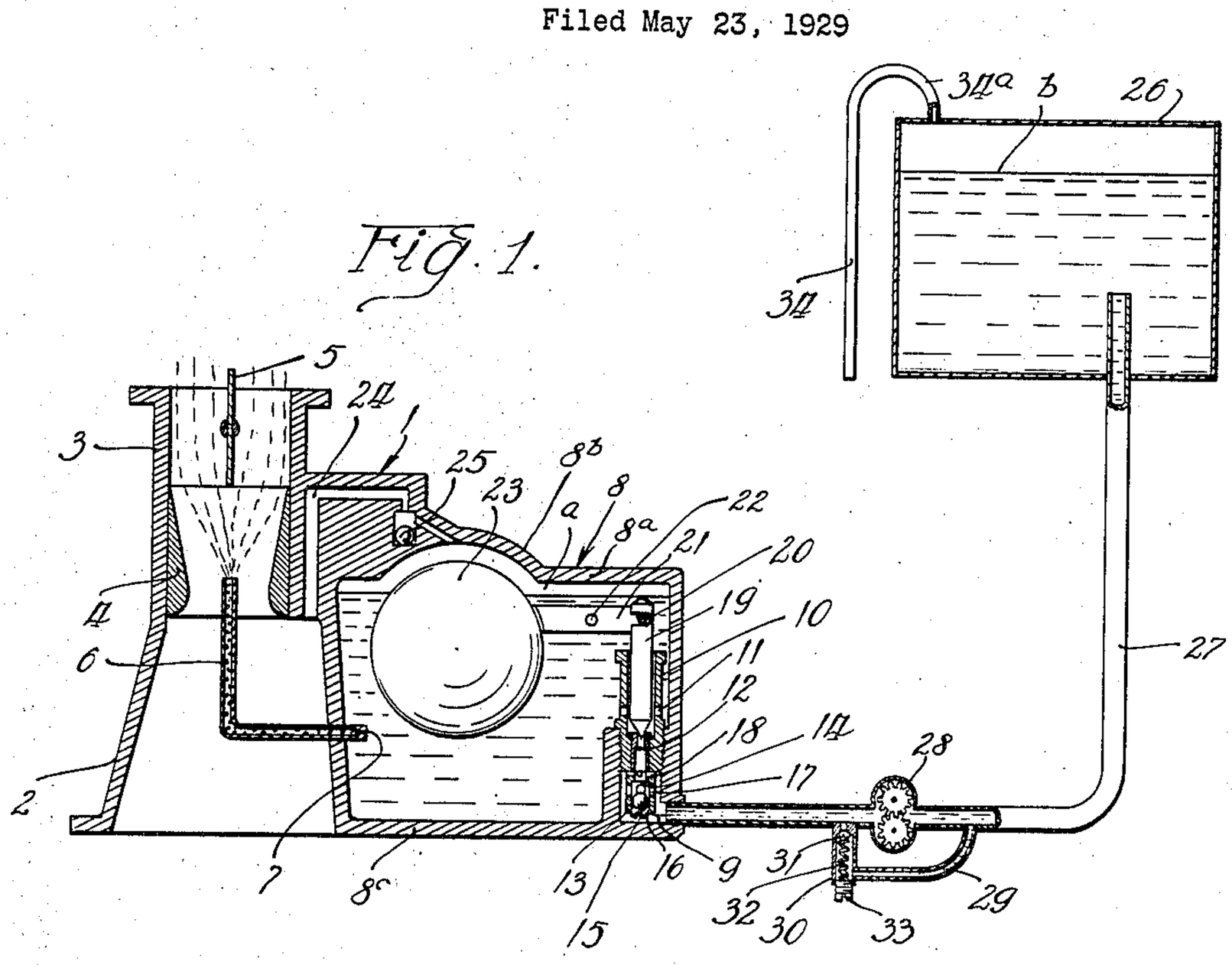


Fig. 2.

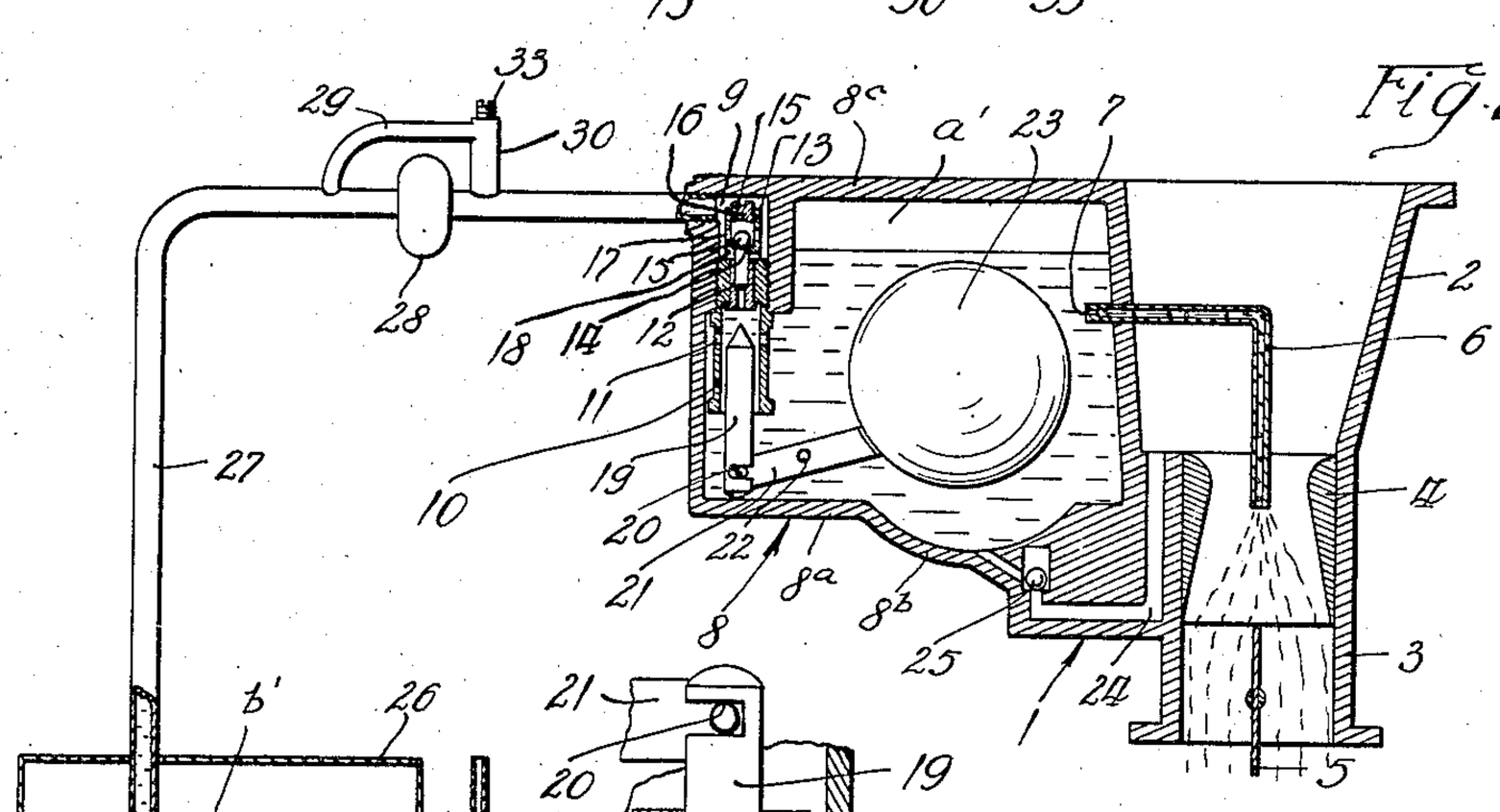
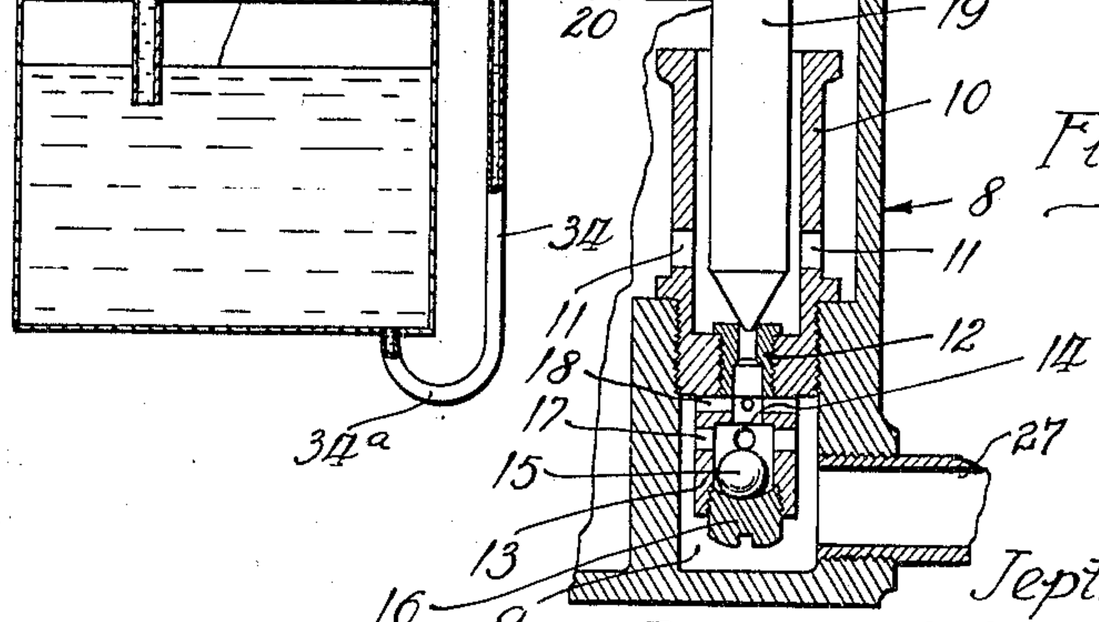


Fig. 3.



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UNITED STATES PATENT OFFICE

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AIRCRAFT CARBURETOR AND FUEL SUPPLY SYSTEM

Application filed May 23, 1929. Serial No. 365,308.

This invention relates to means for supplying fuel to aircraft engines, and more particularly to a fuel supply system and a carburetor adapted for use in such system whereby an adequate and proper supply of fuel is assured at all times, both when the aircraft is flying in an upside down position and when it is flying in an upright position.

Carburetors are in use in which provision is made for cutting off the supply of fuel to the float chamber when an aeroplane carrying such carburetor is in upside down position and the carburetor is, therefore, in inverted position, the float chamber being so designed and of such capacity as to supply fuel to the engine for an appreciable length of time when the carburetor is inverted. In such a carburetor, the capacity of the float chamber is necessarily limited and the period of time during which the aeroplane can remain in an upside down position is correspondingly limited.

While carburetors of the type referred to have proved to be highly satisfactory in many respects and during ordinary maneuvering, conditions may be encountered where it is desirable or even essential that the aeroplane remain in upside down position for a much longer period of time than is possible in using carburetors in which the supply of fuel to the float chamber is cut off when the carburetor is inverted.

One of the main objects of my invention is to provide a carburetor having means whereby the supply of fuel to the float chamber is uninterrupted, and is at a proper rate to assure satisfactory operation of the engine, when the carburetor is inverted. Another object is to provide means whereby supply of fuel to the carburetor in proper quantity to assure continuous and satisfactory operation of the engine, both when the aircraft is in inverted position and upright position, is provided for. A further object is to provide a fuel supply system, in conjunction with the carburetor, in which the rate of supply of fuel to the float chamber may be greater when the carburetor is in upright position than when it is in inverted position, so as to assure adequate supply of fuel to the engine during positive acceleration thereof when the aircraft is in upright position. Further objects and advantages of my invention will appear from the detailed description:

In the drawings:

Figure 1 is a diagrammatic view of a fuel supply system in accordance with my invention, the carburetor being shown in section and semi-diagrammatically, the carburetor being in upright position;

Figure 2 is a view similar to Figure 1 but with the carburetor in inverted position;

Figure 3 is a detail, on an enlarged scale and in section of the valve cage and associated parts in upright position.

In the copending application of Leonard F. Hobbs for aircraft carburetor and fuel supply system, Serial No. 347,808, filed March 18, 1929, there is disclosed a system and carburetor in which the carburetor is provided with an inlet duct which comprises a restriction of proper area to provide supply of fuel at proper rate for operation of the engine of an aeroplane flying in upside down position. The system includes means for supplying fuel to the duct under constant pressure at such time. While the system and the carburetor of the Hobbs application above identified has proved to be highly satisfactory, in the main, it is open to one objection. When an aeroplane is flying in upright position and dives, the engine tends to speed up considerably, and if the fuel restriction referred to is made of the right size for upside down flight, it is too small to feed to the carburetor enough gasoline at the increased engine speed which obtains during a dive.

In order that a fuel supply system and carburetor of the character above set forth may operate satisfactorily under all conditions, provision must be made for supplying fuel to the carburetor at one predetermined rate when the aircraft is flying in upside down position and at an increased rate when the aircraft is flying in upright position.

It is the primary object of my invention to avoid the objection above referred to and to provide simple and efficient means whereby the rate of supply of fuel to the carburetor is such, when the aircraft is in upside down po-

sition, as to assure proper supply of fuel to the engine at such time and, when the aircraft is in upright position, the rate of supply of fuel to the carburetor is increased sufficiently to assure proper supply of fuel to the engine during positive acceleration thereof such as occurs during a dive. In its broader aspects, my invention comprehends any suitable means whereby this difference in the rate of supply of fuel to the carburetor at the times stated can be accomplished, it being understood that the particular means illustrated and herein described is by way of example only and is subject to variation.

The carburetor is designated, in its entirety, by the reference character 1, and is shown semi-diagrammatically. This carburetor comprises a downwardly opening air horn or bell 2 from the upper end of which extends a stack 3 in which is mounted a venturi 4.

A throttle valve 5 is mounted in the upper end of the stack above the venturi, and is operated in a known manner. A main fuel nozzle 6 extends upwardly into venturi 4 and communicates, by a restricted metering opening or port 7, with float chamber 8.

This float chamber comprises a fuel inlet passage 9 into the upper end of which is screwed a sleeve 10 having radial ports 11 which open into the chamber 8. A bushing 12 is secured in sleeve 10 and opens, at its lower end, into a valve cage 13 which depends from the sleeve into passage 9, this cage being formed integrally with the sleeve as a reduced element thereof. The valve cage 13 comprises a valve seat 14 adjacent the upper end thereof with which coacts a ball valve 15 loosely mounted in the cage, the lower end of which is closed by a screw plug 16. The cage is provided with a series of ports 17 disposed below the valve seat 14 and a second series of ports 18 disposed above the valve seat. These ports open into the fuel inlet passage 9 and establish communication between the same and the bore of the cage above and below the valve seat. The bore of the valve cage communicates with the bore of bushing 12 and constitutes, therewith, a fuel supply duct which communicates with the fuel inlet passage 9, the inner end of the bushing defining a fuel inlet orifice through which fuel is admitted to sleeve 10 and thence, through openings 11, into chamber 8.

When the carburetor is in upright position, as in Figure 1, the ball valve 15 is in the lower end of its cage so that the ports 17 and 18 are all effective to supply fuel to the fuel receiving chamber 8. The combined areas of the ports 17 and 18 are such as to assure adequate supply of fuel at all times when the aircraft is flying in upright position, and particularly during positive acceleration of the engine such as occurs during a dive.

As will be noted more clearly from Figure 3, referring also to Figure 2, when the carburetor is inverted, valve 15 rests upon seat 14 thus closing the bore of the valve cage between the two series of ports 17 and 18, rendering the ports 17 ineffective. The ports 18 are preferably somewhat smaller than the ports 17, as illustrated, the total of the combined areas of the ports 18 being sufficient to supply fuel to the chamber 8 at a proper rate to assure efficient operation of the engine when flying in upside down position. I thus assure supply of fuel to the fuel receiving chamber of the carburetor at proper rate to assure efficient operation of the engine at all times, both when the aircraft is flying in upside down position and when it is flying in upright position and in a dive.

The fuel inlet orifice defined by the upper end of bushing 12 is controlled by a needle valve 19 which is slidably mounted in sleeve 10. This valve is connected, at is upper end, by a pin and slot connection 20 to the outer end of a float arm or lever 21 pivoted at 22 for rocking movement.

A float 23 is suitably secured to the other end of arm 21 and serves, when the carburetor is in upright position as in Figure 1, to actuate valve 19 so as to regulate the effective size of the fuel inlet orifice in accordance with the fuel level in float chamber 8.

An air vent passage 24 establishes communication between float chamber 8, at the top thereof, and the main air passage of the carburetor, when the carburetor is in upright position. When the carburetor is in inverted position, this air passage is closed by a ball valve 25, as in Figure 2, to prevent flow of fuel from the float chamber through passage 24.

A main fuel supply tank 26 is disposed so as to be above the carburetor when it is in upright position, as in Figure 1. A fuel pipe or conduit 27 extends through the bottom wall of this tank and upwardly into the same for an appreciable distance, the intake of this conduit constituting the outlet of the tank and being so disposed as to be submerged in both positions of the carburetor, that is, both when the carburetor is upright as in Figure 1 and when it is inverted as in Figure 2. The outlet end of this tube or conduit 27 is suitably secured in the fuel supply or inlet passage 9. With the carburetor in upright position, fuel from tank 26 can flow by gravity through the conduit 27 and into the float chamber 8 to replenish the fuel supply therein.

The normal fuel level, when the carburetor is in upright position, is at *b*, Figure 1. It will be noted that top wall 8*a* of the float chamber 8 is provided with an upwardly extending rounded portion 8*b* into which the upper portion of float 23 normally extends.

The air space *a* in the chamber 8 is quite small relative to the body of fuel in this chamber. It will also be noted that the restricted metering opening or port 7 is disposed at about the central portion of the float chamber and the space between the float 23 and the bottom wall 8*c* of chamber 8 is much greater than the space between the float and the top wall of this chamber, when the carburetor is in upright position. With the carburetor in this position, the float operates to actuate valve 19 so as to regulate the effective size of the inlet orifice in accordance with the fuel level in the float chamber, as is known in the art.

When the carburetor is in inverted position, as in Figure 2, the tank 26 is disposed below the carburetor and, in order to assure a proper supply of fuel to float chamber 8, it is necessary to provide means for withdrawing fuel from tank 26 and supplying it to the float chamber. Various means may be provided for this purpose. I have shown, by way of example, a gear pump 28 of known type disposed in conduit 27. This pump may be driven from the engine of the air-craft in any suitable manner, and acts to withdraw fuel from tank 26 and to force it through conduit 27, beyound the pump, into the fuel inlet passage 9 of the carburetor.

A by-pass tube 29 opens into conduit 27 in advance of pump 28. At its other end, this tube communicates with a valve casing 30 in which is mounted a spring pressed valve 31 which controls communication between conduit 27 and valve casing 30, at the other side of pump 28. A spring 32, which normally holds the valve 31 seated, is adjusted by a screw 33 threading into the outer end of valve casing 30. The valve 31 opens outwardly from conduit 27 and the valve casing 30 and tube 29 constitute a by-pass to permit reverse flow of the fuel around the pump 28. I find the pump 28 a satisfactory means of supplying fuel to passage 9, as this provides continuous pressure on the fuel and, by properly adjusting the spring of valve 31, the pressure to which the fuel in passage 9 is subjected can be of any desired value, within limits.

When the carburetor is in inverted position, as when the aircraft is flying upside down, the air space *a'* is between the body of fuel in chamber 8 and wall 8*c* of this chamber. The float 23 rises in the chamber 8 so as to be moved toward the wall 8*c* thereof, thus moving the valve 19 into full open position, the opening movement of this valve being limited by contact thereof with top wall 8*a* of chamber 8, as in Figure 2. It will thus be seen that, in my carburetor, the fuel inlet orifice is completely open when the carburetor is in inverted position so as to permit supply of fuel to the float chamber.

In practice, the ports 18 are of such size, and the spring 32 of valve 31 is so adjusted, that the pressure in the float chamber, with the carburetor in inverted position, is substantially atmospheric pressure and a slightly rich mixture is supplied to the engine. The rate of supply of fuel to the float chamber is adjusted so as to equal the rate at which the fuel is withdrawn from this chamber through the fuel nozzle 6. This renders it possible for the carburetor to supply to the engine a proper fuel mixture to assure satisfactory operation thereof, when in upside down position, for an indefinite period of time. This adjustment of the fuel supply is, of course, for a given altitude and, preferably, for full engine speed at open throttle. By varying the adjustment so as to vary the feed of fuel to chamber 8, the altitude and speed at which the engine would operate satisfactorily can be varied. Any given adjustment of the fuel feed, however, is intended for use at but one altitude and one engine speed. As stated, the adjustment is preferably such as to permit of the engine being operated satisfactorily at high speed at a given altitude.

When the aircraft is in upright position, the ports 17 become effective and the rate of supply of fuel from passage 9 to the inlet orifice controlled by valve 19 is greatly increased over the rate of supply of fuel to this orifice when the carburetor is inverted. With the carburetor in upright position, when the aeroplane dives, positive acceleration of the engine speed occurs so that the fuel is withdrawn from chamber 8 much more rapidly than under normal conditions.

When this occurs, the valve 19 is opened by float 23 and fuel is supplied through the inlet orifice to replenish the fuel in chamber 8, this replenishing of the fuel in the fuel receiving chamber in such manner as to assure an adequate supply for the engine at such time being rendered possible by the increased rate of supply of fuel to the inlet orifice due to the ports 17 being effective when the carburetor is in upright position. I thus assure highly efficient operation of the engine at all times both when the aeroplane is flying in inverted position and in upright position.

In order that fuel may be withdrawn from tank 26, it is necessary to provide this tank with a suitable vent. For this purpose I provide a vent tube 34 which opens through the top wall of the tank and extends downwardly along the same with its lower end in the plane of the bottom wall of the tank when the carburetor is in upright position, as in Figure 1, the upper end portion of this tube being of arcuate or approximately semicircular shape as at 34*a*. The amount of fuel in tank 26 is at all times such that the outlet of the tank is submerged in both positions thereof. In Figure 1 the fuel level is indicated at *b* and in Figure 2 this fuel level is indicated at *b'*.

What I claim is:

1. In a fuel supply system for aircraft, a carburetor comprising a float chamber having a fuel inlet orifice, a valve controlling the orifice, and a float within the chamber and having operating connection with the valve, said float acting to hold the valve in open position when the carburetor is in inverted position, and means for supplying fuel to the orifice at one predetermined rate when the carburetor is in upright position and at a second predetermined rate when the carburetor is in inverted position.

2. In a fuel supply system for aircraft, a carburetor comprising a float chamber having a fuel inlet orifice, a valve controlling the orifice, and a float within the chamber and having operating connection with the valve, said float acting to hold the valve in open position when the carburetor is in inverted position, and means for supplying fuel to the orifice at one predetermined rate when the carburetor is in upright position and at a less rate when the carburetor is in inverted position.

3. In combination in a fuel supply system for aircraft, a carburetor comprising a float chamber having a fuel inlet orifice, float controlled means for regulating the effective size of the orifice when the carburetor is in upright position and for opening said orifice when the carburetor is inverted, and means for supplying fuel to the orifice when the carburetor is in upright position and at a predetermined rate and for decreasing the rate of supply of fuel to the orifice when the carburetor is inverted.

4. In combination in a fuel supply system for aircraft, a carburetor comprising a float chamber having a fuel inlet orifice and a fuel inlet passage, the chamber also having a fuel supply duct communicating with said passage and leading to the orifice, float controlled means for regulating the effective size of the orifice when the carburetor is in upright position and for opening the orifice when the carburetor is inverted, means for supplying fuel to said passage in both positions of the carburetor, and means for reducing the area of communication between the duct and said passage when the carburetor is inverted.

5. In combination in a fuel supply system for aircraft, a carburetor comprising a fuel receiving chamber, means for supplying fuel to the chamber entrance at a predetermined rate when the carburetor is in upright position and at a less rate when the carburetor is inverted, and means for regulating the entry of fuel into the chamber only when the carburetor is in upright position.

6. In an aircraft carburetor, a fuel receiving chamber comprising a fuel inlet passage, a fuel inlet orifice, and a fuel supply duct connecting the passage and the orifice, means for regulating the effective size of the orifice when the carburetor is in upright position and for opening the orifice when the carburetor is inverted, and means for reducing the area of communication between the duct and the passage when the carburetor is inverted.

7. In an aircraft carburetor, a fuel receiving chamber comprising a fuel inlet passage, a fuel inlet orifice, and a fuel supply duct extending from the orifice and having a plurality of fuel inlet ports opening into the passage, said duct being otherwise closed and all of the ports being open when the carburetor is in upright position, means for regulating the effective size of the orifice when the carburetor is in upright position and for opening the orifice when the carburetor is inverted, and means for rendering certain of said ports ineffective when the carburetor is inverted.

8. In an aircraft carburetor, a fuel receiving chamber comprising a fuel inlet passage, a bushing mounted in the upper end of the passage and comprising a fuel inlet orifice, a valve cage, said cage opening into the bushing and comprising a valve seat and fuel inlet ports above and below the seat and opening into said passage, a valve in the cage, said valve being seated when the carburetor is inverted and unseated when the carburetor is in upright position, and means for opening said orifice when the carburetor is inverted.

9. In an air craft carburetor, a fuel receiving chamber comprising a fuel inlet passage, a member secured in the upper end of the passage and having an element depending into the passage and comprising a valve cage provided with a valve seat and with inlet ports disposed above and below the seat, a bushing mounted in said member and opening at its lower end into the upper end of the valve cage, the upper end of the bushing defining a fuel inlet orifice, means for regulating the effective size of the orifice when the carburetor is upright and for opening the orifice when the carburetor is inverted, and a valve in said cage below the valve seat, said valve being seated when the carburetor is inverted and unseated when the carburetor is upright.

10. In an air craft carburetor, a fuel receiving chamber comprising a fuel inlet passage, a member secured in the upper end of the passage and having an element depending into the passage and comprising a valve cage provided with a valve seat and with inlet ports disposed above and below the seat, the ports above the seat being of less effective area than the ports below the seat, a bushing mounted in said member and opening at its lower end into the upper end of the valve cage, the upper end of the bushing defining a fuel inlet orifice, means for regulating the effective size of the orifice when the carburetor is upright and for opening the orifice when the carburetor is inverted, and a valve in said cage below the valve seat, said valve being

seated when the carburetor is inverted and unseated when the carburetor is upright.

11. In an aircraft carburetor, a float chamber comprising a fuel inlet passage, a sleeve secured in the upper end of the passage and comprising a depending valve cage provided adjacent its upper end with a valve seat, said cage having fuel inlet ports above and below the valve seat, a bushing secured in the sleeve and opening at its lower end into the upper end of the valve cage, the upper end of the bushing defining a fuel inlet orifice, a needle valve operating in the sleeve for controlling the effective size of the orifice, float controlled means for varying the opening and closing of the valve when the carburetor is inverted, and a ball valve in said cage below the seat therein, the ball valve being seated when the carburetor is inverted and unseated when the carburetor is upright.

12. In a carburetor having a fuel chamber and a float therein, a valve controlled by the float to regulate flow of fuel to the chamber in the upright position of the carburetor and to open the valve in the inverted position, a fuel passageway to the valve, and means to restrict flow in the passageway only when the carburetor is inverted.

13. In a carburetor having a fuel chamber and a float therein, a valve controlled by the float to regulate flow of fuel to the chamber in the upright position of the carburetor and to open the valve in the inverted position, a fuel passageway to the valve, and a gravity operated valve to restrict flow in the passageway only when the carburetor is inverted.

14. In a carburetor, a fuel chamber having an outlet valve, a float adapted to close the valve and permitting normal flow of fuel when the carburetor is upright, said float being designed to open the valve when the carburetor is inverted, and means restricting flow to the chamber only in the inverted position.

15. In a carburetor, a fuel chamber, means for maintaining a constant fuel level therein when the carburetor is upright and permitting a variable level when the carburetor is inverted, an inlet pipe to the chamber, and means imposing a restriction in the inlet pipe only when the carburetor is inverted.

16. In a carburetor, a fuel chamber, means for maintaining a constant fuel level therein when the carburetor is upright and permitting a variable level when the carburetor is inverted, an inlet pipe to the chamber, and a gravity operated valve partially closing the inlet pipe only when the carburetor is inverted.

In witness whereof, I hereunto subscribe my name this 18th day of May, 1929.

JEPTHA MACKENZIE MILLER.