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AIRCRAFT CARBURETOR AND FUEL SUPPLY SYSTEM

Original Filed March 18, 1929

Fig. 1.

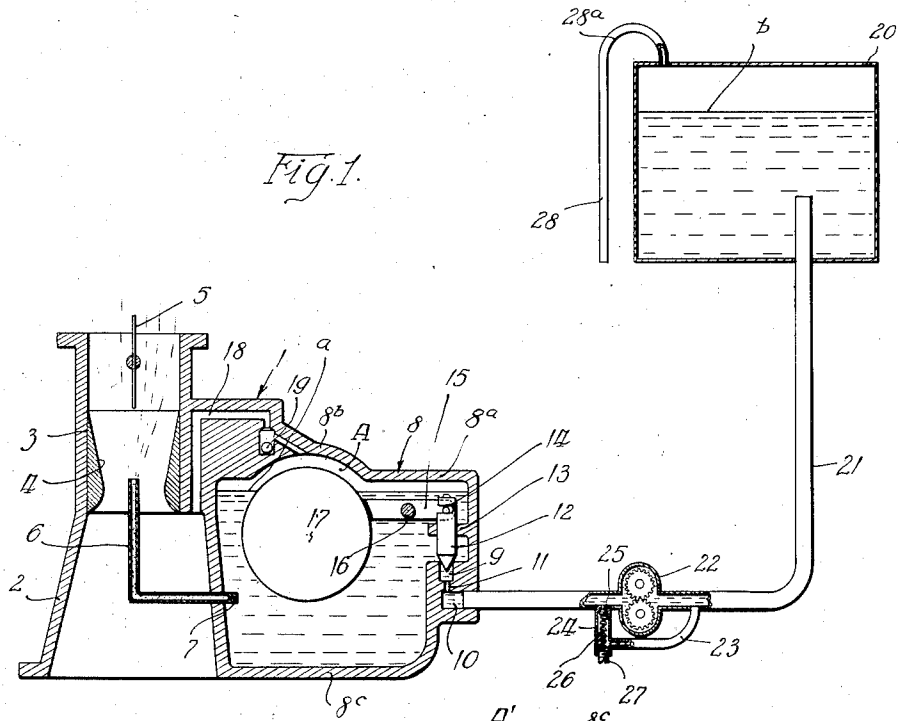
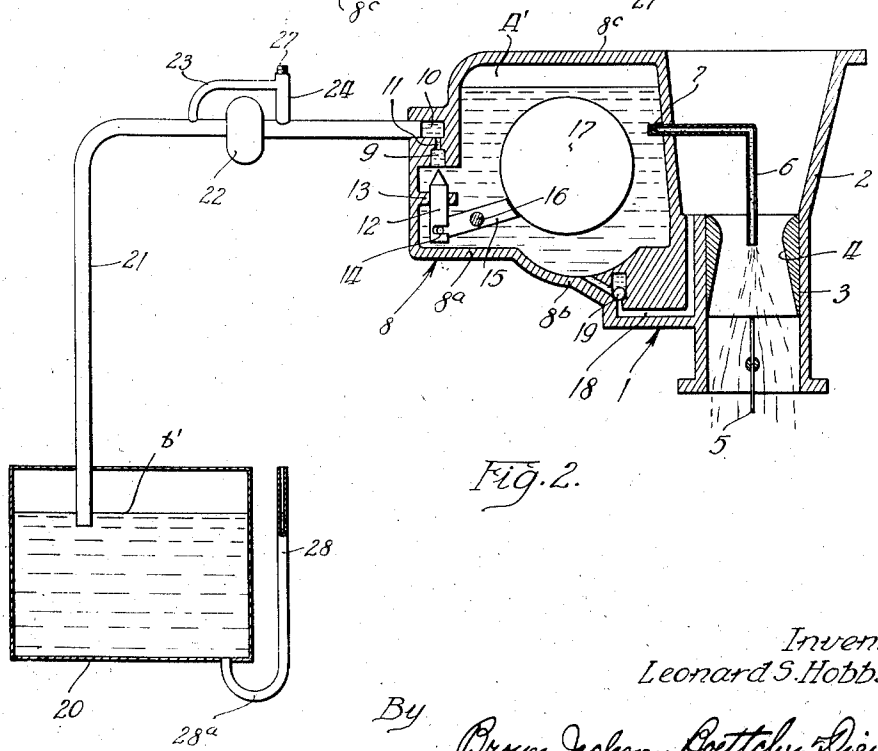


Fig. 2.



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UNITED STATES PATENT OFFICE

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AIRCRAFT CARBURETOR AND FUEL SUPPLY SYSTEM

Application filed March 18, 1929, Serial No. 347,808. Renewed October 21, 1931.

This invention relates to means for supplying fuel to air craft 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, particularly when the air craft is flying in an upside down 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 also 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 when the carburetor is inverted. Another object is to provide means whereby proper supply of fuel to the carburetor in proper quantity to assure continuous and satisfactory operation of the engine is provided for. A further object is to provide a fuel supply system, in conjunction with the carburetor, whereby proper supply of fuel to the float chamber when the carburetor is both in upright position and in inverted position is assured. Further objects and advantages will appear from the detailed description:

In the drawing:

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.

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. The float chamber is provided with a fuel inlet orifice 9 from which extends a fuel inlet duct 10 which comprises a metering restriction 11 between the body of the duct and the orifice 9. The fuel inlet orifice is controlled by a needle valve 12 slidably mounted through a lug 13 which projects inwardly from the adjacent wall of chamber 8. This valve is connected, at its upper end, by pin and slot connections 14 to the outer end of a float arm or lever 15 pivoted at 16 for rocking movement. A float 17 is suitably secured to the other end of arm 15 and serves, when the carburetor is in upright position as in Figure 1, to actuate valve 12 so as to regulate the effective size of orifice 9 in accordance with the fuel level in float chamber 8. An air vent passage 18 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 19, as in Figure 2, to prevent flow of fuel from the float chamber through passage 18. The carburetor so far described is, in general, of similar construction to the carburetor disclosed in my copending application for carburetor, Serial No. 122,838, filed July 16, 1926, except as to the provision of the restriction 11 and the connection between the needle valve 12 and the float arm 15. As will be explained more fully, these distinc-

tions are of vital importance in my present invention.

A main fuel supply tank 20 is disposed so as to be above the carburetor when it is in upright position, as in Figure 1. A fuel pipe or conduit 21 extends through the bottom wall of this tank and upwardly into the same for an appreciable distance, the intake end 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 21 is suitably secured in the fuel supply duct 10. With the carburetor in upright position, fuel from tank 20 can flow by gravity through the conduit 21 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 17 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 port or opening 7 is disposed at about the central portion of the float chamber and the space between the float 17 and 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 12 so as to regulate the effective size of orifice 9 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 20 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 20 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 22 of known type interposed in conduit 21. This pump may be driven from the engine of the aircraft in any suitable manner, and acts to withdraw fuel from tank 20 and force it through conduit 21, beyond the pump, into the fuel inlet duct 10 of the carburetor.

A by-pass tube 23 opens into conduit 21 in advance of pump 22. At its other end this tube communicates with a valve casing 24 in which is mounted a spring pressed valve 25 which controls communication between tube or conduit 21 and valve casing 24, at the other side of pump 22. Spring 26, which normally holds the valve 25 seated, is adjusted by a screw 27 threading into the outer end of valve casing 24. The valve 25 opens outwardly from conduit 21 and the valve casing 24 and tube 23 constitute a by-pass to permit reverse flow of the fuel around the pump 22. I find the pump 22 a satisfactory means of supplying fuel to duct 10 as this pump provides a continuous pressure on the fuel and, by properly adjusting the spring of valve 25, the pressure to which the fuel in duct 10 is subjected can be of any desired value, within limits.

When the carburetor is in inverted position, as when an aeroplane 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 17 rises in the chamber 8 so as to move toward the wall 8*c* thereof, thus moving the valve 12 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 present carburetor, the fuel inlet orifice 9 is completely open when the carburetor is in inverted position so as to permit supply of fuel to the float chamber.

In practice, the metering restriction 11 is of such size, and the spring 26 of valve 25 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.

In order that fuel may be withdrawn from tank 20, it is necessary to provide this tank with a suitable vent. For this purpose I provide a vent tube 28 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 semi-circular shape as at 28*a*.

The amount of fuel in tank 20 is at all times such that the outlet of the tank is sub-

merged 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 combination in a fuel supply system for aircraft, a carburetor comprising a fuel reservoir and having a fuel inlet orifice, a valve controlling the orifice, and level controlling means within the reservoir and having operating connection with the valve, said level controlling means acting to hold the valve in full open position when the carburetor is in inverted position, and means for supplying fuel to the fuel reservoir through said orifice when the carburetor is inverted and at a predetermined rate.

2. In combination in a fuel supply system for aircraft, a carburetor comprising a fuel reservoir having a fuel inlet orifice, level controlling means for regulating the effective size of said orifice when the carburetor is in upright position and for completely opening the fuel inlet orifice when the carburetor is in inverted position, and means for supplying fuel to the fuel reservoir through said orifice when the carburetor is inverted and at a predetermined rate.

3. In combination in a fuel supply system for aircraft, a carburetor comprising a fuel reservoir having a fuel inlet orifice and a fuel supply duct leading to said orifice, the duct being of a predetermined cross sectional area for a portion of its length to meter the flow of fuel therethrough, level controlling means for regulating the effective size of the orifice when the carburetor is in upright position and for completely opening the fuel inlet orifice when the carburetor is in inverted position, and means for supplying fuel to said duct when the carburetor is in upright position, said fuel supplying means comprising means for supplying fuel to the fuel supply duct under substantially constant pressure when the carburetor is in inverted position.

4. In combination in a fuel supply system for aircraft, a carburetor comprising a fuel receiving chamber and means for supplying fuel to said chamber and for maintaining the amount of fuel fed to the chamber substantially constant in both the upright and the inverted positions of the carburetor.

5. In combination in a fuel supply system for aircraft, a carburetor comprising a fuel reservoir having a fuel inlet orifice, level controlling means for regulating the effective size of the orifice when the carburetor is in upright position and for completely opening the orifice when the carburetor is in inverted position, a fuel supply duct communicating with said orifice and comprising a metering restriction, a fuel supply tank, a conduit connecting the outlet of the tank to said duct, the outlet of the tank being submerged both when the tank is in upright position and in inverted position, and means interposed in the conduit for feeding the fuel therethrough to the fuel inlet duct and at a predetermined pressure.

6. 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 completely opening the orifice when the carburetor is in inverted position, a fuel supply duct communicating with said orifice and comprising a metering restriction, a fuel supply tank disposed above the carburetor when the latter is in upright position, the outlet of the tank being connected to the duct and being submerged both when the carburetor is in upright position and in inverted position, and means for withdrawing fuel from the tank and supplying it to said fuel duct under predetermined pressure when the carburetor is in inverted position.

7. 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 completely opening the orifice when the carburetor is in inverted position, a fuel supply duct communicating with said orifice and comprising a metering restriction, a fuel supply tank disposed above the carburetor when the latter is in upright position, the outlet of the tank being connected to the duct and being submerged both when the carburetor is in upright position and in inverted position, and pump means for withdrawing fuel from the tank and supplying it to said fuel duct under predetermined pressure when the carburetor is in inverted position.

8. In combination in a fuel supply system for aircraft, a carburetor comprising a fuel reservoir having a fuel inlet orifice, level controlling means for regulating the effective size of the orifice when the carburetor is in upright position and for completely opening the orifice when the carburetor is in inverted position, a fuel supply duct communicating with said orifice and comprising a metering restriction, a fuel supply tank disposed above the carburetor when the latter is in upright position, the outlet of the tank being connected to the duct and being submerged both when the carburetor is in upright position and in inverted position, and means for withdrawing fuel from the tank and supplying it to said fuel duct under constant predetermined pressure when the carburetor is in inverted position.

9. In combination in a fuel supply system for aircraft, a carburetor comprising a fuel reservoir having a fuel inlet orifice, level controlling means for regulating the effective size of the orifice when the carburetor is in

upright position and for completely opening the orifice when the carburetor is in inverted position, and a fuel supply duct communicating with the orifice and comprising a metering restriction, a fuel supply tank having its outlet submerged in both positions of the carburetor, and means for withdrawing fuel from the tank and supplying it to the duct under pressure in both positions of the carburetor.

10. In combination in a fuel supply system for aircraft, a carburetor comprising a fuel reservoir having a fuel inlet orifice, level controlling means for regulating the effective size of the orifice when the carburetor is in upright position and for completely opening the orifice when the carburetor is in inverted position, and a fuel supply duct communicating with the orifice and comprising a metering restriction, a fuel supply tank having its outlet submerged in both positions of the carburetor, a conduit connecting the outlet of the tank to the fuel supply duct of the carburetor, a pump connected into the conduit for withdrawing fuel from the tank and forcing it through the conduit to said duct, and a by-pass about the pump comprising yielding means for resisting reverse flow therethrough of the fuel.

11. In an aircraft carburetor, a float chamber having a fuel inlet orifice and a fuel inlet duct extending from the orifice and comprising a metering restriction, a float in the chamber, a valve controlling the orifice means for supplying fuel to the float chamber in both upright and inverted positions, and operating connections between the valve and the float acting to regulate the extent of opening of the valve in accordance with the fuel level in the chamber when the carburetor is in upright position and to hold the valve open when the carburetor is in inverted position.

12. In an aircraft carburetor, a float chamber having a fuel space and an air space and a fuel inlet orifice remote from the top wall thereof, a float arm rockably mounted intermediate its ends and above the orifice, a float attached to the inner end of the arm, a valve controlling the orifice, and a pin and slot connection between the upper end of the valve and the outer end of the arm, the float being disposed adjacent the top wall of the chamber and the fuel space of the chamber being relatively greater than air space, when the carburetor is in upright position.

13. In a carburetor having a positive fuel feed, a constant level fuel reservoir having a fuel inlet, a level controlling valve in said reservoir controlling said inlet when the carburetor is in upright position, and a metering restriction controlling said inlet when the carburetor is in inverted position.

14. In a carburetor having a constant level fuel reservoir and a positive feed therefor, a fuel inlet and a fuel outlet in said reservoir, and metering restrictions in said inlet and outlet for controlling the flow of fuel through said chamber when the carburetor is in inverted position.

In witness whereof, I hereunto subscribe my name this 11th day of March, 1929.

LEONARD S. HOBBS.