Oct. 19 1948. H. J. DE N. McCOLLUM 2,451,627

INTERNAL-COMBUSTION AIRCRAFT-TYPE HEATER

Filed Oct. 6, 1942

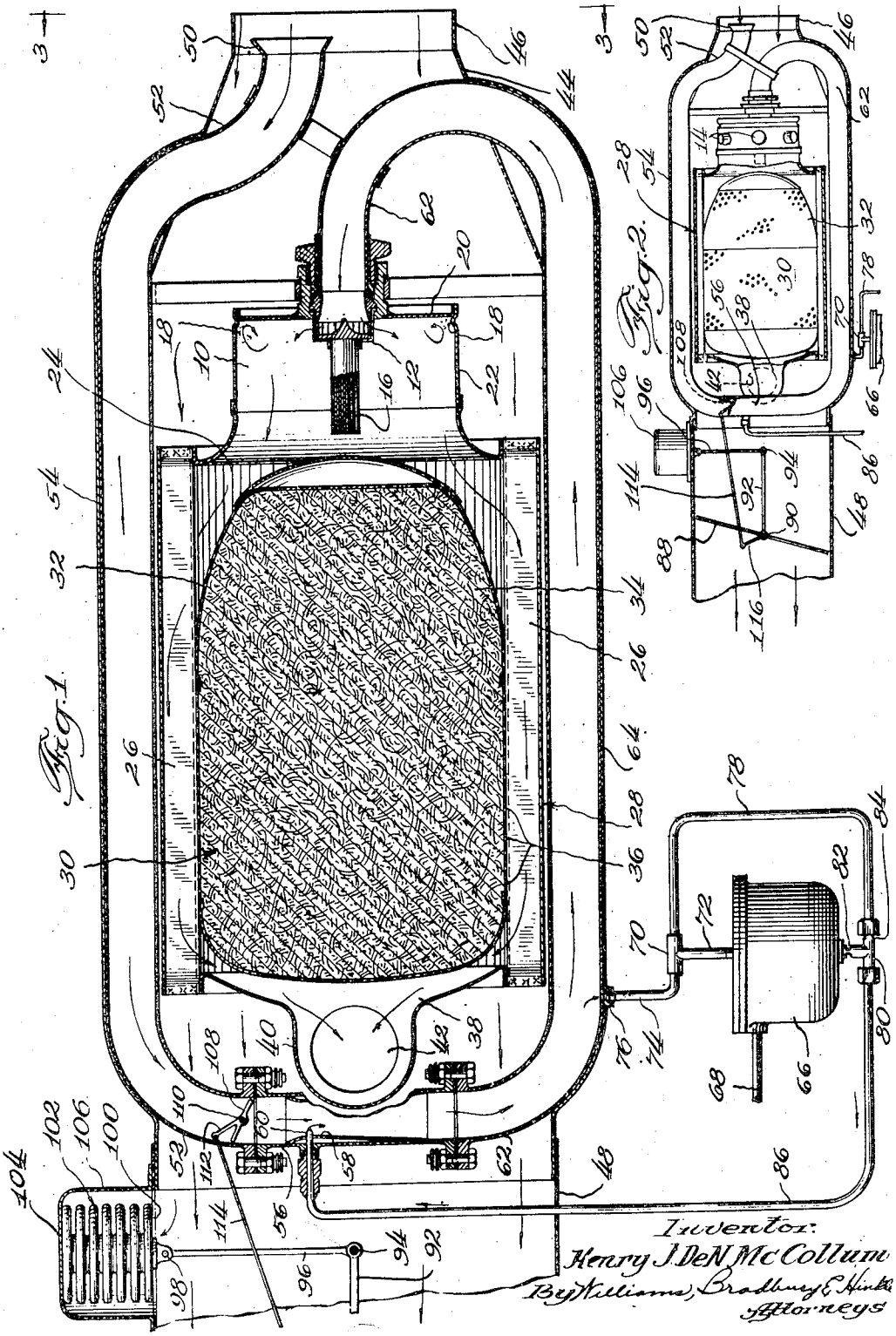


Fig. 1.

Fig. 2.

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Patented Oct. 19, 1948 2,451,627

UNITED STATES PATENT OFFICE

2,451,627

INTERNAL-COMBUSTION AIRCRAFT-TYPE HEATER

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Application October 6, 1942, Serial No. 460,970

5 Claims. (Cl. 126—116)

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My invention relates to heaters and more particularly to heaters of the internal combustion type especially adapted for, but not limited to, use in aircraft.

An object of my invention is to provide a new and improved internal combustion heater which will operate efficiently both at low and high altitudes.

Another object of my invention is to provide a new and improved internal combustion type of heater which automatically adjusts itself for variations in altitude whereby a substantially uniform flow of heated ventilating air is provided for all altitudes.

Another object of my invention is to provide an internal combustion heater having new and improved means for preheating air for combustion.

Another object of my invention is to provide a heater having a new and improved altitude control.

Another object of my invention is to provide a heater having improved means for forming a combustible mixture.

Another object of my invention is to provide a heater of the internal combustion type having new and improved means for creating a combustible mixture which is substantially homogeneous for all altitudes.

Other objects and advantages will become apparent as the description proceeds.

In the drawings:

Fig. 1 is a view showing a longitudinal section of one form of heater embodying my invention and also showing the manner in which the fuel is supplied to this heater; and

Fig. 2 is a view similar to Fig. 1, but on a reduced scale and showing more clearly the mechanism for controlling the circulation of ventilating air at different altitudes.

In the drawings, I have illustrated a heater comprising a combustion chamber 10 to which a combustible mixture of fuel and air is supplied by a burner tube 12. This fuel is ignited by the igniters 14 which may be provided with the usual thermostatic switch for disconnecting these igniters from their source of electricity when the heater attains operating temperature. Thereafter ignition in the combustion chamber is maintained by a re-igniter 16 and also by a flaming ring of burning fuel which collects in the annular pocket 18 formed at the junction of the end plate 20 with the annular wall 22 of the combustion chamber.

The hot gases which are produced by the combustion in the combustion chamber 10 flow through a tapered annular passage 24 into the ducts 26 provided by the longitudinally extending hollow fins of a tubular heat transfer means or heat exchanger 28. A muffler 30 is located in the heat exchanger 28 and comprises a sheet metal shell 32 filled with heat resisting and sound absorbing material 34, such as stainless steel wool or glass wool. Openings 36 in the muffler shell form acoustic couplings between the interior of the muffler and the ducts 26 in the hollow fins.

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The gases of combustion give up their heat to the heat exchanger 28 and after these gases have traversed the ducts 26, they pass into an outlet chamber 38 formed between the end plate 40 and the adjacent end of the muffler 30. These gases are then discharged through an outlet 42 which may lead directly to atmosphere or may be connected with any suitable exhaust pipe.

The parts thus far described are enclosed in a sheet metal casing 44, which is generally cylindrical and closely fits about the heat exchanger 28. This casing cooperates with the hollow fins of the heat exchanger to form longitudinally extending passages for ventilating air between these fins and ventilating air is supplied to these passages through the inlet end 46 of the casing 44. This inlet end is adapted to be connected to a ram, blower, or other air supply means. The opposite end of the casing 44 is connected to a ventilating duct 48 leading to the aircraft cabin or other space to be heated.

Part of the air entering the inlet 46 flows into the flared mouth 50 of a tube 52 which extends lengthwise of the casing 44 and is located between an outwardly bulged portion 54 of this casing and the heat exchanger 28, so that air flowing through the tube 52 picks up heat from the heat exchanger 28. The lefthand end of the tube 52 is connected to a carburetor 56 having a restricted throat 58. The jet 60 is located in the restricted throat of the carburetor and serves to supply an extremely rich mixture of fuel and air thereto. This rich mixture admixes with the heated air supplied by the tube 52 to form a combustible mixture which is discharged into the lefthand end of a second tube 62 extending lengthwise of the heater and lying between the heat exchanger 28 and a second bulged portion 64 of the casing 44. As the combustible mixture traverses tube 62, it is heated from the heat transfer means 28 and passes from the righthand end of the tube 62 into burner tube 12, from whence it passes to the combustion chamber 10.

The means for supplying the rich mixture of fuel and air to the jet 56 is shown most clearly in Fig. 1 and comprises a float bowl 66 having a fuel supply pipe 68, to which fuel is furnished under gravity head or by pump pressure from any suitable fuel tank. The float in the float bowl 66 maintains a substantially constant level of fuel therein. The T fitting 70 has a leg 72 connected to the tube of the float bowl 66 and a pipe 74 connects the T 70 to an air inlet 76 communicating with the interior of the tube 62. Pipe 78 connects T 70 with a second T 80 connected to the bottom of the float bowl 66 through a small orifice 82. A second orifice 84 controls communication between the T 80 and the pipe 78, this second orifice having a cross-sectional area approximately four times that of the orifice 82. Pipe 86 connects T 80 with carburetor fuel jet 60.

The fuel supply means which I have just described is illustrated and described more fully in my co-pending application, Serial No. 456,335, filed August 27, 1942 which has matured into Patent No. 2,416,935. This fuel supply means requires only a slight pressure differential for its operation, wherefore the pressure at the jet 60 need be only slightly below the pressure at the inlet 76. The carburetor throat 58, therefore, need be only slightly restricted and offers only slight resistance to the flow of air through the tubes 52 and 62. This is of particular value where the heater is used in aircraft operating at high altitudes where the atmospheric pressure and air density are low.

The air pressure at the inlet 76 is communicated to the float bowl 66 and this pressure plus the hydrostatic head of the fuel in the float bowl forces the fuel through the restricted orifice 82 and into the T 80. Pressure at the inlet 76 forces a small amount of combustible mixture through this inlet and through pipe 74, T 70, pipe 78 and orifice 84 into T 80 where it mixes with fuel flowing through restricted orifice 82. The rich mixture of fuel and air thus formed flows through pipe 86 to jet 60. Since the pipe 86 contains a mixture of fuel and air instead of being filled with solid liquid fuel, only slight force is required to lift this fuel and air mixture from the T 80 to the jet 60.

I shall now describe my novel means for regulating the flow of combustible air and ventilating air for different altitudes. The flow of ventilating air is controlled by a butterfly valve 88 located in ventilating air duct 48. This valve is mounted on a shaft 90 and is shifted within its range of movement by an arm 92 pivoted at 94 to a rod 96 connected by pivot pin 98 to the free end 100 of a barometric bellows 102. The other end of this bellows is attached at 104 to a base of a sheet metal cup 106 rigidly mounted on a wall of the ventilating duct 48. The bellows 102 is so constructed that it contracts with increasing atmospheric pressure and expands with decreasing atmospheric pressure.

Flow of combustible air through the tube 52 is controlled by a second butterfly valve 108 mounted on a shaft 110 and shifted through its range of movement by an arm 112 pivotally connected to one end of a link 114. The other end of the link 114 is connected to an arm 116 which is rigid with the arm 92. The connections between the butterfly valves 88 and 108 and the bellows 102 are such that as this bellows expands, the valves are moved toward open position and as the bellows contracts these valves move toward closed position. In other words, when the aircraft is operating at low altitude and the atmospheric pressure and density are relatively great, these valves are nearly closed to reduce the flow of combustion air and ventilating air, whereas when the aircraft is operating at high altitudes where the air pressure and density are relatively low, the valves are in wide open position to provide free flow for the ventilating air and combustion air.

The heating of the combustible mixture is effected in two stages. The air for combustion is heated as it traverses the tube 52 and its temperature raised sufficiently to eliminate the formation of ice at the jet 60. The upper end of the fuel supply pipe 86 is located in the ventilating duct 48 and the rich mixture of fuel and air flowing through this portion of the pipe 86 receives some heat from the ventilating air and this feature also contributes to the elimination of icing at the jet 60. The vaporization of the fuel which occurs adjacent this jet reduces the temperature of the combustion air and produces a combustible mixture which is considerably colder than the combustion air delivered to the carburetor 56. This combustible mixture is heated as it traverses the tube 62 connecting the carburetor with the combustion chamber. In thus heating the combustible mixture formed in the carburetor 56, better vaporization and distribution of the fuel is obtained and condensation of the fuel is eliminated. The combustible mixture delivered to the combustion chamber 10 is of substantially homogeneous mixture having a temperature conducive to excellent combustion.

The foregoing provisions for heating the combustion air and combustible mixture make my heater particularly adapted for high altitude flying. The automatic control for regulating the supply of combustion air and the quantity of ventilating air flowing through the heater also contribute to the utility of my novel heater for high altitude, as well as low altitude, flying. At high altitudes, there is very little pressure drop across the heater and the butterfly valves 88 and 110 are, therefore, positioned to offer minimum resistance to flow of ventilating and combustion air, whereas at low altitudes these valves restrict the flow of combustion air and ventilating air.

While I have illustrated and described an embodiment of my invention, it is to be understood that my invention is not to be limited to the details shown and described but may assume numerous other forms and that my invention is to be construed as including all modifications and variations falling within the scope of the appended claims.

I claim:

1. In a heater of the class described, comprising heat transfer means, means forming a combustion chamber for supplying hot gases to said heat transfer means, a casing enclosing said heat transfer means, means forming an air inlet and outlet for said casing, a carburetor in said casing and adjacent the outlet thereof, a tube connecting said carburetor with said inlet, said tube extending between said casing and heat transfer means whereby air passing from said inlet to said carburetor is heated in passage, a second tube connecting said carburetor with said combustion chamber, said second tube extending between said casing and said heat transfer means whereby combustible mixture formed in said carburetor is heated prior to introduction into said combus-

tion chamber, and means for igniting the combustible mixture in said combustion chamber.

2. An aircraft heater of the class described, comprising heat transfer means, means forming a combustion chamber for supplying hot gases to said heat transfer means, a casing enclosing said heat transfer means, means forming an air inlet and outlet for said casing, a carburetor in said casing and adjacent the outlet thereof, a valve regulating flow through said casing, a tube connecting said carburetor with said inlet, said tube extending between said casing and heat transfer means whereby air passing from said inlet to said carburetor is heated in passage, a valve in said tube, a second tube connecting said carburetor with said combustion chamber, said second tube extending between said casing and said heat transfer means whereby combustible mixture formed in said carburetor is heated prior to introduction into said combustion chamber, means for igniting the combustible mixture in said combustion chamber, and altitude responsive means for shifting said valves.

3. A heater of the class described, comprising heat transfer means, means forming a combustion chamber for supplying hot gases to said heat transfer means, a casing enclosing said heat transfer means, means forming an air inlet and outlet for said casing, a carburetor in said casing and adjacent the outlet thereof, a tube connecting said carburetor with said inlet, said tube extending between said casing and heat transfer means whereby air passing from said inlet to said carburetor is heated in passage, a second tube connecting said carburetor with said combustion chamber, said second tube extending between said casing and said heat transfer means whereby combustible mixture formed in said carburetor is heated prior to introduction into said combustion chamber, means for igniting the combustible mixture in said combustion chamber, said carburetor having a jet, said second tube having an opening therein, a conduit connecting said opening and jet, and means connected to said conduit for supplying a rich mixture of fuel and air to said jet.

4. A heater of the class described, comprising tubular heat transfer means, means forming a combustion chamber located at one end of said heat transfer means for supplying hot gases thereto, a casing enclosing said heat transfer means

and cooperating therewith to provide a passage for ventilating air, said casing having an inlet adjacent said combustion chamber, a carburetor for supplying combustible mixture to said combustion chamber, said carburetor being located adjacent the end of said heat transfer means which is remote from said combustion chamber, means for conducting air from said inlet to said carburetor, means for conducting combustible mixture from said carburetor to said combustion chamber, both of said conducting means being adjacent to said heat transfer means and exposed to heat therefrom, and ignition means for said combustion chamber.

5. A heater of the class described, comprising a tubular heat transfer means, means forming a combustion chamber for supplying hot gases to one end of said heat transfer means, a carburetor located at the opposite end of said heat transfer means and exposed to heat therefrom, means for conducting combustible mixture from said carburetor to said combustion chamber, and an air supply duct for said carburetor, said duct having an inlet at the combustion chamber end of said heat transfer means.

HENRY J. DE N. McCOLLUM.

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