Jan. 4, 1949. L. A. WILLIAMS, JR 2,458,042

FUEL FEEDING SYSTEM FOR LIQUID FUEL BURNERS HAVING MEANS FOR DISPOSING OF FUEL VAPORS

Filed March 20, 1944 2 Sheets-Sheet 1

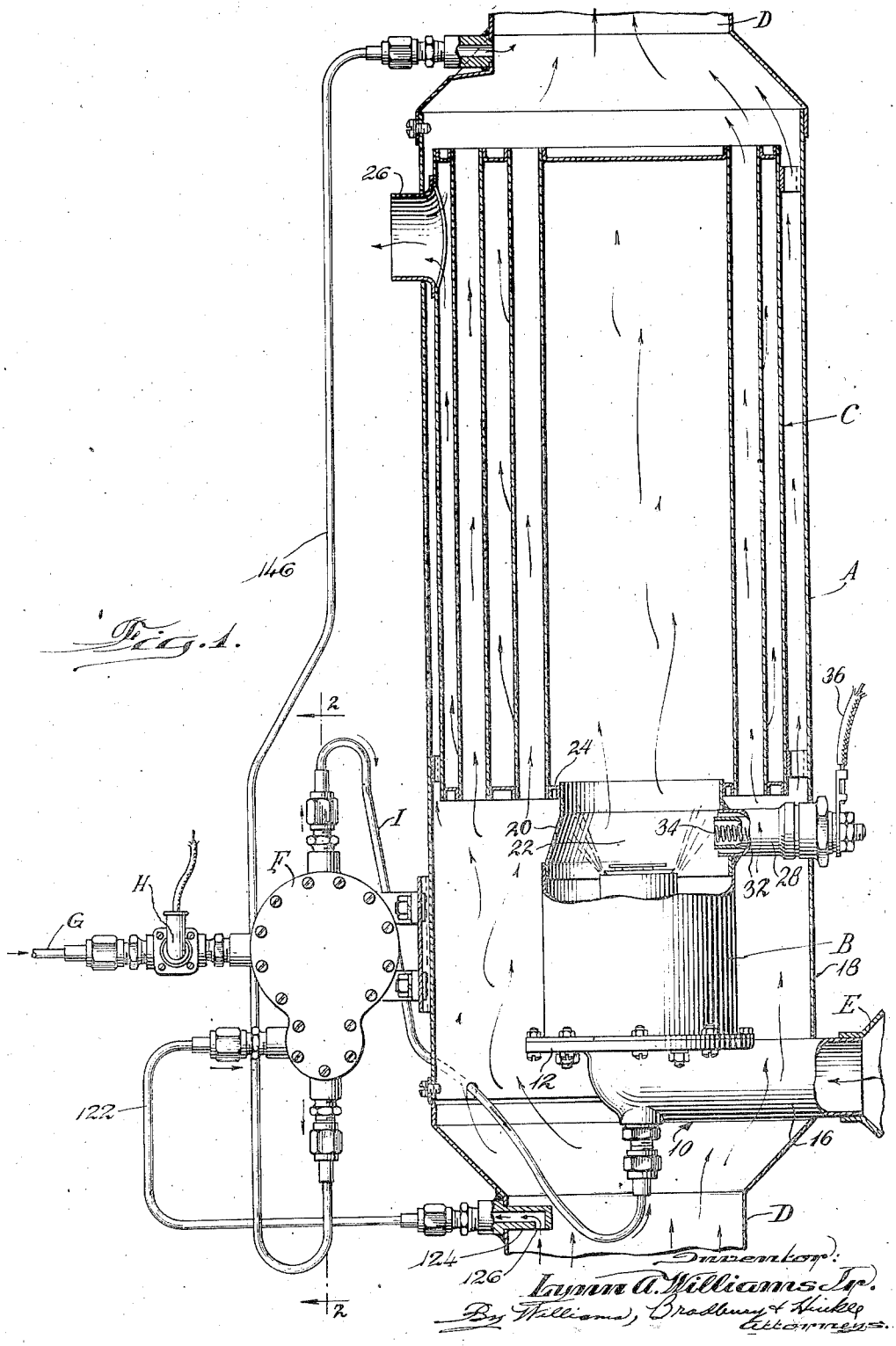



Fig. 1.

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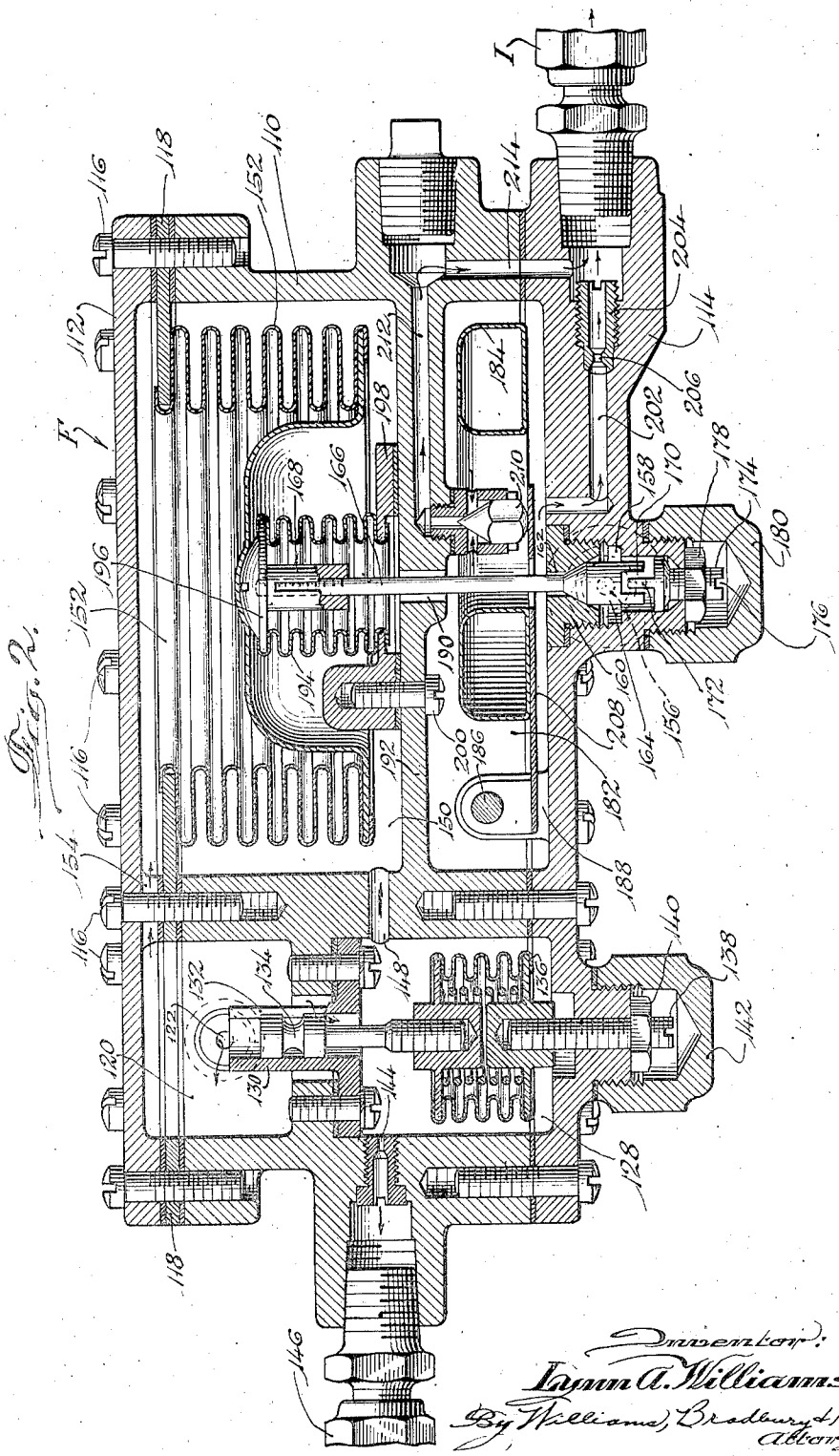


Fig. 2.

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## FUEL FEEDING SYSTEM FOR LIQUID FUEL BURNERS HAVING MEANS FOR DISPOSING OF FUEL VAPORS

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3 Claims. (Cl. 158—36)

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My invention relates to fuel feeding systems for heaters, and more particularly to fuel feeding systems for heaters of the internal combustion type used in airplanes wherein it is of great importance to provide means for preventing vaporized fuel which may be present from intefering with the operation of the heater.

An object of my invention is to provide a new and improved fuel feeding system for internal combustion heaters wherein mechanism is provided to prevent any vaporization of the fuel which may occur from interfering with the operation of the heater.

Another object of my invention is to provide a new and improved fuel feeding system for heaters having means for taking care of vaporized fuel, and which is inexpensive to manufacture, reliable in operation, and easy to install.

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

In the drawings:

Fig. 1 is a view of the heater installation embodying a preferred form of my invention and showing the heater in longitudinal section;

Fig. 2 is a sectional view of the pressure carburetor and is taken on the line 2—2 of Fig. 1.

In Fig. 1 of the drawings I have illustrated my invention as being incorporated in a heater installation comprising in general a heater indicated generally by reference character A and having a burner B and heat exchanger C. Ventilating air is supplied to the heater through an inlet pipe D connected to a ram, blower or other suitable source of air. The heated ventilated air discharged from the heat exchanger C flows through an outlet duct D to the aircraft cabin or other space or spaces to be heated. Air for combustion purposes is supplied to the burner B by way of a combustion air supply pipe E which may also be connected with a ram, blower or other suitable source of air which may be the same as or independent of the source for the ventilating air pipe D.

A fuel feed control device F is interposed between the burner B and the fuel supply pipe G which is connected to any suitable source of liquid fuel under pressure. The pressure on the fuel may be created by a pump, gravity head, or in any other suitable manner. A solenoid shut-off valve H is preferably incorporated in the fuel supply line G to the fuel feel device F to completely cut off the supply of fuel when the burner is not operating. The fuel feed device F delivers fuel to the burner through a pipe I.

The burner B is preferably especially designed

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to maintain the gravimetric rate of air flow to the combustion chamber of the heater substantially constant. A burner suitable for this purpose in which the rate of flow of air into the combustion chamber is automatically controlled conjointly by the pressure drop across the heater, and the absolute pressure is claimed in Patent No. 2,374,569, issued April 24, 1945 to Vernon N. Tramontini. Such a burner includes a generally elbow-shaped induction pipe casting 10 having a flange 12 and a tubular extension 16 which is connected at one end to the combustion air supply pipe E. A tubular sheet metal casing 18 is secured to the flange 12 and to the extension 16. The upper portion of the casing 18, together with a tapering sheet metal section 20, forms a combustion chamber 22. The upper end of the section 20 is welded or otherwise suitably secured to the end wall 24 of the heat exchanger C.

The heat exchanger C may be of any suitable construction adapted to receive the products of combustion from the combustion chamber 22, and to transfer heat to ventilating air which flows past the combustion chamber and associated parts and through or around the heat exchanger itself. In the particular embodiment selected for illustration the heat exchanger C is of the spiral type and has an outlet 26 which may be connected with any suitable exhaust pipe through which the cooled products of combustion are discharged to atmosphere.

An igniter supporting tube 28 projects through the section 20 and is suitably welded thereto. This tube houses an igniter shell 32. Within the igniter shell 32 is the usual hot wire igniter 34, the inner end of which is secured to the shell 32 and the outer end of which is suitably connected to a wire 36 which is insulated from the shell 32 and supplies energizing current to the igniter. Suitable thermostatic control means are preferably provided to cause energization of the igniter during starting and in the event that the flame in the burner becomes extinguished.

The fuel feed regulator F which controls the flow of fuel to the burner is best shown in Fig. 2. This mechanism is illustrated as comprising a body casting 110 and upper and lower castings 112 and 114 are secured to the body 110 by cap screws 116. A plate 118 is located between the upper casting or cover 112 and the body 110 and serves a purpose which I shall hereinafter describe. Suitable gaskets are interposed between the various parts to render the assembly air and fuel tight.

The feed regulator has an air inlet chamber 120 connected by a pipe 122 to a pitot tube 124

located in the ventilating air inlet pipe D and having an inlet 126 directed upstream of the air flowing in this pipe whereby air is forced through the inlet 126 and pipe 122 into chamber 120. A second chamber 128 communicates with the chamber 120 by way of a valve comprising a sleeve 130 having a slot 132 formed in the wall thereof and a valve member 134 which shifts to variably uncover the slot 132 and thereby variably control communication between the chambers 120 and 128.

The valve member 134 is controlled by an aneroid bellows 136 located in the chamber 128. This bellows is attached to the lower casting 114 by a screw 138 which may be adjusted to support the valve member 134 in any desired position. A lock nut 140 secures the screw 138 in adjusted position and a pin, not shown, prevents rotation of the bellows with the adjusting screw 138. A cap 142 encloses and protects the outer end of the adjusting screw 138.

A portion of the air entering the chamber 128 by way of the valve slot 132 is bled through a restricted outlet 144 and a pipe 146 to the outlet or downstream end of the heater. The slide valve which controls communication between the chambers 120 and 128 serves to maintain a constant pressure in the chamber 128. This constant pressure is communicated through a bore 148 to a chamber 150 surrounding a bellows 152. The interior of this bellows communicates through a slot 154 with the air inlet chamber 120 so that the pressure in the interior of the bellows 152 corresponds at all times with the pressure in the inlet chamber 120 and reflects the gravimetric flow of air in the ventilating air supply pipe D. The bellows 152 controls the position of a fuel metering means which I shall now describe.

Referring particularly to Fig. 2 it will be seen that the fuel from the fuel tank or other source of supply enters the fuel feed device through a bore 156 leading to a valve chamber 158. The upper end of this chamber 158 is closed by a tubular plug 160 threaded into the casting 114 and having a discharge port 162 variably controlled by a valve 164. The valve 164 has a tapered upper end cooperating with a flaring or tapered portion of the plug 160 leading to the port 162. The valve 164 has a valve stem 166 which is threaded at its upper end into a socket member 168 attached to the base of the bellows 152. The lower end of the valve 164 is provided with a slot 170 receiving the tongue 172 of a valve adjusting member 174. The adjusting member 174 has a kerf 176 into which a screw driver or similar tool may be inserted to rotate the adjusting member 174, valve 164 and valve stem 166 and screw the latter into or out of the member 168 attached to the base of the bellows 152. A nut 178 clamps the adjusting member 174 in adjusted position and the cap 180 encloses and protects the lower end of the adjusting member 174 and its nut 178.

Fuel flowing past the flow control valve 164 and through port 162 enters a float chamber 182 containing a float 184 pivotally mounted at 186 to an upstanding boss 188 formed integral with the casting 114. The valve stem 166 extends completely across the float chamber 182 and passes through an opening 190 in a partition 192. In order to prevent fuel from flowing through the opening 190 into the chamber 150, a bellows 194 connects the flange 196 of member 168 with a ring 198 held in sealing engagement with partition 192 by screws 200.

Fuel in the float chamber 182 is discharged therefrom through an outlet passage 202 leading to the pipe I which delivers the gasoline to the burner B. A screw plug 204 having a restricted orifice 206 is located in the passage 202 and offers some resistance to the flow of fuel therethrough. The float 184 is attached to a T-shaped lever 208 having a portion located directly beneath a vapor escape valve 210 which controls communication between the upper part of the float chamber 182 and bores 212 and 214 which together constitute a vapor escape passage communicating with pipe I leading to the burner. The accumulation of any appreciable quantity of vapor in the float chamber will cause the float to drop sufficiently to open valve 210 whereupon the vapor can escape to the pipe I by way of bores 212 and 214. The orifice 206 provides a sufficient pressure differential thereacross to insure free discharge of vapor as soon as valve 210 opens.

Liquid fuel or vapor can pass from the float chamber 182 through opening 190 to the interior of bellows 194. The pressure in this bellows therefore corresponds at all times to the pressure in the float chamber 182. This float chamber pressure acting over the area of bellows 194 tends to resist expansion of bellows 152 under the force created by air flow in the ventilating air supply pipe D, and this resistance is taken into account in designing the relative sizes of the bellows 194 and 152.

In the operation of the apparatus, combustion air under pressure is supplied through pipe E to the inlet extension 16 of the burner casting 10 and flows in the direction of the arrows. At the same time, fuel under pressure is supplied by the fuel feed device F to the burner through the pipe I. In the particular arrangement shown the quantity of fuel supplied varies with the pressure drop across the ventilating air side of the heater.

The combustible mixture produced in the burner will be ignited by the electrical igniter 34 and substantially complete combustion will take place within the combustion chamber 22 and the inlet end portion of the heat exchanger C.

In the particular embodiment shown, the fuel supply is caused to vary with the pressure drop of the ventilating air across the heater so that the rate of fuel supply varies with the heat output requirements corresponding to variations in the rate at which ventilating air is fed through the heater. By connecting the air inlet and air outlet ports of the fuel feed device to different parts of the heater, the fuel supply can be caused to vary with any other characteristic of the heater, and it is to be understood that my invention is not limited to an installation identical with that herein disclosed.

Under certain conditions some vapor is given off by the fuel and if means is not provided for automatically taking care of this vapor, the presence of the vapor will interfere with the proper operation of the heater. A most common cause of such interference is the accumulation of slugs of vapor between slugs of liquid fuel and the irregular operation of the burner resulting from alternate deliveries of slugs of vapor and liquid fuel. Where the slugs of vapor become sufficiently large, the combustion in the heater may be put out when a particularly large vapor slug is delivered thereto.

With my invention the vapor accumulates in the float chamber, and when a predetermined amount has accumulated, this vapor is supplied

to the burner in diluted form mixed with liquid fuel, so that at no time does the burner receive only vapor. The proportion of vapor is at no time large enough appreciably to affect burner operation. In other words, my invention automatically relieves the accumulated vapor in such manner that efficient burner operation is maintained and vapor accumulation is prevented from building up to a point where it can interrupt the supply of liquid fuel to the burner.

The heat exchanger shown and described is claimed in the application of William C. Parrish, Serial No. 490,162, filed June 9, 1943, now Patent No. 2,432,929, issued December 16, 1947. Certain features of the fuel feed control device are claimed in my earlier application, Serial No. 476,429, filed February 19, 1943, now Patent No. 2,427,758, issued September 23, 1947, and in the patent of William A. Marshall, Jr., No. 2,381,358, issued August 7, 1945, therein referred to.

While I have illustrated and described only a single embodiment of my invention, it is to be understood that my invention may assume numerous other forms and includes all modifications, variations and equivalents coming within the appended claims.

I claim:

1. In combination with a burner, a fuel feeding system comprising means providing a fuel chamber, means for supplying liquid fuel under pressure to said chamber, said fuel being of a nature to give off vapor, a conduit which conducts said liquid fuel from said chamber to the burner, means forming a vapor passage and a passage for liquid fuel connecting said conduit with the upper and lower portions respectively of said fuel chamber whereby vapor from said chamber is mixed with the liquid fuel conducted to the burner, and a float controlled valve responsive to fuel level in said chamber regulating communication between said chamber and the vapor passage.

2. In combination with a burner, a fuel feeding system comprising means providing a fuel chamber, means for supplying liquid fuel under pressure to said chamber, said fuel being of a nature to give off vapor, a conduit which conducts said liquid fuel from said chamber to the burner, means forming a vapor passage and a passage for liquid fuel connecting said conduit with the upper and lower portions respectively of said fuel chamber whereby vapor from said chamber is mixed with the liquid fuel conducted to the burner, and a float controlled valve responsive to fuel level in said chamber and regulating communication between said chamber and the vapor passage, together with means forming a flow restriction in the other passage.

3. A fuel feeding system for an aircraft heater burning a liquid fuel, said system comprising means providing a fuel chamber, means for supplying liquid fuel under pressure to said chamber, said fuel giving off vapor under certain conditions, automatic vapor relief valve means for said chamber, a conduit adapted to feed liquid fuel from said chamber to said heater, and conduit means adapted to feed said vapor from said relief means back into the liquid fuel in said conduit for preventing interruption to the flow of liquid fuel to the heater by such vapor.

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