Nov. 23, 1948. S. E. HEYMANN 2,454,512

AIRCRAFT HEATER INCLUDING MEANS TO PREVENT FUEL CONTAMINATION OF THE VENTILATING AIR

Filed Aug. 17, 1945 3 Sheets-Sheet 1

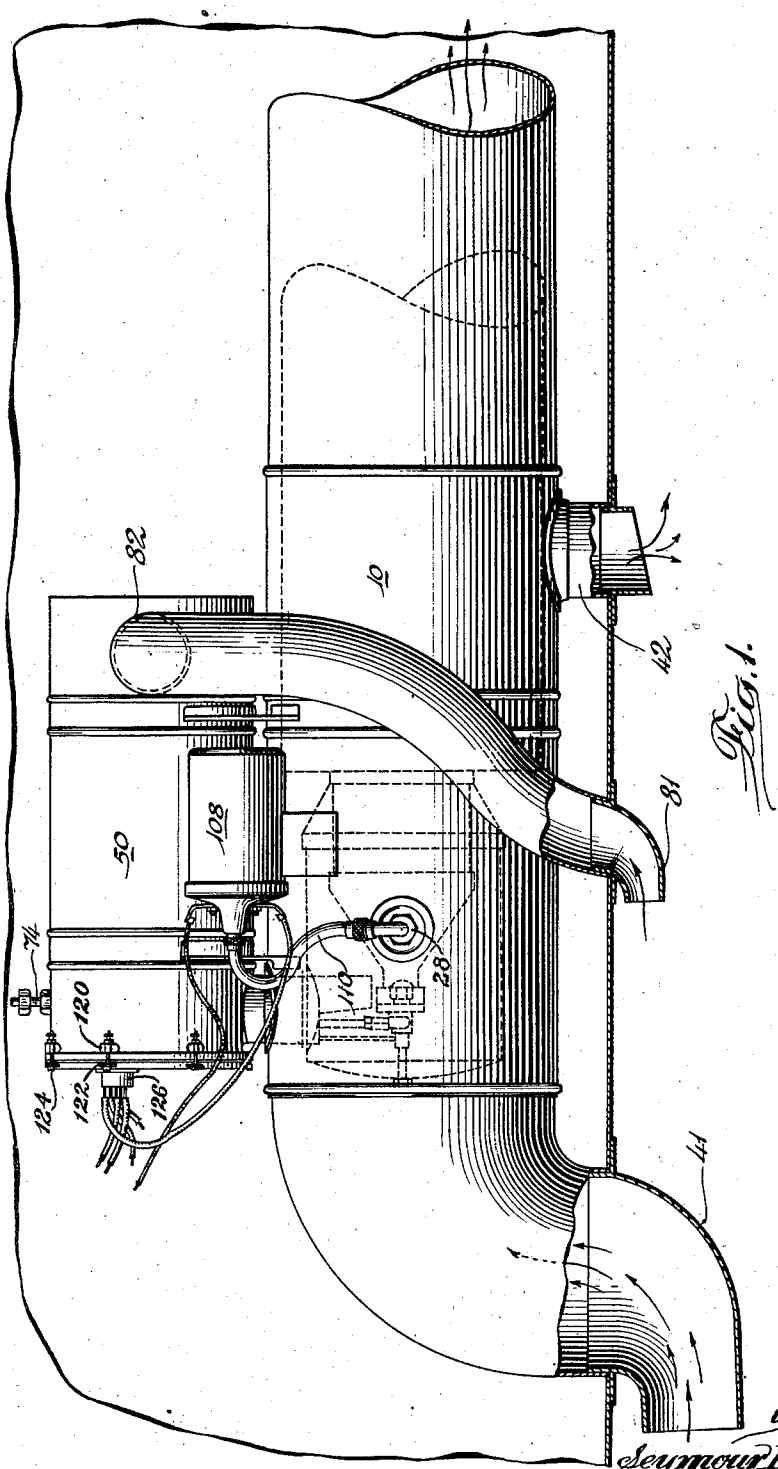


Fig. 1.

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Filed Aug. 17, 1945 3 Sheets-Sheet 2

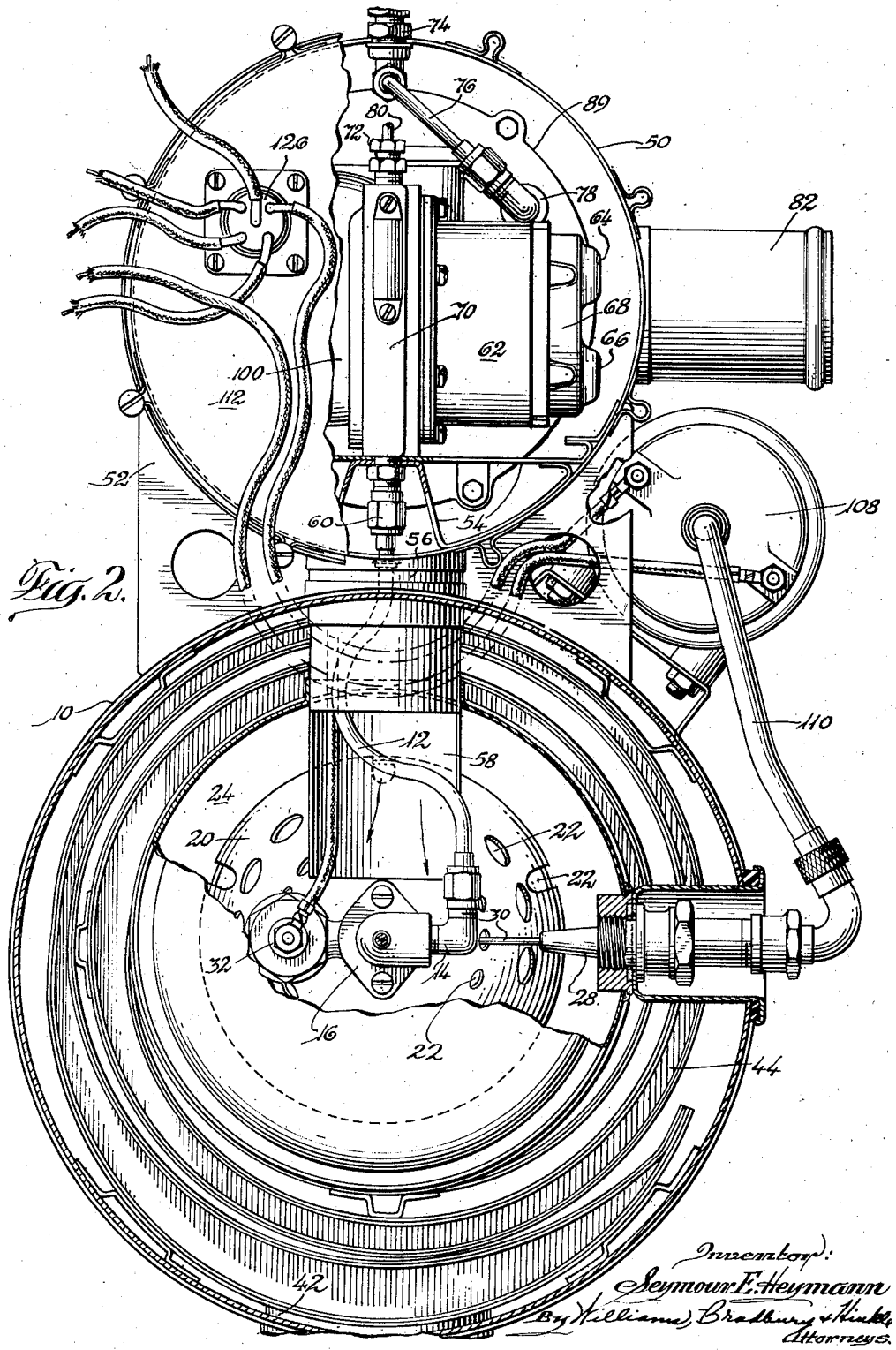


Fig. 2.

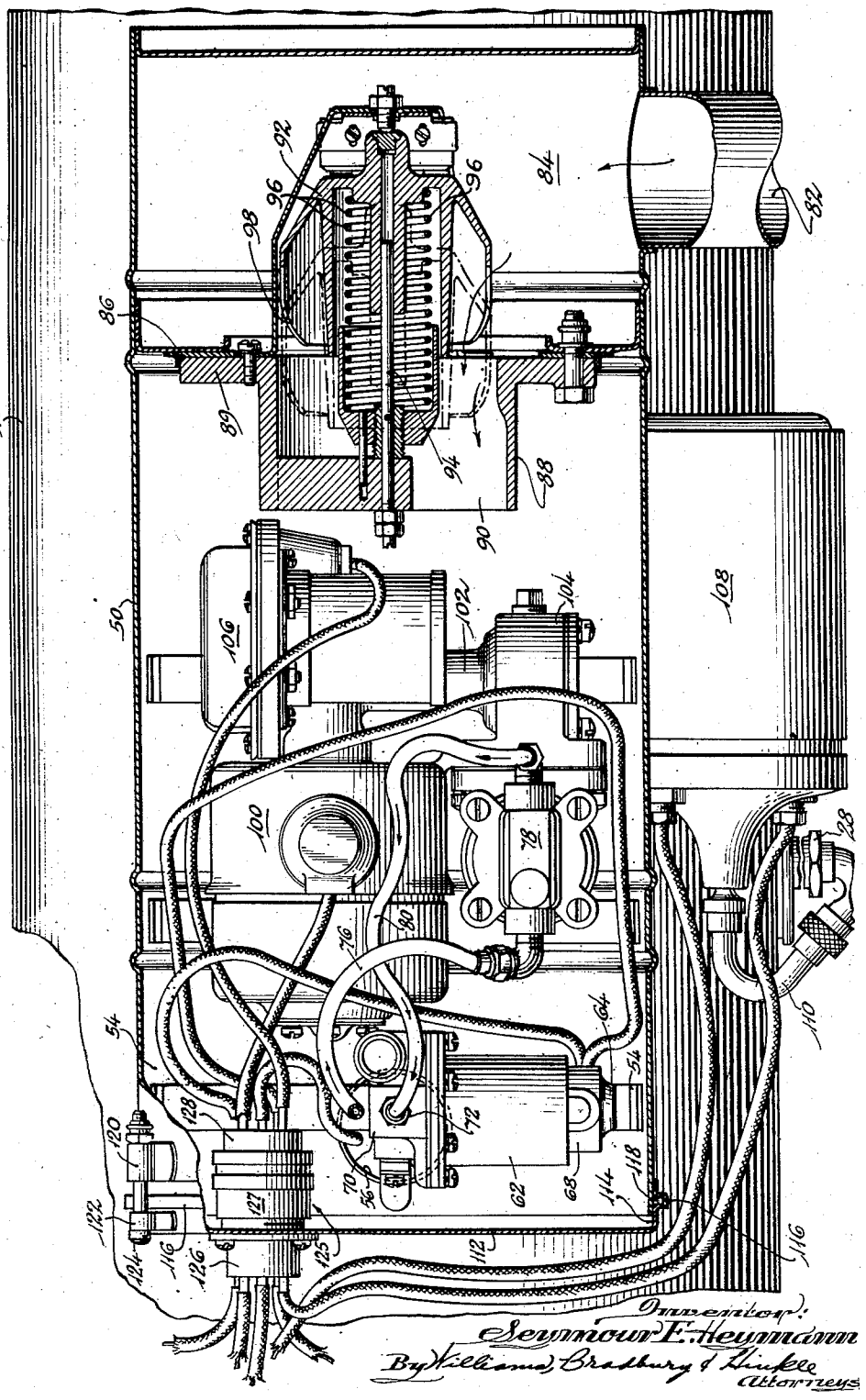
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Fig. 3.



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AIRCRAFT HEATER, INCLUDING MEANS TO PREVENT FUEL CONTAMINATION OF THE VENTILATING AIR

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5 Claims. (Cl. 126—116)

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This invention relates to heaters of the internal combustion type and it is particularly concerned with heaters of this class designed for use on aircraft. In such installations heretofore there has been some danger of fire in the event of a leak or a break in the gasoline feed line—it being understood that this type of heater usually employs as fuel the same liquid fuel which is used in the engine of the aircraft. To obviate or minimize the danger which might arise from a break in the fuel line, the present invention provides an enclosing box or chamber for the accessory mechanism associated with the heater and particularly for the fuel pump and its feed pipe. This box or chamber is provided with an opening through which the air for combustion is drawn into the heater so that if any leakage of liquid fuel takes place in the connections between the pump and the heater, the combustion air sweeping through the enclosing chamber will carry along such fuel to the burner where it will be consumed along with other fuel introduced through the nozzle. The fuel pump housed within the enclosing chamber adjacent the heater is of the type which is capable of producing considerable suction on the inlet side so that there is sub-atmospheric pressure in the fuel line all the way from the supply tank to the pump; hence a leak admitting air to that part of the line will merely allow the fuel to flow back to the tank, since the tank is probably located below the pump.

One object of the invention therefore is to provide a new and improved heater of the internal combustion type, together with fuel feeding mechanism therefor and a housing enclosing such mechanism adjacent the heater.

Another object of the invention is to provide an internal combustion heater together with a pump and associated mechanism for supplying liquid fuel thereto and connections for furnishing combustion air to the heater, together with a chamber enclosing such fuel feeding mechanism and arranged to receive the air for combustion and to furnish it to the heater, said air flowing over and past the fuel feeding mechanism in its movement through the chamber.

It is also an object of the invention to provide an internal combustion heater for use on aircraft or other vehicles driven by internal combustion engines, said heater being adapted to employ the same fuel as said engines and including not only its own fuel feeding pump but also means by which it can be connected directly to the engine fuel pump in the event of failure or unsatisfactory operation of the heater pump.

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In general, therefore, it is the object of the invention to provide an improved heater of the internal combustion type particularly adapted for use on aircraft by reason of the arrangement of its fuel connections mainly within an enclosing chamber vented to the heater itself for safe disposal of any liquid which might leak from said connections.

Other objects and advantages of the invention will appear from the following description taken in connection with the drawings, in which:

Fig. 1 is a somewhat diagrammatic representation of a heating system embodying the present invention shown installed in an aircraft;

Fig. 2 is an end elevation of the device with a portion of the end wall broken away so as better to disclose the structure therebeneath; and

Fig. 3 is a longitudinal medial sectional view of a portion of the device.

The heater to which this invention relates and which is of the internal combustion type includes a cylindrical casing 10 within which the burner structure is supported. This structure includes a liquid fuel feed pipe 12 connected by an elbow 14 into a nozzle supporting block 16 from which the fuel nozzle 18 discharges into the burner cone 20. This cone is formed with openings or perforations 22 which may be variously arranged and which are shown as including circular openings in two sizes and some elongated openings, all of which admit air from the chamber 24 which surrounds the burner cone 20. Within the casing 10 and around the air chamber 24 there is an annular space 26 serving as a flow passage for ventilating air which is to be warmed by the heater.

The combustible mixture formed by the fuel issuing from the nozzle 18 and the air which enters the burner cone 20 through the openings 22 is initially ignited by means of a spark plug 28 having its electrode 30 extended within one of the openings 22 but out of contact with the edge of the opening, thus forming a spark gap at which ignition of the fuel takes place. An

auxiliary or emergency igniter of the hot wire type is shown at 32 disposed adjacent a special opening 34 in the burner cone 20 to be used if the spark ignition system should fail. The flame and products of combustion resulting from ignition of the fuel in the cone 20 travel through the cylindrical passage 36 to the combustion chamber 38 which is an approximately cylindrical space within the spiral heat exchanger. The hot products of combustion travel from this central space 38 through the spiral passage which leads to the exhaust or outlet connection shown at 42 in Fig. 1. The air which is to absorb heat from the products of combustion is supplied by a ventilating air ram 41 and travels in substantially straight paths through the spaces 44 formed between the spiral turns and the heated air flows through an outlet conduit 46 for discharge to the cabin of the aircraft or into several branch passages for distribution to different portions of the space to be heated.

The auxiliary chamber or housing 50 is shown supported by brackets 52 extending from the casing 10, and within the housing 50 a bracket structure 54 supports the various elements of the mechanism. An air tube 56 provides a passage extending from the interior of the housing 50 across the annular space 26 in the heater casing 10 and communicating with the air chamber 24. As shown in Fig. 2, the rear half of the air tube is cut away from the portion which projects into the chamber 24 but the forward half 58 extends downwardly therein serving as a screen or baffle to prevent the air from flowing directly into the openings 22 of the burner cone, thus causing the air to be more generally distributed in the chamber 24 so as to enter the cone 20 from all sides. The fuel pipe 12 is seen in Fig. 2 extending upwardly from the elbow 14 through the air tube 56 and terminating in a coupling 60 which connects with the valve device 62 by which the flow of fuel to the heater is controlled. The bracket 54 supports the valve device 62 with the coupling 60 extending from the lower side of the latter. The device 62 includes two solenoid operated valves, one providing for restricted flow of fuel and the other serving as a shut-off valve. The interior structure of these valves is not a feature of the present invention and need not be described in detail, but the location of the restriction solenoid is indicated by the boss 64 and the location of the shut-off solenoid is denoted by the boss 66 formed in the cover 68 which encloses this structure. The fuel passage controlled by the two valves is indicated at 70 extending between the coupling 60 and a fitting 72 at the upper side of the valve device 62. The fuel supply pipe leading from a suitable tank or other source of supply is shown entering the housing 50 through the fitting 74, while the tube 76 within the housing 50 connects the fitting 74 with the pump 78. From the pump the fuel is fed through a pipe 80 to the connection fitting 72 which leads into the valve control passage 70. The fitting 74 is clamped to the wall of the housing 50 in air-tight relation thereto.

Thus it will be seen that the various couplings between the fittings and connecting sections of tubing through which the fuel is led from the supply pipe to the pump 78 and then through the valve device 62 are enclosed within the chamber 50, while the feed pipe 12 extends through the air pipe 56 directly to the burner within the casing 10. With air flowing through the chamber 50 to the burner by way of the air

tube 56, any leakage of the gasoline or other liquid fuel which occurs at any of these connections will be readily carried along to the burner itself and consumed without producing any risk of fire outside the heater.

The air flow through the chamber 50 is maintained by means of a blower in some cases but usually by means of a ram 81 which is directed forwardly, in the direction of travel of the aircraft or other vehicle, and which is connected to the intake pipe 82 shown in Fig. 3 entering the chamber 50 near one end. At this end of the chamber 50 a compartment 84 is formed by a transverse partition 86 which supports an air inlet fitting 88 formed with a flange 89 by which it is attached to the partition and having an air passage 90 which is controlled by a movable valve member 92. This valve is slidable on a stem 94 which is supported in the fitting 88, and a spring 96 urges the valve member 92 yieldingly to its fully open position in which the flaring slots 98 in the skirt of the valve member 92 admit the air to the passage 90. Increased velocity of the aircraft increases the pressure of air entering through the passage 82 and acts against the valve member 92 to compress the spring 96 and to shift the valve toward the position shown in dotted outlines in Fig. 3. This reduces the available portions of the flaring slots 98, and in this manner the valve operates to regulate the air pressure supplied to the heater. The air flowing from the passage 90 through the chamber 50 sweeps over the pump 78 and over the fuel valve device 62 and the fuel passages connected to these parts so as to pick up any film or drops of liquid fuel which may leak from these parts or the couplings connecting them.

As seen in Fig. 3, the fuel pump 78 is driven by an electric motor 100 by connection with a drive shaft enclosed in a tubular casing 102 and gearing contained in a casing 104. The motor also actuates a make and break device enclosed in a housing 106 and cooperating with a high tension spark coil 108 which is mounted outside the chamber 50 for furnishing current to the spark plug 28. The high tension current from the coil 108 is conducted to the spark plug through a special conduit 110 disposed externally of the chamber 50 and the heater casing 10.

One end wall 112 for the chamber 50 is made removable, being formed with a peripheral flange 114 which engages in a channel formed by a ring 116 secured to the cylindrical wall of the chamber near the end thereof with a ring of packing material 118 disposed in the channel for sealing the joint thus formed. Loops 120 of strap material are welded to the cylindrical wall of the chamber 50 and loops 122 are welded to the cover flange 114, so that tie bolts 124, each extending through one of the loops 120 and one of the loops 122, serve to secure the cover 112 in position to make the chamber 50 air tight. The electrical conductors leading to the mechanism inside the chamber 50 are arranged in a terminal block 125 having a part 126 secured to the outer face of the cover 112 with the ends of the various wires sealed into it. Suitable terminal fittings extend from the part 126 through the cover and into the part 127 of the block mounted on the inner face of the cover 112, and the flexible wires inside the chamber 50 are connected into a separable plug 128 which has contact means arranged in the conventional manner for interconnection with corresponding contacts in the block part 130. This makes it possible to readily

disconnect the external wiring from the wires within the chamber **50** whenever it becomes necessary to service or repair the parts in said chamber or to remove and replace a defective heater.

The particular electrical connections for operating the specific heater illustrated need not be described since they form no part of the present invention. The particular fuel line controls shown may be considered as typical although the controls used will vary from one heater to another or from one installation to another, the important consideration being that whatever fuel controls are used which might leak should be located within the sealed container **50** and that suitable electrical connections be brought into the container in sealed relation to the wall thereof.

While there is shown and described herein certain structure illustrating the invention, it is to be understood that the invention is not limited thereto or thereby but may assume numerous other forms and includes all modifications, variations and equivalents coming within the scope of the following claims.

I claim:

1. In combination with an internal combustion heater including a burner, a combustion chamber and a heat exchanger, means forming an auxiliary chamber closed except for an air supply inlet and an air outlet passage leading directly to the burner, a supply conduit for liquid fuel entering said auxiliary chamber through a wall thereof in sealed relation thereto and extending through the air outlet passage to the burner, electrically actuated means enclosed in said auxiliary chamber and controlling the flow of fuel through said conduit, said auxiliary chamber having a removable wall with sealing and clamping means to secure it, a terminal block in two parts secured to opposite faces of said wall with electrical conductors extending through said block in air tight relation thereto, a separable plug engageable with the part of said block on the inner face of said wall, and electrical conductors extending from said plug to said flow controlling means.

2. An aircraft heater comprising a spray-type liquid fuel burner, a combustion chamber and a heat exchanger associated with said burner, a ventilating air case enclosing said heat exchanger and supporting the latter, said spray-type burner including a fuel nozzle and a fuel line passing through said air case and connected to said nozzle and means forming a jacket enclosing said connection, an air pipe for supplying combustion air to said burner, said air pipe being connected to said jacket and enclosing said fuel line so that fuel leaking from the connection will be carried into said burner along with the combustion air, a pressure-tight container, means securing said container to said casing so that said container is supported from said casing, said container having a pressure-tight closure member, fuel control means located in said container and connected to said fuel line, means connecting said air pipe to the bottom of said container, said pipe acting as means for conducting combustion air to said burner, an inlet combustion air connection for said container, and a fuel supply fitting passing through the wall of said container in air-tight relationship thereto, said fitting being connected to said fuel control means.

3. A unitary removable aircraft heater adapted to be used in an airplane having a forwardly facing ram thereon and including ventilating air ductwork therein comprising a liquid fuel burner and a heat exchanger sealed to said burner and supplied with hot products of combustion from said burner, a casing surrounding said heat exchanger and adapted to be connected at its ends to said ventilating air ductwork, a combustion air line leading from said forwardly facing ram and sealed to said burner, and an exhaust pipe leading from said heat exchanger and sealed thereto to the exterior of said aircraft, all of said seals being pressure tight so that said combustion air pipe, said burner, said heat exchanger and said exhaust pipe form a pressure tight sealed system communicating at both ends with the atmosphere outside the aircraft, said combustion air pipe having an enlargement adjacent said heater, said enlargement having a portion of its wall secured in removable relationship thereto, securing and sealing means for securing said removable wall portion in pressure tight relation to the remaining portion of said wall, fuel control means located within said enlargement, means for supplying fuel to said fuel control means, and a fuel pipe connected between said fuel control means and said burner, said fuel pipe passing from said enlargement to said burner by way of the portion of said combustion air pipe between said burner and said enlargement.

4. An aircraft heater comprising a liquid fuel burner, a heat exchanger having a combustion side and a ventilating air side and connected to receive hot products of combustion from said burner on said combustion side, a ventilating air case surrounding said heat exchanger and burner and supporting the same, said air case having air duct adapters at its ends adapted for quick attachment to a ventilating air duct system, a pressure-tight container, means physically attaching said container to said case so that said case supports said container, said container having a removable pressure-tight wall, a combustion air inlet fitting carried by said container and adapted for connection to a combustion air line for supplying air under pressure to said container, an air passage-forming fitting connecting said container to said burner, a fuel fitting for attachment of a fuel line extending through the wall of said container, fuel flow-controlling means disposed within said container and connected on its inlet side to the last said fitting, means forming a fuel conduit connected to the outlet side of said fuel flow-controlling means and to said burner, said fuel conduit passing from said container to said burner by way of said air passage-forming fitting, and the system comprised of said container, said combustion air inlet fitting, said air passage-forming fitting, said burner, and the combustion side of said heat exchanger including sealing means to make it pressure tight with respect to the ventilating air side of said heat exchanger and the atmosphere immediately surrounding said heater.

5. In combination with an internal combustion heater including a burner, a combustion chamber and a heat exchanger, a tubular casing for enclosing said heat exchanger and supporting the latter, means forming an auxiliary chamber closed except for an air supply inlet and an air outlet passage leading from substantially the bottom thereof directly to the burner, means connected to said auxiliary chamber and to said casing for supporting said auxiliary chamber from said casing, a supply pipe for liquid fuel extending through a wall of said auxiliary chamber in sealed relation thereto, a fuel control valve within

the auxiliary chamber connected with said supply pipe, a feed pipe leading from said valve to said burner through the air outlet passage, electrical operating means for said valve within the auxiliary chamber and electrical conductor means therefor extending through a wall of the auxiliary chamber in sealed relation thereto, and sealing means for rendering the system comprising said auxiliary chamber, said inlet and outlet air passages, said burner, and one side of said heat exchanger pressure tight with respect to the atmosphere surrounding said heater.

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