Jan. 11, 1949.

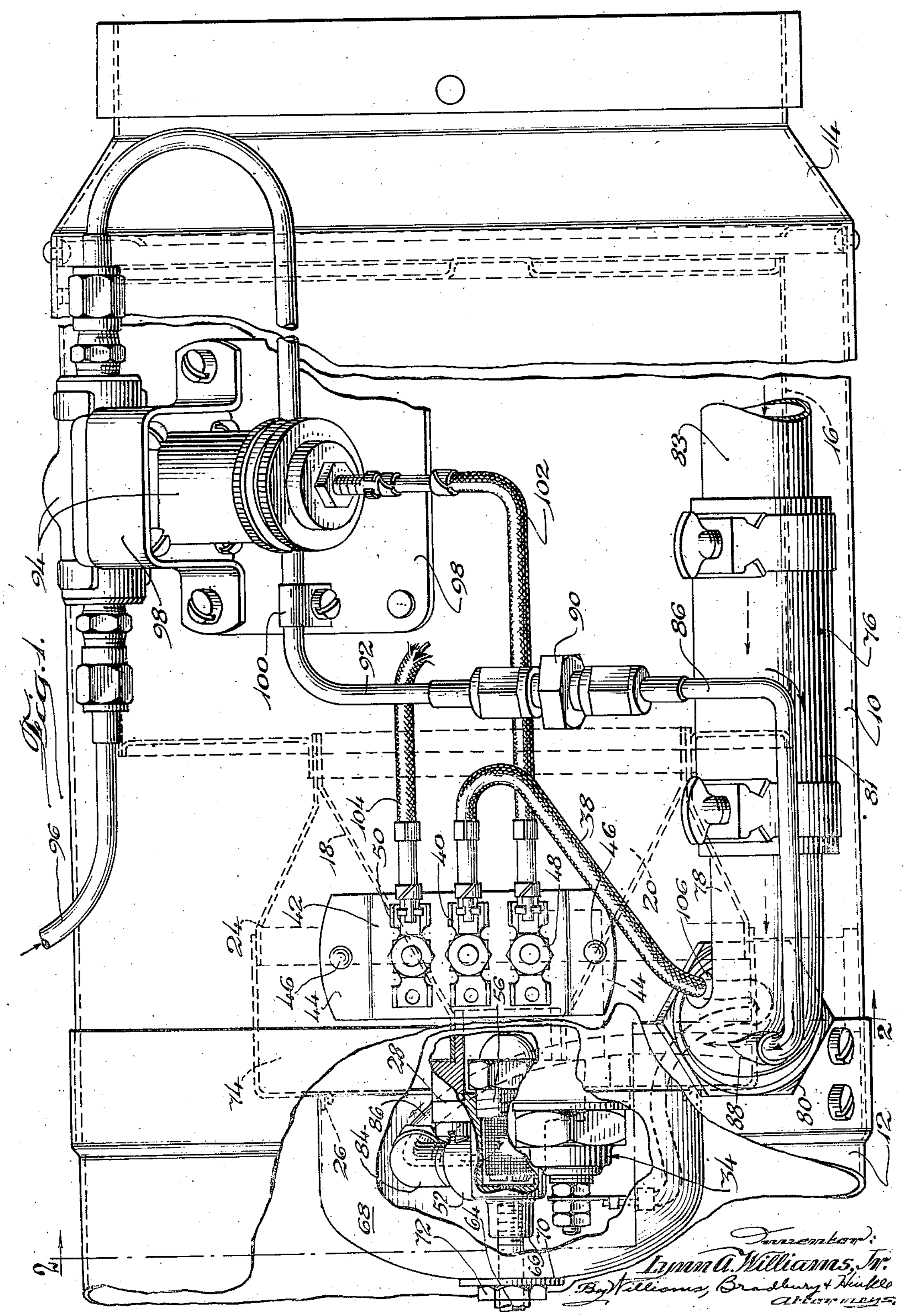
L. A. WILLIAMS, JR

2,458,968

INTERNAL-COMBUSTION HEATER HAVING MEANS TO PREVENT FUEL CONTAMINATION OF THE VENTILATING AIR

Filed Nov. 6, 1943

2 Sheets-Sheet 1



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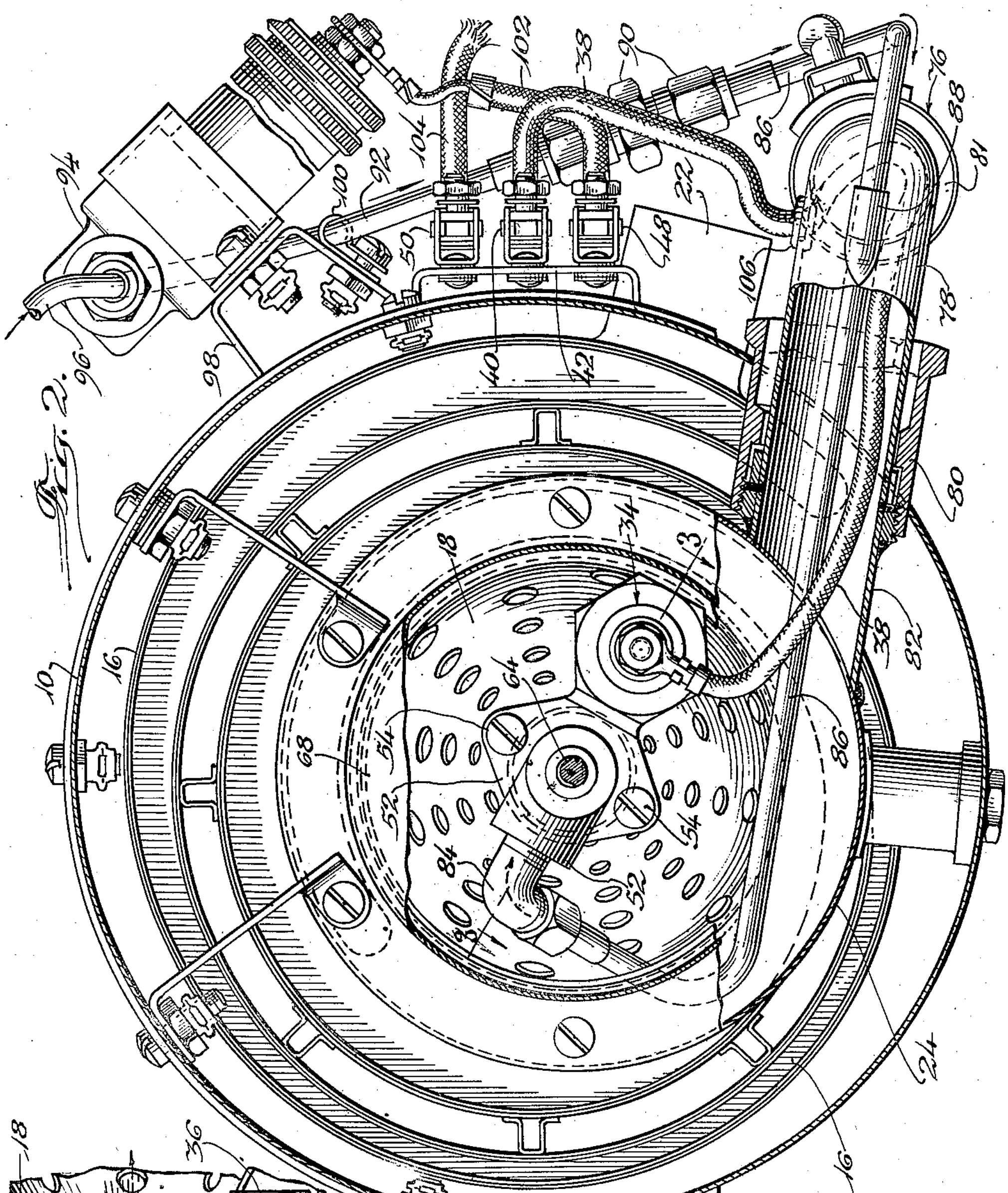

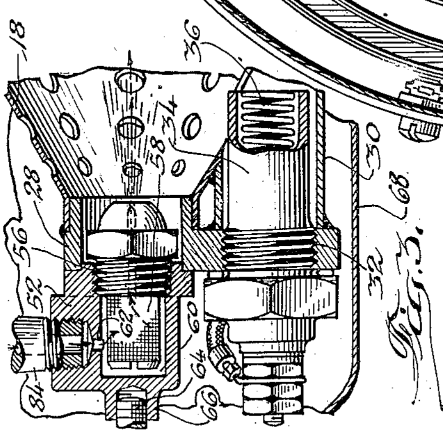

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INTERNAL-COMBUSTION HEATER HAVING MEANS TO PREVENT FUEL CONTAMINATION OF THE VENTILATING AIR

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2 Claims. (Cl. 126—116)

1

My invention relates to internal combustion heaters of the type particularly adapted for, but not limited to, use in heating the cabins and other parts of aircraft.

An object of my invention is to provide a new and improved heater which prevents fuel or fuel vapor from entering the heated ventilating air supplied to the cabin or other enclosed spaces of an aircraft.

Another object of my invention is to provide an internal combustion heater having new and improved means for preventing vapor lock in the fuel supply line.

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

In the drawings:

Fig. 1 is a side view of a heater installation embodying my invention and showing parts cut away to illustrate detail of construction;

Fig. 2 is a transverse, irregular sectional view taken on the line 2—2 of Fig. 1; and

Fig. 3 is a partial, sectional view of the nozzle assembly and is taken on the line 3—3 of Fig. 2;

I have illustrated my invention as comprising a heater casing 10 having its lefthand end attached to an air supply pipe 12 which leads to a ram, blower, or any other suitable source of air supply. The righthand or outlet end of the heater casing 10 is connected to a duct 14 leading to an aircraft cabin or other space or spaces to be heated with ventilating air furnished by the heater. It will be understood that the duct 14 may have one or more outlets and may be provided with any usual or desired arrangement of shutters for controlling flow of ventilating air into the space or spaces supplied by the heater.

The casing 10 encloses a heat exchanger 16 which may be of any suitable type, but which is illustrated herein as being of the spiral type disclosed and claimed in the co-pending application of William C. Parrish, Serial No. 494,155, filed July 10, 1943, and assigned to the assignee of the present application. A perforated cone 18 has its large end attached to the lefthand or inlet end of heat exchanger 16 and forms a conical combustion chamber 20 supplying hot products of combustion to the heat exchanger. These hot gases flow through a spiral gas passage in the heat exchanger 16 and are discharged to atmosphere through an exhaust outlet 22, as more fully illustrated and described in the aforesaid Parrish application. The cone 18 is enclosed in a sheet metal housing 24 which surrounds this cone in spaced relation thereto and terminates in the rolled over edge 26.

2

The casting 28 is welded or otherwise secured to the smaller end of the cone 18 and to the corresponding end of a cylindrical shell 30, welded or otherwise suitably secured to the cone, and in effect constituting a part thereof. This casting 28 is threaded as indicated at 32, to receive a plug-like electrical igniter 34, having a resistance wire 36 in open communication with the interior of the cone 18. This igniter is supplied with current through an insulated conductor 38 having one end attached to the igniter plug and the other end attached to a terminal 40 of a terminal bracket 42, having outwardly turned ends 44 attached to the casing 10 by rivets 46. The terminal plate or bracket 42 also has additional terminals 48 and 50.

A nozzle casting 52 is removably secured to the casting 28 by screws 54. This casting is threaded to receive a plug-like nozzle 56, including a cylindrical strainer 58 for removing impurities from the fuel before this fuel enters the nozzle and is discharged thereby into the combustion chamber 20 in the form of a conical spray. The strainer 58 is located in a chamber 60 formed in the casting 52 and supplied with fuel through a restricted inlet 62. A stud 64 is threaded into a boss 66 provided by the casting 52. This stud projects through an opening in a cover 68 which is clamped against the lefthand end of the housing 24 by washer 70 and nut 72 screwed onto the end of the stud 64.

The cover 68 and housing 24 provide a combustion air space 74 surrounding cone 18 and the nozzle and igniter assembly secured thereto. Air from the combustion air space 74 passes through the perforations in the cone 18 to mix with the fuel delivered by the nozzle 56 and form the combustible mixture which is burned in the combustion chamber 20. Air for the combustion air space 74 is furnished by a combustion air supply pipe indicated generally by the reference character 76. This pipe includes a metal elbow 78 attached at one end by a coupling 80 to a nipple 82 welded or otherwise secured to the housing 24 and in open communication with the interior of this housing. The other end of the elbow 8 is clamped to one end of a short section of flexible hose 81, the other end of which is clamped to a rigid pipe 83 leading from any suitable source of combustion air supply.

The fuel supply line for the nozzle 56 comprises an elbow 84 threaded into the nozzle casting 52, a section 86 of copper tubing or other rather flexible tubing bent, as clearly shown in the drawings, and having a part extending through the nipple 82, coupling 80 and adjacent portion of the elbow 78 of the combustion air supply pipe. This elbow 78 is provided with a short sleeve 88 welded thereto and this sleeve snugly fits about the copper tubing 86 adjacent a point where it passes through a wall of this elbow. One end of the copper tubing 86 is connected by a coupling 90 to a second section of copper tubing 92 leading to a solenoid valve 94 connected to a fuel supply pipe 96 leading from a fuel pump or any other suitable source of fuel under pressure.

The solenoid valve 94 is strapped to a bracket 98 suitably secured to the casing 10 and this bracket is illustrated as providing a clip 100 forming an intermediate support for the copper tubing. A conductor 102 connects the solenoid valve to the terminal 48. A third conductor 104 is illustrated as being connected to the terminal 50 and this conductor may lead to any additional control means not shown. It will be understood that suitable circuits are connected to the terminals 40, 48 and 50 for supplying current to these terminals and such circuits may include thermal switches, manual switches and other usual control elements.

Particular attention is called to the fact that the fuel supply line for the nozzle 56 is surrounded by the air inlet pipe where this line extends across the ventilating air space between the casing 10 and the housing 24. This is important in that it prevents contamination of the ventilating air by fuel leaking from this fuel supply line. Any fuel which leaks from a portion of the fuel supply line adjacent the ventilating air passage between the heater casing 10 and housing 24 passes into the combustion air space 74 and vaporizes to mix with the combustion air delivered to the combustion chamber through the openings in the cone 18. Attention is also called to the fact that the electrical conductor 38 for the igniter 34 also enters the housing 24 by way of the combustion air supply line. The elbow 78 has a grommet 106 surrounding an opening through which this conductor extends. This grommet closely fits the conductor to prevent or minimize leakage of combustion air from the combustion air supply pipe at this point. The points at which the electrical conductor 38 and copper tubing 86 pass through the wall of the elbow 78 are outside of the ventilating air stream so that slight leakage of combustion air at these points is immaterial, as such leakage will not tend to contaminate the ventilating air.

The combustion air flowing through the combustion air supply pipe and chamber 74 connected therewith will prevent overheating of the fuel flowing to the nozzle 56 and will prevent vapor lock occurring in the section of the fuel supply pipe adjacent the nozzle. Where extreme cooling of this portion of the fuel supply line is desired, the combustion air supply pipe should be connected with a source of unheated air. However, where a heavy fuel is used or where, for other reasons, vapor lock is not a problem, the combustion air supply pipe may, if desired, be supplied with heated air from the duct 14 or from any other suitable source.

A feature of my invention lies in the particular arrangement of the fuel nozzle and igniter relative to each other and to the combustion chamber so that heat from the igniter is transmitted to the nozzle during the starting period, but relatively little heat is transmitted to the nozzle from the combustion chamber while the heater is in normal operation. The casting 28 is preferably made of material having a high heat conductivity such as, for example, brass. This casting supports the igniter plug 34 and transmits heat therefrom to a point adjacent the end of the nozzle 56 which is surrounded by a tubular-like portion of this casting. This construction functions to conduct heat to the nozzle both by radiation from the adjacent portion of the casting 28 to the nozzle and by conduction through the nozzle casting 52 into which the nozzle is threaded. It will be understood that the igniter 34 is cut off from its source of current by the usual thermostatic switch after the heater has attained normal operating temperature so that heat is transmitted from the igniter to the nozzle only during the starting period.

The combustion air entering the interior of the housing 24 and the cover 68, which is in sealing engagement therewith, surrounds the cone 18 and nozzle and igniter assembly and absorbs heat therefrom during normal heater operation; furthermore, the nozzle is indirectly attached to the small end of the cone 18 through castings 52 and 28 and the former casting is preferably made of cast iron, or other material having a relatively low coefficient of heat conductivity. Only a small part of the casting 28 is directly exposed to the combustion chamber, and a large part of the heat absorbed by this casting is conducted to the igniter plug 34 and shell 30 and dissipated therethrough; furthermore, the small end of the cone 18 is surrounded by a large body of combustion air which is flowing to the combustion chamber through the perforations in this cone, so that the end of the cone attached to the casting 28 is the coolest part of this cone. All of these factors combine to prevent excessive heating of the nozzle during burner operation, and thereby to prevent cracking of the fuel passing therethrough.

While I have illustrated and described only a single embodiment of my invention, it is to be understood that my invention is not limited to the particular details shown and described, but may assume numerous other forms, and that my invention includes all modifications, variations and equivalents coming within the following claims.

I claim:

1. An internal combustion heater of the class described, comprising a ventilating air casing, a heat exchanger located within said casing, a liquid fuel burner for supplying hot gases to said heat exchanger including a fuel spray nozzle removably attached to one end of said burner, said burner being located within said casing at one end of said heat exchanger so as to provide space for ventilating air to flow through said casing around said burner, a fuel line leading to said nozzle, a fitting exterior to said burner and within said casing for connecting said fuel line to said nozzle, a jacket forming a combustion air space surrounding said burner and open at the rear end thereof to permit ready access to said burner for insertion or removal of said nozzle, fitting, or fuel line, a detachable cap for closing the open end of said jacket and enclosing said fuel line and fitting, a conduit for conducting combustion air to the interior of said jacket and cap, said air conduit having its inlet end located remotely from said heater, and said fuel line being located inside said conduit between said cap and a point outside of said casing whereby said nozzle is easily removable for cleaning and whereby fuel leakage at said nozzle or fitting cannot contaminate the ventilating air flowing through said

casing and heat exchanger and around said burner.

2. An internal combustion heater of the class described, comprising a ventilating air casing, a heat exchanger located within said casing, a liquid fuel burner for supplying hot gases to said heat exchanger including a fuel spray nozzle removably attached to one end of said burner, said burner being located within said casing at one end of said heat exchanger so as to provide passages for ventilating air to flow through said casing around said burner, a fuel line leading to said nozzle, a fitting exterior to said burner and within said casing for connecting said fuel line to said nozzle, means defining a combustion air space surrounding said burner and open at the rear end thereof to permit ready access to said burner for insertion or removal of said nozzle, fitting or fuel line, a detachable cap for closing said open end and enclosing said fuel line and fitting, an air pipe for supplying air for combustion to said burner, said pipe traversing the ventilating air casing between said combustion air space defining means and the exterior of said casing and terminating at a source of air remote from said heater and said fuel line being located inside said air pipe between said combustion air space defining means and a point outside of said casing.

LYNN A. WILLIAMS, Jr.

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