

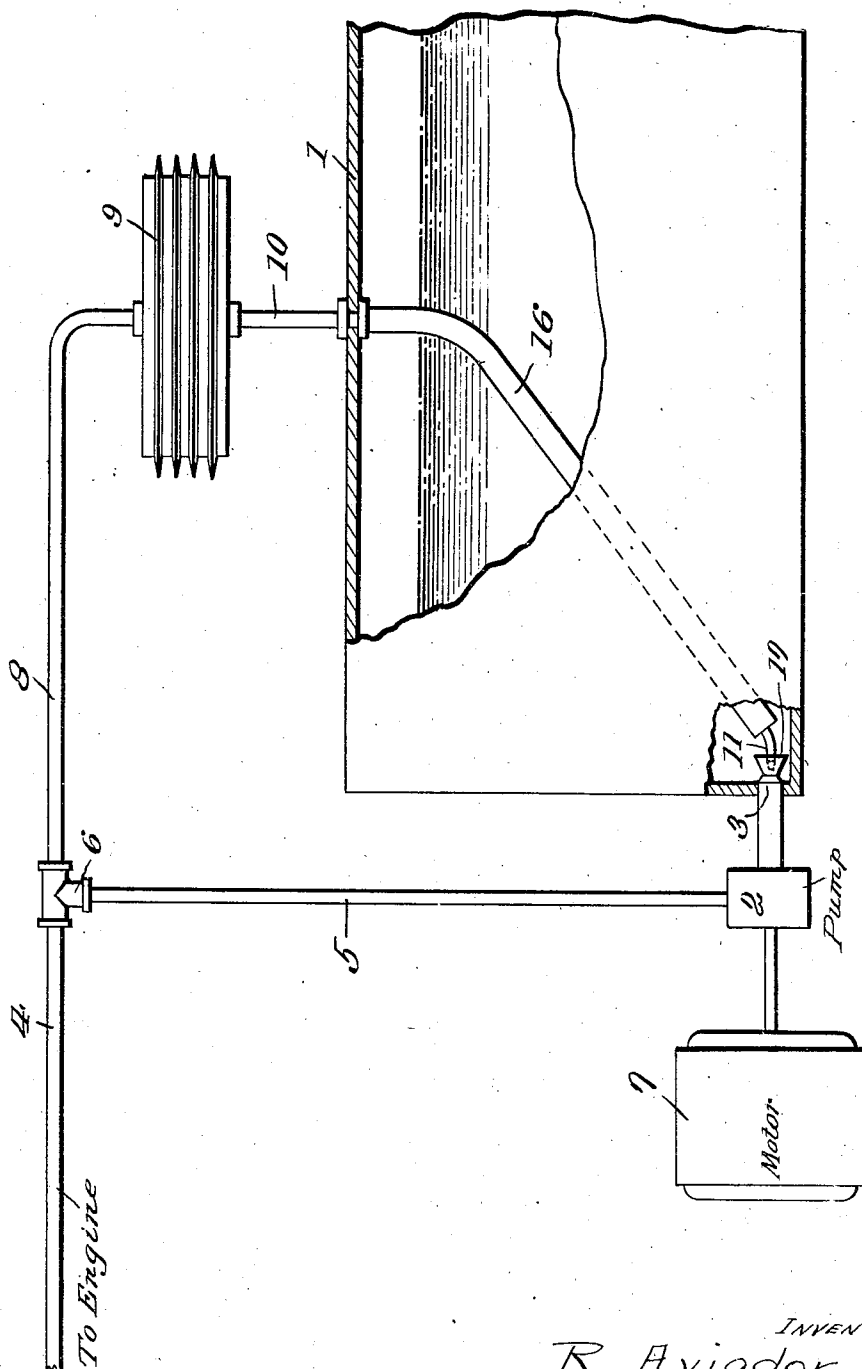
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FUEL FEEDING DEVICE FOR AIRCRAFT

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FUEL FEEDING DEVICE FOR AIRCRAFT

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8 Claims. (Cl. 103—5)

This application is a continuation-in-part of applicant's prior application Serial No. 256,157 filed February 13, 1939, now Patent No. 2,263,864, granted November 25, 1941.

This invention relates to a fuel feeding device for aircraft in which means are provided for counteracting the evaporation of liquid fuel due to high altitudes.

The liquid fuel required for the operation of the internal combustion engine of an airplane is fed to the engine by means of a pump from one or more tanks located at suitable places in the airplane. The pump is driven by an electro-motor which may be mounted in the casing of the pump or externally thereto.

It is a purpose of the invention to locate the pump externally of the fuel tank so that ready access may be had thereto for repairs or replacements and at the same time with the inlet of such pump located near the bottom of the tank and closely adjacent the return line from a cooling system for maintaining the fuel in liquid form at the inlet of the pump.

The fuel tank may be provided with insulated walls or may consist of walls constructed of non-metallic substances.

It has been found in practice that tanks of the above-mentioned type act as heat-accumulators and that the fuel within such tank becomes heated and accumulates the heat absorbed for a considerable time. Such heating is a consequence of the sun rays and the outside temperature. Therefore, as soon as an airplane with its fuel heated in such a way ascends to a considerable height the fuel in the tank will begin to evaporate and gasify due to the decreasing air pressure. The result will be that the pump can no longer satisfactorily feed the fuel to the engine. This is because a blade pump is generally used and the feeding action of such a pump will stop as soon as trapped gases or vapors of the fuel occur in the feed path of the pump. Furthermore, it is impossible to cool the fuel within the tank because of the insulated walls and also because the climbing speed of airplanes has been so increased that the airplane reaches a considerable height in an exceedingly short time. This causes uncertain feed of the fuel and in such case the feed may be entirely stopped.

Furthermore when the fuel within the tank is heated the gases and vapors are trapped generally closely above the bottom of the tank. Now, since the inlet of the feed pump is located at such place within the tank it may occur that

the fuel supply may be stopped even in the case of a small increase of the temperature of the fuel. Moreover, just at the inlet zone of the pump a somewhat reduced pressure is created by the suction of the pump rotor as compared with the pressure in the surrounding mass of liquid and therefore evaporation or gasification of the fuel will occur at such point earlier or more intensively than throughout the remainder of the tank.

It is an object of the invention to remove the above disadvantage by effecting a cooling of the fuel by circulation from the tank through an outside cooler and then back to the tank. This circulation of the fuel may be produced by means of a pump located externally of the tank. The return flow of the fuel from the cooler, however, is to take place at a point in the vicinity of the inlet of the pump feeding the fuel to the motor.

It is also an object of the invention to utilize the pump which feeds fuel to the engine for feeding fuel to the cooler and in such case a portion of the fuel delivered by the engine feed pump is branched off and passed through the cooler located outside of the fuel tank. The return flow of such fuel from the cooler enters the tank in the vicinity of the inlet of the motor feed pump.

A further object of the invention is the locating of the cooler at a convenient place on the airplane so as to be subjected to the air current. A cooler of this nature need have but relatively small dimensions since the outside temperature at considerable heights is very low and then in addition the strong air current caused by the flight of the airplane itself produces a strong heat exchange.

Furthermore, since the pumps used always have a greater capacity than the fuel consumption of the engine, the branching off of part of the fuel for circulation through a cooler for cooling the fuel contents of the tank may be carried out without extensive alterations of the power plant.

It is a further object of the invention to provide a construction wherein the fuel returning from the cooler in liquid form is directed towards the inlet of the feed pump at a certain pressure or at a certain speed so that the pump need produce less power than if the fuel were fed to the pump only due to the pressure head of the liquid column in the tank. Therefore, the energy used for circulating the fuel to the cooler is partially compensated by the smaller amount of energy

necessary to be produced by the pump. An object of the invention, therefore, is to devise a cooling system which consumes relatively little power.

It is especially advantageous to construct in accordance with the invention the outlet end of the return conduit so as to form an injector for the fuel surrounding said return conduit end. In such construction the fuel carried along by the injector action is not only cooled but also urged toward the rotor of the pump. The speed of the cooled fuel leaving the return conduit is then utilized in a special way.

A still further object of the invention, therefore, is to provide a construction whereby it is possible to effectively cool in a short time, the contents of a fuel tank by circulation so that even in the hottest season and under very strong sun radiation the temperature of the fuel is kept so low that no evaporation or gasification can occur.

The invention is shown in the drawing diagrammatically by way of example and the figure illustrates an elevation with parts in section of an embodiment of the invention.

Referring to the drawing the fuel tank of an airplane is shown at 1 and the pump 2 is located externally thereof with its inlet 3 located close to the bottom of the tank 1. The fuel is fed by the pump through the conduit 5 to the T connection 6 where part of the fuel is fed through the conduit 4 to the engine and a portion of the fuel is branched off through the conduit 8 to the cooler 9. The cooler 9 is mounted on an airplane in such a manner that it is subjected to the air current or is exposed in such a manner that the fuel is effectively cooled. The outlet conduit 10 from the cooler returns the cooled fuel in liquid form to the tank 1 and discharges such fuel through the outlet 11 at a point adjacent the inlet 3 of the pump. A strainer may be provided if desired at the inlet to the pump. The motor for operating the pump 2 is shown at 7.

The operation of the construction described is as follows:

The pump 2 feeds fuel in liquid form continuously through the conduits 5 and 4 to the engine of the airplane and at 6 a portion of such fuel is branched off through the conduit 8 into the cooler 9. In the cooler the warm fuel coming from the tank 1 is cooled and flows back through the conduit 10 into the tank. Part of the fuel leaving the outlet end 11 of the conduit 10 is mixed with the warm fuel in the tank 1 and thereby reduces gradually the temperature of the fuel.

In a relatively short time the total amount of fuel in the tank 1 has been passed through the cooler 9 and in this way a rapid cooling of the fuel is obtained so that no evaporation or gasification due to the heat accumulating walls of the tank can occur.

In order to utilize the pressure head of the circulating fuel resulting from the operation of the pump and the position of the cooler 9, the outlet end of the return conduit of the fuel is formed as an injector. The outlet end 11 of the conduit 10 is located within a tapering hollow member 17 and together therewith forms an injector. The fuel leaving the outlet 11 draws in the fuel surrounding the injector and carries such fuel along towards the pump 2. At the same time the fuel carried along by the action of the injector is cooled while the pressure head of the return conduit promotes the feed at the same

time. The fuel therefore flows at a certain speed and at a certain pressure to the rotor of the pump 2 and the advantages referred to above are obtained. The conduit 10 for the return flow from the cooler 9 is provided with a special heat insulating layer 16 so that the fuel is supplied to the inlet of the feed pump at the lowest possible temperature.

It will be noted that the pump utilized in this construction serves two functions, namely the feeding of the airplane engine and the circulation in the cooling arrangement. It therefore is not necessary to provide an additional pump.

With regard to the cooler 9, the coil cooler or a cooler of any other type may be used to secure the requisite action.

Various changes may be made in the construction shown but as is evident both the motor and the pump are easily accessible in the construction outlined for repairs or replacements.

I claim:

1. A fuel feed device for aircraft comprising a fuel tank, a pump unit located externally of such tank the pump of which constitutes the motor feed pump and said pump having an inlet connected to said tank for withdrawing fuel from said tank, a cooler having means to facilitate heat exchange and located outside said fuel tank to maintain the fuel in liquid form, a motor feed conduit connected to said pump, a conduit connecting the motor feed conduit to said cooler for feeding to said cooler part of the fuel delivered by the motor feed pump and an insulated conduit from the cooler to a point adjacent the inlet of said feed pump to return the cooled fuel to said feed pump.

2. A fuel feeding device for aircraft comprising a fuel tank, a cooler having means to facilitate heat exchange and located outside said tank to maintain the fuel in liquid form, an engine feed pump located externally of said tank with its inlet connected to said tank for withdrawing fuel from said tank, means for branching off a portion of the fuel delivered by said pump to said cooler and insulated means for returning the fuel cooled by said cooler to said tank at the vicinity of the inlet of said pump.

3. A fuel feeding device as set forth in claim 2 in which said insulated means for returning the fuel cooled by said cooler cooperates with the pump inlet so as to form a fuel injector.

4. A feed device for readily volatile liquid fuel for aircraft comprising a fuel tank, a motor feed pump located externally of said tank and having its inlet connected to said tank for withdrawing fuel from said tank, a cooler having means to facilitate heat exchange to insure maintaining the fuel in liquid form located outside said fuel tank, a motor feed conduit connected to said pump, a conduit connecting said motor feed conduit to said cooler for feeding to said cooler part of the fuel delivered by the motor feed pump and a conduit from said cooler to a point adjacent the inlet of said pump for returning cooled fuel in liquid form to said feed pump.

5. A feed device for readily volatile liquid fuel for aircraft comprising a fuel tank, a motor feed pump located externally of said tank and having its inlet connected to said tank for withdrawing fuel from said tank, a cooler having means to facilitate heat exchange to insure maintaining the fuel in liquid form located outside said fuel tank, a motor feed conduit connected to said pump, a conduit connecting said motor feed conduit to said cooler for feeding to said cooler part

of the fuel delivered by the motor feed pump and a conduit from said cooler to a point adjacent the inlet of said pump for returning cooled fuel in liquid form to said feed pump, said last-named conduit being insulated.

6. A feeding device for readily volatile liquid fuel for aircraft comprising a fuel tank, a cooler having means to facilitate heat exchange to insure maintaining the fuel in liquid form located outside said tank, an engine feed pump located externally of said tank with its inlet connected to said tank for withdrawing fuel from said tank, means for branching off a portion of the fuel delivered by said pump to said cooler and means for returning the fuel cooled by said cooler in liquid form to the vicinity of the inlet of said pump.

7. A feed device for readily volatile liquid fuel for aircraft comprising a fuel tank, a motor feed pump located externally of said tank with its inlet connected to said tank for withdrawing fuel from said tank, a cooler having means to facilitate heat exchange to insure maintaining the fuel in liquid form located outside said fuel tank, a motor feed conduit connected to said pump, a conduit connecting said motor feed conduit to said cooler for

feeding to said cooler part of the fuel delivered by the motor feed pump and a conduit from said cooler to a point adjacent the inlet of said pump for returning cooled fuel in liquid form to said feed pump and said last-named conduit cooperating with said pump inlet so as to form a fuel injector.

8. A feed device for readily volatile liquid fuel for aircraft comprising a fuel tank, a motor feed pump located externally of said tank with its inlet connected to said tank for withdrawing fuel from said tank, a cooler having means to facilitate heat exchange to insure maintaining the fuel in liquid form located outside said fuel tank, a motor feed conduit connected to said pump, a conduit connecting said motor feed conduit to said cooler for feeding to said cooler part of the fuel delivered by the motor feed pump and a conduit from said cooler to a point adjacent the inlet of said pump for returning cooled fuel in liquid form to said feed pump and said last-named conduit cooperating with said pump inlet so as to form a fuel injector, said last-named conduit being heat insulated.

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