Nov. 21, 1950 F. H. CAREY 2,530,649

FUEL SUPPLY SYSTEM FOR CONTINUOUS COMBUSTION TURBINE TYPE AIRCRAFT

Filed Jan. 14, 1948 4 Sheets-Sheet 1

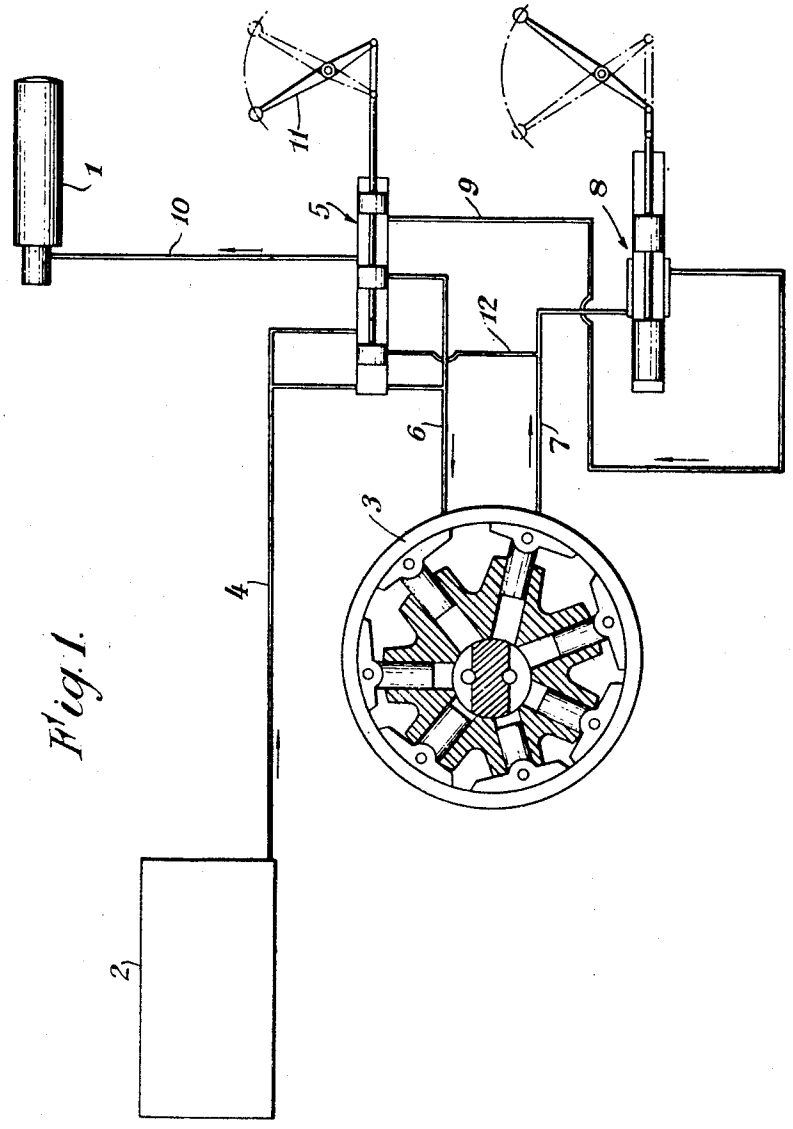


Fig. 1.

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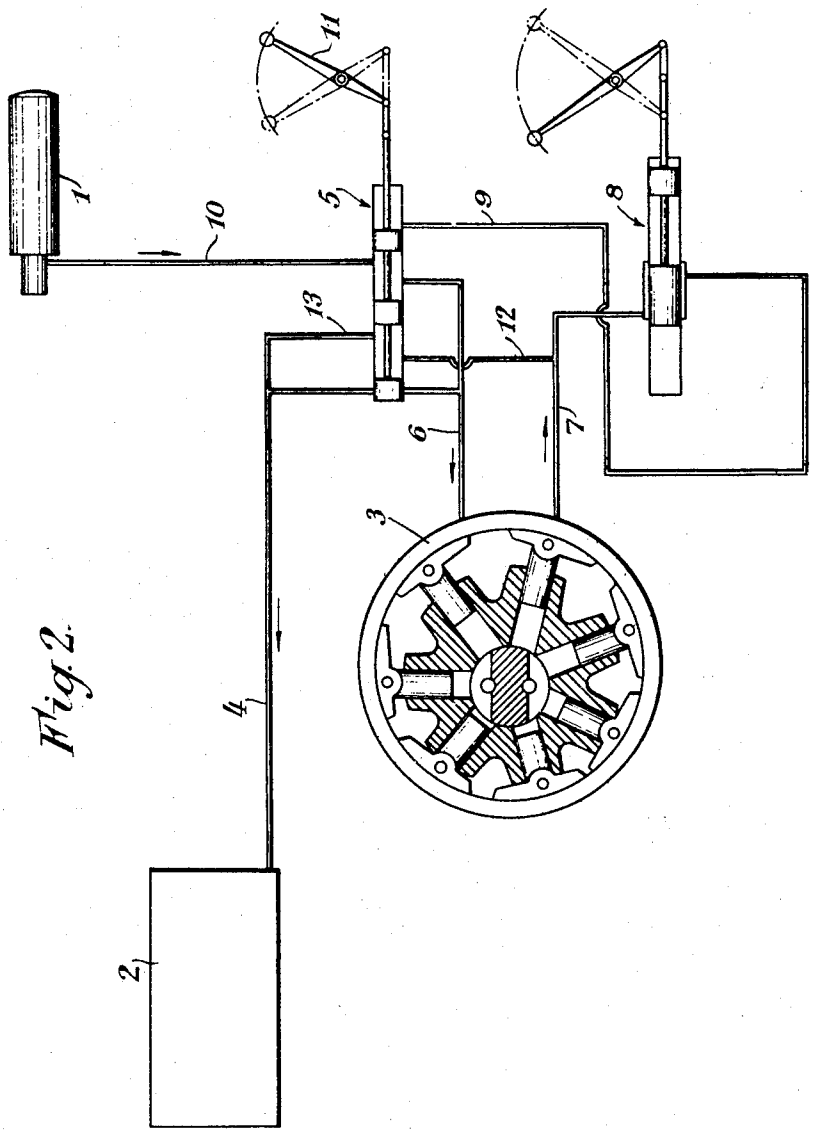


Fig. 2.

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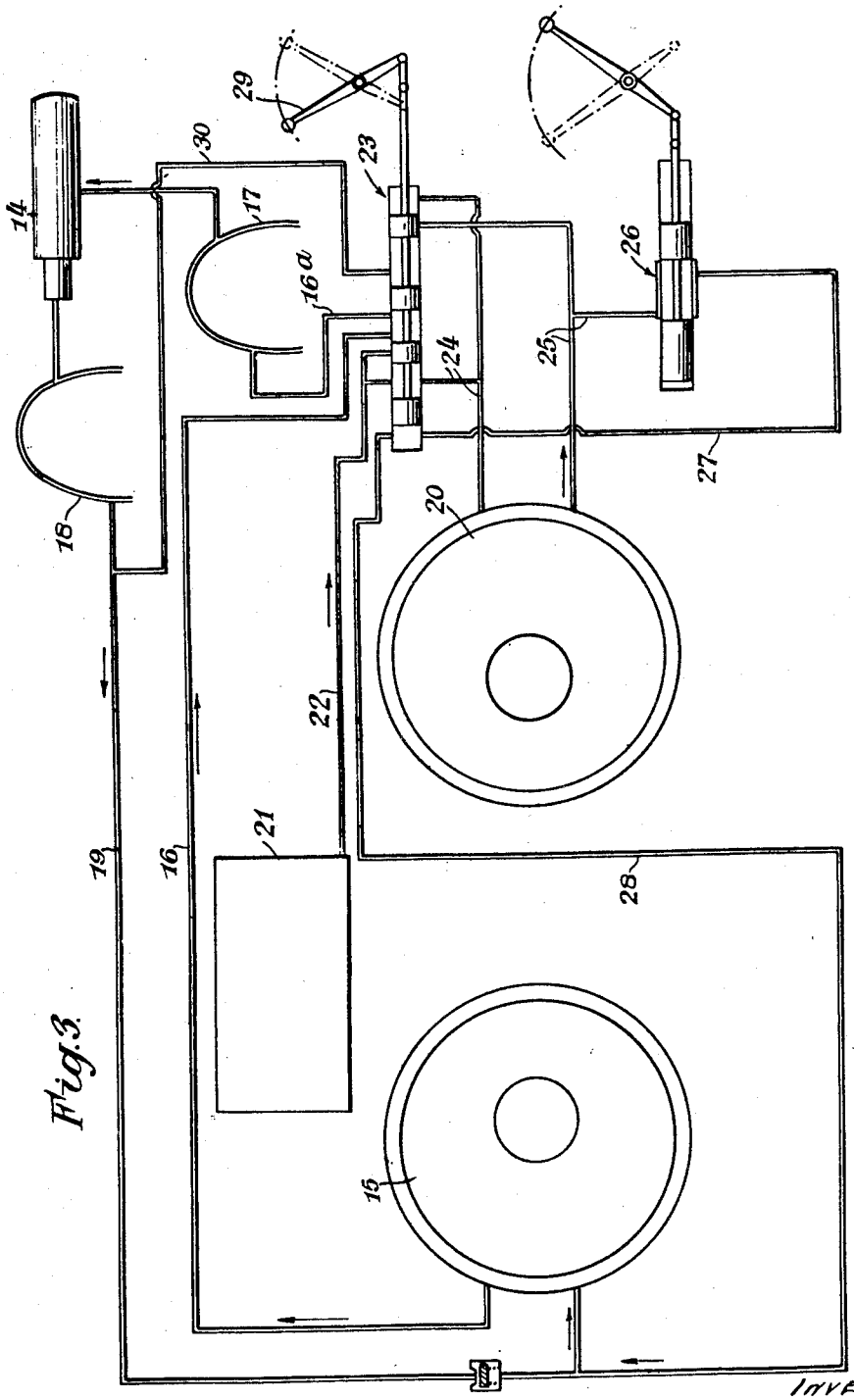


Fig. 3.

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Filed Jan. 14, 1948 4 Sheets-Sheet 4

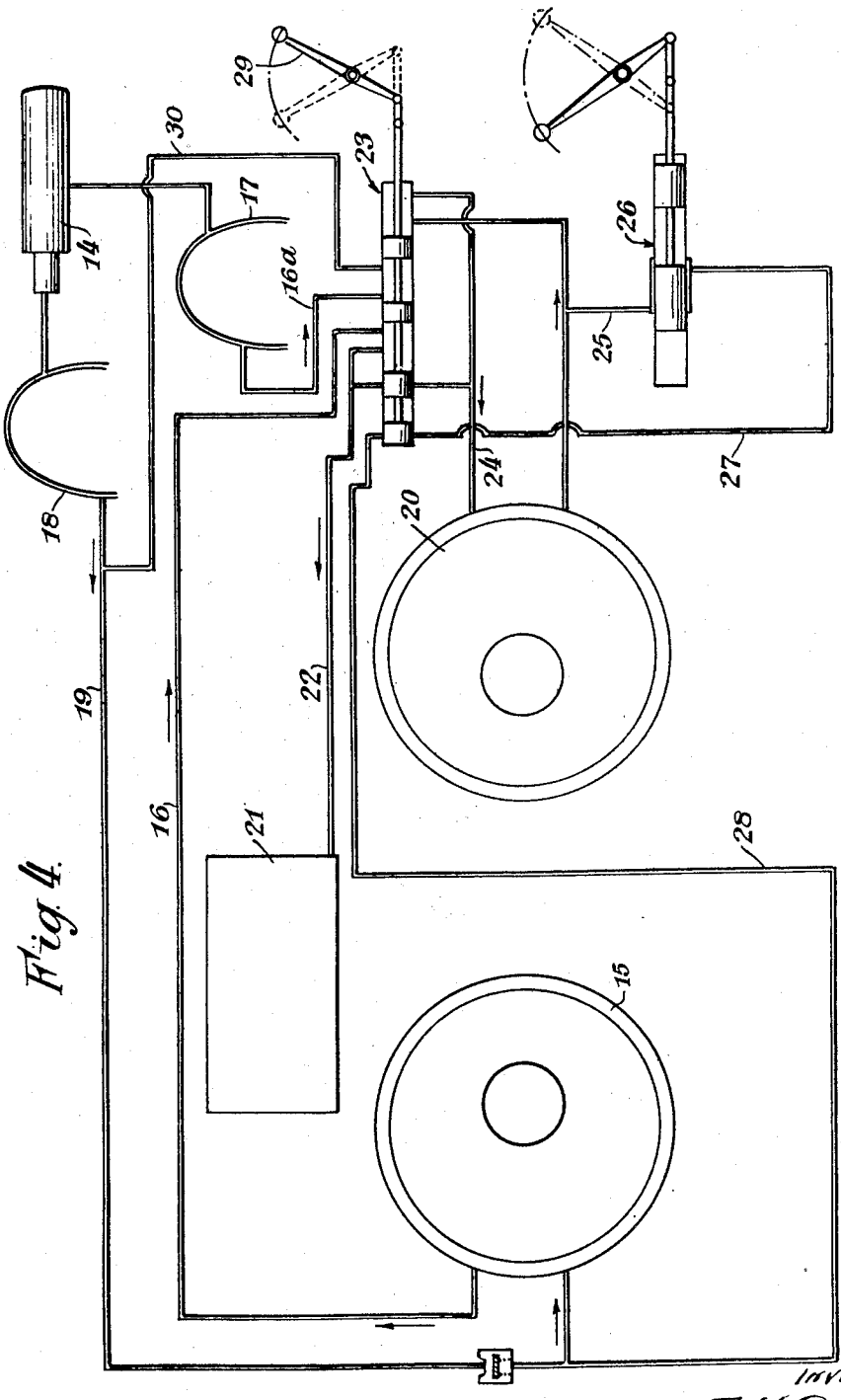


Fig. 4.

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UNITED STATES PATENT OFFICE

2,530,649

FUEL SUPPLY SYSTEM FOR CONTINUOUS COMBUSTION TURBINE TYPE AIRCRAFT

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Application January 14, 1948, Serial No. 2,341
In Great Britain December 24, 1947

5 Claims. (Cl. 158—36.4)

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This invention relates to systems for supplying liquid fuel to the engine of a continuous combustion turbine type power unit, such as is shown in my copending application, Serial No. 2,343, filed January 14, 1948, and is concerned with the problem of leaving the engine burners and combustion chambers dry in order that a fresh starting-up operation can be carried out with safety and without detrimental effects upon the engine. To this end, and in accordance with the invention, such a system comprises pump means which, during a stopping condition of the system, serves as a scavenging pump by having its inlet in communication with the burners and its outlet in communication with the tank. It is convenient to use as the scavenging pump a pump which during starting or running conditions of the engine forms a part of the normal supply system by serving or assisting in the delivery of fuel to the burners. When such a pump is engine-driven it is utilized as a scavenging pump in accordance with the invention by transferring the supply communication with the burners from the outlet to the inlet of the pump and at the same time placing the outlet of the pump in communication with the tank. In this way flow in the supply line from the pump to the burners is reversed and any fuel which is not consumed at the burner nozzles during the process of stopping the engine and any fuel in the system which is adjacent to the burners will be withdrawn by the pump and passed back towards the fuel tank.

The necessary modifications to the system to effect changeover from "running" to "stopping" can conveniently be made by one or more valves, turn-cocks, or equivalent, operated simultaneously by a hand or other actuator.

By means of the invention, the burners and adjacent portions of the system are automatically drained of fuel thus avoiding the risk of fuel pools forming in the combustion chambers which on starting would cause local and general overheating of the engine. It is an advantage of the invention therefore that there is no necessity for draining away or "dumping" unused fuel which hitherto would have succeeded in entering and forming pools in the combustion chambers.

It is not essential that the whole of the system be drained in this way, it being sufficient and in fact desirable to drain only the burners and the fuel lines in the vicinity of the burners, and to maintain any movable parts of the system, such as pumps and valve elements, in a flooded condition to avoid the risk of corrosion.

The invention is applicable to systems of differing types and some examples will now be described with reference to the accompanying diagrammatic drawings, of which:

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Figures 1 and 2 show one system in its normal running and stopping conditions respectively, and

Figures 3 and 4 are similar views of another system.

The system shown in Figures 1 and 2 incorporates simple direct-injection type burners one of which is designated by the reference numeral 1. The burners 1 are supplied with fuel from a tank 2 by an engine-driven pump 3 which draws the fuel along a conduit 4, through a portion of what may be termed a change-over valve indicated generally at 5, and along an intake conduit 6, and delivers it along the output conduit 7 through a metering valve 8, along the conduit 9, and through another part of the change-over valve 5 to the supply line 10 of the burners. When the system is to be converted from its normal running to its stopping condition the movable element of the change-over valve 5 is displaced by the clockwise rocking of a control lever 11 from the position shown in full lines in Figure 1 to the position shown in full lines in Figure 2. This displaces the movable element of the valve 5 so that the intake conduit 6 of the pump 3 is cut off from the conduit 4 and is placed in communication with the supply line 10 of the burners. Flow in the supply line 10 is therefore reversed, and the pump delivers through the conduit 7 and branch conduit 12 and through a section of the change-over valve 5 to the conduit 4 by way of the branch conduit 13. At the same time the delivery conduit 9 is cut off from the normal supply line 10, at the valve 5, hence the line 9 does not drain. Reversal of the metering valve 8, normally simultaneously with reversal of the valve 5, further prevents drainage of the line 9.

The system shown in Figures 3 and 4 incorporates burners of the known spill type one of which is indicated at 14, and comprises essentially two pumps of which one, an engine-driven circulating pump 15, operates normally to circulate fuel around a circuit including a supply conduit 16, 16a, a burner ring 17, burners 14, of which several would be connected to the burner ring 17, and a collector ring 18 and return conduit 19. The other pump, an engine-driven supply pump 20, operates normally to inject fuel into the circulating flow at a point in the return conduit 19. The supply pump 20 withdraws fuel from a tank 21, the fuel flowing along a conduit 22, through a section of a change-over valve 23 and along an

intake conduit 24. The pump 20 delivers the fuel along a conduit 25, through a metering valve or throttle 26, along a conduit 27, through another section of the valve 23 and along a conduit 28 which joins the return conduit 19 running from the collector ring 18 to the circulating pump 15. When the system is to be transformed from its normal running condition shown in Figure 3 to its stopping condition shown in Figure 4, a hand lever 29 associated with the movable element of the valve 23 is moved in a clockwise direction away from the full line position of Figure 3 into the full line position of Figure 4. The communications between various conduits is now modified with the result that a portion of the burner supply line 16, indicated at 16*a*, now communicates through a portion of the valve 23 and through a conduit 30 with the return conduit 19 so that fuel within the burners 14 and within the burner and collector rings 17 and 18 respectively is withdrawn along the return conduit 19 by the pump 15 which now delivers through the conduit 16 and through a section of the change-over valve 23 back to the tank 21 along the conduit 22. The circuit is at the same time modified so that the supply pump 20 now serves merely to circulate fuel around a circuit including the conduit 25, the change-over valve 23, and the conduit 24. In case the system should be changed to a stopping condition with the metering valve 26 open, the flow along the conduits 27 and 28 by which the fuel normally injects into the circulating flow, is interrupted by the change-over valve 23.

In the examples illustrated, the flow in the supply line from the pump to the burners is reversed and any fuel not consumed at the burners during the stopping process and any fuel adjacent to the burners is withdrawn back towards the tank so that no fuel is allowed to form pools in the combustion chambers of the engine. The invention enables a fresh starting-up operation to be carried out with safety and without detrimental effects upon the engine and avoids the necessity for the "dumping" of any fuel.

I claim:

1. A fuel supply system for aircraft engines of the continuous combustion turbine type, comprising a fuel reservoir, a burner nozzle, pump means, a change-over valve casing, a valve in said casing shiftable between a normal operating position and a stopping position, and conduit means interconnecting the pump means with the reservoir and with the burner nozzle, respectively, by way of the valve casing, for supply of fuel during normal operation to the nozzle and return of unused fuel therefrom during stopping, said conduit means including two by-pass passages, one between the nozzle and the intake side of the pump means and the other between the delivery side of the pump means and the reservoir, respectively, and said valve being formed with lands and passages arranged to close off said by-pass passages during normal operation and leave open the normal pump supply and delivery conduits, but to open the by-pass passages and close off the normal pump supply and delivery conduits, for withdrawing from the nozzle during stopping the unused fuel which was theretofore supplied to it during normal operation, and for returning the so-withdrawn fuel to the fuel reservoir.

2. A fuel supply system as in claim 1, characterized in that the burner nozzle is formed for supply of fuel to it and return from it of unused fuel, and further characterized in that the pump means comprises a circulating pump and a separate supply pump, and wherein the conduit means directly connected to the circulating pump normally affords a closed circulating path which includes the burner nozzle and its supply and return lines but not the reservoir, and the conduit means directly connected to the supply pump draws from the reservoir and feeds into the burner return line to the circulating pump, and further characterized in that the by-pass passages are arranged to provide a closed circulation path for the supply pump during stopping, and to connect the burner nozzle to the intake side of the circulating pump and the latter's delivery side to the reservoir.

3. A fuel supply system as in claim 1, characterized in that the burner nozzle is formed for supply of fuel to it and return from it of unused fuel, and further characterized in the inclusion of conduit means to connect the supply and return sides of the nozzle to the intake side of the pump means during stopping, but to connect them respectively to the delivery and the intake sides during normal operation.

4. A fuel system for an aircraft internal combustion turbine engine comprising, in combination with a burner, a fuel tank, and a pump; first conduit means extending from the fuel tank and branched for connection with each of the intake and delivery sides of the pump, second conduit means extending from the burner supply port and likewise branched for connection with each of the intake and delivery sides of the pump; valve means in said first and second conduit means controlling communication between the pump and each of the fuel tank and the burner, and normally positioned to leave open one branch in the first conduit means for supply from the fuel tank to the intake side of the pump, and to block that branch from the fuel tank to the delivery side of the pump, and also to leave open one branch in the second conduit means for supply from the pump to the intake port of the burner, and to block that branch from the intake port of the burner intake port to the intake side of the pump, said valve means being shiftable to a stopping position, wherein to open that branch in the second conduit means which establishes communication between the burner's intake port and the intake side of the pump, and to block that branch which formerly established communication between the burner and the delivery side of the pump, and also to open that branch in the first conduit means which establishes communication between the delivery side of the pump and the fuel tank, and to block that branch which formerly established communication between the fuel tank and the intake side of the pump.

5. A fuel supply system for aircraft engines of the continuous combustion turbine type, comprising a fuel reservoir, a burner nozzle, a single pump, a change-over valve casing, a fuel supply line running for normal operation to the pump from the reservoir by way of said valve casing, and having a branch normally blocked off, for alternate return communication from the valve casing back to the reservoir, a fuel delivery line running from normal communication from the pump, by way of the valve casing, to the burner nozzle, and having a branch, normally blocked off, for alternate return communication from the pump to the valve casing and thence by way of the aforesaid alternate branch to the reservoir, and an alternate

by-pass, normally blocked off, from the nozzle by way of the valve casing to the intake side of the pump, and a valve in said valve casing shiftable between a normal operating position, to afford communication between the reservoir and the pump, and thence to the burner nozzle, and a stopping position, wherein it blanks off the normal connections between the pump and reservoir and the valve casing, and establishes the alternate connections, for pump-actuated scavenging of the burner nozzle and return of unused fuel therefrom to the reservoir.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,334,679	Mason et al.	Nov. 16, 1943
2,494,778	Plass	Jan. 17, 1950

FOREIGN PATENTS

Number	Country	Date
14,234-28	Australia	July 4, 1929