March 11, 1958 A. W. GAUBATZ 2,826,147

LIQUID TRANSFER SYSTEM

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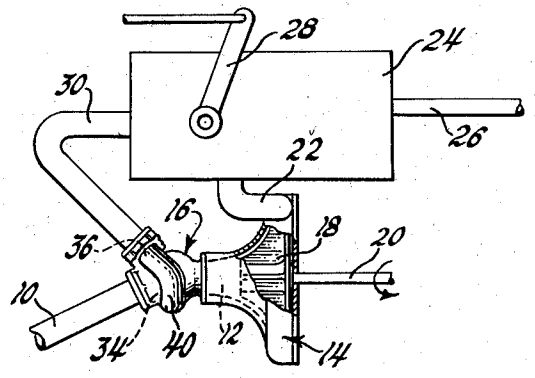


Fig. 1

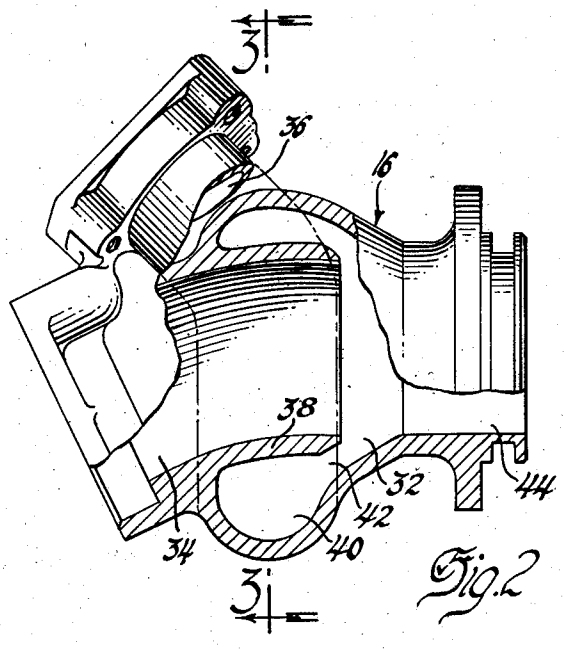


Fig. 2

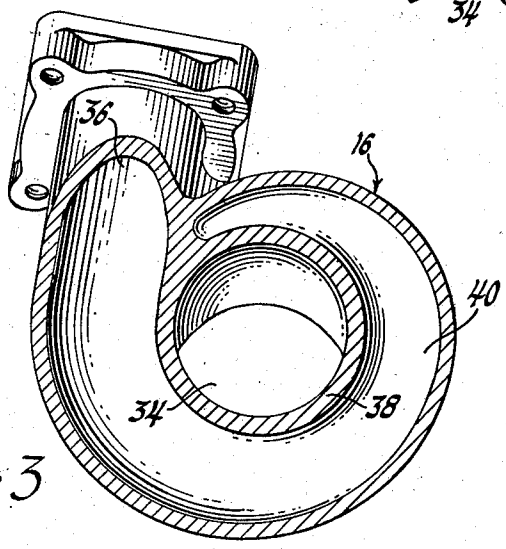


Fig. 3

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LIQUID TRANSFER SYSTEM

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1 Claim. (Cl. 103—5)

This invention relates to high capacity liquid transfer systems and more particularly to a pump inlet fitting therefor.

The fitting is particularly useful in high capacity fuel systems for jet engines and the like, although it should be realized that it may be utilized in other high flow pumping systems to great advantage.

The fuel system to which the fitting is particularly applicable generally includes a source of fuel for the engine, a fuel control device to regulate the delivery of fuel to the engine, a high speed pump for supplying the fuel control device with fuel from the source and a by-pass in the fuel control device whereby excess fuel from the output side of the pump may be returned to the input side of the pump.

Previous fuel systems had a T or Y fitting at the inlet eye of the pump to place the same in communication with the main fuel supply conduit and the by-pass fuel supply conduit. Such fittings promoted turbulent flow and vapor formation at the entrance of the pump resulting in poor pump efficiency and possible destruction thereof by cavitation.

An object of the invention is to provide a liquid transfer system of the forenoted or similar type with a pump inlet fitting for smoothly merging flow from separate sources in a desirable manner.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a partial schematic, partially broken away, of the liquid transfer system of the invention;

Fig. 2 is an elevational view, partially broken away, of the fitting shown in Fig. 1; and

Fig. 3 is a section taken substantially on the plane indicated by the line 3—3 of Fig. 2.

Referring now to Fig. 1, the fuel system includes a main fuel supply conduit 10 which delivers fuel to the inlet passage or eye 12 of the centrifugal pump 14 through a fitting 16, the pump rotor 18 being driven by an air turbine (not shown) through shaft 20. A conduit 22 conducts the output of the pump to the fuel control device 24 for delivery to the fuel nozzles (not shown) by conduit 26. A throttle lever 28 determines the rate of fuel delivery through the nozzle supply conduit 26 and this rate is usually less than the rate of fuel delivery to the fuel control device 24 through the conduit 22. A by-pass conduit 30 conducts the excess fuel from the fuel control device 24 to the inlet side of the pump by way of the fitting 16 for recirculation through the pump. The illustrated fuel system is commonly used for the afterburners of jet engines. The principles of the invention may also be applied to advantage to the main fuel systems of jet engines. Such main fuel systems generally have a centrifugal pump feeding a gear pump, both pumps being engine driven.

An important factor in obtaining high pumping efficiency is the maintaining of smooth or non-turbulent flow at the inlet 12 of the pump. The pump efficiency is also aided by imparting some pre-swirl to the fluid in the direction of pump rotation. The relative flow in the conduits 10 and 30 is variable in accordance with the operating condition of the engine and it is essential for the fitting 16 to deliver the combined flow to the pump inlet in a non-turbulent manner despite the variance in relative flow.

Referring now to Figs. 2 and 3, the fitting 16 is provided with a conically shaped swirl chamber 32 that receives fuel from both the main conduit 10 and the by-pass conduit 30 by way of a main inlet passage 34 and a by-pass inlet passage 36. The main inlet passage 34 has a lip portion 38 that opens axially into the swirl chamber 32. The by-pass inlet passage 36 has a terminal scroll portion 40 of decreasing cross-sectional area that loops around the lip portion 38 and opens along one side at 42 into the periphery of the swirl chamber 32 and around the lip portion 38. The spiral configuration of the terminal portion 40 of the by-pass inlet passage imparts swirl to the joint flow of fluid through the swirl chamber 32 in the same direction as the rotation of the pump rotor, as may be seen by the directional arrow of Fig. 1. An outlet passage 44 conducts the joint fuel stream to the inlet passage 12 of the pump and it should be noted that the main inlet passage 34, the swirl chamber 32 and the outlet passage 44 are coaxial and have substantially the same cross-sectional area as the inlet passage 12 of the pump.

When the relative flow of by-pass fuel is low, the fitting 16 will deliver fuel to the pump inlet in substantially the same manner as a straight and uniform sectioned conduit for the conical enlargement of the swirl chamber 32 is not sufficient to promote turbulence and vapor formation. It should be realized that there will be at least some flow of by-pass fuel to impart pre-swirl under practically all engine operating conditions. When the relative flow of by-pass fuel is high, the spiraling of fuel through the swirl chamber 32 will prevent turbulence and vapor formation. By introducing the main fuel flow into the core of the swirl chamber the smooth and vapor free flow of fluid to the inlet passage of the pump is accomplished.

While the preferred embodiment of the invention has been described fully in order to explain the principles of the invention, it is to be understood that modifications of structure may be made by the exercise of skill in the art within the scope of the invention which is not to be regarded as limited by the detailed description of the preferred embodiment.

I claim:

A liquid fuel transfer system comprising a centrifugal pump having a rotor and an inlet passage forming the inlet eye of the pump, a main fuel supply conduit for the pump, a by-pass fuel supply conduit for the pump, and a fitting connecting both conduits to the inlet passage of the pump, the fitting having a swirl chamber for fuel from both conduits converging in the direction of flow through the fitting, a main inlet passage in said fitting from the main conduit having a lip portion opening axially into the swirl chamber, a by-pass inlet passage in said fitting from the by-pass conduit having a terminal scroll portion of decreasing section looped around the lip portion of the main passage in the direction of rotation of said rotor to produce a smooth, non-turbulent flow toward said inlet eye and opening along one side into the periphery of the swirl chamber around the lip portion of the main passage, and an outlet passage from the swirl chamber to the inlet passage of the pump, the main inlet passage, the swirl chamber, and the outlet passage of the fitting being substantially coaxial with, and

of substantially the same cross sectional area as the inlet passage of the pump.

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