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ROTARY PUMP HAVING A VISCOSITY-CONTROLLED BY-PASS

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Fig. 2

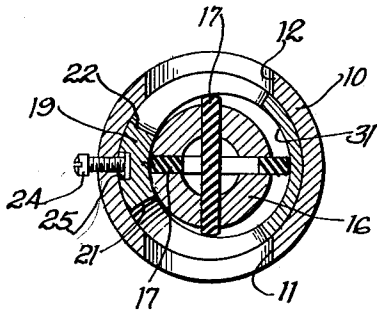


Fig. 1

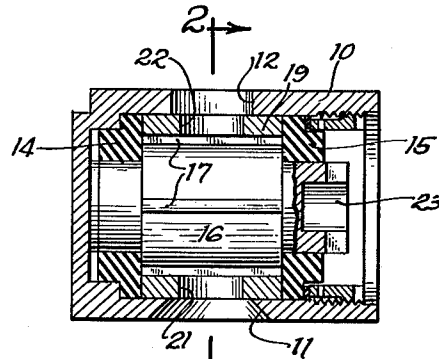


Fig. 3

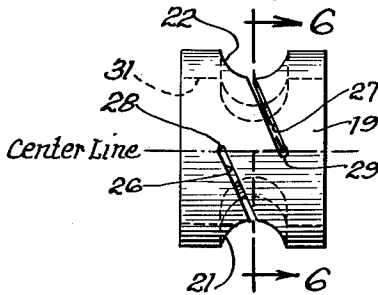


Fig. 4

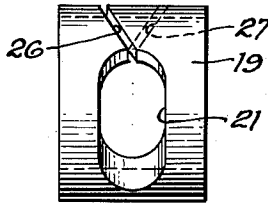


Fig. 5

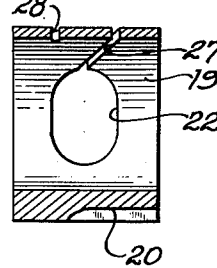


Fig. 6

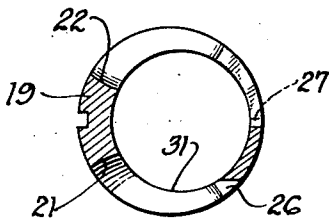
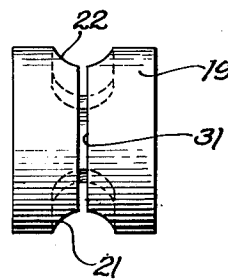


Fig. 7



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ROTARY PUMP HAVING A VISCOSITY-
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6 Claims. (Cl. 103—41)

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This invention relates to a rotary pump. More specifically it has relation to a positive displacement rotary pump in which vanes are caused to rotate in a casing to displace the fluid from the inlet to the outlet.

In the case of aircraft engines of the internal combustion type it often becomes necessary to inject water into the fuel-air mixture to improve engine performance. Such procedure is generally accomplished by providing a reservoir for the water, and a positive displacement pump associated therewith to transfer water therefrom to a nozzle whereby the water is injected into the intake manifold of the engine. In the event the reservoir runs dry a positive displacement pump, unless provision is made thereagainst, will then supply air to the injection nozzle, thus disturbing the then pre-set fuel-air ratio, and causing the engine to misfire or even to fail completely.

In order to insure against this latter contingency this invention has for its object the provision of a positive displacement pump so constructed as to deliver water as long as an adequate supply thereof is maintained at its inlet, but when such supply fails, air sucked into the pump is by-passed automatically back to the inlet.

In the drawing which shows certain preferred modes of carrying the invention into practice:

Fig. 1 shows a longitudinal cross section through a rotary vane type of positive displacement pump embodying the invention;

Fig. 2 is a transverse cross section taken on the line 2—2 of Fig. 1;

Fig. 3 is a side elevational view of the pump liner;

Fig. 4 is a bottom plan view of the pump liner;

Fig. 5 is a view similar to Fig. 4, but in cross section;

Fig. 6 is a cross section taken on the line 6—6 of Fig. 3; and

Fig. 7 is a side-elevational view of a modified form of liner.

Generally regarded the invention is based on the differing viscosities of air and water, and the greater resistance created by a passage of predetermined cross-sectional area to flow of water than of air, and comprehends the provision of a channel interconnecting the inlet and outlet ports and of such cross section that water will be pumped from inlet to outlet at a rated pressure and volume, but such that air will be by-passed through the channel and thus prevented from reaching the point of delivery of the pump.

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Referring to Figs. 1 to 6 there is shown by way of example a rotary vane type of positive displacement pump broadly including features well known in this art, namely a casing 10, inlet and outlet ports 11 and 12 respectively, rotor bearings 14 and 15 supported in the casing, rotor 16, slidable vanes 17—17, and liner 19 having inlet and outlet ports 21 and 22 in line respectively with ports 11 and 12. Rotation is imparted to the rotor by a motor (not shown) coupled thereto at 23. Liner 19 is a press fit in the casing 10, and is additionally secured by a screw 24 entering a slot 25.

Directing attention specifically to Figs. 3 to 6, the liner 19 is provided with a pair of slots 26 and 27 extending substantially helically thereof, one end of each slot opening into the inlet and outlet ports 21 and 22 respectively, and the other or closed ends 28 and 29 terminating just beyond the center line of the liner, and as clearly indicated in Fig. 3. By offsetting the ends 28 and 29 of the slots axially of the line there is no danger of unduly weakening the wall of the liner such as would be the case if a continuous slot were cut from port to port. However such alternative is within the scope of the invention, and will be explained hereinafter.

In the exemplificative pump, the bore 31 is 1.094" in diameter, its length 1.1263", and the pump is so designed otherwise that when operated at a speed of 3000 R. P. M. it will deliver 110 gallons of water per hour at 31 pounds per square inch. Accordingly slots 26 and 27 have been found to provide adequate by-pass of air when made $\frac{1}{16}$ " wide and caused to overlap the center line 0.031" on each side. At the mid-plane indicated by the center line of Fig. 3 the thickness of the liner is 0.093".

It will be noted that the outer edges of the vanes 17 are arcuate throughout their length so that substantially a line contact is obtained between an edge of a vane and the wall of the liner. Consequently at no time may a vane completely overlap both ends 28 and 29 of the slots, and therefore constant communication is afforded between the inlet and outlet ports via the slots and the interior of the liner. While an insignificant volume of water may be by-passed from outlet to inlet during operation, this is never such proportion of the total volume as to affect seriously the rated performance. However if the supply of water should become completely exhausted, and air is pumped, the proportions of the by-pass route are such as to short circuit the pump, and air pressure built up on the dis-

charge side is never sufficient to cause flow thereof to the intake manifold of the engine. The viscosity of water at 20° C. is 1.005 centipoises, and of air at this same temperature is 180.8 micropoises. Since 1 centipoise is 0.01 poise, the viscosity ratio of water to air is 10,000 to 1. Thus in the exemplificative pump channels as small in cross section as those described have been found sufficient to perform in the manner described.

In Fig. 7 is shown a modification wherein the slots 26 and 27 find equivalent in a single slot 31. However such construction, while lessening the cost of manufacture, decreases the strength of the liner as compared to the construction heretofore detailed. It will be apparent that both the modified and preferred forms of the invention function similarly.

Having in mind that the casing 10 is generally a casting, and that production of small passages therein by means of cores is to be regarded as a practical impossibility, it will be comprehended that the use of a separate liner having the by-pass slots cut therein represents a simple, inexpensive solution of the problem contemplated by the invention. Moreover, that the cross-sectional area of the by-pass slots may be controlled within close limits by simply choosing a saw of suitable width for cutting the slots. The invention may be carried into practice by forming recesses in the surface of the liner, in lieu of the slots through the wall thereof, as heretofore described.

While I have shown particular embodiments of my invention, it will be understood, of course, that I do not wish to be limited thereto since many modifications may be made, and I therefore contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A rotary vane liquid pump comprising a casing having an aperture, a liner defining the pump bore secured within said aperture, a rotor supported for rotation within said bore, a plurality of vanes slidably supported in said rotor and coactive with the bore to displace liquid through the pump, said casing and liner having aligned inlet and outlet ports, said liner having a continuously open channel in the wall thereof for providing communication between said inlet and outlet ports, said channel having a transverse cross-sectional area such as to provide an effective block to fluid flow at all normal rated pressures of the pump and for all viscosities of liquid for which the pump is designed but to allow air to be by-passed therethrough in the absence of liquid at the inlet.

2. A rotary vane pump comprising a casing having an aperture, a liner defining the pump bore secured within said aperture, a rotor supported for rotation within said bore, a plurality of vanes slidably supported in said rotor and coactive with the bore to displace fluid through the pump, said casing and liner having aligned inlet and outlet ports, said liner having a pair

of slots in the wall thereof, each slot being in fluid communication at one end with the inlet and outlet ports respectively and being oppositely directed, and said slots terminating beyond an axial element of the liner surface in overlapping relation, the closed terminal ends of the slots being spaced apart along said element.

3. A rotary vane pump comprising a casing having an aperture, a liner defining the pump bore secured within said aperture, a rotor supported for rotation within said bore, a plurality of vanes slidably supported in said rotor and coactive with the bore to displace fluid through the pump, said casing and liner having aligned inlet and outlet ports, said liner having a pair of slots in the wall thereof, said slots being in fluid communication at one end with the inlet and outlet ports respectively, said slots extending substantially helically around the periphery of the liner in opposite directions and each terminating beyond an axial element of the liner in overlapping relation, the closed terminal ends of the slots being spaced apart along said element.

4. A rotary vane liquid pump comprising a casing having an aperture, a liner defining the pump bore secured within said aperture, a rotor supported for rotation within said bore, a plurality of vanes slidably supported in said rotor and coactive with the bore to displace liquid through the pump, said casing and liner having aligned inlet and outlet ports, said liner having a continuously open passage therein for providing communication between said inlet and outlet ports, said passage having a transverse cross-sectional area such as to provide an effective block to fluid flow at all normal rated pressures of the pump and for all viscosities of liquid for which the pump is designed but to allow air to be by-passed therethrough in the absence of liquid at the inlet.

5. A pump as recited in claim 4 in which said passage comprises a slot through the wall of the liner.

6. A rotary vane liquid pump comprising a body defining a pumping chamber, fluid displacing means in said body, inlet and outlet ports for said chamber, said body having a continuously open passage therein for providing communication between said inlet and outlet ports, said passage having a transverse cross-sectional area such as to provide an effective block to fluid flow at all normal rated pressures of the pump and for all viscosities of liquid for which the pump is designed but to allow air to be by-passed therethrough in the absence of liquid at the inlet.

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