June 23, 1970 R. T. J. SKINNER 3,516,758

LIQUID DISPLACEMENT PUMPS

Filed June 4, 1968 2 Sheets-Sheet 1

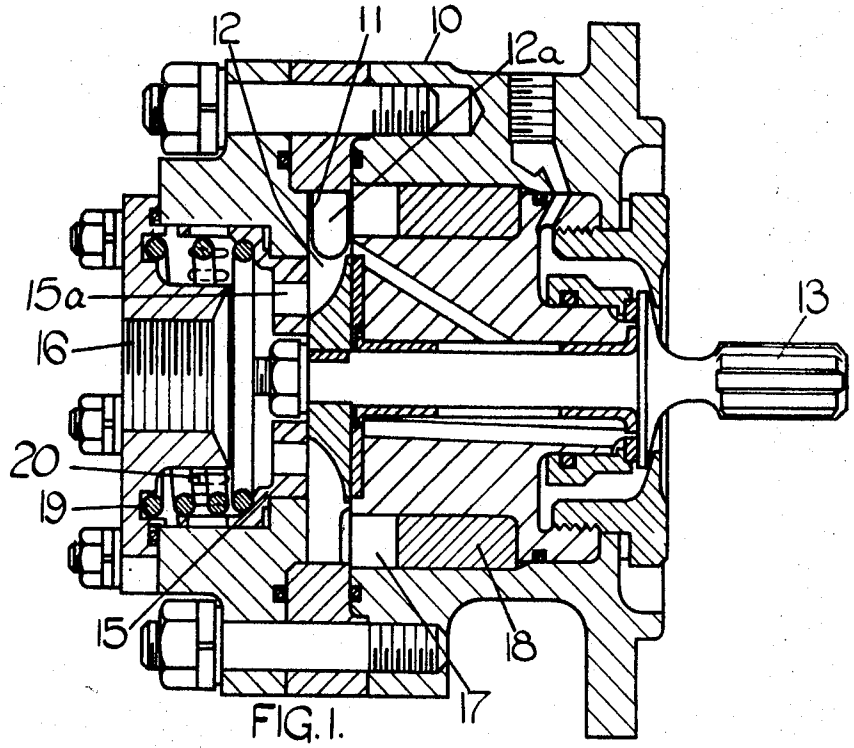

FIG. 1.

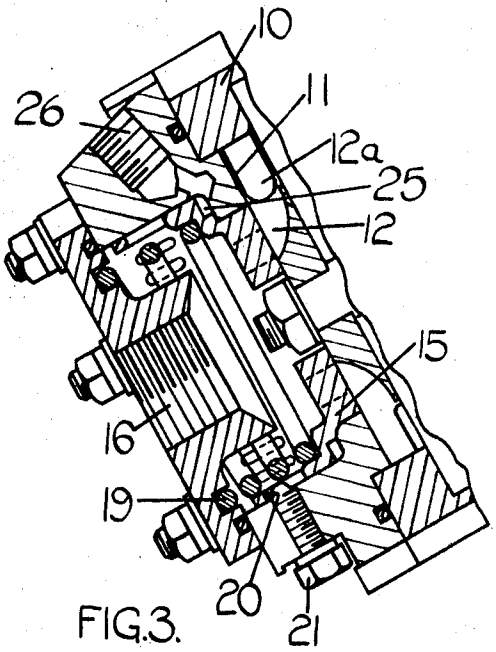

FIG. 3.

INVENTOR
R. T. J. Skinner
BY Glascock, Downing & Seibold
ATTORNEYS

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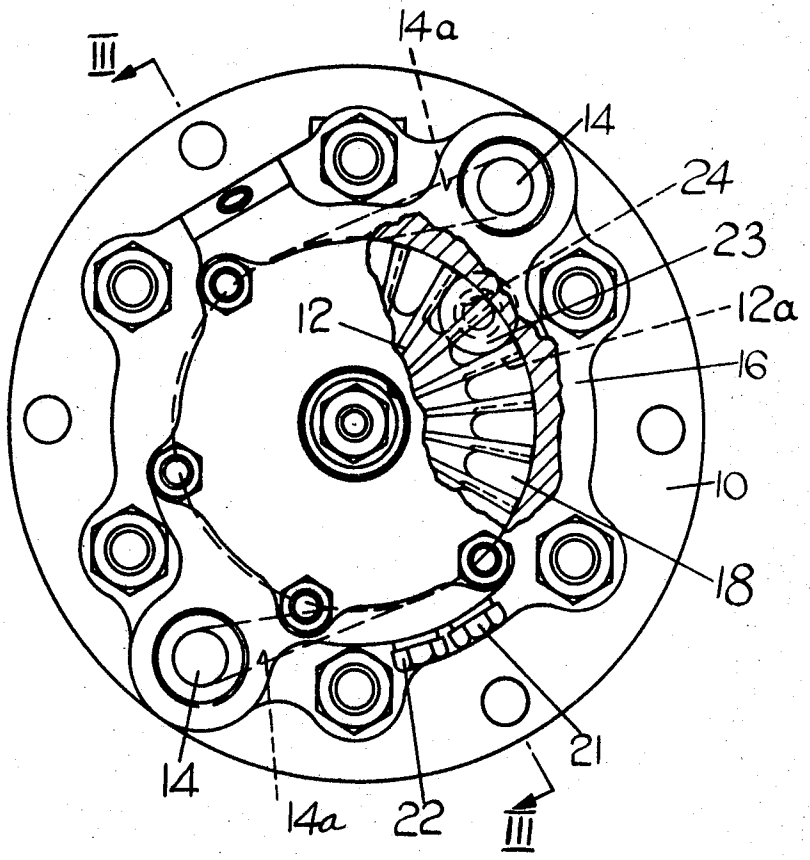

FIG. 2.

INVENTOR
R. T. J. Skinner
BY
ATTORNEYS

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3,516,758

LIQUID DISPLACEMENT PUMPS

Robert Thomas John Skinner, Kenilworth, England, assignor to Joseph Lucas (Industries) Limited, Birmingham, England

Continuation-in-part of application Ser. No. 557,043, June 13, 1966. This application June 4, 1968, Ser. No. 734,441
The portion of the term of the patent subsequent to Dec. 24, 1985, has been disclaimed
Int. Cl. F04d *15/00, 27/100*
U.S. Cl. 415—126 4 Claims

ABSTRACT OF THE DISCLOSURE

A liquid displacement pump in which a body is provided with an interior cavity, a bladed rotor cavity, an inlet and an outlet disposed at respective angularly spaced positions in the cavity, and the side wall of the cavity defines a part annular recess adjacent to the rotor edge, and extending between the inlet and the outlet. Control means is actuable to vary the effective combined volume of the cavity and the recess which is available for the flow of liquid between the inlet and the outlet.

BACKGROUND OF THE INVENTION

This application is a continuation-in-part of my application No. 557,043, filed June 13, 1966, now abandoned, and entitled: "Liquid Displacement Pumps."

In my earlier application I have disclosed a liquid displacement pump of the type having a body, a bladed rotor mounted within a cavity in the body, an inlet and and outlet in the body communicating with the cavity and a part annular recess in the side wall of the cavity in the body adjacent to the rotor periphery, with the recess extending around the rotor intermediate the position of the inlet and that of the outlet.

The present application relates to a liquid displacement pump of this type generally as disclosed in my earlier application and in addition discloses parts and features of the pump not referred to in the original application.

The object of the invention is to provide a pump of the kind specified, in a convenient form.

SUMMARY OF THE INVENTION

In accordance with the present invention, a liquid displacement pump of the type specified is characterized by the provision of control means whereby the effective combined volume of the cavity and recess in the body which is available for the flow of liquid between the inlet and the outlet, can be varied.

The invention will now be described by way of example with reference to the accompanying drawings in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional view of a pump incorporating the present invention,

FIG. 2 is an end elevation view, and

FIG. 3 is a fragmentary cross-sectional view on the line III—III in FIG. 2.

DETAILED DESCRIPTION OF THE INVENTION

These drawings illustrate a pump which incorporates altenative arrangements as will be described, and it is to be understood that certain parts can, if desired, be omitted. The pump is suitable for supplying liquid fuel to a gas turbine engine. The pump has a multi-part body **10** which defines a generally cylindrical internal cavity **11**

within which is mounted a bladed rotor **12** connected to a shaft **13** which can be driven by the engine to which the pump is intended to supply fuel. The rotor blades, in this example, extend radially and are flat on both faces except at the outer end of the leading face of each blade. At this position, the blade is formed with a concave recess indicated at **12***a* of part cylindrical cross-section, to form a scoop at the outer end of the blade. The axial depth of the rotor is equal to the width of the recess so that, except for the center, the whole of the cavity is swept by the rotor blades. In the cylindrical wall of the cavity are a pair of diametrically opposite tangential outlets **14***a* communicating with respective outlet passages **14** as illustrated in FIG. 2.

One sidewall of the cavity **11** is defined by an inlet plate **15** having a pair of diametrically opposite inlet openings **15***a* which communicate with a central inlet port **16** formed in the body **10**. These inlet openings **15***a* in the plate **15** are disposed near the inner edges of the rotor blades and are angularly spaced from the outlets **14***a* respectively.

The opposite sidewall of the cavity **11** has an annular recess **17** of rectangular channel shape in cross-section. The outer peripheral edge of this coincides with the cylindrical wall of the cavity **11** and the radial width of the recess is approximately a quarter of the radius of the rotor **12**. The recess **17** is divided by a pair of fixed abutments **23** secured in the body to form a pair of semicircular recess portions. Radially aligned with one end of the recesses is one of the inlet openings **15***a* and radially aligned with the other end of each is one of the outlets **14***a*.

The base wall of the recess **17** is constituted by the crown of an annular piston **18** mounted in the body **10**, with this piston being movable in a direction parallel to the axis of the rotor toward and away from the rotor under control of springs **24** acting beneath the abutments **23**. At the opposite end of the piston **18** is defined a space to which fluid under pressure can be admitted to control the position of the piston **18** against the action of its springs **24**. These springs **24** urge the piston away from the rotor **12** so that when no fluid pressure exists in the space at the end of the piston, the recess **17** will be of maximum depth.

In use, as the rotor **12** rotates, flow of liquid takes place through the inlet openings **15***a*, between the rotor blades and into the respective portions of the recess **17**, and thence again through the spaces between the rotor blades to the outlets **14***a*. As the liquid flows through the spaces between the blades and through the recess **17** it tends to follow a generally part-toroidal path about a center coincident with the rotor axis between the inlet openings and the outlets respectively; the magnitude of this toroidal movement and therefore the pressure and rate of flow of the liquid leaving the outlets are dependent upon the physical dimensions of the respective recess portions. By varying the position of the annular piston **18**, the volume of the recess **17** available for liquid flow can be increased or decreased and it is known that the smaller the recess, the less will be the increase in pressure generated by the toroidal flow. When the recess **17** is completely filled by the piston **18**, there will be no tendency for toroidal flow to be generated and the pump will operate in the manner of a normal centrifugal pump.

The pump thus far described can be used as such, but alternatively or additionally to the arrangements for controlling the pressure in the outlet, the position of the inlet plate **15** may be varied. For this purpose, the inlet plate **15** has a flange and is urged toward the rotor **12** by a spring **19**. The outer periphery of the inlet plate **15** is stepped and engages in a stepped bore in the body **10**.

Between the respective shoulders of the body **10** and inlet plate **15** is defined an annular space **25**, with which communicates a fluid pressure inlet passage **26**, shown in FIG. 3.

Admission of fluid under pressure to the space **25** causes the inlet plate **15** to be moved against the action of the spring **19**. This moves the inlet openings **15***a* away from the rotor so that the volume of the cavity available for flow is increased. The flow of fluid liquid will now take place, not from two specific points around the rotor, but towards the outlets **14***a* before entering the spaces between the blades. The pump will operate more like a conventional centrifugal pump, having no recess **17**, than when the inlet plate **15** is adjacent to the rotor side face. The pressure rise across the pump will under these circumstances, be less than when the inlet plate **15** is closely adjacent to the rotor. To guide the inlet plate **15** and limit the permitted travel towards and away from the rotor, the flange of the plate **15** has a plurality of elongated slots **20** engaged by a pair of screws **21**, **22**.

The inlet plate **15** is angularly adjustable to move the inlet openings **15***a* towards and away from the outlets **14***a* respectively, thus varying the effective lengths of the recesses which are available for flow between the inlet openings and the outlets respectively. Releasing of the screws **21**, **22** engaging in the slots **20** in the inlet plate enables the angular adjustment of the inlet plate **15** to be effected.

If the movable inlet plate is employed instead of the movable piston **18**, the body **10** will be provided with a fixed recess **17**.

In an alternative construction, there is one recess with one abutment only and the inlet opening is at one side of it and the outlet at the other. The double arrangement described and illustrated affords a better distribution of loads on the piston thus reducing the risk of this jamming.

In a still further form the outlets are formed in a ring defining the outer peripheral wall of the cavity. This ring is angularly movable to vary the distance between the inlet openings and outlets. Adjustments may be achieved in the manner adopted for angular adjustment of the inlet plate **15** in the form illustrated.

It is to be understood that in the form illustrated two forms of volume variation are provided. In practice only one would be provided in a pump.

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

1. A liquid displacement pump comprising a body defining an interior cylindrical cavity, a bladed rotor rotatably mounted in the cavity in the body, said body having an inlet and an outlet disposed at respective positions, spaced angularly about the rotor rotational axis, the outlet being disposed in the cylindrical wall of the cavity, a part annular recess being provided in one side wall of the cavity, the recess having an outer peripheral edge adjacent to the cylindrical wall of the cavity, said recess extending around the rotor intermediate the position of the inlet and that of the outlet, and control means actuable

to vary the effective combined volume of the cavity and the recess which is available for flow of liquid between the inlet and the outlet.

2. A liquid displacement pump comprising a body defining an interior cylindrical cavity, a bladed rotor rotatably mounted in the cavity in the body, an inlet and an outlet in the body disposed at respective positions, spaced angularly about the rotor rotational axis, the outlet being disposed in the cylindrical wall of the cavity, a part annular recess in one side wall of the cavity, the recess having an outer peripheral edge adjacent to the cylindrical wall of the cavity, said recess extending around the rotor intermediate the position of the inlet and that of the outlet, and control means comprising a piston forming the base of the recess in the body, and means for moving said piston in a direction parallel to the rotor rotational axis to vary the volume of said recess which is available for flow of liquid between the inlet and the outlet.

3. The liquid displacement pump as claimed in claim **2** in which there are two inlets and two outlets in the body and the recess is divided into two portions extending between the respective inlets and outlets.

4. A liquid displacement pump comprising a body defining an interior cylindrical cavity, a bladed rotor mounted for rotation in the cavity, said body having an inlet and an outlet disposed at respective positions spaced angularly about the rotational axis of the rotor, said outlet being disposed in the cylindrical wall of the cavity, one side wall of the cavity having an annular recess of rectangular channel shape in cross section, the outer peripheral edge of the recess coinciding with the cylindrical wall of the cavity, a pair of fixed abutments secured in the body and dividing the recess into a pair of semi-circular portions, the inlet being radially aligned with one end of the recess and the outlet with the other end, and control means for varying the volume of the recess which is available for liquid flow between the inlet and the outlet, said control means including an annular piston having a crown mounted in the body, with the crown defining the base wall of the recess, spring means beneath the abutments for moving the piston in a direction parallel to the axis of the rotor, a space at the opposite end of the piston into which pressure fluid can be introduced to control the piston position against the action of the spring means, and said spring means normally urging the piston away from the rotor when no fluid pressure exists in the space.

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LEONARD H. GERIN, Primary Examiner

U.S. Cl. X.R.

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