United States Patent

Freeman

[15] **3,657,971**

[45] **Apr. 25, 1972**

[54] RADIAL PISTON PUMPS OR MOTORS

[72] Inventor: **Frank George Freeman,** Solihull, England

[73] Assignee: **Joseph Lucas (Industries) Limited,** Birmingham, England

[22] Filed: **Apr. 21, 1970**

[21] Appl. No.: **30,442**

[52] **U.S. Cl.** **91/487,** 417/203

[51] **Int. Cl.** **F01b 1/06**

[58] **Field of Search** 91/485, 486, 487

[56] **References Cited**

UNITED STATES PATENTS

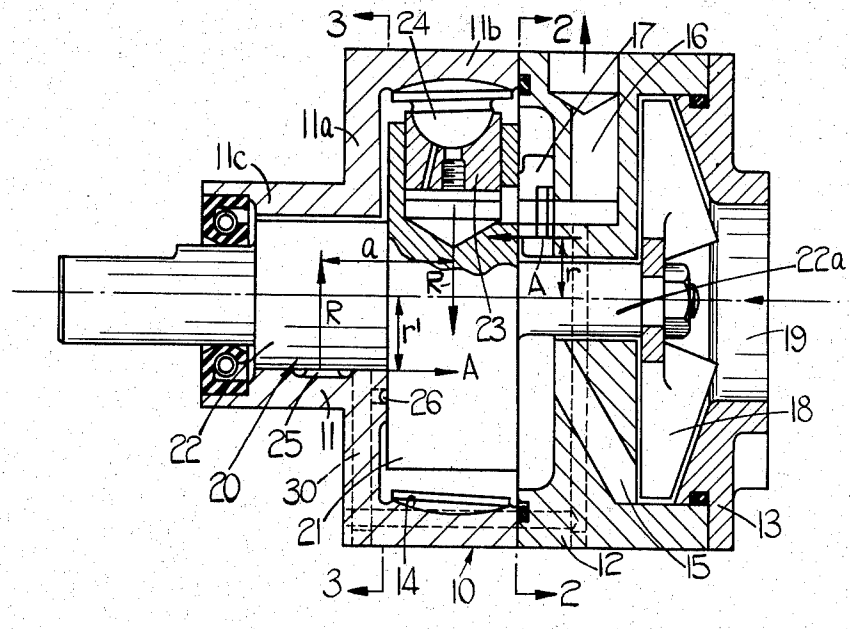
3,044,412	7/1962	Orshansky	91/492
2,827,859	3/1958	Crane	91/492
2,620,733	12/1952	Overbelle	91/485
2,458,985	1/1949	Ferris et al.	91/492
3,096,723	7/1963	Puryeak	91/485
2,506,974	5/1950	Sokensen	91/485

Primary Examiner—William L. Freeh
Attorney—Holman & Stern

[57] **ABSTRACT**

A radial piston pump includes two recesses connected to the high pressure port with one recess arranged in proximity to the rotor face, to provide an axial force to counterbalance the axial force on the rotor from the high pressure port, and the other recess in proximity to the rotor shaft to provide a radial force to counterbalance the radial force from high pressure liquid in the bores in the rotor. The axial force and the radial force form two couples which have equal and opposite moments.

1 Claim, 3 Drawing Figures



PATENTED APR 25 1972

3,657,971

SHEET 1 OF 2

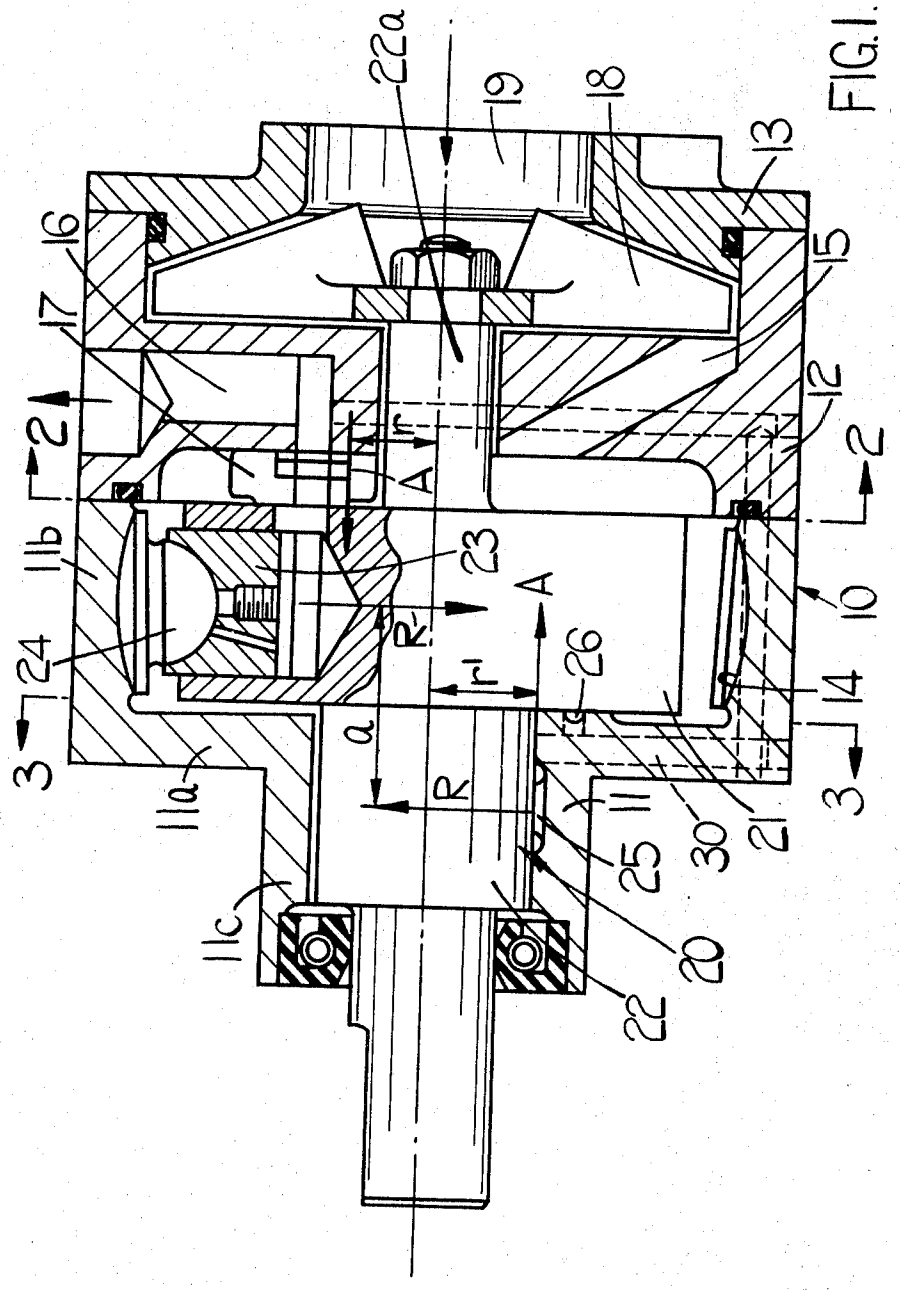


FIG. 1.

INVENTOR
Frank George Freeman
Holman, Glascock, Downing & Seebold
ATTORNEYS

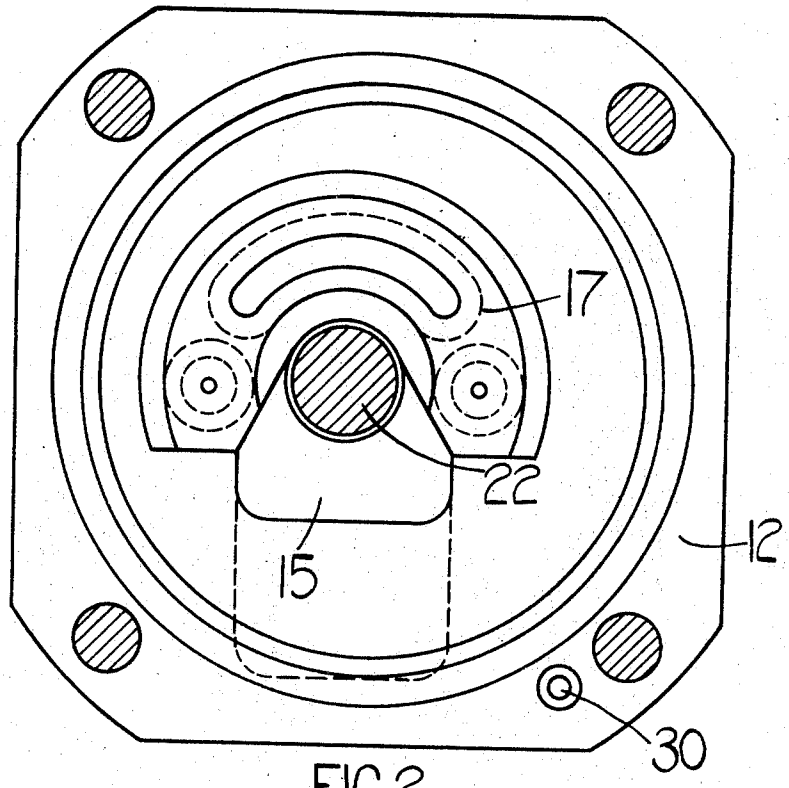


FIG. 2.

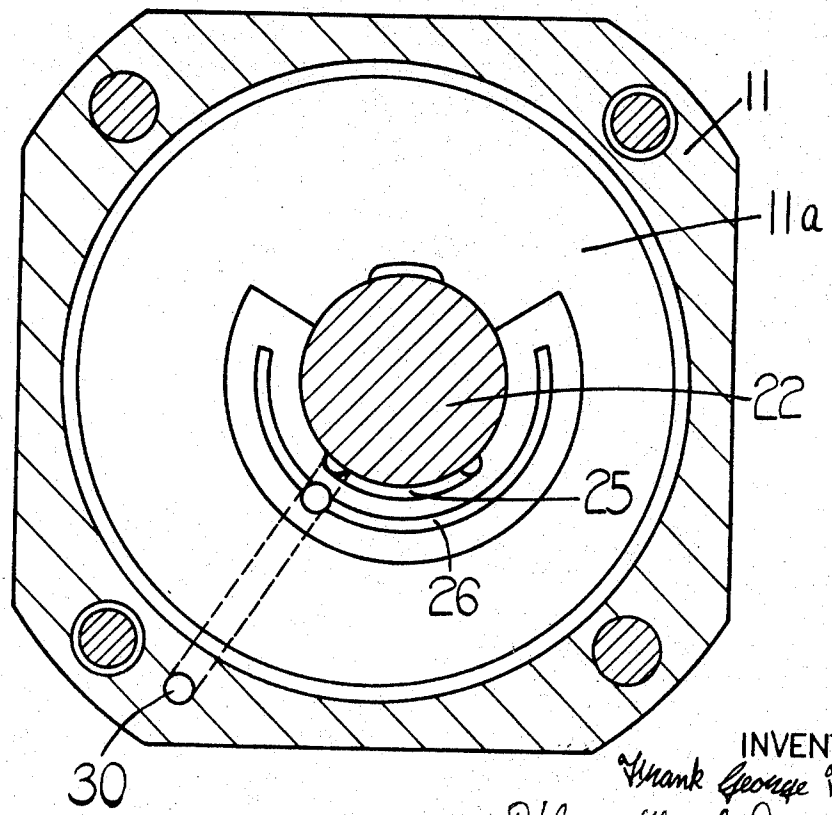


FIG. 3.

INVENTOR
Frank George Freeman
Holman, Glascock, Downing & Seebold
ATTORNEYS

RADIAL PISTON PUMPS OR MOTORS

This invention relates to a radial piston pump or motor of the type comprising a housing, a rotor including a disc portion within the housing and a shaft projecting from the housing, said disc portion being formed with a plurality of radial bores and with transverse passages communicating with said pores respectively and opening on to one face of said disc portion, a plurality of pistons slidable respectively in said bores, a cam in the housing for causing the pistons to reciprocate in said bores as the rotor is rotated, and inlet and outlet ports in the housing with which the passages are successively brought into communication as the rotor is rotated.

In a pump or motor of this type the rotor is subjected to a radial force caused by the pressure of fluid in the bores and to an axially directed force offset from the rotary axis and caused by the pressure of liquid in the passages and in which ever of the ports is at high pressure. These forces cause some difficulty in providing suitable bearings for the rotor and it is an object of the invention to provide a pump or motor of the kind specified in which the effect of these forces is overcome.

In accordance with the invention there is provided a pump or motor of the kind specified in which the housing is formed with first and second recesses in communication with the port which is at high pressure in use, said first recess being arranged so that the fluid therein applies a force to the shaft equal and opposite to the radial force applied to the rotor by high pressure fluid in said bores and at a position axially spaced from the rotor, said second recess being arranged so that fluid therein applies to the rotor a force equal and opposite to the force applied thereby by high pressure fluid in the passages and the port which is at high pressure, at a position diametrically opposite the port which is at high pressure, the arrangement being such that the moments of the equal and opposite forces applied to the rotor are equal and opposite.

In the accompanying drawings:-

FIG. 1 is a section through one example of a pump in accordance with the invention; and

FIGS. 2 and 3 are sections respectively taken on lines 2—2 and 3—3 of FIG. 1.

The pump shown includes a housing **10** in three parts **11**, **12** and **13**. The part **11** comprises a disc portion **11***a*, a rim portion **11***b* and a boss portion **11***c*. The rim portion **11***b* is coaxial with the disc portion **11***a* but the boss portion **11***c* is offset. The rim portion **11***b* is formed internally with a cam track **14**.

The housing part **12** is formed with an inlet port **15** and an outlet port **16**. The outlet port **16** has associated with it a kidney shaped flat member **17**. The housing part **13** forms in combination with the housing part **12** a casing for a centrifugal impeller **18** by means of which fluid is caused to flow from the inlet **19** of the pump to the inlet port **15**.

The housing rotatably supports a rotor **20**. This rotor consists of a disc portion **21** which lies within the cam track **14**, a shaft portion **22** projecting from one face of the disc portion and an auxiliary shaft portion **22***a* projecting from the other side of the disc portion **21** and supporting the impeller **18**. The disc portion **21** is formed with radial bores in which pistons **23** are slidably mounted. Each piston **23** carries at its radially outer end a slipper **24** which engages the cam track **14**. The face of the disc portion **21** remote from the shaft portion **22** is formed with passages which can communicate with the outlet port **16** through openings in the member **17**. The arrangement is such that, in use, the bores in the disc portion **21** can draw in fluid from the inlet port **15** as the pistons **23** are moving outwardly, which occurs over half of each revolution. Over the other half of the revolution the pistons are moving inwardly

and can cause liquid to be displaced through the openings in the member **17** and through the outlet port **16**. It will appreciated that over the half revolution during which the pistons are moving inwardly there will be high pressure present in the bores and hence in the passages which communicate with the outlet port **16**. Thus there is a radial force applied to the disc portion **21** with its line of action as indicated by the arrow R in FIG. **1**. Also an axial force is applied to one face of the disc portion **21** with its line of action, indicated by arrow A in FIG. **1** offset from the axis of the rotor by a distance r.

To counteract these out-of-balance forces there are provided within the part **11** of the housing first and second recesses which are connected via drillings **30** in the housing to the high pressure port **16**. The first of these recesses, **25**, is formed within the boss portion **11**c so that fluid pressure in the recess **25** acts upon the shaft portion **22**. The area and location of the recess **25** are such that the force applied to the shaft portion **22** is equal and opposite to the force R. The line of action of the force applied by fluid pressure in the recess **25** is shown in the drawing by the arrowR′ and the spacing between the lines of action R and R′ is *a*. The other recess **26** is of arcuate form and acts upon the face of the rotor disc **21** opposite that in which the passages which communicate with the ports **15**, **16** are formed. This recess **26** is so disposed and of such dimensions that the pressure of fluid in the recess **26** applies an axial force A′ (which is equal and opposite to the force A) to the rotor at a position offset by distance *r′* (*which is equal to r*) from the axis in the opposite direction to the direction *r*. The arrangement is such that the moment *a*R of the radial forces is equal and opposite to the moment 2A*r* of the axial forces so the rotor is held in equilibrium.

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

1. A radial piston type pump or motor comprising a housing, a rotor including a disc portion within the housing and a shaft projecting from the housing, said disc portion being formed with a plurality of radial bores and with transverse passages communicating with said bores respectively and opening onto one face of said disc portion a plurality of pistons slidable respectively in said bores, a cam in the housing operatively related to the pistons to reciprocate the pistons in said bores as the rotor is rotated and high and low pressure ports in the housing into communication with which the passages are successively brought as the rotor is rotated the housing being formed with first and second recesses in communication with the high pressure pot, said first recess being disposed adjacent the shaft at a position axially spaced from the disc portion and has an effective area such that high pressure fluid therein applies a radial force to the shaft equal and opposite to a radial force applied to the rotor by high pressure fluid in said bores said radial forces having parallel lines of action spaced by a first distance from one another, said second recess being disposed adjacent a face of the disc portion opposite that on to which the transverse passages open and having an effective area such that high pressure fluid therein applies to the disc portion an axial force equal and opposite to an axial force applied thereto by high pressure fluid in the passages and the high pressure port at a position diametrically opposite the high pressure port with respect to axis of the rotor, so that the axial forces have lines of action spaced by a second distance, and the product of the effective area of the first recess and the first distance being equal to the product of the effective area of the second recess and the second distance so that the moments of the equal and opposite forces applied to the rotor are equal and opposite.

* * * * *