Aug. 8, 1967 R. W. DYMOND 3,334,591

PUMP

Original Filed April 26, 1965

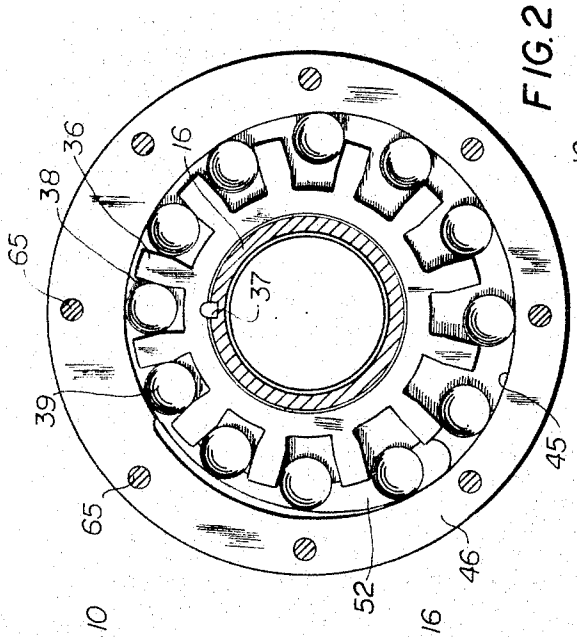

FIG. 2

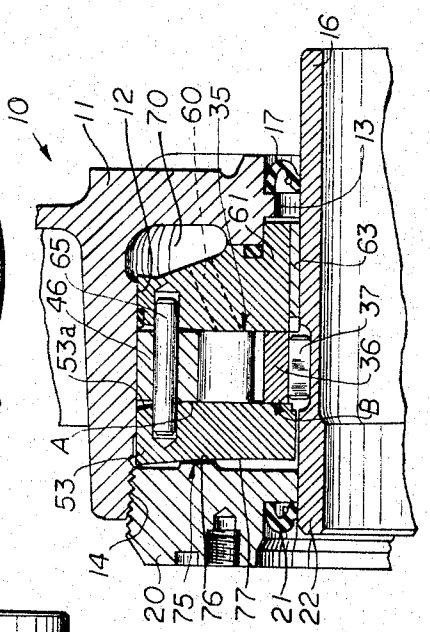

FIG. 3

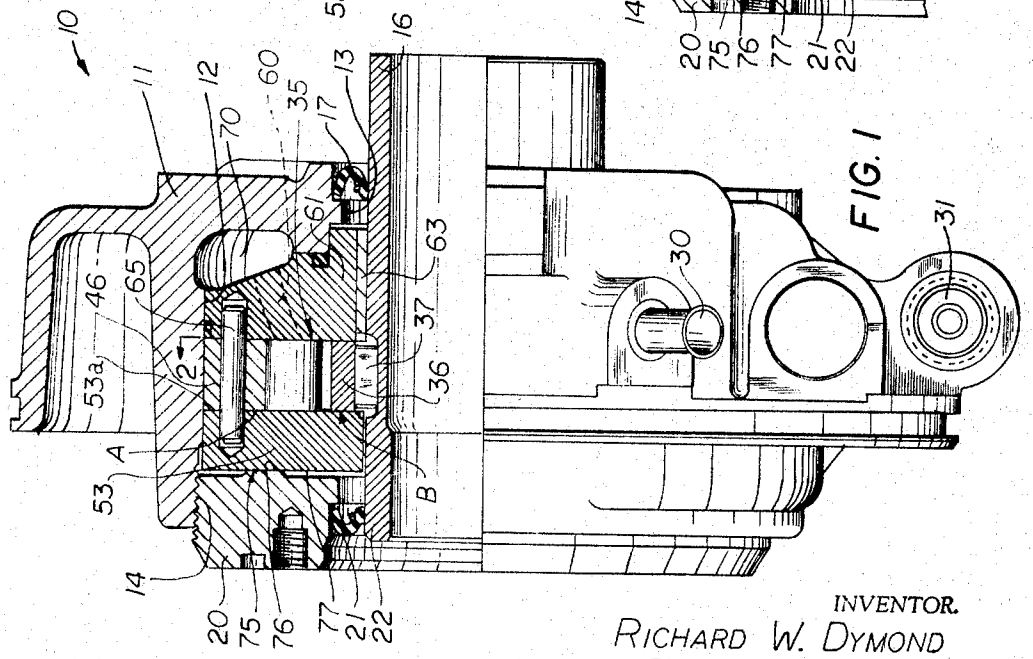

FIG. 1

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PUMP

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13 Claims. (Cl. 103—136)

This application is a continuation of application Ser. No. 450,917, filed Apr. 26, 1965, now abandoned.

The present invention relates to a fluid pump and, particularly, to a rotary fluid pump.

Known rotary fluid pumps include a housing means enclosing a pumping mechanism. The pumping mechanism includes a rotatable rotor means and a cam means having an arcuate wall surface encircling the rotor means. Pumping elements are carried by the rotor means and engage the arcuate wall surface of the cam means and cooperate therewith to effect pumping of fluid as they rotate relative thereto. The fluid flows through an intake passageway formed in a port plate supported adjacent the rotor member, into the pumping chamber in which the pumping elements operate, and out of the pumping chamber through a discharge passageway formed in a pressure plate supported on the axial side of the rotor member opposite the side on which the port plate is located. The discharge passageway in the pressure plate connects with a discharge chamber located on the side of the pressure plate opposite the side adjacent the rotor means and the pressure therein acts on the pressure plate, which tends to balance the pressure within the pumping chamber which would otherwise cause deflection of the pressure plate away from the rotor means. The port plate, however, does not have fluid pressure acting against the side opposite the rotor means and therefore as pressure within the pumping chamber increases, the port plate tends to deflect away from the rotor means. The deflection of the port plate in prior art pumping mechanisms has greatly reduced the volumetric efficiency of the pump, particularly at high pressures when the deflection of the port plate is greatest, and is, therefore, quite undesirable and detrimental to the pump operation.

Accordingly, the principal object of the present invention is the provision of a new and improved pump, of the above-noted type, having an improved volumetric efficiency, particularly at high pumping pressures.

A more specific object of the present invention is the provision of a new and improved pump mechanism, as noted hereinabove, wherein the housing means is provided with a fulcrum means engaging the port plate and located to provide for deflection of the port plate in such a manner as to improve the sealing engagement between the port plate and the rotor member due to deflection of the port plate and thereby reduce the leakage of fluid between the port plate and rotor member at high pressures and maintain a high volumetric pump efficiency at high pressures.

A still further object of the present invention is the provision of a new and improved pump mechanism, as noted in the next preceding paragraph, wherein the fulcrum means is in the form of an arcuate projecting lug member which extends from a cover meber forming a part of the housing and engages the axial side of the port plate opposite the side adjacent the rotor means and the outer peripheral portion of the port plate deflects toward

the cover member about the fulcrum provided by the projecting lug member and the inner portion of the port plate tends to move inwardly toward the rotor member and provides an effective seal between the rotor member and the port plate.

Further objects and advantages of the present invention will be apparent to those skilled in the art to which it relates from the description of the preferred embodiment thereof made with reference to the accompanying drawings forming a part of this specification, and in which:

FIG. 1 is an axial sectional view, partly in elevation, of a pump mechanism embodying the present invention;

FIG. 2 is a transverse sectional view of the pump mechanism of FIG. 1, looking at the pump mechanism of FIG. 1 along the section line 2—2 thereof; and

FIG. 3 is a schematic view indicating the application of the forces acting on a portion of the pump shown in FIG. 1.

The present invention provides a highly improved pump mechanism which is less susceptible to leakage at high pressures than known pump mechanisms of its type and, therefore, has a high volumetric efficiency at high pressures. As representing the preferred embodiment of the present invention, the drawings illustrate a pump mechanism **10**. The pump mechanism **10** includes a pump housing including a housing member **11** having a chamber **12** therein. The housing member **11** has an opening **13** at one end thereof communicating with the chamber **12** and a second opening **14** which is threaded internally which also opens into the chamber **12**. A driving shaft member **16** extends through the opening **13** in the housing member **11** and into the chamber **12** and a suitable seal **17** is located in the opening **13** and encircling the shaft **16** and providing an effective seal between the shaft and the housing member **11**. A cover member **20** forms a part of the pump housing and is threaded into the threaded opening **14** in the housing member **11** and carries a seal **21** which acts between the cover member and the outer portion **22** of the shaft **16** and provides an effective seal therebetween.

The housing member **11** has a suitable fluid inlet passage means **30** which is adapted to be connected to a supply of fluid. The housing member **11** also includes a suitable outlet passage means **31** which is adapted to be connected with a suitable conduit leading to a fluid motor. The fluid is pumped from the inlet passage means **30** to the outlet passage means **31** by a suitable pumping mechanism **35** located in the chamber **12**.

The pumping mechanism **35** includes a rotor member **36** which is fiexedly connected by a key **37** to the shaft **16** and rotates with the shaft **16** upon rotation thereof. The rotor member **36** includes a plurality of slots **38** therein. The slots **38** are spaced circumferentially around the rotor member in spaced locations. As is well known, the slots carry pumping elements and in the present embodiment, the pumping elements are in the form of rolls **39**, although other suitable pumping elements may be used. The rolls **39** are positioned in the slots so as to be movable inwardly and outwardly thereof. The rolls **39** are also rotatable with the rotor member **36** upon rotation thereof by engagement of a surface portion of the rotor member defining the slots with the trailing surface portion of the roller member located in the particular slot.

Upon rotation of the rotor member 36, the rolls 39 contact an arcuate surface 45. The arcuate surface 45 is an arcuate cam surface of a cam member 46 which is located radially outwardly of the rotor member 36. The cam surface 45 is so shaped that as the rotor member 36 rotates, the rolls 39 move inwardly and outwardly in the slots and pumping is accomplished in a manner well known to those familiar with vane-type pumps. The cam surface 45 may be shaped so as to provide for a plurality of pumping strokes of the rolls 39 for each revolution of the rotor member 36.

The fluid flows into the pumping chamber through fluid inlet ports or passageways. In the embodiment shown, the fluid flows through passageway 52 formed in a port plate 53. The passageway in the port plate connects in a well-known manner with the inlet port 30 so that fluid therefrom is drawn into the pump as the rotor 36 rotates. The port plate 53 comprises an arcuate plate member or disk member which is supported in the chamber 12 and is fixed against rotation with the shaft 16. One axial side 53*a* of the port plate 53 at the outer periphery thereof engages one axial side of the cam member 46 and the axial side 53*a* of the inner portion thereof is adjacent one axial side of the rotor member 36 with suitable running clearance therebetween. The axial length of cam member 46 is made slightly larger than the axial length of rotor 36 and rolls 39 so that when the port plate 53 is pressing tightly against cam member 46, the rotor 36 and rolls 39 remain free to rotate in the cavity provided therein. The engagement of the port plate 53 with the cam 46 provides a first fluid seal A between the cam member 46 and the port plate 53 and the clearance between the rotor 36 and port plate is kept small so that a second fluid seal B is provided between the rotor member 36 and the port plate 53 at their interfaces. The seal B between the rotor member 36 and the port plate 53 is located, of course, immediately adjacent to the shaft 16.

The fluid being pumped flows through a suitable fluid outlet passageway, not shown, formed in a pressure plate 61. The pressure plate 61, like the port plate 53, comprises a disk-like member which is located in the chamber 12. In the position shown in FIG. 1, the outer periphery of the pressure plate engages the axial side of the cam member 46 opposite the side which engages the port plate 53 and the inner portion of the pressure plate engages the side of the rotor member opposite the side engaged by the port plate 53. A bearing 63 encircles the shaft 16 and is located in an opening 60*a* in the pressure plate 61. The outermost peripheral portions of the port plate and the pressure plate are indexed to the cam member 46 by a plurality of pin members 65 which extend into openings therein and through the cam member 46.

The passageway 60 in the pressure plate 61 communicates with and delivers fluid under pressure to a pressure discharge chamber 70 which is defined in part by the pressure plate and in part by the pump housing 11. The pressure discharge chamber 70 is located on the side of the pressure plate 61 opposite the side which engages the cam member 46. The pressure chamber 70 also communicates with the outlet port 31 by suitable passageways, not shown, in order to provide for fluid discharge from the pump mechanism. Of course, the pressure of fluid builds up in the pressure discharge chamber 70 and acts against the outer peripheral portion of the pressure plate 61. This pressure or force is transmitted from the outer peripheral portion of the pressure plate 61 to the cam member 46 and from the cam member 46 to the outer peripheral portion of the port plate 53.

In order to reduce or minimize the leakage of fluid between the inner portion of the port plate 53 and the rotor member 36, the pump 10 is provided with a fulcrum means located between the pump housing and the port plate 53. This fulcrum means provides for pivoting of the port plate 53 thereabout and permits movement of the outer portion of the port plate to the left, as viewed in FIG. 3, and tends to effect movement of the inner portion of the port plate to the right, as viewed in FIG. 3 which maintains the seal B between the port plate 53 and the rotor member 36 and thereby minimizes leakage of fluid therebetween. This, of course, maintains a high volumetric efficiency of the pump at high pressures.

In the prefered embodiment of the present invention as illustrated in the drawings, the fulcrum means is located between the cover member 20 and port plate 53 and comprises an annular extending lug or ledge portion, designated 75, which extends outwardly of the cover member 20 and toward the port plate 53. The ledge portion 75, however, could be formed integrally with the port plate 53. The ledge portion 75 has a surface portion 76 which engages the surface portion 77 of the port plate 53, which surface, of course, is the surface opposite the surface which engages the cam member 46. The engagement occurs at a location which is radially inwardly of the point where the effective force due to the pressure in the pressure chamber 70 is applied to the port plate by the cam member 46 and outwardly of the sealing engagement B. As a result, it can be seen that the outer portion of the port plate 53 will deflect to the left, as viewed in FIG. 3, into the area above the ledge 75, whereas the inner portion of the port plate 53 tends to deflect to the right, as viewed in FIG. 3, where the deflection is shown in an exaggerated manner. From the above, it should be apparent that this construction does reduce leakage of fluid between the inner portion of the port plate 53 and the rotor member 36 and, thereby, greatly minimizes fluid leakage at high pump pressures and provides a good volumetric efficiency for the pump.

From the above description, it should be readily apparent that Applicant has provided a new and improved pump mechanism and that certain changes, modifications, and adaptations may be made therein by those skilled in the art to which it relates, and it is intended hereby to cover all such modifications, changes, and adaptations which come within the scope of the appended claims.

Having described my invention, I claim:

1. A fluid pump comprising a pump housing having a chamber therein, said pump housing having a fluid inlet passage and a fluid outlet passage, pumping mechanism located in said chamber and operable to pump fluid from said inlet to said outlet passage, a port plate supported in said chamber and having a first portion in a sealing relationship with a first portion of said pumping mechanism, a pressure plate supported in said chamber and having fluid passageway means communicating said outlet passage with said pumping mechanism and extending adjacent a second portion of said pumping mechanism, said pressure plate defining at least in part a pressure discharge chamber on the side thereof opposite the side adjacent said pumping mechanism and the fluid pressure in said discharge chamber applying a force through the pressure plate and said second portion of said pumping mechanism to a second portion of the port plate spaced from said first portion, and means located between said pump housing and said port plate to inhibit movement of said first portion thereof out of sealing engagement with said pumping mechanism.

2. A fluid pump comprising a pump housing having a chamber therein, said pump housing having a fluid inlet passage and a fluid outlet passage, pumping mechanism located in said chamber and operable to pump fluid from said inlet to said outlet passage, a port plate supported in said chamber and having first and second portions in a sealing relationship with spaced portions of said pumping mechanism, a pressure plate supported in said chamber and having fluid passageway means communicating said outlet passage with said pumping mechanism and extending adjacent a portion of said pumping mechanism, said pressure plate defining at least in part a pressure discharge chamber on the side thereof opposite the side en-

gaging said pumping mechanism and the fluid pressure in said discharge chamber applying a force through the pressure plate and the portion of the pumping mechanism adjacent to which it extends to said second portion of the port plate, and fulcrum means located between said pump housing and said port plate at a location intermediate the first and second portions thereof and with the second portion of the port plate deflecting about said fulcrum means toward said housing and the first portion of said port plate tending to move about said fulcrum means into engagement with a portion of said pumping mechanism.

3. A fluid pump comprising a pump housing having a chamber therein, said pump housing having a fluid inlet passage and a fluid outlet passage, pumping mechanism located in said chamber and operable to pump fluid from said inlet to said outlet passage, a port plate supported in said chamber and having first and second portions in engagement with spaced first and second portions of said pumping mechanism, a pressure plate supported in said chamber and having fluid passageway means communicating said outlet passage with said pumping mechanism and extending adjacent a third portion of said pumping mechanism, said pressure plate defining at least in part a pressure discharge chamber on the side thereof opposite the side adjacent said pumping mechanism and the fluid pressure in said discharge chamber applying a force through the pressure plate and third portion of said pumping mechanism to said second portion of said port plate, and a lug member located between said pump housing and said port plate at a location intermediate the first and second portions thereof and with the second portions of the port plate deflecting about said lug member toward said housing and the first portion of said port plate tending to move about said lug member into engagement with said first portion of said pumping mechanism.

4. A fluid pump as defined in claim 3 wherein said pump housing includes a housing member and a cover member connected to the housing member and said lug member is formed integrally with said cover member and extends therefrom into engagement with said port plate.

5. A fluid pump comprising a pump housing having a chamber therein, rotor means disposed within the chamber and rotatable therein, cam means nonrotatably supported in said housing and spaced radially from said rotor means and having a continuous arcuate wall surface defining at least one pumping chamber, pumping elements carried by said rotor means and engageable with said arcuate wall surface and cooperable therewith to effect pumping of the fluid, said pump housing having a fluid inlet passage and a fluid outlet passage, a port plate nonrotatably supported in the housing and having a first portion in sealing relationship with said rotor means and a second portion engaging an axial side of said cam means, a pressure plate nonrotatably supported in the housing and having fluid passageway means communicating said outlet passage with said pumping chamber and engaging the axial side of said cam means opposite the axial side thereof engaged by said port plate, said pressure plate defining at least in part a pressure discharge chamber on the side thereof opposite the side engaging said cam means, and the fluid pressure in said discharge chamber applying a force through the pressure plate and the cam means to said second portion of the port plate, and means located between a portion of said housing and said port plate to inhibit movement of said first portion out of sealing engagement with said rotor means.

6. A fluid pump comprising a pump housing having a chamber therein, rotor means disposed within the chamber and rotatable therein, cam means nonrotatably supported in said housing and spaced radially from said rotor means and having a continuous arcuate wall surface defining at least one pumping chamber, pumping elements carried by said rotor means and engageable with said arcuate wall surface and cooperable therewith to effect pumping of the fluid, said pump housing having a fluid

inlet passage and a fluid outlet passage, a port plate nonrotatably supported in the housing and having a first portion in sealing relationship with said rotor means, and a second portion engaging one axial side of said cam means, a pressure plate nonrotatably supported in the housing and having fluid passageway means communicating said outlet passage with said pumping chamber and engaging the axial side of said cam means opposite the axial side thereof engaged by said port plate, said pressure plate defining at least in part a pressure discharge chamber on the side thereof opposite the side engaging said cam means, and the fluid pressure in said discharge chamber applying a force through the pressure plate and the cam means to said second portion of the port plate, and fulcrum means located between said pump housing and said port plate at a location intermediate the first and second portions thereof and with the second portion of the port plate deflecting about said fulcrum means toward said housing and the first portion of said port plate tending to move about said fulcrum means into sealing engagement with said rotor means.

7. A fluid pump as defined in claim 6 wherein said fulcrum means comprises an annular lug member formed integrally with a portion of said housing and extending circumferentially of said rotor means.

8. A fluid pump as defined in claim 7 wherein said pump housing includes a main housing member and a cover member and said annular lug member is formed integrally with said cover member.

9. A fluid pump comprising a pump housing having a chamber therein, a shaft member extending into said chamber and rotatable relative to said housing, rotor means rotatable with said shaft and disposed within said pumping chamber and rotatable therein, cam means located radially outwardly of the rotor means and having a continuous arcuate wall surface encircling said rotor means and defining at least one pumping chamber, pumping elements carried by said rotor means and engageable with said arcuate wall surface and cooperable therewith to effect pumping of fluid, said pump housing having a fluid inlet passage and a fluid outlet passage, a port plate nonrotatably supported in the housing and having an outer peripheral portion engaging one axial side of said cam means and an inner portion in sealing engagement with an axial side of said rotor means, a pressure plate nonrotatably supported in said housing and having fluid passageway means communicating said outlet passage with said pumping chamber and engaging the axial side of said cam means and said rotor means opposite the axial sides thereof engaged by said port plate, said pressure plate defining at least in part a pressure discharge chamber on the side thereof opposite the side engaging said cam means and the fluid pressure in said discharge chamber applying a force through said pressure plate and said cam means to said outer portion of said port plate, and fulcrum means located between said pump housing and said port plate at a location intermediate said inner and outer portions thereof and with the outer portion thereof deflecting about said fulcrum means in one direction and the inner portion tending to move about said fulcrum means in a second direction opposite said one direction and into sealing engagement with said rotor means.

10. A fluid pump as defined in claim 9 wherein said fulcrum means comprises an annular lug member formed integrally with a portion of said housing and extending circumferentially of said rotor means.

11. A fluid pump as defined in claim 10 wherein said pump housing includes a main housing member and a cover member and said annular lug member is formed integrally with said cover member.

12. A fluid pump comprising a pump housing having a chamber therein, said pump housing having a fluid inlet passage and a fluid outlet passage, pumping mechanism located in the chamber and operable to pump fluid from the inlet passage to the outlet pasage, a member posi-

tioned in the chamber and having a first portion in a sealing relationship with a first portion of the pumping mechanism, said member having a second portion spaced from the first portion and which is acted upon by a force proportional to the magnitude of the discharge pressure of the pump, and fulcrum means at a location intermediate said first and second portions and providing for movement of said first portion into sealing engagement with said pumping mechanism upon an increase in said force acting on said second portion.

13. A fluid pump as defined in claim 12 wherein said force acts on said second portion in a direction away

from said pumping mechanism and said fulcrum means is disposed between said pump housing and said member.

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