Nov. 30, 1948. E. C. RUMSEY 2,455,194

ROTARY FLEXIBLE VANE PUMP

Filed Nov. 10, 1943

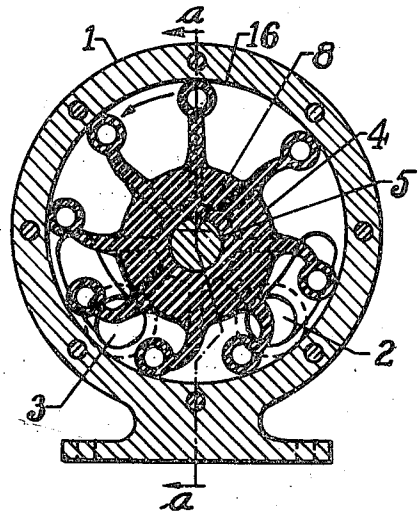


Fig. 1

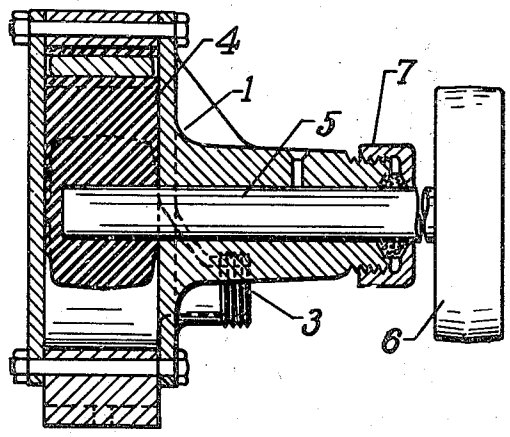


Fig. 2

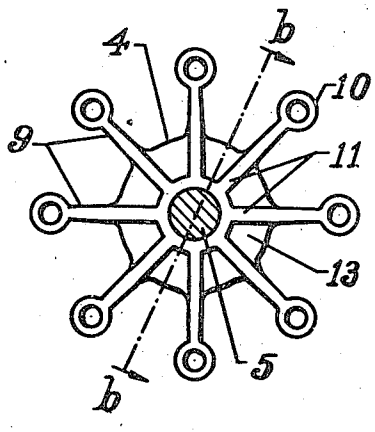


Fig. 3

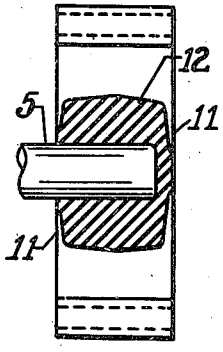


Fig. 4

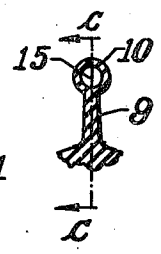


Fig. 6

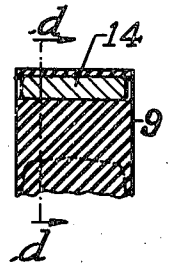


Fig. 5

INVENTOR.

BY Edward C Rumsey

Patented Nov. 30, 1948 2,455,194

UNITED STATES PATENT OFFICE

2,455,194

ROTARY FLEXIBLE VANE PUMP

Edward C. Rumsey, Detroit, Mich.; Lillian Gray Rumsey executrix of said Edward C. Rumsey, deceased

Application November 10, 1943, Serial No. 509,673

7 Claims. (Cl. 103—117)

1

This invention relates to pumps, particularly to the eccentric type of rotary pump, wherein the rotor made of resilient material is provided with a plurality of flexible vanes, the outer edges of which contact the inner surfaces of the cylindrical case in which the rotor is rotated.

An object of my invention is to provide a rotary pump of the flexible vane type in which the edges of the vanes operate in contact with the surfaces of the pump rotor case without clearance, thus preventing internal leakage, but only doing so while the discharge pressure or head is less than the pre-determined, or designated head or outlet pressure.

Another object is to provide a rotary pump of the character stated; the rotor of which can be rotated or driven uninterruptedly regardless of the opening or closing of the discharge port, or varying the discharge head.

Another object is to provide a pump of the character stated, wherein the periphery of the rotor hub does not operate in contact with the peripheral wall of the rotor case, thus providing a clearance space that will allow foreign matter to pass through this clearance space, thus permitting the rotor to clear itself and thereby prevent jamming and stoppage of the pump.

Another object is to provide a pump of the character stated, wherein the vanes are extended toward the rotor driving shaft over the hub, appearing there only as slight ridges operating in contact with the end walls of the rotor case; the hub itself being slightly depressed between ridges; thus ingress is provided for lubricant to the areas of the casing end walls over the rotor body hub ends, such lubricant is needed to extract the heat generated by friction when the hub is in full and complete running contact with these casing wall areas such generated heat, if not extracted, results in a short life of the rotor material and the pump efficiency is much impaired.

Another object is to provide a pump of the character stated, wherein the axis of the rotor is located away from the center of the axis of the rotor's cylindrical cavity, thus the vanes are consecutively flexed as shown, thereby reducing the volume of the chamber encompassed by the end walls, an arc of the circular wall of the rotor cavity and the hub and a pair of the adjacent vanes, and effectively ejecting the displaced liquid through the outlet port, further rotation permits the chamber, due to the release of the flexing force plus the centrifugal force set up in the vane by its mass and its rapid motion, to gradually return to its normal volume.

2

Another object is to provide a pump of the character stated, wherein the rotor and vanes are so formed and so positioned in respect to the intake and discharge ports, as to permit the rotor to be rotated in either direction, thereby discharging the liquid from either one port or the other, without altering the pump in any particular.

Another object is to provide a pump of the character stated, wherein the discharge head can be pre-determined, by the proper selection of vane thickness, offering a given resistance to flexing, plus the mass of the vane which in conjunction with the revolutions per minute of the rotor, further adds to the resistance to flexing and further by the choice of the number of vanes used.

Another object is to provide a pump of the character stated, wherein the flexible vanes of the rotor are provided with an enlargement at their outer end, such enlargement having provision for enclosing therein a mass of greater specific weight than the material of which the vane is composed, such mass to be in the form of a non-flexible bar or rod, thus the centrifugal force can be augmented and the longitudinal edge of the vane being stiffened by said bar, is restrained from buckling or flexing locally thus improving the sealing or packing conditions; by this adjustable means the leakage is controllable so that the back pressure can be adjusted to any predetermined back pressure or "head" as the operator may choose.

Another object is to provide a pump of the character stated, wherein the rotor casing cavity is cylindrical in form, most inexpensive and simple to make.

Another object is to provide a pump of the character stated, wherein the rotor with its vanes may be formed ready for use in a mold, said rotor being composed of resilient material such as rubber, or any desirable synthetic material, such as "Chemigum," "neo-prene" or the like. As no further work is required to ready the rotor for use, it is inexpensive to manufacture and durable in service.

Another object is to provide a pump of the character stated, wherein the rotor housing cavity is cylindrical in form; the periphery being circular in form, lends itself readily to machining and polishing, also it may be made of any desired material, such as metal, rubber, thermoplastic material, glass or porcelain; the end walls may be made of similar materials; thus any liquid may be pumped with little injury to the pump, and furthermore liquids containing foreign matter, such

as grit, sand, lint, metal chips, paper, etc., will have little effect on the long efficient operating life of the pump.

Other objects, advantages and features of invention may appear from the accompanying drawing, the subjoined detailed description and appended claims.

In the drawing

Figure 1 is a transverse sectional view of the pump.

Figure 2 is a sectional view taken on line *a—a* of Figure 1.

Figure 3 is a view of the rotor free of its casing.

Figure 4 is a sectional view taken on the line *b—b* of Figure 3.

Figure 5 is a sectional view of the rotor vane, taken on the line *c—c* of Figure 6.

Figure 6 is a sectional view of a rotor vane taken on line *d—d* of Figure 5.

Referring more particularly to the drawing, the numeral 1 indicates the pump housing or casing which is provided with intake and outlet ports 2 and 3.

The rotor 4 is fixed to the end of the driving shaft 5, which is driven by any suitable power means through any suitable means such as a pulley 6, said shaft may be provided with packing and packing gland nut as 7. The rotor 4 with its co-axially positioned shaft 5 are so positioned in the casing 1, that the axis of the rotor 4 is away from the casing axis indicated by numeral 8.

Figure 3, shows the rotor 4 free of its casing 1, clearly indicating the plurality of vanes 9, disposed about the rotor hub and 10 indicates the enlargement at the end of each vane, and 11 indicates the extension of the vane edge over the hub 12, toward the hub's center, in the form of a narrow rib, each pair forming the boundary on two sides of the depressed area on the end faces of the hub 12.

In Figure 5 is shown a sectional view of a vane 9, wherein has been inserted a heavy mass 14, such as iron or lead, and Figure 6 is a sectional view of the same vane showing the molded chamber 15, in the vane enlargement, into which the weight 14 can be inserted.

In operation, the rotor may be driven either in clockwise or counterclockwise direction, but assuming it to be rotated counterclockwise as indicated by the arrow in Figure 1, it will be noted that the vanes will be either flexed or unflexed as shown depending upon their position in relation to the casing cavity periphery 16, it is apparent that the chambers formed by adjacent vanes, the end walls and an arc of the periphery of the casing cavity will vary in volume from maximum to minimum once per revolution; this is due to the flexible material of which the rotor and its vanes are made and augmented by the centrifugal force, which tends to straighten the vanes after having been flexed, this successive flexing will cause liquid to be drawn into the pump through the intake port 2 and discharged through the outlet port 3.

However, should the outlet port be restricted or closed entirely, as by a valve in the fittings, the liquid will be confined in the chamber or "trapped," and a pressure will be created in that chamber, great enough to overcome the restraining effects of the centrifugal force, plus the inherent rigidity of the vane and thus will flex the trailing vanes allowing the liquid to remain unmoved thus pumping will cease, but rotor rotation will continue uninterrupted.

The pressure attained in the chamber is predetermined by the material, the thickness and shape and number of vanes, and the mass of the vane which by rapid rotation creates centrifugal force that aids in holding the vane radially straight outward from the hub; it is apparent that by adding mass to the vane tip the centrifugal force can be increased; again it can be influenced by increasing the rate of rotation of the rotor.

Whenever a pump of this general type is operated without clearance between the rotor hub and the casing internal end walls, heat will be generated, due to the friction between the dry surfaces, this heat is undesirable in many respects; to reduce this element of trouble the rotor hub 12 is provided with recessed areas 13, permitting the liquid pumped to wet the casing and hub surfaces while rotating and absorb and carry away the heat as it is generated.

As the rotor vanes and extended ribs are in contact with the walls of the cavity when the pump is operating against a discharge pressure lower than the pre-determined pressure the "slippage" will be at a minimum, thus pump volumetric efficiency is enhanced.

While in pumping operation, should any solid matter enter the pump such as cloth, paper or metal chips, and not be at once ejected through the outlet port, they may be carried around one or more revolutions by the rotor, without jamming, due to the clearance provided between the rotor hub and the casing periphery.

It will be apparent to those skilled in the art that various modifications in construction and design may be made without departing from the spirit or scope of the invention as defined by the appended claims.

Having described my invention, I claim:

1. A rotary displacement pump comprising a cylindrical casing consisting of an annular wall and opposed flat end walls, said casing having spaced inlet and outlet ports, a rotor body of resilient material within said casing, said rotor body consisting of a rotor hub and a plurality of spaced integral flexible vanes each extending radially from the said rotor hub, means rotating said rotor body in either clock-wise or counter-clock-wise direction of rotation, said vanes rotatable in either direction with equal functional results, said rotating means and the rotor body having their respective axii concentric, said axii being disposed eccentrically relative the axis of the casing annular wall, said rotating means being supported in said casing, said rotor hub periphery being spaced from the said casing annular wall, the lateral edges of said vanes engaging said casing end walls, the longitudinal edges of said vanes engaging said casing annular wall to form pumping chambers, each of said vanes being successively flexed due to the varying relationship of the annular wall and the rotor body during each revolution of said rotor body, said vane longitudinal edges sealing the said pumping chambers against leakage only when the back pressure of the fluid being pumped is less than the predetermined amount, said rotor body hub being provided with means for reducing the heat generated by the friction of the rotor body hub ends that operate under pressure in contact with the said cylindrical casing end walls.

2. A rotary displacement pump comprising a cylindrical casing consisting of an annular wall and opposed flat end walls, said casing having spaced inlet and outlet ports, a rotor body of

resilient material within said casing, said rotor body consisting of a rotor hub and a plurality of spaced integral flexible vanes each extending radially from the said rotor hub, means rotating said rotor body in either clock-wise or counter-clock-wise direction of rotation, said vanes rotatable in either direction with equal functional results, said rotating means and the rotor body having their respective axii concentric, said axii being disposed eccentrically relative the axis of the casing annular wall, said rotating means being supported in said casing, said rotor hub periphery being spaced from the said casing annular wall, the lateral edges of said vanes engaging said casing end walls, the longitudinal edges of said vanes engaging said casing annular wall to form pumping chambers, each of said vanes being successively flexed due to the varying relationship of the annular wall and the rotor body during each revolution of said rotor body, said vane longitudinal edges sealing the said pumping chambers against leakage only when the back pressure of the fluid being pumped is less than the predetermined amount, and means for extracting heat from that area of said casing end walls encompassed by and adjacent the said rotor body hub.

3. A rotary displacement pump comprising a cylindrical casing consisting of an annular wall and opposed flat end walls, said casing having spaced inlet and outlet ports, a rotor body of resilient material within said casing, said rotor body consisting of a rotor hub and a plurality of spaced integral flexible vanes each extending radially from the said rotor hub, means rotating said rotor body in either clock-wise or counter-clock-wise direction of rotation, said vanes rotatable in either direction with equal functional results, said rotating means and the rotor body having their respective axii concentric, said axii being disposed eccentrically relative the axis of the casing annular wall, said rotating means being supported in said casing, said rotor hub periphery being spaced from the said casing annular wall, the lateral edges of said vanes engaging said casing end walls, the longitudinal edges of said vanes engaging said casing annular wall to form pumping chambers, each of said vanes being successively flexed due to the varying relationship of the annular wall and the rotor body during each revolution of said rotor body, said vane longitudinal edges sealing the said pumping chambers against leakage only when the back pressure of the fluid being pumped is less than the predetermined amount, said rotor body hub ends having a recess in the said pumping chambers between adjacent vane lateral edges, said recess being means for ingress and egress of lubricant to those areas of the casing end walls located adjacent the rotor body hub ends.

4. A rotary displacement pump comprising a cylindrical casing consisting of an annular wall and opposed flat end walls, said casing having spaced inlet and outlet ports, a rotor body of resilient material within said casing, said rotor body consisting of a rotor hub and a plurality of spaced integral flexible vanes each extending radially from the said rotor hub, means rotating said rotor body in either clock-wise or counter-clock-wise direction of rotation, said vanes rotatable in either direction with equal functional results, said rotating means and the rotor body having their respective axii concentric, said axii being disposed eccentrically relative the axis of the casing annular wall, said rotating means being

supported in said casing, said rotor hub periphery being spaced from the said casing annular wall, the lateral edges of said vanes engaging said casing end walls, the longitudinal edges of said vanes engaging said casing annular wall to form pumping chambers, each of said vanes being successively flexed due to the varying relationship of the annular wall and the rotor body during each revolution of said rotor body, said vane longitudinal edges sealing the said pumping chambers against leakage only when the back pressure of the fluid being pumped is less than the predetermined amount, a non-flexible bar encompassed in the extremity of each of said vanes, said bar having a mass greater than the mass of the equivalent volume of the rotor body material, said non-flexible bar stiffening said vane against longitudinal flexing or buckling without impairing the flexibility of said vane in the lateral plane, said stiffening of said vane edge improving the sealing or packing of the pumping chamber against leakage, thereby increasing the back pressure to any variant desired amount.

5. A rotary displacement pump comprising a cylindrical casing consisting of an annular wall and opposed flat end walls, said casing having spaced inlet and outlet ports, a rotor body of resilient material within said casing, said rotor body consisting of a rotor hub and a plurality of spaced integral flexible vanes each extending radially from the said rotor hub, means rotating said rotor body in either clock-wise or counter-clock-wise direction of rotation, said vanes rotatable in either direction with equal functional results, said rotating means and the rotor body having their respective axii concentric, said axii being disposed eccentrically relative to the axis of the casing annular wall, said rotating means being supported in said casing, said rotor hub periphery being spaced from the said casing annular wall, the lateral edges of said vanes engaging said casing end walls, the longitudinal edges of said vanes engaging said casing annular wall to form pumping chambers, each of said vanes being successively flexed due to the varying relationship of the annular wall and the rotor body during each revolution of said rotor body, said vane longitudinal edges sealing the said pumping chambers against leakage only when the back pressure of the fluid being pumped is less than the predetermined amount, said vanes having non-flexible means adjustable and alterable to vary the leakage when the set back pressure of the fluid pumped is attained.

6. The combination in a rotary displacement pump comprising a cylindrical casing consisting of an annular wall and opposed flat end walls, said casing having spaced inlet and outlet ports, a rotor body of resilient material within said casing, said rotor body consisting of a rotor hub and a plurality of spaced integral flexible vanes each extending radially from the said rotor hub, means rotating said rotor body in either clock-wise or counter-clock-wise direction of rotation, said vanes rotatable in either direction with equal functional results, said rotating means and the rotor body having their respective axii concentric, said axii being disposed eccentrically relative the axis of the casing annular wall, said rotating means being supported in said casing, said rotor hub periphery being spaced from the said casing annular wall, the lateral edges of said vanes engaging said casing end walls, the longitudinal edges of said vanes engaging said casing annular wall to form pumping chambers, each of said

vanes being successively flexed due to the varying relationship of the annular wall and the rotor body during each revolution of said rotor body, said vane longitudinal edges sealing the said pumping chambers against leakage only when the back pressure of the fluid being pumped is less than the predetermined amount, said rotor body hub being provided with means for ingress of a flow of lubricant (such as the fluid being pumped) to the casing flat end wall areas encompassed by and adjacent to the said rotor body hub, with adjustable means stiffening said vane longitudinal outer edge to increase or decrease leakage between said vane outer edge and the said casing annular wall when the predetermined back pressure of the fluid pumped has been attained.

7. The combination in a rotary displacement pump comprising a cylindrical casing consisting of an annular wall and opposed flat end walls, said casing having spaced inlet and outlet ports, a rotor body of resilient material within said casing, said rotor body consisting of a rotor hub and a plurality of spaced integral flexible vanes each extending radially from the said rotor hub, means rotating said rotor body in either clockwise or counter-clock-wise direction of rotation, said vanes rotatable in either direction with equal functional results, said rotating means and the rotor body having their respective axii concentric, said axii being disposed eccentrically relative the axis of the casing annular wall, said rotating means being supported in said casing, said rotor hub periphery being spaced from the said casing annular wall, the lateral edges of said vanes engaging said casing end walls, the longitudinal edges of said vanes engaging said

casing annular wall to form pumping chambers, each of said vanes being successively flexed due to the varying relationship of the annular wall and the rotor body during each revolution of said rotor body, said vane longitudinal edges sealing the said pumping chambers against leakage only when the back pressure of the fluid being pumped is less than the predetermined amount, a non-flexible bar encompassed in the extremity of each of said vanes, said bar having a mass greater than an equivalent volume of the rotor body material, said non-flexible bar stiffening said vane against longitudinal flexing or buckling without impairing the flexibility of said vane in the lateral plane, said stiffening of said vane edge improving the sealing or packing of the pumping chamber against leakage, thereby increasing the back pressure to any variant desired amount, with means extracting heat from that area of said casing end walls encompassed by and adjacent the said rotor body hub.

EDWARD C. RUMSEY.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
855,590	Ripberger	June 4, 1907
1,019,499	Levy et al.	Mar. 5, 1912
1,053,321	Scrock	Feb. 18, 1913
1,192,978	Belyea	Aug. 1, 1916
2,189,356	Briggs	Feb. 6, 1940
2,203,974	Weinhardt	June 11, 1940
2,258,371	Wernert	Oct. 7, 1941