

Dec. 30, 1930.

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1,786,435

CENTRIFUGAL PUMP

Filed June 11, 1928

2 Sheets-Sheet 1

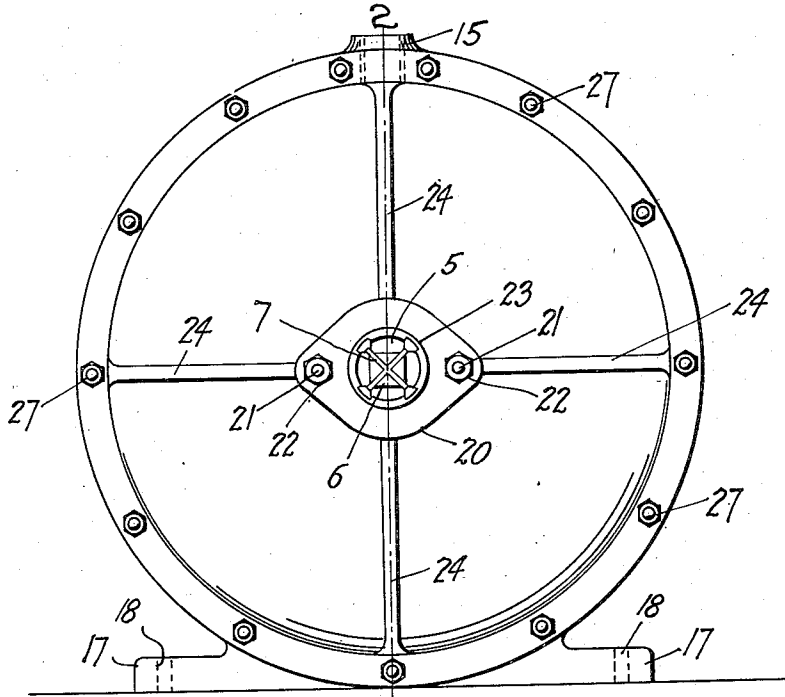


FIG. 1.

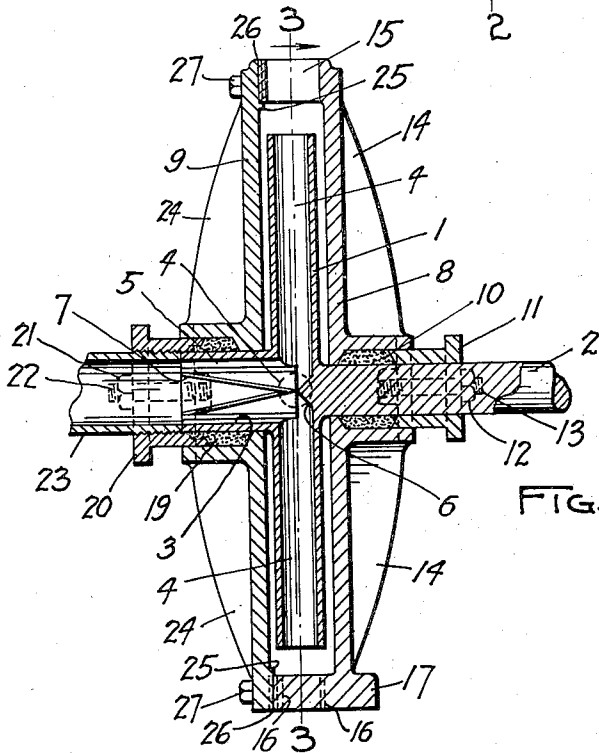


FIG. 2.

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2 Sheets-Sheet 2

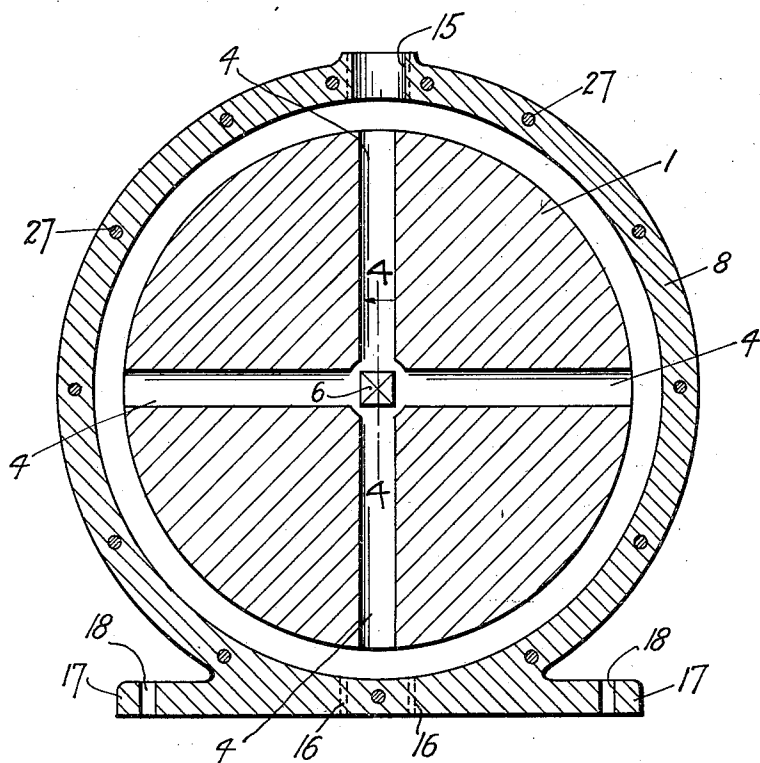


FIG. 3.

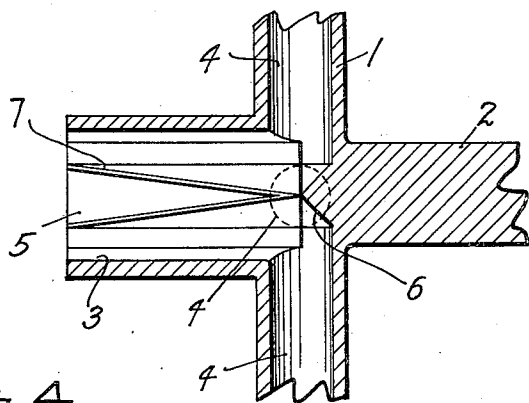


FIG. 4.

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CENTRIFUGAL PUMP

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My invention relates to pumps, and more especially to centrifugal pressure pumps, adapted to impart energy to fluids.

In the ordinary centrifugal pump, the drive shaft drives a rotor having curved blades or curved passages in a transverse plane, or the rotor may be composed of a series of radiating arms having passages and connected only at their hub.

In centrifugal pumps having rotor passages of unequal sectional area the tendency is to permit, in the rotor, short circuits, or to create eddy currents in the fluid being pumped.

In centrifugal pumps provided with separate rotor arms having passages and connected only at the hub, there is a tendency to cause outside of the rotor, short circuits or eddy currents in the fluid being pumped.

In centrifugal pumps having rotor passages curved in a transverse plane, the centrifugal force combined with the curved passages, acts to increase or direct the velocity of the fluid being pumped at the expense of the centrifugal force, which naturally decreases the resulting pressure.

In centrifugal pumps in general, any contour, or proportion, either within or without the rotor, which prevents the perfect streamlining of the fluid being pumped in its complete passage through the pump, acts to decrease the efficiency of the pump, and the possible pressure that can be developed in any one pump.

The object of this invention is to provide a centrifugal pump in which the short circuit and eddy current losses are reduced to a minimum.

A further object is to provide such a pump in which all of the centrifugal force is employed to provide pressure, and none of it is employed to provide velocity at the expense of pressure.

A further object is to provide such a pump, which because of freedom from short circuit

and eddy current losses and the use of none of the centrifugal force to provide velocity of discharge at the expense of pressure, is adaptable to high pressure without resorting to multistaging.

A further object is to provide such a pump, which will operate with equal efficiency with either direction of rotation of the rotor.

A further object is to provide such a pump which may be operated with the minimum of power when its output is restricted below its maximum capacity, or entirely cut off.

A further object is to provide such a pump in which the discharge pressure will not substantially rise above or drop below the rated pressure of the pump at a given uniform speed, even though said discharge is partially or entirely shut off.

A further object is to provide such a pump, which, due to the equalized capacity of its channels maintains a substantially uniform velocity upon the fluid as it passes through the pump.

I attain the above objects by providing a construction in which the rotor has an axial intake having a distributor which divides the fluid into channels, while it is still moving axially.

The rotor is composed of a round smooth surfaced disk provided with equally spaced straight radial holes or channels of uniform cross section along their entire length, each hole connecting direct with one of the above mentioned axial channels.

The rotor is mounted in a housing provided with stuffing boxes, and with preferably a single outlet, the interior of the housing being smooth and having ample clearance with the rotor, all of which is described more in detail below and is shown clearly in the drawings, in which:—

Figure 1 is an elevation of the intake side of my pump, with the intake pipe removed.

Figure 2 is a central vertical section on the line 2—2 of Figure 1.

Figure 3 is a vertical section on the line 3—3 of Figure 2, but with the distributor removed.

Figure 4 is a section through the rotor on the line 4—4 of Figure 3, but with the distributor in place.

The rotor 1 is driven by the drive shaft 2, upon which it is mounted securely in any proper manner, and is provided with the hollow intake shaft 3.

The rotor 1 is a smoothly finished disk, and is provided with the equally spaced radial centrifugal passages 4, whose combined cross sectional area is substantially equal to the cross sectional area of the intake shaft passage 5.

In making the passages 4 in the rotor 1, I prefer, for the purpose of illustration, to use a solid disk and to form the passages by drilling, stopping the point of the drill at the center line of the shaft 2; the passage 5 in the shaft 3 is also bored, the square bottom of the bore being on the center lines of the passages 4.

Any other proper method of obtaining the same or substantially the same passages may be employed, if desired.

If, as shown in the drawings, four passages 4 are employed, this preferred method of construction provides what might be called a four sided pyramid 6 at the end of the passage 5, each face of the so-called pyramid being concave, due to the cutting edges of the drill which forms the passages 4.

The axial distributor 7, formed in any proper manner and of any proper material, is made to fit in the passage 5 of the intake shaft 3, and as shown, the outer edges of its four tapered wings fit into keyways cut in the inner face of the shaft 3. This acts to prevent rotation of the distributor 7 with respect to the shaft 3 and maintains its wings aligned with the edges which separate the concave faces of the so-called pyramid. Any other proper method of constructing and aligning the distributor may be used provided it is reliable and satisfactory.

The four wings of the distributor 7 thus provide four separate channels, each channel being directly connected with one of the passages 4 of the rotor 1. The purpose of the distributor wings being made tapered is to decrease the shock of imparting rotary movement to the fluid in its axial progress toward the passages 4.

Thus, as the fluid being pumped enters the distributor 7, it is gradually divided and made to revolve in four parts, and from that time on till it is discharged from the rotor 1, each of these four parts remains separate, and unaffected by any of the other parts.

By this construction the fluid while still moving axially is positively rotated, and due to the concave faced pyramid its direction is changed from axial to radial with little

frictional loss, and due to the substantially uniform cross sectional area of each fluid stream from the inner portion of the distributor 7 to the outer end of its passage 4, a stream line effect is produced within the rotor which not only does not permit short circuits or eddy currents within the rotor, but which also maintains the efficiency of each fluid stream through the rotor as the capacity and fluid velocity is increased, or as the revolutions per minute and pressure per square inch is increased.

In the drawings, the rotor 1, drive shaft 2 and intake shaft 3, are all shown as of one piece of metal. The rotor, however, may be made of any material desired, or to meet the conditions of any special case, and the construction instead of being completely integral, can be wholly or partially built up, to fit any set of requirements, or the judgment of any designer or the requirements of any conditions or set of conditions, so long as the result is a rotor with disk and drive and intake shafts which act together substantially as one piece.

Likewise, the distributor 7, may either be made of metal or may be made of any desired or required material to fit any given case.

The distributor may be made separate from the rest of the rotor as shown in the drawings, or integral therewith as may be desired, or as the conditions of each case may dictate, so long as the final result is that the distributor rotates as one piece with the rotor and combines with the centrifugal passages 4 to form separate fluid streams through the rotor when in operation.

The housing consists of two pieces, the case 8 and the cover 9.

The case 8 is provided with a bearing to properly receive and support the drive shaft 2, and is also provided with packing 10 and a packing gland 11, the position of the gland, and the pressure on the packing being controlled by the gland nuts 12, on the studs 13.

Any other proper method or construction of bearing for mounting the shaft and of packing for prevention of leakage may be employed if desired.

The side of the case 8 may be strengthened and braced by ribs such as indicated at 14. The case is provided with the threaded discharge port 15, and may if desired be provided with one or more other discharge ports as indicated by dotted lines at 16, Figure 2.

Since my pump operates exclusively upon centrifugal force, and not partially upon centrifugal force combined with velocity of fluid discharge, the exact position of the discharge ports is not vital so long as the construction is such as to permit stream action of the fluid passing thereto. If one discharge port is used, it should be threaded to receive the standard pipe whose cross sectional in-

ternal area is equal to or the nearest below that of the intake passage 5.

The case 8 is also provided with a proper mounting base 17, of any desired proportions or construction, and with holes 18 for the proper attachment of the case upon its mounting, or with any other proper provision for mounting and attachment.

The cover 9 is provided with a bearing for the proper reception of the intake shaft 3, and is provided with the packing 19 and the internally threaded gland 20. Any other proper method or construction of bearing for mounting the shaft 3 and of packing for the prevention of leakage may be employed if desired, or the bearing may be dispensed with in some cases.

The gland 20 is provided with a counter-bore at its inner end so that the packing 19 will act not only to pack against leakage from the housing out along the shaft 3, but will also pack against leakage from the passage 5 around the inner end of the gland 20.

The position of the gland 20 and the pressure on the packing 19 are controlled by the nuts 21, on the studs 22. The intake pipe 23 is threaded into the gland 20. Any other method or construction for packing against leakage from the passage 5 and for the connection of the intake pipe 23 may be used if desired so long as the results are practical and reliable.

The side of the cover 9 may be strengthened and braced by ribs such as indicated at 24.

The cover 9 is properly centered on the case 8 by the shoulder 25 or in any other proper manner, the joint between them being made tight by the gasket 26. Under some conditions it may be desired to dispense with the gasket 26 and use a ground joint between the case 8 and the cover 9, but I believe in most cases the gasket construction will be preferred.

The cover 9 is held securely to the case 8 by the capscrews 27, the cover and case then combining to form a tight housing for the rotor.

The housing may be properly built up of any number of pieces joined together in any suitable manner so long as the final assembled unit is reliable and satisfactory.

The housing is to be so proportioned that there will be ample cross sectional area for the passage of the fluid being pumped from the rotor passages 4 to the discharge passage 15 in either direction, and regardless of the direction of rotation of the rotor.

The inner surfaces of the housing are preferably to be smoothly finished, the circumferential face being concentric with the rotor 1.

It will now be seen that all the objects sought have been attained by the construction described and illustrated:—

There is a minimum of short circuit and

eddy current losses; all of the centrifugal force is turned into pressure, and none of it is lost in giving velocity to the fluid discharge; because of the absence of short circuits and eddy currents and their losses, and because of the smooth stream-line construction throughout, high rotative speed of the rotor is possible, with the resulting high pressure without multistaging; in fact a sixteen inch rotor at 3600 revolutions per minute gives 420 pounds per square inch pressure with water.

Since the construction of the rotor and of the housing is perfectly symmetrical, the direction of rotation of the rotor is immaterial.

The pressure being due entirely to centrifugal force can not exceed or drop below its rated amount at its rated revolutions per minute, even though the discharge is partially or entirely restricted.

And since the pressure can not exceed its rated amount, the power required to operate the pump at a certain speed will decrease as the amount of fluid discharged is restricted.

And, since the total sectional area of the fluid streams from the entering of the distributor to the outer end of the rotor passages is substantially uniform and the housing is concentric with the rotor, making all passages outside of the rotor substantially of equal sectional area, it follows that a substantially uniform velocity will be maintained upon the fluid as it passes through the pump.

I am aware of various modifications that might be made by a competent mechanic to suit different situations and requirements, so I do not wish to limit my protection narrowly to the exact construction described and illustrated, but what I claim as new, and desire to protect by Letters Patent, is as follows:—

1. In a centrifugal pump, a closed housing provided with discharge means, a rotor concentrically mounted to rotate in the housing and spaced from the internal circumference thereof, the rotor being provided with a central axially extending intake passage and with straight radial passages in communication therewith, a concave faced pyramid at the inner end of said intake passage having a concave face aligned with each radial passage, and a distributor in said intake passage provided with channels adapted to register with said radial passages and said concave faces whereby the fluid pumped is divided into separate streams during its movement through said intake passage and provided with streamline paths of travel from the intake passage to the radial passages said channels being separated adjacent their outer circumference at the outer end of the distributor by walls of small radial extent, tapered portions being removed from the central part of said walls.

2. In a centrifugal pump, a closed housing provided with a discharge port, a rotor con-

centrically mounted to rotate in the housing and spaced from the internal circumference thereof, the rotor being provided with a central intake passage and straight radial passages in a transverse plane and in communication with the intake passage, and a distributor having axially extending tapered wings in the intake passage contacting the inner surface of said intake passage along their longer side and adapted to form at their inner widest portion separate axially extending channels aligned with the radial passages.

3. In a centrifugal pump, a closed housing provided with discharge means, a rotor concentrically mounted to rotate in the housing and spaced from the internal circumference thereof, the rotor being provided with a central intake passage and straight radial passages in a transverse plane and in communication with the intake passage, and a distributor having axially extending tapered wings in the intake passage, each wing being longest adjacent the inner wall of said intake passage and adapted to form at their inner widest portion separate axially extending channels aligned with the radial passages, and means forming curved communicating passages between the axial channels and their respective radial passages.

4. In a centrifugal pump, a closed housing provided with discharge means, a rotor concentrically mounted to rotate in the housing and spaced from the internal circumference thereof, the rotor being provided with a central intake passage and straight radial passages in a transverse plane in communication with the intake passage, and a distributor having axially extending tapered wings in the intake passage, their greatest length being adjacent their outer radius, and adapted to form at their inner widest portion separate axially extending channels aligned with the radial passages, and means forming curved communicating passages between the axial channels and their respective radial passages, the cross sectional area of the aligned axial channels, communicating passages and radial passages being substantially uniform throughout their combined length.

5. In the rotor of a centrifugal pump having a central revoluble axially extending intake passage communicating with passages in a transverse plane, a distributor in said intake passage provided with tapered wings, their short sides adjacent each other and centrally located, forming channels aligned with the passages in said transverse plane, whereby entering fluid will be progressively divided into separate streams.

6. In the rotor of a centrifugal pump having a central revoluble axially extending intake passage, transverse revoluble means provided with drilled radial holes in communication with said intake passage, a portion of the end of said holes as drilled forming

curved surfaces adapted to decrease the shock of the fluid passing from the intake passage to the said radial holes, and a distributor in said intake passage provided with tapered wings, their short sides adjacent each other and centrally located, forming channels aligned with the said radial holes whereby entering fluid will be progressively divided into separated streams prior to contact with said curved surfaces.

7. In a centrifugal pump, a closed housing provided with a substantially circular interior and with discharge means therefrom, a circular, exteriorly smooth rotor concentrically mounted to rotate in the housing and spaced from the internal circumferential face thereof, the rotor being provided with a central axially extending intake passage, and straight radial passages in a transverse plane in communication with the intake passage, a concave faced pyramid at the inner end of said intake passage having a concave face aligned with each radial passage, and walls adapted to form fluid channels in said intake passage separated adjacent the walls of said intake passage for their full length and aligned with said concave faces and radial passages, said walls being joined at their inner ends and separated at their outer ends.

8. In a centrifugal pump, a closed housing provided with a substantially circular interior and with discharge means therefrom, a circular exteriorly smooth rotor concentrically mounted to rotate in the housing and spaced from the internal circumferential face thereof, the rotor being provided with a central axially extending intake passage and straight radial passages in a transverse plane in communication with the intake passage and walls in the intake passage and contacting the inner surface thereof for their full length, separate from each other at their outer ends and joined only adjacent their inner ends, adapted to progressively form within a predetermined distance, separate fluid channels in said intake passage aligned respectively with said radial passages, and means forming a curved contour between each axial channel and its communicating radial passage.

9. In a centrifugal pump, a closed housing provided with a substantially circular interior and with discharge means therefrom, a circular exteriorly smooth rotor concentrically mounted to rotate in the housing and spaced from the internal circumferential face thereof, means to prevent leakage from said housing along said rotor, the rotor being provided with a central axially extending intake passage, and straight radial passages in a transverse plane in communication with the intake passage, and walls in the intake passage adapted to progressively form within a predetermined axial distance, separate fluid channels in said intake passage aligned re-

spectively with said radial passages, said fluid channels being separated adjacent the inner surface of said intake passage for their full length, and means forming a curved contour in the connection between each axial channel and its communicating radial passage, the walls in said passage being tapered with the outer narrow portions contacting the inner face of said intake passage.

In testimony whereof I affix my signature.

STEVE KOMFALA.