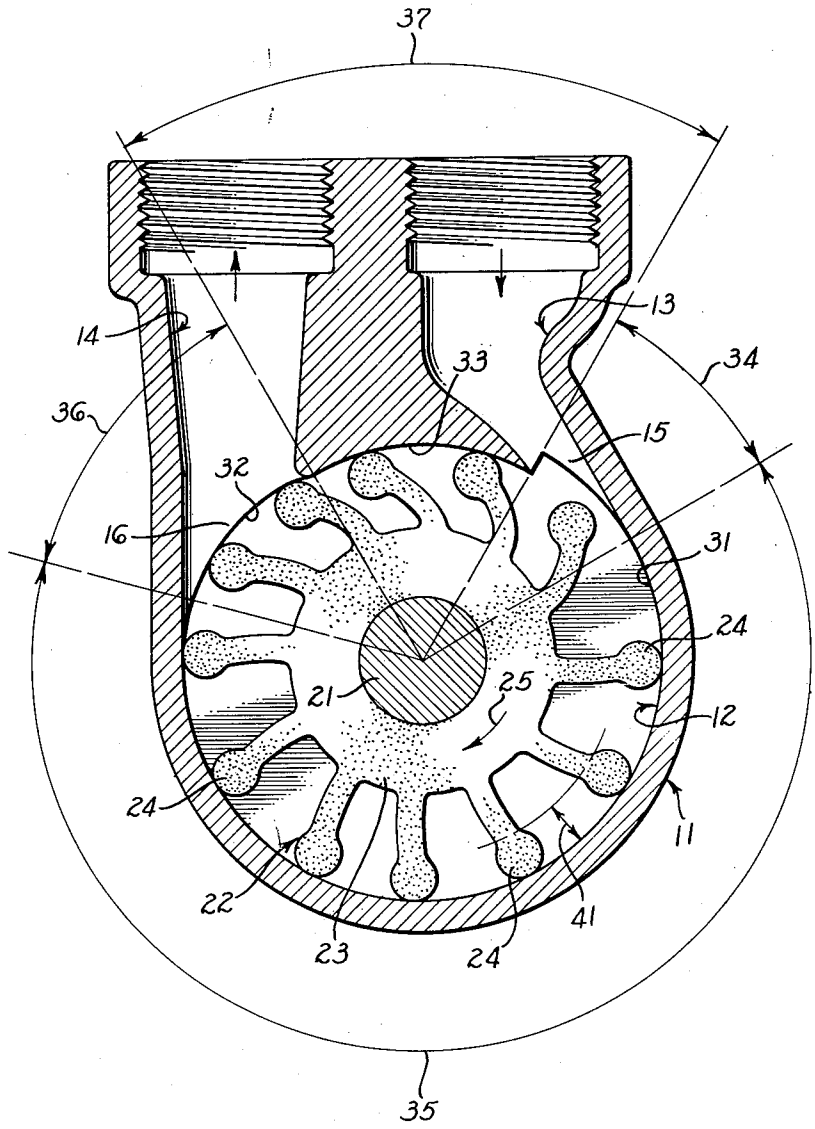
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IMPELLER PUMP

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IMPELLER PUMP

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The present invention relates in general to pumps of the radial vane type and, more particularly, to a pump having an impeller operable in an impeller chamber of variable radius and having flexible vanes perferably formed of rubber, it being understood that the term "rubber" is intended to include not only natural rubber, but various synthetic materials having the same general properties.

In prior pumps of the foregoing general character, the radius of the peripheral wall of the impeller chamber gradually decreases from a maximum to a minimum in the vicinity of the outlet passage and then gradually increases from the minimum back to the maximum in the vicinity of the inlet passage, the fluid being pumped thus being drawn into the spaces between the vanes from the inlet passage as the vanes straighten out and being squeezed out of the spaces between the vanes into the outlet passage as the vanes are flexed to reduce the volumes of the spaces therebetween. In such a pump, as in any pump of the radial vane type, it is essential, if losses due to turbulence are to be avoided, to accelerate the fluid entering the impeller chamber through the inlet passage to a velocity and direction corresponding to the velocity and direction of the vanes in the vicinity of the inlet passage. In the past, this has been accomplished by making the inlet passage in the form of a nozzle which serves to provide the incoming fluid with the proper velocity and direction. However, this way of accelerating the incoming fluid has the effect of materially reducing the static pressure of the fluid, which is undesirable since the discharge pressure is correspondingly reduced.

Accordingly, a primary object of the present invention is to avoid the foregoing disadvantages of the prior art.

More particularly, a primary object of the invention is to provide a pump wherein the energy stored in the flexed vanes is utilized to accelerate the incoming fluid to the proper velocity and direction, this being accomplished by providing a structure which permits the vanes to snap from their flexed positions to their unflexed positions, which is an important feature.

Still more particularly, an important object of the invention is to provide an impeller chamber, the radius of which abruptly increases in the vicinity of the inlet passage so that the flexed vanes may snap into their unflexed positions and, in doing this, transfer the energy stored therein to the incoming fluid to accelerate it to the proper velocity and direction. In this connection, it should be pointed out that the present invention thus utilizes energy which is dissipated in prior art pumps of this general character, which is an important feature.

Still another important object of the invention is to provide a pump wherein the minimum cross-sectional area of the inlet passage is greater than the effective cross-sectional area of the space between the core or hub of the impeller and the peripheral wall of the impeller chamber so that the velocity of the incoming fluid in the inlet passage is lower than its velocity through the impeller chamber. Providing such a relatively large inlet passage minimizes static pressure losses in the inlet passage, which is an important feature.

Tests have indicated that pumps constructed in accordance with the present invention are more efficient and have a longer impeller life than prior art pumps of the same general character, which are important features.

The foregoing objects and advantages of the present invention, together with various other objects and advantages thereof which will become apparent, may be attained with the exemplary embodiment of the invention which is illustrated in the accompanying drawing and which is described in detail hereinafter, the drawing comprising a cross-sectional view of a pump of the flexible-vane type which embodies the invention.

Referring to the drawing, the numeral **11** designates a pump housing having therein a generally cylindrical impeller chamber **12** and having therein inlet and outlet passages **13** and **14** which communicate with the impeller chamber, the inlet passage **13** terminating in an inlet port **15** formed in the peripheral wall of the impeller chamber and the outlet passage commencing with an outlet port **16** formed in the peripheral wall of the impeller chamber. Disposed within the impeller chamber **12** and mounted on an impeller shaft **21** is an impeller **22** having a hub or core **23** and flexible radial vanes **24**, the entire impeller preferably being formed of rubber. The impeller **22** is rotated in the direction of the arrow **25** by any suitable means, not shown, connected to the impeller shaft **21**.

The peripheral wall of the impeller chamber **12** includes first, second and third circumferentially extending segments **31**, **32** and **33**, the segment **31** subtending arcs **34** and **35**, the segment **32** subtending an arc **36** and the segment **33** subtending an arc **37**. The radius of the peripheral wall of the impeller chamber **12** varies between a maximum and a minimum, the radius of the segment **31** being the maximum, the radius of the segment **33** being the minimum and the radius of the segment **32** gradually descreasing from the maximum to the minimum in the direction of rotation of the impeller **22**. The inlet port **15** is formed in that portion of the segment **31** which is subtended by the arc **34** and is disposed adjacent the junction of the third and first segments **33** and **31**. The outlet port **16** is formed in the segment **32** of the peripheral wall of the impeller chamber.

An important feature of the present invention resides in abruptly increasing the radius of the peripheral wall of the impeller chamber **12** at the junction of the segments **33** and **31**. Considering the new result attained by this sudden increase in the radius of the impeller chamber **12** at the inlet port **15**, it will be noted that the vanes **24** are flexed by engagement with the segment **32** of gradually decreasing radius and the segment **33** of minimum radius, the purpose of such flexing being to discharge the pumped fluid into the outlet passage **14**, as is well known in the art. Considerable energy is stored in the flexed vanes in engagement with the segment **33**, and this energy is released when the vanes disengage the third segment **33** because of the sudden increase in radius at the junction of the third segment **33** and the first segment **31**. Consequently, the vanes tend to snap from their flexed positions to their normal, or relatively unflexed positions, the vanes re-engaging the peripheral wall of the chamber **12** approximately at the line dividing the arcs **34** and **35**. As the vanes unflex throughout the arc **34**, the energy stored therein is transferred to the fluid entering the impeller chamber **12** through the inlet passage **13** so that this fluid is accelerated to substantially the velocity and direction required to cause it to move along smoothly with the vanes. Thus, instead of being dissipated, as in prior pumps of this general character, the energy stored in the flexed vanes **24** is usefully employed

to accelerate the incoming fluid to the desired velocity and direction, which is an important feature.

Another important feature resulting from the utilization of the energy stored in the flexed vanes **24** in this manner is that the minimum cross-sectional area of the inlet passage **13** may be large as compared to prior pumps of this general character so as to maintain a higher static pressure in the inlet port **15**, thereby increasing the discharge pressure. Preferably, the velocity of the incoming fluid in the inlet passage **13** is less than the velocity of the fluid in the space between the core **23** of the impeller **22** and the segment **31** of the peripheral wall of the impeller chamber, the fluid being accelerated to the velocity in such space by the energy transferred thereto by the unflexing vanes. Consequently, the minimum cross-sectional area of the inlet passage **13** is greater than the effective cross-sectional area of the space between the core **23** and the segment **31**, measured in a plane extending longitudinally of the impeller chamber and containing the axis of the impeller, instead of being less than the effective cross-sectional area of such space, which is an important feature of the invention since it permits maintaining maximum static pressure in the inlet port **15**. The effective cross-sectional area of the space between the core **23** and the segment **31** is regarded as a value which takes the volume occupied by the vanes **24** in such space into consideration. In other words, the effective cross-sectional area of such space is the difference between the total volume of the space and the volumes of the vanes therein divided by the length of the space, the width of the equivalent effective passage being designated by the dimensional arrow **41**.

Preferably, the outlet passage **14** diverges outwardly to form a diffuser means which acts to convert part of the velocity energy of the discharged fluid to pressure energy, thereby increasing the discharge pressure.

While I have disclosed an exemplary embodiment of my invention herein for purposes of illustration, it will be understood that various changes, modifications, and substitutions may be incorporated in such embodiment without departing from the spirit of the invention.

I claim as my invention:

1. In a device for pumping a fluid, the combination of: a housing having therein a generally cylindrical impeller chamber providing an axis and provided with a peripheral wall, said housing also having therein inlet and outlet passages for the fluid to be pumped, said inlet and outlet passages respectively terminating in inlet and outlet ports which communicate with said impeller chamber, said peripheral wall including a first circumferentially extending segment of a maximum radius relative to said axis, a second circumferentially extending segment of a gradually decreasing radius relative to said axis and a third circumferentially extending segment of a minimum radius relative to said axis, said peripheral wall having a substantially radial segment relative to said axis at the junction of said third and first circumferentially extending segments so that the radius of said peripheral wall relative to said axis increases abruptly from said minimum to said maximum at the junction of said third and first circumferentially extending segments, said inlet port having a first edge located substantially in radial alignment relative to said axis with said radial segment of said peripheral wall, and having a second edge circumferentially spaced from said first edge thereof and located intermediate the ends of said first circumferentially extending segment, said outlet port communicating with said chamber adjacent said second circumferentially extending segment, and said third circumferentially extending segment being located intermediate said inlet and outlet ports; an externally driven shaft extending into said impeller chamber with its center line coinciding with said axis; and an impeller rotatable in said impeller chamber and having radially extending, flexible vanes the radii of which relative to said axis are at least equal to said maximum radius when said vanes are unflexed so that the ends of said vanes are engageable with each of said first, second and third circumferentially extending segments of said peripheral wall, said impeller being rotatable by said externally driven shaft in a direction to move said vanes over said first, second and third circumferentially extending segments in that order to pump fluid entering said impeller chamber through said inlet passage and said inlet port into said outlet port and said outlet passage, said vanes snapping from engagement with said third circumferentially extending segment into engagement with said first circumferentially extending segment as they move across said inlet port from a position where they are substantially in radial alignment relative to said axis with said first edge of said inlet port to a position wherein they are substantially in radial alignment relative to said axis with said second edge of said inlet port, whereby the energy released by said vanes as they snap from engagement with said third circumferentially extending segment into engagment with said first circumferentially extending segment in moving across said inlet port is transferred to the fluid in said inlet port and said inlet passage to draw it into said impeller chamber.

2. A device for pumping a fluid as defined in claim 1 wherein said inlet and outlet ports are located in said peripheral wall, said inlet port being located in said radial segment and in an adjacent portion of said first circumferentially extending segment, and said outlet port being located in said second circumferentially extending segment.

3. A device for pumping a fluid as defined in claim 1 wherein said first and third circumferentially extending segments are of constant radii and are concentric about said axis of said impeller chamber as their center.

4. A device for pumping a fluid as defined in claim 1 wherein said impeller is provided with a core carrying said vanes, the effective cross-sectional area of the space between the core of said impeller and said first circumferentially extending segment of said peripheral wall, measured in a plane extending longitudinally of said impeller chamber and including said axis, being less than the minimum cross-sectional area of said inlet passage.

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