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ROTARY PUMP STATOR

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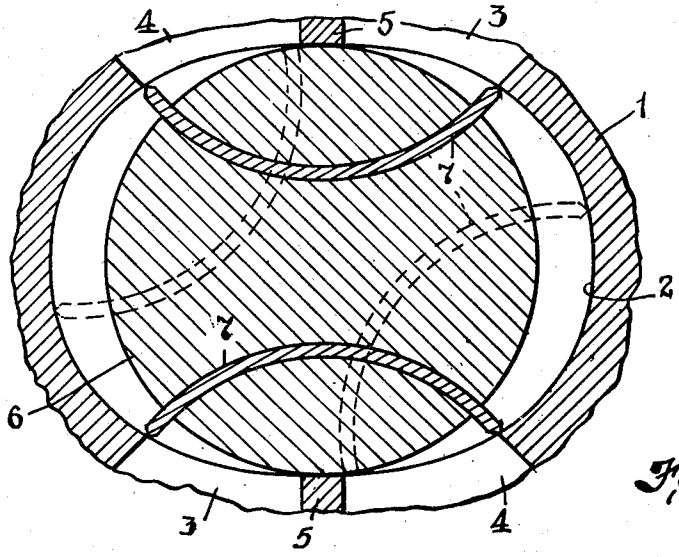
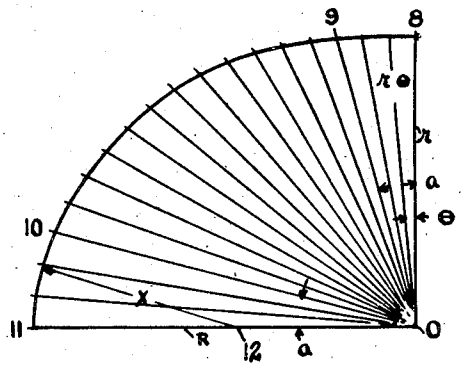


Fig. 1

Fig. 2



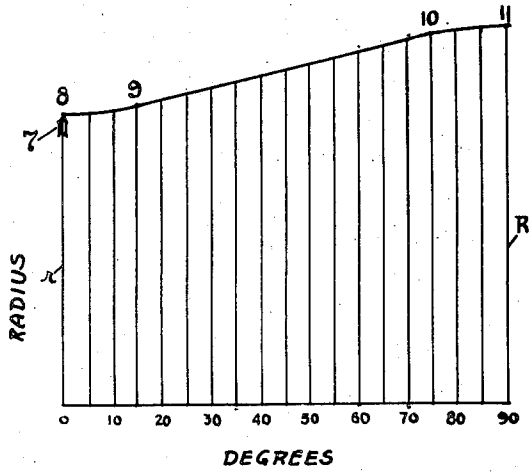


Fig. 3

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ROTARY PUMP STATOR

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9 Claims. (Cl. 103—135)

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The present invention relates generally as indicated to a rotary pump and more particularly to that type of pump in which a vane carrying rotor operates in a stator formed with a non-cylindrical bore, said vanes having their opposite ends in engagement with the wall of said bore.

It is one of the primary objects of this invention to provide a pump of the above character in which the stator bore is of such unique form that the pump has improved operating characteristics especially with regard to the operating efficiency thereof and the absence of mechanical shock therein.

Other objects and advantages of the invention will appear as the following description proceeds.

To the accomplishment of the foregoing and related ends, said invention then comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawing setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

In the drawing:

Fig. 1 is a transverse sectional view of the rotor and stator portions of the pump constituting the present invention;

Fig. 2 is a diagrammatic representation of the manner in which the stator bore is formed; and

Fig. 3 is a layout of the diagram of Fig. 2 on Cartesian coordinates to more clearly indicate the smooth nature of the stator bore.

Referring now to the drawing, the structure illustrated in Fig. 1 comprises a stator 1 formed with a bore 2 of generally elliptical form, such bore being intersected by two pairs of diametrically opposed inlet ports 3 and outlet ports 4 which form diametrically opposed partitions 5 therebetween. As shown, the partitions 5 are so arranged that their center lines coincide and pass through the axis of bore 2, thus dividing the bore into two similar and oppositely arranged sections.

Within the bore 2 is a rotor 6 which has a close running fit with the partitions 5 to provide a fluid tight seal therebetween. Rotor 6 carries arcuate vanes 7 so arranged that the ends thereof project from the rotor at 90° intervals into engagement with or close proximity to the wall to the bore 2.

The bore 2, as previously mentioned, is generally elliptical in shape and consists of four similar and alternately oppositely arranged curves each formed in the manner illustrated by the diagram in Fig. 2.

In Fig. 2 the radii of the minor and major axes

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from the pole 0 are respectively designated "r" and "R." The portion of the curve between points 8 and 9 is a straight line parallel to the major axis and perpendicular to the minor axis and therefore the radius r_θ to any point between 8 and 9 is equal to $r\sec\theta$, "θ" being the angle between the radii r and r_θ.

The portion of the curve between points 9 and 10 is a section of an Archimedes' spiral which is tangent to the aforesaid straight line at the point 9, such spiral section being the path traced by the end of a ray which lengthens with uniform velocity as the ray revolves with uniform angular velocity about "0." In other words, if the angle between the points 9 and 10 were divided into equal parts, the radius from "0" to the spiral section would increase a predetermined amount from one radius to the next succeeding one.

The remaining portion of the curve between points 10 and 11 is such that at point 10 it is tangent to the Archimedes' spiral section and at point 11 it is parallel to the minor axis and perpendicular to the major axis, such curve starting at the point 11 and decreasing in radius by an amount equal to that which radius r_θ increases at the portion of the curve between the points 8 and 9. It will be observed that the angle a between points 10 and 11 is the same as between points 8 and 9. The equation of this last described portion of the curve is $R_\theta = R - r(\sec\theta - 1)$ wherein R_θ is the radius at any angle θ between the radii R and R_θ. Although this portion of the curve is preferably made in conformance with the equation, it has been found that in many instances this curve may be a circular arc of radius X struck from a point 12 along the major axis of the bore and tangent to the Archimedes' spiral at the point 10, such radius X obviously being less than the radius from the pole 0.

Having thus defined the elements of one quarter of the bore 2, it will now be apparent that with a bore formed by four of such curves arranged as shown, the straight line portions 8—8 will smoothly join one another as will the curved line portions 10—11.

As illustrated in Fig. 3, the edge of a vane 7 in contact with the wall of bore 2 will, between the points 8 and 9, gradually accelerate from zero velocity to the constant velocity effected by the Archimedes' spiral section thereof as represented by the straight line between the points 9 and 10 on Fig. 3 and a gradual deceleration from such constant velocity to zero velocity between the points 10 and 11. With a bore formed as described, the sum of the radii of the two points on

bore 2 contacted with by the two edges of each vane 7 is a constant and inasmuch as the bore 2 is so formed that for each increment of rotation of the rotor 6 one edge of the vane moves inwardly exactly the same amount that the other edge thereof moves outwardly both edges of each vane 7 will at all times be in contact with the wall of bore 2, thus providing an efficient pump capable of delivering maximum volume of fluid at a maximum delivery pressure. Furthermore, by reason of the unique shape of the bore 2 there is no mechanical shock to contend with whereby the pump may be operated at very high speeds.

A further feature of the bore 2 is that because the surfaces of the partitions 5 are flat, there is provided a better seal between the rotor 6 and the bore 2 than could be provided if the bore 2 consisted merely of oppositely arranged Archimedes' spiral sections.

A pump constructed as explained above is easy to manufacture, is capable of operating at high speeds and because of the smooth nature of the bore 2 is subject to little wear.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims or the equivalent of such be employed.

I therefore particularly point out and distinctly claim as my invention:

1. A stator for a rotary pump formed with a bore of cross-section which in part comprises a curved line constituting a portion of an Archimedes' spiral, a straight line tangent to one end of such curved line, and another line tangent to the other end of such curved line.

2. A stator for a rotary pump formed with a bore of cross-section which in part comprises a curved line constituting a portion of an Archimedes' spiral, a straight line tangent to one end of such curved line, and another line tangent to the other end of such curved line, such last-mentioned line decreasing in radius with reference to the pole of such curved line and from a point commencing at such other end of the latter by the same amount that the distance from such pole to such straight line decreases from a point commencing at such one end of such curved line.

3. A stator for a rotary pump formed with a bore of cross-section such that one quadrant thereof successively constitutes straight line, Archimedes' spiral, and curved line portions, such straight and curved line portions each being tangent to such spiral portion.

4. A stator for a rotary pump formed with a bore of cross-section such that one quadrant thereof successively constitutes straight line, Archimedes' spiral, and curved line portions, such straight and curved line portions each being tangent to such spiral portion and subtending equal angles with reference to the pole of such spiral portion.

5. A stator for a rotary pump formed with a bore of cross-section as defined by four equally spaced identical but oppositely disposed sections of Archimedes' spirals joined by straight line portions tangent to two pairs of adjacent ends of such spiral sections and by curved line portions tangent to the other two pairs of adjacent ends of such spiral sections.

6. A stator for a rotary pump formed with a bore of cross-section as defined by four equally spaced identical and copolar but oppositely disposed sections of Archimedes' spirals joined by straight line portions tangent to two pairs of adjacent ends of such spiral sections and by curved line portions tangent to the other two pairs of adjacent ends of such spiral sections, such straight line portions being bisected by and normal to a line through the common pole of such spiral sections.

7. A stator for a rotary pump formed with a bore of cross-section as defined by four equally spaced identical and copolar but oppositely disposed sections of Archimedes' spirals joined by straight line portions tangent to two pairs of adjacent ends of such spiral sections and by curved line portions tangent to the other two pairs of adjacent ends of such spiral sections, such curved line portions at their mid points crossing a line through the common pole of such spiral sections at right angles.

8. A stator for a rotary pump formed with an oblong bore having minor and major axes respectively equal to $2r$ and $2R$, one quadrant of such bore including end elements whose radii r_θ and R_θ at an angle θ from r and R respectively conform to the equations $r_\theta = r\sec\theta$ and

$$R_\theta = R - r(\sec\theta - 1)$$

and an intermediate element comprising an Archimedes' spiral section tangent to such end elements.

9. A stator for a rotary pump formed with an oblong bore having minor and major axes respectively equal to $2r$ and $2R$, one quadrant of such bore including end elements whose radii r_θ and R_θ at an angle θ from r and R respectively conform to the equations $r_\theta = r\sec\theta$ and

$$R_\theta = R - r(\sec_\theta - 1)$$

and an intermediate element comprising an Archimedes' spiral section tangent to such end elements, the pole of such intermediate element coinciding with the intersection of such minor and major axes.

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