May 21, 1963 R. MOREIRA 3,090,547

MULTI-STAGE RADIAL SLIDING VANE PUMP

Filed June 12, 1962 2 Sheets-Sheet 1

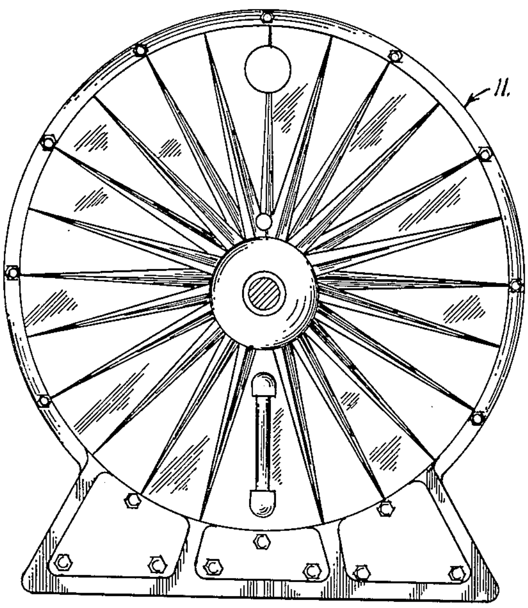

Fig. 1.

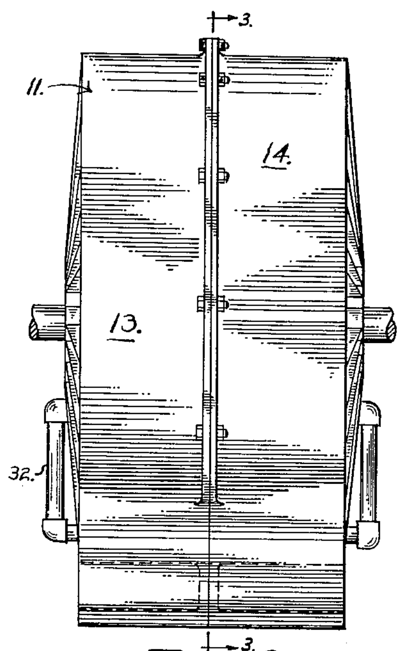

Fig. 2.

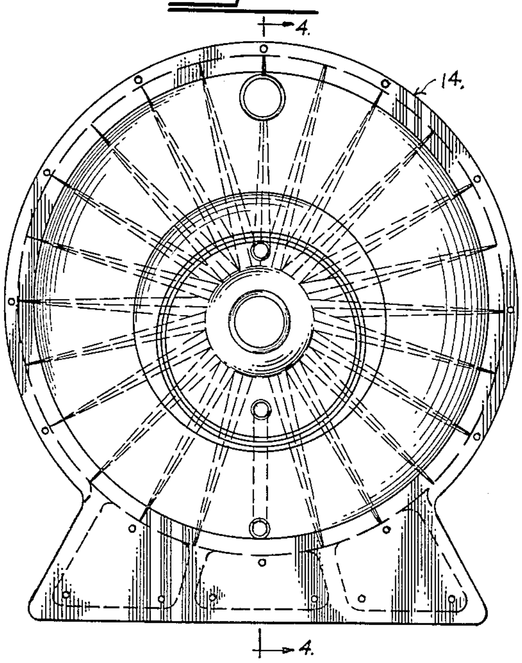

Fig. 3.

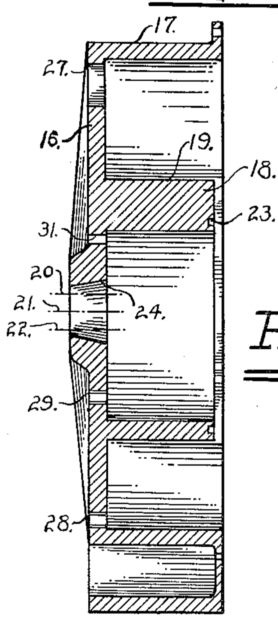

Fig. 4.

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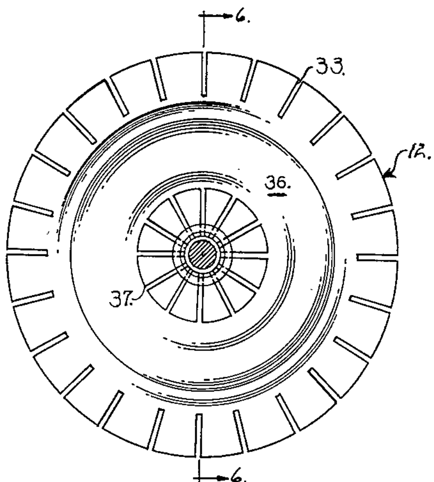

Fig. 5.

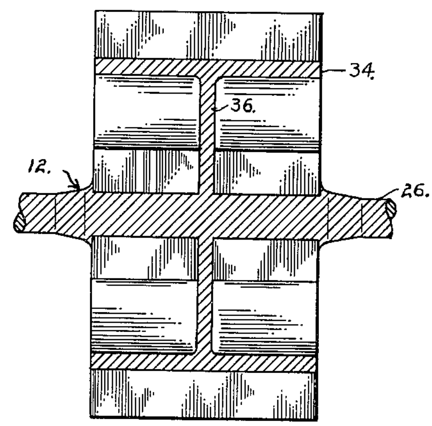

Fig. 6.

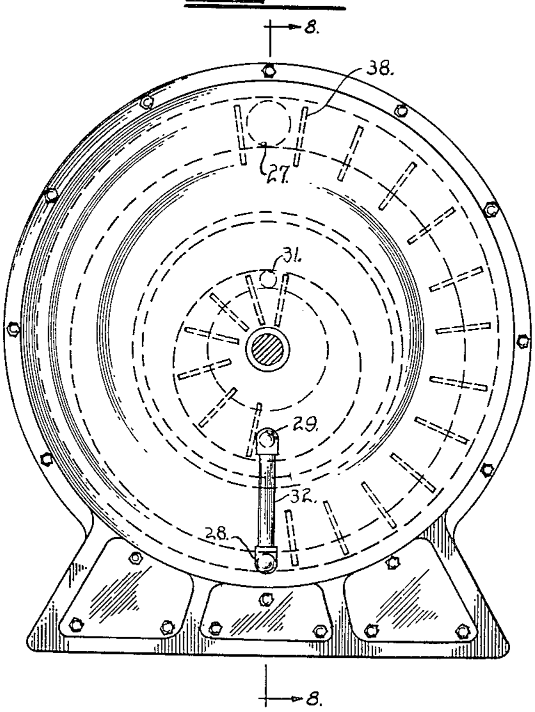

Fig. 7.

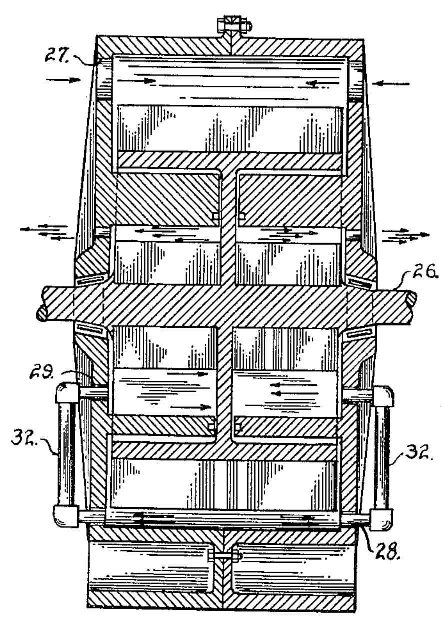

Fig. 8.

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MULTI-STAGE RADIAL SLIDING VANE PUMP

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6 Claims. (Cl. 230—158)

This invention relates to pumps and compressors, and, more particularly, this invention relates to a multi-stage radial sliding vane pump and compressor.

In the past, there have been disclosed various types of multi-stage radial sliding vane pumps and compressors. This invention is of the aforesaid type and discloses a device wherein the stages, while discrete, are fixed to a common shaft and are disposed substantially co-planar, one circumferentially about the other.

The present invention comprises a housing having a rotor therein, said rotor being provided with a first and a second set of substantially co-planer sliding vanes, one circumferentially arranged about the other. The vanes are adapted to travel there between discrete pockets of fluid through a first stage along a first crescent-shaped path from an intake port to an exhaust port and thence through a second stage along a second crescent-shaped path from a second intake port to an exhaust port.

It is a general object of this invention to provide a pump and compressor of the type described that is characterized by a simple design and symmetrical construction which is adapted for relatively inexpensive manufacture.

It is another object of this invention to provide a multi-stage pump or compressor wherein the successive stages of compression take place within a single housing, said stages being substantially diametrically opposed and arranged circumferentially relative to one another, providing a higher degree of balance while in operation, thereby reducing vibration effects in relation to other devices of the same type.

It is also an object of this invention to provide a multi-stage compressor pump of the type described which is provided with an outlet port for each stage whereby there may be delivered by the device two separate outputs of fluid having separate values of pressure, temperature and volume.

In accordance with these and other objects which will become apparent hereinafter, the instant invention will now be described with reference to the accompanying drawings illustrating a preferred embodiment thereof.

In the drawings:

FIG. 1 is an end elevation view of the instant invention;

FIG. 2 is a side elevation view of the instant invention;

FIG. 3 is a view taken along line 3—3 of FIG. 2 and looking in the direction of the arrows;

FIG. 4 is a cross-sectional view taken along the line 4—4 of FIG. 3 and looking in the direction of the arrows;

FIG. 5 is an end elevation view of the rotor housed within the apparatus shown in FIGS. 3 and 4;

FIG. 6 is a cross-sectional view taken along line 6—6 of FIG. 5 and looking in the direction of the arrows;

FIG. 7 is an end elevation view illustrating schematically the operation of the device disclosed more fully hereinafter, and

FIG. 8 is a cross-sectional view taken along line 8—8 of FIG. 7 and looking in the direction of the arrows.

Referring more particularly to the drawings, wherein like reference characters designate like or corresponding parts throughout the different views, and referring particularly to FIG. 1, 11 designates a housing having a symmetrical rotor 12, said housing being provided

with heat dissipating fins as required on the exterior surface thereof. As best seen upon reference to FIG. 2, the housing 11 is formed by a fluid type fastening of two confronting cup-shaped housing halves 13 and 14. The housing halves, as may be seen in FIGS. 3 and 4, have projecting inwardly from the end 16 thereof an outer peripheral wall 17 defining a first chamber, which is circular in cross section relative to the center line designated 20 in FIG. 4. The end 16 of the housing halves are further provided with an inwardly extending projection 18 having a radial thickness such that the outer peripheral side thereof 19 defines a circle relative to the center line 21 and the inner side thereof defines a second chamber which in cross section is circular relative to the center line 22. It will be seen that the radial thickness of the projection 18 is such that it decreases uniformly and symmetrically in thickness in both a clockwise and counter-clockwise direction from a circumferential point of maximum thickness to a diametrically opposed point of minimum thickness. It will further be observed that the inwardly extending projection 18 does not extend the same axial distance as that of the outer peripheral wall 17, and that when the two housing halves 13 and 14 are fastened together in fluid-tight relation, there is a gap between the confronting projections. The two confronting ends of the projections 18 of the housing halves are provided with an annular groove 23 for receiving therein a rotary sealing ring. The housing halves are provided with a bore 24 in the ends, said bores being circular in cross section about the center line 21 and being adapted to receive therein a shaft 26 of a rotor 12. Suitable means are provided to render fluid tight the juncture of shaft and housing halves. Intake and outlet ports are provided in the ends 16 of the housing halves; the primary intake port is designated 27 and communicates with the interior of the inner chamber adjacent the periphery thereof at the point at which the outer peripheral wall 17 is at the maximum distance from the center line 21 and the primary outlet port is designated 28 and communicates with the inner chamber adjacent the periphery thereof at a point at which the outer peripheral wall 17 is at the minimum distance from the center line 21; while the secondary intake port 29 communicates with the second chamber adjacent the periphery thereof at the point of minimum radial thickness of the projection 18, which point is on a diametrical line from the primary intake 27, and the secondary outlet port 31 communicates with the second chamber adjacent the periphery thereof at the point of maximum radial thickness of the projection 18, which point is on a radial line from the primary intake 27. Suitable duct work 32 may be provided to form a fluid passageway from the primary outlet port 28 to the secondary intake port 29.

Referring to FIG. 5 and FIG. 6, in which the rotor 12 is shown, it will be seen that the rotor is generally cylindrical in shape and is provided on the periphery thereof with a first plurality of spaced, transversely disposed radial slots 33. The ends 34 of the rotor are each provided with an annular chamber, which is substantially rectilinear in cross section, defining a center disk 36, the radially inward peripheral walls of each chamber being provided with a second plurality of spaced, transversely disposed, radial slots 37. The rotor 12 is further provided with the shaft 26, and vanes 38 comprising flat plates are disposed in each of the slots, the length of the vanes depending on the plurality of slots 33 or 37 in which they are adapted to be received.

In assembly, the rotor 12 is disposed in the housing 11 with the shaft being received in the bores 24 in fluid tight relation. The disk 36 is adapted to be rotatably disposed between the two confronting ends of the projections 18 and sealing means, not shown, are provided in the annular groove 23, whereby there are formed an outer and an inner crescent-shaped path circumferentially arranged one about the other.

In operation, which may be quickly understood upon reference to FIG. 7 and FIG. 8, fluid enters the primary intake port 27, whereupon the vanes 38 in slots 33 of the rotor 12 pick it up and travel it along the outer crescent-shaped path to the primary outlet port 28. The fluid thus compressed may be traveled through the passageway 32 to the secondary inlet port 29, whereupon it is again traveled by the vanes 38 in slots 37 through a second stage along the second crescent-shaped path between the secondary inlet port 29 and the secondary outlet port 31. Alternatively, fluid compressed in the first stage between the primary inlet and outlet port may be used independently of fluid compressed between the secondary inlet and outlet ports by removing the duct work 32.

Under the influence of centrifugal forces, the vanes 38 in slots 33 and 37 are thrust outwardly upon rotation of the rotor and are adapted to engage the outer confronting wall of the chambers defining pockets adapted to travel discrete segments of fluid along the crescent-shaped paths. The slots are such that the vanes are retractable therein and may be provided with spring means mounted in the slots to urge them.

For purposes of illustration, the crescent-shaped paths are not shown to be such that they are reduced to zero volume; however, this is not intended to be a limitation upon the disclosure herein.

Referring to the center disk 36, it may be provided with holes therethrough, whereby the pressure of the fluid being compressed in the second stage may be equalized on the other side thereof.

The inlet ports may be transversely disposed on the periphery or may be arcuate in shape on the sides of the housing, and the drawing is intended to be descriptive but not limiting in this regard.

While the instant invention has been shown and described herein in what is conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is, therefore, not to be limited to the details disclosed herein, but is to be accorded the full scope of the claims so as to embrace any and all equivalent apparatus and articles.

What is claimed is:

1. A multi-stage radial sliding vane pump comprising; a cylindrically-shaped housing having a first chamber therein of circular cross section relative to a first center line, each end of said housing having an axially-extending, rigid, annular projection therein within said first chamber forming a second chamber of circular cross section relative to a second center line, said second center line being radially displaced relative to said first center line, said projection

being of a radial thickness such that the radially outward edge thereof defines a circle having a third center line disposed between said first and second center lines, said projections confronting one another and having a space therebetween; and a cylindrically-shaped rotor rotatably mounted in said housing and adapted for rotation relative to said third center line, said rotor being provided with a first series of transverse radial slots in the outer periphery thereof and having in each end thereof an annular chamber defining a center disk therebetween, the radially inward axially-extending walls of the chambers being provided with a second series of transverse radial slots, said center disk being adapted for rotational movement in the said space relative to said projections whereby there is formed between the outer periphery of said rotor and said housing a first fluid path, and between the radially inward axially-extending walls of said rotor and the projections a second fluid path, said fluid paths having maximum and minimum radial dimensions at diametrically opposed points in said housing, said paths being substantially coplanar with said first path being circumferentially arranged about said second path; and a series of vanes slideably disposed in said radial slots, said housing being provided with a first intake and first outlet port communicating with the maximum and minimum radial dimensions of said first path and a second intake and second outlet port communicating with the maximum and minimum radial dimensions of said second path.

2. A multi-stage radial sliding vane pump as set forth in claim 1 wherein the housing comprises a pair of identical confronting housing halves defining a first and a second chamber as set forth in claim 1, said housing halves being fastened together in fluid tight relation.

3. A multi-stage radial sliding vane pump as set forth in claim 1 wherein means are provided between said center disk and said projection for maintaining fluid tight relation between said first and second chambers.

4. A multi-stage radial sliding vane pump as set forth in claim 1 wherein said housing is provided with an anchoring base mounted thereto and adapted to be anchored to a rigid surface.

5. A multi-stage radial sliding vane pump as set forth in claim 1 wherein said rotor is provided with an axial bore therethrough and a rotatable shaft keyed to the bore of said rotor for rotation therewith.

6. A multi-stage radial sliding vane pump as set forth in claim 5 wherein ducts are provided communicating between the outlet port of said first fluid path and the inlet port of said second fluid path.

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