

Jan. 8, 1963

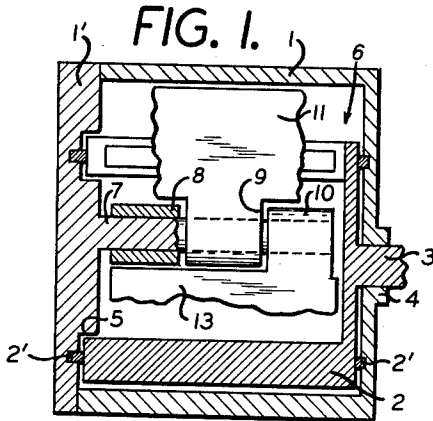
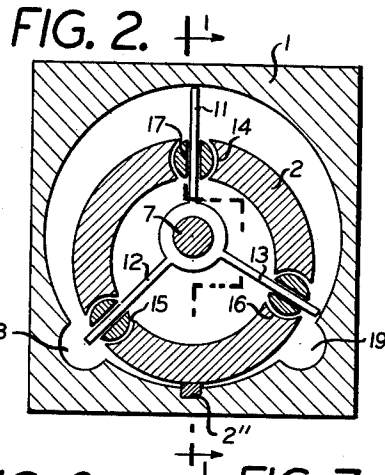
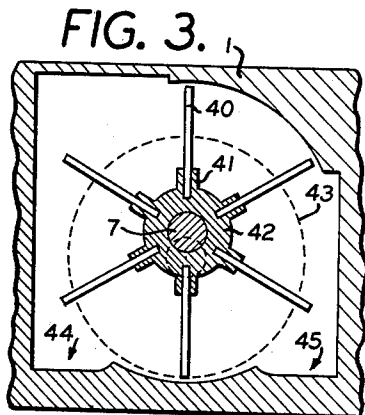
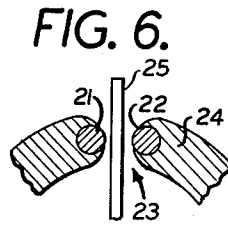
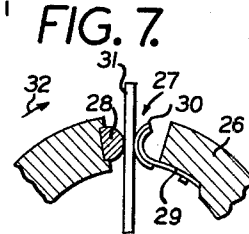
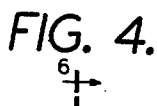
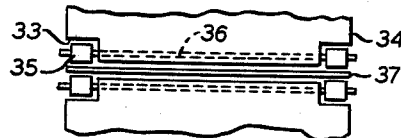
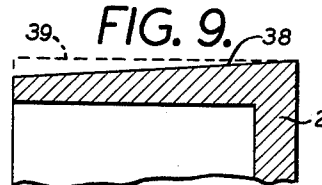
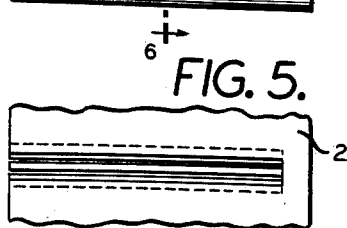
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3,072,068

VANE PUMPS

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2 Sheets-Sheet 1



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2 Sheets-Sheet 2

FIG. 11.

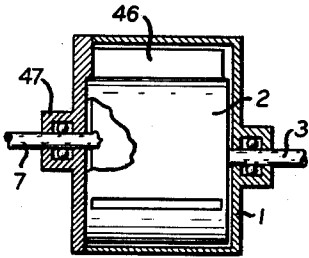


FIG. 12.

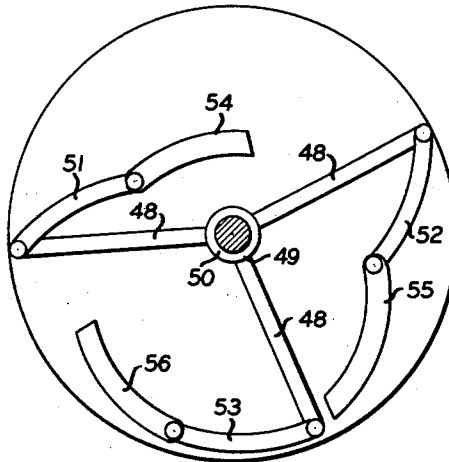


FIG. 13.

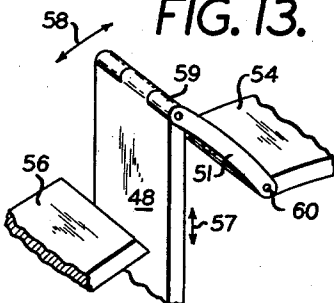


FIG. 14.

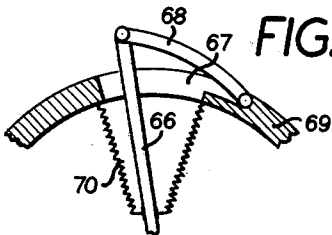


FIG. 15.

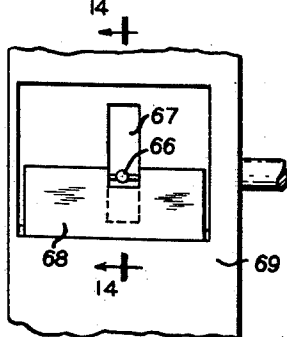


FIG. 16.

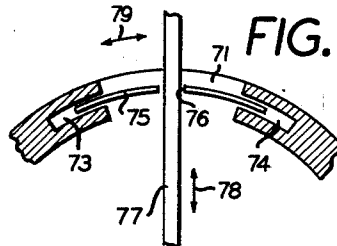
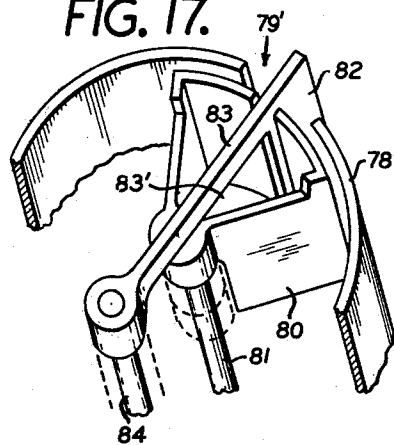


FIG. 17.



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1

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VANE PUMPS

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4 Claims. (Cl. 103-144)

This invention relates to rotary pumps especially suited to feed air, gas, fuel vapors, liquids or exhaust mixtures to or from catalytic elements, respectively.

One of the objects of the invention is to provide a gas pump of the rotary type of simple and rugged construction capable of operating at relatively elevated temperatures with a high degree of efficiency.

Another object of the invention is to reduce friction to a minimum without any lubrication and without substantial wear and other losses, and more specifically, to eliminate oil from the pump entering into any of the following lines or parts of the equipment.

A more specific object of the invention is to provide a rotary pump consisting of a stationary outer casing and an eccentrically rotatable inner casing or rotor mounted thereon rotatable and coaxial with the outer casing and an impeller having at least one vane extending from its axis to a distance very close to but not in contact with the outer casing.

Another object of the invention is to provide in an eccentric rotor a radial vane rotating under control of the rotor in a peripheral opening of the rotor but having at its inner end stopping means preventing contact with the outer casing.

Still another object of the invention is to provide one or more radial vanes forming an impeller supported rotatable about an axis coaxial with the casing in an eccentric pump rotor, said vanes being slidably supported in guide slots provided along the periphery of the rotor and equipped with friction reducing fittings or coatings such as nylon or Teflon layers or the like.

Alternatively, the edges of the guide slots are made of hard material such as chrome-plated steel while the vanes are made of relatively soft material such as laminated plastic, preferably containing graphite or other friction-reducing particles.

According to an additional object of the invention the outer casing of a guided vane pump consists of diecast material with a cylindrical bore and a cover disc attached thereto, the cylindrical bore having an axial projection forming a bearing for the impeller, the rotor consisting substantially of another single diecasting, which is rotatable and supported eccentrically on the cover, having peripheral slots slidably supporting one or more radial impeller vanes extending therefrom to a predetermined distance from the inner wall of the cylindrical bore.

Alternatively, the axial projection supporting the impeller may be provided on the cover disc, the rotor being supported eccentrically rotatable on the casing.

Still another object of the invention is to provide the impeller vanes with a rotatable support flexibly on a common shaft so that the vanes may rotate freely relative to each other under control of the rotor movements.

These and any other objects of the invention will be more fully apparent from the drawings annexed herewith in which

FIGS. 1 and 2 represent in front and side elevations, respectively, and partly in section, a pump vane embodying certain features of the invention.

FIG. 3 represents a modification of the impeller as shown in FIG. 2.

FIG. 4 represents the corresponding rotor in top view and FIG. 5, a modification of FIG. 4.

2

FIG. 6 represents the vane sliding arrangement of FIG. 4 in cross section.

FIG. 7 represents a modified vane sliding arrangement, and FIG. 8, another modification of such an arrangement.

FIGS. 9 and 10 represent modifications of a rotor and stator, respectively, such as shown in FIGS. 1, 2, 3, and 4.

FIG. 11 represents in cross section another fuel pump with a modified vane support.

FIG. 12 represents diagrammatically a pump including another vane support also coupled to the rotor.

FIG. 13 represents a perspective view of a portion of the arrangement shown in FIG. 12.

FIGS. 14 and 15, in front and top elevations, respectively, the former in cross section, show another vane support.

FIG. 16 represents another sealing mechanism for the vanes and FIG. 17, a modification of FIG. 16 in a perspective view.

In FIGS. 1 and 2, the stationary housing or stator 1 of a rotary vane pump is provided with a ring-shaped rotor 2 which is rotatably mounted eccentrically with respect to stator 1, on one side thereof, on a shaft 3 and bearing 4, and on the other side thereof, in an annular groove 5. The parallel end surfaces of rotor 2 are in contact with annular felt rings 2'. A similar strip 2'', made of felt or of resilient low friction material, may be provided at the near contact point of casing bore 6 and rotor 2.

The annular felt rings 2', being impregnated with graphite or molybdenum disulfide containing grease or silicon lubricant and the like, form a leakage seal.

Stator 1 is provided with a cylindrical bore 6 into which extends axially a shaft 7, integrally connected with or attached to cover plate 1' of stator 1, and supported rotatably thereon on hubs 8, 9, and 10, are vanes 11, 12, and 13, respectively.

Vanes 11, 12, and 13 extend into bore 6 through longitudinal slots 14, 15, and 16 of rotor 2 between semicircular sliding rods 17 which are rotatably mounted in slots 14, 15, and 16 and which slide radially on vanes 11, 12, and 13 causing rods 17 to rotate about their common axis in accordance with the relative movement between vanes 11, 12, 13 and rotor 2.

In accordance with a specific feature of the invention, vanes 11, 12, and 13 are not arranged in frictional engagement with the wall of cylindrical bore 6 but have a clearance of, say, five thousandths of an inch from said wall which has been found sufficient to assure efficient operation of the pump mechanism.

Inlet and outlet openings are provided in stator 1 at 18 and 19, respectively, in otherwise well known manner.

In this way with a minimum wear and frictional loss, high efficiency of operation is assured.

At the same time, friction members 17 can be made in an extremely simple manner, easily exchangeable and provided with low friction surfaces for example in the form of nylon rods or grease-impregnated felt inserts shaped to conform with the semicircular configuration required of parts 17 or any other form.

Alternatively, rods 17 may be replaced by steel, carbon, glass, or other wear-resistant material while vanes 11, 12, 13 may be made of relatively soft material such as phenolic plastic, or conversely.

As apparent from FIGS. 1 and 4, slots 14, 15, 16 in rotor 2 are closed at both ends thereof to assure relative position and predetermined motion of members 17 under control of the movement of vanes 11, 12, 13 relative to rotor 2.

In another modification shown in FIG. 5, the slots in rotor 2 are closed at one end only and open at the other end as indicated in FIG. 5 at 20.

In this case, the sliding members are not arranged rotatable but firmly attached to the side walls of the slots in a manner such as shown, for example, in FIG. 6 where cylindrical low-friction rods 21, 22 are fixedly inserted into the walls of a slot 23 in a rotor body 24 with the vane 25 being arranged slidingly therebetween.

In another modification shown in FIG. 7, rotor body 26 has slots 27, one wall of which has attached thereto at 28 a low-friction member of semicircular shape, and the other wall of which has attached thereto a flexible pressure member as, for example, indicated at 29 and provided with a low-friction nylon coating as indicated at 30 with vane 31 being arranged therebetween.

With rotor 26 rotating in the direction shown at 32, the main friction load will be carried by low-friction edge 28 while pressure member 29 merely serves to define the position of vane 31 in its rest position or at speed change, or to take up any wear of edge 28.

In the modification shown in FIG. 3, the number of vanes is increased to six to reduce wear on the individual vanes and also to increase the noise frequency which is more easily muffled.

At the same time, each vane 40 is supported, not on rings sliding on shaft 7, as shown in FIG. 2, but molded into elastic body 42, bearing ridges 41, which is attached to, pressed on, or molded over shaft 7.

Body 42 is made of rubber or other elastic but long-wearing material to permit oscillatory movement of blades 40 in corresponding slots (not shown) of an eccentric rotor such as shown in FIG. 3 at 43 but otherwise constructed in a manner similar to that shown in FIG. 1 at 2.

In this embodiment, the inner space of casing 1 has two part-cylindrical portions. The axes of shaft 7 and said part-cylindrical portion are co-incident. The axis of cylindrical rotor 43 is offset with respect to and parallel to the (longitudinal) axis of shaft 7. The six axial slots of rotor 43 extend in the direction of length thereof and are equally circumferentially spaced. Body 42 serves as an elastomer hub fixedly mounted upon shaft 7. The ridges 41 are projections unitary and integral with hub 42 and are equally circumferentially spaced, circumferentially flexible and resilient. Projections 41 are in respective general correspondence with respective rotor slots and are located radially inwardly of rotor 43.

The vanes 40 are respectively imbedded in the respective hub projections 41 and extend approximately to the inner ends thereof. Vanes 40 extend generally radially from hub 42 and also extend longitudinally. Vanes 40 are of length corresponding to the axial length of the rotor slots. Hub 42 and projections 41 are generally of the same length as vanes 40.

Vanes 40 respectively extend slidably through the respective rotor slots. The tips of vanes 40 are located in a cylinder of revolution whose axis is co-incident with the axis of shaft 7. Each part-cylindrical casing portion has a radius such as to receive the tips of the rotating vanes 40 in close, generally uniformly spaced relationship to said part-cylindrical wall portions.

The smaller angle (between adjacent vanes 40), being 60° plus or minus the angular oscillations varying, for example, from 5° to 15°, also admits as compared to the structure of FIG. 1 of enlarged inlet and outlet openings 44, 45; for clockwise rotation, part 44 of FIG. 3 represents the vacuum side, and part 45, the pressure side of a pump.

In case the principle of FIG. 3 is to be used to produce a vacuum as well as pressure, opening 44 may be made smaller, preferably similar to opening 45.

In the modification shown in FIG. 8, vane friction is further reduced by providing, in wall portions or recesses 33 of a rotor 34, rollers 35 rotatably mounted on a shaft 36 which in turn is mounted in rotor 34. Rollers

35 hold therebetween the vanes such as shown in FIG. 8 at 37 thereby reducing vane friction to a predetermined and desired extent.

All gaps of course should be held to a minimum size to reduce leakage.

In the modification of FIG. 9, the wall of rotor 2, such as shown in any of FIGS. 1-8, is conically shaped or tapered outside, as shown at 38, in order to compensate for the deformation shown in dotted line at 39 occurring due to centrifugal force during rotation of the rotor at high speed.

In another modification such as shown in FIG. 10, casing 1 is provided with an inner taper such as shown at 40.

If required, both the outer surface of rotor 2 and the inner surface of casing 1 may be tapered without departing from the scope of the invention, as can be easily visualized without any further illustration.

In FIGS. 1-2, vanes 11, 12, 13, as stated above, are supported with their hubs sliding on a fixed shaft 7.

FIG. 11 shows a modification in which a shaft of the type shown in FIG. 1 at 7 is arranged rotatable in the wall of a cover plate such as schematically shown in FIG. 11 at 1'.

The vanes, such as shown in FIG. 11 at 46, are rigidly attached to shaft 7 which is supported in ball bearings 47 which in turn are supported on cover plate 1'.

In this way in FIG. 11 the individual friction of the sliding hubs 8, 9, 10 supporting vanes 11, 12, 13 in FIGS. 1-3 is reduced to a single friction in the form of ball-bearings 47. Accordingly, assembly is substantially facilitated.

In order to accommodate the rather large oscillatory movement of the relatively fixed vanes, however, the slots must be made relatively large which may be accomplished, for example, as shown in FIGS. 16 and 17.

In the modification shown diagrammatically in FIG. 12, vanes 48 are rigidly attached to individual hubs 49 and rotatable about common shaft 50, the outer ends of the vanes having attached rotatably thereto guiding vanes or flaps schematically shown in FIG. 12 at 51, 52, and 53, respectively.

The opposite ends of flaps 51, 52, 53 in turn are hingedly attached to the ends of rotor sectors 54, 55, 56 forming the rotor of a vane pump which is eccentrically supported and rotated in otherwise well known manner.

In this modification, vane friction is further reduced by avoiding any sliding contact of vanes 48 with the rotor.

The perspective view of FIG. 13 explains this type of movement in greater detail with the vane indicated at 48 and moving circumferentially in directions 58 in the large gap between sectors 54 and 56 of an eccentric rotor.

At the same time, flap 51 is attached by its rotary hinges, schematically indicated at 60 and 59, respectively, to sector 54 and vane 48, respectively, thus assuring the proper guidance of the vane movement together with reduction of friction.

In the modification of FIGS. 14 and 15, vanes 48 of FIG. 13 are replaced by rods, one of which is shown in FIGS. 14 and 15 at 66 and arranged movable in slots schematically indicated at 67 under the guidance of flaps or vanes 68 hingedly attached at both ends to rod 66 and rotor 69, respectively.

Reduction of dead space is assured by providing around opening 67 a bellow member, schematically indicated in FIG. 14 at 70, and permitting free movement of rod 66 while effecting a seal between the high and low-pressure areas on either side of vane 68.

While the embodiments in FIGS. 1-15 assumed vanes with rotational freedom, relative to each other, FIGS. 16 and 17 show an embodiment where the vanes are rigidly mounted on a shaft. Thus, arrangements must be made to permit (angular) oscillatory motion relative to the rotor slots. This is accomplished in FIG. 16 by sliding

5

members 75 and in FIG. 17 by triangular rotating members 80.

In the modification of FIG. 16, a seal is effected by providing in the walls of the relatively large openings 71 of a rotor 72 longitudinal slots extending in a direction parallel to the rotor axis as schematically indicated in FIG. 16 at 73 and 74, respectively.

Within these slots 73 and 74 anti-friction members, for example plastic plates, are arranged slidably, one being schematically shown at 75, having slots 76 which permit movements of vanes of the type shown in FIG. 16 at 77 relative to rotor 72 in directions indicated by arrows 78 and 79, respectively.

At the same time, during these vane movements, slots 71 in rotor 72 remain continuously closed thereby preventing leakage.

The modification of FIG. 17 also provides continuous coverage of relatively large slots in a rotor such as shown in FIG. 17 at 78'.

In this case, slots of the type shown at 79' are continuously covered by triangular cover members 80 made of low-friction metal or plastic (or provided if necessary at the friction points with low-friction inserts) and supported on shaft 81 of rotor 78'.

It is apparent that in this case vanes must extend at their points 82 outside of rotor 78' over the entire length of gap 79' while their inner portion or holding arm 83 must be cut out as shown in FIG. 17 at 83' when supported on its respective shaft 84 so as to clear the triangular cover members 80 and shaft 81.

The invention is not limited to the particular shape of vanes, supporting members, cover members, rotors, rotor parts, stators and stator parts, nor to the arrangements or connections shown or described but may be applied in any form or manner whatsoever without departing from the scope of this disclosure.

I claim:

1. A rotary pump, comprising an outer casing having a longitudinal axis and having an inner space with transverse end walls and a peripheral wall having at least a part-cylindrical portion, a shaft, means mounting said shaft rotatably in said casing with said shaft extending axially, the axes of said shaft and said part-cylindrical portion being co-incident, a cylindrical rotor, means mounting said rotor in said casing so that its axis is offset with respect to and parallel to said longitudinal axis, said shaft extending through said rotor, said rotor having axial slots extending in the direction of length thereof and equally circumferentially spaced, an elastomer hub fixedly mounted on said shaft and of generally cylindrical shape, said hub having unitary, equally circumferentially spaced, integral, circumferentially flexible and resilient projections extending radially therefrom in respective general correspondence with respective rotor slots and located radially inwardly of said rotor, rigid vanes respectively secured to the respective hub projections, said vanes extending generally radially from said hub and also extending longitudinally, said vanes being of length corresponding to the axial length of said rotor slots, said hub and said projections being of generally the same length as said vanes, said vanes respectively extending slidably through the respective rotor slots, the tips of said vanes being located in a cylinder of revolution whose axis is said longitudinal axis, said part-cylindrical peripheral wall portion having a radius such as to receive the tips of the rotating vanes in close, generally uniformly spaced relationship to said part-cylindrical peripheral wall portion.

6

2. Rotary pump according to claim 1, said vanes being embedded in said hub projections.

3. A rotary pump comprising an outer casing having a longitudinal axis and having an inner space with transverse end walls and a peripheral wall having at least a part-cylindrical portion, a shaft, means mounting said shaft rotatably in said casing with said shaft extending axially, the axes of said shaft and said part-cylindrical portion being co-incident, a cylindrical rotor, means mounting said rotor in said casing so that its axis is offset with respect to and parallel to said longitudinal axis, said shaft extending through said rotor, said rotor having axial slots extending in the direction of length thereof and equally circumferentially spaced, an elastomer hub fixedly mounted on said shaft and of generally cylindrical shape, said hub having unitary, equally circumferentially spaced, integral, circumferentially flexible and resilient projections extending radially therefrom in respective general correspondence with respective rotor slot and located radially inwardly of said rotor, rigid vanes respectively secured to the respective hub projections, said vanes extending generally radially from said hub and also extending longitudinally, said vanes being of length corresponding to the axial length of said rotor slots, said hub and said projections being of generally the same length as said vanes, said vanes respectively extending slidably through the respective rotor slots, said rotor having sealing means on each longitudinal edge of each slot engaging frictionally and sealingly against the opposite faces of the vane in said slot, the tips of said vanes being located in a cylinder of revolution whose axis is said longitudinal axis, said part-cylindrical peripheral wall portion having a radius such as to receive the tips of the rotating vanes in close, generally uniformly spaced relationship to said part-cylindrical peripheral wall portion.

4. Rotary pump according to claim 3, said vanes being embedded in said hub projections.

References Cited in the file of this patent

UNITED STATES PATENTS

891,372	Reichhelm	June 23, 1908
1,007,933	English	Nov. 7, 1911
1,045,754	Smith	Nov. 26, 1912
1,053,321	Schrock	Feb. 18, 1913
1,221,333	Killman	Apr. 3, 1917
1,227,968	Silvestri	May 29, 1917
1,535,275	Westin	Apr. 28, 1925
1,607,383	Aurand	Nov. 16, 1926
1,716,901	Rochford	June 11, 1929
1,852,503	Cambell	Apr. 5, 1932
2,071,799	Mobille	Feb. 23, 1937
2,189,356	Briggs	Feb. 6, 1940
2,233,017	Lambin	Feb. 25, 1941
2,387,629	Waseige	Oct. 23, 1945
2,470,656	Shorrock	May 17, 1949
2,814,255	Lorenzetti	Nov. 26, 1957

FOREIGN PATENTS

2,328	Great Britain	of 1868
882	Great Britain	of 1880
27,906	Great Britain	of 1902
128,677	Great Britain	July 3, 1919
204,852	Germany	Dec. 5, 1908
1,029,522	Germany	May 8, 1958
180,761	Switzerland	Feb. 1, 1936
1,063,685	France	Dec. 16, 1953