

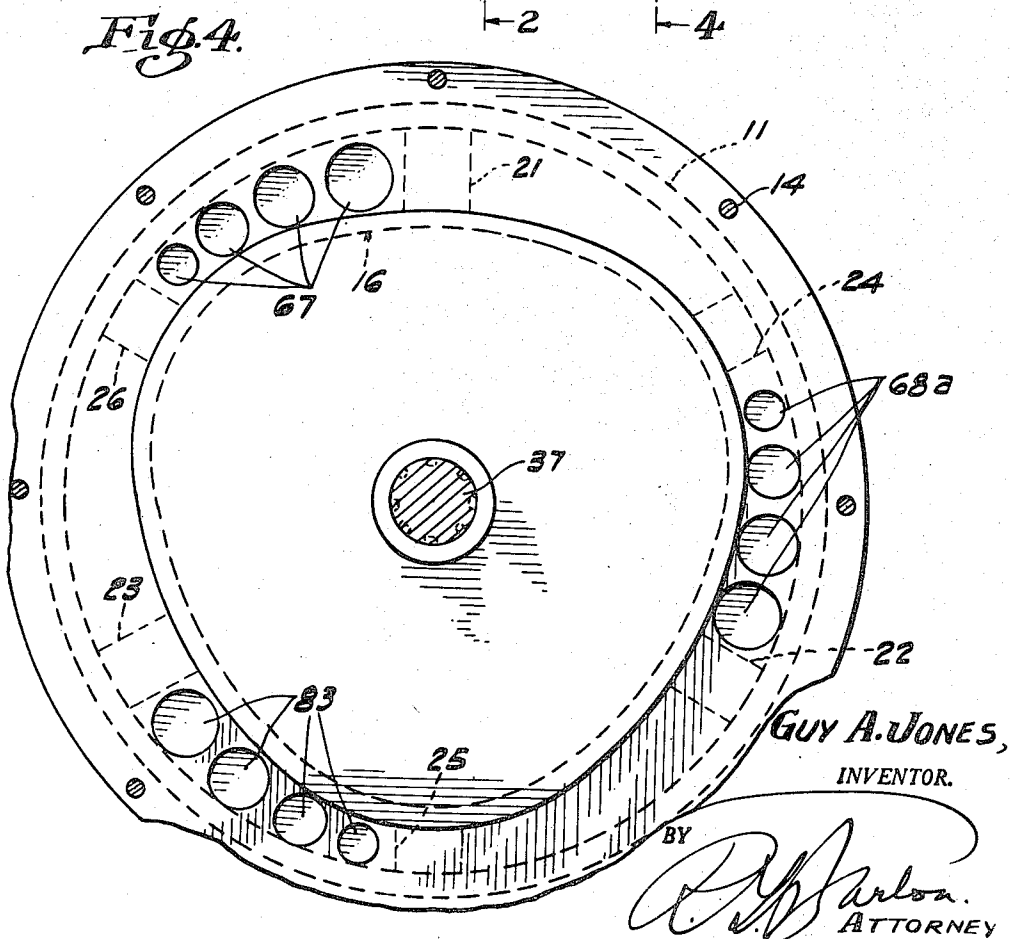
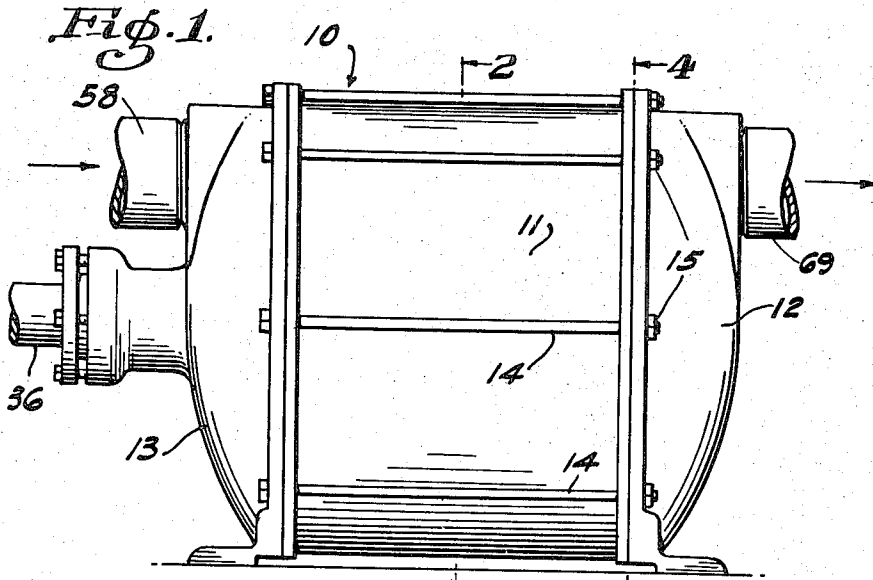
Oct. 26, 1948.

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Filed May 19, 1945

3 Sheets-Sheet 1



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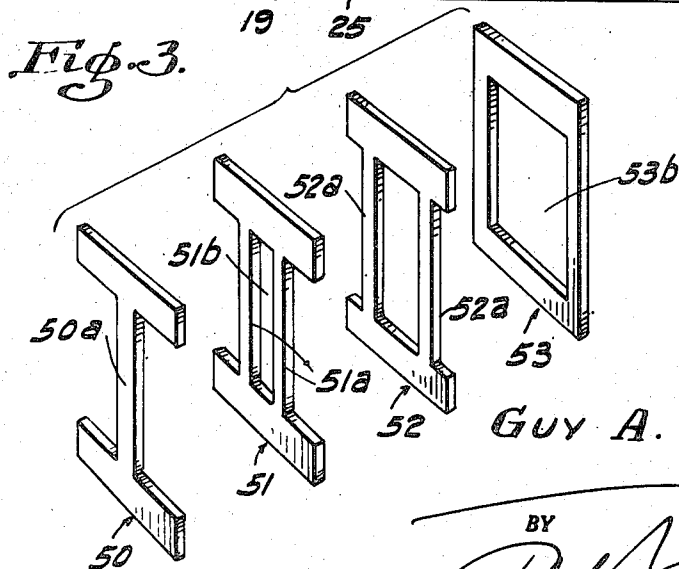
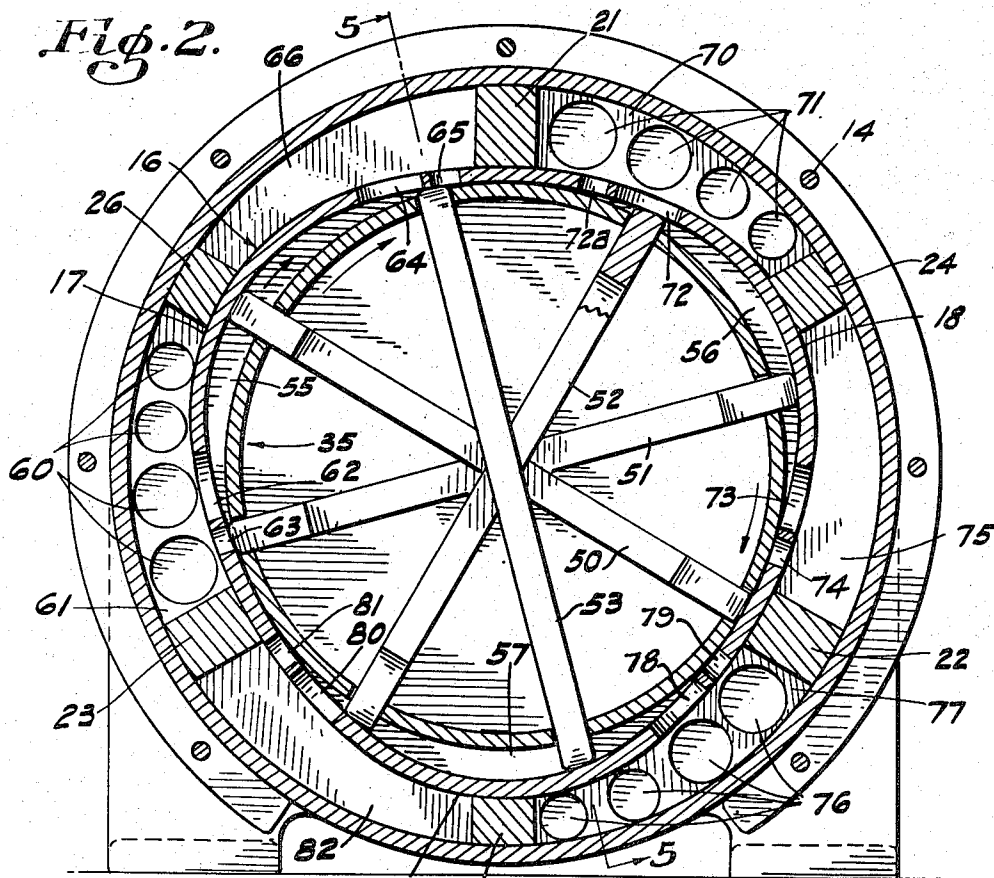
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## UNITED STATES PATENT OFFICE

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## ROTARY VANE PUMP

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2 Claims. (Cl. 103—138)

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This invention relates to a rotary vane pump.

More specifically speaking the invention pertains to an improved construction and arrangement of pumping blades in an assembly contained within a rotatable rotor shell or casing, said blades projecting slidably through openings provided for them in the periphery of said casing.

Heretofore in the construction of rotary vane pumps of the kind to which this invention pertains it has been a common practice to provide various sorts of hub members with which the inner ends of the pumping blades have been connected in various ways. In a structure of that kind having an even number of pumping blades each blade may be regarded as consisting of two opposed sections, said sections being separated from each other by the intervening hub, whereas only half the number of blades would be required were they so constructed as to all extend diametrically across the pump without any hub being present.

It is an object of the present invention to overcome the necessity for using any hub or like member in the situation above stated and, instead, so to construct the individual pumping blades that they will all extend diametrically across the rotatable rotor shell, that is to say, all pass through its center of rotation, and yet will not obstruct the operation of each other; and by doing this greatly simplify the construction of the pumping blade assembly while considerably reducing the cost of manufacture thereof.

Another object is to provide an assembly of pumping blades that will operate in a smoother, more accurate and dependable manner, thus making the pump particularly well adapted for use as an air pump usable either to produce a vacuum or to force air into a reservoir of air under pressure.

Still another object is to provide, in combination with a rotatable cage or rotor shell; an assembly of interlaced, diametrically movable pumping blades the end portions of which project varying distances through peripheral openings in said cage or shell during the rotation thereof, the pumping operation being performed by said projecting end portions of said blades. The interlaced relation of the pumping blades to each other is an important feature of the invention.

Other objects, advantages and features of invention will hereinafter appear.

Referring to the accompanying drawings which illustrate what is at present deemed to be a preferred embodiment of the invention,

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Fig. 1 is a side elevation of the rotary vane pump on a reduced scale.

Fig. 2 is a transverse section on line 2—2 of Fig. 1.

Fig. 3 is a perspective view of the set of piston blades which make up the piston blade assembly, the blades being separated from each other for clearness of illustration.

Fig. 4 is a transverse section on line 4—4 of Fig. 1.

Fig. 5 is a view on an enlarged scale showing the outer portion of the casing in longitudinal mid-section and the stationary non-rotatable cylinder in side elevation, portions of the latter being broken away to show, in elevation, parts of the blade cage or rotor.

Fig. 6 is a perspective view on about the same scale as that of Fig. 1 of the rotor per se, one part being broken away to show underlying structure.

Referring in detail to the drawings, the working parts of the pump are contained within an outer casing or housing 10 which may be of a conventional character so far as its outer wall is concerned, including, as it does a peripheral wall 11 and end walls 12 and 13, these end walls or caps having abutting peripheral flanges, headed and screwthreaded tie rods 14 and nuts 15 being utilized in cooperation with said flanges to secure together the main parts of said housing.

In an internally spaced relation both to the side and end walls of said housing 10 is the non-rotatable pump "cylinder" 16 which though not truly cylindrical, is related to the pumping blades described later in a manner analogous to the way the cylinder of a reciprocating piston is related to the latter. The peripheral wall of this stationary member 16 is circular except that, as shown in Fig. 2, it has three out-swelled portions 17, 18 and 19 120 degrees apart at their centers, these outswelled portions extending from end to end of the space enclosed within said cylinder 16.

In order to maintain the cylinder 16 in a proper inwardly spaced relation to the housing wall 10 three relatively large spacer bars 21, 22 and 23 are shown and midway between them, circumferentially speaking, three smaller spacing bars 24, 25 and 26. By preference and as shown all of these six spacer bars are rectangular in cross section. The smaller bars are shown located in narrow spaces resulting from the projection of the aforesaid three peripheral swells of the generally cylindrical shell member toward the surrounding circular housing wall 10, and the larger bars are located in a parallel, mid-spaced relation to the other three bars. All these six bars extend from

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end to end of the space surrounding the pumping cylinder 16 and bounded at the left end (Fig. 5) by the peripheral portion 27 of the end partition wall 28 of the housing, and on the right hand end by a corresponding peripheral portion 29 of the end partition wall 30 of the housing, there being an annular shoulder 31 at the left and 32 at the right between the different parts of these end wall portions, these shoulders providing annular seats into which the annularly chamfered end portions of the rotor cage are fitted. The end portions of said member 11 are shown inset into annular grooves 33 in the aforementioned outer peripheral parts 27 and 29 of the end walls 28 and 30.

Within the stationary pumping member 16 is contained a truly cylindrical hollow skeletal rotor or cage 35, which is axially connected with and is driven by the power shaft 36, and which is furnished at its opposite end with a stub shaft 37 which has its bearing in a socketed portion 38 of the housing end wall 12. Said power shaft 36 has a bearing 36a and is splined to the end wall 39 of rotor, and the stub shaft is splined to the opposite end wall 40 of the rotor. Said rotor end walls 39 and 40 have respectively annular lips 41 and 42 which aid in making leak-proof joints between the shaft portions mentioned and the end walls 28 and 30. Said end walls 39 and 40 are made of a thickness equal to the depth of the shoulders 31 and 32 so as to provide a flush internal face across the partition structures 27, 28 and 29, 30 of the housing.

Describing the rotor 35 in further detail, the end walls 39 and 40 thereof are shown as each having a circumferentially spaced series of broad notches 45 with intervening intact portions 46. Filled into these notches are the end portions of a series of circumferentially spaced peripheral panels 47 which are secured by any suitable means, as for example, screws 48. By this structure the required slots 49 are prepared through which extend with working fits the end portions of the pumping blades 50, 51, 52 and 53.

The pump is provided with three pumping pockets 54, 56 and 57 which result respectively from the out swells 17, 18 and 19 of the form-retaining sheet material which forms the peripheral portion of the pumping cylinder 16. Hence with the port arrangement which will now be described three continuous blended streams of liquid are being pumped whenever the rotor is turning, and a uniform expenditure of driving power is secured by reason of the pumping blades being so arranged so that the sum total of the pumping pressures against the four blades is uniform or nearly so. Said outswells 17, 18 and 19 are symmetrically shaped and arranged, each of them being shaped as the end portion of an ellipse and being circumferentially spaced apart, the spaces between them being bridged by outcurves into which they blend in a streamline manner, said outcurves being parts of circles struck from radii of greater than half the mean diameter of said piston cylinder. Said outswells with their connecting outcurves permit rapid rotation of the rotor in either direction so that the structure may be used either as a rotary vane pump or fluid driven motor.

The liquid being pumped enters (see Fig. 5) the left end wall of the housing through a supply pipe 58 which leads into the supply chamber 59 surrounding the shaft bearing 36a. From this chamber liquid is conducted through a plurality of ports 60, see Fig. 2, into a chamber 61, located between the spacer bars 23 and 26. From

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said chamber 61 the liquid passes through a plurality of rows of ports 62 and 63 into the adjacent piston pocket 55 where it is acted upon by the piston blades as they move through said pocket, thus causing the liquid to be ejected through a plurality of rows of ports 64 and 65 into a chamber 66 located between the spacer bars 26 and 21. From said chamber 66 the liquid is ejected through a plurality of ports 67 at the right hand end of the pump as viewed in Fig. 4, thus conducting the liquid to the end chamber 68 from which it flows out through the discharge pipe 69.

Simultaneously with this action a corresponding flow of liquid takes place through the pumping pocket 56, liquid entering the pumping pocket 56 from chamber 70 located between spacing bars 21 and 24, said chamber being supplied from the end chamber 59 through a plurality of ports 71 and passing out from said chamber 70 through a plurality of rows of ports 72 and 72a into the pocket 56, whence it flows out through a plurality of rows of ports 73 and 74 into the chamber 75 located between spacing bars 22 and 24 whence the liquid flows into the right hand end chamber 68. From said chamber 68 the liquid is ejected through a plurality of ports 68a at the right hand end of the pump as viewed in Fig. 4, thus conducting the liquid to the end chamber 68 from which it flows out through the discharge pipe 69.

Simultaneously with the two courses of liquid flow already described, a third liquid current flows through the remaining pumping pocket 57, the course of the latter flow being out from end chamber 59 through ports 76, chamber 77, ports 78 and 79, pocket 57, ports 80 and 81, chamber 82, ports 83, right hand end chamber 68 and to the common outlet 69.

Describing next the detailed preferred construction of the four interlaced piston blades, as best shown in Fig. 3, the piston blade 50 is I-shaped and the piston blade 51 is also I-shaped, but differs from the blade 50 in that its stem 51a, 51a has along its mid-width a slot 51b, the width of which is such that the stem 50a of the blade 50 will fit therein with a working fit.

The next blade 52 of the series has a double stem 52a, 52a, the two parts of which are spaced apart from each other the proper distance to receive between them with a working fit the two-part stem 51a of the blade 51.

Finally the blade 53 is shaped like a rectangular picture frame having within it a large rectangular opening 53b the sides of which are spaced apart the proper distance to receive between them the outer edge portions of the stems 52a of the blade 52. The end portions of all these blades are of equal width, this width being such as to render all the blades fittable with a working fit between the end walls 39 and 40 of the rotor 35.

The end portions of all the blades fit with a working fit through the openings provided for them in the periphery of the rotor and each blade has an intact end portion of sufficient width to insure that it efficiently performs the required pumping function as it passes through the three pumping pockets.

It will be observed that when the pumping blades are mounted in the rotor in the interlaced manner which has been explained, the mid-length portions of all the blades will intersect at the center of the rotor, and each blade will nevertheless be free to slide lengthwise the distance required to keep one of its end portions in a

proper pumping relation to any pumping pocket through which it may be passing under the urge of the cam action of the inner surface of the peripheral wall of the stationary cylinder against the opposite end of such blade.

What is claimed is:

1. A rotary vane pump comprising a non-rotatable piston cylinder the peripheral wall of which consists of form-retaining sheet material having outswelled peripheral portions forming piston pockets, said outswelled portions being contoured like ends of an ellipse and being circumferentially spaced apart, the spaces between them being bridged by outcurves into which they blend in a streamline manner, said outcurves being parts of circles struck from radii of greater than half the mean diameter of said piston cylinder, a hollow skeletal cylindrical rotor having its periphery contacting the inner surface of the peripheral portion of the wall of said non-rotatable cylinder between adjacent said outswells thereof, and an assembly of interlaced piston blades within said rotor and extending diametrically there-through, said rotor having peripheral openings through which the diametrically opposite end portions of said piston blades project varying distances as they pass through said pockets to perform the pumping operation, there being inlet and outlet ports associated with said pockets.

2. In a rotary vane pump, a non-rotatable piston cylinder the peripheral wall of which consists of form-retaining sheet material having a plurality of outswelled peripheral wall portions, said outswelled portions being contoured like the ends of an ellipse, a skeletal rotor within said piston cylinder and having a peripheral wall that cooperates with said outswells to form piston pockets, a housing having a generally circular wall surrounding said piston cylinder and thereby forming around it an annular space the width of which is varied by said outswells, spacing bars paralleling the axis of said piston cylinder and partially filling in the spaces between said outswells and the adjacent housing wall portions, other spacing bars parallel to the first recited

bars and located midway between them and partially filling in the spaces across the wider portions of said annular space, said housing having end portions furnished with ports communicating with said annular space, said skeletal rotor comprising end walls each having a circumferentially spaced series of broad notches with intervening intact portions, a series of circumferentially spaced peripheral panels forming said peripheral wall of said rotor, said panels having their end portions filling said notches thereby providing slots between adjacent panels which extend lengthwise of the rotor from one to the other of said intact portions of said end walls, the latter slots communicating with said piston pockets, piston blades within said rotor with end portions projectable through said slots to perform a pumping operation as said blade end portions pass through said pockets, the aforesaid ports which are located in the end portions of the housing being divided into two sets, the ports of one set being located in one end portion of the housing and communicating with alternate spaces of the circumferential series of spaces formed by the aforementioned spacing bars, and the other of said two sets of ports communicating with the intervening spaces of said circumferential series.

GUY A. JONES.

#### REFERENCES CITED

The following references are of record in the file of this patent:

#### UNITED STATES PATENTS

| Number    | Name                   | Date          |
|-----------|------------------------|---------------|
| 803,599   | Jungersen et al. ----- | Nov. 7, 1905  |
| 1,660,563 | Malbay -----           | Feb. 28, 1928 |
| 2,260,888 | Davis -----            | Oct. 28, 1941 |
| 2,293,119 | Davis -----            | Aug. 18, 1942 |

#### FOREIGN PATENTS

| Number  | Country      | Date          |
|---------|--------------|---------------|
| 733,731 | France ----- | July 18, 1932 |
| 608,438 | France ----- | Apr. 23, 1926 |