Jan. 11, 1955 E. G. BARRETT 2,699,151

ROTARY MOTOR

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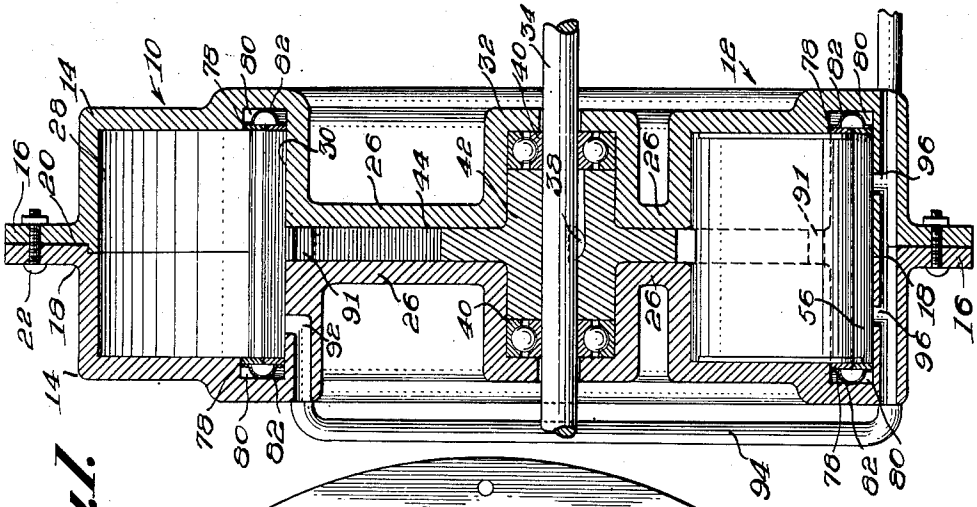


Fig. 1.

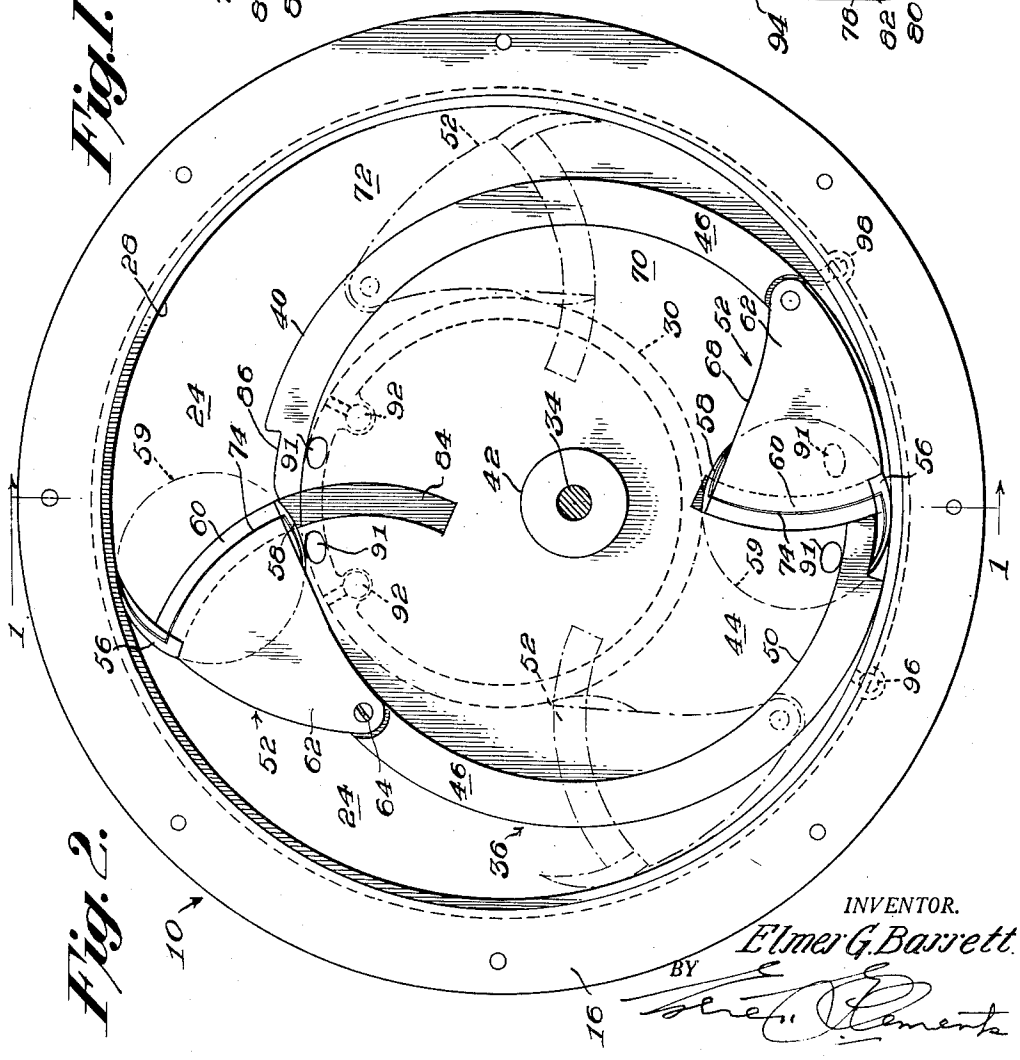


Fig. 2.

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Fig. 3.

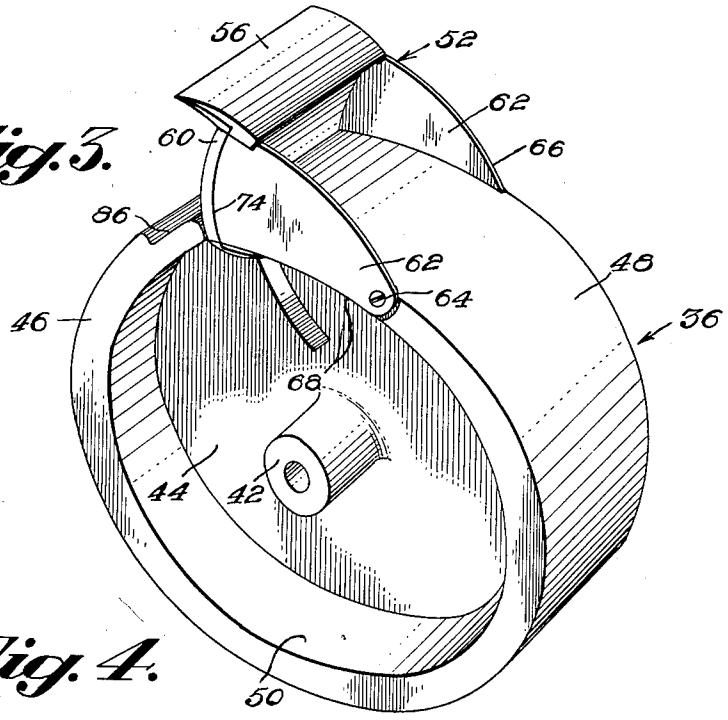


Fig. 4.

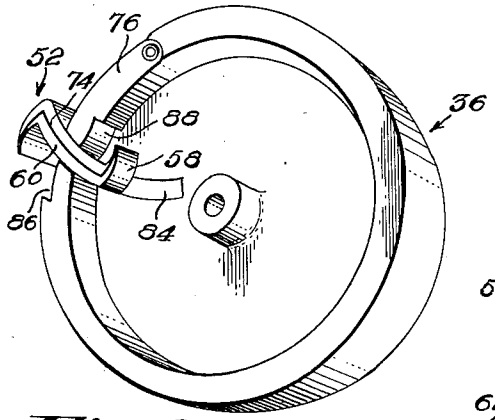


Fig. 5.

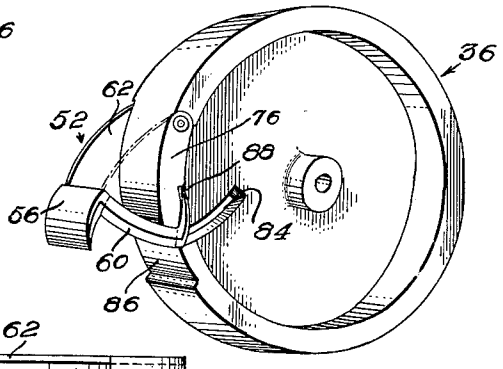
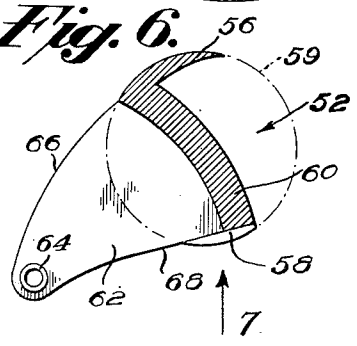


Fig. 6.



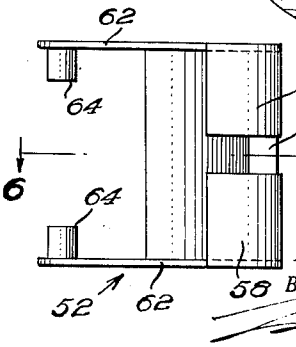


Fig. 7.

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ROTARY MOTOR

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Application April 30, 1954, Serial No. 426,891

5 Claims. (Cl. 121—93)

This invention relates to rotary motors of the multiple expansion type and in particular to an improvement in the piston vanes thereof.

In rotary motors wherein a housing has a chamber formed by an outer flange portion having a radially inward facing wall and a hub portion having a radially outwardly facing wall in concentric relation to the flange wall and a rotating rim means carrying piston vanes pivotally mounted thereon and disposed in non-concentric relation to said walls forming two crescent shaped working and expansion chambers with the walls so that the rotation of the rim means causes the wall portions of the housing to act as cam surfaces to actuate the piston vanes between the working and expansion chambers of the outer wall and rim means and the working and expansion chamber of the inner wall and rim means creates considerable friction between the housing and hub wall surfaces and the piston vanes along the sealing line of contact therebetween.

Further, there is much difficulty in mounting these piston vanes on the rim means in order to have a positive seal between the first working and expansion chamber which is disposed radially outwardly of the inner housing wall and radially inwardly from the rim surface and the second working and expansion chamber which is disposed radially outwardly from the rim flanges and radially inwardly from the outer housing wall.

It is, therefore, a primary object of this invention to provide an improved and more efficient piston vane for rotary motors of the type described above which provides a decreased friction along the seal contact between the vane and chamber walls which form the work expansion chamber of the motor.

It is a further object of this invention to provide a more efficient seal between the work expansion chambers of a rotary motor of the type described above wherein there is disposed a vane which is pivotally secured to a rotating rim.

Other objects and advantages of the invention will become apparent in the course of the following detailed description, taken in connection with the accompanying drawings wherein:

Fig. 1 is an axial section of a rotary motor including my novel piston vane in operative relation therewith;

Fig. 2 is a radial view of Fig. 1 with part of the housing removed and showing various operative positions of the piston vane in dash-dot lines;

Fig. 3 is an isometric view of the rotating rim means and a single piston vane;

Figs. 4 and 5 are isometric views of the rim means and single piston vane, similar to Fig. 3, but with a securing arm of the vane removed and with the vane in various operative positions;

Fig. 6 is a vertical section through the center of a piston vane along the line 6—6 of Fig. 7; and

Fig. 7 is a plane view of Fig. 6 looking from the arrow 7.

Referring more particularly to the drawings wherein like elements are represented by the same reference character there is shown in Figs. 1 and 2 a rotary motor generally designated **10** comprising a housing **12** having mating portions **14** provided with radially extending flange elements **16**, registration elements **18** and sealing means **20**. The mating portions **14** are secured together by means of bolts **22**, or the like, passing through the flanges

16. It is to be understood that the housing **12** is adapted to be mounted and retained in a stationary position.

Each of the housing mating portions are of a specific sectional configuration, and attention is drawn to Fig. 1, wherein the housing portions **14** form a chamber **24** by reason of reduced sections **26**. The chamber **24** is enclosed on its radial outer side by wall surfaces **28** and on its radial inner side by wall surfaces **30**.

Radially inwardly from the reduced portions **26** of the housing mating portions **14** there is provided a hub element **32** adapted to receive a power take-off shaft **34** which is radially offset from the center of the cylindrical surfaces **28**, **30**. It is to be noted that the cylindrical surfaces **28**, **30** are concentric to each other. A rotating rim element **36** is secured to rotate with the shaft **34** by means of a key **38**.

Attention is directed to Fig. 1 wherein there is positioned anti-friction means **40** providing rotational movement of the shaft **34** and rim element **36** within the hub **32** of the housing **12**. As shown in Fig. 3 the rotating rim element **36** is of T-shape in section and comprises a hub **42**, stem **44**, sides **46**, outer surface **48** and inner surface **50** and it is to be noted that the rotating rim element and power shaft are concentrically mounted with relation to each other, but are both radially offset in regard to the radially disposed cylindrical surfaces **28**, **30**.

There is provided a plurality of piston vanes generally designated **52**, see Figs. 2, 6 and 7, which are pivotally mounted for radial movement on the sides **46** of the rotating rim element **36** adjacent the rim surface **48**.

For the sake of brevity I shall limit the disclosure of my invention to a single piston vane **52**, bearing in mind that each of the plurality of these vanes is substantially identical in structure, operation and function. Further, I have disclosed a plurality of two piston vanes **52**, in Fig. 2, and it is to be understood that more or less than four of the vanes may be used with successful results.

Attention is now directed to Figs. 3–5 wherein there is shown an isometric view of the rotary rim element **36** having pivotally disposed thereon a piston vane **52**. As shown in Fig. 2 my novel piston vane **52** has the outer leg **56** thereof in frictional contact with the wall surfaces **28** and the inner leg **58** is in frictional contact with the wall surfaces **30**.

I shall now describe in particularity the configuration of the piston vane **52** and it is to be noted that the outer leg portion **56** and the inner leg portion **58** are arcs of the surface of a cylinder having the diameter of the radial distance between the outer surfaces **28** and inner surfaces **30** of the chamber **24**. This cylinder **59** is shown by dotted lines in Figs. 2 and 6 and it is to be noted that the cylinder circumscribes the main body portion **60** of the piston vane **52** and provides for the development of a cylindrical body which would have a height equal to the distance between the portions **14** which provide for the ends the chamber **24**. I found by providing a cylinder as developed above between the surfaces **28** and the surfaces **30** that there would only be a frictional line contact between the sides of the cylinder and the surfaces stated above.

The piston vanes generally used in rotary motors, of the type described above, are usually provided with a rectilineal frictional surface between the vane and the corresponding sides of the power chambers and it is obvious that a frictional surface of rectilineal shape creates considerable more friction than a vane having a line contact with the corresponding surfaces of the power chambers. It is further obvious that a cylinder disposed in the chamber **24** would not function as a vane and accordingly I developed from the cylinder the specific piston vane **52** of my invention. Each of the legs **56** and **58** are merely segments of the surface of such a cylinder and accordingly it is necessary to join these legs by a main body element **60** which is curved in order to provide the greatest possible area to be exposed to the working expansion of the actuation fluid. It will be noted that the resulting sectional configuration of the vane is of S-shape, as shown in Fig. 6. There is further provided attaching means for securing the piston vane **52** to the rim element **36** which in the embodiment as disclosed comprises arms

62 secured to the main body element 60 and pivotally mounted on the rim element 36 by means of a pin 64. It is to be understood that the particular means for pivotally securing the piston vanes 52 to the rim element 36 may be of various types and I have shown but the preferred form in this embodiment of my invention.

It should be noted that the inner edge 68 of the arms 62 are cut on an arc which has a radius equal to the radius of the rim element surface 50. Also the outer edge 66 of the arms 62 are cut on an arc which has a radius equal to the radius of the cylindrical surface 28. It is necessary to so cut the edges 66, 68 of the arms 62 in order to provide clearance for the arms when the motor is in operation.

In order to provide a positive seal between the first power expansion chamber 70 and the second power expansion chamber 72 which are provided in the chamber 24 by the disposition of the rim element 36 therein, I provide seals 74 adjacent the edges of the outer leg 56, inner leg 58, main body portion 60 and arms 62. Further, in order to provide a smooth side 46 on the rim element 36 there are provided recesses 7 allowing the arms 62 to be positioned flush with the side surface 46 of the ring 36. There is further provided a seal element 78 in the mating portions 14 of the housing 12. The seals 78 are placed in a groove 80 provided in the portions 14 adjacent and in alignment with the sides 46 of the rim element 36, not Fig. 1, and the seals 78 are urged in an axial direction towards the sides 46 of the rim element 36 by means of leaf spring 82.

There is further provided in the rim element 36 an arcuate slot 84 for each piston vane 52 which provides for allowing the piston vane main body portion 60 to be received therein when the piston vane 52 is positioned at the farthest point on its radial inward path, note the lower vane of Fig. 2.

In order to provide clearance for the outer leg portion 56 between the outer rim surface 48 and surfaces 28 there is provided a recess 86 in the outer surface 48. Similarly there is provided on the inner surface 50 of the rotating rim element 36 a recess 88, see Figs. 4, 5, which receives the inner leg 58 of the piston vane 52 when the vane is in its radially outer position as shown on the top side of Fig. 2. It is to be noted that the inner leg element 58 has provided therein a slot 90 for clearance in the inner leg element to receive the stem portion 44 of the rim element 36 when the piston vane pivots between its radial outer position and its radial inner position in regard to its disposition on the rim element.

It is to be noted that there are provided in the housing 10 of the rotary motor, as shown in Fig. 1 intake and exhaust ports 92 which are connected to a source of actuating fluid, not shown. Fluid under pressure enters the first power chamber 70 through a port 92 and enters both sides of the chamber 70 by reason of ports 91 through stem 44 and makes one complete revolution and exhausts from chamber 70 through the other port 92 in the housing mating portion 14. The ports 92 act as intake or exhaust ports depending upon the desired rotation of the motor. The ports 92 are connected by means of a conduit 94 to an intake port 96 in the housing portion 14 and enters the second power chamber 72. The actuating fluid is allowed to have double expansion, first upon entering the chamber 70 which is of smaller area than the chamber 72, and second when the fluid enters the larger chamber 72 from chamber 70. After entering the second chamber 72 the fluid makes one complete revolution through the chamber and is exhausted to atmosphere or a condensing chamber, not shown, through exhaust port 98 in the housing portion 14.

At this time I would like to explain the operation of my novel piston vane 52 when in use with a rotary motor of the type described above. Attention is directed to Fig. 2 wherein there are shown two piston vanes 52, in solid lines, and the same vanes are shown in various operative positions in dotted lines. It is to be understood that the actuating fluid is admitted into chambers 70 and 72, as explained above.

Since the piston vanes 52 are carried by the rim element 36 actuation by the power fluid against the vanes 52 cause the rim element 36 and vanes 52 to rotate and the pivotal action of the vanes 52 about the pins 64 causes the vanes to be properly positioned in both chambers 70, 72, by means of the cam action of the surfaces 28, 30 so that the vanes will receive the force exerted by the pressure of the expanding fluid in the respective chambers 70, 72. It is to be noted that the contacts between the surface 28 and leg 56 and surface 30 and leg 58 lie on the radius of the concentric cylindrical surfaces 28, 30.

Further, it is to be noted that these contacts are line contacts by reason of the arcuate shape of the legs 56, 58. Also, due to the fact that the vanes 52 and rim element 36 are rotating and the surfaces 28, 30 are actuating the vanes 52 into proper position the leg elements 56, 58, in effect, rock along their respective chamber surfaces 28, 30. This rocking effect can be noted by the comparison of the two vanes 52, as shown in Fig. 2. This rocking line contact between the vane legs 56, 58 and surfaces 28, 30 respectively, decreases to a minimum the friction created between the legs and chamber surfaces. This decrease of friction provides a more effective and ease in operation of the rotary motor.

While I have shown and described my invention as embodied in an improved type of rotary motor with some degree of particularity, it will be realized that the modifications and changes may be resorted to under special conditions. I, therefore, do not wish to be limited and restricted to the exact details shown and described but reserve the right to make such changes and modifications as may fairly fall within the scope of the subject matter now being claimed.

Having thus described my invention, what I claim is:

1. In a rotary motor, a housing having concentrically disposed inner and outer wall surfaces defining therebetween an annular chamber, a plurality of power cylinders in said chamber defined by said wall surfaces, a rim element and a piston vane, said rim element being disposed intermediate said wall surfaces in non-concentric relation thereto, said piston vane extending between said wall surfaces in sealing arrangement with said rim element providing a seal between said cylinders, anti-friction means providing relative rotating motion between said housing and said rim element, said piston vane comprising a body portion having spaced arcuate shaped wall surface engaging portions with the arc thereof being segments of the surface of a cylinder which circumscribes said body portion, and means carrying said piston vane on said rim element with said surface engaging portions making sealing line contact with each of said wall surfaces of said power cylinders and providing relative radial movement between said spaced line contacts whereby effective sealing line contact is maintained between the piston vane and the wall surfaces of said power cylinders.

2. The structure defined in claim 1, wherein said body portion of the piston vane is arcuate and said spaced arcuate shaped wall surface engaging portions comprise leg elements rigid with and extending in opposite directions from said arcuate body portion.

3. A rotary motor comprising a housing having concentrically disposed inner and outer wall surfaces defining therebetween an annular chamber, a plurality of power cylinders in said chamber defined by said wall surfaces, an annular rotor, and a piston vane element, said rotor being disposed in said chamber eccentrically and intermediate of said wall surfaces, said piston vane element extending between said wall surfaces in sealing arrangement with said rotor providing a seal between said cylinders, said piston vane comprising a body portion having spaced arcuate shaped leg elements depending therefrom, means carrying said piston vane on said rotor with said leg elements making a line contact with each of said concentric wall surfaces of said power cylinders providing an effective sealed line contact between the piston leg elements and the concentric wall surfaces, said arcuate shaped leg elements of the piston vane being a portion of the surface of a cylinder having a diameter equal to the radial spacing of said concentric wall surfaces, and said means further providing relative radial movement of said vane element on said rotor between said spaced line contacts whereby said effective sealing line contact is maintained between the piston vane and the wall surfaces of said power cylinders.

4. A rotary motor comprising a housing having axially spaced side walls and concentrically disposed inner and outer wall surfaces defining therebetween an annular chamber, a plurality of power cylinders in said chamber defined by said axially spaced walls, concentrically disposed wall surfaces, an annular disk type rotor and a

piston vane, a drive shaft journaled in said side walls and extending radially through said annular chamber, said annular disk type rotor being secured to said drive shaft between said side walls, a rim portion integral with said disk type rotor and disposed intermediate said wall surfaces in non-concentric relation thereto, said piston vane comprising a body portion having spaced arcuate shaped leg elements depending therefrom, means pivotally carrying said piston vane on said rim element with said leg elements making a line contact with each of said concentric wall surfaces of said power cylinders providing an effective sealed line contact between the piston leg elements and the concentric wall surfaces, said arcuate shaped leg elements of the piston vane being a portion of the surface of a cylinder having a diameter equal to the radial spacing of said concentric wall surfaces, said means comprising arms secured at one end thereof to the main body portion of said vane and pivotally mounted on the rim element and a radially extending arcuate shaped slot in said rim element providing clearance for said main body portion during relative movement of said piston vane on said rotor between said spaced line contacts causing a constant effective sealing line contact between the piston vane and the concentric wall surface of the power cylinder during the transmission of rotary power to said drive shaft for said rotor.

5. The structure defined in claim 4 wherein said body portion of the piston vane is arcuate and said spaced arcuate shaped wall surface engaging portions comprise leg elements rigid with and extending in opposite direction from said arcuate body portion.

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