United States Patent

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[54] **ROTARY MACHINE**
2 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **418/188,** 418/191, 418/196, 418/200
[51] **Int. Cl.** **F01c 1/08,** F01c 11/00
[50] **Field of Search** ..... 103/125; 230/150; 91/81, 92; 123/13 B; 418/188, 191, 200, 196

[56] **References Cited**

UNITED STATES PATENTS

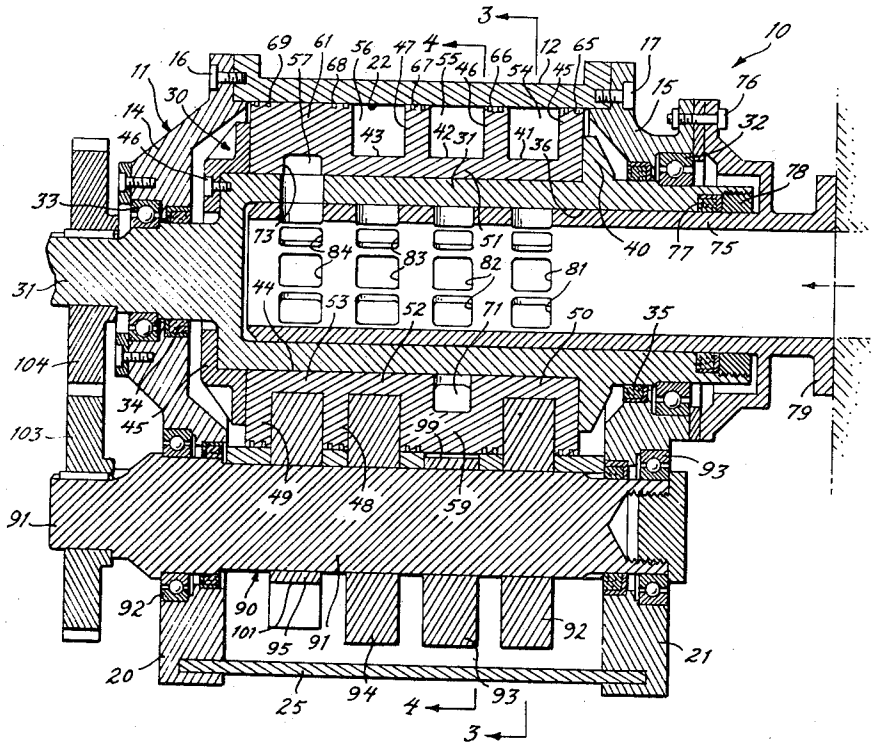
Re. 12,874	11/1908	Bleecker	91/81
318,968	6/1885	Dow	103/125
2,655,112	10/1953	White	91/81

FOREIGN PATENTS

784,554	10/1957	Great Britain	103/125

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ABSTRACT: A rotary machine for use as a pump or motor wherein a hollow rotor is rotatable within a casing and combines with the latter to define therebetween an annular chamber. A vane or arm extends from the rotor for rotation therewith about the annular extent of the chamber and a fluid inlet passageway communicates between the hollow of the rotor and the chamber on one side of the vane or arm for passing fluid into the chamber on said one side of the vane. An outlet is provided in the casing for the egress of fluid from the chamber on the other side of the rotor vane.



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SHEET 1 OF 2

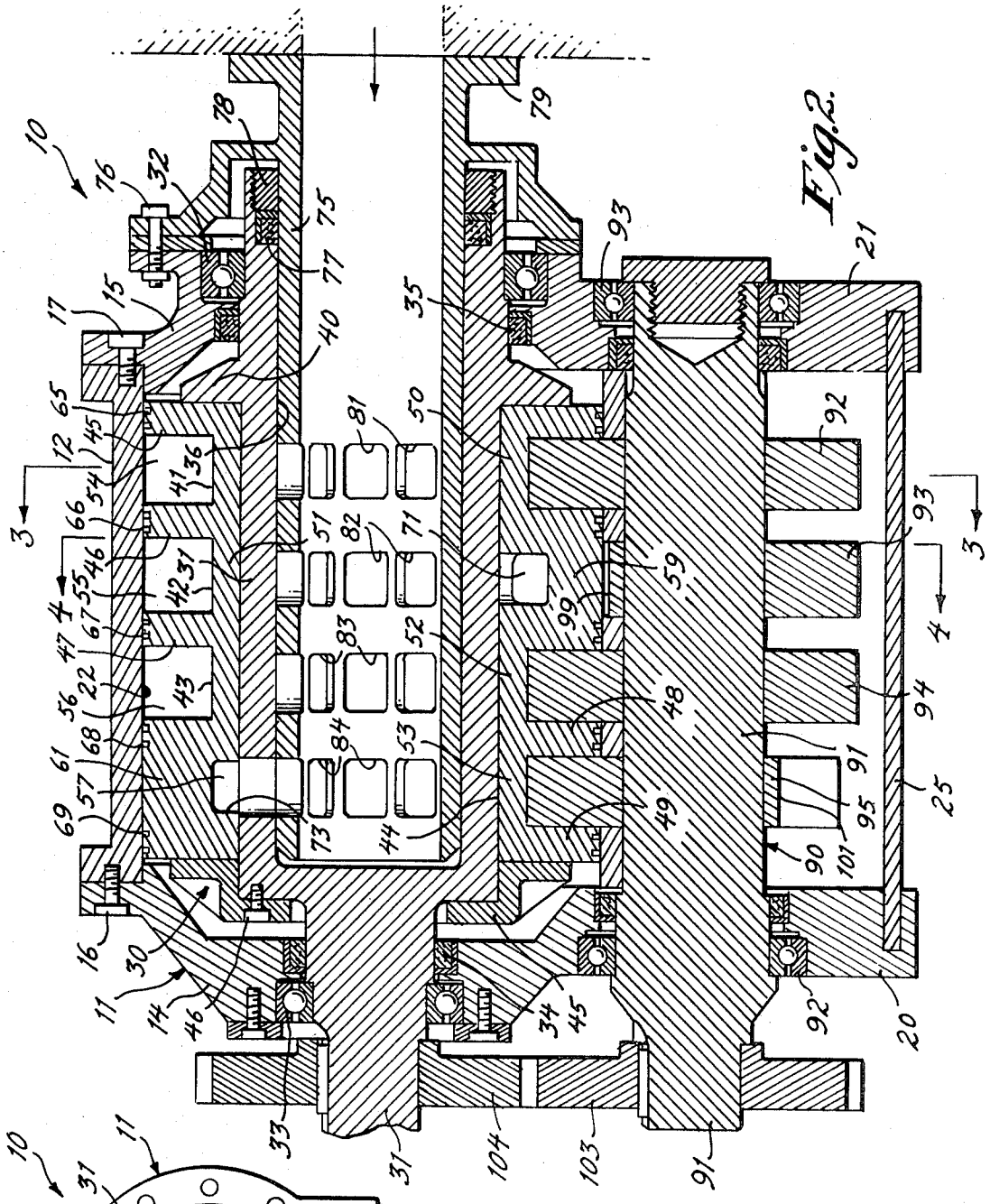


Fig. 2.

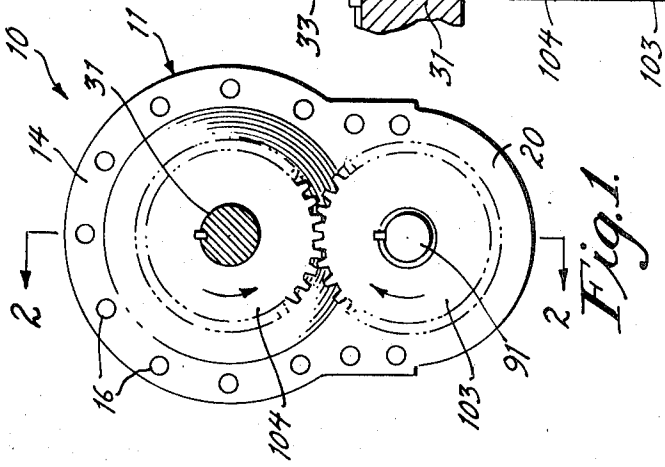


Fig. 1.

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Fig. 4.

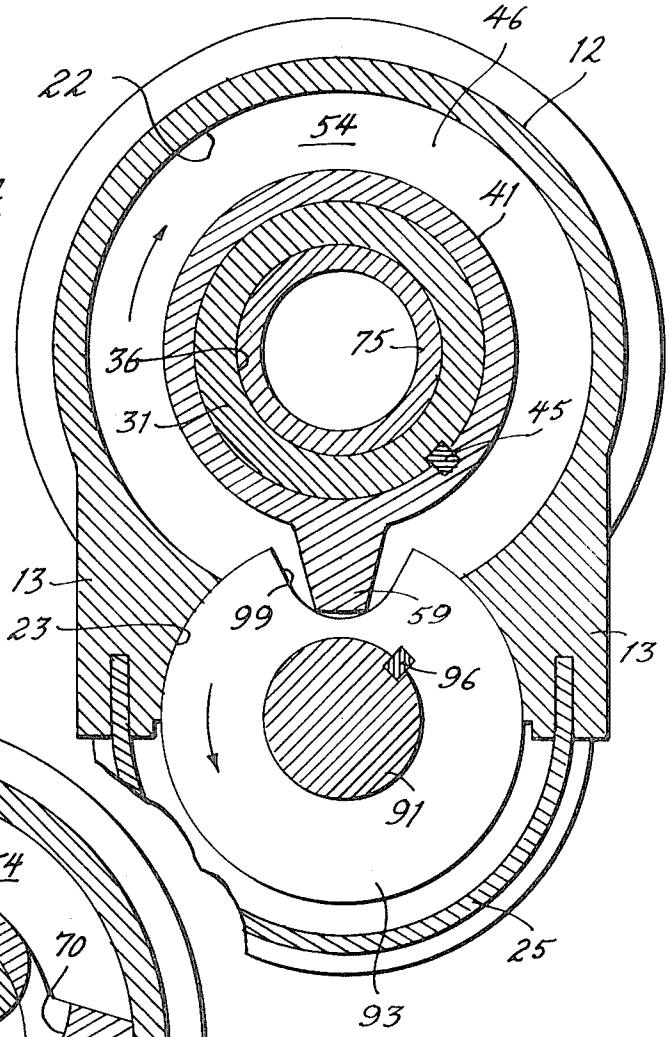
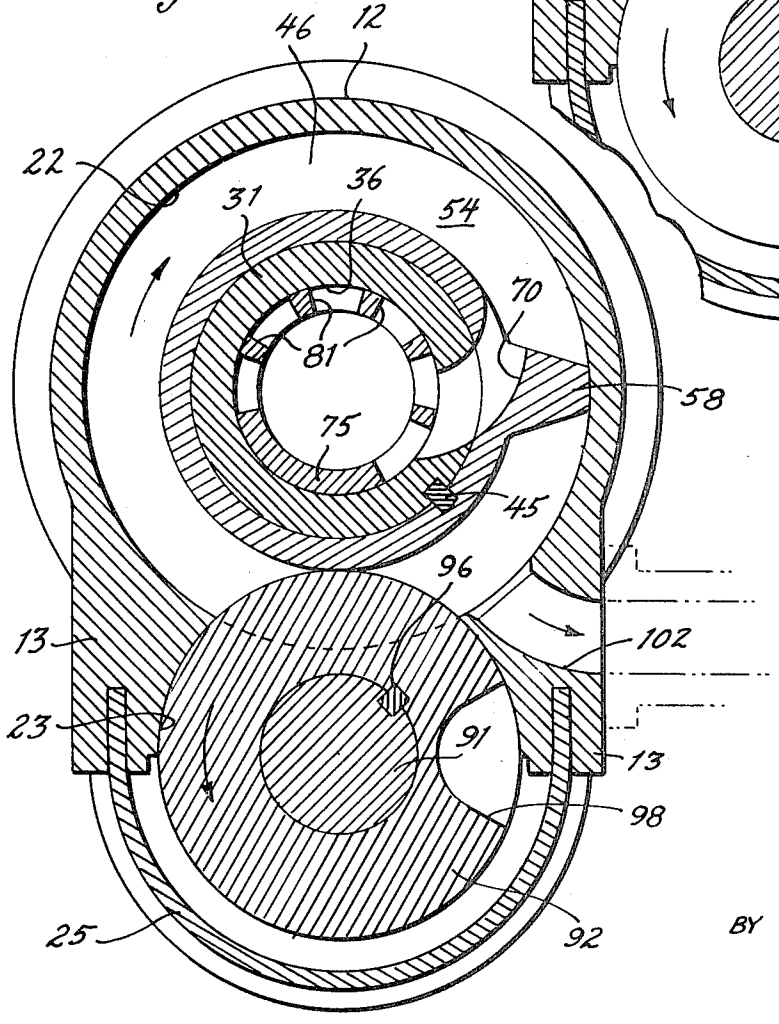


Fig. 3.



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ROTARY MACHINE

BACKGROUND OF THE INVENTION

As is well known to those versed in the art, purely rotary machines, such as motors and pumps, have inherent advantages over reciprocating machines in reduced inertia forces, quicker response to change, smoother operation at low speeds, easier dynamic balancing, and others.

SUMMARY OF THE INVENTION

It is an important object of the present invention to provide a rotary machine which may serve as a fluid motor or pump, achieving the above-mentioned advantages of rotary equipment, and providing an extreme simplicity of construction, reliability in use, high efficiency in operation, and durability for a long useful life.

Other objects of the present invention will become apparent upon reading the following specification and referring to the accompanying drawings, which form a material part of this disclosure.

The invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts, which will be exemplified in the construction hereinafter described, and of which the scope will be indicated by the appointed claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an end elevational view showing a rotary machine constructed in accordance with the teachings of the present invention.

FIG. 2 is a longitudinal sectional elevational view taken generally along the line 2—2 of FIG. 1, enlarged for clarity.

FIG. 3 is a transverse sectional view taken generally along the line 3—3 of FIG. 2.

FIG. 4 is a transverse sectional view taken generally along the line 4—4 of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now more particularly to the drawings, and specifically to FIGS. 1 and 2 thereof, a rotary machine of the present invention is there generally designated 10 and may include an outer casing or housing 11. The casing 11 includes a generally cylindrical, open-ended sidewall 12, having a pair of laterally spaced depending wall portions 13, best seen in FIGS. 3 and 4. A pair of end walls or closures 14 and 15 are respectively secured, as by fasteners 16 and 17, in closing relation with opposite ends of the casing sidewall 12.

As best seen in FIG. 1, the casing end wall 14 is of a vertically elongate configuration, as defined by an upper relatively large circular configuration intersecting with a lower relatively small circular configuration. The upper relatively large circular configuration of end wall 14 closes the upper generally cylindrical formation of casing sidewall 12, while the lower portion of end wall 14, as at 20, extends between and below the depending wall portions 13. The end wall 15 is of similar overall configuration to the end wall 14, having an upper portion closing one end of casing sidewall 12, the right-hand end as seen in FIG. 2, and having a lower portion 21 extending between and below the wall portions 13.

Interiorly of the casing sidewall 12, the configuration thereof defines a generally cylindrical interior, as at 22, while the inner contours of wall portions 13 define a generally semicylindrical interior, as at 23. Extending between the lower ends of wall portions 13 is a generally semicylindrical, upwardly concave bottom wall 25, which combines with the semicylindrical lower housing hollow 23 to define a lower cylindrical interior hollow. The lower wall 25 extends longitudinally to the lower regions 20 and 21 of end walls 14 and 15, so that the latter effectively close the lower interior cylindrical hollow 23.

Generally coaxially within the cylindrical interior 22 of casing 11, there is mounted a rotor, generally designated 30. The rotor 30 may include a coaxially extending hollow shaft 31 having one end journaled, as by suitable bearing means 32, in the end wall 15, and extending outward therebeyond. The other end of shaft 31 extends outwardly through, and is rotatably journaled, as by bearings 33, in the end wall 14. If desired, suitable seals or glands may be interposed between the housing ends 14 and 15, and received ends of shaft 31, such as seals 34 and 35 extending about the shaft 31 and seated in casing ends 14 and 15, respectively.

As best seen in FIG. 2, the rotor shaft 31 is interiorly hollow, as at 36, the interior hollow being closed at one end adjacent to casing end wall 14, and open at its other end passing through casing end wall 15.

The hollow rotor shaft 31 may be provided with an annular rib or collar 40 adjacent to the end wall 15, and an assembly of one or more rotor formations, as at 41, 42, 43 and 44, may be circumposed about and nonrotatably secured to the shaft 31 as by key means 45, see FIGS. 3 and 4, or other suitable securing means. Additionally, the rotor formations 41–44 may be retained on the hollow shaft 31 by an end retainer member 45 detachably secured, as by fasteners 46, to the shaft in position to hold the rotor formations against longitudinal movement on the shaft.

The several rotor formations 41–44 may be formed integrally, or fabricated of a plurality of parts, as most convenient for manufacture and assembly. The several rotor formations are formed of a plurality of generally annular discs 45, 46, 47, 48 and 49 arranged in coaxial alignment with each other nonrotatably circumposed about the hollow portion of shaft 31, and axially spaced therealong, as by respective annuli or bands 50, 51, 52 and 53. The rotor annuli or bands 50–53 may serve to space apart adjacent pairs of annular rotor discs 45–49, each adjacent pair of annular discs or plates and its intermediate spacer band combining with the casing wall 12 to define a generally annular chamber, as at 54, 55, 56 and 57, respectively. Projecting generally radially outwardly from each rotor band 50–53, and extending entirely across its associated annular chamber 54–57, is a radial protrusion, arm or vane, as at 58, 59, 60 (not shown) and 61. The peripheral edges of the several annular plates or discs 45–49 may be formed with labyrinth grooves, as at 65–69, or other means to improve sealing, as desired.

It will now be understood that the entire rotor 30, which includes the hollow shaft 31 and its circumposed structure, rotates as a unit about the axis of the shaft. Further, as will be understood more fully hereinafter, the rotor vanes or arms 59–61 are each angularly offset 90° from the adjacent arm or vane. As seen in FIGS. 3 and 4, the adjacent rotor formations 41 and 42 have their vanes or arms 59 and 58 angularly offset 90° from each other. Similarly, the remaining rotor vanes or arms are offset 90° from the adjacent vanes or arms. Also, the shaft 31 and each rotor annuli or band 50, 51, 52 and 53 are provided with generally radially extending inlet passageways, each opening adjacent to and on one side of the associated vane, in the manner shown in FIG. 3. In particular, the inlet opening or passageway 70 shown in FIG. 3 communicates between the interior of rotor shaft 31 and the chamber 54 on the counterclockwise side of vane 58. The rotor formation 42 is formed with a similar fluid inlet passageway 71, while the rotor formation 43 includes a similar fluid inlet passageway which is obscured in the drawings, and the rotor formation 44 includes a similar inlet fluid passageway at 73.

A fluid conduit or pipe 75 extends into the interior hollow 36 of shaft 31, inwardly through the open end thereof, and may be suitably fixed to the casing 11, as by fasteners 76 secured to the casing end wall 15. Suitable sealing means, as at 77 may be interposed between the fixed conduit 75 and the interior of rotary shaft 31, the sealing means being removably retained in position, as by a retainer ring 78. The outer end of conduit 75 may be flanged, as at 79, or otherwise formed for convenient connection to a source of fluid supply. Interiorly of

the rotor **30**, the fluid conduit **75** is provided with groups or sets of ports, as at **81, 82, 83** and **84**, each set of ports being in radial alignment with a respective rotor formation **41, 42, 43** and **44**. Hence, upon rotation of the rotor **40**, the inlet passageways **70–73** of the several rotor formations rotate in respective registry with the sets of ports **81–84** to provide fluid communication between the interior **36** of rotor **30** and the respective rotor chambers **54, 55, 56** and **57**. In this manner, fluid passes from the interior hollow **36** of rotor **30** to the several annular chambers **54–57**. Further, by the angularly spaced relation of the several vanes **58–61**, and the similarly angularly spaced location of the several fluid inlet passageways **70–73**, it will be apparent that fluid is fed sequentially to the rotor formations or chambers **54–57** for a smooth well-balanced operation.

Located in the lower region of casing **11**, as between the lower end wall regions **20** and **21**, may be a rotary head construction, generally designated **90**. The rotary head **90** includes a shaft **91** extending in general parallelism with the rotor shaft **31**, and journaled at its opposite ends by suitable bearing means, as at **92** and **93** in respective end walls **14** and **15**. Nonrotatably carried by the shaft **91** between the lower regions **20** and **21** of end walls **14** and **15** are a plurality of disclike members or head members respectively designated **92, 93, 94** and **95**. That is, the head members or discs **92–95** are each circumposed about the shaft **91**, being nonrotatable relative thereto, as by suitable key means **96**, see FIG. **3**, and each located to extend radially into a lower region of a respective annular chamber **54–57**. That is, the head member **92** extends upwardly into the lower region of annular rotor chamber **44**, the head member **93** extending upwardly into the lower region of annular rotor chamber **55**, the head member **94** extending upwardly into the lower region of annular rotor chamber **56**, and the head member **95** extending upwardly into the lower region of annular rotor chamber **57**. Each head member **92–95** is formed with a peripheral notch, as at **98** in head member **92** (see FIG. **3**), **99** in head member **93** (see FIG. **2**), **100** in head member **94** obscured in the drawings, and **101** in head member **95**. The notches or recesses **98–101** are successively offset angularly with respect to each other, being in the instant embodiment angularly spaced 90° apart. The formation of each recess or notch **98–101** is such as to smoothly receive and engage with the associated rotor vane or arm **58–61**, respectively. Toward this end, the head shaft **91** is rotated in timed relation with respect to the rotor shaft **31**, as by suitable timing means. One such timing means may be that of meshing gears **103** and **104** respectively carried by shafts **31** and **91** to maintain a proper timed relation therebetween.

While operation is believed obvious from the foregoing description, a brief resume follows. In use of the instant rotary machine as a motor, fluid may be supplied under pressure, say compressible fluid such as steam or air, or incompressible fluid such as liquid. The fluid enters through the stationary conduit **75** from which it passes successively through ports **81, 82, 83** and **84** into respective annular chambers **54, 55, 56** and **57**. As best seen in FIG. **3**, the ports **81** are uncovered or opened by the inlet passageway **70** after the vane **58** has passed in its clockwise movement beyond the head **92**. Fluid may therefore enter into the chamber **54** between the vane **58** and head **92**, causing the vane to continue its clockwise rotation. As best seen in FIG. **3**, the casing **11** is provided with an outlet passageway **102** communicating between the interior of annular rotor chamber **54** and the exterior of the casing at a location adjacent to head member **92**. Similarly, each of the remaining rotor chambers **55, 56** and **57** are provided with an outlet passageway at the same general location, or in substantial alignment with the outlet passageway **102** of rotor unit **41**. It will be obvious that fluid contained in the annular rotor chamber **54** between the head member **92** and the leading side of the vane **58** is expelled by movement of the latter through the outlet passageway **102**. Operation is essentially identical for each of the rotor units **42, 43** and **44**, operation being in a sequential relationship for minimizing vibration and internal stresses. By the timed relationship between rotation of rotor **30** and head **90**, each rotor vane **58–61** engages in its respective head member notch or recess **98–101** for passage through the location of the respected head. This vane movement through the head position is shown in FIG. **4**.

If desired, suitable leakage drain and recovery passageways may be provided, say between the exterior of rotor and interior of casing **11**, and communicating in turn with the interior of the lower casing region within lower casing wall **25**. Drain or recovery means may be provided therefrom, if desired.

In the above-described engine or motor operation, it will be apparent that the shaft **31**, as extending leftward in FIG. **2**, may provide a power output or drive shaft.

Conversely, power may be applied to the shaft **31**, or to the head shaft **91**, if desired, either effecting timed rotation of the rotor **30** and head **90**. In pump operation the rotor vanes may be rotated in the same direction, clockwise as seen in FIG. **3**, each rotary unit simultaneously operating a "suction stroke" and "pressure stroke." That is, rotation of each rotor unit **41–44** simultaneously draws fluid from the rotor interior **36** through its respective inlet passageway **70–73** to the associated rotor chamber **54–57** on the trailing side of the rotor vane. Simultaneously, previously drawn fluid is discharged under pressure through the fluid outlet **102** and corresponding outlets of respective rotor units.

From the foregoing, it is seen that the present invention provides a rotary machine capable of both motor and pump operation, which fully accomplishes its intended objects and is otherwise well adapted to meet practical conditions of manufacture and use.

Although the present invention has been described in some detail by way of illustration and example for purposes of clarity of understanding, it is understood that certain changes and modifications may be made within the spirit of the invention.

What is claimed is:

1. A rotary machine comprising a generally cylindrical casing, a centrally hollow shaft defining a rotor in coaxially spaced relation within said casing, a plurality of coaxial annular walls spaced longitudinally along said shaft and extending from said shaft toward said casing to define therebetween a plurality of generally annular chambers surrounding said rotor, a plurality of vanes arranged in longitudinal spaced relation along said rotor and each extending radially from said rotor between the adjacent annular walls and entirely across said chamber for rotation with said rotor about the annular extent of said chamber in equally angularly spaced relation with respect to each other, said rotor having a plurality of inlet passageways each communicating generally radially between said hollow and said chamber adjacent to and on one side of a respective vane, a plurality of rotary generally disc-shaped heads each extending radially inwardly across one region of a respective one of said chambers for rotation through said one region and having an edge notch configured to receive the associated one of said vanes when the latter passes through said one region, timing means operatively connecting said rotor and heads for entry of said vanes in said recesses, and a pipe extending coaxially into the hollow of said rotor and having radial ports communicating with said inlets during limited portions of rotor rotation for passing fluid to said chambers between each of said heads and the associated said one side of said vane, said casing having outlet passageways adjacent to said disc-shaped heads communicating with said chambers for passing fluid from said chambers between said heads and the other sides of said vanes.

2. A rotary machine according to claim **1**, said timing means comprising gearing interposed in driving relation between said rotor and head.