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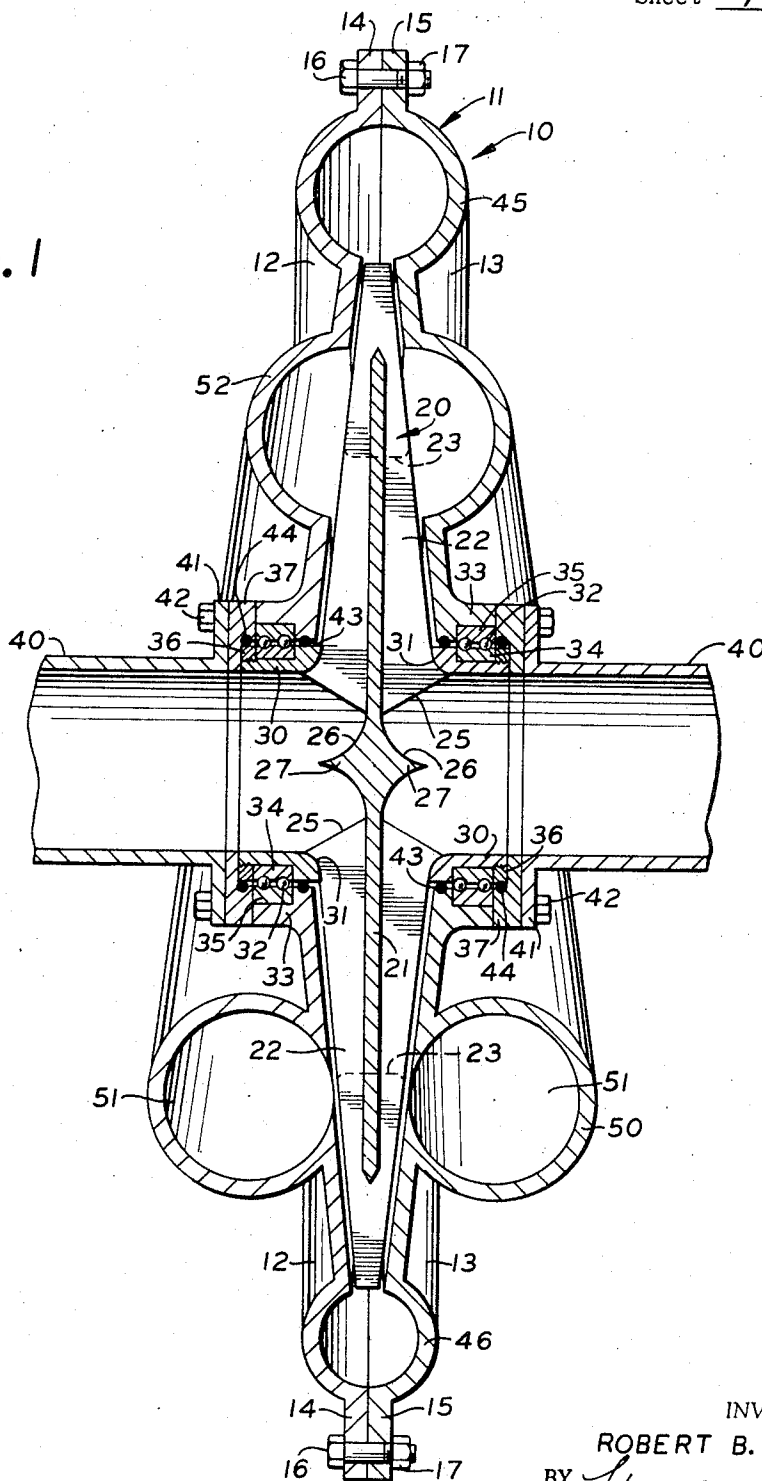
3,430,921

FLUID IMPELLER APPARATUS

Filed July 25, 1966

Sheet 1 of 2

FIG. 1



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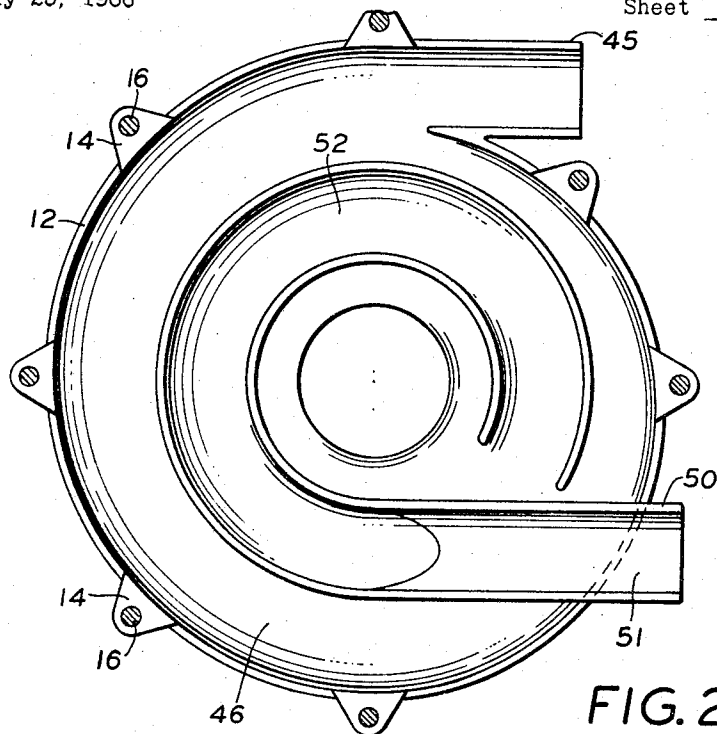


FIG. 2

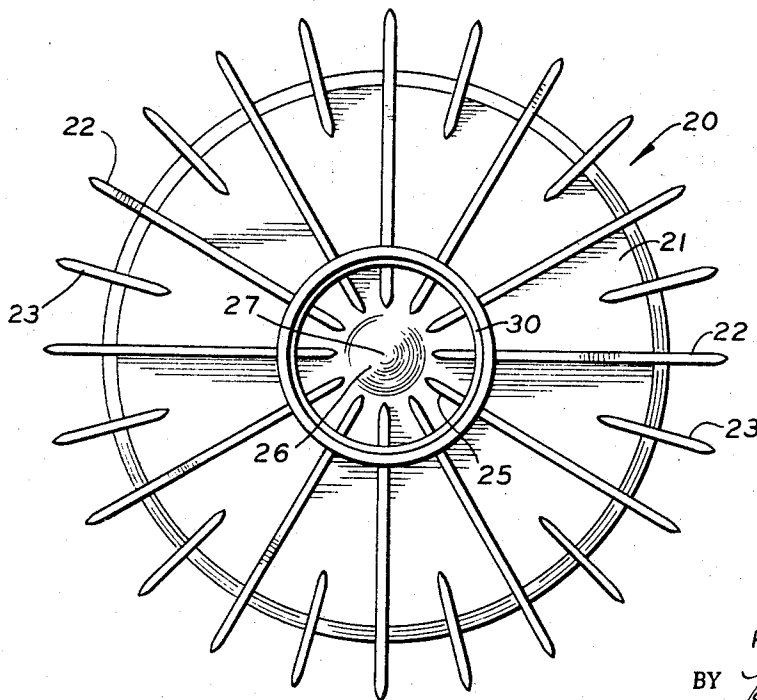


FIG. 3

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FLUID IMPELLER APPARATUS
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7 Claims

ABSTRACT OF THE DISCLOSURE

A fluid pressure conditioning impeller apparatus having a supported rotor mounted in a partially hollow housing, three or more input and output ducts communicating with the rotor at different radial positions, with one of the ducts being an input, one of the ducts being an output, and each of the ducts communicating with each of the other ducts via the rotor.

This invention relates generally to rotating impeller devices having a plurality of entrance and discharge manifolds for converting the pressure and kinetic energy characteristics of a fluid. More particularly, the invention relates to rotating impeller devices having in excess of two entrance and discharge manifolds at predetermined positions radially of said impeller. Specifically, the invention relates to a pump, turbine, or combination device having a rotating impeller with at least one entrance or discharge manifold and at least two corresponding discharge or entrance manifolds, respectively.

In recent years, there has been considerably activity directed toward improving the operating efficiency of pumps and turbines, including those employing rotating impellers. In general, most efforts have been directed toward optimizing the design parameters of the impeller vanes or runners, the entrance and discharge guide cases or manifolds, and the flow directivity and turbulence of the fluid. Other innovations which are frequently exploited to advantage in particular applications include the multistaging of pumps and the provision of a plurality of passes by the fluid through the impeller in turbines.

Although the above advancements have reduced losses in efficiency of these devices appreciably, there remains considerable latitude for further improvement. An example exists in the area of multistage hydraulic pumps where the output, transfer, and input passages between successive stages result in efficiency losses on the order of five to fifteen percent per stage. However, staging is still employed in instances where a multiplicity of output pressures are required or where the specific speed of the pump is sufficiently low to benefit significantly in terms of efficiency from the increase in stage specific speed made possible by providing a multiplicity of stages. Thus, although multistage designs may be advantageous over single staging in certain environments, and losses in efficiency remain relatively high.

An additional example exists in the field of water conduits constituting a distribution system where the ultimate customers are located at widely differing elevations. In such cases, it is common practice to arrange, insofar as possible, the supply reservoir at some intermediate elevation and to install pressure relief ponds at lower elevations to avoid unreasonably high pressures which would tend to damage these lower system components. Electric motors or diesel engines normally drive water pumps to service portions of the systems at higher elevations than the supply reservoir.

Accordingly, a principal object of the present invention is to provide an impeller device for fluids having as a characteristic the entrance and/or exit pressures propor-

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tionally related to a function of the radial disposition of the entrance or exit manifolds.

Another object of the invention is to provide a single impeller device which operates simultaneously as a turbine and a pump to combine functions at considerable cost and power advantage over conventional components or which provides various pressure outputs at improved efficiency as compared with staging systems.

A further object of the invention is to provide a single impeller, combination turbine and pump wherein fluid is introduced to the impeller housing intermediate the radial dimension of the impeller and discharged radially inwardly and outwardly of the entrance at reduced and increased pressures, respectively.

An additional object of the invention is to provide a combination turbine and pump apparatus having one or more entrance manifolds intermediate the radial dimension of the impeller and one or more discharge manifolds located radially inwardly and/or outwardly of the entrance manifolds.

Still another object of the invention is to provide a pump, turbo-compressor, or turbo-blower for fluids having a single, rotating impeller with one or more entrance manifolds and one or more discharge manifolds located radially outwardly thereof on the impeller.

A still further object of the invention is to provide a turbine or motor for fluids having a single, rotating impeller with one or more entrance manifolds and one or more discharge manifolds located radially inwardly thereof on the impeller.

Various other objects and advantages will appear from the following description taken in conjunction with the attached drawings, and the novel features will be particularly pointed out hereinafter in conjunction with the appended claims.

In the drawings:

FIG. 1 is a section view of a fluid impeller device according to the present invention showing a rotor and housing with axial conduits or passageways shown in fragmentary form.

FIG. 2 is a side elevation in reduced scale of the interior portion of one section of the split housing shown in FIG. 1.

FIG. 3 is a side elevation in reduced scale of the exemplary rotor depicted in FIG. 1 removed from the casing or housing.

Referring now to the drawings generally and particularly to FIG. 1, a fluid impeller device, generally indicated by the numeral 10, is shown and described as a combination turbine and pump depicting an exemplary form of the invention. The impeller device 10 is provided with a casing or housing, generally indicated by the numeral 11, which serves as a protective cover, supports internal components as more fully hereinafter described, and retains fluids being processed. As shown, the housing 11 is vertically split into two opposed sections 12 and 13 which are intermittently joined at circumferentially spaced flanges 14 and 15, respectively, by suitable machine bolts 16 and nuts 17, or comparable fastening means (FIGS. 1 and 2).

It should be noted that the mechanical positioning of the housing 11 plays no part in the instant invention. Depending upon the construction and intended use of a particular impeller device, it might be more advantageous to employ a horizontally rather than a vertically split housing. Further, the horizontal placement of the rotational axis of the impeller device 10 is a design factor to be considered in each individual installation and no significance is to be attributed to the horizontal placement shown herein.

Disposed within the housing 11, a rotor assembly, generally indicated by the numeral 20, is freely rotatably

mounted. Referring now to FIGS. 1 and 3, the primary structural component of rotor assembly 20 is a substantially circular disk 21 which may be positioned axially centrally of the housing 11. A plurality of radial vanes 22 are spaced circumferentially about the disk 21 and project radially and axially therefrom. The vanes 22 preferably extend from a position spaced a short distance from the center of disk 21 radially outwardly to an extent just short of the radial extremity of housing 11. In order to achieve efficient operation, the vanes 22 preferably extend axially to a position proximate, but clearing, the interior walls of the sections 12, 13 of housing 11, thereby preventing the escape of any appreciable quantities of fluid about the axial extremities. If desired, supplemental vanes 23 of shorter radial extent, but otherwise similar, may be provided between the vanes 22 near their radially outward extremities to minimize the size of turbulent cells formed in the fluid as it is displaced outwardly to the larger volume portions of impeller 20, thereby preventing excessive power losses.

In the embodiment of the invention shown, the impeller device 10 is provided with discharge ducts 25 at the radially center portion of the disk 21 on either side thereof defined by the radially inner extremities of the vanes 22. The radial center of disk 21 may be provided with opposed outwardly curved surfaces 26 terminating in apexes 27 to provide guide surfaces for fluid discharged from diametrically opposed vanes 22 and reduce turbulence. A pair of hollow shafts 30 project axially in either direction from rotor 20, preferably at a position slightly radially outwardly of the ducts 25, and constitute a carrier for fluids expelled from the ducts 25. The shafts 30 are non-rotatably and rigidly attached to the vanes 22 of rotor 20 at the juncture 31, as by welding or other suitable fastening means.

The hollow shafts 30 also serve the function of rotatably suspending and positioning the rotor assembly 20 within the housing 11. A free rotational mounting for rotor 20 may be achieved by positioning ball bearings 32 between the hollow shafts 30 and annular flanges 33 projecting outwardly from the sections 12, 13 of housing 11. The ball bearings 32 may be conventionally mounted in grooved inner and outer races 34 and 35, respectively. The inner races 34 may be held in place on the outer surface of shafts 30 by threaded clamps 36, or comparable means of securement. Annular cover plates 37 about the axial extremities of flanges 33 of housing 11, the axial extremities of shafts 30 and the ends of outer races 35 to achieve similar placement. A wide assortment of conventional bearings are available to meet the radial and thrust loads of different designs.

Seated against and projecting axially outwardly of the cover plates are discharge conduits or tubes 40 which serve as extensions of the discharge ducts 25 and the hollow shafts 30. The discharge conduits 40 may be provided with radial flanges 41 which are secured to the cover plates 37 and the flanges of housing 11 by fasteners, such as the machine screws 42. Ring seals 43 may be positioned between the shafts 30 and the flanges 33 of housing 11 to isolate the bearings 32 from the fluid between the vanes 22. Similarly, ring seals 44 may be interposed between the threaded clamps 36 and the cover plates 37 to isolate the bearings 32 from fluid passing through the shafts 30 to the discharge conduits 40.

In addition to the discharge ducts 25 at the radial center of rotor 20, the housing 11 is provided with two additional apertures for the ingress or egress of fluids. Referring now to FIGS. 1 and 3, an output duct 45 is positioned at the radially outer extremity of the housing 11. The duct 45 merges with the housing 11 to form an outlet manifold 46 which extends substantially the circumference of the housing 11 and may be somewhat volute shaped, as shown, to optimize flow characteristics of exiting fluids. An input duct 50 is positioned intermediate the output ducts 25, 45 and may constitute a pair of circular tubes

51 positioned substantially tangentially to the axial extremities of the vanes 22 of rotor 20. The duct 50 merges with the housing 11 to constitute an inlet manifold 52 of gradually tapering cross sectional area preceding circumferentially clockwise in FIG. 2. The reduced area portion of manifold 52 may approximate an oblate spheroid, centered on the disk 21, or other appropriate configuration, to provide a smooth, substantially equal division of fluid to the vanes 22 disposed axially on either side of the disk 21 of rotor 20.

In operation, a pressurized fluid is introduced at the inlet duct 50, directed through the manifold 52, and contacts the vanes 22 of rotor 20. Since the fluid is introduced at a greater velocity than the tangential velocity of a point on the vanes 22 at the input manifold radius, a portion of the fluid introduced is centripetally directed radially inwardly to rotate the rotor 20 on a turbine principle, wherein the fluid is constrained to have the same angular velocity as the rotor vanes at any given radius. This decrease in velocity potential of the fluid releases energy which is imparted to the rotor 20 causing rotation. This portion of the fluid is expelled from the outlet ducts 25 into the discharge conduits 40 at a decreased pressure.

The remaining portion of the pressurized fluid introduced at inlet duct 50 and not directed radially inwardly is acted upon by the rotating vanes 22. Under well known centrifugal pump or blower principles, this portion of the fluid is directed radially outwardly by centrifugal force, thereby acquiring increased velocity potential in proportion to the increase in radius and increased pressure potential in proportion to a function of the increase in radius. If desired, the increased velocity potential may be converted to pressure potential as an additional boost by employing well known design criteria at the output duct 45.

Due to the aforementioned high efficiency losses which take place at inlet and outlet ducts and manifolds, as between stages of a pump, it is apparent that the apparatus disclosed herein is inherently advantageous. The transmittal of a fluid through a conventional turbine and, subsequently, a pump would require passage through four (4) input and output ducts; the present invention accomplishes the same functions while employing only three (3) comparable ducts.

It can be readily seen that the present invention also encompasses an impeller device having more than two outlets along the radius of the impeller. Thus, a plurality of outlets at lower pressure could be effected by ducts located radially inwardly of the input duct and the total turbine action would be derived from the sum of the flows from these ducts. Similarly, a plurality of outlets at higher pressure could be effected by ducts located radially outwardly of the input duct and the total pumping action would be derived from the sum of the flows from these ducts. In a similar manner, the impeller device may be constructed with a multiplicity of inlets at differing radial positions as well as a plurality of outlets. It is manifest that the number of inlets and outlets and their locations is limited only by the requirements that the total mass flow rate in equal the total mass flow rate out, that energy in equal energy out minus losses due to bearing friction and viscous and turbulent fluid losses, and that spacing between input and output manifolds be sufficient to meet physical design requirements.

Although the vanes 22 and 23 of rotor 20 are depicted as straight radial vanes for purposes of illustration, they may be otherwise shaped and positioned in accordance with established design techniques to optimize selected performance characteristics of the impeller device 10. This would include a design wherein the vanes outwardly of the input duct would differ from those inwardly to optimize the respective pump and turbine functions. It should also be understood that the shaft 30 may be a solid cylindrical member with all input and output ducts located radially outwardly thereof.

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Since the disk 21 of rotor 20 constitutes an axial divider of the vanes 22, it is apparent that the construction of the illustrative embodiment has two totally separate discharge conduits 40. Thus, the flow rate from these discharge conduits could be individually varied by the application of back pressures in the outlet conduits. It should further be recognized that although the structure shown herein is bilaterally symmetrical for obviating thrust loads, a single sided structure with appropriate thrust bearing means would as well represent the invention. It is also to be understood that the input and output ducts and manifolds may take forms other than those depicted. An example would be the supplying of a fluid through a conduit located interiorly of the rotor 20 and the discharge through a nozzle at a selected position radially thereof.

A preferred form of the invention has been shown and described in sufficient detail to enable one skilled in the art to practice the invention. Since various modifications in details, materials, and arrangements of parts, in addition to those suggested herein, are within the spirit of the invention herein disclosed and described, the scope of the invention should be limited solely by the scope of the attached claims.

What is claimed is:

1. A fluid impeller apparatus comprising, a partially hollow housing means, support means disposed within said housing means, rotor means with vane means encased in said housing means and carried by said support means, and at least three input and output means in said housing means communicating with said rotor means at differing positions radially thereof for the purpose of meeting desired pressure and velocity requirements, wherein at least one of said input and output means is an input means, at least one of said input and output means is an output means, and each of said input and output means communicates with each of the other of said input and output means via said rotor means, thereby constituting a fluid pressure conditioning device.

2. Apparatus according to claim 1, wherein at least

one input means is positioned radially intermediate a plurality of output means, thereby constituting a combination turbine and pump device.

3. Apparatus according to claim 1, wherein at least one input means is positioned radially inwardly of a plurality of output means and said rotor means is driven by an external power source, thereby constituting a pumping device having differing output pressures at each of said output means.

4. Apparatus according to claim 1, wherein at least one input means is positioned radially outwardly of a plurality of output means, thereby constituting a turbine device having differing output pressures at each of said output means.

5. Apparatus according to claim 1, wherein an output means is located substantially radially centrally of said rotor means and directed axially therefrom.

6. Apparatus according to claim 1, wherein said support means comprise, bearing mounted shaft means.

7. Apparatus according to claim 1, wherein said input and output means comprise, duct means merging into manifolds proximate to said vanes of said rotor.

References Cited

UNITED STATES PATENTS

2,537,344	1/1951	Gruss	230—116
3,103,325	9/1963	Leutzing	

FOREIGN PATENTS

503,510	3/1920	France.
1,003,735	11/1951	France.
76,030	7/1961	France.
		(1st addition to French Pat. No. 1,237,157)
343,982	11/1922	Germany.

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U.S. Cl. X.R.

230—116; 103—87