Dec. 19, 1944. A. W. THOMANN ET AL 2,365,310

ROTOR UNIT

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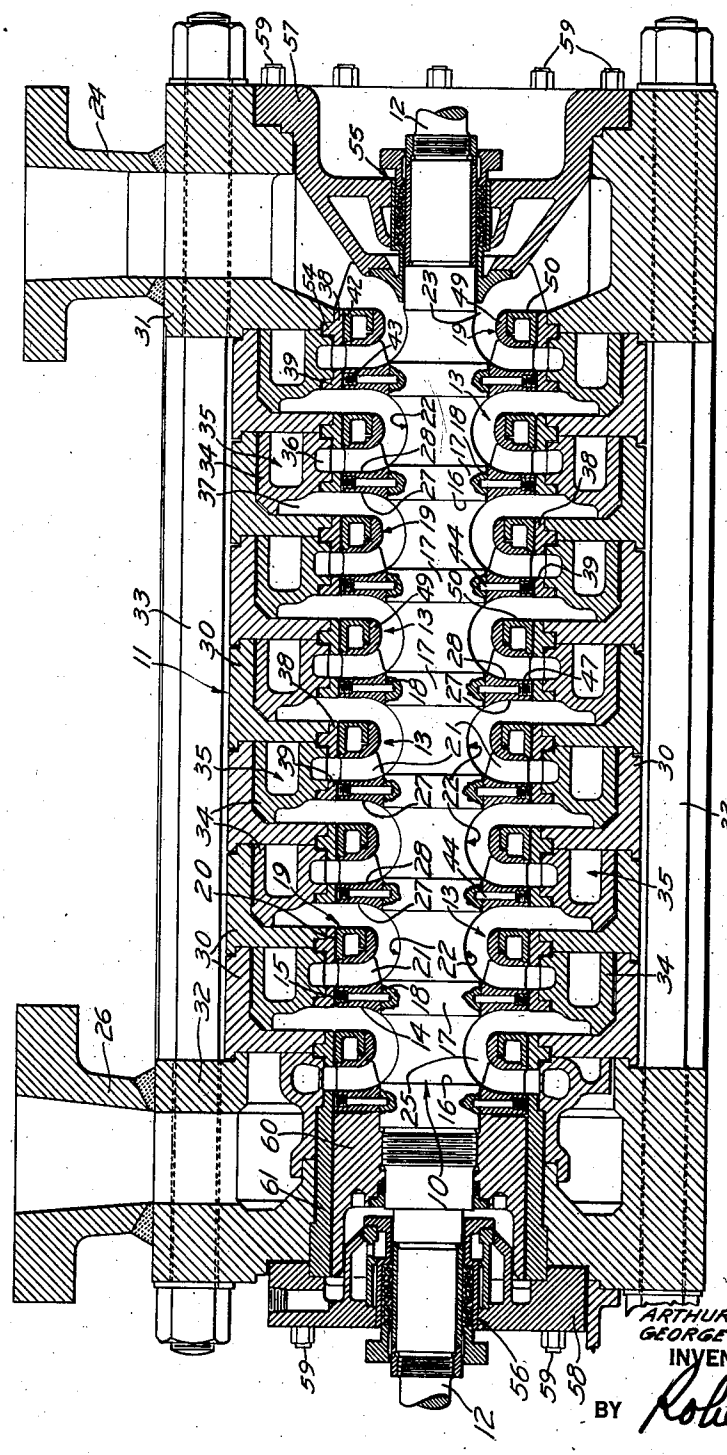


Fig. 1

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Fig. 2

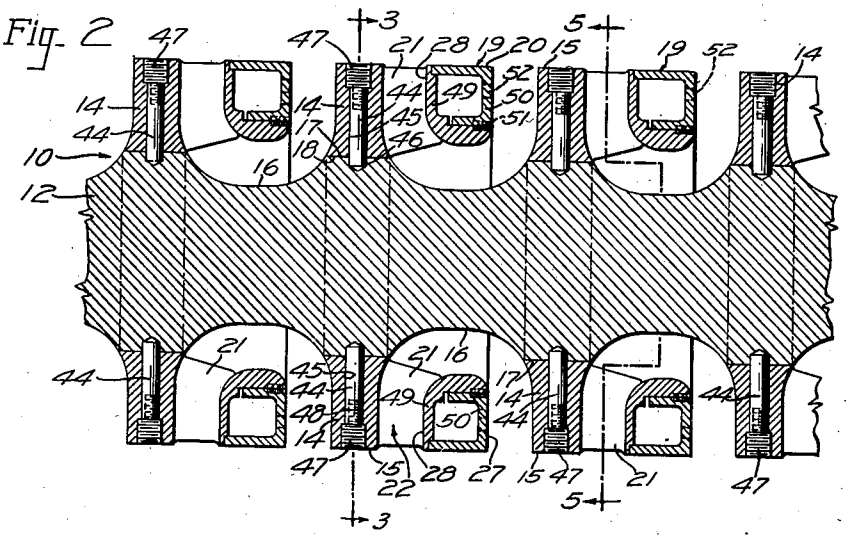


Fig. 3

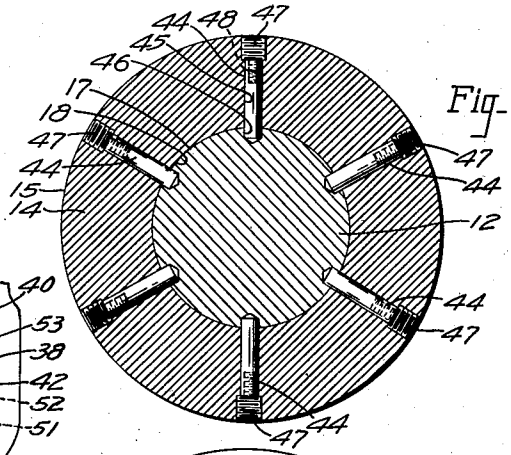


Fig. 4

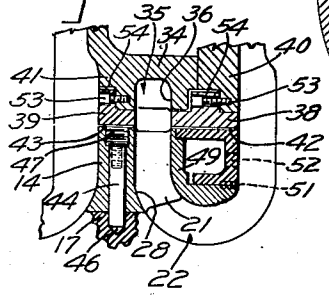
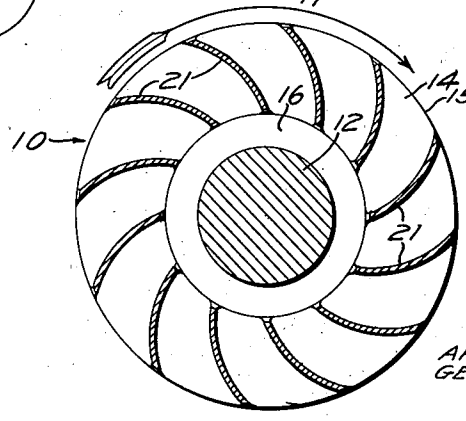


Fig. 5



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UNITED STATES PATENT OFFICE

2,365,310

ROTOR UNIT

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Application March 2, 1944, Serial No. 524,714

6 Claims. (Cl. 103—115)

This invention relates to centrifugal machines such as pumps, compressors and the like, and more particularly to a rotor for such machines.

An object of the present invention is to provide a rotor unit comprising a shaft having impeller means permanently attached thereto, and in which novel impeller fastening means are provided for fixedly relating the impeller means and the shaft.

Another object is to provide a rotor of the multistage type wherein the impellers thereof are provided with wearing surfaces having diameters at least equal to or slightly greater than the outside diameters of the respective impellers to avoid the necessity of any stationary parts which reach between the impellers of the individual stages, in which the impellers are permanently or semi-permanently attached to the rotor shaft by pin means which lie in the planes of the respective wearing faces of the impellers, and in which those portions of the pin means exposed through the wearing surfaces may be machined simultaneously with the impellers after complete assembly of the rotor.

Another object is to provide a rotor wherein the impellers of the respective stages are permanently attached to the rotor shaft, and in which pins are employed for fastening the impellers to the shaft, with the pins so arranged as to provide a durable structure, in addition to unobstructed accessibility for assembling purposes.

A further object is to provide a rotor wherein a series of stage impellers is pinned to the rotor shaft in a permanent manner, and in which the pins are so anchored as to preclude accidental unloosening thereof.

With these and other objects in view, as may appear from the accompanying specification, the invention consists of various features of construction and combination of parts, which will be first described in connection with the accompanying drawings, showing a rotor unit of a preferred form embodying the invention, and the features forming the invention will be specifically pointed out in the claims.

In the drawings:

Figure 1 is a longitudinal sectional view of a centrifugal pump embodying the present invention.

Figure 2 is an enlarged longitudinal sectional view of a portion of the rotor.

Figure 3 is a sectional view taken along the line 3—3 of Figure 2.

Figure 4 is a sectional detail view of a portion of one of the impellers.

Figure 5 is a sectional view taken along the line 5—5 of Figure 2.

Referring more particularly to the drawings, Figure 1 illustrates a boiler feed pump wherein a rotor 10 is mounted in a casing 11. This rotor includes a shaft 12 on which impellers 13 are permanently or semi-permanently mounted. Each impeller includes a side wall or disc 14 provided with an annular wearing surface 15, and all the wearing surfaces 15 are of the same diameter. The shaft 12 is undercut at 16, the undercuts comprising circumferential grooves. The walls 14 are mounted on the cylindrical portions 17 of the shaft 12, and the walls are provided with bores 18 press fitted to the cylindrical portions.

Annular rings 19 are arranged between the walls 14, which rings are provided with annular wearing surfaces 20 of the same diameters as the wearing surfaces 15. Outward flow fluid vanes 21 fixedly connect the rings 19 with their respective walls 14, and the rings are of such shape and arranged in such manner as to co-act with the walls 14 and the faces of the undercuts 16 to provide fluid passages 22 generally U-shaped in cross-section. Figure 1 illustrates the inlet eye of the pump at 23, which eye has communication with the suction inlet 24 of the pump. The last stage impeller 25 has communication with the pump discharge 26. Each fluid passage 22 extends circumferentially of the axis of the rotor 10, and the legs 27 and 28 of the fluid passages comprise fluid inlets and fluid outlets, respectively. Both the fluid inlets and the fluid outlets extend 360° about the rotor and open through the annular perimeter thereof. The vanes 21 are arranged in the legs 28 of the respective fluid passages 22, and the side faces of the walls 14 flare outwardly adjacent the shaft 12 in conformity with the face contours of the undercuts 16 so that the latter comprise continuations of the respective fluid passages.

The casing 11 illustrated in Figure 1 comprises a series of stage pieces or annular members 30 and two end pieces 31 and 32. All these pieces are arranged in end to end relationship and clamped into a unitary structure by means of bolts 33 extending through the two end pieces 31 and 32 but lying outside the stage pieces 30. The stage pieces 30 and the end pieces 31 and 32 are of such inside diameters as to provide a chamber for the rotor 10. In Figure 1, the stage pieces 30 are generally L-shaped in cross-section and so arranged as to provide space for diffuser 34 co-acting with the stage pieces to provide fluid passages 35 having fluid inlets 36 and fluid outlets 37 communicating with the fluid outlets 26 and fluid inlets 27, respectively. Casing rings 38 and 39 are attached to the flanges 40 and 41, respectively, of the stage piece 30 and diffuser 34. The casing rings 38 and 39 having wearing surfaces 42 and 43 arranged in co-active relationship with the wearing faces 20 and 15, respectively. All the wearing surfaces 42 and 43 are substantially of the same diameter so that the rotor

10 may be axially removed as a unit from the casing 11, since no part of the rotor is of larger diameter than the wearing surfaces 15 and 20, and the wearing surfaces 42 and 43 define the smallest inside diameter of the casing 11.

A machine of the foregoing type, particularly with respect to axial removability of the rotor intact from the casing, forms the subject matter of an application for patent on centrifugal pump filed by George F. Wislicenus, a joint inventor herein, on even date herewith. The present invention is primarily concerned with the attachment of the impeller or impellers to the rotor shaft.

Means for fastening the walls 14 to the shaft 12 comprise pins 44 having a press fit in radial bores 45 in the walls and opening through the wearing surfaces 15. The inner ends of the pins 44 press fitted in bores 46 in the cylindrical portions 17. The bores 45 are of enlarged diameters at their outer ends for the reception of plugs 47 threaded into the bores, since the outer ends of the pins 44 terminate some distance inwardly from the wearing surfaces 15. The plugs 47 bear against the outer ends of the pins 44 to prevent loosening of the pins. In building the rotor, all the walls 14 are attached to the shaft 12 before machining of the rotor. Thus the plugs 47 are machined simultaneously with the walls 14 so that the exposed ends of the plugs constitute portions of the annular wearing surfaces 15. Accordingly, the rotor may be accurately machined in one setting and dynamically balanced as a whole.

In view of the fact that the wearing surfaces 15 define the largest diameter of the rotor, location of the fastening means for the impellers in the planes of the walls 14 provides unrestricted accessibility which greatly facilitates assembly of the parts. All work is done from a position beyond the annular perimeter of the rotor. The walls 14 are of such thickness as to amply accommodate the bores 45 and the plugs 47 so that the impeller fastening is of durable construction.

Since the rotor 10 may be axially removed intact from the casing, the impeller structure may be permanently attached to the rotor shaft, in the manner shown; should removal become necessary, the pins 44 are provided with threaded bores 48 into which a suitable pulling tool may be threaded. Before the pins 44 can be withdrawn, however, it is necessary to either remove the plugs 47 or open the plugs to gain access to the threaded bores 48. Such access may be gained by boring openings of sufficient size through the plugs.

The rings 19 comprise wall portions 49 which are fixed to the vanes 21. The walls 49 are generally L-shaped in cross-section. Second walls 50 are attached to the walls 49, the walls 50 being in the nature of channels in cross-section and opening toward the walls 49. Screws 51 are threaded into the walls 49 and 50 to prevent accidental disconnection of the two wall parts. The walls 49 and 50, because of their cross-sectional contours, provide cavities in the rings 19 so that the latter are of hollow formation, thereby requiring less material and reducing the weight of the structure. While the walls 50 are press-fitted to the walls 49, leakage might occur between some of the parts. To prevent an unbalanced rotor condition because of such leakage, the walls 50 are provided with openings 52 so that fluid may occupy all the cavities in a like manner to the end that the rotor may remain perfectly balanced.

Means for fixedly securing the casing rings 38 and 39 comprise screws 53 extending through the flanges 54 on the casing rings and threaded into the flanges 40 and 41, respectively.

The shaft 10 extends through stuffing boxes 55 and 56 carried by end covers 57 and 58, respectively, the end covers being detachably connected with the end pieces 31 and 32, respectively, by bolts 59. A balancing drum 60 is attached to the shaft 12 at the discharge end of the pump, which drum lies within the plane of a balancing drum head 61.

Obviously the foregoing structure is equally well adapted for use in compressors, turbines and the like without departing from the spirit of the present invention.

It will be understood that the invention is not to be limited to the specific construction or arrangement of parts shown, but that they may be widely modified within the invention defined by the claims.

What is claimed is:

1. A rotor unit comprising a shaft, impellers mounted on said shaft and having wearing surfaces of diameters at least equal to the outside diameters of their respective impellers, and fastening means fixedly securing the individual impellers to said shaft, said fastening means extending through the outer periphery of the walls of the impellers.

2. A rotor comprising a shaft having axially spaced cylindrical portions, impellers having annular walls provided with bores press-fitted to the respective cylindrical portions, said annular walls having wearing surfaces of diameters at least equal to the outside diameters of their respective impellers, and pin means extending radially through said annular walls and into said cylindrical portions to fixedly connect the individual impellers with said shaft, said pin means extending through the periphery of the walls of the impellers.

3. A rotor comprising impellers having walls provided with openings, a rotor shaft extending through said openings, and means extending radially through said walls and into said shaft for fixedly connecting the impellers with said rotor shaft, said walls being provided with machined wearing surfaces and said means having faces machined in continuation of said wearing surfaces.

4. A rotor comprising impellers having annular walls provided with openings, a rotor shaft press-fitted in said openings, the respective annular walls and said shaft having co-axial bores, said bores extending radially through said walls and their annular perimeters, pins in said bores for fixedly attaching the individual impellers to said shaft but terminating short of the outer ends of said bores, and means secured in the outer ends of said bores and engaging said pins to restrain the latter from relative outward movement in the bores, said walls having machined wearing surfaces and said means having faces machined in continuation of said wearing surfaces.

5. A rotor comprising impellers having annular walls provided with openings, a rotor shaft press-fitted in said openings, the respective annular walls and said shaft having co-axial bores, said bores extending radially through said walls and their annular perimeters, pins fitted in said bores for fixedly attaching the individual impellers to said shaft but terminating short of the outer ends

of said bores, and plugs threaded into the outer ends of said bores and engaging said pins to restrain the pins from relative outward movement in their respective bores, said walls having machined wearing surfaces and said plugs having faces machined in continuation of said wearing surfaces.

6. A rotor comprising impellers having annular walls provided with openings, a rotor shaft press-fitted in said openings, the respective annular walls and said shaft having co-axial bores, said bores extending radially through said walls and their annular perimeters, pins fitted in said bores for fixedly attaching the individual impellers to said shaft but terminating short of the outer ends of said bores, and plugs threaded into the outer ends of said bores and engaging said pins to restrain the pins from relative outward movement in their respective bores, said walls having machined wearing surfaces and said plugs having faces machined in continuation of said wearing surfaces, said pins being provided with threaded openings in their outer ends for connection with a pin withdrawing tool after removal of the respective plugs.

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