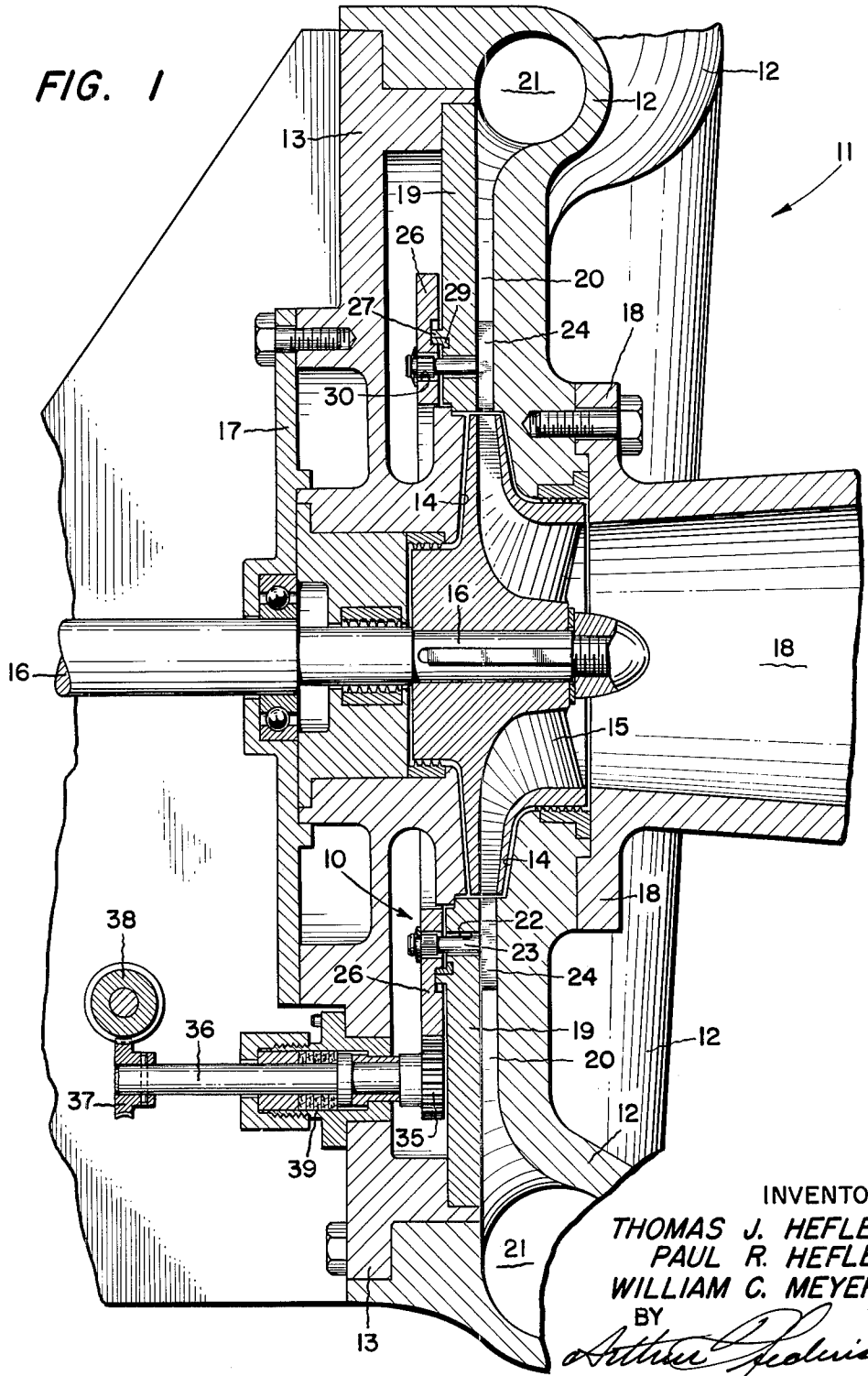
March 29, 1966 T. J. HEFLER ETAL 3,243,159

GUIDE VANE MECHANISM FOR CENTRIFUGAL FLUID-FLOW MACHINES

Filed April 27, 1964 4 Sheets-Sheet 1

FIG. 1



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GUIDE VANE MECHANISM FOR CENTRIFUGAL FLUID-FLOW MACHINES

Filed April 27, 1964 4 Sheets-Sheet 2

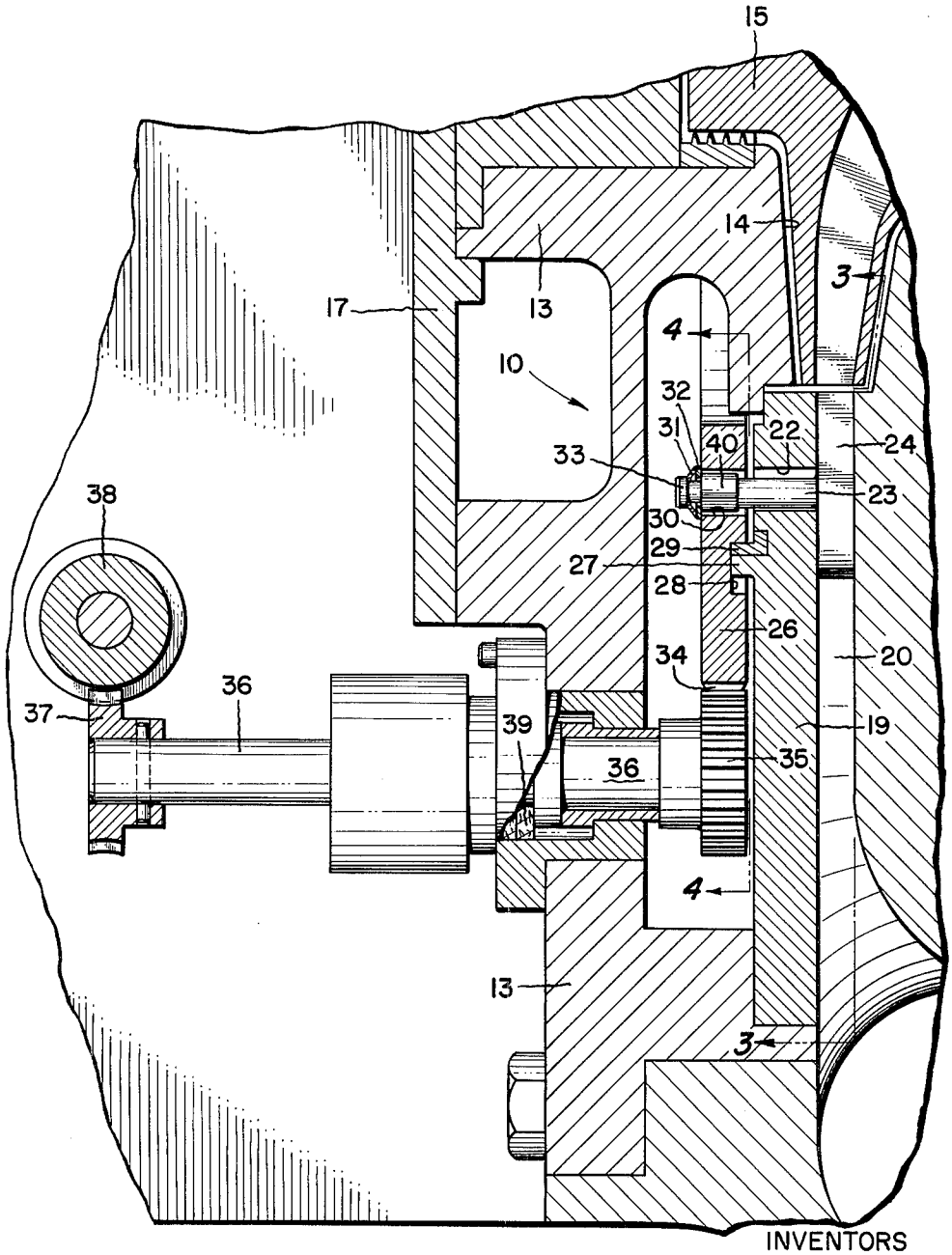


FIG. 2

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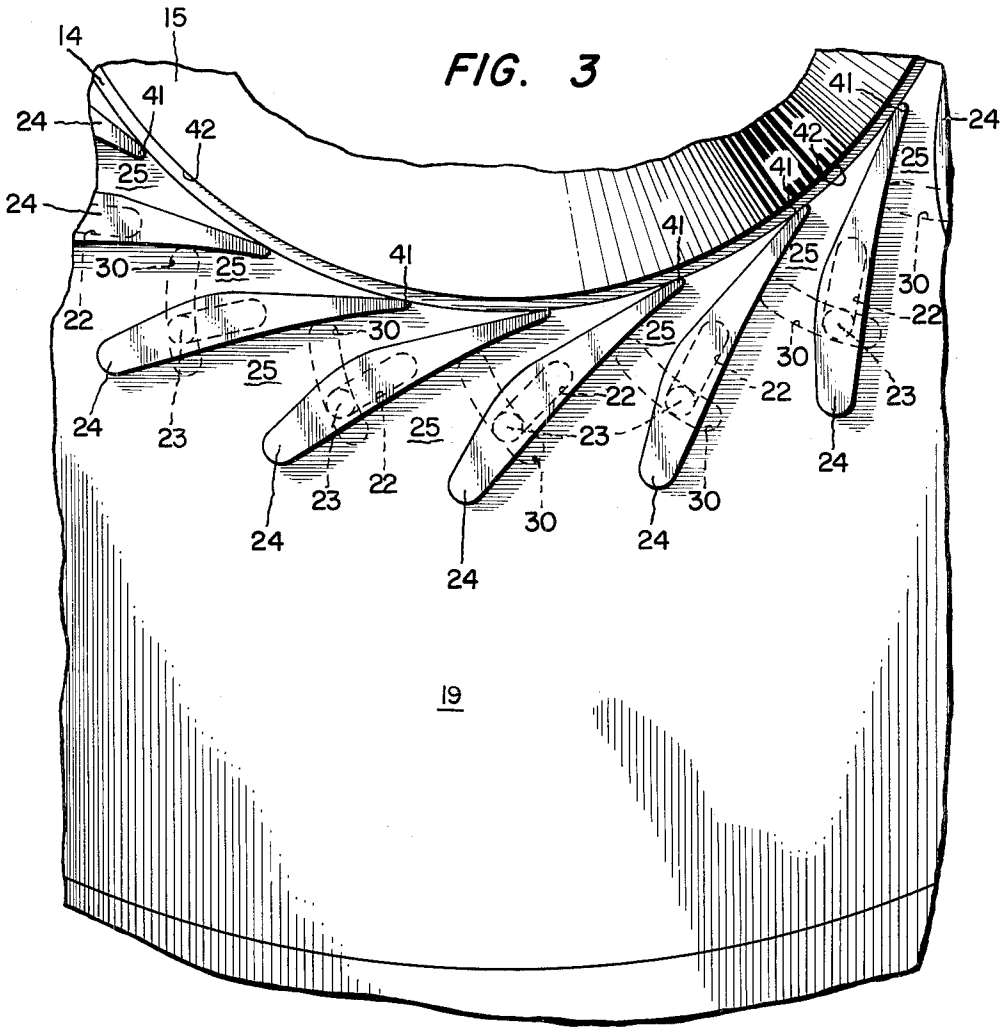
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GUIDE VANE MECHANISM FOR CENTRIFUGAL FLUID-FLOW MACHINES

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FIG. 3



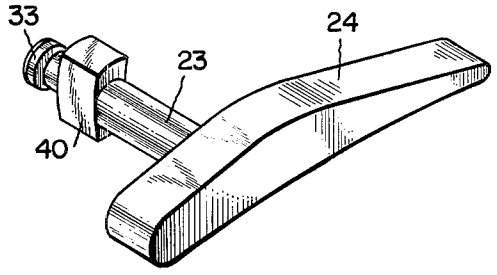


FIG. 6

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GUIDE VANE MECHANISM FOR CENTRIFUGAL FLUID-FLOW MACHINES

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FIG. 4

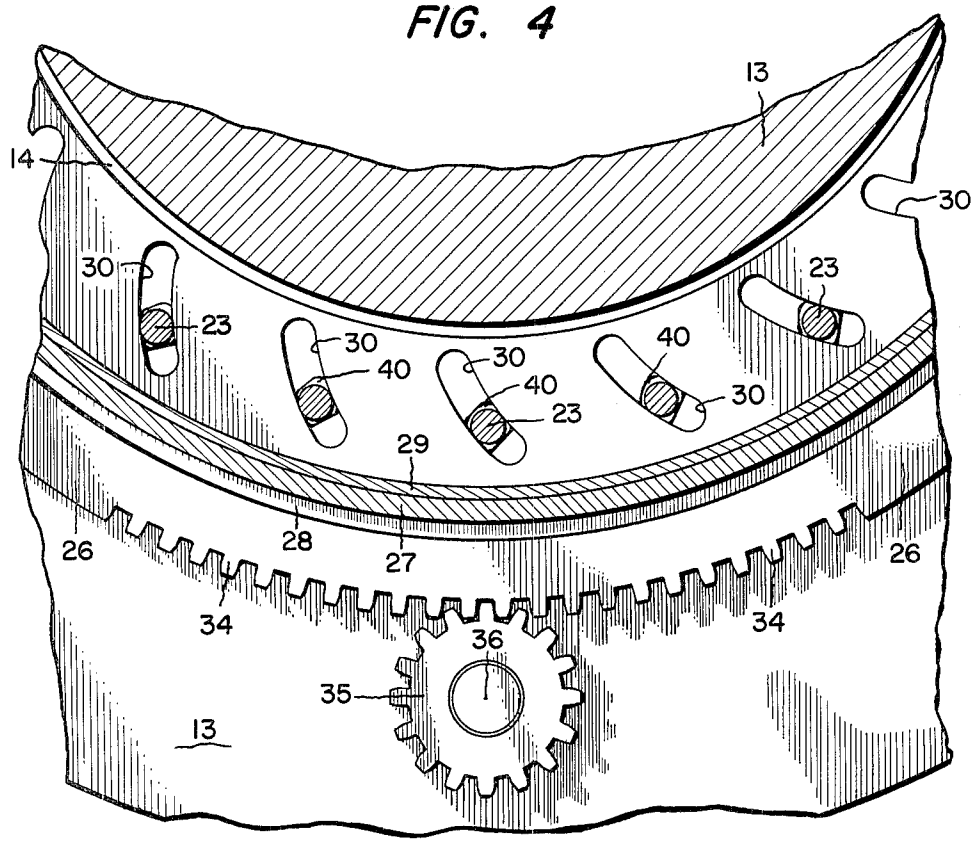
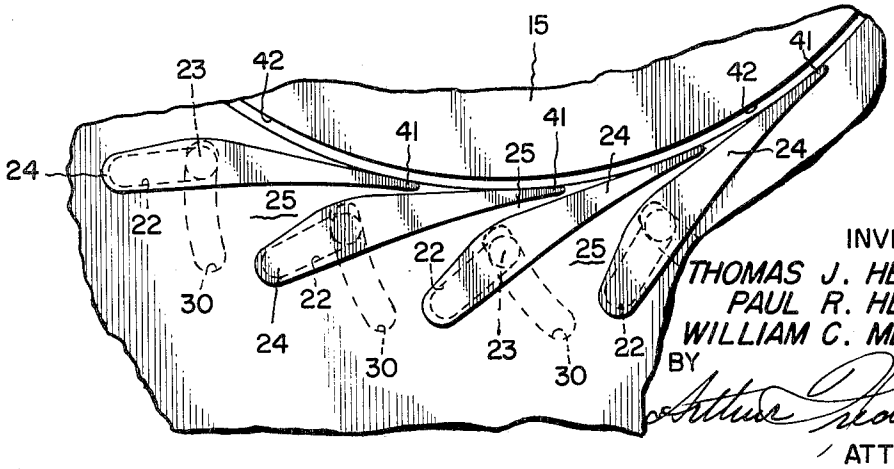


FIG. 5



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United States Patent Office 3,243,159 Patented Mar. 29, 1966

3,243,159

GUIDE VANE MECHANISM FOR CENTRIFUGAL FLUID-FLOW MACHINES

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Filed Apr. 27, 1964, Ser. No. 362,757
8 Claims. (Cl. 253—122)

This invention relates to centrifugal fluid-flow machines, such as turbines and compressors, and more particularly to adjustable guide vane mechanisms to vary the angle or the throat area of the fluid passages defined by the guide vanes of the vane mechanism.

In the adjustable guide vane mechanisms it has been found desirable to provide means for moving the guide vanes so that each vane end maintains a constant-spaced relationship with the impeller of the centrifugal machine. One such adjustable guide vane mechanism is shown in U.S. Patent No. 2,985,427. It is also desirable for the maximum efficiency of the centrifugal machine that the guide vane mechanisms be of such construction that it presents no interference with or obstruction to the flow of the fluid through the gas passages between the guide vanes in the nozzle area of a turbine or the diffuser assembly in the case of a compressor.

Accordingly, it is an object of the present invention to provide an adjustable guide vane mechanism for centrifugal machines, which mechanism presents no interference with or obstruction to the fluid flow in the gas passage channels of the machines.

It is another object of this invention to provide an adjustable guide vane mechanism of a relatively simple and inexpensive construction and having a minimum number of parts that are subject to wear, which mechanism is capable of moving a plurality of guide vanes so that one of each vane remains a predetermined distance from an impeller.

A further object of the present invention is to provide an adjustable guide vane mechanism for a centrifugal fluid-flow machine wherein the likelihood of the jamming of the guide vane mechanism due to dirt particles and other deleterious matter entrained in the fluid is minimized.

The above and other objectives and advantages of this invention will appear more fully hereinafter from a consideration of the detailed description which follows when taken together with the accompanying drawings wherein one embodiment of the invention is illustrated.

FIG. 1 is a fragmentary view, in cross section, of a turbine having an adjustable guide vane mechanism according to this invention;

FIG. 2 is an enlarged fragmentary view of the lower portion of the adjustable guide vane mechanism shown in FIG. 1;

FIG. 3 is a fragmentary cross-sectional view taken substantially along line 3—3 of FIG. 2;

FIG. 4 is a fragmentary cross-sectional view taken substantially along line 4—4 of FIG. 3;

FIG. 5 is a view, similar to FIG. 3, showing another extreme operative position of the adjustable guide vane mechanism; and

FIG. 6 is a perspective view of a guide vane according to this invention.

Now, referring to the drawings and more particularly to FIG. 1, 10 generally designates an adjustable guide vane mechanism according to this invention incorporated in a turbine 11.

The turbine comprises a volute or scroll-shaped housing having one wall 12 secured to a mounting plate 13. Wall 12 and plate 13 define a centrally located impeller

chamber 14 in which is disposed an impeller 15. Impeller 15 is connected to a shaft 16 which is journaled in a bearing support wall 17 suitably bolted to mounting plate 13. An outlet connection 18 is secured to wall 12 in coaxial relationship with impeller 15.

Adjustable guide vane mechanism 10 includes a ring-shaped vane support plate 19 which is held in mounting plate 13 coaxial to impeller 15 and in spaced relation to wall 12 to define with the latter an annular fluid passage 20. Fluid passage 20 communicates the scroll inlet chamber 21 with impeller chamber 14 to conduct the fluid under pressure from inlet chamber 21 to the vanes of impeller 15. Support plate 19 is provided with a plurality of circumferentially spaced slots 22 (see FIGS. 3 and 5) adjacent impeller chamber 14. Each of the slots 22 extends at an angle with respect to the radii of plate 19 and is dimensioned to receive therethrough the actuating pin or shank portion 23 of the guide vanes 24 which are disposed within passage 20. Guide vanes 24 form between the adjacent guide vanes a plurality of subpassages 25 within the throat area of fluid passage 20.

To provide for the actuation of each of guide vanes 24 to vary the size of subpassages 25 and thereby control the flow of the pressurized fluid into impeller 15, a drive ring 26 is mounted on support plate 19. Drive ring 26 is supported for rotative movement relative to support plate 19 on an annular flange 27 which is formed integral with and projects from the surface of the support plate into an annular groove 28 in the adjacent surface of drive ring 26. Flange 27 is provided with a bearing ring 29. As best shown in FIG. 4, drive ring 26 is provided with a plurality of circumferentially spaced, arcuate-shaped camming slots 30. Each of the camming slots 30 is positioned to intersect and register with a slot 22 in support plate 19 and is dimensioned to receive pin or shank portion 23 of guide vane 24 therethrough. Drive ring 26 is held adjacent to support plate 19 by the resilient retaining rings 31 which bias drive ring 26 in a direction toward vanes 24 and draw guide vanes 24 into abutment against plate 19 so as to minimize the possibility of foreign particles passing from passage 20 into and through slots 22. Each of the retaining rings 31 is disposed on shank portion 23 of guide vane 24 between a washer 32 which bears against drive ring 26 and the head 33 of shank portion 23. To provide for the rotation of drive ring 26, the drive ring is provided with a gear segment 34 which meshes with a pinion 35.

Pinion 35 is supported for rotation on a shaft 36 which is journaled in mounting plate 13. At the end of shaft 36 opposite from pinion 35, a worm gear 37 is secured in meshing relation to a worm 38. Worm 38 is rotated by any suitable means (not shown), such as a motor or a mechanical assembly. A suitable packing 39 is provided around shaft 36 to prevent leakage along the shaft.

In order to provide for the pivotal movement of each of the guide vanes 24, each shank portion 23 of guide vanes 24 is provided with an integral camming "shoe" 40 which is dimensioned and shaped to slide between the opposite arcuate-shaped sides of slot 30 (see FIG. 4).

The relative positions of slots 30 and 22 are such that guide vanes 24 may be moved toward and away from each other to vary the size of subpassages 25 without changing the distance of the vane ends 41 from the peripheral surface 42 of impeller 15 or the axis of impeller 15.

In the operation of guide vane mechanism 10, if it is assumed that drive ring 26 rotates in a counterclockwise direction as viewed in FIGS. 3 and 4, slots 30 cam the guide vanes 24 inwardly toward peripheral surface 42 of the axis of impeller 15 and simultaneously tend to pivot or rotate the guide vanes clockwise so that vane

ends 41 tend to move outwardly away from peripheral surface 42 of the axis of impeller 15, but guide vanes 24 are simultaneously moved toward peripheral surface 42 or the axis of the impeller by the camming action of slots 22 on shank portions 23 to the same extent that the guide vanes tend to move away from peripheral surface 42. This combination of simultaneous rotation and linear movement of the guide vanes results in maintaining each of the vane ends 41 of the guide vanes at a constant distance from peripheral surface 42 of the axis of impeller 15.

In the operation of adjustable guide vane mechanism 10, to vary the size of subpassages 25 between guide vanes 24—as, for example, from the position shown in FIG. 4 to the closed position shown in FIG. 5—shaft 36 is rotated in a counterclockwise direction by the rotation of worm 38 and worm gear 37 through suitable means (not shown). The rotation of shaft 36 effects the rotation of drive ring 26 through the meshing relationship of pinion 35 with gear segment 34 of drive ring 26. The counterclockwise rotation of drive ring 26, as previously explained, causes guide vanes 24 to move closer together and to the position shown in FIG. 5 without changing the distance of vane ends 41 from the peripheral surface 42 or the axis of the impeller. To increase the spacing between guide vanes 24 or the size of subpassages 25, drive ring 26 is rotated in a clockwise direction as viewed in FIGS. 3, 4, and 5.

It is believed now readily apparent that the present invention provides a novel adjustable guide vane mechanism having relatively few parts that are subject to wear. It is also an adjustable guide vane mechanism wherein the components thereof do not interfere with the free flow of the fluid in the throat area of fluid passage 20. In addition, the mechanism does ont expose any spaces to passage 20 through which dirt and/or other deleterious matter might pass and cause jamming of the mechanism. FIGS. 3 and 5 clearly show guide vanes 24, in any adjusted position, cover slots 22 in support plate 19 and abut support plate 19 in sealing relationship with the latter.

Although but one embodiment of the invention has been illustrated and described in detail, it is to be expressly understood that the invention is not limited thereto. Various changes can be made in the arrangement of parts without departing from the spirit and scope of the invention, as the same will now be understood by those skilled in the art.

We claim:

1. A guide vane mechanism for a centrifugal fluid-flow machine having an impeller and a plurality of walls defining a fluid-flow passage communicating with the impeller, comprising

(a) a plurality of guide vanes disposed in the fluid-flow passage,

(b) a plurality of spaced slots corresponding in number to the number of guide vanes in one of said walls defining said fluid-flow passage,

(c) each of said guide vanes having an actuating pin projecting through one of said slots,

(d) a drive ring supported for rotative movement adjacent said one of said walls defining said fluid-flow passage,

(e) said drive ring having a plurality of spaced camming slots,

(f) each of said camming slots extending so as to intersect and register with a slot in said one of said walls defining said fluid-flow passage and receiving the actuating pin projecting through its respective intersected and registered slot, said camming slots and said slots in said one of said walls defining said fluid-flow passage being arranged to permit movement of said guide vanes relative to each other without changing the distance of one end of each of said guide vanes from the axis of said impeller, and

(g) a drive means for rotating said drive ring relative to said one of said walls defining said fluid-flow passage to simultaneously move all the guide vanes relative to each other.

2. The apparatus of claim 1 wherein each of said slots in said one of said walls defining the fluid-flow passage extends at an angle with respect to the radii of the impeller and is longitudinally substantially parallel to the guide vane associated therewith to be constantly covered by the guide vane associated therewith.

3. The apparatus of claim 2 wherein means resiliently urge said guide vanes towards said one of said walls defining said fluid-flow passage to form a fluid tight seal between said guide vanes and said one of said walls.

4. In combination with a centrifugal fluid-flow machine having a casing forming a volute chamber communicating with an impeller through an annular passage, a guide vane mechanism comprising

(a) a support plate secured in said casing to form one wall of said annular passage,

(b) said support plate having a plurality of circumferentially spaced slots adjacent the impeller, said slots each extending at an angle relative to the radii of said impeller,

(c) a plurality of guide vanes corresponding in number to the number of slots and disposed in said annular passage,

(d) a drive ring mounted on said support plate for rotative movement relative to the latter,

(e) said drive ring having a plurality of circumferentially spaced camming slots, each of which extends to intersect and register with a slot in said support plate, said camming slots each extending arcuately relative to the radii of said impeller,

(f) each of said guide vanes having a pin laterally extending therefrom and projecting through a registered slot and a camming slot, and

(g) a means for rotating said drive ring to thereby simultaneously move all the guide vanes relative to each other to control the flow of the fluid in said passage.

5. The mechanism of claim 4 wherein the longitudinal axis of each of said registered slots substantially coincides with the longitudinal axis of the respective guide vane associated therewith.

6. The mechanism of claim 5 wherein means resiliently urge each of said guide vanes towards said support plate to form a fluid tight seal between said guide vanes and said support plate to prevent fluid leakage through said slots in said support plate.

7. A guide vane mechanism for a centrifugal fluid-flow machine including a casing, an impeller chamber within said casing, an impeller within said impeller chamber for rotation therein, a volute chamber within said casing, and an annular passage within said casing communicating said impeller chamber with said volute chamber, the guide vane mechanism comprising:

(a) a ring-shaped support plate secured in said casing to form one wall of said annular passage,

(b) said support plate having a plurality of circumferentially spaced slots adjacent said impeller, said slots extending towards and at an angle to the radii of said impeller,

(c) a plurality of guide vanes corresponding in number to the number of slots and disposed in said annular passage, the longitudinal axis of said guide vanes extending substantially parallel to and upon the longitudinal axis of said slots,

(d) a drive ring having a concentric circular groove in one face thereof,

(e) a concentric circular flange projecting from the face of said support plate and dimensioned to project into the circular groove in the drive ring to rotatively support the latter,

(f) said drive ring having a plurality of circumferentially spaced camming slots, each of which extends to intersect and register with a slot in the support plate, said camming slots each extending arcuately towards the radii of said impeller,

(g) an actuating pin projecting laterally from each of said guide vanes and through a pair of registered slots, and

(h) a gear means for rotating said drive ring relative to said support plate to simultaneously move all the guide vanes relative to each other without changing the distance of one end of each of the guide vanes from the axis of the impeller.

8. The apparatus of claim **7** wherein means resiliently bias each of said guide vanes individually towards said support plate to provide a fluid tight seal between each of said guide vanes and said support plate.

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