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[54] **CENTRIFUGAL MACHINE**

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[58] **Field of Search** 416/155, 156; 415/129, 415/130, 140, 141

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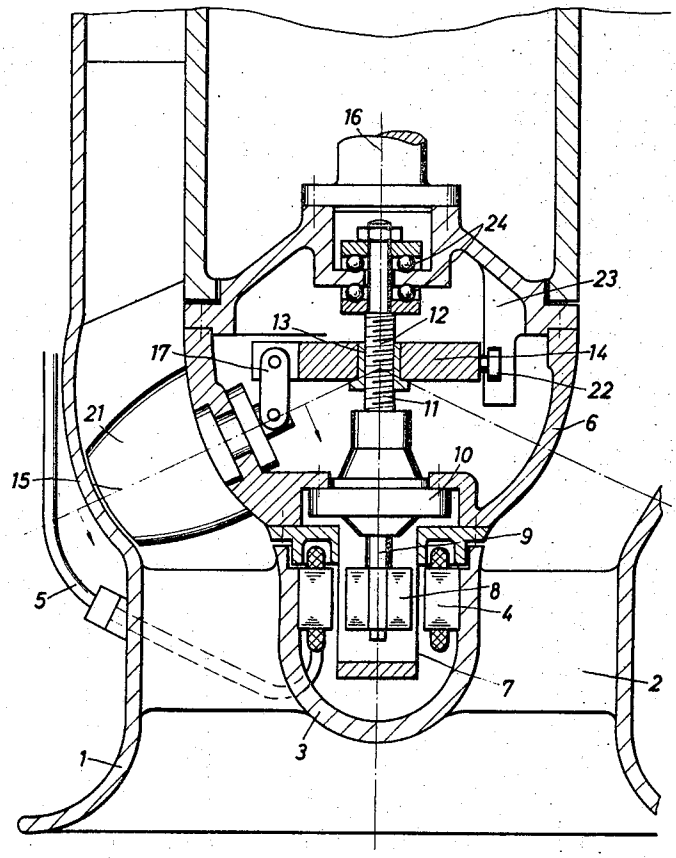
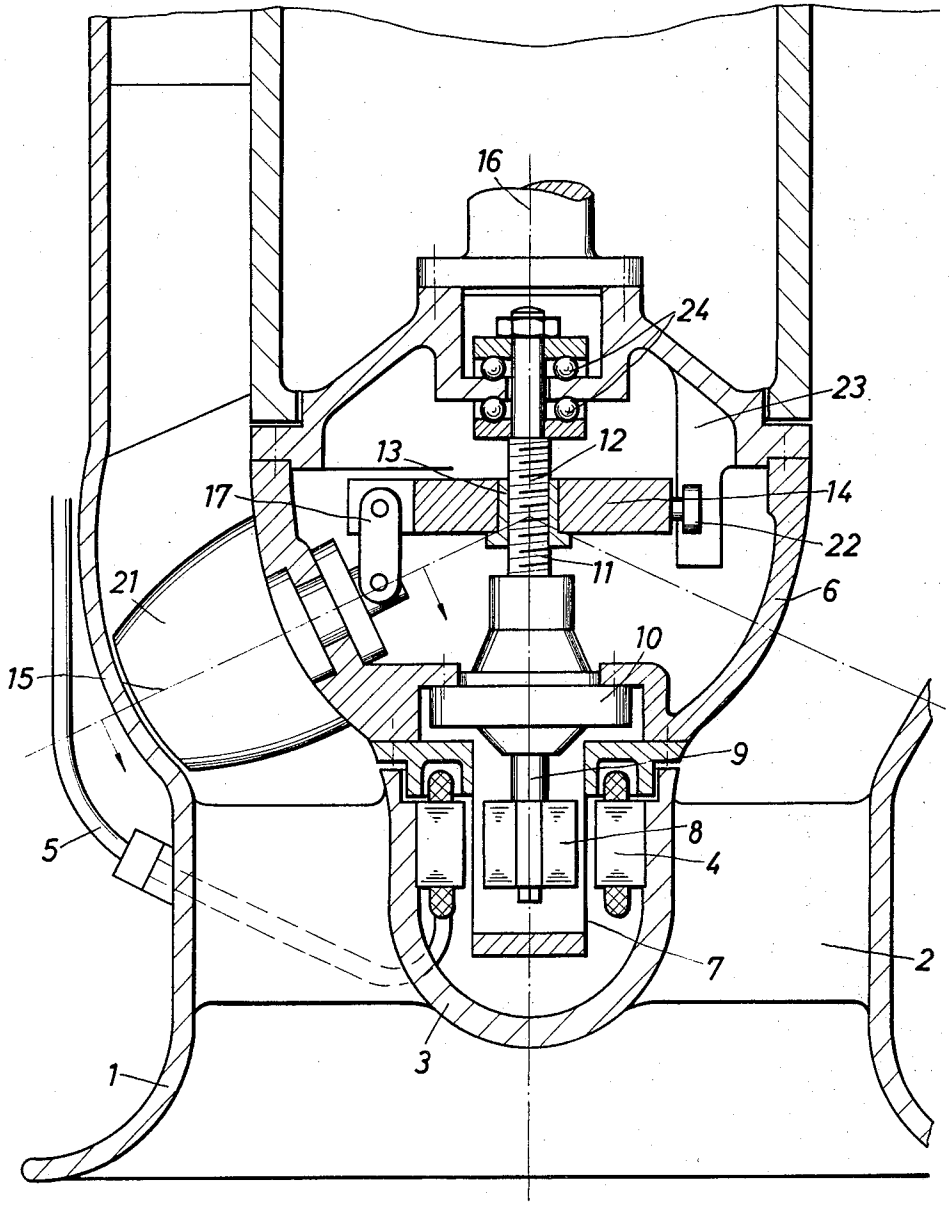
[57] **ABSTRACT**

A centrifugal machine, such as a centrifugal pump, has a support and a propeller shaft which is rotatably mounted on the support. A plurality of propeller vanes are mounted on the propeller shaft for rotation with the same and can be moved between at least two inclined positions relative to the axis of the propeller shaft. An arrangement is provided for moving the vanes between their positions, and a drive is provided for activating this arrangement. The drive includes a drive shaft coaxial with the propeller shaft and rotatable relative to the same, being connected to the adjusting arrangement. A rotor of an electromotor is mounted on the drive shaft for rotation with the same and a stator surrounds the rotor and is mounted on the support. A sleeve is mounted on an end portion of the propeller shaft for rotation with the same, and this sleeve is interposed between and out of contact with the stator and the rotor and fluid-tightly surrounds the latter.

5 Claims, 1 Drawing Figure

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CENTRIFUGAL MACHINE

BACKGROUND OF THE INVENTION:

The present invention relates generally to a centrifugal machine, and more particularly to a centrifugal machine constructed as a centrifugal pump of vertical type.

It is already known to construct apparatus of this type, and in particular to provide an arrangement for varying the inclination of the propeller vanes with reference to the axis of the propeller shaft on which they are mounted. Such construction is, for instance, disclosed in German allowed application Pat. No. 2,015,112, to which reference may be had for details of the construction and operation. It is also known to electrically perform this adjustment of the vanes with reference to the axis of the propeller shaft, for instance from German allowed application Pat. No. 1,528,841 to which reference may also be had for further details.

This type of apparatus has the advantage that the entire arrangement for adjusting the inclination of the vanes is located close to the latter, and requires only a small amount of space. It eliminates further the use of a special coupling with a built-in motor for carrying out the adjustment of the vanes, and with a gear drive, which were heretofore required and had to be separately installed. Also, the use of long mechanical connecting elements, such as rods or sleeves with the corresponding couplings, is avoided, and the propeller shaft itself can be of solid cross-section rather than hollow as was necessary in the previous constructions.

There is, however, still one aspect in which the otherwise satisfactory prior-art approach should be further improved. This is the fact that the provision of the electromotor for adjusting the inclination of the vanes increases the axial length of the centrifugal machine, as compared to the length of the same machine which is not provided with such an adjusting arrangement. This means that the propeller shaft and the casting for the hub must be different in both instances, that is it is impossible to use identical components in both cases. Evidently, this is undesirable in terms of manufacturing economy and stock-keeping requirements. Also, it is necessary to provide slip rings and brushes or analogous components to supply electric energy to the motor for adjusting the inclination of the vanes, and of course the electrical components must be insulated with respect to the medium which is being pumped and provision must be made for protecting them against excessive wear.

SUMMARY OF THE INVENTION

Accordingly, it is a general object of the present invention to provide the aforementioned further improvements.

More particularly, it is an object of the present invention to provide an improved centrifugal machine, particularly an upright centrifugal pump, which incorporates these improvements.

In keeping with the above objects, and others which will become apparent hereafter, one feature of the invention resides, in a machine of the character which is described herein, in a combination comprising a support and a propeller shaft rotatably mounted on the support and having an end portion. A plurality of propeller vanes is mounted on the propeller shaft for rotation with the same and also for movement between at least two inclined positions relative to an axis of the propeller shaft. Moving means is provided for effecting the movement of the vanes between their positions, and drive means is provided for driving the moving means. The drive means includes a drive shaft coaxial with the propeller shaft and rotatable relative to the same. The drive shaft is connected to the moving means. A rotor is mounted on the drive shaft for rotation with the same, and a stator surrounds the rotor and is mounted on the support. A sleeve is mounted on the end portion of the propeller shaft for rotation with the same, and is interposed between and out of contact with the stator onto the rotor, the latter of which it surrounds in fluid-tight relationship.

Utilizing the construction according to the present invention, it is now possible to use the casting for the hub and the propeller shaft both in a centrifugal pump which is not provided with an arrangement for adjusting the inclination of the vanes, and in a pump which has such an arrangement. In other words, because the arrangement according to the present invention does not increase the dimensions of the pump, the aforementioned components can be of one and the same size for both types of pumps.

Moreover, the construction according to the present invention omits the necessity for supplying electrical energy to the electromotor by means of slip rings, and thus avoids the disadvantages attendant thereto. The provision of the sleeve, which does not participate in any movements during changing of the inclination of the vanes, reliably precludes any access of medium being pumped to the components which are to be protected. Moreover, if the medium is of the type which contains solid particles, for instance sand contained in sea water or the like, then damage to the various components of the drive means due to contact with such particles is reliably avoided by the presence of the sleeve. Such damage might result in a blocking and destruction of the drive if the sleeve were not arranged in the manner disclosed herein.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The single FIGURE is a fragmentary vertical section through a centrifugal pump embodying the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The embodiment illustrated in the FIGURE shows the invention on hand of a centrifugal pump of the axial type, having a vertical propeller shaft. The pump has a suction nozzle **1** which is provided with a cross-shaped member **2** serving as a guide and flow rectifier for the incoming liquid being pumped. The member **2** has a hollow hub **3** which constitutes a support on which the stator **4** of an electromotor is mounted. Electrical en-

ergy is supplied from the exterior via a cable **5** through a hollow rib of the member **2.**

A thin-walled hollow cylinder or sleeve **7** is provided on the propeller hub **6,** with which it is concentric and to which it is fluid-tightly secured. The sleeve **7** rotates with the hub **6** and is located between but out of contact with the stator **4** and the cage rotor **8,** which latter is located within the confines of the stator **4.** The rotor **8** is mounted on an elongated drive shaft **9** of a coaxial step-down gear **10** which is also mounted in the hub **3,** and the shaft portion **11** of which is configurated as a screw having self-locking threads which cooperate with the internal threads of a spindle nut **13** which is fixedly mounted in a cross-mount **14.** The latter is movable only axially of the shaft **11,** in dependence upon the turning of the latter and in dependence upon the inclination which it is to impart to the axis **15** of the propeller vanes with respect to the longitudinal axis of rotation **16** of the propeller shaft. A connection between the cross-mount **14** and the propeller vanes **21** can be carried out by means of the double-pivoted lug **17** which can pivot about the pivot points **17***a* and **17***b*, or by other means. Thus, when the shaft **11** is turned by the electromotor, the crossmount **14** is moved via the nut **13** and changes the inclination of the axes **15** of the respective vanes **21** with respect to the axis of rotation **16.**

Rotation of the cross-mount **14,** which is supposed to move only axially, is prevented in suitable manner. In the illustrated embodiment, a roller **22** is provided on the cross-mount **14** and engages in an axially extending guide recess **23.** Of course, two or more such rollers or analogous components can be provided, and each can be arranged to cooperate with its own guide recess **23.**

The large axial forces and the small radial forces which act in the pump are taken up by a double-acting bearing **24,** preferably a roller bearing.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in a centrifugal machine, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can be applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. In a machine of the character described, a combination comprising a support; a propeller shaft rotatably mounted on said support and having an end portion; a plurality of propeller vanes mounted on said propeller shaft for rotation therewith and for movement between at least two inclined positions relative to an axis of said propeller shaft; moving means for effecting movement of said vanes between said positions; and drive means for said moving means, including a drive shaft coaxial with said propeller shaft and rotatable relative to the same and connected to said moving means, a electric rotor mounted on said drive shaft for rotation therewith, a electric stator surrounding said rotor and mounted on said support, and a sleeve mounted on said end portion of said propeller shaft for rotation with the same, said sleeve being interposed between and out of contact with said stator and rotor and fluid-tightly surrounding the latter.

2. A combination as defined in claim **1**; further comprising a spoked flow-guiding element having a hollow hub, and wherein said sleeve, rotor and stator are at least partially located within the confines of said hub.

3. A combination as defined in claim **2,** wherein said support forms a suction nozzle, and said element is located in said nozzle.

4. A combination as defined in claim **1,** wherein said propeller shaft includes a casing mounted on and rotatable with said end portion and having an opening coaxial with said axis; said drive shaft extending through said opening and having one portion located within and another portion located without said casing, and said rotor being mounted on said other portion.

5. A combination as defined in claim **4,** wherein said sleeve is coaxial with said opening exteriorly of said casing, said sleeve having an open end in registry with said opening and sealingly connected with said casing, and a closed end remote from said open end.

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