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(54) Multistage pump for submersible electric pumps.

(57) A multistage pump for submersible electric pumps is described in which the axial anchoring and the centering of the stage body assembly are achieved by means of anchoring and centering elements consisting of projections (12a, 12c) provided in the outer casing (1) of the pump. This allows a more solid and economical construction and a simplification of the assembly and disassembly of the pump, with a reduction of the number of inner structural locking elements.

The floating-ring (24) sealing construction of the stage bodies (2) allows an improvement of the sealing effect and of the hydraulic performance.

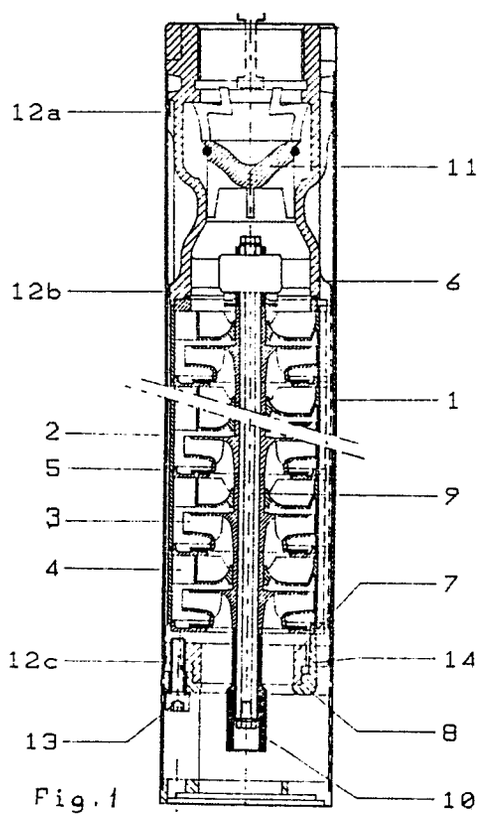

Fig. 1

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MULTISTAGE PUMP FOR SUBMERSIBLE ELECTRIC PUMPS

This invention relates to a multistage pump for submersible electric pumps, and more in particular to a multistage pump for submersible electric pumps with an improved system for the anchoring, centering and assembly of the stage bodies and of the related components.

In submersible pumps, intended to lift liquids from relatively great depths and therefore to develop a high head, the axial thrust exerted by the impeller of each stage on the adjacent stages and the sum of these thrusts applied to the motor shaft, as well as the delivery pressure, can reach considerable values such as to affect the structural concept and the mechanical design of the entire electric pump and of its assembly system.

It is known to axially stack within a tubular external pump casing of a submersible electric pump a plurality of elementary pump bodies hydraulically in series, each constituting a stage and formed by an impeller, a diffuser and a diffuser cover. In order to contain the abovementioned stresses, said elementary pump bodies, or stage bodies, stacked one atop the other, are secured within the outer tubular casing according to the prior art by various expedients, such as for example by means of external tension elements, or by means of threads inside the two ends of the outer tubular casing and upper and lower threaded plugs, or by means of elastic rings in adapted circular seats, or by enclosing in synthetic resin.

Each of these methods of the prior art has different disadvantages. Thus, for example, external tie elements, besides constituting an undesirable additional bulk outside the tubular casing, are also easily deformable, due to their considerable length, and cannot be easily protected against corrosion. Thread-type fixing systems are expensive due to the severe size tolerances required for the machining of threads and due to the complexity of their assembly and disassembly. Enclosure within resins allows neither repairs nor maintenance.

The aim of the present invention is therefore to eliminate the above described disadvantages and provide an improved system for the anchoring, centering and assembly of the stage bodies and of the related components, so as to allow, in particular, to reduce the machining and assembly and disassembly costs, and at the same time so as to increase the solidity, the centering and the hydraulic tightness of the structure of the pump.

This aim is achieved in a multistage pump for submersible electric pumps with an external tubular casing containing a plurality of stage bodies axially stacked atop one another within the outer casing, each stage body comprising an impeller, a diffuser, and a diffuser cover, characterized in that the assembly consisting of a plurality of stacked stage bodies is interposed between a pressure chamber, arranged on the delivery side, and a locking plate and a suction chamber, both arranged on the suction side, in that the outer casing is provided with a plurality of axial elements for axial anchoring and centering consisting of abutment and centering elements or projections, protruding radially towards the interior thereof and circumferentially spaced with respect to one another along at least two circumferences spaced axially along the outer casing and engaging in corresponding peripheral notches provided respectively in the pressure chamber and in the locking plate and in that the suction chamber is connected to the locking plate by means of fixing bolts, and is provided with pressure fingers which pass through corresponding openings in the locking plate so as to press on the stage body assembly in an adjustable manner depending on the tightness of the fixing bolts.

Conveniently, at least one further group of abutment and centering elements, or projections, identical to the ones previously described, is furthermore provided in the outer casing, and is arranged on at least one circumference which is axially intermediate and acts only radially, with a centering function.

This system for anchoring, centering and assembly allows to achieve a structure which is simpler and more solid and easier to assemble than the prior art, and in particular it allows to reduce the inner locking elements of the stage body assembly to only three (suction chamber, locking plate, pressure chamber) with respect to the six generally required according to the prior art (pressure chamber, shaft guide, two locking plates respectively for suction and for delivery, and suction chamber or motor coupling spider).

Conveniently, each stage body is provided as a sealed unit. This facilitates assembly and achieves greater solidity and greater safety in sealing against infiltrations and leakages of water.

These and other advantageous improvements and developments of the invention will become apparent from the following detailed description of a preferred embodiment, illustrated only by way of non-limitative example with reference to the accompanying drawings, wherein:

figure 1 is a longitudinal cross section view of the pump for submersible electric pumps according to the present invention, from which a central portion has been removed for convenience in illustration;

figures 2, 3 and 4 are respectively views of the position of the anchoring and centering projections in the outer casing, and an enlarged detail of a projection in longitudinal and transverse cross section;

figures 5 and 6 are respectively detail views, in cross section, of a stage body and of its floating ring.

figures 7 and 8 are respectively detail views, in cross section, of a stage body and of its floating ring.

With particular reference to figure 1, the pump for submersible electric pumps therein consists of: an outer tubular casing 1; a plurality of stage bodies 2 axially stacked one atop the other, each comprising an impeller 3, a diffuser 4 and a diffuser cover 5; a pressure chamber 6 on the delivery side; a locking plate 7 and a suction chamber 8 on the suction side. A shaft with hexagonal cross section is inserted in the hub of the impellers 3 and by means of the joint 10 it is coupled to the shaft of the electric motor (not shown).

At the periphery of the stage bodies 2, an axial recess 15 is provided to allow the passage of the motor power supply cable (not shown).

A one-way valve with a shutter 11 is contained in the pressure chamber. For the sake of simplicity, the other structural elements of the pump which are not significant with regard to the present invention are not considered in this specification.

The outer casing 1 is provided, on the delivery side, with axial anchoring projections 12a which engage in corresponding notches provided in peripheral ridges of the pressure chamber 6, with centering projections 12b engaged radially against the axially internal end of said pressure chamber, and with axial anchoring projections 12c on the suction side, engaged in corresponding notches of the locking plate 7. The fixing bolts 13 connect the suction chamber 8 to the locking plate 7. By tightening the bolts 13, the pressure fingers 14 of the suction chamber 8 which pass through corresponding openings of the locking plate 7 allow the compression of the assembly of the stage bodies 2 against the pressure chamber 6 axially anchored by the projections 12a, reacting on the locking plate 7 which is in turn anchored by the projections 12c. By virtue of this structure of the suction chamber 8, illustrated in detail in figures 5 and 6, said chamber also acts as a connecting spider for the motor (not shown).

The anchoring by means of projections according to the present invention features,has among the other previously mentioned advantages, that of allowing to obtain the outer casing from pipes commonly available on the market, having relatively ample tolerances, without requiring subsequent grinding, since the centering is made by the projections.

The stage bodies 2 are preferably made of molded plastic material, loaded with glass fibers. In each stage body, the joint 20 (figure 7) between the diffuser 4 and the diffuser cover 5 is preferably sealed by electric welding or ultrasonic welding. The cover 5 of the diffuser is furthermore composed of two substantially annular parts 21 and 22 which are welded to one another, a ring 24 provided in its outer edge with an extension or axial ring 25 matingly coupled above the mouth of the impeller 3 (figures 7 and 8) being provided freely floating in an interspace 23 of said parts 21 and 22.

This construction allows a more compact structure, an improved hydraulic seal between one impeller and the other of the stages, and an improved hydraulic and mechanical performance by virtue of the play existing between the diffuser cover 5 and the floating ring 24.

Naturally, numerous modifications and variations of the present invention are possible according to the preceding description. It is therefore assumed that the invention can be embodied differently with respect to what has been specifically described.

Claims

1. Multistage pump for submersible electric pumps with an external tubular casing (1) containing a plurality of stage bodies (2) axially stacked atop one another within the outer casing, each stage body (2) comprising an impeller (3), a diffuser (4), and a diffuser cover (5), characterized in that the assembly consisting of a plurality of stacked stage bodies (2) is interposed between a pressure chamber (6), arranged on the delivery side, and a locking plate (7) and a suction chamber (8), both arranged on the suction side, in that the outer casing (1) is provided with a plurality of elements for axial anchoring and centering (12a, 12c) consisting of abutment and centering elements or projections, protruding radially towards the interior thereof and circumferentially spaced with respect to one another along at least two circumferences spaced axially along the outer casing (1) and engaging in corresponding peripheral notches provided respectively in the pressure chamber (6) and in the locking plate (7) and in that the suction chamber (8) is connected to the locking plate (7) by means of fixing bolts (13), and is provided with pressure fingers (14) which pass through corresponding openings in the locking plate (7) so as to press on the stage body assembly in an adjustable manner depending on the tightness of the fixing bolts.

2. Multistage pump according to claim 1, characterized in that at least one further group of said abutment and centering elements, or projections, is furthermore provided in the outer casing (1), and is arranged on at least one circumference which is axially intermediate, acting only radially with a centering function (12b).

3. Multistage pump according to claim 1 or 2, characterized in that the abutment and centering elements or projections (12a, 12b, 12c) are provided in the outer casing (1) by punching.

4. Multistage pump according to one of the preceding claims, characterized in that the joint between the diffuser (4) and the diffuser cover (5) in each of the stage bodies (2) is sealed, containing the impeller in its interior.

5. Multistage pump according to claim 4, characterized in that the diffuser cover (5) consists of two substantially annular parts (21, 22) sealed to one another, within which is enclosed a ring (24) which freely floats in an interspace (23) formed between said two parts, the ring (24) being provided in its inner perimeter with an axial ring (25) which can be matingly coupled over the impeller inlet (3).

6. Multistage pump according to claims 4 and 5, characterized in that the seal between the diffuser (4) and the diffuser cover (5) and between the two parts (21, 22) of the diffuser cover (5) is achieved by ultrasonic welding.

7. Multistage pump according to claims 4 and 5, characterized in that the seal between the diffuser (4) and the diffuser cover (5) and between the two parts (21, 22) of the diffuser cover (5) is achieved by electric welding.

8. Multistage pump according to one of the preceding claims, characterized in that the suction chamber (8) with pressure fingers (14) performs the double function of compression of the stage body assembly (2) and of spider for connection to the motor.

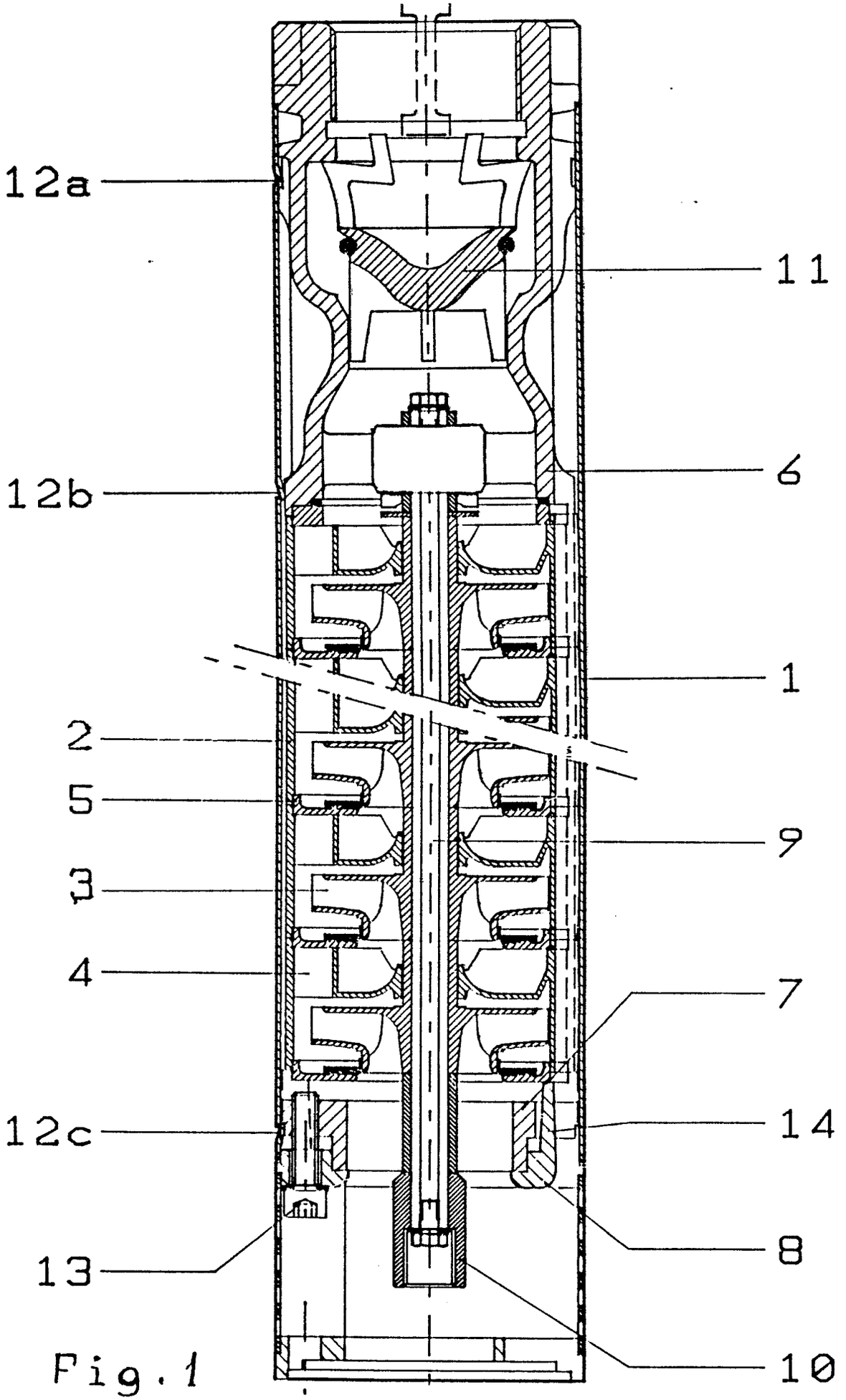

Fig. 1

Fig.3

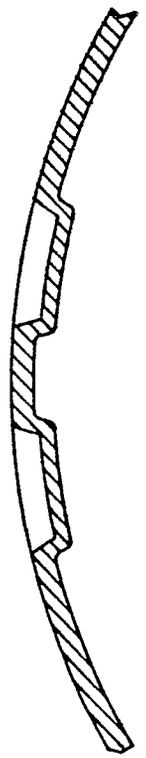

Fig.4

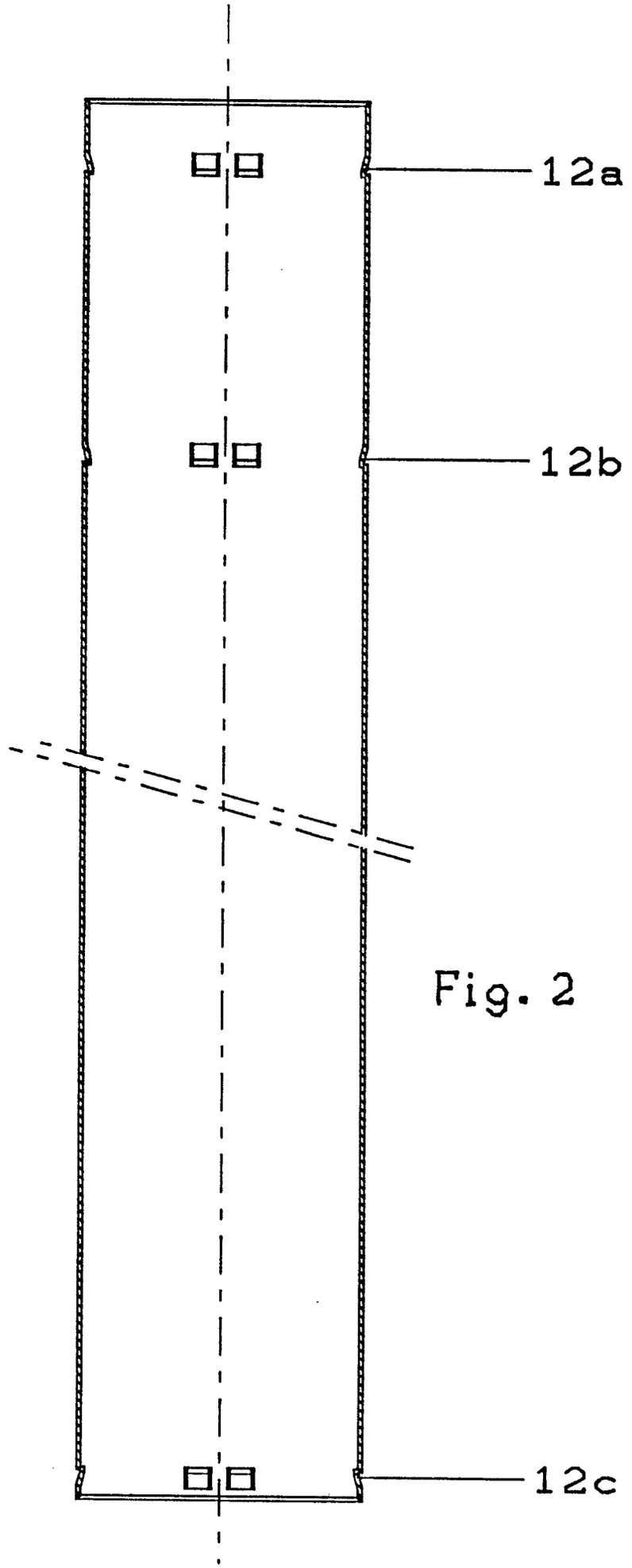

Fig. 2

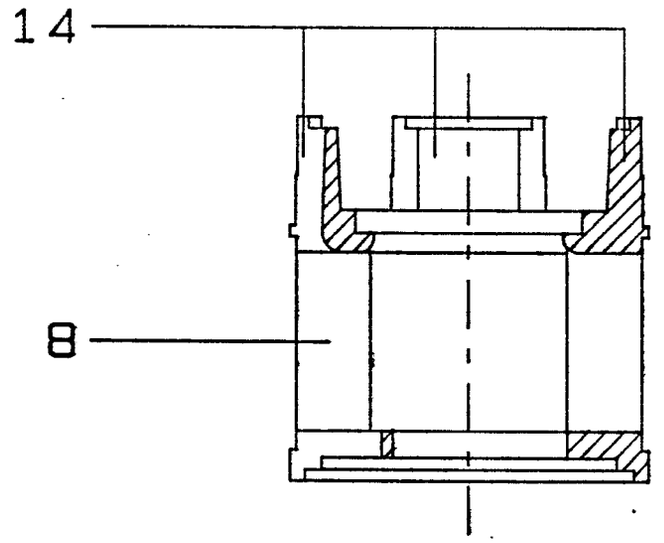

Fig.5

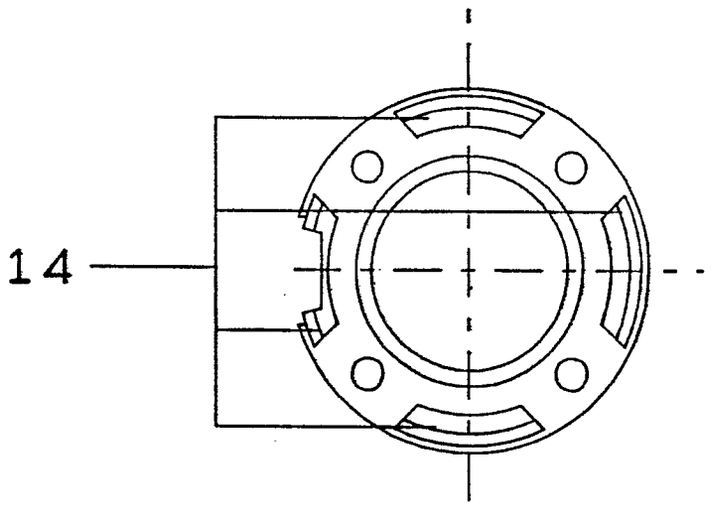

Fig.6

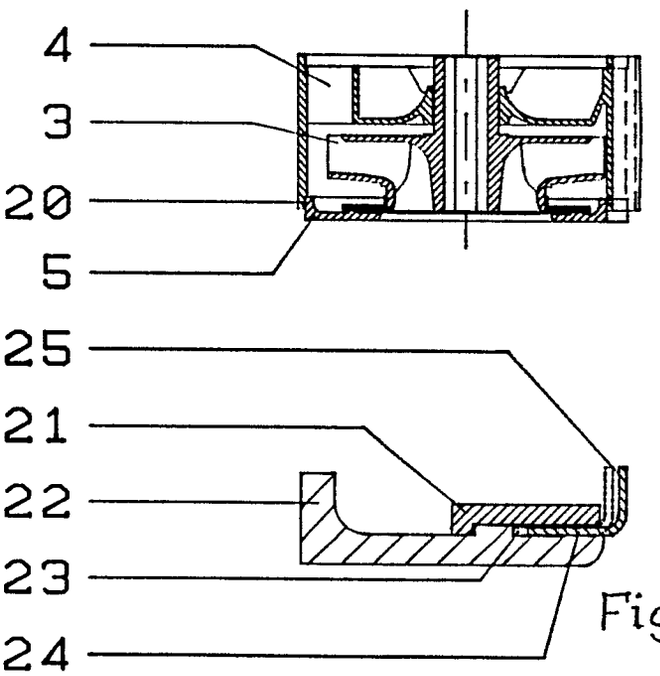

Fig.7

Fig.8