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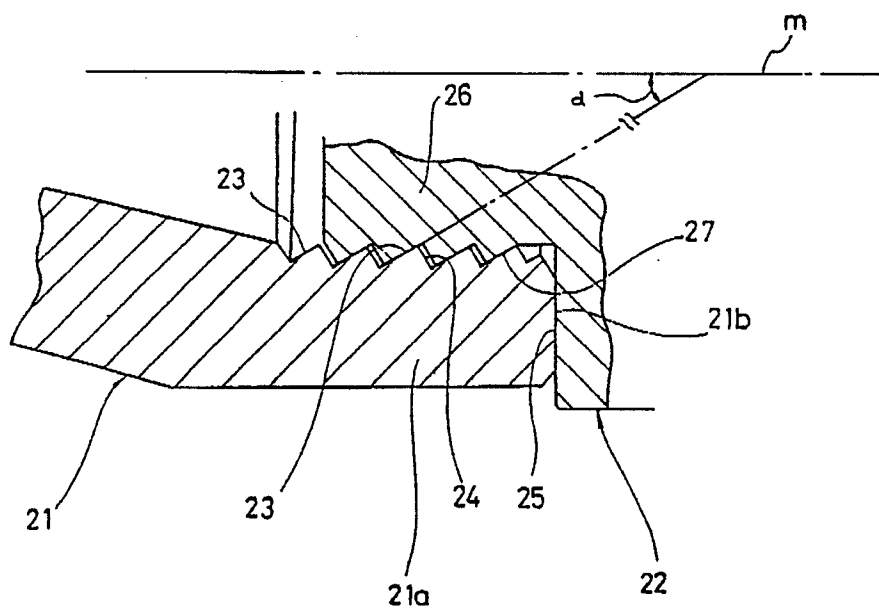
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(54) Fluid energy converter.

(57) In a fluid pump or motor, particularly one of the radial piston type, a main casing 21 is screwed to an end cover 22 by a mating helical screw formation using a taper plane 23 which is at an angle α of less than 45° to the axis m . An external thread in the boss 26 of the cover 22 is screwed into the internal thread of the part 21a until surfaces 21b and 25 are engaged to determine the axial position.

FIG. 4



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Fluid energy converter.

Background of the Invention

This invention to a fluid energy converter used as fluid pump or fluid motor. In general radial piston type liquid pressure pump/motor, or special liquid pressure pump/motor stated below, a rear cover is fitted to the opening end of its casing, and a cylinder barrel disposed within said casing is supported on this rear cover by way of an eccentric pintle. In such constitution, due to the effects of working fluid at high pressure, a large misaligning force in the radial direction may occur between said casing main body and rear cover. What is more, smooth operation is spoiled unless the casing and the rear cover are coupled in a correctly positioned state.

Conventionally, therefore, a spigot was provided between the casing main body and the rear cover, and a flange coupling part was disposed at its outer side, and the two parts are accurately coupled together by placing a bolt or other fixing means in this flange coupling part.

However, in order to keep a high positioning precision at the spigot, machining a high precision is required, but when the precision is too high, it is hard to fit the two parts with each other. Besides, since the flange coupling part must be provided at the outer side of the spigot, the casing outside dimension increases, and it is hard to design compactly. In particular, when two sets of such fluid energy transducer are placed side by side, and one is used as the pump and the other as motor, that is when composing a unitized HST or HMT system transmission by fluid energy converters, the entire structure becomes very large due to the bulkiness in the direction of diameter of the both parts.

This invention is therefore intended to solve these problems securely and easily.

Brief Summary of the Invention

This invention, in order to achieve said object, is characterized by the screw-fitting structure by the helical taper plane provided in the coupling part of the casing main body and cover.

That is, the fluid energy transducer of this invention is composed by helically forming a taper plane at an angle of 45° or less with respect to the axial center on the inner circumference or outer circumference of the opening end part of the casing main body, forming a helical taper plane at a same angle as said taper plane on the cover and a

stopping plane to stop the opening end of the casing main body, and screwing the taper plane forming part of the casing main body up to the position where the opening end is stopped on said stopping plane.

In such constitution, by screwing the cover having a helical taper plane having a same angle into the outer circumference or inner circumference of the opening end of the casing main body helically forming a taper plane, and tightening until the opening end of the casing main body abuts against the stopping plane, the taper plane of the casing main body rides on the taper plane of the cover in tight contact. As a result, the taper guide action is exhibited, and the cover and casing main body are positioned in specified state. Thus, in this state, the gap between the casing main body and cover in the radial direction is completely eliminated.

Moreover, since these taper planes are slightly inclined at 45° or less with respect to the axial center, the taper plane of the cover will hardly slide along the taper plane of the casing main body if a load is applied in the radial direction. Accordingly, due to the effects of the fluid pressure, if a misaligning force should occur in the radial direction between the casing main body and cover, the two parts will never be dislocated.

Besides, since the taper planes are formed helically the casing main body and cover may be coupled by a simple operation similar to screw fitting. Still more, by fitting the opening end of the casing main body on the stopping plane of the cover, the positioning of the two parts in the axial direction may be accurately achieved.

Therefore, in such construction, without using spigot and flange coupling part, the casing main body and cover can be securely and accurately joined together.

Brief Description of the Drawings

Fig. 1 to Fig. 5 relate to an embodiment of this invention, in which Fig. 1 is a longitudinal sectional view, Fig. 2 is a sectional view of II-II in Fig. 1, Fig. 3 is a lateral sectional view, Fig. 4 is a partial sectional view showing a magnified view of arrow IV part in Fig. 1, and Fig. 5 is an explanatory diagram showing the mode of use. Fig. 6 is an explanatory diagram corresponding to Fig. 5 to indicate a prior art.

Detailed Description of the Invention

Referring now to Fig. 1 to Fig. 5, a preferable embodiment of this invention is described in details below.

The fluid energy converter shown in Fig. 1 to Fig. 3 has a structure as disclosed in the Japanese Laid-open Patent No. 58-77179. That is, this energy converter is composed of casing 1, a torque ring 4 possessing inner flat planes 3 respectively at the inside of the positions corresponding to plural first static pressure bearings 2 rotatably fitted relatively through said static pressure bearings 2 provided on the inner circumference 1a of this casing, plural pistons 6 being disposed inside of this torque ring 4 with its end fitted to said inner flat planes 3 through second static pressure bearings 5, a cylinder barrel 8 holding these pistons 6 in a slidable manner and forming a free space 7 for entry and discharge of fluid in these pistons 6, a pintle 9 for rotatable supporting said cylinder barrel 8 being disposed reciprocatably in the direction orthogonal to the axial center m of said casing 1 and torque ring 4, and fluid passages 11, 12 forming a pair to communicate with the space 7 of which volume is increased and with the space 7 of which volume is decreased when the casing 1 and torque ring 4 are relatively rotated with the axial center n of this pintle deviated from the axial center m of the casing. In this setup, the fluid to fill up said spaces 7 is led into corresponding first and second static pressure bearings by way of the fluid passages 13, 14, and it is designed to develop a couple in the torque ring 4 around the rotation axial center m by the static pressure of the fluid led into the first static pressure bearing 2 and the static pressure of the fluid led into the second static pressure bearing 5.

In this construction, thus, with the axial center n of pintle 9 deviated from the rotation axial center m, when a high pressure fluid is supplied into the space 7 existing in the right region A in Fig. 3, through, for example, the first fluid passage 11, a couple to rotate the torque ring 4 in the direction of arrow S occurs in this torque ring 4, and the function as a motor is exhibited. Or, when this torque ring 4 is rotated in the direction of, for example, arrow R by an external force, the high pressure fluid is discharged from said first fluid passage (see arrow Q), so that the function as a pump is fulfilled.

The casing 1 of such fluid energy converter is composed of a casing main body 21, and a rear cover 22 fitted to the opening end of this casing main body. The casing main body 21 is shaped like a cup to accommodate said torque ring 4, piston 6, and cylinder barrel 8, and its rear end is opened. A taper plane 23 is formed in the inner

circumference of the opening end 21a of this casing main body 1. This taper plane has an angle α of 45° or less with respect to the axial center m of this casing main body 1, with a specified width, and it is formed helically. That is, this taper plane 23 has a helical taper surface. A steep slope 24 of a specified width is formed between the top edge and bottom edge of this taper plane 23.

On the other hand, the rear cover 22 is shaped like a disc to support the cylinder barrel 8 by way of the pintle 9, and it has a trapezoidal groove 22a in which the base end part 9a of the pintle 9 is fitted slidable. This rear cover 22 has an annular stopping plane 25 for stopping the opening end 21b of the casing main body 21, and a circular bulging part 26 formed inside this stopping plane 25. On the outside of this circular bulging part 26, there is a spiral taper plane 27 having the same angle as said taper plane 23. This taper plane 27 has the same angle α with respect to the axial center m of the casing main body 21, with a specified width, and is formed helically in the same pitch as that of said taper plane 23.

In the taper plane 27 forming area of this rear cover 22, the taper plane 23 forming area of the casing 21 is tightened by screwing up to the position where the opening end 21 is fixed on the stopping plane 25.

In this construction, due to the reaction force the casing main body 21 receives from the stopping plane 25 of the rear cover 22, the helical taper plane 23 provided inside the casing main body 21 rides over the taper plane 27 of the rear cover 22 to contact tightly. As a result, the tape guide action is exhibited, and the casing main body 21 and rear cover are coupled in an accurately positioned state.

In this state, the gap in the radial direction between the casing main body 21 and rear cover 22 is completely eliminated. Still more, since these taper planes 23, 27 are slightly inclined at an angle of 45° or less with respect to the axial center, if a considerably large load in the radial direction is applied on the casing main body 21, the taper plane 23 of the casing main body 21 will hardly slide along the taper plane 27 of the rear cover 22. Accordingly, if a relative misaligning force in the radial direction should be applied between the casing main body 21 and rear cover 22, the both parts will not be dislocated from each other. That is, if having a steep helical plane at 45° or more with respect to the axial center, as in an ordinary screw, slipping of the parts along the helical plane may occur when a radial load is applied to cause dislocation easily, but when the taper planes 23, 27 are used, as in this invention, as far as the range of load is normal, using ordinary members, the relative positions of the casing main body 21 and rear cover 22 will be accurately maintained.

Therefore, it is not necessary to form a spigot between the casing main body and rear cover to set the relative tolerance strictly as required in the prior art, and the machining may be facilitated and the difficulty of assembling will be solved spontaneously.

In addition, since the casing main body 21 can be positioned by abutting its opening end 21b against the stopping plane 25 of the rear cover 22, the repeatability of positioning in the axial direction will be also excellent.

In this composition, furthermore, when the both taper planes 23, 27 are tightened by screwing, the wedge actions are induced between the taper planes 23, 27 not only in the rotating direction but also in the axial direction, so that the coupling is hardly loosened. This construction, still more, since the flange coupling part is not needed, the maximum outside diameter of the casing 1 may be reduced, so that the entire equipment may be designed compactly. Fig. 5 and Fig. 6 are explanatory drawings to clarify this effect more clearly. That is, in Fig. 5, beside the fluid energy converter 11 explained hereabove, another fluid energy converter 12 of the same constitution is disposed, and the rear covers 22, 22 of these two fluid energy converters 11, 12 are coupled together into one body. Moreover, the first and second fluid passages 11, 12 of one fluid energy converter 11, and the first and second fluid passages (not shown) of the other fluid energy converter 12 are connected with each other by way of first and second communicating routes 28, 29 formed at both sides of the rear cover 22, thereby composing a liquid pressure transmission of so-called HST type. Thus, in such mode of use, when the junction of the casing main bodies 21 and rear cover 22 of the fluid energy converters 11, 12 are achieved by screwing of the helical taper planes 23, 27, the spacing distance La between the casing main bodies 21 of the fluid energy converters 11, 12 may be defined to an extremely small length. On the other hand, in the case of the prior art shown in Fig. 6, the casing main bodies a and rear covers b of the fluid energy converters 11, 12 are positioned by the spigots c, and by placing bolts e into the flange connection parts d provided outside, the casing main bodies a and rear covers b are joined, which means it is difficult to reduce the spacing distance Lb between the two casing main bodies a. In this invention, therefore, as compared with the conventional equipment, the outside diameter can be notably reduced, and the entire equipment may be reduced in size and weight.

In the embodiment described herein, the taper plane is formed inside the opening end of the casing main body, which is not, however, limitative. For example, a spiral taper plane may be formed outside the casing main body, and a taper plane fitting with this taper plane may be formed inside the dent part provided in the rear cover.

The internal structure of the fluid energy transducer is not limited to the above constitution, and it may be also possible, for example, to apply an ordinary radial piston type pump/motor.

This invention, having such organization, is intended to position and joint the casing main body and cover accurately, without requirement of high precision in machining or difficulty in assembling work, and if a large misaligning force in the radial direction is applied between the casing main body and cover, its positioning state will not be spoiled, so that it is possible to present an excellent fluid energy converter reduced in both size and weight by spontaneously reducing the maximum outside diameter of the entire equipment.

Claims

1. A fluid energy converter with the cover to support the cylinder barrel positioned and mounted on the casing main body, wherein a taper plane at an angle of 45° or less with respect to the axial center is formed helically on the inner or outer circumference of the opening end of the casing main body, and a helical taper plane at the same angle as said taper plane and a stopping plane to stop the opening end of the casing main body are formed on the cover, and the taper plane forming area of the casing main body is screwed into the taper plane forming area of the cover until the opening ends is stopped on said stopping plane.

2. A fluid energy converter having a main casing (21) and an end cover (22) characterized in that the casing (21) and cover (22) are connected by the engagement of helical screw threads formed by taper planes (23) at an angle (α) less 45° to the axis (m) of the helical threads, and the axial position of the casing (21) is determined by a stop plane (25) on the cover (22) against which the end (21b) of the casing is engaged.

FIG. 1

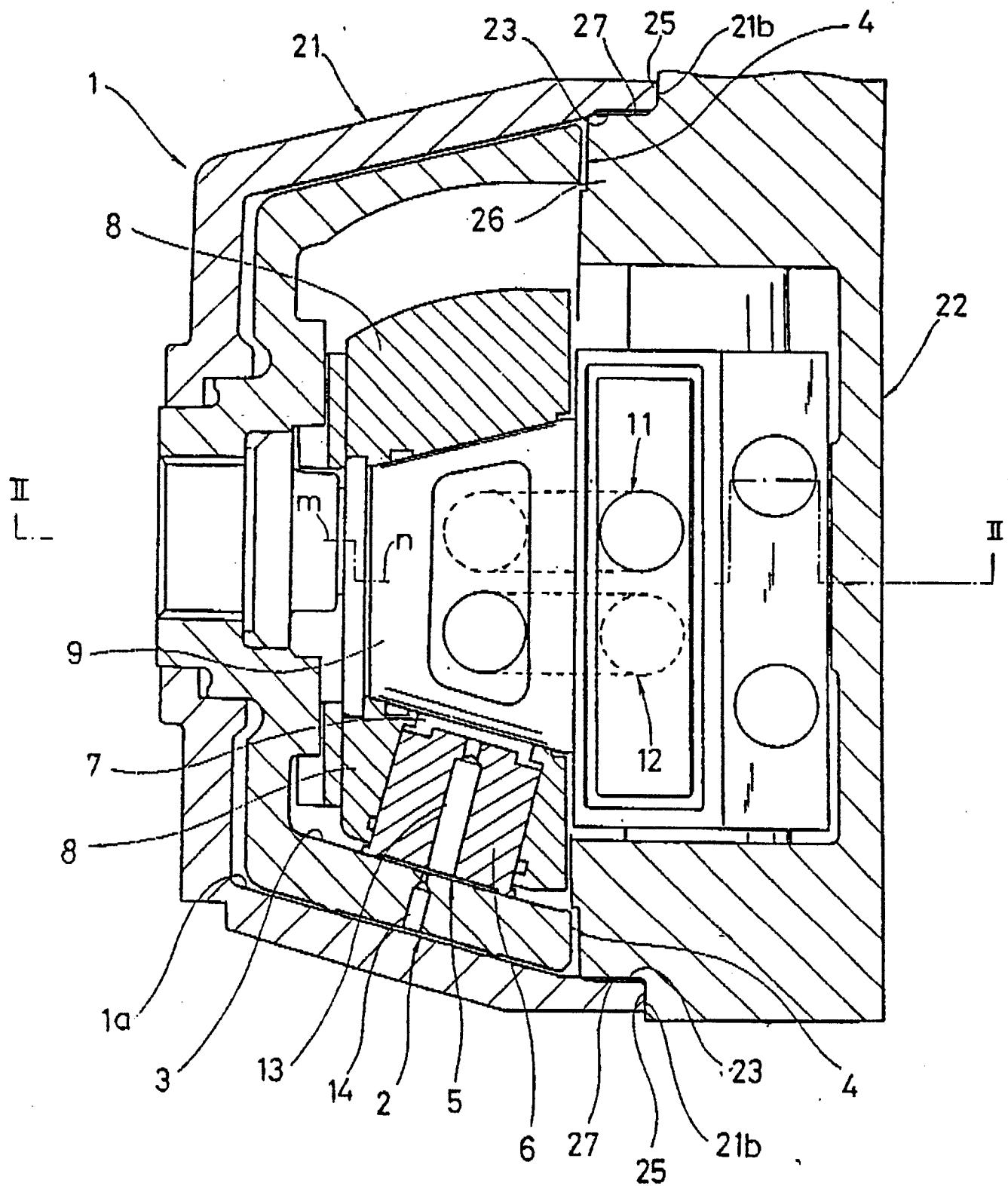


FIG. 2

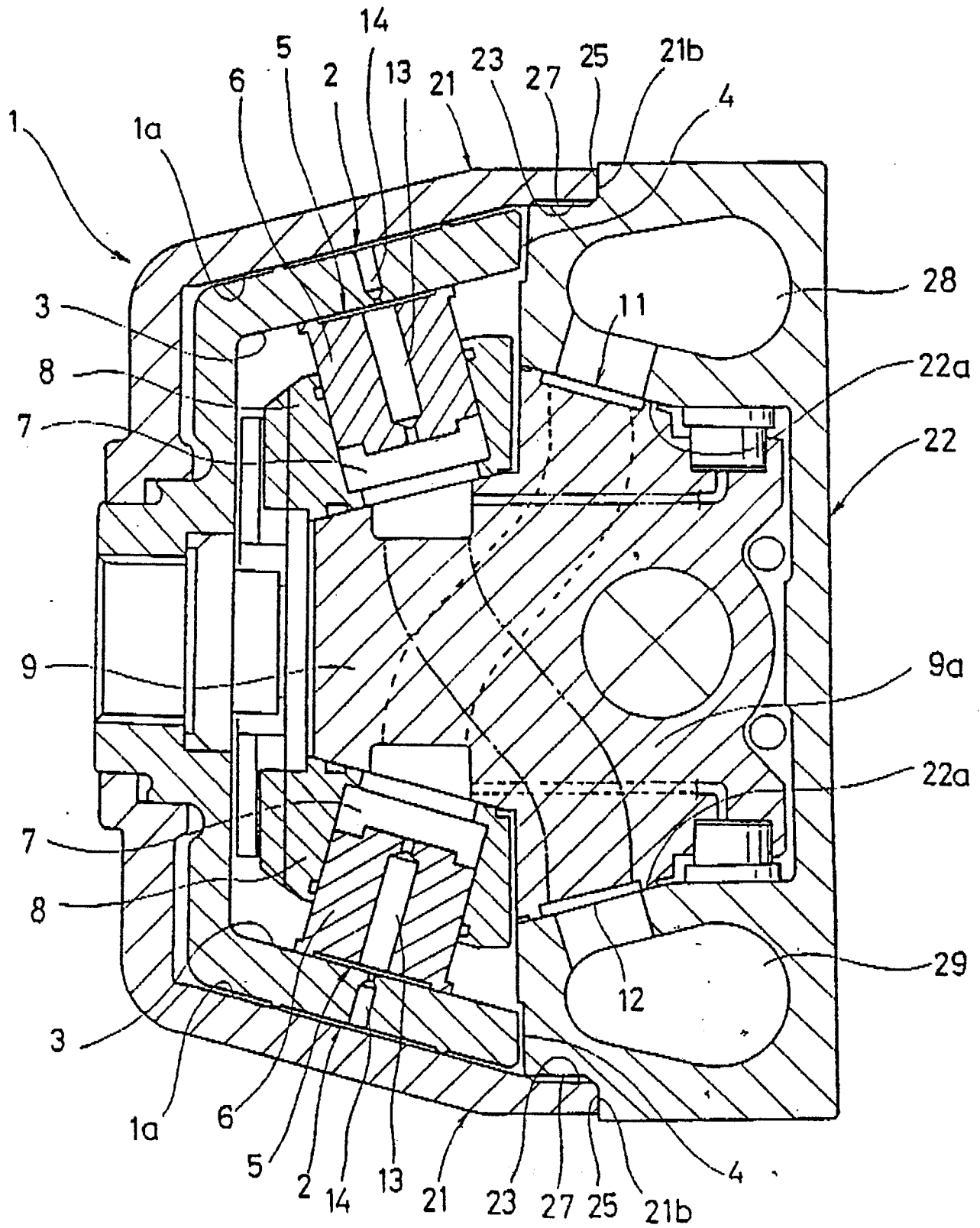


FIG. 3

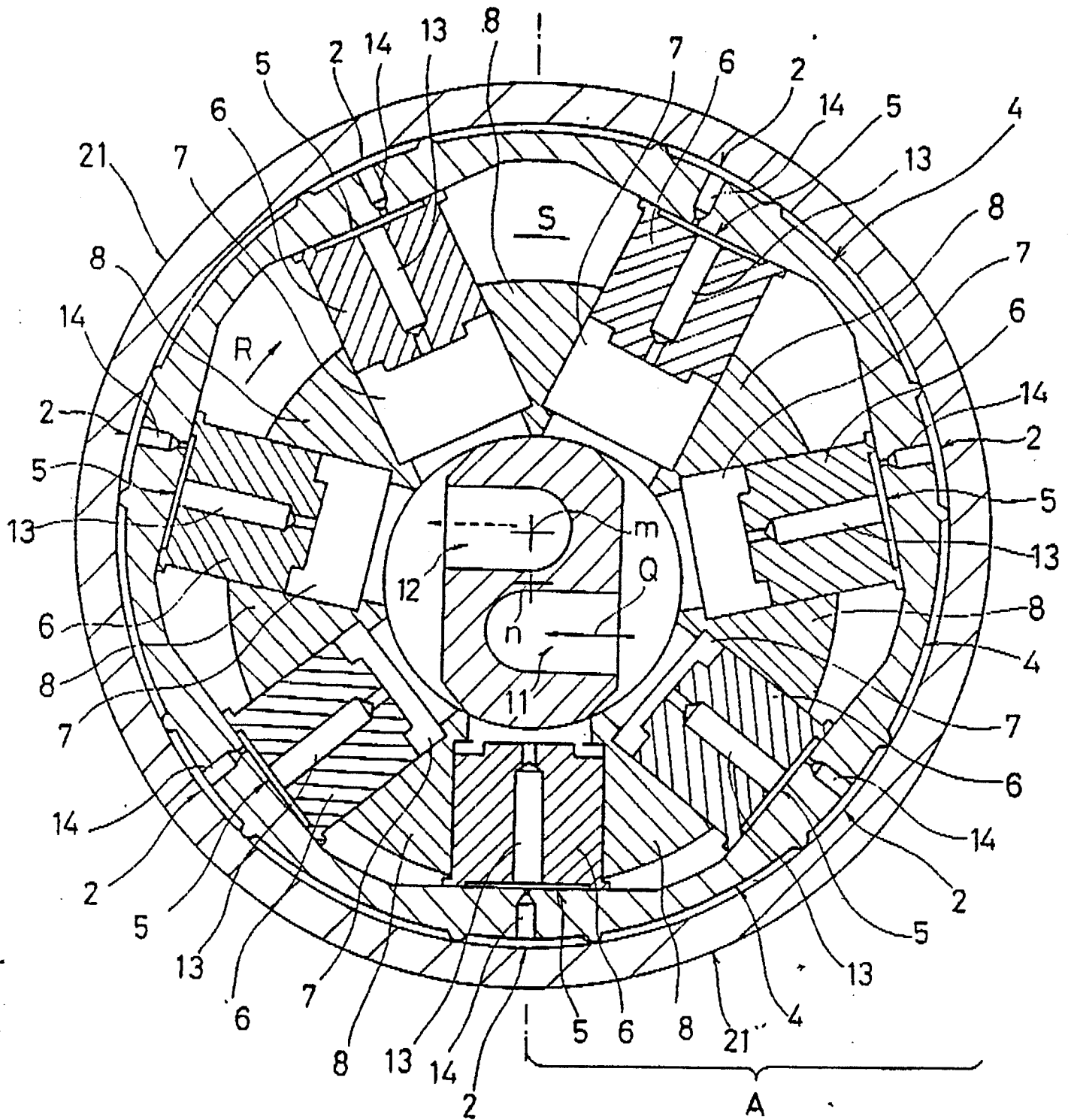


FIG. 4

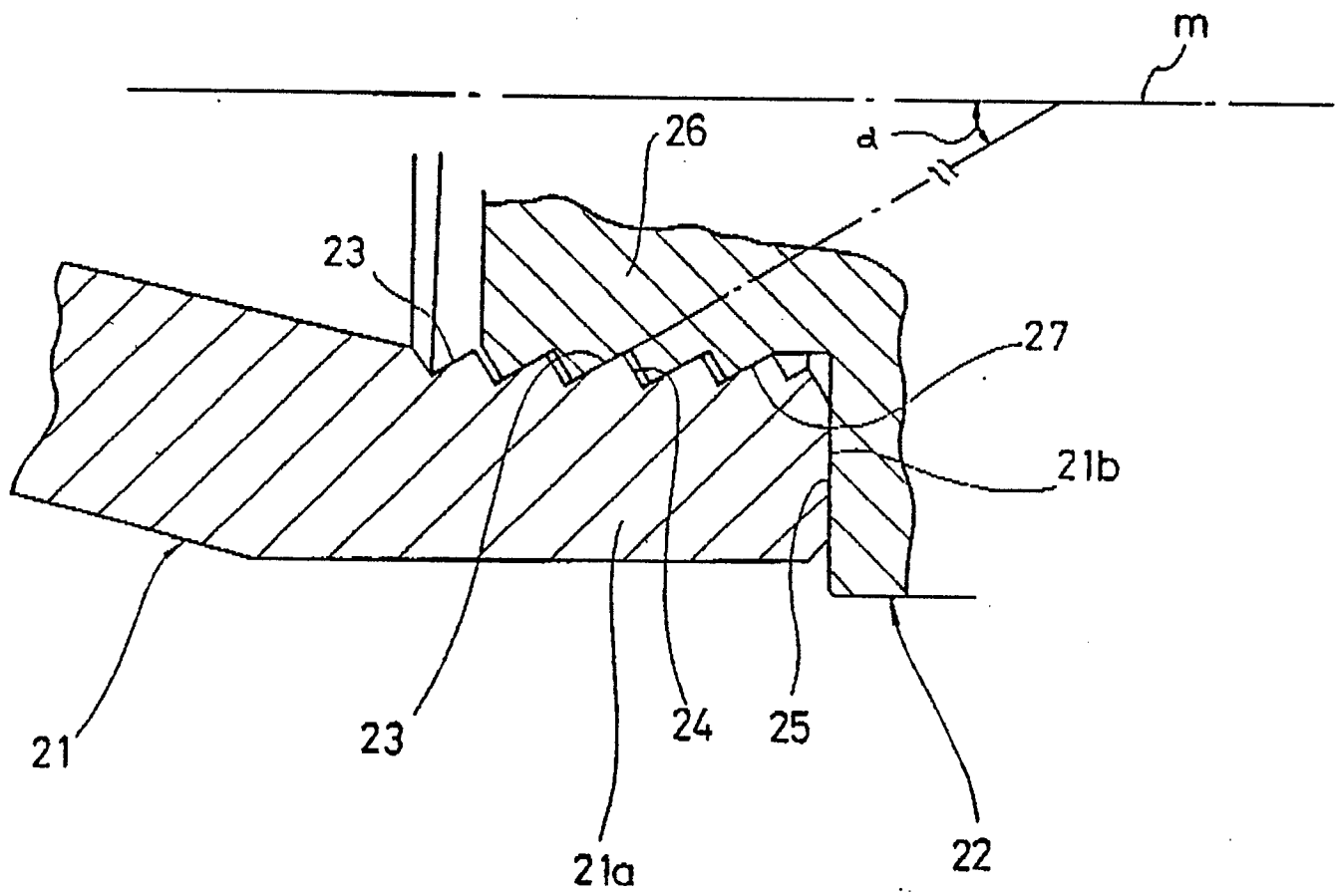


FIG. 5

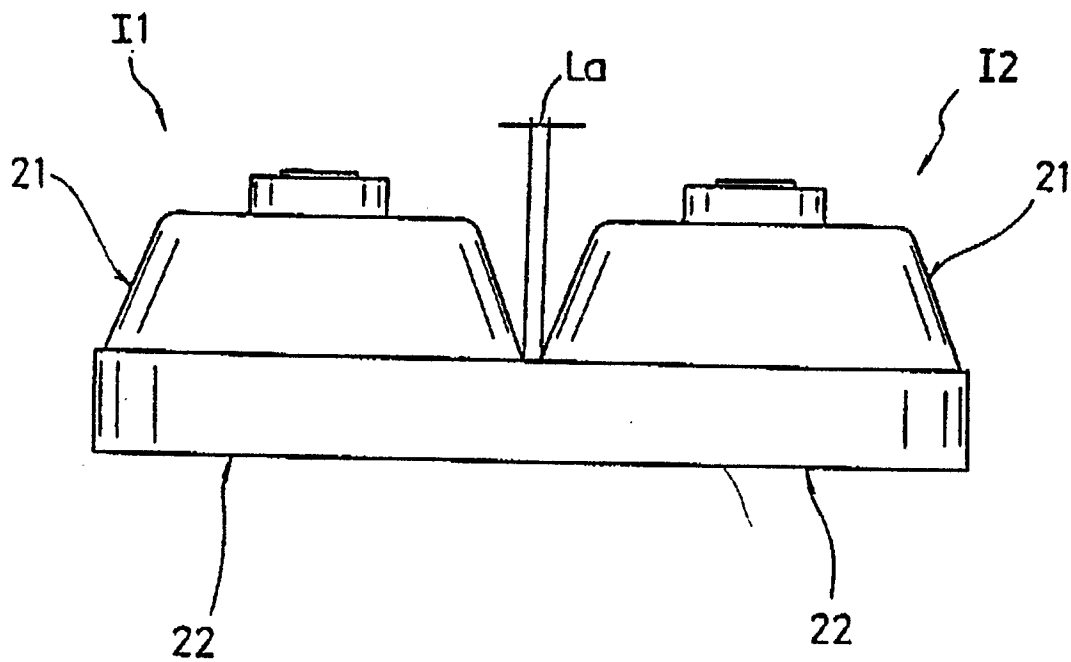


FIG. 6

