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(54) Rotary pump.

(57) The pump comprises a housing (1,2,3) defining a cylindrical working chamber (10), a piston in the form of a substantially cylindrical body (6) whose height corresponds to that of the working chamber (10) and a piston collar (7) in the form of a flat oval disc situated on the cylindrical body (6) obliquely to its axis.

A side groove (16) is provided in the housing walls and comprises a reciprocable partition (8). A suction duct (1) and a discharge duct (6) are situated at either side of said slide groove (16).

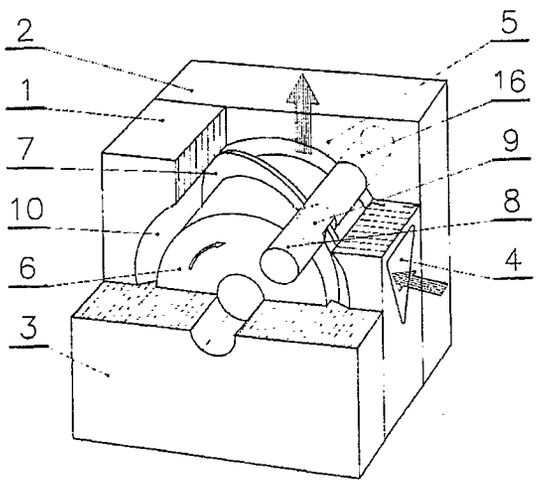

Fig.1

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ROTARY PUMP

The invention relates to a rotary pump comprising a rotary disc-shaped piston and a movable partition. The pump is particularly suitable for pumping liquid substances containing incompressible admixtures and biological liquors which cannot be pumped by means of orthodox pumps.

The aim of the invention is to substantially mitigate some drawbacks of well-known pumps, such as relatively short life-time, limited piston revolution rate, and a questionable sealing of the sucking and discharge spaces from each other, which, as a rule, requires non-return valves.

It is an object of the present invention to provide an improved rotary pump with a rotary disc-shaped piston and a movable partition, comprising a housing forming a working chamber of the pump and defined by a central side wall and two mutually opposite front and back walls.

According to the invention, the working chamber receives a piston in the form of a short cylindrical body whose height corresponds to that of said cylindrical working chamber. Over said cylindrical piston body there is drawn a piston collar whose peripheral curve is an ellipse. The major axis of the latter is identical with the diagonal of axial section of said cylindrical working chamber while its minor axis is identical with the diameter of said chamber. The major axis of the ellipse includes with the axis of working chamber an angle of at most 30° which prevails also in contact points of the piston collar and the outer area of said cylindrical body. The pump working stroke is also characterized by said angle.

In the chamber part of the housing there is provided a cylindrical sliding groove designed for receiving a movable cylindrical partition for separating the suction and the discharge space from each other.

The inlet opening of suction duct is circular while the outlet suction opening is triangular, the shape of inner surface of the suction duct simulating the shape of piston collar. Similarly, the discharge duct has a circular outlet discharge opening while the inlet discharge opening is of triangular configuration, the shape of inner surface of said discharge duct in the housing wall simulating the piston collar shape.

The ducts are being opened and closed, due to piston collar revolution while in the movable cylindrical partition there is freely mounted a sealing ball with a recess allowing the passage for the piston collar. This passage depends upon the varying angle of turning of the piston collar, relative to the partition in a set of planes; thus the presence of said sealing ball makes it possible to build the piston collar in the form of a flat elliptical disc.

A higher effect of the invention consists in a relatively simple pump structure which is free of any suction or discharge valves. The embodiment of the sealing partition together with the sealing ball enables a plain flat configuration of the piston collar to be used whereby claims laid on the manufacture thereof, in view of the hitherto applied pistons of more complicated shapes, are markedly reduced. The pump operates quite smoothly, ie without pressure impacts. The structure makes it possible to pump media containing even some minor incompressible objects, since the piston collar curve configuration and partition embodiment allow such media to be discharged without the piston being seized by such an incompressible object. It is why the pump of the invention is very suitable to be used for processing media of alimentary character as well as biotechnological liquid substances, since the pumping operation is very gentle.

A preferred embodiment of the invention will now be described, by way of example, with reference to the accompanying diagrammatic drawings, in which:

Figure 1 is a perspective, partially sectional view of the pump;

Figure 2 is a perspective view of the piston together with the partition (on the left) and the housing with the chamber (on the right);

Figure 3 is a front elevation of the pump, with the front wall of the housing being omitted;

Figure 4 is a sectional view of the pump along the plane defined by the piston axis and the axis of the discharge duct;

Figure 5 is a section taken along the line A-A in Figure 3;

Figures 6a, 6b and 6c are perspective views of the external area of the cylindrical working chamber, showing the peripheral curve of the piston collar in three pumping phases; and

Figures 7a, 7b and 7c show a developed surface of the working chamber, and the course of peripheral curve of the piston collar as well as the situation of the partition in the three pumping phases.

As can be seen in the drawings, and particularly Figure 1 thereof, the pump has a housing defined by a sidewall 1, which may be formed by two mutually opposite partial sidewalls, and two mutually opposite end walls, namely a front wall 3 and a back wall 2. The housing provides in its interior a working chamber 10 of a substantially cylindrical configuration. In said chamber 10, is provided a cylindrical slide groove 16 for receiving a partition 8, the groove 16 being substantially

parallel to the axis of the chamber 10. The slide groove 16 extends through the end walls 2 and 3 into boxes 15 for said partition 8. In the sidewall are provided at one side of the slide groove 16 the opening of a suction duct 4 and at the other side thereof the opening of a discharge duct 5. Both said openings are of a triangular configuration. The ducts 4 and 5 merge into respective flanges 11 and 12 which are attached to the housing walls. A suction conduit 13 in the flange 11 is of circular cross-section which gradually changes into a triangular one which is identical with the profile of the suction duct 4. Similarly, a discharge conduit 14 in the flange 12 changes its circular cross-section to a triangular one corresponding to the cross-section of the discharge duct 5.

The pump piston received in the working chamber 10 is constituted by a cylindrical body 6 and a piston collar 7 in the form of a flat elliptical disc which is situated obliquely on the cylindrical body 6. The collar 7 includes with the axis of the body 6 and of the working chamber 10 an angle of at most 30°. Thus the peripheral curve of the piston collar 7 has the configuration of an ellipse whose major axis is identical with the diagonal of axial section of the cylindrical working chamber 10 (Figure 4) while the minor axis thereof is identical with the diameter of said chamber 10 (Figure 3). The curve intersecting the piston collar 7 and the cylindrical body 6 is also constituted by an ellipse whose major axis is identical with the diagonal of axial section of said cylindrical body 6. As results from the foregoing, the piston collar 7 contacts in every point of its outer periphery the surface of the working chamber 10 (Figure 6). In the axis of the cylindrical body 6 and in the two end walls 2 and 3 is provided an opening for mounting a driving shaft of the piston.

The slide groove 16 receives slidably the movable cylindrical partition 8 in the middle of which a sealing ball 9 is freely mounted. The ball 9 has a recess forming a passage for the piston collar 7.

The cylindrical piston body 6 together with the piston collar divide the working chamber 10 into two parts, each of which is in turn divided by the partition 8 in two parts so that four separate spaces are formed which revolve, owing to the rotation of the piston 6 with the collar 7, about the axis of the working chamber 10. During this motion, the working chamber 10 assumes alternately the suction and discharge function, the partition 8 separating in each phase the discharge space.

The mode of operation of the pump is apparent from Figures 6a, 6b and 6c and 7a, 7b and 7c. Figures 6a, 6b and 6c are perspective views of the surface of the working chamber, showing the suction and the discharge openings. Dashed line indicates the peripheral curve of the piston collar 7. These Figures show also the surface of the slide groove 16. For the sake of clarity, the piston and the partition have been omitted.

Figures 7a, 7b and 7c which correspond to Figures 6a, 6b and 6c, respectively, show the developed surface of the working chamber 10 together with peripheral curve of the piston collar 7 and the position of the partition 8.

Figures 6a and 7a show the first pumping phase. The piston collar 7 contacts the circular bases of the working chamber 10 at points B and D. The partition is in this phase in its left-hand extreme position. The suction duct is fully opened into the suction space in the right-hand portion of the working chamber while the discharge duct is fully opened into the discharge space in the right-hand portion of the working chamber. The two spaces are separated from each other by the partition 8 and the piston collar 7 at the point D (see Figure 7a). In the left-hand space of the working chamber, the suction has just ended, the suction duct has been closed and, due to the continuing turning of the piston, the discharge duct opened. At this instant, the suction space becomes the discharge one.

Figures 6b and 7b show the next pumping phase. The rotary piston has turned through 90° and the piston collar 7 has displaced the partition to its middle position. By turning the piston collar 7, vacuum begins to be produced in the new suction space in the left-hand portion of the working chamber 10. The suction duct is opened into said space only partially and, as the piston turns, it is being further opened. The left-hand suction space is separated from the left-hand discharge space by the partition 8 and the piston collar 7 at the point B (see Figure 7b). Simultaneously, the right-hand suction space is being gradually closed. At this instant, the discharge duct has been opened into the left-hand discharge space and as the piston turns, it is being further opened. On the contrary, in the right-hand discharge space the discharge is being ended and the discharge duct, due to the rotation of the piston, is being closed.

The next pumping phase is shown in Figures 6c and 7c. As the piston has made a half-revolution (180°) from its initial position and the piston collar has displaced the partition into its right-hand extreme position, the right-hand discharge space has faded, and at the next moment a new suction space has arisen behind the partition. Thus the discharge duct is fully opened into the discharge space in the left-hand portion, and the suction duct is fully opened into the suction space also in the left-hand portion of the working chamber. The right-hand suction space has been just closed, after having reached its maximum capacity, and, due to the continuing rotation of the piston, it becomes the

discharge space, since the discharge duct commences to be opened and the discharge space reduced.

As results from the drawings, the shapes of the suction and discharge ducts exactly simulate the shape of peripheral curve of the piston collar. It is further apparent that the suction or vacuum spaces are being enlarged proportionally to the closing of the suction duct; similarly, the discharge spaces are being reduced in dependence upon the opening of the discharge duct. Thus the pump operation is absolutely continuous, ie free of impacts.

Claims

1. A rotary pump with a rotary disc-formed piston and a movable partition, comprising, in combination,
   - a housing defined by a side wall (1) and opposite front and back walls (3, 2),
   - a cylindrical working chamber (10) provided in the housing,
   - a piston in the form of a substantially cylindrical body (6) whose height corresponds to that of the working chamber (10),
   - a piston collar (7) in the form of a flat oval disc situated on the cylindrical body (6) obliquely to its axis, the peripheral curve of the collar (7) being an ellipse whose major axis corresponds to the diagonal of axial section of the cylindrical working chamber (10) while its minor axis corresponds to the diameter of the cylindrical working chamber (10), the intersecting curve of the piston collar (7) and the cylindrical body (6) being also an ellipse whose major axis corresponds to the diagonal of axial section of the cylindrical body (6) and form an angle of at most 30° with the axis of the working chamber (10),
   - a slide groove (16) provided in the housing walls and comprising a movable partition (8), and
   - a suction duct (1) and a discharge duct (6) situated at either side of said slide groove (16), respectively.

2. A pump according to Claim 1, wherein the inlet suction opening of the suction duct (4) is circular and the outlet suction opening is triangular, the shape of the inner surface of the suction duct (4) in the housing wall (1) simulating the shape of the piston collar (7), and wherein analogously the discharge duct (5) has a circular outlet opening while the inlet opening is triangular and the shape of the inner surface of the discharge duct (5) simulates the shape of the piston collar (7).

3. A pump according to Claim 1, wherein the movable cylindrical partition (8) a sealing ball (9) is freely received, having a recess allowing the passage of the piston collar (7).

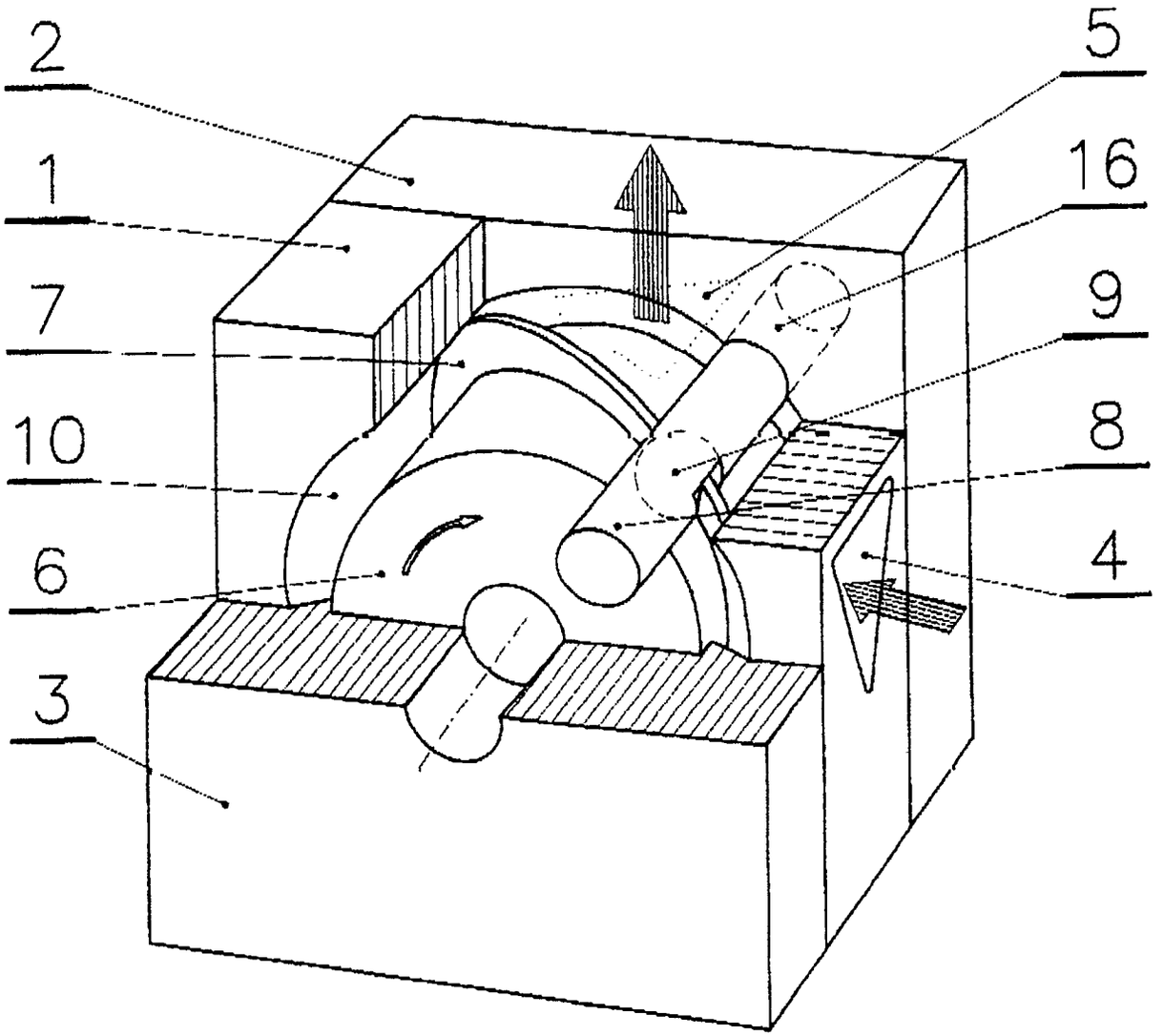

Fig.1

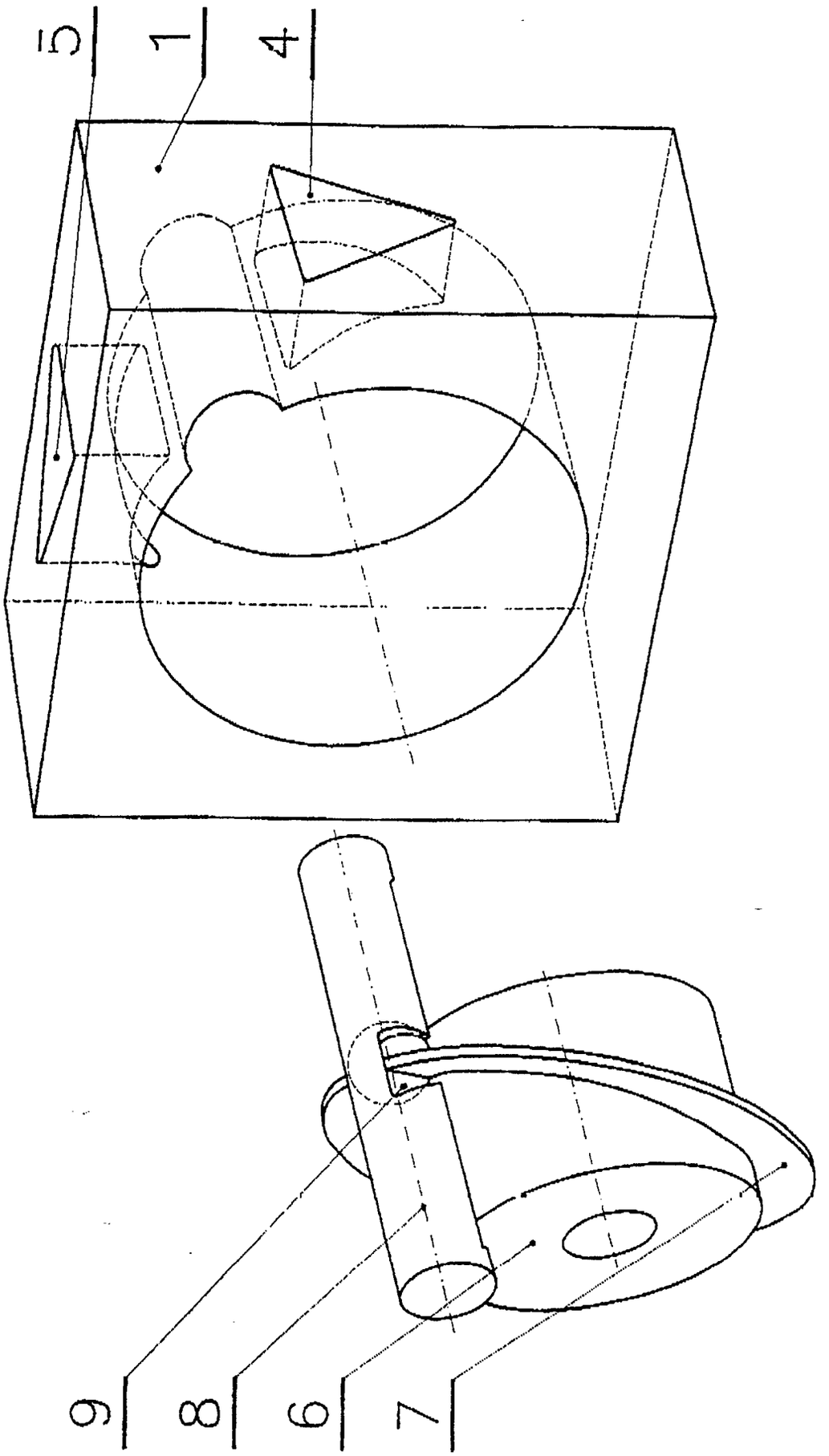

Fig.2

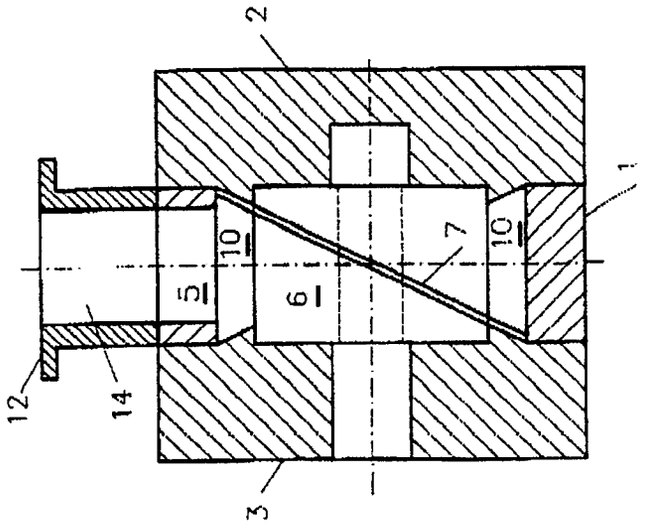

Fig. 4

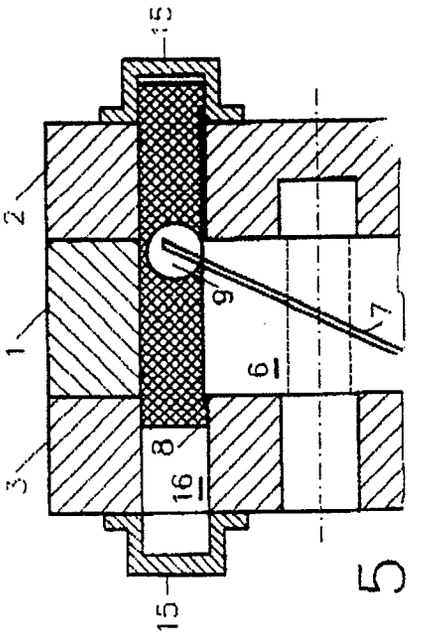

Fig. 5

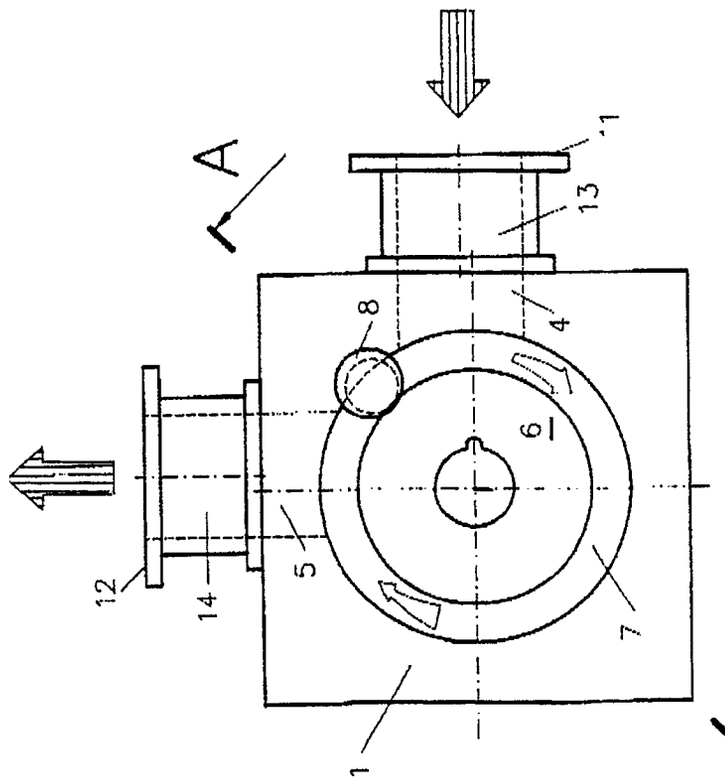

Fig. 3

A-A

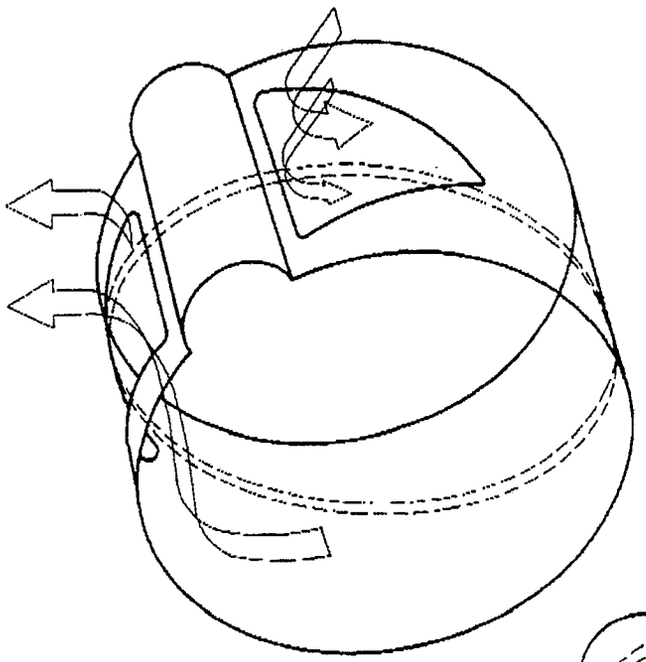

Fig.6b

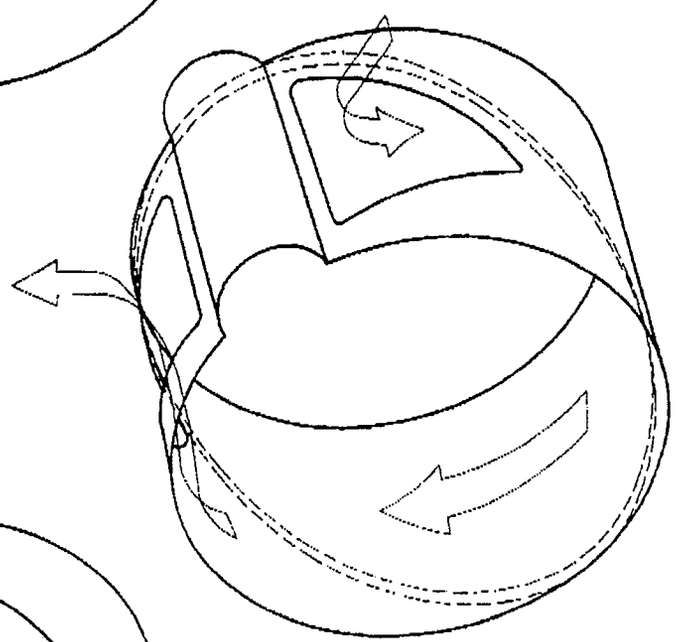

Fig.6c

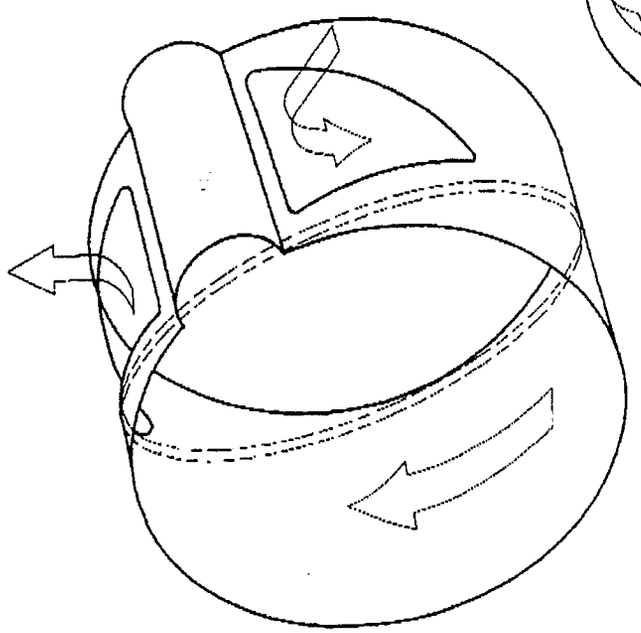

Fig.6a

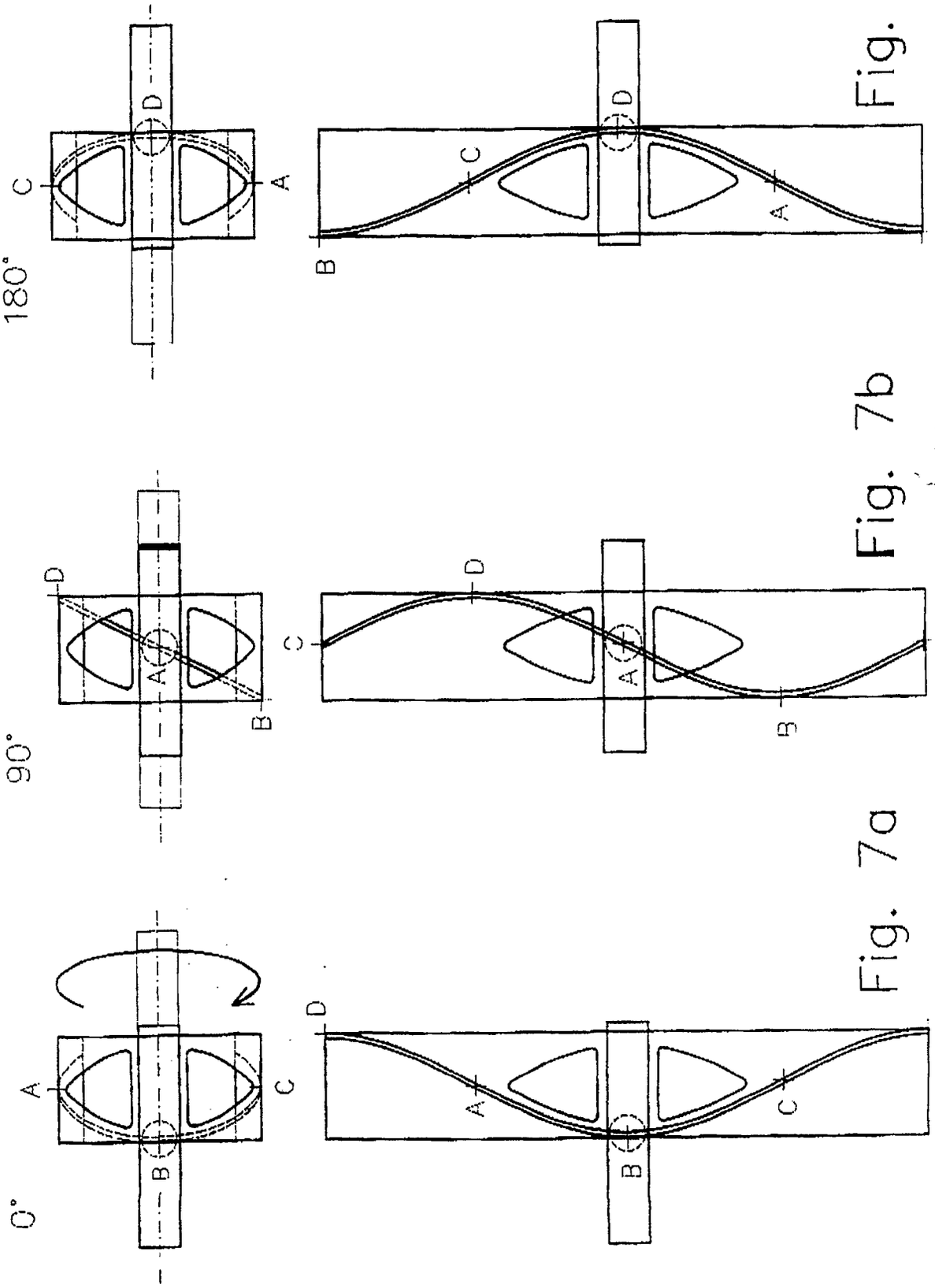

Fig. 7c

Fig. 7b

Fig. 7a