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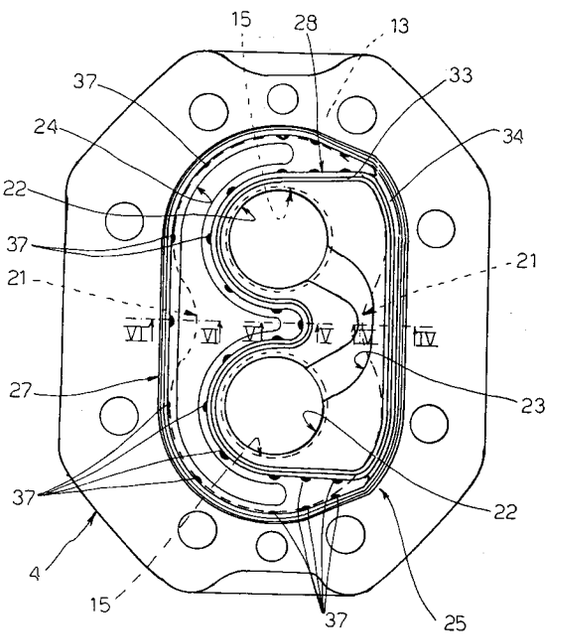
(54) Gear machine.

(57) A machine (1) comprising two meshing gears (5, 6); two bushes (13) supporting the gear hubs (7, 8); a machine body (2) housing the gears (5, 6) and bushes (13); and two cover plates (3, 4) for the machine body (2). Each plate (3, 4) presents a seat (26) for a seal (25) formed in one piece and comprising a first annular element (27), and a second annular element (28) inwards of and joined over a long portion to the first annular element (27) by a thin wall (34) defining two channels (35, 36) for high-pressure fluid. The seal (25) defines two gaps, one for low-pressure fluid, defined by the second element (28), and the other for high-pressure fluid, defined by both elements (27, 28).

Fig.2



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The present invention relates to a geared machine that may be employed as a pump or motor.

Known geared machines currently comprise a machine body housing two gears, one of which, in pump operating mode, drives the other. The axial sides of the machine body are closed by plates between which and the machine body provision is made for seals defining gaps between the plates and the bushes supporting the gear hubs. Pressurized fluid is fed into one of the gaps for balancing and compensating the clearance walls defined between the bushes and the top of the gear teeth.

Major drawbacks of machines of the aforementioned type are the number of seals required between the cover plates, on one side, and the machine body and bushes on the other; and the amount and high cost of precision machining required of the plate, the machine body and, at times, the bushes, for forming the seal seats.

It is an object of the present invention to provide a geared machine functioning as a pump or motor and designed to overcome the aforementioned drawbacks, i.e. which presents a sealing assembly of relatively straightforward design, enabling troublefree assembly, and which does not involve extensive precision machining of the machine components.

Further aims and advantages of the present invention will be disclosed in the following description.

According to the present invention, there is provided a geared machine functioning as a pump or motor, and comprising:

two meshing gears;

two bushes located on either side of said gears so as to define respective clearance walls, and supporting the hubs of said gears;

a machine body housing the gear-bush assembly; and

two cover plates for said machine body;

characterized by the fact that, on the side facing said machine body and respective said bush, each said plate presents a seat for a seal formed in one piece and comprising a first annular element, and a second annular element inwards of and joined over a long portion to said first annular element by a thin wall defining, inwards and outwards of said seat, two channels for a high-pressure fluid; said seal defining two gaps, one for low-pressure fluid, defined by said second element, and the other for high-pressure fluid, defined between respective portions of said first and second elements.

A preferred non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Fig.1 shows a section of a gear pump in accordance with the teachings of the present invention;

Fig.2 shows a view along line II-II in Fig.1;

Fig.3 shows a smaller scale section along line III-III in Fig.1;

Fig.s 4 to 6 show respective sections along lines IV-IV, V-V and VI-VI in Fig.2.

Number 1 in Fig.1 indicates a gear pump in accordance with the teachings of the present invention, and comprising a machine body 2 closed axially by two lateral cover plates 3 and 4, and housing two meshing gears 5 and 6. Gear 5 is a driven gear having a hub 7 of substantially the same length as machine body 2; while gear 6 is a drive gear having a hub 8, which, on one side, extends through a hole 11 in plate 3 housing a hydraulic sealing assembly 12, and is connected in any manner to the output shaft of a motor (not shown). Hubs 7 and 8 are supported by respective bushes 13 located on either side of gears 5 and 6 and defining respective clearance walls 14 with the top of the gear teeth.

As shown in Fig.s 1, 2 and 3, machine body 2 is shaped internally to reproduce the contour of gears 5 and 6, i.e. is shaped in the form of an 8, as are bushes 13, each of which presents two parallel through holes 15 engaged by hubs 7 and 8. At the point at which gears 5 and 6 mesh, machine body 2 presents an inlet 16 on one side, and an outlet 17 on the other. The teeth of gears 5 and 6 are of known shape, and such, when meshed, as to prevent hydraulic communication between inlet 16 and outlet 17. At the point of contact between the gear teeth and the inner wall of machine body 2, the gear teeth are so shaped as to prevent fluid leakage between the adjacent tooth spaces. Pump 1 is a self-compensating, balanced type, as described later on, so that a minimum amount of fluid leakage along clearance walls 14 is required.

As the fluid is entrained at one pressure and discharged at a higher pressure, clearance walls 14 are subjected to irregularly distributed hydrostatic pressure, which is minimum at the inner orifice of inlet 16 and maximum at outlet 17. By way of explanation, the hatching in Fig.3 indicates the surface of bush 13 subjected to a pressure (herein referred to as internal pressure) greater than the minimum, i.e. intake, pressure. As shown in Fig.3, the surface subjected to said internal pressure differs in shape from the face (wall 14) of bush 13, so that the center of gravity no longer lies along the axis of symmetry of bush 13. This therefore tends to swing about hubs 7 and 8, thus resulting in fluid leakage along clearance walls 14. Bushes 13 are balanced by compensating, on the plate 3 and 4 side, the pressure exerted on bushes 13 at clearance walls 14. On the inner face of plates 3 and 4, a respective gap is therefore formed containing

high-pressure fluid, by virtue of communicating hydraulically with the inner orifice of outlet 17, which communication may be achieved by forming, along the central outer surface portion of bush 13, a recess 21 as shown by the dotted line in Fig.2. To the side of said gap, a second gap is formed containing low-pressure fluid, by virtue of communicating with the inner orifice of inlet 16 via a second recess 21 formed on the opposite side of bushes 13 to the first. At the second gap, plate 4 presents two round recesses 22 at hubs 7 and 8; and a recess 23 connecting recesses 22 and having a portion facing respective recess 21. Plate 3 presents the same design as plate 4, but with only one recess 22, the place of the other being occupied by hole 11. At the first gap, plates 3 and 4 each present a respective substantially E-shaped recess 24.

As shown in Fig.s 2, 4, 5 and 6, for each plate 3 and 4, pump 1 presents a seal 25 formed in one piece and preferably made of soft rubber. Seal 25 defines said gaps, and is housed in a seat 26 formed in each plate 3 and 4, and having a rectangular section consisting of two side walls connected by a bottom wall. Seal 25 comprises a first annular element 27, and a second annular element 28 located inwards of the first and defining said second low-pressure fluid gap; the first high-pressure fluid gap being defined by respective portions of elements 27 and 28. Element 27 is substantially ovaloid in shape, with two opposite straight portions connected by two circular portions, and rests entirely on a corresponding face of machine body 2. Element 28 presents a straight portion parallel to and formed in one piece with a first of said straight portions of element 27; and a curved portion extending from one end of said straight portion, running around part of recesses 22, and connected to the other end of said straight portion. Said first gap is thus E-shaped, being defined by the second straight portion and two circular portions of element 27, and by the curved portion of element 28. The straight portion of element 28 contacts machine body 2, while the curved portion contacts respective bush 13.

As shown in Fig.6, element 27 presents a rectangular section with two side walls; a bottom wall resting on the bottom wall of seat 26 and, like the latter, joined by said side walls; and a top wall flush with the face of respective plate 3 or 4. Element 27 is double-lipped, in that it presents two parallel projections 31 extending from the top wall over the entire length of element 27 and projecting entirely from seat 26.

As shown in Fig.5, element 28 presents a rectangular section with two side walls; a bottom wall connecting the side walls and resting on the bottom wall of seat 26; and a top wall projecting beyond seat 26 by substantially the same amount as projections 31 on element 27. Along the entire length of element 28 facing the second gap, the edge defined by the top wall and one of the side walls presents a recess 32 housing a tight-fitting antiextrusion seal 33, the section of which combines with that of recess 32 to produce an element 28-seal 33 assembly having a substantially rectangular section. More specifically, recess 32 is defined by two oblique faces sloping respectively in relation to the bottom and respective side wall of seat 26.

As shown in Fig.4, the straight portion of element 28 is connected to the first straight portion of element 27 by a thin wall 34 connecting the side walls of elements 27 and 28, with which it defines two channels 35 and 36. Channel 35 is shallower than channel 36, and defined facing the bottom wall of seat 26; while channel 36 is defined outwards of seat 26 and therefore (in Fig.4) open at the top. Over the one-piece portion of elements 27 and 28, seat 26 is wider than the rest, to enable it to house said portion of both elements 27 and 28; and channels 35 and 36 communicate hydraulically with the first gap at each end of the straight portion of element 28.

As shown in Fig.s 2, 5 and 6, from the side wall of elements 27 and 28 facing inwards of the first gap, there extend a number of projections 37 contacting a side wall of seat 26. Seal 25 is molded in one piece to the finished shape, while seal 33 is also molded in one piece, but from hard silicon-based plastic or nylon material.

The advantages of the present invention will be clear from the foregoing description.

In particular, in place of a number of seals seated in the machine body and cover plates, pump 1 presents a one-piece seal seated solely in the cover plates, thus eliminating machining of the machine body (and/or bushes in certain cases) for forming the seats, and simplifying assembly of the seal, which involves only one operation. Moreover, seal 25 provides for improved hydraulic sealing, as well as for improved performance and seating of antiextrusion seal 33 along element 28, by virtue of channels 35 and 36 defined between the one-piece portions of elements 27 and 28 enabling uniform high fluid pressure to be exerted on both sides of wall 34 for pressing said portions against the respective side walls of seat 26. Moreover, by virtue of projections 37 contacting the side wall of seat 26, seal 25 is necessarily fitted tightly in place, thus permanently engaging seals 25 and 33 (since they are assembled simultaneously) and so enabling troublefree handling of the cover plates during assembly. Between the side wall of seat 26 and that of elements 27 and 28 from which projections 37 originate, a high-pressure fluid channel is

formed which provides for improved hydraulic sealing by pressing elements 27 and 28 towards the opposite side wall of seat 26. Seal 25 is so designed as to enable automatic and hence fast, efficient, low-cost assembly, and to receive an annular antiextrusion seal, thus enabling seal 25 to be made of soft rubber for improving the mechanical efficiency of pump 1. Soft rubber, in fact, reacts to a lesser degree to the thrust exerted by the fluid along the clearance walls of bushes 13, as described previously, so that, for a given thickness projecting from seat 26, seal 25 (being preloaded to a lesser degree) reduces the thrust exerted on bushes 13, particularly during startup of pump 1.

To those skilled in the art it will be clear that changes may be made to the geared machine as described and illustrated herein without, however, departing from the scope of the present invention.

Claims

1. A geared machine functioning as a pump or motor, and comprising:

two meshing gears (5, 6);

two bushes (13) located on either side of said gears (5, 6) so as to define respective clearance walls (14), and supporting the hubs (7, 8) of said gears (5, 6);

a machine body (2) housing the gear-bush assembly (5, 6, 13); and

two cover plates (3, 4) for said machine body (2);

characterized by the fact that, on the side facing said machine body (2) and respective said bush (13), each said plate (3, 4) presents a seat (26) for a seal (25) formed in one piece and comprising a first annular element (27), and a second annular element (28) inwards of and joined over a long portion to said first annular element (27) by a thin wall (34) defining, inwards and outwards of said seat (26), two channels (35, 36) for a high-pressure fluid; said seal (25) defining two gaps, one for low-pressure fluid, defined by said second element (28), and the other for high-pressure fluid, defined between respective portions of said first and second elements (27, 28).

2. A machine as claimed in Claim 1, characterized by the fact that said thin wall (34) is of constant thickness.

3. A machine as claimed in Claim 1 and/or 2, characterized by the fact that said first element (27) presents a substantially ovaloid contour comprising two substantially straight portions, and two portions joining said straight portions; said first element (27) contacting a corresponding face of said machine body (2).

4. A machine as claimed in Claim 3, characterized by the fact that said second element (28) comprises a first substantially straight portion joined parallel, by said thin wall (34), to one of said substantially straight portions of said first element (27); and a second curved portion defining said second gap together with the remaining portions of said first element (27); said substantially straight portion of said second element (28) contacting said machine body (2), and said curved portion of said second element (28) contacting a respective said bush (13).

5. A machine as claimed in Claim 4, characterized by the fact that said second gap presents a substantially E-shaped contour.

6. A machine as claimed in Claim 5, characterized by the fact that, from said portions of said elements (27, 28) defining said second gap, there extend, inwards of said second gap, a number of projections (37) contacting the side wall of said seat (26) so as to form therein a high-pressure fluid channel.

7. A machine as claimed in at least one of the foregoing Claims, characterized by the fact that the top edge of said second element (28) facing inwards of said first gap presents a recess (32) housing an antiextrusion ring (33) of relatively hard material.

8. A machine as claimed in at least one of the foregoing Claims, characterized by the fact that said seal is made of relatively soft material.

9. A machine as claimed in at least one of the foregoing Claims, characterized by the fact that said first element (27) presents a rectangular section comprising two side walls; a bottom wall resting on the bottom wall of said seat (26); and a top wall flush with the face of a respective said plate (3, 4); said first element (27) being double-lipped by presenting two parallel projections (31) extending from the top wall over the entire length of said first element (27) and projecting entirely from said seat (26).

10. A machine as claimed in Claim 9, characterized by the fact that said second element (28) presents a rectangular section comprising two side walls; a bottom wall resting on the bottom wall of said seat (26); and a top wall projecting beyond said seat (26) by substantially the

same amount as said projections (31) on said first element (27).

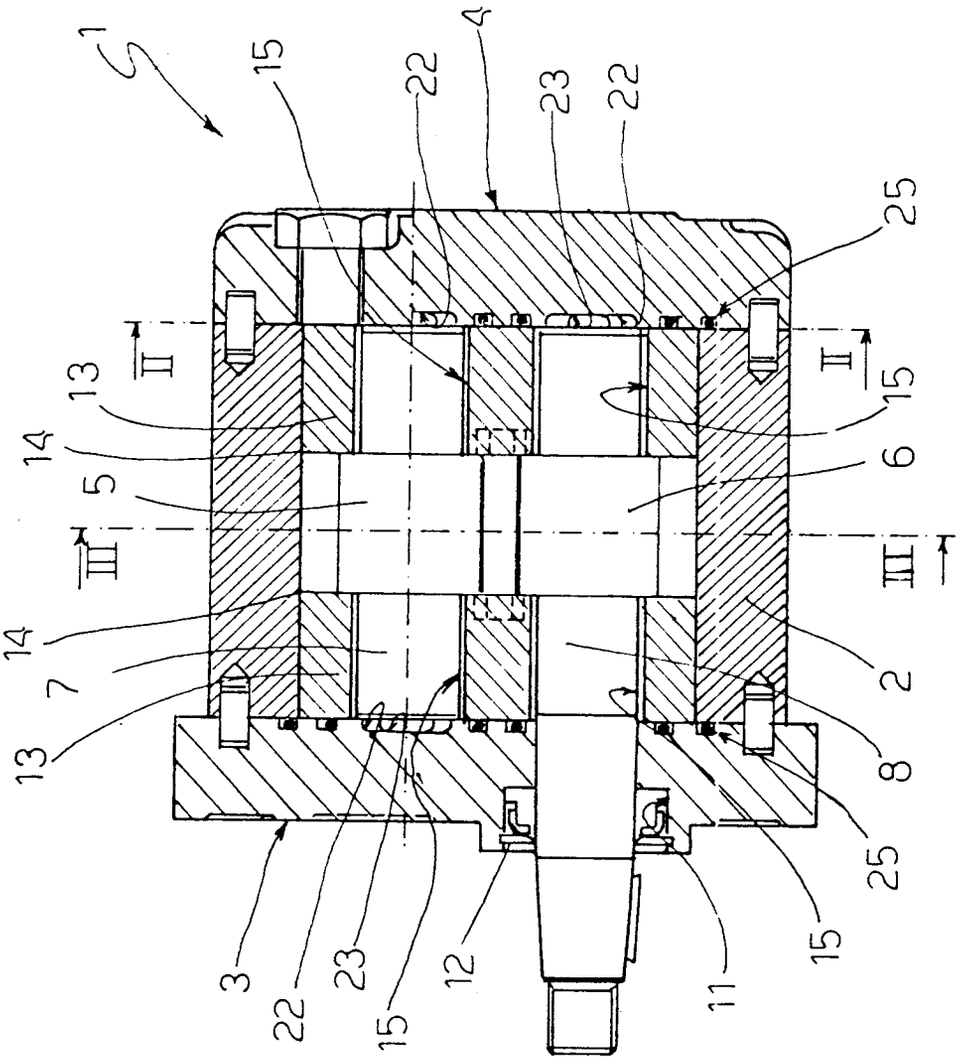
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Fig.1

Fig.2

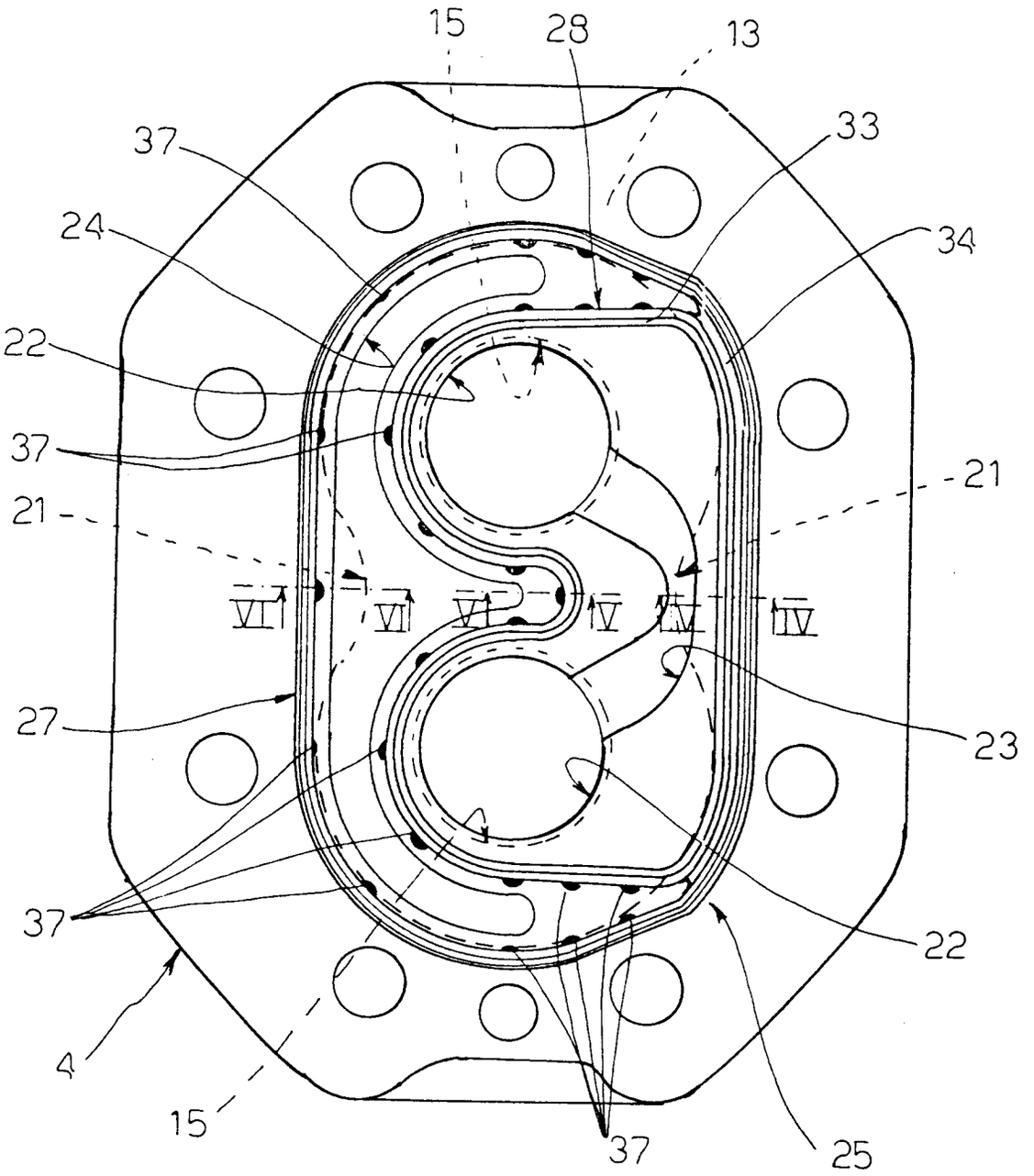


Fig.3

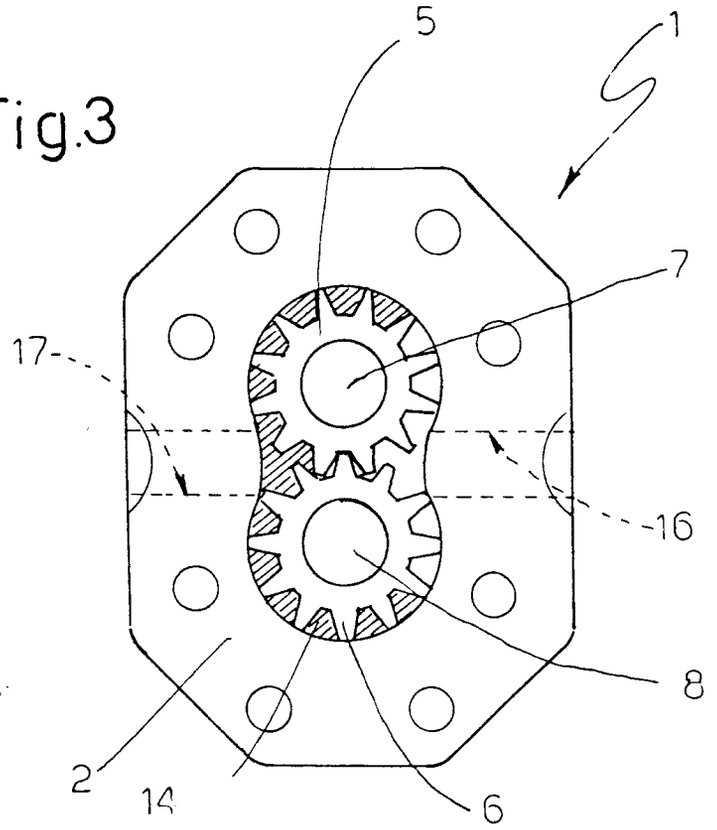
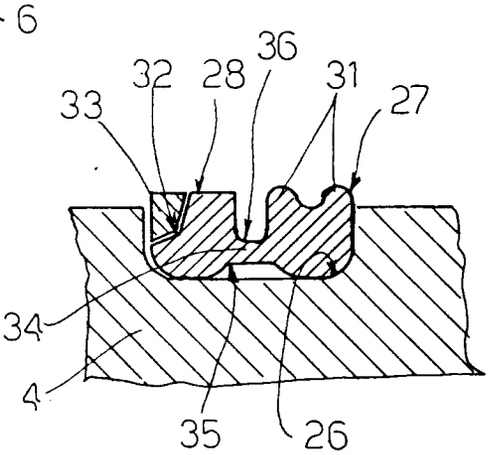


Fig.4



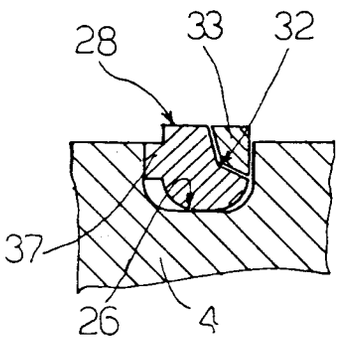


Fig.5

Fig.6