(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 531 124 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
18.05.2005 Bulletin 2005/20

(51) Int Cl.[7]: **B63C 11/22**

(21) Application number: **04016074.9**

(22) Date of filing: **08.07.2004**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL HR LT LV MK

(30) Priority: **14.11.2003 IT GE20030092**

(71) Applicant: **HTM SPORT S.p.A.**
16035 Rapallo (IT)

(72) Inventor: **Pietrelli, Nino**
16030 Sori (IT)

(74) Representative: **Porsia, Attilio, Dr. et al**
c/o Succ. Ing. Fischetti & Weber
Via Caffaro 3/2
16124 Genova (IT)

(54) Pressure regulator for the regulator first stage of a two-stage aqualung

(57) Pressure regulator for the regulator first stage of a two-stage aqualung, comprising a reduction chamber (501; 901) which communicates, via a delivery valve (401), with an admission channel (101) for admitting the high-pressure mixture of breathable gases, and with at least one outlet (701) connected, via suitable connection means, to a regulator second stage, there being a flexing chamber (801) for an elastically deformable diaphragm (2) connected to a rod-shaped control member (431) of the delivery valve (401), and there being an annular choke (621; 921) allowing axial sliding of the said member (431) and obstructing the direct flow of gas between the said reduction chamber (501; 901) and the said flexing chamber (801), characterized in that the regulator is provided with a channel (811) which connects the said reduction chamber (501; 901) with the said flexing chamber (801), flow adjustment means (821) being provided in the said channel.

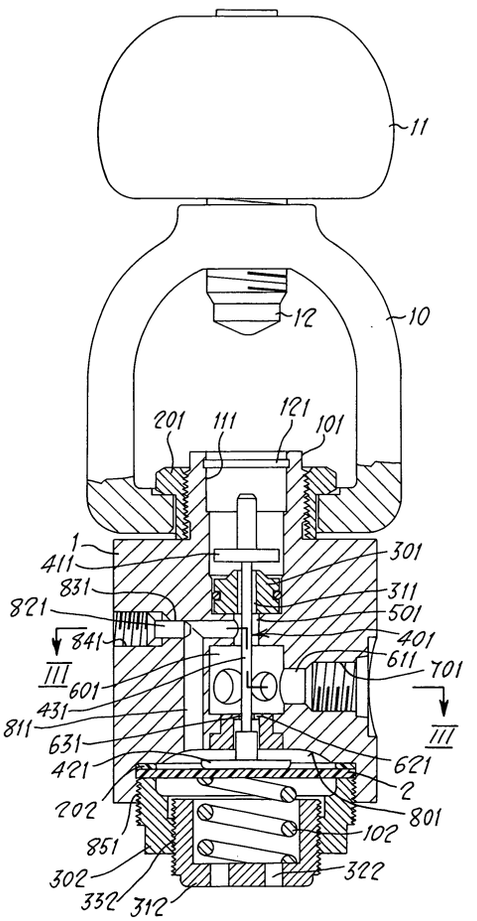

Fig. 1

EP 1 531 124 A2

Description

[0001] The present invention relates to aqualungs, particularly pressure regulators for the regulator first stage in two-stage aqualungs.

[0002] The diaphragm-type regulator first stage of a two-stage aqualung normally includes a reduction chamber which communicates via a delivery valve with the source of air or other gas mixture contained at high pressure in the tank. The gases are then transferred, via a connecting channel, to the regulator second stage. The delivery valve is controlled by a control member comprising an impermeable and elastically deformable diaphragm, one wall of which faces a chamber which is in communication with the external environment. The pressure of the external environment, combined with the pressure drop generated in the second stage by the action of the diver inhaling, opens the valve, which will later be reclosed by the pressure of the gas delivered into the reduction chamber. Although the adjustment of the first stage tends to produce the correct pressure coming into the second stage, during operation the pressures encountered for this intermediate pressure during inhalation are always sub-optimal. The difference between the ideal pressure and the actual pressure increases if the diving conditions become more extreme and critical, for example if the diver goes deeper, or if the tank begins to empty, or if the diver becomes breathless.

[0003] To avoid this problem, one known solution is to place the chamber housing the diaphragm, that is the flexing chamber, in communication with the flow of gases intended for delivery, in such a way as to increase the length of the opening stroke of the delivery valve due to the depression generated in the flexing chamber.

[0004] This result is brought about by forming a channel in the body of the regulator between the outlet to the second stage and the said flexing chamber. One problem with the control of the flexing of the diaphragm may be linked to the influence of the high-pressure gas passing out of the valve in the reduction chamber, if there is some communication between this chamber and the flexing chamber.

[0005] Document IT-A-1 251 831 discloses a regulator first stage in which the reduction chamber communicates with the connector to the second stage by a spout that extends partly into the depression chamber, avoiding influences on the diaphragm. However, the manufacture and calibration of a regulator first stage of this type is very complicated.

[0006] IT-A-1 257 365 proposes a device which obtains similar results to the device of the document cited above, with an obvious simplification of construction: in the communication channel between the reduction chamber and the flexing chamber is an annular choke such as to allow sliding of the control member of the delivery valve, yet preventing the direct flow of gases between the two chambers. This device is extremely efficient; nonetheless it has disadvantages. In the first place there is no way of adjusting the ejection action in the depression chamber relative to the flexing chamber; and the production of a regulator first stage with multiple connectors for the second stage would appear, in the light of the technology employed, to be extremely complicated.

[0007] It is therefore an object of the present invention to provide a pressure regulator for the regulator first stage of a two-stage aqualung in which it is possible to adjust, as and when required, via means that can be controlled from the outside, the influence of the gas flow delivered by the delivery valve on the pressure in the diaphragm flexing chamber communicating with the exterior.

[0008] The subject of the present is therefore a pressure regulator for the regulator first stage of a two-stage aqualung, comprising a reduction chamber which communicates, via a delivery valve, with an admission channel for admitting the high-pressure mixture of breathable gases, and with at least one outlet connected, via suitable connection means, to a regulator second stage, there being a flexing chamber for an elastically deformable diaphragm connected to a rod-shaped control member of the delivery valve, and there being an annular choke allowing axial sliding of the said member and obstructing the direct flow of gas between the said reduction chamber and the said flexing chamber; the regulator is provided with a channel which connects the said reduction chamber with the said flexing chamber, flow adjustment means being provided in the said channel.

[0009] In a preferred embodiment, the said channel that connects the reduction chamber to the flexing chamber enters the said reduction chamber via a port formed radially with respect to the said chamber, and positioned upstream of the outlet connected to the said second stage.

[0010] The said regulator first stage is advantageously provided with a plurality of outlets connectable to regulator second stages; in this case the reduction chamber is provided with a manifold from which the said outlets lead off.

[0011] Other advantages and features of the present invention will become clear in the course of the following detailed description of several embodiments thereof, presented by way of non-restrictive example, with reference to the accompanying sheets of drawings, in which:

Figure 1 is a sectional view through a first embodiment of the device according to the present invention;

figure 2 is a sectional view through an alternative embodiment of the device seen in Figure 1;

figure 3 is a sectional view taken on the plane marked III-III in Figure 1;

figure 4 is a sectional view taken on the plane marked IV-IV in Figure 2.

[0012] Figure 1 shows the device according to the invention, with 1 denoting the body of the diaphragm-type regulator first stage for two-stage underwater breathing apparatus. The said body 1 is provided axially at one end with a spigot 101 in which is formed the admission channel 111 for the mixture of breathable gases contained in a tank (not shown in the figure). This channel 111 contains the filter 121. Attached to the spigot 101 by a ring nut 201 is the yoke 10, which in turn is provided, at the diametrically opposite end, with a knob 11 controlling the clamping screw 12. Inside the channel 111 is the shut-off element 411 of the valve 401, which acts on the seat 301, which sits on the bottom of the said channel and contains an axial hole 311 in which the stem 431 of the valve 401 slides. The axial hole 311 of the seat 301 communicates with the reduction chamber 501, which in turn communicates with the distribution chamber 601, from which there lead off the channels 611 communicating with the outlets 701, to which the hoses will be connected for connection to the regulator second stages (which are not shown in the figure). The stem 431, through the hole 631 of the choke 621 on the wall of the chamber 601, ends in the flexing chamber 801 where it is attached to the face plate 421 which rests against the diaphragm 2. The latter is held leaktightly in the chamber 801 by the sealing means 202 and by the ring nut 302 screwed into the threaded opening 851 of the flexing chamber 801. A threaded hole 332 is formed axially in the ring nut and into it a threaded cap 312 is engaged, having through holes 322,while a spring 102 is inserted between the cover 312 and the diaphragm 2. The flexing chamber 801 communicates with the reduction chamber 501 via the channel 811. Engaged in a hole 831, which is formed in the body 1 of the regulator and communicates with the channel 811 and with the exterior, is the grub screw 821 able to engage with the thread 841 of the hole 831, and partly or totally to obstruct the channel 811.

[0013] Figure 2 illustrates a regulator first stage similar to that of Figure 1, except for the fact that the reduction chamber 901 has radial channels 911 placing it directly in communication with the outlets 701. In the same way the choke 921 containing the through hole 931 allows the stem 431 of the valve 401 to pass through the reduction chamber 901, as far as the face plate 421 which rests against the diaphragm 2.

[0014] Figures 3 and 4 further clarify the difference between the embodiments illustrated in Figures 1 and 2, respectively. Clearly visible too is the position of the grub screw 821 relative to the port of the channel 811 which places the flexing chamber in communication with the reduction chamber.

[0015] The way in which the device according to the present invention works will now be made clear. In order to allow greater control over the ejection effect produced by the flow passing out of the admission channel 101 into the chamber 501 or 901, via the valve 401, the adjustment means 821 have been introduced into the regulator of the invention. This adjustability makes the regulator more adaptable to the varying situations of use, given the fact that is not always necessary to prolong the opening stroke of the valve too far. In this way, in the extreme situation illustrated in Figures 1 and 2, with the adjustment means 821 fully open, the channel 811 will allow the maximum action of the gas flow of the reduction chamber, increasing the opening stroke of the valve. With the adjustment means fully closed, on the other hand, the only influence on the valve 401 will be the action of the external pressure on the diaphragm.

[0016] Moreover, the fact that the channel 811 ends upstream of the outlets 701 in the reduction chamber means that the regulator of the invention can be produced with a plurality of outlets without compromising its functionality, the point here being that if the communication channel between the flexing chamber and the depression chamber, that is the reduction chamber and the outlet together, were formed at the outlet itself, in the case of a regulator with several outlets there would be two problems related to the complexity of the design of this structure as well as to the fact that, more particularly, at the outlets the velocity of the gas flow would drop sharply, greatly limiting the ejection effect.

[0017] The two alternative embodiments illustrated in Figures 1 and 3, and 2 and 4, respectively, relate to the organization of the connection between the various outlets and the reduction chamber. In the first case, between the reduction chamber 501 and the outlets 701 is a distribution chamber 601 from which the channels 611 lead off to the outlets 701; while in the second case the channels 911 lead off directly from the reduction chamber. Although the two versions are substantially similar, the first can take a larger number of outlets because of the larger size of the distribution chamber 601 compared with the reduction chamber 501. In the second case the adopted version, which is much simpler in construction terms, is more suitable for a smaller number of outlets.

Claims

1. Pressure regulator for the regulator first stage of a two-stage aqualung, comprising a reduction chamber (501; 901) which communicates, via a delivery valve (401), with an admission channel (101) for admitting the high-pressure mixture of breathable gases, and with at least one outlet (701) connected, via suitable connection means, to a regulator second stage, there being a flexing chamber (801) for an elastically deformable diaphragm (2) connected to a rod-shaped control member (431) of the delivery valve (401), **characterized in that** the regulator is provided with a channel (811) which connects the said reduction chamber (501; 901) with the said

flexing chamber (801), flow adjustment means (821) being provided in the said channel.

2. Regulator according to Claim 1, containing an annular choke (621; 921) allowing axial sliding of the said rod-shaped control member (431) of the delivery valve (401) and obstructing the direct flow of gas between the said reduction chamber (501; 901) and the said flexing chamber (801).

3. Regulator according to Claim 1 or Claim 2, in which the said channel (811) that connects the reduction chamber (501; 901) to the flexing chamber (801) enters the said reduction chamber via a port positioned upstream of the outlet (701) connectable to the said second stage.

4. Regulator according to Claim 3, in which the said regulator is provided with a plurality of outlets (701) connectable to regulator second stages, each outlet (701) being connected to the said reduction chamber (901) by a suitable channel (911).

5. Regulator according to Claim 3, in which the said regulator is provided with a plurality of outlets (701) connectable to regulator second stages, each outlet (701) being connected by a suitable channel (611) to a distribution chamber (601) which in turn is in communication with the said reduction chamber (501).

6. Regulator according to any one of the preceding Claims 1 to 5, in which the said means (821) for adjusting the flow in the said channel connecting the reduction chamber (501; 901) to the flexing chamber (801) are manually controllable from the outside of the body (1) of the said regulator.

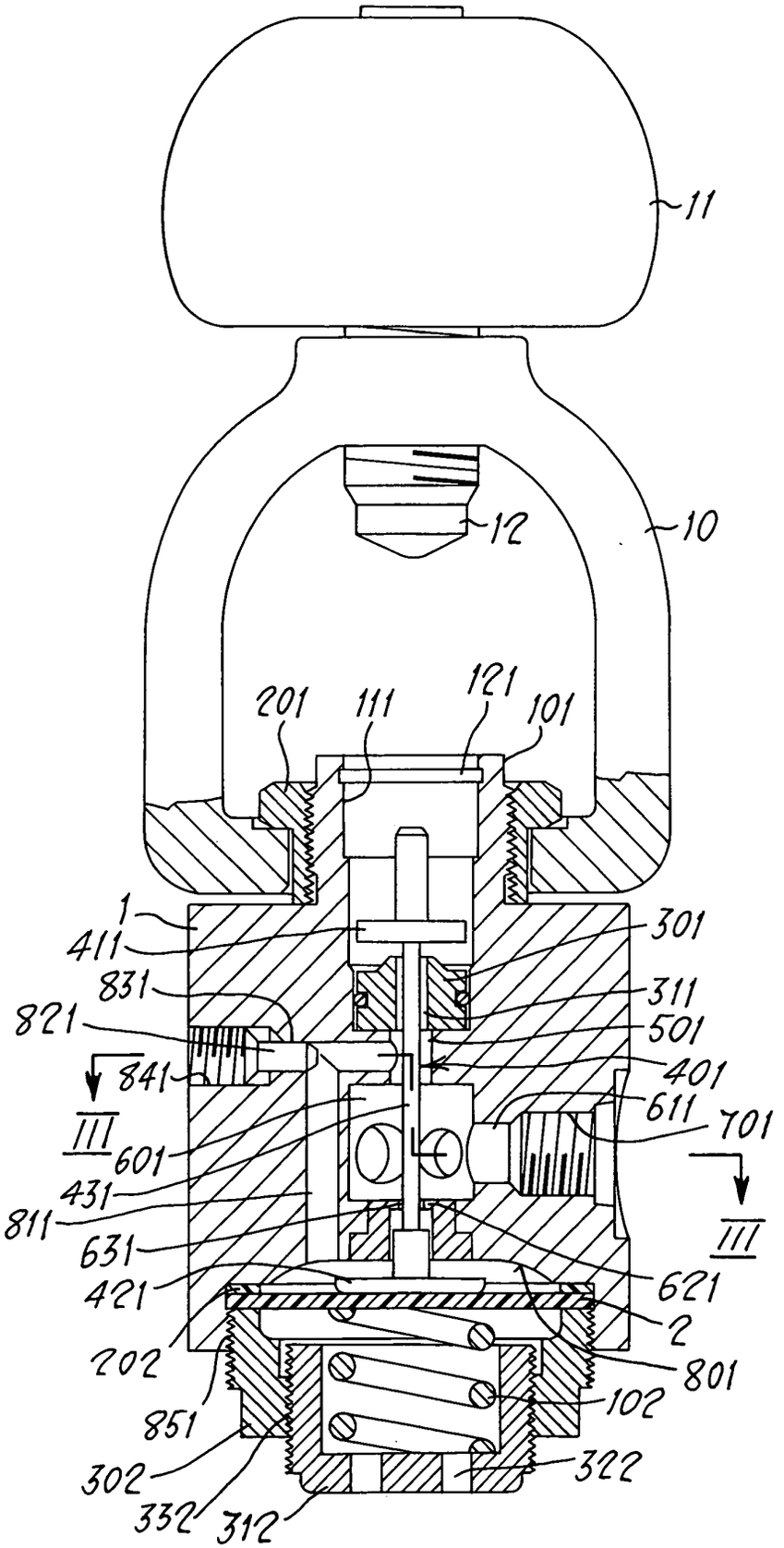
11
12
10
201
111
121
101
1
411
831
821
841
III
601
431
811
631
421
202
851
302
332
312
301
311
501
401
611
701
III
621
2
801
102
322

Fig. 1

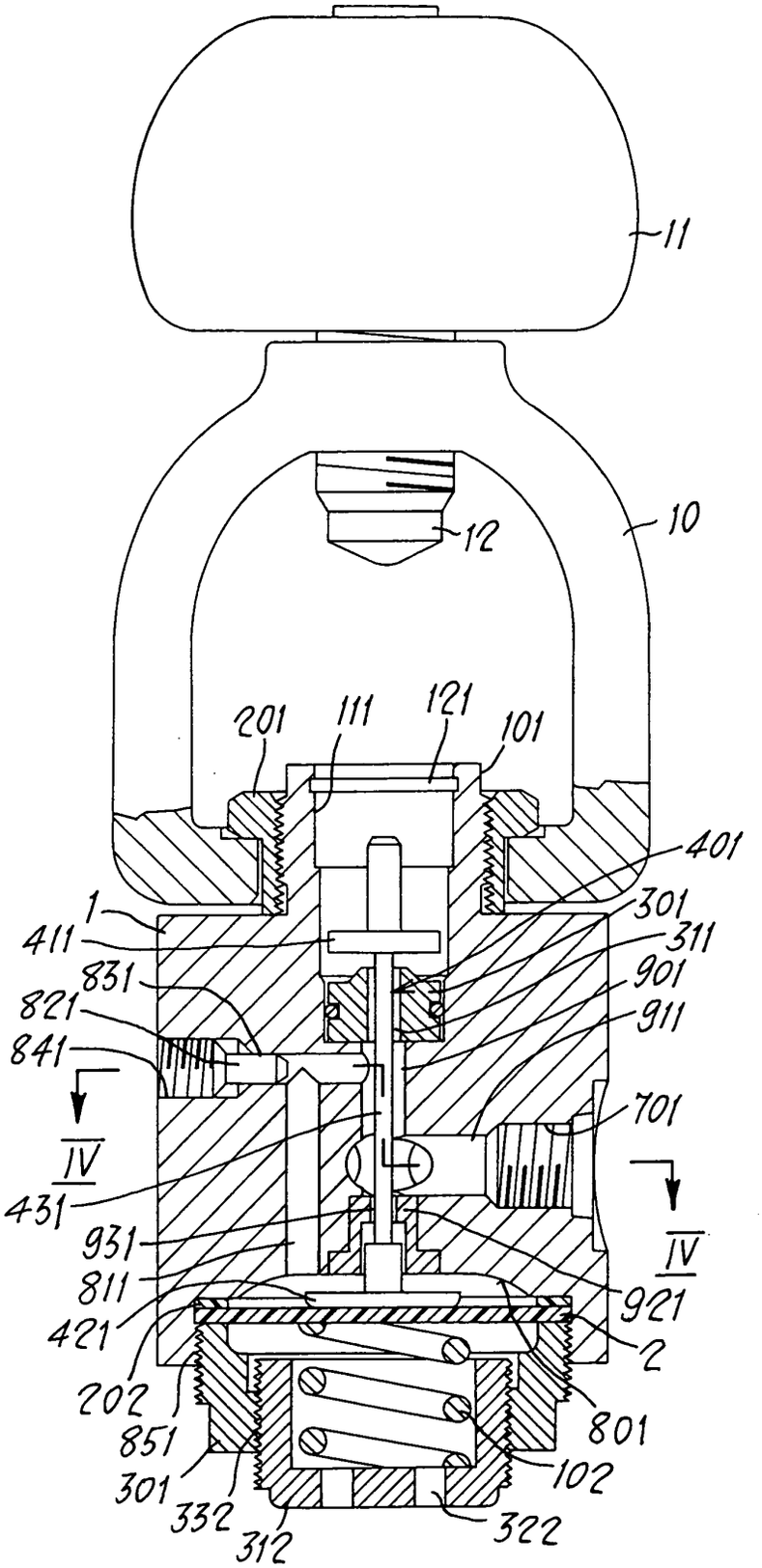
11
10
12
201
111
121
101
401
1
411
831
821
841
301
311
901
911
701
IV
431
931
811
421
202
851
301
332
312
322
102
801
921
2
IV

Fig. 2

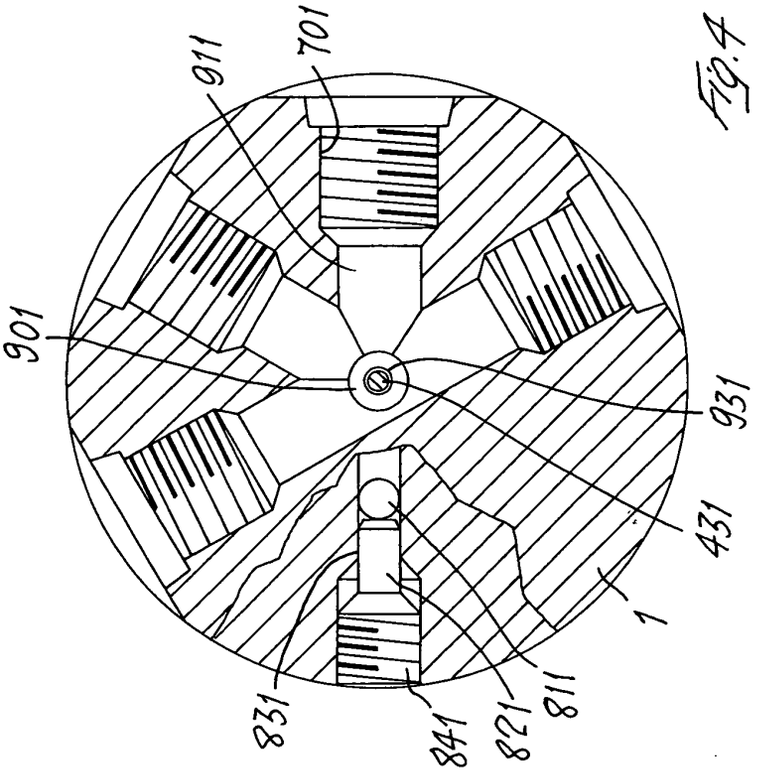
911
701
901
931
431
1
831
841
821
811

Fig. 4

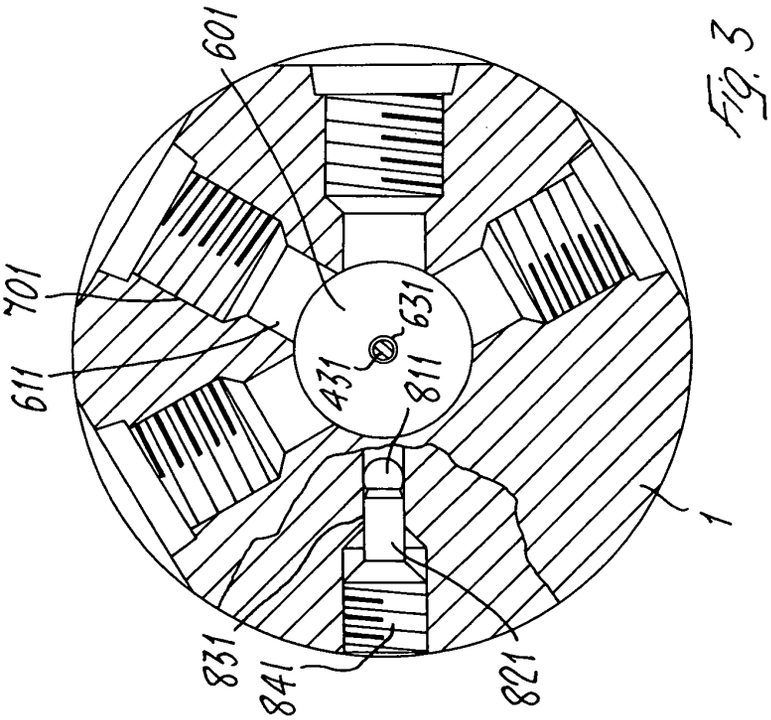
601
701
611
631
431
811
1
831
841
821

Fig. 3