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

(11) EP 1 672 221 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
21.06.2006 Bulletin 2006/25

(51) Int Cl.:
F04D 23/00 (2006.01) F04D 29/08 (2006.01)

(21) Application number: 05026935.6

(22) Date of filing: 09.12.2005

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

(30) Priority: 15.12.2004 DE 202004019366 U

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(54) Compressor, in particular lateral channel compressor

(57) The compressor, in particular lateral channel compressor, comprises a casing member (2, 4) and an impeller (6) which is disposed therein rotatably about an axial axis of rotation and which is spaced from the casing member (2, 4) by a sealing gap (18). The sealing gap is sealed by means of a sealing arrangement which comprises an encircling sealing ring (20) and a spring element (34, 44, 46, 48) that forces the sealing ring (20) against a contact surface (22). The spring load that is applied by the spring element (34, 44, 46, 48) helps obtain automatic, dynamic adaptation to alternating spatial geometries during operation, for example upon temperature fluctuations, which ensures constantly good sealing effects.

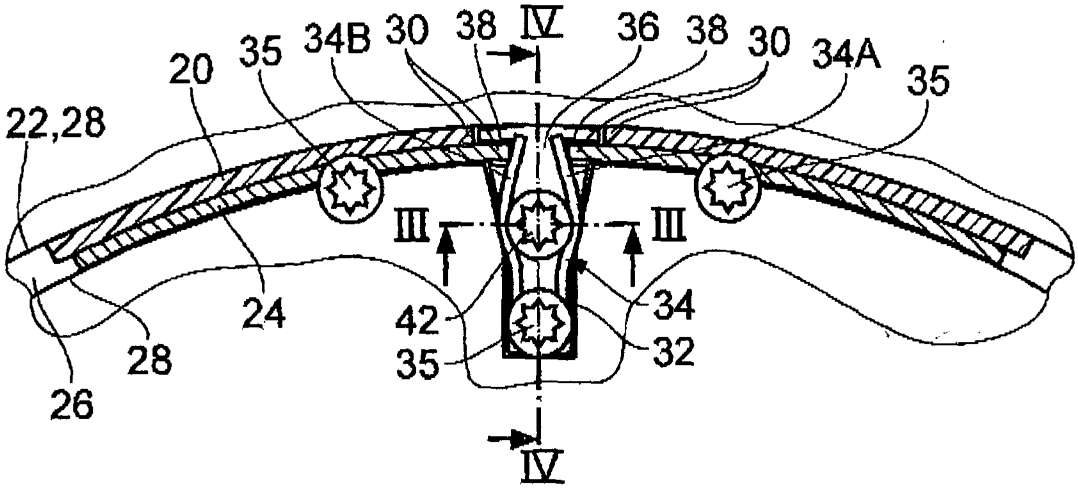

Fig. 2

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Description

[0001] The invention relates to a compressor, in particular a lateral channel compressor, comprising a casing member and an impeller which is disposed therein rotatably about an axial axis of rotation and which is spaced from the casing member by a sealing gap, the sealing gap being sealed by a sealing arrangement which comprises a sealing ring.

[0002] A lateral channel compressor of the species is described for example in DE 100 41 332 C1 or EP 0 708 248 B1. In a lateral channel compressor, the efficiency is substantially determined by a leakage flow which, owing to pressure conditions, originates across the sealing gap between a lateral channel and a hub of fihe impeller. For optimal efficiency, such a leakage flow must be avoided. To this end, a sealing arrangement is customarily provided, closing the sealing gap between the impeller and the casing. According to DE 100 41 332 C1 or EP 0 708 248 B1, provision is made for a plastics or metal sealing ring in the form of sealing tape which is clamped by fastening screws, bearing against the casing by the aid of a retaining ring. According to DE 100 41 332 C1, the sealing ring is a slit ring which can be expanded upon installation for minimization, as far as possible, of the gap towards the impeller.

[0003] Upon operation of the lateral channel compressor, varying temperature and pressure strains bear the risk that the sealing ring does not move in the way defined i.e., it migrates between the fastening screws in the axial as well as radial direction. On the one hand, this may occasion undesired leakage flows. On the other hand, there is the risk of increased wear of the sealing ring, which will ultimately lead to durable drops in efficiency and continuous deterioration of characteristic curves.

[0004] Moreover, sealing the gap as accurately as possible requires highly precise installation of the sealing ring, the retaining ring and the fastening screws, which is complicated and costly.

[0005] It is an object of the invention to embody a lateral channel compressor by which to achieve high efficiency even for a prolonged service life.

[0006] According to the invention, the object is attained an a compressor, in particular a lateral channel compressor, which comprises a casing and an impeller wheel which is disposed therein rotatably about an axial axis of rotation and which is sealed by means of a sealing arrangement which comprises an encircling sealing ring. For the sealing function to be ensured, the sealing arrangement comprises a spring element which forces the sealing ring against a contact surface in particular on the casing.

[0007] Consequently, the spring element helps subject the sealing ring to permanent flexible spring load. This is accompanied with the special advantage that, upon changes in volume during operation, for instance due to temperature fluctuations, these volumetric changes are dynamically compensated by the spring load applied. This means automatically tracking compensation of any changes in volume by the sealing ring, which ensures that the remaining gap between the two rotating parts, namely the casing on the one hand and the impeller on the other, is kept constant and as small as possible for any operating status so that constantly good efficiency is obtained. Moreover, the flexible spring load applied by the spring element reduces the risk of the sealing ring being abraded, which is the case with a conventional prior art sealing ring that is tightly clamped, resulting in damages or at least in deterioration of characteristic curves. Installation is not at all susceptible to tolerances and thus simple. With pre-load no longer being set by a fastening screw that is adjusted upon installation, but rather automatically by reason of the springiness of the spring element, the risk of faulty installation is clearly reduced.

[0008] For a necessary gap dimension and tolerance clearance between the casing and impeller to be ensured or maintained, an appropriate further development provides that the contact surface is a wall area of a groove worked into the casing and that the wall area is oriented and configured in such a way that the sealing ring, when in a position of contact, has the tolerance clearance towards the impeller during standard operation. Correspondingly, a sectional surface of the sealing ring is pressed against a side wall of the groove, while another sectional surface laps over the sealing gap which is to be sealed, and over a sectional surface, adjoining the sealing gap, of the impeller.

[0009] Suitably, provision is made for a clamping ring which bears against, and acts on, the sealing ring and on which acts the spring element. The clamping ring transmits the spring load that is exerted by the spring element on to the sealing ring. With the clamping ring being pressed against the sealing ring by the periphery thereof, uniform, homogeneous transfer of the flexible spring load on to the sealing ring beyond the circumference thereof is ensured so that a homogeneous sealing effect is obtained througout the circumference of the sealing ring.

[0010] In keeping with a preferred improvement, it is provided that the pre-load of the spring element is adjustable be a setting element. This is a simple way of compensating, without any problems, fluctuations of tolerance and dimensional accuracy of the sealing and clamping ring during assembly.

[0011] In accordance with a preferred first alternative, the spring load of the spring element works in the radial direction so that the sealing ring is radially expanded towards the contact surface or compressed in the radial direction. In this case the spring element is in particular configured as a compression or extension spring.

[0012] According to a preferred first embodiment of a spring element that works in the radial direction, the spring element is a spring washer, bearing by its circumference against the sealing ring. In this context, spring washer is to be understood as a ring exhibiting spring load in its radial direction.

[0013] According to a preferred second configuration of spring load acting in the radial direction, provision is made for the clamping ring or the sealing ring to have a point of separation with two opposed ring ends which the spring element acts on. The two ring ends are either spread apart or contracted for the clamping or sealing ring to the expanded or compressed radially.

[0014] Appropriately it is provided that the spring element comprises two spring legs, the spring load of which acting on one of the two ring ends. The two spring legs are in particular the free ends of a spring wire that is bent approximately in the shape of a U or a leaf spring that is bent approximately in the shape of a U. In the vicinity of the bight of the U, the spring element is held up in a fixed point. The free ends act flexibly on the ring ends.

[0015] For spring pre-load adjustment the adjusting element is suitably disposed between the two spring legs. As a result, the spring pre-load is set simultaneously for both spring legs so that symmetric overall springiness is exercised

[0016] Preferably the spring element rests by both spring legs on an intermediate element which is disposed between the spring element and a lateral wall, extending in the radial direction, of the casing. This intermediate element comprises groove-type guides for the ends of the sealing ring and/or clamping ring. The groove-type guides ensure controlled transfer of the spring load in the vicinity of the spring element in particular for the clamping ring. In the simplest of cases, the intermediate elements are simple stampings.

[0017] For reliable action of the spring element on the ring ends, the spring element is safeguarded by a fastener against axial migration or displacement.

[0018] In keeping with a preferred second configuration, provision is made for the spring load to work in the axial direction, forcing the sealing ring axially against the contact surface.

[0019] The principle of sealing by the separate spring element that acts on the sealing ring, is suitable for radial as well as axial sealing. In the first alternative of radial sealing, the sealing ring is pressed in a direction towards an encircling inside periphery and outside periphery of the impeller, the perpendicular of which periphery extends in the radial direction. In the second alternative of axial sealing, the sealing ring is pressed in a direction towards a ring-type front face of the impeller, the perpendicular of which extends in the axial direction.

[0020] Details of the invention will become apparent from the ensuing description of exemplary embodiments of the invention, taken in conjunction with diagrammatic and in part strongly simplified illustrations, in which

Fig. 1 is a diagrammatic cross-sechonal view of details of a lateral channel compressor in the vicinity of a lateral channel;

Fig. 2 is an illustration, on an enlarged scale, of details of a first embodiment of a sealing arrangement that works in the radial direction in an axial viewing direction;

Fig. 3 is a sectional view on the line III-III of Fig. 2;

Fig. 4 is a sectional view on the line IV-IV of Fig. 2;

Fig. 5 is an illustration of a second embodiment of a sealing arrangement that works in the radial direction;

Fig. 6 is a strongly diagrammatic illustration of a sealing arrangement that acts in the axial direction;

Fig. 7 is a sectional view of details of a lateral channel compressor in the vicinity of the sealing arrangement, in which the sealing ring is pressed against an inside periphery of the impeller;

Fig. 8 is a sectional view, by analogy to Fig. 7, in which the sealing ring is pressed against an outside periphery of the impeller; and

Fig. 9 is a cross-sectional view, by analogy to Figs. 7 and 8, in which the sealing ring is pressed in the axial direction against a frontal side face of the impeller.

[0021] In the figures, component parts that work in the same way have identical reference numerals.

[0022] The lateral channel compressor, details of which are seen in Fig. 1, comprises a two-piece casing, namely a casing member 2 and a cover 4. An impeller 6 is disposed in the casing; it is rotatable about an axial axis of rotation. In the figure, the axial direction 8 is roughly outlihed by a doubleheaded arrow. The impeller 6 is driven by a driving motor (not shown) and a drive shaft. The impeller 6 has a hub 10 which extends in the radial direction and, on the side of its end, terminates in a supporting ring 14 on which are mounted a plurality of individual blades 16 which are distributed along the circumference. In the embodiment, the supporting ring 14 projects on both sides over the hub 10 in the axial direction 8. In the projecting area, the supporting ring 14 forms a cylindrical inside periphery which extends in the axial direction 8 towards the two casing members 2, 4.

[0023] Located between the impeller 6, in particular the supporting ring 14, and the two casing members 2, 4 is a gap which is termed sealing gap 18 and which must be sealed for leakage flows to be avoided. The casing members 2, 4 are substantially adapted to the contour of the impeller 6, in particular in the vicinity of the hub 10 and the supporting ring 1,4.

[0024] A sealing arrangement is provided for closing the sealing gap. It comprises a sealing ring 20 which consists for example of plastics, in particular Teflon, or of metal, and which is forced by spring load against a contact surface 22 on the casing member 2, 4. In the embodiment of Fig. 1, the spring load is transferred to the sealing ring by means of a clamping ring 24 that is embodied in particular as metal strip. The sealing ring 20 as well as the clamping ring 24 jointly rest in a sealing groove 26. It is worked into the respective casing member 2, 4, extending in the axial direction so that the bottom of the groove extends in the radial direction 12 and the two side walls 28 run in the axial direction 8. In the embodiment of Fig. 1, the contact surface 22 is formed by the top side wall 28 that is oriented towards the blades 16. The sealing ring 20 is pressed against this side wall 28. The sealing ring 20 projects in the axial direction 8 over the sealing gap 18, standing out in the axial direction 8 from a sectional area of the inside periphery of the supporting ring 14. The inside periphery of the supporting ring 14 has a radius or diameter that slightly exceeds the side wall 28 which constitutes the contact surface 22 so that, with the sealing ring 20 resting on the contact surface 22, there is still some minor tolerance clearance between the sealing ring 20 and the inside periphery of the supporting ring 14, This helps prevent the impeller 6 from rubbing on the sealing ring 20.

[0025] A first embodiment of the sealing arrangement is illustrated in Figs. 2 to 4, According to Fig. 2, the sealing ring 20 rests outwards and the clamping ring 24 inwards in the sealing groove 26. Both rings 20, 24 are slit, having a gap and opposed ring ends 30. In the casing member 2, 4, provision is made for a spring-element-34 incorporation chamber 32 which extends in the radial direction 12. The spring element 34 of the embodiment is designed in the way of a spring wire bent in the shape of a U and having two spring legs 34A, B. In the front area of the spring legs 34A, B, the spring element 34 has a crimp; it is entirely inserted in the incorporation chamber 32 where it is fixed by a fastening screw 35 and safeguarded in particular against displacement in the axial direction 8. The spring legs 34A, B rest on an intermediate element 36 which is clamped between the spring legs 34A, B and a side wall of radial extension of the casing member 2, 4. In its radially outward marginal area, the intermediate element 36 has two opposed guiding grooves 38, with the ring ends 30 of the clamping ring 24 resting therein.

[0026] The spring load of the spring legs 34A, B acts in the circumferential direction on the ring ends 30, thus expanding the clamping ring 24 so that overall spring load of the clamping ring 24 acts throughout the periphery in the radial direction 12 on the sealing ring 20.

[0027] In the vicinity of the crimp of the two spring legs 34A, B, provision is made for another screw in the form of a setscrew 42. This adjusting or regulating element helps set the pre-load of the spring element 34 during assembly. To this end, the shank of the setscrew 42 is for example eccentric so that the spring legs 34A, B are forced outwards by rotation of the setscrew 42.

[0028] Further fastening screws 35 are provided, which are distributed along the circumference of the clamping 24 and the sealing ring 20, axially securing the two rings 20, 24.

[0029] In keeping with an alternative embodiment according to Fig. 5, the sealing ring 20 is compressed in the radial direction by way of the clamping ring 24. In this embodiment, the two ring ends 30 of the clamping ring 24 are connected to each other by way of an extension spring 44 in the form of a helical spring.

[0030] In the embodiment according to Fig. 6, the sealing ring 20 is pressed in the axial direction 8 against the contact surface 22 which extends in the radial direction 12, In this embodiment, a compression spring 46 of the type of a helical spring acts directly on the sealing ring 20. In doing so, the compression spring 46 supports itself by its rear end on the casing member 2, 4.

[0031] The various alternatives of sealing of the exemplary embodiments according to Figs. 1 to 4, 5 and 6, are once again illustrated by way of example, taken in conjunction with Figs. 7 to 9. The embodiment according to Fig. 7 corresponds to the embodiment according to Fig. 1, in which the sealing arrangement of Figs. 2 to 4 is used i.e., in which the sealing ring 20 is expanded radially outwards.

[0032] In the embodiment according to Fig. 8, the sealing ring 20 is compressed radially - as shown by way of example in the embodiment according to Fig. 5. The sealing ring 20 seals the sealing gap 18 towards an external periphery of the supporting ring 14. For abrasion to be prevented, this external periphery has a radius smaller than the contact surface 22.

[0033] In the embodiment according to Fig. 9, use is made of an axial seal, which is strongly simplified by way of example in Fig. 6. In this sealing arrangement, the sealing ring 20 is pressed against the contact surface 22 which extends in the radial direction 12, and the sealing ring 20 projects over the sealing gap 18 as well as a sectional surface of the supporting ring 14 in the radial direction 12. In the embodiment of Fig. 9, provision is made for a spring element of the type of a spring assembly 48 for exertion of the spring load that acts in the axial direction 8, with several compression springs 46, in this spring assembly 48, being distributed along the circumference between two retaining rings and combined to constitute a pre-fabricated constructional unit.

[0034] All the embodiments have in common that the sealing ring 20 is forced against the contact surface 22 by the spring load of the respective spring element, sealing the gap 18. The flexible springiness helps achieve dynamic adaptation of the sealing ring 20 during the operation of the lateral channel compressor. The advantage resides in that, upon assembly, the dimensions of the gaps, pre-load etc. will not need any high-precision adjustment for sufficient sealing effects to be ensured. The assembly is considerably simplified, with in particular any defective assembly being precluded. Moreover, this embodiment can do without the prior art retaining ring of DE 100 41332 C1, which clamps the sealing ring in the axial direction.

[0035] With the sealing ring 20 being automatically and dynamically entrained by the spring element, varying thermally conditioned deformations of the sealing ring 20, the clamping ring 24 and the casing member 2, 4 are not critical. Moreover, any uncontrolled expansion or displacement of the sealing ring 20 is avoided, which ensures that the impeller 6 does not rub on the sealing ring 20. Another advantage consists in the improved emergency running properties. If, for example, the supporting ring 14 hits on the sealing ring 20 in the case of bearing damages, the sealing ring 20 is able to yield, owing to the flexible accommodation, which will keep the friction between the sealing ring 20 and supporting ring 14 low. With the sealing, ring 20 adjusting dynamically to respective current spatial geometries, such a lateral channel compressor is less susceptible with a view to tolerances in shape and dimension during the manufacture of the individual parts of the lateral channel compressor, such as sealing ring 20, groove 26, diameter of the supporting ring 14 and contact surface 22, width of the sealing gap 18 etc. On the whole, the spring-element arrangement enables the sealing ring 20 to rest uniformly on the sealing groove 26 even in the case of fluctuations in load and temperature. Necessary tolerance clearances do not affect the sealing effect.

Claims

1. A compressor, in particular lateral channel compressor, comprising a casing member (2,4) and an impeller (6) which is disposed therein rotatably about an axis of rotation and which is spaced from the casing member (2, 4) by a sealing gap (18) which is sealed by a sealing arrangement that comprises a sealing ring (20), **characterized in that** the sealing arrangement comprises a spring element (34, 34a, 34b, 44,46, 48) which forces the sealing ring (20) against a contact surface (22).

2. A compressor according to claim 1, **characterized in that** the contact surface (22) is a wall area (28) of a sealing groove (26) that is worked into the casing member (2, 4); and **in that** the wall area (28) is such that, with the sealing ring (20) contacting, it exhibits a tolerance clearance towards the impeller (6) during standard operation.

3. A compressor according to claim 1 or 2, **characterized in that** a clamping ring (24) is provided which rests on the sealing ring (20) and which the spring element (34, 34A, 34B, 44) acts on and which transfers the spring load to the sealing ring (20).

4. A compressor according to one of the preceding claims, **characterized in that** the spring pre-load is adjustable by an adjusting element (42).

5. A compressor according to one of the preceding claims, **characterized in that** the spring load acts in a radial direction so that the sealing ring (20) is expanded or compressed radially.

6. A compressor according to claim 5, **characterized in that** the spring element is a spring washer which rests by its circumference on the sealing ring (20).

7. A compressor according to claim 5, **characterized in that** the clamping ring (24) or the sealing ring (20) comprises a point of separation with two opposed ring ends (30) which the spring element (34, 34A, 34B, 44) acts on.

8. A compressor according to claim 7, **characterized in that** the spring element (34) comprises two spring legs (34A, 34B), the spring load of which acts on a respective ring end (30).

9. A compressor according to claim 8, **characterized in that** the adjusting element (42) is disposed between the spring legs (34A, 34B) for setting the spring pre-load.

10. A compressor according to one of claims 7 to 9, **characterized in that**, between the spring element (34, 34A, 34B, 44) and a side wall, extending in the radial direction, of the casing member (2,4), provision is made for an intermediate element (36) which comprises guiding grooves (38) for the ring ends (30) of the sealing ring (20) and/or the clamping ring (24).

11. A compressor according to one of claims 5 to 10, **characterized in that** the spring element (34, 34A, 34B, 44) is safeguarded by a fastening element (35) against displacement in an axial direction.

12. A compressor according to one of claims 1 to 4, **characterized in that** the spring load acts in the axial direction so that the sealing ring (20) is pressed axially against the contact surface.

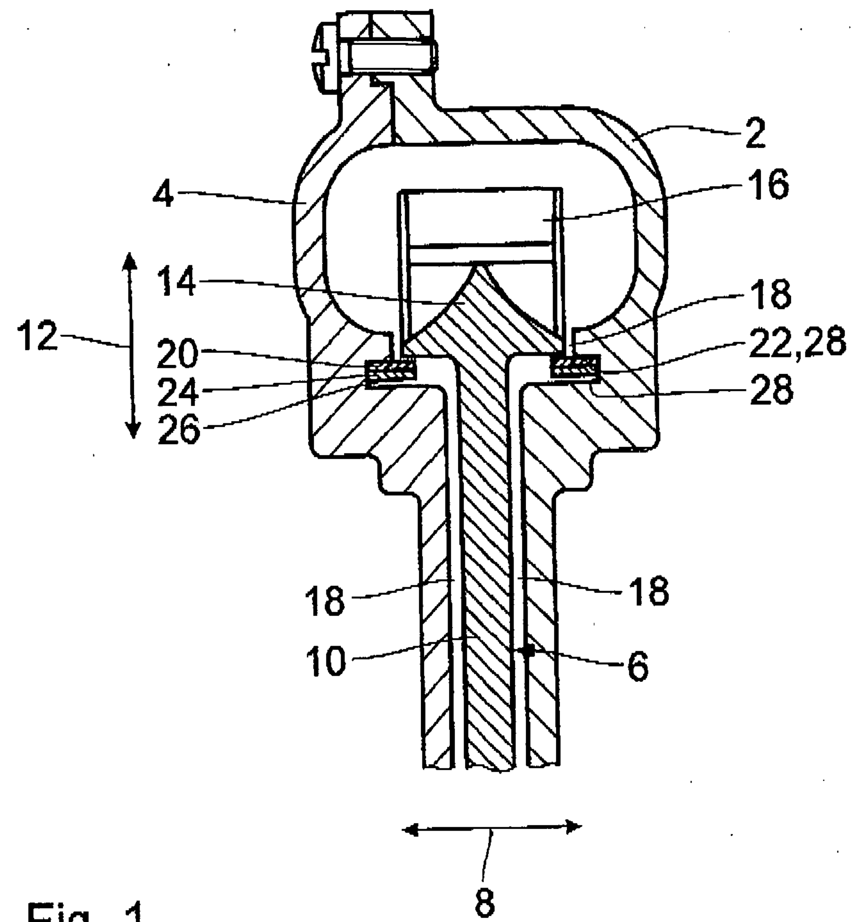
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Fig. 1

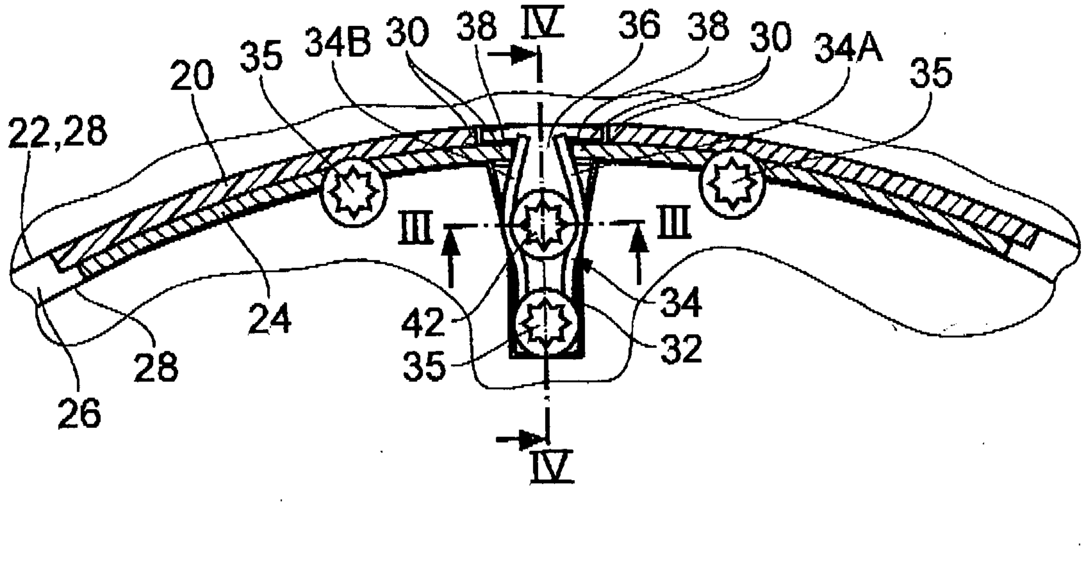
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Fig. 2

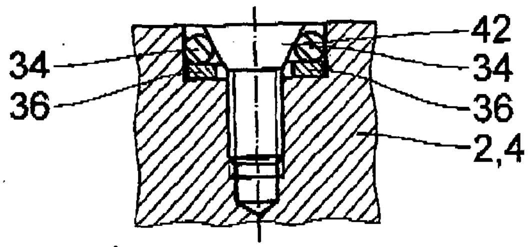

Fig. 3

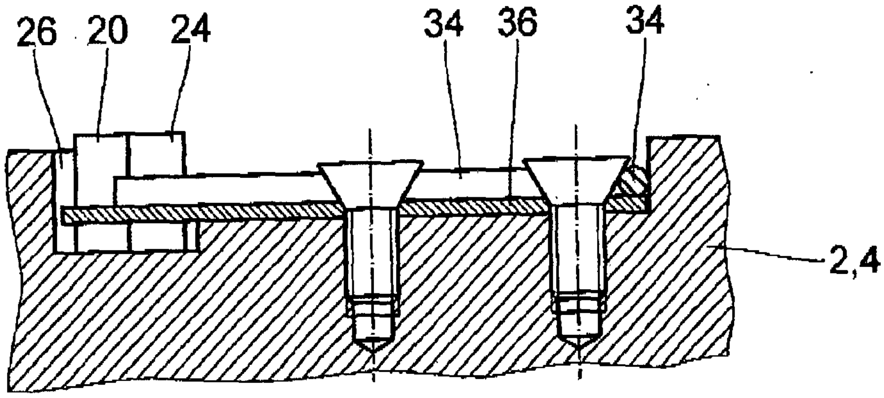

Fig. 4

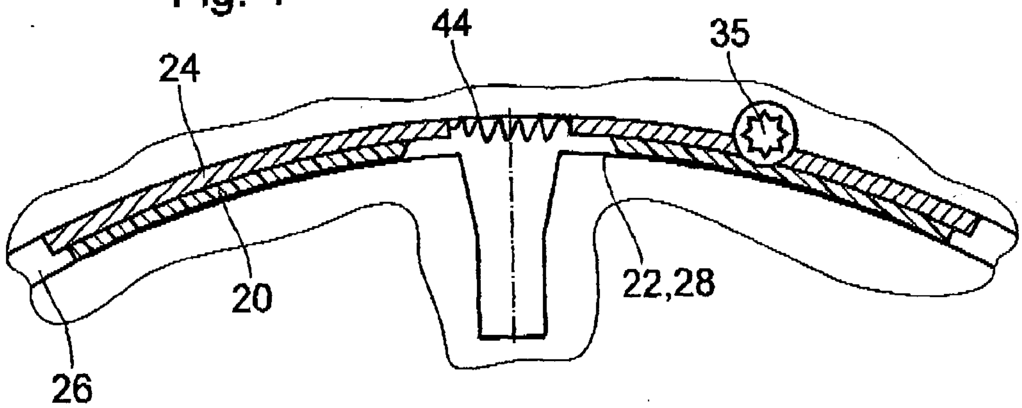

Fig. 5

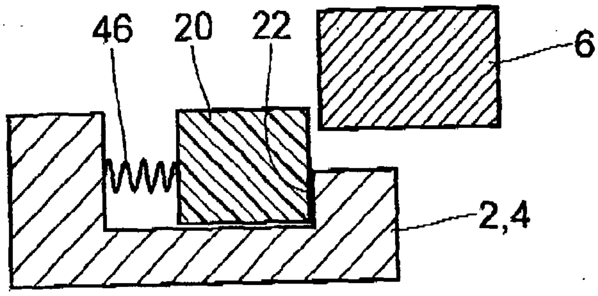

Fig. 6

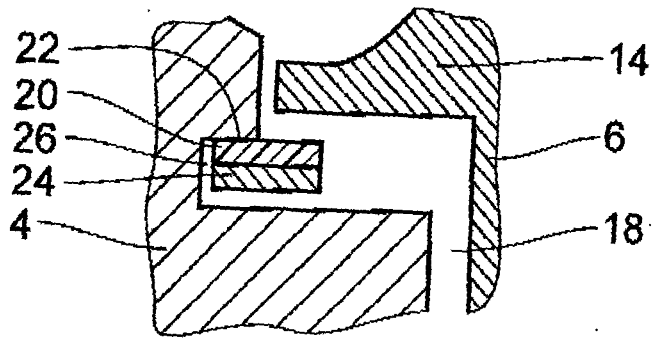

Fig. 7

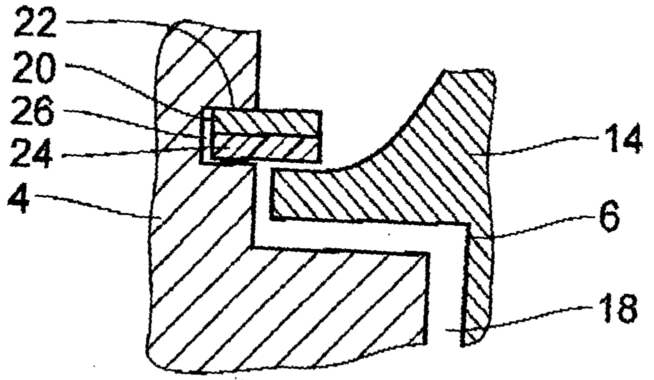

Fig. 8

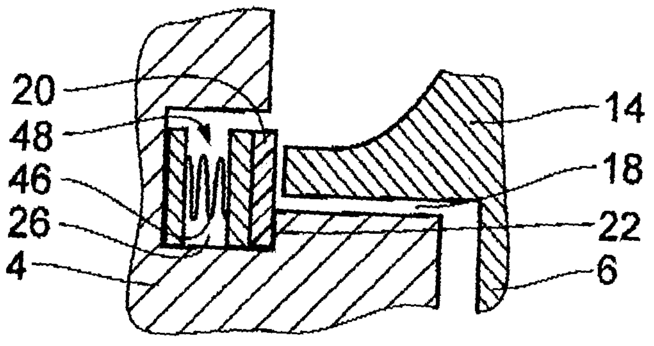

Fig. 9