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(54) **Device for adjusting the height of an object**

Vorrichtung zur Höheneinstellung eines Objektes

Dispositif pour ajuster la hauteur d'un objet

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Description

[0001] The invention relates to a device for adjusting the height of an object, for instance a work surface, relative to a fixed point, cf. the preamble of claim 1.

[0002] Such a device is known from the Netherlands patent application no. 9100324. The known device forms part of a column in a leg construction of adjustable length for supporting a work surface together with at least one other leg construction, which leg construction comprises: a foot for placing on the ground, a support for coupling to the work surface and two columns of adjustable length which are rigidly connected on one side to the foot and on the other side to the support. Each of the columns comprises two parts telescopically movable relative to each other, i.e. an upper part connected to the support and a lower part which is connected to the foot and provided with a spindle nut into which is screwed a screw spindle mounted on the upper part, and a right-angled transmission with conical toothed wheels present on the upper part. The right-angled transmissions of both columns have the same transmission ratios and are mutually coupled by means of a coupling shaft which has at least one cardan coupling and which is slidable to a limited extent relative to these right-angled transmissions such that when the screw spindles are rotated the columns undergo equal changes in length.

[0003] The coupling shaft in the known leg construction has the at least one cardan coupling because in this leg construction driving or driven shafts extending in horizontal direction of the right-angled transmissions will never lie exactly mutually in line.

[0004] It is a drawback of the known leg construction that the coupling shafts used for coupling the length-adjustable columns have to be provided with a cardan coupling, this of course being more expensive than comparable rigid coupling shafts.

[0005] It is a further drawback of the coupling shafts in the known leg construction that the degree to which the coupling shafts are slidable is inherently limited by the position of the conical toothed wheels on the outer ends of the coupling shafts relative to the co-acting conical toothed wheel on the screw spindle in the respective columns. If the co-acting toothed wheels are pressed too heavily onto each other, the transmission runs with difficulty, which will at the very least result in premature wear; if the co-acting toothed wheels are pressed too lightly onto each other this likewise results in premature wear, while the transmission moreover generates a relatively large amount of noise.

[0006] It is an object of the invention to provide a device for adjusting in rapid manner the height of an object to be loaded mechanically, for instance a work surface, in a mechanically stable position.

[0007] It is a further object to provide such a device which can be coupled in simple manner to a co-acting similar device, wherein the coupling is effected according to a construction which enables reliable operation without extreme dimensional tolerances, which is wear-resistant, requires little maintenance and is inexpensive to manufacture.

[0008] These objectives are achieved and other advantages obtained with a device of the type stated in the preamble, wherein according to the invention the gear transmission comprises a first crown wheel and at least one cylindrical pinion co-acting therewith.

[0009] A crown wheel is a toothed wheel for a right-angled transmission which co-acts with, and is therefore defined in its shape by, a cylindrical pinion with straight or angled evolvent teeth. Other than in a right-angled gear transmission with conical toothed wheels, the axial position of one of the two rotating, mutually perpendicular shafts coupled by the gear transmission is not at all critical when the pinion is sufficiently long: the shaft provided with the cylindrical pinion co-acting with the crown wheel can accommodate a clearance in axial direction which is determined by the difference in length of the teeth of the pinion and of the crown wheel.

[0010] In an embodiment of a device according to the invention and a second device coupled thereto by means of a coupling shaft, the coupling shaft is a rigid shaft which is provided with cylindrical first pinions co-acting with the respective first crown wheels.

[0011] In a subsequent embodiment of a device according to the invention and a second device coupled thereto by means of a coupling shaft the first crown wheel in the respective devices is situated at the top of the respective screw spindles and the coupling shaft is assembled from two sub-shafts mutually coupled by a right-angled coupling gear transmission with a coupling crown wheel, which sub-shafts are each provided with a first cylindrical pinion co-acting with one of the respective first crown wheels and with a second cylindrical pinion co-acting with the coupling crown wheel.

[0012] A compound coupling shaft coupled by a crown wheel and two respective co-acting cylindrical pinions provides the additional advantage relative to the known coupling shaft assembled from a cardan coupling, in addition to the above stated insensitivity to clearance in axial direction of the (component parts of the) coupling shaft, that the chosen angle between the component parts, should the position of the coupled adjusting devices require such, can be much smaller than in a coupling shaft with cardan coupling. Another advantage is that the coupled shafts can be driven by a drive on the shaft of the coupling crown wheel, whereby it is possible for instance to drive four adjusting devices placed in a rectangle simultaneously and in balance with only one drive motor placed on the diagonal of the rectangle.

[0013] In an advantageous embodiment of a device according to the invention and a second device coupled thereto by means of a coupling shaft, the first cylindrical pinions of the coupling shaft co-act at a location along the periphery of the respective first crown wheels with

these crown wheels such that a rotation of the respective first crown wheels relative to each other will always be the same in any direction.

[0014] Unlike in a right-angled transmission with conical toothed wheels, use is made in this latter embodiment of the option of coupling a crown wheel to a coupling shaft which intersects the produced part of the rotation axis of this crown wheel, wherein the pinion co-acts with the crown wheel at a location along the periphery diametrically opposite the only location possible when using a conical toothed wheel. In such an embodiment one of the crown wheels can for instance be coupled to a horizontal, manually operable drive shaft. The rotation direction of this drive shaft can for instance be chosen solely by the choice of the location where it co-acts with the crown wheel such that a rotation to the right results in an upward movement of the object to be adjusted by this embodiment.

[0015] In a further embodiment the respective right-angled gear transmissions are provided by a modular element wherein the respective crown wheel and the at least one cylindrical pinion are mounted in each case in a housing, which housing substantially takes the form of for instance a straight prism in the base of which the crown wheel is mounted and in at least one of the standing side surfaces of which is mounted a cylindrical pinion co-acting with the crown wheel. Such a housing is for instance fixed with its upper surface against the underside of the object, for instance a table top.

[0016] In this embodiment the base of the straight prism is preferably a regular polygon, for instance a square.

[0017] In a very advantageous embodiment with a modular element the housing substantially takes the form of a straight cylinder, in the base of which cylinder the crown wheel is mounted and wherein the wall of this cylinder comprises at least one wall part which is rotatable in peripheral direction relative to the base and in which is mounted a cylindrical pinion co-acting with the crown wheel.

[0018] This embodiment is for instance used in a height-adjustable combination of two table tops coupled at an angle in a horizontal plane, wherein the angle is adjustable.

[0019] The respective crown wheels and cylindrical pinions in a device according to the invention can be manufactured from a plastic material and are advantageously manufactured from a sintered metal.

[0020] In an advantageous embodiment the housing for a right-angled gear transmission is manufactured from injection moulding material.

[0021] The invention will now be elucidated hereinbelow on the basis of embodiments with reference to the drawings.

[0022] In the drawings

Fig. 1 shows a partly broken-away perspective view of a length-adjustable leg according to the invention, for instance for a work surface,

Fig. 2 shows a schematic top view of a table with four legs coupled according to the invention,

Fig. 3A shows in partly broken-away perspective view a block-shaped housing in which a crown wheel and two pinions are mounted,

Fig. 3B shows the housing of Fig. 3A in "exploded view".

Fig. 4A is a schematic top view of a table top with a combination of two coupled devices provided with a drive shaft,

Fig. 4B shows the table of fig. 4A in partly broken-away perspective view,

Fig. 5A shows in schematic top view a combination of two table tops coupled at an angle in a horizontal plane, wherein the angle is adjustable,

Fig 5B shows the table of fig. 5A in partly broken-away perspective view, and

Fig. 6 is a partly broken-away perspective view of a cylindrical housing in which a crown wheel and two pinions are mounted.

[0023] Corresponding components are designated in the figures with the same reference numerals.

[0024] Fig. 1 shows a device 1 for adjusting the height of a support plate 3 for screwing under a table top relative to a foot 2, a column 4 of adjustable length which comprises an upper hollow part 5 connected to support plate 3 and a lower hollow part 6 rigidly connected to foot 2, which parts 5, 6 are telescopically movable relative to one another. Rigidly connected to foot 2 is a spindle nut 7 into which a screw spindle 8 is screwed which is mounted on upper column part 5 and which is provided on its top with a crown wheel 29 which co-acts with a cylindrical pinion 28 of a horizontal drive shaft 11. Crown wheel 29 is mounted in a cylindrical housing, wherein a wall part 46 which is rotatable in peripheral direction and in which cylindrical pinion 28 is mounted extends from base 45. It is immediately apparent from the figure that the operation of right-angled transmission 29, 28 is inherently insensitive to clearance of drive shaft 11 in axial direction (as according to double arrow 16) at least as long as this clearance is an order of magnitude smaller than the length of the teeth of crown wheel 29, which will of course be the case in a practical situation.

[0025] Fig. 2 shows a table top 22 which is supported by four length-adjustable, identical legs which are synchronously height-adjustable using horizontal drive shafts 11 which are coupled in the centre of table top 22 to a crown wheel 19 by second cylindrical pinions 20, which crown wheel 19 is driven by a motor 24 by means of a third cylindrical pinion 25 on a drive shaft 23. By making use as in this example of a horizontal drive shaft 23, the position of drive motor 24 under table top 22 can be chosen such that motor 24 does not form an inconvenient obstacle for a user of the table. In an application of a table wherein the space below the centre does not

have to be left clear, the crown wheel can be provided with a downward extending vertical drive shaft and drive motor 24 is for instance placed directly below crown wheel 19 and coupled to this drive shaft.

[0026] Fig. 3A shows a housing 30 manufactured from injection moulding material which substantially takes the form of a regular (square) prism, in the base 31 of which a crown wheel 9 is mounted using a needle bearing (not shown) and in two 33, 34 of the standing side surfaces 32-34 of which is mounted a cylindrical pinion 10 co-acting with crown wheel 9. Crown wheel 9 and cylindrical pinions 10 are manufactured from sintered plastic material, housing 30 is manufactured from injection moulding material PA6GV reinforced with ribs of glass-fibre material.

[0027] Fig. 3B shows housing 30 of Fig. 3A in "exploded view" with the square base 31.

[0028] Fig. 4A shows in top view a table top 15 with a combination of two adjusting devices, represented in the figure by the respective crown wheels 9, 9', which are coupled by a coupling shaft 11 and which co-act with cylindrical pinions 10, 10'. Coupling shaft 11 intersects the produced part of the rotation axis of right-hand crown wheel 9' so that pinions 10, 10' co-act at corresponding locations with respective crown wheels 9, 9', as a result of which a rotation of these crown wheels 9, 9' relative to each other will always be the same in any direction. The height of table 15 can be adjusted in simple manner using a drive handle 23, 23' placed on the left or right and provided with a pinion 25, 25' co-acting with respective crown wheels 9, 9'.

[0029] Fig. 4B shows the table of fig. 4A in broken-away perspective.

[0030] Fig. 5A shows in schematic top view a combination of a table top 41 of adjustable height which is provided with a round short side along which is coupled a second height-adjustable table top 42 provided with a corresponding concave side. The height of combination 41, 42 can be adjusted using three adjusting devices coupled by respective coupling shafts 11, 43 and represented in the figure by respective crown wheels 9, 29, 39 which co-act with respective cylindrical pinions 10, 28, 40. Coupling shafts 11, 43 intersect the produced part of the rotation axis of the respective crown wheels 9, 39 so that pinions 10, 40 co-act with respective crown wheels 9, 39 at corresponding locations, as a result of which a rotation of the three crown wheels 9, 29, 39 relative to each other will always be the same in any direction. The height of table 15 can be adjusted in simple manner using a drive handle 23 provided with a pinion 25 co-acting with crown wheel 39. Central crown wheel 29 is coupled to pinion 44 on coupling shaft 11 of attached table 42 in a manner such that the angle α between coupling shafts 11, 43, and therewith the angle between table tops 42, 41, is adjustable through a range of about 180°.

[0031] Fig. 5B shows the table of fig. 5A in broken-away perspective.

[0032] Fig. 6 shows a part of a straight cylindrical housing 50 for a height-adjusting device which can for instance be used under table top 41 of Fig. 5, with a base 45 in which a crown wheel 29 is mounted, wherein there extend from base 45 wall parts 46, 47 which are rotatable in peripheral direction and in which cylindrical pinions 28, 44 co-acting with crown wheel 29 are respectively mounted.

Claims

1. Device (1) for adjusting the height of an object (3, 15, 22, 41, 42), for instance a work surface, relative to a fixed point (2) by means of a rotatable vertical axis screw spindle (8) which at its top is mounted to the object (3, 15, 22, 41, 42) by means of a right-angled gear transmission (29, 28; 9, 10; 39, 40) and at its opposite end is screwed into a spindle nut (7) coupled rigidly to the fixed point (2), which gear transmission connects rotation of the vertical axis screw spindle (8) and rotation of a horizontal axis (11, 43) pinion, **characterized in that** the gear transmission comprises a first crown wheel (29, 9, 39) and at least one cylindrical pinion (28, 10, 40) co-acting therewith.

2. Device (1) as claimed in claim 1 and a second device (1) as claimed in claim 1 coupled thereto by means of a coupling shaft, **characterized in that** the coupling shaft is a rigid shaft (11, 43) which is provided with cylindrical first pinions (28, 10, 40) co-acting with the respective first crown wheels (29, 9, 39).

3. Device (1) as claimed in claim 1 and a second device (1) as claimed in claim 1 coupled thereto by means of a coupling shaft, **characterized in that** the first crown wheel (9) in the respective devices (1) is situated at the top of the respective screw spindles (8) and the coupling shaft is assembled from two sub-shafts (11) mutually coupled by a right-angled coupling gear transmission (19, 20) with a coupling crown wheel (19), which sub-shafts (11) are each provided with a first cylindrical pinion (10) co-acting with one of the respective first crown wheels (9) and with a second cylindrical pinion (20) co-acting with the coupling crown wheel (19).

4. Device as claimed in claim 2 or 3, **characterized in that** the first cylindrical pinions of the coupling shaft co-act at a location along the periphery of the respective first crown wheels with these crown wheels such that a rotation of the respective first crown wheels relative to each other will always be the same in any direction.

5. Device as claimed in any of the claims 1-4, **charac-**

terized in that the respective right-angled gear transmissions are provided by a modular element wherein the respective crown wheel (9, 29) and the at least one cylindrical pinion (10, 28, 44) are mounted in each case in a housing (30, 50).

6. Device as claimed in claim 5, **characterized in that** the housing substantially takes the form of a straight prism (30), in the base of which the crown wheel is mounted and in at least one of the standing side surfaces of which is mounted a cylindrical pinion co-acting with the crown wheel.

7. Device as claimed in claim 6, **characterized in that** the base of the straight prism is a regular polygon.

8. Device as claimed in claim 7, **characterized in that** the base of the straight prism is a square (31).

9. Device as claimed in claim 5, **characterized in that** the housing substantially takes the form of a straight cylinder (50), in the base (45) of which cylinder (50) the crown wheel (29) is mounted and wherein the wall of this cylinder (50) comprises at least one wall part (46, 47) which is rotatable in peripheral direction relative to the base (45) and in which is mounted a cylindrical pinion (28, 44) co-acting with the crown wheel (29).

10. Device as claimed in any of the claims 1-9, **characterized in that** the respective crown wheels are manufactured from a plastic material.

11. Device as claimed in any of the claims 1-9, **characterized in that** the respective crown wheels are manufactured from a sintered metal.

12. Device as claimed in any of the claims 1-11, **characterized in that** the respective cylindrical pinions are manufactured from a plastic material.

13. Device as claimed in any of the claims 1-11, **characterized in that** the respective cylindrical pinions are manufactured from a sintered metal.

14. Device as claimed in any of the claims 5-9, **characterized in that** the housing is manufactured from injection moulding material.

Patentansprüche

1. Vorrichtung (1) für das Einstellen der Höhe eines Objektes (3, 15, 22, 41, 42), zum Beispiel einer Arbeitsfläche, in Bezug auf einen Festpunkt (2) mittels einer um eine senkrechte Achse drehbaren Schraubenspindel (8), die an ihrer Spitze an das Objekt (3, 15, 22, 41, 42) mittels eines rechtwinkligen Zahnradgetriebes montiert ist und an ihrer gegenüberliegenden Seite in eine starr mit dem Festpunkt (2) gekoppelte Spindelmutter (7) geschraubt ist, und dieses Zahnradgetriebe Rotation der senkrechten Schraubenspindel (8) und Rotation eines Ritzels um eine waagerechte Achse (11, 43) verbindet, **dadurch gekennzeichnet, dass** das Zahnradgetriebe ein erstes Kronrad (29, 9, 39) und zumindest ein damit zusammenarbeitendes zylindrisches Ritzel (28, 10, 40) umfasst.

2. Vorrichtung (1) nach Anspruch 1 und eine damit mittels einer Kupplungswelle gekoppelte zweite Vorrichtung (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** die Kupplungswelle eine starre Welle (11, 43) ist, die mit zylindrischen ersten Ritzeln (28, 10, 40), welche mit den jeweiligen ersten Kronrädern (29, 9, 39) zusammenarbeiten, ausgestattet ist.

3. Vorrichtung (1) nach Anspruch 1 und eine damit mittels einer Kupplungswelle gekoppelte zweite Vorrichtung (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** sich das erste Kronrad (9) in den jeweiligen Vorrichtungen (1) an der Spitze der jeweiligen Schraubenspindeln (8) befindet und die Kupplungswelle aus zwei Teilwellen (11), die durch ein rechtwinkliges Kupplungszahnradgetriebe (19, 20) mit einem Kupplungskronrad (19) gegenseitig gekoppelt sind, zusammengesetzt ist, und jede dieser Teilwellen (11) mit einem ersten zylindrischen Ritzel (10), welches mit einem der jeweiligen ersten Kronräder (9) zusammenarbeitet, und mit einem zweiten zylindrischen Ritzel (20), welches mit dem Kupplungskronrad (19) zusammenarbeitet, versehen ist.

4. Vorrichtung nach Anspruch 2 oder 3, **dadurch gekennzeichnet, dass** die ersten zylindrischen Ritzel der Kupplungswelle an einer Stelle längs des Umfangs der jeweiligen ersten Kronräder mit diesen Kronrädern so zusammenarbeiten, dass eine Drehung der jeweiligen ersten Kronräder in Bezug auf einander immer dieselbe Richtung hat.

5. Vorrichtung nach einem der Ansprüche 1-4, **dadurch gekennzeichnet, dass** die jeweiligen rechtwinkligen Zahnradgetriebe durch ein modulares Element verschafft werden, wobei das jeweilige Kronrad (9, 29) und das zumindest eine zylindrische Ritzel (10, 28, 44) immer in einem Gehäuse (50) montiert sind.

6. Vorrichtung nach Anspruch 5, **dadurch gekennzeichnet, dass** das Gehäuse im Wesentlichen die Form eines geraden Prismas (30) hat, in dessen Grundfläche das Kronrad montiert ist und in zumindest einer von dessen aufrechten Seitenflächen ein

mit dem Kronrad zusammenarbeitendes zylindrisches Ritzel montiert ist.

7. Vorrichtung nach Anspruch 6, **dadurch gekennzeichnet, dass** die Grundfläche des geraden Prismas ein regelmäßiges Vieleck ist.

8. Vorrichtung nach Anspruch 7, **dadurch gekennzeichnet, dass** die Grundfläche des geraden Prismas ein Quadrat (31) ist.

9. Vorrichtung nach Anspruch 5, **dadurch gekennzeichnet, dass** das Gehäuse im Wesentlichen die Form eines geraden Zylinders (50) hat, in der Grundfläche (45) dieses Zylinders (50) das Kronrad (29) montiert ist und wobei die Wand dieses Zylinders (50) wenigsten ein in Bezug auf die Grundfläche (45) in Umfangsrichtung drehbares Wandteil (46, 47) umfasst, in dem ein mit dem Kronrad (29) zusammenarbeitendes zylindrisches Ritzel (28, 44) montiert ist.

10. Vorrichtung nach einem der Ansprüche 1-9, **dadurch gekennzeichnet, dass** die jeweiligen Kronräder aus einem Kunststoffmaterial hergestellt sind.

11. Vorrichtung nach einem der Ansprüche 1-9, **dadurch gekennzeichnet, dass** die jeweiligen Kronräder aus einem Sintermetall hergestellt sind.

12. Vorrichtung nach einem der Ansprüche 1-9, **dadurch gekennzeichnet, dass** die jeweiligen zylindrischen Ritzel aus einem Kunststoffmaterial hergestellt sind.

13. Vorrichtung nach einem der Ansprüche 1-9, **dadurch gekennzeichnet, dass** die jeweiligen zylindrischen Ritzel aus einem Sintermetall hergestellt sind.

14. Vorrichtung nach einem der Ansprüche 5-9, **dadurch gekennzeichnet, dass** das Gehäuse aus einem Spritzgussmaterial hergestellt ist.

Revendications

1. Dispositif (1) de réglage de la hauteur d'un objet (3, 15, 22, 41, 42), par exemple d'une surface de travail, par rapport à un point fixe (2), au moyen d'une broche à vis à axe vertical rotative (8), qui est montée à son extrémité supérieure sur l'objet (3, 15, 22, 41, 42)) au moyen d'une transmission à engrenages en angle droit (29, 28; 9, 10; 39, 40) et est vissée à son extrémité opposée dans un écrou de broche (7) rigidement couplé au point fixe (2), ladite transmission à engrenages associant la rotation de la broche à vis à axe vertical (8) et la rotation d'un pignon à axe horizontal (11, 43), **caractérisé en ce que** la transmission à engrenages comprend une première couronne d'entraînement (29, 9, 39) et au moins un pignon cylindrique (28, 10, 40) co-agissant avec celle-ci.

2. Dispositif (1) suivant la revendication 1 et deuxième dispositif (1) suivant la revendication 1 couplé à celui-ci au moyen d'un arbre de couplage, **caractérisé en ce que** l'arbre de couplage est un arbre rigide (11, 43) qui est pourvu de premiers pignons cylindriques (28, 10, 40) co-agissant avec les premières couronnes d'entraînement respectives (29, 9, 39).

3. Dispositif (1) suivant la revendication 1 et deuxième dispositif (1) suivant la revendication 1 couplé à celui-ci au moyen d'un arbre de couplage, **caractérisé en ce que** la première couronne d'entraînement (9) dans les dispositifs respectifs (1) est située au sommet des broches à vis respectives (8), et l'arbre de couplage est assemblé à partir de deux sous-arbres (11) mutuellement couplés par une transmission à engrenages de couplage en angle droit (19, 20) avec une couronne d'entraînement de couplage (19), lesdits sous-arbres (11) étant chacun pourvus d'un premier pignon cylindrique (10) co-agissant avec l'une des premières couronnes d'entraînement respectives (9), et d'un deuxième pignon cylindrique (20) co-agissant avec la couronne d'entraînement de couplage (19).

4. Dispositif suivant la revendication 2 ou 3, **caractérisé en ce que** les premiers pignons cylindriques de l'arbre de couplage co-agissent à un endroit situé le long de la périphérie des premières couronnes d'entraînement respective avec ces couronnes d'entraînement, de telle sorte qu'une rotation des premières couronnes d'entraînement respectives les unes par rapport aux autres sera toujours la même dans n'importe quelle direction.

5. Dispositif suivant l'une quelconque des revendications 1 à 4, **caractérisé en ce que** les transmissions à engrenages en angle droit respectives sont pourvues d'un élément modulaire dans lequel la couronne d'entraînement respective (9, 29) et le au moins un pignon cylindrique (10, 28, 44) sont montés dans chaque cas dans une enceinte (30, 50).

6. Dispositif suivant la revendication 5, **caractérisé en ce que** l'enceinte adopte substantiellement la forme d'un prisme droit (30), dans la base duquel la couronne d'entraînement est montée, et dans au moins une des surfaces latérales dressées duquel est monté un pignon cylindrique co-agissant avec la couronne d'entraînement.

7. Dispositif suivant la revendication 6, **caractérisé en**

ce que la base du prisme droit est un polygone régulier.

8. Dispositif suivant la revendication 7, **caractérisé en ce que** la base du prisme droit est un carré (31).

9. Dispositif suivant la revendication 5, **caractérisé en ce que** l'enceinte adopte substantiellement la forme d'un cylindre droit (50), cylindre (50) dans la base (45) duquel la couronne d'entraînement (29) est montée et dans lequel la paroi de ce cylindre (50) comprend au moins une partie de paroi (46, 47) qui est rotative dans la direction périphérique par rapport à la base (45) et dans laquelle est monté un pignon cylindrique (28, 44) co-agissant avec la couronne d'entraînement (29).

10. Dispositif suivant l'une quelconque des revendications 1 à 9, **caractérisé en ce que** les couronnes d'entraînement respectives sont fabriquées à partir d'une matière plastique.

11. Dispositif suivant l'une quelconque des revendications 1 à 9, **caractérisé en ce que** les couronnes d'entraînement respectives sont fabriquées à partir d'un métal fritté.

12. Dispositif suivant l'une quelconque des revendications 1 à 11, **caractérisé en ce que** les pignons cylindriques respectifs sont fabriqués à partir d'une matière plastique.

13. Dispositif suivant l'une quelconque des revendications 1 à 11, **caractérisé en ce que** les pignons cylindriques respectifs sont fabriqués à partir d'un métal fritté.

14. Dispositif suivant l'une quelconque des revendications 5 à 9, **caractérisé en ce que** l'enceinte est fabriquée à partir d'une matière moulée par injection.

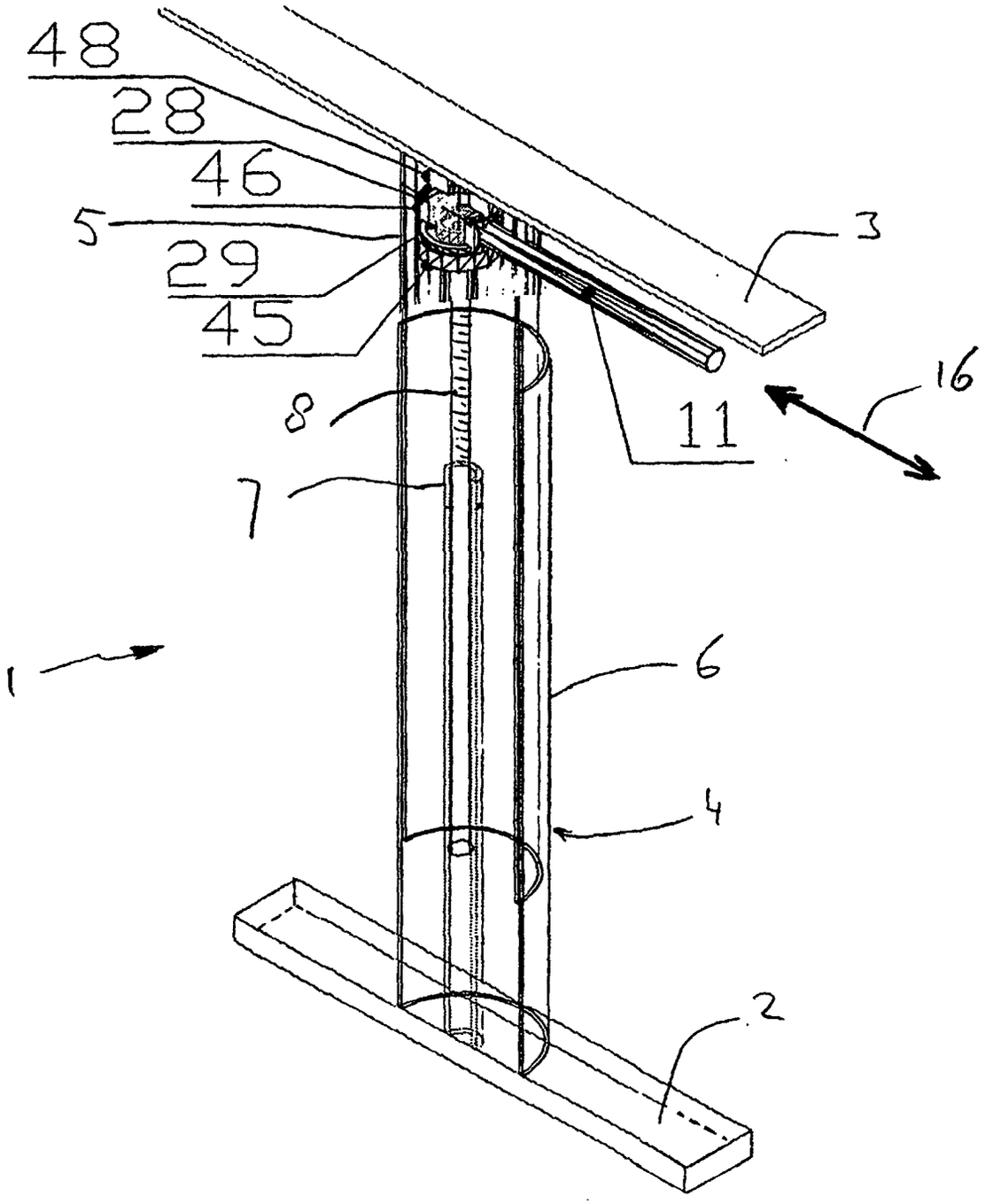

Fig. 1

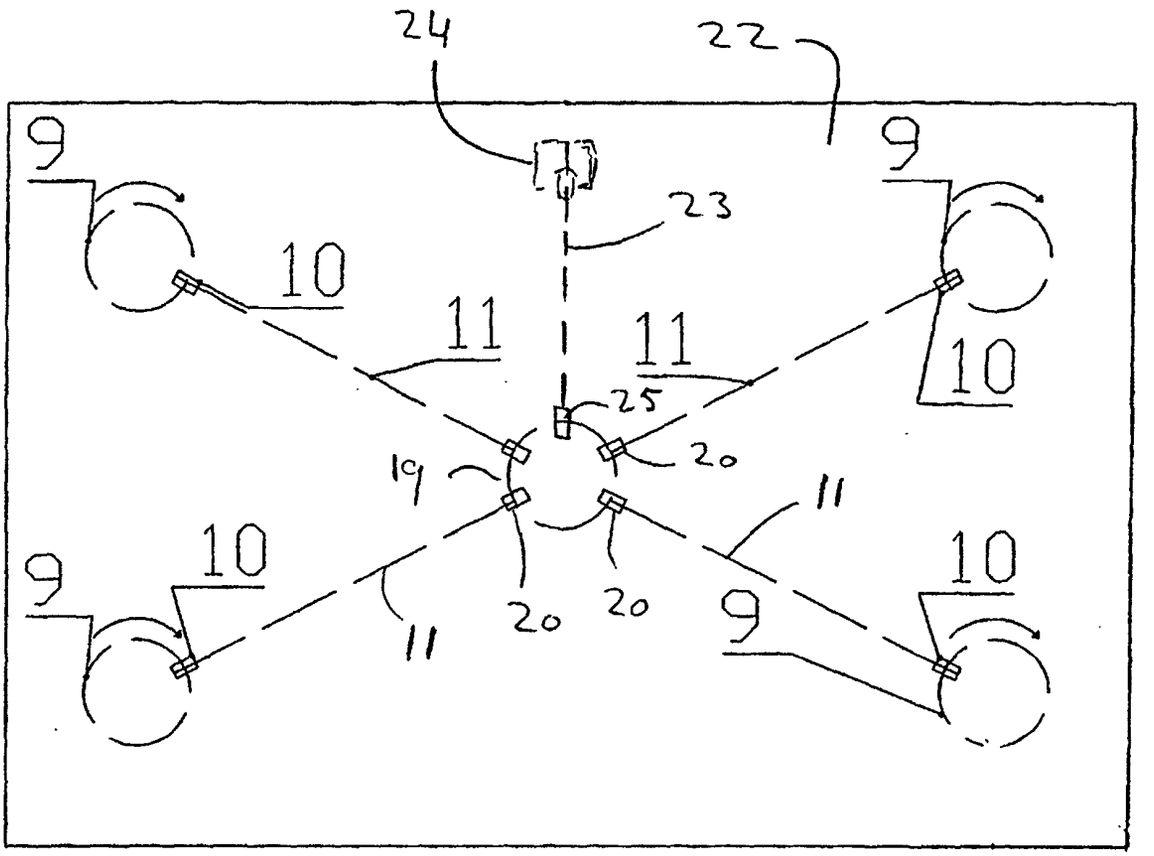

Fig. 2

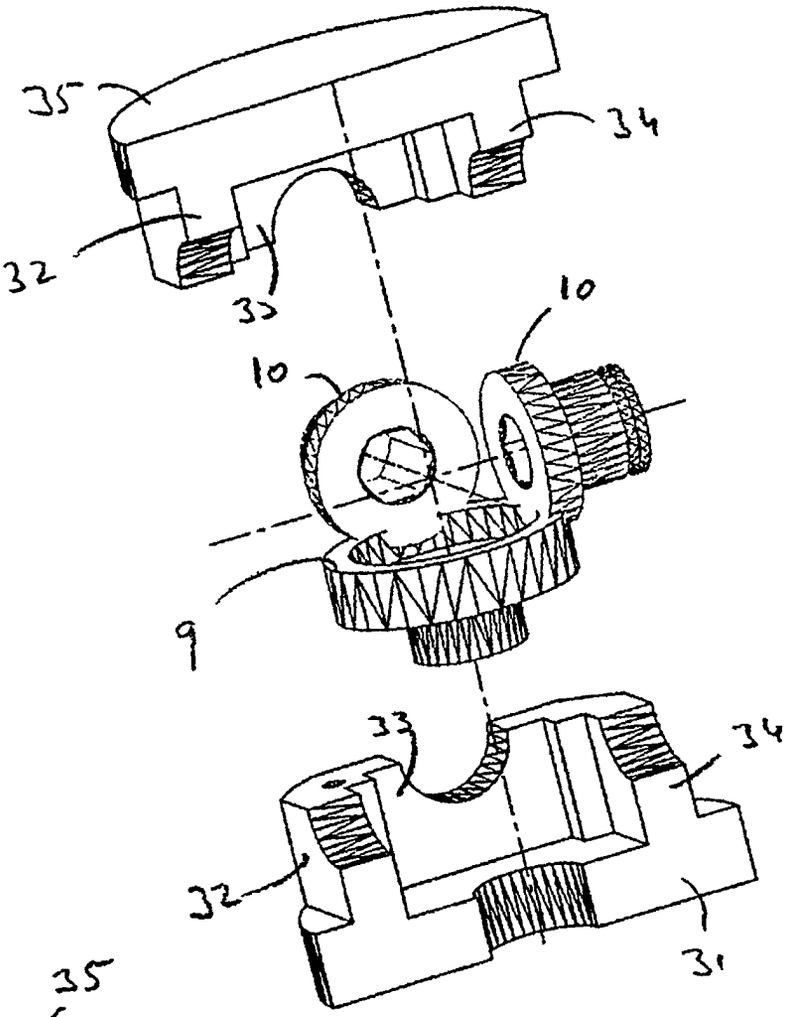

Fig. 3B

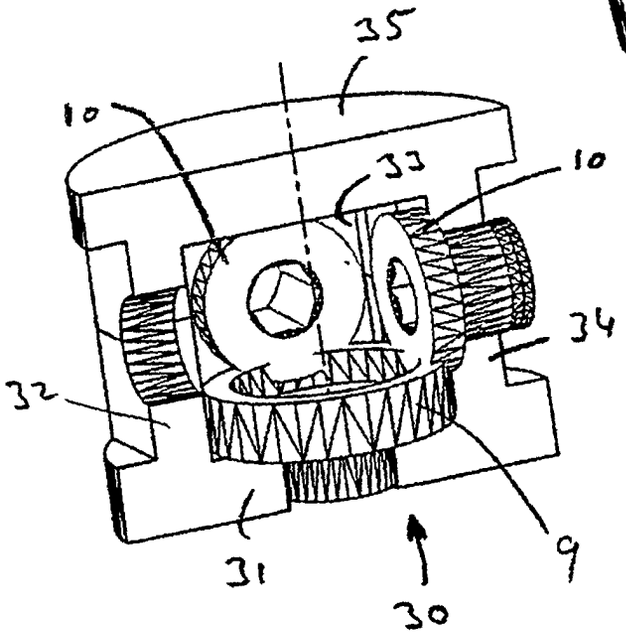

Fig. 3A

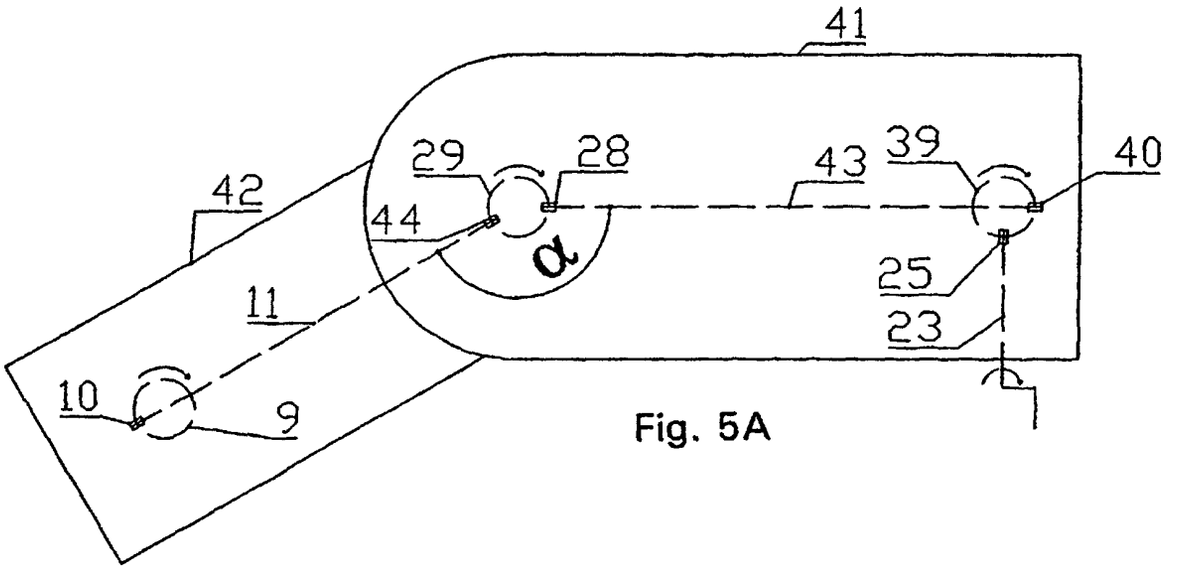

Fig. 5A

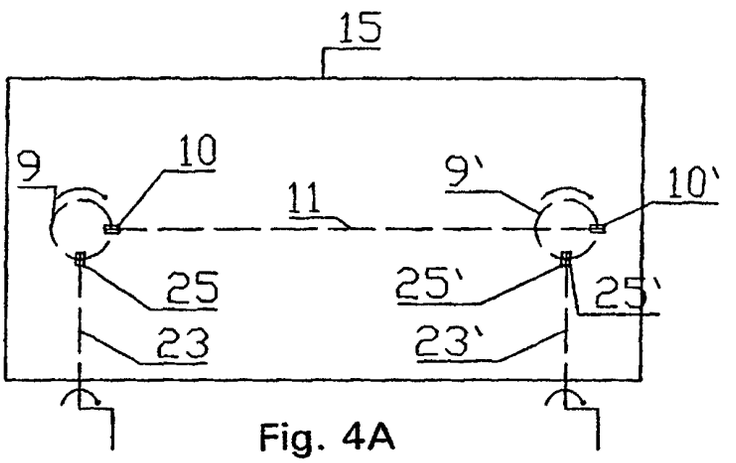

Fig. 4A

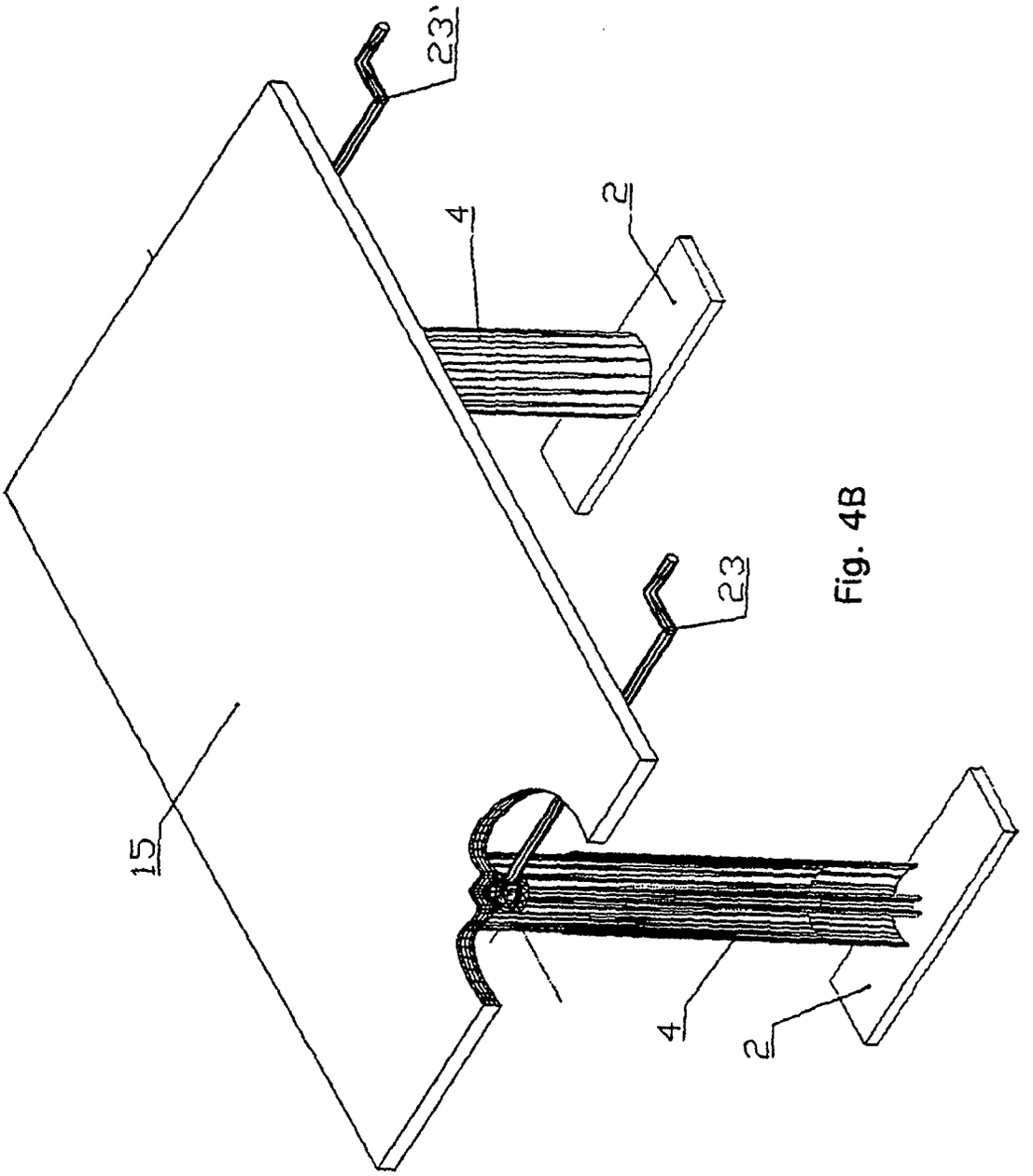

Fig. 4B

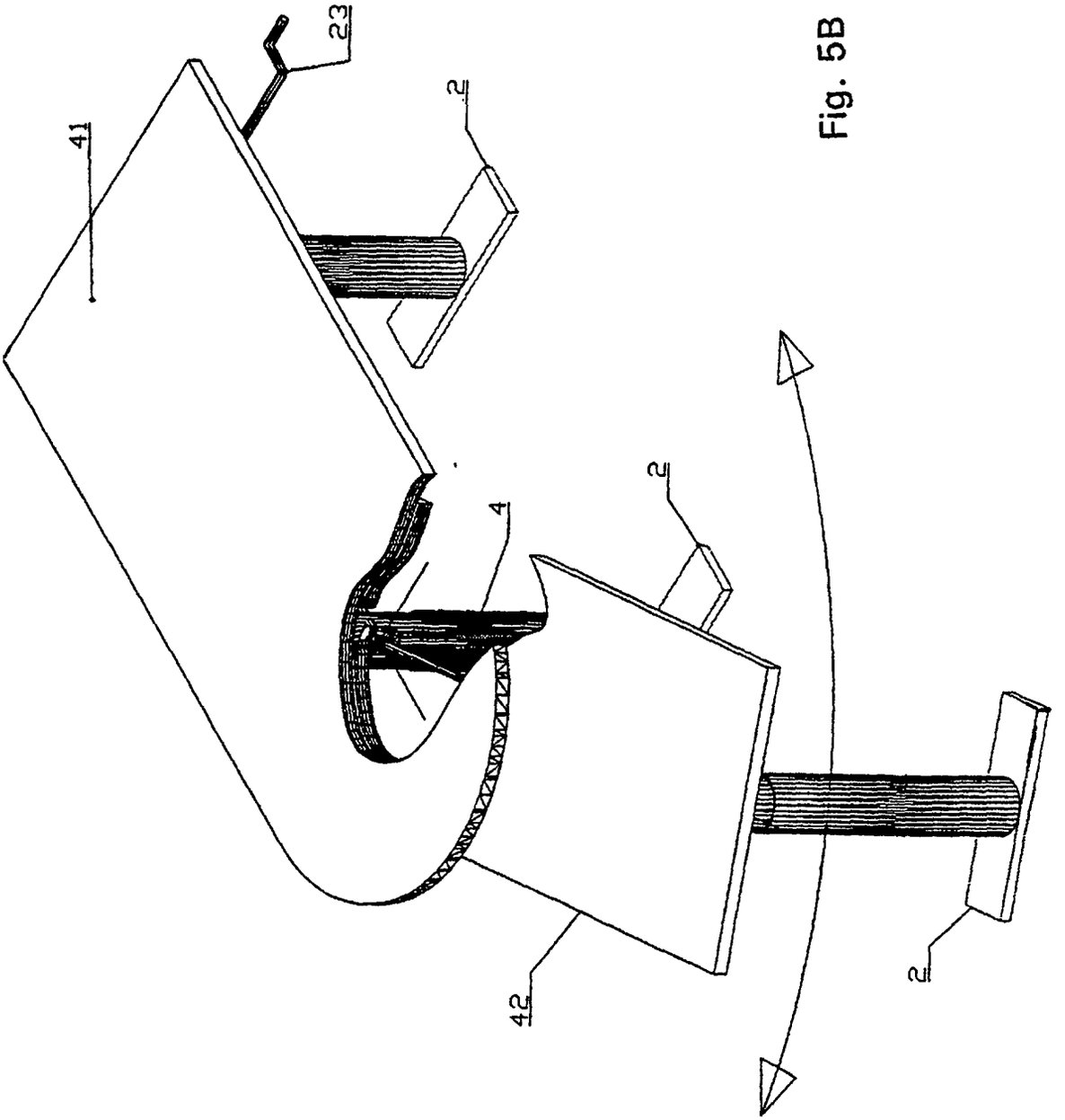

Fig. 5B

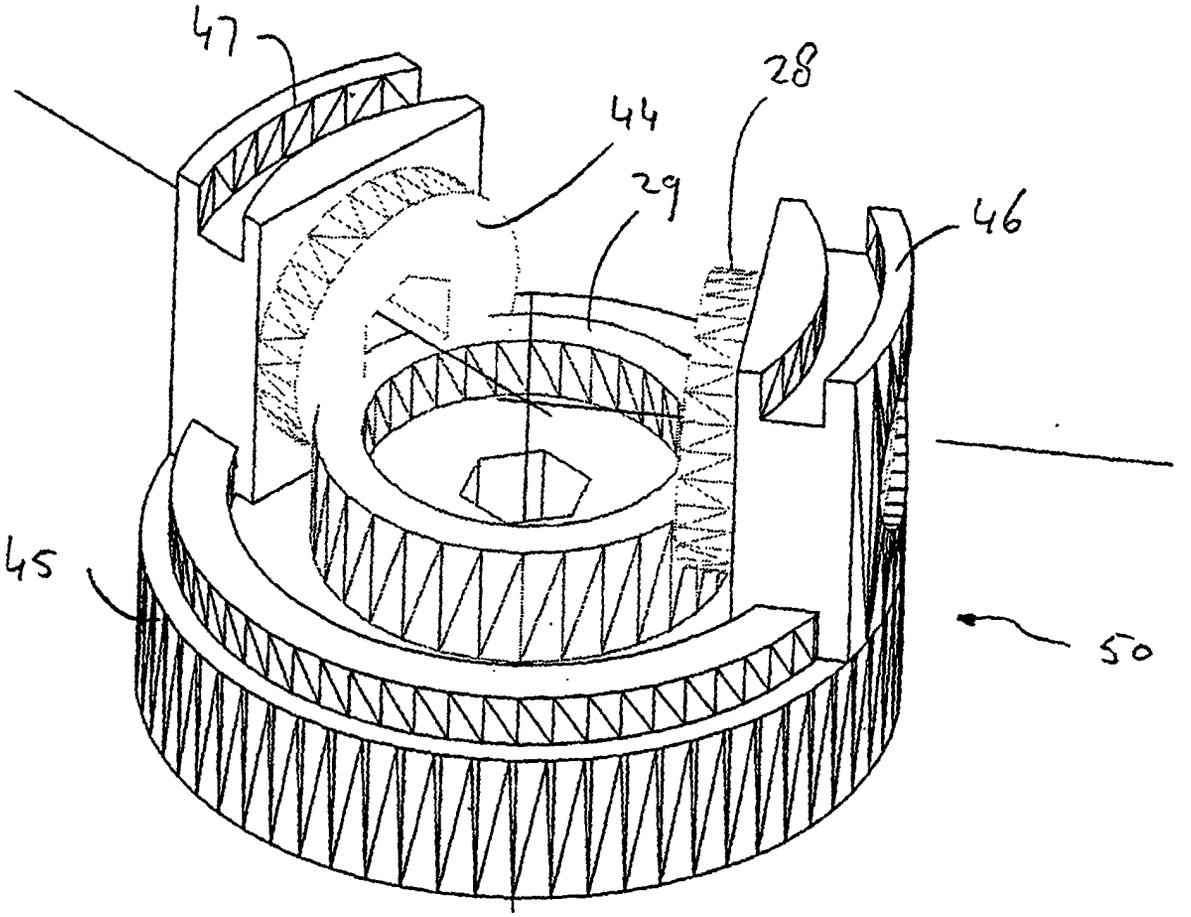

Fig. 6