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(54) **Title:** STARWHEEL CONVEYING DEVICE INCLUDING A WHEEL VERTICAL ADJUSTMENT DEVICE

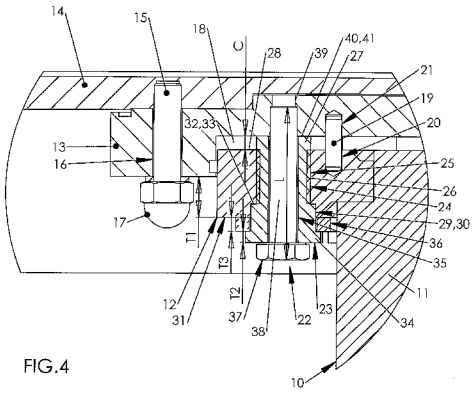

FIG.4

(57) **Abstract:** An article conveying device (1) comprising: a star wheel (1) (2) having a plurality of gripping devices (3) mounted on the circumference thereof, a rotary drive shaft (2) (8), a hub (3) (10) coupling the wheel (2) to the drive shaft (8), said conveying device (1) being characterized in that it comprises adjustable fastening devices (4) (22) for coupling the star wheel (2) to the hub (10), each fastening device (22) comprising: a drift bolt (5) (23) including: - a body (6) (24) having a threaded portion (25) screwed into a hole (26) provided in the hub (10), said body (24) protruding from an upper face (7) (28) of the hub (10), - a head (8) (34) protruding from a lower face (9) (31) of the hub (10), - a central bore (10) (30), a washer (11) (36) interposed between the head (34) of the drift bolt (23) and the lower face (31) of the hub (10), said washer (36) having a predetermined thickness (T3), whereby the starwheel (2) rests on an upper face (12) (40) of the drift bolt (23) with a predetermined clearance (C) with respect of the hub (10), a bolt (13) (37) mounted in the bore (30), said bolt (37) having a threaded portion (14) (38) protruding from the drift bolt (23) and screwed into a hole (39) provided in the wheel (2), thereby fastening the wheel (2) to the hub (10).

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Starwheel conveying device including a wheel vertical adjustment device

FIELD OF THE INVENTION

The invention relates to the article conveying industry, and more specifically to the container manufacturing/filling industry.

BACKGROUND OF THE INVENTION

In the container manufacturing/filling industry, containers are often transferred at high speed rates from a first station, where a first operation (such as molding) is performed, to a second station, where a second operation (such as filling) is performed.

A container handling machine is generally provided with a plurality of adjacent conveying devices including at least one rotary starwheel conveying device provided with a plurality of container gripping elements for loading/unloading containers, see e.g. U.S. Pat. No. 5,683,732 (Valles) and U.S. Pat. No.6,520,349 (Humele).

Considering the high speed rates (up to several tens of thousands of containers per hour), it is critical that the adjacent conveying devices be properly and precisely positioned with respect to each other. Otherwise, containers may be improperly loaded on the conveying devices, resulting in container-jamming and machine stop. Vertical positioning is one of the most critical issue.

In existing handling machine, conveying devices are generally adjusted in vertical position by moving the entire device with respect of a machine foundation. Considering the weight of one single conveying device (up to a ton), such a solution is time and effort consuming. Moreover, adjustment is not precise enough for the required purpose. In an alternate solution, vertical positioning may be achieved through peelable shims which can be added – or removed – between the wheel and a supporting hub. Such a solution unquestionably allows for precise vertical adjustment. However, since the wheel needs to be removed from its hub, it is also time and effort consuming.

SUMMARY OF THE INVENTION

It is therefore an object of the invention to provide an article conveying device, the vertical position of which can be easily adjusted.

It is another object of the invention to provide an article conveying device, the vertical position of which can be rapidly adjusted.

It is another object of the invention to provide an article conveying device, the vertical position of which can be precisely adjusted.

The proposed article conveying device comprises:

- a star wheel having a plurality of gripping devices mounted on the circumference thereof,
- a rotary drive shaft,
- a hub coupling the wheel to the drive shaft,
- adjustable fastening devices for coupling the star wheel to the hub, each fastening device comprising:
  - a drift bolt including:
    - a body having a threaded portion screwed into a hole provided in the hub, said body protruding from an upper face of the hub,
    - a head protruding from a lower face of the hub,
    - a central bore,
  - a washer interposed between the head of the drift bolt and the lower face of the hub, said washer having a predetermined thickness, whereby the starwheel rests on an upper face of the drift bolt with a predetermined clearance with respect of the hub,
  - a bolt mounted in the bore, said bolt having a threaded portion protruding from the drift bolt and screwed into a hole provided in the wheel, thereby fastening the wheel to the hub.

The above and other objects and advantages of the invention will become apparent from the detailed description of preferred embodiments, considered in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top perspective view of a starwheel conveying device

according to the invention.

FIG. 2 is a bottom perspective view of a starwheel conveying device according to the invention.

FIG. 3 is an elevation cut view of the starwheel conveying device of **FIG.1**.

FIG. 4 is an enlarged cut view of the starwheel conveying device of **FIG.3**, showing detail IV.

FIG. 5 is a bottom cut view of the starwheel conveying device of **FIG.3**, taken along line V-V.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now to the figures, there is shown an article conveying device **1** for transferring containers, such as bottles for liquid beverages, from a loading point **P1** to an unloading point **P2**. The conveying device **1** may be part of a container handling machine including other operational devices such as a molding unit, a filling unit and a capping unit. The conveying device **1** may be interposed between two successive operational devices in order to ensure transfer of the containers from one operational unit to the other.

The conveying device **1** comprises a star wheel **2** provided on its circumference with a plurality of gripping devices **3** each including a pair of fingers **4** pivotally mounted along the circular edge of the wheel **2**. For the sake of clarity, only some of the gripping devices **3** are represented on **FIG.1** and **FIG.2**. Each gripping device **3** includes a cam follower **5** fixed to one finger **4** and adapted, when reaching the loading point **P1** or the unloading point **P2**, to run on a cam path **6** provided between the radial ends of supporting arms **7**, thereby opening the fingers **4** and allowing one container to be held by the gripping device **3**.

The conveying device **1** also comprises a vertical central rotary drive shaft **8**, which is pivotally mounted in a coaxial cylinder **9** fixed to a machine frame, and a hub **10** coupling the wheel **2** to the drive shaft **8**. The drive shaft **8** therefore forms the central rotation axis of the star wheel **2**.

The hub **10** has a cylindrical body **11** which is rigidly fixed to the drive

shaft **8** e.g. by means of a welding, and a circular peripheral flange **12** having a thickness **T1** and radially protruding from or rigidly fixed to the body **11** at an upper end thereof.

As depicted on **FIG.3** and **FIG.4**, the wheel **2** has a central lower plate **13** fixed to the hub **10**, and an upper plate **14** fixed to the lower plate **13** by means of a plurality of studs **15** screwed to the upper plate **14** and fitted into arc of circle shaped elongated openings **16** provided in the periphery of the lower plate **13**. To each stud **15** a nut **17** is screwed to fasten the upper plate **14** to the lower plate **13** in a predetermined angular position with respect of the central rotation axis of the star wheel **2**. Angular adjustment serves to precisely synchronize the opening and closing of the gripping devices **3** at the loading and unloading points **P1**, **P2**.

As depicted on **FIG.4**, the lower plate **13** is provided with a central circular recess **18** where the peripheral flange **12** of the hub **10** is received. Diameters of the recess **18** and the peripheral flange **12** are substantially equal (with a clearance), in order for the hub **10** and wheel **2** to remain coaxial.

As depicted on **FIG.4**, the conveying device **1** is provided with at least one dowel **19** fitted into two facing holes **20**, **21** provided respectively in the hub **10** and the lower plate **13** of the wheel **2** for preventing angular displacement of the wheel **2** with respect of the hub **10**.

The conveying device **1** further comprises adjustable fastening devices **20** for coupling the star wheel **2** to the hub **10** with vertical adjustment. Each fastening device comprises **20** a drift bolt **21** having an overall length **L** and including a body **24** having an upper threaded portion **25** screwed into a threaded hole **26** provided in the flange **12** of the hub **10**. As depicted on **FIG.4**, when completely screwed to the flange **12**, the body **24** protrudes at **27** from an upper face **28** of the hub **10**. The body **24** has a non-threaded lower portion **29** greater in diameter than the threaded portion **25** and received in a corresponding bore **30** formed in the flange **12** near a lower face **31** thereof. At the junction with the threaded portion **25**, the non-threaded lower portion **29** forms a shoulder **32** which may, when the drift bolt **21** is completely screwed to the flange **12**, come to abutment against a stop surface **33** formed at the junction

between the threaded hole **26** and the bore **30**. Non-threaded portion **29** of the body **24** protrudes from the lower face **31** of the flange **12**, even when the drift bolt **21** is completely screwed thereto.

The drift bolt **21** further includes a nut-shaped head **34** having a thickness **T2** and protruding radially from the non-threaded portion **29** of body **24** at a lower end thereof. Head **34** protrudes from the lower face **31** of the flange **12**. The drift bolt **21** is provided with a central through bore **35**.

Each fastening device **20** also comprises a washer **36** of predetermined thickness **T3**, interposed between the head **34** of the drift bolt **21** and the lower face **31** of the flange **12**.

Each fastening device **20** further comprises a bolt **37** mounted in the through bore **35**. The bolt **37** has a threaded portion **38** which protrudes from the drift bolt **21** at an upper end thereof and is screwed into a hole **39** provided in the lower plate **13** of the wheel **2**.

When assembled, the star wheel **2** rests, via its lower plate **13**, on an upper end face **40** of the drift bolt **21** with a predetermined clearance **C** between a lower face **41** of the lower plate **13** forming the bottom of the recess **18**, and the upper face **28** of the flange **12**. As washer **41** is tightened between the head **34** of the drift bolt **21** and the lower face **31** of the flange **12**, clearance **C** calculates as follows:

$$C = L - T1 - T2 - T3 \quad (1)$$

As length **L** and thicknesses **T1**, **T2** are fixed, the value of clearance **C** depends on the value of thickness **T3**. In other words, vertical position of the star wheel **2** depends upon the choice of the washer **36**.

On the other hand, clearance **C** calculates as the difference between height **H1** of the wheel **2** (to be set), measured to the lower face **41** of the lower plate **13**, and height **H2** (fixed) of the hub **10**, measured to the upper face **28** thereof:

$$C = H1 - H2 \quad (2)$$

The wheel **2** and hub **10** are assembled as follows.

First of all, the vertical height **H1** of the wheel **2** is precisely determined in function of the height of the loading and unloading points **P1** and **P2**.

Clearance **C** is then calculated according to equation (2).

Thickness **T3** of the washer **36** is then calculated through equation (1) as follows:

$$T3 = L - T1 - T2 - C$$

A washer **36** having a thickness equal to **T3** is then be picked up among an assortment of washers and joined to the drift bolt **21** to be mounted on the hub **10**.

"Equal to" does not necessary means strictly identical. Of course, a certain clearance around thickness **T3** may be tolerated, e.g. 1/10 mm, depending on the precision with which the wheel **2** is to be positioned vertically on the hub **10**.

Each washer **36** is mounted on the non-threaded portion **29** of a drift bolt **21**.

The drift bolts **21** are screwed into the flange **12** from its lower face **31** until the washers **36** are tightened between the heads **34** of the drift bolts **21** and the lower face **31** of the flange **12**. In order to facilitate the screwing of each drift bolt **21**, the head **34** is nut-shaped to permit wrench driving.

At this point, the protruding portions **27** of the drift bolts **21** have a length equal to the clearance **C**. The wheel **2** is then mounted onto the hub **10** with the flange **12** positioned in the recess **18** and the dowel **19** fitted into the two facing holes **20**, **21**, until the wheel **2** rests on the upper end faces **40** of the drift bolts **23**.

The bolts **37** are then inserted in the bores **30** of the drift bolts **23** and screwed to the lower plate **13**, thereby fastening the wheel **2** to the hub **10**.

Modifying vertical position of the star wheel **2** is conducted as follows.

Clearance **C** and thickness **T3** of the washers **36** are re-calculated as

stated hereabove.

The bolts **37** are unscrewed from the wheel **2** and removed from the drift bolts **23**. Without removing the star wheel **2**, the drift bolts **23** are unscrewed from the flange **12** of the hub **10** and removed therefrom. The former washers **36** are replaced by the new ones picked up from the assortment and the drift-bolts **23** are screwed back into the hub **10**. As soon as they reach the end of the threaded holes **26**, the upper end faces **40** of the drift bolts **23** push the lower face **41** of the lower plate **13** and therefore elevate the star wheel **2** until the washers **36** are tightened between the heads **34** and the lower face **31** of the flange **12**. The bolts **37** are then inserted back in the drift bolts **23** and screwed again to the lower plate **13**.

Adjusting the vertical position of the wheel **2** with respect of the hub **10** is therefore quick, easy and simple. It is not necessary to remove the wheel **2**. In addition, provided that proper washers **36** are affordable (they should be manufactured in consequence), vertical positioning of the wheel **2** is also precise.

Furthermore, it is possible to mount washers **36** of different thicknesses on the same hub **10** in order to slightly shift the wheel **2** with respect of the rotation axis, for example to compensate a lack of verticality thereof or to compensate a lack of horizontal alignment of the loading and unloading points **P1**, **P2**.

CLAIMS

1. An article conveying device (**1**) comprising:

- a star wheel (**2**) having a plurality of gripping devices (**3**) mounted on the circumference thereof,
- a rotary drive shaft (**8**),
- a hub (**10**) coupling the wheel (**2**) to the drive shaft (**8**),

said conveying device (**1**) being characterized in that it comprises adjustable fastening devices (**22**) for coupling the star wheel (**2**) to the hub (**10**), each fastening device (**22**) comprising:

- a drift bolt (**23**) including:
  - a body (**24**) having a threaded portion (**25**) screwed into a hole (**26**) provided in the hub (**10**), said body (**24**) protruding from an upper face (**28**) of the hub (**10**),
  - a head (**34**) protruding from a lower face (**31**) of the hub (**10**),
  - a central bore (**30**),
- a washer (**36**) interposed between the head (**34**) of the drift bolt (**23**) and the lower face (**31**) of the hub (**10**), said washer (**36**) having a predetermined thickness (**T3**), whereby the starwheel (**2**) rests on an upper face (**40**) of the drift bolt (**23**) with a predetermined clearance (**C**) with respect of the hub (**10**),
- a bolt (**37**) mounted in the bore (**30**), said bolt (**37**) having a threaded portion (**38**) protruding from the drift bolt (**23**) and screwed into a hole (**39**) provided in the wheel (**2**), thereby fastening the wheel (**2**) to the hub (**10**).

2. The article conveying device of claim 1, wherein the head (**34**) of the drift bolt (**23**) is nut shaped for wrench driving.

3. The article conveying device of claim 1 or 2, further comprising a dowel (**19**) fitted into two facing holes (**20**, **21**) provided respectively in the hub (**10**) and the wheel (**2**) for preventing angular displacement of the wheel (**2**) with respect of the hub (**10**).

4. The article conveying device of any of claims 1-3, wherein the star wheel (**2**) has a lower plate (**13**) fixed to the hub (**10**) and an upper plate (**12**) fixed to the lower plate (**13**).

5. The article conveying device of claim 4, further comprising:

- a plurality of studs (**15**) screwed to the upper plate (**14**) and fitted into arc of circle shaped elongated openings (**16**) provided in the lower plate (**13**),
- a plurality of nuts (**17**) screwed to each stud (**15**), thereby fastening the upper plate (**14**) to the lower plate (**13**) in a predetermined angular position.

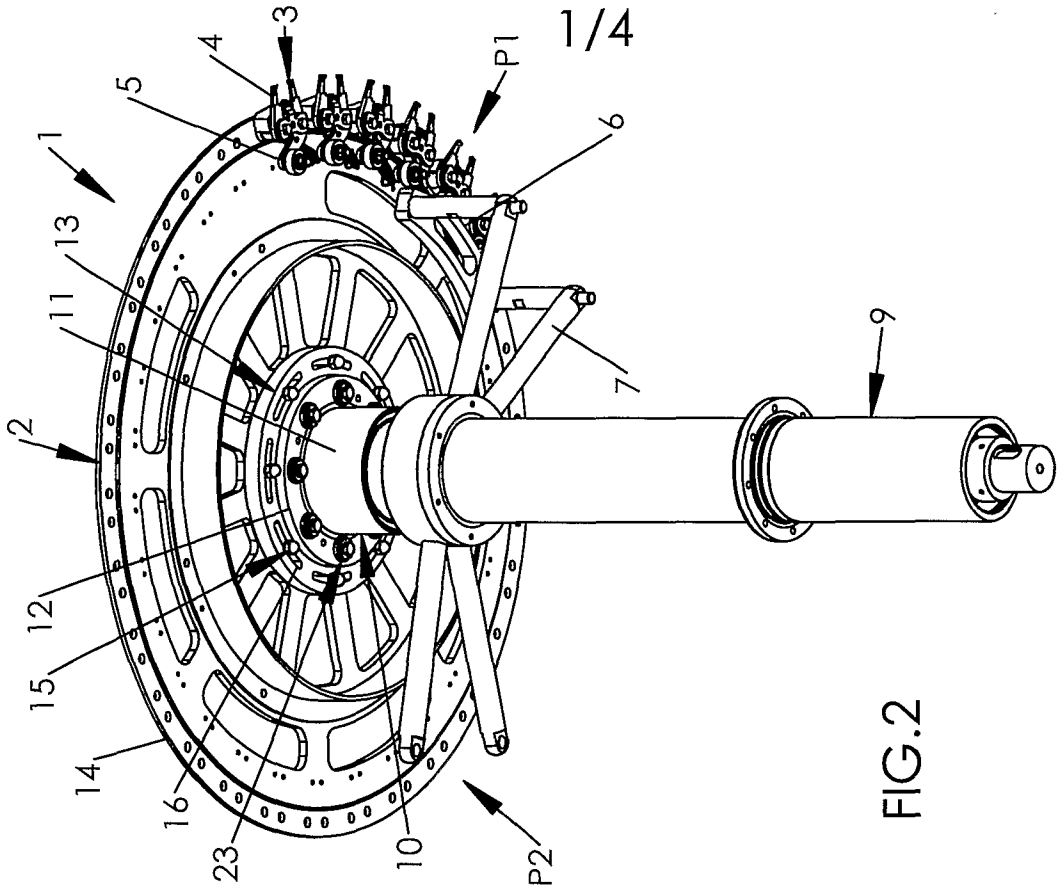

FIG.2

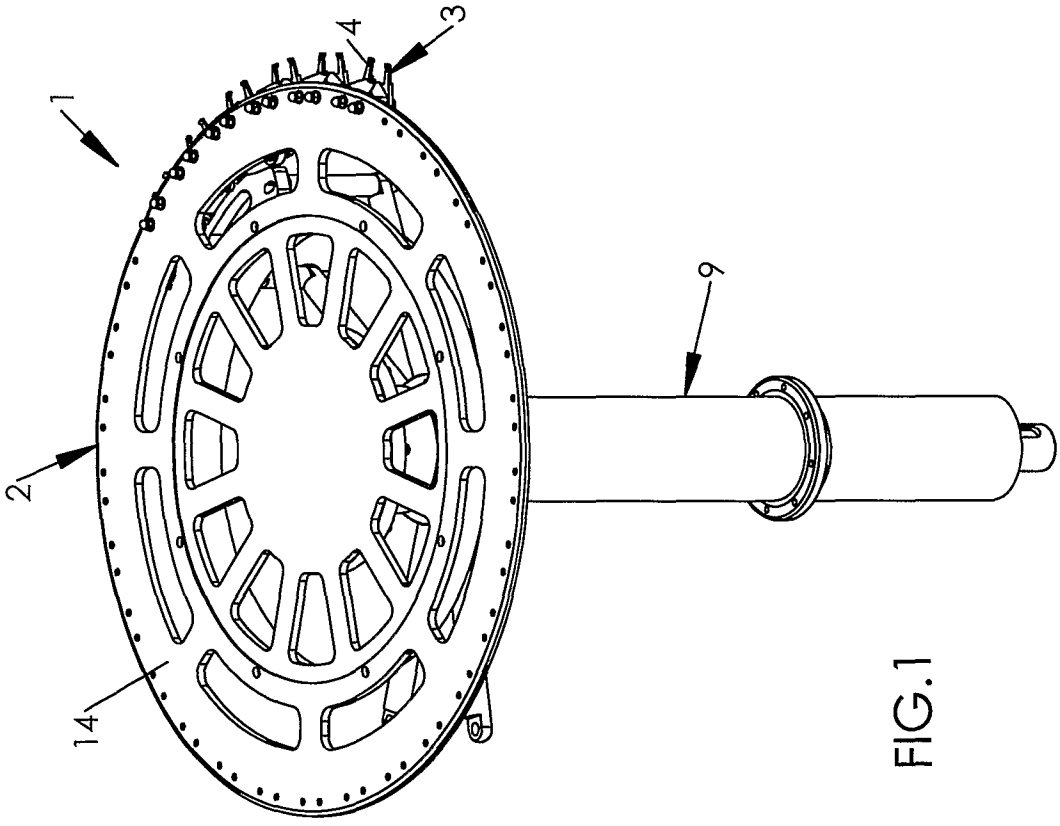

FIG.1

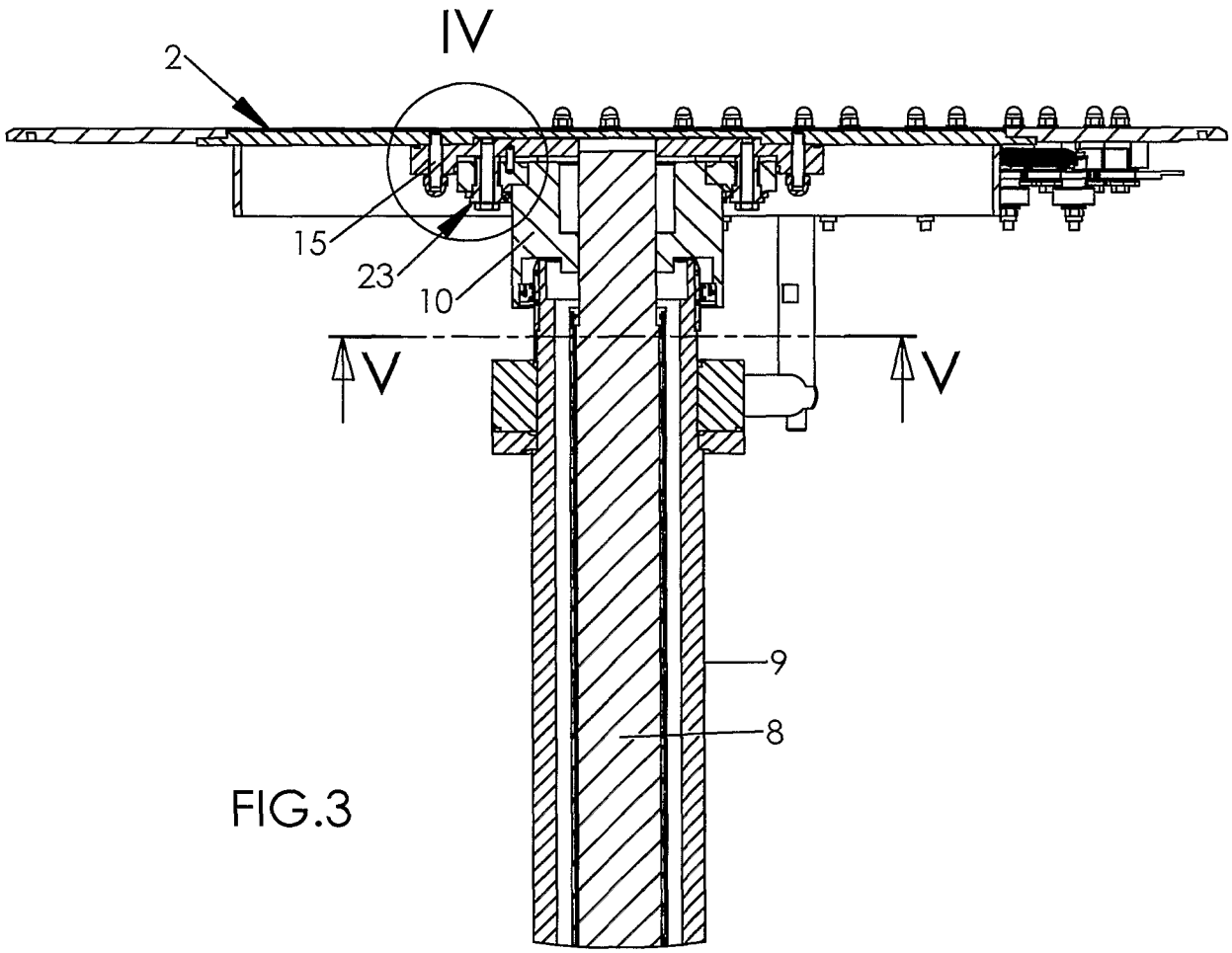

FIG.3

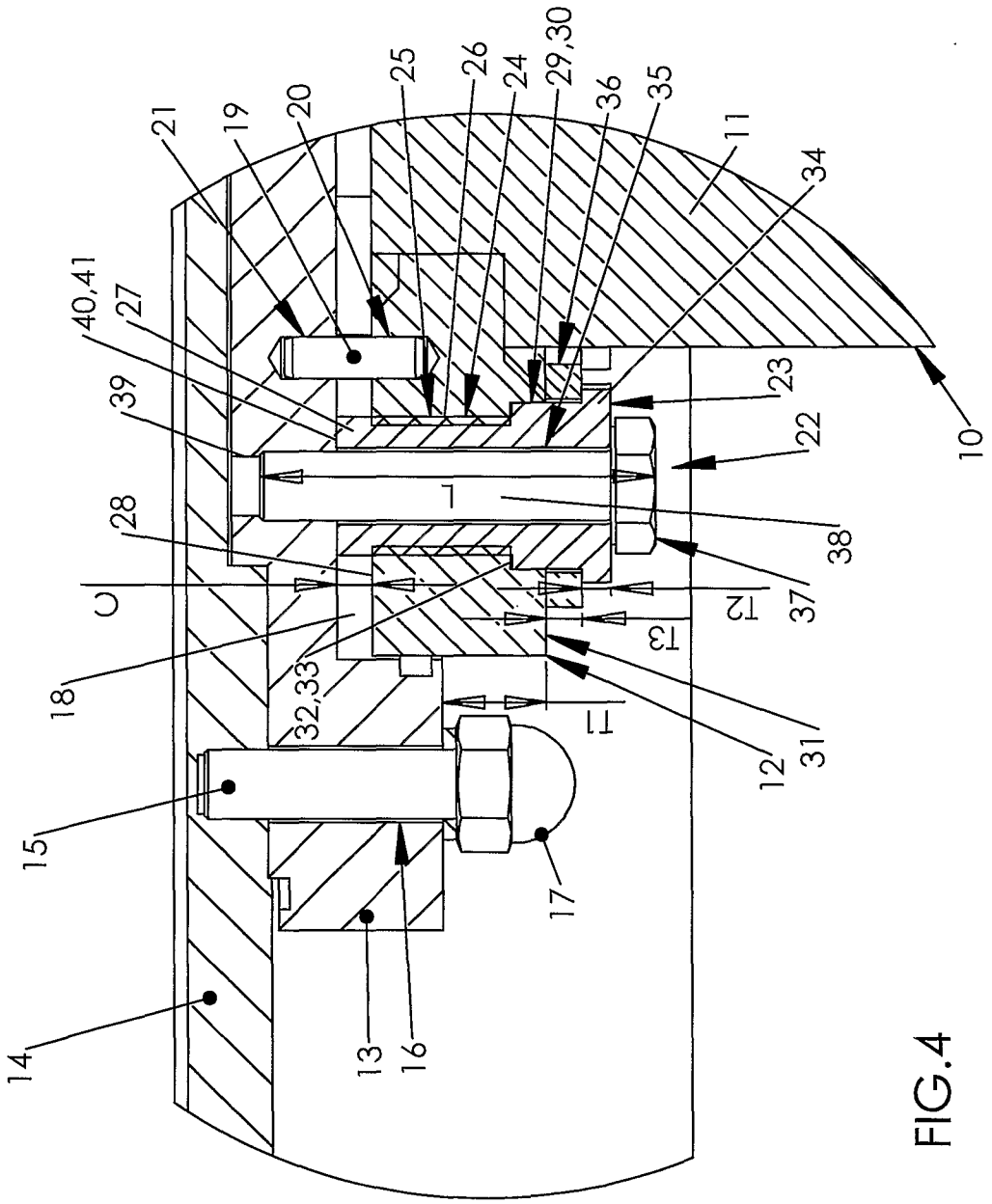
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FIG.4

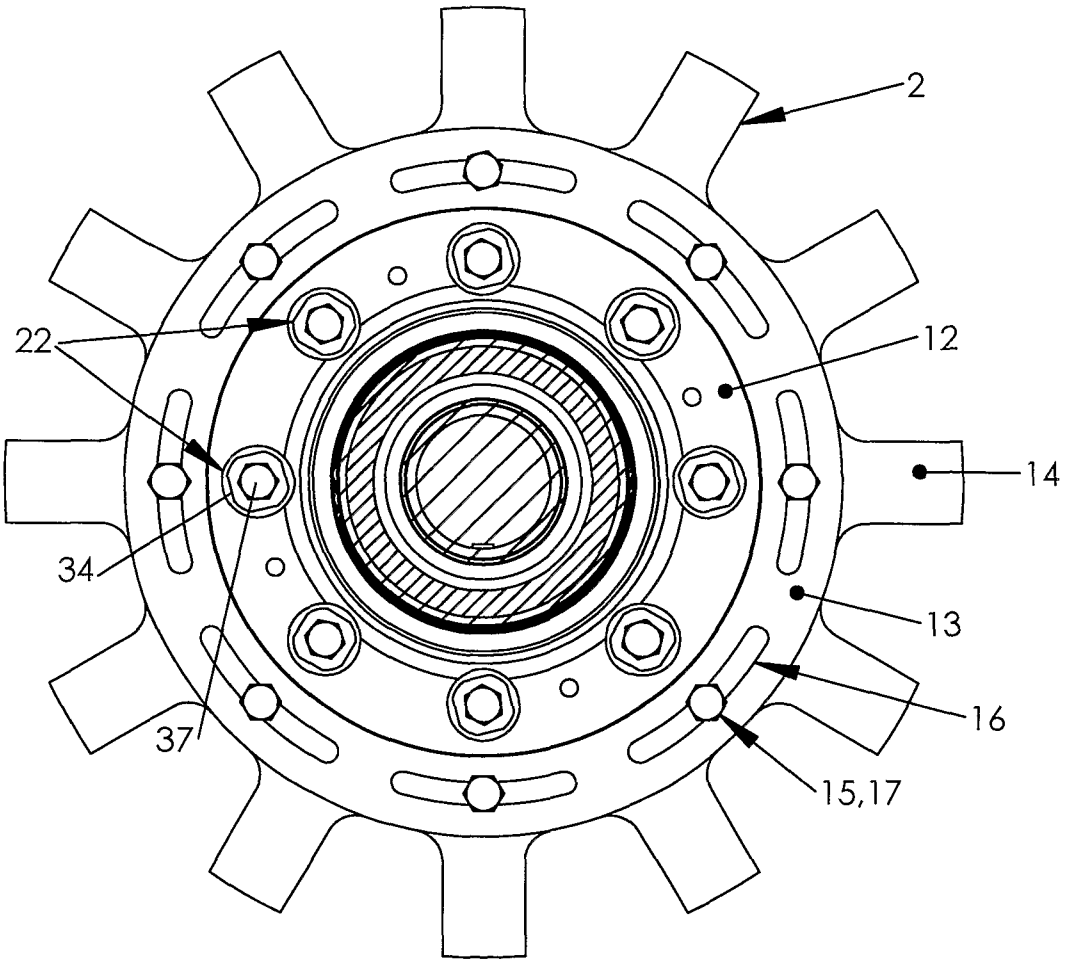

FIG.5

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2007/002298

A. CLASSIFICATION OF SUBJECT MATTER
INV. B65G47/86

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B65G B29C B67C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	US 5 784 857 A (FORD COLIN P [US] ET AL) 28 July 1998 (1998-07-28) abstract; figures 2,4	1-5
A	GB 2 149 740 A (MG 2 SPA) 19 June 1985 (1985-06-19) page 1, lines 70-105; figure 3	1-5
A	US 5 590 753 A (BERTSCHI PETER [CH] ET AL) 7 January 1997 (1997-01-07) column 2, lines 51-61; figure 3	1-5

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
11 January 2008	30/01/2008

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2007/002298

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2004/238330 A1 (SHENDGE DEVENDRA WIN [US]) 2 December 2004 (2004-12-02) paragraph [0052]; figures 8-17	1-5
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INTERNATIONAL SEARCH REPORT

Information on patent family members

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