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- **Burlacu, Mihail
Valenii de Munte (RO)**
- **Drinceanu, Florin
Maneciu Ungureni (RO)**

(71) Applicant: **Saint-Gobain Glass France
92400 Courbevoie (FR)**

(74) Representative: **Petcu, Costin
Rominvent S.A. Patents
35, Ermil Pangratti Str.
1st Floor
Sector 1
011882 Bucuresti (RO)**

(72) Inventors:

- **Sandu, Marian Cristian
Valenii de Munte (RO)**

(54) **SAFETY HINGE FOR A VERTICAL DOOR**

(57) Safety hinge for a vertical door, comprising a cam (1) provided with a first vertical cam profile (c1) and a second vertical cam profile (c2), a cam follower (2) provided with a first vertical cam follower profile (f1) configured to work in conjunction with the first vertical cam profile (c1), and a second vertical cam follower profile (f2) configured to work in conjunction with the second vertical cam profile (c2), the safety hinge being configured to move from a first resting position into a second resting position by moving the cam (1) such that the first vertical cam profile (c1) drives the first vertical cam follower profile (f1), and to move from the second resting position back into the first resting position by moving the cam (1) such that the second vertical cam profile (c2) drives the second vertical cam follower profile (f2).

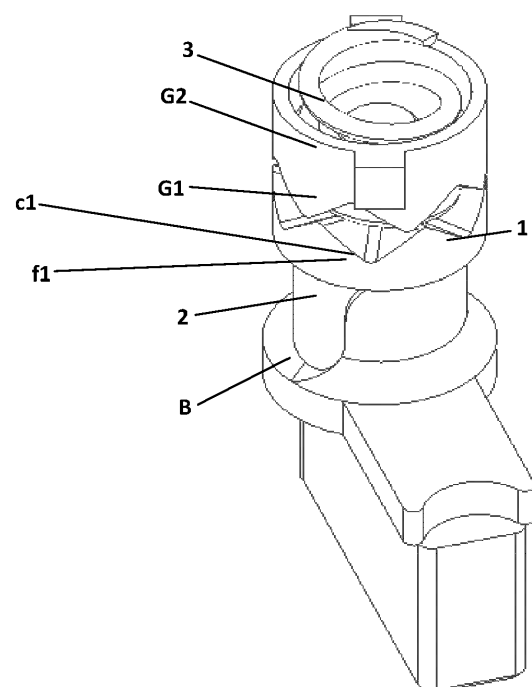


Figure 6b

Description

[0001] The invention refers to a safety hinge for a vertical door, in particular for a vertical door of a refrigerator cabinet.

[0002] Safety hinges for vertical doors are known in the art, such as the safety hinge disclosed in the European patent application no. 21197322.7 filed on 17.09.2021 and having the same applicant as that of the present invention.

[0003] The disadvantage of the above mentioned prior art document is that, although the solution is simple and inexpensive, it still involves the replacement (by a relatively specialized person) of a broken safety screw with a new one, thus leading to a time-consuming operation.

[0004] The present invention aims to eliminate the afore-mentioned disadvantage, by providing an equally simple and inexpensive safety hinge, whose troubleshooting can be performed swiftly by any person, because absolutely no technical skills are needed and no parts need to be replaced.

[0005] The safety hinge according to the invention comprises:

- a cam provided with a first vertical cam profile and a second vertical cam profile that is symmetrical to the first vertical cam profile,
- a cam follower provided with a first vertical cam follower profile configured to work in conjunction with the first vertical cam profile, and a second vertical cam follower profile, that is symmetrical to the first vertical cam follower profile, configured to work in conjunction with the second vertical cam profile, the cam follower being fixed at its top to a first crown gear that has upwards oriented teeth and has freedom of rotation about its vertical central axis,
- a second crown gear situated above and in contact with the first crown gear, has downwards oriented teeth, having a same pitch as that of the first crown gear, has only freedom of translation along its vertical central axis that coincides with the vertical central axis of the first crown gear, each tooth of the first and second crown gears has an identical apex angle in the range $100 \div 130$ degrees, and has a same height in the range of $2 \div 3.5$ mm,
- an elastic element exerting a vertical compression force on the second crown gear, thereby ensuring a permanent contact between the teeth of the second crown gear and the teeth of the first crown gear,
- the safety hinge having a first resting position wherein the first crown gear is in mesh with the second crown gear, and a second resting position wherein the first crown gear is in mesh with the second crown gear, and the teeth of the first crown gear are offset with one pitch in respect to the teeth of the second crown gear, in comparison to the first resting position,

- the safety hinge being configured to

- move from the first resting position into the second resting position by moving the cam such that the first vertical cam profile drives the first vertical cam follower profile,
- move from the second resting position back into the first resting position by moving the cam such that the second vertical cam profile drives the second vertical cam follower profile.

[0006] In a preferred embodiment of the safety hinge according to the invention, the cam is provided with a first central circular through hole, the first crown gear is provided with a second central circular through hole, the second crown gear is provided with:

- a third central circular through hole, an annular seating fixed concentrically with and inside the third central circular through hole, and a pair of diametrically opposed guides situated on an outer lateral surface of the second crown gear. The elastic element is a helical spring provided with a plurality of coils.

[0007] The safety hinge further comprises:

- a hollow member, fixable to a frame, and provided with an upper opening and a lower opening, the interior of the hollow member having a substantially cylindrical shape bounded respectively by said upper and lower openings, and being provided with a pair of diametrically opposed grooves along the entire height of the hollow member such that each guide of the second crown gear is slidable along a respective groove,
- a cover removably fixed to the hollow member and covering the upper opening thereof,
- an abutment body fixed to the cam, said body being fixable to a door, configured to operate in conjunction with said frame,
- a pin passing through the first, second and third central circular through holes, as well as through several coils of the helical spring, and having its lower end fixed to the abutment body.

[0008] The cam is partially housed within the hollow member and partially (namely its lower portion) protruding through the lower opening of the hollow member. The cam follower is partially housed within the hollow member and partially (namely its lower portion) protruding through the lower opening of the hollow member such that the lower part of the cam follower freely abuts on the abutment body. The first crown gear and the second crown gear are both totally housed within the hollow member. The helical spring is totally housed within the hollow member, and has its upper extremity in contact with the cover and its lower extremity in contact with the annular seating. The cam is rotatable about the pin in both clock-

wise and anti-clockwise directions.

[0009] In a preferred embodiment of the safety hinge according to the invention, the angle of rotation of the cam about the pin, corresponding to movement of the safety hinge from the first resting position to the second resting position, is in the range $105 \div 120$ degrees, preferably 110 degrees.

[0010] The invention will be better understood from the following embodiment, explained in detail and based on the figures, that represent:

Figure 1: exploded view of the safety hinge according to the invention;

Figure 2: exploded view of the upper elements of the safety hinge according to the invention;

Figure 3: axonometrical view of the safety hinge according to the invention;

Figures 4a and 4b: partial section view of the safety hinge according to the invention, corresponding to a first resting position (closed door position);

Figure 5: partial section view of the safety hinge according to the invention, corresponding to a partially open door position;

Figures 6a and 6b: partial section view of the safety hinge according to the invention, corresponding to another partially open door position;

Figure 7a and 7b: partial section view of the safety hinge according to the invention, corresponding to a second resting position (maximally open door position);

[0011] **Figure 1** shows an explosion view of the safety hinge according to the invention, that comprises a cam **1** provided with a first vertical cam profile **c1** and a second vertical cam profile **c2** that is symmetrical to the first vertical cam profile **c1**. The cam **1** is also provided with a first central circular through hole **h1**.

[0012] The safety hinge further comprises a cam follower **2** provided with a first vertical cam follower profile **f1** configured to work in conjunction with the first vertical cam profile **c1**, and a second vertical cam follower profile **f2**, that is symmetrical to the first vertical cam follower profile **f1**, configured to work in conjunction with the second vertical cam profile **c2**. Said two cam follower profiles **f1**, **f2** are not visible in **figure 1**, but are visible in **figure 2**.

[0013] The cam follower **2** is partially housed within a hollow member **4** that is fixable to a frame **F**. For example, screws may be used to fix the hollow member **4** to a door frame **F**. The hollow member **4** is provided with an upper opening covered by a cover **5** and a lower opening through which the cam follower **2** protrudes. The cover **5** is preferably removably fixed to the hollow member **4**. For example, screws may be used to fix the cover **5** to the hollow member **4** (as shown in figure 2).

[0014] The cam **1** is fixed to an abutment body **B** fixable to a door **D**, said door **D** being configured to operate in conjunction with said frame **F**. The cam **1** and the abutment body **B** may be fixed directly to the door **D**, or may

be, as shown in **figure 1**, be fixed to the door **D** by means of an auxiliary member **A**. Press-fitting may be used to fix the abutment body **B** to the door **D** or to the auxiliary member **A**, as well as of the auxiliary member **A** to the door **D**.

[0015] A vertical pin **7** has its lower end fixed to the abutment body **B** and passes through the first central circular through hole **h1**.

[0016] The cam **1** is rotatable about the pin **7** in both clockwise and anti-clockwise directions.

[0017] **Figure 2** shows an exploded view of the upper elements of the safety hinge according to the invention, more precisely of those elements housed within the hollow member **4**.

[0018] The interior of the hollow member **4** has a substantially cylindrical shape bounded respectively by said upper and lower openings, and is provided with a pair of diametrically opposed vertical grooves **g1** along the entire height of the hollow member **4**.

[0019] The cam follower **2** is fixed at its top to a first crown gear **G1** having upwards oriented teeth. The cam follower **2** may be integral with the first crown gear **G1** (i.e. made in one piece) or may be welded or glued to the first crown gear **G1**. The first crown gear **G1** is provided with a second central circular through hole **h2** and has freedom of rotation about its vertical central axis.

[0020] The hollow member **4** further houses a second crown gear **G2** situated above and in contact with the first crown gear **G1**, and having downwards oriented teeth with a same pitch as the teeth of the first crown gear **G1**. The second crown gear **G2** is provided with a third central circular through hole **h3**, with an annular seating **6** fixed concentrically with and inside said third central circular through hole **h3**, and with a pair of diametrically opposed guides **g2** situated on an outer lateral surface thereof. Each guide **g2** of the second crown gear **G2** is slidable along a respective groove **g1** of the hollow member **4**.

[0021] Due to the guides **g2** - grooves **g1** arrangement, the second crown gear **G2** movement is restricted exclusively to the translation along its vertical central axis that coincides with the vertical central axis of the first crown gear **G1**.

[0022] The hollow member **4** further houses an elastic element, preferably a helical spring **3**, configured to exert a vertical compression force on the second crown gear **G2** and thereby ensuring a permanent contact between the teeth of the second crown gear **G2** and the teeth of the first crown gear **G1**. The helical spring **3** has its upper extremity in contact with the cover **5** and its lower extremity in contact with the annular seating **6**.

[0023] Each tooth of the first and second crown gears **G1**, **G2** has an identical apex angle in the range $100 - 130$ degrees and has a same height in the range of $2 \div 3.5$ mm.

[0024] Although not shown in **figure 2**, the pin **7** depicted in **figure 1**, passes through the first **h1**, second **h2** and third **h3** central circular through holes, as well as

through several coils of the helical spring **3**.

[0025] Figure 3 shows an axonometrical view of the safety hinge according to the invention, in a first resting position corresponding to a closed door position.

[0026] Figures 4a and 4b each show a partial section view of the safety hinge according to the invention, in a first resting position (corresponding to the one of figure 3) corresponding to a closed door position. In said first resting position, the first crown gear **G1** is in mesh with the second crown gear **G2**, the cam **1** is not in contact with the cam follower **2** (namely the first vertical cam profile **c1** is not in contact with the first vertical cam follower profile **f1**), and the spring **3** is minimally compressed.

[0027] Figure 5 shows a partial section view of the safety hinge according to the invention, corresponding to a partially open door position, wherein the position of the two crown gears **G1** and **G2** is identical to the one form figures 4a and 4b (i.e. in mesh), while only the cam **1** together with the first crown gear **G1** have rotated clockwise about the pin **7**, such that the first vertical cam profile **c1** just comes into contact with the first vertical cam follower profile **f1** (i.e. the first vertical cam profile **c1** exerts substantially no pressure on the first vertical cam follower profile **f1**). The spring **3** is minimally compressed.

[0028] Figures 6a and 6b each show a partial section view of the safety hinge according to the invention, corresponding to a different (in respect to figure 5) partially open door position, wherein the cam **1** together with the first crown gear **G1** have further rotated clockwise and the two crown gears **G1** and **G2** make contact only at the apex of their respective corresponding teeth. The first vertical cam profile **c1** is in contact with and exerts pressure on the first vertical cam follower profile **f1**. The spring **3** is maximally compressed.

[0029] Figures 7a and 7b each show a partial section view of the safety hinge according to the invention, in a second resting position corresponding to a maximally open door position, wherein the cam **1** together with the first crown gear **G1** have even further rotated clockwise and the first crown gear **G1** is in mesh with the second crown gear **G2** but the teeth of the first crown gear **G1** are offset with one pitch in respect to the teeth of the second crown gear **G2** in comparison to the first resting position; the first vertical cam profile **c1** is in contact with but exerts substantially no pressure on the first vertical cam follower profile **f1**. The spring **3** is minimally compressed.

[0030] The functioning of the safety hinge according to the invention will be explained in the following paragraphs.

[0031] Initially, the door is in the closed position (and the safety hinge is in its first resting position), as in figures 4a and 4b, wherein the cam **1** is not in contact with the cam follower **2**, i.e. their respective profiles **c1**, **f1** are not in contact. The two crown gears **G1**, **G2** are in mesh and the spring **3** is minimally compressed.

[0032] As the door gradually opens (opened by a user), the cam **1** together with the first crown gear **G1** rotate

clockwise about the pin **7** until the profiles **c1**, **f1** just come into contact, as shown in figure 5. The cam follower **2**, the second crown gear **G2** and the spring **3** do not change their positions in respect to those corresponding to the closed door position.

[0033] If the door is further opened (in respect to the position of figure 5) at an angle of about 97 degrees in respect to the closed door position, the user will feel resistance (i.e. he will sense that a greater force needs to be applied to further open the door) and implicitly understand that he should avoid opening the door further. This is an advantage of the invention, because the user, based on the perceived information (resistance felt), avoids damaging the hinge. Said resistance is due to the opposition of the second crown gear **G2** to the rotation of the first crown gear **G1** and implicitly to the cam follower **2**.

[0034] If the user continues to further open the door, intentionally or unintentionally, at an angle over 97 degrees, the further rotation of the cam **1** will determine the cam follower **2** and implicitly the first crown gear **G1** to rotate clockwise. Because the second crown gear **G2** is limited exclusively to a vertical translation movement (due to the guides **g2** - grooves **g1** arrangement), the teeth of the first crown gear **G1** will move relative to the teeth of the second crown gear **G2**, thus pushing upwards the second crown gear **G2** (the teeth of the second crown gear **G2** will move upwards on the left flanks of the respective corresponding teeth of the first crown gear **G1**). Consequently, the user will feel an even greater resistance from the door, signaling him that he should stop opening it. The feature that the second crown gear **G2** can only translate vertically is essential to obtain said door resistance feeling for the user.

[0035] If nevertheless the user further opens the door, at some point, the teeth of the two crown gears **G1**, **G2** will be in contact only at their apex level, as in figures 6a and 6b. In this position, the second crown gear **G2** is at its maximum height and the spring **3** is maximally compressed.

[0036] If the door continues to open even further, the teeth of the second crown gear **G2** will start descending (will move downwards on the right flanks of the respective corresponding teeth of the first crown gear **G1**), thereby the second crown gear **G2** descending until the teeth of both crown gears **G1**, **G2** are again in mesh, as shown in figures 7a and 7b. In this position, the door is maximally open and the safety hinge is in its second resting position.

[0037] In the second resting position the teeth of the first crown gear **G1** are offset with one pitch in respect to the teeth of the second crown gear **G2**, in comparison to the first resting position.

[0038] During the descent of the second crown gear **G2**, the user will feel that the necessary door opening force is starting to decrease, until a minimum corresponding to the second resting position.

[0039] If the user still continues opening the door, he will feel again that the necessary door opening force is

starting to increase.

[0040] The above succession of sensory warnings should eventually determine the user to be aware of the abnormal situation (risking to damage the hinge) and stop further opening the door.

[0041] The returning of the door from its maximally open position to its closed position is extremely simple (thus a significant advantage provided by the safety hinge according to the invention): all the user has to do is to close the door. During this operation, the cam **1** rotates anti-clockwise and will make contact with the cam follower **2** through their other respective profiles **c2** and **f2**. Consequently, the process described in the previous paragraphs takes place in reverse and the two crown gears **G1**, **G2** will finally be in mesh again, with no offset teeth.

[0042] An essential feature of the invention is the geometry (namely apex angle and height) of the crown gears **G1**, **G2** teeth. If said geometry is out of the specified ranges, the safety hinge either cannot operate at all (because a more acute tooth apex angle together with a higher tooth height make impossible the translation of the second crown gear **G2**), or operates ineffectively (because a more obtuse tooth apex angle together with a lower tooth height do not provide notable sensory warnings to the user).

Claims

1. Safety hinge for a vertical door, comprising:

- a cam (1) provided with:

a first vertical cam profile (c1) and a second vertical cam profile (c2) that is symmetrical to the first vertical cam profile (c1),

- a cam follower (2) provided with:

a first vertical cam follower profile (f1) configured to work in conjunction with the first vertical cam profile (c1), and a second vertical cam follower profile (f2), that is symmetrical to the first vertical cam follower profile (f1), configured to work in conjunction with the second vertical cam profile (c2),

the cam follower (2) being fixed at its top to a first crown gear (G1) that has upwards oriented teeth and has freedom of rotation about its vertical central axis,

- a second crown gear (G2):

- situated above and in contact with the first crown gear (G1),
- has downwards oriented teeth, having a

same pitch as that of the first crown gear (G1),

- has only freedom of translation along its vertical central axis that coincides with the vertical central axis of the first crown gear (G1),

- each tooth of the first and second crown gears (G1, G2) has an identical apex angle in the range $100 \div 130$ degrees, and has a same height in the range of $2 \div 3.5$ mm,
- an elastic element (3) exerting a vertical compression force on the second crown gear (G2), thereby ensuring a permanent contact between the teeth of the second crown gear (G2) and the teeth of the first crown gear (G1),
- the safety hinge having

a first resting position wherein the first crown gear (G1) is in mesh with the second crown gear (G2), and

a second resting position wherein

- the first crown gear (G1) is in mesh with the second crown gear (G2), and
- the teeth of the first crown gear (G1) are offset with one pitch in respect to the teeth of the second crown gear (G2), in comparison to the first resting position,

- the safety hinge being configured to:

- move from the first resting position into the second resting position by moving the cam (1) such that the first vertical cam profile (c1) drives the first vertical cam follower profile (f1),
- move from the second resting position back into the first resting position by moving the cam (1) such that the second vertical cam profile (c2) drives the second vertical cam follower profile (f2).

2. Safety hinge according to claim 1, wherein

- the cam (1) is provided with a first central circular through hole (h1),
- the first crown gear (G1) is provided with a second central circular through hole (h2),
- the second crown gear (G2) is provided with:

- a third central circular through hole (h3),
- an annular seating (6) fixed concentrically with and inside the third central circular through hole (h3),
- a pair of diametrically opposed guides (g2), situated on an outer lateral surface of the

second crown gear (G2),
 - the elastic element (3) is a helical spring (3) provided with a plurality of coils,
 the safety hinge further comprising:

- a hollow member (4), fixable to a frame (F), and provided with an upper opening and a lower opening,

- the interior of the hollow member (4) having a substantially cylindrical shape bounded respectively by said upper and lower openings, and being provided with a pair of diametrically opposed grooves (g1) along the entire height of the hollow member (4) such that each guide (g2) of the second crown gear (G2) is slidable along a respective groove (g1),

- a cover (5) removably fixed to the hollow member (4) and covering the upper opening thereof,
 - an abutment body (B) fixed to the cam (1), said body (B) being fixable to a door (D), configured to operate in conjunction with said frame (F),
 - a pin (7) passing through the first (h1), second (h2) and third (h3) central circular through holes, as well as through several coils of the helical spring (3), and having its lower end fixed to the abutment body (B),

wherein

- the cam (1) is partially housed within the hollow member (4) and partially protruding through the lower opening of the hollow member (4),
 - the cam follower (2) is partially housed within the hollow member (4) and partially protruding through the lower opening of the hollow member (4) such that the lower part of the cam follower (2) freely abuts on the abutment body (B),
 - the first crown gear (G1) and the second crown gear (G2) are both totally housed within the hollow member (4),
 - the helical spring (3) is totally housed within the hollow member (1), and has its upper extremity in contact with the cover (5) and its lower extremity in contact with the annular seating (6),
 - the cam (1) is rotatable about the pin (7) in both clockwise and anti-clockwise directions.

3. Safety hinge according to claim 2, wherein the angle of rotation of the cam (1) about the pin (7), corresponding to movement of the safety hinge from the first resting position to the second resting position, is in the range $105 \div 120$ degrees, preferably 110 degrees.

4. Vertical door provided with a safety hinge according to any of the claims 1-3.

5. Vertical door according to claim 4, wherein the vertical door is a vertical door of a refrigerator cabinet.

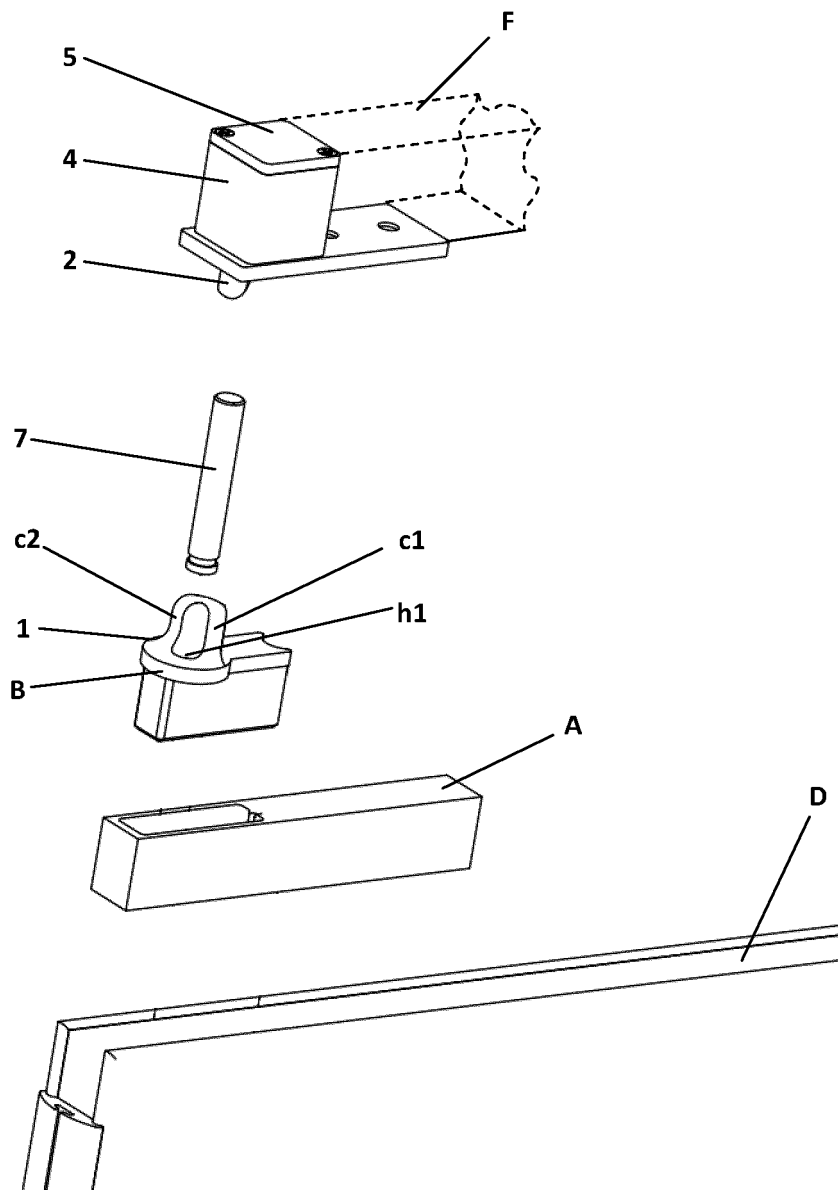


Figure 1

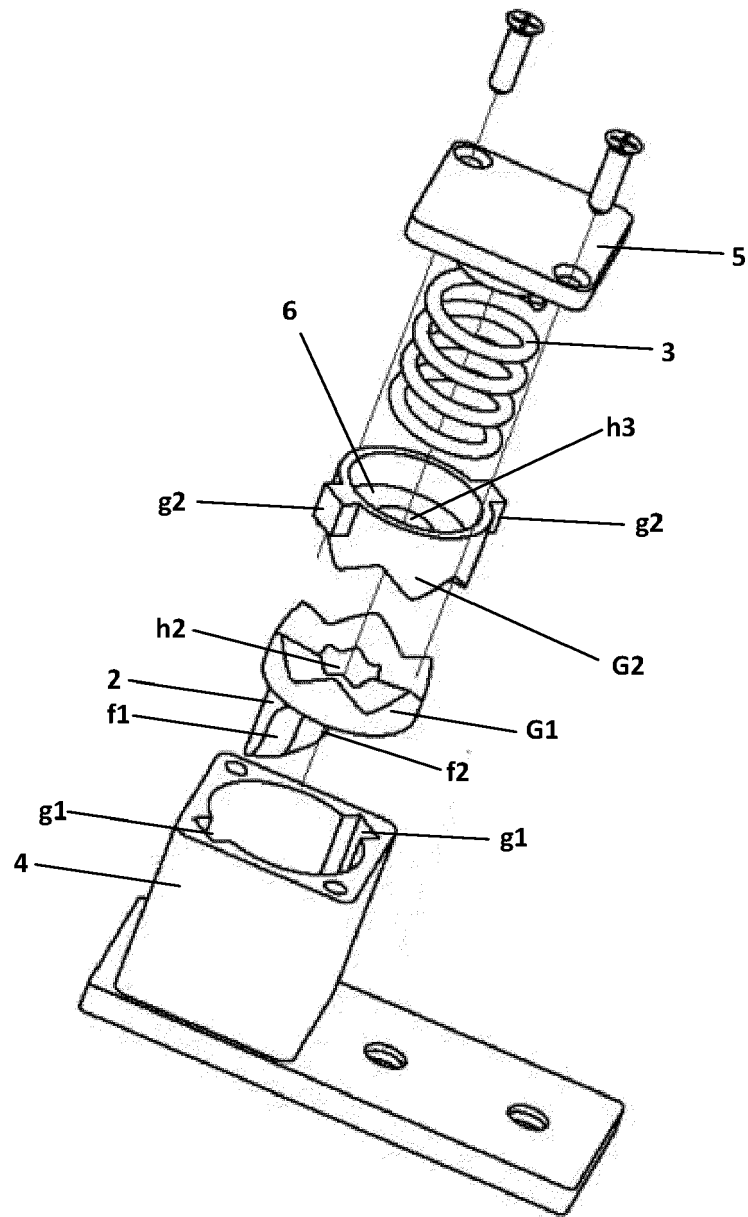


Figure 2

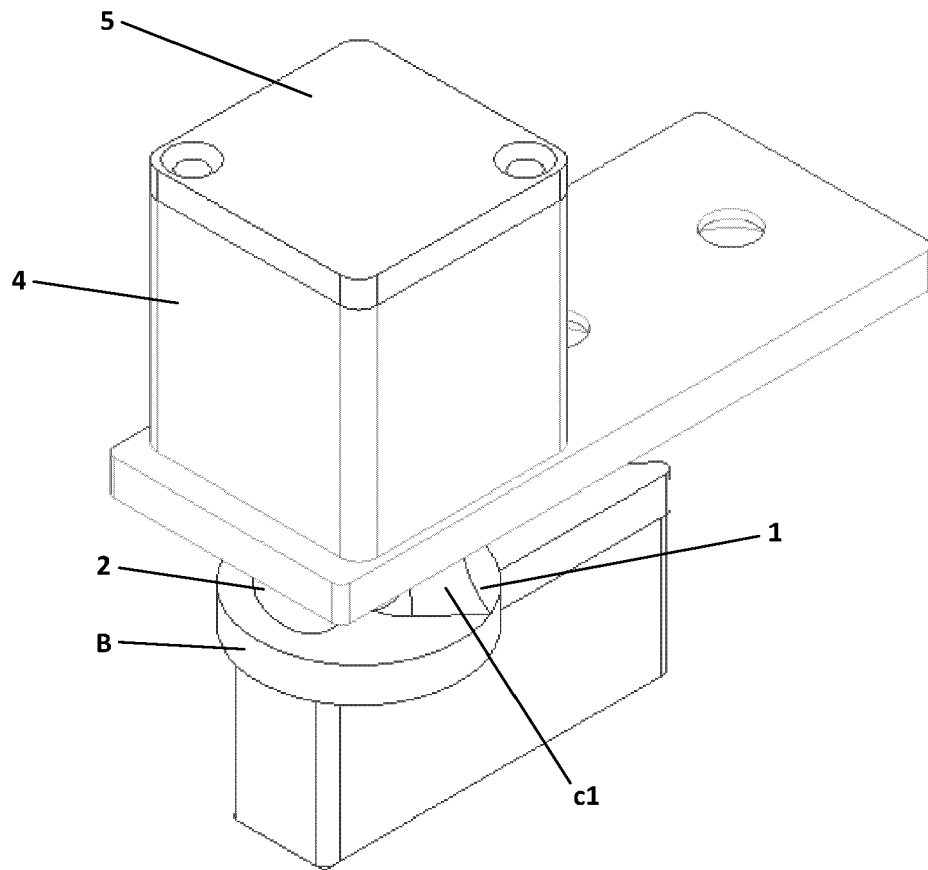


Figure 3

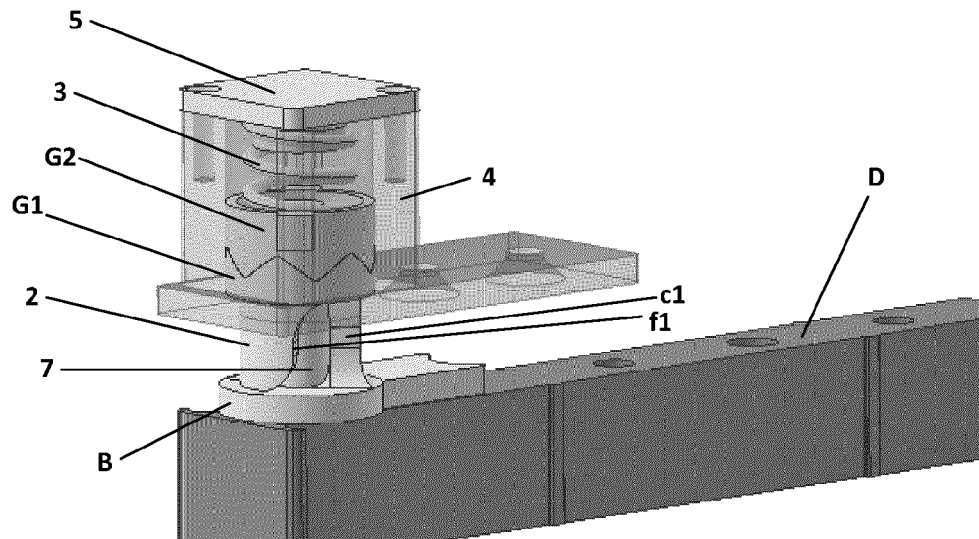


Figure 4a

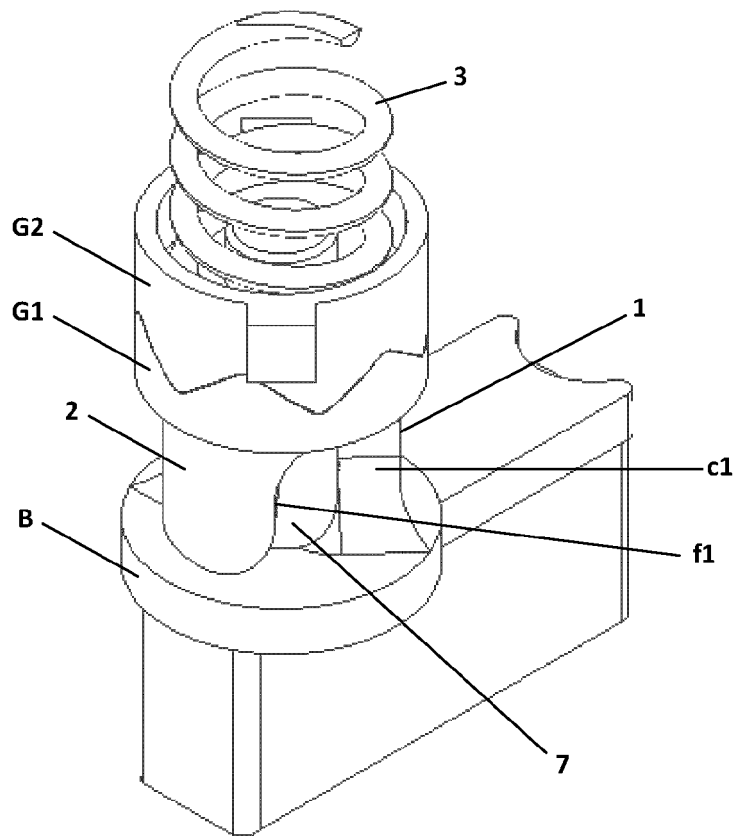


Figure 4b

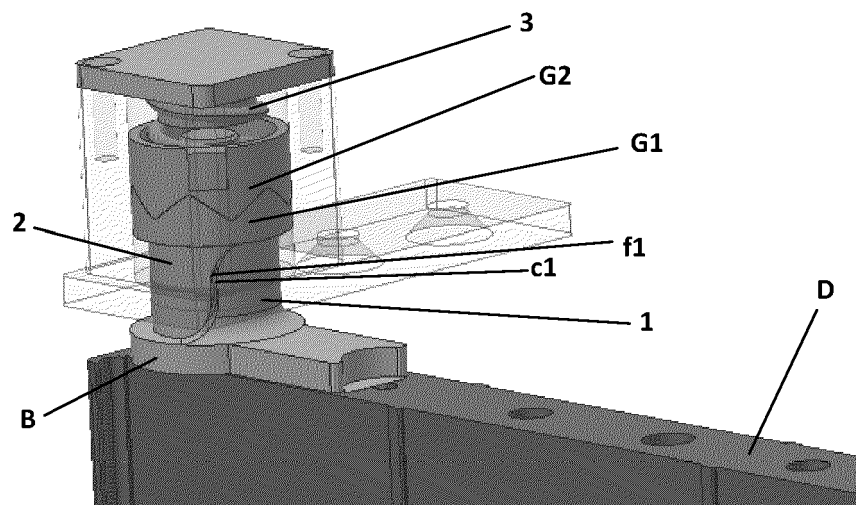


Figure 5

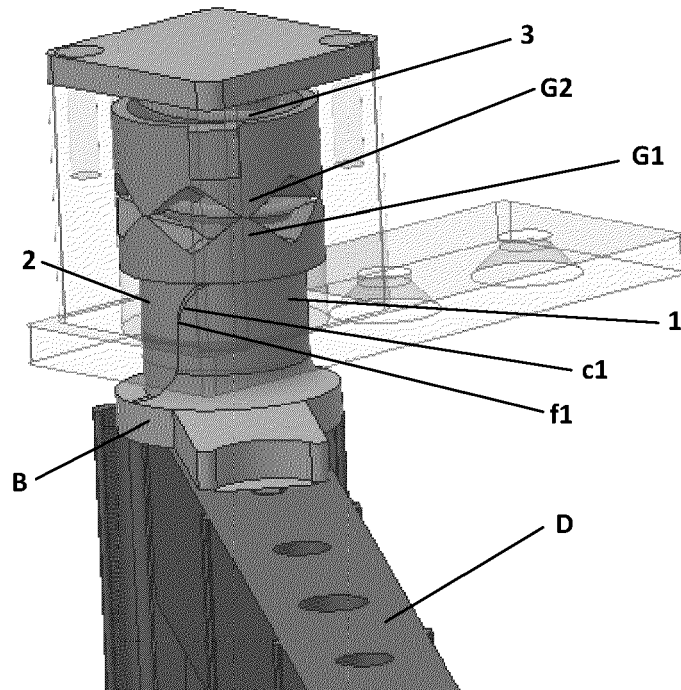


Figure 6a

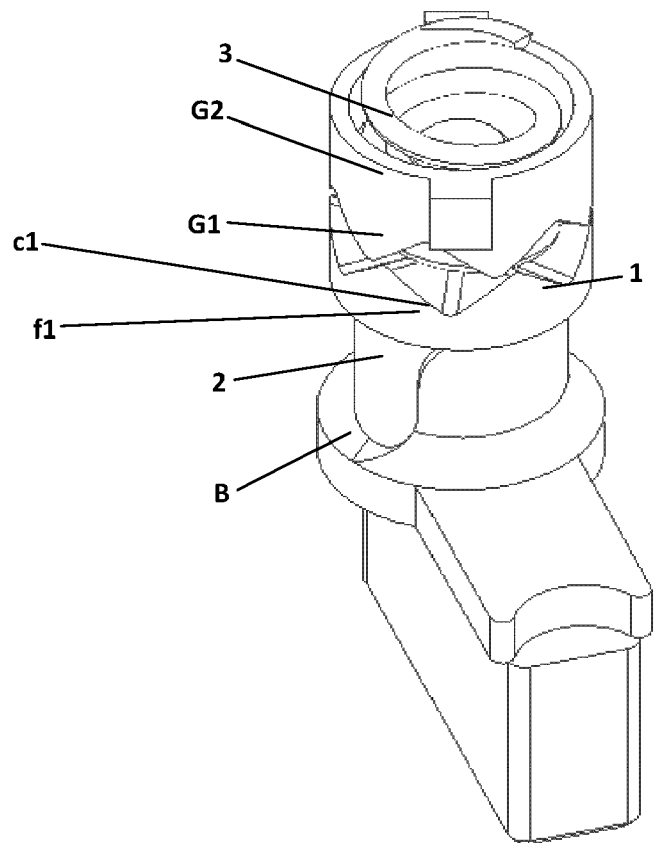


Figure 6b

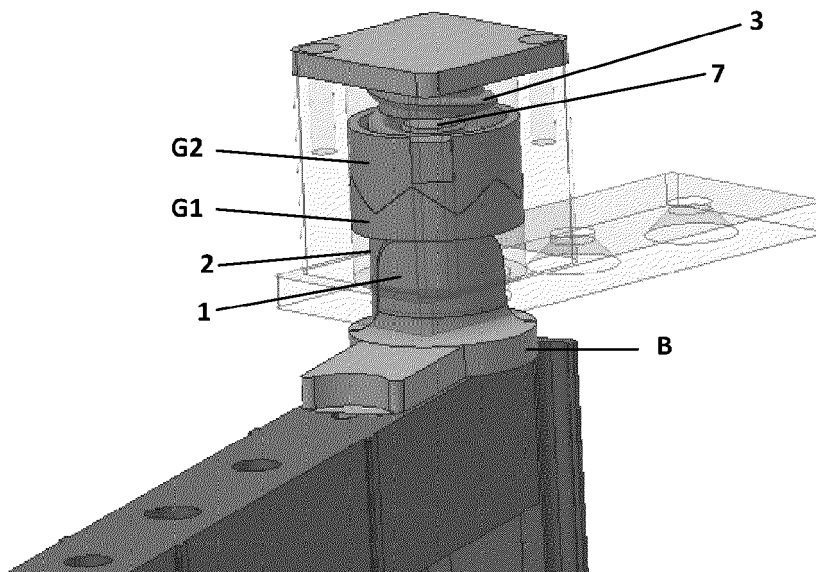


Figure 7a

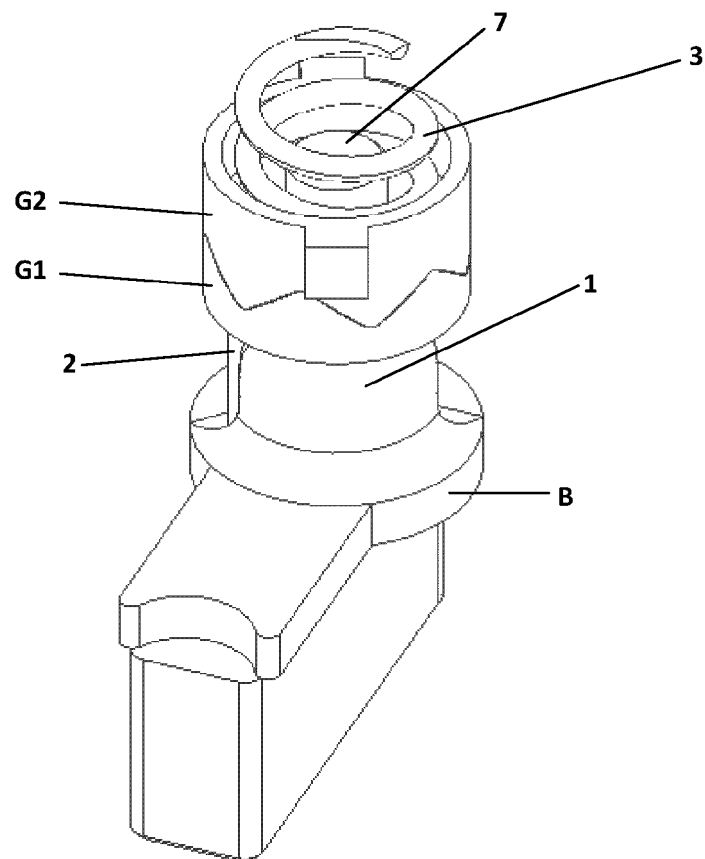


Figure 7b



EUROPEAN SEARCH REPORT

Application Number

EP 22 16 7750

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EPO FORM 1503 03.82 (P04C01)

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X	EP 2 789 944 A2 (SAMSUNG ELECTRONICS CO LTD [KR]) 15 October 2014 (2014-10-15) * paragraph [0031] - paragraph [0077]; figures 1-9 *	1-5	
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X	US 2014/259532 A1 (MILLARD MATTHEW DAVID [US] ET AL) 18 September 2014 (2014-09-18) * paragraph [0015] - paragraph [0030]; figures 1-7 *	1-5	
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X	WO 2012/029720 A1 (NIFCO INC [JP]; ARAKI MINORU [JP]) 8 March 2012 (2012-03-08) * paragraph [0019] - paragraph [0051]; figures 1-50 *	1-5	TECHNICAL FIELDS SEARCHED (IPC) E05D
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 19 September 2022	Examiner Viethen, Lorenz
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

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