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(54) **Hinge for the door of electrical household appliances, particularly for hinging the door of dishwashers**

Scharnier für eine Tür von elektrischen Haushaltsgeräten, insbesondere Scharnier für die Tür von Spülmaschinen

Charnière pour la porte d'appareils électroménagers, notamment pour articuler la porte de lave-vaisselles

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Description

[0001] The present invention relates to a hinge for the door of electrical household appliances, particularly for hinging the door of dishwashers.

[0002] As is known, the doors of electrical household appliances, such as traditional ovens, microwave ovens or dishwashers, are connected to the body of the appliance by means of a pair of coaxial hinges, which allow the door to rotate with respect to the body of the appliance in order to open or close it.

[0003] Several types of hinges for the door of electrical household appliances are known depending on the type of appliance in which they are to be installed and depending on the requirements to be met.

[0004] In particular, in the field of dishwashers, hinges are known which are designed to be used in pairs so as to allow the rotation of the door of the dishwasher with respect to the body of the appliance about a horizontal axis that is proximate to the lower side of the door. Such hinges are composed of a coupling element, to be fixed to the body of the appliance, and a supporting element, to be fixed to the door, which are mutually hinged about a main axis, which constitutes the axis about which the door is rotated with respect to the body of the appliance in order to open or close it. In these types of hinges, an effect of compensation of the weight of the door is generally required which can vary from appliance to appliance and depending on the covering panel, if any, that is applied to the outer side of the door, such as for example in the case of fitted appliances. Such compensation effect is obtained generally by means of a spring, which is connected to the supporting element by means of a connecting element, which is hinged to a portion of the supporting element about a second axis which is parallel to, and spaced from, the main axis so that the elastic reaction of the spring generates a torque, about the main axis, that contrasts the torque generated by the weight of the door, which increases as the extent of the opening of the door increases. The function of the connecting element is to vary adequately the arm of the elastic reaction generated by the spring, with respect to the main axis, in order to counterbalance in the best possible manner the weight of the door both during opening and during closure.

[0005] Document US 4 163 344 A1 shows a hinge mechanism including a bracket rigidly mounted to the side wall of a oven structure for pivotally securing a door to the side wall of the oven housing.

[0006] In the field of dishwashers, the need is felt to be able to keep the door open in any position despite the two contrasting forces, the weight of the door and the elastic reaction of the spring, which are unlikely to be perfectly balanced in any position.

[0007] In order to meet this requirement, several hinges have been devised which however are structurally complicated and/or expensive.

[0008] The aim of the present invention is to meet the

requirement described above by providing a hinge for the door of electrical household appliances, particularly for hinging the door of dishwashers, which is structurally simple.

5 **[0009]** Within this aim, an object of the invention is to provide a hinge that is composed of a limited number of components that are simple to manufacture and assemble.

[0010] Another object of the invention is to provide a hinge that can be manufactured with competitive costs.

10 **[0011]** This aim, as well as these and other objects that will become better apparent hereinafter, are achieved by a hinge for the door of electrical household appliances, particularly for hinging the door of dishwashers, comprising a coupling element, which can be fixed to the body of the appliance, and a supporting element, which can be fixed to the door and is hinged to said coupling element about a main axis, an element being provided for connecting said supporting element to elastic means that contrast the rotation of said supporting element with respect to said coupling element in the direction of rotation that corresponds to the opening rotation of the door with respect to the appliance, friction means being also provided which are interposed between said connecting element and said coupling element in order to slow the rotation of said supporting element with respect to said coupling element about said main axis, **characterized in that** said friction means are connected to said coupling element and engage against two opposite faces of said connecting element.

20 **[0012]** With reference to the figures, the hinge according to the invention, generally designated by the reference numeral 1, comprises a coupling element 2, which can be fixed to the body of the appliance, and a supporting element 3, which can be fixed to the door and is hinged to the coupling element 2 about a main axis 4.

25 **[0013]** The coupling element 2 and the supporting element 3 can be made, in a per se known manner, of blanked and folded metal plate and be fixed respectively to the body of the appliance and to the door, which are not illustrated for the sake of simplicity, by way of connecting means of a known type, such as for example screws, bolts, rivets or other technically equivalent connecting means.

30 **[0014]** The hinge according to the invention also comprises an element 5 for connecting the supporting element 3 to elastic means 6, which contrast the rotation of the supporting element 3 with respect to the coupling element 2 in the direction of rotation that corresponds to the opening rotation of the door with respect to the appliance.

35 **[0015]** The hinge according to the invention further comprises friction means 7, which are interposed between the connecting element 5 and the coupling element 2 in order to slow the rotation of the supporting element 3 with respect to the coupling element 2 about the main axis 4.

40 **[0016]** According to the invention, the friction means 7

are connected to the coupling element 2 and engage against two opposite faces of the connecting element 5.

[0017] The connecting element 5 has a substantially plate-like shape and the friction means 7 engage the two opposite larger faces of the connecting element 5.

[0018] The connecting element 5 is hinged, proximate to one of its ends, to the supporting element 3 about a second axis 8, which is parallel and spaced with respect to the main axis 4, and to the coupling element 2 about a third axis 9, which is parallel and spaced with respect to the main axis 4 and the second axis 8. The connecting element 5 is connected to the elastic means 6 with a portion thereof that is arranged opposite the second axis 8 with respect to the third axis 9, and the connecting element 5 can slide, on a plane which is perpendicular to the main axis 4, with respect to the coupling element 2.

[0019] More particularly, the third axis 9 is formed by a pivot 10, which is fixed to the coupling element 2, and the coupling element 5 mates with such pivot 10 by means of an elongated slot 11, so that the connecting element 5 can rotate, in its plane of arrangement, with respect to the coupling element 2 about the third axis 9, i.e., with respect to the axis of the pivot 10, and can also perform a translational motion, in its plane of arrangement, with respect to the pivot 10.

[0020] Conveniently, a resting element 12 is provided, which is connected to the coupling element 2 laterally to the connecting element 5. Such resting element 12 defines, in cooperation with the pivot 10, a guiding passage 13 for a portion of the connecting element 5 that is arranged between the slot 11 and a side of the connecting element 5 that faces the resting element 12.

[0021] The resting element 12 is preferably constituted by a roller 14 or a pulley, which is pivoted to the coupling element 2 about a fourth axis 15, which is parallel to the main axis 4.

[0022] The elastic means 6 are constituted by a helical spring 16, which is connected, with one of its ends, to the coupling element 2 and, with its opposite end, to the portion of the connecting element 5 that is arranged opposite the second axis 8 with respect to the third axis 9.

[0023] The friction means 7 comprise a pair of plates 17a, 17b, preferably made of synthetic material, which are fitted on the pivot 10 with the connecting element 5 interposed so as to engage the two opposite larger faces of the connecting element 5.

[0024] Advantageously, pushing means 18 are provided for pushing the plates 17a, 17b against the two opposite faces of the connecting element 5.

[0025] Conveniently, the pusher means 18 comprise at least one spring 19, which is constituted preferably by a conical helical spring which is fitted around the pivot 10 and is interposed between a shoulder 10a of the pivot 10 and one of the two plates 17a, 17b so as to pack together the plates 17a, 17b and the connecting element 5.

[0026] In practice, one of the two plates 17a, 17b, constituted by the plate 17a, is interposed between the con-

necting element 5 and the coupling element 2, while the other plate 17b is interposed between the connecting element 5 and one end of the spring 19, which engages, with its opposite end, against the shoulder 10a that is formed at one end of the pivot 10.

[0027] Operation of the hinge according to the invention is as follows.

[0028] In order to hinge a door to the body of an electrical household appliance, two hinges according to the invention are used which are fixed by means of the coupling element 2 to the body of the appliance and by means of the supporting element 3 to the door so that the main axes of the two hinges coincide, generally horizontally, so as to define the axis about which the door is rotated in order to open and close the appliance.

[0029] If the appliance is constituted by a dishwasher, the two hinges are arranged proximate to the lower side of the door, so that the rotation axis of the door is proximate and parallel to the lower side.

[0030] Starting from the fully closed position of the door, shown in Figure 1, a rotation of the door in the opening direction and therefore a rotation of the supporting element 3 about the main axis 4 with respect to the body of the appliance, i.e., with respect to the coupling element 2, produces a partial rotation of the connecting element 5 about the third axis 9 and a sliding of the connecting element 5 with respect to the pivot 10, between said pivot 10 and the roller 14, as shown in Figures 2 and 3. This sliding of the connecting element 5 causes an elongation of the spring 16, which produces an elastic reaction that generates a torque which contrasts the opening rotation of the supporting element 3 about the main axis 4 with respect to the coupling element 2.

[0031] The opening rotation of the supporting element 3 with respect to the coupling element 2 about the main axis 4 can continue until the door is completely open and is reached when the slot 11 stops with one of its ends against the pivot 10, as shown in Figure 3.

[0032] Starting from this fully open position of the door, a rotation of the door in the closing direction and therefore a rotation of the supporting element 3 about the main axis 4 with respect to the body of the appliance, i.e., with respect to the coupling element 2, causes the sliding of the connecting element 5 with respect to the coupling element 2 between the pivot 10 and the roller 14. This sliding is assisted by the elastic reaction of the spring 16.

[0033] Both during the opening rotation and during the closing rotation of the supporting element 3 with respect to the coupling element 2 about the main axis 4, the sliding of the connecting element 5 with respect to the coupling element 2 is slowed by the friction of the plates 17a, 17b against the two opposite faces of the connecting element 5.

[0034] This slowing effect of the plates 17a, 17b allows to stop the door in any position between the fully open position and the fully closed position, simply by releasing the door. In this case, the fraction of the weight of the door or of the elastic reaction of the spring that is in excess

is in fact contrasted effectively by the friction generated by the plates 17a, 17b against the two opposite faces of the connecting element 5.

[0035] The spring 19 of the pusher means 18 has the effect of increasing the friction between the plates 17a, 17b and the connecting element 5 and to recover any plays arising from the machining tolerances of the plates 17a, 17b of the coupling element 2, of the pivot 10 and of the connecting element 5, and of compensating for the wear of the plates 17a, 17b.

[0036] In practice it has been found that the hinge according to the invention fully achieves the intended aim, since it allows to stop the opening of the door in any position despite a structure that is extremely simple and composed of a limited number of elements that are simple to manufacture and assemble.

[0037] The hinge thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims; all the details may further be replaced with other technically equivalent elements.

[0038] In practice, the materials used, as well as the dimensions, may be any according to requirements and to the state of the art.

[0039] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A hinge (1) for the door of electrical household appliances, particularly for hinging the door of dishwashers, comprising a coupling element (2), which can be fixed to the body of the appliance, and a supporting element (3), which can be fixed to the door and is hinged to said coupling element (2) about a main axis (4), an element (5) being provided for connecting said supporting element (3) to elastic means (6) that contrast the rotation of said supporting element (3) with respect to said coupling element (2) in the direction of rotation that corresponds to the opening rotation of the door with respect to the appliance, friction means (7) being also provided which are interposed between said connecting element (5) and said coupling element (2) in order to slow the rotation of said supporting element (3) with respect to said coupling element (2) about said main axis (4), **characterized in that** said friction means (7) are connected to said coupling element (2) and engage against two opposite faces of said connecting element (5).

2. The hinge according to claim 1, **characterized in**

that said connecting element (5) has a substantially plate-like shape, said friction means (7) engaging the two opposite larger faces of said connecting element (5).

3. The hinge according to claims 1 and 2, **characterized in that** said connecting element (5) is hinged, proximate to one of its ends, to said supporting element (3) about a second axis (8), which is parallel and spaced with respect to said main axis (4), and to said coupling element (2) about a third axis (9), which is parallel and spaced with respect to said main axis (4) and said second axis (8); said connecting element (5) being connected to said elastic means (6) with a portion thereof that is arranged opposite said second axis (8) with respect to said third axis (9) and said connecting element (5) being able to slide, on a plane which is perpendicular to said main axis (4), with respect to said coupling element (2).

4. The hinge according to one or more of the preceding claims, **characterized in that** said third axis (9) is formed by a pivot (10), which is connected to said coupling element (2), said connecting element (5) mating with said pivot (10) by means of an elongated slot (11) for the rotation of said connecting element (5) with respect to said coupling element (2) about said third axis (9) and for the sliding of said connecting element (5) on its plane of arrangement with respect to said pivot (10).

5. The hinge according to one or more of the preceding claims, **characterized in that** said elastic means (6) comprising a helical spring (16), which is connected, by means of one of its ends, to said coupling element (2) and, by means of its opposite end, to said portion of the connecting element (5) that lies opposite said second axis (8) with respect to said third axis (9).

6. The hinge according to one or more of the preceding claims, **characterized in that** it comprises a resting element (12), which is connected to said coupling element (2) laterally to said connecting element (5), said resting element (12) defining, in cooperation with said pivot (10), a guiding passage (13) for a portion of said connecting element (5) that is arranged between said slot (11) and a side of said connecting element (5) that faces said resting element (12).

7. The hinge according to one or more of the preceding claims, **characterized in that** said resting element (12) is constituted by a roller (14) pivoted to said coupling element (2) about a fourth axis (15), which is parallel to said main axis (4).

8. The hinge according to one or more of the preceding claims, **characterized in that** said friction means (7)

comprise a pair of plates (17a, 17b) which are fitted around said pivot (10) with said connecting element (5) interposed so as to engage the two opposite larger faces of said connecting element (5).

9. The hinge according to one or more of the preceding claims, **characterized in that** it comprises pushing means (18) for pushing said plates (17a, 17b) against the two opposite faces of said connecting element (5).
10. The hinge according to one or more of the preceding claims, **characterized in that** said pusher means (18) comprise at least one spring (19), which is fitted around said pivot (10) and is interposed between a shoulder (10a) of said pivot (10) and one of said two plates (17a, 17b) in order to pack together said plates (17a, 17b) and said connecting element (5).
11. The hinge according to one or more of the preceding claims, **characterized in that** said spring (19) is constituted by a conical helical spring.

Patentansprüche

1. Ein Scharnier (1) für die Tür elektrischer Haushaltsgeräte, insbesondere für die gelenkige Verbindung der Tür von Geschirrspülern, das ein Kopplungselement (2) umfasst, welches am Körper des Geräts befestigt werden kann, und ein tragendes Element (3), das an der Tür befestigt werden kann und um eine Hauptachse (4) gelenkig mit dem Kopplungselement (2) verbunden ist, wobei ein Element (5) bereitgestellt ist, um das tragende Element (3) mit elastischen Mitteln (6) zu verbinden, die der Drehung des tragenden Elements (3) im Verhältnis zu dem Kopplungselement (2) in die Drehrichtung entgegenwirken, die der Öffnungsdrehung der Tür im Verhältnis zum Gerät entspricht, wobei auch Reibungsmittel (7) bereitgestellt sind, die zwischen dem Verbindungselement (5) und dem Kopplungselement (2) angeordnet sind, um die Drehung des tragenden Elements (3) im Verhältnis zu dem Kopplungselement (2) um die Hauptachse (4) zu verlangsamen, **dadurch gekennzeichnet, dass** die Reibungsmittel (7) mit dem Kopplungselement (2) verbunden sind und gegen zwei gegenüberliegende Flächen des Verbindungselements (5) eingreifen.
2. Das Scharnier gemäß Anspruch 1, **dadurch gekennzeichnet, dass** das Verbindungselement (5) eine im Wesentlichen plattenartige Form hat, wobei die Reibungsmittel (7) mit den beiden gegenüberliegenden größeren Flächen des Verbindungselements (5) in Eingriff treten.
3. Das Scharnier gemäß Anspruch 1 und 2, **dadurch**

gekennzeichnet, dass das Verbindungselement (5) nahe einem seiner Enden gelenkig mit dem tragenden Element (3) um eine zweite Achse (8) verbunden ist, die parallel zu und beabstandet von der Hauptachse (4) ist, und mit dem Kopplungselement (2) um eine dritte Achse (9), die parallel zu und beabstandet von der Hauptachse (4) und der zweiten Achse (8) ist; wobei das Verbindungselement (5) mit einem Teil davon, der mit Bezug auf die dritte Achse (9) der zweiten Achse (8) entgegengesetzt angeordnet ist, mit den elastischen Mitteln (6) verbunden ist und wobei das Verbindungselement (5) im Verhältnis zu dem Kopplungselement (2) auf einer Ebene gleiten kann, die senkrecht zu der Hauptachse (4) ist.

4. Das Scharnier gemäß einem oder mehreren der obigen Ansprüche, **dadurch gekennzeichnet, dass** die dritte Achse (9) aus einem Zapfen (10) besteht, der mit dem Kopplungselement (2) verbunden ist, wobei das Verbindungselement (5) mit dem Zapfen (10) über einen Längsschlitz (11) verbunden wird, zum Zwecke der Drehung des Verbindungselements (5) im Verhältnis zu dem Kopplungselement (2) um die dritte Achse (9) und zum Gleiten des Verbindungselements (5) auf seiner Anordnungsebene im Verhältnis zu dem Zapfen (10).
5. Das Scharnier gemäß einem oder mehreren der obigen Ansprüche, **dadurch gekennzeichnet, dass** die elastischen Mittel (6) eine Spiralfeder (16) umfassen, die an einem ihrer Enden mit dem Kopplungselement (2) und an ihrem gegenüberliegenden Ende mit dem Teil des Verbindungselements (5) verbunden ist, der mit Bezug auf die dritte Achse (9) gegenüber der zweiten Achse (8) liegt.
6. Das Scharnier gemäß einem oder mehreren der obigen Ansprüche, **dadurch gekennzeichnet, dass** es ein Auflageelement (12) umfasst, das seitlich zu dem Verbindungselement (5) mit dem Kopplungselement (2) verbunden ist, wobei das Auflageelement (12) im Zusammenwirken mit dem Zapfen (10) einen Führungsgang (13) für einen Abschnitt des Verbindungselements (5) bestimmt, der zwischen dem Schlitz (11) und einer Seite des Verbindungselements (5) angeordnet ist, die dem Auflageelement (12) zugewandt ist.
7. Das Scharnier gemäß einem oder mehreren der obigen Ansprüche, **dadurch gekennzeichnet, dass** das Auflageelement (12) aus einer Rolle (14) besteht, gelenkig verbunden mit dem Kopplungselement (2) um eine vierte Achse (15), die parallel zu der Hauptachse (4) ist.
8. Das Scharnier gemäß einem oder mehreren der obigen Ansprüche, **dadurch gekennzeichnet, dass** die Reibungsmittel (7) ein Paar von Platten (17a,

17b) umfassen, die um den Zapfen (10) herum montiert sind, mit dem Verbindungselement (5) dazwischen angeordnet, um die zwei gegenüberliegenden größeren Flächen des Verbindungselements (5) zu halten.

9. Das Scharnier gemäß einem oder mehreren der obigen Ansprüche, **dadurch gekennzeichnet, dass** es Schubmittel (18) zum Schieben der Platten (17a, 17b) gegen die zwei gegenüberliegenden Flächen des Verbindungselements (5) umfasst.
10. Das Scharnier gemäß einem oder mehreren der obigen Ansprüche, **dadurch gekennzeichnet, dass** die Schubmittel (18) mindestens eine Feder (19) umfassen, die um den Zapfen (10) herum montiert und zwischen einer Schulter (10a) des Zapfens (10) und einer der beiden Platten (17a, 17b) angeordnet ist, um die Platten (17a, 17b) und das Verbindungselement (5) zusammenzupacken.
11. Das Scharnier gemäß einem oder mehreren der obigen Ansprüche, **dadurch gekennzeichnet, dass** die Feder (19) aus einer konischen Spiralfeder besteht.

Revendications

1. Charnière (1) pour la porte d'appareils électroménagers, en particulier pour articuler la porte de lave-vaisselles, comprenant un élément de couplage (2) qui peut être fixé sur le corps de l'appareil et un élément de support (3) qui peut être fixé sur la porte et est articulé par rapport audit élément de couplage (2) autour d'un axe principal (4), un élément (5) étant prévu pour raccorder ledit élément de support (3) à des moyens élastiques (6) qui s'opposent à la rotation dudit élément de support (3) par rapport audit élément de couplage (2) dans la direction de rotation qui correspond à la rotation d'ouverture de la porte par rapport à l'appareil, des moyens de friction (7) étant également prévus, qui sont intercalés entre ledit élément de raccordement (5) et ledit élément de couplage (2) afin de ralentir la rotation dudit élément de support (3) par rapport audit élément de couplage (2) autour dudit axe principal (4), **caractérisée en ce que** lesdits moyens de friction (7) sont raccordés audit élément de couplage (2) et se mettent en prise contre deux faces opposées dudit élément de raccordement (5).
2. Charnière selon la revendication 1, **caractérisée en ce que** ledit élément de raccordement (5) a sensiblement une forme de plaque, lesdits moyens de friction (7) mettant en prise les deux faces opposées les plus grandes dudit élément de raccordement (5).
3. Charnière selon les revendications 1 et 2, **caractérisée en ce que** ledit élément de raccordement (5) est articulé, à proximité de l'une de ses extrémités, par rapport audit élément de support (3) autour d'un deuxième axe (8), qui est parallèle et espacé par rapport audit axe principal (4) et audit élément de couplage (2) autour d'un troisième axe (9) qui est parallèle et espacé par rapport audit axe principal (4) et audit deuxième axe (8); ledit élément de raccordement (5) étant raccordé auxdits moyens élastiques (6) avec une partie de ces derniers qui est agencée à l'opposé dudit deuxième axe (8) par rapport audit troisième axe (9) et ledit élément de raccordement (5) pouvant coulisser, sur un plan qui est perpendiculaire audit axe principal (4), par rapport audit élément de couplage (2).
4. Charnière selon une ou plusieurs des revendications précédentes, **caractérisée en ce que** ledit troisième axe (9) est formé par un pivot (10) qui est raccordé audit élément de couplage (2), ledit élément de raccordement (5) se couplant avec ledit pivot (10) au moyen d'une fente allongée (11) pour la rotation dudit élément de raccordement (5) par rapport audit élément de couplage (2) autour dudit troisième axe (9) et pour le coulisser dudit élément de raccordement (5) sur son plan d'agencement par rapport audit pivot (10).
5. Charnière selon une ou plusieurs des revendications précédentes, **caractérisée en ce que** lesdits moyens élastiques (6) comprennent un ressort hélicoïdal (16) qui est raccordé, au moyen de l'une de ses extrémités, audit élément de couplage (2) et au moyen de son extrémité opposée, à ladite partie de l'élément de raccordement (5) qui est à l'opposé dudit deuxième axe (8) par rapport audit troisième axe (9).
6. Charnière selon une ou plusieurs des revendications précédentes, **caractérisée en ce que** elle comprend un élément d'appui (12) qui est raccordé audit élément de couplage (2) latéralement par rapport audit élément de raccordement (5), ledit élément d'appui (12) définissant, en coopération avec ledit pivot (10), un passage de guidage (13) pour une partie dudit élément de raccordement (5) qui est agencée entre ladite fente (11) et un côté dudit élément de raccordement (5) qui fait face audit élément d'appui (12).
7. Charnière selon une ou plusieurs des revendications précédentes, **caractérisée en ce que** ledit élément d'appui (12) est constitué par un rouleau (14) pivoté sur ledit élément de couplage (2) autour d'un quatrième axe (15) qui est parallèle audit axe principal (4).
8. Charnière selon une ou plusieurs des revendications

précédentes, **caractérisée en ce que** lesdits moyens de friction (7) comprennent une paire de plaques (17a, 17b) qui sont montées autour dudit pivot (10) avec ledit élément de raccordement (5) intercalé afin de mettre en prise les deux faces opposées les plus grandes dudit élément de raccordement (5). 5

9. Charnière selon une ou plusieurs des revendications précédentes, **caractérisée en ce qu'**elle comprend des moyens de poussée (18) pour pousser lesdites plaques (17a, 17b) contre les deux faces opposées dudit élément de raccordement (5). 10

10. Charnière selon une ou plusieurs des revendications précédentes, **caractérisée en ce que** lesdits moyens de poussée (18) comprennent au moins un ressort (19) qui est monté autour dudit pivot (10) et est intercalé entre un épaulement (10a) dudit pivot (10) et l'une desdites deux plaques (17a, 17b) afin d'empaqueter lesdites plaques (17a, 17b) et ledit élément de raccordement (5) ensemble. 15
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11. Charnière selon une ou plusieurs des revendications précédentes, **caractérisée en ce que** ledit ressort (19) est constitué par un ressort hélicoïdal conique. 25

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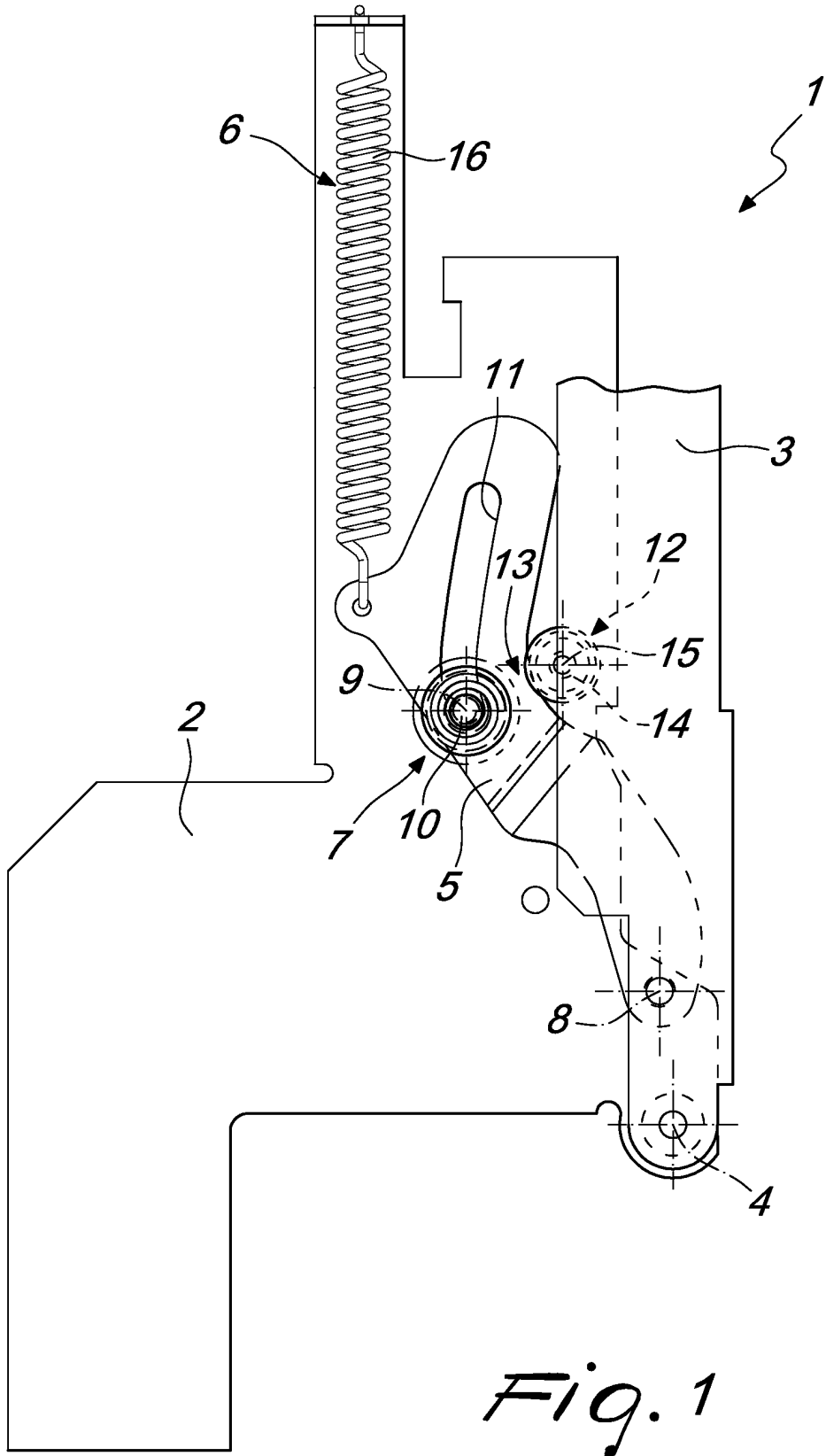
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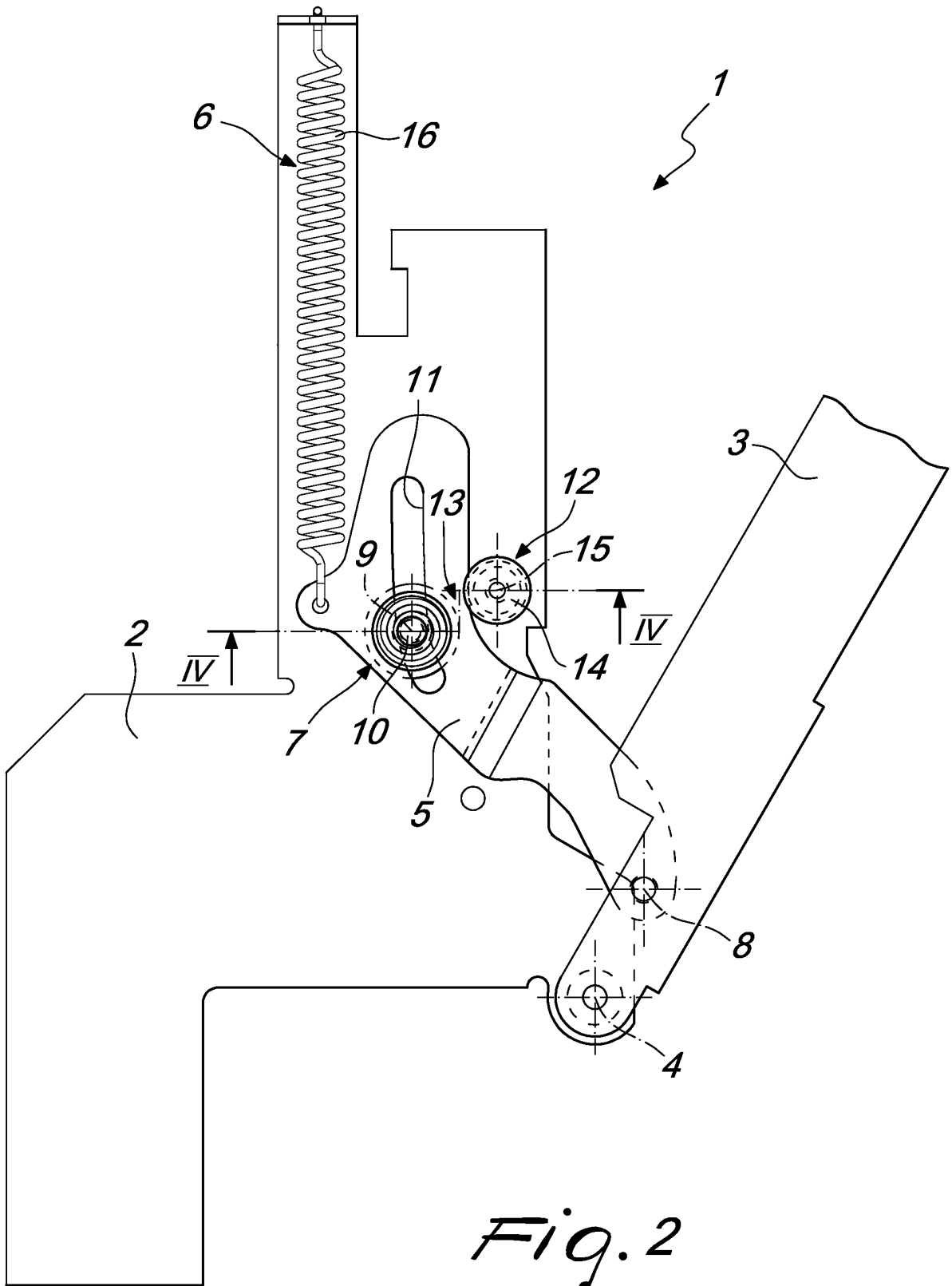
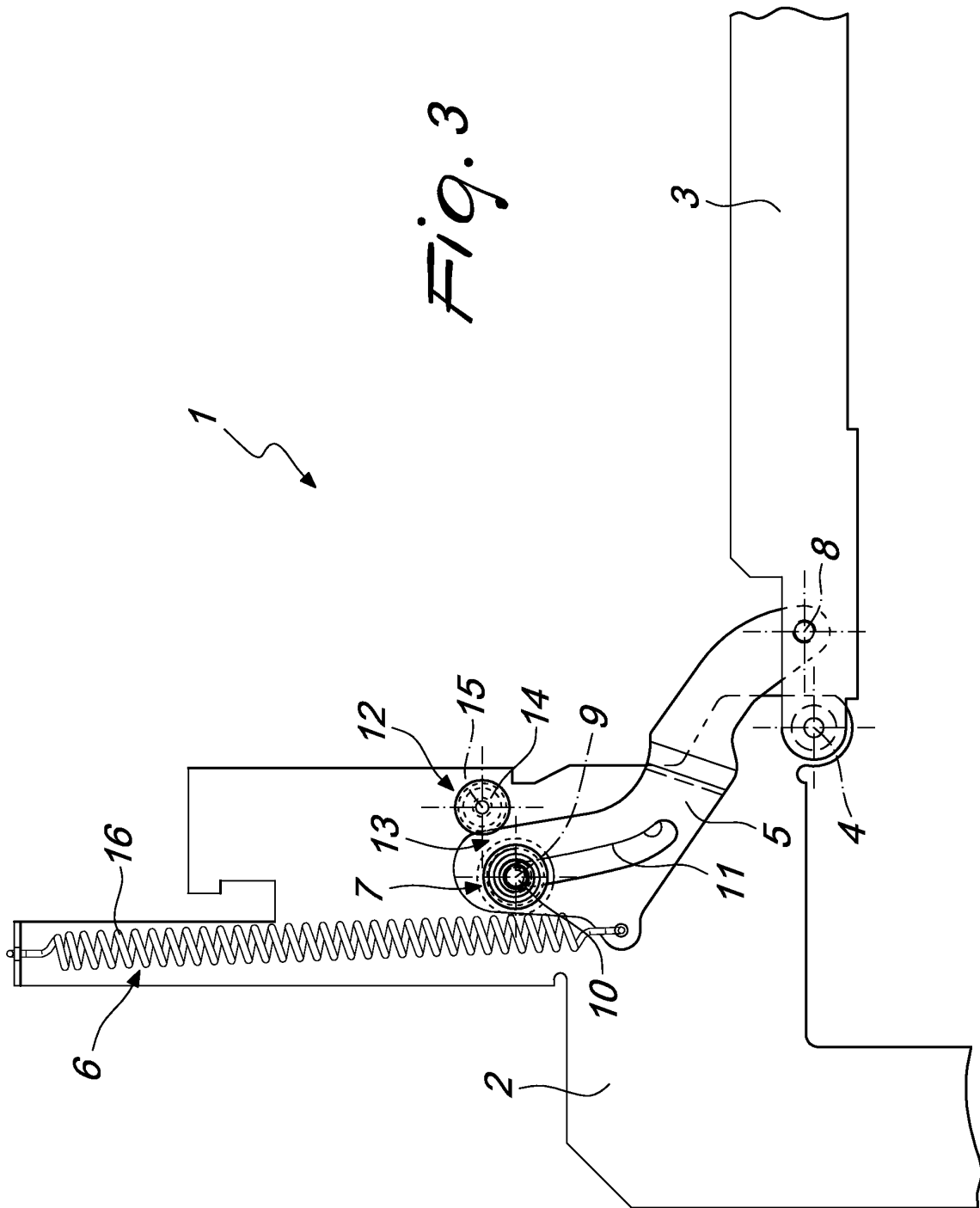


Fig. 2



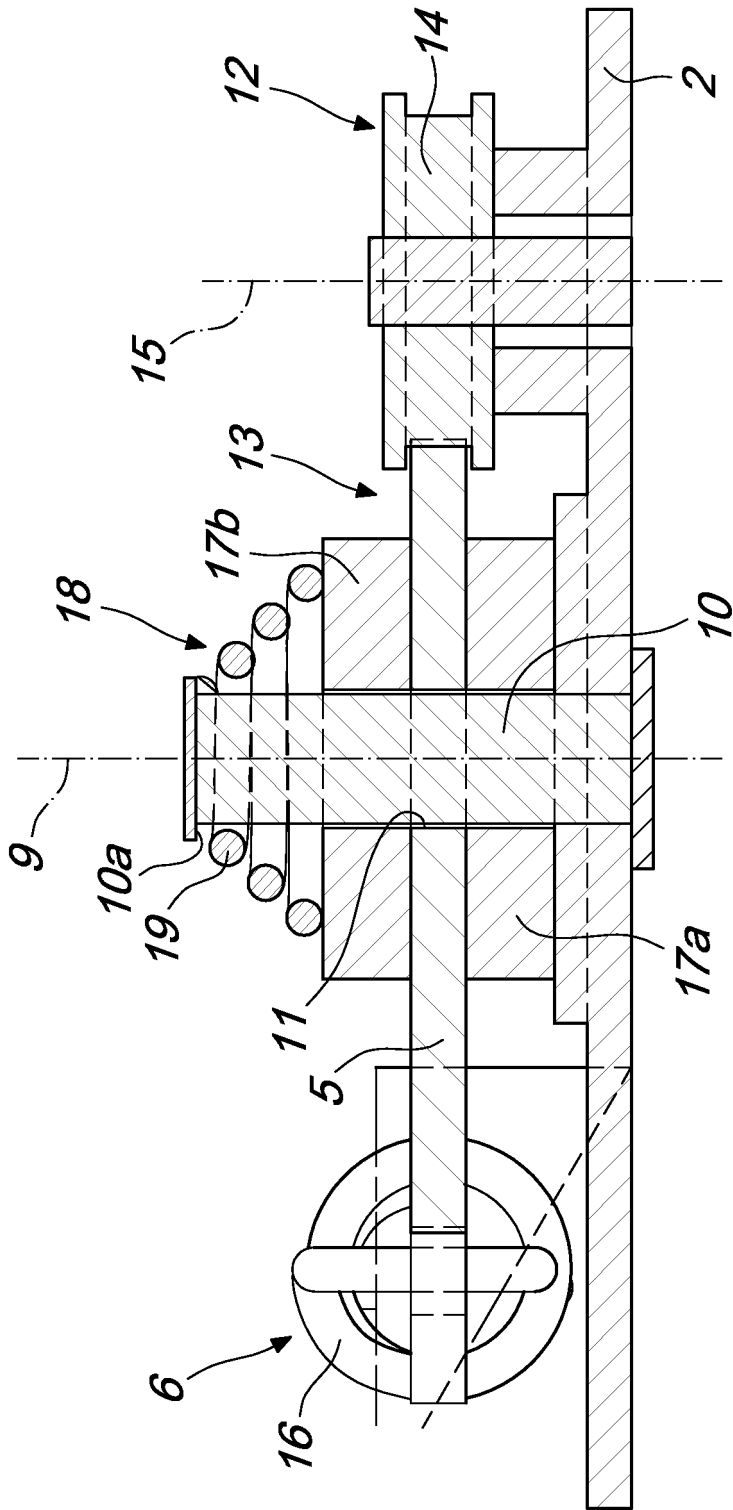


Fig. 4

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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