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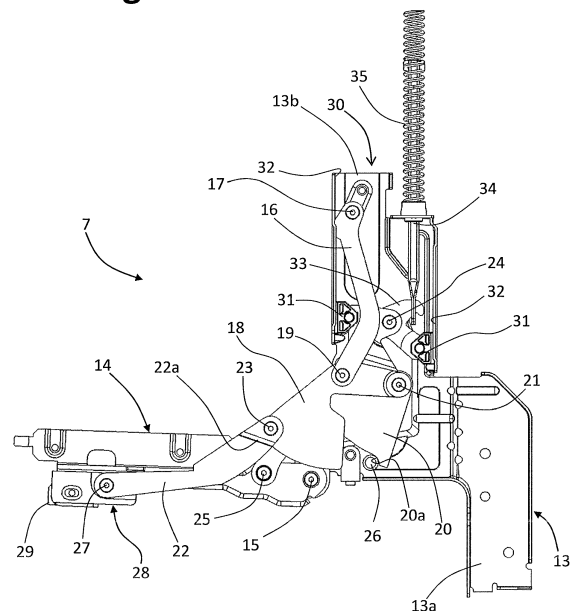
(54) **ELECTRICAL HOUSEHOLD APPLIANCE AND HINGE FOR AN ELECTRICAL HOUSEHOLD APPLIANCE**

(57) An electrical household appliance has a load-bearing structure, a door constrained to which is a front panel and a hinge (7) for hinging a lower region of the door to the load-bearing structure in such a way that the door can turn according to a substantially horizontal axis of rotation between a closed position and an open position, in which the door is substantially vertical and substantially horizontal, respectively. The hinge (7) comprises a first part (13), pre-arranged for fixing to the load-bearing structure of the electrical household appliance, and a second part (14), which is articulated to the first part (13) and is pre-arranged for fixing to the door of the electrical household appliance. The hinge (7) further comprises a transmission system (16, 18, 20, 22, 28, 29), which is configured for being connected to a front panel slidably carried by the door, the transmission system (16, 18, 20, 22, 28, 29) interacting with the first part (13) and the second part (14) of the hinge (7) and comprising a system of levers (16, 18, 20, 22) that includes at least one first lever (18), pivoted to which is a second lever (22) that connects the first lever (18) to a sliding member (28, 29) configured for fixing to the front panel. According to the invention:

third lever (20) relative to the first hinge part (13) in the aforesaid open position of the door (6).

- the transmission system (16, 18, 20, 22, 28, 29) of the hinge (7) further comprises a third lever (20), which connects the second hinge part (14) to the first lever (18);
- the hinge (7) has a first arrest arrangement (22a) pre-arranged for blocking angular movement of the second lever (22) relative to the first lever (18) in the aforesaid open position of the door (6); and
- the hinge (7) has a second arrest arrangement (20a, 26) pre-arranged for blocking angular movement of the

**Fig. 6**



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## Description

### Field of the invention

**[0001]** The present invention relates to built-in electrical household appliances and, more in general, to electrical household appliances having a load-bearing structure articulated to the front part of which is a door, there being in turn associated to the latter a decorative front panel. The invention finds preferred application in the sector of dishwashers.

### State of the art

**[0002]** Some electrical household appliances, typically dishwashers, have a door that is hinged in its lower region to the load-bearing structure of the appliance so that it can turn about a substantially horizontal axis. In these appliances, the load-bearing structure typically includes a base, the front of which is in a position recessed with respect to the door, in order to enable the latter to be opened, i.e., to prevent the lower edge of the door from being hindered by the base. In some applications, associated to the door of the electrical household appliance is a decorative front panel. This solution is adopted in particular in the case of electrical household appliances of the so-called "built-in" type, i.e., designed to be housed or integrated in the kitchen furniture of a domestic environment, for example a modular kitchen. In such appliances, frequently associated to the front of the base is a skirting board, which also has aesthetic purposes.

**[0003]** In the case of use of a decorative front panel having a height greater than the height of the door of the electrical household appliance (which is in general between 720 and 760 mm), there exists the problem that the lower edge of the panel itself may interfere with the front of the base, thus preventing complete opening of the door. This problem is particularly felt when the front panel has a height decidedly greater than the door in so far as it is designed for performing also the function of the aforesaid skirting board, i.e., that of hiding from view practically the entire front of the base of the appliance. In these cases, the decorative panel may have a height of 800 mm or more.

**[0004]** A first known solution to the problem referred to above is to reduce the dimension of depth of the base, i.e., set its front further back. This measure determines, however, less space available in the base for housing functional components of the appliance. This solution can also cause problems of stability of a dishwasher, in particular when its door is opened and one or both of its racks loaded with dishes are brought into the corresponding extracted position.

**[0005]** According to other solutions, the decorative front panel is associated to the door by means of a slidable coupling in such a way that the panel can slide on the door, in a direction substantially orthogonal to the axis of rotation of the door. In these solutions, during

opening of the door, the panel slides from beneath upwards on the door. During reclosing of the door, the panel performs a sliding movement opposite to the previous one, from top downwards, thus once again hiding at least in part the base of the appliance.

**[0006]** For example, EP 1529482 A discloses a dishwasher in which the decorative panel is slidably associated to the door in the way described above and has a height such that its lower edge comes into contact with the front of the base in the final phase of opening of the door. In this way, as the movement of opening proceeds, the panel is forced to slide on the door, enabling opening of the latter. In this known solution, the coupling system between the door and the panel includes an elastic element, such as a spring, which tends to bring the panel back into its initial lowered position during reclosing of the door.

**[0007]** This known solution, albeit simple and inexpensive, does not enable use of front panels decidedly higher than the door and each time implies a mechanical interference between the panel and the base of the dishwasher, with consequent possible damage, yielding, and misalignment, in the long term between the door and the panel.

**[0008]** A solution suitable for solving the above specific problems is known from EP 1894509 A. In this further solution, the door is hinged to the load-bearing structure of the dishwasher via a pair of fixed-fulcrum hinges, where also the decorative panel is connected to the load-bearing structure via an articulated system of levers. This system of levers comprises in particular a first lever, having one end articulated to a pin fixed on the load-bearing structure and the opposite end articulated to a second lever, which is in turn pivoted to the decorative panel. The system of levers further includes a third lever, having one end pivoted to a rotating sector, belonging to the articulation arrangement of a corresponding hinge of the door, and the opposite end pivoted to the pin that articulates the first and the second levers to one another. The system of levers operates in the sense of pushing the panel to slide upwards on the door, during opening of the latter, in such a way that the lower edge of the panel does not interfere with the front of the base. During reclosing of the door, the system of levers recalls the panel into the initial position; i.e., it determines sliding thereof downwards on the door.

**[0009]** The solution according to EP 1894509 A presents the drawback of requiring a pair of articulated systems of levers, which are additional to the corresponding hinges of the door and must be appropriately constrained to the load-bearing structure of the machine, each underneath the corresponding hinge. These systems of levers are moreover relatively cumbersome in so far as they project underneath the hinge so that the solution according to the document cited is not suitable for use in combination with decorative front panels having a relatively reduced height, i.e., ones that project beyond the bottom edge of the door only by a small amount.

**[0010]** Also known from EP 2407723 A, on which the preamble of Claim 1 is based, is a hinge conceived for solving the problems indicated in relation to EP 1894509. The hinge includes a fixed part, secured to the load-bearing structure of the electrical household appliance, a movable part, secured to the door of the electrical household appliance, and a transmission arrangement, configured for interacting with the two parts of the hinge so as to cause displacement of a sliding member, which is connected to the decorative front panel and is constrained to move in a corresponding linear guide defined in the movable part of the hinge. The hinge according to EP 2407723 has a relatively compact structure, immune from the problems cited in relation to EP 1529482. An embodiment described, the transmission arrangement of which is based upon the use of gears, is, however, relatively complex. In other embodiments the transmission arrangements are based upon the use of levers, among which an oscillating lever connected, directly or via interposition of a further lever, to the aforesaid sliding member: these solutions present the drawback that the entire weight of the decorative panel is discharged on the movable part of the hinge and on its rotation pin, which are hence subject to greater stress, with possible drawbacks in terms of operation in the long term.

#### Summary of the invention

**[0011]** In its general terms, the object of the present invention is to solve the aforesaid drawbacks and to provide a hinge and an electrical household appliance of the type indicated that is simple and inexpensive to produce and assemble, as well as reliable in operation in the long term.

**[0012]** The above and yet other objects, which will emerge more clearly hereinafter, are achieved, according to the present invention, by an electrical household appliance and by a hinge having the characteristics indicated in the claims. The claims form an integral part of the technical teaching provided herein in relation to the invention.

#### Brief description of the drawings

**[0013]** Further purposes, characteristics, and advantages of the invention will emerge clearly from the ensuing detailed description, with reference to the annexed drawings, which are provided purely by way of explanatory and non-limiting example and in which:

- Figure 1 is a partial and schematic perspective view of an electrical household appliance according to one embodiment of the invention;
- Figure 2 is a partial and schematic perspective view of a hinge according to one embodiment of the invention;
- Figure 3 is a partially exploded view of a hinge according to one embodiment of the invention;

- Figures 4, 5, and 6 are schematic views, in side elevation, of a hinge according to one embodiment of the invention, in three different operating conditions;
- Figure 7 is a view similar to that of Figure 6, which highlights the corresponding points for supporting the weight of a decorative front panel associated to a door of the electrical household appliance that uses the hinge illustrated;
- Figure 8 is a partial and schematic perspective view of an assembly comprising a door and a corresponding front panel, associated to which is a hinge according to one embodiment of the invention;
- Figure 9 is a detail of Figure 8 at a larger scale; and
- Figures 10, 11, and 12 are partial and schematic views, in side elevation, of an assembly comprising a door and a corresponding front panel, associated to which is a hinge according to one embodiment of the invention, in operating positions corresponding to those of Figures 4, 5, and 6, respectively.

#### Description of preferred embodiments of the invention

**[0014]** Reference to "an embodiment" or "one embodiment" in the framework of the present description is meant to indicate that a particular configuration, structure, or characteristic described in relation to the embodiment is comprised in at least one embodiment. Hence, phrases such as "in an embodiment", "in one embodiment", and the like, that may be present in various points of the present description do not necessarily all refer to one and the same embodiment. In addition, the particular configurations, structures, or characteristics may be combined in any adequate way in one or more embodiments. The references used in what follows are only provided for convenience and do not define the sphere of protection or the scope of the embodiments.

**[0015]** It is moreover pointed out that in the ensuing description the electrical household appliance according to the invention will be described limitedly to the parts of interest for the purposes of providing an understanding of the invention, without entering into detail of the characteristics thereof that depart from the invention.

**[0016]** In Figure 1, designated as a whole by 1 is an electrical household appliance according to one embodiment of the invention. In the example, the electrical household appliance is a dishwasher, in particular of the so-called built-in type. The dishwasher 1 has a load-bearing structure, here comprising at least one base 2, for example made of plastic material, rising from which are two front uprights 3, connected together by an upper cross member 4. The base 2 supports a wash tub 5, of a conception in itself known, open at the front. The side and top walls of the tub are mechanically connected in the respective front regions to the uprights 3 and to the cross member 4, respectively, that encompass the front opening of the tub 5.

**[0017]** The dishwasher 1 has a front door 6, which is hinged in a lower region thereof to the load-bearing struc-

ture via at least one hinge 7, in particular a pair of hinges provided in the bottom corner areas of the door. In what follows, a single hinge 7 will be illustrated and described, it being taken for granted that the other hinge may be built in the same way. In one embodiment, the hinge 7 has a first part that is fixed to the load-bearing structure, in particular between the base 2 and a respective upright 3, a second part that is fixed to the door 6, and an articulation that connects together the first and second parts in such a way that the door 6 can turn about a substantially horizontal axis of rotation, between a closed position and an open position, in which the door is substantially vertical and substantially horizontal, respectively. In Figure 1 the door 6 is represented in the aforesaid open position. In one embodiment, the articulation arrangement includes a pin that connects together the first and second parts of the hinge, the latter being a fixed-fulcrum hinge.

**[0018]** In a preferred embodiment, the door 6 is made up of a number of parts, which preferably comprise at least an inner metal shell 8, an outer metal shell 9, and a component 10 associated to the upper end of the outer shell 9. The inner shell 8, which is made, for example, of stainless steel, has a height substantially corresponding to that of the front opening of the tub and is designed to provide a front wall of the latter, when the door is closed. The outer shell 9, which is for example made of sheet metal, provides the load-bearing structure of the door, preferably fixed to which is the aforesaid second part of each hinge 7. The outer shell 9 has a height lower than the inner shell 8 so that fixed to its top is the component 10, preferably made of plastic material, which has a width substantially similar to that of the shells 8 and 9. The component 10, which may have a substantially box-shaped structure, is preferably configured for housing control and/or warning elements of the dishwasher 1. In a preferred embodiment, these control and/or warning elements have respective parts accessible at the top edge of the component 10, to provide a control panel 11.

**[0019]** Slidably associated to the door 6 is a decorative front panel 12, of a conception in itself known. For this purpose, provided in the upper region of the door 6, in particular in a position corresponding to the upper component 10, is at least one slidable coupling, suitable for constraining the panel 12 to the door 6. Preferably, two slidable couplings are provided, generally parallel to one another, a possible embodiment of which will be described hereinafter. Preferably, the slidable couplings comprise two guide elements, provided in the door, in particular in its component 10, each in a respective lateral area, and corresponding guided elements, each of which is fixed to a back of the decorative panel 12 and is engaged in a respective guide element. The slidable coupling is configured for enabling sliding of the panel 12 with respect to the door 6 in a direction substantially orthogonal to the axis of rotation of the door.

**[0020]** As will emerge more clearly hereinafter, at least one of the hinges 7 comprises a transmission system, which is connected to the panel 12 and interacts with the

parts 13 and 14 of the hinge 7, in such a way as to cause the aforesaid sliding of the panel 12 in a direction orthogonal to the axis of rotation of the door 6. In preferred embodiments of the invention, said transmission system comprises a plurality of angularly movable transmission elements, in particular in the form of levers. Each transmission element is rotatable about at least one respective axis, at least some of the axes of the system being able to translate in the course of the displacement of the door between its open and closed positions.

**[0021]** A hinge provided according to one embodiment of the invention is represented, in different views, in Figures 2, 3, and 4. In Figure 3, the lines of connection between the points of articulation of various elements represented are designated by the same reference numbers as those of the corresponding pins, described hereinafter.

**[0022]** With initial reference to Figure 2, designated by 13 is the part of the hinge 7 designed for fixing to the load-bearing structure of the dishwasher, whilst designated by 14 is the part of the hinge designed to be fixed to the door. In one embodiment, the part 13 comprises a substantially plate-shaped bracket, shaped so as to present a lower portion 13a, designed for fixing in a front corner area of the base 2, and an upper portion 13b, designed for fixing in a lower area of a respective upright 3 (see, for example, Figure 1). Also the part 14 may comprise a substantially plate-shaped bracket, designed for fixing in a lower corner area of the door 6, in particular of its outer shell 9. Fixing of the parts 13 and 14 may, for example, be obtained via screws or similar threaded members.

**[0023]** With reference also to Figures 3 and 4, in a preferred embodiment the hinge 7 is a fixed-fulcrum hinge, preferably with the parts 13 and 14 that are directly hinged together via a pin 15, which identifies the axis of rotation of the door 6. As has been mentioned, the hinge 7 also comprises a transmission system for causing the panel 12 to slide. This transmission system comprises a first angularly movable lever or transmission element 16, for example in the form of oblong metal plate, preferably having a generally arched shape. The lever 16 has an upper end pivoted to the hinge part 13, and especially to its portion 13b, via a corresponding pin 17 in a stationary position. Hinged, instead, to the lower end of the lever 16, via a corresponding pin 19, is an oscillating lever or transmission element 18, in what follows also referred to as "rocker".

**[0024]** The rocker 18, for example in the form of a shaped metal plate, is pivoted in an intermediate area thereof to the first lever 16, via the aforesaid pin 19, which provides the oscillation pin of the rocker 18. Hinged in an upper end region of the rocker 18 - or distal end region, with respect to the hinge part 14 - is a third lever or transmission element 20, via a corresponding pin, visible in Figures 5 and 6, where it is designated by 21. In a lower end region - or proximal end region, with respect to the hinge part 14 - hinged to the rocker 18 is a fourth lever

or transmission element 22, via a corresponding pin 23.

**[0025]** As will emerge more clearly hereinafter, according to a characteristic of the invention, the hinge 7 has a first arrest arrangement pre-arranged for blocking the angular movement of the lever 22 with respect to the lever 18 in the position of complete opening of the door 6.

**[0026]** For this purpose, in a preferred embodiment, the rocker 18 defines an arrest element, preferably in its proximal end region, which is able to co-operate with a corresponding arrest element of the lever 22. In the example shown, the aforesaid arrest element of the rocker 18 is obtained by a portion of the lower edge of the aforesaid proximal end region, in particular by a recess of this edge, designated by 18a for example in Figure 3.

**[0027]** In one embodiment, the hinge 7 includes or has associated thereto a counter-balancing system, designed to counter or offset the effect of the weight of the door 6 and of the front panel 12 during displacement of the door between the open and closed positions. This counter-balancing system may be of any conception known in the sector.

**[0028]** With reference in particular to Figure 4, in a preferred embodiment, such as the one represented, the counter-balancing system - designated as a whole by 30 - comprises a guide that extends in a direction generally orthogonal to the axis of rotation of the door 15, where slidably mounted within this guide is at least one friction element 31. The guide comprises at least one rail element or, as in the example illustrated, two opposed rail elements, designated by 32, which are preferably generally parallel. The rail elements 32 may, for example, be defined by shapings of walls of the hinge part 13, in particular at its upper portion 13b. Hence, in the example, the guide, i.e., each rail element 32, extends substantially vertically.

**[0029]** The at least one friction element 31 has basically the function of braking the movement of rotation of the door 6. In one embodiment, for this purpose a connection member 33 is provided, associated to which is at least one friction element 31 designed to co-operate with the aforesaid guide. In the example illustrated, the body of the connection member 33 - for example, in the form of a plate - is pivoted to an upper end region of the lever 20, via a corresponding pin 24, and supports at one end, in an articulated way, a first friction element 31, for example in the form of a pad or slide, preferably made of plastic material, slidably guided by a corresponding rail element 32. Once again with reference to the example illustrated, a second friction element 31 is provided, in a position generally opposite to the first friction element 31, slidably guided by the other rail element 32. In the example considered, the second friction element 31, which has a shape similar to that of the first friction element 31, is mounted in an articulated way on the lever 20a, in a position generally opposite to that of the pin 24. In possible variant embodiments (not represented) the two friction elements 31 may be mounted on opposite sides of one and the same connection member 33, which is pur-

posely shaped, or else on opposite sides of the lever 20.

**[0030]** The friction element or elements 31, which may possibly be constituted by rollers, basically have the function of generating a friction that varies as a function of the torque determined by the weight of the ensemble comprising the door 6 and the panel 12, during the angular movements of the door.

**[0031]** In a preferred embodiment, the system 30 further comprises an elastic element, connected to the element 33 or else, if the element 33 is absent, directly to the lever 20. The elastic element may comprise, for example, a spring reacting in compression or tension. In the example illustrated, a stem 34 surrounded by a helical spring 35 is provided for this purpose, with the spring that is compressed when the stem 34 is pulled downwards by the lever 20, here via the connection element 33. In the example, the lower end of the stem 35 is coupled to the element 33, which is preferably provided with a hook engaged to which is an eyelet or similar element for engagement of the stem. Preferably, the pin 17 for articulation of the lever 16 is located further up with respect to the pin 24 for connection of the lever 20 to the counter-balancing system 30.

**[0032]** The third lever 20, which is also for example in the form of a shaped metal plate, is pivoted in an intermediate area thereof to the rocker 18, via the aforesaid pin 21. In an upper end region, the lever 20 is preferably connected to the counter-balancing system 30, whereas, in a lower region, it is pivoted to the movable part 14 of the hinge 7, i.e., the part fixed to the door 6, via a corresponding pin 25.

**[0033]** According to a further characteristic of the invention, the hinge 7 has a second arrest arrangement, pre-arranged for blocking the angular movement of the lever 20 with respect to the hinge part 13 in the position of complete opening of the door 6.

**[0034]** For this purpose, in a preferred embodiment, the lever 20 defines an arrest element, which is able to co-operate with a corresponding arrest element in the fixed position. In the example shown, the aforesaid arrest element of the lever 20 is obtained by a portion of the lower edge of a part of the lever itself that is in a position generally intermediate with respect to its articulation pins 21 and 25, in particular by a recess of the aforesaid lower edge, designated by 20a for example in Figure 3. Preferably, the aforesaid arrest element with which the lever 20 is able to co-operate is located in a fixed position on the stationary part 13 of the hinge 7, this position being generally opposite to the pin 17, preferably relatively close to the pin 15. In the example, the fixed arrest element comprises a pin 26 or similar element projecting from the plate-like body that provides the part 13 of the hinge 7. With reference to the example illustrated, in the condition of closing of the door 6, and hence of the hinge 7, the fixed element 26 is at an intermediate height between the pins 15 and 23.

**[0035]** The fourth lever 22, for example in the form of an oblong metal plate, preferably having a generally

arched shape, is pivoted in a distal end region thereof to the rocker 18, in particular to the lower or proximal end of the rocker 18. The opposite end region of the lever 22 is pivoted via a pin 27 to a sliding member, designated by 28, which is designed to be mechanically connected to the decorative panel 12 of Figure 1, in particular via a corresponding bracket 29 having a preferably L-shaped cross section. As will emerge more clearly hereinafter, the member 28 is able to slide in a direction generally parallel to the direction of longitudinal extension of the movable part 14 of the hinge 7 in order to cause sliding of the panel 12 with respect to the door 6.

**[0036]** As mentioned previously, the lever 22 defines a corresponding arrest element, which is able to co-operate with the arrest element 18a of the rocker 18. In a preferred embodiment, arrest of the lever 22 is obtained by a bend or intermediate step of the lever 22, designated in the figures by 22a. As may be appreciated in Figure 3, the step 22a separates from one another two portions 22' and 22" of the lever 22, which extend generally parallel to one another, with the aforesaid step that is able to co-operate with the lower edge of the rocker 18, in particular at the corresponding recess 18a. Preferably, in the assembled condition of the hinge 7, the portion 22' of the lever 22 is generally parallel to the rocker 18, which is articulated via the pin 23, whilst the portion 22", articulated by means of the pin 27 to the sliding member 28, is generally coplanar to the rocker 18.

**[0037]** In the embodiment exemplified, the various pins referred to above are parallel or substantially parallel to one another, as may be clearly seen from Figure 3.

**[0038]** Operation of the hinge 7 of Figures 2-4 is described in what follows.

**[0039]** Figure 4 illustrates the hinge 7 in the condition of closing of the door (see for reference also Figure 10), with the hinge part 14 generally close and/or parallel to the hinge part 13, in particular to its upper portion 13b. As highlighted in Figure 5, in the initial step of the movement of opening of the door 6, the hinge part 14 moves angularly (in the counterclockwise direction as viewed in Figures 4-6), about the axis defined by the pin 15. The angular movement of the part 14 causes a displacement downwards of the lever 20, by means of the pin 25. As has been seen previously, the lever 20 is pivoted to the rocker 18, via the pin 21, and the lever 16 is in turn pivoted to the rocker 18, via the pin 19, the lever 16 being in turn pivoted to the fixed part 13 via the pin 17 in a stationary position. Lowering of the lever 20, together with the action of constraint exerted by the lever 16, hence causes a rotation upwards and outwards of the rocker 18, substantially with a clockwise movement. Pivoted to the lower end of the rocker 18 is the lever 22, via the pin 23: the angular movement of the rocker 18 determines a corresponding movement outwards of the lever 22, thereby pushing the sliding member 28 outwards, which, as will be seen, is constrained in its linear movement.

**[0040]** The movement downwards of the lever 20 moreover causes a downward pull of the connection el-

ement 33 with the associated friction element 31, in contrast to the action of the elastic element represented by the stem 34 and by the spring 35 of the system 30 in order to counterbalance the weight of the door 6 and the panel 12. Of course, in this step also the second friction element 31 is displaced downwards together with the lever 20.

**[0041]** As the movement proceeds, the lever 20 drops further, determining also continuation of the movements of the levers 18, 22 and 16. The rocker 18 turns further, with its lower portion that displaces outwards, the lever 22 is pushed further outwards and induced to turn in a counterclockwise direction about the pin 23, thereby pushing further the sliding member 28 in its travel, and the lever 16 turns progressively outwards about the pin 17.

**[0042]** At the end of the step of rotation of the movable part 14 of the hinge, the angular movement of the lever 20 is mechanically stopped, via the second arrest arrangement referred to previously. As may be seen in Figure 6, the lever 20, in particular in the area of its arrest element 20a, stops on the corresponding arrest element 26 associated to the fixed part 13 of the hinge 17. In this way, also the position of the pin 21 is blocked, and the triangle formed by the levers 16 and 18 is thus rendered rigid, as highlighted by the dashed lines in Figure 7; i.e., the position of the pins 19 and 23 is blocked.

**[0043]** In the preferred embodiment of the invention, the rocker 18 and the lever 22 are shaped in such a way that the knee that they form around the fulcrum constituted by the pin 23 has an arrest position such as to prevent, in the position of maximum opening of the hinge, rotations downwards of the lever 22 under the action of the weight of the decorative panel 12 associated to the door 6. As has been seen previously, in the example of embodiment described provided for this purpose is the aforesaid first arrest arrangement, which comprises the bend 22a of the lever 20 and the recess 18a of the rocker. In the arrest position, the lever 22 is blocked and thus supports the weight of the panel 12 via the levers 16, 18, and 20, together with the fixed part 13 of the hinge 7.

**[0044]** It will be appreciated that, in the condition of opening of the door 6 of the electrical household appliance and thanks to the arrest arrangements referred to above, the weight of the panel 12 associated to the members 28 of the hinges 7 is for the most part supported by the fixed parts 13 of the hinges themselves.

**[0045]** During passage between the positions of Figure 5 and Figure 6 the counter-balancing system 30 continues to operate as already described above, with a further downward pull of the friction elements 31 and a consequent further compression of the spring 35. During reclosing of the door 6, the articulation arrangement of the hinge 7 and the corresponding counter-balancing system 30 operate in a way opposite to the one described above.

**[0046]** Figure 8 is a schematic illustration of the door 6, of which the representation of the inner shell 8, with the associated panel 12 and a hinge 7, is omitted. In the

case exemplified, it may be seen how, preferably, the hinge part 14 is fixed to the outer shell 9 of the door 6, in particular at an inner side of its side wall 9a. From this figure it may be clearly noted how, in a preferred embodiment, at least one portion of the sliding member 28 is set in an intermediate position between a front surface 14a of the hinge part 14 (see also Figure 2) and a corresponding portion W of the inner surface of the front or major wall 9b of the shell 9. Consequently, as may be appreciated, in operation of the hinge 7, the sliding member 28 is constrained to perform substantially linear movements between the surfaces 14a and W, which face one another. The facing surfaces 14a and W are preferably at least in part parallel so as to guide sliding of the member 28 precisely.

**[0047]** The member 28, which is preferably made of plastic material, is mechanically connected to the panel 12, at the back of the latter. For this purpose, in a preferred embodiment, the front wall 9b of the shell 9 comprises an opening or window 9c, which extends in length in a direction perpendicular to the axis of rotation (15) of the door 6. At this opening 9c, fixed to the back of the panel is the aforesaid bracket 29, substantially in the form of a metal square, which is in turn articulated to the member 28. As may be appreciated, in this way, sliding of the member 28 can be transferred to the panel 12, via the bracket 29 that can slide within the opening 9c.

**[0048]** As mentioned previously, in a preferred embodiment, provided in the upper regions of the door and the panel is at least one slidable coupling, preferably a pair of slidable couplings. Preferably, each slidable coupling includes at least one part that is defined or integrated in the door 6, in particular in the component 10, which is preferably made of plastic material, such as an injection-mouldable thermoplastic material. As already mentioned, each coupling comprises at least one guide element, which extends in a direction generally perpendicular to the axis of rotation of the door. In the example illustrated in Figure 8, the two slidable couplings are designated as a whole by 50.

**[0049]** The detail of Figure 9 shows a possible embodiment of one of the couplings 50, which, in the example illustrated, includes a formation 41 defined in the proximity of, or in a position corresponding to, a side wall 10a of the component 10. In a position corresponding to the formation 41 the front wall 10b of the component 10 has a through slit 41 a extending in length in a direction perpendicular to the axis of rotation (15) of the door. The formation 41 has then a lateral groove 41 b, which extends in length generally parallel to the slit 41 a.

**[0050]** Designated as a whole by 42 is a guided element, which is fixed to the rear side of the panel 12, in an upper region thereof, so as to have a part passing in the slit 41 a and a part engaged in the groove 41 b of the formation 41. In a preferred embodiment, the guided element 42 is substantially mushroom-shaped; i.e., it has a stem 42a and a head 42b that projects laterally or radially with respect to the stem 42a. The stem 42a, which

is preferably of a substantially cylindrical shape, is secured to the rear side of the panel 12 so as to pass through the slit 41a. The head 42b, which is also preferably of a cylindrical shape, is engaged in the groove 41 b of the formation 41. As may be appreciated, the element 42 is able to move linearly with respect to the guide element defined in the formation 41, i.e., with the slit 41 a and the groove 41 b that guide the movement of the element 42 precisely, thereby guiding accordingly movement of the panel 12. Preferably, the longitudinal ends of the formation 41, or in any case of the guide element here represented by the groove 41 b with the corresponding slit 41 a, are located in the proximity of points of fixing of the component 10 to the inner shell 8 of the door 6 in order to bestow greater solidity on the structure. For this purpose, in Figure 9, designated by 10c are bushings formed integral in the component 10, for passage of corresponding screws for fixing to the shell 8 (see for reference Figure 1).

**[0051]** As has been seen previously, in the lower region of the back of the panel 12 it is possible to fix a corresponding sliding member 28, via the corresponding bracket 29 (see, for example, Figure 8), designed for connection with the lever 22 of the transmission arrangement of the respective hinge 7. In a preferred embodiment, the member 28 and the bracket 29 can be coupled together with the possibility of regulation, for example by means of at least one screw, in order to enable a precise adaptation of the relative position of the member 28 with respect to the pin 27 and/or to the lever 22. Very preferably, coupling between the member 28 and the bracket 19 is adjustable according to two degrees of freedom, for example in the direction of height and in the direction of width of the panel, albeit not excluded is also a possibility of regulation in the direction of the thickness of the panel 12.

**[0052]** Figure 10 illustrates a condition of the hinge 7 corresponding to that of Figure 4, i.e., with the door 6 in the closed position. Preferably, in this condition the top edge of the panel 12 is substantially flush with the top edge of the door 6, here corresponding to the top edge of the component 10. On the other side, in the example illustrated, the bottom edge of the panel 12 extends underneath the bottom edge of the door. It may be assumed, for example, that the heights of the door 6 and of the panel 12 are of 720 mm and 800 mm, respectively, and that the panel fulfils also the function of hiding practically entirely from view the front 2a of the base 2 of the appliance, here represented partially with a dashed line.

**[0053]** Figure 11 illustrates an intermediate phase of opening of the door 6, for example carried out manually, with the hinge that is in a condition corresponding to that of Figure 5. As explained above, in the movement of opening of the door 6 the transmission system of the hinge 7 has the effect of exerting a thrust on the sliding member 28, which, given that it is constrained in its linear movement, transfers this thrust to the panel 12. At the upper part of the door and the panel the guided member

42 of Figure 9 starts to slide along the slit 41 a and the guide represented by the groove 42b, being guided precisely thereby. The panel 12 thus slides upwards on the door 6, as may be seen in Figure 11, and this prevents the bottom edge of the panel 12 from interfering with the front 2a of the base and/or with elements associated to the front.

**[0054]** As the movement of opening of the door 6 proceeds, the transmission arrangement causes further sliding upwards of the panel 12, as far as the final position visible in Figure 12, where the hinge is in the same condition as in Figure 6. In this position the panel 12 is in its position most raised with respect to the door 6, with its bottom edge at a distance from the front 2a of the base 2. As has been explained, in this condition, the arrest arrangements 18a, 22a and 20a, 26 cause the weight of the panel 12 associated to the members 28 to be largely supported by the fixed parts 13 of the hinge 7. The movable parts 13 of the hinges 7, and hence the corresponding rotation pins, are consequently less loaded, to the advantage of reliability of operation even in the long term.

**[0055]** Of course, during closing of the door there occurs an opposite movement of the panel with respect to the door, with sliding of the panel downwards.

**[0056]** From the above description the characteristics of the present invention emerge clearly, as likewise its advantages. It is clear that numerous variations may be made by the person skilled in the art to the electrical household appliance described by way of example, without thereby departing from the scope of the invention as defined by the annexed claims.

**[0057]** For example, in possible variant embodiments, the articulation arrangement between the two parts 13 and 14 of each hinge 7 may be different from the one exemplified herein, provided that it performs the same functions. Possibly, the hinges used for implementation of the invention could be variable-fulcrum hinges.

**[0058]** Also the slidable coupling provided between the panel and the door may be different from what has been exemplified, provided that it performs the same functions. There may be mentioned, for example, the possibility of providing one or more guide elements on the back of the panel 12 and the corresponding guided elements on the front of the door 6, in particular of its upper component 10.

## Claims

1. An electrical household appliance (1) having a load-bearing structure (2) and a door (6) constrained to which is a front panel (12), wherein the door (6) is hinged in a lower region thereof to the load-bearing structure (2) via at least one hinge (7) so as to turn according to a substantially horizontal axis of rotation (15) between a closed position and an open position, in which the door (6) is substantially vertical and substantially horizontal, respectively, the hinge (7) comprising a first part (13),

which is fixed to the load-bearing structure (2), and a second part (14), which is fixed to the door (6) and is articulated to the first part (13);

wherein the front panel (12) is constrained in an upper region thereof to the door (6) by means of at least one slidable coupling (50), configured for enabling a movement of sliding of the front panel (12) relative to the door (6) in a direction substantially orthogonal to the axis of rotation (15);

wherein the hinge (7) comprises a transmission system (16, 18, 20, 22, 28, 29) connected to the front panel (12) and interacting with the first part (13) and the second part (14) of the hinge (7), the transmission system comprising a system of levers (16, 18, 20, 22) that includes at least one first lever (18), pivoted to which is a second lever (22) that connects the first lever (18) to a sliding member (28, 29) fixed to the front panel (12) and configured for causing the aforesaid movement of sliding of the front panel (12), the electrical household appliance (1) being **characterized in that:**

- the transmission system (16, 18, 20, 22, 28, 29) of the hinge (7) further comprises a third lever (20), which connects the second hinge part (14) to the first lever (18);

- the hinge (7) has a first arrest arrangement (18a, 22a) pre-arranged for blocking angular movement of the second lever (22) relative to the first lever (18) in the aforesaid open position of the door (6); and

- the hinge (7) has a second arrest arrangement (20a, 26) pre-arranged for blocking angular movement of the third lever (20) relative to the first hinge part (13) in the aforesaid open position of the door (6).

2. The electrical household appliance according to Claim 1, wherein the first lever is an oscillating lever (18), in particular a rocker, and the transmission system (16, 18, 20, 22, 28, 29) of the hinge (7) comprises a fourth lever (16) pivoted at an upper end thereof to the first hinge part (13), the oscillating lever (18) being pivoted in an intermediate region thereof to a lower end of the fourth lever (16), via an oscillation pin (19).

3. The electrical household appliance according to Claim 2, wherein the oscillating lever (18) is pivoted in two generally opposite end regions thereof to the second lever (22) and to the third lever (20), respectively.

4. The electrical household appliance according to any one of Claims 1 to 3, wherein the first arrest arrangement (18a, 22a) comprises an arrest element (18a) defined by the oscillating lever (18) and a corresponding arrest element (22a) defined by the second

lever (22a).

5. The electrical household appliance according to any one of the preceding claims, wherein the second arrest arrangement (20a, 26) comprises a first arrest element (26) in a fixed position, in particular a projecting element of the second hinge part (13).

6. The electrical household appliance according to Claim 5, wherein the second arrest arrangement (20a, 26) comprises a second arrest element (26), which is defined by the third lever (20) and is able to co-operate with the first arrest element (26).

7. The electrical household appliance according to any one of Claims 1 to 6, wherein the hinge (7) has a counter-balancing system (30) for countering the effect of the weight of the door (6), with the associated front panel (12), during displacement of the door (6) between the open and closed positions.

8. The electrical household appliance according to Claim 7, wherein the third lever (20) is pivoted in two generally opposite end regions thereof to the second hinge part (14) and to the counter-balancing system (30), respectively.

9. The electrical household appliance according to Claim 7 or Claim 8, wherein the counter-balancing system (30) comprises:

a guide (32) in a fixed position, in particular fixed with respect or integral to the first hinge part (13), which extends in a direction substantially orthogonal to the axis of rotation (15); and  
at least one friction element (31) slidably engaged in the guide (32) and connected to the third lever (20),  
wherein the friction element (31) is moreover connected to balancing means (37, 38), in particular comprising a spring.

10. The electrical household appliance according to any one of Claims 1 to 9, wherein the at least one slidable coupling (50) comprises:

a guide element (41) defined in an upper region of the door (6), the guide element including at least one guide (41 a, 41 b) that extends in a direction generally perpendicular to the axis of rotation (15);  
a guided element (42), fixed to a back of the front panel (12) and having at least one respective part (42a, 42b) engaged in a path of the guide (41a, 41b),  
the at least one guide preferably comprising a through slit (41a) defined in a front wall (9b, 10b) of the door (6).

11. The electrical household appliance according to any one of Claims 1 to 10, wherein the sliding member (28, 29) is configured for fixing on a back of the front panel (12), the sliding member (28, 29) preferably comprising two parts coupled together with the possibility of regulation.

12. The electrical household appliance according to Claim 11, wherein the door (6) has a front wall (9b, 10b) provided with a through opening (9c) that extends in length in a direction substantially perpendicular to the axis of rotation (15), the sliding member (28, 29) being fixed to the rear side of the front panel (12) in a position corresponding to said through opening (9c).

13. The electrical household appliance according to any one of Claims 1 to 12, wherein the sliding element (28, 29) is constrained to perform substantially linear movements.

14. The electrical household appliance according to any one of Claims 1 to 13, wherein at least one portion (28) of the sliding element (28, 29) is slidably set between two mutually facing surfaces, one said surface being a front surface (14a) of the second hinge part (14) and the other said surface (W) belonging to an inner side of a front wall (9b, 10b) of the door (6).

15. A hinge (7) for hinging a lower region of a door (6) to the load-bearing structure (2) of an electrical household appliance (1) in such a way that the door (6) turns according to a substantially horizontal axis of rotation (15) between a closed position and an open position, in which the door (6) is substantially vertical and substantially horizontal, respectively, wherein the hinge (7) comprises a first part (13), pre-arranged for fixing to the load-bearing structure (2) of the electrical household appliance (1), and a second part (14), which is articulated to the first part (13) and is pre-arranged for fixing to the door (6) of the electrical household appliance (1); and wherein the hinge (7) further comprises a transmission system (16, 18, 20, 22, 28, 29), which is configured for being connected to a front panel (12) slidably carried by the door (6), the transmission system (16, 18, 20, 22, 28, 29) interacting with the first part (13) and the second part (14) of the hinge (7) and comprising a system of levers (16, 18, 20, 22) that includes at least one first lever (18), pivoted to which is a second lever (22) that connects the first lever (18) to a sliding member (28, 29) configured for fixing to the front panel (12),  
the hinge (7) being **characterized in that:**

- the transmission system (16, 18, 20, 22, 28, 29) of the hinge (7) further comprises a third lever (20), which connects the second hinge part

(14) to the first lever (18);

- the hinge (7) has a first arrest arrangement (18a, 22a) pre-arranged for blocking angular movement of the second lever (22) relative to the first lever (18) in the aforesaid open position of the door (6); and 5

- the hinge (7) has a second arrest arrangement (20a, 26) pre-arranged for blocking angular movement of the third lever (20) relative to the first hinge part (13) in the aforesaid open position of the door (6). 10

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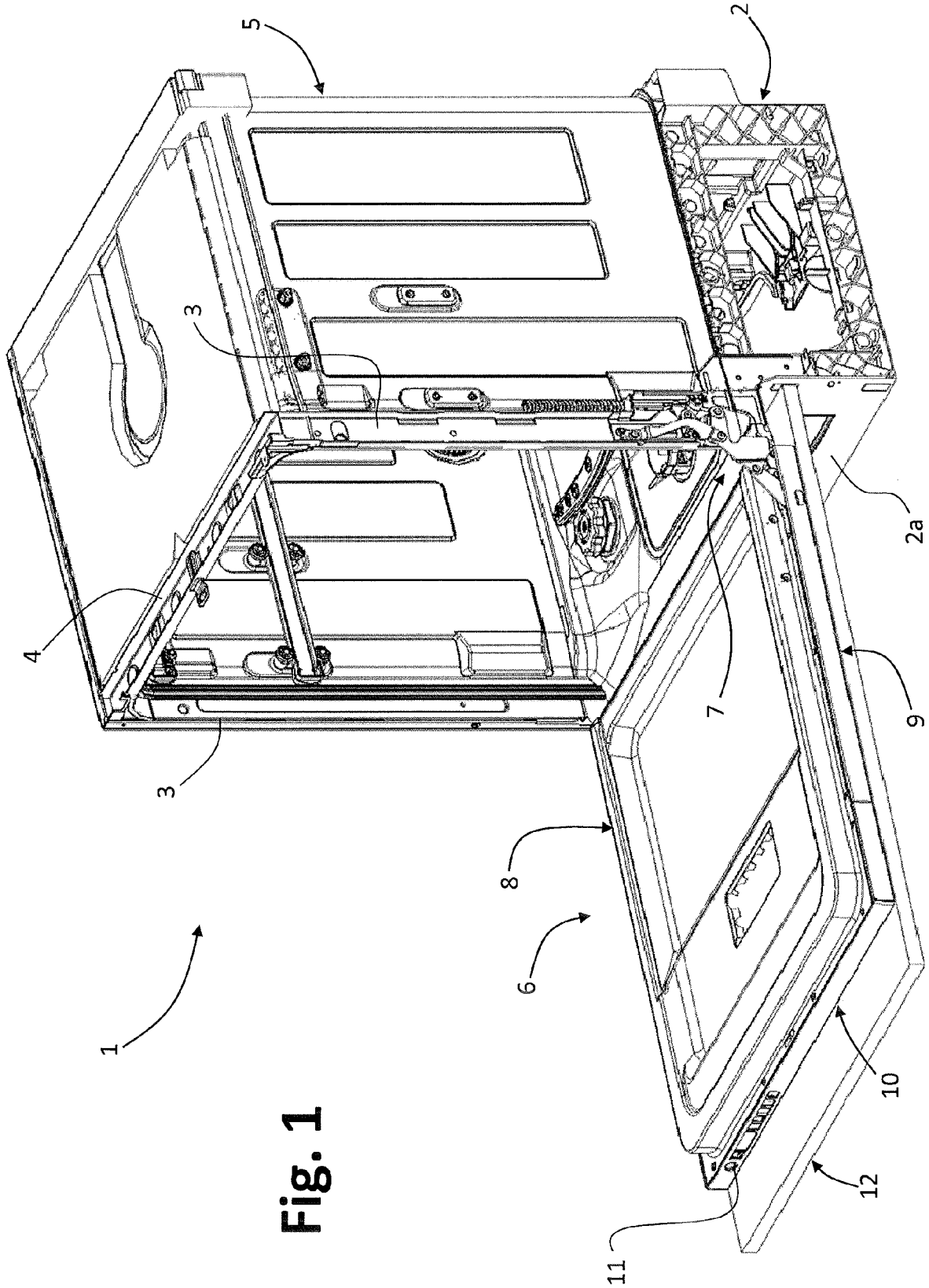
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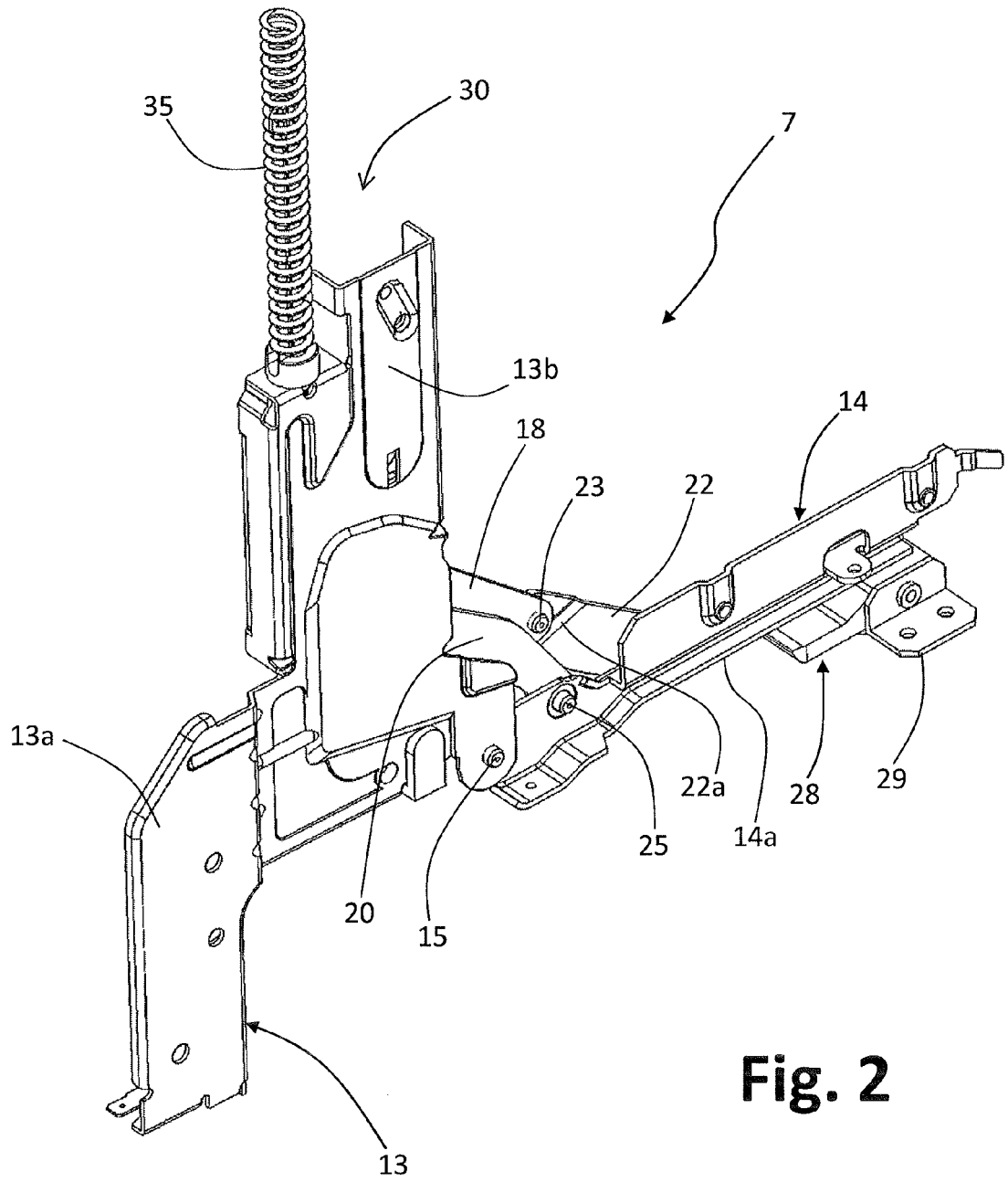
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**Fig. 1**



**Fig. 2**

Fig. 3

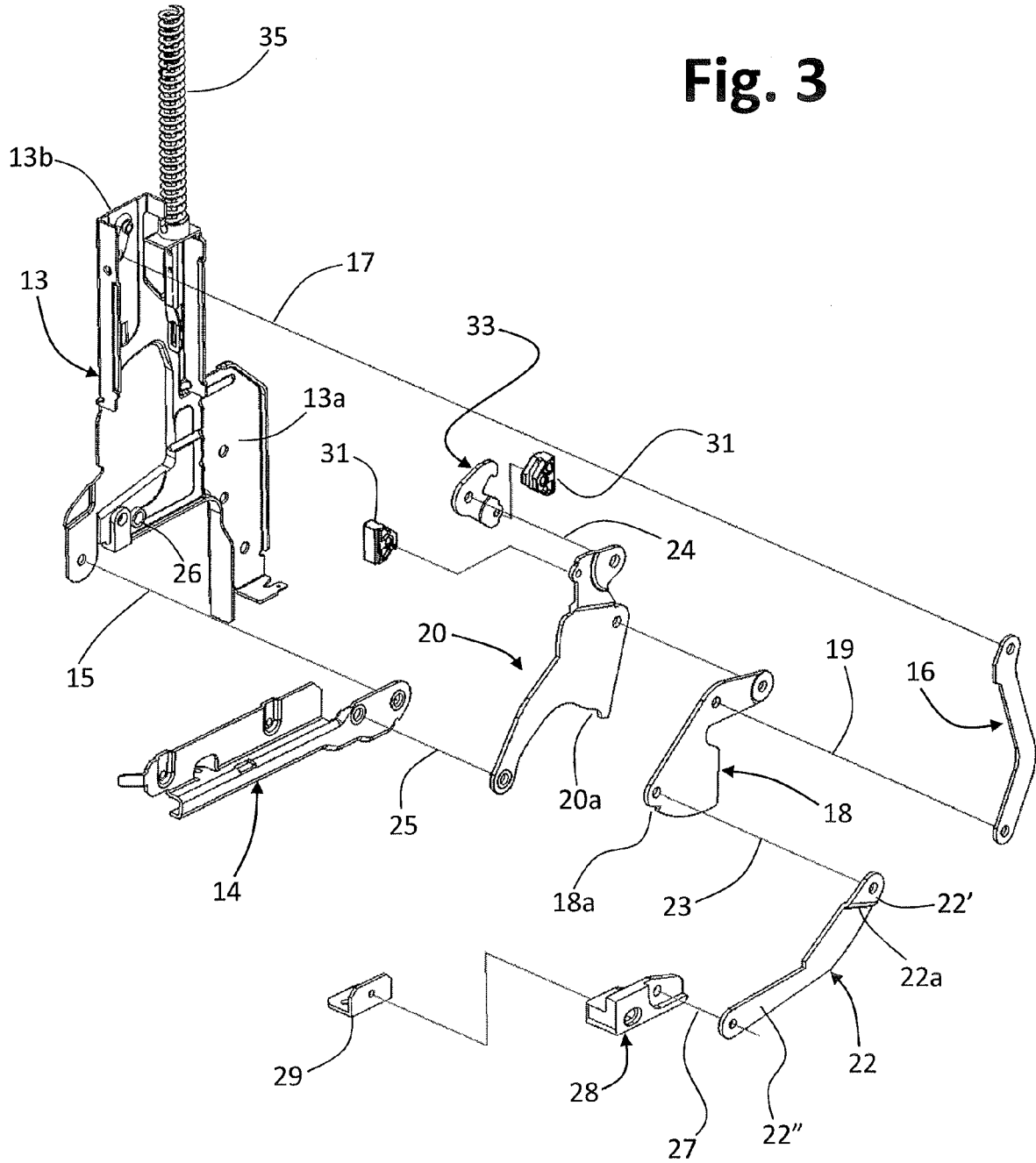


Fig. 4

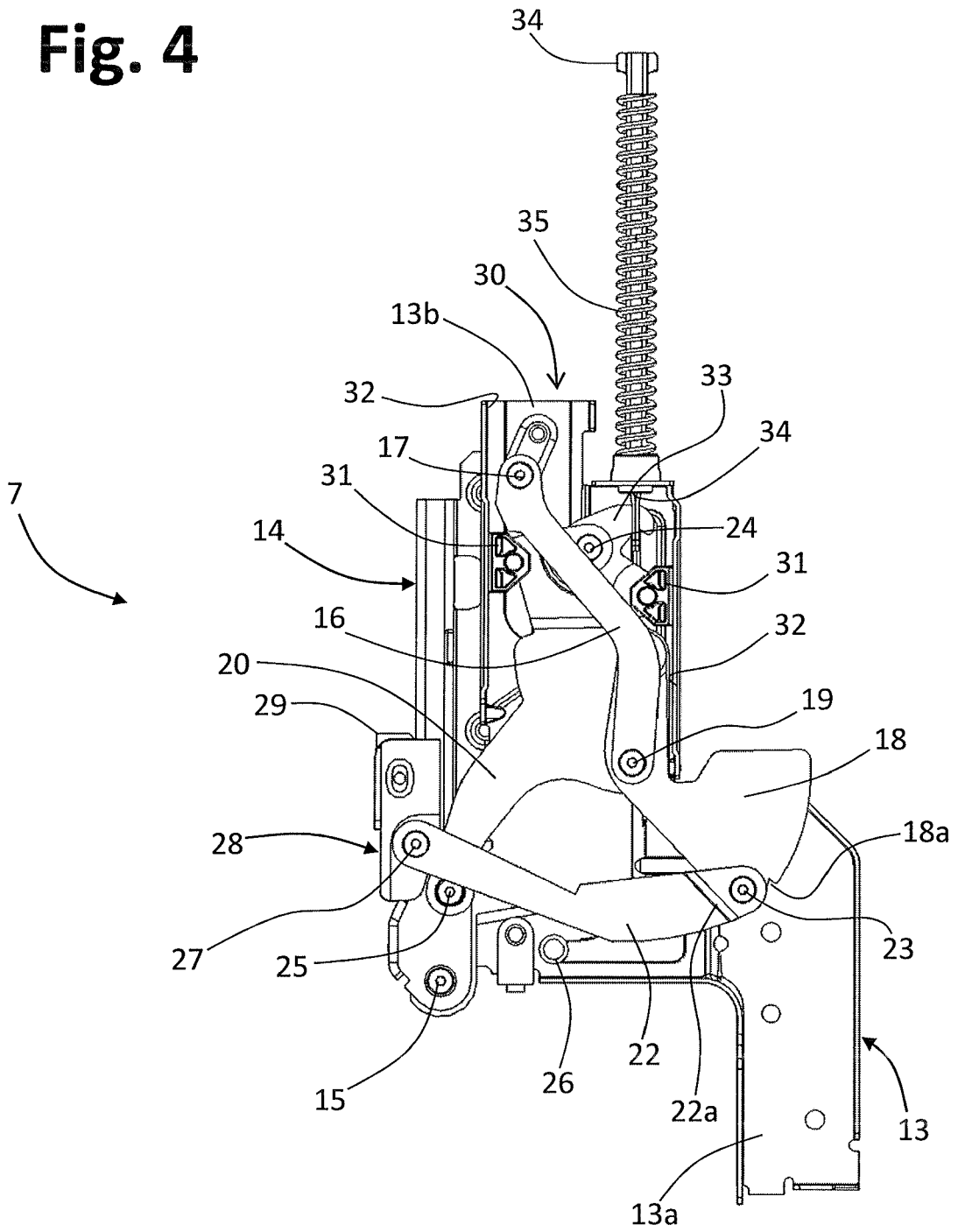




Fig. 6

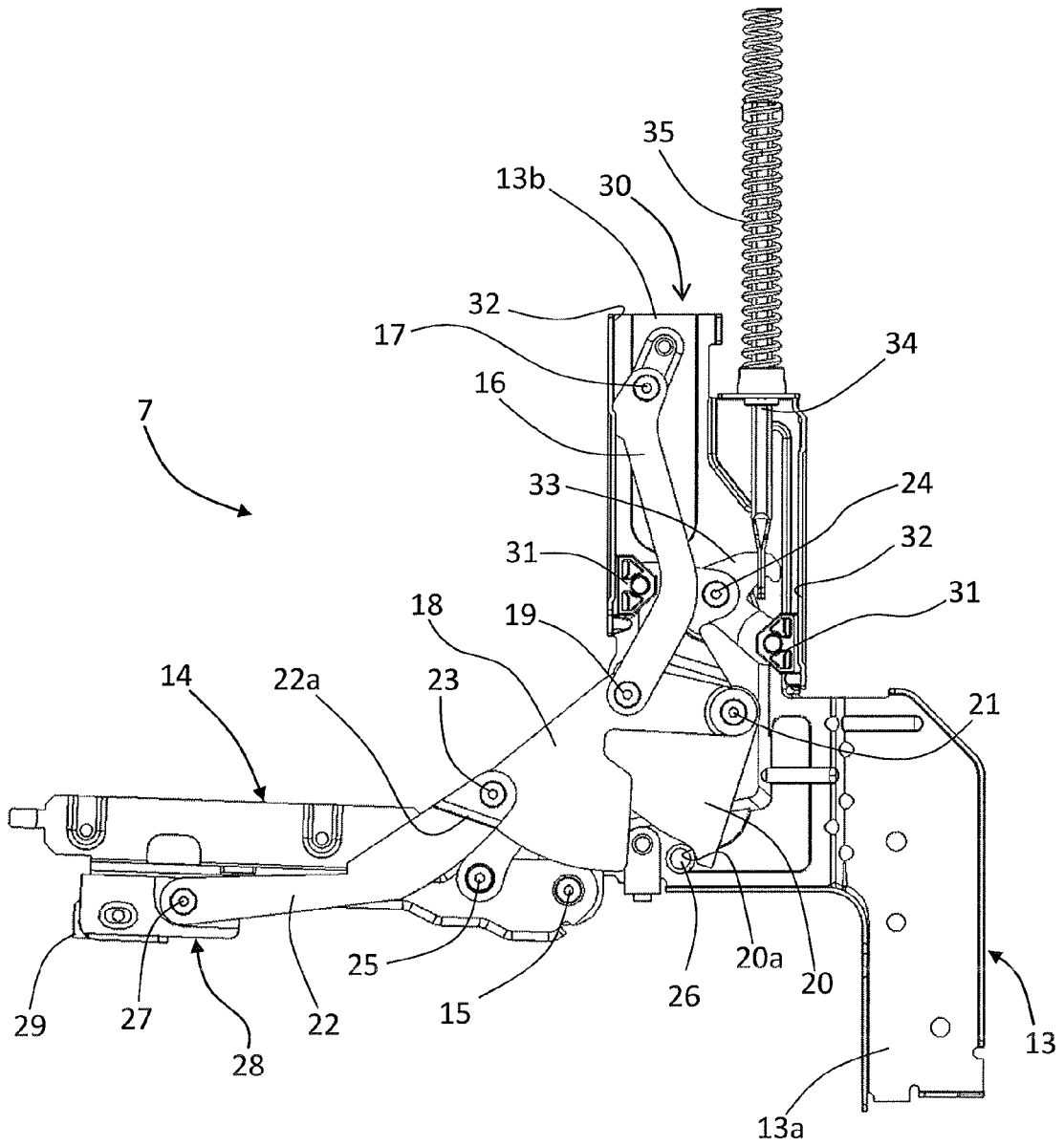


Fig. 7

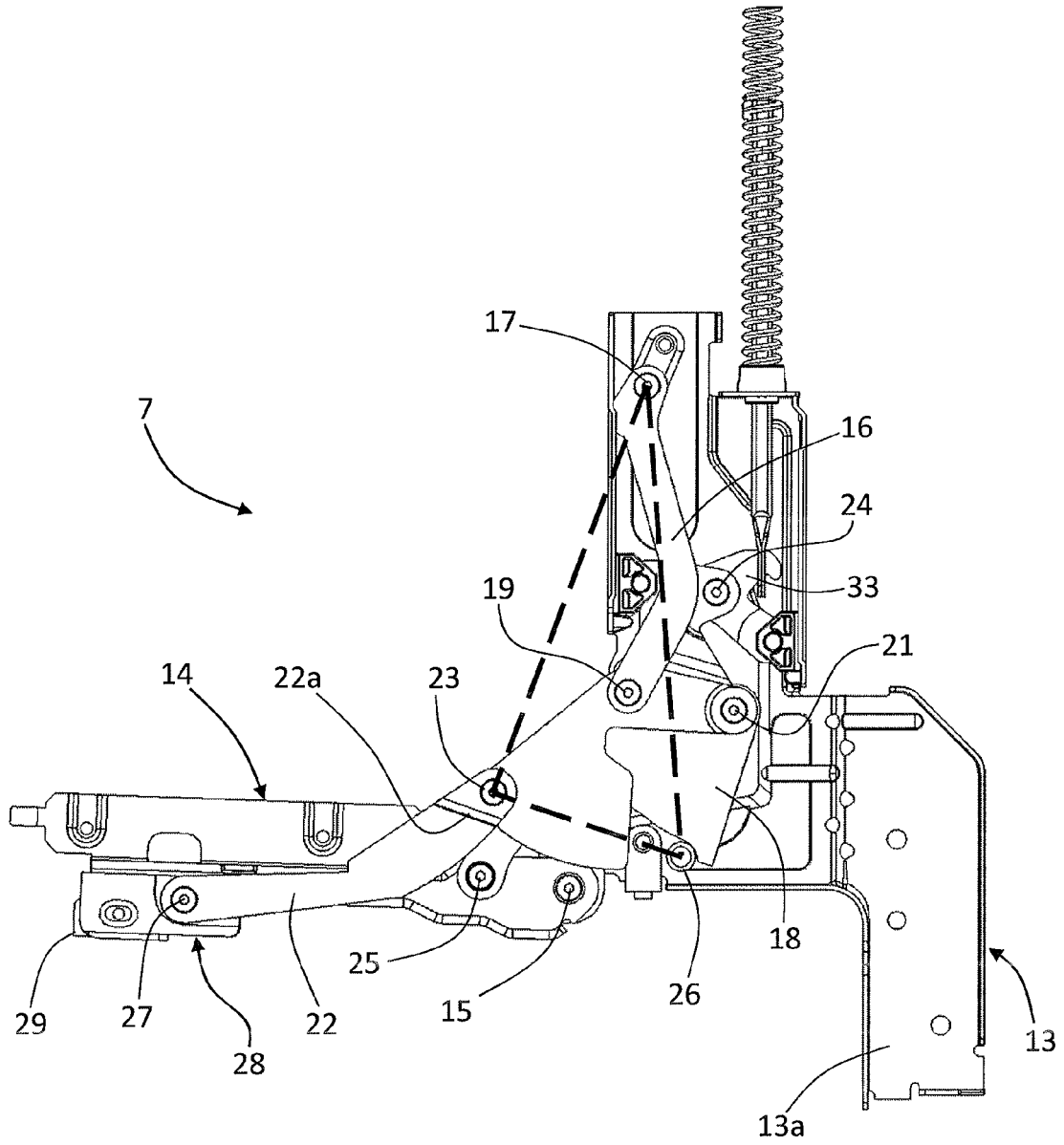
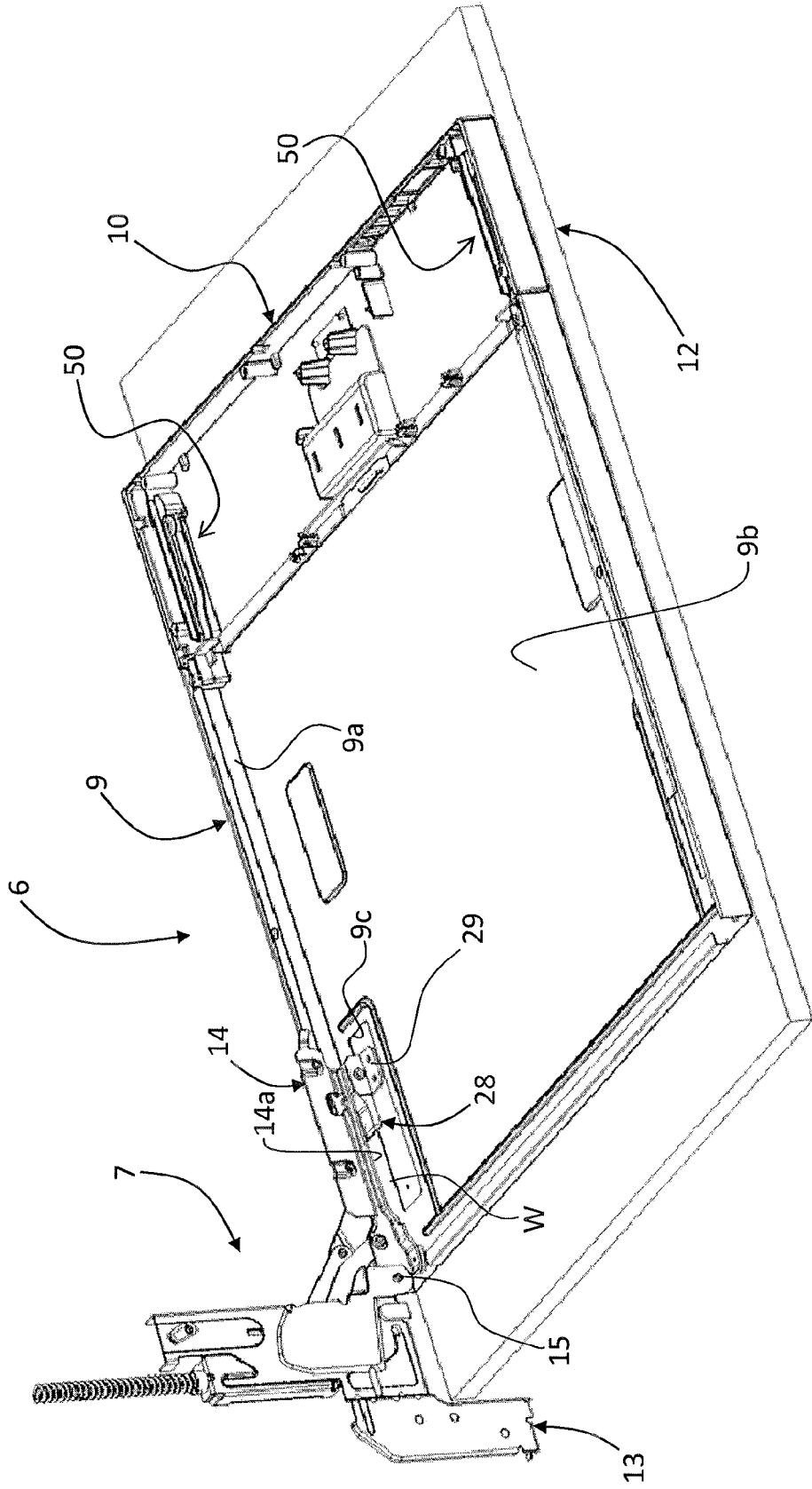
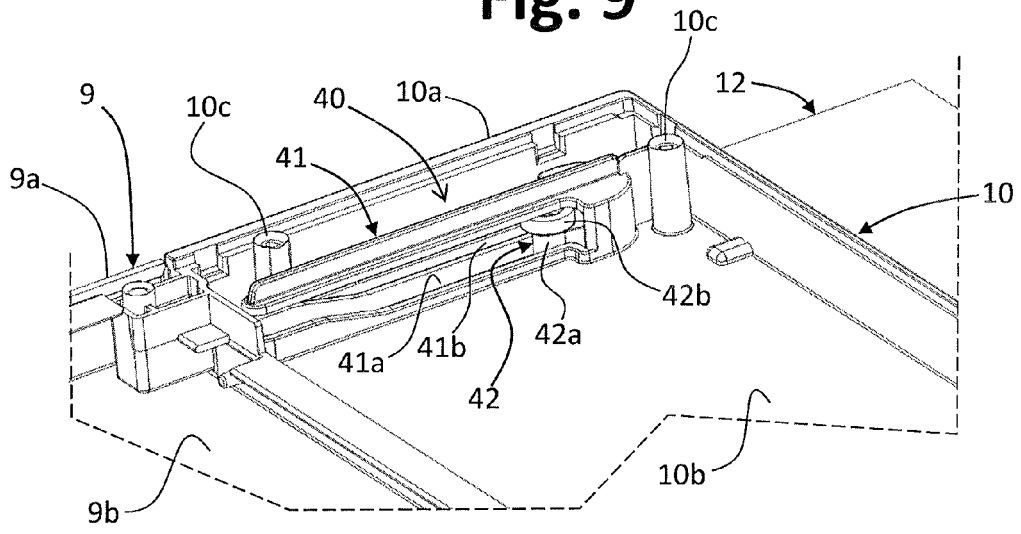


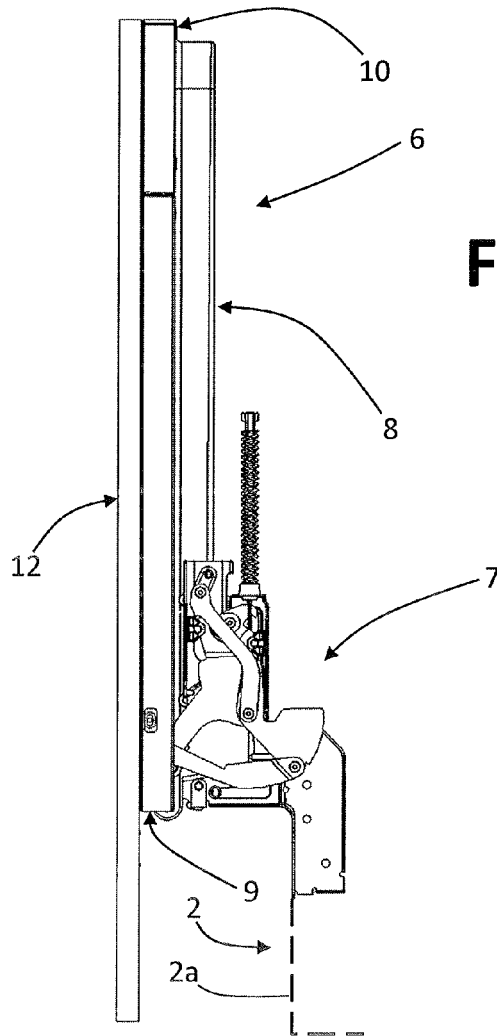
Fig. 8



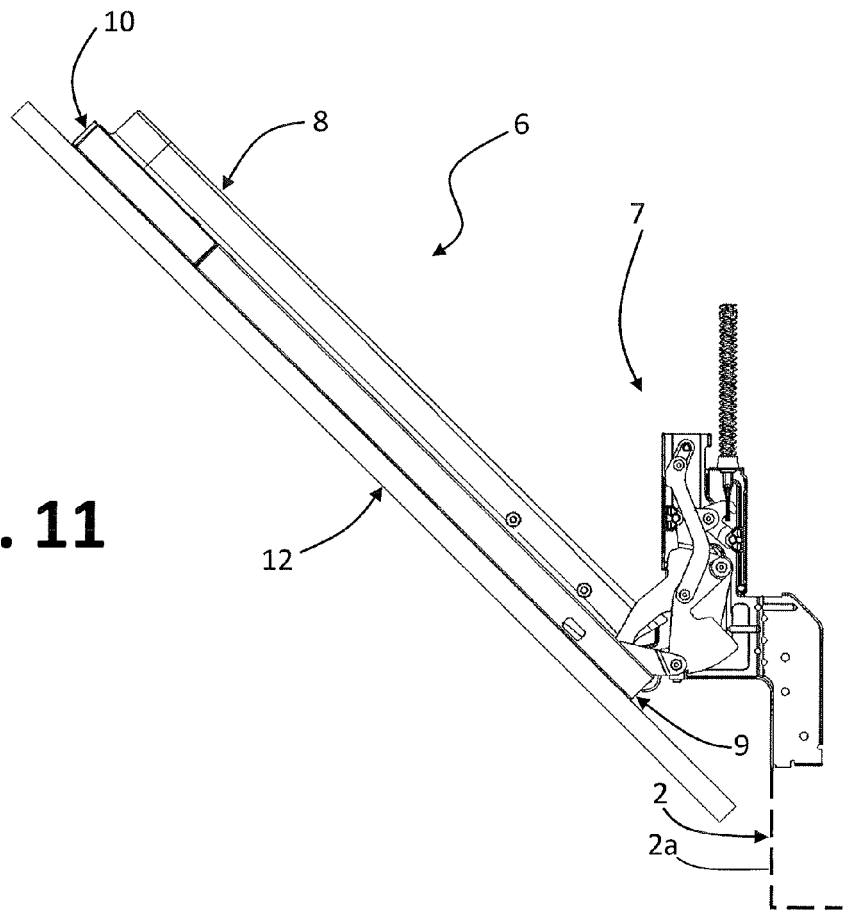
**Fig. 9**



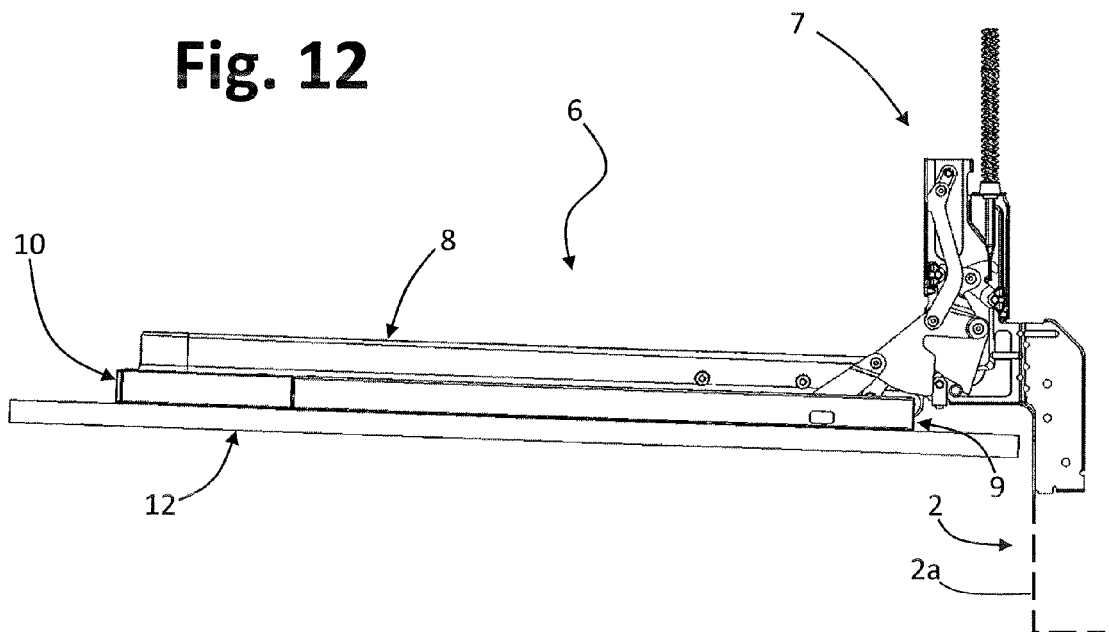
**Fig. 10**



**Fig. 11**



**Fig. 12**





EUROPEAN SEARCH REPORT

Application Number  
EP 15 17 4051

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			A47L
Place of search		Date of completion of the search	Examiner
Munich		30 November 2015	Jeziarski, Krzysztof
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