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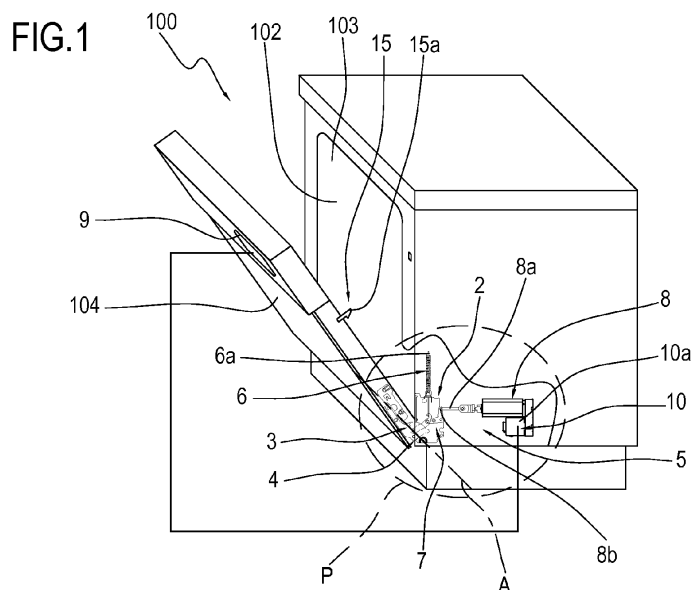
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(54) **Movement system for a door or openable part of an electrical household appliance and electrical household appliance equipped with the system**

(57) A movement system for a door or openable part of an electrical household appliance (100) comprises a first hinge body (2) attachable to a frame (101), a second hinge body (3) attachable to a door (104) and rotatably connected to the first body (2) to rotate between a first, closed position and a second, open position, and movement means (5) by which the second body (3) is moved relative to the first body (2) and which comprise elastic means (6) and a link mechanism (7) associated with the elastic means (6) to transfer the force generated thereby to the second body (3) in such a way that the force con-

tributes to rotating the second body (3) relative to the first body (2). The elastic means (6) are dimensioned to apply a force suitable for generating a moment which is smaller than a resistance moment (R) generated by the door (104) when the second body (3) is at the second position, and the movement means (5) comprise at least one actuator (8) associated with the link mechanism (7) and configured to act in conjunction with the elastic means (6) in order to deliver a total force such as to overcome the resistance moment and allow the door (104) to move from the second position to the first position.



Description

[0001] This invention relates to a movement system for a door or openable part of an electrical household appliance and to an electrical household appliance equipped with the system.

[0002] This invention is applicable in particular to the production of electrical household appliances, especially (but not exclusively) those with doors which open by tilting, that is, by rotating about a horizontal axis, such as oven or dishwashers.

[0003] Typically used in the prior art are door movement systems of elastic type, where a preloaded spring is connected by a suitable link mechanism to one edge of the door, close to the hinge point. It should be noted that for this reason, it is often necessary to use springs capable of providing particularly high resistance and return forces.

[0004] Although high-performing in terms of balance and drive movement, door systems of this kind always require manual force applied by the user to open and close the door.

[0005] To avoid manual action, the prior art proposes numerous solutions where the "spring-action" movement system is substituted for an electric drive. For example, document US2007267401 describes a movement system equipped with two hinges, one spring operated and one motorized, both applied to the door of an oven.

[0006] Document JP8240069 also relates to an automatic opening/closing device applied to a door hinge. The device comprises a linear motor interposed between the frame and the door and acting directly on the door to allow the tilt opening movement.

[0007] Alternatively, patent document US2009113803 also relates to a device for opening/closing a door but equipped with rotary drive means configured to allow opening the door by means of a rotating motor and a mechanism of the lead screw type.

[0008] Disadvantageously, all the above mentioned documents describe systems with actuators mounted close to the door hinge point (an essential feature in household appliances) and which therefore require high powered drives to overcome the disadvantage in terms of lever effect.

[0009] In light of this, these devices require large motors or drives and, considering the stringent dimensional constraints in the technical sector of electrical household appliances, this requirement gives rise to more than a few critical design issues, even in terms of costs.

[0010] Moreover, these solutions necessarily involve choosing either to increase the overall size of the appliance or to reduce its capacity.

[0011] Also known are devices for closing the doors of electrical household appliances where the force of the drive is transmitted to the hinge by flexible drive transmission means, such as metal tie rods, for example, which generally come into operation when the door is being closed. These known solutions therefore have the

disadvantage of not damping the drive motion sufficiently when the door is being opened.

[0012] This invention therefore has for an aim to overcome the above mentioned disadvantages of the prior art.

[0013] More specifically, one aim of the invention is to provide a movement system for a door or openable part of an electrical household appliance which is at once automatic and reduced in size.

[0014] Another aim of the invention is to provide an electrical household appliance equipped with an automatic means for opening/closing the door and which is simple and inexpensive to make.

[0015] These aims are achieved by means of the features set out in one or more of the appended claims and, more specifically, by a movement system for a door (or openable part) of an electrical household appliance comprising a frame and a door (or openable part) of predetermined weight, the system comprising a first hinge body attachable to the frame, a second hinge body attachable to the door and rotatably connected to the first body to rotate between a first, closed position where the door abuts the frame, and a second, open position, where the door is transversal to the frame, allowing access to a compartment inside the electrical household appliance, and movement means by which the second body is moved relative to the first body and which comprise elastic means and a link mechanism associated with the elastic means to transfer the force generated by the elastic means to the second body, close to the hinge point, in such a way that the force contributes to rotating the second body relative to the first body. According to the invention, the elastic means are dimensioned to apply a force such as to generate a moment which is smaller than a resistance moment generated by the predetermined weight of the door at least when the second body is at the second position.

[0016] The movement means comprise at least one actuator associated with the link mechanism and configured to act in conjunction with the elastic means in order to deliver a total force such as to overcome the resistance moment and allow the door to move from the second position to the first position.

[0017] The term "resistance moment" is used in this text to mean the force applied by the weight and inertia of the door to oppose the movement imparted to the door itself from the second position (open) to the first position (closed).

[0018] Advantageously, the solution proposed by this invention provides an electrical household appliance which can be opened and closed automatically by driving the actuator but without the need for a large actuator and limiting the overall dimensions and costs of the movement system.

[0019] In effect, the presence of elastic means (more specifically, a spring) dimensioned to provide only a percentage of the load required to move the door makes it possible to use an actuator which only needs to deliver

the difference in force between the load supplied by the elastic means and the load necessary.

[0020] In light of this, it is relatively economical to fit an actuator even in a movement system of prior art type, thereby making it easier to upgrade household appliances already in use.

[0021] To control the operation of the actuator, the movement system comprises a control unit, preferably configured to receive a signal representing a movement of the door from the second position to the first position (sent by specific activation means, such as a key or remote control) and to send to the actuator a signal representing the value of a force to be delivered in order to obtain that movement.

[0022] It should be noted that the control unit is configured to keep the actuator active for the full closing stroke of the second body (and thus of the door) from the second position to the first position.

[0023] On the other hand, at least part of the movement of the second body from the first position to the second position occurs by gravity.

[0024] Thus, the actuator operates mainly when the door is being closed and remains in a substantially passive configuration when the door is being opened.

[0025] More precisely, the actuator is configured to provide an initial pickup action at the start of the opening stroke in order to overcome the inertia of the door and to move the door from its position of vertical equilibrium (that is to say, the first position), after which the door continues its movement under the action of gravity, controlled by the elastic means and, preferably, by a damping element.

[0026] The damping element may be defined by the actuator itself, which limits the speed of rotation of the door (that is, of the second body) as a function of a signal received from specific sensor means.

[0027] Thus, advantageously, it is possible to control the movement of the door continuously even though the door is fitted with a small actuator.

[0028] These features of the invention will become more apparent from the following detailed description of a preferred, non-limiting embodiment of it, illustrated by way of example in the accompanying drawings, in which:

- Figures 1 and 1 a are perspective views showing an electrical household appliance equipped with a first embodiment of a movement system according to the invention and a detail of the movement system;
- Figures 2 and 2a are perspective views showing an electrical household appliance equipped with a second embodiment of a movement system according to the invention and a detail of the movement system;
- Figures 3 and 3a are perspective views showing an electrical household appliance equipped with a third embodiment of a movement system according to the invention and a detail of the movement system;
- Figure 4 shows a schematic side view of a detail of a further preferred embodiment of the movement

system according to this invention.

[0029] With reference to the accompanying drawings, the numeral 1 denotes a movement system for a door or openable part of an electrical household appliance 100 in accordance with this invention.

[0030] The electrical household appliance 100 concerned is preferably of a type equipped with a frame 101, with a substantially box-shaped structure defining inside it a receiving compartment 102 accessible through an opening 103 (typically at the front).

[0031] To close the opening 103, the electrical household appliance 100 also comprises a door 104 (or openable part) pivoted to the frame 101 to rotate between a closed configuration where it abuts against the frame 101 to close the opening 103, and an open configuration where it is rotated transversely to the frame 101 making the opening 103 accessible. Preferably, the door 104 is connected to the frame 101 in "tilting fashion", that is, with a substantially horizontal hinge axis "A".

[0032] In light of this, this invention is preferably (but not exclusively) applicable to electrical household appliances such as ovens or dishwashers.

[0033] More specifically, the door 104 is connected to the frame 101 by the movement system 1 according to this invention.

[0034] The system 1 comprises a first hinge body 2 and a second hinge body 3 attachable (that is, fixed) to the frame 101 and to the door 104 (or openable part), respectively.

[0035] The second hinge body 3 is rotatably connected to the first hinge body 2 in such a way as to rotate relative thereto and to define the above mentioned tilting movement.

[0036] Thus, the second hinge body 3 is rotatably connected to the first hinge body 2 to rotate between a first position, where the door 104 connected thereto abuts against the frame 101, and a second position, where the door 104 connected thereto is transversal to the frame 101 and allows access to the compartment 102 of the electrical household appliance 100. Thus, the first and second positions of the second hinge body 2 are open and closed positions which, in use, correspond to the open and closed configurations of the door 104, respectively.

[0037] More in detail, the first hinge body 2 and the second hinge body 3 are connected to each other by a pin 4, thereby defining a hinge element. Preferably, the first hinge body 2 and the second hinge body 3 are box-shaped bodies.

[0038] Preferably, the movement system 1 is defined by two first hinge bodies 2 and two second hinge bodies 3 fitted on opposite sides of the door 104.

[0039] In other words, the electrical household appliance 100 preferably comprises two hinge elements.

[0040] According to the invention, the movement system comprises (at one of these hinge elements) movement means 5 by which the second hinge body 3 is moved

relative to the first hinge body 2. The movement means 5 are configured to rotate the second hinge body 3 relative to the first hinge body 2.

[0041] The movement means 5 comprise elastic means 6 and a link mechanism 7 associated with the elastic means 6 to transfer the force generated by the elastic means 6 to the second body 3 in such a way that the force contributes to rotating the second body 3 relative to the first body 2. Preferably, the elastic means 6 are defined by at least one helical spring 6a. The link mechanism 7, on the other hand, is preferably defined by a plurality of lever arms 7a interposed between the first hinge body 2 and the second 3 and operatively associated with the elastic means 6 (that is, with the spring 6a).

[0042] In other words, the elastic means 6 and the link mechanism 7 are operatively interposed between the first hinge body 2 and the second 3 to contribute to generating a relative movement between the two hinge bodies 2, 3.

[0043] More precisely, the elastic means 6 are associated with the link mechanism 7 to generate a force on the second hinge body 3 in such a way as to generate thereon (and thus, on the door 104) a return moment, that is, such as to contribute to rotating the second body 3 from the second position to the first position.

[0044] Thus, the elastic means 6 (in conjunction with the link mechanism 7) are configured to apply a force such as to generate a moment on the second hinge body 3.

[0045] According to the invention, however, the elastic means 6 (in conjunction with the link mechanism 7) are dimensioned in such a way that the moment generated on the second hinge body is less than a resistant moment generated by the weight of the door 104, at least when the second hinge body 3 is at the second position (that is, in the condition which is most critical for the movement of the door 104).

[0046] In other words, the door 104 has a predetermined weight (for example, for European ovens, normally less than 12 kg) which, at different positions between the first position and the second of the second body 3, generates a resistant moment which is variable as a function of the distance between the barycentre of the door 104 itself and the hinge point (that is, the pin 4) measured in the horizontal plane.

[0047] Thus, the elastic means 6 (in conjunction with the link mechanism 7) are dimensioned to generate a return moment (defined by the force delivered multiplied by the distance from the pin 4) which is less than the resistant moment and, consequently, insufficient to move the second body 3 (that is, the door 104) from the second position to the first position.

[0048] In this regard, the movement means 5 comprise at least one actuator 8 associated with the link mechanism 7 and configured to act in conjunction with the elastic means 6 in order to deliver a total force such as to allow moving the door 104 associated with the second body 3 from the second position to the first position.

[0049] Thus, the actuator 8 is dimensioned to deliver a complementary force concordant with the force delivered by the elastic means 6, so as to make up the difference between the return moment generated by the elastic means 6 and the resistant moment generated by the weight of the door 104.

[0050] Consequently, the elastic means 6 and the actuator 8 are configured to operate in conjunction (that is, in synergy) to move the door 104 (that is, the second hinge body 3) from the second position to the first position, that is to say, during closure.

[0051] It should be noted that to limit the size of the actuator 8, the elastic means 6 are dimensioned to provide at least 2/3 of the force necessary to move the second body 3 (that is, the door 104) from the second position to the first position.

[0052] In other words, the elastic means 6 and the actuator 8 are configured to operate in conjunction to deliver a predetermined force. The contribution of the elastic means 6 is greater than 2/3 of the predetermined force and the contribution of the actuator 8 is (consequently) less than a 1/3 of the predetermined force.

[0053] Preferably, the contribution of the elastic means 6 is greater than 80% of the predetermined force and, still more preferably, greater than 90%. Consequently, the contribution of the actuator 8 is less than 20% of the predetermined force and, still more preferably, less than 10% of the predetermined force.

[0054] For example, a door 104 weighing 10 kg comprises elastic means 6 (and a link mechanism 7) capable of delivering 250 Nm and an actuator 8 configured to act in conjunction with the link mechanism 7 to deliver a complementary force on the second body 3.

[0055] In light of this, the elastic means 6 and the actuator 8 are configured to operate in parallel.

[0056] Thus, the elastic means 6 operate on the link mechanism 7 continuously, whereas the actuator 8 can be activated selectively to contribute to the action of the elastic means 6.

[0057] In a first embodiment, the link mechanism 7 comprises at least two arms 7a each associated respectively with the elastic means 6 (that is, the spring 6a) and actuator 8.

[0058] That way, the elastic means 6 and the actuator 8 can be activated simultaneously on the link mechanism 7 in parallel, making it possible (for example) to keep the actuator disabled during opening of the door 104 by gravity.

[0059] Alternatively, the elastic means (that is, the spring 6a) and the actuator 8 might be associated with a single drive rod 13 connected to the link mechanism 7.

[0060] In this embodiment, the spring 6a and the actuator 8 operate coaxially on the aforementioned rod 13. More specifically, the rod 13 is slidably associated with the frame 101 of the electrical household appliance 100 or with the first hinge body 2 and the spring 6a is interposed between one end of the rod 13 and an abutment shoulder formed on the frame 101 of the electrical house-

hold appliance 100 or the first hinge body 2. The actuator 8 operates on the end of the rod 13 to move it in a direction concordant with the action of the spring 6a, contributing to the rotation of the second hinge body 3 (that is, of the door 104).

[0061] To allow driving the actuator 8, the movement system 1 comprises activation means 9 associated with the actuator 8 and controllable by (and accessible to) a user to issue a command for moving the actuator 8 in a desired manner in such a way as to at least allow the second hinge body 3 to be moved from the second position to the first.

[0062] More precisely, the system 1 comprises a control unit 10 operatively interposed between the activation means 9 and the actuator 8.

[0063] The control unit 10 is configured to receive from the activation means 9 a signal representing a movement of the door 104 (that is, of the second hinge body 3) from the second position to the first position and to send to the actuator 8 a signal representing the value of a force to be delivered in order to obtain the movement.

[0064] It should be noted that the activation means 9 may be defined by a keypad mounted (or mountable) to the frame 101 of the electrical household appliance 100.

[0065] Alternatively, the activation means 9 may be defined by a remote control, which can be operated by a user even at a distance from the electrical household appliance 100.

[0066] The control unit 10 may further comprise a memory unit 10a programmable by the user to set a time switch for opening/closing the door 104 (that is, for moving the second hinge body 3) at preset times, even in the absence of a direct command.

[0067] In this embodiment, the activation means 9 are associated with the programmable memory unit 10a to allow the user to send data to the memory unit 10a.

[0068] Preferably, the control unit 10 is configured to keep the actuator 8 active for the full closing stroke of the second hinge body 3 from the second position to the first position.

[0069] In other words, the control unit 10 is configured to send to the actuator 8 a drive signal at all the angular positions of the second hinge 3 between the first position and the second.

[0070] In this regard, the system 1 comprises a sensor means 11 associated with the second hinge body 3 to identify the angular position thereof (relative to the first body 2) during rotation.

[0071] The sensor means 11 is connected to the control unit 10 to send it a signal representing the angular position of the second body 3.

[0072] Thus, the control unit 10 is configured to receive the signal representing the angular position of the second body 3 and to drive the actuator 8 as a function of that signal.

[0073] Preferably, the sensor means 11 is embodied by an encoder or the like. Alternatively, the actuator 8 might operate in open loop. In such case, the control unit

10 is programmed to impart to the second hinge body 3 (and hence to the door 104) a movement correlated with specific preset characteristics.

[0074] Preferably, the activation means 9 are configured to send to the control unit 10, as a function of a user command, a first signal, representing a movement of the door 104 (that is, of the second hinge body 3) from the first position to the second, and/or a second signal representing a movement of the door 104 (that is, of the second hinge body 3) from the second position to the first.

[0075] More precisely, when the activation means 9 send the first signal to the control unit 10, the control unit 10 sends to the actuator 8 a first drive signal representing the value of an initial pickup action at the start of the opening stroke in order to overcome the inertia of the door 104 and to move the door from its position of vertical equilibrium (that is to say, the first position), after which the door continues its movement under the action of gravity.

[0076] More precisely, the second hinge body 3 has a third position, intermediate between the first position and the second and close to the first position. The control unit 10 is configured, when it receives the second signal, to send to the actuator 8 the first drive signal representing the value of a force to be delivered in order to move the second hinge body 3 (only) from the first position to the third position, being disabled between the third position and the second position.

[0077] The first drive signal may be such as to activate the actuator 8 for the full stroke of the second body 3 from the first position to the third or it may represent only a force sufficient to overcome the inertia of the door 104 at the first position.

[0078] Whatever the case, the movement of the second hinge body 3 from the third position to the second position preferably occurs by gravity. Preferably, the system 1 comprises an initial pickup element (not illustrated) associated with the door 104 and configured to act in conjunction with the actuator 8 at the start of the opening stroke in order to overcome the inertia of the door 104 and to move the door from its position of vertical equilibrium (that is to say, the first position of the second body 3).

[0079] In other words, the initial pickup element is configured to act on the door 104 (or on the second body 3) during opening, so as to contribute to moving the door 104 from the position of equilibrium, which is particularly disadvantageous for the actuator 8 because all the pivots of the system are substantially aligned.

[0080] In the preferred embodiment, the initial pickup element comprises a preloaded elastic element (not illustrated) operating on the second body 3 to move it from the first position to the second.

[0081] More precisely, the elastic element (or secondary spring) is positioned in such a way as to act on a cam (not illustrated) during the stroke of the second body 3 from the first position to the third position.

[0082] In this regard, it should be noted that to keep the second body 3 at the first position, that is, to keep

the door 104 at the closed position, the system 1 comprises lock means 15 which are operatively interposed between the door 104 (or the second body 3) and the frame 101 (or the first body 2). The lock means 15 can be selectively switched between a locked configuration, where they keep the door 104 at the closed position, and a released configuration, where they leave the door 104 free.

[0083] Thus, the lock means 15 are preferably associated with the control unit 10, which is configured to send to them a signal representing a released state such as to impart to them a movement from the locked to the released configuration.

[0084] Preferably, the control unit 10 is configured to send the signal representing the released state when the above mentioned first signal is sent.

[0085] In the preferred embodiment, the lock means 15 comprise a motor-driven hook 15a.

[0086] Alternatively, the lock means 15 might be embodied by other devices, either driven by the control unit or, if necessary, by a mechanical cam (comprising elastic means and mechanical guides).

[0087] The movement means 5 also comprise at least one damping element 12 associated with the link mechanism 7 and configured to reduce the speed of rotation of the second hinge body 3 from the first position to the second position, at least in the proximity of the second position.

[0088] In other words, the damping element 12 is operatively connected to the link mechanism 7 in order to oppose the rotation of the second body 3 from the first position to the second so as to reduce the angular speed (that is, the rotation speed) thereof.

[0089] Preferably, the damping element 12 is embodied by the actuator 8 itself. Thus, the control unit 10 is configured to monitor the speed of rotation of the second hinge body 3 (through the agency of the sensor means 11) at least during the rotation from the first position to the second position and, more precisely, at least from the third position to the second position.

[0090] The control unit 10 is also configured to drive the actuator 8 as a function of a signal representing the rotation speed sent by the sensor means 11 to define the damping element.

[0091] In other words, owing to the under-dimensioning of the elastic means 6 relative to the weight of the door 104, some embodiments are provided with the damping element 12 to act in conjunction with the elastic means 6 to slow down the rotation of the door 104 (that is, of the second body 3) from the first position to the second position, in particular in the proximity of the second position.

[0092] It should be noted that the damping element 12 might also be embodied by a damping/dissipating element associated with the link mechanism 7. When the activation means 9 send the second signal to the control unit 10, the control unit 10 send to the actuator 8 a second drive signal representing a movement obtained by a force

to be delivered to move the second hinge body 3 from the second position to the first position.

[0093] This second drive signal is such as to drive the actuator to deliver a force which is complementary to the force generated by the elastic means and concordant therewith, so that the total force generated by the movement means 5 is capable of generating (on the second hinge body 3) a moment which is greater than the resistant moment generated by the door 104 (that is, by the weight of the door).

[0094] In the preferred embodiment, the control unit 10 is configured to drive the actuator 8 in such a way that the force delivered by the actuator is reduced in proportion to the angular position of the second hinge body 3 (that is, of the door 104) from the second position to the first position.

[0095] Thus, the control unit 10 is configured to drive the actuator 8 as a function of a signal sent by the sensor means 11.

[0096] Preferably, the elastic means 6 are embodied by at least one helical spring 6a connected to the first hinge body 2 or to the second hinge body 3 and associated with the link mechanism 7.

[0097] In the preferred embodiments, the spring 6a has a rigidity of between 78 kgf at 76 mm and 1 Kgf at 91 mm.

[0098] More precisely, the rigidity of the spring is dimensioned as a function of the weight of the door 104.

[0099] It should be noted that, thanks to the innovation introduced by this invention, it is possible to use the same spring 6a for different types of doors 104, by programming the actuator to deliver the force necessary to compensate for the under-dimensioning of the spring 6a.

[0100] Preferably, the actuator 8 is a linear actuator and comprises a linearly movable portion 8a having one end 8b connected to the link mechanism 7. In the preferred embodiment, the actuator 8 is an electric linear actuator. Preferably, the actuator 8 comprises a motor (a stepping motor) connected to a recirculating ball screw. More preferably, the motor is a servomechanism which can be powered by 24 Volts.

[0101] In the embodiment illustrated, the actuator 8 has a predetermined stroke, preferably of approximately 30 mm. The working stroke, however, that is, the stroke used for the drive movement, is less than approximately 20 mm. It should be noted that for a door 104 weighing approximately 10 kg, the actuator 8 is preferably capable of delivering a thrust force of at least 200 N, and more preferably, at least 250 N.

[0102] Alternatively, the actuator 8 is defined by an electromagnet.

[0103] In alternative embodiments, the actuator 8 might also be hydraulic.

[0104] Figure 4 illustrates a variant embodiment of the system 1 according to the invention.

[0105] In the embodiment illustrated in Figure 4, the movement means 5 comprise a rocker lever 14 operatively interposed between the link mechanism 7 and the actuator 8.

[0106] The rocker lever 14 is pivoted on a respective element 15, which is fixed relative to the frame 101, so as to rock about a pin 16.

[0107] The rocker lever 14 has two portions 14a and 14b located on opposite sides of the pin 16 and connected respectively to the link mechanism 7 and to the linearly movable portion 8a of the actuator 8.

[0108] Advantageously, at the points where the lever 14 is connected to the link mechanism 7 and to the portion 8a of the actuator 8, there are respective slots 17, 18 designed to reduce the negative effects of possible jamming and/or imprecision in assembly.

[0109] The lever portions 14a, 14b are dimensioned in such a way as to make the rocker lever 14 an advantageous lever.

[0110] The rocker lever 14 thus has the advantage of increasing the stroke of the portion 8a of the actuator 8, thereby making it easier to control its movement.

[0111] The lever 14 thus made also has the advantage of increasing the force generated by the actuator 8.

[0112] Advantageously, but not necessarily, between the rod 13 and the portion 14a of the lever 14 there is interposed an elastic element 19 designed to damp possible oscillations and disturbances in the system 1, in particular during the movement of the door 104 from its second position, where it is open, to its first position, where it is closed.

[0113] With the actuators currently available on the market, the portion 8a of the actuator 8 is relatively short and, in this situation, any irregularities in the movement of the actuator would inevitably be reflected in the operation of the door 104: this circumstance is avoided thanks to the elastic element 19.

[0114] Advantageously, in further embodiments, which are not illustrated, the system 1 comprises means for disabling the actuator 8 (if the user opts for manual opening of the door 104). These disabling means, not illustrated, are at least partly built into the control unit 10 and if the unit 10 detects a value of current absorption exceeding a certain value, it disables the position control, thereby disengaging the actuator from the movement means 5.

[0115] The functional feature just described in connection with the possibility of opening the door manually can also be applied advantageously for the purposes of user safety.

[0116] The invention achieves the intended aims and brings important advantages.

[0117] One advantage is that it allows positive control of door movement, both for opening and closing.

[0118] Also, the use of under-dimensioned elastic means in conjunction with an actuator dimensioned to deliver only the force necessary to compensate for the under-dimensioning makes it possible to obtain an electrical household appliance with automatic (and programmable) opening/closing of the door, while keeping reduced the size of the actuator and limiting its costs.

[0119] Moreover, the presence of elastic means oper-

ating in conjunction with the actuator allows keeping the movement of the door under control along its full stroke.

[0120] The presence of the control unit and of the angular sensor makes the movement system fully controllable, preventing the rotation of the door from going outside design specifications and avoiding possible faults.

Claims

1. A movement system for a door or openable part of an electrical household appliance (100) comprising a frame (101) and a door (104) of predetermined weight, the system comprising:

- a first hinge body (2) attachable to the frame (101),
- a second hinge body (3) attachable to the door (104) and rotatably connected to the first body (2) to rotate between a first, closed position, where the door (104) abuts the frame (101), and a second, open position, where the door (104) is transversal to the frame (101), allowing access to a compartment inside the electrical household appliance (100);
- movement means (5) by which the second body (3) is moved relative to the first body (2) and which comprise elastic means (6) and a link mechanism (7) associated with the elastic means (6) to transfer the force generated by the elastic means (6) to the second body (3) in such a way that the force contributes to rotating the second body (3) relative to the first body (2);

characterized in that the elastic means (6) are dimensioned to apply a force suitable for generating a moment which is smaller than a resistance moment (R) generated by the predetermined weight of the door (104) when the second body (3) is at the second position, and **in that** the movement means (5) comprise at least one actuator (8) associated with the link mechanism (7) and configured to act in conjunction with the elastic means (6) in order to deliver a total force such as to overcome the resistance moment and allow the door (104) to move from the second position to the first position.

2. The movement system according to claim 1, **characterized in that** the movement means (5) comprise a rocker lever (14) interposed between the link mechanism (7) and the actuator (8), the rocker lever (14) being pivoted on a respective element (15) which is fixed relative to the frame (101).

3. The movement system according to claim 2, **characterized in that** the movement means (5) comprise an elastic element (19) interposed between the link mechanism (7) and the rocker lever (14).

4. The movement system according to any one of the preceding claims, **characterized in that** it comprises activation means (9) associated with the actuator (8) and controllable by a user to issue a command for moving the actuator (8) in such a way as to at least allow the second body (3) to be moved from the second position to the first.
5. The movement system according to claim 4, **characterized in that** it comprises a control unit (10) operatively interposed between the activation means (9) and the actuator (8) and configured to:
 - receive from the activation means (9) a signal representing a movement of the second hinge body (3) from the second position to the first position;
 - send to the actuator (8) a drive signal representing the value of a force to be delivered in order to obtain the movement.
6. The movement system according to claim 5, **characterized in that** the control unit (10) is configured to keep the actuator (8) active for the full closing stroke of the second body (3) from the second position to the first position.
7. The movement system according to claim 5 or 6, **characterized in that** the activation means (9) are configured to send to the control unit (10), as a function of a user command, a first signal, representing a movement of the door (104) from the first position to the second, and/or a second signal representing a movement of the door (104) from the second position to the first.
8. The movement system according to claim 7, **characterized in that** the second body (3) also has a third position, intermediate between the first position and the second and near the first position; the control unit (10) being configured, when it receives the first signal, to send to the actuator (8) a first drive signal representing the value of a force to be delivered in order to move the second body (3) only from the first position to the third position.
9. The movement system according to claim 8, **characterized in that** the movement of the second body (3) from the third position to the second position occurs by gravity.
10. The movement system according to any of the claims from 5 to 9, **characterized in that** it comprises a sensor means (11) associated with the second hinge body (3) to identify an angular position of the second body (3) relative to the first body (2) and connected to the control unit (10); the control unit (10) being configured to receive a signal representing the angular position of the second body (3) and to drive the actuator (8) as a function of that signal.
11. The movement system according to any of the preceding claims, **characterized in that** the movement means (5) comprise a damping element (12) associated with the link mechanism (7) and configured to reduce a speed of rotation of the second body (3) from the first position to the second position, at least when near the second position.
12. The system according to claim 11, **characterized in that** the control unit (10) is configured to:
 - monitor a speed of rotation of the second body (3) through the agency of at least one sensor means (11) at least during the rotation from the first position to the second position;
 - drive the actuator (8) as a function of the sensor means (11) to define the damping element (12).
13. The movement system according to any of the preceding claims, **characterized in that** the actuator (8) is a linear actuator and comprises a linearly mobile portion (8a) having an end (8b) which is connected to the link mechanism (7).
14. The movement system according to any of the preceding claims, **characterized in that** the elastic means (6) and the actuator (8) are configured to operate in conjunction in order to deliver a force of predetermined extent, where the contribution of the elastic means (6) is greater than 2/3 of the predetermined extent and the contribution of the actuator (8) is less than 1/3 of the predetermined extent.
15. An electrical household appliance, comprising:
 - a frame (101) defining a compartment (102);
 - a door (104);**characterized in that** it comprises a movement system (1) according to any of the preceding claims, where the first hinge body (2) is fixed to the frame (101) and the second hinge body (3) is fixed to the door (104) at a perimeter edge of the selfsame door (104).

Amended claims in accordance with Rule 137(2) EPC.

1. A movement system for a door or openable part of an electrical household appliance (100) comprising a frame (101) and a door (104) of predetermined weight, the system comprising:

- a first hinge body (2) attachable to the frame

(101),

- a second hinge body (3) attachable to the door (104) and rotatably connected to the first body (2) to rotate between a first, closed position, where the door (104) abuts the frame (101), and a second, open position, where the door (104) is transversal to the frame (101), allowing access to a compartment inside the electrical household appliance (100);

- movement means (5) by which the second body (3) is moved relative to the first body (2) and which comprise elastic means (6) and a link mechanism (7) associated with the elastic means (6) to transfer the force generated by the elastic means (6) to the second body (3) in such a way that the force contributes to rotating the second body (3) relative to the first body (2);

the elastic means (6) being dimensioned to apply a force suitable for generating a moment which is smaller than a resistance moment (R) generated by the predetermined weight of the door (104) when the second body (3) is at the second position, and in that the movement means (5) comprise at least one actuator (8) associated with the link mechanism (7) and configured to act in conjunction with the elastic means (6) in order to deliver a total force such as to overcome the resistance moment and allow the door (104) to move from the second position to the first position.

characterized in that the movement means (5) comprise a rocker lever (14) interposed between the link mechanism (7) and the actuator (8), the rocker lever (14) being pivoted on a respective element (15) which is fixed relative to the frame (101).

2. The movement system according to claim 1, **characterized in that** the movement means (5) comprise an elastic element (19) interposed between the link mechanism (7) and the rocker lever (14).

3. The movement system according to any one of the preceding claims, **characterized in that** it comprises activation means (9) associated with the actuator (8) and controllable by a user to issue a command for moving the actuator (8) in such a way as to at least allow the second body (3) to be moved from the second position to the first.

4. The movement system according to claim 43, **characterized in that** it comprises a control unit (10) operatively interposed between the activation means (9) and the actuator (8) and configured to:

- receive from the activation means (9) a signal representing a movement of the second hinge body (3) from the second position to the first position;

- send to the actuator (8) a drive signal representing the value of a force to be delivered in order to obtain the movement.

5. The movement system according to claim 4, **characterized in that** the control unit (10) is configured to keep the actuator (8) active for the full closing stroke of the second body (3) from the second position to the first position.

6. The movement system according to claim 4 or 65, **characterized in that** the activation means (9) are configured to send to the control unit (10), as a function of a user command, a first signal, representing a movement of the door (104) from the first position to the second, and/or a second signal representing a movement of the door (104) from the second position to the first.

7. The movement system according to claim 6, **characterized in that** the second body (3) also has a third position, intermediate between the first position and the second and near the first position; the control unit (10) being configured, when it receives the first signal, to send to the actuator (8) a first drive signal representing the value of a force to be delivered in order to move the second body (3) only from the first position to the third position.

8. The movement system according to claim 7, **characterized in that** the movement of the second body (3) from the third position to the second position occurs by gravity.

9. The movement system according to any of the claims from 4 to 98, **characterized in that** it comprises a sensor means (11) associated with the second hinge body (3) to identify an angular position of the second body (3) relative to the first body (2) and connected to the control unit (10); the control unit (10) being configured to receive a signal representing the angular position of the second body (3) and to drive the actuator (8) as a function of that signal.

10. The movement system according to any of the preceding claims, **characterized in that** the movement means (5) comprise a damping element (12) associated with the link mechanism (7) and configured to reduce a speed of rotation of the second body (3) from the first position to the second position, at least when near the second position.

11. The system according to claim 10, **characterized in that** the control unit (10) is configured to:

- monitor a speed of rotation of the second body (3) through the agency of at least one sensor means (11) at least during the rotation from the

first position to the second position;
- drive the actuator (8) as a function of the sensor means (11) to define the damping element (12).

12. The movement system according to any of the preceding claims, **characterized in that** the actuator (8) is a linear actuator and comprises a linearly mobile portion (8a) having an end (8b) which is connected to the link mechanism (7).

13. The movement system according to any of the preceding claims, **characterized in that** the elastic means (6) and the actuator (8) are configured to operate in conjunction in order to deliver a force of predetermined extent, where the contribution of the elastic means (6) is greater than 2/3 of the predetermined extent and the contribution of the actuator (8) is less than 1/3 of the predetermined extent

14. An electrical household appliance, comprising:

- a frame (101) defining a compartment (102);
- a door (104);

characterized in that it comprises a movement system (1) according to any of the preceding claims, where the first hinge body (2) is fixed to the frame (101) and the second hinge body (3) is fixed to the door (104) at a perimeter edge of the selfsame door (104).

FIG.1

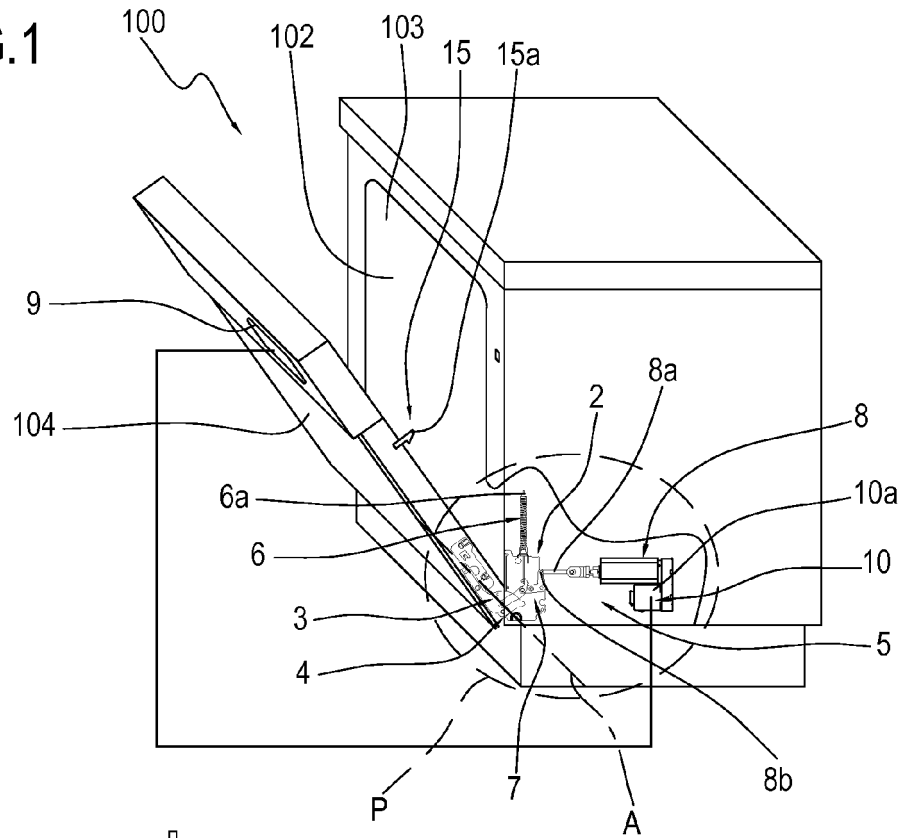


FIG.1a

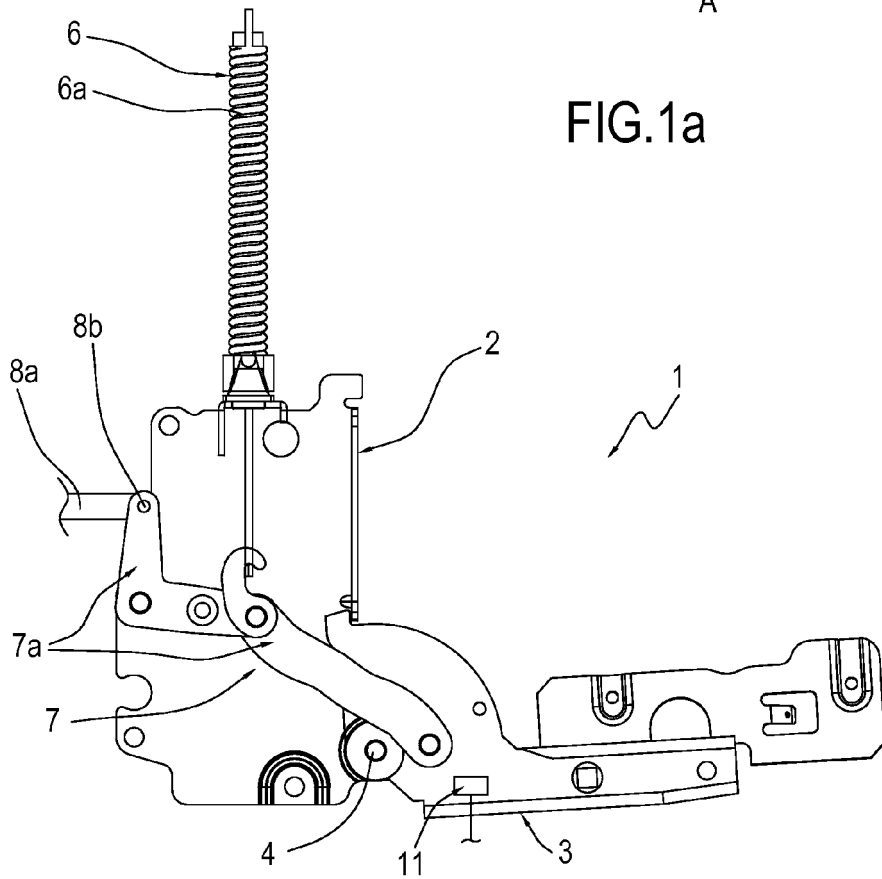


FIG.2

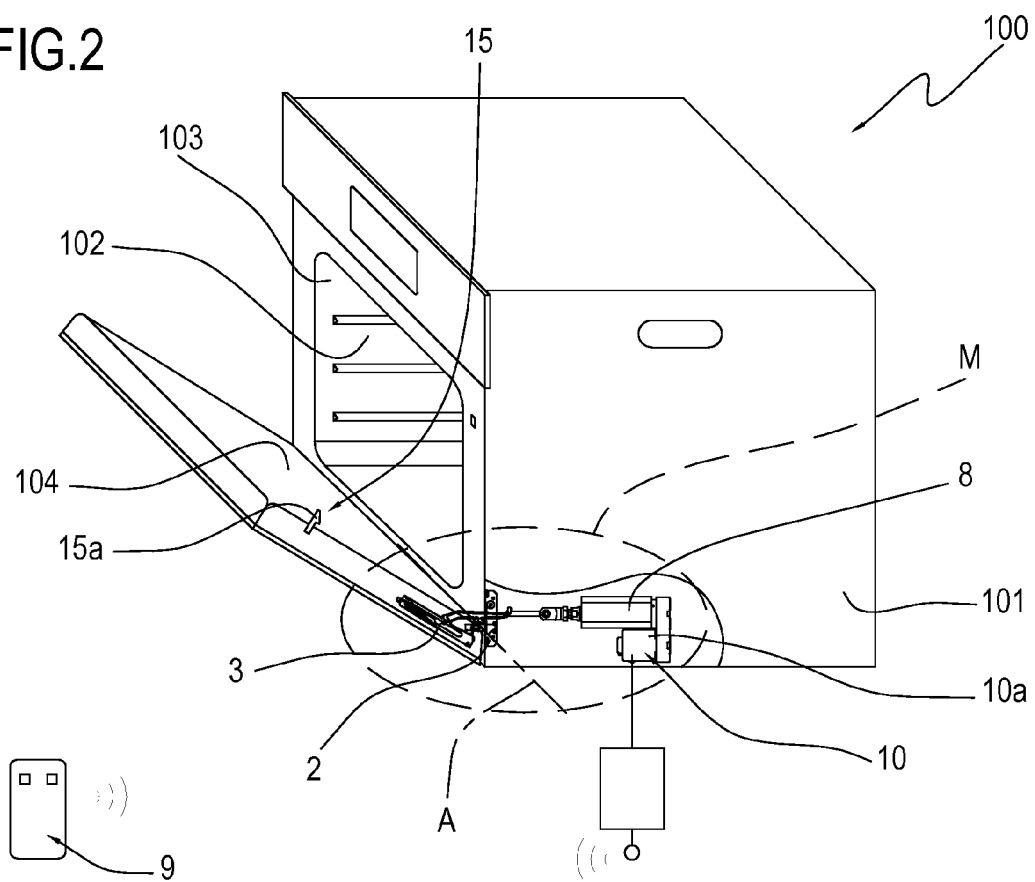


FIG.2a

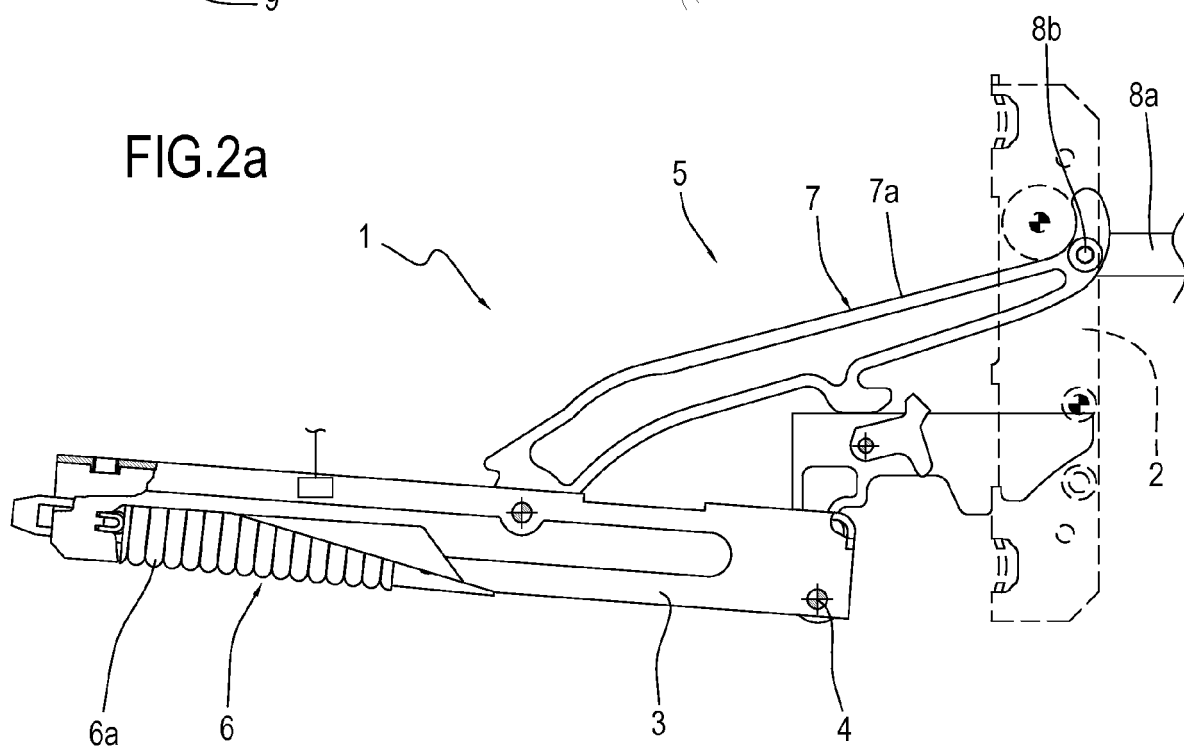


FIG.3

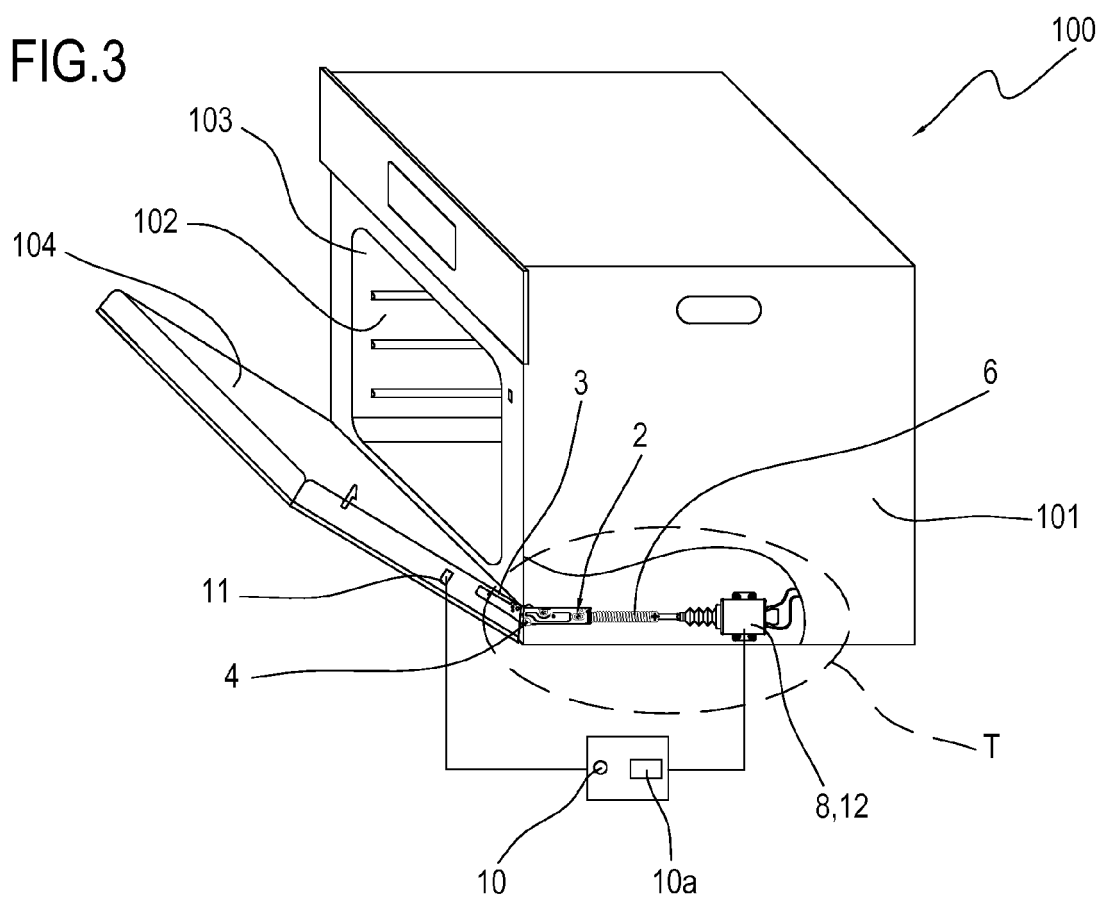


FIG.3a

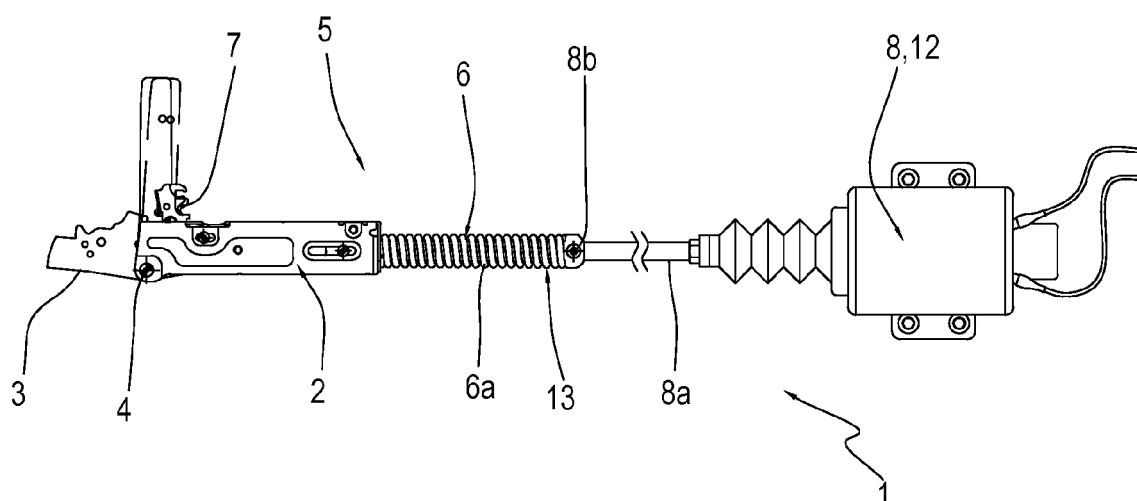
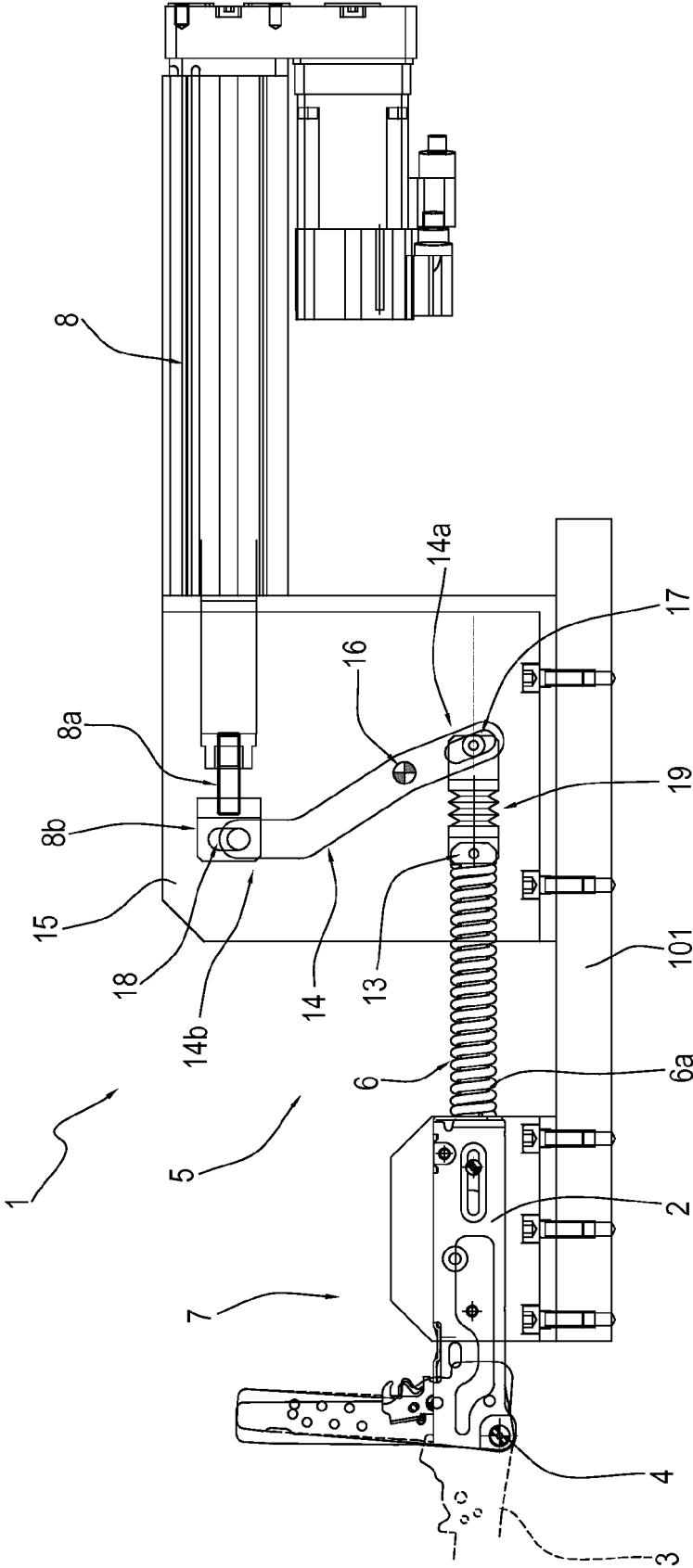


FIG.4





EUROPEAN SEARCH REPORT

Application Number
EP 14 16 1936

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Place of search The Hague		Date of completion of the search 19 May 2014	Examiner Rémondot, Xavier
CATEGORY OF CITED DOCUMENTS		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	
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