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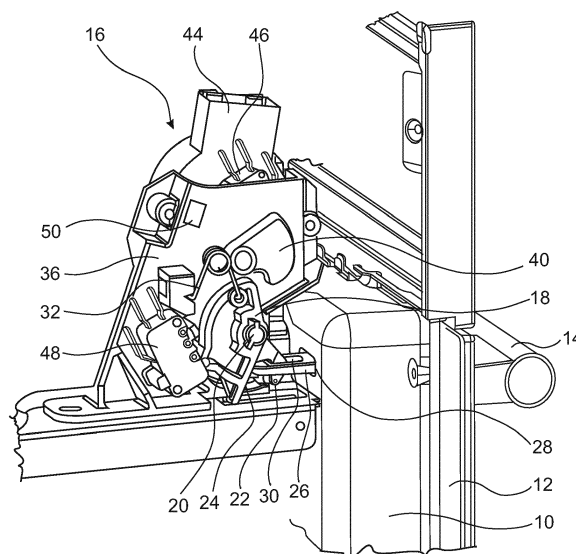
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(54) **DOOR OPENING SYSTEM FOR A KITCHEN APPLIANCE**

(57) A kitchen appliance comprises:  
- a door (12) which is pivotable between a closed position and an open position,  
- a latch operable to lock the door (12) in the closed position; and  
- an opening mechanism (16) operable to move the door

(12) towards the open position; wherein  
- the door (12) is pivotable about a horizontal axis that extends proximal a lower edge of the door, and  
- the opening mechanism (16) is operable to unlock the latch and to pivot the door (12) beyond a dead center of the door.



**FIG. 1**

## Description

**[0001]** The present invention relates to a kitchen appliance and in particular to a kitchen appliance having a door opening system.

**[0002]** In certain types of kitchen appliances it can be advantageous to provide a door opening system which is operable, either upon activation by a user or activated by a program control, to automatically open the door of the kitchen appliance.

**[0003]** Thus for example, microwave ovens can be equipped with door opening systems, which automatically open the oven door upon expiry of a preset operation duration. Similarly, dishwashers can be provided with door opening systems to open the dishwasher door at the end of a washing cycle so as to promote the venting of the tub in an effort to improve the drying process.

**[0004]** In EP 0 342 307 B1 there is disclosed a cooker which comprises a door which is pivotable between a closed position and an open position, a latch which is operable to lock the door in the closed position, and an opening mechanism which is operable to move the door towards the open position. In such cooker, the door is pivotable about a vertical axis that extends along one of the lateral edges of the door. The door is biased by a spring towards the open position of the door, and a locking mechanism provides for locking the door in the closed position. A motor driven opening mechanism is operable to unlock the door so that the door opens by the force of the spring.

**[0005]** The use of springs to provide for a force for opening the door of a kitchen appliance is problematic in as far as the spring load is difficult to adjust. Thus even in a kitchen appliance as delivered, the angle of opening of the door as caused by the spring is difficult to predict, and over an extended use of the appliance will change over time. Furthermore, particularly for kitchen appliances with heavier doors, such as baking ovens with cooled glass front, the spring load required to open the door necessitates a correspondingly high closing force which is undesirable in terms of ease of use.

**[0006]** It is an object of the present invention to provide for a kitchen appliance which provides for reliable opening of the door of the kitchen appliance, but which nevertheless is user friendly.

**[0007]** In a kitchen appliance comprising a door which is pivotable between a closed position and an open position, a latch which is operable to lock the door in the closed position, and an opening mechanism which is operable to move the door towards the open position, the above object is solved in that the door is pivotable about a horizontal axis that extends proximal a lower edge of the door, and the opening mechanism is operable to unlock the latch and to pivot the door beyond a dead center of the door. While in a kitchen appliance having door that is pivotable about a horizontal axis that extends proximal a lower edge of the door, only a relatively small opening angle of the door is required to pivot the door beyond the

dead center of the door, a relatively small opening force has to be provided by the opening mechanism to pivot the door beyond its dead center, whereupon passing the dead center the door falls open by gravity.

**[0008]** Preferred embodiments of the present invention are defined in the dependent claims.

**[0009]** In particular, the latch can comprise an engageable member that is attached to the door and a latching member which can be engaged with the engageable member. The engageable member can be any member that allows engagement by the latching member, such as a hook and eye engagement, or a detent that engages a correspondingly shaped latching member.

**[0010]** In preferred embodiments the engageable member comprises a push rod operable to be engaged by the opening mechanism to push the door beyond its dead center. In such embodiments the engageable member serves the double function of acting as part of the latch during closing the door, and to transfer the pushing force to the door during opening the door.

**[0011]** Preferably the opening mechanism comprises a rotatable lever having a first portion which forms the latching member and a second portion that is operable to apply a pushing force onto the push rod. The first portion thus can have the shape of a hook which by rotation of the rotatable lever can be engaged with a respective portion of the engageable member, such as a rod that is provided which an eye into which the hook-shaped first portion of the rotatable lever can be inserted so as to provide for latching of the engageable member. With the engageable member being attached to the door, by such latching action the door can be locked in the closed position, and correspondingly can be unlocked by rotating the rotatable lever in the opposite direction. When further rotating the rotatable lever in the opening direction, the rotatable lever engages the engageable member with the second portion, so as to apply a pushing force onto the push rod, thus pushing the door open beyond its dead center, so that the door falls open by gravity.

**[0012]** Preferably the kitchen appliance further comprises a dead center spring acting on the rotatable lever so as to bias the latching member into engagement with the engageable member when the door is in the closed position, and to bias the second portion into engagement with the push rod when the rotatable lever has been rotated to unlock the latch. The dead center spring thus provides for a dynamic closing force which tends to maintain the engagement of the latching member with the engageable member when the door is in the closed position, but which also assists the opening of the door by providing for a dynamic force that intensifies the engagement of the second portion of the rotatable lever with the push rod.

**[0013]** In preferred embodiments, the kitchen appliance further comprises a cam for rotating the rotatable lever in the second direction. Whereas the cam thus provides for rotation of the rotatable lever during an opening operation of the door so as to activate the push rod in

order to pivot the door beyond its dead center, the rotation of the rotatable lever during a closing operation can be effected manually by a user closing the door, in which case the engageable member that is attached to the door engages the second portion of the rotatable lever. During the further closing movement of the door the rotatable lever is rotated in the first direction, so as to provide for an engagement of the latch by which the door is locked in the closed position.

**[0014]** Preferably, the rotatable lever and the cam are configured to allow free rotation of the rotatable lever once the rotatable lever has been rotated beyond its the dead center of the spring. While for engaging and disengaging the latch and also for pivoting the door beyond its dead center the rotatable lever has to be rotated only for a certain angular range, the engagement between the cam and the rotatable lever can be restricted to such angular range. In embodiments in which there is provided the above mentioned dead center spring which acts on the rotatable lever, the cam and the rotatable lever can be disengaged during movement of the rotatable lever in the opening direction already as soon as the dead center of the spring has been passed, so that the spring force can freely act onto the rotatable lever without interference of the cam. When activating the opening mechanism, the rotatable lever thus first is rotated by the action of the cam to unlock the latch and at the same time to compress the dead center spring, and then upon having passed the dead center, the cam and the rotatable lever disengage so that the spring load is released onto the push rod so as to nudge away the push rod and thus provide a thrust on the door, so that the door pivots beyond its dead center.

**[0015]** Furthermore, providing for a cam that engages the rotatable lever only for a restricted angular range is of particular advantage when there is provided a motor for rotating the cam because in this manner during closing the door of the kitchen appliance, during which the rotatable lever is rotated in the reverse direction, the motor can be decoupled from the rotatable lever thus preserving the motor. Furthermore, for rotating the cam a motor can be used which is operable in only one direction which provides for a cost advantage versus having to provide for a reversible motor.

**[0016]** When the kitchen appliance further comprises a motor for rotating the cam, such motor preferably can be activated by control means of the kitchen appliance, so that the opening sequence can be initiated either by a user request, or automatically at the end of a pre-programmed operation cycle.

**[0017]** While the opening angle of the door usually is limited by some stop means, the kitchen appliance preferably comprises dampening means for dampening the opening movement of the door, so as to decelerate the movement of the door before it reaches a predetermined open position. In an oven such open position usually will be a substantially horizontal position of the door. In a dishwasher the open position either also may be also a

substantially horizontal position, or can be an intermediate position in which the dishwasher door is opened for only a few centimeters, such as 5 to 20 cm, so as to allow venting of the dishwasher tub at the end of a washing cycle.

**[0018]** In order to control the operation of the device in dependency of the movement of the various parts, the kitchen appliance can comprise means for detecting the rotational position of the rotational switch and or means for detecting the rotational position of the cam. For example, when the kitchen appliance is a microwave oven, the microwave function can be switched off for safety reasons as long as the door is not fully closed, which can be ascertained by such detection means. Furthermore, the means for detecting the rotational position of the cam also can be used with advantage to switch on and off a motor for rotating the cam, so as to reliably uncouple and decouple the cam and the rotational switch.

**[0019]** The present invention can be employed in any kitchen appliance which allows installing the door to be pivotable about a horizontal axis. Thus, the kitchen appliance particularly can be a cooking oven, such as a baking oven, a microwave oven, a steam oven, a combination oven, or a dishwasher.

**[0020]** Preferred embodiments of a kitchen appliance made in accordance with the present invention will be described by reference to the drawings, in which:

Fig. 1 is a perspective view of a kitchen appliance; and

Fig. 2 illustrates an opening mechanism as it is employed in the kitchen appliance of Fig. 1.

**[0021]** In the embodiment illustrated in Fig. 1 the kitchen appliance is a cooking oven having an oven muffle 10 that is closed by a door 12 which is pivotable about a horizontal axis that extends along a lower edge of the door. Whereas the pivotal movement of the door can be an exclusively rotational movement, the pivotal movement of the door also can comprise a combination of rotational and pivotal movement, such as in embodiments, in which the door is hinged to lateral lever elements, so that the horizontal pivot axis is not a fixed axis, but itself is shifted during an opening or closing movement of the door.

**[0022]** Close to the upper edge of the door there is provided a handle 14 for manually pivoting the door, which in the cooking oven described herein particularly applies to closing the door, whereas the opening of the door is effected automatically by means of an opening mechanism, designated generally with reference sign 16.

**[0023]** As shown in Figs. 1 and 2, opening mechanism 16 comprises a rotatable lever 18 which is mounted on an axle 20, which in the embodiment shown in Figs. 1 and 2 is a stationary axle. Rotatable lever 18 comprises a first portion 22 which forms a latching member and a second portion 24 that is operable to apply a pushing force onto a push rod 26 which is affixed to the door 12.

As illustrated in Fig. 1, when the door 12 is closed, the push rod 26 projects through an aperture 28 in a border portion of the over muffle, and an eye 30 provided in the push rod 26 is engaged by the latching member which is formed by the first portion 22 of rotatable lever 18.

**[0024]** A spring 32 having two legs is hinged with a first leg 34 to a carrier 36 of the opening mechanism 16, so that the spring can pivot about the anchoring point of the first leg 34 at carrier 36. A second leg 38 of spring 32 is pivotally connected to rotatable lever 18. In the closed position of the door 12, which is shown in Fig. 1, the spring exerts a biasing force onto the rotatable lever 18 which tends to rotate the lever in the clockwise direction, thus providing a force that pulls push rod 26 inwardly to keep door 12 closed.

**[0025]** When rotatable lever 18 is rotated in the counter-clockwise direction towards the position illustrated in Fig. 2, latching member 22 is disengaged from eye 30 thus unlocking the door 12. At the same time, second portion 24 of push rod 26 engages the free end of push rod 26 thus applying a pushing force to pivot the door 12 towards its open position.

**[0026]** The rotation of rotatable lever 18 is effected by a cam 40 which is affixed to an output shaft 42 of a motor 44, that is attached to the rear side of carrier 36 (as seen in Figs. 1 and 2). As will be understood from Figs. 1 and 2, rotatable lever 18 and cam 40 are shaped so that for opening the door 12 starting from the situation shown in Fig. 1 the cam 40 is rotated in the clockwise direction, so as to rotate rotatable lever 18 in the counter-clockwise direction, until passing the dead center of spring 32, at which point the rotatable lever 18 and the cam 40 rotate out of engagement, and thus spring 32 can unload to thrust rotatable lever 18 further in the counter-clockwise direction, nudging away push rod 26. In this manner door 12 is reliably pivoted beyond its dead center, which is reached at an opening angle of only a few degrees, so that the door 12 falls open by gravity.

**[0027]** From the situation shown in Fig. 2, where the rotatable lever 18 has reached its end position when the door has been pushed open, cam 40 is rotated further in the clockwise direction so as to bring the cam back into the orientation depicted in Fig. 1, where it does not engage the rotatable lever 18 irrespective of the rotational position of the rotatable lever 18. In this manner the rotatable lever 18 can be returned from the open door end position shown in Fig. 2, to its second end position when the door is closed as is shown in Fig. 1. Such closed door end position of the rotatable lever 18 is reached by the user manually closing the door 12, i.e. in Fig. 1 pivoting the door in the counter-clockwise direction. Shortly before reaching the completely closed position the push rod 26 engages second portion 24 of the rotatable lever 18. By further closing the door 12, the rotatable lever 18 is rotated further in the clockwise direction against the force of spring 32, until the fully closed end position shown in Fig. 1 is reached, in which the latching member 22 is engaged with eye 30 of push rod 26.

**[0028]** The operation of the motor 44 as well as of further parts of the kitchen appliance can be controlled in dependency of the rotational position of the cam and/or the rotational position of the rotational switch. Thus, as noted above, from the situation depicted in Fig. 2, when the rotatable lever 18 has reached its end position and thus the door has been pushed open, the cam 40 is to be returned to the orientation depicted in Fig. 1, where it does not engage the rotatable lever 18 irrespective of the rotational position of the rotatable lever 18. In order to stop the motor 44 when the cam has reached its intended end position shown, a switch 46 detects the rotational position of output shaft 42, such as by providing a switching cam on output shaft 42 which engages a push-button of switch 46.

**[0029]** In a similar manner, the rotational position of rotational switch 18 is detected by a switch 48. Based on the output of switch 48 which detects when the rotational switch 18 reaches the position shown in Fig. 2 and thus provides for an indication that the door is opened, the operation of further components of the kitchen appliances can be controlled, such as by deactivating a microwave functionality in an oven, or by turning on an illumination and/or a vent when the kitchen appliance is a dishwasher.

**[0030]** In case that the opening mechanism suggested herein is designed as a retrofit unit for replacing a door latch, which only comprises a latching member and an engageable member attached to the door, the opening mechanism 16 further can be provided with circuitry 50, which in the simplest case can be a relay, to supplement the desired functionality for the control of the kitchen appliance.

### Reference signs

#### [0031]

|    |                                 |
|----|---------------------------------|
| 10 | oven muffle                     |
| 12 | door                            |
| 14 | handle                          |
| 16 | opening mechanism               |
| 18 | rotatable lever                 |
| 20 | axle                            |
| 22 | first portion (latching member) |
| 24 | second portion                  |
| 26 | engageable member / push rod    |
| 28 | aperture                        |
| 30 | eye                             |
| 32 | spring                          |
| 34 | first leg                       |
| 36 | carrier                         |
| 38 | second leg                      |
| 40 | cam                             |
| 42 | output shaft                    |
| 44 | motor                           |
| 46 | switch                          |
| 48 | switch                          |

50 circuitry

## Claims

### 1. A kitchen appliance comprising:

- a door (12) which is pivotable between a closed position and an open position,
- a latch operable to lock the door (12) in the closed position; and
- an opening mechanism (16) operable to move the door (12) towards the open position;

### characterized in that the

- the door (12) is pivotable about a horizontal axis that extends proximal a lower edge of the door, and
- the opening mechanism (16) is operable to unlock the latch and to pivot the door (12) beyond a dead center of the door.

2. The kitchen appliance of claim 1, wherein the latch comprises an engageable member (26) that is attached to the door (12) and a latching member (22) which can be engaged with the engageable member (26).

3. The kitchen appliance of claim 2, wherein the engageable member comprises a push rod (26) operable to be engaged by the opening mechanism (16) to push the door (12) beyond its dead center.

4. The kitchen appliance of claims 2 and 3, wherein the engageable member (26) comprises an eye (30) operable to be engaged by the latching member (22).

5. The kitchen appliance of claim 3 or 4, wherein the opening mechanism (16) comprises a rotatable lever (18) having a first portion (22) which forms the latching member and a second portion (24) that is operable to apply a pushing force onto the push rod (26).

6. The kitchen appliance of claim 5, wherein the rotatable lever (18) is arranged to engage the latching member (22) with the push rod (26) when the rotatable lever (18) is rotated in a first direction, and to engage the push rod (26) so as to pivot the door (12) beyond its dead center when the rotatable lever (18) is rotated in a second direction opposite to the first direction.

7. The kitchen appliance of claim 5 or 6, further comprising a dead center spring (32) acting on the rotatable lever (18) so as to bias the latching member (22) into engagement with the push rod (26) when the door (12) is in the closed position, and to bias

the second portion (24) into engagement with the push rod (26) when the rotatable lever (18) has been rotated to unlock the latch.

8. The kitchen appliance of claims 5 to 7, further comprising a cam (40) for rotating the rotatable lever (18) in the second direction.

9. The kitchen appliance of claims 7 and 8, wherein the rotatable lever (18) and the cam (40) are configured to allow free rotation of the rotatable lever (18) once the rotatable lever (18) has been rotated beyond the dead center of the spring (32).

10. The kitchen appliance of claim 8 or 9, further comprising a motor (44) for rotating the cam (40).

11. The kitchen appliance of claim 10, comprising control means for activating the motor (44).

12. The kitchen appliance of any one of the preceding claims, comprising dampening means for dampening the opening movement of the door (12).

13. The kitchen appliance of claim 5 and any claim dependent thereon, comprising means (48) for detecting the rotational position of the rotational switch (18).

14. The kitchen appliance of claim 10, further comprising means (46) for detecting the rotational position of the cam (40).

15. The kitchen appliance of any of the preceding claims, which is a cooking oven, or a dishwasher.

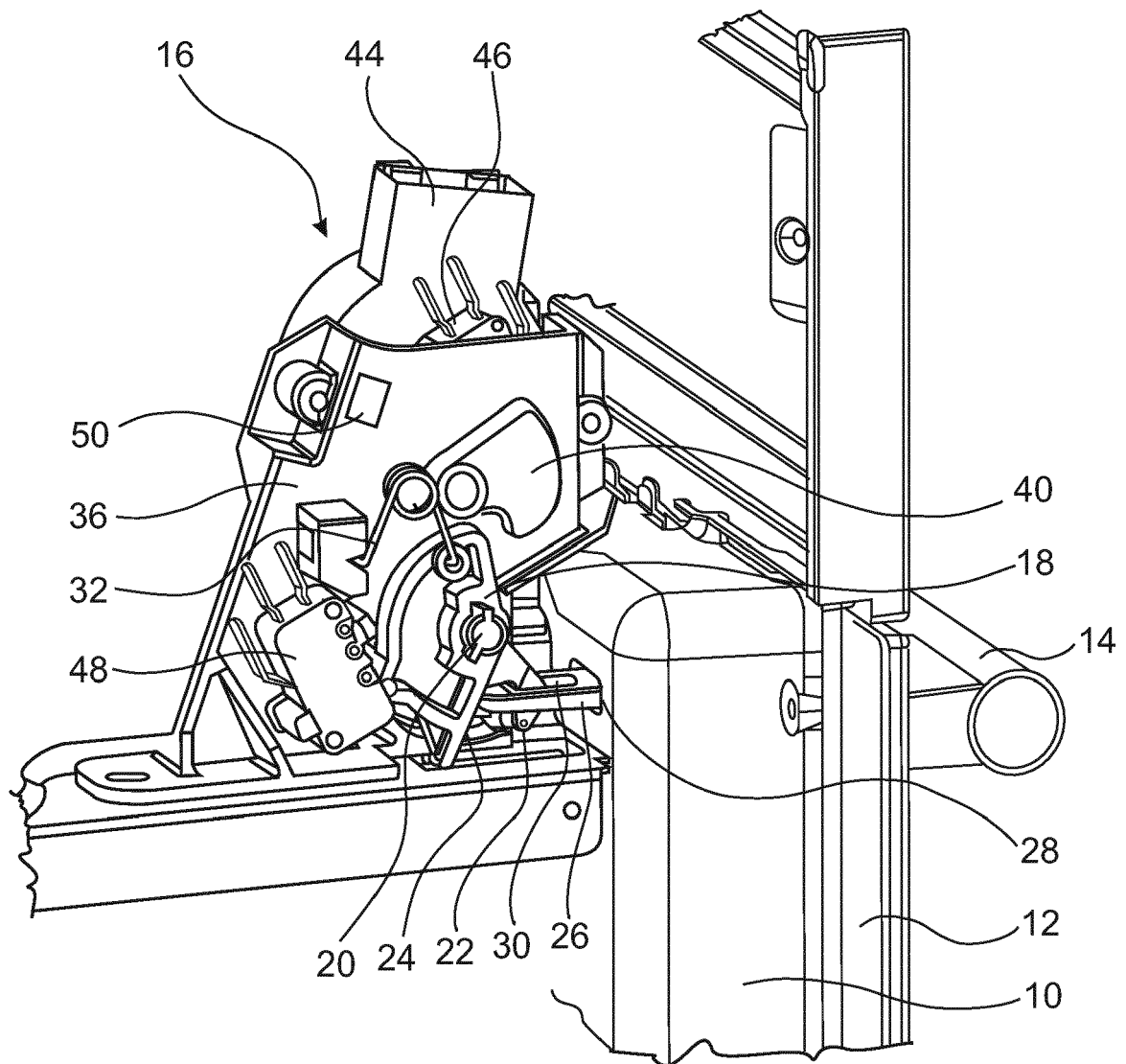


FIG. 1

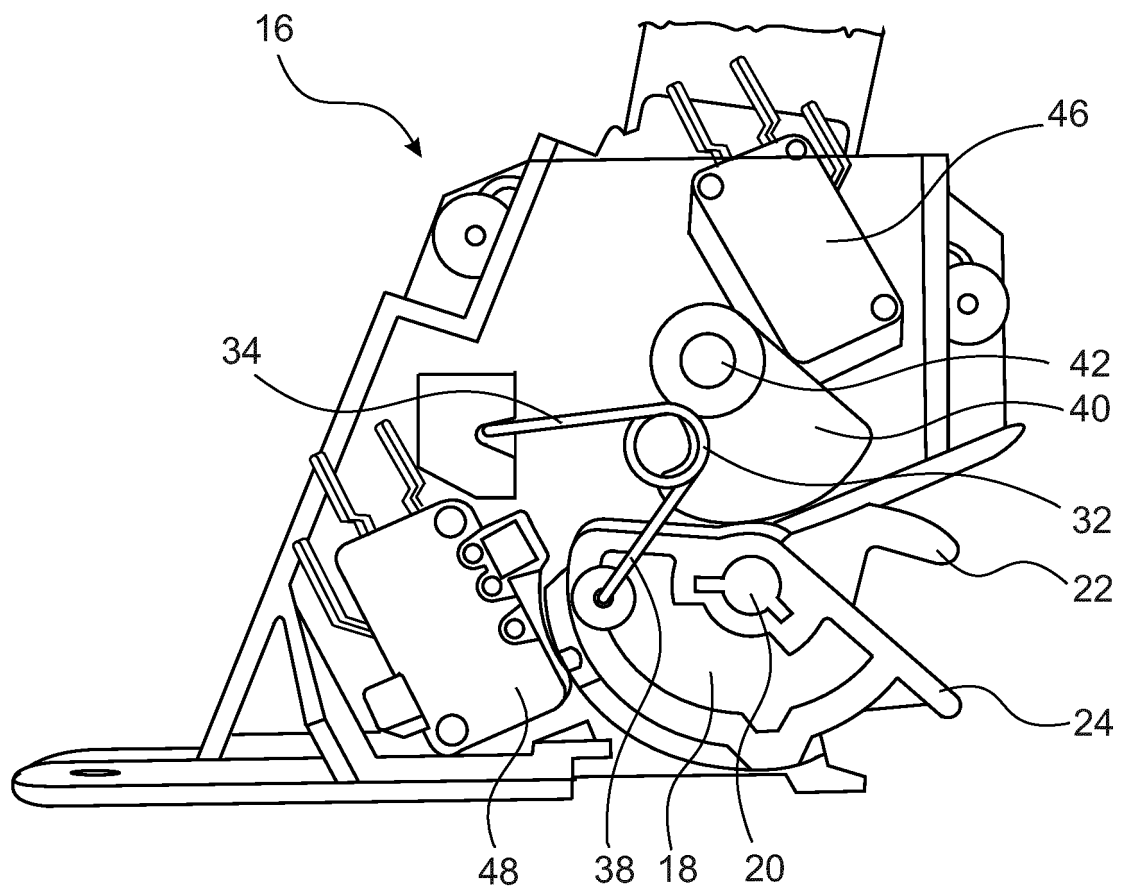


FIG. 2



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| Place of search<br>The Hague   |   | Date of completion of the search<br>25 January 2018 | Examiner<br>Fest, Gilles                                |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document<br>T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |   |   |   |

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