



(11)

EP 3 112 517 A1

(12)

## EUROPEAN PATENT APPLICATION

(43) Date of publication:  
04.01.2017 Bulletin 2017/01

(51) Int Cl.:  
D06F 37/10 (2006.01)

(21) Application number: 15174403.4

(22) Date of filing: 29.06.2015

(84) Designated Contracting States:  
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB  
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO  
PL PT RO RS SE SI SK SM TR**

Designated Extension States:

**BA ME**

Designated Validation States:

**MA**

(71) Applicant: **Whirlpool Corporation**  
Benton Harbor, MI 49022 (US)

(72) Inventors:

- **Cagliani, Marco**  
21025 Comerio (IT)

- **Caruso, Luca**  
21025 Comerio (IT)
- **Civanelli, Claudio**  
21025 Comerio (IT)
- **Parachini, Davide**  
21025 Comerio (IT)

(74) Representative: **Guerci, Alessandro**  
Whirlpool Europe S.r.l.  
Patent Department  
Viale G. Borghi 27  
21025 Comerio (VA) (IT)

### (54) TOP-LOADING WASHING MACHINE COMPRISING A DRUM DOOR

(57) A top-loading washing machine comprises a tub, a perforated drum rotatably mounted within said tub about a horizontal axis and having an aperture on its cylindrical side, a drum door slidably supported by the drum for opening and closing said aperture following a predetermined rotation of the drum, catching means supported by the tub and configured to selectively engage

said sliding door for opening and closing thereof. The drum comprises a flap hinged to an edge of said aperture of the drum and having first engaging portions configured to cooperate with second engaging portions of the sliding part, said catching means being also configured to cooperate with said flap in order to free it from the sliding part.

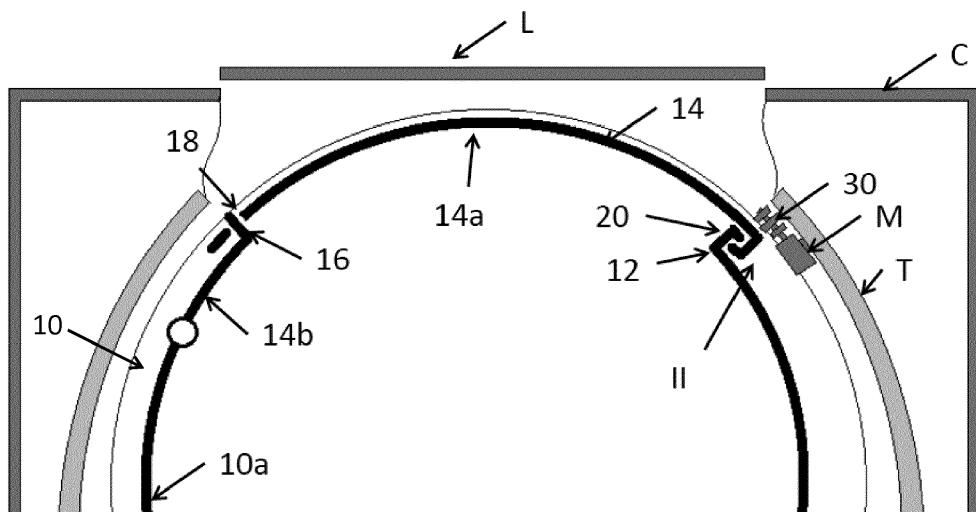


Fig. 1b

## Description

**[0001]** The present invention relates to washing machine, particularly a top-loading washer, comprising a tub with an access opening, a perforated drum rotatably mounted within said tub about a horizontal axis and having an aperture on its cylindrical side, a drum door slidably supported by the drum for opening or closing said aperture following a predetermined rotation of the drum, and catching means supported by the tub and configured to selectively engage said slidable drum door in order to open or close it.

**[0002]** Such kind of washing machine is shown in FR-A-2751669. Another similar solution is disclosed by DE-A-10316696.

**[0003]** Even if such known solutions allow an automatic opening of the drum, therefore reducing the operations requested to the user for accessing the interior of the drum for loading and unloading clothes (i.e. manual opening of a upper lid for accessing the opening of the tub and manual opening of the drum door for accessing the interior thereof), nevertheless they do not guarantee a sufficient strength of the drum door assembly in the closed configuration, particularly in view of the high spinning speed of the modern washing machines. Since in such machines the drum is designed to rotate at a very high speed (up to 1800 rpm and beyond), it develops at the periphery an acceleration of the order of magnitude of hundreds of g (even beyond 400 g), and therefore its structure must resist to very high forces, typically of some tons. The structure must be designed to stand to these forces, despite the need of having something lightweight and easy to manufacture.

**[0004]** The automatic opening mechanism of the drum must reflect the same requirements as well.

**[0005]** Moreover, in the above known solutions said catching means comprises electromagnets with plungers which cooperate directly with an edge portion of the sliding door, and this solution need a considerable amount of space which reduces the overall capacity of the arrangement tub/drum.

**[0006]** It is therefore an object of the present invention to provide a washing machine of the above type which does not present the above mentioned drawbacks.

**[0007]** Such object is reached thanks to the features listed in the appended claims.

**[0008]** According to the invention, the drum door comprises a flap hinged to an edge of the aperture of the drum and having first engaging portions configured to cooperate with corresponding second engaging portions of the sliding door. Moreover, according to a preferred embodiment of the invention, the catching means comprises a rotating member with at least a cam surface configured to cooperate with said flap in order to rotate it, in an opening configuration of the drum door, and to disengage said first engaging portions from said second engaging portions.

**[0009]** In a second embodiment of the invention, the

catching means comprises at least a linear actuator, for instance a plunger moved by an electric motor, oriented radially with reference to the drum.

**[0010]** The solution according to the invention is an automatic system having a high mechanical reliability that, at the end of the washing cycle, is capable of opening the door of the drum without any manual intervention of the user. In this way when the user opens the external lid, the drum is already open and allows the user to take out the laundry without the need to open the drum door manually. In the same way, when the user opens the external lid to load the washer, the drum is already open and it closes automatically when the washing machine is operated.

**[0011]** According to another feature of the first embodiment of the invention, the rotating member presents a first cam surface for acting on the flap in order to rotate it and disengage it from the sliding door and a second cam surface in order to engage a corresponding portion of the sliding drum door in order to keep it in a predetermined position with reference to the tub.

**[0012]** In a second embodiment of the invention, the relative movement between the flap and the sliding door in order to disengage them and maintaining the sliding door in a fixed predetermined position during the rotation of the drum (in the opening sequence of the door) is driven by at least one linear actuator.

**[0013]** Further features and advantages of a washing machine according to the invention will become clear from the following detailed description, with reference to the attached drawings in which:

- Figures 1 a and 1 b are a cross section of the assembly tub and drum of a washing machine according to the invention, and a schematic view of a portion of the drum of such washing machine respectively;
- Figures 2a and 2b are enlarged perspective views of a details of a drum of figure 1 in a closed and partially open configuration of the drum sliding door;
- Figures 3a-3d are perspective views of a rotating member used with the drum of figure 1;
- Figure 4 is a perspective view of a detail of a washing machine in a starting position of the opening sequence of the drum door;
- Figure 5 is a perspective view similar to figure 4 showing a configuration in which the sliding door is engaged and a safety device is opened;
- Figure 6 is a perspective view similar to figures 4 and 5 and refers to a configuration in which the safety device is completely open and the hooks of the door flap are disengaged from the sliding door;
- Figure 7 is a perspective view of a detail showing how the door flap is pushed down by the sliding door in the closing configuration of the drum door;
- Figure 8 is a perspective view of the tub of the washing machine according to a second embodiment of the invention; and
- Figure 9 is a perspective view of the drum of a wash-

ing machine according to the second embodiment of the invention.

**[0014]** With reference to the drawings, a drum 10 of a top loading washer W comprises a stainless steel cylindrical wrapper 10a provided with a rectangular drum opening 12 provided with a door 14. The drum 10 is rotating within a plastic tub T mounted, with the interposition of known dampers, within a cabinet C. Such cabinet is provided with a lid L for closing the access opening towards the drum 10. The door 14 of the drum 10 comprises a sliding part 14a and a rotating flap 14b whose rotation is allowed only towards the inside of the drum 10 by abutting parts of the drum (not shown). A spring (not shown) urges the rotating flap 14b towards the position shown in figure 1.

**[0015]** The structural continuity of the drum mantle is guaranteed during the spin extraction by the chain formed by a hinge rod of the rotating flap 14b, the flap 14b itself, hooks 16 of the flap 14b engaging corresponding slots 18 of the sliding part 14a, the sliding part 14a itself and a connecting rod 20 (figures 1 and 2a) of the sliding part 14a.

**[0016]** A safety device 22 (figure 4) is necessary to prevent accidental openings during the tumbling of the drum (in the spin the centrifugal force is more than enough to prevent the opening) and to ensure a correct closure at the end of the loading / unloading sequence. It is generally done with a specially shaped spring operated pushbutton or lever.

**[0017]** The automatic opening system must satisfy the same kind of requirements as the manual system, since it must stand to the same kind of stress. It is so necessary to guarantee the continuity of the structural chain, the safety of the closure and, of course, it has to be completely automatic.

**[0018]** The use of a sliding part 14a, which presents big dimension compared to the rotating flap 14b, offers not only an automatic operation, but also a wider opening.

**[0019]** During the operation of the washer, the couple of hooks 16 of the small rotating flap 14b are engaged in a couple of corresponding slots 18 in the sliding part 14a.

**[0020]** To ensure the structural continuity to stand against the centrifugal force, the metallic rod 20 (stainless steel typically) is fixed to the drum wrapper 10a, and offers to the sliding part 14a a solid anchor point for several auxiliary hooks 22 (figure 2b) formed bending the door metal.

**[0021]** These hooks 22, in combination with the rod 20, allow the movement of the sliding lid in the direction of the opening, but prevent the movement in the direction of the closure and so the disengagement of the lid from its guides (figures 2a-2b).

**[0022]** At the end of the washing cycle, the drum opening 12 is closed and a number of actions must be executed.

**[0023]** First, the drum must be rotated in the correct position with the opening in an upper position, but not yet

in the load/unload position. Then, it is necessary to disengage the safety device (figure 5).

**[0024]** At this point the small, rotating flap 14b is pushed down to disengage the sliding part 14a. While keeping in place the sliding part 14a, the drum 10 is rotated again in order to reach the load/unload position.

**[0025]** The relative movement of the drum 10 vis a vis the sliding part 14a (now kept in the due position) causes the opening of the sliding part 14a and the positioning of the drum access, matching the opening of the external lid (not shown) of the washer (upper position).

**[0026]** Vice versa, when the washer must be loaded before the start of a washing cycle, the reverse sequence of operation must be completed.

**[0027]** First, the drum 10 rotates to close the sliding part 14a that is still kept in the same position. A specific upper profile 26 of the sliding part 14a (figure 7) drives the rotating flap 14b to slide below the sliding part 14a.

**[0028]** Once reached the closure angle, the drum is stopped.

**[0029]** The rotating flap 14b is released and the hooks 16 on it can go inside the slots 18 in the sliding part 14a.

**[0030]** The safety device 22 is released and thanks to a spring moves back to the safety position. The sliding part 14a is released and the washer is now ready to start with a new washing cycle.

**[0031]** To perform all of the above described operations, different solutions that involve electromechanical devices may be used.

**[0032]** The preferred one implies the use of a rotating member 30 with a complex cam shaft supported by the tub (T) and operated by a motor M. The rotating axis of the rotating member 30 is oriented substantially tangentially with reference to the wrapper 10a of the drum 10.

**[0033]** In this way the space dedicated to the rotating member is much smaller when compared to similar device of the prior art.

**[0034]** The motor M of the rotating member 30 is controlled in a way that the position is well determined at every relevant step of the correct opening sequence.

**[0035]** In figures 3a-3d there are shown different views the rotating member 30 with the cam set capable to manage the complex of operations necessary to open the drum 10. The cam 30b has an internal profile rather than an external one.

**[0036]** The starting position of the opening sequence (after the correct positioning of the drum) is shown in figures 1 and 4.

**[0037]** It is possible to notice that the flat sides of the cam set are facing the drum 10. Therefore there is neither interference nor engagement and the drum is free to rotate. In fact the drum just reached this position rotating freely.

**[0038]** The opening sequence is as follows:

**[0039]** The rotating member 30 starts to rotate and cam 30a pushes down the sliding part 14a and through it also

the swiveling flap 14b that is below. This limited rotation of the sliding part 14a is allowed since such part of the door 14 is configured to slide in side guides of side walls of the drum that have a predetermined width larger than the thickness of the sliding part 14a.

**[0040]** Continuing the rotation, the cam 30b of the rotating member 30 engages on its inside a protrusion 32 on the sliding part 14a. This will prevent further movement downwards. At the same time, it opens the safety device 22 (figure 5).

**[0041]** As the cam 30c starts to push down the rotating flap 14b to disengage it from the sliding part 14a, the safety device 22 is completely open and the sliding part 14a is kept in position (both horizontally and vertically) by the cam 30b (figure 6).

**[0042]** Now the drum can be rotated to the load/unload position. The cam 30b keeps firmly in position the sliding part 14a of the drum door 14 allowing the opening of the drum. Now the washer can be unloaded safely.

**[0043]** When a new washing cycle has to be started, the user loads the washer drum 10 that is in the open status. The drum 10 must be now closed again before starting any other operation of the washing machine. First, the motor rotates the drum in a direction that is the opposite of the opening direction. Before the rotating flap 14b touches the sliding part 14a, a couple of profiles 26 on the rotating flap 14b drives such flap to move down (towards the centre of the drum 10) in a way that allows the correct positioning of the hooks 16 right below the corresponding slots 18 and below the cam 30c (figure 7).

**[0044]** The flap 14b is now kept down by the cam 30c. In the following step the rotating member 30 rotates in the opposite direction than when opening, making the reverse series of operation. The cam 30c releases the flap 14b, allowing the engagement of the hooks 16, the cam 30b releases the sliding part 14a and the safety device 22, preventing any accidental opening and at last the cam 30a frees the sliding part 14b allowing the normal rotation of the drum so that the washing cycle can be started.

**[0045]** With reference to figures 8 and 9 a second embodiment of the invention is shown, in which a couple of linear actuators are used, driving a couple of rods, mounted in radial direction with reference to the drum.

**[0046]** Figures 8 and 9 show the structure of the solution with two linear actuators 50 which are supported by the tub T. Each actuator 50 comprises an electric motor which, by means of a gear, drives a plunger 50a or 50b. The plunger 50a is placed on a side of the cylindrical wall of the drum 10 and is passing in an opening provided in the sliding part 14a of the door 14. The plunger 50b is placed centrally with reference to said cylindrical wall, and is passing in another opening of the sliding part 14a. The construction of the actuators 50 is compact if compared to linear actuators of prior art.

**[0047]** The opening sequence, according to this solution is the following.

**[0048]** Once the drum is in the right position, the plung-

er 50b is operated and enters in the opening of the sliding part 14a of the door 14, in order to release the safety device. The plunger 50b continues its travel, pushing down the two parts of the door, i.e. the sliding part 14a and the rotating flap 14b. This extra run is necessary because (as in the case of the cams described with reference to the first embodiment) is the only way to allow the disengagement of the hooks 16 of the swiveling flap 14b from the slots 18 of the sliding part 14a.

**[0049]** Then the plunger 50a is sequentially operated and, passing through the respective hole in the sliding part, pushes down furthermore the swiveling flap 14b, disengaging the hooks 16. Then the drum 10 starts to rotate, while the rod 50b keeps in place the sliding part 14a preventing its rotation and causing the opening of the drum.

**[0050]** The plunger 50a (now useless) is then immediately moved up to allow the free rotation of the drum 10 until a specific recess is positioned exactly below it. Once

the drum reaches the position of the maximum opening, the motor of the washing machine is stopped and the plunger 50a is operated again. It reaches, passing through the hole of the sliding lid 14a, a recess in the drum structure (not shown) preventing any further rotation of the drum 10 and allowing the safe loading and / or unloading of the clothes. Once the loading of the washer is completed, in order to execute the washing cycle the drum 10 must be closed. First, the plunger 50a is lifted, disengaging the drum 10 and allowing its rotation.

The drum then starts to rotate in order to close the sliding door 14. The sliding part 14a of the door 14 is still kept in position by the plunger 50b. The plunger 50b keeps also open the safety device.

**[0051]** As the swiveling flap 14b reaches the sliding part 14a, thanks to the profiles on both of the sides of its leading edge is pushed below the sliding part 14a.

**[0052]** Since the plunger 50a is not in position to keep down the swiveling lid 14b, thanks to a couple of springs the swiveling lid, once reached the final position, is pushed up and allows its hooks 16 to engage the corresponding slots 18 on the sliding part 14a of the door 14. The plunger 50b is then lifted, releasing the safety device, allowing the safe closure of the drum 10 and allowing the execution of the washing cycle.

**[0053]** Advantages of such embodiment are the possibility to adjust for tolerances in the assembling by biasing the position of the plunger 50a, 50b with the control and the possibility to apply such solution on both belt driven and direct drive driving system for the drum rotation.

**[0054]** Moreover the actuators 50 are compact and are completely hidden, so they do not interfere with the tub and drum openings.

55

## Claims

1. A top-loading washing machine comprising a tub (T).

a perforated drum (10) rotatably mounted within said tub (T) about a horizontal axis and having an aperture (12) on its cylindrical side (10a), a drum door (14, 14a) slidably supported by the drum (10) for opening and closing said aperture (12) following a predetermined rotation of the drum (10), catching means (30, 50) supported by the tub (T) and configured to selectively engage said sliding door (14a) for opening and closing thereof, **characterized in that** said drum (10) comprises a flap (14b) hinged to an edge of said aperture (12) of the drum (10) and having first engaging portions (16) configured to cooperate with second engaging portions (18) of the sliding part (14a), said catching means (30, 50) being also configured to cooperate with said flap (14b) in order to free it from the sliding part (14a).

2. A washing machine according to claim 1, wherein the first engaging portions are shaped as hooks (16) whose ends are oriented toward the outside of the drum (10), said second engaging portions being shaped as slots (18) placed adjacent an edge of the sliding part (14a).

3. A washing machine according to claim 1 or 2, wherein in said catching means comprises a rotating member (30) with at least a cam surface (30a, 30b, 30c) configured to cooperate with said flap (14b) in order to rotate it and disengage said first engaging portions (16) from said second engaging portions (18).

4. A washing machine according to any of the preceding claims, wherein the rotating member (30) presents a first cam surface (30a, 30c) configured to cooperate with the flap (14b) for driving its rotation towards the inside of the drum (10) and a second cam surface (30b) configured to cooperate with a corresponding portion (32) of the sliding door (14a) for keeping it in a fixed position during opening and closing of the door (14, 14a, 14b).

5. A washing machine according to claim 4, wherein the second cam surface (30b) is configured to drive a safety latch (22) of the drum door (14, 14a, 14b).

6. A washing machine according to claim 1 or 2, wherein in said catching means comprises at least one linear actuator (50, 50a, 50b) configured to act on the flap (14b) for rotating it and to cooperate with an aperture in the sliding part (14a) for keeping it in a predetermined position during the opening of the drum door (14, 14a).

7. A washing machine according to claim 6, wherein it comprises two linear actuators (50a, 50b), one of them (50b) configured to cooperate with a safety latch (22) of the drum door (14, 14a, 14b) and to keep the sliding part (14a) in a predetermined position during the opening sequence of the door, the second (50a) being configured to allow a disengagement between the sliding part (14a) and the rotating flap (14b).

8. A washing machine according to claim 6 or 7, wherein in each actuator (50) comprises an electric motor driving a gear for moving the plunger (50a, 50b).

9. A washing machine according to any of the preceding claims, wherein the flap (14b) can assume a first position in which it is substantially flush with the drum (10, 10a) and a second position in which it is rotated towards the inside of the drum (10).

10. A washing machine according to any of the preceding claims, wherein the flap (14b) presents, on its surface facing outside the drum (10), at least a cam profile (26) configured to cooperate with the sliding door (14a) during its closing movement in order to partially go under such sliding door (14a).

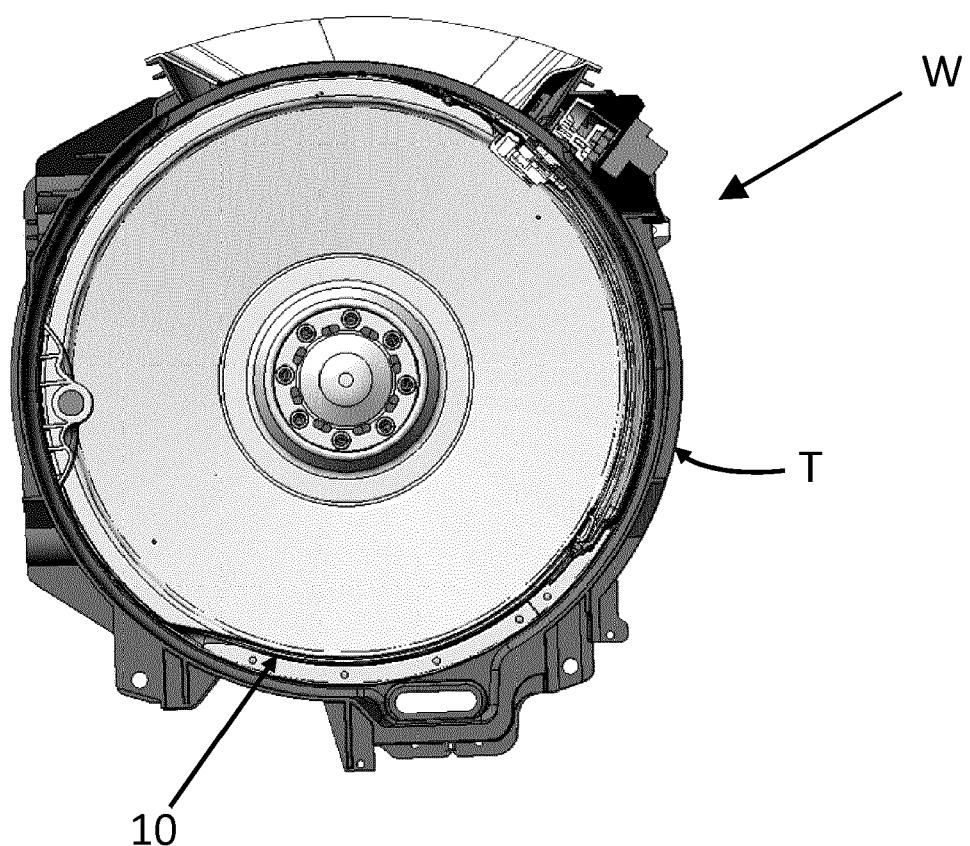


Fig. 1a

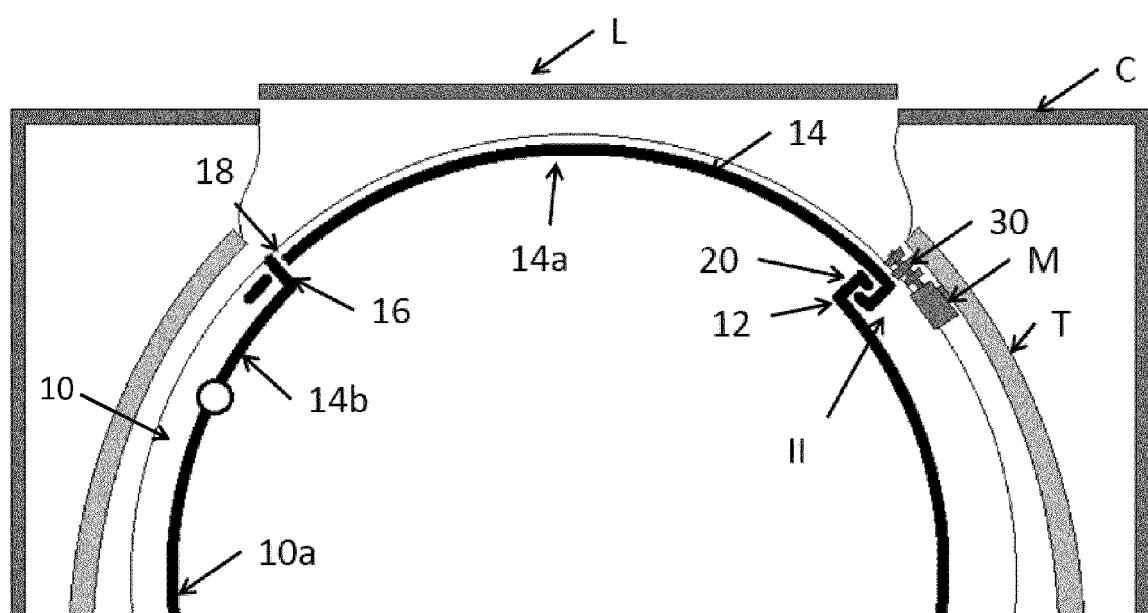


Fig. 1b

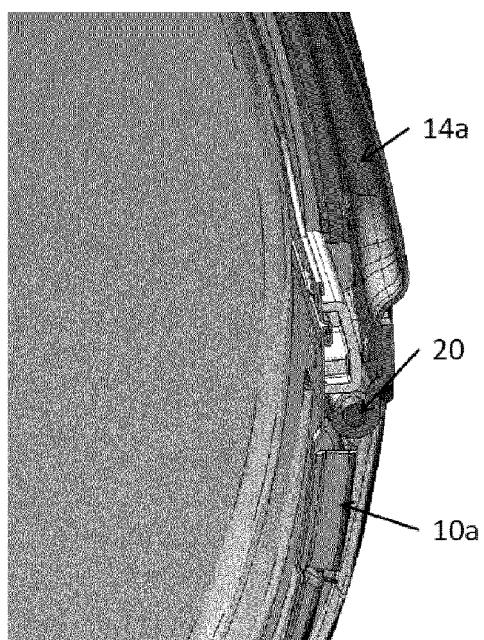


Fig.2a

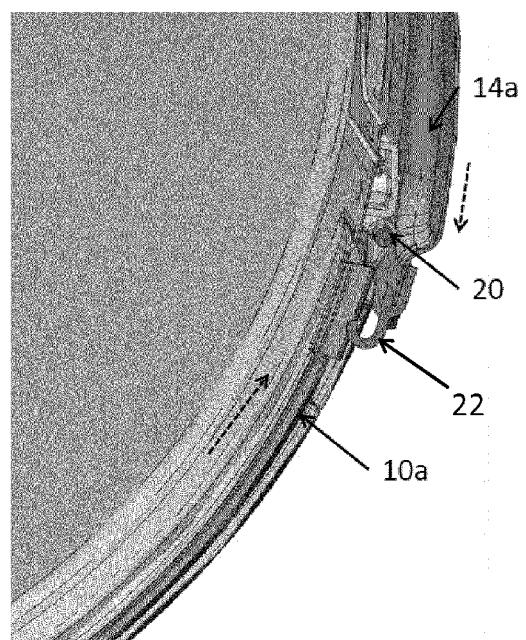
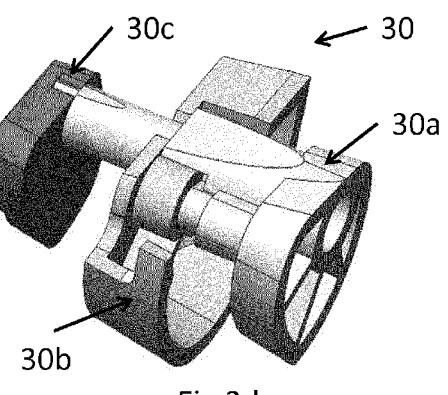
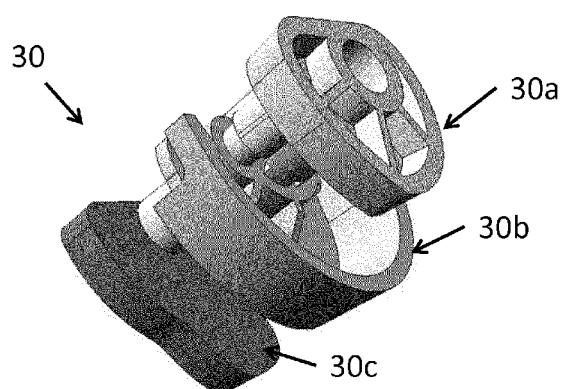
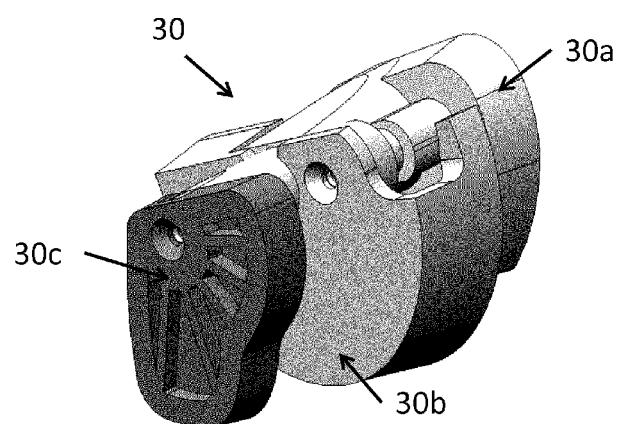
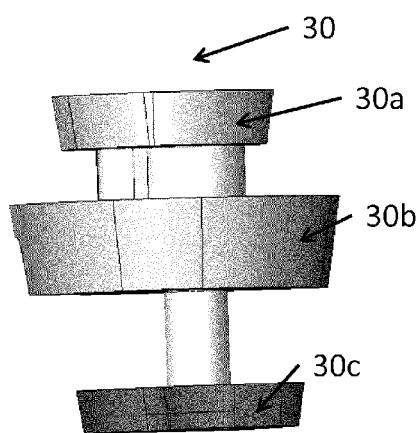


Fig.2b



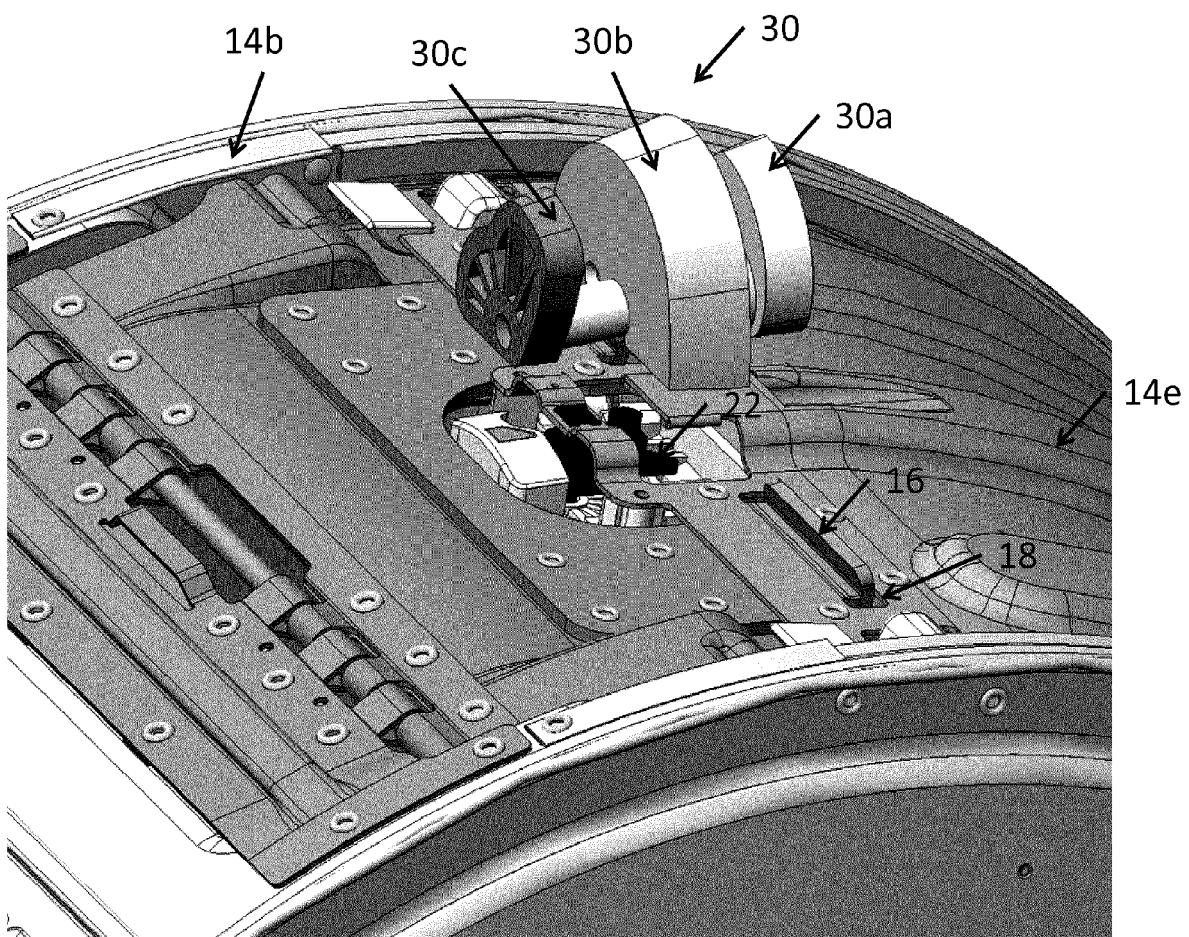
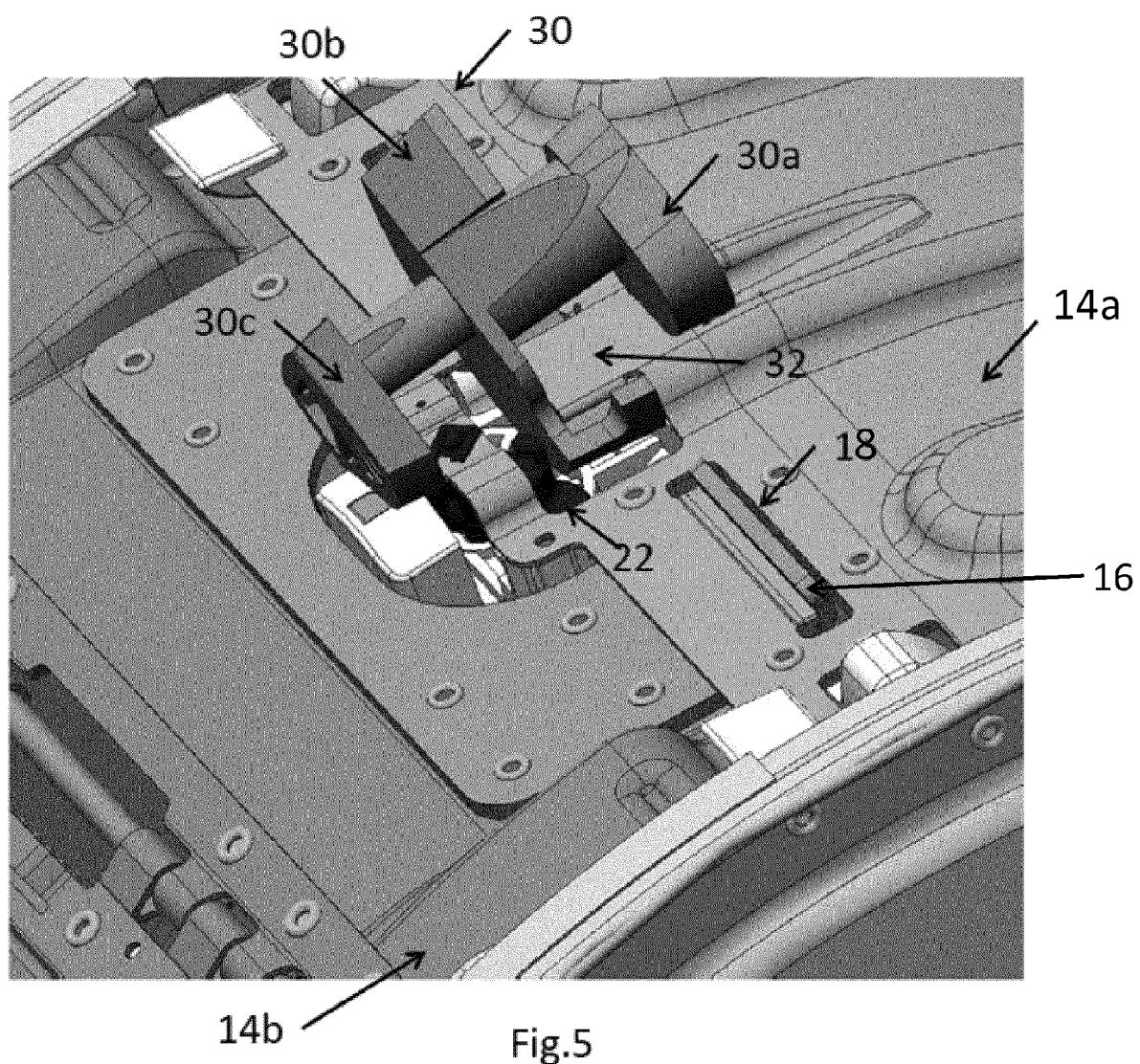


Fig.4



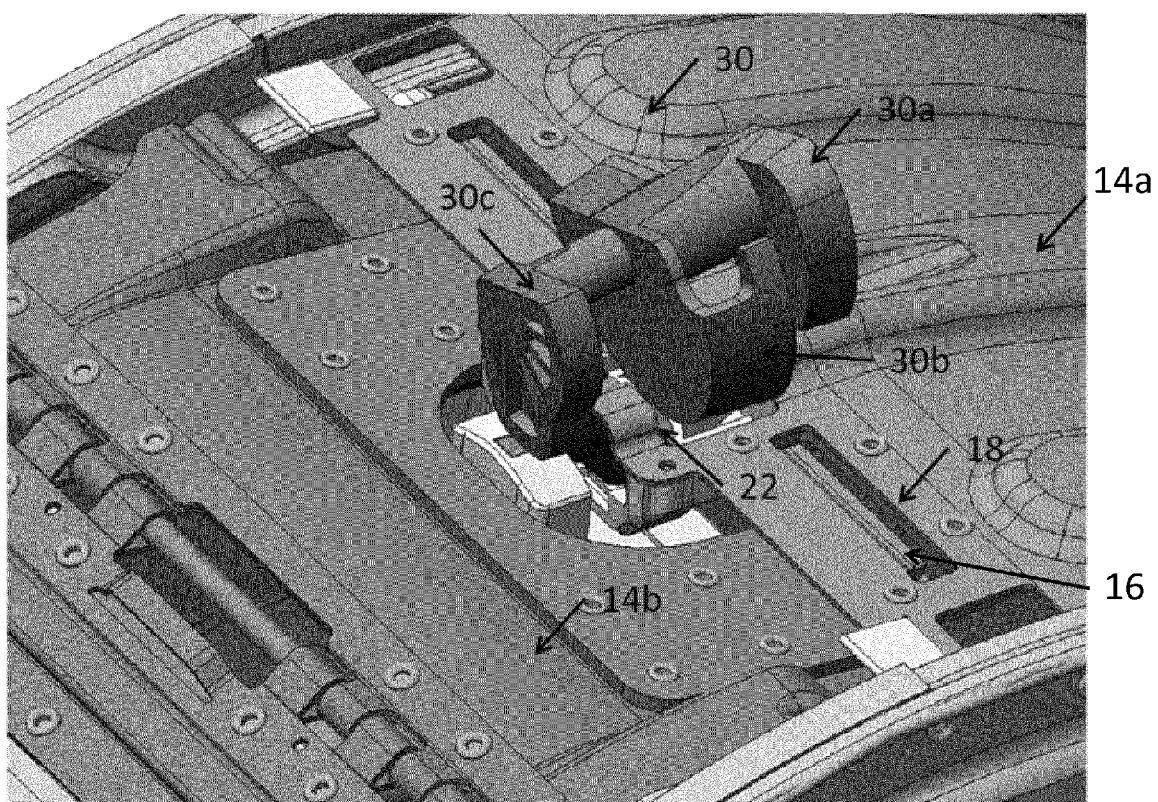


Fig.6

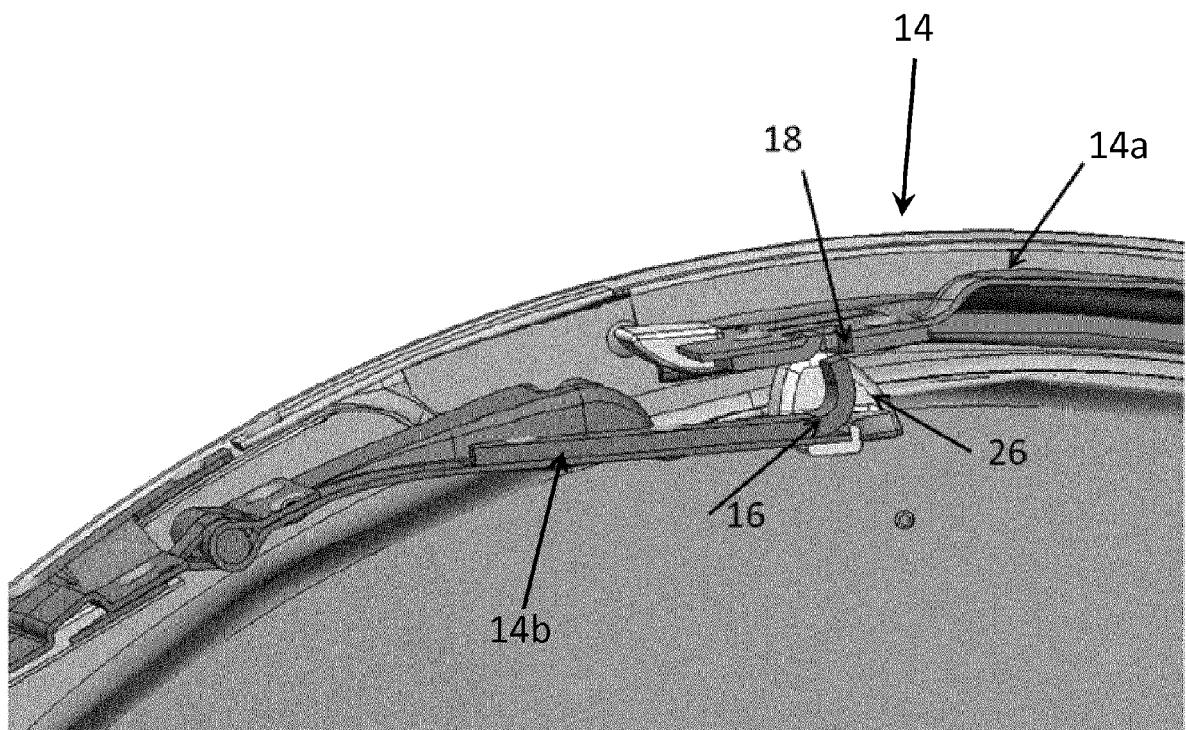


Fig.7

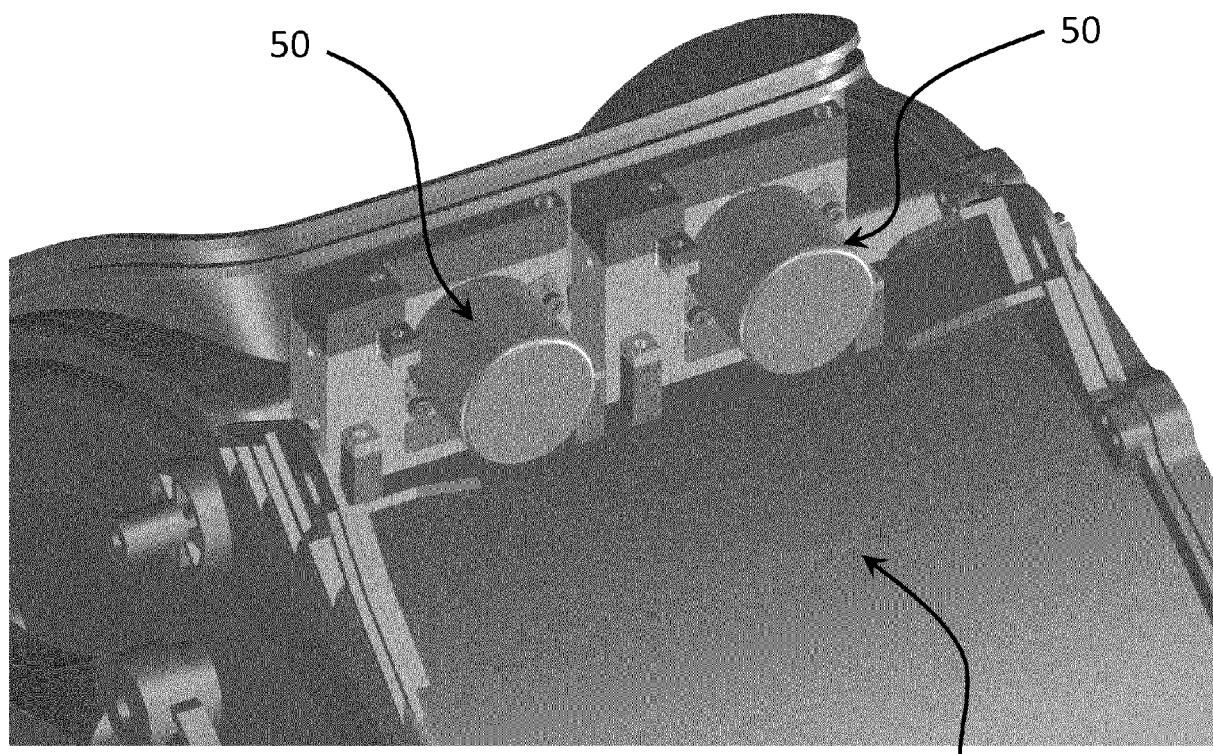


Fig. 8

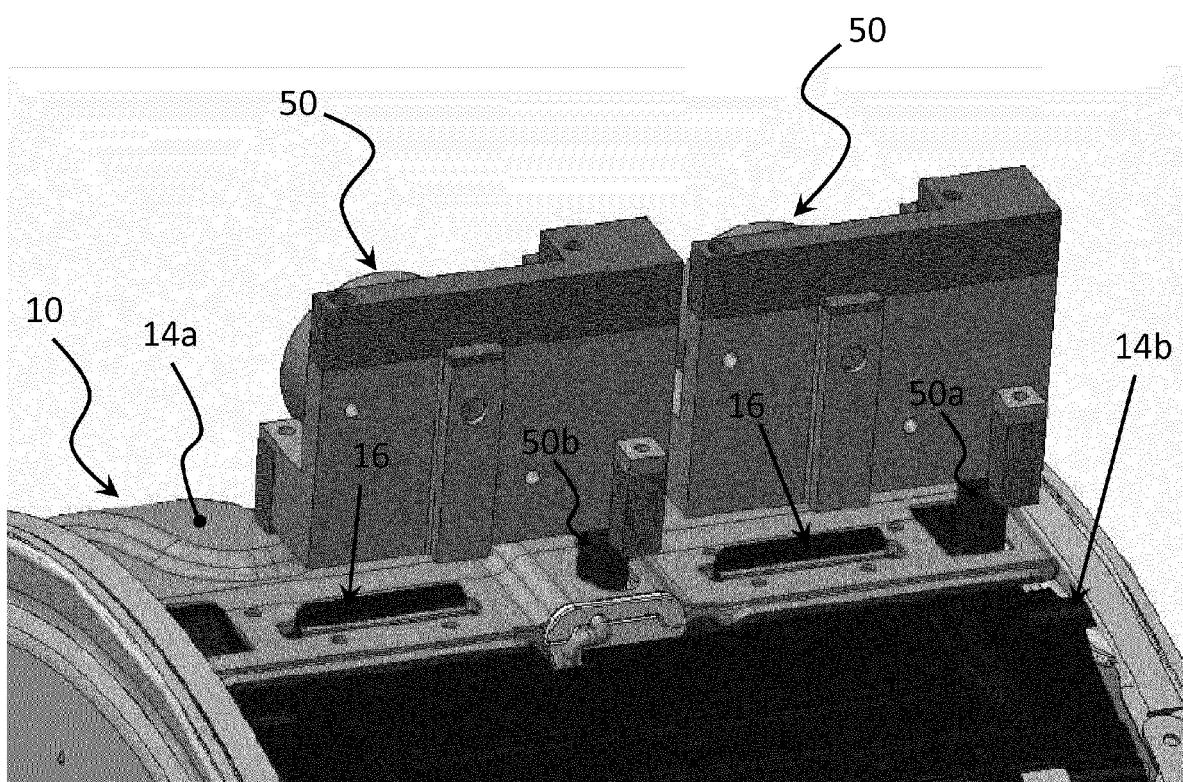


Fig. 9



## EUROPEAN SEARCH REPORT

Application Number

EP 15 17 4403

5

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
10 X	EP 0 048 643 A1 (THOMSON BRANDT [FR]) 31 March 1982 (1982-03-31) * the whole document *	1,9,10	INV. D06F37/10
15 Y	US 5 437 168 A (MASON ANTHONY [US] ET AL) 1 August 1995 (1995-08-01) * abstract; figures *	2-6,8 -----	2-5
20 Y	JP H01 317488 A (MITSUBISHI ELECTRIC CORP) 22 December 1989 (1989-12-22) * abstract; figures *	6,8 -----	
25 X	EP 1 548 170 A1 (BRANDT IND [FR]) 29 June 2005 (2005-06-29) * abstract *	1,2,9,10 -----	
30 A	US 2007/227199 A1 (KIM JIN WOONG [KR] ET AL) 4 October 2007 (2007-10-04) * the whole document *	1-10 -----	TECHNICAL FIELDS SEARCHED (IPC)
35 A	US 2003/061841 A1 (NAKAMURA SATOSHI [JP] ET AL) 3 April 2003 (2003-04-03) * the whole document *	1-10 -----	D06F
40 A	EP 1 696 068 A1 (TOSHIBA KK [JP]; TOSHIBA CONSUMER MARKETING [JP]; TOSHIBA HA PRODUCTS) 30 August 2006 (2006-08-30) * the whole document *	1-10 -----	
45			
50 3	The present search report has been drawn up for all claims		
55	Place of search Munich	Date of completion of the search 18 September 2015	Examiner Prosig, Christina
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			
T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... & : member of the same patent family, corresponding document			

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

EP 15 17 4403

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

18-09-2015

10	Patent document cited in search report	Publication date		Patent family member(s)	Publication date
15	EP 0048643	A1	31-03-1982	EP 0048643 A1 ES 8206697 A1 FR 2490689 A1	31-03-1982 16-11-1982 26-03-1982
20	US 5437168	A	01-08-1995	AU 682095 B2 AU 1778895 A CA 2148147 A1 CN 1128310 A DE 69518108 D1 DE 69518108 T2 EP 0681051 A2 NZ 272035 A TW 288068 B US 5437168 A	18-09-1997 09-11-1995 03-11-1995 07-08-1996 31-08-2000 14-12-2000 08-11-1995 26-05-1997 11-10-1996 01-08-1995
25	JP H01317488	A	22-12-1989	JP H01317488 A JP H07100104 B2	22-12-1989 01-11-1995
30	EP 1548170	A1	29-06-2005	AT 544896 T EP 1548170 A1 ES 2379550 T3 FR 2864114 A1 PL 1548170 T3	15-02-2012 29-06-2005 27-04-2012 24-06-2005 31-07-2012
35	US 2007227199	A1	04-10-2007	CN 101046045 A EP 1842951 A2 KR 100762143 B1 US 2007227199 A1	03-10-2007 10-10-2007 02-10-2007 04-10-2007
40	US 2003061841	A1	03-04-2003	NONE	
45	EP 1696068	A1	30-08-2006	CN 1886545 A EP 1696068 A1 JP 3776908 B2 JP 2005160511 A TW I242618 B WO 2005052242 A1	27-12-2006 30-08-2006 24-05-2006 23-06-2005 01-11-2005 09-06-2005
50					
55					

**REFERENCES CITED IN THE DESCRIPTION**

*This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.*

**Patent documents cited in the description**

- FR 2751669 A [0002]
- DE 10316696 A [0002]