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(54) Low-noise household clothes drying machine

(57) Clothes drying machine comprising:

- a rotating drum including two cylindrical half-shells joined to each other via an intermediate insulating separation member,
- a pair of electric sliding brushes, each one of which arranged in contact with a respective one of said half-shells,

in which at least one of said electric brushes comprises a solid electric-contact member articulated with the structure of said clothes drying machine by means of three distinct arms, of which a first arm is firmly joined to the solid member, a second arm is connected between said first arm and a third arm (7), the latter being linked in a firmly joined manner to the structure of the machine. The second arm is rotatably connected to the first arm and the third arm by means of two respective parallel pins, an elastic member pressing an extremity of the first arm against one of the half-shells of the drum being provided between said second arm and said third arm.

Preferably, said solid electric-contact member has at least an edge, which forms the contact surface against the respective half-shell, and which is oriented in the same direction as the relative motion of the instantaneous contact surface.

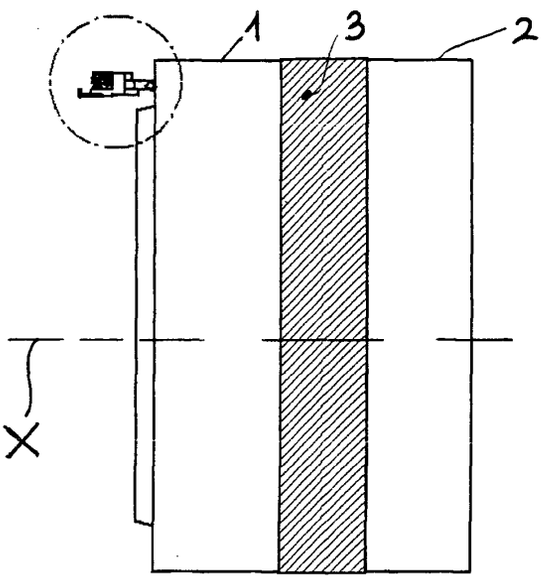

FIG. 1

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Description

[0001] The present invention refers to an improved kind of clothes drying machine, preferably of the type for use in households, which is particularly quiet in its operation.

[0002] Largely known in the art is the general requirement for the noise generated by household appliances in their operation to be reduced as much as possible; also largely known in the art is the fact that in clothes washing machines use is largely made of the measurement of the residual moisture in the clothes in order to correspondingly control the operating programme of the machine in an adequate manner, in particular in order to be able to calculate in advance the moment at which the drying process must be concluded, and the related cycle terminated, so as to obtain the desired result.

[0003] A number of systems are known and used to so measure the moisture content remaining in the clothes, and therefore to so detect the degree of dryness reached by the same clothes, these systems being based substantially on two concepts, i.e. the measurement of temperature and the measurement of conductivity.

[0004] In the following description, reference will be made to clothes drying machines that are provided with means for controlling the dryness degree of the clothes based on the conductivity measurement concept.

[0005] These control means are rather accurate in their operation. As hinted above, they are based on the measurement of the conductivity of the clothes, which is known to normally vary in accordance with the moisture content of the same clothes.

[0006] On the other hand, these systems call for the use of rather sophisticated control devices; furthermore, as this is described for instance in EP 0106283, the clothes drying machine must be equipped with a metal rotating drum comprised of two half-shells separated from each other by a ring-shaped insulating member.

[0007] There are also clothes drying machines on the market, which are provided actually with a single-piece rotating drum, but are equipped with internal devices for the detection of the conductivity of the clothes, and are anyway provided with at least an outer brush applied onto a circular planar base of the drum; in this case, these drums may also be nonconductive, provided of course that the instantaneous contact surfaces thereof, i.e. the surfaces thereof that are in contact with the brushes, are conductive.

[0008] According to the prior-art, the concept is that the varying moisture content in the clothes being dried affects the conductivity thereof, so that the actual dryness degree of the clothes can be detected by measuring the conductivity being detectable between said two electrically isolated half-shells, which form the drum and in this way become the "terminals" of a series circuit, in which the element to be measured is exactly constituted by the clothes in contact with both said half-shells.

[0009] In order to be able to perform such measurement on said two rotating half-shells of the drum, the practice is known of having said two half-shells made of metal and a pair of so-called metal and, therefore, electrically conductive "brushes" arranged in an appropriate position in contact therewith, each one of said brushes being provided so as to maintain a fixed position relative to the structure of the machine, and being further pressed against the respective half-shell in such a manner as to establish a continuous electric contact therewith, especially when said half-shells are rotating.

[0010] Said brushes are in turn connected independently to control means of an appropriate kind, which according to generally known methods are capable of detecting the conductivity measured between such brushes and letting the operating cycle of the machine be performed and controlled in accordance with the detected value of such conductivity.

[0011] However, during its rotation, the drum must rub against said brushes and, owing to the latter being made in the shape of small cylinders or prisms of a conductive material, with the longer sides thereof arranged in a substantially orthogonal manner relative to the rotating surface of the respective half-shell, by so moving relative to and against each other, said surfaces generate a peculiar sliding noise (of the kind generally perceived when writing on a blackboard with a piece of chalk), which proves to be even more annoying owing to its being continuous throughout the drying cycle, which the machine may take even hours to bring to completion.

[0012] In addition, the fact that the contact surface of said brushes is rather limited and, above all, the fact that said brushes are so arranged as being oriented "head-on" relative to the surface of the drum, practically cause each even quite slight unevenness or irregularity in the contact zone to in turn cause the brush to undergo a kind of micro-leap, thereby leading to a temporary loss of electric contact with unfavourable consequences as far as a correct operation of the machine is concerned.

[0013] A further drawback of prior-art solutions is encountered when, owing to a contact member being pressed "head-on" against the rotating surface, and this contact member being usually fitted in a seat that is orthogonal to the contact surface, it can be noticed that there takes place a kind of dragging effect of said contact by the surface of the drum, which leads to an anomalous, asymmetrical wear-out of the parts concerned. Furthermore, owing to the clearances of said contact member within the seat in which it is accommodated, the same contact member is oriented in a definite direction with the relative motion of the drum taking place in a given direction; when the direction of said motion changes, the contact is caused to undergo a jolt, i.e. to leap, and for a certain period of time it follows the motion of the drum without rubbing thereagainst, thereby giving rise to obvious drawbacks; moreover, owing to the different orientation it offers a contact surface that is different from the just quitted one, this practically meaning

a typical additional noise resulting as a consequence thereof.

[0014] It would therefore be desirable, and it is actually a main purpose of the present invention, to provide a clothes drying machine operating according to the control principle based on the measurement of the conductivity, which is provided with at least a brush arranged upon an appropriate rotating half-shell, and which however does not show the afore-noted drawback of an excessive noise being generated.

[0015] Furthermore, such clothes drying machine must be able to be easily manufactured using existing, readily available materials and techniques, and be competitive in its construction; it shall in particular be able to be implemented with a minimum extent of modifications having to be introduced in currently produced clothes drying machine designs; it shall in addition be able to incorporate all these modifications and improvements without suffering any alteration or reduction in the performance abilities and the reliability thereof.

[0016] According to the present invention, these aims are reached in a clothes drying machine incorporating such operating and control means as described below by mere way of non-limiting example with reference to the accompanying drawings, in which:

- Figures 1 and 1A are a side view of a drum with a brush according to the present invention and an enlarged view of a detail thereof, respectively;

- Figures 2 and 2A are again a side view, from a position turned by a right angle with respect to the view appearing in Figure 1, of a drum with a brush according to the present invention and an enlarged view of a detail thereof, respectively;

- Figures 3 and 3A are a front view of a drum with a brush according to the present invention and an enlarged view of a detail thereof, respectively, according to an improved embodiment thereof;

- Figures 4 and 4A are a perspective view of a drum with a brush according to the present invention and an enlarged view of a detail thereof, respectively, according to an improved embodiment thereof;

- Figures 5 and 5A and Figure 6 are three respective orthogonal views of the brush according to the present invention, as illustrated individually;

- Figure 7 is a perspective view of the brush shown in the preceding Figures, as illustrated individually.

[0017] With reference to the above-listed Figures, a clothes drying machine according to the present invention comprises a drying drum comprised of two distinct substantially cylindrical half-shells 1, 2 made of metal and joined to each other on the side of a mutually facing base thereof.

[0018] The above-cited half-shells are joined to each other via an electrically insulating annular separating member 3 disposed therebetween, so that said half-shells are practically isolated from each other.

[0019] Each one of said half-shells is associated to a respective brush comprising:

- a solid conductive member 4,

- an articulation including a first arm 5 firmly joined to said solid member, a second arm 6 and a third arm 7, in which said second arm 6 is rotatably connected by means of a joint or a hinge to appropriate points of said first arm 5 and said third arm 7 with the use of hinging or similar pins 5A and 7A, respectively. In addition, said third arm 7 is secured in a firmly joined manner to an appropriate portion of the structure of the machine (not shown).

[0020] As illustrated in Figures 1A, 2A and 3A, the above-mentioned brush is made and provided in such a manner that, when it is applied to the respective half-shell, the related articulation enables both the sliding solid conductive member 4 to adapt to the surface of the half-shell 1, on which it is able to slide in a much more effective and quiet manner as compared with prior-art sliding contacts.

[0021] To this purpose, following measures must be taken and following construction improvements musty be introduced.

[0022] A first improvement consists in that the two axes Y and Z of the first pin 5A and the second pin 7A, respectively, are parallel not only to each other, but also to the instantaneous contact surface 10 (illustrated symbolically in Figures 2A and 4A), between a half-shell 1 and the respective sliding solid conductive member 4.

[0023] A second improvement relates to the geometry of said first arm 5. This arm is in fact provided in such a manner that, as this is illustrated in Figure 2A, the vector of the force F acting on said first arm 5, and exerted by the second arm 6 towards the instantaneous contact surface 10, lies inside the two extremities 12, 13 of the sliding solid conductive member 4 with respect to the relative sliding direction H thereof; in a more general way, the vector of said force F must intercept the instantaneous contact surface 10 in a position inside the half space delimited by the two parallel planes A, B passing through said two extremities 12, 13 and extending orthogonally to said relative sliding direction H.

[0024] A third improvement consists in providing said second arm 6 and said third arm 7 with an elastic member 14 so that said first pin 5A is constantly biased towards and against the contact surface, thereby pushing said sliding solid contact member 4 in the same direction.

[0025] Owing to the third arm being anchored to the structure of the machine, the aggregate effect of the

above-described improvements enables a considerable amplitude to be obtained as far as the capability of movement of the sliding contact member 4 orthogonally to the instantaneous contact surface 10 is concerned, the sliding contact member 4 itself being in this way enabled to very well adapt to and cater for any possible irregularity or unevenness of said surface. Furthermore, the pressure being so exerted turns out as being significantly constant, thanks also to the considerable capability of said second arm to oscillate.

[0026] A fourth improvement lies in the fact that said brush is not applied to the outer cylindrical surface of the half-shell, actually, but rather to a planar wall 14 constituting a base therefore and extending orthogonally to the axis of rotation X of the same half-shell, as shown in Figures 4 and 7.

[0027] In this way, on said planar wall there may be identified an annular surface 16, as this is shown in Figure 7, which is progressively exposed to the contact and, therefore, the sliding movement of said brush.

[0028] This solution enables the amplitude of displacement of the second arm 6 to be minimized and, at the same time, the assembly work to be facilitated, owing to the fact that said planar wall is much more accessible and even, as well as far less oscillating than the cylindrical surface of the half-shells.

[0029] A further improvement can be obtained by minimizing the contact or sliding surface, however without thereby impairing the reliability and constancy of the contact. This is achieved by shaping said sliding member 4 in such a manner as to provide it with at least an edge 15, and by orienting said edge in such a manner as to enable it to act as the sole sliding contact surface of said brush. However, for said sliding contact surface to be minimized also on the half-shell side, it is highly preferable that said edge be oriented in a substantially orthogonal manner with respect to said two pins 5A, 7A, so that the relative tangential velocity of the shell at an intermediate point of the sliding solid member 4 is parallel to the edge in contact therewith.

[0030] It will of course be appreciated that the above-described solution has been illustrated as an example of possible embodiments of the present invention, and that the same solution may therefore be applied to both the brushes of a drum comprised of two half-shells and the brushes of a drum that is substantially comprised of a single shell, which may even be nonconductive.

Claims

1. Clothes drying machine comprising:

- a rotating drum for holding and drying the clothes to be dried, possibly comprised of two half-shells (1, 2),
- external means adapted to circulate a controlled flow of heated-up air within and through said drum,
- means adapted to rotatably drive said drum in a pre-established manner about an axis of rotation (X) coinciding with the axes of said two half-shells,
- a pair of electric sliding-contact brushes, each one of which being arranged in contact with a respective portion of said drum,
- said clothes drying machine being adapted to carry out a pre-established sequence of operating phases comprising at least a drying phase,

characterized in that at least one of said electric brushes comprises a solid electric-contact member (4) articulated with the structure of said clothes drying machine by means of at least three distinct arms (5, 6, 7), of which a first arm (5) is firmly joined to said solid member, a second arm (6) is connected between said first arm and a third arm (7), the latter being firmly joined to the structure of the machine.

2. Clothes drying machine according to claim 1, **characterized in that** said second arm (6) is rotatably connected to said first arm and said third arm by means of two respective pins or hinges (5A, 7A).

3. Clothes drying machine according to claim 2, **characterized in that** said two pins are provided with respective axes (Y, Z) extending parallel to each other, as well as to the instantaneous electric-contact surface (10) of said solid member (4).

4. Clothes drying machine according to any of the preceding claims, **characterized in that** the contact surface of said drum, or a portion thereof, is a ring-shaped surface (16) arranged on a planar base and extending orthogonally to the axis of rotation thereof.

5. Clothes drying machine according to claim 2 or 3, **characterized in that** between said second arm and said third arm there is provided an elastic member (14) adapted to bias against said contact surface the extremity of said first arm that is hinged on said second arm.

6. Clothes drying machine according to any of the preceding claims or combination thereof, **characterized in that** said solid electric-contact member (4) has at least an edge (15), and that said edge forms the zone being in contact with the respective half-shell (1).

7. Clothes drying machine according to claim 6, **characterized in that** said edge is oriented orthogonally relative to said two pins (5A, 7A), so that said edge (15) is parallel to the tangential velocity of the drum

in the instantaneous contact surface.

8. Clothes drying machine according to any of the preceding claims or combination thereof, **characterized in that** the vector of the force (F) acting on said pin (5A), which is provided between said first arm and said second arm, intercepts said instantaneous contact surface (10) at a point inside the half space delimited by the two parallel planes (A, B) passing through the two opposite extremities (12, 13) of said solid member and extending orthogonally to said instantaneous contact surface.

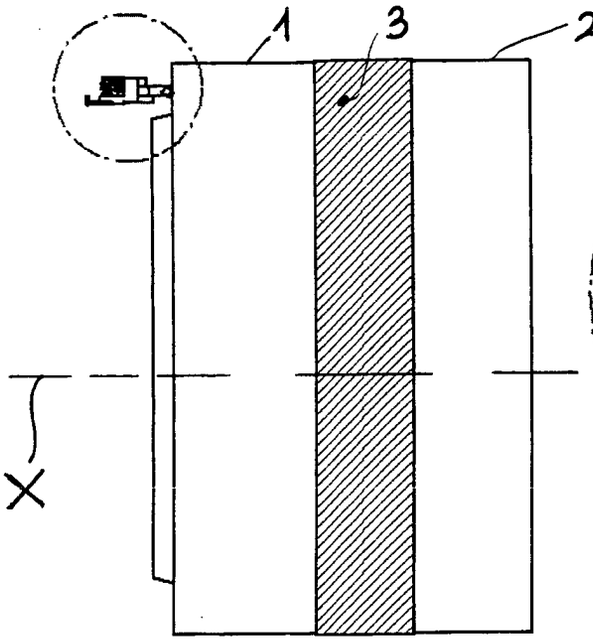

FIG. 1

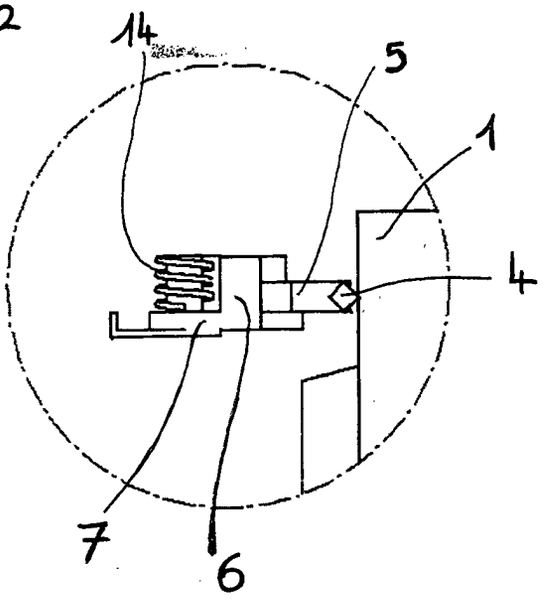

FIG. 1A

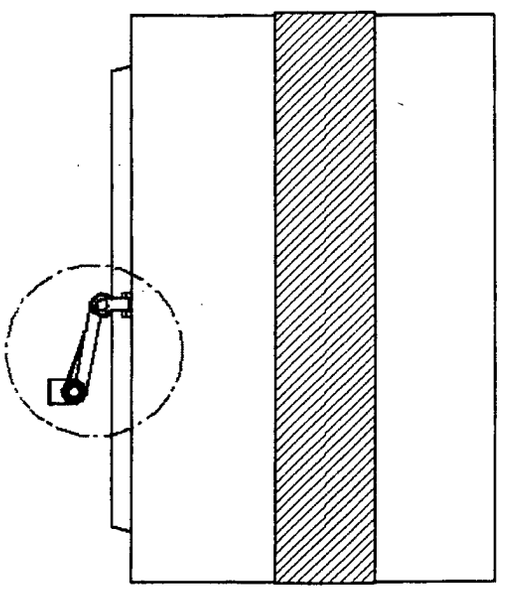

FIG. 2

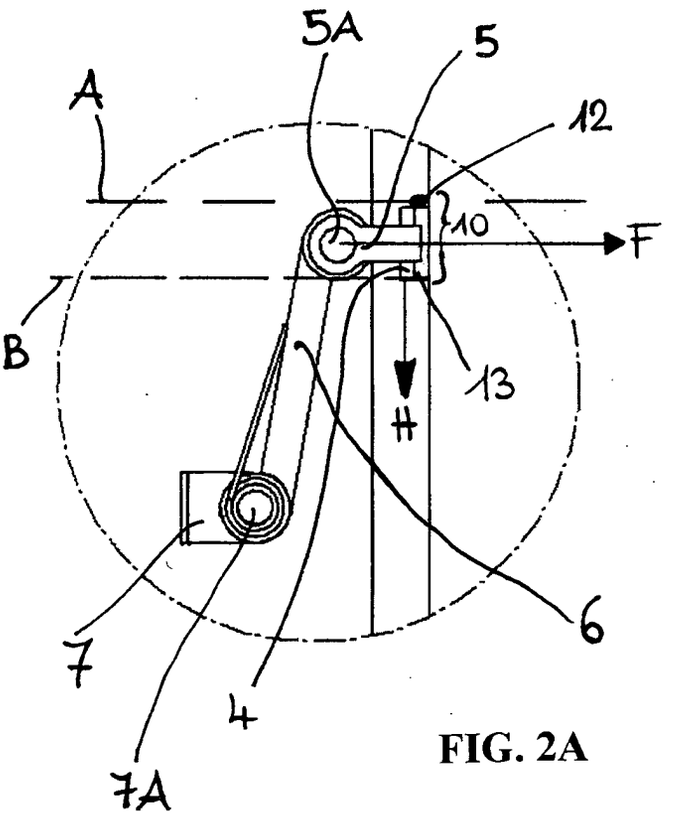

FIG. 2A

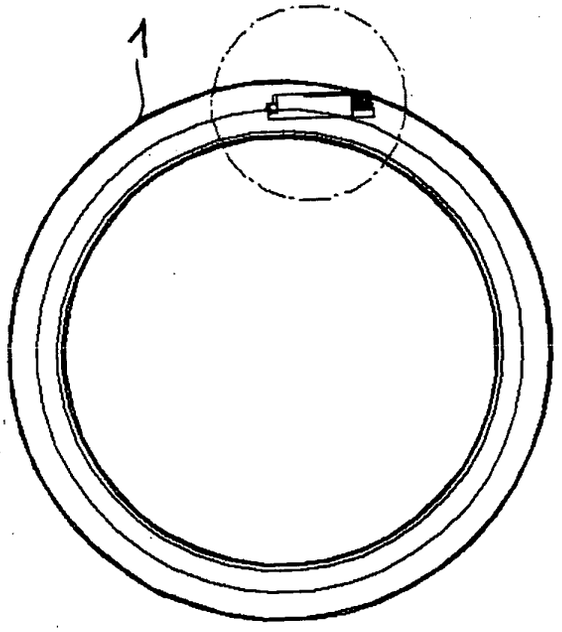

FIG. 3

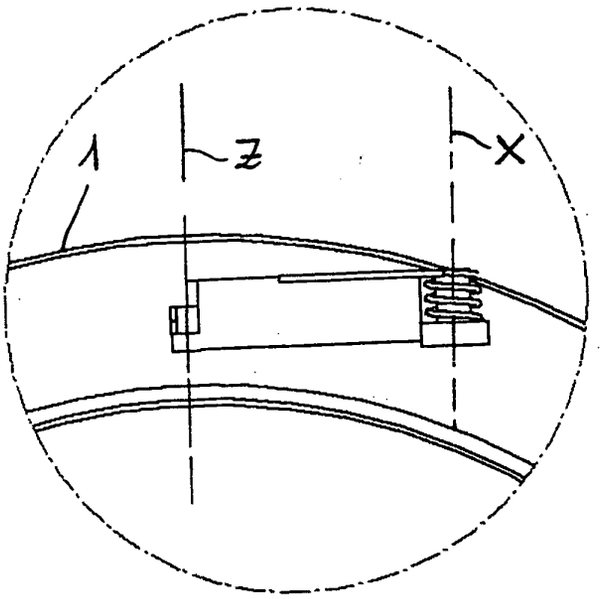

FIG. 3A

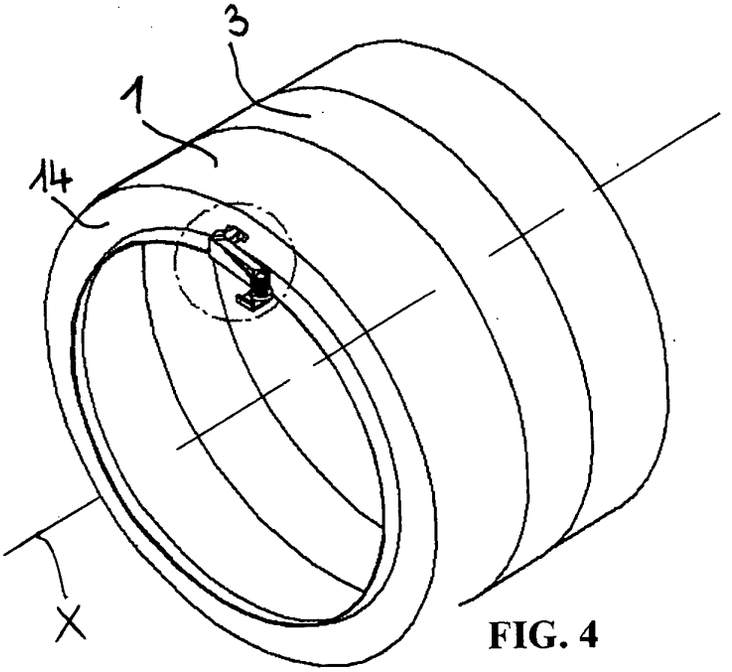

FIG. 4

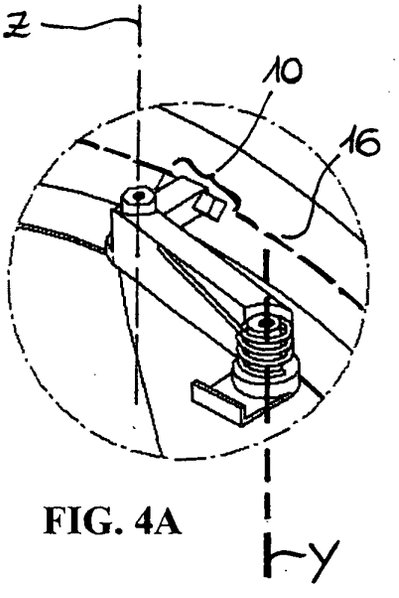

FIG. 4A

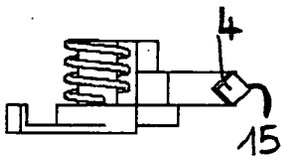

FIG. 5

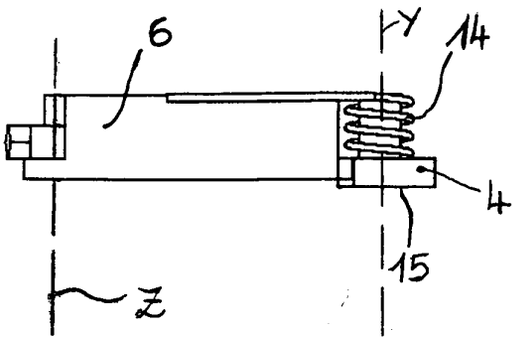

FIG. 5A

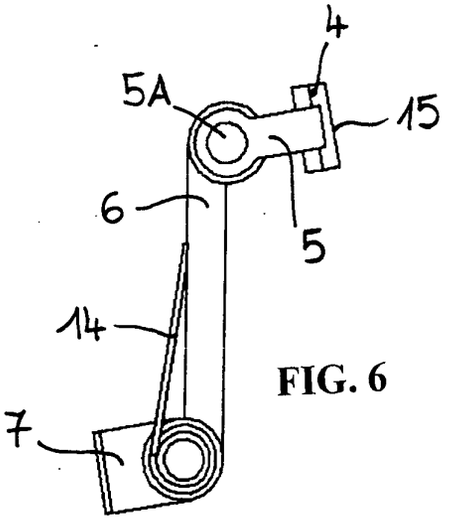

FIG. 6

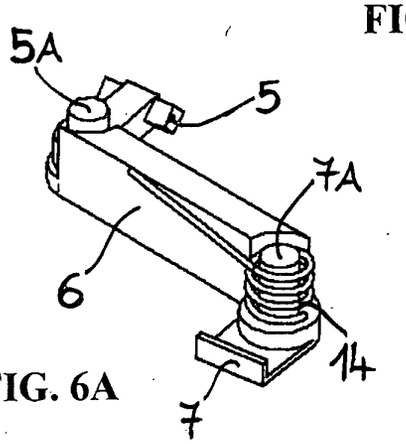

FIG. 6A

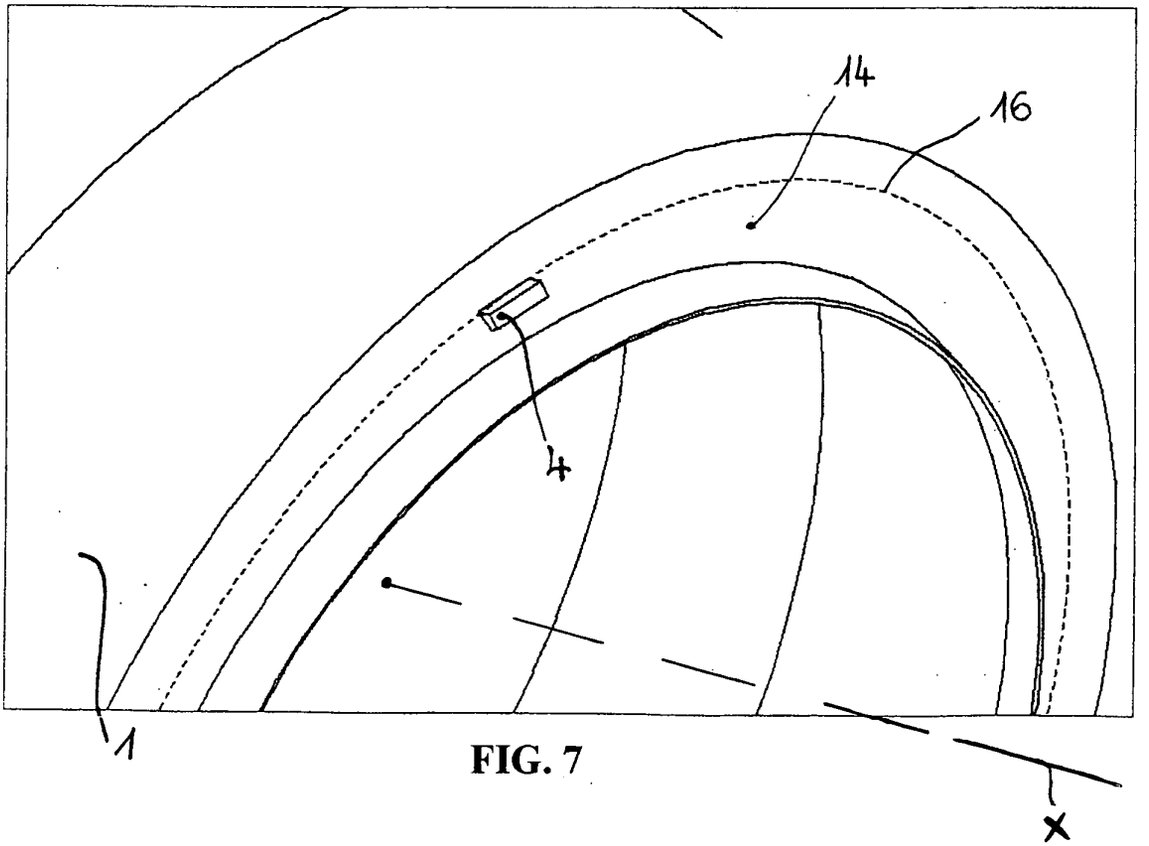

FIG. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 03 02 7525

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	DE 44 37 635 A (MIELE & CIE) 25 April 1996 (1996-04-25) * page 4; figure 4 *	1-8	D06F58/28
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A	EP 0 351 608 A (ZANUSSI A SPA INDUSTRIE) 24 January 1990 (1990-01-24) * the whole document *	1-8	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

D06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	5 May 2004	Spitzer, B

CATEGORY OF CITED DOCUMENTS

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