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(54) **Drying machine**

(57) A drying machine comprising an electric circuit for determining the resistance and/or conductivity of the laundry (2) contained in a rotating drum (3), the electric circuit comprising at least one electrode (4) adapted to contact the laundry (2), a conductive contact member (5) electrically connected to the electrode (4) and extending around an external annular surface (6) of the drum (3), a sliding contact (7) adapted to slide along the conductive contact member (5) in constant galvanic connection therewith when the drum (3) is rotating, the conductive contact member (5) and the electrode (4) being electrically insulated from the drum (4), and a control unit (8) that is electrically connected between the sliding contact (7) and the drum (3) for measuring an electrical quantity depending on the residual moisture content in the laundry (3); an electrically insulating adhesive layer (9) is provided between the external annular surface (6) of the drum (3) and said conductive contact member (5) to secure the member (5) to the drum (3).

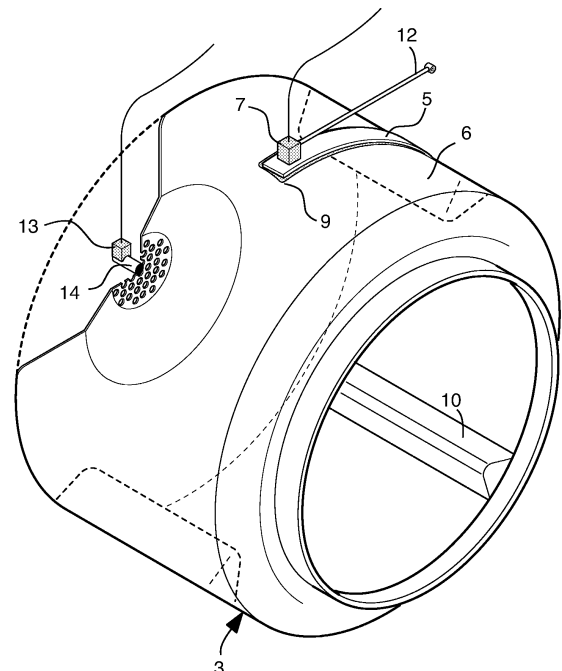


FIG 3

Description

[0001] The present invention refers to a clothes drying machine.

[0002] In a laundry dryer a very important feature is the ability to appropriately measure the degree of dryness of the clothes in order to adjust the duration of the drying cycle accordingly. To this purpose, a laundry dryer is generally provided with an electric circuit adapted to measure the residual moisture content in the clothes based on such parameter as the electric conductivity or resistance. Such circuit provided to carry out these moisture measurements generally comprises an electrically conductive contact strip supported on the annular wall of the dryer drum. The strip is electrically insulated from the drum by an electrically non-conductive pad bonded to the drum and interposed between the strip and the drum. On the other hand, the strip itself is electrically connected to the internal region of the drum, i.e. the region where the clothes to be dried are placed, via the clothes rising ribs, or lifters, disposed on the internal surface of the cylindrical wall of the drum. A scanning arm carrying a brush is mounted on the machine casing such that the brush is able to engage the conductive strip. The brush itself is electrically connected to a control unit, which is also in contact with an electric terminal in electrical communication with said internal region of the drum. When an electric current is supplied to the circuit, this can therefore flow through the wet clothes being dried and the control unit can calculate the resistance and/or the conductivity of said clothes, thereby determining the appropriate duration of the drying cycle being performed.

[0003] A major drawback of the above-cited prior-art solution is in connection with the fact that the contact strip is attached to the outer surface of the cylindrical wall of the drum with the use of fastening means that engage both apertures provided in the same strip and receptacles provided through the cylindrical wall of the drum. This of course implies an additional machining or metal-forming operation to be performed not only on the contact strip in view of providing such apertures, but also - and above all - on the wall of the drum in view of providing it with the receptacles adapted to receive the fastening means.

[0004] Moreover, in view of ensuring the required electrical insulation between the drum and the contact strip, non-conductive members - usually made of rubber or plastics - are interposed between the receptacles in the wall of the drum and the fastening means received therein, while a plastic band is positioned between the outer surface of the wall of the drum and the contact strip.

[0005] It can therefore be most readily appreciated that attaching the contact strip to the drum actually requires the drum in its whole to undergo additional processing aimed at forming the receptacles intended to receive the fastening means, as well as a sequence of time-consuming operations aimed at insulating the contact strip from the drum in an appropriately effective manner.

[0006] Mounting said contact strip on the drum turns

therefore out as being particularly complicated, while additionally requiring a lot of time for it to be completed.

[0007] It is therefore a main object of the present invention to provide a drying machine, which is effective in doing away with the above-noted drawbacks of the cited prior art.

[0008] Within this general object, it is another purpose of the present invention to provide a drying machine, in which the contact strip is capable of being applied in a most simple and quick manner.

[0009] According to the present invention, these aims, along with further ones that will become apparent from the following disclosure, are reached in a drying machine that incorporates the features as defined and recited in the claims appended hereto.

[0010] Features and advantages of the present invention will anyway be more readily understood from the description that is given below by way of nonlimiting example with reference to the accompanying drawings, in which:

- Figure 1 is a front elevational view of a drying machine according to the present invention;
- Figure 2 is an enlarged view of a detail of Figure 1;
- Figure 3 is a perspective view of the drum of the drying machine according to the present invention;
- Figure 4 is a perspective view of the drum of a second embodiment of the present invention.

[0011] With reference to the above-cited Figures, the drying machine, as generally indicated with the reference numeral 1, comprises an electric circuit for determining the resistance and/or conductivity and, hence - the residual moisture content of the laundry 2 contained in a rotating drum 3, in which said electric circuit comprises at least one electrode 4 adapted to contact the laundry 2, a conductive contact member 5 electrically connected to said electrode 4 and fitted around the external cylindrical surface 6 of the drum 3, a sliding contact 7 adapted to slide along the conductive contact member 5 in constant galvanic connection therewith when the drum 3 is rotating, wherein said conductive contact member 5 and said electrode 4 are electrically insulated from the drum 4, and a control unit 8 that is electrically connected between said sliding contact 7 and said drum 3 for measuring an electrical quantity depending on, i.e. being in a relation with the residual moisture content in the laundry 2.

[0012] An electrically insulating adhesive layer 9 is applied between the external cylindrical surface 6 of the drum 3 and the conductive contact member 5 to secure the conductive contact member 5 to the drum 3.

[0013] Provided inside the drum 3 there is a plurality of clothes lifters 10 adapted to assist in appropriately tumbling the clothes being dried in the drum. Each such lifter

10 comprises at least one of said electrodes 4, e.g. in the form of a metal surface associated to the lifter 10 and adapted to contact the laundry placed within the drum as it is tumbled during the rotation of the same drum. Such electrode 4 is suitably insulated from the drum 3 by means of a support of a non-conductive material, and the lifter itself may be made of an electrically insulating material.

[0014] A conductive member 11 electrically connects the electrode 4 of the lifter 10 with the conductive contact member 5 through a passage formed in the cylindrical wall of the drum 3 in the zone where the same lifter 10 is due to lie.

An insulating member is interposed between said conductive member 11 and the passage in the wall of the drum 3 in view of electrically insulating said conductive member 11 from the same drum.

[0015] The conductive member 11 protrudes from the drum 3 so as to be able to establish an electric contact with the conductive contact member 5 that is applied on the outer cylindrical surface 6 of the drum through the electrically insulating adhesive layer, as this shall be explained in greater detail further on.

[0016] The sliding contact 7 is made of graphite, copper or a similar material, and it is preferably provided in the form of a contact wiper, or brush, associated to the internal structure of the machine so as to maintain a stationary, i.e. fixed position relative to the same machine. A scanning arm 12 may for example be provided for carrying such brush. This arm is mounted on the machine casing so as to be able to slidably engage the conductive contact member 5 and enable the sliding contact 7 to stay in a condition of electric contact constantly established with the conductive contact member 5 as the latter rotates jointly with the drum during a drying cycle.

[0017] The sliding contact 7 is electrically connected with the control unit 8, which is in turn connected to an electric terminal 13 that is in a condition of electrical communication with the drum 3. In particular, this electric terminal 13 may for instance comprise a second contact wiper in a condition of constant galvanic contact with the rotating or driving shaft 14 of the drum 3. Via the rear metal flange of the drum 3, to which it is coupled mechanically, the driving shaft 14 of the drum is electrically connected with the cylindrical wall of the drum 3, which is in contact with the clothes thereinside. It will however be appreciated that different kinds of electric connections and arrangements may be used between the control unit 8 and the drum 3.

[0018] The afore-cited electric circuit is therefore basically comprised of a first contact path including the sliding contact 7, the conductive contact member 5 and the electrode 4 of the lifter 10, and a second contact path including the electric terminal 13 and the drum 3, wherein the control unit 8 connects the two contact paths with each other.

[0019] The wet clothes inside the drum enable the electrode 4 of the lifter 10 to establish an electric com-

munication with the drum 3, thereby closing, i.e. completing the circuit.

[0020] The control unit 8 is adapted to power the electric circuit so that an electric current is able to flow across the electric circuit and, as a result, also through the wet clothes residing in the drum. Since the resistance or the conductivity, as the case may be, of the electric circuit depends on the residual moisture content in the clothes being dried, the control unit 8 is able to continuously determine the degree of dryness reached by the laundry 2 during the operation of the drying machine, so as to be in a position as to identify an end-of-cycle condition at which the drying cycle is to be interrupted upon reaching the final degree of dryness selected by the user for the clothes being handled.

[0021] The conductive contact member 5, which may for instance be of such material as stainless steel or aluminium, is attached to the external cylindrical surface 6 of the drum 3 by means of an adhesive layer of electrically insulating glue.

[0022] This adhesive layer 9 enables the conductive contact member 5 to be secured to the drum 3 in a quick manner, while doing fully away with the use of any fastening means and, as a result, the need for such fastening means to be electrically insulated from the drum.

[0023] In addition, the adhesive layer 9 prevents a mechanical contact from being formed between the conductive contact member 5 and the drum 3 and provides the electric insulation required for the electric circuit arrangement to be able to operate correctly without any need arising for further or additional insulating means to be interposed between the conductive contact member 5 and the drum 3.

[0024] It should further be noticed that the adhesive layer 9 and the conductive contact member 5 form a kind of sound-absorbing covering that is particularly effective and advantageous in absorbing the sound waves generated by the clothes falling upon or colliding against the metal wall of the drum 3 as the latter is rotating, especially when striking against such wall are some hard items generally associated to garment pieces, such as buttons or zippers.

[0025] The sound waves that are generated by the pulse-like occurrences deriving from the clothes striking against the inner surface of the drum 3 are for the most part absorbed by the adhesive layer 9 which, by the effect of its viscoelastic properties, substantially converts these sound waves into heat, thereby heating up the adhesive layer 9.

[0026] On the other hand, the sound waves that succeed in passing through and issuing from the glue layer are transmitted to the conductive contact member 5, where they undergo further damping.

[0027] The sound-absorbing covering arrangement created by the adhesive layer 9 and the conductive contact member 5 forms a system that is able to damp and absorb sound waves propagating within a given frequency range, which depends on the characteristics of the

adhesive layer 9 and the conductive contact member 5.

[0028] In particular, it has been found that an adhesive layer having a thickness ranging from 100 to 300 μm and a surface density ranging from 50g/m² to 150g/m², proves particularly effective in absorbing sound waves with a frequency lying within a range of 500 to 10000 Hz, which are typical frequencies of the noise generated by clothes and hard items thereof striking against the walls of the drum. It has on the other hand been found that a conductive contact member 5 having a thickness ranging from 150 to 300 μm optimally combines with an adhesive layer 9 having the characteristics as indicated above.

[0029] It has in practice been found that the more the thicknesses of the cylindrical wall of the drum 3 and the conductive contact member 5 are similar to each other, if not preferably equal to each other, the more effective are the sound-wave damping and absorption characteristics thereof.

[0030] It has furthermore been found that the effectiveness in absorbing the sound waves is the greatest one when use is made of a conductive contact member 5 that is made of the same metal material, which the drum is made of. For instance, in the case of a drum 3 made of stainless steel, a conductive contact member 5 that is itself made of stainless steel would ensure the best sound-wave absorption performance.

[0031] An adhesive layer 9 formed of silicone-based or acrylic glue has proven particularly effective thanks to both the viscoelastic properties thereof and the fact that such glues can be used in a temperature range from -40°C to 120°C while keeping their sound-wave absorption and damping characteristics unaltered in the long term notwithstanding the temperature variations, which they are subject to during drying processes.

[0032] In addition, such glues prove as being particularly effective when working at the typical temperatures reached by the drying air in a drying machine.

[0033] In a particularly advantageous embodiment of the present invention, which is illustrated in Figure 4, the conductive contact member 5 is provided to cover most of the external cylindrical surface 6 of the drum 3, for example the member 5 is 15cm width or more, so as to be able to maximize the sound-wave absorption effect. In practice, the conductive contact member 5 can be wrapped around the entire external cylindrical surface of the drum 3. The adhesive layer is preliminarily applied to the surface of the contact member 5 that is due to be associated to the external surface of the drum. Then, the conductive contact member 5 is glued onto the external cylindrical surface of the drum.

[0034] Preferably, the conductive contact member 5 is made in a single-piece, unitary construction. However, the possibility is also given for a plurality of conductive members, which are electrically connected with each other, e.g. by means of complementary edges or protrusions, and are adapted to be contacted by the sliding contact 7, to be glued around the external cylindrical surface of the drum.

[0035] Conclusively, it can therefore be stated that the drying machine according to the present invention provides a contact strip that is simple to manufacture and attach to the drum, thereby doing away with the aforementioned drawback shared by prior-art machines.

[0036] In addition, the contact strip with the inventive adhesive layer provides a sound-absorbing covering arrangement that is most effective in absorbing and damping sound waves generating from the clothes striking, i.e. colliding against the inner wall of the drum.

Claims

1. A drying machine comprising an electric circuit for determining the resistance and/or conductivity of the laundry (2) contained in a rotating drum (3), said electric circuit comprising at least one electrode (4) adapted to contact the laundry (2), a conductive contact member (5) electrically connected to said electrode (4) and extending around an external annular surface (6) of the drum (3), a sliding contact (7) adapted to slide along the conductive contact member (5) in constant galvanic connection therewith when the drum (3) is rotating, said conductive contact member (5) and said electrode (4) being electrically insulated from the drum (4), and a control unit (8) that is electrically connected between said sliding contact (7) and said drum (3) for measuring an electrical quantity depending on the residual moisture content in the laundry (3), **characterized in that** an electrically insulating adhesive layer (9) is provided between said external annular surface (6) of the drum (3) and said conductive contact member (5) to secure the member (5) to the drum (3).
2. Machine according to claim 1, wherein said electrically insulating adhesive layer (9) has a thickness ranging from 100 to 300 μm .
3. Machine according to claim 2, wherein said electrically insulating adhesive layer (9) has a surface density in the range from 50g/m² to 150g/m².
4. Machine according to claim 3, wherein said conductive contact member (5) has a thickness in the range from 150 to 300 μm .
5. Machine according to claim 3, wherein said conductive contact member (5) has the same thickness as the cylindrical wall of the drum (3).
6. Machine according to any of the preceding claims, wherein said conductive contact member (5) and said drum (3) are made of the same metal material.
7. Machine according to any of the preceding claims, wherein said adhesive layer (9) is comprised of a

silicone-based and/or acrylic glue.

8. Machine according to any of the preceding claims, wherein said conductive contact member (5) is applied to cover almost the entire external annular surface (6) of the drum (3). 5
9. Machine according to any of the preceding claims, wherein the conductive contact member (5) is provided in the form of a single-piece unitary construction. 10
10. Machine according to any of the preceding claims, wherein the conductive contact member (5) comprises a plurality of conductive members that are electrically connected with each other and adapted to be electrically contacted by said sliding contact (7). 15

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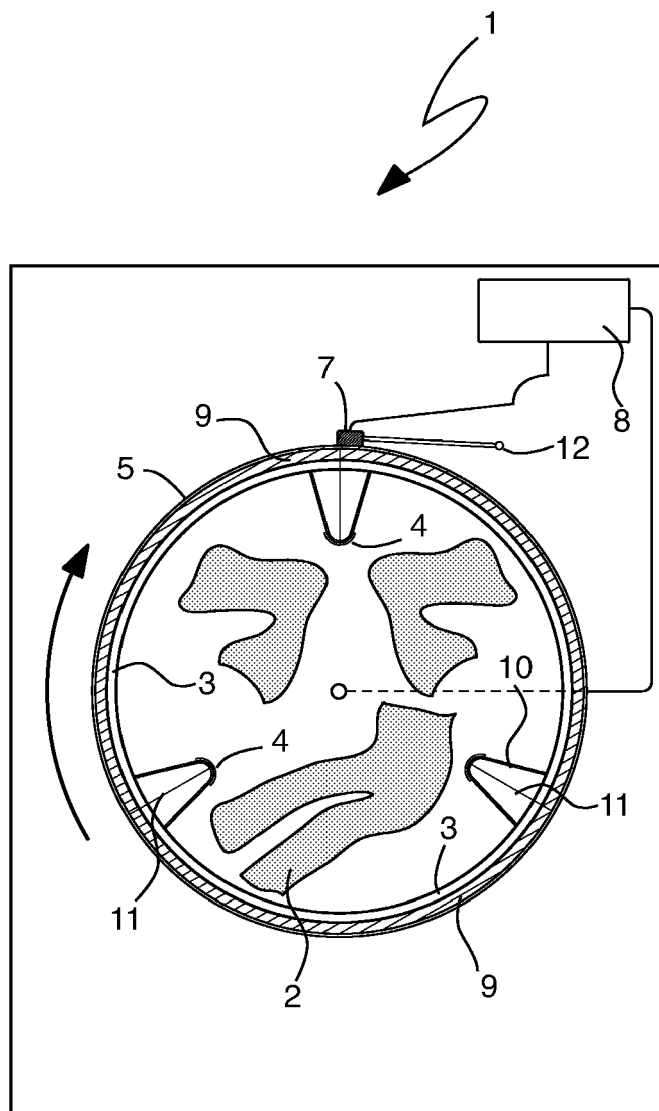


FIG 1

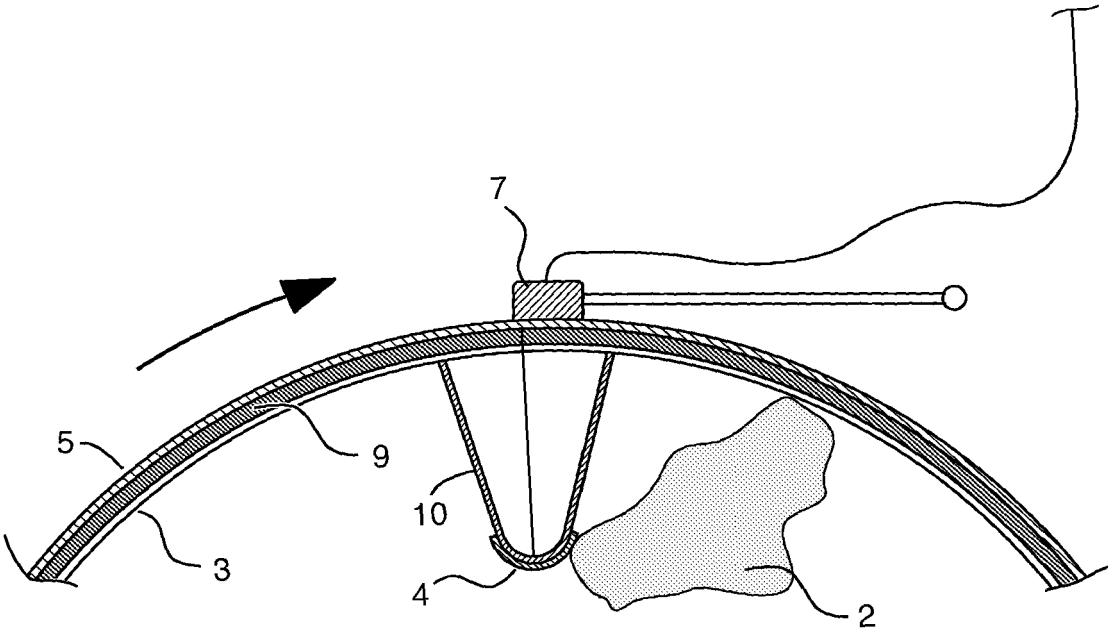


FIG 2

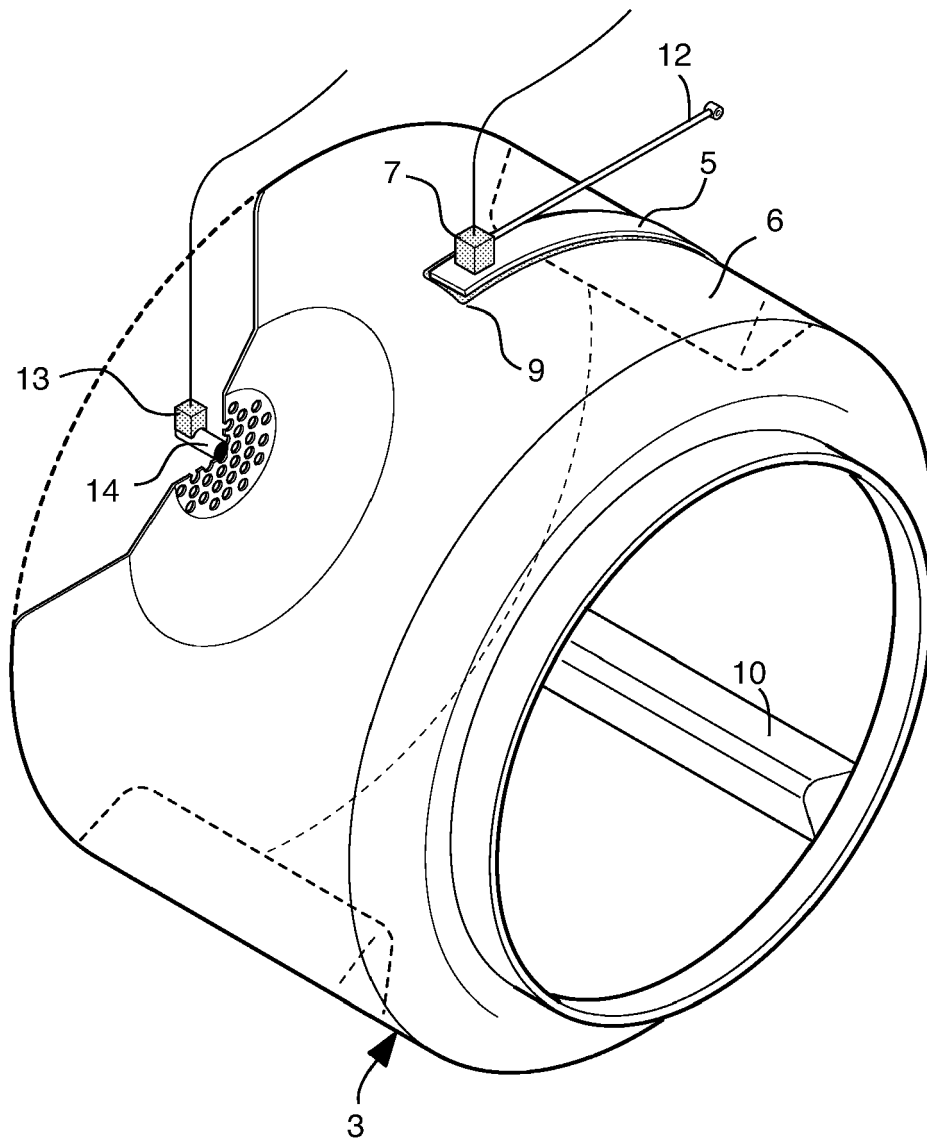


FIG 3

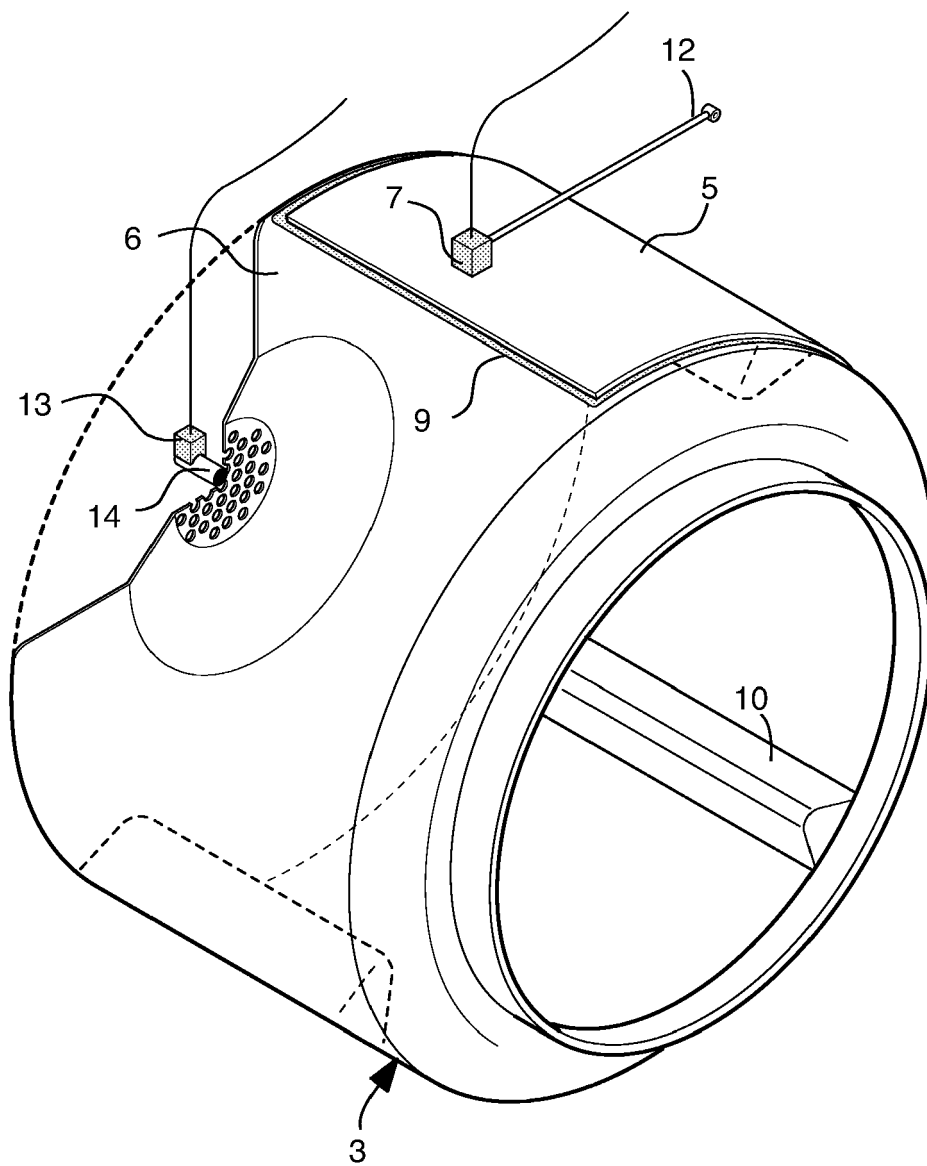


FIG 4



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 195 22 432 A1 (MIELE & CIE [DE]) 2 January 1997 (1997-01-02)	1,5,8-10	INV. D06F58/28
Y	* column 1, line 53 - line 63; claim 1; figures *	6	
Y	----- DE 75 37 772 U (WILH. CORDES KG MASCHINENFABRIK, 4740 OELDE) 25 March 1976 (1976-03-25) * claim 1; figures *	6	
A	----- US 3 402 478 A1 (HETRICK GEORGE L) 24 September 1968 (1968-09-24) * the whole document *	1-10	
A	----- DE 40 28 117 A1 (BAUKNECHT HAUSGERAETE [DE]) 12 March 1992 (1992-03-12) * the whole document *	1-10	
A	----- US 3 266 167 A1 (FRANCIS FINNEGAN) 16 August 1966 (1966-08-16) * the whole document *	1-10	
A	----- EP 1 443 139 A1 (E G O CONTROL SYSTEMS GMBH & C [DE]) 4 August 2004 (2004-08-04) * the whole document *	1-10	TECHNICAL FIELDS SEARCHED (IPC) D06F
A	----- US 3 335 501 A1 (JANKE DONALD E ET AL) 15 August 1967 (1967-08-15) * the whole document *	1-10	
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 7 March 2007	Examiner DIAZ, M
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 06 12 2606

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
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07-03-2007

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 19522432	A1	02-01-1997	NONE
DE 7537772	U	25-03-1976	NONE
US 3402478	A1		NONE
DE 4028117	A1	12-03-1992	NONE
US 3266167	A1		NONE
EP 1443139	A1	04-08-2004	NONE
US 3335501	A1		NONE