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(54) **Dryer and drying method**

Wäschetrockner und Trocknungsverfahren

Machine à sécher et méthode de séchage

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Description

[0001] The object of this invention is a dryer and a method for drying a product. The use of this dryer and drying method is particularly advantageous for delicate garments that have a tendency to become matted (wool for example). Inside the dryer the garments to be dried are placed within a rotary drum. It is known that in order to minimise the risk of garment matting, it is necessary to reduce the stress that the rotation of the drum transfers to the garment to be dried. The rotating drum carries the garment from the bottom to the top, where gravity forces it to drop back down again. Normally the speeds at which the dryer drum rotates do not permit the centrifugal force to hold the garment against the surface of the drum for the entire rotation (contrary to what happens in a washing machine during the spinning phase).

[0002] A dryer preventing garment matting by using a moveable frame connected to the rotary drum is known. The garment to be dried is physically held between the cylinder wall of the drum and this frame so that it remains stable in this position. The frame comprises a border that encloses an inlet to allow the transit of hot air from the centre of the drum to the garment to be dried.

[0003] This dryer is not without its drawbacks.

[0004] In fact, due to the limited dimensions of the drum, the garment to be dried (a shirt for example) folds back on itself before being positioned between the frame and the cylinder wall of the drum. Consequently it is always the same portion of the garment facing the centre of the drum, thereby increasing the drying time of the garment. Furthermore, in dryers the hot air normally enters and leaves the drum via the two opposite surface areas of the drum corresponding to the rotation axis of the drum (2) itself.

[0005] As the garment to be dried is found along the cylindrical surface area of the drum (therefore not along the trajectory used by the hot air), it will only be marginally touched by the flow of hot air and as a result of this will take longer to dry.

[0006] In this context the technical basis of this invention is to propose a dryer and drying method that overcome the drawbacks of the above-mentioned technique.

[0007] More specifically, the scope of this invention is to create a dryer that has the capacity to improve the drying speed of delicate garments, particularly wool and other fabrics that have a tendency to become matted.

[0008] A further aim for this invention is to improve energy efficiency when drying delicate garments.

[0009] The technical basis indicated and the specific aims are substantially achieved by a dryer and by a drying method designed in accordance with the technical features expressed in one or more of the annexed claims.

[0010] Further features as well as further advantages of the present invention will become apparent from the following description of an embodiment of a dryer and a drying method thereof as shown in the annexed drawings, which are supplied by way of non-limiting example, wherein:

- figure 1 shows a schematic view of a dryer according to this invention;
- figure 2 shows in detail a dryer component for this invention.

[0011] The object of this invention is a dryer for at least one product. Such dryers are characteristically designed to dry textile garments, particularly delicate textile garments that have the tendency to become matted (typically wool). In the annexed drawings this dryer is identified with the reference number (1).

[0012] The dryer (1) comprises a rotary drum (2) that appropriately rotates on a primary axis (22); advantageously the drum (2) presents substantial cylindrical symmetry, in having as its axis of symmetry the said primary axis (22) of rotation of the drum (2).

[0013] The dryer (1) also comprises a perforated shell (3) that may be placed inside the drum (2) to create an inner compartment (30) suitable for holding said at least one product to be dried. Advantageously it is free from any apparatus extending inside the said inner compartment (30) and that acts as a support for said at least one product to be dried. The support function for the said product to be dried is therefore exclusively carried out by at least one wall (possibly with a reticular structure) of the shell (3) that is used to define the outside of the said inner compartment (30).

[0014] The presence of one or more perforations (35) in the shell (3) is important in order to permit air outside the shell (3) to enter the compartment (30) and dry said at least one product. This previously heated external air facilitates the drying of at least one product. The presence of at least one perforation (35) also facilitates evacuation of moisture from the internal compartment (30).

[0015] The said perforated shell (3) comprises an outer rolling surface (31) that during rotation of the drum (2) is free to roll along the first inner surface (32) of the drum (2), thereby rotating the said perforated shell (3). During rotation of the drum (2) the outer rolling surface (31), by rolling along the first inner surface (32) of the drum (2), appropriately rotates the said perforated shell (3) on a secondary axis of rotation (36) in a straight line with the shell (3) itself. This secondary axis of rotation (36) essentially passes through the barycentre of the outer rolling surface (31). The rolling can be with or without sliding (the latter is the ideal situation that will be referenced later for further detailed considerations herein). There is rolling between two bodies when the instantaneous axis of rotation of the relative movement of the two bodies is in alignment with the area of contact.

[0016] In the case in question the two bodies are the shell (3) and the drum (2). Said secondary axis of rotation (36) is different to the instantaneous axis of rotation of relative motion indicated by reference number (5) in figure 1.

[0017] Said one or more perforations (35) pass through

said outer rolling surface (31). If there are more perforations (35) the outer rolling surface (31) has a reticular structure with more cells, each perforation (35) being identified by a cell within this reticular structure. The shell (3) is appropriately rigid to prevent said at least one product to be dried being placed within the compartment (30), from being squashed. When the shell (3) is positioned inside the drum (2) it uses gravity to support itself against the first inner surface (32) of the drum (2).

[0018] The drum (2) is operated using a motorised means, for example an electric motor and possibly a drive belt or cog mechanism.

[0019] The dryer (1) comprises a door that can be opened to permit the introduction and extraction of the products to be dried inside the drum (2). The shell (3) may also be inserted into and removed from the rotary drum (2). In particular, using this door it is also possible to insert and remove the shell (3) into and from the drum (2). Advantageously the shell (3) and the drum (2) are not coupled together and the shell (3) is therefore considered to be an additional accessory to the dryer (1).

[0020] In addition to the first inner surface (32) the drum (2) also comprises a rear wall (21) opposite the door. This rear wall (21) horizontally defines the primary axis (22) of rotation of the drum (2). The first inner surface (32) of the drum (2) is completely closed and expands around the primary axis of rotation (22) of the drum (2) without intersecting it. Advantageously the first inner surface (32) of the drum (2) follows a curved and rounded line of expansion to facilitate its movement relative to the shell (3). This line of expansion is advantageously circular. The first inner surface (32) expands in the area between the rear wall (21) and the door.

[0021] Under ideal operating conditions, during rotation of the drum (2), the perforated shell (3) always remains in contact with the first inner surface (32) of the drum (2).

[0022] Under ideal conditions, the secondary axis of rotation (36) always remains parallel to the primary axis (22) of rotation of the drum (2).

[0023] Under ideal conditions, the perforated shell (3) rolls without sliding on the first inner surface (32) of the drum (2).

[0024] Under ideal operating conditions, the position of the secondary axis of rotation (36) tends to essentially remain fixed within the space, at least when the drum (2) turns at a uniform speed.

[0025] Under ideal conditions without any sliding between the outer rolling surface (31) of the shell (3) and the first inner surface (32) of the drum (2), the linear velocity at one point of the outer rolling surface (31) is equal to the linear velocity of the first inner surface (32) of the drum (2).

[0026] Advantageously the rolling surface (31) of the shell (3) has a radius r_2. Similarly the first inner surface (32) of the drum (2) has a radius r_1.

[0027] As the shell (3) can be placed inside the drum (2), the radius r_2 of the outer rolling surface (31) will be less than the radius r_1 of the first inner surface (32).

[0028] Under ideal conditions without any sliding between the outer rolling surface (31) of the shell (3) and the first inner surface (32) of the drum (2) the modulus v of the linear velocity at one point of the outer rolling surface (31) is equal to the modulus v of the linear velocity of the first inner surface (32) of the drum (2). From the equation $v=\omega_1 r_1=\omega_2 r_2$, it can be noted immediately that ω_2 is greater than ω_1, where ω_1 is the angular speed of rotation of the drum (2) on the primary axis (22) and ω_2 is the angular speed of rotation of the shell (3) on the secondary axis (36).

[0029] In relation to the shell (3), in order for the product to be dried when placed in the compartment (30) to remain in its position it is necessary that the rotation speed of the shell (3), not of the drum (2), is sufficient for the centrifugal force associated with the rotation of the shell (3) to overcome the gravitational force acting on the product placed in the compartment (30). This results in what is known in slang as satellisation; the corresponding rotation speed of the shell (3) around the secondary axis (36) is also known as satellisation speed. The Applicant has verified that the satellisation speed of a textile garment directly and freely positioned, without the shell (3), in a conventional dryer drum is equal to 70 rpm. The centrifugal force acting on a garment depends on the mass m_1 of the garment, the distance of the rotation axis and the angular speed of the garment in relation to the rotation axis.

[0030] Consequently in conditions of satellisation, it can be more or less assumed that $m_1 r_1 70^2 = m_1 r_2 \omega_2^2$. Combining this with the ideal condition of pure rolling motion $\omega_1 r_1 = \omega_2 r_2$ results in the properties of the radius r_2 of the outer rolling surface (31).

[0031] This condition indicates that the appropriate radius r_2 for the outer rolling surface (31) is less than or equal to:

$$r_1 \cdot (\omega_1)^2/4900$$

where:

ω_1 is the rotation speed of the drum (2) expressed in rpm;

r_1 is the radius of the first inner surface (32) of the drum (2) along which the shell (3) is free to roll, expressed in the same unit of measurement as r_2.

[0032] Normally ω_1 is between 45 and 65 rpm. The radius r_1 is usually between 200 and 300 millimetres.

[0033] The radius r_2 of the outer rolling surface (31) is greater than 50 millimetres, preferably greater than 100 millimetres. This allows it to easily contain the shell (3) as well as a product to be dried of a certain size. The radius r_2 of the outer rolling surface (31) is appropriately smaller than 150 millimetres (in order not to excessively

reduce the multiplication effect of the angular speed from the drum (2) to the shell (3) and to allow the shell (3) to pass through the opening door of the dryer (1)).

[0034] During actual operation, the dryer (1) may behave very differently to these ideal conditions and may show particular evidence of transitory sliding between the rolling surface (31) of the shell (3) and the first inner surface (32) of the drum (2). Therefore the rolling of the shell (3) in the drum (2) could also be accompanied by some sliding. In any event, even in the presence of sliding, it would still be possible to obtain the benefits previously expressed in reference to the ideal circumstances (meaning that the shell (3), having a smaller radius, would roll at a rotation speed greater than that of the drum (2), possibly resulting in satellisation of the product to be dried placed in the compartment (30)).

[0035] Generally when the shell (3) containing said at least one product to be dried is placed inside the drum (2), no other products to be dried are introduced into the said drum (2) and outside the shell (3); this in fact would hinder the motion of the shell (3), rendering it ineffective. Furthermore, the said at least one product to be dried placed inside the compartment (30) would benefit more from the air flow than it would if held against the first inner surface (32) of the drum (2). As the shell (3) rolls the product to be dried is in periodical proximity to the primary axis of rotation (22) of the drum (2) (as previously indicated the hot air enters and leaves via two opposite surfaces close to the primary axis of rotation (22) of the drum (2) and therefore the said at least one product to be dried benefits more from the flow of hot air entering the drum (2)).

[0036] The shell (3) conveniently may be opened to permit said at least one product to be dried to be placed inside and removed from the compartment (30).

[0037] The shell (3) also conveniently comprises a first and a second portion (330, 340) that together enclose the said inner compartment (30).

[0038] Advantageously the first and second portions (330, 340) correspond to a first and second semi-shell (33, 34), which may be fitted together and taken apart as two halves of the main shell (3).

[0039] The first and second portions (330, 340) can be screw-threaded onto and unscrewed from each other. The threading allows the first and second portions (330, 340) to be screwed and unscrewed.

[0040] This threading is made on both the first and second portions (330, 340) corresponding to a joint (37) between them. As an alternative, another type of moveable connection would be suitable for joining together the first and second portions (330, 340) corresponding to a joint (37) between them. For example, elastic deformable catch-and-release mechanisms could be used. The solution with the two portions (advantageously two semi-shells) that can be screwed together and unscrewed is however preferable as it is less likely that the two semi-shells will become inadvertently separated during the drying process. The first and second portions (330, 340), advantageously the first and second semi-shells (33, 34), when not in use can be placed one on top of the other, with the concave sides facing towards the same plane of reference in order to reduce the amount of space that they occupy.

[0041] The said shell (3), advantageously, is substantially spherical or ellipsoidal.

[0042] The said outer rolling surface (31), advantageously, is substantially spherical or ellipsoidal (with perforations (35) in the outer rolling surface (31)).

[0043] It is important that the outer rolling surface (31) is rounded. This device (especially if the outer rolling surface (31) is spherical) permits, regardless of the orientation of the shell (3) in relation to the drum (2), rolling without the outer rolling surface (31) becoming caught on the first inner surface (32).

[0044] Alternatively the shell (3) could be cylindrical but in this case the shell (3) could only rotate around the axis of cylindrical symmetry.

[0045] Consequently if the secondary axis of rotation (36) and the primary axis of rotation (22) of the drum (2) were not parallel, the operation would be adversely affected. Amongst the possible causes of incorrect positioning of the primary and secondary axes of rotation (22, 36) are incorrect initial positioning on the part of the user or undesirable stress during the rotation of the drum (2), (it must be kept in mind that in the event of satellisation the shell (3) acts as a body with eccentric mass due to the presence of said at least one product to be dried; obviously this eccentricity generates unwanted stresses that can result in sliding or displacement of the shell (3) in relation to the drum (2)).

[0046] Advantageously at least one part of the rolling surface (31) of the shell (3) is made from a material suitable for dampening the noise generated by the movement of the shell (3) along the first inner surface (32) of the drum (2). For example, the shell (3) can have inserts made of rubber or plastic or in a material that is slightly deformable. It should be noted that it is usual for a large part of the shell (3) to be made from plastic.

[0047] Advantageously the shell (3) could also have on the outer rolling surface (31) indentations to interact (or more specifically, to mesh together with) corresponding indentations along the first inner surface (32). This device would conveniently reduce sliding of the shell (3) in relation to the first inner surface (32). The indentations in the first inner surface (32) completely surround the primary axis of rotation (22) of the drum (2). Similarly, on the shell (3) indentations on at least one plane of the section completely encompass the said compartment (30).

[0048] An alternative solution is for the first inner surface (32) to be smooth (and therefore lacking in any obvious irregularities). In this way there is less risk of the shell (3) coming away from the drum (2) whilst the shell (3) is rolling along the drum (2).

[0049] Advantageously the dryer (1) comprises a housing chamber (4) for the drum (2). In order to deter-

mine when a certain level of dryness has been attained, the dryer (1) normally has a humidity sensor (41). This sensor (41) is indicated in figure 1 with a dotted line to show that it has been taken out of this view so that the underlying elements can be better seen. Advantageously this humidity sensor (41) is fixed to the said chamber (4) and the drum (2) turns in relation to the humidity sensor (41). Normally the humidity sensor (41) is located above the locus of points of the first inner surface (32) that are found at the minimum distance from a fictitious horizontal plane underlying the dryer (1). The humidity sensor (41) works on an electrical signal and therefore it is important that it comes into electrical contact with the damp clothes (thereby acting as electrical conductors) to be able to evaluate the level of dampness of the clothes. If the first inner surface (32) has a cylindrical lateral surface, this said locus of points coincides with the generatrix of the cylinder, which is found at the minimum distance from the fictitious horizontal plane. In order for the humidity sensor (41) to function correctly, it is necessary that the vertical component of the distance between the humidity sensor (41) and the said locus of points of the first inner surface (32) is less than or equal to the diameter of the outer rolling surface (31) of the shell (3). To this regard it would also be necessary for at least part of the shell (3) to be made from electrically conductive material. In this way the shell (3) can function in cooperation with the humidity sensor (41). At the moment that the humidity sensor (41) acts on an electrical signal, if at least part of the shell (3) is made from electrically conductive material this would allow it to connect the sensor (41) with the damp clothes, thereby acting as electrical conductors. Advantageously the shell (3) includes an element made from electrically conductive material that electrically connects the inside of the shell (3) to the outside of the shell (3). This element made from electrically conductive material runs through the thickness of the shell (3). This element made from electrically conductive material is conveniently surrounded by (preferably enclosed in) portions of the shell (3) that are made from electrically insulating material. This element in electrically conductive material is designed to come into contact with the sensor (41).

[0050] The object of this invention is also a method of drying at least one product using a dryer. This method concerns the drying of at least one delicate fabric garment (wool for example) The method comprises the following stages:

- inserting said at least one product to be dried inside a perforated shell (3) with an outer rolling surface (31);
- placing the said perforated shell (3) inside the drum (2);
- rotating the drum (2), first inner surface (32) of the drum (2) transferring the movement to the rolling surface (31) of the perforated shell (3), the rolling of the shell (3) on the first inner surface (32) of the drum (2) permitting the rotation of the perforated shell (3) at a rotation speed greater than that of the drum (2). This permits satellisation of the product to be dried placed in the shell (3).

[0051] During the rotation stage of the drum (2), the shell (3) is rotated by the drum (2) at a rotation speed greater than or equal to the satellisation speed of said at least one product to be dried placed in the shell (3). During rotation of the drum (2), at least at its fullest potential, the product to be dried remains stable in relation to the shell (3), therefore allowing the product to be dried without being subjected to stresses and movements that may damage it (for this reason the method is particularly beneficial for delicate fabric garments).

[0052] The stage of placing the said perforated shell (3) inside the drum (2) takes place when inside the drum (2) there are no further objects (typically fabric garments) to be dried. The stage of rotating the drum (2) takes place when there are no further objects (typically fabric garments) to be dried placed in the drum (2) outside the shell (3).

[0053] Advantageously the rotation speed of the drum (2) around the primary axis (22) of rotation of the drum (2) is between 50 and 60 rpm.

[0054] Appropriately, the rotation speed of the shell (3) around the secondary axis (36) of rotation of the shell (3) is between 75 and 100 rpm.

[0055] As previously indicated under ideal operating conditions during the rotation of the drum (2) the perforated shell (3), particularly the outer rolling surface (31), remains substantially in contact with the first inner surface (32) of the drum (2).

[0056] Still under ideal operating conditions, during rotation of the drum (2) the perforated shell (3) rolls substantially without sliding on the first inner surface (32) of the drum (2).

[0057] This method is advantageously implemented by a dryer (1) comprising one or more of the previously described technical features.

[0058] The stage of introducing said at least one product to be dried inside the perforated shell (3) requires opening up the said shell (3). The stage of opening up the shell (3) is also necessary at the end of the drying process in order to remove the said at least one product to be extracted from the shell (3). In order to advantageously open up the said shell (3) at least two sides of a first and a second portion (330, 340) of the shell (3) - conveniently a first and a second semi-shell (33, 34) - can be detached. The first and second portions (330, 340), like the first and second semi-shells (33, 34), as per the other technical features detailed in reference to the method, can be of the type described beforehand in reference to the structural and functional features of the dryer (1). The stage of opening up the first and second semi-shells (33, 34) can be carried out by unscrewing the first and second semi-shells (33, 34), one from the other.

[0059] Advantageously during the rotation of the drum (2) an electrically conductive element of the shell (3) comes into contact (periodically at least) with a humidity sensor (41) integrated into the dryer (1). This electrically conductive element electrically connects the inside of the shell (3) with the outside of the shell (3) (as explained in more detail previously). In particular, this electrically conductive element puts into contact the product to be dried inside the shell (3) and the humidity sensor (41) to provide the dryer with a predetermined signal, upon which the drying cycle is interrupted. Typically this signal is linked to detection by the humidity signal (41) of an electrical current below the determined threshold.

[0060] The invention has significant benefits. First and foremost it allows the products to be dried to attain satellisation speed, even in dryers where the drum rotation speed would be insufficient to achieve this effect. This, as previously described, makes this dryer particularly beneficial for use with delicate garments.

[0061] Furthermore, the invention permits optimisation of the drying times required for fabric garments.

[0062] The idea for the invention is subject to numerous modifications and variations, all within the scope of the inventive concept by which it is defined. Furthermore, all the details may be substituted by other technically equivalent elements. In practice, all the materials used, as well as the dimensions, may vary according to the requirements.

Claims

1. A dryer of at least one product comprising:

- a rotary drum (2);
- a perforated shell (3) which may be fitted inside the drum (2) and defining an inner compartment (30) suitable for holding at least one product to be dried;

wherein the perforated shell (3) comprises a substantial spherical or ellipsoidal outer rolling surface (31) which during the rotation of the drum (2) is free to roll spontaneously along a first inner surface (32) of the drum (2) thereby rotating the perforated shell (3), the radius r_2 of said outer rolling surface (31) being less than the radius r_1 of said first inner surface (32), **characterised in that** the rolling surface (31) has a radius r_2 greater than or equal to 100 millimetres and/or less than or equal to:

$$r_1 \cdot (\omega_1)^2/4900$$

where:

ω_1 is the angular speed of rotation of the drum (2) expressed in rpm;
r_1 is the radius of the first inner surface (32) of the drum (2) along which the shell (3) is free to roll, expressed in the same unit of measurement as r_2.

2. The dryer according to any of the foregoing claims, **characterised in that** the shell (3) may be opened to permit the introduction and extraction of at least one product to be dried.

3. The dryer according to any of the foregoing claims, **characterised in that** the shell (3) comprises, or coincides with, a first and a second portion (330, 340) which in combination encompass the inner compartment (30) and which may be screwed on and screwed off to and from one another.

4. The dryer according to any of the foregoing claims, **characterised in that** at least a part of the rolling surface (31) of the shell is made from a material suitable for dampening the noise generated by the movement of the shell (3) along the first inner surface (32) of the drum (2).

5. The dryer according to any of the foregoing claims, **characterised in that** the shell (3) comprises an element made from electrically conductive material which electrically connects the inside of the shell (3) with the outside of the shell (3).

6. The dryer according to any of the foregoing claims, **characterised in that** it is free from any apparatus extending inside the inner compartment (30), which acts as a support for at least one product to be dried.

7. A method for drying at least one product using a dryer, the method comprising the steps of:

- introducing at least one product to be dried inside a perforated shell (3) comprising a substantial spherical or ellipsoidal outer rolling surface (31);
- placing the perforated shell (3) inside the drum (2);
- rotating the drum (2), a first inner surface (32) of the drum (2) transferring the movement to the rolling surface (31) of the perforated shell (3), the radius r_2 of said outer rolling surface (31) being less than the radius r_1 of said first inner surface (32), the rolling of the shell (3) on the first inner surface (32) of the drum (2) permitting the rotation of the perforated shell (3) at a speed of rotation greater than that of the drum (2), wherein the rolling surface (31) has a radius r_2 greater than or equal to 100 millimetres and/or less than or equal to:

$$r_1 \cdot (\omega_1)^2/4900$$

where:

ω_1 is the angular speed of rotation of the drum (2) expressed in rpm;
r_1 is the radius of the first inner surface (32) of the drum (2) along which the shell (3) is free to roll, expressed in the same unit of measurement as r_2.

Patentansprüche

1. Trockner wenigstens eines Produktes, umfassend:

- eine Drehtrommel (2);
- eine perforierte Hülle (3), welche innerhalb der Trommel (2) angeordnet sein kann und einen inneren Raum (30) definiert, welcher zum Halten von wenigstens einem zu trocknenden Produkt geeignet ist;

wobei die perforierte Hülle (3) eine im Wesentlichen sphärische oder ellipsoidische äußere Rollfläche (31) umfasst, welche während der Drehung der Trommel (2) frei ist, spontan entlang einer ersten inneren Fläche (32) der Trommel (2) zu rollen, wodurch die perforierte Hülle (3) gedreht wird, wobei der Radius r_2 der äußeren Rollfläche (31) geringer als der Radius r_1 der ersten inneren Fläche (32) ist, **dadurch gekennzeichnet, dass** die Rollfläche (31) einen Radius r_2 aufweist, der größer als oder gleich 100 Millimeter ist und/ oder geringer als oder gleich:

$$r_1 \cdot (\omega_1)^2/4900$$

ist,
wobei:

ω_1 die Winkelgeschwindigkeit der Drehung der Trommel (2) ist, welche in upm ausgedrückt ist;
r_1 der Radius der ersten inneren Fläche (32) der Trommel (2) ist, entlang welcher die Hülle (3) frei ist, zu rollen, ausgedrückt in der gleichen Maßeinheit wie r_2.

2. Trockner nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Hülle (3) geöffnet werden kann, um die Eingabe oder Entnahme von wenigstens einem zu trocknenden Produkt zu erlauben.

3. Trockner nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Hülle (3) einen ersten und einen zweiten Teilbereich (330, 340) umfasst oder damit übereinstimmt, welche in Kombination den inneren Raum (30) umgeben und welche aneinander an- oder voneinander abgeschraubt werden können.

4. Trockner nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** wenigstens ein Teil der Rollfläche (31) der Hülle aus einem Material gefertigt ist, welches dazu geeignet ist, das Geräusch, welches durch die Bewegung der Hülle (3) entlang der ersten inneren Fläche (32) der Trommel (2) erzeugt wird, zu dämpfen.

5. Trockner nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Hülle (3) ein Element umfasst, welches aus einem elektrisch leitfähigen Material gefertigt ist, welches die Innenseite der Hülle (3) mit der Außenseite der Hülle (3) elektrisch verbindet.

6. Trockner nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** er frei von jeglichem Gerät ist, das sich in den inneren Raum (30) erstreckt, das als eine Halterung für wenigstens ein zu trocknendes Produkt fungiert.

7. Verfahren zum Trocknen von wenigstens einem Produkt unter Verwendung eines Trockners, wobei das Verfahren die Schritte umfasst:

- Eingeben von wenigstens einem zu trocknenden Produkt in eine perforierte Hülle (3), welche eine im Wesentlichen sphärische oder ellipsoidische äußere Rollfläche (31) umfasst;
- Platzieren der perforierten Hülle (3) innerhalb der Trommel (2);
- Drehen der Trommel (2), wobei eine erste innere Fläche (32) der Trommel (2) die Bewegung zu der Rollfläche (31) der perforierten Hülle (3) überträgt, wobei der Radius r_2 der äußeren Rollfläche (31) geringer ist, als der Radius r_1 der ersten inneren Fläche (32), wobei das Rollen der Hülle (3) an der ersten inneren Fläche (32) der Trommel (2) die Drehung der perforierten Hülle (3) mit einer Drehgeschwindigkeit ermöglicht, die größer ist als die der Trommel (2), wobei die Rollfläche (31) einen Radius r_2 aufweist, der größer als oder gleich 100 Millimeter ist und/ oder geringer als oder gleich:

$$r_1 \cdot (\omega_1)^2/4900$$

ist,
wobei:

ω_1 die Winkelgeschwindigkeit der Drehung der Trommel (2) ist, welche in upm ausgedrückt ist;
r_1 der Radius der ersten inneren Fläche (32) der Trommel (2) ist, entlang welcher die Hülle (3) frei ist, zu rollen, ausgedrückt in der gleichen Maßeinheit wie r_2.

Revendications

1. Séchoir d'au moins un produit comprenant :

- un tambour rotatif (2) ;
- une coque perforée (3) qui peut être installée à l'intérieur du tambour (2) et définissant un compartiment interne (30) approprié pour contenir au moins un produit à sécher ;

dans lequel la coque perforée (3) comprend une surface de roulement externe sensiblement sphérique ou ellipsoïdale (31) qui, lors de la rotation du tambour (2), est libre de rouler spontanément le long d'une première surface interne (32) du tambour (2), faisant ainsi tourner la coque perforée (3), le rayon r_2 de ladite surface de roulement externe (31) étant inférieur au rayon r_1 de ladite première surface interne (32), **caractérisé en ce que** la surface de roulement (31) a un rayon r_2 supérieur ou égal à 100 millimètres et/ou inférieur ou égal à :

$$r_1 \bullet (\omega_1)^2/4\ 900$$

où :

ω_1 est la vitesse de rotation angulaire du tambour (2) exprimé en tr/min
r_1 est le rayon de la première surface interne (32) du tambour (2) le long de laquelle la coque (3) est libre de rouler, exprimé dans la même unité de mesure que r_2.

2. Séchoir selon la revendication précédente, **caractérisé en ce que** la coque (3) peut être ouverte pour permettre l'introduction et l'extraction d'au moins un produit à sécher.

3. Séchoir selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la coque (3) comprend, ou coïncide avec, une première et une seconde portion (330, 340) qui, en combinaison, englobent le compartiment interne (30) et qui peuvent être vissées ensemble ou dévissées l'une de l'autre.

4. Séchoir selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**au moins une partie de la surface de roulement (31) de la coque est fabriquée à partir d'un matériau convenant à l'atténuation du bruit généré par le déplacement de la coque (3) le long de la première surface interne (32) du tambour (2).

5. Séchoir selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la coque (3) comprend un élément fabriqué à partir d'un matériau électriquement conducteur qui connecte électriquement l'intérieur de la coque (3) avec l'extérieur de la coque (3).

6. Séchoir selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**il est dépourvu de tout appareil s'étendant à l'intérieur du compartiment interne (30), qu'il agit en tant que support pour au moins un produit à sécher.

7. Procédé de séchage d'au moins un produit en utilisant un séchoir, le procédé comprenant les étapes :

- d'introduction d'au moins un produit à sécher à l'intérieur d'une coque perforée (3) comprenant une surface de roulement externe sensiblement sphérique ou ellipsoïdale (31) ;
- de placement de la coque perforée (3) à l'intérieur du tambour (2) ;
- de rotation du tambour (3), une première surface interne (32) du tambour (2) transférant le mouvement vers la surface de roulement (31) de la coque perforée (3), le rayon r_2 de ladite surface de roulement externe (31) étant inférieur au rayon r_1 de ladite première surface interne (32), le roulement de la coque (3) sur la première surface interne (32) du tambour (2) permettant la rotation de la coque perforée (3) à une vitesse de rotation supérieure à celle du tambour (2), dans lequel la surface de roulement (31) a un rayon r_2 supérieur ou égal à 100 millimètres et/ou inférieur ou égal à :

$$r_1 \bullet (\omega_1)^2/4\ 900$$

où :

ω_1 est la vitesse de rotation angulaire du tambour (2) exprimé en tr/min ;
r_1 est le rayon de la première surface interne (32) du tambour (2) le long de laquelle la coque (3) est libre de rouler, exprimé dans la même unité de mesure que r_2.

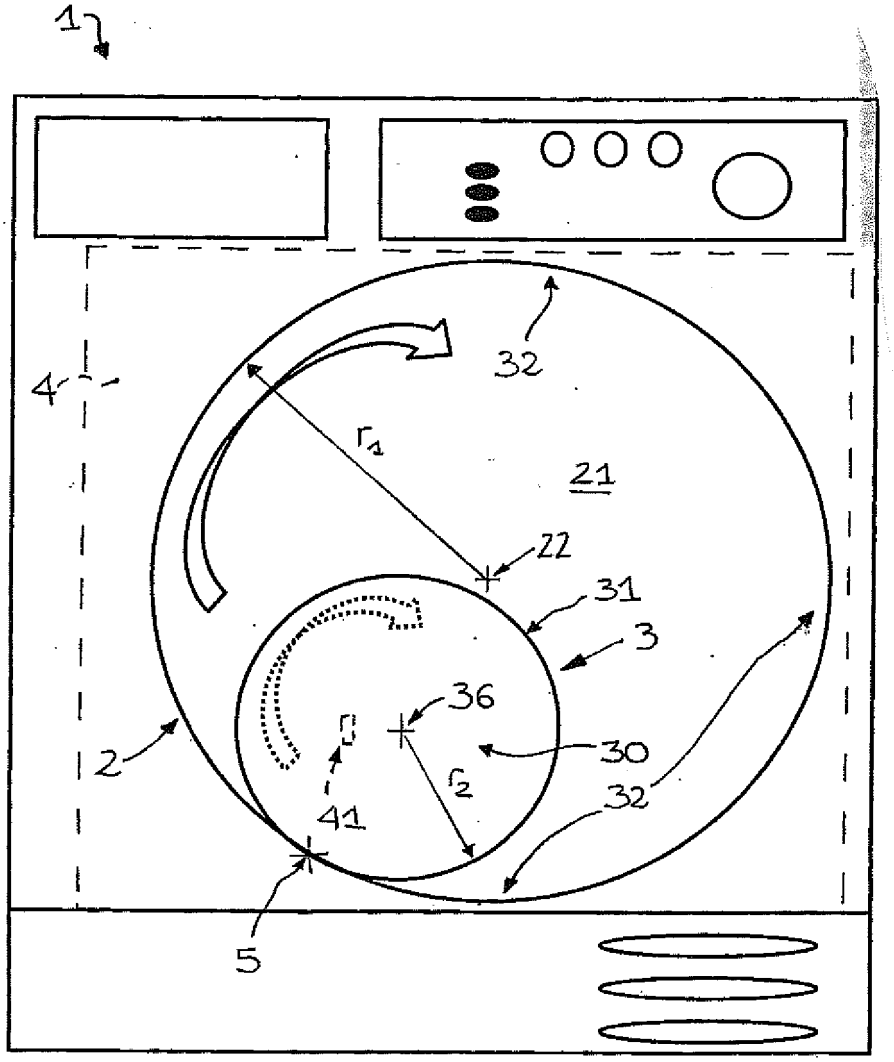

Fig. 1

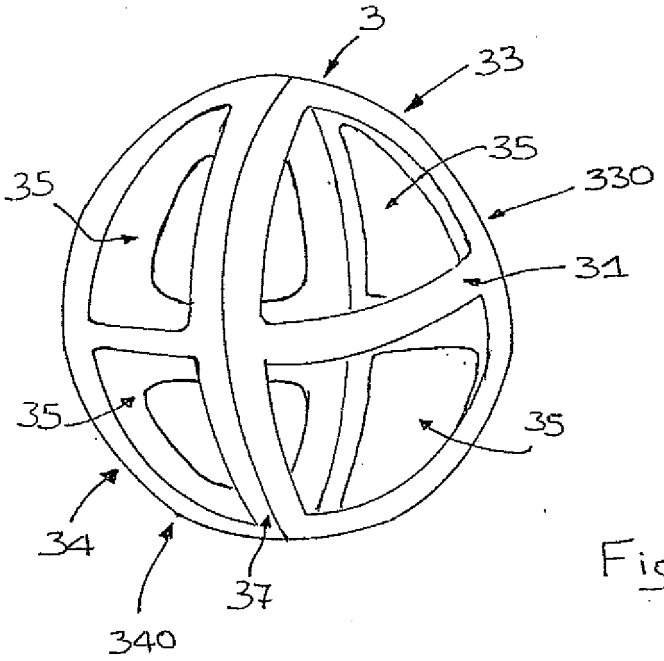

Fig. 2