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(54) **Laundry treating machine including a rotatable drum**

Wäschebehandlungsmaschine mit einer rotierenden Trommel

Machine de traitement de linge comprenant un tambour rotatif

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to the technical field of laundry treating machines. It is underlined that in the present application the expression "laundry treating machine" may as well indicate a "simple" laundry washing machine (i.e., a machine which can only wash and rinse the laundry), a "simple" laundry drying machine (i.e., a machine which can only dry the laundry) and a laundry washing-drying machine (i.e., a machine which can wash, rinse, and dry the laundry), both of the front-loading type and of the top-loading type (both of the horizontal axis type and of the vertical axis type).

[0002] Furthermore, the present invention relates to a rotatable drum for such a laundry treating machine.

[0003] The following description refers, purely by way of example, to a front-loading type laundry washing machine and to a rotatable drum thereof, without this implying any loss of generality.

BACKGROUND ART

[0004] As it is known, front-loading laundry type washing machines generally comprise:

- an outer box casing structured for resting on the floor;
- a washing tub, for example suspended in a floating manner inside the casing , directly facing a laundry loading and unloading opening realized in the casing;
- a door hinged to the casing to rotate to and from a closing position in which the door closes the opening to seal the washing tub;
- a rotatable drum for housing the laundry to be washed, the rotatable drum being housed inside the washing tub to rotate about its longitudinal axis.

[0005] To assure adequate water circulation across the rotatable drum during all phases of the washing cycle, the drum is typically provided with a large number of through holes which are generally evenly distributed on the lateral wall of the drum.

[0006] As a general rule, efficiency of the washing and rinsing phases of the laundry washing cycle increases together with the overall perforated area of the lateral wall of the rotatable drum, thus several attempts have been made to maximise the overall perforated area of the rotatable drum either increasing the through holes density for surface unit, or increasing the nominal diameter of the through holes.

[0007] Unfortunately, the increase of the through holes density implies a conspicuous rising of the overall production costs of the drum and may also compromise the stiffness of rotatable drum, whereas an excessive increase of the nominal diameter of the through holes may cause severe damages to the laundry textile.

[0008] In fact, if the nominal diameter of the through holes on the lateral wall of the drum is too high, particularly during the spin phase of the washing cycle the textile portion resting immediately above each through hole is not properly supported and tends to radially bend outwards of the drum through the hole, thus causing an excessive local stretching of the textile fibers.

[0009] On the other hand, during the washing and rinsing phases, if the nominal diameter of the through holes is too small, the fast-flowing outflow of the washing water out of the rotatable drum is thwarted with negative effects on the washing and rinsing efficiency.

[0010] Moreover, in the recent years the volume ratio between the average volume of the laundry stored in the drum and the nominal internal volume of the drum has significantly increased (in other words, nowadays the drum of the laundry washing machine is proportionally filled with much more laundry than in the past), causing an appreciable increase of the average thickness of laundry resting on the inner surface of the lateral wall of the drum. This increase of the laundry density for surface unit implies that the laundry is strongly pressed against the inner surface of the lateral wall of the drum, thus significantly reducing or even partially blocking the outflow of the washing water through the drum holes.

[0011] A rotatable drum with the features of the preamble is disclosed in US 2005/044899 A1.

[0012] Patent application n. EP 2372010 in the name of the same Applicant discloses a rotatable drum for a laundry washing machine comprising a substantially cylindrical lateral wall provided with a plurality of through holes which are arranged in an orderly manner in a plurality of outwards-projecting bulges formed on the substantially cylindrical lateral wall. In particular, EP 2372010 discloses an embodiment wherein each bulge has a flat bottom having a central through hole and six further through holes, which are located at the vertexes of a hexagon located roughly centered to the bulge. The perimeter of the bulges is substantially circular in shape and the plurality of bulges are aligned one another along a number of adjacent longitudinal rows staggered one another.

[0013] Although such a rotatable drum fulfils the above-mentioned requirements and overcomes the above-mentioned drawbacks in a convincing manner, the Applicant has continued to study other new rotatable drums for laundry treating machines which can at least be so efficient, cheap and easy to produce as the rotatable drum according to EP 2372010.

[0014] The main object of the present invention is therefore to reach the above mentioned goal.

[0015] In particular, it is one object of the present invention to provide a rotatable drum for laundry treating machine with both a high washing efficiency and an appropriate stiffness.

[0016] Another object of the present invention is to provide a rotatable drum for a laundry treating machine which is relatively cheap and easy to produce.

[0017] A further object of the present invention is to provide a rotatable drum for a laundry treating machine which has a different looking appearance so that the consumer can immediately distinguish it from the rotatable drums of known laundry treating machines.

[0018] Advantages, objects, and features of the invention will be set forth in part in the description and drawings which follow and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention.

DISCLOSURE OF INVENTION

[0019] According to a first aspect thereof, the present invention relates to a rotatable drum for a laundry treating machine, the rotatable drum comprising a substantially cylindrical lateral wall having a rotation axis, the substantially cylindrical lateral wall being provided with at least one perforated portion having a plurality of through holes which are arranged in an orderly manner so as to form groups of through holes, said through holes in each group being separated one another by first interspaces, said groups being in turn separated one another by second interspaces lacking through holes, the rotatable drum being characterized in that said first interspaces and said second interspaces of said at least one perforated portion have substantially the same radial distance from said rotation axis.

[0020] The feature that the first and second interspaces of the perforated portion have substantially the same radial distance from the rotation axis implies that the first and second interspaces substantially belong to a single substantially cylindrical wall lacking inwards/outwards radial projections. This fact grants that water/air can easily move between the first and the second interspaces, without being obstructed or being captured by possible protrusions, bulges, depressions, etc.; advantageously, in the case the laundry treating machine is a washing or washing-drying machine, the water (or water/detergent mixture) entering the holes of the perforated portion freely flows on the first and second interspaces, without any sort of stagnation (which can occur for instance in the outwards-projecting bulges of the rotatable drum according to EP 2372010). In the case the laundry treating machine is a drying or washing-drying machine, the drying air advantageously flows through the holes with extremely low pressure drop.

[0021] Furthermore the rotatable drum of the invention advantageously has great stiffness and allows obtaining high washing efficiency. Advantageously, such a rotatable drum is cheap, easy to produce and easy to be serviced and/or repaired. Moreover, the consumer immediately distinguishes it from the rotatable drums of known laundry treating machines because it has a totally different looking appearance.

[0022] In the case the laundry treating machine is a washing or washing-drying machine, the arrangement of the through holes in the groups (wherein the through holes are separated one another by the first interspaces) "imposes" a particular path direction to the water (or water/detergent mixture), which helps the water exchange during the washing cycle phase and gives a better evacuation during the spinning cycle phase. Due to the second interspaces, at low angular speed of the drum, the water (or water/detergent mixture) is dragged by the drum rotation and it follows a slightly longer path, staying in contact with the laundry for a longer period and ensuring a deeper wetting action beyond the simply immersion into the water contained into the tub. In addition thereof, a film of water occurs on the second interspaces, prolonging the above mentioned effect. On the other hand, during spinning phase at high angular speed of the drum, the second interspaces contrast the centrifugal force by pressing against the laundry and providing an additional wringing effect.

[0023] In the case the laundry treating machine is a drying or washing-drying machine, the arrangement of the through holes in the groups provides a good air flow through the drum, in this way allowing good drying performances.

[0024] Preferably, said groups of through holes are arranged in a plurality of parallel rows, said groups being staggered one another.

[0025] Advantageously, said arrangement allows obtaining a high through holes density for surface unit.

[0026] Preferably, the arrangement of the through holes in each of said groups defines a substantially polygonal pattern. More preferably, said substantially polygonal pattern is a regular polygon or a portion thereof. Even more preferably, said regular polygon is defined by a number of through holes equal at least to the number of vertexes of the regular polygon, for each vertex a through hole being formed.

[0027] In a preferred embodiment of the invention, said regular polygon is a hexagon.

[0028] Advantageously, said hexagonal pattern is easy to realize and it allows obtaining a very high through holes density for surface unit. In addition, a hexagonal pattern allows obtaining a homogeneous perforated portion using a single pattern, due to the fact that hexagons tessellate.

[0029] In a particularly preferred embodiment of the invention, said hexagon is formed by nineteen staggered through holes, which are arranged so that said hexagon has a central through hole surrounded by six through holes, surrounded in turn by twelve through holes, each side of said hexagon having three through holes.

[0030] Surprisingly, the Applicant found that this particular hexagonal pattern allows obtaining - in the case the laundry treating machine is a washing or washing-drying machine - an optimal water exchange during the washing cycle phase and evacuation during the spinning cycle phase.

[0031] Preferably, the percentage ratio between a first area taken up by said through holes and a second area taken up by said through holes, said first interspaces and said second interspaces - said ratio being multiplied by 100 - is comprised in the range between 9.9% and 10.1%, extremes being included, and preferably said percentage ratio is of about 10%. Surprisingly, Applicant found that these particular percentage ratios allow obtaining - in the case the laundry treating machine is a washing or washing-drying machine - optimal performances during both the washing and spinning cycle phases. Indeed, values of percentage ratios lower than the above-mentioned range gives higher washing performances, but poorer spinning performances, and vice versa.

[0032] Preferably, said through holes are substantially circular and have substantially the same diameter.

[0033] More preferably, said diameter is comprised in the range between 2 mm and 4,5 mm, extremes being included, and even more preferably said diameter is about 3 mm.

[0034] Advantageously, Applicant found that these particular diameters allow obtaining - in the case the laundry treating machine is a washing or washing-drying machine - optimal performances during both the washing and spinning cycle phases.

[0035] Preferably, said substantially cylindrical lateral wall is provided with more than one perforated portion and the rotatable drum comprises a plurality of lifters interposed between said perforated portions of said substantially cylindrical lateral wall, said lifters being associated with and projecting inwardly from said substantially cylindrical lateral wall.

[0036] More preferably, the rotatable drum according to the invention comprises three lifters arranged substantially equidistantly along said substantially cylindrical lateral wall.

[0037] In a preferred embodiment of the invention, said substantially cylindrical lateral wall defines an inner and an outer substantially cylindrical surface, and each through hole includes an aperture realized on said inner substantially cylindrical surface and a sleeve projecting radially outwards from said outer substantially cylindrical surface, wherein said sleeve preferably projects radially outwards from said outer substantially cylindrical surface for a radial height comprised in the range between 0.4 mm and 0.8 mm, extremes being included, and more preferably said radial height is of about 0.6 mm.

[0038] Advantageously, these particular heights do not damage the laundry.

[0039] Preferably, said sleeve of said through holes has substantially rounded fillets in respect of said outer substantially cylindrical surface, said substantially rounded fillets preferably having a curvature radius "r" comprised in the range between 1.0 mm and 1.4 mm, extremes being included.

[0040] Advantageously, by using such particular curvature radii, the water can easily slide through the holes, in the case the laundry treating machine is a washing or washing-drying machine. Furthermore, by using such particular curvature radii, the laundry is protected from any damage, since there are not sharp edges at the free end of said sleeves of the through holes.

[0041] According to a second aspect thereof, the present invention relates to a laundry treating machine including a casing accommodating a rotatable drum suitable for receiving laundry to be treated, and a door provided for allowing access to the rotatable drum, the rotatable drum being realized according to what has been just mentioned above.

[0042] In other words, preferably, such a rotatable drum of said laundry treating machine has - individually or in combination - all of the structural and functional features discussed above with reference to the rotatable drum of the present invention and therefore has all of the above-mentioned advantages.

BRIEF DESCRIPTION OF THE DRAWINGS

[0043] Further features and advantages of the present invention shall become clearer from the following detailed description of a preferred embodiment thereof, made with reference to the attached drawings and given as an indication and not for limiting purposes.

[0044] In particular, the attached drawings are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification. The drawings together with the description serve to explain the principles of the invention. In the drawings, corresponding characteristics and/or components are identified by the same reference numbers. In such drawings:

- figure 1 schematically shows a perspective view of a laundry treating machine (in particular, a front-loading laundry washing machine) according to the invention, wherein a door is shown in its opened position, so that a rotatable drum included in said laundry treating machine is visible;
- figure 2 schematically shows a perspective view of the rotatable drum of figure 1;
- figures 3 and 4 schematically show elevation views (front and back, respectively) of the rotatable drum of figures 1 and 2;
- figures 5a-5d schematically show side elevation views of the rotatable drum of figures 1 and 2, in four different angular positions of the drum rotating about its rotation axis;
- figure 6 schematically shows a perspective view of a substantially cylindrical lateral wall of the rotatable drum of figures 1 and 2;
- figure 7 schematically shows a plant view of the sub-

stantially cylindrical lateral wall of figure 6, wherein the substantially cylindrical lateral wall is rectified;

- figure 8 schematically shows a enlarged view of a portion of the rectified substantially cylindrical lateral wall of figure 7;

- figure 8a schematically shows an enlarged view of detail 8a of figure 8;

- figure 8b schematically shows an enlarged view of the squared detail 8b of figure 8; and

- figure 9 schematically shows a cross sectional view of the substantially cylindrical lateral wall of figure 6, taken according to the plane IX - IX of figure 8a, which is perpendicular to the rotation axis of the rotatable drum of figures 1 and 2.

DETAILED DESCRIPTION OF THE INVENTION

[0045] With initial reference to figure 1, a laundry treating machine according to the invention is shown, which is globally indicated with reference numeral 2.

[0046] In particular, a laundry washing machine is shown, without this implying any loss of generality, i.e., the laundry treating machine of the invention can be a laundry washing machine, a laundry washing-drying machine or a laundry drying machine. The laundry treating machine 2 is hereinafter also referred to as washing machine 2.

[0047] More in particular, a laundry washing machine of the front-loading type is shown. It is however clear that the invention is applicable, substantially without any crucial modification, to a laundry treating machine of the top-loading type (both of the horizontal axis type and of the vertical axis type).

[0048] A rotatable drum 1 is mounted into the laundry washing machine 2 for housing the laundry to be washed.

[0049] The washing machine 2 illustrated in figure 1 advantageously comprises: an outer box casing 3, preferably, though not necessarily, parallelepiped-shaped; a hollow washing tub (not indicated in the enclosed figures), substantially cylindrical, suspended in floating manner inside the casing for example via a suspension system preferably, though not necessarily, comprising a number of coil springs (not shown) connecting the upper portion of the washing tub to the top of the casing 3, and one or more vibration dampers (not shown) connecting the lower portion of the washing tub to the bottom of the casing 3. The rotatable drum 1 is positioned in axially rotating manner inside the washing tub for rotating about its longitudinal axis L; and an electric motor assembly (not shown) for rotating, on command, the rotatable drum 1 about its rotation axis L inside washing tub is also included.

[0050] In the present description and in the following claims, the words "top", "bottom", "above", "below", or the like, refer to the relative positions of portions of the washing machine 2 with respect to the floor.

[0051] As indicated above, the washing machine 2 illustrated in the enclosed figure 1 is a front-loading type washing machine, and therefore the washing tub is suspended substantially horizontally inside the casing 3, with a front opening (not indicated in the enclosed figures) of the washing tub directly faced to a laundry loading and unloading opening 4 formed in a front face 3a of the casing 3.

[0052] Moreover, the front-loading type laundry washing machine 2 advantageously comprises: an elastic-deformable bellows 8 (chematically illustrated in figure 1), preferably substantially cylindrical, which connects the front opening of washing tub to the laundry loading and unloading opening 4 formed in the front face 3a of the casing 3; and a porthole door 9 which is advantageously hinged to the front face 3a of the casing 3 so as to rotate to and from a closing position in which the porthole door 9 closes the laundry loading and unloading opening 4 located in the front face 3a, so as to watertight seal the washing tub.

[0053] The rotatable drum 1, in turn, is preferably, though not necessarily, housed into the washing tub so that its longitudinal axis (or rotation axis) is oriented substantially horizontally and approximately coincides with the longitudinal axis of washing tub (clearly the invention may be applied without any crucial modification also to a washing machine, not illustrated, in which the washing tub and the rotatable drum are inclined with respect to the horizontal plane).

[0054] With reference to figure 1, the washing machine 2 is also advantageously provided with:

- a water supply circuit (not shown) which is structured for supplying a given amount of tap water into washing tub;

- a washing water recirculating and draining circuit (not shown) which is structured for sucking the washing water from the bottom of the washing tub and feeding this water back inside into the rotatable drum 1 during the washing and rinsing phases of the washing cycle, or alternatively draining the water accumulated on the bottom of the washing tub directly into a waste-water exhaust duct (non shown) located outside the casing 3; and

- a water heater (not shown), for example an electrical resistor, which is located preferably on the bottom of washing tub, preferably, thought not necessarily, into an outwards-projecting basin-shaped seat (not shown) realized on the bottom of washing tub, and is structured for heating the washing water accumulated on the bottom of the washing tub.

[0055] In a different embodiment, the washing water recirculating and draining circuit may be replaced by a

washing water draining circuit which is structured for solely sucking the washing water from the bottom of the washing tub and feeding this water directly into the wastewater exhaust duct (not shown) located outside the casing 3.

[0056] The casing 3, the washing tub, the suspension system, the electric motor assembly, the bellows 8, the porthole door 9, the fresh water supply circuit, the washing water recirculating and draining circuit and the water heater are commonly know parts in the laundry washing machine technical field, and therefore are not described in detail.

[0057] With particular reference to figures 2, 3, 4 and 5a-5d, the rotatable drum 1 comprises a substantially cylindrical and hollow body 13 preferably, thought not necessarily, made of metal material, for example stainless steel.

[0058] Advantageously, the rotatable drum 1 may optionally comprise also a number (for example three) of transversal protruding ribs or lifter 14, which are located on an inner surface 13d of a substantially cylindrical lateral wall 13a of the body 13, evenly spaced one another. In jargon, the substantially cylindrical lateral wall 13a is also called wrapper of the drum 1.

[0059] Moreover these transversal protruding ribs 14 preferably, thought not necessarily, extend substantially parallel to the longitudinal axis L of the body 13, i.e., of the rotatable drum 1, and project from the inner surface of the substantially cylindrical lateral wall 13a towards the center of the drum 1 so as to lift the laundry during the rotation of the rotatable drum 1.

[0060] With particular reference to figures 6, 7, 8, 8a, 8b and 9, the rotatable drum 1 is provided with a plurality of through holes 15 which are arranged at least on the substantially cylindrical lateral wall 13a (however further through holes may be optionally provided also on one or more of the front and back bases 13b, 13c of the substantially cylindrical and hollow body 13) so as to assure adequate water circulation across the drum 1 during all phases of the washing cycle. In jargon, the through holes 15 are also called drain holes.

[0061] Advantageously, the substantially cylindrical lateral wall 13a is provided with one or more perforated portions 13a' each one comprising a plurality of through holes 15 which are arranged in an orderly manner so as to form groups 15a of through holes 15.

[0062] As clearly shown in the non-limiting example illustrated in figure 7, the perforated portions 13a' may be for example three. Three lifters 14 are in this case preferably interposed between the three perforated portions 13a'. The three lifters 14 are associated with three linking portions 14a of the substantially cylindrical lateral wall 13a, each linking portion 14a being circumferentially arranged between two of the perforated portions 13a', so that the three lifters 14 are arranged substantially equidistantly along the substantially cylindrical lateral wall 13a.

[0063] Each linking portion 14a comprises element(s) (for example slots 50)for associating the lifter 14, for example through shape coupling between fin(s) and/or hook(s) comprised in the lifters 14 and slots 50.

[0064] In the non-limiting example of figure 7, the substantially cylindrical lateral wall 13a further comprises two opposed side portions 13a'', advantageously lacking through holes, arranged at the two opposed free side of the substantially cylindrical lateral wall 13a, so that the perforated portions 13a' and the linking portions 14a are interposed between the two opposed side portions 13a''. Alternatively, the perforated portion(s) 13a' may cover the whole width of the substantially cylindrical lateral wall 13a.

[0065] As visible in figure 8a, where a single group 15a of through holes 15 is depicted, the through holes 15 in each group 15a are separated one another by first interspaces 15b. The groups 15a are in turn separated one another by second interspaces 15c lacking through holes (see figures 8 and 8b). The first and second interspaces 15b, 15c are substantially non-perforated wall sections that separates the holes 15 from each others and the groups 15a one from the others, respectively.

[0066] According to a feature of the present invention, the first interspaces 15b and the second interspaces 15c of the perforated portions 13a' have substantially the same radial distance from the rotation axis L. In other words, the first interspaces 15b and the second interspaces 15c substantially belong to a single substantially cylindrical wall lacking inwards/outwards radial projections. Thus, this substantially cylindrical wall, besides holes 15, in section substantially defines a circumference, having center on the rotation axis L and polar coordinates $r(\varphi)$ - a wherein a = constant.

[0067] The groups 15a of through holes 15 are preferably arranged in a plurality of parallel rows, the groups 15a being staggered one another.

[0068] In figure 8, at least three different types of parallel rows can be identified, whose directions have been indicated with three axis, numbered R1, R2 and R3.

[0069] The parallel rows having direction R1 are substantially perpendicular to the rotation axis L, the parallel rows having direction R2 are substantially parallel to the rotation axis L, and the parallel rows having direction R3 are slanting to the rotation axis L.

[0070] In the non-limiting example of the preferred embodiment illustrated, the arrangement of the through holes 15 in each of the groups 15a defines a substantially polygonal pattern which is a hexagon or a portion thereof.

[0071] In particular, a regular hexagon has been used in the illustrated preferred embodiment, but a different polygon (preferably a regular polygon) can be used as well (like a pentagon, a triangle, etc.). Preferably, a tessellating polygon is used. The (regular) polygon pattern allows obtaining a high "compression" of the groups 15a, i.e. a high group density for surface unit.

[0072] In this case, owing to the hexagonal pattern of the groups 15a, the angle between the rows having axis R3 and an axix perpendicular to the rotation axis L (e.g.

axis R1) is about 34°.

[0073] As clearly shown in figure 8a, the hexagon is preferably formed by nineteen staggered through holes 15, which are arranged so that said hexagon has a central through hole 15' surrounded by six through holes 15", surrounded in turn by twelve through holes 15"', each side of this hexagon having three through holes 15'" and the vertex angle being of about 120°. In other words, the nineteen through holes 15 of the hexagon are arranged in five staggered rows (having - in sequence - three, four, five, four and three through holes 15, respectively) extended along a direction substantially perpendicular to the rotation axis L (circumferential direction of the rotatable drum 1) and in nine rows (having - in sequence - one, two, three, two, three, two, three, two and one through holes 15, respectively) extended along a direction substantially parallel to the rotation axis L (axial direction of the rotatable drum 1).

[0074] The hexagonal groups 15a are separated one from the other of a distance substantially equal to the space occupied by a row of holes.

[0075] In the non-limiting example of the preferred embodiment illustrated in figure 8b, the hexagonal groups 15a are separated one from the other by a first distance substantially equal to the space occupied by a row of holes only along a direction substantially parallel to the rotation axis L (i.e. R2). This first distance is substantially equal to the width w1 of the rectangle indicated with A in figure 8b. Along four directions substantially slanting to the rotation axis L, the hexagonal groups 15a are separated one from the other by a second distance slightly lower than the space occupied by a row of holes. This second distance is substantially equal to the width w2 of the rectangle indicated with B in figure 8b. In the present description, with the expression "slightly lower" it is meant that said second distance (w2) is lower than the space occupied by a row of holes of a percentage comprised in the range between 55.7% and 58%, extremes being included, and more preferably said percentage is of about 56.8%.

[0076] As clearly shown in figure 8b, the second interspaces 15c include both the rectangles A and B.

[0077] In other words, one side of one hexagon is separated from one respective side of another adjacent hexagon by a distance w1 in direction L (or R2), and w2 in directions different from L (or R2). Thus, one hexagon is surrounded by a second interspace 15c shaped as a substantially hexagonal ring, which separates such hexagon from the adjacent hexagons and whose sides have a width respectively w1 or w2.

[0078] Preferably, along the direction substantially parallel to the rotation axis L (i.e. R2), the centers of the through holes 15 (i.e., the distance between two center through holes 15' of two adjacent hexagons) of two adjacent hexagons are spaced apart one another by a third distance w3, preferably comprised in the range between 42.5 mm and 43.1 mm, extremes being included, and more preferably said third distance w3 is of about 42.8 mm.

[0079] Preferably, along the four directions substantially slanting to the rotation axis L, the centers of the through holes 15 of two adjacent hexagons are spaced apart one another by a fouth distance w4 comprised in the range between 37.8 mm and 38.4 mm, extremes being included, and more preferably said fourth distance is of about 38.1 mm.

[0080] In this manner, it is obtained a sequence of hexagonal groups 15a placed in a preferential slanting direction, with an angle of about 34° in respect of an axis perpendicular to the rotation axis L (i.e. R), which results in a "cross chess" visual effect.

[0081] The total amount of hexagonal groups 15a in the perforated portion 13a' may change depending on the length and width of rotatable drum 1, which depends on the laundry treating machine 2.

[0082] Preferably at the edges of the perforated portion 13a', the groups 15a can be shaped not as a full hexagon, but also as a portion of the same, for example the groups 15a can have twelve through holes 15 arranged in three staggered rows (having - in sequence - three, four and five through holes 15, respectively) extended along a direction substantially perpendicular to the rotation axis L.

[0083] In general, the groups 15a form hexagons each of which can be defined by a number of through holes equal at least to six (i.e., the number of vertexes of the hexagon), for each vertex a through hole being formed.

[0084] The through holes 15 are substantially circular and have substantially the same diameter.

[0085] Preferably, such a diameter is comprised in the range between 2 mm and 4,5 mm, extremes being included, and more preferably said diameter is about 3 mm.

[0086] Preferably, along a direction substantially perpendicular to the rotation axis L (i.e. R1), the centers of the through holes 15 of each group 15a are spaced apart one another by a fifth distance w5 comprised in the range between 31.2 mm and 31.8 mm, extremes being included, and more preferably said fifth distance is of about 31.5 mm.

[0087] As clearly shown in figure 9, the substantially cylindrical lateral wall 13a defines an inner and an outer substantially cylindrical surface 13d and 13e. Each through hole 15 includes an aperture (or inlet) 16d realized on the inner substantially cylindrical surface 13d and a sleeve (comprising an outlet) 16e projecting radially outwards from the outer substantially cylindrical surface 13e.

[0088] The sleeve 16e preferably projects radially outwards from the outer substantially cylindrical surface 13e for a radial height comprised in the range between 0.4 mm and 0.8 mm, extremes being included, and more preferably this radial height is of about 0.6 mm.

[0089] Furthermore, the sleeve 16e has substantially rounded fillets 16e' in respect of the outer substantially cylindrical surface 13e.

[0090] The substantially rounded fillets 16e' preferably have a curvature radius ("r" in figure 9) comprised in the

range between 1.0 mm and 1.4 mm, extremes being included, and more preferably said curvature radius is of about 1.2 mm.

[0091] Advantageously, the through holes 15 with the above-mentioned respective sleeves are obtained by embossing. By this embossing, the inner substantially cylindrical surface 13d has rounded profile in order to avoid any damage of the laundry due to rips and tears.

[0092] Preferably, the percentage ratio between a first area taken up by the through holes 15 and a second area taken up by the through holes 15, the first interspaces 15b and the second interspaces 15c - said ratio being multiplied by 100 - is comprised in the range between 9.9% and 10.1%, extremes being included. More preferably, such a percentage ratio is of about 10%.

[0093] In other words, said percentage ratio is the ratio between a "surface of holes" (i.e., the first area taken up by the through holes 15) and a "total surface" of one single perforated portion 13a' of the substantially cylindrical lateral wall 13a of the rotatable drum 1 (i.e., the second area taken up by the through holes 15, the first interspaces 15b and the second interspaces 15c). Said "total surface" of one single perforated portion 13a' is clearly visible in figure 7, wherein three perforated portions 13a' are shown. In particular, the "total surface" of one single perforated portion 13a' is the surface of one of the three rectangles indicated in figure 7 by dotted lines, each rectangle defining one perforated portion 13a' and being the smallest rectangle circumscribed about the groups 15a of through holes 15 of one single perforated portion 13a'.

[0094] General operation of the laundry washing (and/or drying) machine 2 is substantially identical to that of a conventional laundry washing (and/or drying) machine, therefore no further explanation is required.

[0095] A production of the rotatable drum 1 comprises the step of punching a substantially flat metal sheet 20 (shown in figure 7) which is preferably, though not necessarily, made of stainless steel, so as to realize, on the latter, the above-described plurality of groups 15a of through holes 15. Generally, the substantially flat metal sheet 20 has a substantially rectangular shape.

[0096] Afterwards, the production of the rotatable drum 1 comprises the step of cylindrically bending the metal sheet 20 so as to form a cylindrical coil (shown in figure 6), in which the sleeves 16e of the through holes 15 protrude outwards (i.e., towards the external of the rotatable drum 1).

[0097] Afterwards, the production of the rotatable drum 1 comprises the step of side-to-side connecting the two facing opposite lateral edges of the metal sheet 20 preferably, though not necessarily, by clinching or welding, so as to form a cylindrical sleeve, i. e., to form the substantially cylindrical lateral wall 13a of the rotatable drum 1.

[0098] If the rotatable drum 1 is to be mounted into a front-loading washing machine, the production of the rotatable drum 1 further comprises the step of fitting, on the two axial ends of the substantially cylindrical lateral wall 13a, respectively the front base 13b (preferably, a ring-shaped flange provided with an opening for loading/unloading the laundry, as shown in figure 3) and the back base 13c (preferably, a rigid disc-shaped plate, as shown in figure 3), both preferably, though not necessary, made of stainless steel. Afterwards, the assembly of the rotatable drum 1 comprises the step of side-to-side connecting, preferably, though not necessarily, via clinching or welding, the external circular border of the flange 13b and of the plate 13c to the the substantially cylindrical lateral wall 13a, so as to realize the substantially cylindrical and hollow body 13, which is preferably bell-shaped (i.e., cylindrical, hollow, closed at one base - i.e., the base 13c - and partially opened at the other base - i.e., the base 13b). Advantageously, but not necessarily, through holes analogous to the ones described above with reference to the substantially cylindrical lateral wall 13a, may be present also in the ring-shaped flange 13b and/or in the disc-shaped plate 13c.

[0099] Alternatively, if the rotatable drum 1 is to be mounted into a top-loading washing machine of the horizontal axis type, the production of the rotatable drum 1 comprises the step of fitting, on the two axial ends of the substantially cylindrical lateral wall 13a, respectively two rigid disc-shaped plates, both preferably, though not necessary, made of stainless steel. Afterwards, the production of the rotatable drum 1 comprises the step of side-to-side connecting, preferably, though not necessarily, via clinching or welding, the external circular border of the two plates to the substantially cylindrical lateral wall 13a, so as to realize a hollow cylindrical body. Moreover, if the rotatable drum 1 is to be mounted into a top-loading washing machine, on the substantially cylindrical lateral wall 13a there is an opening, not illustrated in the enclosed figures, adapted for allowing the loading/unloading of the laundry. This opening is advantageously closable by one or more lids associated (for example hinged, or slidably associated) to the rotatable drum 1. Advantageously, but not necessarily, through holes analogous to the ones described above with reference to the substantially cylindrical lateral wall 13a, can be present also in one or both the disc-shaped plates and/or on the one or more lids.

[0100] It has thus been shown that the present invention allows all the set objects to be achieved.

[0101] Clearly, changes may be made to the rotatable drum and to the laundry treating machine (including such a rotatable drum) as described herein.

[0102] Although an illustrative embodiment of the present invention have been described herein with reference to the attached drawings, it is to be understood that the present invention is not limited to the specific embodiment illustrated and described herein, and that various other changes and modifications may be affected therein by one skilled in the art without departing from the scope of the invention. All such changes and modifications are intended to be included within the scope of

the invention as defined by the following claims.

[0103] It is underlined that dependent claims refer to preferred embodiment of the invention.

Claims

1. Rotatable drum (1) for a laundry treating machine (2), the rotatable drum (1) comprising a cylindrical lateral wall (13a) having a rotation axis (L), the cylindrical lateral wall (13a) being provided with at least one perforated portion (13a') having a plurality of through holes (15) which are arranged in an orderly manner so as to form groups (15a) of through holes (15), said through holes (15) in each group (15a) being separated one another by first interspaces(15b), said groups (15a) being in turn separated one another by second interspaces (15c) lacking through holes, the rotatable drum (1) being **characterized in that** said first interspaces (15b) and said second interspaces (15c) of said at least one perforated portion (13a') have the same radial distance from said rotation axis (L) and **in that** the arrangement of the through holes (15) in each of said groups (15a) defines a hexagon and **in that** the second interspaces (15c) include rectangles of respective widths w1 and w2.

2. Rotatable drum (1) according to claim 1, wherein said groups (15a) of through holes (15) are arranged in a plurality of parallel rows, said groups (15a) being staggered one another.

3. Rotatable drum (1) according to claims 1 or 2, wherein said hexagon is defined by a number of through holes (15) equal at least to the number of vertexes of the hexagon, for each vertex a through hole (15) being formed.

4. Rotatable drum (1) according to claims 1 to 3, wherein said hexagon is formed by nineteen staggered through holes (15), which are arranged so that said hexagon has a central through hole (15') surrounded by six through holes (15''), surrounded in turn by twelve through holes (15'''), each side of said hexagon having three through holes (15''').

5. Rotatable drum (1) according to any one of the previous claims, wherein the percentage ratio between the surface of holes (15) and the total surface of one single perforated portion (13a') is comprised in the range between 9.9% and 10.1%, extremes being included, and preferably said percentage ratio is of about 10%.

6. Rotatable drum (1) according to any one of the previous claims, wherein said through holes (15) are circular and have the same diameter.

7. Rotatable drum (1) according to claim 6, wherein said diameter is comprised in the range between 2 mm and 4,5 mm, extremes being included, and preferably said diameter is about 3 mm.

8. Rotatable drum (1) according to any one of the previous claims, wherein said cylindrical lateral wall (13a) is provided with more than one perforated portion (13a') and the rotatable drum (1) comprises a plurality of lifters (14) interposed between said perforated portions (13a') of said cylindrical lateral wall (13a), said lifters (14) being associated with and projecting inwardly from said cylindrical lateral wall (13a).

9. Rotatable drum (1) according to claim 8, comprising three lifters (14) arranged equidistantly along said cylindrical lateral wall (13a).

10. Rotatable drum (1) according to any one of the previous claims, wherein said cylindrical lateral wall (13a) defines an inner (13d) and an outer cylindrical surface (13e), and each through hole (15) includes an aperture (16d) realized on said inner cylindrical surface (13d) and a sleeve (16e) projecting radially outwards from said outer cylindrical surface (13e), wherein said sleeve (16e) preferably projects radially outwards from said outer cylindrical surface (13e) for a radial height comprised in the range between 0.4 mm and 0.8 mm, extremes being included, and more preferably said radial height is of about 0.6 mm.

11. Rotatable drum (1) according to claim 10, wherein said sleeve (16e) of said through holes (15) has rounded fillets (16e') in respect of said outer cylindrical surface (13e), said rounded fillets (16e') preferably having a curvature radius (r) comprised in the range between 1.0 mm and 1.4 mm, extremes being included, more preferably said curvature radius (r) being of about 1.2 mm.

12. Laundry treating machine (2) including a casing (3) accomodating a rotatable drum (1) suitable for receiving laundry to be treated, and a door (9) provided for allowing access to the rotatable drum (1), the rotatable drum (1) being configured according to any one of the previous claims..

Patentansprüche

1. Rotierende Trommel (1) für eine Wäschebehandlungsmaschine (2), wobei die rotierende Trommel (1) eine eine Drehachse (L) aufweisende zylindrische Seitenwand (13a) umfasst, wobei die zylindrische Seitenwand (13a) mit wenigstens einem perforierten Abschnitt (13a') versehen ist, der eine Vielzahl von Durchbrechungen (15) aufweist, die auf ei-

ne geordnete Weise angeordnet sind, um Gruppen (15a) von Durchbrechungen (15) zu bilden, wobei die Durchbrechungen (15) in jeder Gruppe (15a) durch erste Zwischenräume (15b) voneinander getrennt sind, wobei die Gruppen (15a) wiederum durch zweite Zwischenräume (15c) voneinander getrennt sind, die keine Durchbrechungen aufweisen, wobei die rotierende Trommel (1) **dadurch gekennzeichnet ist, dass** die ersten Zwischenräume (15b) und die zweiten Zwischenräume (15c) des wenigstens einen perforierten Abschnitts (13a') den gleichen radialen Abstand von der Drehachse (L) aufweisen und dass die Anordnung der Durchbrechungen (15) in jeder der Gruppen (15a) ein Sechseck festlegt und dass die zweiten Zwischenräume (15c) Rechtecke mit einer jeweiligen Breite w1 und w2 enthalten.

2. Rotierende Trommel (1) nach Anspruch 1, wobei die Gruppen (15a) von Durchbrechungen (15) in einer Vielzahl von parallelen Reihen angeordnet sind, wobei die Gruppen (15a) versetzt zueinander sind.

3. Rotierende Trommel (1) nach Anspruch 1 oder 2, wobei das Sechseck durch eine Anzahl von Durchbrechungen (15) festgelegt ist, die wenigstens gleich der Anzahl von Ecken des Sechsecks ist, damit für jede Ecke eine Durchbrechung (15) ausgebildet wird.

4. Rotierende Trommel (1) nach den Ansprüchen 1 bis 3, wobei das Sechseck durch neunzehn versetzte Durchbrechungen (15) gebildet ist, die so angeordnet sind, dass das Sechseck eine zentrale Durchbrechung (15') aufweist, die von sechs Durchbrechungen (15'') umgeben ist, die wiederum von zwölf Durchbrechungen (15''') umgeben sind, wobei jede Seite des Sechsecks drei Durchbrechungen (15'''') aufweist.

5. Rotierende Trommel (1) nach einem der vorhergehenden Ansprüche, wobei sich das prozentuale Verhältnis zwischen der Fläche der Durchbrechungen (15) und der Gesamtfläche eines einzelnen perforierten Abschnitts (13a') in einem zwischen 9,9% und 10,1% liegenden Bereich, in dem die Grenzwerte enthalten sind, befindet, und das prozentuale Verhältnis vorzugsweise bei ungefähr 10% liegt.

6. Rotierende Trommel (1) nach einem der vorhergehenden Ansprüche, wobei die Durchbrechungen (15) kreisförmig sind und den gleichen Durchmesser aufweisen.

7. Rotierende Trommel (1) nach Anspruch 6, wobei sich der Durchmesser in dem zwischen 2 mm und 4,5 mm liegenden Bereich, in dem die Grenzwerte enthalten sind, befindet, und der Durchmesser vorzugsweise bei ungefähr 3 mm liegt.

8. Rotierende Trommel (1) nach einem der vorhergehenden Ansprüche, wobei die zylindrische Seitenwand (13a) mit mehr als einem perforierten Abschnitt (13a') versehen ist und die rotierende Trommel (1) eine Vielzahl von Hebern (14) umfasst, die zwischen den perforierten Abschnitten (13a') der zylindrischen Seitenwand (13a) angeordnet sind, wobei die Heber (14) in Verbindung mit der zylindrischen Seitenwand (13a) stehen und von dieser nach innen vorstehen.

9. Rotierende Trommel (1) nach Anspruch 8, die drei Heber (14) umfasst, die gleichabständig entlang der zylindrischen Seitenwand (13a) angeordnet sind.

10. Rotierende Trommel (1) nach einem der vorhergehenden Ansprüche, wobei die zylindrische Seitenwand (13a) eine innere (13d) und eine äußere zylindrische Fläche (13e) festlegt und jede Durchbrechung (15) eine auf der inneren zylindrischen Fläche (13d) realisierte Öffnung (16d) und eine von der äußeren zylindrischen Fläche (13e) radial nach außen vorstehende Hülse (16e) enthält, wobei die Hülse (16e) von der äußeren zylindrischen Fläche (13e) vorzugsweise um eine radiale Höhe radial nach außen vorsteht, die sich in dem zwischen 0,4 mm und 0,8 mm liegenden Bereich, in dem die Grenzwerte enthalten sind, befindet und die radiale Höhe besonders bevorzugt ungefähr 0,6 mm beträgt.

11. Rotierende Trommel (1) nach Anspruch 10, wobei die Hülse (16e) der Durchbrechungen (15) rundliche Stege (16e') in Bezug auf die äußere zylindrische Fläche (13e) aufweist, wobei die rundlichen Stege (16e') vorzugsweise einen Krümmungsradius (r) aufweisen, der sich in dem zwischen 1,0 mm und 1,4 mm liegenden Bereich, in dem die Grenzwerte enthalten sind, befindet und der Krümmungsradius (r) besonders bevorzugt ungefähr 1,2 mm beträgt.

12. Wäschebehandlungsmaschine (2), die ein Gehäuse (3), in dem eine rotierende Trommel (1) untergebracht ist, die geeignet ist, zu behandelnde Wäsche aufzunehmen, und eine Tür (9) enthält, die dazu vorgesehen ist, einen Zugang zu der rotierenden Trommel (1) zu ermöglichen, wobei die rotierende Trommel (1) nach einem der vorhergehenden Ansprüche ausgelegt ist.

Revendications

1. Tambour rotatif (1) pour une machine de traitement de linge (2), le tambour rotatif (1) comprenant une paroi latérale cylindrique (13a) présentant un axe de rotation (L), la paroi latérale cylindrique (13a) étant pourvue d'au moins une partie perforée (13a') com-

portant une pluralité de trous traversants (15) qui sont agencés de façon ordonnée de manière à former des groupes (15a) de trous traversants (15), lesdits trous traversants (15) dans chaque groupe (15a) étant séparés les uns des autres par de premiers espaces intermédiaires (15b), lesdits groupes (15a) étant à leur tour séparés les uns des autres par de seconds espaces intermédiaires (15c) dépourvus de trous traversants, le tambour rotatif (1) étant **caractérisé en ce que** lesdits premiers espaces intermédiaires (15b) et lesdits seconds espaces intermédiaires (15c) de ladite au moins une partie perforée (13a') présentent la même distance radiale à partir dudit axe de rotation (L), et **en ce que** l'agencement des trous traversants (15) dans chacun desdits groupes (15a) définit un hexagone, et **en ce que** les seconds espaces intermédiaires (15c) comprennent des rectangles de largeurs respectives w1 et w2.

2. Tambour rotatif (1) selon la revendication 1, dans lequel lesdits groupes (15a) de trous traversants (15) sont agencés en une pluralité de rangées parallèles, lesdits groupes (15a) étant décalés les uns par rapport aux autres.

3. Tambour rotatif (1) selon la revendication 1 ou 2, dans lequel ledit hexagone est défini par un nombre de trous traversants (15) égal au moins au nombre de sommets de l'hexagone, un trou traversant (15) étant formé pour chaque sommet.

4. Tambour rotatif (1) selon les revendications 1 à 3, dans lequel ledit hexagone est formé par dix-neuf trous traversants décalés (15), qui sont agencés de telle sorte que ledit hexagone présente un trou traversant central (15') entouré par six trous traversants (15"), entourés à leur tour par douze trous traversants (15"'), chaque côté dudit hexagone comportant trois trous traversants (15''').

5. Tambour rotatif (1) selon l'une quelconque des revendications précédentes, dans lequel le rapport de pourcentage entre la surface des trous (15) et la surface totale d'une seule partie perforée (13a') est compris dans la gamme entre 9,9 % et 10,1 %, les extrêmes étant inclus, et de préférence ledit rapport de pourcentage est d'environ 10 %.

6. Tambour rotatif (1) selon l'une quelconque des revendications précédentes, dans lequel lesdits trous traversants (15) sont circulaires et ont le même diamètre.

7. Tambour rotatif (1) selon la revendication 6, dans lequel ledit diamètre est compris dans la gamme entre 2 mm et 4,5 mm, les extrêmes étant inclus, et de préférence ledit diamètre est d'environ 3 mm.

8. Tambour rotatif (1) selon l'une quelconque des revendications précédentes, dans lequel ladite paroi latérale cylindrique (13a) est pourvue de plus d'une partie perforée (13a') et le tambour rotatif (1) comprend une pluralité d'éléments de soulèvement (14) interposés entre lesdites parties perforées (13a') de ladite paroi latérale cylindrique (13a), lesdits éléments de soulèvement (14) étant associés avec et faisant saillie vers l'intérieur à partir de ladite paroi latérale cylindrique (13a).

9. Tambour rotatif (1) selon la revendication 8, comprenant trois éléments de soulèvement (14) agencés de façon équidistante le long de ladite paroi latérale cylindrique (13a).

10. Tambour rotatif (1) selon l'une quelconque des revendications précédentes, dans lequel ladite paroi latérale cylindrique (13a) définit une surface cylindrique intérieure (13d) et extérieure (13e), et chaque trou traversant (15) comprend une ouverture (16d) réalisée sur ladite surface cylindrique intérieure (13d) et un manchon (16e) faisant saillie radialement vers l'extérieur à partir de ladite surface cylindrique extérieure (13e), dans lequel ledit manchon (16e) fait de préférence saillie radialement vers l'extérieur à partir de ladite surface cylindrique extérieure (13e) pour une hauteur radiale comprise dans la gamme entre 0,4 mm et 0,8 mm, les extrêmes étant inclus, et mieux encore ladite hauteur radiale est d'environ 0,6 mm.

11. Tambour rotatif (1) selon la revendication 10, dans lequel ledit manchon (16e) desdits trous traversants (15) présente des congés arrondis (16e') en relation avec ladite surface cylindrique extérieure (13e), lesdits congés arrondis (16e') présentant de préférence un rayon de courbure (r) compris dans la gamme entre 1,0 mm et 1,4 mm, les extrêmes étant inclus, mieux encore ledit rayon de courbure (r) est d'environ 1,2 mm.

12. Machine de traitement de linge (2) comprenant une carrosserie (3) contenant un tambour rotatif (1) approprié pour recevoir du linge à traiter, et une porte (9) prévue pour offrir un accès au tambour rotatif (1), le tambour rotatif (1) étant réalisé selon l'une quelconque des revendications précédentes.

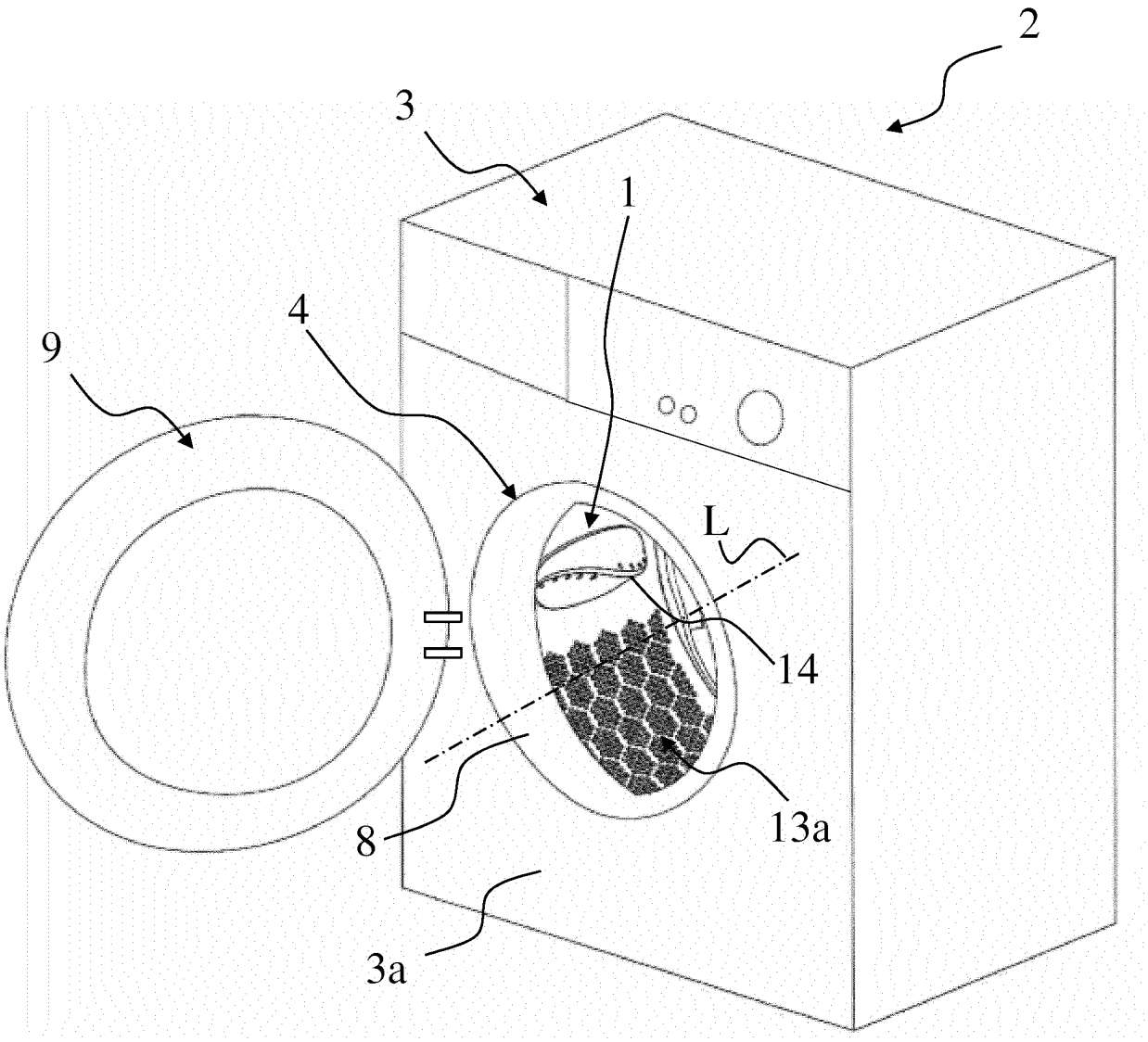


Fig. 1

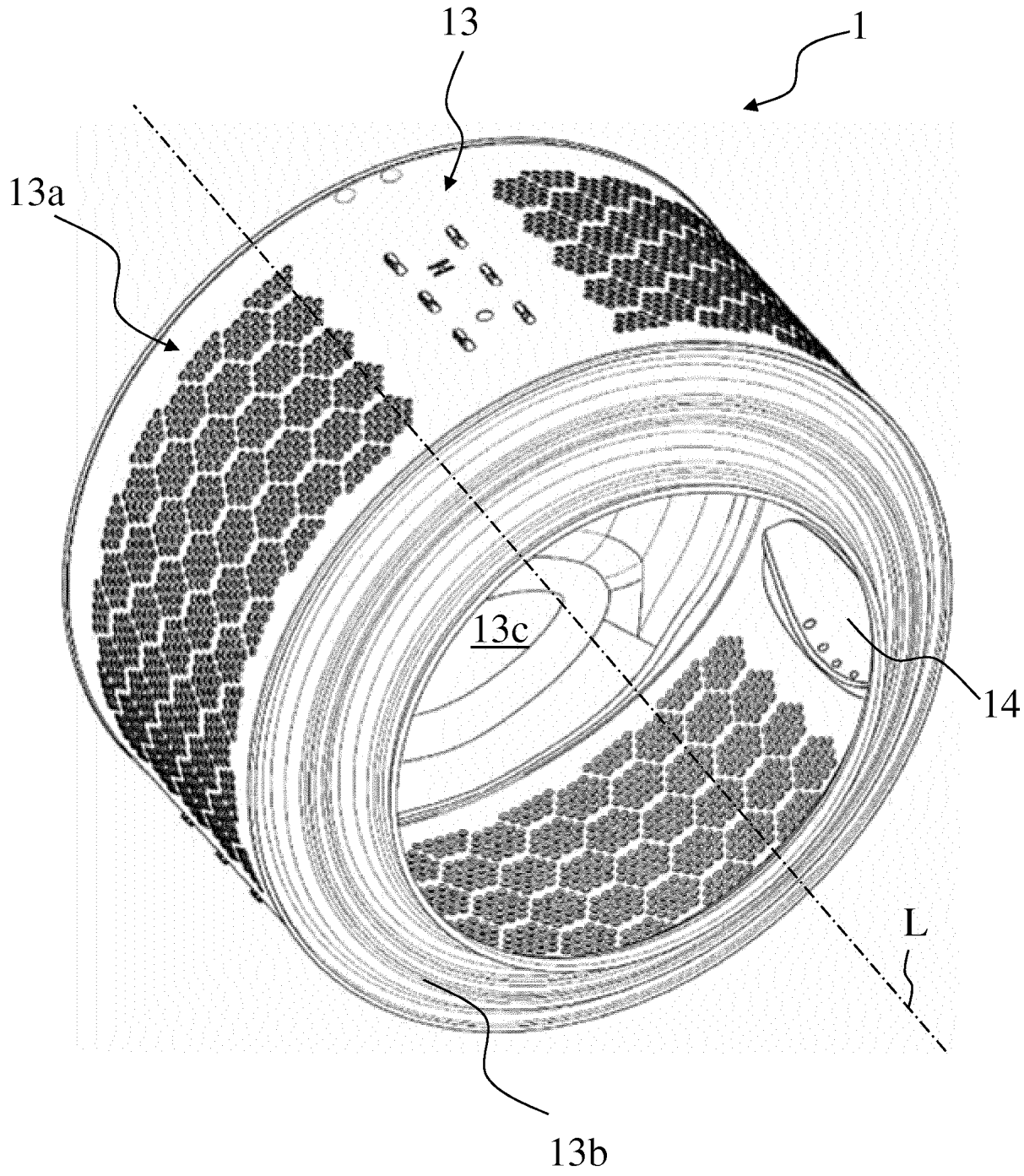


Fig. 2

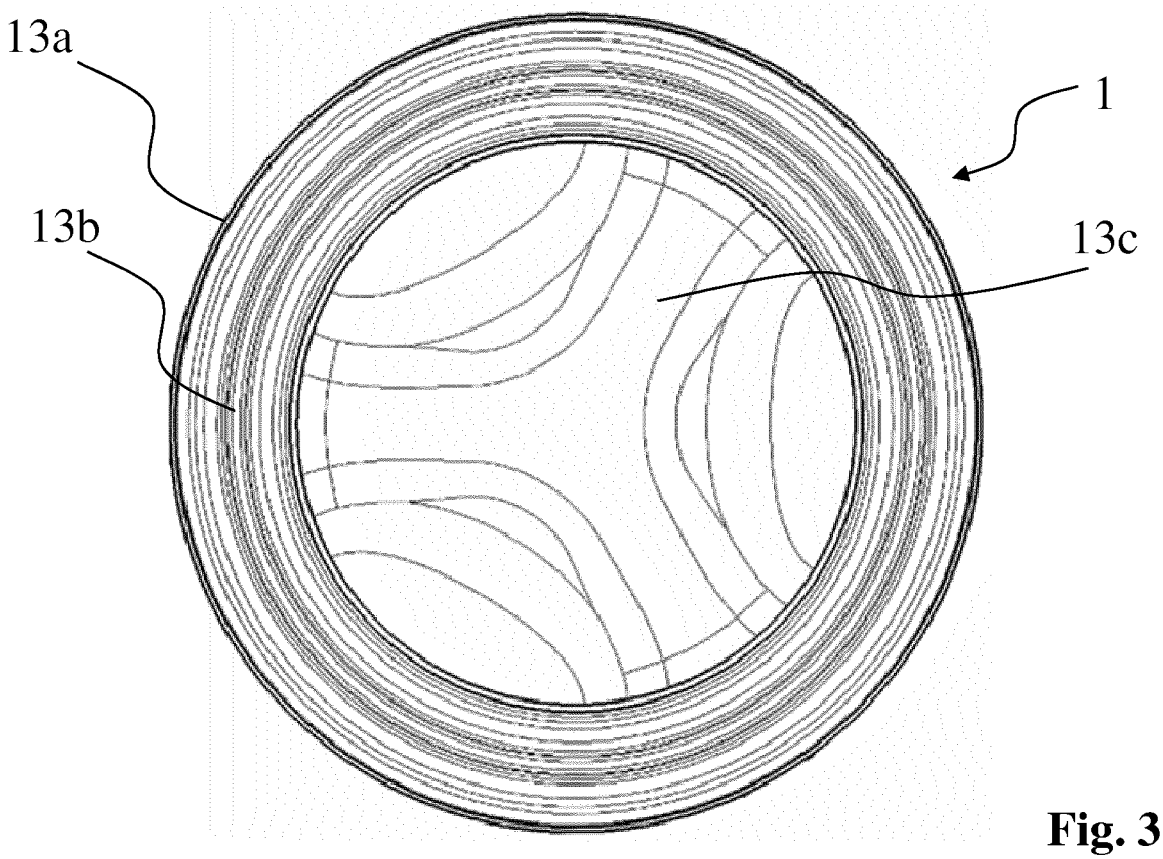


Fig. 3

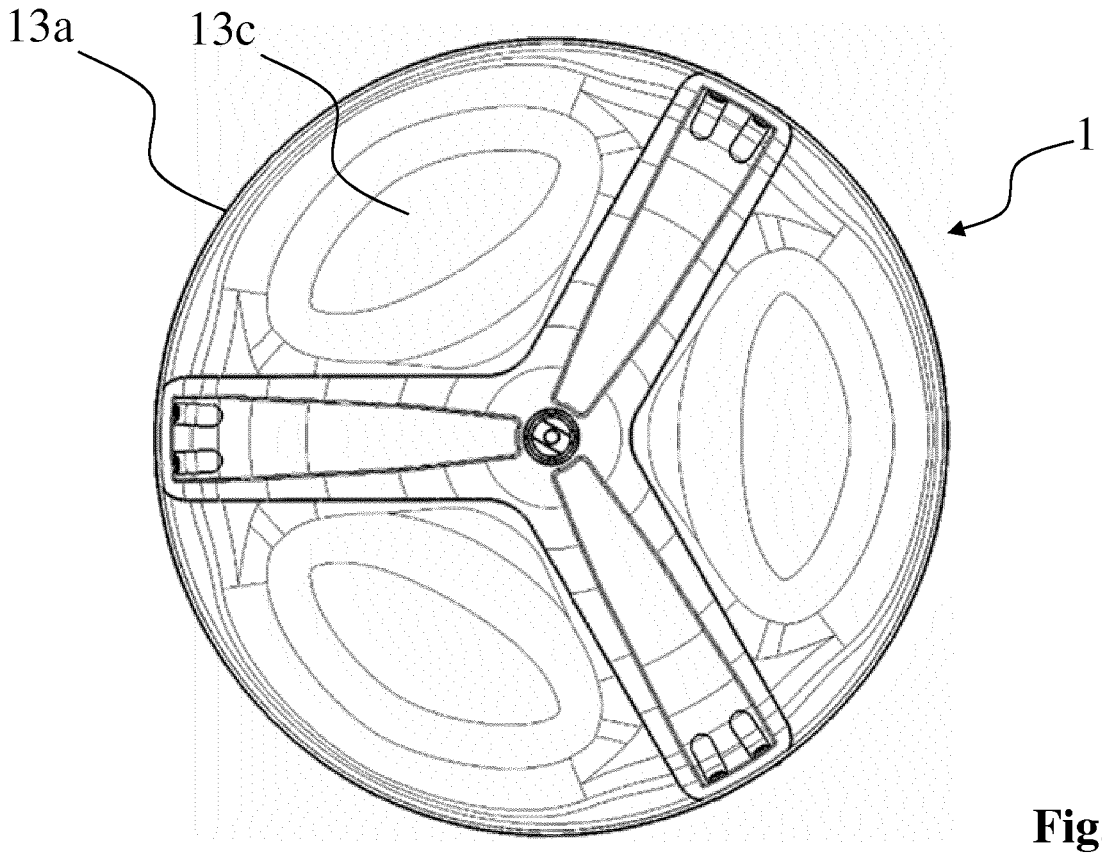


Fig. 4

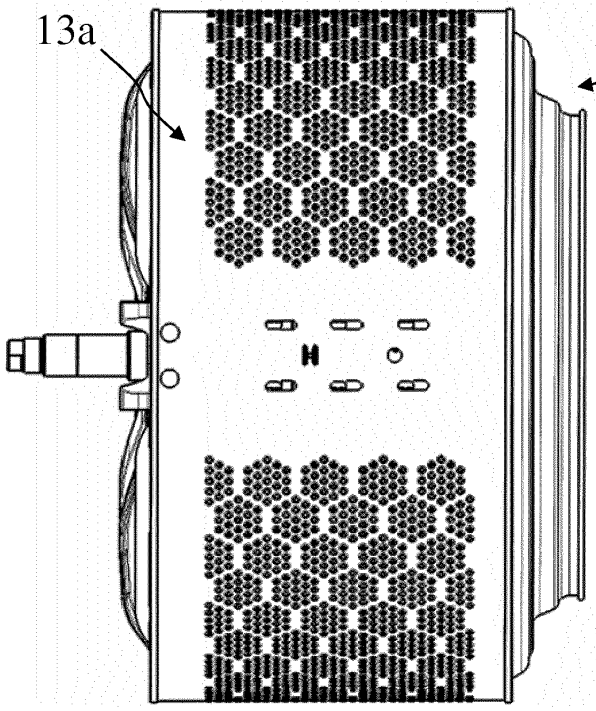


Fig. 5a

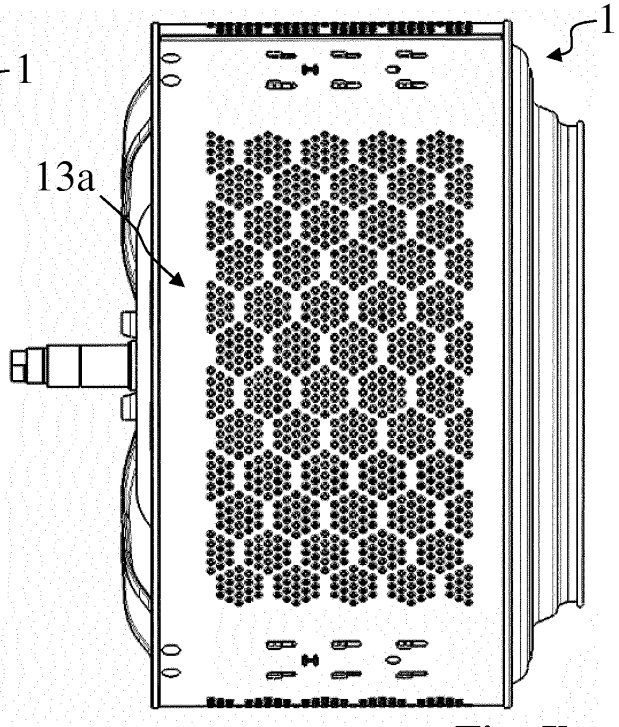


Fig. 5b

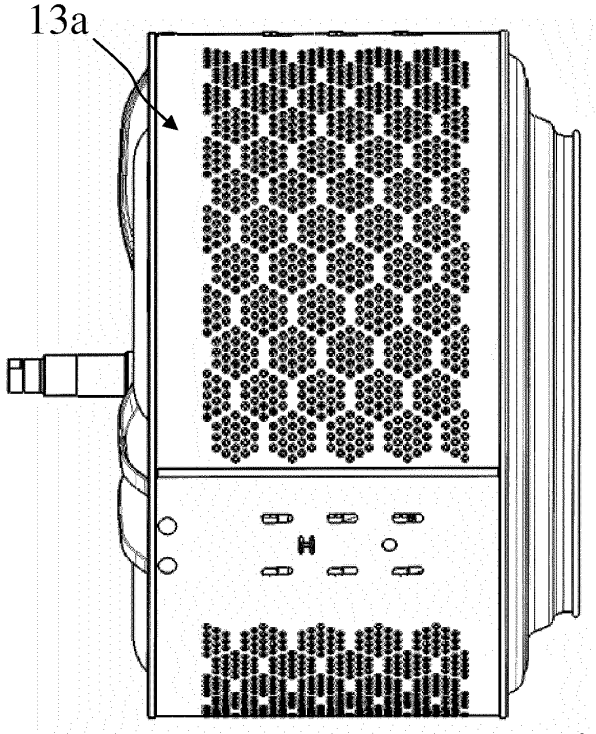


Fig. 5c

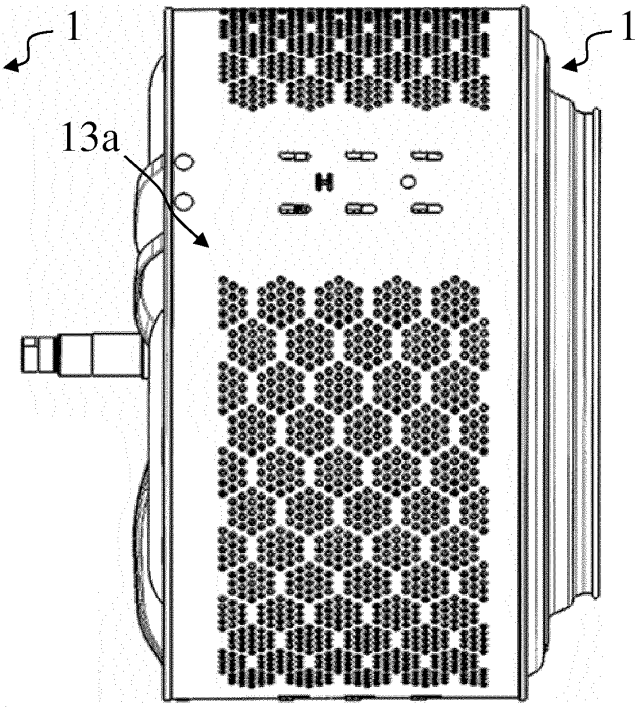


Fig. 5d

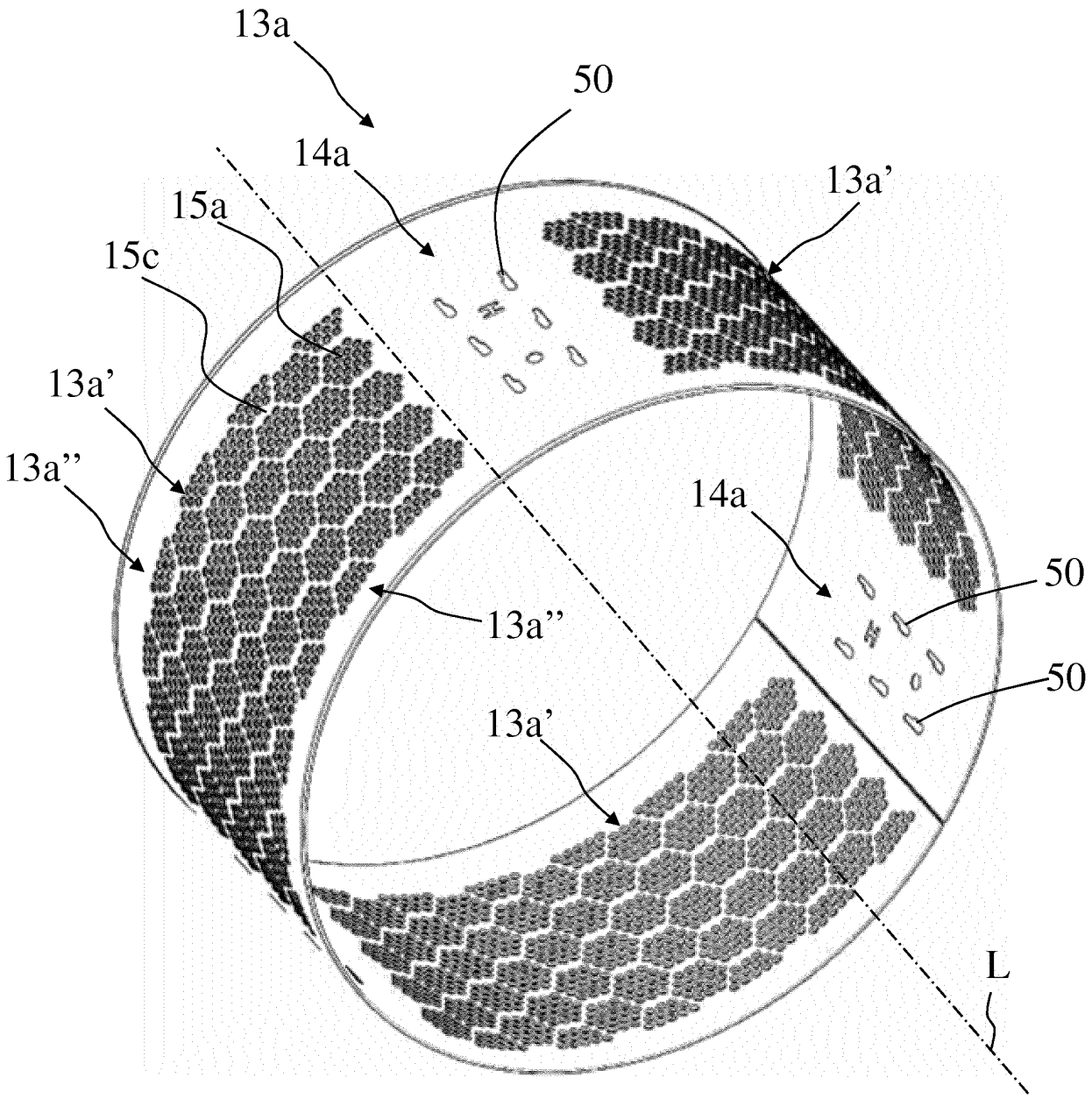


Fig. 6

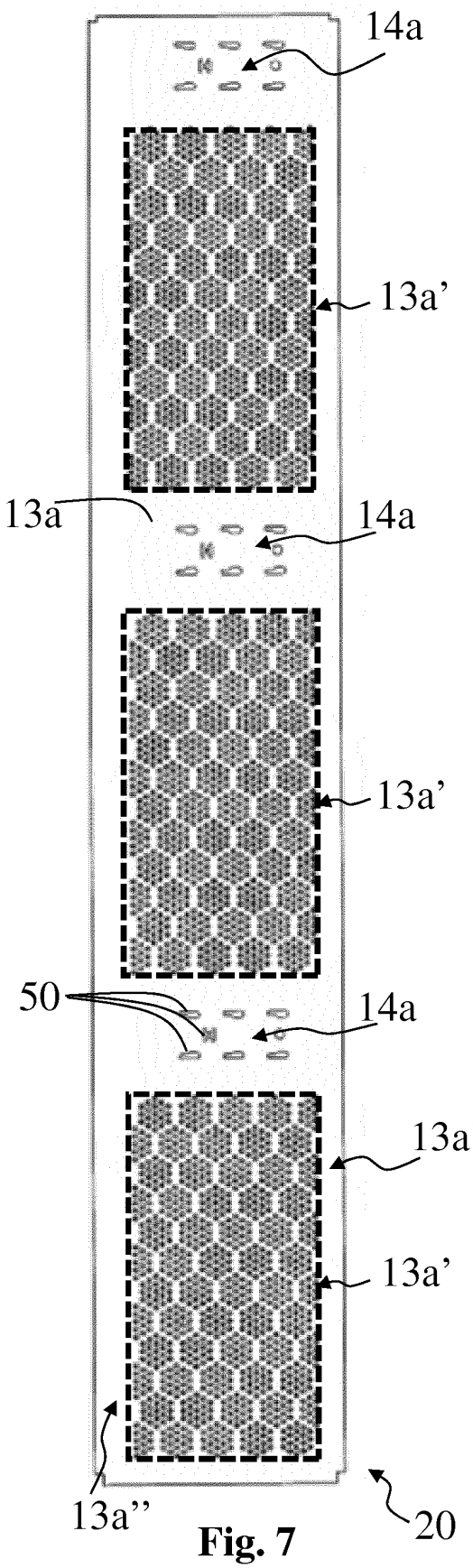


Fig. 7

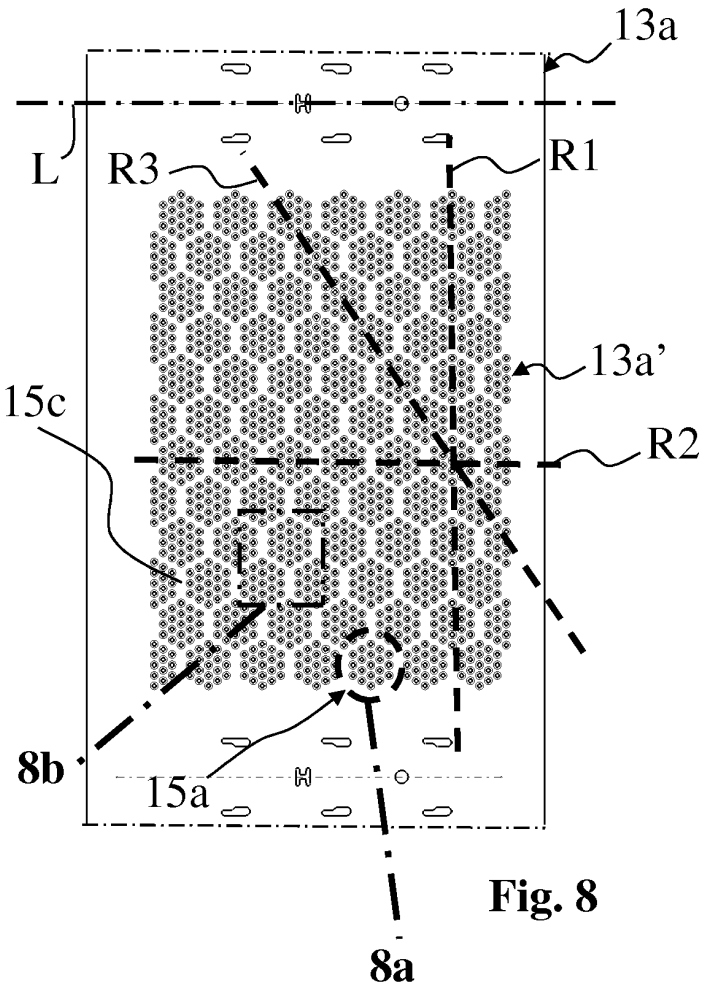


Fig. 8

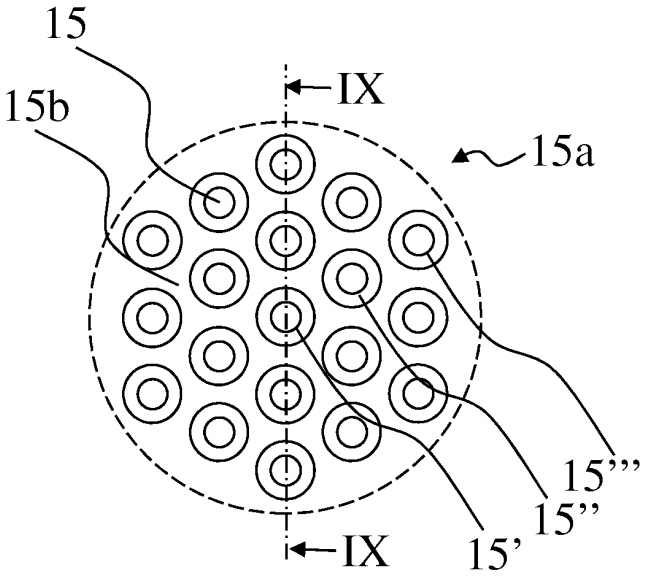


Fig. 8a

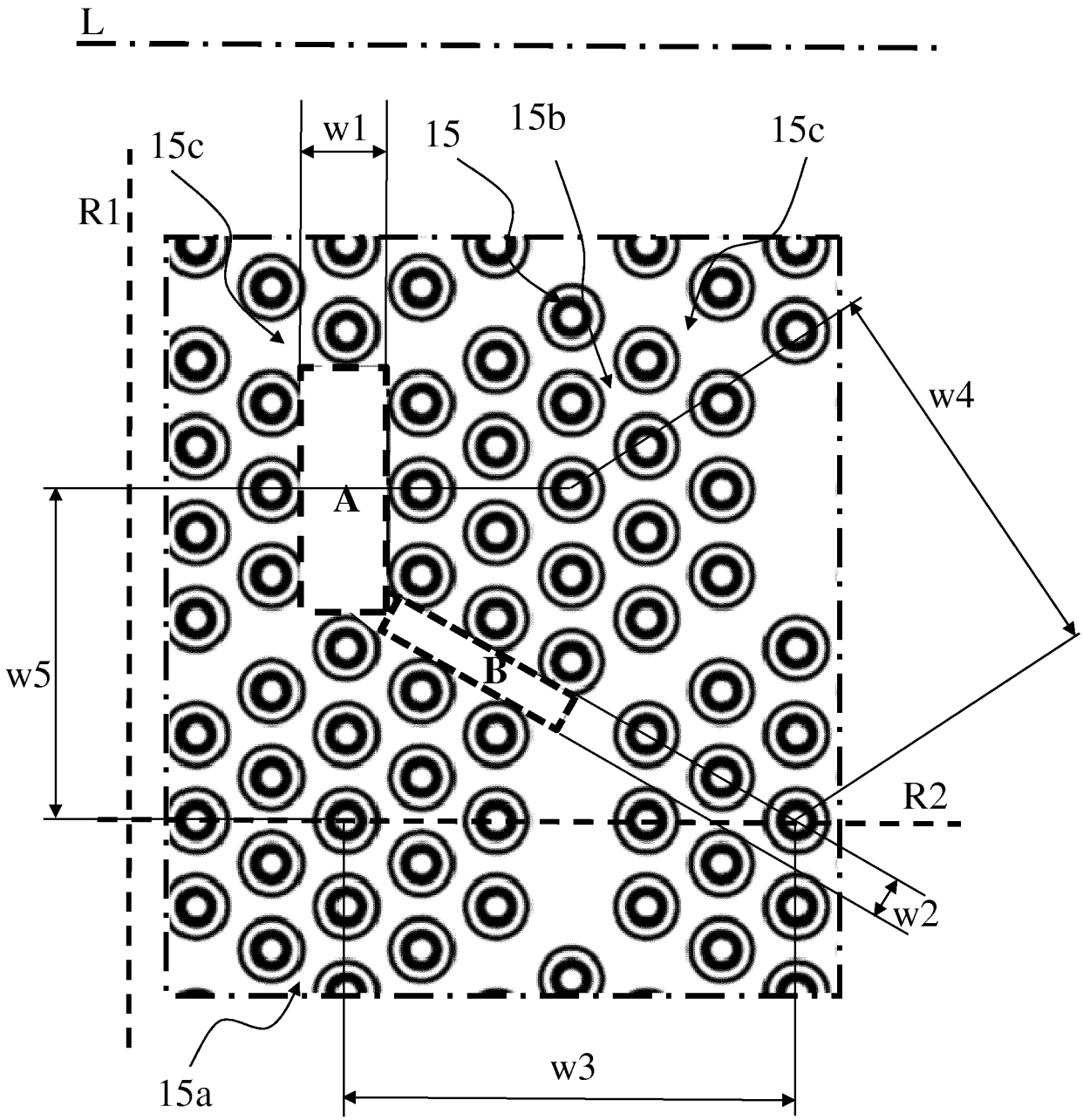


Fig. 8b

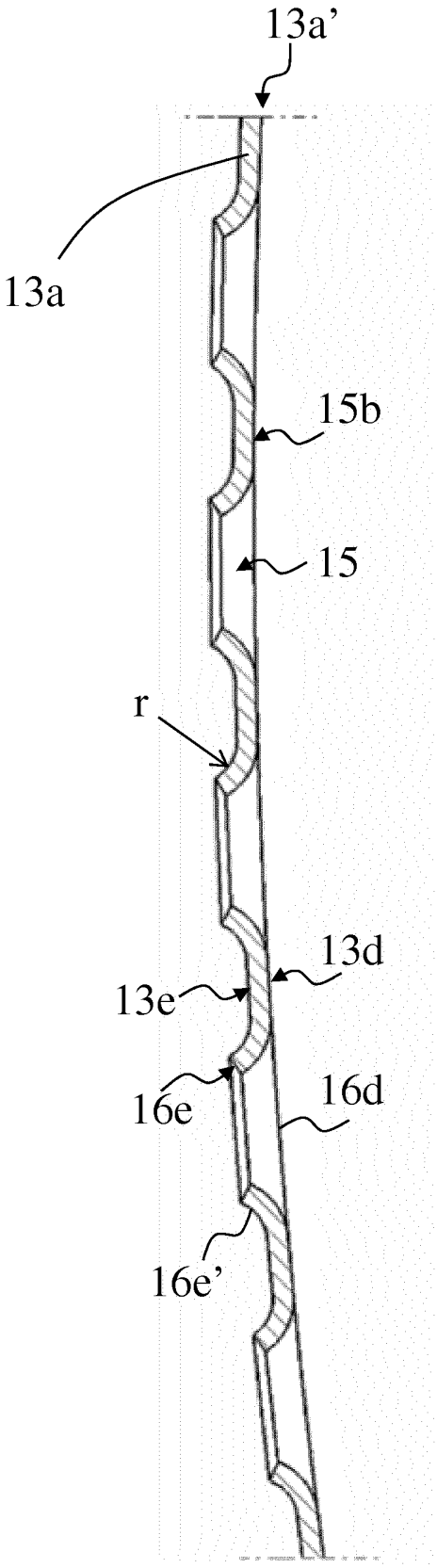


Fig. 9

REFERENCES CITED IN THE DESCRIPTION

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- EP 2372010 A **[0012] [0013] [0020]**