PATENT: “SELF-EQUILIBRATING DRUM FOR WASHING MACHINES”

Filed in Italy on 18/11/2008 N° TO 2008 A 000848

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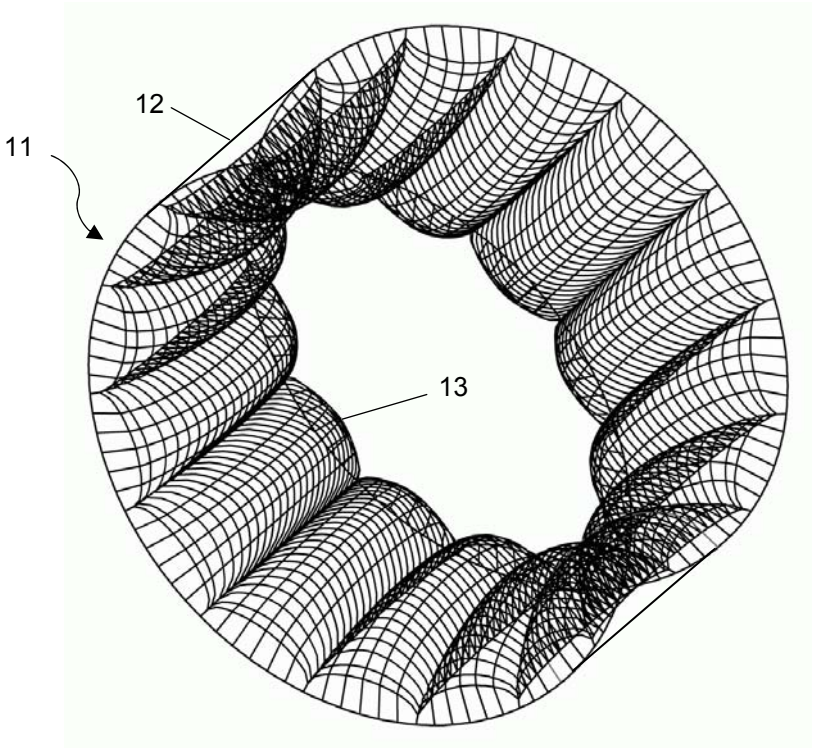
ABSTRACT

A drum of a washing machine, wherein is secured a toroidal bag (11), made of elastomer, provided with protuberances (13), oriented towards its rotation axis, and filled with a liquid fluid.

During a washing phase, said protuberances drag the clothes load.

During a spin drying phase, said fluid contained in said toroidal bag, by effect of centrifugal force, tends to dilate and to flatten said protuberances, so that said toroidal bag tends to level itself into a cylindrical "water bed".

The heaviest parts of a clothes load tend to sink in said "water bed", and displace a mass of fluid equal to their unbalance, which redistributes itself under the lighter parts of said load. The radial force exerted over said drum will result to be uniform along all of its cylindrical perimetral wall, and said drum on the whole will result to be balanced.



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DESCRIPTION

FIELD OF THE INVENTION

The present invention relates to a device for the self-equilibration of drums of automatic washing machines.

BACKGROUND OF THE INVENTION

Current washing machines are provided with inertial systems, including heavy counterweights secured to the tub, in order to reduce the effect of load's unbalance, and suspensions, made of one or more springs and one or more dampers, which allow the tub to oscillate around its barycentre, while preventing it to resonate at its characteristic frequency.

Some washing machines, in order to reduce the effects of unbalanced clothes loads during the spin drying phase, may be provided with various devices or systems as: cavities automatically filled with a fluid in opposition to the load's unbalance (as in US patents 2463801 and 6129768); fluids free to move within rings (as in US patents 2836083 and 5735006); counterweights free to move within rings (as in US patents 2984094 and 6442782). Said systems, besides still requiring counterweights and suspensions, increase costs and, as long as the drum spins under its critical speed, may even increase the unbalance.

Other washing machines, in order to reduce said additional costs, are provided with various electronic and software systems and methods, to measure the load's unbalance, and/or to try to eliminate it by means of inversions of the drum's spin, and/or by reducing the spin speed, and/or by aborting the spin drying phase after an established number of failed balancing attempts (as in US patents 2917175 and 6029300), eventually downgrading the drying performance.

Hence originates a demand for a self-equilibrating system which can overcome said limitations and, possibly, be cheaper than current systems.

SCOPES OF THE INVENTION

A scope of this invention is to realize drums for washing machines, which dynamically self-equilibrate the eventual unbalance of a clothes load during a spin drying phase.

A further scope of this invention is to eliminate the complex system of counterweights and suspensions, and the eventual additional balancing devices, used in current washing machines.

A further scope of this invention is to significantly reduce the weight of a washing machine, by eliminating said counterweights, and so reducing the cost of shipping and installation, allowing a single installer to install it, even when it is needed to lift it up by one or more floors by manual means.

SUMMARY OF THE INVENTION

The present invention, as will be better understood from the following description, allows to realize drums for washing machines, which dynamically self-equilibrate themselves during the spin drying phase, by means of a single additional component.

A preferred embodiment of the present invention is a drum, inside which is secured a toroidal bag,

made of elastomer, provided with protuberances oriented towards its rotation axis and filled with a liquid fluid.

During a washing phase, said protuberances drag the clothes load.

During a spin drying phase, the fluid contained in said toroidal bag, by effect of the strong centrifugal force, stretches and flattens said protuberances, so that the inner side of said toroidal bag tends to level itself into a cylindrical "water bed". The centrifugal force pushes the clothes load against said toroidal water bed and, according to the load's distribution, the heaviest part of said load tend to sink into said waterbed and displace a mass of fluid equal to its unbalance, which redistributes itself under the lighter parts of said load, so that the force exerted on said drum will result to be uniform along all of its cylindrical perimetral wall and the drum on the whole will result to be balanced. The water extracted from clothes during the spin drying phase is drained through the sinkings laying between each other protuberance of said toroidal bag, then is ejected through holes of the two side walls of said drum and finally is collected into the tub of said washing machine.

BRIEF DESCRIPTION OF THE DRAWINGS

A detailed description of the present invention is hereinafter described, with specific reference being made to the drawings, wherein:

FIG. 1 is a reticular isometric view of a preferred embodiment of a toroidal bag.

FIG. 2 is a reticular front view of the toroidal bag of FIG. 1.

FIG. 3 is an isometric view of a drum of a washing machine, inside which is secured the toroidal bag of FIG. 1.

FIG. 4 is a cross section of the drum of FIG. 3.

FIG. 5 is an enlarged detail of Fig. 4.

FIG. 6 is a reticular isometric view of the toroidal bag of Fig. 1, while deformed by centrifugal force during a spin drying phase.

FIG. 7 is a reticular front view of the toroidal bag of FIG. 6.

FIG. 8 is a front view of the toroidal bag of Fig. 7, containing an unbalanced clothes load.

FIG. 8 is a cross section of a second embodiment of a drum of a washing machine.

FIG. 10 is an enlarged detail of Fig. 9.

DETAILED DESCRIPTION OF THE INVENTION

The foregoing detailed description is given, by way of illustration and example only, of some significant embodiments of the present invention and is not intended to limit the scope of the claims in any manner, the spirit and scope of the present invention being limited solely by the appended claims.

FIG. 1 illustrates **a preferred embodiment** of a toroidal bag 11, made of elastomer, filled with a liquid fluid, whose outer side 12 is cylindrical, and whose inner side 13 is provided with elongated protuberances, whose profile is shown in Fig. 2.

Said toroidal bag 11 may be manufactured by rotational moulding, of elastomeric powder, or by joining an injection moulded outer side 12 to an injection moulded inner side 13.

Fig. 3 illustrates a toroidal bag 11, secured inside a drum 14 of a washing machine. Fig. 4 illustrates a vertical section of the drum of Fig. 3, which shows the fluid 15 filling said toroidal bag 11. Fig. 5 illustrates an enlarged detail of Fig. 4, which shows that the cylindrical outer side 16 of said toroidal

bag 11 is provided with lateral borders 17, which are secured between the edges of a cylindrical outer wall 18 and the edges of two side walls 19 of said drum 14.
The quantity of fluid 15 contained in said toroidal bag 11 is slightly larger than the volume strictly needed to fill it, so that said toroidal bag 11, made of elastomer, is forced to strain slightly, generating an internal pressure, which confers to it a required consistence.
When said drum 14 spins at a slow speed during a washing phase, said protuberances of said toroidal bag 11, perform the function of dragging the clothes load.
Said dragging function of said protuberances may be further improved by filling said toroidal bag 11 with a dilatant non-newtonian fluid which, by effect of the shear stress exerted on it by the oscillations of said drum 14 and of said clothes load, stiffens itself and said protuberances.
When said drum 14 spins at a high speed during a spin drying phase, as illustrated in Fig. 6 and 7, the fluid contained in said toroidal bag 11, being pushed outwards by centrifugal force, tends to fill the sinkings 21 laying between each other protuberance 22 of said toroidal bag, which, being made of elastomer, stretches itself and changes its shape, so that protuberances 22 become lower and flatter and the inner side of said toroidal bag 11 tends to level itself into a cylindrical shape.
Fig. 8 illustrates a toroidal bag 11, during a spin drying phase of an unbalanced clothes load 23. Said load, being pushed by centrifugal force, exerts a non uniform force over the inner side of said toroidal bag. In the area 24, over which said clothes load exerts a stronger force, said protuberances are compressed and part of the fluid contained in them redistributes itself in the other protuberances. Said toroidal bag 11 behaves like a centrifugal water mattress. A load placed on a water mattress sinks into said mattress, displacing a mass of fluid equal to its mass, which redistributes itself in the rest of said mattress, so that the resulting pressure exerted on the bottom of said mattress is uniform, and is not influenced by the position wherein said load is placed. Similarly, the centrifugal force exerted on the outer side 12 of a toroidal bag 11 is uniform along all of its cylindrical perimetral wall, independently of the arrangement of a clothes load, and so that any unbalance of said clothes load is annulled.
During a spin drying phase, water contained in a clothes load 23 is progressively extracted by centrifugal force, is drained through the sinkings 21 of said toroidal bag 11, then is ejected through holes 20, Fig. 3 and 5, of the two side walls 19 of said drum, and finally is collected into the tub of said washing machine.
During a spin drying phase, a clothes load 23 may generate, onto the protuberances 22 of said toroidal bag 11, depressions which may collect some residual water and may prevent it to be drained out. Said residual water can be expelled by means of a method of operation of said drum 14, wherein a spin drying phase is splitted into at least two spin drying sub-phases, alternated by spin inversions, at the scope of redistributing said clothes load 23, so that said residual water can be expelled during the next spin drying sub-phase.
Said drum 14, including said toroidal bag 11 filled with a fluid 15, must be equilibrated after assembly, in order to compensate any eventual geometric imperfections in its construction.
An alternative embodiment of the present invention, illustrated in Fig. 9 and 10, is a drum for washing machines 30, provided with a toroidal hollow body filled with a fluid 31, similar to the one illustrated in Fig. 4 and 5, but composed of a half-bag 32 made of elastomer, sealed to the cylindrical

outer wall 33 of said drum. Said half-bag 32 may be manufactured by means of injection moulding. On assembly, said half-bag 32 is sealed to said cylindrical outer wall 33 of said drum, by means of co-moulding or sealants.

While the above described embodiments of the present invention are referred to drums for washing machines with a horizontal rotation axis, it should be noted that they are directly applicable to **drums with a vertical rotation axis as well**.

The above description should not be intended to give a comprehensive list of all the possible variations of the present invention. While only some preferred embodiments of the present invention have been shown and described, it will be understood that various modifications and changes could be made thereunto, without departing the spirit and scope of the invention disclosed.

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CLAIMS

1. A drum of a washing machine, inside which is secured a closed and sealed toroidal hollow body, filled with a liquid fluid, whose inner side, that is the side oriented towards the axis of rotation of said drum, is made of elastomer.

2. A drum of a washing machine, according to claim 1, wherein said fluid, contained in said toroidal hollow body, is a dilatant non-newtonian fluid.

3. A drum of a washing machine, according to claim 1, wherein said inner side of said toroidal hollow body is provided with a plurality of protuberances oriented towards the axis of rotation of said drum.

4 A drum of a washing machine, according to claim 3, wherein said fluid, contained in said toroidal hollow body, is a dilatant non-newtonian fluid.

5. A drum of a washing machine, according to claims 1, 2, 3 or 4, wherein the outer side of said toroidal hollow body is made of elastomer, has a cylindrical shape matching the inner surface of the cylindrical perimetral wall of said drum, and is jointed to said elastomeric inner side, so as to form a closed and sealed toroidal bag.

6. A drum of a washing machine, according to claims 1, 2, 3 or 4, wherein the outer side of said toroidal hollow body is constituted of the cylindrical perimetral wall of said drum, which is jointed to said elastomeric inner side, so as to form said closed and sealed toroidal hollow body.

5. A method of operation a drum of a washing machine, according to any one of the above claims, wherein the spin drying phase is splitted into at least two spin-drying sub-phases, alternated by at least one spin inversion of said drum.

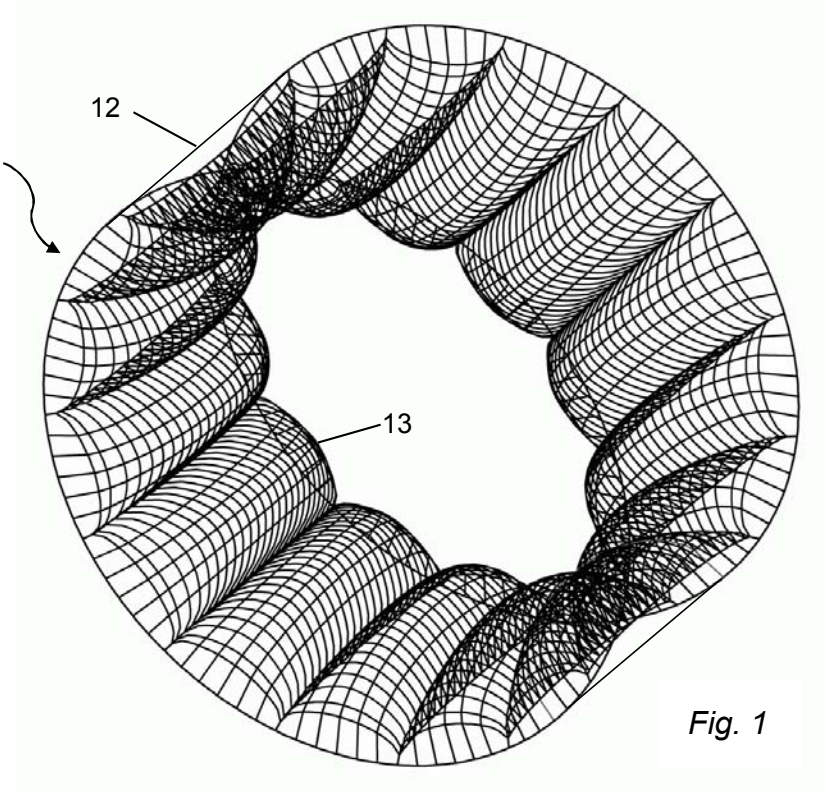

Fig. 1

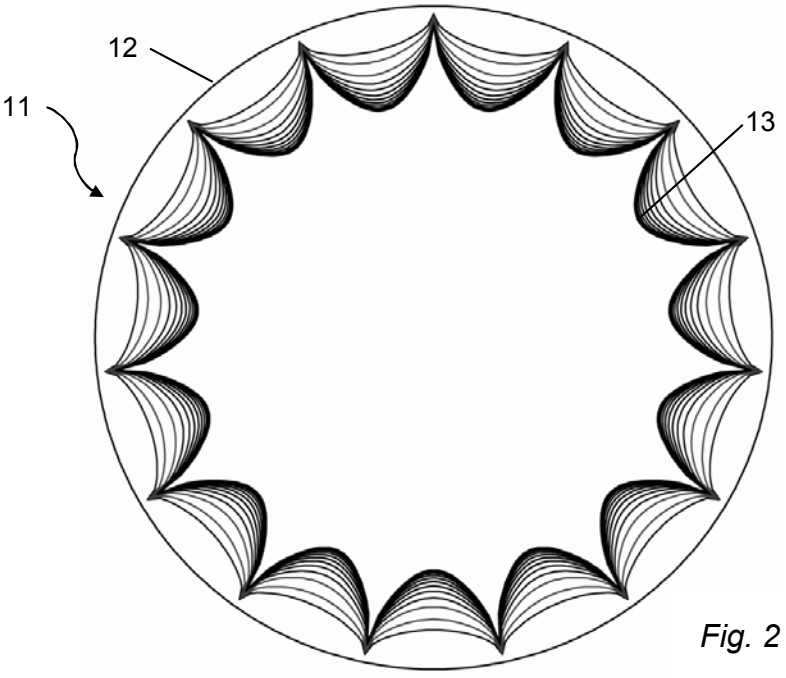

Fig. 2

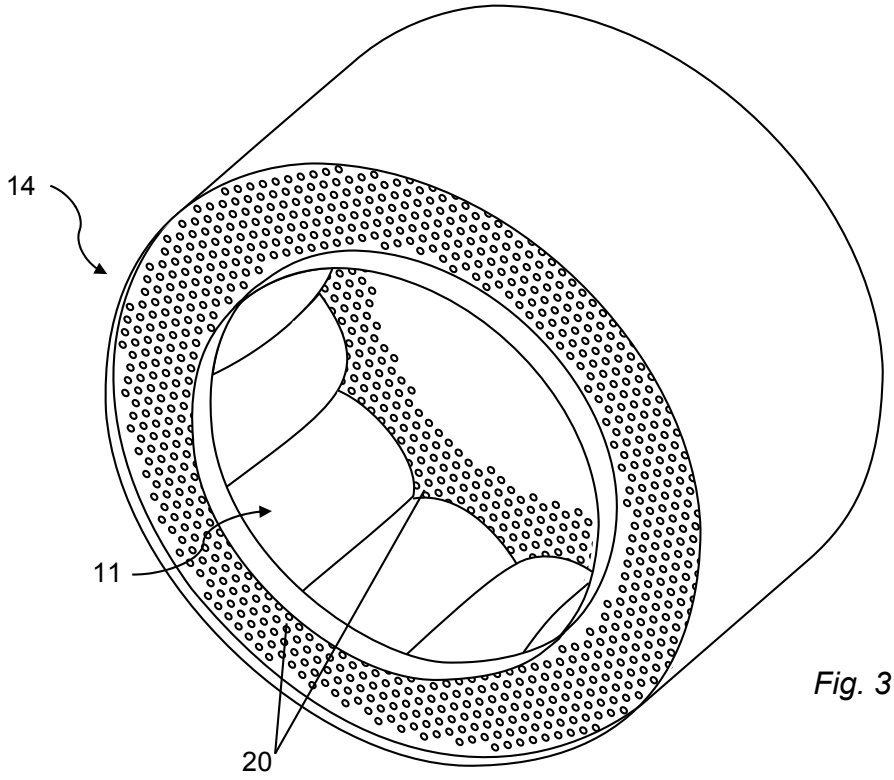

Fig. 3

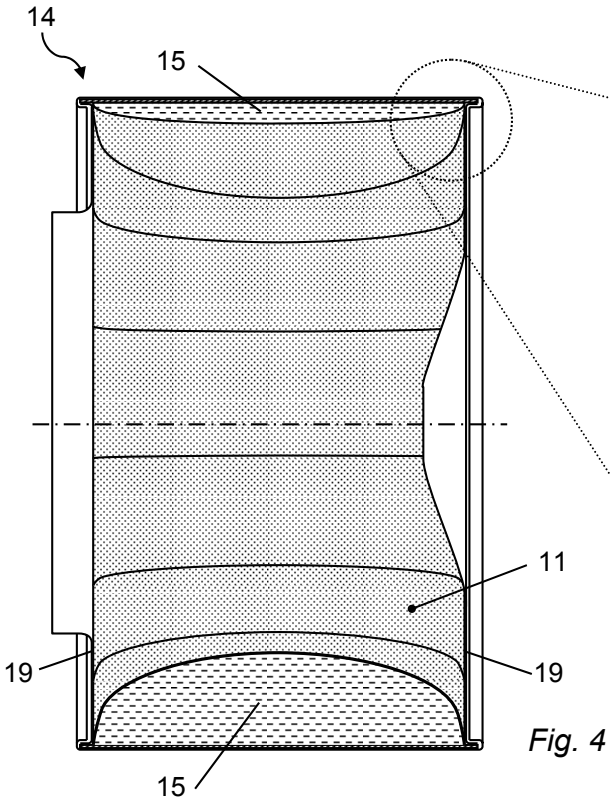

Fig. 4

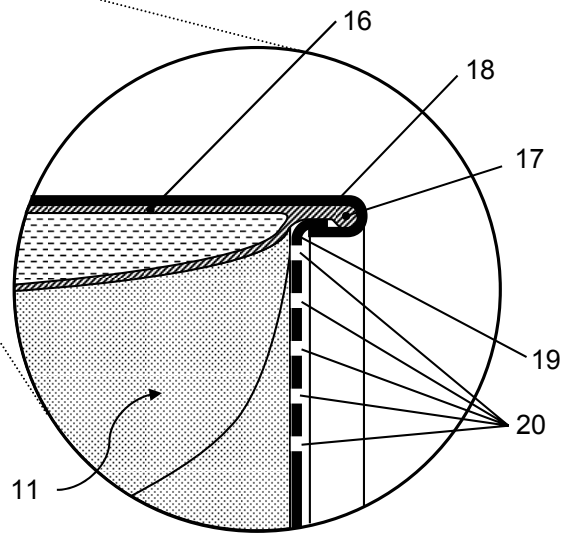

Fig. 5

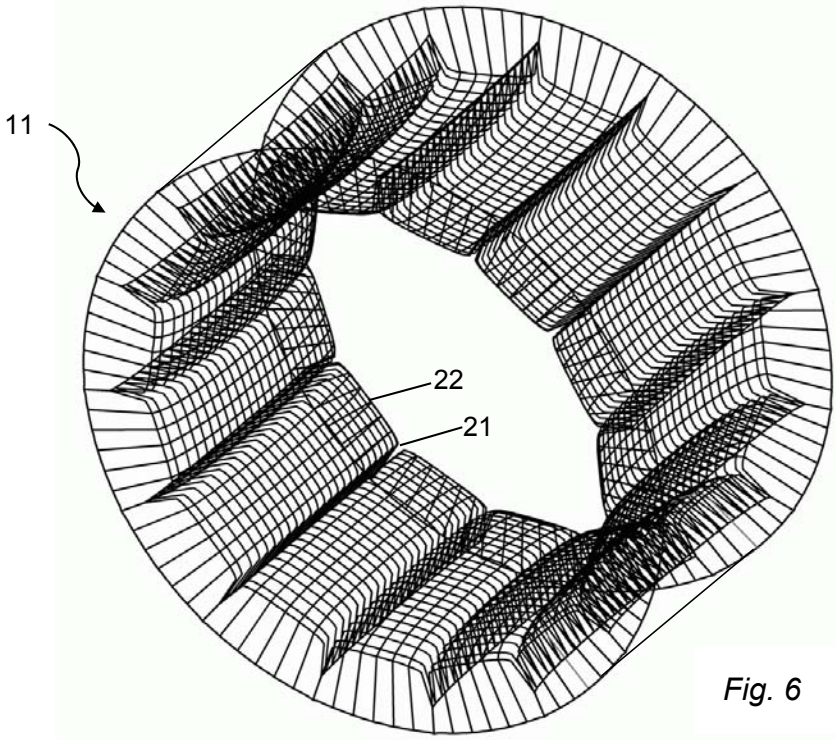

Fig. 6

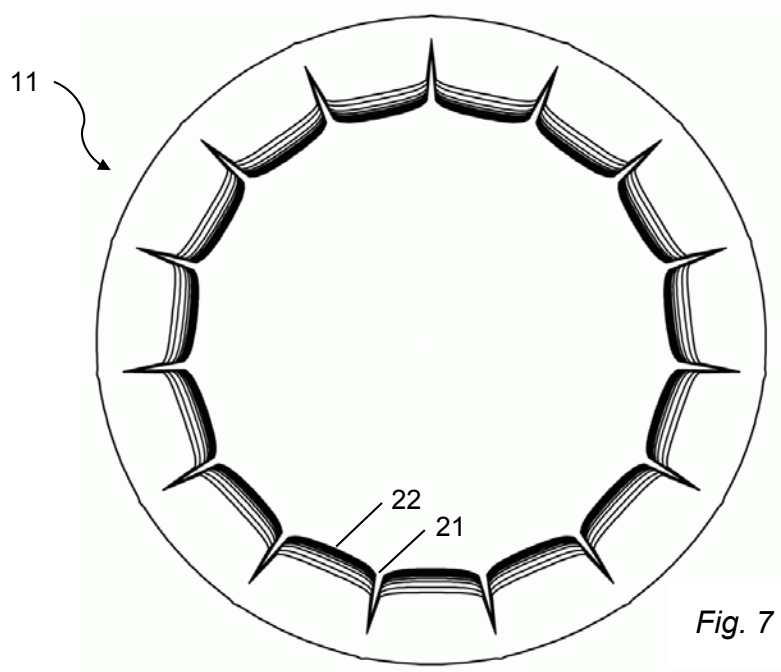

Fig. 7

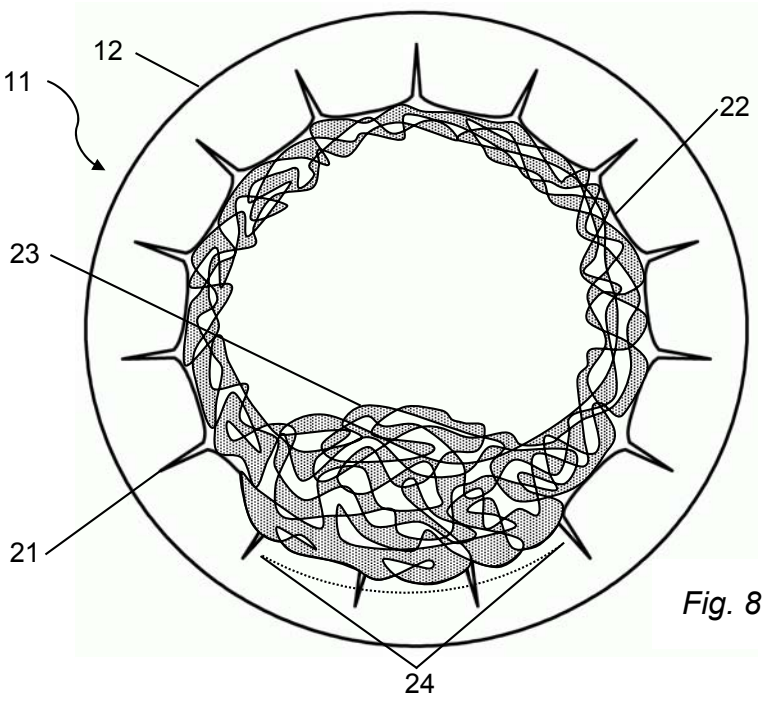

Fig. 8

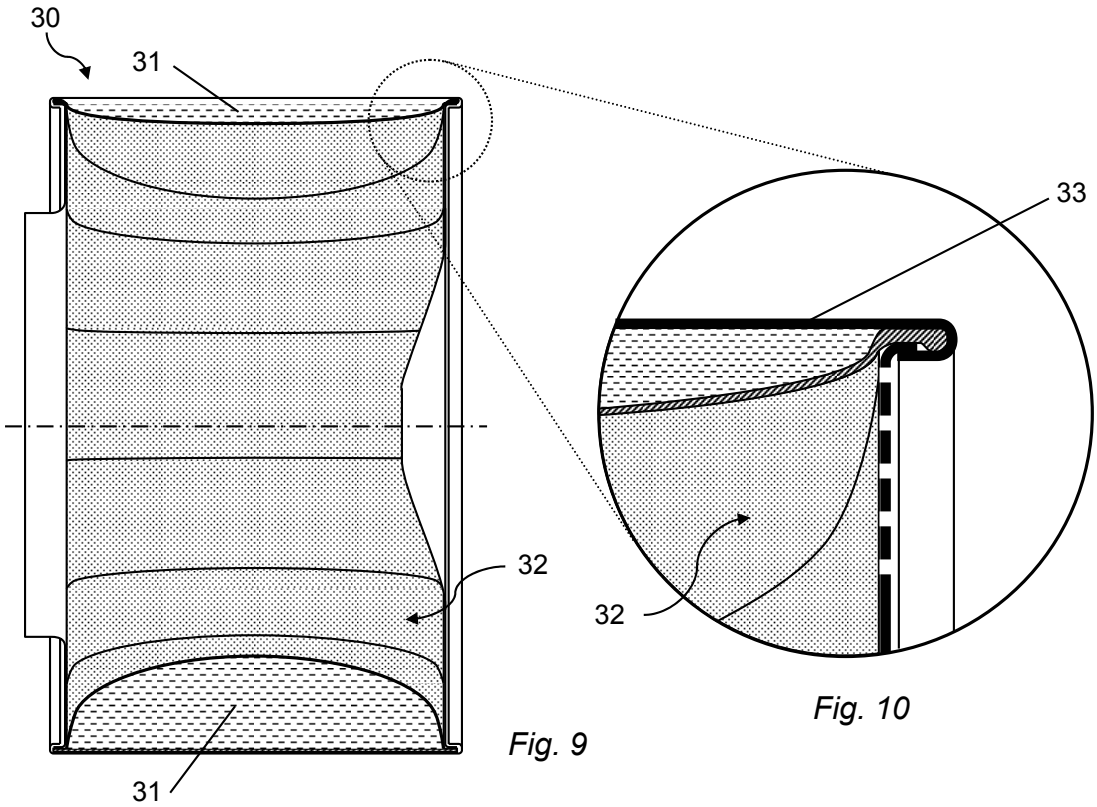

Fig. 9

Fig. 10