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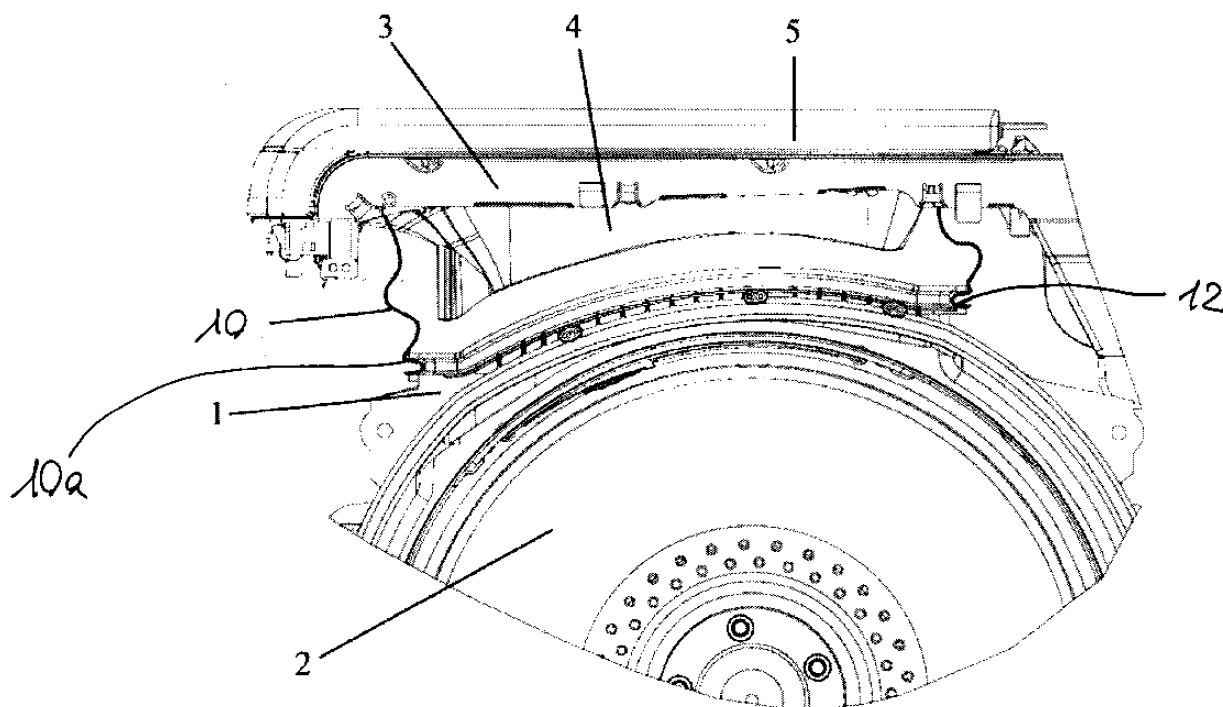
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(54) **Washing machine**

(57) A washing machine comprises a cabinet into which a tub (1) is mounted containing a rotatable drum (2), between the cabinet and the tub (1) being installed a deformable tubular device (10) made of fabric for allowing the load and unload of clothes through aligned

apertures in the cabinet, in the tub (1) and in the drum (2) and for preventing water spillage outside the tub (1). The use of a bellow-shaped fabric instead of a traditional rubber bellow decreases the transmission of vibrations towards the cabinet.



Description

[0001] The present invention relates to a washing machine comprising a cabinet into which a tub is mounted containing a rotatable drum, between the cabinet and the tub being installed a deformable tubular device for allowing the load and unload of clothes through aligned apertures in the cabinet, in the tub and in the drum and for preventing water spillage outside the tub.

[0002] In the known washing machines the above deformable tubular device is a rubber bellow which performs the above functions.

[0003] Unbalance load causes the wash unit, i.e. the assembly of the tub and drum, to move inside the cabinet, transmitting forces and vibrations through dampers, springs and bellow to the cabinet and therefore to the floor as well.

[0004] Despite the flexibility of the known rubber bellows, the material and geometric stiffness thereof causes the transmission of relevant forces between the wash unit and the cabinet, particularly tangential forces. This high loads do create high reaction forces which require a design utilizing space which would be better used by using a bigger wash unit.

[0005] An object of the present invention is to provide a washing machine of the type specified at the beginning of the description which does not present the above technical problems, without increasing the overall cost of the machine.

[0006] The above object is reached thanks to the features listed in the appended claims.

[0007] The basic idea underlying the present invention is to replace the traditional rubber bellow with a component made of a textile or fabric with very low stiffness between the wash unit and the cabinet for sealing purposes. With the term "fabric" we mean any kind of woven, knitted or felted material. The advantage compared to existing solutions, i.e. rubber bellows, is mainly the high flexibility and independence of geometric "decoupling" features of the fabric compared to the material and geometric stiffness of current rubber seals. Fabric will not buckle under tangential load, hence not creating high reaction forces. This may allow for a design utilizing less space for mechanical structure. As a consequence, noise and vibrations are reduced to a surprising and unexpected extent if compared to machines using the traditional rubber bellows. The lower level of forces and vibrations between the washing unit and the cabinet allows a higher spinning speed and, at the same time, increases the life of the appliance. According to a preferred embodiment of the present invention, with the aim of having homogeneous properties of the fabric component, this latter may be produced by using continuous tube knitting or seamless knitting in order to avoid any change of thickness throughout the entire surface of the tubular device made of fabric. The two ends of the tubular device may use sewing to enclose attachment elements (for instance rubber O-rings or toroidal metal or polymeric springs) for

fixing the device to the tub, on one side, and to the cabinet, on the other side.

[0008] Further advantages and features according to the present invention will be clear by the following detailed description, with reference to the attached drawing which shows the application of a fabric sealing within a state of the art top loading washing machine.

[0009] Even if the present description of one possible execution of the invention is focused on a top loading washing machine, it is clear that the solution of the present invention can be used also on front loading washing machines as well.

[0010] With reference to the drawing, a bellow 10 made of fabric is interposed between a tub 1 containing the rotating drum 2 and a top frame 3 or inner frame 4 of the washing machine cabinet which is the aperture for loading and unloading clothes to or from the drum 2. A lid 5 that closes the top frame 3 requires an additional seal (not shown) which is not a function of the fabric sealing.

[0011] The fastening of the fabric bellow 10 to the tub 1 is achieved by coating the contact surface of the fabric bellow end 10a with rubber and by using an annular spring (not shown) in an annular groove 12 to apply pressure against the tub 2. The fastening to the top frame 3 is achieved in the same way. The interface for the water inlet (not shown) is done by using an O-ring that is fit between the pipe and the fabric and then clamped.

[0012] The fabric component 10 must fulfill the technical requirements of the operating environment which are resistance (shrinkage, swelling, fatigue, etc.) to contact with water and detergent solution with temperatures ranging from 10°C to 95°C as well as vapor of detergent solutions, of chemical solutions (including ozone) as can be found in a washing machine as well as steam, self contact due to folding at frequencies up to 250Hz and occasional contact to adjacent components at lower frequencies, contact (tearing) with sharp objects of laundry (i.e. zipper) during loading and unloading, contact with laundry items at high speeds (only for front loaders), and decolorization due the above.

[0013] The fabric must be attached and form a sealing interface (>100mm water column) with the wash unit (i.e. tub 1), the entrance (i.e. inner frame or front panel 3) as well as inlet systems for water, steam, detergent or lighting. This can be done directly or by using attachment elements like springs, wires or clamps. The fastening area of the fabric bellow 10 may be treated or modified to achieve better fit (i.e. over molded or coated with rubber, plastic, metal or rubber parts sewn into the fabric).

[0014] The fabric used for bellow 10, which for top loaders has a roughly square pattern and for front loaders has a circular cylindrical shape, can be chosen among synthetic textiles with waterproof properties. For instance, the textiles made by polyester fibers, aramid fibers, polyamides as nylon, polyurethane and polyolefines. The above textiles can be dyed, and treated in order to obtain water resistance. Metallic nanoparticles for making textiles more resistant to water and pathogens such

as bacteria and fungi can be used as well.

Claims

1. Washing machine comprising a cabinet (3, 4) into which a tub (1) is mounted containing a rotatable drum (2), between the cabinet and the tub being installed a deformable tubular device (10) for allowing the load and unload of clothes through aligned apertures in the cabinet, in the tub and in the drum and for preventing water spillage outside the tub, **characterized in that** said tubular device (10) is made of fabric.
2. Washing machine according to claim 1, wherein the tubular device (10) is seamless.
3. Washing machine according to claim 1 or 2, wherein fastening means are used for fixing ends (10a) of the tubular device (10) to the tub (1) and to the cabinet (3, 4) respectively.
4. Washing machine according to claim 3, wherein the ends (10a) of the tubular device (10) have a coating of rubber material or the like for assuring a waterproof connection with the tub (1) and the cabinet (3, 4).
5. Washing machine according to claim 3 or 4, wherein said fastening means are annular springs or O-rings.
6. Washing machine according to any of the preceding claims, wherein the fabric is chosen in the group consisting of polyester textiles, aramid textiles, polyamide textiles, polyurethane textiles, polyolefines textiles and combination thereof.

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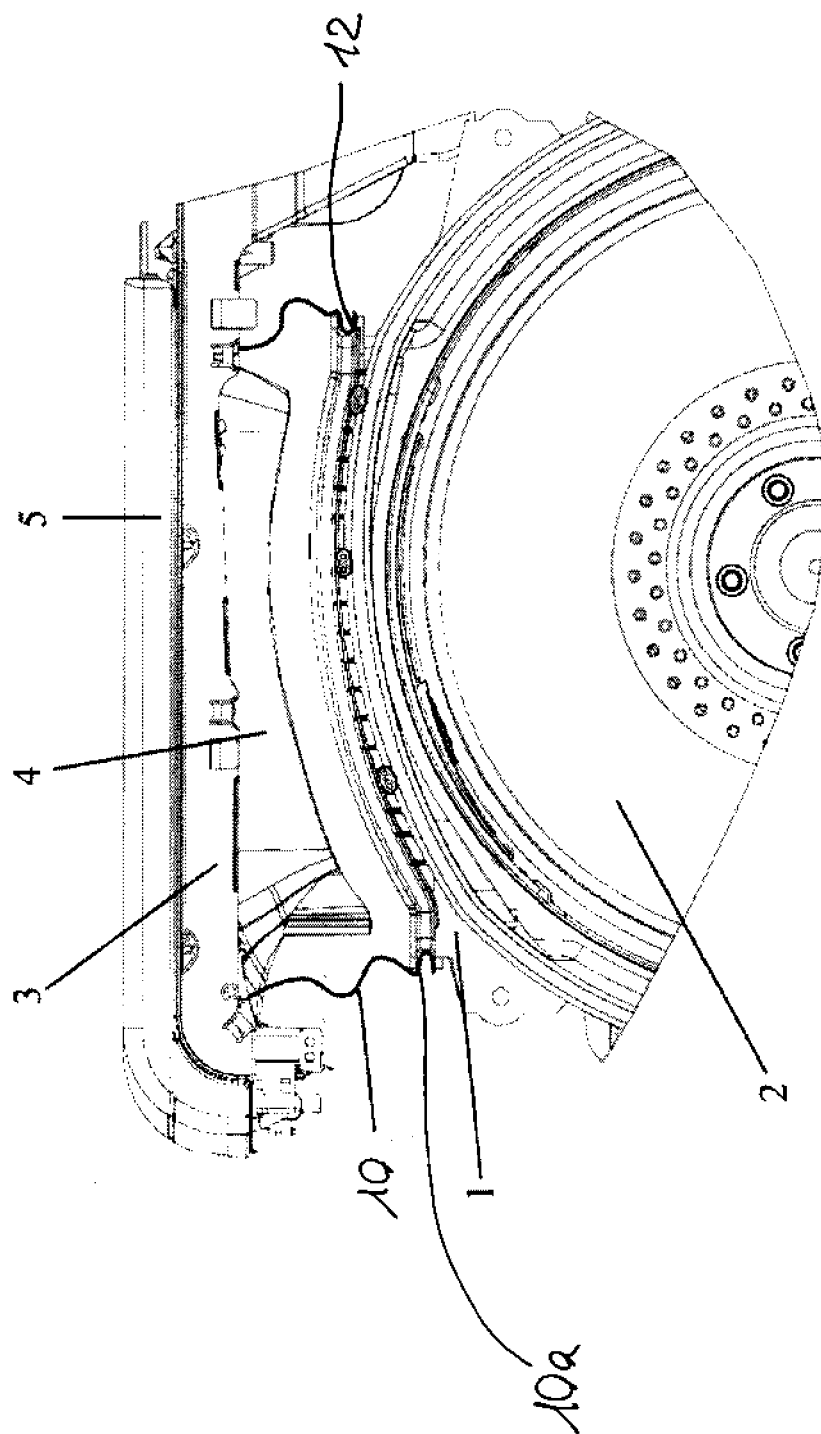
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EUROPEAN SEARCH REPORT

Application Number
EP 09 15 2750

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 14 July 2009	Examiner Kising, Axel
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 09 15 2750

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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