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(54) Laundry washing machine

(57) Laundry washing machine (1) comprising an outer box casing (2), and a washing tub (3) suspended in floating manner inside the casing (2) via a suspension system (4); the suspension system (4) comprising one or more elastic elements (8) connecting the washing tub (3) to the upper portion of the machine casing (2), and one or more vibrations dampers (9) connecting the washing tub (3) to the lower portion of the machine casing (2); the vibrations dampers (9) being frictional dampers (9) comprising an external housing (11) having a first eyelet (11a) hinged to the machine casing (2) or to the washing tub (3) via a first mechanical joint (10), and an axially movable rod (12) having a second eyelet (12a) hinged to the washing tub (3) or to the machine casing (2) via a second mechanical joint (10); said first (10) and/or second mechanical joints (10) comprising a solid locking pin (10) which is made of a cross-linked foamed polymer or polymers blend, and which engages directly the first (11a) or second eyelet (12a) of said vibrations damper (9).

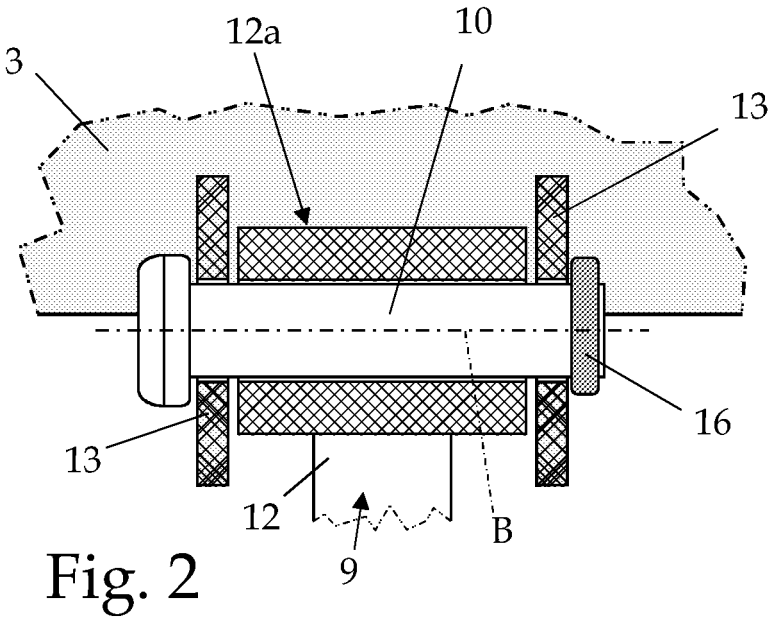

Fig. 2

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Description

[0001] The present invention relates to a laundry washing machine.

[0002] More specifically, the present invention relates to a front-loading home laundry washing machine, to which the following description refers purely by way of example.

[0003] As is known, front-loading laundry washing machines generally comprise a parallelepiped-shaped outer box casing resting on the floor; a substantially bell-shaped washing tub which is suspended in floating manner inside the casing, directly facing a laundry loading and unloading opening formed in the front face of the casing; a door hinged to the front face of the casing to rotate to and from a rest position in which the door closes the opening in the front face of the casing to seal the washing tub; a revolving drum for housing the laundry to be washed, and which is housed inside the washing tub to rotate about its longitudinal axis; and an electric motor assembly for rotating the revolving drum about its longitudinal axis inside the washing tub.

[0004] Since high-speed rotation of the revolving drum produces severe mechanical vibrations, in today's laundry washing machines the entire washing assembly (i.e. the washing tub and the revolving drum mounted in axially rotating manner inside the washing tub) is suspended in floating manner into the machine casing via a system of coil springs and frictional dampers designed to absorb the mechanical vibrations before they reach the casing.

[0005] In particular, the washing-tub suspension system typically comprises two or more coil springs connecting in elastic manner the upper portion of the washing tub to the top of the machine casing, and two or more frictional dampers connecting the lower portion of the washing tub to the bottom of the machine casing.

[0006] More specifically, the ends of the coil springs are simply hooked to corresponding coupling rings protruding from the upper portion of the washing tub, whereas the end of each frictional damper is hinged to the lower portion of the washing tub via a mechanical joint consisting of a selflubricant cylindrical bushing extending inside the eyelet on the frictional damper; of a cylindrical rubber sleeve of appropriate thickness, which is fitted to the cylindrical bushing for elastically keying the bushing body to the surrounding damper body; and of a transversal locking pin which engages both the selflubricant cylindrical bushing, and two through holes realized on two winglets protruding from the washing tub one faced to the other, on opposite sides of the same eyelet.

[0007] To reduce vibrations transmission to the machine casing, in today's high-end washing machines the transversal locking pin is made of thermoplastic polyamide resin, whereas the selflubricant cylindrical bushing is made of acetylic polymeric resin.

[0008] Unfortunately, due to the stiffness, strength and elastic modulus of the various plastic materials involved, this kind of mechanical joint between washing tub and frictional damper seems to be too much sensible to the mechanical stresses generated in the transversal locking pin during assembly, and quite often it causes an undesired increase in the noise level of the washing machine.

[0009] When fitted into the cylindrical bushing, in fact, the locking pin is subjected to both axial and circumferential strains which may occasionally lead to an undesired anomalous permanent deformation of the pin body, compromising the proper alignment of the frictional damper.

[0010] It is the aim of the present invention to provide a mechanical coupling between washing tub and frictional dampers, designed to eliminate the aforementioned drawbacks.

[0011] According to the present invention, there is provided a laundry washing machine as claimed in Claim 1 and preferably, though not necessarily, in any one of the dependent Claims.

[0012] A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

- Figure 1 shows a perspective view, with parts in section and parts removed for clarity, of a laundry washing machine in accordance with the teachings of the present invention;
- Figure 2 shows a section view of the mechanical coupling between the washing tub and the vibrations damper of Figure 1 washing machine, with parts removed for clarity; and
- Figure 3 shows a section view of a variation of the Figure 2 mechanical coupling between the washing tub and the vibrations damper.

[0013] With reference to Figure 1, number 1 indicates as a whole a laundry washing machine comprising a preferably, though not necessarily, parallelepiped-shaped outer box casing 2 resting on the floor; a substantially bell-shaped washing tub 3 suspended in floating manner inside casing 2 via a suspension system 4; a revolving drum 5 for housing the laundry to be washed, and which is housed inside washing tub 3 to rotate about its longitudinal axis A; and an electric motor assembly 6 for rotating revolving drum 5 about its longitudinal axis A inside washing tub 3.

[0014] In particular, in the example shown, laundry washing machine 1 is a front-loading washing machine wherein washing tub 3 is suspended in floating manner inside casing 2, with the front opening of washing tub 3 directly faced to a laundry loading and unloading opening formed in front face 2a of casing 2; and revolving drum 5 is housed inside washing tub 3 so as that its longitudinal axis A is oriented substantially horizontally, and coincides with the longitudinal axis of washing tub 3.

[0015] With reference to Figure 1, laundry washing machine 1 is also provided with a cylindrical elastic-deformable bellows 7 connecting the opening of washing tub 3

to the laundry loading and unloading opening formed in front face 2a of casing 2, and with a sealing door (not shown) hinged to front face 2a of casing 2 to rotate to and from a rest position in which the door closes the laundry loading and unloading opening in front face 2a to seal washing tub 3.

[0016] Casing 2, washing tub 3, revolving drum 5, electric motor assembly 6 and bellows 7 are commonly know parts in the washing machine technical field, and therefore not described in detail.

[0017] As regards the washing-tub suspension system 4, it comprises a number of coil springs 8 connecting washing tub 3 to the upper portion of casing 2, and one or more vibrations dampers 9 connecting washing tub 3 to the lower portion of casing 2.

[0018] More specifically, with reference to Figure 1, suspension system 4 comprises two or more coil springs 8 (only one shown in Figure 1) connecting in elastic manner the upper portion of washing tub 3 to the top of casing 2, and two or more vibration dampers 9 (only one shown in Figure 1) connecting the lower portion of washing tub 3 to the bottom of casing 3.

[0019] In particular, in the example shown, suspension system 4 comprises two coil springs 8 and two vibration dampers 9 distributed around washing tub 3 in a substantially X-shaped arrangement, so as that each coil spring 8 is substantially aligned to a corresponding vibration damper 9. The two ends of each coil spring 8 are simply hooked to casing 2 and to washing tub 3, whereas the two ends of each vibration damper 9 are connected to casing 2 and to washing tub 3 via corresponding mechanical joints 10, each of which allows free rotation of damper 9 about a corresponding rotation axis B substantially parallel to the longitudinal axis of washing tub 3.

[0020] More specifically, with reference to Figures 1 and 2, each vibration damper 9 is a frictional damper and comprises a cylindrical external housing 11 having, in its bottom end, a first eyelet 11a hinged to casing 2; and an axially movable rod or shaft 12 which is fitted in axially sliding manner and with friction into damper housing 11, coaxial to the latter, and has, in its free end, a second eyelet 12a hinged to washing tub 3.

[0021] Differently from known laundry washing machines, each mechanical joint 10 connecting damper 9 to washing tub 3 or to machine casing 2 consists of a preferably, though not necessarily, nail-shaped cylindrical solid locking pin 10 which is made of a foamed (i.e. expanded) and preferably, though not necessarily, cross-linked polymer or polymers blend, and which extends coaxially to hinge rotation axis B for engaging, at the same time, the eyelet 11a on damper housing 11 or the eyelet 12a on damper rod 12, and two through holes extending, coaxially to hinge rotation axis B, on a couple of winglets 13 or 14 rigidly protruding, respectively, from washing tub 3 or from machine casing 2, one faced to the other and on opposite sides of damper eyelet 11a or 12a; locking pin 10 having a density ranging preferably, though not necessarily, between 0,1 and 0,95 grams per cubic centimetre, and an elastic compressive modulus ranging preferably, though not necessarily, between 5MPa to 30MPa.

[0022] More specifically, in the example shown locking pin 10 is made of foamed (i.e. expanded) polyethylene which is cross-linked using suitable cross-linking agents such as organic peroxides or silanes, and which is preferably, though not necessarily, mixed with one or more additives having selflubricant properties.

[0023] In addition to the above, locking pin 10 is fitted into damper eyelet 11a or 12a and into through holes on winglets 13 or 14, so as to be in direct contact with the plastic or metal body of damper housing 11 or damper rod 12. More specifically, locking pin 10 is radially compressed and then driven into the two through holes on winglets 13 or 14 and into damper eyelet 11a or 12a, so as to expand within through holes on winglets 13 or 14, and remain firmly locked to the body of winglets 13 or 14.

[0024] In other words, with reference to figure 2, in mechanical joints 10 connecting damper 9 to washing tub 3, the free end of damper rod 12 is located between winglets 13, with damper eyelet 12a aligned to the through holes on both winglets 13, and locking pin 10 is driven, at the same time, into the damper eyelet 12a and into the two through holes on winglets 13, to keep the damper eyelet 12a coaxial to the hinge rotation axis B. Similarly, with reference to figure 1, in mechanical joints 10 connecting damper 9 to machine casing 2, the bottom end of damper housing 11 is located between winglets 14, with damper eyelet 11a aligned to the through holes on both winglets 14, and locking pin 10 is driven, at the same time, into the damper eyelet 11a and into the two through holes on winglets 14, to keep the damper eyelet 11a coaxial to the hinge rotation axis B.

[0025] Finally, with reference to Figure 2, each mechanical joint 10 connecting damper 9 to washing tub 3 or machine casing 2 is preferably, though not necessarily, provided with an annular retaining washer 16 or similar retaining element, which is firmly secured to the tip of locking pin 10 to avoid the extraction of locking pin 10 from the two through holes on winglets 13 or 14.

[0026] Alternatively to foamed and preferably, though not necessarily, cross-linked polyethylene optionally mixed with one or more additives having selflubricant properties, solid locking pin 10 could also be made of foamed and preferably, though not necessarily, cross-linked Ethylene-vinyl-acetate, preferably, though not necessarily, mixed with one or more additives having selflubricant properties; or of a foamed and preferably, though not necessarily, cross-linked blend of polyethylene and Ethylene-vinyl-acetate, preferably, though not necessarily, mixed with one or more additives having selflubricant properties. The ratio of polyethylene and Ethylene-vinyl-acetate in the foamed polymers blend ranges between 10% and 90%.

[0027] In addition to the above, solid locking pin 10 could also be made of foamed and preferably, though not necessarily, cross-linked rubber (EPDM), preferably,

though not necessarily, mixed with one or more additives having selflubricant properties.

[0028] General operation of laundry washing machine 1 is clearly inferable from the above description, with no further explanation required.

[0029] The particular structure of mechanical joints 10 has lots of advantages. A locking pin 10 made of cross-linked polyethylene, of a blend of polyethylene and Ethylene-vinyl-acetate, or of cross-linked rubber (preferably, though not necessarily, mixed with one or more additives having selflubricant properties) revealed to be completely unsensitive to the mechanical stresses generated during locking-pin assembly.

[0030] In addition to the above, a locking pin 10 made of the above cited materials does not require the presence, into damper eyelets 11a and 12a, of any self lubricant cylindrical bushing and/or rubber sleeve, thus reducing costs of washing-tub suspension system 4.

[0031] Clearly, changes may be made to laundry washing machine 1 as described herein without, however, departing from the scope of the present invention.

[0032] For example, with reference to Figure 3, locking pin 10 may be in the shape of a substantially cylindrical solid rod, with conical-truncated heads on the two axial ends. In which case, each mechanical joint 10 may comprise also two annular retaining washers 17 which are firmly secured to locking pin 10, on opposite sides of damper eyelet 11a or 12a and between the damper body and the winglets body, to avoid the extraction of locking pin 10 from the two through holes on winglets 13 or 14.

[0033] In a further non shown embodiment, only the mechanical joints 10 connecting damper 9 to washing tub 3 or the mechanical joints 10 connecting damper 9 to machine casing 2, may consist exclusively of a solid locking pin 10 made

of foamed and preferably, though not necessarily, cross-linked polyethylene;

of foamed and preferably, though not necessarily, cross-linked Ethylene-vinyl-acetate;

of a foamed and preferably, though not necessarily, cross-linked blend of polyethylene and Ethylene-vinyl-acetate; or

of foamed and preferably, though not necessarily, cross-linked rubber; (in all cases preferably, though not necessarily, mixed with one or more additives having selflubricant properties).

Claims

1. Laundry washing machine (1) comprising an outer box casing (2) and a washing tub (3) suspended in floating manner inside said casing (2) via a suspension system (4); said suspension system (4) in turn comprising one or more elastic elements (8) connecting the washing tub (3) to the upper portion of the machine casing (2), and one or more vibrations dampers (9) connecting the washing tub (3) to the lower portion of the machine casing (2); at least one of said vibrations dampers (9) comprising an external housing (11) having a first eyelet (11a) hinged to the machine casing (2) or to the washing tub (3) via a first mechanical joint (10), and an axially movable rod (12) having a second eyelet (12a) hinged to the washing tub (3) or to the machine casing (2) via a second mechanical joint (10); the laundry washing machine being **characterized in that** at least one of said first (10) or second mechanical joints (10) comprises a locking pin (10) which engages directly the first (11a) or the second eyelet (12a) of said vibrations damper (9), and which is made of a foamed polymer or polymers blend.

2. Laundry washing machine as claimed in Claim 1, wherein said foamed polymer or polymers blend is cross-linked.

3. Laundry washing machine as claimed in Claim 1 or 2, wherein said foamed polymer or polymers blend has a density ranging between 0,1 and 0,95 grams per cubic centimetre.

4. Laundry washing machine as claimed in anyone of the foregoing Claims, wherein said foamed polymer is polyethylene or Ethylene-vinyl-acetate or rubber, and said foamed polymers blend comprises polyethylene and Ethylene-vinyl-acetate.

5. Laundry washing machine as claimed in anyone of the foregoing Claims, wherein said foamed polymer or polymers blend is mixed with one or more additives having selflubricant properties.

6. Laundry washing machine as claimed in anyone of the foregoing Claims, wherein said locking pin (10) extends coaxially to a hinge rotation axis (B) for engaging, at the same time, the first (11a) or the second eyelet (12a) of said vibrations damper (9), and two through holes extending, coaxially to said hinge rotation axis (B), on a couple of winglets (13, 14) rigidly protruding from the washing tub (3) or machine casing (2), one faced to the other, on opposite sides of said first (11a) or second damper eyelet (12a).

7. Laundry washing machine as claimed in anyone of the foregoing Claims, wherein said locking pin (10) is a substantially nail-shaped cylindrical solid locking pin (10).

8. Laundry washing machine as claimed in Claim 7, wherein said mechanical joint (10) also comprises a retaining element (16) firmly secured to the tip of said locking pin (10), to avoid the extraction of the locking pin (10) from the through holes on the two winglets (13, 14) rigidly protruding from the washing tub (3) or machine casing (2).

9. Laundry washing machine as claimed in anyone of Claims 1 to 6, wherein said locking pin (10) is a substantially cylindrical solid rod with two conical-truncated heads on both axial ends.

10. Laundry washing machine as claimed in Claim 9, wherein said mechanical joint (10) also comprises also two annular retaining washers (17) which are firmly secured to the locking pin (10), on opposite sides of said first (11a) or second damper eyelet (12a) and between the damper body and the winglets body, to avoid the extraction of the locking pin (10) from the through holes on the two winglets (13, 14) rigidly protruding from the washing tub (3) or machine casing (2).

11. Laundry washing machine as claimed in anyone of the foregoing Claims, wherein the axially movable rod (12) of said at least one vibrations damper (9) is fitted in axially sliding manner and with friction into the external housing (11) of the same vibrations damper (9).

12. Laundry washing machine as claimed in anyone of the foregoing Claims, **characterized by** also comprising a revolving drum (5) for housing the laundry to be washed, and which is housed inside the washing tub (3) to rotate about its longitudinal axis (A); and an electric motor assembly (6) for rotating the revolving drum (5) about its longitudinal axis (A) inside said washing tub (3).

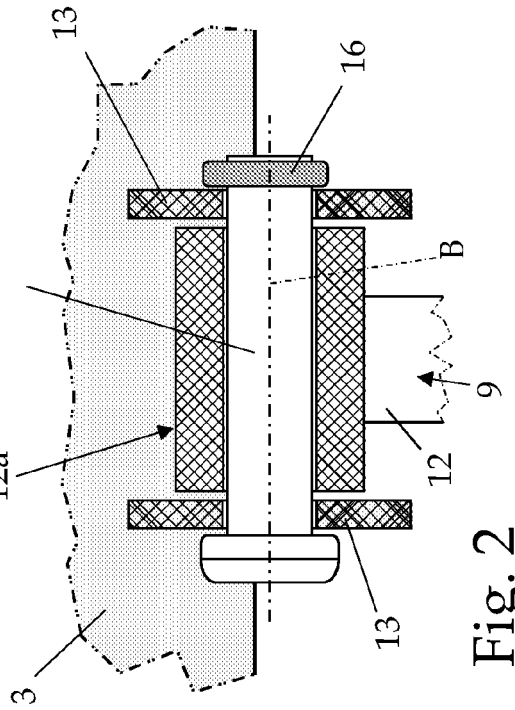

Fig. 2

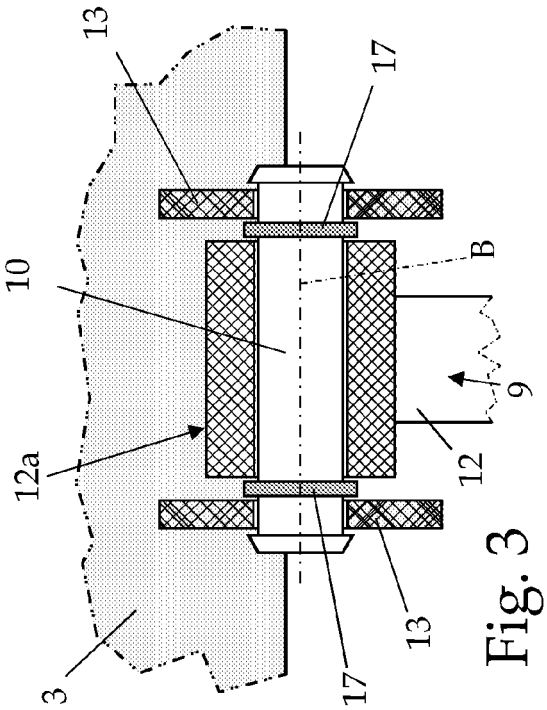

Fig. 3

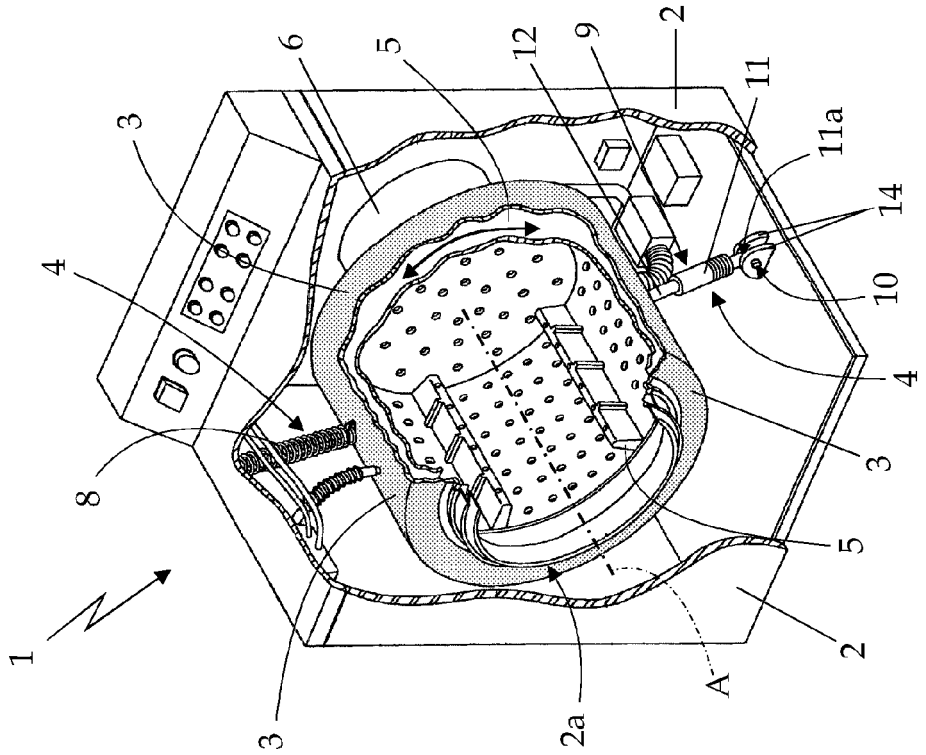

Fig. 1

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 08 15 6768

DOCUMENTS CONSIDERED TO BE RELEVANT

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			TECHNICAL FIELDS SEARCHED (IPC)
			F16F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	2 October 2008	Fachin, Fabiano

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 08 15 6768

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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