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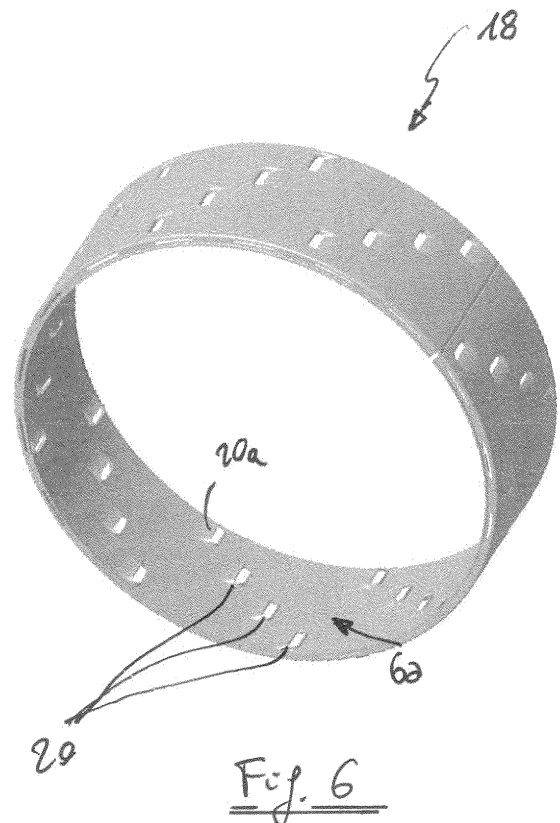
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(54) **Horizontal axis washing machine with balance means**

(57) A laundry washing machine comprises a rotatable drum (14) having a generally horizontal axis of rotation, a tub (12) coaxially aligned with said axis of rotation and surrounding said drum (14), and a water balancer adapted to reduce the effects of unbalanced laundry during spinning. The balancer comprises a cylindrical wrapper (18) interposed between the drum (14) and the tub (12), coaxially fastened to the drum (14) and adapted to collect at least part of liquid from spinning laundry.



Description

[0001] The present invention relates to a laundry washing machine comprising a rotatable drum having a generally horizontal axis of rotation, a tub coaxially aligned with said axis of rotation and surrounding said drum, and balancing means adapted to reduce the effects of unbalanced laundry load during spinning.

[0002] It is well known in the art of washing machines, particularly horizontal axis washing machines, the need of mitigating the effects of unbalanced laundry during spinning, such effects being high vibrations of the machine and high mechanical stresses on bearings supporting the drum. The usual means includes counterweights mounted on the tub in order to increase its overall mass therefore reducing its movements due to unbalance. This is a general measure adopted by the majority of washing machines, but of course the total mass of counterweight cannot overcome certain threshold and moreover, even if vibrations are reduced, mechanical stresses on bearings are not. Other means includes specific control software capable of detecting unbalances condition of the load before going into full spinning speed. Even if such software means are effective in preventing the effects of unbalance, sometime they prevent the drum from rotating at an acceptable spinning speed, with the consequence that the laundry load is very wet at the end of the washing cycle.

[0003] A third group of means includes the use of balance rings attached at least to one end of the drum and containing a balancing material that is movable circumferentially around each balance ring through its interior cavity. Such balancing material can be a plurality of metal balls, a liquid having high density or water.

[0004] US 6158257 discloses a horizontal axis clothes washing machines in which the drum is provided with two balance rings attached to the drum proximate corresponding spaced-apart ends of the drum, each ring having an axis coaxially with the axis of rotation of the drum. In this rings wash water can enter and acts as the balancing material, with such washing/rinsing water being basically present in the balance rings only during the spinning phase of the washing cycle. Even if such known solution has the advantage of avoiding a waste of energy which is usually needed for heating up liquid or steel ball balancers, nevertheless the total volume of the rings cavity is substantially low and cannot guarantee a proper balancing. Moreover, the two rings reduce the useful space of the drum, since they are placed on the outside surface of the drum. Another drawbacks lies in the need of producing the drum flared radially outward toward the ends proximate the balance rings, in order to assure the proper flow of balancing wash water towards the ring.

[0005] It is an object of the present invention to provide a washing machine with balancing means which overcomes the drawbacks of known solutions. In particular it is an object of the present invention to provide balance means which does not consume useful space, which

does not heed any energy to heat up the balancing material and which can guarantee a good balancing effect mainly due to the total amount of wash water used as balancing material.

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

[0007] The applicant has discovered that by using a cylindrical wrapper interposed between the drum and the tub, coaxially fastened to the drum and collecting water coming from the spinning laundry load, the effect of reducing unbalance is at least similar to that of known more expensive water balancing rings. This solution does not only decrease the effect of unbalance, but it also allows using the space between the drum and the tub in an effective way. Due to the reduction of unbalance effect, it is even possible to reduce the clearance between the wrapper and the tub compared to the present clearance between the drum and the tub, therefore allowing getting the balancing effect without any actual reduction of the useful volume of the drum.

[0008] Further features and advantages of a washing machine according to the invention will become clear from the following detailed description, with reference to the attached drawings in which:

- Figure 1 is a perspective view of a portion of a partially sectioned washing machine according to the invention;
- Figure 2 is a sectioned longitudinal view of a portion of the washing machine of figure 1;
- Figure 3 is a cross section view of a portion of the machine of figure 1;
- Figure 4 is a schematic view showing how the balancing means according to the invention works;
- Figure 5 is a perspective view of a component of the washing machine according to a second embodiment of the invention;
- Figure 6 is a perspective view of the component of figure 5, according to a third embodiment of the invention,
- Figure 6a is a cross-section view of a detail of figure 6, and
- Figures 7-9 are diagrams showing horizontal and vertical accelerations of a tub of a washing machine according to the invention.

[0009] With reference to the drawings, an oscillating washing system 10 is mounted in a cabinet of a washing machine (not shown) with the interposition of suspension means of known type. The system comprises a plastic tub 12 in which it is rotatably mounted a metal drum 14 having a front opening 16 for loading the laundry. The plastic tub 12 has known fixing portion 12a for installing counterweights (not shown). To the drum 14, by means of struts 14a or similar elements, it is fixed a coaxial external metal wrapper 18 having a cylindrical shape with a diameter slightly higher than the diameter of the drum 14 so as to be interposed between the drum 14 and the

tub 12. The wrapper 18 is provided with L-shaped bent edges 18a whose functions will be clear in the following description. The wrapper is also provided with shaped apertures 20 (figures 1, 3 and 6). Each aperture 20 has a rectangular shape and is somehow funnel-shaped so that one edge 20a (parallel to the rotation axis of the drum) is inclined while a second edge 20b, opposite to the first edge 20a, is substantially orthogonal to the surface of the wrapper 18. Other opposite edges 20c, slightly inclined, define with edges 20a and 20b each funnel-shape aperture 20. The rotation of the drum is driven by an electric motor (not shown) interposed between the tub 12 and an axle of the drum 14 (so called "direct-drive" motor). Of course the invention may be used in washing machines having a drum rotated by a motor with the interposition of a belt and pulley.

[0010] At the beginning of the spinning cycle wash water passes through holes in the drum and collects into the wrapper 18, dynamically distributing in a way as to compensate the unbalance of the load. The bent edges 18a of the wrapper 18 prevent that water flows immediately in the tub 12. Also the funnel shape of the apertures 20, with bent edges directed toward the centre of the wrapper 18, prevent at least a part of water from flowing directly into the tub 12. It is assumed that during spinning water in the wrapper 18 may assume different configurations shown in figure 4, depending on the kind of unbalance in the drum (unbalance at the front, at the rear or in the middle of the drum). Independently on the kind of unbalance, the amount of water involved in the balancing is much higher than the water used in the known balancing rings. This effect can be shown in figures 6 to 8 which refer to experimental test carried out by the applicant with a drum having capacity of 64 liters.

[0011] Figure 6 refers to an artificial unbalanced load (rubber piece of 0,5 kg placed in the middle of the drum) with water added at high speed (1000 rpm). The test shows that when water is added into the drum (timing highlighted by reference W in the figures), there is reduction of horizontal and vertical accelerations from 2 g to 1 g. Similar results are obtained for higher spinning speed (1400 rpm of figure 8, with reduction from 2 g to 1 g). Good results are obtained also for unbalance load on one end of the drum (front end). Figure 7 shows for the same artificial load of figures 6 and 8 placed on the front, when water is added to the wrapper at 1000 rpm the horizontal and vertical accelerations are reduced from 1 g to 0,75 g and from 0,75 g to 0,6 g respectively.

[0012] In order to obtain the above good result in terms of vibrations reduction, in the wrapper 18 an amount of about 0,8 kg of water is collected for an unbalanced load centered in the drum, and of about 0,4 kg for an unbalanced load at front or rear portion of the drum.

[0013] In order to discharge the water remaining in the wrapper 18 at the end of the spinning phase, the shaped apertures 20 allows a discharge of water if rotation of the drum at low speed is carried out in the direction of arrow F (clockwise direction referred to figure 3). The spin di-

rection (arrow E) is counterclockwise. The shaped aperture 20 have preferably a height different from the centre of the wrapper 10 compared to its ends. This is shown in figure 6a (where apertures 20 are placed on a same line parallel to the axis of the wrapper for explanatory purposes only) in which shaped apertures 20 with smallest height are in the middle of the wrapper 18.

[0014] According to a second embodiment of the invention (figure 5), the wrapper 18 has ends 18a with a Z-shaped cross section, i.e. with a flat portion 22 at 90° with respect to the cylindrical wall of the wrapper, followed by a short stiffening cylindrical portion 24 having a diameter smaller than the diameter of the wrapper 18. On the flat portion 22 there are a plurality of slots 26 which allow a predetermined overflow of the wash water if its depth is higher than depth D.

[0015] The overall length of the wrapper 18 may be substantially identical to the length of the drum 14, but tests carried out by the applicant have shown that good balancing effect can be obtained by using a wrapper shorter than the drum, for instance with a length comprised between one third and one half of the length of the drum. This "short" version of the wrapper 18 is shown in figure 6.

[0016] The wrapper 18 is preferably made of metal sheet but it can be also made of polymeric material, for instance a reinforced thermosetting or thermoplastic resin. Moreover the drum 14 can have a plurality of bulges directed towards the outside of the drum which act as radial supports for the wrapper, the connection between the metal drum and the metal wrapper being made by welding or by gluing. In all cases the wrapper is substantially integral with the drum.

Claims

1. Laundry washing machine comprising a rotatable drum (14) having a generally horizontal axis of rotation, a tub (12) coaxially aligned with said axis of rotation and surrounding said drum (14), and balancing means adapted to reduce the effects of unbalanced laundry during spinning, **characterized in that** said balancing means comprises a cylindrical wrapper (18) interposed between the drum (14) and the tub (12), coaxially fastened to the drum (14) and adapted to collect at least part of liquid from spinning laundry.
2. Laundry washing machine according to claim 1, wherein said cylindrical wrapper (18) presents two longitudinally spaced-apart ends (18a) each having a bent edge.
3. Laundry washing machine according to claim 2, wherein each bent edge (18a) comprises a flat end portion (22) comprised between the wrapper (18) and a cylindrical stiffening rim (24) having a diameter

smaller than the diameter of the wrapper (18).

4. Laundry washing machine according to claim 3, wherein the flat end portion (22) presents a plurality of slots (26) in order to allow a predetermined over-flow of water into the tub (12). 5
5. Laundry washing machine according to any of the preceding claims, wherein the cylindrical wrapper (18) comprises a plurality of shaped passages (20) adapted to allow passage of water only when drum (14) rotates in a predetermined direction (F). 10
6. Laundry washing machine according to claim 5, wherein said shaped passages (20) are funnel-shaped and present an inclined edge (20a). 15
7. Laundry washing machine according to claim 6, wherein said funnel-shaped passages (20) have an height in the middle of the wrapper which is lower than the height of the passages at the ends of the wrapper (18). 20
8. Laundry washing machine according to any of the preceding claims, wherein the length of said cylindrical wrapper (18) is substantially identical to the length of the drum (14). 25
9. Laundry washing machine according to any of the claims 1-7, wherein the length of said cylindrical wrapper (18) is lower than the length of the drum (14). 30
10. Laundry washing machine according to claim 9, wherein the length of said cylindrical wrapper (18) is comprised between one third and one half of the length of the drum (14). 35
11. Laundry washing machine according to any of the preceding claims, wherein the drum (14) is provided with a direct drive motor. 40

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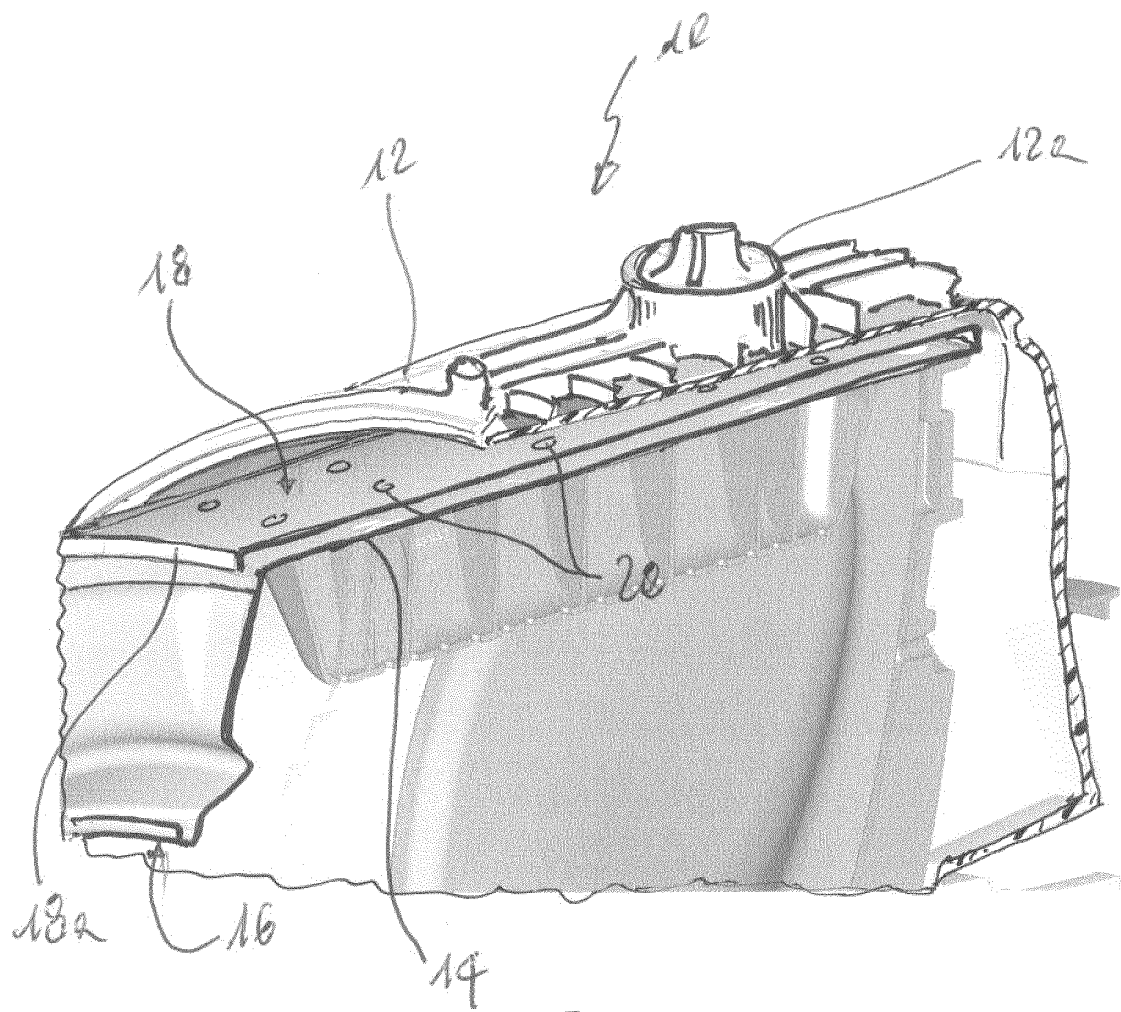


Fig. 1

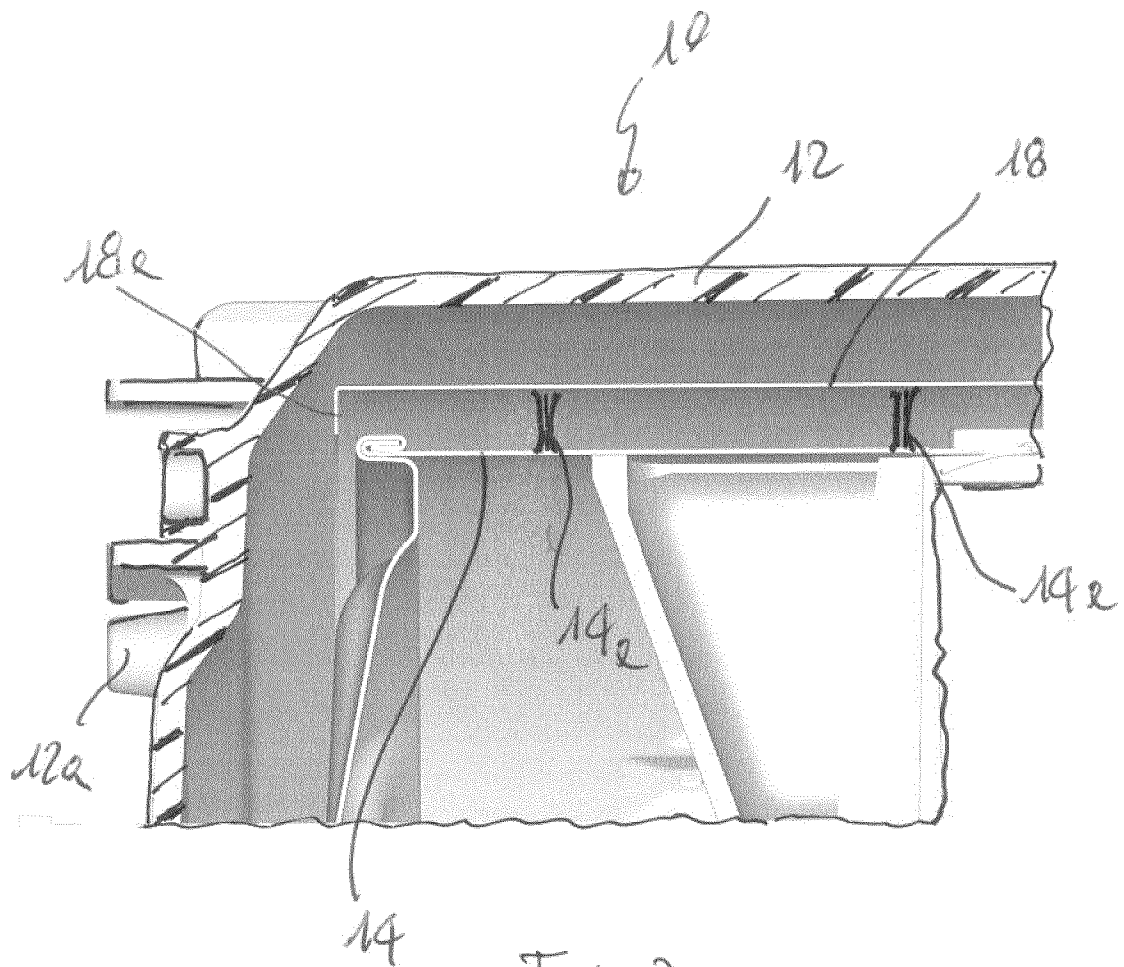
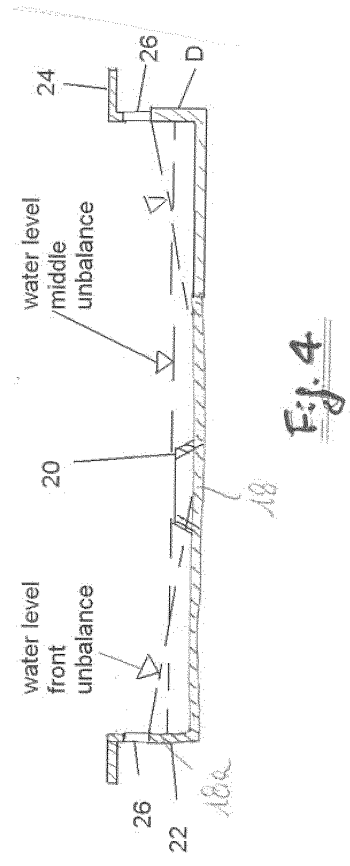
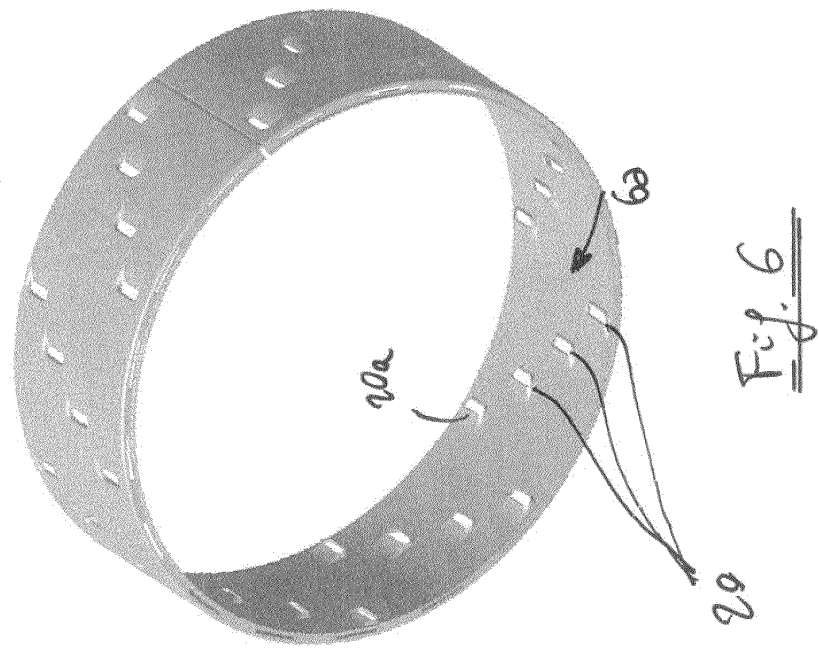
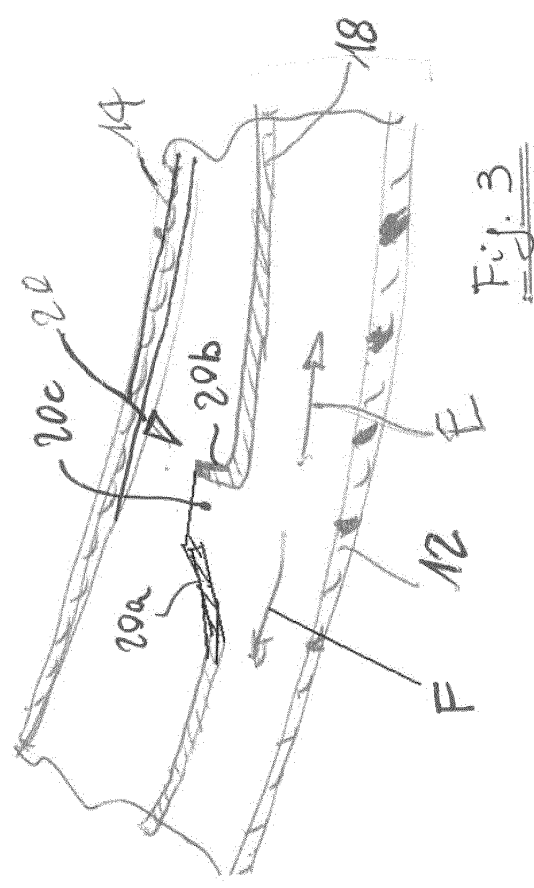
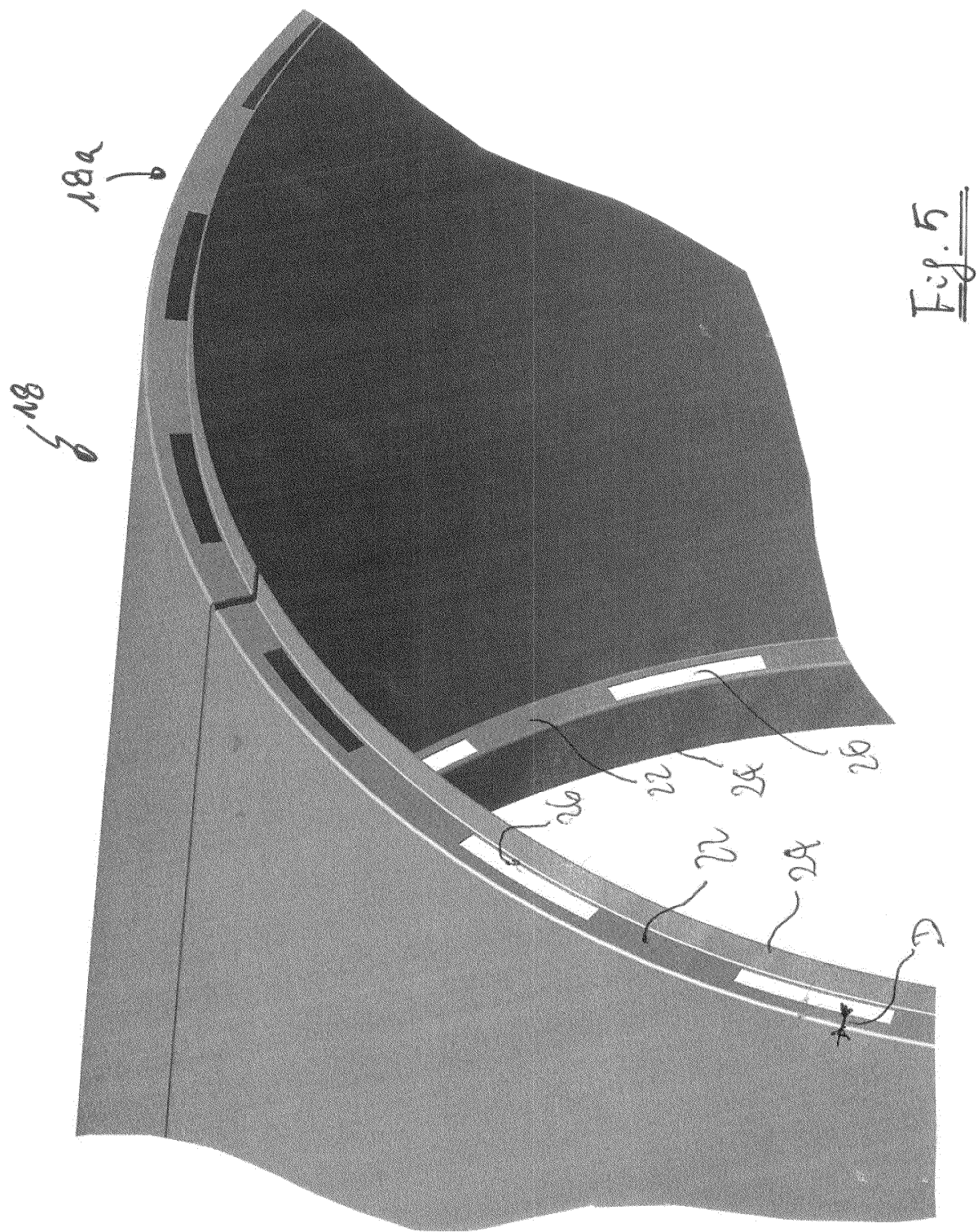


Fig. 2





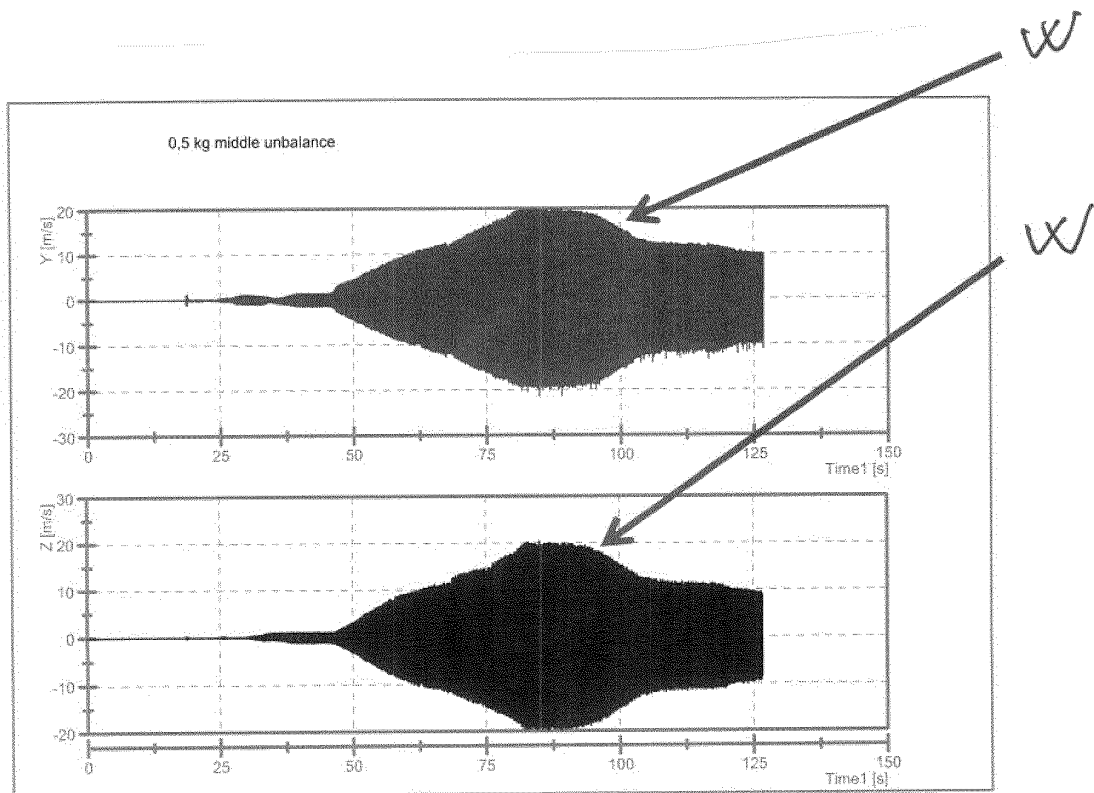
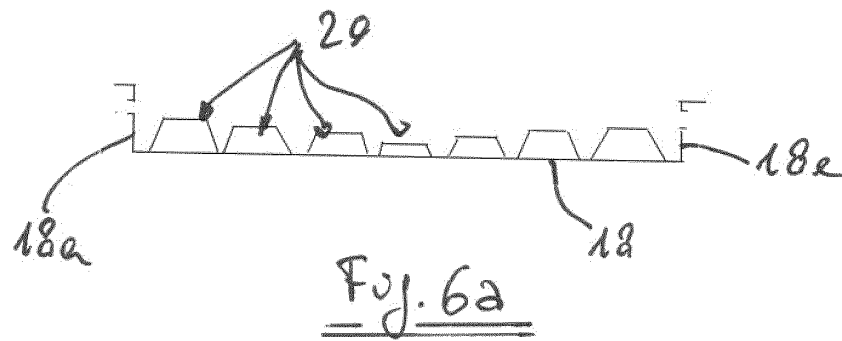


Fig. 7

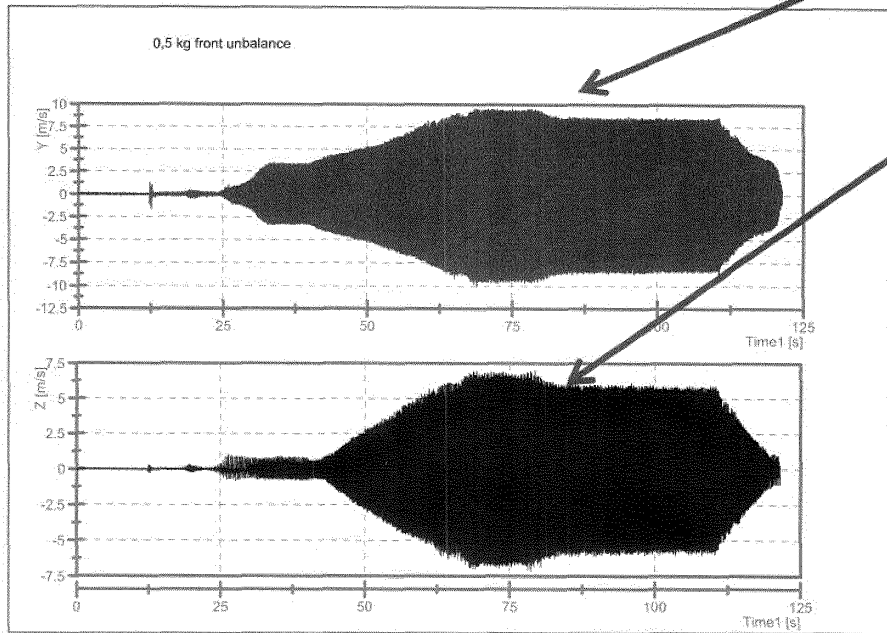


Fig. 8

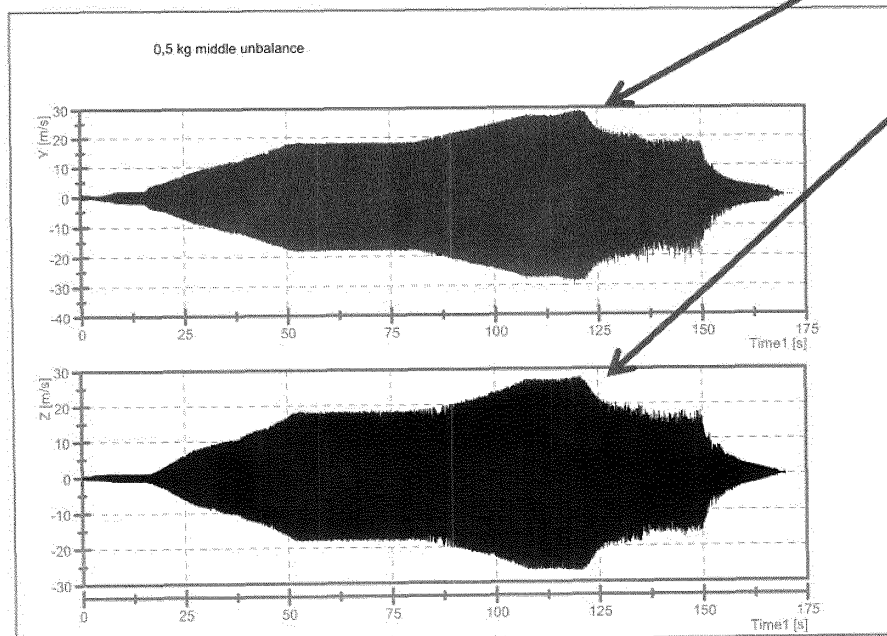


Fig. 9



EUROPEAN SEARCH REPORT

Application Number
EP 12 19 2170

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	CH 439 201 A (SCHULTHESS & CO AG MASCHF [CH]) 15 July 1967 (1967-07-15)	1-3,8	INV. D06F37/22
Y	* column 2, line 10 - line 23; figures 1,2	9,11	
A	*	4-7	
Y	----- WO 2011/025312 A2 (JANG JAE HYUK [KR]; KOO BON KWON [KR]) 3 March 2011 (2011-03-03) * figure 1 *	11	
Y	----- US 2 463 801 A (PAGE HERBERT E) 8 March 1949 (1949-03-08)	9	
A	* column 1, line 49 - column 2, line 17; figures 1,2 *	1,2	
			TECHNICAL FIELDS SEARCHED (IPC)
			D06F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 11 March 2013	Examiner Engelhardt, Helmut
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
ON EUROPEAN PATENT APPLICATION NO.**

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11-03-2013

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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