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(54) Household appliance column assembly

(57) Household appliance column assembly (1) formed by a washing machine (2) and a laundry dryer (3) stacked in floating manner one above the other; both washing machine (2) and laundry dryer (3) comprising a respective cabinet (4)(9), and laundry dryer (3) being also provided with at least one supporting foot (10) extending from the bottom of its cabinet (9) to rest on the top (4a) of the washing machine cabinet (4); the at least one supporting foot (10) of the laundry dryer (3) comprising a rigid element (13) projecting from the bottom of the cabinet (9), and at least one elastic pad (14) of viscoelastic polymeric gel covering the distal end (13a) of said rigid element (13) so as to be interposed between the rigid element (13) and the top surface (4a) of the cabinet (4) of the washing machine (2).

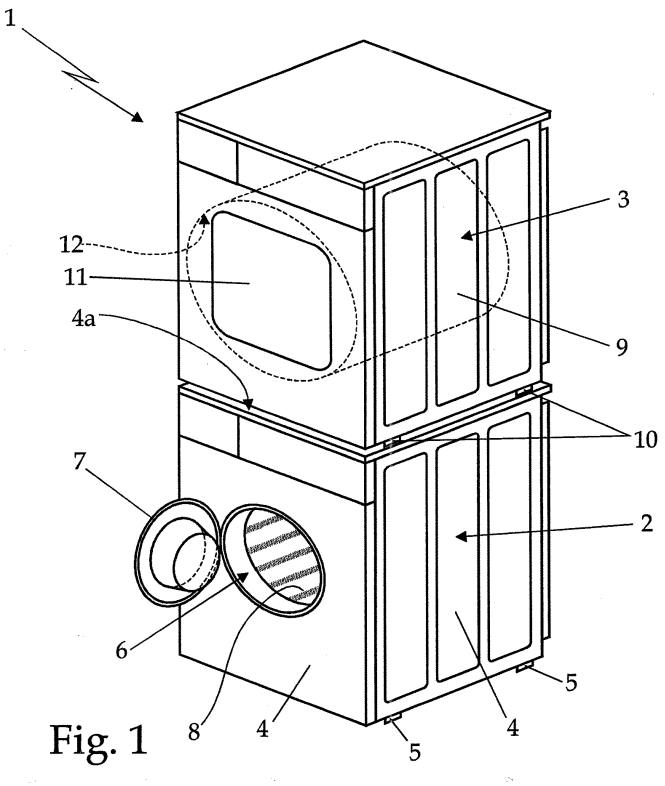

Fig. 1

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Description

[0001] The present invention relates to a household appliance column assembly.

[0002] More specifically, the present invention relates to a household appliance column assembly formed by a laundry dryer stacked on a washing machine.

[0003] As is known, high-speed rotation of the revolving drum of the washing machine usually produces severe machine vibrations which are transferred to the casing of the washing machine, and which normally become much more problematic as the speed of the revolving drums increases. To reduce machine vibrations, in today's laundry washing machines the revolving drums is connected in floating manner to the casing by a suspension system designed to partially absorb vibrations before they reach the casing.

[0004] To further reduce machine vibrations, today's washing machines are also provided with a vibration damper which is fixed to the machine casing to reduce casing vibrations at resonance speeds, and which normally comprises an oscillating mass and a number of coil springs connecting the oscillating mass to the washing machine casing. The oscillating mass and the coil spring system are properly dimensioned to vibrate, during rotation of the drum, out of phase with respect to vibrations transmitted to the casing by the floating suspension system of the drum, thus reducing the amplitude of the casing vibrations.

[0005] Unfortunately washing machine total weight is one of the main parameters to be taken into consideration in the dimensioning of the above cited vibration damper (traditionally known as "Frahm damper"). Thus in particular installation conditions the drum floating suspension system and the vibration damper of the washing machine fail to sufficiently reduce machine vibrations reaching the casing, so that the washing machine becomes noisy.

[0006] For example, when a laundry dryer is rigidly fixed to the top of the washing machine so as to form a rigid household appliance column assembly, household appliance total weight substantially doubles. Thus the washing machine vibration damper does not provide for optimum dumping performances and the vibrations generated by the revolving drum during the spin cycle may be resonance-amplified to an unacceptable noise level. This phenomenon becomes much more evident when the household appliance column assembly rests on a flexible floor, such as a wooden floor, a soft floor, or a floor resting on a thin slab.

[0007] It is an object of the present invention to provide a household appliance column assembly designed to eliminate the aforementioned drawbacks.

[0008] According to the present invention, there is provided a household appliance column assembly as claimed in Claim 1 and preferably, though not necessarily, any one of the Claims depending directly or indirectly on Claim 1.

[0009] According to the present invention, there is also provided a household appliance as claimed in Claim 9, and preferably, though not necessarily, any one of the Claims depending directly or indirectly on Claim 9.

[0010] 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 of a laundry dryer and a washing machine forming a household appliance column assembly in accordance with the teachings of the present invention;
- Figure 2 shows a schematic front view of a detail of the Figure 1 household appliance column assembly laundry dryer.

[0011] Number 1 in the accompanying drawings indicates as a whole a household appliance column assembly formed by two household appliances stacked one above the other on the floor, wherein each of two household appliances comprises a preferably, though not necessarily, parallelepiped-shaped cabinet or casing and a series of supporting feet extending from the bottom of the cabinet to rest on the floor or on the top of the cabinet of the lower household appliance.

[0012] More in particular, in the example shown household appliance column assembly 1 is formed by a washing machine 2 resting on the floor, and by a laundry dryer 3 resting on the top of washing machine 2.

[0013] Washing machine 2 comprises a preferably, though not necessarily, parallelepiped-shaped cabinet 4, a series of supporting feet 5 extending from the bottom of cabinet 4 to rest on the floor, and a cylindrical washing tub 6 which is positioned inside cabinet 4 and is provided with a front opening selectively closable by a door 7 hinged to cabinet 4.

[0014] Washing machine 2 also comprises a revolving drum 8 fitted in rotary manner about a horizontal rotation axis inside washing tub 6, and an electric motor (not shown) connected to drum 8 by a transmission system so as to rotate, on command, drum 8 about its longitudinal rotation axis inside washing tub 6.

[0015] With reference to figure 1, laundry dryer 3 in turn comprises a preferably, though not necessarily, parallelepiped-shaped cabinet 9, a series of supporting feet 10 extending from the bottom of cabinet 9 to rest on the top of washing machine cabinet 4, and a drying chamber (not shown) which is located inside cabinet 9 and is provided with a front opening selectively closable by a door 11 hinged to cabinet 9.

[0016] Likewise washing machine 2, laundry dryer 3 also comprises a revolving drum 12 fitted in rotary manner about a horizontal rotation axis inside the drying chamber, and an electric motor (not shown) connected to drum 12 by a transmission system so as to rotate, on command, drum 12 about its longitudinal rotation axis inside the above cited drying chamber.

[0017] With reference to figures 1 and 2, unlike known solutions, laundry dryer 3 (i.e. the upper household ap-

pliance of household appliance column assembly 1) is stacked on the top of washing machine 2 (i.e. the lower household appliance of household appliance column assembly 1) in floating manner without any rigid connection between the two household appliances; and each supporting foot 10 of laundry dryer 3 (i.e. of the upper household appliance) comprises a rigid element 13 projecting from the bottom of cabinet 9, and at least one elastic pad 14 of viscoelastic polymeric gel covering the distal end 13a of rigid element 13 so as to be interposed between rigid element 13 and the top surface 4a of cabinet 4 of washing machine 2.

[0018] More in particular, in the example shown rigid element 13 is formed by a plastic or metal stem 15 projecting from the bottom of cabinet 9 coaxially to a vertical reference axis A, and by a disk-shaped washer 16 fixed to the end of stem 16 so as to lie on a reference plane perpendicular to reference axis A, whereas pad 14 is defined by a monolithic disk-shaped piece 14 of viscoelastic polymeric gel covering the lower flat surface of washer 16, i.e. the distal end 13a of rigid element 13.

[0019] As concerns the viscoelastic polymeric gel, in the example shown elastic pads 14 are made of viscoelastic Polyurethane or Silicone gel having a dynamic elastic modulus G' lower than 300.000 pascals within a frequency range between 5 Hertz and 15 Hertz, and a dynamic loss factor η greater than 0,1 within a frequency range between 5 Hertz and 15 Hertz.

[0020] In particular, preferably, though not necessarily, elastic modulus G' of the viscoelastic polymeric gel should be lower than 300.000 pascals within a frequency range between 3 Hertz and 30 Hertz, and loss factor η should be greater than 0,1 within a frequency range between 3 Hertz and 30 Hertz.

[0021] More specifically, in a preferred embodiment elastic modulus G' of the viscoelastic polymeric gel is comprised between 10.000 pascals and 100.000 pascals within a frequency range between 5 Hertz and 15 Hertz, and preferably, though not necessarily, within a frequency range between 3 Hertz and 30 Hertz; and loss factor η of the viscoelastic polymeric gel is comprised between 0,1 and 0,5 within a frequency range between 5 Hertz and 15 Hertz, and preferably, though not necessarily, within a frequency range between 3 Hertz and 30 Hertz.

[0022] Assuming that one end of the material sample (i.e. the viscoelastic polymeric gel) is fixed to a rigid support, that the opposite end of the material sample is subjected to shear deformations due to a sinusoidal (periodic) strain, and that a sinusoidal stress torque is transmitted to the support; the elastic modulus G' is defined by the following formula:

$$G' = \cos\delta\left(\frac{\tau}{\lambda}\right)$$

wherein δ is the phase angle between strain and stress trends (i.e. phase shift between strain and stress vectors); τ is the value of the stress vector; and λ is the value of the strain vector.

[0023] The value τ of the stress vector is defined by the following formula:

$$\tau = MK_{\tau}$$

wherein M is the value of the sinusoidal stress torque transmitted to the support, and K_τ is the geometrical stress constant of the tested material sample.

[0024] The value λ of the strain vector is defined by the following formula:

$$\lambda = \theta\ K_{\lambda}$$

wherein θ is the value of the angular displacement of the end of material sample (i.e. the viscoelastic polymeric gel) subjected to the sinusoidal strain, and K_λ is the geometrical strain constant of the tested material sample.

[0025] Finally the loss factor η is defined by the following formula:

$$\eta = \tan\delta$$

wherein δ is the phase angle between strain and stress trends (i.e. phase shift between strain and stress vectors).

[0026] In use, the absence of any rigid connection between washing machine 2 and laundry dryer 3 and the presence of the elastic pads 14 of viscoelastic polymeric gel on the supporting feet 10 of laundry dryer 3, let the laundry dryer 3 act as a vibration damper which, thanks to its heavy oscillating mass, is capable of considerably reducing the vibrations amplitude of the whole household appliance column assembly 1 when the revolving drum 8 of washing machine 2 rotates at high speed during the spin cycle.

[0027] Household appliance column assembly 1, as described above, has numerous advantages: the use of laundry dryer 3 as a vibration damper takes away the need to replace the internal "Frahm damper" of the washing machine 2 when the latter becomes part of a household appliance column assembly. Moreover assembling of laundry dryer 3 on the top of washing machine 2 is earlier and faster than in today's household appliance column assemblies.

[0028] In addition to what above, thanks to the high weight ratio between the mass of laundry dryer 3 and the mass of washing machine 2, and thanks to softness and high loss factor of the elastic pads 14 made of viscoelastic

polymeric gel, damping performance of the floating laundry dryer 3 remains high over a extremely wide operative range of frequencies, thus strongly improving stability and silenceness of the household appliance column assembly 1.

[0029] Clearly, changes may be made to household appliance column assembly 1 as described herein without, however, departing from the scope of the present invention.

[0030] For example, supporting feet 10 of laundry dryer 3 may be replaced by a single large supporting foot comprising a rigid bedplate fixed to the bottom of cabinet 9, and at least one elastic pad of viscoelastic polymeric gel covering the lower surface of the bedplate so as to be interposed between the bedplate and the top surface 4a of washing machine cabinet 4.

Claims

1. Household appliance column assembly (1) comprising a first (2) and a second household appliance (3) stacked one above the other on the floor; both first (2) and second household appliance (3) comprising a respective cabinet (4)(9), and the second household appliance (3) also comprising at least one supporting foot (10) extending from the bottom of said cabinet (9) to rest on the top (4a) of the cabinet (4) of said first household appliance (2); said household appliance column assembly (1) being **characterized in that** said second household appliance (3) is stacked in floating manner on the top of said first household appliance (2), and said at least one supporting foot (10) of the second household appliance (3) comprises a rigid element (13) projecting from the bottom of the cabinet (9), and at least one elastic pad (14) of viscoelastic polymeric gel covering the distal end (13a) of said rigid element (13) so as to be interposed between said rigid element (13) and the top surface (4a) of the cabinet (4) of said first household appliance (2).

2. Household appliance column assembly as claimed in Claim 1, **characterized in that** said elastic pad (14) of viscoelastic polymeric gel has an elastic modulus (G') lower than 300.000 pascals within a frequency range between 5 Hertz and 15 Hertz, and a loss factor (η) greater than 0,1 within a frequency range between 5 Hertz and 15 Hertz.

3. Household appliance column assembly as claimed in Claim 2, **characterized in that** elastic modulus (G') of said viscoelastic polymeric gel is lower than 300.000 pascals within a frequency range between 3 Hertz and 30 Hertz; and loss factor (η) of said viscoelastic polymeric gel is greater than 0,1 within a frequency range between 3 Hertz and 30 Hertz.

4. Household appliance column assembly as claimed in any of the preceding Claims, **characterized in that** elastic modulus (G') of said viscoelastic polymeric gel is comprised between 10.000 pascals and 100.000 pascals within a frequency range between 5 Hertz and 15 Hertz; and loss factor (η) of said viscoelastic polymeric gel is comprised between 0,1 and 0,5 within a frequency range between 5 Hertz and 15 Hertz.

5. Household appliance column assembly as claimed in any of the preceding Claims, **characterized in that** the cabinet (4) (9) of said first (2) and/or said second household appliance (3) is a parallelepiped-shaped cabinet (4) (9) .

6. Household appliance column assembly as claimed in any of the preceding Claims, **characterized in that** said at least one elastic pad (14) of viscoelastic polymeric gel is made of Polyurethane or Silicone gel.

7. Household appliance column assembly as claimed in any of the preceding Claims, **characterized in that** said first household appliance (2) is a washing machine (2).

8. Household appliance column assembly as claimed in any of the preceding Claims, **characterized in that** said second household appliance (3) is a laundry dryer (3).

9. Household appliance (3) comprising a cabinet (9) and at least one supporting foot (10) extending from the bottom of said cabinet (9); said household appliance (3) being **characterized in that** said at least one supporting foot (10) comprises a rigid element (13) projecting from the bottom of said cabinet (9), and at least one elastic pad (14) of viscoelastic polymeric gel covering the distal end (13a) of said rigid element (13).

10. Household appliance as claimed in Claim 9, **characterized in that** said elastic pad (14) of viscoelastic polymeric gel has an elastic modulus (G') lower than 300.000 pascals within a frequency range between 5 Hertz and 15 Hertz, and a loss factor (η) greater than 0,1 within a frequency range between 5 Hertz and 15 Hertz.

11. Household appliance as claimed in Claim 10, **characterized in that** elastic modulus (G') of said viscoelastic polymeric gel is lower than 300.000 pascals within a frequency range between 3 Hertz and 30 Hertz; and loss factor (η) of said viscoelastic polymeric gel is greater than 0,1 within a frequency range between 3 Hertz and 30 Hertz.

12. Household appliance as claimed in Claims 10 or 11, **characterized in that** elastic modulus (G') of said viscoelastic polymeric gel is comprised between 10.000 pascals and 100.000 pascals within a frequency range between 5 Hertz and 15 Hertz; and loss factor (η) of said viscoelastic polymeric gel is comprised between 0,1 and 0,5 within a frequency range between 5 Hertz and 15 Hertz.

13. Household appliance as claimed in any one of Claims 9 to 12, **characterized in that** the cabinet (9) of said household appliance (3) is a parallelepiped-shaped cabinet (9).

14. Household appliance as claimed in any one of Claims 9 to 13, **characterized in that** said at least one elastic pad (14) of viscoelastic polymeric gel is made of Polyurethane or Silicone gel.

15. Household appliance as claimed in any one of Claims 9 to 14, **characterized in that** said household appliance (3) is a laundry dryer (3).

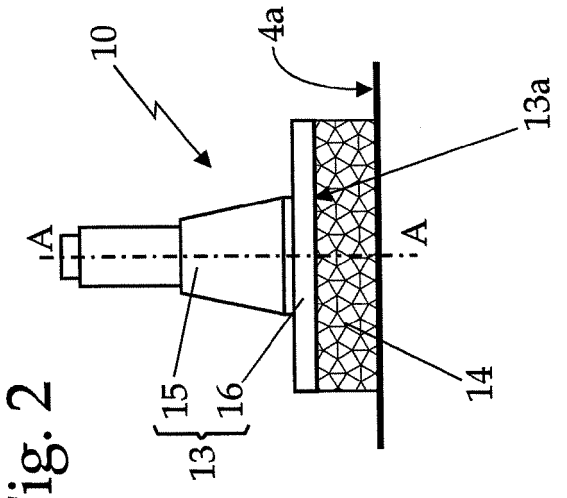

Fig. 2

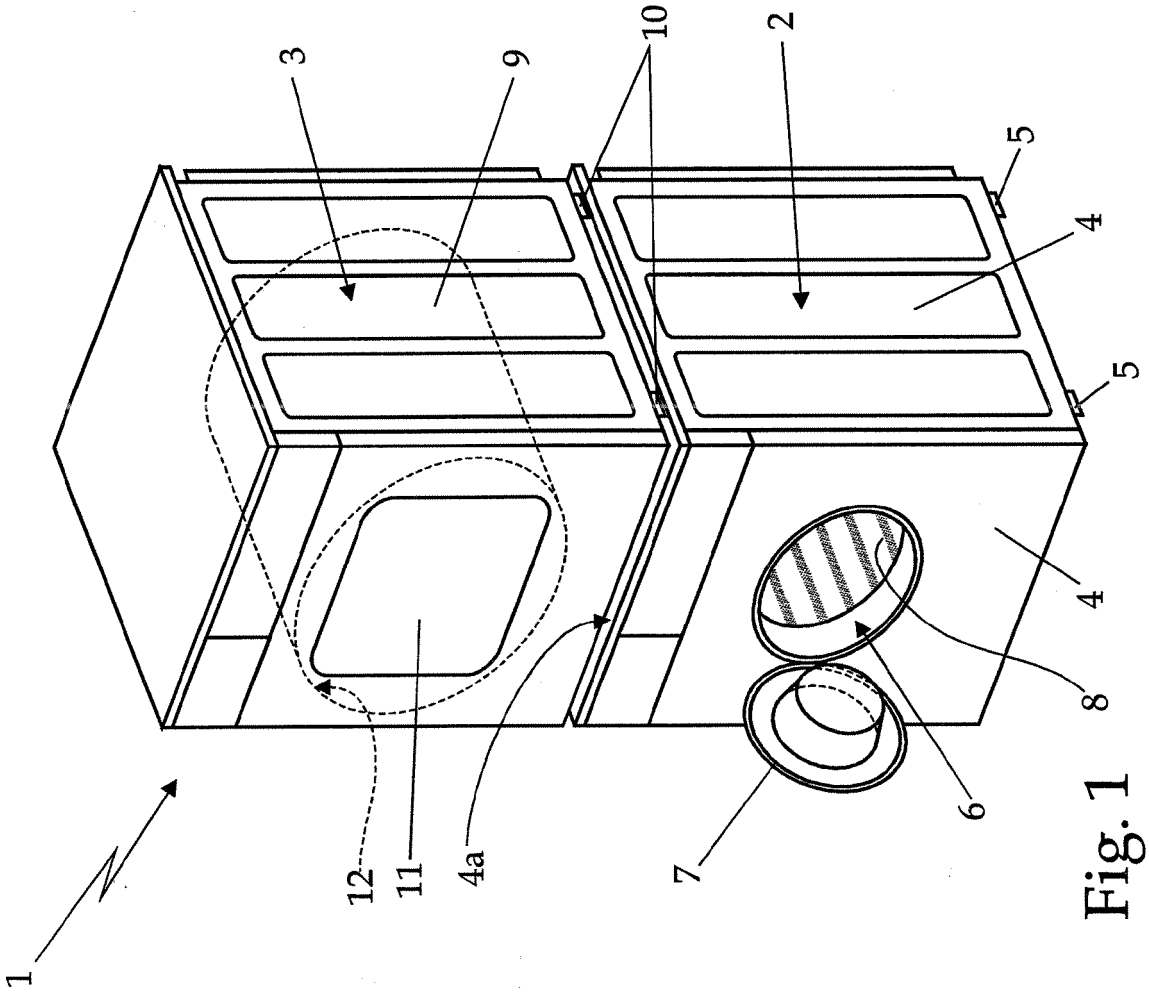

Fig. 1

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Application Number
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	13 June 2007	Norman, Pia

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