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HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR,
KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG,
MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM,
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(54) Title: NOISE-REDUCING DEVICE FOR HOUSEHOLD APPLIANCES

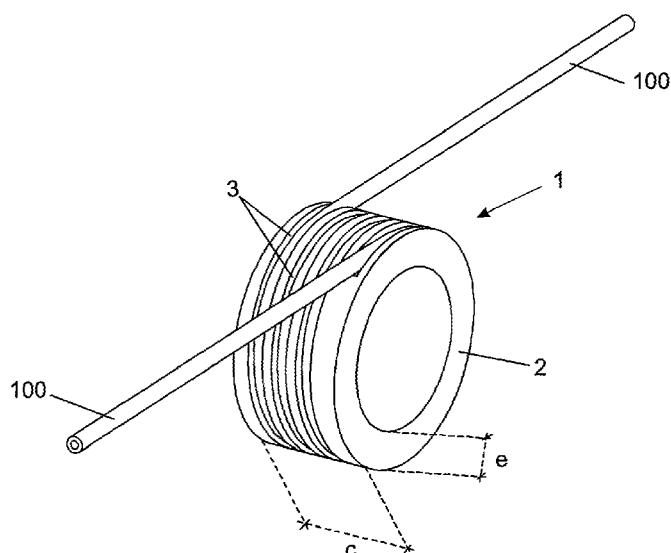


FIG. 2

(57) Abstract: The present invention pertains to a noise-reducing device for household appliances, more specifically to assist in reducing noise originating from the vibration of the capillary tubes of cooling systems produced by the expansion of cooling gas which runs through its inside. The invention is characterized by comprising means to promote the muffling of vibrations originating from operating frequencies varying from 250 Hz to 630 Hz in an expansion device (100), wherein said means comprise at least a body (2) comprising at least a groove (3) cooperating with the at least an expansion device (100), wherein the mass of the at least a body (2) is comprised within the interval varying from 8 to 18 grams.



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“NOISE-REDUCING DEVICE FOR HOUSEHOLD APPLIANCES”

Field of the invention

The present invention pertains to a noise-reducing device for household appliances, more specifically to assist in reducing noise originating from the vibration
5 of the capillary tubes of cooling systems produced by the expansion of cooling gas which runs through the inside thereof.

Background of the Invention

As known in the art, cooling systems basically comprise standard cooling cycle comprising stages of expansion, evaporation, compression and condensation
10 of a fluid that constantly runs through the piping system. In short, the cooling fluid which is in liquid form passes through the expansion device, also known as expansion valve or capillary tube, allowing a sharp drop in pressure of the cooling fluid flow, and subsequently said fluid is conducted to the evaporator, where vaporization thereof occurs by capturing the heat from the environment to be cooled,
15 which is then conducted to the compressor. It is here that the increase in temperature and pressure of the fluid occurs, which then follows on to the condensing device.

As seen in the brief description above, one of the essential components of a cooling system is a means of expanding the cooling fluid located at a certain point in the cycle, and said means has the capacity to cause a reduction in the pressure and
20 in the temperature of the coolant due to adiabatic expansion. However, the workings of this means of expansion may cause noise originating from its vibration frequencies.

In this regard, the state of the art comprises certain documents that disclose attempts at solutions to enable a decrease in the noise generated on account of the
25 high pressure of the fluid which passes through the expansion devices such as, for example, document CN1171529 which describes a silencer in the form of a conical section tube which inter connects the capillary tube and the evaporator tube. This solution, however, does not provide means of muffling the noise originating specifically from the tube vibration, whereby providing a partial solution to the
30 problem.

Document KR2009080242 comprises a noise-reducing element comprised of insulating material which involves the capillary tube, but without providing any type of additionally muffling mass to modify the vibration frequencies.

The object of document CN201306899 provides a solution that comprises a cylinder-shaped sponge endowed with a central hole to couple to the capillary tube, and has fastening rings to assist in keeping the sponge fastened to the tube. However, just as in the other documents cited, the sponge material has no effect over the vibration frequency owing to the absence of muffling mass and, therefore, solving the noise problem is ultimately limited.

The solution of document CN202532792 describes a fastening device basically comprising a board containing grooves for coupling the rings of the capillary tube of a cooling system, with a construction that is essentially designed to fix and maintain the steps of the parallel capillary tube. However, said device does not have constructive characteristics that provide sufficient mass to providing a significant muffling effect for reducing the noise of the system.

Therefore, in light of the above, it can be seen that the current state of the art is lacking in technical and functional solutions capable of effectively providing a muffling effect capable of modifying the vibration frequencies of the expansion devices and thereby significantly reducing the degree of emission noise from the cooling systems.

Objectives of the invention

Having established this, it is an objective of the present invention is to provide a noise-reducing device for household appliances which acts by modifying the vibration frequencies of the expansion device of cooling systems.

Therefore, it is an objective of the present invention to disclose a noise-reducing device that comprises a muffler for the capillary tubes of the cooling system.

Another objective of the invention is to disclose a noise-reducing device which besides comprising a mass to muffle vibrations, also provides a means of fastening the capillary tubes of the system, which was carefully designed and sized to act specifically upon the frequency ranges of interest, in the most optimized manner possible.

Summary of the Invention

The objectives and technical effects referred to above are achieved by way of the noise-reducing device for household appliances of the present invention, more specifically for cooling systems of refrigerators and air-conditioning units which
5 comprise at least an expansion device, characterized wherein said noise-reducing device comprises at least a body comprising at least a groove cooperating with the at least an expansion device, wherein the mass of the at least a body is comprised within the interval varying from 8 to 18 grams.

In a preferred embodiment of the invention, the mass of the at least a body of
10 said noise-reducing device is comprised, more specifically, within the interval varying from 11 to 15 grams.

Also in a preferred embodiment, the body of said noise-reducing device is substantially cylindrical in shape, and said at least a groove comprises, more specifically, a toroidal-contoured groove along thickness "e" and length "c" of the
15 body to house, on its inside, the steps of the expansion device.

One of the main characteristics of the invention presented herein is to provide vibration muffling for frequencies chiefly comprised within the interval varying from 250 Hz to 630 Hz.

Accordingly, in short the noise-reducing device for household appliances is
20 fundamental characterized by comprising means to promote the muffling of vibrations originating from operating frequencies varying from 250 Hz to 630 Hz in said expansion device, wherein said means comprise at least a body comprising at least a groove cooperating with the at least an expansion device, wherein the mass of the at least a body is comprised within the interval varying from 8 to 18 grams.

Summarized Description of the Drawings

The present invention will now be described in greater detail based on the drawings specified below, wherein:

Figure 1 shows a side view of the noise-reducing device for household appliances of the present invention, duly coupled to an expansion device (capillary
30 tube) of a generic cooling system;

Figure 2 shows a perspective view of the device represented in Figure 1, and

Figure 3 shows a graph with levels of noise emitted by two cooling systems, one of which is provided with the noise-reducing device of the present invention.

5 Detailed Description of the Invention

The object of the present invention will now be described and explained in greater detail based on the accompanying drawings, which are merely exemplary as opposed to limitative, since adaptations and modifications may be made without straying from the scope of the protection claimed.

10 The noise-reducing device 1 object of the present invention was devised for cooling systems such as, for example, those used in cooling equipment and air-conditioning units, which operate with cooling systems basically comprising a compressor interconnected to a suction pipe and to a discharge pipe, wherein the discharge pipe interconnects with a condenser and, thereafter, the cooling system
15 comprises an expansion device 100 (or capillary tube) and an evaporator whose outlet is connected to the suction pipe which returns to said compressor.

In a preferred embodiment of the invention as illustrated in accompanying Figures 1 and 2, the noise-reducing device 1 comprises a substantially cylindrical-shaped body 2 having thickness "e" such that it is able to have, along its length "c",
20 toroidal-contoured grooves 3 (thread) capable of housing on its inside the different steps or turns of the piping of which the expansion device 100 of the cooling system is constituted.

It should be highlighted that the geometry of said noise-reducing device 1 was meticulously studied, bearing in mind specialist knowledge that ideal muffling for
25 expansion devices has an effect at frequencies of 250 Hz to 630 Hz, and said frequencies are excited by a force that bears a direct relationship to the mass involved – remembering that $F \text{ (force)} = \text{mass (m)} \times \text{acceleration (a)}$. Accordingly, the weight of the noise-reducing device 1 was calculated to operate in these frequency ranges and, accordingly, by means of simulation analyses, a preferred value of 13
30 grams was obtained.

In this regard, it is worth remembering that if the mass of the noise-reducing device 1 is excessive, there is a risk of transferring the vibration of the expansion device 100 to other frequency ranges which perhaps already tend to be practically null in the system, which may cause the undesirable result of increasing the noise. In contrast, if the mass of the device 1 is much lower than that specified, the practical results of reducing noise on account of acceleration will not be noted and, therefore, the device will not be effective.

Another important aspect of the noise-reducing device 1 object of the present invention pertains to the quantity of grooves 3 that it has, since the quantity of turns of the expansion device 100 generates an increase in the length of the capillary tube, whereby reducing the speed of the cooling gas such that because of this, the energy dissipates more easily.

The grooves 3 act as guides for coupling the various steps or turns of the expansion device 100, and also facilitate and provide greater accuracy for the assembly thereof in the noise-reducing device 1, whereby providing greater robustness to the process. In this sense, it is emphasized that in the preferred embodiment of the invention represented in the accompanying Drawings, the noise-reducing device 1 is mounted at a site near the evaporator to achieve the desired results, that is, so that the alteration of the frequency modes of vibration generated by the expansion of the cooling gas such that it minimizes noise to the greatest possible extent. Accompanying Figure 3 reveals the difference, in Hertz, of the noises emitted by systems operating without and with the noise-reducing device 1 of the present invention, demonstrating that effectively the level of sound emission is significantly reduced when used.

Moreover, the spring-shaped geometry of the noise-reducing device 1 ultimately makes the structure more prone to muffling the vibrations of the expansion device, which is also highly beneficial for obtaining the desired results.

It is thus perceived that the noise-reducing device 1 that is the object of the present invention solves the technical problem of excessive emission of noise originating from the expansion device 100 by means of a vibration-muffling technique

based on the geometry and on the mass of the device which, moreover, also acts as a kind of "template" for facilitating the assembly of the system's capillary tube.

It is clarified that to achieve the desired results in an easier fashion, the noise-reducing device should preferably be made of a polymer material, yet other materials may be used without straying from the scope of protection sought.

It is also important to emphasize that although preferred constructive forms of the present invention have been shown, it should be understood that any constructive omissions, substitutions and alterations may be introduced by a person skilled in the art, without straying from the spirit and scope of protection sought. It is also expressly foreseen that all the combinations of the elements that perform the same function in substantially the same manner to achieve the same results are within the scope of the invention. Substitutions of elements of a modality described by others are also entirely intended and contemplated.

CLAIMS

1. A noise-reducing device for household appliances, more specifically for cooling systems of refrigerators and air-conditioning units which comprise at least one expansion device (100), **CHARACTERIZED** by the fact that said noise-reducing device (1) comprises at least one body (2) comprising at least one groove (3) cooperating with the at least one expansion device (100), wherein the mass of the at least one body (2) is comprised within the interval varying from 8 to 18 grams.

2. The device as claimed in claim 1, **CHARACTERIZED** by the fact that the mass of the at least one body (2) of said noise-reducing device (1) is comprised, more specifically, within the interval varying from 11 to 15 grams.

3. The device as claimed in claims 1 and 2, **CHARACTERIZED** by the fact that the at least one body (2) of said noise-reducing device (1) is substantially cylindrical in shape.

4. The device as claimed in claim 1, **CHARACTERIZED** by the fact that the at least one groove (3) comprises, more specifically, a toroidal-contoured groove along thickness (e) and length (c) of the at least a body (2) to house, on its inside, the steps of the expansion device (100).

5. The device as claimed in any of claims 1 to 4, **CHARACTERIZED** by providing the muffling of vibrations for frequencies comprised, mainly, within the interval varying from 250 Hz to 630 Hz.

6. A noise-reducing device for household appliances, more specifically for cooling systems of refrigerators and air-conditioning units that comprise at least one expansion device (100), **CHARACTERIZED** by comprising means to promote the muffling of vibrations originating from operating frequencies varying from 250 Hz to 630 Hz in said expansion device (100), wherein said means comprise at least one body (2) comprising at least a groove (3) cooperating with the at least one expansion device (100), wherein the mass of the at least one body (2) is comprised within the interval varying from 8 to 18 grams.

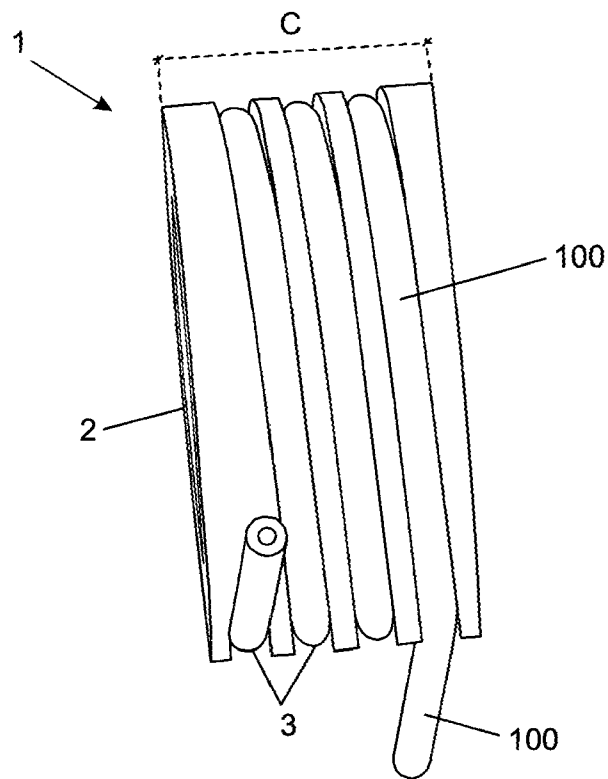
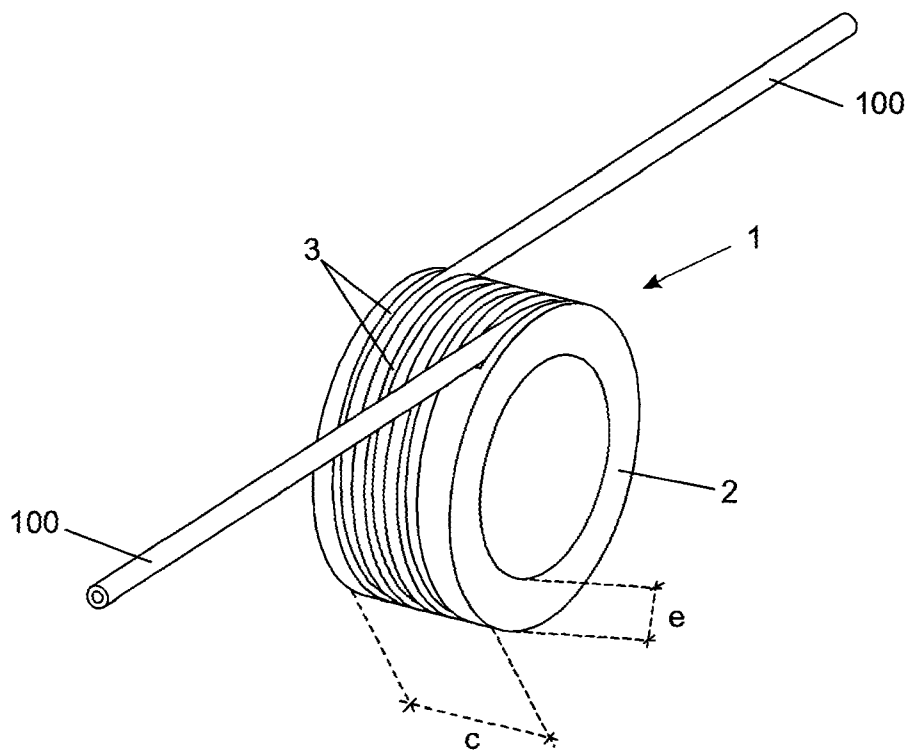


FIG. 1

**FIG. 2**

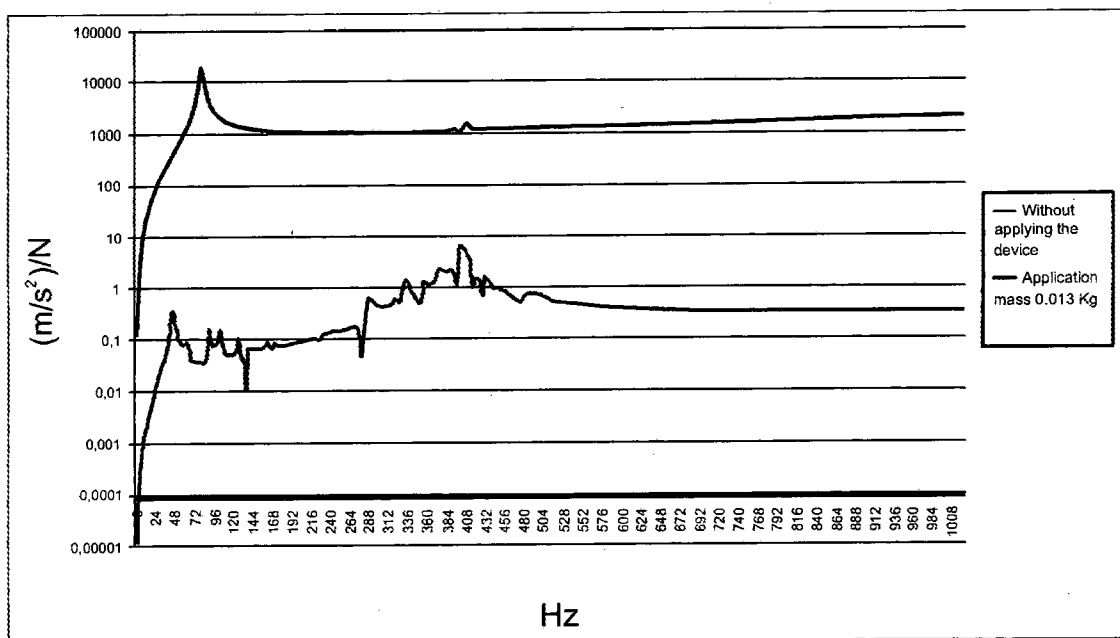


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No

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A. CLASSIFICATION OF SUBJECT MATTER
INV. F25B41/06
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F25B F16L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 20 2006 007921 U1 (LIEBHERR HAUSGERAETE LIENZ [AT]) 30 August 2007 (2007-08-30) paragraphs [0025] - [0032]; figures 3-6 -----	1-6
X	KR 2008 0103282 A (LG ELECTRONICS INC [KR]) 27 November 2008 (2008-11-27) abstract; figure 4 paragraph [0043] -----	1-6
X	CN 202 532 792 U (TCL AIR CONDITIONER ZHONGSHAN) 14 November 2012 (2012-11-14) cited in the application paragraphs [0012] - [0013]; figures -----	1-6
X	CN 201 306 899 Y (ZHEJIANG KANGSHENG PIPE CO LTD) 9 September 2009 (2009-09-09) cited in the application figures ----- -/-	1-6



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

3 February 2015

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Name and mailing address of the ISA/

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Authorized officer

Ritter, Christoph

INTERNATIONAL SEARCH REPORT

International application No

PCT/BR2014/000420

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 2009 0041682 A (WINIAMANDO INC [KR]) 29 April 2009 (2009-04-29) figure 3 -----	5,6

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/BR2014/000420

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		DE 202006007921 U1	30-08-2007
		EP 2013553 A2	14-01-2009
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CN 201306899 Y	09-09-2009	NONE	

KR 20090041682 A	29-04-2009	NONE	
