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(54) **Add-on silencer for hairdryer**

(57) The present invention relates to a universal add-on silencer to be used optionally on hairdryers of various

dimensions comprising broadband and tonal noise reduction means.

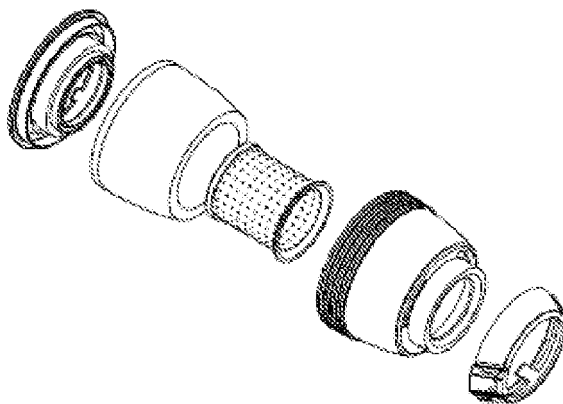


Fig.11b

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Description**Field of the Invention**

[0001] The present invention relates to an add-on silencer to be optionally used onto various hairdryers. The silencer reduces broadband noise by dissipative foam and tonal noise by a Helmholtz resonator array and/or acoustic liner. The add-on silencer of the present invention is tuned to a broadband that is sufficient to cover different motor speeds that are due to variation in supplied voltage or due to the variety of hairdryers.

Introduction and State of the Art

[0002] Noise of a hair dryer is typically broadband noise and tonal noise (see Fig.1). Broadband noise can be reduced by means of so-called dissipative silencers (foam, expansion chambers, ...) whereas tonal noise can be reduced by means of so-called reflective silencers, like quarter-wave resonators or Helmholtz-resonators.

[0003] One of the origins of tonal noise is the rotating fan in the dryer. The fan gives a tonal noise at a certain frequency, i.e. the so-called "blade passing frequency" (BPF) and its harmonics. This blade passing frequency equals:

$$\text{BPF} = n \times a / 60$$

in which:

- n: rotating speed of fan (rpm)
- a: number of vanes on the fan

[0004] Helmholtz resonators (Fig.2) are "tuned" to a certain frequency, the so-called resonant frequency. At this frequency, the noise attenuation will be maximum (Fig.3):

$$f_{\text{res}} = (c/2\pi) \cdot (S/l_{\text{eff}} \cdot V)^{1/2}$$

in which:

- c : speed of air (mm/s)
- S : surface area of neck opening (mm²)
- l_{eff}: effective length of neck (mm)
- V : volume of cavity (mm³)

[0005] Helmholtz resonators can thus be tuned to the BPF in order to reduce the tonal noise that is due to the rotation of the fan in a hairdryer. Unfortunately, the Helmholtz resonator only works well at a very narrow bandwidth (Fig.3).

[0006] This is unfortunate for a hairdryer, as the BPF is directly proportional to the speed of the fan, which is directly coupled to the speed of the motor to which the fan is mounted. The speed of the motor itself depends on the voltage supplied to the motor. This voltage can easily vary between 220 V and 240 V depending on location and other circumstances. So, the Helmholtz resonator tuned to the blade passing frequency (BPF) at a certain voltage will be much less effective if the speed of the motor is changed because of the supplied voltage. Also, one hairdryer may function at max settings at a specific speed, but a second hairdryer may function at a speed somewhat less or higher. The Helmholtz resonator can therefore only be really effective for a very narrow range of speeds.

[0007] At comparable performances, hairdryers with integrated noise reduction are always heavier and bigger than hairdryers without integrated noise-reduction system. Those hairdryer are therefore more difficult to handle than hair-dryers without integrated noise-reduction equipment.

[0008] A low-noise hand-held hairdryer has been disclosed in US 4,596,921. This hairdryer comprises an integrated sound insulation and does not offer the possibility of optional use.

[0009] WO 2009/112690 A2 discloses a quiet hairdryer generating particular sound frequencies and an integrated silencer of a particular configuration determined as a function of said particular sound frequencies.

[0010] EP 0 631 738 A1 discloses a housing attachment for a hairdryer which is fitted over the intake opening adjacent to the fan of said hairdryer. The housing attachment forms a housing chamber with a second intake opening which

precedes the first intake opening, wherein the flow cross-section of the second intake opening is smaller than the flow cross-section of the first intake opening. The disclosed attachment does not disclose any specific broadband noise or tonal-noise reduction means.

Aims of the Invention

[0011] The present invention aims to provide an add-on silencer suitable to be used on various existing hairdryers and able to overcome the drawbacks of the prior-art silencers.

[0012] The present invention additionally aims to provide a universal add-on silencer suitable to be used on existing hairdryers of various dimensions, the silencer comprising efficient broadband and tonal-noise reduction means.

Summary of the Invention

[0013] The present invention discloses a universal add-on silencer with snap-fit means suitable to be used on existing hairdryers of various dimensions, said silencer comprising broadband and tonal-noise reduction means.

[0014] Specific embodiments of the present invention comprise at least one or a suitable combination of the following features:

- the snap-fit means is a segmented annular snap-fit arrangement to fit around the back housing of existing hairdryers;
- said snap-fit means comprises in addition to the segmented annular snap-fit arrangement two "push-to-open" snap fits at 180° to allow the easy removal of said add-on silencer;
- the broadband noise reduction means is a dissipative foam;
- the dissipative foam is a foam ring inserted between the annular snap fit and the back housing of the hairdryer;
- the tonal-noise reduction means is a Helmholtz resonator array with at least two chambers;
- the Helmholtz resonator array comprises three successive rings separating the chambers, the first ring being tuned to a frequency corresponding to a supplied voltage of about 220 V, the second ring being tuned to a frequency corresponding to a supplied voltage of about 230 V and the third ring being tuned to a frequency corresponding to a supplied voltage of about 240 V;
- the noise-dissipative foam is added to the walls of each chamber;
- the tuning of the different volumes is performed by means of a smaller or larger neck opening or neck length of said Helmholtz array;
- the tonal-noise reduction means comprises a so-called "acoustic liner", said acoustic liner comprising various sizes of holes, each size of holes being arranged for each resonant frequency of the hairdryer.

Brief Description of the Drawings

[0015] Fig.1 shows the typical noise spectrum of a hairdryer.

[0016] Fig.2 shows a schematic Helmholtz resonator.

[0017] Fig.3 shows the typical transmission loss for a Helmholtz resonator.

[0018] Fig.4 shows the principle of the add-on silencer of the present invention.

[0019] Figs.5a-5d show in a 3-D view a segmented annular snap-fit configuration of the add-on silencer of the present invention.

[0020] Fig.6 shows in a 3-D view of a segmented annular snap-fit configuration with "pull-to-open" snap-fits at 180° to allow the easy removal of said add-on silencer.

[0021] Fig.7 is a table showing measured motor speeds and calculated BPF for a number of commercial professional hairdryers.

[0022] Fig.8 shows the array of Helmholtz resonators.

[0023] Fig.9 shows the transmission loss for array of Helmholtz resonators.

[0024] Figs.10-11c show an acoustic liner wherein a broadened transmission loss of noise is achieved by creating three sizes of holes, one for each resonant frequency of the hairdryer.

[0025] Figs.11a-11b show a 3-D view of an acoustic liner arrangement with various hole sizes for each resonant frequencies.

[0026] Fig.12 represents an example of a specific add-on silencer according to the invention.

[0027] Fig.13 represents the noise spectrum of a hairdryer (type Babyliss Sovereign BAB6160E) without add-on silencer according to the invention.

[0028] Fig.14 represents the noise spectrum of a hairdryer of the type Babyliss Sovereign BAB6160E with add-on silencer according to the invention.

[0029] Figs.15-21 represent the noise spectrum of two hairdryer of the type Babyliss Sovereign BAB6160E (Figs.

19-21) and Portofino BAB6610E (Figs.15-18). These figures show a reduction of the peak corresponding to the blade passing frequency (BPF) at a voltage of 220, 230 and 240 V.

Detailed Description of the Invention

[0030] The present invention discloses a silencer as "add-on" to an existing hairdryer (Fig.4).

[0031] The present invention offers the possibility of an optional use of a universal add-on silencer for existing hairdryers, which can be used under specific circumstances or left away under other circumstances.

[0032] The universal add-on silencer of the present invention comprises a segmented annular snap-fit geometry to fit around the back housing of various types of existing hairdryers (Figs.5a-5d and Fig.6). The snap-fit system grips to the filter mounted on the back of the existing hairdryer. Due to the segmented nature of the snap-fit configuration, it adapts to different sizes of hairdryers. A foam ring is inserted between the annular snap fit and the back housing of the dryer to prevent any hair from entering the dryer at this position and to add to the broadband noise reduction.

[0033] Improved configurations of the snap-fit system are possible without extending the scope of the present invention, for example a configuration with two snap-fits at 180° to allow the easy removal of the add-on silencer by "push-to-open" (Fig.6).

[0034] The voltage supplied in different countries typically varies between 220 and 240 V. The table of Fig.7 shows that varying the supplied voltage will vary the motor speed and also the BPF.

[0035] Fig.8 shows an array of Helmholtz resonators. The configuration represented shows three rows, each row consisting of a number of chambers. In this configuration, the middle ring is tuned to the frequency corresponding to a supplied voltage of 230 V. The first ring can then be tuned to a frequency corresponding to a supplied voltage of 220 V, the last ring tuned to a frequency corresponding to a supplied voltage of 240 V.

[0036] The tuning of the different volumes can for example be done by means of a smaller or larger neck opening or neck length.

[0037] Fig.9 shows for example the effect of creating an array of three "rings" of chambers, each chamber tuned to a different frequency. If these frequencies are close enough to each other, this will create a broadened transmission-loss "peak".

[0038] Adding foam to the walls of each chamber will help to broaden the transmission-loss peak.

[0039] A similar effect as an array of Helmholtz resonators can be achieved by means of a so-called "acoustic liner". The broadened transmission loss here can be achieved by creating for example three sizes of holes, one for each resonant frequency. Again, for example, the first frequency can be selected at for example 2400 Hz, the second frequency at 2550 Hz and the last frequency at 2700 Hz.

Claims

1. Universal add-on silencer with snap-fit means suitable to be used on existing hairdryers of various dimensions, said silencer comprising broadband and tonal-noise reduction means.
2. Universal add-on silencer of Claim 1, wherein said snap-fit means is a segmented annular snap-fit arrangement to fit around the back housing of existing hairdryers.
3. Universal add-on silencer of Claim 2, wherein said snap-fit means comprises in addition to the segmented annular snap-fit arrangement two "push-to-open" snap-fits at 180° to allow the easy removal of said add-on silencer.
4. Universal add-on silencer of any of the previous claims, wherein said broadband noise reduction means is dissipative foam.
5. Universal add-on silencer of Claim 4, wherein said dissipative foam is a foam ring inserted between the annular snap fit and the back housing of the hairdryer.
6. Universal add-on silencer of any of the previous claims, wherein said tonal-noise reduction means is a Helmholtz resonator array with at least two chambers.
7. Universal add-on silencer of any of the previous claims, wherein said Helmholtz resonator array comprises three successive rings separating the chambers, the first ring being tuned to a frequency corresponding to a supplied voltage of about 220 V, the second ring being tuned to a frequency corresponding to a supplied voltage of about 230 V and the third ring being tuned to a frequency corresponding to a supplied voltage of about 240 V.

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8. Universal add-on silencer of any of the previous claims, wherein noise-dissipative foam is added to the walls of each chamber.
9. Universal add-on silencer of any of the previous claims, wherein the tuning of the different volumes is performed by means of a smaller or larger neck opening or neck length of said Helmholtz array.
10. Universal add-on silencer of any of the previous claims, wherein said tonal-noise reduction means comprises a so-called "acoustic liner", said acoustic liner comprising various sizes of holes, each size of holes being arranged for each resonant frequency of the hairdryer.

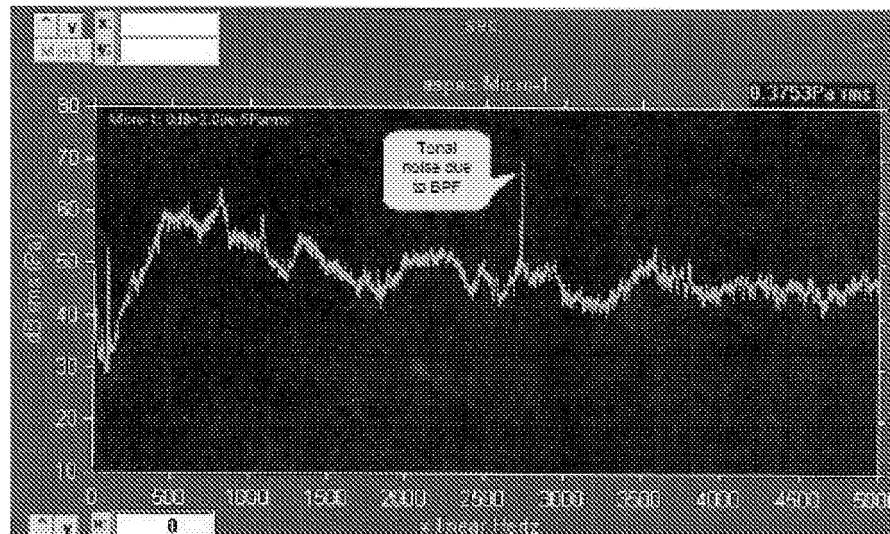


Fig.1

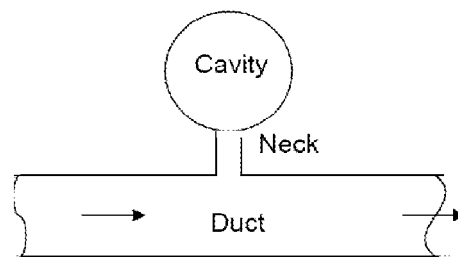


Fig.2

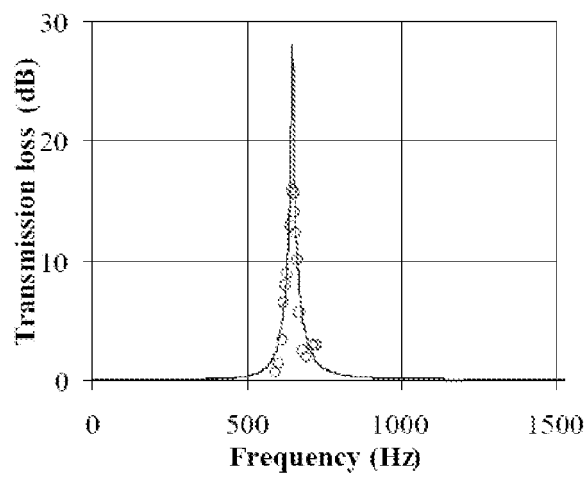


Fig.3

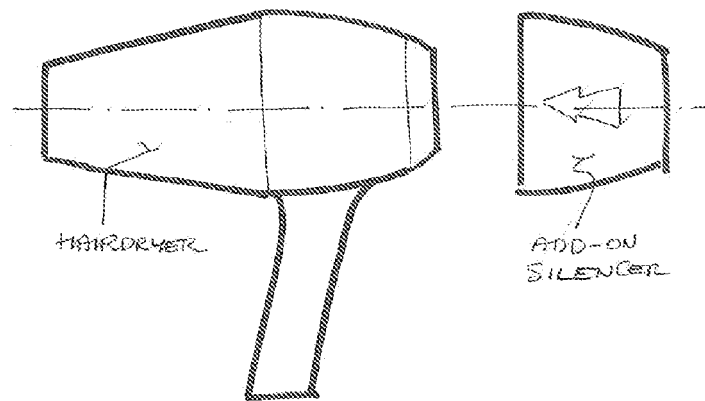
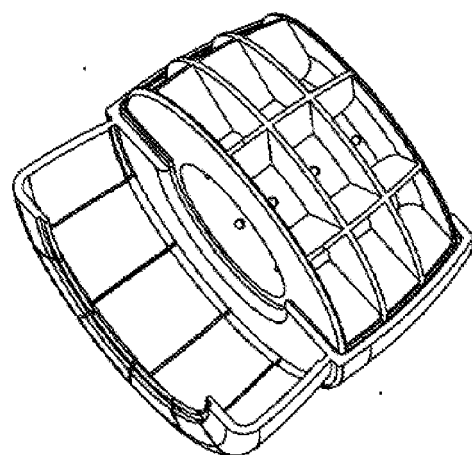
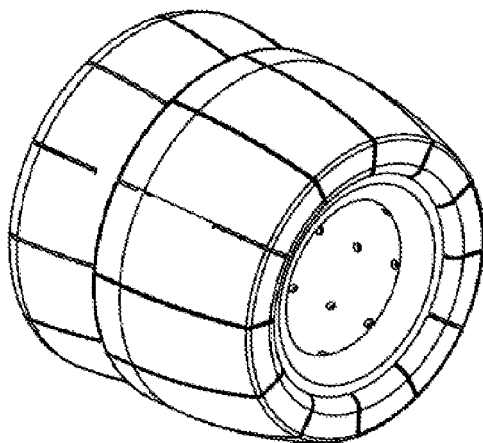
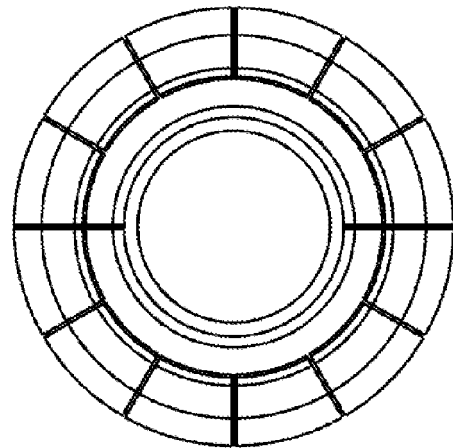
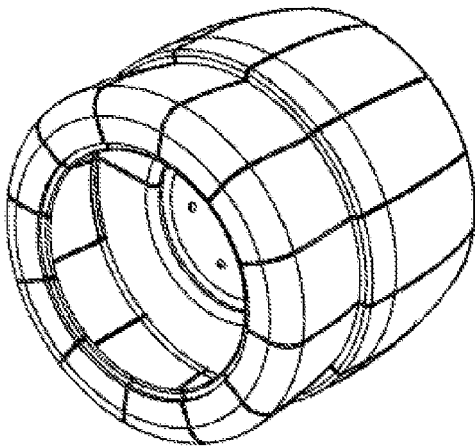


Fig. 4



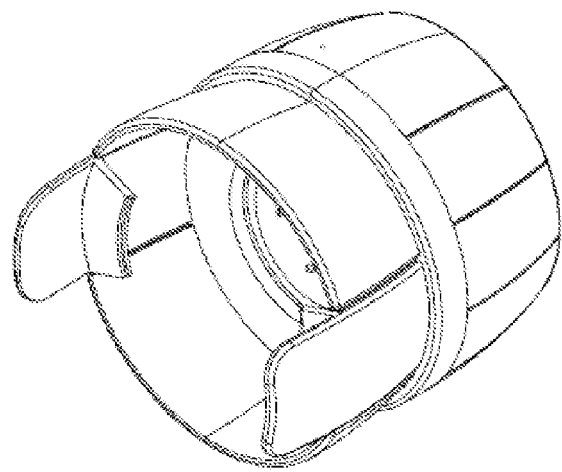


Fig. 6

Hairdryer	Motor speed			# vanes	BPF		
	At 220V	At 230V	At 240V		At 220V	At 230V	At 240V
A	16200	16500	16900	9	2430	2475	2535
B	16150	16350	16850	9	2423	2453	2528

Fig. 7

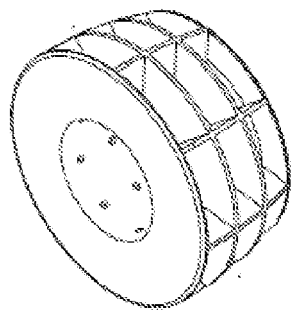


Fig. 8a

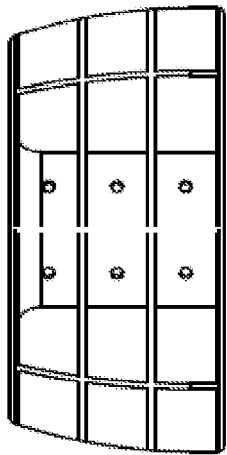


Fig. 8b

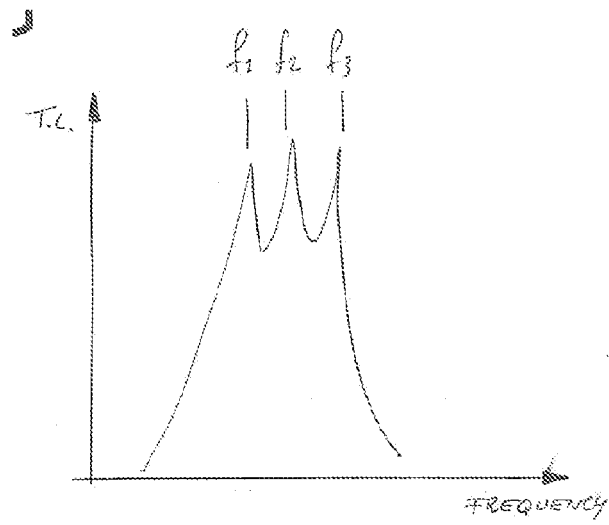
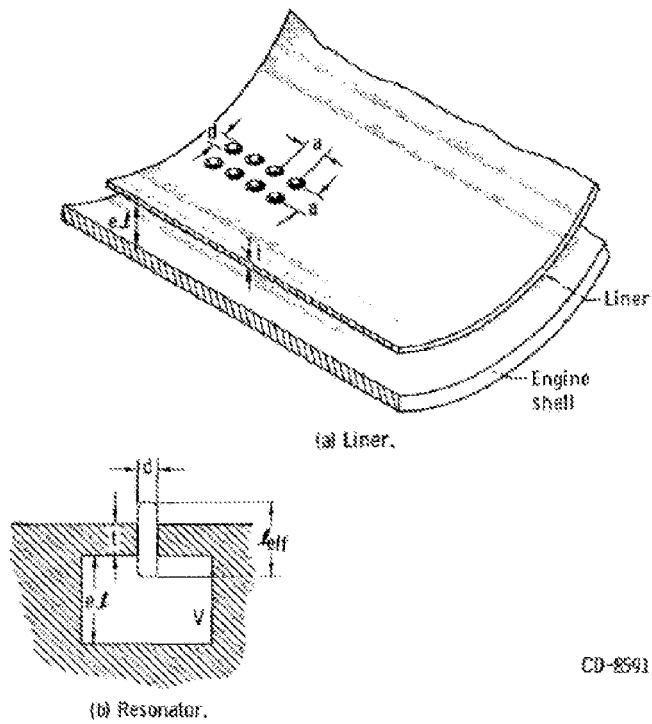


Fig. 9



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Fig. 10

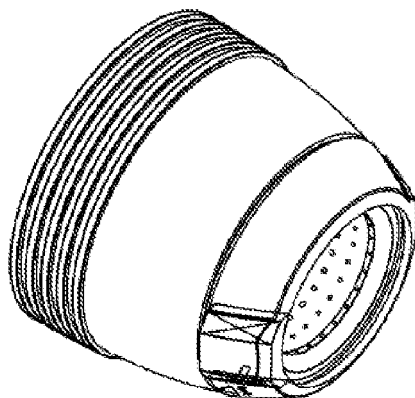


Fig. 11a

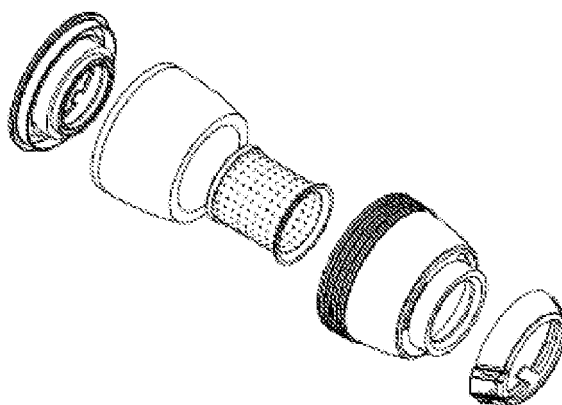


Fig. 11b

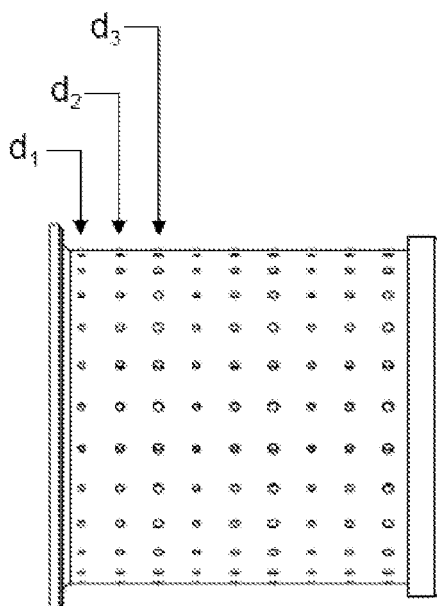


Fig. 11c

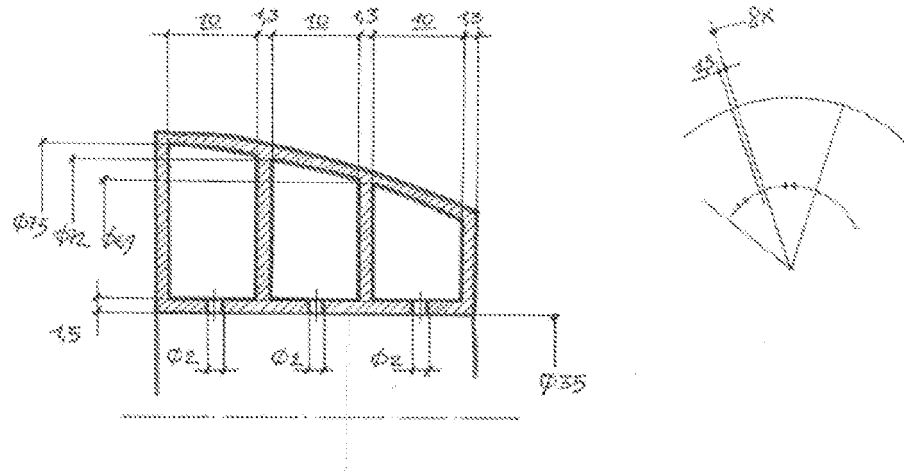


Fig.12

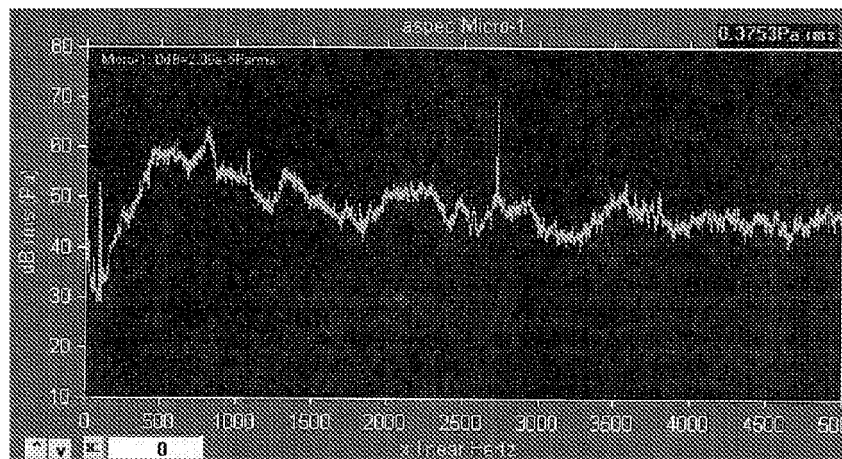


Fig.13

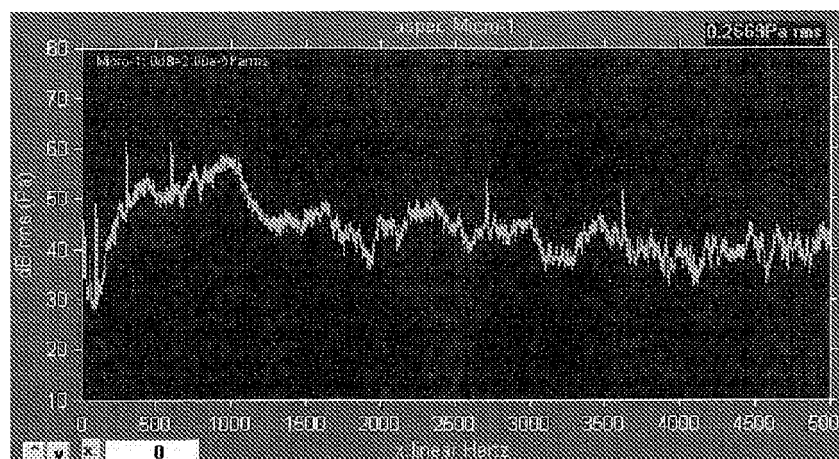


Fig.14

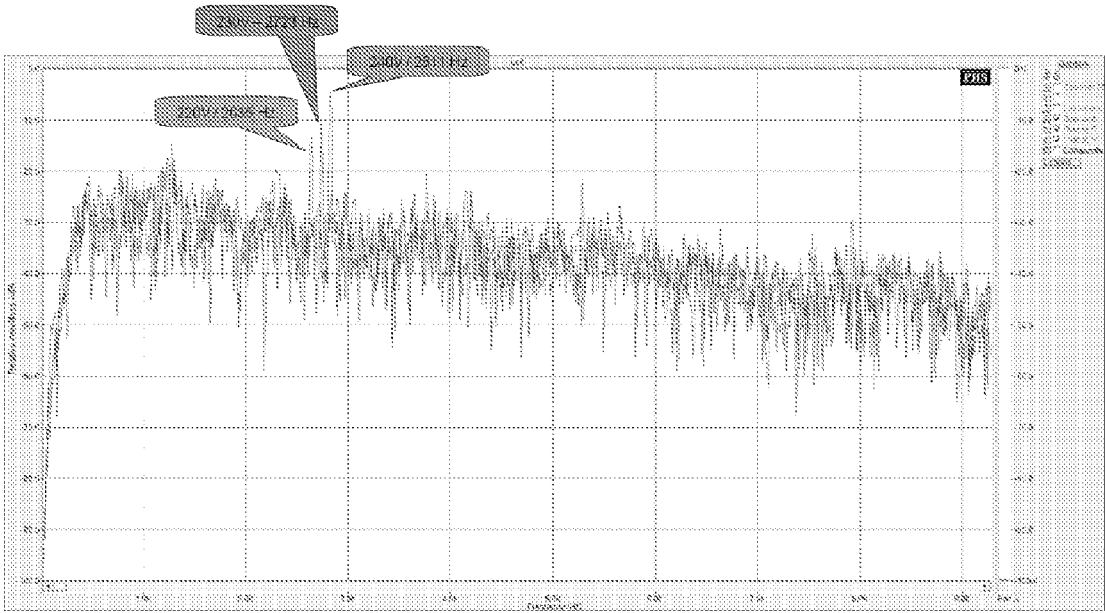


Fig.15

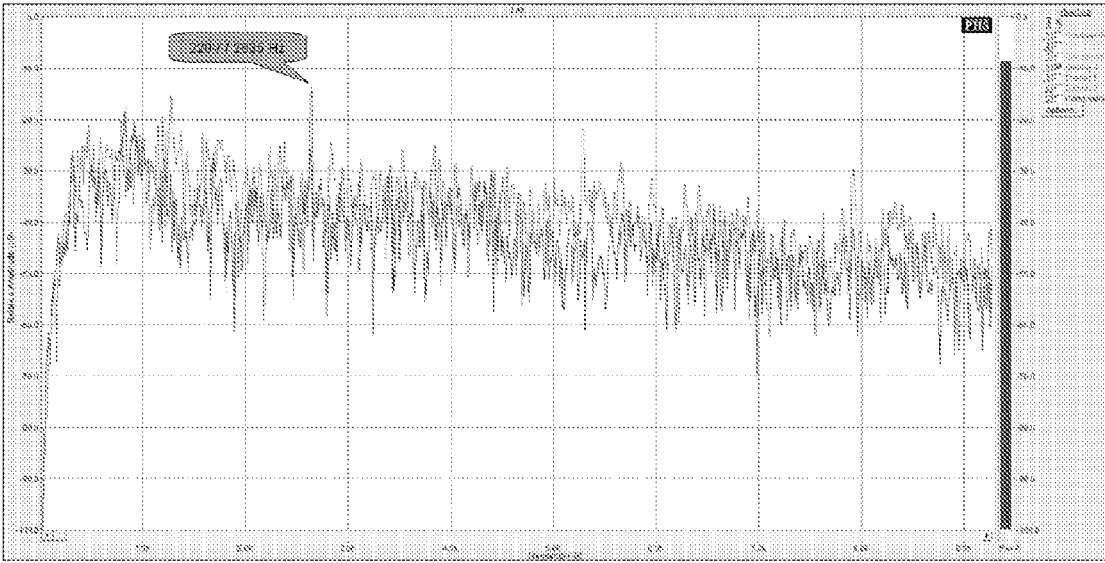


Fig.16

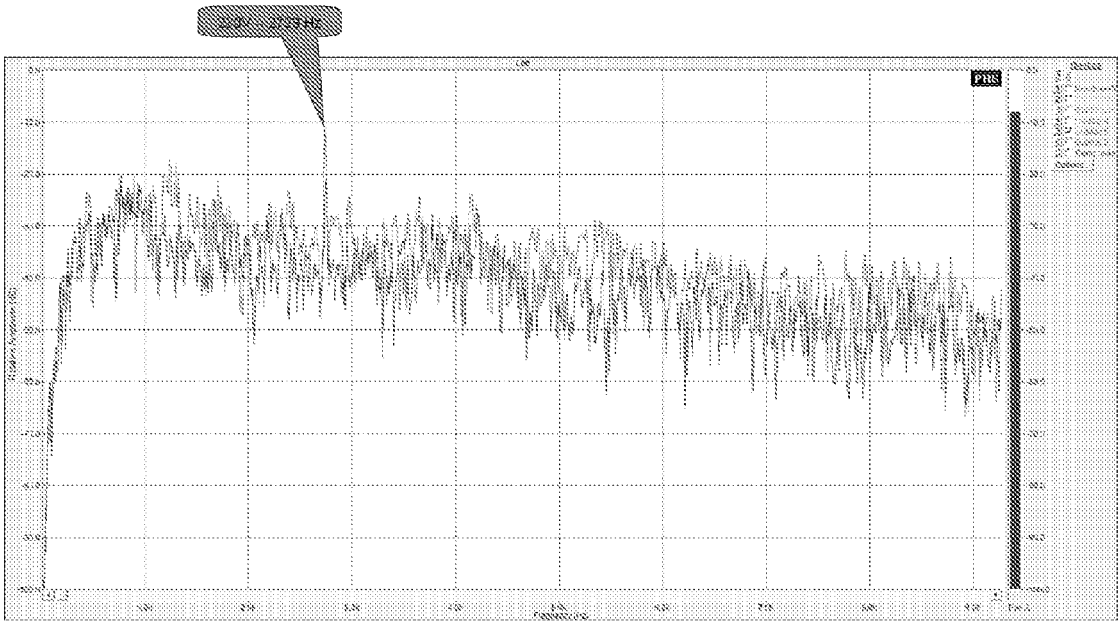


Fig.17

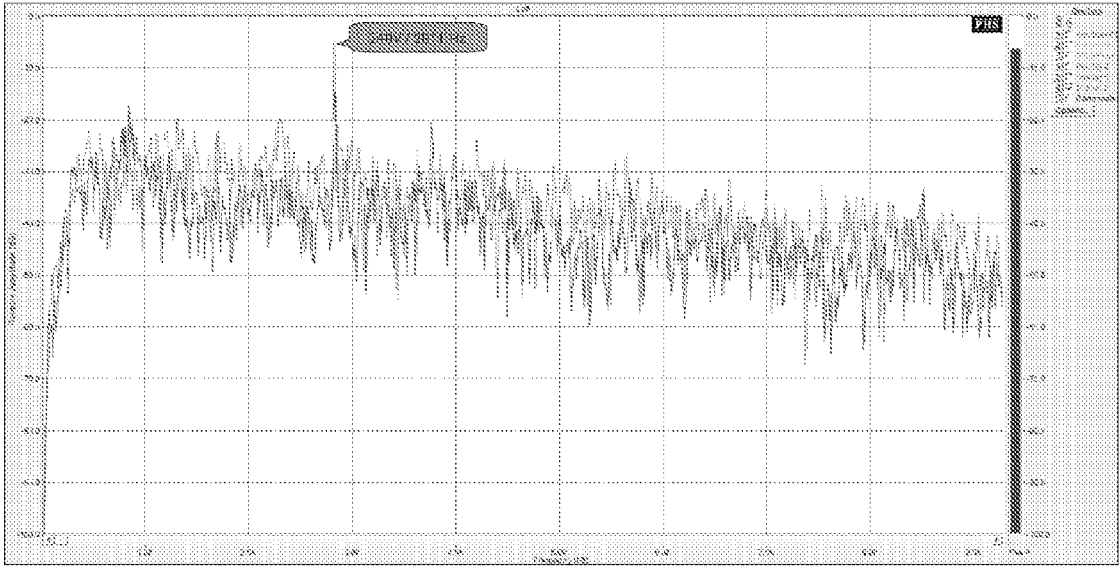


Fig.18

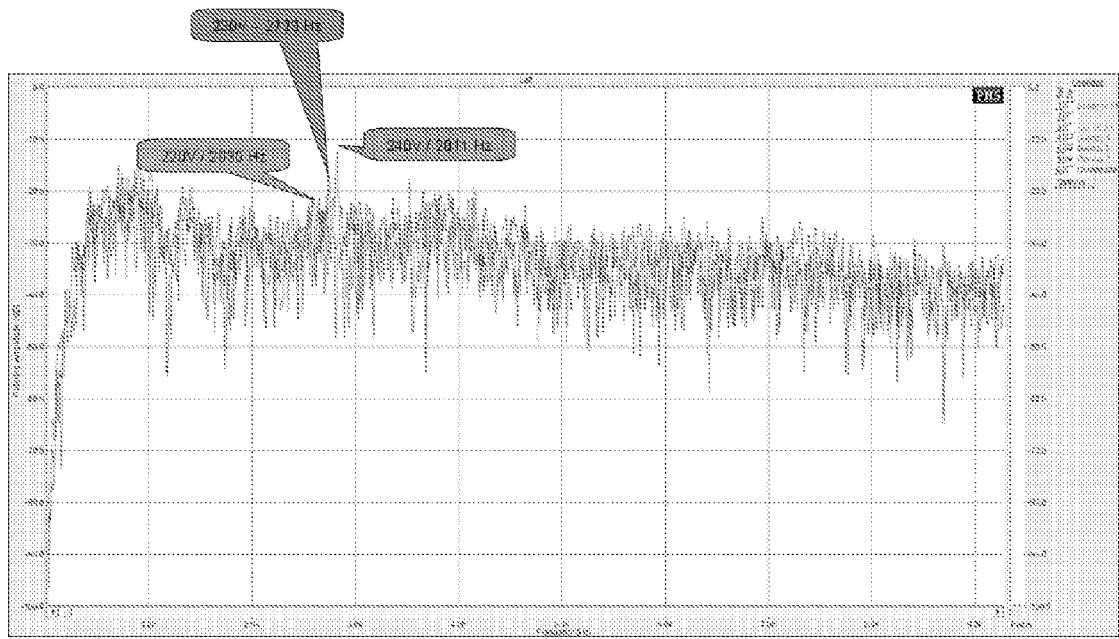


Fig.19

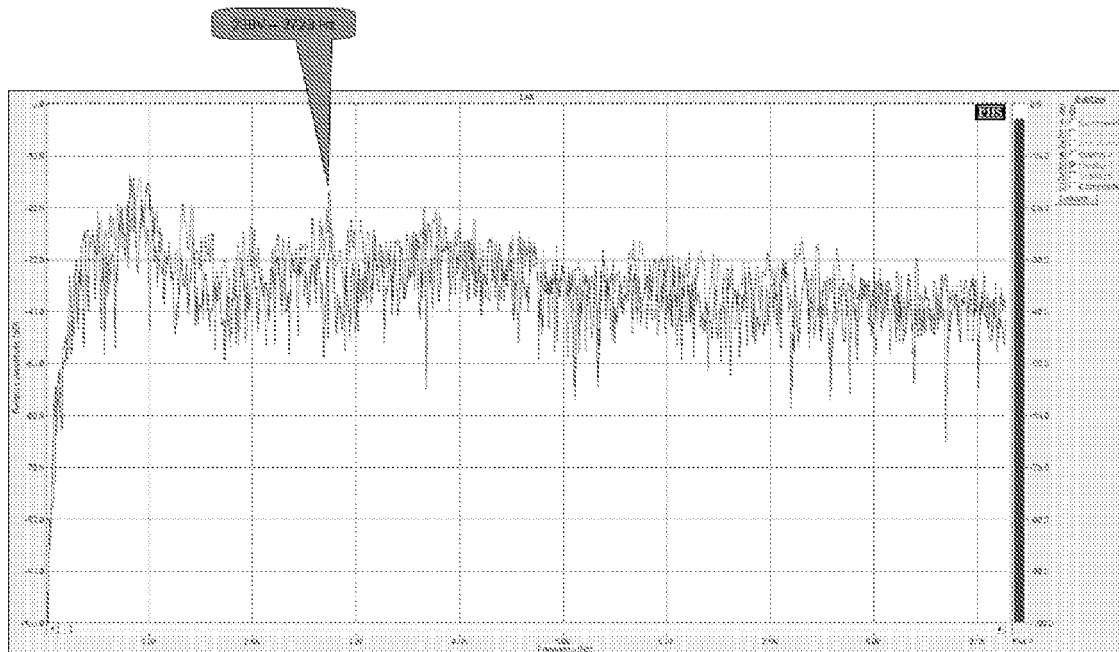


Fig.20

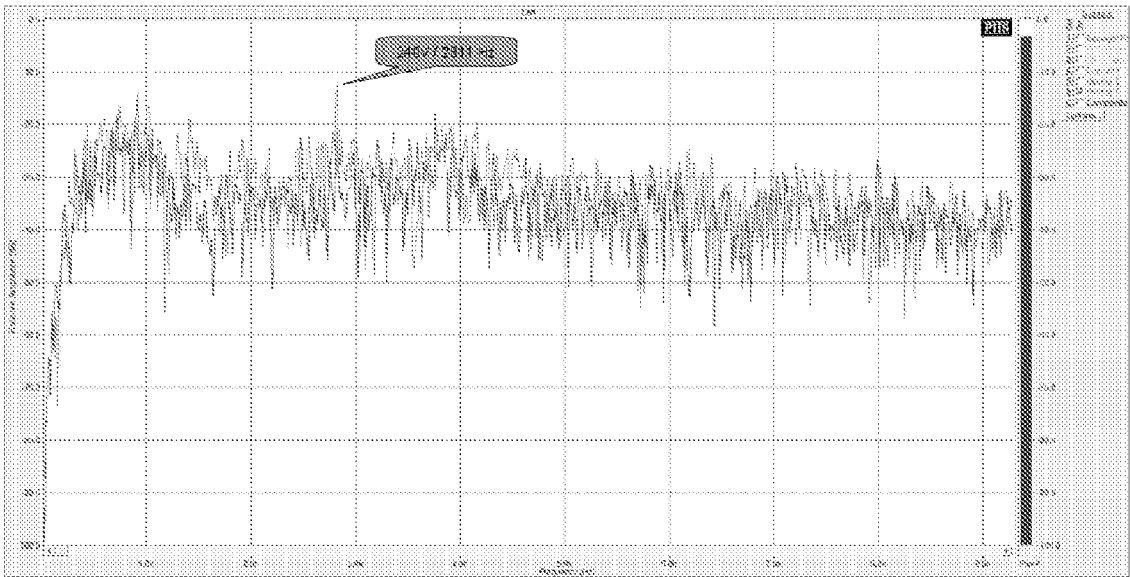


Fig.21



EUROPEAN SEARCH REPORT

Application Number
EP 09 17 7178

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 88 05 910 U1 (MERGES, MARCO) 16 June 1988 (1988-06-16) * page 3, paragraphs 2,3; figures 1-3 * * page 4, paragraph 1 - page 5, paragraph 2 *	1-10	INV. A45D20/12 A45D20/42 F01N1/00
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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 26 July 2010	Examiner Escudero, Raquel
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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26-07-2010

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