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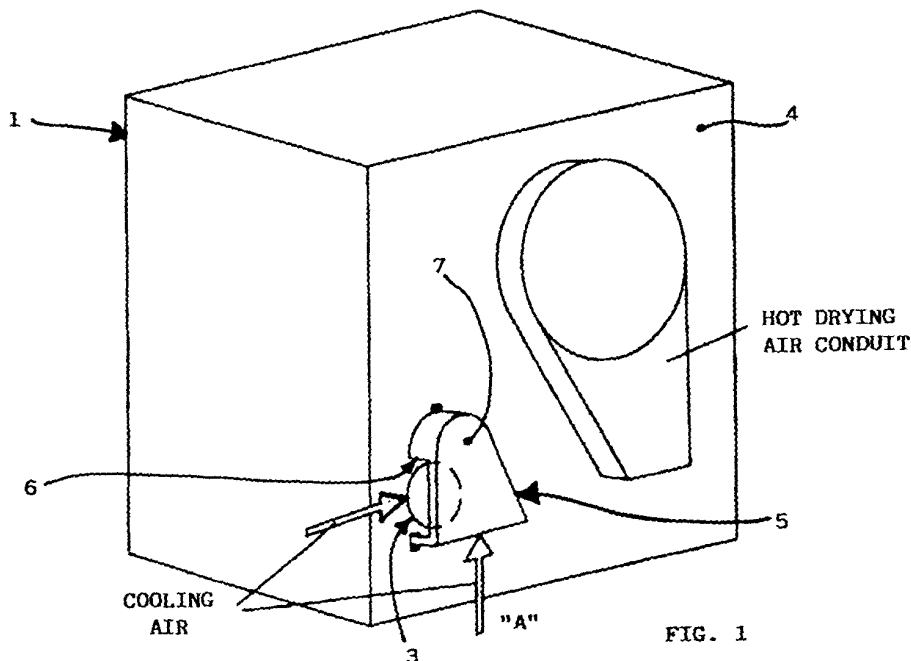
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Household clothes drying machine with muffled air intake

(57)

A clothes drying machine comprises a condenser with a flow of cooling passing therethrough, said cooling air being taken in from outside and conveyed to said condenser through a conduit opening outwardly with a rear intake mouth (3); the arrangement comprises a muffling member (5), preferably in the shape of a cylinder or a prism, arranged on the outside on the back wall (4) of the machine, over said rear intake mouth of said conduit, and provided with at least an inlet opening (6) for the outside air to flow therein.

Said muffling member and the corresponding rear intake mouth (3) are situated in the lower portion of said back wall of the machine and, preferably, said inlet opening is directed downwards in a direction that is parallel to the same back wall. The inner surface of said silencing member may advantageously be coated with a layer of sound-deadening material (10).



Description

[0001] The present invention refers to an improved kind of condenser-type clothes drying machine, preferably of the type for use in households, which is particularly quiet in its operation.

[0002] Largely known in the art is the general requirement for the noise generated by household appliances in their operation to be reduced as much as possible; also largely known in the art is the fact that the noise generated by condenser-type clothes washing machines during their operation is perceived as being particularly high and annoying, since the noise generated by the normal and typical operation of the motor used to drive the rotating drum of the machine, as well as the fan used to circulate the drying air, is aggravated by the additional noise generated by the flow of cooling air that is taken in from the outside of the machine and must then be conveyed to the condenser.

[0003] In particular, two kinds of circumstances may typically arise in this connection: when the condenser cooling air is taken in from an area in front of the machine, the noise generated by the intake mouth is transmitted on to the outside ambient in a much more direct manner, practically without any sound-deadening effect whatsoever, so that it is perceived in a more irritating and annoying manner; if on the contrary the air intake noise is situated in the back wall of the machine, and therefore on the rear side thereof, then the noise propagating throughout the outside ambient therefrom is generally attenuated to some extent; in this case, however, there may arise an additional, alternative problem in that, owing to the machine being most easily capable of being installed with its back wall standing very close to a wall of the room where it is installed, the rear intake mouth thereof may come to be situated just too close to said wall and, as a result, the stream of cooling air being taken in may practically turn out to be kind of "choked" by an altogether too small flow section of the inflow channel of said air stream being so taken in.

[0004] It may in fact be reasonably assumed that said flow section is given by the area of the cylinder having the circumference of said intake mouth as the base thereof, and the distance of said intake mouth to the wall standing in front of it as the height thereof.

[0005] It would therefore be desirable, and it is actually a main purpose of the present invention, to provide a clothes drying machine operating according to the principle of condensing the moisture contained in the drying air, while ensuring a sensible reduction in the extent of the above-mentioned drawback of an excessive noise brought about by the inflow of the condenser cooling air into the machine.

[0006] Another purpose of the present invention is to provide said clothes drying machine with means that are effective in preventing the flow-path section of the cooling air from being reduced to any excessive extent, when said cooling air is taken in from the rear side of

the machine, as well as ensuring a constant inflow of said cooling air regardless of whether the machine is or is not installed close to a wall standing therebehind.

[0007] A further purpose of the present invention is to provide said clothes drying machine with technical solutions that make it possible for the energy efficiency of the same machine to be improved by taking in the ambient air for cooling the condenser from a generally non-heated zone of the machine casing and, therefore, by taking in substantially cool air.

[0008] According to another purpose of the present invention, this clothes washing machine shall be able to be easily manufactured using existing, readily available materials and techniques, and be competitive in its construction; it shall furthermore be able to incorporate all these improvements without suffering any alteration or reduction in the performance abilities and the reliability thereof.

[0009] According to the present invention, these aims are reached in a condenser-type clothes drying machine that is provided with means of operation as described below by mere way of non-limiting example with reference to the accompanying drawings, in which:

- Figure 1 is a simplified perspective view of the rear wall of a clothes drying machine according to the present invention;
- Figure 2 is a side cross-sectional view of the clothes drying machine shown in Figure 1;
- Figure 3 is a perspective view of a specific component part included in the clothes drying machine shown in the preceding Figures;
- Figures 4, 5 and 6 are respective orthogonal planar views of the component part illustrated in Figure 3;
- Figures 7 and 8 are respective diagonal perspective views of the component part illustrated in the preceding Figures, as viewed from almost opposite viewpoints;
- Figures 9 and 10 are diagrammatical views of the noise detected in a machine provided with means according to the present invention as compared with the noise detected in a machine that is not provided with such means, in both directions of rotation of the cooling air intake fan;
- Figure 11 is a diagrammatical view of four charts relating to the sound power generated in four respective circumstances, i.e. with the fan rotating in both opposite directions of rotation thereof, and with and without muffling member installed.

[0010] With reference to the above listed Figures, and in particular Figures 1 and 2, a clothes drying machine

according to the present invention comprises an outer casing 1, inside which there is provided a conduit intended to convey the flow of cooling air towards and into the condenser, said conduit being so arranged as to open outwardly through a rear intake mouth 3 passing through the rear wall 4 of the machine.

[0011] Over said rear intake mouth 3, and applied externally onto said rear wall 4 of the machine, there is provided a muffling member 5, which is constituted substantially by a half-closed casing that is applied with the open side thereof against said rear wall 4. It therefore is in the form of a hood that substantially surrounds said intake mouth 3, however without shutting it. In fact, in said muffling member 5 there is provided at least a large opening 6 that enables the air being taken in from the outside ambient, and flowing towards said intake mouth, to pass therethrough.

[0012] As a result, said muffling member, which is in a form that is partially closed outwardly, and which substantially covers said intake mouth 3, performs practically as a kind of silencer, or muffler, that is adapted to deaden the noise and the swishing sound generated by the air flowing through said intake mouth, thereby reaching the main object of the present invention.

[0013] This muffling member can still be advantageously improved through following improvements.

a) The first improvement relates to the shape of said muffling member; it is implemented in the shape of a cylinder or in the shape of a prism, either of them having anyway horizontal axes, in which a base is constituted by said open side applied against said rear wall of the machine, whereas the other base 7 is in a substantially planar form and, when the muffling member is so applied onto the rear wall of the machine, is arranged vertically (see Figure 2).

This configuration, therefore, enables a minimum and predeterminable distance d to be established and maintained between the rear wall of the machine and the contiguous wall 8 of the room, so that an adequate flow section is anyway ensured for the inflow channel of the cooling air stream being taken in (it should be recalled here that said flow section has been hereinbefore defined as being constituted by the side surface of the cylinder having the circumference of said intake mouth as the base thereof, and said distance d of said intake mouth to the wall standing in front of it as the height thereof).

b) The second improvement depends substantially on the above-described first one and is practically based on the fact that said inlet opening 6 is provided in the side cylindrical or prismatic surface of said muffling member; this feature is in fact such as to enable the prismatic configuration of said muffling member to be used to a maximum extent of benefit, since the horizontally jutting size of the same muffling member will anyway ensure that a minimum desired distance be kept from the wall of the room, whereas the remaining side surface thereof is used to arrange said at least an inlet opening 6 therein.

fling member will anyway ensure that a minimum desired distance be kept from the wall of the room, whereas the remaining side surface thereof is used to arrange said at least an inlet opening 6 therein.

c) The third improvement is easily identifiable: in fact, said openings 6 (in the case that several such opening are used) are in a useful and effective manner so provided as to ensure that the sum of the respective inflow sections thereof is at least equal to or slightly larger than the area of the inflow section of said rear intake mouth 3.

d) The fourth improvement lies in arranging said rear intake mouth 3 and, as a result, the related muffling member 5 in the lowest possible position on the rear wall of the machine, and preferably at a height that is not greater than one third of the total height of said rear wall of the machine. This enables the air to be taken in from below and, therefore, from a zone that is usually colder, owing to its being closer to the floor and, furthermore, not being subject to any particular heating-up effect by the air exhausted from the machine itself, considering that such air is usually exhausted from the opposite (front) side of the same machine and, furthermore, tends to almost immediately rise due to its being warmer.

e) Owing to the fact that the air lying close to the floor is generally colder, a further improvement lies in the fact that said openings 6 may be oriented downwards, so that the air is taken in preferably from the lowest possible position, and more preferably from the usually still colder floor, so as to follow a direction A that is therefore substantially vertical and, anyway, parallel to the rear wall of the machine.

It should be noticed that, in the illustrations appearing in Figures 2 and 3, said muffling member 5 is located in a position on a side of the jutting portion of the hot drying air conduit 9, below the latter, so that the two improvements that have been just cited under d) and e) above turn out as being particularly suitable and effective in preventing ambient air to be taken in, which would anyway come also from the zone surrounding said jutting portion and, therefore, would unavoidably have been heated up by the related conduit, which may lie at temperatures as high as 70°C. As a result, these two last improvements, when combined together, will ensure a flow of cooling air being taken in and sent to the condenser at the lowest ambient temperature, thereby ensuring at the same time a sensible improvement of the energy efficiency of the machine.

f) The sixth improvement relates to the inner surface of said base 7 that closes said muffling member externally. With reference to Figures 3, 5 and 6, said

inner base 7 is advantageously coated with a layer of sound-deadening material 10, which may also be a mat-like layer of the kind used to muffle dishwashing machines, but which may of course be provided with the use of any material fitting the particular application and known as such in the art.

This solution ensures a marked improvement in the sound-deadening effect, since the noise being generated is mainly transmitted outside only along the path followed by the air being taken in, in particular downwards and at the region of the rear wall of the machine, i.e. in the zone that is the least sensible to the air intake noise being generated.

In the course of exhaustive experiments, it has also been found that, during the operation of the machine, not only the noise emitted from the cooling air intake mouth is reduced to a sensible extent starting from frequencies of approximately 1000 Hz and upwards, as this has been measured and represented in the graphs appearing in Figures 9 and 10, but also the two values relating to the sound power (Lwa) emitted during the rotation of the fan in its two opposite directions of rotation are sensibly equalized with each other, as this is shown in the basically self-explaining Figure 11.

In this connection, it may be appropriate to even shortly recall here the fact that, in clothes drying machines, the fan used to circulate the condenser cooling air is quite often driven by the same motor used to rotatably drive the clothes holding drum, which is largely known to have to alternately rotate in both directions of rotation in order to prevent the clothes from getting entangled. As a result, also the cooling air fan is caused to alternately rotate in the two opposite directions, so that it generates two respective, distinct kinds of noise.

g) Finally, a last improvement is obtained by sizing the same muffling member 5 in an adequate manner; it has in fact been found that an optimum compromise can be reached between the muffling effect (which would certainly require the use of very large mufflers) and the overall size of said muffling member (which should preferably be as small as possible) if the ratio of the area of said external base 8 to the inflow section of said rear intake mouth 3 is not less than 1:1.

Claims

1. Clothes drying machine comprising:

- a condenser, through which both a flow of hot drying air and a flow of cooling air are caused to pass, and
- means adapted to take in and convey to said condenser said flow of cold air for cooling the

same condenser, and comprising a conduit (2) for carrying said flow of cooling air from the outside ambient towards said condenser, **characterized in that** it further comprises a muffling member (5) arranged on the rear wall (4) of the machine, externally to the casing of the same machine, over the rear intake mouth (3) of said condenser cooling air conduit, and provided with at least an opening (6) for letting in the cooling air being so taken in from the outside ambient.

2. Clothes drying machine according to claim 1, **characterized in that** said muffling member is substantially in the shape of a cylinder or straight prism, with the outer base (8) thereof arranged vertically and closed to the passage of air.

3. Clothes drying machine according to claim 2, **characterized in that** said at least an inlet opening (6) is situated in the substantially cylindrical or prismatic wall of said muffling member.

4. Clothes drying machine according to any of the preceding claims, **characterized in that** the aggregate area of the inflow sections of said at least an inlet opening (6) is slightly larger than the area of the inflow section of said rear intake mouth (3).

5. Clothes drying machine according to any of the preceding claims, **characterized in that** said muffling member (5) and the corresponding rear intake mouth (3) are located in the lower portion of said rear wall of the machine, preferably at a height that is not greater than one third of the overall height of said rear wall.

6. Clothes drying machine according to any of the claims 3 to 5, **characterized in that** said at least an inlet opening (6) is directed downwards in a direction that is substantially parallel to said rear wall of the machine.

7. Clothes drying machine according to any of the preceding claims, **characterized in that** the inner surface of said silencing member (5) is at least partially coated with a layer of sound-deadening material (10).

8. Clothes drying machine according to any of the preceding claims, **characterized in that** the ratio of the area of said external base (8) to the inflow section of said rear intake mouth (3) is not less than 1:1.

Amended claims in accordance with Rule 86(2) EPC.

1. Clothes drying machine comprising:

- a condenser, through which both a flow of hot drying air and a flow of cooling air are caused to pass, and
- means adapted to take in and convey to said condenser said flow of cold air for cooling the same condenser, and comprising a conduit (2) for carrying said flow of cooling air from the outside ambient towards said condenser, 5
- a muffling member (5) arranged on the rear wall (4) of the machine, externally to the casing of the same machine, over the rear intake mouth (3) of said condenser cooling air conduit, and provided with at least an opening (6) for letting in the cooling air being so taken in from the outside ambient, 10 15

characterized in that said muffling member is substantially in the shape of a cylinder or prism, with a base applied against said rear wall of the machine, whereas the other base is arranged vertically and closed to the passage of air. 20

2. Clothes drying machine according to claim 1, characterized in that said at least an inlet opening (6) is situated in the substantially cylindrical or prismatic wall of said muffling member. 25

3. Clothes drying machine according to any of the preceding claims, characterized in that the sum of the inflow sections of said at least an inlet opening (6) is slightly larger than the area of the inflow section of said rear intake mouth (3). 30

4. Clothes drying machine according to any of the preceding claims, characterized in that said muffling member (5) and the corresponding rear intake mouth (3) are located in the lower portion of said rear wall of the machine, preferably at a height that is not greater than one third of the overall height of said rear wall. 35 40

5. Clothes drying machine according to any of the claims 2 to 4, characterized in that said at least an inlet opening (6) is directed downwards in a direction that is substantially parallel to said rear wall of the machine. 45

6. Clothes drying machine according to any of the preceding claims, characterized in that the inner surface of said silencing member (5) is at least partially coated with a layer of sound-deadening material (10). 50

7. Clothes drying machine according to any of the preceding claims, characterized in that the ratio of the area of said external base (8) to the inflow section of said rear intake mouth (3) is not less than 1:1. 55

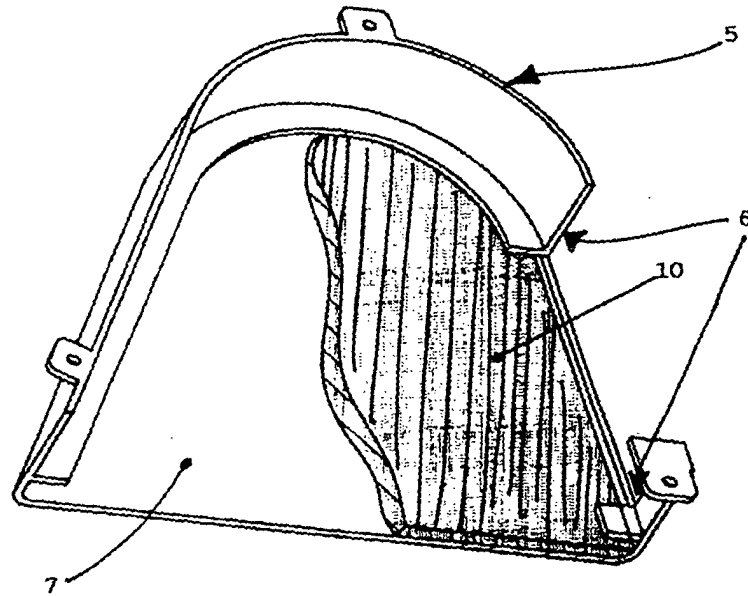


FIG. 3

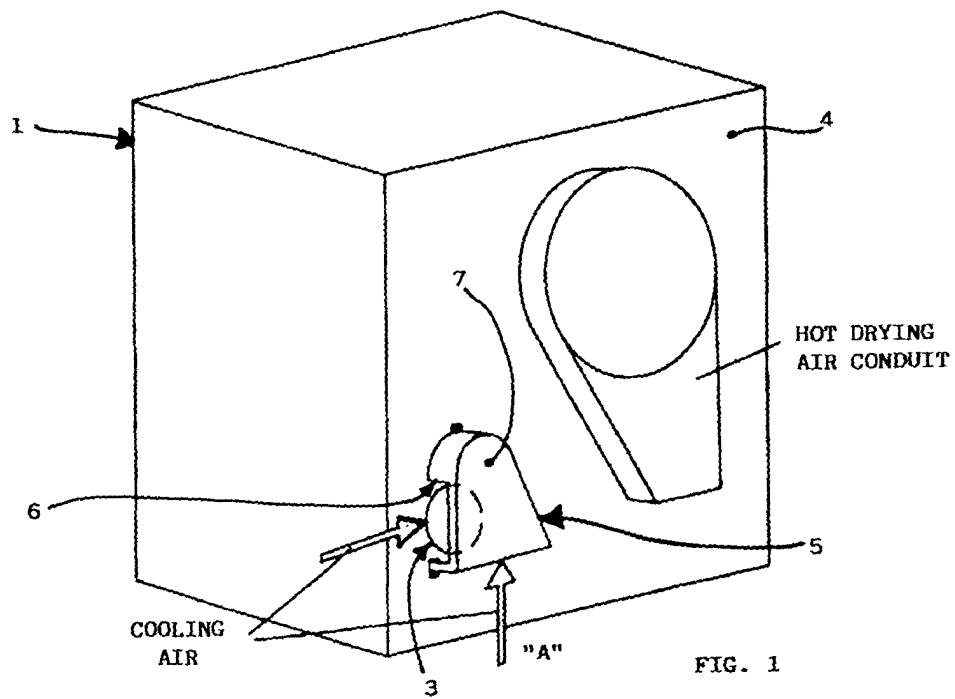


FIG. 1

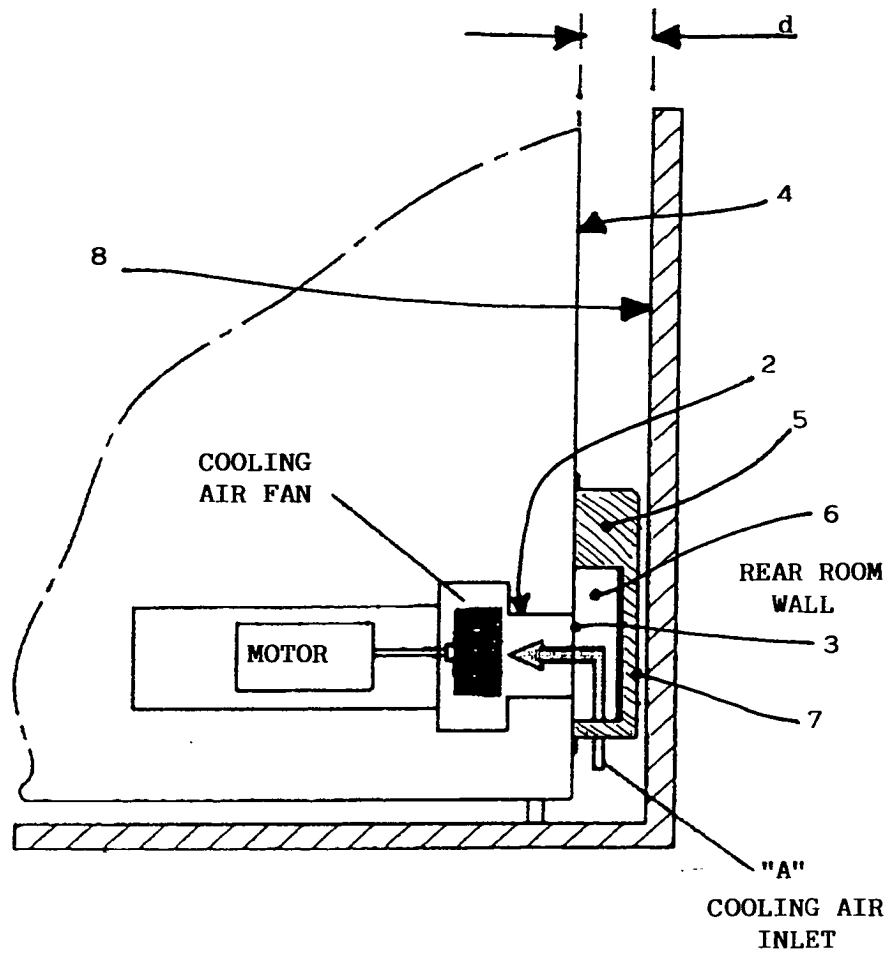


FIG. 2

FIG. 4

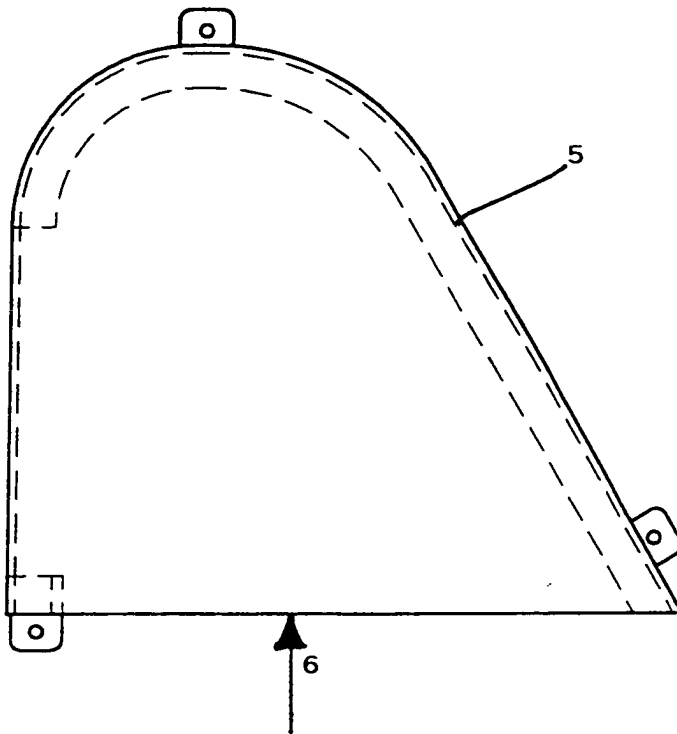


FIG. 5

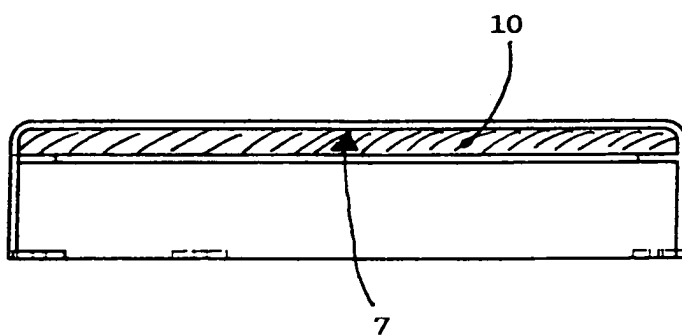
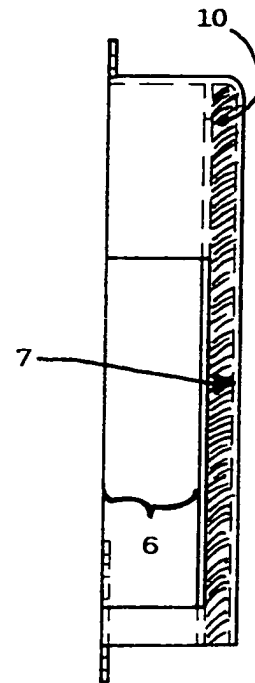


FIG. 6

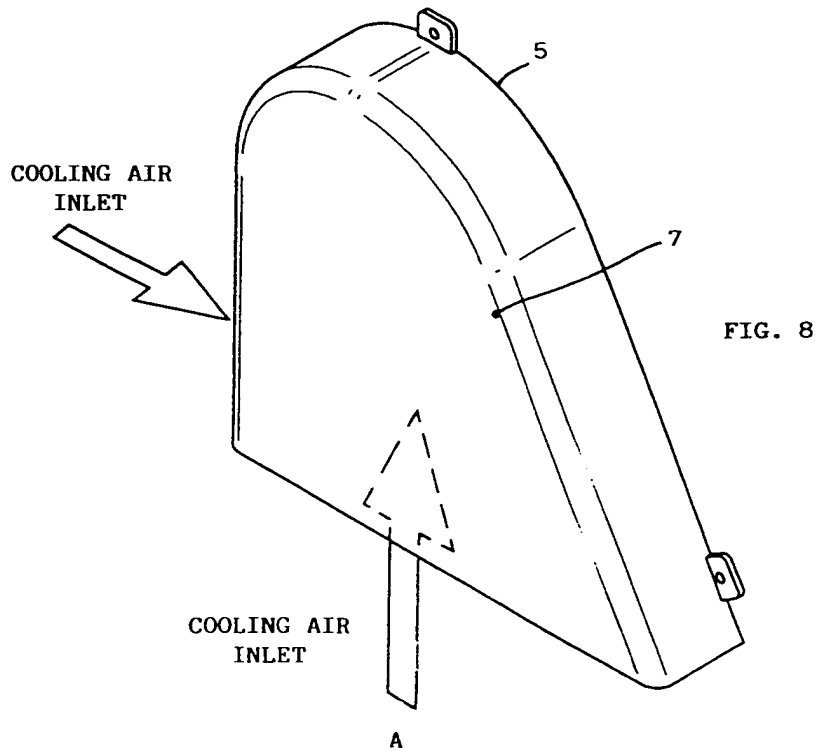
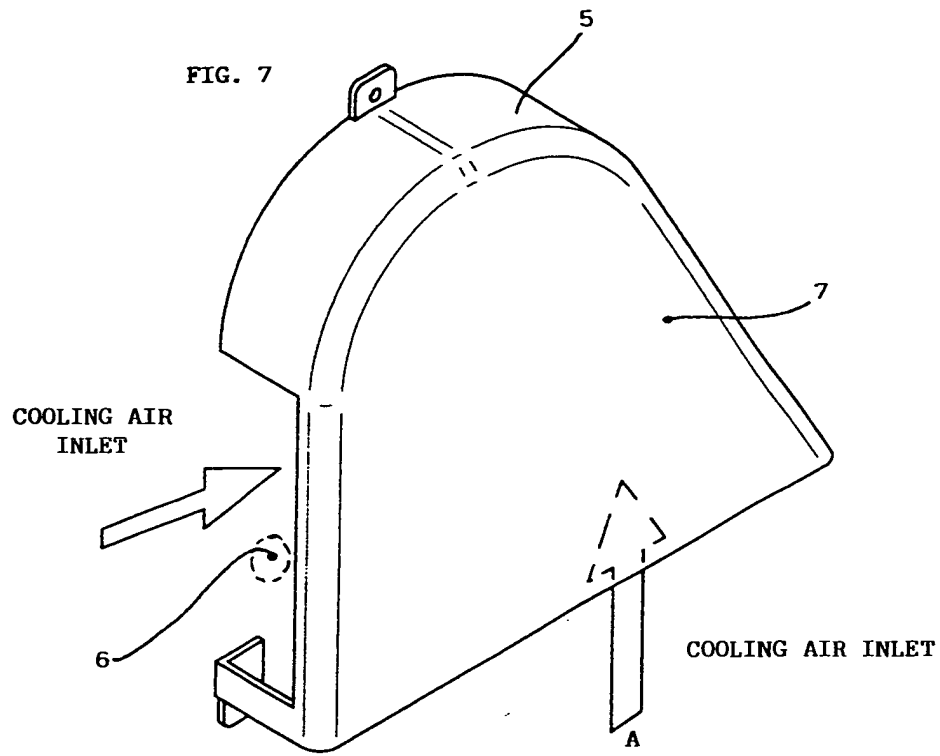


FIG. 9
MUFFLING MEMBER EFFECT (CLOCKWISE ROTATION)

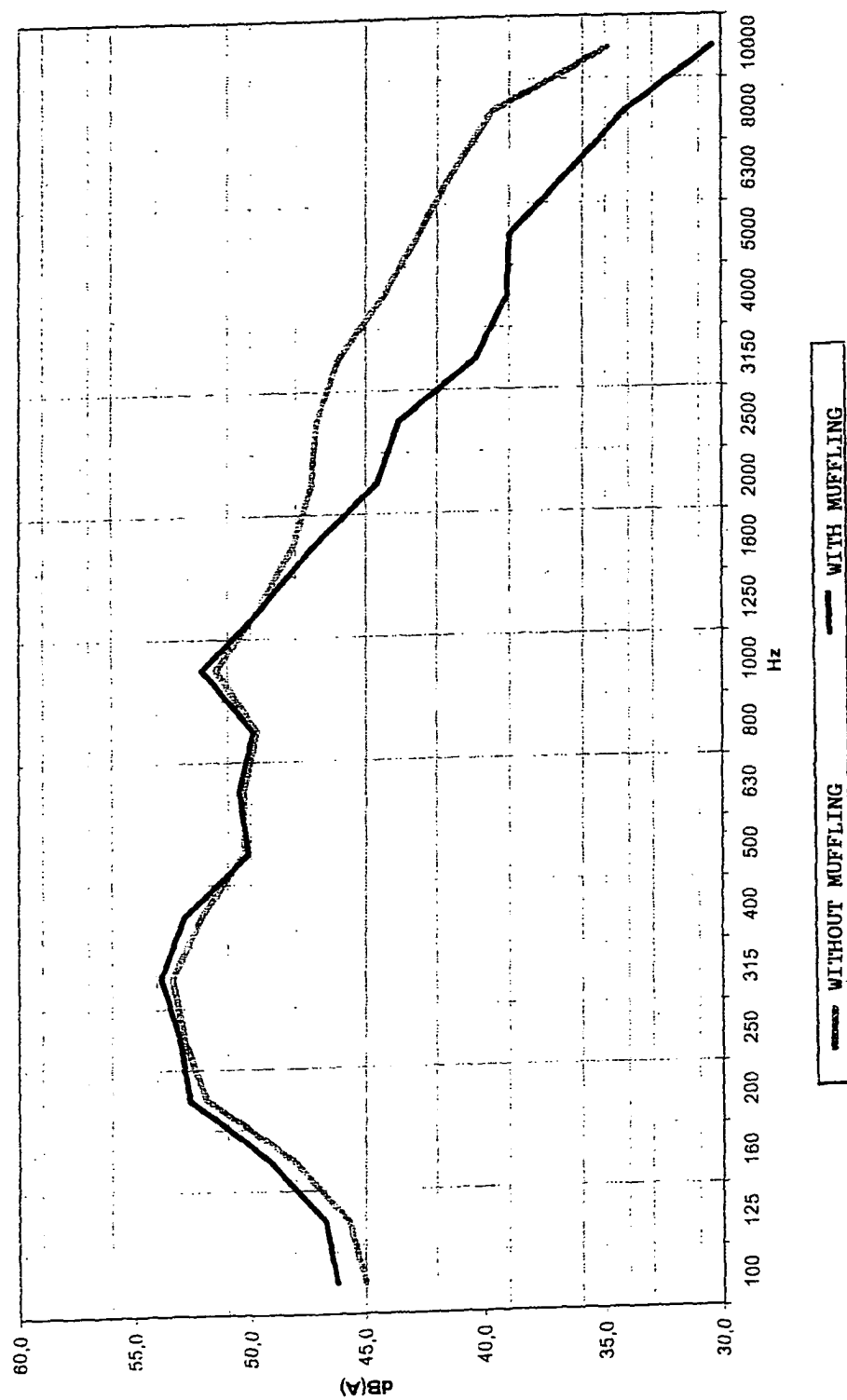


FIG. 10

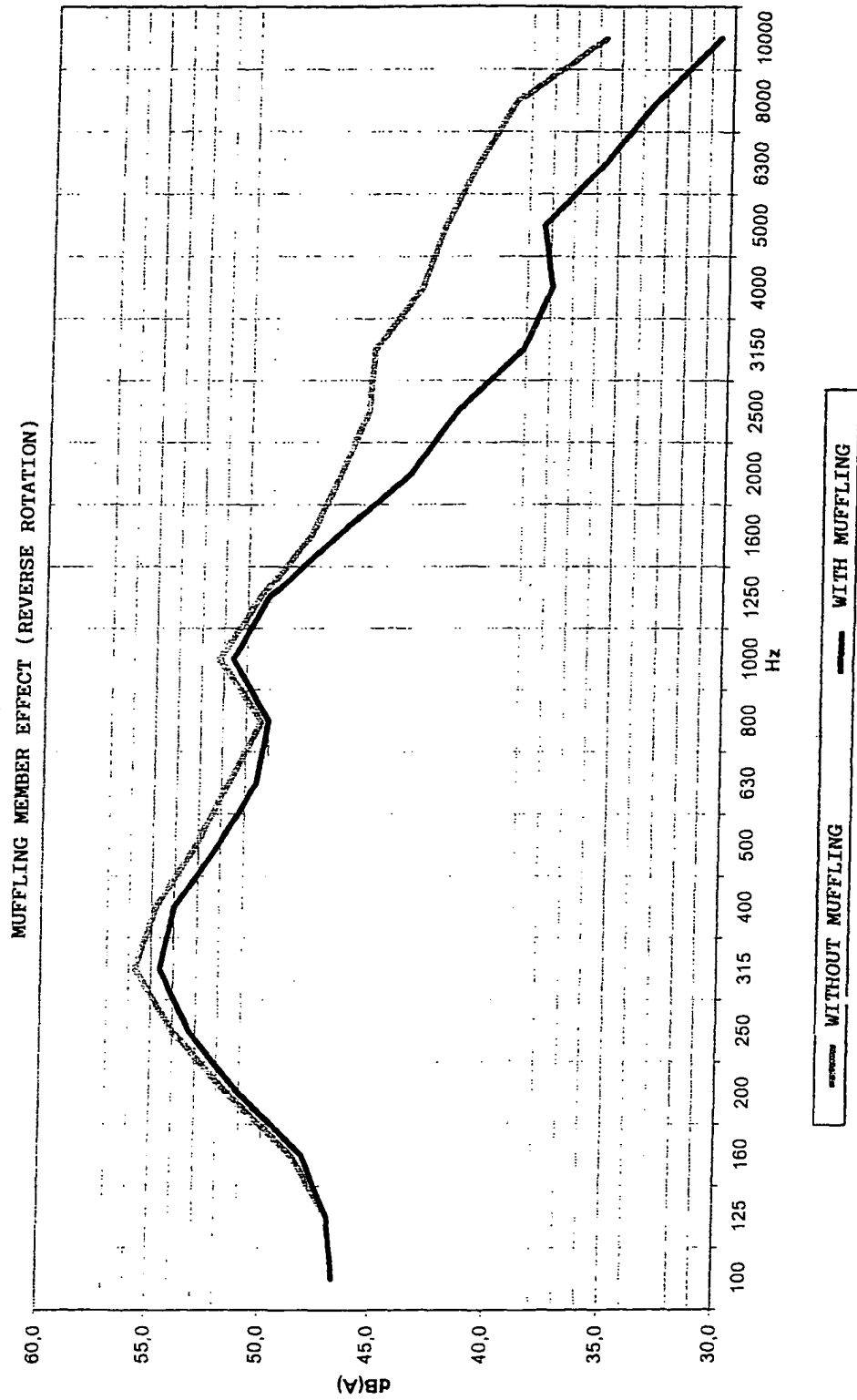
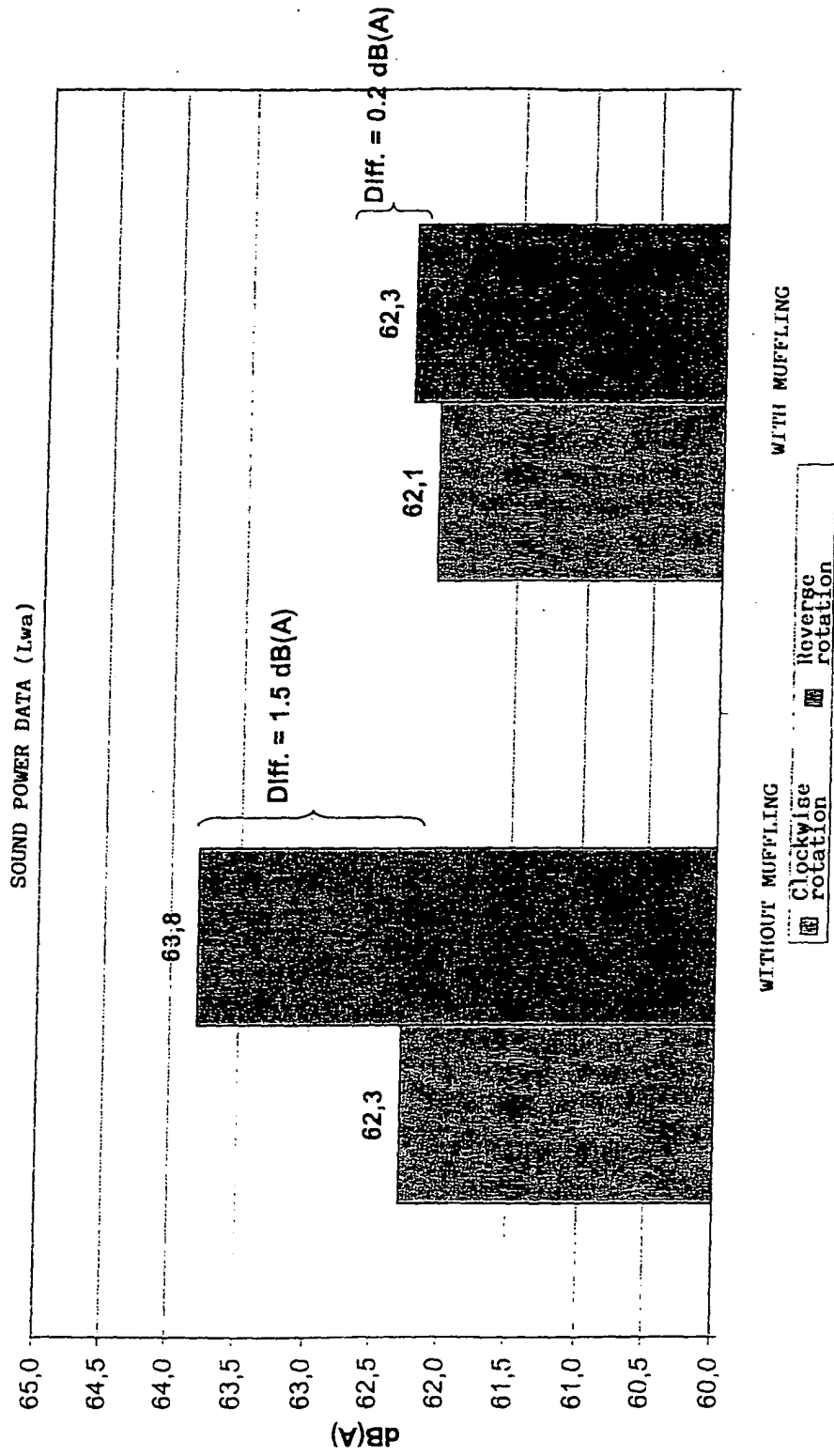


FIG. 11





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 02 3424

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			D06F F16L F24F F04D
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		15 March 2004	Ureta, R
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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EP 03 02 3424

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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15-03-2004

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