



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
12.12.2007 Bulletin 2007/50

(51) Int Cl.:
D06F 58/24 (2006.01)

(21) Application number: **06114971.2**

(22) Date of filing: **06.06.2006**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI
SK TR**
Designated Extension States:
AL BA HR MK YU

- **Del Pos, Maurizio**
33170 Pordenone (IT)
- **Gerolin, Giancarlo**
33070 Polcenigo (Pordenone) (IT)

(71) Applicant: **Electrolux Home Products Corporation
N.V.**
1930 Zaventem (BE)

(74) Representative: **Giugni, Valter**
PROPRIA S.r.l.
P.O. Box 365
Via della Colonna, 35
33170 Pordenone (IT)

(72) Inventors:
• **Bari, Elisabetta**
30026 Portogruaro (Venezia) (IT)

(54) **Drying machine comprising a noise absorption device**

(57) Drying machine comprising a drying air circuit for causing air to be circulated through a perforated rotating drum, a fan assembly (2) for taking air in from the surrounding ambient, an air inlet duct (3) fluidly connected to the fan assembly (2), a ventilation louver (4) to

guard an air intake aperture (5) of said air inlet duct (3); the louver (4) comprises a nose-like body (6) that is located inside said air inlet duct (3) to absorb the sound waves propagating along the air inlet duct (3) from the fan assembly (2).

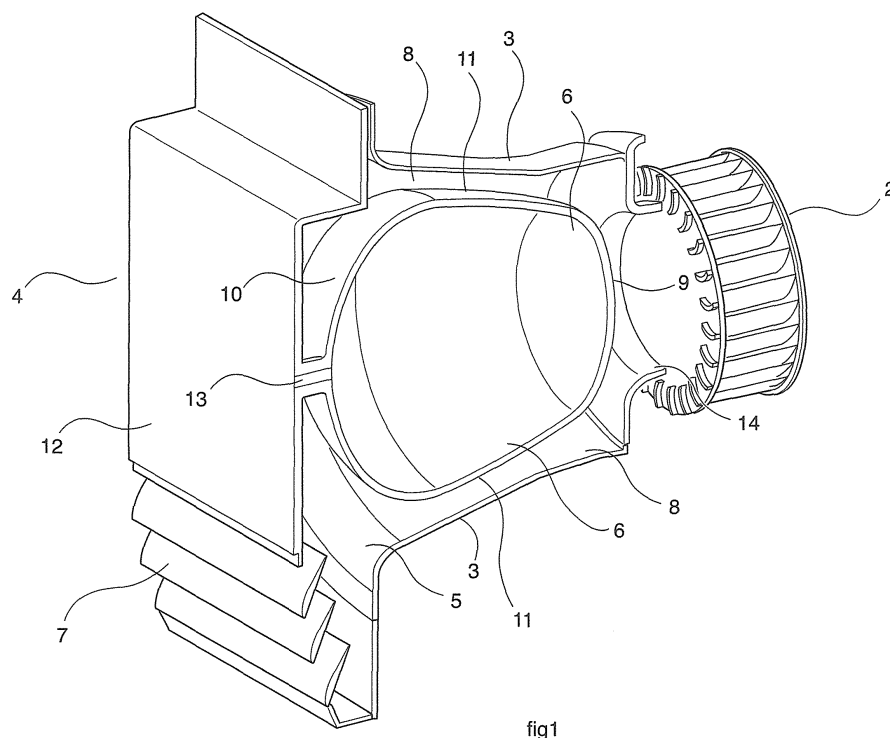


fig1

Description

[0001] The present invention refers generally to a clothes drying machine and, more particularly, to a so-called tumble dryer.

[0002] Some tumble dryers known from the prior art are provided with an open-loop air circuit, by means of which an air flow is taken in from the outside ambient, i.e. the atmosphere, to be directed into the drum so as to remove the moisture from the clothes contained therein, or to be directed towards a condenser unit to properly cool it down before being eventually exhausted into the outside atmosphere again.

[0003] The air is taken in through an air inlet duct that is fluidly connected to a fan assembly. Such air inlet duct defines an air intake aperture that is provided in the outer casing of the drying machine and is usually guarded by means of a ventilation grille.

[0004] The air circulating circuit itself is a source of noise contributing to a really considerable extent to the overall noise usually generated by a clothes drying machine during the operation thereof.

[0005] The turbulences in the flow of air passing through the air inlet duct, the rotation of the fan and the interaction of the fan blades with the air flow itself give in fact rise to sound waves that are directed by the air inlet duct itself towards the air intake aperture, from which they then propagate into the surrounding ambient, i.e. the room where the drying machine is installed and operating, thereby polluting it acoustically.

[0006] This particular kind of occurrence becomes even more marked in the case that the open-loop air circulating circuit is also designed to cool down the condenser unit, since air must be taken in and circulated at a particularly high flow rate for the drying machine to be enabled to operate in an adequately effective manner, so that a really considerable amount of noise is unavoidably generated and conveyed outwards.

[0007] In some clothes drying machines, the air intake aperture is provided in the outer casing on the front side thereof, in view of improving and boosting the flow of air being taken in. Now, it can be most readily appreciated that, in these machines, the sound waves are directly poured out into the surrounding ambient without even that minimum of attenuating effect that typically occurs in dryers in which the air intake aperture is located in the rear wall of the outer casing thereof.

[0008] The need for the overall operating noise of drying machines - as perceived by users - to be reduced is therefore fully apparent.

[0009] In this connection, it should further be noticed that the energy rates charged in a number of countries make it particularly advantageous for electric appliances to be used during evening or night hours. An adequately low noise level of such appliances is therefore a prerequisite for the same appliances to be capable of being used at night-time, actually.

[0010] It is therefore a main object of the present in-

vention to provide a clothes drying machine, which is effective in doing away with the above-cited drawback of prior-art machines.

[0011] Within this general object, it is a further purpose of the present invention to provide a clothes drying machine that generates an extremely low level of noise when operating.

[0012] According to the present invention, these aims, along with further ones that will become apparent from the following disclosure, are reached in a drying machine incorporating the features as defined and recited in the claims appended hereto.

[0013] Features and advantages of the present invention will anyway be more readily understood from the description that is given below by way of nonlimiting example with reference to the accompanying drawings, in which:

- Figure 1 is a perspective cross-sectional view of open-loop air circuit of a drying machine according to the present invention;
- Figure 2 is a similar view as the one appearing in Figure 1;
- Figure 3 is a partially cross-sectional view of a nose-like body of the drying machine according to the present invention;
- Figure 4 is a cross-sectional view of an air inlet duct of the drying machine according to the present invention;
- Figure 5 is an enlarged view of the slats shown in Figure 2.

[0014] With reference to the above-cited Figures, the drying machine according to the present invention comprises a drying air circuit adapted to cause air to be circulated through a perforated rotating drum holding the laundry to be dried, a fan assembly 2 for taking air in from the surrounding ambient, an air inlet duct 3 fluidly connected to the fan assembly 2, a ventilation louver 4 to guard an air intake aperture 5, or air inflow port, of said air inlet duct 3.

[0015] The louver 4 comprises a nose-like body 6 that is located inside said air inlet duct 3 to absorb the sound waves propagating along the air inlet duct 3 from the fan assembly 2, thereby producing a marked noise-dampening effect.

[0016] The drying machine further comprises heater means adapted to heat up the drying air, and a condenser unit adapted to remove moisture from the hot moisture-laden drying air as it exits the drum after having flown through the laundry items placed in the drum for drying.

[0017] In a preferred embodiment of the present invention, the drying machine comprises a closed-loop drying-air circuit, through which the hot moisture-laden drying

air is conveyed upon leaving the perforated rotating drum containing the laundry to be dried, and the dehydrated drying air from the condenser unit is then returned into the drum - via the heater means to have it duly heated up again - so as to remove additional moisture from the laundry items being tumbled therein.

[0018] In such preferred embodiment, the drying machine further comprises an open-loop cooling-air circuit adapted to cause a stream of cooling air taken in from outside to circulate through and over the condenser unit to properly cool it down before being eventually exhausted into the outside atmosphere again.

[0019] The fan assembly 2 for taking in air from the outside ambient, the air inlet duct 3 fluidly connected to the fan assembly 2, and the ventilation louver 4 guarding said air inlet aperture are provided in the open-loop cooling-air circuit.

[0020] On the other side, blower means are provided to cause the drying air to circulate inside the drum and through the closed-loop drying-air circuit.

[0021] Via this closed-loop drying-air circuit, the hot moisture-laden air is caused to leave the perforated rotating drum to be conveyed towards and through the air-cooled condenser unit, where moisture is removed therefrom. The dehydrated air exiting the condenser unit is then sent back into the drum - via the heater means to have it duly heated up again - for removing additional moisture from the laundry items being tumbled therein.

[0022] The heater means themselves are provided downstream from the drying-air condenser outlet, so as to properly heat up the dehydrated drying air due to be returned into the drum.

[0023] The condenser unit comprises in turn a plurality of fluid passageways, along which the drying air is able to flow in view of having moisture condensed and removed therefrom, and these fluid passageways are capable of being invested by, i.e. are exposed to the flow of cooling air flowing through the open-loop cooling air circuit.

[0024] The ventilation louver 4 is adapted to be applied on to the outer casing of the drying machine at a proper accommodation site where the air intake aperture 5 of the open-loop cooling-air circuit is provided. The louver 4 comprises a plurality of aeration slats or fins 7, through which the air taken in and directed towards the condenser unit by the fan assembly 2 is able to flow.

[0025] The louver 4 further comprises a nose-like, i.e. ogive-shaped body 6 that, when the louver 4 is applied on to the outer casing of the drying machine, extends inwards in the air inlet duct 3, so that the air inlet duct 3 and the nose-like body 6 cooperatively define an annular inflow passageway 8 therebetween, through which the air taken in by the fan assembly 2 is able to flow.

[0026] In turn, the nose-like body 6 defines a front portion 9 due to face the fan assembly 2, a rear portion 10 due to face the louver 4, and a side portion 11 due to face the air inlet duct 3 so as to form the annular inflow passageway 8.

[0027] Advantageously, the louver 4 and the nose-like body 6 may be provided in a single-piece construction, wherein the nose-like body 6 is provided so as to protrude from one or more suitably reinforced slats 7 or from a support member provided between the slats 7 at a central site on the louver 4.

[0028] Alternatively, the nose-like body 6 may be provided as a self-standing member separate from the louver, adapted to be applied to the same ventilation louver 4 with the aid of appropriate fastening means.

[0029] In the embodiment being described herein by way of example to illustrative purposes, the ventilation louver 4 forms - further to a plurality of slats or fins 7 - a support wall 12 designed to face a central portion of the air intake aperture 5 of the air inlet duct 3 when the louver 4 is applied on to the outer casing of the drying machine.

[0030] As best shown in Figures 1 and 2, the louver 4 comprises a first portion, in which there are provided the slats or fins 7, and a second portion, in which there is provided the support wall 12. Alternatively, the support wall 12 can be limited to a central portion of the louver 4, whereas the slats 7 are provided to extend along the remaining outer portion(s).

[0031] The support wall 12 comprises a connecting stem 13 that, when the louver 4 is in its place on the outer case of the drying machine, projects from the support wall 12 itself towards the fan assembly 2. This connecting stem 13 is adapted to associate the nose-like body 6 to the support wall 12 as duly spaced therefrom.

[0032] Advantageously, the support wall 12, the connecting stem 13 and the nose-like body 6 are provided integrally as a unitary-piece construction.

[0033] Alternatively, the nose-like body 6 may be provided in the form of a self-standing, autonomous structure adapted to be associated to the stem 13, e.g. by screwing-in or interference-fit coupling, whereas the connecting stem 13 may be provided integrally as a unitary piece with the support wall 12. Or, again, the nose-like body 6 may itself integrally define a connecting stem 13 adapted to engage the support wall 12 at an appropriate fastening site or receptacle.

[0034] The nose-like body 6 is adapted to absorb the sound waves that - as generated by the fan assembly 2 - propagate along the air inlet duct 3 towards the air intake aperture 5, so as to acoustically isolate the fan assembly from the outside ambient surrounding the drying machine.

[0035] The nose-like body 6 develops inside the air inlet duct 3 so as to be arranged in proximity of the fan assembly 2, so that the front portion 9 of the nose-like body 6 faces the impeller of the fan assembly 2 and, in particular, an intake section 14 of the impeller of the fan assembly 2.

[0036] Preferably, the nose-like body 6 is comprised of an internally hollow structure having a wall thickness of just a few millimetres, so as to avoid putting any excessive stress upon the connecting stem 13 and the support wall 12 of the louver 4.

[0037] The nose-like body 6 may be fully made of plastic material or, still better, a sound-absorbing material so as to improve the noise-deadening effect and the sound insulation of the fan assembly 2. Alternatively, a layer of sound-absorbing material may be used to cover the nose-like body 6.

[0038] In a further embodiment thereof, the nose-like body 6 has at least its front portion 9, which faces the fan assembly 2, that is made of a sound-absorbing material.

[0039] In a most preferred embodiment of the present invention, the nose-like body 6 is comprised of a preferably hollow member 15 made of a sound-absorbing material and at least partially covered by an outer surface 16, which may for instance be of plastics, featuring a plurality of perforations 17 provided to expose the sound-absorbing material of the underlying member 15 to the sound waves.

[0040] The perforations 17 in the outer surface 16 have a same pre-established diameter, and are arranged equidistantly spaced, i.e. at a same pre-established distance from each other, wherein such diameter and such distance of the perforations from each other are determined in accordance with the actual wavelength of the sound waves to be absorbed.

[0041] In particular, the outer surface 16 covers the member 15 of sound-absorbing material in such manner as to ensure that the perforations 17 are provided laterally on the nose-like body 6 along the annular passageway 7 so as to come to face the air inlet duct 3.

[0042] Preferably, the front portion 9 of the nose-like body 6 is comprised of the member 15 of sound-absorbing material not covered by the outer surface 16; the side portion 11 of the nose-like body 6 is comprised of the member 15 of sound-absorbing material covered by the outer surface with the perforations 17, whereas the rear portion 10 of the nose-like body 6 is comprised of the member 15 of sound-absorbing material covered by a portion of the outer surface 15 that is free of perforations.

[0043] This solution enables the sound waves generated by the fan assembly 2 to be absorbed in an effective manner, while avoiding any increase in airflow resistance and preventing any turbulence to be introduced in the same air flow. It further enables the aerodynamic distribution of the air flow along the air inlet duct 3 to be improved, thereby enhancing the performance of the fan assembly 2.

[0044] In a preferred embodiment of the present invention, the air inlet duct 3 comprises an inner perforated conduit 18 featuring a plurality of perforations 19 and an outer cladding 20 made of a sound-absorbing material that covers the internal conduit 18 externally so as to close said perforations 19.

[0045] The internal conduit 18 faces the side portion 11 of the nose-like body 6, thereby forming the annular intake passageway 7 adapted to direct the flow of air being taken in towards the fan assembly 2.

[0046] The perforations 19 of the internal conduit 18 enable the sound-absorbing material of the outer clad-

ding 20 to be exposed to the sound waves propagating within the air inlet duct 3.

[0047] As a result, the sound waves that penetrate the perforations 19 of the internal conduit 18 are absorbed by the sound-absorbing material of the outer cladding 20. Again, the perforations 19 of the internal conduit 18 have a same pre-established diameter, and are arranged equidistantly spaced, i.e. at a same pre-established distance from each other, wherein such diameter and such distance of the perforations from each other are determined in accordance with the actual wavelength of the sound waves that - as generated by the fan assembly 2 - have to be absorbed.

[0048] The structure of the air inlet duct 3 is such as to enable the sound waves propagating from the fan assembly 2 to be absorbed while avoiding any multiple reflection that would tend to direct the sound waves towards the air intake aperture 5 and, from here, into the ambient surrounding the machine, without this affecting the aerodynamic efficiency of the air inlet duct to any appreciable extent.

[0049] Advantageously, the air inlet duct 3 is given such conformation as to have it defining a flared, i.e. widening-up end that forms the air intake aperture 5, and tapered end at which there is provided the intake section 14 of the fan assembly 2. Such conformation enables the aerodynamic distribution of the flow inside the air inlet duct 3 to be improved, while minimizing turbulences and flow resistance.

[0050] In a further embodiment of the present invention, the slats 7 of the louver 4 are at least partially clad with a layer 21 of sound-deadening material adapted to absorb the sound waves propagating from the fan assembly 2. In particular, the layer 21 of sound-absorbing or sound-deadening material is provided on the side of the slats 7 that faces the fan assembly 2. Alternatively, the slats 7 can be integrally made of a sound-absorbing material.

[0051] Fully apparent from the preceding description is therefore the ability of the present invention to effectively reach the afore-cited aims and advantages by providing a drying machine that generates an extremely low level of noise, thereby doing away with the serious drawback shared by prior-art machines. The inventive drying machine is adapted to absorb, i.e. deaden the sound waves being generated by the fan assembly, and propagating therefrom along the air inlet duct towards the air intake aperture of the machine, so as to acoustically isolate the same fan assembly and the air inlet duct from the outside ambient surrounding the drying machine.

Claims

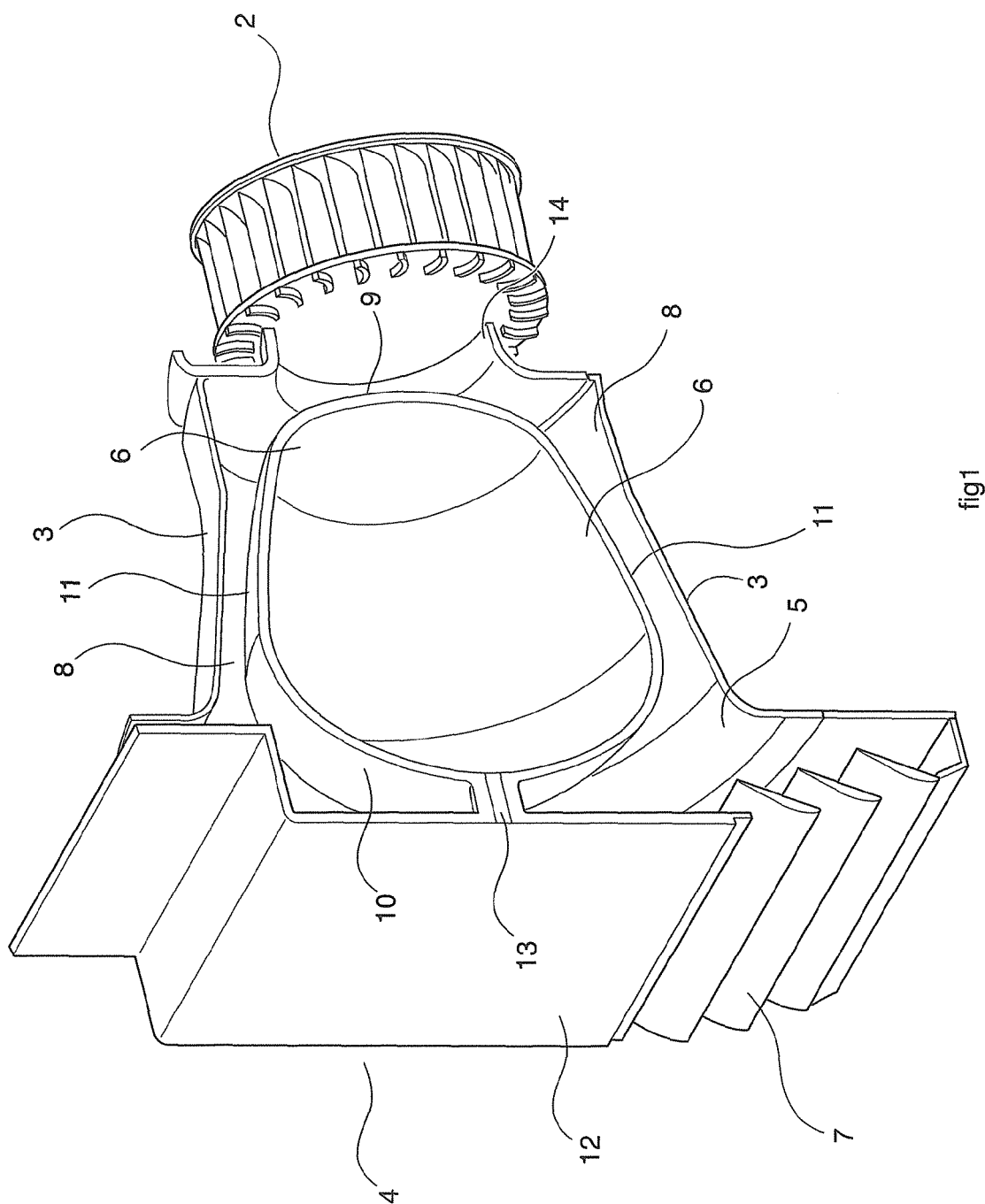
1. Drying machine comprising a drying air circuit for causing air to be circulated through a perforated rotating drum, a fan assembly (2) for taking air in from the surrounding ambient, an air inlet duct (3) fluidly

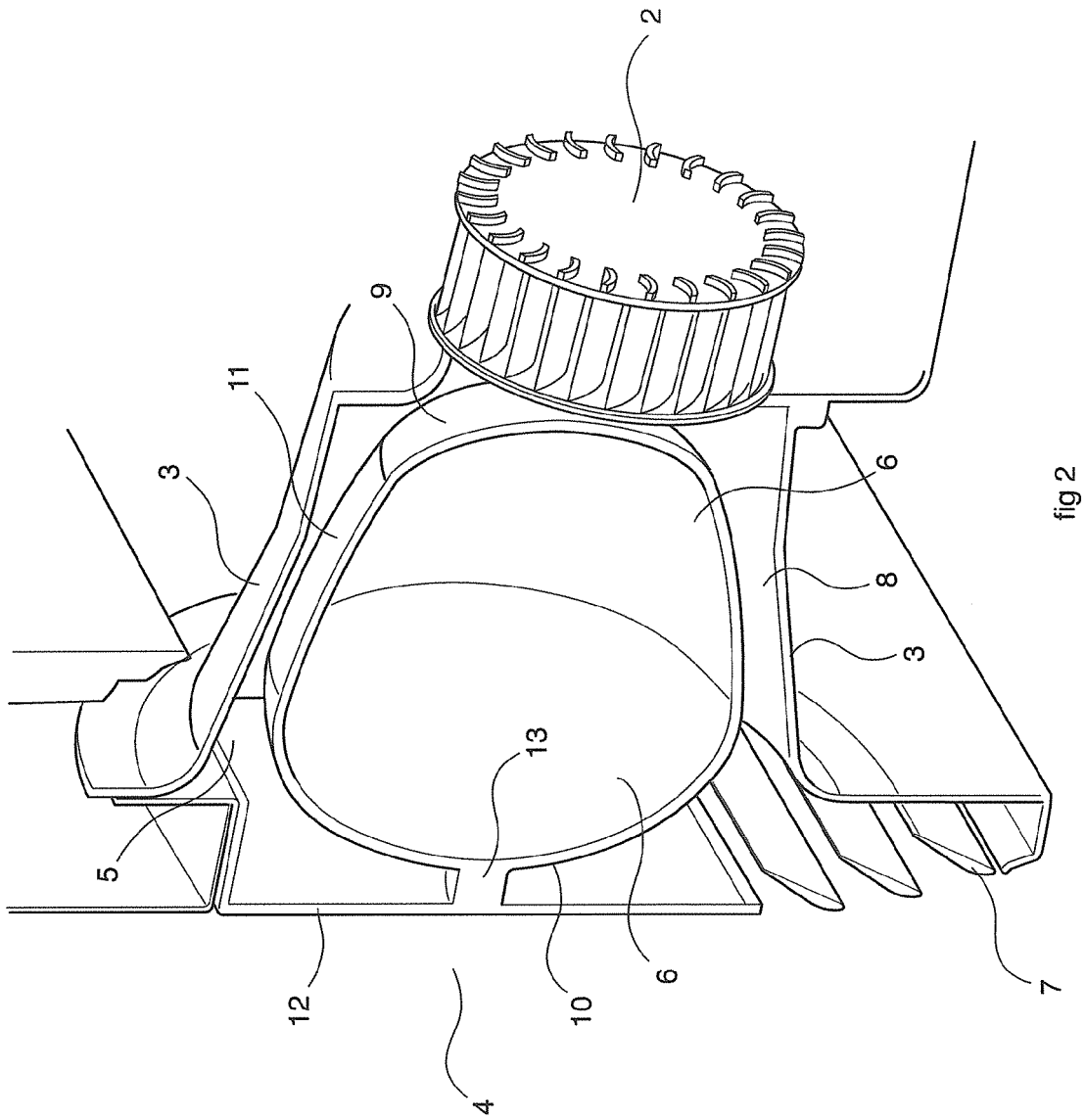
connected to the fan assembly (2), a ventilation louver (4) to guard an air intake aperture (5) of said air inlet duct (3), **characterized in that** said louver (4) comprises a nose-like body (6) that is located inside said air inlet duct (3) to absorb the sound waves propagating along the air inlet duct (3) from the fan assembly (2).

2. Drying machine according to claim 1, wherein said nose-like body (6) extends inside the air inlet duct (3) so as to be arranged in proximity of the fan assembly (2), so that a front portion (9) of the nose-like body (6) faces an intake section (14) of an impeller of the fan assembly (2). 5
3. Drying machine according to claim 2, wherein at least said front portion (9) of the nose-like body (6) is made of a sound-absorbing material. 10
4. Drying machine according to claim 1, wherein said air inlet duct (3) and said nose-like body (6) cooperatively define an inflow passageway (8) therebetween, through which the air taken in by the fan assembly (2) is able to flow. 15
5. Drying machine according to any of the preceding claims, wherein said ventilation louver (4) forms a plurality of fins or slats (7) and a support wall (12) designed to face a middle portion of the air intake aperture (5) of the air inlet duct (3) to support said nose-like body (6). 20
6. Drying machine according to claim 5, wherein a connecting stem (13) projecting from the support wall (12) towards the fan assembly (2) is provided to associate the nose-like body (6) to said support wall (12) in a spaced arrangement relative thereto. 25
7. Drying machine according to any of the preceding claims, wherein the nose-like body (6) is comprised of a member (15) made of a sound-absorbing material and at least partially covered by an outer surface (16) featuring a plurality of perforations (17) provided to expose the sound-absorbing material of the underlying member (15) to the sound waves generated by the fan assembly (2). 30
8. Drying machine according to claim 7, wherein said perforations (17) in the outer surface (16) have a same pre-established diameter, and are arranged equidistantly spaced, i.e. at a same pre-established distance from each other, said diameter and said distance of the perforations from each other being determined in accordance with the actual wavelength of the sound waves to be absorbed. 35
9. Drying machine according to claim 8, wherein said outer surface (16) covers the member (15) of sound- 40

absorbing material in such manner as to ensure that said perforations (17) are provided laterally on the nose-like body (6) so as to come to face the air inlet duct (3). 45

10. Drying machine according to any of the preceding claims, wherein said louver (4) and said nose-like body (6) are made integral with each other as a unitary piece. 50
11. Drying machine according to any of the preceding claims, wherein the air inlet duct (3) comprises a perforated inner conduit (18) featuring a plurality of perforations (19) and an outer cladding (20) made of a sound-absorbing material that covers the internal conduit (18) externally so as to close said perforations (19), said perforations (19) having a same pre-established diameter and being arranged equidistantly spaced, i.e. at a same pre-established distance from each other, in which said diameter and said distance of the perforations from each other are determined in accordance with the actual wavelength of the sound waves that, generated by the fan assembly (2), have to be absorbed. 55





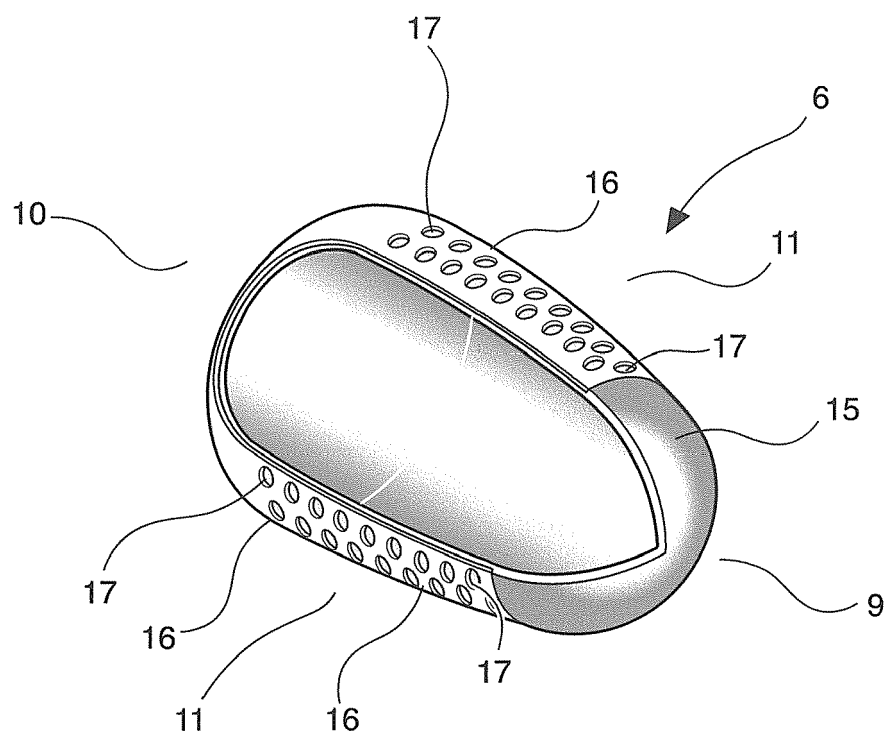


fig 3

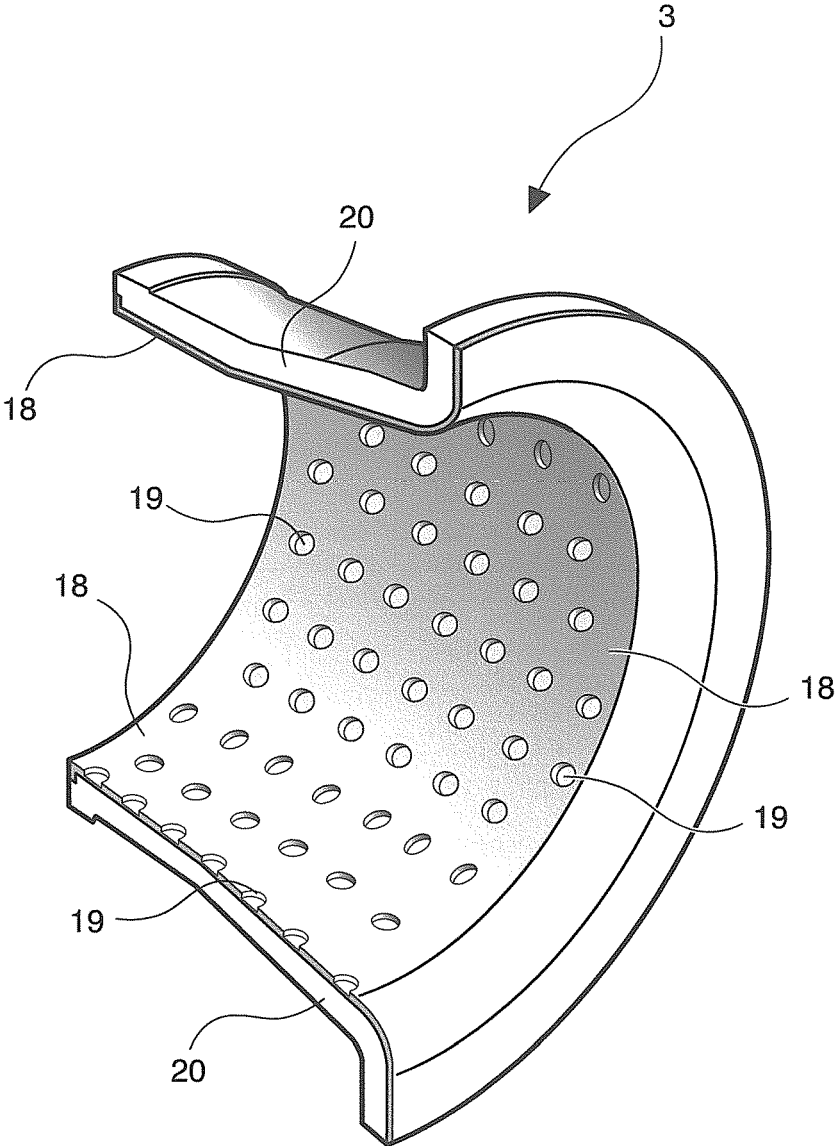


fig4

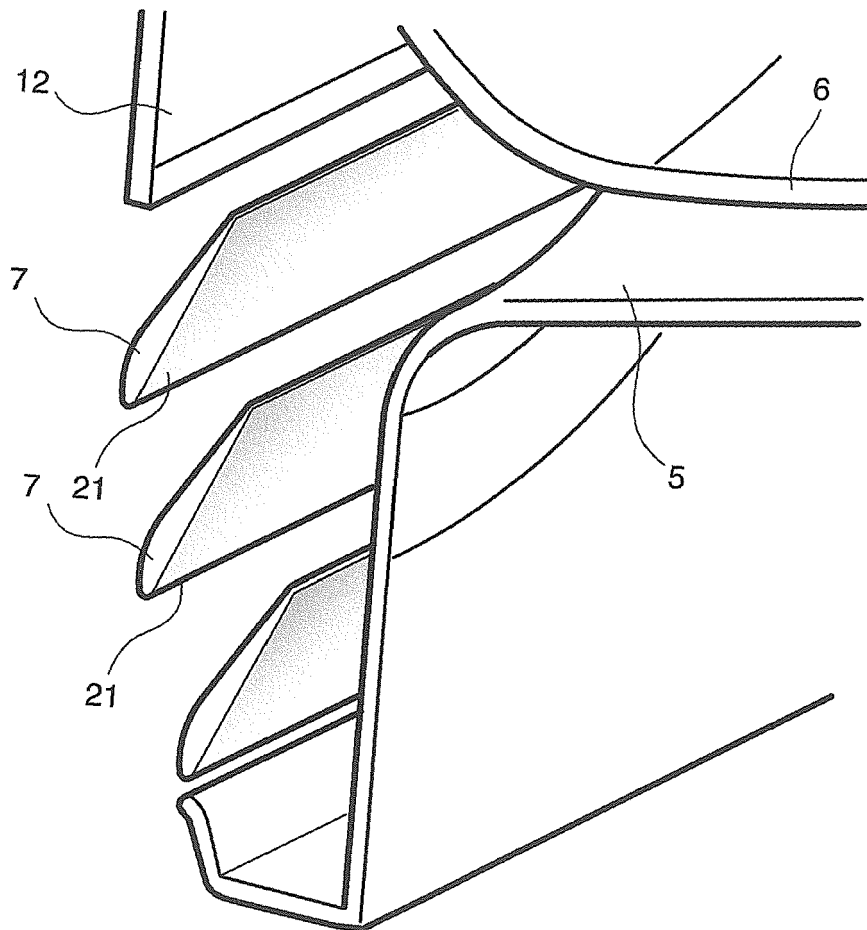


fig 5



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 06 11 4971

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2005/217139 A1 (HONG KYUNG-SEOP [KR]) 6 October 2005 (2005-10-06) page 1, paragraph 2, page 2, paragraphs 28-40, 46; abstract; figures 4-9 -----	1-11	INV. D06F58/24
A	EP 1 584 733 A2 (LG ELECTRONICS INC [KR]) 12 October 2005 (2005-10-12) column 1, paragraph 1; column 3, paragraph 16 - column 4, paragraph 31; abstract; figures 4-9 -----	1-11	
A	GB 2 129 920 A (PHILIPS ELECTRONIC ASSOCIATED) 23 May 1984 (1984-05-23) * the whole document *	1-11	
A	US 2 927 380 A (OLTHUIS EUGENE G) 8 March 1960 (1960-03-08) * the whole document *	1-11	
			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 10 October 2006	Examiner Clivio, Eugenio
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			

2
EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 06 11 4971

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

10-10-2006

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 2005217139	A1	06-10-2005	CN	1680651 A	12-10-2005
EP 1584733	A2	12-10-2005	NONE		
GB 2129920	A	23-05-1984	DE	8330386 U1	19-01-1984
			FR	2535748 A1	11-05-1984
US 2927380	A	08-03-1960	NONE		