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Condenser-type low-noise household clothes drying machine
Lärmarmer Haushaltswäschetrockner des Kondensationstyps
Sèche-linge domestique silencieux à condensation

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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 to and from the condenser, as well as the really non-negligible blowing noise due to said air when exhausted from the machine and blown again into the room.

[0003] Known from the disclosure in GB 2253 035 is an arrangement adapted to muffle the noise generated by the flow of drying air in a clothes drying machine of a traditional type; it has however been found experimentally that such a solution does not actually deaden the generated noise to any effective extent, especially if considered against the background of the costs and space requirements thereof.

[0004] Also known from prior disclosures in GB 2 129920A and US 2,927,380 are further solutions aimed at deadening the noise generated by the drying air or condenser cooling air being exhausted from a household-type clothes drying machine. Anyway, the solutions proposed in said documents have a number of drawbacks in their practical application, owing to both the complexity found in their implementation and the rather modest results that are to be achieved therewith.

[0005] Furthermore, the motor used to drive the fan circulating the condenser cooling air is usually an uncooled motor, so that by operating in a continuous manner it tends to heat up to quite a considerable extent. This brings about a number of additional drawbacks in terms of a reduction in the electric efficiency and a need for a higher class of insulation to be adopted, which again means higher production and operating costs.

[0006] From DE 3904988 A1 a laundry drying machine of the condenser type is divulged; however there is no provision aimed to cool down the unique motor that operates the fan for the drying air and the fan for the cooling air.

[0007] From US 6,035,552 a household dryer of the condenser type is known wherein the primary side of heat exchanger 9 is split into at least two portions 10 and 11 connecting them in series.

[0008] From JP55070298 it is known a type of laundry dryer of the condensation type provided with a first and a second outlet openings, the latter being arranged in proximity of said motor and oriented forward it.

[0009] 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 the condensation of 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 outflow of the condenser cooling air from the machine.

[0010] According to another purpose of the present invention, this clothes drying machine should be capable of making use of a motor for drying the cooling air circulating fan, which poses far less severe constraints in terms of heat endurance and electric insulation in its construction and is therefore far less expensive to manufacture.

[0011] According to a further purpose of the present invention, this clothes drying machine must 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.

[0012] According to the present invention, these aims are reached in a condenser-type clothes drying machine incorporating the characteristics as recited in the appended claims; a condenser-type clothes drying machine includes such operating means as described below by mere way of non-limiting example with reference to the accompanying drawings, in which:

- Figure 1 is a merely symbolical schematic view of the layout and the functional component parts of the drying-air and cooling-air conduits of a clothes drying machine according to the present invention;
- Figure 2 is a partially see-through view of the condenser and the associated cooling conduits in a clothes drying machine according to the present invention;
- Figure 3 is a top view of the assembly illustrated in Figure 2;
- Figure 4 is a perspective bottom view of an improved embodiment of a clothes drying machine according to the present invention;
- Figure 5 is a perspective symbolical view of an improved embodiment of a condenser of a clothes drying machine according to the present invention;
- Figure 6 is a symbolical, planar projection view of the flow pattern in the conduits downstream of the condenser illustrated in Figure 5.

[0013] With reference to the above listed Figures, and in particular Figures 1 and 2, a clothes drying machine comprises an outer casing 1, inside which there are ar-
ranged:

- a drying drum 2,
- means situated outside of said drum and adapted to circulate a controlled flow of heated-up air into and through said drum, said means comprising:
  - a first conduit 3 for letting drying air into and out of the drum,
  - a fan 4 to generate a continuous flow of drying air through said first conduit and said drum,
  - an electric heating element 5 to heat up said drying air,
  - a condenser 6, through which said flow of drying air is caused to pass,
  - further means adapted to convey a flow of fresh air to said condenser to cool down the same condenser, said means comprising:
    - a second conduit 7 to convey said flow of cooling air to and from said condenser,
    - a respective fan 8 associated to said second conduit and adapted to bring about said flow of cooling air,
    - a motor 9 associated to said respective fan 8.

[0014] Said second conduit is a conduit that is substantially open at both extremities thereof; on the one side it is in fact provided with an inlet opening 10 for taking in fresh air from the surrounding ambient, preferably on the rear side of the outer casing of said clothes drying machine, while on the other side, at the outlet from the condenser 6, said conduit splits into a first outlet opening 11 for exhausting part of the flow of air conveyed therethrough, i.e. into the ambient surrounding the machine, and into a second outlet opening 12 for exhausting inside the machine, i.e. towards the interior of said outer casing 1, the remaining part of said flow of air conveyed therethrough.

[0015] The reason behind such a solution is as follows: since the cooling air, which is generally indicated at 1A prior to flowing through the condenser, must be eliminated upon being passed through the condenser, if it is the entire flow thereof that is exhausted outside the machine, it then occurs that between the grilles of the outlet opening, which is usually situated on the front side of the machine, there is generated exactly that kind of sensible noise that should desirably be on the contrary eliminated. In view of preventing this from happening, a part 2B of said outflow of cooling air is diverted towards the interior of the outer casing of the machine, into which it is eventually let through said second outlet opening 12; the remaining part 2A of said outflow is on the contrary exhausted outside immediately through said first outlet opening 11.

[0016] Since the outer casing of the machine is a substantially closed structure, except for the bottom side facing the floor, it practically behaves, as regards said flow of air expanding therewithin, as a noise deadening chamber, or a silencing muffler, and this occurrence is promoted by the considerable mass forming said machine. In this way, therefore, a first beneficial sound-deadening effect is obtained.

[0017] However, in view of further improving such an effect, it has been considered advantageous, and has been actually found so experimentally, to have a wall 13 arranged on the bottom side of said outer casing of the machine, so as to substantially close the inner volume of the machine from the outside ambient also at the bottom thereof, as this is shown symbolically in Figure 4.

[0018] In this manner, the muffling chamber effect brought about by the outer casing of the machine is magnified, owing to the fact that said outer casing is in this way made in the form of a volume that is substantially closed on all sides. On the other hand, no problems have been noticed to occur in connection with the eventual outflow into the outside ambient of the cooling air being first exhausted inside said outer casing of the machine, since the casing itself has not a sealed, air-tight construction, actually, and has anyway an adequate number of leakage zones through which said part 2A of said flow let into said outer casing, can eventually escape therefrom into the outside ambient.

[0019] At this point, the question may logically arise as to why not the whole amount of air flowing out of the condenser is actually exhausted into the outer casing of the machine, since this should in theory prove effective in further improving the noise reduction effect, i.e. the quietness of the machine. The answer to such a question lies in the fact that, if all of the air outflow from the condenser would be blown into the machine, the dynamic flow resistance of said leakage zones, and the resistance to the outflow of the air into the outside ambient, would in that case prevent the air from escaping at an adequate rate, i.e. in an adequate amount, thereby giving rise to an increase in the internal pressure that would in turn interfere with a correct passage of the flow of cooling air through the condenser.

[0020] Among other things, the above-described solutions allow for a further advantageous improvement to be achieved; in fact, with reference to Figures 2 and 3, the inwardly diverted part 2B of the flow of cooling air is so oriented as to as much as possible hit said motor 9 before diffusing within the outer casing of the appliance. This may quite easily be obtained by arranging the related second outlet opening 12 as close as possible to said motor, duly oriented towards the latter.

[0021] The immediate effect of such an arrangement is the ability of said motor to cool down in a definitely more intensive manner, with the ultimate result that the possibility then arises for a motor to be used, which cer-
tainedly may feature a lower class of electric insulation and, therefore, can be manufactured at sensibly lower costs.

[0022] This advantageous effect can be sensibly magnified if said clothes drying machine is designed so as to enable said motor 9 to drive both the fan 4 associated to said first conduit 3 for the drying air and the fan 8 associated to said second conduit 7, since the above-mentioned advantage of a less expensive motor for the operation of said fan 8 would in this way be automatically extended to the operation of said fan 4 of the conduit 3 for the drying air.

[0023] In addition, the above-illustrated improvement carries another advantage with it, namely an advantage in terms of energy usage, owing to a flow of air pre-heated by the motor being actually let into the outer casing of the machine. This obviously causes the temperature of the air inside the outer casing to rise, and this temperature rise is automatically passed over to the drum, which is in this way able to take in part of the heat released by the motor. It can at this point be readily appreciated that if this result of a rise in the temperature of the wall of the drum, even if this is brought about from the outside, is an increase of the internal temperature thereof and a corresponding reduction of the amount of heat that must be generated and transmitted by the heating element 4, under clear benefits in terms of overall energy usage.

[0024] A further improvement may finally be advantageously obtained with the following technical solution: with reference to Figures 5 and 6, the condenser 6 is made in the form of a parallelepiped, in which two opposite walls 20, 21 are passed through by the flow A of the drying air, whereas other two other opposite walls 22, 23 are passed through by the flow B of the cooling air.

[0025] According to this improvement, on the cooling-air outflow wall 23 there is arranged a channel that has a first curved section 24 and then a following rectilinear section 25; the curved section 24 of this channel causes the flow B to turn by 180° and to move on further, via the following rectilinear section 25 of the same channel, over a wall of said condenser, in an exactly opposite direction with respect to the flow "B" entering the condenser.

[0026] It will of course be appreciated that the channel section 24 may also take different forms, provided that, as this is for instance shown in Figure 5, it is capable of diverting its airflow in an opposite direction with respect to the direction of the inflowing air.

[0027] It may be recalled here that, according to an alternative, said flow B of cooling air must at a certain point be split into two separate flows 2a and 2b to be exhausted outside and redirected into outer casing of the machine, respectively. Such a function is achieved by means of a partition S that is inserted in an appropriate position in said channel section 25, where it is arranged in such a manner as to enable it to assist the shape of said channel section 25 in splitting said two flows, diverting them in two respective directions, and conveying them towards an outflow grille 31 and said motor 9, respectively.

[0028] The advantage of such a configuration derives from the utmost compactness of the whole arrangement and the inexpensiveness thereof, wherein such inexpensiveness may be further enhanced if said channel section 25 is arranged downwards, on the bottom of the machine, and the outer wall 32 thereof (i.e. the one opposing the wall being shared with the condenser) is obtained by simply adapting and using the afore-mentioned bottom plate 13 correspondingly. In this way, the additional advantage may in fact be obtained of saving the use of two specific walls for said channel section 25, since said outer wall 32 would be obtained directly out of said existing bottom wall 13, while the opposite wall is simply the wall separating the channel itself from the body of the same condenser 6.

[0029] It should be specially noticed at this point that, although Figure 5 shows that the condenser 6 passed through by the airflow B, is spatially separated from the conduit 25 represented thereunder, such a representation is solely aimed at giving a clearer indication of parts shown in a see-through view in an ideal arrangement. In a preferred real embodiment, on the contrary, said condenser 6 and the second channel section 25 are provided in contact with each other, so that said first channel section 24 is shortened accordingly.

Claims

1. Clothes drying machine comprising:

   - a drum (2) for holding and drying the clothes to be dried,
   - a conduit (3), a heating element (5) and a fan (4) adapted to circulate a controlled flow (A) of heated-up air within said drum,
   - a condenser (6), through which said flow of heated-up air is caused to pass,
   - further means adapted to convey a flow of fresh cooling air (1a) to said condenser to cool down said condenser, these further means comprising:
   - a second conduit (7) to convey the cooling air to (1a, B) and from (B) said condenser, comprising:
   - an intake opening (10) for taking in fresh ambient air,
   - a first outlet opening (11) for exhausting part (2a) of the conveyed air flow outside the machine,
   - a second outlet opening (12) for exhausting part (2b) of the conveyed air flow inside said machine,
   - a respective fan (8) associated to said second conduit and adapted to bring about said flow of cooling air,
   - a motor (9) associated to said respective fan (8), said second outflow opening (12) being ar-
ranged in proximity of said motor (9) and is orien-
ted towards the latter, characterized in that
the cooling-air outflow wall (23) of said condens-
er lets into a first channel section (24) and a sec-
ond channel section (25), in which said first
channel section (24) diverts the flow of cooling
air (B) in an opposite direction with respect to
the direction followed by the cooling air (B) inside
said condenser, and in which said second chan-
nel section (25) is rectilinear and leads said flow
of cooling air in the opposite direction with re-
spect to the flow of cooling air (B) inside said
distributor.

2. Clothes drying machine according to claim 1, char-
acterized in that
an airflow partition (S) is arranged
inside said second channel section (25) and is adapt-
ed to divert a part of the flow (2a) outside the machine
and the remaining part of the flow (2b) towards said
motor (9).

3. Clothes drying machine according to claim 1 or 2,
classified in that
said second channel section
(25) is arranged on the bottom of the machine, and
that a portion of said wall (13) closing said machine
on the bottom thereof also forms the outer wall (32)
of said second channel section (25).

Patentansprüche

1. Wäschetrocknermaschine, die Folgendes umfasst:
   - eine Trommel (2) zum Aufnehmen und Trock-
en der zu trocknenden Wäsche,
   - eine Leitung (3), ein Heizelement (5) und einen
     Ventilator (4), der geeignet ist, einen kontrollier-
ten Strom (A) erhitzter Luft in der Trommel zu
     zirkulieren,
   - einen Kondensator (6), durch den der Strom
     erhitzter Luft geführt wird,
   - ein weiteres Mittel, das geeignet ist, einen
     Strom frischer Kühlung (1a) in den Kondensator
     zu befördern, um den Kondensator abzukühlen,
   - einen zugehörigen Ventilator (8), der der
     zweiten Leitung zugeordnet und geeignet ist,
     den Kühlstrom zu erzeugen,
   - einen Motor (9), der dem entsprechenden
     Ventilator (8) zugeordnet ist, wobei die
     zweite Auslassöffnung (12) in der Nähe des
     Motors (9) angeordnet und auf diesen hin
     ausgerichtet ist, dadurch gekennzeich-
net, dass die Kühl-Luft-Auslasswand (23)
     des Kondensators in einen ersten Kanalab-
     schnitt (24) und einen zweiten Kanalab-
     schnitt (25) führt, in dem der erste Kanalab-
     schnitt (24) die Strömung der Kühlung (B) in
die der Kühlung (B) innerhalb des Konden-
sators entgegengesetzte Richtung lenkt
und in dem der zweite Kanalabschnitt (25)
rechteckig ist und den Kühlstrom in die
dem Kühlstrom (B) innerhalb des Kon-
densators entgegengesetzte Richtung
führt.

2. Wäschetrocknermaschine gemäß Anspruch 1, da-
durch gekennzeichnet, dass
innerhalb des zwei-
ten Kanalabschnitts (25) eine Luftstromtrennwand
(S) angeordnet ist, die geeignet ist, einen Teil des
Stroms (2a) nach außerhalb der Maschine und den
restlichen Teil des Stroms (2b) auf den Motor (9) hin
abzulenken.

3. Wäschetrocknermaschine gemäß Anspruch 1 oder
2, dadurch gekennzeichnet, dass
der zweite Ka-
nalabschnitt (25) an der Unterseite der Maschine an-
geordnet ist und dass ein Teil der Wand (13), welche
die Maschine an ihrer Unterseite abschließt, auch
die Außenwand (32) des zweiten Kanalabschnitts
(25) bildet.

Revendications

1. Machine à sécher le linge, comprenant :
   - un tambour (2) pour contenir et sécher le linge
     à sécher,
   - un conduit (3), un élément chauffant (5) et un
     ventilateur (4) adapté pour faire circuler un cou-
     rant contrôlé (A) d’air chauffé dans ladite cuve,
   - un condenseur (6) à travers lequel le débit courant
d’air chauffé est forcé de passer,
   - d’autres moyens adaptés pour acheminer un
     courant d’air de refroidissement frais (1a) vers
     le débit condenseur afin de refroidir le débit conden-
     seur, ces autres moyens comprenant :
   - un deuxième conduit (7) pour acheminer l’air
de refroidissement vers (B) et depuis (1a ; B)
     le débit condenseur, comprenant :
     - une ouverture d’admission (10) pour introduire
de l’air amiant frais,
une première ouverture de sortie (11) pour rejeter une partie (2a) du courant d’air acheminé à l’extérieur de ladite machine,
- une deuxième ouverture de sortie (12) pour rejeter une partie (2b) du courant d’air acheminé à l’intérieur de ladite machine,
- un ventilateur respectif (8) associé audit deuxième conduit et adapté pour produire ledit courant d’air de refroidissement,
- un moteur (9) associé audit ventilateur respectif (8), ladite deuxième ouverture de sortie (12) étant agencée à proximité dudit moteur (9) et étant orientée en direction de ceux-ci,

**caractérisée en ce que** la paroi (23) de sortie d’air de refroidissement dudit condenseur conduit dans une première section de canal (24) et une deuxième section de canal (25), dans laquelle la première section de canal (24) dévie le courant d’air de refroidissement (B) dans une direction opposée par rapport à la direction suivie par l’air de refroidissement (B) à l’intérieur dudit condenseur, et dans laquelle ladite deuxième section de canal (25) est rectiligne et conduit courant d’air de refroidissement dans la direction opposée par rapport au courant d’air de refroidissement (B) à l’intérieur dudit condenseur.

2. **Machine à sécher le linge selon la revendication 1,**

**caractérisée en ce que** une cloison d’écoulement d’air (S) est placée dans ladite deuxième section de canal (25) et est adaptée pour dévier une partie du courant (2a) à l’extérieur de la machine et la partie restante du courant (2b) en direction dudit moteur (9).

3. **Machine à sécher le linge selon la revendication 1 ou 2,**

**caractérisée en ce que** ladite deuxième section de canal (25) est agencée sur le fond de la machine, et

**en ce que** une partie de ladite paroi (13) fermant ladite machine sur son fond forme également la paroi extérieure (32) de ladite deuxième section de canal (25).
REFERENCES CITED IN THE DESCRIPTION

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