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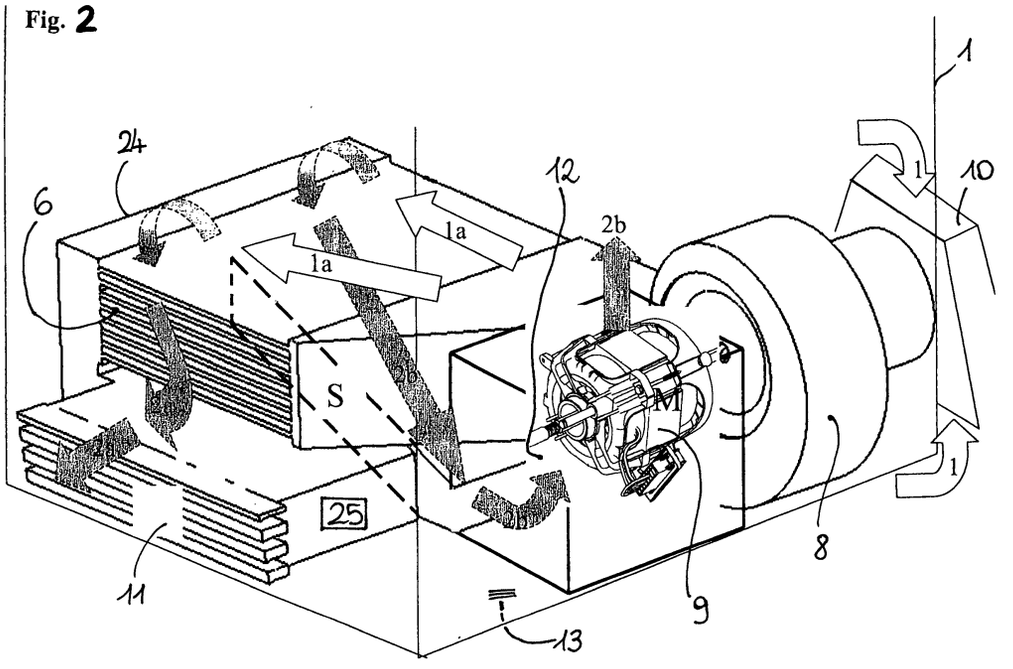
(54) Condenser-type low-noise household clothes drying machine

(57) A clothes drying machine comprises means adapted to circulate a controlled flow of heated-up air within the drum (2), a condenser (6) for condensing moisture out of the drying air, a conduit (7) for conveying cooling air to and from said condenser, a respective fan (8) to circulate said cooling air, a motor (9) associated to said fan, wherein said conduit comprises an opening (10) for taking in fresh ambient air, a first outlet (11) opening for partially exhausting part of the conveyed air flow outside the machine, and a second outlet opening (11) for partially exhausting part of the conveyed air flow inside the machine.

Preferably, the bottom side of said machine is substantially closed by an appropriate base plate; in addition, said second outlet opening is arranged in proximity of said motor and oriented towards the latter.

Fig. 2



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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 non-cooled 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] 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.

[0007] 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.

[0008] 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.

[0009] 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 and including 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.

[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 are arranged:

- a drying drum 2,
- means situated outside of said drum and adapted to circulate a controlled flow of heated-up air into and through sad 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 valve 8 associated to said second conduit and adapted to bring about said flow of cooling air,

  - a motor 9 associated to said respective valve 8.

[0011] 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 outside, 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.

[0012] 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.

[0013] 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.

[0014] 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 of thereof, as this is shown symbolically in Figure 4.

[0015] 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.

[0016] 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.

[0017] 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.

[0018] 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 certainly may feature a lower class of electric insulation and, therefore, can be manufactured at sensibly lower costs.

[0019] 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.

[0020] 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 the 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.

[0021] 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.

[0022] 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.

[0023] 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.

[0024] It may be recalled here that, according to the present invention, 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.

[0025] 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.

[0026] 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 conduit 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 (5) adapted to circulate a controlled flow 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 to said condenser to cool down said condender, these further means comprising:

- a second conduit (7) to convey the 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),

characterized in that said second conduit (7) comprises:

- an intake opening (10) for taking in fresh ambient air,
- a first outlet opening (11) for exhausting part of the conveyed air flow outside the machine,
- a second outlet opening (12) for exhausting part of the conveyed air flow inside said machine.

2. Clothes drying machine according to claim 1, **characterized in that** said machine is provided on the bottom side thereof with a wall (13) adapted to substantially close the inner volume of said machine with respect to the outside ambient.

3. Clothes drying machine according to any of the preceding claims, **characterized in that** said second outflow opening (12) is arranged in proximity of said motor (9) and is oriented towards the latter.

4. Clothes drying machine according to any of the preceding claims, **characterized in that** the cooling-air outflow wall (23) of said condenser lets into a first channel section (24) and a second channel section (25), in which said first channel section (24) diverts the flow of cooling air in an opposite direction with respect to the direction followed by the air inside said condenser, and in which said second channel section (25) is rectilinear and leads said flow of cooling air in the opposite direction with respect to the flow inside said condenser.

5. Clothes drying machine according to claim 4, **characterized in that** an airflow partition (S) is arranged inside said second channel section (25) and is adapted to divert a part of the flow (2a) outside the machine and the remaining part of the flow (2b) towards said motor (9).

6. Clothes drying machine according to claim 4 or 5, **characterized 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).

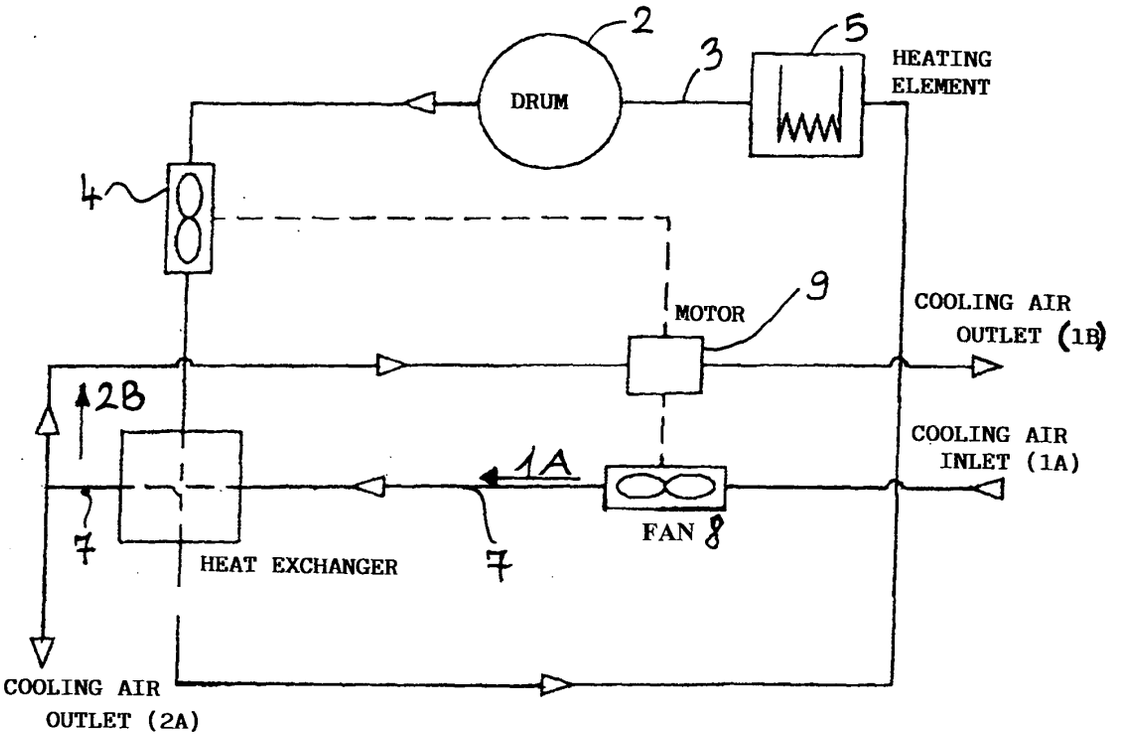
2
DRUM
3
5
HEATING ELEMENT
4
MOTOR
9
COOLING AIR OUTLET (1B)
12B
COOLING AIR INLET (1A)
1A
7
HEAT EXCHANGER
7
FAN 8
COOLING AIR OUTLET (2A)

Fig. 1

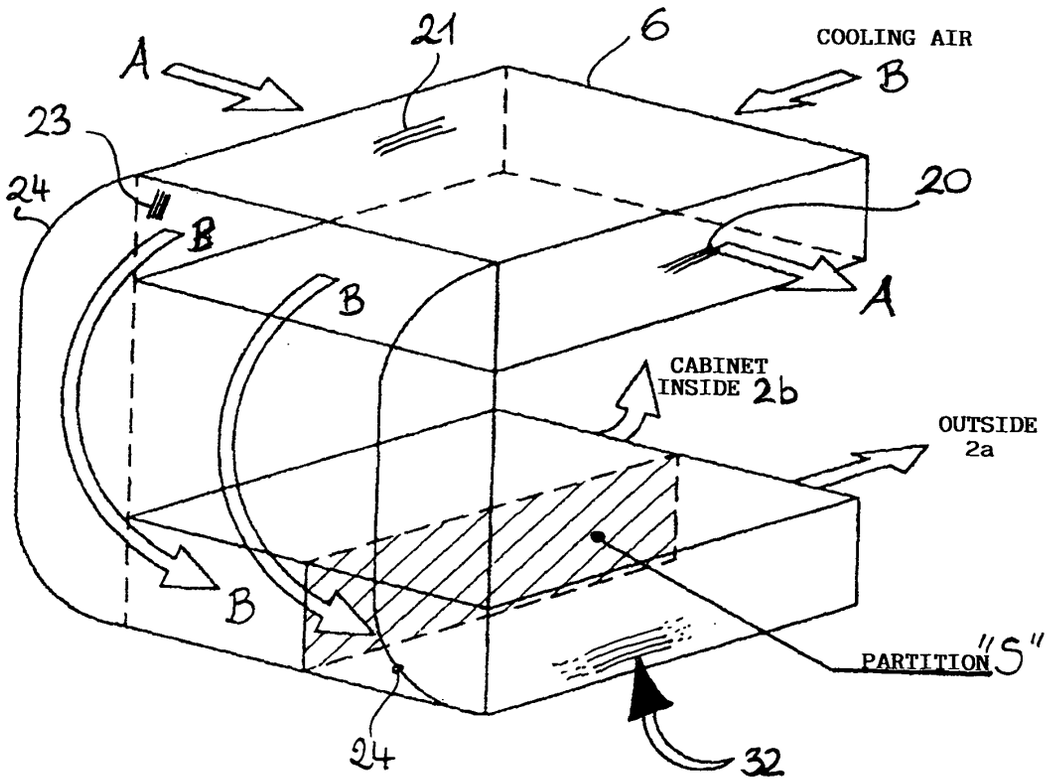
A
21
6
COOLING AIR
B
23
24
20
B
B
A
CABINET INSIDE 2b
OUTSIDE 2a
B
PARTITION "S"
24
32

Fig. 5

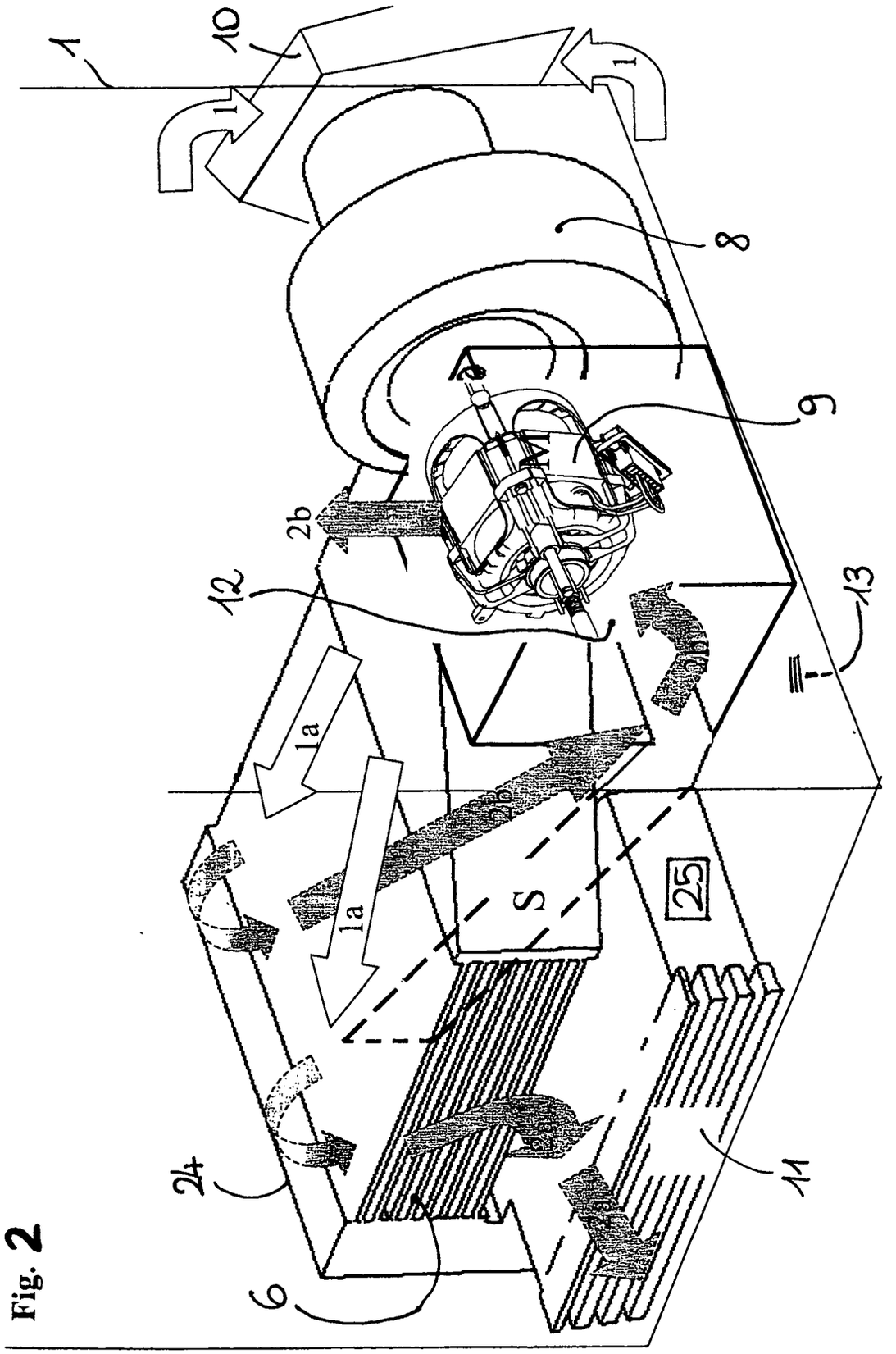

Fig. 2

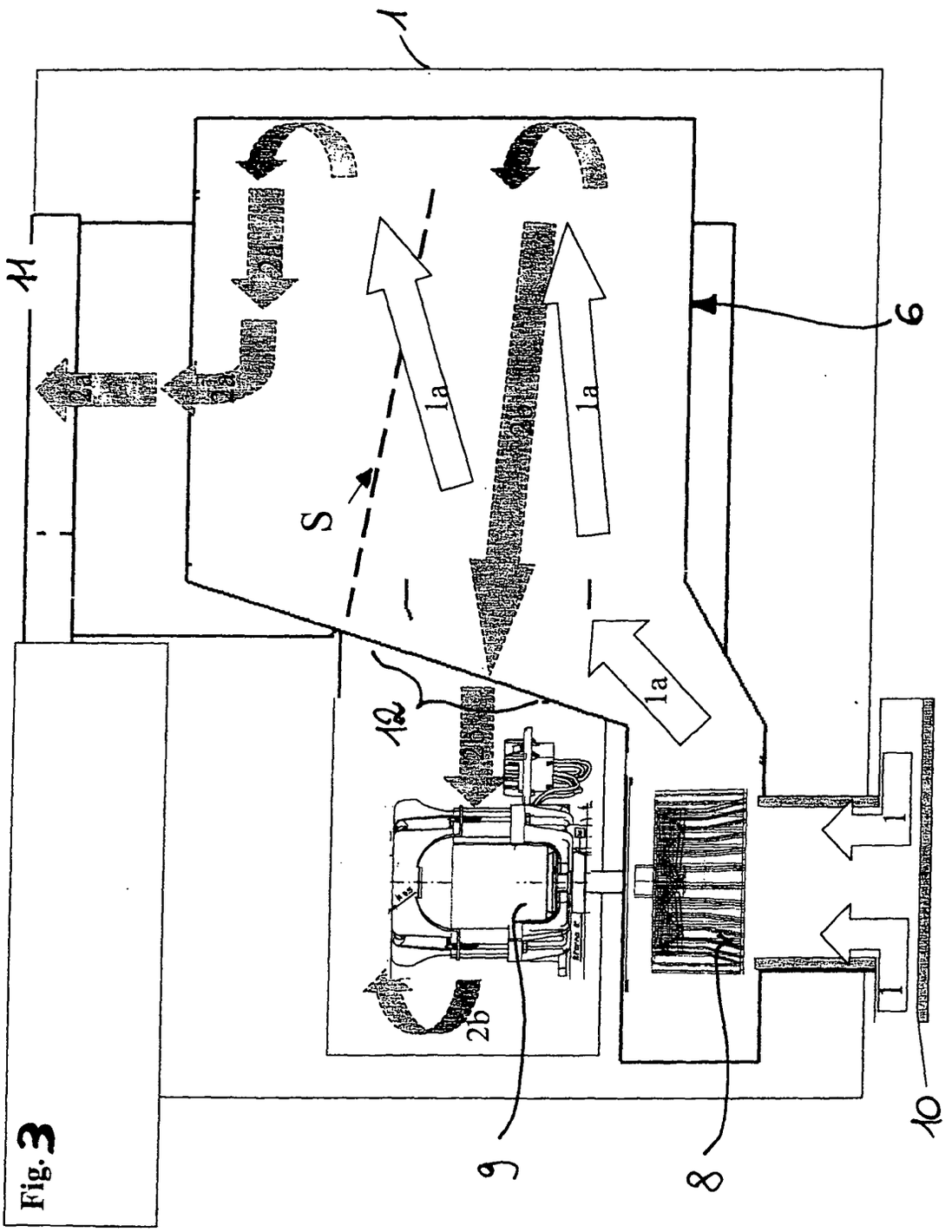

Fig. 3

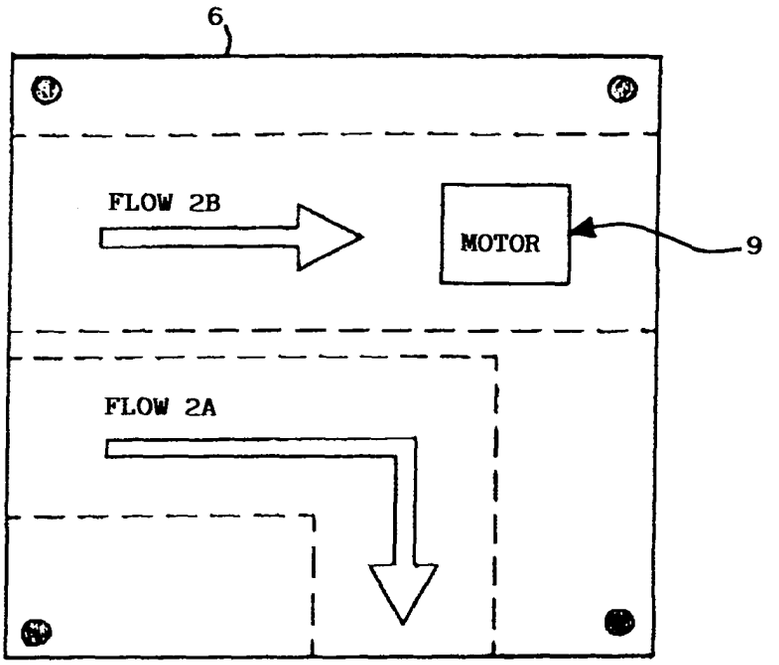

FIG. 6

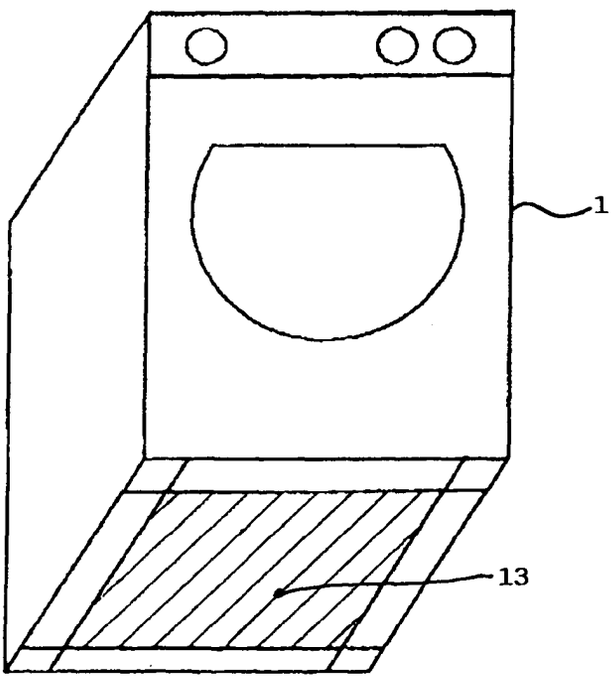

FIG. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 03 02 1383

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	19 February 2004	Ureta, R

CATEGORY OF CITED DOCUMENTS

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