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(54) **METHOD AND DEVICE FOR COOLING THE DRIVING MOTOR TO A FAN IN A DRYING CHAMBER
WORKING WITH CIRCULATING DRYING AIR**

Verfahren und Vorrichtung zur Kühlung des Antriebsmotors eines Lüfters in einem Trocknungsraum
mit Trocknungsluftumwälzung

PROCEDE ET DISPOSITIF PERMETTANT DE REFROIDIR LE MOTEUR D'ENTRAINEMENT D'UN
VENTILATEUR DANS UNE ENCEINTE DE SECHAGE A CIRCULATION D'AIR SECHANT

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Description

[0001] The present invention relates to a method for cooling the driving motor of a fan in a drying chamber working with circulating drying air according to the preamble of claim 1 as well as to a device for carrying out the method. Such a method is known from US-A-5 444 215.

[0002] Facilities that work with circulating heated air are used in a range of different applications, and one such application that will be described in greater detail below relates to a facility for drying cut timber. When drying timber, spaces that are essentially sealed off from the outside, so-called drying chambers, are used in which stacks of timber elements are placed. Warm air and/or steam from the heating unit is introduced to the timber by adjustable fans, whereby the temperature is raised from that of the surrounding atmosphere to between 50 and 140 °C. The fans force the heated air to flow through the stacked timber and take up, absorb, moisture from the timber. Facilities intended for the heat treatment of timber and that operate at temperatures up to about 250°C are also known. It is easy to understand that great demands are placed on the equipment in such facilities.

[0003] The motor devices that are considered for driving the fans are commonly of an electrical type with adjustable speeds of rotation, whereby the fans are of the axially or radially working types. In order not to over-heat or be adversely affected in other ways by the high temperatures and the moist atmosphere that prevails inside the chamber, the motors that are used for driving the fans must normally be placed outside of the actual drying chamber, at least in those instances when the drying temperature exceeds 100 °C. To reduce the drying time, one tries, in the majority of cases, to increase the drying temperatures as much as possible and, as named above, drying temperatures up to 140 °C are not uncommon.

[0004] To try and maintain a suitable operating temperature for the motors, they are usually located in a temperature-controlled area that is separate from the drying chamber. The transfer of power from the motors to the fans takes place via transmissions in the form of, for example, axles, gears and couplings connected to one another. The arrangement of this special area for the motors and the relatively complicated transmissions for transferring the power that are needed between the motors and the fans naturally act to increase the cost of this type of drying facility.

[0005] In other words, there has long been a wish to have a simple way of cooling a driving motor for a fan mounted inside a drying chamber, and the aim of this invention is to achieve a method that realises this desire. Another aim of this invention is to achieve a device for carrying out the actual method.

[0006] These aims are realised by the method and device according to this invention having the features and

characteristics stated in the claims and, more specifically, that the method according to the invention is characterised in principle in that the motor is arranged in an enclosed connection with a source that yields a flow of cooling air in the form of forced air and that the mass of air leaving the source is brought to be forced to pass through the motor.

[0007] This not only achieves the cooling that is required for being able to use a motor mounted within a drying chamber at the relatively high temperatures that one wants to maintain during the drying process, but also has the advantage that the heat from the motor that is taken up by the cooling air can advantageously, from an energy saving point of view, be supplied to the drying process. Studies and calculations have shown that this can make a positive contribution that raises the total efficiency of a drying facility, especially during the so-called warming-up phase of the drying process.

[0008] The invention is described in greater detail below with reference to the enclosed drawings, where **Fig. 1** clarifies, in a very schematic manner, the principle that forms the basis for the present invention, **Fig. 2** shows a view of a device according to the invention with the parts separated, **Fig. 3** shows a view equivalent to **Fig. 2** with certain details removed, **Fig. 4** shows the box-like inner enclosure according to **Fig. 2** in a longitudinal section viewed from above, and **Fig. 5** shows an alternative embodiment of the device according to the invention in a longitudinal section viewed from above.

[0009] **Fig. 1** shows, very schematically in the form of a partial section viewed from above, parts included in a conventional facility for drying timber and, as is evident in this case, such a facility primarily includes a drying chamber 2 arranged in building 1. In the said drying chamber 2, there is a wall 3 extending between the floor of the drying chamber and its ceiling that demarcates a corridor from that part of the chamber where the timber that is to be dried, here designated 4, is placed. To achieve a circulating flow of air in the drying chamber, at least one fan 6 driven by a motor 5 is arranged in the said corridor. In the embodiment of the invention described and shown here, this fan is of the axially working type. The motor 5 is suitably electric and preferably of the type that can be reversed and have an adjustable speed of rotation. Even if it is not shown on the drawing, it can be mentioned that a radiator fed with hot water is usually located in the corridor adjacent to the fan for warming the circulating air, as well as possibly one or more nozzles for dampening the dry air with water. The drying facility described above is exemplified merely to describe an application of the invention and does not itself constitute any part of the invention.

[0010] **Figs. 1 and 2** show the principles of the invention and as is evident from this, the drying facility in this respect includes a source, generally designated 7 and located outside of the drying chamber, that yields a flow of cooling air, and where this source includes a fan unit 8. A main duct 9 that is dimensioned to supply a number

of drying facilities with cooling air is connected to the outlet of a housing included in the said fan unit 8. Smaller ducts 10, so-called branch ducts, run off from the main duct 9 and have an enclosed connection with a motor 5 arranged in each drying chamber so that forced cooling air emanating from the fan unit is brought to be forced through the motor before being led out to be mixed with the circulating drying air in the drying chamber 2.

[0011] The manner in which the enclosed connection between the motor 5 and the source 7 of cooling air is achieved naturally varies depending on a number of factors, not least on the constructive design of the motor. A conventional electric motor of the type that is intended to have an effect during normal climatic conditions with regard to temperature, moisture, etc., is used in the example of the embodiment described here. Figs. 2 and 3 show that the motor 5 includes, in the known manner, a stationary stator part and a rotor part from which the motor axle 12 emerges mounted to rotate in the stator end walls 11, 11'. The motor is suitably of the commonly occurring type where the stator end walls are provided with openings and having a fan blade that is firmly attached to the motor axle at the said openings to achieve a cooling flow of air passing through the motor.

[0012] As is best evident from Figs. 2 to 4, the motor is accommodated in a box-like inner enclosure, generally designated 13, to protect the motor and in this respect also achieve an enclosed connection between the motor 5 and the forced cooling air generated by the fans 8. This box-like inner enclosure 13 is mounted in a suitable manner in the corridor of the drying chamber 2 and has an inner space that outwards is primarily demarcated by a bottom 14, rear section 15, front section 16, an upper section 17 and two side walls 18, 18'. The inner space formed by this is in turn demarcated by a first 19 and a second chamber 20 via a dividing wall 21 arranged in the space, whereby the motor 5 is accommodated in the second chamber and an electrical connecting and coupling unit 22 for the motor is located in the first chamber. The first chamber 19 has an opening 23 arranged in the front section 16 to which duct 10 is connected via a sealing sleeve 24, whereby the said chamber in this way finds itself in connection with source 7.

[0013] As is evident from Figs. 2 and 3, a space 25 is formed in the upper section 17 that is connected to the first chamber 19, where this space 25 accommodates the first part of a cable set 26 belonging to the motor 5 and extending between an electrical connection point 27 on the motor 5 and the coupling unit 22. Emerging from the coupling unit 22 and accommodated in the branch duct, a second part 28 of the said cable set runs to a drive and control unit 29, located outside of the drying chamber, for the motor 5. To prevent the first part of cable set 26 being subjected to high temperatures, it can suitably be arranged so that a certain exchange of air can take place between the space 25 and the second chamber 20. This is suitably achieved though communication being established between space 25 and the

second chamber so that a limited partial flow of cooling air can be led past the first part 26 of the cable set.

[0014] An opening 30 is arranged in the dividing wall 21 and connected to one end of a hood device 31 whose comparatively larger opening at the other end is connected in a manner that ensures a tight seal to stator end wall 11' of motor 5. In this way, the coolant air that is led into the first chamber 19 is brought to be forced to pass through the motor 5 before it is allowed to enter into the second chamber 20 and then finally led out into the drying chamber via the channels 32, 32' that extend along the inside of the upper section 17 and their outlets.

[0015] In Fig. 3, arrows 33 and 34 designate cooling air that has passed through the motor, and arrow 35 air that emerges from the opening of a separate channel (not shown in the figures) that is in direct connection with the first chamber 19 of the box-shaped inner enclosure 13 and that, when required, has the task of achieving a specially effective cooling of the motor axle 12. As is shown in Figs. 2 and 4, the motor axle extends outwards from the box-shaped casing 13 via an opening 34 arranged in the rear section 15, against which the motor axle is arranged in a tightly sealed manner to prevent moist warm air from forcing its way into the motor 5 in the box-shaped inner enclosure 13. In order to achieve an effective cooling of the motor axle 12, the sealing arrangement between the said motor axle and the opening 34 is designed so that a certain flow of air is allowed to pass out from the second chamber 20 of the box-shaped inner enclosure 13 in the area between the motor axle and the opening. The sealing arrangement suitably includes a labyrinth seal 36 arranged at opening 34, whereby the outflow of air from the sealing can be easily adjusted by varying the inner pressure of the box-shaped inner enclosure, the so-called back-pressure. In the embodiment of the invention described here, the inner pressure is adjusted by means of restriction means in the form of end caps 37, 37' arranged in the outlet ends of channels 32, 32' that can be adjusted to regulate the degree of opening of the said outlet ends.

[0016] Fig. 5 shows the device in an alternative embodiment, whereby a means, generally designated 101, has been added so that one can choose to allow the cooling air emerging from motor 5 to either be directed onwards and out into the drying chamber 2 for mixing with the drying air, or be directed out from the drying chamber so that the said cooling air does not come into contact with the circulating drying air. The said alternative flow paths for the cooling air from the motor 5 are illustrated with the reference numbers 102 and 103 respectively in Fig. 1. In this way, the advantage is obtained that the warm contents emerging from the motor 5 can on one hand be exchanged and recovered for the circulating air in the drying chamber during those phases of the drying process where there is a large demand for warming up, for example, during the so-called warming-up phase, and on the other hand, can be switched out from the chamber so that the said cooling air does

not come into contact with the circulating drying air in the drying chamber. The requirement to lead cooling air out from drying chamber 2 can, for example, arise during those parts of the drying process where the facility is working with very high temperatures.

[0017] In this described embodiment, the means 101 of directing the air flow that is arranged after the motor 5 when viewed in the direction of movement of the cooling air includes air flow switches 104 in the form of draught valves or similar for directing the air flow between a number of ducts connected to the box-shaped casing 13 of which one pair of ducts 102 open into the drying chamber and another pair of ducts 103 have an enclosed connection with the surrounding atmosphere of the building 1 of the drying chamber 2 via a collecting duct that extends through wall 105 that is included in building 1.

[0018] The function of the device described above is described as follows:

[0019] Fan unit 8 generates forced cooling air that is led into the first chamber 19 of the box-shaped inner enclosure 13 via the main duct 9 and the branch ducts 10. To lead off the heat generated by the motor 5, the main part of the cooling air is led onwards through the opening 30 in the dividing wall 21, the hood device 31, and the active stator and rotor parts 5 of the motor to then, via the second chamber 20 of the box-shaped inner enclosure 13 and the channels 32, 32' that are arranged on the underside of the upper section 17, exit directly into the drying chamber 2 or alternatively out from the drying chamber.

[0020] The total requirement for cooling air can be dimensioned for a specific number of users or a number of specific drying facilities with the aid of simple calculation methods. However, the requirement for cooling air can momentarily vary depending on the specific running programs or running cycles of the different facilities.

[0021] The present invention is not restricted to that described above or shown in the drawings but can be changed and modified in a number different ways within the scope of the concept of the invention stated in the following claims.

Claims

1. Method for cooling the driving motor of a fan in a drying chamber wherein the drying chamber is essentially sealed off from the outside that works with circulating, heated drying air in the chamber said method comprising
 - arranging the driving motor (5) with an enclosed connection to a source (7) for yielding a flow of cooling air in the form of forced air and
 - bringing the mass of air emanating from the source to be forced to pass through the motor**characterised in that**
 - the driving motor is mounted inside the said

chamber (2).

2. Method according to claim 1 **characterised in that** the cooling air emerging from the motor (5) is arranged so that it can be selected to be directed onwards into the drying chamber (2) or alternatively out from the drying chamber.
3. Method according to claim 1 or 2 **characterised in that** the forced air is led in and out through the motor (5) via the stator end walls (11, 11') of the motor.
4. Method according to any of the previous claims **characterised in that** a part of the cooling air mass flowing towards the motor (5) is deflected in a separate flow path for cooling the motor axle (12).
5. Method according to any of the previous claims **characterised in that** a fan unit (8) arranged outside of the drying chamber (2) is used as the source (7) to obtain a flow of cooling air.
6. Device for cooling the driving motor of a fan according to the method of claim 1, said device comprising
 - the driving motor (5) that is arranged with an enclosed connection to a source (7) for yielding a flow of cooling air in the form of forced air and
 - means for arranging the mass of air yielded by the source to be forced to pass through the motor**characterised in that**
 - the driving motor is mounted inside the said chamber (2).
7. Device according to claim 6 **characterised in that** it includes, when viewed in the direction of flow of the cooling air, a means (101) located after the motor (5) for selecting the switching of the cooling air emerging from the motor onwards into the drying chamber (2) or alternatively out from the drying chamber.
8. Device according to claim 6 or 7 **characterised in that** the enclosed connection of the source (7) with the motor (5) is established by means of a hood device (31) located between the motor and the source whose one end is connected to the source (7) for yielding a flow of cooling air and whose other end is connected by a tight seal to the stator end wall (11') of the motor.
9. Device according to claim 8 **characterised in that** it includes a box-like casing (13) enclosing both the hood device (31) and motor (5) and that has an opening (34) through which the motor axle (12) extends out from the casing, whereby the inner space defined by the casing is demarcated in a first and a second chamber (19, 20) with the motor and the hood device arranged at the interface between the

said chambers and in which the cooling air supplied to the first chamber (19) is led out from the second chamber (20) to pass through the motor.

10. Device according to claim 9 **characterised in that** a cable set (26, 28) intended to be connected electrically to the motor (5) is accommodated in the duct (10) that, for transporting the forced cooling air, is arranged to extend between the box-like inner enclosure (13) and the source (7).

Patentansprüche

1. Verfahren zur Kühlung des Antriebsmotors eines Ventilators in einer Trocknungskammer, wobei die Trocknungskammer im wesentlichen gegen aussen abgeschlossen ist und mit zirkulierender, erhitzter Trocknungsluft in der Kammer arbeitet, wobei das Verfahren
 die Ausrüstung des Antriebsmotors (5) mit einer geschlossenen Verbindung zu einer Quelle (7) zur Abgabe eines Kühlluftstroms in Form von zwangsumgewälzter Luft und
 die zwangsweise Durchleitung der aus der Quelle austretenden Luftmasse durch den Motor beinhaltet,
dadurch gekennzeichnet, dass
 der Antriebsmotor innerhalb der genannten Kammer (2) montiert ist.
2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** die aus dem Motor (5) austretende Kühlluft wahlweise in die Trocknungskammer (2) weitergeleitet oder aber aus der Trocknungskammer hinausgeleitet wird.
3. Verfahren nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die zwangsumgewälzte Luft durch die Statorstimwände (11, 11') des Motors ein- und ausgeleitet wird.
4. Verfahren nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** ein Teil der zum Motor (5) strömenden Kühlluftmasse in einen separaten Flussweg umgeleitet wird, um die Motorachse (12) zu kühlen.
5. Verfahren nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** eine ausserhalb der Trocknungskammer angeordnete Ventilatortereinheit (8) als Quelle zur Erzeugung eines Kühlluftstroms dient.
6. Vorrichtung zur Kühlung des Antriebsmotors eines Ventilators gemäss dem Verfahren nach Anspruch 1, wobei die Vorrichtung
 den mit einer geschlossenen Verbindung zu

einer Quelle (7) zur Abgabe eines Kühlluftstroms in Form von zwangsumgewälzter Luft ausgerüsteten Antriebsmotor (5) sowie

Mittel zur zwangsweisen Durchleitung der von der Quelle abgegebenen Luftmasse durch den Motor aufweist,

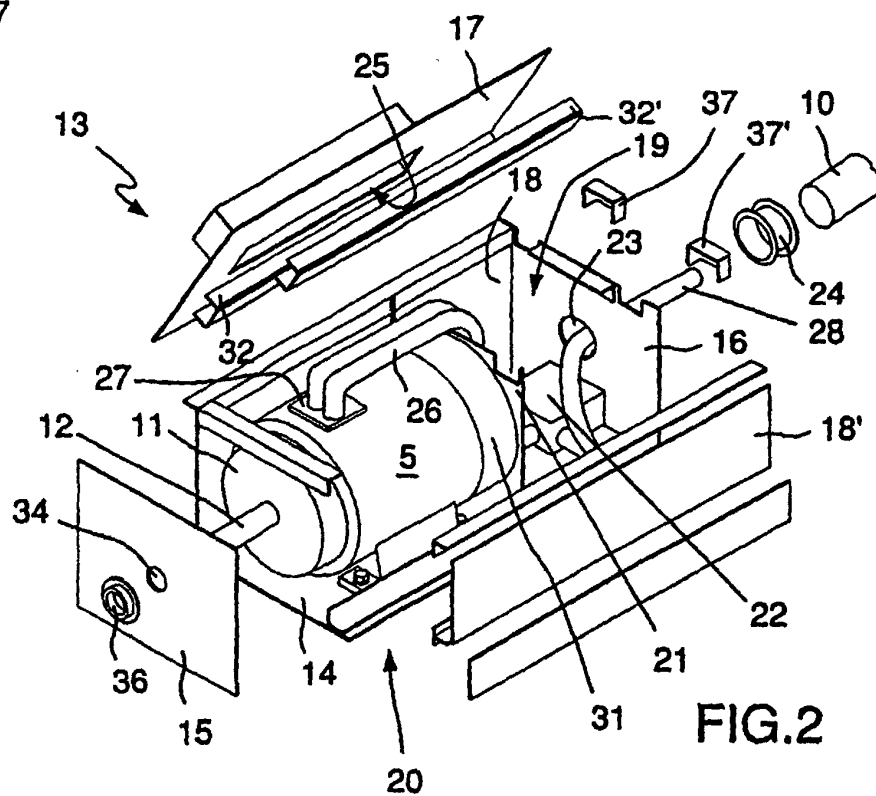
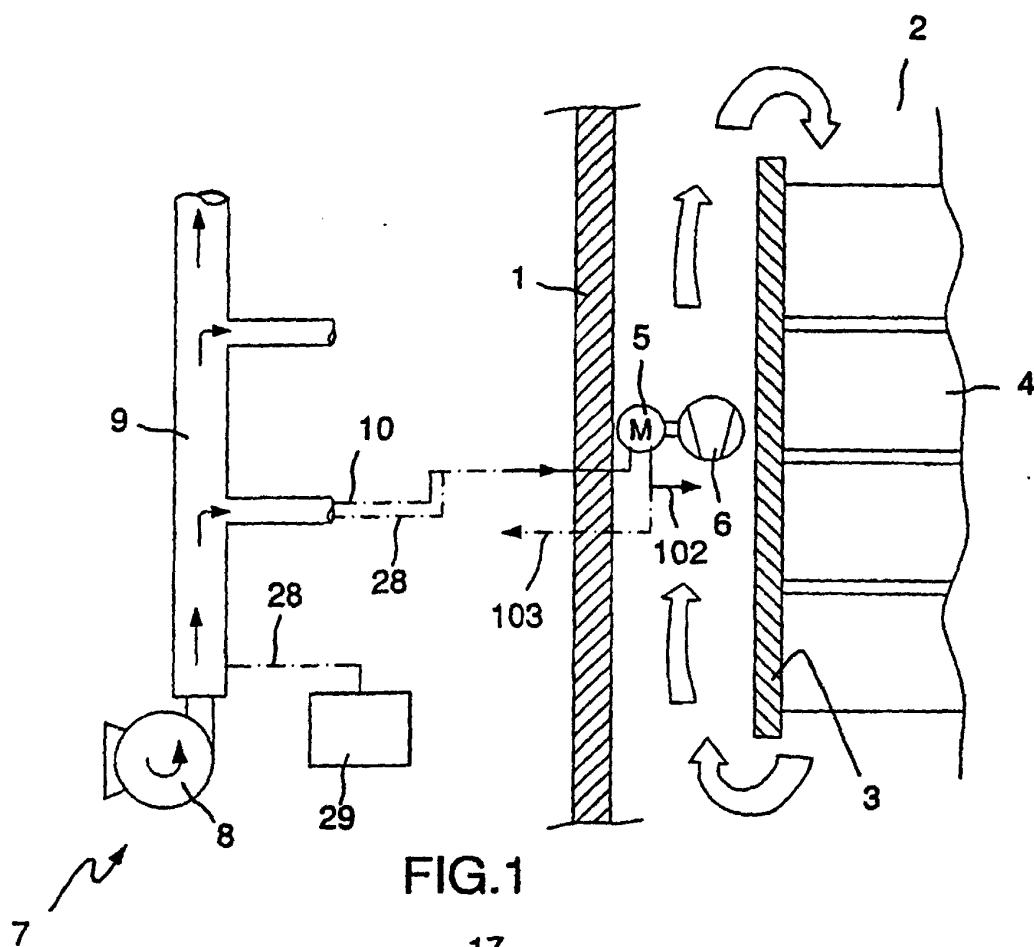
dadurch gekennzeichnet, dass
 der Antriebsmotor innerhalb der genannten Kammer (2) montiert ist.

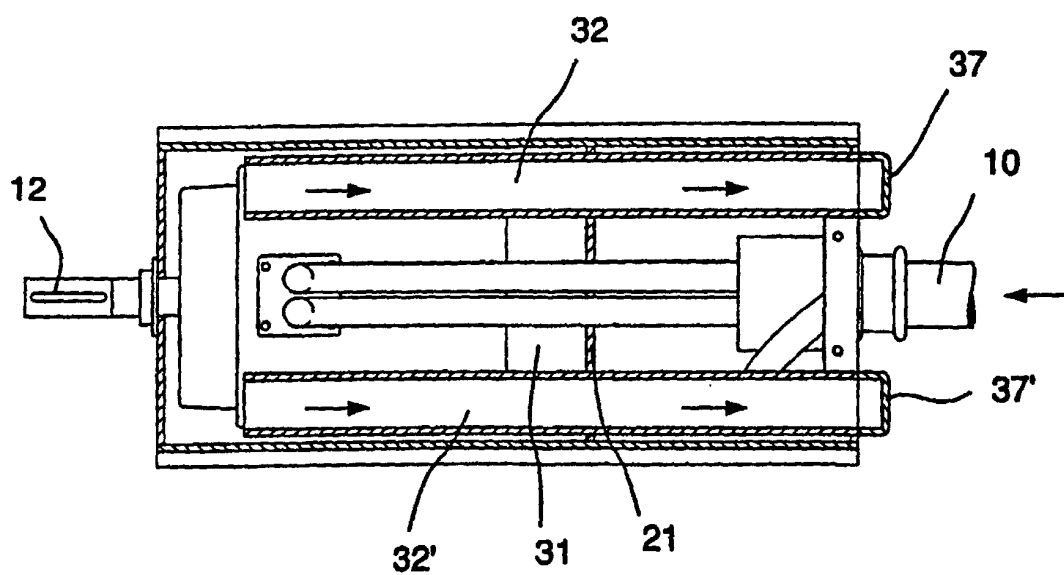
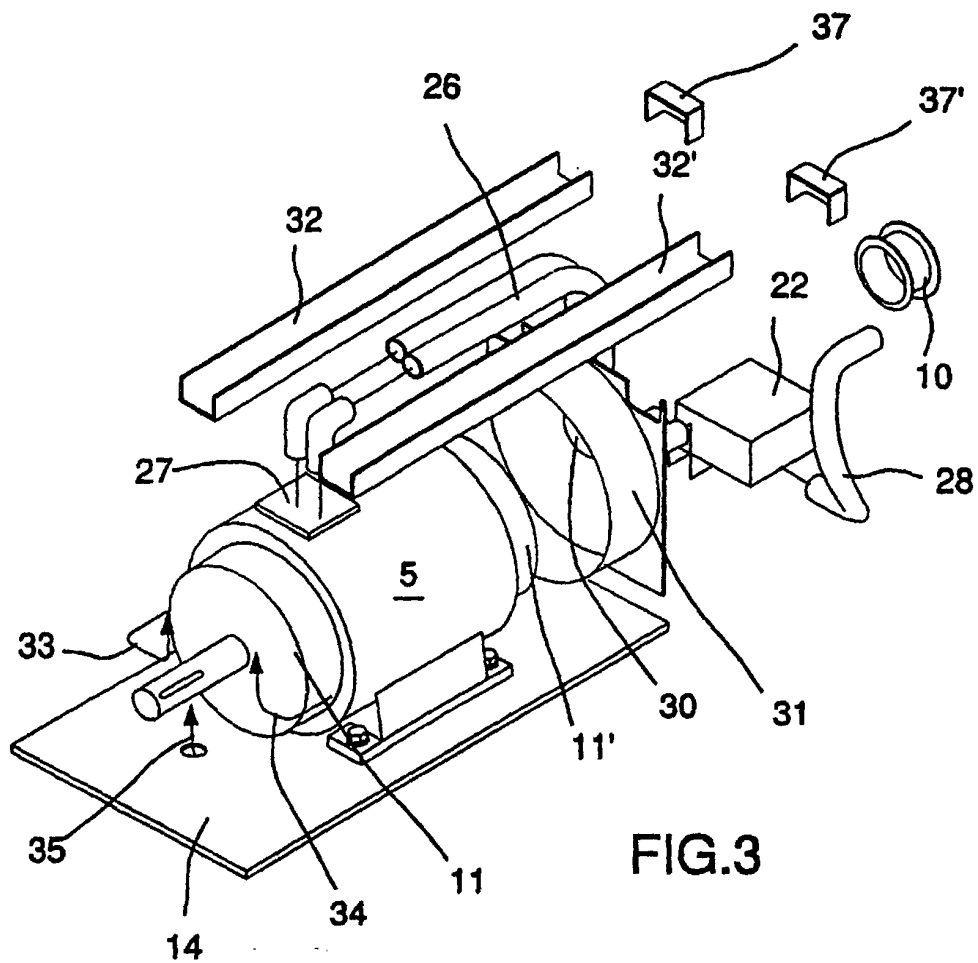
7. Vorrichtung nach Anspruch 6, **dadurch gekennzeichnet, dass** sie ein in Richtung des Kühlluftstroms gesehen nach dem Motor (5) angeordnetes Mittel (101) zum wahlweisen Umschalten zwischen der Weiterleitung der aus dem Motor austretenden Kühlluft in die Trocknungskammer (2) oder zum Ausleiten derselben aus der Trocknungskammer aufweist.
8. Vorrichtung nach Anspruch 6 oder 7, **dadurch gekennzeichnet, dass** die geschlossene Verbindung der Quelle (7) mit dem Motor (5) durch eine zwischen dem Motor und der Quelle angeordnete Haubenvorrichtung (31) hergestellt wird, deren eines Ende mit der Quelle (7) zur Abgabe eines Kühlluftstroms und deren anderes Ende über eine undurchlässige Dichtung mit der Statorstimwand (11') des Motors verbunden ist.
9. Vorrichtung nach Anspruch 8, **dadurch gekennzeichnet, dass** sie ein kastenförmiges Gehäuse (13) aufweist, welches sowohl die Haubenvorrichtung (31) als auch den Motor (5) umgibt und eine Öffnung (34) besitzt, durch welche die Motorachse (12) aus dem Gehäuse austritt, wobei der vom Gehäuse gebildete Innenraum in eine erste und eine zweite Kammer (19, 20) aufgeteilt ist und der Motor und die Haubenvorrichtung an der Schnittstelle zwischen den genannten Kammern angeordnet sind, und wobei die der ersten Kammer (19) zugeführte Kühlluft aus der zweiten Kammer (20) abgeführt wird, um sie durch den Motor zu leiten.
10. Vorrichtung nach Anspruch 9, **dadurch gekennzeichnet, dass** ein Kabelsatz zum elektrischen Anschluss an den Motor (5) in der Leitung (10) untergebracht ist, welche zum Transport der zwangsumgewälzten Kühlluft zwischen dem kastenförmigen inneren Gehäuse (13) und der Quelle (7) angeordnet ist.

Revendications

1. Procédé de refroidissement du moteur d'entraînement d'un ventilateur dans une enceinte de séchage, l'enceinte de séchage étant essentiellement étanche par rapport à l'extérieur et employant de

- l'air séchant chauffé qui circule dans la chambre,
ledit procédé comprenant
l'aménagement du moteur d'entraînement (5)
avec une connexion fermée à une source (7) fournissant un courant d'air refroidissant sous forme d'air forcé, et 5
le passage forcé de la masse d'air émanant de ladite source par le moteur,
caractérisé en ce que
le moteur d'entraînement est monté à l'intérieur de ladite chambre (2). 10
2. Procédé selon la revendication 1, **caractérisé en ce que** l'air refroidissant émergeant du moteur (5) est adapté à être sélectivement conduit dans l'enceinte de séchage (2) ou hors de l'enceinte de séchage. 15
3. Procédé selon la revendication 1 ou 2, **caractérisé en ce que** l'air forcé est alimenté au moteur (5) et quitte celui-ci par les parois frontales statoriques (11, 11') du moteur. 20
4. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'une** partie de la masse d'air refroidissant s'écoulant vers le moteur (5) est déviée dans un chemin de flux séparé pour refroidir l'arbre (12) du moteur. 25
5. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'une** unité à ventilateur (8) agencée à l'extérieur de l'enceinte de séchage (2) est utilisée comme source (7) fournissant un courant d'air refroidissant. 30
6. Dispositif de refroidissement du moteur d'entraînement d'un ventilateur selon le procédé de la revendication 1, ledit dispositif comprenant
le moteur d'entraînement (5), aménagé avec une connexion fermée à une source (7) fournissant un courant d'air refroidissant sous forme d'air forcé, et 40
et
des moyens permettant le passage forcé de la masse d'air émanant de ladite source par le moteur,
caractérisé en ce que 45
le moteur d'entraînement est monté à l'intérieur de ladite chambre (2).
7. Dispositif selon la revendication 6, **caractérisé en ce qu'il** comporte, vu dans la direction du courant d'air refroidissant, un moyen (101) situé après le moteur (5) pour conduire l'air refroidissant émergeant du moteur à choix dans l'enceinte de séchage (2) ou hors de l'enceinte de séchage. 50
8. Dispositif selon la revendication 6 ou 7, **caractérisé en ce que** la connexion fermée entre la source (7) et le moteur (5) est établie au moyen d'un capot (31) 55
- situé entre le moteur et la source, dont l'une des extrémités est reliée à la source (7) fournissant un courant d'air refroidissant et dont l'autre extrémité est reliée par un joint étanche à la paroi frontale statorique (11') du moteur.
9. Dispositif selon la revendication 8, **caractérisé en ce qu'il** comporte un boîtier (13) en caisson entourant à la fois le capot (31) et le moteur (5) et pourvu d'une ouverture (34) par laquelle l'arbre (12) du moteur sort du boîtier, l'espace intérieur défini par le boîtier étant divisé en une première et une deuxième chambre (19, 20) alors que le moteur et le capot sont disposés à l'interface entre lesdites chambres, et que l'air refroidissant alimenté à la première chambre (19) est conduit hors de la deuxième chambre (20) pour passer par le moteur.
10. Dispositif selon la revendication 9, **caractérisé en ce qu'un** faisceau de câbles (26, 28) destiné à être électriquement connecté au moteur (5) est logé dans le conduit (10) arrangé, afin de transporter l'air refroidissant forcé, entre le boîtier intérieur (13) en caisson et la source (7).





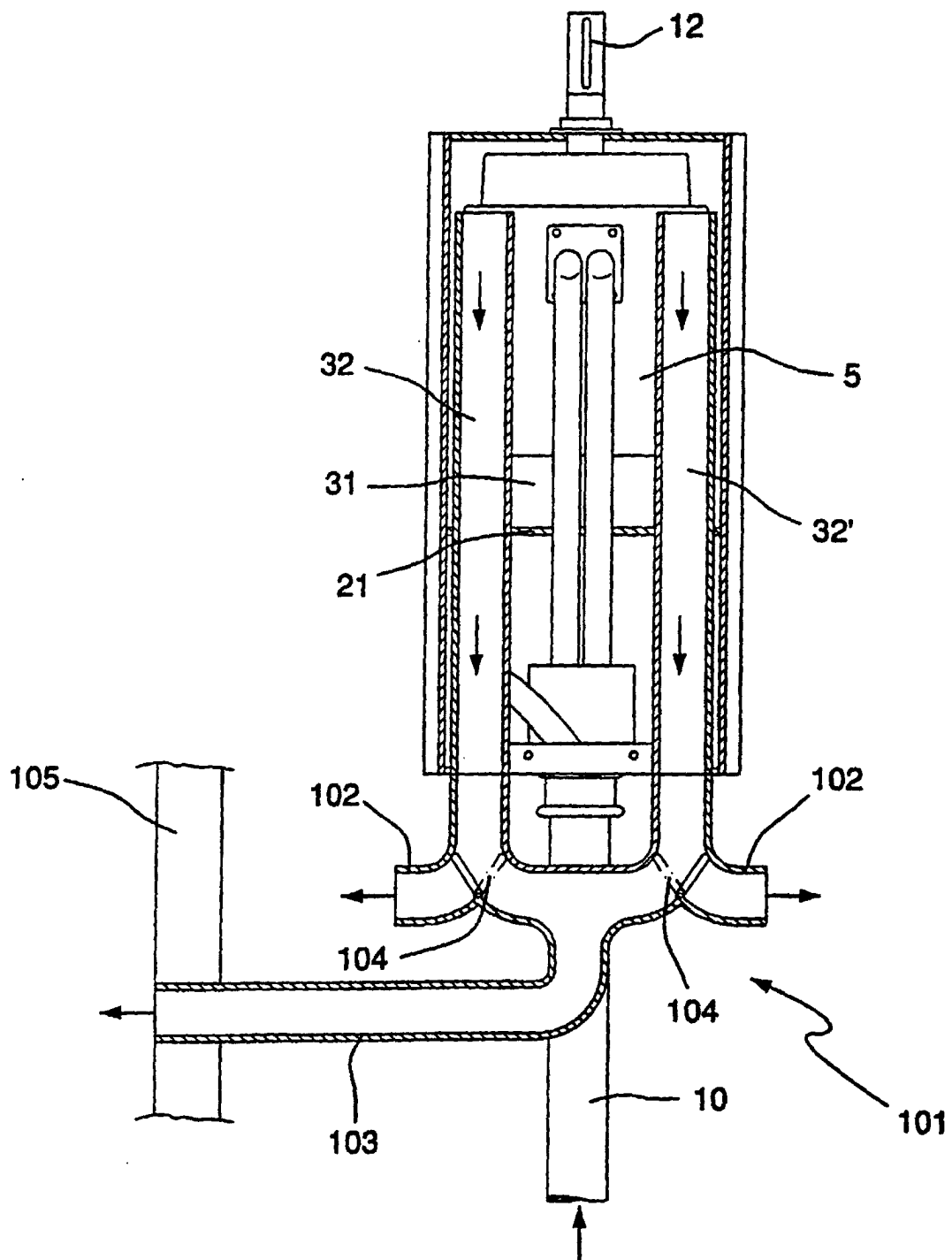


FIG.5