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(54) **Household clothes drying machine with vibrating lint filter**

Haushaltswäschetrockner mit vibrierendem Flusenfilter

Séchoir à linge domestique doté d'un filtre à charpie vibrant

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## Description

**[0001]** The present invention refers to an improved kind of clothes drying machine, preferably of the type for use in households, which is particularly comfortable and easy to use.

**[0002]** Even if in the following of this description it is be referred to a front-loader drying machine, it will be understood that the invention may be applied to any combined washing-and drying machine, as well as to an only drying machine, both top- and front-loader, and both with vertical or horizontal axis.

**[0003]** It is a largely known fact that, when it leaves the drying drum, the flow of air is caused to pass through one or several filters, which are provided there to retain lint and other small foreign matters and particles that are usually carried away by and borne in the same flow of air passing through the clothes in the drum. In fact, if this lint is allowed to freely circulate along with the flow of air, it would give rise to a number of damages and problems that are well known as such in the art, so that there is no point in having them described here.

**[0004]** However, these lint filters are subject to clogging, and in fact they tend to clog up rather quickly, so that they make it necessary for the user to quite frequently perform a disassembly, cleaning and maintenance chore that, albeit not particularly difficult or laborious, is generally found as something that users do not like very much to carry out, so that they often tend to avoid doing it. Owing to such generally low care and concern by the users, lint filters are quite often left unattended, i.e. without any proper maintenance, so that they soon end up by getting clogged with the unavoidable result that the flow of air therethrough is sensibly slowed down, thereby deteriorating the drying performance of the machine accordingly. In addition, under such conditions the air inside the drum tends to undergo a significant increase in its temperature and this, as anyone skilled in the art is able to readily appreciate, gives rise to both safety problems of a general nature for the machine and a worsening in the handling conditions of the drying load.

**[0005]** In order to overcome such a problem, various solutions have been proposed; for sake of brevity only the European patent application n. 05101960.2-1265, filed on March 14 2005 by the same applicant, is cited, together with the documents therein cited.

**[0006]** All described solutions are based on the fact that the lint filter is to be periodically cleaned in a mechanical way, and alternatively at time intervals which are controlled by the machine operation programme.

**[0007]** However the mechanical cleaning of the lint filter, although effective, is hindered by a number of specific drawbacks, which mainly are:

- complexity of the mechanical cleaning devices,
- related general burdens,
- operation criticality, as they are either delicate and are frequently worn, or tend to harm the same filtering

septum, which, as well known, being very thin, is logically very delicate too.

**[0008]** In this connection, it should be noticed that, for filtering and retaining lint, the use is generally preferred of two or more separate filters, rather than a single one, since, for a same filtering effectiveness, multiple filters tend to clog less and, furthermore, give rise to a smaller overall pressure loss, as anyone skilled in the art is well aware of.

**[0009]** However, the provision of two or more filters is the cause of additional costs, construction complications and, on top of that, greater maintenance and cleaning requirements.

**[0010]** It would therefore be desirable, and it is actually a main object of the present invention, to provide a clothes drying machine, either of the condenser-type or the exhaust-type, which is provided with a single filter for the flow of drying air, to be located at the outlet mouth of the drying-air re-circulation conduit, or exhaust conduit as the case may be, wherein this filter itself, and associated devices as it will better explained later on, is capable of automatically and permanently performing a cleaning action of said single filter, without any need for the user him/herself to carry out any cleaning or maintenance.

**[0011]** As a result, owing to its being cleanable by the effect of such automatic action, i.e. being kept constantly clean in such automatic manner, this filter becomes much more effective, thereby doing away with the need for a further filters and complicated and burdensome devices to be provided downstream to aid in retaining lint, and thus eliminating the inconveniences and disadvantages generally connected with the provision of such further filter arrangement.

**[0012]** DE 3438575 A1 discloses a drying machine wherein to control the vibration mechanism of a filter bag and the swing mechanism of a door closing the conduit from the drum to the bag it is provided an electric control means. Said control means is designed so that the vibration mechanism is activated with intervals, i.e. through rapid, alternate impulses of the pneumatic cylinder, whereby the intervals are adjustable by clocks, load counting devices and program keyboards of the control means. The control of the vibration mechanism and that of the swing mechanism is coupled so that the actuation of the vibration mechanism is carried out only when the communication between the drum and the filter bag is interrupted by the door operated by the swing mechanism.

**[0013]** DE 29620412 U1 discloses a drying machine comprising control means to control a vibration motor to vibrate a filter at 150 HZ.

**[0014]** US 7,040,039 B 1 discloses a clothes dryer with lint detector position within the clothes dryer. A light source is also positioned within the clothes dryer. The lint detector has a surface that receives light emitted by the light source. Further, the lint detector has a photocell that receives light reflected for the surface if lint covers

the surface.

**[0015]** According to the present invention, these aims, along with further ones that will become apparent further on in the following description, are reached in a clothes drying machine incorporating the features and characteristics as recited in the appended claims. Anyway. Features and advantages of the present invention will be more readily and clearly understood from the description that is given below by mere way of nonlimiting example with reference to the accompanying drawings, in which:

- Figure 1 is a simplified schematic view of the conduits of the drying air flow and of the condensing air flow according to the prior art, wherein the generally assigned position of the lint filter is evidenced,
- Figures 2 and 3 show two views of two kinds of lint filter positioning when removed from its usual lodging, respectively placed inside the machine front wall and placed in correspondence to the inner door side, and in any case just at the drum outlet,
- Figure 4 is an "exploded" view of the assembly containing the filter, the filtering septum and the lower collecting portion according to an improved embodiment of the invention,
- Figure 5 is an enlarged perspective view of a basic embodiment of the invention.

**[0016]** A drying machine according to the prior art comprises a rotating drum 1 to hold the clothes to be dried, to which there is associated an exhaust conduit 2 for the outflow of the drying air.

**[0017]** In condenser-type clothes drying machines, this conduit continues by connecting to a so-called recirculation conduit 3, which is provided in order to collect the flow of drying air exiting the drum and convey it through an appropriate condenser arrangement and, from this condenser, on again into the drum.

**[0018]** The ways according to which the drying air is heated, blown and how it is expelled and eventually recirculated are well known in the art, and are not relevant for the instant patent application, and therefore their explanation will be omitted.

**[0019]** From the clothes holding drum, the flow of drying air thus contains a certain amount of small material which is left by the drying items and which is conventionally called: lint. As already explained such lint are intercepted by filtering means provided with proper filtering septa 5 made of thin and very close-mesh net.

**[0020]** It is apparent that after a certain time period from the beginning of the drying cycle said filtering septum is being clogged, causing the above described and well known drawbacks.

**[0021]** It comes so mandatory to clean said filtering septa from the relevant lint; to this purpose various means and operations are used; which however are all based on a mechanical treatment of the filter and of the same lint.

**[0022]** Contrarily to such technical habits, the instant

invention use the effect of a vibration to free the filtering septum, i. e. imposes to the same septum a vibration whose characteristics will be explained in the following.

**[0023]** In the facts it has been verified that during a number of tests and experimental analysis that, if the frame of a filtrating septum, used in the drying conduit of a drying machine, is subjected to a vibration for a definite time length, the same lint, stuck to the septum, are being spontaneously "lost", separating from the septum itself, and so leaving the septum again clean and perfectly working.

**[0024]** It is so apparent the remarkable advantage offered by the possibility of cleaning in a fully automatic way and in the most adequate times, and without any user operation, the filtering septum of a common household drying machine.

**[0025]** By exhaustive tests the vibration features have been identified, to which the filtering septum must be subjected, which assure the best cleaning performances, and also the preferred machine operation modes with regard to which said vibration has to be imposed to said filtering septum.

**[0026]** Obviously the vibration has not to be induced directly on the filtering septum, but advantageously it has to be imposed to the frame 4 supporting said septum.

**[0027]** To sum up, it has been found that:

- said filtering septum must be connected to a vibration generating means through the connection between said vibration generating means and the frame 4 of the septum,
- moreover said connection between said generating means and said frame must be of such mechanical configuration so that the vibrations are conveyed in a direction which is parallel to the main plane of the same septum,
- said vibrations offer the best effect when they are comprised between 10 and 1000 Hz,
- alternatively, a positive result is achieved when the vibrations are acceleration-driven, with an acceleration higher than 2 g (1 g= gravity acceleration),
- in order to further improve the effect of lints removing, the vibration induced to said filtering septum must be composed by a sweep with frequency varying from the minimum frequency value, to the maximum frequency value, in order to assure that, if the vibration at a specific frequency is not able of removing some lints, than said lints are however subjected to all frequencies comprised in said sweep, so increasing the possibility that a vibration at some other and different frequency, comprised in said sweep, is able of "doing the work".

**[0028]** Moreover, with regard to the drying machine in which the septum is mounted, it is an obvious thing to suppose that the vibratory action on the filtering septum is carried out in the time intervals only when the drying air flow going out of the drum is stopped; as a matter of

facts, should the drying air flow be continued even during the septum vibration, the lints which are removed would be dragged into the filter septum again, so vanishing the vibrations effect.

**[0029]** Remembering then that in many machines types, during the short time intervals when the drum rotation is inverted, the drying air flow also is stopped, it comes a proper solution to activate the phase of septum vibration during said time intervals.

**[0030]** Moreover in the case that such a possibility of interrupting said air flow could not be possible (as a matter of facts some machine are available wherein the drying air flow keeps on even during the time intervals of inversion of the drum rotation), such constraint may be overcome simply imposing to the drying cycle itself to stop at definite time intervals, and activating the vibrating function during such time intervals.

**[0031]** A further improvement refers to the optimum positioning of the filtering septum; in the facts, in order to obtain the most spontaneous lint removal, after their "loosening" from the filtering septum caused by the vibration, it was realized that the most advantageous position is when the filtering septum is vertically oriented, as in such a case the lints, which are set free, are separate by gravity from the septum itself.

**[0032]** Even if with an horizontal positioning of the septum, the lints being placed on the lower surface, it would be possible to properly vibrate the septum itself; but one should solve the problem of finally removing the lints from where they are collected, and obviously the solution should extent for the whole or almost the whole lower septum projection; therefore the available room or the collecting container should be quite wide, and this fact clashes with the need of reducing as much as possible the room taken for such an embodiment.

**[0033]** With reference to figures 2 and 3, two typical embodiments of the invention in a presently produced drying machine are shown; specifically fig. 2 shows a machine 10 wherein the portion below the lower edge of the opening, to access to the inner drum, is connected to an outlet conduit 2 for the moisture laden air flow; said portion is shaped so as to lodge a filtering septum 5, according known means.

**[0034]** Alternatively, and with reference to fig. 3, it is observed that such a machine 10 is provided with a front door 11 inside which a conduit 22 is arranged, to exhaust the moisture laden air flow from the drum.

**[0035]** Said conduit 22 is conveyed either towards a discharge mouth, not shown, or and preferably towards an air recirculation circuit, this being not shown either.

**[0036]** In correspondence to the access mouth of said conduit 2, said mouth being properly shaped as a pocket, the filter means is lodged, which is formed by a frame 4 and by a relevant filtering septum 5, vertically oriented.

**[0037]** Obviously said filter and said access mouth do show corresponding shapes so as they may match each other.

**[0038]** With reference to fig. 3 and 4, a device for gen-

erating vibrations 15 is solidly connected to said frame 4; therefore, very simply said, when said device 15 is being activated, the vibrations so generated are directly conducted to the frame itself, and from it to the filtering septum 5, causing the wanted effect of lint separation, and consequent their falling down by gravity.

**[0039]** The whole said filter is lodged in a proper filter body 16, inside which the filtering septum 16 is then positioned.

**[0040]** The lower portion of said filter body 16 is not closed, not even by a wide-mesh net, but is opened, and below said filter body a collecting element 17 is placed, which is able to collect and to contain the lints falling down from the above placed septum.

**[0041]** In such a way the lints are being not dispersed but may be concentrated into a proper container, which may be periodically removed and emptied from the lints themselves.

**[0042]** Advantageously said frame 4 may be connected not to only to one of said vibration generators 15, but to two or more 15 and 15A of such devices, wherein such devices are placed on two sides which are substantially orthogonal to each other 18, 19, belonging to the same frame 4.

**[0043]** It has been actually experimentally demonstrated that such solution proves to be remarkably more efficient for the lints removal, than when said devices are placed on opposite sides, or on the same side of the same frame 4.

**[0044]** This circumstance may be easily explained considering that in this case the vibrating action is performed on two different directions, and therefore those lints which would not be removed by one of said vibrating devices due to a peculiar kind of sticking to the septum with respect to a certain vibration direction, may more easily get free if the vibration direction is substantially changed.

**[0045]** As far as the various embodiments are concerned, it has been observed that the requested vibration may be generated by a very simple and cheap electro-mechanical transducer (bobbin and core), which are properly supplied and controlled by proper means apt of generating an electric frequency at controlled frequency, well known in the art.

## Claims

1. Clothes drying machine or washing-drying machine, comprising:

- a rotating drum (1) holding the clothes to be dried,
- a drying air conduit (2, 22), apt to convey a drying air flow towards the inside of said rotating drum and from it to the outside, to be let in the room or re-circulated, dried, heated and again blown into said drum,

- at least a filtering septum (5) apt to intercept the foreign bodies/matter, and specifically the lint dragged by said air flow running into said conduit (2,22),
- means apt to provide the cleaning of said filtering septum, comprising a device to generate vibrations (15) able to cause/make said filtering septum to vibrate,
- characterized in that** it is provided with control means able to generate a sweep of vibrations, which range in a substantially continuous mode from the value of minimum frequency to the value of maximum frequency.
2. Clothes drying machine according to claim 1, **characterized in that** said device to generate vibrations (15) is mechanically connected to said filtering septum.
3. Clothes drying machine according to claim 2, **characterized in that** said device to generate vibrations is connected to said filtering septum in such a way that the generated vibrations are transferred on directions which are parallel to at least a main plane of said filtering septum.
4. Clothes drying machine according to claim 2 or 3, **characterized in that** the vibrations generated by said device (15) stretch in the range 10 - 1000 Hz.
5. Clothes drying machine according to any of the previous claims, 1 **characterized in that** the vibrations generated by said device make said septum to vibrate with an acceleration greater than 2 g.
6. Clothes drying machine according to claim 1, **characterized in that** said control means is automatically activated during at least a portion of the inversion time-intervals of the drum rotation.
7. Clothes drying machine according to any of the preceding claims 1 to 6, **characterized in that**, during the operation of said device to generate vibrations (15, 15A), the air flow circulation in said drying air conduit (2, 22) is automatically and temporarily stopped.
8. Clothes drying machine according to any of the previous claims, **characterized in that** said filtering septum (5) is oriented in a substantially vertical position, and **in that** a collecting element (17), apt to collect and contain the matter set free from the septum cleaning, is placed below said filtering septum.
9. Clothes drying machine according to any of the previous claims,

**characterized in that** said means to clean said filter septum (5) comprise at least two devices (15, 15A) generating vibrations, and able to make said septum to vibrate, and **in that** said two devices are placed on two sides of the same septum, which are substantially orthogonal to each other.

10. Clothes drying machine according to any of the previous claims, **characterized in that** said control means is automatically activated at the end of any drying cycle.

#### Patentansprüche

1. Wäschetrockner oder Waschmaschine/Trockner, umfassend:

eine Drehtrommel (1) zum Aufnehmen der zu trocknenden Wäsche,  
eine Trocknungsluftleitung (2, 22), die zum Befördern eines Trocknungsluftstroms in Richtung auf das Innere der Drehtrommel und daraus nach außen geeignet ist, um in den Raum gelassen oder wieder in Umlauf gebracht, getrocknet, erwärmt und wieder in die Trommel eingeblasen zu werden,  
mindestens eine Filterwand (5), die zum Auffangen der Fremdkörper/-stoffe und spezifisch der Flusen, die von dem in die Leitung (2, 22) strömenden Luftstrom eingebracht werden, geeignet ist,  
Mittel, die zum Bereitstellen der Reinigung der Filterwand geeignet sind, umfassend eine Vorrichtung zum Erzeugen von Schwingungen (15), die die Filterwand zum Schwingen bringen kann,

**dadurch gekennzeichnet, dass** er mit Steuermitteln bereitgestellt ist, die einen Durchlauf von Schwingungen bewirken/erzeugen können, die sich in einer im Wesentlichen kontinuierlichen Form von dem Wert der minimalen Frequenz zu dem Wert der maximalen Frequenz erstrecken.

2. Wäschetrockner nach Anspruch 1, **dadurch gekennzeichnet, dass** die Vorrichtung zum Erzeugen von Schwingungen (15) mit der Filterwand mechanisch verbunden ist.
3. Wäschetrockner nach Anspruch 2, **dadurch gekennzeichnet, dass** die Vorrichtung zum Erzeugen von Schwingungen mit der Filterwand auf eine solche Art und Weise verbunden ist, dass die erzeugten Schwingungen auf Richtungen übertragen werden, die zu mindestens einer Hauptebene der Filterwand parallel sind.

4. Wäschetrockner nach Anspruch 2 oder 3, **dadurch gekennzeichnet, dass** die von der Vorrichtung (15) erzeugten Schwingungen sich in dem Bereich von 10 - 1000 Hz erstrecken.
5. Wäschetrockner nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** die von der Vorrichtung erzeugten Schwingungen die Wand mit einer Beschleunigung über 2 g zum Schwingen bringen.
6. Wäschetrockner nach Anspruch 1, **dadurch gekennzeichnet, dass** die Steuermittel während mindestens einem Teil der Zeitintervalle der Umkehrung der Trommeldrehung automatisch aktiviert werden.
7. Wäschetrockner nach einem der vorstehenden Ansprüche 1 bis 6, **dadurch gekennzeichnet, dass** im Betrieb der Vorrichtung zum Erzeugen von Schwingungen (15, 15A) die Luftstromzirkulation in der Trocknungsluftleitung (2, 22) automatisch und zeitweise unterbrochen wird.
8. Wäschetrockner nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** die Filterwand (5) in einer im Wesentlichen senkrechten Position ausgerichtet ist und dass ein Auffangelement (17), das zum Auffangen und Halten der aus der Wandreinigung freigesetzten Stoffe geeignet ist, unterhalb der Filterwand angebracht ist.
9. Wäschetrockner nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** die Mittel zum Reinigen der Filterwand (5) mindestens zwei Vorrichtungen (15, 15A) umfassen, die Schwingungen erzeugen und die Wand zum Schwingen bringen können, und dass die beiden Vorrichtungen an zwei Seiten der gleichen Wand angebracht sind, die im Wesentlichen senkrecht zueinander sind.
10. Wäschetrockner nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** die Steuermittel am Ende von jedem Trocknungszyklus automatisch aktiviert werden.
- dans ledit tambour,  
- au moins un septum de filtration (5) apte à intercepter les corps/matériaux étrangers, et en particulier la charpie entraînée par ledit flux d'air passant dans ledit conduit (2, 22),  
- des moyens aptes à réaliser le nettoyage dudit septum de filtration, comprenant un dispositif pour produire des vibrations (15) apte à amener/faire ledit septum de filtration à vibrer,
- caractérisé en ce qu'il** présente des moyens de commande aptes à produire une plage de vibrations qui s'étendent selon un mode sensiblement continu de la valeur de la fréquence minimum à la valeur de la fréquence maximum.
2. Sèche-linge selon la revendication 1, **caractérisé en ce que** ledit dispositif pour produire des vibrations (15) est relié mécaniquement audit septum de filtration.
3. Sèche-linge selon la revendication 2, **caractérisé en ce que** ledit dispositif pour produire des vibrations est connecté audit septum de filtration de telle manière que les vibrations produites sont transférées dans des directions qui sont parallèles à au moins un plan principal dudit septum de filtration.
4. Sèche-linge selon la revendication 2 ou 3, **caractérisé en ce que** les vibrations produites par ledit dispositif (15) s'étendent dans la plage de 10-1000 Hz.
5. Sèche-linge selon l'une quelconque des revendications précédentes, **caractérisé en ce que** les vibrations produites par ledit dispositif amènent ledit septum à vibrer avec une accélération supérieure à 2g.
6. Sèche-linge selon la revendication 1, **caractérisé en ce que** ledit moyen de commande est activé automatiquement durant au moins une portion des intervalles de temps d'inversion de la rotation du tambour.
7. Sèche-linge selon l'une quelconque des revendications précédentes 1 à 6, **caractérisé en ce que** durant l'opération dudit dispositif pour produire des vibrations (15, 15A), la circulation de flux d'air dans ledit conduit d'air de séchage (2, 22) est arrêtée automatiquement et temporairement.
8. Sèche-linge selon l'une quelconque des revendications précédentes, **caractérisé en ce que** ledit septum de filtration (5) est orienté dans une position sensiblement verticale, et **en ce qu'un** élément de collecte (17), apte à collecter et à contenir les matières dégagées par le nettoyage du septum, est placé en dessous dudit septum de filtration.

## Revendications

1. Sèche-linge ou machine de lavage-séchage, comprenant :
- un tambour tournant (1) retenant le linge à sécher,
  - un conduit d'air de séchage (2, 22) apte à envoyer un flux d'air de séchage vers l'intérieur dudit tambour tournant et depuis celui-ci vers l'extérieur, à rester dans l'enceinte ou à être recirculé, séché, chauffé et à nouveau soufflé

9. Sèche-linge selon l'une quelconque des revendications précédentes, **caractérisé en ce que** lesdits moyens pour nettoyer ledit septum de filtration (5) comprennent au moins deux dispositifs (15, 15A) produisant des vibrations, et aptes à amener ledit septum à vibrer, et **en ce que** lesdits deux dispositifs sont placés sur deux côtés du même septum qui sont sensiblement orthogonaux l'un à l'autre. 5
10. Sèche-linge selon l'une quelconque des revendications précédentes, **caractérisé en ce que** ledit moyen de commande est activé automatiquement à la fin de n'importe quel cycle de séchage. 10

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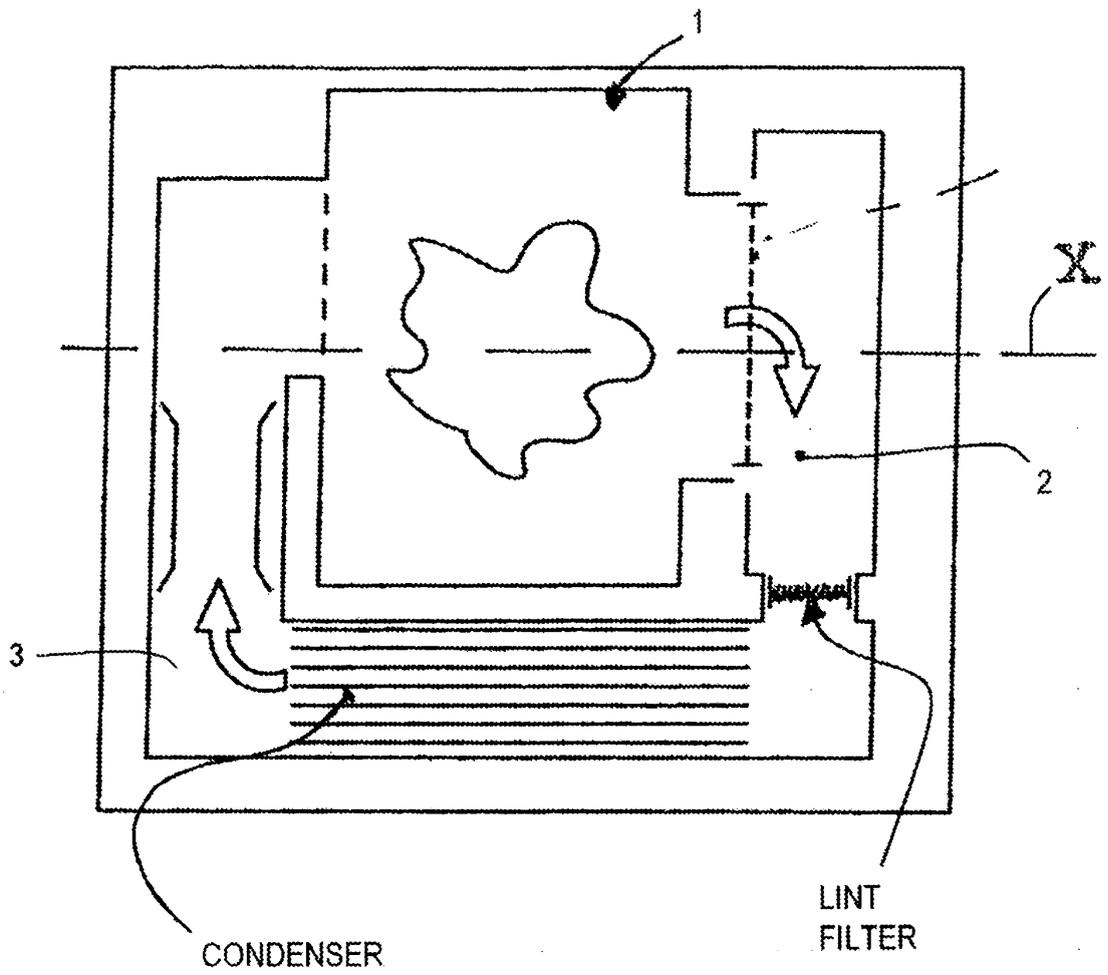


FIG. 1

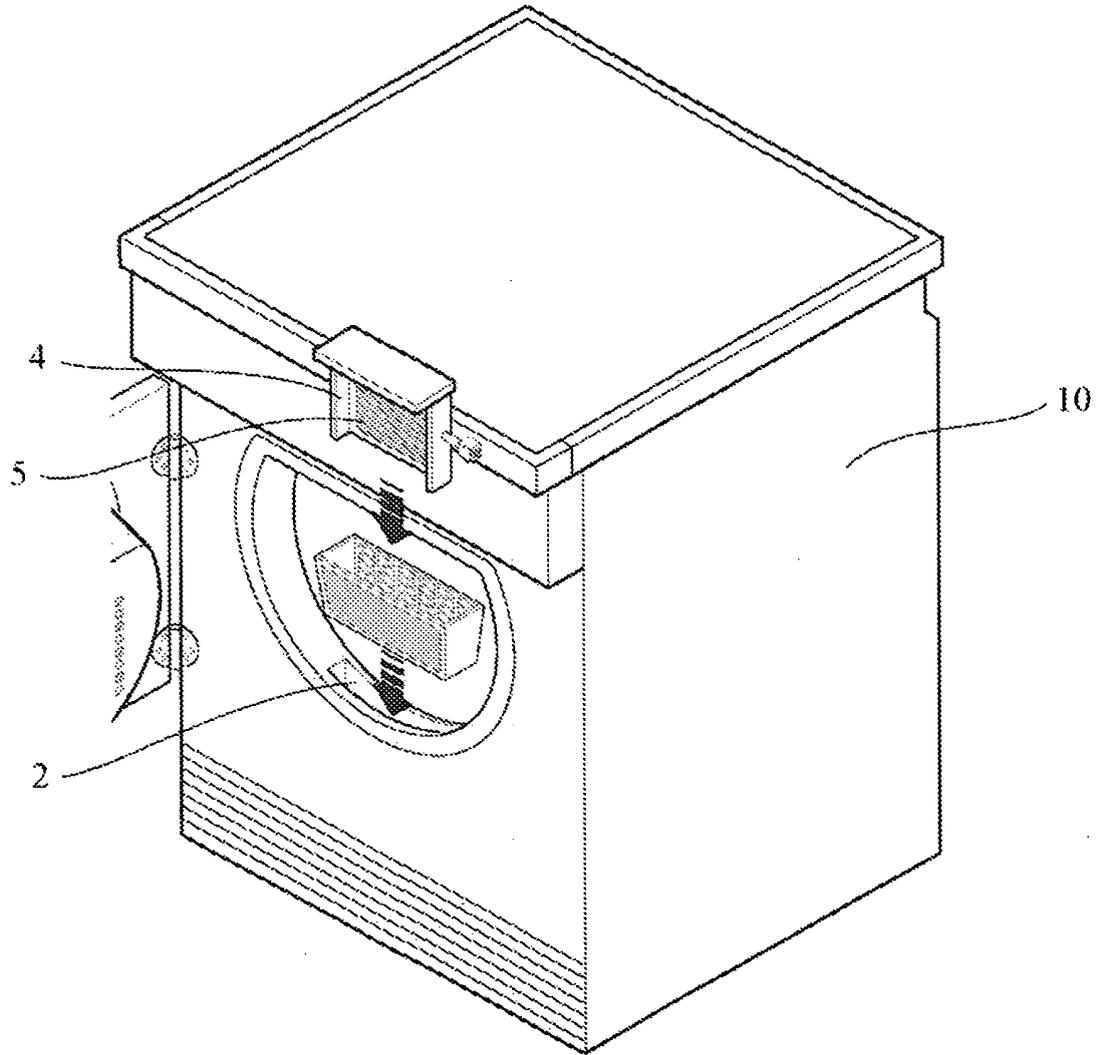


FIG. 2

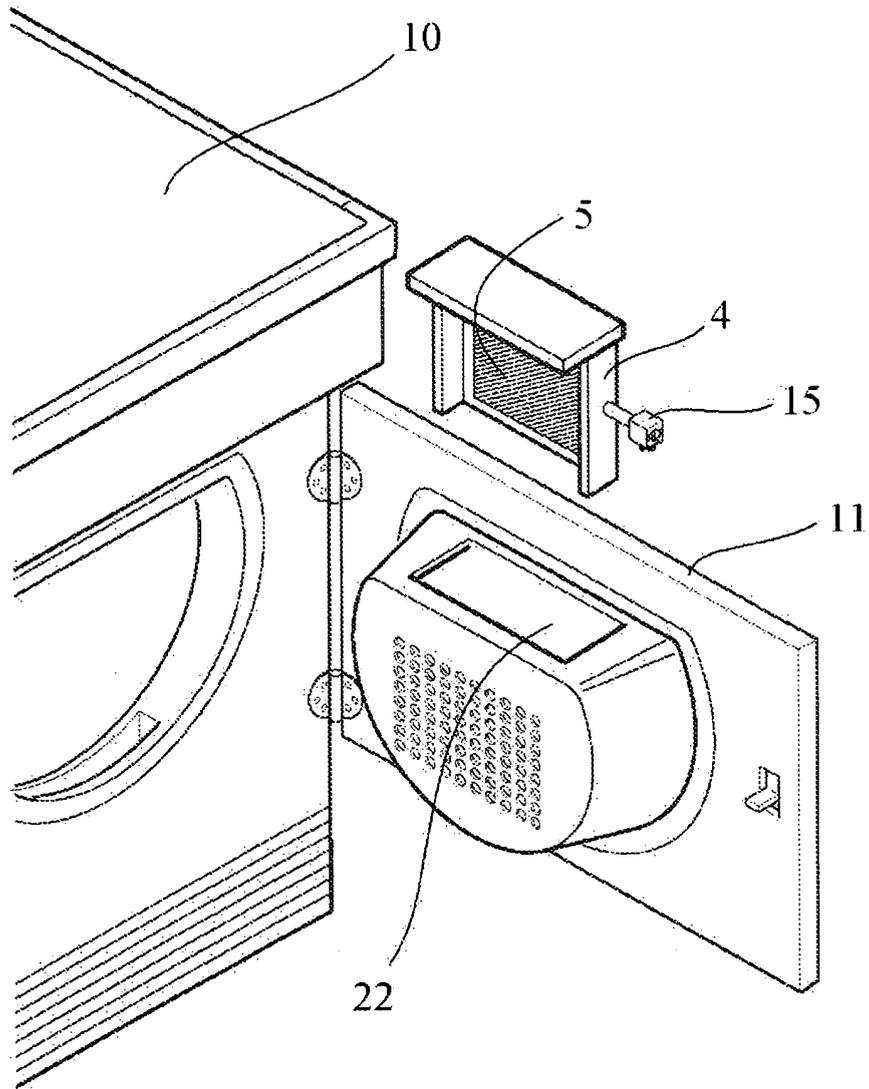


FIG. 3

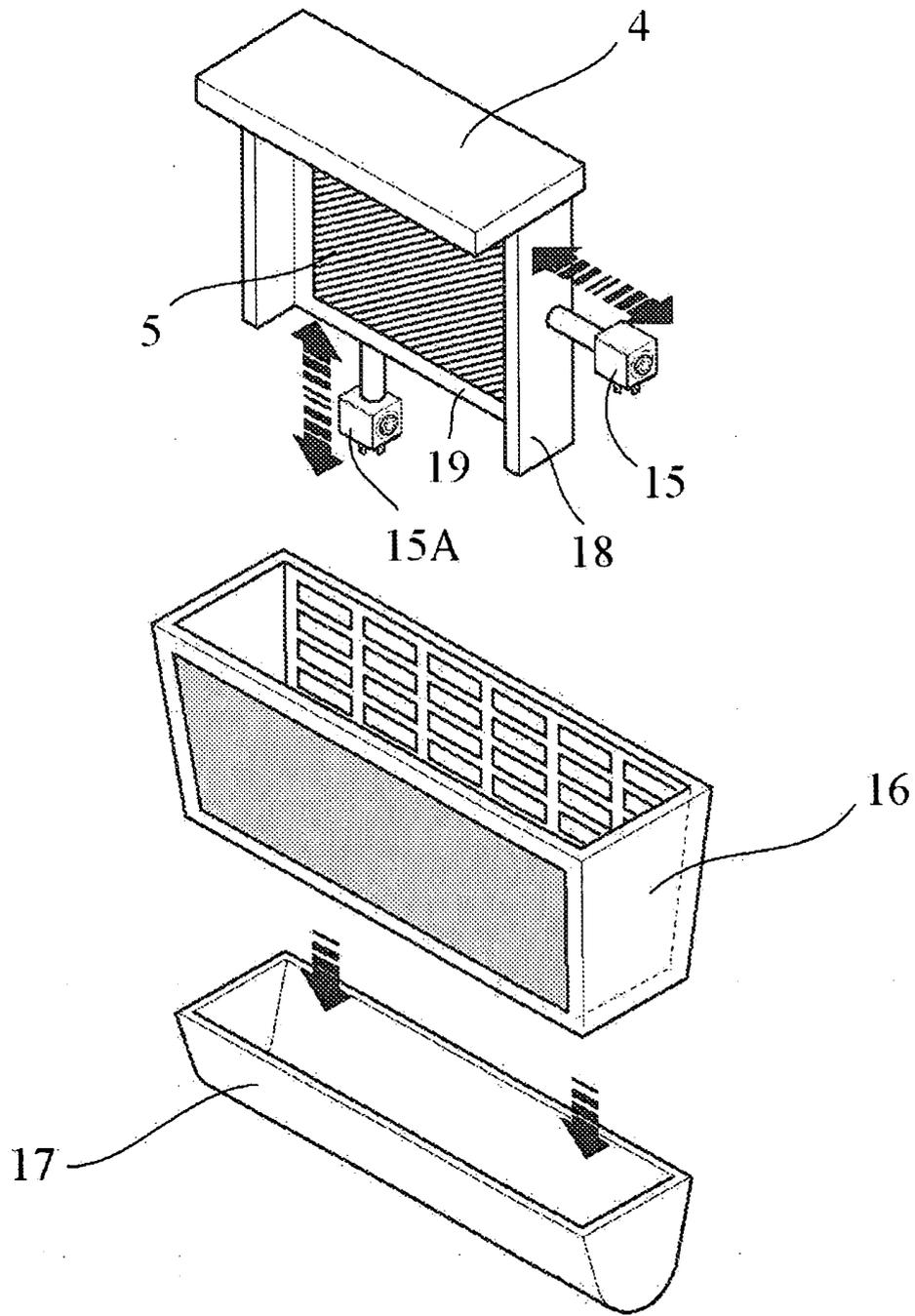


FIG. 4

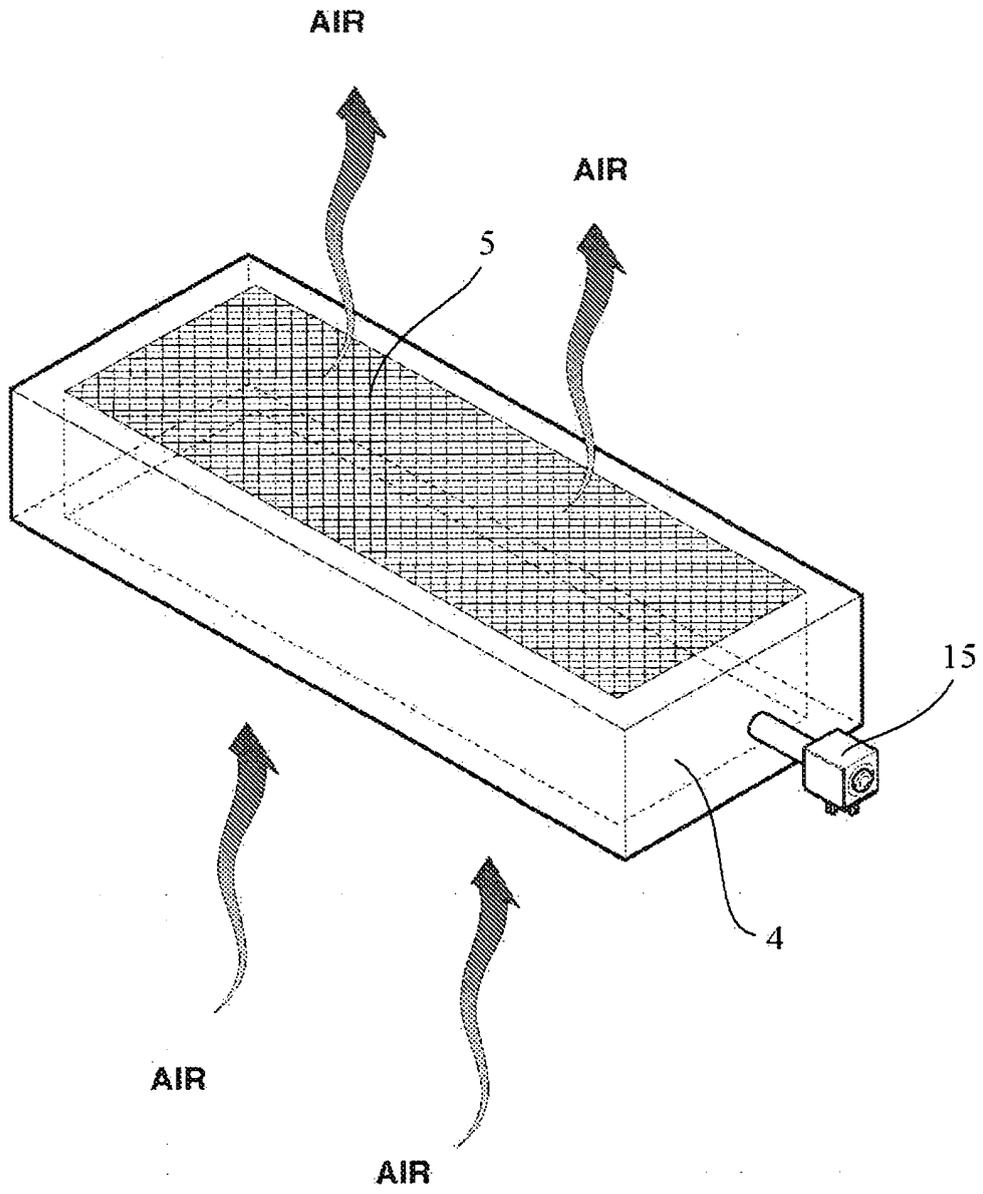


FIG. 5

**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

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- DE 29620412 **[0013]**
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