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Clothes dryer, especially a cabinet dryer

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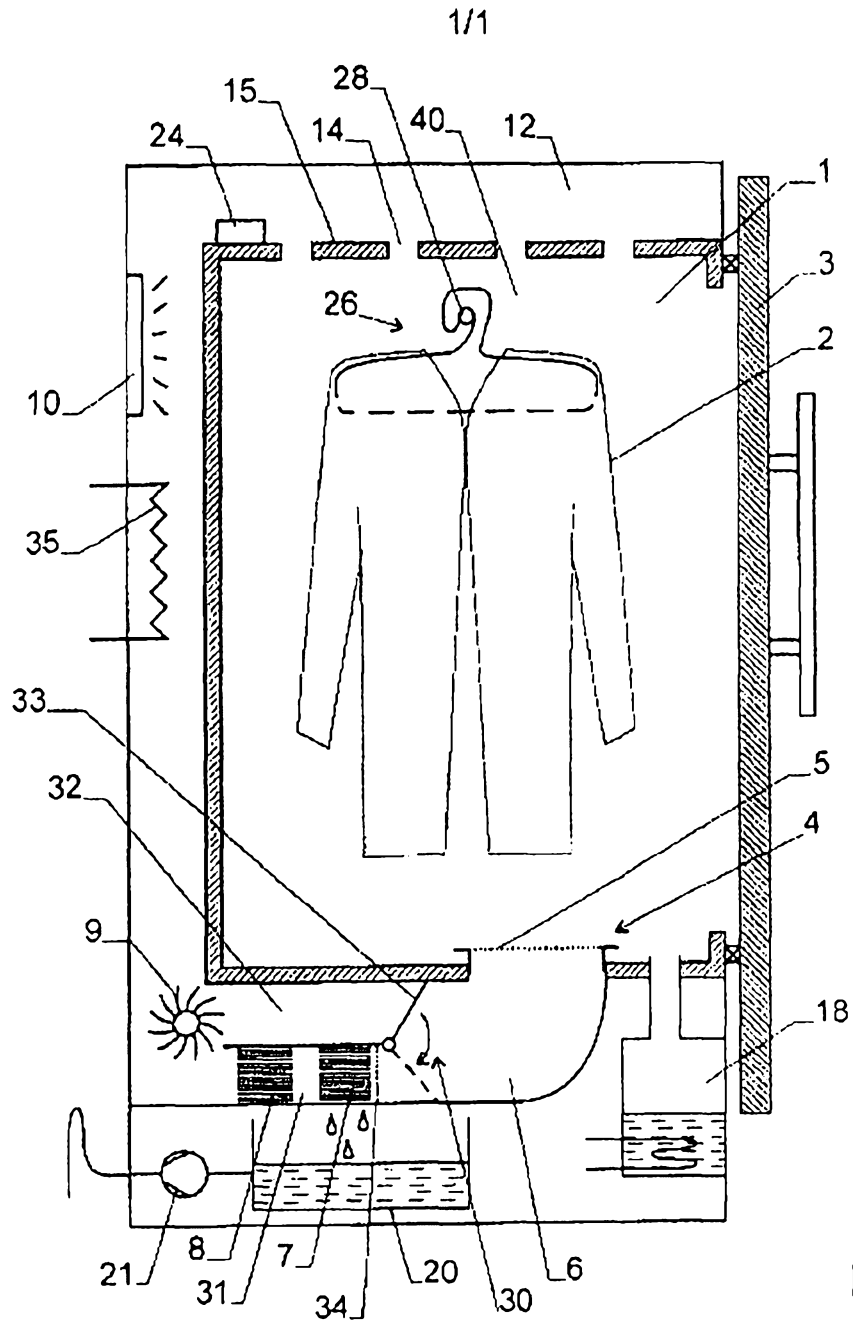
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Abstract

5 In a clothes dryer, in particular in a drying
cabinet, cooling equipment (7) and heating equipment (8)
are provided, through which the process air can be passed
to dry it. The cooling equipment and the heating
equipment (7, 8) are located in a first duct (31). A
10 second duct (32) is provided in parallel with the first
duct (31), through which the process air can be passed
through the cooling and heating equipment (7, 8). In
particular in process phases in which the cooling and
heating equipment is not required, it is possible in this
15 way to save energy, reduce noise and/or generate a larger
flow of process air, thereby improving the effectiveness
of the deodorisation.

Fig. 1.



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**ORIGINAL COMPLETE SPECIFICATION
STANDARD PATENT**

Invention Title

Clothes dryer, especially a cabinet dryer

The following statement is a full description of this invention, including the best method of performing it known to me/us:-

5

Field of the invention

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The invention concerns a clothes dryer, in particular a cabinet dryer, for drying clothes, as well as a method for operating such a device.

Background

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Clothes dryers with process air conditioning comprising a heat pump with which heating equipment and cooling equipment are operated, are known in principle. In such devices, the process air is conditioned by first passing it through the cooling equipment, where water is extracted and then through the heating equipment, where it is heated up again. A process air circuit is implemented, to pass the process air in a circuit through a utility compartment (or tub) of the device and through the process air conditioning unit.

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The cooling equipment and the heating equipment are usually constructed as heat exchangers, and offer a large contact surface to the process air. This does, however, lead to problems, such as that caused by the resulting high flow resistance.

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DE 43 06 217 describes a clothes dryer that possesses a first bypass for the evaporator and a second bypass for the condenser of the heat pump. The two bypasses can be inserted into the process circuit as alternatives to one another.

Description of the invention

5 The object, therefore, is to reduce the problems described above.

This object is met by the device and by the method according to the independent claims.

10 The process air conditioning system accordingly comprises two ducts, arranged so that the airflow in them is parallel, i.e. the two ducts start at a common starting location and end at a common destination location (although they do not need to be parallel to one another in the geometrical sense). A changeover device is associated with the two ducts, and is designed to pass 15 the process air optionally through either the first or the second duct. The cooling equipment and the heating equipment are only present in the first duct. This arrangement has the advantage that in those phases of the process where the cooling equipment and the heating 20 equipment are either not required, or are only needed to a reduced extent, at least part of the process air can be passed through the second duct, bypassing the cooling and heating equipment. As a result, the energy requirement falls during these phases of the process and/or increased 25 flows of process air can be generated. Noise emissions can, furthermore, be reduced, while the heating and cooling equipment is exposed to less contamination.

30 For reasons of space, the second duct is favourably located above or below the first duct, although it can also be to the side of the first duct.

In a clothes conditioning process comprising a drying phase and the conditioning phase, a device designed in this way can advantageously be operated as follows:

- In the drying phase, the second duct is closed by the changeover device, so that essentially all the air in the process air circuit flows through the first duct. In this way the air can be dried and heated again.

5 - In the conditioning phase, which may precede or follow the drying phase, and in which, for instance, procedures for odour reduction and/or sterilisation may be carried out, the second duct is not closed, so that at least part of the process air in the process air circuit
10 flows through the second duct.

The device has preferably a supplementary heater in addition to the heating equipment. In that case the device is designed in such a way that at least during one process phase (e.g. in the conditioning phase mentioned
15 above), the process air is passed through the second duct and the supplementary heater is operated. In this way it is possible to heat the process air even when it is passing through the second duct.

In one preferred embodiment the clothes dryer is
20 implemented in the form of a drying cabinet. In this kind of drying cabinet, the washing is hung up in the utility compartment. Suitable hanging facilities are provided in the utility compartment for this purpose.

25 Short description of the drawings

Further embodiments, advantages and applications of the invention will be found in the dependent claims and in the description below by way of the diagram, which
30 shows a sectional view through one embodiment of a drying cabinet.

Ways of implementing the invention

Drying cabinet:

Fig. 1 shows a sectional view through a clothes dryer in the form of a drying cabinet with a utility compartment 1 to contain the washing 2. The utility compartment 1 is closed by a door 3 at the front. In the embodiment illustrated, the floor region of the utility compartment has one or more openings 4, where a first filter 5 is located. A process air conditioning system 6 is connected to the opening 4. Here the process air is passed through a changeover device 30, two parallel-flow ducts 31, 32, a fan 9, past a source of UV light 10 into the roof area 12 of the device. The roof area 12 is joined to the utility compartment 1 through openings 14 in the ceiling 15 of the utility compartment 1.

The device also incorporates a steam generator 18 to add steam to the process air. In the present embodiment, the steam generator 18 is arranged in such a way that it introduces steam into the utility compartment from below, so that the steam (which is hotter than the process air) can rise up through the washing. The steam and the heater allow the device and the textiles to be heated to preferably at least 70°C (although it can be less), and sanitised in that way. The creases are removed by the heating in combination with the airflow. The steam treatment of dry textiles is particularly advantageous, since the slight humidification and heating by the steam greatly improves the removal of creases, and makes a further contribution to refreshing the clothes.

The device described here constitutes a process air circuit which preferably is essentially closed, in which process air is passed through the utility compartment 1

and through the process air conditioning system 6 back to the utility compartment 1.

5 In the illustrated embodiment, the changeover device 30 precedes the two ducts 31, 32, and in the illustrated embodiment comprises a flap 33 with which optionally one of the two ducts 31, 32 can be fully or partially closed. In the first of the two ducts, that is in duct 31, cooling equipment 7 and heating equipment 8 are arranged in series. A lint filter 34 is provided in the first duct 10 31 prior to the cooling and heating equipment 7 and 8, in order to prevent lint from getting trapped in the cooling and heating equipment 7 and 8. The lint filter can also serve to hold back particles of the fragrant materials that can damage the heat exchangers. A lint filter of 15 this sort is not required in the second duct 32, or at any rate a wide-mesh filter (e.g. filter 5) will suffice.

A collecting tank 20 is located underneath the cooling equipment 7 in order to collect water condensed out of the air. The water can be emptied from there, 20 either automatically by means of pumping equipment 21, or manually.

The air is cooled in the cooling equipment 7 in order to condense moisture out of it. The air is then heated once again in the heating equipment 8, so that it is able 25 to absorb further moisture.

The cooling equipment 7 and the heating equipment 8 are operated by a heat pump (not illustrated). The heat pump's condenser is here thermally coupled to the heating equipment 8, and the evaporator to the cooling equipment 30 7.

The fan 9 serves to circulate the air through the process air circuit.

The UV light source 10 decomposes organic compounds, either directly, or through the formation of ozone, or through photo-catalysis at approximately 356 - 390 nm. UV radiation at 185 nm generates ozone from the oxygen in the process air. In this way oxidisable pollutants are decomposed and permanently neutralised. If the UV light source generates light with a wavelength of, for instance, 254 nm, it damages the DNA of cells and microbes.

Instead of, or in addition to, the UV light source, it is also possible to incorporate an ozone generator that forms ozone by means, for instance, of intense electric fields.

A sensor is preferably arranged downstream of the UV light source or the ozone generator, which measures the concentration of ozone and controls it such that a specified limit is not exceeded.

The cabinet dryer, furthermore, preferably includes a fragrance dispenser 24 that releases fragrances. This can be implemented simply, for instance in the form of absorbent material that is soaked in a fragrance such as an etheric oil. A heated evaporator or a spray device is, however, also conceivable. The fragrance dispenser 24 can be arranged in such a way that it releases fragrance directly into the utility compartment 1, or it may release it in the process air conditioning system 6, preferably after the UV light source 10 or the ozone generator. The process air circuit is preferably designed in such a way that it introduces at least part of the process air into the utility compartment 1 from above. In the embodiment according to Fig. 1 this is done through the openings 14. It is, however, also conceivable that the process air could, at least in part, be introduced

from below, from the sides, or from the corners into the utility compartment.

The device preferably also possesses a supplementary heater 35, whose purpose is described further below.

5 Preferably this supplementary heater 35 is arranged in the air-conditioning system 6 in flow direction downstream of ducts 31, 32.

10 In order to further reduce the formation of creases and to improve the drying, the process air is favourably, for at least some of the time, introduced into the utility compartment 1 at such a speed that the washing begins to flutter. It is advantageous for the airspeed to be set in the range between 2 to 10 m/s.

15 Preferably the utility compartment 1 is permanently connected to the environment through a small opening, so that the pressure inside the utility compartment is essentially the same as the ambient pressure, allowing the door 3 to be opened and closed easily. The other parts of the process air circuit, on the other hand, are
20 not connected to the outside.

A controller (not illustrated) is also incorporated, designed in such a way as to control the clothes dryer through the process steps described here.

Operation of the cooling and heating equipment:

25 If the cooling and heating equipment 7 and 8 are required, e.g. during a drying phase, then the changeover device 30 is preferably set in such a way that all, or at least a large proportion, of the process air flows through the first duct 31. At the same time the heat pump
30 is operating, so that the air in the cooling equipment 7 is dried, after which it is heated again in the heating equipment 8.

If the cooling and heating equipment 7 and 8 are not required, e.g. during a conditioning phase in which it is not necessary to dry the air, then the changeover device 30 is favourably set in such a way that all, or at least a large proportion, of the process air flows through the second duct 32. In this case the heat pump is preferably not in operation. Because the flow resistance in the second duct 32 is less than it is in the first duct 31, it is possible in this case to pass more process air through the process air conditioning system 6 with the same fan power, or it is possible to reduce the fan power and to generate less noise while passing the same amount of process air through the process air conditioning system 6.

In particular it is, for instance, possible during at least part of the conditioning phase for a greater flow of air to be passed through the process air-conditioning system 6 than it is during the drying phase, for example in order to make the washing flutter as described above, or to carry out sterilisation and/or deodorisation.

If the second duct 32 is opened, the heater 8 is only able to heat the process air ineffectively, if at all. In order to make it possible to heat the process air even in this case, it can be heated with the supplementary heater 35. For this reason the control of the device is preferably designed in such a way that at least during one process phase (e.g. in at least one part of the conditioning phase mentioned above), the process air is passed through the second duct 32 and the supplementary heater 35 is operated at the same time. The flap 33 may also have a number of positions in order to give the process greater flexibility in respect of volume flow rates. It is also conceivable that the duct 31 does not

necessarily have to be closed when duct 32 is operating, since duct 31 offers a greater resistance, so that the air automatically flows through duct 32.

5 Changeover device:

 As described earlier, the changeover device 30 according to Fig. 1 has a flap 33 or a closing mechanism of some other type. With this closing mechanism, at least the second duct 32 can be closed, so that the process air
10 can be forced through the first duct 31 (which has a higher resistance to airflow). As soon as the closing mechanism opens the second duct 32, at least a high proportion of the process air is then diverted through it, since the resistance to the airflow is lower there.

15 Preferably the closing mechanism can be operated to close either the first or the second duct, so that if necessary a flow of air through the first duct 31 can be stopped entirely. For this purpose, the flap 33 in the embodiment according to Fig. 1 has two positions, of
20 which one (in which the first duct 31 is closed) is shown with a broken line in Fig. 1, whereas the other (in which the second duct 32 is closed) is shown as a solid line.

 Means for decomposition of odorous substances:

25 In one preferred embodiment, the cabinet dryer incorporates a means for decomposing odorous substances such as those created by bacteria.

 This can, for instance, comprise a means of adding enzymes with which the odorous substances are decomposed.
30 Suitable enzymes, for instance, include hydrolases, in particular esterases or oxidoreductases. Either the process air is passed through a carrier material containing the enzymes mentioned above, or an enzyme

mixture finely distributed in water is added to the flow of process air.

Alternatively, or in addition, it is also possible to incorporate a photocatalyst and a light source in order to activate the photocatalyst, such as a photocatalyst incorporating TiO_2 . The user is able to control the means for decomposing odorous substances optionally through a function on the operating panel.

The term "photocatalyst" refers to a material which acts as a catalyst when illuminated by light of a suitable wavelength, in particular by visible or ultraviolet light.

The photocatalyst is preferably a catalyst based on titanium oxide with UV radiation, i.e. a catalyst that contains, for instance, TiO_2 (titanium dioxide), although catalysts based on CdS (cadmium sulphide), WO_3 (tungsten oxide) or ZnO (zinc oxide) may also be considered.

Suitable photocatalysts are described, for instance, in DE 20 2004 005 677 U1 and EP 1 205 244. When they absorb light, electrons and holes are generated, so inducing chemical reactions that decompose organic compounds and which are capable of killing micro-organisms, viruses, bacteria and germs. Catalysts based on titanium dioxide are particularly preferred, due to their high effectiveness and the biological compatibility of this material.

The product "Titanium Shield®" can, for instance, be used as the photocatalyst.

The decomposition of odorous substances by means of oxidation, for instance by adding ozone or through UV irradiation, may also be considered.

Means of suspension:

Means of suspension 26 are provided in order to hang the washing up in the utility compartment. These can, for instance, comprise a suspension in the form of a clothes rail 28 or of appropriate clothes hangers, clips or the like.

Notes:

The cabinet dryer described here can be used for drying or for conditioning of washing. The term "conditioning" does not necessarily here refer to water extraction. It may also, for instance, refer to hygienic treatment and/or crease removal (e.g. by means of steam, a UV or ozone generator and photocatalysis) or the neutralisation of odours (e.g. with the aid of the methods described above for the addition of enzymes or with the UV or ozone generator and photocatalysis).

The present invention can be employed to particular advantage in a cabinet dryer, since it is advantageous in such cabinet dryers for phases to occur in which the cooling or heating equipment 7 and 8 are not required, e.g. the phase described above in which an increased quantity of air is passed through the cabinet in order to make the washing flutter, or when the process air is treated with steam, ozone, UV light or fragrance.

The present technique can, however, also be used in other clothes dryers, in particular in tumble dryers. Here again it is possible for at least a proportion of the process air to bypass the cooling and heating equipment by means of the second duct 32, e.g. at a time when the washing is being subjected to steam treatment.

In summary, in a clothes dryer, in particular in a drying cabinet, cooling equipment and heating equipment are provided, through which the process air can be passed

to dry it. The cooling and heating equipment is located in a first duct. A second duct is provided in parallel with the first duct, through which the process air can bypass the cooling and heating equipment. In particular
5 in process phases in which the cooling and heating equipment is not required, it is possible in this way to save energy, reduce noise and/or generate a larger flow of process air.

Whereas the present application describes preferred
10 embodiments of the invention, it must be emphasised that the invention is not restricted to those, and can also be implemented in other ways within the scope of the following claims.

Throughout this specification and the claims which
15 follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step
20 or group of integers or steps.

The reference in this specification to any prior publication (or information derived from it), or to any matter which is known, is not, and should not be taken
25 as an acknowledgment or admission or any form of suggestion that that prior publication (or information derived from it) or known matter forms part of the common general knowledge in the field of endeavour to which this specification relates.

30

The reference numerals in the following claims do not in any way limit the scope of the respective claims.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

- 5 1. Clothes dryer, in particular a cabinet dryer, for
drying washing with
 a utility compartment (1) to hold the washing,
 a process air conditioning facility (6) which
incorporates cooling equipment (7), heating equipment (8)
10 and a heat pump for cooling the cooling equipment (7) and
for heating the heating equipment (8),
 a process air circuit to guide the process air in a
circuit through the utility compartment (1) and the
process air-conditioning system (6), in which the process
15 air-conditioning system (6) comprises a first and a
second duct (31, 32), in which the two ducts are arranged
so that the flow of air through them is in parallel, and
the ducts are fitted with a changeover device (30) to be
able to guide the process air through the first or second
20 duct (31, 32),
 characterised in that the cooling equipment (7) and
the heating equipment (8) are located in a first duct
(31), in which the device is constructed in such a way
that the process air can be passed through the second
25 duct (32), bypassing the cooling equipment (7) and the
heating equipment (8).
2. Clothes dryer according to claim 1, in which the
first duct (31) is located above, to the side or
underneath the second duct (32).
- 30 3. Clothes dryer according to one of the foregoing
claims, in which the changeover device (30) incorporates
a closing mechanism (33) with which at least the second
duct (32) can be closed.

4. Clothes dryer according to claim 3, in which the closing mechanism can optionally close the first or the second duct (31, 32).

5. Clothes dryer according to one of the foregoing claims which, in addition to the heating equipment (8) incorporates at least one supplementary heater (35), and whereby it is designed so that in at least one process phase, process air is passed through the second duct (32) and the supplementary heater (35) is operated.

10 6. Clothes dryer according to one of the foregoing claims, which is implemented as a drying cabinet, in which a means of suspension (26) for hanging up the washing is arranged in the utility compartment.

15 7. Clothes dryer according to one of the foregoing claims, which is designed to pass a greater airflow through the process air-conditioning system (6) when the process air is passed through the second duct (32) than is the case when the process air is passed through the first duct (31).

20 8. Clothes dryer according to one of the foregoing claims, in which a lint filter (34) is located in the first duct (31) but not in the second duct (32).

25 9. Clothes dryer according to one of the foregoing claims, in which the process air circuit is a closed process air circuit.

30 10. Method for operating the clothes dryer according to one of the foregoing claims, characterised in that in a washing conditioning process, in a drying phase the second duct (32) is closed by the changeover device (30), and that in a conditioning phase that precedes or follows the drying phase, the second duct (32) is not closed, so that at least part of the process air flows in the process air circuit through the second duct (32).

11. Method according to claim 10, in which during at least part of the conditioning phase the process air is heated by a supplementary heater (35).

12. Method according to one of claims 10 or 11, in which the heat pump is switched off during the conditioning phase.

13. Method according to one of claims 10 to 12, in which during the conditioning phase the process air is treated with steam, ozone, UV light, photocatalysis or fragrance.

14. Method according to one of claims 10 to 13, in which during at least one part of the conditioning phase, a greater flow of air is passed through the process air-conditioning system (6) than is the case during the drying phase.

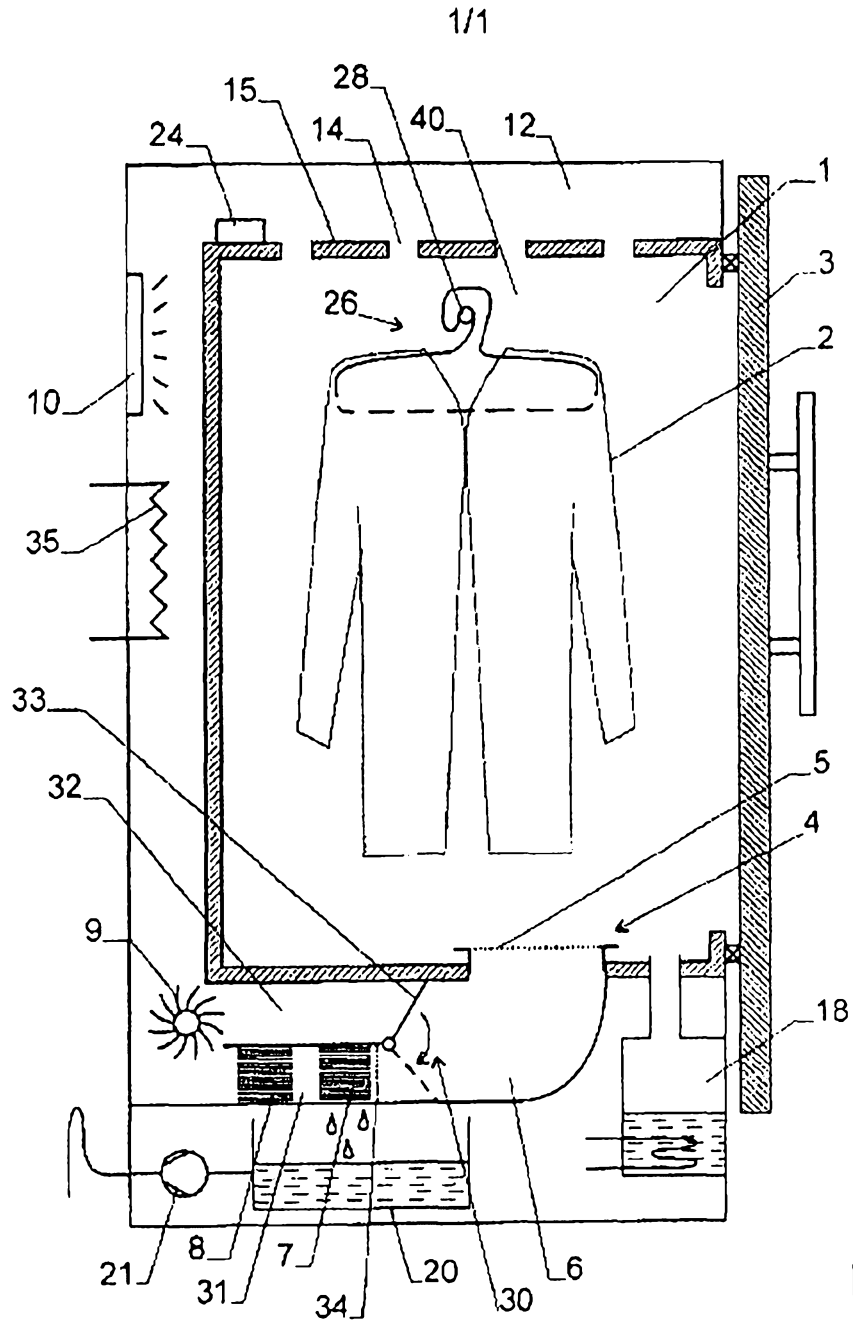


Fig. 1