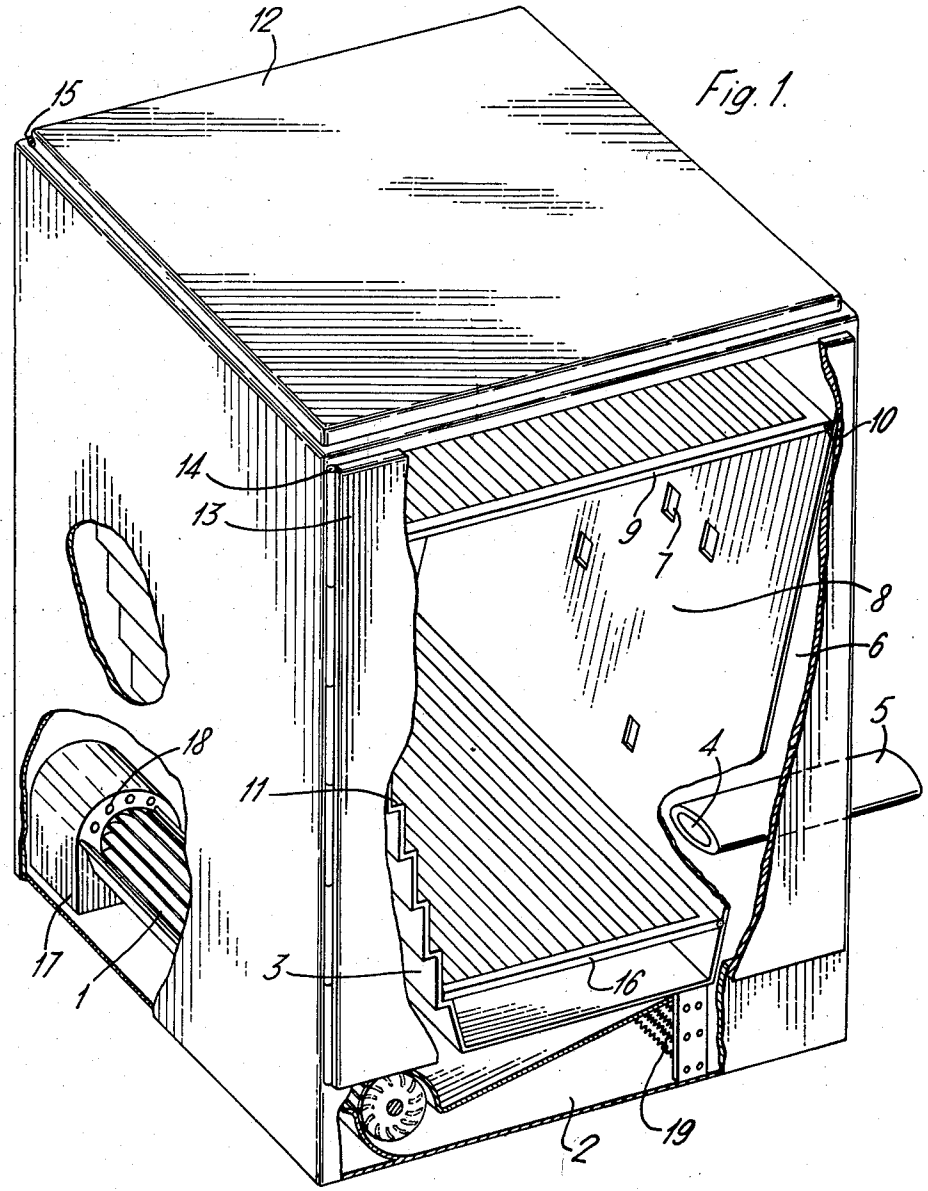
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LAUNDRY DRIER

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Fig. 1.



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Fig. 2.

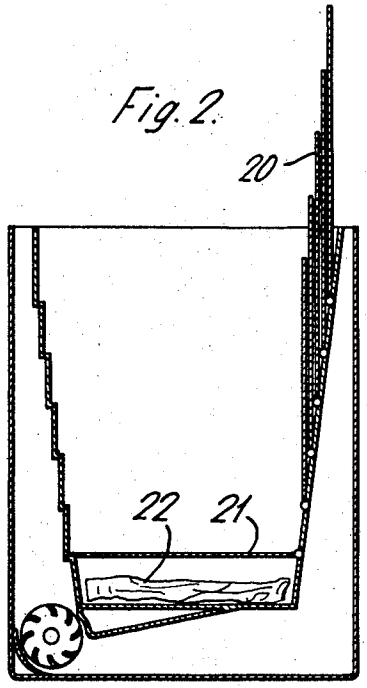


Fig. 3.

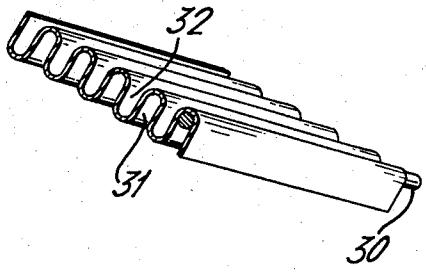
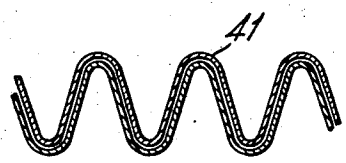


Fig. 4.



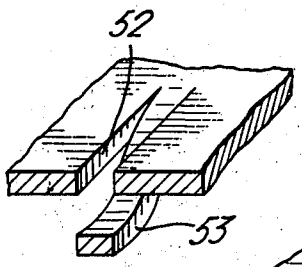


Fig. 5A

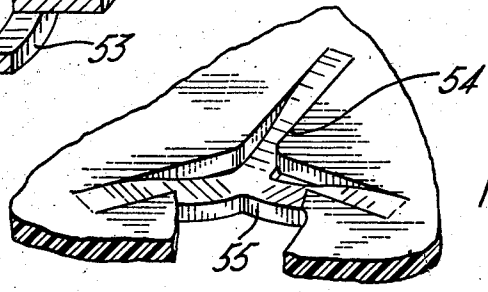


Fig. 5B

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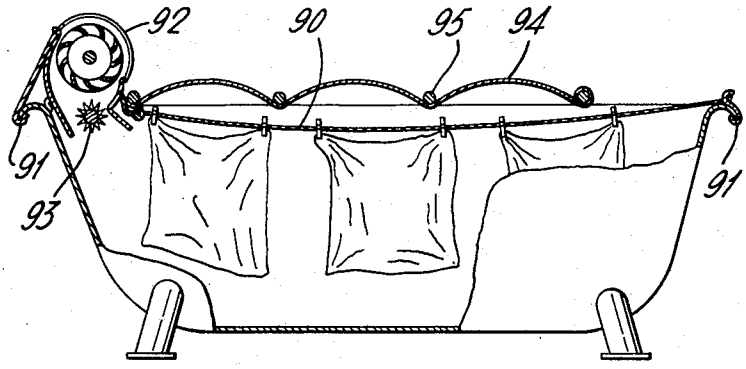


Fig. 9A

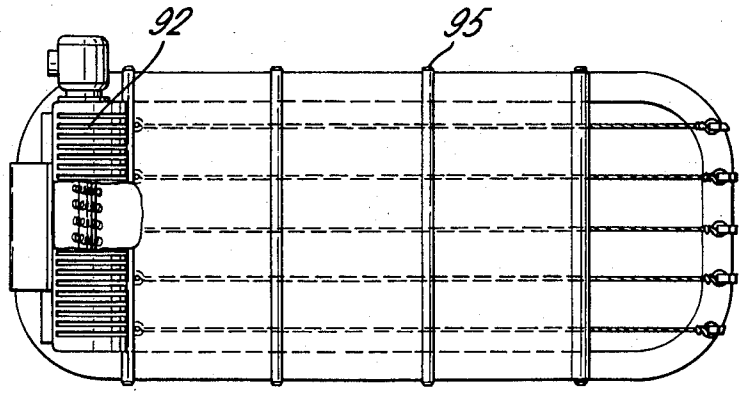
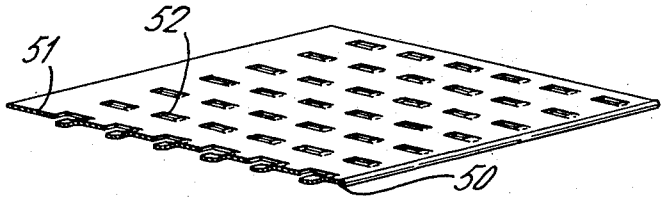


Fig. 9B

Fig. 5C



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Fig. 6.

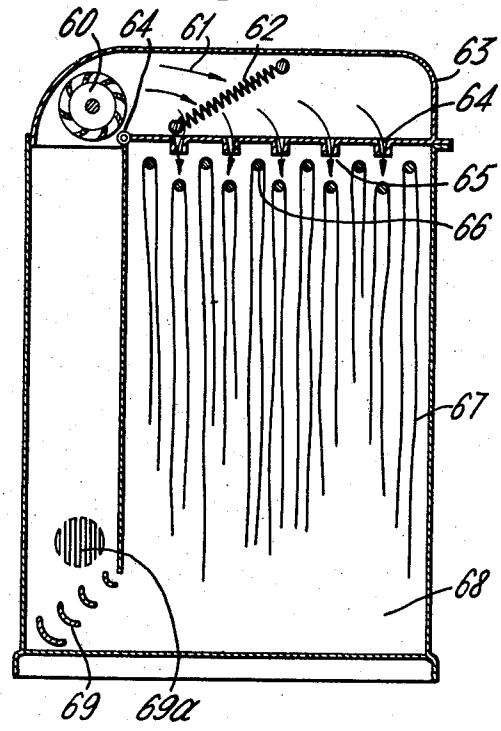


Fig. 7.

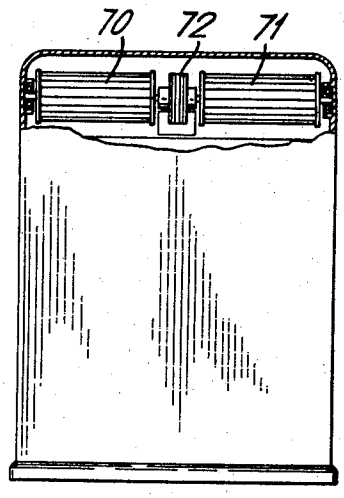


Fig. 8A

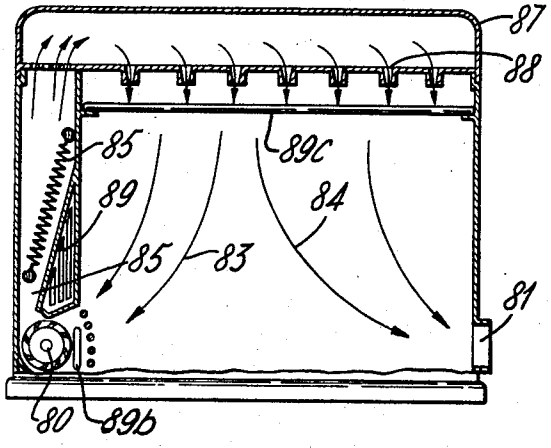
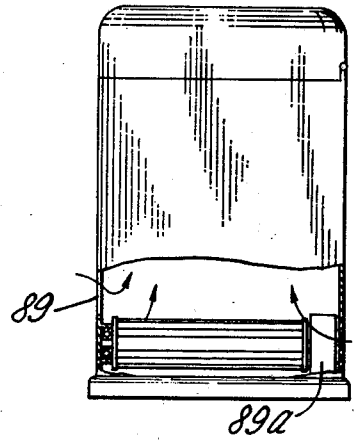


Fig. 8B



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Fig. 10.

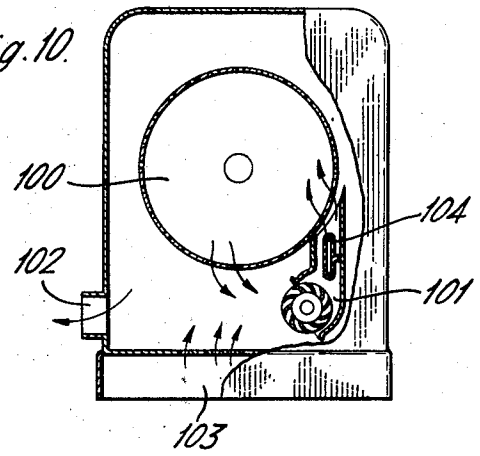


Fig. 11.

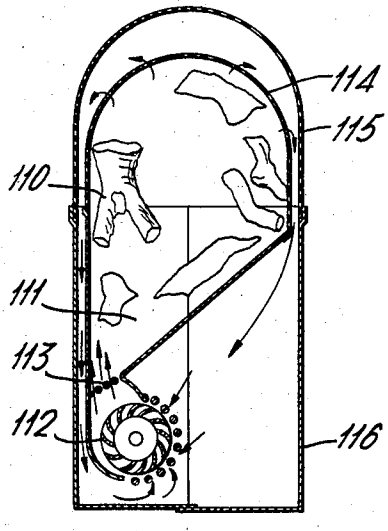
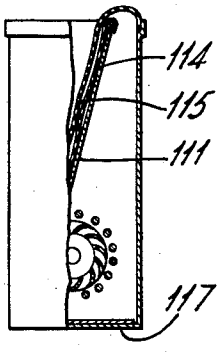


Fig. 11a.



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Fig. 12.

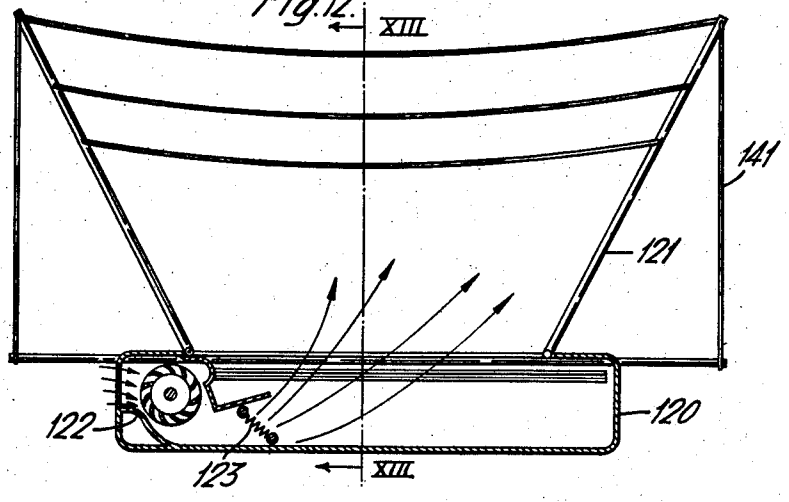


Fig. 13.

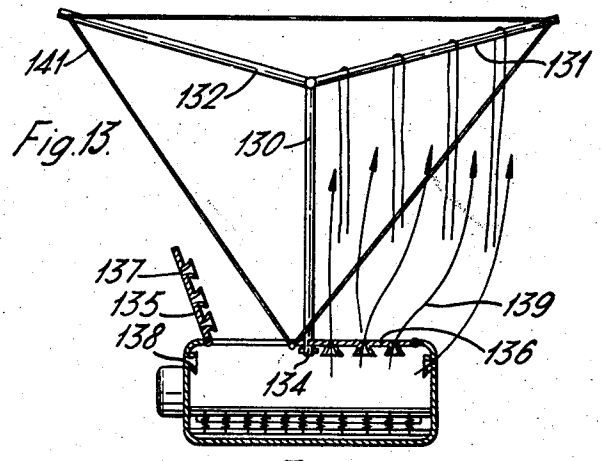
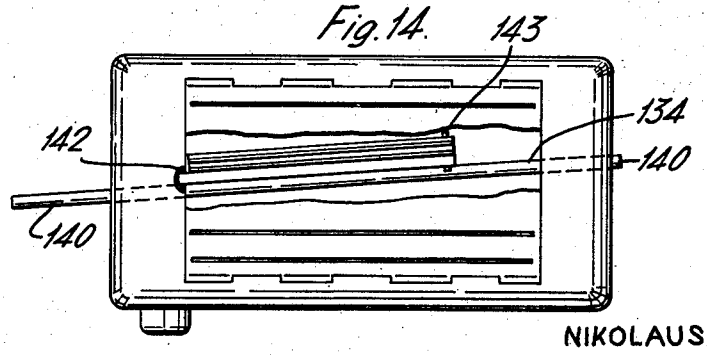


Fig. 14.



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Fig. 15.

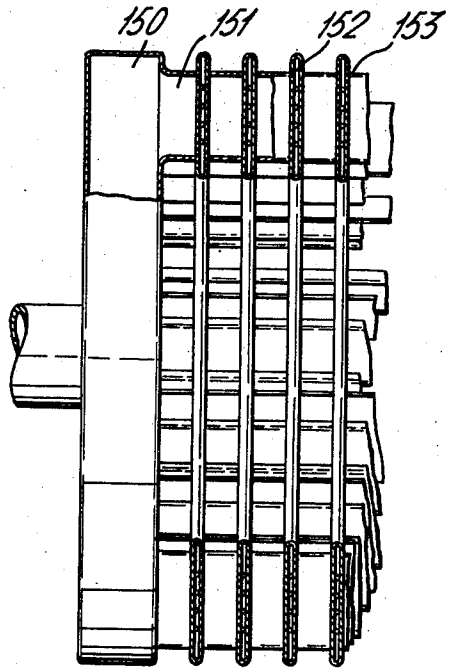


Fig. 16.

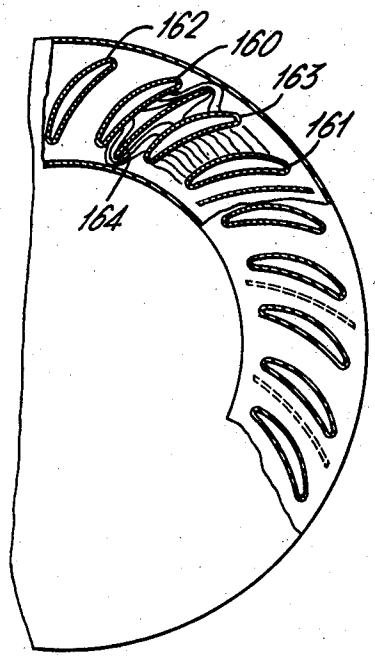
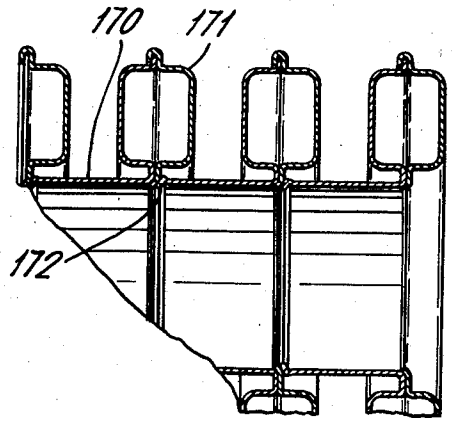


Fig. 17.



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BY *Mestern, Ross & Mestern*

United States Patent Office 3,152,876 Patented Oct. 13, 1964

3,152,876

LAUNDRY DRIER

Nikolaus Laing, Rosenbergstrasse 24,
Stuttgart, Germany

Filed Apr. 26, 1960, Ser. No. 24,807
Claims priority, application Germany Apr. 28, 1959
3 Claims. (Cl. 34—151)

The present invention relates to an arrangemement for the drying of laundry or the like, in which the damp laundry, which is disposed on a rack or like support, is dried by streams of air passing through the laundry.

Drum-type drying apparatus are known which operate in combination with axial or radial blowers. The principal disadvantage of these conventional types of apparatus resides in the fact that the overall dimensions of such apparatus are relatively large and the blower noise is considerable. Furthermore other known apparatus provide means whereby the laundry is suspended inside a housing through which air is blown with the aid of axial blowers. The considerable space requirement and the complicated charging of the machine with the laundry or other items to be dried are the disadvantages of these conventional types of blowers.

It is, therefore, the principal object of this invention to provide a compacted quiet laundry drier. The aforementioned disadvantages can be avoided when the drying air streams are produced with the aid of at least one elongated fan-rotor body, whose periphery is formed by a plurality of angularly spaced blades bridging substantially the entire length of the rotor and arranged preferably paraxially, extending in the radial direction between two imaginary concentric circular cylinders; the blades are disposed and terminated between at least two lateral terminal disks provided at the opposite ends of the rotor, by which the air to be circulated is radially inducted, is redirected in the inside of the hollow rotor by an eddy superimposed upon the through-put air current, and is thereupon applied to the laundry. Accordingly, the present invention contemplates the use of a novel type of air displacement means, namely a tangential blower.

Tangential blowers are transversally traversed drum-type rotors in which a potential eddy in the inside of the rotor, provides the guidance of the air flow or current between the first and the second blade-grid passage. These blowers can be designed to have any desired length of rotor and are of angular configuration when viewed in the plane of rotation. For this reason they are capable of being disposed in that particular corner of a housing where a redirection or deflection of the flow is necessary anyway. This housing or casing has walls defining a generally rectangular shape in horizontal section, an inner enclosure being provided within the outer casing. This enclosure has a bottom wall and a vertical wall adjoining at a horizontal junction and defining first and second chambers with corresponding walls of the outer casing, the cross-flow or tangential blower being disposed between the chambers, means is provided for heating and for recirculating the air.

A further advantage is to be seen in the extremely low noise production, as well as in the high efficiency at small Reynold's numbers. Also the rectangular gap or slit has an advantageous effect inasmuch as highly loaded high-resistance heat conductors can be accommodated in a convenient manner. For the heating the invention provides the employment of electric heat exchangers, but also of gas-heated ribbed heating pipes, as well as of heat exchangers which can be connected to central heating system.

The advantages of the invention will now be described with reference to the accompanying drawings.

In the drawing:

FIG. 1 is a perspective view of a laundry drier, according to the invention, with parts broken away;

FIG. 2 is a somewhat diagrammatic side cross-sectional view with the clothes-supporting racks raised;

FIG. 3 is a perspective view, partly in section, of a modified rack drawn to an enlarged scale;

FIG. 4 is a cross-sectional view of another rack assembly;

FIGS. 5A, 5B and 5C are perspective views of further rack structures showing still other modifications;

FIG. 6 is a vertical cross-sectional view from a side of another laundry drier;

FIG. 7 is a front-elevational view thereof with part broken away to illustrate a bipartite rotor;

FIG. 8A is a view similar to FIG. 6 of yet a further drier;

FIG. 8B is a rear-elevational view, partly broken away of the drier of FIG. 8A;

FIG. 9A is a longitudinal cross-sectional view and FIG. 9B is a plan view of a bathtub-type drier embodying the invention;

FIG. 10 is a front-elevational view, partly in section of a drum-type clothes drier;

FIGS. 11 and 11*a* are side-elevational view in operative and inoperative condition of another drier according to the invention;

FIGS. 12–14 are partly sectional elevational views of laundry driers with laundry-support ropes; and

FIGS. 15–17 are detail views of blower rotors according to the invention.

FIG. 1 shows a laundry-drying apparatus (laundry drier) according to the invention, in which a tangential or cross-flow blower 1 is arranged in the lower left-hand corner. The tangential blower opens into a diffuser 2. The blower sucks the air from a first compartment 3 with wedge-shaped cross-section. Through the opening 4, the air then partly either escapes into the ambient atmosphere or into the exhaust pipe 5, while the greater portion of the air streams in a circulating flow through the apparatus and enters the pressure chamber 6, likewise having a wedge-shaped cross-section. From the pressure or surge chamber 6 the air passes through rows of slots 7 in the inner enclosure which are provided with nozzle- or jet-shaped wall recesses, into the drying space 8. Racks or trays 9, capable of being swung by means of hinges 10, are arranged in a foldable manner inside the drying space 8. These hurdles rest on projections 11 provided on the opposite side of the enclosure. Preferably, these trays are equipped with a spring arrangement, e.g. a pivot rod coinciding with the axis, by which a raising of the trays is effected as soon as the tray is unloaded, by an angle of about 30–45°. The flap 12 may form one structural unit with the door 13, but it is also possible to provide a door which is capable of being swung around the hinge axis 14, as well as a cover flap capable of being swung around the hinge axis 15; in other words, both flaps may be capable of being swung separately. According to the invention the flaps may also be replaced by a roller-blind arrangement, which may be composed of individual metal foils, or of one plastic foil.

For the drying of clothes the bottom tray 16 is turned down. This tray is then charged with the laundry, and thereupon the next tray is turned down, and so forth. After the apparatus is completely charged with laundry, the blower 1 is put into operation. This blower is driven by the motor 17 which is preferably ventilated, for which purpose on the one hand openings extending through the rear wall of the apparatus are provided and, on the other hand, openings 18 permit cold air is permitted to flow into the inside of the motor housing. In the case

in which the volume of inducted air amounts to the through-put capacity of the apparatus. The heating system may be arranged either in the diffuser at 19 or in the wedge-shaped space 6 of the pressure chamber.

FIG. 2 is a schematic representation of the trays 20 in the turned-up condition, as they are positioned during the charging of the apparatus. Only the bottom tray 21 is turned down after the laundry has already been positioned in the lowermost space 22.

FIG. 3 is an illustration of a tray consisting of corrugated sheet metal or corrugated plastic, preferably of polyester. In order to facilitate, understanding of the function of the tray, the corrugation is shown drawn to a considerably enlarged scale. The tray is capable of being pivoted the axis 30. The air passes through the channels 31 and 32, so that the laundry can be positioned closely between two neighboring trays.

FIG. 4, on principle, shows two trays which fit into one another in their raised positions, as also shown in FIG. 2. The thickness of the walls as well as the pitch of the corrugation profile 40 are chosen thus that a neighboring tray 41 can be accommodated.

FIGS. 5A, 5B and 5C show a modified type of tray. The latter, which is capable of being swivelled around the axis 50 (FIG. 5C), consists of a plate 51 provided with recesses 52 arranged in a staggered relation. Below each of these recesses, as shown best in FIG. 5A in a small magnified portion, loop-shaped projections 53 are arranged which, because they consist of a flexible material, effect a pressing-down of the layer of laundry positioned thereunder. In this way, the laundry is subjected to a bias or predeflection, whereby the transfer of the stream of liquid is more easily performed with the aid of capillary action. The arrangement is made in such a way that the loops 53 can be formed by tools which extend through the slot 52.

In a modified embodiment (FIG. 5B) slots are provided which are offset angularly in relation to one another by 120°, as is indicated by the reference numeral 54. The resulting basket 55 now takes over the pressing-on function. As a suitable material, polyethylene can be used. According to the invention, however, it is also possible to use a wire netting or a resilient wire. In particular, structure have proved suitable which consist of two perforated plates, preferably of sheet metal, between which springs are arranged, by which the plates are spaced apart.

FIG. 6 shows a box arrangement in which the tangential or cross-flow blower 60 is provided with a diffuser 61, at the end of which a heating register 62 is arranged. All of the aforementioned parts are arranged inside a cover or lid portion 63 of the outer casing which is capable of being swung around a hinge 64.

This hinge arrangement has the advantage that the box-type drier can be positioned directly adjacent a structural wall. The lower portion of the hollow cover 63 is formed by a nozzle or jet plate 64 in which either circular or slot-shaped nozzles 65 are disposed in such way that the escaping air is blown between the rows of laundry 67 suspended or hung over rods 66. The air then accumulates in the lower chamber of the box 68 and is redirected upwardly by the blade-like grid 69 in order to partly flow again to the blower 60 through the compartment between the inner enclosure and the outer casing. An escape for part of air may be effected through the exit pipe 69*a* which is arranged either at the side or at the rear wall.

FIG. 7 is a view of the same apparatus at a reduced scale seen from the front. The rotors 70 and 71 are arranged on both sides of a motor 72. Alternatively, it is also contemplated in accordance with the invention that each rotor may have a motor of its own. In this case it is also possible to put only one half of the apparatus into operation without subjecting the flow velocities between the articles of laundry to any noteworthy changes. In this particular case a partition wall has to be provided at the height of the motor 72 in the cover or lid portion which may be similar to that of FIG. 6 (see cover 63).

FIGS. 8A and 8B show an arrangement somewhat resembling that of FIG. 6, with the exception that in this case the blower 80 is arranged in the bottom corner of the apparatus, while the outlet duct 81 is disposed on the opposite side. This arrangement has the advantage that the flow or current in the inside of the container is divided in order to flow partly in the direction 83, and partly in the direction 84. The distribution of the air, which is lead from the diffuser 85 via the heat conductor 86, is accomplished by a cover 87 which is equipped with a nozzle plate 88. The fresh air intake is now effected from the front through the slot 89, and partly through the interior of the motor 89*a*. By means of suitable control means the cross-section of the slot 89 can be varied. The air passes or flows through the motor 89*a* and, thereupon, enters through the openings 89*b* at the suction side of the blower 80. Preferably the rods 89*c* are again arranged in a staggered relation with respect to height, and may be detachable or removable.

FIGS. 9A and 9B show a special type of construction and in which an ordinary household bath tub can be used as the laundry container. The laundry is disposed on clothes ropes 90 which are fastened to the bath tub by means of suitable hooks 91. The blower 92 blows a stream of heated air at the one end of the bath tube, via the electric heat exchanger 93, into the interior. The heated air then escapes at the other end of the bath tub. The bath tub is covered with a foil 94 which is loaded by or weighted with the rods or bars 95. In the non-used condition the foil is rolled up and, together with the blower-heating unit, forms a small, easy to handle and easily stored unit.

FIG. 10 shows a laundry drier employing a rotating drum 100. A cross-flow blower 101 directs an air stream against the drum, and the air escaping from the drum is sucked-in again by the blower. Inside the apparatus a small superatmospheric pressure is produced, so that the damp air escapes through the outlet 102. The fresh air intake is effected through the pedestal or base portion 103 of the apparatus. The heating is advantageously effected by a surface-type heat exchanger 104. The application of the tangential or cross-flow blower in the case of drum-type laundry driers has the advantage that the rotor of the blower may extend over the entire length of the cylindrical drum, so that a very high air utilization can be effected with the lowest possible losses.

FIG. 11 shows a laundry drier in which the laundry 110 is positioned in a funnel 111, at the bottom end of which a tangential or cross-flow blower 112 is arranged whose rotor is again preferably as long as the entire apparatus. The outflow of the tangential blower, which passes through a grid or perforated plate 113, causes an upward spin movement of the laundry, whereupon the laundry drops back again and, in this way, is agitated in the drying air. A wire netting or a perforated foil 114 forms the upper limit of the clothes-displacement path. The air which has become damp in the course of this operation, is permitted to escape through this foil or netting. The entire apparatus is covered up by a further foil 115 blocking the passage of air. The intake and outlet conditions of the air inside the apparatus, as already described hereinbefore with reference to the examples of other types of apparatus, are so chosen that in the apparatus a slight superatmospheric pressure prevails. In this way the permeable layer or foil 114 as well as the impermeable hood 115 may consist of flexible foils with extremely thin walls held in place by air pressure during operation of the device. The use of foils bears the advantage that the apparatus, during operation, may extend over a very considerable height, while it may become extremely small in the inoperative condition, because the foils 114 and 115 are dropped into the apparatus

or stowed away therein (FIG. 11*a*). Furthermore, the housing **116** according to FIG. 11 may be constructed in such a way that it can be retracted or pushed together as shown at **117** in FIG. 11*a*. In this case also the diffuser of the blower **112** or at least the diffuser wall has to be movable. In all cases, it is provided by the invention, that the electric-heater elements can be replaced by a heat exchanger, which may be connected to a central-heating system.

FIG. 12 shows a drying apparatus which consists of a box or casing **120** serving for the distribution of air, and a rack **121** capable of being tilted or swung into the box, and serving for the suspension of the laundry. The box **120** contains a blower **122** as well as heater elements **123**.

FIG. 13 shows a section taken on line XIII—XIII of FIG. 12. In this representation the elements **130**, **131** and **132** of the rack are visible, together with a strut **134** extending diagonally inside the box. The element **130** is pivotally hinged to the strut **134**, and the elements **131** and **132** are hinged to the rod **130** permitting them to be folded and rotated. The lid or cover portion of the box consists of two parts **135**, **136** of which one part **135** is shown in the opened condition, while the second part **136** is shown in the operationally closed condition. These parts are provided with nozzles **137** extending over the entire length of the apparatus. Furthermore nozzles **138** are provided in the casing itself, as well as on the longitudinal and transversal sides. In this way the air stream is guided between the suspended pieces of laundry as indicated by the arrows **139**.

FIG. 14 shows a top view in which the strut **134** is shown in its diagonal position. In this strut, axially displaceable, extractable rods **140** are provided, to which the suspension or spanning ropes **141** (as shown in FIGS. 12 and 13) are hooked. In the right-hand portion of FIG. 14 the rod **140** is shown in its retracted position. In the same way the element **130** is shown swivelled around the axis **142** in a position extending parallel to the strut **134**.

The terminal disk of the rotor illustrated in FIG. 15 forms a hollow chamber **150** which is connected with a water heater (boiler), not shown, by way of a hollow rotor shaft. The cooled water or the condensation product is evacuated either via a second, unillustrated pipe line, or is led out of the rotor at the other end thereof. Steam or water coming from chamber **150** then passes through the hollow blades **151**. The blades extend through the rings **152** which are likewise of a hollow design. The interior of the rings is connected with the interior of the blades by the cutaway portions or openings **153**.

FIG. 16 shows one of the rings **152** of FIG. 15 in a more detailed representation, in which the openings for the blades are clearly visible. The influx is effected in such manner that the blades **160** and **161** have a higher internal pressure than the blades **162** and **163**. By this measure either water or steam is permitted to flow transversally between two neighboring blades. Since the transverse flow or crosscurrent tends to flow along the shortest path, a constriction is provided, in accordance with the invention, between the walls of two neighboring blades forming the ring, with a line of contact as indicated by the reference numeral **164**. By this constriction the current is urged toward the outer wall regions of the ring.

FIG. 17 shows a ring with its axial dimension distorted which, at the same time and in combination with the neighboring ring, forms the blades in that a projection **170**, extending axially from the ring, forms in its cross-section a blade member received in a recess or depression provided in the ring **171**, and is soldered thereto at **172**.

By this combination of a heat exchanger with the blower, the boundary layer which is decisive for the heat transfer, is built up in accordance with the rate of revolution of the rotor, and is destroyed again by an oppositely directed initial flow of the blower stream in the course of the second passage of the air through the rotor, so that the heat-exchanging surfaces function in a non-stationary manner. The practical employment of such a type of heat exchanger is in no way restricted to drying apparatus.

What is claimed is:

1. A laundry drier comprising an outer casing having walls defining a generally rectangular shape in horizontal section, an inner enclosure within the outer casing having a bottom generally horizontal wall and a generally vertical wall which walls join one another along a horizontal junction and are spaced from corresponding walls of the outer casing to define first and second chambers, a cross-flow blower comprising a cylindrical bladed rotor mounted between said chambers for rotation about a horizontal axis parallel to the junction of said walls, said rotor extending over the greater part of the length of the walls, said blower further including a motor driving said rotor and co-operating guide means inducing a flow of air on rotation of the rotor twice through the blades of the rotor in stream lines which run generally in planes transverse to the rotor axis and change direction by an angle similar in magnitude and orientation to that between the outer enclosure walls at said junction, said air flow taking place between the first and second chambers, means for heating air passing through the blower, means for recirculation of at least part of the air from said second chamber through the inner enclosure back to the first chamber, adjustable means to support laundry in said inner enclosure, and a removable lid closing said inner enclosure whereby access is had thereto for insertion of said laundry on said supports, said inner enclosure including a second generally vertical wall opposite said first wall, both said walls extending generally inwardly and downwardly, and said laundry support means comprising a series of trays hinged to one of said walls along horizontal pivot axes and movable with said lid removed from a generally horizontal operative position supported between said inner enclosure walls and an upstanding inoperative position in which said trays are stable by reason of their resting against said inner enclosure wall to which they are pivoted.

2. A laundry drier as claimed in claim 1, wherein the inner enclosure wall opposite that to which the trays are pivoted is formed to provide ledges for the support of said trays.

3. A laundry drier as claimed in claim 1, wherein said trays nest together when in operative position.

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