

# PATENT SPECIFICATION

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## (54) A METHOD FOR DRYING FLAT MATERIAL AND ARTICLES, SUCH AS LAUNDRY, AND A DRYING CABINET FOR CARRYING OUT SUCH METHOD

- (71) I, HANS BALTES, a citizen of the German Federal Republic, of Heideweg 21a, 5841 Dortmund-Holzen, German Federal Republic, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—
- 10 The present invention relates to a method of drying flat material or articles, particularly laundry or washing, within a drying cabinet and to a drying cabinet for carrying out the method.
- 15 It has been proposed to dry laundry in a drying cabinet by a method in which air is aspirated from the exterior of the drying cabinet, compressed and heated, passed through the drying cabinet with the material disposed therein, and thereafter exhausted, with the drying air floating against the material from the one side of the interior of said cabinet while being directed against the edges of said material, and with the air being discharged at the opposite side of the interior of said cabinet. The drying cabinet for carrying out this previously proposed method comprises a charging door, an air suction opening, a blower or fan, a heating device for the drying air and bars or rods for suspending the material, said bars extending from a first wall of said cabinet to the second, opposite wall thereof, wherein air guiding means are disposed in said first cabinet wall to provide for uniform flow of the drying air from said first cabinet wall into the interior of said cabinet, and wherein said second cabinet wall includes in its inner lower portion an exhaust port for exhausting said drying air from the interior of said cabinet. (See e.g. laid-open German Patent Application Nos. 2,149,873 and 2,125,369). These drying cabinets have enjoyed a high degree of success, but suffer from the minor drawbacks that the laundry which is suspended adjacent the second wall requires an ex-

tended drying period such that the total drying period is unnecessarily increased; that the exhausted air stream is very hot and carries the water removed from the laundry in an uncondensed state, that energy consumption is not as low as practically possible, and that the suspending device for the laundry is complicated to handle and may sag under high loads.

It is also a disadvantage for inexperienced users that they do not know the exact drying period for their laundry, so that they may feel induced to set too long a period of drying. Such excessive drying periods, however, are disadvantageous because not only do they result in unnecessary energy consumption, but excessively dried laundry may tend to become hard and rigid.

According to one aspect of the present invention there is provided a method of drying flat material or articles, within a drying cabinet wherein air is drawn from the exterior of the cabinet, compressed and heated, passed through the drying cabinet, with the material disposed therein, so as to flow against said material or articles from one side of the interior of said cabinet while being directed against the edges of said material or articles, discharged at the opposite side of the interior of said cabinet, and exhausted from the cabinet, and wherein the exhausted warm air is caused to exchange part of its thermal energy with the drawn in cold air.

According to another aspect of the present invention there is provided a drying cabinet for carrying out the method just indicated, comprising a charging door, an air suction opening, a blower or fan, a heating device for drying the air, bars or rods for suspending the material or articles, said bars extending from a first wall of said cabinet to a second, opposite wall thereof, air guiding means disposed in said first cabinet wall to provide for uniform flow of the drying air from said first wall into the interior of said cabinet, said second cabinet

wall including in its inner lower portion an exhaust port for exhausting said drying air from the interior of said cabinet and including in its upper portion and, optionally, in its centre portion one or more slot-shaped exhaust ports for the drying air, and a condenser or heat exchanger disposed externally of the interior of said cabinet and so arranged that air drawn into the interior of said cabinet can be preheated by heat exchange with the air exhausted from the interior of said cabinet thereby to cool said exhausted air. Preferably said rods or bars, with the exception of the rearmost bar, are adapted to be folded down individually with respect to the mounting bracket thereof, the free ends of said bars each carrying protective caps of a plastics material of high slidability, or rollers; and wherein the wall of the cabinet not carrying said bar mounting bracket has a groove in which said protective caps or rollers may slide to run, respectively, when said bars are slid into and withdrawn from said cabinet.

The present method can be carried out in such a way that uniform drying is obtained across the full space of the drying compartment of the drying cabinet which may be designed to be of simple structure, to be of more compact construction, and to dry a relatively larger amount of laundry than conventional laundry drying cabinets or closets. Furthermore, the drying cabinet may allow for condensation of the moisture extracted from the laundry.

In order to avoid excessive drying or over-drying of the laundry which would result in a hard and rigid "feel" of the dried pieces of laundry, heating of the drying air may be terminated at a given point of time in advance of the end of the drying period, and said switch-off period may be about 15 minutes.

Another method of terminating the drying operation as soon as the laundry has been dried completely, comprises measuring the temperature or humidity of the drying air to be exhausted and switching off the heating means or terminating the drying operation when a given temperature is reached, or when a given temperature increase per unit of time is detected, or when a predetermined low degree of humidity is reached.

Advantageously, the second wall of the drying cabinet has in its upper portion and, optionally, also in its centre portion one or more slot-shaped discharge or exhaust openings for the drying air with the greater cross-sectional areas of the openings for exhausting the drying air from the interior space being disposed in the lower portion. Furthermore, the drying cabinet may include suspending means for the laundry wherein a supporting surface having a width equal to the spacing between the bars is present

in said suspending means between a stationary and a movable portion, when the bars for suspending the laundry are folded upwards.

This suspending means may be used for the suspension of laundry, sheet-like material and other foldable articles. Furthermore and preferably, in such drying cabinet the bars adapted to be individually folded down relative to their mounting bracket may have their free ends provided with protective caps of plastics material of high sliding capacity, or with rollers, and the cabinet wall not supporting the bracket of the bars may have a groove in which the protective caps or said rollers slide or run, respectively, when the bars are retracted or extended into the cabinet.

Improved pivoting and latching or locking of the bars may be obtained in that the periphery of an anchoring or tie element mounted to a wall is of circular configuration with the exception of a peripheral portion at the upper side thereof, with said element having at said upper side a flat portion and a projection joined thereto, with the front face of said projection which is directed away from the bars or articles, extending vertically. The ends of the bars or articles adjacent the anchoring element have attached thereto at least one end element having an aperture through which said anchoring element passes; the upper portion of said aperture has a configuration complementary to that of the upper portion of said anchoring element, such that both faces are adapted to be fitted or nested together without clearance; and that said element has joined to its upper portion a pair of parallel legs with the spacing between said legs corresponding to the diameter of said element, and said legs having an inner, straight surface extending perpendicularly to the extension of the bars or of said article, with the length of said surface being greater than the height of the front of said anchoring element.

In order to enable the invention to be more readily understood, reference will now be made to the accompanying drawings, which illustrate diagrammatically and by way of example an embodiment thereof, and in which:—

Figure 1 is a front elevational view of a drying cabinet;

Figure 2 is a sectional view of the drying cabinet of Fig. 1;

Figure 3 is a plan view of the drying cabinet with a bar grid extended;

Figure 4 is a flow diagram showing the flow of air through the cabinet and showing how the exhausted air stream heats the entering air stream;

Figure 5 is a perspective view of the drying cabinet including an extensible

mounting bracket for the bars, with the free end of the bracket being movable within a groove in the opposing wall;

Figure 6 is a perspective view of a holding or retainer element with a bar for suspending the laundry inserted thereinto;

Figure 7 is a sectional view of a holding or retainer element placed upon an anchoring or tie element;

Figure 8 is a plan view of the mounting bracket with a bar inserted; and

Figure 9 is a perspective sectional view of a telescoping strut for supporting an anchoring element.

Referring now to the drawings, there is shown a drying cabinet comprising sidewalls 1 and 2 of double-wall construction. The cabinet is arranged so that air can flow in a uniform distribution across the interior 3 from slots 4 formed in one sidewall 1, so as to be exhausted through slots 4 provided in the other sidewall 2. Further, the interior space or compartment is bounded by a rear wall and a door 6, as well as a bottom plate 7 and an upper cover plate 8.

The sidewall 2 of the cabinet has, in its lower portion, at least one large slot 4 and, in its upper portion, at least one small slot 4. However, intermediate slots 4 may be provided between these slots with the number of such slots increasing towards the bottom. The arrangement of the slots is such that air is discharged from the interior space in a non-uniform fashion with the major portion of the air being exhausted in the lower part. In this way, a primary flow from above to below is obtained and the pieces of laundry are always neatly and vertically suspended, such that a transverse flow component when impinging against the edges of the articles or laundry, is prevented from blowing such articles towards the side wall 2 thereby to avoid blocking of the air flow path between the articles of laundry. However, the provision of the slot(s) 4 in the upper part of the sidewall 2 results in the elimination of region of insufficient air flow which would otherwise exist. In a further embodiment of the invention, the width of slots 4 is therefore made variable, or flow impeding baffles are mounted at the rear of these slots, such that the passage of air through the slots 4 provided in the upper portion and, optionally, in the centre portion, is kept small.

Bars or rods 9 for suspending articles of laundry or the like extended from the sidewall 1 to the sidewall 2, said rods 9 or other suitable suspending elements being arranged in three levels and, as shown in Figure 3, adapted to be moved out from the cabinet, or adapted to be folded down individually or as a unit.

A removable drip trough 14 may be provided below or above the bottom plate 7.

Above the upper cover plate 8 and below the bottom plate 7, there are provided at least one blower or fan 10, heater elements 11 as well as the control elements and the suction and exhaust ports for the drying air. In this construction, suitable air conduit or baffle means serve to guide the air through the blower 10 and heater elements 11 into the sidewall 1 and from the sidewall 2 into a condenser or heat exchanger 12. The aforementioned components may be formed as insertable modules, and these components may include the measuring devices for detecting humidity or air temperature, separately or in dependence upon a timer unit, as well as the cut-off means to stop the flow of air, or the heater elements.

As shown in Figure 4, the inlet air aspirated into the cabinet is brought into thermal contact with the exhaust air from the drying compartment within the condenser or heat exchanger 12, such that the temperature of the inlet air is increased, while the temperature of the exhaust air is substantially reduced. For example, a nest of tubes may serve as the heat exchanger, with the inlet air flowing through the tubes and the exhaust air contacting the outer sides of the tubes, whereby part of the moisture is condensed and the exhaust air is thereafter blown out in a substantially cooled state. The inlet air is first passed to the blower (fan), then to the condenser, then to the heater and thereafter to the air conducting sidewall 1. As the entering air is already pre-heated, substantial savings in energy may be realized. In particular, the exhausted air is greatly cooled so as to be prevented from annoyingly heating the surroundings of the drying cabinet. Below the heat exchanger 12, a (not illustrated) drip trough is positioned in which condensed water is collected. The drip trough may be adapted to be removed separately, or it may be connected to the drip trough 14 in the lower part of the cabinet by a pipeline, or provided with continuous draining means.

From the outlet of the condenser 12, the flow of drying air is heated by the heater elements 11 to the temperature required for drying purposes, i.e. to about 80 to 120°C.

As shown in Figure 5, a telescoping mounting bracket for the bars or rods 9 is positioned on the sidewall 1. The opposite sidewall 2 has formed therein a groove 16 in which the free ends of the bars 9 are guided during withdrawal of the bars and when the bars are inserted again. In order to provide for better guidance of the bars, the free ends thereof carry protective caps 17 consisting of a highly slidable plastics material, such as PVC or PTFE. In a further modification, the protective caps 17 may be replaced by rollers thereby to facilitate the insertion of the rods or bars

9 when large or heavy loads are suspended from the rods or bars 9.

The mounting bracket for a rod 9 shown in Figure 9 comprises an outer section 32 secured to sidewall 1 or inserted into a groove thereof, and in which another section 34 is slidably guided. The latter section, in turn, has attached thereto an anchoring or tie elements 21 for the rods 9.

In order to provide for improved support of the anchoring or tie element 21, the rearmost rod 9 is securely mounted thereto, and the guides are of so short a length that the rearmost rod cannot be withdrawn from the cabinet, but that the free end thereof is constantly retained within the groove 16.

The user of the present drying cabinet would first load the rearmost rod 9 with articles, would thereafter fold up the rod in front of the rearmost rod and hang articles from such rod and continue in this manner until all rods are loaded, whereupon the rods or bars will be slid into the cabinet. It is immaterial whether the rods are each placed into the cabinet directly after having been loaded, or whether the fully loaded grid is slid into the cabinet only.

The dried laundry may then be removed by reversing the above operation, unless the direct placing onto, and removal from, the horizontally extending rods is preferred.

As shown in Figures 6 to 9, the mounting bracket for the suspending rods or bars for laundry and other downwardly foldable articles generally comprises an anchoring or tie element 21 having a length corresponding to an integral multiple of end elements 26 into which the rods 9 are inserted, if required. The end elements 26 have a specific width in the range of some centimetres, and the width thereof corresponds to the spacing between a pair of rods, such that the width thereof is determined by thermodynamic considerations.

Although the mounting bracket is suitable particularly for suspending rods or bars for the drying of laundry, this structure may, however, be used in the industrial field for the drying of any other material. For example, each of said end elements may be employed for supporting plates, such that the mounting bracket may be used also for fold-down shelves, table tops, supports or braces, doors for use in furniture and the like. This use is only restricted by the requirement that anchoring or tie elements 21 must be properly fastened; but regardless of such requirement, any desired articles may be securely held or suspended even in the case of high loads and limited available space.

Even laundry articles of great length may be suspended in the drying cabinet using

the mounting bracket if, for example, the lower rows of bars or rods are folded down and not loaded.

The anchoring or tie element 21 has both ends thereof either connected to the exterior plate of a telescoping strut such that the thus formed suspending device may be completely withdrawn from a drying cabinet. In the inserted state, the rods then extend from one sidewall to the other.

In detail, the anchoring or tie element has major part of its circumference formed with a circular configuration, and only the upper side of the element 21 is formed with a flat portion 22 which joins a projection 23 at the end adjacent the rod(s), which projection, in turn, has a front face 24 at its side opposite from the rods. For reasons of weight reduction, the anchoring or tie element 21 may be hollow.

The end elements 26 of rods 9, or plates, preferably of circular configuration, are each formed in the lower portions thereof with an aperture the upper part of which is shaped complementary to the upper portion of said anchoring or tie elements 21, such that the two mating surfaces are adapted to be nested or slid into each other without any clearance.

At the side of the anchoring or tie elements 21, end elements 26 include a pair of legs 27 each extending perpendicularly to the rods in parallel with each other, and the free height of which is at least as great as the height of the front faces 24. Thus, the end elements 26 may be lifted relative to the anchoring element 21 by at least the height of the front faces 24, whereby the edges of projections 23 are released from each other and rods 9 may be swung into a vertical position.

For reasons of strength, the legs have their lower sides interconnected by an integral yoke 27a such that a closed annular structure of high strength is formed; at least, however, such lower ends are angularly bent inwards.

The type of attachment of the anchoring elements 21 to base plates or telescoping struts, as explained above, is optional and need not be described in any greater detail. Studs or, as shown in Figure 9, screws or bolts 31 may be used.

According to Figure 9, the anchoring elements 21 may be connected to a telescoping strut of particularly advantageous construction, by means of screws 31 or studs. Telescoping struts of this type may be employed both in drying cabinets of the above-outlined type, and in any desired pieces of furniture, such as for drawers of writing desks, tables and closets, as well as for wire baskets in dish washing machines, refrigerators and the like. Accordingly, the use of these elements is not limited to dry-

ing cabinets; rather, they may be used in any place where conventional telescoping struts are employed and subject to particularly high demands with respect to easy slidability, extensibility and, especially, strength to bending or twisting.

As shown in Figure 9, the telescoping struts comprise a U-shaped section 32 stationarily mounted to the cabinet and having the outer flanges thereof continuing into inwardly directed hook-shaped flanges 33, and a fitting piece 35 disposed in the area of the flanges of section 32 while a further fitting piece 36 or a plurality of corresponding fitting pieces are arranged in the flange area of section 34, said fitting pieces being formed of plastics material or of a suitable material having self-lubricating properties. Fitting pieces 35 are secured to the outer flanges of section 34, and fitting pieces 36 are secured to said studs or screws 31 of other suitable fastening elements.

For improved attachment of fitting piece 35, the centre portion of section 34 may have both sides thereof extended beyond the outer flanges, and between the fitting pieces 36 disposed in upper and lower positions, respectively, there may be present a bridge member integrally connecting said fitting pieces and having an anchoring or tie element 37 formed therein during manufacture thereof or at a later point of time. This anchoring element 37 then allows the insertion of the studs or the threaded engagement of the screws 31 or of other connecting means. The modern plastics materials and other, properly chosen materials show minimum coefficients of friction relative to smooth surfaces, e.g. of steel or aluminium sections or profiles, such that extension and retraction of the telescoping strut requires minimum effort even under high pressure or compressive loads.

The use of fitting pieces in the place of the conventional ball guide means provides freedom from backlash, such that torsion or bending (deflection) is thereby avoided.

#### WHAT WE CLAIM IS:—

1. A method of drying flat material or articles within a drying cabinet wherein air is drawn from the exterior of the cabinet, compressed and heated, passed through the drying cabinet, with the material disposed therein, so as to flow against said material or articles from one side of the interior of said cabinet while being directed against the edges of said material or articles, discharged at the opposite side of the interior of said cabinet, and exhausted from the cabinet, and wherein the exhausted warm air is caused to exchange part of its thermal energy with the drawn in cold air.

2. A method as claimed in claim 1, wherein the drying air is first passed from

the interior of the cabinet to a condenser from the condensation of part of the water entrained by the air stream while simultaneously cooling the latter, and is subsequently exhausted, and wherein fresh air is sucked in by a blower, then passed to said condenser and preheated therein, thereafter passed to a heater and finally passed to the interior of the cabinet.

3. A method as claimed in claim 1 or 2, wherein the humidity of the drying air to be exhausted is measured and the heating or the drying operation is terminated when the humidity has decreased below a given value.

4. A method as claimed in claim 1 or 2, wherein the temperature of the drying air to be exhausted is measured and the heating or the drying operation is terminated as soon as a given temperature is reached or a specific temperature increase per unit of time is detected.

5. A method as claimed in any one of claims 1 to 4, wherein a major part of the drying air is exhausted from the lower portion of the drying cabinet and a smaller part of said drying air is exhausted from the upper portion of the drying compartment.

6. A method as claimed in any one of claims 1 to 5, wherein the heating of the drying air is terminated at a given point of time prior to the end of the drying operation.

7. A drying cabinet for carrying out the method claimed in any one of claims 1 to 6, comprising a charging door, an air suction opening, a blower or fan, a heating device for drying the air, bars or rods for suspending the material or articles, said bars extending from a first wall of said cabinet to a second, opposite wall thereof, air guiding means disposed in said first cabinet wall to provide for uniform flow of the drying air from said first wall into the interior of said cabinet, said second cabinet wall including in its inner lower portion an exhaust port for exhausting said drying air from the interior of said cabinet and including in its upper portion and, optionally, in its centre portion one or more slot-shaped exhaust ports for the drying air, and a condenser or heat exchanger disposed externally of the interior of said cabinet and so arranged that air drawn into the interior of said cabinet can be preheated by heat exchange with the air exhausted from the interior of said cabinet thereby to cool said exhausted air.

8. A drying cabinet as claimed in claim 7, wherein the said rods or bars, with the exception of the rearmost bar, are adapted to be folded down individually with respect to the mounting bracket thereof, the free ends of said bars each carrying protective

caps of a plastics material of high slidability, or rollers; and wherein the wall of the cabinet not carrying said bar mounting bracket has a groove in which said protective caps or rollers may slide or run, respectively, when said bars are slid into and withdrawn from said cabinet.

9. A drying cabinet as claimed in claim 8, wherein said rearmost rod or bar is of a stronger construction than said front bars, and is securely connected to said mounting bracket, said bracket being extensible only to such a degree that the free end of said rearmost bar is always retained within said groove.

10. A drying cabinet as claimed in claim 8 or 9, wherein said cabinet wall has secured thereto a section into which an intermediate telescope member is slidably inserted and is guided by rollers or sliders, said telescope member in turn having inserted thereinto in telescopic fashion said bracket of said bars under the guidance of rollers or sliders.

11. A drying cabinet as claimed in any one of claims 8 to 10, wherein said bar mounting bracket includes an anchoring or tie element having its circumference formed with a circular configuration with the exception of a peripheral portion at the top of said element; said anchoring element including at the top thereof a flat or plane portion and a projection joined thereto, with the front face of said projection which is opposite from said bars or articles extending vertically; wherein the ends of said articles adjacent said anchoring element have attached thereto at least one end element having an opening through which said anchoring element passes, the upper portion of said opening having a configuration complementary to that of said upper portion of said anchoring element, whereby both surfaces are adapted to be fitted or nested together without clearance; and wherein said end element has joining the upper portion thereof a pair of parallelly

extending legs with the spacing between said legs corresponding to the diameter of said element, said legs having a straight interior surface extending perpendicularly to the extension of said article and the length of which is greater than the height of said front face of said anchoring element, said legs having their ends bent inwards or interconnected by an integrally formed yoke.

12. A drying cabinet as claimed in claim 11, wherein the upper slides of said anchoring element and of said end element are of circular configuration, said anchoring element having its upper side formed with vertically extending radial bores adapted to receive pins of said end element, with the length of said pins being at most as great as the length of the straight surfaces of said legs, with said pins extending in parallel with said surfaces or said legs.

13. A drying cabinet as claimed in any one of claims 7 to 12, wherein a stationary U-shaped section of said cabinet, the outer flanges of which continue into inwardly directed hook-shaped flanges, has slidably positioned therein a U-shaped section of identical configuration, and wherein the flange portions of said profiles have each fitted thereinto a fitting piece each formed of plastics material or of other material having self-lubricating properties, with said fitting pieces being secured to the outer flanges of said section and said fitting pieces being secured to studs or other suitable mounting means.

14. A method of drying flat material or articles substantially as hereinbefore described with reference to the accompanying drawings.

15. A drying cabinet substantially as hereinbefore described with reference to the accompanying drawings.

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Fig.1

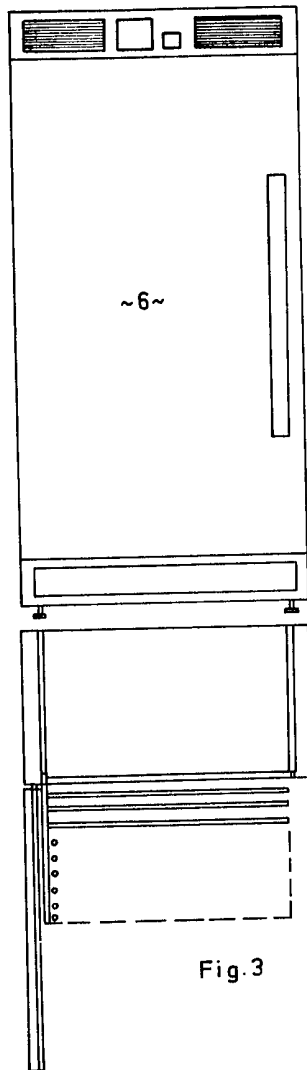


Fig.2

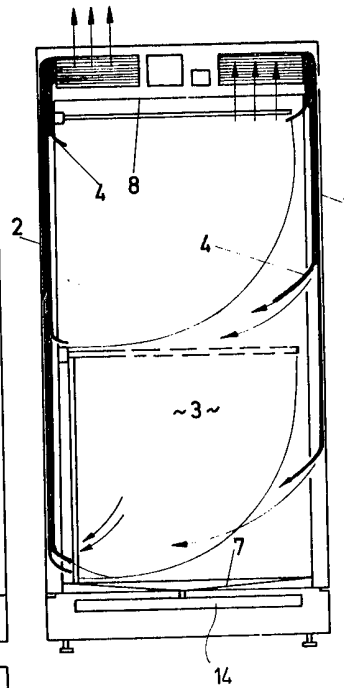
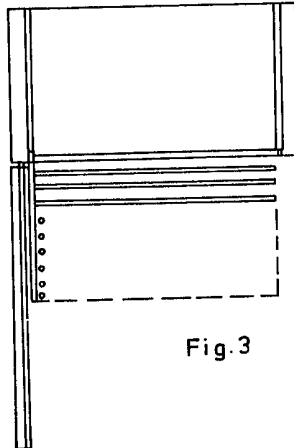


Fig.3

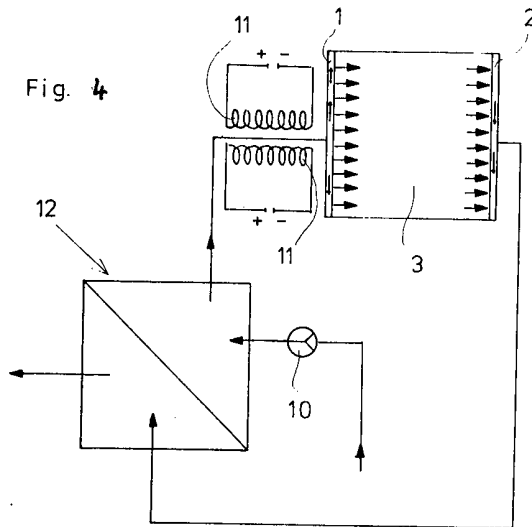


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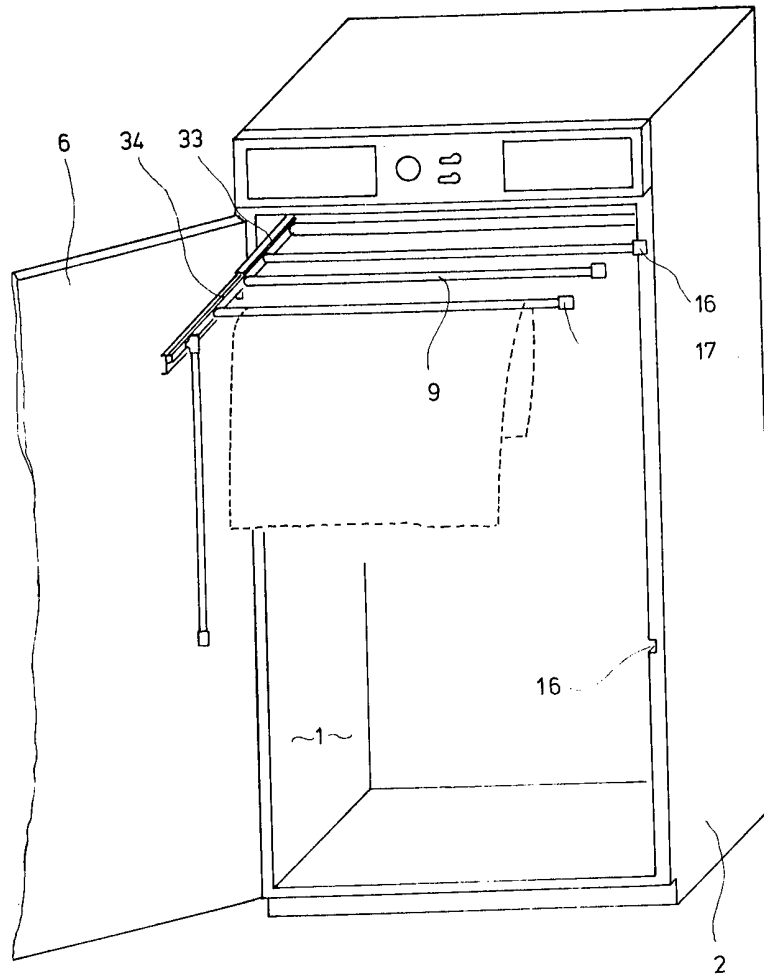


Fig. 5

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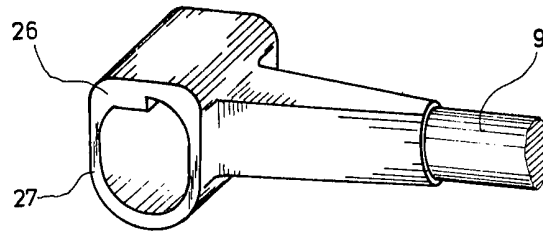


Fig. 6

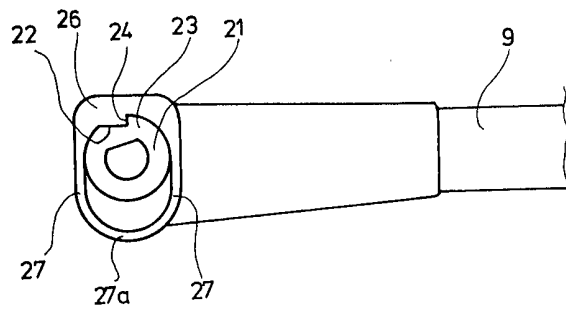


Fig. 7

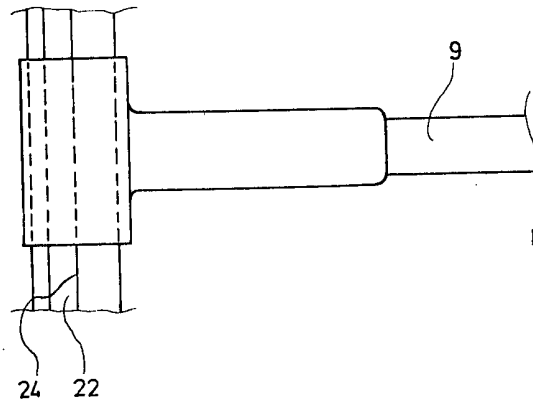


Fig. 8

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