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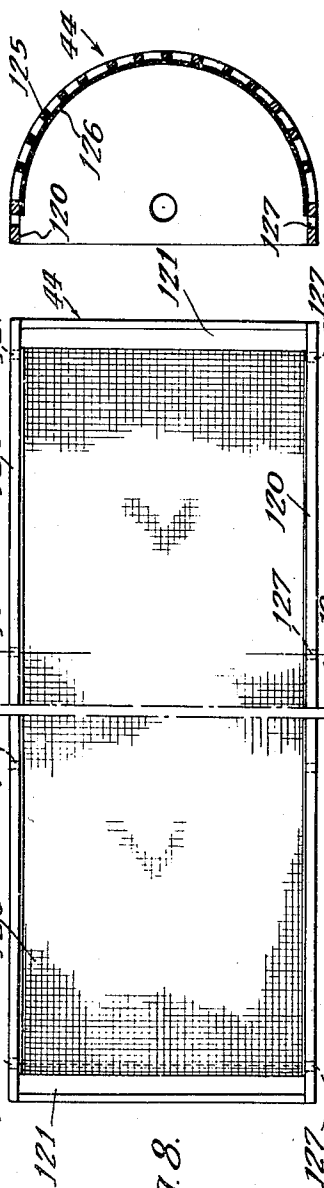
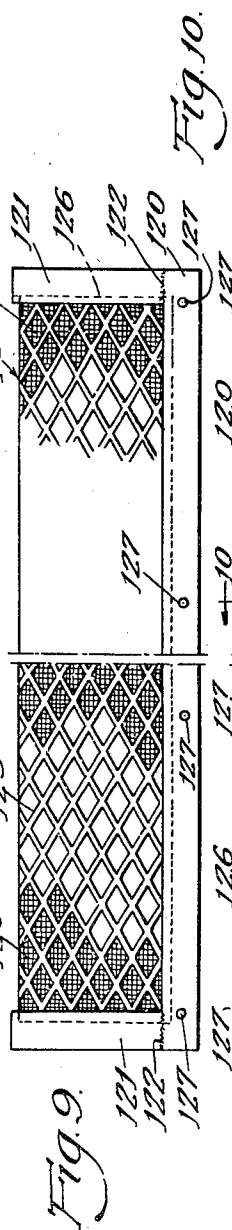
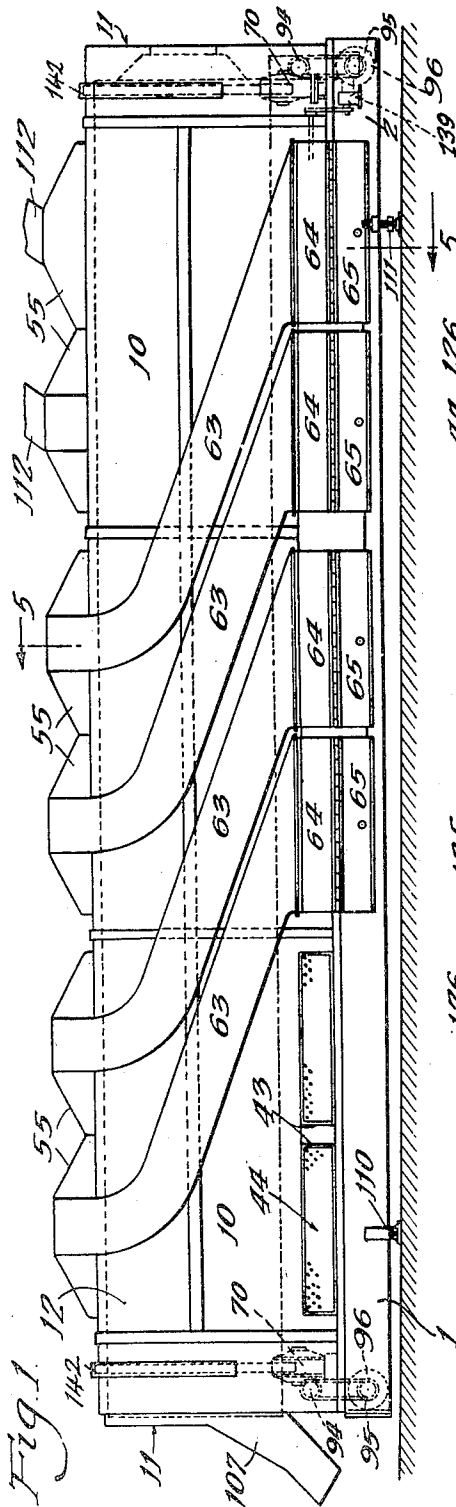
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2,451,206

METHOD AND DEVICE FOR DRYING WOVEN FABRIC MATERIAL

Filed Jan. 10, 1945

8 Sheets-Sheet 1



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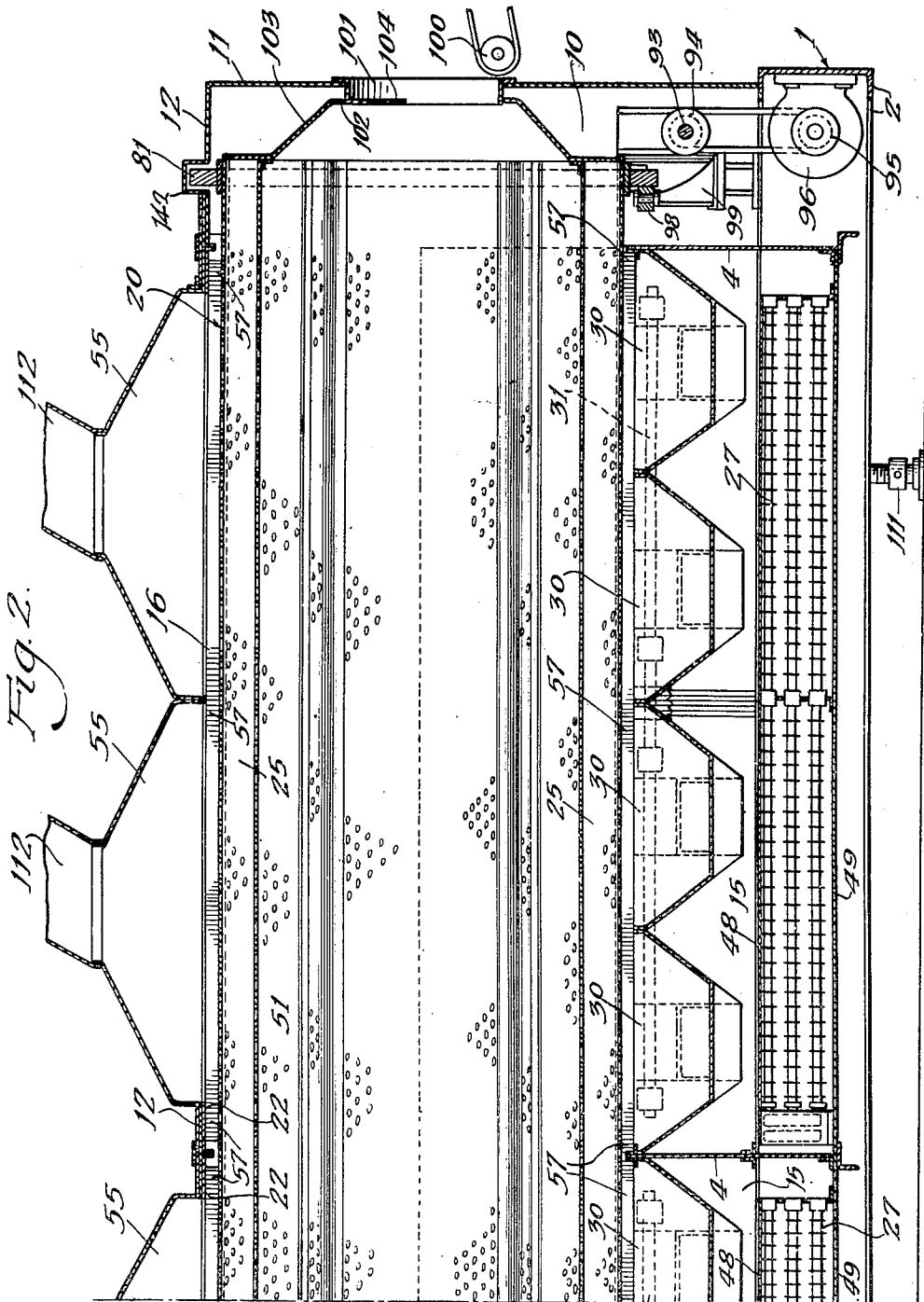
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METHOD AND DEVICE FOR DRYING WOVEN FABRIC MATERIAL

Filed Jan. 10, 1945

8 Sheets-Sheet 2



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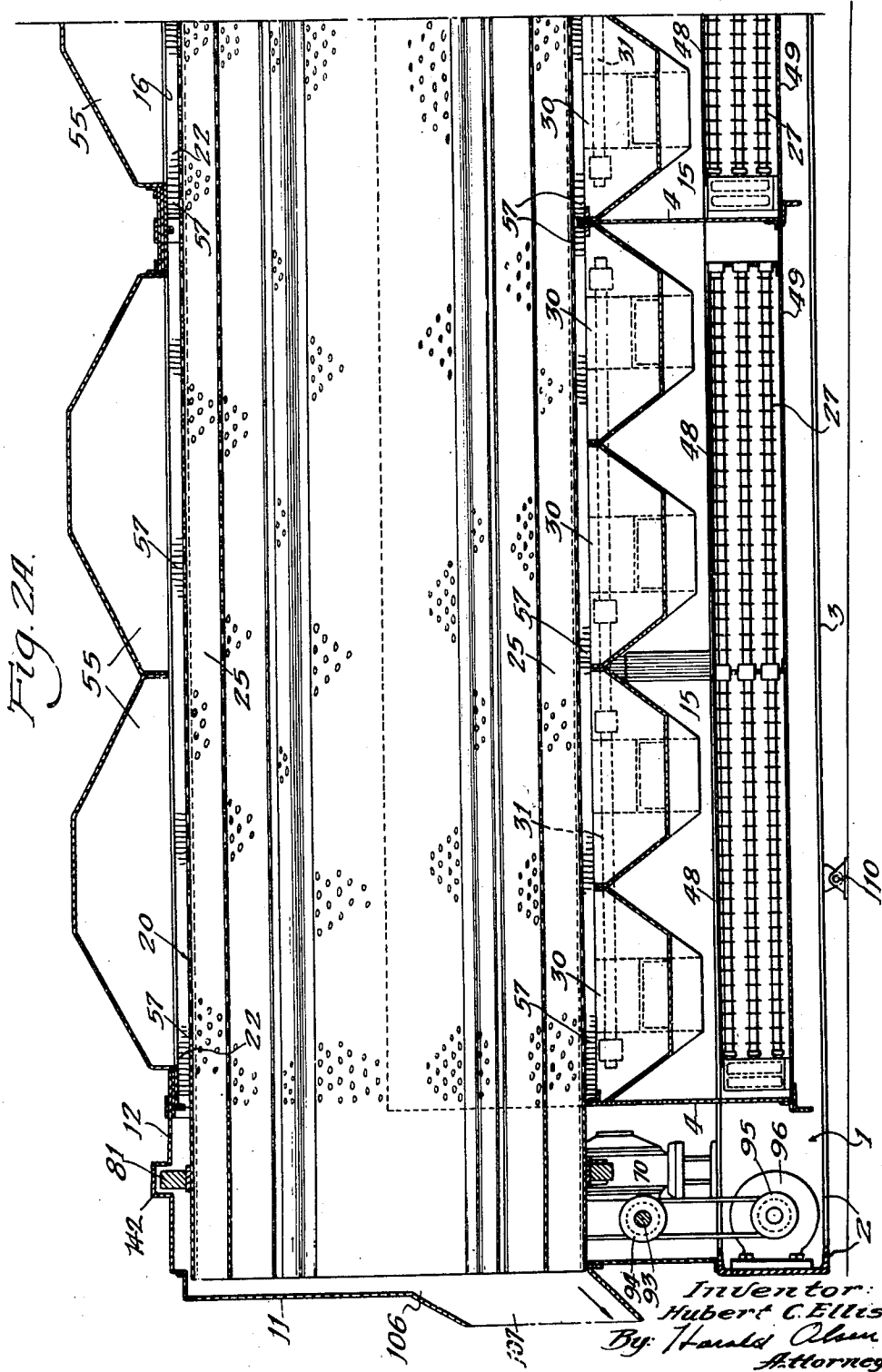
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2,451,206

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Filed Jan. 10, 1945

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Oct. 12, 1948.

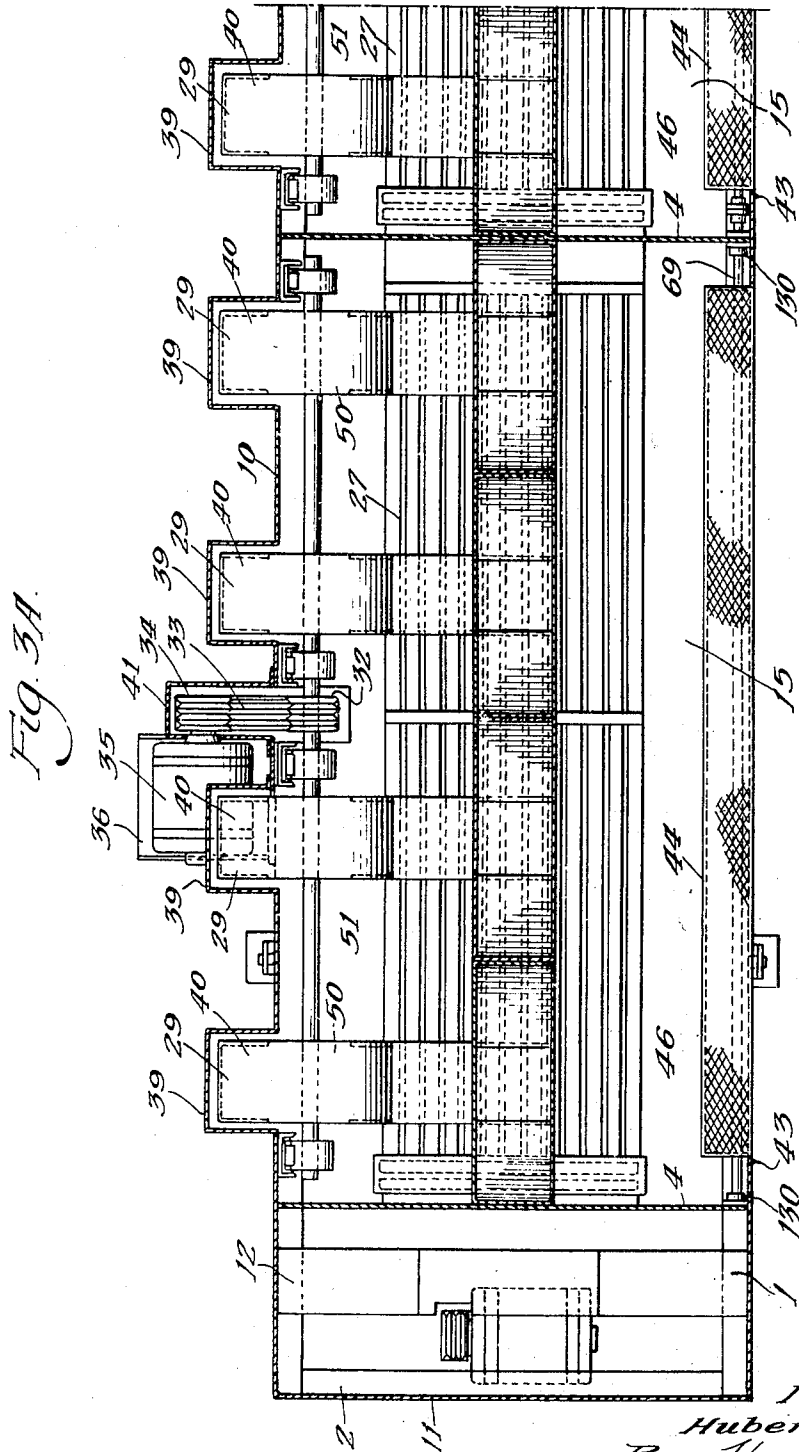
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Filed Jan. 10, 1945

8 Sheets-Sheet 5



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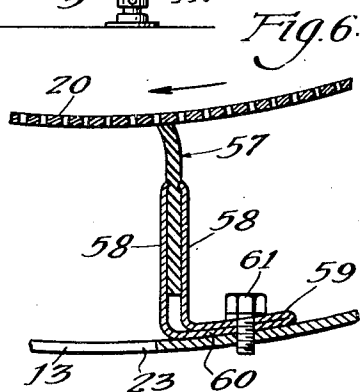
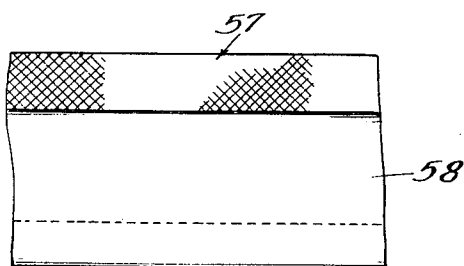
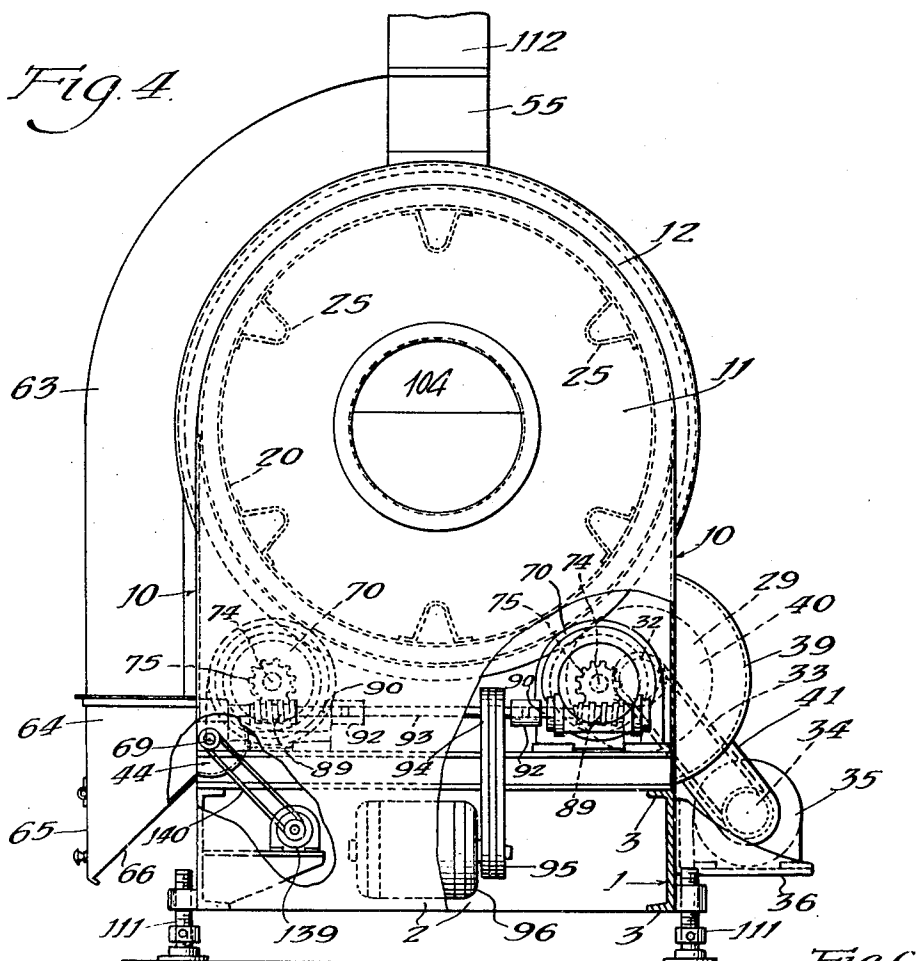
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2,451,206

METHOD AND DEVICE FOR DRYING WOVEN FABRIC MATERIAL

Filed Jan. 10, 1945

8 Sheets-Sheet 6



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METHOD AND DEVICE FOR DRYING WOVEN FABRIC MATERIAL

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Fig. 5.

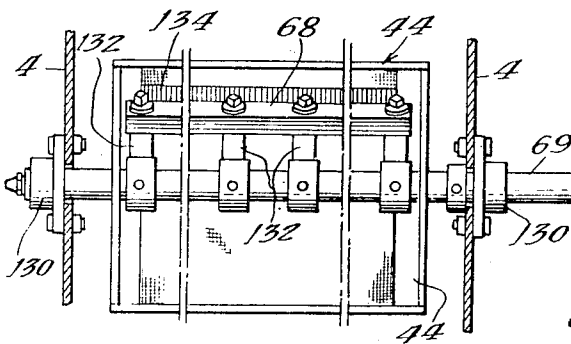
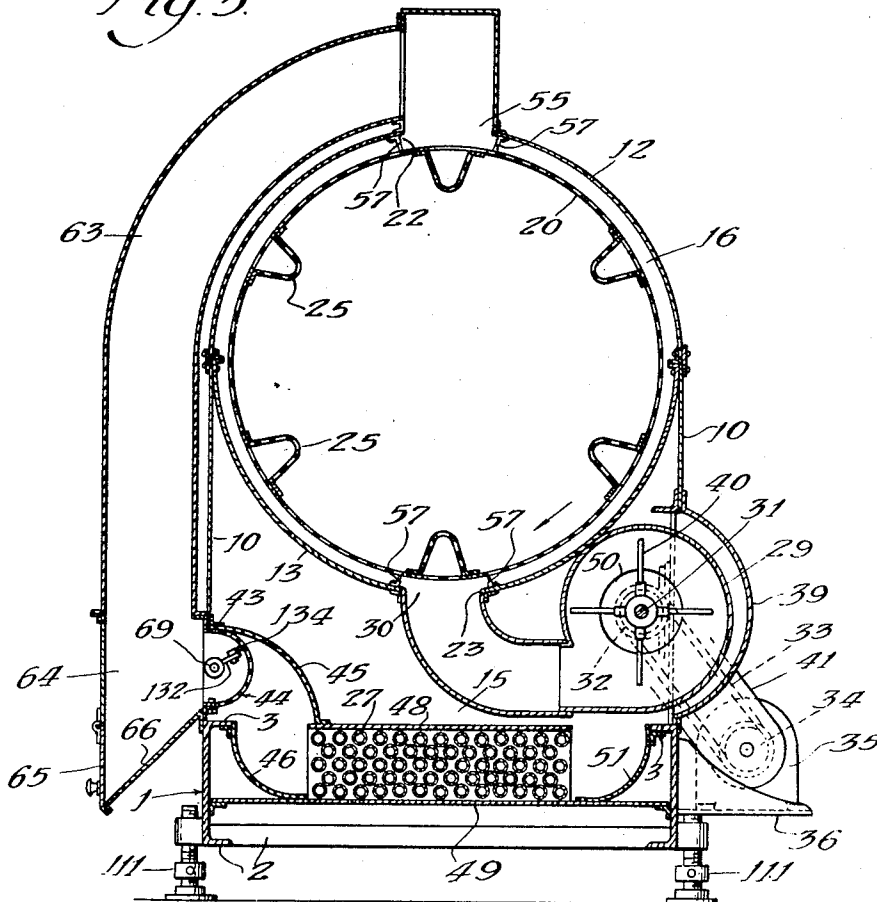
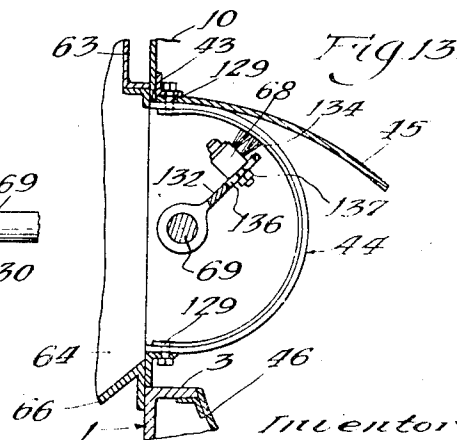


Fig. 14.



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Filed Jan. 10, 1945

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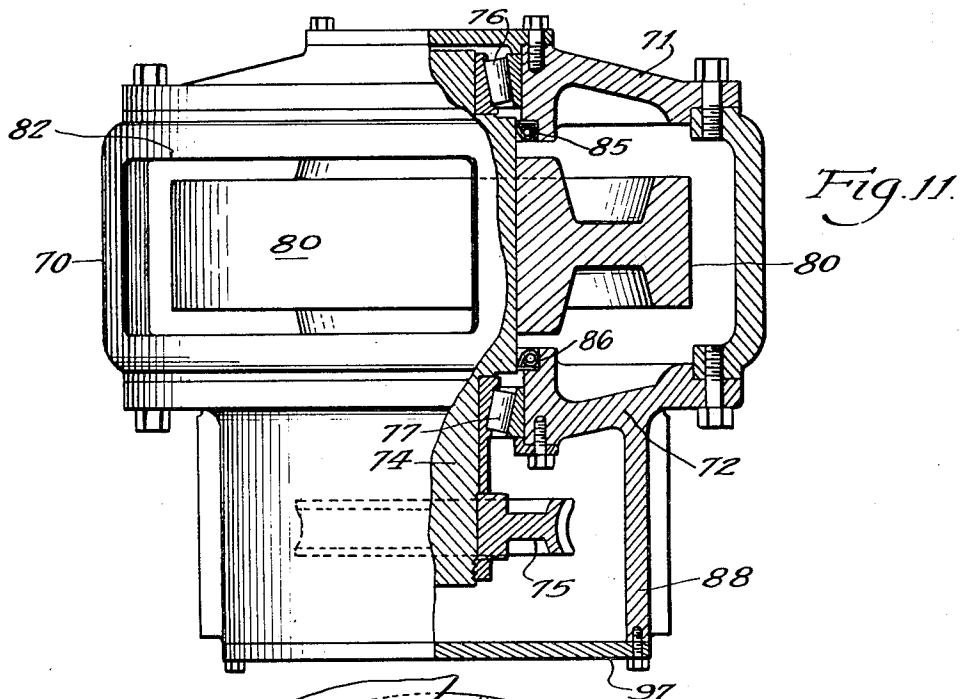


Fig. 11.

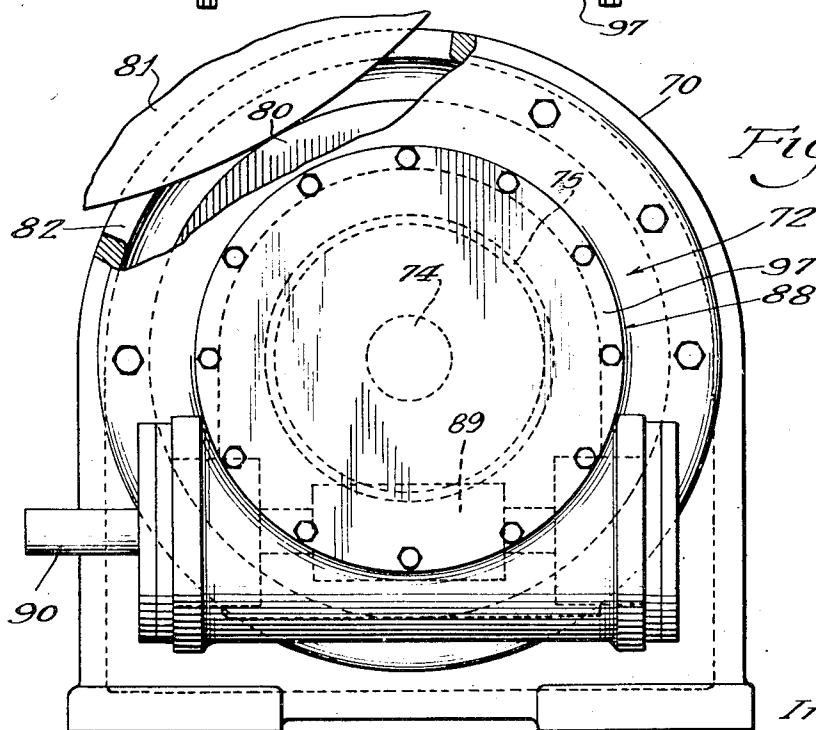


Fig. 12.

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UNITED STATES PATENT OFFICE

2,451,206

METHOD AND DEVICE FOR DRYING WOVEN
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Application January 10, 1945, Serial No. 572,193

2 Claims. (Cl. 34—133)

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This invention relates to improvements in drying apparatus particularly adapted for drying washable fabric material, more quickly and more thoroughly and with a minimum expenditure of heat. The device is particularly designed for drying large quantities of material. I am aware that various attempts have been made to simplify and make more efficient devices known as dry tumblers, but all of the devices known to me are complicated, relatively expensive and are of small capacity.

Moreover, prior devices known to me require doors in the cylindrical side of the drying drums and in the outer casing which surrounds the drum. In order to introduce or remove material from the drum a mechanism must be provided for causing the drum to be stopped so that its doors register or are opposed to the door or doors of the outer casing. Another objection is that the door of the drum-enclosing casing is generally of such size and weight that power devices are required to open it and hold it open while the material is being introduced or removed through the door openings of the drying cylinder. These power devices are mounted on the device itself. All of these various devices are complicated and expensive, and it is an object herein to do away with substantially all of them and to provide a dry tumbler in which there are no doors, either for the tumbler itself or for the casing which surrounds the tumbler.

Another object is to provide a device of very large capacity but which is much cheaper to make and to operate than any device for the same purpose known to me and in which the heating costs are reduced due to the method herein of heating and reheating the air.

Another object is to provide an improved means which serves the double function of rotatively supporting the drum and of driving it.

Another object is to provide an end-feed and end-discharge drum, rather than a side-feed drum which requires doors, and another object is to provide a device to which the material to be dried can be fed continuously, as by means of a belt conveyor.

Another object is to provide means whereby heated air as a drying medium can be circulated, reheated and recirculated and be used to much greater advantage than is generally true in devices known to me, for the same purpose.

Another object is to use a relatively large number of blowers in a manner to maintain even volume and pressure of the heated air, and to arrange the relatively small fans or blowers in

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groups and to provide structures by which the air delivered by a group of fans is combined so as to form a substantially uniform stream of air, and to confine air flow to a diametric region of the drum.

Another object is to so arrange the groups of fans that one group blows the air upwardly through the material while another group acts on the air during its upward passage to withdraw it and move it across a heater and then blow the reheated air again upwardly through a different portion of the drum.

Another object of the invention is to provide a relatively cheap base structure and devices for supporting heating coils below the drum and to provide a plurality of heating devices, each of which is adapted to heat air for a particular zone of the drum and to further provide means whereby the air after passage through the drum is directed to another heater which heats the air for another zone of the drum. A further object of the invention is to remove the lint from air after passage through the material of the drum and immediately before it reaches the heating coils.

Features of the invention include: All details of construction shown or described; the specific drive and supporting mechanism for the drum; the arrangement of blowers in groups and the arrangement of delivery ends of the blowers beneath the drum in a manner to direct a continuous stream upwardly through the drum; the application of the stream of heated air in the diametric region of the tumbler; the use of collector hoods, each adapted to receive air from a plurality of fans after the upward passage of that air through the drum and material; the conduit connections between these receiving hoods and lint-collector chambers; the specific structures of the air seal; the specific structure of the delinter screen; the specific structure by which air is delivered from a lint-collector chamber to the heater coils and passed through the heater coils to the blowers; the specific casing structure which surrounds and insulates the perforated tumbler drum and the means for mounting and moving the bottom frame of the device so that the axis of the drum is slanted downwardly from its receiving to its delivery end.

Objects, features and advantages of the invention will be set forth in a description of the drawings forming a part of this application, and in said drawings—

Fig. 1 is a side elevation illustrating one embodiment of my invention;

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Figs. 2 and 2A are parts of a single view, in vertical longitudinal section, showing the relation of the zones of the tumbler drum to the heating and blowing zone-chambers;

Figs. 3 and 3A are parts of a single view, in plan section, illustrating the structure of the heater and zone-chambers;

Fig. 4 is an end elevation of the receiving end of the device, with parts broken away to show some of the driving mechanism;

Fig. 5 is a vertical transverse section taken approximately on line 5—5 of Fig. 1;

Fig. 6 is a vertical transverse detail section illustrating the air seal in relation to the tumbler cylinder;

Fig. 7 is a side elevation of a portion of the air seal;

Fig. 8 is an elevation of the delinter screen looking at its concave side;

Fig. 9 is a top plan of Fig. 8;

Fig. 10 is a vertical section on line 10—10 of Fig. 8;

Fig. 11 is a plan section illustrating the drum-supporting and drive roller and its supporting casing;

Fig. 12 is an elevation, partly in section, of the structure of Fig. 11;

Fig. 13 is a vertical transverse detail section showing how the delinter screen is attached with the screen in end elevation; and

Fig. 14 is a view showing the delinter screen in elevation and in relation to the brush shaft and delinter brushes.

In the drawings (see Figs. 3 and 3A) the numeral 1 generally designates an elongated rectangular base frame composed of channel irons 2 having their flanges 3 turned inwardly. This frame is divided longitudinally into three chambers or zones (see Figs. 2 and 2A) by means of vertical transverse partitions 4. This "zone" division corresponds to the passage of heated and reheated air through different portions of the material. The different portions of the air are heated and reheated, circulated and recirculated.

Supported by the base frame 1 is a casing structure providing opposite longitudinally extending side walls 10 and end walls 11. These walls are heat-insulated by means not shown. There is also provided a semicylindrical wall portion 13 which forms the top of the aforesaid zone-chambers now designated 15, and completes (with the semicylindrical upper dome portion 12 of the casing structure) an elongated upper chamber 16 of cylindrical configuration extending the full length of the machine over the zone-chambers 15.

Within the upper cylindrical chamber 16 is arranged an elongated and extensively perforated cylindrical tumbler drum 20 rotatable in the chamber on a downwardly slanting axis (see Figs. 1, 2 and 2A). In the present embodiment the length of the cylinder or tumbler drum is about thirty-three feet and its internal diameter is about fifty-four inches. This drum is preferably made in a plurality of welded-together sections. For convenience only a few of the many perforations of the drum have been shown. Those portions of this drum which lie over the three zone-chambers 15 heretofore described, are considered to be zones each of a longitudinal extent equal to that of the corresponding zone-chamber. It is upwardly through these zones that separately generated streams of air of uniform pressure and volume are blown or forced by the blowing action of one set of fans and the suction action of another set.

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In the uppermost part of the cylindrical wall 12 of each zone of the casing structure there is a longitudinal opening 22, and in the wall 13 which forms the lower cylindrical half of the chamber 16 is a similar opening 23. The latter openings receive heated air under pressure from the blowers of that zone and the openings 22 receive air after its passage through the material in the drum. The longitudinal openings 22 and 23 are therefore vertically aligned in a region diametric to the drum and to the cylindrical chamber 16.

The drum 20 is provided with a plurality of longitudinally extending hollow tumbler elements or projections 25, also made of extensively perforated material, and thus the drum as well as its tumbler elements are highly perforated to facilitate the passage of heated air therethrough and through the material. Since the rotative axis of the drum is slanted, rotation thereof will cause the material to move from one end to the other in a spiral path. The tumbler elements cause motions and placements of the woven materials, such as to enhance the drying action of the heated and circulated air. The air passes through the arched or hollow tumbler elements and through the material hanging thereon and falling therefrom. The material falls from those tumbler elements into the upwardly directed stream of heated air. This air is forced vertically through a diametric zone of every portion of the drum throughout its entire length in an unbroken stream of substantial volume.

In each zone-chamber 15 is a heater or heater unit 27, in this instance composed of a large number of horizontal pipes having radiation fins. Steam is preferably used as a heating agent. These heaters are of considerable capacity and extend lengthwise and crosswise as shown respectively in Figs. 3, 3A and 5. Since the cylindrical wall 13 forms the tops of the zone-chambers 15, some heat is applied to the lower wall of the chamber 16 which extends the full length of the drum.

In each of the lower zone-chambers 15 there is, in addition to the heater, a set of blowers, in this instance four blowers for each chamber. Each blower 29 is adapted, as will be more fully hereinafter disclosed, to suck air through the heater unit 27 of a chamber 15 and force the heated air upwardly through the elongated openings 23 and 22 heretofore described.

Now referring to Figs. 3, 3A and 5. The delivery ends 30 of the blowers are so arranged with relation to the opening 23 that an upward stream of heated air is forced through the drum. As shown in Figs. 2 and 2A the delivery ends about one another to form a continuous longitudinal throat for each zone. The four blowers for each zone are driven from a common shaft 31 which has a belt pulley 32 driven by a belt 33 from pulley 34 of an electric motor 35. This motor is mounted at a point outside of the wall 10 of the casing structure and is suitably held on a horizontal support 36 attached to the base frame 1 as best shown in Fig. 5. The casing structure has outwardly extending arcuate portions 39, each of which receives a corresponding cylindrical portion 40 of the fan or blower. A belt opening (see Figs. 3 and 3A) is provided in the wall 10. A suitable casing 41 surrounds the belt and its pulley to provide a seal at this point to prevent escape of heated air.

In that wall 10 of the casing structure which is opposite the wall of the fan or blower are provided elongated air intake openings 43 which are

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thus in one and the same wall of the casing structure. One of these openings 43 is shown in elevation in Fig. 1, one is shown in Fig. 5, and the relations of these openings to the zone-chambers 15 are also shown in Figs. 3 and 3A. Each opening is of substantially the same longitudinal length as the length of the corresponding zone-chamber, and each of these openings has secured therein a semicylindrical or arcuate delinter screen 44 of highly perforated material. The structure of this screen as well as the manner of connecting it are features.

In order to guide the air from an intake opening 43 to and through the heating coils of a zone-chamber, there are provided arcuate elements 45, 46 of sheet metal disposed as shown in Fig. 5 to form a passage or channel connecting with one side of the heater. For convenience element 45 is omitted in Figs. 3 and 3A. On top of the heater elements or pipes of each heater is arranged a sheet metal cover 48 (omitted in Figs. 3 and 3A) and this cover with the support 49 for the heater coils, together with the arcuate elements just mentioned, form a channel which confines and directs the air across and between the coils. At the side of the coils nearest the intake opening 50 of the fan 29 is another arcuate sheet metal element 51 which acts to guide the air upwardly toward the intakes of the set of fans or blowers. The air-guiding structure in its relation to the fans and delinter screen is a feature.

Each upper opening 22 has thereover a pair of hoods 55, see Figs. 2 and 2A. In this instance there are three pairs of hoods, one pair for each of the three heater zones, and it will be noted that there is one hood above each pair of fans or blowers, that is, a pair of fans delivers upwardly to each hood.

Now referring to Fig. 5. In order that the heated air may be confined to a vertical diametric region of the drum to obtain a jet-effect of the upwardly forced heated air there are provided at each side of each of the openings 22 and 23 respectively of the upper and lower cylindrical parts of the casing structure wiper-like elements generally designated 57. These elements are supported as best shown in Fig. 6 and sealingly wipe against the exterior surface of the drum. The material of the wipers is preferably composed of heavy canvas of a width greater than the space between the casing and the drum, and initially flexed to forcibly engage the drum and allow for takeup due to wear. The air jets are forced upwardly by combined blowing and suction actions, blowing at the bottom suction at the top.

Reverting to the pairs of elements 57 and to Fig. 6. This structure is another feature of the invention. As before stated, the elements 57 are made of fabric material, preferably canvas duck. This element 57 extends the full length of a zone and is clampingly held by means of a pair of arms 58 which are formed by bending a piece of sheet steel on itself as shown at 59 to provide a base 60 which is clamped to the cylindrical wall 13 by a suitable screw 61, the elements 58 being bent substantially at right angles to the base 60 as shown.

Features of this invention relate both to the method of handling the air and to the various structures for so handling it. Thus far means have been provided for tumbling the material in a perforated drum while moving it in a spiral course lengthwise of the drum and for forcing heated air in jet-like form vertically through all portions of the material, as it is thus moved.

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The method includes the repeated heating of the air and the forcing of heated air through the drum, each time at a different region lengthwise of the drum, and so operating as to maintain even pressure flow of air from its region of entry below the bottom of the drum to its region of exit above the drum. The method also includes the heating of the air to different temperatures in different zones conformably to the moisture content of the load or batch of material.

Referring to Figs 1 and 5. Repeated reheating of the air is accomplished herein in the following manner: The two receiving hoods 55 of that zone nearest the delivery end of the drum are connected by suitable conduits 63 with the corresponding openings 43 through which heated or reheated air is delivered to the heaters. These conduits are arranged at the outside of the casing structure. In this embodiment reheating occurs in those two zones which are most remote from the delivery end of the drum, and in this instance also there are only two zones in which the air is reheated, the air of the first zone being received from the room or enclosure in which the device is used, and being received through that opening 43 which is nearest the delivery end of the drum. A greater number of zones and reheatings may be used.

In order to obtain and maintain maximum heating efficiency for the heaters, means is provided to remove the lint from the air after it is passed through the material or batch in the drum, and before it is again passed across the heater. It will be understood that during passage of the heated air upwardly through the material, it gathers considerable lint. Therefore, means is provided to remove this lint from the air to prevent its deposit on the heaters. To this end each pair of conduits 63 delivers into a lint chamber 64. These chambers have been omitted in Figs. 3 and 3A. There is one of these chambers for each heating zone, and two conduits 63 deliver into each chamber. Each chamber has two doors 65 at its bottom and each chamber has an outwardly, downwardly slanting bottom 66 as shown in Fig. 5. The doors close against the outer edge of the downwardly slanting bottom. The heated air passes from a chamber 64 through the delinter screen 44 of the corresponding intake opening 43, thence to and through the heater. A brush 68 is provided for each screen and is mounted on a shaft 69. The mounting of the brush elements is best shown in Figs. 13 and 14. These brushes are rotated and wipe against the perforated semi-cylindrical screens 44.

Thus, each hood 55 is connected with the intake opening 43 of the next zone so that air is heated and reheated successively in each of a plurality of zones or portions located lengthwise of the path of movement of the material. This arrangement not only conserves heat, but provides an increased drying capacity for this device by which, in a drum which is thirty-three feet long, the material can be moved from end to end and dried in about twenty minutes.

Another feature of this invention, in a device of this class, is the manner of driving the drum. The location of this drive means is best shown in Figs. 1, 2, 2A and 4. The drum is provided at a point immediately adjacent each opposite end with a ring or tire, in this instance preferably made of steel. The position of the ring and its cross-sectional configuration is shown in Figs. 2 and 2A.

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Now referring to Fig. 4. The ring rests on and the whole drum is supported and driven by only four rollers, a pair at each end.

In Figs. 11 and 12 is illustrated the structure of one of these drive roller units constituting a supporting and drive element for the drum. The device comprises a hollow body 70 providing a roller housing or chamber. The two opposite sides of this body are closed by bearing supporting structures respectively generally designated 71, 72. Held in these structures is a drive shaft 74 having a worm gear 75 thereon. This drive shaft is journaled in the elements 71 and 72 by means of roller bearings indicated at 76, 77 and on the shaft 74 is secured a drive and supporting wheel 80 upon which rests a steel tire 81, see also Figs. 2 and 2A. The upper cylindrical portion of the casing 70 is cut out as at 82 to receive the tire 81. The structures 71 and 72 are suitably secured to the body 70 by screw bolts as shown and oiling wicks for the bearings are arranged as shown at 85, 86 and these wicks are respectively carried by elements 71 and 72. The element 72 has a hollow extension 88 which forms a chamber for the worm gear 75 and for its companion gear 89 (see Fig. 12) carried by shaft 90 journaled in the lower part of element 88. The shafts 90 of each pair of worm gears 89 are connected (see Fig. 4) by suitable couplings 92 with a drive shaft 93 having a pulley 94 belted to pulley 95 of a drive motor 96. The hollow extension 88 is closed by a plate 97 removably held by suitable bolts. The drum may be rotated at from twenty-two to twenty-five R. P. M., at which speed the material travels thirty-three feet in about twenty minutes.

The structure of this bearing and its manner of driving for my purpose are believed to be new. So far as I am aware, dry tumbler drums have never been driven by means of this kind heretofore. The device is simple and relatively inexpensive. Only four devices like that shown in Figs. 11 and 12 are necessary to support a drum thirty-three feet long. The drive through the steel ring is positive and the weight of the drum or cylinder itself assures this positiveness.

Referring to Fig. 2. There is provided means for preventing longitudinal or axial movement of the drum during its rotation, and this means comprises a roller 98 contacting the inner side of the drive ring 81 as shown. The roller 98 is supported by a bracket 99 carried by the bottom frame 1. This thrust roller 98 prevents any axial movement of the slanted drum toward its delivery end. Means not shown is provided for varying the speed of the motor so that the drum can be operated at any suitable R. P. M.

The material is preferably fed to the drum by suitable belt means 100 shown in Fig. 2 and for this purpose the casing structure has a receiving opening 101 flanged as shown, the flange extending inwardly and into or through an opening 102 in a conically shaped end wall 103 of the drum. In the upper part of the openings is a curtain or plate 104 which closes about half of the opening 101. This closure element is preferably flexible. It may be considered to be an apron.

At the discharge end of the casing structure there is an opening 106 equipped with a discharge spout 107 as best shown in Figs. 1 and 2A. If these driers are used in tandem the discharge spout of one machine may deliver into the receiving opening of another.

Means is provided for varying the degree of slant of the drum from its receiving to its deliv-

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ery end (see Figs. 1 and 4). Attached to the bottom frame near the delivery end of the device are means generally indicated at 110 pivotally supporting the bottom frame. Only one of these means is shown in Fig. 1, but one of these means is provided at each opposite side. At the opposite end are arranged a pair of jack screws 111, as best shown in Fig. 4. A good degree of slope for the rotative axis of the drum is one and one-half inches to each ten feet. This may be advantageously varied within certain limits.

It will be noted that the pair of hoods which are nearest the intake opening deliver into ducts 112 which are provided with exhaust fans (not shown) leading to the atmosphere or to another drier, if a plurality of these driers are interconnected so that heated air delivered from the last zone of one drier is made to enter that zone of another drier which is nearest its delivery end. In such a case this first zone will be provided with a lint chamber and brush. Therefore, standard sections are each equipped for the use or nonuse of lint-removing brushes and chambers.

Referring now to the structure of the delinter screen and its manner of attaching. The numeral 44 generally designates this screen. The screen structure is best illustrated in detail in Figs. 8, 9, and 10 and comprises a metal frame composed of upper and lower longitudinal strips 120 and arcuate strips 121 of cylindrical form welded thereto as at 122. Tack-welded to the elements of the frame is a section 125 of cylindrically shaped flat expanded metal. Soldered to the inside of this expanded metal 125 is a section 126 of Monel wire cloth of about 50 mesh .009 inch wire. The longitudinal strips 120 are provided with openings 127 for suitably fastening devices by which each screen is secured in its opening 43 as best shown in Fig. 13. Either a single or a plurality of delinter screens 44 may be introduced into each opening 43. Each screen may be twenty-nine and one-half inches over all in length and have an outside radius of four and one-half inches.

As shown in Figs. 3 and 3A, each delinter screen 44 is made in a single section which is secured in the corresponding opening 43. These screens may be made in shorter sections and suitably secured together or can be separately attached by screws 129, in the manner best shown in Fig. 13. The end walls of the lint chambers form closures for the ends of the delinter screens. In this instance the brush shaft 69 of the delinter is made in sections and extends from one end of the machine to the other and is supported in bearings 130 which are carried by transverse division plates 4. The structure of the delinter brushes is best shown in Figs. 13 and 14 and comprises arms 132 which are secured to the shaft 69, a plurality of arms for each brush 68, the brush bridging and being connected to the arms. Each brush comprises a wooden bar provided with suitable numbers of brush elements 134, each formed of a suitable number of tufts of black hair held in the bar or block by twenty-four gauge copper wire. These brushes as shown in Fig. 13 are adjustable radially on the arms 132 so that the outer ends of the bristles may assume the proper relation to the Monel wire cloth which is soldered to the inside of the flat expanded metal element best shown in Fig. 10. Slots 136 are provided in the arms 132 (see Fig. 13) and bolts 137 pass through the slots and have clamping units.

The delinter brush shaft 69 is driven by a

motor 139 (see Figs. 3 and 4) by sprocket chain drive means 140. The shaft 69 is driven at about three R. P. M.

The following is an example of the method involving reheating and recirculation. The air from the room enters the first set of heating coils at 60° Fahrenheit and its temperature is raised by the coils to 200°. By passage of the air through the material of the first zone of the tumbler its temperature is reduced to 140°. The air then enters the heating coils of the second zone at 140° and is raised 100°, that is, to 240° before it is forced upwardly through the second zone. During forcing through the second zone the temperature is reduced again to 140° and it is then heated a third time to bring the temperature to 240° before passing it upwardly through the third zone. After the third passage it is led off by means of the exhaust ducts 112 to a point outside the machine.

Broadly speaking, the fabric material is moved in a spiral course while being tumbled, and while this occurs heated air is repeatedly forced upwardly through the drums and is reheated after each passage through the material. Each upward forcing is in a zone which is nearer to the receiving end of the drum. After each upward passage lint is removed before the air is reheated, and after a final upward passage which is nearest the receiving end, the air is led off from the machine by ducts in which the air is moved by suitable exhaust fans. During this "zoned" passage of the heated air through the material in the drum the air is so heated as to maintain it at the maximum temperature desired.

The support of the drum by only four rolls arranged in pairs, one pair at each extreme end of the drum, and the manner of separately driving pairs of rolls, is a feature of this invention and the arrangement of the heating units immediately of these drive rolls and below the drum is also a feature, see Figs. 2, 2A, 3 and 3A.

Another feature of the invention relates to the arrangement of the heating and blowing means below the drum (see Fig. 5), and the mounting of all of the elements including the heaters in a manner shown in Figs. 3 and 3A, on a base frame to which the outer or enclosing casing for the drum can be connected and from which frame these structures can be easily removed or assembled after the drum is mounted and resting on its rollers, and without disturbing the drum. The lint chambers and conduits are attached to the outer casing. This arrangement facilitates assembly, and cuts down the cost thereof and very much generally simplifies and reduces the cost of the making of the device as a whole. The conduits 63 are separable from the lint boxes 64 and from the hoods 55, and the lint boxes themselves are separable from the upright walls of the casing, and these upright walls are adapted to be separately assembled on or disassembled from the base frame.

It is to be noted that there are four transverse partition elements 4 which in this instance define three heating chambers. The outer casing is made in sections, the sections corresponding in length to the distance between these partitions. In this instance, therefore, there are five domed casing sections, three longer middle sections, and two shorter terminal sections. Each of these shorter sections is provided in its upper portion with a circumferential pocket 142 for receiving the drive ring of the drum, and one of these

terminal sections has the conical extension 103 and the other has the discharge spout 107.

I claim as my invention:

1. A device for drying woven fabric material which comprises, an elongated upper cylindrical chamber the wall of which has diametrically related superposed upper and lower openings which are circumferentially narrow but which extend substantially the full length of the chamber, a perforated tumbler drum rotatable in said chamber between the openings, a plurality of consecutive adjacently disposed separate zone chambers under and arranged lengthwise of said upper chamber, heating means within each zone chamber, air-enforcing means within each zone chamber having delivery conduit means delivering through said lower opening, said forcing means being adapted to move air through the heater of that chamber and then through a corresponding zone of the drum and conduit means for receiving air from the upper opening after its passage through a corresponding zone of the drum and for delivering the air to the next consecutive zone chamber for passage through the heater of that chamber.

2. A device for drying woven fabric material which comprises, an elongated cylindrical drum and means for rotating it, a cylindrical casing surrounding the drum throughout its entire length and having superposed upper and lower narrow elongated openings diametrically related to the drum, means providing a plurality of zone chambers under and arranged lengthwise of the casing, a heater in each zone chamber, air-forcing means in each zone chamber adapted to receive heated air from the heater and deliver it to the drum, conduit means leading from the delivery side of each air-enforcing means and connecting with the lower opening of said casing and adapted to discharge throughout the full length of that portion of the opening which is over a given zone chamber, and a conduit leading from that portion of the upper opening which is over a given zone of the drum to the next consecutive zone chamber for delivering air for re-heating.

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