Aug. 4, 1964 R. E. SWARTHOUT 3,143,398

SEALED APPARATUS FOR DRYING, WARMING AND AERATING MATERIALS

Filed Sept. 14, 1962

3 Sheets-Sheet 1

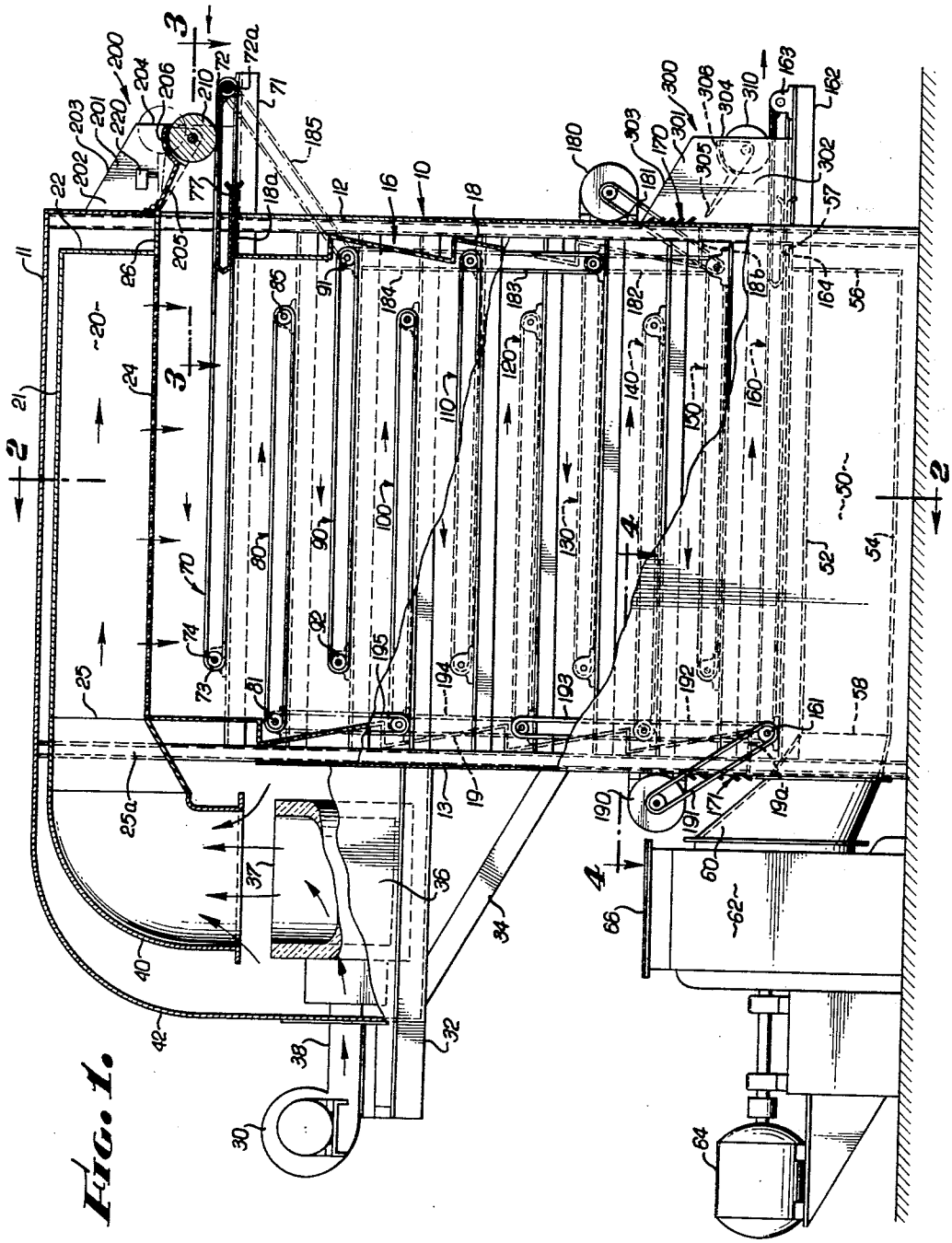

Fig. 1.

INVENTOR.
RASSELE EDWARDS SWARTHOUT
BY
Huebner & Worrel
ATTORNEYS.

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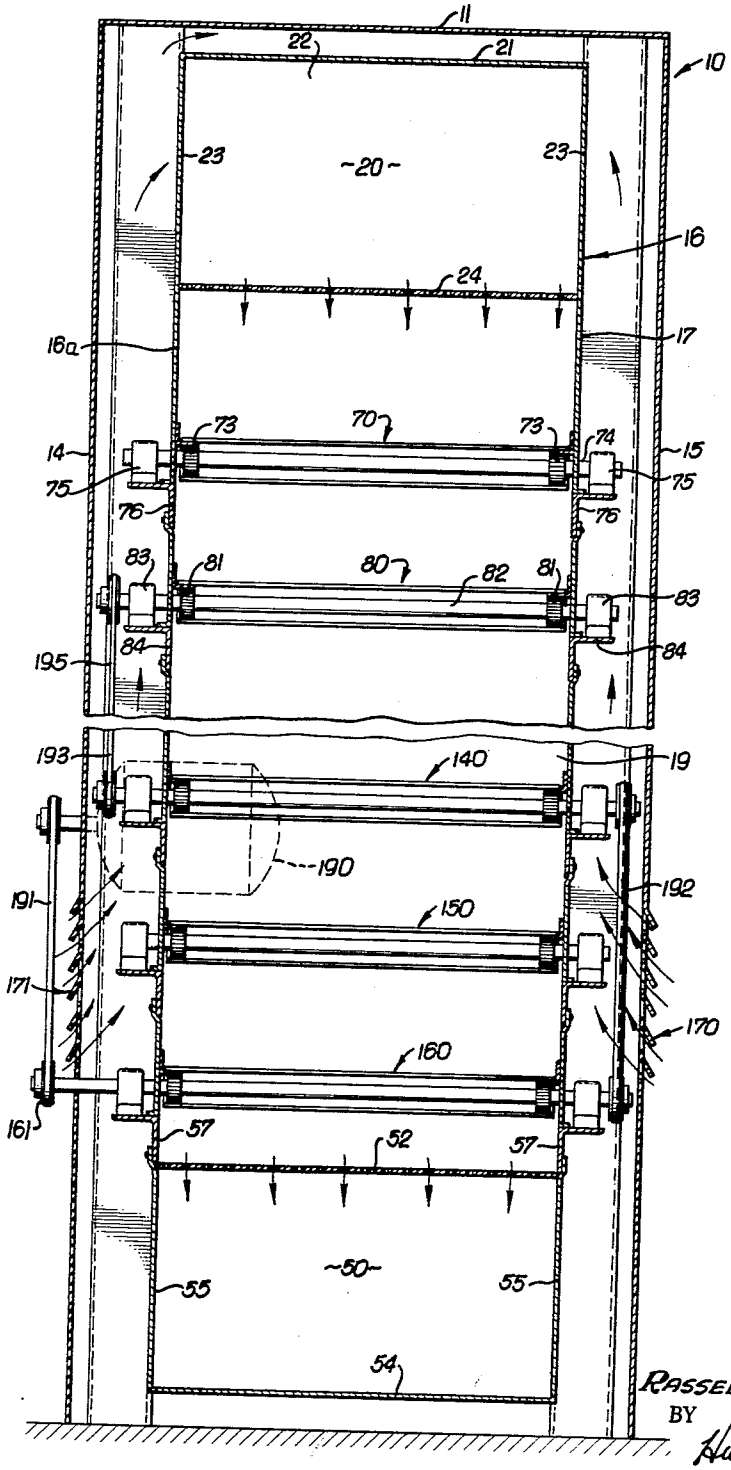

FIG. 2.

INVENTOR.
RASSELE EDWARDS SWARTHOUT
BY
Huebner & Worrel
ATTORNEYS.

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FIG. 3.

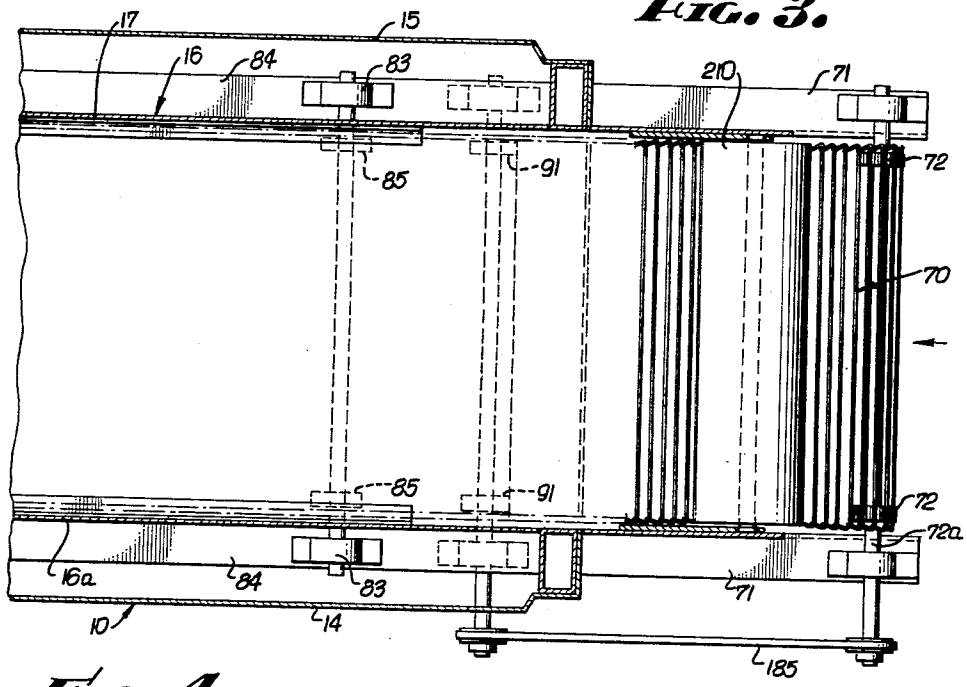
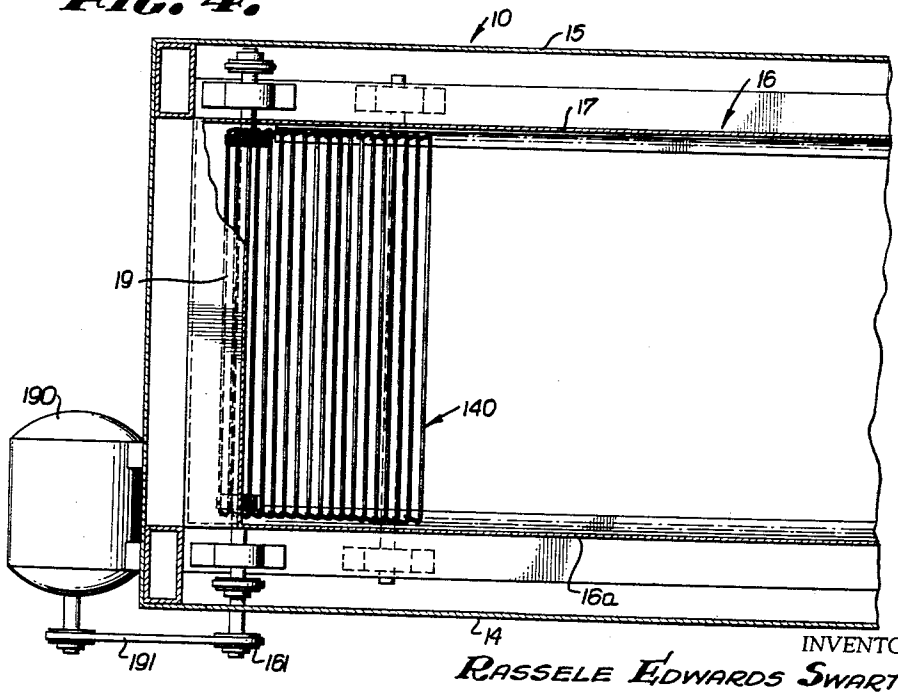


FIG. 4.



INVENTOR.
RASSELE EDWARDS SWARTHOUT
BY
Huebner & Worrel
ATTORNEYS.

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3,143,398

SEALED APPARATUS FOR DRYING, WARMING AND AERATING MATERIALS

Rassele E. Swarthout, Downey, Calif., assignor to Challenge-Cook Bros., Incorporated, Los Angeles, Calif., a corporation of California

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3 Claims. (Cl. 34—203)

This invention relates to a device for drying, warming and aerating materials, particularly damp textile materials, although its adaptability for use as a dehydrator for removing liquids from any other materials or matter by aerating and drying will be readily apparent from the description hereinafter contained. The device is especially useful as a commercial laundry dryer.

Laundry dryers presently in use are generally of the type in which damp clothes are tumbled about in a perforate basket or similar container, with warm air passing through the perforations in the basket or container. The effectiveness of such devices is limited by several factors. For instance, heavier clothes, or those having a greater moisture content, often do not receive sufficient exposure to the warm air passing through the perforations, and thus are subjected to a limited amount of drying, whereas, the lighter clothes, or those having a lesser moisture content, are frequently subjected to excess warm air exposure beyond normal needs, so that consistency of drying is difficult, and often impossible, to maintain. Consequently, and particularly in commercial laundry operations, due to the varying moisture content of the articles of clothing removed from the dryer after the drying operation, subsequent operations, such as mangling or ironing operations, must be constantly adjusted to compensate for the differences in moisture content of various articles in the same processed batch of clothing.

It is therefore an object of the present invention to provide a drying device which will gently process the treated material throughout the drying operation without subjecting it to the rigors of tumbling, and will permit the full aeration of all of the materials in a batch, without regard to varying weights and moisture content, so that all materals simultaneously processed will be delivered from the device in a consistently dry or damp condition, and further processing in a mangler or ironer may be accomplished without frequent adjustment of the mangler or ironer.

It is another object of the invention to provide a device for dehydrating materials by which the heat applied to the materials and the time of processing may be accurately regulated to control the amount of moisture removed from the processed materials.

It is still another object of the invention to provide a device of the character described which will permit gentle and effective aeration of materials being processed therein for controlled periods of time.

It is a further object of the invention to provide such a device which is of relatively simple construction and which is easy to maintain and operate.

With these and other objects in view, the invention consists of the construction, arrangement and combination of the various parts of the device whereby the objects contemplated are attained, as hereinafter set forth, pointed out in the appended claims, and illustrated in the accompanying drawings.

In the drawings:

FIGURE 1 is a side elevational view, partly in section, of the device of the present invention.

FIGURE 2 is an enlarged view, partially broken away, taken on the line 2—2 of FIGURE 1.

FIGURE 3 is an enlarged view, partially broken away, taken on the line 3—3 of FIGURE 1.

FIGURE 4 is an enlarged view, partially broken away, taken on the line 4—4 of FIGURE 1.

As illustrated in the drawings, a rectangular, closed, outer housing 10 is provided, said outer housing 10 having a top panel 11, side walls 12 and 13, a front wall 14, and a rear wall 15.

Within said outer housing 10 is an inner housing, generally designated 16, the walls of which are spaced apart from the walls of said outer housing 10 to form a passage for secondary ambient air. Said inner housing 16 is comprised of a front wall 16*a*, a rear wall 17, and side walls 18 and 19. Portions of said side walls 18 and 19 may be irregularly constructed to form baffles, as illustrated in FIGURE 1 of the drawings.

A plenum chamber 20 is disposed within inner housing 16 adjacent top 11 of housing 10, but spaced apart from top 11 and side wall 12 of housing 10 to form a passage for ambient air around plenum 20. Said plenum 20 has a top panel 21, an end wall 22, side walls 23, and a perforate bottom 24. The other end 25 of plenum 20 is open and is aligned with an opening 25*a* in outer housing side wall 13. Inner housing side wall 19 terminates at bottom 24 of plenum 20 so as to support plenum 20. Plenum 20 may also be supported in spaced relationship to side wall 12 by any suitable means, such as by a bracket 26. Wall 18 of inner housing 16 terminates at a point aligned with the bottom of an opening in wall 12 of outer housing 10, at which point a right angle leg or bracket 18*a* is provided, said leg 18*a* being disposed in said opening in wall 12 of housing 10 so as to form a support for wall 18.

A burner 30 is provided. Burner 30 is suitably mounted on and supported by a platform 32 which is cantilevered externally on side wall 13 of housing 10 below opening 25*a*. Platform 32 in turn may be supported by a support bracket 34 mounted on platform 32 and side wall 13. Platform 32 also has mounted thereon a combustion chamber 36, and an air duct 38 leads from heater 30 to combustion chamber 36. The top 37 of combustion chamber 36 is open.

Disposed above combustion chamber 36, and preferably spaced apart from open top 37 of chamber 36, is an air duct 40 which passes through opening 25*a* in wall 13 of housing 10 and gives access to plenum 20 at open end 25 thereof, so that air heated in chamber 36 will flow freely from chamber 26 into plenum 20, and thence through perforated bottom 24 of plenum 20 into inner housing 16.

Chamber 36 and duct 40 are enclosed in a housing 42, duct 40 being spaced from said housing 42 so as to continue the secondary ambient air passage hereinabove mentioned.

Adjacent the bottom of inner housing 16 is a second plenum chamber 50, having a perforated top 52 to allow the passage of air from inner housing 16 into plenum 50. Plenum 50 has a bottom 54, side walls 55, and an end wall 56. Plenum 50 is supported in housing 10 by any suitable means, such as by a bracket 57 disposed in an opening in wall 12 of housing 10. End 58 of plenum 50 is open. Wall 19 of inner housing 16 terminates above open end 58 of plenum 50, and may be supported on wall 13 of outer housing 10 by any suitable means, such as a leg or bracket 19*a*.

Mounted on open end 58 of plenum 50 is an air duct 60 which passes through an opening in housing 10 to an exhaust blower 62 driven by a motor 64. Blower 62 has an exhaust opening 66. Blower 62 is preferably spaced apart from housing 10.

A series of endless conveyor belts, spaced one from the other, are disposed substantially horizontally and parallel to each other within housing 10 between plenum 20

and plenum **50**. Ten of said conveyor belts are illustrated in FIGURE 1 of the drawings, but it will be understood that any number of said belts, greater or less than ten, may be provided. Said belts are designated **70**, **80**, **90**, **100**, **110**, **120**, **130**, **140**, **150**, and **160**. Said belts are preferably perforate, and are of any suitable flexible construction. By way of illustration, but not by way of limitation, said belts may be constructed of spaced wires, articularly jointed at their ends, such as belts known commercially as "Cyclone Flex-Grid Belts," illustrated in FIGURES 3 and 4 of the drawings.

Said belts move alternately in opposite directions, the top of belt **70** moving to the left, as it is illustrated in FIGURE 1 of the drawings, the top of belt **80** moving to the right, etc., through the entire series of belts.

Belt **70**, the uppermost of said belts, is spaced below the perforated bottom **24** of plenum **20**. A platform **71** is cantilevered outwardly from side wall **12** of housing **10**; and mounted on platform **71**, adjacent the outer end of said platform **71**, are drive sprockets **72**, mounted on a shaft **72***a*. Belt **70** is disposed around drive sprockets **72** and passes through the lower portion of the opening in wall **12** in which leg **18***a* is disposed, to and around idler sprockets **73**, said sprockets **73** being spaced apart some distance from wall **19** of inner housing **16**.

Idler sprockets **73** are mounted on shafts **74**, as best illustrated in FIGURE 2 of the drawings, each of said shafts **74** being rotatably supported by a bearing **75**, which is mounted on a bracket **76**, said bracket **76** being mounted externally on walls **16** and **17** and disposed between walls **16** and **17** and walls **14** and **15** of housing **10**, with each shaft **74** passing through an appropriate opening in either wall **16** or **17**.

An air barrier **77** is disposed between the upper and lower flights of belt **70** adjacent sprockets **72** and within the opening in wall **12**, the purpose of said air barrier **77** being to prevent the free escape of air from the interior of housing **16**.

Belt **80**, the next belt below **70**, is disposed around drive sprockets **81**, which are mounted closely adjacent to wall **19**. Each of the sprockets **81** is mounted on a shaft **82**, rotatably supported by a bearing **83**, in turn mounted on a bracket **84**, mounted externally on walls **16** and **17** and disposed between walls **16** and **17** and walls **14** and **15**, each said shaft **82** passing through an appropriate opening in either wall **16** or **17**.

After passing around drive sprockets **81**, belt **80** extends to and passes around idler sprockets **85**, said idler sprockets **85** being spaced apart some distance from wall **18**. As illustrated in FIGURE 2 of the drawings, sprockets **85** and the shaft on which they are supported are mounted and supported similar to idler sprockets **73** for belt **70**.

Belt **90**, the next belt below belt **80**, is disposed around drive sprockets **91**, which are mounted closely adjacent to wall **18**. Each of the sprockets **91** is shaft mounted and disposed and supported similarly to drive sprockets **81** for belt **80**. After passing around drive sprockets **91**, belt **90** extends to and passes around idler sprockets **92**, which are spaced apart some distance from wall **19**. Each of said idler sprockets **92** is shaft mounted and disposed and supported similarly to idler sprockets **85** for belt **80**.

Alternately, belts **100**, **120** and **140** are disposed, mounted and driven similarly to belt **80**; and belts **110**, **130** and **150** are disposed, mounted and driven similarly to belt **90**, the drive sprockets for belts **100**, **120** and **140** being arranged in a substantially vertical plane with drive sprockets **81** for belt **80**; the idler sprockets for belts **100**, **120** and **140** substantially in a vertical plane with idler sprockets **85** for belt **80**; the drive sprockets for belts **110**, **130** and **150** in a substantially vertical plane with drive sprockets **91** for belt **90**; and the idler sprockets for belts **110**, **130** and **150** in a substantially vertical plane with idler sprockets **92** for belt **90**.

Wall **18** of inner housing **16** is terminated closely adjacent to belt **150**, and may be supported on the wall of housing **10** by a bracket or right angle leg, such as leg **18***b*, illustrated in FIGURE 1 of the drawings.

Belt **160**, the lowermost of the belts, is spaced above the perforated top **52** of plenum **50**. Belt **160** is disposed around drive sprockets **161**. Said sprockets **161** are mounted closely adjacent to the terminal end of wall **19**, and are shaft mounted and supported similarly to the drive sprockets for belts **80**, **100**, **120** and **140**, and in a substantially vertical plane with said other drive sprockets. A platform **162** is cantilevered outwardly from side wall **12** of housing **10**; and mounted on said platform **162**, adajcent the outer end of said platform **162**, are idler sprockets **163**. Belt **160** is disposed around drive sprockets **161** and passes through the lower portion of an opening in wall **12** of housing **10**, to and around idler sprockets **163**.

An air barrier **164** is disposed between the upper and lower flights of belt **160** adjacent sprockets **163** and within the opening in wall **12**, the purpose of said air barrier **164** being to prevent the free escape of air from the interior of housing **16**.

Louvers, such as louvers **170** and **171**, illustrated in FIGURE 1 of the drawings, are provided in the walls of housing **10**, the purpose of said louvers being to permit the introduction of secondary ambient air into the air passage space between the outer and inner housings, **10** and **16**, respectively.

Mounted externally on walls **12** and **13** are motors **180** and **190**, respectively.

Motor **180** propels a belt or chain drive **181** which is operatively mounted on the shaft of the drive sprocket for belt **150**. A belt or chain drive **182** is operatively mounted on the same shaft of the drive sprocket for belt **150**, and to the shaft of the drive sprocket for belt **130**. Similarly, a belt or chain drive **183** is operatively mounted on the same shaft of the drive sprocket for belt **130** and the shaft of the drive sprocket for belt **110**; a belt or chain drive **184** is operatively mounted on the same shaft of the drive sprocket for belt **110** and the shaft of the drive sprocket for belt **90**; and a belt or chain drive **185** is operatively mounted on the same shaft of the drive sprocket for belt **90** and the shaft of the drive sprocket for belt **70**, the latter belt or chain drive **185** passing through openings in the inner and outer housings of the device.

Motor **190** propels a belt or chain drive **191**, which passes through an appropriate opening in the walls of the outer and inner housings and is operatively mounted on the shaft of the drive sprocket for belt **160**. A belt or chain drive **192** is operatively mounted on the same shaft of the drive sprocket for belt **160** and to the shaft of the drive sprocket for belt **140**. Similarly, a belt or chain drive **193** is operatively mounted on the same shaft of the drive sprocket for belt **140** and the shaft of the drive sprocket for belt **120**; a belt or chain drive **194** is operatively mounted on the same shaft of the drive sprocket for belt **120** and the shaft of the drive sprocket for belt **100**; and a belt or chain drive **195** is operatively mounted on the same shaft of the drive sprocket for belt **100** and the shaft of the drive sprocket for belt **80**.

It will thus be seen that when motors **180** and **190** are actuated, the various belt or chain drive linkages from motor **180** will cause the top flights of belts **150**, **130**, **110**, **90** and **70**, to move to the left, in the position of the device illustrated in FIGURE 1 of the drawings, and the various belt or chain drive linkages from motor **190** will cause the top flights of belts **160**, **140**, **120**, **100** and **80**, to move to the right, so that each succeeding flight will move in a direction opposite to that of the flight immediately above it. Regulation of the speeds of motors **180** and **190** will control the predetermined time of passage of the material to be treated along each flight and through the entire operation. It will also be apparent that the time of passage of the material through any given por-

tion of the device may be controlled and regulated by merely varying the relative size of the sprockets, or, preferably, varying the number of teeth in various sprockets, so that, for instance, as is generally desired, the upper belts will move relatively slower and the lower belts will move relatively faster, permitting longer exposure of the material to heat in the upper portions of the device, and shorter exposure in the lower portions.

The openings in side wall **12**, through which belt **70** and belt **160** extend, are necessarily relatively large, and extend a substantial distance above the top flights of said belts, in order to permit the free passage of the materials to be processed into and out of the device. It is preferred that means be provided to prevent the free escape of heated air in the device through said enlarged openings. To accomplish this result, an air seal or shield **200** is provided for the opening through which belt **70** passes; and an air seal or shield **300** is provided for the opening through which belt **160** passes.

Shield **200** comprises a housing **201**, which is mounted on platform **71** and extends upwardly therefrom so as to surround the opening in side wall **12** at which the material to be processed is introduced into the device. Housing **201** has side walls **202**, and a top section **203**, said side walls **202** and top section **203** being mounted on wall **12**. The end **204** of housing **201** is open.

Pivotally mounted at wall **12**, adjacent the top of the opening in wall **12**, is a transverse plate **205**, the outer end **206** of which is arcuate to accommodate the roller hereinafter described.

A roller **210** is suitably rotatably mounted on transverse plate **205** below arcuate end **206** of transverse plate **205**, and disposed so that upward movement of said roller **210** will cause transverse plate **205** to pivot upwardly within housing **201**. Roller **210** is of substantially the same width as belt **70**.

Transverse plate **205**, with roller **210** mounted thereon, may be spring-biased downwardly, or may be normally downwardly disposed by gravity, as desired.

A stop **220** is mounted within housing **201** to limit the upward movement of transverse plate **205** with roller **210** mounted thereon. Roller **210** may be an idler roller or, if desired, may be power driven. If roller **210** is power driven, in lieu of stop **220** an automatic shutoff safety control may be provided, the purpose of stop **210**, or the automatic shutoff safety control, being to limit the height of the material to be introduced into the device for processing.

Shield **300** is similar in construction to shield **200**. It comprises a housing **301**, which is mounted on platform **162** and extends upwardly therefrom so as to surround the opening in side wall **12**, at which the material which has been processed is discharged from the device. Housing **301** has side walls **302** and a top section **303**, said side walls **302** and top section **303** being mounted on wall **12**. The end **304** of housing **301** is open.

Pivotally mounted at wall **12**, adjacent the top of the opening in wall **12**, is a transverse plate **305**, the outer end **306** of which is arcuate to accommodate the roller hereinafter described.

A roller **310** is suitably rotatably mounted on transverse plate **305** below arcuate end **306** of transverse plate **305**, and disposed so that upward movement of said roller **310** will cause transverse plate **305** to pivot upwardly within housing **301**. Roller **310** is of substantially the same width as belt **160**.

Transverse plate **305**, with roller **310** mounted thereon, like transverse plate **205**, may be spring-biased downwardly, or may be downwardly disposed by gravity, as desired. Roller **310** may be an idler roller or, if desired, may be power driven.

In operation, burner **30** is ignited and warm air then flows from combustion chamber **36** through duct **40** into plenum chamber **20**, from which it passes through the perforations in the bottom **24** of plenum chamber **20** into

inner housing **16**, and is drawn by the action of exhaust blower **62** down through the entire interior of the device, into lower plenum chamber **50**, and then through duct **60** to exhaust blower **62**, from which it is exhausted through opening **66**.

FIGURE 1 of the drawings shows the heated air being introduced from the side of the device to the upper plenum chamber, and then progressing downwardly through the device and being exhausted through the lower plenum chamber. It will be understood that in lieu of introducing the heated air from either side, it may be introduced from the back, front, or top of the device, as desired, and furthermore, that by reversing the positions of the heating assembly and the exhaust assembly, the heated air path as illustrated may be reversed, with the heated air being introduced into the bottom plenum chamber and progressing upwardly until it is exhausted at the top of the device.

Furthermore, it will be understood that the amount of heat applied may be controlled, if desired, by any suitable means, such as by a heat meter (not illustrated) introduced, preferably, into the air exhaust assembly.

The continuous exhaustion of the heated air from the device will cause ambient air to enter through the louvers, such as louvers **170** and **171**, from which, by reason of the combustion action in combustion chamber **36**, said ambient air is drawn through the space between the outer and inner housings into heater housing **42**, where it is mixed with warm air, heated and circulated through the device as hereinabove described. The passage of such ambient air between the outer and inner housings not only provide a ready air supply, but also serves to control the outside temperatures of the outer walls of the housing **10**.

Meanwhile, motors **180** and **190** are actuated to drive the various drive sprockets for belts **70**, **80**, **90**, **100**, **110**, **120**, **130**, **140**, **150** and **160**, as hereinabove described, causing said belts to move in the alternate directions hereinabove mentioned.

The material to be dried, warmed or aerated is placed on belt **70** over platform **71**, externally of housing **10**, and before roller **210**. Belt **70**, moving to the left, as illustrated in FIGURE 1 of the drawings, will carry said materials into housing **10**. Roller **210** will ride over the material being processed as the material passes under roller **210**. If the mass of the material being processed is too high to pass through the opening in wall **12** and be carried internally along the belt system of the device, the stopping of roller **210** by the stop or automatic safety control **220** will prevent the further passage of the material into the device until the excessively high material is removed or adjusted to proper height.

The material being processed will be carried continuously along belt **70** until belt **70** reaches and passes around its idler sprockets **73**. The continuous movement of belt **70** around idler sprockets **73** will cause the material to flop over and drop to the next belt **80** directly below belt **70**. The movement of belt **80** to the right in a direction opposite to belt **70**, will carry the material through the device in the opposite direction until belt **80** reaches and passes around its idler sprockets **87**, whereupon the material being carried by belt **80** will flop over and drop to the next belt **90** directly below belt **80**. This process will continue until the material has flopped over and dropped to the lowermost belt **160**. The movement of the top flight of belt **160** to the right will complete the drying, warming or aerating process and will carry the material out of the housing, under roller **310** and along platform **162**, where the processed material is removed.

The baffled construction of walls **18** and **19** will aid in turning the materials being processed as the materials pass from one belt to the next lower belt, so that alternately, opposite sides of the material will be exposed to greater aeration. As shown in FIGURE 1 of the draw-

ings, the baffles are an integral part of the walls **18** and **19**, are disposed at inwardly directed angles, and extend generally from a point adjacent the top of one belt flight to a point adjacent the top of the next succeeding flight below, so as to turn the material and direct it to the next lower flight.

In lieu of forming said baffles as an integral part of walls **18** and **19**, said baffles may be separately, pivotally mounted so as to be adjustable in pitch.

The drying and aeration of the materials being processed of course will be greatly facilitated by the fact that various belts are perforate and permit the free passage of the warm air therethrough.

Although the invention has been herein shown and described in what is conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is not to be limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent structures and devices.

What is claimed is:

1. A device for drying, warming and aerating materials which comprises: a substantially air-tight main housing having outer walls, and having inner walls spaced from said outer walls; plenum chambers mounted adjacent the top and the bottom of said main housing; means for introducing warm air into one of said plenum chambers and passing said warm air from said plenum chamber into the interior of said main housing; means for passing said warm air from the interior of said main housing into the other of said plenum chambers; means for exhausting warm air from the other of said plenum chambers; a plurality of power-driven, substantially horizontal conveyor belt flights vertically spaced from each other and disposed seriatim in said main housing in the stream of said warm air intermediate said plenum chambers, each belt flight moving in a direction opposite to that of the belt flight immediately above it, the topmost and the lowermost of said belt flights extending beyond said main housing; a horizontal platform mounted externally of said main housing; an opening in said main housing aligned with said platform, the topmost of said belt flights extending over and being supported by said platform and passing through said opening, said opening accommodating said topmost belt flight and materials loaded thereon; a secondary housing mounted on said platform and on the main housing, said secondary housing enclosing said opening and having an open external end; a transverse plate disposed in said secondary housing and pivotally mounted on said main housing above the opening in said main housing; a roller suspendably mounted on said transverse plate and disposed so as to ride on said topmost belt flight and to serve, in combination with said transverse plate, as an air seal for said main housing opening; means for dropping said materials from each belt flight to the next belt flight immediately below it at the end of each such belt flight; and means for removing said materials from the lowermost of said belt flights externally of said housing.

2. A device for drying, warming and aerating materials, as defined in claim 1, including stop means in said secondary housing for limiting the upward pivotal movement of said transverse plate and the roller mounted thereon.

3. A device for drying, warming and aerating materials, as defined in claim 1, wherein the means for removing said materials from the lowermost of said belt flights comprises: a horizontal platform mounted externally of said main housing; an opening in said main housing aligned with said platform, the lowermost of said belt flights extending over and being supported by said platform and passing through said opening, said opening accommodating said lowermost belt flight and materials loaded thereon; a secondary housing mounted on said platform and on the main housing, said secondary housing enclosing said opening and having an open external end; a transverse plate disposed in said secondary housing and pivotally mounted on said main housing above the opening in said main housing; a roller suspendably mounted on said transverse plate and disposed so as to ride on said lowermost belt flight and to serve, in combination with said transverse plate, as an air seal for said main housing opening.

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