

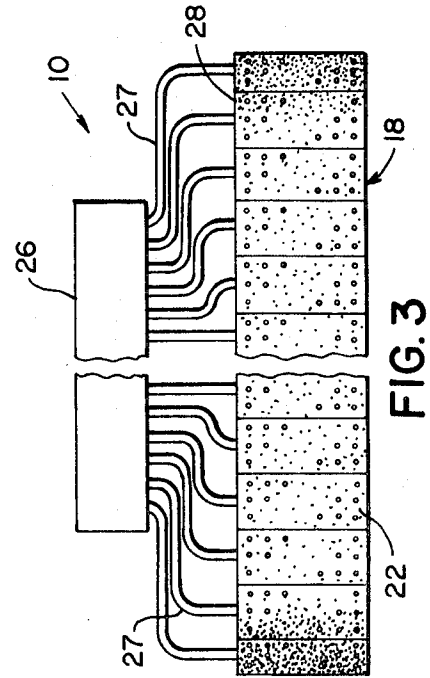
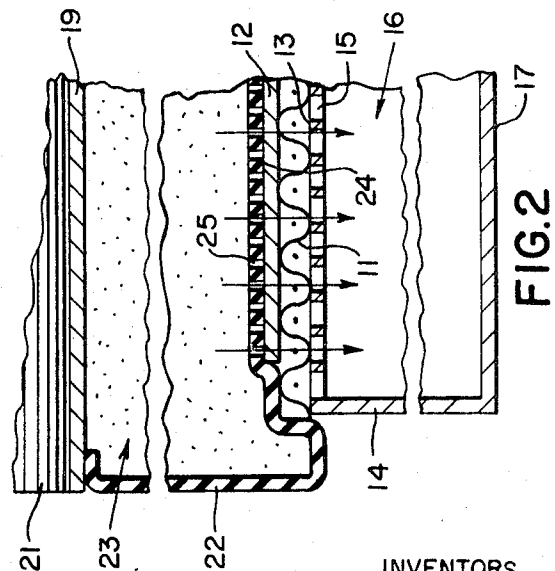
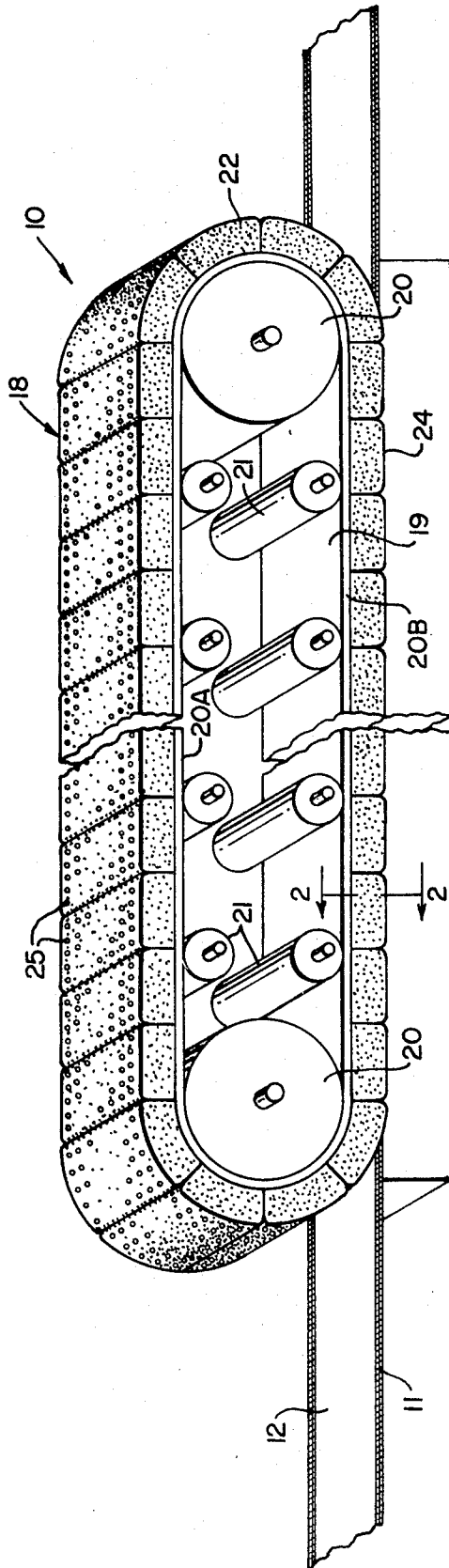
July 13, 1971

R. R. CANDOR ET AL
METHOD AND APPARATUS FOR TREATING SHEET-LIKE
MATERIAL AND THE LIKE

3,592,585

Filed Oct. 22, 1969

2 Sheets-Sheet 1



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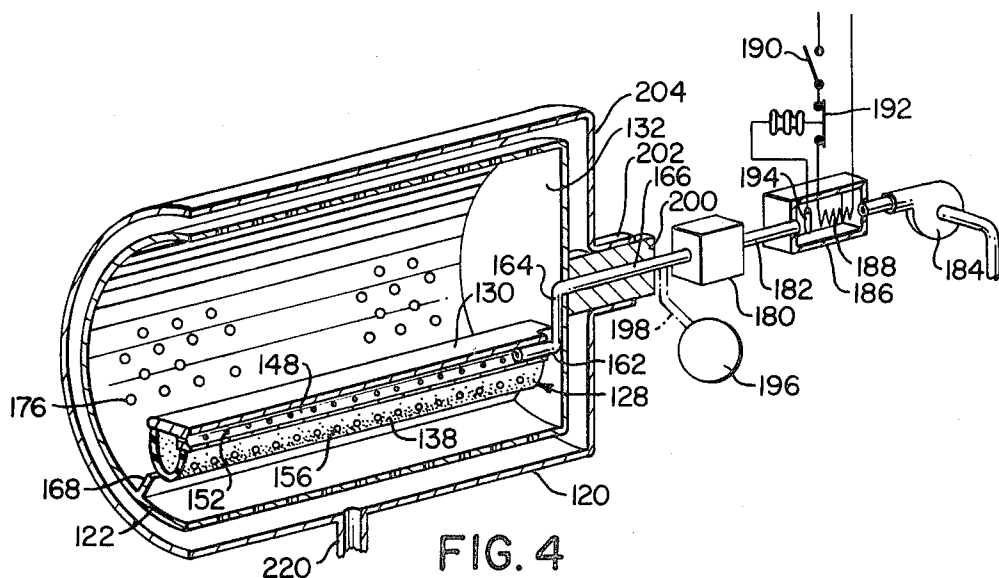


FIG. 4

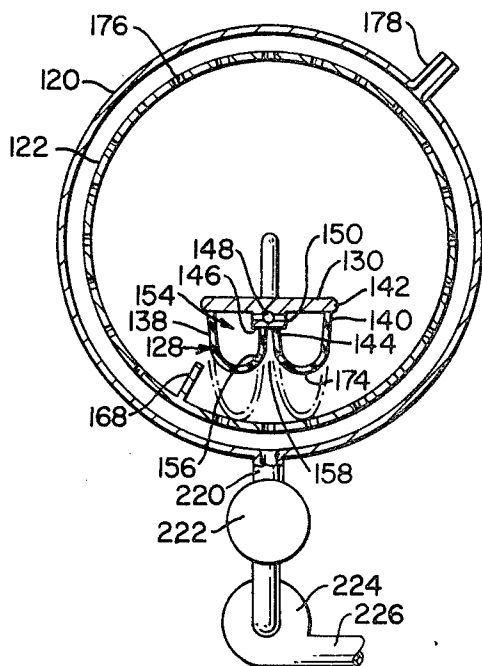


FIG. 5

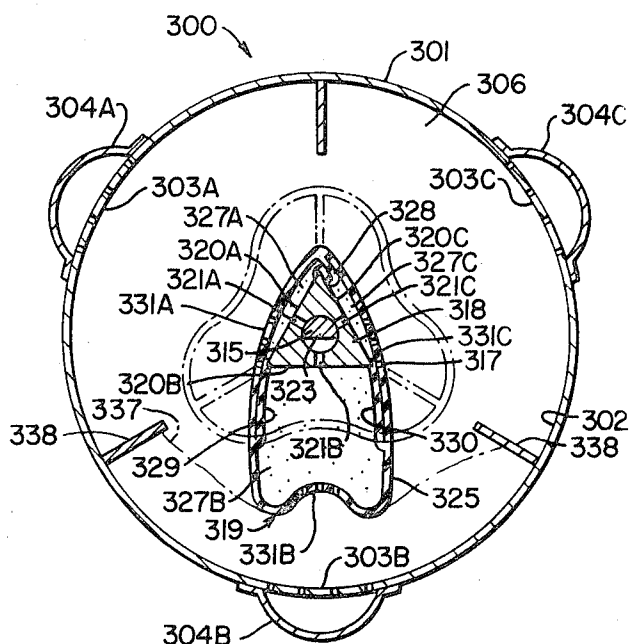


FIG. 6

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3,592,585

METHOD AND APPARATUS FOR TREATING SHEET-LIKE MATERIAL AND THE LIKE

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Continuation-in-part of application Ser. No. 690,636, Dec. 14, 1967, which is a continuation-in-part of application Ser. No. 635,848, May 3, 1967. This application Oct. 22, 1969, Ser. No. 868,396

Int. Cl. F26b 13/02; B05b 3/02; B05c 8/04
U.S. Cl. 8—151 14 Claims

ABSTRACT OF THE DISCLOSURE

Supporting means receiving sheet-like material and conveying the same in substantially flat form and movable nozzle means having an end means provided with opening means and engaging against the material for a predetermined substantially straight line length of travel therewith, the nozzle means comprising a flexible sheet means at least partially surrounding the opening means and defining the end means thereof and providing a fluid flow between the opening means of the nozzle means and the section of material aligned between that opening means and the supporting means to treat that section of material with fluid. Means are provided for causing the end means to be disposed in substantially sealed relation with the section of material engaged thereby by creating a pressure differential across the sheet means to cause one side thereof to press against the material on the supporting means.

This application is a continuation-in-part application of the copending patent application Serial No. 690,636, now Patent No. 3,491,386, filed Dec. 14, 1967, and entitled "Laundry Apparatus or the Like," which, in turn, is a continuation-in-part application of its copending patent application Ser. No. 635,848 filed May 3, 1967, and entitled "Laundry Apparatus or the Like," now Pat. No. 3,447,174.

This application relates to a method and apparatus for treating sheet-like material such as paper webs, fabric webs, or other sheet material by causing a direct fluid flow between the material while it is being conveyed on a supporting means and a flexible nozzle means engaging against the material during a portion of its travel on the supporting means.

In particular, it is well known from the U.S. patent to Holden, No. 3,284,285, that in the dewatering of fibrous webs, such as paper webs, a greater amount of dewatering thereof can take place if a pressure differential can be created across the web greater than the pressure differential provided by conventional suction box means. This patent also teaches that if the fibrous web can be under a compressed condition so that the moisture remaining therein will fill all voids in the material, the resulting pressure differential across such compressed web has a tendency to remove a greater amount of moisture therefrom than when the web is in an uncompressed condition.

Therefore, it is a feature of this invention to provide an improved method and apparatus for treating sheet material by providing a pressure differential across the same with a treating fluid whether the treating fluid is gaseous or liquid or both as will be apparent hereinafter.

In particular, one embodiment of this invention provides a movable supporting means for receiving the sheet material and conveying the same through the apparatus in substantially flat form. A movable nozzle is carried by the apparatus and has an end means provided with an opening means. Means are provided for causing the material to

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have a section thereof disposed between the end means of a nozzle means and to move in unison with the nozzle means and supporting means for a predetermined substantially straight line length of travel through the apparatus. Means are also provided for causing the end means of the nozzle means to be disposed in substantially sealed relation with the section of material during the predetermined length of travel through the apparatus. During such predetermined length of travel through the apparatus, a direct fluid flow is provided between the opening means of the nozzle means and the section of material aligned between the opening means and the supporting means to treat that section of material with the fluid. The nozzle means comprises a flexible sheet means at least partially surrounding the opening means and defining the nozzle end means, the means for causing the end means to be disposed in substantially sealed relation with the section of material comprising means for creating a pressure differential across the sheet means to cause one side thereof to tend to press against the material on the supporting means during the predetermined length of travel of that section of material through the apparatus.

Accordingly, it is an object of this invention to provide an improved apparatus for treating a substantially sheet-like material and the like with fluid, the apparatus of this invention having one or more of the novel features set forth above or hereinafter shown or described.

Another object of this invention is to provide an improved method for treating substantially sheet-like material and the like with a fluid, the method of this invention having one or more of the novel features set forth above or hereinafter shown or described.

Other objects, uses and advantages of this invention are apparent from a reading of this description which proceeds with reference to the accompanying drawings forming a part thereof and wherein:

FIG. 1 is a schematic perspective view illustrating the improved method and apparatus of this invention.

FIG. 2 is an enlarged, fragmentary, cross-sectional view taken substantially on line 2—2 of FIG. 1 with the inside surface of the flexible wall being stippled to illustrate its flexibility.

FIG. 3 is a schematic top view of the apparatus of FIG. 1 and illustrates the method for supplying fluid under pressure to the nozzle means of the apparatus.

FIG. 4 is a perspective view illustrating a laundry apparatus of the aforementioned U.S. Pat. No. 3,447,174, the laundry apparatus being partly in cross section.

FIG. 5 is a cross section transverse to FIG. 4 in vertical cross section.

FIG. 6 is a view similar to FIG. 5 and illustrates another laundry apparatus as shown and described in the aforementioned copending patent application Ser. No. 690,636, new Pat. No. 3,491,386.

While the various features of this invention are hereinafter described and illustrated as being particularly adapted for treating fibrous webs, such as paper sheets, carpeting, etc., it can be understood that the various features of this invention can be utilized singly or in any combination thereof to provide methods and apparatus for treating other types of material as desired, such as non-moisture bearing or absorbing materials.

Therefore, this invention is not to be limited to only the embodiments illustrated in the drawings, because the drawings are merely utilized to illustrate one of the wide variety of uses of this invention.

Referring now to FIGS. 1, 2 and 3, the improved method and apparatus of this invention is generally indicated by the reference numeral 10 and comprises a movable foraminous supporting means 11 formed of metal, fibre or any other suitable material and being adapted to convey flat

sheet-like material 12 from left to right in FIG. 1 through the apparatus 10, the flat sheet-like material 12 being fibrous paper stock, carpeting, etc., as will be apparent hereinafter.

The supporting belt 11 is adapted to pass over the upper side 13 of conventional suction box means 14 having the upper side 13 thereof provided with perforations or openings 15 leading to the internal chamber means 16 thereof which is adapted to be evacuated by conventional suction means in a manner well known in the art or merely remain at atmospheric condition and be provided with suitable drain means in the bottom wall 17 thereof for removing moisture from the chamber 16 as the same accumulates therein in a manner hereinafter described.

As previously stated, the U.S. patent to Holden, No. 3,284,285 clearly teaches that it is desirable to create a high pressure differential across the sheet means 12 to remove moisture therefrom in a dewatering operation by causing a flow of high pressure air through the material 12 and the foraminous supporting means 11 into the chamber 16 at a force greater than can be provided solely by the result of the chamber 16 being evacuated by conventional suction means. In addition, the U.S. patent to Holden, No. 3,284,285, teaches that if the material 12 can be compressed so as to cause the moisture therein to fill all of the voids of the fibrous material 12 so as to provide a substantially continuous, sheet-like moisture layer therein, such pressure differential across the sheet means 12 removes the moisture in a manner more effective than merely by an entrainment of such moisture in the air rushing through the material 12.

However, the U.S. patent to Holden, No. 3,284,285 does not provide means for effectively compressing the sheet-like material 12 in a sealed manner while conforming to the exterior contour of the sheet material 12.

It will be apparent that the features of this invention do provide means for providing the high pressure differential across the sheet means 12 for the aforementioned dewatering purposes as well as for applying or impregnating liquid, such as dye or the like, into the sheet means 12, if desired, while compressing such material 12 against the support means 11 and effectively sealing against the sheet means 12 regardless of its exterior contour.

In particular, the aforementioned U.S. Patent No. 3,447,174, fully discloses the use of a flexible nozzle means engaging against moisture bearing material and compressing the same against a supporting means while causing a direct fluid flow between an opening means of that nozzle means and the compressed material on the foraminous supporting means, the nozzle means comprising a flexible sheet means at least partially surrounding the opening means and being urged against the aligned material by a pressure differential acting across that sheet means to cause one side thereof to press against material on the support means.

Such flexible nozzle means is provided in FIGS. 4 and 5 and will be hereinafter described.

The aforementioned copending patent application Ser. No. 690,636, now Pat. No. 3,491,386, further discloses how such flexible nozzle means can be utilized in a plural arrangement thereof to have the plurality of flexible nozzle means serially engage against the material on the supporting means in a continuous manner, such plural nozzle means being illustrated in FIG. 6 and hereinafter described.

Therefore, by combining such features of the aforementioned copending patent application and issued patent, a flexible nozzle means is provided for the apparatus 10 of this invention to act on the sheet means 12 while it is being conveyed in substantially flat form through the apparatus 10, the nozzle means being generally indicated by the reference numeral 18 in FIGS. 1-3.

The flexible nozzle means 18 comprises a continuous backing member 19 formed of metal, plastic or other

suitable material to permit the same to be looped around a pair of roller means 20 and be driven thereby in a counterclockwise direction at substantially the same speed of movement of the foraminous supporting means 11 from left to right in FIG. 1, the upper and lower runs 20A and 20B of the supporting member 19 being supported intermediate the outboard rolls 20 by a plurality of backup rolls 21 as diagrammatically illustrated and sufficiently close to each other to maintain the runs 20A and 20B substantially straight and parallel to the path of movement of the support means 11. If desired, the rolls 20 and 21 can be closer or spaced more than illustrated to maintain the runs 20A and 20B substantially straight as previously described.

A plurality of flexible sheet means 22 are interconnected to the backing member 19 in such a manner that each defines a chamber 23 therebetween and has a bottom or outer wall means 24 provided with a plurality of perforations or opening means 25 passing therethrough and being so controlled in the size and relationship thereof relative to each other that such opening means 25 will be arranged to engage against the sheet material 12 when the same is aligned therebetween in the manner illustrated in FIG. 2.

Of course, the flexible sheet means 22 can be one continuous sheet means with internal chambers being formed therein separate from each other in the same manner as provided by the individual sheet means 22 illustrated in FIGS. 1, 2 and 3, such as in the manner set forth in the copending patent application, Ser. No. 635,848, now Pat. No. 3,447,174.

In any event, the interiors of the chambers 23 of the flexible sheet means 22 are adapted to be supplied with fluid under pressure from a valving means 26, FIG. 3, in any of the manners set forth in the aforementioned U.S. Pat. No. 3,447,174, and/or the copending patent application Ser. No. 635,848, now Pat. No. 3,447,174 through individual conduit means 27 fluidly interconnected to the chambers 23 of the flexible sheet means 22 at the side wall means 28 thereof as illustrated in FIG. 3 whereby as each individual nozzle means 22 moves in a counterclockwise direction in FIG. 1, its respective conduit means 27 will follow such movement at both ends thereof and continuously supply fluid pressure thereto.

However, it is to be understood that the valve means 26 could be so constructed and arranged that when a particular nozzle means 22 passes to the right beyond the right hand roller 20 to cross the top run 20A and just before the same engages against the sheet means 12 at the left hand roller means 20, no fluid pressure would be supplied to that particular nozzle means 22, as desired.

Therefore, it can be seen that as the particular flexible nozzle means 22 engages against the travelling sheet means 12 at the left hand roller means 20, such nozzle means 22 moves in unison therewith for a substantially straight line path through the apparatus 10 until that particular nozzle means 22 begins to move around the right hand roller means 20. However, while that particular nozzle means 22 is moving between the left hand and right hand roller means 20 at the lower run 20B of the nozzle means 18, the fluid pressure being directed into the chamber 23 thereof creates a pressure differential across the lower wall 24 and causes the same to press and squeeze against the sheet means 12 compress the sheet means 12 against the foraminous means 11 to not only tend to squeeze the liquid therefrom, but also to tend to cause the remaining liquid in the material 12 to fill all voids of the material 12 for the advantageous reasons set forth in the aforementioned patent to Holden, No. 3,284,285, the nozzle means 22 at the same time directing fluid under pressure out through the perforations 25 thereof and directly through the sheet material 12 and foraminous supporting means 11 into the opening means 15 of the box means 14. If

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desired, the interior 16 of the box means 14 can be interconnected to a vacuum source so as to further enhance the pressure differential acting across the sheet means 12 for the dewatering or drying purpose previously described.

Of course, the fluid under pressure being delivered to the chambers 23 of the nozzle means 22 can be heated air or the like to further enhance the drying effect of the apparatus 10 on the material 12.

Also, it is to be understood that the fluid being directed to the chambers 23 of the nozzle means 22 could be a liquid, such as a dye or the like, so as to effectively impregnate the material 12 in a believed to be more efficient manner than prior art devices for such purposes.

In any event, it can be seen that since the nozzle means 22 each has a flexible lower end 24, such lower end 24 fully conforms to the exterior contour of the sheet means 12 so as to provide effective sealing around each perforation 25 thereof against the sheet means 12 and by so arranging the perforations 25 across the lower wall 24, such perforations 25 can be located just in the region of the sheet means 12 so that there is no escape of fluid from the chamber means 23 through the supporting means 11 outboard of the sheet means 12, if desired. However, it is to be understood that if the perforations 25 are sufficiently sized, even perforations 25 outboard of the sheet means 12 will not adversely affect the operation of the nozzle means 22 forcing fluid through the other perforations 25 inboard of the sheet means 12 for the reasons previously set forth.

Therefore, it can be seen that the flexible nozzle means 18 of the apparatus and method 10 of this invention engages against the material 12 for a predetermined substantially straight line length of travel thereof through the apparatus 10 with the flexible sheet means 22 pressing against the material 12 to not only squeeze the same, but also to seal the openings 25 thereof against the sheet means 12 so that a direct fluid flow will be provided between the chambers 23 of the nozzle means 22 through the sheet means 12 to remove moisture therefrom or to drive liquid therein, the squeezing and sealing action being provided by the resulting pressure differential being created across the end walls 24 of the nozzle means 22 with such pressure differential being increased by providing suction means on the other side of the sheet means 12, such as by the suction box means 14 illustrated and previously described.

In order to better understand the function and operation of the nozzle means 22 previously described, reference is now made to FIGS. 4 and 5 wherein a single nozzle means is hereinafter described in connection with a laundry apparatus as set forth in the aforementioned issued patent No. 3,447,174, it being understood that while the nozzle means moves in a circular path and the supporting means is cylindrical, the hereinafter described features and functions can be readily applied to a straight run moving sheet means in the manner provided by the nozzle means 18 of the apparatus 10 previously described.

Referring first to FIGS. 4 and 5, a stationary, imperforate, cylindraceous outer drum 120 is provided to retain washing or dry cleaning liquid for washing, dry cleaning, or otherwise treating materials such as laundry or articles to be washed and/or dry cleaned. An inner cylindraceous, perforate drum 122 is rotatably mounted in the stationary drum 120, within which the articles to be treated are placed. These articles may be introduced into and removed from the apparatus through an access opening which may be placed at one end of the drums 120 and 122 in a manner well known to those skilled in the art. Such opening may be provided with suitable covering or door means, also well known to those skilled in the art, for the purpose of retaining the articles to be treated and the liquid introduced therein, also as is well known to those skilled in the art.

Under certain conditions the drum 120 may be rotatable, but for the purpose of brief description it may be

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referred to as a stationary drum, with the understanding that, under certain conditions, the drum 120 may be rotatable.

A surface effect air pressure applying baffle or nozzle means 128 may be placed in the perforated drum 122 and may be so mounted that it can rotate simultaneously with such drum 122. In the embodiment shown in FIGS. 4 and 5, such baffle 128 may be provided with a relatively rigid plate support 130, which may be supported or secured to one or both of the end members of the rotatable drum 122. For example, such plate may be secured to the end wall 132 of the rotatable drum 122. A similar wall may be provided at the other end of the drum 122, and such wall may have an access opening for introduction and removal of clothes and the like, as is obvious to those skilled in the art.

The plate 130 may also be secured to the other end wall, which may be the front end wall of the perforate drum 122, which may be provided with an access opening of the character heretofore described. As shown in FIG. 4, the plate support 130 may be secured to the rotatable end walls 132 so that the plate 130 rotates with the drum 122.

A flexible, air pressure applying curtain or flexible sheet means 138 may be secured to the plate 130 in such a manner that the curtain 138 tends to hang downwardly from the plate 130, when the plate 130 is in its lowermost position, as shown in FIGS. 4 and 5.

The curtain 138 may be a single curtain, or a double curtain, depending how the central part of the curtain is produced. The outer edges 140, FIG. 5, may be secured to the outer edges 142 of the plate 130. The inner edges 144 of the curtain 138 may be united together, if desired, or they may be separately secured to a central air distributing bar 146, which is provided with a central conduit 148, which has one or more branches 150 with one or more openings 152 for distributing the air to the interior or interiors 154 of the curtain 138. The curtain 138 may have small openings 156 for permitting the air to discharge from the interior or interiors 154 into the central plenum portion 158 of the curtain 138.

The curtain 138 has end closures to retain the air in the interior or interiors 154.

The central conduit 148 of the plate support 130 may be connected to a compressed air supply pipe 162, which may have an offset portion 164 connected to a central portion 166, which may be connected to an air supply means to be described.

If desired, a rigid longitudinal baffle 168 may be provided on the drum 122 on the rear or following side of the curtain 138, it being understood that the drum 122, as shown in FIGS. 4 and 5, rotates in a counterclockwise direction. The purpose of the baffle 168 is to cooperate with the curtain 138 to cause the articles to be treated to form into an accumulation partly under the curtain 138 to cause such accumulation of clothes to rise with the curtain 138 on the right hand of FIG. 5 and to continue completely around with the curtain 138 until it reaches some position on the falling side where the clothes may fall partly or wholly from the curtain 138.

The curtain 138 is of such a character that it tends to retain compressed air from the pipe construction 162-166 to press the curtain 138 downwardly to form lobes 174, which tend to press the clothes downwardly against perforated drum 122 and also allow the compressed air to discharge from the lobes 174 into the central plenum part 158 of the curtain construction and then through the clothes and through the openings 176 in the drum 122. The air then may be allowed to escape, such as through a discharge pipe 178, which may be vented to any desired place, such as to the exterior of the building in which the apparatus is being used, if desired.

The pipe 162-166 may be supplied with compressed air, which, if desired, may also be heated. For example, the pipe 166 may pass through a packing box or the like, 180, of well-known construction, which allows the pipe

section 166 to rotate with the drum 122 and allows the stationary pipe section 182 to be stationary and to be connected to the air compressor 184. The construction is such that the compressor 184 may supply compressed air through the stationary pipe 182, packing box 180, to the rotatable part 166 of the supply sections 162, 164, 166. If desired, the pipe 182 may pass through or be a part of a chamber 186, which may be heated by an electric heater 188, which heats the air which is pumped by the pump 184 and supplies the same in heated condition to be caused to pass through the clothes and dry the same at the proper time. The electric heater 188 may be automatically controlled by a timer operated switch 190, which energizes the heater during the desired time of the washing operation to produce the drying action. Additionally, the heater 188 may be controlled by the thermostatic switch 192, which may be responsive to the air temperature in the chamber 186, such as by a thermostatic bulb 194.

The perforated drum 122 may be driven at a suitable rotational speed, such as to cause the tumbling action heretofore described. For example, such drum 122 may be rotated by the motor 196, which actuates a speed reduction transmission 198, of any well-known construction, and which may be manually or automatically adjustable, so that it drives the rotatable shaft 200, which partly or wholly supports the drum 122 and drivingly rotates the same. The shaft 200 may be rotated within the bearing 202, which is connected to the rear wall 204 of drum 120.

The outer drum 120 may be provided with a suitable drain 220 at the bottommost part, which may be connected to a drain valve 222. This valve 222 may be solenoid operated to open and close at the proper time. The valve 222 may be connected to a water pump 224, the discharge portion 226 of which may be connected by a suitable flexible hose or the like to a drain or laundry tub, as is obvious.

In the operation of FIGS. 4 and 5, clothes may be introduced through openings and the various parts of the apparatus may be controlled by a suitable timer in the usual manner which controls the desired operation of the various parts of the machine. The timer may cause the drum 122 to be rotated at a slow speed, such that it allows the articles to be washed or cleaned to be caught by the baffle 168 and be accumulated under the curtain 138, when the parts reach the lowermost position of FIG. 5. The curtain 138 contacts the top of a portion of the clothes so that the compressed air from the pipes 166, 164, and 162 enters the lobes 174 of the curtain 138 and passes through the openings 156 into the plenum chamber 158 from whence the air is forced through the clothes and may pass out through openings 176 to the drum 120 and out through the discharge pipe 178 to the exterior.

During the initial washing operation, no compressed air need be introduced into the baffle 128 and, the baffle 128 may lift and drop the clothes during the washing operation. On the other hand, if desired, air may be introduced into the curtain 138 during the washing operation and this will aid in the lifting and dropping of the clothes from and into the water at the bottom of the apparatus. The valve 222 is closed during this time.

The drain valve 222 may be opened, and the pump 224 operated, if necessary. The liquid is then drained from the tub 120. The tub 122 may be rotated or allowed to continue to rotate with the curtain 138 inflated by the compressed air. This action lifts and drops the clothes so that different parts of the clothes are subjected to the compressed air from the curtain 138 repeatedly. The action can continue indefinitely to a complete drying of the clothes. The compressed air may be heated continuously, or only during the time of the evaporative drying of the clothes, when the switch 190 may be closed, to energize the heater 188 for the desired time, with or without automatic cycling by the thermostat 192.

While the laundry machine has been previously described and illustrated as having the nozzle means thereof provided with only one general opening means 156 surrounded by the pressurized flexible sheet means 138 to hold the opening means in a sealed relation with the laundry disposed between such nozzle means and the supporting structure, it is to be understood that the embodiment of this invention can have the nozzle means thereof provided with a plurality of such pressure sealing opening means to direct fluid from the nozzle means into the aligned laundry as previously described.

For example, reference is now made to FIG. 6 where, in another laundry apparatus of this invention is generally indicated by the reference numeral 300 and comprises a rotatably mounted liquid retaining drum means 301 for supporting and tumbling laundry therein. However, the inside surface 302 of the drum 301 has a plurality of longitudinal perforated sections 303A, 303B and 303C which in the embodiment illustrated in the drawings are spaced in equal distances about the inside circumference of the drum 301, each perforated section 303A-303C having the exterior side thereof sealed from the exterior of the drum 301 by respective trough-like members 304A, 304B and 304C secured to the drum 301 in any suitable manner.

Such perforated longitudinal section and cooperating troughs are fully disclosed and claimed in the patent to Candor et al., No. 3,344,447, to which patent reference is now made for further details and use of such perforated sections and troughs as well as for further information concerning suitable means for sealing closed the front end of the drum means 301 as well as for supporting such rotating drum means 301.

The drum 301 has a closed rear end wall means 306 rotatably mounted on a bearing means supported on a stationary hub whereby the drum 301 can be rotated relative to the stationary hub by any suitable drive means, such as belts, gears, etc., in a manner well known in the art.

The stationary hub has an extension 315 that projects through a central opening in the rear wall 306 of the drum 301 and is telescopically received in a cylindrical opening 317 of a nozzle hub 318.

The nozzle hub 318 is secured to the drum 301 at the rear wall 306 thereof in any suitable manner so as to rotate in unison therewith on the stationary extension 315 of the stationary hub. However, the nozzle hub 318 and stationary extension 315 cooperate together to provide a valve means for a nozzle means of this invention generally indicated by the reference numeral 319.

In particular, the nozzle hub 318 has substantially equilateral triangular cross-sectional configuration as illustrated in FIG. 6 and is thus provided with three outwardly facing flat end surfaces 320A, 320B and 320C medially interrupted by a plurality of respective passages 321A, 321B and 321C leading to the cylindrical passage 317 in the hub 318. The stationary extension 315 of the stationary hub 308 has its outer periphery disposed in substantially sealing relationship with the hub 318 except at a recess means 323 formed therein which communicates with a passage means in the stationary hub.

Thus, it can be seen from FIG. 6 that as the drum 301 rotates in a counterclockwise direction, the hub 318 likewise rotates in unison with the drum 301 whereby the passages 321A-321C are sealed from the passage of the hub until the same come into alignment with the recess 323 in the extension 315 and stay in fluid communication therewith until the hub 318 is further rotated in a counterclockwise direction to have the outer peripheral surface of the extension 315 again seal off the passages 321A-321C. Accordingly, each end surface 320A, 320B and 320C has its exterior fluidly interconnected to the passage of the hub in substantially a sequential manner as the drum 301 rotates for a purpose hereinafter described.

The nozzle means 319 includes a flexible sheet means 325 arranged in tubular form around the hub 318 and

having the opposed ends thereof completely sealed to the hub 318, the tubular sheet means 325 being divided into three compartments 327A, 327B and 327C by intermediate walls 328, 329 and 330 formed of flexible material and respectively extending from equally spaced apart points on the inside surface of the tubular sheet means 325 to the apexes of the hub 318 as illustrated in FIG. 6 to be secured thereto in order to completely seal the compartments 327A, 327B and 327C from each other while such compartments are respectively fluidly interconnected to the passage means 321A, 321B and 321C.

The tubular sheet means 325 is provided with three longitudinal perforated areas or sections 331A, 331B and 331C to respectively cooperate with the compartments 327A, 327B and 327C in forming outlet end means for such compartments in controlling the fluid flow therefrom as will be apparent hereinafter.

The passage means of the stationary hub 308 is disposed in fluid communication with an outlet conduit means of a suction pump similar to pump 184 of FIG. 4.

The operation of the apparatus 300 of this invention will now be described.

The housewife or the like disposes the desired quantity of laundry or the like into the drum 301 and initiates the operation of the laundry apparatus 300 whereby water or other treating liquid is directed into the interior of the drum 301 in any suitable manner, such as by the means fully disclosed in the aforementioned patent to Candor et al., No. 3,344,447. For example, the water or other treating liquid can be directed from a supply pipe and pump through the nozzle means 319 into the interior of the drum 301.

In any event, after or during the accumulation of a suitable quantity of treating liquid in the drum 301, the drum 301 can be rotated in any desired manner in a counterclockwise direction whereby the laundry therein, is represented by the line 337 in FIG. 6 is caused to rotate and tumble in the drum 301 in a conventional manner and can be assisted in such tumbling action by a plurality of inwardly directed baffle means 338 carried on the interior of the drum 301.

Such agitation of the laundry 337 in the drum 301 can be accomplished in the conventional manner without utilizing the nozzle means 319 in combination therewith. However, if it is desired that the nozzle means 319 be utilized in assisting the liquid in treating the laundry 337 for "agitation" purposes in either the wash cycle or rinse cycle or both, the pump means can be turned on during such wash or rinse cycle to cause the pump to draw treating liquid through the particular perforated section 303A, B or C during the time each trough 304A, B or C is in fluid communication with the inlet of the pump whereby the liquid being pumped out of the pump is redirected into the interior of the drum 301 through the nozzle means 319 of this invention.

In particular, as the fluid is being forced from the outlet of the pump into the recess 323 of the extension 315, the same will enter the particular compartment or compartments 327A, B or C that is disposed in fluid communication with such recess 323.

For example, in the position of the drum 301 in FIG. 6, the recess 323 of the stationary extension 315 is disposed only in communication with the compartment 327B whereby the entire flow of liquid out of the pump is directed into the compartment 327B and must exit from the same out through the perforated section 331B thereof back into the drum 301.

However, since the liquid being directed into the compartment 327B of the nozzle means 319 is under pressure, the same acts against the inside surface 320B of the compartment 327B to force the tubular sheet means 325 between the walls 329 and 330 radially outwardly in the manner of the previously described nozzle constructions of this invention except that it can be seen that the troughs 304A, B and C respectively face the flat surfaces

320A, B and C of the hub 318 so as to cooperate therewith.

In particular, as the compartment 327B is being expanded downwardly by being in fluid communication with the recess 323, the laundry 337 is being compressed and squeezed between the tubular sheet means 325 and the perforated section 303B so that not only is the section of laundry confined between the pressurized compartment 327B and the perforated section 303B being compressed therebetween, but also the same is being placed into sealing relationship against the perforated section 303B to have the treating liquid drawn therethrough by the pump and the laundry 337 is in sealing relationship against the perforated section 331B of the sheet means 325 to have the treating liquid directly forced into the same from the compartment 327B so that an almost fluid direct circuit is provided between the compartment 327B and the interior of the trough 304B cooperating therewith through the laundry 337 trapped therebetween.

In this manner, it is believed that by forcing the treating liquid through each section of laundry as it cooperates with an expanding compartment of the nozzle means 319 and the associated suction action of its respective trough means, the treating liquid more effectively cleans or treats the laundry.

It can be seen from the dash line configuration of the nozzle means 319 in FIG. 6, that if each compartment 327A, B and C thereof were being simultaneously pressurized, the nozzle means 319 would be in a substantially uniform spaced relation about the hub 318. However, by so constructing the recess 323 in the stationary extension 315 so that the compartment means 327A, B and C will only be in fluid communication therewith during a segment of the rotation of the particular compartment about the stationary part 315, the pressurized compartment, such as compartment 327B illustrated in FIG. 6, collapses the non-pressurized compartments 327A and 327C so that the expanded compartment 327B can extend all the way down to the inside surface of the drum 301 depending upon the amount of accumulation of laundry 337 trapped between the expanding compartment 327B and the perforated section 303B.

Further, each trough 304A, B or C will only be interconnected to the inlet of the pump at the same time that its respective nozzle compartment means 327A, B or C is being interconnected by the recess 323 at the outlet side of the pump.

After the treating liquid in the drum 301 has been removed in any suitable manner, such as being withdrawn out of the troughs 304A, B and C and not returned into the same, such as being directed by the pump out a drain line and not into the nozzle means 319, the apparatus 300 can be utilized to dry the remaining wet laundry therein.

In particular, the pump in the drying cycle will cause air to be drawn through the section of laundry aligned with the respective perforated sections 303A, B or C that has its respective trough 304A, B or C interconnected to the inlet side of the pump while the cooperating compartment means 327A, B or C of the nozzle means 319 will be directing heated air against the trapped section of laundry 337 to again provide a substantially closed circuit of heated fluid flow through the particular trapped section of laundry between the expanded sheet means 325 and the cooperating perforated section 303A, B or C, the flow of air through the laundry sweeping and vaporizing the moisture in the laundry to be entrained in the air stream and passed through a condenser to have moisture and vapor removed therefrom before being returned to the nozzle means 319.

Thus, it can be seen that during the drying cycle of the apparatus 300, the drum 301 is continuously rotated in a counterclockwise direction and the nozzle means 319 cooperates with the troughs 304A, B and C in directly directing the heated air through trapped sections of the laundry to dry the same in a manner not requiring a centrifuging operation on the wet laundry.

In view of the above, it can be seen that the nozzle means 18 of FIGS. 1-3 can have the size and number of openings 25 formed in the end walls 24 so controlled relative to the magnitude of the fluid pressure being detected into the chambers 23 that the optimum results are obtained on the sheet means 12 without squeezing the same to an adverse degree while still substantially forcing and removing the moisture therein in the manner previously described.

Accordingly, it can be seen that this invention provides an improved apparatus and method for treating sheet-like material and the like.

What is claimed is:

1. Apparatus for treating sheet-like material comprising movable engaging means for engaging said material and at least assisting in the conveying of the same through said apparatus in substantially sheet form, movable nozzle means carried by said apparatus and having an end means provided with opening means, means for causing said material to have a section thereof disposed between said end means of said nozzle means and said engaging means to move in unison with said nozzle means and said engaging means for a predetermined length of travel through said apparatus, means for causing said end means of said nozzle means to be disposed in substantially sealed relation with said section of material during said predetermined length of travel through said apparatus, and means for causing a direct fluid flow between said opening means and said section of material aligned between said opening means and said engaging means to treat said section of material with said fluid, said nozzle means comprising flexible sheet means at least partially surrounding said opening means and defining said nozzle end means, said means for causing said end means to be disposed in said substantially sealed relation with said section of material comprising means for creating a pressure differential across said flexible sheet means to cause one side thereof to tend to press against said material and thereby press said material against said engaging means.

2. Apparatus as set forth in claim 1 wherein said means for causing said direct fluid flow comprises means for directing said fluid under pressure to said nozzle means and out through said opening means thereof into said particular section of material.

3. Apparatus as set forth in claim 1 wherein said means for creating said pressure differential across said flexible sheet means comprises means for directing fluid under pressure against the other side of said flexible sheet means.

4. Apparatus as set forth in claim 3 wherein said fluid directed against said other side of said flexible sheet means also passes out of said opening means and into said particular section of material to provide said fluid for said direct fluid flow.

5. Apparatus as set forth in claim 4 wherein said opening means comprises a plurality of openings passing through said flexible sheet means and each having said fluid under pressure passing out the same into said particular section of material.

6. Apparatus as set forth in claim 1 wherein said engaging means and said nozzle means convey said section of material in a substantially straight line length of travel through said apparatus.

7. Apparatus as set forth in claim 1 wherein said engaging means comprises supporting means for receiving said material thereon and for conveying the same through said apparatus.

8. Method for treating sheet-like material comprising the steps of providing an engaging means for engaging

said material to at least assist in conveying said material in substantially sheet form, causing said material to have a section thereof disposed between an end means of a movable nozzle means and said engaging means to move in unison with said nozzle means and said engaging means for a predetermined length of travel, moving said end means of said nozzle means to be disposed in substantially sealed relation with said section of material during said predetermined length of travel of said section of material, and creating a direct fluid flow between opening means in said end means of said nozzle means and said section of material aligned between said opening means and said engaging means to treat said section of material with said fluid, said step of moving said end means of said nozzle means to be disposed in substantially sealed relation with said section of material comprising the step of creating a pressure differential across a flexible sheet means of said nozzle means that at least partially surrounds said opening means thereof and defines said end means to cause one side of said flexible sheet means to tend to press against said material and thereby press said material against said engaging means.

9. A method as set forth in claim 8 wherein said step for creating said direct fluid flow comprises the step of directing said fluid under pressure to said nozzle means and out through said opening means thereof into said particular section of material.

10. A method as set forth in claim 8 wherein said step for creating said pressure differential across said flexible sheet means comprises the step of directing fluid under pressure against the other side of said flexible sheet means.

11. A method as set forth in claim 10 wherein said step for creating said direct fluid flow comprises said step of directing fluid under pressure against the other side of said flexible sheet means where said fluid passes out of said opening means and into said particular section of material to provide said fluid for said direct fluid flow.

12. A method as set forth in claim 11 wherein said opening means comprises a plurality of openings passing through said flexible sheet means and each having said fluid under pressure passing out of the same into said particular section of material.

13. A method as set forth in claim 8 wherein said step of causing said material to have a section thereof disposed between said end means of said movable nozzle means and said engaging means includes the step of conveying said section of material in a substantially straight line length of travel in a particular direction as said nozzle means, engaging means and section of material move in unison.

14. A method as set forth in claim 8 wherein said engaging means comprises supporting means and including the steps of disposing said material on said supporting means, and moving said supporting means to convey said supported material.

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