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Rayment et al.

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[45] **Oct. 2, 1973**

[54] **TEXTILE FINISHING PROCESSES**

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Apr. 23, 1971	Great Britain	10,898/71
June 23, 1971	Great Britain	29,376/71
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[52] **U.S. Cl.** ..... **8/149.1**, 8/149.3, 8/152, 8/158, 68/5 C, 68/20, 68/58, 68/177, 68/178

[51] **Int. Cl.** **B05c 5/00**

[58] **Field of Search** ..... 68/5 C, 58, 177, 68/178; 8/158, 149.1, 149.3, 152

[56] **References Cited**

UNITED STATES PATENTS

1,675,160	6/1928	Carroll	68/5 C
1,948,568	2/1934	Faber et al.	68/5 C X
2,556,303	6/1951	Traube	68/58 X
2,846,776	8/1958	Clark	68/58 X
3,401,052	9/1968	Berger et al.	68/58 X

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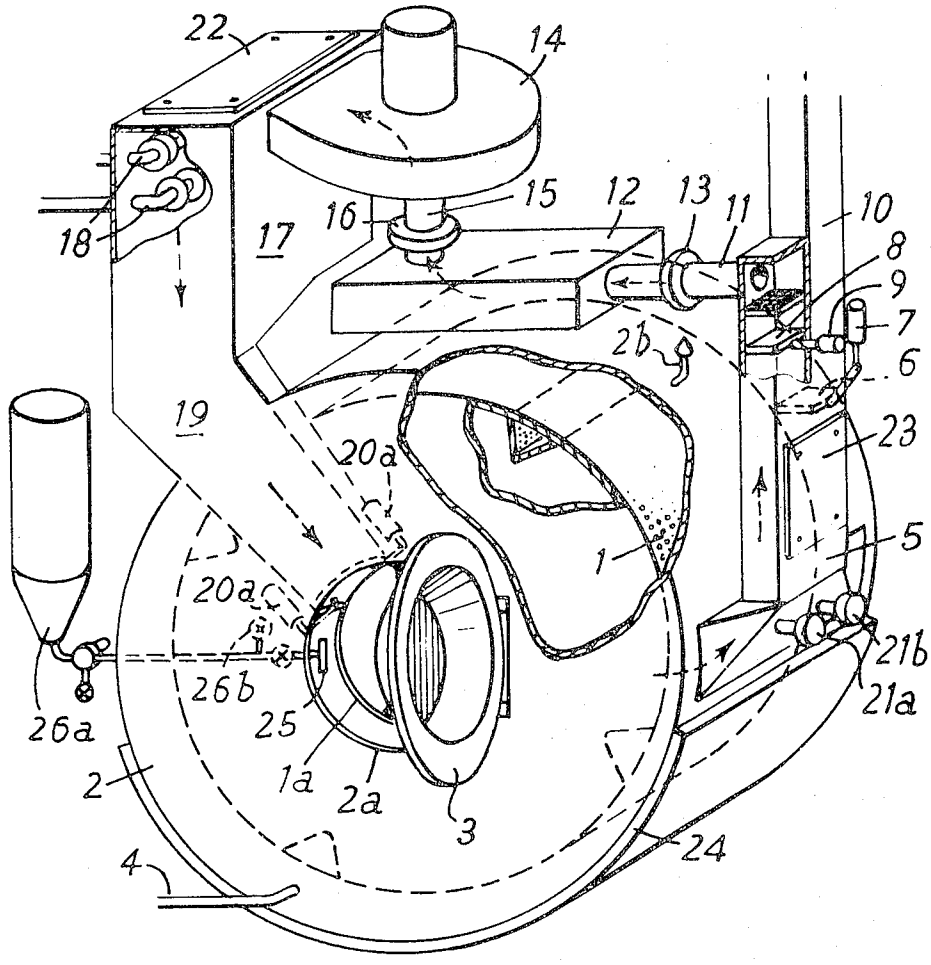
[57] **ABSTRACT**

The invention sets out a method of and apparatus for finishing textiles, e.g., for dyeing, bleaching, scouring etc. It is particularly concerned with low liquor ratio processes, i.e., where the ratio of textile to liquor is such that all or substantially all of the liquor is absorbed during an impregnation step of the process. The impregnation step is followed by a heating step and this comprises moving the impregnated textile in a water vapour saturated atmosphere while heating it to a predetermined temperature. One machine for performing the method comprises a rotatable drum mounted in a casing; textile is tumbled within the drum, the casing defining a chamber within which a saturated atmosphere is maintained. Alternatively a loop of textile e.g. a length of carpet, may be arranged round a drive drum within a casing and may be moved by being driven around within the casing.

15 Claims, 8 Drawing Figures



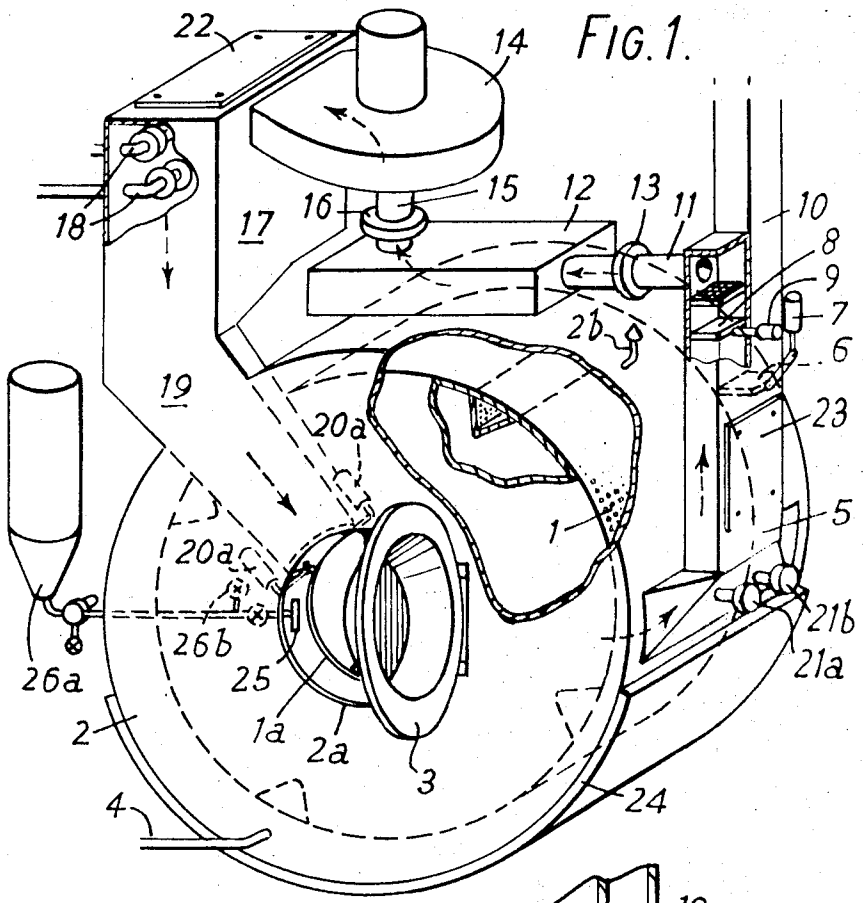

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FIG. 1.

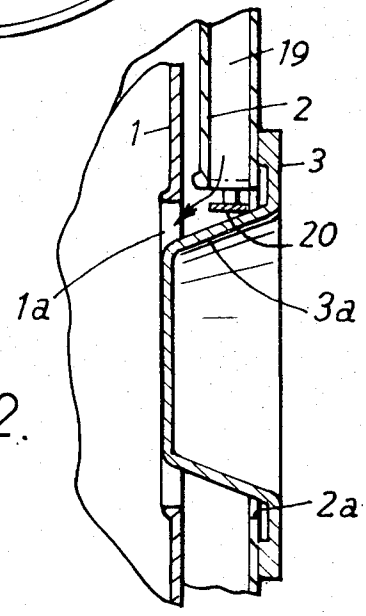
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FIG. 2.

FIG. 4.

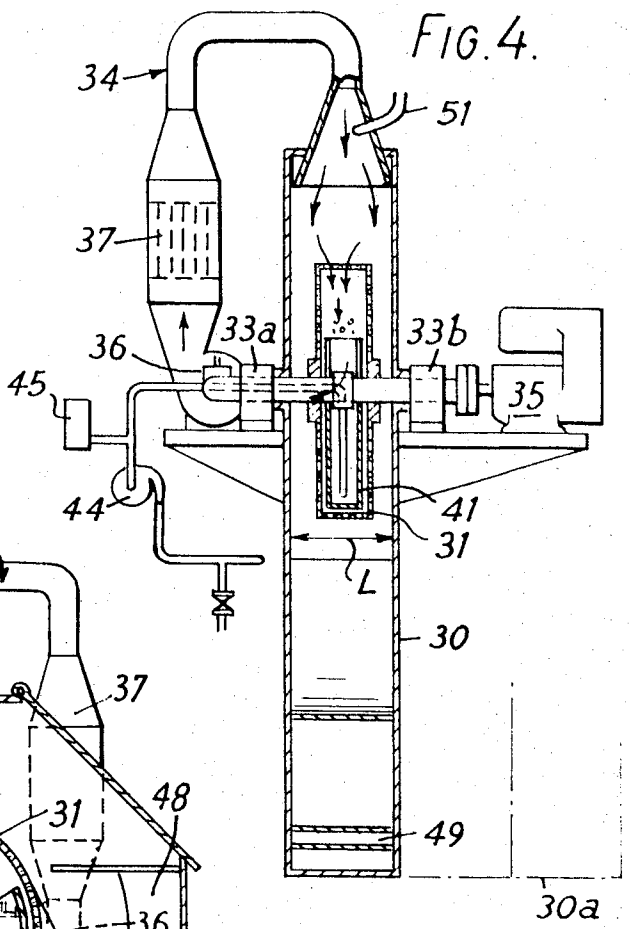
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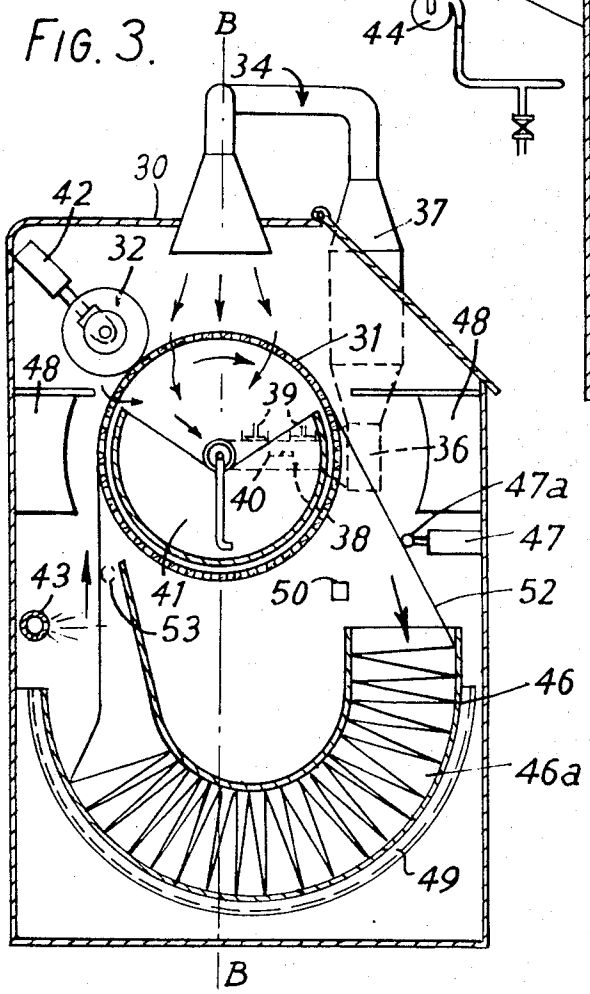
FIG. 3.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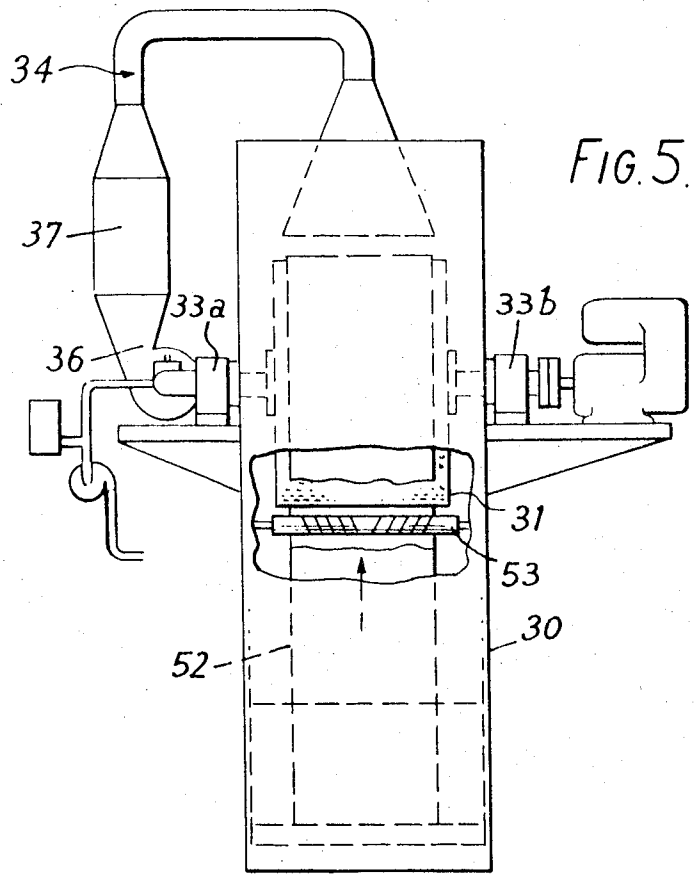


FIG. 5.

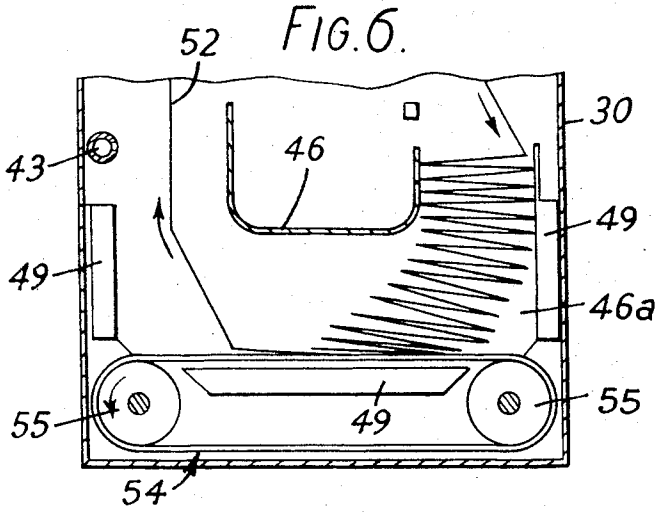


FIG. 6.

FIG. 7.

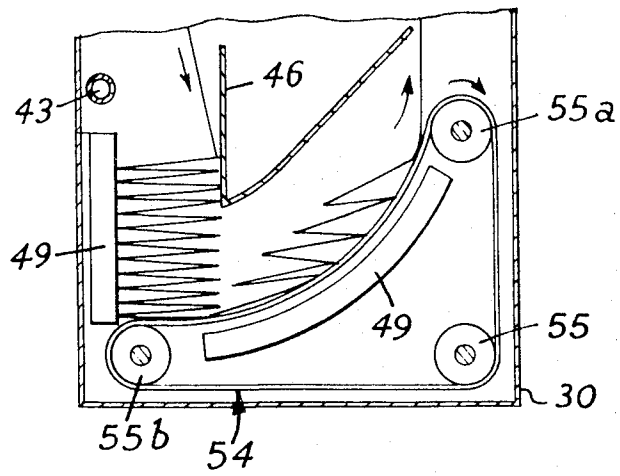
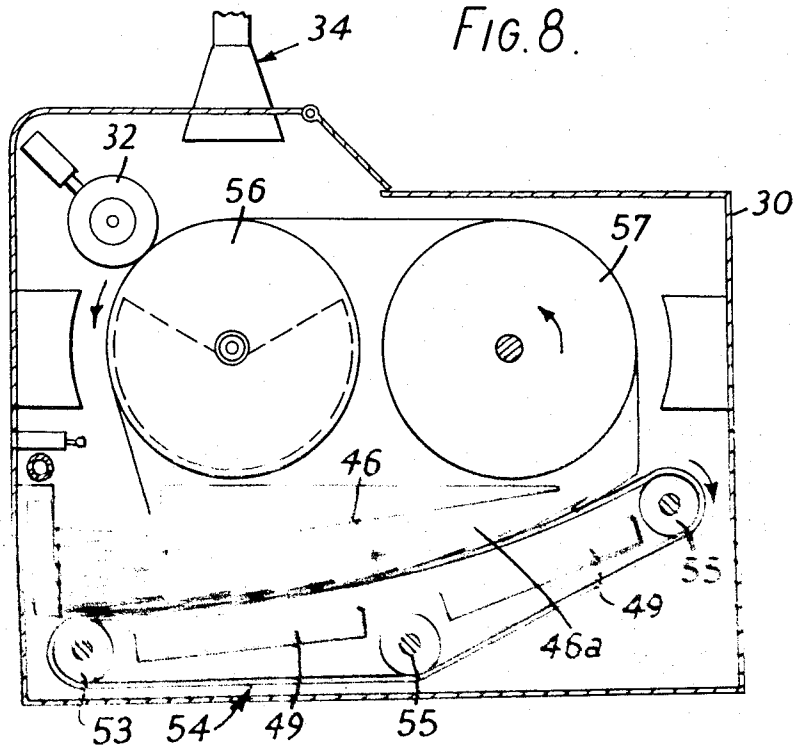


FIG. 8.



TEXTILE FINISHING PROCESSES

This invention relates to the finishing of textiles in a process which involves impregnating the textile with a liquor comprising a solution or emulsion of a finishing agent in or with water, and heating the impregnated textile. The term 'textile' when used hereinafter includes piece goods, yarn, made-up garments and analogous fibrous materials including leather. The expression 'finishing' when used in this context, includes the treatment of textiles in processes as outlined above by any of the commonly used finishing agents, such as dyes, scouring agents, softening agents, bleaching agents, or optical brighteners.

Moreover, the invention is concerned exclusively with finishing processes in which the ratio by weight of water plus finishing agent is low and particularly to such processes of the kind which are characterised in that the textile takes up all or substantially all of the available liquor during the impregnation step. A process which is characterised in this manner will hereinafter be referred to as 'a low liquor ratio finishing process of the kind concerned.'

In many conventional finishing processes the heating step is performed by heating is performed by heating a bath of the liquor, and thus the textile contained therein. This is not possible with low liquor ratio finishing processes of the kind concerned since there is little or no free liquor and the conduction and convection of heat through the impregnated textile is inhibited by the discontinuous nature of the liquid phase of the liquor. One particular finishing process of the kind concerned utilizes foam forming qualities of a foaming agent as an additive to the liquor; the impregnation step is so performed as to foam the liquor within and on the surface of the textile. In this particular process of the kind concerned further difficulties arise in the heating step because of the heat insulating properties of the foam.

In addition the impregnated textile has a tendency to dry as it is heated and premature drying causes uneven treatment.

The present invention sets out to overcome the above-mentioned problems.

Accordingly, the present invention resides in a low liquor ratio finishing process of the kind concerned in which, during the heating step, the impregnated textile is heated while being moved in an atmosphere which is substantially or completely saturated with water vapour.

The said atmosphere is utilized as a heating medium for the textile and its associated liquor. This eliminates the problems of excessive evaporation, with consequent premature drying so that the temperature of the impregnated textile can be raised rapidly without risks of uneven treatment. The level of water vapour in, i.e., the degree of saturation of, the atmosphere should not be so high as to result in excessive condensation onto the textile which would cause excessive dilution of the liquor with consequent formation of an excessive amount of free foam, where forming agents are used and/or uneven treatment.

The impregnated textile will be heated to a predetermined temperature during the heating step; in the case of dyeing this temperature is known as the fixing temperature. The textile may then be cooled immediately or it may be maintained at the said temperature for a predetermined length of time during which the finishing agent takes effect. In the latter case the humidity of the atmosphere may be reduced once the aforesaid temperature has been attained so that a certain permissible amount of evaporation of water from the textile so effectively increasing the concentration of finishing agent therein to improve the level of treatment.

In the performance of the finishing process the effect of the liquor on the textile into which it has been impregnated may be modified, when desired, by the addition of an appropriate chemical or chemicals in vapour or atomised spray form to the atmosphere in which the heating step is performed.

For example goods or garments to be dyed are often made from different threads which are preferentially dyed in say, alkaline, neutral and acidic conditions. The liquor contains dyestuffs which are active in alkaline neutral and acidic environments and the pH value of the liquor is adjusted accordingly by suitable additions to the atmosphere to render the dyestuffs active in sequence. Chemicals which may be added to the atmosphere to modify the liquor for such a purpose are Ammonia, Acetic Acid and Formic Acid.

Additiona may also be made to the atmosphere to provide a carrier to increase the rate of migration of dispersed dyes into hydrophobic textiles; one such additive is Benzyl Alcohol. Formaldehyde can be similarly introduced towards the end of a finishing process so as to enhance the fixation of, for example, direct dyes.

Addition is simple where the chemical additive concerned volatilizes below the boiling point of water i.e., at 100°C where the process is performed at atmospheric pressure; however the chemicals may be injected in atomised form to assure rapid vapourisation. In the case of chemicals, such as Benzyl alcohol, their steam volatility facilites vapourization. Where the chemicals do not volatilize at the boiling point of water addition may be achieved by the use of wick devices.

The method of obtaining the desired atmopshere may vary. Preferably the water which is required to saturate the atmosphere to the desired extent in which the fixing step is performed is injected into a stream of air in the form of steam or atomised water and the air is circulated through a chamber which contains the textile. This air may be circulated through the chamber during the heating step and its temperature may be raised externally of the said chamber.

Again, the heating step may be performed in a closed chamber. A quantity of water which is sufficient to ensure substantial or complete saturation of the atmosphere in the vessel or system without drying of the textile when raised to the fixing temperature is incorporated in the finishing liquor and the volume of the said closed chamber is so selected as to ensure saturation of the atmosphere therein without drying of the textile. The excess water evaporates as the temperature within the chamber increases so that the atmosphere therein becomes saturated. The humidity may be reduced at the end of the heating step by opening the chamber and allowing or causing the saturated atmosphere therein to be replaced.

A machine for performing the process preferably comprises a casing defining a treatment chamber for the textile, means for moving the textile within the said chamber, an external air circulating system comprising heating means and means for passing air heated by the heating means in recirculation through the chamber,

and means for adding liquid or liquid vapour into air circulated by the circulating system.

The accompanying drawings show details of machines for performing a low liquor ratio finishing process of the kind concerned in accordance with the invention. In these drawings:

FIG. 1 is a general perspective view partially cut away of one preferred machine in which the textile is tumbled in a rotatable horizontally journellad drum.

FIG. 2 is a section of an important part of the machine of FIG. 1.

FIG. 3 is a diagrammatic front view of an alternative machine for use where the textile is in the form of a "rope," the front of the machine hving been cut away,

FIG. 4 is a section on the line B—B in FIG. 3,

FIG. 5 is similar to FIG. 4 but shows a machine for use where the textile is in the form of a flat web, and

FIGS. 6, 7 and 8 illustrate modifications to the machines shown in FIGS. 3 to 5.

The machine shown in FIG. 1 and 2 provides a rotatable drum 1 which is perforated over its cylindrical wall and a cylindrical casing 2 in which the drum 1 is journalled. The casing 2 defines a treatment chamber in which textile in the drum 1 is processed, the latter being rotated at low speed by an electric motor (not shown) at desired times to move the textile by a tumbling action and being provided on the interior of its cylindrical wall with axially extending lifters. Access to the drum 1 is through an opening 1*a* which communicates with an opening 3*a* in the casing 2, the latter being closable by door 3 which is hinged to the casing 2.

The general constructional details of the parts described above are well known in tumble dryers and so-called horizontal washing machines and therefore they have not been shown in detail.

A steam injector 4 is arranged to dishcarge into the lower part of the casing 2 outside the drum 1. An external air circulating system is arranged to withdraw air from the interior of the casing 2 to heat it and recirculate it into the drum 1 by way of the access opening 1*a*.

The circulating system comprises a vertical chimney 5 which enters the cylindrical casing 2 tangentially of the latter. The chimney 5 is provided with sensors 21*a* and 21*b* which extend into the casing 2 to sense the temperature and pressure respectively in the casing 1 and also with a damper 6 actuable by a piston cylinder unit 7 and a further damper 8 actuable by a piston cylinder unit 9. The damper 8 controls the passage of air from the casing 2 into an exhaust duct 10 while the damper 6 controls the passage of air into a further part of the circulating system, viz. a duct 11.

An inlet of a filter unit 12 is connected to the duct 11 by way of a quick release connector 13 and the outlet of the filter unit 12 connects with the inlet of a centrifugal fan 14 by way of a duct 15 which incorporates a further quick release connector 16.

The filter 12 may be of any suitable construction and material; for example, open-cell expanded foam polymers, metal gauzes, sintered metals, metallic wool, fabric, paper or suitably arranged baffles may be arranged to constitute the filter elements. As will be appreciated from the drawings, the quick release connectors 13 and 16 permit the filter to be removed from the circulating system for cleaning or replacement when necessary.

The fan 14 is arranged to discharge into a heater box 17 which houses gilled tube steam heaters 18 and the heater box 17 in turn connects with the interior of the drum 1 by way of a duct 19 which is provided on a front wall of the casing 2, and discharges into the opening 1*a* by way of opening 2*a*.

The discharge exit of the duct 19 is shown in section in FIG. 2. As can be seen this exit is closeable by means of a damper 20 which is actuated by a pair of piston cylinder units 20*a* shown in FIG. 1. When the damper 20 is open it is received against an inner transparent portion 3*a* of the the door 3 and air passing through the duct 19 is discharged into the interior of the drum 1 through the opening 1*a* as indicated by arrows in the drawings.

The heater box 17 is provided with an access door 22 for cleaning purposes and a door 23 is provided in the chimney 5 for these purposes.

The machine is also provided with a steam coil heating jacket 24. The purpose of this heating jacket is as follows; in order to perform with optimum efficiency the heaters 18 have been designed to raise the temperature of the textile at a high rate and it is improtant that uneven heating of the textile and condensation in the machine are prevented. To this end the heating jacket 24 is arranged to heat the lower part of the casing 2 in which any condensate will collect. The heating jacket 24 is designed to heat the said part of the casing 2, and also the remainder of the latter by conduction, at a rate which approximates closely to the rate at which the heaters 18 raise the temperature of the atmosphere in the casing 1 and hence the textile.

The heating jacket 24 thus reduces condensation by virtue of the fact that the average temperature of the casing is maintained close to the temperature of the atmosphere within the latter; also it ensures that any condensation which odes occur is re-evaporated because it is so positioned to heat that part of the casing in which any condensation, e.g., such as may occur in the chimney 5, collects. Furthermore it greatly reduces the amount of heat which must be added to the atmosphere by the heaters 18. For example, consider a machine weighing 4,000 lb. and constructed from stainless steel containing a textile load of 60 lb. of polyester yarn impregnated at a liquor/goods ratio of 1.5 : 1 by weight. Now if the textile is to be heated from 60°F to 210°F the total quantity of heat required is equivalent to 86.4 lb of steam; of this only the equivalent of 16.4 lb of steam is required to heat the textile, the remaining quantity of heat is required to heat the machine and the majority of it can be provided by the heating jacket 24.

The heating jacket 24 can alternatively be supplied with cold water when the machine is to be cooled at the end of a process.

The machine is advantageously utilized for performing both the impregnating and the heating steps of a low liquor ratio finishing process of the kind concerned. To this end it is provided with a spray bar which is arranged in the vicinity of the access opening 2*a* to discharge into the drum 1 through the opening 1*a*. The spray bar 25 is alternatively connectible to a pumped and metered source of liquor 26*a* or to a source of water as at 26*b*; when the latter source is effective water or other rinsing liquid sprayed into the drum and is also caused to reverse flush the connection between the spray bar 25 and the source 26*a* so as to prevent cross-batch contamination.

In using the machine for performing a low liquor ratio finishing process of the kind concerned textile is

placed in the drum 1, the door is then closed and sealed.

The dampers 6, 8 and 20 are closed so that the chamber defined by the casing 2 is isolated from the circulating system.

An impregnation step is now performed by rotating the drum 1 at a low speed in either one or in alternate directions to tumble the textile whilst the predetermined quantity of a suitable finishing liquor is sprayed on to the textile by way of the spray inlet 25.

When a predetermined quantity of treatment liquor has been sprayed onto the textile the spray inlet is closed. The tumbling of the textile is continued so as mechanically work the textile to ensure even impregnation of the textile by the liquor; the tumbling also generates a foam where a foam forming additive is in use. During this time the drum remains isolated from the circulating system thus any liquor and in particular any foam, which becomes detached from the textile is prevented from leaving the casing.

Once even impregnation has been achieved the heating step is commenced. The heating step comprises heating the textile while moving it in an atmosphere which is saturated or completely saturated. In the case of dyeing heating of the textile continues until the so-called fixing temperature is reached; this latter expression will be used for convenience when referring to the temperature to which the textile is heated. The heater 18 is rendered effective, the fan 14 is energised and the dampers 8 and 20 are opened. At the same time the heater 24 is rendered effective to heat the casing 2 and live steam is injected through injector 4 to bring the humidity within the casing 2 and hence in the drum 1 to a predetermined level at which it is substantially or completely saturated.

The atmosphere within the casing 2 is maintained in a substantially or completely saturated condition whilst the temperature is raised by the circulation of the atmosphere through the heater 18. Any initial condensation of water from the atmosphere onto the textile aids the heating of the latter. It will be appreciated that any finishing liquor which is displaced from within the drum 1 by the action of the heated air will be trapped within the filter 12 for subsequent removal. The textile is tumbled throughout the heating step.

The heat removed from the atmosphere by the textile is replaced by the heater 18, when however, the tempeature within the drum 1 reaches a predetrmined level as determined by the temperature sensor 21*a* (this temperature being beneath the fixing temperature), the dampers 6 and 20 are closed and the fan 14 and the heater 18 are rendered ineffective. The heater 24 is, however, maintained in operation so that the temperature within the casing 2, which is now again isolated from the circulating system, continues to rise, albeit at a lower rate, by transfer from the casing; also the steam injector 4 is operated as necessary to maintain the desired humidity within the casing.

Where the fixing temperature is equal to the boiling point of the water content of the finishing liquor at the pressure existing in the drum the rapid increase in pressure as the water commences to boil is utilized to actuate the pressure sensing means 21*b* which is arranged to de-energise the heater 24. The textile in the drum may thus be maintained at the fixing temperature within very precise limits for a sufficient length of time to ensure even fixing of the treatment liquor. If the machine is pressurised, and the casing 2 may well be constructed to withsatnd pressurisation, the boiling point of the liquor will be increased; thus the pressure sensing means 21*b* may be utilized, in conjunction with the relief valve 2*b*, to maintain the temperature at any desired level.

The action of the finishing liquor on the textile during the fixing step may be modified, if desired, by introducing atomized or vapourised additives through the injector 4. Such additives may, as discussed previously, be utilized to adjust the pH value of the finishing liquor and are applied to the latter by condensation from the atmosphere within the drum.

At the end of the heating step the drum 1 is rotated rapidly in one direction for a predetermined length of time so as to centrifugally extract substantially all of the finishing liquor remaining in the goods. This extracted liquor is discharged to the casing 2 from whence it may be allowed to drain by gravity or may be removed by suitable pump means (not shown). This extraction may be performed either at the fixing temperature or after cooling to a predetermined lower temperature as required and may be followed by a rinsing step.

The dampers 6 and 20 are opened and the fan 9 and heaters 18 are again rendered effective. Air is thus drawn into the machine, heated by the heater 18, forced through the textile in the drum 1 and discharged by way of the duct 10; this rapidly dries the textile in the drum. The dry textile is allowed to cool and may then be removed through the opened door 3.

FIGS. 3 and 4, show diagrammatically an alternative machine in which textile in rope form can be finished in an efficacious manner in accordance with the invention.

The machine comprises a casing 30 inside which the process is performed, this containing a rotatable drive drum 31 which is perforated around its circumference for driving a continuous length of textile in rope form and a nip roller 32 for engaging the textile as it is driven between the drum 31 and the roller 32.

The drum 31 is mounted on trunnions 33*a* and 33*b* in the upper part of the casing 30 and the inlet of a circulation and heating system 34 is connected to one of the trunnions 33*a* which is of tubular form, whilst a drive motor 35 is connected directly to the other of the trunnions 33*b*.

The circulating and heating system 34 includes a fan 36 and a heat exchanger 37 and is connected to discharge heated air withdrawn from the interior of the drum 31 through the hollow trunnion 33*a* into the top of the casing 30.

A conduit 38 (see FIG. 3) at the suction side of fan 36 has branches to atmosphere controlled by dampers 39. Between these, in conduit 38, is a butterfly valve 40 which, when closed and with the dampers 39 open, will allow air to be drawn into the machine by fan 36 from outside and eventually discharged from the machine after passing through the casing 30.

An imperforate blanking member 41 of arcuate form is supported by the trunnions 33 and hangs within the drum 31 so that it closes off the perforations in the lower part of the latter.

The roller 32 is adjustably supported for movement radially of the drum 31 on a pair of piston/cylinder units 42 mounted in the casing so that its "nips" may be adjusted. The roller may be constituted by a tubular element of a resilient impermeable material, e.g., syn-

thetic rubber, which is mounted between circular end cheeks; the resilient material is inflated by pressurising the interior of the roller so as to ensure an even adjustable "nip" over the width of the drum **31** in such a case the piston/cylinder units **42** are not required. The roller has a foam forming function when a foam-forming additive is utilised, i.e., it performs mechanical work on textile carried beneath it. The roller could be covered with foamed or sponge material or it could be replaced by a brush.

A spray bar **43** extends along one wall of the casing **30** connected to the outlet of a pump **44** which is arranged to spray finishing liquor at a metered rate from a supply vessel **45**. The inlet of the pump **44** is also connectible to the interior of the blanking member **41** which is of trough form (see FIG. **4**).

A baffle **46** is secured within the casing **30** and defines a passage or so-called 'J-box' **46***a* within the lower part of the casing. A piston/cylinder unit **47** carries a roller **47***a* which extends transversely of the entrance to the passage **46***a*. The roller **47***a* is reciprocated, when the machine is in use, to 'plate' or fold textile as it enters the passage **46***a* in the normal direction of operation as shown in the drawing.

The rope of textile is 'plated' by the roller **47***a* in both transverse directions with respect to its line of movement; i.e., it is layered from side to side of the 'J-box' **46***a* as shown by arrow L in FIG. **4** and also it is folded across the width of the J-box as indicated in FIG. **3**.

The machine also incorporates internal radiant heaters **48** and the lower part of the casing **30** is provided with a steam-coil heater **49** through which hot water or steam may be circulated so that the J-box defining part of the machine is heated; the function of this heater is the same as that of heater **24** in the previous described machine. The temperature is controlled by a textile temperature sensor **50**. An injector **51** for steam or atomised water is provided in the inlet to the casing **30** from the circulation system **34**.

The apparatus is utilized in a manner which is essentially similar to that previously described with reference to FIGS. **1** and **2**; in this case, however, a continuous length of textile in rope form, as indicated at **52** is looped around the drum **31** which is driven clockwise, as shown in the drawing and the unit **47** is rendered effective so that the textile is driven around within the casing in the manner indicated in chain dotted line in FIG. **3**. Also the fan **37** is energised throughout to drive air round the circulating system **34** into the casing **30** through the perforations in the drum **31** and hence through the textile so as to ensure that the latter is driven without slipping.

Any liquor which is displaced from the textile during the impregnation step by the air passing therethrough is received in the member **41** and is recirculated by the pump **44** to the spray bar **43**.

The speed at which the textile is circulated will vary with the conditions and the particular material involved, but provision will be made to enable it to be moved at high speeds, e.g., of the order of 100 – 300 metres per minute or even higher. This will ensure even temperature distribution at high rates of heating.

If necessary vapourised or atomised additives, may be injected through the injector **51** at desired times; the additive will modify the atmosphere in the casing **30** and will therefore act on the textile herein in the manner discussed hereinbefore.

At the end of the heating step it is necessary to remove the exhausted finishing liquor from the textile. This can be done in a number of ways. Preferably, however, the "nip" of the roller **42** is increased so that treatment liquid is expelled from the textile and is caught by the blanking member **41** for removal from the casing by the pump **44**.

The removal of the treatment liquor as described above is only carried out after the textile has been brought to an appropriate temperature. Thus in the case of a textile fabric, the latter may be cooled to a temperature at which creasing or other blemishing is liable to occur. This can be done by cooling the machine, for example by circulating cooling air therethrough after valve **40** has been closed and dampers **39** have been opened. Advantageously this cooling will be performed at a controlled rate tempered to the particular characteristics of the material concerned.

If desired the textile can be rinsed in the apparatus so as to remove any remaining treatment liquid. A rinsing step can be performed by using a rinsing agent in a manner which is similar to that described above.

It will be understood that a number of machines similar to that described may be mounted in tandem so that a plurality of "ropes" of textile may be finished simultaneously; the chain-dotted lines **30***a* in FIG. **4** indicate the casings of two such machines which could be coupled directly to the machine described so as to be driven by a single motor **35**.

FIG. **6** shows a machine for treating a flat web of woven or knitted textile or a length of carpet. This machine differs from the machine shown in FIGS. **3** and **4** in respect of the axial length of the drum **31** which is required to support a web of textile in a flat condition. Also a scroll bar **53** is mounted beneath the drum **31** to spread the textile to its full width as it arrives at the take-up side of the drum; the position of this scroll bar is indicated in dotted line in FIG. **3**, and it may be adjustable with respect to the line of textile so as to adjust its action on the latter.

The modified machines shown in part of FIG. **6**, **7** and **8** each provide a conveyor in the bottom of the J-box **46***a*, the machines of FIGS. **6** and **7** are otherwise identical to the machines previously described with reference to FIGS. **3** and **4** or **5**.

The conveyors, each of which is indicated at **54**, are intended to prevent undue packing of textile as it passes through the J-boxes. In each case the conveyor **54** is arranged to define a lower wall of the J-box **46***a* which is driven, by rollers **55**, in the normal direction of passage of textile through the J-box.

In FIG. **6** the drive drum (not shown) is driven clockwise and the upper run of the conveyor **54** is driven from right to left (as shown in the drawing). Accordingly the lower layers of 'plated' textile are continuously driven towards the exit of the J-box **46***a*, thus facilitating withdrawal of the textile by the drive drum **31**.

In the machine shown in part in FIG. **6**, the direction of movement of textile is opposite to that shown in the machine of FIG. **5**. In this case the upper run of the conveyor **54** hangs between two drive rollers **55***a* and **55***b* and rises in its normal direction of travel as indicated by the arrows. The action of this conveyor not only continuously drives the lower layers of 'plated' textile towards the exit of the J-box **46***a* but also acts

to straighten the textile to a considerable extent before it leaves the J-box.

It will be appreciated that the conveyors 54 will not be driven at a speed which corresponds with the speed of the drum 31 but at a lower speed determined by the extent to which textile is plated in the J-box and hence by the overall length of fabric in the machine concerned.

The machine shown in FIG. 8 is generally similar to the machines described hereinbefore, but it will be seen that this machine is provided with a pair of drums around which the textile is driven. One of the drums 56 functions in an identical fashion to the drum 31 of the previously described machines, the other drum 57 may also be of the same form; preferably, however, it is unperforated and is driven at the same speed as the drum 36 so as to carry textile over its surface to the drum 56. It may be provided with a nip roller similar to the roller 32. This construction enables the overall height of machine to be reduced to a minimum without requiring extensive 'plating' of textile in the J-box.

It will be appreciated that water vapour may be added to the atmosphere within the casings of any of the machines described by means other than injectors. For example, the provision of 'wick' devices in the circulating and heating system will enable the water vapour and also such additives as may be required to be taken up by air circulated within the system without the need for pumps or jets.

If desired a machine of the form shown in FIG. 1 and 2 may be utilized to treat textile in web or rope form. To this end the drum 1 of such a machine may be provided with a hollow perforated spigot. In use the spigot will be arranged axially of the drum 1 with its interior connected into the doors opening to receive air discharged from the passageway 13. A web or rope of textile to be treated is formed into one or more loops around the spigot before the latter is positioned in the drum the length of the or each of the loops being such that the spigot drives the loops within the drum when the latter is rotated.

It will be appreciated that the liquor ratio in any low liquor ratio finishing process of the kind concerned will depend on the absorbent power of the textile concerned. For example, where the textile is a garment made from a fully fashioned plain knit texturized polyester, the liquor ratio, i.e., the ratio of liquor to textile by weight will probably be between 1.0 and 1.5:1; a simulated synthetic fur material, on the other hand, could absorb far more liquor and the liquor ratio in such a case could be as high as 6:1.

We claim:

1. A low liquor ratio textile finishing process of the kind which comprises a step in which the textile is impregnated with a finishing liquor comprising finishing agent and water and a heating step in which the temperature of the textile is raised to a predetermined finishing temperature, the quantity of finishing liquor being such that the textile absorbs substantially all of the available liquor during the impregnation step, wherein the heating step comprises heating the impregnated textile to the predetermined finishing temperature while moving it in an atmosphere which is substantially or completely saturated with water vapour.

2. A low liquor ratio finishing process in accordance with claim 1, wherein the impregnated textile is moved by a tumbling action and the said atmosphere is circulated around and through the textile as it is tumbled.

3. A low liquor ratio finishing process in accordance with claim 1, in which the impregnated textile is in the form of a continuous loop, for example, a web or rope, and wherein the textile is moved by driving said loop within said atmosphere which is circulated around and through the textile as the latter is moved.

4. A low liquor ratio finishing process in accordance with claim 1, wherein the said atmosphere further comprises liquid additives in vapourised or atomised form.

5. A low liquor ratio finishing process in accordance with claim 1, wherein steam is injected into said atmosphere so as to saturate it to the desired extent.

6. A low liquor ratio finishing process in accordance with claim 1, wherein subsequent to reaching the predetermined finishing temperature, the quantity of water in the said atmosphere is reduced so as to permit a reduction of the liquor ratio thereby to enhance the activity of the finishing agent.

7. A low liquor ratio finishing process in accordance with claim 1, wherein the textile is heated to the predetermined temperature in a closed chamber and the heating step is terminated in response to an increase in pressure in said chamber consequent on boiling of the water content of the liquor with which the textile is impregnated.

8. A machine for performing the method according to claim 1, comprising, in combination, a casing defining a treatment chamber for the textile, means for moving the textile within said chamber, an external air circulating system comprising heating means and means for passing air heated by the heating means in recirculation through the said chamber and means for adding liquid or liquid vapour into air circulated by the circulating system.

9. A machine in accordance with claim 8, wherein said textile moving means comprises a drum which is rotatably supported on a horizontal or inclined axis within the casing and into which textile can be placed and moved by rotation of the drum, and wherein damper means are provided in the circulating system for isolating the casing and hence the drum from said system.

10. A machine in accordance with claim 9, wherein the rotatable drum is perforated and the said means for adding liquid or liquid vapour is arranged to discharge into the casing between the latter and the exterior of the drum.

11. A machine in accordance with claim 8, wherein the said textile moving means is a rotatable drive drum journalled within the casing to drive a loop of textile in the form of a flat web or in rope form which is passed around the exterior of the said drum and wherein a roller cooperates with the drum so as to define a nip through which the textile is driven by rotation of the drum.

12. A machine in accordance with claim 11, wherein the roller is constituted by an inflatable tubular member supported between end eheeks the tubular member being inflated when the machine is in use so as to give a desired loading on textile driven through the said nip.

13. A machine in accordance with claim 11, wherein the drive drum is perforated and the circulating system is connected at its inlet to the interior of the drive drum so that, when the circulating system is in operation, the

textile is held against the surface of the drive drum by the passage of air therethrough.

14. A machine in accordance with claim **8**, further comprising heating means arranged to heat the casing which collects any condensation which occurs during a heating step at a rate which approximates with the rate at which the heaters of the circulating system is designed to raise the temperature of the textile.

15. A machine in accordance with claim **14**, wherein the casing is so constructed as to be pressurisable and in that pressure sensing means are provided to sense the pressure within the chamber, the pressure sensing means being arranged to control the heating during the heating step so that heating is discontinued as soon as the water content of the liquor with which the textile is impregnated boils.

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Notice of Adverse Decision in Interference

In Interference No. 99,215, involving Patent No. 3,762,866, J. Rayment, D. D. McCordell and C. Parr, TEXTILE FINISHING PROCESSES, final judgment adverse to the patentees was rendered Feb. 17, 1977, as to claims 1, 2, 4 and 5.

[*Official Gazette July 5, 1977.*]