Dec. 11, 1962 N. BRUNT 3,067,602

APPARATUS FOR THE TREATMENT OF TEXTILE MATERIALS

Filed Sept. 18, 1961 2 Sheets-Sheet 1

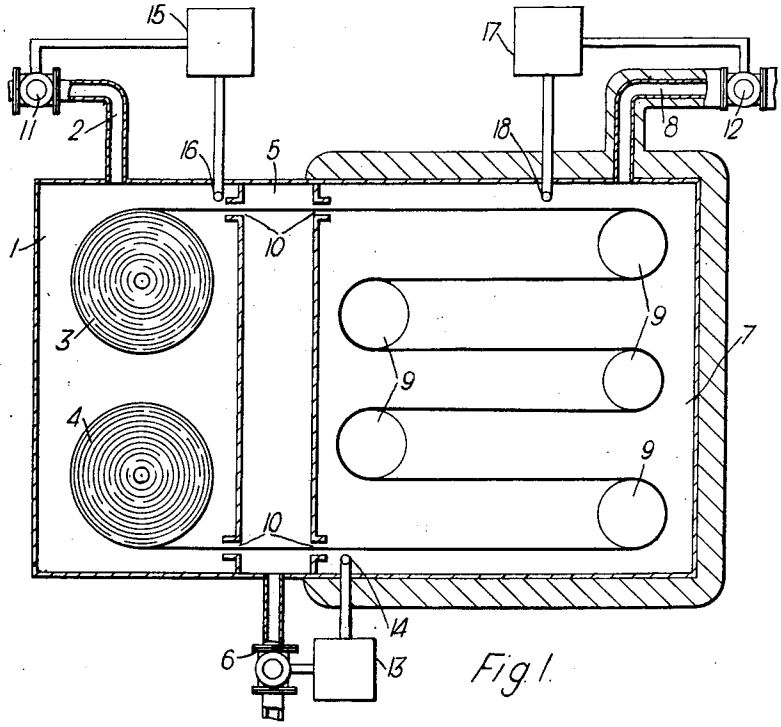


Fig. 1.

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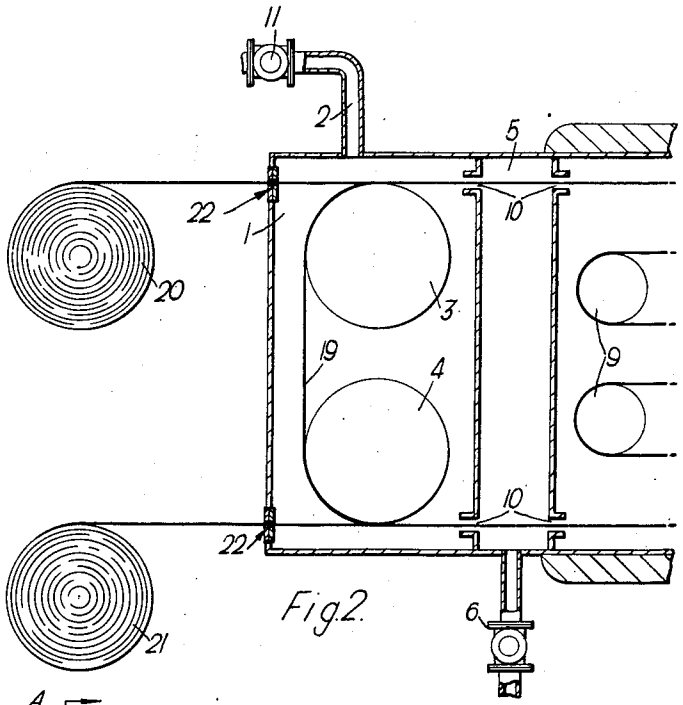


Fig.2.

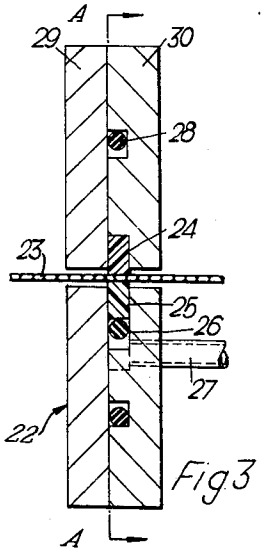


Fig3

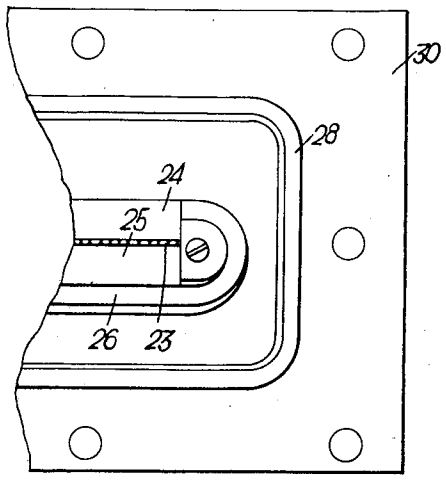


Fig.4.

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APPARATUS FOR THE TREATMENT OF TEXTILE MATERIALS

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6 Claims. (Cl. 68—5)

This invention relates to apparatus for the treatment of textile materials and more particularly for the treatment of textile materials in continuous lengths by steam under pressure.

Examples of textile materials in continuous lengths are textile fabrics, warps and yarn, for instance nylon fabric.

The expression "steam under pressure" means that the steam shows a gauge pressure; in other words the steam is at a pressure above atmospheric pressure. Any specific pressures referred to throughout the specification will thus be gauge pressures.

The great difficulty encountered in effecting such steam treatment is to prevent the steam under pressure escaping from the steam chamber through the orifices provided for the ingress and egress of the travelling textile fabric, particularly when higher pressures, e.g. 3.5 kgm. per sq. cm. are necessary to produce the desired temperature. To prevent or minimize the leak of steam which constitutes an expensive waste, numerous efforts have been made to seal the aforesaid orifices by means of flaps, rubber rollers and like devices, but without affording what can be regarded as a successful or satisfactory solution to the problem. Indeed it has hitherto been impossible to work with pressures of the order of 7 kgm. per sq. cm.

In the present invention no attempt is made to close hermetically the above-mentioned orifices for the fabric. Instead the leakage of steam is prevented or minimized by confronting said steam at the orifices with an atmosphere of air at substantially the same pressure. If the air were at precisely the same pressure as the steam, it is true that no leak of steam would occur by flow through the orifices, but owing to diffusion of the air and steam and entrainment of the gases by the travelling fabric an invasion of the steam chamber by the air would take place causing an undesirable fall in the temperature of the steam to ensue. To prevent this diffusion the pressure outside the steam chamber is allowed to fall very slightly below that of the steam, so that the steam leaks very slowly out of the orifices preventing any intrusion of the air into the steam chamber. This is accomplished by means of apparatus which comprises three adjacent chambers, namely a first chamber fitted with a conventional air supply to maintain a pressure of air therein and adapted to accommodate the feed roll and take up roll for the continuous lengths of textile material, a second intermediate diffusion chamber having an escape valve, and a third chamber fitted with a conventional steam supply to maintain a pressure of steam therein and containing appropriate rolls or other known devices for carrying the textile material to be treated, the chambers intercommunicating by means of orifices designed closely to fit the cross-sectional contour of the textile material whilst permitting its passage from the first to the third chamber and its return to the former.

Although the orifices, whilst allowing easy passage of the textile material should fit its cross-sectional contour snugly to diminish diffusion, there is no question of gas-tightness involved in the orifices connecting the three chambers because there is no pressure gradient across these orifices except a minute one deliberately introduced to engender the slow leak already discussed. Whilst both saturated and superheated steam can be used in the present apparatus, the former is usually to be preferred on

account of its general availability and the convenient fixed relationship between its temperature and pressure, which means that a desired temperature can be ensured by maintaining the corresponding pressure.

The invention includes a process for the treatment with steam under pressure of textile materials in continuous lengths comprising forwarding said textile materials from a first chamber filled with air under pressure through an orifice into a second adjacent chamber containing a mixture of air and steam at a slightly lower pressure and then through an orifice into a third adjacent chamber filled with steam at the same, or very nearly the same, pressure as that of the air in the said first chamber, and thence back through orifices by way of the second chamber to the first chamber, said orifices being designed closely to fit the cross-sectional contour of the textile materials whilst permitting their easy passage.

The working of the invention will now be explained in greater detail with reference to the accompanying diagrammatic drawings, wherein FIGURE 1 illustrates one embodiment of the apparatus including the automatic control thereof, FIGURE 2 another embodiment permitting nearly continuous working and FIGURES 3 and 4 details of the orifices for the passage of textile material. The designation of the various parts of the apparatus is as follows:

FIGURE 1:

- **1**, first chamber
- **2**, air supply to first chamber controlled by valve **11**
- **3**, feed roll for textile material
- **4**, take-up roll for textile material
- **5**, second chamber (diffusion chamber)
- **6**, escape valve of second chamber
- **7**, third chamber (steam chamber)
- **8**, steam supply to third chamber controlled by valve **12**
- **9**, rolls for supporting textile material
- **10**, orifices for passage of textile material
- **11**, valve to first chamber
- **12**, valve to third chamber
- **13**, pneumatic temperature-sensitive device to third chamber
- **14**, probe of device **13**
- **15**, pneumatic temperature-sensitive device to first chamber
- **16**, probe of device **15**
- **17**, pneumatic pressure-sensitive device to third chamber
- **18**, probe of device **17**

FIGURE 2:

- **19**, continuous pin track
- **20**, feed roll for textile material
- **21**, take-up roll for textile material
- **22**, narrow slots to accommodate running textile material

(The other numerals in FIGURE 2 have the same significance as in FIGURE 1.)

FIGURE 3:

- **22**, slot to accommodate running textile material
- **23**, continuous length of textile material
- **24**, fixed strip
- **25**, moveable strip
- **26**, rubber sealing member to movable strip
- **27**, air supply pipe
- **28**, rubber sealing member to component parts **29**, **30** of slot

FIGURE 4: The numerals have the same significance as in FIGURE 3.

In operating the apparatus illustrated in FIGURE 1, a roll of the textile material for treatment is inserted at **3** and the material taken through the orifices **10**, round the rolls **9** in chamber **7** and back to the take-up roll **4**. Saturated steam at the required pressure to produce the requi-

site temperature is admitted to chamber 7 by maens of the supply line 8 carrying a conventional pressure regulating valve. An equal pressure of air is similarly maintained in chamber 1 by the supply line 2 which is likewise furnished with a pressure regulating valve. In order to prevent air finding its way into the steam chamber 7, the valve 6 is very slightly opened. The fabric is then mechanically forwarded from roll 3 through the second or diffusion chamber 5 into the third or steam chamber 7, round the rolls 9 and back via the diffusion chamber 5 to the take-up roll 4. The steam chamber 7 may advantageously be conventionally lagged and fitted with a water trap (not shown). The fact that only a slow leak of steam through valve 6 is required to prevent the intrusion of air into the steam chamber 7 constitutes a very important economic advantage of the invention.

By way of example, in treating plain weave nylon fabric constructed of yarn of 205 denier and 48 inches wide the orifices 10 take the form of slots. An appropriate steaming temperature is 153° C. This corresponds to a steam pressure in chamber 7 of 4.2 kgm. per sq. cm. Accordingly the air pressure in chamber 1 is also adjusted to 4.2 kgm. per sq. cm. Valve 6 is slightly opened to effect the necessary slow leak which need only be of the order of about ⅔ kgm. of steam per hour. The corresponding drop in pressure in the diffusion chamber is very small, amounting to about 0.25 cm. of water, say. The nylon fabric is forwarded through the steam chamber 7 on a suitable stenter, which controls its width, at such a speed that its time of passage therethrough, that is to say, its period of treatment is 3 minutes. The rolls 3 and 4 are both positively driven, the former 5% faster than the latter in order to afford this degree of overfeed and allow corresponding longitudinal shrinkage of the fabric. The nylon fabric is then found to have been more efficiently set so that it does not become creased during domestic washing.

The above apparatus may with advantage be controlled automatically, for example, as explained below.

Thus, with further reference to FIGURE 1, the pneumatic pressure-sensitive device 17 controls the steam supply valve 12. If the pressure falls below 4.2 kgm. per sq. cm., the drop in pressure is duly signalled by the probe 18 to the device 17, which thereupon opens the valve 12 more widely to admit more steam. If the pressure in chamber 7 rises above the desired value of 4.2 kgm. per sq. cm., then a high pressure signal passes from the probe 18 to the device 17 and the steam valve 12 is caused to close somewhat so as to reduce the supply of steam. As already mentioned, any invasion of the steam chamber 7 by air from chamber 5 causes a fall in the temperature (153° C.). This is detected by the probe 14 (situated near to an orifice for the passage of the textile fabric) and a low temperature signal from the probe then causes the temperature-sensitive device 13 to open valve 6 more widely, thus allowing the pressure outside the steam chamber to fall below that of the steam, so that steam leaks out of the steam chamber 7, and so prevents any instrusion of air thereinto. When the temperature of 153° C. is attained the valve 6 is automatically closed to its former setting, which in practice is adjusted so that the volume of air/steam mixture leaking therefrom is just insufficient to prevent air passing into the steam chamber 7. The pressure of the air in the chamber 1 is conveniently maintained at 4.2 kgm. per sq. cm. by ensuring a sufficient pressure to prevent any steam (mixed with air) from the diffusion chamber 5 finding its way into chamber 1. This is automatically accomplished by the pneumatic temperature-sensitive device 15 with its probe 16 (positioned near one of the orifices for the passage of the textile fabric) because any instrusion of steam into chamber 1 causes a rise in the temperature of the air. The air in chamber 1 does in fact in any case become heated above room temperature owing to the propinquity of the steam chamber and the diffusion chamber and the hot

fabric coming from the steam chamber. As a result the air reaches a temperature lying between room temperature and 153° C. even when the pressure is at 4.2 kgm. per sq. cm., i.e. great enough to prevent the intrusion of steam. The actual temperature reached depends on numerous conditions including the size and shape of the apparatus and will be referred to as temperature T° C. Any intrusion of steam from chamber 5 into chamber 1 would raise the temperature still further. The device 15 is therefore set so that it opens the valve 11 (to increase the air pressure in chamber 1) if the temperature rises above T° C. and closes the valve again as soon as the temperature returns to T° C.

In working the above apapratus it is necessary, when the feed roll has become empty by the passage of all the textile material on to the take-up roll, to release the air and steam pressures, so that the first chamber can be opened, and the feed roll and take up roll exchanged for fresh ones. Then the air and steam pressures must be re-established before work can recommence. However by fitting the rolls numbered 3, 4 and 9 shown in FIGURE 1 of the drawings with a continuous pin track and removing the feed and take-up rolls of textile outside the first chamber as shown in FIGURE 2 of the drawings, the process can be made nearly continuous in the following manner. With respect of FIGURE 2, it is to be noted that the automatic devices have been omitted for the sake of simplicity; also the right-hand side of the steam chamber is omitted for want of space but is the same as shown in FIGURE 1.

Accordingly the present invention includes an apparatus for the treatment of textile materials in continuous lengths with steam under pressure, comprising three adjacent chambers intercommunicating by means of orifices designed closely to fit the cross-sectional contour of the textile material whilst permitting its passage from the first to the third chamber and its return to the former, whereof the first chamber is fitted with a conventional air supply to maintain a pressure of air therein and (in addition to the orifices referred to above) possesses two orifices communicating with the outside atmosphere to permit the untreated textile material to enter the first chamber from the outside and the treated material to return thereto from the first chamber, which two orifices are sealed to prevent undue leakage of air, the second intermediate diffusion chamber has an escape valve and the third chamber is fitted with a conventional steam supply to maintain a pressure of steam therein, and the first and third chambers contain appropriate rolls or other known devices which bear an endless track adapted to carry the textile material and running from the first chamber where the textile material joins it, through the second and third chambers and back through the second chamber to the first chamber, where the textile material leaves said track.

All the rolls in the aforesaid FIGURE 2 of the drawings carry the continuous pin track 19 which thus runs from roll 3, round all the rolls 9 and thence on to roll 4 from which the pin track runs on to roll 3 making a complete circuit. The continuous pin track 19 may consist of conventional tenter chains with pins (as shown in FIGURE 1 of U.S. Patent 2,591,861) or equivalent clips (see U.S. Patent 2,343,351, for example). The feed and take up rolls 20, 21 communicate with the pin track by means of appropriate narrow slots 22 in the left-hand wall of chamber 1 of the aforesaid drawing designed to accommodate the textile material as it runs into the chamber. When the apparatus is in operation therefore, a continuous length of textile material is wound off set feed roll 20, passes into the said chamber 1 through the beforementioned slot, and then engages with the pin track 19 and is carried by the track through chamber 5 into chamber 7, where the textile material passes round the rolls 9 and is then taken back to roll 4 by the pin track. Here the textile material parts company with the pin track (which runs continuously to roll 3), leaves chamber 1

through the narrow slot 22 provided, and is wound up on the take-up roll 21 situated outside chamber 1.

The slots 22 provided in the wall of chamber 1 for the passage of the continuous lengths of textile material must be sealed as well as possible to prevent undue leakage of air from chamber 1. Suitable means for sealing can comprise known arrangements of nip rolls, but it is preferred to effect the sealing by constructing the slot of two strips of material, e.g. metal or resin, and especially polytetrafluoroethylene, one strip being fixed whilst the other may approach or recede therefrom to suit the thickness of the textile material. Such an arrangement is illustrated in FIGURE 3 of the drawings which shows an enlarged cross-section of preferred slots 22 in FIGURE 2, each slot comprising a fixed strip of polytetrafluoroethylene 24 and a moveable strip thereof 25. The moveable strip 25 is urged against the textile material 23, in order to minimize leakage of air, by suitable resilient means, the latter consisting conveniently of air pressure, applied indirectly to the back of said strip 25 (i.e. that edge which is remote from the edge in contact with the textile material). Thus the strip is shown in contact with a rubber sealing member 26, running along the length of the back of the strip and pressed thereagainst by air under pressure, which is supplied through the pipe 27. FIGURE 4 is a view of the cross-section of FIGURE 3 taken along the line A—A in the direction of the arrows. The slot shaped orifices are conveniently made adjustable by conventional mechanical means so as to fit different widths of fabric.

The working of the present aparatus can be nearly continuous because when the feed roll or textile material has become empty, it is only necessary to sew the end of the length of textile material being treated on to the beginning of a length carried on a fresh feed roll. At the same time the end of textile material emerging from the apparatus is severed and attached to a fresh (empty) take-up roll.

What I claim is:

1. Apparatus for the treatment of textile materials in continuous lengths with steam under pressure comprising three adjoining chambers including two end chambers and an intermediate chamber therebetween, means for supplying air under pressure to one end chamber, means for supplying steam under pressure to the other end chamber, each of said end chambers communicating with the intermediate chamber by means of orifices designed closely to fit the cross-sectional contour of the textile material while permitting passage thereof from the air chamber through the intermediate chamber to the steam chamber and back through the intermediate chamber to the air chamber, and an escape valve communicating with said intermediate chamber.

2. Apparatus as defined in claim 1, wherein said air chamber is adapted to accommodate a feed roll and a take up roll for the continuous lengths of textile material, and said steam chamber is provided with guide rolls for leading the textile material therethrough.

3. Apparatus as defined in claim 1, wherein said air chamber is provided with two orifices in an outer wall thereof to permit untreated textile material to enter the air chamber from the outside and treated textile material to emerge from the air chamber, and sealing means associated with said orifices to prevent undue leakage of air therethrough.

4. Apparatus as defined in claim 1, wherein said air chamber is provided with two orifices in an outer wall thereof to permit untreated textile material to enter the air chamber from the outside and treated textile material to emerge from the air chamber, and sealing means associated with said orifices to prevent undue leakage of air therethrough, said sealing means including two strips of material, one of which is fixed and the other movable, and resilient means urging said movable strip toward said fixed strip.

5. Apparatus as defined in claim 1, wherein said air chamber is provided with two orifices in an outer wall thereof to permit untreated textile material to enter the air chamber from the outside and treated textile material to emerge from the air chamber, and sealing means associated with said orifices to prevent undue leakage of air therethrough, said sealing means including two strips of polytetrafluoroethylene, one of which is fixed and the other movable, and resilient means urging said movable strip toward said fixed strip.

6. Apparatus as defined in claim 1, including means for automatically controlling the supply of air to said one end chamber, the supply of steam to said other end chamber, and said escape valve.

References Cited in the file of this patent

UNITED STATES PATENTS

1,663,845	Jacoby	Mar. 27, 1928
1,738,946	Chapin	Dec. 10, 1929
1,808,701	Wigglesworth	June 2, 1931
2,532,471	Wedler	Dec. 5, 1950
2,641,119	Jacoby	June 9, 1953