Sept. 26, 1967 R. V. HAYMAN 3,343,378

APPARATUS FOR THE TREATMENT OF TEXTILE MATERIALS

Filed April 5, 1965 5 Sheets-Sheet 1

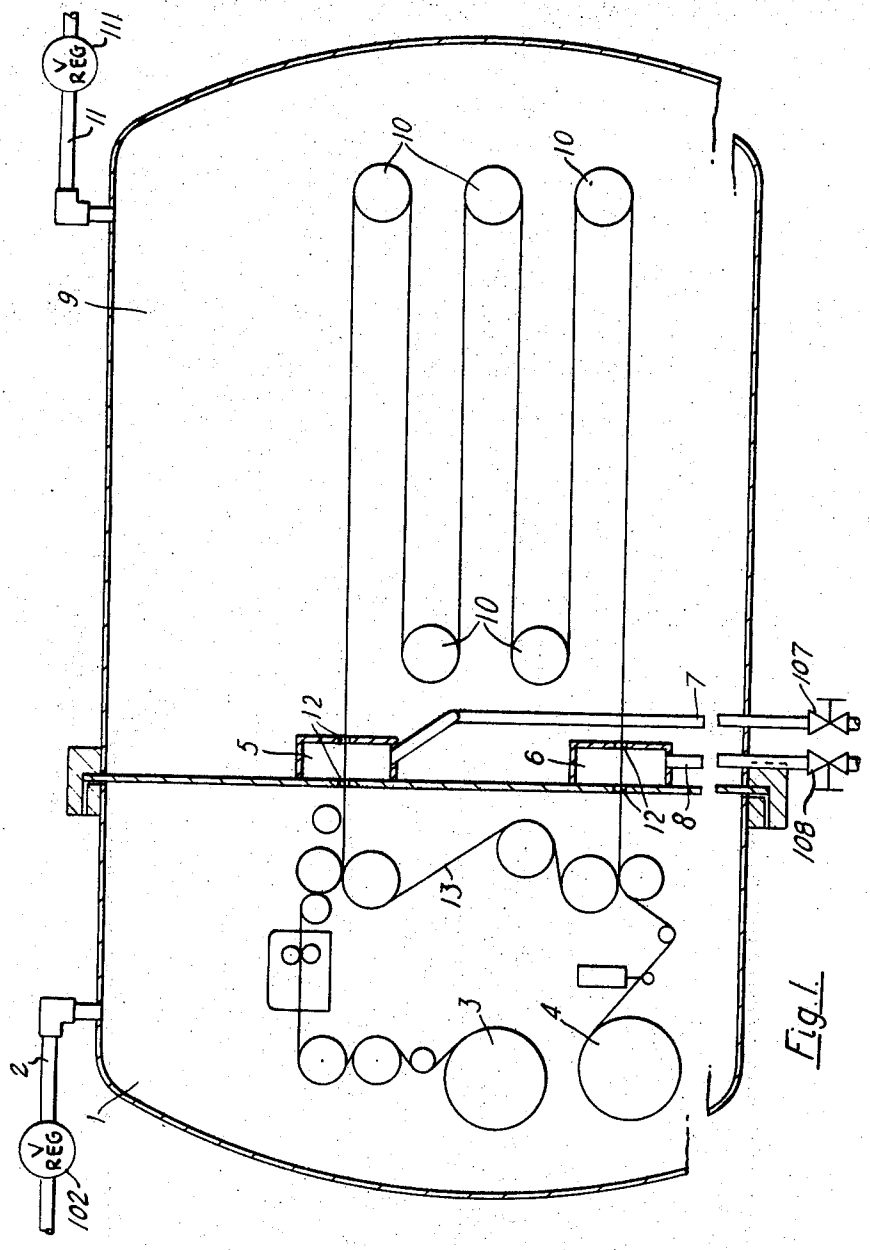

Fig. 1

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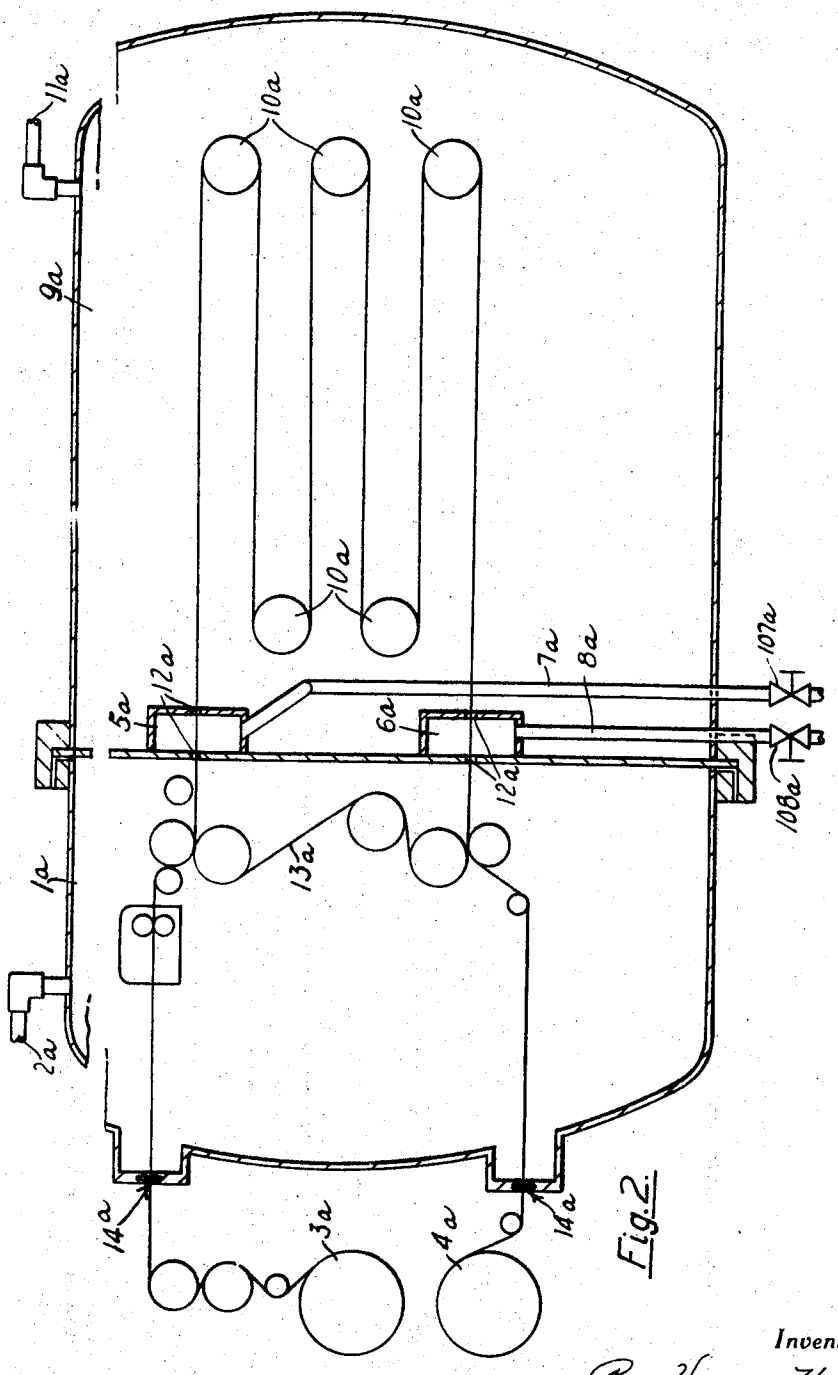

Fig. 2

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APPARATUS FOR THE TREATMENT OF TEXTILE MATERIALS

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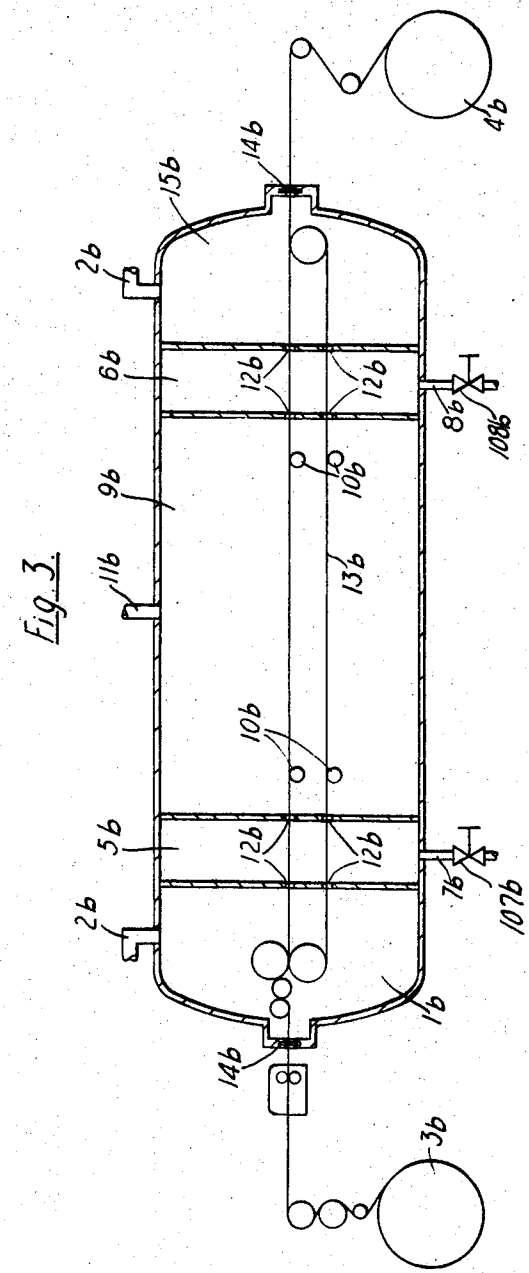
Fig. 3.



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APPARATUS FOR THE TREATMENT OF TEXTILE MATERIALS

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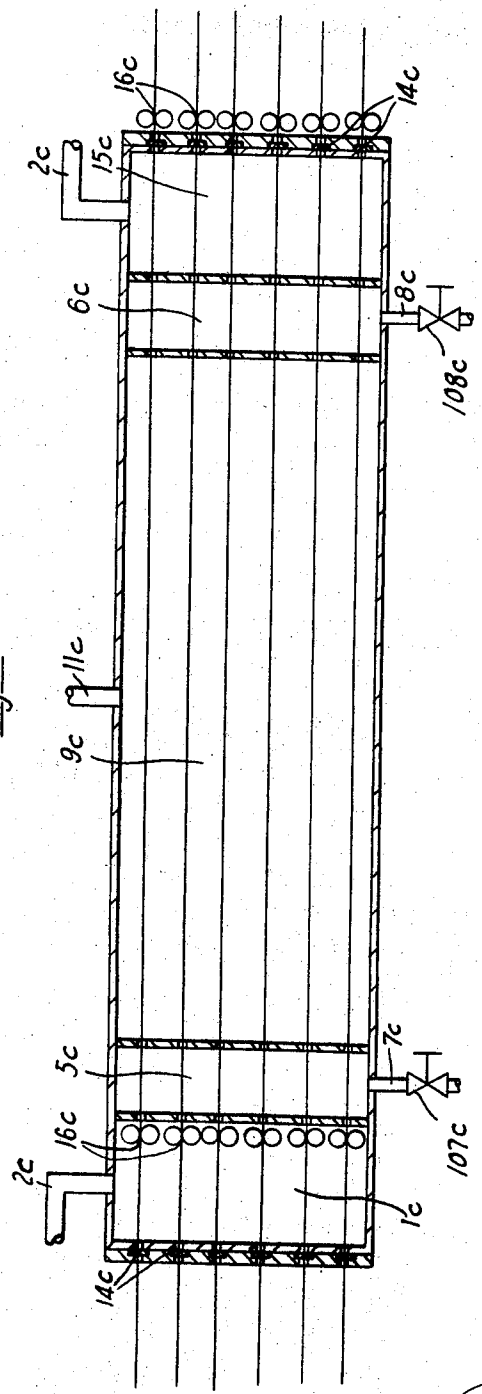

Fig 4

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APPARATUS FOR THE TREATMENT OF TEXTILE MATERIALS

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Fig. 5.

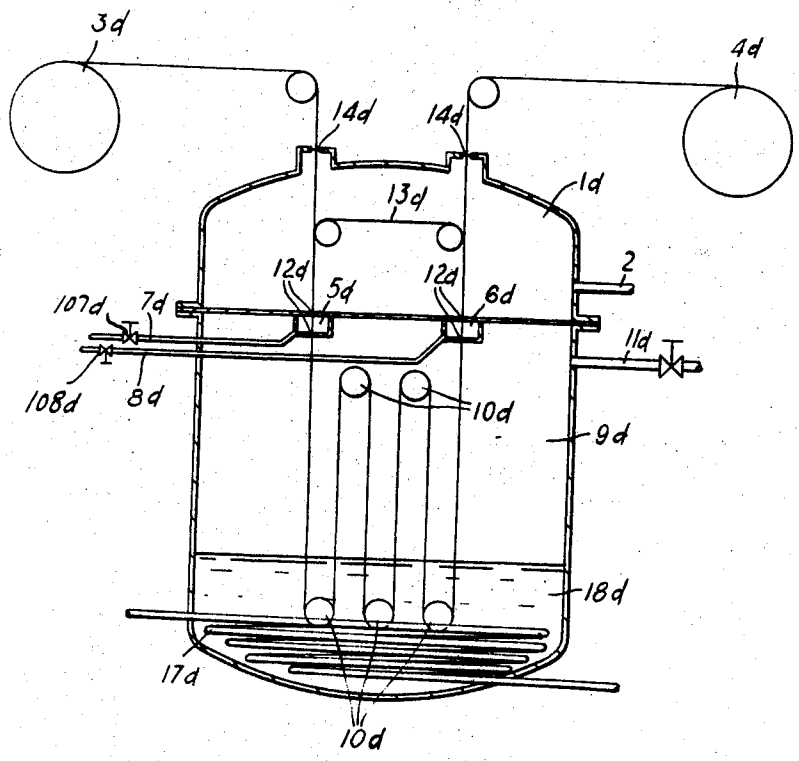
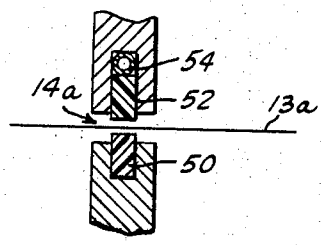


Fig. 6.



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United States Patent Office 3,343,378
Patented Sept. 26, 1967

3,343,378

APPARATUS FOR THE TREATMENT OF TEXTILE MATERIALS

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Filed Apr. 5, 1965, Ser. No. 445,426
Claims priority, application Great Britain, Apr. 18, 1964, 16,144/64
8 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 in steam under pressure, or in aqueous liquids beneath an atmosphere of steam under pressure.

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

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.

It is frequently required to treat textile materials with saturated steam at temperatures exceeding the boiling point of water, at which temperatures the said steam is accordingly under pressure. Thus steaming treatments are employed to fix the colours on dyed or printed fabrics. Another important application of steam under pressure is in the setting of nylon yarn of fabrics in order to stabilise the physical shape or configuration thereof. Crimped yarn for example would be set to prevent the crimp being destroyed during dyeing. Likewise nylon fabric would be set in a smooth state to prevent subsequent creasing during finishing or in after-treatments, e.g. dyeing. Furthermore, it is often advantageous to execute continuous hot wet treatments in aqueous liquids at temperatures above the boiling point of water. The atmosphere above such liquids comprises steam under pressure.

The great difficulty encountered in effecting such steam or hot aqueous liquid treatment continuously 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 minimise 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.

The same problem arises in the treatment of textile materials in continuous lengths by the application thereto of aqueous liquids at temperatures above the boiling point of water, for example in dyeing or scouring operations, since the atmosphere above such liquids will comprise steam under pressure, into and out of which the textile materials must pass in coming from and returning to the outside atmosphere.

In the invention described in British patent specification, corresponding to United States Patent 3,067,602, No. 914,600 no attempt is made to close hermetically the above-mentioned orifices for the fabric. Instead the leakage of steam is prevented or minimised 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 through the second to the third chamber and its return via the second chamber to the first chamber.

In the above apparatus textile materials in continuous lengths which are to be treated with steam are forwarded 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. It has now been found that the size of the intermediate diffusion chamber can conveniently be reduced by restricting its cross-sectional area to the neighbourhood of each orifice so that in fact the original single diffusion chamber becomes two smaller diffusion chambers, both however communicating with the air chamber which accommodates the feed roll and take up roll.

The invention of British patent specification No. 914,600 also includes however 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. Now this form of the apparatus in which the air chamber no longer accommodates the feed roll and take up roll can conveniently be modified not only by restricting the cross-sectional area of the diffusion chamber to the neighbourhood of each orifice but also by restricting the cross-sectional area of the air chamber in like manner so that it becomes two smaller air cham-

bers corresponding with the two smaller diffusion chambers. In other words each orifice of the steam chamber can be regarded as covered by its own diffusion surmounted by its own air chamber.

It will furthermore be observed that treatment of textile materials with steam in the apparatus of British patent specification No. 914,600 involves reversing the direction in which they run at least once, since they return from the third chamber back to the first chamber by way of the second chamber. Now in the case of fabrics in continuous lengths which are submitted to steam treatment, a degree of tension is necessary both in the warp direction, i.e. direction of travel, and also in the weft direction. So long as the fabric travels in a straight line the forces of tension tending to cause the fabric to contract lie in the plane of the fabric. If however there is a change of direction components of the forces come into existence which are at right angles to the plane of the fabric. Especially is this so at reversal when the fabric is turned through an angle of 180°. It will be understood that the original forces of tension are increased by any tendency to shrink induced by the steam treatment. Since the fabric is normally held only at the edges (selvedges) the aforesaid tensions produce a sagging or a waist in the fabric at the turning point which is sometimes troublesome. The fabric may even, in extreme cases, be torn away from the selvedges, particularly if it is a cloth of light construction. It is possible to prevent the aforesaid sagging or waist-formation by providing a supporting roller across the full width of the fabric at each turning point but such a device is mechanically complicated since the roller must be telescopic, i.e. capable of adjustment to fit different widths of fabric and also it must present a very smooth surface to the fabric in order to avoid marking the latter. This solution to the problem is consequently expensive and unattractive from a practical point of view.

It has now been found that the above difficulties can be overcome by modifying the apparatus of British patent specification No. 914,600 so that the fabric can enter the steam chamber (referred to in that specification as the third chamber) on one side and leave it on the opposite side after passing straight through. This involves a duplication of the air chamber and diffusion chamber (referred to as the first and second chamber respectively) since one of each sort of chamber is required to be positioned both at the entry side of the steam chamber and at the exit side of the steam chamber. Morever, since the steam chamber of the present modified apparatus may contain only one straight length of the fabric being treated, this chamber is often relatively long and narrow compared with the steam chamber illustrated in British patent specification No. 914,600. By relatively narrow is meant, strictly speaking, of relatively restricted cross-sectional area. The long and narrow shape is not regarded as inconvenient from the point of view of factory planning, nor indeed need the apparatus be unduly long despite the air and diffusion chambers at each end of it since for a given time of treatment the length of the steam chamber clearly depends on the rate at which it is desired to pass the fabric through the apparatus. The present apparatus is moreover relatively simple to build inasmuch as it does not necessitate the somewhat elaborate devices employed in the apparatus of British patent specification No. 914,600 to carry or convey the fabric along a sinuous or zigzag path within the steam chamber. That is not to say that the use of such devices is excluded from the present invention. The latter includes moreover long narrow steam chambers having a plurality of orifices at each end so that a number of separate textile materials can be passed through simultaneously. In such a case the orifices at each end can be covered by one diffusion and one air chamber, or if preferred each orifice may have its own diffusion and air chamber. Alternatively, each orifice can be provided with its own diffusion chamber, all the diffusion chambers at each end of the steam chamber communicating with a single air chamber. The provision of a plurality of diffusion chambers thus constitutes a characteristic of the present invention. When the feed roll and take up roll for the textile material are positioned outside the air chamber or air chambers the sealing of the orifices in the latter communicating with the outside atmosphere may be effected by any conventional or known means.

Accordingly the present invention consists of an apparatus for the treatment of textile materials in continuous lengths in steam under pressure or in aqueous liquids beneath an atmosphere of steam under pressure, comprising a steam chamber fitted with a conventional steam supply to maintain a pressure of steam therein and having a plurality of orifices designed closely to fit the cross-sectional contour of the textile material and permit its passage into and out of the chamber, a plurality of diffusion chambers furnished with escape valves, with which diffusion chambers said orifices communicate, one or more air chambers communicating in turn by means of the same total number of similarly shaped orifices with the aforesaid diffusion chambers, provided with a conventional air supply to maintain a pressure of air therein and either adapted to accommodate the feed and take up rolls for the continuous lengths of textile material or having one or more sealed orifices to permit the untreated textile material to enter the air chamber from the outside and enable the treated material to return thereto by leaving the air chamber, and appropriate rolls or other known devices adapted to carry the textile material into and out of the steam chamber by way of an air chamber and a diffusion chamber.

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 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 sealed orifices used in the air chambers when the latter communicate with the outside atmosphere may comprise, for example nip rolls, flap valves, or deformable elements pressed against the textile material, but it is preferred to effect the sealing by constructing each orifice or 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.

Known devices adapted to carry the textile material include tenters of stenters with continuous pin tracks, also accessories used in connection therewith such as fabric guiding devices, stripper rolls for separating fabrics from the pin track, scroll rolls for smoothing fabrics, uncurlers for uncurling the selvedges especially in the case of knitted fabrics, conventional mechanical arrangements for controlling the width and tension of fabrics and overfeeding devices.

The present apparatus may optionally be employed in conjunction with other apparatus for treating textile materials in continuous lengths so that other treatments, e.g. dyeing, bleaching, scouring, and coating with impervious or other materials, e.g. rubber, can be combined consecutively with the steam treatment in one continuous process.

This invention is advantageously applicable not only to processes for the treatment of textile materials in continuous lengths in steam itself under pressure, but also to processes involving the application to the textile materials of aqueous liquids at temperatures above the boiling point of water, which are accordingly covered by an atmosphere comprising steam under pressure, into and

out of which the textile materials must pass in coming from and returning to the outside atmosphere.

The working of the invention will now be explained in greater detail with reference to the accompanying diagrammatic drawings, wherein FIGURE 1 is a sectional view illustrating one embodiment of the apparatus, FIGURES 2, 3, 4 and 5 are sectional views of second, third, fourth and fifth embodiments and FIGURE 6 is a fragmentary view illustrating part of FIGURE 2.

FIGURE 1 (illustrating a case of two diffusion chambers and one air chamber which contains the rolls of textile material):

1—air chamber
2—air supply to air chamber
3—feed roll for textile material
4—take-up roll for textile material
5, 6—diffusion chambers
7, 8—vent pipes of diffusion chambers with valves
9—steam chamber
10—rolls for supporting textile material in steam chamber
11—steam supply to steam chamber
12—orifices for passage of textile material
13—continuous pin track conveyor.

In this and other FIGURES 2–5 the lagging which would normally be fitted to the steam chamber **9** and any steam pipe to prevent loss of heat has not been shown.

FIGURE 2 (illustrating a case of two diffusion chambers and one air chamber, with the rolls of textile material in the outside atmosphere):

14*a*—sealed orifices to accommodate running textile material.

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

FIGURE 3 (illustrating a case of two diffusion chambers and two air chambers with the rolls of textile material in the outside atmosphere):

The numerals **1–14** have the meanings already assigned above.

15*b*—second air chamber.

FIGURE 4 (illustrating a case of two diffusion chambers and two air chambers with six separate tows):

The numerals **1–15** have the meanings already assigned above.

16*c*—nip rolls.

FIGURE 5 (illustrating an arangement similar to FIGURE 2, except that the steam chamber is positioned vertically and accommodates a bath of hot aqueous liquid):

The numerals **1–13** have the meanings already assigned.

17*d*—heating coil.

18*d*—aqueous liquid.

In operating the apparatus illustrated in FIGURE 1, a roll of the textile material for treatment is inserted at **3** and the material taken on the continuous pin track conveyor **13** through the orifices **12** round the rolls **10** in chamber **9** and back to the take-up roll **4**. Saturated steam at the required pressure to produce the requisite temperature is admitted to chamber **9** by means of the supply line **11** carrying a conventional pressure regulating valve **111**. 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 **102**. In order to prevent air finding its way into the steam chamber **9**, the valves **107** and **108** of the vent pipes **7** and **8** are very slightly opened. The fabric is then mechanically forwarded from roll **3** through the diffusion chamber **5** into the steam chamber **9**, round the rolls **10** and back via the diffusion chamber **6** to the take-up roll **4**. The steam chamber **9** may advantageously be conventionally lagged and fitted with a water trap (not shown). The fact that only a slow leak of steam through the vent pipes **7** and **8** is required to prevent the intrusion of air into the steam chamber **9** 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 120 cm. wide the orifices **12** take the form of slots. An appropriate steaming temperature is 153° C. This corresponds to a steam pressure in chamber **9** of 4.2 kgm. per sq. cm. Accordingly the air pressure in chambers **5** and **6** is also adjusted to 4.2 kgm. per sq. cm. Through the two vent pipes **7** and **8** a slow leak is allowed which need only amount to a total of about ⅔ kgm. of steam per hour. The corresponding drop in pressure in the diffusion chambers is very small, about 0.25 cm. of water, say. The nylon fabric is forwarded through the steam chamber **9** 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 in the following manner. As already mentioned any invasion of the steam chamber **9** by air from chamber **5** or chamber **6** causes a fall in temperature. This can be detected by suitably positioned temperature probes. It is arranged that a low temperature signal from such a probe causes a conventional temperature-sensitive device to increase the leak from the vent pipe (**7** or **8**) in question and thus prevent air invading the steam chamber. The pressure of steam in the latter can likewise be automatically controlled so that it is maintained at a selected value, e.g., 4.2 kgm. per sq. cm. Likewise a similar temperature-sensitive device can be placed, if desired, in chamber **1**, which detects by the rise in temperature the presence of any steam finding its way into that chamber and automatically increases the leak from the vent pipes (**7** and **8**). Alternatively instead of adjusting the leak from the vent pipes, the latter can be maintained at a constant value, and the invasion of the air chamber **1** by steam prevented by the automatic adjustment of the pressure of the air admitted to chamber **1**. Similarly the invasion of the steam chamber **9** by air can be prevented by the automatic adjustment of the pressure of the steam admitted to the said chamber **9**.

In working the above apparatus 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 air 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 removing the feed and take-up rolls of textile material outside the air chamber as shown in FIGURE 2 of the drawings, the process can be made nearly continuous, since fresh feed and take-up rolls can be fitted without releasing the air and steam pressures. Thus the feed and take-up rolls **3***a* and **4***a* communicate with the pin track conveyor **13***a* by means of the two sealed orifices **14***a* in the left-hand wall of the air chamber **1***a*. These orifices are narrow slots designed to accommodate the textile material as it runs into and out of the air chamber. When the apparatus is in operation therefore, a continuous length of textile material is wound off the feed roll **3***a*, passes into the said chamber **1***a* through one of the before-mentioned slots, and then engages with the pin track **13***a* and is carried by the track through chamber **5***a* into chamber **9***a*, where the textile material passes round the rolls **10***a* and is then taken back through chamber **6***a* by the pin track. The textile material then parts company with the pin track, leaves chamber **1** through the narrow slot **14***a* provided, and is wound up on the take-up roll **4***a* situated outside chamber **1***a*.

The slots **14***a* provided in the wall of chamber **1***a* 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***a*. Suitable means for sealing can comprise known arrangements of nip rolls, but as shown in FIGURE 6 it is preferred to effect the sealing by constructing the slot of two strips **50** and **52** of polytetrafluoroethylene, one strip **50** being fixed whilst the other **52** may approach or recede therefrom to suit the thickness of the textile material. The movable strip **52** is urged against the textile material, in order to minimise leakage of air, by suitable resilient means, the latter consisting conveniently of air pressure, applied indirectly to the back of said strip by inflating a rubber tube **54** held thereagainst. The slot shaped orifices are conveniently made adjustable by conventional mechanical means so as to fit different widths of fabric.

The working of the apparatus 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. These operations can be carried out within about a minute, whereas to change the textile rolls in the apparatus shown in FIGURE 1 may occupy about 10 minutes on account of the necessity to release the steam and air pressures, and then re-establish them after the textile rolls have been changed.

The apparatus illustrated in FIGURE 3 comprises a realtively long and narrow steam chamber compared with that of FIGURES 1 and 2, and has air and diffusion chambers at each end. In operating this apparatus the textile material, for instance a fabric, is conveyed from feed-roll **3***b*, through the sealed orifice **14***b* into the air chamber **1***b* where the fabric runs on to the pin track conveyor **13***b*. It is carried on the latter, via the orifices **12***b*, through the diffusion chamber **5***b* into chamber **9***b*, which is full of saturated steam at a pressure of 4.2 kgm. per sq. cm. corresponding to a temperature of 153° C. Thence the fabric is conveyed via orifices **12***b* through the diffusion chamber **6***b* into the air chamber **15***b* and from there via orifice **14***b* to the wind-up roll **4***b*.

The steaming apparatus of FIGURE 3 may be employed for fixing the colours on dyed or printed fabrics. Thus a scoured plain weave nylon fabric is conventionally dyed with a disperse dyestuff in a jig or with a vat dyestuff, e.g. Colour Index Vat Green No. 3 in a mangle, in a continuous process, the dyed fabric being dried by an oven. The fabric is then passed through the steaming apparatus of FIGURE 3 at such a speed that the time spent by any part of the fabric in the steam chamber **9***b* is 1 minute. The steamed fabric is dried by passage through an oven and wound up. It will thus be understood that with reference to FIGURE 3 for the combined treatment now under consideration, there would be interposed between the feed-roll **3***b* and the air chamber **1***b*, conventional apparatus (not shown) for dyeing and drying. Likewise, an oven for drying would be positioned between the air chamber **15***b* and the wind-up roll **4***b*.

Instead of the above dyeing operation there can be substituted a printing operation effected by a screen or roller printing machine or else a bleaching treatment. For instance a cotton fabric, which has been duly singed and desized can be bleached with an aqueous solution containing the following ingredients per litre:

	Gms.
Magnesium sulphate heptahydrate	2.5
Sodium silicate	2.5
Sodium hydroxide	1.0
Anhydrous sodium carbonate	2.0
Sodium cetyl sulphate	1.0
35% weight by weight hydrogen peroxide	20.0

The steaming apparatus of FIGURE 3 can likewise be advantageously applied to the curing of proofed fabrics such as a tarpaulin. For instance a fabric weighing 185 gms. per square metre constructed from nylon yarn of 840 denier is coated on each side with a layer of rubber 0.015 cm. thick, by repeated immersion in a soltuion of rubber in an organic solvent and removal of the latter by drying the fabric in an oven. The roll of coated fabric is positioned at **3***b* and the fabric passed through the steaming apparatus of FIGURE 3 at such a speed that each part of the fabric spends 1 hour in chamber **9***b* which contains saturated steam at a temperature of 153° C. In this way the curing time can be reduced to about one quarter of the time normally needed when a conventional process employing saturated steam at atmospheric pressure is used. Furthermore, the fault of porosity in the rubber apt to occur in the latter process is eliminated.

The long narrow form of the present apparatus lends itself particularly to the simultaneous treatment of a plurality of separate textile materials in continuous lengths. In FIGURE 4 is shown an apparatus wherein six crimped nylon tows each having a total denier of 1,000,000 are passed simultaneously through the steam chamber **9***c* with its air chambers **1***c* and **15***c* and diffusion chambers **5***c* and **6***c* in order to set the crimp. The feed-rolls and take-up rolls are not depicted in FIGURE 4. The saturated steam in chamber **9***c* is maintained at a pressure of 6.3 kgm. per square cm. corresponding to a temperature of 166° C. The tows are conveyed through the steam chamber **9***c*, which is 122 cm. long at a speed of 366 metres per minute, and thus become effectively set.

FIGURE 5 illustrates an embodiment of the present apparatus similar to that of FIGURE 2, except that the steam chamber **9***d* is arranged vertically with the air chamber **1***d* and diffusion chambers **5***d*, **6***d* at the top. In the bottom of the steam chamber is a 2% by weight aqueous solution of sodium hydroxide. Under a pressure of 4.2 kgm. per sq. cm. this solution boils at about 153° C. The solution is raised to this temperature by means of the heating coil **17***d*. The escape of steam is prevented by admitting air through pipe **2***d* so as to maintain an air pressure of 4.2 kgm. in chamber **1***d* and at the same time allowing a slight leak from the diffusion chambers **5***d* and **6***d* by means of pipes **7***d* and **8***d*. Cotton fabric which is to be scoured is conveyed through the hot sodium hydroxide bath by the pin track conveyor **13***d* round the rolls **10***d* at such a speed that any point on the fabric takes 5 minutes to pass through the chamber **9***d*. In this manner the cotton fabric is rapidly scoured without creasing or staining taking place.

What I claim is:

1. An apparatus for the treatment of textile materials in continuous lengths in steam under pressure and in aqueous liquids beneath an atmosphere of steam under pressure, comprising a steam chamber; steam supply means maintaining an above atmospheric steam pressure in said chamber, said chamber having a plurality of orifices designed closely to fit the cross-sectional contour of the textile material and permit its passage into and out of the chamber, a plurality of diffusion chambers with which diffusion chambers said orifices communicate; means including escape valves maintaining said diffusion chambers at a lower pressure than the pressure in said steam chamber; an air chamber communicating in turn by means of the same total number of similarly shaped orifices with the aforesaid diffusion chambers; air supply means maintaining an air pressure in said air chamber about equal to the steam pressure in said steam chamber, said air chamber having sealed orifices to permit the untreated textile material to enter the air chamber from the outside and enable the treated material to return thereto by leaving the air chamber, and means for carrying the textile material into and out of the steam chamber by way of an air chamber and a diffusion chamber.

2. An apparatus for the treatment of textile materials in continuous lengths in steam under pressure and in aqueous liquids beneath an atmosphere of steam under pressure, comprising a steam chamber; steam supply means maintaining an above atmospheric steam pressure in said chamber, said chamber having a plurality of orifices designed closely to fit the cross-sectional contour of the textile material and permit its passage into and out of the chamber, a plurality of diffusion chambers with which diffusion chambers said orifices communicate; means including escape valves maintaining said diffusion chambers at a lower pressure than the pressure in said steam chamber; an air chamber communicating in turn by means of the same total number of similarly shaped orifices with the aforesaid diffusion chambers; and textile feed and take-up rolls in said air chamber; air supply means maintaining an air pressure in said air chamber about equal to the steam pressure in said steam chamber.

3. An apparatus as claimed in claim 1, wherein the sealed orifices are each constructed of two strips of material, one strip being fixed whilst the other may approach and recede therefrom to suit the thickness of the textile material.

4. Apparatus as in claim 1 wherein there is a single air chamber and wherein each of said diffusion chambers communicates with said steam chamber through a single orifice and with said air chamber through a single orifice, each of said diffusion chambers having a cross section, in a direction transverse to the direction of fabric travel through the orifices, which is substantially smaller than the cross sections of said air chamber and said steam chamber.

5. An apparatus for the treatment of textile materials in continuous lengths in steam under pressure and in aqueous liquids beneath an atmosphere of steam under pressure, comprising a long narrow steam chamber fitted with a conventional steam supply to maintain a pressure of steam therein and having at each end a plurality of orifices designed closely to fit the cross-sectional contour of the textile material and permit its passage into and out of the chamber, a plurality of diffusion chambers furnished with escape valves, with which diffusion chambers said orifices communicate, a plurality of air chambers communicating in turn by means of the same total number of similarly shaped orifices with the aforesaid diffusion chambers, provided with a conventional air supply to maintain a pressure of air therein and appropriate known devices to carry the textile material into and out of the steam chamber by way of an air chamber and a diffusion chamber.

6. Apparatus for the treatment of textile materials in continuous lengths comprising: walls defining a steam chamber; steam supply means maintaining an above atmospheric steam pressure in said steam chamber, said walls having at least two orifices designed closely to fit the cross-sectional contour of the textile material and permit its passage into and out of said steam chamber; walls defining at least two diffusion chambers each communicating with said steam chamber through a different one of said orifices; means including escape valves maintaining said diffusion chambers at a lower pressure than the pressure in said steam chamber; walls defining at least one air chamber, said walls having at least two orifices each of which communicates with a different one of said diffusion chambers; conveyor means carrying textile material into and out of said steam chamber by way of an air chamber and a diffusion; and air supply means maintaining an air pressure in said air chamber about equal to the steam pressure in said steam chamber.

7. Apparatus as in claim 6 wherein there is a separate diffusion chamber located at each end of said steam chamber and a separate air chamber adjacent each of said separate diffusion chambers, wherein the orifices associated with said chambers are in general alignment with each other, and wherein said textile carrying means carries the textile through said apparatus in generally a straight line.

8. An apparatus as claimed in claim 6, wherein the number of diffusion chambers is two and the number of air chambers is from one to two.

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