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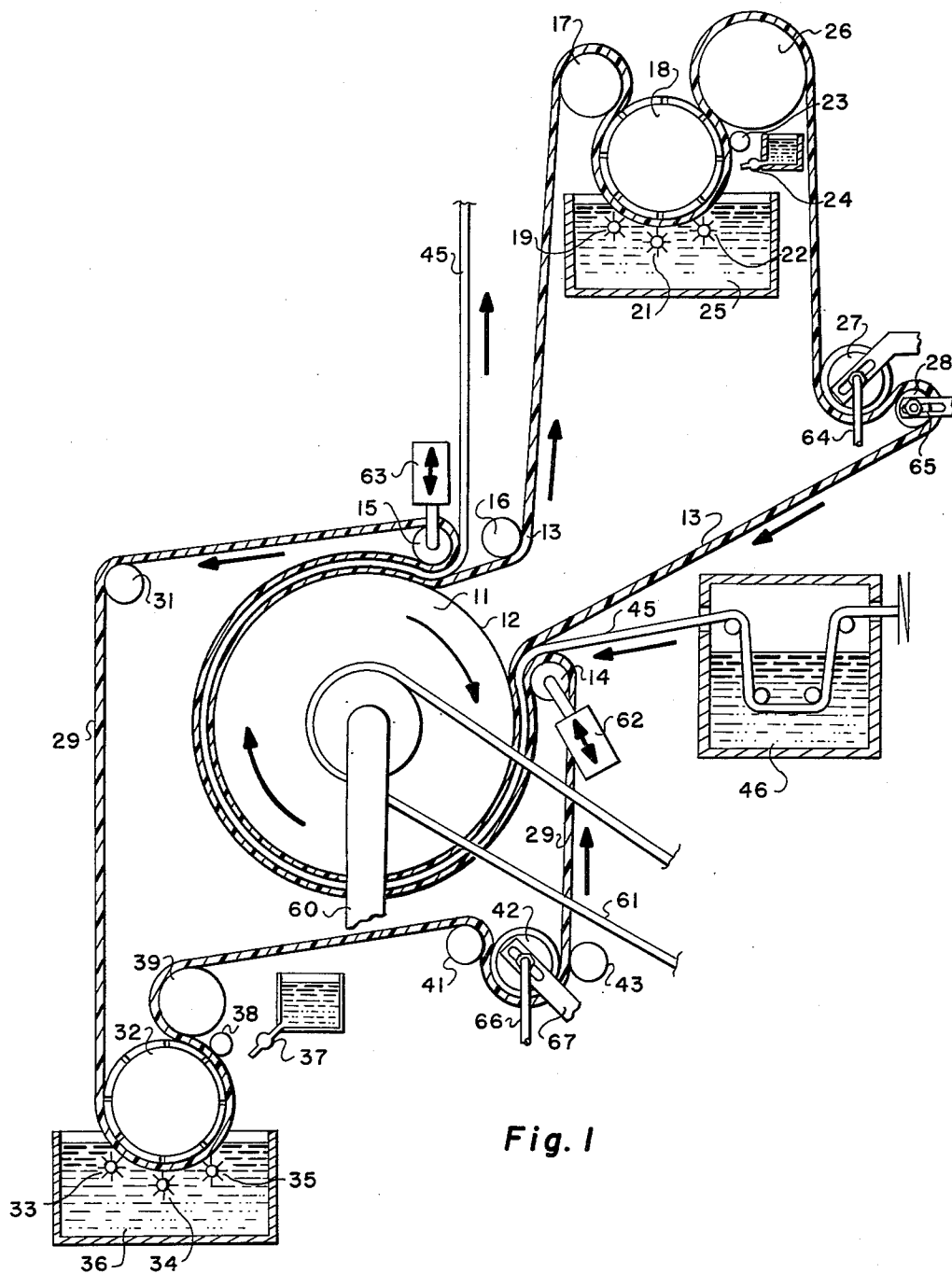
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3,046,771

TEXTILE PROCESSING APPARATUS

Filed Aug. 4, 1958

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

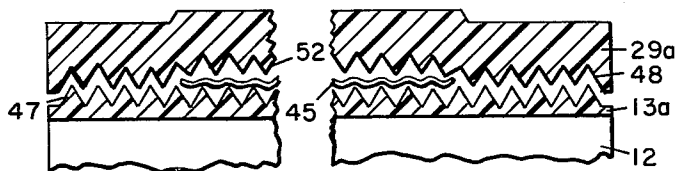


FIG. 2.

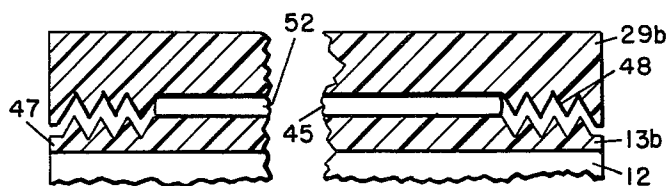


FIG. 3.

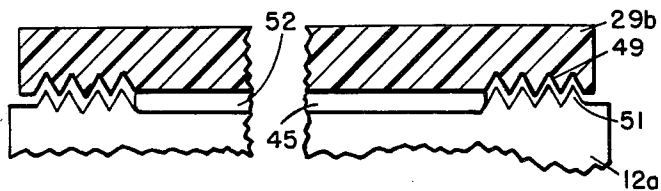


FIG. 4.

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TEXTILE PROCESSING APPARATUS

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This invention relates to the continuous processing of textile materials under elevated temperatures and pressures. More specifically it relates to such processing when carried out by passing the textile between a revolving heated cylinder and an endless flexible support band which passes around the cylinder and holds the cloth in contact with the surface of the cylinder. It also relates to means for providing a pressure holding seal between the cylinder and the band and the means for preventing the build up of deposits on the heated surface of the cylinder.

Numerous processes for the treatment of textiles require the application of heat and preferably of pressure to the textile. Such processes include for example, bleaching of the textile in the initial stages of processing and the fixing and setting of dyes, resin coatings or colors in the finishing operations. In a typical modern bleaching process for example, the cloth is first desized or soured or scoured depending upon its ultimate utilization according to normal procedures and is then re-washed in a so-called grey washer. After the cloth leaves the grey washer it is squeezed so that the water content is about 0.8 pound of water per pound of cloth and while in this condition is passed into a chemical saturator containing a bleach solution. A typical bleach solution contains approximately 2.5 to 3.5% of 35% hydrogen peroxide, 1.5 to 2.5% of sodium silicate, 0.4 to 0.8% of caustic soda, 0.3 to 0.6% of borax and the remainder water. The saturator is provided with exit squeeze rolls which are adjusted so that the cloth upon leaving the saturator has approximately 1 pound of solution per pound of cloth. After it leaves the saturator, the cloth is immediately heated to a temperature of between 208° and 210° F. and maintained at this temperature in a saturated atmosphere for a period of from 1 to 1½ hours. After the bleaching process is completed, the cloth is re-washed one or more times.

A major disadvantage of such a process lies in the hour or hour and a half holding time required to complete the bleaching operation. When the bleaching equipment is operated at any reasonable speed, it can readily be seen that a J-box or kier or other holding or treating chamber of a very substantial size is required to contain the quantity of cloth that can be treated in a period of an hour or an hour and a half. In the case of the kier, there is a further disadvantage that the fabric is introduced and maintained in a rope form in the chamber. Frequently the degree of treatment is not uniform throughout the length and width of the fabric since the degree of treatment is extremely dependent upon the temperature and a considerable length of time is necessary to raise all portions of the cloth in a kier to the desired temperature after portions of the cloth have reached this temperature. To a lesser degree a J-box suffers from a similar disadvantage since a textile is conventionally introduced in a rope form and the inner portion of the rope is less accessible to the effect of the heat than the outer portion. The resulting lack of uniformity of treatment in such instances frequently results in lack of uniformity of finish especially if a resin finish is later applied to the bleached cloth.

It has been long appreciated that the treatment time can be reduced appreciably if the temperature can be elevated. Since the treatment must be under saturated

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conditions, this necessarily requires an increase of pressure over atmospheric pressure in the holding chamber. For example, in a specific reaction of this nature that requires 75 minutes for completion at 212° F., the reaction time is reduced to 1 minute at 272° F., ½ minute at 302° F. and less than 2 seconds at 322° F. The corresponding saturated pressures for steam at these temperatures are approximately 29, 54 and 78 pounds per square inch gauge respectively.

Since a conventional kier is similar to an autoclave, a kier can be made to operate at elevated temperatures and pressures. However, the reduced process time greatly increases the difficulties occasioned by an uneven degree of processing caused by an uneven rate of heating throughout all portions of the length and the breadth of the textile in the kier.

To overcome these difficulties numerous attempts have been made to provide a continuous device for treating cloth under heat and pressure. A primary difficulty with such devices is the inherent difficulty in providing a seal at the entrance and exit point for the cloth that would permit the cloth to pass through without damage and yet withhold a substantial amount of pressure. More recently a continuous textile device has been disclosed in French Patent 1,056,910 wherein the cloth in open width is passed around the circumference of a heated drum and is maintained in contact with a heated drum by means of a continuous rubber-faced belt that passes around the drum and thence over a series of rollers in a reverse flight to return again to the drum. Provision is made for washing the face of this belt and for reheating the belt prior to its re-entry to the drum.

While this particular apparatus works very well at moderate temperatures, i.e. in the range of 220° F. the apparatus suffers from two disadvantages when the temperature is increased appreciably above that level. In the first place, it is impossible to remove any deposits that may form on the surface of the drum at such elevated temperatures without stopping the apparatus and permitting the drum to cool. These deposits are formed by the evaporation of the liquid phase of solutions, emulsions or dispersions which leaves the solid material contained therein on the surface of the drum. Such deposits will either interfere with the heat transfer characteristics of the surface of the drum or transfer to and spoil subsequent sections of the cloth. In the second place, since no provision is made for the retention of any pressure between the drum and the belt except a face to face contact of the flat surface of the belt on the flat surface of the drum, only a very few pounds per square inch gauge pressure may be developed without the release of steam vapor and of any pressure that may develop. Such a release of vapor at these low pressures prevents obtaining a saturated atmosphere of substantially in excess of 212° F.

I have developed certain modifications for this apparatus which overcome these difficulties. These modifications may best be understood by reference to the attached drawings wherein:

FIGURE 1 is a diagrammatic elevation of my improved apparatus;

FIGURE 2 is a cross-sectional view showing an arrangement wherein the cloth to be treated passes between two belts arranged on the face of the drum;

FIGURE 3 is a view similar to FIGURE 2 showing an alternative arrangement of the belts;

FIGURE 4 is a cross-sectional view showing an alternative arrangement wherein the cloth passes between a single belt and the drum.

Referring to FIGURE 1, the basis of the apparatus is drum 11 which has a substantial diameter and a smooth surface indicated at 12. Drum 11 is provided with heat-

ing means such as conduit 60 for passing superheated steam or high boiling fluid to heat its interior to a predetermined temperature and means such as a drive belt 61 to rotate it at a predetermined speed. Drum 11 is provided with two pressure rollers 14 and 15 which rollers are provided with means such as hydraulic cylinders 62 and 63 for forcing said rolls toward the surface of said drum at predetermined pressures.

Inner belt 13 which is formed of a relatively thin strand of temperature resistant material such as a heat-resistant rubber, for example, silicone rubber reinforced with asbestos or glass cloth, which material has a relatively high coefficient of heat conductivity, passes between pressure roller 14 and surface 12 of drum 11 around the periphery of drum 11 and between pressure rollers 15 and drum 11. The returning flight of belt 13 then passes over roller guides 16 and 17 and through a washer indicated by perforated washer roller 18. The washer indicated at 18 is provided with a series of washer brushes 19, 21 and 22 and squeeze roller 23 which brushes and roller rotate independently of washer roller 18 and act in a conventional way upon the surface of inner belt 13 to remove any deposits which may have formed upon said inner belt 13. Conventional auxiliary washing equipment such as water spray 24 and pan 25 for washing solutions are likewise provided. After leaving washer roller 18, inner belt 13 then passes around guide roller 26 and over heated preheater roller 27 provided with conventional means such as conduit 64 for passing a heated fluid for heating roll 27 to a predetermined temperature. Inner belt 13 then passes over guide and take-up roller 28 and returns to the nip formed between drum 11 and pressure roller 14. Roller 28 is mounted in a movable support 65 so that it may be moved relative to preheater roller 27 to take up any slack that may develop in and to maintain the desired degree of tension on inner belt 13.

Outer belt 29 which like belt 13 is formed of a resilient strand of temperature resistant material such as silicone rubber reinforced with asbestos or glass cloth, but which strand is preferably thicker and more resilient than inner belt 13 passes between pressure rollers 14 and drum 11 adjacent to roller 14 and around drum 11 in face to face contact with belt 13. After passing around pressure roller 15, outer belt 29 passes over guide roller 31 and through a washer indicated by perforated washer roller 32. The washer indicated by washer roller 32 is provided with a series of washer brushes 33, 34 and 35, wash pan 36, water spray 37 and squeeze roller 38, and operates similarly to the washer indicated by washer roller 18 on the face of outer belt 29. After passing through the washer section indicated by washer roller 32, belt 29 passes around guide rollers 39 and 41 and over preheater roller 42. Preheater roller 42 is provided with conventional means such as conduit 66 for passing a heated fluid for maintaining roller 42 at a predetermined temperature and is mounted on adjustable support 67 to permit movement of roller 42 relative to drum 11 whereby by adjustment of roller 42 any slack that may develop in outer belt 29 may be taken up and the desired degree of tension maintained on belt 29. Belt 29 then passes over guide roller 43 and returns to pass between the nip formed between pressure roller 14 and drum 11.

The textile to be treated is indicated at 45. After pretreatment in a saturator or a coater or the like indicated generally at 46, textile 45 passes through the nip formed by drum 11 and roller 14 between inner belt 13 and outer belt 29 and is carried about said drum 11 while maintained between said inner and outer belt. After the combination consisting of inner belt 13, textile 45 and outer belt 29 passes through the nip formed between drum 11 and pressure roller 15, inner belt 13 and outer belt 29 are separated and the now disengaged textile 45 is led off for any further processing that may be required.

The pressure seals at the points of entry and exit of textile 45 are provided by the nip formed between drum 11 and pressure rollers 14 and 15. Since inner belt 13

and outer belt 29 are formed essentially of a heat-resistant elastomeric material such as silicone rubber, both belts are slightly deformable and under the pressure developed between the pressure rollers 14 and 15 in drum 11 will deform and tightly envelop the textile located between the two belt.

The pressure seal along the margins of the belts, which pressure seal makes the combination of inner belt 13 and outer belt 29 a pressure chamber enclosing textile 45 while passing around drum 11 is provided by making both the inner belt 13 and the outer belt 29 substantially wider than the textile to be treated and providing a series of interlocking continuous parallel V-shaped grooves at least in the area beyond the width of the textile. This construction is more clearly shown in FIGURES 2 and 3. As shown in these figures inner belts 13a and 13b rest against the surface 12 of drum 11. Outer belts 29a and 29b rest on top of inner belts 13a and 13b and a number, preferably at least 5, of the V-shaped grooves, 47 and 48 extending beyond the width of textile 45 interlock to form a version of a continuous labyrinth seal. This labyrinth seal on either side of the mated pair of belts prevents or at least materially reduces the escape of steam from the interior pressure chamber indicated at 52 containing textile 45.

In FIGURE 2, the mating surfaces of inner belt 13a and outer belt 29a are shown with V-shaped grooves across the entire width. The grooves in the area containing the textile may be the same as the grooves forming the labyrinth seal or they may be different. Alternatively, as shown in FIGURE 3 the portion of the belts 13b and 29b which form the major wall of the pressure chamber 52 may be flat and ungrooved. In addition, it is sometimes advantageous to provide a grooved surface on one of the belts and an ungrooved surface on the other.

The advantages of the two belt arrangement as disclosed are rather obvious. Using this arrangement all of the surface containing the treated cloth has been freshly cleaned and reheated at the time of contact with the cloth and there therefore is no opportunity for a build-up of the concentration of the treating liquor or for the formation of scale or other deposits. The advantage of using belts having grooves entirely across the surface is that the use of such grooves tends to prevent shrinkage of the textile material under treating conditions and prevents or inhibits lateral transfer and concentration of the treating liquor in those instances where there is a slight escape of steam through the continuous labyrinth seal formed by grooves 47 and 48 on either side of belts 13a and 29a.

However, in certain instances where only a moderate temperature and a moderate pressure is desired and where there is no appreciable danger that the liquor will concentrate or that scale will form when the heated surface of drum 11 is exposed to normal atmospheric pressure while maintained at elevated temperatures in that portion of the arc between pressure rollers 15 and 14 where the surface 12 of drum 11 is not covered by the belt it may be desirable to omit inner belt 13. In such an instance the labyrinth seal may be divided by providing the surface 12a of drum 11 with parallel V-shaped grooves 51 as shown in FIGURE 4 which grooves interfit with grooves 49 of outer belt 29b.

In other instances it may be desirable to conduct the pretreatment or the saturation of the web and the subsequent heating substantially in the absence of oxygen. In such an instance the air in the pretreater 46 may be displaced by steam and the textile 45 led through an enclosed duct from the pretreater 46 to the nip between the drum 11 and roll 14, or preferably belts 13 and 29 may be led into pretreater 46. In the latter instance, belts 13 and 29 may be superimposed upon textile 45 inside pretreater 46 and the textile 45 may be carried to the nip between drum 11 and roll 14 while still enclosed.

I claim:

1. Apparatus for heat treating strip material such as a

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textile which comprises a drum, means for heating said drum to a predetermined temperature, means for rotating said drum, hold down means comprising an endless, impermeable, heat resistant, belt passing around the majority of the surface of said drum, means for washing the surface of said hold down means at a point remote from said drum, support means for preventing formation of deposits upon the surface of said drum comprising an endless, impermeable, heat resistant, belt passing between said hold down means and the surface of said drum, means remote from said drum for washing the surface of said support means, means for introducing said strip material between said hold down means and said support means, means for maintaining said hold down means and said support means under tension and means including continuous interfitting V-shaped grooves located at least on the marginal surfaces of said hold down means and said support means to form a labyrinth seal along the side of said hold down means and said support means.

2. Apparatus for heat treating strip material such as a textile which comprises a drum, means for heating said drum to a predetermined temperature, means for rotating said drum, an outer, endless, impermeable, heat resistant, belt formed from a heat-resistant resilient material passing around the majority of the surface of said drum, and inner, endless, impermeable, heat resistant, support belt formed from a heat-resistant resilient material passing around a majority of the surface of said drum between said outer belt and the surface of said drum, means for introducing said strip material between said outer belt and said inner belt, means for washing said outer belt and said inner belt at points remote from said drum, means for maintaining said outer belt and said inner belt under tension, means for reheating said outer belt and said inner belt between said respective washing means and the point at which said outer belt and said inner belt return to said drum and means including interfitting labyrinth seals along the longitudinal margins of each belt to inhibit the escape of superatmospheric pressure generated therebetween.

3. Apparatus for continuously heat treating strip material such as a textile in open width at temperatures in excess of the boiling point of water in the presence of an atmosphere of steam maintained at a superatmospheric

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pressure which comprises a drum, means for heating said drum to a predetermined temperature in excess of the boiling point of water, means for rotating said drum, hold down means comprising an endless, impermeable, heat resistant, belt passing about the periphery of said drum, support means for preventing formation of deposits upon the surface of said drum comprising an endless, impermeable, heat resistant, belt passing between said hold down means and the surface of said drum, means for substantially saturating said strip material with an aqueous solution, means for feeding said saturated strip material between said hold down means and said support means, means for removing said strip material from said drum, means comprising a pressure roller for pressing said hold down means, said strip material, and said support means, firmly against the surface of said drum at the point of which said strip material first contacts said drum and at the point at which the said strip material leaves said drum, means for maintaining said hold down means and said support means under tension and means including continuous interfitting V-shaped grooves located at least on the marginal surfaces of said hold down means and said support means to form a labyrinth seal along the side margins of said hold down means and said support means whereby escape of steam generated by heating the saturated strip material to a temperature in excess of the boiling point of water is inhibited.

References Cited in the file of this patent

UNITED STATES PATENTS

1,235,027	Harrison	July 31, 1917
1,764,631	Hubinger	June 17, 1930
1,791,728	Linfesty	Feb. 10, 1931
2,013,242	Johns	Sept. 3, 1935
2,433,122	Hornbostel	Dec. 23, 1947
2,494,807	Haeblerlin	Jan. 17, 1950
2,724,254	Zanger	Nov. 22, 1955
2,792,700	Altosaar	May 21, 1957

FOREIGN PATENTS

393,740	Great Britain	June 15, 1933
616,071	Great Britain	Jan. 17, 1949
1,056,910	France	Oct. 28, 1953