

Dec. 31, 1929.

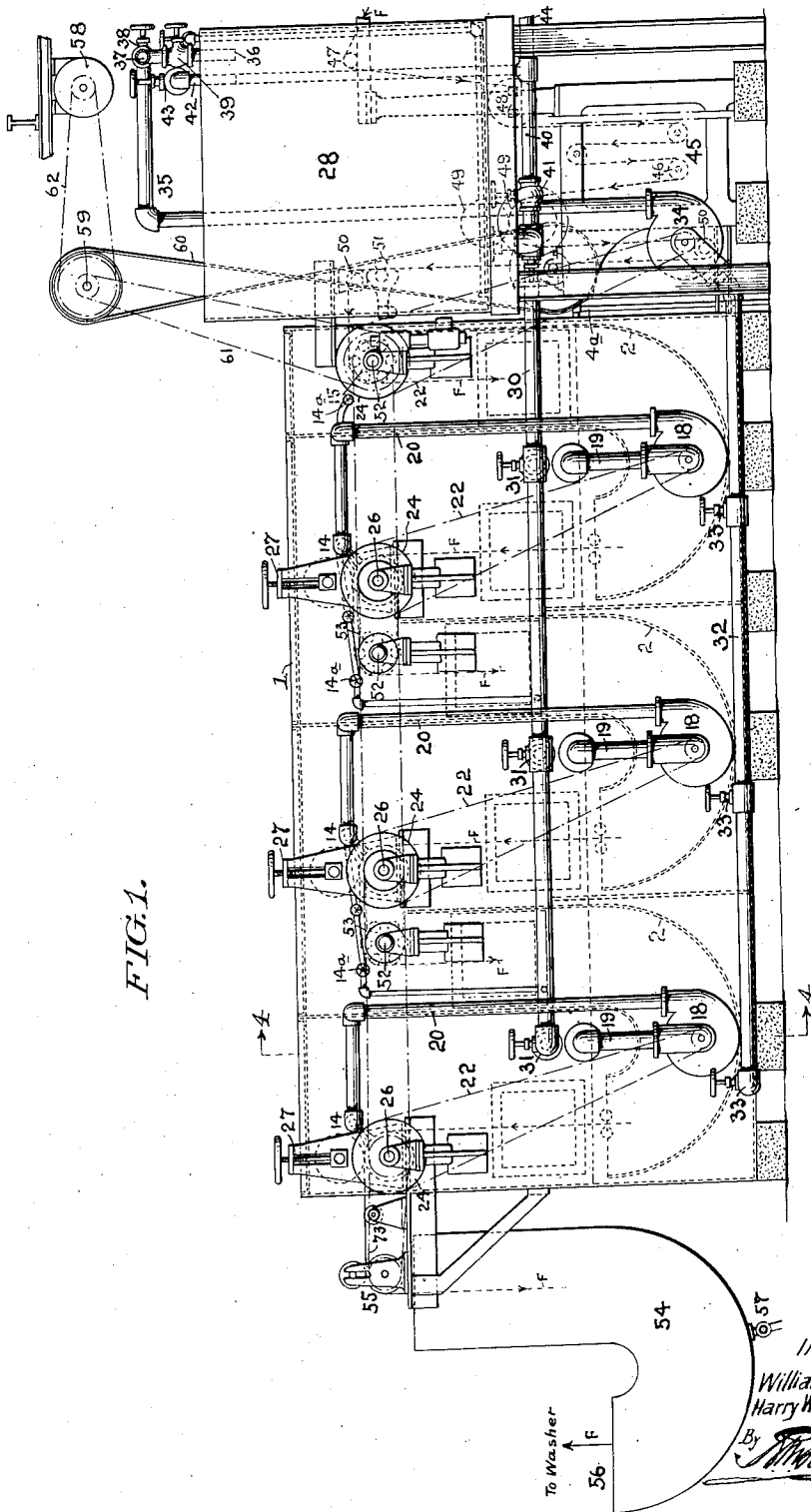
W. S. ROWLEY ET AL

1,741,338

METHOD AND MEANS FOR TREATING TEXTILE FABRICS

Filed Sept. 23, 1924

3 Sheets-Sheet 1



INVENTOR

William S. Rowley

Harry W. Butterworth Jr.

By *[Signature]*

ATTORNEY.

Dec. 31, 1929.

W. S. ROWLEY ET AL

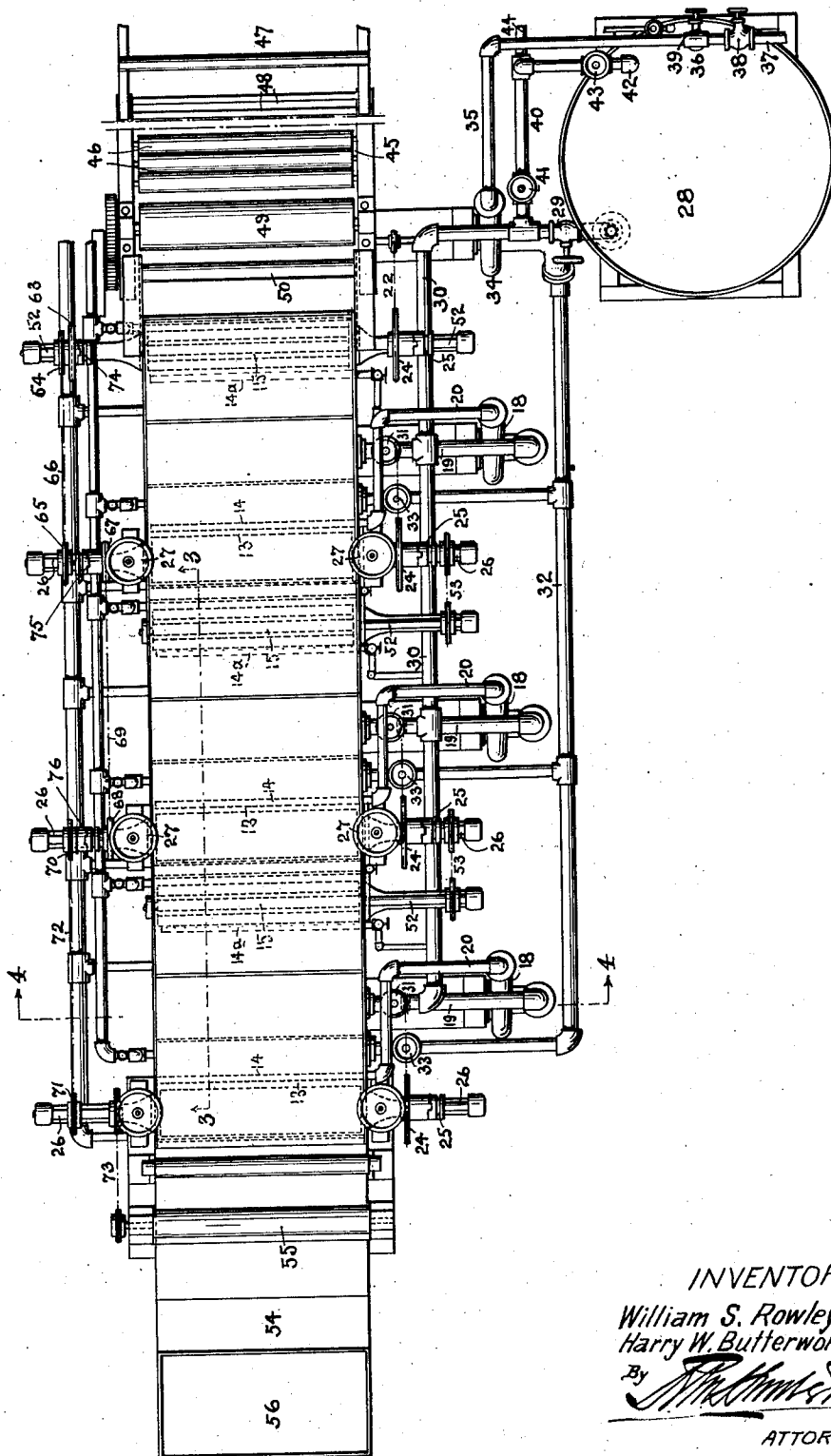
1,741,338

METHOD AND MEANS FOR TREATING TEXTILE FABRICS

Filed Sept. 23, 1924

3 Sheets-Sheet 2

FIG. 2.



INVENTORS

William S. Rowley.
Harry W. Butterworth Jr.

By *W. S. Rowley*

ATTORNEY.

Dec. 31, 1929.

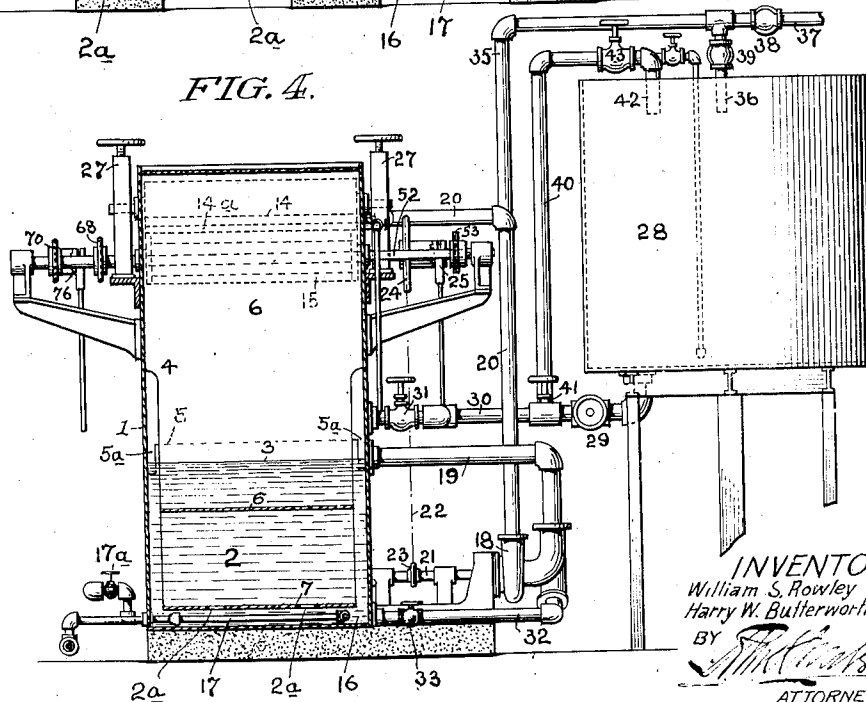
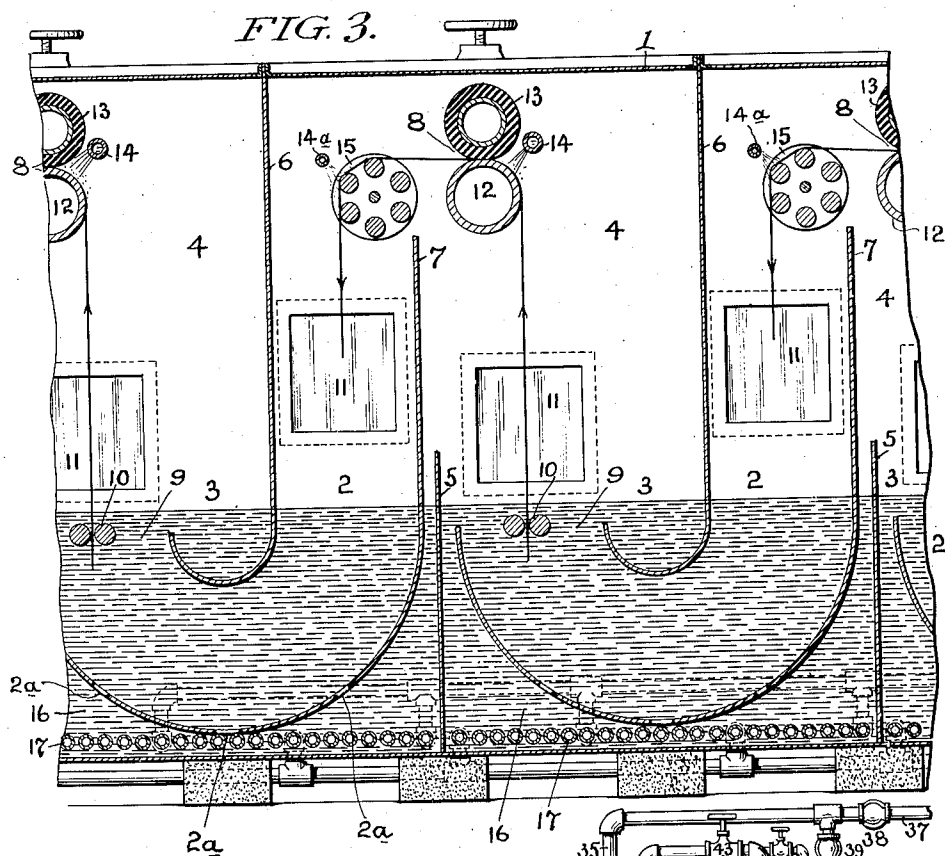
W. S. ROWLEY ET AL

1,741,338

METHOD AND MEANS FOR TREATING TEXTILE FABRICS

Filed Sept. 23, 1924

3 Sheets-Sheet 3



INVENTORS
 William S. Rowley
 Harry W. Butterworth Jr.
 BY *Attorney*
 ATTORNEY.

UNITED STATES PATENT OFFICE

WILLIAM S. ROWLEY AND HARRY W. BUTTERWORTH, JR., OF PHILADELPHIA, PENNSYLVANIA, ASSIGNORS TO H. W. BUTTERWORTH & SONS COMPANY, A CORPORATION OF PENNSYLVANIA

METHOD AND MEANS FOR TREATING TEXTILE FABRICS

Application filed September 23, 1924. Serial No. 739,285.

The object of our invention is generally to provide a method and means for continuously and rapidly subjecting textile material, whether in flat web or other suitable condition, to a preliminary treatment comprising boiling in an alkaline liquor, spraying and squeezing, which shall cleanse the fabric and put it in such condition that after thorough washing, it is suitable for the bleaching, dyeing or other operation to which it is to be subjected.

In the method heretofore generally practiced for boiling cloth, it has been customary to wet the cloth through the use of a wetting machine and then to gather it into rope form through a pot-eye and plate, delivering it into a large tank or kier, and laying or plaiting the rope form fabric in all directions upon itself with the object of packing it as uniformly as possible. The alkaline liquor is then let into the kier submerging the textile material therein and the boil started. As it is difficult to lay the rope-like textile material in the kier to insure a uniform resistance vertically to the flow of the liquor, it very often finds channels or avenues of least resistance and percolates through these channels during the boil instead of properly treating the textile material itself. The result is that the treatment will not be uniform over the entire fabric but will frequently be so defective in parts that a repetition of this operation will be necessary in a second kier. The length of time necessary to boil a kier under the conditions given above is usually from eight to twelve hours, this length of time being necessary because the volume of goods is so great that the liquor, even though brought under pressure, does not percolate through the fabric uniformly and consequently the cloth must be allowed to remain in the kier for a length of time which will safely assure that all parts of the goods are uniformly boiled or at least to such an extent that the required condition is obtained. Because of the fact that it has been found that a single boil in many cases was not sufficient to completely penetrate all of the goods uniformly, a second boil is frequently resorted to, and this requires that the goods shall be withdrawn from the first kier, washed through a bleaching house washing machine, and thereafter deposited in the second kier in the same manner in which they were placed in the first kier, though in this case the goods which were at the upper portion of the first kier will then be deposited at the bottom in the second kier and vice versa.

It will be readily seen that by this process, portions of the goods which were independently exposed to the action of the kier in the first boil will be more fully exposed to the boiling action of the liquor in the second boil. The length of time consumed in the first and second boils, together with the necessary time for the goods to pass through the washer and from one kier over to the other, has been approximately twenty-four hours. Furthermore, the extent of action of the liquor upon the goods is so ununiform and greatest at the beginning and ending of the length of goods to be treated as compared to the treatment at the middle, that there is always a doubt whether the goods, after being processed, are of a uniform character or technically "bottom" condition throughout its length.

Aside from the difficulties thus enumerated in connection with the use of the old form of kier and process, there are many other difficulties which enter into the treatment, such as require handling of the goods by boys in large numbers and who are recognized as dirty workers, often doing considerable injury to the goods in the handling. Further, damage is frequently done by entangling of the goods which has been improperly placed in the kiers by the boys and frequently requiring the same to be cut to enable removal thereby, shortening the piece lengths, and in that way injuring its salability.

Our improvements primarily have for an object the overcoming of all the difficulties which have heretofore been inherent to the boiling in a kier as above outlined, and in addition to the special features of advantage first above mentioned, our improvements embody a capacity for manipulating the goods throughout the treatment without any personal handling by the attendants and the avoidance of all tangling or irregularity in

the treatment of the goods, so that upon once passing through the machine in a continuous manner, it may be taken as an unfailing fact that the treatment will be complete and uniform and the goods may be said to be definitely "bottomed" from one end to the other.

The special feature of our improvements resides in the fact that the goods may be treated in a continuous manner with as many repetitions of the treatment as desired and at whatever speeds the conditions may require, the fabric between each spraying and squeezing operation being subjected to a boiling in a weak caustic alkaline solution for any predetermined period which may be necessary.

Our object is furthermore, to provide an apparatus of this character with capacity for subjecting the fabric to kier action in successive stages with caustic solutions of different strengths or temperatures as required, boiled for different lengths of time in each solution as may be desired while the operation as a whole is a continuous one.

A still further object of our improvements is to eliminate entirely the necessity of boiling under pressure, because every part of the length of the fabric is subjected to exactly the same treatment in the boiling caustic solution, and consequently pressure to insure circulation is not necessary.

With the above and other objects in view, the nature of which will be more fully understood from the description hereinafter, the invention consists in the novel method and means for treating textile fabrics, as hereinafter more fully described and defined in the claims.

Referring to the drawings: Fig. 1 is a side elevation of our improved kier when composed of three sections, in cooperative relation; Fig. 2 is a plan view of the same; Fig. 3 is a longitudinal vertical section on line 3—3 of Fig. 2; and Fig. 4 is a transverse vertical section on line 4—4 of Fig. 2.

1 is an elongated chamber having from its bottom upwardly extending transverse division plates 5 forming a series of tank compartments in its lower part each holding the caustic solution or fluid which is to constitute the boil. The bottom of these tanks are fitted with steam coils 17 which may be supplied with steam under any suitable control, such as a control valve 17^a, and in this manner control the temperature of the respective fluids in the tanks 16 during the boiling operation. The interior of the chamber 1 is further divided transversely and within and above the respective tank compartments 16 with curved or J shaped partitions 6 and 7 which, together, provide a J shaped passage 2 the discharge end of which opens at 9 below the level 3 of the solution within the tank, as clearly indicated in Fig. 3. The passage 2 at its intake end extends well up-

ward within compartment 4 and to a considerable distance above the level of the fluid. It will be noted that the partition 6 extends from the top or roof of the tank 1 down into the fluid adjacent to the middle of the tank 16 below, and, therefore, forms to a large extent, substantially a water seal between adjacent tanks or compartments 4, 4, so far as the vapors are concerned, and into which compartments the opposite ends of the J passages 2 open; and the sides of the partitions 6 and 7 are so formed near and below the liquid level as to permit side entrance of the caustic solution to the fabric passing through the said J passages 2. This same construction is followed in respect to each of the sections of the apparatus, that is, in respect to each of the tank portions 16 of the apparatus.

In each of the compartments 4, the following devices are arranged. Above the entrance end of the J passage 2 is a transversely journaled feeding drum 15 which may conveniently be formed by end disks on a shaft and carrying a circular row of transverse bars, the rotation of which drums feed the textile material downward into the J passage, as indicated by the arrow lines. Arranged in the upper part of the compartment 4 above the discharge end 9 of the J passage and at or about the level of the drum 15 is a pair of squeeze rolls 8 comprising a cylinder roll 12 and a rubber covered roll 13 above and between which the fabric passes, as indicated by the arrow line and by which the surplus solution carried up by the fabric is squeezed back into the tank 16 from which the fabric rises. A transverse spraying pipe 14 is arranged to spray the fabric as it passes upward and between the two rolls 12 and 13, the said spray being drawn from the tank 16 immediately below. 10 are guide rolls or bars between which the fabric is guided as it rises from the discharge end 9 of the J passage 2. This same construction applies to each of the compartments 4 with the exception that in the first compartment into which the fabric is delivered, there are no squeeze rolls 8, and in the last compartment of the series there is no drum or reel 15. In this latter case, the fabric F, after leaving the squeeze rolls 12 and 13 passes through an opening in the tank structure and thence between a pair of guide rolls 55 and down into the upper open end of a J-box 54, where it is collected and from the lower end 56 thereof it is drawn upward and fed on to the washer for further treatment. This J box 54 may have a drain 57 at its lower part. The only purpose of the J box 54 is to provide a means for receiving the boiled textile materials and to compensate for any variation in the speeds of the passage of the fabric through the boiling operation and its delivery through the washing operation. It obviates the necessity of maintaining the textile material under

tension in passing from the boiling to the washing apparatus, and, moreover, provides ample time between the boiling and the washing to permit of proper chemical action and, in this manner, upward of a thousand yards of fabric may be at one time passing through the J box 54. What has been stated in respect to J box 54 where the fabric is subjected only to air treatment other than by the caustic which it contains, will equally apply to all the J passages 2 in the series of tanks 16 and compartments 4, with the further understanding that in these cases the fabric or textile goods passing through the J passage is subjected therein to a boiling with caustic solution. It will, therefore, be understood that in actual practice, each of these J passages will be loaded with upward of a thousand yards of material and, therefore, while the materials are being continually fed into the higher leg of the passage by the reel 15, it is being drawn out of the lower leg of the passage by the squeeze rolls 12 and 13. It will further be understood that the greater the number of yards which are permitted to remain in the J passages 2 during the operation of treatment will insure that much greater boiling in any tank 16 per unit of time, assuming, of course, that the fabric is being fed into and out of the J passage at a uniform rate. For example, if the J passage is operated to hold approximately four thousand yards of goods, then in the kier of three sections, as shown, there would in all be twelve thousand yards being subjected to the boiling treatment. Further, assuming that the delivery of the goods from the kier is one hundred yards per minute, it follows that every part of the goods under the conditions stated would receive a two hour boil. Furthermore, during the boil, the goods would be sprayed and squeezed in each compartment, which adds to the treatment three washes and three squeezings, and inasmuch as the cloth is moving at all times and the caustic liquor is kept up to one strength, the system insures each yard of goods being boiled at the same temperature conditions and in the same strengths of liquor, and consequently a uniform result is obtained and the goods will emerge having what is technically known as a "bottom" throughout its entire length.

11 are windows through which observation may be made of interior conditions within various parts of the compartment and by which any irregularity may be detected should such occur.

In respect to the spraying or washing by the sprays from the transverse pipe 14, it will be understood that the centrifugal pumps 18 draw the solution from the tank 16 by pipes 19 and discharge it by pipes 20 to the corresponding spray pipes 14, as will be understood more particularly by reference to Fig.

1. The pressure of the rubber faced squeeze roll 13 upon the cylindrical squeeze roll 12 may be adjusted by the screw adjusting means 27 and, in this manner, any desired degree of pressure may be provided to suit the character of materials being treated.

28 is a storage tank for the caustic solution and from which the solution may be supplied to the respective tanks 16 by the distributing pipe 30 with branches to the respective tanks 16 each controlled by a valve 31. A shut-off valve 29 may be provided for use in case of repairs. The solution from the several tanks may be drained off by drainage pipes 32 having branches connecting with the tanks and provided with control valve 33, said drain pipe 32 being connected with the suction of a centrifugal pump 34 which delivers the solution through a pipe 35 into the tank 28 by a branch pipe 36 having a control valve 39, or it may be discharged as waste through a pipe 37 having a valve 38 to be closed when the solution is to be returned to the tank 28.

44 is a pipe leading from a source of water supply and by which water may be delivered into the tank 28 through a pipe 42 having a control valve 43, or, when necessary, the water may be delivered by a pipe 40 through a control valve 41 into the distributing pipe 30 and in that manner be supplied to the tanks 16 when it is desired to wash them clear of alkali. Under these conditions, the centrifugal pump 34 will operate to draw off the washing solution and will discharge it by pipes 35 and 37 as waste, it being understood at this time that the valve 39 will be closed and valve 38 open. In addition to the valves thus described, there is provided a single compartment box 45 in which there are upper and lower guide rolls 46 about which the goods to be treated are passed in zigzag direction. This box contains the solution which is to impregnate the goods to thoroughly wet it out before it passes into the first compartment of the kier. The solution in this compartment box 45 may be a two per cent caustic solution, by way of example. The fabric F is delivered to the compartment box 45 by passing over a roller or guide 47, thence around and between transverse guide bars for adjustable friction, and thence into the box 45. The goods on leaving the box passes between the squeeze rollers 49 and thence downward about guide rollers 50 and through the opening in the end of the kier to the first reel, which delivers into the first J passage 2 within the kier.

In the case where the goods being treated is in the woven form and it is desired that it shall remain in that form in passing through the kier, it is desirable to employ the well known "Foxwell" guiders at the selvages thereof for stretching the goods transversely

just before it enters the kier proper, the position of such guiders being indicated at 51. These guiders are well known devices used on tentering machines and various other machines where it is necessary to maintain the fabric in a lateral stretched condition during its forward feeding.

It will be understood that our invention is applicable to the employment of one section only or as many additional sections through which the goods will be successively treated in series as may be preferred, and it will be evident that the greater the number of sections employed the greater the boil given to the unit of length of the goods and consequently the more rapid may the speed be of the fabric through the kier, or, where desired, with a given delivery of goods per minute, the increase in numbers of sections employed may give a greater boil where such is required from the nature of the goods. It will be observed that in the example given, the duration of the boil was two hours, whereas in the old process first referred to, in which the boil was required to be done under pressure, the time required was from eight to twelve hours, or from four to six times as long. From this it is manifest that the character of apparatus forming the subject matter of this application is especially useful not only in insuring a more uniform treatment but an increased capacity and with greatly less workmen for maintaining the process in operation.

As the goods which are fed into the long leg of the J passage 2 descend, they distribute themselves in folds and keep on applying weight sufficient to feed the lower portions of the goods down and around the curved portion of the passage and, at the same time, maintaining it in a submerged condition. As the goods are being drawn upward from the other end of the J passage, it is manifest that the withdrawal of the goods is done without any possibility of tangling, consequently the passage of the goods through the boiling operation is accomplished without any difficulties and under precisely the same conditions for every portion of the length of the goods and, therefore, insures a uniform treatment.

So far, we have not described any special means for operating the rotating parts of the apparatus, it being understood that these parts may be driven in any suitable manner. However, the particular means shown for driving these parts in the construction illustrated will now be briefly referred to by way of example but not as restriction. 58 represents an electric motor and this drives through a belt 62 a shaft 59 which through suitable belt transmission 60 drives the squeeze rolls 49 of the compartment box 45. The shaft 59 also drives by sprocket chain 65 transmission a sprocket wheel 63 on the shaft

52, said shaft being the shaft of the first reel or drum 15. The sprocket wheel 63 is loose upon the shaft 52 but is secured to a sprocket wheel 64, whereby the two sprocket wheels rotate together. A clutch 74 on the shaft 52 may be employed for coupling the said shaft to the sprocket wheel 63 when the reel or drum 15 is to be rotated. The sprocket wheel 64 by means of sprocket chain 66 drives the sprocket wheel 65 on the shaft 26 which is an extension of the squeeze roll 12 of the second compartment. 67 is a sprocket wheel loosely supported upon the said shaft 26 and may be coupled with the said shaft by a clutch 75, whereby it is rotated by the shaft when driven by the sprocket wheel 65 and chain 66. The sprocket wheel 67 drives the chain 69 and by it a sprocket wheel 68 which is secured to a second shaft 26 corresponding to the extension of the squeeze roll 12 in the next compartment 4. This shaft 26 has also upon it with freedom of rotation a sprocket wheel 70 which may be coupled into driving relation with the shaft by a clutch 76. Finally, the sprocket wheel 70 is arranged to drive a chain 72 which, in turn, drives a sprocket wheel 71 secured to the third shaft 26 corresponding to the squeeze roll 12 of the last of the three sections. It is also seen that this last mentioned shaft 26 by means of a chain and sprocket connection 73 drives the feed rolls 65 of the J box 54. It will now be understood that if the clutches 74 and 75 and 76 are thrown into engaged relation, all of these shafts 52 and 26 will be properly driven at the same commensurate speeds. The use of the clutches is more particularly to enable the sections to be coupled into operative relation when threading or first putting the apparatus into operation, when the fabric has to be fed through the machine and coupled from the J passage in each compartment up to the squeeze rolls and over the reel therein. When this has been done in the first compartment in respect to the reel 15, the fabric is fed downward into the J compartment 2 and when that is filled to the right capacity in yards, the free end of the fabric is then inserted between the press-rolls 12 and 13 of the next compartment and thence over the reel 15 therein to the next J passage. When this is done, the clutch 74 is thrown into operation and the fabric is fed through until the last mentioned J passage is also filled, thence the threading of the free end through the next pair of squeeze rolls 12 and 13 and over the next reel is accomplished, and thereupon the clutch 75 is thrown into driving position. Then again, when the final passage J 2 is filled, the free end of the fabric is adjusted between the last pair of squeeze rolls and thence between the guide rolls 55 to the J box 54 and the last of the clutches 76 is thrown into driving position. The tanks 16 may be supplied with caustic 130

5 solution before or after the threading of the machine, and if desired, may from the storage be brought to a boil and with the proper circulation by the spray pipes 14 and there-
after the kier is in condition for treating
10 the fabric in any length desired. It is manifest that when any given batch of goods is about completed, a new batch may be sewn on to the end of that about completed so that it is automatically threaded into the machine as the first mentioned batch passes therefrom into the J box 54.

15 The means for driving the centrifugal pumps 18 and 34 will be understood from Figs. 1, 2 and 4. In respect to the pumps 18, the same are driven by sprocket and chains 22 from the sprocket wheels 24 on the squeeze roll shafts 26 when clutches 25 are
20 thrown into gear, that is to say, the pump for a tank 16 is driven by the squeeze roll shaft 12 corresponding to that tank. There are, therefore, three of these drives in the particular apparatus shown. In respect to the pump 34, this is driven by means of chains
25 22 and sprocket wheel 24 from the shaft 52 of the reel 15 of the first compartment 4 when the clutch 25 is thrown into gear. Any other suitable means for driving these pumps may be employed, if so desired. It will also
30 be seen that the reel 15 in the two middle compartments 4 are driven by chain and sprocket wheel drives 53 from the shafts 26 of the squeeze rolls 13.

35 As compared to the process heretofore in practice which would require twenty-four hours for completion, the process as carried on in our improved construction of kier will have capacity for a delivery of one hundred to two hundred yards per minute, depending
40 upon the weight of the cloth processed; and assuming the speed to be only one hundred feet per minute the time required for completion of the operation would be approximately two hours or only one-twelfth the
45 time required by the old process. Furthermore, the operation will be continuous, all damage due to weakening or tendering the goods is eliminated, the consumption of steam will be less, the amount of caustic soda necessary will be approximately one-half of that
50 used formerly, the woven goods will be processed without being handled in the rope form, and as every portion of the goods in its length will be treated to exactly the same extent and under the same conditions, the boil
55 will be absolutely uniform and the "bottom" obtained on the goods will be perfect throughout. Furthermore, the caustic solution may be pumped back to its source without any waste, the liquor may also be re-
60 filtered, if desired, and practically all of the caustic reclaimed. It will also be noted that inasmuch as the liquor in each compartment of the kier, after spraying the goods, drips
65 back to its own tank, the most polluted liquor

is kept in the first tank and from there on the liquor in the succeeding tanks is cleaner and consequently the fabric as it becomes cleaner is treated to a cleaner caustic solution, thereby insuring the cleanest and most thorough
70 treatment possible. The insurance of securing a uniform "bottom" guarantees the securing of a uniform dyeing in the subsequent treatment and, therefore, the process herein carried out has great advantages over the
75 irregular and costly process heretofore practiced.

While we have shown the fabric received from the boiling operation as carried on in the apparatus forming the subject matter of
80 this invention delivered into a J box 54 from the outer end 56 of which it may be drawn to pass to the washer of the bleach house, we do not restrict ourselves to this manner of receiving the boiled fabric, as the same may
85 be received upon a truck and transferred to the bleach house in the ordinary way.

While this apparatus is adapted particularly for the cleansing or scouring of textile material as a preparatory step to subsequent
90 operations, such as bleaching, dyeing, it is to be understood that this same apparatus may be employed for other uses such as dyeing in which case one or more of the sections may be employed, according as to whether one or
95 more dippings are necessary, but in such cases, it will be preferable that less material be passed through the curved passages 2 at any moment of time so as to avoid undue
100 packing thereof. We, therefore, do not limit ourselves to the particular use to which this apparatus and method of treatment may be put, as it is adapted for any use to which a continuously moving textile material is re-
105 quired to be subjected to fluid treatment for a considerable period of time.

While we have shown our improved apparatus as comprising a series of sections for repeated treatment of a similar character
110 upon the goods during its passage therethrough, it will be understood that the structure of a single section as well as the process carried on therein may separately be used, if so desired, and, therefore, our improvements comprehend one of a plurality of these
115 sections in the organized apparatus. Furthermore, while it is the special purpose of treating woven fabrics in the web form in our improved apparatus, we do not restrict ourselves to the particular character of the material which may be treated so long as it is
120 capable of being fed through the apparatus in a continuous manner.

The circulation of the caustic solution, during the boil, within the curved passages 2 is
125 possible by reason of the fact that the sides of the plates 6 and 7 forming the passage terminate a few inches from the side plates of the chamber 1, as indicated in Fig. 4; and may also, if desired, have apertures 2^a in the sub-
130

merged portion of the lower curved plate 7. Any other means for insuring the circulation may be employed.

While it is desirable to squeeze out the alkaline solution from the fabric and back into the tank from which the fabric has just emerged, it is preferable that the fabric be fully wetted out with a secondary spray nozzle 14^a just before it is fed down into the curved passage of the next tank 16 to insure proper action chemically and to prevent piling of the fabric in too dry a state, especially in that portion of the curved or J shaped passage wherein it is temporarily above the solution in the tank. These spray nozzles 14^a may be supplied with solution from the tank in which the piling is being done or from any separate source, as from the storage tank 28, in which latter case, the fresh supply of spray solution supplements the tank charges and compensates for losses due to moisture carried off in the fabric. This addition of spray solution, when taken from an outside source may cause a gradual flow of the surface fluid and scum of the tanks 16 toward the intake end of the apparatus and be removed in a continuous manner from an overflow pipe 4^a, this being made possible, if desired, by side notches 5^a in the upper parts of the tank plates 5 adjacent to the longitudinal side walls of the chamber 1. Renewal of fluid in this manner retains the purity of the solution in the tanks for a longer period than would otherwise be the case.

We have described our improved method and means in that particularity which we deem to be the best exposition of our invention, and that which we prefer in commercial practice, but we do not restrict or confine ourselves to the minor or secondary details, as such are susceptible of modification which may be resorted to as matters of mechanical skill and without a departure from the spirit of the invention.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent is:

1. The herein described method of treating a textile fabric in a continuous manner, which consists in passing the fabric successively into and out of a heated fluid in a closed tank compartment containing a hot vapor above the fluid, and during each of the passages into and out of the fluid piling the fabric upon itself above the fluid and causing the piled fabric as it accumulates to pass downward by gravity into and through the fluid and thence upward whereby the accumulating piled fabric which is descending under the action of gravity is of greater height and weight than the piled fabric which is rising in the fluid and by reason of which it is overbalanced, withdrawing without resistance the upper and leading end of the piled fabric from the upper portion of the upwardly ris-

ing accumulations thereof whereby it is gradually withdrawn from the fluid in a heated condition, subjecting the fabric when out of the fluid to hot sprays formed from the heated fluid, piling the fabric again into and withdrawing it in a similar manner in another and purer portion of the same fluid within the same tank compartment and so on for a series of treatments, and finally discharging the fabric in a continuous manner from the compartment.

2. The method according to claim 1, further characterized by subjecting the heated fabric as it rises out of the fluid in each instance to a squeezing action between rolls whereby the excess fluid is removed from the fabric and returned to the body of fluid in the compartment from which the fabric was immediately withdrawn and whereby the fabric is subjected to a plurality of squeezing operations alternately with fluid treatments.

3. The herein described method of treating a textile fabric in a continuous manner, which consists in passing the fabric successively through fluids in a series of tanks and during the passage into and out of the respective tanks piling the fabric upon itself above the fluid and causing the accumulated piled fabric to pass downward into and through the fluid under the action of gravity and withdrawing the leading portion of the piled fabric from out of the fluid, piling it into the next tank and so on through the series to the last tank, and finally discharging the same in a continuous manner from the last tank, said method also characterized by forcing the fluids of the respective tanks in the form of spray upon the fabric as it rises in the tanks, and subjecting the fabric to pressure to squeeze out the excess of fluid before it is piled into the next tank, said spray fluid being forced upon the fabric immediately at the time of being squeezed.

4. The herein described method of treating a textile fabric in a continuous manner, which consists in passing the fabric successively through fluids in a series of tanks and during the passage into and out of the respective tanks piling the fabric upon itself above the fluid and causing the accumulated piled fabric to pass downward into and through the fluid under the action of gravity and withdrawing the leading portion of the piled fabric from out of the fluid, piling it into the next tank and so on through the series to the last tank, and finally discharging the same in a continuous manner from the last tank, said method also characterized by having the fluids in the respective tanks maintained in a boiling condition during the passage of the fabric therethrough, and wherein further, the fluids are of approximately the same character in composition and that portion of the fluid contained in the rising fabric from each of the tanks is squeezed back so as to be respectively returned to its own tank whereby

the dirt removed from the fabric passing through the respective tanks will remain substantially in the tank wherein it was removed so that purity of the fluid in the respective tanks increases from the first to the last tank of the series in the direction in which the fabric travels, the fabric entering the first tank containing the most impure fluid and so on and emerging from the last tank having the purest fluid and in its final clean condition, and withdrawing the scum from the upper surface of the fluids in the respective tanks, the same passing successively over the surfaces of fluids in said tanks in a reverse direction to that of the travel of the fabric relatively to the tanks.

5. The herein described method for treating a textile fabric, which consists in passing the fabric into and out of a closed compartment containing fluid in a heated condition and causing said fabric within the compartment to descend in a piled condition and guided in that condition downward and thence upward through the fluid, spraying the fabric with a portion of the heated fluid before it descends and assumes the piled condition, spraying the fabric after it rises from the fluid and out of the piled condition and at the same time subjecting the fabric to a squeezing action whereby the excess of fluid is squeezed from the fabric and caused to flow downward upon the same into the body of fluid contained within the compartment.

6. The herein described method of subjecting a fabric to alternate action of hot vapor and a body of heated fluid in a closed tank in a continuous manner, the same consisting in piling the fabric into and causing it in piled condition to pass by gravity through a curved passage submerged in a fluid with which the fabric is to be treated and thence upward and out therefrom, and withdrawing the advancing portions of the fabric upward from the outlet of the curved passage and out of the body of fluid with a speed commensurate with the speed with which the fabric was piled into the curved passage, whereby a great length of fabric may during treatment be submerged in the fluid for long periods to prolong the treatment while at the same time the fabric enters and leaves the passageway and fluid in a continuous and rapid manner while under the influence of the vapor, and repeating the said treatment in the same manner and while still enclosed within the compartment.

7. The method according to claim 6, further characterized by subjecting the fabric each time it leaves the fluid to the action of pressure whereby the excess fluid contained therein is squeezed back into the body of fluid to be again utilized.

8. In an apparatus of the character stated, the combination of a closed chamber divided at its lower part to provide a plurality of con-

nected tanks each provided with a curved passage open on its sides to the fluid and arranged in the lower portion of the tank so as to be submerged in the fluid to be contained in the tank when in use and each of said curved passages having its ends opening upwardly, separate means for feeding a textile material downward and into the receiving open end of each of the respective curved passages whereby it is piled therein and by gravity caused to move downwardly and through the same so as to be acted upon by the fluid contained in the tank and while in a submerged condition, separate means for withdrawing the piled fabric from the delivering open end of each of the respective curved passages and delivering it to the feeding means for the next tank in succession, separately controlled means for each tank for heating the fluid therein, and wherein all of the connected tanks, curved passages and feeding and withdrawing means are arranged within the same closed chamber.

9. The invention according to claim 8, wherein further, the heating means comprise separately controlled heating coils below the curved passages for heating the fluid beneath the piled fabric.

10. In an apparatus of the character stated, the combination of a chamber divided at its lower part to provide a plurality of tanks, with a plurality of curved passages respectively arranged within the tanks and so as to be submerged in the fluid of the tanks and each passage having its ends opening upwardly, separate means for feeding a textile material downward and into the receiving open end of the respective curved passages whereby it is piled therein and by gravity caused to move through the said passages and the fluid therein, and separate means for withdrawing the piled fabric from the delivery open ends of the respective curved passages for delivering the fabric to the feeding means for the next tank in succession, and wherein further, the tanks are each provided with separately controlled heating coils below the curved passages for heating the fluid and also with circulating means for spraying the heated fluid upon the fabric while being fed into the curved passages and also before it reaches the means for withdrawing it from the curved passage.

11. In an apparatus of the character stated, the combination of a chamber divided at its lower part to provide a plurality of tanks with curved passages respectively arranged low down in said tanks and each passage having its ends opening upwardly, means for each of the tanks for maintaining therein a fluid about the curved passages, separate means for feeding a textile material downward and into the receiving open end of the respective curved passages whereby it is piled therein and by gravity caused to move

- through the passage so as to be acted upon by the fluid therein, and separate means for withdrawing the piled fabric from the delivery open end of the respective curved passages and delivering the fabric to the feeding means for the next tank in succession, and wherein further, the means for withdrawing the fabric from the delivery end of the curved passages comprises a pair of squeeze rolls above each tank whereby the fabric is moved upward and at the same time subjected to a squeezing action to express therefrom the fluid and return it to the same tank from which the fabric is being withdrawn, and means are also provided in connection with each tank for circulating the fluid thereof and spraying it upon the fabric being withdrawn therefrom prior to its being squeezed by the squeeze rolls.
12. In an apparatus of the character described, a closed tank like compartment, heating means for heating a fluid in the tank like compartment, a curved passage arranged within the tank like compartment and open at its sides to the fluid contained within said compartment and presenting upwardly directed open ends extending to different levels, the higher end constituting the receiving end and the other constituting the delivery end, means to feed a textile fabric into the receiving end of the curved passage whereby it may be piled therein above said fluid and caused by action of gravity to travel downwardly and through the curved passage and fluid and be reversed in its piled condition while in the delivery end of the curved passage, means for withdrawing the forward part of the fabric in a continuous manner from the piled fabric in the delivery end of the passage and squeezing the fluid from said fabric, said squeezing means located in the closed compartment whereby the fluid squeezed from the fabric is maintained in a heated condition and returned to the tank, and means for recirculating the fluid through the tank and spraying it upon the fabric immediately before being squeezed.
13. The invention according to claim 12, wherein further, the apparatus therein defined is duplicated, and means are provided for feeding the fabric in its squeezed condition in one closed compartment into the next adjacent compartment and delivering it to the feeding means therein.
14. The invention according to claim 12, wherein further, the tank like compartment is divided into separate tanks and the apparatus for handling the textile fabric specified in said claim is duplicated within the same tank like compartment and associated with the respective tanks so that the fabric leaving the means for withdrawing and squeezing it in connection with the curved passage of one tank delivers the fabric to the means for feeding the same into the receiving end of the curved passage of the next adjacent tank and the recirculating means of the several tanks are maintained independent of each other but acting upon the travelling fabric in succession, and wherein also means are provided for supplying additional fluid to the delivery end of the tank like compartment and the tank portions of the compartment are so formed as to provide separate fluid bodies respectively for the plurality of curved passages but having at their upper parts communicating passages whereby the scum upon the surface of the fluid bodies may flow through the successive tanks in a general direction opposite to the general direction of passage of the fabric and caused to be removed from the fluid bodies within the tanks and without materially intermingling the main bodies of fluid of the respective tanks.
- In testimony of which invention, we hereunto set our hands.
- WILLIAM S. ROWLEY.
HARRY W. BUTTERWORTH, JR.

70

75

80

85

90

95

100

105

110

115

120

125

130