May 5, 1931. W. P. COHOE 1,803,664

MACHINE FOR AND METHOD OF DYEING CLOTH AND OTHERWISE TREATING TEXTILES

Filed Dec. 28, 1926 6 Sheets-Sheet 1

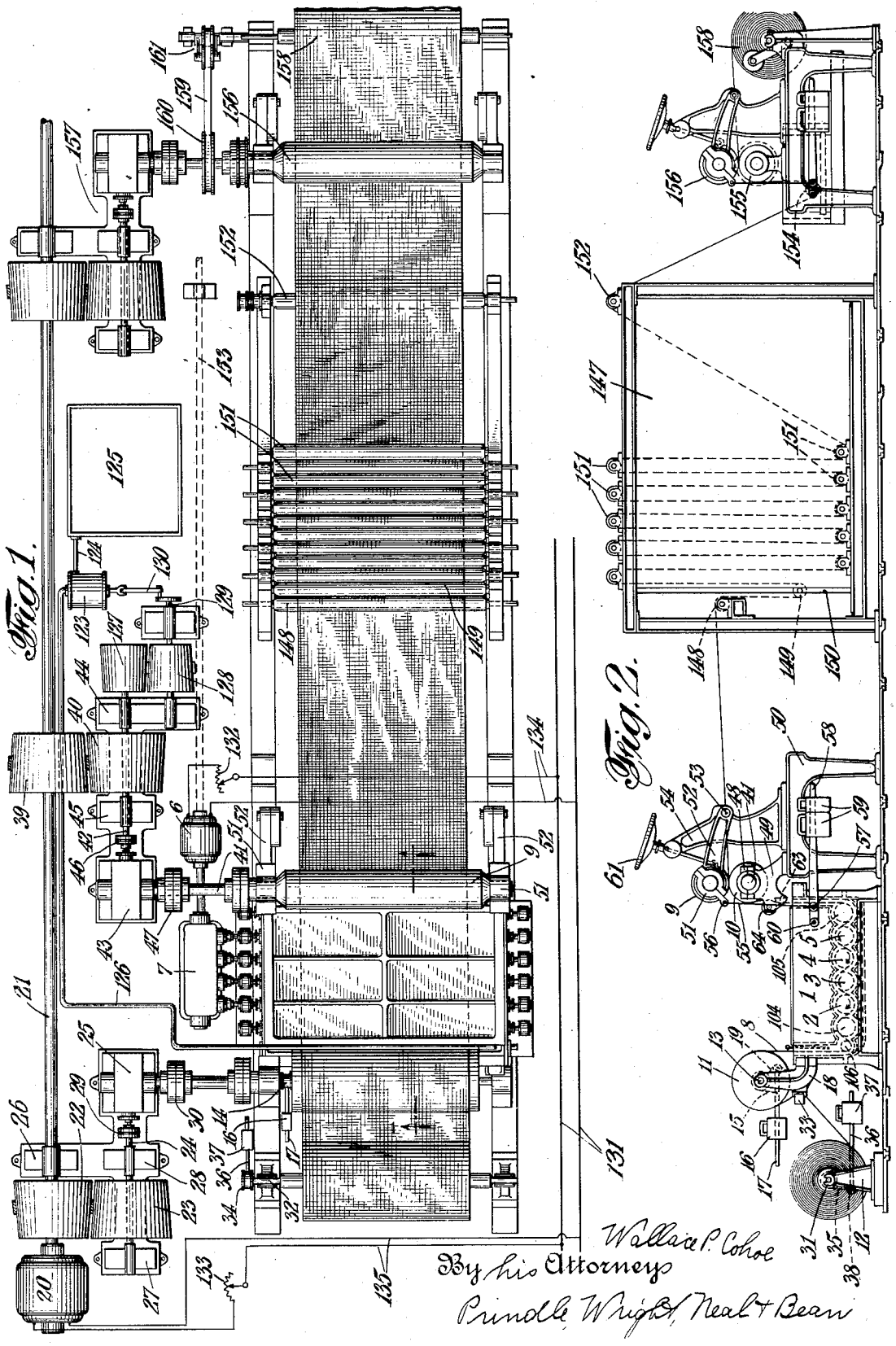


Fig. 1.

Fig. 2.

Witness: William P. Cohoe

By his Attorneys

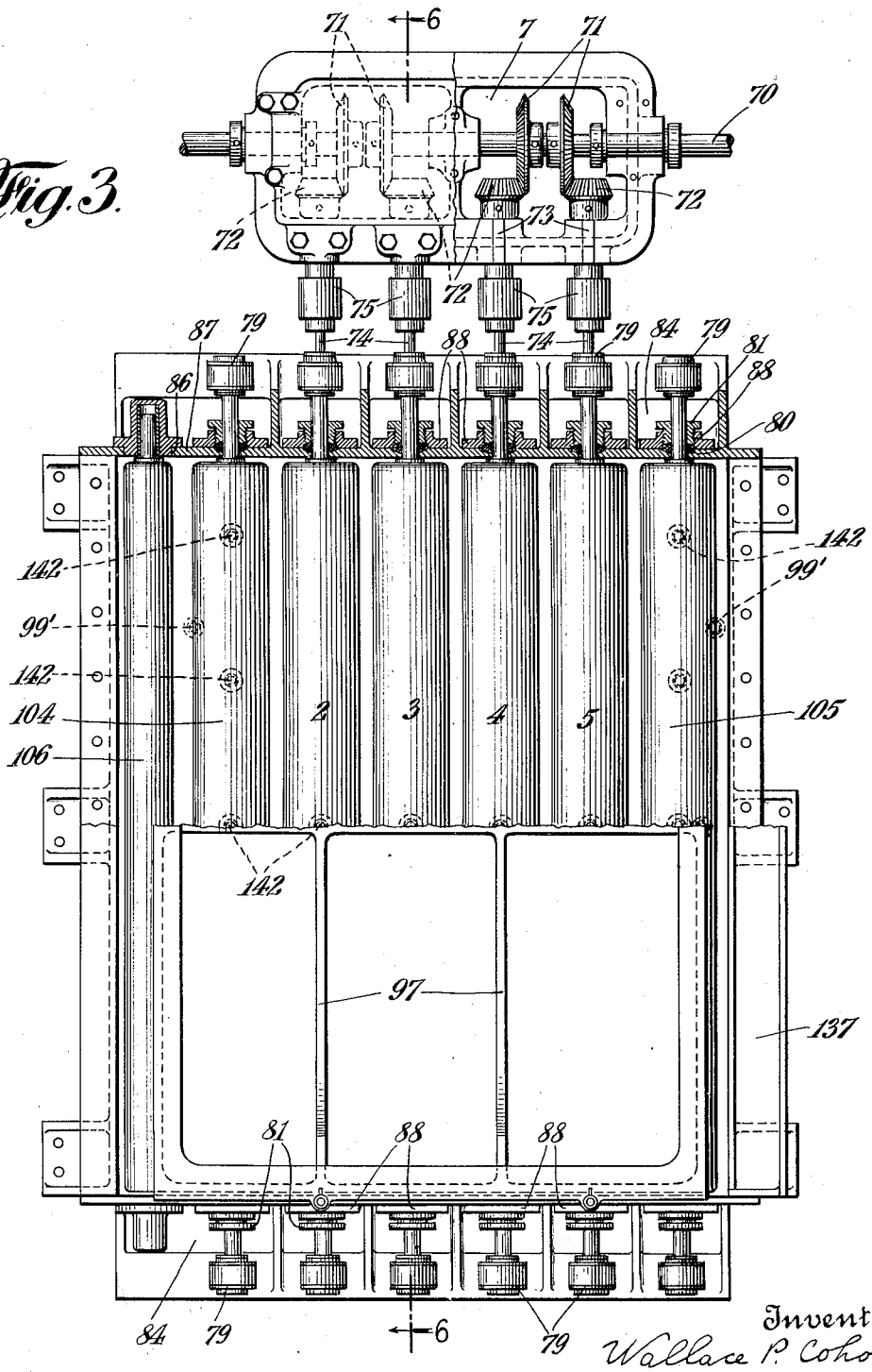
Prindle, Wright, Neal & Bean

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MACHINE FOR AND METHOD OF DYEING CLOTH AND OTHERWISE TREATING TEXTILES

Filed Dec. 28, 1926 6 Sheets-Sheet 2

Fig. 3.



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MACHINE FOR AND METHOD OF DYEING CLOTH AND OTHERWISE TREATING TEXTILES

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Fig. 4.

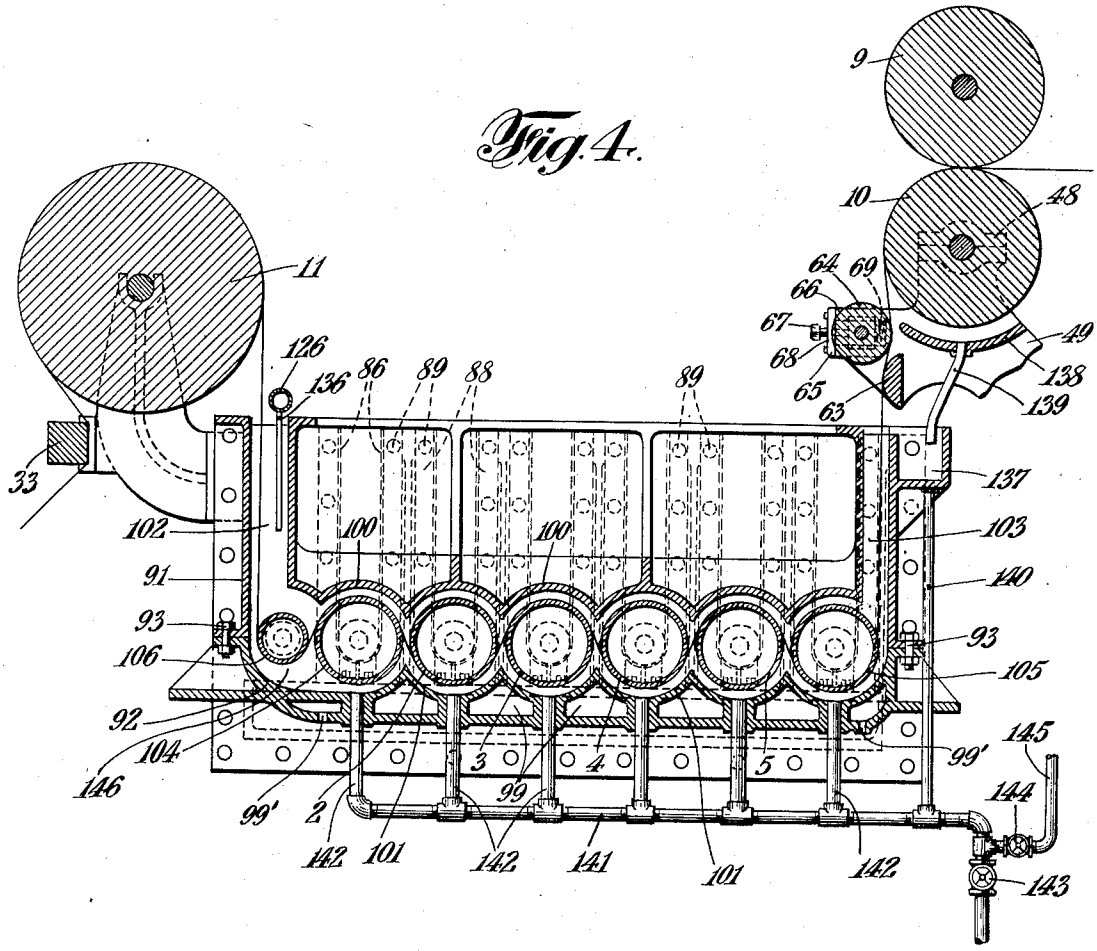
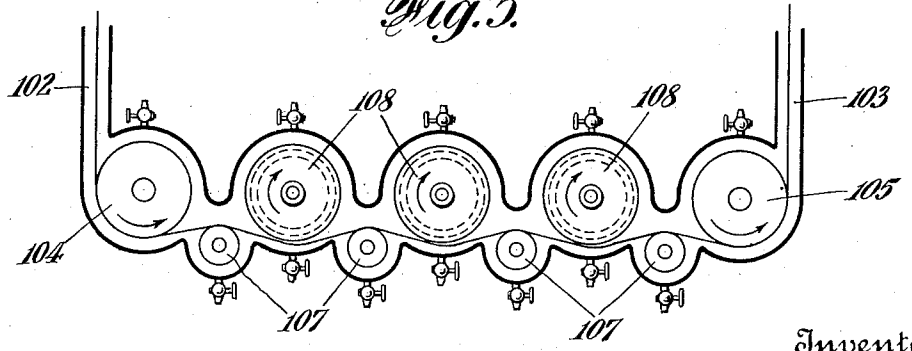


Fig. 5.



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MACHINE FOR AND METHOD OF DYEING CLOTH AND OTHERWISE TREATING TEXTILES

Filed Dec. 28, 1926 6 Sheets-Sheet 4

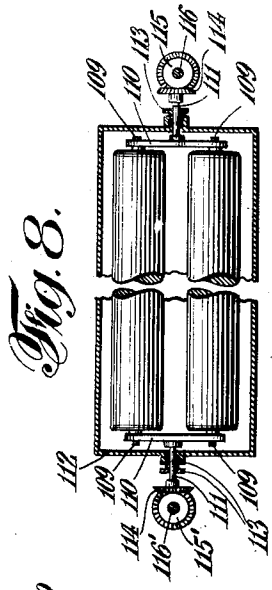


Fig. 8.

Fig. 6.

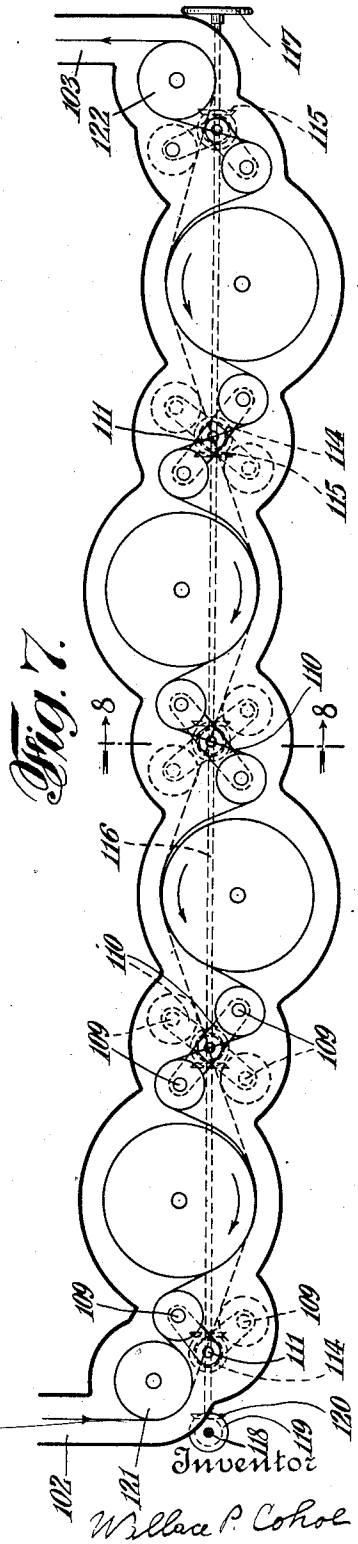


Fig. 7.

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MACHINE FOR AND METHOD OF DYEING CLOTH AND OTHERWISE TREATING TEXTILES

Filed Dec. 28, 1926 6 Sheets-Sheet 5

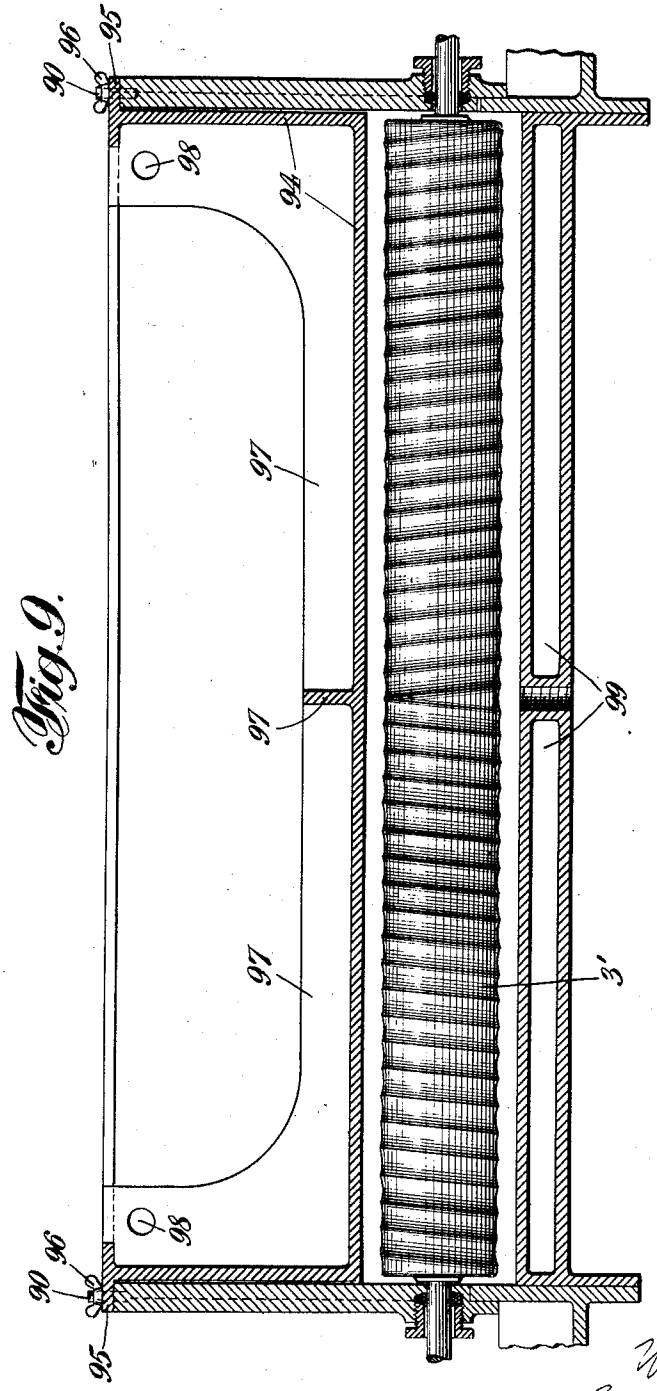


Fig. 9.

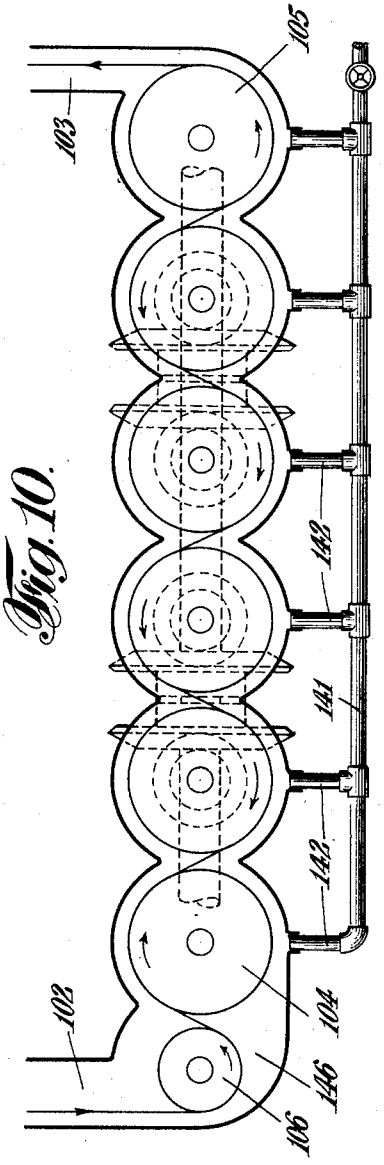


Fig. 10.

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MACHINE FOR AND METHOD OF DYEING CLOTH AND OTHERWISE TREATING TEXTILES

Filed Dec. 28, 1926 6 Sheets-Sheet 6

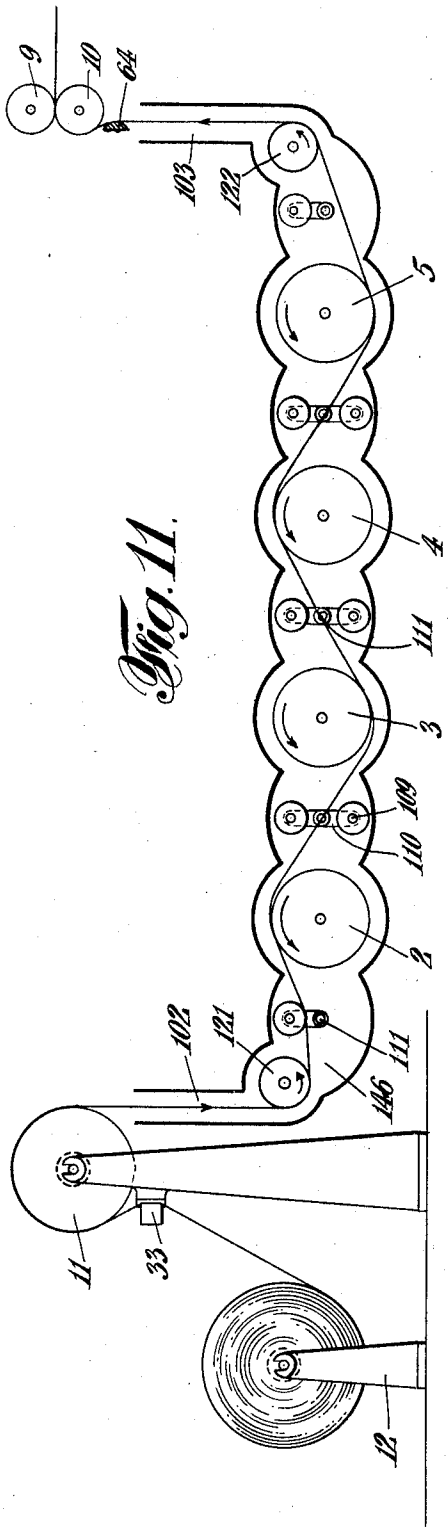


Fig. 11.

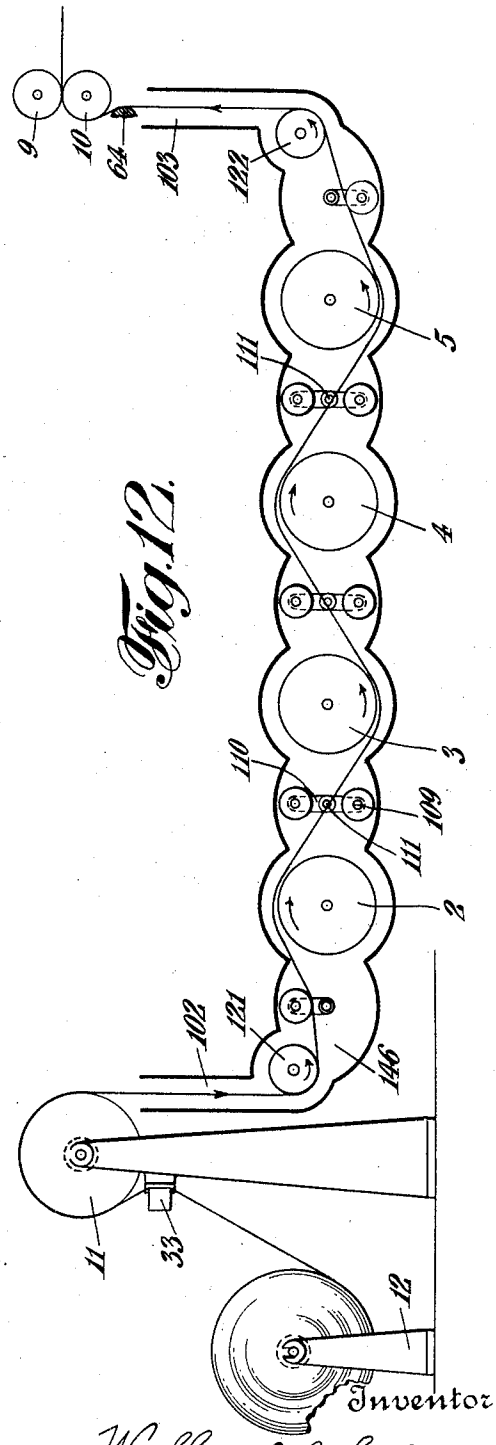


Fig. 12.

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Patented May 5, 1931

1,803,664

UNITED STATES PATENT OFFICE

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MACHINE FOR AND METHOD OF DYEING CLOTH AND OTHERWISE TREATING TEXTILES

Application filed December 28, 1926. Serial No. 157,520.

This invention relates to a method and machine for dyeing cloth and otherwise treating textiles with fluids and is a continuation in part of my co-pending application, Serial Number 76,407, filed December 19, 1925.

As is explained more fully in my co-pending application, I apply the phenomenon of skin friction to the treatment of textiles and similar materials with a fluid preferably by rapidly revolving a roll, in contact with the fluid and passing the textile adjacent to the roll so that the roll draws with it a stream of fluid which is forced against the textile and either penetrates the textile or passes entirely through it depending upon the way in which the machine is operated and upon the textile used. The rapidly moving body or roll creates the stream of fluid which possesses a large amount of kinetic energy and when the textile is interposed in the path of the moving stream in such manner as to decrease the velocity of the stream, considerable pressure is exerted tending to force the fluid to penetrate or even pass entirely through the textile.

It will be understood that the area of influence of the rapidly moving body, specifically illustrated by a rapidly revolving roll, extends quite a distance from the surface of said moving body and that the fluid which is in contact with the surface of the moving body moves at approximately the same speed as the speed of the moving body, but those portions of the fluid which are not in contact with the surface of the moving body move more slowly than the body moves and the farther the fluid is from the surface of the moving body the slower the fluid moves; in other words, the fluid may be considered to be in layers parallel to, or in the case of a roll concentric with, the surface of the body and when the body is moved those layers which are next to the surface of the body move with approximately the same speed as said surface, but those layers which are farther removed from said surface move more slowly, and the speed of movement of the fluid layers will vary inversely as their distance from the surface of the moving body. Therefore, if I consider the fluid stream which is set up by the surface of the rapidly moving body as composed of a series of layers, it will be understood that those layers which are next to said surface possess more kinetic energy than those layers which are farther removed from the surface and therefore textiles may be differently treated depending upon whether or not they are held closely adjacent to the surface of the moving body or are held away from it, that is, textiles may be differently treated depending upon whether they are treated by the layers which possess a large amount of kinetic energy or those which possess a less amount of kinetic energy.

In my machine I may adjust the position of the textile in relation to the surface of the moving body either by auxiliary or guide rolls or by manipulation of the means for passing the textile into the fluid container, and to the active or pumping rolls, that is, I may adjust the position of the textile in the fluid stream and change the position of the textile from one to another of the above mentioned layers of the fluid stream to obtain the desired treatment of the textile.

If the surface of the body is roughened, there is, of course, a greater co-efficient of friction between the surface of the body and the fluid than when the surface of the body is smooth and therefore a roughened roll will impart greater movement to the fluid than will a smooth roll which is revolved at the same peripheral speed. It will also be understood that in the cases where the surface of the moving body is a given special shape or contour, special currents may be set up in or imposed upon the fluid stream created by the rapid movement of the body. Thus, by rotating a grooved roll in a fluid a stream of fluid will be formed which will have a greater speed than will a stream formed by the movement of a smooth roll because there will be greater friction between the surface of the grooved roll and the fluid than there will be between the surface of a smooth roll and the fluid, and also if the grooves in the roll be at an angle to the direction of movement of the surface of the roll, for instance if the surface of the roll be helically grooved, the fluid will

not only move in the direction of movement of the surface of the body but it will also have a component of motion parallel to the grooves.

It is well understood that in some cases of treating a textile with a fluid, particularly in some instances of treating a textile with a solution of dye in water, it is desirable to have the fluid or the textile or both, hot. In other cases it is desirable to keep the fluid cool so that chemical reactions within it will be retarded, but it is desirable to apply the fluid to the textile while either the fluid or the textile is hot. In my machine I am able to heat the textile locally and apply the fluid to the textile either before or after the textile is heated while maintaining the majority of the fluid at either a low or a high temperature as desired. I may accomplish this by holding the textile in contact with the roll, which has movement relative to the textile, so that heat is developed by the friction between the textile and the roll and thus heat the textile either before or after the textile is subjected to the action of the fluid stream.

In the mercerization of textiles it is highly desirable, if not absolutely necessary, to maintain the textile under tension both in its length and in its width. In my machine and my method I am enabled to maintain the textile under tension by manipulation of the means for passing the textile through the container, and by the use of helically grooved active or pumping rolls, or helically grooved guide rolls.

With this short general exposition of the broad principles of my invention, I shall give a short description of some of the features thereof, which are as follows.

One of the features of the present invention is a machine in which the textile may be treated with an even number of active rolls to the end that both sides of the textile may receive equal treatment.

Another feature of the invention is a machine having guide rolls for the textile, the positions of which rolls, relative to the active rolls, may be changed from the outside of the machine to adjust the position of the textile with relation to the active rolls to obtain different treatments of textiles in the machine.

Another feature of the invention is a machine in which the textile may be treated on only one side by the active rolls.

Another feature of the invention is a machine of the type described in which the textile, while being treated by the active rolls, may be spread and kept under tension both in its width and in its length.

Another feature of the invention is a machine in which the treatment of the textile by the active rolls can be varied by changing the tension on the textile.

Another feature of the invention is a machine of the above type in which the walls of the container are so shaped that they assist in directing against the textile the fluid stream which is created by the active rolls.

Another feature of the invention is a machine in which the textile may be forced into contact with the active rolls revolving at a high rate of speed and thus, by friction, develop local heat and thereby apply the fluid to the textile while it is hot.

Other features of the invention are the methods of utilizing a machine, having any or all of the above numerated features, to treat textiles.

Other objects and features of the invention will more fully appear from the following description and accompanying drawings and will be particularly pointed out in the claims.

The drawings illustrate in elevation, section, and detail a preferred form of construction adapted for use in a machine of the type described and the methods of use thereof and embody the broad principles of the invention.

In the drawings:

Fig. 1 is a plan view of a range of machines which may be used for treating a textile with a fluid.

Fig. 2 is a side elevation of Fig. 1.

Fig. 3 is a plan view of the machine containing the active or pumping rolls with a portion of the top of the machine broken away to show its construction.

Fig. 4 is a vertical section through the machine containing the active or pumping rolls.

Fig. 5 illustrates diagrammatically a section through a machine in which the active or pumping rolls are used to treat only one side of the textile.

Fig. 6 is a section on line 6—6 of Fig. 3.

Fig. 7 illustrates diagrammatically a form of construction of a machine having guide rolls to position the textile with relation to the active or pumping rolls.

Fig. 8 is a broken section substantially on line 8—8 of Fig. 7.

Fig. 9 is a view similar to Fig. 6 showing one form of grooved roll which may be used as an active or pumping roll.

Fig. 10 is a diagrammatic side elevation showing the method of driving the active or pumping rolls of Fig. 4.

Figs. 11 and 12 are diagrammatic longitudinal side views of my machine showing various methods of treating textiles on my machine, and in accordance with my process.

Only such mechanism is illustrated in the drawings and will be described in the specification as is necessary to illustrate how the machine is used in a single step in the general process of treating a textile with a fluid solution of a dye. It is to be understood that this description is merely illustrative of general methods of treating textiles with fluids by the use of my machine and, although only a single machine with its as-

sociated apparatus is shown, it will be understood that other units or complete ranges of the machines may be used in sequence for the further treatment of textiles with fluids as, for instance, the washing and further treatment of a cloth after it has been dyed by the machine and in accordance with the method about to be described.

The range of machines illustrated herein may, for convenience of description, be divided into two units, the first comprising the means for applying the dye to the textile, and the second comprising the means for washing the surplus dye from the textile or oxidizing it.

My invention has particularly to do with the mechanism illustrated in the first of these units, namely, the application of the dye to the textile. The machine includes a container 1 within which the active or pumping rolls 2, 3, 4 and 5 are revolved at a high rate of speed preferably from a motor 6 through a gear box 7. Although any number of active rolls may be used, I preferably use an even number in order that, as will be described later, the textile may receive equal treatment on both sides. The textile 8 is led into the container and adjacent to the active rolls and then out of the container between the upper and lower press rolls 9 and 10 respectively. As is more fully disclosed in my above designated co-pending application, the active rolls, which are revolved at a high rate of speed, create a stream of the dye liquor which possesses a large amount of kinetic energy. The stream of fluid thus created moves in the direction of movement of the roll which creates it and is driven with great force against the textile which is passed adjacent to the rolls, preferably at a speed slower than the peripheral speed of the rolls and either in the direction of movement of the rolls or contra thereto, so that there is a differential movement between the cloth and the periphery of the adjacent roll. Due to the kinetic energy of the fluid stream the fluid may be forced entirely through the textile or, if the rolls are driven more slowly, the fluid stream may be given only sufficient energy to penetrate the textile and not pass entirely through it. In the case where the textile is led partially around the rolls a pocket or enclosure is formed by the textile adjacent each roll, within which pocket the stream of fluid builds up a very appreciable pressure which causes the fluid to pass through the textile.

The textile is fed to the machine over a feeding roll 11 from a stand 12. The surface of the feed roll 11 is preferably of a soft friction material, such as felt, to which the textile adheres so that by controlling the movement of the feed roll the rate of feeding the textile into the container may be controlled. It is desirable that the rate at which the textile passes into the container be positively controlled because the fluid stream set up by the active rolls may exert a great force tending to pull the textile into the machine in the case where the periphery of the rolls and the textile move in the same direction.

For the purpose of controlling the manner in which the textile is fed into the container and thus controlling the treatment of the textile, means are provided for either braking the feed roll 11, or driving it forward. For this purpose the shaft 13 of the feed roll may be provided with a collar 14 over which passes a brake band 15 the tension of which may be controlled by moving a weight 16 on an arm 17 to give a variable and even braking action. The feed roll may conveniently be supported on a bracket 18 on which the arm 17 may be pivoted, as shown at 19, and the fixed end of the brake band may also be fastened at the point 19. Obviously by moving the weight 16 on the arm 17 nearer to or farther from the pivot 19 the braking action of the band 15 on the roll may be decreased or increased and thus the tension on the textile changed.

At times it may be desirable positively to feed the textile into the container as fast as it is removed therefrom in order to relieve the tension on the textile and thus to control the treatment of the textile by the active rolls, as will more fully be explained hereafter. For this purpose any suitable mechanism may be provided for positively driving the feed roll. As is illustrated, the feed roll is positively driven from motor 20, through shaft 21, and variable speed cones 22 and 23, shaft 24 and gearing enclosed in gear box 25. Suitable bearings 26, 27 and 28, preferably ball or roller bearings, permit the free rotation of the shafts 21 and 24 and suitable coupling mechanisms 29 and 30 permit the mechanism easily to be assembled and disconnected from the feed roll when it is not needed. It will therefore be seen that by controlling the speed of revolution of the feed roll 11 by means of the braking mechanism or the mechanism for positively revolving the feed roll, more or less tension may be applied to the length of textile under treatment. The stand 12 has an open bearing 31 so that the roll of textile may easily be placed in position by lowering the spindle 32 on which it is wound, into the bearing. In order to keep the width of textile smooth on the feed roll, it is led in contact with a bar 33 which may conveniently be fastened upon the bracket 18 and which is preferably in the illustrated position with relation to the feed roll so that there is a large area of contact between the textile and the feed roll which assists in the control of the textile from the feed roll. The textile is maintained under tension prior to its passage over the bar 33 and feed roll 11 by means of the friction pulley 34 and the

friction belt 35 which operate in conjunction with a pivoted lever 36 and weight 37 which may be moved along the lever. The lever 36 may be pivoted at 38 at which point one end of the friction belt may be fastened. The other end of the friction belt is fastened to the lever 36. This mechanism is similar to the mechanism for braking the feed roll.

The textile may be drawn through the container by any suitable mechanism such as the following which has proven to be satisfactory. The lower press roll, 10, may be driven from the shaft 21 by means of a mechanism similar to that which is used to drive the feed roll 11. This mechanism consists of variable speed cone friction pulleys 39 and 40 by means of which the axle 41, of the press roll 10, is driven through shaft 42 and gearing in the gear box 43. Suitable ball or roller bearings 44 and 45 permit the easy rotation of the shaft 42 and suitable coupling mechanism 46 and 47 permit the mechanism easily to be assembled or disconnected. The lower press roll 10 may conveniently be supported in its position by bearings 48 which are fastened in, or form a part of, the bracket 49 which in turn is fastened to the table 50. The upper press roll 9 revolves in bearings 51 fastened to or made a part of the bracket 52 which is pivoted at 53 on a standard 54 fastened to the table 50 so that it may be pressed toward the lower press roll to hold the textile in contact with the lower press roll in order that there may be no appreciable slippage between the textile and the lower press roll as well as to perform its function of squeezing the fluid out of the textile. The upper press roll is forced against the lower press roll with an adjustable positive but yielding pressure by means of a link 55 movably fastened at one end to the bracket 56, which may be a part of the bearing 51, and movably fastened at the other end, at 57, to a lever 58 along which weights 59 may be adjusted. The weights may be entirely removed if little or no pressure is desired. The lever 58 may conveniently be pivoted at 60 to a side of the container 1. The surfaces of the squeeze rolls are preferably of a soft yielding material such as rubber and to prevent the rolls from contacting when they are not in use and thus to prevent the flattening of one side of the rolls as well as to lift the upper press roll when the textile is being threaded through the machine, the bracket 52 and the upper press roll may be raised by means of the hand wheel 61 which bears against the upper end of the stand 54 and has threaded connection with the rod 62 pivotally fastened to the bracket 52.

It will thus be understood how the press rolls or the feed roll or both (depending upon whether the active rolls revolve with or against the direction of motion of the textile) constitute a means for passing the textile through the container at a speed slower than the peripheral speed of the active or pumping rolls. It will also be understood that, due to the fact that the tension on the textile may be adjusted by braking or driving the feed roll the textile may be drawn tightly in contact with or permitted to belly away from the active rolls, and thus the position of the textile in the fluid stream, be adjusted.

The textile is preferably smoothed, and as much as possible of the dye liquor removed therefrom, before it passes to the squeeze rolls. For this purpose the textile may be led in contact with a bar 63 and a roller 64. The bar 63 is preferably a half round as is shown and may have grooves, similar to those shown on the roll 3′ in Fig. 9, to spread the textile. It is supported by and between the brackets 49 which may also support the roller 64. In order to adjust the pressure of the textile against the bar 63 and the roller 64, the roller may be supported in bearings 65 which are movable along guides 66 supported from and fastened to the forward extension of the bracket 49. Bolts 67 threaded through the plate 68 and fastened to the bearings 65 permit the adjustment of the roll 64 toward or away from the textile and springs 69 caught between the bearings 65 and the end of the guides 66 insure the retention of the bearings in their adjusted positions. The bar 63 and the roller 64 thus serve to keep the textile flat as it is fed to the squeeze rolls and scrape off the liquor adhering to the surface of the textile.

For the purpose of easily and positively driving the active or pumping rolls at the desired high rate of speed the rolls are connected to a source of power through gearing in the gear box 7. In the preferred form of construction the motor 6 rotates shaft 70 on which beveled gears 71 are removably fastened. These gears mesh with pinions 72 removably fastened to the short shafts 73 and 74 which are joined by a universal coupling 75 of the type which may easily be disconnected in case it is desired to remove any individual roll. The shaft 74 is preferably connected to the spindle 76 of the active roll by means of a squared sliding connection 77 to permit a slight amount of end play in the active rolls so that the spindles of the rolls may adjust themselves for free rotation in the frictionless bearings 78 illustrated herein as ball bearings. Housings 79 of any suitable construction enclose the bearings and are preferably spaced a sufficient distance from the side wall of the container to permit chains or hooks to be placed around the spindle of the roll on both sides to remove a roll. Packing 80 surrounds the spindle and a packing nut 81 is threaded into the adjacent portion of the container to prevent leakage of the fluid from the container. The housings 79 for the bearings are preferably supported on angle

irons 82 which in turn are supported on shelves 83 spaced from the main wall of the container so that the bearing housings 79 may be spaced from the container for the reason above stated as well as to provide a trough 84 to catch any of the fluid which may possibly leak past the packing 80. Webs 85 join the main wall of the container with the shelves 83 to assist in forming a rigid structure. Obviously by changing the ratio of the gears any roll may be driven faster or slower than any other roll and by changing the position of any beveled gear relative to its pinion, the direction of rotation of any roll may be changed.

The side walls of the container have a novel construction for the purpose of permitting the rolls easily to be placed in or removed from the container so that different sizes and types of rolls may quickly be substituted for others in order to treat different kinds of goods with the same machine. To this end slots, indicated by the dotted lines 86 on Fig. 4, are formed in the main side wall 87 of the container from the top of the wall as far down as is necessary to permit the lowering of the rolls to their proper position. Wall plates 88 which are apertured to permit the passage of the spindles of the rolls through them and which are threaded to receive the packing nuts 81 and which are of a size to cover and extend well over the edges of the slots 86, are held against the main wall 87 by the bolts 89. These wall plates are preferably provided at their tops with threaded studs 90 so that if it is desired to remove a roll, an overhead derrick having chains, on the ends of which are nuts of a size to screw onto the studs 90, may be brought over the roll which is to be removed and the nuts screwed onto the studs. After loosening the bolts 89 and, if desired, placing hooks under the spindles of the rolls as described above, the wall plates and roll may together be lifted from the container. This construction provides a very convenient method of assembling the machine because the rolls, bearings and wall plates may be assembled in the machine shop, which in a dye plant is frequently at a distance from the dye house, and then brought to the machine in the dye house in assembled relation, lowered into position and the wall plates bolted to the side walls of the container.

The outer portion of the container, that is, the container proper, is preferably made in two sections as is clearly illustrated on Fig. 4 and comprises the upper section 91, the sides of which have been previously designated 87, and the bottom 92. These sections are held together in any suitable manner, as illustrated by means of bolts 93. The top of the container is preferably a separate piece 94 which fits down in between the side walls of the container and is supported on the tops of the side walls by flanges 95. The flanges have properly placed openings through them so that they may fit over the studs 90, and wing nuts 96 threaded on the studs 90 hold the top firmly in position. To strengthen the top, cross webs 97 are formed on it and holes 98 through the cross webs permit the insertion of hooks attached to the chains of an over-head derrick for the purpose of raising or lowering the top.

The bottom of the container is preferably made so as to provide spaces 99 for the circulation of cold or hot water or steam to control the temperature of the fluid in the container. These heating or cooling media may be introduced into the spaces 99 through the openings 99′.

The portions 100 and 101 of the top and bottom respectively of the container which are adjacent to the rolls are preferably curved to assist in directing the fluid stream set up by the rapidly revolving active or pumping rolls. These portions 100 and 101 may be given any suitable curvature to direct the fluid stream as desired but preferably the said portions are curved concentrically with the rolls and therefore the fluid stream set up by the active rolls is always concentric with the rolls. The said portions 100 and 101 may be spaced from the rolls as desired and it is evident that if a machine is made for a certain size roll and then a smaller roll is used there will be more space between the surface of the roll and the portions 100 and 101 than if the original size roll was retained and also the opposite will be true in case a larger size roll is substituted. In treating some types of fabrics, as will be described later, it has been found to be desirable to provide a rather large space between the surface of the roll and the adjacent portions 100 and 101 to permit the textile to belly away from the roll and in other cases it is desirable to have the surface of the roll quite close to the portions 100 and 101 so that a fairly narrow and swiftly moving stream is produced.

As is illustrated, the top and side walls of the container extend upwardly above the tops of the rolls thus, in effect, providing entry and exit openings 102 and 103 respectively for the textile which openings act as standpipes so that treatment of the textile by the fluid may take place under pressure.

For the purpose of guiding the textile over the active or pumping rolls and, in some instances, for the purpose of adjusting the position of the textile with relation to the active rolls and in the various layers of the fluid stream or in the film of fluid formed on the surface of the active rolls, I preferably provide guide rolls over or under which the textile passes. Several different forms of guide rolls may be used and they may be differently placed with relation to the active

rolls for accomplishing the specific result desired. The guide rolls are not driven but are revolved by contact with the textile. In Figs. 1, 2, 3 and 4 I have shown guide rolls which are adapted for use in a particular form of machine therein shown. As illustrated therein I provide front and rear guide rolls 104 and 105 respectively which are of the same size as are the active or pumping rolls. As shown in the drawings, the axes of the guide rolls 104 and 105 are on the same level as are the axes of the active or pumping rolls and the axis of each of the guide rolls 104 and 105 is spaced the same distance from the adjacent active or pumping roll as the active or pumping rolls are spaced from each other. The result of such a location of the guide rolls 104 and 105 is that the textile passes from the guide roll 104 onto the active or pumping roll 2 at the same angle that the textile passes from the active or pumping roll 3 onto the active or pumping roll 4 and similarly the textile passes from the last active or pumping roll 5 onto the guide roll 105 at the same angle that the textile passes from the active or pumping roll 3 onto the next active or pumping roll 4; in other words, the guide roll 104 is of such a diameter and so positioned with respect to the first pumping roll that the angle at which the textile meets the first pumping roll after leaving the guide roll is the same at the angle at which the textile meets another of the pumping rolls after leaving the preceding pumping roll and the guide roll 105 is of such a diameter and so positioned with respect to the last pumping roll 5 that the angle at which the textile leaves the last pumping roll is the same as the angle at which the textile leaves another of the pumping rolls to pass onto a succeeding pumping roll. When the guide rolls which are adjacent to the first and last active rolls are thus located so that the textile passes between the guide rolls and the adjacent pumping rolls at the same angle that the textile passes between the active rolls, the textile always surrounds the same proportion or part of each of the active or pumping rolls and thus the textile is evenly treated. The bearings for these guide rolls are preferably the same as the bearings for the active rolls and therefore they revolve very easily. In addition to the large guide rolls I may provide an additional auxiliary guide roll 106 so positioned that the textile, in passing from the feed roll 11 into the container, passes into the entry opening 102 of the container parallel to the walls thereof and then passes to the guide roll 104 at the proper angle. The auxiliary guide roll 106 is preferably placed at the front end of the container, because as the textile passes over the active rolls which are revolving contra to the direction of movement of the textile, the fluid stream created by each of the active rolls adds to the tension on the textile and, with the auxiliary guide roll contacting with the textile before it passes over the active rolls, the tension on the textile, where it leaves the machine, is less than if the auxiliary guide roll were at the rear end of the container. The bearings for this auxiliary guide roll need not be ball or roller bearings, but may be bearings formed in the proper wall plate 88 and closed off at the end to prevent the leakage of the fluid. The guide rolls may be perfectly smooth or they may be helically grooved from their center toward the ends, as is shown in Fig. 9 for an active roll, in order to spread the textile as well as smooth it out prior to its passage to the active or pumping rolls.

In Fig. 5 I have illustrated a form of machine adapted to treat a textile on only one side and therein show the guide rolls 104 and 105 as large guide rolls. In this type of machine the small auxiliary guide rolls 107 are placed in the lower part of the container so that the textile may be led through the container, as shown, with the same side of the textile facing the active rolls for treatment only on one side. Of course, where both sides of the textile do not have to be equally treated, that is, where the textile is treated only on one side, an uneven number of active or pumping rolls may be used and consequently only three active rolls 108 are shown on this figure. This form of machine, using helically grooved active rolls, as will more fully hereinafter be explained, is especially adapted for the treatment of napped or high pile textiles which are passed through the container with the napped side toward the active rolls.

In the form of machine illustrated in Figs. 7, 8, 11 and 12 the guide rolls, illustrated as small auxiliary rolls, may be adjusted in their position with relation to the active rolls so that different textiles may receive different treatments in the same machine. These guide rolls extend entirely across the container and are so supported that their positions with relation to the adjacent active rolls may be changed without interfering with the passage of textile through the container. For this purpose the spindles 109 of the guide rolls may be journaled in arms 110 fastened to short shafts 111 which pass through the side walls of the container, which walls are diagrammatically shown on Fig. 8 and designated 112. Packing and packing nuts 113 surround the shafts 111 to prevent the leakage of fluid. A beveled gear 114 is fastened to each of the shafts 111 and meshes with a gear 115 on a rod 116 which extends the full length of the container and which is rotated by the hand wheel 117. It is desirable for the arms on each side of the container to move in unison with each other and therefore the rod 118 extends across

the outside of the container and, by means of gear 119 which meshes with gear 120 on the rod 116 and a gear similar to gear 119 which meshes with a gear similar to gear 120 on the rod 116', the rod 116' is rotated in unison with the rod 116 to move the arms adjacent to rod 116' in unison with the arms adjacent rod 116. The auxiliary guide rolls which are between the active rolls are preferably in pairs so that the textile may be guided onto adjacent active rolls at substantially the same angle, but it is only necessary for a single auxiliary guide roll to be used adjacent the end active rolls. In cases where a machine having the construction diagrammatically illustrated in Figs. 7, 11 and 12 is used, the guide rolls 121 and 122 may be, and preferably are, used to lead the textile directly from the feed roll 11 into the container. These adjustable guide rolls are very important in that they permit different textiles to be treated differently in the same machine as will more fully hereinafter be described.

As the textile passes through the machine it absorbs and removes the fluid with which it is treated and it is therefore desirable to introduce fresh fluid to make up for that which is absorbed by the textile and thus removed from the container. In my machine I provide a vat for the fresh fluid and means for introducing it into the container in measured quantities depending upon the rate at which the fluid within the container is absorbed by the textile and removed. For this purpose I provide a fluid pump 123, preferably of the plunger type, which, by means of pipe 124, draws a measured quantity of fresh fluid from a vat 125 and forces it through pipe 126 into the container. The pump is driven by the variable speed cone pulleys 127 and 128, shaft 129 and link 130 from the shaft 21 and pulleys 39 and 40 and shaft 42. In this way the rate of feed of the fresh fluid is correlated to the rate at which the textile passes through the machine because the feed drum 11, the squeeze roll 10 and the pump 123 are all driven from the same shaft 21. Furthermore, the rate at which the textile passes through the machine, and the rate of feed of the fresh fluid may be correlated to the rate of revolution of the active or pumping rolls because the motors 6 and 20 for driving the active rolls and the shaft 21, respectively, may be synchronous motors and may be connected to the same alternating current bus bars 131. Thus the motors 6 and 20 and the devices which they drive may be connected by electrical means. The rheostats 132 and 133, or other suitable devices for starting and controlling the motors 6 and 20 respectively, may be placed in the lines 134 and 135 which convey the electricity to the motors and thus the speed of rotation of the active rolls relative to the rate of passage of the textile through the container may be changed. The rate of feed of the fresh fluid may be varied by means of the cone pulleys 127 and 128 so that when a light textile, which absorbs a small amount of fluid, is treated in the machine a proportionately small amount of fresh fluid may be fed into the container, but when a heavy textile, which absorbs a large amount of fluid is treated in the machine the rate of feed of the fresh fluid may be increased to make up for the larger amount of fluid which is absorbed by the heavier textile. In all cases however, after the pulleys 127 and 128 are set the rate of feed of the fresh fluid is constant and in proportion to the rate at which the textile passes through the container. The fresh fluid is preferably introduced into the container at the point where the textile enters and in order to distribute it evenly I provide a series of pipes 136 spaced across the entry opening 102, which pipes connect with the pipe 126 and dip below the level of the fluid in the entry opening because, in the case of a dye solution, the textile absorbs the dye from the liquid very rapidly where the textile first enters the liquid and it is desirable to replenish the dye at that point with fresh dye to maintain the strength of the solution.

In order to catch the fluid which is removed from the textile by the bar 63 and roller 64 I provide a trough 137 at the exit end of the container in such a position with relation to the bar 63 that the fluid falls into the trough and for the purpose of catching the fluid which is removed from the textile by the press roll 10, I place the pan 138 under the press roll 10 and conduct the fluid caught therein, by means of pipe 139, into the trough 137. From the trough 137 the pipe 140 permits the fluid to flow into the pipe 141 from which, by means of the pipes 142 it may again enter the bottom of the container. I have found that in the operation of machines which are not provided with the pipes 142 there is a difference in the level of the fluid at entry and exit ends of the container but when the pipes 142 are used the level of the fluid in said entrance and exit ends of the container is substantially equalized. This is due to the fact that the fluid circulates within the container in the direction of rotation of the greatest exposed area of the active or pumping rolls and also a current of the fluid is set up in the direction of movement of the textile. Therefore, if the active rolls within the container are rotated in the direction indicated by the arrows in Fig. 2 the fluid is driven from the end of the container at which the textile enters toward the end of the container at which the textile leaves and this causes a hydrostatic head at the exit end of the container in addition to the head caused by the textile pulling the fluid with it through the container. There-

fore the fluid will flow through the pipes 141 and 142 from the exit end of the container toward the entry end where it will mix with the fresh strong fluid entering through the pipes 136. To facilitate the flow of the fluid from the exit end of the container to the entry end, additional openings for pipes 142 are provided under the front and rear guide rolls 104 and 105 respectively as is shown on Fig. 3. The pipes 142 are threaded into the bottom of the container at the lowest point under each of the active rolls so that the fluid may entirely be withdrawn from the container when it is to be changed. A valve 143 may be opened to permit the withdrawal of the fluid. A valve 144 in pipe line 145 permits the entrance of another fluid, for instance water when the container is to be filled for washing.

In order to provide for the thorough mixing of the fresh strong fluid, which enters the container through the pipes 136, with the fluid already in the container so that a constant strength and evenly mixed fluid mixture may be maintained at the entry end of the container, the bottom 92 and the top 94 of the container are so formed as to provide the enlarged reservoir and mixing chamber 146 in which the fresh strong fluid may mix with the fluid returned by the pipes 141 and 142. The violent agitation of the fluid by the active rolls thoroughly stirs and mixes the fluid within the main body of the container and maintains the chemicals, such as the dye, or soaping substances or fillers, very uniformly distributed in the fluid so that there are no localities where the concentration of the chemicals is high nor where the concentration is low. It has been found that in the instances where fresh dye, or other chemicals or substances are introduced at one end of the container, for instance by the pipes 136, to make up for those absorbed by the textile, they are almost instantly distributed throughout the entire fluid.

After the textile leaves the press rolls 9 and 10 it may pass into another container 147 which may contain a liquid for washing or further treating, for example oxidizing the dye on, the textile. If the textile is of light weight it is possible that all of the dye will be oxidized by the air and therefore the sides of the container 147 may be removed to permit the free circulation of the air. The textile passes into the container 147 over the roll 148 and then under the weighted take up roll 149 which has free vertical movement in the guides 150. This take up roll obviously maintains the proper tension on the textile in the container 147. After passing back and forth over a suitable number of rolls 151, the textile may be led out of the container 147 over the guide roll 152. In case the textile under treatment is heavy so that the dye which is on the fibers at the center of the textile cannot successfully be treated by the described air oxidation or by the simple passage of the textile through an oxidizing bath, a container having one or more active rolls, and similar to the container hereinbefore described, may be used instead of the container 147 illustrated on the drawings. Should a machine having active rolls be used instead of the container 147 the active rolls are preferably driven from the extension of shaft 70, shown in dotted lines at 153 on Fig. 1.

After leaving the container 147 the textile passes under a guide roll 154 and then between press rolls 155 and 156 which may have associated parts similar to those described in connection with press rolls 9 and 10. These press rolls are driven from the shaft 21 by a variable speed mechanism designated generally at 157 which is similar to the mechanism which drives the press roll 10.

After leaving the press rolls 155 and 156 the textile may either be wound on a reel 158 or pass to another range of machines for further treatment. In case the textile is wound on reel 158, said reel may be driven by a belt 159 from a pulley 160 on the spindle of the press roll 155. The mechanism 161 which rotates the reel 158 is such that as the reel becomes filled with the textile the belt 159 slips slightly to maintain the proper tension on the textile but allows for the increased diameter of the roll.

In case the textile is not wound on the reel 158 but is taken to another range of machines similar to those hereinbefore described, the active rolls of the next range of machines are preferably driven from the extended shaft 153 and the various feed rolls and press rolls of the succeeding ranges of machines are preferably driven from an extension of the shaft 21 through variable speed mechanisms such as those previously described, so that all of the parts in the succeeding ranges of machines may be synchronized for the complete and continuous treatment of a continuous length of textile. If the textile is mordanted in the first range of machines it may be dyed in the second range and then washed, soaped, starched, oiled and otherwise finished in succeeding ranges. In case one or more soaping or washing units are used the soaping or washing fluid may flow countercurrent to the textile passing through the succeeding units as will easily be understood by those familiar with the art.

A few of the many methods of treating textiles with the machine will now be described. For the purpose of description textiles may be divided primarily into two classes (1) the heavy thick closely woven textiles and (2) the light loosely woven textiles. Obviously more force is required to drive the fluid into or through the heavy textiles than is required to drive the fluid into or through

the light textiles. It is true of the operation of my machine that the film of fluid which is on the surface of an active roll is revolving at substantially the same speed as the roll and possesses the greatest kinetic energy, and that the layers of the fluid stream move at lesser speeds and possess smaller amounts of kinetic energy the farther they are from the active rolls. Furthermore, if the surface of the roll is roughened for instance by forming grooves in it, there is more friction between the surface of the roughened roll and the fluid than if the surface of the roll is absolutely smooth, and consequently a roughened roll will create a fluid stream having more kinetic energy than a smooth roll will create. Also the faster the roll revolves the greater will be the force of the fluid stream and the kinetic energy it possesses. Therefore, in general, a heavy textile is preferably treated by holding it closely to the active rolls to obtain the full force of all of the fluid stream but a light textile is treated by holding it at a distance from the surface of the roll where it does not obtain the full force of the stream.

The position of the textile with relation to the active rolls and the film of fluid on the surface of the rolls and the position of the textile in the different layers of the fluid stream may be, and actually is, controlled in my machine in two distinct ways. The first way of adjusting the position of the textile is by moving the movable guide rolls illustrated on Figs. 7, 8, 11 and 12 in the manner hereinbefore described. If the guide rolls are in the position shown in full lines in Fig. 7 and the textile is led over the guide rolls as is indicated by the full lines in said figure, it is obvious that the textile will be forced more closely to the surfaces of the active rolls than if the guide rolls and textile assume the dotted line positions, and therefore when a heavy textile is treated the guide rolls and textile will usually be in the full line positions but when a light textile is treated, the guide rolls and textile will usually be in the dotted line positions. When the leading in strip of material is threaded between the rolls, the guide rolls are usually given the dotted line position in order to facilitate the threading of the textile through the machine, but when the machine is in actual operation these guide rolls may assume any position to accomplish their purpose of guiding the textile over the active rolls in the desired manner and either holding the textile away from the active rolls or forcing it against them.

The position of the textile may also be adjusted by controlling the tension on the textile. As has previously been explained, the fluid stream may be considered to be made up of a plurality of layers of fluid each of which moves at a less speed as it is farther removed from the surface of the roll, and this fluid stream tends to belly the textile away from the rolls. Thus, as the textile bellies away from the adjacent roll it moves to a position in one of the outer layers of the fluid and it will continue to belly out until the pressure of the fluid stream, that is, the pressure of the fluid between the textile and the roll, is equal to the pressure caused by the tension on the textile tending to pull the textile toward the roll. Obviously, there will be less pressure on the textile the farther it is from the roll and therefore the textile may be positioned in the various fluid layers, and thus receive various treatments by the fluid, by varying the tension on the textile. The tension on the textile may easily be regulated by means of the brake mechanism on the feed roll 11 and the cloth stand 12 and by the use of the mechanism for positively driving the feeding roll. If a heavy braking pressure is applied to the brake on the feed roll 11 great tension is placed on the textile which is forced closely to the surface of the rolls so that the full effect of the fluid stream is exerted against the textile; on the other hand, if the feed roll is not braked but is driven in the direction of movement of the textile to feed the textile into the container at a rate equivalent to the rate at which the press rolls draw the textile from the container, the textile is under no tension other than that produced by its contact with the moving streams of fluid set up by the rolls and therefore can belly away from the rolls. Of course, the tension produced by the fluid streams may be very great and in cases where the active rolls have been driven at an exceedingly high rate of speed in a direction contra to the direction of movement of the textile through the container, the tension caused by the fluid stream has torn the textile apart near the last active or pumping roll; however, when the textile is positively fed into the container, that is, where no tension is placed on the textile by the feed roll, the textile usually bellies a considerable distance from the active rolls and by controlling the operation of the feed roll and thus controlling the tension on the textile where it enters the container, the position of the textile with relation to the surface of the adjacent active roll and thus the position of the textile in the fluid stream and in the several layers of the stream, may be adjusted at will.

In the case where all of the active or pumping rolls are driven in the direction of movement of the textile through the container, as shown in full lines in Fig. 12, it is obvious that the textile will tend to move through the container without being drawn through it by the press rolls 9 and 10. The tendency of the textile to move through the container is opposed by the friction of the guide rolls and the drag of the feed roll and thus the position of the textile may be controlled by

braking the feed roll. If the textile is led over the guide rolls and active rolls as shown in full lines in Fig. 7, it will be understood that the tension on the textile is greater, due to the friction of the guide rolls, than if the textile is led through the container as shown in dotted lines, and thus the tension on the textile may be increased by manipulation of the guide rolls as well as by the operation of the feed roll and press rolls.

To prevent the textile being placed under too great a tension by the active rolls it may be desirable to revolve one roll in the direction of movement of the textile and the other roll against the movement of the textile as shown in full line in Fig. 11. Thus, each roll will exert its full effect on the textile and the textile adjacent that roll will be placed under the tension caused by the fluid stream created by that roll, but because the next roll will be exerting a tension opposite to the tension of the preceding roll, the resulting tension on the textile after passing two rolls revolving in opposite directions with relation to the direction of movement of the textile, will be practically the same as was the tension on the textile when it passed the feed roll that is, the tensions caused by the two rolls will neutralize each other and will be practically nothing.

Obviously the speed of the fluid stream and its kinetic energy depends upon the peripheral speed of the active roll which creates it and therefore if a large and small roll are revolving at the same number of revolutions per minute the small roll will create less of a fluid stream than will the large roll. Therefore when light textiles are to be treated in my machine I may remove the large active rolls and substitute smaller rolls for the large rolls. In addition to creating a fluid stream moving at a slower rate of speed and therefore having less kinetic energy than the stream formed by the revolution of a large roll, the periphery of the small roll will obviously be spaced a greater distance from the curved portions 100 and 101 of the top and bottom of the container and therefore when a small roll is used the textile may belly farther away from the surface of the roll before it contacts with the wall of the container than if a large roll is used, which condition is desirable when treating a light textile such as chiffon.

On the other hand, if a heavy textile is to be treated a large roll may be used which leaves only a slight space between its surface and the adjacent portions 100 and 101 of the container. The great peripheral speed of the surface of the large roll will create a very swiftly moving fluid stream having a great amount of kinetic energy, the force of which will be accentuated because of the small distance between the periphery of the roll and the adjacent curved portions 100 and 101 of the wall of the container.

According to the preferred method of treating textiles in the machine the heavy textiles are forced closely adjacent to, but not in actual contact with, the active rolls so that the textile rides over the rolls on a fluid film, a part of the fluid of which film passes through the textile, and the light textiles are permitted to belly away from the rolls so that they receive a lighter treatment. In some instances however, particularly in the case of the treatment of heavy textiles, it is desirable to have the textile contact with the surface of the adjacent roll. If the textile is forced against the roll with considerable pressure, either by means of the guide rolls or the tension on the textile or both, the friction develops considerable heat. In this way it is possible to heat the textile locally either before or after it is subjected to the action of the fluid stream. In the case where the roll revolves contra to the direction of movement of the cloth as does roll 2 in Fig. 11, and the textile is in contact with a roll local heat is developed and locally applied and the cloth thus heated is subjected to that film of the fluid which is on the surface of the roll and which, therefore, is moving at the highest rate of speed and possess the largest amount of kinetic energy.

In the case where the textile and active roll move in the same direction, as does roll 3 in Fig. 11, and the textile is held in contact with the roll, the textile is subjected to the full force of the fluid stream and then passes into contact with the roll which develops local heat and applies it locally and therefore the textile is first treated with the fluid and then heated, in other words, the textile is heated while the dye is on it.

In the case where all of the active rolls are driven contra to the direction of movement of the textile through the container, it is obvious that as the textile passes adjacent each successive active roll, the tension on the textile increases and therefore the textile is drawn more closely toward the surface of each succeeding active roll. Therefore, if the textile contacts with the first active roll over a certain area it will contact with the second active roll over a greater area and with the third active roll over a still greater area (provided the guide rolls are so set as to permit this) and therefore more heat will be developed as the cloth passes over successive rolls. In this way I am enabled to develop greater amounts of heat at each successive roll and apply the fluid to the textile at successively higher temperatures.

In the same way if all of the active rolls are revolved in the direction of movement of the textile, the textile is under less and less tension as it passes over successive active

rolls and therefore the greatest area of contact of the textile with an active roll will be at the first active roll so that in this case I am enabled to treat the textile with the fluid at successively decreasing temperatures.

When the textile rides over the active roll on a film of the fluid there is no appreciable heat developed and therefore by regulating the position of the textile so that it does not touch the active rolls I am enabled to treat the textile with the fluid at the temperature of the bath.

Smooth rolls revolving in contact with a textile tend to polish the surface of the textile and therefore in my machine, if I revolve a smooth roll in contact with the textile in a direction contra to the movement of the textile, I am enabled to apply the fluid to the polished textile while if I revolve the roll in contact with the textile in the same direction as the textile moves I am enabled to apply the fluid to the textile and then polish it.

In some instances, it is desirable to stretch the textile in its width and for this purpose spirally grooved rolls 3′, shown specifically in Fig. 9, may be used either as guide rolls or as active rolls. These rolls are of special value when the textile is treated with a mercerizing fluid, because they stretch the material in its width, and the feed roll and press rolls may be used to stretch the material in its length. When the spirally grooved rolls are used as the active rolls, the grooves set up currents of fluid moving from the center of the roll and textile toward the edges thereof which tend to stretch the textile; when the textile is passed in contact with a spirally grooved active roll, the ridges of the grooves add their stretching effect to that of the currents of fluid.

The grooved rolls also find special application when a napped material, such as a carpet or a velvet, is to be treated with a fluid. In this case the spirally grooved active rolls may contact with the nap and the ridges of the grooves tend to part the upstanding nap so that the fluid may be forced directly down to the base fabric. In this way the fibers which constitute the nap are treated with the fluid throughout their entire length with the result that the fibers of the nap are dyed the same color all the way down to the ends which are attached to the base fabric. The grooved rolls are therefore of special value for use in a machine such as is illustrated in Fig. 5 where the textile is treated only on one side, for instance on the napped side.

In the specification and claims I have used certain terms in describing my invention and I desire to define those terms more fully for the purpose of construing the specification and claims.

By the term "textile" as used in the specification and claims, I have in mind the definition of the word appearing in Webster's International Dictionary, namely, "That which is, or may be, woven, a fabric or material for weaving", because the machine and process are applicable not only to the handling and treating of woven, knitted, or braided fabrics, but also a series of warps or other suitable yarns from a beam, thus treating the yarns in a similar manner to fabrics.

By the term "fluid stream" or "fluid film" or equivalent expressions as used in the specification and claims, I mean such a stream or film as is set up by a body moving through the fluid at a high rate of speed and not at the usual speeds at which cloth is moved through jigs etc., in the usual processes of dyeing or otherwise treating the cloth with a fluid.

Although a particular preferred form of the invention has been described, it is recognized that modifications may be made and it is distinctly to be understood that the invention is to be construed as broadly as the limitations in the claims taken in conjunction with the prior art may allow.

I claim:

1. A machine for treating a textile with a fluid comprising a container for the fluid, a roll within the container for contact with the fluid and adjacent which the textile passes, means adapted to pass the textile through the container, means adapted to move the roll at such a rate of speed that a film of the fluid is formed on the surface of the roll and moves therewith, and means to adjust the distance of the textile from the surface of said roll.

2. A machine for treating a textile with a fluid comprising a container for the fluid, a roll within the container for contact with the fluid and adjacent which the textile passes, means adapted to pass the textile through the container, means adapted to revolve the roll at a sufficient speed to draw with it by friction sufficient fluid to form a moving stream of the fluid, and means to change the position of the textile in said stream.

3. In a method of treating a textile with a fluid, the steps which include revolving a roll contacting with the fluid at such a rate of speed as to form a film of the fluid on the surface of the roll, and passing the textile adjacent to the roll and adjusting the position of the textile with relation to the roll to obtain the desired treatment.

4. In a method of treating a textile with a fluid, the steps which include revolving a roll contacting with the fluid at such a rate of speed as to form a film of the fluid on the surface of the roll, and passing the textile adjacent to the roll, and adjusting the position of the textile with relation to said film to obtain the desired treatment.

5. A machine for treating a textile with a fluid including a container for the fluid, a plurality of rolls within the container for contact with the fluid and adjacent which the textile passes over and under alternate rolls, means adapted to pass the textile through the container, and means connected to an even number of the rolls and adapted to revolve said connected rolls at such a rate of speed that each roll draws with it by friction a film of fluid having sufficient force to penetrate the textile thereby to obtain substantially equal treatment of both sides of the textile.

6. In a method of treating a textile with a fluid, the step which includes passing the textile alternately over and under an even number of rolls contacting with the fluid and revolving said rolls at such a rate of speed that the fluid is forced against alternate sides of the textile an equal number of times thereby to obtain substantially equal treatment upon both sides of the textile.

7. A machine for treating a textile with a fluid including a container for the fluid having entry and exit openings for the textile, walls surrounding said openings and extending upwardly well above the top of the container, a roll within the container adjacent which the textile is adapted to pass, means for revolving the roll at a rate of speed sufficient to force the fluid against the textile, means for passing the textile through the container, and pipe connections between said entrance and exit openings to equalize the level of the fluid at said entrance and exit openings.

8. A machine for treating a textile with a fluid including a container for the fluid, a roll within the container adjacent which the textile is adapted to pass, means for revolving the roll at a rate of speed sufficient to force the fluid against the textile, means for feeding the textile into the container, and a pump for feeding fresh fluid into the container at a constant predetermined rate correlated to the rate of feed of the textile.

9. In a method of treating a napped textile with a fluid, the step which includes passing the napped side of the textile adjacent to a plurality of rolls contacting with the fluid, and revolving the rolls at such a rate of speed that the fluid is forced against the nap of the textile.

10. A machine for treating a textile with a fluid including a container for the fluid, a plurality of rolls within the container for contact with the fluid and adjacent which the textile passes with the same side of the textile facing the rolls, means adapted to pass the textile through the container and means adapted to revolve the rolls at such a rate of speed that the fluid is forced against the textile.

11. A machine for treating a textile with a fluid including a container for the fluid, a grooved roll within the container for contact with the fluid and adjacent which the textile passes, means adapted to pass the textile through the container and means adapted to revolve the roll at such a rate of speed that the fluid is forced against the textile.

12. A machine for treating a textile with a fluid including a container for the fluid, a plurality of rolls within the container for contact with the fluid and adjacent which the textile passes, one of said rolls being helically grooved from its middle toward its ends, means adapted to pass the textile through the container, and means adapted to revolve one of said rolls at such a rate of speed that the fluid is forced against the textile.

13. In a method of treating a textile with a fluid the steps which include passing the textile adjacent to a grooved roll contacting with the fluid and revolving said roll at such a rate of speed that the fluid is forced against the textile.

14. In a method of treating a textile with a fluid the steps which include passing the textile adjacent to a roll contacting with the fluid and is helically grooved from its middle toward its ends, and revolving said roll at such a rate of speed that the fluid is forced against the textile.

15. A machine for treating a textile with a fluid comprising a fluid container, a roll within the container for contact with the fluid, means adapted to revolve the roll at a sufficient speed to draw with it by friction sufficient fluid to form a moving stream of the fluid, and means adapted to pass the textile through the container in said fluid stream and in contact with said roll.

16. A machine for treating a textile with a fluid comprising a fluid container, a roll within the container for contact with the fluid, means adapted to revolve the roll at a high peripheral speed, and means adapted to pass the textile through the container at a speed slower than the peripheral speed of the roll and to hold the textile in contact with the periphery of the roll.

17. In a method of treating a textile with a fluid, and steps which include revolving a roll contacting with the fluid at a sufficient speed to draw with it by friction sufficient fluid to form a moving stream of the fluid and passing the textile through the container in said fluid stream and in contact with said roll.

18. In a method of treating a textile with a fluid, the steps which include revolving a roll in contact with the fluid at a high peripheral speed, and passing the textile through the container at a speed slower than the peripheral speed of the roll and maintaining the textile in contact with the roll.

19. In a method of treating a textile with a fluid, the steps which include revolving a roll contacting with the fluid at a sufficient speed to draw with it by friction sufficient fluid to form a moving stream of the fluid, passing the textile through the container in said fluid stream, and adjusting the position of the textile in said fluid stream by changing the tension on the textile.

20. In a method of treating a textile with a fluid, the steps which include revolving a roll contacting with the fluid at a high peripheral speed, passing the textile through the container at a speed slower than the peripheral speed of the roll, and maintaining tension on the textile to adjust its position with relation to the periphery of the roll.

21. A machine for treating a textile with a fluid including a container for the fluid, a plurality of rolls of odd number within the container for contact with the fluid and adjacent which the textile passes, means adapted to pass the textile through the container, and means connected to an even number of the rolls and adapted to drive said connected rolls at such a speed that the fluid is thereby forced against the textile, the unconnected roll or rolls being used as guide rolls.

22. A machine for treating a textile with a fluid including a container for the fluid, a plurality of active rolls of even number and a plurality of guide rolls of odd number within the container for contact with the fluid and adjacent which the textile passes, means adapted to drive the active rolls at such a speed that the fluid is thereby forced against the textile and means adapted to pass the textile through the container.

23. A machine for treating a textile with a fluid including a container for the fluid, a plurality of active rolls of even number and a plurality of guide rolls of odd number within the container for contact with the fluid and adjacent which the textile passes, means adapted to drive the active rolls at such a speed that the fluid is thereby forced against the textile and means adapted to pass the textile through the container, the guide rolls being so positioned that the textile passes adjacent an even number of guide rolls where it enters the container and adjacent an odd number where it leaves the container.

24. A machine for treating a textile with a fluid including a container for the fluid, an even number of active rolls and three guide rolls within the container for contact with the fluid and adjacent which the textile passes, means adapted to drive the active rolls at such a speed that the fluid is thereby forced against the textile and means adapted to pass the textile through the container, the guide rolls being so positioned that the textile passes adjacent two guide rolls where it enters the container and adjacent one guide roll where it leaves the container.

25. A machine for treating a textile with a fluid including a container for the fluid, a plurality of rolls within the container adjacent which the textile passes, said container having a bottom presenting side walls, and a top, said bottom and top having portions adjacent the rolls concentric therewith and said top being a unitary structure adapted to fit within said side walls.

26. A machine for treating a textile with a fluid including a container for the fluid having side walls, a roll within the container adjacent which the textile passes and presenting spindles projecting beyond said side walls, slots in the side walls extending from below the spindles to the top of the walls to permit the roll being lifted out of the container and plates removably fastened over said slots.

27. A machine for treating a textile with a fluid including a container for the fluid having side walls, a roll within the container adjacent which the textile passes and presenting spindles projecting beyond said side walls, slots in the side walls extending from below the spindles to the top of the walls to permit the roll being lifted out of the container, plates removably fastened over said slots and having openings therein to permit the spindles to project beyond said side walls, and packing means surrounding the spindles and closing said openings to prevent the leakage of fluid.

28. A machine for treating a textile with a fluid including a container for the fluid, a roll within the container for contact with the fluid and adjacent which the textile passes, means for revolving the roll to force the fluid against the textile, means adapted to pass the textile through the container, and means for introducing fresh fluid into the container including a main fluid conduit extending substantially across the container and a plurality of smaller conduits spaced across the container and connected to the main conduit to deliver the fresh fluid into the container.

29. A machine for treating a textile with a fluid including a container for the fluid, a roll within the container for contact with the fluid and adjacent which the textile passes, means for revolving the roll to force the fluid against the textile, means adapted to pass the textile through the container and means for introducing fresh fluid into the container including a main fluid conduit extending substantially across the container and a plurality of smaller conduits spaced across the container with each of said smaller conduits opening at one end into the main conduit and having the other end below the surface of the fluid in the container, to feed fresh fluid into the container.

30. A machine for treating a textile with

a fluid including a container for the fluid, a roll within the container for contact with the fluid and adjacent which the textile passes, means for revolving the roll to force the fluid against the textile, means adapted to pass the textile through the container and means for introducing fresh fluid into the container including a main fluid conduit extending substantially across the container and a plurality of smaller conduits spaced across the container with each of said smaller conduits opening at one end into the main conduit and having the other end below the surface of the fluid in the container adjacent the textile as it enters the container, to feed fresh fluid into the container.

31. In a method of treating a textile with a fluid the steps which include passing the textile adjacent a roll contacting with the fluid, revolving the roll at such a rate of speed that the fluid is thereby forced against the textile, and maintaining the textile under tension across its width as the fluid is forced against it.

32. In a method of treating a textile with a fluid the steps which include passing the textile adjacent a roll contacting with the fluid and adapted to stretch the textile across its width as the roll revolves, and revolving the roll at such a rate of speed that the fluid is thereby forced against the textile and the textile is maintained under tension across its width as the fluid is forced against it.

33. In a method of treating a textile with a fluid the steps which include passing the textile adjacent a roll contacting with the fluid, revolving the roll at such a rate of speed that the fluid is thereby forced against the textile, and guiding the textile adjacent the roll by means of a guide roll adapted to maintain the textile under tension across its width.

34. A machine for treating a textile with a fluid including a container for the fluid, a roll within the container for contact with the fluid and adjacent which the textile passes, means adapted to pass the textile through the container, means adapted to revolve the roll at such a rate of speed that the fluid is thereby forced against the textile, and means to maintain the textile under tension across its width as the fluid is forced against it.

35. A machine for treating a textile with a fluid including a container for the fluid, a roll within the container for contact with the fluid and adjacent which the textile passes, means adapted to pass the textile through the container, means adapted to revolve the roll at such a rate of speed that the fluid is thereby forced against the textile, and a roll adapted to maintain the textile under tension across its width as the fluid is forced against it.

36. A machine for treating a textile with a fluid including a container for the fluid, an active roll within the container for contact with the fluid and adjacent which the textile passes, means adapted to pass the textile through the container, means adapted to revolve the active roll at such a rate of speed that the fluid is thereby forced against the textile, and a guide roll adapted to guide the textile adjacent the active roll and to maintain the textile under tension across its width as the fluid is forced against the textile.

37. A machine for treating a textile with a fluid including a container for the fluid, an active roll within the container for contact with the fluid and adjacent which the textile passes, means adapted to pass the textile through the container, means adapted to revolve the active roll at such a rate of speed that the fluid is thereby forced against the textile, and a grooved guide roll adapted to guide the textile adjacent the active roll and to maintain the textile under tension across its width as the fluid is forced against the textile.

38. A machine for treating a textile with a fluid including a container for the fluid, an active roll within the container for contact with the fluid and adjacent which the textile passes, means adapted to pass the textile through the container, means adapted to revolve the active roll at such a rate of speed that the fluid is thereby forced against the textile, and a guide roll having grooves extending from its middle toward its ends adapted to guide the textile adjacent the active roll and to maintain the textile under tension across its width as the fluid is forced against the textile.

39. A machine for treating a textile with a fluid including a container for the fluid, a roll within the container for contact with the fluid and adjacent to which the textile passes, means adapted to revolve the roll at such a rate of speed that the fluid is thereby forced against the textile, means adapted to pass the textile through the container including press rolls to press the fluid from the textile after it leaves the container, and means to return to the container the fluid which is pressed out of the textile by the press rolls.

40. In a method of treating a napped textile with a fluid, the step which includes passing the napped side of the textile adjacent to a roll adapted to part the nap as the roll revolves, and revolving the roll at such a rate of speed that the fluid is thereby forced against the nap of the textile and the nap is parted as the fluid is forced against it.

41. In a method of treating a napped textile with a fluid, a step which includes passing the napped side of the textile adjacent to a helically grooved roll adapted to part the nap as the roll revolves, and revolving the

roll at such a rate of speed that the fluid is thereby forced against the nap of the textile and the nap is parted as the fluid is forced against it.

In testimony that I claim the foregoing, I have hereunto set my hand this 27th day of December, 1926.

WALLACE P. COHOE.