Jan. 13, 1931. C. CALLEBAUT ET AL 1,788,980

DYEING OF KNITTED AND WOVEN FABRICS

Filed March 10, 1926 2 Sheets-Sheet 1

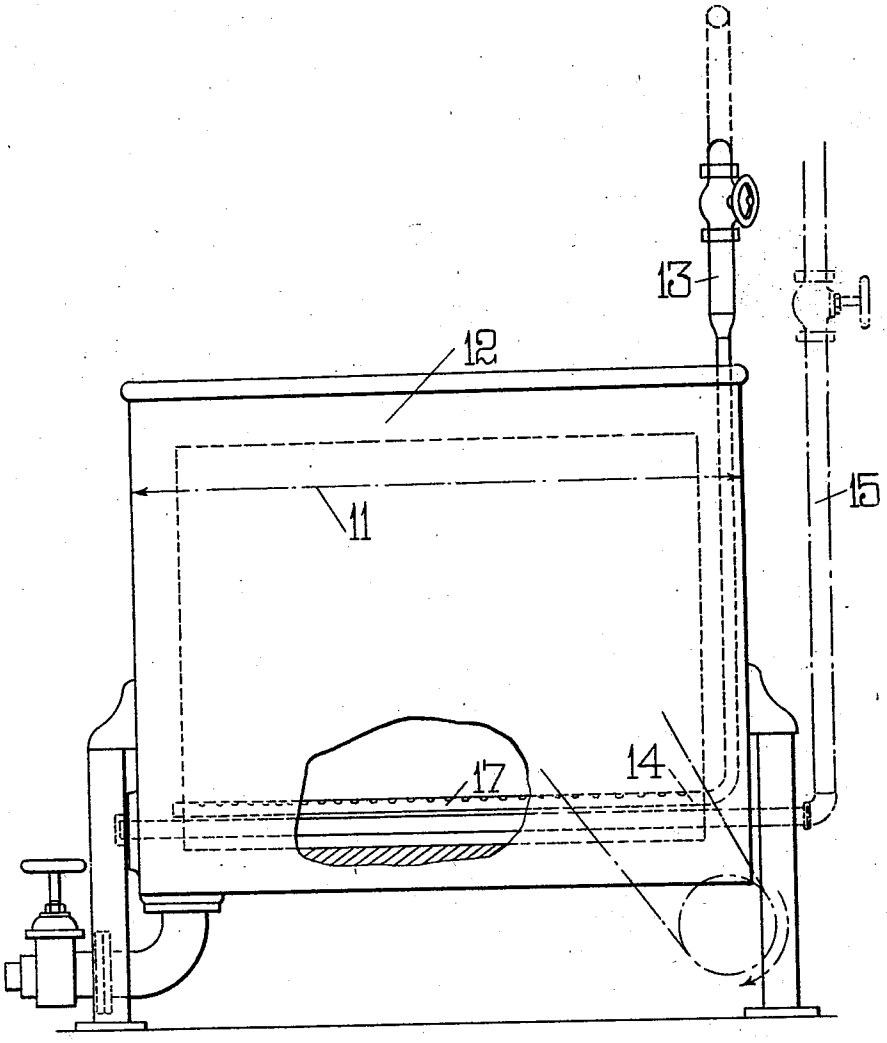

Fig.2.

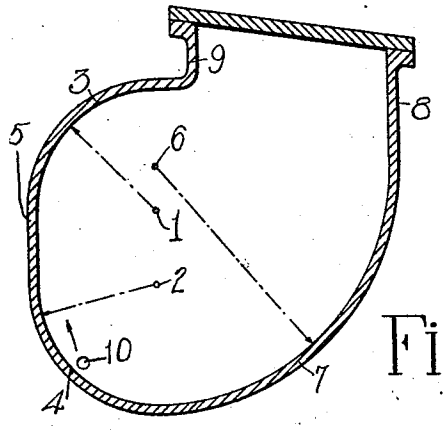

Fig.1

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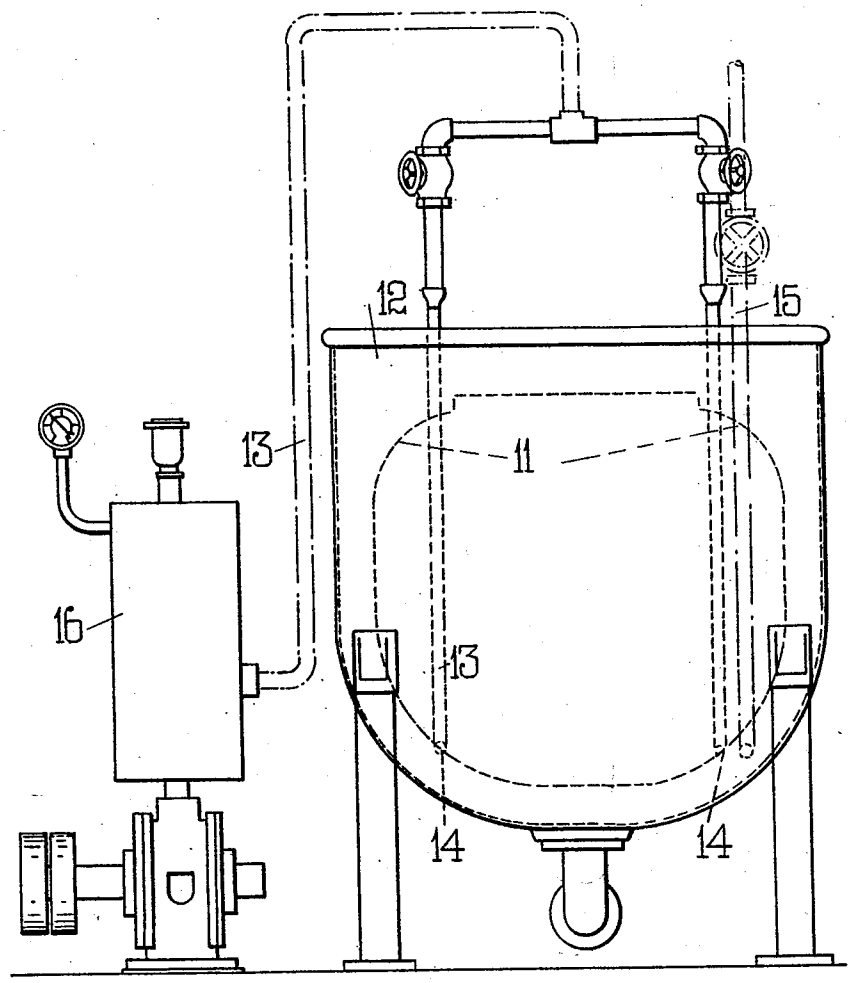

Fig. 3.

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UNITED STATES PATENT OFFICE

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DYEING OF KNITTED AND WOVEN FABRICS

Application filed March 10, 1926, Serial No. 93,667, and in Great Britain July 16, 1925.

The present invention relates to improvements in dyeing machines and more particularly in the dyeing of knitted or woven articles.

Hitherto in methods for dyeing socks, stockings, knitted goods and the like, the goods were immersed in a vat or tank of dye, then moved about from the outside by means of poles. It was later suggested to agitate the liquor by means of injected steam and paddle wheel or the like, but the effect of the steam was to heat up that liquor to an undesirable extent.

According to the present invention agitation or circulation of the dyeing liquor is obtained by means of compressed air passing through it.

The compressed air is further adapted to agitate lift or circulate the material within the dyeing tank in addition to the agitation or circulation of the liquor. The dyeing machine includes a tank or vat the contour of the shell of which is constructed with a view to creating a path for the agitated liquor and material over the whole of the internal space of the tank. It has been found by experiment that a tank of circular cross section is unsuitable in that the stream of compressed air and agitated fluid does not follow completely the curvature of the shell but takes a path of an ellipse having its major axis vertical, the said ellipse covering a portion only of the cross section of the tank. In this way the circulation or agitation current is short circuited i. e. part of the fluid and the material in the tank remains untouched by the stream of fluid created by the compressed air.

Further by the present invention the goods may be arranged within a drum or enclosure mounted within a vat, the drum being perforated preferably at the top and bottom only to allow of circulation through it of the liquor in the vat.

Heating means such as a steam pipe may be provided in the vat exterior to the drum or container for the goods.

Within the drum and preferably arranged in the walls thereof towards its base are one or more pipes having perforations therein, through which compressed air can be passed, so that by this means a circulation of the liquor and with the liquor a continuous circulation and turning over of the goods within the drum is obtained. Suitable control means may be provided on the pipes where one or more are provided so that circulation can be reversed when desired.

The invention is more particularly described with reference to the accompanying drawings in which:—

Figure 1 shows in diagrammatic form the curvature of a tank constructed according to the present invention.

Figure 2 is a view in side elevation of the dyeing machine with the drum shown in dotted lines; in this case the drum has symmetrical sides so that the agitating or circulating fluid may travel either clockwise or anti-clockwise within the drum to prevent the goods becoming entangled. The drum however may be identical in shape with that shown in Figure 1.

Figure 3 is a view in end elevation corresponding to Figure 2.

It has been found by experiment that the most suitable contour of the shell of the vat or tank is as shown in Fig. 1 of the accompanying diagrammatic drawings, which Figure 1 shows a tank in cross section. The length of this is proportional to the desired capacity and has no relation to the height or width of the tank. The basic measurement of the tank is the vertical distance between the points 1, 2. With centre 1 and radius between one and a half times to twice the distance between the points 1 and 2 a curve 3 is described which will form one of the bounding walls of the tank. Similarly the centre 2 and the same radius (whatever radius that may be between the above stated margin) a curve 4 is described. The curves or quadrants 3 and 4 are joined by the portion or wall 5 which is tangential to both curves 3 and 4. Thus the height of the tank is between four to five times the distance between the basic points 1 and 2, while the wall 5 is equal to the distance between the basic points 1 and 2.

With centre 6 and radius between three to four times the vertical distance between the points 1 and 2, the quadrant 7 is described. The point 6 is displaced from the point 1 by an amount equal to the desired radius of the quadrant 7 less the vertical distance between the basic points 1 and 2 and the radius of either of the quadrants 3 or 4. It will be seen that, as the radius of the quadrant 7 is between three to four times the distance between the basic points 1 and 2, whilst the radius of the quadrants 3 and 4 are between one and a half to twice the distance between the basic points 1 and 2, the radius of the quadrant 7 is between one and a half to two and two thirds times the radius of the quadrants 3 and 4.

In the preferred form of construction the radii of the quadrants 3 and 4 are twice the distance between the base points 1 and 2, while the radius of the quadrant 7 is four times the distance between the said basic points that is to say the radius of the quadrant 7 is double that of either of the quadrant 3 or 4, and the height of the tank is five-sixths of the width.

Portions 8 and 9 of the shell are then determined, the portion 8 being a vertical continuation of a path tangential to the quadrant 7 and the portion 9 being in a vertical plane at a distance of between two and a quarter to three and a quarter times the distance between the basic points 1 and 2, or the height of the vertical wall 5. The upper parts of the portions 8 and 9 constitute the loading opening of the vat and it will be noticed that the uppermost part of the section 8 of the shell lies above the horizontal plane tangential with the portion 3 thereby eliminating overflow of fluid within the tank.

One or more inlets for the compressed air are provided at 10, the path of travel of the compressed air being as indicated by the arrow. In this way the liquid and the material within the tank are being lifted while the compressed air is travelling around the portion on the left hand side or circulating curve of the tank shown in the drawings, whilst the material commences to drop after it has reached its uppermost position on the right hand side, i. e. beneath the opening of the tank. The quadrant 7 of the tank is thus termed the dropping curve. In a modified form of construction and in the case where it is desirable to provide two alternate directions of flow of the compressed air for example clockwise and anticlockwise, the dropping curve of the tank is eliminated and a second circulating curve is formed diametrically opposite the first, the two curves being separated by an opening of similar width to that disclosed in the above calculations. In tanks of this type it is possible to pass the compressed air into the tank through one or more orifices 10 whereby the material, dye liquor and compressed air will travel clockwise, and after a given period to close such orifice or orifices and open the other at a corresponding position at the foot of the second circulating curve so that the material, dye liquor and compressed air will travel anti-clockwise. This method of procedure eliminates the possibility of the material becoming entangled.

A further feature of the invention resides in preheating the compressed air, i. e. heating such air prior to its entrance into the tank to contact with the dye liquor. In dyeing knitted or woven articles it is desirable to maintain the dye liquor at a certain temperature dependent upon the particular articles to be dyed. For example in dyeing cotton, silk or artificial silk articles, such as stockings and wool articles the range of temperature within which the dye liquor should be maintained is from 100° F. to 212° F. according to the nature of the colour and kind of material.

By preheating the compressed air it is possible to maintain the temperature within the tank substantially at the desired height or within the desired range.

According to a modified method of heating, in addition to the compressed air orifices and jets, a number of steam jets may be used, the object of these steam jets primarily being to provide a heating means for the liquor up to the desired temperature, or again these steam jets may be used in combination with jets of preheated air. It is of course well known to provide steam jets alone in dyeing tanks or vats, the steam serving the double purpose of heating the liquor and at the same time circulating it. The disadvantage of this known arrangement is that in order to maintain the necessary circulation of the liquir it is impossible to cut off the supply of steam when the desired temperature has been reached and the operator is then faced with the alternative of either increasing the temperature in order to maintain the circulation of the liquor or stopping the circulation of the liquor in order not to exceed the desired temperature.

By providing therefore one or more air jets for the circulation of the liquor and material and one or more steam jets for the purpose of heating the liquor, the heating source may be cut off at will without interfering with the circulation or agitation of the liquor and material.

Further if desired a number of paddles or the like may be utilized as an auxiliary agitating means in conjunction with the supply of compressed air.

In the construction according to Figures 2 and 3 the goods to be treated are placed

within a drum 11 mounted within a vat 12 the drum being perforated preferably at the top and bottom only to allow of circulation through it of the dye liquor within the vat. This drum may however be shaped similar to the vat shown in Figure 1 if desired.

The air supply pipe is shown at 13 this supply of air passing from an air receiver 16 and entering the drum at the base thereof, namely, at the parts 14. The horizontal portion 17 of the air supply pipe situated within the drum 11 is perforated throughout its length to promote agitation of the liquor within the drum.

Heating means such as a steam pipe 15 are provided in the vat such heating means 15 being situated exterior of the drum 11 within which the goods are placed.

The apparatus may be used solely with the air pipes, or alternatively with the steam pipes and further still with both pipes so that the air supply may be used for agitation purposes the steam supply for heating purposes.

By such an arrangement, i. e., the provision of a drum within the vat, it is possible to insert fresh dye within the vat and externally of the drum, to renew the strength of the dyeing liquor, without destroying the homogeneity of the dye liquor circulating immediately adjacent the goods.

It will also be seen that in the above described arrangement a circulation of the goods can be obtained which may be quite independent of the heating of the liquor. Further fresh dye stock can be introduced, and only gradually will pass to the goods, as this extra dye stock can be introduced into the exterior vat, and will then progressively and gradually percolate into the liquor within the perforated interior drum, when it has become thoroughly mingled and distributed with the vat liquor.

A further advantage is that as the liquor will tend to froth, this froth will pass through the perforation in the drum to the exterior, so that the goods within the drum are maintained immersed in liquor and the froth does not thereby interfere with their effective turning over and circulation.

A further advantage is that the heating can be applied quite independently of the circulation means.

It will be noted that in each instance a pool of dyeing liquor is provided in a substantially unobstructed vat, this pool having dimensions of the same order in the vertical direction and in a horizontal direction, that is, in Figs. 1 and 3, the height of the tank is substantially equal to its width. The goods are immersed in this pool of liquor and the body of the liquor with the goods therein is caused to rotate by the introduction of compressed air beneath the body of liquid adjacent one side of this body, so that the entire body of liquid and goods are caused to revolve without the production of eddies or stagnant points in which dyestuffs may accumulate or become impoverished whereby it produces a different dyeing effect than the main rotating body of the liquor.

We declare that what we claim is:—

A method of dyeing knitted, woven or the like articles consisting in providing a pool of dyeing liquor, immersing the articles in the liquor, and alternately introducing air into the body of liquor at opposite sides of the pool whereby to produce successive rotation of the body of liquor and articles immersed therein in opposite directions.

In witness whereof, we have hereunto signed our names this 23rd day of February, 1926.

CHARLES CALLEBAUT.
JULIEN DE BLICQUY.