Jan. 15, 1929.

1,698,778

F. W. CLARK

APPARATUS AND PROCESS FOR DYEING

Filed Jan. 21, 1925

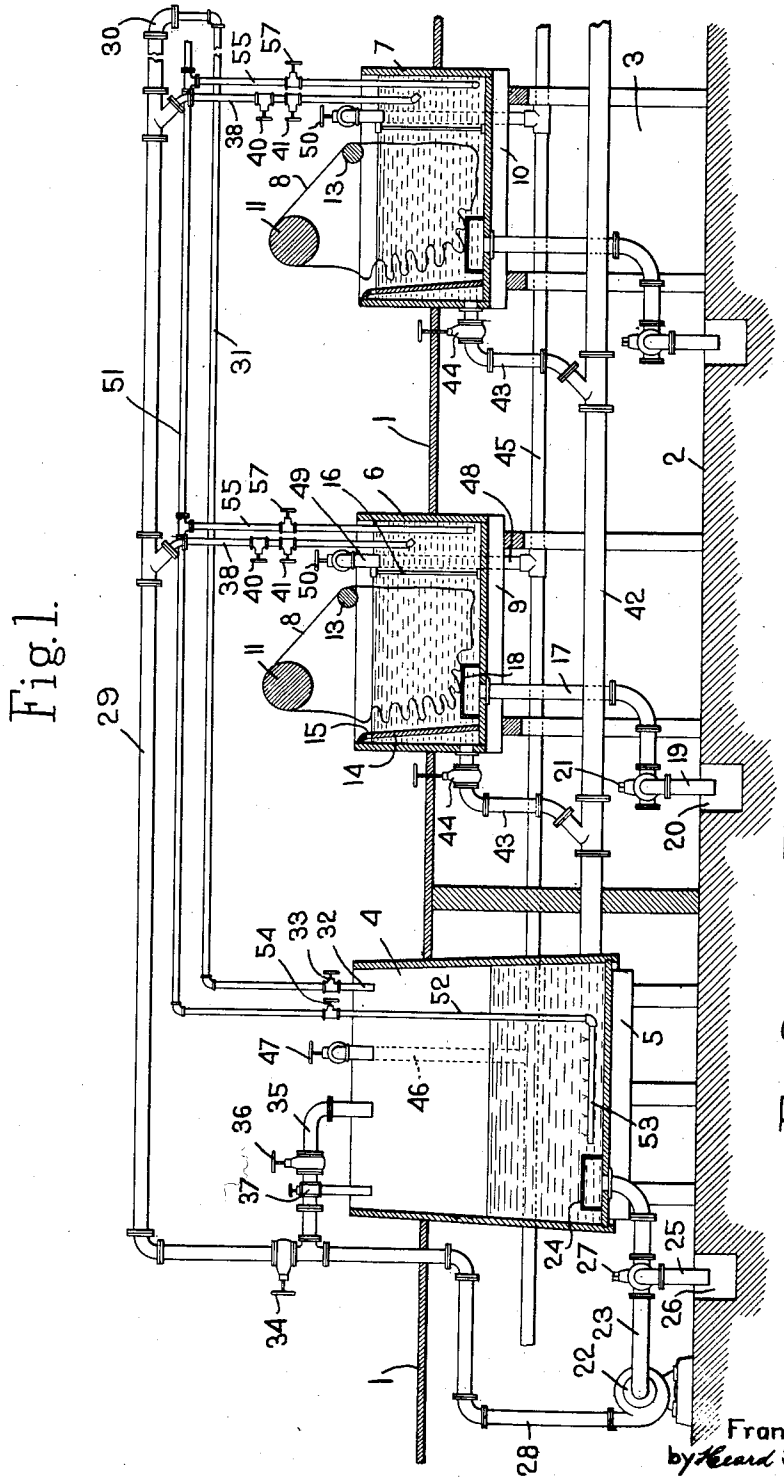


Fig. 1.

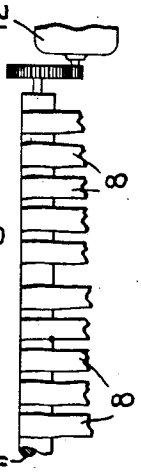


Fig. 4.

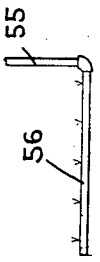


Fig. 3.

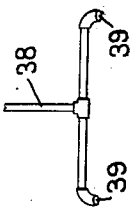


Fig. 2.

Inventor.
Frank W. Clark
by Heard Smith & Tennant.
Attys.

Patented Jan. 15, 1929. 1,698,778

UNITED STATES PATENT OFFICE.

FRANK W. CLARK, OF SANFORD, MAINE.

APPARATUS AND PROCESS FOR DYEING.

Application filed January 21, 1925. Serial No. 3,714.

This invention relates to an apparatus and a process for dyeing a large quantity and particularly a large number of articles.

One of the principal objects of the invention is to enable a large number of articles such, for example, as a large number of similar pieces of fabric to be dyed to precisely the same shade. While theoretically a single dye tub may be made of any size, there are practical and economical limitations, so that as a result it is found desirable to restrict the size of a dye tub. But when the number of articles to be dyed is larger than the capacity of a single dye tub so that several tubs are required, it is found to be extremely difficult and practically impossible to produce precisely the same shade of color in the articles dyed in all of the different tubs. It is frequently a matter of great importance that the shade shall be precisely the same. For example, at the present time it is not uncommon for an automobile manufacturer to superimpose fifty "pieces" of upholstery fabric and cut them up simultaneously. It is obvious that all these fifty pieces must be of the same shade or discrepancies of shade will be likely to appear in the upholstery of the cars.

The present invention presents an apparatus and a process which not only enables practically any desired number of articles readily and easily to be dyed to the same shade, but also one which may be employed for dyeing any less number and for dyeing to different shades and colors. In other words, a very flexible system is presented by this invention which is adaptable to a wide range of work. This system enables the particular object of dyeing a large number of articles to the same shade to be secured without a large capital outlay for that particular purpose, because the main units of the apparatus are available for use independently.

The object of the invention is further to provide an apparatus and process for the dyeing by groups of a large number of articles in which the conditions of temperature and circulation of the dye liquor with respect to the articles are independently controllable with respect to each group.

The nature and object of the invention will appear more fully from the accompanying description and drawings and will be particularly pointed out in the claims.

The drawings illustrate in a form which is largely diagrammatical a simple and preferred type of apparatus embodying the invention and adapted to carry out the process of the invention as applied to the dyeing of a large number of "pieces" of fabric.

In the drawings:

Fig. 1 is a view in elevation and largely in vertical cross section showing the entire apparatus with duplicate portions thereof broken away.

Fig. 2 is an end elevation of the lower end of one of the supply branches.

Fig. 3 is an end elevation of the lower end of one of the steam outlets.

Fig. 4 is an end elevation of a portion of one of the reel mechanisms.

The general nature and scope of the invention will be best understood by the description of a simple, practical and preferred form of apparatus for dyeing a large number of similar "pieces" of fabric. Such "pieces" are usually somewhat over forty yards in length and of one of the standard widths.

As illustrated, the floor 1 of the dye house is shown located well above the foundation 2 so as to provide between a basement chamber 3. This enables the various tanks and tubs to be set at such a level as to be readily operated from the dye house floor 1.

One feature of the apparatus resides in the master mixing tank 4. This is built of suitable material, preferably wood, supported at the bottom upon a platform 5 and of ample size.

Another important feature of the apparatus resides in the unit dye tubs, of which two are shown at 6 and 7. But there may be as many of these dye tubs as required. They should all be of such size as to be readily available for independent pieces of dye apparatus. In the illustration, each tub is assumed to be of a capacity to hold ten pieces of material 8, as indicated in Fig. 4. There is practically no limit to the number of these individual units or dye tubs that may be employed, provided the master mixing tank is made of sufficient capacity.

The dye liquor is mixed in the tank 4, but as the several tubs are filled with water, as is usual at the beginning of the dyeing operation, it is only necessary for the tank to have a capacity sufficient to take care of the circulation hereinafter described. It will be observed, therefore, that the master mixing tank does not have to be increased materially in size with additional units, nor does it have

to equal in capacity the total capacity of the tubs. It is sufficient only that the master tank have a capacity such that will enable the required circulation through the tubs to be maintained.

The tubs 6, 7, etc., are mounted upon platforms 9 and 10 so that the tubs preferably stand on the same level as the tank 4. Where such articles as pieces of fabric are to be dyed, suitable means are provided in each tub for circulating the articles through the dye liquor. Such means may be of the usual type, as, for example, a reel 11 mounted above the tub, driven by a motor 12 geared to the reel. A suitable idler roll or bar 13 guides and separates the pieces. Each tub, in the illustrated case, is provided with a separate motor 12, thus enabling the speed of the reel to be controlled and thus affording a means whereby the speed of circulation of the pieces may be adjusted to be the same in all the tubs.

Each tub is preferably divided into three compartments by the solid partition 14 having the overflow opening 15 and by the grill 16. The compartment to the right of the grill 16 is provided to receive the water, dye liquor and steam admitted to the tub and thus prevent the agitation resulting therefrom extending with full force into the body of the tub. The partition 14 determines the level of the dye liquor in the tub and consequently the quantity of the dye liquor in which the articles are submerged and circulated. The dye liquor is drawn off from the compartment formed at the left of this partition.

Each tub is provided with a suitable drain shown as a pipe 17 tapped into the bottom of the tub and covered by a strainer 18. This pipe has an outlet 19 over a drain or sewer 20 and is opened and closed by a valve 21.

An important feature of the invention resides in the circulation of the dye liquor. In the construction illustrated, a suitable suction pump 22 is mounted adjacent the tank 4. A supply main 23 leads from the bottom of the mixing tank 4 to the pump and is covered at its outlet from the tank by the strainer 24. This branch of the supply main is also conveniently utilized when required to drain the tank. For that purpose it is provided with an outlet section 25 opening over a drain or sewer 26, and with a valve 27 by means of which this outlet section may be shut off or opened. The supply main continues at 28 from the pump up through the floor 1 and in a long run 29 above the series of tubs. Its extreme end 30 is preferably connected to an auxiliary return pipe 31 which discharges at 32 into the tank 4 and is provided with a shut off valve 33. This auxiliary return pipe prevents any "dead end" in the supply main and serves to equalize the flow.

The supply main is provided with a shut-off valve 34 and directly below this valve with a branch 35 opening from the supply main into the tank 4. This branch 35 is provided with a shut-off valve 36 which is closed when the dyeing operation is proceeding. A relief valve 37 is conveniently located in the branch 35 so that if the pressure exerted by the pump becomes too great, the valve will open and allow the circulating liquor to discharge into the tank 4.

The supply main 29 is provided opposite each tub with an outlet branch 38 opening into the compartment of the tub to the right of the grill 16. This branch at its lower end is preferably shaped as shown in Fig. 2 so as to have two discharge openings 39 pointed away from the center of the tub. A throttle valve 40 in each branch enables the rate of flow through the branch to be regulated or adjusted accurately. A shut-off valve 41 in each branch enables the flow through the branch to be shut off without disturbing the regulating valve 40. A return main 42 extends through the basement chamber 3 beneath all the tubs and discharges into the tank 4. This return main is connected by branches with each tub. The return branch 43 opens out from the chamber at the left of the partition 14 in each tub so as to take the liquor overflowing from the main compartment of the dye tub. Each return branch is provided with a shut-off valve 44.

It will be seen that the supply main 23, 28, 29 extends from the master tank past the series of dye tubs and that the return main 42 extends past the series of dye tubs to the tank and that the dye tubs are connected, by means of the supply branch pipes 38 and the return branch pipes 43, in parallel between and to said supply and return mains. Consequently, when the pump is in operation, the circulation takes place through the supply main, thence through the several tubs to the return main and thence through the return main to the tank.

Means are provided for introducing water into the tank and into the several tubs. For that purpose a water main 45 extends through the basement and is provided with a branch 46 having an outlet over the top of the tank controlled by a valve 47 and with a branch 48 at each tub having an outlet 49 over the top of each tub controlled by a valve 50.

Suitable means are also provided for heating the water or dye liquor in the tank and tubs. This is conveniently secured by injecting steam into the liquor. For this purpose a steam main 51 extends above the tank and series of tubs. A branch 52 extends into the tank 4 and is provided with a spray section 53. This branch 52 is provided with a valve 54, by means of which the amount of steam admitted to the tank, and consequently the temperature of the liquor in the tank, may be controlled.

A branch 55 from the steam main extends into each tub and is provided at its lower end with a spray section 56 as shown in Fig. 3. Each of these branches is also provided with a regulating valve 57 by means of which the flow of steam, and consequently the temperature, can be accurately regulated.

It will be noted that the water outlet 49, the branch 38 from the circulating main, and the branch 55 from the steam main all enter the chamber in the tub at the right of the grill 16 so as to prevent, so far as possible, agitation of the main body of liquor in which the articles to be dyed are located.

Assuming now that it is desired to dye a large number of pieces of fabric to the same shade, the required number of tubs are provided and in each tub is mounted a given number of pieces. In the particular apparatus illustrated, each tub would have ten pieces.

The dye liquor is then mixed in the master mixing tank 4. In order to circulate and mix throughly the ingredients of this liquor, the shut-off valve 34 is closed and the valve 36 opened and the pump set in motion. This causes a circulation from the tank through the main 23 and 28, through the branch 35 back into the tank. The required amount of water is added through the water branch 46 and the liquor brought to the required temperature by the introduction of steam through the pipe 52.

In the meantime each tub is filled with cold water from the pipe 49 and the reels 11 set in motion to circulate the pieces through the water.

Next the valve 36 is closed and the valve 34 opened. This opens the circulatory system and at once the dye liquor in the master mixing tank 4 begins to circulate through the supply main, thence through the supply branches into the several tubs, mixing with the water in the tubs, and thence the mixture passes out through the return branches into the return main and back into the mixing tank. As this circulation proceeds, the conditions in the several tubs are equalized. In the first place, the quantity of liquor present in each tub is maintained at a predetermined, and preferably at the same, amount by reason of the overflow 15 in the partition 14, which regulates the height of liquid in the tub. In the second place, the rate of flow of the liquor from the supply main into each tub is controlled by the valve 40, so as to be the same at each tub. In the third place, the temperature conditions in each tub are controlled by means of the valve 57 in the branch 55 from the steam main, and preferably controlled so as to be the same in each tub.

In the preferred form of the invention where all the articles are to be dyed to the same shade, these controls are arranged so that there shall be the same quantity of dye liquor in each tub, the same rate of flow into each tub and the same temperature conditions in each tub. Under these circumstances the circulation of the dye liquor through the system causes the same conditions to be present in each tub. Steam injected in the tank and tubs to produce the required temperature condenses, but the resulting dilution is equalized throughout by means of the circulation. The rate of circulation should be such that the total quantity of liquor in the apparatus shall circulate through the complete cycle a plurality of times during a given dyeing operation. It has been found, for example, that in a dyeing operation requiring about an hour, from eight to ten complete cycles of circulation produce most satisfactory results.

The invention produces an apparatus and presents a process of great flexibility. Practically any number of dye tubs may be employed so that the total number of articles dyed at the same time to the same shade may be as many as required.

Each dye tub is an independent unit and may be cut out from the system and used independently in the usual manner that such tubs are used. All that it is necessary to do is to close the valves 41 and 44. Then the dye may be mixed and used in the individual tub.

While the invention is illustrated particularly in relation with piece dyeing, stock, various materials or articles may be dyed by proper location of the overflow and adjustment of the conditions.

In the process of this invention by which a large number of articles may readily and expeditiously be dyed to the same shade, it will be seen that a master pool of dye liquor is maintained in the tank 4 and that the tubs contain baths of dye liquor of a predetermined depth. In these baths the articles to be dyed are circulated by groups, that is, one group in each bath. A constant circulation of the dye liquor is maintained from the pool at an equal rate through each bath and then back to the pool, and preferably this rate of circulation is such that the total quantity of dye liquor in the pool and baths circulates through the complete cycle a plurality of times during the dyeing operation.

An essential element of the apparatus is means for equalizing the flow of the dye liquor so that the flow is at exactly the same rate through the several tubs, said means being embodied in the throttle valves 40, in the outlet branches 38. I am enabled by thus equalizing the flow of the dye liquor to cause a uniform concentration of the coloring matter in the dye liquor on the articles contained in the several tubs, so that all of the articles are dyed precisely alike, or to the same shade. In practice I experimentally adjust the valves 40 before the dyeing operation, until it is known that the liquor is entering the

several tubs at the same rate. When the desired adjustment is attained, the valves 40 are allowed to remain in their adjusted positions, and the dyeing operation proceeds as above described.

It is to be noted that, according to the present invention, when a plurality of pieces of fabric or similar sheet goods are being dyed, the sheets are progressively passed through each of the baths of dye liquor while a continuous movement or flow of the dye liquor is produced in each of the baths in a direction non-parallel to the direction of travel of the sheets. As shown on the drawing, the sheets are passed or propelled through the baths with stretches or portions thereof maintained substantially vertically while a movement of liquor is produced substantially horizontally across the sheets. This causes the liquor to pass through the openings and interstices of the fabric and at the same time to produce a uniform impregnation and dyeing of its constituent yarns, dyeing conditions being maintained substantially uniform as the total quantity of dye liquor passes from the master pool through the baths a plurality of times while the sheets are being passed therethrough during a dyeing operation.

Having thus described the invention, what is claimed as new, and desired to be secured by Letters Patent, is:

1. An apparatus for dyeing a plurality of articles, comprising a master mixing tank, a supply main from the master tank, having a plurality of branches, a plurality of dye tubs open to the atmosphere and arranged to receive dye liquor from said branches, a return main connected with the master tank and having branches connected with the several tubs, means for circulating dye liquor from the tank through the supply main, its branches, the tubs, the return main branches, and the return main, back to the tank, and means having provisions for moving the liquor horizontally through the tubs, and independently regulable valves in the supply main branches for equalizing the flow of the dye liquor through said supply main, its branches and the tubs, so that the coloring matter is uniformly concentrated on the articles in the several tubs.

2. An apparatus for dyeing a plurality of articles, comprising a master mixing tank, a supply main from the master tank having a plurality of branches, a plurality of dye tubs open to the atmosphere and arranged to receive dye liquor from said branches, a return main connected with the master tank and having branches connected with the several tubs, means for circulating dye liquor from the master tank through the supply main, its branches, the tubs, the return main branches, and the return main, back to the master tank, said means having provisions for moving the liquor horizontally through the tubs, means for equalizing the flow of the dye liquor through said supply main and its branches, and the tubs, so that the coloring matter is uniformly concentrated on the articles in the several tubs, and means for maintaining a predetermined depth of dye liquor in each tub, the supply main branches communicating with one end of the storage spaces in the tubs, while the return main branches communicate with the opposite ends of said spaces, so that the liquor maintained at a predetermined depth, is adapted to flow horizontally across articles supported in intermediate portions of the tubs.

3. A process of dyeing articles in a plurality of dye baths to a uniform shade, which comprises maintaining a master pool of dye liquor in independent circulatory communication with each of the dye baths, and while the articles are immersed in the dye baths causing circulation of the liquor through the baths at a rate ensuring the recirculation of the total quantity of liquor from the master pool through the baths a plurality of times during a dyeing operation, thereby maintaining substantially uniform dyeing conditions in all the baths.

4. A process of dyeing articles at elevated temperature in a plurality of dyeing baths to a uniform shade, which comprises maintaining a master pool of dye liquor in independent circulatory communication with each of the dye baths, injecting steam directly into the dye liquor to maintain it at elevated temperature, and while the articles are immersed in the dye baths causing circulation of the liquor through the baths at a rate ensuring the recirculation of the total quantity of liquor from the master pool through the baths a plurality of times during the dyeing operation, thereby maintaining substantially uniform elevated temperature dyeing conditions in all the baths.

5. A process of dyeing a plurality of sheets of fabric to a uniform shade, which comprises maintaining a master pool of dye liquor in circulatory communication with a bath of dye liquor, passing the sheets progressively through the bath of liquor, and while the sheets are being passed therethrough circulating the total quantity of dye liquor several times from the pool through the bath during the dyeing operation, thereby ensuring substantially uniform dyeing conditions during the operation.

6. A process of dyeing a plurality of sheets of fabric to a uniform shade in a plurality of dye baths, which comprises maintaining a master pool of dye liquor in independent circulatory communication with each of the baths of dye liquor, passing the sheets progressively through the baths of liquor, and while the sheets are being passed therethrough producing a continuous movement

of the liquor through each of the baths in a direction non-parallel to the direction of travel of the sheets and at the same time circulating the total quantity of liquor several times from the pool through the baths during a dyeing operation, thereby ensuring substantially uniform dyeing conditions during the operation.

7. A process of dyeing a plurality of sheets of fabric to a uniform shade in a plurality of dye baths, which comprises maintaining a master pool of dye liquor in independent circulatory communication with each of the baths of dye liquor, passing the sheets progressively through the baths of dye liquor with stretches thereof maintained substantially vertically, and while the sheets are thus being passed therethrough producing a continuous movement of the liquor through each of the baths substantially horizontally across the sheet and at the same time circulating the total quantity of dye liquor several times from the pool through the baths during a dyeing operation, thereby ensuring substantially uniform dyeing conditions during the operation.

In testimony whereof, I have signed my name to this specification.

FRANK W. CLARK.