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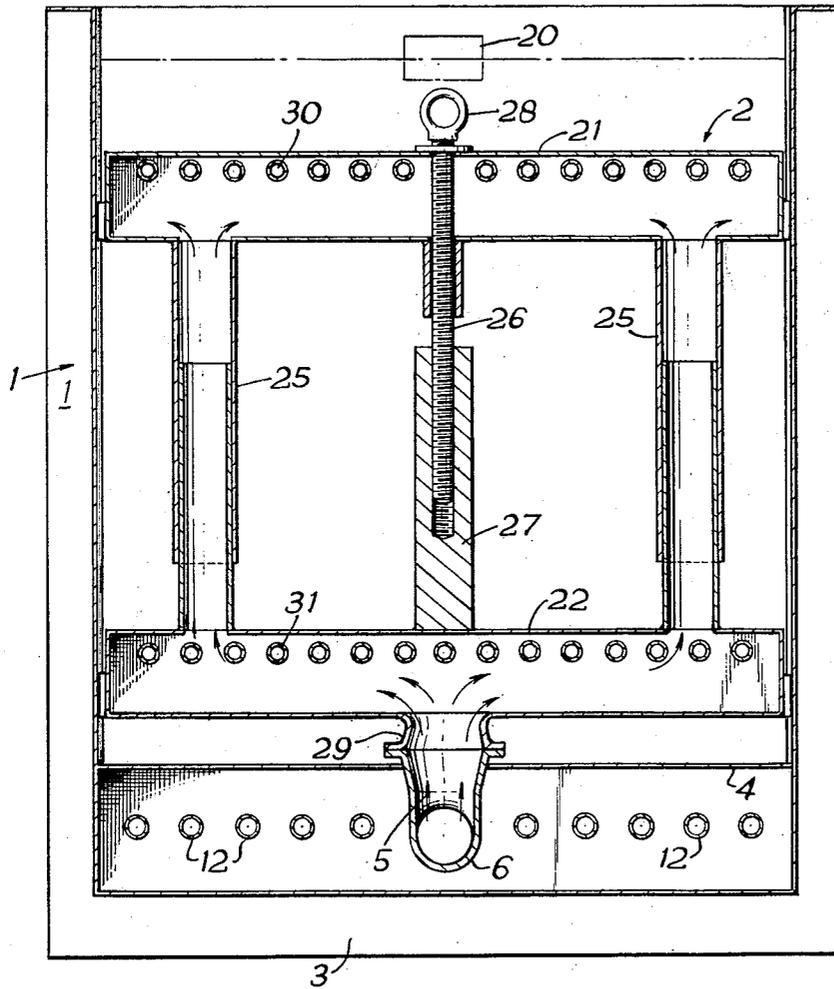
G. S. HELLIWELL  
HANK DYEING MACHINES

3,159,992

Filed Aug. 5, 1960

4 Sheets-Sheet 1

Fig. 1.



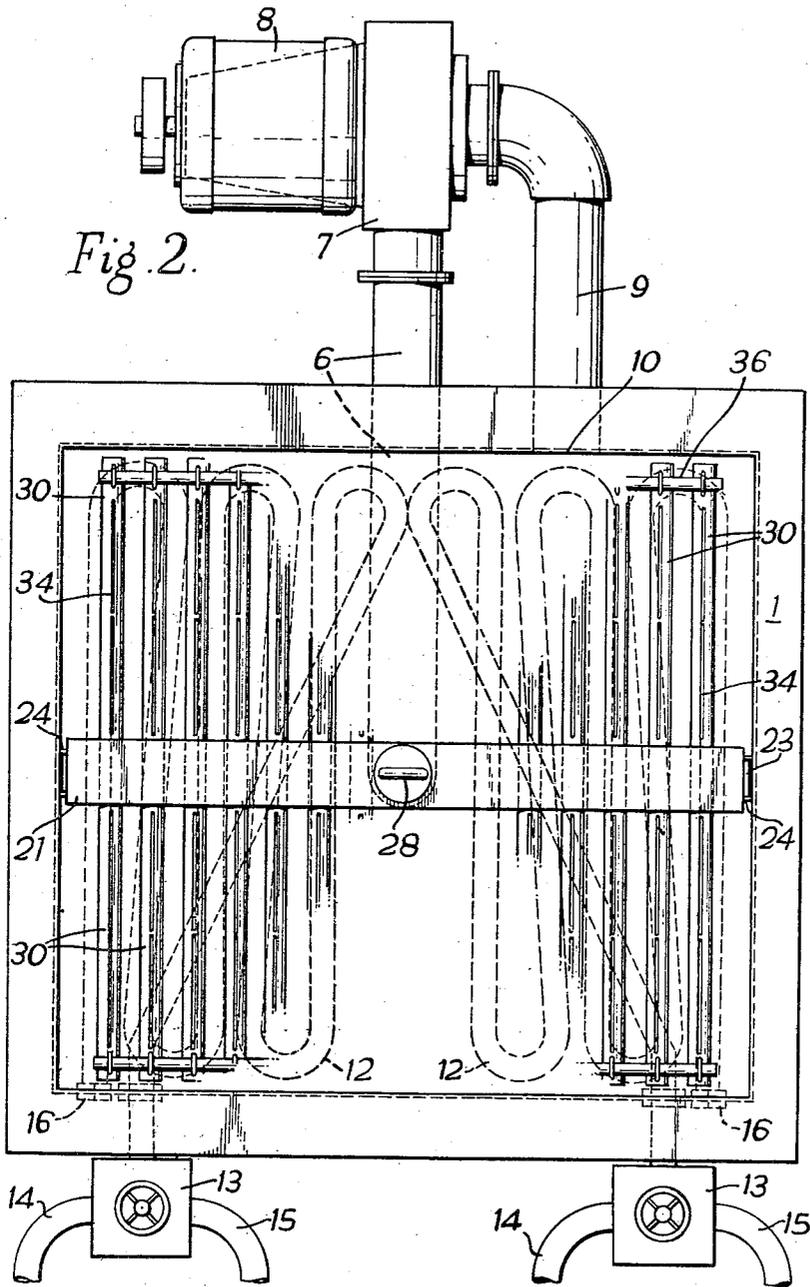
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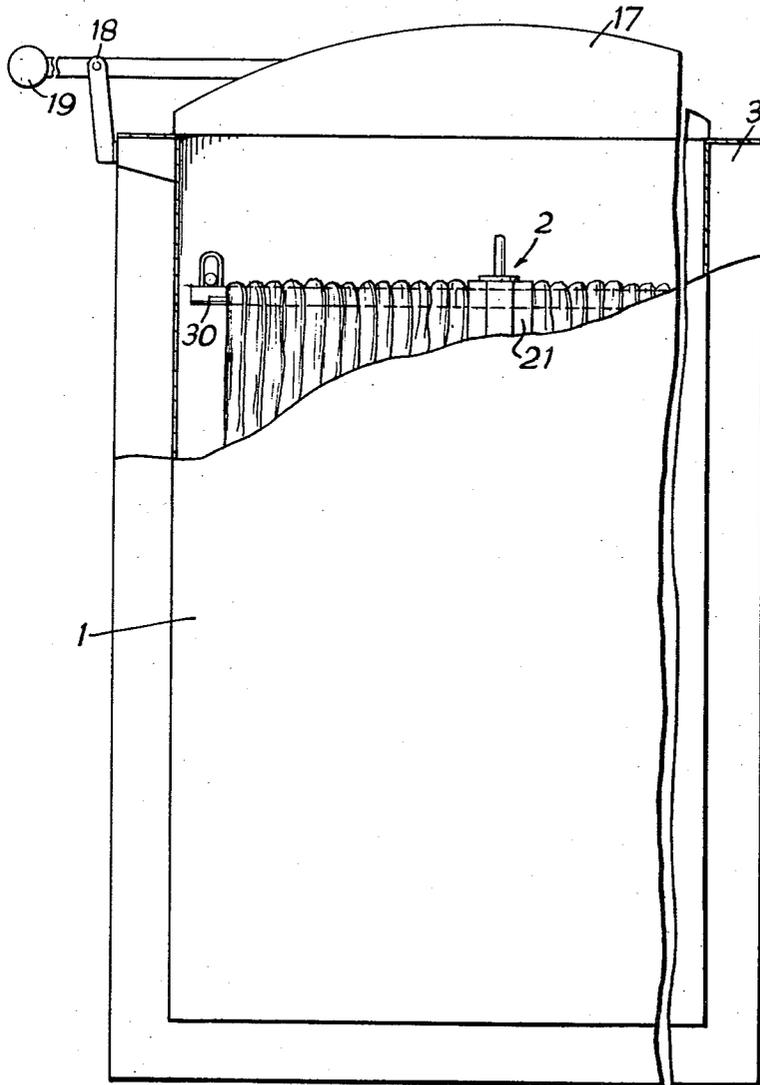
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Fig. 3.



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Fig. 4.

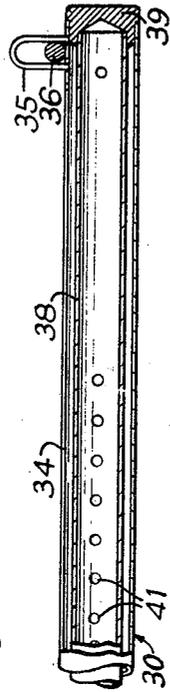
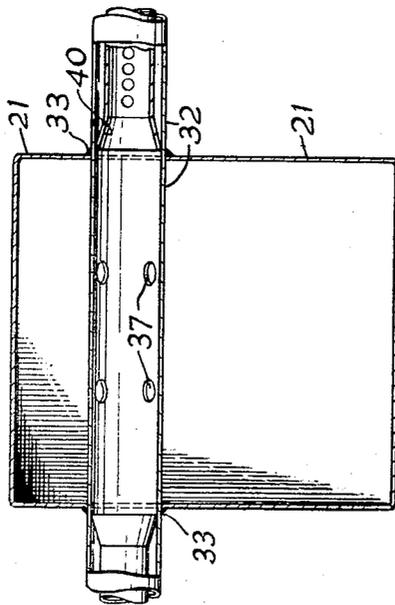
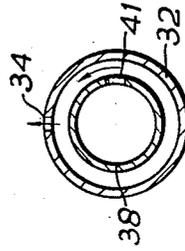


Fig. 5.



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## HANK DYEING MACHINES

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2 Claims. (Cl. 68-206)

This invention relates to the art of hank dyeing, i.e. that in which hanks of yarn are looped over poles or equivalent arms in the dyeing chamber of a vat or like vessel and are subjected to the action of dyeing liquor circulated through the chamber.

In conventional dyeing machines of this character the hanks to be dyed are looped over poles which are detachably mounted on supports on the walls of the dyeing vat, or of a removable frame in this vat, so that the poles span the width of the vat. In practice there is at least one set of upper poles and usually a corresponding set of lower poles, and each hank is looped around one pole of each set.

One of the great drawbacks of prior methods and machines lies in the difficulty of achieving uniformity in the dyeing, and this is particularly true of the parts of the hanks which rest on the poles. Direct access of the liquor to the inside bends of these parts is practically prevented by the poles and, primarily at any rate, these inside bends are dyed by percolation of liquor through the thickness of the hank.

Again, in the case of many synthetic yarns, it has been found that the appearance and uniformity of texture is impaired due to a flattening at these bends under the effect of the weight of the hank applied at this part. This effect is further promoted by reason of the slower cooling of the poles (usually metal) than the dyeing liquor itself in the latter stages of hot dyeing processes and as a result of the consequent temperature differential between the fibres contacting the hotter poles and the remainder.

In overcoming these drawbacks, in a method presented by the present invention each hank is fully submerged in a draped condition in a body of dyeing liquor during its treatment but is maintained, in effect, in a floating condition in this body by controlled application of infed dyeing liquor upwardly against the upper inside bend of the draped hank.

It is found that this technique, means for the accomplishment of which will be described below, will avoid the faulty dyeing of the hank and the chance of a blemished appearance at the upper inside bend for any of the reasons specified above, allied with a more rapid dyeing time than that required in conventional methods.

A sine qua non of hank dyeing is that all the hanks dealt with shall be of uniform tone, irrespective of their particular dispositions in the chamber of the vat or vessel during the dyeing operation. Since the hanks are usually hung in rows across the width of the dyeing vessel and are therefore variously spaced from the liquor entry into the dyeing chamber, it is necessary to prolong the dyeing until such time as the depth of colour or tone is the same in all the hanks, or to use expensive and elaborate means aimed at uniform distribution of the liquor in the chamber.

To remedy these inconveniences, in accordance with a further feature of the present invention there is a controlled distribution of liquor from a central source to form a longitudinally- and uniformly-spread upsurge of liquor against the inside bends of the or each row of side-by-side draped hanks to produce a uniform lifting and "floating" of these hanks as described, and a homogeneous dyeing throughout the chamber. Again, advantageous means to accomplish this object are disclosed in

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the ensuing description of a specific form of dyeing machine in accordance with the present invention.

The invention also includes a dyeing machine, which has the object of suppressing the detrimental factors as far as possible and allow hanks to be dyed quickly and economically, and with a high degree of uniformity of tone.

To this end, the machine is equipped, in the dyeing zone thereof (which in most instances is represented by the major part of the interior of the dyeing vessel), with at least one hank support which is furnished with at least one liquor outlet which can communicate with a dyeing liquor feed and can thereby introduce the liquor positively and directly to the inside loop of a hank slung on this support.

In practice the machine according to this invention advantageously has a hank-supporting structure with a plurality of perforated arms on which hanks are supported for dyeing and through which dyeing liquor can be expelled into the immediate vicinity of the individual hanks particularly at the parts of the latter which are draped over the arms when the structure is loaded.

Advantageously there will be registering upper and lower arms to take each hank (in practice to take a set of side-by-side hanks) and, to make maximum use of available space there will be at least one set of upper arms and a corresponding set of lower arms. These corresponding arms will, moreover, be spaced so that the hanks (which are of standard lengths) will be looped fairly loosely on the arms whereby, in the course of the dyeing treatment the hanks will be lifted away to some extent from the supporting arms by the impulsion of liquor issuing from the arms, this "floating" effect enabling the liquor to commingle directly with the fibres of the yarn or with the filaments at the inside of the "loop" in the hank. The lower arms will serve to control the shifting of the hanks and, since the hank loop does not tend to contact them tightly, need not be perforated.

To allow for adaption of the spacing of corresponding upper and lower arms to different hank lengths, the hank-supporting structure will best be of adjustable height, for example comprise telescopically-adjustable parts.

Again it is preferred that the arms shall be fixed in the hank-supporting structure. In the first place this has the advantage over the "removable hank pole" system that the practical nuisance of trapping yarn lengths between poles and their mountings, which often occurs in loading and unloading the hanks and produces blemishes in the dyed product, is eliminated. Secondly it lends itself to a most convenient arrangement in which the arms, or at any rate the upper ones, are hollow or bored, and communicate with the main members of a hollow supporting structure (being fixed to the latter), whereby the liquor flowing out of the arms can be rationally and conveniently distributed.

The form of the supporting structure will, of course, be suited to the dyeing vessel in which this system is employed. In the case of the conventional dyeing vat of quasi-rectangular cross-section, for instance, the supporting structure and its arms may be of a corresponding cross-sectional shape leaving sufficient all-round clearance in the vessel for introduction and removal from the latter of a structure loaded with hanks.

Such a structure will advantageously comprise parallel upper and lower, medial, longitudinal headers each in the form of a hollow duct and serving as a spine from opposite sides of which the arms extend. These headers may be connected by one or more telescopic uprights, and again this or these may be hollow for the passage of dyeing liquor from a suitable source, e.g. from a bored mount in the bottom of the dyeing vessel.

As has been indicated, the liquor flow is preferably produced through supporting arms such as have been described. Moreover, the aim being primarily to distribute the inflowing liquor as uniformly as possible, to apply a "floating" effect to the hanks, and to give each and every hank a direct individual flushing, the perforations in the arms will conveniently consist of a row of small holes distributed over the length of the arms or in other patterns, an elongated slot, or a combination of these ideas.

In a preferred arrangement, however, at least the upper set of arms are in the form of composite members which have the liquor-outlet perforations in an inner tube surrounded, with a clearance, by an apertured sleeve which presents the outer surface proper of the arm and forms the support on which the hanks are looped and carried.

The outer sleeve, which itself is conveniently of cylindrical form and concentric with the inner tube, is apertured to allow for an appropriately directed application of the liquor to the hanks, and in a preferred arrangement this aperture takes the form of at least one longitudinal slot which gives, in effect, an elongated upward surge of liquor from the composite arm during dyeing. This slot will, of course, best be disposed at the crown of the sleeve, but slots at other positions could be employed to promote the required effect.

Further to militate against the production of turbulence in the liquor flow from the arms, the perforations in the inner tube are conveniently angularly offset from the slots(s) in the outer sleeve in relation to the longitudinal axis of the arm. With the slot(s) arranged at the crown of the outer sleeve, the perforations in the inner tube will conveniently be arranged so that they open in a horizontal direction.

In order to achieve the further object mentioned above of obtaining a uniform outflow of liquor into commingling contact with the several hanks on an arm, and to obtain a smooth and uniformly "spread" flow of liquor from the upper slot in the sleeve, the perforations in the inner tube, if they are of equal size, are preferably arranged at graduated distances from the feed inlet of liquor into the tube, i.e. the "root" of the arm concerned in the parent header or duct.

The inner tube may be removably mounted, for example with a push fit, in the outer sleeve so that it can be removed therefrom for cleaning, inspection or other purposes, without any difficulty.

An example of a dyeing machine constructed in accordance with the present invention is illustrated in the accompanying drawings, in which:

FIGURE 1 is a vertical cross section through the machine.

FIGURE 2 is a plan view of this machine.

FIGURE 3 is a side view of the same partly broken away.

FIGURE 4 illustrates an upper hank-supporting arm used in this machine, and

FIGURE 5 is a cross section through the arm illustrated in FIGURE 4.

The machine illustrated basically comprises a rectangular tank or casing 1 and a hank-supporting structure, generally denoted 2 which is mounted therein for the dyeing operation, but can be removed for loading and unloading hanks of yarn.

The tank or casing 1 is of box form and provided with reinforcing flanges 3 on which, inter alia, is supported on the ground. Internally it is furnished with a fixed false bottom 4 in which is disposed a fixed hollow elbow 5 connected to a pipe 6 which extends out through a bottom wall of the casing and is connected to the delivery side of a pump, in a housing 7, which is driven by a motor 8 and has its suction side connected through a conduit 9 to an opening 10 in the wall of the casing 1. The pump 7 is used for re-cycling dyeing liquor through the dyeing chamber defined by the casing 1, and dye to control the

colour is introduced into the casing in any of several manners well known in the art. Also installed in the bottom of the casing, below the floor 4, is a serpentine tubular system in two parts 12, 12 of which the coils cover substantially the full area of the bottom of the casing. A valve 13 is disposed at the inlet end of each of the serpentine pipes 12 and provides for alternative connection through pipes 14 and 15 for steam and cold water supplies respectively. The opposite ends 16 of the serpentine 12 are similarly connected to steam and water disposal units, e.g. through further valve means (not shown). These further units may, in fact, be associated with the pipes 14 and 15 thereby allowing for continuous circulation of steam or cold water (as the case may be) through the serpentine windings. In any event the arrangement caters for the heating up of dyeing liquor in the casing 1 during a dyeing operation and forced cooling of this liquor at a terminal part of the operation.

The casing is, furthermore, provided with a top cover 17 for sealed closure thereof during a dyeing operation, this cover being hinged at 18 and being provided with a counterweight 19. The casing also has a window 20 in a wall thereof to enable the correct liquor level in the casing to be checked.

The hank supporting structure 2 basically comprises upper and lower box section ducts or headers, 21 and 22 respectively, which are made of sheet metal and which are dimensioned so that they extend across substantially the complete width of the casing 1. Each such header is provided at its ends with a rib 23 which is slidingly received between outer ribs 24 on the casing, thereby to guide the structure 2 correctly into position when introduced from above into the casing.

The headers 21 and 22 are coupled together through telescopic conduits 25, these allowing for variation in the distance apart of the headers. This, as will be observed later, is to adapt the structure to different hank lengths, and the setting is effected by means of a screwed stem 26 carried by the upper header 21 and screwing into a block 27 on the lower header. A handle 28 is provided to allow for the required rotation.

In addition the lower header 22 is provided with a central downturned hollow spigot 29 which has an outer flange adapted to seat on a corresponding flange at the upper end of the elbow 5.

A row of hank supporting arms 30 extends from each side of the upper header 21, and aligned arms 31 extend from two sides of the lower header 22. In practice hanks are looped over a registering pair 30, 31 of arms, the second of these arms only serving to hold the hank against excessive upward movement during the dyeing operation, whereas the hanks actually rest on a film of dye liquor on the upper arms 30. In the present instance the arms 30 are of perforated form whereas the arms 31 are imperforate, although it will be appreciated that the same or similar perforated forms could be used in both cases.

The arms 30, which extend laterally in rows of parallel arms from the spine formed by the header 21, as can be clearly seen in FIGURE 2 are, in fact, built up in pairs, i.e. one structure is used to form an aligned pair of arms extending one from each side of the header. This is achieved (see FIGURE 4) by passing a cylindrical open-ended steel tube 32 through the width of the header 21 and welding it in position at 33. The portion of the tube 32 outside the header represents the outer sleeve of the arms 30 and, as indicated above, each of these sleeves is slotted to provide for a narrow upward surge of liquor from the interior of the arm. The slot has been designated 34 in the drawing and it will be noted that it extends over the major part of the length of the arm at the crown of the latter, as seen in cross section. At each outer end the tube 32 is provided with a short stirrup piece 35 to enable a pole 36 to be threaded through the aligned stirrup at the ends of the bearer support arms 30 to avoid any

chance of hanks slipping off the latter during transfer of the structure 2 to the dyeing tank 1, or during actual operation of the machine.

Finally it is to be noted that the tube 32 is provided within the header 21 with perforations 37 to allow for entry of dyeing liquor from this header into the interior of the arms.

Each of the outer sleeves referred to is provided internally with a removable inner tube 38 which is again of metal but has a smaller diameter than, and a clearance from, the outer sleeve. Each tube 38 is provided at its outer end with a cap 39 which is welded to the tube and has a press fit into the end of the corresponding outer sleeve 32. At its opposite and inner end 40 the removable tube 38 is flared to a diameter having a close fit within sleeve 32. Thus, the arms are assembled by push fitting the inner tube 38 into the outer sleeve 32 and, in the assembled condition, the flared end 40 is positioned to receive the full flow of liquor from the part of the sleeve 32 disposed in the header 21. In addition each inner sleeve 32 is provided along its length with a line of perforations 41 which allow the liquor to flow from the interior of the tube into the surrounding part of the outer sleeve. The spacing of these perforations is preferably graduated for the purpose stated above. In practice it is found convenient, for manufacturing purposes, to arrange these perforations in groups of contrastingly spaced perforations, the smallest spacing being found in the case of the group nearest the flared end 40. The perforations, as in the case illustrated in FIGURE 4, commence close to the flared end 40 and terminate well in advance of the outer end of the tube 38, and it is to be noted that the axes of these perforations are horizontal, as contrasted with the vertical axial plane of the slot 34 in the outer sleeve (see FIGURE 5). Thus, when liquor flows out of perforations 41, it undergoes two abrupt changes in direction before it emerges from the tube 32, and this reduces any tendency to turbulence of flow. Further, the flow is, by the arrangement described, spread evenly over the length of the arm with the objects stated above, and the resultant emergent upsurge of liquor from the slot 34 is found to maintain the required "floating" condition of the hanks and consequent uniform treatment, particularly at the upper inside bends of the latter.

The operation of this machine will be clear from the foregoing, but may be summarised very briefly as follows.

In the first place the hank supporting structure 2 is loaded with hanks outside the casing 1. To this end the headers 21 and 22 are set at the required distance apart by means of the screw and nut mechanism 26, 27, and then hanks are threaded over the registering pairs of upper and lower arms 30, 31. The poles 36 are then threaded into position and the structure dropped into the casing 1, which is then filled with liquor to the required height and closed. Steam is then circulated through the serpentines 12 to heat up the dyeing liquor and the pump 7 started to circulate this liquor through the work. As will be clear from the foregoing, from the delivery side of the pump it flows through the pipe 6, the elbow 5, the spigot 29 into the bottom header 22, up the conduits 25 and into the top header, to pass out eventually through the perforations 41 and slots 34, producing the "floating" action referred to.

When the requisite period of hot circulation has expired, the cooling of the liquor can be accelerated before removal of the hank supporting structure, by passing cold water through the serpentine arrangement. As will be appreciated, with the hanks "floating" the circulating liquor is at all times in contact with the whole surface of each supporting arm 30, so that these supporting arms are cooled much more rapidly by heat exchange with the cooling liquor, and unsightly shine is avoided in the case of synthetic fibres.

It will also be understood that this machine lends itself to dyeing operations carried out under static pressure,

and that the casing itself is of relatively simple form and can be used with other forms of supporting structure, for example frames carrying bobbins.

I claim:

1. A hank dyeing machine comprising: a casing defining a dyeing chamber; a hank supporting structure removably accommodated in said chamber, said hank supporting structure comprising superimposed hollow headers, tubular conduits between said headers, a liquor inlet union for the lower of said headers, stationary hank supporting arms extending laterally from the upper header, said arms being hollow and having radially directed openings in the upper circumferential portions thereof for substantially the entire length thereof; means in said hollow arms for directing pressurized fluid therein out through said openings in a substantially radial direction; means for impelling dyeing liquor into said arms under pressure for maintaining the hanks in a floating state in the liquid in said chamber away from the outer surface of said arms by virtue of the radial emission of said liquor from said openings; each of said arms being double-walled and comprising a perforated inner tube surrounded by an apertured outer sleeve, the outer sleeve containing said radially directed openings and the inner tube constituting said means for directing pressurized fluid through said openings in a substantially radial direction, means closing said outer sleeve from direct communication with said upper header, said apertures in said inner tube being angularly displaced from said openings in said outer tube, and the outer surface of said inner tube being radially spaced from the inner surface of said outer sleeve.

2. A hank dyeing machine comprising: a casing defining a dyeing chamber; a hank supporting structure removably accommodated in said chamber, said hank supporting structure comprising superimposed hollow headers, tubular conduits between said headers, a liquor inlet union for the lower of said headers, stationary hank supporting arms extending laterally from the upper header, said arms being hollow and having radially directed openings in the upper circumferential portions thereof for substantially the entire length thereof; means in said hollow arms for directing pressurized fluid therein out through said openings in a substantially radial direction; means for impelling dyeing liquor into said arms under pressure for maintaining the hanks in a floating state in the liquid in said chamber away from the outer surface of said arms by virtue of the radial emission of said liquor from said openings; each of said arms being double-walled and comprising a perforated inner tube surrounded by an apertured outer sleeve, the outer sleeve containing said radially directed openings and the inner tube constituting said means for directing pressurized fluid through said openings in a substantially radial direction, means closing said outer sleeve from direct communication with said upper header, said apertures in said inner tube being angularly displaced from said openings in said outer tube, and the outer surface of said inner tube being radially spaced from the inner surface of said outer sleeve, said tubular conduits between said headers comprising telescoping joints to permit said headers to be moved relative to each other, and adjustable screw means for adjusting the distance between said headers.

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