The turning of the dye sticks by the means previously explained, causes the skeins to slowly change their positions on the sticks, thus insuring perfectly even dyeing, since all parts of the skeins will then be exposed to the dye-liquor uniformly, at the same time preventing any tangling of the yarn.

The machine is furnished with two sets of sticks for each compartment, so that while one batch is being dyed, the other set of sticks is loaded with another batch of skeins, and in this manner prevents delay between dyeing the batches. The steam pipes for the steam are entered into the bottom of the tank from the side and placed under the partition or false back 2, this arrangement being necessary, since these pipes are perforated, and the false back has to be used to prevent the jets of steam from striking the yarn.

The dyestuff is poured into a bronze kettle, attached to the outside of the machine, and is accurately fed to the bath, without any danger of spilling, being carried and discharged into the tank by means of perforated copper pipes 32.

The wooden cover for the machine has cast iron frames attached to each end, and to insure strength and rigidity, these are coupled together by rods extending from one side frame to the other.

The openings on each side of the machine, where the reel is loaded and unloaded, are covered with canvas curtains when the machine is in operation. These curtains roll up and leave the openings clear when the machine is being loaded or unloaded. This cover is used on the machine to confine the steam, thereby keeping the bath at an even temperature with less steam than it would be possible to do if reel was exposed; also keeping the dye house free from steam which would be impossible if the covering was not used.

The machine is equipped with fast and slow speed, and the direction of rotation of the reel can be reversed if so desired.

An outlet valve is placed on the side of the tank at the bottom and is of sufficient size to carry away the dye-liquor quickly after being used.

An alarm bell is attached to the machine, so that should any of the skeins become tangled, or a breakage of the sticks occur, the dyer is immediately notified by the bell.

With reference to silk dyeing, single and double width machines are built, to color from 5 to 200 lbs. of silk in the gum, said machines being designed so that the reel may be hoisted out of the bath, so as to facilitate sampling, and to allow any manipulation or changing of the bath that might be necessary. The tanks are also copper lined, and on account of this lining can be quickly and thoroughly cleaned with very little trouble between dyeing different colors.

For dyeing sulphur colors, the tank and cover are constructed entirely of iron and the latter is water tight, thus allowing the skeins to be completely submerged in the dye-liquor during the dyeing. All other parts of this machine are also made of iron.

When used for bleaching purposes, the spiders and fittings are made entirely of bronze, and the tank is copper lined, while if to be used for scouring, the machines have iron spiders and fittings.

Among the advantages of the machine are that, being automatic, it therefore produces an evenness of dyeing that cannot be obtained by hand. The machines are under control at all times and the skeins treated with a uniformity that insures a perfect production.

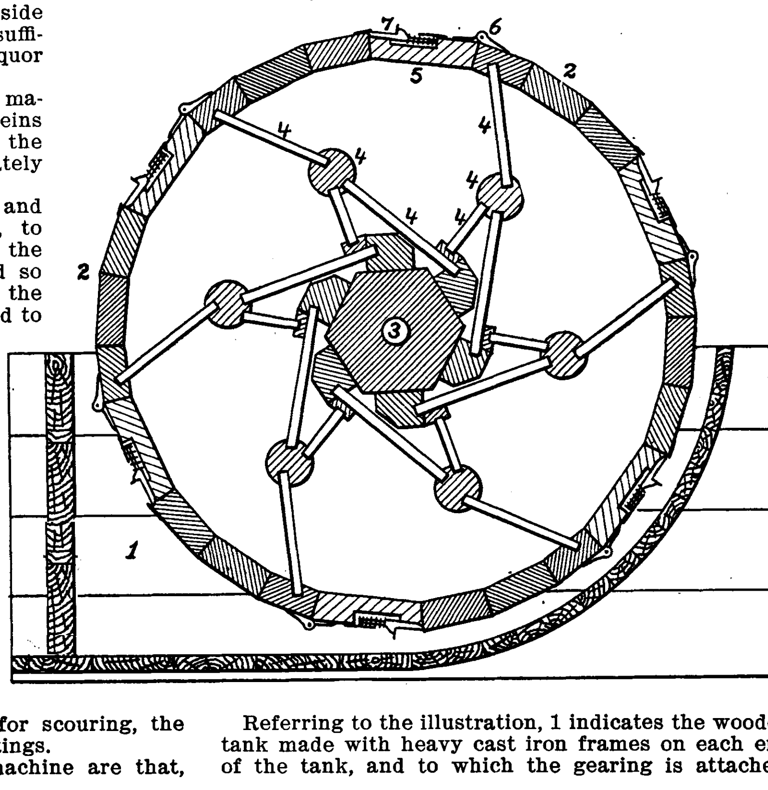
The dyer is relieved from the supervision of a large number of men and necessarily saved an amount of worry and annoyance.

One of the largest items in its favor is the saving in labor, since after the machine is loaded and started, it requires, comparatively speaking, no attention until the process is finished. Other items are, a saving in floor space, less steam required, economical use of dyestuffs, more accurate dyeing, a careful and gentle manipulation of the material during the process of dyeing and consequently a saving in labor and material in rewinding the material in the mill. (Klauder-Weldon Dyeing Machine Co., Amsterdam, N. Y.)

THE KLAUDER-WELDON KNIT GOODS DYEING MACHINE.

This machine is used for dyeing hosiery, underwear, caps, etc., which come to the dye house in an unfinished condition, that is with reference to the underwear, made up into unfinished garments. After coming to the dye house, the fabrics to be dyed are first boiled out, in the same machine as afterwards used for dyeing, and which consists of a tank for holding the dye-liquor and through which the goods are passed, a wooden cylinder divided into compartments, which holds the goods to be dyed, and which revolves with its lower half submerged in the dye-liquor, and a wooden cover which may either cover both the tank and cylinder or only the tank.

The details of the construction and operation of the machine are best shown by means of the accompanying illustration, which is a cross sectional view of the machine.



Referring to the illustration, 1 indicates the wooden tank made with heavy cast iron frames on each end of the tank, and to which the gearing is attached.

The cylinder, indicated by 2, is made almost entirely of white pine and cypress, each end head being supported by a bronze casting, the hub of which is keyed to a shaft 3. The cylinder is divided into six compartments by the partitions 4, which are so shaped as to prevent the goods being matted together by the revolution of the cylinder during the dyeing process, thus enabling the goods to be more evenly and thoroughly dyed.

The partitions of the compartments consist either of perforated boards or series of round pins, so placed that a perfect circulation of the dye-liquor is obtained. The steel shaft 3 extends through the centre of the cylinder and rests in bearings on the sides of the tank. This shaft is covered with wood on the inside of the cylinder to prevent the goods from coming in contact with the steel, the object of this being to prevent rust spots on the goods. Each compartment is provided with a door 5, and through which the goods are loaded and unloaded. The doors are perforated to allow the dye-liquor to circulate from the tank through the compartments, and are provided with heavy bronze hinges 6 and catches 7 to close and fasten said doors.

A steam pipe is entered in the side of the tank at the bottom and extends across said tank. The goods, being inside the cylinder, are thus not disturbed or injured by the steam.

An outlet valve for discharging the water, etc., is located on the side of the tank and is constructed of cast iron, bronze and rubber.

The top covering is supported on each end by cast iron frames and is well rodded. The openings at the back and front of the machine are covered by canvas curtains and which are rolled up during the loading and unloading process. The object of the top is to save steam, as it confines the heat; the volume of liquor is also reduced to a minimum, as compared with the amount of material being dyed, which results in using the dyestuff to the best advantage.

The cylinder is rotated by a driving arrangement, either from the side or from the back of the tank. When driven from the side, a worm gear is attached to the end of the main shaft 3, that runs through the centre of the cylinder, and this gear is driven from a worm located on the same shaft with the driving pulley. When driven from the back, a bronze rack is attached to the periphery of each end head of the cylinder, and the same driven from a shaft extending across the back of the tank on which are placed two pinion gears which mesh with the bronze rack. On the end of this back shaft is located a worm gear which is driven by a worm on the same shaft with the driving pulley. The back drive is preferable, for the reason that it relieves the main shaft of all strain, since the latter simply rests and rotates in the bearings on the sides of the tank.

A crank is furnished with each machine, so that should accidents occur, or power be cut off, the machine can be operated by hand, thus preventing the batch of goods being spoiled.

The goods to be dyed are first counted so that each compartment will have about an equal share of the batch. The doors are then closed and the goods boiled out, after which they are washed in running water in the machine, and when sufficiently washed, the water allowed to run off, and after which the dyeing process is begun, the material thus not being handled until the process is finished. The cylinder rotates slowly through the liquor and the machine requires no attention other than the regulating of steam and entering the dyestuff. The goods are thus alternately brought into the liquor and then carried around with the cylinder. During this passage, the goods in each compartment fall from one side to the other, and thus are always in a different position when entering the liquor from that during the preceding immersion. In this way all parts of the material are exposed to the action of the dye in the same degree.

Care must be taken not to run the machines at too great a speed and cause the goods to roll and knot up, as this will cause uneven dyeing. One man can attend three or four machines. From 150 to 400 pounds of goods per batch can be dyed in a machine, and from 5 to 10 batches per day, according to the material being dyed.

Among the advantages of the machine are the uniform application of the color, the large production, small amount of labor required, economy of steam and dyestuffs, and simplicity of construction.

The dyeing of knit goods requires care and experience. The dyes used are nearly all of the "direct" type, that is, colors which require no previous mordant. For light shades, the goods are generally boiled for one-half hour in the dye before adding salt or Glauber's salt and then the dyeing continued for one-half hour longer in order to complete the dyeing and thoroughly exhaust the dye-bath.

The dyes chosen for this work are those which are fast to washing and hot pressing and those which are easily soluble and go on evenly. For very light shades, the goods are bleached before dyeing, but in most cases this is omitted and the dyeing is done in the gray.

After being dyed, rinsed and extracted, the goods are sent to the boarding room to be shaped and dried. This is done by putting the garments on wooden forms called boards when they are wet, and drying them in this stretched condition. The garments are next removed from the boards to be finished, that is, to have the bands and buttons sewed on and to be pressed and boxed.

Roll Dyeing Machine. The system of dyeing knit goods before cutting up the roll into pieces, is now coming into general use and is carried out in a roll dyeing machine as follows: The goods are sent to the dye house in the form of rolls just as they come from the knitting machines. These goods are unrolled and usually boiled out in an open kier, then put through a washing machine, and in turn extracted. After extracting, they are dyed in kettles provided with a roll over which several pieces are passed side by side, the ends of each piece being sewed together to make it endless, so that they are continually passing through the liquor until the dyeing is complete. The length of these pieces should be as nearly equal as possible, so they will all get the same circulation in the same time. If one piece is, say 100 yards long and another 200 yards in length, both traveling at the same rate over the reel, one would pass out of the liquor twice as many times as the other, and what is likely to cause different shades in the same dyeing. (Klauder-Weldon Dyeing Machine Co., Amsterdam, N. Y.)

THE COHNEN CENTRIFUGAL DYEING MACHINE.*

The chief advantage of this machine is that it has successfully solved the problem of dyeing sulphur colors.

Two difficulties in the dyeing of sulphur colors have prevented the extended use of these valuable dyes.

1. Bronziness, streaks and irregularity of shade.
2. Harshness of the material dyed.

The first of these difficulties is due to the improper,

*Manufacturers desiring to see the machine in operation, with a view to purchases, may do so at any time, and on their own material, if they will forward the same to our Providence Office, 13 Matthewson Street. A. Klipstein & Company, 122 Pearl Street, New York City.

untimely and irregular oxidation of the dye in the material treated.

The second, to the oxidation of the dye in the liquor and its deposition on the outside of the material, producing in raw cotton a peculiar harshness that seriously interferes with its spinning, and in yarns in a similar way with weaving and knitting.

The cause of both difficulties must be sought in the nature of the sulphur dyes themselves, as well as their treatment during the operation of dyeing.

The Nature of Sulphur Colors. The sulphur colors have two striking peculiarities.

First.—They can only be dissolved in water by the addition of strong alkalies, which not only dissolve them, but at the same time reduce them to a colorless condition.

Secondly.—On exposure to air they absorb oxygen (oxidize) which at once develops the color and renders it insoluble in water or "fast." This oxidation takes place whether the color is in an alkaline solution or in the fibre of the material to be dyed. It is absolutely necessary in order to get a color at all, but if it is untimely, that is to say, if it takes place during the dyeing operations, it results in bronziness, streaks and unevenness; while if it takes place in the dye-liquor, the insoluble oxidized dye is deposited on the outside of the fibre and causes harshness and at the same time a total loss of the dyestuff so oxidized.

With reference to these sulphur colors, the Cohnen Centrifugal Dyeing Machine is a successful attempt to solve the dyeing of cotton, etc., in every stage of manufacture, raw stock, slubbing, yarns (cops, hanks, cones, warps, etc.), hosiery, etc. The machine itself is a combination of a pack or pump machine with a centrifugal machine, having the advantage over the former of providing for scientific packing to prevent "channeling" and irregular results; and over the latter of avoiding the loss of time, disagreeable work and untimely oxidation involved in changing the boxes. It does this by the attendant simply reversing the pumps, forcing the dye-liquor first from within outwards, then from without inwards. Its distinguishing characteristic is the combination of this reversible pump with perforated metal boxes placed in a closed, unperforated centrifugal drum, fitted with two sets of valves; one air tight for producing a vacuum, the other non air tight for ordinary hydroextraction.

It is this combination which solves the problem of dyeing sulphur colors without bronzing or streaks and with a saving of at least 20% of the dyestuff formerly used.

The Process of Dyeing is as follows:

1st. Packing. The material to be dyed is packed into suitable perforated metal boxes with exact allowance for the shrinkage that results from wetting. This packing prevents uneven pressure and therefore "channeling" and results in such uniform results that "cops" may be dyed with perfect evenness.

2nd. After packing, the boxes are placed in the closed centrifugal drum which is then connected with the reversible pump. The pump is put into action, and in thirty minutes has completed the dyeing operation, having forced the dye-liquor through the fabric at the rate of 600 gallons per minute.

3rd. On completion of the dyeing, the pump is detached, the air tight valves opened and the centrifugal machine set in motion to extract in vacuum. This operation drives all the surplus dye-liquor out of the cotton just as an ordinary centrifugal dyeing machine would do with the great difference that no air is admitted, and no untimely oxidation takes place.

4th. This operation completed, a fan is attached to the centrifugal drum which forces a current of air through the dyed material freed from the surplus dye-liquor until complete and uniform oxidation has been effected.

5th. After oxidation, the closed centrifugal drum is again connected with the reversible pump and the dyed material is thoroughly washed, although if the oxidation has been complete, washing is hardly necessary because even the first wash water is practically colorless, thus showing that absolutely no dyestuff is lost.

6th. Finally, after washing, the pump is again disconnected, the regular non air tight valves opened and the centrifugal drum run as an ordinary hydroextractor, leaving the material ready for the drying rooms.

All the changes thus described are made in a few seconds, and during the dyeing operation a second set of boxes is packed. The removal of the boxes containing the dyed material and the insertion of the freshly packed boxes requires at the outside ten minutes, thus avoiding all loss of time in loading and discharging and rendering the operation of the machine practically continuous during the working hours of the day.

Summarized, the Cohnen Centrifugal Dyeing Machine has the following points of advantage:

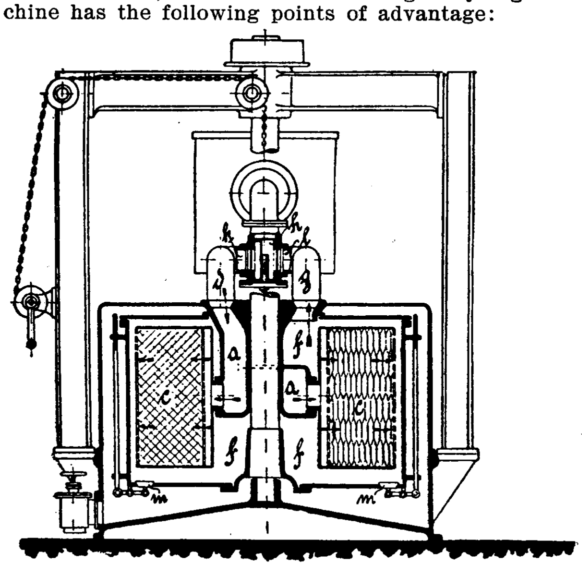


Fig. 1.

1st. Scientific packing to insure uniform dyeing.

2nd. Hydroextraction in vacuum before washing to prevent untimely oxidation of color on the fibre and all oxidation of color in the dye-liquor, thus saving 20% of dyestuff.

3rd. Perfect oxidation.

4th. Delivery of the dyed material ready for the drying room.

5th. Saving of time and labor in loading and discharging.

6th. Perfect dyeing.

7th. Saving in steam of 60 to 75% as compared with a Cylinder Machine.

It may be added that the size of the boxes permits of handling by one man with the greatest ease. That at the end of the operation both the machine and the dyed material are cold, and therefore in condition for easy handling. In dyeing sulphur colors, the time required is something over one hour, so that seven operations may be made in ten hours. Direct colors may be dyed in thirty minutes, including the changing of the boxes.

One practical form of the machine is best explained in connection with the accompanying illustrations, of which Fig. 1 is a sectional elevation of the machine proper; Fig. 2 is a side elevation, drawn on a smaller scale than Fig. 1, being given more particularly to show position of reservoir, working tank, pump, and pipe connections, also showing in dotted lines the working boxes (containing the material to be treated) raised by overhead pulleys and chains out of the centrifugal dyeing machine; Figs. 3 and 4 are detail sectional views of the dyeing machine, showing six boxes *c*, for holding the material to be dyed, in connection with the passageways for liquid (dye-liquor, water, etc., as the case may be) to enter and leave said boxes, *i. e.* material.

Inside the plain, unperforated centrifugal drum, is an inner chamber *a*, into which the dye-liquor is forced by means of a centrifugal pump *b*, through either the pipe *d* or *g* (see Fig. 1). This inner chamber is in direct communication with a set of partially perforated boxes *c* (which will be more fully described later), into which the material to be dyed is packed. After the liquid has entered by, say, the pipe *d*, it passes from the inner chamber *a* into the boxes, saturates the material, flows into and fills the collecting chamber *f*, then leaves the machine by the pipe *g*, returning thence to the pump to circulate again in the manner described. The conduit pipes *d*

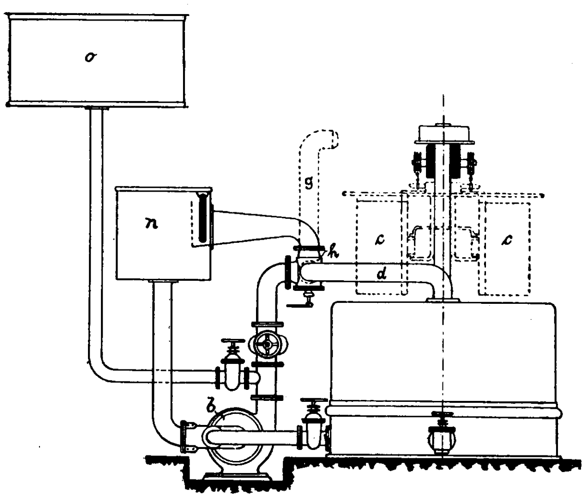


Fig. 2.

and *g* are so constructed that they can be easily disconnected from the drum, in which case they are swung up into the position indicated by the dotted lines in connection with pipe *g* in Fig. 2, after the dyeing, etc. operations have been completed, leaving the hydroextractor principle of construction of the machine to be then brought into operation.

These two pipes *d*, *g*, are connected by a three-way cock *h*, which controls the direction of flow of the dye-liquor, and can be regulated at will—that is to say (see Fig. 1) the liquid entering first at *k* and leaving at *l*, can, by simply turning this cock, have its flow reversed, entering at *l* and leaving at *k*. The liquid then flows through the material from the outside, inwards, and not as at first, from the inside, outwards. By this twofold direction of flow more uniform results in the dyeing are obtained, because it prevents "channeling," and during the whole of the time the liquid is being circulated, the centrifugal drum remains hermetically closed and at rest. The dyeing being completed, the outlet valves *m* are opened and the hydroextracting carried out in the usual manner.

The dye-liquor that is in the tank *n*—to which allusion will be made again—in the conduit pipes, and the collecting chamber *f*, as well as the extracted liquor from the goods, can either be pumped into the reservoir *o*, if required for further use, or be allowed to run off.

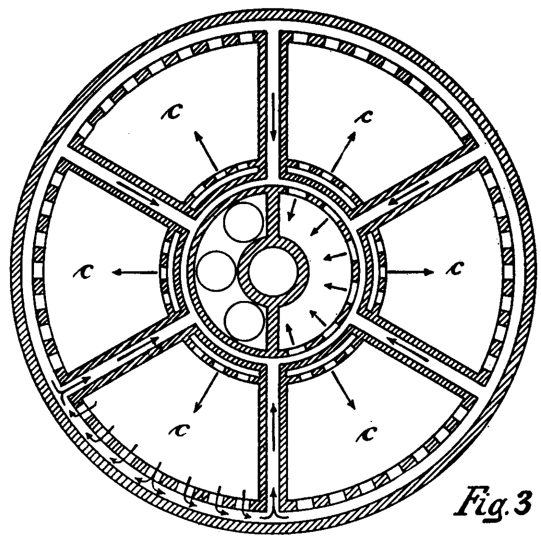


Fig. 3

The entire operation being complete, the lid of the drum is unscrewed and wound up by suitable means, carrying with it the centre casing and the boxes filled with material (see dotted lines, Fig. 2). These boxes are connected with the casing in such a manner that they can be easily taken off and replaced by others.

Spare boxes are provided with each machine, and as these will have been filled during the dyeing of the previous set, a very few minutes suffice for the exchange, after which the machine is again ready for work. These boxes are of somewhat peculiar shape, roughly resembling an old-fashioned wooden cradle with the addition of a lid, each box having eight

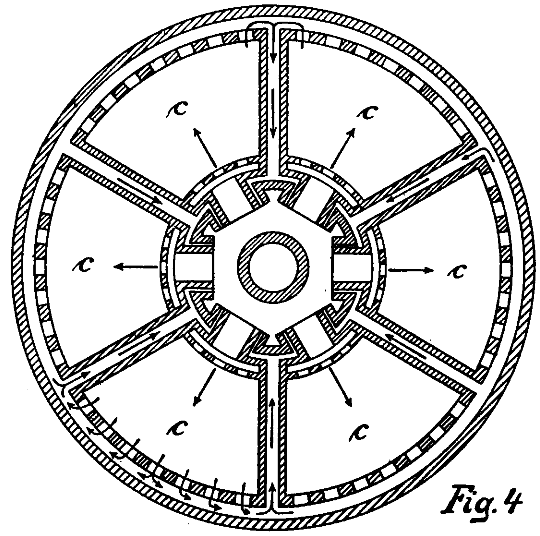


Fig. 4

sides, including the top and bottom. The back and front sides are parallel to each other, but unequal in breadth, so that while the two sides at right angles to the front are equal and parallel to each other, the remaining two sides taper down to the width of the back. The front wall of the box is perforated and removable, being in reality a lid, while the back has a round aperture in the centre onto which a short branch pipe or neck is fixed, and which serves as an inlet and outlet for the dye-liquor. This neck fits into an aperture of corresponding shape in the centre casing, which, with the addition of a simple but strong locking device that can be quickly operated, forms an absolutely tight connection. Inside the tapered part a perforated plate is fitted, and upon this the material to be dyed is piled above the level of the box; the lid is then placed on the top and forced into position by means of a strong screw press worked by hand, and firmly secured by winged nuts. The material being thus tightly packed within the confines of the box, the dye-liquor in penetrating it encounters a uniform resistance. If working only with two, three, or four boxes in connection with a six compartment machine, the remaining apertures in the centre casing are then tightly closed.

A notable feature is the working tank *n*, one function of which is to provide space for the increase in volume of the dye-liquor resulting from the condensation of steam used for boiling. It is here, too, that the dye-liquor is strengthened, tests made, and the liquid kept under observation generally during progress of the work. The height at which this tank is placed allows the liquor to flow down into the machine, and, filling it, simultaneously forces out the air—a consideration of the utmost importance when dyeing with sulphur dyes. Overhead driving has been adopted in the machine to avoid the danger of the strap becoming saturated, and the machine itself is driven by friction. (A. Klipstein & Co., New York, N. Y., American Agents for the machine.)

THE VACUUM DYEING MACHINE.

This machine operates by circulating the dye-liquor through the material, vice versa to some of the other dyeing machinery, which are operated on the principle of circulating the material in the dye-liquor, and can be used for dyeing Raw Stock, Yarns, Hosiery, Shoddy, etc., and is built in four different

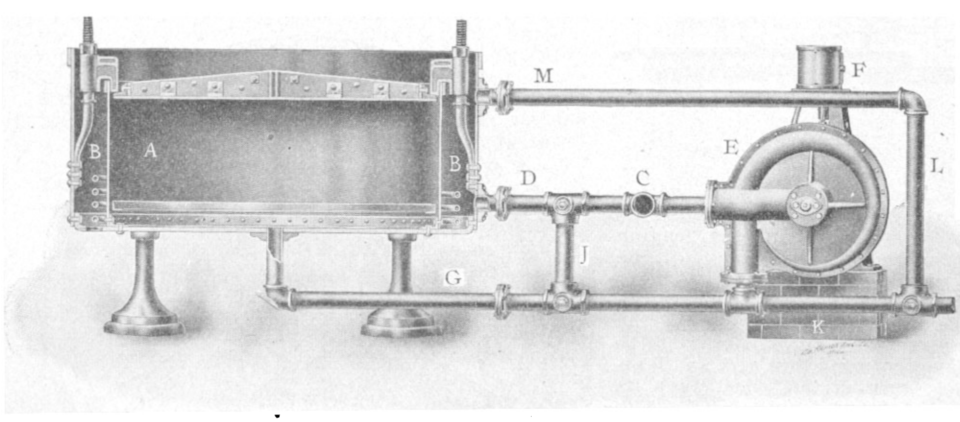


Fig. 1.

standard sizes to suit the varying requirements of a mill or job dye house, viz.:

48 inches machines requiring	5′ × 8′	floor space,
60 " " "	6′ × 9′	" "
66 " " "	6′ × 10′	" "
98 " " "	8′ × 16′	" "

and will handle from one hundred pounds of material like for example yarn or hosiery, to one bale of cotton (= about 500 pounds) at one operation. In the latter instance no special handling of the bale of cotton is required, the complete contents of the bale minus the bagging, without being compelled to open out the more or less matted cotton as caused by the heavy compressing at the ginnery, being placed direct in the dyeing machine, it being the purpose of the machine to dye most any textile material, or any soft kind of fabric like hosiery, no matter how much compressed when inserted, under the action of the circulating dye-liquor.

In order to explain the construction and operation of the machine, the accompanying three illustrations are given and of which Fig. 1 is a sectional elevation of the dyeing machine, showing pump, engine, supply pipes, etc., in perspective. This illustration shows a smaller size of machine, in which the dyeing reservoir is placed on stands, whereas in larger machines the latter are omitted, the casing of the machines being extended to rest on the floor as will be readily seen by consulting Figs. 2 and 3, and of which Fig. 2 shows such a large machine, its top covering being lifted by means of an overhead trolley and hoist arrangement. Fig. 3 is a perspective view of the machine, etc., with the top covering taken away, showing the contents of the dyeing machine—the material dyed—lifted bodily up and away from the machine by means of raising the perforated bottom of the dyeing reservoir, by means of the overhead trolley and hoist arrangement.

With reference to Fig. 1 more in detail, we see that the machine consists of two compartments, viz.: A the dyeing reservoir or chamber, and B the outer reservoir or tank. After the material to be dyed has been placed in the dyeing chamber A, the dye-liquor, having previously been prepared in a suitable tank (not shown), placed conveniently away from the machine and above its level, is then allowed by means of gravity, to enter through suitable piping at C and flow through pipe D into the outer tank or reservoir B. Steam is then turned on into the heating coil as situated in the lower portion of outer tank B, so as to bring the dye-liquor to a proper temperature. As soon as this tank B is pretty well filled, the pump E, operated by a special small engine F, is started, leaving the supply of dye-liquor on at C, which then, in connection with the liquor in tank B through pipe D, by means of the pump E, is forced through the bottom supply pipe G into the dyeing chamber A. Previously to entering the latter, the dye-liquor comes in contact with a "distributor" as is situated on the bottom of chamber A, and which distributor is shown in connection with Fig. 2, when examining said illustration more particularly. The purpose of this distributor is to distribute the dye-liquor upon entering the dyeing chamber A most uniformly all over the perforated bottom of said chamber, in order to act uniformly upon the material to be dyed. The dye-liquor thus introduced in chamber A, after passing through the material to be dyed, in turn overflows through the perforated top covering into the outer reservoir B, and from where, by means of pump E, it is circulated, *i. e.* drawn through pipe D to the pump E and from there forced back again through pipe G, into the dyeing chamber A, thus producing

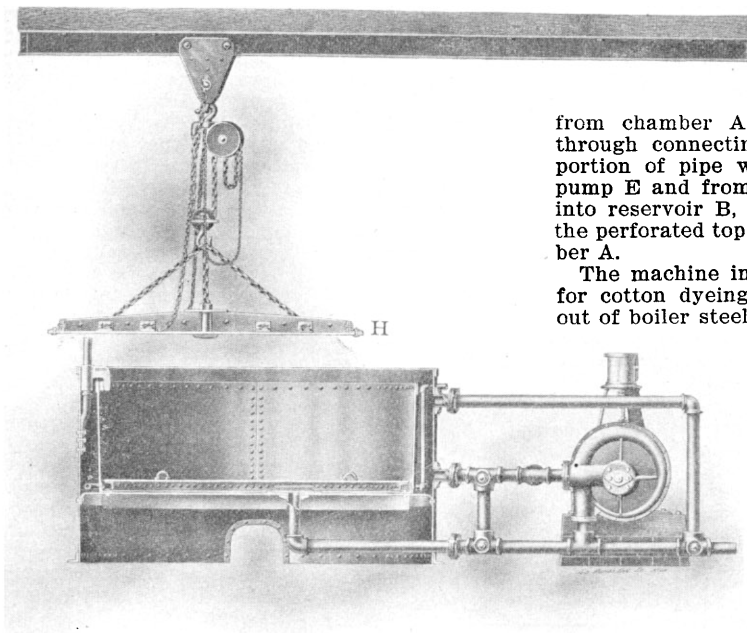


Fig. 2.

the characteristic circulation of the dye-liquor through the machine, *i. e.* the material to be dyed. After the machine has been filled with dye-liquor, stop the supply of dye-liquor at C from the outside tank (not shown).

The valve shown in connection with pipe D as well as the two valves shown in connection with pipe G are what is known as 3-way valves. The valve as situated at inlet C is also connected with a water supply pipe, and consequently after the machine has done dyeing, and the dye-liquor run off, water is introduced and the stock washed without having to be removed from the machine. The dye-liquor as withdrawn from the machine leaves the system of pipes at I, and from where it is guided back to the supply tank previously referred to, and from which it at the beginning was taken.

In unloading this machine, the top cover H is removed, as shown in Fig. 2. Then the hoist is brought again into position, and the entire load of dyed material, resting on the perforated inner bottom, is bodily raised, see Fig. 3, and shifted to one side of the machine and dumped. The perforated inner bottom plate is then replaced and when the machine is again ready for another dyeing.

If found advisable, the direction of circulating the dye-liquor through the machine, and thus also through the material, can be reversed by changing all 3-way valves previously referred to, circulating the dye-liquor then by drawing the same from chamber A through the bottom pipe G, up through connecting pipe J, through the right hand portion of pipe where inlet C is situated, into the pump E and from there through pipes K, L and M, into reservoir B, and by means of overflow through the perforated top cover H back into the dyeing chamber A.

The machine in its present state is more adapted for cotton dyeing, on account of being constructed out of boiler steel, which naturally would be affected by the acid, as used more or less in connection with wool dyeing; however, if dyeing wool where no acid is used, the machine can be used, for example: Wool waste, cotton and wool mixtures dyed in connection with salts black can be handled. The machine will also be found of advantage in dyeing cotton successfully in connection with those modern sulphur colors, at present coming so much in demand in connection with cotton manufacturing. These colors will oxidize on coming in contact with the air during the process of dyeing, and since the Vacuum Machine prevents this, by the dye-liquor covering the material completely on top during dyeing, the advantages of this machine will be quickly grasped.

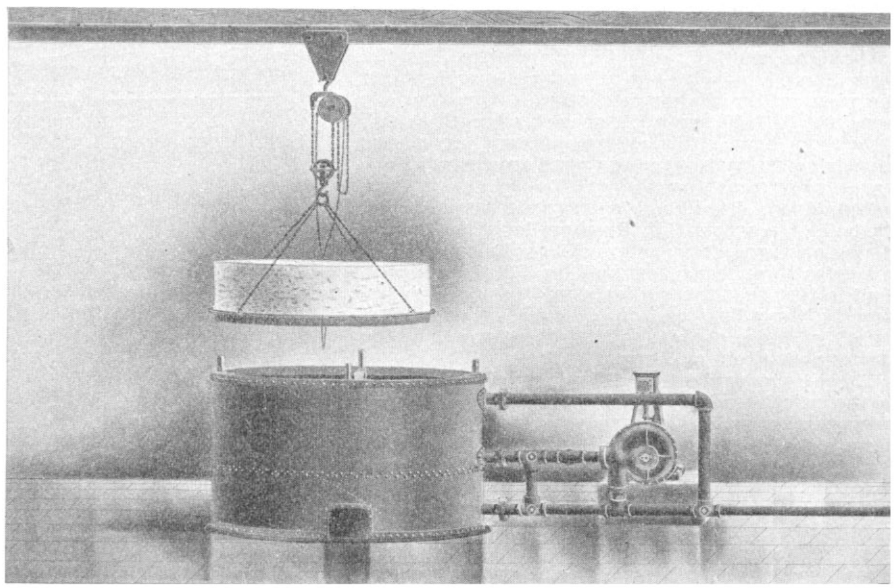


Fig. 3.

The Manufacturers of these machines are now building a Single Tank Machine, made of cast iron, or something similar in construction. This machine can be used for wool and bleaching purposes; the perforated top cover, as well as the perforated inner bottom plate being faced with copper and all supply pipes lead lined. The principle of operating the machine for bleaching being identical with that of dyeing; the bleaching-liquor being forced, *i. e.* circulated through the material to be bleached. (Vacuum Dyeing Machine Company, Chattanooga, Tenn.)

WARP DYEING.

There are two well known and distinct systems of dyeing cotton yarn in the warp, known respectively as the Long Chain or Scotch system, and the Short Chain or English system. On account of different impressions that may be conveyed by the use of the terms, Long Chain and Short Chain, it may be advisable to mention that by the Long Chain system of warps is understood the preparation of very long chains or warps which in turn are boiled, doubled, dyed, dried and split, and which may refer for either warp or filling purposes. Such as intended for warp purposes, after splitting, are then beamed and in turn slashed, whereas filling chains after splitting, are sized, dried and taken to a quiller for winding on bobbins (quills) ready for the shuttle. By the term Short Chain system of warps is understood the preparation of shorter chains or warps, to say from 1000 to 1500 yards, *i. e.* of such a length as will fill a loom beam; this system of handling chains usually referring to yarn for warp purposes. Such warps after reaching the dye house are in turn boiled, dyed, dried, and afterwards beamed and slashed. On account of the short lengths of these chains or warps, this system of handling yarn does not refer to such as destined for filling purposes, for the fact that the quiller would require too frequently threading up, on account of the short length of these chains, so that there would be no saving over skein quilling.

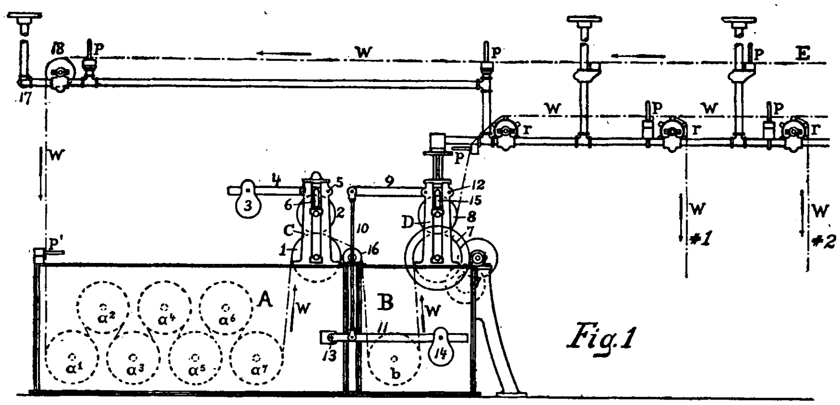


Fig.1

There is considerable difference of opinion as to the relative merits of these two systems with reference to handling warp yarn, but it depends more upon the quantity of yarn and the variety of shades to be dyed, which system should be used, than upon individual preference. Warp or chains dyed by the Long Chain system are usually from five to sixteen thousand yards long, each consisting of 275 to 500 ends, while those dyed by the Short Chain system are often warped the full number of ends, or else are dyed in lots of 2, 4 or 6 warps. For either system they are best brought to the dye house in "balls," but what in reality is not a ball in the ordinary sense of the word, said balls being made on a ball-warper by winding on a wooden cylinder a number of warp ends drawn together as one strand which is traversed back and forth along said cylinder, crossing and recrossing so as to prevent tangling.

Warp Boiling Out Machine. Whether the Long or Short Chain system is used, the first process in the dye house, and one of great importance is to thoroughly wet out and cleanse the yarn preparatory to dyeing, as otherwise it is impossible to get good results. This is done by running the warps through boiling water. Fig. 1 shows, in its side elevation, the machine especially designed and built for this work by the Textile Finishing Machinery Company of Providence, R. I., and which is the latest and most approved machine for this purpose. It has two iron tanks A and B, the one, A, for the boiling water (for loosening the dirt from the yarn), and the smaller one, B, for the cold water rinse. Each tank A and B is fitted with a draw-off plug for changing the water when the same becomes loaded with impurities removed by it from the warps under treatment. At the delivery end of each tank A and B, we find placed, on top of it, a set of nip stands C and D, each supporting in their housings a pair of squeeze rolls supplied with suitable pressure attachments for squeezing all superfluous water from the warps as they leave either tank. In this manner we find the nip stand C of the hot water tank A carrying the bed-roll 1, mounted upon which is the pressure-roll 2, and which receives additional pressure, besides its own weight, exerted on its shaft from weight 3, through lever arrangement 4, 5 and 6. It will be readily understood, that by moving the weight 3 in or out on lever 4, previously to tightening the former onto the latter, a varying degree of pressure of roll 2 upon

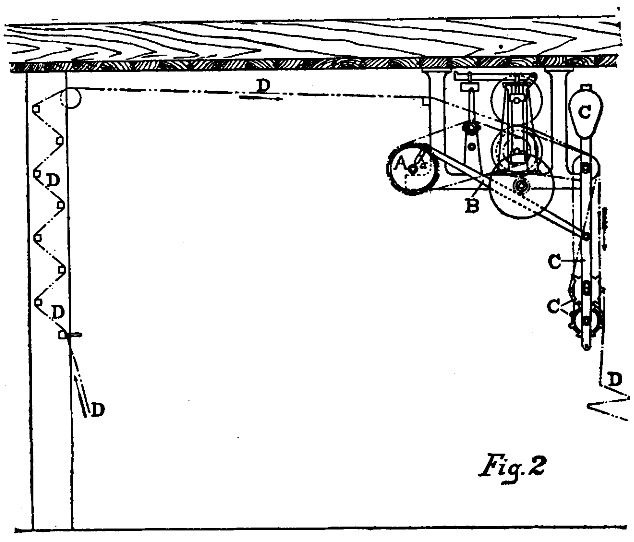
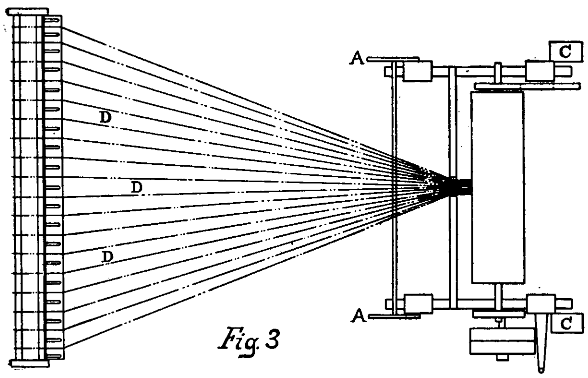


Fig.2

roll 1, *i. e.* upon the warps as passing between said rolls, is exerted; the amount of pressure required to be given, depending upon the amount of warp yarn treated in one run through the machine.

With reference to the squeeze rolls employed in connection with the cold water rinse tank B, we find in this instance a compound lever arrangement used, in order to be able to exert a heavier pressure, *i. e.*

free the warps treated more thoroughly from its water. D = nip-stand; 7 = bed-roll; 8 = pressure-roll; 9, 10, and 11 = compound levers, fulcrumed respectively at 12 and 13, and exerting pressure by means of weight 14 through lever 15 upon the shaft of the pressure roll 8, and thus upon the warp pass-



ing between rolls 7 and 8, in turn delivering said warps from the machine in the proper condition as to moisture required for the next operation. It will be readily understood that in connection with either set of squeeze rolls 1, 2 and 7, 8 the water thus squeezed out of the warps is delivered back to its own tank.

a^1, a^2, a^3, a^4, a^5, a^6 and a^7 are seven cylinders arranged in tank A, for leading the warp through the boiling (boiling out dirt) process. Roll 16 guides the warps into the cold water rinse, and cylinder *b* leads them through this rinse.

The machine is driven by tight and loose pulley, and is fitted with a neat and light, but strong overhead rigging, supporting the necessary pin rails *p*, reels *r*, etc., for receiving and delivering the warps. Two deliveries, #1 and #2, are only shown in the illustration for the sake of bringing the latter within compass of the page; three deliveries as a rule being supplied by the builders of the machine, this third, or an additional delivery, being a duplicate of delivery #2, with reference to rigging, pin rail and reel, the only difference being in the entering arrangement of the rigging and where the hangers of said section #3 (not shown) carry no pin rail, the same being applied to the end (last) hanger of the rigging (not shown). The end-joining (not shown) of the rigging at section broken out (right hand side of illustration) is identical to the join made and shown at 17 at the left hand side of the illustration. 18 is a guide roller for guiding, *i. e.* entering the warps from the overhead entry by means of pin rail *p′* into the boiling tank A. The direction of the run of the warps, from their entry into the room at E, through the machine, to the deliveries #1, #2, etc., is clearly shown by means of arrows accompanying the line indicating the run of the warps.

The cold water compartment, or tank B, is frequently omitted, but is of great value for certain classes of work, as it leaves the yarn thoroughly rinsed and cool, and prevents it from drying up before it can be dyed, and from mildewing when allowed to lie for some time before further treatment, especially in warm or damp weather.

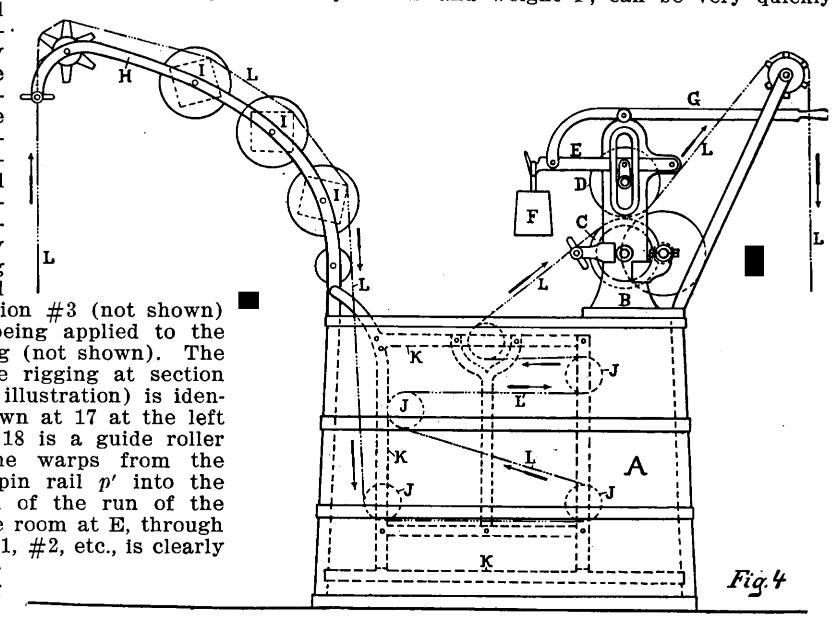
Q

The width of the machine depends upon the number of warps it is desired to handle. The machine shown in the illustration (plus a delivery #3 not possible to be shown) is fitted to receive and deliver 20 warps or skeins at a time, each consisting of 275 to 500 ends; but these machines are built and fitted by The Textile Finishing Machinery Company, to run 12, 16, 20, 36 and sometimes up to 60 warps or sections of warps at a time. They also build smaller and consequently more simple machines, to handle four or more warps only.

The Long Chain System. By this system the warps as they leave the boiling-out machine previously described, are dropped into boxes or cans and are next taken to a warp doubling machine, where each is doubled a certain number of times and reduced in length to say 400 to 1000 yards.

Fig. 2 is an elevation, and Fig. 3 a plan view of the warp doubling machine as built by the Textile Finishing Machinery Co., the same being designed to hang from the ceiling, and when consequently by its use very little floor space is required for this process. At its delivery end is a traverse motion A, B, and folder C for plaiting down (D) the warps into trucks. The amount of the traverse motion given to the folder can be regulated by adjusting the end of lever B higher or lower in the slot *a* of the disk A.

The warps are now ready to be dyed, which is done in round or Scotch dye tubs. Fig. 4 shows such a dye tub in its elevation, the warps being run through the tub from four to seven times, depending on the shade to be dyed. The standard Scotch dye tub, as shown in the illustration, consists of a round wooden tub A, 55″ diameter at the bottom and 41″ deep, fitted with iron nip stands B, supporting two squeeze rolls C and D, with pressure attachments (lever E and weight F), so arranged that by means of the handle of the long lever G, the pressure as exerted both by roll D and weight F, can be very quickly



removed while the ends of the warps are passing through the nip of rolls C and D, in order to avoid cutting the yarn.

On the entering side of the tub we find iron brackets H, with square beater or tension rolls I, and in the tub we find brass immersion rolls J, supported in brass frame K, for leading the warps through the dye-liquor. The run of the warps through the tub is shown by line L accompanied by arrows.

After being dyed, the warps are split out into their original length by a warp splitting machine, of which a plan view is given in Fig. 5. This machine consists of iron frames which support beaters, pin rail, etc. There are small iron frames to hang from the ceiling

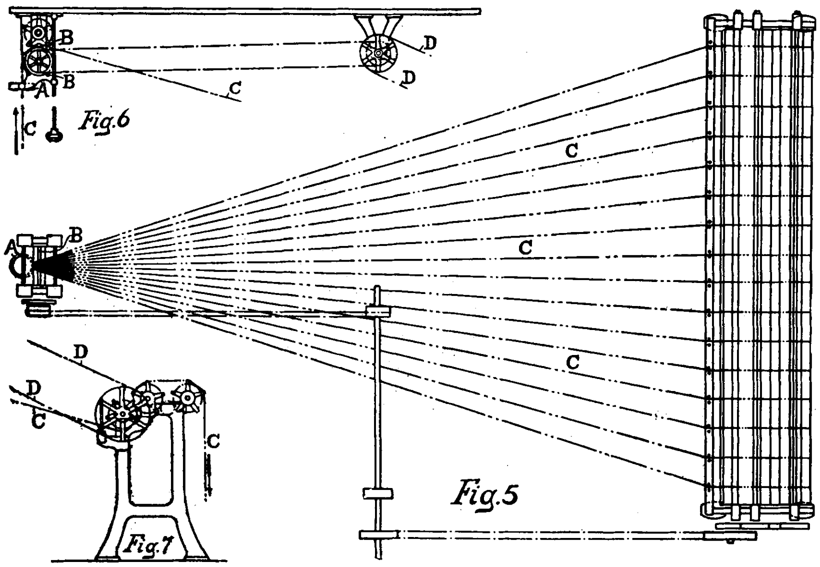


Fig. 6 Fig. 5 Fig. 7

to support pot eye A and small beaters B which draw the warps C up towards the ceiling from boxes or trucks placed on the floor. The driving of the machine is so arranged that the beaters on both frames or sections of the machine (receiving and delivery) start, stop and run in unison.

Fig. 6 is a detail illustration (elevation) of the receiving section of the machine, as is fastened to the ceiling, and Fig. 7 an elevation of the delivery section or frame of the machine. D in Figs. 6 and 7 = drive of delivery section from overhead frame.

The Short Chain System. By this system, the warps after being run through the boiling-out machine are taken direct to the dyeing machines, which are usually single compartment machines as shown in the accompanying illustration Fig. 8, which is an elevation of such a warp dyeing machine. However, in mills where large quantities of certain shades of yarn have to be dyed, two, three, four or even more compartment machines will be found advisable to be used.

Where the single compartment machine is used, the yarn is run through the same machine a number of times, depending upon the shade required, or it may be taken from one machine to another. The machine shown, consists of a wooden tub A, supported in iron frames B, to which are bolted the nip stands C, supporting two iron squeeze rolls D and E, which in the best machines, are covered with rubber and have attachments (levers F, G and weight H) for applying pressure. I, are immersion rolls for leading the warps through the dye-liquor. These warp dyeing machines are usually provided with a light but strong pipe overhead rigging, supporting the necessary pin rails J, bars K, and reels L, for receiving, running through and delivering side by side, four, six or eight warps, at a time, depending upon the width of the machine. The arrows in connection with line M indicate the run of the warp through the machine. When dealing with two or more compartment machines it will be readily understood that each compartment *i. e.* tub, is correspondingly provided with its own set of nip stands, squeeze rolls, immersion rolls, etc.

Indigo Dyeing Machine. It is of great importance that warps to be dyed with indigo should be properly prepared. This is best done on the complete warp boiling-out machine with the cold water rinse compartment shown and explained in connection with Fig. 1, as by the use of this machine, the yarn is left in the best possible condition to take the indigo.

There are many different arrangements of tanks and fittings for dyeing warps with indigo, but the arrangement shown in a general way in Fig. 9, and which is built by the Textile Finishing Machinery Company, is very largely used, is very convenient, economical and gives the best of results.

The vats are made up in sets of two, three, or sometimes four, with one overhead rigging for handling the warps for each set. These vats A, consist of cast iron plates, bolted together and are each 8′ long by 7′ deep by 30″ wide. For convenience in operating, they are sunk or let through the floor, so that the top is only a short distance above the floor.

The overhead rigging consists of a wooden frame B, which straddles the vats, and rolls (C) on a track so that it can be moved from vat to vat. This frame supports nip stands D, containing rubber covered squeeze rolls E, F, carrier rolls G, pin rail H, etc., and an immersion frame (shown in dotted lines) which by means of handle I through gears J and rope or chain connection K, can be raised from or

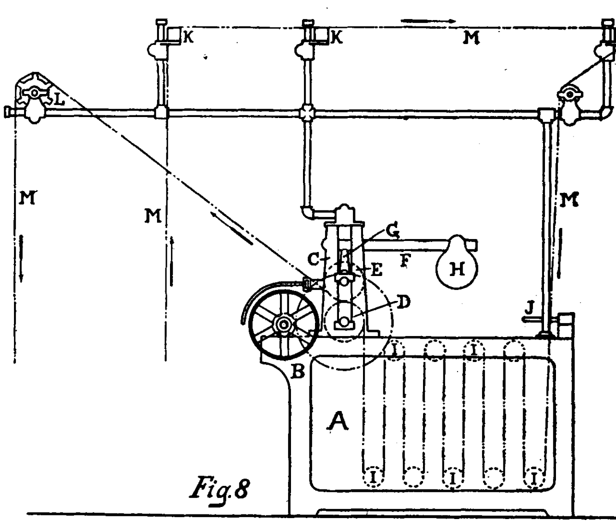


Fig. 8

lowered into the tanks A, and which supports the brass immersion rolls L, for leading the warps M through the dye-liquor. The warps to be dyed should be of such a length that they can be run through before it is necessary to stop the machine for any reason, as at noon or the close of the working day, since otherwise uneven dyeing will result. From three to four runs are usually given to the warps, they being dropped at the delivery end of the machine into trucks and allowed to oxidize between each run.

After dyeing the warps are dried on a warp drying machine.

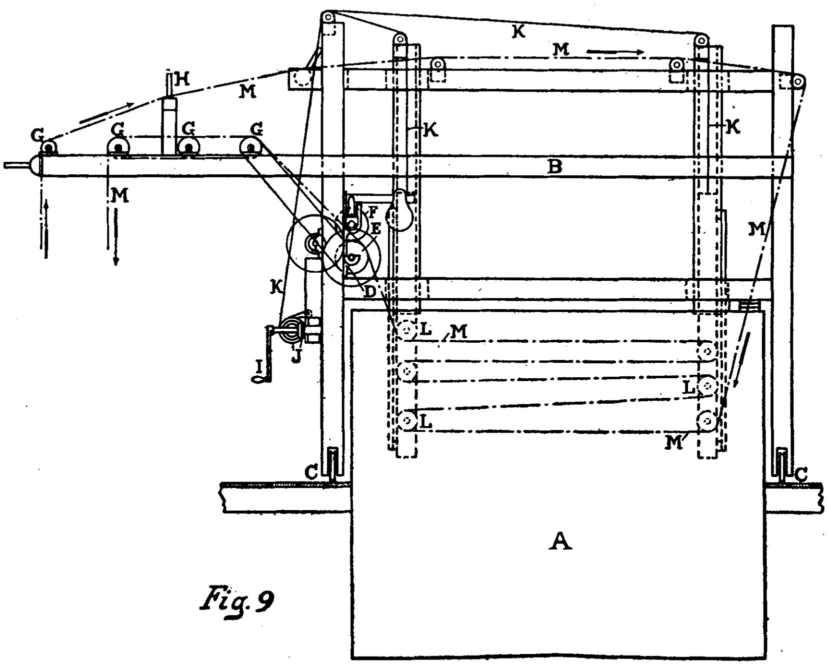


Fig. 9

Warp Drying Machines. Warps after they have been dyed by either the long or short chain system, and also warps which have been dyed in the indigo dyeing machine are then dried on a warp drying machine. While these machines vary considerably in size and capacity, what has come to be regarded as the standard machine for this work, consists of eighteen tinned iron cylinders arranged in two columns of nine cylinders each; each cylinder 144″ face × 23″ diameter. These upright drying machines, in mills where a large capacity is desired, sometimes have 22 cylinders arranged in two columns of 11 cylinders in each column, whereas for drying smaller quantities of yarn, drying machines with fourteen, nine, or even less cylinders are built.

Drying machines are also constructed of what is known as the horizontal type machine. Whichever style, these drying machines, as built by the Textile Finishing Machinery Co., are always very carefully constructed, with heavy iron frames, boxes and gears, and furnished with cylinders made from the best imported English tinned iron, having iron heads with vacuum valves and fitted with their patent spiral scoops (see special article on these spiral scoops in the Finishing chapter) for keeping the cylinders free of exhaust water. Usually these warp drying machines are fitted with pin rails, wooden drag rolls, etc., for handling two or four warps at a time, although sometimes cylinders are made 72″ face to run one or two warps only at a time.

Warp Sizing. After the warps have been dried on a warp drying machine, if for warp yarn, the same is run direct on a slasher beamer and then starched or sized on a cylinder slasher, built by the Textile Machinery Co., as is described on pages 186 and 187.

Filling yarn, while still in warps, however is sized on a sizing machine built especially for this purpose by the Textile Finishing Machinery Co. Such a machine is shown in its elevation Fig. 10, and consists of a wooden tub A, supported on iron legs B, fitted with iron nip stands or housings C, supporting nip or squeeze rolls D and E supplied with suitable pressure attachments (levers F, G and weight H), so that the warps will be thoroughly squeezed after being sized in the tub A, which for this purpose contains a brass immersion frame (not shown) which supports brass rolls I and the necessary brass guides for leading the warps J through the size (see arrows for indicating the run of the warps through the machine). These machines are sometimes made with a single compartment, but usually two compartments side by side are the machines mostly in demand, and when one compartment is used to size yarn dyed in dark shades and the other for the sizing of light shades. These machines are fitted with light, but strong, pipe overhead rigging K, carrying pot eyes L, guide rolls M and reels N, to receive, size and deliver one warp in each compartment. After being sized, the warps are again dried on a warp drying machine as used previously to this sizing process.

The warps are then taken to the quiller and wound on quills or filling bobbins. This process of preparing filling yarn for the loom is more economical if practised with the long chain system, the short chain system requiring too frequent threading up.

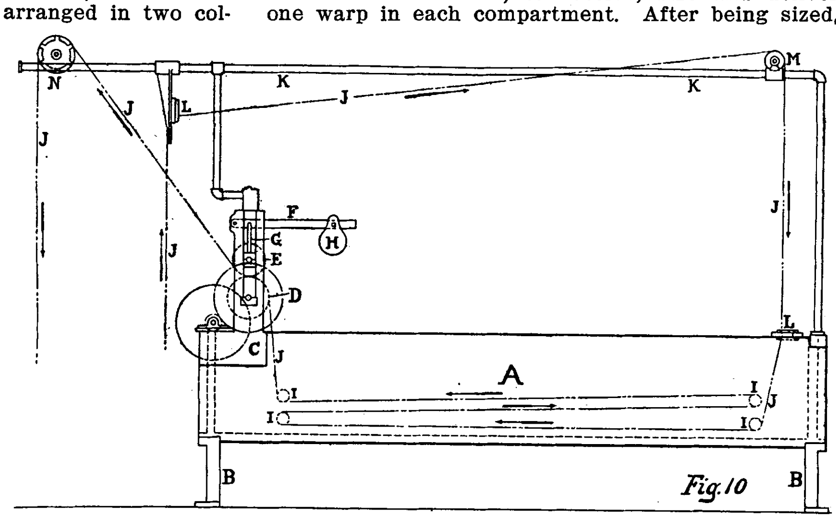


Fig. 10

PREPARING WARPS FOR CHAIN DYEING.

All manufacturers of colored goods, the yarns for which are bleached or dyed before using, are only too familiar with the constant annoyance and expense caused by the snarling and breaking of the yarn in the various processes of the dye house. Since the introduction of chain quilling machines, by far the largest part of cotton yarns, both warp and filling, have been colored in the chain, which, notwithstanding all its drawbacks, has been found on the whole the most economical method.

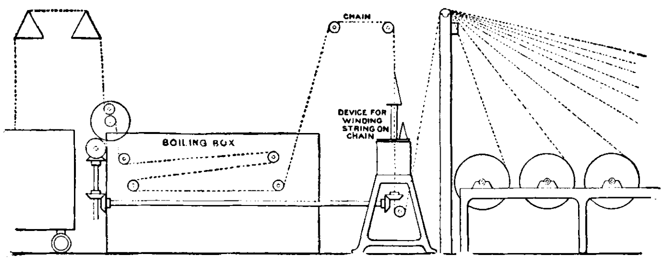


Diagram Showing the Winding-on Process.

The most difficult and unsatisfactory process in all manufacturing has hitherto been the rewinding or beaming of the colored or bleached chains after they are returned from the dye house. No one familiar with the manufacture of colored goods needs to be reminded of the endless number of broken and snarled chains, slack threads and twisted selvages, which are continually turning up in the beaming room, however carefully the dye house is managed.

There has long been an urgent need for some process or method by which the excessive damage done to chains in the dye house might be avoided, and the following processes of manufacture be thus rendered less difficult. This need has at length been supplied by the introduction of special machines and methods by the Draper Company, of Hopedale, Mass., by the use of which the snarling and breaking of chains in the dye house can be practically entirely prevented.

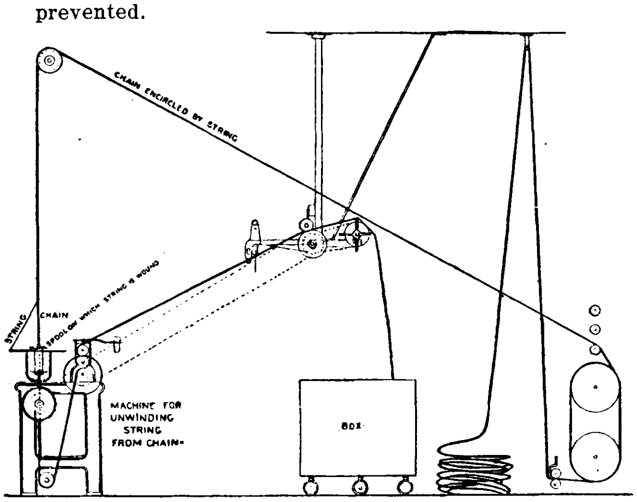


Diagram Showing the Unwinding Process.

The gist of the affair consists in winding or coiling around each chain from end to end a cord of suitable strength to hold the various threads together and prevent snarling and breaking in the dye house.

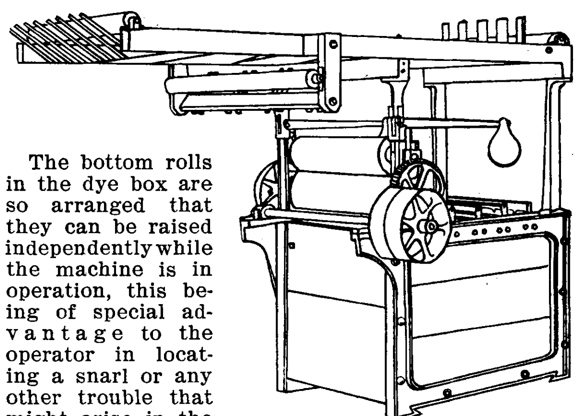
We believe we are well within bounds when we say that a net saving of at least one-half the whole cost of rebeaming may be readily made in the dressing room alone, and the gain in the weaving rooms, from the greatly improved preparation and the absence of knots and twists, should be nearly as much more.

This system of chain dyeing, including both the winding and unwinding process, is already in use by the principal mills that use colored warps, so that the field for further introduction is certainly somewhat limited.

The accompanying two illustrations, by means of their details given will at once convey to the reader a good idea of how said machines are used. We seldom have seen an idea introduced that won so prompt a recognition and gave so large a return on the capital invested. It certainly ranks with the most important of recent textile inventions. (Draper Co., Hopedale, Mass.)

BUTTERWORTH'S WARP DYEING MACHINE.

These machines are built of various sizes, for dyeing four to twelve cotton warps at one time, and are made complete with overhead frame, so the yarn can be fed and delivered from the same end.



The bottom rolls in the dye box are so arranged that they can be raised independently while the machine is in operation, this being of special advantage to the operator in locating a snarl or any other trouble that might arise in the liquor box. (H. W. Butterworth & Sons Co., Philadelphia, Pa.)

HUSSONG'S DYEING MACHINE.

The object of this machine is to dye the yarn in the shape of skeins, the construction and operation of it being readily seen by the accompanying illustrations, of which Fig. 1 is a longitudinal sectional view of a portion of this dyeing machine, and Figs. 2 and 3 detail illustrations (enlarged compared to Fig. 1).

A indicates the dye-vat, having an end compartment at *a* (but none at the other end of the machine), in which is a circulating wheel B, and under the compartment for the hanks of yarn is a circulating chamber C, so that the dye-liquor is kept in constant circulation. The partition D is perforated. E is the carrying frame for the yarn, consisting of two side members, one on each side of the frame (only one F, being shown in the illustration). The side member F, as illustrated in detail illustration, Fig. 2, consists of two longitudinal bars *a*, secured together at intervals by bolts, while the side member (not shown) is a single frame. These two side members have each near their end, an extension G, coupled to longitudinal bar H, which is in turn attached to cross bar I. On these bars are eyes J, with which engage hooks K, carried by chains L, for raising the yarn-carrying frame E out of the dye-liquor when so required.

Extending from one side member F to the other (not shown), is a partition having a series of perforations therein, which allow the dye-liquor to pass onto the upper portions of the hanks of yarn. The two longitudinal bars *a*, are perforated at intervals, and form the bearings for the worm wheels N, which have extended hubs *b*, mounted in the bearings in the longitudinal bars *a*, the teeth of the worm wheels extending between the two bars, as are shown in

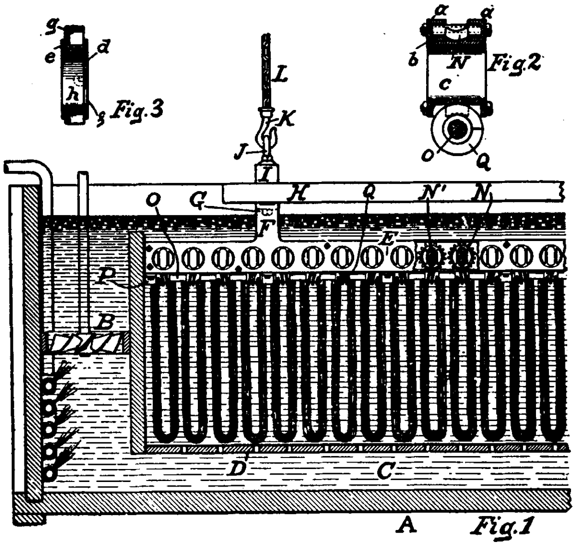


Fig. 2. Each worm wheel N is slotted at *c*, for the reception of the end of the dye sticks, on which the hanks of yarn are mounted. O is a longitudinal shaft running the full length of the carrying-frame E, being secured to the side member F by bearings P. On this shaft O, are worms Q, which mesh with the worm wheels N, as clearly illustrated in Fig. 1. One end (not shown) of the shaft O is shaped to fit a suitable handle, so that when the yarn frame is raised, this handle can be applied to turn the shaft O, which will, through the medium of the gearing thus described, turn the dye sticks (which are oblong in cross section, see N′ in Fig. 1), and thus will change the position of the hank of yarn on said dye sticks, allowing in turn an even dyeing of the hanks under operation.

The worms Q are alternately arranged right and left, so that every other dye stick, with its hank, will turn in one direction, while the others will turn in the opposite direction.

The other side member of the carrying-frame E, as cannot be shown in Fig. 1, is simply a single frame, and mounted in this frame, see Fig. 3, are disks *d*, each having a flange *e* at one side, and secured to the disk is a cap plate *f*, which holds the disk in position in the side member *g*, as illustrated in Fig. 3. The disks are slotted at *h*, to receive the ends of the dye sticks. This construction of a dyeing machine permits a ready removal of the dye sticks when it is desired to change a batch of yarn. The carrying-frame is comparatively light, and therefore can be readily raised and lowered by suitable arrangements. (J. Hussong, Camden, N. J.)

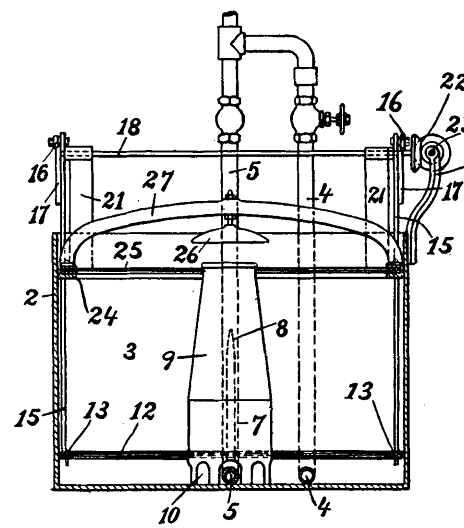
KERSHAW'S DYEING MACHINE,

for dyeing, mordanting, or similarly treating with liquids, wool, slubbing, yarn, and other fibrous material, is shown in the accompanying illustration in its section.

The vat 2 has an end partition 3 fitted at the end where the steam pipes 4 and 5 enter the machine, in order to keep the material from actual contact with the pipes. The pipe 4 runs along the bottom of the vat, and is perforated along the horizontal part, for heating the liquid in the bath by the emission of steam. The other pipe 5, runs along the centre of the bottom of the vat, and in an average size of machine has three vertical branches 7 terminating in nozzles 8. Only one of these branches 7 can be shown in the illustration, the others being duplicates, at proper distances apart, throughout the length of the machine. These branches 7, are surrounded by hollow cones 9, secured to the bottom of the vat, but having a number of openings 10 all round the bottom. A false bottom 12, of wirework or other reticulated material, is supported on the frame 13, fitting the bath above the pipes 4 and 5; and this frame is supported at each of the four corners of the machine, by vertical rods 15, extending above the bath, each having an anti-friction roller 16 at the top, each resting on an eccentric 17, carried by the two end shafts of the machine, one on each side of it.

The rods 15 have slots at the top, fitting the shafts 18, and are supported by bearing standards 21, being coupled together by the bevel wheels 22 at each end of the back shaft 23. When the shafts are put in motion, the eccentrics are rotated, thereby raising and lowering the rods 15, and with them the perforated false bottom 12. The shafts are driven by a worm wheel, together with a worm and driving pulley (all not shown in the illustration). Holes are made in the false bottom 12 to admit the bases of the cones 9, which latter are cylindrical to the height the bottom 12 rises.

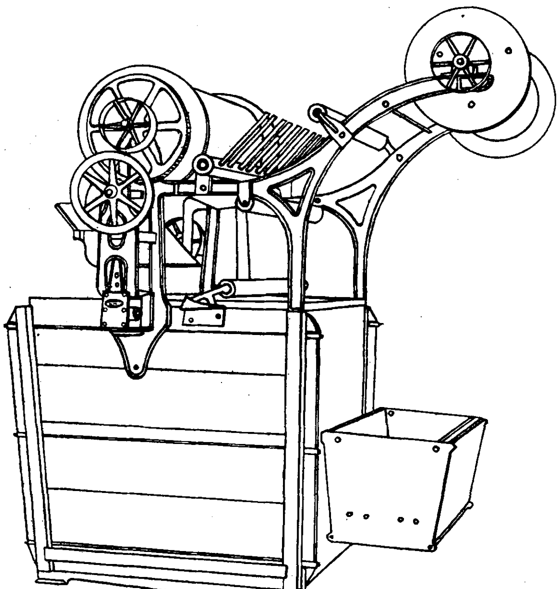
The material to be mordanted or dyed, is placed evenly in the vat 2 on the false bottom 12, and is packed more or less up to the internal flange 24, surrounding the vat, and a wirework cover 25 (made in two or more sections) is secured to the flange 24 by turn buttons, secured to the flange and turned across slots in the sides of the cover 25. Holes are formed in the cover for the tops of the cones 9.



When steam at a suitable pressure is turned onto the pipe 5, it is discharged at the nozzles 8 with sufficient force to carry a constant stream of liquid out of the tops of the cones, and such streams, meeting the concave deflectors or spreaders 26, are broken up into small jets or spray and evenly distributed over the cover and percolating through the material again enters the cones and is again distributed, thus maintaining a constant circulation. At the same time the false bottom 12 can be raised and lowered to alternately increase and relax the pressure on the material. The increase of the pressure and the relaxation thereof taking place from below, enables the material to readily open out or expand as the pressure is relaxed. The deflectors 26 are carried by bridge or span pieces 27, secured to the sides of the covers 25. (Joe Kershaw, Bradford, Eng.)

BUTTERWORTH'S PIECE DYEING MACHINE.

The accompanying illustration shows this machine, as used for the dyeing of worsteds, etc., in its perspective view, the same being a machine of unusually substantial construction. They are built usually in two sizes, for handling six and eight strings of cloth.



After dyeing, the cloth is passed through a cooling box, shown in front of the dyeing machine.

The driving can either be by engine as shown, or by friction clutch and chain wheel when driven by the power of the mill. (H. W. Butterworth & Sons Co., Philadelphia, Pa.)

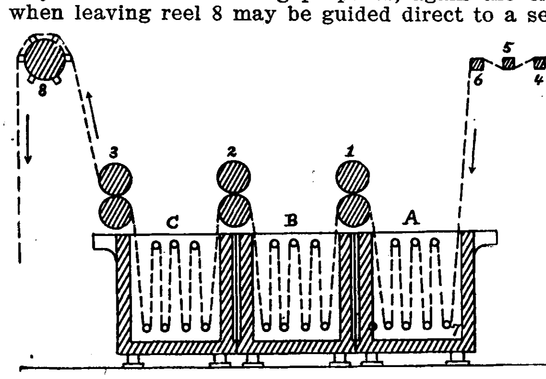
THE ARLINGTON BOX DYEING MACHINE

For the Continuous Dyeing of Cotton Fabrics.

Unlike the dye jig, as previously explained, and where the pieces enter the dye vessels perpendicularly, and return in same direction, the pieces in the box dyeing machine are made to travel over rollers fixed in cisterns beneath the surface of liquid, until delivered at the end of the course.

This machine is arranged to have one or more wood cisterns, three of which are shown in the accompanying illustration, representing a 3-box machine, in its section, each wood cistern or box A, B, C, laid in successive order, and having a series of seven small guide rollers, with a pair of nip or squeeze rollers 1, 2 and 3, placed over the joints of the various boxes for the purpose of drawing the cloth and squeezing the dye-liquor thoroughly into the pores of the fabric, and at the same time any surplus liquor back in its respective tank.

The pieces of cloth, after being sewn end to end, so as to form a continuous chain, are entered in the machine through overhead tension rails 4, 5, 6, and then under first guide roll 7 beneath the surface of liquor in first box A, and in turn circulated, as shown by dotted lines, throughout the whole length of the machine, *i. e.* as many boxes as there are used, and laid upon a truck on the floor of the dye house, by reel 8. One of the boxes shown or an additional box may be used for washing purposes, again the cloth when leaving reel 8 may be guided direct to a sepa



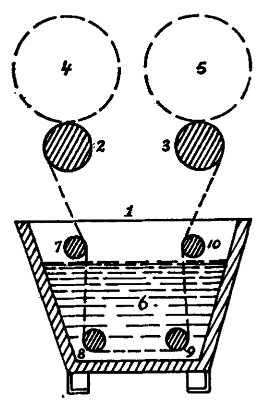
rate washer, in fact any arrangement of advantage to the mill may be used.

The housings of the squeeze rollers 1, 2 and 3 are mounted on specially designed side frames independent of wooden boxes, and are supplied each with top lever and weights for applying pressure to nip of rollers. Hand wheels and screws for lifting rollers are also provided. The whole arrangement is driven by side shaft and bevel gears through bottom roll. (Arlington Machine Works, Arlington Heights, Mass.)

THE ARLINGTON DYE JIG

For Dyeing Cotton Fabrics.

The accompanying illustration shows a section of the machine, the same consisting of a wooden tank 1 with cast iron side frames of suitable design, upon which are mounted two rolls 2 and 3, located sufficiently apart from each other to enable the operator to observe the correct routine of cloth, and to see that it undergoes an even and complete saturation in the dye-liquor.

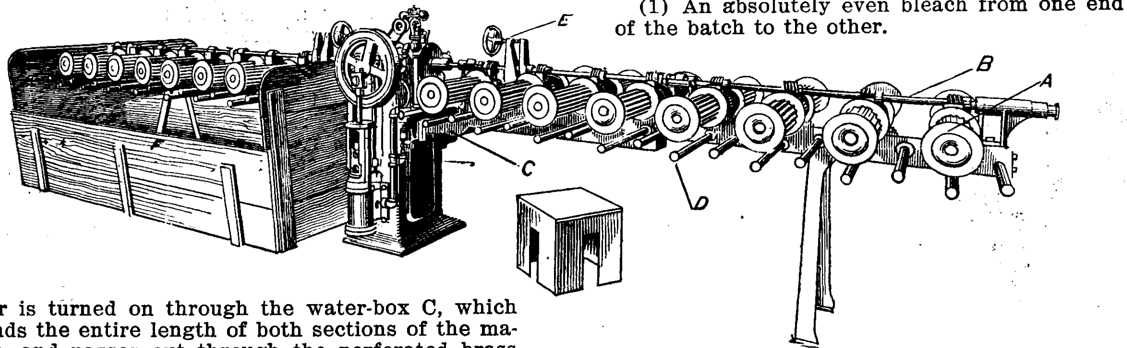


The reel of cloth 4 or 5 is placed on the surface of one of the rolls 2 or 3, and is thus made to revolve by frictional contact. The cloth (indicated by dotted line) is drawn by this method back and forth from roll to roll, guided in this travel through the dye-liquor 6 by small rolls 7, 8, 9 and 10, as often as may be required in establishing proper shade or color up to sample. The machine is driven by line shaft, mitre gear, and clutches. (Arlington Machine Works, Arlington Heights, Mass.)

THE WEBENDORFER SILK SKEIN WASHING MACHINE.

A most rapid and economical method of washing skein silk after dyeing, etc., is by means of the machine shown in the accompanying illustration; the operation of which is as follows:

The skeins to be washed are first hung loosely on the porcelain rollers A, the rollers on both sides of the machine being entirely filled with silk skeins before the machine is started up. The porcelain rollers are revolved through a worm and gear motion, said worms being on, and consequently operated by a shaft B running the entire length of each section of the machine. As soon as the rollers A are started,



water is turned on through the water-box C, which extends the entire length of both sections of the machine, and passes out through the perforated brass pipes D, extending horizontally from the water-box, and which are so located that each and every skein is deluged with water on both sides. This washing is continued as long as may be deemed necessary, in order to remove the surplus dye-liquor, etc., from the skeins, generally two or three minutes being necessary, and when one section of the machine is stopped by tightening the brake E, the silk is removed, and replaced by a fresh lot, and the operation is repeated.

During the washing of the silk, the porcelain rollers revolve, without interruption, in alternate directions, for short periods of time, first in one direction and then in the other, so that thorough washing of all parts of the silk is assured.

As will be seen from the illustration, the machine is built in two sections, precisely alike in construction, one to the right and the other to the left hand side of the engine for operating the machine. The machine thus operates continuously, one section washing, while the other is being loaded and unloaded with silk.

The rollers A are made of a highly glazed porcelain, and the water-pipes are of heavy brass, with brass caps.

In order to prevent water from running about over the floor, boxes F, open at the bottom, surround each section of the machine, only one being shown in the illustration in the left hand section of the machine, the other being taken away to show the construction of the machine more clearly. (Webendorfer Machine Co., Paterson, N. J.)

BUTTERWORTH'S BLEACHING MACH'Y

For Treating Textile Fabrics in the Open State.

In the bleaching of Heavy Sateens, Drills and similar goods, precaution and care have to be observed to obtain good results. The ordinary method of bleaching such goods—namely, running them through bleaching boxes in rope form—has many disadvantages. Probably the chief of the objections to this form of bleaching is that it is impossible to prevent the selvages curling. Another objection of only slightly less importance is that the face of the cloth is caused to break up or crack, producing a very undesirable effect. To obviate these defects, open bleaching had been instituted, it being performed by passing the cloth continuously, at its full width, through a number of ordinary cisterns; but the defect of this system is, that no pressure is brought to bear upon the cloth, and it is therefore, slow and laborious.

We illustrate herewith the modern, Jackson & Hunt's patent, open bleaching kier, as built by the H. W. Butterworth & Sons Co., Philadelphia, along with its necessary adjuncts, bleaching and souring machines and which by means of any number of machines at work, both here and abroad, has proven the following advantages:

(1) An absolutely even bleach from one end of the batch to the other.

(2) Selvages which have a tendency to curl are prevented from so doing, and after treatment in the kier will remain straight for subsequent processes.

(3) The face of the cloth is not broken.

(4) A better width is obtained than in rope bleaching.

(5) The cloth is "fuller" and less punished than in ordinary bleaching.

To take the machines in order, dealing with the first to operate upon the cloth, we find in Fig. 1 the preparing and batching machine, shown in its section, and in which machine the fabric is wound into a hard reel of cloth or batch. Examining this illustration we find the cloth fed in at the place indicated by arrow A, and from where it then passes under

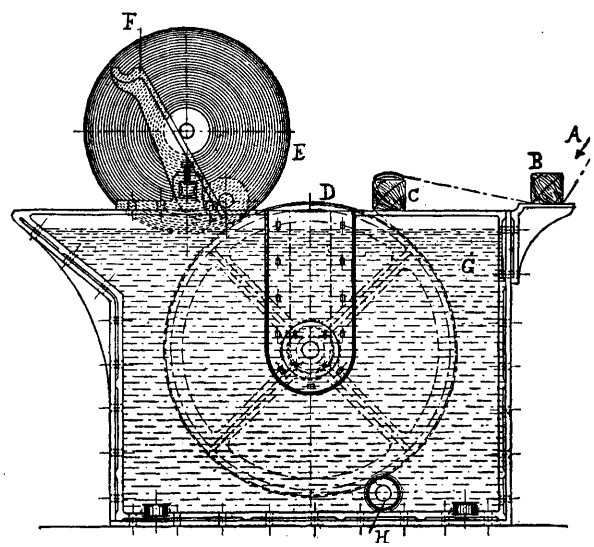


Fig. 1.

and over tension rolls B, C, and then around and under a metal drum D. It is then wound on a small metal drum or roller, which is arranged to slide up an incline F as it fills itself with the reel of cloth E.

The weight of the small drum keeps the growing reel of cloth or batch tight and in close contact with the large drum D, so that the cloth is wound in a regular and perfectly straight manner. The cistern G is made of cast iron and filled with caustic liquor which has previously been used in the kier. A perforated steam pipe H arranged along the bottom of the cistern G keeps the liquor at the required temperature, and also serves to drive it through the cloth as it is traveling around the drum D. One preparing and batching machine is sufficient to deal with the production of two or three kiers.

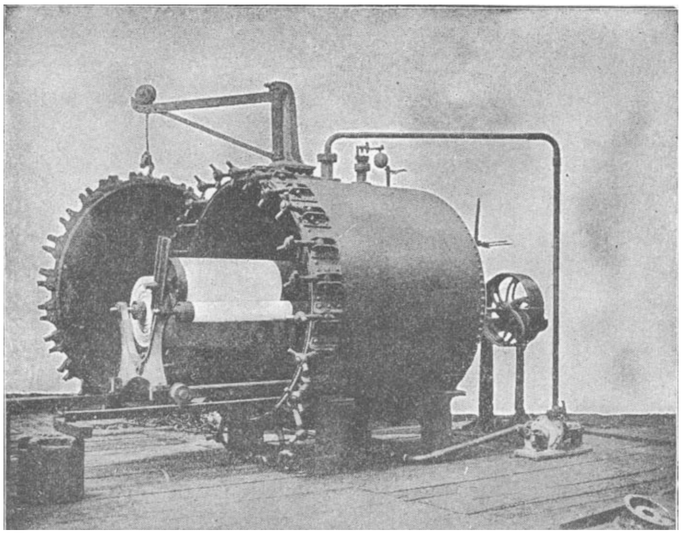


Fig. 2.

The prepared batch or reel of cloth with its metal roller, upon which it is wound, is then taken to the patent open bleach kier, shown in Fig. 2. As will be seen, the kier is fixed in a horizontal position, being made of steel plates, strong enough to stand

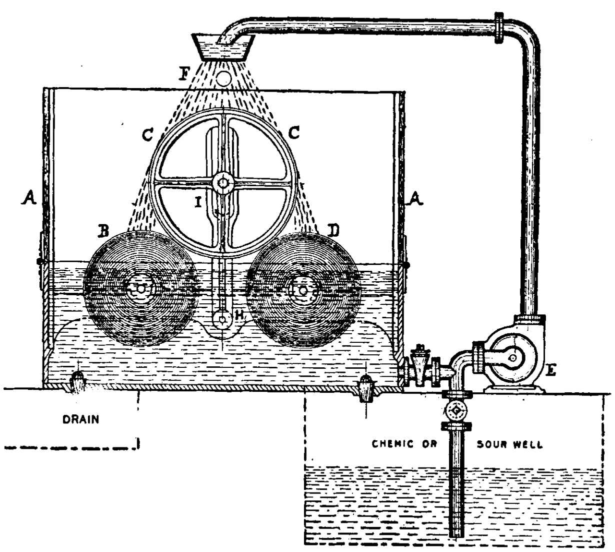


Fig. 3.

a working pressure of 60 lbs. to the square inch. A jib crane is employed to swing open the door, as required, it being so mounted that its attachment or detachment is easily accomplished. The cloth in the form of a batch is placed in position on a wagon, which, when run into the kier, automatically couples with the driving and reversing gear at the back. A drum is placed between the full and empty batch roller, remaining in contact with both, all the time winding is going on. Upon the door of the kier being closed, caustic liquor is run into the kier by means of a centrifugal pump, and steam pressure is applied until a pressure of 40 lbs. is obtained. The cloth is wound from one batch roller to the other, and vice versa, for a space of two hours. In the meantime a force pump is constantly circulating the liquor, drawing it from the bottom of the kier and delivering it in a shower on the top of the moving cloth.

Suitable mechanism is provided for automatically reversing the winding when the cloth on batch rollers is within a few yards of the end. At the end of this time, steam is turned off and the liquor drained out, when the door can be removed and the batch taken out and carried to the chemicing and souring machine. In the meantime another batch is placed in the kier, and the process progresses as explained before.

Some cloths, for example, plain blacks, require nothing but a washing after leaving the kier, but for chemicing and souring goods, the machine shown in Fig. 3 is used. The mechanical arrangements are identical with those in the interior of the kier, only the process is, of course, in this case carried out without pressure. A is a cistern into which the reel or batch of cloth is placed, B and D show this batch about one-half wound and unwound, respectively, the cloth continually being wound from one small wood roll to the other, *i. e.* within the last few yards at either end. During this winding process the cloth is made to pass over the wood lagged drum C, as carried by oscillating levers or arms I, which are free to move from side to side, being pivoted at H. As the arms have an open jaw at the top, the drum C adjusts itself to the increasing and decreasing sizes of the batches as the cloth is wound on and off. The object sought by this arrangement is that of keeping the cloth always at the same tension and free from the creases. It also brings pressure to bear upon the cloth, squeezing the liquor through it. In order to facilitate the removal of the batches from the cistern, the sides are provided with hinged doors. E is the pump and F the spurt pipe, as used for washing the cloth when the acid, or other liquor, is removed from the cistern. (H. W. Butterworth & Sons Co., Philadelphia, Pa.)

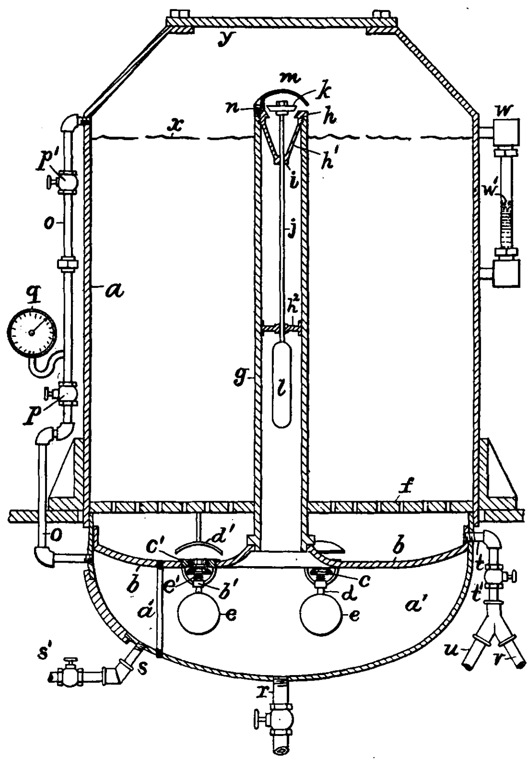
TYMS' BLEACHING KIER.

In this kier the liquor is discharged from a chamber in the bottom of the tank through a stand pipe to the upper part of the tank and thereafter circulated downward through the goods and upward through the stand pipe by variations of pressure arising within the tank and chamber.

Examining illustration given, which is a vertical section upon the centre line (where hatched) of the bleaching kier, we find a tank *a* provided near the bottom with partition *b*, having apertures in which valve seats c^1 are secured. Each seat is provided with arms to sustain a guide b^1 for the stem *d* of the valve *c*, which is supported upon the guide by spiral (cushions) spring e^1 when not pressed upwardly against the seat by a float *e*, attached to the valve stem. A grating *f* is fixed in the tank for supporting the goods to be bleached. Each of the valve seats c^1 is protected by a guard plate d^1, which is suspended from the grating and serves to prevent lint and other particles, which work down through the grating *f*, from falling directly upon the valve.

A stand pipe *g* is fixed in the middle of the partition and has a valve seat *h* secured within its top, being provided with downwardly extending arms h^1, having a guide *i* for a valve stem *j*. The top of the stem is provided with the valve *k*, which opens upwardly from the seat *h*, and the bottom of the stem is provided with a float *l*, which is suspended below the middle of the stand pipe. A guide h^2 is fixed in the stand pipe and fitted to the stem *j* just above the float. Guard *m* is fixed above the valve seat *h*, being sustained upon three studs *n*, through which screws are passed into the valve seat to support the guard with its edge above the seat to permit the escape of the liquor. A glass water gauge *w* is connected with the side of the tank near the upper part, and a pipe *o* connects the upper part of the tank with the chamber a^1 and with a pressure gauge *q*.

Cocks *p* and p^1 are placed above and below the pressure gauge, and the opening of each in turn serves to indicate the pressure in the part of the



kier with which such cock is connected. *r* is a waste pipe connected to the bottom of the chamber a^1. A steam pipe *s*, with cock s^1, is also connected to the chamber, and the tank next above the partition *b* is connected with a pipe *t*, having cock t^1 and branches *u* and *v* for supplying water or liquor, as may be desired, to the kier.

The operation of the kier is as follows: The goods to be bleached are placed in the tank *a*, which may be filled to the level indicated by broken line *x*, and the cover *y* of the tank is then tightly closed. Before any liquor is introduced the check valves *c* are held open by their weight and that of the float *e* as shown in the illustration, but the valve *k* upon the stand pipe is closed by its weight and that of its float. Liquor is then introduced through the pipe *t* above the partition *b* and flows through the open valves *c* into the chamber a^1, until the liquor raises the floats and closes the valves *c*, after which the liquor is supplied to the tank above the partition until it reaches a level somewhat below the top of the goods, as indicated by the line w^1 in the water gauge *w*. The cock t^1 being closed, the cock s^1 is opened, and the steam admitted to the chamber a^1 being confined therein by the closed valves *c*, rises in the stand pipe *g* and opens the valve *k*. The upward movement of the steam carries more or less of the liquor therewith and produces a constantly increasing pressure in the upper part of the tank. The liquor is not raised by the steam until it is thoroughly heated and boiled, so that the ebullition raises it to the bottom of the stand pipe, and it is then carried upward by the steam, raising the valve *k* in its passage, which promotes the upward flow of the fluids, as the upper part of the kier is at much lower pressure than the chamber a^1.

When the level of the liquor is lowered sufficiently by its upward discharge, the floats *e* drop and the valves *c* open, and as the pressure becomes equalized in the upper and lower parts of the kier the valve *k* closes. The liquor which is thus raised from the chamber a^1 above the goods, percolates gradually downward through the same and through grating *f*, and descends through the valve seats e^1 into the chamber a^1. When the liquor accumulates sufficiently to close the valve *c*, the pressure rises in the chamber a^1, as before, and drives the liquor from the chamber upward again through the stand pipe, opening the valve *k* and discharging the liquor upon the top of the goods, after which the intermittent movement of the liquor is continued, first upwardly through the stand pipe, and then downwardly by percolating through the goods until the valves *c* are closed. (John C. Tyms, Garfield, N. J.)

ALLEN'S BOILING AND BLEACHING KIER.

This improved kier, as it exists to-day, is not the design of a moment, but the combination of a practical knowledge of boiler making, guided for years by suggestions of operators of the leading bleaching plants all over New England.

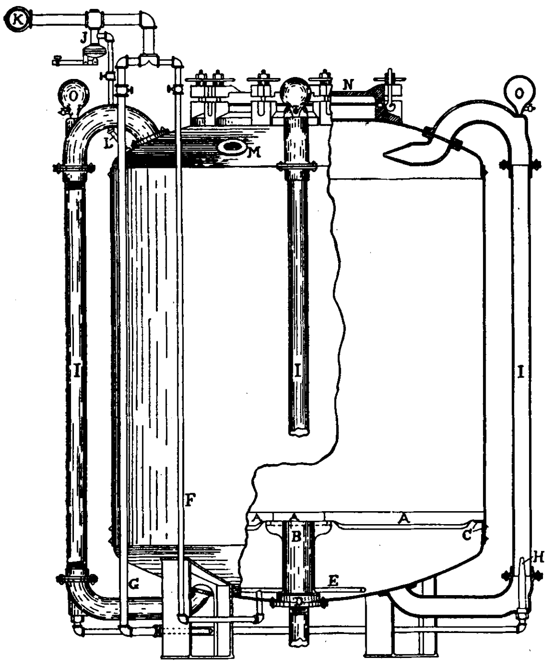
The bleaching of goods depends principally upon (1) the rapidity of circulation of the liquor through the goods, (2) the even distribution of this liquor during its circulation, (3) the temperature of the liquor, and (4) the strength of solution.

(1) Rapidity of Circulation. In the Allen Kier, the circulation is caused by the condensation of the steam as it leaves the projector points, causing a decrease of pressure in the vomit pipes, drawing the liquor from the basin to this point where the velocity of the issuing steam forces upward the liquor already in the pipes. Both of these actions are positive, and do not depend upon the working of any valve or part, nor upon the natural ebullition of the liquor. The liquor is forced through the pipe on to the top of the goods by a positive action, which can in no way fail to work, and is *independent of the working pressure* of the kier.

(2) Even Distribution of this Liquor During its Circulation. If the circulation of the liquor through the goods is uneven, that is, if more liquor passes through the goods at one point than at another, that point receiving the greater amount of circulation and having the greater chemical action will have the better boil. In order to obtain an even distribution of this liquor, it is essential that there should be sufficient liquor at all times on top of the goods to cover them, and deep enough to supply the downward trend of the liquor, without interruption at any point.

This quantity of liquor on top of the goods is easily maintained in the Allen Kier, by the positive and rapid flow of liquor in the outside vomit pipes, as previously described. It is absolutely essential for the even circulation of the liquor to have the kier evenly loaded and uniformly packed, for which one point should be as accessible as another, and there should be no chance to form channels down through the goods.

In the Allen Kier, the entire interior is free and clear, giving ample opportunity to spread the goods evenly, and pack with equal pressure, a feature not possible in connection with other styles of kiers where a centre vomit pipe is used, or any form of a kier having pipes or other parts passing up through the goods, since such pipes or parts form a natural channel down through the goods, for the liquor to flow more freely than in other parts of the kier. Having the entire interior in the Allen Kier free and clear, naturally there is nothing to interfere with the treading down of the goods, and the packer will be able to walk all around and all over the cloth, in turn giving a uniform density throughout the thus packed cloth. This is impossible to be done in other makes of kiers where there is a pipe passing up through the goods, and where there is a tendency for the packer to always walk more or less in a ring



around this pipe, leaving a space close to it which has not been thoroughly trodden by him, and which means a less density of cloth in such places, giving in turn a chance for the liquor to flow in such places more freely, and which consequently will result in an uneven boil. Again the advantage, *i. e.* convenience, of having a perfectly clear space inside the kier for loading and unloading the cloth will be readily understood.

(3) The Temperature of the Liquor. With wooden or iron open kiers, it is impossible to boil at more than atmospheric pressure, which means a temperature of the liquor of 212° F., whereas with the Allen Boiling and Bleaching Kier, which is operated under pressure, the boil can be run at 15 to 20 pounds pressure, which means a temperature of 250 to 275° F.; however, since these kiers are constructed to withstand a working pressure of from 60 to 80 pounds, if so desired, they will permit the temperature to be raised to 300 or 325° F., a feature which in connection with some classes of fabrics is of great benefit, besides the extra thickness of the material adds greatly to the life of the kier. In kiers, as previously referred to, having internal vomit pipes, the temperature throughout the goods cannot be kept even, since the upward flow of liquor is considerably hotter than that which has been distributed and is coming down, for which reason the goods in the immediate vicinity of this pipe will be several degrees hotter than at any other point, a feature which again will produce an uneven boil.

(4) Strength of Solution. The thorough and rapid circulation in the Allen Kier, makes it possible to use in connection with this kier, with equal results, a much weaker solution than could be used in other kiers not having this rapid and even circulation of the liquor, and since a weaker solution means less chemicals required for treating a given amount of goods, besides retaining more of the natural strength of the goods. Mills using this kier report a saving of about 75% in the amount of chemicals required for the boil, as compared to those styles of kiers where a centre vomit pipe is used, and from 10% to 20% in comparison with other makes of kiers. It might be well here to also mention the fact that on account of the rapid circulation of the weaker solution permissible to use, and the superior construction of this kier, only from 50% to 75% of the time as that necessary in connection with other types of kiers is required for the procedure.

A Description of the Construction of this Kier is best given by quoting letters of reference accompanying the illustration, showing this kier in its side elevation, partly in section, and with a portion of the shell removed to show its interior construction. In this illustration A indicates the grate, or false bottom, supported in its centre on a cast iron stand B, and at its circumference on an angle iron C, riveted to the shell of the kier at the outside. D is a bottom flange, tapped for 4″ pipe connections for blow off; however, when so desired, connection can also be made to this flange for filling the kier. E is the boiling pipe, being a circular pipe, perforated with ¼″ holes, and F is its supply pipe, supplying steam to the boiling system. G is a circulation supply pipe, which supplies steam to the projector nozzles H, whose peculiar construction and formation cause the rapid circulation of liquor in this kier. I are the outside vomit pipes and J the reducing valve, which reduces the pressure on the main steam line to that desired in the kier. K indicates the main steam supply pipe for the bleach house, L the low pressure connection, for pressure regulator, M the safety valve flange, N the manhole, and O the air chambers.

The shell of the kier is made of tank steel, of 60,000 lbs. tensile strength, with flanged steel heads of 55,000 lbs. tensile strength. The castings are all heavy, and made of best grey cast iron. The shell seams of the kier are of the double riveted butt joint type, with outside covering straps. As the rivets are countersunk on the inside, there is consequently a perfectly smooth surface where the goods come in contact with the kier.

The Operation of the Kier is very simple: In starting, open the valves on pipes F and G, which will cause the kier to boil quickly. The lever of a safety valve (not shown) connected to flange M, must be left up, so that the air pressure on top of the goods can escape as the boiling commences. When steam escapes from the safety valve, drop the lever, thus closing the safety valve, and then partly close off the valve on the pipe F, leaving the projector pipes wide open. Leave them in this position until the steam gauge begins to register, then partly shut off the supply for the projector nozzles H. The final adjustment of the valves on pipes F and G can only be determined by experiment, permitting in some instances the pipe F to be shut off entirely, the steam necessary to run the projector nozzles being in this instance sufficient to keep the kier boiling, however in most instances, this valve must be left open a very little. The valve on pipe G, and which governs the projector nozzles, should be shut off until the nozzles throw the liquor up through the pipes in a continuous stream, which is determined by opening the pet cock in the air chamber, and provided the valve on pipe G is open too far, there will be sputterings of steam and liquor from the pet cock, on the other hand, if it is closed down too far, nothing but steam or air will appear; again when the valve is closed to its proper point, nothing but liquor will appear at the pet cock. This point when once determined by the operator is always the same. The safety valve should be set to blow at the desired working pressure, and in case the pressure should get beyond this point, and blow too freely through the safety valve, then close down the boiling pipe F.

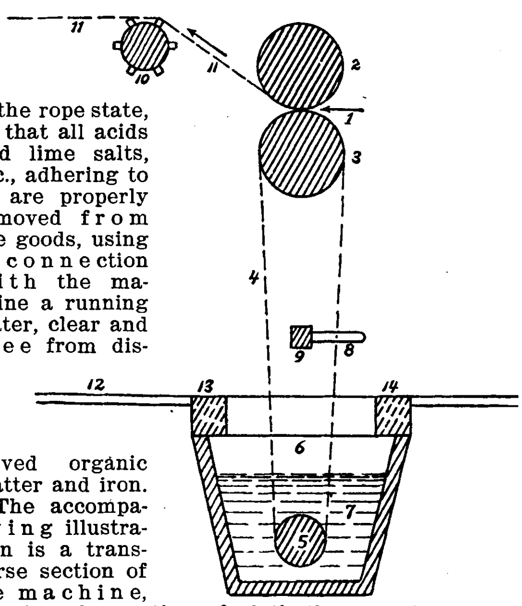
When working properly, the safety valve should not remain perfectly tight, but when up to its proper pressure should shake slightly and blow steam at short intervals, until the boil is finished.

In a great many bleach houses, it is customary on cotton goods to have the water valve connected to the tee on the under side of the safety valve. This pipe is used for washing out the goods after they have finished boiling, and also to cool the kier down as quickly as possible. When boiling under 15 pounds or over, there is a liability, if blown clear off and not cooled down, of stains showing in the goods when finished, due to the high temperature.

In regard to the time of boiling and the strength of the solution, these are questions which each bleacher has to decide for himself, as they vary on different goods. The common way is to boil with the strength to which they have been accustomed for the first two or three boilings, and to reduce the strength and time of boiling gradually, to the point at which the desired results are obtained. (Wm. Allen Sons Co., Worcester, Mass.)

THE ARLINGTON BLEACH HOUSE WASHER.

The object of this machine is to thoroughly wash the cotton cloth as coming from the bleaching kiers, in the rope state, so that all acids and lime salts, etc., adhering to it, are properly removed from the goods, using in connection with the machine a running water, clear and free from dissolved organic matter and iron.



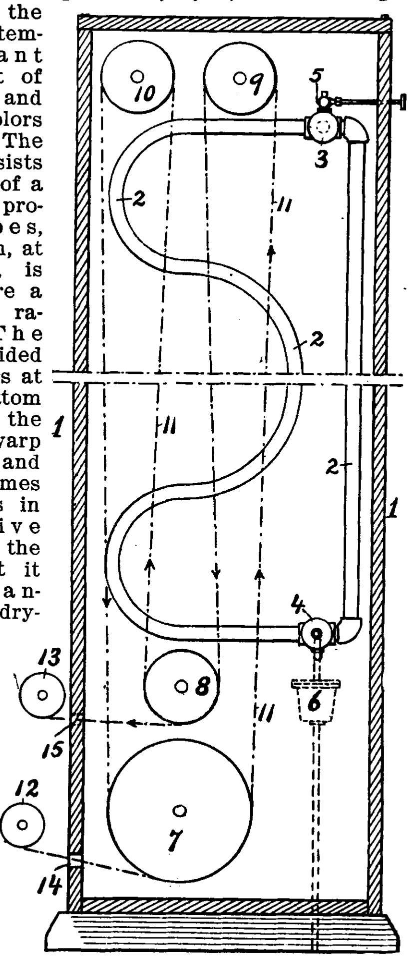
The accompanying illustration is a transverse section of the machine, showing the routine of cloth through the machine, and thus the principle of complete saturation with water and alternate squeezing by the upper rolls.

The cloth is drawn from the kiers through pot eyes (see arrow 1) by the nip of the two upper rolls 2 and 3 and then in a downward course (4) underneath a roll 5, deeply immersed in the box 6 containing the water 7; the cloth then is drawn upwards, and guided to its proper position on upper squeeze rolls 2 and 3 by wood pegs 8, a series of which is pitched out side by side from peg rail 9, so as to allow free passage for cloth. This operation of running the cloth around rolls 3 and 5 is repeated up and down, first in water, and then squeezed, until the whole width of the machine has thus been threaded by the cloth, and when after passing upwards between the last two pegs of the series, the cloth is carried away by reel 10, see dotted line 11, and conveyed to squeezers. 12 indicates the floor line, and 13, 14 the foundation beams.

The altitude at which the upper rolls are placed, allows a downward current of the water coming from nip of rollers to add materially to a thorough wash. (Arlington Machine Works, Arlington Heights, Mass.)

OXIDIZING AND DRYING MACHINE.

The object of this machine is to provide a drying apparatus which will simultaneously subject the material, which has been previously dyed, to a steaming process and to the action of high temperature radiant heat, the object of which is to fix and brighten the colors on the material. The machine consists principally of a closed chamber, provided with pipes, into which steam, at high pressure, is passed, to secure a high degree of radiant heat. The chamber is provided with guide rollers at the top and bottom and the yarn in the form of a chain warp is passed back and forth several times around the rolls in order to receive more action of the process, so that it becomes substantially dry, said drying process being carried on in a bath of steam which fills the chamber. The dyed yarn is passed through an atmosphere of steam, while being subjected to a high temperature of radiant heat, which has the effect of expelling the excess of moisture in the dye on the material under treatment, in turn developing, brightening and fixing the color.



The compartment in which this process is carried on is kept supplied with steam, provided by vaporizing the moisture carried in with the yarn, consequently, after once filling the chamber with steam, no further supply from the outside is necessary.

A diagram of the machine, showing the arrangement of the pipes and the passage of the yarn, is given in the accompanying illustration, which is a sectional side elevation of the machine.

Referring to the illustration, 1 indicates the closed chamber, having the steam pipes 2 of which there is a series in the machine, all being connected at the top and bottom to manifolds 3 and 4 respectively. Steam is admitted through a valve 5 and a trap for condensed steam is provided at 6. Bottom guide rolls 7 and 8, and top guide rolls 9 and 10 extend across the machine and the yarn 11 is guided from a guide roll 12, under the roll 7, then up between two lines of pipes 2 to the upper roll 9, and from there down and under the other bottom roll 8, then up again to the other upper roll 10, from where it is guided again to the first bottom roll 7 and over the same rolls, as explained, until the whole length of the rolls is covered, the yarn passing up between different lines of pipes 2 and at last passing out of the chamber, from the roll 8, to a guide roll 13. Guide rolls 12 and 13 are used to prevent the yarn from coming in contact with the sides of the openings 14, and 15 respectively, of the chamber.

The yarn in this manner comes from the machine in a dry condition, that is, not absolutely dry, but in such a condition that the moisture left in it is only that due to the action of the steam at high temperature. The guide rolls 7, 8, 9 and 10 are all driven at the same surface speed through proper gearing connecting them. (John W. Fries, Winston-Salem, N. C.)

MERCERIZING.

Considerable interest has during late years been taken in mercerizing cotton, chiefly for producing a silky effect on cotton yarns and fabrics. The process itself, originally, was discovered by John Mercer, a prominent calico printer in Lancashire, England, and was patented by him in 1850; however Mercer missed to discover the proper application of the material under treatment, as practiced so extensively at the present day. Mercer was born at Great Harwood, near Blackburn, England, Feb. 21st, 1791, and died Nov. 30th, 1866.

Before going more in detail in explaining the subject of mercerizing, it may be interesting to mention here that dilute solutions of caustic soda (or caustic potash) of from 2 to 7% strength, have no action on cotton, in the cold, even at a prolonged immersion of the fibre with the alkaline solution. Solutions of from 1 to 2% strength have little if any action upon the cotton, no matter how high a temperature and pressure used (a feature of great importance to bleachers). Solutions of caustic soda of greater strength than 3%, when boiled under pressure, convert cotton fibres into soluble bodies, dissolving as much as 20 per cent. of it under such a treatment. However the action of strong solutions of caustic soda or caustic potash upon cotton is different, and is the cause of its mercerization.

Mercer's original patent, gives a very complete account of the process as practiced now, some fifty years after its invention, since all he missed to discover was to apply the yarn or fabric to his process under tension; in turn losing one of his claims, one which never proved of any great value, viz., shrinkage of the cotton fibre in its length and thus increase in strength, but on the other hand would have gained a far superior point, viz., a silky lustre to cotton yarns and fabrics thus treated (the present day mercerizing) by his process. However his patent otherwise covers mercerizing as practiced now completely, and is thus quoted:

My invention consists in subjecting vegetable fabrics and fibrous materials—cotton, flax, etc.—either in the raw or manufactured state, to the action of caustic soda or caustic potash, dilute sulphuric acid or chloride of zinc, of a strength and temperature sufficient to produce the new effects and to give the new properties to them which I have hereinafter described.

The mode I adopt of carrying into operation my invention to cloth made wholly or partially from any vegetable fibres, and bleached, is as follows: I pass the cloth through a padding machine charged with caustic soda or caustic potash of sp. gr., say, 60° to 70° Tw., at the common temperature, say, 60° F. or under, and without drying the cloth wash it in water, then pass it through dilute sulphuric acid and wash again; or I run the cloth over and under a series of rollers in a cistern with caustic potash or soda of sp. gr. from 40° to 50° Tw., at the common atmospheric temperature, the last two rollers being so set as to squeeze the excess of potash or soda back into the cisterns; the cloth then passes over and under rollers placed in a series of cisterns charged at the commencement of the operation with water only, so that at the last cistern the alkali has been nearly all washed out of the cloth; when the cloth has either gone through the padding machine or through the cisterns above described, I wash the cloth in water, pass it through dilute sulphuric acid, and wash again in water.

When I adapt the invention to grey or unbleached cloth made from vegetable fibrous material, I first boil or steep the cloth in water, so as to have it thoroughly wet, and remove most of the water by the squeezer or hydroextractor, and then pass the cloth through the soda or potash solution, etc., and proceed as before described.

I apply my invention in the same way to warps, either bleached or unbleached, but after passing through the cistern containing the alkali, the warps are either passed through squeezers or through a hole in a metallic plate to remove the alkali, and washed as before described. When thread or hank yarn is operated on, I immerse the thread or yarn in the alkali and then wring out, as is usually done in sizing or dyeing them, and afterwards wash, sour, and wash in water as before described.

When I apply my invention to any fibre in the raw state, or before it is manufactured, I first boil it in water and then free it from most of the water by the hydroextractor or a press. I then immerse it in the alkaline solution, and then remove the alkali by the hydroextractor, or I press the alkali out with a press and then wash in water, sour in dilute sulphuric acid, wash again, and then remove the water by a press or hydroextractor.

When cloth, made from vegetable fibre, cotton, flax, etc., has been subjected to the action of caustic soda or potash, as before described, by padding, immersion, or any other way, and then freed from alkali by scouring and washing according to my said invention, the cloth will be found to have acquired certain new and valuable properties, the more remarkable of which I here describe. It will have shrunk in its length and breadth, or have become less in its external dimensions, but thicker and closer, so that by the chemical action of caustic soda or potash I produce on cotton and other vegetable fabrics and fibres effects somewhat analogous to that which is produced on woolens by the process of fulling or milling.

It will have acquired greater strength and firmness, each fibre requiring greater force to break it. It will also have become heavier than it was before it was acted on by the alkali, if in both cases it be weighed at the temperature of 60° F. or under.

It will have acquired greatly augumented and improved powers of receiving colors in printing and dyeing. The effects of the application of my invention to the vegetable fibre in any of its various stages before it is manufactured into cloth will be readily understood by reference to its effects upon cloth composed of such fibres.

Secondly, I employ sulphuric acid diluted to 105° Tw., and at 60° F. or under; I use this acid instead of soda or potash, and operate in all respects the same as when I use soda or potash, except the last scouring, which is here unnecessary.

Thirdly, when I employ solution of chloride of zinc, instead of soda or potash, I use the solution of sp. gr. 145° Tw., and at 150° to 160° F., and operate the same in all respects as when I use soda or potash. When I operate on mixed fabrics, partly of vegetable and partly of silk, wool, or other animal fibres, such as delaines or jeans, etc., I prefer the strength of the alkali not to be over 40° Tw., and the heat not above 50° F., lest the animal fibres should be injured.

I may, in conclusion, remark that the construction of the apparatus or machinery and the strength and temperature of the soda or potash, sulphuric acid or chloride of zinc solution, may be varied to a considerable extent, and will produce proportionate effects without at all deviating from my invention. For instance, caustic potash or soda may be used even as low as 20° Tw., and still give improved properties to cotton, etc., in receiving colors in printing and dyeing, particularly if the temperature be low, for the lower the temperature the more effectively the soda or potash acts on the fibrous material. I do not, therefore, confine myself to any particular strength or temperature of the substances I employ, but the particular strengths and temperatures here described are those which I have found best and prefer.

And I claim, as of my invention, the subjection of cotton, linen and other vegetable fibrous material, either in the fibre or any stage of its manufacture, either alone or mixed with silk, woolen or other animal fibrous material, to the action of caustic soda or caustic potash, dilute sulphuric acid, or solution of chloride of zinc of a temperature and strength sufficient to produce the new effects, and give to them the new properties before described, either by padding, printing or steeping, immersion, or any other mode of application.

By this process as then invented and practiced by Mercer, there were produced on cotton fibres, in yarns and fabrics, effects somewhat similar to those which are produced on woolens by the process of fulling; the fibres shrinking about 20% of their length, at the same time acquiring greater strength and an increase in their diameter, *i. e.* they became heavier than before being acted on by the alkali, provided in both cases they were weighed at the temperature of 60° F. or under. We also notice from the patent quoted, that Mercer discovered that cotton treated by his process acquires a very considerable affinity for dyestuffs, taking them up much more readily from dye baths, than cotton not mercerized, and that mercerized cotton can be dyed in very brilliant shades. Mercer however never realized any value from his invention, for the contractions of the yarn and cloth (about 20%) after passing through this process made them more expensive, and the advantages gained (strength and affinity for dyestuffs) were more than overcome by their increased cost of production, so that the process was for years practically forgotten, for the fact that it must be remembered that Mercer never discovered the actual advantages of his process as practiced at the present day, that is—if properly handled during his process, the cotton fibre will obtain a silky lustre.

The next application of Mercer's process was in the manufacture of silk and of worsted crepons, a light dress fabric, a distinctive feature of which was its crepe or crinkly effect produced in weaving, and which were very popular and the height of fashion for ladies' wear some ten to fifteen years ago. Goods of this description were made to be washable, so that they would not lose their crepiness through washing, and as a rule were commonly dyed in plain colors. They were woven with two warps, a back and a face; the back warp being woven tight, *i. e.* under a severe tension, whereas the face warp was let off loose. This feature of two kinds of let offs for the warp coupled with peculiar weaves for each system of warp, produced the crinkly or crepe effect, previously referred to, to the fabrics. Soon goods were brought into the market (from Germany) that had this peculiar crepe effect exaggerated into large puffs, which then at once took the popular fancy and were extensively imported, and naturally drove their more modest predecessor out of the market. Examination of the latter styles showed that the back warp was of cotton sparsely scattered across the width of the goods and that filling threads were also thrown on the back in regular or irregular patterns as desired, and that the much sought after effect had been produced by passing the goods with their cotton back and worsted or silk face through the original mercerizing process, shrinking the cotton in all directions of from 20 to 25 per cent, and throwing the face (worsted or silk), which was unaffected by the cold caustic alkali, into great puffs and blotches.

Later, a firm of German dyers, experimenting on some half-silk and cotton goods which they desired to piece dye, found that the cotton did not take the dye with the same intensity as the silk, and to help themselves over the trouble, they concluded to mercerize the fabrics, and when, to prevent the loss in the cotton by shrinkage, put it through the concentrated solution of caustic soda in a strongly stretched condition. This experiment was a perfect success. They not only found that they had achieved all they desired, but to their astonishment, also *that the cotton had assumed a lustre* equal to that of silk. They developed this discovery into a process to produce the silk lustre upon cotton now known as mercerized cotton, silkoline, sub-silk, silk-lustre, etc., *i. e.* the process known at present as mercerizing.

To obtain this silk lustre, the general method to be pursued is as follows: Skeins, yarns, warps, or piece goods in a stretched condition are immersed in a solution of caustic soda for about fifteen minutes in a strength of bath about 30° B. The goods are then lifted, and the surplus liquor is removed either by squeezing the goods through rolls, or putting them through the hydroextractor. They are then thoroughly washed with clear water. A second bath of diluted sulphuric acid neutralizes all remaining alkali, when a final rinsing leaves the goods in condition for either bleaching or dyeing.

The quality and degree of lustre and silk-like appearance is largely dependent upon the quality of the cotton used, long stapled Sea Island and Egyptian cotton (combed), giving the best results. If the yarn is gassed, and thus the ends of the fibres removed, the result is still further improved. Ordinary mule yarns, and ordinary calico made of short stapled cotton, only receive a slight lustre. Loosely spun cotton yarns slip in mercerization under tension, but in hard twisted yarns most of the fibres get really stretched; hence a perfect silky lustre can only be produced when the twist is sufficient to prevent many threads from escaping the tension. Cotton mercerized loose (*i. e.* Mercer's original invention) has a leathery appearance, and the fibres are shortened and thickened, whereas stretching makes them thinner and more shiny. The greatest lustre to the fibres is obtained when the thread has reached its elastic limit, *i. e.*, just before it breaks. The more the lye soaked cotton is stretched, the greater the lustre, and consequently a scale of lustres with their corresponding tensions, can be readily constructed in any mill or mercerizing establishment. The intensity of the dyeing stands in the closest connection with this scale. Loose mercerized cotton dyes the darkest, whereas the more the mercerized cotton has been stretched, the lighter the color; that is, the most lustred cotton takes the lightest shade, but even this is distinctly darker than it would have been on unmercerized materials. This silky lustre on cotton is very durable, and resists bleaching, washing and dyeing; only color lakes, thick precipitates on the fibre such as Turkey red can hide it. That a chemical change has taken place in the cotton fibre after mercerizing is at once apparent; it will be found that the sulphur dyestuffs will dye in many instances from a cold bath, in from one-quarter to one-half the time usually required for dyeing in connection with cotton not mercerized, a feature which has given many a dyer trouble to produce even shades. The action of many azo colors, as used for wool dyeing, will be also worth notice. They do not stain unmercerized cotton, a feature made use of by manufacturers in certain lines of mixed goods; but when mercerized cotton threads are substituted, it will be found that they are stained to such an extent as to preclude their use. That the mercerizing process is actually a chemical one is clearly demonstrated by the action of pure tannin solutions upon both, ordinary and mercerized cotton, since cotton not mercerized has the property of taking up in a given time, and under the same conditions, a greater amount of tannin than mercerized cotton, thus indicating that the tannin absorbing factor for cotton is reduced by means of mercerizing.

On account of the speed with which mercerized goods take up dye, as previously mentioned, they are liable to do so with want of uniformity, and consequently retarders, such as Glauber's salt and phosphate of soda have to be used. Turkey red oil is also very good for this purpose. To get the lively colors so much in demand for mercerized articles, the direct dyes are usually topped with basic dyes, and which go on very fast, and consequently care and speed must be exercised during the process, which should be carried out in the cold, in presence of acetic acid. In using adjective dyes it must be remembered that mercerization increases the affinity of cotton for mordants as well as for dyes, and that consequently less of the former than of the latter must be used. Baths of tartar emetic should be about 30% weaker. To prevent too rapid dyeing, the bath should be cold, and acidified with acetic acid. The dye should be added gradually, and the goods carefully worked. If the bath is not exhausted enough with deep shades, heat to about 130° F. for a quarter of an hour.

When it is desired that mercerized cotton should rustle similarly to silk, besides having the silky lustre, this is facilitated by bleaching the mercerized material.

Bleached yarns, after dyeing and rinsing, are passed through a cold neutral soap bath, rinsed and soured with acetic, or better with tartaric acid. Yarn so treated has a very persistent rustle. Unbleached yarns, after dyeing, are passed first through a 1.5% bath of commercial acetate of lime for about a quarter of an hour, then through a lukewarm 1% bath of Marseilles soap for a quarter of an hour, and finally for a third quarter through a cold 2.5% bath of acetate acid, and in turn extracted and dried, without rinsing. All these baths can be used again, the first changing very slowly in strength. For dark shades and black, pyrolignate of lime, which is cheaper than the acetate, can be used instead of it. The soap bath must lather continually while in use, and must be kept frothing by adding more soap from time to time. The last bath must be distinctly acid all the while it is in use, and as the acetate is neutralized by the lime more of it must be added.

Practically no success has attended the numerous attempts which have been made to dye goods before mercerizing it; since even those dyes which stand the action of caustic soda best undergo a perceptible change of shade when subjected to it, and the others will bleed.

We might ask the question, how does mercerized cotton acquire its high lustre? The best and most readily understood reply is that the cotton, through the action of the caustic soda, is brought to a gelatinous or parchment-like condition; the extreme tension rounding and concentrating the fibres so that the rays of light as they fall upon them are reflected instead of being absorbed.

In mercerizing, to save expense, the first rinsings, which are caustic soda lye of 15 to 20° B., are collected and used for diluting stronger lyes, or for dissolving the solid caustic. In some instances it has been suggested that the lye is cooled during use by means of ice. This process however has lost ground, on account of the heavy expenses connected with thus cooling the liquor, it being cheaper to use a stronger lye at an ordinary temperature, especially when dealing with cotton containing little or no size. In mercerizing at ordinary temperatures, about 65° F., the lye should be about 30° B., whereas at about 36° F., a lye of 18 to 22° B., could be used to get the same results. To get the greatest possible lustre, the lye must be strong enough to produce the maximum amount of contraction in loose cotton. The time of exposure to the lye is not of much consequence; ten to fifteen minutes is enough. So long as the goods get thoroughly penetrated by the caustic alkali, it is immaterial whether they are entered wet or dry. In the latter case more care is naturally necessary to see that they do get perfectly soaked. Enough lye must be washed out of the mercerized goods to prevent them from again shrinking before the tension is relaxed, but if the water in the washing compartment brings the lye in the fibres below 10° B. no further shrinkage will take place.

The peculiar feature of the process, *i. e.* that the intensity of the action lessens, with the rise of temperature; or, in other words, the higher the temperature the stronger the lye required in order to produce any given effect, has thus far not yet been satisfactorily explained. At ordinary temperatures, the action begins when the lye contains 10% of NaHO, which corresponds to a specific gravity of 1.115. The effect increases, the temperature remaining constant, until the specific gravity of the lye reaches 1.34, and when it contains 31% of NaHO. The temperature must however not exceed 70° F. at the most. Lyes varying in strength between 20 and 25% of NaHO, *i. e.* between 1.225 and 1.275 S. G., act well and quickly at from 50-65° F., but if the concentration falls below 10% of NaHO, the lye will not mercerize except brought to an extremely low temperature. Naturally, it is impossible to make a very weak lye mercerize at any temperature. It is a remarkable fact, however, that the presence of zinc, in some unexplained manner, assists the mercerizing action of caustic soda. A lye of that substance of 1.1 specific gravity, which has no action on cotton, will act on it energetically if zinc oxide is dissolved in it in the proportion of two molecules of zinc oxide to one of sodium monoxide ($2ZnO$ to Na_2O).

As mentioned before, mercerizing increases the strength of the cotton fibre in all cases, whether mercerized under tension or not, however the fact is, that cotton mercerized under no tension will obtain considerably more strength compared to its condition before mercerizing, whereas cotton mercerized under tension will only gain about one-half of this additional strength, than when not mercerized; this result showing that the full strengthening of the fibre is only obtained when the same is permitted to shrink by the process, *i. e.* mercerized without tension. This feature however is of less importance to the manufacturer and only quoted for a fact; the increase in lustre as obtained by mercerizing under tension being the important point for him. Another interesting difference between mercerizing with or without tension is that in the first instance the lye does not affect the original elasticity of the cotton, while in the latter case the elasticity of the yarn is increased about one-third.

In order to obtain a perfect mercerizing (evenness of lustre) the yarns or fabrics as the case may be, must be thoroughly scoured and extracted before passing to the lye-bath. It will be readily understood, that the less yarn is handled after being mercerized, the better its lustre, and nothing will hurt the lustre so much as handling and treating with chemical liquors; and if the yarn is to be bleached after being mercerized, it will have to undergo several handlings and treatments to bleach it, and consequently there will be a risk of loss of lustre, to avoid which it seems advisable to bleach previous to mercerizing; however, the general run of opinion is that bleaching should follow mercerizing, possibly that in this way a washing, a scouring and a drying are saved, and besides a perfect white the result. With reference to piece goods they should be subjected to crabbing before mercerizing, and the preliminary boiling and wetting out done thoroughly. With reference to yarns, as already mentioned, the same should be previous to the process gassed, since otherwise the hairy fibres remain loose, are not stretched, and consequently shrink, remain without lustre, and in turn to a certain extent hide the otherwise lustred surface of the yarn.

Regarding the cross section of the cotton fibre after mercerizing loose and in the form of yarn under tension, the former is in nearly every instance circular and with the central lumen very much smaller, and frequently of irregular shape, whereas on the other hand, cross section of the fibres from yarn mercerized under tension, appear polygonal, especially those fibres composing the core of the thread, due to the pressure of each fibre against its neighbors in the thread, while the fibres as situated on the outside of the thread only show this pressing on the sides towards the centre of the thread. The characteristic of the central hole or lumen is, in many cases, quite distorted, thus indicating an expansion of fibre substance in two directions, towards the centre, and towards the circumference.

Besides caustic soda, both nitric acid and sulphuric acid have been proposed for mercerization. Diluted nitric acid gives no results worth having, and no lustre under tension is got with strength below 38 to 43° B. Practically therefore, caustic soda is the everyday mercerizing agent, the lye bath to be used at a strength of about 30° B., or practically the same strength as originally suggested by Mercer.

To distinguish mercerized from unmercerized cotton, the microscopic test can be employed, also a dyeing test, which is as follows: 5 oz. of potassium iodide are dissolved in from 12 to 24 of water, 1 to 2 oz. of iodine added, and these mixed with a solution of 30 oz. of zinc chloride in 12 of water. The cotton is soaked in water and then immersed in this solution for about three minutes; then rinsed with water. If the cotton is unmercerized, it will quickly lose its color, while mercerized cotton keeps its blue color much more obstinately. This reaction can be used even with dyed cotton. If, for example, it is desired to know whether some dyed cotton has been mercerized, some mercerized and some unmercerized cotton is dyed the same color, and then all three cottons tried with the above solution. Mercerized cotton will show darker after rinsing. To test for mercerization in dark dyed goods, the color should first be discharged with bleaching powder, acetate of tin, etc. For bleached or lightly dyed goods it is often enough to compare the cotton after the above iodine treatment with another sample which has been soaked with water only.

The Application of Mercerized Cotton for Textiles. The discovery of the fact that by mercerizing cotton under tension, the same acquires a permanent silky lustre, has in late years led to some considerable changes in the production of textile fabrics. The part that mercerized cotton is taking in this direction is continually growing, and it is now utilized along with silk and wool for the production of novel and artistic effects in all kinds of textiles that were formerly undreamt of. In many classes of mohair and alpaca goods, it has made its appearance with pleasing results, again for making certain kinds of lustre fabrics it is now much used. For the production of satins (silk cotton goods) it results in a fabric more closely resembling silk than was formerly attainable. It also has found a prominent place in the manufacture of woolen and worsted figured dress goods. It is now also extensively used in the manufacture of worsteds for men's wear, for special effects formerly produced by silk only. In the figured damask table cloth trade it has also been found of service. In connection with upholstery goods, draperies, curtains, coverings, it has simply revolutionized the construction and design of these fabrics. In fact there would seem to be no end to the variety of goods and the variety of effects which can be obtained from the use of mercerized cotton. Among the changes of a chemical character which occur, there is one that must not be overlooked, for it is one which in the hands of a dyer constitutes one means of increasing the novelty of effects in fabrics obtained by the combination of mercerized cotton with other fibres, based upon the marked increase in the affinity of mercerized cotton over ordinary cotton for dyes. For instance, if a piece of cotton cloth woven partly from ordinary cotton and partly from mercerized cotton be dyed, then the latter takes a much deeper color than the former, a feature which can be used for producing novelties, the design being thrown up and brought into more prominence as a dark shade on a light ground, or vice versa.

THE KLAUDER-WELDON WARP MERCERIZING MACHINE.

As we have seen from the previous article, one of the great disadvantages inherent in the process of mercerizing is that the warp tends to shrink very decidedly under the influence of the caustic bath, thereby decreasing in length and thus, more or less, depreciating in value. Various methods have been devised by which to overcome this disadvantage of shrinking, such as by stretching the material before and after subjecting it to the influence of the caustic bath, or by a positive stretching of the material while it is subjected to the action of the caustic, this latter method being the one employed in the Klauder-Weldon machine, in which it is possible to feed the warp, in its open width, continuously through the caustic and other necessary baths, and at the same time exerting sufficient tension on said warp to prevent it from shrinking during the process, thus avoiding the disadvantage mentioned, and doing away with the necessity for any positive stretching of the warp, either before or after the process. In this manner, the machine provides for the continuous production of a properly mercerized warp which shall have the requisite lustre and strength, without having suffered in appreciable shrinking during its passage through the machine. By having the warp in the sheet form, insures the perfect treatment of every individual thread, since the tension on each thread is uniform and in a great measure regulates the evenness with which the operation is performed.

The warp mercerizing system, where advisable to be used, is generally preferred to skein mercerizing, for when the skein is put under tension during the

1	2	3	4	5	6	7	8	9	10
Wet	Boil	Cool	Mercerizing	Wash	Wash	Acid	Wash	Wash	Soap

Fig. 1.

process, the different threads, *i. e.*, different rounds of the same thread, will not receive the same amount of tension, owing to the shape of the skein which makes the outside layer longer than the inside layer, and consequently the mercerizing will be more or less uneven. Uneven mercerizing on yarn to be dyed, as explained in the article on Mercerizing, will naturally produce uneven dyeing during that process, because a mercerized yarn takes dyes better than an unmercerized yarn, and consequently the portions of the yarn which did not receive the full benefit of the mercerizing process will not dye as readily and bright as the fully mercerized portion.

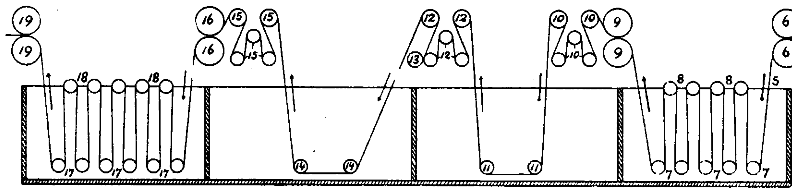


Fig. 2.

The arrangement of the different baths in the machine for the warp mercerizing, and the details of the construction and operation of said machine are best given by means of the accompanying illustrations, of which Fig. 1 is a diagram showing a plan of the baths, and Fig. 2 is a diagram given for the purpose of showing the arrangement of the different rolls as used in the various baths, and the methods of passage of the warp through the various baths.

Referring to Fig. 1 for an outline description of the process as carried on in this machine, 1 indicates the wetting out bath for the warp, the water for this purpose containing a small amount of caustic soda; 2 is the boiling water bath through which the warp passes after leaving bath No. 1; 3 is a cold water bath; 4 is the mercerizing bath and which is made up principally of a caustic soda solution; 5 is a rinsing bath, using cold water for this purpose; 6 is a similar rinsing bath to bath No. 5; 7 is the acid bath; 8 is a rinsing bath of cold water to wash the excess of acid from the goods; 9 is a similar rinsing bath to bath No. 8; 10 is the soaping bath, which of course, contains a soap solution. Two rinsing baths 8 and 9 respectively are used in order to free the material of any possible traces of acid previous to entering the soap bath, because if present the same would neutralize the soap. The method of passing the warp through the various baths, as mentioned before, is shown in Fig. 2.

The passage of the warp 5 through the different baths is very rapid, said warp passing through the machine in the direction of the arrows, entering the machine through a pair of feed rollers 6, then into the first bath by passing under and over guide rollers 7 and 8 respectively. After leaving the first bath, the warp passes similarly through two more baths (not shown) and after thus leaving the third bath, the warp passes between a pair of what might be termed delivery rolls 9 and from there, around the tension rolls 10, then down under the guide rolls 11 in the mercerizing bath. After leaving this bath, the warp passes around tension rolls 12, similar to those at 10, and a roll 13, being in contact with one of these rolls, acts with it as a delivery pair and also squeeze rolls for the purpose of saving the mercerizing liquor, and which thus runs back into its bath.

After leaving the top tension roll 12, the warp is passed successively into two rinsing baths (not shown), the passage being similar to the first bath explained, and after that passes down under the guide rolls 14 in the acid bath. From this bath, the warp passes around the tension rolls 15 and between the delivery rolls 16, and from there into two successive rinsing baths (not shown), the passage being similar to the first one explained. After having all traces of acid removed, the warp then passes under and over the rolls 17 and 18 in the soap bath, and from there passes from the machine through a pair of delivery rolls 19.

The object in having the warp pass around the different rolls is to keep it at all times under the proper tension, and in this manner avoid any shrinkage, as is its tendency to do. The arrangement of the sets of rolls for the other baths is similar to those explained, as will be seen from the illustration, with the same object in view of keeping the warp under tension in its passage through the machine.

After being delivered from the last pair of rolls of the machine, the warp is run into truck boxes and is either taken to the drying machine or to the dyeing machine, as the case may be. It is impracticable to have the drying and beaming apparatus continuous with this mercerizing machine, because of the greater speed of the passage of the warp through this mercerizing machine as compared to its speed through any make of drying and beaming machinery.

All of the rolls on the mercerizing machine are driven at the same surface speed, and thus hold the warp under tension without stretching. For the convenience of the operator in running the machine, shipper rods are placed on each side of the machine to enable him to stop the machine from practically any point. In some cases only one shipper is provided, if desired. (The Klauder-Weldon Dyeing Machine Co., Amsterdam, N. Y.)

PALMER'S SKEIN MERCERIZING APPARATUS.

The novelty of construction refers to the frame for stretching and moving yarn during its dipping process, and the means for supporting and conveying this stretching frame.

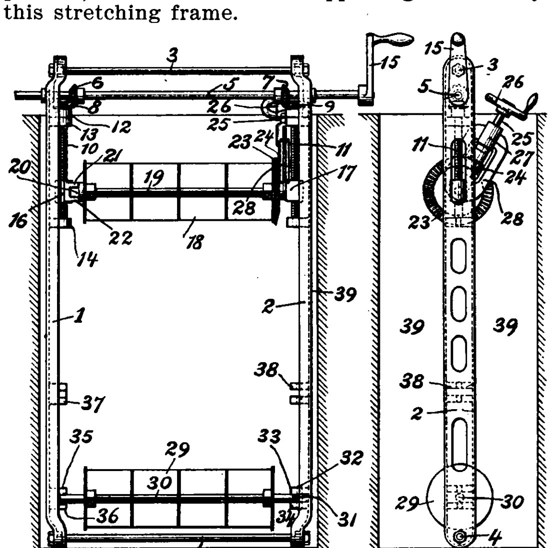


Fig.1 *Fig.2*

Fig. 1 is a view of the yarn stretching frame in side elevation, in the position which it assumes when inserted in a vat; the vat being indicated in section. Fig. 2 is an end view of the same.

The yarn frame consists of a pair of vertical side bars 1 and 2, set with their outer faces toward each other, and top and bottom bars 3, 4, for holding the side bars 1, 2, at the proper distance apart. A shaft 5 is journaled in the side bars near the upper ends of the same, and is provided with bevel gear pinions 6 and 7, which mesh with bevel gear pinions 8 and 9 on screws 10 and 11 respectively. The screws 10 and 11 are swiveled in lugs fast to the faces of the side bars 1 and 2, as follows: The larger part of the screw stem in proximity to the bevel gear 8, passes through a lug 12, and the stem of the screw is then reduced, forming a shoulder which rests on the lug 13, through which the stem passes, the lower end of the screw being reduced still further and working in a lug 14. In like manner the screw 11 is swiveled to the bar 2. The shaft 5 is provided with a crank 15 for rotating it, and thereby simultaneously rotating the screws 10 and 11. On the screw 10 there is a vertically traveling nut 16, and on the screw 11 there is a vertically traveling nut 17.

The upper reel 18 is mounted to rotate on a spindle 19, the latter being secured at one end to the nut 17 and at its opposite end being adapted to removably engage the nut 16, so that the end of the spindle 19 with the reel thereon, which is engaged with the nut 16, may be swung away from the nut on the screw 11 as a hinge, into a position to permit the removal of the skein of yarn already treated and place another skein or hank of yarn on to be treated. The end 20 of the shaft 19 is squared, permitting it to swing between a pair of jaws or lips 21, 22, on the nut 16, the face of the jaw 22 being slightly recessed to prevent the spindle from unintentional displacement. The end of the reel toward the nut 17 is provided with a bevel gear wheel 23, which is engaged by a pinion 24, carried by a shaft 25 provided with a hand wheel 26 for operating it and mounted in a sleeve 27, fixed to a bracket 28, carried by the nut 17.

The lower reel is denoted by 29, and is mounted to rotate on the spindle 30, hinged at one end by means of an eye 31 and pin 32 between a pair of lugs 33, 34, fixed to the face of the reel 2, and at its opposite end is adapted to enter between a pair of lugs 35, 36, one or both of them having their faces slightly recessed to prevent the unintentional removal of the spindle, while at the same time permitting it to be swung on its hinged connection outwardly into a position similar to that as previously explained in connection with reel 18. Additional sets of lugs 37, 38, are provided, to adapt the machine to varying sizes of skeins or hanks.

In operation, the reels 18 and 29 having been swung at one end outwardly, the skein is placed thereon, and then the reels swung back into the position shown in the illustration. The stretching of the skein or hank is then accomplished by turning the crank 15, which will simultaneously turn the screws 10, 11, and thereby cause the nuts 16, 17, to travel in a direction to move the reel 18 away from the reel 29, or, if it is desired to remove the skein, turning the crank in the reverse direction will cause the reel 18 to approach the reel 29, and permit the ready removal of the skein. While the frame is in the vat, the reels may be caused to travel with the yarn thereon by turning the wheel 26, which by the engagement of its pinion 24 with the bevel gear 28, will cause the reel 18 to rotate, and this will, through the yarn stretched thereon, cause the reel 29 to rotate.

For convenience in lowering the yarn frame, thus explained, into the vat 39, and removing it therefrom, said frame is supported by means of a rope, or chain, passing over a pulley, depending from a carriage, and being provided on its opposite end with a counterbalance weight, so that the frame can be handled with ease. For removing the frame from over the vat to recharge it, an endless curved track, for the carriage, previously referred to, to run on, is provided, so that the carriage may follow from a position over the vat around into position over the same vat without retracing its course.

Two platforms, conveniently located in the course of the track, are provided, for resting the frame either for purposes of draining or for recharging. For example, the frame as it comes directly from the vat may be left on the first platform to drain, while a previous frame may be receiving its charge of yarn on the other platform, to be moved along the track in position over the vat for immersing it, and the frame on the first platform may be subsequently moved to second platform for recharging, while the frame fresh from the vat may be moved into position for drainage on the first platform.

An Improved Reel for this Skein Mercerizing Apparatus has also been devised, the same having for its object to keep the individual strands or threads of yarn composing the skeins, during mercerizing under an even tension, in order to secure the proper working of the process, the object of the improvement being to provide a frame for holding the skeins in the bath with an even and uniform tension on all of the yarn, both on the inside as well as the outside of the skeins, and which tension has heretofore been more or less uneven, the outside of the skeins having been stretched to a greater degree than the inside, owing to the outside of the skeins being farther from the reel holding them, than the inside of the skein, said uneven stretching of the skeins resulting naturally in uneven mercerizing, and consequently uneven dyeing, provided if dealing with yarns to be dyed, all features previously explained in the article on Mercerizing.

The arrangement of the frame by which an even and uniform tension is given to the skeins is best shown by means of the accompanying illustration, Fig. 3, which is a diagram of the position of the reels in the frame for holding the skeins, showing a skein held by the reels, said skein, however, being exaggerated in order to show clearly the action of the reels on the tension of the entire skein.

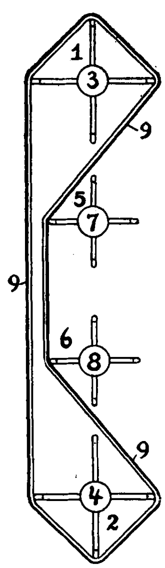


Fig. 3.

Referring to the illustration, 1 indicates the top reel over which the skeins to be mercerized are hung, and 2 is the bottom reel around which the lower portions of the skeins are placed.

The top reel is mounted to rotate on a shaft 3, one end of which is secured within a vertically traveling bar, and the other end is removably held by another vertically traveling bar, thus allowing said reel to be swung out horizontally when required. Each vertically moving bar is provided with a screw threaded lug, which are engaged on the screw threaded portions of two respective vertical shafts; and by means of handles secured to the top of both shafts the top reel may be raised or lowered to put tension on the skeins or take it off. The bottom reel 2 is loosely mounted on a stationary shaft 4, one end of which is hinged in a lug on the side of the frame, and the other end is temporarily held by a lug on the opposite frame, so that this reel can also be swung out when required, that is, when yarn is to be put in the machine on the reels, or taken out.

In order to prevent an uneven tension in the skeins on the reels, as previously pointed out, two smaller reels 5 and 6 are placed between the two main reels with their shafts 7 and 8 in the same vertical line with shafts 3 and 4, and thus force the skeins of yarn 9 out of a straight line, as shown. This action will cause a greater tension to be put on the inside of the skein as represented by the lighter line on that side of the two large reels, for the same reason that a greater tension is put on the outside of the skein as represented by a heavy line, by it passing around the two reels 1 and 2. Thus the extra tension given to the outside of the skein is counterbalanced by the extra tension given to the inside by the two reels 5 and 6, and the tension over the entire skein then becomes uniform.

In placing the skeins on the reels 1 and 2, the same are swung outwardly as explained, after the reels 5 and 6 have been swung away from the opposite side of the frame as a pivot. After placing the skeins on the reels, they are all swung back to the position shown, and the skeins put under tension by raising the top reel 1 through the mechanism previously explained. (Isaac E. Palmer, Middletown, Conn.)

DYESTUFFS AND CHEMICALS

SOCIETY OF CHEMICAL INDUSTRY, BASLE, SWITZERLAND.

The Society of Chemical Industry are the largest manufacturers of Coal Tar Dyes in Switzerland. Basle is a seat of this industry, and has six firms engaged in the business. Although there are no patent laws in Switzerland to encourage invention, yet the Society of Chemical Industry has become famous through the patented dyestuffs which it has put on the market. These patented dyestuffs are the following:

Auramine.	Acid Violets.
Victoria Blue.	Rhodamine B and G.
Violet Crystals 6B.	Rhodamine S.
Ethyl Purple.	Rhodamine 6G.
Tartrazine.	Anthracene Red.
Alkali Violet.	Patent Phosphine.

Direct Indigo Blue.

Owing to the necessity of purchasing raw materials from the larger German works, the Society of Chemical Industry arranged for the manufacture of these patented products partly with the Badische Anilin & Soda Fabrik and partly with Fredk. Bayer now known as the Farbenfabriken of Elberfeld.

The latter patented articles, such as the Patent Phosphine and Direct Indigo Blue, are being worked direct, without sharing with the German manufacturers.

In addition to these patented colors the Society of Chemical Industry make the whole series of Direct Dyeing Cotton Colors, such as:

Carbide Black.	Direct Green.
Direct Blue.	Direct Yellow.

Direct Brown.

They also manufacture the principal colors used for wool, such as Diamond Black, Naphtol Black, Naphtylamine Black, Fast Chrome Blacks, Blues, Browns and Yellow.

Within the past few years, recognizing the demand for colors fast to light, washing, and the ordinary processes of manufacture, and recognizing the value of direct application, they have studied out thoroughly the manufacture of so-called sulphur dyes, and to-day have not only the most extended line of *Sulphur Colors* on the market, but at the same time stand preëminent for the quality of the colors produced.

The *Pyrogen Indigo* made by them has no equal in Sulphur Blues. It combines all the valuable properties of a sulphur color with the brilliancy of the basic colors.

Pyrogen Blue R and 2R have been more extensively sold than any other Sulphur Blue made. The same is true of Pyrogen Browns manufactured by the Society.

In Blacks, which is one of the most largely used of all colors, the Thiophenol Black in its different shades, stands preëminent for strength, solubility and beauty of shade.

To these standard products have recently been added *Pyrogen Green* and *Pyrogen Yellow*, so that it is safe to say that in this entire class of dyestuffs the Society of Chemical Industry stand preëminent, not only as to the variety of colors they produce, but as to the ability to produce them cheap enough to meet the severe competition which prevails to-day in the coal tar industry.

On account of the great importance of the dyestuffs of the Society of Chemical Industry, we herewith quote a list of their various products, arranged according to their fastness and application with reference to textile manufacturing—Cotton, Wool, Silk and Jute.

DYESTUFFS FOR COTTON.

Dyestuffs for Apparatus Dyeing. Specially suitable for Cops.) Easily soluble and very level dyeing.

Chlorantine Yellow JJ, JG, T.
Cotton Yellow CH.
Fast Yellow R1209.
Chlorantine Orange TR, TRR.
Direct Orange R.
Chlorantine Brown R.
Direct Brown R1804.
Cupranil Brown R, G, B.
Direct Brown M617.
Chlorantine Red 4B, 8B.
Acid Congo R.
Direct Safranine G, B.
Direct Pink GN, BN.
Chlorantine Pink.
Cotton Red D.
Chlorantine Violet R, B.
Chlorantine Lilac B, BB, R.
Tolamine Violet 2422.
Direct Blue BX, 2B, 3B.
Acetylene Blue 3R, BX, 3B, 6B.
Acetylene Pure Blue.
Acetylene Sky Blue.
Direct Light Blue 550.
Direct Sky Blue, green shade.
Direct Indigo Blue A, BN, BNK.
Cotton Blue N, R.
Indigen Blue BB, B, R.
Direct Green B695, G. (Dissolve without Soda.)
Indigen Black B.
Melantherine HW, BH, JH, BO, RO.
Carbide Black S, E.
Neropaline P.
Direct Black 1602, 1718.
The various Pyrogene Colors and Thiophenol Blacks.

Dyestuffs Rendered Fast to Water by aftertreatment with Aluminium Salts.

*Fast Yellow R1209.
Direct Yellow *1704, CR, 2192.
Direct Orange G.
Direct Brown *1655, JJ, P, 1659, R1804.
Chlorantine Brown R, B.

Cupranil Brown *R, G, B.
Direct Violet *CB, N582.
*Tolamine Violet 2422.
Chlorantine Violet *B, R.
*Chlorantine Lilac B, BB, R.
Cotton Red 12B, 11B, *10B, *6B.
*Cotton Red 5B, B.
Acid Congo R1573.
*Direct Safranine B, G.
Chlorantine Red 4B, 8B.
Chlorantine Bordeaux B.
Chlorantine Blue BB.
*Cotton Blue R.
*Direct Blue B, R.
Neropaline P.
*Opaline 2G.
Direct Green J, B695.
*Tolamine Green 2040.
Carbide Black *E, S.
Direct Black CR, 1602, 1718, 1632.
Direct Grey B, R.

*These colors bleed a little into white cotton when steeped in warm water.

Direct Dyestuffs for Cold Dyeing.

Fast Yellow R1209.
Cotton Yellow CH.
Direct Yellow T, TO.
Direct Orange G, R.
Direct Pink BN369, GN403.
Chlorantine Lilac B.
Chlorantine Brown R, B, BB. (Fairly good.)
Acetylene Blue 6B.
Acetylene Pure Blue.
Acetylene Blue 3R.
Direct Safranine B1687, G1688. (Up to 2%.)
Melantherine BH678, JH.

These are applied in cold or lukewarm bath, with the addition of 10-15 lbs. Glauber's salt, 1-1½ lbs. Soda per 100 gallons.

Dyestuffs Fast to Washing.

The following cotton dyestuffs do not bleed into white cotton on washing with neutral soap:

(1) The various basic dyestuffs, after-treated with tannic acid and tartar emetic.

The following bleed a little:

Rhodamine S, B, G.
Fast Green O, JJO.
Victoria Blue B.
Brilliant Victoria Blue RB.
New Victoria Blue GG.
Chrysoidine G, R.
Bismark Brown G, R.

(2) The various Pyrogene colors. (Fast to fulling.)
Rosanthrene O, R, A, B, CB. (Developed.)

(3) Melantherine BH, HW, JH. (Developed.)
Neropaline P. (Developed.)
Cupranil Brown B, G, R. (With copper.)
Direct Yellow CR. (With bichromate and copper sulphate.)
Direct Brown M, V. (Developed.)
Nitranil Brown various brands. (With p-nitraniline.)
Indigene Blue B, BB, R. (Developed.)
Direct Sky Blue, green shade. (With copper.)
Acetylene Sky Blue. (With copper.)

As comparatively fast may be mentioned:

Chlorantine Yellow JJ, JG.
Fast Yellow R1209.
Direct Yellow T.
Chlorantine Orange TR, TRR.
Chlorantine Pink.
Chlorantine Lilac B, BB, R.
Direct Blue 2B548.
Chlorantine Blue B, BB.
Direct Indigo Blue A.
Direct Brown J, JJ, 1655, 1804.
Cupranil Brown B.
Direct Black 1718.
Direct Grey G.

Dyestuffs Fast Towards Hot or Boiling Size.

BASIC DYESTUFFS.

*Auramine O, II.
Brilliant Phosphine G, 3G, 5G.
Patent Phosphine GG, G, M.
Safranine GOOO, BOOO.
*Rhodamine 6G, B, 3B.
*Violet 2B, 3B.
*Crystal Violet 5BO.
*Ethyl Violet.
Brilliant Violet 6B, 8B.
Methylene Blue G.
*New Blue RS.
Victoria Blue B.
*Fast Blue MD.
*Victoria Blue R, 4R.
*Brilliant Victoria Blue RB.
New Fast Green 2B, 3B.
Fast Green JJO, O.

The fastness to sizing of the above dyestuffs is considerably increased by after-treating with tannic acid and tartar emetic. Those colors marked * are particularly fast to sizing.

DIRECT AND PYROGENE DYESTUFFS.

The various Pyrogene colors and Thiophenol blacks.
Rosanthrene O, R, A, B, CB. (Developed.)
Direct Yellow CR. (With bichrome or chrome alum.)
Melantherine BH, HW, JH. (Developed.)
Neropaline P. (Developed.)
Cupranil Brown B, G, R. (With copper sulphate.)
Direct Sky Blue, green shade. (With copper.)
Acetylene Sky Blue. (With copper.)
Direct Brown M, V. (Developed.)
Direct Pink BN, GN. (For pale shades.)
Direct Green B695. (With chrome alum.)

Most direct dyestuffs, which are rendered fast to water by an aftertreatment with aluminium salts, also withstand the action of warm size (at 122-140° F.).

Dyestuffs Which Dye Cotton, but Leave Woolen Threads Untinted in Boiling Acid Bath.

Auramine II, O, G.
Pyrogene Yellow M. (Direct and treated with chlorine.)
Patent Phosphine M, G, GG, R.
Brilliant Phosphine 5G-G.
Rosanthrene CB. (Developed.)
Direct Brown M, V.
Pyrogene Brown G, 3G, 5G, B, D, M, R, V.
Pyrogene Cutch 2G.
Nitranil Brown. (Various brands.)
Safranine GOOO, BOOO.
Rhodamine 6G, B, 5G, 3B, S.
Methylene Blue G.
New Blue RS.
Pyrogene Blue R and RR.
Pyrogene Direct Blue, red shade and green shade.
Indigene Blue B, BB, R.
Victoria Blue. (Various brands.)
Melantherine HW, BH.
Neropaline P.
Indigene Black B, BB.
Pyrogene Black. (Various brands.)
Thiophenol Black. (Various brands.)
Fast Green O, JJO, I.
New Fast Green 2B, 3B.

The Direct Dyestuffs diazotized and developed (or after-treated with diazotized paranitaniline).

The Basic Dyestuffs after-treated with tannic acid and tartar emetic.

DYESTUFFS FOR WOOL.

Dyestuffs Which May be Dissolved in the Hot Acid Dye-bath.

Naphtol Yellow S.
Quinoline Yellow.
Tartrazine.
Orange II, R.
Paper Red PSN, PE.
Ponceau S for silk, 4161.
Kiton Red S.
Amaranth G and B.
Acid Violet 4R, 3BN, 6BN, 7B.
Kiton Blue.
Kiton Green B.
Benzyl Green B.
Anthracene Acid Green.
Navy Blue BW and HH.

Easy Leveling Dyestuffs.

Naphtol Yellow SS.
Azo Yellow O, I.
Orange II.
Rhodamine G, B.
Diamond Magenta.
Kiton Red S.
Violet 3R-4B.
Crystal Violet 5BO.
Kiton Blue B.
Wool Green S.
Alkali Blue 3R-6B.

As Sufficiently Level Dyeing for Ordinary Requirements the following may also be mentioned:

Quinoline Yellow.
Tartrazine.
Orange MNO, N, R.
Ponceau S for silk, 4161.
Benzyl Bordeaux B.
Acid Violet 7B-4R.
Benzyl Violet 10B, 6B, 4B. (Neutral, very good.)
Alkali Violet O.
Victoria Blue B. (Not in mixtures.)
Navy Blue BW and HH.
Acid Green O, yellow shade.
Acid Green O, blue shade.
Benzyl Green B. (Neutral, very good.)
Acid Black NN, 3X, D.
Chrome Fast Yellow G, GG.
Chrome Fast Brown G, R, B.
Chrome Fast Black F, BB, FW, R.

Dyestuffs Fast to Fulling.

ACID AND MORDANT (CHROME) DYESTUFFS.

*Quinoline Yellow.
Tartrazine.
Orange *N, R.
Ponceau S for silk, 4161.
Paper Red PSN, E.
Rocceline.
Benzyl Bordeaux B.
Acid Rhodamine R, RR, RRR.
Anthracene Red I.
Benzyl Violet 6B, 10B, 4B, 5B.
Induline.
Acid Violet 3BN, 4BN, 6BN, 7B.
Alkali Violet.
Fast Cloth Blue G, R, RRB.
Grey R, B, BB.
*Wool Green S.
Anthracene Acid Green.
Benzyl Green B.
Benzyl Blue B, S.
Chrome Fast Yellow GG, G.
Chrome Fast Brown R, G, B.
Chrome Fast Black F, BB, FW, R.
Acid Black NN, 3X, D.

*These colors stain white wool slightly.

BASIC DYESTUFFS.

Rhodamine G, B.	Victoria Blue B.
Diamond Magenta.	Ethyl Violet.
Violet 3R-4B.	Crystal Violet 5BO.

DIRECT DYESTUFFS.

Cotton Yellow CH.
Direct Yellow CR.
Direct Orange G, R.
Acid Congo R.
Cotton Red 4B.
Direct Pink BN, GN.
Direct Safranine G, B.
Chlorantine Red 4B, 8B.
Acetylene Blue 3R. (Stands a light fulling.)
Direct Blue BX.
Acetylene Blue BX.
Direct Blue W104.
Direct Blue 3B, 2B. (As Acetylene Blue 3R.)
Acetylene Blue 3B. (As Acetylene Blue 3R.)
Acetylene Blue 6B.
Acetylene Pure Blue.
Direct Light Blue 550.
Direct Sky Blue, green shade.
Acetylene Sky Blue.
Direct Green B695.
Melantherine BH, HW.
Indigene Black 2980.
Direct Brown M.
Direct Brown R.
Cupranil Brown B, G, R.

The direct dyestuffs do not bleed into white wool during fulling, but white cotton becomes more or less stained.

Dyestuffs Fast to Finishing. (Steaming.)

ACID DYESTUFFS.

Quinoline Yellow.	Eosine.
Naphtol Yellow S.	Erythrosine.
Tartrazine.	Ponceau S for silk.
Orange II, R.	Ponceau 4161.

BASIC DYESTUFFS.

Rhodamine B, G.	Violet 4R-3B.
Diamond Magenta.	Crystal Violet 5BO.

In addition, those direct dyestuffs which are applicable to wool.

MORDANT DYESTUFFS.

Chrome Fast Yellow G, GG.
Chrome Fast Brown G, B, R.

Not quite so fast are:

Azo Yellow O, I.
Orange MNO.
Kiton Red S.
Rocceline.
Benzyl Bordeaux B.
Acid Violet 7B-4R.
Pure Blue ARI-BSI.
Alkali Blue 6B-3R.
Kiton Blue.
Alkali Violet O.
Benzyl Violet 10B-4B.
Navy Blue BW, HH.
Acid Green O, yellow shade.
Acid Green O, blue shade.
Wool Green S.
Anthracene Acid Green.
Kiton Green B.
Benzyl Green B.
Acid Black NN, 3X, D.
Chrome Fast Black BB, F, FW.
Grey B, BB, R.
Victoria Blue 4R, B.
Benzyl Black B, 4B.

Dyestuffs Fast to Stoving.

BASIC DYESTUFFS.

*Auramine G, O, II.
*Rhodamine B, G.
Diamond Magenta.
Violet 3R-3B.
Crystal Violet 5BO.
*Night Blue.
*Victoria Blue 4R, B, R.

ACID DYESTUFFS.

*Quinoline Yellow.
*Naphtol Yellow S.
Azo Yellow O, I.
Orange MNO, II, R, N.
*Tartrazine.
*Ponceau S for silk, 4161.
*Kiton Red S.
Rocceline.
Benzyl Bordeaux B.
Benzyl Violet 4B-10B.
Amaranth G and B.
Anthracene Red.
Anthracene Acid Green.
*Wool Green S.
Benzyl Green S.
Acid Violet 4R-7B.
Benzyl Blue B, S.
Navy Blue BW, HH.
*Grey R, B, BB.
*Chrome Fast Yellow G, GG.
*Chrome Fast Brown B, R, G.
*Chrome Fast Black BB, R, FR, F, FW.
Benzyl Black B and 4B.

DIRECT DYESTUFFS.

*Cotton Yellow CH.
*Direct Yellow CR.
Direct Orange G, R.
Direct Violet C, CB, N.
Acid Congo R.
Chlorantine Red 4B, 8B.
Direct Safranine G, B.
*Direct Blue 2B, 3B.
Direct Blue BX, 3R, W104.
*Direct Sky Blue, green shade.
Acetylene Pure Blue.
Acetylene Sky Blue.
*Direct Light Blue 550.
Acetylene Blue *3B, 6B, BX, 3R.
Direct Green J, B695.
Direct Brown R, M.
Melantherine BH, HW, JH.

*These colors answer the highest requirements in this respect.

Dyestuffs Fast to Acids.

ACID DYESTUFFS.

†*Quinoline Yellow.
†*Naphtol Yellow S.
‡*Azo Yellow O, I.
†*Orange II, R.
†*Tartrazine.
‡*Orange MNO, N.
†*Acid Rhodamine R, RR, RRR.
†*Amaranth G, B.
Benzyl Bordeaux B.
†*Ponceau.
Paper Red PSN, PE, E.
‡*Rocceline.
†*Eosine.
†*Erythrosine.
†*Anthracene Red.
‡*Alkali Blue 6B-3R.
‡*Alkali Violet.
‡*Acid Violet 4R.
†*Acid Violet 3BN, 4BN, 6BN, 7B.
†*Benzyl Violet 4B-10B.
†*Acid Green O, yellow shade.
†*Acid Green O, blue shade.
Kiton Blue.
Navy Blue BW, HH.
†*Benzyl Blue B, S.
†*Induline.
†*Wool Green S.
Benzyl Green B.
Anthracene Acid Green.
Kiton Green B.
†*Acid Black 3X, NN, HA.
Benzyl Black B, 4B.

MORDANT DYESTUFFS.

†*Chrome Fast Yellow GG, G.
†*Chrome Fast Brown R, G, B.
†*Chrome Fast Black R.
Chrome Fast Black FW, BB, F.

BASIC DYESTUFFS.

Auramine II, O.
Patent Phosphine G, GG.
†*Rhodamine G, B.
Rhodamine 3B.
Diamond Magenta.
‡*Violet 2B, 3B.
‡*Crystal Violet 5BO.
Brilliant Violet 6B, 8B.
Victoria Blue 4R, B.
Brilliant Victoria Blue RB.

*These colors are fast to carbonizing, the rest are simply fast to perspiration. † Represents very good. ‡ Represents sufficient.

DIRECT DYESTUFFS.

All direct dyestuffs applicable to wool are sufficiently fast to perspiration. The fastness to carbonizing does not come into consideration, as the burrs are dyed by these colors, thus rendering the process of carbonizing unnecessary.

Dyestuffs for Carpet Yarn.

*Chrome Fast Yellow GG, G.
*Chrome Fast Brown G, R, B.
*Chrome Fast Black F, R, BB.
Anthracene Red I.
Quinoline Yellow.
Tartrazine.
Kiton Red.
Benzyl Bordeaux B.
Rocceline.
Paper Red PSN, PE.
Acid Violet 4R.
Induline.
Wool Green S.
Benzyl Green B.
Kiton Green.
Grey BB, R, B.
Benzyl Black B, 4B.

*These colors to be after-treated with 1.5% Bichrome.

Dyestuffs for Shoddy and Mungo.

Naphtol Yellow S.
Tartrazine.
Direct Yellow T.
Fast Yellow R1209.
Orange MNO, II.
Rhodamine B.
Direct Safranine G, B.
Anthracene Red.
Cotton Red 12B.
Diamond Magenta.
Benzyl Bordeaux B.
Cotton Red 11B1436.
Tolamine Violet N.
Direct Blue W104.
Benzyl Violet 4B, 6B, 10B.
Acid Violet 3BN, 4BN, 6BN, 7B.
Opaline 2G.
Alkali Violet O, I.
Violet 3R-4B.
Crystal Violet 5BO.
Pure Blue. (All brands.)

Brilliant Violet 6B and 8B.
Victoria Blue B, R, 4R.
Benzyl Blue B and S.
Brilliant Victoria Blue RB.
Alkali Blue 3R-6B.
Direct Indigo Blue BN, BNK, A, BK.
Kiton Green B.
Tolamine Green B.
Wool Green S.
Benzyl Green B.
Fast Green O and JJO.
Cupranil Brown B, G, R.
Acid Black. (All brands.)
Carbide Black RI.
Direct Deep Black 1718.

Shoddy is dyed with direct dyestuffs in 10-15 times its weight of water, with addition of 40 lbs. Glauber's Salt per 100 gallons, for ½ hour boiling.

Direct dyestuffs are especially suitable for the dyeing of mungo or shoddy containing cotton, or such as are required fast to washing.

Basic dyestuffs are applied in neutral bath.

Acid dyestuffs and Victoria Blue R and 4R are dyed for one hour at the boil, with an addition 8% sulphuric acid.

Dyestuffs Fast to Water.

The dyestuffs in the following list do not bleed into either white wool or white cotton on steeping 3 days in cold water.

Chrome Fast Yellow G, GG.
Tartrazine.
Cotton Red D.
Acid Congo R1573.
Acid Rhodamine R, RR, RRR.
Anthracene Red.
Amaranth G, B.
Acid Violet 3BN, 6BN, 7B, 4BN.
Benzyl Violet 4B, 6B, 10B.
Alkali Violet.
Pure Blue B.
Water Blue CIII.
Victoria Blue 4R, R.
Alkali Blue 6B, BB, R, 3R.
Benzyl Blue S, B.
Navy Blue RIII.
Induline.
Benzyl Green B.
Kiton Green.
Chrome Fast Black F, R, B, FR, FW.
Grey R, B, BB.

DYESTUFFS FOR SILK.

Basic Dyestuffs.

Auramine *O, *II, †G.
*Patent Phosphine G, GG.
*Brilliant Phosphine 5G, 3G, G.
†Chrysoidine G, R.
†Bismark Brown G, R.
†Diamond Magenta.
*Rhodamine G, B, S, †6G, 3B.
†Safranine GOOO, BOOO.
†Cotton Scarlet G.
†Cardinal Red G.
*Violet B-4B.
†Violet. (Redder brands.)
*Crystal Violet 5BO.
*Ethyl Violet
*Brilliant Violet 6B, 8B.
*Methylene Blue G. (Mostly for topping purposes.)
*Victoria Blue 4R, R, B.
*Brilliant Victoria Blue RB.
*New Victoria Blue GG.
*Brilliant Glacier Blue.
*New Fast Green 2B, 3B.
*Fast Green JJO and O.
†Jute Black N, V, GN.

Mordant Dyestuffs.

‡*Chrome Fast Yellow G and GG. (Chromed.)
‡*Chrome Fast Black. (Chromed.)

Acid Dyestuffs.

*Tartrazine.
Quinoline Yellow.
†Naphtol Yellow S.
Yellow WR.
†Azo Yellow O, I.
Orange MNO, N, II.
†Paper Red PSN, PE.
Acid Rhodamine R-RRR.
Ponceau S for silk.
*Acid Violet 7B-3BO.
*Amaranth G, B.
*Kiton Red S.
Rocceline.
Benzyl Bordeaux B.
Alkali Violet I.
Alkali Blue 3R-6B.
Induline.
*Pure Blue B for silk.
*Navy Blue 5R, RIII, RSP.
Night Blue.
Blue Fluorescent.
Kiton Blue B.
*Acid Green O, yellow shade.
Acid Green O, blue shade.
Kiton Green.
†Wool Green S.
*Grey R, B, BB.
Benzyl Green B.
Acid Brown G, R, B.
Resorcine Brown.
Acid Black NN, HA.
Silk Acid Black.
Eosine JLI.
Erythrosine B.

Direct Dyestuffs.

‡Thiazol Yellow.
‡¶Direct Yellow CR, T.
§Cotton Yellow CH.
‡¶Chlorantine Yellow JJ.
§Chlorantine Yellow JG.
‡Fast Yellow R1209.
§¶Chlorantine Orange TR, TRR.
§Direct Orange G, R.
‡Cupranil Brown G, R.
Cupranil Brown B. (Coppered.)
‡¶Chlorantine Brown B.
Chlorantine Brown R, BB.
§Direct Brown ¶M, R.
‡Direct Brown V. (Developed.)
§Direct Safranine G, B.
Direct Pink GN, BN.
§Chlorantine Red 4B, 8B.
‡Chlorantine Lilac B, BB.
§Chlorantine Pink.
§Direct Violet N.
§Direct Blue 3B, 2B, BX, 3R.
§Acetylene Blue 3B, BX, 3R.
§Chlorantine Blue B, BB.
§Direct Light Blue 550.
‡Indigene Blue B, BB. (Developed.)
§¶Direct Sky Blue, green shade.
¶Acetylene Sky Blue.
‡Direct Green J.
Direct Green B695.
§Direct Grey.
‡Melantherine BH, HW, developed. (Direct dyeings bleed.)
‡Indigene Black B.
Indigene Black HS. (Developed.)

The dyeings obtained with the basic dyestuffs, and the majority of the acid and direct colors, gain considerably in fastness to washing by steeping for several hours in 3-6% tannic acid at 85-105° F. (All Direct Dyestuffs are fast to water.)

*These silk colors (Basic, Mordant, Acid, as well as all Direct Dyestuffs quoted) are fast to water.
†Fairly fast to water.
‡Fast to washing and fulling. (At 122° F. with 5 lbs. soap per 100 gallons.)
§Fast to washing and fulling, but bleed slightly into cotton.
¶Become faster to fulling and washing, if after-treated with 5-10% chrome alum at 194-212° F.

Dyestuffs Suitable for Dyeing Silk Yarn Intended to be Woven with Raw Silk, and "Boiled Off" in the Piece.

The series of Pyrogene colors. (Special treatment.)
Melantherine BH. (Developed with β naphtol or resorcine.)
Direct Blue 2B. (Developed with β naphtol.)

Dyestuffs for Heavily Weighted Silk. (Tin weighting.)

Azo Yellow I, O.
Citranine OOO.
Orange II, R.
Acid Rhodamine R, RR.
Acid Violet 4R, 3R.
Alkali Violet.
Brilliant Victoria Blue RB.
New Victoria Blue GG.
Victoria Blue 4R.
Brilliant Glacier Blue.
Acid Brown G.
Benzyl Green B.

DYESTUFFS FOR JUTE.

Auramine O, II, G.
Patent Phosphine G, GG, M.
Azo Yellow I, O.
Orange MNO, II, R.
Chrysoidine G, R.
Jute Scarlet B, 4R, G.
Rocceline.
Paper Red PSN, PE.
Russian Red, yellow shade.
Russian Red, blue shade.
Chlorantine Red 4B, 8B.
Rhodamine S.
Safranine GOOO, BOOO.
Diamond Magenta.
Violet 3R-3B.
Crystal Violet 5BO.
Brilliant Violet 6B, 8B.
New Blue RS.
Victoria Blue 4R, R, B.
Pure Blue AI, ARI, BSI.
Water Blue CIII.
Brilliant Victoria Blue RB.
New Victoria Blue GG.
Brilliant Glacier Blue.
Fast Green JJI, FII, I, BBI.
Chlorantine Brown R, B, BB.
Cupranil Brown G, R, B.
Jute Black N, GN, V5093.
Catechu Brown.

Full particulars regarding how to use the products of the Society of Chemical Industry may be found in a handbook which they publish, and which will be gladly furnished by their agents in the United States and Canada, A. Klipstein & Company, 122 Pearl St., New York.

COTTON DYEING.

Among the chief classes of dyestuffs used for cotton dyeing may be mentioned the Diamine Colors, Immedial Colors, Basic Colors, and Acid Colors as manufactured by the Cassella Color Co., of New York. They are used for dyeing cotton in practically all forms, that is, in the raw stock, sliver, roving, hank, cops, chain warps, and piece goods, as well as hanks and chain warps that have been mercerized previously. All of the classes mentioned will dye direct, that is, without a previous mordanting process, except some of the Basic colors which require the use of a mordant, although a few are suitable for direct dyeing.

DIAMINE COLORS.

Besides direct dyeing colors, there are some which require an aftertreatment either with metallic salts, or by means of diazotizing and developing or by coupling.

Diamine colors are very extensively used for dyeing loose cotton and their application for this purpose is continually increasing owing to the prominent advantages gained thereby, which are:

(1). Simplicity of working, one hour's dyeing being sufficient in most cases.

(2). The softness and spinning properties of the cotton are perfectly preserved, hence the dyed cotton may be spun to the same fineness as the raw cotton, without any appreciable waste being produced.

(3). The carding of the cotton is very much facilitated and consequently there is very little wear on the card clothing.

Most of the Diamine colors yield, by direct dyeing, dyes of good fastness to washing, which especially in pale shades satisfy most demands. The direct dyed dark shades are also satisfactory for many purposes, especially if the colors are not milled together with white cotton. If, however, the demands in regard to fastness to milling are more exacting, the colors must be fixed on the fibre to improve their fastness to washing, this being obtained either by metallic salts, or by diazotizing and developing, or by coupling.

The Diamine colors for direct dyeing are dyed at the boil with the addition of such neutral salts, as Glauber's salt or common salt, and with or without the addition of alkaline salts like soap or soda. The presence of alkaline salts retards the absorption of the coloring matter by the fibre, whereas neutral salts have the opposite effect; the more neutral salts the dye-liquor contains, the more rapidly the absorption.

These colors are usually dyed in a boiling bath or just below the boil, for about one hour. Very light shades require only about ½ hour at 105-120° F.

In the case of dark shades it is advantageous, after dyeing at the boil, to allow the cotton to feed in the cooling bath, *i. e.* to dye only about ¾ hour boiling and to allow about ¼ to ½ hour for feeding.

The Dye-bath for Direct Dyeing is prepared as follows:

For light shades 1% soda ash, 1-2% soap, and 3-5% sodium phosphate or (if preferred) Glauber's salt.

For medium shades—2% soda ash, 10% Glauber's salt (calc.).

For dark shades—2% soda ash, 20% Glauber's salt (calc.).

The soap used for light shades may be replaced by Turkey-red oil, and Glauber's salt in most cases by common salt, of which, however, 50% more have to be used, *e. g.*, for dark shades instead of 2% soda ash and 20% Glauber's salt use 2% soda ash and 30% common salt.

The dye-bath is best prepared by adding the constituents in the following order; first, the soda ash, then the color solution, and finally the Glauber's salt or common salt. In the case of shades of uneven dyeing tendency, the salt may be added in 2 or 3 portions after the dyeing has been progressing for some time.

The degree of concentration of the dye-liquor is an important factor when dyeing with the Diamine colors. The more dilute the bath, the more difficult it is to exhaust, whereas the more concentrated the solution, the more readily the coloring matter is absorbed by the cotton.

Aftertreatment with Metallic Salts. Owing to the fact that the resistance to light of direct dyeings produced with Diamine Colors may be considerably enhanced by a treatment with metallic salts and this process being exceedingly simple in its application, it has been steadily gaining in importance with the various industries.

The usual methods of aftertreatment are the following:

(1) Aftertreatment with cupric salts.

(2) Aftertreatment with bichromate of potash and sulphate of copper.

(3) Aftertreatment with bichromate of potash, chrome alum or chromium fluoride.

Aftertreatment with Cupric Salts. Sulphate of copper is the agent most generally utilized in this case. According to the depth of the shade required, 1-3% are used (reckoned on the weight of the goods), and added along with 1-3% acetic acid to the bath for aftertreatment.

The treatment with sulphate of copper in the first place increases the fastness to light and simultaneously improves the resistance to washing. The aftertreatment is generally carried out in a hot liquor; the latter may, however, equally well be merely lukewarm, or even cold, if it is to increase the fastness to light only.

Cupric Oxide of ammonia may replace sulphate of copper with advantage, it having the same effect, the application of sulphate of copper is however more convenient and cheaper. Of cupric oxide of ammonia, 1-2% should be taken, calculated on the weight of the cotton.

Aftertreatment with Bichromate of Potash and Sulphate of Copper. According to the depth of the shade 1-2% each of bichromate of potash, sulphate of copper and acetic acid should be taken. The effect of this aftertreatment with reference to resistance to light is the same as with sulphate of copper alone; with regard to fastness to washing, a combination of sulphate of copper and bichromate of potash has a more favorable effect. The aftertreatment is carried out in a boiling bath.

Aftertreatment with Bichromate of Potash, Chrome Alum or Chromium Fluoride. According to the depth of shade, 2-3% each of bichromate of potash, Chrome Alum or Chromium Fluoride, and acetic acid should be used. These salts are applied in a boiling bath and render some colors considerably faster to washing; the fastness to light is however not effected thereby. In place of bichromate of potash, bichromate of soda may be used.

Metallic salts do not interfere with the shading; goods after-treated with metallic salts may be shaded at will by first rinsing them thoroughly and topping with suitable Diamine Colors in a fresh bath containing 2-3% soda. It is in such a case unnecessary to repeat the aftertreatment.

Diazotized and Developed Dyeings. The fixing of Diamine Colors by diazotizing and developing, is, as is well known, one of the processes most frequently applied. This treatment increases on the one hand the intensity of the shades, rendering them in some cases twice as heavy, and on the other hand fixes the colors so well that the developed dyeings may be termed very fast to washing and milling.

The Diamine Colors which may be diazotized and developed are: Primuline; Diamine Cutch; Diamine Browns M, S, V; Cotton Browns A, N; Diamine Blues 2B, 3B; Diaminogene Blues BB, G, NB, NA, 3RN, Sky-blue N, Dark Blue; Diamine Azo Blues 6B, 2R, R; Diamine Heliotropes G, B, O; Diamine Blacks BH, RO, BO; Diamine Blue Black E, Diamine Azo Black B, Diamine Beta Blacks B, BB; Diaminogenes B, extra, BW, CCL.

The following three operations are necessary for producing diazotized and developed dyeings:

(1). Dyeing with one of the colors capable of being diazotized in the manner as will be explained, and rinsing in cold water (whizzing or wringing off after rinsing is hardly necessary).

(2). Diazotizing for 10 or 15 minutes in cold water containing nitrite of soda and hydrochloric acid, then rinsing in water containing a little hydrochloric acid.

(3). Developing for 10 or 15 minutes in cold water containing a developer, such as Beta Naphthol, Naphthylamine ether powder, Phenylene Diamine, Phenol, etc.

With regard to the dyeing process, nothing need be added to what has already been stated in connection with the production of direct shades. The diazotizing always takes place in a cold bath.

The Bath is made up as follows: 2½% nitrite of soda, 7½% hydrochloric acid 20° B., or 5 % sulphuric acid 66° B.; Reckoned on the weight of the goods, and calculated for very dark shades.

First, dissolve the nitrite of soda in some water and add the solution to the bath, then add the sulphuric or hydrochloric acid.

If the bath has been already used, add ⅓ of the above quantities for every 10 lbs. of cotton.

It is seldom necessary to prepare a stronger diazotizing bath than the above. In order to ascertain whether the bath is still active, dip into it a piece of paper impregnated with starch paste and potassium iodide, which should at once turn blue. Further, the presence of the necessary nitrous acid can be detected by its smell. If, however, the odor of the bath is too pungent, it is an indication that too much nitrite is present. An excess of nitrous acid in the diazotizing bath is not injurious, but ought to be avoided for economical reasons.

When light shades are to be developed, the quantities given may be still further reduced as follows: 1½% nitrite of soda, 5% hydrochloric acid 20° B., or, 3% sulphuric acid 66° B.; Reckoned on the weight of the goods.

For diazotizing in dyeing machines, or for diazotizing piece goods on the jigger, reduced quantities must also be taken.

The diazotizing is best conducted in wooden vessels. When dyeing in machines, the diazotizing and developing may also take place in copper vessels.

The diazotizing and developing operations are always conducted in a cold bath, and the developing bath is charged with the necessary developer, in solution; the goods are turned for a few minutes in this bath, lifted, and rinsed, or soaped as desired. The shade and fastness of the dyeings obtained differ according to the developer employed.

Coupled Dyeings. A certain number of Diamine Colors can be fixed with Nitrazol C or Paranitraniline, by the so-called Coupling Process, in a similar way as by diazotizing and developing. An advantage of this process is that it is carried out in one bath only. The shades produced by coupling are as fast to washing and milling as those obtained by developing, and they possess, besides, a prominent fastness to acids.

The Dyestuffs Suitable for Coupling are:

For black:—Diamine Nitrazol Black B, Oxy Diamine Blacks A, D, AM, JB, JEI, JW, UI.

For blue:—Diamine Blue NC.

For Brown:—Diamine Nitrazol Browns RD, BD, G, B, T, Oxy Diamine Orange G and R, Oxy Diamine Brown G, Cotton Browns A, N, Diamine Brown S.

For yellow and mode shades:—Primuline, Diamine Fast Yellow A, Diamine Bronze G, Diamine Grey G.

The coupling is effected by treating the dyed and rinsed cotton goods for ½ hour in one of the cold coupling baths charged as follows for 100 lbs. cotton:

Coupling with Nitrazol C.

For 1½-2% dyeings: 2 lbs. Nitrazol C pat., ½ lb. soda ash, 3¼ oz. acetate of soda.

For 3-4% dyeings: 3-4 lbs. Nitrazol C pat., ¾-1 lb. soda ash, 3-4 oz. acetate of soda.

To dissolve the Nitrazol C, it should be stirred up with a little cold water (68-77° F.). Any lumps that may have formed should be carefully broken up, and the Nitrazol should finally be brought into solution by pouring a sufficient quantity of cold water over it.

The coupling bath is charged by first adding the solution of Nitrazol, then the soda, and finally the acetate of soda.

The cotton is worked in this cold bath for ½ hour and rinsed as usual.

Coupling with Paranitraniline C.

For 1½-2% dyeings: 4½ gallons diazotized Paranitraniline C, ½ lb. soda ash, 3½ oz. acetate of soda.

For 3-4% dyeings: about 6¼-8¾ gallons diazotized Paranitraniline C, ¾-1 lb. soda ash, 4¼-6¼ oz. acetate of soda.

The diazotized Paranitraniline to use is prepared as follows: Dissolve 2 lbs. Paranitraniline C with 2 gallons boiling condensed water, stir well, and then add 5 pints hydrochloric acid 20° B.; after some stirring, complete solution will have set in; then add 4¼ gallons cold water, which precipitates the hydrochloride of Paranitraniline in the form of a yellow paste. This solution should always be prepared a few hours before it is used in order to give it time to cool down by standing. When quite cold, add 1½ lb. nitrite of soda dissolved in 7 pints cold water, whilst stirring. After about 20 minutes, a clear solution results, which is then brought up to 25 gallons with cold water.

The diazo solution will keep for some time if preserved in wooden or earthen vessels and protected from heat or sunlight.

IMMEDIAL COLORS.

The Immedial Colors yield dyes of eminent fastness to milling, acids and light and are exceedingly well adapted to the dyeing of loose cotton, sliver, and roving and hanks, etc., in dyeing machines. The process of dyeing is most simple and it must only be observed that the dye-liquor should not come into contact with copper.

The machines constructed of iron, or nickel and the nickel-plated iron machines have proved the best. Great care should be taken that the water be free from lime, this condition being essential for the machine-dyeing generally, whatever coloring matter may be used.

The Immedial colors are best dissolved in wooden vessels by pouring over them hot water containing part of the sodium sulphide required for the dyeing process. Vessels, pipes or fittings of copper or brass should also be avoided for dissolving the dye. The metallic parts necessary should be of either iron or lead.

Copper has an injurious effect on the liquor only; dyed cotton may after rinsing come into contact with any kind of metal without suffering in any way.

The dye-bath is charged with soda, sodium sulphide and common salt or Glauber's salt. The quantities of each required for the various colors vary for the different processes of dyeing.

Sodium sulphide fulfils the very important mission of keeping the color in solution during the dyeing process, and the aspect of the dye color is therefore a reliable guide as to the correctness of the addition made; a sufficiently large quantity of sodium sulphide keeps the bath absolutely clear, whereas an insufficient addition renders it turbid, and the liquor, if dropped on white blotting paper, shows a visible precipitation. In the latter case a further addition of sodium sulphide brings the bath up to the required condition. It is specially requisite to restore the bath in this way, either after prolonged disuse or after too severe boiling. Unnecessary and excessive boiling should therefore be avoided, because it favors oxidation of the sulphide too much. On the other hand, an excess of sulphide cannot be recommended, the dyeings thereby remaining thin.

Soda ash is added in order to preserve the alkalinity of the dye-bath and to increase the effect of the sodium sulphide. In some cases soda ash is substituted by caustic soda lye.

Common salt and Glauber's salt promote the exhaustion of the dye-baths in a similar manner as when employed in dyeing with Diamine Colors. For pale shades the quantities of common salt or Glauber's salt must be moderated, whilst dark shades require an increase of salts.

The first bath per 10 gallons of liquor is prepared with:

8 oz. soda ash, 18-20 oz. cryst. sodium sulphide, 2 lbs. cryst. Glauber's salt, 2-4 lbs. Immedial Black.

For subsequent lots (considering the weight of the cotton to be dyed) use 2% soda ash, 9-10% cryst. sodium sulphide, 12-13% Immedial Black, 5-10% cryst. Glauber's salt.

The dye-bath is first charged with soda, then with the dyestuffs previously dissolved with sodium sulphide, and finally with Glauber's salt.

The dye-bath having been boiled up with all the additions, the cotton is entered and dyed either at the simmer for one hour or at full boil for about ¼ hour, in which latter case the steam is shut off after that time and the hot liquor allowed to circulate.

Other additions are sometimes made, but only in special cases, as, for instance, dextrine or sodium chromite for the dyeing of black on piece goods, or Turkey-red oil for the dyeing of Immedial Sky Blue on hanks or loose cotton, or for Immedial Black on warps, etc., in order to facilitate penetration.

The dye-baths may be preserved for constant use without fear of deterioration. If the sodium sulphide contained in the liquor should become oxidized by prolonged contact with the air and the coloring matter be thereby precipitated, the dye-bath merely needs boiling up and the addition of some fresh sodium sulphide to be fit for use again.

The Immedial Colors are generally dyed by boiling up the dye-bath charged with all the ingredients, shutting off steam and entering the goods and dyeing to the finish at or near boiling temperature.

An exception is made with Immedial Skyblue, and the Immedial Indones, Maroon and Bordeaux G, Immedial Skyblue being always dyed at a low temperature, about 70-85° F., and the others at about 120-140° F.

At the conclusion of the dyeing process, the liquor is run off, and the liquid remaining in the material is rapidly drawn or pressed off. The cotton is then at once rinsed with cold water or lifted and placed in a second machine filled with cold water. In either case the goods are finally rinsed with lukewarm or hot water.

When there is no aftertreatment, the goods must be very thoroughly rinsed after dyeing.

Black dyeings, whether after-treated or not, should be treated with an addition to the last rinsing bath of 3-5 oz. acetate of soda per 10 gallons of water; having remained a short period in this bath they are dried without any further rinsing. This aftertreatment with acetate of soda should never be omitted, unless the cotton is to be soaped or otherwise softened after dyeing.

It is very important that the goods be squeezed as perfectly as possible, and rinsed immediately after dyeing. The more thoroughly and evenly the goods are squeezed and rinsed, the greater will be their resistance to rubbing and the more even the shade.

The first rinsing bath, which will contain a fair amount of dyestuff, may be added to the dye-bath again or serve for dissolving the next addition of coloring matter.

In dyeing Immedial Blue C and CR there is a deviation in the process in so far as the cotton must not be rinsed after dyeing, but only well squeezed or evenly wrung and steamed in this state.

In the same manner as some of the Diamine colors are improved by aftertreatment, so also are some of the Immedial colors improved by aftertreatment.

Five patented processes are as follows:—(1). Aftertreatment with chromium salts, (2). Aftertreatment with acetate of soda, (3). Steaming with admission of oxygen, (4). Treatment with the peroxides of hydrogen or of sodium and (5). Development of brown dyeings with Nitrazol.

Aftertreatment of Dyeings with Chromium Salts:—This is resorted to chiefly in the case of Immedial Black, whilst for Immedial Brown, bichromate of potash and sulphate of copper are to be preferred. The aftertreatment of Immedial Black chiefly serves the purpose of varying the shade according to requirements, whereas in the case of Immedial Brown it improves the fastness to light.

Aftertreatment with Acetate of Soda:—This aftertreatment is of especial importance for blacks produced with Immedial Black, and should be applied in every case unless the dyeings be subjected to one of the usual alkaline finishing operations, such as soaping, oiling, etc. For this purpose, 3-5 oz. of acetate of soda per 10 gallons of water are added to the last rinsing bath; the cotton is worked in this liquor for a few minutes and dried without being rinsed again.

If the yarns or pieces are subject to some finishing process, the acetate of soda may be added to the finish.

In the case of dyeings which are scrooped with acids, as is frequently done with yarns, the acetate of soda should be added direct to the scrooping bath.

The cotton hanks are then soaped as usual and passed through a bath containing, instead of acetic acid alone, 1 pint of acetic acid and ½-1 lb. of acetate of soda, per 10 gallons of liquor.

Developing Immedial Blue C and CR by Steaming. This operation may be very easily carried out in any box made either of wood, copper or iron, or equally well in an ordinary dye-vat.

It should in any case be observed that the cotton must not be rinsed after dyeing, but simply well hydro-extracted or otherwise freed from an excess of liquor before being subjected to the steaming process.

Yarns and pieces are suspended on laths in the steam-box so that the steam may penetrate the goods evenly, whereas loose cotton or warps should only be piled up in layers of reasonable height. The steam-box remains closed during the steaming operation. If the steam-box be constructed of wood, the lid should be covered with felt or woolen cloth in order to render it as tight as possible.

The steam is best introduced at the lower part of the box in order to allow the condensed water to run off freely, and altogether care must be taken to prevent any condensed liquid from spotting the goods.

Very wet steam may however be rendered more serviceable by placing along the bottom of the box a gilled steam pipe for heating the box previous to charging it with the goods.

The hotter and drier the steam, the more rapid is the developing and the brighter the shade of the blue.

Air is also introduced into the steam-box simultaneously with the steam. This is done by means of a small injector which is adjusted between the steam pipes by means of two flanges.

Similar to developing by steam is the developing of Immedial Blue by smothering the dyed, moist cotton (loose cotton, yarn or piece).

The method of working is as follows:—The dyed and hydro-extracted cotton, the heat of which must be retained as well as possible, is placed into skeps or wooden boxes, the inside of which is lined either with oiled brown paper or oil-cloth (American cloth); these receptacles are then covered up in order to prevent a cooling or drying of the contents, and placed for a few hours, or overnight, in the drying room. The developing of the blue in this manner is best carried out with the temperature of the drying room at 140-160° F.

For smothering piece goods and warps, the same may be placed in the ordinary dyer's barrows, but care must be taken to place them in such a way that they do not dry where they touch the sides and that they retain their heat for a few hours.

After lifting, the cotton is rinsed in hot water.

Immedial Blue can also be developed by topping with Indigo instead of being steamed, the reducing action of the Indigo vat also developing the blue shade of Immedial Blue.

Developing Immedial Blue with Sodium Peroxide or Hydrogen Peroxide. Immedial Blue can also be developed by the application of the peroxides of sodium or hydrogen: the fact however that steaming is a cheaper and less complicated process accounts for the diminishing employment of these chemicals.

Aftertreatment of Immedial Brown with Nitrazol. This aftertreatment, the so-called "coupling process," causes the shades to turn considerably yellower and very much deeper. This coupling process is carried out exactly as previously described.

BASIC COLORS.

The application of the basic dyestuffs is restricted to the production of those exceptionally bright shades which cannot be obtained with either Diamine Colors or Immedial Colors.

For most purposes, however, it is sufficient to use the basic dyestuffs for topping cotton which has been grounded with Diamine or Immedial Colors without any previous mordanting.

The method of dyeing most frequently employed is to mordant the cotton first with tannic acid, or other tannins, and to fix the tannin subsequently with tartar emetic. The cotton is then well rinsed and dyed with basic dyestuffs.

The water used for mordanting with tannic acid should be free from iron if possible, as cotton mordanted in water containing iron acquires a more or less grey appearance, which is particularly objectionable for pale shades. If water free from iron is not at hand, a few drops of hydrochloric acid should be added to the mordanting liquor, whilst calcareous water is best corrected with acetic acid.

The mordanting bath is prepared: for light shades with 1½-2% and for dark shades with 4-5% of tannic acid.

The mordanting bath is not kept in the case of light shades; for dark shades, however, the baths may be used continuously, in which case they are freshened up with 3-4% tannic acid.

The above quantities refer to a mordanting bath containing a volume of liquor not more than 15-16 times the weight of the cotton. When mordanting in more liquor, the quantity of tannin should be correspondingly increased.

The cotton, which has previously been well boiled off and rinsed, is brought into the hot tannin liquor, turned several times, and then left standing immersed in and fully covered by the liquor.

For pale shades, 1-2 hours' mordanting is sufficient; for dark shades the cotton generally remains in the liquor overnight.

Since the tannin is taken up best in a cooling bath, the mordanting bath for dark shades should be warm on entering, but only lukewarm or cold when the cotton is taken out.

After mordanting with tannin, the cotton is well wrung or hydro-extracted and then brought into an antimony bath without being rinsed.

After mordanting with tannin and tartar emetic, the cotton must always be well rinsed before it can be dyed. In order to fix the tannin, the mordanted cotton is worked for 20-30 minutes in a cold bath containing about ⅓ or ½ of tartar emetic of the weight of the tannin employed. After the fixation of the mordant, the cotton must be very thoroughly rinsed.

The cold dye-bath is charged first with 2-3% acetic acid or 2-3% alum; enter the cotton, give a few turns and lift; then add the well-dissolved dyestuff in two or three portions, through a sieve, and raise the temperature slowly to 140-160° F.; allow to cool in the bath for 15-20 minutes and rinse.

Instead of being dyed on a mordant of tannin and antimony, some of the basic dyestuffs may, similarly to the Diamine Colors, be dyed also in a salt bath, although the fastness to light and washing is considerably inferior. Naphtindone BB and Irisamine G are principally used in this manner.

According to the depth of shade to be dyed, the bath is prepared with 3-5 lbs. of salt per 10 gallons of liquor; the cotton is then entered at 105-120° F. and the bath brought slowly to the boil. Irisamine may be dyed at 105-120° F. without any further heating.

In machine-dyeing the basic dyestuffs are used chiefly for topping.

The dyestuffs principally used are: Indazine, Naphtindone, New Methylene Blue, Methyl Violet, Solid Green and Brilliant Green, Safranine, Paraphosphine, Thioflavine T.

The cotton which has been dyed with Diamine or Immedial Colors is rinsed and then topped in a cold bath with the afore named basis dyestuffs, with the addition of 3% acetic acid (or alum) calculated on the weight of the cotton.

ACID COLORS.

Acid dyestuffs are used on cotton principally for bright shades which are not required to be fast to washing, and are divided into Scarlets, Eosines and Soluble Blues.

Scarlets:—Brilliant Croceïne M, R, B to 9B, Scarlet FR, FRR, FRRR, and Croceïne AZ.

Amongst these the Croceïnes are especially important, as they yield brilliant scarlet shades of excellent fastness to light; their resistance to washing however is very poor.

At dyeing, the quantity of liquor should be as small as possible (not more than 10 parts of liquor to 1 part of yarn), the bath being prepared with the requisite quantity of coloring matter and about 5 oz. alum and 2 lbs. Glauber's salt, per 10 gallons of liquor.

The cotton is entered at 120°-140° F. and turned for half an hour, whilst the bath is cooling off. The cotton is then evenly wrung and, without rinsing, dried at a moderate temperature.

Eosines:—Eosine 3G, GGF, BN, Eosine Scarlet B, Erythrosine yellow shade, extra N, B, D, Phloxine (749), Rose Bengale extra N, Irisamine G, and Rhodamine B. These dyestuffs yield still more brilliant shades than the Croceïnes, but are inferior to them in fastness to light.

The cotton is dyed for half an hour in a concentrated bath at 85°-105° F. with addition of 4-5 lbs. of salt per 10 gallons of liquor, and then dried without rinsing. It is important that not more dye-liquor than necessary (at the utmost 10-12 gallons of water for 100 lbs. of cotton) is used.

Soluble Blues:—Water Blues B, RB, R, Pure Soluble Blue, Methyl Blue for Cotton, Blues JBP, JB, BS, FS, RS, RRS and Alkaline Blues RRR to 6B.

There are two general methods of dyeing these colors, viz:

1. Direct dyeing with alum and Glauber's salt.

These dyestuffs are dyed exactly as previously described for the Croceïnes, however, only half as much coloring matter being required. The quantities of alum and Glauber's salt used remain the same.

2. Dyeing on tannin mordants.

The dyestuffs are dyed on tannin mordants exactly as previously described for basic dyestuffs, and yield then very bright colors, which though *faster* to washing than those dyed by the first method, cannot even then be termed practically fast to washing. The Alkaline Blues especially are dyed according to this second method.

TOPPING DIAMINE AND IMMEDIAL COLORS WITH BASIC DYESTUFFS.

The dyed produced with Diamine colors either by direct dyeing or by developing, possess the property of taking up and fixing the basic dyestuffs. This property may be made use of for brightening or shading such dyes with suitable basic dyestuffs. In the same advantageous way basic dyestuffs may be fixed on dyeings produced with Immedial colors.

The topping is always effected in a fresh bath containing the solution of the basic dyestuff and an addition of 2-3% acetic acid or 2-3% alum (of the weight of the cotton). The dyeing is done cold or lukewarm, and in the case of such basic dyestuffs which have a great affinity to the cotton the precaution is taken to turn the material several times in the liquor, which has been previously charged with alum or acetic acid only, subsequently adding the color solution in two or three portions.

For piece goods the topping has the special advantage of better covering the impurities (such as fragments of straw, dead cotton, etc.) always present in a low class goods.

COMBINATION OF INDIGO WITH DIAMINE AND IMMEDIAL COLORS.

The Diamine colors are used both for bottoming and for topping vat blues, whereby very much indigo is economized and the material is better dyed through. Particularly linen yarns, linen pieces and other tightly woven materials are bottomed, as they are not satisfactorily penetrated by Indigo alone.

All black and dark blue Diamine colors may be used for bottoming. Most extensively employed are diamine Jet Black SS, Diamine Black RO and Diamine Black BH. In a few cases Diamine Brown V is also used for the production of coppery shades.

The goods are for example bottomed with: 1½% Diamine Black RO, ½% Diamine Brown V, with the addition of 2% soda ash, 5% Glauber's salt and then dyed in the Indigo vat.

For topping Indigo shades, principally blue and violet Diamine colors are used, especially Diamineral Blue R, Diamine Fast Blue C and Diamine Violet N, all of which possess very good fastness to light and washing.

With reference to Immedial colors, apart from Immedial Black, Immedial Blue C and CR as well as Immedial Direct Blue B have given the most satisfactory results for bottoming Indigoes.

The bottoming with Immedial Black is chiefly employed for dark shades, and is done by dyeing first with 2-5% Immedial Black, this color being subsequently topped in the Indigo vat.

In bottoming with Immedial Blue, Immedial Blue C is used for light shades and Immedial Blue CR for deeper and more violet shades.

As a rule Immedial Blues are not steamed when applied for such bottoming purposes, however, this depends in the first instance on the shade to be produced and on the kind of vat employed.

For topping in the hydrosulphite vat the previous steaming may be dispensed with, both for pale and for dark shades.

If the topping be done in the zinc dust lime vat, pale shades will come out brighter, if steamed before topping, whilst for medium and dark shades steaming is unnecessary.

If the color be topped in the copperas-lime vat, it is advisable to steam previously, as this process renders the colors much brighter.

It is of no consequence whether the goods be washed before the topping to be unwashed into the vat; it is, however, of great advantage to leave the goods unwashed for 2-3 hours after having been topped in the vat, and to sour them off and wash them subsequently.

After dyeing piece goods with Immedial Blue they are frequently left unwashed and well covered with felting for 12-24 hours and then dyed in the vat.

In many cases yarns are first dyed in the vat and subsequently topped with Immedial Blue. Dyeing and steaming of Immedial Blue is then done.

Immedial Direct Blue B may be applied in the same way as Immedial Blue for bottoming Indigo with the advantage that it can be used for all sorts of vats directly without developing by steaming. It is dyed to a depth of 2-5%, washed and then topped with Indigo.

The basic dyestuffs are used in combination with Indigo only for topping the same and serve principally for brightening. Frequently, however, their application is even necessary in order to better cover the burls of cotton piece goods which are not well enough dyed by Indigo.

For this purpose, especially the various brands of New Methylene Blue, such as N, R and 3R and also Indazine M and Naphtidone BB are used.

The dyeing is effected exactly as described for topping Diamine and Immedial colors. In few cases only the Indigo dyed goods are mordanted with tannin and tartar emetic before being dyed with basic dyestuffs, in order to obtain greater fastness; in the latter case they should be dyed according to the method described for basic dyestuffs.

TETRAZO, TETRANIL AND TETRAZODE COLORS

of the American Dyewood Co., are Substantive, or Direct-Dyeing Colors, which dye cotton from the neutral bath in one operation. These colors are made in a large variety of shades, and are used on cotton according to the regular substantive dyeing methods as follows:—

For light shades, make up the dye-bath with the color, with 1% to 2% soda, and 5% to 10% Glauber's salt or common salt. Dye the material just below the boil for 30 to 45 minutes.

For dark shades, make up the dye-bath with the color, with 1% to 2% soda and 15% to 25% common salt or Glauber's salt. Dye the material for one hour.

The goods thus dyed should also be steeped for about 15 minutes in the dye-bath after boiling, in which case the shades become brighter and fuller.

It is advisable, when dyeing heavy or dark shades, to restore the same bath, as subsequent operations in the same bath require only about ⅔ the amount of dyestuffs and ⅓ the amount of assistants to be added to it.

As examples of the ordinary substantive dyestuffs, may be mentioned Tetrazo Red B, Tetrazo Pink BU, Tetrazo Blue 4R, Tetrazo Yellow R, Tetrazo Black G, etc.

Tetrazo Chlorine Yellow, Tetrazo Chlorine Brown, Tetrazo Chlorine Blue 4B, etc., are characterized by their good resistance to washing, light, acids and alkalies. Tetrazo Chlorine Yellow is especially fast and may be used for shading purposes, in connection with diazotized and developed colors, maintaining its own shade throughout the different operations. Tetrazo Yellow R, Tetrazo Red B, Delta Purpurine 5B, and Tetrazo Black N are of interest as being quite fast to acid. Tetrazo Black N is of importance, giving shades which do not change on exposure to air, and which stand acid well. This black is also of value for dyeing cotton in the fulling mill. In union work, cotton is dyed heavier than the wool. Tetrazo Pink BU is worthy of notice as being among the fastest substantive colors and answers the requirements for clear shades of pink, of excellent fastness to light and washing. This color, with Tetrazo Red B, Tetrazo Chlorine Rose Conc., Tetrazo Chlorine Red 8B and Tetrazo Chlorine Lilac B, forms part of a series that should commend themselves for light and delicate shades of uncommon fastness where ordinary colors fail.

Many of the Tetrazo colors may be utilized to good advantage for the dyeing of union goods in one-bath. Some color both fibres equally, while others dye the cotton heavier and still others have more affinity for the wool. Tetrazo Lemon Yellow, Tetrazo Blue 3G, Tetrazo Brilliant Blue BB, Tetrazo Azurine G, Tetrazo Reds, Tetrazo Blacks G and R, Tetrazo Greens, Tetrazo Orange TG, Tetrazo Chlorine Yellow GG, and Tetrazo Chlorine Lilac B, color both fibres to about the same depth.

Some of the Tetrazo colors, such as Tetrazo Yellow CH, Tetrazo Orange TG, Tetrazo Red B, Delta Purpurine 5B, Tetrazo Azurine G, and Tetrazo Brilliant Blue BB, may be used to advantage on wool, dyeing with the aid of acetic acid, the resultant shades being extremely fast to milling.

The Tetranil colors have the additional property of being capable of aftertreatment with metallic salts, such as bichrome and bluestone, which is carried out as follows:—

With Bluestone: Run the goods for 15 to 30 minutes at 175° F. through a fresh bath containing 2% to 4% bluestone.

With Bichrome: Run the goods for 15 minutes through a boiling bath containing 1% to 3% bichrome. Colors thus treated become very fast to light and washing.

Tetrazode colors may be used as direct colors, but are of greater importance when diazotized and developed. For the latter make up the dye-bath, with the color, 2% soda and 25% common salt or Glauber's salt. Dye at the boil for one hour.

The dyed and rinsed cotton is then worked for 15 minutes in a cold diazotizing bath containing 2½% to 3% nitrite of soda, 7½% to 12% muriatic acid 20° B. or 32° Tw., and afterwards rinsed in water, slightly acidulated with muriatic acid, and then entered immediately into the developing bath.

The cold developing bath is prepared with the necessary amount of developer, such as Developer D or Developer N, and the materials are worked for 15 minutes; then rinsed and soaped, if necessary.

TETRAZO SULPHUR COLORS.

This important class of cotton dyes is of comparatively recent development, the series including blacks, blues, browns, drabs, yellows, greens.

Sulphur dyes are extremely fast to all influences usually brought to bear on dyed material, such as light, acids, crabbing, fulling, alkalies, and the mercerizing process; thus are applicable in a great variety of cases, and consequently their use is extensive.

There are two types of sulphur colors, one requiring an aftertreatment with some oxidizing agent in order to develop and fix the color, while the other group produces the fully developed color direct.

In the ordinary method of application the dyestuff is used in conjunction with sulphide of soda, the function of which is to act as a solvent for the color as well as a reducing agent.

In addition to sulphide of soda, it is usual to add to the sulphur black bath considerable quantities of common salt or sodium sulphate, in order to make the reduced dye less soluble, and thus produce deeper colors from a given amount of dye.

Sulphur black dye-baths cannot be well exhausted, for which reason it is necessary to use a large amount of dye in the first instance, and to keep the bath as a "standing bath" for use over and over again after suitable replenishment. The sulphur blacks vary considerably in their properties; some may be dyed almost as easily as the direct cotton colors, while in other cases it is necessary to use great precautions in order to produce a successful result.

Tetrazo Sulphur Blacks of the American Dyewood Co. are examples of the first mentioned class of colors, being concentrated colors dyeing direct without aftertreatment, and of exceptional value where it is desired to obtain dyeings on cotton which are fast to light, washing, fulling and cross-dyeing.

The formula for applying these dyes for 100 pounds of cotton, is as follows:

Start the bath with about—

150 gals. water.

10 to 14 lbs. dyestuff.

13 to 18 lbs. Sulphide Soda Conc. (or twice as much Sulphide Soda Crys.).

8 lbs. Sal Soda.

50 lbs. Common Salt or

80 lbs. Calcined Glauber's Salt.

The Sulphide Soda and dyestuff are usually boiled together and added to the dye-bath, but they may be added directly to the dye-bath, first putting in the Sulphide Soda, and the bath boiled to thoroughly dissolve the dye.

Dye one hour at a boil; rinse quickly in cold water, and then thoroughly three times. Keep a standing bath.

For the second bath add 8 lbs. to 12 lbs. dyestuff.

For the third bath add 6 lbs. to 10 lbs. dyestuff.

For the fourth and following baths add 5 lbs. to 9 lbs. dyestuff and three-quarters to seven-eighths the amount of Sulphide Soda Conc. as of dyestuff, and as much Sal Soda and salt as corresponds to amount of water used (usually ⅕ to ⅙ amount of first bath).

After dyeing, soften the yarn in a bath at 210° F. with 1 qt. Olive Oil and 2 lbs. Chip Soap.

If the water contains lime, some Sal Soda or Wyandotte Textile Soda should be added. Turn 4 times (about 15 minutes).

The dyestuff must be perfectly dissolved, and must remain in solution throughout the dyeing operation, it being noted that the developed dyes themselves are insoluble in water, acids or alkalies. The dye must be converted into a reduced form, in order to be soluble in alkalies. The reducing agent used is sodium sulphide, which, being alkaline, acts also as a solvent for the reduced dye. Any deficiency of sodium sulphide results in the presence of undissolved color particles in the dye-bath, and these, becoming temporarily fixed on the cotton, cause the dyed material to rub off. Excess of sodium sulphide in the dye-bath tends to prevent the fixation of the dye, and thus to produce weak shades.

The sodium sulphide is gradually oxidized by the atmosphere to sulphite and finally to sulphate, in which condition its solvent and reducing properties are lost.

The presence of caustic soda in the dye-bath tends to prevent the precipitation of free sulphur from the sulphide. Provided the dye is sold in the completely reduced condition, alkali alone will be required, adding just sufficient sulphide to counteract the oxidizing action of the atmosphere or the air in the water.

The dye-bath must be very concentrated, since sulphur blacks are what might be termed weak dyes. The amount of dye which is necessary to fix on the material in order to produce a good black varies from about 4 per cent in the case of the most concentrated to about 20 per cent with weaker dyes. Under the most favorable conditions, it is impossible to fix, on the cotton, in any one operation more than about 20 per cent of the amount of dyestuff present in the dye-bath at the time. It is therefore necessary, in order to prevent great waste, that a standing bath should be kept and used with the proper replenishment between each dyeing operation. A dye-bath may be used for several months before requiring to be emptied and reset; but the amount of sediment present, the degree of alkalinity, the density of the bath, etc., must be carefully watched and controlled in order to ensure satisfactory results.

To assist still further in the fixation of the dye, it is best to add to the dye-bath a considerable amount of common salt or Glauber's salt, but in replenishing the bath, it is not necessary to add this in proportion to the additional amount of color added, since a comparatively small amount is removed from the dye-bath by a single dyeing operation.

It is always best to avoid, as much as possible, exposure of the material under operation to the atmosphere during the dyeing. If oxidation takes place irregularly or superficially, uneven or bronzy dyes will result. In the same way an even and thorough squeezing of the material as it leaves the dye-bath is essential, and this should be followed at once by a thorough rinsing, in order to remove any superficially fixed dye. The presence of any metallic copper or copper compounds in the dye-bath must be carefully excluded, since the sodium sulphide at once attacks any copper with which it comes into contact, and the dyestuff is rapidly precipitated in an insoluble condition, with resulting loss of dye, rapid destruction of the copper, and bronziness and rubbing off of the dye.

The soaping of the material after being dyed, has for its object the removal of all the loosely adhering dye, thus rendering said material clean and also removing any bronziness, and at the same time softening the fibre which has become more or less harsh during the dyeing operation. For this purpose a hot solution of olive oil soap or an emulsion of oil and soap is used, and after washing off the goods coming from the dyeing, they are worked in this solution.

Sulphur blacks are very commonly used in dyeing warps, which are afterwards used in connection with wool filling for union fabrics in which the wool is afterwards cross-dyed with acid colors. In order that these goods do not soil white cloth when rubbed on it, it is necessary to leave in the material a small amount of acid, which, during the subsequent finishing operations, will frequently involve singeing, thus causing the cotton fibre to become tender.

The sulphur blacks are very suitable for topping with aniline black by treating the sulphur dyed cotton in an aniline black dye-bath, and since the latter contains some oxidizing agent, the sulphur black is developed simultaneously with the production of the aniline black.

Sulphur blacks, as developed with potassium bichromate, may also be topped with alizarin dyes, in which instance the chrome acts as a mordant for both.

Although Basic colors may be used for topping, the bloom imparted is very fugitive.

Loose cotton is dyed either in open dye-vats, or in dyeing machines, in the former instance it being advisable to keep the vat covered, in order to diminish the access of air to the material, and also to retain the heat. When using dyeing machines, the cotton must be entirely covered by the dyeing liquor, since the cotton as well as the liquor must not be exposed to the air more than is absolutely necessary.

The cotton after being dyed, must be immediately well washed, and finally softened. The necessity for the complete avoidance of copper in any of the apparatus with which the dye-liquor comes into contact, is equally important for this kind of dyeing.

The formula for dyeing Tetrazo sulphur colors on raw cotton for 100 pound batches is as follows:

Start the bath with
5 to 15 lbs. dyestuff.
5 to 15 lbs. Sodium Sulphide Conc.
2 to 3 lbs. Sal Soda.
25 to 75 lbs. Common Salt.

The Sodium Sulphide and dyestuff, as stated for dyeing sulphur black, are usually boiled together and added to the dye-bath, but they may be added directly to the dye-bath, first putting in the Sodium Sulphide, and the bath boiled to thoroughly dissolve the dye. Dye one hour at a boil; rinse quickly in cold water and then thoroughly three times.

It is advisable to keep a standing bath, in which case only about ⅔ of the quantity of Sulphide and dyestuff is necessary for the standing bath, adding enough salt to keep the density up to the original strength. In dyeing Tetrazo Sulphur Indigo the cotton should be allowed to oxidize in the air for one hour before rinsing.

The dyeing of cotton cops can be satisfactorily carried on in suitable cop-dyeing machines, using iron skewers for supporting the cops, however, an important point in connection with this style of dyeing must be seen to, and that is that the dye used in the bath should be in perfect solution, and on this account a somewhat larger addition of sodium sulphide than is used for other methods of dyeing is advisable.

When dyeing cotton in the form of hanks, great care has to be taken in order to produce a perfectly uniform color even when using the most level dyeing colors, since the production of perfectly even shades on hanks by means of these dyes is a matter of some difficulty. In the same manner as when dyeing in any style with sulphur dyes, an immediate and thorough squeezing and washing of the hanks are necessary operations.

Warps are now dyed with sulphur colors for use in connection with union goods, which are afterwards cross-dyed as previously mentioned, using for this purpose an ordinary continuous warp-dyeing machine, slightly modified so that the upper set of rollers is below the surface of the dye liquor and thus keep the warp from being exposed to the air during the operation. Two or three dyeing boxes are provided, followed by rinsing boxes. The warp should travel during the operation at such a speed that any given portion of it passes through the machine in four or five minutes. By thus dyeing in so short a time, it is necessary to use a much stronger bath than is required for loose cotton or for yarn dyeing.

Piece goods dyeing with sulphur colors is also carried on, although it is a more or less difficult operation, owing to the trouble in the production of level shades of sufficient intensity, in many cases an irregular bronziness being produced, which is due to irregular exposure of the goods to the air, or, more frequently to uneven squeezing or drying. By having the goods kept beneath the surface of the liquor, these deficiencies are practically overcome.

For Dyeing Tetrazo Sulphur Blues, Browns, Greens, Yellows, etc., of which there are various shades of each color, such as Tetrazo Sulphur Blue B, Blue R, Brown P, Brown R, Brown 4R, Brown RG, Brown G, Brown M, Bronze, Green B, Yellow G, etc., the first dye-bath is made up as follows for 100 pounds of cotton:

150 gals. water.
1 to 10 lbs. dyestuff.
1½ to 8 lbs. Sulphide Soda Conc. (or twice as much Sulphide Soda Crys.).
1 to 3 lbs. Sal Soda.
10 to 80 lbs. Common Salt.

The Sulphide Soda and dyestuff are usually boiled together and added to the dye-bath, but they may be added directly to the dye-bath, first putting in the Sulphide Sodium, and the bath boiled to thoroughly dissolve the dye.

Dye one hour at a boil; rinse quickly in cold water and then thoroughly three times.

Tetrazo Sulphur Yellow G, is dyed similarly, except that more Sodium Sulphide Conc. (3 to 12 lbs.) is required. This product gives shades of extreme brilliancy, being almost equal to the brightest substantive colors.

Tetrazo Sulphur Indigo is a very useful color for dyeing brilliant indigo blue shades with greenish cast, and requires to be applied as follows:

For 100 pounds of cotton:
200 to 250 gals. water.
6 to 15 lbs. dyestuff.
6 to 15 lbs. Sodium Sulphide Conc.
10 to 15 lbs. Sal Soda.
25 to 50 lbs. Salt.
3 pints Mineral Oil.

Dissolve the dyestuff, Sodium Sulphide Conc. and oil together in boiling water and add to dye-bath. Dye for one hour just below the boil, keeping yarn under surface of the dye-bath. Squeeze off liquor and hang in air for one hour, turning yarn occasionally. Rinse well in cold water and then work in bath at 75° F., containing 1 to 2 lbs. Ammonia per 100 gals. water.

For a standing bath one-half the quantity dyestuff and Sulphide Sodium Conc. are sufficient and correspondingly reduced amounts of salt, soda and oil.

Besides dyeing with single sulphur colors, by the methods explained, mixed shades may also be obtained by using more than one color in the same bath, said colors being either of the same class or of different classes as the case may be. The simplest method is to use two sulphur dyes in the same bath, and is excellently adapted for dyeing pale shades and where the retention of the dye-bath is not important. The production of dark colors may be also economically obtained when large quantities of the same shade are required; but for small quantities of goods to be dyed the same shade, it is not advantageous, since the dye-bath cannot be well exhausted and consequently a great deal of dyestuff would be lost when the bath is emptied.

In pale shades the mixture of sulphur browns and blacks yields a great variety of drabs and greys, and in darker shades, the black increases the depth of shade. The blacks may also be used to darken the blues, or the blues and yellows to tone the blacks, etc.

The shades produced by the sulphur colors, may also be modified by direct cotton colors, especially for producing bright colors with the sulphur colors, the main condition being to select such direct cotton dyes as will dye in a bath containing sodium sulphide.

Mordant dyes may be used for topping sulphur colors, when the latter are *developed with metallic salts*, this being a useful method of producing rich, full shades. Colors produced in this manner are extremely fast to all processes except cross dyeing, but are apt to bleed somewhat if subjected to a treatment with boiling acid.

Basic dyes are well suited for topping sulphur colors, since the latter act the part of powerful mordants towards them. This process is largely resorted to for the purpose of "toning" and "blooming" the shades. The topping with Basic colors should be done in a fresh bath after the sulphur dyed material has been well washed, and usually a small addition of acetic acid to the topping bath is desirable. The temperature of this bath should not exceed 140° F., and since many of the basic dyes are taken up very rapidly by the dyed cotton, it is advisable to add the color solution to the bath in several portions.

With reference to the properties of the sulphur dyes, they must be considered as the fastest of any of the cotton colors. They are very fast to light, although some of the yellows, greens, and blues do not stand this action so well. After developing, the fastness to light is usually increased. Their fastness to washing is generally excellent, many of the colors being unaffected even by boiling with soap. Boiling with dilute acid does not affect the sulphur dyes, and which are very suitable for cross-dyeing. When properly dyed these dyes do not rub and are unchanged by hot pressing.

PYROGENE INDIGO.

This is a new Sulphur dyestuff, lately brought in the market by the Society of Chemical Industry, and which with reference to cotton dyeing is superior to Indigo as regards its properties of fastness. In addition to its beautiful shade, which excels that of Indigo in brilliancy, and its fine overhand appearance, which approaches that of the basic dyestuffs, its low price renders its use more economical than Indigo and all its substitutes to cotton manufacturers. Pyrogene Indigo also possesses great covering power, and is very easily applied, requiring no aftertreatment. As regards its fastness to washing, fulling, acids, boiling and light, it may be classed as excellent; however the same as with all Sulphur dyestuffs, its fastness to chlorine is poor, but at the same time it is worthy of note to mention that Pyrogene Indigo retains its fine greenish blue shade on washing, whereas many of the ordinary Sulphur Blues acquire an objectionable reddish tone on washing.

Pyrogene Indigo may be combined with the various brands of Pyrogene Direct Blue, green shade and red shade, in all proportions, and all the shades of Indigo in vogue can be obtained with the help of these products. Blue shades dyed in this way may be used for all the purposes for which Indigo dyed cotton is employed; they possess considerable importance for the production of colored woven goods, and for the dyeing of piece goods. Pyrogene Indigo can be discharged with aluminium chlorate in the same way as Pyrogene Direct Blue, green shade and red shade, and these products form an excellent substitute for Indigo in the production of blue and white discharge effects.

Dyeing Recipe for Pyrogene Indigo.

For 100 lbs. cotton yarn or loose cotton:

170 -200 gallons water,

1 - 12 lbs. Pyrogene Indigo,

2½- 30 lbs. Sodium Sulphide Cryst. (2½ times the weight of dyestuff);

2½- 3 lbs. Soda Calc. (1½ lb. per 100 gallons).

For pale shades—

8½-20 lbs. Glauber's Salt Cryst. (5-10 lbs. per 100 gallons).

For full shades—

34-60 lbs. Glauber's Salt Cryst. (20-30 lbs. per 100 gallons).

The goods are dyed under the surface of the dye liquor for one hour, just below the boil (194° F.), squeezed off, and allowed to hang for ½-¾ hour in the air without washing. They are then washed well.

In the case of dark shades (6-8% and upwards) it is advisable, after oxidizing and washing, to soap the goods at 122-140° F. They are then washed and dried at a gentle heat.

For a standing bath, ⅔ of the original quantity of Pyrogene Indigo and 1½ times this amount of sodium sulphide will be quite sufficient. The additions of soda and Glauber's salt vary according to the amount of water which must be added to bring up the bath to its original volume.

Mixtures of Pyrogene Indigo and Pyrogene Direct Blue are applied in the same way; but, in this case, the quantities of sodium sulphide and Glauber's salt should be slightly reduced.

When dyeing on the jigger with Pyrogene Indigo, the recipe given may be used, and, in addition, it is recommended to add to the bath 6-10 lbs. dextrine per 100 gallons. After dyeing, the goods are immediately squeezed off, allowed to lie ¼-½ hour, washed, and, in the case of dark shades, soaped. Goods intended for discharging do not require soaping at this stage, as they are soaped after the discharging operation.

We might remark that since preparing this article an improvement has been made in this Indigo as regards solubility—the new mark, A. F., being much more soluble than the original product, and is especially adapted to work on the Cohnen Dyeing Machine (see pages 249 to 252) in consequence. (A. Klipstein & Co., New York.)

SULPHUR COLORS ON HOSIERY.

The most satisfactory dyeing processes for hosiery are those based upon the use of sulphur colors. In the early stages of their introduction there was much diversity of opinion as to the permanence of the black and the strength of the dyed material, but recent results demonstrate conclusively that the sulphur blacks yield results that meet every technical and commercial requirement.

The sulphur blacks have marked affinity for cotton in any form, and when applied to the fibre in a boiling bath, in the presence of the suitable accessory chemicals or salts, the results are remarkable. The color is fast to all influences. When properly washed after dyeing, it does not crock, rub or smut, and when properly dyed with suitable quantities of ingredients in the bath, the color will not fade under any influence, and will resist continued washing to the limit of endurance of the stocking itself. As to the bleeding of the black into adjacent white material, like any other similar color, this is only likely to occur when the washing is not thorough enough.

As more fully described in connection with the article on *"Tetrazo Sulphur Colors,"* some sulphur blacks are dyed in one operation and all completed when lifted from the dye-bath, washed and dried. Others require to be fixed; that is, in order to fix the color on the fibres, it is necessary to subject the dyed materials to the action of certain metallic salts of an oxidizing tendency, the most important being copper sulphate and bichromate of potash. Some sulphur colors require special precautions for dyeing, such as guarding against the action of the atmosphere, by keeping the hosiery totally immersed during the dyeing. Some blacks require the addition of sodium sulphide to the bath; others do not. Again, a few cannot be dyed without the presence of caustic soda. These are mere details and have a chemical bearing upon the process only, while the results may be exactly the same. The one essential point for all sulphur blacks, irrespective of details of making up the baths, is the absolute necessity of boiling during the dyeing operation; unless this is done, the resulting black will not possess the good qualities hoped for.

Hosiery manufacturers, especially those who do not have dyeing plants, should look carefully into the possibility of dyeing their own output with the sulphur blacks, as they will thereby be enabled to materially economize and incidentally reduce the yield of seconds. Hosiery dyed with any of the commercial marks of sulphur blacks, each of which has its own peculiar shade of black, however, will be found to have many excellent qualities, and will be in a good condition to be finished in any way desired.

The wearing qualities of sulphur-black-dyed hosiery compare favorably with hosiery dyed by the aniline black process, in that heel and toe do not wear out as easily. There is no doubt that the sulphur blacks are the blacks for hosiery of the future. The cost of installing a dyeing plant is much less than for any other process, while the dyeing estimates for equal lots or outputs for a definite time will show a much lower figure, not including known savings on seconds.

For hosiery yarns, the same points hold good, and as yarn-dyed hosiery is usually of a much higher grade than web-dyed material, the saving will be at once apparent. Yarns dyed with the sulphur colors are, as a rule, much stronger than those dyed with aniline black and consequently the delays are less numerous at the knitting machines, a feature which effects a material saving in the general expense account of the mill.

UNION DYEING.

Since it has been found possible to dye wool and cotton to the same shade with certain direct cotton colors in neutral Glauber's salt bath, these dyestuffs have assumed a position of tremendous importance in the dyeing of half-wool goods.

By employing the "one-bath method," so called in contra-distinction to the older method of mordanting with sumac and iron, it is possible to obtain brilliant solid shades on union fabrics.

ONE-BATH METHOD FOR UNIONS.

As already stated, the goods are dyed in one-bath with addition of 10-20 lbs. Glauber's salt per 100 gallons; the bath should be kept as concentrated as possible, 15-20 times the weight of the goods, as in this way better results are obtained than in more dilute baths. Hard water should be corrected according to the degree of hardness with ½-1½ lbs. soda per 100 gallons, and in fact a slight excess of soda is not altogether a disadvantage.

It should be noted as an important rule, that the majority of the direct dyestuffs go more on to the wool, at the boil, than on to the cotton, whereas at lower temperatures the cotton takes up more dyestuff than the wool.

The method of procedure is as follows:

The goods are entered at 140-158° F., dyed for half an hour at this temperature, raised to boil during the next quarter of an hour, and boiled until the wool is sufficiently dyed, which may take from one-half to three-quarters of an hour boiling. Then the goods are sampled (bitted); if the cotton is too light then more dyestuff is added, and the goods are allowed to run for some time in the cooling bath.

Attention should naturally be paid to the nature of the goods being dyed; for instance, goods containing a large amount of cotton should be dyed at a lower temperature, say 140° F.

As already mentioned, a slight excess of soda (or other alkaline salt, such as borax, sodium phosphate, sodium silicate, etc.), has a beneficial effect, inasmuch as it prevents the dyestuff from going too much on to the wool; for this reason the presence of acid, which often occurs in goods containing shoddy, should be avoided. On the other hand, a large excess of soda should be avoided, as it impairs the strength and handle of the wool.

For this purpose direct dyestuffs are used, and chiefly those which have the property of dyeing the cotton the same shade or a deeper shade than the wool, and for the purpose of shading the wool, such acid dyestuffs are employed as have the property of dyeing the wool in neutral bath without dyeing the cotton. The various brands of Benzyl Blue and Benzyl Violet of the Society of Chemical Industry, have proved particularly useful in this respect, and find extensive application in union dyeing.

In the dyeing of blue shades Alkali Blue is often used for the purpose of shading the wool; in this case an addition of 2-4 lbs. borax or sodium phosphate per 100 gallons is made to the dye-bath, as well as the usual quantity of Glauber's salt, and the goods are soured after dyeing.

The dye-baths may be used for further operations, and are replenished with ⅕ of the original quantity of Glauber's salt, and ⅔-¾ of the original quantity of dyestuff.

By the same method, two colored effects (shots) can be obtained, by employing different dyestuffs for the wool and cotton, and in selecting the cotton dyestuffs, particular care should be taken to use only such coloring matters as dye the wool as little as possible; however, these goods are usually dyed by the two-bath method, which we shall now proceed to describe.

TWO-BATH METHOD FOR UNIONS.

This can be carried out in several different ways, as follows:

1. The cotton may be first dyed in a concentrated, weakly alkaline bath for one-half to three-quarters hour at 104-140° F. with suitable direct coloring matters, the wool being afterwards dyed in a fresh acid bath with acid dyestuffs either lukewarm or boiling.

2. The operations may be carried out in the reverse order, the wool being first dyed in boiling bath with acid dyestuffs, the cotton being afterwards dyed in a cold or lukewarm bath, with addition of ¼-½ lb. soda per 100 gallons.

3. An older method, which is still extensively employed, is as follows:

The wool is first dyed in a boiling bath with acid dyestuffs; after washing, the cotton is mordanted with tannic acid or sumac for two to three hours cold, fixed by passing through tartar emetic, and afterwards dyed cold or lukewarm with basic dyestuffs. This method is particularly suitable for the production of bright two-colored effects, but is also much used for solid shades.

BURR DYEING.

The property which the direct colors possess of dyeing the cotton only in alkaline bath is often made use of in the so-called process of burr dyeing; the necessary dyestuff is added to the fulling liquor during the fulling process. In this way any cotton bits (nops or burrs) occurring in the woolen goods, which would otherwise show up in the finished goods as white spots, are perfectly covered.

The burr dyeing, as is explained in the special article on Burr Dyeing in the "Finishing" chapter, can also be conveniently carried out in the washing machine in a warm, slightly alkaline bath, which should be as concentrated as possible.

Carbide Black SO and E, and Direct Deep Black 1718 of the Society of Chemical Industry are particularly suitable for burr dyeing.

DYESTUFFS OF THE SOCIETY OF CHEMICAL INDUSTRY FOR UNION DYEING.

Direct Dyestuffs Which Dye the Wool Darker Than the Cotton in a Neutral Boiling Glauber's Salt Bath.

Cotton Yellow CH.
Direct Yellow CR1746.
Acid Congo R.
Direct Pink GN, BN.
Direct Safranine G, B.
Cotton Red 4B, 6B, 10B, 11B, 12B.
Chlorantine Red 4B, 8B. (Wool rather yellower.)
Chlorantine Pink. (Wool rather yellower.)
Direct Violet C, CB.
Direct Blue R. (Wool redder.)
Acetylene Blue 3R. (Wool redder.)
Direct Blue W104.
Direct Brown R.

By a suitable reduction of the temperature and by using a larger quantity of Glauber's salt (and in some cases by addition of a trace of soda), the above dyestuffs may be employed for the production of solid shades on union goods.

Direct Dyestuffs Which Dye the Wool and Cotton Alike in Neutral Boiling Glauber's Salt Bath.

Thiazol Yellow 2192.
Direct Orange G, R.
*Tolamine Violet.
Direct Blue *B, BX.
Acetylene Blue BX.
*Direct Blue R.
Direct Sky Blue.
Union Blue WGI, WGII, WGIII, WGIV.
Direct Indigo Blue A, BK, BN, BNK. (Wool redder. With addition of acetic acid both fibres are dyed alike.)
*Direct Grey BR.
Direct Brown M, R.
Cupranil Brown *G, R.
Union Brown M.

*These colors dye wool redder.

Direct Green B695, Y.
Direct Black 1602, 1718.
Carbide Black S, E.
Union Black K, S2050.

Direct Dyestuffs Which Dye the Cotton More Than the Wool in a Neutral Boiling Glauber's Salt Bath.

Chlorantine Yellow JJ, JG.
Fast Yellow R1209.
Direct Yellow T.
Chlorantine Orange TR, TRR.
Direct Grey 1474, 1368. (Wool yellower.)
Cupranil Brown B. (Wool slightly redder.)
Chlorantine Brown R, B.
Chlorantine Brown BB.
Direct Brown V.
Direct Blue 2B, 3B.
Acetylene Sky Blue.
Acetylene Pure Blue.
Acetylene Blue 3B, 6B.
Direct Light Blue 550.
Direct Violet N.
Melantherine JH.

Acid Dyestuffs Which Dye Only the Wool in Neutral Boiling Bath, and Which Can Therefore be Used in the Same Bath with Direct Dyestuffs.

Yellow WR.
Citronine OOO.
Orange MNO, R.
Acid Rhodamine R-RRR.
Rocceline.
Benzyl Bordeaux B.
Anthracene Red.
Acid Brown G, B, V.
Acid Violet 4R, 3BN, 4BN, 6BN, 7B.
Benzyl Violet 4B, 6B, 10B.
Benzyl Blue B, S.
Alkali Violet O.
Alkali Blue 3R-6B. (Must be subsequently soured.)
Anthracene Acid Green.
Wool Green S.
Benzyl Green B.
Fast Cloth Blue R, G, B, RB.
Acid Black HA, 3X, NN.
Benzyl Black B, 4B.

Rhodamine B is also useful for the purpose of covering the wool.

Direct Dyestuffs Particularly Useful for Dyeing Union Skirt Bindings.

Direct Yellow CR1746, 2039, T.
Chlorantine Red 4B, 8B.
Direct Pink GN, BN.
A mixture of 50 parts Acetylene Blue 6B, 50 parts Direct Blue W104.
Chlorantine Lilac B, BB.
Direct Indigo Blue BN, BNK, A, BK.
Cupranil Brown G, B.
Union Brown M.
Direct Black 1602, 1718.
Carbide Black E.
Direct Green G1574.

Directions for Dyeing. The dyebath is prepared with the necessary dyestuff and 15-20% Glauber's salt. The goods are entered at 140° F., worked at this temperature for 30 minutes, and then boiled for 20 minutes; in the case of Direct Yellow CR only 5-10 minutes.

Direct Yellow 2039 and T are boiled 20 minutes, then 2% acetic acid is added, and the boiling continued for one-quarter hour.

In the same way, Direct Indigo Blue A, BN, BK are boiled 20 minutes, then 2½-3% acetic acid is added, and the boiling continued for one-half hour.

Dyestuffs for Union Felts.

Chlorantine Yellow JG, Cotton Yellow CH, together.
Direct Yellow T.
Direct Orange G, R.
Acid Congo R1573.
Cotton Red 11B, 1436.
Chlorantine Red 4B, 8B.
Direct Indigo Blue BN, BNK, A, BK.
Union Blue WGI, WGII, WGIII, WGIV.
Direct Blue W104. (For darkening the wool.)
Melantherine HW.
Direct Black 1602, 1718.
Union Black K old, S2050.
Direct Green B695.

Directions for Dyeing. The dye-bath is prepared with the necessary amount of coloring matter and 30 lbs. crystallized Glauber's salt per 100 gallons. The goods are entered at 140° F., worked one-quarter of an hour at this temperature, then boiled three-quarters to one hour, and afterwards washed.

The duration of the dyeing at 140° F., is regulated according to the quantity of cotton contained in the goods; the above directions refer to felt containing 40% cotton; felt containing a larger amount of cotton is dyed rather longer at the lower temperature.

The goods should be well scoured before dyeing. (A. Klipstein & Co., 122 Pearl St., New York.—Sole Agents for the products of the Society of Chemical Industry in the United States.)

DYEING OF WOOL-SILK FABRICS.

These goods may be dyed either on the wince dyebeck or on a jig dyeing machine. The latter ensures, perhaps, a more level dyeing and is, by the tension it exerts on the fabric, a great preventive of wrinkling, however many prefer for these goods the wince dye machine, taking due care to keep them as open as possible by means of suitable batching or guide rails.

In the dyeing of wool and silk fabrics, heat plays an important part in the fixation of the color on the fibre, and in the wince dyebeck the goods are more continuously in the hot liquor than in the case of the jig machine. It is important to keep the goods open full width, as that tends to promote levelness of dyeing and the prevention of wrinkling.

The means of heating the dyeing machines must be adequate and so arranged that the temperature can be carefully regulated, for changes of heat have some influence on the degree in which the two fibres take up the dye. These goods may be dyed either in one uniform color or in two colors, that is the silk in one and the wool in another color.

Dyeing Self Colors. Generally speaking, the easily leveling acid dyeing colors will be found to give the best results on wool-silk goods, there being added to the bath either Glauber's salt and sulphuric acid, or Glauber's salt and acetic acid, or bisulphate of soda in the usual proportions. It is not easy to lay down hard and fast rules as to the exact conditions of carrying out the work, so much depends upon the dyestuff or dyestuffs used; some can be dyed well on to both the silk and the wool at 180° to 190° F., and as far as possible, such dyes should be used; while others need to be first worked at about 180° F. and then given a short boil, in order to become fixed on the wool. A little practical experience and observation with the particular dyestuffs favored by the dyer will soon show him which way to work.

Among acid dyes which have been found to work well, the following may be named: Tropaeoline O, Indian Yellow, Orange Extra, Brilliant Croceïne M, Cyanole Extra, Thiocarmine R, Indigo Blue N, Fast Acid Green BN, Formyl Violets, Brilliant Orseille C, Acid Magenta, Alizarine Blacks, Anthracite Blacks, Gloria Blacks, Victoria Black B, Fast Red A, Mentanil Reds, Croceïne Orange G, Fast Light Yellow G, Brilliant Acid Green 6B, Fast Green Bluish, Fast Light Green, Wool Blues, Azo Acid Violet R, Fast Acid Violet 10B, Victoria Violet 4BS, Acid Violets.

Many of the direct dyes of the Benzo, Diamine, etc., series dye very good level shades on to wool-silk goods from dye-baths which contain Glauber's salt and a little acetic acid. Among such dyes may be named Diamine Rose BD, Diamine Scarlets B and 3B, Diamine Red 5B, Diamine Bordeaux S, Diamine Fast Yellow B, Thioflavine S, Diamine Browns 3G and M, Diamine Catechine G, Diamine Catechine B, Diamine Blues, Diamine Dark Green N, Union Black S, Oxy-Diamine Black N, Diaminogene Congo Orange R, Pluto Orange G, Chloramine Yellow, Chrysophenine, Brilliant Benzo Green N, Benzo Dark Blues, Sulfon Cyanines, Chloramine Violet R, Direct Deep Blacks, Benzo Chrome Browns, Benzo Fast Scarlets, Benzo Rhoduline Red, Deltapurpurine, Geranine.

Dyeing Two-Colored Effects. The dyeing of two-colored effects on wool-silk goods is certainly not so easy as dyeing of self colors. The operation depends upon the fact that under some conditions, certain dyes will dye the silk better than the wool, as, for instance, at low temperatures, basic colors will go on to the silk very well but not on to the wool, while there are some acid dyes which will dye the wool but not the silk. In some cases, a single-bath process may be used, while in others, a two-bath process is adopted, dyeing the wool first and the silk last.

The one-bath method consists in using a combination of acid and basic dyes in a single-bath, along with acetic acid, the basic dye going on mostly to the silk. The goods are entered into the bath at 100° to 110° F., worked for about one-half hour, then the heat is slowly raised to 160° F. to dye the silk; finally the heat is raised to the boil to dye the wool. If necessary, the silk may be topped with a basic dye to bring it up to shade; in this case, the bath must be allowed to cool down.

In the two-bath process, the wool is first dyed in an acetic acid bath at the boil, and the following dyes leave the silk white under these conditions: Azo Cochineal, Azo Fuchsine, Azo Crimson, Azo Phloxine 2G, Cochineal Scarlet PS, Fast Red NS, Fast Yellow Extra, Naphthol Yellow S, Alizarine Saphirol B, Lanafuchsine, Brilliant Cochineal, Alizarine Lanacyl Blue, Naphthol Black. After thus dyeing, the silk is dyed with basic colors in a bath at about 100° F. The wool may take up a little of the color. The following colors dye the silk at 80° to 100° F., without staining the wool very materially: Thioflavine T, Amaranth, Acid Green, Methyl Blue, Formyl Violet S4B, Milling Yellow, Brilliant Croceïne, Brilliant Cochineal, Alizarine Lanacyl Violet B.

SILK DYEING.

The Direct Cotton Dyestuffs.

Many direct cotton (substantive) dyestuffs give dyeings on silk which, like those obtained on wool, are remarkable for their excellent fastness to water and washing; they have, on this account, met with considerable application in the dyeing of silk.

They are particularly useful for the manufacture of embroidery silks fast to washing, and are also used in the dyeing of silk thread effects fast to milling, and in the dyeing of waste silk.

By diazotizing and developing, or by aftertreatment with metallic salts, shades are produced which answer the highest requirements as regards fastness to washing, and which withstand the severest possible treatment with alkalies to which they may be subsequently subjected.

The direct cotton colors are applied to silk either in weakly acid bath containing Glauber's salt, or in a "boiled off" liquor-bath acidified with acetic acid.

The method of working is as follows:

(a) Dyeing in Glauber's Salt Bath.

The dye-bath is prepared, according to the depth of the shade required, with 5-10% Glauber's salt, the goods are entered at 104-122° F., raised gradually to the boil, the acetic acid being added in small quantities from time to time. 1-10% acetic acid is required, according to the exhausting power of the dyestuff; for pale shades the acetic acid may be omitted, or the minimum quantity will be found to be quite sufficient.

If a further addition of dyestuffs is required for shading purposes, the bath should be cooled down somewhat.

(b) Dyeing with Direct Dyestuffs in a Bath containing "boiled off" liquor and acetic acid.

The silk is then dyed in a bath containing 15% (on the volume of the dye-bath) "boiled off" liquor, with addition of just sufficient acetic acid to render the bath neutral or slightly acid.

The addition of acetic acid varies according to the depth of shade required, and to the exhausting power, *i. e.*, the leveling properties of the dyestuff; rapidly exhausting coloring matters require less, dyestuffs which exhaust more slowly require more acetic acid; as much as 10 per cent. may be required.

After dyeing, the silk is brightened with sulphuric or acetic acid, in the usual manner.

Diazotizing and Developing may be applied to silk by dyeing with suitable direct cotton colors, and afterwards diazotizing and developing according to the directions given for cotton. The fastness of the developed colors so obtained is about the same as those of the developed dyeings on cotton. Silk yarn so dyed is suitable for weaving with silk which has not been "boiled off," the goods being subsequently "boiled off" in the piece.

Aftertreatment with Metallic Salts is carried out exactly in the same way as in the case of cotton, the same dyestuffs being used.

The dyeings after-treated with copper sulphate are worthy of note on account of their excellent fastness to light; those after-treated with chrome alum are remarkable for their good fastness to water.

ACID DYESTUFFS.

The acid dyestuffs are also usually applied to silk in a broken "boiled off" liquor-bath, and for this purpose sulphuric acid is generally added to the bath until it shows a distinctly acid reaction; the Eosines and similar dyestuffs are applied in "boiled off" liquor-bath acidified with acetic acid.

The goods are entered at 122° F., the dyestuff being added in several portions to the bath. The temperature of the bath is then brought to the boil and kept at that temperature for some time; if necessary a further addition of acid is made during the course of the dyeing operation. The silk is then washed and brightened with sulphuric or acetic acid.

Alkali Blue is dyed on silk according to the following recipe:

The silk is dyed with addition of 3-5 lbs. Marseilles soap per 100 gallons in a boiling bath. It is then rinsed and soured in a fresh bath at 140-180° F., with 1½-5% sulphuric acid 66° B. (D. O. V.)

In the souring bath the goods may be "topped" or shaded with other dyestuffs. In this case it is recommended to wash and brighten in a fresh cold sulphuric acid bath.

BASIC DYESTUFFS.

The basic dyestuffs are dyed similarly to the acid dyestuffs, but in a "boiled off" liquor-bath containing acetic acid, or in a neutral soap bath; just sufficient acetic acid should be added, in the former case, to render the bath slightly acid. The goods are entered at 105° F., and raised slowly to boil, the dyestuff being added in several portions during the operation. Dyestuffs which dye level at lower temperatures may be dyed at 140° F.

After dyeing, the silk is washed and brightened as usual. As already stated, Eosine and Rhodamine are applied in a similar manner.

DYESTUFFS SOLUBLE IN OIL AND SPIRIT.

Whereas the dyestuffs insoluble in water are scarcely ever applied to wool and cotton, they are of importance in silk dyeing in connection with the so-called "dry-dyeing" process. They are used principally in this branch of the industry, in the dyeing of very light silk fabrics, point lace, gauze, and similar materials, which would be damaged by treatment in an ordinary dye-bath. The process consists in treating the goods with a solution of the necessary dyestuff in alcohol or benzene. These solvents have no detrimental action on the structure of the fabrics, and quickly volatilize, leaving a thin layer of dyestuff on the goods.

Shades obtained in this way are by no means fast, but are generally sufficiently fast to fulfil the requirements of this class of goods.

THE DYEING OF WEIGHTED SILK.

Among the many dyestuffs now on the market, only a limited number are suitable, on account of their good exhausting and easy leveling properties, for dyeing silk which has been heavily weighted with tin salts.

The dyestuffs, and which are given in table on page 277, possess the useful property of dyeing perfectly level shades at a temperature of 120° F., so that the weighted silk suffers no loss in weight during the dyeing operation.

These dyestuffs, with the exception of Alkali Violet, are applied in "boiled off" liquor-bath, with addition of sulphuric acid. The goods are dyed at 120° F., washed and brightened with acetic acid; Alkali Violet is dyed in neutral soap bath at 120° F., washed and brightened with sulphuric acid.

The dyestuffs may be mixed for the purpose of producing compound shades. (A. Klipstein & Co., New York.)

DYES FAST TO WASHING ON WEIGHTED SILK.

The use of alizarine dyes for silk dyeing depends on their forming lakes on the fibre with the mordant. This method of dyeing, however, is impossible, with weighted silk. For example, if we try to get a fine red with alizarine, on a silk weighted with tin, the oxides of tin and sodium which are present, together with silicic and phosphoric acids, form ugly, dirty looking lakes with the alizarine. Similar effects occur in all other cases. We have, nevertheless, in the diamine colors, dyes which can be used on weighted silk.

If, for example, we have to dye a cardinal red which is not required to be very fast to washing, we can get fine full shades on weighted silk with Diamine Scarlet B or 3B. Diamine Fast Red F gives shades on it which are very much faster to washing and stand light splendidly if after-treated with chromium fluoride. If red shades absolutely fast to washing are desired on weighted silk, use Primuline by the diazotizing process. Dye with a water-bath, heat with a little acetic acid, rinse, diazotize with sodium nitrate and hydrochloric acid in the cold and develop according to shade with betanaphtol, or a mixture of that and phenol; betanaphtol alone is best for staring reds.

For darker red shades and Bordeaux, develop with alphanaphtol or Bordeaux developer, *i. e.*, a mixture of alpha and betanaphtol. For delicate yellow shades, use Thioflavine S or Diamine Yellow FF. For golden shades, dye with Primuline, diazotize and develop with soda or sodium-phenol. By mixing the latter with various amounts of resorcin, various shades up to a full golden brown can be obtained. All other diamines can be used with success on weighted silk, so long as they can be after-treated with chromium or sulphate of copper. There is hardly any shade which cannot be obtained on weighted silk by a proper choice of diamines; even fast blacks can thus be obtained.

Another class of dyes which will play their part in dyeing weighted silk in the future is the sulphur dyes, especially the Immedial dyes. A mixture of Immedial Black and Immedial Blue gives upon weighted silk, navy blue shades of great durability. The same effects can be produced with Immedial Indone R alone or with Immedial Direct Blue OD alone and are much more superior to those obtained on ordinary silk with Alizarine Blue, but the use of those two dyes presents at present yet some difficulties.

A NOVEL PROCESS OF PRINTING COTTON.

The new process consists in printing the fabric with a suitable resist, treating in turn said resist imprinted on the goods with a solution of a suitable alkali, then thoroughly drying the goods and dyeing the same in an alkaline bath.

The new process is carried on thus: The fabric is first printed by means of suitable rolls with a resist of the following composition: 20 kilograms of lead sulphate in paste form, 12½ kilograms of lead nitrate, 7½ kilograms of sugar of lead, 3 kilograms cupric sulphate, 6 liters cupric nitrate, 3 kilograms alum, 3 kilograms leiogomme, 4 kilograms lightly burned starch, 8 kilograms of a solution of suitable gum, and ½ kilogram tallow. The fabric is dried after printing and then saturated, as by spraying or splashing, with a concentrated aqueous solution of potash (specific gravity 1.54), then thoroughly dried and passed through a dye-bath, containing, per one hundred liters, 2 kilograms of "immedial blue CR," 1 kilogram sodium sulphite, ½ kilogram soda lye of 40° B., and 2 kilograms common salt. The fabric is then steamed, if necessary, washed, acidified, and dried.

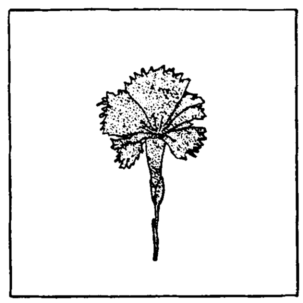
If the fabrics are to be dyed also in indigo they are not required to be washed and acidified before dyeing with indigo, since the latter step can be accomplished directly in the usual hydrosulphite soda bath. After the indigo bath is applied to the fabrics they are acidified, washed and dried.

The process described produces a blue ground with white designs, the undyed portions as protected by the resist appearing in clear white, producing clear effects. If designs in other colors, such as yellow or orange, are desired, this effect is obtained by passing the fabric subsequently through a bath of bichromatic solution. (F. Schaab, Trier, Ger.)

A NEW PROCESS OF SILK PRINTING.

The object of the process is to change the effect (dull or lustre) between ground and figure in fabrics constructed of raw silk only, a feature otherwise obtained by using raw and degummed silk combined in the construction of the fabric, using in connection with a Jacquard loom one of the silks for warp and the other for filling. By the new process of printing no fancy loom or figured weaving is necessary, the result aimed at being obtained by printing the design (on a plain-woven fabric) by means of a paste containing a caustic alkali—for instance, caustic soda—and then subjecting the so-printed material to proper subsequent treatment. It must be mentioned here that unless great care be exercised in this process the action of the caustic alkali is very apt to go beyond the mere removal of the silk gum and thus attack the silk fibre itself, in turn reducing its strength. For this reason the action of the caustic alkali must be modified by the addition of grape sugar or glycerine, so that the gum only is removed and the strength of the silk fibre not affected.

If the fabric is dyed and the shade of the printed goods is to remain unimpaired, the coloring matter in the dyed fabric employed must be indifferent to the action of the degumming paste. The printing paste may also contain such colors or coloring matter as are not affected by the degumming paste and for which purpose indigo, anthraquinone black, oxamin red, etc., are suitable. Again, the designs can be produced by printing such reverses like chrome acetate on the fabric, which when dried or steamed are indifferent to the action of alkali, and by then passing the so-printed fabric through a bath containing caustic alkali, such as caustic soda, and a substance which will limit the action of the bath to the silk gum, such as grape sugar or glycerine.



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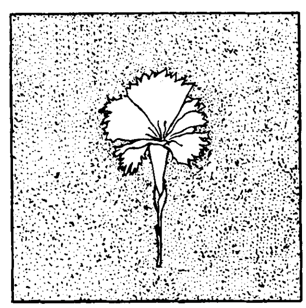

B

The accompanying illustrations are given to explain the new process, showing in diagram A the ground part of the design executed in a glossy effect, while the figure part thereof is kept dull; B showing the reverse, *i. e.*, a glossy figure upon a dull ground.

The following examples illustrate the method of carrying the new process into effect. The parts are by weight:

Example 1. Printing a degumming paste containing caustic soda.—Make a paste of 200 parts of British gum and 400 parts of hot water. Cool and add 400 parts of caustic soda solution of 40° B. Print this paste upon dyed or undyed raw silk, dry at a moderate temperature, say 95° F., rinse, and, if desirable, pass through an acid bath. The so-prepared material can be dyed in the usual manner, if desired.

Example 2. Printing a degumming paste containing caustic soda and a limiting agent.—Introduce 100 parts of British gum in the usual manner into 700 parts of caustic soda solution of 40° B. Prepare also a mixture of 300 parts of grape sugar in 100 parts of water by heating on a water bath, stir until cool and pour into the British gum caustic soda paste and bring up to 1,200 parts by addition of water, if necessary. Print this paste and finish the material as in Example 1.

Example 3. Printing a degumming paste containing caustic soda, a limiting agent and a coloring matter.

(A) Make a paste of 10 parts of anthraquinone black and 40 parts of cold water; also, mix 60 parts of British gum with 700 parts of caustic soda solution of 40° B., and add to this 300 parts of grape sugar mixed with 90 parts of water. Mix all these and bring up to 1,200 parts by addition of water, if necessary. Print and finish as in Example 1.

(B) Introduce 60 parts of British gum into 700 parts of caustic soda solution of 40° B. Add 30 parts of indigo J. Prepare also a mixture of 300 parts of grape sugar and 100 parts of water by heating on a water bath. Stir until cool and pour into the British gum, indigo J and caustic soda paste, and bring up to 1,200 parts by addition of water, if necessary. Print this paste and finish the material as in Example 1.

Example 4. Printing a reserve and locally degumming by means of caustic soda and a limiting agent.—Mix 550 parts of hot water with 300 parts of British gum. Cool and add 150 parts of a solution of chrome acetate of 20° B. and make up to 1,000 parts by addition of water. Print this paste onto the material, dry, and then pass through a bath containing 300 parts of glycerine, 200 parts of water, 700 parts of caustic soda solution of 40° B., for from two to five minutes. Then rinse well in running water. (Badische Anilin & Soda Fabrik.)

BLEACHING WITH PEROXIDE OF SODIUM.

The rapid adoption of Peroxide of Sodium by textile mills of every kind, for bleaching all classes of fabrics, running from plain cotton, knit or woven, to all-wool fabrics, and including mixtures of cotton and wool or silk, has developed a set of helpful and still inexpensive machinery, with which to carry on the bleaching process. The type of machine to be used depends on the class of goods to be bleached and the method in which they have to be handled.

The pine vat with double bottom, under which a lead heating pipe is placed, forms the basis for all types of bleaching machinery, and is perfectly satisfactory for goods which are laid down in the bath or bleached in bundles, bags or nets. Broad goods are treated in the open width, being bleached on jigs, the quantity of liquor needed being only sufficient to cover the part of the goods below the inside rolls.

The endless chain method is employed for all piece goods which may run in rope form, the operation consisting in passing the goods over a large reel on top of the bleach tank or vat, the goods in turn dropping from the reel and falling against a slanting side of the bleach tank, collecting at the bottom in regular folds, and from where they are taken up on the other side of the tank by the rotation of the reel. A number of chains of cloth may pass through the bath at the same time and over the same reel by using wooden guide pins at the side of the tank to keep them separated. Yarns, formed into a loose chain, are bleached in the same manner.

The Peroxide of Sodium treatment has especially benefited the knit goods trade. It leaves cotton knits with their full strength, also preserving their elasticity and leaving no chemicals in the fibre; while for bleaching all classes of woolens, mixtures and unions, it has come to be regarded as one of the safest and most satisfactory methods. The reason for this is easily understood, if one comprehends the true significance of the Peroxide action. It is purely an oxidation process, and there never is in the bleach bath any deleterious combination of chemicals which might attack any fibre. The natural coloring matter in the fibre is oxidized to a colorless, soluble compound, which passes away in the after-washing and thus is entirely removed.

Mixtures of animal and vegetable fibres are treated in one-bath for two or three hours at a moderate heat, the bath still retaining a large part of its bleaching strength after the process. After restoration of the same, *i. e.* making it up again to the standard strength, which takes but a few moments, another batch of goods is entered, while a final lot is bleached over night, thus practically making a continuous and very economical method of running the bleach.

Mixtures, as well as all-wool, all-silk, or all-cotton goods, pass through the bleaching process without acquiring a foreign or disagreeable odor, while the white obtained is permanent and furnishes a magnificent basis for all the light shade dyes which go on evenly and do not tend to become streaked or faded.

White woolen blankets have been particularly improved by being bleached with Peroxide of Sodium, as they never yellow-up with age or washing, and any offensive odor is entirely eliminated. Curtains, laces and all fine cotton fabrics are left much more durable after passing through the process, as compared to some of the older methods, since the delicate peroxide action leaves the finest thread uninjured. The margin of safety in using the peroxide is large, that is, the process is not by any means a difficult one to prevent injury to the goods, as soon as it is properly understood.

Owing to the many advantages of peroxide of sodium as a bleaching agent, as already pointed out, we expect the same will continue to supersede the older processes in all branches of the industry. With reference to the details of the process, the reader is referred to Posselt's Textile Library, Vols. II and VIII.

WYANDOTTE TEXTILE SODA.

The same is used principally for scouring wool in any stage required during its manufacture, whether in the raw stock, yarns or fabrics. It is a mild form of carbonated alkali, free from caustic soda and other substances injurious to animal fibres. It is completely soluble in warm water to a clear solution, and owing to the process used in its manufacture, it is pure and uniform in strength. It can be used alone, but preferably in connection with any good soap, since the latter is one of the best scouring agents known. Wyandotte Textile Soda acts directly upon the wool grease and adhering dirt, loosening it, and facilitating its complete removal by rinsing. It does not act injuriously upon the finest wool fibres, a feature which is very important, as it obviates any possibility of complaints.

Wyandotte Textile Soda leaves wool stock, after being scoured, in a remarkably free and lofty condition, soft to the touch and without odor. It acts as an energetic assistant to the soap, in connection with scouring, almost instantly resolving the dried suint on the wool and rendering it extremely soluble.

When used in conjunction with soap for scouring yarns and fabrics, Wyandotte Textile Soda almost immediately emulsifies the wool oil, previously used in lubricating the stock, thereby leaving the yarns or fabrics, as the case may be, clean and in a most suitable condition ready for dyeing or finishing. Material after having been scoured with Wyandotte Textile Soda and rinsed, is ready for dyeing, which process in turn produces level shades, for the reason that the scoured wool is left almost as pure fibre.

Besides being used for wool, yarn or cloth scouring, Wyandotte Textile Soda is also a good softening agent for hard water. It also can be used in connection with soap for fulling, thus reducing the quantity of the latter which would otherwise be necessary for the process. It is also valuable as a boiler compound, since the lime in the water which causes the scales in the boiler is precipitated and on settling at the bottom can be readily blown off.

Wyandotte Textile Soda is also used to scour Tussah silk warps, in place of the more costly pearl ash, and this without leaving the threads harsh, thereby materially reducing the cost of this branch of silk mill work. It should, however, be used in connection with silk soaps, in order to secure the very best results.

Softening Water. In scouring wool it is necessary, from an economical standpoint, that the water used should be soft, in order not to destroy the scouring properties of the soap used. For hard water, therefore, use sufficient quantity of Wyandotte Textile Soda to make the water feel soft to the hand. If water contains iron or is yellow it is best to first heat it to about 120° F., then adding the Wyandotte Textile Soda and allow the precipitate to settle for an hour or more. All foreign matter is thus precipitated, and if the water is then drawn from a pipe a few inches above the bottom of the tanks, said water will be clear and sparkling.

For Scouring Fleece Wool with Alkali Alone. Where 100 lbs. pure alkali (soda ash) has been formerly used, it is necessary to use only 50 lbs. pure alkali (soda ash) and 20 lbs. Wyandotte Textile Soda, or if preferred, pure alkali (soda ash) may be used in the first bowl as formerly, and Wyandotte Textile Soda alone in the second bowl, using in this instance 25% less in weight than of pure alkali (soda ash) previously used. Also use a 3% solution of Wyandotte Textile Soda in the last bowl for rinsing, which will make the wool softer, loftier and of a better color. This process will retain the life of the wool and put it in a better working condition and eliminate entirely all possibility of burning the fibre of the wool during the process.

For Scouring Fleece Wool and Cloth with Textile Soda and Soap. Use ½ lb. soap and ½ lb. Wyandotte Textile Soda to each gallon of water. In making up your soap bath, run the water into a tank to about ⅓ the tank capacity, bring same to a boil, put in your soap, thoroughly dissolve same and when thoroughly dissolved and boiling, commence to fill the tank with water. Dissolve the Wyandotte Textile Soda in warm water, then add to the bath and stir well. When tank is full, shut off steam. *Do not boil soap after the Wyandotte Textile Soda has been added to the bath.*

Use this same solution for wool scouring, also in the cloth scouring department of the finishing room, using sufficient amount to thoroughly scour the wool or cloth as the case may be. The quantity of this soap solution to be used, depends upon the condition of the wool or cloth which you are scouring.

In connection with wool scouring use this same solution in the first and second bowl. Use a 3% solution of Wyandotte Textile Soda in the last rinse bowl. This will remove all soap and leave the wool soft, lofty and white. Owing to its efficient solvent action, it will be found in practice that wool scouring can be carried out at a lower temperature than formerly, thereby materially aiding in ensuring a high quality of scoured wool. The colors produced by dyeing on wool thus scoured will be brighter, more uniform and more lasting.

With reference to Cloth Scouring, use a sufficient quantity of Wyandotte Textile Soda solution in the first cold rinse after goods have been fulled, since this will remove all the soap and leave the cloth much softer. The quantity of Wyandotte Textile Soda to be used must be governed by the number of pieces you have been scouring and the condition of the water.

For Scouring Yarns. Wyandotte Textile Soda may be used alone in the box-machine, or in connection with soap in the second bowl, when it will leave the yarns in an excellent condition for being dyed fast and even shades.

Wyandotte Textile Soda as a Boiler Compound. Throw every day into the feed water of the boiler, 1½ lbs. of Wyandotte Textile Soda to each 100 gallons of water used. For ordinary hard water this is amply sufficient. For very hard water, 2 lbs. should be used to each 100 gallons of water. Use the blow-off tap freely. The detrimental effect of boiler scales is shown by the following: A scale of ⅛ of an inch in thickness causes 16% increase in the consumption of coal, ¼ of an inch thickness of scale an increase of 50%, and a scale of ½ inch in thickness increases the consumption of fuel 150%. The lime which causes the hardness of the water is precipitated as a muddy sediment by the Wyandotte Textile Soda, which is thus easily removed, instead of forming on the plates and tubes of the boiler as a scale. Wyandotte Textile Soda is absolutely harmless, and will not rust or pit the metal parts nor injure the fittings, and readily dissolves in cold or hot water. (The J. B. Ford Co., Wyandotte, Mich.)

IMPARTING TO COTTON STOCKINGS, ETC., A LISLE THREAD FINISH.

The gist of this new process, invented by A. N. Dubois, of Philadelphia, consists in saturating the goods to be treated with a mixture of chemicals having the property of changing the physical condition of cellulose fibre, removing the fluid by a hydro-extractor, and then subjecting the goods to a drying action until the chemical impregnating them changes the character of the fuzz as adhering to the cotton thread, subjecting the goods at the same time to an energetic attrition, which breaks off the brittle fibre and imparts the lisle thread lustre and finish to the goods. The active chemicals are then neutralized or removed from the goods to prevent them from further acting on the body of the fabric. The new process may be used as a part of the dyeing operation or preparatory to dyeing or preparatory to bleaching.

The application of the new process is thus: Take four hundred pounds of cold water and add to it either four pounds of sulphuric acid of 66° Baumé or twelve pounds of hydrochloric acid of 22° Baumé or seven pounds of nitric acid of 36° Baumé or a mixture of these acids. In this solution immerse the cotton stockings, or other fabrics, in a "tomtom," for about thirty minutes. Then remove them and extract them in a hydroextractor, and in turn put them in an "oxidizing machine," in which the goods are thoroughly mixed up and tumbled about while exposed to a regulated heat. In this machine first dry the goods at a temperature of not over 92° F., and with the ventilator of the drying room open in full, and after the goods are sensibly dry, at from 90° to 120° F. maintain the tumbling and consequent attrition of the goods until the filamental fuzz is rendered brittle and broken off and the surface of the goods shows the desired lisle thread finish. Then remove the goods from the oxidizer and allow them to cool off, after which give them a cold alkaline bath of carbonate of sodium, carbonate of potassium, ammonia liquor, or the like in the proportion of about five pounds of the alkali to the hundred pounds of goods. This neutralizes the acid in the goods, which then wash, hydroextract and dye or bleach in any usual way.

When bleaching instead of dyeing the goods, first boil them before removing the filament, etc., with an alkali to free them from oil or dirt, and then proceed as before described.

When producing the lisle thread effect during dyeing, include in the dyeing solution some of the chemicals having the desired effect on cellulose fibre. Many dyes contain such chemicals in substantially the proper proportions, a feature especially true of all the aniline oxidized fast black dye-liquors. (A. N. Dubois, Philadelphia, Pa.)

COMPARATIVE TABLE OF HYDROMETER DEGREES BAUMÉ AND TWADDELL.

B.	Tw.	B.	Tw.
1	1.4	35	64.0
2	2.8	36	66.4
3	4.4	37	69.0
4	5.8	38	71.4
5	7.4	39	74.0
6	9.0	40	76.6
7	10.2	41	79.4
8	12.0	42	82.0
9	13.4	43	84.8
10	15.0	44	87.6
11	16.6	45	90.6
12	18.2	46	93.6
13	20.0	47	96.6
14	21.6	48	99.6
15	23.2	49	103.0
16	25.0	50	106.0
17	26.8	51	109.2
18	28.4	52	112.6
19	30.4	53	116.0
20	32.4	54	119.4
21	34.2	55	123.0
22	36.0	56	127.0
23	38.0	57	130.4
24	40.0	58	134.4
25	42.0	59	138.2
26	44.0	60	142.0
27	46.2	61	146.4
28	48.2	62	150.6
29	50.4	63	155.0
30	52.6	64	159.0
31	54.8	65	164.0
32	57.0	66	168.4
33	59.4	67	173.9
34	61.6	68	179.4

THERMOMETERS.

In ordinary thermometers two fixed points are taken, viz., those respectively at which water freezes and boils. In graduating an instrument, after exhausting the tube, filling with mercury and sealing, the height at which the column of mercury stands at these temperatures is determined by experiment. The space on the tube between these two fixed points is then divided into equal parts; the number of parts being 80, 100 or 180, according to the particular scale employed; and in order to extend the scale below the freezing point, and above the boiling point of water, the equal divisions are continued as far as necessary beyond the fixed points in both directions.

There are three thermometers in use, viz., Fahrenheit (F.), Reaumur (R.) and Celsius (C.), the relationship of which is as follows:

Freezing point or 32° F. = Zero in C. or R.
Boiling point or 212° F. = 100° C. or 80° R.

HOW TO CHANGE DEGREES OF CENTIGRADE OR REAUMUR INTO DEGREES FAHRENHEIT, AND VICE VERSA.

Centigrade into Fahrenheit.

$$F = \frac{9 \times {}^\circ C \text{ given}}{5} + 32$$

Example.—Find degrees F. for 40° C.

40 × 9 = 360 ÷ 5 = 72 + 32 = 104.

Answer.—40° C = 104° F.

Reaumur into Fahrenheit.

$$F = \frac{9 \times {}^\circ R \text{ given}}{4} + 32$$

Example.—Find degrees F. for 32° R.

32 × 9 = 288 ÷ 4 = 72 + 32 = 104.

Answer.—32° R = 104° F.

Fahrenheit into Celsius.

$$C = \frac{5 \times (\text{degrees F given} - 32)}{9}$$

Example.—Find degrees C. for 104 F.

5 × (104 — 32) 72 = 360 ÷ 9 = 40.

Answer.—104° F = 40° C.

Fahrenheit into Reaumur.

$$R = \frac{4 \times (\text{degrees F given} - 32)}{9}$$

Example.—Find degrees R. for 104° C.

$$\frac{4 \times (\text{degrees F given} - 32)}{9}$$

104 — 32 = 72 × 4 = 288 ÷ 9 = 32.

Answer.—104° C = 32° F.

Reaumur into Celsius.

$$C = \frac{5 \times \text{degrees R given}}{4}$$

Example.—Find degrees C. for 32° R.

5 × 32 = 160 ÷ 4 = 40.

Answer.—32° R = 40° C.

Celsius into Reaumur.

$$R = \frac{4 \times \text{degrees C given}}{5}$$

Example.—Find degrees R. for 40° C.

4 × 40 = 160 ÷ 5 = 32.

Answer.—40° C = 32° R.