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# Posselt's Textile Journal

*A Monthly Journal of the Textile Industries*

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28. Woolen Cloth.—American Woolen Company, Boston.

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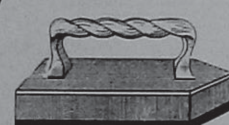
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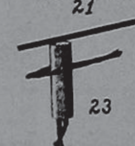
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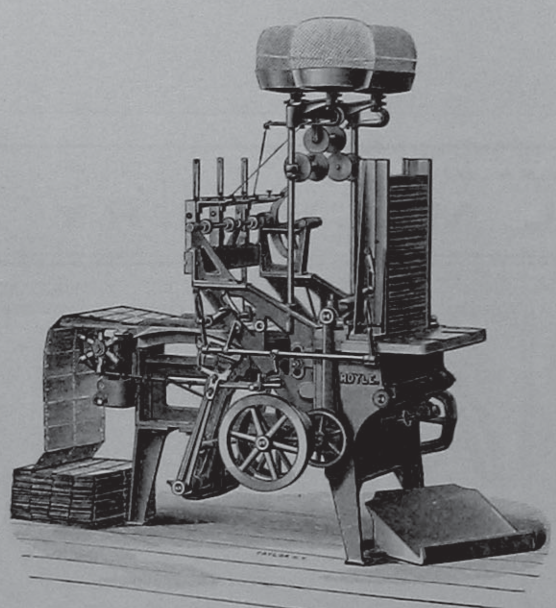


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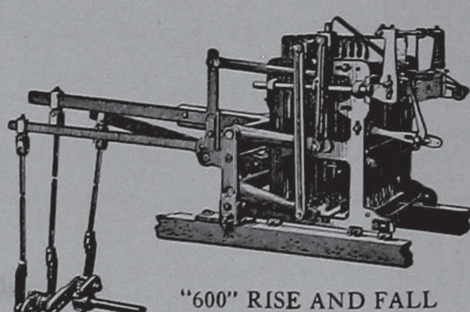

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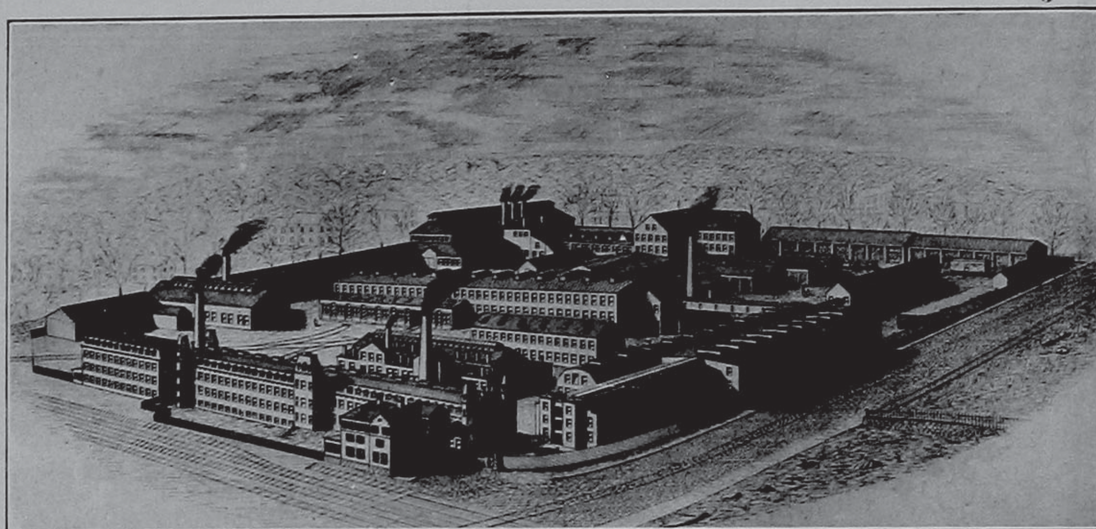

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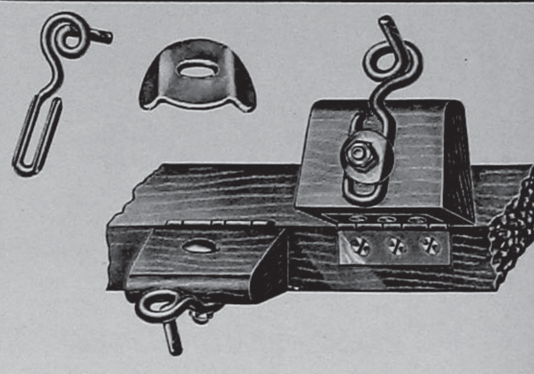

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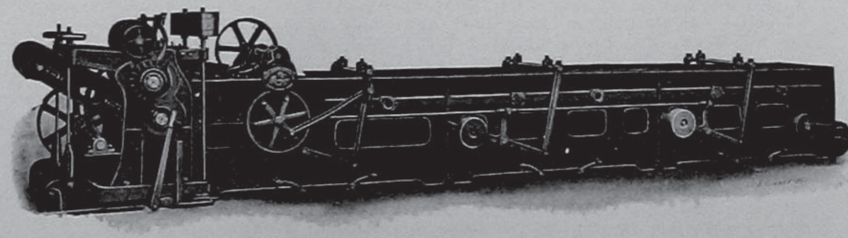

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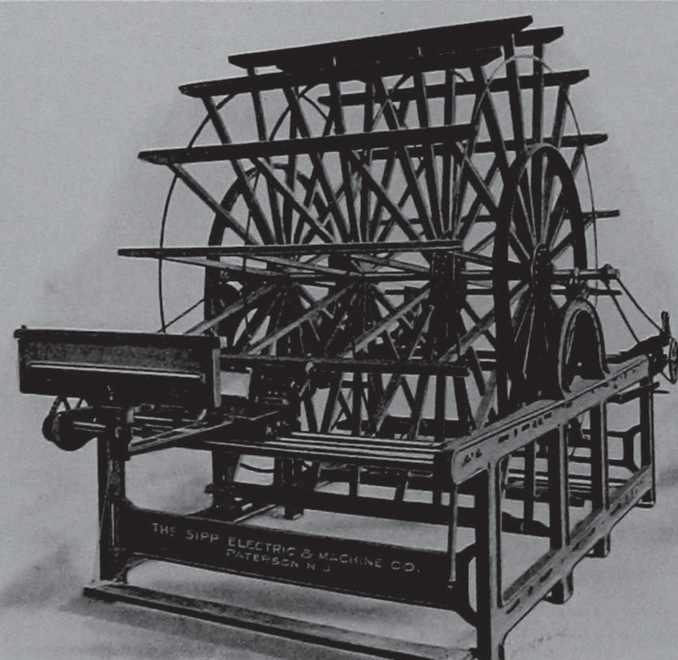


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Posselt's Textile Journal

Vol. V. November, 1909. No. 5.

# DYEING COTTON CHAINS

Two distinct systems of dyeing cotton yarn in the chain are practised, 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

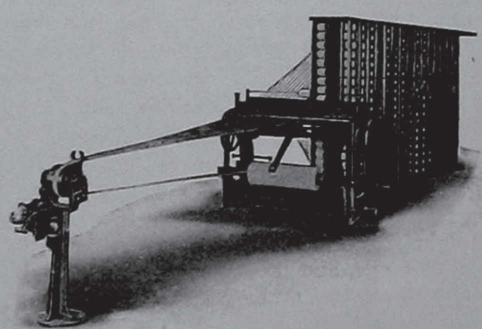

FIG. 1

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, 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 only. 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 frequent threading up, on account of the short length of these chains, so that there would be little if any saving over skein quilling.

Chains dyed by the Long Chain system are from 5,000 to 16,000 yards long, and run from 275 to 500 ends, while those dyed by the Short Chain system are often warped the full number of ends the warp contains in the loom, or provided there are too many ends in the warp, they are then handled in lots of 2 or more sections.

This will show us that in connection with long chain dyeing, warps can be dyed long enough to make a slasher set about 15,000 yards in length, thereby getting 15,000 yards of cloth uniform in color. The disadvantage of this system is that in mills where dyestuffs are used that bleed into white or light shades, they are apt to do so on the slasher unless two starch boxes and two sets of squeeze rollers are used. The cost of dyes and labor is about the same for both, and depends in a great measure upon the class of colors used. The short chain system is most advantageous for small mills taking orders of from 2,000 to 3,000 yards of a style of pattern, since it does not require as much floor space as the long chain system; no slasher is required and light shades and white, if used in the patterns, will always come out clear.

For either system the chains are best brought to the dye house in *balls*, but which 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 shell, collectively a number of ends drawn together as one strand, which is traversed back and forth along said shell, crossing and recrossing, so as to prevent tangling.

### The Ball Warper.

Fig. 1 shows us the Ball Warper as built by the Globe Foundry and Machine Company, of Frankford, Philadelphia.

The machine consists of three parts: The Creel, the Measuring Device and the Winding Mechanism. In order to ensure quantity as well as quality of production, the machine is provided with electrical stop motions at several points.

*The Creel.* The same is of the V-type shape, with a direct pull, the thread of each bobbin being in turn passed separately through a detector wire, loosely pivoted on an upright piece of the creel, and which forms one terminal of the circuit of the electrical stop motion. Situated just behind this upright piece is a

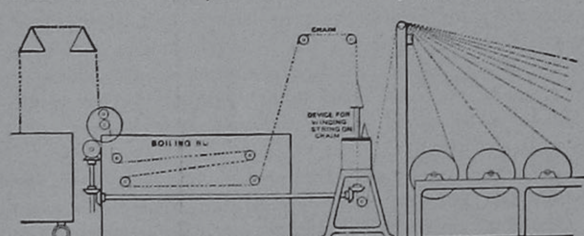

FIG. 2

contact strip, which forms the other terminal for the electric circuit, so that when a detector wire swings down on its pivot, it forms a contact with the strip, completes the circuit and stops the machine.

The ends coming from the creel pass through a guide reed, over and under several guide rollers, through the lease reed and in turn to

*The Measuring Device*, as situated some distance in front of the warper. Said measuring device, is carried on a pedestal, and equipped with two dials; a large dial for measuring the total length of warp put on the shell (beam for holding the ball warp), and a small dial for measuring the length of a cut. The large dial is made to indicate up to 24,000 yards, although as a rule only from 10 to 16,000 yards are used, the smaller dial being made to measure up to 1,000 yards. Two leases are taken between each cut. Both dials are connected with the electric stop motion of the warper as well as with a bell. When the bell rings and the machine stops, it indicates that either a cut has been wound on and leases have to be taken, or that the desired length of warp has been wound on the shell and that the latter is to be doffed. When the machine stops minus bell ringing, it then indicates that a thread has been broken in the creel or between the guide rollers.

*The Winding Mechanism.* The warp is wound on the shell by a direct drive. The machine is driven by a fixed pulley on the driving shaft, attached to the far end of which is the differential motion, which in turn conveys the motion to a sprocket on the same shaft, which by means of a chain operates another sprocket on the traverse, spiral grooved shaft, carrying the guide as resting on the wound ball. This shaft at the same time imparts motion to the shell on which the ball warp is wound, by means of a sprocket and chain, situated on the opposite side of the shaft, *i. e.,* producing a direct drive from creel to shell.

The ball is built up by what is known as the *regular wind, i. e.,* the number of inches for each layer being uniform for first and last layer on the shell, the shell wheel drive being provided with a *hunting tooth* in order to put each layer in a different position from the one before, in order to be able to build up a perfect ball. This change of layers is about the width of the warp fed. A shell as low as 3 inches diameter can be used.

*Speed Changing Device.* The same is automatic in its operation, the speed being governed by the size of the ball wound. It is accomplished by the differential motion previously referred to, producing a uniform speed of yarn from creel to shell all the time, no matter what the size of the ball on the shell.

Having no slow motion, the machine is started by gradually increasing the pressure on one of the foot pedals, which starts the machine gradually, the operator, if so desired, guiding the start of the machine by one of the large hand wheels secured on the spiral shaft. The speed of the machine is from 50 to 60 yards per minute.

*Doffing.* To doff the wound ball, unscrew the clamping bolt, on each side of the square shaft, as extending on each side and through the centre of the shell, turn the machine forward and the ball warp will drop on a truck previously set beneath it.

### Thread Winding Attachment.

Whether the Long or the Short Chain system is employed, the warps, *i. e.,* chains, previous to dyeing are boiled-out.

Before entering long chains into the boiling-out machine, they are passed through a patented device which has for its purpose to obviate the constant annoyance and expense caused by the snarling and breaking of the yarn in the various processes of the dye house, no matter how carefully the work is carried on.

By means of this device a cord of suitable strength is coiled around each chain, to hold the various threads together, to prevent slacks and kinky yarns in the subsequent processes and thus insure less broken chains, with the result of less cost in beaming. The device thus referred to is patented and built by the Draper Co.

Fig. 2 illustrates a boiling-out box with this thread winding device attached. The latter is seen about the centre of the illustration, the run of the chain through the entire process being shown by dotted lines. The chain enters the device from below, passing in turn through a disc which is revolved by means of a most simple drive, clearly seen in the illustration. Secured to the top of this disc is a guide arm for guiding, *i. e.,* winding the cord around the chain as the latter passes through the hollow of the disc onto the guide roller, as situated directly above it, passing from there to whatever make of a boiling-out machine the device is connected to.

### Boiling-out Machine.

Boiling-out has for its object to properly wet out and cleanse the yarn previously to dyeing. It is of the greatest of importance provided clear and level dyeings are desired, more particularly when medium and bright shades are to be dyed. The process is a most simple one, and the machinery required a small expense, hence the process is what we might say universally practised.

Fig. 3 shows the Boiling-out Machine as built by the Textile Finishing Machinery Company. 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 yarn 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 rollers supplied with suitable pressure attachments for squeezing all superfluous water from the chains as they leave either tank. In this manner we find the nip stand *C* of the hot water tank *A* carrying the bed roller 1, mounted upon which is the pressure roller 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 roller 2 upon roller 1, *i. e.,* upon the chains as passing between said rollers, is exerted; the amount of pressure required to be given, depending upon the amount of yarn treated in one run through the machine.

With reference to the squeeze rollers 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 chains treated more thoroughly from their water. *D* indicates the nip stand, 7 the bed roller, 8 the pressure roller, 9, 10 and 11 the 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 roller 8, and thus upon the yarn passing between rollers 7 and 8, in turn delivering the chains of yarn 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 rollers 1, 2 and 7, 8 the water thus squeezed out of the yarn is delivered back to its own tank.

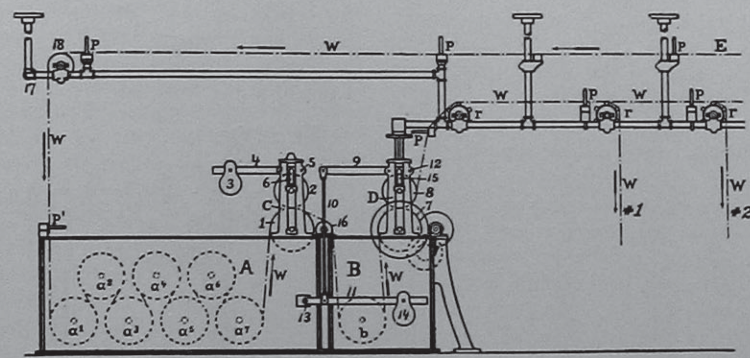


FIG. 3.

$a^1$, $a^2$, $a^3$, $a^4$, $a^5$, $a^6$ and $a^7$ are seven cylinders arranged in tank *A*, for leading the chains through the boiling (boiling out dirt) process. Roller 16 guides the chains 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 an overhead rigging, supporting the necessary pin rails *p*, reels *r*, etc., for receiving and delivering the chains. Two deliveries, #1 and #2, are only shown in the illustration, three deliveries as a rule being supplied, 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 chains from the overhead entry by means of pin rail *p'* into the boiling tank *A*. The direction of the run of the chains, 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 chains.

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.

The width of the machine depends upon the number of chains it is desired to handle.

*(To be continued)*

## COTTON FINISHING.

### Bleaching.

*(Continued from page 93.)*

When the lime boil is completed, run off the liquor and give the goods in the kier a cold water wash, which will cool them previously to coming in contact with the air, at the same time preventing them from drying while saturated with lime.

When taken from the kier, the goods are then run through a washing machine (a specimen of which was shown and explained in connection with Fig. 13 in the September issue), in order to remove from the goods any excess of lime, as well as other soluble substances formed during the lime boil.

**The Brown Sour.** This is the next process the goods under operation are subjected to, the process being also variously called the *gray sour,* the *lime sour* or the *acid treatment,* the latter name explaining the procedure; *i. e.,* the goods are washed with dilute hydrochloric acid.

During this process insoluble lime soap, resulting from the lime boil, is decomposed and the lime removed; any other metallic oxides present are also dissolved out, and the brown coloring matter of the fibre is loosened. Hydrochloric acid (muriatic acid) is preferred to sulphuric acid (oil of vitriol), since the former results in a more soluble compound with the lime. Both acids combined will also work well, a good recipe for it being quoted:

To 75 gallons of water add two carboys of sulphuric acid, then two carboys of hydrochloric acid, adding in turn sufficient water to bring the Sp. G. of the liquor to 10 deg. Tw. The liquor is then run into the souring machine. The cloth when entering this machine will then, on account of the water in it, dilute the strength of the liquor considerably, care being taken to constantly keep the liquor at a strength of about 2 to 3 deg. Tw. If pressed with work, the strength of the liquor may be increased to 3½ deg. Tw., remembering however, that it is advisable to rather devote more time to the process and use a weaker liquor, 2 deg. or even 1½ deg. Tw., being preferable; in fact some bleachers use acid as weak as ½ deg. Tw., heating this liquor to about 190 deg. F., for twenty minutes to one half hour.

The construction of the souring machine as well as the process itself must be such that every portion of the goods under operation is acted upon uniformly and most thoroughly by the acid. Care also must be taken to maintain the strength of the dilute acid as uniform as possible, by having a regular flow of fresh acid from a stock cistern, as well as making now and then, rapid acidimetrical tests.

After souring, do not leave the cloth for too long a time in its acid state, since any exposed portions are liable to become tender, for which reason wash them at the earliest possible moment. It is also necessary that this washing is done as completely as possible, since otherwise a tendering of the goods may occur during successively following processes.

Provided the goods have to remain piled up for some time, say for instance over night, sprinkle them with water.

The goods, after leaving the washing machine, are then run through a soda ash solution and in turn through a pair of squeeze rollers, to remove any chances of free acid remaining in the cloth, and which might become the cause for the formation of iron stains when the cloth is run into the kier for the next process.

**Lye Boil.** The object of this operation is to remove the fatty matters still remaining in the cloth. The fatty matters having been decomposed during the lime boil, and the lime removed from the lime soaps by the souring, the fatty acids remaining on the cloth are now readily removed by boiling the cloth with alkaline solutions. The brown coloring matters of the fibres are also chiefly removed at this stage. The boiling takes place in the same make of a kier as was shown and described in connection with Fig. 14. With 50 pounds pressure, boiling for from 3 to 4 hours will in an average be found sufficient, whereas with low pressure or open kiers, from 10 to 12 hours' boiling may be required.

The alkalies available for this boil are soda ash and caustic soda, the other boiling agent used being rosin or rosin soap, prepared by boiling 100 pounds of rosin with 10 gallons of caustic soda solution, 60 deg. Tw., adding a sufficient quantity of water to make a homogeneous mass. Be careful that during the process, the caustic soda does not become the cause of tendering the goods under operation.

Soda ash, for the reason given, is a much safer alkali to use, and accomplishes the same purpose as caustic soda, but the process takes more time. To shorten the time without running too great a risk of tendering the goods, frequently a mixture of soda ash and caustic soda is used, a good proportion being 85 parts soda ash and 15 parts caustic soda.

The time required for the boil depends a great deal upon the make of the kier used in the Bleachery (a strong point in favor of the Allen Kier), the construction and condition of the goods under operation, as well as the idea of the Superintendent of the Bleachery on the subject; but for common print cloth, it usually lasts from 6 to 12 hours.

For handling, say 500 pieces of print cloth, bleachers will use approximately 150 pounds of soda ash, and rosin soap corresponding to 13 pounds of rosin. In place of the soda ash, a mixture of 20 pounds of caustic soda, and 120 pounds of soda ash can be substituted.

After the lye boil, in order to insure the complete removal of fatty matters and undissolved rosin, boil the goods with a soda ash solution.

WASHING. Since the cloth is very liable to contract iron stains if left in the kier too long after the alkaline liquor has been drained away, it is well to wash immediately. If the latter process has been carried out properly, any fatty matter still present in the goods is then easily soluble in water, hence readily removed at the washing.

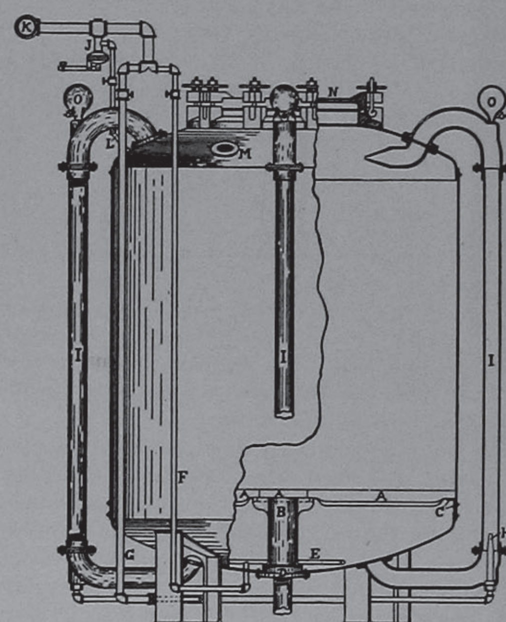

FIG. 14.

The only impurities yet present are a small amount of natural coloring matter, showing as a faint yellowish or creamy tint in the goods, the removal of which is the object of the next process, *i. e.*, that of

**Chemicking.** In this process the goods are passed in a chemicking machine through a rather dilute solution of chloride of lime, *i. e.*, bleaching powder solution (1 to 2 deg. Tw.). A chemicking machine is of the same construction as that used for washing (see Fig. 13), only in this case it is well to replace the wooden cistern with one of cement. The goods are allowed, while still moist, to lie in pile exposed to the air, for a few hours or over night.

The bleaching action, which must be considered as one of oxidation, takes place largely during this exposure, hypochlorous acid being then liberated by the action of the carbonate acid of the air.

It is essential that the bleaching powder solution should not be too strong, since otherwise the cloth might become tendered, or partially changed into oxycellulose, and thereby apt to attract certain coloring matters in the dye bath, or to contract brown stains during subsequent steaming processes. For the same reason the solution of bleaching powder should be entirely free from undissolved particles.

A simple form of apparatus for preparing the bleaching powder solution consists of a perforated, wrought iron, lead-lined drum, into which the bleaching powder is deposited. This drum is revolved in a rectangular lead-lined iron tank through which water is run. The bleaching powder solution is drawn off at a tap located far enough from the bottom to prevent the removal of sediment.

The bleaching solution should be kept at a uniform strength, testing for this reason, the liquor occasionally, *i. e.,* ascertain how much of it is required to decolorize a specially prepared standard solution of arsenate of soda, tinted with indigo extract or cochineal decoction, making up any deficiency in the strength of the bleaching liquor, by an additional flow of fresh solution.

The solution of bleaching powder in the stock reservoir should stand at about 3 deg. Tw., the water contained in the cloth diluting this to its proper strength. Provided the goods do not hold sufficient water, such is introduced along with the stock solution as passing into the chemicking machine.

If using bleaching solutions of from 1 deg. to 2 deg. Tw., from 5 to 6 hours' exposure will produce satisfactory results. Do not forget that a solution at a temperature of 75 deg. to 85 deg. F. (in summer), will act quicker than if used at a lower temperature in the winter.

WASH. After chemicking the goods are treated to a hasty wash, in order to remove any excess of bleaching powder. If this were not done, the amount of chlorine liberated during the following process of white souring, would compel the workmen to leave the bleach house.

**White Sour.** This operation does not differ from the lime sour previously described. Its object is to complete the bleaching action by decomposing any *chloride of lime* still in the cloth; also to remove the lime, the oxidized coloring matter, and any traces of iron present. It consists in passing the goods through a 2 to 2½ deg. Tw. sulphuric acid solution, then through squeeze rollers, and in turn into the final washer.

A very energetic bleaching action goes on during the white sour, owing to the rapid liberation of chlorine, the cloth being left in a very white and bright condition. After the *white sour,* the goods are then subjected to a

FINAL WASH. The same must be done as thorough as possible, the same as was done with every washing process throughout Bleaching; tender goods being more often the result of an imperfect (insufficient) washing, than is caused by too strong liquors.

*(To be continued.)*

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When dyeing *mixed goods* with sulphur colors, an excess of sodium sulphide should be avoided on account of its injurious action on animal fibres. The dyeing should be done at the lowest possible temperature.

**COTTON SPINNING.**

**The Ring Frame.**

*(Continued from page 101.)*

In Fig. 272 the various parts of the Draper spindle are shown assembled and the interior parts also separately. Commencing with the blade, inspection will show that its shape has been modified since the first introduction of this model. As now made, it is of larger section than in earlier types, and the whirl cannot be forced off by a downward blow. The present

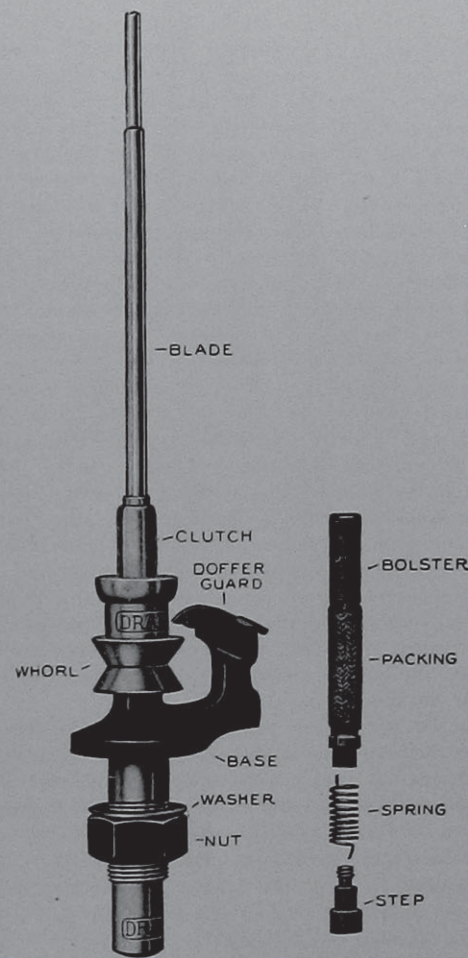


FIG. 272

taper of the blade also allows waste yarn to be easily removed. The base or holder is now universally fitted with the *Woodmancy* design of *oil tube and doffer guard,* admitted by all to be the neatest and most practical form ever known. The bolster is another simple piece, but its design and dimensions are vital. The running of the spindle depends largely upon the fit of the bolster in the base, and gauge limits have been brought to within $\frac{1}{1000}$th part of an inch, so that each spindle has the same limits of movement, so far as mechanical skill can ensure. The bolster is wrapped, in its lower part, with a packing material, as the experience of years has proved that greater steadiness is possible in this way and better wearing results in consequence. Steps are made of hardened steel with flat top, as this combination makes a superior wearing surface. The adjustment of the spindle to the bolster, involving the spring lock, is a characteristic element of this modern spindle.

*The Rabbeth centrifugal bobbin clutch* is seen on this model. When the clutch is used the base is slightly different than when the ordinary friction seat is applied, since the bolster is necessarily lowered and the base top shortened.

The spindle proper consists of a vertical shaft, the spindle blade, tapered at the lower end, about the middle of which is mounted a sleeve, which when in position drops over the upper part of the spindle base. This sleeve carries the whirl by which the spindle is driven, and slightly above the whirl carries a bobbin cup, on which the bobbin rests. Under the sleeve of the whirl a brass washer is placed to prevent oil from escaping over the top of the base. The threaded part of the spindle base passes through the spindle rail and is firmly bolted to the same by a nut, a washer being placed between the rail and the nut. The bolster occupies the space between the spindle and the base, fitting inside the base, which is hollowed out to receive it, the lower end of the spindle in turn fitting into the bolster and resting on the step. The packing is slipped over the outside of the bolster, as shown in the illustration, and is secured to it by strings. The spindle when dropped into position, is retained in the bolster by the doffer guard. The style here shown is known as the Woodmancy guard and oil tube cover, which acts both as a doffer guard and as a cover for the oil tube, doing away with the separate hook and cup, arrangement shown in connection with the Rabbeth spindle. In addition to being connected with the usual screw thread, there is a spiral spring between the foot step and the bolster, shown in detail at the right hand side of the illustration.

The Draper spindle contains many of the features of the Rabbeth spindle, however, it has its parts so proportioned to enable it to be used on heavier work. The spindle shaft is proportioned so that a maximum strength at the weakest bending section is secured. It differs from the Rabbeth also in having a steel spiral spring between the bolster and the step, which are connected by the usual screw thread, and it also is made without the locking pins used in the latter. The spring is intended to form a yielding connection, thus adding to the smooth running of the spindle, allowing the spindle to adjust itself while rotating. Should the spindle be too tight in the bearing, it will turn the bolster against the spring in the direction of its rotation, which will also turn it downward on the screw step, and the spindle will thus be loosened because of the taper bore of the bearing. Should the spindle be either too tight or too loose, it can be easily adjusted by moving the spring in the notches provided for its locking end. Excessive vibration of the spindle will indicate to the spinner the necessity for adjustment.

The Woodmancy guard shown in Fig. 272 consists of a hinged lid which is so arranged that it serves both, as a catch to prevent the lifting of the spindle when doffing and also as a cover for the oil tube, preventing fly and dirt from getting into the oil. When the spindle is put in place and the sleeve is dropped over the base, the cover of the tube acts as a doffer guard and automatically locks the spindle in place. The spindle can be easily removed by raising the lid of the oil tube and turning it back out of the way. The base of the spindle is filled by pouring the oil down the angular tube, the cover being turned back. At other times, the oil tube is always covered. A brass collar is forced on the spindle, below the whirl, to prevent the oil from rising and flowing out over the outside of the case.

The Rabbeth centrifugal bobbin clutch shown in Fig. 272 is the greatest improvement that has been made in spindles for a long time. In order to understand the advantages of this clutch it is well to consider the disadvantages of the old conventional whirl seat and bobbin cup as seen in Fig. 271. In this type, the bobbin is preferably driven by frictional contact of the whirl in the bobbin chamber, the cup merely preventing splitting, and the upper bearing being made free. The difficulty with this, and all other friction drivers, is inherent in the bobbins themselves, which, being made of wood, are liable to great changes, especially bobbins used for filling yarn that are liable to be dampened by excess of steam or other moisture. Bobbins that swell will not come down properly into place on the whirl, so that the yarn either runs down over the base, or the traverse must be set to accommodate the high bobbins, thereby losing in the total amount of yarn spun on the same. If the bobbins are loose, they will not run steadily and also lose twist, making weak yarn. It is almost unnecessary to point out the disadvantages of not getting the full amount of yarn on the bobbin. With warp yarn, it means more frequent doffing, more work at the spooler, and more knots in the warp. With filling yarn, it means more frequent changing of shuttles on the common loom, more bobbins to place in the hopper on an automatic filling changing loom.

With the Rabbeth centrifugal clutch, the bobbin fits loosely, and may be placed with less labor and annoyance than the bobbin which has to be jammed down into place. It should perceptibly reduce the time necessary for doffing. There will be no tendency to bend the spindle blade causing crooks and even breaks when warped bobbins should have to be used. The loose pieces on the whirl are thrown out as far as they can go by the centrifugal effect of the spindle's rotation and ensure driving contact with the bobbin by this yielding pressure. In the preferred form, the diameter of the circle of the clutch is much less than that of the circle of the regular whirl at the same point, allowing the bobbin to be thicker and stronger at the base. This is especially advantageous for filling bobbins, as it gives greater leeway for reaming, when reaming is necessary. The use of the centrifugal clutch will not only allow all the bobbins on all the frames in a spinning room to be at exactly the same height, thereby gaining in length of traverse at least one-half an inch, but also lessen repairs or replacements of bobbins, for the bobbins used will be not only stronger, but subject to much less rough usage. This centrifugal clutch idea can be adapted to any make of spindle referred to in this treatise.

The assembled spindle is shown in our illustration Fig. 272. Attachments are provided so that the complete spindle can be fastened to the spindle rail and the power for driving be applied at the most suitable point. The spindle itself has a bearing at its lower end on the foot step, which can be adjusted to compensate for wear, and the tapered portion of the spindle has a long bearing against the bolster, which prevents excessive friction. The spindle cannot fly off when running or when being doffed, on account of the doffer guard. When in place, the bobbin is securely held by the bobbin cup at the bottom, and the blade of the spindle at the top. The spindle is shown in position on the ring frame in Fig. 227. This type of spindle has a flexibility which allows it to rotate out of its theoretical centre, when subjected to unusual load or strain. This is accomplished by making the outside diameter of the bolster a little smaller than the inside diameter of the base in which it is placed—usually $\frac{1}{005}$ part of an inch. This allows the spindle a little play, so that when running out of alignment, it can swing to one side or the other until it finds a centre of gyration, on which it can rotate without vibrating. In this self-adjusting action, the foot of the spindle remains in one position, but the point can move a small fraction of an inch one way or the other, this motion giving the spindle its flexibility.

THE WHITIN (OR GRAVITY) SPINDLE is shown in Fig. 273. In outward appearance it resembles the Draper spindle, but from the illustration of a section of its lower portion, it will be seen that the foot step of the spindle is tapered and rests in a bolster, which is drilled to correspond. The bolster has no packing and has a flattened outer base resting on a flat surface at the bottom of the spindle base or bolster case. Oil is supplied through a tube covered with the Woodmancy doffer guard, and percolates into the bolster case and through two small holes into the bolster itself and to the spindle. The bolster only has a sliding fit in its case, being about $\frac{1}{500}$ inch less in diameter, thus there is a space for a thin film of oil to always surround the vital parts of the spindle. This sliding fit furthermore gives the foot of the bolster sufficient play to maintain the flexible character of the spindle, by allowing it to find its own center within certain limits.

The whole structure of bolster, spindle, bobbin, and its yarn load rests upon a solid pin milled into the bottom of the bolster case. To prevent the escapement of oil which the high speed of the spindles naturally forces out under the whirl, a small ring, extending down a short distance into the bolster, is driven onto the spindle under the whirl. When starting up new spindles, the oil chamber and tube should be completely filled, and afterwards, in order to get the best results, a little fresh oil should be added every week. An examination of the illustration shows that the oil is admitted to spindle bearings through two small ducts. Thus the main supply of oil is not agitated by the motion of the spindle, and all dirt settles at bottom of the bolster case.

The spindle is ordinarily built to drive the bobbin from a cone at the base of the spindle blade, and by this method of driving, the interior of the bobbin is

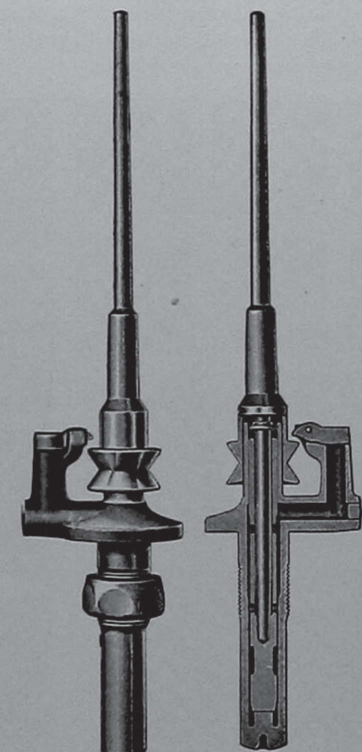

FIG. 273

not materially cut away and its strength is maintained. The same spindle can be used for either warp or filling yarn, a convenience which will be appreciated by those whose work calls for frequent changes. The easy running of this spindle is largely due to the arrangement of the parts of the bolster and its case opposite the centre of the whirl. A sliding fit between the interior and exterior cylindrical surfaces of the bolster case (or base) and bolster respectively allows the foot of the bolster sufficient play to obviate any tendency to gyrate. Thus it will be seen that with these surfaces arranged as described, and with the band pull at or near the middle of the same, the spindle is kept in a vertical position at all times, as the power of the band is exerted to bring these cylindrical surfaces in alignment, even when the unbalanced load tends to throw the bottom of the bolster out of its central relation. Thus the spindle remains true with the ring; the band pull does not deflect the spindles, whether tight or loose; and no influence is felt on the spinning of yarn by it. The position of the whirl is such that an even pressure is exerted upon the whole length of the spindle bearing.

*(To be continued)*