smooth wound spool. Either the regular spindle take-up with single or double head drive is provided, or the drum take-up with open fingers or swinging bobbin-hangers is furnished, the latter giving uniform speed of wind, greatly increasing the product over the spindle take-up.

The swift-hangers are adjustable for height and have triple bearings for various size swifts to be used; the knee-rails are adjustable to suit different sizes of swifts used. The drive of the frame is by cone pulley and cross-head, either geared or variable speed cones; provision is also made for permitting the attaching of electric drive.

Fig. 19 is a working diagram of this Hard Silk Winder, clearly showing its operation. *a* shows by means of dotted lines the outlines of one of the end frames of the machine. *b* is one of the swift hangers adjustable as to height, being secured at *c* to two rods *d* extending the full length of the machine. *e* is one of the swifts for carrying skein *f*, the end *g* of which passes through the eye of porcelain guide *h* (secured to the traverse bar *i*) and from there onto the take-up bobbin *j*, driven by friction wheel *k*. As seen from Fig. 18 there is one friction wheel for each bobbin in the frame. *l* in Fig. 19 is the knee board, adjustable to suit the size of swifts used. Arrow *o* shows the direction of travel of the silk thread from the skein *f* to the take-up bobbin *j*.

h^1 i^1 and k^1 indicate respectively the guide, the traverse bar and the friction wheel of the other bank or section (rear in this instance) of this winder.

During winding, any cleaning of the silk thread that is necessary is done; knots, nibs, slugs, fine and coarse ends, waste and other imperfections in the thread, if present, are removed by hand.

It is customary in the sale of grège to indicate the number of bobbins a winder can handle, thus indicating its quality. Since the introduction of the knotted ends known as *bouts noués* in the original reeling of the

grège at the filatures, the winding at the throwing plants has been considerably simplified.

European silk permits the winder to attend to about 100 bobbins, whereas with some of the China grèges, like Tsatlees, only about 15 to 20 bobbins can be handled. The latter are, as a rule, more or less full

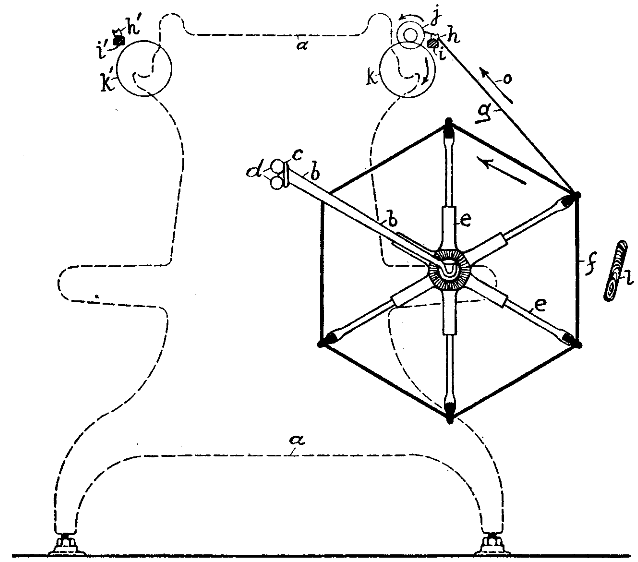


Fig. 19

of the imperfections previously referred to, hence breaking of the thread is a frequent occurrence. The winding of such grèges consequently requires the greatest of care on the part of the operator, since visible imperfections to the thread must be removed by her during the winding process or the thread run through a "Cleaner" referred to later on. This at the same time indicates that the amount of waste made in winding these China silks is rather excessive, varying from 3 to 5 per cent, whereas the waste made with European silks does not, as a rule, amount to more than $\frac{1}{4}$ to $\frac{1}{2}$ per cent. The condition of China silks is however for years steadily improving. Similar in their cleanliness to European silks are those of Japan, the same unwinding practically uninterrupted from their skeins.

The impurities thus removed by the operator from the grège silk however comprise only a portion of that which the silk contains. The main work of the operator consists in breaking out those threads that in longer or shorter distances carry more or less knots; excessively thin or thick places found in the yarn, must also be removed by her.

When the grège thread has to be cleaned during the winding, the thread when leaving the swift passes through an eyelet, and from there to a cleaner (formed by means of two adjustable steel blades) between which the silk thread is made to pass, the two blades being set sufficiently close to scrape off any impurities or have knots and bunches in the yarn catch on the blades, which by means of operating a stop motion arrest the motion of the bobbin and in turn give the operator a chance to take out any imperfections in the yarn. Another way (but not as good) of cleaning a cheap, imperfect grège is to run the same through guide eyes covered with a soft (plush) cloth, and in this way brush off some of the impurities this silk contains.

If dealing with such imperfect silk, the best plan to follow is to wind it first on the "Hard Silk Winder" and then rewind said bobbins on other bobbins on a special constructed "Cleaning Frame," running your thread through "Cleaners" (as before explained) in their travel from one bobbin to another; repeating the procedure if found necessary to do so.

The wound silk in some instances is placed for about 10 minutes in a steam box and there treated in lukewarm water, a treatment which it is claimed increases the lustre and pliability of the thread.

Having obtained clean "Singles" (also called "Dumb-singles") the next process the latter is subjected to depends upon the purpose the silk is to be used for later on.

It may be used either as Thrown-singles, Floss, Tram or Organzine; also for some special yarns, which will be treated later on.

(1) Thrown-singles. For this purpose Singles are twisted by themselves (on a Spinning Frame) in order to impart roundness and strength to the thread which then is used in this condition in the construction of certain fabrics, the yarn then being known as "Thrown-singles." Such of the yarn destined for warp receives more twist than that for filling. On account of the greater strength of silk in its gum state, Thrown-singles are sometimes woven in this state into plain and figured pongees, some kind of satins, etc., the gum being boiled-off afterwards in the woven fabric. In some instances such Thrown-singles are also dyed without boiling-off the gum (sericin); this is done at a sacrifice of lustre, however the additional strength retained by the yarn will result in better weaving. At the same time, by the woven cloth gaining in strength and weight it may repay for some of the lustre sacrificed by not boiling-off.

(2) Floss. The same is also known as *No-throw* and refers to the doubling of 2, 3 or more Singles into one thread, either without twist on the Doubling Frame, or imparting only a very slight twist to the compound thread on the Spinning Frame; just sufficient twist ($\frac{1}{2}$ turn or more) to keep the minor threads somewhat united so as to insure proper running off of the compound thread from the bobbin or the skein, as the case may be.

(3) Tram. For this purpose from 2 to 10 Singles are either doubled on a Doubling Frame and then twisted on a Spinning Frame, inserting from 1 to 2 turns of twist per inch (never more than 3 turns, and this only in extreme cases and for special fabrics)

or the two processes are accomplished by one operation on what is known as a "Combined Doubling and Spinning Frame for Tram." The small amount of twist inserted into Tram is done to make it fill better in the woven cloth.

(4) ORGANZINE. For this purpose Dumb-singles are subjected to a *first-spinning* on a Spinning Frame, *i. e.,* are transformed into Thrown-singles, which are then *doubled* on a Doubling Frame and in turn have a *second-spinning,* (a second twist) imparted to the compound thread on a Spinning Frame. In either process the twisting in the second-spinning is done in the reverse direction from that of the first-spinning.

The amount of twist imparted in these two spinnings varies, some throwsters considering 12 turns for the first-spinning and 10 turns in the second-spinning, technically expressed as "12 and 10 turns per inch" (12/10) as a very good (regular or standard) twist for organzine, whereas others go above or below this, depending upon the kind of fabric for which the organzine is intended. Satin and umbrella organzines are often thrown 10/8 turns, taffetas 14/12, heavy linings 16/14; for some exceptionally strong and hard organzine 18/16 is used.

These three processes as practiced in connection with the spinning of organzine, *i. e.,* first-spinning, doubling and second-spinning, are now combined in one operation by using the "Combination Spinning, Doubling and Twisting Frame."

Since either separate machines, or combination machines are used for the throwing of the silk yarns, we will explain both systems, *viz:* the "Doubling Frame," the "Spinning Frame," the "Combined Doubling and Spinning Frame for Tram," and the "Combination Spinning, Doubling and Twisting Frame for Organzine," thus giving a complete description of any kind of machinery you may come in contact with in any modern throwing plant.

Doubling.

Doubling comprises the winding of from 2 to 10 Dumb-singles, previously cleaned and wound on bobbins, or in addition twisted, *i. e.,* Thrown-singles, side by side upon one bobbin. The chief object

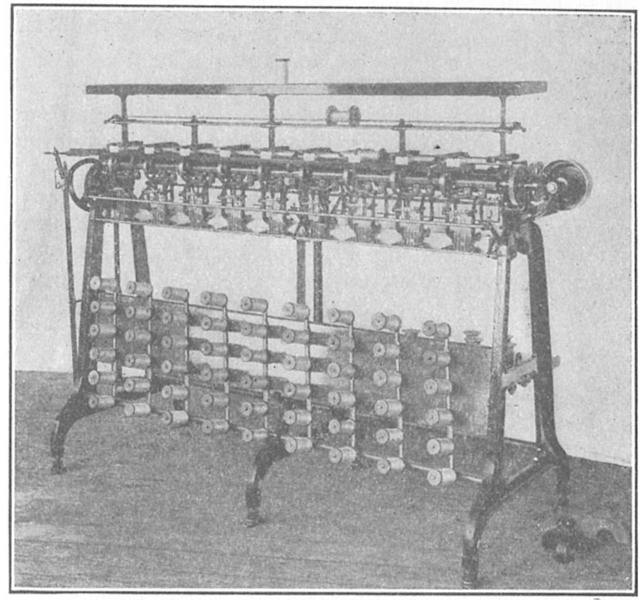


Fig. 20

aimed at in the process of doubling is to wind these minor threads under a most equal tension, accomplished by suitably provided weighting rollers and counter-weights. To preserve the roundness of the threads do not use an excessive tension, which might have a tendency to flatten the threads.

Silk is doubled without twist — to the cotton or worsted spinner this may seem queer, but it is so. The minor silk threads are in this instance first run together and wound on one bobbin, before being twisted on another machine.

Doubling is done on what is known as a DOUBLING FRAME. Fig. 20 is a perspective view of such a machine, built by the Atwood Machine Company. The same refers to a double bank machine and is built in any length desired, to suit the demands of the mills. It is driven direct or by cross-head; cones 4, 5 and 6 inches diameter for 1¼ inch belt are furnished. Spindles are either wood or iron head; the drop wires are of the vertical type; the stop motion is very quick acting and lifts the spindle from its mate friction wheel. The machine is equipped with hinged reversible jack-boards shown in illustration, fitted for six end-pin doublings (up to ten end-pin doublings are furnished if so desired). The angle of the jack-boards is adjustable, in turn exerting more or less friction on the spools. During the winding on of the ply thread a slight twist imparts itself to it, sufficient to hold the minor threads together, so that the bobbin runs well off at the spinning frame without breaking. The twist thus referred to is again automatically taken out when the compound thread is running off the bobbin. Every spindle is driven by friction, any one of which can be arrested independent of the others. An individual stop motion is provided for each spindle to automatically arrest the motion of the take-up bobbin anytime a minor thread breaks.

Fig. 21 is a diagrammatical section of this Doubling Frame, being given to more clearly show the process by means of quoting letters of reference in the illustration, and of which *a* shows by means of dotted lines one of the heads of the machine. *b, b'* are two jack-boards, one for each bank, having secured to them pin rail *c,* carrying in this instance six pins for each vertical section; up to ten pins to one section are used, in which instance up to ten minor threads may be used for doubling into one compound

thread. The six minor threads used in our specimen of a machine, as clearly shown, are then passed (see arrow *o*) alternately over and under parting rod *d*

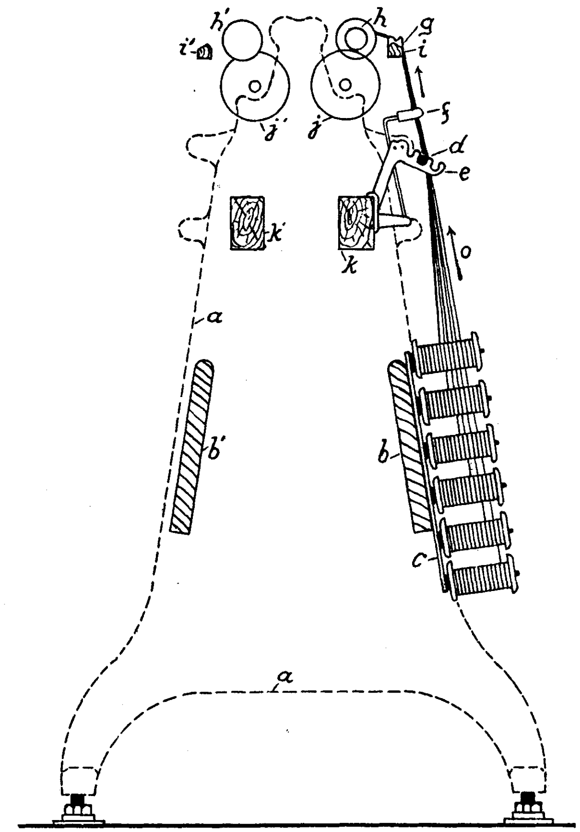


Fig. 21

(carried in rod stand *e*) passing in turn through faller wires *f,* through guide *g* onto the take-up bobbin *h.* The guide *g* is secured to traverse bar *i,* which receives a to and fro motion, to guide and regulate the winding of the compound thread onto its take-up bobbin. *j* is the friction wheel for imparting motion to the take-up bobbin. *k* and *k'* are two wooden girts extending the full length of the machine. *i'*, *h'* and *z'* refer to the rear bank of the machine. The speed of the take-up shaft of this Doubler is from 225 to 250 r.p.m.

The Spinning Frame.

The same is used for:

(1) Imparting twist to Dumb-singles after the same have been wound on bobbins on the Hard Silk Winding Frame, *i. e.,* changing Dumb-singles to Thrown-singles.

(2) Imparting the necessary twist to tram as received from the doubling frame, if handled by the older method of throwing machinery, which is yet extensively used. The doubled silk then goes to the reeling frame. The usual amount of twist inserted for tram is about 2½ to 3 turns per inch, which is merely enough to hold together the several ends composing the thread.

The more up-to-date method of making tram is on a machine known as the "Combined Doubler and Spinner", which takes the spools from the Hard Silk Winder and spins them direct, thus eliminating the separate operation of doubling. This machine will be fully explained later on.

Tram skeins are usually reeled 5, 10 or 15 thousand yards, depending upon coarseness of thread.

(3) Imparting "first-spinning" or "first-time twist" followed by "doubling" and later on "second-spinning" or "second-time twist" to organzine, if handled by the older method of throwing machinery, still extensively used.

For the "first-spinning", the filled bobbins are received from the Hard Silk Winder. The twist imparted in this "first-spinning" as a rule is a left-hand twist of 16 turns per inch. The number of spindles

on a single machine of this type is about 200, and a fair average per operator is about 1,200 spindles.

After receiving the "first-time" twist, the silk, which has been run on iron head shafts, is placed on a steam box and steamed for several minutes. This tends to prevent the silk from snarling. The silk is now taken to the Doubling Frame, where two, three, four or more ends are run together, after which the "second-time" or right-hand twist is given to the thread with 14 turns per inch. The thread thus resulting is known as a 16/14 twist, and will be varied in accordance with its intended use.

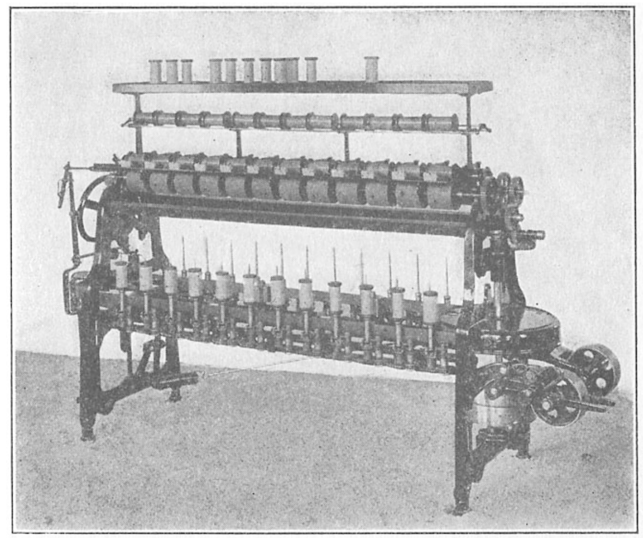


Fig. 22

The improved method of making organzine is by the use of a "Combination Spinner, Doubler and Twister", which does the work of "first-time" twist, "doubling" and "second-time" twist in one operation. It also makes it unnecessary to steam as frequently and thus tends to preserve the life of the silk. This machine will be fully explained later on.

Fig. 22 shows a perspective view of a Spinning Frame, built by the Atwood Machine Company. Fig. 23 shows a diagrammatical end view and Fig. 24 a

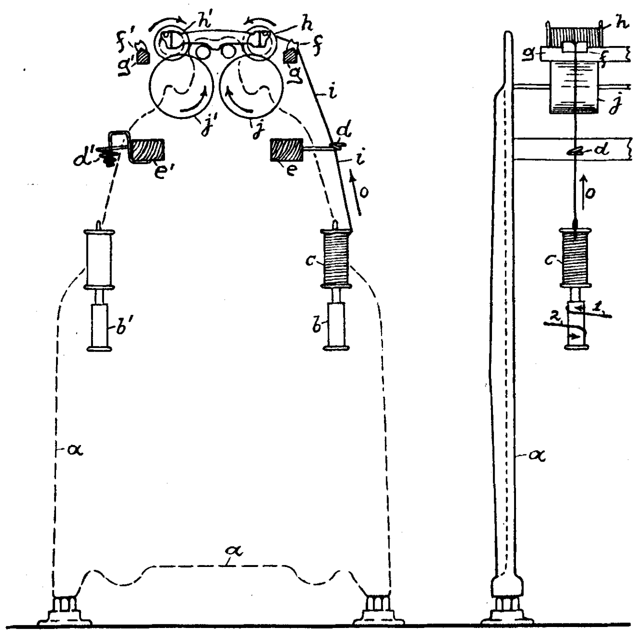


Fig. 23 *Fig. 24*

diagrammatical front view of a portion of this machine, both views being given to show the course of the thread through the machine.

This machine can be built any length desired; standard lengths built are 112 spindles for first time spinning and 92 spindles for second time spinning. Fig. 22 clearly shows the endless belt for driving the

spindles by friction, and which belt can be made to run one way or the other, as required.

Letters and numerals of reference in Figs. 23 and 24, are selected to correspond, *i. e.,* indicate the same parts, *viz: a* one of the end frames or heads of the machine. *b* one of the spindles, arrow 1 indicating direction of rotating spindles for "first-time" twist, arrow 2 indicating direction of rotating spindles for "second-time" twist. *b'* one of the spindles of the rear bank. *c* delivery bobbin, *d* centring eye secured to wooden girt *e,* extending the entire length of the machine. *d'* shows a cone tension wire attached to girt *e',* used if so desired in place of the centring eye *d.* *f* is a porcelain guide, secured to traverse bar *g,* and *h* the take-up bobbin.

The twisted thread *i,* upon leaving the delivery bobbin *c,* passes (see arrow *o*) through the centring eye *d* (or the cone tension wire *d'*) and is then wound most uniformly onto the take-up bobbin *h* by means of the porcelain guide *f* being moved to and fro (by means of the traverse rod *g* to which it is fastened) the entire width of the bobbin; *j* is the drum for turning the take-up bobbin. *f'* is the porcelain guide, *g'* the traverse bar and *j',* the drum for the rear bank of the machine, being identical with those of the front bank explained. The r.p.m. of the spindles with a "First Spinner" is from 9,600 to 11,000 and that of a "Second Spinner" according to flyer system or without flyer, from 8,000 to 10.000.

Combined Doubling and Spinning Frame for Tram.

A perspective view of this machine is given in Fig. 25, the same combining the two operations of doubling and spinning in one. This machine, like any other spinning or winding machine, is built any length desired, a standard length often met with being 100 spindles, measuring 20 feet over all, 1 foot, 3 inches wide. The machine is driven by tight and loose pulleys, 10 inches diameter, 2 inches face. One revolution of the driving pulley gives 15 revolutions to the spindles; the latter being run at from 5,000 to 6,000 r.p.m.

This frame is designed for tram spinning and will double and spin up to six, eight, and ten ends. The spindles are belt driven and self-oiling. The threads

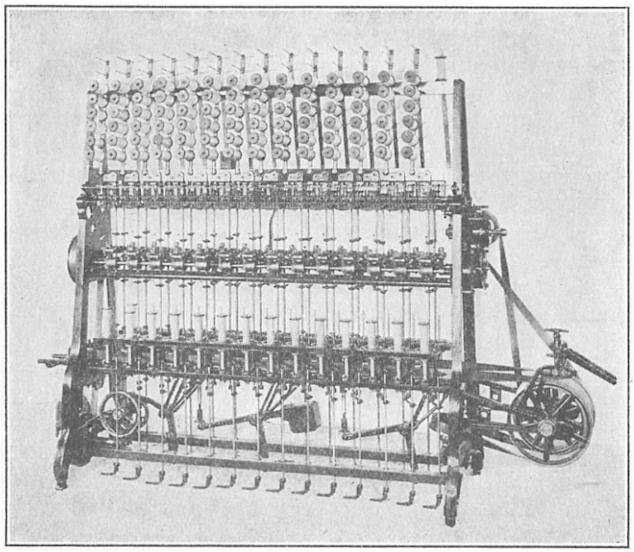


Fig. 25

are delivered from the bobbin above, passing down through drop-wires to gear driven feed-rollers, which ensures accurate doubling of the threads delivered to the spindle below; the flat ring and bar traveler are used. The spindles run four to five thousand revolutions per minute on about three turns per inch; ample provision is made for all adjustments of spindles, traverse and changes of twist; change gears are furnished with each machine.

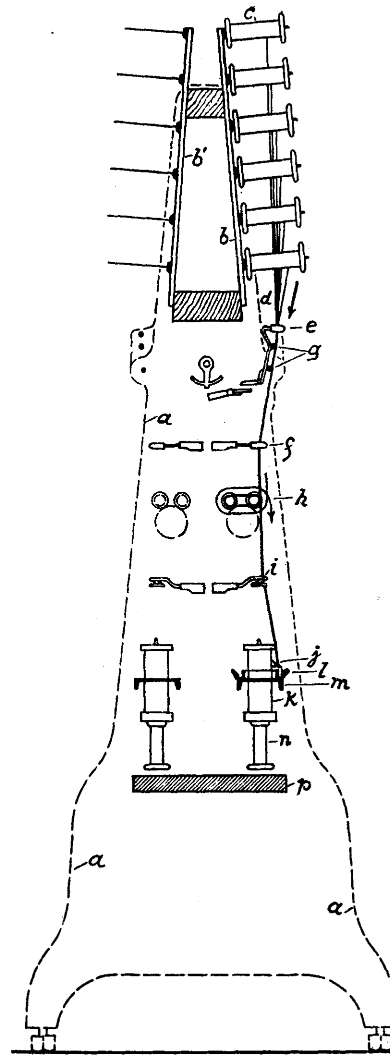


Fig. 26

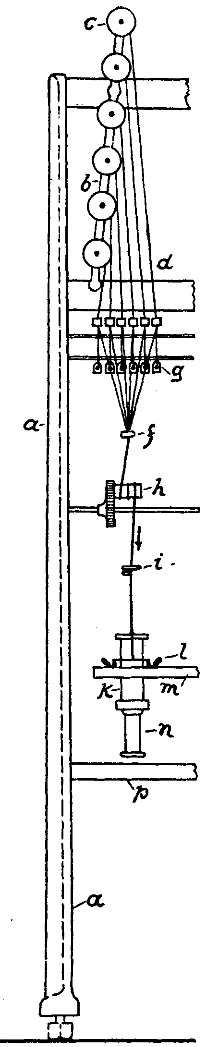


Fig. 27

Fig. 26 is a diagrammatic end elevation and Fig. 27 a similar front elevation of this machine. Letters of reference in both illustrations are selected to correspond and indicate thus:

a one of the end frames of the machine, *b* and *b'* one of the front and rear bank creel frames for holding delivery bobbins *c*, as received from the Hard Silk Winder previously explained; six bobbins to one tire are shown; less or more (up to ten) may be used. The six minor ends *d* coming from the delivery bobbins are shown at *e* to enter the faller wires of the stop motion, in their travel to the centring eye *f*.

g are strained wires operating with the stop motion, and *h* are gear driven feed rollers around which the ply thread travels (twice around) ensuring accurate doubling of the threads, which in turn, passing through centring eye *i* are twisted into one, being delivered through the ring traveler *j* onto take-up bobbin *k*. The ring traveler *j* runs on the flange of ring *l* as is secured to the ring rail *m*.

n is the spindle which turns in one direction only, since one twist only is inserted into tram; *p* indicates the spindle rail.

Combination Spinning, Doubling and Twisting Frame.

This is the combination machine for spinning organzine by one operation in place of three machines as used in some mills, *i. e.*, combining first-spinning, doubling and second-spinning in one operation.

Fig. 28 shows this machine as built by the Atwood Machine Company, in its perspective view. This Combination Organzine Frame can be built in any length, a standard size being 160 first-time and 80 second-time spindles, dealing with a machine 19 feet, 5 inches long, 1 foot, 11 inches wide and 3 feet, 8 inches high to feed rollers.

The spindles are belt-driven, and of the self-oiling type, the first-time spindles being mounted in an automatic, swinging holder and the second-time spindles

in an adjustable holder, thus ensuring uniform drive with minimum of power; the arrangement of spindle belts is very simple and effective, and are provided with suitable take-up devices.

The first-time spindles take a standard winder bobbin in general use; the twist is regulated by the change of a single gear and the relative amount of

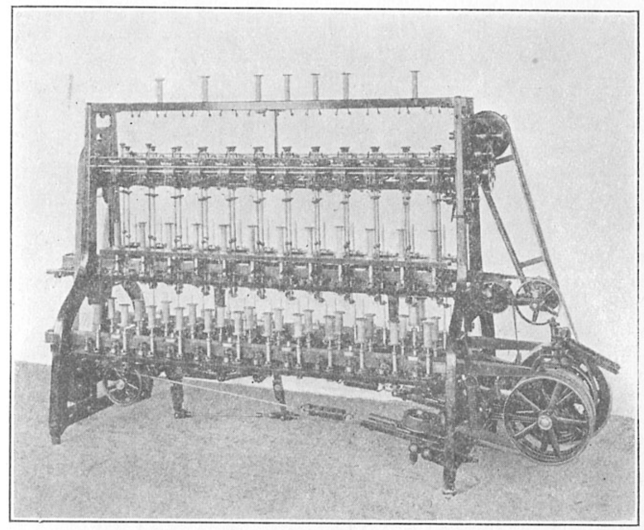


Fig. 28

first and second-time twist is obtained by change of a single pulley. Feed rollers are removable singly and all parts of the frame are easily accessible; stop motion is very simple and instant in operation; rings are of the double adjustable type.

In operation, the first-time ends are brought up through the drop wires, around the feed-rollers and down to the receiving bobbin; any break of either end releases the faller, lifts the feed-rollers and stops the receiving of twisting spindles.

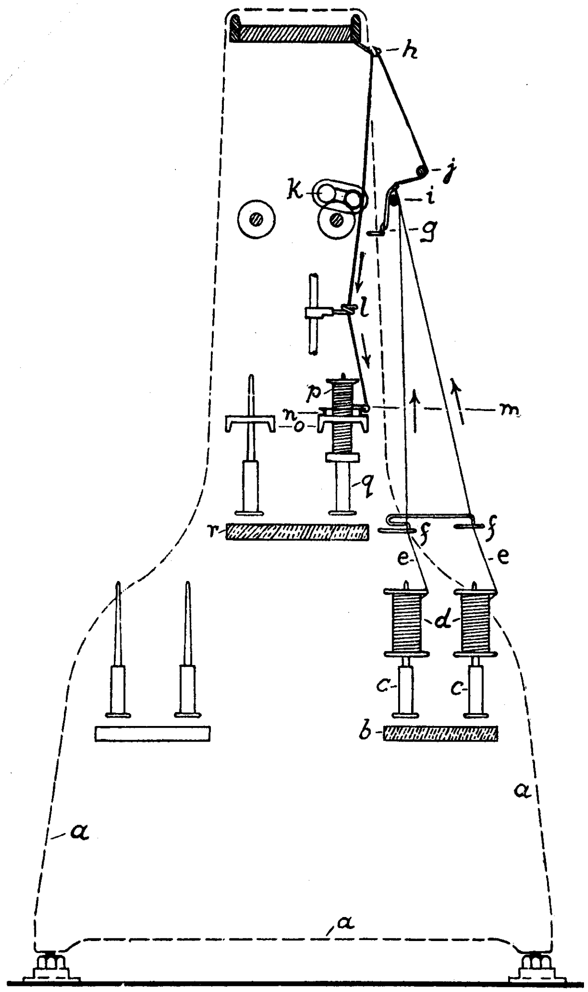


Fig. 29

Fig. 29 is a diagrammatical end view of the machine, clearly showing the run of threads through it.

a is one of the two end frames, shown by dotted lines. *b* is the spindle rail and *c* the spindles for carrying the "first-time" bobbins *d,* the ends *e* of which are brought up through tension wires *f* and in turn through faller wires *g,* then through guide eye *h.* The two threads are guided in their travel by two parallel rods *i* and *j.*

From guide eye *h* the threads pass several times around feed rollers *k* in order to produce a uniform doubling of the two minor threads, after which the now twisted thread passes through the automatic centring eye *l,* through the loop of the ring traveller *m* (as sprung onto the flange of ring *n* carried on ring rail *o*) and onto the "second-time" bobbin *p* carried and operated by spindle *q* working in conjunction with spindle rail *r.* The r.p.m. of spindle *q* is from 9,600 to 10,000.

Water Stretching.

After twisting, in some instances the silk is stretched on a machine known as a "Water Stretcher," of which a perspective view is given in Fig. 30. This treatment smoothens and consolidates the constituent fibres, imparting a superior evenness to the silk. A sufficient number of filled bobbins are for this purpose placed in water and the silk wound on to the lower of the two copper rollers of the machine. From the lower roller it passes upward to the upper roller, which turns faster than the lower one, thereby stretching the silk. From the upper roller it passes again on to a bobbin, to be in turn reeled off in hanks or skeins (in the next process) and when then it is ready for the dyehouse.

Reeling.

Thrown silk is yarn, but is hardly ready for all purposes. The natural gum (sericin) still clings to it, and its color is very dull. In this condition the silk is in some instances woven, the boiling-off and dyeing being done to the cloth. This does not always serve; in most instances, the thrown silk must be boiled-off, dyed, bleached, weighted, lustred, etc., previous to weaving, and when the yarns then must

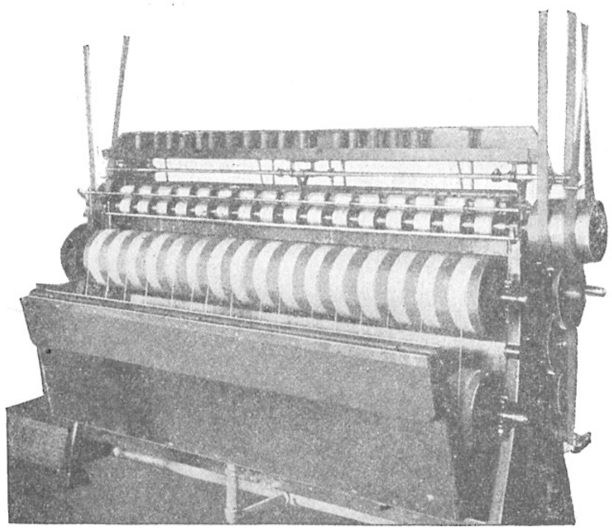


Fig. 30

be unwound from the bobbins and changed into skeins so they can be handled by the dyer. Another reason for reeling the filled bobbins into skeins is the fact that silk in commerce is handled to a great extent in skeins.

This reeling process is simply the reverse from that of the winding process previously explained, *i. e.*, the silk on the spools being, in this instance, rewound on skeins.

Fig. 31 shows such a Reeling Frame (used for organzine or tram) in its perspective view, the same

being built by the Atwood Machine Company. The illustration shows one section, with only one reel in, the rear bank reel being omitted in order to show the construction of the machine more clearly. For practical use the machine is built in sections of two reel-flys each, each fly being driven independently, by friction. The width of the machine is 2 feet, 9 inches;

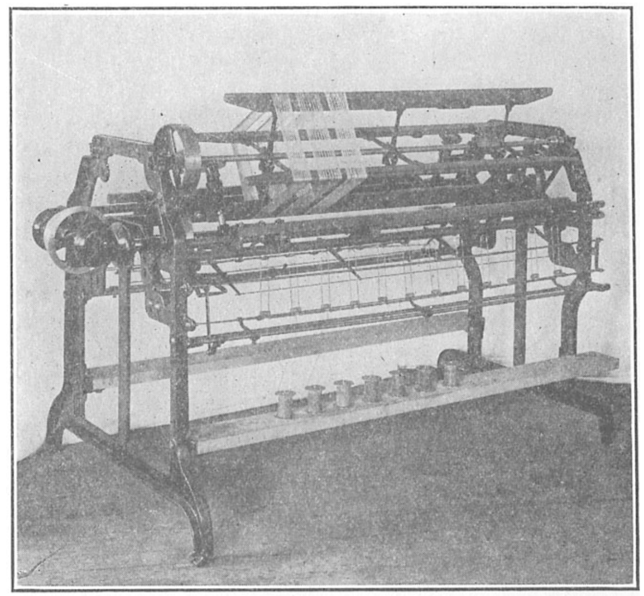


Fig. 31

the length of 2 sections is 11 feet, 3 sections 16 feet, 4 sections 21 feet. The machine is driven by cross head, 6 and 7 inch cone for 1½ inch belt, or direct idler drive, pulley 9 inch diameter, for 2 inch belt. The machine is built with the reel bearings detachable; stop motion for each end operating instantly; the action of starting the reel lifts the drop wires of the stop motion into position. It is provided with a quick or slow traverse motion, to produce any style of skein crossing desired. As will be seen from the illustration, the bottom shelf, holding the delivery bobbins, is adjustable in the head framings up or down. The reel-flys are strongly built and well balanced, thus allowing a speed of from 350 to 400 r.p.m. As a rule, the dimensions of the reel-fly and the machine are such that the skeins wound are spaced four inches apart from centre to centre, with 12 skeins per fly. The counting or registering device is of two styles, quickly adjusted; one style can be set each 50 yards, up to 25,000 yards by an indexed register; the other style is locked for the required length of skein and the reel cannot be removed, or the counter changed in any way until the skein is completed, thus preventing any tampering with length of skein by the operative.

The standard skein for thrown silk in the United States is 54 inches; however larger sizes of reeling frames are also built, taking reel-flys up to 60 inch circumference. Coming back to our standard reel of 54 inches circumference, organzine is usually made up into 20,000 yard skeins, but tram is made in 5,000; 7,500; 10,000; 15,000 and 20,000 yard skeins depending upon the demands of the manufacturer. There would, therefore be on a 54 inch reel 3,333; 5,000; 6,666; 10,000; 13,333 turns respectively for the sizes of skeins quoted.

Different countries use different measurements for their skeins. For example, England uses a skein 48 inches in circumference (= 1.219 m) with 2,496 threads, or a skein of 44 inches circumference (= 1.118 m) with 818 threads. In France the circumference of the skein in 1 m, 1 skein = 4 sections at 3,000 threads, thus 12,000 m.

An average variation of 5 per cent is allowed from the number of yards per skein, as ordered for

thrown silk. The minimum number of test skeins is twenty.

Fig. 32 is a diagrammatical section of the Reeling Frame, shown in Fig. 31 in its perspective view,

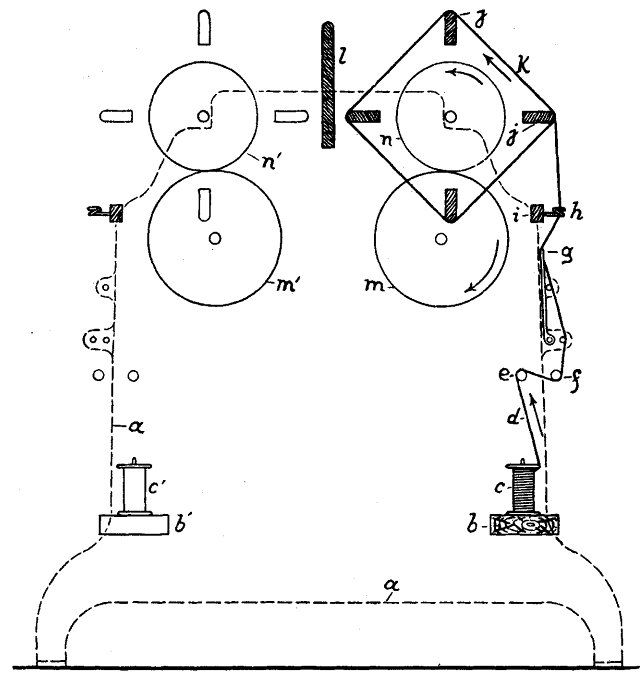


Fig. 32

clearly showing the operation of the Reel by quoting letters of reference used in the illustration.

a is one of the heads of the machine, into which the bottom shelf *b*, carrying the delivery bobbins *c*, is adjustably secured. The silk thread *d*, whether organzine or tram, is guided from its delivery bobbins *c* over and under guide rods *e* and *f*, through drop wire *g* of the stop motion, through guide eye *h* as secured to wooden bar *i* and onto reel-flys *j* forming the skein *k*. A suitable *to* and *fro* motion (by cams) is given to bar *i* and thus in turn to porcelain guide eye *h;* imparting to the skein the characteristic "diamond" winding so essential for good winding.

l is a wooden shield to keep the wind, or draft of the reel-fly off the rear bank reel-fly and vice versa. *m* and *m'* are the two driving pulleys for the reel-fly pulleys *n* and *n'*. Arrows accompanying illustration indicate travel of the organzine or tram thread from bobbin to skein, also rotation of reel, driving pulleys as well as reel-fly pulleys.

After reeling, the skeins are again steamed, either while still on the reel, or while suspended loosely as skeins, the action of the steam on the reels which are collapsible, is harmful, so that in many mills the other method of steaming is followed.

After reeling, laces are placed in the skeins as an aid in the proper placing of the skeins on the swifts, for rewinding on bobbins for the warper, the quiller, or on bobbins used by the knit goods industry, etc. The final step in the throwing department is to make the skeins up into bundles, in what is known as a *Bundling Press* and in which shape they may be sent to the warehouse, the dye-house or the mill who furnished the grége for having it thrown.

Points of Interest.

One of the most frequently met with troubles for which the throwster is generally blamed, is that of poorly wound skeins. The trouble may rest with the foreman, he may consider that all he has to do is to occasionally inspect guides and faller wires, changing them when he notices that they are worn out and cut. This is all very well, but these examinations should be made regularly and this at stated times; besides this, he should remember that there is more to be done by him to insure the making of a perfectly wound skein, producing a skein well filled, one that after subjecting it to boiling-off and dyeing,

etc., will reach the soft-silk winder in the weaving or knitting mill in a condition that is a credit to the throwster.

One of the most important items for the overseer of the reeling department is to see to it that there is as little drag as possible on the threads pulling over the guide rods and through the faller wires of the stop motion, onto the reel-fly. Provided this tension is not proper it will be noticed that the skein bags when stripped from the fly, whereas if the skein has been formed with too light a tension, the result then will be a mussy skein when stripped from the fly, and for which reason the foreman must see to it that a good medium between the two extremes are used.

When stripping the skeins from the fly, care must be exercised to draw them uniformly and evenly from the latter, since if bunched the skein will become snarled and the lacings displaced.

When hanging the strippings, be careful that the skeins when hung up do not twist, each stripping to be hung on a long pin provided for this purpose and long enough to keep the skeins intact. Do not twist each stripping, since this is an unnecessary process and a waste of time. Provided each stripping as taken from the fly is put upon a long peg, it will simplify the work for the maker-up of bundles, thus enabling him to pick his skein singly, clean and free for inspection without having to lose any time.

The skein may be perfectly reeled on the machine, but may have been injured by the bundler in his work, thus reaching the dyer in a poor condition. It will not do for the bundler to twist the rolls too tight, since it will have a tendency to cause the sides of the skein to bag. The skeins, whether two, three or four are included in a roll, should be twisted together as lightly as possible, the bundler keeping in mind that the strong point for him to observe is to keep the skeins free from bagging and sagging, regardless of the looks of the packages. Broken ends in skeins will result from tight twisting by the bundler.

The foreman should be in constant touch with reelers, lacers, strippers and bundlers, closely watching their work, since poor bundling may spoil good work previously done in the mill.

It will be of interest here to refer to an improvement in reeling introduced by C. H. Knepka, a silk reeling expert, who stated that some time ago, feeling that he had his reeling department in the best possible condition, it occurred to him that he could produce a still better skein. By carefully studying how to produce such a skein, he noticed that where the flys were run at a speed of about 500 revolutions per minute, that the play of the traverse bar caused the thread on every reverse motion of the traverse to strike the faller wires of the stop motion, on account of the restriction in the play of from three-quarters to one inch, thus jumping the thread so that it built up thicker on the edges of the skein, leaving hollow centres. When stripped, the skeins bagged, and readily snarled, resulting in troublesome winding.

The accompanying illustration Fig. 33 shows a front view, and Fig. 34 a side elevation of what Knepka did to overcome the trouble. As the circular part of the regular faller wire through which the thread passes from the delivery bobbin *a* to the reel-fly *b* is only about three-quarters of an inch in diameter, he concluded that owing to the high speed of the flys, this limited range of play for the thread caused it to bind on the edges of the skein, raising them higher at these points than in the centre.

Noticing this, he stripped a few of the regular faller wires on the machine, inserting in place of them some faller wires of his own construction, see *c* in illustrations. These wires were made with a round eye on the bottom for fastening on the faller rod and terminating in a flat oval loop at the top, through which the thread passes. This oval loop is to be about a quarter of an inch wider than the width of the skein

to be wound. The material of the wire is the same as that used for the faller wires in the regular stop motion. The flat oval eye *c*, through which the thread passes, permits the same to play the full width of the traverse, resulting in a skein of uniform thickness

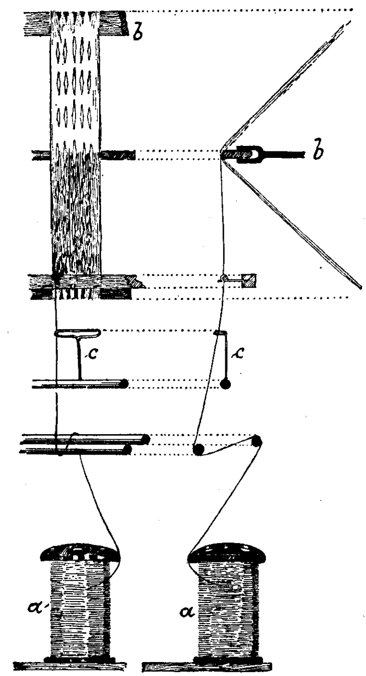


Fig. 33 *Fig. 34*

throughout its width, with the crosses preserved in perfect diamond shapes throughout the skein.

Another advantage possessed by this style of a faller wire in connection with a stop motion is, that, since the thread is not restricted in the small eye of the present faller wire it does not cut, and consequently lasts as we might say, indefinitely.

It is also of the greatest of importance in a throwing plant that the bobbins used are the best that can be procured. All spinner bobbins should have the upper head at least of fibre, and all be kept in racks or on pins; the old method of throwing them all promiscuously into boxes or baskets and bruising the heads of the bobbins, should not be tolerated in a modern, well managed mill.

There is a great need for technically educated foremen and superintendents of throwing plants. The hardest thing in these days is for the manager to find a foreman who really knows silk and how to handle it. Mills are willing to pay high salaries to men who can handle their machines and silk understandingly and properly, but are unable to find them. It is no uncommon thing for the owner of a plant to send to the builder of the machines for a man to come and put them in order after a few months operation under the care of a so-called competent foreman.

Although competition has reduced the throwing prices, there is still a good return for a well equipped, up-to-date mill that is intelligently and economically managed.

To prevent drawing or curling up of twisted skeins of silk (organzine—heavily twisted) place them after reeling in a lukewarm water bath. In Italy a treatment known as *brova* is in use, it referring to a steaming of the yarn while on the reel for from 15 to 20 minutes, after which the silk is placed in a drying chamber and for a short time subjected to a heat of from 80 to 90 deg. C. It is claimed that this procedure greatly enhances the lustre and pliability of the silk, but the drying is not made use of everywhere.

Organzines, trams and floss, for convenient handling in transit, are made up into hanks, each hank containing a number of skeins. These hanks are then made up into bundles; those of organzine are generally short and weigh from 6 to 8 lbs., whereas those of tram are long, the length of the reel, weighing

from 12 to 17 lbs. The bundles are then tied up in the ordinary way with string, but as there is always an allowance made to the buyer on account of using this string, throwsters are not very sparing in this respect.

Defects met with in Thrown Silk.

In connection with thrown silk, *i. e.,* floss, tram or organzine, defects we may come across are:

(1) Minor ends running out or breaking, caused by the stop motion being out of order and this trouble not noticed at once by the attendant;

(2) Uneven tension given to some of the minor threads as fed to the doubler or the spinning frame, which will give to the twisted thread a spiral effect, technically known as corkscrew;

(3) Uneven counts or sizes of minor threads put up for twisting into one thread, may also be at the bottom of corkscrew, and so also

(4) the union of minor threads containing a different percentage of moisture, which in turn will cause an uneven contraction of the thread when dry.

Corkscrew of the thread, in connection with organzine, will cause trouble at the weaving; the short minor thread of the organzine, not being able to stand the strain of weaving, will break, and when the loose end will form itself into a bunch, which will catch either in the mail of the harness or in the dents of the reed, and thus be the cause of the end breaking during weaving.

With reference to the first twist, *i. e.,* the twist imparted to the minor threads, in connection with organzine, defects met with are: soft twisted ends, and kinks or snarls. The first may be the result of slack spindle bands, sticky spindle bolsters or spindles out of true.

Such a soft twisted thread can be readily detected by the attendant, since the spools containing such silk will handle soft. Such yarn should not be used in this state in connection with perfectly spun yarn, since if used, it will clearly reveal the defect after passing through the boiling-off process, and finally may be the cause of spoiling the face of the fabric.

Kinks or snarls in the first twisting process can be generally traced back to improper working of the stop motion, *i. e.,* the latter failing to operate when the spindle stops. Kinks should either be stretched, rubbed or pieced out, previously to again starting up the machine.

Other Kinds of Silk.

Besides dumb and thrown singles, floss, tram and organzine, we may come in contact with:

Sewing Silk: Refers to silk composed of 3 to 24 threads, 2, 4, or 6 of which are united by twisting.

Embroidery Silk: Refers to silk composed of untwisted threads, a number of which are united by a slight twisting.

Cordonnet Silk: Is a silk used for braiding, knitting, etc.; it consists of 4 to 8 threads loosely twisted with a left-hand twist to form the primary threads, 3 of which are then twisted together with a right-hand twist.

Marabout Silk: Is a silk used for crapè; it consists of 2 or 3 threads united without preliminary twisting, then dyed without scouring and strongly twisted together, so as to yield a stiff thread.

Soiè Ondee: Refers to a silk prepared by doubling a coarse and a fine thread. It is used in making gauze, to which it gives a watered appearance.

Buying Silk on Guarantee.

When thrown silk is bought, stipulate the price per pound on the basis of:

(1) A certain amount of moisture.

(2) A certain amount of fibre (not boil-off).

(3) A certain size (length). Subject to official tests.

When:

Amount of moisture is less than stipulated, pay for the difference.

Amount of fibre is more than stipulated, pay for the difference.

Size is finer than stipulated, pay for the difference, and vice-versa.

The application of this method automatically removes all unpleasantness and disputes, as all those will testify who have resorted to this practice. This method is known as the "100 per cent proportion basis of thrown silk."

It may become necessary or desirable to incorporate in the contract a certain minimum size and possibly a certain maximum size.

Supposing a transaction had been closed thus:

Price per lb. $4.00.

Moisture rate 11 per cent (conditioned weight).

Fibre rate 77 per cent (boil-off 23 per cent).

Size 8.53 drams per 1000 yards. (30,000 yards per lb.) and supposing a shipment of lbs. 100.00 net weight had been made and tests showing:

(*a*) Conditioned weight lbs. 98.00.

(*b*) Fibre rate 78.57 per cent (boil-off 21.43 per cent).

(*c*) Size 8.70 drams (29.425 yards per lb.)

the bill would read:

100 lbs. net at $4.00 = $400.

$400.00 ÷ 100 × 98 = $392. (moisture).

$392.00 ÷ 77 × 78.57 = $400. (fibre).

$400.00 ÷ 8.70 × 8.53 = final $392.30 (length).

This shows:

(1) A loss on account of excessive moisture.

(2) An increase on account of increased fibre.

(3) A loss on account of reduced length.

Vice-versa, supposing the tests had shown:

(*a*) Conditioned weight lbs. 102.

(*b*) Fibre 75 per cent (boil-off 25 per cent).

(*c*) Size 8.36 drams (30622 yards).

Bill would read:
100 lbs. net at $4.00 = $400.
$400. ÷ 100 × 102 = $408.00 (weight).
$408. ÷ 77 × 75 = $397.40 (fibre).
$397.40 ÷ 8.36 × 8.53 = final $405.47 (length).

The difference between the bills on the net basis and after adjustments may naturally become very much greater than in these examples, the differences in the final bills become larger in the same proportion as the difference in the condition of the silk between the actual delivery and the condition stipulated become larger, for which reason this method can be called the self balancing or self adjusting purchasing method, otherwise known as the 100 per cent basis.

The One Hundred Per Cent throwing method, closely corresponding to what is known in Europe as La Grande Façon (equivalent to "the complete working out" or demonstration) is a method of adjusting the price to be paid for throwing, on a basis which determines the amount of waste made by the throwster for which he is required to pay at the thrown silk price.

Advantages of the Method.

The cost per pound of the thrown silk is known definitely in advance—after deducting raw boil-off samples—since the throwster pays for all the waste, allowance for which is included in the increased price for throwing.

The weights of the raw and thrown silk and the loss by boiling off are definitely known, instead of being estimated or assumed, giving the clearance a mathematical accuracy obtainable in no other way.

The use of this method tends to produce a minimum of waste, as a direct loss to the throwster is the result of any waste made in excess of the amount expected.

Both the owner and throwster proceed on a known basis regarding the weight of the silk at all stages

where the weight is affected, and both parties are on a mutually understood basis where their respective rights can be accurately determined by mathematical processes.

The conditioned weight and boil-off of the thrown silk being known, the manufacturer is able to order his weightings with greater precision.

Throwing Silk for the Knit Goods Industry.

The continually growing demand for silk hosiery has brought into the silk market a large and growing consumer of raw and thrown silks, and for a fact, with some of our public throwsters, the knit goods field has become an important and special feature. The kinds and grades of silks used for hosiery and knit neckwear varies according to the class of goods made, ranging from Tussah to fine Italians including Shinshiu, Kansai Filatures, some of the intermediates like Tsatlee Filatures, etc., also Canton Filatures and Rereels.

The greater part of the raw silk used by the knitting industry is 13/15 denier silk. Provided the silk was of such an even construction that the thread was at no place finer, nor coarser than 14 deniers, the amount of waste made in throwing would probably then amount to only about one-tenth part of what it actually amounts to. Such waste would then consist chiefly of those short clippings made after tying a knot (for one reason or another) since there would be no breaks of the threads anywhere. But silk is not of such even construction; silk of 14 deniers may in certain places run as heavy as 20 deniers, and in other places may be as fine as 10 deniers, or even less. Those fine ends become so fine at places that the thin thread cannot hold the weight of the skeins and swifts or the spools, and consequently will break. Wherever such a break occurs it will be necessary to remove all those fine portions which at times may amount to hundreds of yards. The more uneven the silk, the more often do these breaks occur. Waste originating from this source may amount to one, two, three and even more per cent, whereas the unavoidable waste or legitimate waste might only have amounted to a small fraction of one per cent. Taking into consideration that the waste caused by the unevenness of the thread naturally consists of but the finest part of the silk in question, we will at once understand that if the waste in weight should have proved to be, say 3 per cent, the waste in length would naturally be more than that.

If, for an example, the average of the size (as before) was 14 deniers, and the 3 per cent of waste in weight was composed of an average of 10 deniers, then we must consider that while the waste in weight was 3 per cent, the waste in length is considerably more.

One hundred pounds of 14 denier silk equal 32,000,000 yards.

Three pounds of waste of 10 deniers equals 1,369,500 yards, being 4.28 per cent waste in length.

There are two systems of grading of silk yarns used, *viz:* the Denier and the Dram system.

THE DENIER SYSTEM. The length of the skein adopted for its basis in the U. S., is 450 meters, and the unit of weight ½ decigram; thus the count is expressed by the number of ½ decigrams that 450 meters of silk weigh.

450 meters = 492.12 yards.
1 lb. = 453.6 grams.
1 gram = 20 deniers.
1 lb. = 9072 deniers.
1 denier = 492.12 yards.
9072 deniers = 4,464,513 yards.

DRAM SYSTEM. This system of grading has for its basis the number of drams (avoirdupois) a 1000

yard hank weighs. Fractions of drams are used, *viz:* ¼, ½ and ¾ of one dram.

The knit goods manufacturer should have a particular interest in the possible improvement of the silk with regard to its evenness, and it is an easy matter for him to contribute toward bringing this about. He should discriminate. He should look for the best silk in this particular direction. He should make it a part of his contract to stipulate what he considers an acceptable silk for his purpose. He should be guided by a standard.

By this he is doing away with all speculation or gambling with regard to the quality. He will not deceive himself. He will know he is economizing by doing away with that unnecessary or invisible waste. When paying the price for a high-grade silk and refusing to accept any substitution at a lower figure, he will naturally create an interest on the part of the producer to produce the best possible silk at an equitable remuneration, contrary to the present interest in producing a low grade silk at a falsely attractive figure.

Establishing of standards will reduce the number of qualities or grades. Every reduction in the number of grades will mean an increase in the efficiency of output and returns. We may not so much be harmed directly by following the course of least resistance as producers, but we should absolutely refuse to adhere to this doctrine as consumers.

Mills running on the better grades of Accordion Knit and Flat Goods, in two-toned mixtures, require the silk to be delivered in skeins.

For converting skeins (either in its *Thrown* or *Dyed* state) the "ALTEMUS **2B** WINDER" should be used, the same being equipped with an ingenious attachment that winds the new type of Yarn-package automatically traversed in its progress of building the Pyramid Cone. This wind will produce a most perfect fabric, uniform in its structure, flexible in its texture, and what is more: eliminates press-offs and seconds and equalizes and increases the production, pairing to the uniformity of requirements.

Mills running on popular-priced grades of goods, which are dyed in the piece, require their silks to be

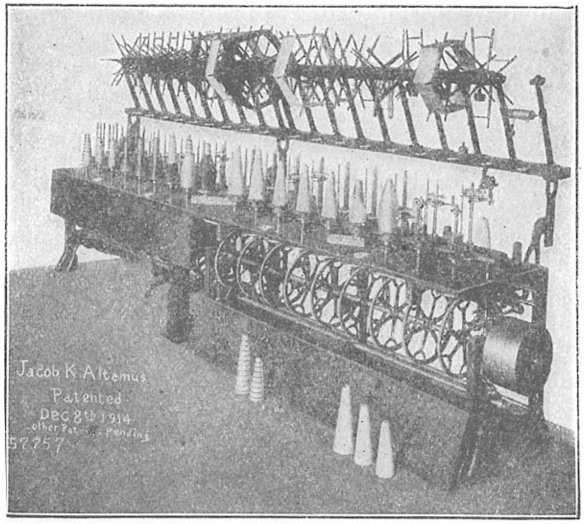


Fig. 35

furnished on cones, this being the reason why some of our throwsters had to install "Altemus **2B** Cone Winders," of which a photographic view is given in Fig. 35.

This Winder will *increase* your *production* and *decrease Press-offs* and *Seconds,* and above all produce a more uniform fabric; save time in pairing up, making your fabric flexible and soft.

Besides all-silk hosiery, a good portion of hosiery is made with cotton foot and top. Where mercerized cotton is used in place of regular cotton, the mercerizing gives the cotton a greater affinity for most dyes, and they, dyed together with the boiled-off silk will produce most satisfactory results.

For piece dyeing the most economical plan is to use the silk in the gum and boil-off the goods previous to bleaching or dyeing.

To produce a popular priced silk hose for the market, tussah is used. This silk, on account of its irregularity, however, lumps up in the latch of the knitting needles, breaks the latches, and makes expensive press-offs and seconds. The working of this silk in knitting machines can be materially improved by imparting to the yarn a little extra twist so as to increase its elasticity. Cleaner yarns will also result through finishing them on special yarn finishing machines which lay any protruding fibres to the body of the thread, resulting in added lustre to the silk, also increasing its elasticity, and of which tussah possesses very little.

Silks thrown for knitting purposes require a most uniform twist, a long drag insuring uniformity in twist.

Care must be also taken in connection with throwing silk for the knit goods trade, that operators piece ends with the bobbin off the spindle, so as to avoid hard twists.

Throwing Silk for the Cotton Industry.

Another broad field for silk throwsters is found in the increased output of cotton and silk mixtures by the fine count cotton goods mills, using silk for stripes and figuring, in the construction of fancy shirtings, dress goods, etc. These mills are continually increasing their consumption of silk, some of which they buy direct from raw silk importers and have them thrown by public throwsters, whereas others are still buying thrown silks, as they need it. While silk mixtures have long been made by these mills, the number of mills engaged in the manufacture of silk and cotton mixtures of a novelty character is constantly growing.

These mills have become such large users of silks that it would not be surprising to see more of them following the lead of some of the large mills which have already installed their own plant of silk throwing,

The Testing of Raw Silks.

Clearances Figured on Yardage.

Some of the inquiries and comments which have been lately received by the U. S. Conditioning and Testing Co., in reference to methods of computing clearance, have revealed to them the fact that many silk manufacturers use the yardage of their thrown silk, determined either by sizing or measuring tests, as a basis for calculating clearances and costs.

The method is subject to so many causes of inaccuracy that it seemed desirable for the Testing Co. to call attention of the silk industry to them and at the same time point out a more reliable method:

The use of yardage as a basis for computing the clearance of a lot of thrown silk may be inaccurate through the following causes:

1st: Variation in the size of skeins.

2nd: Variation in the size of the silk, both raw and thrown.

3rd: Stretching of the silk in winding.

First: According to the Rules and Regulations of the Silk Association of America, governing transactions in the throwing of silk; an average variation of five per cent shall be allowed from the number of yards per skein as ordered for thrown silk. This rule indicates that in the opinion of the Association the reeling of thrown silk is a mill operation, subject to such variation that if the average length of the skeins produced does not differ more than five per cent from the length specified, the delivery shall be satisfactory.

Since the rule applies to the *average* length as determined by test, the delivery may be good and still have in it skeins which differ from the length ordered by an amount considerably larger than five per cent.

Take a ten-bundle lot, as illustration, ordered to be thrown into organzine 20,000-yard skeins. The lot returned by the throwster is sent to the Conditioning House for a measuring test. Ten skeins are drawn at random, one from each bundle, wound onto spools and re-reeled into skeins on a precision reel having an accurately divided dial for reading the number of revolutions of the fly.

Suppose the average is 19,500 yards per skein, equal to 2.5 per cent less than the ordered yardage. Some of the skeins in the test must have been shorter than 19,500 yards and others between 19,500 and 20,000 yards. The probability that an appreciable number in the lot should exceed 20,000 yards is, with the modern reel, very remote. The lot would contain approximately 1,600 skeins, which, in a moderate size throwing plant, would probably have been reeled upon at least ten different flies. Of the 1,600 skeins, ten skeins, or approximately 0.6 per cent, were selected for the test and the manufacturer who uses the measuring test to calculate the total number of yards of organzine or tram in a lot by multiplying the average yardage by the total number of skeins is assuming that these ten skeins can be so selected that their average will be the same as the average of the whole 1,600 skeins found by measuring them all.

When the Silk Association in its Rules and Regulations declares that a variation of five per cent in the lengths of skeins is a permissible allowance, and from this it may be inferred that individual skeins might vary as much as ten per cent from the ordered skein, it should require but slight consideration to see that the probability of the average yardage, by the measuring test, equaling the true average yardage of the whole lot, is very remote.

The manufacturer who attempts to calculate his clearance and the commission throwster who accepts a clearance based upon a chance, where the odds are liable to be so great, introduces a very dangerous element of chance into the control of his business. The measuring test was never intended by its originators as a means of calculating quantity of material. It cannot be made with sufficient accuracy and is subject to too many uncertainties to be used for such a purpose. For determining the number of warps, the length of warps or roughly the production which can be gotten to advantage from a given lot or even determining for limited orders the quantity to be dyed, it may be quite accurate enough. But in the accurate control of the quantity of as valuable material as silk it should certainly have no place.

The thing which seems to recommend it is its cheapness and simplicity, but he who uses it to measure pounds of material at from $4.00 to $5.00 per pound is practicing a penny wise and pound foolish policy and deceiving himself into thinking that he is watching his "wastes and leaks by testing."

SECOND: A clearance calculated on a sizing test which gives the number of drams per 1,000 yards, and yards per pound of a thrown silk is slightly better than one based on the measuring test, but is also subject to some of the same inaccuracies. For the sizing test, ten skeins are drawn, from which twenty small skeins are re-reeled and weighed. The average of these twenty skeins is the average size and may be expressed in yards per pound. From the weight of the lot, the number of yards returned may be calculated. The selection of ten skeins from a ten-bundle, 1,600-skein lot, depends upon the same principle as the measuring test, but the size of thrown silk does not vary as much as the size of the skeins, and hence the sizing sample will be very much more representative than the measuring sample and the average size upon a single test will agree more closely with the average or true size of the lot. Variation in length of the skeins or the number of skeins does not affect the size.

But to apply the sizing to determine the yardage of the lot, the weight must be known, and at this point the amount of moisture, soap and oil in the thrown silk enters. Unless the conditioned weight and boil-off is determined no accurate clearance can be calculated.

But these are the only tests required to make an accurate clearance based upon clean fibre as described below.

If the throwster's invoice weight is accepted and the size applied to it to determine yardage, the uncertainties regarding it enter into the value.

The sizing test is influenced by the natural variation in the raw silk. This is recognized in the silk trade as shown by expressing the size between limits instead of the average size.

THIRD: Probably the greatest weakness of the yardage as a basis of computing clearance is the possibility of stretching the silk by reeling it into skeins at increased tension. The elasticity or stretch of the silk thread ranges from fifteen per cent to twenty-five per cent before it breaks. The first half of this stretch is accomplished by a small increase in tension. The stretch increases with increase of moisture and therefore, by the adjustment of tension and moisture, it is possible to manipulate the yardage. The yardage determined either by measuring or sizing test becomes therefore almost useless as a basis for computing clearance of thrown silk.

CORRECT METHOD.

Clearances of thrown silk should always be computed upon the basis of conditioned weight of clean fibre. The conditioned weight and boil-off of the raw should be determined by the Conditioning House before the silk is shipped from New York and the thrown silk should be returned to the Conditioning House either in New York, Philadelphia or Paterson, and the conditioned weight and boil-off again determined.

Every five-bale lot should have two bales conditioned, three bales shirt weighed and one boil-off made on the raw; then two conditionings of five bundles each and two boil-off on the thrown.

The selection of bales and bundles to be tested should always be made by the Conditioning House.

With the information which these tests will furnish, it is possible to compute an accurate, reliable clearance not subject to manipulation. The slight increase in expense will be more than justified by the saving involved.

Points on the Proper Raising (*Cross-breeding*) of Silkworm Eggs.

This subject has been excellently dealt with by *Dr. Umberto Zanoni,* one of Italy's experts on this subject, and from which we quote items that will be of the greatest of interest.

Italy, the most important silk producing country of Europe, is, likewise, at the head of silk raising countries in the production of silkworm eggs by modern improved methods.

While the Far East, China and Japan, are the leading countries in so far as amount of cocoons produced, they have not, however, yet approached the technique and science attained of late by Italy in the production of the eggs.

Japan is now beginning to take up seriously the improvement along this line, having, during the last years, sent to Italy several students, in order to learn these methods, for adoption in their country. Numerous, already, are the establishments in Japan engaged exclusively in the production of silkworm eggs, which have adopted the system of cellular selection. In China less progress has as yet been made in the microscopical selection of silkworm eggs.

The production of the eggs, as practised in Italy, includes various processes, *viz.:*

(*a*) *Preparation of the cocoons for reproductive purposes.*

(*b*) *Treatment of the cocoons in the reproduction.*

(*c*) *Microscopical selection of reproductive moths in cells.*

It aims at:

1st. Producing eggs of yellow Italian varieties, in accordance with the requirements of the silk exporting trade and adapted to the localities, in Italy, where they are raised.

2nd. Obtaining on a large scale crossbreeds, especially with Chinese varieties.

In the other important silk raising countries, namely, in France, China and Japan, this industry aims almost exclusively at producing eggs of pure local varieties. In France are usually reproduced the local yellow species, in China the Chinese white and yellow, and in Japan more especially the Japanese white.

In the above stated countries, no less than in Italy, the necessity is beginning to be felt of resorting to *crossing,* chiefly *for the purpose of further strengthening the larva,* destined to silk raising on a commercial scale.

In Italy conditions arising from competition in the silk market have of late years caused the producers of silkworm eggs to turn their attention to the production of pure species, and of such crossbreeds as will secure the highest production, together with the best quality, of silk, and the largest yield at the basin.

The producer of silkworm eggs in Italy, after first having secured, with the adoption of the *cellular system,* safe immunity from the pebrine disease, has, of late years, aimed continually at the improvement of his seed productions. This was done in order to enable the raiser of silkworms to obtain the highest yield in silk from his cocoons, as well as to strengthen the position of the reeler on the market, and enable him to overcome the competition, which has become gradually keener from the Far East and from those other countries, which, of late years, have, by various means of encouragement, promoted and gradually developed their silk industry.

In Italy, the substitution with crossbreeds of the Italian yellow varieties has been due to the fact that in almost the entire North the various yellow species were subject to serious attacks of *flacherie,* one of the most dreaded diseases of the silkworm. By crossing different species, breeds have been obtained more resistant to this disease.

The Chinese cross, as is commonly designated the issue from an Italian yellow crossed with a Chinese, is the variety that has now prevailed over all others, having demonstrated its aptness to answer the requirements of both good quality and good yield of the silk, reeled from its cocoons, besides being sufficiently hardy, a quality that the producers of silkworm eggs had formerly exploited to their advantage and obtained (not without prejudice, however, to the quality and yield of the silk) by crossing the Italian yellow with the vigorous Japanese green and Japanese white.

The raising of silkworms for reproductive purposes usually takes place in the healthiest localities of Italy, it having been ascertained that species yielding small cocoons succeed satisfactorily in Northern Italy; while experience has shown that the Italian yellow gives better results in the climate of Central and Southern Italy.

Cultivations for this purpose are usually of a fractional character, seldom reaching in individual cases one ounce (of grams, 30.35) of seed, and are entrusted to the best of the small raisers of silkworms in the localities chosen for reproductive purposes.

The best, among these, are for Northern Italy the hilly districts of Venetia and Lombardy, and for Central Italy the hilly regions of the Marches and Abbruzzi.

A district, to be suitable to the raising of silkworms for reproductive purposes, should be characterized by healthy climate and good quality of the mulberry foliage, and should present conditions most favorable to the rearing, especially in regard to freedom from hereditary contagious diseases, and particularly from pebrine, the most feared. Preventive disinfections, thoroughly accomplished, of the rearing house, material and utensils used, are indispensable every season.

The systems of rearing silkworms which have proved to fulfil the best requirement of the case, and to

promote the healthy condition of the larva, such as the economical method of the primitive Frioulan cloth, suspended on horses, are especially recommendable in the rearing of silkworms for reproductive purposes and the production of seed.

Treatment of the Cocoons.

Cocoons for reproductive purposes are picked when perfectly developed, and carried in small baskets, or in light layers on trays, so as to avoid damage while in transit to the seed rearing establishment.

Upon arrival at the establishent, the cocoons undergo several operations. They are, first of all, freed from their coating of floss, and are next submitted to a process of selection, in order to separate the good from the faulty cocoons.

The freeing of the cocoons from the coating of floss in which they are enveloped, yields cocoons with a decidedly clean surface, which helps the moths, at the time of disclosure, to detach themselves from the cocoons. The deflossing of the cocoons is accomplished by means of very simple machines, in going through which the cocoons are brought in contact with grooved steel cylinders, revolving on their longitudinal axis, and freeing them thoroughly of the floss.

The selection of the cocoons is usually accomplished by hand, and consists in eliminating all cocoons which are imperfect as to quality of the silk, or as to form, color, strength of the silk tissue, etc.

In this manner are obtained the cocoons destined to maintain, by reproduction, the racial characters, either for crossbreeding or for the continuation of the species.

The separation of the male from the female cocoons is the next operation, accomplished by means of specially devised scales, known under the designation of *ginecrini,* of which the most popular are the multiple types, capable of sorting several cocoons at a time.

Sex separation, although accomplished, in the case of the cocoons, only in an approximate manner, is, however, especially important for the purpose of cross-breeding, enabling the rearer of seed to govern his breeding and to obtain crossbreeds with different strains, suitable to the requirements and demand of the raisers of silkworms.

In order to separate the sexes, and avoid copulation between males and females of one same race, cocoons are usually placed in so-called insulators, which, by confining each moth within its own cell, keep them separate upon coming out of the cocoons.

The hatching of the cocoons and caring of the moths is the most important stage in the production of silkworm eggs, as it comprehends all the phases from the hatching to the pairing and separation of the couples, to the bagging of the moths in the cells (*cellular system of production*), to the tying and hanging of the cells on the so-called harps, in order to preserve the eggs deposited.

Microscopical Selection.

The microscopical selection of the reproductive moths, in order to obtain cellular seed, immune from pebrine, was readily adopted after the important investigations of Cantoni and Pasteur, by all rational producers of silkworm eggs. The truth of the following conclusion, arrived at at the First International Congress of Sericulture, held at Gorizia in 1870 has thus received practical recognition: "The microscopical selection of the productive moths, paired in cells, is, in the present condition of the silkworm industry, the only means to secure seed immune from corpuscular infection and of reproducing the valuable old yellow species, freeing ourselves from the heavy tribute which is now paid to Japan."

Microscopical selection includes two phases, *viz.:*

(*a*) Crushing and mashing of the moths.

(*b*) Microscopical examination of the mashed specimens of each individual moth.

The moths are usually crushed in small mortars, either of porcelain, ebonite, brass, or other suitable material, operated by hand.

In crushing the moths, sufficient care must be taken to avoid the possibility of spreading, by contagion through contact either with the hands or with utensils, the pebrine disease, thus augmenting, instead of eliminating the actual percentage of infection.

Crushing may be accomplished by means of special mechanical crushers, reproducing to some extent the action of ordinary hand mortars.

Following right upon the mashing of the moths is the microscopical examination, which consists in examining under the microscope a drop of each individual moth specimen, so as to identify the diseased moths and eliminate the eggs deposited by them.

The microscopical examiners are handed the slides, already prepared, of the specimens for examination, so that they can readily proceed with their work, collecting in a special small receptacle of glass, for the final checking, the specimens found free from infection.

The cells containing the eggs deposited which have been found upon examination sound and immune from pebrine are grouped and hung again in the rooms where the seed is kept.

The microscopical examination of the eggs takes place usually in August, September and October.

Collecting the Seed.

The gathering of the eggs from the cells begins in November.

This operation is preceded, however, by a careful selection and re-examination of the eggs, made by opening each individual cell and by eliminating by means of a suitable brush faulty eggs, such as yellow (empty), shriveled, black, or badly shaped eggs.

The eggs are collected by placing the cells in water baths, as from the moistened paper, to which the eggs adhere, they are easily detached.

The detached seed is carefully washed by means of suitable sieves and next bathed in special disinfecting liquids in order to secure, together with a thorough cleansing, a superficial disinfection of the eggs.

The grain is next air dried by means of powerful ventilators, which eliminate also all impurities and residues, and separate thoroughly the light and imperfect eggs from the good eggs.

After the previously stated treatment the seed is weighed and packed in small gauze bags or cardboard boxes and is in a condition for hibernation, which takes place usually in January, February and March.

At the beginning of April distribution of the seed to silkworm raisers commences, and this closes the work of the grain producer and marks the commencement of the labors of the rearer.

It is rightly said that the production of silkworm eggs is an industry of special importance, and of thorough confidence in the establishment from which the seed is obtained.

Importance of Soap and Water in Treatment of Silk.

From the cocoon to the finished fabric, soap plays a very important part in the treatment of silk, and the commercial value of a number of fabrics depends upon the quality and nature of the soap used.

It is not the purpose of the present article to treat on any special make of soap, but to direct the attention of the throwster and dyer to the difference existing in various soaps and the influences they are likely to have upon the silk.

The ideal soap for the treatment of silk is a hard curd of settled soap, made from caustic soda and olive oil, or a very high-grade olive oil foots, the latter being the most widely used, because it is cheaper than the white olive oil soap. Some dyers prefer the use of a white soap provided the silk later on is to be dyed delicate colors. Either soap should be perfectly neutral, that is, should contain neither free alkali nor free fat.

At one time large quantities of soap of French manufacture known as Marseilles soap were imported, and a few still find their way to our market, but to-day Marseilles does not signify anything. Centuries ago, soap made in Marseilles was a pure olive soap, but to-day it may be anything. It is even made here, and stamped Marseilles, thus the name Marseilles alone, now stands for nothing, without being upheld by the name of a reputable maker, to be sure you are getting the proper article.

Formulas in soap books give Marseilles soap as containing olive oil, bleached palm, tallow, cocoanut oil, and even cotton-seed oil, so that you can readily see that Marseilles means nothing.

Our domestic manufacturer can produce the best that is possible to-day. It is only necessary to *know from whom to buy it;* that is, to know the house with the reputation for making the pure article.

There are, however, on the market many brands of silk soaps recommended on account of one or more properties, but what the silk man is particularly anxious about, is a soap that is firm, readily soluble, and which has a reasonably quick solvent action on the silk gum, *i. e.,* sericin.

No free alkali should be present in olive silk soap on account of the consequent impairment to the natural lustre of the silk.

The choice of olive oil for the manufacture of silk soap is a matter of some concern, and the higher grade of oil or foots employed, *the better* will be the soap. What is termed "fair average quality foots" or "soap stocks," which are the second or third pressing, and of a dirty brown reddish color, coming from countries where the olive originally is of an inferior grade, find their way in cheap grades of soap, but better grades of oil are to be desired when a soap for silk manufacturing is intended.

It is curious that the oil from certain regions has properties of producing soaps of different consistencies, it being conceded that the Italian oils produce the highest grade soaps.

Owing to competition, the soap maker is tempted to use cheaper oils than olive, and this has opened the door for cotton-seed, rape-seed, peanut, corn, poppy and sesame oils, none of which, however, add to the value of the soap, but on the contrary, produce very poor and unsatisfactory results.

It is also a fact that powdered soapstone and even barytes have been found as fillers. Olive oil soaps for silk purposes should contain from 60 to 65 per cent of fatty acids (upon which the real value of the soap depends) and from 6½ to 7½ per cent of sodium oxide, while the insoluble matter should be not over 0.5 per cent. The moisture in the soap should be between 27 and 33 per cent.

Consumers of fairly large quantities of soap should always purchase upon specification and contract, and have deliveries frequently analyzed by a competent chemist, naming specifically the soap constituents to be determined, for the reason that the average soap consumer, not being a chemist, is frequently unable to read and understand a chemist's report worded in technical language.

It should be remembered that what the manufacturer wants is soap, consisting of a compound of soda and olive oil and containing a certain amount of water held mechanically, and there is no occasion for excessive quantities of water to form part of any delivery. If a soap consumer orders "olive oil soap"—which is what he should use for silk—the soap manufacturer should deliver it; and it is quite within the province of the chemist to report whether or not the fatty oil used in making the soap was olive oil, or the same mixed with other and cheaper oils. It is not a case of one soap doing what another will do, but of the silk worker getting what he pays for.

Some soaps rinse out more readily than others. Some soaps, while apparently completely removed by rinsing, leave a distinct soapy odor which baffles removal. One of the most prominent advantages of pure olive oil soaps for silks, is not only its effective solvent action on silk gum, but its easy removal by rinsing with luke-warm soft water without leaving any odor behind.

Silk thoroughly degummed, if to be weighted and dyed, should be rinsed with the utmost care and attention, for lack of care at this stage may cause the silk to be responsible for defective pieces later.

By care is meant the use of soft water, for not only the boiling-off but for the rinsing as well, the reason being that any hardness of water due to the presence of magnesia or calcium, immediately forms insoluble alkaline earth soaps with the fatty acid of the remaining traces of soap adhering to the skeins. These magnesia and calcium soaps stick tenaciously to the skeins and are difficult of removal, and when these skeins at a later time are either weighted in a tin bath, or not weighted but dyed in an acidulated dye-bath, the fatty acids are liberated, and it is well known that free fatty acids are positively detrimental to silk and cause its ultimate disintegration.

Many silk fabrics, perfect otherwise, perhaps moderately weighted, show occasionally one or more threads adjacent to each other, which seems to suddenly lose their strength and fall to pieces in the fabric, and the consensus of opinion of those who have investigated the silk fiber, after it has been made up into fabrics, is that such breaking is in all probability due to the presence of fatty acids.

Of course there are other substances besides the above mentioned that act destructively upon silk, sodium chloride (common salt) being also an enemy that must be seriously considered.

In dyeing blacks with logwood, silk soap is very frequently added to the second dye-bath, and if after dyeing, the rinsing has not been thorough, appreciable traces of soap may remain in the goods, and in such cases the use of muriatic-acid-olive-oil brightening mixture is certain to liberate free fatty acids that would in time positively injure the goods.

Water a Most Important Item.

The water problem in silk mills comes prominently in mind when soap is considered, as both go hand in hand. No silk mill can turn out a uniform article, if the quality of the water changes, which is a matter of frequent occurrence in mills depending upon a natural source of supply.

Calcareous water is not to be considered, and no silk mill should be located where such water only is to be had. Naturally soft water from granitic regions is eminently suitable, but such localities are not numerous.

The chemical treatment of water containing excessive quantities of lime or magnesia is not an easy matter in the dye house, and any attempt to correct water by the tubfull is usually without result.

The safest course to pursue by a mill using reasonably large quantities of water daily, is to install one of the softening plants and processes that are available, the result being that the dyer will always have at command a sufficient volume of water for his requirements of uniform quality, thereby relieving his mind of any consequences that would arise under other circumstances.

A soft (zero) water always leads to level shades in dyeing, especially for colors, while a hard water causes a certain loss of dyestuff, which not only tends to unevenness, but materially influences the crocking.

The process for water softening now most commonly used is that requiring very simple chemicals, known as the Permutit Process, resulting in an unfailing supply of Zero Water. Cases are known where

so-called soft water had been used, the adoption of "Permutit" resulted in a saving of more than half the soap formerly used—to say nothing of important added savings in dyes, labor, fuel and power costs. The result is practically complete removal of the soluble impurities in the water, the same being thrown out as an insoluble precipitate, leaving the water clear and soft.

The operation of these various plants can be adjusted to such a degree of nicety, that very little attention is required, while water of uniform purity is constantly delivered.

There is no question but that the two items, **soap** and **water**, are not given the full attention in silk mills that their importance demands, and this should not be, as all the good qualities possessed by a finished fabric have a direct bearing upon the quality of both soap and water.

Chemical Analysis of Textile Soaps

Long custom dictated that soaps intended for use in the silk industry should be so-called hard soaps and made from an olive oil base. Owing to the delicacy of the silk fiber, throwsters and dyers have insisted, and quite properly, that silk soaps should be practically free from any free or uncombined fat—*i. e.*, oil or fat not wholly changed into soap, and also from any free alkali, *i. e.*, alkali not completely removed from the soap, after cooking of the soap batch is finished.

The present article is written principally to indicate a line of practical chemical analysis easily adapted to the needs of throwsters, dyers and silk mills, which will enable them to keep in close touch with their soap problems.

There are many methods published for soap analysis, but it is a matter of some difficulty for the young mill chemist to make a proper selection of the one that has been found best suited to his general practice. As a rule, most methods that have been published are overburdened with a number of unnecessary details that cause the mill chemist to go very slowly before deciding upon a choice.

Except in very few instances, the buyer of soaps for a mill or the throwster who does his own buying is only interested in knowing that what he has had delivered to him is the soap found best suited for his purpose. It is not a brand or trade-mark that he is buying, but soap; consequently he wants to know how much real soap, moisture, free alkali if present, free fat filler if present, and information as to whether the base is olive oil or some other oil or fatty mixture.

In order to analyze a sample of soap properly, cut a bar through the middle, taking the outside as well as the core of the bar. About four ounces are sufficient to cover all the tests, the first of which is for moisture.

MOISTURE IN SOAP is determined by taking a carefully weighed portion of the sample in thin shavings and drying in an oven, heated to 105 deg. C. cooling and weighing from time to time until the weight remains constant. The difference is recorded as *moisture*. To carry out this apparently simple operation, there is required a flat, wide mouth, thin and light weighing bottle and a dessicator, in which to place each article while warm from the oven and in which it is allowed to become cold before weighing.

Example of moisture determination records from practice:

Weighing bottle with soap sample.....	27.19	grams.
Weight of empty bottle..............	21.62	"
Weight of soap taken for drying......	5.57	"
AFTER DRYING:		
Weight of bottle and dried soap......	25.83	grams.
Weight of empty bottle..............	21.62	"
Weight of dried soap................	4.21	"

Subtracting the weight of the dried soap from the weight of the same sample before drying, the loss of moisture is ascertained, *viz:* 1.36 grams, which is equal to 24.41 per cent.

The difference between 24.41 and 100 is 75.59, which represents the *actual percentage* of *real soap* in the sample.

The next determination is to find the amount of fatty acid contained in the sample. Have ready an absolutely clean straight sided, tall round glass beaker of 300 cubic centimetres capacity and also a glass rod. Place in the clean and dry weighing bottle a quantity of soap shavings and weigh. Then transfer from the bottle to the beaker about 10 grams of the soap without weighing, but ascertain the exact amount transferred by reweighing the bottle and noting the loss in weight.

Dissolve this transferred quantity of soap in about 200 cubic centimetres of water with the aid of heat, but it is not necessary to boil the solution. To this soap solution add a few drops of a solution of methyl orange, and add from a graduated burette, 40 cubic centimetres of normal solution of hydrochloric acid. This acid decomposes the soap, setting free the fatty acids which must be taken up and weighed, and which is done by weighing accurately about 15 grams of pure stearic acid, and carefully placing in the beaker containing the decomposed soap solution. Heat gradually on a ring stand until the solid stearic acid has melted, when it completely takes up the free fatty acids from the soap solution. Allow to become cold after standing a few hours and carefully remove the round cake of solid fatty acids, wiping off any drops of solution that may adhere, place in the dessicator for an hour and weigh. The increase in weight over the recorded weight of the stearic acid taken is that of the fatty acids, and which multiplied by the factor .968 gives the weight of the fatty-acid anhydride in the soap taken.

Thus:	Soap taken	10	grams.
	Stearic acid	15.00	"
	Stearic acid plus fatty acids	22.165	"
	Fatty acids	7.165	"

7.165 multiplied by .968 (anhydride factor) gives 6.936, which corresponds exactly to 6.936 per cent of fatty acid anhydride, as we took exactly 10 grams of soap for the test.

We have remaining in the beaker the solution containing an excess of normal hydrochloric acid. Add from a burette a solution of normal sodic hydrate (1 cc neutralizes exactly 1 cc of the normal acid that was previously used in the same beaker) until the pink coloration changes to yellow, showing that the excess of normal hydrochloric acid added to effect the complete separation of the fats, is completely neutralized. The number of cubic centimeters of normal soda added, subtracted from the total number of cubic centimeters of hydrochloric acid added, gives the number of cubic centimeters of the acid actually required to combine with the total soda of the soap sample. Thus:

Normal acid added....................	40 ccs
Normal soda added to bring back to neutralizing point	19.9 ccs
Difference, amount of acid required to combine with the total alkali of the soap..	20.1 ccs

As 1 cc of this normal acid corresponds to .031 grams of Na_2O (Oxide of sodium) 20.1 ccs equal .623 grams, therefore we have .623 grams of total alkali, or 6.23 per cent.

Our analysis now reads:

Moisture	24.41	per cent.
Fatty acid anhydride..............	69.36	"
Total alkali	6.23	"
Total	100.00	per cent.

To this it is always best to add the following *qualitative tests*. Pure soap always dissolves in pure grain alcohol, giving a clear solution. (Do not use denatured alcohol.) The presence of silicate of soda, clay, starch, etc., including common salt is always shown by such substances being insoluble, and clouding the solution. If only silicate of soda is present as an adulterant, it will be shown after acidulating a water solution of the soap with sulphuric acid; fatty acids will rise to the surface upon standing while the silicate will collect on the bottom in a jelly-like cloud.

A drop of a solution of phenolphthalein applied to the fresh cut surface of a bar of the soap will instantly indicate the presence of *free caustic alkali* by showing a red spot.

Soaking Oils.

The oils most often met with for soaking silk previously to the process of throwing are Neatsfoot Oil, Olive Oil, Nilsap, etc.

To understand the difference in grade, and why different oils can be sold at such widely varying prices, it is necessary to understand the general methods of their manufacture.

Briefly, the first oils obtained from the raw product are the best and highest priced, and the last, the poorest and lowest priced.

In olive oils, the best grades are those obtained from the first light pressing of the fruit. The next grades are obtained by more severe pressure in which the olives are crushed to a pulp. These are the two grades of olive oil used as edible oils.

Hot water is then added and the mass pressed again. This gives a third grade of oil, which is used for soap-making, soaking, etc. The fourth grade of oil is obtained by beating the remaining pulp, which still contains from ten to twenty per cent of oil, in special mills with hot water. After standing for a period, the oil is skimmed off the surface of the water. Finally the pulp is extracted with a volatile solvent to remove the last traces. These lowest grades are called "foots."

In the manufacture of Neatsfoot Oil the feet of cattle are boiled in water and the oil skimmed from the surface as it rises. The best grades are the first skimmings, and the poorer grades the later skimming. Further treatment consists of continued boiling with steam, and of concentration, which gives the lower grades of oil.

Testing Soaking Oils Used.

Previously to purchasing a soaking oil, the first point to determine is its purity, *i. e.,* freedom from adulteration with some cheaper oil, which is sometimes difficult to do, since small amounts of another oil are frequently difficult to find. Physical and chemical analysis can be made which give certain factors, which are constant within a small variation for any one type of oil, and adulteration is shown by higher or lower values.

After the purity is determined, the actual quality of the oil should be obtained.

The first thing to be done is to determine the percentage of free acid. A large amount of it being present shows the oil is rancid, due either to a poor grade of raw material, to the age of the oil, or both, or to adulteration. Fermentation of the olive oil pulp or putrefaction of the neatsfoot oil stock will give a high free acid content to the oil. As a rule the lower the grade of oil, the higher the percentage of free acid and vice versa.

The best edible olive oils and highest grades of neatsfoot oil contain very litttle free acid, perhaps one to three per cent or even less, while the lower grades may contain from ten per cent to twenty-five per cent, or even more. Besides showing a very low quality of oil, a large amount of free acid gives an unsatisfactory soaking bath, forming both a scum and a poor emulsion.

An examination for mineral oil and cotton seed oil

should always be made. This last oil is quite commonly used to adulterate olive oils.

Unsaponifiable matter is that matter which can not be "saponified" or made into soap. It is therefore apt to stick in the silk after washing in the soap and often causes trouble in the dyeing later on. Tests for the amount of unsaponifiable matter should therefore be made.

An emulsification test should be made as nearly as possible following the actual working conditions as to strength of the soap solution, amount of oil, temperatures, etc.

Additional tests of value are the flash and fire points, specific gravity, iodine number, saponification number, temperature test, viscosity, etc.

The tests that are necessary for a complete examination will vary somewhat with the sample under consideration, but the final result should give the purity, freshness, grade and suitability of the oil.

Briefly, then, those qualities which are found in a good high grade oil are purity (that is freedom from adulteration) low free acid content, freshness, cleanliness, a small amount of unsaponifiable matter, a good light color, and standard physical and chemical constants.

Things to be guarded against are, a large amount of free acid or unsaponifiable matter, suspended dirt, staleness, adulteration of any kind, particularly with mineral oil, dark color, and variable and unnatural chemical and physical constants.

Nilsap.

Nilsap is a whitish color and of a soft soap consistency; it possesses a distinct odor of neatsfoot oil; it retains its semi-solid or pasty consistency at ordinary temperatures; it is neutral in reaction, and forms with warm water or hot water an emulsion, which, when viewed under the microscope, shows the globules of free oil to be in a most finely divided state. The emulsion appears to retain this condition for a long period of time without "breaking."

Carefully made tests to ascertain the usefulness of this composition in the treatment of raw silk, demonstrate that it possesses the property of softening the natural gum or "sericin" on the silk fibres, thereby loosening the fibres, but without any appreciable solvent action on the sericin itself.

When the silk is immersed in an emulsion made with this "composition" in a suitable proportion, the action is not at once noticeable, but after a period of two or more hours, a softening is apparent, and upon a further immersion of six to ten hours, the action is practically complete. The "sericin" has been effectively softened, and the fibres are free. The oil contained in the "composition," instead of being deposited *on* the fibres, is completely absorbed, and this property adds a certain amount of weight to the silk, which will probably offset the usual small amount of waste that always is present in the operation of throwing.

The proportion of this "composition" that may be necessary for satisfactory work on average qualities of raw silk, according to experiments, is about two per cent (2%) of the weight of the silk to be treated. That is, two pounds of the "composition" for each one hundred pounds of skein silk. This proportion may be varied, depending upon the nature and quality of the silk to be treated, from as low as 1½ pounds to 2½ pounds. This detail can only be determined by working up large scale lots in a throwing mill. However, tests show conclusively, that by immersing the skeins of raw silk in a bath of the emulsion as before outlined, a silk is obtained that possesses all the qualities of skeins ready for throwing.

The practical details, as worked out for treating raw silk with *"Nilsap"* is as follows:

For 100 Pounds of Raw Silk

weigh off two pounds of the composition, and make a thin cream of it with about five gallons of water heated

to about 125° *F.*, then stir until no particles remain as lumps—all must break up, forming an emulsion. This emulsion is then added with constant stirring, to the vats or kettles in which the silk is to be immersed. These vats should be filled with proper amount of hot water, at about 100° *F.*, stir well, and then enter the skeins of silk. As silk has a tendency to float, a lattice may be placed in the vat to keep the silk below the surface of the liquor in the bath. Keep the temperature between 90 and 100° *F.*, and allow the silk to remain immersed over night. In the morning, remove the skeins from the bath, allow them to drain, and then hydro-extract them to remove the excess of soaking solution, and dry.

After drying, the skeins (containing the soapy and oily proportions of the emulsion) are then exposed to the action of free air so that the silk fibres may take up from the atmosphere the normal amount of moisture. They are then ready for winding.

Some throwing establishments permit the practice of winding the skeins while in a damp condition, and while we do not attempt to question the practice of any mill, this course is likely to be detrimental, since some portions of skeins may thus be drier than others, and cause thereby uneven winding, which has at times reflected upon the "kind of soap" and oils used by the throwster.

With this "Nilsap Composition" we believe that constant uniformity of output is assured, provided the throwster exercises care to wind under constantly uniform conditions.

No additions are found necessary to use in connection with this "composition," since it contains within itself, all the essential components to prepare the skeins for proper throwing, and is a distinct advantage over the usual compounds made in throwing establishments, where soaps and oils are weighed or measured, and combined together in the vat. It also appears to possess the advantage of not being liable to become rancid.

Diseases of Silkworms.

This subject has been dealt with in a most interesting article by Iwajiro Honda, Director of the Tokyo Imperial Sericultural Institute, and of which we quote.

"He states that if the silkworm is stricken with *Muscardine,* this disease does not show any remarkable symptoms at the beginning, and the silkworm has every appearance of good health, but begins to cease taking leaves, to be in agony, and to show an intense impulse of its dorsal vessel a few hours before its death; moreover irregular brownish black spots often appear in the skin of the ventral or the lateral part of the body. In short, it is always impossible to be aware of the presence of the disease until the first few worms have been suddenly stricken and die. The disease is specially characterized by the fact that the dead body becomes hardened after several days, and sometimes presents a reddish violet color which afterward changes into white. Muscardine attacks not only the larvae, but also both pupa and moths.

Besides muscardine, we find several kinds of silkworm diseases, caused by *parasitic fungi.* Those which have been known up to the present time are as follows: Nomuræa parcina Delacroix, Oospora destructor, Isaria densa Link (A. Giard.), Isaria farinsoa Fr., Isaria funosorosæ Cashimir Wze., and a variety of Aspergillus species, etc. These injurious fungi cause sometimes great damage, but they are not so serious as in the case of the muscardine.

In order to prevent the disease caused by *Botrytis bassiana* and other fungi, the following data should be noticed:

(1) The disinfection of breeding chamber and instruments.

(2) Precaution during breeding.

(3) Worms attacked accidentally with the fungi are distinguished from healthy ones, and are so far as possible taken out previous to their forming spores, and the litter is often removed to clean the silkworm tray. Since a damp atmosphere greatly assists the growing of the fungus, we should avoid too much wetness in the breeding chambers so far as possible.

(4) Flacherie is a disease caused by parasitic microbes. Although the silkworms in every stage are attacked by this disease, it especially happens at the end of the fifth age, and the following days up to the time of moulting, causing serious damage to the sericulturists.

(5) Various bacteria are injurious to the silkworms among which *Bacillus sotto Ishiwata,* and *Streptococcus bombycis Chon.* are important. The former is a bacillus with a rod like shape. The body is covered with a fruitful crop of fine cilia with which the bacillus moves violently. It forms an oval endospore in the middle or one side of the body. The bacillus produces a kind of toxin in this endospore, and its pathogenic action is due to the production of the toxin. The bacillus which has been swallowed by a silkworm causes its sudden death after from thirty minutes to an hour. The form and color of the body of an effected worm are not distinguished from those of a healthy worm, but in looking at the body carefully, we will find the following symptoms: The two or three segments near the head are somewhat transparent at the beginning of the disease and the silkworm raises its head, shaking it right and left. The posterior part has always a wrinkled skin; the legs losing the power to hold the body, the worm easily falls down if only touched, it becomes soft and flabby to the touch. The bacillus attacks not only worms, but larva and moths, lurking for a while in the body after contagion.

The second microbe is a round *streptococcus.* These bacteria do not cause as severe a malady as the ones just mentioned. The diseased worm presents the first disorder after a great multiplicity of the microbes in the mucous membrane of the alimentary canal. It injures vigorous worms but little, but on account of its causing a formidable malady to the weak ones, often a great many of them are suddenly condemned to death.

The symptoms of the disease vary according to the period attacked, worms stricken with this disease after their moulting remain small and lose their vital aspect; those attacked with it during the active period of feeding also remain small and finally die or the fore part of the body is swollen up and becomes transparent and the end part shrinks into a remarkably small compass. The streptococcus attacks worms at any stage but it is especially injurious to them before moulting.

By the following directions the rearer can prevent the disease:

(*a*) By the disinfection of the silkworm chambers and instruments.

By disinfection of the silkworm chambers and instruments any bacteria left are destroyed.

(*b*) By the selection of healthy seed.

On account of the fact that vigorous silkworms are little attacked by the disease, healthy seed is selected and protected completely.

(*c*) Precautions during breeding.

A proper temperature and moisture are kept, good ventilation is indispensable in the nurseries; that a proper quantity of food be given to the worms; of course the affected or attacked silkworms are taken out and the removal of the litter is often practiced.

(*d*) The *"Uji"* disease, caused by the parasitic growth of an insect called *Ugimiya* (Crossoscosmia) *sericaria Rondani*. This parasitic maggot caused great damage to our sericulturists. The cause of the disease is due to the worm's swallowing the eggs of the fly which are laid on mulberry leaves. The fly

lays eggs between the middle and the latter part of May on mulberry leaves which are given to the worms after the third age. The female and the male imago of the maggot are different in size; the male is fifteen *mm.* in length and its wings are thirty *mm.* in length and female fourteen *mm.* in length and its wings twenty-eight *mm.* The body is blackish brown and covered with coarse hairs. We always find some seven or eight thousand eggs in the female body among which several thousand eggs are actually laid. The female flies do not lay their eggs in any one place but in so many places that the number of eggs laid on one mulberry leaf being only one or two, at most seven or eight, thousands of the leaves receive the eggs of only a single female fly. The egg is black and shiny and has the marks of a regular hexagonal shape, like the meshes of a net. The form of the egg is an elongated oval, its length is 0.33 *mm.* and its width is 0.2 *mm.* As soon as the egg is laid, its nucleus begins to develop and finally hatches into a tiny larva soon after it is swallowed by the poor worm. The larva or maggot escapes into the body space through the wall of the alimentary canal and finally invades a ganglion. The time from the hatching until it reaches this stage, is only one hour. Thus the maggot lives on the ganglion, and after one or two weeks it comes out again into the body space and remains in the inside of a stigma, turning its hind end to the stigma and stretching its mouth into the interior of the body. In this position the maggot grows, absorbing the nutriment from the diseased worm. After the maggot continues one to three weeks in this state, it matures and leaves the patient, that is ten to fourteen days after the worm has spun a cocoon. Either when the worm is attacked with the disease while it is young or when it is injured by several maggots, the worm is killed before it spins a cocoon. The mature maggot is of a cylindrical form whose one end is round and the other pointed, it is yellowish white, twenty *mm.* in length, six *mm.* in width and consists of twelve segments. It moves very actively and lies low in the ground escaping out of the nurseries through a narrow space. The maggot has thus buried itself in the ground, changes into a chrysalis whose puparium is a blackish brown and elongated oval. Passing the Winter in earth, the maggot reappears as an imago or fly in the middle of April, of the next Spring. Many swarm about mulberries and lay eggs on the leaves.

The worm attacked with the disease presents different symptoms. In the case of an attack by a single maggot, the silkworm has every appearance of good health and accomplishes all the stages but after pupation the stigma of the pupa is always black and it can never change into a moth. On account of this fact, the parasite causes a serious damage to our egg producing. Either when the worm is stricken with this disease while it is young, or when the worm is attacked by several maggots, it presents such symptoms as *Tareko* (the hanging worm) that means the worm which hangs down on the edge of the tray and dies, *Kubimagari* (the worm bending its anterior parts) or sometimes *Hadaka-sanagi* (the naked pupa) that is the pupa which does not imprison itself in a cocoon.

In order to prevent this disease the rearer should take the following measures:

(*a*) The maggots which come from the cocoons should be killed.

(*b*) The rearer should sweep and dust under the floors of the mulberries after the breeding is finished and destroy the puparium of the maggot which lies low in the ground to pass the Winter.

(*c*) Mulberry leaves which are suspected of carrying the eggs of the fly should not be given to silkworms and especially the leaves should be carefully selected to feed the worms of the fifth age.

Japanese Raw Silks.

By Mitsui & Co. (Ltd.) New York.

The bulk of the higher grades of Japanese raw silks is sold to the U. S.; the Japanese retain chiefly the lower grades for home consumption. Over three-fourths of the exports are taken by the U. S., at present.

In the raw-silk trade there are very few spot sales from stock in New York; the usual custom is for the American manufacturers to place contracts for future delivery with raw-silk importers, who in turn cover by placing orders with Japanese filatures.

American manufacturers place orders with raw-silk dealers at least a month in advance, more often three to six months ahead, and often for deliveries extending over a period of months.

On arrival of a silk cargo the importers make up solid *"silk specials"* and send these across from San Francisco, or other Pacific port, to New York in about six days, the silk mostly being delivered and paid for in New York.

When railroad facilities are normal it does not take, at longest, over 24 days actual time for shipments to reach New York from Yokohama, the great silk port. Yokohama to San Francisco requires about 17 days; Yokohama to Seattle or Tacoma about 12 to 15 days, according to the steamer; Yokohama to Vancouver only 12 days. In fact, two Canadian Pacific Railway Steamship Co.'s steamers ran between Vancouver and Yokohama in 9 days. The difference is due not only to the distance, but also to the speed of the steamers which are in service.

The freight rate on raw silk across the American continent is $4 per 100 pounds. There has been no change in this rate for years, but we hear that this rate may be raised shortly. Steamship rates, however, have increased considerably. From Yokohama to American ports on the Pacific the rate was $2 per 100 pounds in 1914, just before the war, and is now (January, 1918) $7. Formerly the rates from Canton, Shanghai and Yokohama were the same, but now steamship rates to American ports on the Pacific are $10 from Canton and $8 from Shanghai, though this latter rate will probably soon be raised to $9 or $10.

Before the war, therefore, the through freight rate to New York on raw silk was $6 per 100 pounds from Yokohama, Canton, or Shanghai, whereas it is now $11 from Yokohama, $12 from Shanghai, and $14 from Canton, which makes the freight item one worth considering.

Raw silk requires very little cargo space. In these days when cargo space is valuable for war needs this fact should be emphasized. The largest import of raw silk from Japan, some 200,000 bales in 1916, did not require over 30,000 tons cargo space. Japanese raw silk is mainly shipped in bales weighing about 140 pounds gross each, and about 7 bales make up a ton of 40 cubic feet. The steamship companies have the option of charging by weight or measurement, and, as they can make more on the weight, the charge for raw silk is per hundred pounds.

The price variations on raw silk during the war are best shown by taking the prices per pound of No. 1 Japanese raw silk as quoted in New York City. This was quoted at $4 per pound on August 1, 1914; it reached high-water mark at $7.15 on August 1, 1917, and declined to $5.45 on November 5, 1917.

When *taffetas* are in fashion the 13/15 deniers is the leading raw-silk count imported. In the last two years, however, with the vogue of *Georgette crêpe* and *crêpe de chine,* there have been larger imports of coarser counts, especially the 16/18, 18/20, and 20/22 deniers, the latter predominating.

Japanese raw silk is numbered according to the standard denier system, which is now almost universal, the count indicating the weight in 5-centigram deniers of a 450-meter hank.

The fineness of cocoon filaments varies considerably with different silks, during different seasons, and at different portions of each cocoon.

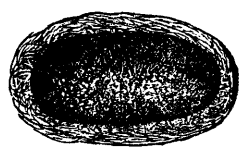
In general, CANTONS will average under 2 deniers, CHINAS (*Shanghai*) about 2¼ deniers, while JAPANS usually vary between 2¼ and 3 deniers. Some Japanese cocoon filaments, however, are found as fine as 1¾ deniers, while some run coarser than 3½ deniers. In all cases the middle portion of the cocoon filament is the thickest and heaviest portion. DOUPIONS (*double cocoons*) form some 5 to 10 per cent of the Japanese cocoons. They are kept mainly for home use. There has been a slightly larger use here of doupions in the last two years for making goods of rough appearance. The main crop of cocoons is produced in the spring with an increasing proportion in the autumn as well as a small amount in the summer.

There are no accurate figures as to the total raw-silk production of the world. The available supply in sight is compiled each year by the Union of Raw Silk Merchants of Lyon. In these figures, however, they show statistics for the raw-silk production of countries like Turkey and Persia, where it is very difficult to obtain accurate statistics, and yet for a country like Japan where the production of cocoons is published by the Government, they list only the exports. There are no accurate figures obtainable as to the total amount of raw silk produced and consumed in China, but the production in Japan has increased so rapidly in the last few decades that it is now usually estimated that Japan is the largest producer of raw silk.

As the largest producer of raw silk Japan is thereby also the largest producer of waste silk. A large proportion of this waste silk is still exported, but an increasing amount is being turned into spun silk in local factories. The largest spun-silk factories are those of the *Fuji Gasu Boseki Kaisha* at *Hodogaya,* a suburb of Yokohama, and those of the *Kanegafuchi Boseki Kaisha* at Kyoto. The larger portion of Japanese spun silk is used in Japan. Of the spun silk exported the bulk is taken by British India.

The Japanese make several special cloths. The most famous of these is *habutae.* This is made in various sections of Japan but particularly in the districts west of Tokyo, especially in *Fukui, Ishikawa,* and *Fukushima.* Neither the Fuji nor the Kanegafuchi mills make habutae. It is, however, now made most usually on power looms and its manufacture is no longer confined to hand-loom weavers. Habutae is always woven in the gray. The gum is boiled out after weaving and before selling.

Another specialty is *kaiki.* This is a changeable taffeta made with dyed yarns. It comes mainly from *Koshu* and might well be classed with other taffetas instead of being shown separately in the export statistics.



The Silk Industry of the U. S.*

Scope of the Industry.

The silk-manufacturing industry includes the manufacture of finished silk products, such as woven fabrics; braids; trimmings; sewing, embroidery, and floss silks; machine twist, etc., whether the preliminary throwing is done or not; and also the manufacture of *thrown* silk (known technically as *organzine* and *tram*) and *spun* silk.

The concerns engaged only in the manufacture of organzine and tram are known as *throwsters;* with these are included winders and manufacturers of spun-silk yarns, the former performing the work of winding or rewinding from skeins to spools, bobbins, quills, etc., or from skeins, spools, etc., of one size to those of another.

Many establishments do not include the entire process of silk manufacture in their operations, a frequent practice being for a weaving mill to buy the raw silk and have it thrown on a commission basis by an independent throwing plant. Although the establishments engaged solely in throwing, winding, etc., in 1914 formed more than one-fifth of the total number of establishments included in the industry and employed more than one-sixth of the total number of wage earners, they reported only 8.8 per cent of the total cost of materials and 8.4 per cent of the total value of products. This is due to the fact that many of the throwsters operated on a commission basis and reported no cost of materials and only the amount received for work done as value of products; the es-

*An Abstract of the 1914 Census of Manufacturers in the U. S., just published by the Dept. of Commerce, under the supervision of W. M. Stewart, Chief Statistician for Manufactures.

tablishments for which the throwing was done reported the cost of the thrown silk in their cost of materials and the amount paid for throwing as contract work, one of the items of expense.

Comparison of Censuses for Ten Years.

	1914	1909	1904
Establishments	902	852	624
Proprietors	591	664	525
Salaried employees	6,810	5,537	4,027
Wage earners	108,170	99,037	79,601
Horsepower	116,924	97,947	71,760
Capital	$210,071,679	$152,158,002	$109,556,621
Salaries	10,506,905	7,527,279	4,742,270
Wages	47,108,469	38,570,085	26,767,943
Contract work	14,550,762	12,008,744	6,859,586
Rent and taxes	2,031,897	1,570,381	1,040,334
Cost of materials	144,442,321	107,766,916	75,861,188
Value of products	254,011,257	196,911,667	133,288,072

"Rent and Taxes" for 1914 and 1909 include internal revenue, those for 1904 exclude internal revenue.

Growth of the Industry.

Statistics for the silk-manufacturing industry were first obtained at the census of 1849 when 67 establishments, employing an average of 1,723 operatives, and manufacturing products valued at $1,809,476, were reported.

At the census of 1859 there were 139 establishments, giving employment to an average of 5,435 operatives, and manufacturing products valued at $6,607,771.

The figures for 1869 include those for establishments that reported silk hose and silk knit goods as their products of chief value, while such establishments are now classified under the hosiery and knit goods industry. As the volume of business of such establishments was comparatively small at that time, this inclusion does not materially affect the comparability of the figures for the different censuses.

During the 10 years, 1904 to 1914, the number of silk mills nearly doubled; wage earners increased 65.4 per cent, value of products advanced 136.8 per cent, and value added by manufacture 144.3 per cent.

While the last censuses each mark a period of development in the industry, the greatest relative growth was from 1904 to 1909, when wage earners increased 24.4, value of products 47.7 per cent, and value added 55.2 per cent.

Location of the Industry.

With reference to "Comparison Table" previously quoted, the following details according to states will be of interest:

States	Number of Establishments	Average Number of Help	Percentage of Distribution of the Latter
Penna.	284	44,755	41.4
N. J.	368	28,263	26.1
Conn.	44	10,668	9.9
N. Y.	143	11,659	10.8
Mass.	19	4,495	4.2
R. I.	12	2,325	2.1
Va.	9	691	0.6
Md.	5	874	0.8
"Others"	18	4,440	4.1
Total:	902	108,170	100.0

States	Value of Products	Percentage of the Latter	Value Added by Manufacture	Percentage of the Latter
Penna.	$86,938,554	34.2	$38,143,073	34.8
N. J.	75,706,449	29.8	34,823,584	31.8
Conn.	30,591,825	12.0	12,185,573	11.1
N. Y.	29,260,763	11.5	12,524,542	11.4
Mass.	10,676,681	4.2	4,715,544	4.3
R. I.	7,664,472	3.0	2,337,878	2.1
Va.	1,772,931	0.7	679,079	0.6
Md.	910,882	0.4	487,367	0.4
"Others"	10,488,700	4.1	3,672,296	3.4
Total:	$254,011,257	100.0	$109,568,936	100.0

"Others" cover: California, Delaware, Georgia, Maine, Ohio, West Virginia and Wisconsin, each state 1. Michigan and New Hampshire each 2. Illinois 3 and North Carolina 4.

From this table thus quoted it will be seen that the silk-manufacturing industry is confined to 19 states, all of which, except California, where there was only one establishment, are located east of the Mississippi River.

The industry in the southern states is represented by 21 establishments located in Maryland, Delaware, West Virginia, Virginia, North Carolina, and Georgia.

Pennsylvania is the leading state in the industry, the value of its product being more than one-third of the total silk manufactures in the United States in 1914, and the number of wage earners employed in the silk mills of the state representing more than two-fifths of the entire number employed in the 19 states reporting. More wage earners have been employed in silk manufacture in Pennsylvania at each of the last three censuses than in any other state, and in 1914 the number employed formed a relatively larger proportion of the total for the industry than did its value of products or value added by manufacture. This is due to the fact that many establishments in Pennsylvania are engaged in throwing raw silk into organzine and tram for further processes of manufacture outside the state, and since such establishments confine their operations largely to contract work, their value of products does not include the value of the organzine and tram produced, but consists mainly of the amount received for work done. Prior to 1914, New Jersey was for many years the ranking state in the value of silk products, but employed fewer wage earners than Pennsylvania both in 1909 and 1904.

The industry is concentrated in a much smaller area in New Jersey than in any other state; 79.1 per cent of the establishments in this state were located within the city limits of Paterson, these establishments reporting 59 per cent of the total value of products of the state. Most of the remaining establishments in New Jersey were located in Passaic County, in which the city of Paterson is situated, or in the counties immediately adjoining.

In Pennsylvania the industry is chiefly concentrated in the eastern half of the state, in the mill towns on the Susquehanna, Schuylkill, and Lehigh Rivers.

New Jersey and Pennsylvania together reported about two-thirds of the total number of wage earners and total value of products for the industry in 1914.

New York ranked third in number of wage earners and fourth in value of products in 1914, and third in each respect in 1909, 1904, and 1899.

Rhode Island, while not an important state in the industry, as measured by value of products, shows the largest percentages of increase from 1904 to 1914 of any of the states.

The counties in New York, New Jersey and Pennsylvania, having more than 10 establishments, together with number of establishments in each county are:

New York:	
Greater New York	94
New Jersey:	
Hudson County	31
Passaic County	306
Pennsylvania:	
Philadelphia	32
Northampton County	23
Lehigh County	39
Berks County	11
Carbon County	11
Lackawanna County	41
Luzerne County	30

The industry was largely centralized in a few cities.

Persons Engaged in the Industry.

The aggregate number of persons engaged in the silk-manufacturing industry in 1914 was 115,571, an increase of 10,333, or 9.8 per cent over 1909. Of the different classes of employees, wage earners represented 93.6 per cent, clerks and other salaried employees 4.4 per cent, and proprietors and officials 2 per cent. Each of these classes shows an increase over 1909 and their proportion of the total persons employed differs only slightly from that of the previous census.

More than half of the silk mills of the country are located in Paterson, N. J.; New York, N. Y.; Philadelphia, Pa.; Allentown, Pa. and Scranton, Pa. The combined production of these cities in 1914 was valued at $83,882,625, or one-third of the total amount reported for the industry. This figure represents an increase of 58.6 per cent during the decade, but a decrease of 6.6 per cent in the proportion of the total output contributed by the five cities in 1914, as compared with 1904. The value of Paterson's production at the last two censuses was greater than that of the other cities combined.

The number of females engaged in the industry in 1914 was considerably in excess of the number of males, the proportion which the two sexes formed of the total being 56.8 per cent and 43.2 per cent, respectively. Relatively fewer women were employed in 1914 than in 1909, however, when they represented 59.9 per cent of the total. Of the total wage earners employed in 1914, 59.2 per cent were females, as compared with 62.6 per cent in 1909.

Wage Earners.

Female wage earners were reported from all the states in which the industry was carried on, and in every state except Connecticut exceeded the males in number. The largest number, 29,288, or 46.4 per cent of the total for the industry in the United States, was reported for Pennsylvania, and the next largest number, 14,623, for New Jersey. The four leading states, as measured by value of products, New Jersey, Pennsylvania, New York, and Connecticut, together employed 54,834 female wage earners, or almost seven-eighths (86.9 per cent) of the total number for the United States. Wage earners under 16 years of age were reported by 16 states; the largest number, 5,519, were in Pennsylvania, in which state they represented 12.5 per cent of the total number of wage earners in the industry. The proportion of children employed was highest in Maryland, where they represented 22.1 per cent of the total number of wage earners in the industry, and lowest in New Jersey, where they constituted only 2.1 per cent.

Among spinners, females greatly outnumbered the males, the ratio being about two and one-half to one

in 1914 and the proportion only slightly less than in 1909. Among the weavers the males were in excess in 1914 by 2,300. A majority of the weavers making broad silks, however, were females.

The relative number of spinners and weavers varied considerably in the different states. In only one of the five states (New Jersey) did the number of weavers exceed the number of spinners. In Pennsylvania, 56.5 per cent of the wage earners were spinners, while in Connecticut such operators constituted only 28.9 per cent of the total. Of the total male wage earners 16 years of age or over in 1914, almost one-half (49.2 per cent) were weavers and about one-third (31.9 per cent) spinners, the proportion of weavers having decreased somewhat during the five-year period 1909-1914, while the proportion of spinners increased slightly.

In the case of women wage earners, the proportions are practically reversed, about one-third (30.8 per cent) of the total number being weavers and more than one-half (57.9 per cent) spinners; the proportion of weavers decreased and that of spinners increased during the five-year period. More than three-fourths (79.6 per cent) of the children employed as wage earners were spinners.

The silk industry is not, to any appreciable extent, subject to seasonal variations; the spring and early summer months of 1914 show the heaviest enrollment of labor for that year, as a result of market conditions.

The smallest number (100,045) of wage earners employed during any month was reported for December, and the largest number (112,761) for May, the minimum number being equal to 88.7 per cent of the maximum. In 1909 the maximum number of wage earners, 100,753, was reported for March, and the minimum number 96,534, for July, the latter number being equal to 95.8 per cent of the former, while in 1904 the minimum number, 76,587, reported for January, was 92.6 per cent of the maximum, 82,724, in December.

Size of Establishments.

The tendency of the industry to become concentrated in large establishments is shown by the statistics given in the accompanying table, covering census 1909 and 1914, the last two taken:

VALUE OF PRODUCT.	Census year.	No. of establishments.	Average number of wage earners.	Value of products.	Value added by manufacture.
Less than $5,000...	1914	46	167	133,454	103,894
	1909	45	242	113,378	69,038
$5,000 to $20,000..	1914	122	2,073	1,627,286	1,131,234
	1909	130	1,930	1,511,784	1,018,282
$20,000 to $100,000.	1914	305	13,527	15,739,554	8,146,471
	1909	298	14,713	15,328,061	8,838,024
$100,000 to $1,000,000	1914	368	51,131	118,210,811	52,077,901
	1909	342	53,582	111,378,638	51,651,501
$1,000,000 and over.	1914	61	41,272	118,300,152	48,109,436
	1909	37	28,570	68,579,806	27,567,906
All classes.....	1914	902	108,170	$254,011,257	$109,568,936
	1909	852	99,037	196,911,667	89,144,751

Although establishments with products valued at $100,000 to $1,000,000 formed the most important class numerically in 1914, and employed the greatest number of wage earners, in value of production, such establishments were surpassed by those with products valued at $1,000,000 and over.

The average value of products per establishment increased from $231,117 in 1909 to $281,609 in 1914 and the average value added by manufacture from $104,630 in 1909 to $121,473 in 1914. The average number of wage earners per establishment, on the other hand, shows but a slight increase—from 116 in 1909 to 120 in 1914.

The large mills (those employing over 500 wage earners) increased from 28 in 1909 to 34 in 1914, and the wage earners employed in these establishments increased by 6,697 or 25.7 per cent. Nearly one-third of the total wage earners employed in the silk mills in 1914 were in establishments of this size, compared with about one-fourth in 1909. The number employed in establishments having between 101 and 500 wage earners in 1914 was 52,059, or nearly one-half of the

total, though such establishments represented but 26.7 per cent of the entire number. This class, however, shows a very slight decrease since 1909 both in number of establishments and in wage earners. The class employing 100 wage earners or less reported the largest number of establishments (625) but employed only 21.6 per cent of all the wage earners. This group showed an increase of 15.9 per cent in wage earners and of 8.1 per cent in number of establishments. There were two establishments in 1914 that employed no wage earners. These were both small plants in which all the work was done by the proprietors.

The large silk mills were distributed throughout a number of states, but the greatest number were located in New Jersey and Pennsylvania.

Summary of the Two Branches of the Industry.

The silk industry is divided into two branches, *viz:* (*a*) mills engaged in the manufacture of finished silk products, and (*b*) those engaged in making partially finished products. The latter branch is composed mostly of throwsters, but includes some winders and manufacturers of spun silk.

Concerns making partially finished products use (to a considerable extent) only two materials *viz:* raw silk, and silk waste, such as frisons, floss, noils, etc. The use of the former was confined to throwsters which produced organzine and tram for sale. The five concerns which manufactured spun silk for sale used all the frisons, floss, noils, etc., reported for this branch of the industry.

One-eighth of the total amount of raw silk used in the industry in 1914, and considerably more than one-half of the frisons, floss, noils, etc., were reported by concerns engaged in throwing, winding, etc. Larger amounts of each of these materials were reported by this branch of the industry in 1914 than in 1909. Of the additional materials shown separately in the accompanying table on "Materials Used in the Industry," almost all were used by concerns making finished products, the cost of all these other materials reported by concerns engaged in throwing, winding, etc., being only $338,383.

Considerably more than half (57 per cent) of the spun silk made for sale in the industry was reported by the five concerns engaged exclusively in the manufacture of this product. The remainder of the spun silk reported for the industry (690,821 pounds) was made by concerns which were engaged primarily in the production of broad silks, ribbons, etc. A few throwsters engaged in the manufacture for sale of organzine and tram, produced as secondary products, machine twist, sewing and embroidery silks, and fringe and floss, to the value of $160,816.

Materials Used in the Industry.

	1914	1909	1904
SILK:			
Raw—			
Pounds	22,374,700	17,472,204	11,572,783
Cost	$86,416,857	$67,787,037	$45,318,416
Spun—			
Pounds	3,209,309	2,112,972	1,951,201
Cost	$8,094,427	$4,848,789	$4,310,061
Artificial—			
Pounds	1,902,974	914,494	466,151
Cost	$3,440,154	$1,926,894	$1,623,473
Organzine and tram purchased—			
Pounds	3,855,899	3,377,972	3,236,744
Cost	$16,703,096	$14,679,719	$14,552,425
Frison, floss, noils and other waste purchased—			
Pounds	4,328,536	2,402,960	*49,811
Cost	$3,066,297	$1,637,187	*$187,159
YARNS, OTHER THAN SILK:			
Cotton—			
Pounds	16,869,511	12,617,292	8,387,048
Cost	$6,163,240	$4,687,173	$2,586,954
Mercerized cotton—			
Pounds	1,464,299	1,494,586	631,247
Cost	$1,078,337	$1,124,409	$471,035
Woolen or worsted—			
Pounds	1,987,918	610,588	443,155
Cost	$2,087,804	$765,989	$409,867
Mohair—			
Pounds	2,645,055	710,108	138,389
Cost	$1,604,362	$640,529	$137,097
All other—			
Pounds	291,672	353,780	130,930
Cost	$438,944	$456,597	$108,841
ALL OTHER MATERIALS	$15,348,803	$9,212,593	$6,155,860
Total cost	$144,442,321	$107,766,916	$75,861,188

* Does not include waste, noils, etc., which were included with "all other materials" in 1904.

Attention is called to the fact that the statistics for raw silk shown in this table do not represent the total amount of this material used in the industry. More than two-thirds of the raw silk used was thrown on contract, either for silk merchants, or for weaving mills, but as this silk was not owned by the mills doing the throwing, its amount and value were not included by them in their report as to materials used. The silk thrown for the weaving mills, however, formed part of the materials reported by such mills and accordingly is included in the table, but that thrown for merchants and dealers, not being owned by the silk-manufacturing concerns, was not reported and so is not included in the statistics for the industry; consequently it is impossible to give the amount of silk so thrown, but the quantity must have been considerable. Silk thrown for merchants and later sold by them as organzine and tram to establishments within the silk industry does not figure in the statistics of materials as a raw silk, but as organzine or tram only.

The tendency toward the manufacture of silk-mixed goods is shown by the relatively large increase in the amount of yarns, other than silk, used during the decade as compared with the increase in the amount of silk used. The amount of cotton yarn used in 1914 was more than twice as great as in 1904, and even greater relative increases are shown for mohair and for woolen or worsted yarns.

The amount of purchased spun-silk yarn used shows a relatively smaller increase during the decade than any other material shown separately in the last table given, except organzine and tram. The quantity used exceeded the quantity reported as made for sale by 1,601,893 pounds in 1914, 1,333,510 pounds in 1909 and 1,380,672 pounds in 1904. A large part of this material is imported, the total quantity brought into the country during the year ending December 31, 1914, being 2,490,655 pounds.

Spun-silk yarn is used principally in the manufacture of velvets, plushes, and other pile fabrics, and also in silk-mixed goods; large quantities are also used in cotton and wool manufactures and in the manufacture of hosiery and knit goods. The spun-silk yarn manufactured in the United States is made chiefly from reelers' waste, that is, from pierced cocoons, filature waste, and frisons—while a comparatively small amount comes from the waste of throwing and winding. Reelers' waste is not a worked-over material, like wool shoddy, but is a sound new fibre, superior to the throwsters' waste.

Owing to the high price of silk and to its limited supply, great efforts have been made to secure satisfactory substitutes. As a result, a number of processes have been invented for making fibres closely resembling animal silk, resulting in the production of artificial silk, the manufacture of which is largely confined to Germany and France, although other countries have mills devoted to its manufacture. The production of artificial silk in the United States was reported in 1914 by only one establishment, but American silk mills used twice as much artificial silk in 1914 as in 1909 and four times as much as in 1904.

Consumption of Silk in all Textile Industries.

In addition to the silk used in the silk-manufacturing industry, considerable amounts are used in other textile industries in the manufacture of mixed goods and silk hosiery and other knit goods. Silk is also used to some extent in the electrical industry for covering wire, but data in regard to its consumption are not available.

The quantity of silk yarn used in other textile industries in 1909 was more than three times as large as in 1899, but increased very little from 1909 to 1914.

The amounts used in the manufacture of hosiery and knit goods show a very large increase during the fifteen year period; the quantity used in wool manufactures more than doubled.

In cotton manufactures, silk is used largely in the manufacture of fancy woven fabrics with silk stripes or figures, and also in cotton-backed satins, and in plain and printed fabrics with cotton warps and silk filling.

The increase shown for the hosiery and knit-goods industry is accounted for by the marked increase in the production of silk hosiery, *viz:* 12,572 dozen pairs in 1899, 42,065 dozen pairs in 1904, 434,414 dozen pairs in 1909, and 2,354,648 dozen pairs in 1914.

Raw Silk Thrown Under Contract.

Formerly the throwing of raw silk in the United States was carried on chiefly in establishments which used the organzine and tram in further processes of manufacture, but there is a growing practice among weaving mills of having the silk thrown under contract in establishments whose activities are limited to this work.

The total amount of raw silk thrown under contract in 1914 was equal to 62 per cent of the total amount used in the industry, the corresponding ratio for 1909 being 73 per cent and that for 1904, 61.4 per cent.

While these percentages do not show the proportion of the total amount of raw silk used within the industry which was thrown under contract in the respective years, owing to the fact that the silk reported as thrown under contract includes that thrown for merchants and others not in the silk manufacturing industry, they are sufficiently close to give a general idea of the relative extent of commission throwing and of increase in the relative importance of such throwing during the 15 years.

The quantity of silk thrown under contract more than trebled during the period 1899-1914. Pennsylvania has reported more silk thrown on commission at each of the last four censuses, than all of the rest of the United States combined, and is moreover, doing an increasingly greater proportion of this kind of work; mills in this state reported 70.3 per cent of the total silk thrown on commission in 1914, 60.6 per cent in 1909, 58 per cent in 1904, and 52.6 per cent in 1899.

Imports.

Silk mills depend upon imports for their raw silk material. The accompanying table shows the quantity and value of imports of raw silk, spun silk, raw silk waste, and artificial silk for each fiscal year from 1904 to 1914, inclusive.

Imported Silk Materials.[1]

Year Ending June 30.	Raw Silk.	Spun Silk.	Raw-silk Waste.	Artificial Silk.
	Quantity. (Pounds).			
1914	28,594,672	3,093,336	5,951,157	2,759,306
1913	26,049,472	3,582,268	6,052,083	1,942,177
1912	21,609,520	3,243,657	4,975,442	1,457,544
1911	22,379,998	3,245,582	4,286,093	[2]1,947,423
1910	20,363,327	3,235,369	3,093,896	([3])
1909	23,333,750	2,343,576	1,854,207	([3])
1908	15,424,041	2,140,848	1,238,091	([3])
1907	16,722,207	2,479,364	2,021,697	([3])
1906	14,505,324	2,257,260	2,846,697	([3])
1905	17,812,133	2,352,406	4,545,174	([3])
1904	12,630,883	2,053,274	4,091,826	([3])
	Value Expressed in Dollars.			
1914	$97,828,243	$5,752,463	$3,101,782	$3,461,039
1913	82,147,523	6,383,872	2,767,194	2,385,350
1912	67,173,382	5,663,691	2,368,290	1,757,989
1911	72,713,984	5,708,804	2,284,281	[2]3,279,559
1910	65,424,784	5,064,111	1,704,819	([3])
1909	78,830,568	3,583,857	1,073,018	([3])
1908	63,665,534	3,702,232	881,369	([3])
1907	70,229,518	3,775,744	1,182,381	([3])
1906	52,855,611	3,227,920	1,224,893	([3])
1905	59,542,892	3,287,642	1,497,161	([3])
1904	44,461,564	3,047,817	1,638,936	([3])

[1] Bureau of Foreign and Domestic Commerce.
[2] Includes also manufactures of artificial silk.
[3] Prior to 1911 included with silk.

Summary of Products.

The total production of silk goods of broad weave (broad silks, velvets, plushes, tapestries, and upholstery) in 1914 was 241,944,522 running yards valued at $157,265,554, as compared with 198,787,027 running yards valued at $115,136,724 in 1909. Broad silks formed nine-tenths of all broad weaves in 1914 and 1909. All-silk goods constituted almost two-thirds of the broad-silk product in 1914, but the production of such goods did not increase as rapidly during the decade as did the production of silk-mixed broad silks.

The production of velvets more than doubled during the decade, but there was even a more marked increase in that of plushes. The production of tapestries and upholstery decreased, all of the decrease taking place during the earlier part of the decade.

Narrow woven fabrics, such as ribbons, are of such varied widths that statistics of output in yards would have little significance.

Figures for organzine and tram made for sale fall short of representing the total production of organzine and tram other than for the use of the establishment doing throwing, owing to the fact that they do not include the large amount of organzine and tram thrown under contract for establishments furnishing the raw silk. A total of 12,869,239 pounds of raw silk was thrown under contract in 1914.

"All other products" for which the value was separately reported in 1914, includes a variety of commodities, some of which may have been included at previous censuses among those for which separate quantities and values were shown. Silk hosiery and knit goods were not separately called for in the schedule used in 1899, 1904, 1909, and 1914. Hence the figures given for silk hosiery under "all other products" may not cover the entire production in silk mills. The various items comprising this total for 1914, in so far as they can be segregated, were as follows:

Articles Included in "All Other Products."	Value.
Trimmings, cords, tassels, ornaments, etc., other than military and tailors' trimmings	$1,674,399
Mufflers and handkerchiefs	76,477
Cravats and tubular neckties	747,508
Fabrics (in the gray)	3,453,744
Labels	971,789
Hatbands	607,204
Fishlines	177,150
Miscellaneous products, other than silk (cotton and woolen yarn, cotton fabrics, etc.)	2,405,604
Silk hosiery and knitted fabrics	1,013,565
Raw silk, skein-dyed	229,415
Miscellaneous, unclassified silk products and waste	2,400,917
Total	$13,757,772

Silk goods to the value of $47,460,109 were manufactured as subsidiary products by establishments assigned to industries other than the silk-manufacturing industry proper.

The accompanying table shows for 1914, the value of the total production of silk goods manufactured in the industry designated "silk manufactures" and by establishments engaged primarily in the manufacture of other products.

Product.	Production in Silk Mills.	Production in Other Industries.
Broad silks:		
Finished	137,719,564	218,156
In the gray	3,141,765	488,040
Plushes	10,135,842	3,750
Ribbons	38,201,293	8,264
Braids and bindings	3,073,648	52,745
Trimmings	642,163	7,293
Fringes and gimps	1,025,188	76,463
Spun silk	4,577,058	666,953
Sewing silk	5,046,452	84,774
Machine twist	4,036,807	126,619
Shirts and drawers	....	1,528,048
Combination suits	....	6,592,350
Hosiery	179,014	29,792,681
Gloves and mittens	....	4,683,479
Jersey cloth and stockinettes	....	2,738,932
Other knit goods	834,551	357,959
All other	45,397,912	43,603
Total value	$254,011,257	$47,460,109

The total value of products reported for the silk-manufacturing industry proper in 1914 includes $20,600,986, representing the value of organzine, tram, and spun silk, a large part of which was sold to other

silk-manufacturing establishments for use as material in the manufacture of silk goods, $8,400,607, constituting the amount received for contract work by silk mills, which involves a very large amount of duplication, and $2,405,604, representing the value of products other than silk manufactures, so far as these were separately returned. The subtraction of these figures from the total value of products for the industry leaves a remainder of $222,604,060, which represents approximately the value of the finished silk goods made in the industry, although it may include the value of some products other than silk goods which were not specifically reported. On the other hand, silk and silk-mixed hosiery and underwear to the value of $37,913,079 were reported by establishments in the hosiery and knit-goods industry, $1,079,249 of this amount being reported by mills using silk materials exclusively. In addition, knitting mills using silk exclusively as a material reported other silk products such as gloves, jersey cloth and stockinette, etc., to the value of $7,770,370, while other silk manufactures to the value of $1,776,660, were reported by establishments engaged primarily in the manufacture of other products. It is probable that these latter two figures do not represent the total production of silk manufactures outside the silk-manufacturing industry, as some establishments making these products may not have reported them separately. Combining the three figures just given with that previously given as representing the approximate value of finished silk goods made by establishments in the silk-manufacturing industry proper, a total of $270,064,169 is obtained, which represents approximately the total value of finished silk goods manufactured in 1914.

The leading product reported by establishments not in the silk industry, is silk hosiery, the value of which in 1914 constituted about two-thirds of the total production of silk manufactures of such establishments. As shown by table given last the total value of silk hosiery manufactured in 1914 was $29,971,695, of which amount less than 1 per cent represented the value of hosiery made in silk mills.

Products, by States.

Pennsylvania is the leading state in the production of each kind of broad silks, except yarn-dyed silk-mixed goods, in the production of which the state ranked second to New Jersey. Pennsylvania produces the largest amount of organzine and tram made for sale, much of which was sold to establishments in other states. More than four-fifths of the total value of ribbons made in the United States come from New Jersey and Pennsylvania. The production of laces, nets, veils, etc., is practically confined to New York and New Jersey. New York also produces nearly two-thirds of the total value of fringes and gimps and more than three-fifths of the value of braids and bindings. Connecticut furnishes almost the entire output of velvet, and more than one-half of the plushes, and also leads in the production of machine twist and of sewing and embroidery silks, as well as in that of spun-silk yarn.

Silk Looms

in operation in 1914.

Broad, inc. Velvets	73,504
Ribbons	11,554
Total	85,058

These looms were operated in the following states:

	Broad		Ribbon		Total
Connecticut:	5,213	+	323	=	5,536
Massachusetts.	3,267	+	12	=	3,279
New Jersey:	23,049	+	4,732	=	27,781
New York:	5,981	+	1,881	=	7,862
Pennsylvania:	29,302	+	4,392	=	33,694
Rhode Island:	3,045	+	.....	=	3,045
Other States:	3,647	+	214	=	3,861
	73,504	+	11,554	=	85,058

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Technology of Textile Design

A Practical Treatise on the Construction and Application of Weaves for all Kinds of Textile Fabrics, Giving Also Full Particulars as to the Analysis of Cloth

By E. A. POSSELT

Editor of Posselt's Textile Journal

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ABSTRACT OF CONTENTS:

DIVISION OF TEXTILE FABRICS ACCORDING TO THEIR CONSTRUCTION. SQUARED DESIGNING PAPER.

FOUNDATION WEAVES: PLAIN. TWILLS. SATINS.

DRAWING-IN DRAFTS.

DERIVATIVE WEAVES: RIB WEAVES. BASKET WEAVES. BROKEN TWILLS. STEEP TWILLS. RECLINING TWILLS. CURVED TWILLS. COMBINATION TWILLS. CORKSCREWS. ENTWINING TWILLS. DOUBLE TWILLS. CHECKERBOARD TWILLS. FANCY TWILLS. POINTED TWILLS. DOUBLE SATINS. GRANITES. COMBINATION WEAVES. COLOR EFFECTS.

SPECIAL SINGLE CLOTH WEAVES: HONEYCOMB WEAVES. IMITATION GAUZE WEAVES. ONE SYSTEM WARP AND TWO SYSTEMS FILLING. SWIVEL WEAVING. TWO SYSTEMS WARP AND ONE SYSTEM FILLING. LAPPET WEAVING. TRICOTS.

DOUBLE AND MORE PLY CLOTH: REGULAR DOUBLE CLOTH. WORSTED COATINGS. MATELASSES. QUILTS. RIB FABRICS. THREE, FOUR, ETC., PLY FABRICS.

PILE FABRICS: VELVETEENS. FUSTIANS. CORDUROYS. CHINCHILLAS. CHENILLE. FRINGES. VELVETS. PLUSHES. TAPESTRY CARPETS. BRUSSEL'S CARPETS. DOUBLE FACED CARPETS. DOUBLE PILE FABRICS. TERRY PILE FABRICS. SMYRNA CARPETS AND RUGS. IMITATION TURKEY CARPETS.

TWO PLY INGRAIN CARPETS. GAUZE FABRICS. THE JACQUARD MACHINE. GOBELIN TAPESTRY. ANALYSIS OF TEXTILE FABRICS.

NOVELTIES IN DESIGNING: DESIGNING WEAVES BY FOUR CHANGES. SHADED FABRICS. SOLEIL WEAVES. CHECK PATTERNS. CRAPE WEAVES. HUCK PATTERNS. WOVEN TUCKS. CRIMP STRIPES BEDFORD CORDS. CROCODILE CLOTH. LARGE DIAGONALS. TO INCREASE THE THICKNESS OF A FABRIC WITHOUT SPECIAL BACKING THREADS. BRACKET WEAVES. FRINGES. PEARL EDGES.

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BRACKET WEAVES.

Under this name we classify weaves in which the body of the fabric is enclosed, on face and back, by a special system of threads.

We may arrange this special system of threads to enclose the body of the fabric either warp or filling ways or in both directions; that means that said body structure may be covered on both sides of the fabric either by a special warp, or by a special filling, or by means of a special warp and filling.

Bracket Weaves Constructed with Two Systems Warp and One System Filling.

A. Arrangement 1 @ 1.

For explaining the subject the accompanying illustration, Fig. 1472, has been given, and which shows the section of the fabric enclosed by means of a special warp. Letters of reference in our illustration indicate thus: *C*, the interior-warp; *i*, the filling; *S* indicates the exterior warp for enclosing (bracketing-in) the body structure.

Fig. 1472.

Fig. 1473.

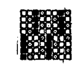

Fig. 1474.

This diagram will indicate at once to the student that for such weaves he must use frequently interlacing weaves (tight interlacing) for the body structure, whereas for the exterior warp (the bracket warp) large floating effects are required. For body structure we generally use the plain weave.

Fig. 1473 shows us the common $\frac{4}{4}$ rib weave warp effect. In weave Fig. 1474 we see said rib weave placed on every alternate warp thread only, on every uneven warp thread in the weave (see ■ type), whereas the even-numbered warp threads, 2–4–6–8, are arranged (see □) to interlace in the plain weave. The floating warp threads of the $\frac{4}{4}$ rib weave will, in weaving, arrange themselves so as to cover face and back of the fabric and hide the plain weaving structure.

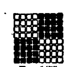

Fig. 1475.

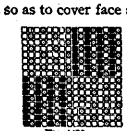

Fig. 1476.

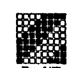

Fig. 1477.

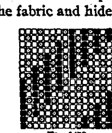

Fig. 1478.

Fig. 1479.

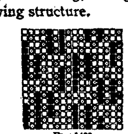

Fig. 1480.

A further example of this system of weaving is shown by means of weaves Figs. 1475 and 1476. Weave Fig. 1475 shows us the common 4 by 4 basket; whereas 1476 shows us said basket arranged for a bracket weave, *i. e.*, every uneven-number warp thread in the new weave interlaces for floating on face and back of the body structure, which in this instance is formed by means of having every even-numbered warp thread in the new weave interlace on common plain.

On account of the plain weaving part of the fabric, the floating threads which have to produce the basket effects on the face and back of the fabric will push apart. If for this reason we would not use an extra high warp texture, the result would be that the basket effect would not appear symmetrical on both sides of cloth, *i. e.*, the squares, as clearly seen by Fig. 1475, would get elongated in the direction of the filling, for this reason the basket weave (in the bracket weave) has been arranged for double its length in the complete weave; and if producing a fabric according to weave 1476, the face and back of the fabric will clearly resemble the common single cloth, weave Fig. 1475. Further examples are shown by means of weaves Figs. 1477 to 1480. The

Textile Calculations

A Complete Guide to Calculations Relating to the Construction of all Kinds of Yarns and Fabrics, the Analysis of Cloth, Speed, Power and Belt Calculations.

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ABSTRACT OF THE CONTENTS

YARN AND CLOTH CALCULATIONS

Grading of the Various Yarns Used in the Manufacture of Textile Fabrics According to Size or Counts. To Find the Equivalent Counts of a Given Thread in Another System. To Ascertain the Counts of Twisted Threads Composed of Different Materials. To Ascertain the Counts for a Minor Thread to Produce, with Other Given Minor Threads, Two, Three or More Ply Yarn of a Given Count. To Ascertain the Amount of Material Required for Each Minor Thread in Laying out Lots for Two, Three or More Ply Yarn. To Ascertain the Cost of Two, Three or More Ply Yarn. To Find the Mean or Average Value of Yarns of Mixed Stocks. Reed Calculations. Warp Calculations. Filling Calculations. To Ascertain the Amount and Cost of the Materials Used in the Construction of All Kinds of Plain and Fancy Cotton and Woolen Fabrics.

STRUCTURE OF TEXTILE FABRICS

The Purpose of Wear that the Fabric will be Subject to. The Nature of Raw Materials. Counts of Yarn Required to Produce a Perfect Structure of Cloth. To Find the Diameter of a Thread by Means of a Given Diameter of Another Count of Yarn. To Find the Counts of Yarn Required for a Given Warp Texture by Means of a Known Warp Texture with the Respective Counts of the Yarn Given. Influence of the Twist of Yarns upon the Texture of a Cloth. To Find the Amount of Twist Required for a Yarn if the Counts and Twists of a Yarn of the Same System, but of Different Counts, are Known. Influence of the Weave upon the Texture of a Fabric. To find the Texture of a Cloth. To Change the Texture for Given Counts of Yarn from one Weave to Another. To Change the Weight of a Fabric without Influencing its General Appearance. To Find Number of Ends Per Inch in Required Cloth. Weaves Which will Work with the Same Texture as the two and two Twill. Weaves which will Work with the Same Texture as the three and three, four and four, etc., Twill. Selections of the Proper Texture for Fabrics Interlaced with Satin Weaves. Rib Weaves. Corkscrew Weaves. Two Systems Filling and One System Warp. Two Systems Warp and One System Filling. Two Systems Warp and Two Systems Filling.

ANALYSIS

How to Ascertain the Raw Materials Used in the Construction of Textile Fabrics. Microscopical Appearance of Fibres. Tests for Ascertaining the Raw Materials Used in the Construction of Yarns or Fabrics. How to Ascertain the Percentage of Each Material Constituting the Fabric. How to Test the Soundness of Fibres or Yarns. How to Test Given Counts of Yarn. How to Ascertain the Weight of Cloth. How to Calculate the Weight. How to test and Analyze the Various Finishes. Cotton Spinning.

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TO FIND THE TEXTURE OF A CLOTH USE–

Rule. – Multiply the number of threads of a given count of yarn that will lie side by side in one inch by the threads in one repeat of the pattern, and divide the product by the number of threads in repeat, plus the corresponding number of interlacings of both systems of threads found in one repeat of the weave.

By the number of interlacings of a weave we understand the number of changes from riser to sinkers, and *vice versa*, for each individual thread in each system.

Examples. – Fig. 10 represents one pick of the common twill known as [illegible] and shown in one full repeat in Fig. 11. Diagram Fig. 12 illustrates the corresponding section to pick 1 shown in Fig. 10. The full black spots represent one repeat, whereas the commencement of the second repeat is shown in dotted lines. A careful examination of both diagrams, Figs. 10 and 12, will readily illustrate to the student the number of interlacings in one repeat (6), as indicated by corresponding numbers below diagram Fig. 12. Thus, in order to find the number of warp threads of a given count per inch for a cloth made with this weave, we must multiply the number of diameters of threads that will lie side by side with 10 (being one complete repeat of the weave) and divide the product thus derived by 16 (10 plus 6, or repeat plus number of interlacings). The result will be the required number of warp threads per inch. If given illustrations would refer to a 32-cut woolen yarn, we find answer as follows:

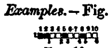
FIG. 10.

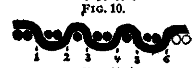

FIG. 12.

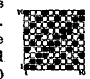
FIG. 11.

32-cut yarn = 9,600 yards per lb.

32-cut yarn = 82.2 threads will lie side by side.

Thus: $82.2 \times 10 = 822 \div 16 = 51\frac{1}{2}$, or

51 warp threads per inch (or actually $51\frac{1}{2}$ per inch, or 103 threads for every two inches of 32-cut woolen yarn will be the proper number to use. In diagram Fig. 13 we illustrate a pick of another 10-harness twill weave. Fig. 14 represents the corresponding section, and Fig. 15 one complete repeat of the weave.

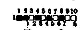
FIG. 13

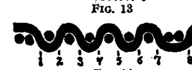

FIG. 14.

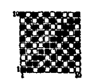
FIG. 15.

All three diagrams show 8 points of interlacings for each thread in one repeat; hence, if applying counts of yarn from previously given example for this case we find:

32-cut yarn = 82.2 threads will lie side by side. Thus: $82.2 \times 10 = 822 + 18 = 45\frac{2}{3}$, or 46 warp threads per inch (actually $45\frac{2}{3}$) of 32-cut woolen yarn are the proper number of threads if using the [illegible] 10-harness twill.

Answers.—For both given examples are as follows:

Warp yarn used 32-cut woolen yarn.

[illegible] 10-harness twill = 6 interlacings = $51\frac{1}{2}$ warp threads per inch.
[illegible] 10- " " = 8 " = $45\frac{2}{3}$ " " "

A careful examination and recalculation of these two examples will readily illustrate to any student the entire modus operandi.

Example.—Find number of threads for warp for a fancy worsted suiting, to be interlaced with the 6-harness [illegible] twill (see Fig. 16) and made of 2/32's worsted yarn. (Fig. 17 illustrates number 1 pick separated and Fig. 18 its corresponding section.)

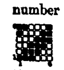
FIG. 16.

$2/32 = 1/16 = 16 \times 560 = 8{,}960$ yards per lb.

$\sqrt{8{,}960}$ less 10 per cent. = 85 threads of 2/32's worsted yarn will lie side by side in one inch. And

FIG 18

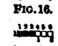
FIG. 17.

$$\left\{\begin{matrix}\text{Diameters}\\ \text{per inch.}\end{matrix}\right\} \times \left\{\begin{matrix}\text{Repeat of}\\ \text{weave.}\end{matrix}\right\} \quad \left\{\begin{matrix}\text{Repeat of}\\ \text{weave.}\end{matrix}\right\} + \left\{\begin{matrix}\text{Interlacings}\\ \text{in repeat.}\end{matrix}\right\}$$

$$85 \times 6 = 510 \div 8 \quad (6 + 2) = 64$$

Wool, Cotton, Silk

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Editor of Posselt's Textile Journal

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Specimen Page of "Wool, Cotton, Silk from Fibre to Finished Fabric."
(Reduced in Size)

44

caustic potash, then wash it well and re-dry it. During boiling add from time to time a few drops of water so as to prevent the alkali from becoming too concentrated. After drying at 212° F. the residue is weighed, the result giving the weight of cotton, and the loss, that of wool. Instead of potash, 7° B. caustic soda may be used, boiling being in this case restricted to a quarter of an hour

To Separate Wool from Cotton, remove any size or dye by boiling the sample in dilute hydrochloric acid, dilute lye, or by extraction with alcohol, ether, etc., and dried at 212° F., and placed in four parts of sulphuric acid and one part of water for twelve hours, then mixed with three volumes of absolute alcohol and water and filtered. The residue is washed in absolute alcohol until the washings are colorless, and afterwards with water, being finally dried and weighed to ascertain the weight of wool present.

Another method is thus: After freeing the sample from dye and sizing as before, and washing, the same is dried and weighed, and then immersed in ammoniacal copper oxide for twenty minutes, after which water is added. The residue left after filtration is thoroughly washed, dried and weighed, the result giving the amount of wool in the mixture.

To Separate Silk, Cotton and Wool in a sample containing these three fibres, remove the size and dye, as previously explained, and in turn treat the sample with ammoniacal nickel oxide, which dissolves the silk at once. The cotton in turn is then dissolved from the remaining portion of the sample by means of ammoniacal copper oxide, leaving the wool behind.

To ascertain the percentage of each in a sample composed of Silk, Cotton and Wool, two samples of yarn, each weighing 2 grams, are dried, weighed and boiled for a quarter to half an hour, in 200 c.c. of 3° B. hydrochloric acid, to remove the size and dye, and are then thoroughly washed and pressed. One sample is then immersed for a short time in a boiling solution of basic zinc chloride, then washed thoroughly, first in acidified, afterwards in clean water, then dried and weighed, the difference in weight giving the amount of silk. The second sample is then boiled for fifteen minutes in 60 to 80 c.c. of caustic soda (sp. gr. 1.02), and then washed, dried, and weighed, the difference in weight representing the proportion of wool. The residue is cotton, the dry weight of which must be augmented by about 5 per cent to compensate for the corrosion of the fibre during the operation.

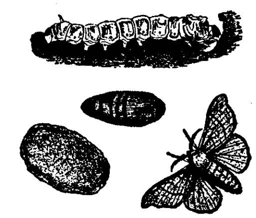
To Separate Silk, Tussah Silk, Wool and Cotton in a sample, have the sample first acted on by boiling half a minute with concentrated hydrochloric acid, which immediately dissolves the silk, the tussah silk being dissolved at the end of two minutes' further boiling. On treating the remainder of the sample with hot caustic potash, the wool will then be dissolved, and the cotton left.

To Determine the Presence of Cotton and Flax in a sample, the same is dyed by immersion in alcoholic fuchsine solution (1 gram fuchsine in 100 c.c. alcohol), then washed with clean water until the color ceases to run, and steeped in ammonia for about three minutes. The flax fibres or threads will then have been dyed rose color, whereas the cotton fibres or threads will be decolorized.

For the purpose of quantitative separation, the sample after having been freed from any size or dye, by a suitable boiling in dilute hydrochloric acid or distilled water, followed by a thorough rinsing, is then dipped for one and a half or two minutes in concentrated 66° B. sulphuric acid, then rinsed out well, rubbed between the fingers and neutralized by steeping in dilute ammonia or sodium carbonate solution. After washing over again in water the sample is pressed between blotting paper and dried and when flax fibres or threads will, as a rule, be found to have retained their structure whilst the cotton fibres or threads have dissolved after passing through a gelatinous stage in which they will tear like tinder.

SILK.

Silk is the simplest, and in its properties the highest and most perfect of all spinning materials. It differs from other textile fibres, both as to its nature as well as the machinery used in preparing it for the loom, the machinery used being much simpler and less cumbersome than the processes employed in preparing other fibres.



THE SILK WORM.
Larva,—Cocoon,—Chrysalis,—Moth.

The countries that produce silk are in the temperate zone. Starting from Japan to China and the belt of Central Asia, including a part of India, the silk-producing belt runs westward through Persia, the Caucasus, Syria, Asia Minor, Turkey, and the countries of South and Western Europe. Silk is divided into three main groups: (1) Cultivated silk, (2) Wild silk, (3) Artificial silk; the most important by far to the textile industry being

CULTIVATED SILK.

The same is imported in the form of "raw silk" *i. e.* in skeins, which are carefully packed in linen, with an outer covering of rush matting. The bales are square shaped, and as a rule contain 9 or 10 compound bundles of 9 or 10 skeins each. These bales, thus received by the manufacturer, on account of the high price of silk (it takes from 2250 to 3000 cocoons to make one pound of reeled silk), are carefully weighed and their contents subjected to a critical examination.

New York City, the only raw silk market in America, now holds the first place among all the raw silk markets of the world, Shanghai alone excepted; more raw silk being annually sold here than is consumed in France, which is still the largest raw silk consuming country in Europe.

The standard sizes of swifts in American mills are twenty-two and twenty-four inches, that is, the skein to measure fifty-six to fifty-eight inches in circumference. The reelers of Japan silks conform more nearly to this standard than do the reelers of Canton and Italian silks. The reelers of China steam filatures are quite uniform in the diameter of their skeins, but are apt to put too little silk in their skeins, which

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BOX MOTIONS AND SHUTTLE BOXES.

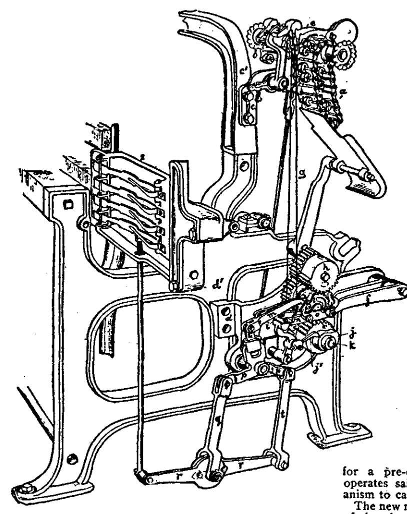
THE KNOWLES GINGHAM BOX MOTION.*

(For 4 x 1 or 6 x 1 Box Looms.)

This motion, as shown in the accompanying illustration, is controlled by the box pattern chain *a*, which is operated in connection with a multiplier chain *b*, by a cam on the bottom shaft (not shown). The stand *c*, for the box pattern and multiplier mechanism is bolted to the arch *c'*, and the stand *d*, for the box motion itself is fastened to the loom side *d'*. The box motion is also run from the bottom shaft. This causes a complete movement of all the parts once in two picks and prevents the boxes from changing when the shuttle is in the dead box.

When a roll of the pattern chain *a*, comes under one of the levers *e*, which is connected with the vibrator lever *f*, by rod *g*, it raises the vibrator lever *f*, into connection with the top cylinder gear *h*. In order to prevent any skips, a lock-knife *i*, closes in under or over the vibrator lever *f*, as soon as it has been raised or lowered to its correct position, the lock-knife *i*, being operated by a cam *j*, (and lock-knife finger *j'*) on the shaft *k*, of the bottom cylinder gear *k'*.

Whenever the vibrator gear *l*, is raised into contact with the top cylinder gear *h*, the vibrator gear *l*, is turned through half a revolution, carrying the vibrator connector *m*, from the left to the right and locking it as it comes into the line of centres; in addition to this there is a lock-lever *n*, and spring *o*, which holds the connector *m* in place.



The motion of the vibrator connector *m*, in connection with the angle lever *p*, raises the boxes. The front lever *t*, using the end of the compound lever *r* as a fulcrum raises two shuttle boxes *s*. The back lever *q*, using the centre of the compound lever *r*, as a fulcrum raises one shuttle box *s*.

In the case of the 6 x 1 box loom there are two levers which raise two boxes each, and one that raises one box.

The adjustment of the box is effected by means of an adjustable tip *u*, which connects the vibrator connector *m*, to the angle lever *p*. (*Crompton and Knowles Loom Works.*)

MULTIPLIER MECHANISM FOR KNOWLES LOOMS.

This invention relates to that class of looms which are provided with an auxiliary or multiplier pattern-chain in addition to the main pattern-chain. By means of the auxiliary or multiplier pattern-chain, certain bars of the main pattern-chain of the drop-box-indicating mechanism may be repeated without constructing successive similar bars in said main pattern-chain.

The object of the present invention is to provide a supplemental mechanism, to be combined with the main-pattern-chain and auxiliary or multiplier pattern-chain mechanism, which will operate automatically to stop, for a pre-determined time, the mechanism which operates said pattern-chains and to start said mechanism to cause the pattern-chains to operate.

The new mechanism may be combined with any loom of the class referred to, and is designed particularly for looms for weaving handkerchiefs, cotton blankets, etc., in which a solid color is put into the body of the goods for a certain number of picks.

In using the improvements on looms of the class referred to, the inventor of the new device, Mr. Wm. Wattie, combines the same with the cloth-take-up friction-roll, so that after a certain amount of cloth is taken up, the mechanism will operate automatically to start the mechanism which drives the pattern-

*See also article on "Mechanism for Operating Shedding and Drop-box Pattern Indicators for Knowles Looms" in previous chapter.

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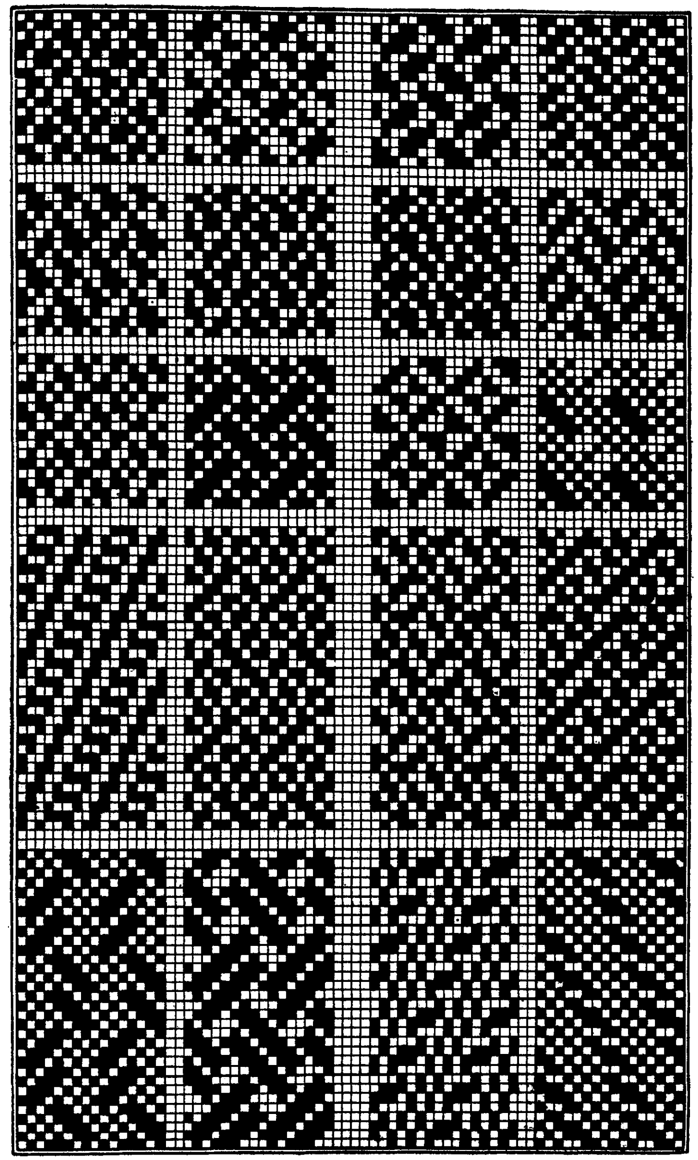
EIGHT HARNESS 47



8×8 8×16

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serves the purpose to keep the slivers better down on the spoons *G*, thus obtaining a prompt action of the stop motion. From the spoons *G*, the slivers pass down a specially shaped guide plate *H*, each sliver being kept separated from the others by means of grooves or channels *I*, through which they pass. The slivers are in this manner brought

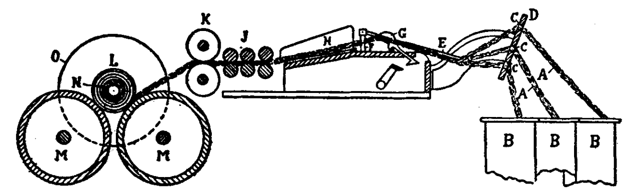

FIG. 106

together and made into a comparatively level sheet without overlapping each other as they enter the series of drawing rolls *J*, side by side. The object of the machine is not to draw the slivers out, but to lay them side by side in the form of an even lap, for which reason the draft in the rollers *J* is just enough to prevent bulkiness of the lap and should not exceed about 1$\frac{3}{4}$ to 2. Emerging from the drawing rolls *J*, the cotton

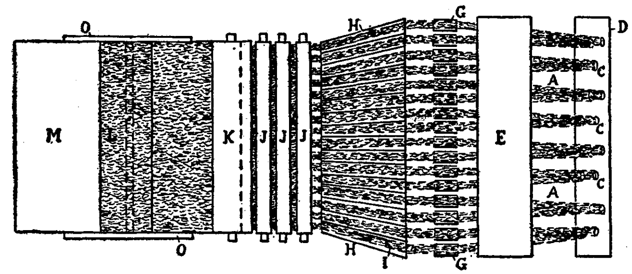

FIG 107

is conducted between a pair of heavy calender rolls *K*, which compress it into a sheet or lap which enables it to be rolled up. The top calender roller *K* is weighted either by a spring or lever arrangement at each end, with from 80 to 140 lbs. pressure. After the cotton leaves the calender rollers *K*, it is wound in the form of a lap *L*, upon the wooden spool *N*

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filling, entering from the left, interlaces in taffeta until coming to the point where the entering threads have to be drawn into the fabric, passing after this below the right hand situated entering thread, sur-

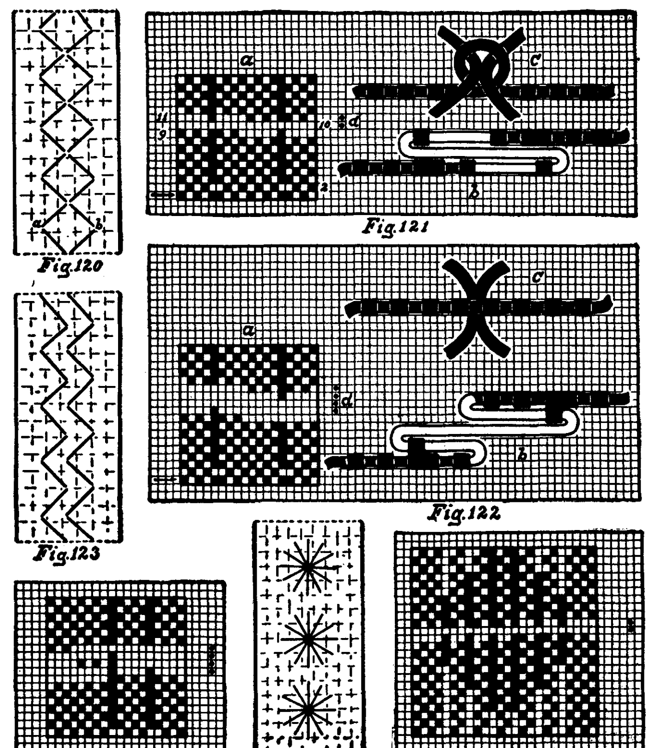

Fig. 120 *Fig. 121* *Fig. 122* *Fig. 123* *Fig. 124* *Fig. 125* *Fig. 126*

rounding then, in union with pick 10, this entering thread as situated on the right hand side of the design.

Pick 10, in unison with pick 11, loops around the left hand situated entering thread; pick 11 forming in the body of the fabric the continuation to pick 9.

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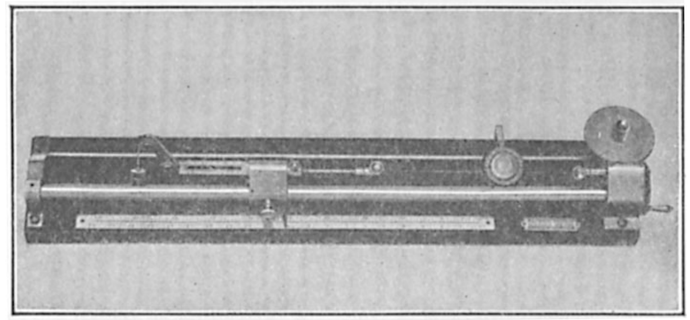

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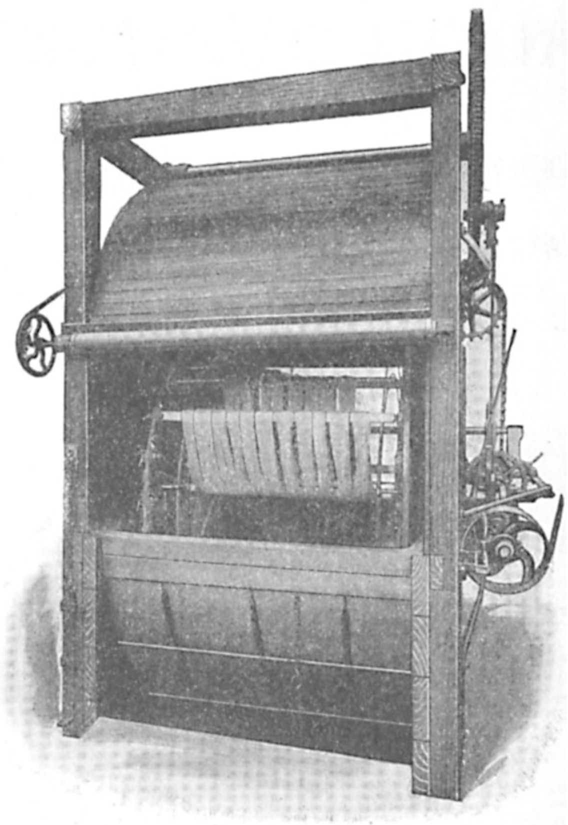

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