in the card of the other set). Cutting a hole for needle *e* will leave hook *g-l* in its vertical position and the crook of the hook will be caught by the stationary griffe, which will hold it during the downward movement of the rester. The movement of hook *h-m* and its result upon the corresponding warp-threads being the same as in the previously explained diagram, the only difference between adopting either plan *B* or *C*, is the lesser amount of slackening of the neck-cord *l-n* which is out of action in using the plan as illustrated by diagram *C*.

Diagram 893*D* shows the warp-thread in the lower section of the bottom shed *s*. (See full line *o-p-t*.) This movement is accomplished by cutting no hole for either needle in its corresponding place in the card, consequently throwing off each hook from either griffe, which will result in the lowering of both hooks by means of rester bars *i* and *k*.

Diagram Fig. 893*E* shows the method of operation necessary if a warp-thread is required to remain in the centre, thus forming the bottom of the upper shed *r* and the top of the lower shed *s*. In this case no hole must be cut in the card for needle *c*, and a hole in the card from the other set for needle *e* to penetrate. Hook *g-l* will thus remain over the stationary griffe-bar (*a*) while the mate hook *h-m* has its crook thrown out of reach of the raising griffe *b*, and consequently descends with the lowering of the rester.

TERRY PILE FABRICS

In which the Pile is Produced During Weaving Without the Aid of Wires.

Pile fabrics in which the pile-threads are raised without the aid of wires are fabrics known as "Turkish toweling" and certain kinds of scarfs used for ornamentation on chairs, bureaus, etc. In the manufacture of these fabrics two (or more) warp-beams are required—one to carry the "pile-warp" for the formation of the loop and the other to carry the "ground-warp" for forming the body of the fabric.

Method of Operation for Producing the "Loop" or "Terry" Pile.

In the process of weaving a terry fabric the upper or terry series of warps is weighted lighter than the lower or body series, for the purpose of allowing the loops to be formed on the surface by the lay swinging or being driven fully up to the body already manufactured after several or one or two picks of the filling have been shot from the shuttle and but partially beaten up, those picks having in the meantime so tightened upon the upper or "terry" warps that the latter are forced with them by the full beat fully up, and thereby forming the pile loops or terry.

FIG. 894*a*.

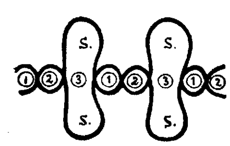


FIG. 894*b*.

The three (or more) picks so interwoven will have slid on the ground-warp, which remains tight during the entire process of weaving.

To illustrate the method of operation more clearly Figs. 894*a* and 894*b* have been designed.

In Fig. 894*a* the pick, indicated by *o*, represents the edge of the cloth. At the first stroke of the lay the first pick, 1, is not driven home. At the second stroke the second pick, 2, is driven against the first pick, 1, and no further; but the third pick, 3, is driven home towards *o*. This pick will in turn naturally take picks 1 and 2 along, pressing them up against the finished edge of the cloth (*o*).

The pile or "terry" warp will thus form the loops *s*, as shown in Fig. 894*b*.

Fig. 895*a* illustrates the drawing-in draft for the regular terry cloth. Harness 1 and 2 are for the pile, harness 3 and 4 for the ground-warp. Fig. 895*b* represents the weave or harness-chain for the above illustrated drawing-in draft.

To give a more perfect understanding of the method of operation in the present style of terry weaving, Figs. 896, 897 and 898 are designed, illustrating the operation of a terry loom patented by Messrs. Holt & Mellor.

Fig. 896 is a cross-sectional elevation of part of a terry loom necessary for properly illustrating the explanations to follow.

Fig. 897 is a plan-view of the same.

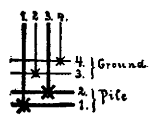


FIG. 895*a*.

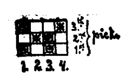


FIG. 895*b*.

Fig. 898 is an enlarged cross-sectional view of the upper part of the lay and the breastbeam.

The operation is as follows: When the cam *D* (see Fig. 897) does not raise the lever *E*, the frame remains lowered, as do also the arms *L*, and when the lay swings toward the breastbeam the outer ends of the arms *L* come in contact with the inner ends of the screws *N* (see Figs. 896 and 897), whereby the arms *L* will be pushed in the inverse direction of the movement of the lay—that is, in the direction of the arrow *b'*—thereby swinging backward the reed and preventing it from driving the last pick home—that is, preventing the reed from driving the last pick against the finished edge of the cloth; but if the cam *D* raises the lever *E* the frame *F* will be moved upward and the arms *L* will be raised so that their shoulders engage with the face of

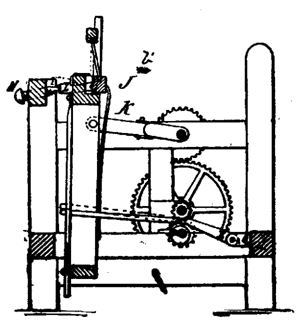


FIG. 896.

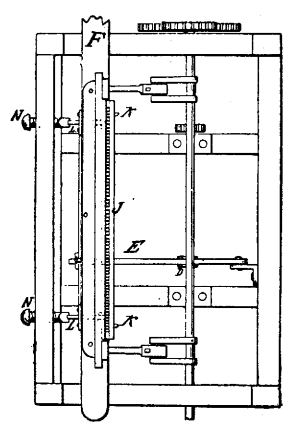


FIG. 897.

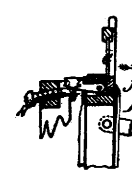


FIG. 898.

the lay, and the free ends of the arms *L* will be raised to such an extent that they will pass over the beveled ends of the screws *N*, and the bar *J*, or lower part of the reed, will not be pressed in the direction of the arrow *b'*, thus permitting the reed to drive the last pick home, as represented in diagram Fig. 898.

The loom can also be so constructed as to drive the second, third, fourth, fifth or sixth pick home, as may be desired, and according to the number of loops desired in the fabric. The length of the loops is adjusted by means of the screws *N*, for the farther the screws project from the breastbeam the greater will be the distance that the bar *J* is swung back, and thus the greater will be the distance between the finished edge of the cloth and the first pick.

Diagrams Figs. 899, 900, 901 and 902 illustrate the principle of construction and the operation of a loom for weaving terry fabrics patented by N. A. Woodhead.

Fig. 899 is an end or cross-sectional elevation of the loom with the movable journal-boxes and crank-shaft thrown fully back, as when partially beating up the filling.

Fig. 900 is a cross-sectional elevation of it without the gear-wheels, showing the journal-boxes and crank-shaft thrown forward and the lay forced fully up.

Fig. 901 is a top view. Fig. 902 is a detail view showing one of the journal boxes and part of its supporting lever, its adjusting screw, and the device for locking the lever and box in a

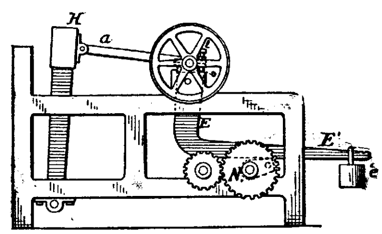


FIG. 899.

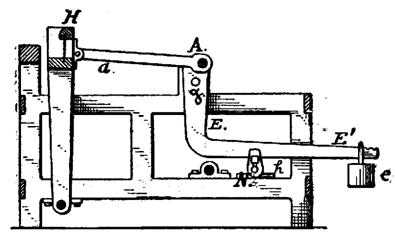


FIG. 900.

forward position for the production of a plain fabric. (Letters indicating the different parts for reference are selected to correspond in all four diagrams.)

The method of operation of the loom thus forming the terry pile is as follows:

The crank-shaft *A* when revolving drives to and fro the lay *H* by means of the rods *a*, communicating with the cranks *b b*, and thus drives the picks partially up at each revolution, when it is thrown back, as illustrated in Fig. 899. In order, however, to produce the terry loop the entire shaft *A* is, after two picks, thrown forward to a point where, when the cranks *b* arrive on a horizontal plane toward the lay *H*, the lay will be caused to make a full beat, driving the picks full up, and producing the terry or pile loop.

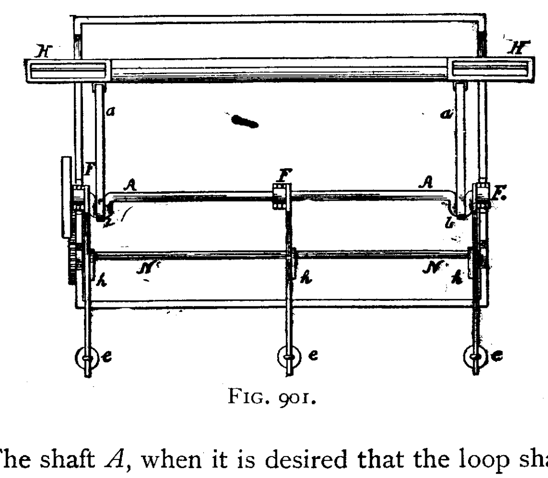


FIG. 901.

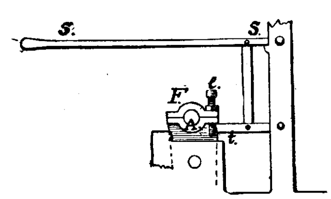


FIG. 902.

The shaft *A*, when it is desired that the loop shall be formed at every third pick, is arranged to revolve by a proper adjustment of the gearing three times while the cam shaft *N* revolves once. When the cams *h* of the cam-shaft *N* are in any position other than an upright position, the lower arm *E'* is at rest, being borne down and held in that position by the weight *e*. As a natural consequence, by reason of the pivotal bearing at *g*, the knee of the arms *E E'* is thrown forward, while the journal boxes *F* of the shaft *A*, being firmly fixed to the arms *E E'*, are thrown back, and the shaft *A*, while revolving in this position, produces by means of the lay but a partial beat of the picks, one throw of the shuttle being made to each revolution of the shaft *A*. When, however, the cams *h* of the cam-shaft *N*, by the revolution of the shaft, begin to assume an upright position, pressing against the lower edge of the arms *E′* as shown in the drawings, the arms *E′* are gradually raised until they assume a horizontal position and thereby, by reason of the pivotal bearing *g*, throw the boxes *F*, adjusted to the extreme upper ends of the arms *E* and containing the crank-shaft *A*, completely forward. Then the shaft, revolving to the proper point, produces a full beat of the lay and makes in the fabric the terry or pile loop at the desired interval.

The length of the terry-loop is regulated by means of the screw *l*, adjusted to the journal boxes *F*. By screwing down the screw the terry-loop is shortened by the shaft *A* being prevented from going as far back as it otherwise would by reason of the lower end of the screw coming in contact with the loom-frame, consequently allowing the short beats of the picks to be driven more nearly full up. When the screw *l* is screwed up, the arms *E′* fall fully down when released from the cam *h* and throw the shaft *A* full back, and this produces an extremely long terry-loop. By this means a terry-loop of any desired length can be produced.

When it is desired to throw the terry devices out of operation and to weave a plain fabric, the lever *S*, connecting with the lug *t*, as shown in Fig. 902, is depressed, the lug *t* thereby engaging the movable journal-box *F*, and, preventing the backward motion, holds it firmly in position and allows of the lay *H* beating full up at every revolution of the shaft *A*.

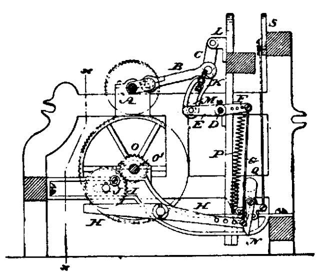


FIG. 903.

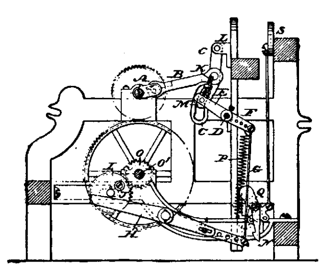


FIG. 904.

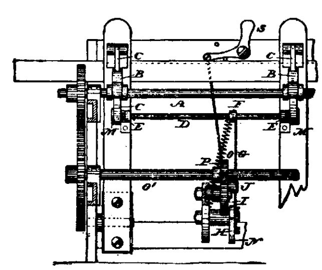


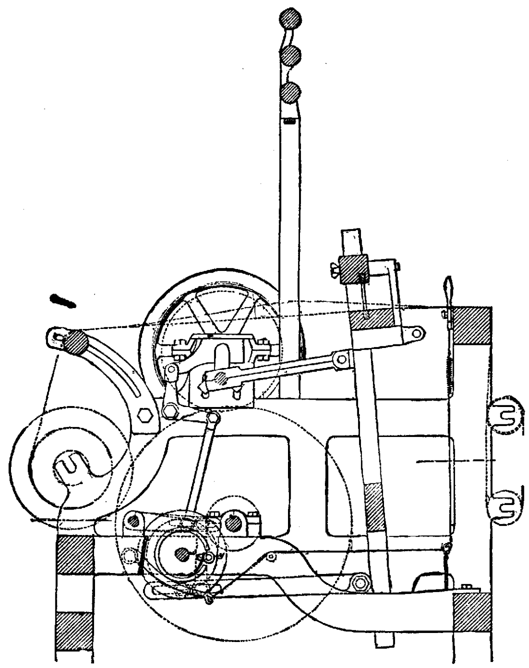
FIG. 905.

Some "terry" fabrics require a combination of the terry pile weaving and the common plain weaving; both systems of weaving to exchange alternately (and sometimes more frequently) in one length of the fabric. For such fabrics the loom illustrated in diagrams Figs. 903, 904 and 905 (as is claimed by its inventor, C. Strobel), is of special advantage.

Figs. 903 and 904 represent vertical sections of the loom; the parts being shown in different positions.

Fig. 905 represents a vertical section of the loom in line *x x* Fig. 903. The shedding, picking and take up motions are substantially the same as are ordinarily used in looms. (The letters of reference in all these drawings are identical.)

The crank and cam shafts *A O′* are geared by gear-wheels, each mounted on shafts and meshing together, and are driven in the usual way. While the rollers *M* are in the bottoms of the slots in the links or levers C the lay will travel forward to a fixed line, this being the cloth making line of the fabric. The roller *J* on the gear *I* at each revolution of the latter, if the lever *H* is not engaged by the hook *N*, presses down the rear end of the lever *H*, causing the forward end to rise, and through the rod *G* and the arm *F* to rock the shaft *D* until the rollers *M* reach the bottoms of the slots of the links *C*. The spring *P*, connected with the arm *F* on the rock-shaft *D*, keeps the rollers *M* in the upper part of the slots of the links *C* when the lever *H* is free from the hook *N* and is not acted on by the roller *J*. When the rollers are in this elevated position, the lay will not travel as far forward as the cloth-forming line, owing to the pivots of the pitmen *B* having been given a lateral movement toward the lay, thus shortening the distance between the crank-shaft and the lay. It will be understood that during these short movements of the lay the filling will be only partially beaten up. The number of short or partial beats to each full beat may be varied by changing the gears *I* or *O*. The present illustrations show the loom arranged so as to have two short strokes to each long or full stroke or beat. At each third pick the lever *H* will be depressed by the roller *J* on the gear *I*, causing it to bring the arms *E* on the shaft *D* to a horizontal position, thus giving the pivots of the pitmen *B* a movement away from the lay, and increasing the distance between the crank-shaft and the lay. By this means the lay in its next forward movement will be moved forward to the cloth-making line, beating home the previously inserted two picks and causing the terry warp-threads to be looped or raised from the body of the cloth. The screws *K*, passing through the side projections of links *C*, act as stops for the roller-supporting levers *E*, limiting their upward movement, thus regulating the length of the terry-loops, making them longer or shorter, as desired. The arms *F* may be given more or less movement by shifting the pivots or screws, by which the connecting-rod *G* is attached to the arm *F* or to the lever *H*. When it is desired to do plain weaving, the



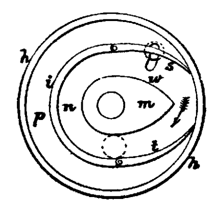


FIG. 907.

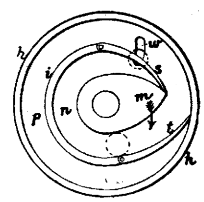


FIG. 906.

FIG. 908.

hand-lever *S* on the breastbeam is moved to the right, causing the lever *Q* to act on the hook *M*, pressing it toward the lever *H*, when it will hook under and lock the lever *H* as soon as the lever is raised to the proper height. The parts will remain in these positions until the hand-lever *S* is thrown to the left, thus unlocking the lever *H* from the hook *N*, when the loom will be in condition for terry-weaving, all these changes being accomplished without stopping the loom.

Before closing the chapter on the construction of the various looms for weaving terry fabrics we refer to the patent of T. A. Brady, it being a loom for weaving terry-pile fabrics such as Turkish towelings, etc., and in which there is a different throw or beat of the lathe, due to the shifting of the boxes or bearings for the crank-shaft of the loom. The shifting of the boxes carrying the crank-shaft is effected by means of a grooved cam.

Figs. 906, 907 and 908 are drawings illustrating the principle of this operation.

Fig. 906 is a longitudinal section of parts of a loom sufficient to illustrate the present explanations.

Figs. 907 and 908 are drawings representing enlarged face views of the cam by which the parts are operated to effect the shifting of the slides forming the bearings for the crank-shaft, and thus regulating the forward beat (towards the last woven part of the fabric) of the lathe.

The cam has an outer flange, *h*, an intermediate segmental flange, *i*, and a central cam, *m*, the inner portion of which is concentric with the flange *i*, so as to form an inner groove, *n*, while the outer portion of the cam is such as to direct the roller on the stud of an arm fastened on the loom into a groove, *p*, formed between the flange *i* and the outer flange *h*.

Pivoted toes *s* and *t* form continuations of the flange *i*, these toes being such that their ends can be thrown inward, so as to bear upon the nose of the cam *m*, or can be thrown outward, so as to come in contact with the outer flange, *h*, of the cam. The toe *s* has a projecting pin passing through a segmental slot, *w*, in the disk of the cam, and having an anti-friction roller, which is acted upon by a spring, tending to thrust the point of the toe outward against the flange *h* of the cam, so that, supposing the cam to be rotating in the direction of the arrow, Fig. 907, the roller on the stud of the arm would be under the influence of the cam *m* and inner groove *n*, and the arm would be depressed at the proper intervals to effect the forward movement of the slides and the full beat of the lathe. If the toe *s*, however, is adjusted to the position shown in Fig. 908, the roller will traverse the outer groove, *p*, of the cam, and will be free from the influence of the cam *m*, so that there will be no vibration of the arm and no movement of the slides and crank-shaft; thus the lathe will move forward to the full-beat point on each stroke, so as to produce plain or unpiled fabric. The toe *t* serves to bridge the groove *n* when the roller is traversing the outer groove, *p*, there being in such case a practically unbroken flange, *i*, so as to insure the proper guidance of the roller.

In order to permit the ready adjustment of the toe *s* to the position shown in Fig. 908, when such adjustment is desired, hang to one of the frames an arm, which is adapted to act on the roller carried by the pin of the toe *s*, this arm being connected by a suitable cord to a lever, hung to a stud on the breastbeam of the loom, so as to be within easy reach of the attendant.

For figured terry fabrics as produced on harness-work, the Geo. W. Stafford Manufacturing Company, Providence, R. I., build a dobbie specially adapted for this purpose. This dobbie requires the pegging of two patterns on the chain. By means of the box-chain we can arrange the former to move automatically sideways so as to bring the different patterns, as required by the fabric, under the operation of the hooks. Thus we can weave terry for a certain distance, and then move the chain for ordinary weaving. For very heavy work the "*Positive Dobbie*" must be used, which, by being a "*Double Action*," is very easy on the yarn.

PILE FABRICS OF A SPECIAL METHOD OF CONSTRUCTION.

Smyrna Carpets and Rugs.

These fabrics are made on a loom specially built for their manufacture and is known as the "*Hautelisse Loom.*"

Diagram Fig. 909 illustrates a section of this loom. In this loom the warp passes from the beam *g* (upon which it is wrapped) over the guiding roller *f*, through heddles *b*, *c*, down towards the place *a*, where the weaver is situated while at work. The heddles being in a horizontal position are fastened to two rollers, *d* and *e*. The latter (by reason of their turning to the right or left) operate the heddles, which in turn produce the opening of the shed. (The loom, it will be observed, is technically a "vertical loom.")

The pile in these fabrics is produced by inserting, separately, loops of yarn for each square on the designing paper of the respective design. This method of producing the pile in a fabric is a slow and troublesome work, still fabrics showing many varieties of colors can be produced.

The body or ground structure of a Smyrna Carpet or Rug is made with either strong woolen-linen or jute threads, and the pile of a soft woolen yarn.

Diagram Fig. 910 illustrates the method of interlacing (shown in the front view). The vertical threads represent the warp, and the horizontal threads the necessary ground or body picks. At *a* is shown the insertion of a loop (pile). This loop, intertwined with the two warp-threads of the ground structure, is shown separately in its section in Fig. 911.

The body-filling is inserted by a "block," as shown in Fig. 912 (clearly indicating the yarn as wound around it, and leaving this block at the place marked *p*). The beating up of the filling (ground and pile) is effected by means of a comb shown in Fig. 913. In this method of operation

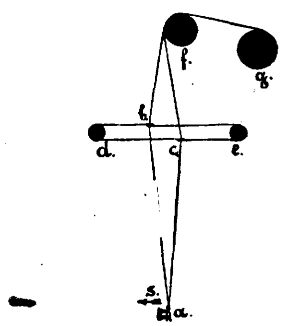


FIG. 909.

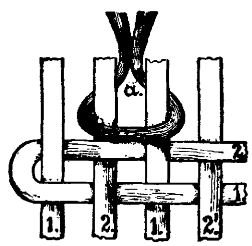


FIG. 910.

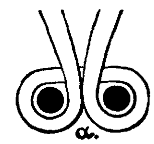


FIG. 911.

the weaver inserts two body-picks; next, he places one row of pile loops over the entire width of the fabric (selecting their different colors in accordance with the design which is to be produced). Then he again inserts two body picks (by turning the rollers *d* or *e* for each pick) to be followed by the next row of loops across the fabric; and selecting the colors as required by the design.

This method of alternately exchanging two body picks with one row of loops is repeated until the fabric is finished. On fabrics of a sufficient width two or more persons can operate at once. After the fabric is finished upon the loom it is "sheared" so as to produce an even height of the pile.

This method of tying each individual pile-thread to the ground structure in Smyrna or Turkey carpets and rugs is very laborious, and hence materially increases their cost of manufacture.

FIG. 912.

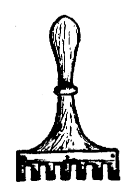


FIG. 913.

Various methods have been devised to imitate these beautiful fabrics in a way that would give a better production for the manufacturer as well as to provide a mode whereby a certain proportion of any desired number of carpets of the same pattern might be produced in one operation. This has been accomplished quite successfully in a process invented by Messrs. Kohn & Watzlawik and resembles in its main features and principles the explanations given by us in a former chapter, pages 154 to 158, on the manufacture of chenille rugs and carpets, and pages 160 to 165, on the manufacture of chenille fringe.

Such imitations of Turkey carpets are produced mechanically from patterns composed of colored squares that clearly indicate the design and arrangement of the colored squares to be reproduced in the carpet. In the carpet each transverse range of squares corresponds to a pick of pile filling, and each pick of this pile filling consists of a woven strip (or ribbon), the warp of which is composed of wool threads of the required colors. These filling strips have edges containing no filling (fringed) and which are intended to be brushed up for forming the pile of the carpet. These ribbons or filling strips also contain no filling in their centre, for two reasons: To form the imitation of the knot characterizing the real Turkey carpets, and again to reproduce the (pile) pattern of the face in an ordinary woven appearance on the back. These explanations demonstrate that *two operations* are necessary in producing the imitation. *First*, the weaving of the fringed strips or ribbons composed of different colored threads, according to the transverse

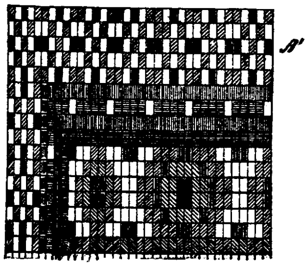


FIG. 914.

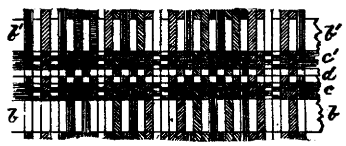


FIG. 915.

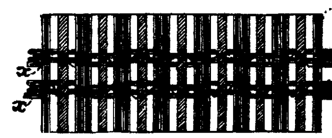


FIG. 916.

ranges of the colored squares in the pattern, and, *second*, the weaving (or setting) of these strips in a common warp to produce the pile carpet.

In diagrams Figs. 914 to 919 a clear illustration of the entire method of operation is given. Fig. 914 illustrates a carpet pattern. Fig. 915 shows one strip (ribbon) cut from a chain corresponding to the upper transverse range (or row) of the pattern Fig. 914. Fig. 916 shows a like strip from which the centre filling has been removed.

Fig. 917 represents the back of the carpet. Fig. 918 illustrates by a perspective view the method of operation at the loom, weaving imitation Turkey carpets. Fig. 919 is a section cut of the shed and two transverse ranges of pile picks previously inserted.

We will next give a short description of the methods for producing the filling strips or ribbons necessary for the construction of the fabric.

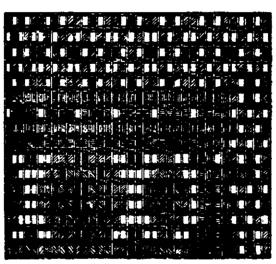


FIG. 917.

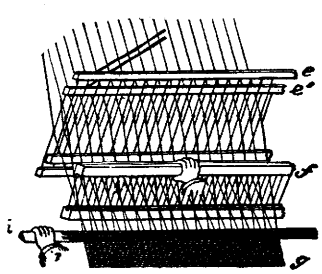


FIG. 918.

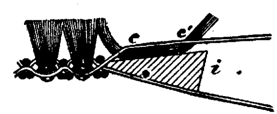


FIG. 919.

As many different warps for weaving the chenille strips for a certain carpet are necessary as there are differently figured or colored transverse ranges (rows of squares) in the pattern of the carpet, each warp producing any desired number of fringed filling or pile strips of the same transverse range of colors, that are woven into suitable warps for as many different carpets of the same pattern, or into a warp for one carpet as many times as the transverse range of colors corresponding to the strip or ribbon recurs in the carpet. Thus, for instance, the strip or ribbon shown in Fig. 916 corresponds with the transverse range A' of the pattern shown in Fig. 914, and, supposing that one hundred such ribbons are produced from one chain of warp, they may be used as a strip (pile pick) in one hundred carpets for one transverse range of colored squares in the pattern, or in a given number of carpets for a multiplicity of identical transverse ranges of squares in the pattern. The length of these multicolored warps therefore not only depends on the number of carpets of the same pattern, but also on the number of times the same transverse range of colors is repeated in this pattern, also on the length of the pile of the carpet. After a warp is beamed, it is bound at intervals equal to twice the length of the pile to be formed by a few picks of any suitable filling, the fabric being cut centrally of the fillingless portion on opposite sides of the filling to form the fringes for the pile. The width of these multicolored-wool chains, or, in other words, the length of the filling strips or ribbons to be produced therefrom, corresponds, of course, to the width of the carpet to be produced thereby, and the number of colored-wool threads per inch, which is usually from four to five threads, according to the quality of the carpet. The length of the fringe in the chenille strips is regulated by interweaving a flat bar or lath, *b*, *b'*, Fig. 915, of a certain width.

After cutting the different strips apart they must be numbered. To prevent the displacement of the wool-yarn filling, these are firmly sewed to the warp with a sewing-machine, as shown by dotted lines *x x* in Fig. 916, and finally the pack-thread *d*, between the wool-threads *c* and *c'*, are drawn out to leave a central fillingless portion in the strip or ribbon, as shown in Fig. 916, that imitates in the completed carpet the knots of the true Turkey carpet, and reproduces the pattern on the back of such carpet, as shown in Fig. 917. By means of these strips or ribbons the carpets are produced as follows, referring more particularly to Figs. 918 and 919: A ground-warp is drawn in two harness, *e* and *e'*, of an ordinary loom, the reed *f* of which contains one thread for each split. (The weave used for interlacing is the common plain weave.)

In beginning a carpet, a few picks of wool-yarn are first introduced into the warp, and then the first strip or ribbon. To prevent the shrinking of these strips they are secured at their ends to a rod or bar, *i*, triangular in cross-section, which is introduced into the chain or warp in such a manner that the rear or thicker portion will be elevated above the forward or thinner portion of this rod. By means of a brush the fringe at the front edge of the ribbon is brushed up or erected to form the pile. The position of the warp-threads is now reversed, the reed beaten up against the rod *i*, and the latter tilted so as to elevate its front edge above the rear edge, which will enable the operator to brush up the fringe along the said rear edge of the filling strip or ribbon, and when this has been effected the strip or ribbon is detached from the rod *i*, and the latter is withdrawn from the warp.

In order to fill out the warp between the pile-threads of adjacent strips or ribbons, a few picks of strong wool yarn are interposed and a new strip of ribbon introduced as a filling into the warp of pack thread and the operation repeated until the carpet is completed, when again a few picks of strong wool yarn are woven in to bind the edges. The carpet so produced is then finished in the usual manner by steaming, beating, brushing and shearing.

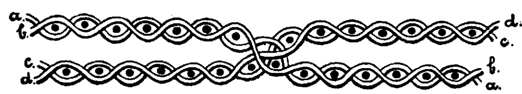
Having given in our chapters on pile fabrics (page 149 to 224) a very closely detailed description of their methods of construction, both theoretical and practical, commencing with the simplest structure and finishing with some of the most intricate pile structures known, we feel confident that we have imparted sufficient details to enable any student of technical designing to master the principles of construction of any given pile fabric. These chapters also illustrate the extensive use of pile fabrics for floor and other household decorations, in addition to their use for clothing purposes. The manufacture of these fabrics is of great extent and importance. In some households is often to be found for floor decorations a less durable and effective fabric known as the "*Ingrain Carpet,*" which is no pile structure but a common double-cloth structure.

In my treatise on "The Jacquard Machine analyzed and explained, with an Appendix on the Preparation of Jacquard Cards and Practical Hints to Learners of Jacquard Designing," the structure of the Ingrain Carpet fabric and the preparing of designs for the same, as also the practical part of manufacturing, and the tying-up of the harness and operating the loom, etc., are fully treated.

The thorough study of these chapters will prove very profitable, especially the chapters on tying-up Jacquard harness for the different other Jacquard fabrics such as damasks, dress goods, upholstery fabrics, gauze, shawls, etc.

Two-Ply Ingrain Carpet.

We herewith give the reader a brief description of the method of construction and the principles governing the manufacture of the Two-ply Ingrain Carpet, an article composed of two fabrics, produced on the regular double-cloth system. These two fabrics are arranged in the loom to form figures by a simple exchanging of positions (see Fig. 920). A great variety of colors may be put into each of these separate cloths, (I and II), and the most elaborate designs



Warp-threads *a* and *b* for cloth number I.
Warp-threads *c* and *d* for cloth number II.

FIG. 920.

may be used for exchanging cloth I and II. On every part of the carpet where these two fabrics do not exchange, each works on the plain weave. The exchanging of these two fabrics binds both into one, thus forming the Ingrain Carpet. In the manufacture of this carpet four sets of warp-threads, and also four sets of filling-threads are generally employed; but if occasionally more or less should be used in warp or in filling, or in both, in the same fabric, the principle of exchanging is still observed. If employing four sets in warp and filling, two sets of each are used for forming the figure, the other two sets forming the ground. Each of the figure threads has as its mate one of the ground threads. In the common effects in the Ingrain carpet, (ground up, figure up, or one or the other shot about effects) these threads are so arranged that when a figure thread appears upon the face of the fabric, its mate appears upon the back, and when the figure thread appears upon the back of the fabric, the corresponding ground thread appears upon the face.

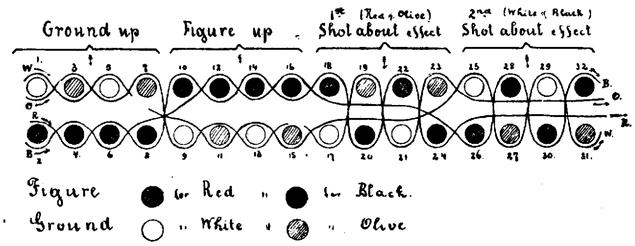


FIG. 921.

Diagram Fig. 921 shows the section of the effect commonly used in ingrain carpet.

Suppose the filling-threads for the figure to be:

Red, indicated by heavy shaded circles; picks 2, 6, 10, 14, 18, 22, 26, 30.

Black, indicated by full black circles; picks 4, 8, 12, 16, 20, 24, 28, 32.

And the filling-threads for the ground to be:

White, indicated by empty circles; picks 1, 5, 9, 13, 17. 21, 25, 29.

Olive, indicated by light shaded circles; picks 3, 7, 11, 15, 19, 23, 27, 31.

A careful examination of the drawing shows that the white threads mate with the red, and the black threads with the olive, so that when one of these colors shows upon the face the mating color will show upon the back, and *vice versa.*

As a general rule, these warp-threads are of the same color as the filling-threads; hence, every filling pick appearing on face is bound by a warp-thread of the same color, and if appearing on back by the other color of the same system; thus, in the present example, the white filling is covered on the face of the fabric by white warp, and if appearing on the back of the fabric by olive warp; the olive filling is covered by olive warp on the face of the fabric and by white warp on the back of the fabric.

The red filling is covered by its red warp on the face of the fabric and by black warp on the back of the fabric; the black filling being covered by black warp on the face of the fabric and by red warp on the back of the fabric.

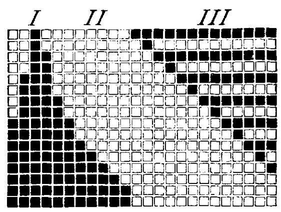


FIG. 922.

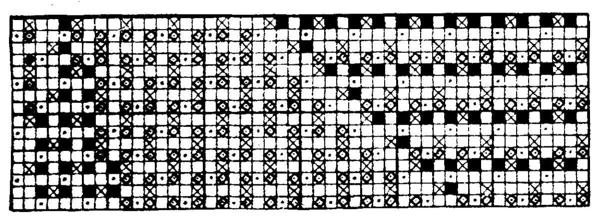


FIG. 923.

In the diagram Fig. 921 the four "standard effects" of the ingrain carpets are illustrated with 32 picks, allowing 8 picks for the illustration of each part.

First effect, picks 1 to 8, is ground up (white and olive).

Second effect, picks 9 to 16, figure up (red and black).

Third effect, picks 17 to 24, is first effect in "shot about" (red and olive up).

Fourth effect, picks 25 to 32, is second effect in "shot about" (white and black up).

Fig. 922 represents a small portion of a design illustrating the three principal combinations required in the manufacture of the two-ply ingrain carpets. *I* = figure up; *II* = ground up; *III* = effect, technically known as "shot about," and derived from "one pick figure up, one pick ground up" (in the design), and repeated.

In Fig. 923 a detailed description or analysis of the interlacing warp and filling of Fig. 922 is given. In the same ■ represents figure up, ◘ represents ground up, produced by the Jacquard machine; ⊠ represents weave for ground, ◻ represents weave for figures, produced by journals.

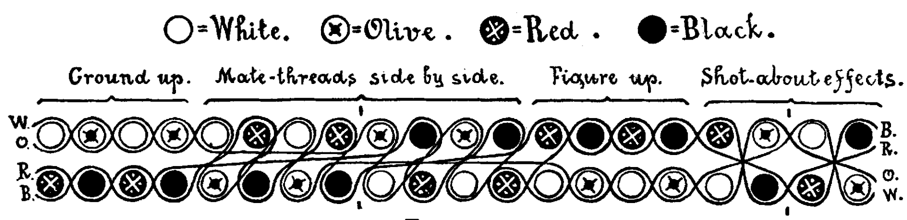


FIG. 924.

In Fig. 923 the weaving of the "shot about" effect calls for two picks face and two picks back. An examination of this part shows that the warp-thread represented by the light pick $^{1}\text{——}_{3}$ is to be raised, or has been raised in the adjoining heavy pick $^{3}\text{——}_{1}$; further, we find the two light picks separated by the raising of a different warp-thread in each pick, which is also effected between the two heavy picks by the lowering of another warp-thread. If these mate threads introduced in succession should be required to show side by side (as may be the case in some special effects) either on the face or the back of the fabric, these changes must be indicated on the design by different colors. If such effects are to be introduced when using the common ingrain Jacquard machine, the needles of the latter must be operated on at each pick. This requires twice as many cards as are used in designs where the mate threads are always placed below or above their respective corresponding threads.

In diagram Fig. 924 a section cut of an ingrain carpet, also containing the previously explained effects of " mate threads side by side on face of the fabric," is shown in connection with the regular effects, " ground-up, figure-up, and both combinations of shot about."

Diagram Fig. 925 indicates the rotation of inserting picks in each ply corresponding to the section of the fabric shown in Fig. 924.

	Ground-up.				Mate threads side by side.								Figure up.				Shot about.				
					1st effect.				2nd effect.								1st effect.		2nd effect.		
Face-ply.	1	3	5	7	9	10	13	14	19	20	23	24	26	28	30	32	34	35	37	40	Face-ply.
Back-ply.	2	4	6	8	11	12	15	16	17	18	21	22	25	27	29	31	33	36	38	39	Back-ply.

FIG. 925. Diagram illustrating the rotation of inserting the picks in each ply, corresponding to section of two-ply ingrain carpet, Fig. 924.

Other effects (combination of colors) in ingrain carpets are produced by using three different colors of filling in each of the two single-cloth fabrics, and also by throwing them singly and in a definite order or succession in each ply. For example, the three colors for the one cloth are black, blue and brown. They must be interwoven as follows: Black—blue, brown—blue, black—blue, brown—blue, and so on.

Suppose the colors required to be used for the other cloth are white, olive and drab. They must be interwoven as follows: White—olive, drab—olive, white—olive, drab—olive, etc.

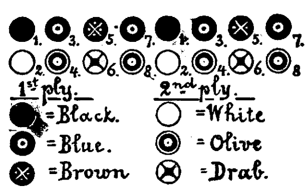


FIG. 926.

As the loom weaves both ply at the same time, throwing a shot in each ply alternately, the actual order of weaving in the present example would be as follows: 1st pick, black; 2d pick, *white;* 3d pick, blue; 4th pick, *olive;* 5th pick, brown; 6th pick, *drab;* 7th pick, blue; 8th pick, *olive*, and so on, eight picks in the repeat of one combination. The colors printed in *italics* representing the colors of one ply, and the colors printed in roman represent the colors of the other ply.

Fig. 926 illustrates a diagram representing the previously explained method of placing colors in an ingrain carpet.

RULES FOR SELECTING THE SQUARED DESIGNING PAPER FOR INGRAIN CARPETS.

In selecting the squared designing paper for a two-ply ingrain carpet, always observe the proportion existing between the number of warp and filling-threads. For instance, take a carpet having 1072 ends warp (536 ground and 536 figure) per yard, with 30 picks per inch (1 pick ground and 1 pick figure, or 15 pairs). Then, $1072 \div 36 = 29\frac{28}{36}$ ends of warp per inch. The proportion is as $29\frac{28}{36} : 30$; or, what is practically the same, $30 : 30$, showing that the paper must be equally divided, and 8 x 8 the squared designing paper to be used.

Again, take a carpet having 832 ends warp (416 ground and 416 figure) per yard, with 20 picks per inch (1 pick ground and 1 pick figure, or 10 pairs). Then, $832 \div 36 = 23\frac{4}{36}$, and the proportion is as $23\frac{1}{9} : 20$, or as $7\frac{19}{27} : 6\frac{2}{3}$, practically $8 : 7$; and 8 x 7 paper may be used.

Gauze Fabrics.

Principle of Construction.

Gauze fabrics form the second main division of textile fabrics, and are characterized by not having their warp-threads resting parallel near each other, as observed in previously explained weaves and fabrics. In gauze fabrics they are more or less twisted around each other, forming through the different ways of twisting as well as of stopping to do so, different designs.

In gauze we find two distinct divisions of warp-threads: The regular warp called the "ground-warp," and the "douping-warp," or the warp used for twisting around the former. The "douping-warp" threads are also known as "whip-threads."

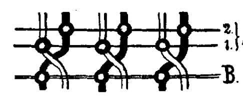


FIG. 929.

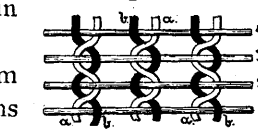


FIG. 927.

In diagram Fig. 927, the structure of a "plain gauze fabric," is shown. Threads indicated by *a* and shown in outlines represent the "ground-warp;" whereas, threads marked *b* and shown in black illustrate the "whip-threads."

Gauze weaving is done upon a system wholly apart from ordinary and pile weaving. For the reason that we find two systems of warp-threads in the gauze fabrics we must use two systems, or sets of harness, for operating the warp at the weaving. One set of the harness is known as the "*Ground-harness set*" (which we will indicate in our following illustrations of drawing-in drafts for gauze weaving by *A*) and the other harness set is technically known as the "*douping harness set*" (which we will indicate through the lecture by *B*). Before proceeding with the weaving and construction of gauze fabrics we will give an explanation of the douping-harness set, and use for explanation the arrangement necessary to produce fabric, Fig. 927, or a single one-sided doup.

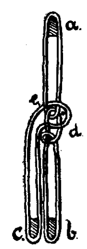


FIG. 928.

In diagram Fig. 928 a specimen of a complete doup is shown. In the same we find a heddle similar to heddles used in regular weaving (see *a*, *b* in diagram) and which is known in the present kind of weaving as the "standard heddle." To this standard heddle we find the actual doup adjusted (see *d*, *c* in diagram). The doup consists of a smooth and strong linen or silk thread which is fastened to the lower part of a common harness frame (see *c* in diagram), passes then through the upper opening of the standard heddle (see *e* in diagram Fig. 928), returning to its starting point by passing through the eye of the standard heddle, and thus connecting the upper part of the doup to the standard heddle. Through the part of the doup extending outside of the upper part of the standard heddle to its eye, the whip-thread is passed, (see black dot at place indicated by *d* in diagram 928 representing its section). Two movements of the doup and the standard heddle contain the entire secret of gauze weaving When these are clearly understood by the student well up in designing and weaving the first main division of textile fabrics, the method of constructing the present system will readily explain itself to him.

In gauze-weaving, every warp-thread (ground as well as whip-thread) must be drawn, the same as for common weaving, in the ground harness set; see *A*, Fig. 929. Next, the whip-thread is passed below the ground-thread through the doup (see *B* in Fig. 929, illustrating the plan of this method of operation), and with its mate (the ground-thread), through *one dent* of the reed.

Now let us examine the first movement of the doup and its standard heddle, and also with reference to the ground harness set.

Suppose we lift the harness frame containing the doup adjusted to its lower shaft, technically known as the "skeleton harness," and so permit the doup to get loose, and consequently allow the whip-thread to be operated on, as in common weaving, by means of the ground harness.

The whip-thread will in this instance return to its regular position near one side of the ground-warp, as regulated by the drawing in of the warp in the ground harness set (to the right hand side in the present example). Suppose, again, we raise this ground harness and insert a pick in the shed thus formed. During this process the doup will raise, but out of action, behind the reed. Having thus inserted pick number one let us next raise the standard heddle and the skeleton harness, leaving the ground harness set undisturbed. This movement of the harness compels the whip-thread to raise, close to the eye of the standard heddle, drawing the whip-thread below the ground-thread and raising the former on the *opposite* side of the ground warp-thread, as done in the previous pick. This time the doup will be in position parallel to the standard heddle, whereas the whip-thread will be crossed behind the reed, between the sets of douping and ground-harness. This crossing and raising of the thread to full height of shed in such a short distance will consequently put a great amount of tension on the whip-thread and therefore necessitate *two points* in the method of operation which we will mention briefly. We must have sufficient space between both sets of harness, *i. e.*, the heddle of the ground harness set in which the whip-thread is drawn and the standard heddle and doup-head through which this whip-thread is passed in rotation. We also must arrange in rear of harness set near the whip-roll an arrangement technically known as "*Slackener*." All the whip-threads required to doup are passed over this slackener, which is situated above the regular warp-line after leaving the "whip-roll" of the loom and in their running towards the ground harness set.

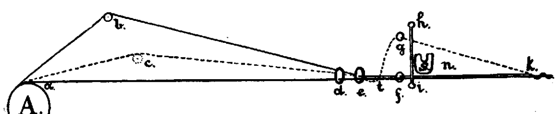


FIG. 930.

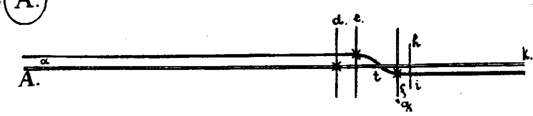


FIG. 931.

On the first pick previously explained, this slackener will remain undisturbed, as no strain is required on the whip-thread, whereas on the second pick explained, this slackener is automatically lowered to bring the whip-thread nearly in the regular warp line in rear of harness. This in turn allows the whip-thread to ease up in front, where required, to cross around the ground warp-thread and is raised a short distance by the doup on the opposite side of the ground warp-thread, as compared with the first pick. This slackener for gauze weaving is also technically known as "easer" (by reason of easing the whip-thread when douping). We will later on return to a more detailed illustration and explanation of the same and its arrangement for plain as well as figured work.

In diagram Fig. 930, *A* represents the whip-roll of the loom, *b* the section of the slackener, *d* ground heddle for ground warp-thread, *e* ground heddle for whip-thread, *f* doup, *h–i* reed, *k* last end of woven fabric. Thus the line shown in full black, *a, d, k*, represents the ground-thread, and line in full black, *a, b, e, k*, represents the whip-thread; both threads "at rest." The object of the present illustration is to explain the principle of the slackener, and therefore we want the doup (standard and skeleton harness) raised (see *f* to *g*) as represented by *g*. To counteract the strain thus put on the whip-thread, we lower at the same time the slackener (see *b* to *c*), giving it position *c*, at the same time the doup is raised to position *g*. Hence the dotted line *a, c, e, g, k* represents the whip-thread when douping. After inserting the filling by means of shuttle (*s*), the shed (*n*) closes and the slackener returns automatically to its point of starting, *b*.

In Fig. 931 we illustrate a corresponding ground plan to diagram Fig. 930, representing a clear idea of the drawing in of the warp and threading of the doup. Outlined warp-thread *a, d, k* represents ground warp-thread, thread shown in full black, *a, e, f, k*, the whip-thread, *d* and *e* the ground harness set, *t* the passing of the whip-thread below the ground warp-thread and *h, i* the reed.

This illustration explains the threading of a whip-thread in a doup situated at the left of the ground warp-thread, but the student will readily apply the same arrangement to the opposite kind of doup by simply reversing the illustration.

We will next turn our attention to the designing of various gauze fabrics, and commence with the plain gauze, as illustrated in Fig. 927. In plain gauze all the warp-threads work in pairs—1 end "whip" and 1 end "ground." The entire warp is drawn on harness similar to any other warp. Afterwards the whip-threads are passed below the standard heddles and threaded in the doup (see Fig. 929), which are passed through the standard heddles (see Fig. 928).

Fig. 932 represents a different method for threading the doup, occasionally used, but which is not as practical as the arrangement of the doup illustrated in Fig. 928.

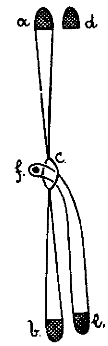


FIG. 932.

In diagram Fig. 929 we illustrate the plan of drawing-in ground harness and threading the doup for producing a piece of plain gauze, as shown in Fig. 927.

A represents the set of ground-harness (2-harness).

B represents the douping set. (Standard and skeleton.)

Standard warp-threads are illustrated in outline.

Whip-thread is shown in full black.

We find, as previously mentioned, every warp-thread threaded first in the ground harness set; next, the whip-threads passed below the ground-warp and threaded to the doup. Examining the plan of the fabric, we find pick 1 requiring the whip warp-thread raised in its proper position as placed by the ground harness (to the right of the ground warp-thread); therefore this pick will require the raising of ground harness 2 and the skeleton harness, hence loosening the doup for common weaving. Pick 2 calls for the raising of the whip-thread on the opposite position of pick 1 (to the left side of the ground warp-threads); therefore we must doup on this pick by raising only the standard and the skeleton harness, or, in the present example, the entire douping set. Pick 3 = pick 1, pick 4 = pick 2, thus 2 picks repeat.

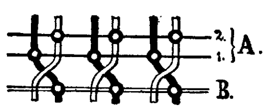


FIG. 933.

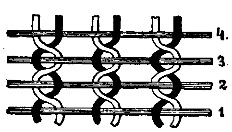


FIG. 934.

In the present example, Fig. 927, we find every pair of warp-threads (1 ground and 1 whip) twist in the same direction and having the crossing in the corresponding drawing-in draft arranged from right to left. This crossing can also be arranged in the other direction, see Fig. 933, but will, in the present fabric, be of no advantage to its general appearance, as shown in Fig. 934.

We will next explain and illustrate the combination of both styles of crossing in the same fabric. For example see Fig. 935. the drawing in of ground harness and arrangement for threading doup: 1st pair, whip-threads

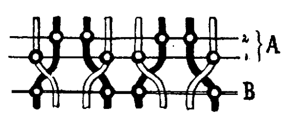


FIG. 935.

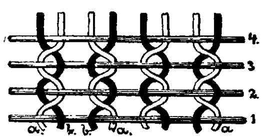


FIG. 936.

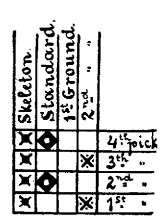


FIG. 937.

Harness-chain for plain guaze fabric, Figs. 927, 936.

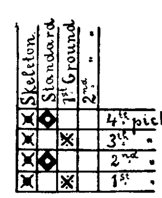


FIG. 938.

Harness-chain for plain gauze fabric, Fig. 934.

threaded to the left-hand side of ground warp-thread; 2d pair, whip-threads threaded to the right-hand side of ground warp-thread.

Fig. 936 is the plan of the woven fabric. Harness chain is similar to the one required and explained for fabric Fig. 927 and illustrated in Fig. 937.

The drawing-in drafts, Figs. 929, 933 and 935, are illustrated for 2 ground harness and 1 doup. This is done to simplify the principle of construction. The same way that we can illustrate the common plain weave drawn in 2-harness straight, for the clear understanding of the beginner and use in practice, 4, 6, 8, etc., harnesses as required and guided by the height in texture of the fabric (number of warp-threads per inch), we may also, in practice, have to increase in gauze-weaving the number of ground harness, or the number of doups (standard and skeleton), or both at the same time.

Peculiar Character of Gauze Fabrics.

Comparing a plain gauze fabric, as shown in Figs. 927, 934 or 936, to any other woven textile fabric results in not finding one as firm in its method of interlacing nor as light in texture.

The principle of gauze-weaving—the twisting of warp-threads around each other and holding at the same time the filling securely fastened between—will necessarily result in producing a very strong fabric; again, the twisting of the warp-threads between each pick, in plain gauze, will not allow the picks to come close together in the fabric, thus resulting in the production of a fabric containing large perforations.

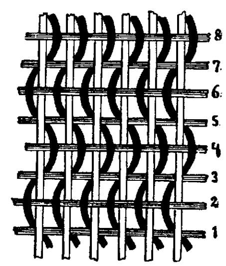


FIG. 939.

In diagram Fig. 939 we illustrate the plan of a fabric which is actually a combination of plain and gauze and is technically known as leno, or half-gauze. Pulling out from the present fabric sample every uneven numbered pick (1, 3, 5, 7) will result in transforming the half-gauze in the fabric to a regular plain gauze effect.

Combination of Plain and Gauze Weaving, Technically Known as Fancy Gauze.

In Fig. 940 a combination of plain weaving and gauze is shown in the plan of a fabric. An analysis of this plan will show 3 picks interlacing on ordinary weaving to exchange with one

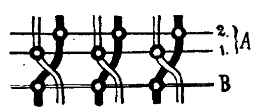


FIG. 941.

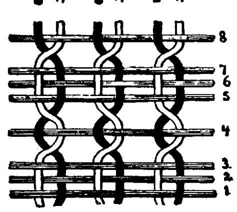


FIG. 940.

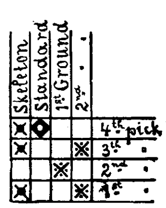


FIG. 942.

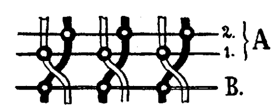


FIG. 944.

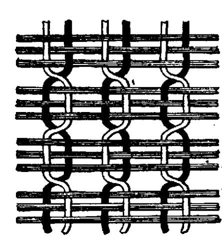


FIG. 943.

gauze pick. Thus four picks in repeat. Drawing in of ground harness and the threading of the doups is shown in Fig. 941. *A* represents the ground harness set, (2 harness), *B* represents the doup (standard harness and skeleton harness).

Fig. 942 illustrates the harness-chain executed correspondingly to Figs. 940 and 941, and so will readily explain itself.

In Fig. 943 another plan of a gauze fabric, combining the common plain cloth with gauze structure, is shown. Liberating picks, 2, 3 and 8, 9, of the present structure would result in changing the same to the fabric shown in its plan in Fig. 940. The drawing in of ground harness set, and the threading of doups to fabric, Fig. 943, is shown in Fig. 944.

In Fig. 945 we illustrate the plan of a gauze fabric similar to the one shown in Fig. 943, the only difference being the using, alternately, left and right-hand threading of the doups. Repeat: four warp-threads, "two pairs," and 6 picks. Drawing in of ground harness set and the threading of doups for producing the present fabric is shown in Fig. 946. In the same we used four-harness for ground-warp, but we can also use the drafting and threading shown in Fig. 935, which only calls for two ground harness in set *A* and will produce the same effect.

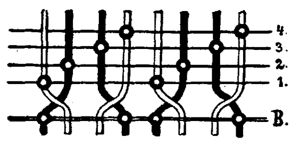


FIG. 946.

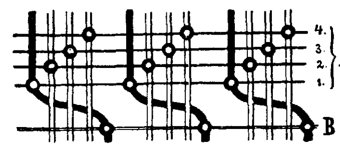


FIG. 948.

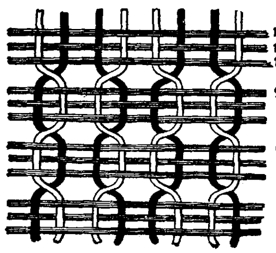


FIG. 945.

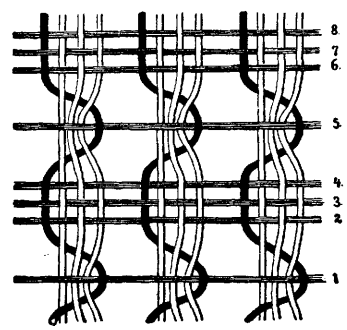


FIG. 947.

Another plan for producing fancy gauze-effects is found in arranging the whip-thread to cross over two or three ground warp-threads; for example, as shown in the plan of a fancy gauze fabric, Fig. 947. In the same we find the whip-thread, after interlacing in connection with three ground-threads into three successive picks, on regular plain cloth, cross below the mate (3) ground-threads for forming at the fourth pick gauze. Repeat: 4 warp-threads, (1 whip, 3 ground), one set drawn in one dent, 4 picks, 3 ordinary plain weaving, 1 douping.

The method of drawing in both systems of warp in the ground harness set, and the method of threading the whip-threads in the doups is shown arranged for three successive sets (correspondingly to fabric sample) in diagram Fig. 948. The same reason which compelled us, in plain gauze, to draw each pair of threads (1 ground, 1 whip) in one dent, leaving as many dents empty between the threading of each pair of warp-threads as required by the size of the perforations in the fabric, requires in the present example of fancy gauze, Figs. 947 and 948, to thread each set of 1 whip-thread and 3 ground-threads in one dent, leaving as many dents empty between the threading of each set as required by the size of perforations wanted in the fabric.

Skeleton	Standard	1st Ground	2nd	3rd	4th	
✕		✕		✕		4th pick
			✕		✕	3rd "
✕		✕		✕		2nd "
✕	◆					1st "

FIG. 949.

Fig. 949 illustrates the harness-chain necessary for weaving the present explained fabric of fancy gauze (Fig. 947.)

The next plan for constructing fancy gauze fabrics is to use two doups in connection with four or more ground harness. In this manner fabric sample, Fig. 950, is constructed. Fig. 951 represents the drawing in of ground harness and the threading of the doups. In the same we find two sections ground harnesses 1 and 2, with doup 1′, forming section 1; ground harnesses 3 and 4, with doup 2′, forming section 2.

In drawing in and threading doups we arranged two repeats for each section, thus 8 warp-threads in repeat of arrangement of pattern. This method of drawing in ground harness as well as threading of doups will, as shown in the fabric sample, allow us to operate each section

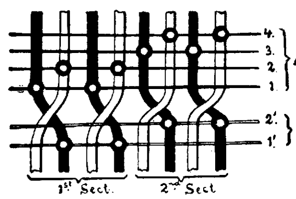


FIG. 951.

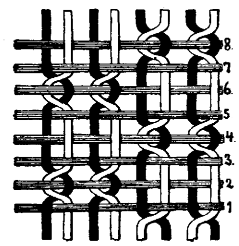


FIG. 950.

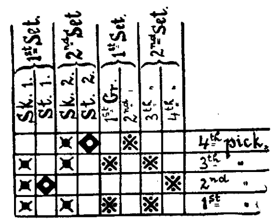


FIG. 952.

independent of the other, thus forming, by arranging the douping for each set for different picks, additional figures in the fabric.

Fig. 952 illustrates the harness-chain for fabric and drawing-in draft, just explained.

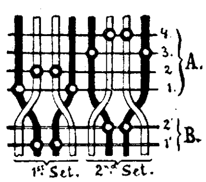


FIG. 954.

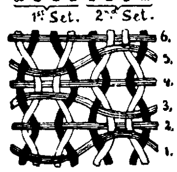


FIG. 953.

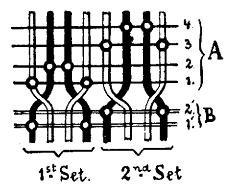


FIG. 956.

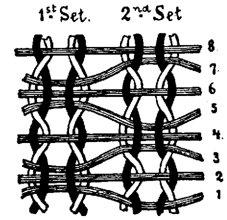


FIG. 955.

In diagram Fig. 953 the plan of another fancy gauze fabric, produced with two doups, is shown. Fig. 954 illustrates the method of drawing in the ground-harness and the threading of the doups, which in the present example is a right-handed and a left-handed doup for each set.

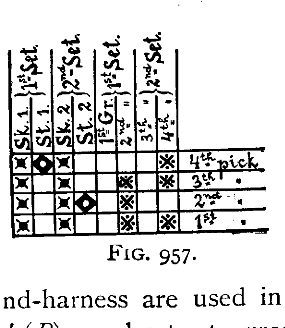


FIG. 957.

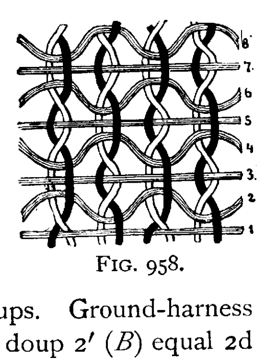


FIG. 958.

Four ground-harness are used in connection with the two doups. Ground-harness 1 and 2 (*A*) and doup 1′ (*B*) equal 1st set; ground-harness 3 and 4 (*A*) and doup 2′ (*B*) equal 2d set.

Fig. 955 illustrates another fancy gauze fabric, produced with two sets of doups and upon a general arrangement in two sections.

Fig. 956 shows the general arrangement for drawing in ground-harness set as well as the threading of the doups. Four ground-harnesses are used in connection with the two doups. Ground-harness 1 and 2 (A) and doup 1′ (B) equal 1st set; ground-harness 3 and 4 (A) and doup 2′ (B) equal 2d set.

Fig. 957 illustrates the harness-chain for the fabric and drawing-in draft just explained.

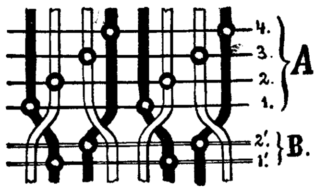


FIG. 960.

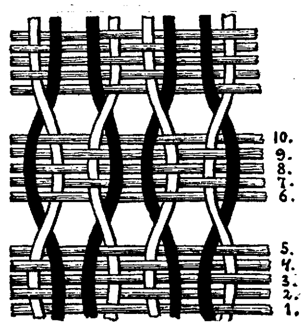


FIG. 959.

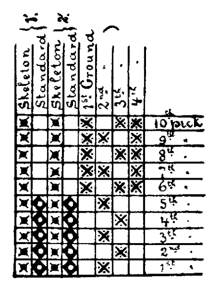


FIG. 961.

Fig. 958 illustrates the plan of another fancy gauze fabric, constructed after the foregoing example, using only warp threads 1, 2, 5 and 6 from the latter (955).

Diagram Fig. 959 illustrates the plan of another fancy gauze fabric.

Fig. 960 illustrates the corresponding drawing in of warp in ground-harness and the threading of the whip-threads in two doups (1′ and 2′),

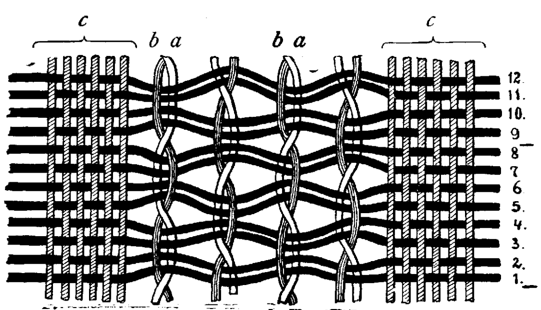


FIG. 962.

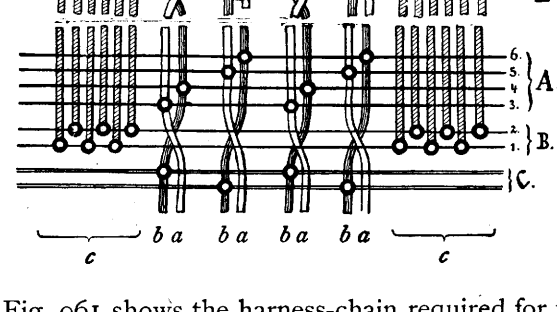


FIG. 963.

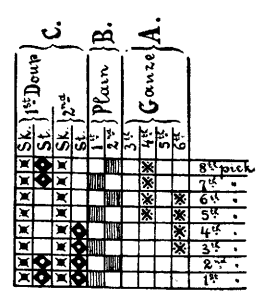


FIG. 964.

Fig. 961 shows the harness-chain required for weaving the fabric shown in Fig. 959.

The "two-section" arrangement, as explained and illustrated, can be extended to three, four or more sections, and in this manner giving fancy effects to an unlimited number of designs.

A further step in producing figured gauze is the combining of gauze and ordinary weaving in the form of stripes. After using a certain number of warp-threads, drawn in its own separate set of harness, for interlacing with the filling either on plain, twill or satin, or in a combination of all three, use similar effects as previously illustrated and explained, either with one, two or more differently working doups, left or right-hand twisting, or all the effects combined. This method of combining stripes of gauze with ordinary woven cloth will also afford great scope for producing figured effects through alternately exchanging both systems of weaving warp and filling ways.

Design Fig. 962 illustrates such a stripe effect in a fabric. Fig. 963 shows the corresponding drawing-in draft and threading of the doups. Warp-threads indicated by *a* (light) are the ground-

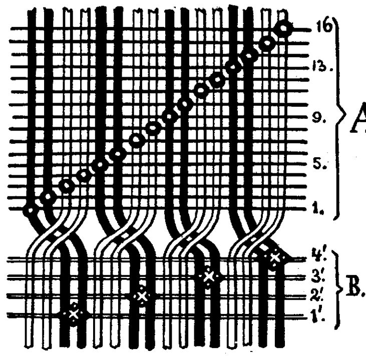


FIG. 965.

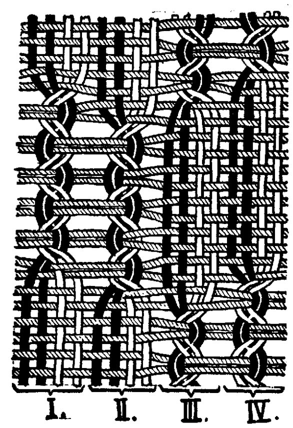


FIG. 966.

threads, and warp-threads indicated by *b* (shaded in vertical direction) are the whip-threads for the gauze; warp-threads indicated by *c* (shaded in diagonal direction) are the threads for producing the ordinary cloth (plain weave in present example). The drawing-in draft shows three different sets of harness used.

The set indicated by *A* represents the ground-harness set for the gauze part; the set indicated by *B* represents the harness for raising warp-threads interlacing in the ordinary cloth; the set indicated by *C* represents the douping set of harness for producing the gauze part.

Fig. 964 represents the harness-chain necessary for weaving a fabric as shown in Fig. 962.

As previously mentioned, figured gauze can also be produced by using two whip-threads against two ground-threads, thus using four ground-harness to one doup. In such an example all four threads must be drawn in one dent.

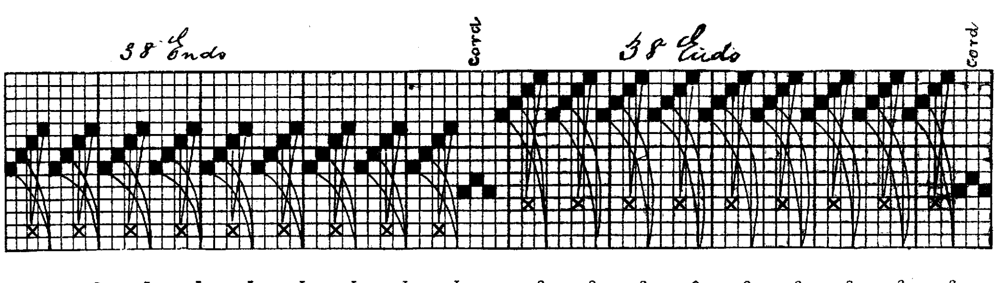


FIG. 967.

Diagram Fig. 965 illustrates a drawing-in draft arranged in this manner, and Fig. 966 shows a corresponding fabric.

The interlacing of the plain for the ordinary interwoven part of the fabric can in this example be extended to any figured weave up to 16-harness. Four independent sets of doups are made use of and so the douping can be correspondingly arranged on each pick at will for each individual doup.

By arranging the present style of drawing in ground harness and threading of doup for a "sectional repeat effect" (repeat the drawing in and threading of doup of each four warp-threads two, three or more times before changing to the next four warp-threads) novel effects for fancy gauze fabrics may readily be obtained (with a correspondingly large figure).

Fig. 967 illustrates the drawing-in draft for a figured gauze on two sets (for illustrating previously mentioned section draws) having four ground harness and one doup for each set (nine repeats in each set). These two sets are also separated by three warp-threads arranged for ordinary weaving, the centre thread of which is indicated as a cord (or a heavy thread, preferably of a different color).

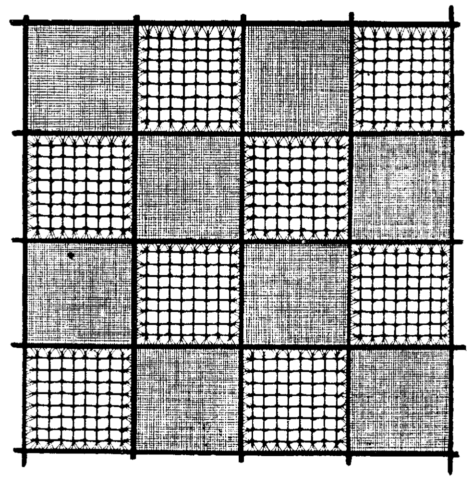
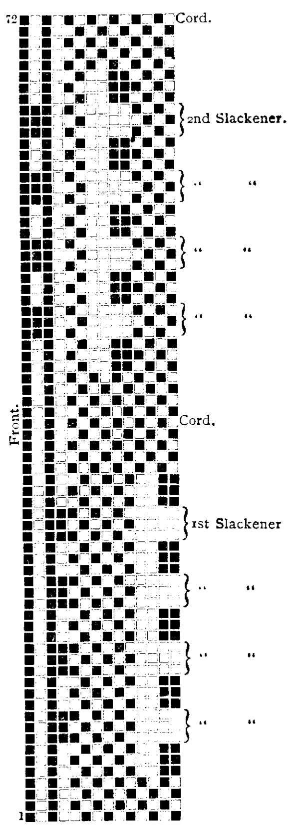


FIG. 968.

If weaving for a certain number of picks ordinary cloth (plain) with set No. 1, and next gauze with set No. 2, changing again afterward, thus arranging for an equal number of picks, set No. 1 for gauze and No. 2 for ordinary cloth (plain), also separating each of these two changes by a few picks ordinary woven cloth, inserting in their centre a heavy filling (similar to cord in warp), we get a checker-board effect for design composed of ordinary and gauze weaving as shown in diagram Fig. 968.



Harness-chain for 14-harness; 72 picks.
FIG. 969.

In reeding the warp for example Fig. 967, leave one, two or more dents empty between each four threads (of two whip and two ground); again, when reaching the three ordinary weaving threads, place the cord in a separate dent and each of the other two ordinary weaving threads in the dent as situated on each side and which is occupied by the set of four threads for gauze weaving. For example, if arranging the reeding of the warp, one dent taken to alternate with one dent left empty all over the regular work, we find the reeding at the part where the cord comes in arranged as follows:

$$\leftarrow 4—0—4—0—5\ (4 + 1)—1\ (\text{cord})—5\ (4 + 1)—0—4—0—4. \rightarrow$$

Fig. 969 illustrates a specimen of a harness chain for weaving the present example of fancy gauze. In the same we find two slackeners used.

1st slackener to lower its whip-threads on picks 8, 9, 10—14, 15, 16—20, 21, 22—26, 27, 28.

2nd slackener to lower its whip-threads on picks 44, 45, 46—50, 51, 52—56, 57, 58—62, 63, 64.

In the beginning of our chapter on gauze we gave the principle of a slackener or easer. We would only state now that for every set of doups which operate the whip-threads at different picks when done on any previous set of doups in the same fabric, we must use a separate slackener; thus in the examples explained as constructed on two sections, we must use two slackeners. This method of using more than one slackener is increased in practical work, when required, up to three but seldom to four.

Diagrams Figs. 970*a* and 970*b* illustrate figured gauze effects as produced by harness work.

Gauze Weaving Mechanism for Open-Shed Looms.

Until lately gauze fabrics, as thus far explained, have been produced only upon looms constructed after the principle known as the "*single-acting*" method, which is characterized by

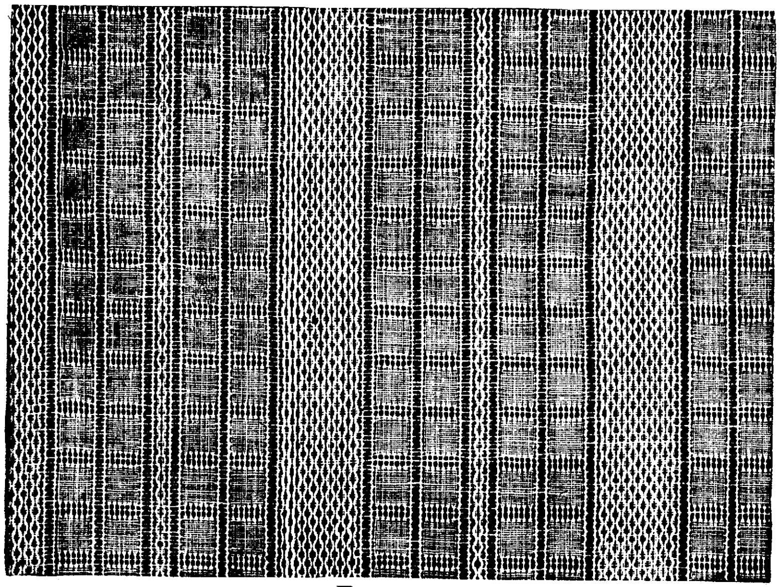


FIG. 970*a*.

leveling the entire warp at every pick, and at this leveling point cross the warps so as to produce the twist. It will be proper to mention that this single-acting method for operating the warp-threads only allows a moderate speed which at the present time is insufficient for the requirements of a loom; hence every manufacturer of this class of fabrics has been anxiously awaiting for

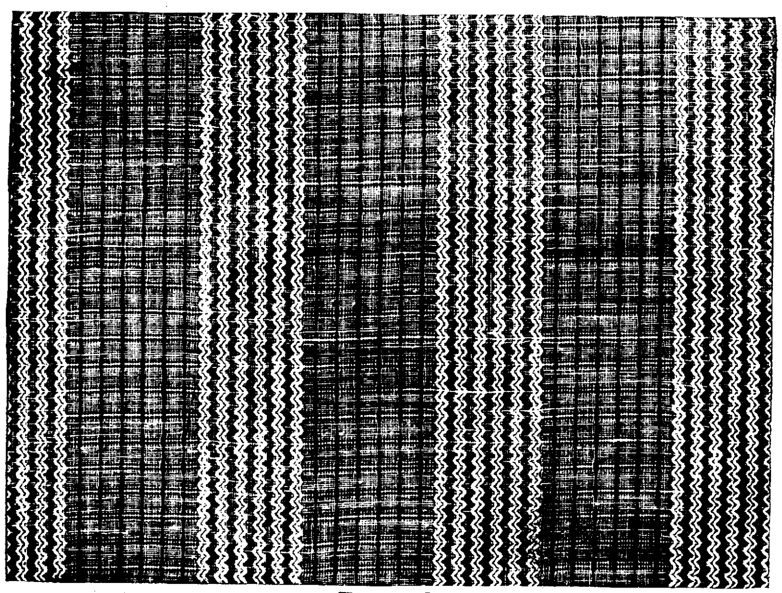


FIG. 970*b*.

a method by which gauze weaving can be successfully executed upon looms built after the principle known as the double-action, giving an increased speed at which the loom can be operated. This gain of speed is owing to the ability of the double-acting loom to select and withhold certain warp-threads for a certain number of succeeding picks of the shuttle, as the pattern being worked may demand.

However, the construction of the *double-acting* loom heretofore employed did not permit of its weaving gauze, because of the inability of the loom to operate a warp-thread so as to raise it for one pick of the shuttle, and then after that pick, lower it and raise it again before the succeeding pick.

The Geo. W. Stafford Manufacturing Co., Providence, R. I., are now building a Double-Action Dobbie which overcomes this defect; hence is capable of weaving gauze with the characteristic high speed of the latter. This is due to the fact that the double-acting loom is adapted to raise a warp for one pick of the shuttle, and then after that pick lower and raise it again before the succeeding pick. The new features of the Dobbie, as thus built by the Stafford Manufacturing Co., are the combining of the ordinary full motions of the recurrent or reciprocating harnesses with a novel and peculiar "*half-and-return*" motion of others of the harnesses when so desired. To gain the "*half-and-return*" motion they use an extra half-stroke lifter (knife), which has half

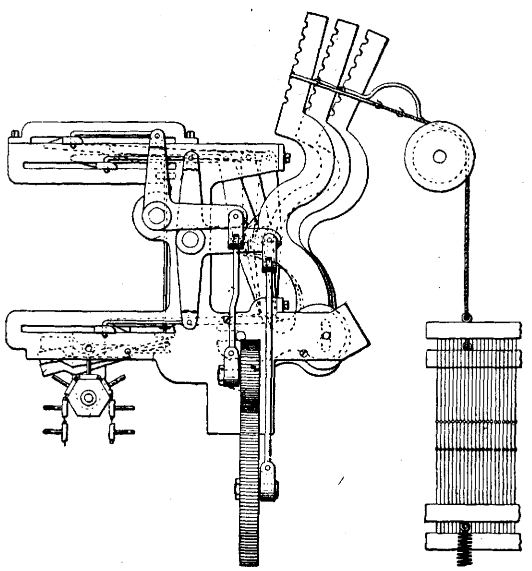


FIG. 971.

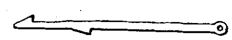


FIG. 971*a*.

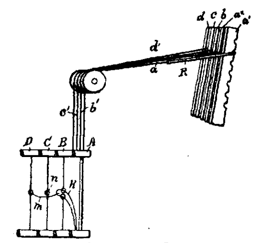


FIG. 971*b*.

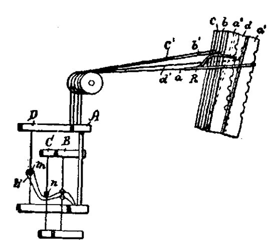


FIG. 971*c*.

the limit of traverse that the ordinary lifters have. The half-stroke lifter has suitable jacks engaging therewith, which are jointed in the common manner with a connecter co-operating with an operating lever.

The half-stroke lifter is reciprocated by a peculiar half-motion device. A second "*half-and-return*" motion for certain other harness is obtained by the arrangement of a pair of ordinary operating levers with connections to a single harness controlled by the levers working simultaneously and oppositely or singly. To give a proper understanding of the subject Figs. 971, 971*a*, 971*b*, 971*c*, 971*d* and 971*e* have been designed.

Fig. 971 represents a rear view of the head or end of the loom containing the harness-operating mechanism. The same also shows the full and half-stroke lifters as at their midway points of travel, and the co-acting jacks and conjoined parts according to their relative positions.

Fig. 971*a* is a view of the double-hooked jack detached.

Figs. 971*b*, 971*c*, 971*d* and 971*e* illustrate four successive relative positions of the harness and harness-operating levers as they occur in the weaving according to the present explained method (plain or gauze).

The parts indicated D and C are portions of harness-frames provided with single-eyed heddles carrying the warps m and n, respectively. These frames are connected by the respective cordings d' and c', with their operating-levers d and c, the former co-acting with full stroke lifters and the latter with the full and half-stroke lifters.

The standard frame B is provided with a doup heddle, through which passes one side of the looped cord or doup k, the ends of which are attached to the skeleton-harness A. Frame B is connected with lever b by means of cording b', and co-acts with full-stroke lifters. The skeleton-harness A (shown in portion) is operated by the half-motion levers a' a^2, to which it is connected by a Y-shaped connecting strap R, both forks of which are equal and connected, one with each lever a' a^2, respectively, and its stem is connected with the skeleton A. The harness-frames B and D make full straight-away motions, while the parts A and C make half-and-return motions, and are also capable of making full straight-away motions. These parts are thus termed, the former "*full-motion*" and the latter "*half-and-return-motion*" harnesses.

Warp-thread indicated by n is the standard warp and warp-thread m the whip-thread.

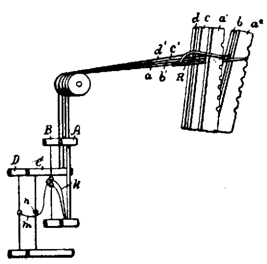


FIG. 971*d*.

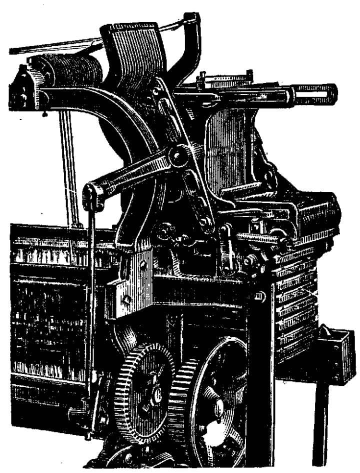


FIG. 971*f*.

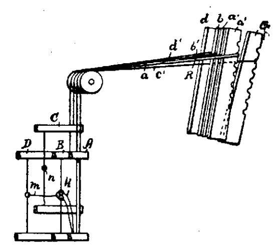


FIG. 971*e*.

The method of operation for producing common gauze weaving is as follows: The harness C, carrying the standard warp n, is given the half-and-return-motion in order to carry the warp to the middle lift, where the descending whip-thread m can be passed under warp n, which then descends, while the doup k raises warp m to form the upper part, while the warp n forms the lower part of the shed for the next pick of the shuttle.

Referring to Fig. 971*b* suppose this position is the first position before starting the loom, which may be supposed to have been previously making gauze stitches, and which came to a rest, while the warps were partly turned on themselves for the next twist. In this position all the harnesses A, B, C, D, are low and the whip-thread and standard-thread, m and n, are leveled and crossed one above the other, before being twisted in the formation of the succeeding gauze stitch. The levers a' a^2 b c d in this first position are all in line and the branches of the forked connections are both taut. Position of Fig. 971*c* is produced by the levers a' and d moving to the outer limit on full-stroke lifters and the levers a^2 b c remaining at rest. This serves to raise harness A and D from lowest to highest limit. By this shedding movement the crossed warps have been tightly twisted on themselves, and the shuttle here makes a pick through the shed and interweaves the filling between the twisted warps. Position Fig. 971*d* is obtained by levers a' and a^2 moving oppositely on full motions—one on a lifter and the other by a retracting-spring, and thereby giving their skeleton-shaft A a half-and-return motion; also, by lever b moving outwardly on a full-stroke lifter, and accordingly moving the standard harness B from low to high limit; also, by lever c

co-acting with the half-stroke lifter and imparting a half-and-return motion to its frame C; also, by the lever d moving inwardly a full motion by means of a retracting-spring, and imparting a like motion to its upper warp-frame, D, which moves accordingly from high to low limit. During this change of position the warps have been crossed and twisted on themselves, forming a gauze stitch, and then the shuttle picks and lays the filling. The next and fourth position of Fig. 971*e* is arrived at by levers d and a' remaining at rest, while a^2 and b are moved in by virtue of their respective retracting-springs, and c is carried out on a full motion by virtue of its jack co-acting with a full-stroke lifter. These movements have caused the doup-frame and harnesses A and B to descend from high to low limit, frame C to rise from low to high limit, and frame D to remain at rest at low limit. In this change of position the warps have not been twisted, but merely crossed side by side, as in plain weaving, and in this position of Fig. 971*e* the shuttle picks and interweaves the filling. This position now changes the position of the upper and under warps (standard and warp-threads) reversely relative to the filling.

From the position of Fig. 971*e* the changes may be made, according to the pattern desired, into a series of succeeding similar positions, and thus make more plain weaving-stitches, or it may be changed back to the second position of Fig. 971*c* and repeat the described gauze pattern.

In Fig. 971*f* we show the (upright lever) double action dobbie as built by the Geo. W. Stafford Manufacturing Company, to which the present explained mode of weaving gauze fabrics applies.

Jacquard Gauze.

In gauze fabrics constructed upon the Jacquard loom, in which it is desired to produce large and elaborate designs by the aid of figuring gauze and ordinary weaving, it will be necessary to arrange a slackener for every whip-thread.

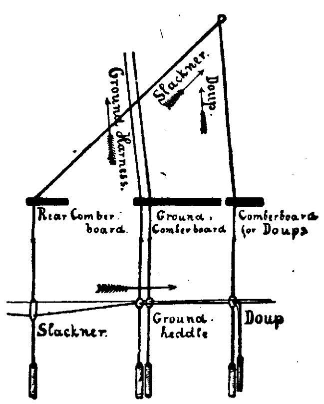


FIG. 972.

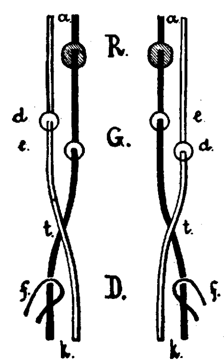


FIG. 973. FIG. 974.

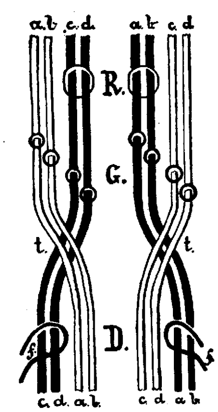


FIG. 977. FIG. 978.

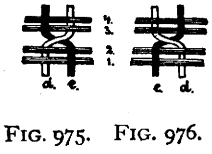


FIG. 975. FIG. 976.

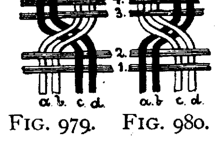


FIG. 979. FIG. 980.

[In my treatise on "The Jacquard Machine, Analyzed and Explained," etc., a chapter is entirely devoted to the method of operation in tying up looms for these fabrics as well as the preparing of designs for the latter fabrics.]

We will next explain the method of operation and adjustment of slackeners in Jacquard fabrics composed of threads working in pairs (one whip-thread douping with one ground-thread).

In such fabrics every whip-thread must be threaded three times; first in a heddle in rear of the regular harness, technically known as the "rear heddle" or "rear harness." These heddles have eyes 1¼ inches high and are fastened from 1¼ to 1½ inches lower than the heddles of the

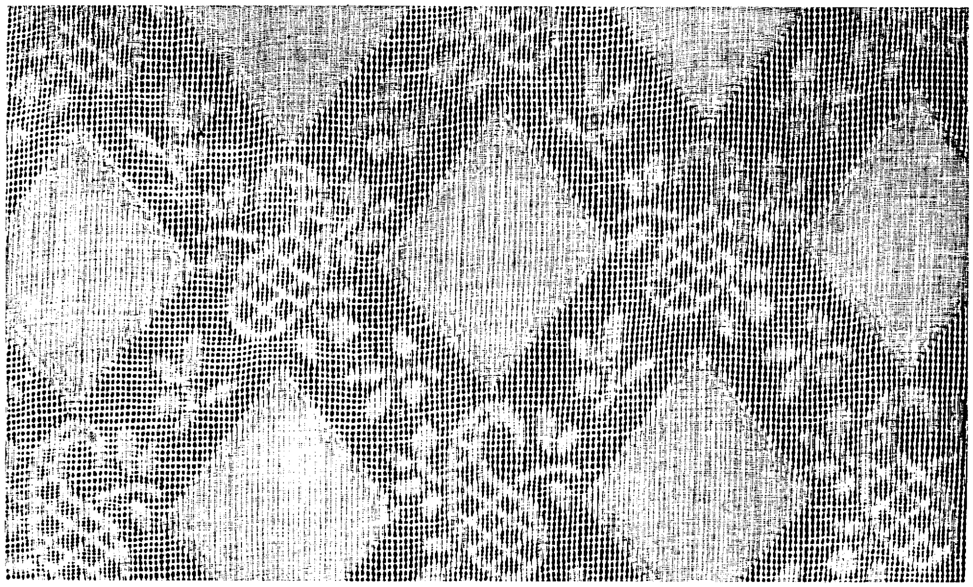


FIG. 981.

ground-harness and the doup. This rear harness is generally placed at a distance of 8 to 10 inches from the ground-harness. Each rear heddle is connected by means of a harness-cord for operating the corresponding standard heddle of the doup at the place where the latter joins the neck-cords of the Jacquard machine (thus both harness-cords to one hook), and consequently the

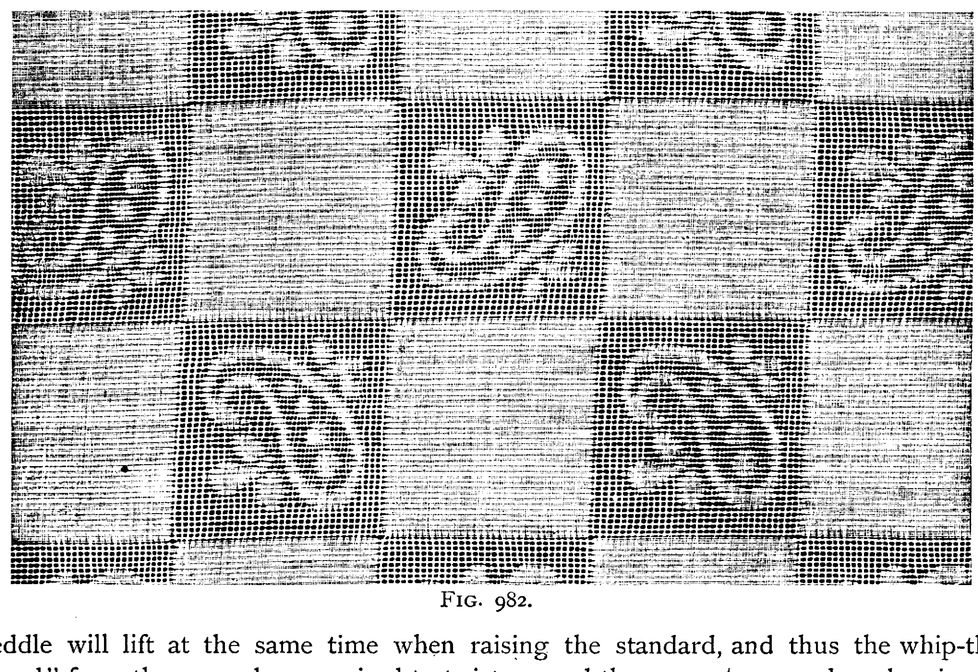


FIG. 982.

rear heddle will lift at the same time when raising the standard, and thus the whip-thread is "slackened" from the rear when required to twist around the ground-warp when douping.

After the whip-thread is drawn in the rear heddle, it is next drawn in its respective heddle of the ground-harness, from where it is threaded to the doup.

In diagram Fig. 972 a plan of the entire procedure as thus far explained is given.

In diagrams Figs. 973 and 974 are shown the ground plans of threading the previously explained Jacquard gauze. Fig. 973 represents the threading of the whip-thread in a doup situated at the left-hand side of the ground-thread (pair). Fig. 974 illustrates a respective threading of the whip-thread to a doup situated at the right-hand side of the ground-thread (pair). Both positions of doups to their respective ground heddle are mentioned as considered by the weaver standing at work in front of the loom. Letters of reference are selected correspondingly: R = rear-harness; G = ground-harness; d = heddle for ground-warp; e = heddle for whip-thread; t = passing of the whip-threads below ground-warp; D = doup-harness; f = doup. Whip-threads are shown in full black, ground-threads are shown outlined.

Fig. 975 shows the corresponding crossing as produced in the fabric by using the arrangement illustrated in diagram Fig 973.

Fig. 976 shows the corresponding crossing as produced in the fabric by using the arrangement illustrated in diagram Fig. 974.

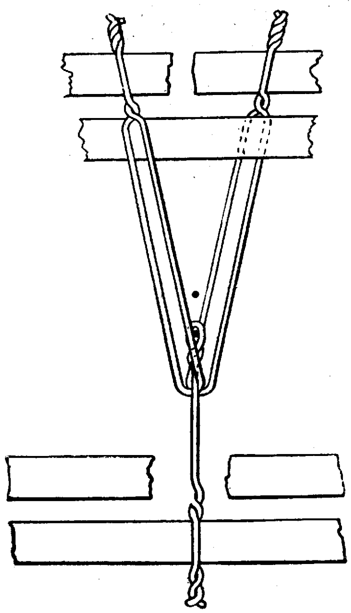


FIG. 983.

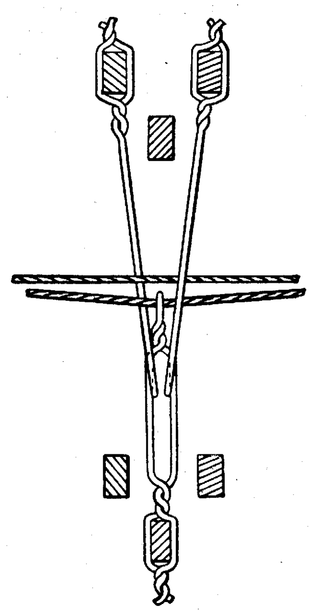


FIG. 984.

Diagrams Figs. 977 and 978 illustrate the ground plans of using two whip-threads for douping against two ground-threads. The following letters of reference are selected correspondingly: R = rear harness; G = ground-harness; D = doup-harness; t = passing of the whip-threads below ground-threads; f = doup. Threads a and b in Fig. 977 = ground warp-threads; threads c and d in Fig. 977 = whip-threads. In diagram Fig. 978 the ground-threads are indicated by letters c and d and the whip-threads by letters a and b.

Diagrams Figs. 979 and 980 show the corresponding crossings as produced in the fabric by the respective threadings of whip and ground-warp, illustrated in diagrams Figs. 977 and 978.

Fig. 977 illustrates the threading of the whip-threads to a doup situated at the left-hand side of the ground-threads. Fig. 978 illustrates the threading of the whip-threads to a doup situated at the right-hand side of the ground-threads.

Figs. 981 and 982 illustrate two examples of Jacquard gauze produced upon principles previously explained.

Substitutes for the regular doups have lately been patented by C. A. Littlefield, consisting of a peculiar combination of metallic half-heddles.

Diagrams Figs. 983, 984, 985, 986 and 987 illustrate his invention.

Fig. 983 is a front view of portions of a set of heddle-frame bars with the invention applied.

Fig. 984 illustrates a vertical section of the bars of the heddle frame, and showing the position of the yarns before the crossing takes place.

Fig. 985 is a similar view showing the half-heddles after the crossing takes place.

Figs. 986 and 987 illustrate a modified form of needle, which for some fabrics are preferable.

The present method of cross-weaving requires three common harness-frames for each set of doups. The middle frame is supplied with a specially-shaped half-heddle or needle formed of properly twisted wire or stamped from sheet metal. When the needle or half-heddle is made of wire, the latter is twisted to form an eye at the top end, through which passes the thread or threads required to produce the desired effect in the pattern woven. Below the twist which forms the eye the wires are separated in such a manner as to form a continuous slot or loop from near the eye to a point at or near the lower end, where the half-heddle is formed with an eye or loop adapted to receive the bar upon which the half-heddle is strung. A single bar only is used for the support of this half-heddle. Through the long slot or loop are passed other loop wires, forming half-heddles, there being two of this description to each one of the first named. These

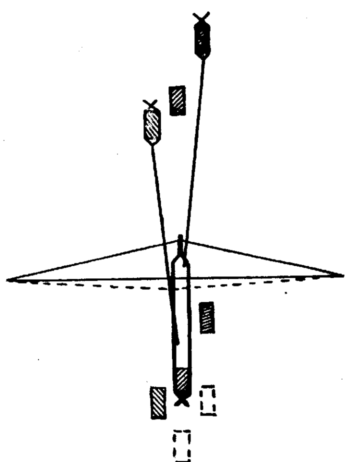


FIG. 985.

FIG. 986.

FIG. 987.

wires are secured, one on the right the other on the left, to the two outside heddle-frames at the top, being strung on the ordinary cross-bars of the harness-frames, the latter passing through suitably-sized loops at the top ends of the looped wires.

To produce the desired pattern, the thread which is to be twisted or crossed about its adjacent thread must be drawn through the eye at the top of the lower half-heddle, and the thread or threads about which it is to cross are to be drawn in between the two upper loops or half-heddles, and in line with the thread passing through the lower heddle-eye. When the harnesses are at rest, the warp-line is established so as to bring the yarn passing through the lower heddle-eye to a position from which it can be drawn up at the forming of the shed upon the desired side of the yarn about which it is to be turned or twisted. The crossing is effected by alternately operating the heddle-frames to which the upper half-heddle or looped wires are secured, the shed being formed by lifting the harness or shaft to the right or left of the frame to which the half-heddles or needles are secured at the bottom. The upper looped wire not lifted slides easily down the long slot or loop in the lower half-heddle, the latter and the upper half-heddle to which the lifting power is applied being drawn into line, thus forming a guide for deflecting the thread about which the crossing or tie is formed to the desired side of the needle or lower half-heddle.

Cross-Weaving for Chenille Fabrics.

A method of cross-weaving other than the one derived by the douping arrangement is largely practised in the manufacture of low-grade Chenille as used for rugs, mosquito-netting and similar fabrics.

In weaving these fabrics the ground-harness set and the douping set of harness are substituted by using two horizontal wooden slats (shafts) of a sufficient strength, which have in a vertical position metal heddles (harness plates or needles) inserted, pointing towards each other. These harness plates are made of thin pieces of metal, each formed with an eye through it for the warp-thread (*r* in Fig. 988*a*) and each beveled at its end near the eye, as shown at *q*, in the same diagram, to form an angle to bring the passing points as near together as possible.

The eyes *q* are formed by making an orifice through the harness-plates and bending the stock on each side of the orifice in opposite directions, so as to permit the warp-threads to pass in a straight line through the eye, and so that there will be but little friction of the warp in the eyes.

In Fig. 988*b* a front elevation of those parts of a loom essential to a clear understanding of the method of operation for these fabrics, is shown. (Warpbeam, lay and shuttle-movement are omitted.)

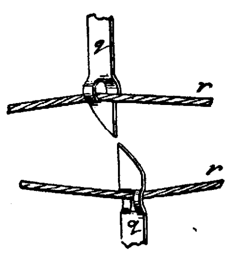


FIG. 988*a*.

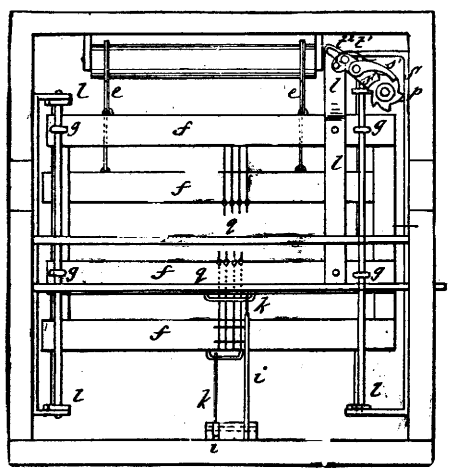


FIG. 988*b*.

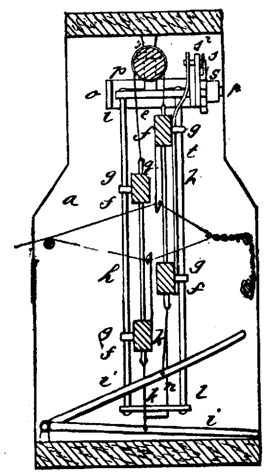


FIG. 988*c*.

Diagram Fig. 988*c* illustrates a transverse sectional view. Letters for indicating the different parts in the diagrams are selected to correspond.

Diagram Figs. 988*a*, 988*b*, 988*c*, illustrate and explain the loom for cross-weaving as patented by Messrs. G. Oldham and Wm. Dixon.

The frame shown is composed of the two side pieces, base, and top cross-piece, on the under surface of which latter are attached brackets for the roller, over which the cords or straps pass, to the ends of which cords or straps the heddle shafts are attached. They are guided at each end by staples *g g*, passing around the upright rods *h h*, and are adapted to be alternately reciprocated by the levers *i i*, pivoted to the base, and connected to the heddles by the connecting-rods *k k*. The upright rods at each end of the heddle-shafts are connected together at their upper and lower ends by plates or cross-pieces *l l*, and these plates or cross-pieces are centrally pivoted to the horizontal supports or arms, forming in this instance a part of the upright plates which are secured to the inner surface of the side pieces of the main frame. In a cross-brace, *o*, is journaled the horizontal shaft *p*, contiguous to one of the plates *l*, which shaft is formed with opposite cams at its ends, so that the shaft when revolved will cause the cams to act alternately against the ends of the plate *l* and vibrate it, and through it and the rods *h h* and other plates, *l*, reciprocate the heddle-shafts *f f* laterally and horizontally at the same time they are reciprocated vertically, which cause the harness-plates to cross the warp-threads *r r* over the filling-threads and to twist them together or cross them between the filling-threads.

The cam-shaft *p* is revolved intermittently by the ratchet-wheel *s*, secured to one end of the shaft, and the pawl *s'*, pivoted to the plate s^2, which is pivoted at one end upon the shaft *p* near the ratchet-wheel *s*, and connected at its other end to the plate *t*, attached to the front heddle-shaft, so the up and down movement of the heddle vibrates the plate s^2 and causes the pawl to turn the shaft *p* at each upward movement of the heddle. The plate s^2 is connected to the plate *t*, in this instance, by the pin *t'* entering a slot, t^2, made in the plate *t*, to accommodate the lateral movement of the heddle.

Another loom for weaving this chenille as used for rugs and curtains has lately been invented by Messrs. H. & C. Topham. Their improved method of operation is shown in diagrams Figs. 989*a* and 989*b* and 990*a*, 990*b* and 990*c*. (Letters of reference for each diagram are selected to correspond.) Diagram Fig. 989*a* represents the end view of a loom, clearly showing its improvements. Fig. 989*b* is a longitudinal section in the line 1—2, Fig. 989*a*.

Figs. 990*a*, 990*b* and 990*c* are perspective diagrams (as used in the illustrations of their invention), showing the prongs carrying the warp-threads in their different positions.

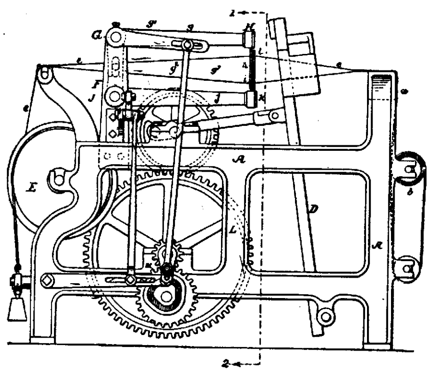


FIG. 989*a*.

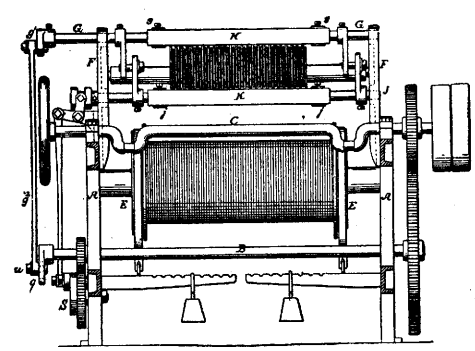


FIG. 989*b*.

Referring to letters of reference: *A A* are the side frames of the loom, *B* is the main shaft and *C* the crank-shaft, *D* is the lathe, *a* is the breastbeam and *b* the cloth-roller, *E* is the warp-beam, *e* the warp-threads.

On the two upright extensions *F* of the side frames is a rock-shaft, *G*, extending from one side of the loom to the other. This rock-shaft carries two arms, *g g*, having at their outer ends a comb *H*, provided with downwardly projecting prongs *h*, which have eyes, *i*, at their outer ends, through which pass one set of warp-threads, *e*. Situated below the rock-shaft before mentioned, but having its bearings in the same upright extensions *F F*, is a rock-shaft, *J*, having two arms, *j j*, which carry a comb, *K*, the prongs *k* of which project upward. These prongs are provided with eyes, *l*, through which the remaining warp-threads pass. Rock-shafts *G* and *J* are connected in such a manner that when the comb *H* is raised the comb *K* is lowered, and *vice versa*.

Rock-shaft *G* derives its motion from main shaft *B*, as clearly shown in diagrams Figs. 989*a* and 989*b*. To regulate the movement of the comb *H* the crank *q* is slotted and carries a crank-pin, *u*, adapted to be adjustably secured therein, so that the rod g^2 can be adjusted either on the crank *q* or arm *g'*.

The lower rock-shaft *J* has also an independent sidewise movement, so that the prongs of the comb *K* will have a sidewise motion as well as the vertical motion. Motion is given to the shaft *J* by a cam, *S*, driven from the main shaft. When the prongs of the combs are parted the sidewise movement of the lower comb and its shaft takes place

The operation is as follows, reference being made to Figs. 990*a*, 990*b* and 990*c*, as showing the prongs carrying the warp-threads in the different extreme positions during weaving. The eyes in the ends of the prongs of the combs are threaded with the warp-threads *e*, and the filling is thrown across, as shown in Fig. 990*a*, while the combs are in the position shown in that figure. The combs are then parted, as shown in Fig. 990*b*, which will tie in the filling previously inserted. Another pick is then made, as shown in Fig. 990*b*, after which a sidewise movement is given to the lower comb, which causes the warp-threads to twist around each other when the combs come

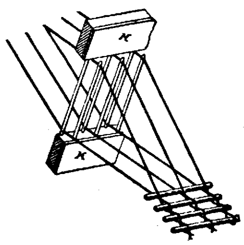


FIG. 990*a*

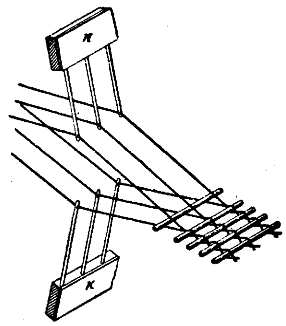


FIG. 990*b*.

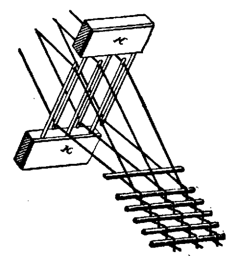


FIG. 990*c*.

together, as shown in Fig. 990*c*. The filling is then pressed towards the woven part of the fabric and another pick is made, throwing another filling across.

Cross-weaving as Used for the Manufacture of Filtering-bags.

Another kind of fabrics (similar to those previously mentioned), which contain the cross-weaving for their principle of construction, are those open-mesh seamless fabrics that are used for filtering-bags for saccharine liquids, etc.

Diagrams Figs. 991, 992 and 993 are given to illustrate the method of operation for producing these fabrics, as patented by B. Muench.

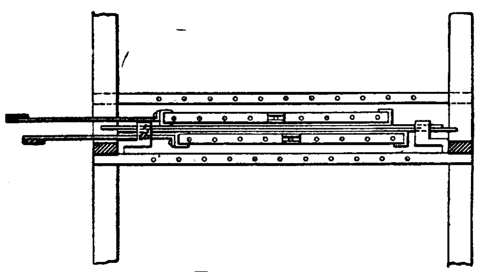


FIG. 991.

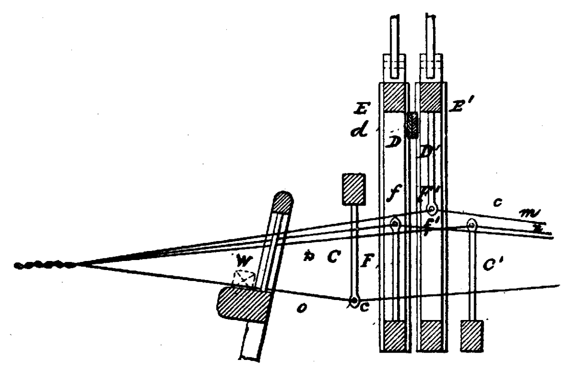


FIG. 992.

Fig. 991 is the top view of part of a loom, showing the fixed and reciprocating frames; one of them has upwardly projecting needles and the other downwardly projecting needles.

Figs. 992 and 993 are cross-sectional views of the harness part of the loom, showing the warps in their different positions. Letters indicating the different parts in the diagrams are used with reference to the following explanations as to construction of these fabrics.

The operation is as follows: Two sets of warps, *o p* and *m n*, are used, one set, *o p*, being used to form the bottom of the seamless fabric in the loom and the set *m n* to form the top of the fabric; the same filling being used for both sets of warps. The warps *o* are passed through the eyes *c* of the front row of fixed needles, *C*, which project downward. The warps *n* are passed through the eyes c' of the rear row of fixed needles C', which project upward. The warps p are passed through the eyes f of the needles F in the front vertically-movable frame D, said needles F projecting upward, and the warps m are passed through the eyes f' of the needles F' in the rear vertically-reciprocating frame D', said needles projecting downward. The warps o and p, which are passed through the eyes of the needles of the front fixed and vertically-reciprocating bar and frame, are the series for making the bottom of the seamless fabric, and the warps m and n, which are passed through the eyes of the needles in the rear fixed and vertically-reciprocating bar and frame, are the series for making the top of the seamless fabric. As shown in Fig. 992, the warps m, n and p are raised and the warps o lowered. The shuttle W is thrown through the space between the warps when those warps are in the positions shown in Fig. 992, and when the shuttle has passed, the filling rests on top of and across the warps o. After the shuttle has thus been thrown, the warps o and p are crossed by the lowering of the frames D and D', and thus the filling is held by warps o and p which form the bottom of the seamless fabric. When the warps are in the position shown in Fig. 993 (and the shuttle thrown), the frames D and D' then raised, the warps m and n are crossed, and the filling is held by warps m and n, forming the top of the seamless fabric, and so on.

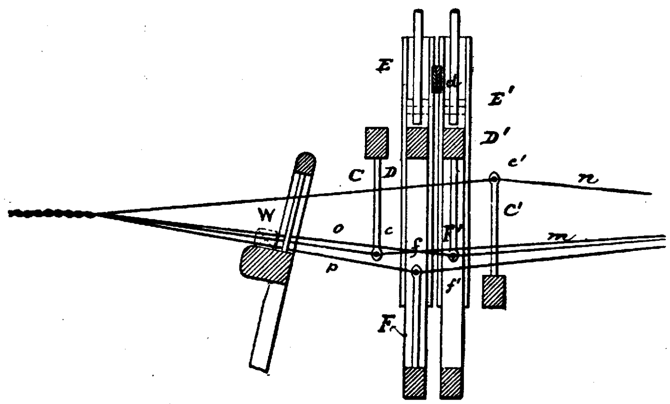


FIG. 993.

In order to hold warps and filling in the position in relation to each other in the fabric, it is necessary that the warps be twisted after each shot. This twisting is obtained by reciprocating the frames E and E' laterally, for as each series of warps has part of its warps passed through laterally-reciprocating needles it is evident that by the shifting of the reciprocating needles such warps will become twisted. The frame D is shifted every time the filling has been shot between the warps o and p, and the frame D' is shifted every time the filling has been shot between the warps m and n.

Cross-Weaving as Used for Producing Fast Centre Selvages.

Cross-weaving is also used in producing fast centre selvages if weaving two or more pieces of a fabric at the same time in the loom. This method of producing such selvages finds extensive use in the manufacture of velvet ribbons, scarfs, and similar fabrics characterized by their narrowness. In dress goods and similar abrics, seldom more than two or three widths are put together to be woven in one width on the loom.

In reeding for fabrics woven with fast centre-selvages, we must be careful to leave one, two or more empty dents in the place where the fabric has to be cut in strips, or separated in pieces after leaving the loom.

In Diagrams 994 and 995, two specimens of such interlacing for headings are shown. In the same threads, B, shown in black, represents the whip-threads. Threads C, illustrated outlined and shaded, represent the ground warp. Threads indicated A, and shown outlined, represent the ordinary woven part of the fabric. The filling is shown outlined in a horizontal position (D).

Ground warp-threads C and corresponding whip-thread B must be drawn in one dent.

In Diagrams Figs. 996, 997 and 998, illustrations are given of the weaving of such fast centre selvages in double pile fabrics, woven side by side in a broad loom. The method of operation is patented by Messrs. Lister and Reixach. For forming two adjacent fast inner selvages, both in the upper and lower cloth in double-pile fabrics, and so as to form the upper cloth immediately

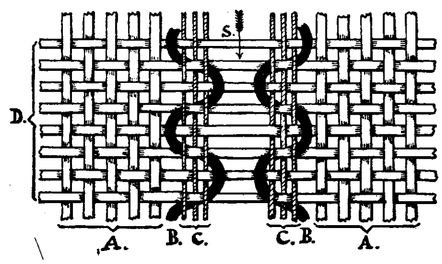


FIG. 994.

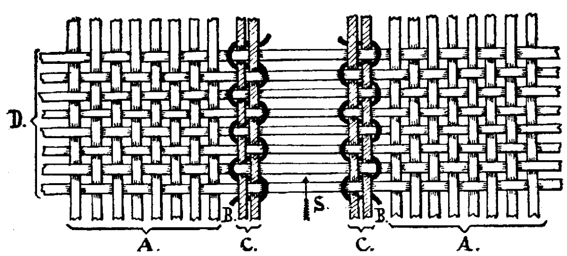


FIG. 995.

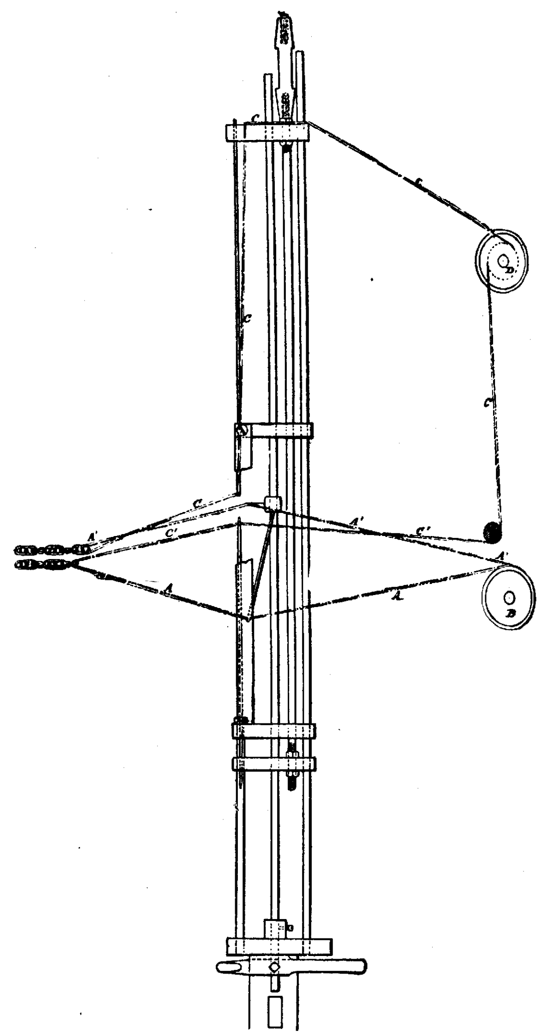


FIG. 996.

above the fast selvages in the lower cloth, two sets of needles of two needles each are required. The needles in the upper set are placed in a line with the needles of the lower set, and made to point downward, while those in the lower set are made to point upward. Both sets of needles are fixed in slides, which can be simultaneously moved up or down in a fixed frame. The needles, near to their points, have eyes formed through them, and through the eyes of the upper pair the binding-threads must be threaded which are to form the fast selvages in the upper cloth, and through the eyes of the lower pair the binding-threads which are to form the fast selvages in the lower cloth must be threaded. With these needles there are also employed two pairs of thread-eyes, to which a lateral movement can be given from the low shaft. Through the upper pair pass two selvage-warps for the upper cloth, and through the lower pair two selvage-warps for the lower cloth. These two pair of eyes are set one above the other at such a distance apart as to leave space enough for a shuttle to pass to and fro between the warps threaded through them. The points of the upper pair of needles are likewise set at a distance from the points of the lower pair of needles. In the upward and downward movement of the needles their points are brought alternately above and below the selvage warp-threads with which the binding-threads, threaded through

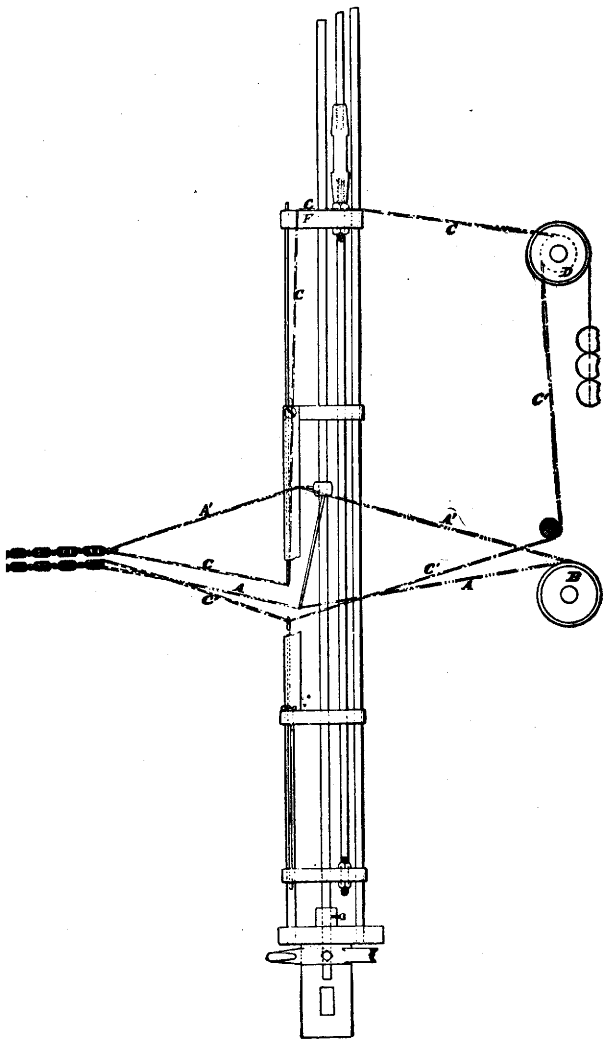


FIG. 997.

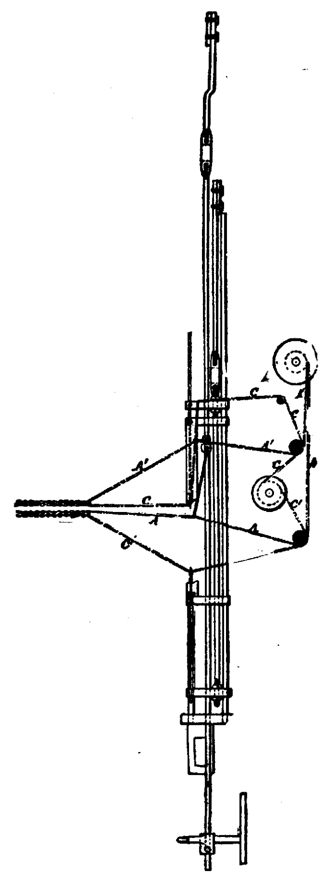


FIG. 998.

the needles, are to be crossed, and when the needles are at one or the other end of their stroke the thread-eyes are made to shog sidewise, so that the warp binding-threads, which receive an up-and-down motion, may be brought to one side and then to the opposite side of the warps, which receive a sidewise movement, and the binding-threads and warps are thus twisted together with a false twist, which, in conjunction with the filling, links them together and forms a fast selvage.

Fig. 996 illustrates a side elevation of mechanism required to be used with a single shuttle-loom for forming the fast inner selvages in the two cloths of a double pile fabric, showing the binding and warp-threads in position while weaving the bottom piece.

Fig. 997 is a side elevation corresponding to the previous one, except that the binding and warp-threads are shown in position while weaving the top piece.

Fig. 998 is a side elevation of the selvage forming mechanism for a two-shuttle loom. Parts of the framework of the loom are illustrated, cut away in the three diagrams to show the needles more clearly.

In Figs. 996 and 997 *A* and A^1 are selvage-warps, which are drawn from a reel or bobbin, *B;* but which also might be taken from the same beam as that upon which the other selvage-warps are carried, or from the main warp-beam. *C* C^1 are the binding-threads, which are drawn from a reel or bobbin, *D*. The warps *A* A^1 are threaded through the thread-eyes, to which a sidewise shogging movement is imparted. The binding-threads *C* C^1 are threaded through the eyes of the needles, to which an up and down movement is imparted.

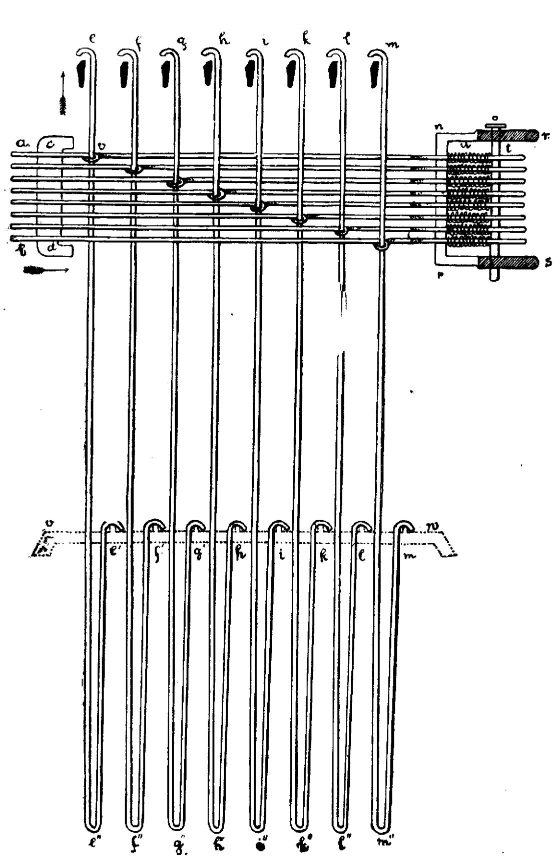


FIG. 999.

The operation is as follows: When the parts are in the position shown in Fig. 996, three picks filling are put into the bottom cloth, and the thread-eyes are during this time shogged sidewise a distance equal to the distance between the needles of each pair. Afterward the needles descend and three picks filling are put into the upper cloth. After this the needles rise and three picks of filling are put into the bottom cloth, and during this time the thread-eyes are shogged back into their former position, and so on continuously. In this way the fast selvage edges are formed in each cloth at a short distance apart from one another, and each cloth can be severed along the small space in between these two selvage edges.

The mechanism shown in Fig. 998 for a two-shuttle loom necessarily differs somewhat from that shown in Figs. 996 and 997, because when two shuttles are thrown simultaneously it is necessary to open two sheds for the shuttles to be passed through.

THE JACQUARD MACHINE.

The Jacquard machine is required for the interlacing of fabrics in which a great number of ends of warps are bound differently in the filling. Every Jacquard machine can be divided into the following parts:

1. The frame and the perforated board through which the neck-cords are passed. 2. The griffe and the necessary attachments for lifting the same. 3. The hooks. 4. The needles. 5. The spring and spring-frame. 6. The needle-board. 7. The cylinder, hammer, and batten. 8. The catches. 9. The cards. 10. The Jacquard harness.

In Fig. 999 we give a clear understanding of the principle of the construction of a Jacquard machine by means of the sectional cut of one cross row in a 200 Jacquard machine, containing 8 hooks, (representing an 8-row-deep machine), illustrating by it the arrangement of hooks, needles, griffebars, springs, frame for holding the latter, and the needle-board. *e*, 1st hook; *f*, 2d hook; *g*, 3d hook; *h*, 4th hook; *i*, 5th hook; *k*, 6th hook; *l*, 7th hook; *m*, 8th hook. These hooks are held in their required places by the eyes of the needles (see place v at hook 1) through which the former are passed.

The needles rest with their heads a to b, in the needle-board, extending outside, towards the cylinder, for about ½ inch. The rear part of the needle—the loop—is passed between two bars of the spring-frame, n, p, and held by the latter firmly, but with sufficient play for a longitudinal motion for pressing towards their springs. The pin O, is inserted for holding the springs in their places, requiring one pin for each vertical row of needles. If the heads of the needles are pushed backwards, in the direction of arrow, the hooks are also moved. If the needles are not pushed, the upper crooks of the hook will remain in position, as in drawing, over the griffebar; and raising the latter, will consequently raise every one of these hooks.

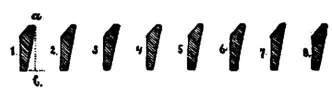


FIG. 1000.

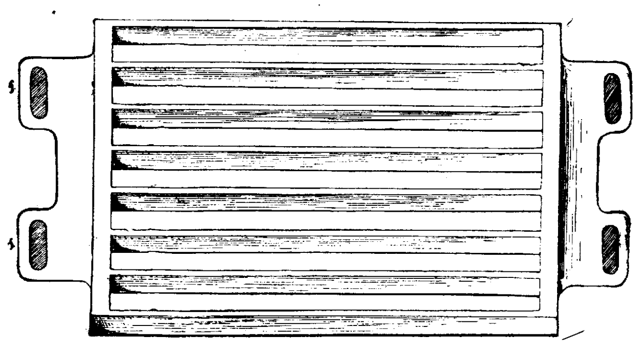


FIG. 1001.

Therefore, if a blank card is pressed against the 208 needles of the machine, used for present illustration, all the needles and hooks will be pushed back out of the way of contact with the griffebars, thus causing an empty lift when they are raised; while by pressing with an empty cylinder, or with a card containing as many holes as the machine has needles, and so placed that the holes are exactly opposite the needles, none of them would be moved, and each hook would remain vertical over its griffebar; and raising the griffe will lift every hook.

The griffe which has its section of the different bars represented in Fig. 1000, is shown in its top view in Fig. 1001. In the drawing, the dark-shaded places, marked f, are the hollow places through which the screw is fastened to the plunger.

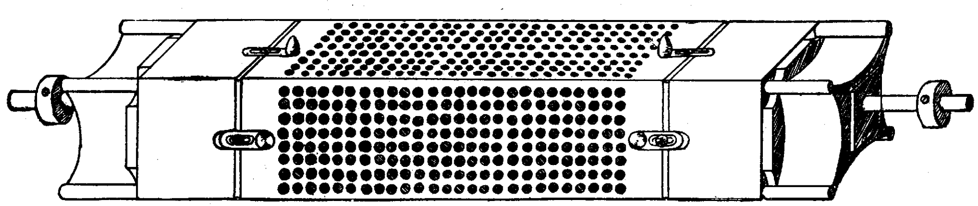


FIG. 1002.

The cylinder around which the cards are working (for operating the needles and these in turn the hooks, neck-cords, leashes and warp-threads) is carried in the batten. This batten has sufficient vibratory motion to enable it to move the required distance away from the needle-board. After coming in contact with the catch, it still moves until the cylinder has performed a complete turn. The cylinder is steadied in the required position by the hammer pressing, by means of a spring, towards the lantern from below. Fig. 1002 represents the cylinder with the lantern for turning the same, by means of the catches mentioned before.

The raising of the "griffe," which in turn also operates the other parts of the Jacquard machine, as previously explained, is generally done by means of a lever arrangement. Fig. 1003 represents the perspective view of a 400 single-acting Jacquard machine (W. P. Uhlinger, Philadelphia, builder).

Fig. 1004 illustrates the "Rise and Fall Shed Jacquard" as built by the Geo. W. Stafford Manufacturing Co., Providence, R. I.

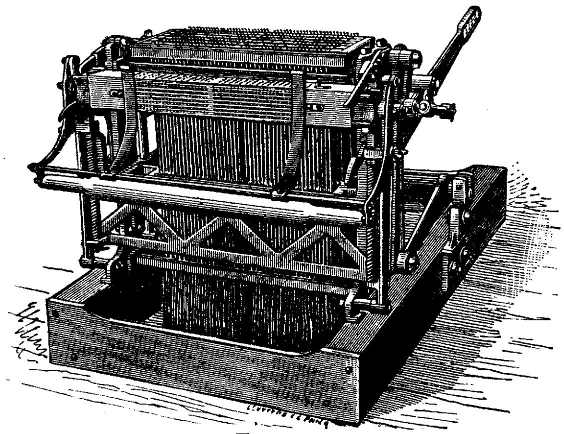


FIG. 1003.

The Jacquard cards have, for regulating the required raising and non-raising of the hooks, holes punched so as to allow their respective needles to penetrate into the cylinder holes and are interlaced in an endless arrangement; hence, one card is brought after the other in rotation towards the needles.

If using a great number of cards in a set, they are made to fold into a "rack." This is done by attaching a wire 1 to 1½ inches longer than the cards, at the junction of say every 12th to 20th card. (See *c*, Fig. 1005, between cards indicated by *a* and *b*.)

Modification of the Single-Lift Jacquard Machine.

During the past few years various modifications in building Jacquard machines have been

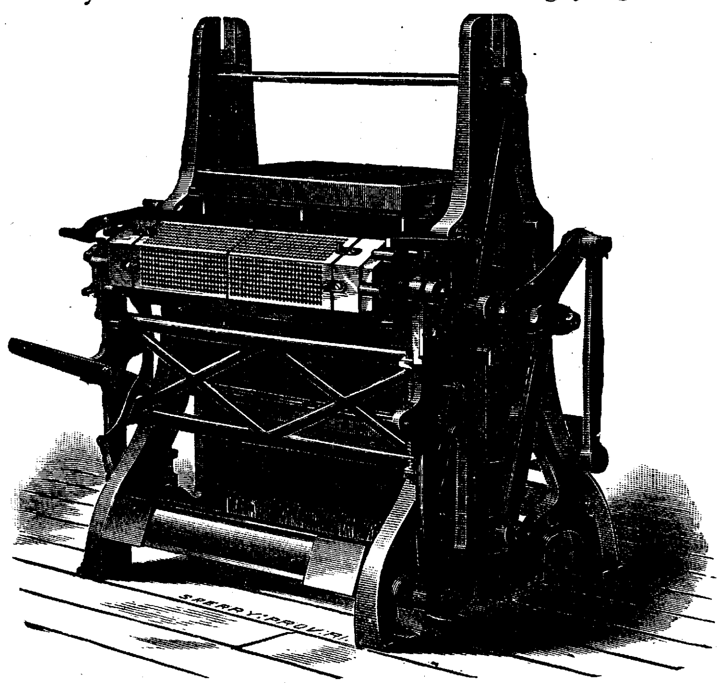


FIG. 1004.

introduced. The object of this has been either the simplifying of designing and card stamping or the saving of card paper and labor for special fabrics, as in the "Ingrain Carpet Machines," the "Brussels Carpet Machines," etc.

Again, the item of "speed," and consequently more production in cloth for a given time, in damasks and similar fabrics, has been satisfactorily solved by the construction of the "Double-Lift, Double-Cylinder Jacquard Machine." Another principle of a modification

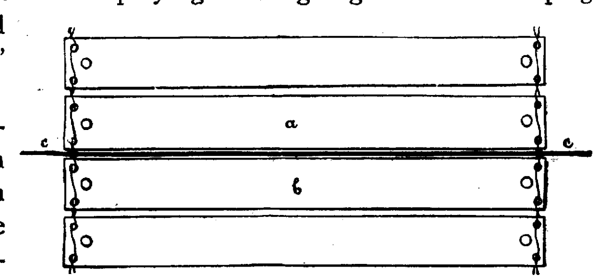


FIG. 1005.

over the single-lift Jacquard machine is to be found in the "Double-Lift, Single-Cylinder Jacquard Machine," which has for its object the saving of the warp by operating each individual thread only when required to, by the changes from *up* to *down*, or *vice versa*, in the design or weave, etc. These machines are, in their principle of construction and method of operation, individually explained and illustrated on pages 67 to 72 in my treatise on "The Jacquard Machine."

Card Stamping.*

As mentioned previously, holes are punched in each individual card, according to the design. This is done for each row at one stroke or revolution of the piano card-punching machine.

Fig. 1006 illustrates the perspective view of such a machine (operated by belt-power), while Fig. 1006*a* represents the top view of the "head" (cover taken off).

In the same, the small open spaces for holding the punches for stamping the holes in the cards for the needles, as well as the large opening for holding the punch for stamping the peg holes, are clearly visible.

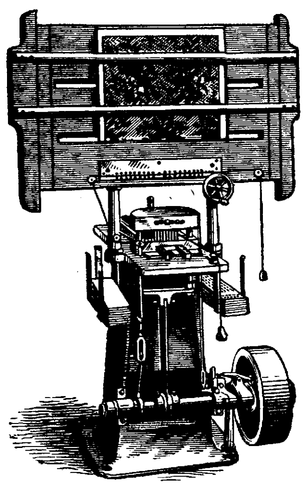


FIG. 1006.

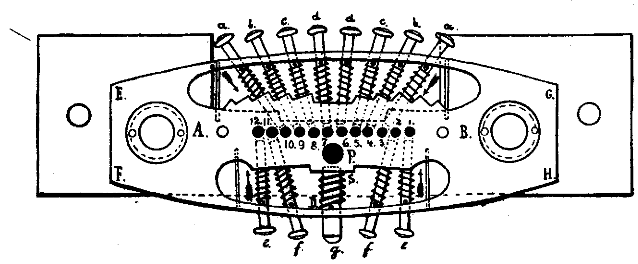


FIG. 1006*a*.

If several sets of cards of one design are required for starting a corresponding number of looms, and the first set has been produced by the piano machine, exact duplicates can be obtained by means of the "Repeating Machine." In this machine the entire card is duplicated at one stroke.

The Jacquard Harness.

To the lower end of the hooks in the Jacquard machine the neck-cords are adjusted. The latter are passed separately through one of the corresponding holes of the perforated bottom board. To these neck-cords are fastened the leashes of the Jacquard-harness, about one-half to one inch above the frame containing the rods which guide the neck-cords vertically, as the hooks are raised and lowered.

The different harness-cords are threaded through the "comber-board," or the "journals," in various ways, and are called "tie-ups." After the harness-cords are threaded the heddles are adjusted.

*In a chapter on "Preparing and Stamping of Jacquard Cards," comprising pages 85 to 102 of the author's treatise on "The Jacquard Machine," a thorough and complete description, conspicuously illustrated (45 illustrations), of the above subject will be found.

In my treatise, already alluded to, the different methods of "tying-up of Jacquard harness" have been classified as follows:

I.—Straight-through tie-up.
II.—Straight-through tie-up for repeated effects, in one repeat of the design.
III.—Straight-through tie-up of Jacquard loom, having front harness attached.
IV.—Centre tie-up.
V.—Straight-through and point tie-ups combined.
VI.—Straight-through tie-up in two sections.
VII.—Tying-up a Jacquard harness for figuring part of the design with an extra warp.
VIII.—Straight-through tie-up in three sections.
IX.—Point tie-up in three sections.
X.—Combination tie-up in two sections.
XI.—Straight-through tie-up in four sections.
XII.—Tying-up of Jacquard looms with compound harness attached.
XIII.—Tying-up Jacquard looms for gauze fabrics.
XIV.—Tying-up harness for carpets.

Each of these methods of tying-up is treated in a thorough manner and is fully illustrated by over one hundred special illustrations.

The Comber-board and Methods of Figuring for it.

The comber-board is placed in the Jacquard-loom for the purpose of guiding the harness-cords from the neck-cords to their respective position as required by the fabric for operating the heddles (to which they are adjusted on their other extreme end.) There are two kinds of comber-boards in use. *a.* Comber-boards made of a solid piece of material, either wood or porcelain, or constructed by using wires crossing each other and adjusted in a frame (see Fig. 1007). *b.* Comber-boards made in strips of either wood or porcelain and adjusted afterwards in a wooden frame (see Figs. 1007*a* and 1007*b*).

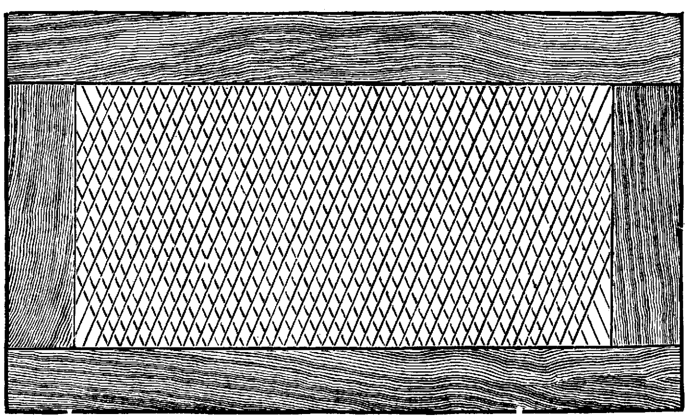


FIG. 1007.

Comber-boards Made of a Solid Piece of Material.

Before ordering a comber-board, it is necessary to know the texture of the fabric in the loom, and also the number or size of the machine to be used; for the number of holes per inch in the comber-board is regulated by this. Afterwards, we may, if we choose, arrange the number of holes in depth of the comber-board, according to the number of griffe-bars in the machine (guided by the fabric to be made). We may have eight griffe-bars in the machine, and arrange the comber-board 4, 6, 8, 10, 12 rows deep; or we may have 12 griffe-bars in the machine, and arrange the comber-board 12, 10, 8, 6, 4 rows deep.

RULE: The number of holes to one inch in the comber-board must equal the texture of the fabric to one inch in loom.

The width and depth of the comber-board are regulated by the width of the cloth required and by the design to be used. The greater the number of rows in depth the closer they must be; the same is true of the width. It is necessary to take care not to have the comber-board too deep, as the consequence would be a bad shed; furthermore, we must not have the holes too close together, as in a high texture this would make trouble in the weaving through the catching of the heddles with the warp, and also cause useless chafing of the warp-threads and the heddles.

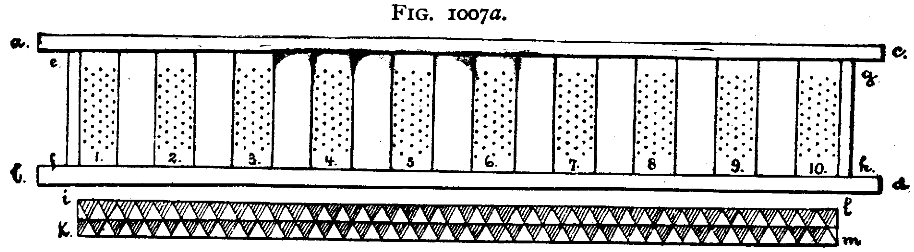
The Changing of Solid Comber-boards for Different Textures.

In Jacquard work we generally use the same texture, or as near as possible, as the loom is tied up for; but changes are unavoidable. If we must reduce the texture of the fabric in a Jacquard loom tied up with a solid comber-board, we must also reduce proportionally the number of hooks and needles used in designing, and hence the number of heddles used per inch. These heddles will thus be left empty when drawing in the warp. To accomplish this, lift the full machine and throw the hooks not to be used from the griffe-bars, lowering in this way every mail which is not to be used. Sometimes there may be only one, two, three, or four hooks to be thrown off, on account of the design. At other times it may be necessary that one-eighth, or one-fourth, or even one-half, of the whole number shall be dropped for this purpose.

Comber-boards Made in Strips and Adjusted Afterwards in a Frame.

By these comber-boards which are used to a great advantage on narrow loom work up to 36-inch fabrics, we can change the texture for the fabric; for the strips composing the comber-

FIG. 1007*a*.



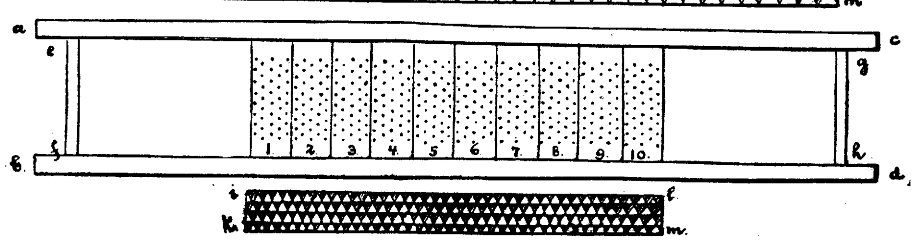


FIG. 1007*b*.

board may be drawn apart, thus changing the high texture to lower. To give a clear understanding, Figs. 1007*a* and 1007*b* are given.

Fig. 1007*b* represents an 8-row deep comber-board, *a*, *b*, *c*, *d*, composed of 10 strips which are set close together. By examining each strip 5 cross-rows of holes will be found, making the whole number of holes 400.

Suppose this comber-board is intended for a texture of 100 ends per inch; this will give for the width of the fabric (shown below, *i*, *k* to *l*, *m*) 4 inches.

In Fig. 1007*a*, the comber-board is arranged for a texture of half as many ends, or 50 holes per inch, and the 10 strips are arranged accordingly; the empty places between the strips are of same size as the strips themselves, and the fabric design below the comber-board is arranged to correspond.

GOBELIN TAPESTRY.

Tapestry is neither real weaving nor true embroidering. Though wrought upon a loom and upon a warp stretched out along its frame, there is no filling thrown across the threads with a shuttle, but the filling is worked with many short threads of various colors, put in with a needle.

Tapestry runs back into remote antiquity. The Greeks and Romans used tapestry for curtains and other hangings; and the use of it for like purposes was common throughout Europe in the succeeding ages. "Arras" was the usual name for hangings of this kind, owing to the excellence of the work produced in that town in England. "French tapestry" has long been famous also. Francis I. brought Flemish workmen to Fontainebleau, and the establishment was kept up by his successors. A hundred years later, Colbert, the celebrated minister to Louis XIV., took under his protection a manufactory which had been set up by two brothers, of the name of "Gobelin," originally dyers; and in a very short time the productions of the "Hotel royal des Gobelins" were universally admired. The well-known tapestry which for many generations hung upon the walls of the House of Lords, London, England, and which were destroyed by the fire of 1834, were Flemish, and executed in the reign of Queen Elizabeth to commemorate the destruction of the Spanish Armada. But the culminating point in the history of tapestry was when Rafaelle was employed to make the designs for a series of Scripture subjects, to be hung upon the walls of the Sistine chapel in Rome.

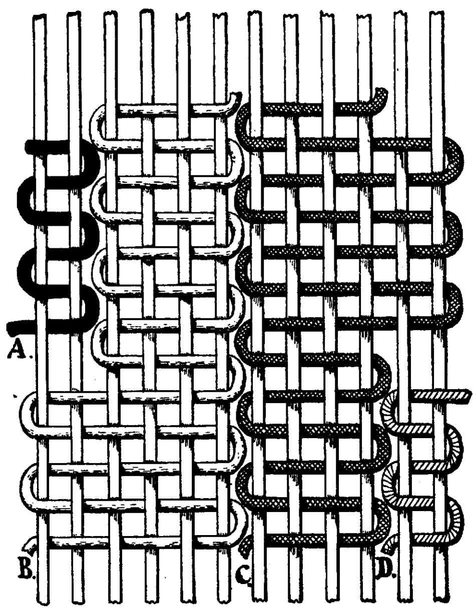


FIG. 1008.

Tapestry work is the most costly and effective of the textile manufacture. We will next explain the method of operation as observed in the manufacture of these fabrics during the last three centuries. (Older kinds of tapestries, for example the well-known "Bayeux tapestry" were wrought by the needle on the surface of the cloth and thus are actually produced by embroidering). As mentioned before, the warp-threads are stretched in a frame (loom) in a vertical position for the weavers. The method of interlacing the filling into the before mentioned warp is done after the principle of the plain weave by means of various numbers of colored filling-threads each guided by a needle. These different colors of filling are arranged after a certain design. For this purpose warp-threads in the required position are pulled by the weaver towards himself with one hand, and with the other hand the required needle (bobbin) block containing the color of filling as called for by the design is inserted. Supposing in the present example the weaver pulls towards himself the uneven numbered warp-threads (1, 3, 5, etc.) with the left hand, and inserts the block containing the required colored thread in the direction from left to right, by means of the right hand. Next he pulls the even numbered warp-threads (2, 4, 6, etc.) and returns the block before mentioned. In this manner the weaver continues to entwine one color until a certain part of the design requiring this color is finished. He takes next another color as required by the design and finishes, similar to the before explained method, any place where this color is required. In this manner he continues to treat each color as required by the design. The beating up of the filling so inserted is done by means of a comb. Taking the fabric into consideration in its vertical position it will be seen that there is no interlacing from one color effect to the other; therefore these effects must be sewed together after the embroidering is done.

Diagram Fig. 1008 illustrates the method of operation for such a Gobelin.

APPENDIX.

Analysis of the Various Textile Fabrics and Calculations Necessary for their Manufacture.

The analysis of textile fabrics forms a prominent part of the knowledge required in a competent designer and manufacturer. In addition to theory a practical experience in the construction of the various fabrics is likewise called for. Thorough analysis consists not only in "picking out" the arrangement of the interlacing of warp and filling (the weave), but also in ascertaining the materials of which both systems of threads are composed, the process such raw materials must be subjected to before the required yarn or thread is produced, necessary for the construction of the fabric on the loom, as also the various processes commonly designated as finishing.

The analysis of a fabric is not always required for duplicating the fabric, as in some instances it has for its main object only one of the previously mentioned points, as to materials used, amount of twist in yarn, process of finishing necessary, etc. But whichever special point is required to be ascertained, or should a complete reproduction of a given sample be required, it is always best to have a clear understanding (or analysis) of all points. For example: A knowledge of the weave will be the guide for a special analysis as to the materials to use—the amount of twist to put into the yarn—or the finish required, for the harder a weave " takes up" the stronger the warp yarn must be (as to quality of material to use, or amount of twist to be put into the yarn) so as to resist the amount of wear incurred during the weaving. The weave employed in interlacing the warp and filling, and the raw materials used in the manufacture of the yarn, will influence the process of finishing required, etc.

The complete analysis of textile fabrics can thus be classified under the following eight points:

I. Ascertaining the Weight per Yard and Ends per Inch in Warp and Filling for the Finished Fabric from a Given Sample.

II. Ascertaining the Weave.

III. Ascertaining Raw Materials Used in the Construction of Textile Fabrics.

IV. Ascertaining the Texture Required in Loom for a Given Fabric Sample.

V. Ascertaining the Arrangement of Threads in a Sample according to their Color and Counts for the Warp and Filling.

VI. Ascertaining the Sizes of the Yarns, or their Counts, as Necessary to be Produced for the Reproduction of the Given Sample.

VII. Ascertaining the Weight of the Cloth per Yard from the Loom.

VIII. Ascertaining the Process of Finishing Necessary, and Amount of Shrinkage of the Fabric during this Process.

These eight points, when carefully considered, will in most cases produce the required object, "a thorough analysis" or a thorough understanding of the construction of the fabric with which the manufacturer has to deal.

I. Ascertaining the Weight per yard of the Finished Fabric, and its Finished Texture (Ends per inch in Warp and Filling).

Usually the sample given to the designer for analysis is less in length than one yard (of the finished fabric), and generally narrower than the finished width of the cloth; oftentimes only one or two square inches, or even less, being furnished. Should, however, one or more yards of a fabric, having its regular width be given, it is easy for the designer to solve the question by weighing the cloths given and dividing the weight thus ascertained by the number of yards in the sample. The result will be the weight per yard of the finished fabric. But when the size of the sample submitted is small (less than one yard) the weight per yard must be found by figuring in proportions.

Rule for Ascertaining from a Small Sample (finished) the Weight of the Fabric in Ounces for One Yard.

Cut your sample to a known size, and divide the number of square inches thus derived into the number of square inches which one yard of the fabric will contain.

1944 square inches $\frac{6}{4}$ wide fabrics = 54 inches wide.

972 " " $\frac{3}{4}$ " " 27 " "

Multiply the result with the weight in grains of your sample and divide the product by $437\frac{1}{2}$ which will give you the ounces per yard for the fabric in question.

For example: Suppose you have a $\frac{6}{4}$ wide fabric. The sample cut, or stamped, with a die, 3 inches by 3 inches equals 9 square inches. Suppose the weight of these 9 square inches is 25 grains.

Question: Required the weight in ounces of one yard of cloth, being $\frac{6}{4}$ wide?

Answer: $\frac{6}{4}$ or 54 inches wide fabric 54×36 or 1944 square inches.

$1944 \div 9 = 216 \times 25 = 5400 \div 437.5 = 12.34$ oz.; thus the weight of the fabric is $12\frac{1}{3}$ oz.

Another example. Take a $\frac{3}{4}$ wide fabric. The sample cut, or stamped with a die 3 inches by 4 inches, equals 12 square inches. Suppose the weight of these 12 square inches is 28 grains.

Question: Required the weight in ounces of one yard of cloth to be 27 inches wide.

Answer: 27 inches wide fabric $= 27 \times 36$ or 972 square inches.

$972 \div 12 = 81 \times 28 = 2268 \div 437.5 = 5.18$ oz., weight of fabric per yard.

Table for Ascertaining the Number of Square Inches in any Fabric with a Width of 18 Inches to 54 Inches.

Width of Fabric in inches.	Number of square inches in one yard.	Width of Fabric in inches.	Number of square inches in one yard.
18	648	37.	1332
19	684	38.	1368
20	720	39.	1404
21	756	40.	1440
22	792	41.	1476
23	828	42.	1512
24	864	43.	1548
25	900	44.	1584
26	936	45.	1620
27	972	46.	1656
28	1008	47.	1692
29	1044	48.	1728
30	1080	49.	1764
31	1116	50.	1800
32	1152	51.	1836
33	1188	52.	1872
34	1224	53.	1908
35	1260	54.	1944
36	1296	60.	2160

To Ascertain the Finished Texture of the Submitted Sample.

For this purpose unravel a few ends of the warp and filling of each system on one side of the sample, and count the number of threads one inch contains (in each system). In the places from which the filling has been extracted the texture for the warp will be found, and in the places from which the warp-threads have been drawn the filling texture will be found. It is best to ascertain the texture for each system of threads in at least two different places, so that if found to be the same it will serve as a test for correct work. If found not to correspond, it will require a third counting of the respective threads per inch, so as to ascertain which of the two previous countings is correct. Fabrics having a fancy arrangement with regard to their threads frequently require to have the number of threads ascertained in more than one inch. In some fabrics the texture must be found by counting the number of threads in one repeat of the pattern and then dividing this result by the number of inches these threads occupy in the fabric.

EXAMPLE.—180 threads of warp in one repeat of the pattern occupy $3\frac{3}{4}$ inches space in the finished fabric. *Question:* Find the texture (average). *Answer:* $180 \div 3\frac{3}{4} = 48$ threads, texture of warp in given sample.

II. Ascertaining the Weave.

This part of the analysis of a fabric is based first of all upon a thorough comprehension of the theory of constructing the various weaves for single cloth, double cloth, etc. It also requires, in dealing with heavy fulled fabrics, or fabrics having the face filling broken during the process of finishing, a considerable amount of patience.

Ascertaining the weave implies to the designer that he is to solve from a sample the manner in which both systems of threads, composing the fabric, interlace each other, and this is technically known as the "picking-out" process. An experienced designer will in most cases ascertain the weave necessary for producing a given sample by a mere glance at it, while in fabrics having fine counts of silk or cotton yarn the microscope will assist him in designating the weave without "picking-out." But as such skill can only be arrived at after years of practice and experience we will define the "picking-out" process for the benefit of the unskilled.

If it is required to ascertain the weave in a fabric having a nap on its surface, the nap must be carefully removed by singeing it off by holding it over a flame, care being taken not to burn the threads. Next carefully remove the burnt refuse adhering to the structure with a sharp knife. (It is well to have a sharp knife or razor always at hand for this purpose.)

Always endeavor to get the samples for "picking-out" sufficiently large, containing at least two or three repeats of the weave, warp and filling-ways, in excess of the amount of cloth necessary for liberating threads in each system, so as to get the proper starting-point for commencing to pick-out. If a sample is submitted for "picking-out" which does not contain a complete repeat of the weave, dissect the amount on hand and finish the complete weave in accordance with the instructions given in the theory of constructing weaves. The experienced designer, when he gets a sample for dissection, readily understands which system of threads are the warp and which the filling, but to the inexperienced this will prove the first difficulty which will have to be mastered. To aid in this the following rules are given, which if carefully considered (with reference to the sample given) must greatly assist the novice in solving the problem.

If the sample submitted for "picking-out" contains a part of the selvage, the latter will readily indicate warp from filling, for the selvage-threads always run in the direction of the warp.

If the threads in one system are "harder" twisted than in the other, the hard-twisted threads are generally the warp system.

If the sample submitted for analyzing has what is technically known as a "face-finish" (kersey, beaver, doeskin, broadcloth, etc.), the direction of the "nap" indicates the warp.

The "counts" of yarn found used in each system will often assist in ascertaining which is the warp and which is the filling, for in most instances the yarn used for warp is of a finer number than the filling.

If the fabric has cotton yarn for one system of threads and woolen for the other (as in union fabrics), the cotton yarn is generally the warp yarn.

If in the sample submitted for analysis the one system of threads is found to have been sized or starched, and not the other, the former is the warp.

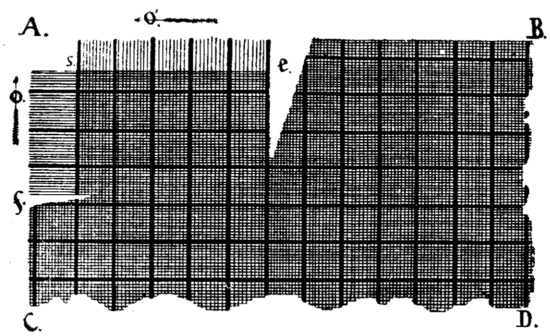


FIG. 1009.

If the sample contains "reed marks" (or imperfections known to the weaver as being caused only by the warp system), such imperfections readily characterize the respective systems of threads.

Another guide for distinguishing the warp from the filling is found in the "style" of the respective fabrics submitted for "picking out." In fabrics having a striped character, or check effects in which the one direction of the lines is prominent compared with the others, the direction of the stripes, or the prominent lines in the check, indicate the warp system.

In fabrics composed of two systems of filling (face filling and backing) and one system of warp, the heavy and soft-spun filling, known as the "backing," indicates itself, and thus the system of threads.

Fabrics are generally dissected by investigating the method of interlacing the filling into the warp; some fabrics require their weaves to be dissected by ascertaining the interlacing of successive warp-threads in the filling, such as the corkscrews, diagonals and similar fabrics. Weaves in pile fabrics, such as velvets, Astrakhans, etc., are ascertained the quickest by analyzing the body structure.

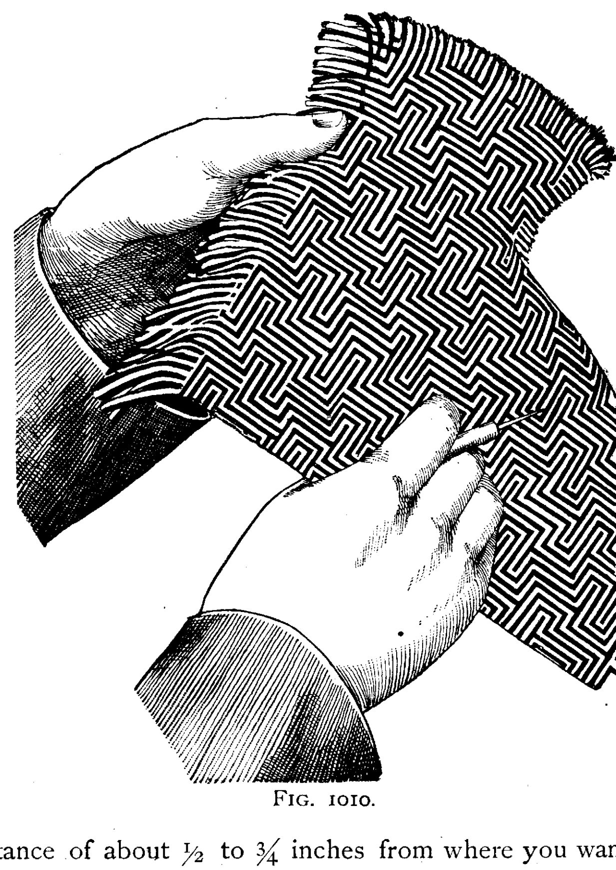


FIG. 1010.

The instrument required for "picking out" is a strong needle with a sharp point. In some instances the microscope is found to be of much service. The work of picking out a sample is most readily accomplished by proceeding as follows :*

Clear off the nap or fibres on the surface of the sample as previously mentioned. In fabrics without a nap this is, of course, not required. Next unravel sufficient filling on top of the fabric, and warp on the left hand side, to produce two fringed edges of say about ¼ to ½ inch in length. If you should desire to save, from the sample submitted for analysis, as much as possible, make straight cuts with the scissors at a distance of about ½ to ¾ inches from where you want to stop dissecting threads. This procedure is illustrated by diagram Fig. 1009. *A-B-C-D*, sample submitted for "picking out." Arrow O direction of warp. Arrow O^1 direction of filling.

*Use picking out of the filling from the structure in the example given for explanation.

The cuts in the fabric are shown at the places indicated by *e* and *f*. Letter *S* indicates the place where the first warp-thread and the first pick meet—the point for commencing to "pick-out."

After the sample is prepared according to the illustration just given, raise the first pick about $\frac{1}{16}$ of an inch with the "picking-out needle." See Fig. 1010.

Place the sample in the left hand as shown in diagram 1011, next ascertain the arrangement of interlacing pick number 1, warp-ways, until repeat is obtained.

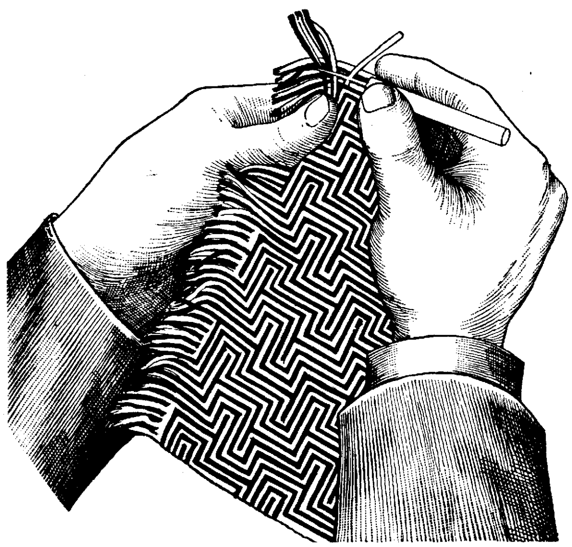


FIG. 1011.

Every time a warp-thread is found situated above the filling, put a corresponding indication on the respective square of the designing paper (with pencil marks or prick holes with the needle), whenever you find the filling covering (floating over) one, two or more successive warp-threads, leave correspondingly one, two or more successive squares empty in the lateral line of small squares upon the designing paper.

After the intersecting of number 1 pick has been clearly ascertained liberate this pick out of the fringed warp edge and duplicate the procedure with pick number 2, to be followed by picks 3, 4, 5, etc., until the repeat is obtained. If dealing with a soft-spun filling yarn be careful in raising it, to avoid breaking the thread; also be careful that after the interlacing of the pick has been ascertained, it is *entirely* removed so that no small pieces of the thread remain in the fringed part of the warp; for if such should be the case it might lead to mistakes in examining the next adjoining pick.

III. Ascertaining Raw Materials Used in the Construction of a Fabric.

In most cases an examination of the threads liberated during "picking-out" with the naked eye will be sufficient to distinguish the material used in the construction of the fabric yet sometimes it is found necessary to use the microscope or a chemical test for their detection. For example: Tests might be required to show whether a certain thread is all wool or whether a certain thread is all silk, etc. For solving such questions, the following methods are given:

A common and ready method for ascertaining the difference between animal and vegetable fibres is to burn some of the threads of yarn in a flame. The vegetable fibre is composed of carbon, hydrogen and oxygen, while the animal fibre, in addition to these, contains nitrogen. By burning, the threads used in testing the first mentioned fibre will result in carbonic acid and water, while those of the latter, or of animal fibre, result in combinations containing nitrogen which element readily makes itself known by its peculiar smell or disagreeable odor similar to burnt feathers. Another point which it is well to note is the rapidity with which the thread composed of vegetable origin burns as compared with the burning of the thread having an animal substance for its basis. In the latter case, only a little bunch of porous carbon forms itself at the end submitted to the flame, and it does not form a flame as in the case of the former. As in some instances these two tests will be found unreliable, a more exact analysis may be required. If so, proceed after one or the other of the following formulas:

To Detect Cotton or other Vegetable Fibre in Woolen or Silk Fabrics.

Boil the sample to be tested in a concentrated solution of caustic soda or potash, and the wool or silk fibre will rapidly dissolve, producing a soapy liquid. The cotton or other vegetable fibre therein will remain undisturbed, even though boiling in weak caustic alkalies for several hours, care being taken to keep the samples below the surface of the solution during the operation. If during this steeping process it is exposed to the air, the cotton fibre becomes rotten, especially when the exposed portions are also at the same time brought under the influence of steam. (Any cotton fibres remaining from the testing, if colored, may be bleached in chlorine water, and afterwards dissolved with cupro-ammonia.)

Prof. E. Kopp gives the following test: "Wool is only soluble in cupro-ammonia by the aid of heat. Concentrated acids, such as sulphuric, nitric, or preferably hydrochloric, act in the cold upon silk, but not on wool. The dissolving properties of cupro-ammonia on all vegetable fibres, make it one of the most reliable of tests. Cupro-ammonia is prepared by suspending strips of copper in concentrated ammonia in a large flask, tightly corked and occasionally shaken, so as to bring the metal in contact with the oxygen of the air. By degrees a tolerably concentrated solution of oxide of copper in ammonia is obtained which dissolves cotton, and other vegetable fibres, leaving animal fibres untouched."

To Detect Silk from Wool or the Vegetable Fibres.

Prof. Hummel gives the following process in his treatise on "The Dyeing of Textile Fabrics:"

"The best solvent for silk is an alkaline solution of copper and glycerine, made up as follows: Dissolve 16 grams copper sulphate in 140–160 c. c. distilled water, and add 8–10 grams pure glycerine (Sp. Gr. 1.24); a solution of caustic soda has to be dropped gradually into the mixture till the precipitate at first formed just re-dissolves; excess of $NaOH$ must be avoided." This solution does not dissolve either wool or the vegetable fibres and thus serves as a distinguishing test.

Still another method is given, as follows: Concentrated zinc chloride, 138° Tw. (Sp. Gr. 1.69) made neutral or basic by boiling with excess of zinc oxide, dissolves silk, slowly if cold, but very rapidly if heated, to a thick gummy liquid. This reagent may serve to separate or distinguish silk from wool and the vegetable fibres, since these are not affected by it. If water be added to the zinc chloride solution of silk, the latter is thrown down as a flocculent precipitate. Dried at 230° to 235° F the precipitate acquires a vitreous aspect, and is no longer soluble in ammonia.

Rules for Arranging the Fabric to be Tested and Methods for Ascertaining the Various Percentages of Each Fibre Composing the Thread or Woven Cloth.

Cut the sample to be tested to a known size with a sharp pair of scissors, or stamp out the desired quantity with a die, of which you know the exact size. Always use the largest sample available and be very accurate in cutting to measure. Next weigh the sample upon a scale (of great accuracy) and make a careful memorandum of its weight; then submit the sample to one of the above mentioned tests (adapted to the material to be tested), and dry the remaining fibre. Weigh the latter after thoroughly dry and deduct the weight from the gross weight previously obtained. The remainder will represent the weight of the fibre dissolved by the test.

"*The amount of each kind of fibre in sample is in proportion to the percentage of each fibre in a full piece of cloth.*"

Example: Required to ascertain percentage of cotton and wool fibres in a fabric.

Sample stamped with a die 2×4 inches $=$ 8 square inches weighs 24 grains. Suppose the "caustic soda" process for testing is used and the refuse of cotton, dried, weighs 8 grains. Hence:

24 grains gross weight of cloth 8 square inches.
8 " weight of cotton in 8 square inches.

16 " " " wool " 8 square inches.

Or, 8 grains cotton in 24 grains gross weight	=	$33\frac{1}{3}$ per cent. of 100.	
16 " wool " 24 " " "	=	$66\frac{2}{3}$ " " "	
24 "		100	

Answer: The cloth given for testing in the present example contains $33\frac{1}{3}$ per cent. cotton and $66\frac{2}{3}$ per cent. wool, or, one-third of the mixture is cotton fibre and two-thirds wool fibre.

IV. To Ascertain the Texture of Fabrics Required in Loom.

Of all the different points required to be ascertained the present is probably the most difficult to master, in fact, it can only be accomplished after considerable practical experience. To materially aid the novice in this work, it is strongly recommended that he provide himself with a collection of different samples of finished fabrics with the given amount of shrinkage of each during finishing. Such a collection he can afterwards use as a guide for ascertaining the texture of similar fabrics.

The Shrinkage of a Fabric in Width from Loom to Case (or Finished State).

The "setting" of a fabric in the loom, or the reed-space the warp must occupy during the process of weaving, compared to the width of the fabric when finished (ready for the consumer) is regulated by the raw material used, the manner in which the yarn has been produced, and the different processes the fabric is to be subjected to during finishing.

Some kinds of woolen fabrics require a large amount of fulling, hence must be "set" wider in the loom than fabrics having a similar material for their basis but requiring very little or no fulling. For example, billiard-cloth must be "set" nearly twice as wide in the loom as its finished width, while beavers, kerseys, and similar woolen fabrics need to be "set" but about one-half their finished width wider, and fancy cassimeres from one-quarter to one-third. Worsted or worsted and cotton dressgoods mostly require but very little wider "setting" in the loom than the finished width of the fabric calls for. The weave itself has also a considerable influence in regulating the shrinkage.

These general rules are worthy of consideration: The finer the quality, and the softer the filling is spun, the more the cloth will shrink in width. If the filling is hard twisted, and of a coarse nature, the cloth will have but little tendency to shrink. If the weave has a wide stitching, it will produce a narrower fabric than when the texture is more closely intertwined. The less tension put on the warp during weaving ("take-up") the narrower the fabric will be. In comparing woolen and worsted yarn, the former produces fabrics which shrink more in width than fabrics made with worsted yarn. This result, when produced from the same raw material, is based upon the two different processes of "carding" or "combing" the wool fibre. By carding the wool every fibre, through mixing up in every shape and direction, is twisted in itself, and such fibres always endeavor to resume their original position. By worsted combing the wool fibres are separately united, besides being combined in one thread. Each fibre is its own, as placed in position for forming the thread, and thus such a thread remains undisturbed in the fabric. The fabric constructed out of such threads will keep wider than if using a wool-spun yarn of equal size and under equal conditions.

Shrinkage or Take-up of Warp During Weaving.

We must also carefully consider the amount of take-up the warp is subjected to during weaving, and the amount of shrinkage in length the cloth undergoes during the finishing process. The latter point will not come into consideration in the case of fabrics which are ready for the market when leaving the loom. The first mentioned shrinkage, or the "take-up" of the warp during weaving, is different, and varies from fabrics requiring two, three, four or more times the length in dressing than the fabric length woven, to fabrics in which the warp-length dressed equals the fabric length woven or, if any difference, to be very little.

The points given in the previous chapter on the shrinkage in width of a fabric also apply to the shrinkage of the fabric in length. *The weave and the number of picks per inch are the chief object in regulating the take-up of the warp during weaving*, for example, a fabric interlaced with a far stitching satin weave (say 8 to 12 harness) will "take-up" very little if any at all, unless we use an unusually high texture of warp and filling. Thus, the oftener a warp-thread intersects the filling in a given distance the greater the amount of take-up required for the warp. For this reason fabrics which have two systems of weaves combined—suppose 1-inch wide plain weave to alternate with a 2-inch wide 8-harness satin = 3 inches repeat, 10 repeats in width of fabric—require two beams—one beam to carry the warp for weaving the plain, and one beam for carrying the warp for weaving the satin. This also applies to worsted fabrics made with woolen back-warps. The amount of shrinkage in warp pile fabrics for its pile-warp is considerable. It is regulated by the height of pile required and the amount of wires or loops per inch. Such fabrics may often require their pile-warp dressed four to eight times longer than the piece measures woven. To ascertain the exact percentage of "take-up" for a fabric needs experience and can only be mastered after thorough study of the theory of constructing the different weaves, as well as the nature of the different raw materials, with their various methods of preparations for the yarns, and the various processes of finishing.

V. Ascertaining the Arrangement of Threads in a Sample, According to their Color and their Counts, for the Warp and Filling.

During the process of "picking out" a fabric sample, it will be advisable to indicate on the squared designing paper near each filling-thread as picked out, its color or general remarks as to thickness, twist, etc. Also, to indicate the colors and size of the warp-threads as found in the sample dissected. (For illustration see Fig. 1012.) By proceeding in this manner it will be found that after a certain number of successive threads in warp and filling have been picked out, the same arrangement of using threads of various colors or counts, or both combined in the sample, repeats over again. This is classified as the "repeat of the pattern." All repeats of a pattern must be similar to each other; thus, if we place two, three or more repeats of the sample above each other, they must in every instance cover itself in color, size or counts of threads, and method of interlacing.

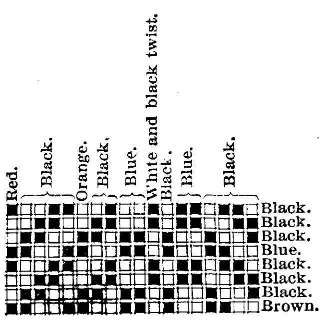


FIG. 1012.

Again, if a number of these repeats are placed near each other in the direction of the warp and filling, they must connect. If patterns are found not to contain this peculiarity, or, in other words, "do not repeat," they must be arranged so as to have this peculiarity, or be made to repeat.

The arrangement of the warp is known as the "dressing," while the arrangement of the filling indicates the building of the "box-chain" in practical work.

VI. Ascertaining the Size of the Yarns (their Counts) Found in Sample, and the Amount and Direction of Twist.

The size or thickness of a thread is ascertained generally by comparing the picked out thread with a collection of yarns of the same material and of a known size. For this purpose prepare a collection of woolen, worsted, cotton and silk yarns most commonly used. In fabrics requiring no fulling, or only a very little, such as worsted dress goods, etc., weigh a small sample of the threads and calculate from their length and weight the size of the yarn; but as a general rule the first given method will be found quick, correct and less troublesome to the designer. Care must be taken to compare threads of which the counts are required to be ascertained with samples of threads of a known size, which have previously been subjected to an equal amount of shrinkage by "fulling" etc.; or, if such a thread cannot be obtained, compare the picked-out thread with the standard threads of a similar material, but take into consideration the process the first mentioned thread has been subjected to during the finishing process of the fabric it was a part of.

VII. Ascertaining the Weight of Cloth per Yard from the Loom.

This subject, based entirely upon results obtained by previous points, forms the most interesting work in the analysis of cloth. Whatever the size of sample may be which is submitted for examination, and whatever the quantity of yards of cloth to be produced, the weight per yard from loom will form the standard upon which future calculations in manufacturing must be based by figuring in proportion. After knowing the number of threads required in the width of a fabric submitted for analysis, the counts of the respective threads, and the dressing and the shrinkage of the warp in weaving, it will be easy to ascertain the weight of warp yarn required.

EXAMPLE A. *Dressing:* 4 threads black, 4 run woolen yarn.
2 " blue, 4 " " "
4 " brown, 4 " " "
—
10 threads in repeat.

3,600 ends in full warp, 6 per cent. shrinkage or take up of warp during weaving.

Required: Find weight of warp yarn of each kind necessary for one yard of the woven fabric.

$100 - 6 = 94$. Thus $94 : 100 :: 36 : x$ and $100 \times 36 = 3600 \div 94 = 38.3$.

Each individual thread requires 38.3 inches length dressed to produce 36 inches interwoven. Hence $3{,}600 \times 38.3 = 137{,}880$ inches $= 3{,}830$ yards of warp required to produce one yard of the woven fabric (plus amount of filling required).

3,830 yards 4 run yarn equal in weight 9.575 oz, ten threads repeat of the pattern, thus: $9.575 \div 10 = 0.9575$ oz. weight in proportion for each thread, consequently:

4 threads black $= 4 \times 0.9575 = 3.830$ oz. per yard.
2 " blue $= 2 \times 0.9575 = 1.915$ " "
4 " brown $= 4 \times 0.9575 = 3.830$ " "
———
9.575 oz. total weight.

Answer: The previously given example requires
3.83 oz. 4 run black warp for each yard woven.
1.915 " 4 " blue " " "
3.83 " 4 " brown " " "
———
consequently 9.575 oz. weight of complete warp in one yard woven (3,600 threads 4 run yarn, six per cent. take up of warp).

The threads used are not always of the same counts. Two, three or more different sizes of yarn may be called for in a fabric. If such is the case first ascertain the number of yards required of each kind and next their weight. Suppose the previously given example read as follows: Example *B.* 3,600 ends in warp—6 per cent. shrinkage of warp in weaving.

Dressing: 4 threads brown 2.30s worsted.
2 " blue 2.28s "
4 " black 2.32s "
—
10 threads repeat of pattern.

As explained in previously given example, 36 inches woven equal 38.3 inches dressed by allowing six per cent. take up.

3,600 ends in warp ÷ by 10 threads in one repeat = 360 repeats of each thread; thus,

4 threads	brown	2.30s worsted	= 360 × 4 =	1,440 threads	(*a*).
2 "	blue	2.28s "	= 360 × 2 =	720 "	(*b*).
4 "	black	2.32s "	= 360 × 4 =	1,440 "	(*c*).
10 threads in repeat.				3,600 threads in warp.	

a. Brown, requires 2.30s worsted = 8400 yards to 1 lb.

36 : 38.3 : : 1440 : x

38.3 × 1440 ÷ 36 = 1532 yards of 2.30s brown worsted required.

8400 : 16 : : 1532 : x

1532 × 16 ÷ 8400 = 2.918 oz. of brown 2 30s worsted required for 1 yard cloth woven.

b. Blue, calls for 2.28s worsted = 7840 yards to 1 lb.

36 : 38.3 : : 720 : x

38.3 × 720 ÷ 36 = 766 yards of 2.28s blue worsted required.

7840 : 16 : : 766 : x

766 × 16 ÷ 7840 = 1.563 oz. of blue 2.28s worsted required for 1 yard cloth woven.

c. Black calls for 2.32s worsted = 8960 yards to 1 lb. The number of threads are equal to ***a***, thus: 1532 yards of 2.32s black worsted required.

8960 : 16 : : 1532 : x

1532 × 16 ÷ 8960 = 2.735 oz. of black 2.32s worsted required for 1 yard of cloth woven.

Answer: The previously given example requires the following amount of yarns:

Brown,	2.30s	worsted	= 2.918 oz.
Blue,	2.28s	"	= 1.563 "
Black,	2.32s	"	= 2.735 "
			7.216 oz. weight of complete warp in 1 yard woven.

TABLE OF RELATIVE LENGTHS

Of Inches Dressed and One Yard Woven, with Reference to a "Take-up" During Weaving, for 1 per cent. to 50 per cent.

Per cent. of take-up during weaving.	Number of inches required dressed to produce one yard or 36 inches woven.	Per cent. of take-up during weaving.	Number of inches required dressed to produce one yard or 36 inches woven.
1	36.36	13	41.38
2	36.73	14	41.86
3	37.11	15	42.35
4	37.50	16	42.85
5	37.89	17	43.37
6	38.30	18	43.90
7	38.71	19	44.44
8	39.13	20	45.00
9	39.56	25	48.00
10	40.00	30	51.43
11	40.45	40	60.00
12	40.91	50	72.00

The next point for ascertaining the weight of cloth per yard from the loom is *to ascertain the amount of filling required for one yard.*

To explain this subject let us continue the example previously given and indicated by ***A.*** Suppose those 3600 ends require 72 inches wide setting in reed (allowing 1 inch for width of selvage on each side), and suppose the filling found used in sample submitted for analysis calls for $3\frac{1}{2}$ run black woolen yarn and 52 picks per inch in loom.

Question: Find amount of filling required for weaving one yard.

52 (picks) $\times$ 72 (width) $=$ 3744 inches filling required for 1 inch of cloth, or 3744 yards of filling required for 1 yard of cloth.

3744 yards of $3\frac{1}{2}$ run filling ($3744 \div 350$) $=$ 10.697 oz.

Answer: 10.697 oz. filling required for weaving 1 yard cloth in the present example.

If two, three or more kinds of threads of various counts of fillings are used, ascertain each kind independent of the other. For illustration let us continue example *B* as previously given for ascertaining the warp.

Suppose the width of fabric (including $\frac{1}{2}$ inch selvage for each side) calls for 64 inches and the arrangement of filling for 6 picks 2.26s black worsted and for 6 picks 2.28s brown worsted $=$ 12 picks in repeat of pattern and 56 picks per inch in fabric.

Question: Find the amount of filling required for weaving 1 yard.

56 (picks) $\times$ 64 (width) $=$ 3584 yards of filling required to weave 1 yard of cloth.

Thus: $3584 \div 2 = 1792$ yards 2.26s worsted black (*a*), and 1792 yards 2.28s worsted brown (*b*), the filling required to weave 1 yard of cloth.

a. 2.26s worsted ($=$ 7280 yards to 1 lb.). Thus: 1792 : x : : 7280 : 16

$1792 \times 16 \div 7280 = 3.938$ oz. of 2.26s black worsted required.

b. 2.28s worsted ($=$ 7840 yards to 1 lb.). Thus: 1792 : x : : 7840 : 16

$1792 \times 16 \div 7840 = 3.657$ oz. of 2.28s brown worsted required.

Answer: 3.938 oz. of 2.26s black worsted.
3.657 oz. of 2.28s brown worsted.

7.595 oz. the amount of filling required for weaving 1 yard of cloth in the present example.

The next thing to be ascertained will be the amount of selvage threads to be used, and their respective weight.

Suppose example *A* calls for 30 threads 2 run (woolen yarn) for selvage for each side of the fabric, thus 60 threads for complete selvage.

$+$ 6 per cent. take-up $=$ 63.82 yards of two run selvage, equal to 0.319 oz. of yarn for 1 yard of woven cloth.

For example B. allow 30 threads of 2.20s worsted for selvage on each side of the fabric; thus 60 threads for complete selvage.

$+$ 6 per cent. take up $=$ 63.82 yards of 2.20s worsted $=$ 0.182 oz. of yarn for 1 yard of woven cloth.

Example A. thus requires:

9.575 oz. warp yarn,
10.697 oz. filling,
0.319 oz. selvage threads.

20.591 oz. the weight of 1 yard of cloth from the loom.

Example B. thus requires:

7.216 oz. warp,
7.595 oz. filling,
0.182 oz. selvage threads.

14.993 oz. the weight of 1 yard of cloth from the loom.

After the weight of 1 yard of the cloth woven is ascertained it is easy to calculate the amount of yarn required for 1 piece of cloth or any number, by simply multiplying the weight per yard with the number of yards required.

For example: Suppose previously given example *A* to be applied to a fabric 40 yards "from loom." Thus:

$$\begin{array}{lll} 9.575 \text{ oz.} \times 40 = 383 \text{ oz.} & = 23 \text{ lbs. } 15 \text{ oz. warp yarn,} \\ 10.697 \text{ oz.} \times 40 = 427.88 \text{ oz.} & = 26 \text{ lbs. } 11.88 \text{ oz. filling yarn,} \\ 0.319 \text{ oz.} \times 40 = 12.76 \text{ oz.} & = \text{——} \ 12.76 \text{ oz. selvage.} \\ \hline 20.591 \text{ oz. total,} & 51 \text{ lbs. } 7.64 \text{ oz. weight for 1 piece 40 yards long.} \end{array}$$

Proof: 20.591 oz., weight of cloth per yard, $\times$ 40, number of yards of cloth required, equals 823.64 oz., $\div$ 16 = 51 lbs. 7.64 oz.

Suppose the previously given example under *B* applied to the following—

Question: Find the amount of yarn required for producing 20 pieces, each 50 yards long from loom, thus:

20 pieces $\times$ 50 yards each cut = 1000 yards of cloth required, hence

$$\begin{array}{lll} 7.216 \text{ oz.} \times 1000 = 7216 \text{ oz.} & = 451 \text{ lbs.} & \\ 7.595 \text{ "} \times 1000 = 7595 \text{ "} & = 474 \text{ "} & 11 \text{ oz.} \\ 0.182 \text{ "} \times 1000 = 182 \text{ "} & = 11 \text{ "} & 6 \text{ "} \\ \hline 14.993 & 937 \text{ lbs.} & 1 \text{ oz. weight required for 20 pieces,} \end{array}$$

each 50 yards long, or 1000 yards of cloth woven.

Proof: 14.993 oz. weight per yard of cloth $\times$ 1000 (number of yards of cloth woven) 14993 oz. $\div$ 16 = 937 lbs. 1 oz.

VIII. Ascertaining the Process of Finishing Necessary and the Amount of Shrinkage of the Fabric.

The shrinkage of a fabric during finishing is regulated by the amount of fulling required. Woolen fabrics, and especially such as are constructed out of soft spun yarn, shrink more than any other textile fabric.

In arranging the width of a fabric for weaving ("setting" in reed) we must calculate the amount of shrinkage of the fabric on the loom as well as during the process of finishing. The shrinkage in length of the fabric can more readily be regulated during the finishing process (fulling). Worsted fabrics, which require no fulling—only scouring—shrink very little, while cotton goods, which require only calendering or pressing, etc., do not lose any, and may possibly rather gain, in length.

During the process of carding and spinning, oil, water, etc., are taken up by the wool, and during dyeing some of the dye-stuff will remain loosely in the yarn. These substances must be removed in the scouring of the cloth; therefore we must allow for a corresponding loss in weight for such fabrics from their relative weight in the loom until the fabric is scoured.

The subsequent processes, such as gigging and shearing, will also reduce the previous loom weight of the fabric. Fabrics requiring none of these processes consequently need none of these considerations, while fabrics requiring a starching, calendering or flocking may even gain in weight during such an operation.

The shrinkage of fabrics in finishing requires, similar to the two different widths (width of fabric when finished, and its width in reed), to figure in two different lengths during calculations. *a* the length of the cloth from loom, *b* its finished length. It will be easily understood that when orders are given for a certain number of yards from a buyer or the commission house, they consider the number of yards given as the "finished yards"; therefore the percentage that the fabric shrinks during the finishing process must be added for ascertaining the number of yards required "*from loom,*" or woven. Take-up during weaving added, will give us a third length, or the length of warps dressed, while the shrinkage of a fabric in finishing regulates, as previously mentioned, the width of the fabric in loom, in addition to the width of the finished fabric.

GRADING OF THE VARIOUS YARNS USED IN THE MANUFACTURE OF TEXTILE FABRICS ACCORDING TO SIZE OR COUNTS.

The sizes of the yarns, technically known as their counts or numbers, are based for each different raw material upon the number of yards necessary to balance 1 lb. (avoirdupois), consequently the higher the count or number the finer the yarn according to its diameter. The number of yards thus necessary to balance 1 lb. is known as the "Standard" and varies accordingly for each material.

I. Cotton Yarns.

Cotton yarns have for the standard 840 yards (equal to 1 hank) and are graded by the number of hanks 1 lb. contains. Consequently if two hanks, or 2×840 yards $= 1680$ yards, are necessary to balance 1 lb., we classify the same as number 2 cotton yarn. If three hanks, or 3×840 yards $= 2520$ yards, are necessary to balance 1 lb., the thread is known and classified as number 3 cotton yarn. Continuing in this manner, always adding 840 for each successive number, it gives us the number of yards the various counts of yarn contain for 1 lb.

Table for Lengths of Cotton Yarns.

(From number 1 to 240s.)

No.	Yds. to 1 lb.	No.	Yds. to 1 lb.	No.	Yds. to 1 lb.	No.	Yds. to 1 lb.
1	840	25	21,000	49	41,160	73	61,320
2	1,680	26	21,840	50	42,000	74	62,160
3	2,520	27	22,680	51	42,840	75	63,000
4	3,360	28	23,520	52	43,680	76	63,840
5	4,200	29	24,360	53	44,520	77	64,680
6	5,040	30	25,200	54	45,360	78	65,520
7	5,880	31	26,040	55	46,200	79	66,360
8	6,720	32	26,880	56	47,040	80	67,200
9	7,560	33	27,720	57	47,880	85	71,400
10	8,400	34	28,560	58	48,720	90	75,600
11	9,240	35	29,400	59	49,560	95	79,800
12	10,080	36	30,240	60	50,400	100	84,000
13	10,920	37	31,080	61	51,240	110	92,400
14	11,760	38	31,920	62	52,080	120	100,800
15	12,600	39	32,760	63	52,920	130	109,200
16	13,440	40	33,600	64	53,760	140	117,600
17	14,280	41	34,440	65	54,600	150	126,000
18	15,120	42	35,280	66	55,440	160	134,400
19	15,960	43	36,120	67	56,280	170	142,800
20	16,800	44	36,960	68	57,120	180	151,200
21	17,640	45	37,800	69	57,960	190	159,600
22	18,480	46	38,640	70	58,800	200	168,000
23	19,320	47	39,480	71	59,640	220	184,800
24	20,160	48	40,320	72	60,480	240	201,600

Cotton yarns are frequently manufactured into 2-ply. In such cases the number of yards required for 1 lb. is one-half the amount called for in the single thread.

For example: 20s cotton yarn (single) equals 16,800 yards per pound, while a 2-ply thread of 20s cotton, technically indicated as 2.20s cotton, requires only 8,400 yards, or equal to the amount called for in single 10s cotton (technically represented as 10s cotton).

If the yarn be more than 2-ply, divide the number of yards of single yarn in the required number by the number of ply.

Rule for Finding the Weight in Pounds of a Given Number of Yards of Cotton Yarn of a Known Count.

Divide the given yards by the number of yards of the known count required to balance 1 lb.

EXAMPLE (single yarn).—Find weight of 1,260,000 yards of 30s cotton yarn.

30s cotton yarn = 25,200 yards to 1 lb. Thus 1,260,000 ÷ 25,200 = 50.

Answer: 1,260,000 yards of 30s cotton yarn weigh 50 lbs.

EXAMPLE (2-ply yarn).—Find weight of 1,260,000 yards of 2.30s cotton yarn.

2.30s cotton yarn = 12,600 yards to 1 lb. Thus 1,260,000 ÷ 12,600 = 100.

Answer: 1,260,000 yards of 2.30s cotton yarn weigh 100 lbs.

Rule for Finding the Weight in Ounces of a Given Number of Yards of Cotton Yarn of a Known Count.

Multiply the given yards by 16 and divide result by the number of yards of the known count required to balance 1 lb.

EXAMPLE (single yarn).—Find weight of 12,600 yards of 30s cotton yarn.

12,600 × 16 = 201,600. 1 lb. 30s cotton yarn = 25,200 yards. Thus 201,600 ÷ 25,200 = 8.

Answer: 12,600 yards of 30s cotton yarn weigh 8 oz.

EXAMPLE (2-ply yarn).—Find weight of 12,600 yards of 2.30s cotton yarn.

12,600 × 16 = 201,600. 1 lb. 2.30s cotton yarn = 12,600 yards. Thus 201,600 ÷ 12,600 = 16.

Answer: 12,600 yards of 2.30s cotton yarn weigh 16 oz.

II. Woolen Yarns—"Run" System.

Woolen yarn is, with the exception of the mills in Philadelphia and vicinity, graded by the "runs," which have for their standard 1600 yards. Consequently 1 run yarn requires 1600 yards to 1 lb.; 2 run yarn, 3200 yards to 1 lb.; 3 run yarn, 4800 yards to 1 lb., etc., always adding 1600 yards for each successive run. In addition to using whole numbers only as in the case of cotton and worsted yarn, the run is divided into halves, quarters and occasionally into eighths, hence

200	yards	equal	1/8	run.
400	"	"	1/4	"
600	"	"	3/8	"
800	"	"	1/2	"
1000	"	"	5/8	"
1200	"	"	3/4	"
1400	"	"	7/8	"
1600	"	"	1	" etc.

The run basis is very convenient for textile calculations by reason of the standard number equalling 100 times the number of ounces that one lb. contains. By simply multiplying the size of a yarn given in "run" counts by 100 and dividing the result into the number of yards given (for which we have to find the weight) gives us as the result the weight expressed in ounces.

EXAMPLE: Find the weight of 7,200 yards of 4 run yarn.

4 × 100 = 400.

7,200 ÷ 400 = 18.

Answer: 7,200 yards 4-run yarn weigh 18 oz.

Question: Find weight of 3,750 yards of 3¾ run yarn.

Answer: 3,750 ÷ 375 = 10 oz.

If the weight of a given number of yards and of a given size of woolen yarn, run system, is required to be calculated in pounds, transfer the result obtained in ounces into pounds or fractions thereof.

Table for Lengths of Woolen Yarns (Run basis) from One-fourth Run to Fifteen Run.

Run.	Yds. to 1 lb.	Run.	Yds. to 1 lb.	Run.	Yds. to 1 lb.
¼	400	4	6400	7¾	12400
½	800	4¼	6800	8	12800
¾	1200	4½	7200	8¼	13200
1	1600	4¾	7600	8½	13600
1¼	2000	5	8000	8¾	14000
1½	2400	5¼	8400	9	14400
1¾	2800	5½	8800	9½	15200
2	3200	5¾	9200	10	16000
2¼	3600	6	9600	10½	16800
2½	4000	6¼	10000	11	17600
2¾	4400	6½	10400	11½	18400
3	4800	6¾	10800	12	19200
3¼	5200	7	11200	13	20800
3½	5600	7¼	11600	14	22400
3¾	6000	7½	12000	15	24000

III. Woolen Yarn—"Cut" System.

As previously mentioned, woolen yarn is also graded by the "cut" system.
300 yards is the basis or standard, consequently if

300 yards of a given woolen yarn weigh 1 lb., we classify it as 1 cut yarn;
600 " " " " " " 1 " " " " 2 " "
900 " " " " " " 1 " " " " 3 " "

and so on, hence the count of the woolen yarn expressed in the "cut," multiplied by 300, gives as the result the number of yards of respective yarn that 1 lb. contains.

Table for Lengths of Woolen Yarns (Cut System).

(From 1 Cut to 50 Cut Yarn.)

Cut.	Yards to lb.	Cut.	Yards to lb.	Cut.	Yards to lb.	Cut.	Yards to lb.
1	300	13	3,900	25	7,500	37	11,100
2	600	14	4,200	26	7,800	38	11,400
3	900	15	4,500	27	8,100	39	11,700
4	1,200	16	4,800	28	8,400	40	12,000
5	1,500	17	5,100	29	8,700	41	12,300
6	1,800	18	5,400	30	9,000	42	12,600
7	2,100	19	5,700	31	9,300	43	12,900
8	2,400	20	6,000	32	9,600	44	13,200
9	2,700	21	6,300	33	9,900	45	13,500
10	3,000	22	6,600	34	10,200	46	13,800
11	3,300	23	6,900	35	10,500	48	14,400
12	3,600	24	7,200	36	10,800	50	15,000

Rule for Finding the Weight in Ounces for a Given Number of Yards of Woolen Yarn, Figured by the "Cut" Basis.

This rule is similar to the one given for cotton yarn. Multiply the given yards by 16 and divide the result by the original number of yards for the given "count" of cotton yarn that 1 lb. contains.

Example.—Find weight for 12,600 yards of 40-cut woolen yarn.
12,600 × 16=201,600. 1 lb. of 40-cut woolen yarn=12,000 yards. Thus 201,600 ÷ 12,000=16.8.
Answer: 12,600 yards of 40-cut woolen yarn weigh 16.8 oz.

Rule for Finding the Weight in Pounds of a Given Number of Yards of Woolen Yarn, Graded by the "Cut" Basis.

This rule is also similar to the one previously given for cotton yarn. Divide the given yards by the original number of yards for the given "count" of woolen yarn (cut basis) in 1 lb. The result expresses the weight in pounds or fractions thereof.

Example.—Find weight of 1,260,000 yards of 40-cut woolen yarn.

40-cut woolen yarn = 12,000 yards to 1 lb. Thus 1,260,000 ÷ 12,000 = 105.

Answer: 1,260,000 yards of 40-cut woolen yarn weigh 105 lbs.

IV. Worsted Yarns.

Worsted yarns have for their standard measure 560 yards to the hank. The number of hanks that one pound requires for balancing indicate the number or count by which it is graded. Hence, if 40 hanks, each 560 yards long, are required to equal one pound in weight, such a yarn is known as 40s worsted. If 48 hanks are required, it is known as 48s worsted, etc. In this manner is found the number of yards for any size or count of worsted yarns by simply multiplying the number by 560.

Worsted yarn is, like cotton yarn, produced very frequently in 2-ply. If such is the case, only one-half the number of yards are required to balance the pound. Hence, 40s worsted (technically for single 40s worsted) requires 22,400 yards per pound, and 2.80s worsted (technically for two-ply 80s worsted) requires also 22,400 yards per pound.

If the yarn be more than 2-ply, divide the number of yards of single yarn in the required number by the number of ply.

Table showing the Number of Yards of Worsted Yarn to the Pound, either Single or Two-ply, in any Count not exceeding 200.

No.	Yds. Single Thread.	Or,	Yds. Two-Ply.
1	560	"	280
2	1,120	"	560
4	2,240	"	1,120
6	3,360	"	1,680
8	4,480	"	2,240
10	5,600	"	2,800
12	6,720	"	3,360
14	7,840	"	3,920
16	8,960	"	4,480
18	10,080	"	5,040
20	11,200	"	5,600
22	12,320	"	6,160
24	13,440	"	6,720
26	14,560	"	7,280
28	15,680	"	7,840
30	16,800	"	8,400
32	17,920	"	8,960
34	19,040	"	9,520
36	20,160	"	10,080
38	21,280	"	10,640
40	22,400	"	11,200
42	23,520	"	11,760
44	24,640	"	12,320
46	25,760	"	12,880
48	26,880	"	13,440
50	28,000	"	14 000
52	29,120	"	14,560
54	30,240	"	15,120
56	31,360	"	15,680
58	32,480	"	16,240
60	33,600	"	16,800
62	34,720	"	17,360
64	35,840	"	17,920
66	36,960	"	18,480
68	38,080	"	19,040
70	39,200	"	19,600
72	40,320	"	20,160
74	41,440	"	20,720
76	42,560	"	21,280
78	43,680	"	21,840
80	44,800	"	22,400
82	45,920	"	22,960
84	47,040	"	23,520
86	48,160	"	24,080
88	49,280	"	24,640
90	50,400	"	25,200
92	51,520	"	25,760
94	52.640	"	26,320
96	53,760	"	26,880
98	54.880	"	27,440
100	56,000	"	28,000
150	84.000	"	42,000
200	112,000	"	56,000

Rule for Finding the Weight in Ounces of a Given Number of Yards of Worsted Yarn.

Multiply the given yards by 16, and divide the result by the number of yards the given "count" of worsted yarn contains balancing 1 pound.

Example: (Single worsted).

Find weight for 12,600 yards of 40s worsted.

$12{,}600 \times 16 = 201{,}600.$

1 lb. of 40s worsted = 22,400 yards, thus:

$201{,}600 \div 22{,}400 = 9.$

Answer:—12,600 yards of 40s worsted weigh 9 ounces.

Question: (2-ply worsted).—Find weight for 12,600 yards of 2.40s worsted.

$12{,}600 \times 16 = 201{,}600.$

lb. of 2.40s worsted = 11,200 yards. Hence, $201{,}600 \div 11{,}200 = 18.$

Answer—12,600 yards of 2-40s worsted weigh 18 ounces.

Rule for Finding the Weight in Pounds of a Given Number of Yards of Worsted Yarn of a Known Count.

Divide the given yards by the number of yarns of the known count required to balance 1 pound.

Example. (Single yarn).

Question:—Find the weight of 1,260,000 yards of 40s worsted yarn.

40s worsted = 22,400 yds. to 1 lb. Thus, $1{,}260{,}000 \div 22{,}400 = 56\frac{1}{4}$ lbs.

Answer:—1,260,000 yds. of 40s worsted yarn weigh 56¼ lbs.

Question: (2-ply yarn).—Find the weight of 1,260,000 yds. of 2.40s worsted yarn.

2.40s worsted = 11,200 yds. to 1 lb. Thus, $1{,}260{,}000 \div 11{,}200 = 112\frac{1}{2}$.

Answer:—1,260,000 yds. of 2.40s worsted yarn weigh 112½ lbs.

V. Silk.

A. Spun Silks.—Spun silks are calculated as to the size of the thread, on the same basis as cotton (840 yards to one hank, and the number of hanks one pound requires indicate the counts).

In the calculation of cotton, woolen or worsted, double and twist yarn, the custom is to consider it the same as twice as heavy as single; thus double and twisted 40s worsted (technically 2.40s worsted) equals single 20s worsted for calculations. In the calculation of spun silk the single yarn equals the two-fold; thus single 40s and two-fold 40s (40.2s) require the same number of hanks (40) = 33,600 yards. The technical expression of two-fold in spun silk is also correspondingly reversed if compared to cotton, wool and worsted yarn.. In cotton, wool and worsted yarn the 2 indicating the two-fold is put in front of the counts indicating the size of the thread (2.40s), while in indicating spun silk this point is reversed (40.2s), or in present example single 80s doubled to 40s.

B. Raw Silks.—The adopted custom of specifying the size of silk yarns is in giving the weight of the 1000 yards hank in drams avoirdupois; thus if one hank weighs 5 drams it is technically known as "5 dram silk," and if it should weigh 8½ drams it is termed "8½ dram silk." As already mentioned the length of the skeins is 1000 yards, except in fuller sizes where 1000 yard skeins would be rather bulky, and apt to cause waste in winding. Such are made into skeins of 500 and 250 yards length, and their weight taken in proportion to the 1000 yards; thus, if the skein made up into 500 yards weighs 8½ drams, the silk would be 17 dram silk; if a skein made up into 250 yards weighs 4 drams, the silk would be 16 dram silk. The size of yarns is always given for their "gum" weight; that is, in their condition before dyeing.

Previous to being dyed silk yarns are subjected to "boiling off," a process taking out the gum or saliva which the silk worm spins into the single thread. In this "boiling off" yarns lose from 24 to 30 per cent according to the class of raw silk used; China silks losing the most, European and Japan silks the least.

The following table shows the number of yards to the pound and ounce from 1 dram silk to 30 dram silk. The number of yards given per pound in the table is based on a pound of gum silk.

Length of Gum Silk Yarn per Pound and per Ounce.

Drams per 1000 yards.	Yards per lb.	Yards per oz.	Drams per 1000 yards.	Yards per lb.	Yards per oz.	Drams per 1000 yards.	Yards per lb.	Yards per oz.
1	256,000	16,000	5	51,200	3,200	16	16,000	1,000
1¼	204,800	12,800	5½	46,545	2,909	17	15,058	941
1½	170,666	10,667	6	42,667	2,667	18	14,222	889
1¾	146,286	9,143	6½	39,385	2,462	19	13,474	842
2	128,000	8,000	7	36,571	2,286	20	12,800	800
2¼	113,777	7,111	7½	34,133	2,133	21	12,190	762
2½	102,400	6,400	8	32,000	2,000	22	11,636	727
2¾	93,091	5,818	8½	30,118	1,882	23	11,130	696
3	85,333	5,333	9	28,444	1,778	24	10,667	666
3¼	78,769	4,923	9½	26,947	1,684	25	10,240	640
3½	73,143	4,571	10	25,600	1,600	26	9,846	615
3¾	68,267	4,267	11	23,273	1,455	27	9,481	592
4	64,000	4,000	12	21,333	1,333	28	9,143	571
4¼	60,235	3,765	13	19,692	1,231	29	8,827	551
4½	56,889	3,556	14	18,286	1,143	30	8,533	533
4¾	53,368	3,368	15	17,067	1,067			

RULES FOR FINDING THE EQUIVALENT COUNTS OF A GIVEN THREAD IN ANOTHER SYSTEM.

A. Cotton, Woolen and Worsted Yarn.

RULE: The counts of a given thread are to the counts of an equal thread (in size) of a different material, or a thread of the same material but figured after a different "*standard*," in the same proportion as the "standard number" of the one to be found is to the "standard number" of the one given.

EXAMPLE 1. Cotton—Worsted. Find equal size in worsted yarn to 21s cotton.

Cotton standard : Worsted standard.

$$840 : 560 = 3 : 2.$$

Thus, $3 : 2 :: x : 21$.

$$3 \times 21 = 63 \div 2 = 31\tfrac{1}{2}.$$

Answer: A thread of 21s cotton equals (in size) a thread of 31½s worsted.

EXAMPLE 2. Cotton—Wool (run system). Find equal size in woolen yarn (runs) to 10s cotton.

Cotton standard : Run standard.

$$840 : 1600 = 21 : 40.$$

Thus, $21 : 40 :: x : 10$.

$$21 \times 10 = 210 \div 40 = 5\tfrac{1}{4}.$$

Answer: A thread of 10s cotton equals (in size) a thread of 5¼-run (wool).

EXAMPLE 3. Cotton—Wool (cut system). Find equal size in woolen yarn (cut basis) to 10s cotton.

Cotton standard : Cut standard.

840 : 300 = 14 : 5.

Thus, 14 : 5 : : x : 10.

$14 \times 10 = 140 \div 5 = 28.$

Answer: A thread of 10s cotton equals (in size) a thread of 28 cut (wool).

EXAMPLE 4. Worsted—Wool (run system). Find equal size in woolen yarn (run basis) to 20s worsted.

Worsted standard : Run standard.

560 : 1600 = 7 : 20.

Thus, 7 : 20 : : x : 20.

$7 \times 20 = 140 \div 20 = 7.$

Answer: A thread of 20s worsted equals (in size) a thread of 7 run (wool).

EXAMPLE 5. Worsted—Wool (cut system). Find equal size in woolen yarn (cut basis) to 15s worsted.

Worsted standard : Cut standard.

560 : 300 = 28 : 15.

Thus, 28 : 15 : : x : 15.

$28 \times 15 = 420 \div 15 = 28.$

Answer: A thread of 15s worsted equals (in size) a thread of 28 cut (wool).

EXAMPLE 6. Worsted—Cotton. Find equal size in cotton to 30s worsted.

$2 : 3 : : x : 30 = 60 \div 3 = 20.$

Answer:—A thread of 30s worsted equals (in size) a thread of 20s cotton.

EXAMPLE 7. Woolen Yarn. Run System—Cut System. Find equal size in the cut basis of a 6-run thread.

$16 : 3 : : x : 6 = 96 \div 3 = 32.$

Answer:—A 6-run woolen thread equals (in size) a 32 cut thread of the same material.

EXAMPLE 8. Woolen Yarn. Cut System—Run System. Find equal size in the run basis of a 32-cut woolen thread.

$3 : 16 : : x : 32 = 96 \div 16 = 6$

Answer:—A 32-cut woolen thread has for its equal in size a 6-run thread of the same material.

B[1]. Spun Silk Compared to Cotton, Woolen, or Worsted Yarn.

The basis of spun silk is the same as that of cotton. Therefore, the rules and examples given under the heading of "Cotton" refer at the same time to spun silk.

B[2]. Raw Silk Compared to Spun Silk, Cotton, Woolen, or Worsted Yarn.

RULE.—Find the number of yards per pound (on table previously given) in raw silk, and divide the same by the standard size of the yarn basis to be compared with.

EXAMPLE 9. Raw Silk—Cotton. Find equal size in cotton yarn to 9 dram raw silk.

9 dram raw silk = 28,444 yds. per lb. Thus, 28,444 ÷ 840 (cotton standard) = $33\frac{6}{7}$.

Answer:—9 dram raw silk equals nearly 34s cotton.

EXAMPLE 10. Spun Silk or Cotton—Raw Silk. Find equal size in raw silk to 38s cotton.

38s cotton = 31,920 yds. per lb. (38×840).

Refer to table for raw silk, where you will find 8 dram per 1000 yards gives 32,000 per lb.

Answer:—A 38s-cotton thread equals (nearly) an 8 dram raw silk thread.

TABLE OF RELATIVE LENGTHS.

Of Cotton Yarns by Numbers and Woolen Yarns by Runs.

Taking the Number as a Basis.
840 yards single Cotton Yarn = 1 Number.
1,600 " " Woolen " = 1 Run.

No. 1	Single Cotton Yarn	=	$\frac{21}{40}$	Run Single Woolen.				No. 15	Single Cotton Yarn	=	$7\frac{7}{8}$	Run Single Woolen.		
2	" " "	=	$1\frac{1}{20}$	" " "				16	" " "	=	$8\frac{2}{5}$	" " "		
3	" " "	=	$1\frac{23}{40}$	" " "				17	" " "	=	$8\frac{37}{40}$	" " "		
4	" " "	=	$2\frac{1}{10}$	" " "				18	" " "	=	$9\frac{9}{20}$	" " "		
5	" " "	=	$2\frac{5}{8}$	" " "				19	" " "	=	$9\frac{39}{40}$	" " "		
6	" " "	=	$3\frac{3}{20}$	" " "				20	" " "	=	$10\frac{1}{2}$	" " "		
7	" " "	=	$3\frac{27}{40}$	" " "				21	" " "	=	$11\frac{1}{40}$	" " "		
8	" " "	=	$4\frac{1}{5}$	" " "				22	" " "	=	$11\frac{11}{20}$	" " "		
9	" " "	=	$4\frac{29}{40}$	" " "				23	" " "	=	$12\frac{3}{40}$	" " "		
10	" " "	=	$5\frac{1}{4}$	" " "				24	" " "	=	$12\frac{3}{5}$	" " "		
11	" " "	=	$5\frac{31}{40}$	" " "				25	" " "	=	$13\frac{1}{8}$	" " "		
12	" " "	=	$6\frac{3}{10}$	" " "				26	" " "	=	$13\frac{13}{20}$	" " "		
13	" " "	=	$6\frac{33}{40}$	" " "				28	" " "	=	$14\frac{7}{10}$	" " "		
14	" " "	=	$7\frac{7}{20}$	" " "				30	" " "	=	$15\frac{3}{4}$	" " "		

TABLE OF RELATIVE LENGTHS

Of Cotton Yarns by Numbers and Woolen Yarns by Cuts.

Taking the Number as a Basis.
840 yards single Cotton Yarn = 1 Number.
300 " " Woolen Yarn = 1 Cut.

No. 1	Single Cotton Yarn	=	$2\frac{4}{5}$	Cut Single Woolen.	No. 15	Single Cotton Yarn	=	42	Cut Single Woolen.
2	" " "	=	$5\frac{3}{5}$	" " "	16	" " "	=	$44\frac{4}{5}$	" " "
3	" " "	=	$8\frac{2}{5}$	" " "	17	" " "	=	$47\frac{3}{5}$	" " "
4	" " "	=	$11\frac{1}{5}$	" " "	18	" " "	=	$50\frac{2}{5}$	" " "
5	" " "	=	14	" " "	19	" " "	=	$53\frac{1}{5}$	" " "
6	" " "	=	$16\frac{4}{5}$	" " "	20	" " "	=	56	" " "
7	" " "	=	$19\frac{3}{5}$	" " "	21	" " "	=	$58\frac{4}{5}$	" " "
8	" " "	=	$22\frac{2}{5}$	" " "	22	" " "	=	$61\frac{3}{5}$	" " "
9	" " "	=	$25\frac{1}{5}$	" " "	23	" " "	=	$64\frac{2}{5}$	" " "
10	" " "	=	28	" " "	24	" " "	=	$67\frac{1}{5}$	" " "
11	" " "	=	$30\frac{4}{5}$	" " "	25	" " "	=	70	" " "
12	" " "	=	$33\frac{3}{5}$	" " "	26	" " "	=	$72\frac{4}{5}$	" " "
13	" " "	=	$36\frac{2}{5}$	" " "	28	" " "	=	$78\frac{2}{5}$	" " "
14	" " "	=	$39\frac{1}{5}$	" " "	30	" " "	=	84	" " "

TABLE OF RELATIVE LENGTHS.

Of Cotton Yarn by Numbers and Worsted Yarn by Numbers.

Taking the Cotton Number as a Basis.
840 yards Single Cotton Yarn = 1 Number.
560 " " Worsted " = 1 Number.

No. 1	Single Cotton Yarn	=	No. $1\frac{1}{2}$	Single Worsted.	No. 22	Single Cotton Yarn	=	No. 33	Single Worsted.
2	" " "	=	3	" "	24	" " "	=	36	" "
4	" " "	=	6	" "	26	" " "	=	39	" "
6	" " "	=	9	" "	28	" " "	=	42	" "
8	" " "	=	12	" "	30	" " "	=	45	" "
10	" " "	=	15	" "	32	" " "	=	48	" "
12	" " "	=	18	" "	34	" " "	=	51	" "
14	" " "	=	21	" "	36	" " "	=	54	" "
16	" " "	=	24	" "	38	" " "	=	57	" "
18	" " "	=	27	" "	40	" " "	=	60	" "
20	" " "	=	30	" "	42	" " "	=	63	" "

No. 44	Single	Cotton	Yarn	=	No. 66	Single	Worsted.		No. 64	Single	Cotton	Yarn	=	No. 96	Single	Worsted.
46	“	“	“	=	69	“	“		66	“	“	“	=	99	“	“
48	“	“	“	=	72	“	“		68	“	“	“	=	102	“	“
50	“	“	“	=	75	“	“		70	“	“	“	=	105	“	“
52	“	“	“	=	78	“	“		72	“	“	“	=	108	“	“
54	“	“	“	=	81	“	“		74	“	“	“	=	111	“	“
56	“	“	“	=	84	“	“		76	“	“	“	=	114	“	“
58	“	“	“	=	87	“	“		78	“	“	“	=	117	“	“
60	“	“	“	=	90	“	“		80	“	“	“	=	120	“	“
62	“	“	“	=	93	“	“		100	“	“	“	=	150	“	“

TABLE OF RELATIVE LENGTHS.

Of Woolen Yarn by Runs and Cotton Yarn by Numbers.

Taking the Run as a Basis.
1600 Yards Single Woolen Yarn = 1 Run.
840 “ “ Cotton Yarn = 1 Number.

1	Run	Single	Woolen	Yarn	= No.	$1\frac{19}{21}$	Single	Cotton	Yarn.
$1\frac{1}{4}$	“	“	“	“	=	$2\frac{8}{21}$	“	“	“
$1\frac{1}{2}$	“	“	“	“	=	$2\frac{6}{7}$	“	“	“
$1\frac{3}{4}$	“	“	“	“	=	$3\frac{1}{3}$	“	“	“
2	“	“	“	“	=	$3\frac{17}{21}$	“	“	“
$2\frac{1}{4}$	“	“	“	“	=	$4\frac{2}{7}$	“	“	“
$2\frac{1}{2}$	“	“	“	“	=	$4\frac{16}{21}$	“	“	“
$2\frac{3}{4}$	“	“	“	“	=	$5\frac{5}{21}$	“	“	“
3	“	“	“	“	=	$5\frac{5}{7}$	“	“	“
$3\frac{1}{4}$	“	“	“	“	=	$6\frac{4}{21}$	“	“	“
$3\frac{1}{2}$	“	“	“	“	=	$6\frac{14}{21}$	“	“	“
$3\frac{3}{4}$	“	“	“	“	=	$7\frac{1}{7}$	“	“	“
4	“	“	“	“	=	$7\frac{13}{21}$	“	“	“
$4\frac{1}{4}$	“	“	“	“	=	$8\frac{2}{21}$	“	“	“
$4\frac{1}{2}$	“	“	“	“	=	$8\frac{4}{7}$	“	“	“
$4\frac{3}{4}$	“	“	“	“	=	$9\frac{1}{21}$	“	“	“
5	“	“	“	“	=	$9\frac{11}{21}$	“	“	“
$5\frac{1}{4}$	“	“	“	“	=	10	“	“	“
$5\frac{1}{2}$	“	“	“	“	=	$10\frac{10}{21}$	“	“	“
$5\frac{3}{4}$	“	“	“	“	=	$10\frac{20}{21}$	“	“	“
6	“	“	“	“	=	$11\frac{3}{7}$	“	“	“
$6\frac{1}{4}$	“	“	“	“	=	$11\frac{19}{21}$	“	“	“
$6\frac{1}{2}$	“	“	“	“	=	$12\frac{8}{21}$	“	“	“
$6\frac{3}{4}$	“	“	“	“	=	$12\frac{6}{7}$	“	“	“
7	“	“	“	“	=	$13\frac{1}{3}$	“	“	“
$7\frac{1}{4}$	“	“	“	“	=	$13\frac{17}{21}$	“	“	“
$7\frac{1}{2}$	“	“	“	“	=	$14\frac{2}{7}$	“	“	“
$7\frac{3}{4}$	“	“	“	“	=	$14\frac{16}{21}$	“	“	“
8	“	“	“	“	=	$15\frac{5}{21}$	“	“	“
$8\frac{1}{4}$	“	“	“	“	=	$15\frac{5}{7}$	“	“	“
$8\frac{1}{2}$	“	“	“	“	=	$16\frac{4}{21}$	“	“	“
$8\frac{3}{4}$	“	“	“	“	=	$16\frac{14}{21}$	“	“	“
9	“	“	“	“	=	$17\frac{1}{7}$	“	“	“
$9\frac{1}{4}$	“	“	“	“	=	$17\frac{13}{21}$	“	“	“
$9\frac{1}{2}$	“	“	“	“	=	$18\frac{2}{21}$	“	“	“
$9\frac{3}{4}$	“	“	“	“	=	$18\frac{4}{7}$	“	“	“
10	“	“	“	“	=	$19\frac{1}{21}$	“	“	“
$10\frac{1}{4}$	“	“	“	“	=	$19\frac{11}{21}$	“	“	“
$10\frac{1}{2}$	“	“	“	“	=	20	“	“	“
$10\frac{3}{4}$	“	“	“	“	=	$20\frac{10}{21}$	“	“	“
11	“	“	“	“	=	$20\frac{20}{21}$	“	“	“
$11\frac{1}{2}$	“	“	“	“	=	$21\frac{19}{21}$	“	“	“
12	“	“	“	“	=	$22\frac{6}{7}$	“	“	“

TABLE OF RELATIVE LENGTHS

Of Woolen Yarn by Runs with Woolen Yarn by Cuts.

Taking the Run as a Basis.
1600 yards Single Woolen Yarn = 1 Run.
300 " " " " = 1 Cut.

1	Run	Woolen	Yarn	.... =	5⅓	Cut.
1¼	"	"	"	.... =	6⅔	"
1½	"	"	"	.... =	8	"
1¾	"	"	"	.... =	9⅓	"
2	"	"	"	.... =	10⅔	"
2¼	"	"	"	.... =	12	"
2½	"	"	"	.... =	13⅓	"
2¾	"	"	"	.... =	14⅔	"
3	"	"	"	.... =	16	"
3¼	"	"	"	.... =	17⅓	"
3½	"	"	"	.... =	18⅔	"
3¾	"	"	"	.... =	20	"
4	"	"	"	.... =	21⅓	"
4¼	"	"	"	.... =	22⅔	"
4½	"	"	"	.... =	24	"
4¾	"	"	"	.... =	25⅓	"
5	"	"	"	.... =	26⅔	"
5¼	"	"	"	.... =	28	"
5½	"	"	"	.... =	29⅓	"
5¾	"	"	"	.... =	30⅔	"
6	"	"	"	.... =	32	"
6¼	"	"	"	.... =	33⅓	"
6½	"	"	"	.... =	34⅔	"
6¾	Run	Woolen	Yarn	.... =	36	Cut.
7	"	"	"	.... =	37⅓	"
7¼	"	"	"	.... =	38⅔	"
7½	"	"	"	.... =	40	"
7¾	"	"	"	.... =	41⅓	"
8	"	"	"	.... =	42⅔	"
8¼	"	"	"	.... =	44	"
8½	"	"	"	.... =	45⅓	"
8¾	"	"	"	.... =	46⅔	"
9	"	"	"	.... =	48	"
9¼	"	"	"	.... =	49⅓	"
9½	"	"	"	.... =	50⅔	"
9¾	"	"	"	.... =	52	"
10	"	"	"	.... =	53⅓	"
10¼	"	"	"	.... =	54⅔	"
10½	"	"	"	.... =	56	"
10¾	"	"	"	.... =	57⅓	"
11	"	"	"	.... =	58⅔	"
11¼	"	"	"	.... =	60	"
11½	"	"	"	.... =	61⅓	"
11¾	"	"	"	.... =	62⅔	"
12	"	"	"	.... =	64	"

TABLE OF RELATIVE LENGTHS.

Of Woolen Yarn by Runs and Worsted Yarn by Numbers.

Taking the Run as a Basis.
1,600 yards Single Woolen Yarn = 1 Run.
560 " " Worsted Yarn = 1 Number.

RUN							
1	Single	Woolen	Yarn	= No.	2 6/7	Single	Worsted.
2	"	"	"	=	5 5/7	"	"
3	"	"	"	=	8 4/7	"	"
4	"	"	"	=	11 3/7	"	"
4½	"	"	"	=	12 6/7	"	"
5	"	"	"	=	14 3/7	"	"
5¼	"	"	"	=	15	"	"
5½	"	"	"	=	15 5/7	"	"
5¾	"	"	"	=	16 3/7	"	"
6	"	"	"	=	17 1/7	"	"
6¼	"	"	"	=	17 6/7	"	"
6½	"	"	"	=	18 4/7	"	"
6¾	"	"	"	=	19 2/7	"	"
7	"	"	"	=	20	"	"
7¼	"	"	"	=	20 5/7	"	"
7½	"	"	"	=	21 3/7	"	"
7¾	"	"	"	=	22 1/7	"	"
8	"	"	"	=	22 6/7	"	"
8¼	"	"	"	=	23 4/7	"	"
8½	"	"	"	=	24 2/7	"	"
8¾	"	"	"	=	25	"	"
RUN.							
9	Single	Woolen	Yarn	= No.	25 5/7	Single	Worsted.
9¼	"	"	"	=	26 3/7	"	"
9½	"	"	"	=	27 1/7	"	"
9¾	"	"	"	=	27 6/7	"	"
10	"	"	"	=	28 4/7	"	"
10¼	"	"	"	=	29 2/7	"	"
10½	"	"	"	=	30	"	"
10¾	"	"	"	=	30 5/7	"	"
11	"	"	"	=	31 3/7	"	"
11¼	"	"	"	=	32 1/7	"	"
11½	"	"	"	=	32 6/7	"	"
11¾	"	"	"	=	33 4/7	"	"
12	"	"	"	=	34 2/7	"	"
12¼	"	"	"	=	35	"	"
12½	"	"	"	=	35 5/7	"	"
12¾	"	"	"	=	36 3/7	"	"
13	"	"	"	=	37 1/7	"	"
13¼	"	"	"	=	37 6/7	"	"
13½	"	"	"	=	38 4/7	"	"
13¾	"	"	"	=	39 2/7	"	"
14	"	"	"	=	40	"	"

TABLE OF RELATIVE LENGTHS
Of Woolen Yarn Cuts and Cotton Yarn by Numbers.

Taking the "Cut" as a Basis.
300 yards Single Woolen Yarn = 1 Cut.
840 " " Cotton " = 1 Number.

1	Cut	Single	Woolen	Yarn	= No.	$\frac{5}{14}$	Single	Cotton	Yarn.
2	"	"	"	"	=	$\frac{5}{7}$	"	"	"
3	"	"	"	"	=	$1\frac{1}{14}$	"	"	"
4	"	"	"	"	=	$1\frac{3}{7}$	"	"	"
5	"	"	"	"	=	$1\frac{11}{14}$	"	"	"
6	"	"	"	"	=	$2\frac{1}{7}$	"	"	"
7	"	"	"	"	=	$2\frac{1}{2}$	"	"	"
8	"	"	"	"	=	$2\frac{6}{7}$	"	"	"
9	"	"	"	"	=	$3\frac{3}{14}$	"	"	"
10	"	"	"	"	=	$3\frac{4}{7}$	"	"	"
11	"	"	"	"	=	$3\frac{13}{14}$	"	"	"
12	"	"	"	"	=	$4\frac{2}{7}$	"	"	"
13	"	"	"	"	=	$4\frac{9}{14}$	"	"	"
14	"	"	"	"	=	5	"	"	"
15	"	"	"	"	=	$5\frac{5}{14}$	"	"	"
16	"	"	"	"	=	$5\frac{5}{7}$	"	"	"
17	"	"	"	"	=	$6\frac{1}{14}$	"	"	"
18	"	"	"	"	=	$6\frac{3}{7}$	"	"	"
19	"	"	"	"	=	$6\frac{11}{14}$	"	"	"
20	"	"	"	"	=	$7\frac{1}{7}$	"	"	"
21	"	"	"	"	=	$7\frac{1}{2}$	"	"	"
22	"	"	"	"	=	$7\frac{6}{7}$	"	"	"
23	"	"	"	"	=	$8\frac{3}{14}$	"	"	"
24	"	"	"	"	=	$8\frac{4}{7}$	"	"	"
25	"	"	"	"	=	$8\frac{13}{14}$	"	"	"
26	"	"	"	"	=	$9\frac{2}{7}$	"	"	"
27	"	"	"	"	=	$9\frac{9}{14}$	"	"	"
28	"	"	"	"	=	10	"	"	"
29	"	"	"	"	=	$10\frac{5}{14}$	"	"	"
30	"	"	"	"	=	$10\frac{5}{7}$	"	"	"
31	"	"	"	"	=	$11\frac{1}{14}$	"	"	"
32	"	"	"	"	=	$11\frac{3}{7}$	"	"	"
33	"	"	"	"	=	$11\frac{11}{14}$	"	"	"
34	"	"	"	"	=	$12\frac{1}{7}$	"	"	"
35	"	"	"	"	=	$12\frac{1}{2}$	"	"	"
36	"	"	"	"	=	$12\frac{6}{7}$	"	"	"
37	"	"	"	"	=	$13\frac{3}{14}$	"	"	"
38	"	"	"	"	=	$13\frac{4}{7}$	"	"	"
39	"	"	"	"	=	$13\frac{13}{14}$	"	"	"
40	"	"	"	"	=	$14\frac{2}{7}$	"	"	"
41	"	"	"	"	=	$14\frac{9}{14}$	"	"	"
45	"	"	"	"	=	$16\frac{1}{14}$	"	"	"

TABLE OF RELATIVE LENGTHS
Of Woolen Yarn by Cuts and Woolen Yarn by Runs.

Taking the "Cut" as a Basis.
300 yards Single Woolen = 1 Cut.
1600 " " " = 1 Run.

1 Cut Single Woolen Yarn	= $\frac{3}{16}$	Run.		6 Cut Single Woolen Yarn	= $1\frac{1}{8}$	Run.
2 " " " "	= $\frac{3}{8}$	"		7 " " " "	= $1\frac{5}{16}$	"
3 " " " "	= $\frac{9}{16}$	"		8 " " " "	= $1\frac{1}{2}$	"
4 " " " "	= $\frac{3}{4}$	"		9 " " " "	= $1\frac{11}{16}$	"
5 " " " "	= $\frac{15}{16}$	"		10 " " " "	= $1\frac{7}{8}$	"

11	Cut Single Woolen Yarn	= $2\frac{1}{16}$	Run.
12	“ “ “ “	= $2\frac{1}{4}$	“
13	“ “ “ “	= $2\frac{7}{16}$	“
14	“ “ “ “	= $2\frac{5}{8}$	“
15	“ “ “ “	= $2\frac{13}{16}$	“
16	“ “ “ “	= 3	“
17	“ “ “ “	= $3\frac{3}{16}$	“
18	“ “ “ “	= $3\frac{3}{8}$	“
19	“ “ “ “	= $3\frac{9}{16}$	“
20	“ “ “ “	= $3\frac{3}{4}$	“
21	“ “ “ “	= $3\frac{15}{16}$	“
22	“ “ “ “	= $4\frac{1}{8}$	“
23	“ “ “ “	= $4\frac{5}{16}$	“
24	“ “ “ “	= $4\frac{1}{2}$	“
25	“ “ “ “	= $4\frac{11}{16}$	“
26	“ “ “ “	= $4\frac{7}{8}$	“
27	“ “ “ “	= $5\frac{1}{16}$	“
28	“ “ “ “	= $5\frac{1}{4}$	“
29	“ “ “ “	= $5\frac{7}{16}$	“
30	“ “ “ “	= $5\frac{5}{8}$	“
31	“ “ “ “	= $5\frac{13}{16}$	“
32	“ “ “ “	= 6	“
33	“ “ “ “	= $6\frac{3}{16}$	“
34	“ “ “ “	= $6\frac{3}{8}$	“
35	“ “ “ “	= $6\frac{9}{16}$	“
36	Cut Single Woolen Yarn	= $6\frac{3}{4}$	Run.
37	“ “ “ “	= $6\frac{15}{16}$	“
38	“ “ “ “	= $7\frac{1}{8}$	“
39	“ “ “ “	= $7\frac{5}{16}$	“
40	“ “ “ “	= $7\frac{1}{2}$	“
41	“ “ “ “	= $7\frac{11}{16}$	“
42	“ “ “ “	= $7\frac{7}{8}$	“
43	“ “ “ “	= $8\frac{1}{16}$	“
44	“ “ “ “	= $8\frac{1}{4}$	“
45	“ “ “ “	= $8\frac{7}{16}$	“
46	“ “ “ “	= $8\frac{5}{8}$	“
47	“ “ “ “	= $8\frac{13}{16}$	“
48	“ “ “ “	= 9	“
49	“ “ “ “	= $9\frac{3}{16}$	“
50	“ “ “ “	= $9\frac{3}{8}$	“
51	“ “ “ “	= $9\frac{3}{4}$	“
52	“ “ “ “	= $9\frac{15}{16}$	“
53	“ “ “ “	= $10\frac{1}{8}$	“
54	“ “ “ “	= $10\frac{5}{16}$	“
55	“ “ “ “	= $10\frac{1}{2}$	“
56	“ “ “ “	= $10\frac{11}{16}$	“
57	“ “ “ “	= $10\frac{7}{8}$	“
58	“ “ “ “	= $11\frac{1}{16}$	“
59	“ “ “ “	= $11\frac{1}{4}$	“
60	“ “ “ “	= $11\frac{7}{16}$	“

TABLE OF RELATIVE LENGTHS

Of Woolen Yarn by Cuts and Worsted Yarn by Numbers.

Taking the Cut as the Basis.
300 yards Single Woolen Yarn = 1 Cut.
560 “ “ Worsted “ = 1 Number.

1	Cut Single Woolen Yarn	=No.	$\frac{15}{28}$	Single Worsted.
2	“ “ “ “	=	$1\frac{2}{28}$	“ “
4	“ “ “ “	=	$2\frac{4}{28}$	“ “
6	“ “ “ “	=	$3\frac{6}{28}$	“ “
8	“ “ “ “	=	$4\frac{8}{28}$	“ “
10	“ “ “ “	=	$5\frac{10}{28}$	“ “
11	“ “ “ “		$5\frac{25}{28}$	“ “
12	“ “ “ “	=	$6\frac{12}{28}$	“ “
13	“ “ “ “	=	$6\frac{27}{28}$	“ “
14	“ “ “ “	=	$7\frac{14}{28}$	“ “
15	“ “ “ “	=	$8\frac{1}{28}$	“ “
16	“ “ “ “	=	$8\frac{16}{28}$	“ “
17	“ “ “ “	=	$9\frac{3}{28}$	“ “
18	“ “ “ “	=	$9\frac{18}{28}$	“ “
19	“ “ “ “	=	$10\frac{5}{28}$	“ “
20	“ “ “ “	=	$10\frac{20}{28}$	“ “
21	“ “ “ “	=	$11\frac{7}{28}$	“ “
22	“ “ “ “	=	$11\frac{22}{28}$	“ “
23	“ “ “ “	=	$12\frac{9}{28}$	“ “
24	“ “ “ “	=	$12\frac{24}{28}$	“ “
25	“ “ “ “	=	$13\frac{11}{28}$	“ “
26	“ “ “ “	=	$13\frac{26}{28}$	“ “
27	“ “ “ “	=	$14\frac{13}{28}$	“ “
28	“ “ “ “	=	15	“ “
29	“ “ “ “	=	$15\frac{15}{28}$	“ “
30	“ “ “ “	=	$16\frac{2}{28}$	“ “
31	“ “ “ “	=	$16\frac{17}{28}$	“ “
32	“ “ “ “	=	$17\frac{4}{28}$	“ “
33	Cut Single Woolen Yarn	=No.	$17\frac{19}{28}$	Single Worsted.
34	“ “ “ “	=	$18\frac{6}{28}$	“ “
35	“ “ “ “	=	$18\frac{21}{28}$	“ “
36	“ “ “ “	=	$19\frac{8}{28}$	“ “
37	“ “ “ “	=	$19\frac{23}{28}$	“ “
38	“ “ “ “	=	$20\frac{10}{28}$	“ “
39	“ “ “ “	=	$20\frac{25}{28}$	“ “
40	“ “ “ “	=	$21\frac{12}{28}$	“ “
41	“ “ “ “	=	$21\frac{27}{28}$	“ “
42	“ “ “ “	=	$22\frac{14}{28}$	“ “
43	“ “ “ “	=	$23\frac{1}{28}$	“ “
44	“ “ “ “	=	$23\frac{16}{28}$	“ “
45	“ “ “ “	=	$24\frac{3}{28}$	“ “
46	“ “ “ “	=	$24\frac{18}{28}$	“ “
47	“ “ “ “	=	$25\frac{5}{28}$	“ “
48	“ “ “ “	=	$25\frac{20}{28}$	“ “
49	“ “ “ “	=	$26\frac{7}{28}$	“ “
50	“ “ “ “	=	$26\frac{22}{28}$	“ “
51	“ “ “ “	=	$27\frac{9}{28}$	“ “
52	“ “ “ “	=	$27\frac{24}{28}$	“ “
53	“ “ “ “	=	$28\frac{11}{28}$	“ “
54	“ “ “ “	=	$28\frac{26}{28}$	“ “
55	“ “ “ “	=	$29\frac{13}{28}$	“ “
56	“ “ “ “	=	30	“ “
57	“ “ “ “	=	$30\frac{15}{28}$	“ “
58	“ “ “ “	=	$31\frac{2}{28}$	“ “
59	“ “ “ “	=	$31\frac{17}{28}$	“ “
60	“ “ “ “	=	$32\frac{4}{28}$	“ “

TABLE OF RELATIVE LENGTHS

Of Worsted Yarns by Numbers and Cotton Yarns by Numbers.

Taking the Worsted Number as a Basis.
560 yards Single Worsted Yarn = 1 Number.
840 " " Cotton " = 1 Number.

No. 1	Single	Worsted	Yarn	= No.	⅔	Single	Cotton	Yarn.
2	"	"	"	=	1⅓	"	"	"
4	"	"	"	=	2⅔	"	"	"
6	"	"	"	=	4	"	"	"
8	"	"	"	=	5⅓	"	"	"
10	"	"	"	=	6⅔	"	"	"
12	"	"	"	=	8	"	"	"
14	"	"	"	=	9⅓	"	"	"
16	"	"	"	=	10⅔	"	"	"
18	"	"	"	=	12	"	"	"
20	"	"	"	=	13⅓	"	"	"
22	"	"	"	=	14⅔	"	"	"
24	"	"	"	=	16	"	"	"
26	"	"	"	=	17⅓	"	"	"
28	"	"	"	=	18⅔	"	"	"
30	"	"	"	=	20	"	"	"
32	"	"	"	=	21⅓	"	"	"
34	"	"	"	=	22⅔	"	"	"
36	"	"	"	=	24	"	"	"
38	"	"	"	=	25⅓	"	"	"
40	"	"	"	=	26⅔	"	"	"
42	"	"	"	=	28	"	"	"
44	"	"	"	=	29⅓	"	"	"
46	"	"	"	=	30⅔	"	"	"
48	"	"	"	=	32	"	"	"
50	"	"	"	=	33⅓	"	"	"
52	"	"	"	=	34⅔	"	"	"
54	"	"	"	=	36	"	"	"
56	"	"	"	=	37⅓	"	"	"
58	"	"	"	=	38⅔	"	"	"
60	"	"	"	=	40	"	"	"
62	"	"	"	=	41⅓	"	"	"
64	"	"	"	=	42⅔	"	"	"
66	"	"	"	=	44	"	"	"
68	"	"	"	=	45⅓	"	"	"
70	"	"	"	=	46⅔	"	"	"
72	"	"	"	=	48	"	"	"
74	"	"	"	=	49⅓	"	"	"
76	"	"	"	=	50⅔	"	"	"
78	"	"	"	=	52	"	"	"
80	"	"	"	=	53⅓	"	"	"
82	"	"	"	=	54⅔	"	"	"
84	"	"	"	=	56	"	"	"
86	"	"	"	=	57⅓	"	"	"
88	"	"	"	=	58⅔	"	"	"
90	"	"	"	=	60	"	"	"
92	"	"	"	=	61⅓	"	"	"
94	"	"	"	=	62⅔	"	"	"
96	"	"	"	=	64	"	"	"
98	"	"	"	=	65⅓	"	"	"
100	"	"	"	=	66⅔	"	"	"
110	"	"	"	=	73⅓	"	"	"
120	"	"	"	=	80	"	"	"
130	"	"	"	=	86⅔	"	"	"

TABLE OF RELATIVE LENGTHS

Of Worsted Yarn by Numbers and Woolen Yarn by Runs.

Taking the Number as a Basis.
560 yards Single Worsted Yarn = 1 Number.
1600 " " Woolen " = 1 Run.

No. 1	Single	Worsted	Yarn	=	$\frac{7}{20}$	Run	Single	Woolen.
2	"	"	"	=	$\frac{7}{10}$	"	"	"
4	"	"	"	=	$1\frac{4}{10}$	"	"	"
6	"	"	"	=	$2\frac{1}{10}$	"	"	"
8	"	"	"	=	$2\frac{8}{10}$	"	"	"
10	"	"	"	=	$3\frac{5}{10}$	"	"	"
12	"	"	"	=	$4\frac{2}{10}$	"	"	"
14	"	"	"	=	$4\frac{9}{10}$	"	"	"
16	"	"	"	=	$5\frac{6}{10}$	"	"	"
18	"	"	"	=	$6\frac{3}{10}$	"	"	"
20	"	"	"	=	7	"	"	"
22	"	"	"	=	$7\frac{7}{10}$	"	"	"
24	"	"	"	=	$8\frac{4}{10}$	"	"	"
26	"	"	"	=	$9\frac{1}{10}$	"	"	"
28	"	"	"	=	$9\frac{8}{10}$	"	"	"
30	"	"	"	=	$10\frac{5}{10}$	"	"	"
32	"	"	"	=	$11\frac{2}{10}$	"	"	"
34	"	"	"	=	$11\frac{9}{10}$	"	"	"
36	"	"	"	=	$12\frac{6}{10}$	"	"	"
38	"	"	"	=	$13\frac{3}{10}$	"	"	"
40	"	"	"	=	14	"	"	"
42	"	"	"	=	$14\frac{7}{10}$	"	"	"
44	"	"	"	=	$15\frac{4}{10}$	"	"	"
46	"	"	"	=	$16\frac{1}{10}$	"	"	"
48	"	"	"	=	$16\frac{8}{10}$	"	"	"
50	"	"	"	=	$17\frac{5}{10}$	"	"	"

TABLE OF RELATIVE LENGTHS

Of Worsted Yarn by Numbers and Woolen Yarn by Cuts.

Taking the Number as a Basis.
560 Yards Single Worsted Yarn = 1 Number.
300 " " Woolen Yarn = 1 Cut.

No. 1	Single	Worsted	Yarn	=	$1\frac{13}{15}$	Cut	Single	Woolen.
2	"	"	"	=	$3\frac{11}{15}$	"	"	"
4	"	"	"	=	$7\frac{7}{15}$	"	"	"
6	"	"	"	=	$11\frac{3}{15}$	"	"	"
8	"	"	"	=	$14\frac{14}{15}$	"	"	"
10	"	"	"	=	$18\frac{10}{15}$	"	"	"
12	"	"	"	=	$22\frac{6}{15}$	"	"	"
14	"	"	"	=	$26\frac{2}{15}$	"	"	"
16	"	"	"	=	$29\frac{13}{15}$	"	"	"
18	"	"	"	=	$33\frac{9}{15}$	"	"	"
20	"	"	"	=	$37\frac{5}{15}$	"	"	"
22	"	"	"	=	$41\frac{1}{15}$	"	"	"
24	"	"	"	=	$44\frac{12}{15}$	"	"	"
26	"	"	"	=	$48\frac{8}{15}$	"	"	"
28	"	"	"	=	$52\frac{4}{15}$	"	"	"
30	"	"	"	=	56	"	"	"
32	"	"	"	=	$59\frac{11}{15}$	"	"	"
34	"	"	"	=	$63\frac{7}{15}$	"	"	"
36	"	"	"	=	$67\frac{3}{15}$	"	"	"
38	"	"	"	=	$70\frac{14}{15}$	"	"	"
40	"	"	"	=	$74\frac{10}{15}$	"	"	"

YARN CALCULATIONS.

Ascertaining the Counts of Twisted Yarns Composed of Two or more minor Threads of which the Counts are Known.

I. If the compound thread is composed of two minor threads of equal counts and material, the compound thread is one-half the count of the minor.

EXAMPLE: 2.60s cotton = single 30s cotton yarn.
2.40s worsted = " 20s worsted.
Double and twist 4-run woolen yarn = 2-run single woolen yarn.
Double and twist 30-cut woolen yarn = 15-cut single woolen yarn.

II. If the yarn be more than two-ply, divide the given counts by the number of ply.

EXAMPLE: 3.90s cotton = 90 ÷ 3 = single 30s cotton yarn.
3.60s worsted = 60 ÷ 3 = single 20s worsted, etc.

III. If the compound thread is composed of two minor threads of unequal counts but the same material, the rule for finding the equal in a single thread as compared with the compound thread, is as follows:

Divide the product of the counts of the minor threads by their sum.

EXAMPLE A.—Find the equal in single cotton yarn to a two-fold cotton thread composed of single 40s and 60s.

$$40 \times 60 = 2400 \div 100\ (40 + 60) = 24.$$

Answer: A two-fold cotton thread composed of single 40s and 60s equals a single 24s cotton yarn.

EXAMPLE B.—Find the equal in a single worsted thread to a two-fold worsted thread composed of single 20s and 30s.

$$20 \times 30 = 600 \div 50\ (20 + 30) = 12.$$

Answer: A two-fold worsted thread composed of single 20s and 30s equals single 12s worsted.

EXAMPLE C.—Find the equal counts in single woolen yarn (run basis) for a double and twist thread composed of single 3-run and 6-run woolen yarn.

$$3 \times 6 = 18 \div 9\ (3 + 6) = 2.$$

Answer: A 3-run and 6-run woolen thread being twisted equals a single 2-run woolen thread.

EXAMPLE D.—Find the equal counts in single woolen yarn (cut basis) for a double and twist thread composed of single 20-cut and 30-cut yarn.

$$20 \times 30 = 600 \div 50\ (20 + 30) = 12.$$

Answer: A 20-cut and 30-cut woolen yarn twisted equals single 12-cut woolen yarn.

IV. If the compound thread is composed of two minor threads of different materials, one must be reduced to the relative basis of the other thread, and the resulting count found in this system. (See tables of relative lengths given on page 276 to 282.)

EXAMPLE A.—Find the equal counts in a single worsted thread to a 2-ply thread composed of single 30s worsted and single 40s cotton yarn.

40s cotton = 60s worsted. Thus $30 \times 60 = 1800 \div 90\ (30 + 60) = 20$.

Answer: Compound thread given in example equals a single 20s worsted thread.

EXAMPLE B.—Find the equal counts in single cotton yarn to a 2-ply thread composed of single 30s worsted and 40s cotton yarn.

30s worsted = 20s cotton. Thus $40 \times 20 = 800 \div 60\ (40 + 20) = 13\frac{1}{3}$.

Answer: Compound thread given in example equals a single cotton thread of number $13\frac{1}{3}$.

EXAMPLE C.—Find the equal counts in single woolen yarn (run basis) to a 2-ply thread composed of single 20s cotton yarn and 6-run woolen yarn.

20s cotton = $10\frac{1}{2}$-run woolen yarn. Thus $10\frac{1}{2} \times 6 = 63 \div 16\frac{1}{2}\ (10\frac{1}{2} + 6) = 3\frac{9}{11}$.

Answer: Compound thread given in example equals a single woolen thread of $3\frac{9}{11}$ runs.

EXAMPLE D.—Find the equal counts in single woolen yarn (cut basis) to a 2-ply thread composed of single 40s cotton yarn and 28-cut woolen yarn.

40s cotton = 112 cuts. Thus $28 \times 112 = 3136 \div 140\ (28 + 112) = 22\frac{4}{10}$.

Answer: Compound thread given in example equals a single woolen yarn of $22\frac{4}{10}$ cuts.

V. If the compound thread is composed of three minor threads of unequal counts, but of the same material, compound any two of the minor threads into one and apply previously given Rule III to this so compounded thread and the third (minor) thread not previously used.

EXAMPLE: A 3-run, 6-run and 8-run thread being twisted together, what are the equal counts in one thread of the compound thread?

$3 \times 6 = 18 \div 9\ (3+6) = 2$. (A 3-run and a 6-run thread compounded equal a 2-run single thread.)

Thus: $2 \times 8 = 16 \div 10\ (2 + 8) = 1\frac{6}{10} = 1\frac{3}{5}$.

Answer: Compound thread given in example equals $1\frac{3}{5}$ run.

EXAMPLE: A 20s, 30s and 40s worsted being twisted together, what is the size of the three-fold yarn?

$20 \times 30 = 600 \div 50\ (20 + 30) = 12$. (20s and 30s worsted compounded into one thread equal single 12 worsted.)

Thus: $12 \times 40 = 480 \div 52\ (12 + 40) = 9\frac{3}{13}$.

VI. If the compound thread is composed of three minor threads of two or three different materials, they must by means of their relative length (see tables of relative length given on pages 276 to 282) be transferred into equal counts in one basis, and afterwards find the size of the compound thread by Rule V.

EXAMPLE: Find equal counts in single woolen yarn, "run" basis, for the following compound thread: A 3-run, a 6-run woolen thread, and a single 20s cotton twisted together.

20's cotton equals $10\frac{1}{2}$-run. $3 \times 6 = 18 \div 9\ (3 + 6) = 2$.

(3-run and 6-run threads compounded equal a single 2-run thread.)

Thus, $2 \times 10\frac{1}{2} = 21 \div 12\frac{1}{2}\ (2 + 10\frac{1}{2}) = 1\frac{17}{25}$.

Answer. The three-fold thread given in example equals in counts a single woolen yarn of $1\frac{17}{25}$ (nearly $1\frac{3}{4}$) run.

By means of the rules and explanations given it will be easy to ascertain the equal counts in a single thread for a two or three-ply thread, composed of yarns of the same basis, as well as compound threads constructed of different materials.

VII. Rule for ascertaining the counts of a thread required to produce with a given single thread a two-fold thread of which the compound size is known.

Multiply the counts of the given single thread by the counts of the compound thread and divide the product by the remainder, obtained by substracting the counts of the compound threads from the counts of the given single thread.

EXAMPLE A.—*Question:* Find size of single yarn required (run basis) to produce with a 4-run woolen yarn a compound thread of 3-run.

$4 \times 3 = 12 \div 1\ (4 - 3) = 12$.

Answer: The minor thread required in the present example is a 12-run thread, or a 4-run and a 12-run woolen thread compounded into a 2-fold yarn, equal in counts to a 3-run single woolen.

EXAMPLE B.—*Question:* Find size of single yarn required (worsted numbers) to produce with a 48's worsted thread a compound thread the equal of 16s worsted yarn.

$48 \times 16 = 768 \div 32\ (48 - 16) = 24$.

Answer: The minor thread required in the present example is a 24s worsted thread, or a 48s worsted thread and a 24s worsted thread compounded into a 2-fold yarn the equal in counts to 16s worsted yarn.

EXAMPLE C.—*Question:* Find size of single yarn required (cotton numbers) to produce with a 80s cotton thread a 2-fold yarn of a compound size of equal 30s cotton yarn.

$$80 \times 30 = 2400 \div 50\ (80 - 30) = 48.$$

Answer: The minor thread required in the present example is a 48s cotton thread, or 80s and 48s cotton threads compounded into a 2-fold yarn equal in this compound size to a single 30s cotton thread.

VIII. If one of the minor threads is to be found for a 3-ply thread, of which two minor threads are known, use the following

RULE: Compound the two minor threads into their equal in a single thread, and solve the question by Rule VII.

EXAMPLE.—Find minor thread required to produce with single 30s and single 60s worsted a 3-ply yarn to equal single 12s worsted counts.

60s and 30s worsted compound = $(60 \times 30 = 180 \div 90\ [60 + 30] = 20)$ single 20s worsted.

$$\text{Thus}\quad 20 \times 12 = 240 \div 8\ (20 - 12) = 30$$

$$\left\{\begin{array}{c}\text{Compound two}\\ \text{minor threads}\\ \text{of which size}\\ \text{is known.}\end{array}\right\} \times \left\{\begin{array}{c}\text{Known size}\\ \text{of ply}\\ \text{yarn,}\end{array}\right\} \qquad \left\{\begin{array}{c}\text{Compound two}\\ \text{minor threads}\\ \text{of which size}\\ \text{is known.}\end{array}\right\} - \left\{\begin{array}{c}\text{Known size}\\ \text{of 3 ply}\\ \text{yarn.}\end{array}\right\}$$

Answer: The size of the third minor thread required to be ascertained in the given example is single 30s worsted yarn or a 3-ply thread composed of a single 30s, 60s and 30s worsted yarn equals single 12s worsted counts.

TABLE OF RELATIVE LENGTHS

Between Metric Measure of Length and the Denominations in use in the United States.

Metric Denominations and Values.		Equivalent in Denominations in Use in the U. S.
1 Millimetre =	.001th of a metre.	0.03937 inches.
1 Centimetre =	.01th " "	0.39370 "
1 Decimetre =	.1 " "	3.93708 "
1 Metre =	Unit of Length.	39.3708 " or 3.2809 feet.
1 Decametre =	10 metres.	393.708 " " 10.9363 yds.
1 Hectometre =	100 "	328 feet 1 inch, or 109.3633 "
1 Kilometre =	1,000 "	0.62138 miles.
1 Myriametre =	10,000 "	6.2138 "

The Metre, the Unit of the Metric Measure (in use in Austria, France, Germany, etc.), is the Ten-Millionth part of a Line drawn from the Pole to the Equator.

U. S. Measures.	Metric Measures.
1 Inch =	2.5399 Centimetres.
1 Yard =	0.9143 Metre.
1 Foot =	3.0479 Decimetres.
1 Mile =	1609.32 Metres.

TABLE OF RELATIVE WEIGHTS

Between Metric Denominations and the Denominations in Use in the United States.

Metric Denominations and Values.		Equivalent in Denominations in Use in the U. S.
1 Milligram =	.001th of a gram.	0.0154 troy grains.
1 Centigram =	.01 " "	0.1543 " "
1 Decigram =	.1 " "	1.5432 " "
1 Gram =	Unit of Weight.	15.4323 " "
1 Decagram =	10 grams.	154.3235 " "
1 Hectogram =	100 "	3.5291 oz. avoirdupois.
1 Kilogram, or 1 Kilo, =	1,000 "	2.2046 lbs. "
1 Myriagram =	10,000 "	22.0462 " "

The Gram, the Unit of the Metric Weights, is the Weight of a Cubic Centimetre of Distilled Water at 4° Centigrade.

U. S. Measures.	Metric Measures.
1 ounce avoirdupois =	28.34 grams.
1 pound " =	453.59 "
1 grain troy =	.0648 gram.
1 ounce " =	31.104 grams.
1 pound " =	.3732 kilo.

TABLE OF RELATIVE MEASURES OF CAPACITY, DRY AND LIQUID,

Between Metric Denominations and the Denominations in use in the United States.

1 Millilitre = .001th of a litre, or 1 cubic Centimetre = 15.432 grain measures, or 0.061 cubic inches.
1 Centilitre = .01th of a litre, or 10 cubic Centimetres = 0.61027 cubic inches.
1 Decilitre = .1th of a litre, or 0.1 cubic Decimetre = 6.1027 cubic inches.
1 Litre = unit of the measures = 1 cubic Decimetre = 1.7608 pints.
1 Decalitre = 10 litres = 10 cubic Decimetres = 2.2009 gallons.
1 Hectolitre = 100 litres = .1 cubic Metre = 22.0097 gallons.
1 Kilolitre = 1000 litres = 1 cubic Metre = 220.0967 gallons.

The Litre, the Unit of the Metric Measures of Capacity, Dry and Liquid, is the Volume of a Cubic Decimetre.

INDEX AND GLOSSARY.

The Structure of Fibres, Yarns and Fabrics

Being a practical treatise for the use of all persons employed in the manufacture of Textile Fabrics.

IN TWO VOLUMES BOUND IN ONE.

VOL. I. Being a description of the growth and manipulation of Cotton, Wool, Worsted, Silk, Flax, Jute, Ramie, Chinagrass and Hemp.

VOL. II. Dealing with all manufacturers' calculations for every class of material, also giving minute details for the structure of all kinds of Textile Fabrics.

Containing also an appendix of Arithmetic, specially adapted for Textile purposes.

—BY—

E. A. POSSELT,

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ABSTRACT OF THE CONTENTS.

THE STRUCTURE OF FIBRES AND YARNS FOR TEXTILE FABRICS.

COTTON.

COTTON, ITS ORDER AND CHARACTERISTICS—GOSSYPIUM BARBADENSE—Sea Island Cotton—Australian Cotton—GOSSYPIUM ARBOREUM—GOSSYPIUM HIRSUTUM—New Orleans Cotton—Upland Cotton—GOSSYPIUM HERBACEUM—GOSSYPIUM PERUVIANUM—GOSSYPIUM RELIGIOSUM—TABLE OF REFERENCE AS TO KINDS, LENGTH OF STAPLE AND DIAMETER OF FIBRES—EXAMINATION OF THE VARIOUS KINDS UNDER THE MICROSCOPE—Ripe and Unripe Cotton—CHEMICAL COMPOSITION—HARVESTING—CLEANING—SEED COTTON CLEANERS OF VARIOUS DESCRIPTIONS—GINNING—SAW-GIN—Improved Brush for Saw Gins—Automatic Oiling Saws—Improved Saw Gin with Device for Grading—MACARTHY-GIN—IMPROVED MACARTHY OR COMB-GIN—MACARTHY DOUBLE ROLLER-GIN—FEEDERS FOR COTTON-GINS—COTTON SPINNING DEFINED—Mixing, Picking, Carding, Combing Drawing, Slubbing, Roving, Spinning, Doubling, Gasing, Polishing, MIXING—Bale-Breaker—OPENING—Creighton Opener—Opener and First Picking—Exhaust Opener and Breaker Picker—Exhaust Opener Picker and Lap Machine—PRINCIPLE OF PICKING—FINISHER PICKER—PIANO FEED—CARDING—Principle of Carding—Card Clothing—Card Teeth—CARDING ENGINES—ROLLER CARD—REVOLVING FLAT CARDING ENGINES—REVOLVING FLAT CLEARER—TOP FLAT CARD—Fall's Patent Double Rack—COMBINATION CARD—DOUBLE CARDING ENGINES—BREAKER AND FINISHER CARD DEFINITIONS—LAP-WINDER—RAILWAY HEAD—CARD CLOTHING MOUNTING MACHINE—CARD GRINDING—STRIPPING—COMBING—HEILMANN COMB—DOBSON AND BARLOWS COMB—IMBS COMB—RIBBON LAPPER—DRAWING—DRAWING FRAMES—Front and Back, Coiler and Can Stop Motions—Electric Stop Motion—SLUBBING, INTERMEDIATE AND ROVING—SLUBBING FRAME—INTERMEDIATE FRAME—ROVING FRAME—SPEEDERS—FLY FRAMES—DIFFERENTIAL MOTIONS—HOLDSWORTH'S DIFFERENTIAL MOTION—TWEEDALE'S DIFFERENTIAL MOTION—SPINNING—COMMON FLY THROSTLE—RING FRAME—Ring and Ring Traveller—Sawyer Spindle—Rabeth Spindle—Sherman Spindle—Whitin Gravity Spindle—Doyle Separator—Cummings Separator—Stop Motion for Delivery of Roving—Tension Regulating device for Spindle Driving Bands—MULE—DOUBLING OR TWISTING—Twisters—Gasing—Polishing.

WOOL.

WOOL, ITS ORDER, ORIGIN AND CHARACTERISTICS—Its Surface Structure—Comparing Wool and Hair—Natural Color—Staple—Elasticity—Chemical Composition—Trueness—Soundness—Softness—MUFLONS OR WILD SHEEP—Argali—Big Horn—Aoudad—European Muflon—Rocky Mountain Goat—Prong Horn Antelope—DOMESTIC SHEEP—Its Classification Upon an Industrial Point of View—AMERICAN BREEDS OF SHEEP—Mexican Sheep—Virginian Sheep—Improved Kentucky Sheep—Merino—FOREIGN BREEDS OF SHEEP—Lincoln Sheep—Romney Marsh Sheep—Leicester Sheep—Cotswold Sheep—Oxford-down Sheep—South-down Sheep—Dorset Sheep—Hampshire-down Sheep—Cheviot Sheep—Shropshire Sheep—Black-faced Scotch Sheep, etc.—Fat-rumped Sheep—Flat-tailed Sheep—Walachian Sheep—MERINO SHEEP—Characteristics

WOOL—Continued.

of this Breed—Sorting of the Fleece as done in Spain—Saxon Merino—Prussian Merino—Silesian Merino—Hungarian Merino Poor Results as to English Merino—French Merino—Russian Merino—Introduction of the Merino into Cape Colony—Australian Merino—American Merino—South American Merino—CASHMERE GOAT—ANGORA GOAT—CAMELS' HAIR—CAMEL-VICUGNA—GUANACO—LLAMA—ALPACA—GRADING OF THE FLEECE, OR WOOL SORTING—Fibres Per Square Inch—Good and Bad Wool—YOLK—SCOURING AGENTS AND THE PREPARATION OF THE SCOURING LIQUOR—Soap—Hard and Soft Water—Heat and Strength for Scouring Liquor—Influence of Scouring Liquor if Either Too Hot or Too Strong, or Both, Upon the Fibre—Stale Urine—Sodium Carbonate—Potassium Carbonate—Ammonium Carbonate—Ammonia—Sal-Ammoniac—Salt—WOOL SCOURING—Old Style—Modern Wool Scouring—CONSTRUCTION OF WOOL SCOURING MACHINES—Rake Scouring Machine—Hydraulic Scouring Machine—Rules for Scouring Wool—WOOL DRYING—Open Air, Screen or Table Wool Dryer—Automatic Continuous Wool Dryer—Combining, Washing and Drying Machines—New Style Dryer—BURRING—CARBONIZING—Carbonization with Sulphuric Acid; Chloride of Aluminum; Chloride of Magnesium; Strong Salt Solution and Acid Vapors—BURRING MACHINES—Self-Feed for Burr Pickers—WOOL DUSTER—Straight Duster—Cone Duster—MIXING—OILING—Oiling by Hand—Atomizing Wool Oiler—Kinds of Oil to Use—Testing Oils—Quantity of Oil to be Used—CONSTRUCTION OF THE WOOL PICKER—CARDING—SET OF CARDS—SELF-FEEDING MACHINES—Bramwell Self-Feed—Peckham Feeder—Lemaire Feeder—CARD CLOTHING AND RELATIVE ACTION OF CARD WIRES—Fillett Winding—Clothing With Sheets—FIRST BREAKER CARDING ENGINE—BANK CREEL—ROVING SPOOLER—BACK STAND—BURRING MACHINES AS ATTACHED TO THE FIRST BREAKER CARD—Single Burring Device—Feed Rolls—Single Burring Device With Feed Rolls Attached—Double Burring Device With Feed Rolls Attached—Retainer Roll for Feeding Attachments to the First Breaker—METALIC BREAST—BURRING DEVICE AND METALIC BREAST COMINED—INTERMEDIATE FEEDING MACHINES—Lap Feeding System—Ribbon System—Side Drawing System—Balling-head—Lap Winder—Backstand—Apperley Feed—SECOND BREAKER—FINISHER CARDING ENGINE—CONDENSERS—Double Deck Condenser—Single Doffer Condenser—Single and Double Rubber Condenser—Three Doffer Condenser—Condensing With Rolls, Aprons, or Aprons and Rolls—BOLETTE CONDENSER—B. C. Made With Single Rubbers—B. C. Made With Double Rubbers—Latest Improved Bolette Condenser—GRINDING—TURNING AND COVERING ROLLERS PREPARING WASTE FOR RE-WORKING—Hard Waste—Soft Waste—RAG OR SHODDY PICKER—GARNETT MACHINE—WASTE DUSTER—SPINNING—MODERN SPINNING MACHINERY—MULE—SPINNING MACHINE—RING SPINNING—SPINNING MACHINES ATTACHED TO FINISHER CARDS—SINGLE YARN—SPOOLING—TWISTING—RING TWISTER—TWO-FOLD YARN.

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JUTE, ITS ORDER AND CHARACTERISTICS—Fibres Magnified—Best Place of Growth—STEEPING, BEATING, WASHING, DRYING—JUTE SPINNING—Crushing Machine—Softening—Jute Line—Hackling, Spreading, Drawing, Roving, Spinning—JUTE TOW—CARDING—Breaker Card—Finisher Card.

RAMIE.

RAMIE, ITS ORDER AND CHARACTERISTICS—ITS PLACE OF GROWTH—DECORTICATING—METHOD AS PRACTICED BY THE NATIVES—THE USE OF THE FIBRE—ITS CULTIVATION—STATUS OF THE RAMIE INDUSTRY—England's Opinion of Ramie—MACHINES AND PROCESSES FOR DECORTICATING RAMIE AS EXHIBITED AT THE LATE PARIS EXPOSITION—AN AMERICAN MACHINE FOR DECORTICATING ILLUSTRATED AND EXPLAINED.

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HEMP, ITS ORDER AND CHARACTERISTICS—PLACE OF GROWTH—Manila Hemp—Piedmont Hemp—Russian Hemp—ITS BEST METHOD OF CULTIVATION—AMERICAN GROWN HEMP—Male and Female Hemp—POWER BRAKE—SPINNING—THE USE OF THE FIBRE FOR TEXTILE PURPOSES.

CALCULATIONS.

GRADING OF THE VARIOUS YARNS USED IN THE MANUFACTURE OF TEXTILE FABRICS, ACCORDING TO SIZE OR COUNTS.

A. COTTON YARNS.
B. WOOLEN YARNS. { *a.* Run System. *b.* Cut System.
C. WORSTED YARNS.
D. SILK YARNS. { *a.* Spun Silks. *b.* Raw Silks.
E. LINEN YARNS, Jute, Ramie, etc.

Explanation of their basis.
Tables for ascertaining lengths (number of yards per pound) for the different counts.
Twisted Yarns.
Rules for finding the weight in ounces or pounds for a given number of yards of single yarn of a known count.
Rules for ascertaining this weight in ounces or pounds for a 2, 3 or more ply yarn composed of minor threads of equal counts or minor threads of different counts.

TO FIND THE EQUIVALENT COUNTS OF A GIVEN THREAD IN ANOTHER SYSTEM.

A. COTTON, WOOLEN AND WORSTED YARNS.
B. SPUN SILKS COMPARED TO COTTON, WOOLEN OR WORSTED YARNS.
C. LINEN, JUTE AND RAMIE YARNS.
D. RAW SILKS COMPARED TO SPUN SILKS, COTTON, WOOLEN OR WORSTED YARNS.

TO ASCERTAIN THE COUNTS OF TWISTED THREADS COMPOSED OF DIFFERENT MATERIALS

A. COMPOUND THREAD COMPOSED OF TWO MINOR THREADS OF DIFFERENT MATERIALS.
B. COMPOUND THREAD COMPOSED OF THREE OR MORE MINOR THREADS 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.

A. ONE SYSTEM OF YARN. *B.* TWO OR MORE SYSTEMS OF YARNS.

TO ASCERTAIN THE AMOUNT OF MATERIAL REQUIRED FOR EACH MINOR THREAD IN LAYING OUT LOTS FOR TWO, THREE OR MORE PLY YARN.

A. DOUBLE AND TWIST YARN { *a.* Composed of minor threads of the same material. *b.* Composed of minor threads of different materials.
B. THREE (OR MORE) PLY YARN { *a.* Composed of minor threads of the same material. *b.* Composed of minor threads of different materials.

TO ASCERTAIN THE COST OF TWO, THREE OR MORE PLY YARNS.

2, 3 OR MORE PLY YARN COMPOSED OF MINOR THREADS OF EQUAL COUNTS, BUT DIFFERENT QUALITIES.
2 PLY YARN COMPOSED OF MINOR THREADS OF UNEQUAL COUNTS AS WELL AS DIFFERENT QUALITIES.
2 PLY YARN COMPOSED OF MINOR THREADS OF DIFFERENT MATERIALS.
3 OR MORE PLY YARN COMPOSED OF MINOR THREADS OF UNEQUAL COUNTS, AS WELL AS DIFFERENT QUALITIES.
3 OR MORE PLY YARN COMPOSED OF MINOR THREADS OF DIFFERENT MATERIALS.

TO FIND THE MEAN OR AVERAGE VALUE OF YARN OF MIXED STOCKS.

TO ASCERTAIN THE MEDIUM PRICE OF A MIXTURE OF WOOL WHEN THE QUANTITY AND PRICE OF EACH INGREDIENT ARE GIVEN.
TO ASCERTAIN THE QUANTITY OF EACH KIND OF WOOL TO USE IN A MIXTURE OF A GIVEN VALUE.
TO ASCERTAIN THE QUANTITY OF EACH KIND, WHEN THE QUANTITY OF ONE KIND, THE DIFFERENT PRICES OF EACH KIND AND THE PRICE OF THE MIXTURE ARE GIVEN.

REED CALCULATIONS.

BASIS FOR GRADING REEDS.
TO FIND ENDS IN WARP WHEN REED, ENDS PER DENT AND WIDTH OF WARP IN REED ARE GIVEN.
TO FIND REED, IF ENDS IN WARP, AND THE WIDTH OF THE WARP IN REED ARE GIVEN.
TO FIND THE WIDTH OF WARP IN REED, IF ENDS IN WARP, REED AND ENDS PER DENT ARE GIVEN.

TO CALCULATE WEIGHT, COUNTS, COST., ETC., OF WARP.

TO FIND THE WEIGHT OF WARP, IF NUMBER OF ENDS, COUNTS AND LENGTH ARE GIVEN.
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TO FIND THE COUNTS FOR WARP YARN, IF NUMBER OF ENDS IN WARP, AMOUNT OF MATERIAL, LENGTH AND WEIGHT TO BE USED ARE GIVEN.
TO FIND THE NUMBER OF THREADS IN WARP TO USE, IF COUNTS OF YARN, LENGTH AND WEIGHT OF WARP ARE GIVEN.
TO FIND THE LENGTH FOR A WARP, IF NUMBER OF ENDS IN WARP, COUNTS AND WEIGHT OF YARN ARE GIVEN.
TO FIND THE COUNTS, NUMBER OF THREADS IN WARP OR LENGTH OF WARP, WHEN TWO OR MORE MATERIALS ARE USED IN THE CONSTRUCTION OF A CLOTH.

TO CALCULATE WEIGHT, COUNTS AND COSTS OF FILLING.

TO FIND THE LENGTH OF YARN REQUIRED FOR PRODUCING ONE OR A GIVEN NUMBER OF YARDS OF CLOTH, IF PICKS PER INCH AND WIDTH OF CLOTH IN REED (including selvage) ARE GIVEN.
TO FIND THE WEIGHT OF YARN REQUIRED, EXPRESSED IN OUNCES, PRODUCING ONE YARD OF CLOTH, IF PICKS PER INCH, WIDTH OF CLOTH IN REED AND THE COUNTS OF YARN ARE GIVEN.
TO FIND THE WEIGHT OF YARN REQUIRED, EXPRESSED IN POUNDS OR FRACTIONS THEREOF, FOR ANY NUMBER OF GIVEN YARDS IF PICKS PER INCH, WIDTH OF CLOTH IN REED AND COUNTS OF YARN ARE KNOWN.
TO ASCERTAIN WEIGHT OF MATERIAL FOR EACH KIND, IF TWO OR MORE DIFFERENT KINDS OF YARN ARE USED. *a.* Same counts. *b.* Different counts or materials.
TO ASCERTAIN THE COUNTS FOR A YARN REQUIRED TO PRODUCE A CERTAIN GIVEN WEIGHT (expressed in ounces) PER YARD CLOTH WOVEN, THE PICKS PER INCH AND THE WIDTH OF WARP IN REED BEING GIVEN.

TO ASCERTAIN THE COUNTS FOR A YARN, TO A GIVEN NUMBER YARDS OF CLOTH WITH A GIVEN WEIGHT EXPRESSED IN POUNDS.

TO FIND THE PICKS PER INCH FOR A CLOTH IN WHICH COUNTS OF YARN, LENGTH OF CLOTH TO BE WOVEN, WIDTH IN REED AND AMOUNT OF MATERIAL TO BE USED ARE GIVEN.

a. Dealing with one counts of yarn.

b. Dealing with two or more kinds of filling of different counts, the repeat of pattern being short.

c. Dealing with two or more kinds of filling of different counts, and of a long and varied arrangement of pattern.

TO FIND YARDS OF CLOTH WOVEN, A GIVEN AMOUNT OF YARN ON HAND WILL PRODUCE.

TO CALCULATE THE AMOUNT AND COST OF MATERIALS USED IN THE CONSTRUCTION OF FABRICS, OR PRACTICAL APPLICATIONS OF WARP AND FILLING CALCULATIONS.

A. TO FIND TOTAL COST OF MATERIALS USED IN THE CONSTRUCTION OF A FABRIC.

B. TO FIND THE COST PER YARD OF FINISHED CLOTH.

EXAMPLES:

FANCY CASSIMERE, WORSTED SUITING, COTTON DRESS GOODS, WOOOLEN TRICOT SUITING } Length of warp as dressed, and length of cloth woven and finished, being given in yards.

WORSTED SUITING, FANCY CASSIMERE } Length of cloth woven and finished to be ascertained by percentage.

FANCY COTTON DRESS GOODS } Giving a practical application of calculating for different "take-ups" of warp during weaving.

TO CALCULATE THE TOTAL COST OF MANUFACTURING.

A. FOR A PIECE OF CLOTH.

B. PER YARD FINISHED CLOTH.

EXAMPLES: WORSTED SUITING—BEAVER OVERCOATING—CARPETS.

THE STRUCTURE OF TEXTILE FABRICS.

TO ASCERTAIN THE PURPOSE OF WEAR FOR THE FABRIC.

TO ASCERTAIN THE NATURE OF THE RAW MATERIALS.

COUNTS OF YARN REQUIRED TO PRODUCE A PERFECT STRUCTURE OF CLOTH.

TO FIND THE NUMBER OF ENDS IN COTTON, WOOLEN, WORSTED, LINEN AND SILK YARNS, WHICH WILL PROPERLY LIE SIDE BY SIDE IN ONE INCH, *i. e.*, to find the diameters for the various yarns by their counts.

TABLE giving the relative diameters of COTTON YARNS from single 5's to 2/160's.

TABLE giving the relative diameters of SPUN SILKS form 5's to 80's in single or any ply.

TABLE giving the relative diameters of WOOLEN YARNS (RUN SYSTEM) from 1 run to 10 run.

TABLE giving the relative diameters of WOOLEN YARNS (CUT SYSTEM) from 6 cut to 50 cut.

TABLE giving the relative diameters of WORSTED YARNS from single 5's to 2/160's.

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TABLE giving the relative diameters of LINEN YARNS from 10's to 100's=2/5's to 2/200's.

TO FIND THE DIAMETER OF A THREAD BY MEANS OF THE 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 YARN GIVEN.

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TO FIND THE AMOUNT OF TWIST FOR A YARN, IF THE COUNTS AND TWIST OF ANOTHER YARN OF THE SAME SYSTEM ARE GIVEN.

INFLUENCE OF THE WEAVE UPON THE TEXTURE OF A FABRIC.

TO FIND THE TEXTURE (ENDS PER INCH) FOR A FABRIC.

TO FIND THE TEXTURE FOR A NEW WEAVE FROM A GIVEN PERFECT STRUCTURE, USING THE SAME COUNTS OF YARN FOR BOTH FABRICS.

TO CHANGE THE WEIGHT OF A FABRIC WITHOUT INFLUENCING ITS GENERAL APPEARANCE, AND TO FIND THE NUMBER OF ENDS PER INCH IN THE REQUIRED CLOTH.

TABLE SHOWING WEAVES WHICH WILL WORK WITH A UNIFORM (STANDARD) TEXTURE OF THE COMMON TWILLS $\frac{2}{3}$, $\frac{3}{3}$, etc.

SELECTION OF THE PROPER TEXTURE FOR FABRICS INTERLACED WITH SATIN WEAVES.

SELECTION OF THE PROPER TEXTURE FOR FABRICS INTERLACED WITH RIB WEAVES.

a. Warp effects. *b.* Filling effects. *c.* Figured rib weaves.

SELECTION OF THE PROPER TEXTURE FOR FABRICS INTERLACED WITH CORKSCREW WEAVES.

SELECTION OF THE PROPER TEXTURE FOR FABRICS CONSTRUCTED WITH ONE SYSTEM WARP AND TWO SYSTEMS OF FILLING.

SELECTION OF THE PROPER TEXTURE FOR FABRICS CONSTRUCTED WITH TWO SYSTEMS OF WARP AND ONE SYSTEM OF FILLING.

SELECTION OF THE PROPER TEXTURE FOR DOUBLE CLOTH FABRICS.

ARITHMETIC.

(SPECIALLY ADAPTED FOR TEXTILE PURPOSES).

ADDITION—SUBTRACTION—MULTIPLICATION—DIVISION.

PARENTHESIS OR BRACKETS—PRINCIPLE OF CANCELLATION.

COMMON FRACTIONS, definition, addition, subtraction, multiplication, division.

DECIMAL FRACTIONS, definition, addition, subtraction, multiplication, division.

SQUARE ROOT—CUBE ROOT.

AVERAGE AND PERCENTAGE—RATIO—PROPORTION—ALLIGATION.

U. S. MEASURES—METRIC SYSTEM OF MEASURES.

LIST OF ILLUSTRATIONS TO

The Structure of Fibres, Yarns and Fabrics

Being a practical treatise for the use of all persons employed in the manufacture of Textile Fabrics.

IN TWO VOLUMES BOUND IN ONE.

VOL. I.—Being a description of the growth and manipulation of Cotton, Wool, Worsted, Silk, Flax, Jute, Ramie, Chinagrass and Hemp.

VOL. II.—Dealing with all Manufacturers'.Calculations for every class of material, also giving minute details for the structure of all kinds of Textile Fabrics. Containing also an appendix of Arithmetic specially adapted for Textile purposes, and a complete Dictionary on Textile subjects in its Glossary.

—BY—

E. A. POSSELT,

Head Master Textile Department Pennsylvania Museum and School of Industrial Art, Philadelphia, Pa.; Author and Publisher of "The Technology of Textile Design," "The Jacquard Machine Analyzed and Explained," "The Preparation of Jacquard Cards and Practical Hints to Learners of Jacquard Designing," etc., etc.

LIST OF ILLUSTRATIONS TO VOL. I.

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(CONTINUED ON NEXT PAGE)

Worsted

Silk

(CONTINUED ON NEXT PAGE)

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Dyeing, Drying and Finishing Machinery,

—FOR—

COTTON, WOOLEN AND WORSTED GOODS.

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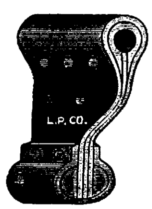
SINGEING MACHINES, (Gas and Plate.)
WASHING MACHINES, Dolly and Open.
CRABBING MACHINES, Single, Double and Treble.
JIGGERS.
PADDING MACHINES.
DYE KETTLES, with Small Engines attached.

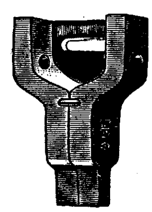
CALENDERS AND MANGLES, with Paper, Cotton and Husk Rolls.
HANK YARN DRYING MACHINES, (Hartman's Patent.)
DRYING MACHINES, with Horizontal and Vertical Frames, and with Copper and Tinned Iron Cylinders.

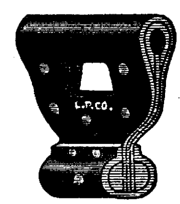
H. W. BUTTERWORTH & SONS,

York and Cedar Streets, - - Philadelphia, Pa.

LOOM PICKER COMPANY,







BIDDEFORD, MAINE,

— Manufacturers of —

RAW HIDE AND LEATHER LOOM PICKERS,

Including many styles of raw hide pickers of which we are the only manufacturers, such as the **Parker Patent Drop Box Picker** which has no plug in the shuttle strike, can not break off at the head nor work loose around the rod hole, and is guaranteed to be more durable than any other drop box picker made. Also **Scoops, Centre Scoops, Pressed Centres, Feathered Feet Bows,** and all other English styles which have heretofore been imported.

LOOM HARNESSES,

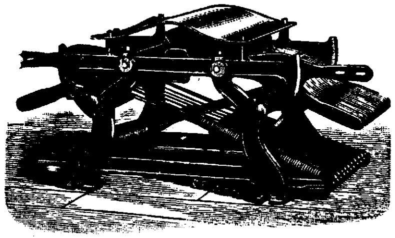
Both single and double knotted, made of the best twine and stock, and finished in the most thorough manner, making them of guaranteed superior quality.

ENGLISH PICKER LEATHER.

This leather is better adapted for picking purposes than any other. We have the same kind and quality which is used almost exclusively in England for this purpose, and will send sample on application.

ILLUSTRATED CATALOGUE AND SAMPLES OF OUR WORK MAILED ON APPLICATION.

Patented Aug. 21, 1888.



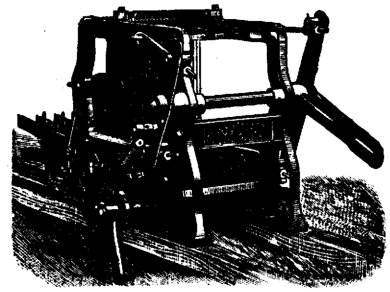
STAFFORD'S
Patent Equalizing Spring Jack
Is constructed so that the weight on harnesses is *reduced* in lifting, making great saving in power. Can be applied to any Loom or motion.

WE LEAD

THEM

ALL.

Patented Aug. 21, 1888.



Horizontal Lever. Double-action Dobbie.
12 to 25 harness capacity.

GEO. W. STAFFORD MFG. CO.,

PROVIDENCE, R. I.

TO THE TEXTILE MANUFACTURERS, GREETING:—

Your attention is called to the superior advantages of our special machinery for fancy weaving, for producing any class of goods that can be woven upon a loom.

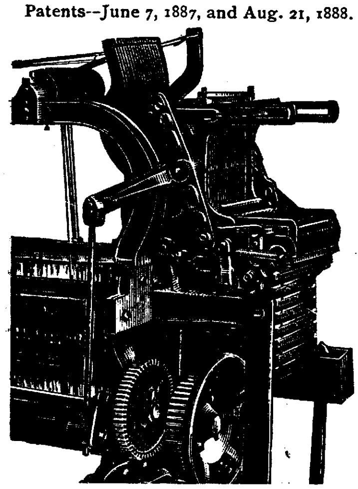
Upward of eight thousand looms fitted up by us in the United States is a sufficient guarantee of our ability to fulfill all we promise.

DOBBIES OF ANY CAPACITY.

JACQUARD MACHINES UP TO 1200 HOOKS,

Single or Double Action, also Rise and Drop Shed for Worsteds.

Patents--June 7, 1887, and Aug. 21, 1888.



Vertical Lever, Double-action Dobbie.
12 to 25 harness capacity. Compact, easy working, reliable.

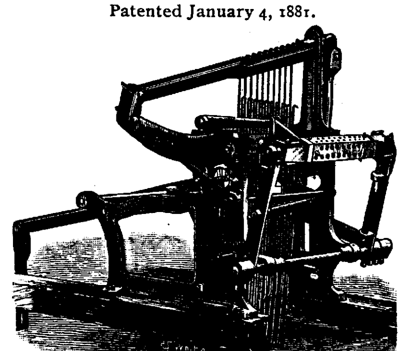
A FULL LINE OF SUPPLIES FOR FANCY WEAVING CONSTANTLY ON HAND.

Correspondence

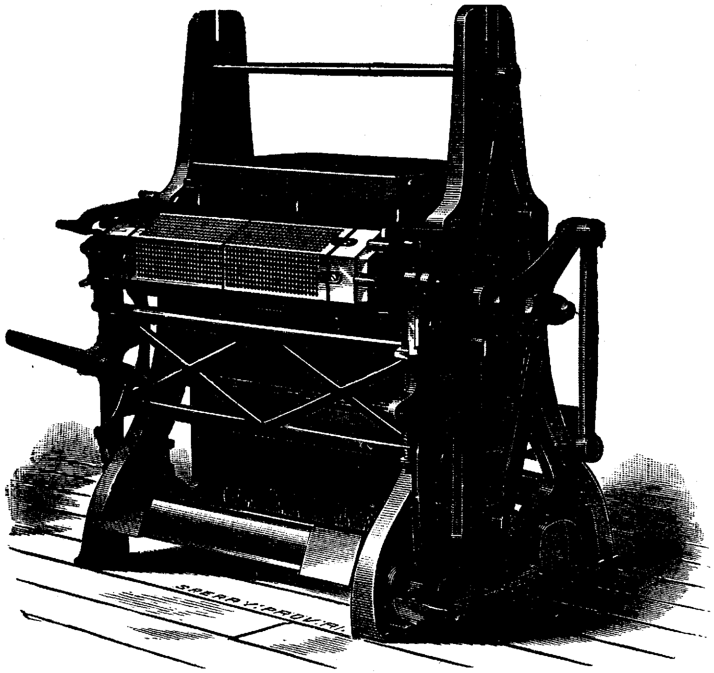
Solicited.

See Next Page.

Patented January 4, 1881.

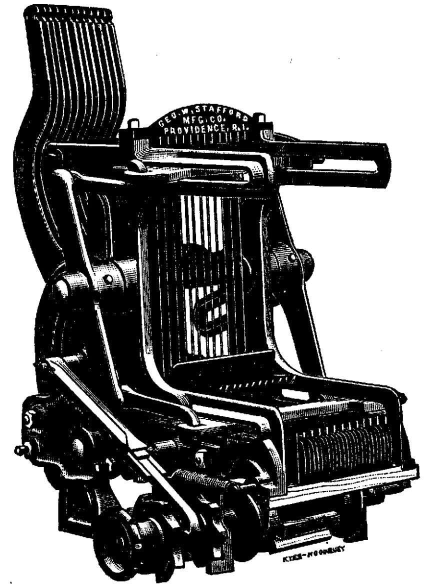


Single-action Shedding Engine.
12 to 30 harness capacity.



Rise and Drop Shed Jacquard.
Specially adapted for Heavy Worsteds and Cloakings. 400 to 600 hooks capacity.

Patents—June 7, 1887, and Aug. 21, 1886.



Sateen Dobbie. 3 to 12 Shades.
More goods can be produced than with cams (1200 in use).

Instruction Given in Weaving Any Class of Goods,

AND SATISFACTION GUARANTEED.

GEO. W. STAFFORD MFG. CO.,

5 POINT STREET,

PROVIDENCE, R. I.

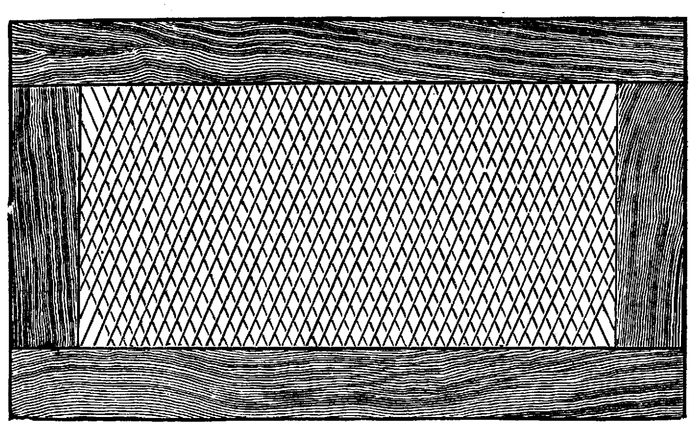
Patented September 6, 1887.

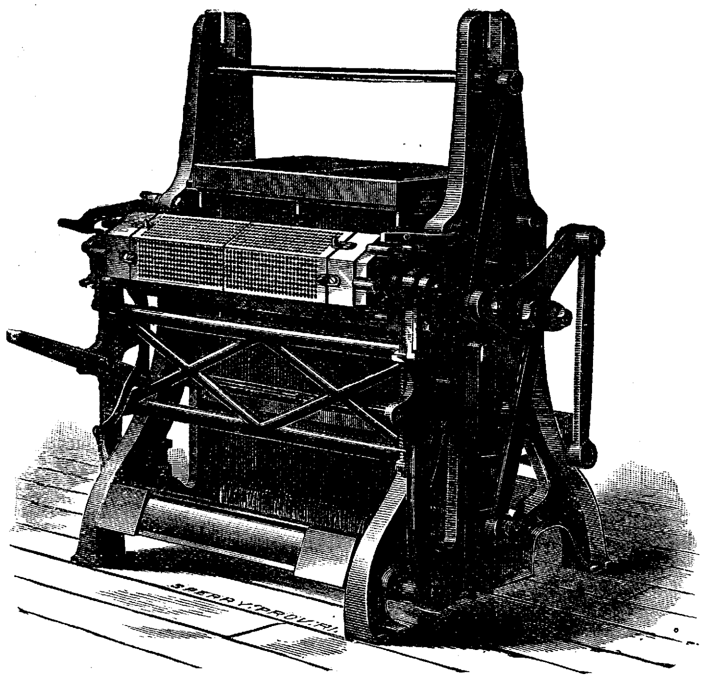
Stafford Comber-Board,

COMPOSED OF WIRE.

Will Not Wear Out, Does Not Cut Harness.

A LARGE NUMBER IN USE.





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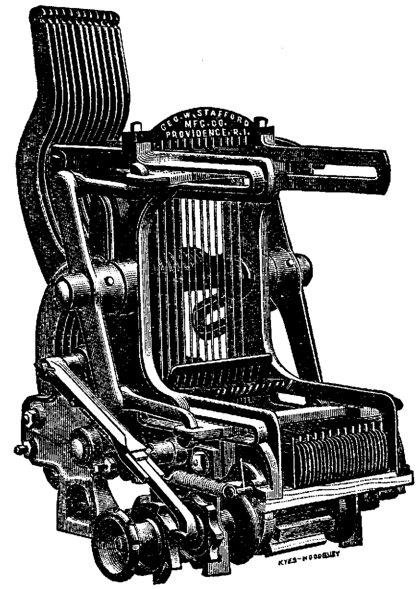

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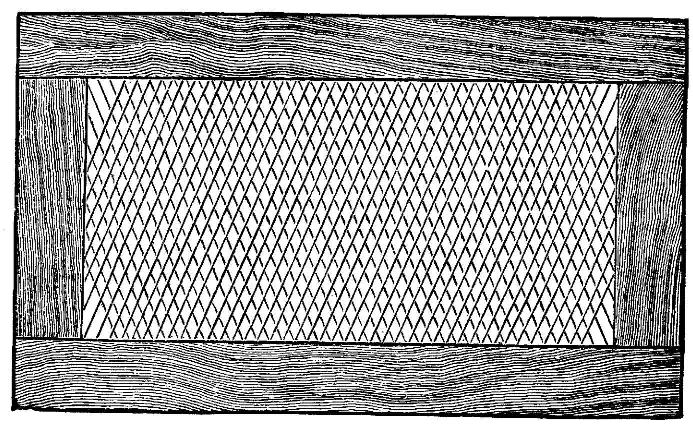
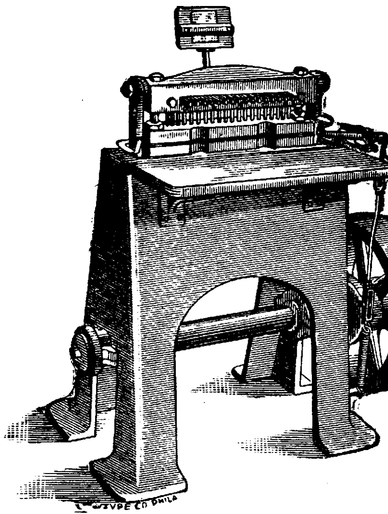


W. P. UHLINGER WORKS,

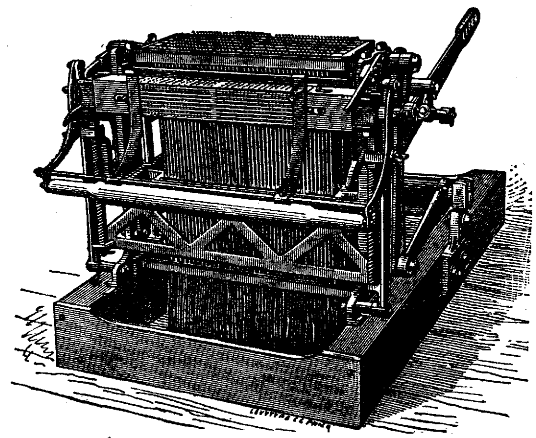
MACHINISTS,

14 to 36 E. Canal St., Phila.



Dobby Card-Punching Machine.

This machine is built for punching Jacquard or Dobby Cards of the strongest pasteboard, punching the whole card at one revolution or stroke. After the keys are set, any number of duplicates can be punched. It is well constructed, simple, and a most effective machine.



JACQUARD MACHINE.

Made for weaving figured goods of all kinds, from the lightest to the heaviest, either for Silk, Cotton or Wool. Single lift, double lift or raise and drop machines. Harness tied up and made ready to set on looms of any make. Our raise and drop are especially adapted to weaving the finest silk and worsted goods.

Ribbon Looms.

Tape Looms.

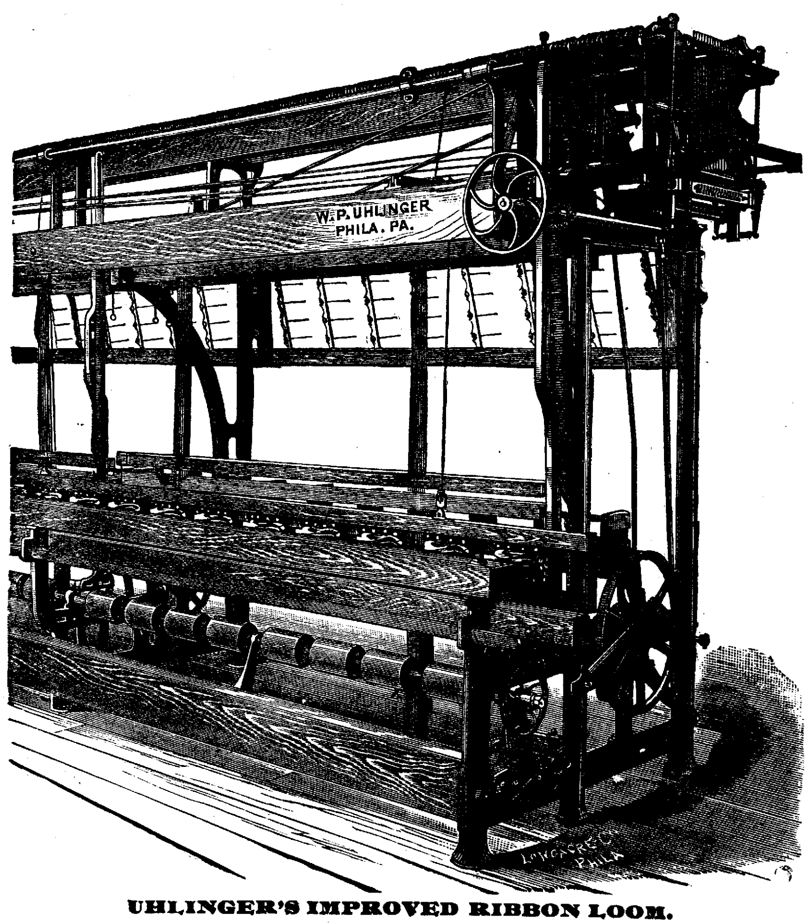
Suspender Looms.

Fringe Looms.

Single Lift Jacquard Machines.

Double Lift Jacquard Machines.

Raise and Drop Shed Jacquard Machines.

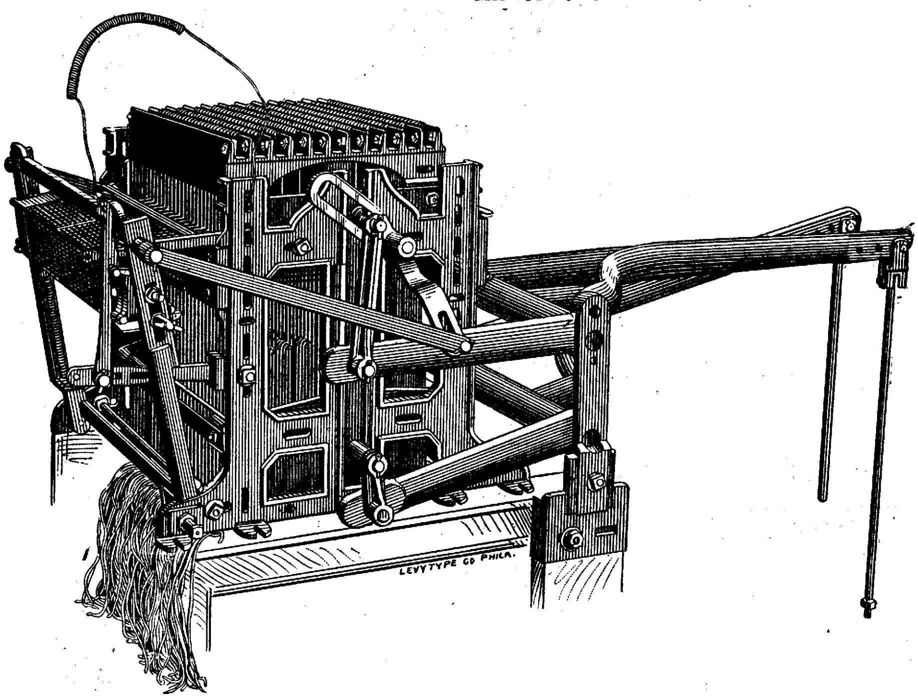


UHLINGER'S IMPROVED RIBBON LOOM.

THOMAS HALTON,

2627 Mutter Street, Philadelphia,

MANUFACTURER OF



RISE and DROP SHED

JACQUARD

For Worsteds.

Of the most approved construction, working with a double cam on crank-shaft of the loom, consequently a saving of power. Can be applied to any loom of any make. (The most perfect machine in the market.)

Also, builder of Improved **DOUBLE-LIFT, DOUBLE-CYLINDER JACQUARD** for weaving Turkey-red goods and table covers of all descriptions. No wear on cards, as the cylinders run only half speed. (Speed—145 picks per minute for 70-inch wide fabrics. Production—25 yards per 10 hours

REPAIRING IN ALL ITS BRANCHES

Promptly attended to and satisfaction guaranteed. Send for Circular.

IMPROVED

Jacquard Machine

FOR

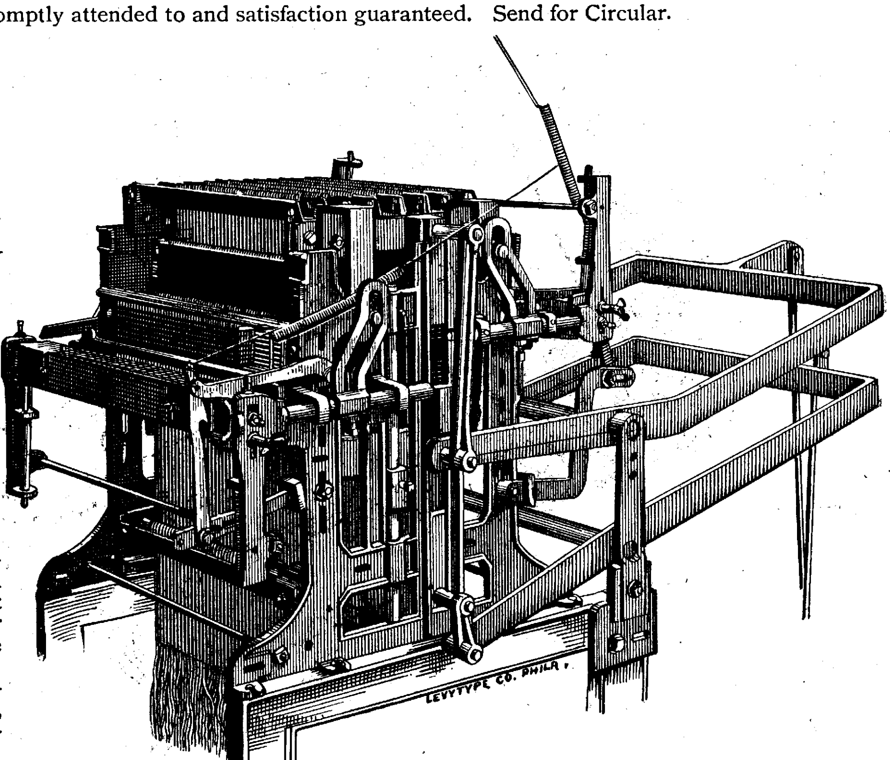
Figured Double Velvet and Plush Fabrics,

Being the only perfect Jacquard for these popular fabrics in the market. (See pages 213 to 215 of this book.)

IMPROVED PATENT DOUBLE-LIFT, SINGLE-CYLINDER JACQUARD.

Can be applied to any loom. This machine has come into general use amongst upholstery and tapestry goods manufacturers, being the best machine for both fine and heavy goods. These machines operate easier on the yarn and thus permit the use of an inferior grade of yarn, with the best results.

Maker of Brussels Jacquard Carpet Machines, Piano and Witch Machines, Comber-boards, Lingos, Etc.



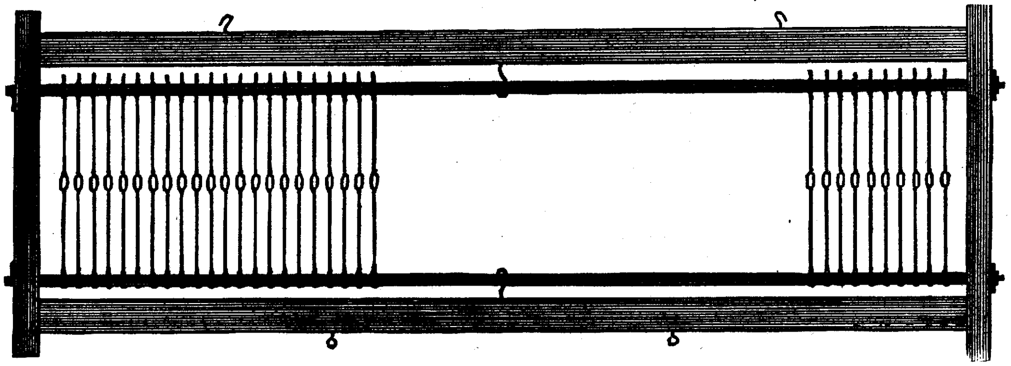
Address all communications to the works,

2627 Mutter Street, Philadelphia.

L. S. WATSON & CO., Leicester, Mass.,

MANUFACTURERS OF

WATSON'S PATENT MACHINE



WIRE HEDDLES.

Guaranteed to be perfectly adapted to Weaving all kinds of Cotton, Woolen and Worsted Fabrics, Fancy Cotton, etc., etc. Superior Harness Frames furnished promptly. Also manufacturers of **Hand Stripper Cards** of every description.

KILBURN, LINCOLN & CO.

MAKERS OF

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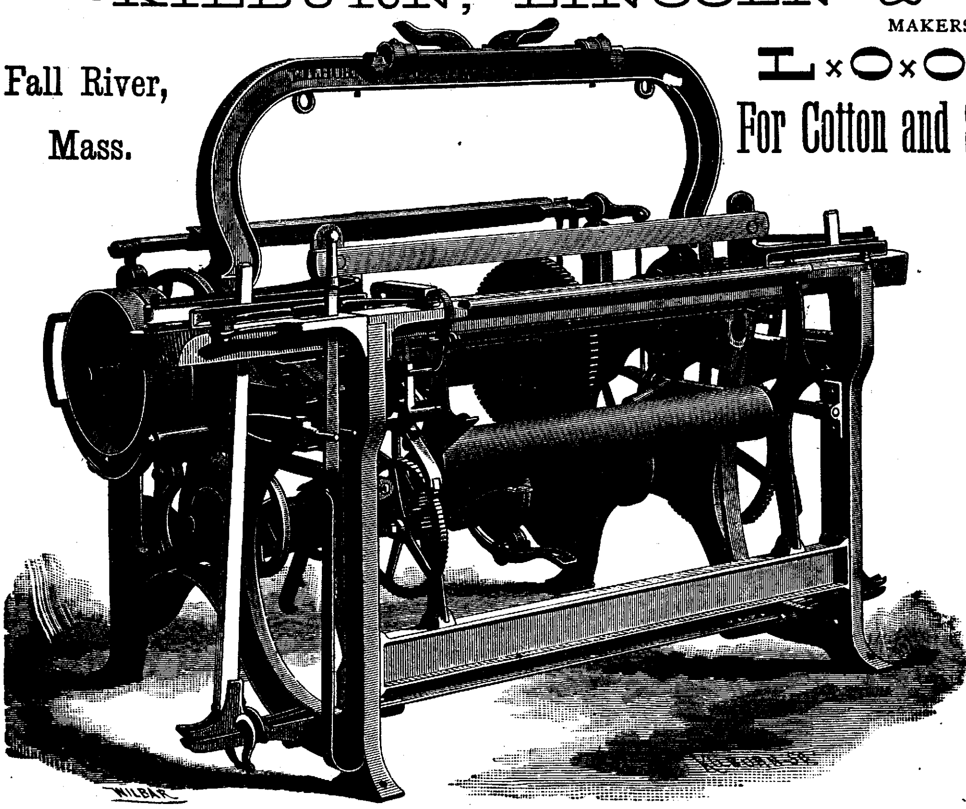
For Cotton and Silk Weaving.

Fall River, Mass.



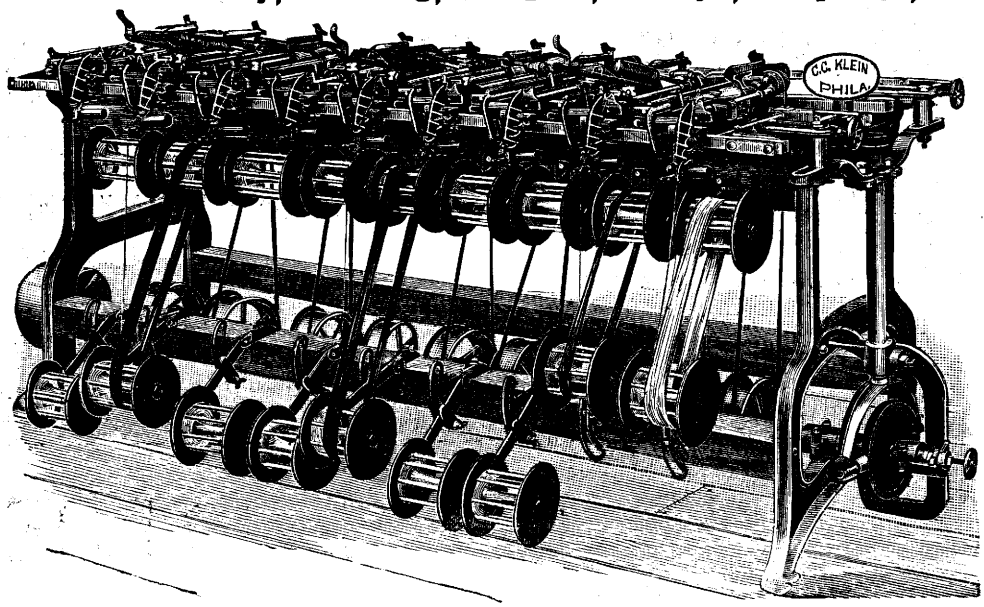
The Seaconnet Mills, of Fall River, wove in 301 days of 10 hours 14,329,219 yards of 64 x 64 goods on 928 of our "High-Speed Looms," a daily average of 51¼ yards per loom per day.

THE CAMBRIA SHAFTING AND MACHINE WORKS,

—MANUFACTURERS OF—

Textile Machinery, Shafting, Hangers, Pulleys, Couplings, Etc.

Our Patent Universal Belt Carrier
Will Connect any Two Shafts, whatsoever their Position may be.



Our Patent Self-Oiling Hangers
Are far Superior to any Similar Device now in the Market.

e above Cut represents our Improved Cop Winding Machine. Much Saving in Stock, Better Results in Woven Cloth, Etc. Write for Particulars.

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SILK NOILS YARNS, WHITE AND FAST COLORS,

FOR

Cloths, Upholstery and Dress Goods.

SPUN SILKS, TINSELS AND FINE COTTON YARNS AND WARPS.

Selling Agents for MALCOLM MILLS CO.

Chenilles, Tinsel Twists and Threads,

Sewing Cotton, Polished Threads and Cords, Fancy Twists

in Worsted Silk and Cotton.