

The Project Method of Teaching

SILK THROWING

PART 10

PREPARED UNDER THE SUPERVISION OF

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With Examination Questions

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ADVICE TO THE STUDENT

You learn only by thinking. Therefore, read your lesson slowly enough to think about what you read and try not to think of anything else. You cannot learn about a subject while thinking about other things. Think of the meaning of every word and every group of words. Sometimes you may need to read the text slowly several times in order to understand it and to remember the thought in it. This is what is meant by study.

Begin with the first line on page 1 and study every part of the lesson in its regular order. Do not skip anything. If you come to a part that you cannot understand after careful study, mark it in some way and come back to it after you have studied parts beyond it. If it still seems puzzling, write to us about it on one of our Information Blanks and tell us just what you do not understand.

Pay attention to words or groups of words printed in **black-face type**. They are important. Be sure that you know what they mean and that you understand what is said about them well enough to explain them to others.

Rules are printed in *italics*; they, too, are important; you should learn to repeat them without looking at the book. With rules are usually given *Examples for Practice*. Work all of these examples according to the rules, but do not send us your work if you are able to get the right answers. If you cannot get the correct answer to an example, send us all of your work on it so that we can find your mistakes. Use one of our Information Blanks.

After you have finished studying part of a lesson, review that part; that is, study it again. Then go on with the next part. When you have finished studying an Instruction Paper, review all of it. Then answer the Examination Questions at the end of the Paper. It is not well to look at these questions until you have finished studying and reviewing the whole Paper.

Answer the Examination Questions in the same order as they are given and number your answers to agree with the question numbers. Do not write the questions. If you cannot answer a question, write us about it on an Information Blank before you send in any of your answers.

Remember that we are interested in your progress and that we will give you by correspondence all the special instruction on your Course that you may need to complete it. Remember, too, that you will get more good from your Course if you learn all that you can without asking for help.

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SILK THROWING

(PART 10)

REELING, BUNDLING, AND SHIPPING

(Continued)

BUNDLING

PRELIMINARY OPERATIONS

1. Object of Bundling.—In the manufacture of thrown silks that are reeled into skeins, bundling is the final operation. The silk is prepared in packages, commonly known as bundles, prior to its return to the customer. The object of bundling is to put the reeled skeins of thrown silk in bundles of a uniform weight containing a definite number of skeins, according to the class of thrown yarn to which the thread belongs or in accordance with the instructions given to the throwster. All reeled silks are not bundled in the same manner; for, the number of skeins per bundle and the method of grouping the skeins vary according to the character of the yarn being bundled or the instructions given to the throwster by the customer.

Although the operation of bundling is comparatively simple, efficient operatives, or bundlers, are required to perform it with skill and speed. Skill is the paramount qualification of a bundler, if neat and carefully prepared bundles are to be returned to the customer. When skill is sacrificed, the bundles may be formed in a careless manner, the wrappings may be poorly adjusted, while the silk may be torn and broken by the cords that are used to tie the bundles. Bundles returned in

this condition lower the throwster's standard of quality. It should be remembered that while poor reeling often lowers the apparent quality of thread that has been carefully prepared in preceding operations, careless bundling reduces more or less the quality of a properly reeled silk.

2. Inspection of Thrown Silk.—After the reeled silk is stripped from the reel fly and loosely grouped into a hank or bundle of from six to twelve skeins, it is removed to the bundling room and carefully inspected prior to bundling. The inspection is usually performed by the bundler and its purpose is to locate and remove any defective threads that may be found in the skeins. By this inspection the reasons for defective work are often determined, and the sources of the defects are located and the necessary adjustments are made to the machine to overcome the faults. Thus, a careful inspection of the thrown silk will result in the discovery of defects that have passed unseen through various departments.

The actual inspection of the skeins is usually carried out in a room that is lighted with an abundance of natural light. The walls are generally painted with white or very light paint. Driven into the wall or a post at a convenient height from the floor is a dressing pole of wood or of metal, similar to the pole used in beating out the skeins in the winding operation. A reflector or background is also provided at times to assist the inspector in examining the skeins. It consists of a dark or black cardboard suitably supported on the other side from the operative. The white or light-colored silk may easily be seen against a black background; but should it be desirable to have the light pass through the skein, the background may be removed.

In the work of inspection, several hanks or rolls as they are received from the stripping buck are hung on the dressing pole. The rolls, which have been twisted just enough to retain their shape, are untwisted and the skeins are allowed to hang from the pole. One hand is inserted into the loop of the skein nearest the end of the pole, and it is gently but firmly beaten out and its general appearance is noted. It is then rotated

while hanging from the pole and each lacing string is examined, to see that it is long enough to allow the skein to spread freely without crowding or cramping. Notice is taken of the method of lacing, that is, whether the laces have been inserted correctly or whether crossed laces are produced. If the laces are crossed, the skein should be relaced. Frequently, broken ends will be found, and these should be tied together so that they will not hang from the skein.

3. While the skein hangs from the pole it should be spread apart and held between the inspector and the light. In this position, the defects of the thread may be very easily discovered. Among the defects of thrown yarns are corkscrew threads, singles, loopy threads, slack twist, hard twist, and so forth, any one of which would cause a blemish in the finished article. When the defective threads are few in number and of very short lengths, the imperfections are broken from the threads and the ends are again tied. This is true when the skein contains corkscrews, loopy ends, and so forth. The operation of removing defects in this way is termed *tying out* the defects.

Sometimes the defective part of the skein is too long to be tied out; or, the skein may be so badly crossed that tying out is impossible. In such a case the defective skein is removed from the lot and returned to the winder, where it is unwound and again placed on a bobbin. While winding, the operative carefully watches the thread as it passes from the swift to the bobbin and removes any defective thread. The filled bobbin is removed from the winder and sent to the reeling department where it is again reeled into a skein. This procedure is taken with all skeins that are considered to be too poorly reeled to be shipped to the customer in that condition.

Different mills, of course, have different methods and do not inspect the silks in the same manner; but in plants in which a high standard of quality is maintained, rigid inspection of all thrown yarn is necessary. The inspection often brings to light defects caused by improper adjustments, which otherwise would be unseen.

4. **Rolling Skeins.**—Before the actual bundling operation, two or three skeins are grouped together and slightly twisted into a roll, the operation being referred to as *rolling the skeins*. After the inspector has examined one skein, it is hung near the end of the dressing pole and a second skein is carefully examined. When the examination of the second skein has been completed, the two skeins are brought together to be rolled. The operative slips one hand into the loop of the skeins at a point near the dressing pole and moves the hand slowly downwards until it reaches the bottom of the loop, the skeins being thus gradually drawn taut. This is done to see whether the skein contains any tight ends, which are produced when the ends become caught and are crossed in the loop of the skein. Should tight ends be found, the operative should trace the crossed thread to the point where it is caught with other threads, carefully untangle it, and work it into its proper position in relation to the remaining threads.

After all the threads have been straightened, the skeins are pulled over the dressing pole with a sort of circular motion. The front part of the skeins is grasped at the bottom of the loop with one hand. The rear part of the skeins is grasped with the other hand at a point about 12 inches from the bottom of the loop and the silk is pulled downwards with this hand. The skeins are thus pulled over the dressing pole under a slight tension. This operation is repeated several times, until the skeins have made one or two complete turns over the pole, which should be enough to bring all the threads straight and taut.

5. After the skeins have been pulled over the pole in the manner just described, the operative grasps the bottom loop of the skeins with the right hand, the thumb underneath the skein and the fingers inside the loop. The hand is then rotated as far as it will go, twisting the two sides of the skein together. The skein is next held by the left hand, a new hold is taken with the right hand, and the twisting is repeated. In this way two or three turns of twist are inserted in the skeins, which is usually sufficient to hold them together.

Sometimes, only part of the twist is inserted from the bottom of the skein. Then the lower loop of the skein is grasped with one hand while the other hand grasps the loop that rests on the pole. The skeins, only partly twisted, are removed from the pole, and the ends are reversed so that the lower loop of the skein rests on the pole. The remainder of the twist is then inserted in the skeins in exactly the same manner as previously described. In rolling the skeins, the operative should insert the same number of turns in each roll, as this will tend to increase the uniformity of bundles and also give them a neater appearance.

6. After the skeins have been twisted, and before they are removed from the dressing pole, they are prepared so that they will not untwist when taken from the pole. While they are still hanging from the pole, the operative grasps a number of strands of silk, equivalent to about one-fourth the thickness of the group of skeins, and draws them upwards. This causes the formation of a sort of pointed end to the skein and effectively prevents the skeins from untwisting. While the operation itself is comparatively simple, considerable time is required for the operative to become sufficiently proficient to finish all rolls so that their appearance will be approximately uniform. Each roll is composed of two or three skeins, depending on the instructions given to the throwster or on the methods employed. Usually throwsters place three skeins of tram in one group to be rolled into a roll, while in shipping organzine only two skeins compose a roll. These numbers, of course, are used in connection with regular tram and organzine; if special orders of this type of thread are received, special instructions are usually given relative to the size of rolls, bundles, and so on.

BUNDLING OPERATION

7. **Bundling Box.**—On completion of the rolling operation, and after the skeins have been prepared so that they will not untwist when they are removed from the dressing pole, they are placed in the bundling box. An illustration of a typical

bundling box that is used in conjunction with a bundling press is given in Fig. 1. The sides *a* are securely fastened to a bottom board and are held together by the strips of wood *a*₁ that extend the length of the box. Further rigidity is obtained from the bracing afforded by the U-shaped strip of iron *a*₂ that is fastened to the bottom board and to the side members. The edges of the boards forming the side members are carefully beveled and $\frac{1}{2}$ -inch spaces are allowed between the pairs of boards. The box thus has an open top and open ends. It is 22 inches long, 10 $\frac{1}{2}$ inches wide, and approximately 16 inches deep. It is usually placed on a table near the operative that

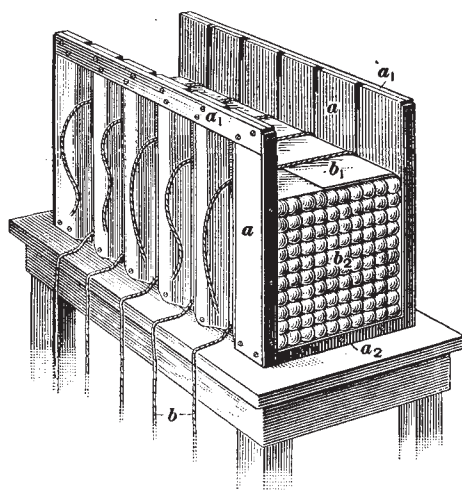


FIG. 1

rolls the skeins so that the skeins may be placed in it without loss of time. First, however, four or five strings *b*, about 45 inches long, are inserted through the slits between the side members, and allowed to hang from the box. These strings are usually the soft twisted cotton strings that were removed from the books of silk prior to the soaking operation. When the string *b* is placed in the box, the end farther from the operative is made long enough so that it may, on the completion of the bundle, be pulled over the top of the silk and tied on the side of the bundle toward the operative. The number of strings used depends on the method of tying adopted in the mill. Generally, five strings are employed, which, when tied, produce a firm, tight bundle. At times only four strings are used, but the bundle, naturally, is not as firmly tied. Four strings should be considered the minimum number to be used when preparing bundles.

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8. With the strings in position across the bottom of the box, Fig. 1, a sheet of manila paper b_1 from 40 to 48 inches long and 22 inches wide is laid on the bottom of the box. The width of the paper is equal to the length of the bundling box, and the sheet is placed so that its width extends lengthwise of the box. The ends of the sheet extend up along the sides of the box and are folded outwards and downwards over the strips a_1 . These ends are later folded inwards over the top of the bundle. With the strings and the paper in place, the rolls b_2 may next be laid in the box. They are arranged side by side, in layers, as shown, until the desired number of layers has been made.

Bundles are made of different sizes, according to the yardage in the skeins, the class of yarn thrown, or the instructions given to the throwster. Yarns of the organzine class usually have two skeins to the roll and 100 rolls in a bundle; that is, each bundle contains 200 skeins. Sometimes organzines have 90 rolls to the bundle, which is equivalent to 180 skeins. Bundles prepared with the number of skeins given generally range from 24 to 28 pounds in weight. Tram, while a slightly heavier thread, is usually reeled in lower yardages; hence, a greater number of skeins may be placed in a bundle. Ordinary tram is usually prepared with three skeins in a roll and 80 rolls in a bundle. This produces a bundle containing 240 skeins, which ranges in weight from 23 to 28 pounds. Sometimes, when preparing tram skeins of low yardages, 160 rolls are placed in a bundle. This, with three skeins per roll, result in 480 skeins per bundle.

9. The method of bundling adopted should produce bundles of medium size. The rolls should be uniformly placed in the box so that the bundles will be alike. For example, should it be desired to have 100 rolls per bundle, each layer should contain ten rolls and there should be ten layers. All silks of the same size and twist should be prepared in the same way, so that the bundles will be uniform. When silks of variant sizes are bundled, the bundles should be neatly formed. The number of rolls in the first layer should be care-

fully determined and each following layer should have the same number of rolls. Should a different number of skeins remain in the last layer, they should be placed at the middle of the preceding layer.

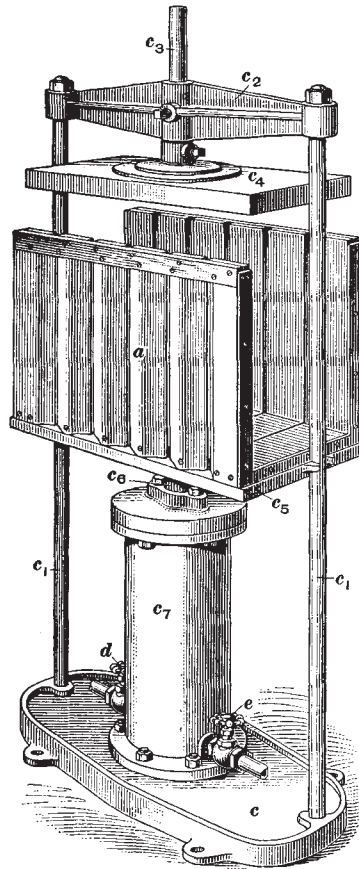


FIG. 2

While it is thus compressed, the strings that pass around it are pulled taut and knotted, thus binding the package and preventing it from returning to its original shape when the pressure is removed. A power bundling press is shown in Fig. 2, with an empty bundling box *a* in position. The base *c* supports the tie-rods *c*₁, at the upper ends of which

After the bundling box has been filled with the required number of rolls, the manila paper hanging down over the edges of the box is folded back over the top of the skeins, as shown in Fig. 1, and the strings are adjusted. The end of string passing through the first slit on the side of the box away from the operative is lifted, guided through the same slit just above the top of the bundle, drawn across the top, out through the first slit on the side of the box toward the operative, and allowed to hang free. The remaining strings are treated in the same manner, after which the bundling box is ready to be placed in the press.

10. Bundling Press.—The bundling press is a device by which the bundle of silk is compressed into a comparatively small space.

is attached the cross-beam c_2 that holds the vertical rod c_3 . This rod at its lower end is fixed to the pressure board c_4 located directly above the bundling box, and of such size as to fit in the box. The pressure board may be adjusted vertically, so that it may be lowered when small bundles are to be pressed. In the illustration, the bundling box is shown resting on the platform c_5 , which is slightly larger than the bottom of the box. It is located between the uprights c_1 and is firmly secured to the piston rod c_6 . The piston rod is attached to a piston, that works inside the cylinder c_7 , which is firmly bolted to the base c . An inlet valve d and an outlet valve e control the admission and escape of the medium by which the pressure is applied.

11. Whether steam, water, or air is to be used to furnish pressure to the power press depends on which is the more readily available. If steam under pressure can always be obtained, a live-steam pipe may be coupled directly to the inlet valve of the press. In many mills, however, steam pressure is not maintained during the entire year; hence, lack of steam during the summer would prevent the operation of the press. Water is often used, if it can be obtained at sufficient pressure to operate the press. The pressure necessary ranges from 60 to 70 pounds per square inch. When neither steam nor water at suitable pressure is available compressed air is often employed. It is produced by a compressor unit consisting of a small electric motor, an air compressor, and a storage tank. The motor drives the compressor and forces the air into the storage tank. An automatic device stops the motor when the desired pressure in the storage tank is reached, and starts the motor when the pressure in the tank drops below a certain point.

12. No matter what medium is used to operate the press, an adequate pressure should be maintained at all times. A pressure of from 60 to 70 pounds per square inch in the cylinder of the press will produce a hard, firm bundle. A lower pressure will result in a softer and less compact bundle.

In the operation of the bundling press, the bundling box is placed on the platform directly under the pressure board, the

strings on the bundle hanging free at one side of the box. The outlet valve is then closed and the inlet valve is opened. The steam, water, or air enters the cylinder, forces the piston upwards, thus carrying the bundling box and its contents upwards against the pressure board. As this board is held stationary by the tie-rods, the bundle is compressed between it and the bottom of the box. With the skeins under compression in the press, the strings are pulled tight and knotted. When all have been tied, the inlet valve is closed and the outlet valve is opened, allowing the steam, water, or air to escape. The platform and the bundling box will then gradually descend to their original position, as shown. While only one press is necessary in a mill of average size, the number of bundling boxes provided must at least equal the number of bundlers in the mill, which allows each bundler a box in which to pack rolls. After the bundle is pressed, the box may be retained, and it is found that this procedure causes the least trouble among the employes and also prevents loss of time.

13. In addition to the power press just described, hand presses are sometimes employed. They perform the operation in an efficient manner, but require a greater length of time to press a bundle. The hand press is similar to the power press in many respects. A stationary support holds the bundling box, and two uprights carry a cross-beam through which passes a large shaft provided with square threads. At the upper end of the threaded shaft is fixed a hand wheel, and a pressure board is fastened to the lower end. In operation, the box is placed on the support, directly under the pressure board. The hand wheel is then turned, causing the pressure board to descend, and sufficient pressure is applied to compress the silk to the desired firmness. After the strings have been tied around the bundle, the hand wheel is turned in the opposite direction, raising the pressure board and enabling the box to be removed from the press.

14. Bundler's Knot.—A characteristic knot is employed by the majority of bundlers when tying bundles, its advantage being that it allows the ends of the strings to be drawn very

tightly and still not slip when the tension is removed from them prior to tying the final knot. The knot consists principally of two parts, namely, a sliding knot that is tied first, and a final knot that binds the former and prevents it from slipping. After the bundle has been compressed, the ends of one string dangling from the box are grasped and gently pulled back and forth. This causes the string to become taut. The first

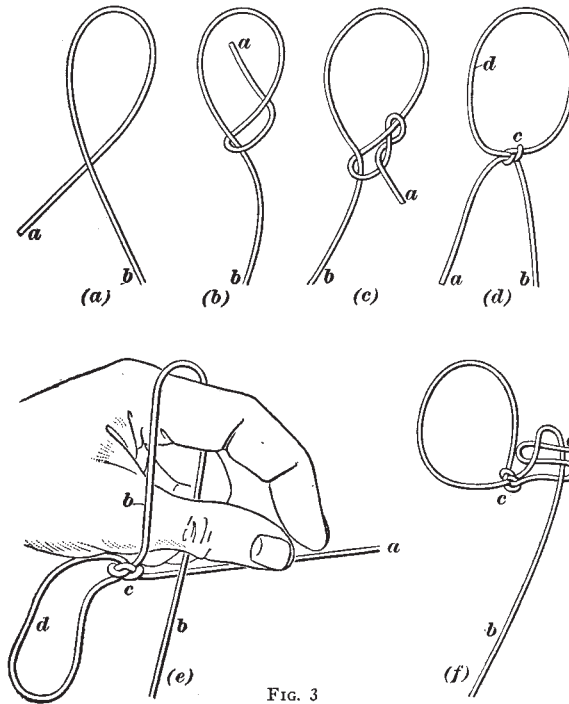


FIG. 3

part of the knot may then be tied. The operative grasps the end of the string that extends through the slit at the top of the bundle, draws it downwards and underneath the string that extends from the under side of the bundle. This is illustrated in Fig. 3 (a), which shows the upper string *a* drawn under the lower string *b* so that approximately 6 inches of the string *a* extends past the string *b*. Then, as shown in (b), the upper string *a* is brought over the lower string *b*,

guided upwards and under itself, and out through the loop. After the end *a* is brought through the loop, which corresponds to the string encircling the bundle, it is passed under itself and slipped through the small loop that was formed, as shown in (*c*). The end *a* is then pulled until the knot is firmly formed, when it will appear as at *c* in (*d*). Next, the knot is grasped between the forefinger and thumb of one hand and the end *b* is pulled with the other hand, causing the knot to move along the string *b* until it rests against the bundle. The loop *d*, or the part that passes around the bundle, is thus drawn taut. Frequently the knot will not readily pass between the side members of the bundling box, and the operative must then force it through with scissors or a similar object. The remaining strings on the bundle are tied in the same manner as the first string, and the knots pulled tightly against the bundle, after which the final knots may be tied.

15. After all the strings are pulled up tight, the final knots are tied, starting with the center string. As shown in Fig. 3 (*e*), the final knot somewhat resembles a half-hitch around the looped end *a*. The string *b* should be looped over the forefinger and thumb of one hand, and while it is in this position the end *a* should be lifted and grasped between the finger and thumb and drawn back into the loop formed by the end *b*. At the same time that the end *a* is drawn through the loop, the end *b* should be gradually drawn taut, as shown in (*f*) so that upon the completion of the knot, the final knot will be against the slip knot first made. When the first knot is properly made and drawn tight against the bundle, the final knot, if properly made, will securely bind and hold it in place. Following the completion of the knots, the tails may be cut off with scissors. Sometimes, the tail *a* of the knot on the second string from the end of the bundle is allowed to remain and to it is attached an identification tag or ticket, by which the character of the bundle may be readily determined.

The methods of tying the bundler's knot vary slightly. For instance, the end *a*, view (*c*), instead of being passed through the small loop only once, is frequently given two

twists; and it is sometimes twisted in the direction exactly opposite to that shown. Similarly, the method of tying the final knot also varies. Sometimes, instead the half-hitch, an ordinary loop knot is made, which is slipped over the first knot and holds it securely.

16. The finished bundles are usually weighed on scales of the direct-reading type. The scales are generally placed on a table with a smooth top on which the final wrapping of the bundles is done. After the weight of the bundle, in pounds and ounces, has been determined, it is marked on the ticket or identification tag and tied to the string left for this purpose. That string is pulled over the edge of the bundle so that after the ticket is attached it will be easily seen when the bundles are arranged in rows on the shelves of the storage room. Some throwsters tie the ticket to the first string on the bundle, but the better practice is to attach it to the second string. The reason is that the ticket and string are often accidentally torn from the bundle, and this is more likely to happen if it is tied to the first string. When a string and its ticket are torn from a bundle they should be immediately replaced, so that the bundle will not become mixed with others that lack identification tags.

DRAMMING

17. In some instances, after the bundling operation has been completed and the weight has been recorded on the ticket, the average dram size of the thrown silk is determined. The object of obtaining the dram size, or drammage, is to supply the customer with the weight in drams of a definite length of silk so that silk of proper size may be selected and employed in the production of a fabric that should have a specified weight. Dramming is not performed in all mills, for in the majority of throwing mills the silk is bundled, weighed, and shipped. Mills that throw silks for use in affiliated weaving plants more frequently dram the silks.

18. The dram weight, or drammage, of a silk is the weight of a skein of 1,000 yards, expressed in drams; in other words,

it is a value that shows the relation between length and weight. It may be found very easily. Every reel is equipped with a yardage clock, so that the skeins produced will contain a uniform yardage; and if the bundles contain the same number

TABLE I
DRAMMAGE OF 2-THREAD SILK

(Either 320 skeins of 10,000 yards or 160 skeins of 20,000 yards)

Weight of Bundle Lb. Oz.	Weight of 1,000 Yards Drams	Weight of Bundle Lb. Oz.	Weight of 1,000 Yards Drams	Weight of Bundle Lb. Oz.	Weight of 1,000 Yards Drams
22 0	1.76	23 2	1.85	24 4	1.94
22 1	1.765	23 3	1.855	24 5	1.945
22 2	1.77	23 4	1.86	24 6	1.95
22 3	1.775	23 5	1.865	24 7	1.955
22 4	1.78	23 6	1.87	24 8	1.96
22 5	1.785	23 7	1.875	24 9	1.965
22 6	1.79	23 8	1.88	24 10	1.97
22 7	1.795	23 9	1.885	24 11	1.975
22 8	1.80	23 10	1.89	24 12	1.98
22 9	1.805	23 11	1.895	24 13	1.985
22 10	1.81	23 12	1.90	24 14	1.99
22 11	1.815	23 13	1.905	24 15	1.995
22 12	1.82	23 14	1.91	25 0	2.00
22 13	1.825	23 15	1.915	25 1	2.005
22 14	1.83	24 0	1.92	25 2	2.01
22 15	1.835	24 1	1.925	25 3	2.015
23 0	1.84	24 2	1.93	25 4	2.02
23 1	1.845	24 3	1.935	25 5	2.025

of skeins, the yardage per bundle will be uniform. As the bundles are weighed before they leave the mill, the weight of a definite yardage of the silk is known, and from it the weight of 1,000 yards, or the drammage, may easily be found by proportion.

EXAMPLE.—What is the average drammage of 2-thread organzine prepared in 20,000-yard skeins, each bundle containing 180 skeins and weighing 24 pounds?

SOLUTION.—As 1 lb. contains 256 drams, the weight of a bundle is $24 \times 256 = 6,144$ drams. The yardage per bundle is $20,000 \times 180 = 3,600,000$ yd. Then, by simple proportion, the drammage x , or the weight per 1,000 yd., is

$$x : 6,144 = 1,000 : 3,600,000$$

from which $x = \frac{6,144 \times 1,000}{3,600,000} = 1.71$ drams. Ans.

TABLE II
DRAMMAGE OF 3-THREAD SILK

(Either 240 skeins of 10,000 yards or 320 skeins of 7,500 yards)

Weight of Bundle Lb. Oz.	Weight of 1,000 Yards Drams	Weight of Bundle Lb. Oz.	Weight of 1,000 Yards Drams	Weight of Bundle Lb. Oz.	Weight of 1,000 Yards Drams
22 0	2.35	23 4	2.48	24 8	2.61
22 1	2.35	23 5	2.49	24 9	2.62
22 2	2.36	23 6	2.49	24 10	2.63
22 3	2.37	23 7	2.50	24 11	2.63
22 4	2.37	23 8	2.51	24 12	2.64
22 5	2.38	23 9	2.51	24 13	2.65
22 6	2.39	23 10	2.52	24 14	2.65
22 7	2.39	23 11	2.53	24 15	2.66
22 8	2.40	23 12	2.53	25 0	2.67
22 9	2.41	23 13	2.54	25 1	2.67
22 10	2.41	23 14	2.55	25 2	2.68
22 11	2.42	23 15	2.55	25 3	2.69
22 12	2.43	24 0	2.56	25 4	2.69
22 13	2.43	24 1	2.57	25 5	2.70
22 14	2.44	24 2	2.57	25 6	2.71
22 15	2.45	24 3	2.58	25 8	2.72
23 0	2.45	24 4	2.59	25 10	2.73
23 1	2.46	24 5	2.59	25 12	2.75
23 2	2.47	24 6	2.60	25 14	2.76
23 3	2.47	24 7	2.61		

TABLE III
DRAMMAGE OF 4-THREAD SILK

(Either 160 skeins of 10,000 yards or 320 skeins of 5,000 yards)

Weight of Bundle Lb. Oz.	Weight of 1,000 Yards Drams	Weight of Bundle Lb. Oz.	Weight of 1,000 Yards Drams	Weight of Bundle Lb. Oz.	Weight of 1,000 Yards Drams
19 8	3.12	21 6	3.42	23 4	3.72
19 9	3.13	21 7	3.43	23 5	3.73
19 10	3.14	21 8	3.44	23 6	3.74
19 11	3.15	21 9	3.45	23 7	3.75
19 12	3.16	21 10	3.46	23 8	3.76
19 13	3.17	21 11	3.47	23 9	3.77
19 14	3.18	21 12	3.48	23 10	3.78
19 15	3.19	21 13	3.49	23 11	3.79
20 0	3.20	21 14	3.50	23 12	3.80
20 1	3.21	21 15	3.51	23 13	3.81
20 2	3.22	22 0	3.52	23 14	3.82
20 3	3.23	22 1	3.53	23 15	3.83
20 4	3.24	22 2	3.54	24 0	3.84
20 5	3.25	22 3	3.55	24 1	3.85
20 6	3.26	22 4	3.56	24 2	3.86
20 7	3.27	22 5	3.57	24 3	3.87
20 8	3.28	22 6	3.58	24 4	3.88
20 9	3.29	22 7	3.59	24 5	3.89
20 10	3.30	22 8	3.60	24 6	3.90
20 11	3.31	22 9	3.61	24 7	3.91
20 12	3.32	22 10	3.62	24 8	3.92
20 13	3.33	22 11	3.63	24 9	3.93
20 14	3.34	22 12	3.64	24 10	3.94
20 15	3.35	22 13	3.65	24 11	3.95
21 0	3.36	22 14	3.66	24 12	3.96
21 1	3.37	22 15	3.67	24 13	3.97
21 2	3.38	23 0	3.68	24 14	3.98
21 3	3.39	23 1	3.69	24 15	3.99
21 4	3.40	23 2	3.70	25 0	4.00
21 5	3.41	23 3	3.71		

19. To eliminate calculation of the dram weight of a silk by the method explained in the preceding article, tables are usually provided. Three such tables are given in Tables I, II, and III. Table I is applicable to 2-thread silks put up in bundles of 320 skeins containing 10,000 yards each, or 160 skeins of 20,000 yards each. Table II is used for 3-thread silks prepared in bundles containing 240 skeins of 10,000 yards each, or 320 skeins of 7,500 yards each. Table III is applied to 4-thread silks in bundles containing 160 skeins of 10,000 yards each, or 320 skeins of 5,000 yards each.

EXAMPLE.—A 3-thread tram is prepared in bundles weighing 23 pounds 10 ounces, each containing 80 rolls of 3 skeins each, and each skein having 10,000 yards. What is the drammage of the silk?

SOLUTION.—There are $3 \times 80 = 240$ skeins in a bundle, and each skein contains 10,000 yd. As 3-thread tram is specified, Table II must be used. The weight of a bundle, or 23 lb. 10 oz., is found in the proper column, and on the same line with it is 2.52. Hence, the drammage of the silk is 2.52 drams. Ans.

SHIPPING

WRAPPING BUNDLES

20. After the bundles are weighed, and prior to shipment from the mill, they are suitably wrapped, this work usually being done in the department in which the silk is bundled. The room generally contains a long table, at one end of which are the scales, and beside them is a pile of sheets of wrapping paper. This paper is usually a heavy manila stock in sheets 36 inches by 42 inches, this size being suitable for bundles weighing 24 pounds. Sometimes the wrapping paper is waterproofed. The bundle is placed on the sheet of wrapping paper, the ticket is removed, and the bundle is securely wrapped and tied, after which the ticket is fastened to the outside wrapping or is slipped under the wrapping twine at one end of the bundle, where it is held in place by the tautness of the twine. The finished bundle is then placed to one side until a sufficient number of bundles have accumulated to warrant

the preparation of a bale for shipment. Six bundles usually compose a bale, the weight being about 150 pounds, depending on the size of the bundles, and the number of bundles per bale.

21. The final wrapping of the silk for shipment is usually the straw matting or burlap covering that was on the bale of raw silk when it was received at the mill. If the straw matting is used, the bundles composing the bale are placed in two layers of three bundles each. The straw matting is then pulled as tightly as possible around the bundles and the open end is closed by sewing with heavy twine, the operation being facilitated by using a large seine needle, which is somewhat like the needle used in lacing skeins. If burlap is used to cover the bundles, it is put on the bale in exactly the same manner as the straw matting, and is sewed with a seine needle and twine. A heavy rope should be passed once around the bale to hold it in shape and produce a firmer package. The rope may be either a heavy cord supplied for the purpose, or the twisted grass rope that was on the raw silk bale. Finally, a shipping ticket should be sewed to one side of the bale. A ticket that is tied to the bale is likely to be torn off.

SHIPPING SILK ON BOBBINS

22. When the silk is shipped from the mill on bobbins, the bobbins are usually packed in wooden boxes specially built for the purpose. Sometimes the boxes have reinforced corners and are provided with handles so that they may be readily moved from place to place. While boxes of different sizes are employed, a common size is one that will easily hold 500 bobbins. After the filled bobbins are brought to the shipping room, they are weighed in large groups and packed in the boxes. Sometimes no effort is made to protect the silk, but in other cases the bobbins are wrapped in paper. One method of wrapping is to group four bobbins together end to end so that the heads of the bobbins are in contact. The bobbins are then wrapped in a sheet of paper, to protect the silk, and the package is placed in the box. By subtracting the weight of

the empty bobbins, which is obtained when they are received at the mill, from the weight of the filled bobbins, the weight of the thrown silk is determined. When the box has been filled and closed the customer's name should be plainly marked on a shipping tag and affixed to the box.

OTHER METHODS OF PREPARATION

23. Coning.—Coning is the term applied to a form of preparation of yarn that is particularly valuable when the yarn is to be used on a knitting machine. Hosiery tram, which is employed in the manufacture of silk hose and other knitted articles, is usually coned. The machine on which the yarn is prepared, commonly called a *coner*, is equipped with a series of horizontal spindles that are individually driven. Each spindle has a split cone holder that, after the cone is in position on it,

is expanded, thus securely holding the cone. An empty pressed-paper cone of the conventional type is illustrated in Fig. 4 (a), while a cone filled with silk is shown in (b). After the cone is in position on the holder, the thread guided from the supply bobbin is wrapped

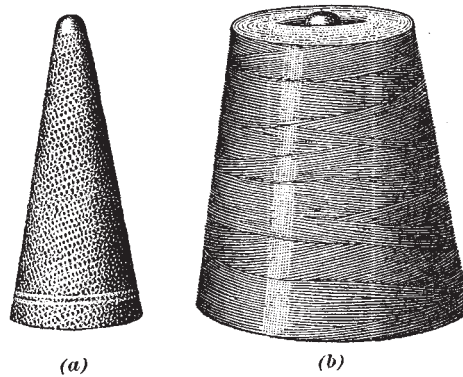


FIG. 4

around the cone several times. In its passage to the cone, the thread is passed through a feeler that forms part of the stop-motion, and also a thread guide that directs the thread on the cone. The stop-motion brings the cone to rest when an end breaks. A tension device is also provided, by which the tautness of the yarn may be varied so as to give a cone of the desired firmness. The thread guide moves back and forth over a distance equal to the height of the cone, and the motion is rather rapid in order that a cross-winding effect will

be produced, which allows the thread to be unwound with greater ease in a later process.

24. When the required amount of yarn has been wound on the cone, giving it the required size, the knock-off motion comes into action and automatically stops the spindle. The cone is then removed from the spindle, the removal being facilitated by a small lever located near the base of the cone. When the outer end of the lever is depressed, the cone is forced slightly from the spindle, allowing it to be withdrawn easily.

The methods employed in preparing cones for shipment vary in different mills. Sometimes the cones are wrapped in thin tissue paper so that when they are packed closely the threads will not rub and be pushed from the base of the cone,

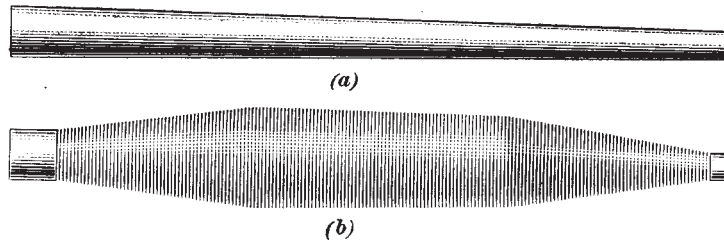


FIG. 5

which would cause waste. After being properly wrapped the cones are usually packed in a strong wooden box that will withstand rough handling in transit. Sometimes the cones are placed in cardboard boxes, each box being of such a size as to hold one cone and equipped with a flap cover that may be closed after the cone is inserted.

25. Copping.—Hard-twist filling yarn for a weaving mill is often prepared on cops or cop tubes instead of shipping bobbins, the object being to prepare the yarn so that the manufacturer, or weaver, may use it immediately without further preparation. The cop tube, as shown in Fig 5 (a), is a slender tapered tube, and is made of paper; a filled cop is shown in (b). The machine on which the cops are wound is known as a *cop winder*, or simply as a *copper*. It is similar to

a coner, having a series of horizontal spindles extending from each side of the machine. The spindles are individually driven and support the cop tubes. The yarn, drawn from a bobbin that rotates on a gudgeon held in hangers, is led through a porcelain tension guide, and thence downwards through a porcelain eye that guides the silk on the cop. The traverse given to the guide eye is very rapid, and the yarn is wound on the cop with a distinct cross-wind. After sufficient yarn has been wound on the cop, the spindle is automatically stopped.

Parallel tubes are sometimes used instead of cops. They are plain cylindrical tubes of pasteboard, with no taper. The silk is wound on them by the same kind of machine, and in the same manner, as it is wound on cops. The traverse motion is arranged to give a cross-wind like that on cones.

26. Quilling.—Another form of yarn preparation that is similar to copping is known as quilling. It is performed on a machine that is like the copper in all respects except that quills



FIG. 6

are used instead of cops. A quill resembles a cop in shape, but it has a wide base or shoulder that forms the foundation for the yarn, as may be seen in Fig. 6, which shows a cast aluminum quill. The spindle is stopped when the quill becomes filled with silk to a point from $\frac{1}{4}$ to $\frac{1}{2}$ inch from the end. When the quill is filled, its diameter should be equal to the diameter of the largest part of the shoulder.

The cops or quills, if filled with hard silk are usually treated, to set the twist in the silk. In some mills, they are placed in a large box and heated to a suitable temperature. This baking treatment tends to set the twist, and eliminates kinking, which is a bad quality in filling yarn.

27. Silk wound on quills is sometimes steamed in order to set the twist in the thread. If wooden quills are used, the steam causes them to swell, thus decreasing the size of the holes in them and increasing the difficulty of placing them in

the shuttles; also, the grain of the wood frequently is raised, and with rough quills the breaks in weaving are increased. For this reason, silk that is to be steamed on quills is often wound on aluminum quills of the type shown in Fig. 6. The transverse holes communicating with the lengthwise hole in this quill enable the steam to permeate the silk effectively.

Silk on pressed-paper cops cannot be steamed, as the tubes would collapse when moist. For this reason, cops are either treated by the baking method, or the silk is thoroughly steamed while on bobbins and then wound on quills or cops. The proper degree of humidity should be maintained in the atmosphere of the room in which coppers or quillers are located, so that the silk will be pliable and run well. The relative humidity of the room should range from 65 to 75 per cent. at all times.

28. Subsequent to the copping, quilling or tubing operation, the silk is carefully packed so that it will not be damaged during transit. Cops and quills are not wrapped individually, like cones, but are packed, usually in one of two ways. Sometimes they are carefully packed in pasteboard boxes that hold from 100 to 200 cops. These boxes in turn are packed in a large wooden shipping case that will hold about 2,500 cops.

When cops are shipped in this manner the shaking and jarring while in transit sometimes cause the silk to unravel from the cop and become tangled with other ends. Then when the cop is removed from the box, the silk from several of the cops is pulled out with it, resulting in considerable waste. To prevent waste of this kind throwsters often ship cops in a special form of paper folder that contains a series of compartments in which the cops are held. The compartments are arranged in two rows, so that 13 cops may be placed in each row, making a total of 26 cops in each folder. When filled, the container is folded in the center, and thus the silk is fully protected and the cops are held so that they cannot turn in the compartments. The full containers are then placed in a shipping box capable of holding 100 paper folders, which may be considered a sufficient number to prepare for one shipment.

GENERAL INFORMATION

VARIETIES OF THROWN SILK

TRAM

29. Tram, for ordinary weaving purposes, forms that part of the fabric extending from one selvage to the other. It is composed of two, three, or more ends of raw silk that are doubled and then twisted with a right twist of from 2 to 5 turns per inch. The yarn is usually produced in the following manner: If it is thrown by the single-process method, the required number of threads are doubled on bobbins, which when filled are transferred to a regular twister that inserts the required twist, whereupon the silk may be removed and reeled. Should the mill be equipped with doubler-spinners, the silk is doubled and twisted in one operation. On removal from the doubler-spinner the silk is reeled into skein form and while still on the fly, it is placed in the steam box and steamed for about 30 seconds, which is long enough to set the twist, since the small number of turns allows the steam to penetrate very rapidly. After steaming, the silk is laced, the skeins are removed from the fly and are bundled as previously described.

Frequently the terms tussah tram and Canton tram are employed with relation to tram silks. Their method of manufacture is like that just described. The term tussah or Canton merely refers to the kind of silk that is employed in the manufacture of the thread.

HOSIERY TRAM

30. Hosiery tram is a tram thread used in the manufacture of silk hosiery. It is usually composed, depending on the desired size, of from 6 to 12 threads held together with a low

number of turns of twist, ranging from 3 or 4 turns per inch upwards. It is produced like the tram previously described; that is, in the single-process method the silk from the winder is doubled and then twisted with the number of turns of twist. When produced on the doubler-spinner, the operations are combined. Following the twisting, the silk is reeled and given a steaming, while on the fly, of from 15 seconds to 1 minute according to the thread. The skeins laced, are then removed from the fly, rolled, and bundled. All hosiery tram is not reeled into skeins; instead, a large part is prepared on cones. In this case, the silk while still on the twister bobbins is steamed, after which it is unwound from the bobbins and wound on cones. When it is prepared in this manner, the cones are frequently placed in individual pasteboard boxes that are then packed in wooden shipping cases.

FLOSS SILK

31. Floss silk is usually made of two or more raw-silk singles that are first doubled and then given only a very small amount of twist, ranging from 1 to 2 turns per inch. The thread is prepared by first doubling the required number of ends on a doubler and then inserting the required twist on a twister. Since the method of preparation for shipment of floss silk is similar to that for silks previously described, it is not necessary to give further explanation. Floss silk is generally employed in fabrics that are to have a well-covered face, and so very little twist is inserted in the thread; for a high twist would tend to hold the threads together and would prevent them from spreading or "covering" well.

ARTIFICIAL SILK

32. Artificial silks received at the throwing mill to be doubled and twisted into thread are passed through the various operations in practically the same manner as natural silk. In winding, however, the winding frame is usually operated at a slower speed, which subjects the thread to less strain and

reduces breakages that are frequently traced to high-speed operation. The speed of all machines is usually decreased to a certain extent until the most efficient operating speed is found. In twisting heavy artificial silk threads, such as corded effects, it is usually necessary to employ a slightly heavier flyer than is used in twisting light-weight or fine denier silk thread; for, a greater drag must be put on the heavier thread to give it the required tension and reduce ballooning. After the twisting operation, artificial silks are reeled, laced, and also prepared into bundles for shipment in the same way as natural silk. Artificial silks, however, are not steamed.

ORGANZINE

33. Organzine, or organ, as it is usually called, is generally employed as warp yarn, which constitutes that group of threads running lengthwise of the fabric. It possesses greater strength than the majority of previously described yarns, because of the manner in which it is prepared. It usually consists of two threads, although 3-thread organ is prepared at times. When producing 2-thread organzine with a standard twist, 16 turns are inserted in the first-time spinning; the threads are then doubled, and 14 turns are inserted in the second-time twisting. Organzines are thrown with 18 turns of twist in the first-time operation and 16 turns in the second-time operation, while a more slackly twisted organzine is often thrown with 14 turns in the first-time and 12 turns in the second-time. When preparing 3-thread organzine, the single ends are first spun toward the left; the three ends are then wound on a bobbin in a group and are twisted to the right in the usual manner. Usually 16 turns are inserted in the first-time spinning and 12 turns in the second-time twisting; or, as sometimes is the case, 14 turns are inserted in the first-time and 10 turns are inserted in the second-time.

34. When throwing organ in accordance with the single-process method, a regular spinner is employed for the first-time spinning; the spun threads are then doubled on a vertical

doubler and the doubled threads are twisted on a second-time spinner or twister that takes up the thread on iron-head steaming shafts. The filled shafts are removed to the reeling department and the silk is reeled into skeins that are steamed while on the fly, a steaming of from 1 minute to 3 minutes being sufficient. After steaming, the skeins are laced, examined, bundled, and shipped.

The method of procedure after the twisting operation is altered in some mills. For example, when the steaming shafts filled with silk are removed from the twister they are placed in bobbin racks. These are then put in the steam box and after being steamed, long enough to assure thorough penetration, they are removed from the steam box, the silk being then reeled into skeins. The remaining operations are identical with those previously described.

35. Another method of manufacture of organzine makes use of the doubler-spinner to double and insert a slight amount of twist in the thread, preparatory to completing the twisting operation on a regular twister. In this method, 16 turns of twist are inserted in the raw-silk singles on a regular first-time spinner. The take-up bobbins from the spinner are placed on the jack-pins of the doubler-spinner and two threads are led downwards to the taper-hole take-up bobbin, on which they are wound at the proper speed so that 3 or $3\frac{1}{2}$ turns of twist will be inserted in the thread. When filled, the take-up bobbins are removed and placed on the spindles of the twister. Here the remainder of the twist is inserted in the thread without the aid of a flyer, and so the machine may be operated at the speed of a first-time spinner. This latter operation is sometimes referred to as *third-time spinning*.

Besides the methods just described, a large part of the organzine thrown at the present time is produced on the three-process machine called the spinner-doubler-twister. The method of procedure when this machine is used has been described in a previous Section, and so it is unnecessary to repeat the details here.

GRENADINE

36. A grenadine twist is produced in exactly the same manner as an organzine thread except that a greater amount of twist is inserted in the yarn. Grenadines are usually composed of two threads of raw silk, each receiving from 35 to 70 turns per inch to the left, according to the amount of twist desired. The spun threads are subsequently doubled, being twisted on a regular second-time spinner or twister and given from 35 to 70 turns to the right. It is evident, therefore, that a thread belonging to this class is merely a hard-twisted organzine.

HARD TWIST

37. Nature of Hard Twist.—When threads are twisted with 18 turns per inch or more, they are usually referred to as hard twists. This name is given because the thread becomes hard, wiry, and lusterless as the number of turns of twist is increased. Hard twists may be divided into several classes, according to the kind of yarn and its use. These classes will be described in succeeding articles.

38. Crêpe.—Crêpe, or ordinary crêpe, as it is also called, is probably one of the most important threads in the hard twist classification. It is generally made from Canton stock because of its high luster when dyed and also because of its clinging nature, although other silks may be employed. The thrown thread usually contains from 2 to 10 or more threads of 13/15-or 14/16-denier raw silk, doubled together and twisted with from 60 to 65 turns per inch. Because of the type of fabric that is made from crêpe thread, half of the lot or shipment of raw silk received by the throwster is twisted to the right and the remainder is twisted to the left. To distinguish the twists during the throwing operation, they are tinted with different colors when in the soaking bath.

There are various methods of producing crêpes, depending on the equipment of the mill and the opinion of the throwster. In a mill equipped with a combination doubler-spinner the

silk may be doubled and given a preliminary spinning of 3 turns to hold the threads together. By transferring the filled bobbin from the doubler-spinner to an ordinary twister, the remaining twist may be inserted without the use of a flyer. The spinning disk is often employed in this operation, although it is not needed if the bobbins are not wound too full.

As the preliminary spinning inserts 3 turns in the thread, it is necessary to insert an addition 60 to 62 turns, and sometimes 65 turns or more, to produce the 60 to 65 turns desired. The additional twist is usually inserted in the thread in two spinnings of 30 or more turns each. When operating in this manner, the speed of the take-up bobbin is such as to cause the thread to pass from the spinner bobbin to the take-up bobbin without forming kinks or snarls. Sometimes when inserting the 30 turns in the final operation, a flyer is employed to give the thread an increased amount of tension, thus preventing the formation of kinks and snarls. The take-up bobbin for the last-time spinning should be an iron-head steaming shaft, which will withstand the steaming operation.

39. Sometimes from 60 to 62 turns are inserted in the thread in one twisting, or spinning, but this is not considered good practice, for the following reasons: The take-up rolls revolve very slowly, and consequently the speed at which the thread passes upwards is also very slow, thus aiding the formation of loops and snarls; also, the thread balloons very easily, especially when a heavy thread is being twisted. Should an end break, it frequently flies in the path of another thread, and causes that one to break. Thus, the breaking of one end frequently causes the breakage of a number of adjoining ends, producing waste and unnecessary work in tying up. Hence, when spinning crêpe, a bobbin is sometimes placed on every other spindle, so that the breakage of one thread will not cause the end to fly in the path of another and break it.

Sometimes after a frame has been in operation for a considerable length of time, the spindles become wobbly and slip, causing slack twist. For example, suppose that, on a frame adjusted to produce 60 turns in one operation, several spindles

slip. Evidently the thread twisted by the spindles that slip will insert a lower number of turns of twist than those that run correctly. The reduction in twist will exist throughout the entire length of thread on the bobbin. If, on the other hand, the thread is twisted in two spinnings, the slack twist is not so evident, because the silk is taken up at a more rapid rate and the two spinnings tend to equalize the twist in the thread.

40. In a mill that is not equipped with combination machines and that throws the silk by the single-process method, the following procedure is usually followed: After the silk is wound, the threads are doubled into the desired ply by the same method as in throwing tram. The doubled silk is removed from the doubler and placed on a twister, which is adjusted to give the required number of turns. This is governed, of course, by the turns of twist required in the finished thread, and the number of spinnings to be given to the thread. Frequently only two spinnings are given, in which case the twisting frame is adjusted to insert 15 turns per inch in the first spinning and a light-weight figure-8 flyer is employed in the operation. A regular taper-hole spinner bobbin is employed to take-up the thread so that the bobbin may be placed on another twister for the second spinning. The second spinning employs a regular twister adjusted to insert 50 turns. To insure a smooth thread free from kinks it is best to use a flyer in this operation also, although it is not always done. The take-up bobbin on the machine should be of a type that will withstand steaming or any other operation that is employed to set the twist.

41. When twisting crêpes on frames equipped with individual gear take-ups, the procedure will differ only slightly from the usual methods. When a gear take-up is employed on the twister the bobbin will revolve at a constant speed, since it is positively driven. As the bobbin takes up the thread, its diameter will gradually increase, and a variation will exist in the turns per inch of the thread that is twisted; for, when the diameter of the bobbin is small, the thread will be taken up at a slower speed than when the bobbin is filled. Also, by

decreasing the surface speed of the bobbin, the twist inserted in the thread will be increased. Consequently, should the frame be adjusted to insert 30 turns, the thread near the barrel would have a greater number of turns; the silk at the center would have 30 turns, and the silk on the outside would have less than 30 turns. In order to remedy this inequality, the silk should be given a second spinning on a machine having a gear take-up adjusted for the same number of turns of twist as in the first spinning. The thread that is drawn from the outside, constituting the slackly twisted yarn, would wind on the take-up bobbin first and receive a harder twist; the portion in the center would receive an average twist; and the silk adjoining the barrel of the spinner bobbin would be slackly twisted. In this way the second spinning tends to correct the unequal twist so that the thread will have approximately the same number of turns of twist throughout. Hence, it should always be remembered that, when twisting crêpes on spinners with gear take-ups, the twistings should always be arranged in multiples of two, so that they will be equalized and thus produce as uniform a thread as possible.

42. Following the twisting operation, the silk should be treated so that the twist will set, thus eliminating kinks and snarls when the thread is pulled from the bobbin. The steaming process already described may be used; or, the twist may be set by soaking. In the latter case, the silk is first wound on maple rolls or some type of bobbin that will withstand the action of water. The filled bobbins of silk are then placed on a bobbin board or rack, and deposited in a soaking tub. The racks are placed in the tub, one on another until the tub is filled, after which a lid is fastened on to clamp the racks in place. Cold water is run into the tank until the silk is completely submerged, and the silk is allowed to soak for a period ranging from 5 to 8 hours. The water is then drained from the tub, and the racks are removed and put in a drying room, similar to the drying room employed when drying the soaked raw silk prior to throwing. The silk is allowed to remain in the drying room for from 10 to 18 hours, during

which time the temperature of the air is maintained at from 80 to 90° F. When the silk is dry, it is removed and redrawn on shipping bobbins.

Sometimes the soaking operation is varied slightly by adding a small quantity of soap to the water, so that a very weak soap solution is formed. It is claimed that this solution tends to give the yarn more softness to the touch and greater pliability.

43. Georgette Crêpe.—Georgette crêpe is the name of a fabric that was originally made from yarns of a higher twist than ordinary crêpe. The yarns were hard twisted trams employed in both warp and filling. They were composed of two ends of a 13/15-denier silk, doubled and then twisted, one half of the lot receiving a right twist and the remainder a left twist. The twists employed ranged from 65 to 70 turns per inch but gradually they were increased so that fabrics of this type now have yarns with twists of 85 or 90 turns per inch. Georgette at one time was considered a 2-thread crêpe; however, yarns are also made with three threads and still considered under this classification. The method of throwing georgette is similar in all details to the throwing of ordinary crêpe, hence a detailed explanation will be unnecessary.

44. Crêpe-de-Chine.—Yarn employed in the manufacture of crêpe-de-Chine fabrics are referred to as crêpe-de-Chine twist. They are usually composed of two ends of raw silk doubled and twisted into one thread on a regular twister. In twisting, usually from 30 to 50 turns are inserted in the thread, but at times as high as 70 or 75 turns are desired for yarns that are to be employed for crêpe-de-Chine fabric. After the twisting operation, the yarns are processed in the same manner as previously described hard twists, and are given a treatment to set the twist prior to redrawing.

45. Chiffon—Another type of hard twisted thread is known as chiffon, which is made as follows: A single end of raw silk is twisted on a regular spinner or twister, from 30 or 35 turns to 80 or 90 turns being inserted in this operation, resulting in a very fine, hard twisted thread that is employed in the manufacture of chiffon fabrics.

HUMIDITY

46. Reference has been made, from time to time, to the maintenance of the proper humidity in the mill while winding, spinning, twisting, and reeling silks. This is very important, as silks work much better in an atmosphere of the correct humidity and temperature than in one that is dry and hot. With the correct amount of moisture in the air, the filaments of silk are pliable; but if the air is dry, the silk is wiry and brittle. Hence, in all throwing operations in which the thread is subjected to bending around guides and so on, it is of the utmost importance that the correct amount of moisture be maintained.

47. The problem of static electricity must also be considered. When silks are worked in a dry atmosphere, the friction of the silk in passing over the porcelain guides, induces static electricity. As dry silk is a very poor electrical conductor, the electricity produces many disturbances in the processes of yarn preparation. For example, ends that break, instead of falling on the skein in the winding operation, fly or spread away from the skein, come in contact with running ends, and cause them to break also. However, when the atmosphere in which the silk is worked contains a sufficient amount of moisture, the absorption of moisture by the silk increases its conductivity, allowing it to carry away the charge of static electricity, and therefore, work with less trouble.

48. The maintenance of the correct humidity in all departments of the mill is very necessary. In the winding department, for example, the atmosphere should contain a sufficient amount of moisture to prevent the skeins from drying out. The silk while on the machine is very loosely spread on a swift that in revolving produces a fanning action on the yarn. In the course of time, the silk loses its natural moisture, becomes somewhat brittle, and breaks with greater ease. Therefore, the atmosphere should be maintained at the proper percentage of relative humidity to give the silk the standard regain. This is correct when the silk contains 11 per cent. of

its absolute dry weight of moisture. With the atmosphere in this condition the winding operation may be performed at an increased speed; for, a yarn containing the proper amount of moisture has greater elasticity, or give, and when stretched will return more nearly to its original length than when in a dry state. The importance of this fact will be realized when it is remembered that in unwinding the silk from the skein the end often becomes entangled in some waste and holds the bobbin, preventing it from turning. When the silk is brittle, the end invariably breaks, thus increasing the number of stops and decreasing the production. However, when the silk contains the proper amount of moisture, its strength is sufficient to prevent the take-up bobbin from rotating until the operative removes the obstruction in the skein, whereupon the winding operation is continued.

49. To insure the standard regain of the silk by absorption of moisture from the air, both the humidity and the temperature must be properly regulated. Practically every department in the mill should be kept at a temperature ranging from 65° to 70° F., and the relative humidity should be kept somewhere between 60 and 70 per cent., and thus cause the silk to retain its normal moisture content more or less closely. If the relative humidity is 65 per cent. when the temperature is 70° F., a regain slightly over 11 per cent. is obtained. By increasing the relative humidity while the temperature remains constant, the regain will become greater. Thus should the relative humidity be 70 per cent. when the temperature is 70° F., the regain will be slightly over 12 per cent., whereas at a relative humidity of 75 per cent. a regain of 13 per cent. will be obtained. The correct relative humidity should be maintained in all departments so that, in producing ply yarns, threads that contain different amounts of moisture will not be combined. A ply thread with a somewhat corkscrew effect will then be produced; for, the difference in moisture content of the individual threads is likely to change slightly the length of the thread when the completed yarn returns to the normal regain. The relative humidity of the spinning and twisting

room should, therefore, be maintained at a uniform percentage. This may be difficult at times, for the great amount of heat generated by the hundreds of spindles, in addition to the heat from the electric motors, reduces the amount of moisture in the air. For this reason the humidification system should be of such capacity as to vaporize a sufficient amount of water to make up for the loss. The rapid evaporation of the moisture discharged from the humidifiers tends to absorb a part of the excessive heat generated by the machinery while in operation, consequently lowering the room temperature. The reduction in temperature, which can best be accomplished with a cooling system, results in a spinning room that is far more comfortable to work in than one with a higher temperature.

Reeling also should be performed in a room that is maintained at the proper relative humidity; for, in the preparation of the skeins, the silk is supported on a rapidly revolving reel fly that has a fanning effect on the silk. If the humidity is low the silk soon dries out, since it is so openly supported on the fly. It is even advisable that a higher relative humidity is maintained in the reeling department than in other departments of the mill so the thrown yarn will possess the correct amount of moisture. For certain reasons, reeling departments often maintain a relative humidity sufficient to cause the silk to regain 13 per cent. However, the maintenance of the correct humidity should not be neglected in other departments and then the deficiency made up in the reeling department, but the humidity should be carefully observed at all times while the silk is passing through the preceding operations.

TWIST TESTING

50. In throwing silk yarns a uniform twist should be maintained throughout the entire length of the thread; however, this is sometimes difficult, and so, for various reasons, the twist in the thread may vary. Throwsters therefore frequently test the thread from all machines that insert twist, in order to determine whether the correct twist is being inserted. The test is usually made on a type of twist tester that conforms

closely in construction to the type employed in the silk-testing house. However, throwing mills also use simpler machines that perform the same work as the more elaborate machines. One type of a simple twist counter designed only for counting the twist, is illustrated in Fig. 7. It is not equipped with a take-up register whereby the take-up of the thread due to twisting may be determined. The graduated bar *a* is supported at one end by the stand *b* and at the other by the stand *c* that carries the large gear *d*. This gear has a graduated dial by which the number of turns of twist may be read and is rotated by a small handle *e*. It turns on a central stud screwed into the stand *c* and meshes with a pinion *f* on a shaft that carries the thread clamp *g* at its opposite end. The clamp consists of two jaws separated by a narrow slit in which the thread is

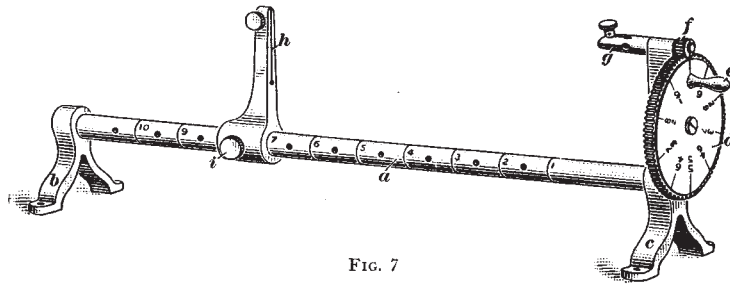


FIG. 7

placed. The thumbscrew is then tightened and the jaws are forced together, thus gripping the thread.

The movable thread clamp *h* may be set at any desired point on the rod *a* and locked in position by the screw *i*, thus accommodating different lengths of thread. It extends to the same height as the clamp *g* and has similar jaws.

51. In preparing for a test, the clamp *h*, Fig. 7, is moved to the left to the mark 10, and the screw *i* is tightened. The machine will then accommodate 10 inches of thread. The thread to be tested is carefully drawn from the bobbin, one end is inserted in the clamp *g*, and the thumbscrew is tightened. The thread is then gently drawn toward the thread clamp *h* and inserted in the slit. By pulling the thread with one hand, the operative can feel the tension with the other, and when

the slackness has been removed, the thumbscrew on the clamp *h* is tightened. The gear *d*, which has previously been set to zero, as shown, is now turned in the proper direction to cause the thread to untwist. If a left twist is in the thread, the gear should turn counter-clockwise; and if a right twist, the gear should be turned clockwise. One revolution of the gear will cause the pinion *f* to revolve 10 times; hence it is only necessary to remember the number of revolutions of the large gear in order to count the twist. For example, if 10 inches of thread is being tested and it is found that three complete turns of the gear, plus 5 divisions on the dial, are necessary to untwist the thread completely, it is known that the pinion makes 35 turns, which is also the number of turns of twist in 10 inches, and the twist is therefore $35 \div 10 = 3.5$ turns per inch. To determine when all the twist has been removed in making a test, the following procedure may be used: When the thread is untwisted, as nearly as can be judged by the eye, the operative inserts a pin or a needle between the plies of the thread at a point close to the clamp *h* and gradually moves it toward the clamp *g*, thus concentrating the twist near the rotating clamp. At the same time the handle is turned so as to remove this twist. When the pin can be freely moved from one clamp to the other, the operative may be certain that all the twist has been removed.

52. The twist inserted in a thread should always be tested after the twist change gears of a machine inserting twist have been altered, so as to discover an incorrect twist prior to starting the entire machine on the yarn. The reason for this caution is that sometimes a change gear is selected to produce 30 turns, but on trial is found to produce a lower twist, thus necessitating the substitution of a gear for a slightly higher twist. If tests are not made, therefore, there is danger of producing a yarn that does not possess the correct twist per inch. In some mills, one operative is employed in testing the twist daily. Several bobbins are selected at random from the machines and a number of tests are made from each bobbin. Subsequently the average twist is obtained and checked against

the required turns per inch. It should be remembered that, although the average turns per inch may be very close to the required twist, the thread may lack uniformity of twist; and so the twist qualities of a thread are usually judged by their uniformity, the closeness of the average twist to the required twist does not always indicate that the thread is good. A thread that varies only slightly above and below the required twist is considered better than a thread that has a great variation but exhibits the same average twist.

COMMISSION THROWING

VARIABLE CONDITIONS IN COMMISSION THROWING

53. A large percentage of the silk yarn used in the United States is not thrown by the owner of the raw silk, which generally, but not always, is the mill that manufactures silk fabrics. Instead, the raw silk is thrown into yarn by mills that operate on a commission basis, throwing the raw silk for a specified price per pound. The term *commission* as applied to silk throwing has much the same meaning as in ordinary business; that is it represents a percentage allowed to a factor or agent as compensation for the performance of certain duties. In silk throwing, however, the factor, or silk throwster, does not receive a percentage of the value of the silk thrown, but rather a monetary compensation based on the number of pounds of raw silk that are thrown. The silk throwster provides the building, machinery, equipment, and so on, and merely charges a certain price per pound for the use and operation of the machines, and for such other expenses as occur. Commission throwing mills, or public throwing mills, range in size from several thousands to hundreds of thousands of spindles. The smaller mills are usually equipped to specialize in one or several classes of yarn, such as hosiery tram, tram, or organzine and the lower twisted silks. The larger mills, however, are usually equipped to throw all kinds of yarn and prepare it for shipment in any form desired by the customer.

54. Because of changes in the type of fabric that is in fashion, corresponding changes are made in the yarns. Thus, should satins and taffetas be in vogue, the yarns to be thrown would include tram and organzine, probably in various twists. Should crêpe fabrics come into style, hard twisted yarns would be demanded by the manufacturers, and the throwster should be able to meet that demand. For this reason, the mill should be equipped with enough machinery to give the necessary flexibility to meet the demands of its customers. When the demand for a certain type of yarn is prolonged, it frequently happens that the throwster must purchase new or additional machinery in order to obtain the necessary orders to keep the mill in operation. In the production of low twisted yarns, a large number of winding and doubling frames must be provided, in comparison to the spinning and twisting machinery, since the length of time the thread is processed on the latter is about the same as on the former machines, more or less. In the manufacture of hard twisted yarn, the number of twisters must exceed the number of winders and doublers to a large extent, since the length of time the thread is processed on the twister is much greater in proportion than the time required for processing low twisted threads.

PROBLEMS OF THROWSTER IN MILL

55. Duties of Throwster.—It is practically impossible to outline all the various duties that must be performed by a silk throwster in order to operate a silk-throwing plant in the proper manner, as they depend so greatly on the size of the mill. For example, in a small mill having several thousand spindles the throwster is usually in immediate contact with all departments, and frequently works side by side with the employes when his routine office duties are completed. In the larger mills, having hundreds of thousands of spindles, the throwster communicates his orders to the various department heads, and merely walks through the mill for the sake of making an inspection. Often, however, in addition to supervising the operations, he spends a large amount of time in the mill.

The reason may be that certain silks run poorly, and to determine the cause and suggest remedies the throwster may operate the machine. In this way he may solve many problems, answer questions, and settle disputes.

56. The type of mill must be considered in conjunction with the throwster, for it is evident that an old mill containing a large amount of worn machinery cannot be operated as efficiently and as successfully as one that is well equipped. The condition of the equipment also has a great influence on the employes; for it is an accepted fact that operatives would rather work in a mill that is equipped with new machinery than in a mill in which old machinery is employed. Furthermore, the surroundings should be kept as clean and cheerful as possible, thus aiding in the upkeep of the morale of the employes. The throwster usually is not alone in performing his duties. If the mill is of sufficient size to warrant the expense, the throwster should employ an assistant; but he should use extreme caution in the selection of the proper man. It seems needless to say that the person should possess a thorough knowledge of throwing; otherwise, he cannot direct others to perform operations that he himself cannot perform. Such a situation often is the source of much dissatisfaction among employes, and reduces their willingness to work in an efficient manner.

57. Overseers and Employes.—Besides the assistant, the throwster should endeavor to obtain skilled persons to act as overseers, or foremen, to superintend the operations in the various departments. Usually, persons for these positions are selected from employes in the mill, who, through faithfulness in service or extraordinary ability may be considered worthy. Sometimes, in order to prevent jealousy among the employes, such positions are given to persons from another mill; in any case, however, the persons should be experienced and possess a thorough knowledge of the operations that must be directed. The throwster should also provide the overseers with assistants who are able to direct operations should the overseers be absent from the mill. Thus, in a well-organized

plant, the absence of an overseer will not cause any confusion among the employes, since the situation may be easily taken care of by the assistant.

The employes must also be selected with care, and the throwster should attempt to obtain only those who are skilled and best adapted to the tasks to which they are assigned. Skilled hands, however, should be kept under careful observation after they begin work, until it is known that their methods are in accord with the methods that have been established in the mill.

58. Skilled hands cannot always be obtained, and so it is necessary at times to employ new hands, or *learners*. Such operatives are usually assigned to an efficient employe in the department, where, under careful tutoring, instruction in the correct methods is gradually imparted to them. This plan, however, does not always work well; for, in mills in which operatives are paid on a piece-work basis, that is, at a certain price per pound, the operatives do not thoroughly assist the learners, but rather allow the new hands to advance with as little instruction as possible. This is to be expected; for when the operative's attention is diverted from the work to the instruction of the learner, there is a decrease in production, which causes a corresponding reduction in wages. In cases of this nature it is best to retain one operative on time work, with the sole duty of instructing all new hands in the rudiments of silk throwing, including such matters as holding the scissors, tying knots, beating out skeins, and so on. Some mills provide schools, or classes, and have special hours daily for the instruction of beginners.

With able overseers and skilful employes, the throwster should endeavor to operate the mill in such a manner that no friction will be created between the various departments. If disputes arise, all misunderstandings and grievances should be very carefully investigated, and only after careful consideration should a decision be given. With an efficient, dependable organization, the throwster may produce a thrown yarn of high quality and maintain such a standard. At times poor

silk will be encountered, which may increase the manufacturing difficulties and decrease the qualities of the yarn. When this occurs, the silk should be carefully worked, so that the final result will be a thrown yarn of the best possible quality that can be produced from the silk.

59. Throwster's Reports.—The throwster, as a rule, sends to the customer a statement of the running or workable qualities of the raw silk. This statement, or throwster's report, as it is generally called, contains information relative to the cleanness and evenness of the silk, and is important to the manufacturer. Defects and imperfections are discovered in the preliminary throwing operations, and so the throwster is in a position to report accurately the condition of the silk.

Variations exist in the form of the throwster's report, because throwster's manage their affairs in different ways; however, the most important matters to be treated in a report of this kind will be listed. The uniformity of color of the silk should be noted and the grading made according to evenness of shade; also, the color of the silk should be observed, and the grading made accordingly. The graduations of color are usually divided into three classes, namely, white, ivory, and cream. The skeins should next be considered, to determine whether they have hard or soft gums or whether they are altogether free from gums. At the same time the lacings may be examined and a report made as to whether the skeins have been prepared in accordance with standard specifications. Defects in cleanness may next be considered, and these are listed in six grades, ranging from very good to very poor. Similarly, defects in evenness and the strength of the thread are listed in the same manner, six divisions being made in each case. The working qualities of the thread are found from an actual running test in which the number of breaks occurring in a given time are counted and marked on the report. Similarly, breaks occurring in first-time spinning are also recorded.

60. In the winding and spinning tests it is customary to observe and count the number of breaks in the thread in at least 300,000 yards of silk, and the results are employed as a

basis for the report. The length of time required for the test will, of course, depend on the number of spindles in operation; however, a sufficient number of spindles are employed to complete the test in 3 or 4 hours.

In the production of tram, particular attention is given to the number of breaks occurring in winding and also in doubling the silk. The results obtained are employed as a basis for the preparation of the report on the working qualities of the thread. When throwing organzine, winding and especially first-time spinning are carefully observed, and the report is based on the results obtained in these operations. Should the silk run poorly and make a considerable amount of waste, the throwster states this in the report and often advises whether the silk can be profitably made into the thread that was ordered. A raw silk that was originally purchased to be made into tram, sometimes may be found to have sufficient strength to be made into organzine, and vice versa; hence, on the recommendation of the throwster, the manufacturer sometimes orders a different thread to be made. Therefore, an accurate throwster's report is valuable to the customer.

61. It may be added that throwsters' reports are sometimes very irregular, because the nature of the raw silk varies considerably. For example, silks that are thrown from the same lot and bearing similar chop tickets or brands, may often work differently; part of the lot may run very well while the remainder of the same lot may run poorly. The part of the lot that runs well may be graded higher than the part that runs poorly. The part of the lot that runs poorly, of course, should be graded accordingly; however, the throwster usually attempts to parallel his report with the grade that was found on the silk when it was received at the mill, and thus avoid questioning. It is evident that a report that grades the silk lower may be questioned by the customer, who may refer it to the raw-silk importer. Nevertheless, the throwster should remember that his report is not to grade the silk, but only to give a statement of the working qualities of the thread, thus indicating the quality of yarn that may be expected to be produced.

62. Throwster's Clearances.—After a lot of raw silk has been thrown, the actual weight of the thrown silk is found by weighing, and the raw silk and the thrown silk weights are compared. The difference of weights thus found is known as the clearance. Its amount depends on the loss of weight of material due to waste, and the increase of weights of the silk due to the absorption of the soaking ingredients. Thus, the throwster may state that a certain lot of silk had a good clearance, indicating that the increased weight, due to soaking, balanced or was greater than the loss due to the waste made while processing the thread.

63. The variation in the clearances of lots of silk may be easily explained by means of an example. Suppose that a certain lot of silk is received at the throwing mill, and, after passing through the operations prior to soaking, it is found that, according to the quality of silk, a light soaking is advisable. The term light soaking indicates that less soap and oil are employed than is usually the case. A heavy soaking, on the other hand, indicates that a greater amount of soap and oil is employed in order to increase the amount of soap and oil absorbed by the silk. In the example, however, a light soaking is considered advisable; so the silk is properly prepared, soaked the required time, and whizzed, after which it is ready for the winding operation. Contrary to expectations, the silk runs poorly, with the result that the percentage of waste is increased. After the silk is thrown and the weight is determined, it may be found that instead of completing the lot, or clearing with a gain, a slight loss is present. This result would invariably be questioned by the customer. In this case, while the increase in waste was not an appreciable amount, it was very quickly recognized because of the light soaking. If a heavy soaking had been employed, a better clearance would have resulted; however, the amount of true silk fiber returned in both cases would have been the same, provided the amount of waste produced was identical.

64. The subject of clearances may be further explained by the following specific example: A customer ships to the

throwster two lots of silk to be thrown into a thread according to instructions given by the customer. It is found on receipt of the silk at the mill that the net weight of the silk is just 100 pounds. During the soaking operation the silk gains $3\frac{1}{2}$ pounds, so that the total weight of the fiber, soap, and oil will be $103\frac{1}{2}$ pounds. The waste made during the throwing operations is gathered and weighed and is found to amount to $2\frac{1}{4}$ pounds. The net weight of silk returned to the customer, therefore, is $103\frac{1}{2} - 2\frac{1}{4} = 101\frac{1}{4}$ pounds. This is $1\frac{1}{4}$ pounds greater than the net weight of silk received from the customer, and represents a gain of $1\frac{1}{4}$ per cent. This gain would be considered sufficient by some customers, and would be satisfactory if the silk is thrown for use in an affiliated weaving mill; however, the gain may be considered too low if the silk is prepared for a thrown-silk dealer.

The second lot sent to the throwster is given the same treatment as the first, using the same ingredients in the soaking mixture and the same period of soaking. But it gains only 2 pounds, or $1\frac{1}{2}$ pounds less than the first lot, so that the weight of fiber, oil, and soap is 102 pounds. The throwing waste weighs $2\frac{3}{4}$ pounds. Hence, the weight of fiber, soap, and oil returned to the customer is $102 - 2\frac{3}{4} = 99\frac{1}{4}$ pounds, or less than the weight received from him. This loss of $\frac{3}{4}$ per cent. is an example of poor clearance. Comparison shows that the second lot has only $\frac{1}{2}$ per cent. more waste than the first, while the final weights differ by 2 per cent. The difference is due to the different natures of the thread, the second lot absorbing less than the first lot in the soaking operation.

65. Greater differences than those given in the preceding article may occur in the clearances in various lots when the atmosphere of the mill is very changeable, as in the change of seasons. For example, if the day is very humid and the operatives open the windows of the mill, and a sudden change in the weather arises, so that the temperature drops and the atmosphere is clear, it may be necessary to heat the mill to maintain a comfortable temperature. When this is done the silk loses a part of the moisture it contained and decreases in

weight, which reduces the returned weight of the silk and assists in increasing the percentage of loss. Moreover, the percentage of difference between the lots will also increase. In view of these facts, the atmosphere of the mill should be kept at the proper temperature in order that the silk will retain the correct amount of moisture. Maintaining the proper humidity is especially important in rooms in which a large surface of silk is exposed, as in winding and reeling. In both of these operations, large surfaces of silk are exposed, and the rapid revolution of the swifts or the reel flies has a fanning action on the thread and tends to dry the silk.

66. Great variations in the results may generally be traced to the soaking room. Mills usually employ a number of what may be termed standard solutions and vary only slightly from these. When the proportions of the ingredients have been found to give a good mixture and the proper absorption of oil, succeeding solutions should be prepared in exactly the same manner, using identical amounts of soap, oil, and water. Moreover, the temperature of the solution should be carefully tested and the silk should be entered at the correct temperature. When silks are prepared for soaking, and soaked in accordance with the methods given in previous Sections, the results that are obtained should be approximately uniform.

THROWING-MILL WASTE

67. Percentages of Waste.—In the various operations of silk throwing, some waste is always made, regardless of the quality of the silk being run or the skill of the attendant in charge of the machine. Waste is produced in every operation, as in winding, spinning, doubling, twisting, reeling, and redrawing. In addition to the waste produced in the various departments, a certain amount is lost in cleaning the bobbins, a small quantity falls to the floor and it is swept away, while a variable amount is carried away by the employes. This latter practice often originates when excessive amounts of waste are made and the operative is reprimanded for carelessness.

Rather than disclose the amount of waste made, the operative carries the waste away and disposes of it at an opportune time. Such a practice should absolutely be discouraged, for the fiber is valuable, even though it is waste.

It is very difficult to give the percentages of waste made in a mill, as so many varying conditions contribute to it. However, the waste made in throwing silks efficiently varies from $\frac{1}{2}$ to 6 per cent., depending on the character of the silk and other factors. Probably a percentage of waste between $1\frac{1}{2}$ and $2\frac{1}{2}$ per cent. represents good average conditions.

68. When producing organzine, the variation in the percentage of waste is quite marked. When throwing organzine from a high-grade silk, and with efficient employes, the percentage of waste usually ranges from $1\frac{1}{2}$ to 2 per cent. With silk of poor quality the waste often ranges from 3 to 5 per cent. The amount of waste produced when throwing tram is dependent, of course, on the same conditions. However, since tram consists of a greater number of singles, the amount of waste will be proportional. The amounts of waste from trams consisting of from 2 to 10 threads may be said to range from $1\frac{1}{4}$ to 4 per cent. With good silk the loss may range from $1\frac{1}{4}$ to 2 per cent. Crêpe yarns, or hard twisted trams, have about the same amounts of waste in throwing as regular tram; but when bad bobbins are employed, from which the heads are frequently pushed, the percentage of waste is considerably increased.

69. Relation Between Waste and Soaking Ingredients.

Since the commission throwster supplies the soaps and oils used in throwing, without a direct charge to the manufacturer, but calculates the price in the throwing cost per pound, it might naturally be supposed that he would not use any greater quantities of these materials than would be required to throw the silk in a satisfactory manner. Often, however, such is not the case, as the use of excessive amounts of soap and oil offers an easy means of covering up careless and inefficient throwing and the production of an excessive amount of waste. The waste made by a commission throwster is usually

retained by him and sold from time to time to waste-silk dealers. The income thus derived is of considerable importance in large establishments. It thus happens that there is no great incentive for a custom throwster to try to throw silk with as little waste as possible; moreover, poor management, run-down machinery, careless operatives, and other factors often result in the production of an amount of waste far in excess of a reasonable percentage. If the throwster should return to his customer an amount of thrown silk much less in weight than the amount of raw silk shipped to him, the owner of the silk would immediately enter a complaint. To cover up the loss due to waste, therefore, silks are sometimes very heavily loaded with soap and oil in the soaking operation.

70. Because of the practice just mentioned, it is becoming more and more the custom to throw silk under a contract carrying a guarantee that the boil-off of the silk will not exceed a certain percentage. This, of course, prevents the throwster from adding ingredients to the soaking solution to increase the weight of the thrown yarn and thus cover any excessive waste that was made. To obtain the data to check up the throwster in this matter, samples must be officially drawn from the bales of raw and thrown silk at the conditioning house. These two samples of raw silk and thrown silk are boiled off and the percentage of boil-off is obtained. Suppose, for example, that the boil-off of the raw silk is 19 per cent. and the boil-off of the thrown silk is 23 per cent. A difference of 4 per cent. exists between the samples, which represents the soap and oil on the silk, absorbed from the soaking bath.

71. The approximate amount of soap and oil employed in the soaking solution may be calculated roughly when the difference of the percentage of boil-off is known. The amount of soap and oil taken up by the silk in the soaking process averages about 60 per cent. Suppose, for example, that 100 pounds of silk absorb 4 pounds of soap and oil in the soaking bath. The 4 pounds then represents 60 per cent. of the soap and oil in the bath. If x represents the total weight of soap

and oil in the bath, or 100 per cent., it may be found by the proportion

$$x:100=4:60$$

Therefore, $x = \frac{4 \times 100}{60} = 6\frac{2}{3}$ pounds, approximately.

In other words, the soaking bath contains roughly about $6\frac{2}{3}$ pounds of soap and oil.

72. Reducing Waste in Mill.—All throwsters, regardless of the arrangement of the plant or the class of operatives employed, are confronted with the problem of wastage of silk in the throwing process. It is a serious problem for the loss of a high percentage of silk may cause the throwster to be considered the manager of an inefficient plant; or if a flagrant loss is sustained, the owner of the silk may suspect the throwster of dishonesty. A certain amount of waste will always be produced in a silk throwing mill, since it is necessary to tie up ends, pull back the silk from the bobbins to find broken ends, and so on. Many times the traverse of the machine is improperly set, causing the silk to be wound unevenly on the bobbins. If this defect is extreme, the silk is frequently pulled from the bobbin until it is assumed that it will run properly. Instead of being pulled from the bobbin and wasted, however, the silk should be rewound on another bobbin, care being taken to adjust the traverse carefully so that the same defect will not be duplicated.

73. Increases in the production of waste may also be caused by the lack of a sufficient number of employes to operate the machines successfully. It sometimes happens that operatives are absent, so that one operative must tend two machines. When this happens, it is impossible for the operative to give the required attention to the work, with the result that many overfilled bobbins are produced and the traverse of the bobbins is not watched carefully. Because of this lack of attention, defective work is produced. When unskilled operatives are employed the percentage of waste sometimes increases; for inexperienced employes will produce more waste

in finding ends, tying ends, and, in fact, in any other operation in which waste is likely to be produced.

74. The waste that is produced in the mill is usually graded into two classes, namely, sorted and unsorted. Sorted waste may be considered as waste that has been gathered from the different departments and kept separated at all times. Unsorted waste is merely waste that is gathered and prepared for shipment without any attempt at separation. Probably the simplest method of gathering the waste is to provide a waste bag at one end of each machine. At the end of the day the waste may be collected and placed in a large bag. The waste from the winding department may be termed winder's waste; that from the spinning department, spinner's waste; and that from the reeling department, reeler's waste. If these are kept separate, the waste that is prepared for sale is in a better condition and consequently usually commands a higher price per pound.

75. Frequently, in the larger mills, the amount of waste produced by each department is weighed daily and the weight is marked on a large sheet, that is posted in a conspicuous place. In addition to the waste made for the day, the amount made on previous days is also left on record, in order that the operatives may easily see how their department ranks with other departments performing a similar kind of work. Having the daily weights constantly in view tends to act as an incentive and cause the operatives to try to reduce their average. It is evident that with hearty cooperation of all departments the amount of waste made may be reduced.

As a further aid in the reduction of waste, an experienced person, designated as a *fixer*, is employed. The duties of the *fixer* consist in straightening tangled skeins, finding the end of silk on a bobbin when the end is hidden, and so on. As the silk is processed, any difficulty that may arise relative to the running of the silk is referred to the *fixer*. Furthermore, learners, or inefficient employes are referred to the *fixer*, who coaches them on the better performance of their particular duties.

CALCULATING THROWING PRICE AND WASTE

76. Old Method.—When throwing silks under what may be termed the old method, the throwster agrees to throw a certain lot of silk into the desired thread at a given price per pound, the weight being almost invariably based on the weight of the raw silk shipped to the throwster. The calculation of the throwing price per pound is performed in many ways, since each mill adopts a system that is thought to be best suited to its needs. In some mills elaborate cost-finding systems are in use, and since all costs are accurately known, it is easy to find the amount to be charged, in order to throw a pound of silk profitably. The throwing price per pound is sometimes obtained as follows: The production of each department is found, and then the labor charge is determined. From these, the departmental charge per pound for throwing is found. After the charges for all departments have been determined, a suitable overhead charge is added, thus furnishing the price per pound to be charged for throwing silk.

77. When an agreement relative to the throwing of silk is signed, no mention is made of the amount of waste that will be made by the throwster in processing the silk. The manufacturer in this case assumes the risk of the throwster's inefficiency. Although the amount of waste that is expected to be made is not mentioned, it is usually assumed that approximately 2 to 2½ per cent. will cover this item. This waste is counter-balanced by the soap and oil used in the soaking bath; therefore, the manufacturer, or owner of the silk, is ignorant of the amount of waste actually made. Should the throwster be dishonest, it is possible that several skeins, or even several pounds, according to the size of the lot, may be removed from the shipment and sold later to a dealer in odd lots of silk. By careful soaking with a sufficient amount of soap in the bath, the loss of silk may be successfully covered. Such a loss, however, may be discovered by means of conditioning and boil-off tests, which will be described later.

78. One Hundred Per Cent. Method.—A method by which the waste made in throwing and the throwing price per pound may easily be calculated is known as the one hundred per cent. method. When silks are thrown on this basis, the amount of waste made by the throwster may be accurately determined, within certain limits; moreover, the loss due to waste made in throwing is transferred to the throwster, the latter guaranteeing that the silk, or its equivalent value, will be returned to the owner. When throwing silk by the one hundred per cent. method, the following procedure is necessary if it is desired to calculate the amount of waste made in throwing: The raw silk is sent to the testing house, where the lot is officially sampled. From the samples that are drawn, a moisture test is made on the raw silk to determine the conditioned weight of the entire lot. Also, a raw boil-off test is made to find the amount of gum, and consequently the true fiber weight, of the lot. After the raw silk has been thrown into the desired yarn, the latter is returned to the testing house, where samples are again drawn from the lot to determine the thrown conditioned weight. A thrown boil-off test is made to determine the amount of soap and oil absorbed by the fiber during the throwing process, and from this, together with the thrown conditioned weight, the conditioned fiber weight of the thrown silk is found.

79. From the foregoing tests, the data obtained, which are essential in the solution of the problem of waste, are as follows: The raw-silk conditioned weight, the raw-silk boil-off, the thrown-silk conditioned weight, and the thrown-silk boil-off. The term conditioned weight of either the raw silk or the thrown silk, indicates that the silk has been placed in an oven and subjected to a current of hot air, at a temperature somewhat above the boiling point of water, for a length of time sufficient to vaporize all the moisture in the fiber. To the dry fiber that remains, 11 per cent. of its absolute dry weight is added, which gives the weight of the silk plus the normal amount of moisture it should contain, or the conditioned weight. The expression raw-silk conditioned weight indicates

that the raw silk has been conditioned as described, while thrown-silk conditioned weight shows that the silk was thrown into a yarn and then conditioned. The term boil-off indicates that the silk has been placed in a soap and water bath and boiled for a prescribed length of time so as to fully remove, or strip, the natural gum that encases the fiber and leave only the pure, or true, silk fiber. When boiling off thrown silks, the soap and oil absorbed during soaking are also removed, in addition to the natural gum on the fiber. The expression conditioned fiber weight, or true fiber weight, indicates that the percentage of gum lost in boiling off has been subtracted from the conditioned weight of the silk, which leaves the conditioned weight of the pure fiber alone.

80. After obtaining the data referred to in the preceding article, the percentage of waste made in throwing may be calculated by the following rule:

Rule.—To find the percentage of waste made in throwing, obtain the conditioned fiber weight, or true fiber weight, of the raw silk and of the thrown silk, in pounds; then take their difference which represents the conditioned fiber weight of waste, and divide it by the conditioned fiber weight of the raw silk.

The simplest way of showing the application of the rule and demonstrating the method of calculating the waste by the one hundred per cent. method is by solving a problem. Suppose, for example, that the conditioned weight of a bale of raw silk, as determined at the testing house, is 135.45 pounds. From this weight a boil-off sample weighing .40 pound is deducted, so that the weight of silk received by the throwster is 135.05 pounds. The boil-off sample is subjected to the boil-off test, which discloses a raw-silk boil-off of 18.30 per cent. After the lot has been thrown, the silk is returned to the testing house and its conditioned weight is found to be 139.38 pounds, which is the original weight minus the throwing waste, but plus the soap and oil. Next, the skeins of thrown silk are removed for the boil-off test and are subjected to that test. Assume that the thrown-silk boil-off is found to be 23.18 per cent. The raw-silk boil-off, on the basis of 135.05 pounds, is

$135.05 \times .1830 = 24.714$ pounds, and the conditioned weight of the true fiber of the raw silk is $135.05 - 24.714 = 110.336$ pounds. Similarly, for the thrown silk, the boil-off is $139.38 \times .2318 = 32.308$ pounds, and the weight of the true fiber of the thrown silk is $139.38 - 32.308 = 107.072$ pounds. Then, the amount of waste produced is $110.336 - 107.072 = 3.264$ pounds. As this waste was produced from 110.336 pounds of true, or clean, fiber sent to the throwster, the percentage of waste is $3.264 \div 110.336 = .02958$, or 2.958 per cent.

81. When throwing silks by the one hundred per cent. method, the throwing price per pound is found in the following manner: The throwster estimates the amount of waste that is expected to be made when throwing the thread into a yarn from raw silk furnished by a manufacturer. The accuracy of this estimate will depend on the throwster's knowledge of the various silks that are processed in the mill and also on his past experience. As, by the one hundred per cent. method, the throwster pays for the waste, a sufficient allowance must be added to the throwing cost per pound to cover the cost of the waste that will be made. The throwing cost, or base price for throwing is the actual cost plus a reasonable profit. In the one hundred per cent. method a percentage equal to the expected amount of waste is added to the throwing cost to reimburse the throwster for the waste made in throwing and for which the throwster pays.

82. Assume that the throwster estimates $2\frac{1}{2}$ per cent. as the amount expected to be wasted. If, after throwing the silk, it is found that exactly that amount of silk was lost, the throwster shall pay for the $2\frac{1}{2}$ per cent. of waste at the price of thrown silk. The amount due to the throwster would be equivalent to the amount received under the old method, since the percentage added to the throwing cost per pound is equal to the value of the wasted silk. However, if the throwster throws the silk with less waste than that stipulated, as, for example, 1 per cent., it will be necessary for him to pay for only the 1 per cent. of waste made, and his compensation will be greater than in the first case. This, of course, is only fair;

for, if the throwster employs skilled and efficient help, so that the silk is thrown with a low percentage of waste, he is entitled to the increased return. On the contrary, if the throwster produces a greater amount of waste than the expected $2\frac{1}{2}$ per cent., he will be required to reimburse the owner of the silk for all that is wasted. To sum up, therefore, when silks are carefully thrown and a small amount of waste is produced, the throwster receives a greater compensation than when the silks are thrown with a large amount of waste. Obviously, the amount of waste expected will not always be correctly estimated; however, after silks are thrown on this basis for some time, the experience acquired may be used in estimating the percentage of waste to be allowed.

83. When calculating the throwing price per pound by the one hundred per cent. method, the following rule may be employed:

Rule.—*To find the throwing price per pound by the one hundred per cent. method, add together the raw-silk price per pound (conditioned weight), and the throwing price per pound (conditioned weight); divide the sum by 1.00 minus the expected percentage of waste and from the quotient subtract the raw-silk price per pound (conditioned weight).*

The application of the preceding rule may be illustrated by the solution of an actual example. Suppose that a throwster receives 135.05 pounds of raw silk valued at \$6.50 per pound, conditioned weight. The chop ticket on the raw silk is of a well-known brand and, as a rule, runs well while in the throwing mill. The silk is ordered thrown into a 2-thread organzine with a 16/14 twist. The throwster, knowing that silks of the kind indicated by the chop ticket can be thrown into organzine with a minimum of waste, estimates 2 per cent. of waste. If the raw silk is valued at \$6.50 per pound and the throwing cost, old method, is \$1.50, the cost of the thrown silk per pound will be \$8.00. The first steps will be to add to the cost of the thrown silk a sufficient percentage to cover the waste made. The throwster in this case estimated 2 per cent.; therefore, 2 per cent. of every pound is expected to be wasted, or 98 per

cent. will be the thrown silk returned. If \$8.00 represents 98 per cent., then $\$8.00 \div .98 = \8.163 is the price per pound of thrown silk by the one hundred per cent. method. By subtracting the raw silk price from the thrown silk price, $\$8.163 - \$6.50 = \$1.663$ is the price per pound charged for throwing.

Suppose that, in throwing the lot of silk, the waste made by the throwster is found, as given in the example in Art. 80, to be 2.958 per cent., or $135.05 \times .02958 = 3.99$ pounds of raw silk. The throwster, in this case, pays for the additional waste made and the bill may be arranged in the following manner:

135.05 pounds thrown @ \$1.66.....			\$224	18
Less 3.99 pounds waste, raw silk @ \$6.50.....	\$25	93		
Less 3.99 pounds @ \$1.66 for throwing.....	6	62		
Subtract cost of waste.....			32	55
Amount due the throwster.....			\$191	63

NOTE—Instead of listing 3.99 pounds of raw silk and the throwing cost for the same number of pounds, the thrown silk price of \$8.16 may be used.

If, instead of making 2.958 per cent. of waste the silk is thrown with only 1.93 per cent. of waste, the throwster will receive a higher compensation. The bill in this case would be as follows:

135.05 pounds thrown @ \$1.66.....			\$224	18
Less 1.93 pounds thrown waste @ \$8.16.....			15	75
Amount due the throwster.....			\$208	43

COMMISSION THROWING RULES

84. To assist in maintaining a certain degree of uniformity in connection with the commission throwing of silk, the Commission Throwsters Division of the Silk Association of America has adopted a set of rules and regulations. The rules have been approved by the Board of Managers of The Silk Association of America. While the rules are a great aid in clarifying

transactions between the throwster and the customer, they are especially useful in case controversies arise in regard to the silk and so they are given here in full.

RULES AND REGULATIONS GOVERNING COMMISSION
THROWING OF SILK

ARTICLE I

General

SECTION 1.—These rules to govern the throwing of silk on commission are promulgated to provide a standard for transactions in this branch of the American silk industry. It is understood that nothing herein shall be construed as waiving the right in individual transactions to make any special or contrary agreement, but that the rules shall govern in cases where they are specified, or where no special or specific contract exists.

SECTION 2.—Raw silk is the single thread as reeled from the cocoons. It is understood to be a continuous thread from beginning to end of the skein and that the skeins in general conform in weight, circumference, and lacing to specification for the American Standard Skein, as issued and approved by The Silk Association of America.

SECTION 3.—All official tests are to be those performed in the Testing Houses of the United States Testing Company, Inc. The expression "Testing House" shall be construed to mean the Testing Houses of the United States Testing Company, Inc.

SECTION 4.—Conditioned weight is the absolute dry weight plus 11%, the standard allowance for moisture.

SECTION 5.—Clean fiber as used in the regulations is the difference between 100% and the boil-off percentage as determined by the standard boil-off test.

ARTICLE II

Transportation, Insurance, etc.

SECTION 1.—The throwster shall pay the transportation charges on receipt of the raw silk and the owner shall pay the transportation charges on the return of the thrown silk, whether such delivery is made to the Testing House, dyer, owner's mill or authorized representative.

SECTION 2.—The owner shall be liable for both the raw and thrown silk while in transit and shall provide at his own expense for such insurance as he may desire. It is understood that the valuation placed on silk in transit shall be the same as the amount of insurance, and the increased transportation charges resulting from such valuation shall be paid for by the owner.

SECTION 3.—The throwster shall fully cover all goods by fire insurance and shall be liable for loss or damage due to negligence or fire.

ARTICLE III

Price, Terms, etc.

SECTION 1.—The price for throwing is net cash. The throwster is entitled to payment on account in proportion to his deliveries and on completion of work when held for orders.

SECTION 2.—In case the contract states an agreed allowance for waste, the adjustment shall be reciprocal, that is, the throwster will pay the owner for excess waste or the owner will pay the throwster for making less than allowable waste.

SECTION 3.—Silk not called for within 30 days after tender of delivery is at the risk of the owner.

ARTICLE IV

Raw Silk

SECTION 1.—The owner shall furnish the throwster a description of the raw silk, giving the origin and market classification, and shall supply the throwster without cost duplicate certificates of all tests made on the raw silk, which could be used in regulating the throwing operations or calculating the clearances. The owner is responsible to the throwster for a proper delivery of the quality of the raw silk agreed upon.

SECTION 2.—*Weight.*—The invoice weight of the raw silk shall be the basis for calculating the throwster's invoice and clearance and said invoice weight shall be furnished to the throwster when shipping in the silk.

ARTICLE V

Clearance

SECTION 1.—The loss in throwing is the difference between clean fiber conditioned weight sent, and the clean fiber conditioned weight returned. The percentage waste shall be calculated by multiplying the loss by 100 and dividing by the clean fiber sent.

SECTION 2.—*Determination of Loss.*—In order to establish a claim against a throwster the owner should have two conditioning tests and one boil-off test made on each five bales of the lot of raw silk, the remaining bales net weighed and the conditioned weight of the lot certified by the United States Testing Company, Inc., furnishing copies of the certificates to the throwster without charge; provided, that by mutual agreement, the net weighings may be waived and the conditioned weight of the lot calculated on the invoice weight of the raw silk.

In order to complete the basis for establishing a claim, the thrown silk should be returned to the United States Testing Company, Inc., for official sampling. At least two conditioning tests and two boil-off tests should be made on each five bales or cases, the net weight of the remaining bales or cases determined and the conditioned weight certified; provided, the bundles or packages so sent for testing represent the average of the lot.

Where two or more tests are made on a lot of the raw or thrown silk, the average shall apply, provided each test represents an equal portion of the lot.

The owner and throwster shall receive certificates of the thrown silk test, the cost of such tests to be paid by the owner.

SECTION 3.—Boil-off test, in order to be acceptable as part of the basis of claims must be made on at least 10% of a shipment, excepting in the case of silks delivered in skeins, when the test must be made on at least 20% of a shipment, but in either case not less than one complete bale, case or package is to be submitted.

SECTION 4.—Where the price of throwing is based on an agreed percentage of waste the throwster shall pay the owner at the invoice price of the raw silk for any excess waste which he makes and the owner shall pay the throwster at this price if the loss is less than the agreed allowance for waste.

Where a maximum waste is stipulated, it will be understood that the throwster is chargeable for the excess at the invoice price of the raw silk.

No claims for excess waste of any kind must be allowed by the throwster or made by the owner excepting those based on Testing House tests made on official samples.

SECTION 5.—The throwster has the right to have check tests made on his own account if he so desires, in which case, the average of the tests will govern adjustments, if any, the cost of such test to be paid for by the throwster.

SECTION 6.—As the percentage of waste permissible necessarily varies with the nature and quality of the silk and is a matter of advance agreement between the throwster and his customer, no claim shall hold in the absence of such advance agreement except in the event of flagrant loss, when the matter shall be submitted to arbitration.

ARTICLE VI

Thrown Silk

SECTION 1.—*Boil-off*.—Only such ingredients shall be used in soaking raw silk as will boil off easily in the ordinary processes of dyeing and only such amounts as shall be necessary for the proper throwing of the silk.

SECTION 2.—*Skeins*.—The thrown silk skeins shall be Grant reeled to the specified length within the limits of variation authorized by the regulations.

SECTION 3.—In the absence of any stated length of skeins the following will apply:

2-thread organzine.....	20,000 yards
3-thread organzine.....	10,000 yards
2-thread tram.....	15,000 yards
3-thread tram.....	10,000 yards
4-thread tram.....	7,500 yards
5-thread tram.....	5,000 yards

The above lengths will apply on thrown silk made from 13/15 and / or 14/16 denier, European, Japan, Canton and China Filatures silks only. On all other grades of thrown silk delivered in skeins, the length is optional with the throwster unless stipulated in contract.

SECTION 4.—An average variation of 5% shall be allowed from the number of yards per skein, as ordered for thrown silk. The minimum number of test skeins is twenty. The procedure is similar to that for sizing silk, Conditioning House rules to apply.

SECTION 5.—No claims for wrong yardage shall be made by owner or allowed by throwster unless based on Testing House tests.

SECTION 6.—The throwster has the right to have check tests made on his own account if he so desires, in which case, the average yardage of the tests will govern adjustments, if any, the throwster to pay the cost of such tests.

SECTION 7.—*Twist*.—In the absence of any twist stipulations, the following turns per inch shall govern thrown silks made from 13/15 and / or 14/16 denier raw silk:

2-thread organzine 16 first-time, 14 second-time.
 3-thread organzine 16 first-time, 12 second-time.
 Tram 2½ to 3.
 2-thread Georgette crêpe 65 to 70.
 Ordinary crêpes 60 to 65.

In the case of all other classes of thrown silk, the twist must be stipulated in contract.

SECTION 8.—The variation of the average twist in turns per inch over or below the average of twist stipulated in contract must not exceed 20% on twist under five turns per inch and 10% on twist over five turns per inch.

At least 10% of a shipment must be sent to the Testing House for twist test, but not less than one complete bale, case or package to permit of proper official sampling

No claims for wrong twist of any kind shall be allowed by the throwster excepting those based on Testing House Tests.

SECTION 9.—The throwster has the right to have check tests made on his own account, if he so desires, in which case the average twist of the test will govern adjustments, if any, the cost of such test to be paid for by the throwster.

ARTICLE VII

Arbitration

SECTION 1.—All disputes, on request of either party, must be submitted to arbitration before a Committee composed of three disinterested persons, one to be nominated by each party, and the two so nominated to select a third. The arbitration shall be governed by the laws of the State of New York in conjunction with the arbitration procedure of The Silk Association of America and the arbitrators shall be approved by the Arbitration Committee of said Association.

SILK THROWING

(PART 10)

EXAMINATION QUESTIONS

Notice to Students.—*Study the Instruction Paper thoroughly before you attempt to answer these questions. Read each question carefully and be sure you understand it; then write the best answer you can. When your answers are completed, examine them closely and correct all the errors you can find; then mail your work to us.*

- (1) What is meant by commission throwing?
- (2) (a) Why are silks less affected by static electricity when the air in which they are worked contains a sufficient amount of moisture? (b) State the proper temperature and percentage of relative humidity that should be maintained in the mill.
- (3) What is the object of bundling?
- (4) State the number of threads employed, also the number of turns of twist and the direction in which the threads are twisted when producing grenadine twist.
- (5) What defects are generally found in thrown silks and how are they removed if only few in number?
- (6) (a) What two operations are closely watched by the throwster when preparing a report on the working qualities of organzine? (b) Explain why a throwster's report is of value to the customer.

(7) Suppose 65 turns of twist are desired in a yarn and a machine which may be designated as A, produces a thread with an average twist of 64 turns, while the thread from a machine, called B, averages exactly 65 turns. However, the twist from machine A varies from 62 to 66 turns while that from machine B ranges from 58 to 72 turns. Which machine would be considered to produce the better thread and why?

(8) State the object of dramming.

(9) Explain how silk, when wound on bobbins, is packed before shipping to the customer.

(10) Give the usual number of skeins per roll and the number of rolls per bundle that are grouped together when preparing a bundle of organzine.

(11) What are the objections to steaming silk when wound on wooden quills?

(12) Describe the operation of the power bundling press illustrated in Fig. 2.

(13) Explain how to insert a thread in the clamps of the twist tester illustrated in Fig. 7 when preparing for a twist test.

(14) Describe two ways in which cops are packed for shipment.

(15) Give several reasons why it is not considered good practice to insert all the twist in a crêpe thread in one twisting operation.

(16) What is floss silk?

(17) Name the four points that are essential in the calculation of waste made in throwing.

(18) Describe how organzine is thrown when a third-time spinning operation is employed.

(19) If a bundle of 4-thread tram contains 150 skeins of 10,000 yards each and weighs 24 pounds, what is the average drammage?
Ans. 4.096 drams.

(20) (a) The conditioned weight of a bale of raw silk as received by a throwster is 132 pounds, the boil-off sample having been removed at the testing house. If the raw boil-off was 19.2 per cent. and the thrown boil-off was 23.75 per cent., while the conditioned weight of the thrown silk was 135.5 pounds, what is the percentage of waste made? (b) If the raw silk is valued at \$6.00 per pound and the throwing cost by the old method is \$1.80 per pound, what will be the throwing price per pound by the one-hundred per cent. method if $2\frac{1}{2}$ per cent. of waste is expected?

Ans. $\begin{cases} (a) 3.128 \text{ per cent.} \\ (b) \$2.00 \text{ per lb.} \end{cases}$

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