

*The Project Method of Teaching*

# SILK THROWING

PART 1

By  
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INSTRUCTION PAPER  
WITH EXAMINATION QUESTIONS  
PREPARED ESPECIALLY FOR  
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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 1)

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## OPENING, SOAKING, AND DRYING

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### INTRODUCTION

**1. Object of Silk Throwing.**—Silk, in common with all fibers employed for textile purposes, must be subjected to certain preliminary yarn-preparation processes before a woven or knitted fabric can be produced, or prior to the use of the material as sewing threads, or for the manufacture of braids, and so on. The various processes employed for the production of cotton, woolen, worsted, linen, and other yarns, are designated as a group by the general term, *spinning*. The preparation of silk yarns from raw silk, however, involves a number of processes that are known by the generic title, *silk throwing*, or simply as *throwing*.

**2.** The object of these yarn-preparation processes, whether known as spinning or throwing, is to produce from the raw material a continuous thread, or yarn, that possesses the characteristics required in manufacturing operations. For instance, the yarn must be of suitable size to produce a fabric of the weight and texture required for various uses. It must be smooth and even, and possess the necessary amount of twist to meet the requirements of subsequent processes. It is of primary importance, also, that the yarn shall possess sufficient strength to withstand weaving and knitting operations if it is a yarn designed for either of these purposes. Other

uses, also, require the production of yarns of adequate strength.

**3. Comparison of Spinning and Throwing.**—Although the preparation of yarns from raw silk is known as throwing, and from other textile fibers as spinning, there is some confusion of names and designations that should be noted. For instance, one of the principal processes of silk throwing is known as spinning and the machine upon which it is performed is called a *spinner*. As will be explained, this designation of a silk-throwing operation as spinning, although it is in accordance with the custom of the trade, is really a misnomer, the operation performed by a silk spinner being merely that of twisting. In fact, the word throwing is derived from the Anglo-Saxon *thrāwas*, meaning, to twist. Spinning, however, means to draw out and twist.

**4. Cotton, wool, flax, and other textile fibers, unlike silk,** are of comparatively short lengths. In consequence, the production of yarns from these fibers involves many preparatory processes and entails the use of many complicated and highly developed machines. The short, tangled fibers of the raw material must be opened, carded, drawn, and twisted. In some cases, also, the material must be subjected to a special combing operation, the object of which is to enhance the quality of the yarn. With the exception of twisting, none of these principles are involved in the production of thrown silk yarns. Moreover, the principle of drawing out, drafting, or attenuating, is inherent to the production of yarns from comparatively short fibers, but is not required in silk-throwing operations. Drafting requires that the material be arranged in loosely formed strands, called sliver and roving, that are gradually drawn out or attenuated until a finished yarn of the required size is produced. This yarn is, of course, twisted to give it the required amount of strength. For other reasons, also, processes and principles are required for spinning yarns from fibers of comparatively short lengths that are not required for the production of thrown yarns from raw silk.

5. The silk fiber is ejected by the silk worm when spinning its cocoon, in the form of a continuous filament varying from 300 to 700 yards in length. The fiber is really a double filament consisting of two very fine parallel filaments called *brins*, that are cemented together throughout their entire length by a gummy deposit. This silk gum, or glue, is known technically as *sericin*, and the double filament of silk as unwound from the cocoon is known as an *end*, or *bave*. The filament produced by the silk worm is too fine to be reeled into skeins for shipment. Hence, from three to eighteen cocoon filaments are grouped together and wound into a skein weighing in the vicinity of  $2\frac{1}{2}$  ounces, and containing, approximately, 50,000 yards of silk. The individual filaments of silk are not twisted during this operation, but are simply unwound from the cocoons and formed into a strand which is wound upon a reel to form the skein. This untwisted strand is known technically as a *silk single*, or simply as a *single*. The silk thread thus produced constitutes the raw silk of commerce, sometimes called *grege*, or *hard silk*, as it is received from the silk-producing countries.

6. Sometimes, silk singles are used for weaving, or other purposes, in the condition received when imported, but this is not often the case, since the thread is very fine and does not possess a great degree of strength. Generally, for weaving, knitting, and similar manufacturing purposes, a yarn of larger diameter and greater strength is required, and often threads of ply construction are desired. In all such cases, the silk must be thrown. Moreover, while it is possible to weave silk singles in the gum, that is, with the natural gum, or *sericin*, that impregnates the raw silk, intact, the silk cannot be boiled off, and the gum removed, or dyed and still remain in a workable condition. Silk that is to be dyed or otherwise treated in the skein must, therefore, be thrown into yarn prior to such operations.

7. Unlike the processes employed for spinning yarns from raw materials of short fiber lengths, silk throwing consists merely of doubling together and twisting a number of silk

singles. These long strands are twisted together without any draft, or attenuation, since it is clearly impossible to draw out, or draft, a strand consisting of fibers of practically unlimited length. Silk throwing, therefore, consists essentially of doubling and twisting processes, together with such other operations as are inherently related thereto. Mills or establishments in which raw silk is thrown are known as *throwing mills*, and persons or firms engaged in this work are spoken of as *silk throwsters*, or simply as *throwsters*.

**8.** It is said that more than two-thirds of the silk thrown in the United States is thrown by commission, or custom, throwsters. These throwing mills throw silk for an agreed price per pound and under certain stipulations, rules, and contracts, for manufacturers who operate weaving mills, for silk importers and merchants, and for others who desire to engage their services.

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#### VARIETIES OF THROWN SILKS

**9.** Raw silk is thrown into many varieties, or classes, of threads, depending on the purposes for which the thrown yarn is intended and the nature of the throwing operations to which the raw material is subjected. It is obvious that silk yarns suitable for sewing, embroidering, or crocheting are unsuitable for weaving purposes. Moreover, weaving yarns must be thrown in accordance with the use that is to be made of them and for the particular type and character of fabric that it is desired to produce. Certain kinds of raw silk, also, are particularly adapted to the production of certain varieties of thrown yarns, and are best thrown by a certain series of throwing operations. All of these considerations, therefore, have a direct bearing on the kind of yarn that is produced in any given instance.

**10.** There are a great many varieties of silk yarns that are well known to the trade, and that may be considered to be standard classes of thrown silks. In general, the names applied to these yarns indicate their uses, but, in some instances,

this is not so. Among the important kinds of thrown-silk yarns may be mentioned: Organzine, tram, thrown singles, crêpe twist, knitting silks, hosiery silks, floss, spool silks, button-hole twists, machine twists, sewing silks, embroidery silks, crochet silks, and many others. By far the most important classes of thrown silk yarns are the weaving yarns known as *organzine* and *tram*.

**11. Organzine.**—The variety of thrown-silk yarn designated as organzine constitutes a class of yarns of superior quality that is principally used for warp yarn in weaving operations. *Warp yarns* are those yarns that form the series of parallel threads that run lengthwise of the fabric. They must be smooth, strong, and of excellent quality in all respects, in order to withstand the strain, chafing, and wear that warp yarns must undergo during weaving. Organzine is thrown from the better grades of raw silk which have been reeled from the most perfect silk cocoons. It is usually composed of two raw-silk singles twisted together, but sometimes three singles are employed. The former is spoken of as a two-thread organzine and the latter is known as a three-thread yarn. Rarely, are more than three singles employed for organzine.

**12.** It is essential that a sufficient amount of twist shall be inserted in organzine to give the yarn the strength required in connection with its use as warp yarn for weaving. Usually, the two raw-silk singles are twisted with about sixteen turns of twist per inch. This twist is inserted in one direction in each of the singles, the operation being called *first spinning*. The two singles are then twisted together in the opposite direction with about fourteen turns of twist per inch; this is called *second spinning*, or *twisting*. These operations, of course, make a two-thread organzine. The actual amount of twist inserted in organzine varies somewhat in accordance with the particular effect desired, character of yarn required, number of singles employed, size of singles, and so on. For instance, organzine for satin fabrics is sometimes made with ten turns of twist per inch in the first spinning and eight turns of twist in the second spinning. This slack-twisted yarn tends to make

the fabric very lustrous, which is an attribute to be desired in satins. Sometimes a combination of fourteen turns and twelve turns of twist is employed, and for very hard, wiry, strong organzine for certain fabrics, eighteen turns and sixteen turns of twist may be used. The reference in each case is to the turns of twist per inch in the first spinning and in the second spinning, or twisting. In many three-thread organzine yarns, sixteen turns of twist per inch are inserted in each of the singles and twelve turns of twist per inch in the opposite direction in the ply yarn.

**13.** In well-thrown organzine, the twist should be uniform and the number of turns of twist per inch should conform closely with the specifications of the yarn. A variation



FIG. 1

typical structure of the yarn.

in the twist per inch of not more than 10 per cent., either way, as determined by averaging the results of a number of tests, is generally considered to be satisfactory. Up to a certain point, additional turns of twist tend to increase the strength of the yarn, but excessive twist will tend to weaken the thread and make it inclined to kink badly. The less twist in a yarn, the more lustrous the yarn will be, but, of course, slackly twisted yarns are weak and likely to fray easily.

**14.** The construction of a typical two-thread organzine silk yarn is illustrated by Fig. 1 (a). The illustration is greatly enlarged and does not purport to show the yarn in exact proportion, but merely indicates the

**15. Tram.**—The thrown silk yarns known as tram are employed in weaving as the crosswise, or filling, threads of the fabric. In making tram, two raw-silk singles, three silk singles, or more, are twisted together with a slack twist. These yarns would be known as two-thread tram, three-thread tram, and so on. No preliminary twist in the opposite direction to that in the completed yarn is inserted in the raw-silk



singles employed for the production of tram. Instead, the component singles are merely twisted together in one twisting operation to produce the finished tram yarn. Usually, only about three or three and one-half turns of twist per inch are employed, since in producing tram, the object is to secure a soft, bulky, highly lustrous yarn that will pack into the fabric well and give it *body*. In tram, or other thrown-silk yarns that contain five turns of twist per inch, or less, a variation in the amount of twist of not over 20 per cent., either way, is usually considered to be satisfactory throwing.

**16.** Since filling yarn, or tram, is not subjected to a great amount of strain or chafing during the weaving operation, it is usually produced from raw silk that has been reeled from the less perfect silk cocoons.

In Fig 1 (*b*) the construction of a typical tram yarn is shown. This illustration, of course, is greatly enlarged to show the structure of the yarn.

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#### PROCESSES EMPLOYED IN THROWING

**17.** The number, sequence, and nature of the processes employed for throwing silk yarn vary in accordance with the character and kind of yarn that it is desired to produce. In addition, not only are there slight differences in the methods of handling the material in various processes in different mills, but the number and sequence of operations are sometimes varied in different establishments, even when the same kinds of yarn are thrown. Certain minor operations may be omitted or certain other operations performed, in accordance with the grade of work in certain mills or because of different ideas as to the best methods of handling the material, or of performing the work to obtain the best results. Variations are also often due to differences in the mechanical equipment of mills, or to the orders of officials or customers.

**18.** In throwing organzine and tram, the initial processes, up to and including winding, are identical, whichever yarn is to be produced. Subsequent operations, however, are quite

different, both as regards the number and the character of the processes. Typical sequences of processes for throwing organzine and tram are as follows:

<i>Organzine</i>	<i>Tram</i>
Weighing and opening	Weighing and opening
Examining	Examining
Soaking	Soaking
Drying	Drying
Winding	Winding
First-time spinning	Doubling
Doubling	Tram spinning, or twisting
Second-time spinning, or twisting	Reeling
Reeling	Bundling
Bundling	Packing
Packing	Shipping
Shipping	

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### WEIGHING AND OPENING

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#### RECEIPT OF SILK

**19.** When a shipment of silk arrives at the throwing mill, the first step necessary is the weighing of the bales to obtain the gross weight of the individual bales and of the entire shipment. Each bale of silk is placed upon a scale and weighed with all of its wrappings intact. The bale number will be found stenciled on the outside wrapper, and should be written on a memorandum slip or in a record book, together with the gross weight of that bale. The total, or gross, weight of the shipment is then found by addition.

**20.** Although the weights of individual bales of silk vary somewhat, bales originating from one source are always of nearly the same size and weight. Bales of silk from different countries vary in both size and weight. The bales received from Japan and China are very similar in general appearance,

and also in weight and construction. In each case, the bale is covered with a woven straw or grass matting. The bales of Oriental silk are smaller than Italian bales, being not only of less weight, but also more dense, or compact. Italian bales are covered with burlap bagging. The gross bale weight of Japanese and Chinese silks varies from 140 pounds to 145 pounds, although Canton bales are about 25 pounds lighter. The gross weight of Italian bales is in the vicinity of 250 pounds.

**21.** A platform scale is a very convenient scale for weighing bales of silk, as the heavy bales can be placed upon it without lifting them. A scale with a direct reading dial is used to a great extent. This type of scale can be easily and quickly read and the correct weight of the bale obtained without the use of balancing weights, which generally must be used on a scale equipped with a sliding weight on a graduated balancing bar.

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#### REMOVAL OF COVERINGS

**22.** After the gross weight of a bale of silk has been found, the bale is taken from the scale and its outer and inner coverings are removed. The outer covering, in the case of the Japanese and Chinese bales, consists of the coarse matting previously mentioned. The inner covering wrapped around the bales of Oriental silk, however, consists of a woven grass matting, much finer in texture than the straw matting employed for the outside covering of the bale. Italian bales, as stated, are covered with burlap, and two thicknesses of the material are employed.

After the outside and inner coverings are removed, the silk will be found to be wrapped in a cotton sack, or *shirt*, and tied with two ropes each passed once around the bale. The bale is now weighed again and its weight recorded. This weight is known as the *weight in cotton shirt and rope* or as the *shirt weight*. The cotton sack is knotted at the top and the ropes which pass around it must be removed, after which the sack is opened. The silk will now be seen to be wrapped in bundles, usually weighing somewhat less than 5 pounds each, the bundles

being covered with a fine paper and tied with strings. These bundles are technically termed *books* of silk. Italian silk is not put up in books; instead, the Italian bale consists merely of a more or less loose mass of skeins covered with heavy paper and the double-thick covering of burlap previously described.

**23.** After all the silk has been removed, the cotton shirt, rope, fine paper, and strings are gathered together and weighed. Their weight is deducted from the shirt weight of the bale and the resulting weight is recorded as the net weight of the silk. The net weight of the silk may also be found by finding the

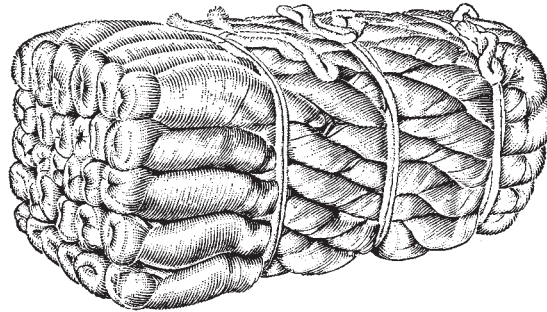


FIG. 2

weight of all of the wrappings, including that of the outside wrappings. This weight is known as the *tare*. Subtracting the tare weight from the gross weight, will, of course, indicate the net weight of the silk.

**24.** If the silk is to be used immediately, it is placed in special soaking bags that will be described later, preparatory to the soaking operation. If not to be thrown at once, the silk is stored in a safe place, often in a fireproof vault built especially for that purpose, but sometimes in a special room.

If a large lot of silk is received at one time, the bale number and gross weight of each bale should be recorded. The outer coverings should then be removed from the bales and a record made of the shirt weight of each bale. The bale number and shirt weight should also be plainly written on the cotton shirt. The bale can now be stored and when required

for use it will only be necessary to strip the cotton shirt, rope, paper coverings, and strings from the silk, weigh them and subtract this weight from the weight written on the shirt, that is, from the shirt weight. The result, of course, will be the net weight.

**25.** Each bale of Chinese or Japanese silk usually contains about thirty paper-wrapped bundles, or books, of silk and each book is generally made up of about thirty skeins. These skeins are twisted and secured by passing one end of the twisted skein through the loop formed in the other end. This method of forming a skein of yarn places the silk in a form

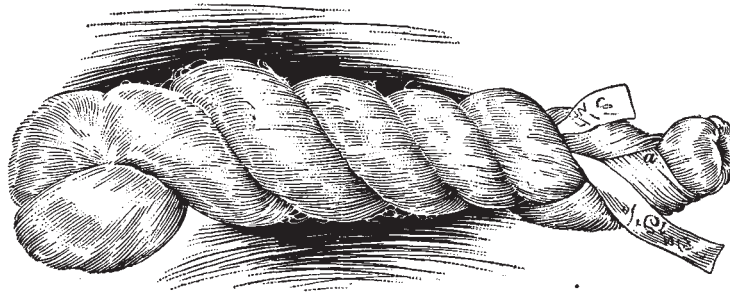


FIG. 3

convenient for handling and prevents the skein from becoming snarled and tangled. In Fig. 2, a book consisting of thirty skeins of silk is illustrated, while a skein of raw silk is shown in Fig. 3.

**26.** A book of silk weighs about 4 pounds and 8 ounces and is from 12 to 14 inches long, 8 to 9 inches wide, and 6 to 8 inches thick. The number of skeins in a book may vary somewhat in certain cases, but each skein usually weighs about  $2\frac{1}{2}$  ounces. It is generally true that the same number of books are contained in a bale of silk as there are skeins in a book of silk, that is, if the books are made up of between 28 and 31 skeins, there will usually be 28 to 31 books in the bale. The number of skeins in a book and the number of books in a bale are not standard, but the bales average 30 books of 30 skeins each. There is, however, some variation in the bales

of silk received from certain sources. Therefore, the weight of the skeins, the number of skeins in a book, the number of books in a bale, and the weight of the bale may be found to vary in some cases from the standard described.

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#### STORAGE OF RAW SILK

**27.** Silk is so valuable a material that special care should be taken to prevent its loss or damage. A special room, preferably of fireproof construction, or a fireproof vault, is usually provided for the storage of raw silk while in the throwing mill and prior to the actual use of the silk in throwing operations. A storage room for raw silk should be provided with a substantial door of fireproof construction which should be adequately locked at all times, except when silk is being withdrawn from storage under proper authority and supervision. Vaults for the storage and safekeeping of silk are usually of brick or concrete construction and provided with heavy fireproof doors of similar construction to those employed for the vaults and safes in which money and securities are kept. Such doors are equipped with combination locks.

**28.** The interior arrangements of a silk-storage room or vault are usually very simple. In most cases, these consist of as many simple, strongly built, open shelves as can conveniently be arranged in the allotted space. Usually, the bundles, or books, of silk are stored on these shelves after the bales have been opened. This is especially true if it is likely that the silk will soon be withdrawn to be thrown. Sometimes, however, the outer coverings of the bales of silk are removed and the silk entered into storage in the cotton shirt, especially if it is not desired to throw the silk for some time. If silk is not to be thrown for a considerable period of time or if it is to be sold or reshipped to another mill, the bales are stored as received, that is, with the outer covering intact. This latter method is also followed in the case of Italian silk, since these silks are not put up in books before being baled. In storing silk, care, of course, should be taken to keep various lots and shipments properly separated and marked.

**29.** The best location for a silk-storage room or vault is usually in the basement or on the ground floor of the mill. Since the silk is received at the ground level, this location usually is convenient and eliminates unnecessary trucking. In addition, the atmospheric conditions are generally better in the lower part of the mill, the air being cooler and the degree of humidity, or amount of moisture in the air, being such that the silk will retain its proper amount of moisture for a longer period. To avoid excessive drying out of the silk while in storage, it is best to build a silk-storage vault at some point remote from boiler or engine rooms, heating plants, and so on.

**30.** When silk is stored for a long time, it will, under certain conditions, become musty. In addition, its weight may vary from the weight recorded when the silk was entered into storage, due to the drying out of the silk or to its absorption of moisture from the air. For these reasons, it is usually best when withdrawing silk from storage for manufacturing purposes, to withdraw those bales that have been in storage for the longest periods of time, provided, of course, this is possible. On account of the capacity of silk for absorbing moisture, it is sometimes stored in very damp places when it is desired to sell the silk. The seller in this way often increases the price received for the silk because of the added weight of the moisture absorbed by the silk while in storage. This practice is not resorted to at the present time so frequently as in the past, because any large amount of silk is now sold on the basis of conditioned weight. That is, the weight of the silk is corrected to be equal to the weight that would be registered by the scales if the silk contained the normal, standard, amount of moisture.

**31.** The temperature and humidity of a silk-storage vault should be tested from time to time, the frequency of such tests varying in different establishments. Unless conditions are observed to be abnormal when the vault is opened for entering or withdrawing silk in the ordinary course of business, frequent tests are not required. Perhaps once a week is often enough to make such tests, unless conditions warrant

more frequent tests. In some cases, however, tests are made several times a day. Large vaults are usually equipped with dry-bulb and wet-bulb thermometers so that the test is merely an observation of the readings of these thermometers. The temperature of the dry-bulb thermometer is noted, and the amount of moisture in the air determined by noting also the reading of the wet-bulb thermometer, after which the humidity can be determined by consulting prepared tables that indicate the degree of humidity for various readings. Some mills keep a record of these tests, with dates, to make sure that they are regularly made and to be able to trace the cause of any abnormal conditions noted in silk withdrawn from storage.

**32.** The atmosphere has an average relative humidity in the vicinity of 70 per cent. when the temperature varies from 65° to 70° Fahrenheit. If, in testing a silk-storage vault, it is found that the atmosphere is too damp, this condition can usually be rectified in ordinary weather by leaving the door of the storage room open for some time. Quite often it is found that there is not enough moisture present in the air and, in consequence, the silk becomes too dry. This condition is often remedied by setting a pail of water in the storage vault or even by sprinkling the floor of the vault with water. Large silk-storage vaults are often equipped with humidifying apparatus whereby the atmospheric conditions in the vault can be positively regulated. It should be noted that when silk is to be thrown in the mill in which it is stored and when no transactions involving its weight are contemplated, the actual amount of moisture in silk withdrawn from storage is not a vital matter. This is true because the silk is immediately subjected to the soaking process on being withdrawn for throwing and, of course, this process saturates the fiber with water. In general, however, it is best to keep silk at all times in such a condition that it contains a normal amount of moisture. In addition, silk should be carefully protected from any damage that might occur through contact with oil, grease, paint, or other substance likely to injure the silk.



### EXAMINING, SORTING, AND TESTING

**33. Examining and Sorting.**—The raw silk received by the throwster is never free from defects of various kinds and, at times, a great deal of difficulty is encountered in the throwing operations because of these defects in the raw material. It is evident that silk which contains comparatively few defects will run better and make less waste than silk that contains many defects. Prior to the soaking of the silk and to the actual throwing operations, therefore, it is customary in some mills to subject the raw silks to a preliminary examination, or visual inspection. In some cases, also, opportunity is taken to perform certain sorting operations at this time.

**34.** The object of examining raw silk in the throwing mill is to ascertain the general condition of the silk as regards quality, and to note any obviously defective material. The faults and defects that the silk contain should be noted and, by this means, an estimate of the quality of the silk should be made, and an opinion as to the best method of handling the material during the throwing operations should be formed. At the same time, the examiner, or sorter, endeavors to select the skeins of silk that are of a quality or character best adapted for throwing the several kinds of silk yarns that it may be desired to produce.

In addition, the sorter, by the expertness attained by long experience, is able to sort out and separate skeins of fine silk from those that are composed of a somewhat coarser thread. While the silk is supposed to be of one size, or *denier*, some skeins may be composed of slightly finer silk and some of slightly coarser silk than the average denier. By sorting the silk at this time, it is possible to arrange for throwing the coarse skeins in one lot and the fine skeins in another lot and thus, to a large extent, avoid the production of corkscrewed, loopy, crinkled, or uneven yarn.

**35.** Corkscrewed yarn is almost invariably produced when fine threads and coarse threads are twisted together, and twisting is an essential feature of throwing operations. In

this case, the tendency of the fine thread is to twist around the coarse thread, the latter tending to remain straight and not to bend around the fine thread. This produces a typical corkscrewed appearance of the ply yarn, the yarn resembling an elongated corkscrew. Corkscrewed yarn is also caused by unequal tension of the individual threads during the twisting of the ply yarn.

**36.** The operation of examining and sorting is very simple, but the operation depends on the skill and degree of expertness of the inspector, or sorter, for its efficiency. The sorter should not only have a good knowledge of silk and its various qualities, but also should have a knowledge of the various throwing operations. This latter knowledge is essential if the silk is to be selected with a view to using it for the production of those silk yarns for which it is most suitable.

In sorting and examining the books of silk, the bundles are opened and the skeins spread upon a suitable table. A general examination of each skein to determine its quality, freedom from defects, and size of thread is now accomplished. Such separation and grouping of skeins is then made as may be deemed necessary in that particular mill. In doing this, attention should also be paid to variations in shade and color, unless it is known that the silk is to be dyed a dark color. Also, very defective skeins and those of doubtful quality should be separated. The degree of hardness, or *nerve*, are qualities that largely determine the *life* of the silk. This is determined by firmly grasping the skein in the hand, long experience enabling this quality to be judged in this way.

**37.** The examination of the raw silk before throwing, as performed in the average or small throwing mill, especially in the establishments of commission, or public, throwsters does not compare in thoroughness with the raw-silk inspection and testing undertaken by raw-silk importers, conditioning houses, or the larger mills. When performed at all, the operation consists merely of a general examination to detect serious faults or defects before commencing to throw the silk, or to perform such simple sorting operations as may be deemed

desirable. Throwsters who manufacture thrown silks for sale and large mills that perform both throwing and weaving operations, however, often have completely equipped inspecting and testing laboratories. In these establishments, complete inspections and tests that follow the practice of the conditioning houses are customarily made. Sometimes, however, even in small mills, one or two skeins from each bale are opened and examined carefully. The skein is thrown over a stretching post, or peg, and opened out, being spread and turned around by the hands. With a black background behind the skein, if a critical examination is made, defects in the silk can easily be noted.

**38.** While it is true that large establishments are paying more and more attention to the inspection of raw silk and are installing adequately equipped departments for pursuing the work, this is not true of the smaller mills and public throwing plants. Since raw silks are now much improved in quality and much more even running in character, there is not much preliminary examination and sorting undertaken in small establishments. In mills that produce thrown yarns for sale, the preliminary examination and sorting may be performed to enhance the quality of the yarns produced. Also, it is often done in those throwing mills that are operated in connection with weaving plants, for the purpose of selecting silks for certain fabrics to which they are best adapted, and for the purpose of safeguarding the reputation of widely advertised fabrics upon the quality of which the reputation of the mill depends.

**39.** While there is no doubt but that raw silk which has been carefully sorted can be thrown into much more even silk yarns than silk that has not been sorted, there is one great objection to the practice that prevents its use to a large extent in American throwing mills. This drawback is the creation of odd lots of fine and coarse skeins of raw silk that must be held until an opportunity is found to use them. For instance, if a certain quantity of raw silk is thrown without sorting, a corresponding quantity of thrown silk that can be employed

in the desired goods will be obtained. Suppose that this silk was sorted. In the first place, a larger quantity of raw silk must be purchased, because after sorting there will be approximately only 70 per cent. of the silk that is to be used for the fabric to be manufactured. While it is true that this silk can be thrown into a superior thread, it is also true that the manufacturer has on his hands about 20 per cent. of coarse silk and 10 per cent. of skeins that are finer than the average size called for in the purchase of the silk. This 30 per cent. of the original purchase must be held, perhaps for a long time, and in addition the original purchase was larger than the requirements for the amount of goods to be manufactured.

**40.** In commission throwing mills, the instructions given to the throwster are to throw a lot of silk into the ply thread desired, the ply and twist of the required yarn being stated. In this case, the throwster proceeds at once to place the silk in the soaking bags, after the preliminary operations of weighing and opening have been attended to; or if the silk is not to be used immediately, it is placed in storage. However, if the skeins appear to have many loose ends, termed *endy* silk, or if the silk is dirty, or otherwise seriously defective, the throwster may send a report of it to the manufacturer for whom the silk is being thrown. But this is not always done, as methods and understandings between throwsters and their customers are variable. For example, it can be shown that the manufacturer may desire a lot of silk to be thrown into organzine, or warp yarn, while in the throwster's opinion the silk is poor and could be better made into tram, or filling yarn, since it is not essential to have a strong thread for filling. Again, the customer may have ordered a certain lot of silk thrown into tram, and the throwster may be of the opinion that it is of satisfactory quality to be made into organzine. In such a case, the manufacturer may be notified by the throwster, but, of course, the silk would be thrown according to the decision made by the customer.

**41. Testing.**—As stated, throwing mills attached to large weaving mills generally are equipped with testing laboratories

in which various practical tests are made to classify raw silk before it is thrown. By this means, the best commercial use of each lot of silk is determined, defects are noted, and decisions are made as to the character of the yarns to be produced from the silk. Large quantities of silk are received at the mill, but the entire lot is not tested. One method is to select four bales from a ten-bale lot, and draw at least ten skeins from each bale. These skeins are used for testing purposes and the results considered to represent the average condition of the lot of silk. The practice varies, however, in different establishments, but, in general, closely follows the practice of the conditioning houses in making such tests.

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#### SOAKING RAW SILK

**42. Object of Soaking.**—The first operation of throwing silk in which the raw material is given a definite treatment tending to alter its nature, is known as *soaking*. This process, while extremely simple, should be carefully and properly performed in order that the silk may not be injured and so that its workable properties in succeeding operations may not be impaired. It consists, essentially, of soaking the raw silk in a solution of hot water, soap, and oil.

**43.** The object of soaking raw silk preparatory to winding and the other actual throwing processes, is twofold. First, soaking softens the natural silk gum, or sericin, and thus enables the winding operation, in which the yarn is unwound from the raw silk skein and wound upon bobbins, to be more readily accomplished, and with less breakage of the silk thread during the unwinding of the skein. Second, soaking raw silk in a bath composed of water, soap, and oil, in suitable proportions, lubricates the thread. The fatty matter contained in the soap and oil is deposited upon the fiber, and more or less impregnates it, so that the thread is manipulated in succeeding operations with greater facility and at higher speeds.

**44.** Although one of the primary objects of soaking raw silk is to soften the natural gum that envelopes the fiber, this

gummy material, in itself, does not absolutely preclude the throwing of the silk. The difficulty caused by the gum is really due to the fact that it makes the threads of the raw silk skein adhere to each other. This makes the unwinding of the skein of raw silk, when winding on to bobbins, very difficult and will cause many broken ends and a much reduced production. When raw silk is reeled into skeins, the cocoons are in a moistened condition and the gum is soft and sticky. Therefore, if the thread is not thoroughly dried before it is wound upon the reel, there is a marked tendency for the threads of the skein to become fastened to each other by the gum as it becomes dry. This tendency is especially noted at those places in the skein where the threads pass over the bars, or arms, of the reel during the formation of the skein. While the soaking of raw silk is intended to soften the gum so that the silk will work properly during winding, the amount of soap and oil employed in the soaking solution must be gauged in accordance with the condition and nature of the silk. In fact, the hard gummy deposits in some silks are so difficult to soften that additional manipulation known as *rubbing the gums* must often be resorted to.

**45.** The second object of soaking raw silk, namely, to lubricate the thread, is also of vital importance. Raw silk of good quality is of a hard, wiry nature, sometimes called *nervy*. In fact, raw silk is often spoken of as *hard silk*. Silk of this character does not lend itself readily to operations that are conducted at high speed. This is principally due to the fact that such material easily becomes charged with static electricity, in which condition it is very difficult to handle. Moreover, hard, wiry threads, if run at high speed through and over the thread guides employed in various kinds of silk-throwing machines, tend to cut and wear the guides badly, thus making frequent replacement necessary. This is not only expensive, but often it would be necessary to reduce speeds to avoid excessive cutting or static electrification, thus reducing production and adding to the cost of throwing. When raw silk has been properly soaked, however, the soap and oil employed in the

soaking solution lubricate the thread and make it soft and pliable. In this condition it can be worked on machines that operate at high speed without abnormal difficulties of the nature mentioned. Moreover, silk that is made pliable and is well lubricated by the soap and oil of the soaking solution can be thrown with uniform twist into a smooth even yarn that is well adapted to the purposes for which thrown-silk yarns are employed.

**46. Bright-Thrown Silks.**—The advantages of soaking raw silk prior to throwing operations are so great, especially in improving the working properties of the thread and in enabling the use of high speeds in throwing processes, that soaking is almost invariably resorted to in America. In England and Continental European countries, however, some silks, especially filatures and rereels, are thrown *in the gum*, that is, without having been subjected to a preliminary soaking process. This method of throwing is spoken of as working, or throwing, the silk *bright*, and thrown silks thus prepared are often spoken of as *bright-thrown silks*. This term should not be confused with the term *bright* silk which refers to thrown silks that have been subjected to boiling off and dyeing processes, subsequent to throwing.

**47.** In England, the Chinese native-reeled silks, sometimes called *tsatlees*, are worked in soap, or soaked, as in America, but on the continent of Europe, even tsatlees are often thrown bright. Certain silks, such as the filatures and rereels previously mentioned, require less soap and oil in the soaking process than do other silks, but in America, no silks are thrown bright except in very special cases, or on special orders. Sometimes, when the nature of the silk will permit the unwinding of the skeins without undue breakage and when silk singles are to be thrown for what is known as single weaving, the silk is thrown bright or, at the most, is subjected to only a very mild and brief soaking process. Occasionally, silk singles are woven without being thrown or twisted, that is, the raw-silk thread is used for weaving just as imported. In such cases, the silk is not soaked, but the natural gum is

allowed to remain hard to give the thread better weaving qualities. Unless a mill is equipped with a complete humidifying and moistening system, and if high speeds are employed in the throwing processes, a great deal of difficulty with static electricity is likely to be experienced in working silk bright, especially during the winter months when the atmosphere of the mill is dry and heated. Less trouble of this nature is experienced in foreign countries because slower speeds are employed for most throwing machinery in such countries.

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#### PREPARATION FOR SOAKING

**48. Opening the Books and Skeins.**—In soaking raw silk, it is of extreme importance that a thorough penetration of the silk by the soaking solution be attained. For this reason, it is almost invariably necessary to loosen the silk by opening the books and skeins of silk prior to entering the material into the soaking bath. There is a great deal of variation in the methods employed by different throwing mills in preparing the silk for soaking. This is due in some cases to the nature of the silk and in other instances to the opinion of the throwster as to the best method of doing the work. In general, however, it may be stated that soaking is an important operation that should be thoroughly and carefully performed. This is true since careful work at this point often results in less trouble in the later operations of throwing. If the soaking is well done, the work will run better because the workable properties of the silk will be enhanced. Preparation for soaking, therefore, should be entirely adequate to the needs of the process. In addition to allowing proper penetration of the silk by the soaking liquor, the silk should be prepared in such form as will allow ease in handling and tend to prevent damage to the silk during soaking and the subsequent operation of extracting.

**49.** If the books of raw silk have not been opened previously for examining and sorting, the strings with which the books are tied, are now untied or cut, care being taken in



the latter case not to injure the silk, and the skeins, which are individually formed as shown in Fig. 3, removed. The skeins are then opened, one at a time, which is accomplished by separating the two ends of the twisted skein that are tucked one within the other, as shown at *a*, Fig. 3. Next, the skein is untwisted, in order to dispose the threads in a loosened condition, and placed loosely upon three strings which have previously been laid in parallel order, a few inches apart, on a suitable support. Quite often, about eight skeins are placed on the strings in the same manner as the first skein, and the entire bundle is then tied loosely so as not to squeeze the skeins.

**50.** If the bundle is tied too tight, the soaking solution can penetrate the portions of the bundle beneath and adjacent to the tying strings only with great difficulty. Usually, the heavy, slackly twisted, or braided cotton strings with which the books of silk are tied, or similar strings, are used for tying these bundles. Rough, heavy cords or strings that are likely to catch the silk, breaking the ends and damaging the skeins, should not be employed for tying the packages of silk. Sometimes, the skeins are folded over once before being laid upon the tying strings. This, of course, makes a shorter and thicker bundle of silk. Occasionally, but not often, the skeins are tied loosely in the middle with one string, the ends of the skeins being allowed to hang free. This method, while allowing a good penetration of the soaking solution, is likely to cause the silk to become tangled and damaged during the soaking or extracting.

**51.** The number of skeins tied in each bundle varies in different mills. Sometimes about three bundles are made from each book and, again, only two bundles are made from a book. In some instances, when operatives are paid on a piece-work basis in the subsequent winding process and the silk is issued to them by weight, an attempt is made to make the bundles of approximately a standard weight. In such a case, the three strings previously mentioned are laid across the weighing pan of a small scale, similar to those used by grocers. Sometimes,

nineteen to twenty skeins are then laid on the strings, and, if found to weigh approximately 3 pounds, they are tied into the characteristic loose package. The bundles may be made of a different standard weight, if desired.

**52.** For convenience in preparing the bundles of skeins for soaking, a device similar to that illustrated in Fig. 4, is

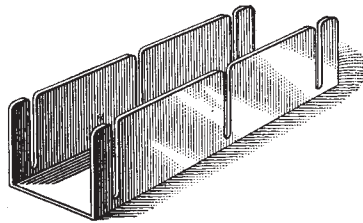


FIG. 4

often employed. This consists essentially of an open box without ends, or trough, in the sides of which three parallel openings, or slots, are cut. The device may be made of sheet metal or wood and of dimensions that are convenient for

assembling and tying the skeins in packages of the desired size. The trough illustrated is about 2 feet long and 5 or 6 inches in width and height. Whether made of wood or metal, such a device should be constructed with rounded edges and corners, and should contain no projections upon which the silk may be caught and injured. A wooden trough, therefore, should be made of straight-grained wood that has no projecting slivers, and should be carefully sandpapered. After sandpapering, the box should be given two coats of hard varnish. In using this device, the three tying strings are placed in the slots in the sides and the requisite number of skeins of silk are then laid in the box in parallel order upon the strings. The strings are then tied loosely around the skeins in the usual manner and the bundle of silk removed. The use of a device of this kind tends to arrange the silk in a uniform manner and to prevent injury to it during the operation of making up the bundles.

**53. Bagging the Silk.**—After the silk has been opened and loosely tied in bundles of the desired size, the next operation, if the best and usual practice is to be followed, is to bag the silk. This consists of placing the bundles of silk in small bags that serve to protect the silk from tangling and aid in ease of handling during the soaking and subsequent extraction,

but which do not prevent a thorough penetration of the silk by the soaking solution. To insure thorough penetration, these bags are made of a coarse-meshed cotton net designed especially for soaking raw silk. The meshes of the bag are fully 1 inch square and the material employed in their construction is a heavy cotton ply cord. To avoid any possible hindrance to proper penetration of the silk by the soaking liquor, care should be taken not to pack the silk in the bags too tightly. The bags are usually made about 22 inches wide and 24 inches in length. This size is large enough to hold about 9 pounds, or two books, of silk.

**54.** After the silk has been packed in the bags, they are closed and securely tied; the silk is then ready to be immersed in the soaking solution. The principal advantage of bagging silk for soaking, in addition to preventing possible damage and tangling of the skeins, is the ease with which the material may be handled when properly bagged. This is especially noticeable in removing the silk from the soaking solution and in filling and emptying the basket of the hydroextractor by means of which the excess of soaking liquor is removed from the silk, following the soaking operation.

**55. Other Methods of Preparation for Soaking.**—So many methods of soaking raw silk and of preparing it for soaking are in vogue, that it is almost impossible to characterize any one method as a standard method of procedure. Sometimes the books and skeins are opened and the silk tied in bundles as described, but it is not placed in soaking bags. Instead, each individual bundle, or several bundles, is wrapped in a single thickness of cheese cloth before being placed in the soaking liquor. The disadvantages of this method are that it is not so convenient as the method in which bags are employed and, moreover, the penetration and circulation of the soaking solution is not likely to be so thorough.

**56.** In some cases, the bundles of loosely tied skeins are packed in the soaking tubs or tanks without being bagged or wrapped in any manner whatsoever. In such cases, the silk

is usually covered with a layer of cheese cloth upon which is placed a slatted wooden or solid board cover. A weight on this cover serves to keep the silk submerged beneath the surface of the soaking liquor so that all portions of the silk will be soaked. It is a little more difficult to handle the silk when this method is employed.

**57.** Sometimes, when certain silks in which the gums are very soft and easily treated, are to be soaked, the skeins of silk are not opened and untwisted, neither is the silk made up into bundles. Instead, the strings are removed from the books of silk and one or two books are placed in a soaking bag. In this case, the skein is in an unopened condition, exactly as it is received from the importer. In general, it may be said that this method is not to be recommended. While it may be used in certain cases where a minimum amount of soaking is required and where the gum is easily softened, the penetration of the soaking solution into the tightly rolled and twisted skeins is not apt to be sufficiently thorough to insure work of the best quality.

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#### SOAKING OPERATION

**58. Preparation of Soaking Solution.**—Although the details of the operation vary in different throwing mills, the method of procedure in soaking raw silk is of extreme simplicity. Usually, the soaking solution is prepared in the tub in which the silk is to be soaked, but sometimes it is mixed and boiled in a separate tub or tank from which it is run into the soaking tub. Often, this tank is large enough to contain a sufficient quantity of solution to supply several soaking tubs. The tubs are usually made of a size large enough to soak one bale of silk and, of course, large mills require a number of such tubs.

**59.** When the soaking solution is prepared in the soaking tub, the usual practice is to place the necessary quantity of soap in the tub, together with about one-quarter of the required amount of water. A hose or flexible joint of metal pipe is

then entered into the tub and steam turned on to boil the mixture. The boiling is continued for a sufficient length of time to dissolve the soap thoroughly. Usually boiling for 15 minutes to  $\frac{1}{2}$  hour will accomplish this purpose, but the actual length of time depends somewhat on the nature of the soap employed, and on how fine it has been sliced or chipped. Sometimes, instead of being boiled in the soaking tub, the stock soap solution is prepared in a kettle or other suitable container. This boiling solution is then poured into the soaking tub. The oil that is often used in soaking solutions is now poured into the soap solution and the mixture thoroughly stirred. This forms a uniform, homogeneous emulsion in which the oil is suspended in finely divided particles.

**60.** The oil and soap are sometimes boiled together, but this is not necessary if the oil employed is one that easily forms an emulsion with the soap and water. Occasionally, a small amount of borax, carbonate of soda, ammonia, or some similar substance is added for the purpose of improving the emulsion and preventing the oil from separating out. Such substances are said to *cut* the oil since they assist in the mixing of the oil and water. They are not necessary in all cases, but are used when the oil employed does not emulsify readily.

**61.** When boiling, the temperature of the solution, of course, is 212° Fahrenheit, but the remainder of the water required for the solution, at normal temperature and about three-quarters of the total amount, is now run into the tub. This water serves to cool the soaking solution to a temperature of from 70° to 85° Fahrenheit. Before the silk is entered into the tub, this temperature is tested with a floating thermometer. If the solution is too hot, it is allowed to cool before the silk is placed in it, but if it is too cool, the steam can be turned on for a few minutes to raise the temperature of the liquor.

**62.** In general, the silk should not be entered into a soaking solution that has a temperature much in excess of 85° Fahrenheit; 90° Fahrenheit may be considered to be the

extreme limit of temperature. If the temperature is too high, there is great danger of seriously injuring the silk and of thus causing damage that will involve a very considerable monetary loss. When the solution is too hot, not only will the natural gum, or sericin, be rapidly softened, but there is great danger of partly degumming the silk, that is, of discharging a considerable portion of the natural silk gum. Should this gum be removed in the soaking operation, the filaments and fibrillae of the silk thread would be allowed to separate and the surface of the thread more or less roughened.

**63.** Moreover, the separation of the raw-silk thread into its component parts tends to make the silk fuzzy owing to the breakage of filaments during throwing. In fact, if silk has been injured in this manner during soaking, it will not only be difficult, but it may be entirely impossible to work the silk in the throwing operations. These facts serve to emphasize the importance of carefulness in soaking raw silk. The object of soaking, it must be remembered, is not to remove the silk gum, but to soften it so that the silk can be easily unwound from the skein and to lubricate the thread to enhance the ease with which it can be worked during the throwing processes.

**64.** After the requisite amount of water has been added to the soap solution to dilute it, the solution should be thoroughly stirred to ensure a well-mixed liquor. By dipping the fingers into the liquor and rubbing them together, the solution can be tested. After experience, a very good idea can be formed in this way as to whether or not the solution has the right feel and is soapy and oily enough. Then, after the temperature is carefully taken, the silk may be placed in the tub.

**65. Method of Procedure.**—In entering the silk into the soaking solution, the material should not be handled roughly, nor should the silk be thrown and jammed into the soaking tub in a careless manner, as is sometimes done. In fact, silk is so valuable and delicate a fiber that it should be handled very carefully at all times, especially when it is in the form of

a skein. The proper method is to pack the bags of silk, prepared as previously explained, carefully into the tub, forcing them below the surface of the solution and, after the required number of bags have been placed in the tub weighting them down with a slatted rack and a suitable weight.

If the bundles of silk have not been placed in bags or wrapped in cheese cloth, extraordinary care must be taken in placing them in the soaking tub. In this case, the bundles should be laid as nearly as possible in parallel order to avoid tangling or matting the silk. They should then be forced beneath the surface of the liquor and covered with a layer of cheese cloth and the usual weighted rack or board cover. While the soaking tubs are customarily made of a size sufficiently large to contain an entire bale of silk, some throwsters, to avoid tangling and matting the skeins, rarely place more than about 60 pounds of silk in one tub.

**66.** It is an almost invariable rule to soak raw silk for a period of time varying from 12 hours to 14 hours. This is due to the usual practice of placing the silk in the soaking solution late in the afternoon, say about 5 o'clock, and removing it immediately when the mill commences operations on the following morning. There are cases, however, where there is special cause for haste in throwing some particular lot of silk or where the silk is of such a nature as not to require long soaking to obtain proper penetration of the soaking liquor, in which the length of time for soaking is reduced to a period of from 5 to 6 hours, or even less. While the soaking solution is usually at a temperature of about 85° Fahrenheit when the silk is entered, no attempt is made to maintain this temperature during the soaking operation. Instead, the solution is allowed to cool gradually during the night and will be found to be of a normal temperature in the morning when the silk is removed.

**67.** In removing the silk from the soaking tubs after the completion of the soaking, it is usually best to drain off the surplus solution that has not been absorbed by the silk, rather

than to lift the packages of silk from the solution. By adopting the former method, not only is there less danger of tangling or injuring the silk, but any soap or oil that may have separated from the emulsion and risen to the surface of the bath, will, in this manner, be allowed to fall through the mass of silk in the tub. Much of this soap and oil, therefore, will be deposited on the silk and being thus caught and retained will not be drawn off as waste.

#### SOAP-SLICING BOX

**68.** The soap employed in preparing silk-soaking solutions is often purchased in chipped or granulated form. Sometimes, however, it is supplied in the form of bars about

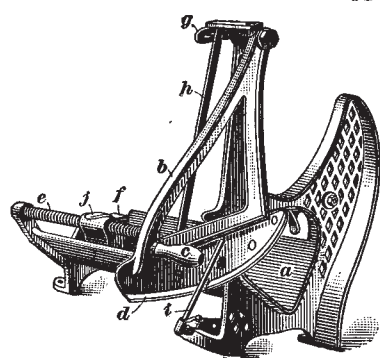


FIG. 5

4 inches square and 10 or 12 inches in length. When the soap is purchased in the latter form, it must be sliced in thin slices or chipped before being used. Unless this is done, the length of time required to dissolve the soap completely is greatly increased and the boiling of the soaking solution must be continued for a much longer period.

To insure that a minimum length of time is required to dissolve the soap, it is desirable to slice it into very thin slices or flakes. Simply cutting the bar of soap into large chunks will not accomplish the desired purpose with the proper degree of efficiency.

**69.** In small throwing mills, where small quantities of soap are used, the soap is often sliced by hand with a heavy knife, but in larger establishments, some mechanical device for slicing or chipping the soap used in soaking the silk is usually employed. A common device of this kind, known as a *soap-slicing box*, is shown in Fig. 5. This mechanism is



comparatively simple, and consists essentially of a **V**-shaped trough *a* in which the bar of soap to be sliced is placed, and a swinging knife for slicing the soap. At the right-hand end of the trough, a cast-iron end frame supports a swinging arm, or frame, *b* to which is attached the operating handle *c* and the curved cutting knife *d*. A screw *e* operates a follower *f* that forces the bar of soap forwards, or toward the cutting knife. This screw is turned at each stroke of the knife by a slotted arm *g* that, through the connecting-rod *h*, operates a pawl and ratchet gear (not shown in Fig. 5), the latter being attached to the forward end of the screw. In operation, the bar of soap is placed in the trough and the operator swings the arm *b* backwards and forwards by means of the handle *c*. The bar of soap being forced into the path of the knife at each stroke by the follower *f*, results in a thin slice of soap being cut from the bar at each forward stroke of the knife. The steel bar *i* is arranged to press against the edge of the knife blade. This serves to sharpen the blade automatically; it also keeps the blade free from soap and removes the slices which, otherwise, might stick to the knife instead of falling into the receptacle provided. The handle *j* disengages the follower *f* from the screw *e* so that it may be slid back to its initial position when it becomes necessary to place a new bar of soap in the trough.

**70.** Sometimes, in large throwing plants where a considerable amount of bar soap is used, a machine that is driven by power is provided for slicing or chipping the soap. Such machines are usually equipped with revolving cutter blades and automatically perform the work with great rapidity.

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#### SOAKING TUBS FOR SILK

**71. Materials of Construction.**—The soaking tubs employed in the soaking of raw silk are made of wood in the majority of cases. Soapstone, slate, porcelain, glazed enamel, and various kinds of metal may be used in the construction of silk-soaking tubs. The former materials make excellent

tubs for the purpose, although they are more expensive and more liable to serious damage than wooden tubs. Certain types of metal tubs have proved satisfactory in some cases, especially those that are lined with tin or lead. Metal tubs, however, should be regarded with suspicion on account of the possibility of the free fatty acids, often contained in the soaps and oils used in the soaking solutions, attacking the metal of which the tub is constructed. While this action might not prove to be especially destructive to the tubs, compounds that injure the silk may be formed by the union of these acids with the metal of the soaking tub.

**72.** For instance, serious trouble is sometimes occasioned by the practice of soaking silk in galvanized iron tubs. In the galvanizing process, such tubs, or the metal from which they are constructed, is heavily coated with zinc. In such cases, the fatty acids of the oil and soap used in the soaking solution often combine with the zinc of the tub and form a zinc compound that is insoluble. This zinc compound is deposited upon the silk as a thin film, but in a very uneven manner. Since this film tends to resist the action of dyestuffs, silks that have been so injured are apt to be dyed very unevenly and thus rendered unfit for the specified use, or greatly depreciated in value. Moreover, the zinc compounds formed by the action of fatty acids on metallic zinc, are almost impossible to remove from silk. They may be removed by treatment with hydrochloric, or muriatic, acid, but this treatment in itself is very likely to injure the silk, unless great care is exercised. While the amount of this zinc compound that is formed is very small, it will occasion considerable trouble on account of its propensity to cover a large amount of silk with a thin film. To avoid difficulty of this nature, galvanized tubs should not be used for soaking silk, and oils used for silk throwing should not be stored in galvanized containers.

**73.** Wooden tubs, if well made of first-class material, give excellent service and are well adapted to the soaking of silk. The best woods to employ in their construction are cypress, cedar, or white pine. First quality, kiln-dried lum-

ber should be used and the tubs should be securely fastened by long bolts passing through the sides, ends, and bottoms. The tubs are usually made of planed planks, not less than 2 inches in thickness and of suitable width. These planks are generally splined and fitted together with white lead in the joints to prevent leakage. The joints should be very carefully made and the workmanship employed in the construction of soaking tubs should be of the best. Care should be taken to finish the insides and edges of the tubs perfectly smooth, so that the silk will not catch on projections or rough places and thus be broken and damaged when being placed in the tubs or removed from them. The customary construction consists of tubs of rectangular shape having one or more compartments, in accordance with the amount of silk to be soaked and the capacity of the throwing mill.

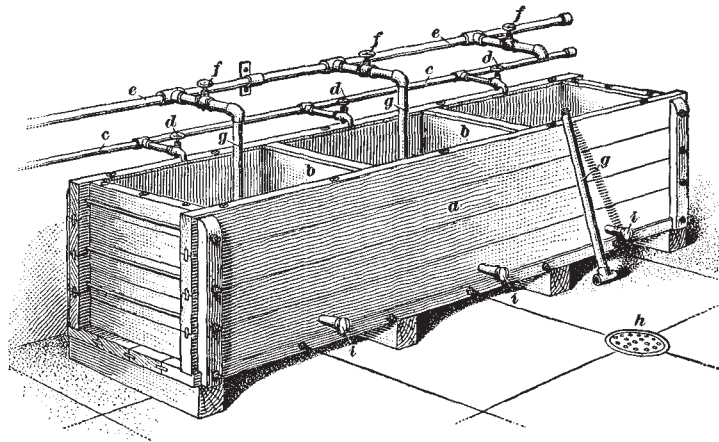


FIG. 6

**74. Arrangement of Tubs.**—A very common arrangement of silk-soaking tubs is illustrated in Fig. 6. In this case, one long tub, or tank, *a* is divided by partitions *b*, into three separate tubs. These tubs are so arranged and equipped that any one or all of them may be used as desired. The tubs are usually placed near the wall of the mill and a cold water pipe *c* secured to the wall just behind and slightly above them. This pipe supplies water to faucets *d*, arranged to supply each indi-

vidual compartment, or tub. Just above the water pipe, and also attached to the wall is a steam pipe *e* of sufficient size to supply steam for heating the water in the several tubs. Extension pipes, with elbows attached at their ends, lead from the steam pipe to a point above each tub and nearly over the center of the tub. Each of these extension pipes is fitted with a steam valve *f* and into the elbow at the end, a short length of pipe *g* is loosely screwed. The pipe *g* extends vertically downwards to a point close to the bottom of the tub and a tee with both ends open is attached to its lower end. When it is desired to boil or heat the soaking solution, the pipe *g* is attached and the steam turned on, but this pipe should be removed when the silk is placed in the tub to be soaked.

**75.** Soaking tubs for silk, together with soap containers, oil storage tanks, hydroextractors, and other necessary equipment, are usually located in the basement of the mill, in a room called the soaking room, which is generally constructed with a floor of concrete or other waterproof material. This floor should be uniformly sloped, or graded, to a drain *h*, Fig. 6, so that when the plugs *i* are removed from the tubs, the excess soaking solution remaining in them after the silk has been soaked, will quickly drain away. Good drainage should be provided, also, so that the tubs can be thoroughly rinsed when required, without causing a sloppy condition because of large quantities of water collecting on the floor. When tubs are allowed to drain upon the floor, they are usually raised from the surface of the floor by being set upon wooden stringers or other supports, as shown. This is an excellent plan when wooden tubs are employed, since it allows a free circulation of air and tends to prevent the moisture from collecting beneath the bottoms of the tubs and rotting them. Frequently, soaking tubs are arranged with a drain pipe in the bottom of each tub, that is, connected directly to the drainage system of the mill. This arrangement tends to keep the soaking room dry and clean, but sometimes considerable trouble is occasioned by the choking or stoppage of the drainage system, making expensive repairs necessary.

**76.** The size and arrangement of soaking tubs vary in different throwing establishments. It is usually good practice to construct each tub of a sufficient size to accommodate one bale, or about 135 pounds, of silk. When the custom of the mill is to soak the silk in smaller quantities, sometimes this is not done. However, tubs of good size are convenient and small quantities of silk may be easily soaked in such tubs, if desired. Individual tubs, or compartments in batteries of tubs, that are about 36 inches long, 30 inches wide, and 26 inches deep will easily hold an entire bale of silk during the soaking operation. Moreover, a tub that is 30 inches in width will permit the standard raw-silk skeins to be placed in it in parallel order without doubling the skeins, if this is desired. Such a tub, also, easily permits the packing of the tub with doubled skeins if this method of preparing the silk for soaking is employed.

**77. Weighting.**—When soaking silk, it is usually necessary to cover the silk with some form of weighted cover in order that it may be kept submerged. This is especially necessary when a large amount of silk is soaked in each tub or when small tubs are employed. If the silk is not completely immersed in the soaking solution during the entire period of the treatment, it will not be uniformly treated. Some parts of the silk will not be softened and lubricated in the desired manner and, hence, such silk will not *machine* well in the subsequent processes. Sometimes, the cover that is used consists of a slatted wooden rack made slightly smaller than the inside dimensions of the tub. In other cases, a solid wooden cover is used, and often such a cover is lined with sheet copper or heavy canvas on the under side to prevent damage to the silk. If all wood, slatted or solid, covers are employed, they should be made perfectly smooth, since the fine threads of silk are likely to catch on any rough spots and be broken.

**78.** After the cover is placed upon the silk, a heavy weight is usually placed upon the cover to make sure that the silk will be kept beneath the surface of the soaking solution. The cover is often heavy enough in itself to insure the submergence of the silk, especially if large tubs are used, but if

a large quantity of silk is placed in the tub, weights should always be placed upon the cover. The weights used in such cases generally are smooth, clean, heavy stones that are kept for this special purpose. Weights made of iron that may cause rust to be deposited on the silk or of any other material that would be likely to cause damage to the silk, should never be employed.

**79.** In some large mills, especially in Europe, special silk-soaking tanks, or kiers, are employed by means of which the soaking solution may be circulated through the silk by means of pumps. Such apparatus usually consists of two tanks, one at a higher elevation for boiling the soap solution and another at a lower elevation in which the silk to be soaked is placed. The latter tank is provided with a tight cover. While such an arrangement is not necessary for the performance of good work, it is claimed that the constant circulation of the soaking solution during the soaking operation insures a uniform penetration of the silk by the solution. Moreover, it is said that the circulation of the liquor keeps the soap and oil from separating out of the solution; that is, it keeps the solution well mixed. It is also claimed that it is unnecessary to open and untwist the skeins before soaking when such tanks are used.

# SILK THROWING

(PART 1)

Serial 5002A

Edition 1

## 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 the object of silk throwing?
- (2) Explain the essential difference between throwing and spinning.
- (3) Describe the construction and explain the uses of:  
(a) Organzine; (b) Tram.
- (4) What throwing process is necessary for the production of organzine that is not required in throwing tram?
- (5) In connection with the weighing and opening of raw silk, explain the following terms: (a) Gross weight. (b) Shirt weight. (c) Net weight. (d) Tare.
- (6) Describe a book of silk.
- (7) Briefly discuss the storage of raw silk in throwing mills.

(8) What is the object of examining raw silk before it is thrown?

(9) Describe a corkscrewed yarn and state what causes this defect.

(10) What is the principal objection to sorting raw silk?

(11) Explain fully why raw silk is soaked before being thrown.

(12) Describe the preparation and bagging of silk for soaking.

(13) Explain the usual method of preparing a soaking solution.

(14) (a) What temperature should be employed in soaking silk? (b) Explain the danger of too high a temperature of the soaking solution.

(15) For how long a period of time is raw silk usually soaked?

(16) Why are galvanized iron tubs unsuitable for soaking silk?

(17) What is meant when it is said that silk is thrown bright?

(18) Why should silk be covered while in the soaking tubs?

(19) Explain the advantage of draining the soaking solution from the tubs before the silk is removed.

(20) Describe how the silk should be placed in the soaking tub.

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