*The Project Method of Teaching*

# SILK TESTING

PART 3


PREPARED UNDER SUPERVISION OF

C. J. BRICKETT

DIRECTOR, SCHOOL OF TEXTILES
INTERNATIONAL CORRESPONDENCE SCHOOLS

By

CARL A. LUFT

GRADUATE, PHILADELPHIA TEXTILE SCHOOL


**5001 C—FIRST EDITION**

## INSTRUCTION PAPER

With Examination Questions

PREPARED ESPECIALLY FOR
INTERNATIONAL CORRESPONDENCE SCHOOLS


Published by

INTERNATIONAL TEXTBOOK COMPANY

SCRANTON, PA.

1925

## 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.

# SILK TESTING

(PART 3)

## IMPORTANT ADDITIONAL TESTS

### SERIMETER TEST

#### PRELIMINARY CONSIDERATIONS

**1. Object.**—The diameter of a silk filament varies at the time the silk is spun, and even after several raw-silk filaments are combined to produce a single, the diameter, or size, is not completely equalized. Hence, a very important factor to be considered when determining the running quality of raw silk is its variation in diameter, or its *evenness*. Thus, should a raw-silk single have numerous fine and coarse places, or should the raw-silk skein contain many fine or coarse threads, the running quality of the silk will be inferior to that of a thread having an approximately uniform diameter throughout. No silk thread is absolutely uniform in diameter; some variation is always present; however, certain grades of silk are more uneven than others.

**2.** The variation in the diameter of the thread affects not only the visible evenness of the silk but also the strength. Fine threads are weaker than coarse threads and consequently break quicker. By observing the variation in the breaking points, the relative evenness of the silk being tested may be determined. As a rule, silks of the same quality and size have breaking points that do not vary appreciably; but when the silks are of different sizes, their breaking points will be different, since their average diameters are not alike. Therefore, the variations in the breaking points of the threads may be taken to indicate the evenness of the silk, and when found from a sufficient number of threads, the result represents the evenness of the silk being tested. Thus, if the breaking points of the strands vary between close limits, the silk is considered even, and its range of evenness is said to be good; but, if the range between the lowest and highest breaking points is very great, the silk is considered uneven. The breaking point of one raw-silk single is determined by a test made on a special machine known as a *serimeter*. Therefore, the object of the serimeter test may be considered as the determination of the amount of variation in the breaking strengths of the threads, above and below the average, and from these results it is possible to judge the evenness of the thread.

**3. Plan of Test.**—The serimeter test, which is purely mechanical in its nature, gives the breaking strength of the single thread being tested. One end of the strand is gripped by an upper clamp that is practically stationary. The other end is held in a lower clamp that is given a steady, slow, downward movement. Thus, a steadily increasing pull is exerted on the thread, and the amount of this pull, in grams, is recorded by a quadrant balance connected to the upper clamp. The pull required to break the thread is the breaking strength, or breaking point. The serimeter also records the amount of stretch of the thread from the moment the pull comes on it until it breaks. This is called the *elongation*, and is indicated on a scale graduated in millimeters. When a number of threads have been tested, the average breaking point is calculated from the results, and the variations of the individual values from this average are carefully noted. If the variations are small, the silk is considered to be even. Then, after determining the elongated length of the sample, that is, its length at the breaking point, the difference between its original length and the elongated length is found, and this is expressed as a percentage of the original length. It may be added that the serimeter test as described in this Section is performed primarily to ascertain the evenness of the threads. In this case, the elongation of the silk is not considered and, therefore, no further mention need be made, since it will be described in a following test.

**4. Selection of Samples.**—If the silk to be submitted to the serimeter test is not to be subjected to other tests, the bale is opened and at least ten original skeins are drawn. This is very carefully done, so that no two skeins will be taken from the same book. The skeined silk must then be wound on bobbins and prepared in smaller skeins similar to the sizing skeins. If a sizing test has previously been made on the silk, ten sizing skeins may be selected. Giving the silk a sizing test before testing it on the serimeter accomplishes a double purpose; namely, it gives a check on the size as reported by the seller, and it is a preparatory process for the serimeter test.

**5.** After the ten sizing-test skeins have been obtained, each skein is cut and opened out flat on a table, so that the threads will lie parallel and in one length. Ten single threads, or strands, are then selected from each cut skein and kept in separate groups. As each single thread is drawn from the cut skein, it is very carefully examined. If it contains any cleanness defects, such as waste, bad casts, slugs, long knots, loops, and so on, it should be rejected immediately and another thread substituted in its place. Sufficient emphasis cannot be laid on the fact that only perfect threads devoid of any defects in cleanness should be selected. For, in the serimeter test, only the evenness quality of the thread is to be found; hence, threads containing cleanness defects are not submitted. After ten clean threads have been selected from each of the sizing skeins, 100 single test threads will be ready for the test. Each thread is tested individually and the test results are recorded separately.

Because the serimeter test is employed only in the determination of the physical qualities of the thread, silks that have been subjected to previous tests affecting its physical qualities should not be used. For this reason, silks that have been subjected to the conditioning test, the conditioned sizing test, or the boil-off test should not be employed.

---

#### SERIMETER

**6. Construction and Operation.**—The serimeter is illustrated in Fig. 1. The column *a* that supports the working parts of the instrument is attached to an adjustable panel *b* and rests on the base *c*, the whole being enclosed in a case having glass sides and front. The front may be opened and swung back, as shown. The lower thread clamp *d* is at one end of a short counterweighted arm *e* pivoted on a pin carried by the movable carriage *f*. Pins *g* and *h* limit the movement of the arm *e*. The carriage and the arm are shown in the positions they occupy just before the thread to be tested is inserted. One end of the thread is passed around the upper clamp *i* and the screw is tightened to hold it firmly. The thread is then drawn down and looped under the post of the lower clamp *d*, and the free end is drawn upwards until the arm *e* is drawn away from the pin *h* and just touches the pin *g*, whereupon the clamp *d* is tightened. The thread is then held between the clamps with the correct initial tension.

**7.** The carriage *f*, Fig. 1, is controlled by a mechanism, not shown, so that it moves downwards at the rate of 80 centimeters per minute. It is connected to a piston moving in an oil dashpot, so that the movement will be very gradual and regular. Attached to the carriage is a bar *j*, to the upper end of which the scale *k* is fixed. As the carriage moves downwards, the scale *k* moves with it, and thus the elongation of the thread is determined. The upper clamp *i* is fastened to the lower end of a rod *l* that at its upper end is connected to the curved casting *m* by a flexible band that lies against the curved face of the casting. This is rigidly connected to the pointer *n*, arranged so as to swing along the graduated quadrant *o*, fixed to the column *a*.

**8.** The serimeter is set in operation by depressing the outer end of the lever *p*, Fig. 1, thus releasing the pointer *n*

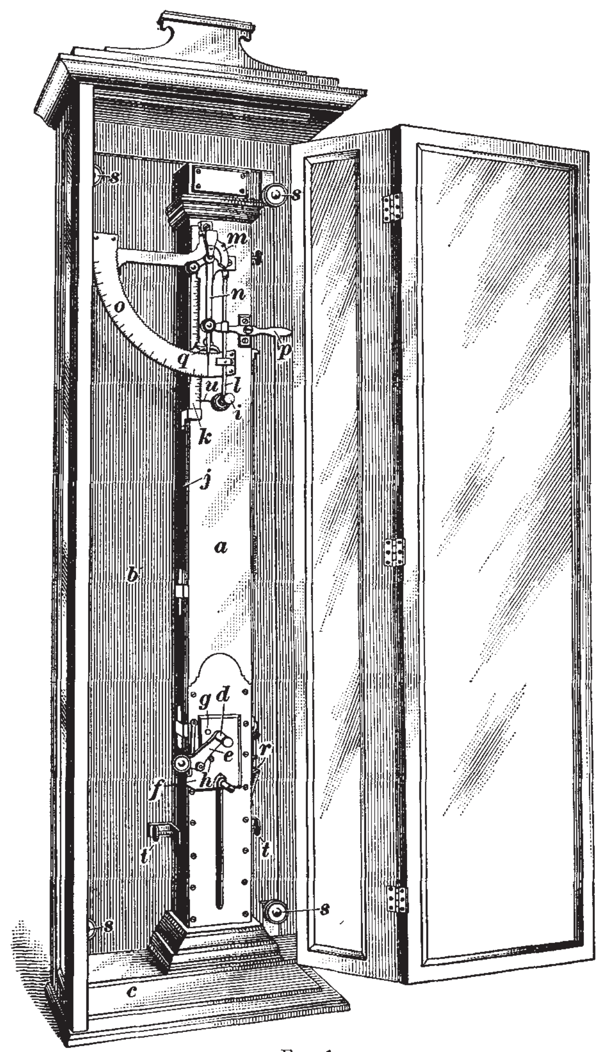



Fig. 1

and at the same time disengaging the catch that holds the movable carriage *f*. As the carriage descends, increasing tension is placed on the thread held between the clamps; and the pull exerted on the thread is transmitted through the rod *l* to the casting *m*, causing the pointer to swing to the left. The amount of swing is proportional to the pull exerted on the thread. The pointer carries near its lower end a light pawl *q* that moves over a ratchet cut on the inner edge of the quadrant *o*. When the breaking point is reached, and the thread snaps under the increasing tension, the pawl catches in the ratchet and holds the pointer in position until the reading can be observed. The pawl is then lifted and the pointer is swung back to its original position.

**9. Preliminary Adjustments.**—Care should be taken to insure that the column of the serimeter is plumb before a test is begun. A plumb bob *r*, Fig. 1, is suspended by a line from a support near the top of the column *a*. When the column is vertical, the point of the plumb bob is directly over a mark on the side of the instrument. Screws *s* at the top and the bottom enable the panel *b* and the column *a* to be moved outwards at top or bottom, and screws *t* permit sidewise adjustment of the column. These screws are adjusted until the plumb bob is over the permanent mark on the instrument.

**10.** Before the test is started, the lower end of the scale *k*, Fig. 1, must be set opposite the pointer *u*, as shown. The pointer *n*, likewise, must be set to the zero on the quadrant scale. The distance between the centers of the clamps, when the instrument is correctly set, is 50 centimeters, or about 20 inches, which is the length of thread to be tested. The clamps should be tightened with just enough pressure to hold the thread. If they are screwed up too hard, the thread may be damaged at the point where it leaves the clamp. If a thread is thus damaged, it should be loosened and then replaced in such a way that the damaged part is not in the length under test. Before the lower clamp is tightened, all kinks or curls should be removed from the thread. Just before the machine is started, the thread should be given a final inspection. If any defects are noted, the strand should be removed and a new one from the same skein should be inserted.

#### SERIMETER REPORTS

**11. Laboratory Record.**—A form of laboratory record used in connection with the serimeter test is shown in Fig. 2. The data given indicate that exactly 100 strands of silk were broken on the serimeter. The breaking strength of each was taken to the nearest 5 grams; that is, if it required 32 grams to break a thread, 30 grams was considered as the breaking strength; if it required 39 grams, the breaking strength was taken as 40 grams. As each thread broke, it was recorded by a downward mark in the column indicating the number of breaks $N$, and on the same line as the value in the first column indicating the breaking strength $G$. When the fifth thread broke, a cross mark was made through the upright ones, so that the number of breaks could be counted quickly. As illustrated, one thread broke at 30 grams; three at 35 grams; six at 40 grams; and so on. The product of the breaking point, in grams, and the number of breaks, represented by $G \times N$, is obtained and written in the product column. These products are added and their sum 5,655, is divided by 100, the total number of breaks; thus, $5{,}655 \div 100 = 56.55$ grams, which is the average breaking point of the silk. In the double column headed *Frequency*, the number of breaks is marked under *No.*, and the corresponding breaking strengths under *Grams*. These two columns, therefore, are practically a transfer of the values in the first and second columns.

**12.** A graphical representation of the breaking points of the threads tested may be obtained by constructing a diagram, as shown at the right of the record, Fig. 2. The lowest recorded breaking strength was 30 grams, and the highest was 75 grams. The values from 30 to 75 are therefore set down in the first column of the right-hand section of the record, on the same horizontal lines as in the first column. At the heads of the next six columns are placed numbers from 5 to 30, increasing by 5, to indicate the number of breaks. The width of each square thus represents five breaks. Now, only one strand broke at 30 grams. So, in the square to the right of 30, a horizontal line is drawn one-fifth of the way across the square to represent by its length one break, because the total width of the square represents five breaks. Three strands broke at 35 grams; so, in the square opposite 35 a line is drawn three-fifths of the way across the square. The remaining

**LABORATORY RECORD**

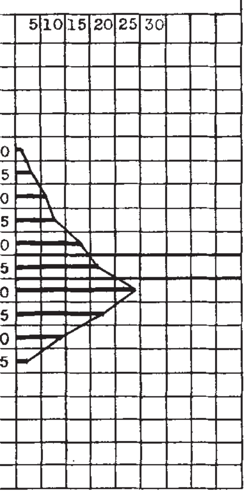
**Serimeter Test**

**Test Number** **Order Number** **Date** **Kind**

**Marks** **Bale Number** **Chop**

**TEST**

| Breaking Point Grams (G) | Number of Breaks (N) | Product GxN | Frequency Grams | No. | DIAGRAM |
|---|---|---|---|---|---|
| 5 | | | | | |
| 10 | | | | | |
| 15 | | | | | |
| 20 | | | | | |
| 25 | | | | | |
| 30 | I | 30 | 30 | 1 | 30 |
| 35 | III | 105 | 35 | 3 | 35 |
| 40 | 卌 I | 240 | 40 | 6 | 40 |
| 45 | 卌 III | 360 | 45 | 8 | 45 |
| 50 | 卌 卌 III | 650 | 50 | 13 | 50 |
| 55 | 卌 卌 卌 I | 880 | 55 | 16 | 55 |
| 60 | 卌 卌 卌 卌 IIII | 1440 | 60 | 24 | 60 |
| 65 | 卌 卌 卌 III | 1170 | 65 | 18 | 65 |
| 70 | 卌 IIII | 630 | 70 | 9 | 70 |
| 75 | II | 150 | 75 | 2 | 75 |
| 80 | | | | | |
| 85 | | | | | |
| 90 | | | | | |
| 95 | | | | | |
| 100 | | | | | |
| Total Products | | 5,655 | | | |
| Average Breaking Point | | 56.55 | | | |




Tested by__________

Computed by__________

Fig. 2

lines are drawn by applying the same method to the other values in the frequency column, and the outer ends of the lines are joined, as shown. The diagram thus obtained shows at a glance the results of the test.

**13.** After the diagram has been drawn, the line representing the average breaking strength is frequently indicated. In Fig. 2, the average breaking point is 56.55 grams, which would be 55 grams if taken to the nearest 5 grams. So, the horizontal lines at the top and bottom of the square designating 55 grams are made heavier on the diagram. The eyes are quickly attracted by the prominence of these heavy lines, and thus the line representing the average breaking strength may readily be found.

**14. Interpretation of Results.**—The degree of evenness of the silk subjected to the serimeter test may be judged by a brief glance at the diagram drawn on the laboratory record. For example, take the diagram in Fig. 2. The average breaking strength is 55 grams, as indicated by the length of the line designated by the including heavy lines. A glance shows that the greater number of threads tested broke at loads that were close to the average. Hence, it is concluded at once that the silk is fairly even. If the lines at the lower breaking strengths were long, indicating many breaks at these values, the silk would be regarded as uneven, because it obviously contained many weak threads. In any diagram, therefore, if the bulk of the longer lines lie close to the line of average breaking strength, the silk may be regarded as even in size.

**15.** When the size of the silk is taken into consideration, a comparison may be made between the actual breaking point as found by testing and a theoretical breaking point, in order to determine whether the silk is as strong as its size indicates. This is done as follows: The average size may be taken, as given by the seller, or as found by a regular sizing test, and multiplied by a constant, the product being the theoretical breaking strength of that size of silk, in grams. For example, it is considered that a thread carefully reeled from healthy silk should support 4 grams for every denier of size; hence, a 14/16-denier silk, having an average of 15 deniers, should support $4 \times 15 = 60$ grams before breaking. The difference between the average breaking point and the grams per denier that the thread should support will give the relative strength of the thread.

## SERIGRAPH TEST

### PRELIMINARY CONSIDERATIONS

**16. Nature of Test.**—The serigraph is similar in many respects to the serimeter; but whereas the serimeter is used to test single strands, the serigraph is used to test a sample composed of several hundred parallel strands. In other words, the serigraph tests a group of threads at one time, and the average result is obtained from the records of the test. The purpose of the serigraph test is to determine the tenacity, elasticity, and elongation of the thread. The tenacity is the pull, in grams per denier, required to break a single thread. Elasticity is the greatest pull, in grams per denier, that the thread will sustain before its physical properties are permanently affected. Elongation is the stretch, or increase of length of the thread from the time the test starts until the breaking point is reached.

**17. Selection of Samples.**—The samples employed in the serigraph test are selected from the sizing test skeins. Ten sample skeins are used and these are picked at random from the thirty skeins prepared in the regular, or 450-meter, sizing test, or from the sixty sizing skeins reeled in the American, or 225-meter, sizing test. However, two precautions must be observed. First, skeins that were twisted too tightly in the sizing test should not be employed, for the gum is likely to be injured in places and that will depreciate the physical qualities of the thread. Secondly, it is imperative that silks subjected to a conditioned sizing test should not be used, for it is possible that the heat of the conditioning oven may affect the physical qualities of the thread.

**18. Preparation of Samples.**—The skeins selected for the serigraph test will be found to be twisted tightly; so they must be opened carefully and hung in a room in which a standard atmosphere is maintained, until they assume a standard condition. They are next weighed individually on a denier balance. The weights are taken to the nearest quarter denier and are recorded on a working sheet. The skeins are cut with scissors, and the cut ends are drawn apart, so that the strands lie flat and parallel. One end of a group of such strands is wrapped carefully around a strip of soft cardboard, and spread out on the cardboard to a width of from $\frac{3}{8}$ to $\frac{3}{4}$ inch. The sample is then ready to be inserted in the serigraph to be tested.

---

### CONSTRUCTION AND OPERATION OF SERIGRAPH

**19. Testing Operation.**—The general appearance of the serigraph is illustrated in Fig. 3. It has two sets of jaws, or clamps, *a* and *b*, the upper ones attached to the mechanism for recording the pull on the sample, and the lower ones movable, so as to produce the necessary pull on the sample. The upper jaws *a* are opened by turning the hand wheel $a_1$, and the end of the sample, wound on the cardboard strip, is inserted. The hand wheel is then turned so as to close the jaws and grip the sample firmly. Great care should be taken not to damage the sample by drawing up the jaws too tightly. Only enough pressure should be used to hold all the threads firmly. Sometimes the flat face of each jaw is covered with friction tape, to prevent the sharp edges from coming in contact with the silk and causing thread breaks.

**20.** With one end of the sample held firmly in the jaws of the upper clamp *a*, Fig. 3, the threads should be stroked downwards gently with the fingers in order to straighten them and give them an even tension. The lower end of the sample should then be wrapped around another piece of soft cardboard and placed between the jaws of the lower clamp *b*. The clamp should then be securely tightened. The sample should again be carefully inspected to see that no threads are cut at the jaws and that the threads are uniformly taut. Furthermore, it is important to see that the portion of the sample not being tested does not interfere with the operation of the machine. After the sample has been properly inserted in both clamps of the serigraph, the machine may be started, which is done by shifting the starting lever *c*.

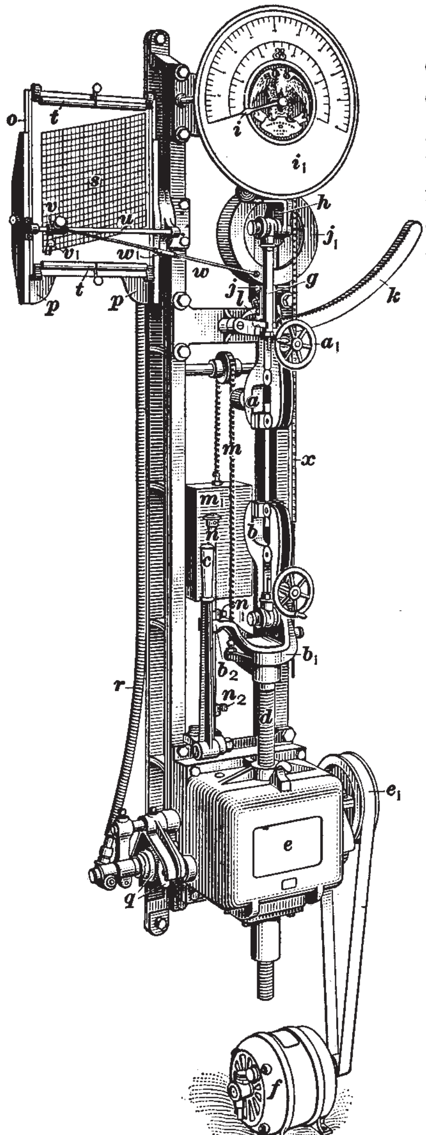


Fig. 3

**21.** The lower clamp *b*, Fig. 3, is attached to a casting $b_1$ on the upper end of the screw *d*. Inside the gear-box *e* the screw passes through a nut that may be rotated through gearing driven by the pulley $e_1$, which in turn receives motion from the electric motor *f*. The motor runs at a constant speed, and when the starting lever *c* is moved, a clutch inside the gear-box connects the shaft of the pulley $e_1$ and the nut on the screw *d*. The nut is then rotated by the motor and the screw is drawn steadily downwards, carrying the casting $b_1$ and the clamp *b* with it and putting a gradually increasing pull on the sample held between the clamps. The speed of the motor is such that the lower clamp descends at the rate of 15 centimeters, or about 6 inches, per minute.

**22.** The increasing pull on the sample, caused by the downward movement of the clamp *b*, Fig. 3, is transmitted to the upper clamp *a*, which is connected by a bar *g* to the casting *h*.

This casting is attached to the mechanism that actuates the pointer $i$; thus, the pull on the sample swings the pointer and registers the amount of the pull on the dial $i_1$. The casting $h$ is also connected to a rod $j$ that is pivoted near its upper end and carries at its lower end a heavy weight $j_1$. The downward pull on the sample causes the rod $j$ and its weight $j_1$ to swing outwards along the quadrant $k$; thus, the farther the weight is swung, the greater is the tension in the sample and the greater is the reading indicated on the dial. A pawl $l$ is attached to the rod $j$ and the upper face of the quadrant is toothed to form a ratchet. When the test sample breaks, the pawl catches in the ratchet and holds the weight in its outward position until the reading can be made from the dial. The pawl is then released and the weight and its arm are swung back to the starting position.

**23.** The casting $b_1$, Fig. 3, has an arm to which is fastened one end of a chain $m$ that passes over a small pulley and carries at its other end a heavy weight $m_1$. The purpose of this weight is to exert a constant upward pull on the screw $d$ and thus take up any backlash, or looseness, that may exist between the screw and its nut by reason of wear. Absence of backlash insures that the test sample will be subjected to a steady pull. The casting $b_1$ has another arm $b_2$ that is forked at its end to fit around the vertical control rod $n$, on which are two adjustable collars $n_1$ and $n_2$. The upper collar $n_1$ is so placed as to be in contact with the arm $b_2$ when the machine is in the starting position. The lower collar $n_2$ is so placed that the arm will strike it after the test sample breaks. The rod $n$ is connected to the clutch mechanism inside the gear-box. When the arm $b_2$ strikes the collar $n_2$, the clutch is thrown and the movement of the screw $d$ is reversed, so as to return the lower clamp to its original position for the next test. On the return travel, the movement of the screw is stopped when the arm $b_2$ strikes the upper collar $n_1$ and moves the control rod $n$.

**24. Autographic Recorder.**—A graphic representation of the pull exerted on the sample and the elongation resulting therefrom is recorded by the autographic device shown at the upper left-hand part of Fig. 3. A platen *o*, consisting of a flat metal plate, is held at the sides in guides formed in the bracket *p* fixed to the frame of the machine. The platen moves downwards in its guides in time with the descension of the screw *d*. This movement is communicated to the platen by the gears *q* and the flexible shaft *r*, which are driven by the motor *f* through the gear-box *e*. The downward movement of the platen therefore corresponds to the amount of elongation of the test sample. The platen carries a ruled chart *s* that is held firmly at top and bottom by spring clips *t*. The paper sheet or chart is thus readily removable.

**25.** Across the face of the platen, Fig. 3, extends a rod *u* held rigidly by the bracket *p*. On this rod is a slide *v* that carries a pen $v_1$. The slide is connected by a light rod *w* to the weight $j_1$; consequently, the outward swing of the weight under the increasing pull on the sample causes the pen to be drawn to the right across the face of the chart. The platen and its chart, it must be remembered, are moving downwards at the same time. The result is that the pen traces on the chart a curved line that extends in a diagonal direction across the chart. The distance of a point on this line from the lowest line of the chart indicates the elongation at that instant, and its distance from the left-hand vertical edge of the chart indicates the corresponding pull at the same instant. The scale to which the chart is constructed is clearly marked thereon, and thus the pull and the elongation at any point in the test may quickly be found from the line traced by the autographic recorder.

**26. Necessary Adjustments.**—Before a test is made, the serigraph should be leveled, which may be done by placing a spirit level on the rod *u*, Fig. 3, and adjusting the frame supports as required. The weight $j_1$ will then be in its lowest position and the pointer *i* should stand at zero on the dial; if it does not, it should be shifted until it does. The turnbuckle $w_1$ should be turned to lengthen or shorten the rod *w* until the pen $v_1$ is exactly at the left-hand edge of the chart; and the chart should be adjusted under its clips until the left-hand end of the lowest line is directly under the pen. The distance between the upper and lower clamps of the machine at the beginning of a test should be 10 centimeters, or about 4 inches. This distance may be checked by the flat steel tape *x*, which is fastened to the lower clamp and is wound on an automatic take-up at its upper end. This graduated tape also enables the speed of descent of the lower clamp to be determined.

**27. Details of Operation.**—It is customary to depress the control rod *n*, Fig. 3, by hand as soon as the sample breaks. If this is not done, the continued movement of the lower clamp will cause the pen of the autographic recorder to trace a vertical line on the chart. This vertical line is of no value, but simply represents the travel of the lower clamp after the sample breaks and until the arm $b_2$ strikes the collar $n_2$ and reverses the movement of the clamp. If desired, the chart may be used to record several tests. In such a case, the platen is moved vertically so that the second recorded curve starts at the left-hand end of the second line from the bottom, the third curve at the end of the third line, and so on.

It will be observed that the dial has two scales. When the serigraph is fitted with a single weight $j_1$ as shown, and known as the half-weight, the pull is read from the inner scale on the dial. When a second weight is added, producing what is termed the full weight, the pull is read from the outer scale. Both scales are graduated in kilograms, the outer one reading from 0 to 50 and the inner one from 0 to 25.

**28. Yield Point.**—The line traced on the chart by the pen of the autographic recorder is straight for some distance from the start, or zero position of the pen. The reason is that, for a time, the rate at which the pull increases is the same as the rate at which the sample stretches. But, at some point in the test, the sample will begin to give way under the pull, and the rate of stretch will be greater than the rate of increase of pull. When that point—known as the yield point—is reached, the line traced by the pen will change slightly from the direction of the straight part thus far recorded. Because this departure from the straight line can be readily seen on the chart, the yield point may be determined quite accurately. Beyond the yield point the curve departs still more rapidly from the straight line until the sample breaks. The yield point is sometimes called the *elastic limit*, because it is the point up to which the sample would return to its original length, due to its elasticity, if the pull were removed.

**29. Care of Serigraph.**—It is very important that the serigraph be kept clean and free from rust. The various moving parts that are subjected to friction should be lubricated with machine oil of medium viscosity. Grease should not be used. Should there be a tendency for the pen to blot, or clog, it should be cleaned thoroughly and filled with a fresh supply of ink; in fact, this should be done periodically to prevent difficulties that may be caused by clogged pens. In addition, the machine should be tested from time to time to determine the accuracy of the reading on the dial. A test weight of known weight may be hooked to the upper clamp of the machine and suspended from it; then the weight registered on the dial should correspond to that of the test weight.

---

### SERIGRAPH TEST REPORTS

**30. Serigraph Chart.**—An illustration of a chart produced by the autographic recorder of a serigraph is shown, to a reduced scale, in Fig. 4. The actual size is $8\frac{1}{2}$ by 11 inches. On it are a series of equally spaced vertical lines cut by a series of parallel curved lines slightly inclined from the horizontal, dividing the area into a number of parallelograms of equal size. The object of curving the lines is to compensate for the slight downward movement of the upper clamp during a test. The height of each space represents an elongation of $\frac{1}{2}$ centimeter, and the width of each space represents 1 kilogram of pull on the test sample. The fact that the scale of pulls in kilograms is marked from 0 to 25 indicates that this chart is to be used with the half-weight on the serigraph. But it may also be used with the full weight. In the latter case, the pull recorded on the chart must be multiplied by 2 to obtain the actual pull on the test sample. The full-weight chart is similar to that shown, except that the lowest line is graduated from 0 to 50; hence, the width of each space represents a pull of 2 kilograms.

**31.** The interpretation of the chart depends on the weight used on the serigraph and the number of threads in the test

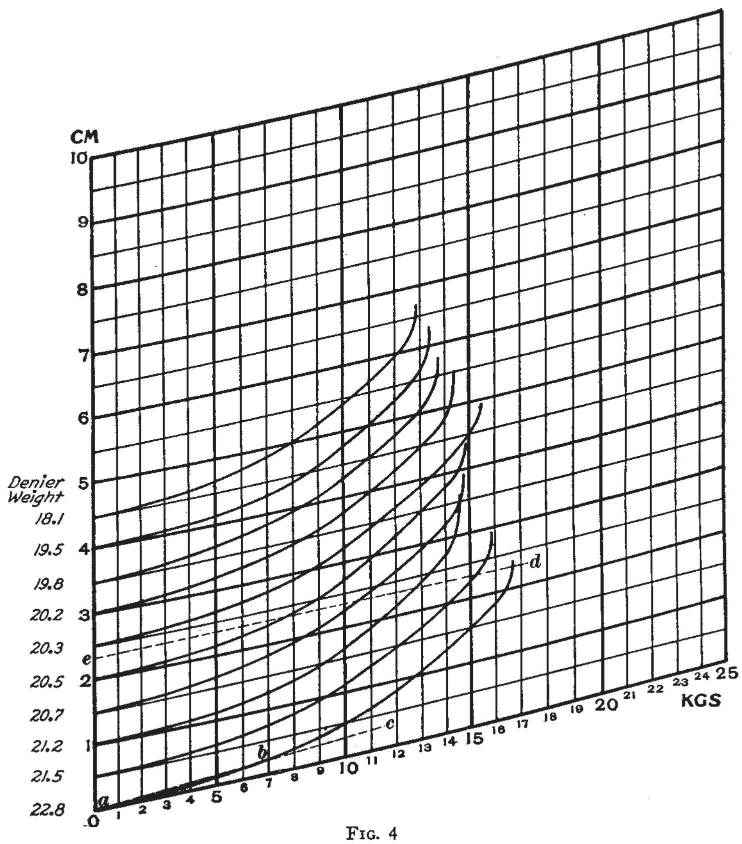



FIG. 4

sample. As a rule, the full weight is used on the machine, and the sample contains 400 threads, although 200-thread samples are occasionally used. Regardless of the weight or the sample, the record is generally made on a half-weight chart like that shown in Fig. 4. With the half-weight and a 400-thread sample, the results are read directly from the scales on the chart.

It is customary to use the half-weight with 200-thread samples, the length of curve thus obtained being approximately the same as with the full-weight and 400-thread samples; consequently, the pull indicated on the chart must be multiplied by 2 to obtain the actual value.

**32.** When coarse threads are tested, the breaking strength is sometimes so great that the recording pen runs off the right-hand edge of the chart before the sample breaks; in other words, the charted record is incomplete. To overcome this difficulty, the full weight should be substituted for the half-weight. By thus doubling the pull on the sample, the length of the curve traced by the recording pen is greatly reduced. However, if the breaking force or pull is read from the scale on the bottom line of the chart, it must be multiplied by 2 to give the true value. It should be noted that, no matter whether the half-weight or the full weight is used, the elongation is always read directly from the scale at the left-hand edge of the chart.

**33.** The curves shown in Fig. 4 are the records of ten tests. Each sample contained 400 threads; therefore, the test skeins were drawn from those of the 450-meter sizing test. The serigraph was fitted with the full weight, and so the results indicated on the chart must be multiplied by 2. As the curves are similar, a description of the characteristics of one will be sufficient. After the chart was removed from the platen, the denier weight of each sample was written opposite the curve for that sample, as shown at the left-hand margin. Let the sample having a weight of 22.8 deniers be chosen for description. From the start of the test, indicated by the point $a$, the curve is very nearly a straight line as far as the point $b$, as may be seen by comparing it with the straight line $a\,c$. The point $b$, where the curve begins to depart from an approximately straight line, is the yield point. It lies on the vertical line denoting a pull of 7 kilograms; hence, the pull on the sample when the yield point is reached is $2 \times 7 = 14$ kilograms.

**34.** The yield point *b*, Fig. 4, indicates the point at which the sample begins to be permanently stretched by the pulling force; consequently, beyond this point, the elongation increases more rapidly than the pull, and the curve departs still further from the straight line. At the point *d*, where the direction of the curve changes to vertical, the rupture of the sample occurs. This is the breaking point, and corresponds to a value of 16.7 kilograms on the scale, or to an actual breaking strength of $2\times16.7=33.4$ kilograms. The elongation is determined by using the scale at the left-hand edge of the chart. The line *d e* is drawn from *d* parallel to the cross-lines of the chart. The distance from *a* to *e* then corresponds to slightly over four vertical spaces on the vertical scale, or about 2.3 centimeters, which is the elongation of the sample at the breaking point. As the elongation is usually expressed in millimeters, its value in this case is 23 millimeters.

**35. Serigraph Report.**—The results of the serigraph test, as indicated on the dial of the machine and recorded on the chart, are generally transferred to a working sheet or laboratory report at the conclusion of each test, in the manner illustrated in Fig. 5. The test skeins are numbered in order to distinguish them, and these numbers are recorded in the first column. The weights of the skeins, in deniers, are placed in the second column. When 450-meter skeins are used, the weights found by the quadrant balance also represent the denier sizes. The third column contains the breaking strengths of the samples, which are read from the dial after rupture occurs, or may be found from the chart. In the case illustrated, the values are taken from the chart, Fig. 4, the readings on the chart being multiplied by 2 to obtain the actual values. For instance, the lowest curve on the chart, representing No. 1 skein, has a breaking point corresponding to 16.7 on the scale; hence, the actual breaking strength is $2\times16.7=33.4$ kilograms, as recorded in the third column, Fig. 5.

**36.** The fourth column, Fig. 5, contains the values of the pull on each sample at its yield point, and these are found from the chart, Fig. 4. For No. 1 skein, the yield point is reached at *b* corresponding to a pull of 7 kilograms as shown on the lower scale. Therefore, the actual pull is $2 \times 7 = 14$ kilograms, which is recorded in the fourth column, Fig. 5. The fifth and sixth columns show the tenacity and elasticity, respectively, each being expressed in grams per denier. The tenacity is found by dividing the breaking strength, in grams, by the product of the denier weight and the number of strands in the sample, which is 400. For skein No. 1, the breaking strength

SERIGRAPH TEST

Sample Length......................10 cm.

Strands per Sample........................400

| Number of Skein | Weight Deniers | Breaking Strength Kilograms | Yield Point Kilograms | Tenacity | Elasticity | Elongation | |
|---|---|---|---|---|---|---|---|
| | | | | Grams per Denier | | Milli-meters | Per Cent. |
| 1 | 22.8 | 33.4 | 14.0 | 3.66 | 1.54 | 23 | 23 |
| 2 | 21.5 | 31.6 | 13.2 | 3.67 | 1.53 | 22 | 22 |
| 3 | 21.2 | 29.0 | 12.8 | 3.42 | 1.51 | 23 | 23 |
| 4 | 20.7 | 29.4 | 11.0 | 3.55 | 1.33 | 22 | 22 |
| 5 | 20.5 | 29.8 | 11.4 | 3.63 | 1.39 | 23 | 23 |
| 6 | 20.3 | 30.8 | 11.8 | 3.79 | 1.45 | 24 | 24 |
| 7 | 20.2 | 28.6 | 12.0 | 3.54 | 1.49 | 22 | 22 |
| 8 | 19.8 | 27.2 | 10.6 | 3.43 | 1.34 | 20 | 20 |
| 9 | 19.5 | 26.6 | 11.8 | 3.41 | 1.51 | 20 | 20 |
| 10 | 18.1 | 25.6 | 10.0 | 3.54 | 1.38 | 19 | 19 |
| Total | 204.6 | 292.0 | 118.6 | 35.64 | 14.47 | 218 | 218 |
| Average | 20.5 | 29.2 | 11.9 | 3.56 | 1.45 | 21.8 | 21.8 |

FIG. 5

is 33.4 kilograms, or 33,400 grams, and the denier weight is 22.8; hence, the tenacity is $33{,}400 \div (22.8 \times 400) = 33{,}400 \div 9{,}120 = 3.66$ grams per denier, as recorded in the fifth column. The elasticity is found by dividing the pull at the yield point, in grams, by the product of the denier weight and the number of strands in the sample. For No. 1 skein it is $(14 \times 1{,}000) \div (22.8 \times 400) = 14{,}000 \div 9{,}120 = 1.54$ grams per denier, as indicated in the sixth column. The tenacity and elasticity, it will be noted, are based on the individual strand and not on the group forming the sample.

**37.** The elongations of the samples tested are recorded in the seventh and eighth columns of Fig. 5, the first giving elongations in millimeters and the other the elongations expressed as percentages of the original lengths. The elongations are found from the chart, Fig. 4, in the manner described in Art. **34.** The per cent. of elongation is found by dividing the elongation in millimeters by the original length of the sample, in millimeters, and multiplying the result by 100. All the samples were 10 centimeters, or 100 millimeters, in length. For No. 1 skein, then, the per cent. of elongation is $(23 \div 100) \times 100 = 23$ per cent., as recorded in the last column of Fig. 5. When the data for the ten skeins have been recorded on the report, the several columns are totaled and the totals are divided by 10, the number of skeins, thus determining the average values given in the last line of the report.

**38.** With group testing of strands, as in the serigraph test, the average result does not coincide with the result of a serimeter test on a single strand, because the group sample does not behave exactly as an individual strand. Results of many tests on both the serimeter and the serigraph show that the breaking strength of a number of threads tested in a group on the serigraph is approximately seven-eighths of the sum of the breaking strengths of the same number of threads of the same silk as found by testing them singly on the serimeter; in other words, the serimeter test gives higher values of the breaking strength. Thus, if a serigraph test shows a sample to have a tenacity of 3.56 grams per denier, it is probable that a serimeter test of the same silk would show a tenacity of $3.56 \div \frac{7}{8} = 4.07$ grams per denier.

**39.** In the fifth column of the record, Fig. 5, the tenacity in grams per denier is that of one strand of silk. Should it be desired to calculate the average tenacity per strand for the denier size of the silk, instead of the grams per denier, the breaking strengths of the ten skeins are totaled and from this the average breaking strength is obtained. The result, if in kilograms, is changed to grams by multiplying by 1,000. The product divided by 400, or the number of strands in one sample, gives the average breaking strength of the individual strands. When the results given in the record are used, the average breaking strength is found to be 29.2 kilograms, or $29.2 \times 1,000 = 29,200$ grams. Since this is the average breaking strength of the skeins and each is composed of 400 strands, the average breaking strength per strand is $29,200 \div 400 = 73$ grams.

**40.** As a rule, a carefully reeled thread of healthy silk should register a tenacity of $3\frac{1}{2}$ grams per denier when tested on the serigraph. A thread of this kind would be considered as having good quality in regard to tenacity. When the average tenacity is between 3 and $3\frac{1}{2}$ grams, the silk is considered poorer in quality than the first-mentioned silk, while if the tenacity is less than 3 grams the thread is referred to as weak. In addition to the tenacity, the average elongation of the thread is also taken into consideration in determining quality. This is usually stated in percentage, and represents the relative stretch of the sample. When tested silks show an average elongation of 20 per cent. or more, they are classed as good. Silks having an average elongation of less than 16 per cent. are considered as poor in this respect.

The comparison of test results with actual mill reports concerning the manner in which the silk runs, soon enables the tester to formulate a table giving the relative tenacity and elongation of different grades of silk. But this should be prepared only after a great number of tests have been made, so that a suitable average result will be obtained. After a table has been compiled, the test results of a new lot of silk may be compared with the tabulated record and an opinion of the workable qualities of the silk may readily be formed.

## GAUGE TEST

### PRELIMINARY CONSIDERATIONS

**41. Defects of Raw-Silk Singles.**—Only the central layers of silk are reeled from the cocoon to produce commercial raw-silk singles, for the reason that the filaments composing the outer and inner layers vary too greatly in diameter; yet even the reelable portion varies somewhat in diameter throughout its length. However, when several cocoon ends are combined to form a single, the union of the coarse parts of one and the fine parts of another tends to produce a thread of approximately uniform size. But, if all the cocoon ends are coarse, a coarse, or heavy, single will be formed; and if the cocoon ends are fine, a light single will result. Variation in the size of the single will also be found if too many cocoon ends are combined or if one or more ends break. The raw-silk single may also contain reeling defects such as waste, corkscrews, poor knots, and bad casts; and such defects as nibs and slugs may be found, these originating at the time the filament is spun by the silkworm.

**42. Purpose of Gauge Test.**—As the manufacturing qualities of a raw-silk thread and the quality of the resultant product depend to a large extent on the uniformity of diameter of the thread, it is desirable to test the silk to determine the number of defects in a specified length. Such a test is made by reeling off a certain length of thread, passing it through gauges that catch and detect the faulty portions, and recording the number of such defects; also, the kinds of defects are determined by examination and are recorded. The *mirror test*, which has the same purpose as the gauge test, is sometimes made. In it the silk is wound on black cardboard and the threads are then carefully examined for defects. The number found, however, depends greatly on the sharpness of vision of the inspector. The defects that are discovered are then classified according to the judgment of the inspector.

#### GAUGE REEL

**43. Construction and Operation.**—The gauge test is made on the gauge reel, shown in Fig. 6, which is similar in many respects to the sizing reel described in a preceding Section. The bobbins *a* are placed on pins in the bobbin

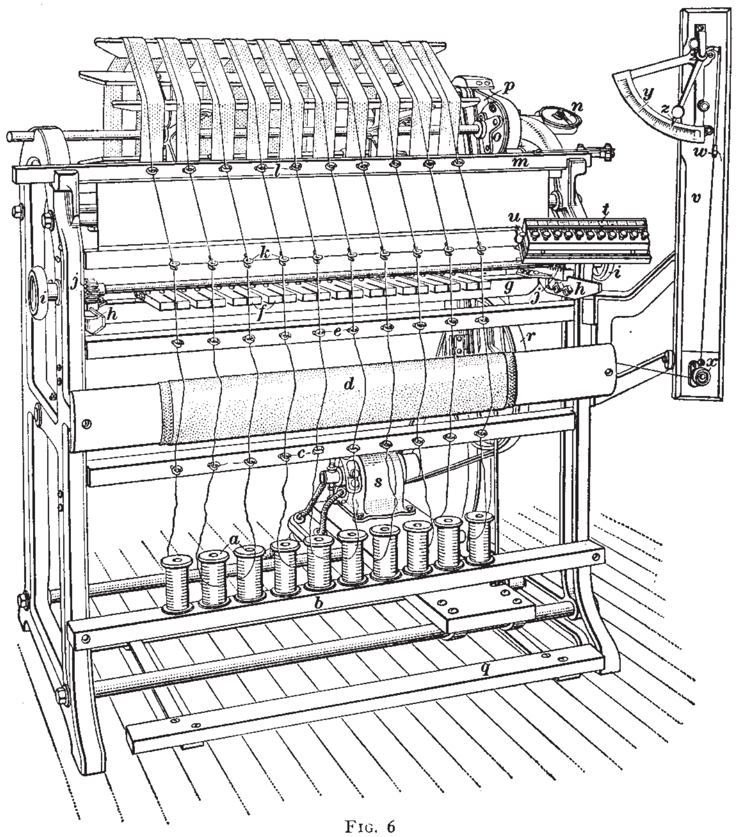



Fig. 6

shelf *b* bolted to the end stands, and the thread from each is led through a pigtail guide *c* directly above the center of the bobbin. It then passes over the plush-board *d*, by which the desired tension is produced in the thread, and is carried upwards through the pigtail guide *e*. Above the guide *e* it enters the slot of the gauge *f* by which the defects are caught. There are ten of these gauges all fixed to a bar *g* that is carried on slides *h* at the ends. By turning either hand wheel *i*, the gears *j* may be rotated, causing the bar *g* to move in or out on its slides. In the position shown, it has been moved back, so that the threads do not pass through the slots in the gauges.

**44.** Above the gauges *f*, Fig. 6, the threads pass through the guides *k*, thus, the guides *e* and *k* compel the threads to travel in a straight line through the gauges. Finally, the threads are led through the guides *l* fixed to the traverse bar *m* and are tied to one of the arms of the reel. A reciprocating motion is given to the traverse bar, so that Grant-reeled skeins are formed on the reel. The number of revolutions of the reel, and consequently the yardage of the skeins, is registered by the measuring device *n*. The reel shaft carries a pulley *o* that is driven by contact with a belt *p* that may be swung against it. The belt *p* is carried by an upper and a lower pulley attached to a frame that may be swung by pressing on the treadle *q*. The lower pulley is on the same shaft as the pulley *r*, which is driven by the motor *s*; thus, the motor becomes the source of power for operating the reel. The speed is such that the thread is taken up at the rate of 250 yards per minute.

**45.** For convenience in tabulating the number and kind of defects found during the testing of silks, a counter *t*, Fig. 6, is attached to the frame of the machine in such a position as to be within easy reach of the operative. It has eleven separate push buttons, each of which operates an individual counter; thus, the number of each of eleven different defects may be recorded separately. The names of the various defects are placed on a strip of cardboard that is affixed to the machine, so that the name of each kind of defect will be above the counters. At the completion of a test the readings of the separate counters are recorded on a sheet and the counters are reset to zero by turning the key *u*.

**46.** To facilitate testing the evenness of threads to determine whether they may be classed as weak or coarse, the gauge reel is provided with a serimeter *v*, Fig. 6. Its operation is similar to that of the serimeter illustrated in Fig. 1, but its construction is much simpler so that tests may be made with greater speed. Thus to operate it, the attendant fastens the end of silk under the binding post *w*, Fig. 6, and guides the thread downwards and beneath the grooved pulley *x*. Then the thread is slowly pulled toward the left by hand at a uniform speed until it breaks. The number of grams of pull required to break the sample is registered on the quadrant *y* by the position of the pointer *z*. After the breaking strength has been read and recorded, the serimeter is reset to zero in readiness for the next test.

**47. Construction of Gauges.**—The gauges *f*, Fig. 6, are of the form shown in Fig. 7. Each consists of two blocks *f* of hardened steel firmly held together at one end by the bolts $f_1$ and $f_2$. Each block is about 6½ inches long, 1 inch wide, and ½ inch thick. The inner adjacent faces of the blocks are ground off at a very slight angle, so that, when the gauge is put together as shown, a slot is formed between the blocks, its width increasing gradually from $f_3$ to $f_4$. A scale is marked along one edge of the slot and is graduated from 10 to 30. When the gauge is properly adjusted, the width of the slot at the point 10 on the scale is such as to accommodate a 10-denier thread and at the point 30 it will accommodate a 30-denier thread. When all the gauges are bolted to the bar *g*, Fig. 6, the hand wheel *i* is turned and the gauges are moved out until the threads pass through the slots at the points on the scale designating the denier size of the silk being tested. If the thread is too large, or if it contains defects, it will catch in the slot and be broken. The opening $f_5$, Fig. 7, allows a thin feeler blade to be inserted and drawn along the slot from $f_3$ to $f_4$ to clean it of accumulated dirt.

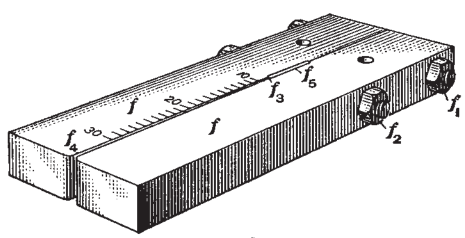


Fig. 7

**48.** The gauges are made heavy in order to prevent warping by changes of temperature or internal stresses set up in the metal during manufacture of the gauges. They are correctly adjusted when they leave the maker, but mishandling during shipment may necessitate readjustment before they are used. To adjust a gauge, the bolts $f_1$ and $f_2$, Fig. 7, are loosened. Then the bolt $f_1$ is drawn up as firmly as possible, thus holding the blocks together at the rear ends. The adjustment of the width of the slot is accomplished by tightening the bolt $f_2$. Two thin strips of steel about $\frac{3}{32}$ inch wide, called feeler blades, are used; one of these is .003 inch thick and is inserted in the slot at the 27-denier mark and the other is .002 inch thick and is inserted at the 12-denier mark. Each feeler has a small weight at its lower end. The bolt $f_2$ is gradually tightened, drawing the blocks together until the weighted feeler blades are gripped in the slot just tightly enough to prevent their falling out and yet allow them to be moved up and down easily.

**49.** The gauges are carefully ground and highly polished during manufacture, and in adjusting them care must be taken not to scratch or damage them, as such scratches will tend to injure the silk and cause breaks. Feeler blades of the correct sizes must be used in making adjustments, and they must not be bent or otherwise defective; blades that are not perfectly smooth should be discarded and replaced by new ones. Before making a test it is advisable to clean the accumulated dirt and dust from the slot. This is usually accomplished by inserting a strip of strong tissue paper in the slot near the fine end, and drawing it toward the coarse end. But sometimes, during a test, the gauges become clogged with waste, dirt, and silk gum, and because of the firmness with which they are lodged between the blades, tissue paper cannot be used to remove them. In such a case, a metal cleaner blade about $\frac{1}{2}$ inch wide and .0015 inch thick is used, as greater force may be applied to it than to the tissue paper.

**50. Details of Drive.**—The manner in which the gauge reel is driven may be better understood from a study of the diagrammatic view, Fig. 8. The pulley *o* is on the end of the reel shaft and the pulley $r$ is driven by the motor $s$. On the same haft $r_1$ with the pulley $r$, and turning with it, is a small pulley $r_2$ connected by the belt $p$ to a pulley $r_3$ that rotates in bearings at the top of the swinging frame $r_4$. This frame is pivoted on the shaft $r_1$ and has a horizontal arm $r_5$ connected by the rod $r_6$ to the treadle $q$. In the position shown, the motor

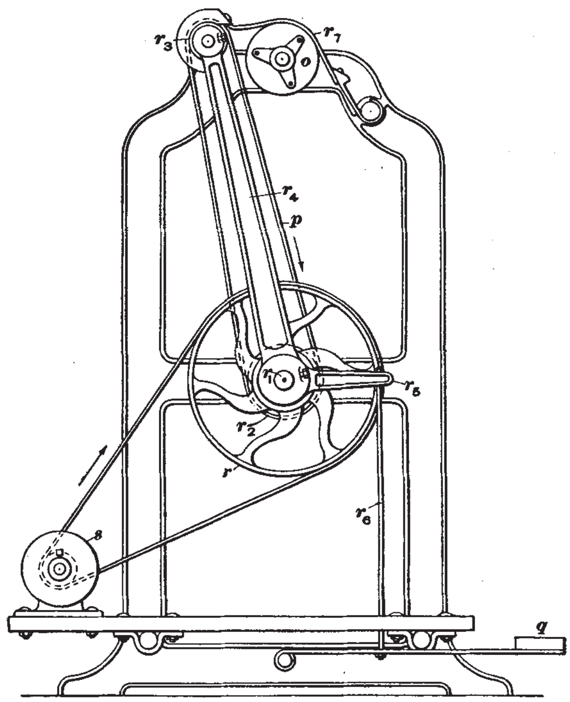



FIG. 8

drives the pulley $r$ and the belt $p$ runs in the direction indicated by the arrow. A brake $r_7$ attached to the upper end of the frame $r_4$ rests on the pulley $o$ while the reel is stationary. When the treadle $q$ is depressed, the frame $r_4$ swings on the shaft $r_1$ and its upper end moves to the right, removing the brake from the pulley $o$ and bringing the moving belt $p$ against the pulley $o$, thus setting the reel shaft in motion. When the treadle is released, the frame swings back the brake is applied, and the reel stops.

### TESTING OPERATIONS

**51. Sampling.**—The number of samples drawn and their preparation for the gauge test are as described in Art. **4**, with one exception; namely, when winding silk that is to be used in the gauge test, breaks must be tied with a distinctive knot, such as a bow knot, so that they may be distinguished when the knots catch in the gauges during that test. Before tying such a knot, no thread is pulled from the broken ends; they are tied without attempting to remove the defective portion. The reason for making large knots when tying breaks made during the winding test is that they will be caught in the gauge test, and examination will disclose their cause. By examining the broken ends of the thread, the cause of the break during winding may be determined; but, if the silk were pulled from the skein and the bobbin before the knot was tied, the cause of the break could not be established.

**52. Details of Gauge Test.**—With the reel in motion, the gauges are adjusted so that the thread will pass through them at the point designating the average denier size of the silk. The reel is run a short time, until it is assured that the gauges have been correctly adjusted; then it is stopped and the measuring device is reset to zero. The reel is again started and the actual testing of the thread is begun, the machine being under constant observation of the operative. The reel is allowed to run until a defective thread catches in a gauge and breaks. As the reel is not equipped with an automatic stop-motion, the operative stops it by removing his foot from the treadle. The defective portion of the thread will be wedged in the gauge, while the other end will hang from the reel. The operative finds both ends, examines them, and determines the kind of defect that has caused the break. A large bow knot indicates that the thread broke during the winding operation; nevertheless, the broken ends are examined and the cause of their parting is determined and recorded. Of course, some experience is necessary to insure rapid classification of defects, for some of them are quite difficult to distinguish; but, by keenly observing the defects and comparing them with plates of specimens furnished with each machine, the defects may be accurately listed.

**53.** After tying the break, the operative again sets the reel in motion, and at the same time allows the thread to slip into the gauge. The test is continued until another thread breaks, whereupon the foregoing operations are repeated. The number and kind of defects are recorded by pressing the proper buttons on the counting device attached to the machine. When the measuring device indicates 800 revolutions, the reel is stopped. The length of yarn wound on the reel during this time is 900 meters, which is equivalent to approximately 1,000 yards; and as there are ten skeins, the total yardage reeled during one period will be approximately 10,000 yards. Generally, three sets of skeins, each set 10,000 yards long, is prepared, so that a total of 30,000 yards of silk is tested. As a rule, this is considered sufficient to obtain a fair estimate of the defects; but when the results are doubtful—that is, when the results are quite varied—three additional sets of skeins are prepared so that a total of 60,000 yards is reeled. Upon completing the test the skeins are removed from the reel. If the silk is of good quality and contains few defects, so that the skein is comparatively free from knots, the tested silk may be returned to the bale from which it was drawn; but if an excessive number of knots are made, the silk is regarded as waste.

**54. Advantages of Mechanical Test.**—Detecting variations in the diameters of threads by means of silk gauges eliminates, to a certain extent, the human element in finding imperfections. Coarse portions will be caught, as an increase in diameter prevents the thread from passing through the gauge at the point designating its size. Fine threads are also generally caught; for, following the fine portion is usually a coarse portion resulting from the addition of a new cocoon end by the reeling girl. This coarse portion catches and breaks the thread, and an examination of both ends reveals that the break is caused by a coarse portion following a fine. Thus the imperfections are detected mechanically, and their correct classification is the only matter depending on the knowledge and experience of the operative. On the other hand, in mirror tests the defects must be discovered by the operative, or inspector, when examining the prepared silk. If he does not possess a keen vision, it is possible that many defects will be overlooked and only those of a serious nature will be noticed. Moreover, persons engaged in this work must be experienced, for detecting the different imperfections in raw silk is difficult. The lengths of silk employed in mirror tests are not so great as in the mechanical test; therefore the sample is not so thoroughly representative of the lot. Testing sufficient lengths is important especially in the higher grades of silk, for the defects in such silks are fewer and farther apart.

---

#### EVENNESS DEFECTS

**55. Variations in Evenness.**—Many defects are found in raw silk as it is imported from the producing country, but their numbers vary in accordance with the quality of the silk. It is known that silks of high quality usually have fewer defects than silks of a known inferior grade. To simplify the tabulation of the defects found by the gauge test, they may be divided into two groups, namely, evenness defects and cleanness defects. Evenness defects are related directly to the strength of the thread and may be recognized by the coarseness or fineness of the thread when compared with its average size. Coarse ends usually catch in the gauge and break the threads. Fine ends do not catch immediately; but as the diameter of the fine end increases, owing to the addition of new cocoon ends during reeling, the thickened thread generally catches in the gauge. An examination of the broken ends will usually disclose one as being fine.

**56.** Whenever an examination of the ends of a broken thread indicates that an evenness defect caused the break, the length of defective thread should be tested on the serimeter to determine its breaking strength. In this manner the actual strength of the silk may be easily ascertained. Since it is known that a strand of silk considered as healthy and strong has an average breaking strength of approximately 4 grams per denier, any variation from this breaking strength may be easily found by comparison with the result of the serimeter test.

The amount of variation from the average breaking strength may be found by the following rule:

**Rule.**—*Multiply the average denier size of the silk by 4 to obtain the average breaking strength, and from the product deduct the actual breaking strength as found by the serimeter test. Divide the difference by the average breaking strength and multiply the quotient by 100. The result will be the variation from the average breaking strength, expressed as a per cent. of the average strength.*

EXAMPLE.—A 13/15-denier silk that breaks during a gauge test is found to have a breaking strength of 42 grams by the serimeter. What is the difference, in per cent., of the average and actual breaking strengths?

SOLUTION.—The average size is 14 deniers, and, according to the rule, the average breaking strength is

$$14 \times 4 = 56 \text{ grams}$$

The difference between the average and actual breaking strength is

$$56 - 42 = 14 \text{ grams}$$

Then, the per cent. of variation below the average breaking strength is

$$\tfrac{14}{56} \times 100 = 25 \text{ per cent. Ans.}$$

**57.** Threads that contain evenness defects are classified, according to strength, as weak threads, very weak threads, coarse threads, and very coarse threads.

Weak threads are those which break at from 30 to 50 per cent. below the average strength of the thread.

Very weak threads are those which break at 50 per cent. or more below the average strength of the thread.

Coarse threads are those which catch and break in the gauges and the strength of which is from 30 to 50 per cent. above the average strength of the thread.

Very coarse threads are those which catch and break in the gauges and the strength of which is 50 per cent. or more above the average strength of the thread.

The thread mentioned in the example of the preceding article would be considered as of normal strength.

### CLEANNESS DEFECTS

**58.** Thread defects caused by improper or careless reeling, and also to a small extent by the worm itself, may be placed in a class known as cleanness defects; in fact, all defects other than evenness defects may be included in this group. Cleanness defects that originate in the reeling operation are often referred to as reeling defects, while those that are caused by the worm are known as cocoon defects. As a rule, reeling defects are quite noticeable, and so, they affect the quality of the finished material, more or less. Cocoon defects, on the other hand, are very small and are not so noticeable as reeling defects. Cleanness defects, because of the variety and the different sizes of the imperfections, are subdivided into two classes, known as *major defects* and *minor defects*. These have been described in another Section, and so they will only be named here. Major defects include waste, slugs, split threads, bad casts, and very long knots. Minor defects are smaller and are not so objectionable unless they occur with great frequency. Those which occur most frequently in raw silk are corkscrew threads, loops, nibs, and long knots.

---

### GAUGE TEST REPORTS

**59.** During the gauge test the defects are recorded on the counting device as they are discovered. These results are then transferred to a working sheet before the counter is reset for the next test. When the test is completed, the totals on the working sheet are found and all the data are transferred to the report. A typical form of report or laboratory record used in connection with the gauge test is illustrated in Fig. 9. It is divided into two parts, the first for recording the evenness defects and the second for the cleanness defects. The section in which the cleanness defects are placed is further divided so as to separate the major and minor defects. It will be noted also that raw knots are reported in compiling the report; however, raw knots are not considered in judging the quality of the silk, as they are unavoidable in reeling raw silk.

By carefully examining reports of gauge tests, the operative eventually is able to judge the general quality of the silk.

LABORATORY RECORD

*Gauge Test*

Test Number...... Order Number...... Date...... Kind......

Marks............ Bale Number............ Chop............

*Test*

EVENNESS

| DEFECTS | 1st 10,000 Yards | 2nd 10,000 Yards | 3d 10,000 Yards | Total For 30,000 Yards |
|---|---|---|---|---|
| Weak Threads | 5 | 8 | 7 | 20 |
| Very Weak Threads | 2 | 3 | 4 | 9 |
| Coarse Threads | 1 | 2 | 2 | 5 |
| Very Coarse Threads | 1 | | | 1 |
| Total | 9 | 13 | 13 | 35 |

CLEANNESS

| | | | | | |
|---|---|---|---|---|---|
| MAJOR | Waste | | 1 | | 1 |
| | Slugs | 4 | 2 | 5 | 11 |
| | Bad Casts | 6 | 3 | 3 | 12 |
| | Split Threads | | | 1 | 1 |
| | Very Long Knots | | 1 | | 1 |
| | Total | 10 | 7 | 9 | 26 |
| MINOR | Corkscrews | 15 | 13 | 10 | 38 |
| | Loops | | 3 | | 3 |
| | Long Knots | 5 | 5 | 4 | 14 |
| | Nibs | 10 | 12 | 15 | 37 |
| | Total | 30 | 33 | 29 | 92 |
| Raw Knots | | 5 | 4 | 2 | 11 |

Tested by........................

FIG. 9

Comparisons of the totals for the several lengths of 1,000 yards will reveal the number of defects in the respective tested lengths. These vary considerably, but in silks of one quality they should be more or less uniform. On sizes of silk ranging up to 18 deniers, the number of defects exhibited by silks of high quality should be few in number, say about five, with a gradual increase in frequency as the quality becomes lower. On silks coarser than 18 deniers, the number of defects should be considerably less, for the union of a greater number of cocoon ends has an evening effect on the single, consequently fewer defects will be found. Furthermore, the latter condition is also aided by the fact that it is less difficult to reel a coarser thread. Nevertheless, regardless of the size, to be classed as good in regard to evenness, the silk must be free from many fine and coarse ends. This is the first requisite in considering this quality as found by the gauge test. In regard to the major cleanness defects, if they are few in number, say about five in 30,000 yards, the silk is considered good in regard to these defects. The silk is considered as a second quality if only up to 25 defects are discovered, while if a greater number are present, a corresponding grading will be given. Minor defects occur with much greater frequency than the foregoing, but are not considered as detracting appreciably from the quality of the silk unless they are in excessive numbers.

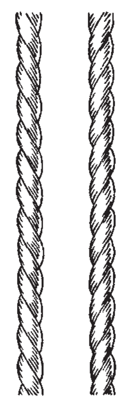
## TWIST TEST

**60. Object.**—If one end of a length of yarn is held stationary while the opposite end is rotated on its own axis, a twist will be inserted in the yarn. In inserting twist, the thread may be rotated in a right-hand direction or in a left-hand direction, producing either a right twist or a left twist in the yarn. Hence, when silk is thrown, or when thrown silk is purchased, one of the most important points to be observed is that the thread contains the proper number of turns of twist in the required direction. The number of turns of twist found in different threads varies widely in accordance with the class of yarn and its final use. The object of the twist test is to determine the number of turns of twist that have been inserted in the thread during the throwing process, and to ascertain its direction. The twist test is made by untwisting the yarn, in a direction opposite to that in which it was originally twisted, and noting the number of complete turns necessary to open the length of thread being tested. From this result the average twist per inch is obtained.

**61. Sampling.**—When thrown yarns are tested for twist at the testing house, at least 10 per cent. of a shipment must be forwarded; but in no case should less than one complete bale, case, or package be sent. This amount is necessary to allow the samples to be drawn in an official manner. When tests are made on coned silks, or crêpe on bobbins, ten cones or bobbins are selected and the yarn is tested when drawn from them. When silk is received in skein form, a slightly different procedure is followed. Ten skeins are selected and each is placed on a winder swift. A sufficient length of thread is drawn from the skeins and wound on bobbins to permit making the test. A twist test only requires about one yard of yarn; however, a much greater length is usually wound on the bobbins. Since a sizing test is generally made in conjunction with a twist test, enough yarn to supply samples for both tests is wound. With the yarn on bobbins, the samples are in readiness for the test. Infrequently, when yarns are twisted very tightly and it is difficult to separate the singles, samples for twist tests are boiled slightly in a soap-and-water bath. In this case, approximately 4 yards of yarn from each skein is wound around a metallic holder, which is then immersed in the boiling solution. After a short time, the silk gum, soap, and oil will be removed from the twisted ply thread so that it may be opened and easily separated into its several strands during the testing operation.

**62.** After the sampling operation has been completed, the silk is slowly pulled from the bobbin, and while this is being done, it is very carefully examined. This inspection is made principally to determine whether the thread contains any knots made during the throwing process. Threads containing knots should be avoided for twist tests, since hard twist is usually found near them; for, when tying breaks in the thread during the twisting operation in the throwing mill, the operative holds the thread stationary and thus permits the rotating spindle to insert an excess amount of twist in a short length of thread. Of course, this is distributed over a portion of the thread, but it is most evident close to the knot. If hard twist due to causes other than knots or if slack twist is discovered, the thread is discarded and a new length is taken for the twist test.

**63. Direction of Twist.**—The designation of a thrown yarn as right twist or left twist may be determined by examination or by noting the direction in which it is necessary to rotate the yarn in order to untwist it. The direction of twist in some yarns may easily be ascertained by carefully examining them. But silk is so fine that the twist, as a rule, can only be seen with the aid of a magnifying glass. This is especially true when the thread is highly twisted. If the thread, when viewed, has the direction of twist shown in Fig. 10 (*a*), it is said to possess a right twist; but if the twist is in the direction shown in (*b*), the thread is said to have a left twist. Another way to determine the direction of twist is to twirl the yarn between the fingers. One end of a piece of yarn about 6 inches long is held in the left hand and the other end is twisted by being twirled between the thumb and forefinger of the right hand. If the yarn opens, or untwists, when twirled away from the operative, it is a left-twist yarn; and if it opens when twisted in the opposite direction, it is a right-twist yarn.



(*a*) (*b*)

Fig. 10

**64.** Sometimes the thread is tested to ascertain the direction of the twist before it is placed in the twist tester, so that the handle of the tester may be rotated in the correct direction to untwist the yarn. Twist testers are usually so constructed that by turning the handle to cause the top of the thread to move toward the operator, an untwisting thread indicates a right twist. When left twists are being tested, the handle should be turned to cause the top of the thread to move away from the operator.

Yarns employed in branches of the textile industry other than silk, are twisted in the same manner as silk yarns, but the designations of right twist and left twist are reversed; that is, the yarn shown in Fig. 10 (*a*) would be considered a left-twist yarn and that shown in (*b*) a right-twist yarn.

**65. Twist Tester.**—After the sample has been selected, it is inserted in the twist tester. One form of this instrument used in testing houses, laboratories, and mills is shown in Fig. 11. The thread to be tested is held taut between two clamps *a* and *b*. The clamp *a* is fixed to a shaft that carries a pinion meshing with a gear to which the handle *c* is attached. The relative sizes of the gear and pinion are such that one turn of the handle produces ten turns of the clamp. The graduated dial *d* also is driven by turning the handle *c* and thus the number of turns

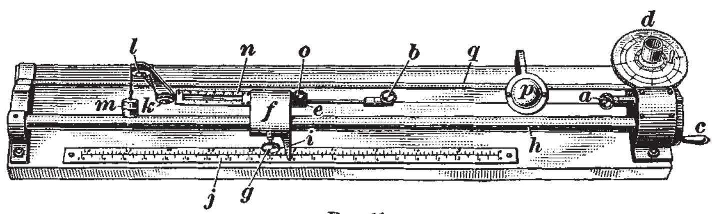



Fig. 11

of the clamp is registered. The clamp *b* is adjustable, so as to enable threads of different lengths to be inserted. The clamp *b* is fixed to a rod supported by a sleeve *e* carried by the bracket *f*. If a 20-inch thread is to be tested, the thumbscrew *g* is loosened and the bracket *f* is slid along its supporting rod *h* until the pointer *i* is opposite 20 on the lower edge of the scale *j*. Then the thumbscrew is tightened to hold the bracket in place. The scale is graduated in centimeters and in inches.

**66.** To the opposite end of the rod that carries the clamp *b*, Fig. 11, is fastened a cord that passes under the pulley *k* and over the pulley *l*. The small weights *m* on the cord tend to pull the clamp *b* to the left and thus the thread being tested is kept taut. The clamp *b* is prevented from turning, but the clamp *a* is rotated by the handle *c* in such a direction as to untwist the test thread. As the thread untwists, it lengthens, the clamp *b* and its rod being drawn to the left by the weights *m*. The amount of movement of the rod, and hence the lengthening of the thread, is registered on the scale *n*. While the thread is being inserted, the thumbscrew *o* holds the rod at the zero mark on the scale. The arrangement of weights and scale for keeping the thread taut and indicating the increase of length of the thread is called the thread take-up device.

**67.** The thread being subjected to the twist test may be examined closely through the magnifying glass *p*, Fig. 11. This glass is held in a frame that may be moved along the rod *q*. The handle *c* is turned until all the twist has been removed from the thread. One way of ascertaining whether all the twist has been removed is to insert a pin or a needle between the strands at the clamp *b* and move it toward the clamp *a*. If all the twist is removed, the pen can be brought up against the clamp *a*; but if any twist remains, it will be concentrated as the pin approaches the clamp *a* and thus may easily be detected. In the latter case, the handle must be turned until the remainder of the twist is removed. When all twist has been removed, the reading on the dial *d* is taken, which is the total number of turns made by the clamp *a*, or the total number of turns of twist in the test sample. This reading, divided by the length of the sample, gives the number of turns of twist per inch in the thread.

**68.** The dial *d*, Fig. 11, which is rather complicated in arrangement, is shown much enlarged in Fig. 12. It is graduated to form four concentric scales. The outer scale $d_1$ has ten divisions and is used in reading single turns of right twist. The next scale $d_2$ has the same number of divisions as the outer scale, but numbered in reverse order, and is used in reading single turns of left twist. The third scale $d_3$ has ten main divisions, each representing 100 turns, and is used in testing right twist. The inner scale $d_4$ is graduated like the scale $d_3$, but in reverse order, and is used when left twists are being tested. The scale $d_5$ between the scales $d_3$ and $d_4$ is used in connection with these scales, and each small division on it represents ten turns of the rotating clamp of the tester.

**69.** Directly beneath the dial on which the scales $d_1$ to $d_5$, Fig. 12, are marked, is another dial of the same diameter but with more teeth on its edge, and to the latter is fixed the pointer $d_6$. Both dials are driven by the same worm; but, by reason of the difference in the number of teeth, the lower one rotates slower than the upper one. As a result, when the upper dial has rotated exactly one revolution, the pointer $d_6$ will have lagged behind a distance equal to one graduation of the inner scale $d_5$. When the upper dial has made two complete turns, the pointer will be two divisions of the $d_5$ scale behind. In a test, then, the tens of turns are read by the position of the pointer on the inner scale and the single turns from one of the scales $d_1$ and $d_2$. The handle $d_7$ enables the dials to be turned and set to zero after they have been lifted out of contact with the driving worm. The zero position is determined by a projection $d_8$ on the head of the tester.

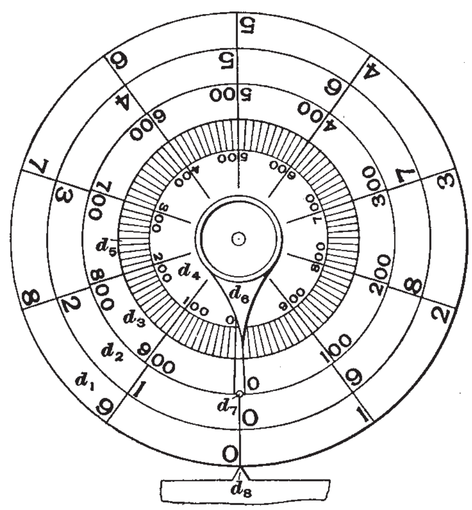


FIG. 12

**70. Details of Operation.**—At the beginning of a test, the pointer and the dial, Fig. 11, are both set at zero. The bracket that carries the adjustable clamp is usually set so as to accommodate a 20-inch thread; for, by using a long thread, the average number of turns of twist per inch is more accurately determined. The test sample of thread is first fastened in the left-hand clamp and then drawn to the right and fastened in the rotating clamp. The clamps should be tightened just enough to hold the thread. Next, the setscrew holding the rod to which the left-hand clamp is attached is loosened, permitting the weights to draw the thread taut. This will probably cause the pointer on the rod to move away from the zero on the scale; so, the left-hand clamp should be loosened and the thread shortened until the pointer stands at zero, after which it may be tightened. The weights used should give the thread approximately the same tension it would have in passing through any manufacturing process in which it would be taut.

**71.** After the thread is in place in the twist tester, it is customary to determine the direction of twist of the yarn by turning the operating handle *c*, Fig. 11, and simultaneously examining the yarn. If the thread opens when the operating handle is turned in a clockwise direction, it will be known immediately that the yarn has a right twist. Should the twist in the yarn be increased when the handle is turned, it will be known at once that it is being rotated in the wrong direction. Should it be desired, the direction of twist may also be determined by untwisting, between the fingers, a short, separate length of the yarn. If the yarn is found to have a right twist the dial of the tester must be adjusted so that the inner pointer $d_6$, Fig. 12, will coincide with the zero mark on the third scale $d_3$. This is known as the right-hand zero mark since it is to the right of the handle $d_7$. Moreover, the outside pointer $d_8$ must coincide with the zero of the outer scale. If the thread is found to have a left twist, then the inner pointer must coincide with the zero on the innermost scale. With the direction of twist determined, the operating handle is turned in the correct direction to open the yarn. If, after operating the tester, it is found that the yarn is being twisted in the wrong direction and that the settings were made incorrectly, the operating handle is turned in the opposite direction until the pointer and the dial return to their original positions. The dials are then lifted from the worm, set for the opposite twist, and the operation is begun again. The operative should carefully observe the thread as it untwists, or opens into its several parts. After all the twist has been removed, the total number of turns required to untwist the thread is read from the dial.

**72.** When the thread has been completely untwisted, the pointer on the scale of the twist take-up device will indicate the increase in length of the thread caused by the removal of the twist. The thread will then have its original, or untwisted, length. Too much weight should not be applied to the thread take-up device, for then the increase of length registered on the scale will be higher than is actually the case. To aid in making calculations relative to the take-up in twist as found on a twist tester equipped with a take-up device, the following rule is given:

**Rule.**—*To find the percentage of take-up in twist, multiply the difference between the original length and the twisted length of the thread by 100, and divide the product by the original, or untwisted, length of the thread.*

EXAMPLE.—In a twist test on 20 inches of thread it is found that, after removing the twist, the thread has lengthened exactly 1 inch. What is the percentage of take-up in twist?

SOLUTION.—The original, or untwisted, length of the thread is $20+1=21$ in. and the difference between the twisted and untwisted lengths is $21-20=1$ in. Then, according to the rule, the percentage of take-up in twist is

$$\frac{1\times 100}{21}=4.761 \text{ per cent. Ans.}$$

**73. Ply Threads With Two Twists.**—Twist tests are frequently made on thrown silk, in which several raw-silk singles are first twisted in one direction to form threads and the threads are then doubled and twisted in an opposite direction to that of the first twist. In testing yarns of this kind, the operator must be very careful to determine accurately the twist of the ply thread and also that of the single threads. The ply thread is inserted in the clamps of the tester as previously described, and its twist is carefully determined. When the twist has been fully removed, the single threads of the ply thread are separated, one thread is broken out, the dial of the tester is reset to zero, and the twist of the remaining single thread is determined.

**74. Motor-Driven Twist Tester.**—When many twist tests must be made, especially on hard-twisted thread, a

United States Testing Co., Inc.
OFFICIAL TESTING HOUSE FOR
The Silk Association of America

Certificate for Size, Twist, Elasticity & Tenacity

No. D Duplicate

New York. ______________________ 19

Certificate for Messrs. ______________________

______________________

for Test made on sample of 2-thread Japan organzine. 10 skeins.

| SIZING | | | Tests made on 20 inch length | | Elasticity | Tenacity |
|---|---|---|---|---|---|---|
| | | | First Twist | Second Twist | | |
| | | | 317 | 278 | | |
| | | | 322 | 278 | | |
| | | | 318 | 280 | | |
| | | | 322 | 279 | | |
| | | | 319 | 285 | | |
| | | | 315 | 281 | | |
| | | | 316 | 277 | | |
| | | | 322 | 283 | | |
| | | | 320 | 280 | | |
| | | | 323 | 279 | | |

| | |
|---|---|
| *Total Addition* | *Average:* |
| *Total Weight* | *First Twist,* 15.97 *Turns per inch* |
| *Average Size on Actual Weight* | *Second Twist,* 14.00 *Turns per inch* |
| | *Elasticity* |
| | *Tenacity* |
| *Average Size on Condition Weight* | *Signed for the Company* |
| *Average Number of Thousand Yards per Pound* | ______________________ |

Charges, $

*N. B.: The samples are 450 meters long, weighed in half Decigrams. The average size is calculated on the total weight taken before the partial weights.*

Elasticity in Millimeters Tenacity in Grams

Laboratory: 340 Hudson Street, New York.

*Telephones* 8751 / 8752 *Spring*

Fig. 13

motor-driven tester is frequently used instead of the hand-driven type. The electric motor, which is of the reversible type, has a long shaft, to one end of which is fixed the thread clamp. The other end carries the worm that drives the dial by which the number of turns of the clamp is registered. A rheostat operated by foot-control enables the motor to be run at six different speeds. The direction of twist of the sample is first ascertained, and then the motor is set to rotate the clamp in the proper direction. Full speed is used until the twist is nearly removed, and then the slow speed is used until the thread is fully opened.

**75. Certificate for Twist.**—A form of report that is used for several different tests, but is shown with only the data obtained in the twist test is illustrated in Fig. 13. The data shown refer to a test made on 2-thread Japan organzine. Ten skeins were selected from the lot and from these the test samples were drawn. Since organzine has both right and left twists, it was necessary to determine the second-time, or last, twist before the first-time twist could be found. As each was determined, it was recorded in the proper column. After completing the testing operation, the values in each column were added and the totals were divided by 200, which was the length of thread tested, namely, ten 20-inch lengths, or 200 inches. The results obtained represent the average number of turns of twist per inch in the tested yarn, which were 15.97 for the first-time twist and 14 for the second-time twist.

---

## MIRROR TEST

**76. Object.**—A knowledge of the evenness and cleanness of a thread is frequently desired when the gauge reel and the serimeter are not available, or when an ocular inspection is considered better than a mechanical test. In such cases the silk is given a mirror test, or very careful ocular examination. To accomplish this, the silk to be examined is wound evenly on an oblong strip of black cardboard so that the threads will lie parallel and close to each other, but not touch. The silk may then be easily examined; therefore, the object of the mirror test may be considered as the determination, by ocular inspection, of the number and kind of defects present in the raw silk, and their classification in accordance with their origin, so that the apparent running quality of the thread may be ascertained.

**77.** The cardboard holder on which the thread is wound is known technically as a mirror; but very frequently the mirror test is referred to as a black-card inspection, since the mirror is made of black cardboard. While being wound on the mirror, the thread is held in specially shaped jaws of a machine known as a yarn evenness controller.

It is generally conceded that better results are obtained when a small amount of silk is very carefully examined than when a large amount of silk is placed on mirrors and inspected very hastily. The experienced eye readily observes whether the silk on the different cards is of the same lot; also, the defects are found and quickly classified according to their origin and frequency. Moreover, this examination will indicate whether the defects on the various cards are similar.

**78. Sample.**—The minimum amount of silk taken for the mirror test is ten skeins from one bale; or, if the silk is taken from the winding-test bobbins, ten bobbins are used. At least one mirror holding 250 meters of thread is prepared from each skein or bobbin, or a total of 2,500 meters is wound on all the mirrors. On large mirrors a greater length may be taken. It is apparent that inspecting larger quantities of silk will give more nearly accurate results than inspecting smaller amounts; therefore, a sufficient yardage should be taken from each selected skein or bobbin. In view of this fact, it is often doubtful whether the small amount of silk tested is a good representation of the entire lot; nevertheless, as questionable as it may be, good results are obtained by employing the lengths just stated.

**79. Adjustment of Mirrors.**—The mirrors employed in the mirror test are not of a standard size, but are prepared in accordance with the size of the machine on which the test is made. A good grade of cardboard may be purchased in stock sizes measuring 22 inches by 28 inches, which may be very conveniently divided into eight parts, each measuring 7 inches by 11 inches, which is the size of a mirror. Thus, with stock of this size, all the cardboard is utilized and no waste is made. Furthermore, this size of mirror is very convenient; for after examination, the specimens may be readily filed away or mailed to those interested in the test. When it is desired to prepare the thread on a mirror more rigid than cardboard, aluminum boards are employed. These are covered with black velvet and hold the thread exactly like the cardboard mirrors.

A mirror is inserted in the clamp of the yarn evenness controller and a bobbin of yarn is placed on a pin provided for it. The end of silk is threaded through the guides and fastened in a small slit cut in the cardboard near the edge. The movable guide that leads the yarn on the mirror is adjusted so as to wind the correct number of threads per inch, which ranges from 50 to 150.

**80. Winding Thread.**—With the guide adjusted, the handle of the machine is turned and the thread is wound on the mirror. This is continued until the card has been filled with yarn, whereupon the thread is broken and fastened so that it will not unravel. This is done by cutting another slit in the mirror and drawing the end into it. The screw in the clamp is loosened, thus permitting the jaws to open and allow the card to be withdrawn from the holder. Cards filled with threads may be placed in a rack, so that the threads will not be brushed together or broken before the inspection. When all the cards have been completed they are inspected. The minute examination of the silk for individual defects produces severe eye strain; therefore, it is considered good practice to alternate this task with other work that does not require close vision, thereby allowing the eye to relax.

**81. Adjustments for Thrown Silk.**—The speed of traverse of the movable guide depends more or less on the size of the silk; for raw-silk threads, or singles, which are of comparatively small diameter, do not occupy so large a space as thrown threads composed of a number of singles. Thrown silk threads wound on the mirror without adjusting the speed of the thread guide, would probably touch, so that it would be impossible to obtain satisfactory results from an inspection. It becomes necessary, therefore, to alter the speed at which the movable guide traverses, so that a greater distance will exist between the centers of the threads; but, as the diameter of the thrown thread is larger, the space between the threads will not be changed. In this case the guide is usually moved at the correct speed to cause only 50 threads per inch to be wound on the mirror.

**82. Yarn Evenness Controller.**—The yarn evenness controller is constructed exactly like the cohesion card winder described in a preceding Section, except that a flat clamp to hold the cardboard mirror is fastened to the main shaft in place of the hexagonal wheel to which the cohesion cards are affixed. The clamp used to hold the cardboard mirrors is so constructed that they will not buckle while the thread is being wound. When aluminum mirrors are employed, a smaller clamp is substituted, because this type of mirror is very rigid and does not require the additional support of a wide clamp.

**83. Mirror Test Reports.**—The results that are obtained in the mirror test closely resemble those of the gauge test in that the same defects are listed on the report sheet. In the gauge test the evenness is determined by testing the defective thread on the serimeter, while the cleanness defects are caught in the gauges and their causes are ascertained in order that they may be properly classified. In the mirror test, however, all defects are classified according to the judgment of the operative or inspector after a critical ocular examination. It may be added that a report of the mirror test is made in practically the same manner as the report of the gauge test, and includes waste, slugs, knots, corkscrews, loops, nibs, and so on. The results are placed on a laboratory record that closely resembles that of the gauge test and therefore will not be repeated here.

**84. Variation in Mirror Tests.**—Other types of machines are designed for holding threads that are to be given an ocular examination. A widely used type of machine is the *seriplane*, which is quite simple in construction, but is large and therefore holds a great deal more yarn. It consists of a very large mirror, also a stand for supporting the mirror when in rotation. The machine is quite long and has a bobbin shelf extending its entire length carrying ten pins on which the bobbins are placed. The thread is drawn over the head of each bobbin, led upwards through an individual tension device, thence over a thread guide screwed into a long traverse bar, and then on to the mirror. As the traverse bar moves to one side, the threads will be spaced evenly on the mirror. Only one traverse bar is employed and its operating mechanism is constructed to permit fine adjustments. At that end of the machine holding the traverse-bar operating mechanism is a micrometer screw by which the speed of the traverse bar may be altered. With a constant rotative speed of the mirror, any increase in the speed of the traverse bar will cause a wider spacing of the threads; thus, by moving the micrometer screw, the traverse bar may be caused to lay the threads 200,100, 66, 50, 40, 33, or 25 per inch. The driving motor is arranged to give either of two speeds, according to the quality of the silk.

**85.** The mirrors are generally 18 inches wide and about 5 feet long. Attached to their edges are narrow strips that extend about $\frac{1}{8}$ inch from the mirror and the threads rest on these instead of against the mirror, leaving a slight space between the silk and the background. As a result, particles of dirt that are usually found on mirrors will not appear to be attached to the silk, as happens when the silk is against the background. By this construction the likelihood of committing errors in judging silk is greatly lessened. The mirror is of such width and thickness that its circumference is exactly one meter; hence, by spacing the threads so that there will be 100 to the inch, a band of silk measuring 5 inches in width will contain approximately 500 meters. Since the silk from ten bobbins is wound on the mirror simultaneously, a total of 5,000 meters will be prepared on each mirror. If during inspection it is found that a band of fine threads is an inch wide, it will be known immediately that the section contains a fine end 100 meters long.

When one mirror is completed, it is removed from the seriplane and placed in a rack, and while it is being examined, another mirror is placed in the seriplane and prepared; or, a series of mirrors may be completed and then inspected. Should it be desired to retain a sample of the threads for reference purposes, it is customary to slip a piece of cardboard between the threads and the mirror and then paste strips of gummed paper across the top and bottom of the cardboard. When these strips have dried, the threads are cut with scissors and the cardboard, with the threads in their correct positions, is withdrawn.

---

### MEASURING TEST

**86. Method of Test.**—As a rule, throwsters are instructed by their customers to reel the thrown silk into skeins of definite yardage. Sometimes, however, the customer fails to stipulate the number of yards the skeins should contain and then the throwster must exercise his judgment and not make the skeins too large. If the product is a staple thrown yarn, the skeins are prepared with yardages that are common to other silks thrown into similar yarns. Later, when the throwster ships the thrown yarn, the yardage of the skeins is marked on a shipping ticket for the information of the customer.

It is obvious that the yardage indicated on the ticket may not be the exact yardage in the skeins; for, in reeling, various difficulties may cause the skein to be wound with a low yardage and cause short skeins. To determine whether the skeins contain the indicated yardage, they are subjected to the measuring test, in which a number of skeins are carefully rereeled and their yardage is accurately determined. This test may be made by a customer to ascertain whether the skeins have the indicated yardage; or, infrequently it is made by a throwster as a check to determine whether the stop-motions and yardage clocks of the reels are working correctly so as to cause the reel to stop instantaneously when an end breaks or the desired yardage has been reeled.

**87.** For making the measuring test, twenty skeins should be drawn at random from a lot of the thrown silk, but usually only ten skeins are taken. The skeins are placed on winding swifts and the silk is wound on bobbins in order that it may be rereeled into skeins. If more than one bobbin is required to hold the silk from a skein, the remainder should be wound on another bobbin and both should be fastened together so that in transferring from one machine to another they will not become separated; for, if they become separated, and mixed with others, the yardage shown on the yardage clock of the reel will be incorrect for the skein. The bobbins are placed upright on the bobbin shelf of the reel so that the silk is pulled over their heads. The thread is passed through the guides and drop wires, and when the yardage clock is set at zero, the reel fly is set in motion. The fly will rotate until a bobbin runs out or an end breaks, in which case it should be tied with a minimum of waste. When a bobbin becomes empty, it indicates that all the silk in one skein has been wound on the reel fly, provided it was unnecessary to use two bobbins for one skein. The number of turns made by the fly, which indicates the yardage of the skein, should be recorded and the fly should again be started. After the silk has been reeled from all the bobbins and the respective yardages have been recorded, the skeins should be laced so they may be removed from the reel fly.

**88.** The yardages that have been recorded for the several skeins are added, thus giving the total yardage; and this result divided by the number of skeins taken will give the average yardage. It may be added that variations in the yardage of the tested skeins from that given by the throwster should be expected. To provide for this difference it is considered a good delivery if the average variation in the length of the skeins is not greater than 5 per cent. of the stipulated yardage.

While the operation is not necessary, the skeins are usually weighed to obtain their total weight. This weight is generally

**United States Testing Co., Inc.**
OFFICIAL TESTING HOUSE FOR
**The Silk Association of America**

Certificate of Length of Skeins

No. C Duplicate

New York, ______________

Test made on 2-thread Japan organzine 20 skeins.

| Mark & Number | | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 19,800 | *Yd.* | 11 | 19,700 | *Yd.* |
| | 2 | 19,760 | " | 12 | 19,780 | " |
| | 3 | 19,760 | " | 13 | 19,710 | " |
| | 4 | 19,730 | " | 14 | 19,730 | " |
| | 5 | 19,780 | " | 15 | 19,890 | " |
| | 6 | 19,730 | " | 16 | 19,800 | " |
| | 7 | 19,890 | " | 17 | 19,780 | " |
| | 8 | 19,710 | " | 18 | 19,760 | " |
| | 9 | 19,700 | " | 19 | 19,730 | " |
| | 10 | 19,780 | " | 20 | 19,760 | " |

*Total* 395,280

*Average* 19,764 *Yd.*

*Average Drammage:* 1.80 *Drams per 1000 Yd.*

*Charges $*

*Signed for the Company* ______________

**Laboratories:** **340-344 Hudson Street, New York**

*Telephones* 8761 8762 *Spring*

Fig. 14

in drams and is employed to calculate the average drammage per 1,000 yards, and the result is marked on the certificate. The average drammage indicates the approximate dram size of the thrown silk.

The reel on which the skeins are measured is frequently referred to as a special measuring reel and it is equipped with an accurate counter, or clock, for indicating the number of revolutions of the reel fly, or the reeled yardage. The reel is also fitted with a very sensitive stop-motion that arrests the motion of the reel fly immediately when an end breaks or when the thread from a bobbin runs out.

**89. Certificate of Length of Skeins.**—A form of certificate employed in connection with the measuring test, is illustrated in Fig. 14. On it are recorded all the data collected during the test. The data shown refer to a test made on 2-thread Japan organzine. From the lot, twenty skeins are selected for the test, the length of each being found and recorded. Then, by adding the yardage of all the skeins, a total of 395,280 yards is obtained, which, divided by the number of skeins tested gives the average yardage, or 19,764 yards. The twenty skeins are found to weigh 712 drams. Knowing the total yardage of the silk in the skeins, the drammage per thousand yards is readily found by proportion to be $712 \times 1{,}000 \div 395{,}280 = 1.80$ drams.

# SILK TESTING

(PART 3)

Serial 5001C — 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 the gauge test?

(2) If, instead of raw silk, thrown silk is wound on the yarn-evenness controller, why should the traverse be adjusted to lay the threads on the card differently?

(3) What two precautions must be taken when selecting samples for the serigraph test?

(4) Why are measuring tests made?

(5) How is the yield point ascertained by examining the curve made on the chart in a serigraph test?

(6) Describe the device by which the carriage supporting the lower thread clamp of the serimeter is caused to move downwards at a uniform rate of speed.

(7) What is the object of the serimeter test?

(8) Why do threads sometimes break repeatedly at the jaws of the serigraph and how may this defect be remedied?

(9) Why is it important that a thread containing knots should not be tested for twist?

(10) (*a*) How is a thread placed in the clamps of the serimeter? (*b*) What precautions should be taken when tightening the clamps?

(11) When silk is being wound preparatory to the gauge test, how should broken ends be tied, and why?

(12) (*a*) When are mirror tests made? (*b*) What is their object?

(13) Define the three physical qualities of silk tested by the serigraph.

(14) How are gauges cleaned of loose dirt, and also of substances that are firmly lodged between the blades?

(15) How is the breaking strength of a thread determined on the serimeter?

(16) Discuss the proper maintenance of the serigraph machine.

(17) How are the gauges of the gauge machine adjusted?

(18) In making a twist test, how is the complete removal of the twist determined?

(19) After the sample is held in the upper clamp of the serigraph, how is it inserted in the lower clamp?

(20) A crêpe thread, exactly 20 inches long when in the twist tester, is untwisted and found to have increased $4\frac{1}{4}$ inches in length. Find the percentage of take-up due to twisting.
Ans. 17.525 per cent.

**Mail your work on this lesson as soon as you have finished it and looked it over carefully. DO NOT HOLD IT until another lesson is ready.**

# SUPPLIES FOR STUDENTS

Our students need paper on which to write lessons; many of them need drawing outfits, chemistry outfits, chemical and other supplies that are not included with their Courses. Many inquiries therefore arise as to the kind of supplies to purchase and where to get them.

It is desirable that the members of our Organization confine their attention wholly to educational service, and arrangements have accordingly been made with the Technical Supply Company, Scranton, Pa., to furnish our students with supplies suitable for doing the work of their Courses. The offers of that Company will therefore reach you, in the effort to help you get whatever you need.

INTERNATIONAL CORRESPONDENCE SCHOOLS

---

## LIGHT-WEIGHT PRINTED ANSWER PAPER

With printed headings especially adapted for use of students of the I.C.S. Size 8½" × 14". This paper is very tough, durable, and has a fine writing surface. It will last for years, and the student is thus enabled to keep a permanent record of the work sent to the Schools.

## I.C.S. COLD-PRESSED DRAWING PAPER

Size 15" × 20". Buff color—easy on the eyes. It is unusually strong and tough; takes a clean, clear line; is not brittle; is not easily soiled. Best for both ink and pencil.

## "TESCO" TRACING CLOTH

Used extensively by draftsmen, architects, engineers, and contractors—a high recommendation of quality. It is transparent, strong, free from knots and other imperfections and contains no air bubbles. I.C.S. instructors assure their students it is thoroughly dependable. Furnished in sheets 15" × 20".

## PORTFOLIOS

For keeping your Examination Papers and drawing plates neat and clean and in order. Don't roll them up and then forget where they are, or leave them where they will become soiled or damaged. Some of these days an employer may ask to see them.

## "TESCO" LIQUID DRAWING INK

"Tesco" Ink flows smoothly and evenly from the pen and leaves a clear, sharp line of uniform intensity, free from cracks and bubbles.

## FOUNTAIN PENS

As answers to Examination Questions must be written in ink, you can, with a fountain pen, answer your papers any time—anywhere—whether it is in the office, shop, factory or home.

## DICTIONARIES

No matter which Course you are studying, no matter what kind of work you do, a dictionary is valuable. Keep it near you when you read and when you study. Don't skip the words you don't understand; look them up, for that is the best way to acquire a vocabulary.

## RUBBER HAND STAMPS

Stamp your name, address, and class letters and number on every lesson and drawing you send to the Schools. Useful for marking envelopes, books, papers, etc.

## DRAWING OUTFITS

The I.C.S. Outfits are not simply "gotten up" to provide something for the student to use during his Course. These Outfits will last long after he has gotten into actual work. They are practical Outfits—made up from specifications furnished by I.C.S. Instructors.

Naturally, then, such Outfits must be right. All instruments must be of a high quality to give long and efficient service. All material must be honest, sincere, dependable. The busy man cannot be annoyed with poor material, and the student must not be retarded by the use of it.

## COMBINATION DRAWING AND STUDY TABLE

Frame made of seasoned oak, top of white pine, size 20"×26". Patent disappearing ledge attached to lower edge. Can be adjusted to any height from 30 to 42 inches. Absolutely rigid and perfectly balanced. Folds to thickness of 3 inches.

## CATALOGS

Any of the following catalogs will be mailed free on application to the Technical Supply Co.:

Drawing Instruments and Materials, Practical Books Relating to Architecture and Building Trades, Practical Books Relating to Electricity, Practical Books Relating to Mechanical and Civil Engineering, Practical Books Relating to Mining, Metallurgy, and Chemistry.

**Send orders to TECHNICAL SUPPLY COMPANY, Scranton, Pa.**

**SEE PRICES ON SEPARATE LIST**

E


INTERNATIONAL CORRESPONDENCE SCHOOLS
INSTRUCTION BY MAIL

88157