The Project Method of Teaching

SILK THROWING

PART 4

By

I. C. S. STAFF

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INSTRUCTION PAPER

With Examination Questions

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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.

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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.

 INTERNATIONAL CORRESPONDENCE SCHOOLS

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SILK THROWING
(PART 4)

HARD-SILK WINDING—(Continued)

VARIATIONS IN CONSTRUCTION

FIXED-HANGER WINDER

1. General Arrangement.—A hard-silk winder that embraces some innovations and variations in construction is shown in Fig. 1. The differences are principally in the means adopted for supporting the bobbins and swifts, in the method of adjusting the cam throw, and in such minor details as the method of attaching the springs to the traverse levers. The frame construction, also, varies to some extent, although it is of the usual general design. One particular difference is in the use of channel bars, instead of pipe ties, to connect the end frames and middle stands of the winder.

2. Bobbin Holders and Swift Hangers.—In the winder illustrated in Fig. 1 the skein a is supported on the swift a_1 by the customary swift strings a_2. The swift is retained in a hanger b_8 that is made in one piece with the bobbin holder, thus supporting both the bobbin and the swift. The castings b_8 are bolted to a flat iron girt b_9 that extends the entire length of the machine. No provision is made for vertical or horizontal adjustments of the bobbin holders and swift hangers, since the positions of the castings b_8 are accurately fixed when the machine is built. The bobbin holder and the swift hanger are maintained in perfect alinement because they are in one piece. One advantage of this arrangement is that the girt b_9 is located in a relatively high position; moreover, the necessity for pipe ties in the center of the winder is eliminated. This provides more space for the swifts and facili-

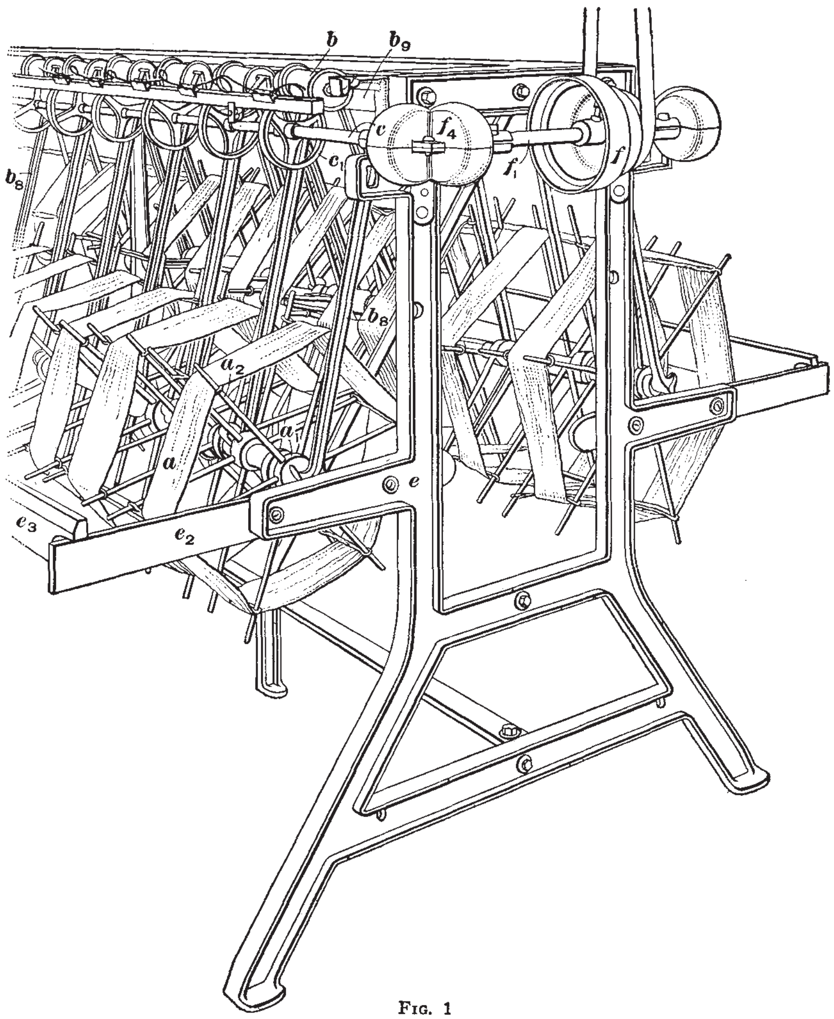

Fig. 1

tates their removal and replacement when the skeins become exhausted, or at other times, if necessary.

3. Cam Adjustment.—The traverse cam of the winder illustrated in Fig. 1 is arranged in the usual manner except that the construction of the hub of the cam, whereby an adjustment of the length of the traverse may be made, is slightly different. In Fig. 2 (*a*) is an end view of the section shown in (*b*), illustrating the means adopted to provide for an adjustment of the throw of the cam. The hub of the cam g is not formed with an elliptical hole at the end farthest from the winder frame; instead, it is arranged to fit quite closely the sleeve g_4, on which the traverse cam is mounted. The inside of the hub is cored out, so that the part that rests on the sleeve is quite narrow, as shown at g_{13}. Moreover, the cam at this point does not fit the sleeve g_4 so tightly as to preclude the possibility of tilting the cam to alter slightly the length of the

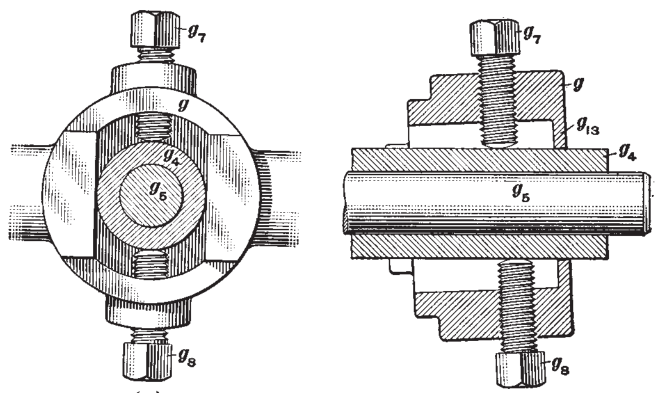

FIG. 2

traverse. The cored-out end of the hub of the cam nearest the gears and the winder frame is formed with an approximately elliptical recess. The small diameter of the ellipse closely fits the sleeve g_4, but the large diameter of the ellipse allows some play. This construction allows the cam to be tilted on the sleeve and the length of traverse altered, the cam being adjusted for position and held securely in place on the sleeve g_4 by two setscrews g_7 and g_8. The cam is adjusted by loosening one setscrew slightly and then tightening the other, the cam being moved slightly in either direction to increase or decrease the length of the traverse, as may be desired. In being adjusted, the cam is moved in a slight arc with the end of the cam that is in contact with the sleeve as a center. The setscrews g_7 and g_8 are slightly offset, so that, when they are tightened, a three-point support with the end of the cam hub is formed. This enables the cam to be held in its correct position and also secures it to the sleeve g_4 with sufficient security, with but little strain on these parts. When in motion, the cam and sleeve rotate on the stud g_5, one end of which is attached to the end stand.

4. Arrangement of Traverse Levers.—The arrangement of the traverse levers in the winder shown in Fig. 1 is somewhat different from the construction in other winders. As illustrated in Fig. 3, the traverse levers h, one for each side of the winder, are connected by a movable equalizing bar h_8. Instead of a separate spring for each traverse lever, a single spring h_2, attached to the center of the equalizing cross-bar h_8, is employed for keeping both traverse levers in constant contact with their respective cams. The tension of the spring h_2 may be readily adjusted by means of the threaded bolt h_9 and winged nut h_{10} so that the cam followers h_5 of both traverse levers will be firmly pressed against the effective surfaces of the cams. With this arrangement, it is important that the traverse cams be set exactly 180 degrees apart in order that one traverse lever may be moving toward the winder when the other is moving away from it. The equalizing bar h_8 will then equalize the movements of the levers and the spring h_2 neither will be unduly stretched nor will it be slackened too greatly at any time.

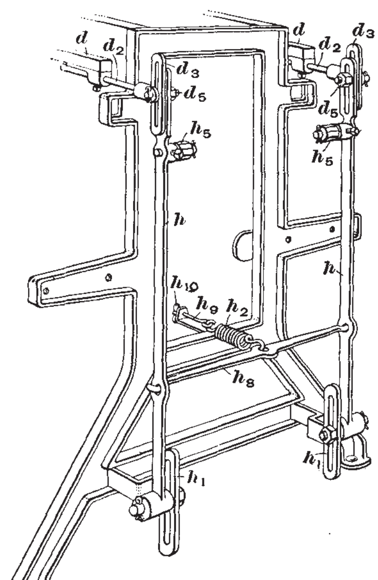

FIG. 3

The traverse levers h may be raised or lowered in the slotted brackets h_1 so that the cam followers h_5 may be adjusted with relation to the traverse cams. In general, the height of the traverse lever should be so adjusted that the cam follower will occupy a position level with the axis of rotation of the cam. Slight adjustments of the length of the movement of the traverse bar d may be made by raising or lowering the stud d_5 in the slotted end of the traverse lever. The movement of the traverse lever is, of course, communicated to the traverse bar through the traverse bar iron d_2 and the slotted casting d_3 attached to it.

VARIABLE-SPEED WINDER

5. Object of Variable Speed.—In winding hard silk, it is desirable that the winder be equipped with an arrangement whereby the speed of winding may be easily and quickly altered. Some mechanism for accomplishing this result is necessary in order that the winding speed may be adjusted in accordance with the character of the silk to be wound. If the silk is of such a nature that it winds poorly, or if the skeins for any reason have become badly tangled or otherwise injured, so that excessive breakage of the ends occurs during winding, it is imperative that the winding speed be reduced. In other cases, where the silk is of excellent quality, the skeins perfect, and the silk free from injuries, it is often desirable to increase the speed of silk winders, thus increasing the production in the winding room. On ordinary winders, the speed variations are accomplished by shifting the belt so that it runs on different steps of the pulley f, Fig. 1.

6. Variable-Speed Mechanism.—In winders of ordinary construction, equipped with cone driving pulleys, it is usually possible to obtain four speeds of winding by shifting the driving belt to different steps of the cone pulleys. In the variable-speed winders, however, the speed of winding may be easily regulated from zero to the highest speed of which the machine is capable, and this may be done while the machine is in operation and without interfering in any way with the driving belt. As illustrated in Fig. 4, the variable-speed winder is not equipped with cone driving pulleys. Instead, motion is imparted to the machine by a belt that drives a pulley *f* of ordinary construction secured to the crosshead shaft of the winder midway between the two spindle take-up shafts. Usually the pulley *f* is driven from a pulley on an overhead shaft, but sometimes the winder is driven from a motor placed upon a bracket secured to the frame of the

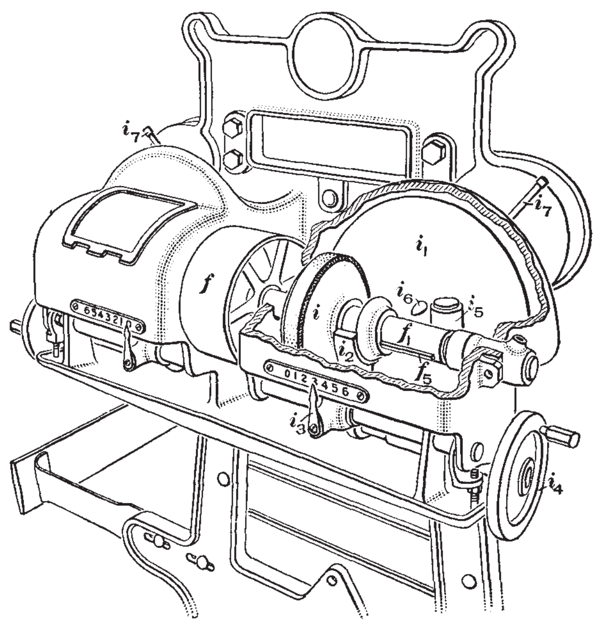

FIG. 4

machine. Motion is imparted to the spindle take-up shafts by two friction driving arrangements that are duplicates of each other. This arrangement allows one side of the winder to operate as usual, while the other side is stopped, or one side of the machine may be run at a different speed from the other side, if for any reason this is desirable.

7. The crosshead shaft f_1, Fig. 4, is fitted with a fixed key, or spline, f_5 that engages a keyway in the hub of a leather-covered friction driving wheel i, mounted on the shaft. This arrangement allows the driving wheel to slide on the crosshead shaft and at the same time compels it to turn with the shaft. A metal disk i_1 is keyed to the take-up shaft of the winder, but is capable of a slight longitudinal movement on the shaft. A strong spring, not shown, is situated in the rear of the disk i_1 and tends to force the disk forwards, thus keeping it in firm contact with the friction driving wheel i. By frictional contact, therefore, the movement of the crosshead shaft is transmitted to the take-up shaft.

8. The hub of the friction driving wheel i, Fig. 4, is constructed with a groove that is constantly engaged by a yoke i_2 that extends downwards and carries on one projection the pointer i_3. The lower end of the yoke has a threaded hub, which fits on a threaded rod, or screw, that extends halfway across the machine, and supports at its one end the hand wheel i_4. Turning the hand wheel rotates the screw and causes the position of the yoke i_2, and consequently the leather-covered wheel i, to be altered in accordance with the direction in which the hand wheel is rotated.

9. The yoke casting i_2, Fig. 4, carries a stop i_5 that moves with the yoke whenever the latter is shifted. The purpose of the stop i_5 is to come in contact with the conical button i_6 located in the center of the disk and to force the disk toward the machine as the leather-covered wheel reaches the periphery of the disk. The disk being thus forced out of contact with the driving wheel, the take-up shaft comes to rest. Moreover, by separating these parts the leather-covered wheel is protected from the damage that would be likely to happen if it came in contact with the periphery of the metal disk. If a stop were not employed, the leather-covered wheel would not be in full contact with the disk, thus causing the leather to become scratched, torn, or otherwise damaged, and the driving wheel would probably lose contact with the disk entirely. To provide a ready means of lubricating the shaft that carries the disk i_1, oil holes and fitted with tubes i_7, through which oil may be injected into the bearing, are provided.

10. When in operation, motion is imparted to the driving pulley *f*, Fig. 4, which is transmitted to the crosshead shaft f_1 and also the leather-covered wheel *i* that is mounted on the shaft. Usually, when starting, the pointer i_3 will register zero, indicating that the stop i_5 is in contact with the button i_6, thus disengaging the disk i_1 and the leather-covered wheel. In other words, the latter wheel will revolve, but the take-up shaft will remain at rest. Therefore, it will become necessary to rotate the handwheel i_4 in the proper direction to cause the stop to release the disk and allow it to come in contact with the driving wheel. The latter will then drive the disk at a point near its periphery. It is evident that the speed of the disk, and consequently of the take-up shaft, will be slow, since the diameter of the driving wheel is a great deal smaller than the part of the disk that it drives. Moreover, this speed is recognized as the lowest speed and is indicated on the scale that is attached to the housing of the device by the position of the pointer at 1.

By a continual but gradual revolution of the handwheel i_4 in the proper direction, the yoke i_2 progresses along the threaded rod, and consequently the leather-covered wheel advances toward the center of the disk. The relative increase of speed may be readily determined by observing the movement of the pointer along the scale. The gradual increase of speed of the take-up shaft is due, of course, to the decreasing size of the driven disk, which results when the leather-covered wheel comes in contact with the disk at a point nearer its center.

11. When the pointer i_3, Fig. 4, stands at the point indicated as number 6 on the scale, the leather-covered wheel drives the disk at a point a very short distance from its center. This corresponds, of course, to a larger driving pulley driving a smaller driven pulley, thus resulting in a higher speed of the disk and also of the take-up shaft. The bobbins that are driven by the take-up shaft will also revolve at a high speed and cause the swifts to rotate at a corresponding speed. Should it be desired to decrease the speed of the bobbins, it will only be necessary to reverse the direction of rotation of the hand wheel i_4.

There are several inherent advantages in the variable-speed winder that are not found in the common type of winder equipped with a cone pulley on the crosshead shaft. The winder equipped with a speed-changing device as illustrated may be operated at a wide range of speeds in order to suit the requirements of the particular kind of silk being wound. Furthermore, the rapidity with which the speed may be changed is very important, and the substitution of pulleys for increasing or decreasing winding speed is unnecessary.

12. Another important point that should be considered is the saving effected in time when starting and stopping the machine. In the ordinary type of winder employing cone pulleys, it is customary, each time the machine is stopped, to *set up* the bobbins so that on restarting the frame, the ends will not break. The setting up is done by lifting the bobbins and spindles and placing them on the bobbin holders in an inoperative position. This is done when the machine is to be stopped, and the bobbins remain in the inoperative position until the winder is again started and all parts are rotating at the required speed. They are then replaced in their respective holders and started in operation. If the bobbins are not set up as described, the swifts are likely to overrun while losing speed and cause the ends to become tangled. Furthermore, the ends are liable to break when the winder is started, since the power is not generally applied in a gradual manner. The result is strained and stretched ends and many breakages that require increased attention. The injuries to the thread, also, are likely to cause delays in other departments.

13. When a variable-speed winder is used, it is possible for the operative to reduce the speed of the bobbins gradually so that the swifts will not overrun. This is usually done shortly before the closing time of the mill, or whenever it is desired to stop the winder. When the pointer indicates zero on the scale, the take-up shafts will be brought to rest, while it is still possible for the pulley on the crosshead shaft to continue to revolve. The bobbins, also, are allowed to remain in the bobbin holders. Should it be desired to start the frame again, it will only be necessary to turn the hand wheel in the reverse direction, causing the disk to come in contact with the driving wheel and to be driven by it. The wheel, of course, should be rotated very slowly, so that excessive strains will not be placed on the running end

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VARIABLE-SPEED TRANSMISSION

14. Mills not equipped with variable-speed winders frequently employ a *variable-speed transmission* to allow the regulation of speed of the winders. It may be arranged to control the speed of a group of ordinary winders or of all the winder line shaft. The belt from the main driving shaft is not a part of the winding frame, but a separate unit in the power transmission line. The transmission is installed at a point between the motor or the main driving shaft and the winder line shaft. The belt from the main driving shaft, which has a constant speed, imparts motion to one shaft of the transmission, and after passing through the mechanism, the motion is imparted to the winder line shaft from the variable-speed shaft of the transmission. The transmission may be readily adjusted while in motion, causing the speed of the variable-speed shaft to be decreased or increased, which affects correspondingly the speed of the winders.

15. By means of the variable-speed transmission, the speed of the winders that it controls may be gradually decreased and increased when stopping and starting the frames. This eliminates the necessity of setting up the bobbins, as is done with ordinary winders operating at a constant speed. Moreover, the speed of the winders may be reduced when the character of the silk demands a slower speed. However, when the speed is decreased by transmission, all the winders are affected, and individual adjustments cannot be made in the same manner as when variable-speed winders are employed.

16. A variable-speed transmission is shown in Fig. 5. It consists of a heavy cast-iron frame j having slotted feet j_1 through which pass the bolts by which the frame is held down. The driven, or variable-speed, shaft k is supported in two bearings k_1 attached to the frame of the machine and carries two conical disks k_2 and k_3. These are splined to the shaft and arranged with their apexes facing, thus forming a **V**-shaped groove. The hubs of the disks are provided with large key-

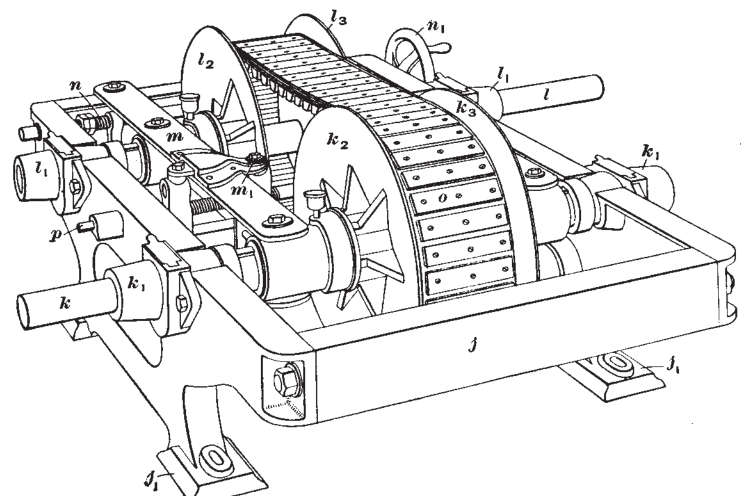


Fig. 5

ways to prevent excessive lost motion at these points after the transmission has been in continued use.

17. The driving, or constant-speed, shaft l, Fig. 5, to which the power is imparted, is supported in bearings l_1 and carries two disks l_2 and l_3 similar to the disks k_2 and k_3. The hubs of the disks k_2 and l_2, which carry roller thrust bearings, are loosely pinned to a shifting lever m pivoted at a point m_1 midway between the driving shafts. A duplicate of this lever is located on the opposite side of the device; it is arranged in the same manner, but cannot be seen in the illustration.

18. Both shifting levers m, Fig. 5, at their farther ends carry threaded hubs that engage with the shifting screw n, which has both right-hand and left-hand threads. When the screw is turned by means of the hand wheel n_1, the ends of the shifting levers will be moved either toward each other, or apart. If they are moved toward each other, the disks l_2 and l_3 will be moved toward each other and the disks k_2 and k_3 will be moved farther apart, since the shifting levers are pivoted at m_1. This action causes the belt o, which transmits the motion between both sets of disks, to assume a higher position between the disks l_2 and l_3 than between the disks k_2 and k_3 and thus alters the speed of the shaft k.

19. The belt o, Fig. 5, consists of a number of hardwood blocks fastened to suitable belting material. It is made endless by a splice block that joins the free ends of the belt. Details of the splice block, coupled to several ordinary blocks, are

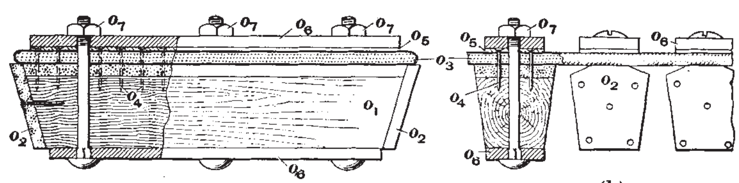


FIG. 6

shown in Fig. 6. In (a) is shown a side view in part section of a splice block; in (b) is shown a cross-section of the splice block and also end views of several ordinary blocks that compose the belt. The hardwood blocks o_1 are of the same size and shape, with tapered ends tipped with small pieces of leather o_2 that bear against the conical disks and form the driving surface of the belt. The blocks are fastened to the belt body o_3 by small escutcheon pins o_4 that pass through the brass strip o_5, the belting material, and into the block. Wrought-iron plates o_6 are then placed on the belt and the under side of the block, while the entire assembly is held together by the bolts o_7. This is the general construction of the splice block. The ordinary blocks have no bolts o, passing through them, but merely large wood screws that pass through the plate and the belt into the block; and there are no iron plates on the under sides.

20. When the belt is placed on the machine, and the free ends are joined by the splice block, it will be too loose to be placed in operation; therefore, it must be tightened by the screw p, Fig. 5. Turning the adjusting screw in the proper direction, will move both pairs of disks closer together, causing the belt to be forced gradually away from the centers of the disks.

21. When it is desired to cause the variable-speed shaft to revolve at a slower speed, the disks on the constant-speed shaft must be separated. This allows the belt to come in contact with the lower portions of the disks l_2 and l_3, Fig. 5, and with the higher portions of the driven disks k_2 and k_3 on the variable-speed shaft. This corresponds to a small pulley driving a large pulley, and results in a slow speed of the driven shaft. By reversing the operation, the disks on the constant-speed shaft will be brought together, producing the effect of a large pulley driving a small pulley, and the variable-speed shaft will then run at a higher speed.

22. It may be added that variable-speed transmissions attached to the floor are usually equipped with hand wheels to adjust the disks. When hung from the ceiling, however, a sprocket is generally substituted for the hand wheel and is connected by a chain to a sprocket within reach of the attendant in charge of regulating the speed. Furthermore, when changing the transmission from a floor to a ceiling installation, it becomes necessary to reverse the positions of the various oil cups, bearings, etc.

DRUM TAKE-UP WINDERS

23. The majority of winding frames employed in the various hard-silk winding operations are of the ordinary spindle take-up type, but infrequently drum take-up winders are used. They differ in construction from the ordinary hard-silk winders only in the method of driving the take-up bobbin. The frame construction, the method of attaching the swift hangers, and of supporting the swifts are identical with the winders already described. Instead of the customary friction wheels, or spindle drive pulleys, the take-up shaft of the drum take-up winder is fitted with drums that drive the bobbins. The drums are about 4 inches in diameter, corresponding to the diameter of the ordinary friction wheel, while their width is somewhat less than the distance between the heads of the bobbins that they drive. Each drum is fastened by a set-screw to the take-up shaft, so that it may be easily set in relation to the position of the take-up bobbin. Generally, the driving face of the drum is bare, but at times some form of covering is applied to increase the friction and to prevent slippage.

24. Instead of the ordinary wooden-headed spindle employed on the spindle take-up winder, a straight gudgeon is inserted in the hole of the bobbin, to engage slots in the fingers and retain the bobbin in position. The gudgeon is slightly longer than the bobbin and extends from $\frac{1}{4}$ to $\frac{3}{8}$ inch from the heads of the bobbin. Usually it is an iron pin slightly smaller in diameter than the hole in the bobbin, but gudgeons sometimes employed are equipped with piano-wire springs identical with those used on wooden-headed spindles of this construction. The best practice dictates that the gudgeon should not fit the hole in the bobbin snugly, but should be free to move with a slight lateral motion, if necessary. The bobbin will then revolve freely and will not bind.

25. The bobbin holders are of the ordinary open-finger type and are similar to the fingers of the spindle take-up winding frame, except that the fingers are duplicates and are equipped with deep slots. The slots permit the gudgeon to move upwards and downwards in the fingers in accordance with the diameter of the bobbin. Thus, when the bobbin is empty, the barrel will be in contact with the drum. As it becomes filled with silk, the diameter naturally increases, thus causing the bobbin to rise. The gudgeon, also, will rise in the fingers, but since the latter are designed with deep slots, the bobbin will be retained in its proper position.

Besides the open-finger bobbin hangers described, drum take-up winders are sometimes equipped with swinging bobbin hangers. Swinging bobbin hangers do not have slotted fingers but are designed with two arms affixed to the rail and extending over the drum. These arms receive the gudgeon carrying the bobbin, whereupon the hanger may be lowered to cause the bobbin to rest on the drum. A good contact between the bobbin and the drum is further assured by a small adjustable spring located so that its tension may be varied in accordance with the pressure required to wind the silk.

26. As the bobbin is increased in size by the yarn that is wound on it, it rises exactly in the same manner as with open fingers. However, since the bobbin is supported in a movable hanger, the latter will rise with it. Thus, when a construction of this type is employed a greater amount of pressure is applied to the bobbin, causing the latter to be made hard and firm. Should it be desirable to cause the bobbin to bear on the drum with greater pressure, it will only be necessary to increase the tension of the spring attached to the hanger, which will cause the latter to be drawn downwards and produce the desired pressure to be applied to the bobbin.

27. Probably the most important feature of the drum take-up winder is the fact that the take-up of thread is uniform throughout the entire period of winding. Thus, since the drum is in contact with the barrel of the bobbin when empty, or with the silk as the bobbin is filled, the surface speed of the working diameter will remain constant. Also, a constant tension will be applied to the thread, and the thread will not be strained at any time, provided, of course, the thread speed is not too high. In addition, the bobbins may be changed much quicker, since it is only necessary to allow the loose gudgeon to slide from the filled bobbin and then insert it in the empty bobbin.

28. While apparently possessing several advantages over the spindle take-up winder, the drum take-up winder is not without its disadvantages. Thus, due to the method of driving the bobbin, the silk is held in contact with the drum by its own and the bobbin's weight, as in the case of the open-finger bobbin holder, or with the aid of a spring when a swinging holder is employed. In either case, the pressure of the bobbin on the drum is sufficient to cause the bobbin to be driven without any slippage. Therefore, while the winding operation is in progress, should a small amount of waste retard the running thread, it is probable that the end would break, since the strength of the silk would not be sufficient to overcome the pull from the bobbin. In the spindle take-up winders, however, the spindle head may slip on the friction wheel, so that the end will not break when retarded by waste. The operative may then remove the waste, which causes the swift to start. Furthermore, when an end breaks, on the drum take-up winders, it is pressed against the silk on the bobbin, and after continued rotation is buried in the silk on the bobbin. It is then extremely difficult to find the end and the silk on the bobbin must be cut in order to find the true end, producing considerable waste. Besides, the continued contact of the silk with the drum sometimes causes the outer layer of threads on the bobbin to become split, or opened, while infrequently the silk has a tendency to become shiny. When the ends split, trouble is usually encountered in future operations.

29. A type of traverse sometimes employed on the drum take-up winder, but which is also found on ordinary hard-silk spindle take-up winders, is known as the *automatic screw traverse motion*. The screw mechanism is located on top of the machine and is situated at the end opposite the drive end, which is usually the cam end of the winder. It consists of two screws rotated by the take-up shaft, a pulley at the end of the latter transmitting power to the traverse mechanism by means of a belt. Each traverse bar is connected, by means of an arm, to a shaft that is given a traverse motion, this being received from the screws, which engage with an arm of special design. When in operation, the traverse bar is moved toward the right, when it is driven by one screw, and on reaching the end of the traverse the second screw is engaged, which moves the traverse bar in the opposite direction. Both traverse bars move simultaneously in the same direction.

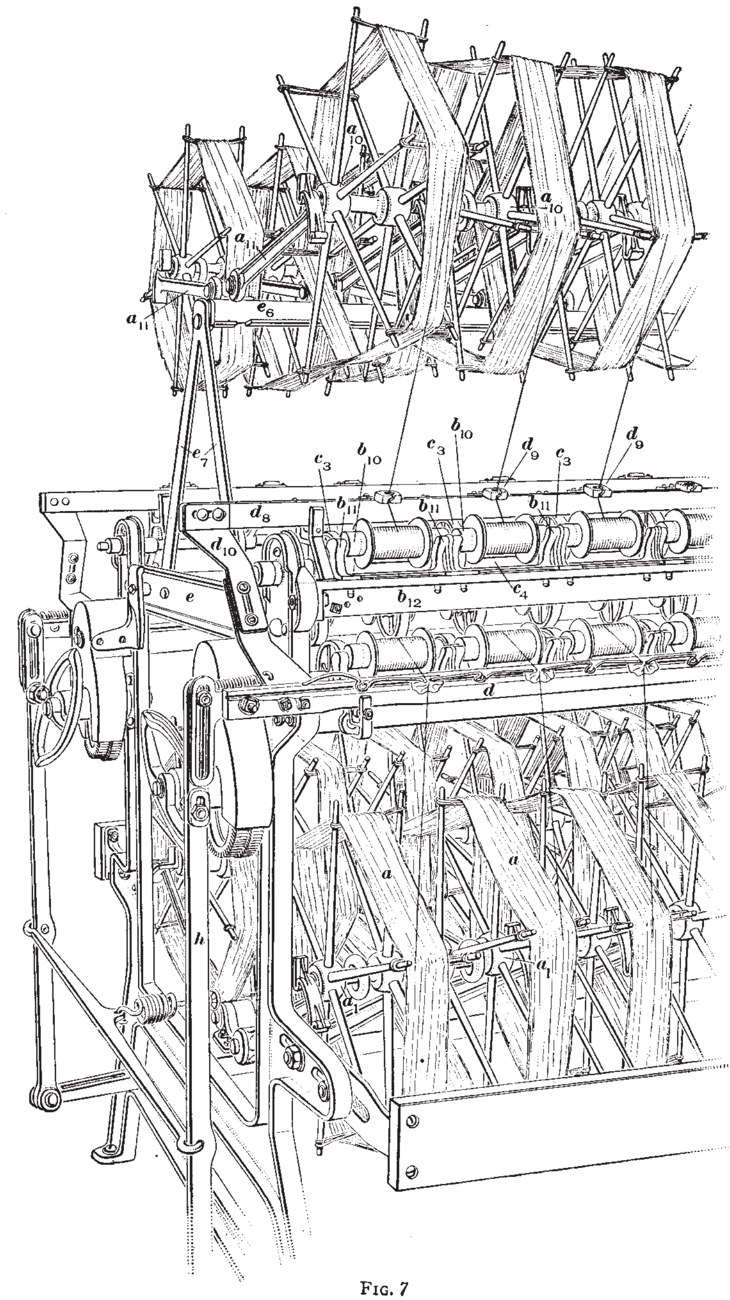
When winders of considerable length employ the screw traverse motion, it sometimes happens that a swaying motion is given to the frame. This motion is caused by the movement of the traverse bars in the same direction and their simultaneous reversing. Furthermore, the screws that cause the movement of the bars become worn after use, and allow the reversal of direction of the bars to take place with less speed, thus permitting the silk to pile up slightly at the heads of the bobbins.

DOUBLE-DECK WINDERS

30. In general design, a double-deck winder may be considered as a single-deck winder with an additional row of swifts supported in suitable swift hangers located above the machine. An extra row of bobbins to wind the silk from the upper row of swifts is situated slightly above the bobbins that wind the silk from the lower row of swifts. As in other silk-throwing machinery, both sides of the machine are duplicates; therefore, a double-deck winder possesses twice as many spindles as a single-deck machine. Moreover, the double-deck winder occupies exactly the same floor-space as does the single-deck winder; but, since it possesses just twice as many spindles, it has the advantage of producing a great deal more work.

31. In Fig. 7 is shown an illustration of a common type of double-deck hard-silk winder with the skeins a on the rows of swifts a_1 arranged exactly as on the ordinary single-deck winder. The additional row of swifts a_{10} is located above the machine and supported in swift hangers a_{11} bolted to the tie e_6. This extends the entire length of the machine and is fastened by means of suitable brackets e_7 to the end stands e. The hangers are spaced so that the swifts will be directly above the bobbins on which the thread is wound.

32. The spindles b_{10}, Fig. 7, which constitute the upper row and hold the bobbins that wind the silk from the skeins on the upper row of swifts, are held in bobbin holders or spindle holders, b_{11} that are somewhat like those already described.



a_{10}
a_{10}
a_{11}
a_{11}
e_6
e_7
c_3
b_{10}
c_3
b_{10}
d_9
c_3
d_9
b_{11}
b_{11}
b_{11}
d_8
d_{10}
e
c_4
b_{12}
d
a
a
a_1
h
d

Fig. 7

The spindle holders are bolted to a long iron bar b_{12} that extends the entire length of the machine and is bolted to the end stands. The spindle holders for the upper deck are like those of the lower deck and have two slots in each finger. With the spindle in one slot, the spindle head is brought in contact with the friction wheel, which corresponds to the operative position of the spindle. With the spindle in the second slot, however, the spindle head is raised from the friction wheel and the spindle is inoperative. When in the operative position, the heads of the spindles b_{10} come in contact with the friction wheels c_3 on the upper take-up shaft c_4. The take-up shaft extends the length of the machine, and is supported in bearings at each end stand and at intervals along the shaft. Two take-up shafts are provided on each side of the frame, the upper shafts being employed to drive the spindles, and consequently the bobbins of the upper deck, while the lower shafts are used to drive similar parts for the lower deck. The lower take-up shaft cannot be seen in the illustration.

33. As the thread leaves the skein on one of the upper swifts and winds on the revolving take-up bobbin driven by the upper take-up shaft, it is given a back-and-forth traverse by the traverse bar d_8, Fig. 7. This bar is supported in traverse fingers in the same manner as the bar d of the lower deck. The upper traverse bar is equipped with porcelain guides d_9 of special design through which the thread passes. A special design is necessary because of the location of the swifts and the bobbins; for, in winding the silk from the upper deck of swifts, the thread tends to be drawn away from the guide, rather than against it. The guides are usually fixed to a slotted bracket held to the traverse bar by two screws, and adjustments are made by loosening the screws and shifting the guide in the desired direction. An ordinary type of porcelain guide is employed on the lower traverse bar and is held in position by spring-wire bows.

34. The upper traverse bar d_8, Fig. 7, is supported in traverse fingers similar in construction to those supporting the bar of the lower deck. The traverse fingers are attached to the iron bar b_{12} and carry the traverse bar slightly to the rear of the bobbins. The lower traverse bar is mounted in front of the bobbins, while both bars are fastened together by the adjustable connector d_{10}. Because the lower bar is affixed to the traverse lever h, any motion imparted to it by the cam will be transmitted to the upper bar by virtue of the connector.

The drive employed on the double-deck winder being described varies somewhat from other winder drives, since it is necessary to propel four take-up shafts instead of two. Furthermore, both take-up shafts on each side of the frame rotate in the same direction to take up the thread in the correct manner. At the end opposite the cam end of the machine, the take-up shafts terminate a short distance from the end stand and each shaft carries an ordinary spur gear. Between the gears on one set of shafts located on one side of the machine, and meshing with them, is a small idler. Pinned to the idler is a bevel gear that meshes with a bevel gear of the same size on the crosshead shaft. By applying motion to the crosshead shaft, all take-up shafts will rotate in the correct direction.

35. When considering economy of floor space, the double-deck winder is preferred; however, there are disadvantages that should not be overlooked. The distance between the upper and lower decks of swifts is so great that it becomes necessary for the operative to stretch somewhat when finding and tying broken ends on the upper deck. This, together with alternate periods of bending over the lower swifts, causes additional fatigue. Furthermore, the operative in tying the ends frequently permits the tails of the knots to drop, after cutting them off. These may fall on the take-up bobbins and be wound in with the silk, or come in contact with the silk on the lower swifts, causing a tangle, or snarl. In addition, waste that loosens from the skein frequently falls on the silk on the lower parts of the machine, while dirt, dust, and lint cause similar difficulties. Double-deck frames are high and operatives are more easily hidden from the observation of the overseer. This, of course, is conducive to carelessness and neglect of work. It may be added that whenever sufficient floor space is available, single-deck winders should be generally selected.

PROCEDURE IN WINDING

ESSENTIAL OPERATIONS

36. In considering the steps necessary in the winding of silk, it will be found that the entire operation consists essentially of the following: First, placing the empty bobbins or spools on the spindles; second, carefully beating out the skeins, prior to placing them on the swifts; third, placing the skeins on the swifts and carefully adjusting the swift strings or braces so that the latter will revolve with a smooth, even motion; fourth, cutting with scissors, and removing the lacing strings that were placed in the skeins when they were laced; fifth, finding the end of the skein on the swift, attaching the end of the bobbin, and starting the latter in conjunction with the swift; sixth, tying up any ends that break after starting; seventh, doffing or removing the bobbins as they become full, and replacing them with empty bobbins; and, lastly, placing new skeins on the swifts where the skein has become exhausted or run out.

PRELIMINARY OPERATIONS

37. Placing Bobbins on Spindles.—The bobbins are usually received at the winder in baskets or boxes, on bobbin boards, or in some other receptacle employed to transfer bobbins from one department of the mill to another. Starting at one end of the winding frame, the bobbins are placed on the spindles as follows: The operative grasps a spindle in the left hand, places a bobbin on the gudgeon, and forces it downwards over the piano-wire springs until the head of the bobbin is pressed firmly against the spindle head. With the bobbin in place on the spindle, the latter is replaced in the fingers or bobbin holders. Here it is either allowed to remain at rest or the spindle head is brought in contact with the friction wheel, causing the bobbin to revolve until the operative desires to attach the end to the bobbin, whereupon it must be stopped.

38. Beating Out Skeins.—The stock, or silk, to be wound is usually received in the winding department in canvas baskets, or on wooden poles from the drying rack. Sometimes, when the winders are working on a piecework basis, the silk is carefully weighed prior to delivery to the operative. On its receipt at the frame, the winder prepares the silk previous to placing it on the swift. This process consists of stretching, or beating out, the skein, which is done either by the aid of a stretching post or by hand. The stretching post is a smooth hardwood bar or a highly polished metal pipe, about 3 inches in diameter and about 30 inches in length. One end is securely fastened to an upright post or to the wall at a point from 4 to 6 feet from the floor, so that it will be at a suitable height for the operative. A skein is removed from the basket or rack, opened, and hung on the post. One hand is inserted in the loop of the skein, at a point directly below the post, and gradually worked downwards. If tight ends are encountered, they should be carefully worked until the operative's hand rests on the lower loop of the skein. The hand should then be given a rapid up-and-down motion, and on the completion of the downward stroke, the lower loop of the skein should be struck with considerable force. This should be continued until the threads that were slightly tangled are in good order when compared with the bulk of the threads in the skein. Instead of the hand, a small round stick is sometimes used. The stick is inserted in the loop of the skein, grasped with both hands, and given a rapid up-and-down motion, serving the same purpose as the hand. Sometimes, a stretching post is not used when beating out the skein, but both hands are inserted in the loop of the skein, brought together, and then rapidly moved away from each other until their motion is arrested, when the skein becomes taut. This operation is repeated several times, and after the operative becomes skilled, the sudden application of tension to the threads will cause a resounding snap. It should be remembered that, although proper beating out of the skeins is conducive to better winding, too harsh an action, especially on fine yarns, is injurious to their running qualities.

39. Placing Skeins on Swifts.—When placing a skein on a pin-hub swift, it is of vital importance that the entire skein should be drawn over the swift sticks and properly adjusted on the swift braces. Although this is a comparatively simple operation, considerable skill and dexterity are required to do it quickly and efficiently. First, one or two of the cotton or fiber braces are moved inwards toward the hub of the swift. The swift is grasped with the left hand and lifted from the hanger, and the skein is slipped over and between the swift sticks, so that it rests on the braces. It is then gradually worked over all the swift sticks, and the swift is replaced in the hanger. After the swift has been replaced in the hanger, it is revolved gradually until the braces that were previously moved toward the center of the swift are toward the operative. The brace is then grasped at the ends, on each side of the skein, and drawn outwards to its original position. The swift is next revolved and all the braces are given a final adjustment, so that the skein will be balanced and run with a smooth, even motion. During the final adjustment of the braces, the operative should grasp the skein at the point where it crosses each brace and carefully spread it so that it will be completely opened and show the diamonds caused in reeling. When a skein is properly placed on the swift and, spread on the braces to show the diamond-shaped crossings, the thread will unwind with greater ease and less breakage than when the skein is carelessly placed on the swift.

40. Sometimes the skein is placed on the swift in a slightly different manner. After several of the swift braces have been moved toward the center of the swift, the skein is placed over the swift sticks while the swift is still in the hanger. The swift is then revolved so that its top moves away from the operative, causing the skein to rest on the braces. After part of the skein has been placed on the braces, the swift should be lifted from the hanger so that the skein may pass the pin that rests in the hanger. The swift is then returned to the hanger, and the remainder of the skein is placed on it. The braces are adjusted as previously described. The method of placing a skein on a geared swift is slightly different. The swift is removed from the hanger and a spoke is turned in the proper direction to cause the supports to move toward the center of the swift. After the supports have moved far enough to allow the skein to be placed on them, the swift should be replaced in the hanger. One of the spokes should then be turned so as to move the supports outwards, and when the skein is held sufficiently taut it is in the proper position for winding.

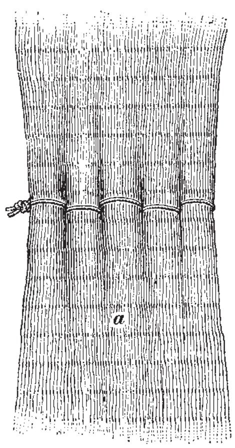


FIG. 8

41. Removal of Lacings.—Subsequent to the spreading of the skein on the swift braces of the pin-hub swift, or on the supports of the geared swift, it is necessary to remove the lacing strings, or tie-bands, that hold the shape of the skein and prevent the ends from crossing and tangling. Although this is a simple and exceedingly insignificant operation, it is very important. Fig. 8 shows part of a raw-silk skein *a* with a lacing string in place. The string interlaces the skein, so that the threads are divided into a number of groups, and its ends are knotted at one side of the skein to prevent it from being accidentally withdrawn from the skein. Since the lacing strings interlace groups of threads, careless removal of them would probably result in unnecessary injury to the skein. For example, the lacing string might become snarled or twisted and catch the threads in the skein, or knots in the lacing string might be pulled through the skein. The latter, of course, may be avoided by cutting the knot carefully from the string, which is usually done in the following manner: The knotted end of the string is pulled away from the skein, and after it clears the skein the entire knot is cut from the string. The skein is then spread out where the lacing string passes through it, and the loop of string on the opposite side of the skein is grasped and gently pulled from the skein. Sometimes the strings are removed in exactly the opposite manner; that is, the loop of the string opposite the knot is cut and the knot is grasped in one hand and pulled, thus drawing the string from the skein. The strings should be drawn from the skein in turn, and the same care should be exercised with each so that the ends will not become tangled or broken.

42. When removing lacing strings, that section of the skein close to the strings should be carefully examined to determine whether the end of the skein is fastened to a string. Often the end is looped through an opening in the skein and then affixed to a string. It is then easily found when the string is removed. In some cases the thread is fastened in a different manner; thus, the inner end is sometimes passed through an opening so that it will be on the outside of the skein. The outer end is then twisted once or twice around the inner end, after which they are looped around the skein and then knotted. When prepared in this manner, care must be taken that the ends looped around the skein are not broken; otherwise, it will be necessary to find the end in the same manner as in finding a broken end.

STARTING

43. Checking Direction of Rotation of Swifts.—After the lacing strings have been removed, and the end of the skein has been found, a small amount of silk should be pulled from the skein in order to determine the direction in which the swift will revolve. The thread should pull from the top of the swift, so that the top side will move away from the operative, or toward the center of the machine. Should the top side of the swift move toward the operative, it will be necessary to remove the swift from the hangers, turn it end for end, and then replace it. Removing the swifts from the hangers and reversing them may be eliminated to a certain extent if the knots on the skeins are observed. For example, if the lacing-string knots are on the left side of the skein when it is on the swift, and the skein revolves in the proper direction, all succeeding skeins should be placed on the swifts with the knots to the left. This may usually be followed throughout the entire lot, for silks that have been reeled in the same filature are usually prepared in a uniform manner.

44. Attaching End to Bobbin.—When the end has been found, it is attached to the bobbin on which it is to be wound. One method is to hold the bobbin on the spindle in the left hand and the end from the skein in the right. The end is laid on the barrel of the bobbin, held with a finger of the left hand, and wrapped several times around the barrel in a direction over the top and away from the operative. Then one finger is again placed on the end and the thread is wound on the barrel in the opposite direction. By reversing the direction of winding and overlapping the end, the end is firmly held on the bobbin. At times the end of the yarn is slightly moistened, so that the thread, on coming in contact with the bobbin barrel, immediately clings to it. As the yarn is wrapped around the barrel, so that it crosses the moistened end, it is firmly bound as the yarn is drawn tight. When the silk is wrapped on the end, the latter should be broken off or lapped under short so that a long tail will not extend from the layer of silk. If this is not avoided, the protruding end sometimes becomes tangled with the running end, so that in later processes the end breaks. It should be remembered that the end should never be tied to the barrel of the bobbin when starting the winding operation; for, in a later process, when the thread runs out on a bobbin, it will become taut and break with a snap, if it has been tied. The snapping frequently causes the thread to fly into other ends and tangle them, resulting in breakage. This reduces production in later processes, all of which could be avoided by exercising sufficient care in the winding operation

45. After the end has been properly wrapped around the barrel, the spindle holding the bobbin is so placed in the fingers, that when the spindle head rests on the rotating friction wheel the bobbin will revolve. When performing this operation, the operative usually holds the bobbin in the left hand and allows the thread to pass through the fingers of the right hand. Simultaneously, when depositing the spindle in the fingers and the bobbin begins to take up the thread, the operative allows the right hand to move toward the center of the machine, causing the swift to start gradually. Frequently the swift is given a slight start by pushing a swift stick in the direction in which the swift is to revolve. These two operations assist the swift in starting, relieve the strain on the thread, and prevent it from becoming injured or breaking. With the bobbin and swift running in the proper manner, the porcelain guides that rest on the traverse bar should be carefully adjusted. If the adjustment is such as to cause the thread to wind high, or pile up, at one head and low at the other, the guide should be adjusted so that the thread will be evenly distributed over the entire bobbin. Bobbins not evenly wound usually cause trouble in subsequent operations and should be avoided. After all the guides have been adjusted, the silk should continue to run until an end breaks or runs out.

46. Thread Tension.—The tension given to the thread is regulated by the weight that is hung from the small leather strap surrounding the hub of the swift. The iron weights employed for this purpose are of different sizes, so that they may be readily changed to suit the strength of the thread being wound. With a weight of the proper size attached to the strap, the swift will revolve steadily giving an even tension to the thread and resulting in a bobbin neither too hard nor too soft. Great care should be exercised in the selection of weights, for it sometimes happens that the thread is stretched and robbed of its elasticity in the winding operation when exceptionally heavy weights are employed. This is especially true in mills in which the silk is wound while it is damp. In this condition the silk stretches very easily, but after it is wound on the bobbin it becomes dry and shrinks slightly, thus causing a hard bobbin. Some silks, particularly those of the finer denier sizes, are often wound from pin-hub swifts that have no weights. This practice is followed to a large extent and is allowable, of course, provided it produces a bobbin that is not too soft, but if the unweighted pin-hub swift should overrun, that is, run with a jerky motion and appear at times as though it were running faster than its normal speed, a very light weight should be suspended from the strap on the hub, to cause an increase in tension on the thread.

47. Broken Ends.—Broken ends are often caused by excessive tension on the threads, especially when the silk is wound in a very damp condition, so that it contains amounts of moisture largely in excess of the standard regain. In this case breakages sometimes increase from 6 to 10 per cent. over those occurring when the silk is wound in a normal condition. Excessive breakage also occurs, when the silk being wound contains fine ends that cannot withstand the tension. Breakages of this nature, while increasing the stoppages in the winding department, reduce stoppages from this cause in succeeding operations, provided the fine ends are removed. Ends often break when a knotted portion of the skein is encountered; and when hard gums have not been rubbed or thoroughly softened in the soaking bath, the thread often clings to the gummy part of the skein and breaks when it cannot pull away. Besides the gummy portions in the skein, the threads often contain waste, slugs, etc., which catch the running end and either stop the bobbin or cause a breakage of the end.

48. After the end has broken, it is customary, first, to find the broken end of the skein on the swift by selecting a top thread of the skein where it crosses the lower layers of the skein. This thread should be picked up with the left hand while the swift is slowly revolved with the right hand in a direction opposite to that in which it was previously revolving. The thread selected should be allowed to slip through the fingers of the left hand, and when a bunch of crossed threads is encountered, the thread that was first picked up should be rejected and the top thread of the bunch should be selected and allowed to slip through the fingers. If another bunch of crossed ends is encountered, the operation previously described should be repeated. Finally, the outside end of the skein will be found, whereupon a considerable length of thread should be pulled from the skein to insure the removal of fine ends or waste, and to allow a perfect start to be made.

49. After the end of the skein has been found, the operative should find the end on the bobbin, so that the broken ends may be tied. This is a comparatively simple operation, for the broken end usually extends two or three inches from the bobbin and may be readily seen. The operative removes the bobbin and spindle from the fingers and pulls a sufficient length of silk from the bobbin to insure that a tight bobbin will not be made. Tight bobbins are usually made when the end is slightly pulled and buried under previous layers of silk. In this case, the operative usually strokes the silk with a moistened finger with a result that the broken thread is pulled through a loop made by a thread that has been previously wound on the bobbin. If a small amount of silk is not pulled from the bobbin prior to tying the end, the tight end will remain unnoticed and pass on to the next operation. The end drawn from a bobbin that has tight ends will break, reducing production and increasing the work of the operatives.

50. After both broken ends have been found, they are tied with an ordinary overhand knot. While this is easily done, the degree of speed necessary comes only through practice. It is sometimes more difficult to tie knots in damp silk than in silks of the proper degree of moisture. After the knot is tied, it should be drawn tight, and the tails should be clipped off close to the body. They must not be cut too short, or the knot will open when under tension; and they must not be too long, or they will cause trouble in succeeding operations. From $\frac{1}{16}$ to $\frac{1}{8}$ inch is considered a good length.

51. Removal of Bobbins.—As the bobbins become filled with thread, they should be removed from the spindles and placed in wooden boxes or on bobbin boards prior to their transfer to another department. The operation of removing the bobbins is known as *doffing*. When doffing a bobbin, especial care should be given to the end before the bobbin is placed on the board. Usually the end is made into a loop that is slipped over one head of the bobbin and drawn up tightly around the barrel. Again, the end is sometimes pulled into the silk adjoining a bobbin head and a long tail is allowed to protrude, so that it may be readily found. This practice is objectionable, for frequently the end breaks when it is buried in the silk and excessive waste is caused in locating the end. It is always well to secure the end in one way or another, as this prevents the silk from unwinding and causing waste, and also reduces the number of tangled ends.

52. Bobbin Boards.—Reference has been made, from time to time, to the bobbin board employed as a holder for

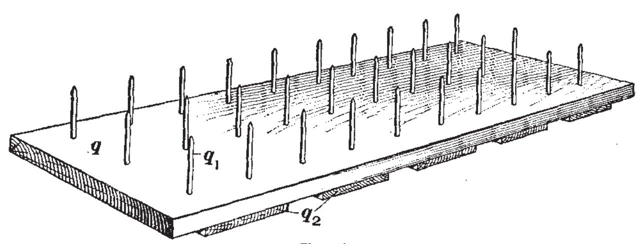


FIG. 9

the empty or filled bobbins, to facilitate their transfer to the various departments of the mill. Bobbin boards, or bobbin racks, are generally made of wood, although metal may be employed. A common type of wooden bobbin board is illustrated in Fig. 9. It consists of an oblong board, or base, q through which large nails, or pins, q_1 are driven in uniformly spaced rows. Small strips of wood q_2 are nailed to the under side of the board to cover the heads of the nails and prevent them from loosening and falling out. The strips also prevent the base from warping in case it is subjected to steam or dampness. The board shown has 30 pins, so as to hold 30 bobbins. When it is filled with bobbins, it may be easily carried to the succeeding machine, and as the full bobbins are removed empty bobbins may be substituted in their places. The board, when filled with empty bobbins, may be returned to the winder.

Instead of bobbin boards, canvas baskets of various sizes may be employed, and are very satisfactory. Use is also frequently made of wooden boxes of a size suitable for holding a large number of bobbins when carefully packed. Boxes or other suitable containers may be easily constructed to meet the requirements in different mills, since operating conditions and the layout of the machinery are not always similar.

MANAGEMENT AND CARE

SUPERVISION

53. Treatment of Operatives.—The proper supervision of a winding department requires considerable experience and tact in order that the operatives shall work in harmony. For this reason, the overseer should have a thorough knowledge of the machinery in the room and know the degree of expertness of each operative employed on the machines. With this in view, when distributing the raw stock to the winders, care must be taken that the best quality of silk will not always be given to the same winders, but that each operative will be required to share the work of running poor silk. If this is not done, the operatives will become dissatisfied because of unfair treatment or partiality, and may leave the employ of the mill. When this occurs it frequently is necessary to obtain new help, and if the latter is unskilled, the percentage of waste will be increased and production will decline. When the new hands have had no previous training, they are usually assigned to a reliable operative in the room whose duty it is to instruct the beginners. After a reasonable length of time, each beginner should be given a certain number of spindles to operate. When the efficiency has been developed to such a degree that the spindles are kept in practically continuous motion, the beginner should be given the same number of spindles as the other operatives. The number of spindles usually given to one attendant is variable, depending on the ability of the operative, the quality of the silk, and the speed at which the winder is operated.

54. Winders' Waste.—The amount of waste produced in the winding department of a silk throwing mill depends on the quality of the silk, the class of yarn being thrown, and the skill of the operatives. Of course, large amounts of silk waste may be made with silks of good quality when run by inefficient employes. For instance, if the major part of the skein runs well, while the latter part causes a considerable amount of trouble, the operative will often cut the troublesome skein from the swift and throw it into the waste bag. This practice is referred to as *snipping skeins*, and should be discouraged.

55. Winder Speed.—The speed at which a winding frame should run depends to a certain extent on the variety or size of the stock being wound; for different qualities or kinds of silks sometimes require different speeds to produce the best results. This is especially true of the finer denier silks, ranging from 13/15-deniers to the finer sizes. The speed of the winder, however, is infrequently altered when winding silks coarser than the 13/15-denier size, since the heavier silks are capable of withstanding the strain of higher speeds. In actual experience it is found that with the crosshead shaft making from 220 to 375 revolutions per minute, a sufficient variation in speeds may be obtained for winding practically all kinds of silk. The speeds may be very easily changed by shifting the driving belt on the cone pulleys.

56. Thread Speed.—When referring to the speed of a winding frame, the rapidity of take-up of the thread on the take-up bobbin is usually given in yards per minute. This is known as the *thread speed*, and may be defined as the number of yards of silk wound on the take-up bobbin in one minute. By the average thread speed is meant the number of yards wound on a half-filled take-up bobbin in one minute. When winding silks on the spindle take-up winder, the average thread speed must be determined, since the take-up in yards per minute increases as the bobbin becomes filled. Thus, when winding thread on the empty barrel of the bobbin, the yardage taken up in a given time will be less than when the bobbin is filled and has a larger diameter. For this reason, it is necessary to obtain an average, which is considered as the speed of take-up on a half-filled bobbin. In adjusting the pulleys to obtain a certain thread speed, however, the maximum speed should be considered; for, should the filled bobbin take up the thread too rapidly, the breakage is likely to increase in proportion.

57. The thread speed of a winding frame is primarily dependent on the winder speed, and is increased or decreased by changing the winder speed. In determining the correct thread speed, it is important to note that the thread should be taken up with sufficient rapidity to cause a hard and firm bobbin. When soft bobbins are formed, trouble usually arises in the subsequent operations of doubling and spinning. When winding at slow speeds, as from 60 to 80 yards per minute, the swifts may be weighted; but since the production will be low and the breakage increase in this case, the thread speed is usually increased until a hard bobbin is produced without weighting the swifts.

Tussah silks, which are coarse and hairy, and certain China silks that exhibit rough characteristics are wound at average thread speeds of from 160 to 170 yards per minute. On better grades of silk the average thread speed may be increased to 200 yards or more per minute. When winding silks of 12/14-denier size, a thread speed of 200 yards per minute is known to give good results. At times, thread speeds up to 250 yards per minute are maintained, but this speed is somewhat injurious to the thread and is productive of many breaks. When the thread speed exceeds 220 yards per minute, the breaks increase from 18 to 20 per cent. over the breaks occurring when winding the average sizes of silk with a lower speed.

GENERAL INFORMATION

58. Power.—A winding frame is a comparatively simple machine and does not consist of many moving parts, and, for that reason, the power consumption is quite low. The power required, of course, is dependent on the number of spindles to be turned. An 80-spindle winder requires from $\frac{1}{4}$ to $\frac{1}{3}$ horsepower, the larger sizes requiring more. The double-deck winder, as a rule, requires about twice as much power as a single-deck winder having half as many spindles.

59. Cleaning and Oiling.—In order to keep the winding room as clean as possible, and also to retain the smooth-running qualities of the winders, the machines should be periodically cleaned and oiled. The cleaning of the machines is usually performed weekly at a given time. Thus, the machinery is generally stopped about 15 minutes prior to the closing time of the mill, giving the attendants an opportunity to clean their respective machines. As an aid to cleaning, small brushes should be provided, together with cotton waste for wiping the oily parts. When cleaning, it is customary to dust off the bobbin shelf, then the traverse bars, shafts, end stands, etc., until the machine is thoroughly cleaned in all its parts. When cleaning the shafts supporting the friction wheels it will often be found that waste silk has become wrapped around the shaft. If it interferes with a bearing, it may throw the latter out of line and cause unnecessary strain or wear at that point. Therefore, all accumulations of waste should be removed, with the aid of a knife, a piece of glass, or some other sharp instrument, and placed in a waste bag.

To prevent the various moving parts from wearing away too rapidly, it is very important that the winder be thoroughly lubricated at all times. For this reason, each winder should be provided with an oil can, whereby the parts that are most rapidly worn may be lubricated frequently. The bearings supporting the crosshead and other shafts should be oiled daily, while the remaining parts may be oiled when the machine is given the weekly cleaning. The bevel gears that transmit motion from the crosshead shaft to the shafts supporting the friction wheels should also be well oiled. At times the gear covers f_4, Fig. 1, should be removed and the adjustment of the gears noted. If the gears are worn, they should be readjusted and the cover filled with oil to the proper level, and replaced in the correct position. The cam follower, also, should be frequently cleaned and thoroughly oiled, so that it will turn readily when hitting a high or low spot of the cam, and present a new face to the latter. Finally, when oiling the various parts, it is also advisable to place a drop of oil in the fingers, so that the friction at these points may be reduced. The application of a small amount of oil at these parts will also cause the spindles to wear much longer, run smoother, and consequently, produce better bobbins.

60. Sizes of Machines.—Winding frames are not built in one standard size, but are constructed in accordance with the instructions given by the throwster. Thus, if the layout of the mill is such that it would be more advantageous to employ a winder with 100 spindles, instead of two 50-spindle winders, the machine would be built accordingly. However, the average number of spindles on a single-deck machine is about 68, while the dimensions of a machine having this number of spindles are as follows: Length, about 20 feet; width, from 38 inches to 48 inches; distance from floor to spindles, approximately 3 feet 6 inches. The weight of a machine having these dimensions is about 900 pounds.

A double-deck winder, while equipped with twice as many spindles, would have exactly the same length and width as would the single-deck machine, but the height would be greater. The double-deck frame would naturally be slightly heavier.

61. Arrangement of Machinery.—The arrangement of the winding machinery is dependent on the judgment of the throwster, size of the machines, available floor space, lighting conditions, and other conditions. When the winding frames are placed in a small room, they are usually arranged with the head ends near one wall and the ends supporting the traverse mechanism, extending into the room. The traverse mechanisms should be well protected by means of wire guards so as to prevent injury to the operatives. If the winding frames are belt-driven from a line shaft, the latter is usually supported by hangers attached to the wall or to the ceiling.

When the winding room is of sufficient width to allow the machines to be arranged in a double row, it is customary to arrange the winders so that the driving ends of two winders are adjacent to each other. In such cases, the driving pulleys of the two frames are sometimes connected by a short crossed belt, and thus only one driving belt from the driving shaft of the room is required to drive two frames. This arrangement makes necessary the purchase of only one-half of the usual number of driving pulleys and also results in a saving of belting. In mills that employ electricity for power, winders are frequently driven by electric motors. The motors are sometimes arranged to drive all the winders in the room, or to drive the winders in groups, in which cases the customary belting arrangements are required. In other cases, where electric drives are employed, each winder is arranged so as to be driven by an individual motor directly attached to the frame, and this motor drives the crosshead shaft by gearing, chain, or belt.

62. When arranging the machines, it is customary to leave an aisle from 24 to 30 inches wide between the kneeboards of adjacent machines. This aisle is frequently referred to as an *alley* and should be of such width that the operative's clothing will not come in contact with the revolving swifts and cause the breakage of ends. Where the machines are arranged in this manner, one operative usually takes care of two or more sides, that is, sides of machines that face the alley. Of course, when the winding frames are equipped with a large number of spindles, it will be possible for the operative to take care of only two sides.

DEFECTIVE WORK

63. Marking Systems.—Since the quality of the work produced in succeeding operations is dependent to a large extent on the quality of the work produced in the winding department, it is of the utmost importance that the winding be performed in the best manner. For example, in the manufacture of organzine, a thread that has been carefully wound spins better than one that is poorly wound; hence, the latter thread would probably affect the quality of the finished product. To keep the percentage of bad work as low as possible, a system of marking is sometimes employed, whereby the work of each attendant is quickly recognized, and the defective work traced to its source. In some mills each operative is given a certain mark, or a number, and when doffing the bobbins, this mark is applied to the head of the bobbin. Then, as the silk is processed in the next department, if any trouble should arise the foreman merely notes the mark on the bobbin and refers it to the winder foreman, who instructs the attendant as to the proper method of winding in order to avoid similar defects in the future. Another method that may be employed in only the smallest mills is to have one head of a bobbin painted a certain color, which is assigned to each operative. This method has a disadvantage in that the same bobbins must be returned to the same operative, and, if the silk, due to a rush order, or a special lot, is delayed in the processing, a shortage of bobbins will surely occur.

64. Still another method of employing colors as a means of distinguishing the work of different operatives is as follows: A small strip of colored tissue paper about $\frac{1}{2}$ inch wide and 4 or 5 inches long is placed on the barrel of the bobbin, prior to starting. The paper is adjusted so that it extends upwards over one head and protrudes about $\frac{1}{4}$ inch from the edge of the flange. The thread is then carefully wrapped around the barrel and also around the tissue paper, holding the latter firmly in position. After the bobbin is filled, the colored paper will be seen extending from the bobbin head, and the operative that wound the bobbin may be readily found, according to the assignment of the colors. This method, of course, requires no sorting of bobbins or returning of the same bobbins to the same operatives; hence, it may be considered advantageous in this respect.

It may be added that many mills do not endeavor to trace poor work, but allow it to go through in the best manner possible. This, of course, is not considered good practice, for defective work cannot be traced to the winding department. The winding department should be operated in a very efficient manner in order that the finished product may be as good as possible for that grade of silk.

Among the various kinds of defective work that are produced in the winding department of a silk throwing mill, those given in the following articles may be considered most common.

65. Tight Bobbins.—Tight bobbins, also known as *looped ends*, are produced when finding the end on the bobbin. This defect frequently occurs when the thread unwinds on the bobbin, forming loose coils, and, when stroking the silk, usually with a moistened finger, the end is crossed or pulled under the loose ends. On finding the end, it is immediately tied to the end on the swift and the bobbin is started. Tight bobbins can be entirely eliminated if the operative pulls a sufficient amount of silk from the bobbin to insure the starting of a new layer.

Looped ends usually break when unwinding in the next operation; hence, they should be avoided. When the looping extends over a short distance it does not always break, but pulls from the bobbin with considerable tension. This, of course, does not spin very well, since in the doubling process it produces uneven tension, which, in turn, causes a corkscrew thread.

66. Hard Bobbins.—Hard bobbins result from many causes, but the most common is winding the silk while it is too damp. When wound in this condition, the silk dries on the bobbin, and, together with the slight shrinkage, the ends are tightly pressed together, causing them to adhere. Thus, when unwinding in succeeding operations, the threads break continuously and the broken end is located with great difficulty, since it is glued to the silk on the bobbin.

Sometimes, when the damp silk is allowed to remain in a hot mill room for a considerable length of time, the silk gum becomes softened, due to a slight decomposition. Later, when the thread is wound on the bobbin, the silk clings together and adheres firmly as it becomes dry.

67. Soft Bobbins.—Soft bobbins are usually produced when an unweighted swift is run at a low speed, or when a swift has not been sufficiently weighted. A soft bobbin sometimes results also when the skein has been carelessly placed on the swift, so that the latter revolves with a jerky, or uneven, motion. This defect may be easily overcome by observing carefully the swift or spindle suspected of producing soft bobbins, and adding small weights to the strap around the hub until the bobbin is of the desired firmness.

Soft bobbins, of course, sometimes cause trouble in first-time spinning, resulting in breakages of ends when the thread leaves the barrel at a point near the upper bobbin head. Furthermore, the tension is not always uniform in tram doubling; hence, defective bobbins of this type should be avoided.

68. Waste.—Waste running in on bobbins is usually due to the carelessness of the winder. Thus, when cutting the tails from knots, the severed ends are frequently allowed to fall on the revolving swift, and coming in contact with the running end, they are wound on the bobbin. Moreover, when removing lacing strings, these are also allowed to come in contact with the running end at times and are wound on the bobbin. Waste on the bobbins sometimes is the cause of breakage of one or several ends in doubling. For this reason, care should be exercised, when cutting tails from knots, to see that the ends are not dropped on the skeins.

69. Lapped Ends.—Lapped ends are caused when an operative, prior to starting after a break, fails to tie the broken ends, and merely wraps the silk around the thread already on the bobbin. This method is a great deal quicker than finding the end on the bobbin; however, it causes delays in the following process, for each time a lapped end comes up, it must be tied in that process.

Lapped ends should be avoided, since it is better to tie the ends properly in the winding operation and thus keep the spinning or doubling frames in more continuous operation.

70. Ridgy Bobbins.—The name given to bobbins that have small ridges or rings encircling their circumference is *ridgy bobbins*. These are sometimes produced when the bobbins are not properly placed on the spindle and wobble slightly while rotating. Again, ridgy bobbins are sometimes produced when the spindle head slips on the friction wheel and does not take up continuously. To prevent this slippage, powdered chalk is sometimes sprinkled on the rotating spindle head to increase the friction and reduce the slippage. In addition, rosin or a mixture of rosin and oil is sometimes applied to the friction wheels of the winder in order to increase the friction. The use of the latter substances, however, is not recommended, since the rosin adheres to the spindle head in small lumps, causing the bobbin to jump while winding. Furthermore, the operative's hands become sticky when withdrawing the spindles from the bobbins, and later the skeins are made sticky by handling and become tangled.

71. Badly Traversed Bobbins.—Badly traversed bobbins include all defects arising from defective setting of the porcelain guides on the traverse bar. If the movement of the traverse bar is sufficient to cause a properly guided thread to be wound between the heads of the bobbins, and one guide is moved to one side, the inevitable result will be a bobbin wound high at one side and low at the other. Hence, because of the variation in speeds of the thread take-up of each end, the high end will have the silk wound hard and firm while the low side will be soft. Consequently, in the spinning operation the thread is liable to break excessively when the silk is drawn from the soft portion. In the doubling operation the tension will vary to a certain extent and a loopy thread is liable to result when pulling the thread from the high part. The difficulty in this case may be entirely eliminated if the operative carefully checks the adjustment of each guide when starting a new bobbin.

Sometimes the traverse mechanism becomes disarranged, so that the throw of the traverse bar is slightly shortened. In this event the silk will not be wound close to each head, but there will be a small space between the heads and the silk. In this case, both ends of the bobbins will be soft, with the accompanying difficulties in the future operations. The traverse fingers should be carefully examined from time to time to insure that the traverse bar will move back and forth freely. Sometimes the bar sticks for an instant and then continues in motion, causing a ridge in the bobbin.

72. Scratched Bobbins.—While scratches on bobbins are not a defect produced in winding operations, they sometimes reduce the production in the succeeding processes. When the empty winder bobbin is returned from the spinning or doubling department, a small amount of silk frequently remains wound on the bobbin. Before placing the bobbin on the winder spindle, the operative pulls the silk from the barrel, thoroughly cleaning all silk from it. Sometimes, in order to facilitate this operation, the operative scrapes or scratches the silk with a knife, scissors, or other object in order to cut the strands and pull them from the bobbin. In doing this the barrel and heads of the bobbin are often scratched, so that the thread, in coming in contact with the bobbin head in a succeeding process, is broken. For this reason, the silk should be pulled from the bobbin without cutting; but if cutting is necessary it should be done with care so that the bobbin will not be damaged.

CALCULATIONS

SPEED

73. As rules and explanations for performing speed calculations have been given in previous Sections, no rules will be given in cases where such subjects are here dealt with, but examples of all the calculations met with in connection with winding frames are given. It should be noted, that while the calculations in the succeeding examples have been carried to three decimal places, this does not signify that these decimal figures are absolutely necessary. On the contrary, they might have been omitted without invalidating the accuracy of the calculation; but they have been retained in order to preserve a certain uniformity in the answers.

EXAMPLE 1.—Find the speed of the crosshead shaft when the driving shaft makes 200 revolutions per minute and drives, from the 5-inch step of the cone pulley, the 4-inch step of the cone pulley on the winder.

SOLUTION.—The speed of the take-up shaft is

$$\frac{200 \times 5}{4} = 250 \text{ r. p. m.} \quad \text{Ans.}$$

NOTE.—Since the take-up shafts are usually driven from the crosshead shaft by bevel gears that contain the same number of teeth, they rotate at the same speed as the crosshead shaft.

EXAMPLE 2.—If the take-up shaft makes 250 revolutions per minute, and a 4-inch friction wheel drives a spindle having a head $1\frac{1}{8}$ inches in diameter, find the speed of the spindle.

SOLUTION.—The speed of the spindle is

$$\frac{250 \times 4}{1\frac{1}{8}} = 888.888 \text{ r. p. m.} \quad \text{Ans.}$$

THREAD SPEED

74. There are several methods of finding the thread speed on a winding frame. The following, while giving the approximate speed, is probably the most simple:

Rule.—*To find the thread speed, in yards per minute, divide the product of the circumference of the skein and the revolutions per minute of the swift by the number of inches in a yard.*

EXAMPLE.—Find the thread speed in yards per minute if the circumference of the skein is 54 inches, and the swift rotates 132 revolutions per minute.

SOLUTION.—Apply the rule, and the thread speed is

$$\frac{54 \times 132}{36} = 198 \text{ yd. per min. Ans.}$$

75. Besides determining the thread speed as just described, the calculation may be made from the spindle, taking into consideration the spindle speed and the average circumference of the take-up bobbin. In that case the rule is as follows:

Rule.—*To find the average thread speed, in yards per minute, divide the product of the speed of the spindle and the average circumference of the bobbin by the number of inches in a yard.*

EXAMPLE.—What is the average thread speed of a winding frame, if the diameter of the bobbin is $1\frac{1}{2}$ inches when empty and $2\frac{1}{2}$ inches when full, and the spindle speed is 800 revolutions per minute?

SOLUTION.—The average diameter of the bobbin is $\frac{1\frac{1}{2}+2\frac{1}{2}}{2} = 2$ **in.** Then, apply the rule, and the thread speed is found to be

$$\frac{800 \times 3.1416 \times 2}{36} = 139.626 \text{ yd. per min. Ans.}$$

76. In addition to finding the thread speed by first finding the average circumference, it may also be determined by obtaining the thread speed of the bobbin when empty and when full, thus finding the minimum and maximum thread speeds, after which the average thread speed may be found. Employing the data given in the example of the preceding article, the thread speed of the empty bobbin, or the minimum thread speed, is

$$\frac{800 \times 3.1416 \times 1.5}{36} = 104.720 \text{ yd. per min.}$$

and the thread speed of the filled bobbin, or the maximum speed, is

$$\frac{800 \times 3.1416 \times 2.5}{36} = 174.533 \text{ yd. per min.}$$

Then, the average thread speed is

$$\frac{104.720 + 174.533}{2} = 139.626 \text{ yd. per min.}$$

77. The thread speeds that have been obtained by calculation in the preceding examples do not take into consideration the slippage that is nearly always present where a frictional contact drive is employed. The actual amount of slippage, of course, is variable and depends on the condition of the spindle heads, the spindle speed, the weighting of the swifts, etc. For this reason, it would be difficult to give the actual percentage of slippage. For the medium-weight silks, however, and running with an average thread speed of from 150 to 200 yards per minute, a slippage allowance of from $\frac{1}{4}$ of 1 per cent. to 2 per cent. would be considered sufficient.

Sometimes, when a considerable amount of heavy silk is to be wound, a heavier spindle is provided in order that the amount of slippage will be reduced to a minimum.

PRODUCTION

78. The production of a winder, in pounds per spindle per hour, may be found by the following rule:

Rule.—*To find the production, in pounds per spindle-hour, multiply the average thread speed, in yards per minute, by the number of minutes in an hour, divide the product by the number of yards per pound, and from the result make the necessary deduction for stoppages.*

EXAMPLE.—What is the production per spindle-hour if the average thread speed is 140 yards per minute when winding a 13/15-denier silk, allowing 15 per cent. for stoppages?

SOLUTION.—A 13/15-denier silk contains 318,895 yd. per lb. Apply the rule, and the production per spindle, neglecting stoppages, is

$$\frac{140 \times 60}{318,895} = .026 \text{ lb. per hr.}$$

As there is 15 per cent. loss by stoppage, the actual production is $100 - 15 = 85$ per cent., or .85 times the result just found; hence,

$$.85 \times .026 = .022 \text{ lb. per hr. Ans.}$$

79. After the production per spindle-hour has been found, the production of any number of spindles in a given time may be calculated by multiplying the production per spindle-hour by the number of spindles and the number of hours of running.

EXAMPLE.—If the production per spindle-hour is .022 pound, how many pounds will be produced in 10 hours on a 108-spindle winder?

SOLUTION.—According to the foregoing statement, the production will be

$$.022 \times 108 \times 10 = 23.76 \text{ lb. Ans.}$$

80. In addition to determining the production of a winding frame by calculation, it is sometimes found by weighing the actual amount of silk wound, in the following manner: An average winder is selected in the department, and, when starting in the morning, it is supplied with empty bobbins. As the bobbins are filled and doffed, the operative marks the head with a cross, in order that the test bobbins may be easily distinguished, and places them in a box. At the end of the test period, the filled bobbins are carefully weighed, and a record is kept. As the bobbins are emptied in the following operation, they are placed in a separate box, and returned to the winding department. The empty bobbins are then weighed and their weight is subtracted from the total weight of the full bobbins, the remainder being the actual production, in pounds.

81. Reference has been made to the percentage of stoppage that should be allowed in solving production problems. It is evident that the stoppage is quite variable, since it is affected by many conditions. For instance, when winding a very high quality of silk of a fine denier, the period between doffing the bobbins and placing new skeins on the swifts would be greater than when winding a very coarse tussah. Moreover, the breakages would be less on the former silk than on the latter, which is also a very important factor. Besides this, the skill of the attendant must be considered; for, if the latter is inexperienced, a greater number of swifts will be idle than when the operative is dextrous and skilful.

When solving winding production problems, it is customary to allow from 10 to 20 per cent. for stoppage, or an average of 15 per cent. In some cases, however, the stoppage is even greater because of the poor running qualities of the silk, and up to 25 per cent. must be allowed in order to give approximately the actual production. The allowance for stoppage is assumed to include the loss due to slipping spindles.

SILK THROWING

(PART 4)

Serial 5002D

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 principal advantage of a double-deck winding frame?

(2) Explain how a skein is placed on a pin-hub swift.

(3) In what way may the silk thread be injured if wound from too heavily weighted swifts?

(4) Why are variable-speed transmissions employed?

(5) Why is it important, when the two traverse bars are retained in position by a single cross-bar and spring, that the cams be set 180 degrees apart?

(6) Name the essential operations of winding.

(7) What is meant by setting up bobbins, and why is it done?

(8) What are some causes of soft bobbins?

(9) How are the skeins *beaten out* prior to being placed on the swifts?

(10) Discuss the advantages and disadvantages of the drum take-up winder.

(11) What are the causes of *ridgy bobbins?*

(12) If a bobbin $1\frac{1}{4}$ inches in diameter when empty, measures $2\frac{1}{8}$ inches in diameter when full, find the average thread speed when the spindle speed is 860 revolutions per minute. Ans. 126.645 yd. per min.

(13) (*a*) A double-deck winder has an average thread speed of 178 yards per minute. What will be the production per spindle-hour if 18/20-denier silk (234,975 yards per pound) is wound? (*b*) If the winder contains 216 spindles and an allowance of 20 per cent. is made for stoppage, what will be the production of the winder in a day of 9 hours?

$$\text{Ans.}\begin{cases}(a)\ .045\text{ lb.}\\(b)\ 69.984\text{ lb.}\end{cases}$$

(14) Why should the practice of lapping ends be discouraged?

(15) State the advantages of the variable-speed winder.

(16) Discuss the removal of the lacing strings from the skein.

(17) What is the effect on the completed bobbin when silk is wound while in a damp, or moist, condition?

(18) State the reason why the thread should not be tied to an empty bobbin barrel when starting the bobbin.

(19) (*a*) What defect is likely to occur when finding the broken end on the bobbin? (*b*) How can it be avoided?

(20) Discuss the method of securing the end when doffing bobbins.

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