

The Project Method of Teaching

SILK THROWING

PART 7

PREPARED UNDER THE SUPERVISION OF
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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.

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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.

[14]

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SILK THROWING

(PART 7)

COMBINATION MACHINES

INTRODUCTION

1. In the order of operations when throwing silk yarns various methods are employed, which, while they differ in various mills, depend mainly on the equipment of the mill and on the most advantageous method of throwing the threads into the desired yarn. If mills are equipped with single-process machinery and perform all throwing operations in this manner, the thread is handled to a greater extent; an increased amount of floor space is required for the machines, and a larger number of operatives are required to attend them, than in a mill that is equipped with combination machines. As the name implies, a combination machine is the result of linking or uniting several operations that were performed on several machines so that they may be performed on one machine, in one operation. This naturally reduces the handling of the thread and also effects a considerable saving in labor.

2. Combination machines are sometimes designated in accordance with the number of operations that may be performed on one machine. For example, when two operations are performed, as spinning and doubling, or doubling and twisting, which in the single-process method were performed on individual machines, the combination machine would be known as a *two-process machine*. In a like manner, combination machines are constructed that perform the operations of

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spinning, doubling, and twisting. When throwing threads in the single-process method, three individual machines are required, but the combination machine performs the three operations simultaneously. The combination machines found in mills are also referred to in a different manner. A two-process machine, for instance, which performs the operations of doubling and twisting, is known as the *doubler-spinner*. It is employed, generally, in the manufacture of tram, which is a thread that is first doubled and then twisted. Even though the operations are doubling and twisting, the machine has been termed a doubler-spinner, by which name it is known throughout the silk-throwing industry. Thus, the name may be given to the machine because the actual twisting operation of the thread closely resembles the operation of inserting the twist in a single thread in spun-silk manufacture, in cotton spinning, and so on, where a spinning ring and a traveler are employed.

The three-process machine is also referred to as a *spinner-doubler-twister*, for it performs these operations at one time. It is quite complicated and requires a considerable amount of attention; however, when properly adjusted, and running a high grade of silk under the supervision of careful attendants, the costs allotted to help are reduced to a minimum.

TWO-PROCESS MACHINES

GENERAL TYPES

3. Various combination machines are manufactured for the purpose of performing two operations at the same time. Among them may be found the doubler-spinner, which doubles the required number of threads and twists them into a ply thread with the desired number of turns of twist. This type of machine is employed to a large extent in many mills, and, while it is essentially a tram machine, it may also be used for the production of different classes of work. Besides this type of two-process machine, another style that is used to a less extent, and, in fact, is becoming obsolete, is the *spinner-doubler*.

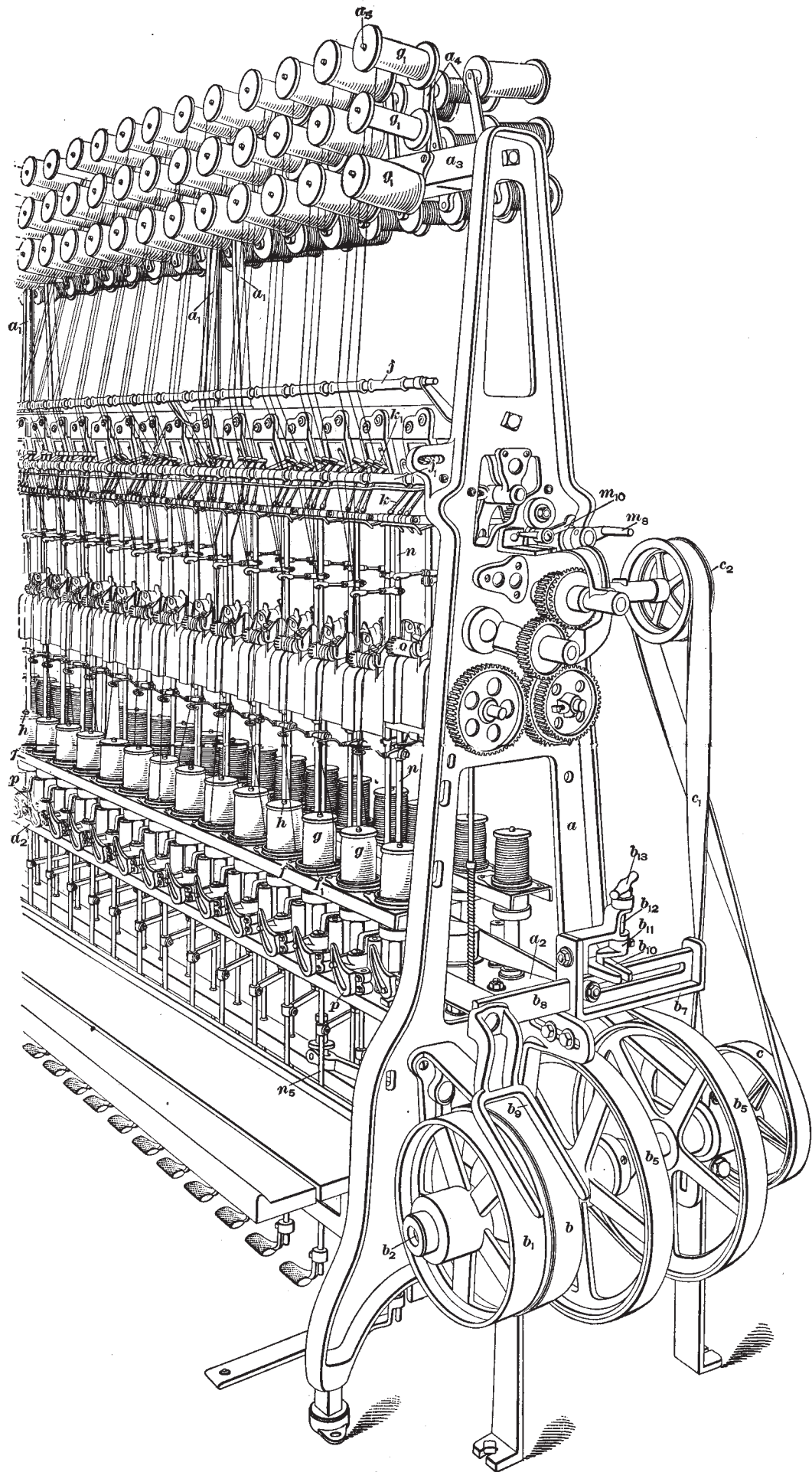


FIG. 1

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As the name implies, it spins and doubles the threads, and, hence, is essentially an organzine machine. The spinner-doubler spins the single ends and then winds them on a take-up bobbin, which is removed when filled and placed on a second-time spinner, or twister, by which the threads are twisted in the opposite direction. Since the doubler-spinner type of machine is found to the greatest extent and may be considered the most important of the two-process machines, it will be described first.

4. The basic principles of doubling and twisting are similar to those employed in single-process operations. In the doubling, the jack-pins are placed on pin rails above the machine instead of below the take-up bobbins. Hence, the thread is led downwards, passing through the drop wires of the stop-motion, and thence to the take-up bobbin located on the spindle. On account of this downward passage of the thread, the spinner is often called a *down spinner*. When the frame is in operation, three principal functions may be observed, namely:

1. The doubling of the desired number of threads into a group and guiding this group to the part of the frame performing the twisting.
2. The twisting of the doubled thread into one having the proper number of turns of twist per inch inserted in it.
3. Winding of the doubled and twisted thread on a take-up bobbin with a suitable traverse.

PRINCIPAL PARTS

5. The doubler-spinner is illustrated in Fig. 1. The end stands a (of which only one is shown) and the middle stands a_1 support the spindle rail a_2 , the pin-rail support a_3 , and the various stationary and moving parts. At the head end of the machine are the main driving pulleys b and b_1 , which are the tight and loose driving pulleys, respectively. The motion imparted by the lineshaft to the tight driving pulley and cross-head shaft b_2 is transmitted by the spindle belt b_3 to the bottom

pulley c located at one end of the crosshead shaft. On this pulley is the leather belt c_1 that transmits the motion to the upper pulley c_2 , and thence to other parts of the machine. In driving the pulley c , the spindle belt traverses the length of the machine, passing around the movable idler d shown in Fig. 2 (*a*), the latter being located at the foot end of the machine.

6. In Fig. 2 (*a*) is also shown the cam e that is driven through a series of pulleys, gears, and shafts from the pulley c , Fig. 1. The cam, of course, furnishes the traverse motion that is imparted to the ring rail f that supports the rings f_1 . The take-up bobbins g of this machine are slipped on the spindles h , which, when in motion, cause the bobbins to rotate, thus inserting the twist in the doubled threads as they are drawn from the supply bobbins g_1 .

In its downward passage from the supply bobbins, the thread passes over the porcelain roller guides j and j_1 . Because of the location of the drop wires k supporting the porcelain hook guides k_1 , in relation to the roller guides, the drop wires will be held in an upright position when the frame is in operation. When a thread breaks, the drop wire that it supports will fall backwards causing the rod n to jump upwards, in turn raising the rod n_5 , which by means of cams and springs, disengages the geared feed-rolls, of which only the front feed-roll o may be seen, from the gear located on the feed-roll shaft, the latter also being hidden in this view. In addition to arresting the rotation of the feed-rolls the spindle is stopped by the movement of the cam p . This action, of course, prevents the formation of hard twist.

DETAILS OF CONSTRUCTION

7. Frame.—The general frame construction of the doubler-spinner is similar to that of other machines previously described. As illustrated in Fig. 1, the head end stand a carries the crosshead shaft, the twist change gears, etc., and supports the bearings for the various shafts, the latter being supported at additional points in bearings mounted in the

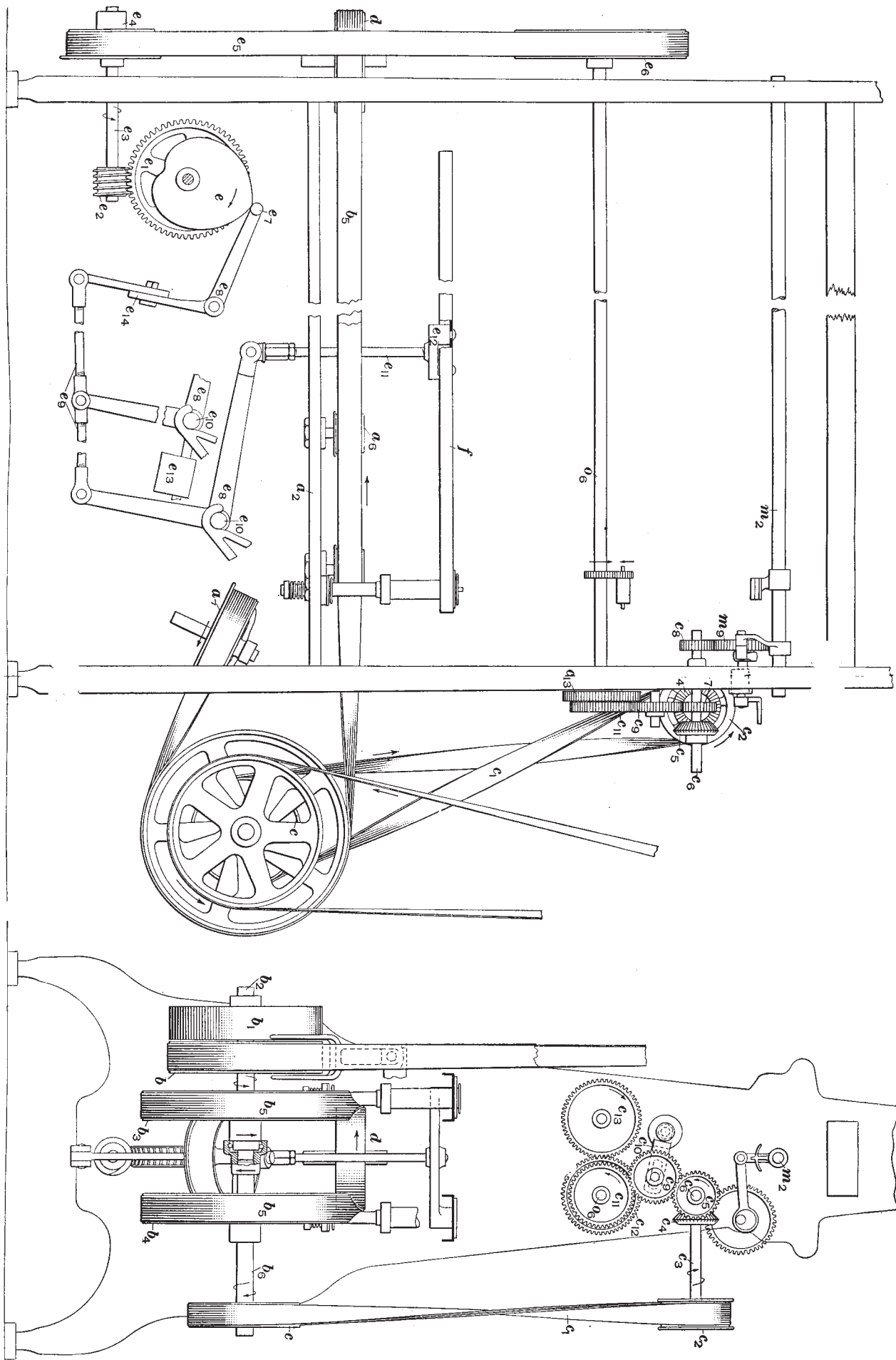


FIG. 2

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Double-page spread rotated 90° to fit on page.

middle stands a_1 . The spindle rails a_2 are also attached to the end stands and support the spindles h .

8. Jack-Pins.—At the top of the end stands is the wooden pin-rail support a_3 , Fig. 1, to which the pin rails a_4 are attached. The latter, in turn, hold the pins a_5 on which the supply bobbins g_1 revolve. The bobbins furnish the threads that eventually compose the ply thread or yarn. The construction and method of attachment of the pin rails are almost identical with those of the doubler. They are arranged in such a way that the threads running from the top bobbins will not be in contact with the bobbins on the lower pins. The machine illustrated is equipped with three pins in a row, which limits its capacity to 3-end doubling from single ends. However, the pin rails are constructed with different numbers of pins so that as many as 12 single ends may be doubled at one time.

METHOD OF DRIVING

9. Crosshead Shaft.—In Fig. 2 (*a*) and (*b*) are shown a side elevation and a drive-end view, respectively, of a doubler-spinner equipped with a crosshead-shaft drive. The machine is driven by belt from an overhead line shaft to the tight driving pulley b . The belt is on the tight driving pulley, but is shipped to the loose pulley b_1 to stop the machine. The latter pulley revolves loosely on the crosshead shaft b_2 . Also located on the crosshead shaft and near the center of the end stand is the spindle-belt pulley b_3 , which may be termed the tight spindle-belt pulley, since it is firmly attached to the crosshead shaft and turns with the tight driving pulley. A corresponding pulley b_4 , which may be called the loose spindle-belt pulley, around which the spindle belt b_5 passes, is located on the crosshead shaft b_6 . The crosshead shaft is in two parts, one part b_2 supporting the tight and loose drive belt pulleys in addition to the tight spindle-belt pulley, and the other part b_6 supporting the loose spindle-belt pulley and the pulley c . The object of this construction is to allow the spindle-belt pulleys to turn in the opposite direction with a minimum amount of friction on

the bearings. However, the crosshead shaft is equipped with ball bearings in order to reduce the power required to drive the frame and also to increase the life of the machine.

10. As on spinners and twisters, the spindle belt, passing around the tight spindle-belt pulley, traverses the entire length of the machine, driving the spindles on that side. The belt is guided by the stationary idlers a_6 , Fig. 2 (*a*), that rotate on studs attached to the spindle rail a_2 located at frequent intervals, in order to prevent the belt from sagging away from the spindles. At the end of the machine the belt passes around the movable idler d , and on the return drives the spindles on the opposite side of the machine; then, passing around the loose spindle-belt pulley, it is guided under the frame to the stationary idler a_7 . In passing around the loose spindle-belt pulley, the motion imparted to the pulley by the spindle belt is transmitted to the crosshead shaft b_6 , view (*b*), since these parts are securely attached. Moreover, the motion from the crosshead shaft b_6 is in turn imparted to the pulley c , which is sometimes referred to as the bottom pulley.

11. The pulley c , Fig. 2 (*a*) and (*b*), is securely attached to the crosshead shaft and transmits the motion to other shafts that are essential in the operation of the stop-motion and the feed-rolls. Around the pulley c is a leather belt c_1 that, guided upwards, passes around the flanged pulley c_2 , sometimes referred to as the top pulley, mounted at the end of the shaft c_3 . The motion from the top pulley shaft c_3 is transmitted to two different parts of the machine. It is transmitted through the various gears and change gears to the feed-roll shafts in the following manner: At the inner end of the top pulley shaft c_3 is a bevel gear c_4 that meshes with another similar bevel gear c_5 mounted on the bevel-gear shaft c_6 . Also mounted on the shaft c_6 are the gears c_7 and c_8 . The spur gear c_7 meshes with a gear c_9 that revolves on a stud held in the bracket c_{10} , view (*b*). Both the stud and the bracket are adjustable, so that the gear that the former supports may be adjusted so as to mesh properly with the gears c_7 and c_{11} . The gear c_{11} is mounted on the feed-roll shaft to which it imparts motion. A

54-tooth spur gear c_{12} on the feed-roll shaft meshes with a similar 54-tooth gear g_{13} on the opposite feed-roll shaft, causing both shafts to revolve at the same speed. Of the gears just referred to, the spur gears c_7 and c_{11} are known as the change gears, while the gear c_9 is known as a single intermediate gear.

The motion from the bevel-gear shaft is also transmitted to the rocker-arm shaft m_2 , which is a part of the stop-motion. The bevel-gear shaft c_6 passes through the end stand a sufficient distance to allow the spur gear c_8 to be attached to its end, and the gear c_8 meshes with the gear m_9 of the stop-motion assembly and transmits the motion necessary for the proper operation of the stop-motion.

12. Reference has been made to shipping the main driving belt from the tight to the loose pulley. The shipper consists of a shipper-bar support b_7 , Fig. 1, that carries a shipper bar b_8 of sufficient length to extend toward the left of the machine and support the shipper fork b_9 at a point above the driving pulleys b and b_1 . The drive belt passes between the tines of the shipper fork while moving toward the pulley on the machine. Bolted to the shipper bar is a slotted casting b_{10} that engages with a pin on the crank b_{11} , which is fastened by a setscrew to the small shaft b_{12} . At the upper end a handle b_{13} is pinned to the shaft, the whole being supported by a hanger bolted to the shipper-bar support b_7 . When the handle b_{13} is turned, the bar b_8 and the fork b_9 will be moved, thus guiding the belt to the desired pulley.

13. Individual Motor Drive.—An individual motor drive may be easily applied to the doubler-spinner. The tight and loose pulleys of the outside drive are removed from the cross-head shaft, and a large sprocket suitable for use with a silent chain is firmly attached to the shaft. A motor of the correct size and equipped with a sprocket similar to that on the cross-head shaft is attached to the end stand and adjusted so that both sprockets will be in line. A silent link chain is then placed on the sprockets and the motor is adjusted so that the chain will have only a small amount of sag; otherwise, the chain

will hum when it is in motion. The motor is placed on a movable carriage or the bolts supporting the motor merely pass through slots in the end stand, thus allowing vertical adjustments to regulate the tautness of the chain.

With an individual motor drive, the machine is invariably equipped with a starting box or switch located on the end stand. Since the direction of twist in the thread is sometimes changed, frames are also equipped with a switch whereby the direction of rotation of the motor may be reversed. When the frame is not so equipped, the motor may be reversed by changing the proper wires.

14. Variation in Construction of Drive.—Various methods are employed for operating doubler-spinners. As illustrated in Figs. 1 and 2, the frame is equipped with the tight and loose pulleys located at one end of the crosshead shaft, from which it derives the name *outside drive*. This is considered objectionable by some throwsters, because the pull of the drive belt, whether from an overhead line shaft or from one located under the floor, tends to produce an unequal strain on the bearings. For this reason, frames sometimes have the tight and loose driving pulleys located between the spindle-belt pulleys, constituting what is called a center drive. With the pulleys arranged in this manner, the machine appears to be balanced better than a machine with an outside drive.

15. A frame with an individual motor drive sometimes has a device that allows the direction of rotation of the spindles and consequently the twist, to be reversed without reversing the motor. The two spindle-belt pulleys are loose on the crosshead shaft and between them is a casting often called a *dog* that forms a collar and is firmly attached to the crosshead shaft. At right angles to the hub of the dog and extending in opposite directions are two arms, one of which contains a hole parallel to the crosshead shaft. Into this hole is fitted a steel pin of about the same length as the width of the dog. It is retained in its position in the dog by two setscrews.

The sides of the spindle-belt pulleys adjoining the dog have lugs cast on spokes, the distance between the lugs and the cross-

head shaft being equal to the distance between the crosshead shaft and the pin referred to. A hole of the same diameter as the pin is bored into each lug, so that the pin may engage the hole. By loosening the setscrew, the pin may be inserted in the hole in the lug of either spindle-belt pulley, thus making that pulley a tight spindle-belt pulley, since it must revolve with the shaft, while the spindle-belt pulley on the opposite side of the dog revolves loosely on the shaft.

16. It frequently happens, when starting a frame equipped with an individual motor drive, that the spindle belt slips from the tight spindle-belt pulley because of the sudden start and rapid acceleration of the motor. This necessitates the removal of the tension from the spindle belt, replacing the belt on the pulleys, and again applying the tension. Such slippage seldom happens on belt-driven frames, as the power may be applied more gradually by slowly shipping the drive belt. To prevent the spindle belts from sliding off the driving pulleys, frames are equipped with flanged spindle-belt pulleys.

Instead of a belt drive from the crosshead shaft to the upper pulley shaft, a chain and sprockets are frequently employed. In this case, a sprocket is fastened to the lower shaft by setscrews, while a second sprocket is attached to the upper shaft, the motion being transmitted between these points by a chain. The chain is enclosed in a guard that may be removed when the chain is to be lubricated.

SPINDLE-BELT TAKE-UP

17. A spindle-belt take-up device on the doubler-spinner takes up slack as the belt stretches. It is located at the foot end of the machine and is bolted to the foot stand. In Fig. 2 (*a*) the relative positions of the movable idler d and the spindle belt b_s may be seen. In Fig. 3, however, a perspective view of the entire take-up mechanism is given. An idler d is fastened by setscrews to the shaft d_1 that extends into a bearing supported by the carriage d_2 . The carriage slides in machined grooves in the bracket d_3 and at the lower

side has a rack d_4 . The teeth of the rack engage a pinion d_5 attached to a short shaft, one end of which extends through the bracket d_3 while the opposite end carries a flanged pulley d_6 . The pulley has a single turn of 1-inch leather belting d_7 wound on it, one end of the belt being riveted to the pulley while a

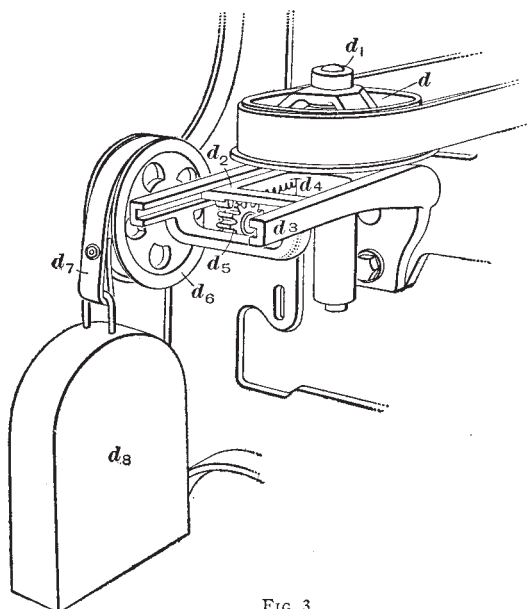


FIG. 3

heavy iron weight d_8 is suspended from the free end. The downward pull of the weight d_8 causes the pulley d_6 to turn, thus turning the pinion d_5 . As the idler d is thus drawn away from the end stand, the spindle belt becomes taut. Only sufficient weight to give the belt the proper tension should be applied at d_8 .

TRAVERSE MOTION

18. Cam.—The cam that operates the traverse mechanism of the doubler-spinner differs from the cam ordinarily employed. Its object is to produce a motion that will guide the silk on the barrel between the heads of the bobbin with a suitable traverse. As illustrated in Fig. 2 (*a*), a heart-shaped

cam e produces the traverse motion. It is attached to a short shaft holding a worm-gear e_1 that meshes with a worm e_2 on the shaft e_3 . The shaft e_3 carries the pulley e_4 , which is connected by the belt e_5 to a pulley e_6 on the feed-roll shaft o_6 , from which it receives motion. When in operation, the cam is turned very slowly because of the size of the worm-gear.

19. The cam roller e_7 , Fig. 2 (*a*), is constantly in contact with the cam e , by the turning of which it is alternately raised and lowered. This motion is transmitted through various levers to the ring rail f . The cam roller e_7 rotates on a stud on the arm e_8 , which is linked to other similar arms by the adjustable rods e_9 . These rods are located under the machine, and their number and length depend on the size of the machine. The arms e_8 pivoted at the points e_{10} extend upwards toward the ring rail, being connected by the adjustable rod e_{11} attached to the support e_{12} . Both ring rails are connected by this support, hence, both rise and fall at the same time.

Because of the constant direct pressure of the ring rails on the various pivot points, the doubler-spinner has a counterweight e_{13} to balance the weight of the rails. It is located on an extension of one of the arms e_8 , and may be moved toward or away from the fulcrum. By moving the weight away from the fulcrum, the weight of the ring rails will be more nearly counterbalanced, thus taking a large amount of strain and wear from the cam roller and stud.

20. A sliding joint e_{14} , Fig. 2 (*a*) on the arm e_8 that supports the cam roller, allows the arm to be lengthened or shortened according to the change to be made when the length of the traverse on the bobbin is to be altered. For example, if a new bobbin is used, with a shorter traverse than the old one, it is necessary to adjust the ring rail so that the silk will be properly wound on the bobbin. The first step is to find the correct length of traverse, which in this case would be shorter. This is done by loosening the nut at the joint e_{14} and raising the lower part of the arm so that its end will be closer to the fulcrum e_{10} . The distance that the ring rail moves is then measured and compared with the distance between the heads

of the bobbin on the spindle. If nearly correct, the adjusting nut at the lower end of the rod e_{11} should be screwed upwards until the thread will be wound adjoining the lower head of the bobbin when the ring rail is at its lowest position, that is, when the cam roller is in contact with the low portion of the cam. If, after running the thread, it is found to wind properly between the heads of the bobbin, the traverse may be considered correct and all adjusting nuts should be tightened to prevent the parts from being thrown out of adjustment because of vibration. If, on the contrary, the thread is not properly guided on the bobbin, the adjustable parts should be moved in the proper direction so that it will wind correctly. The ring rail may also be adjusted by turning the rods e_9 . This will not affect the length of the traverse and may be employed to raise or lower the rail slightly if the traverse is correct but does not wind the thread on the bobbin properly.

21. When the silk is to be wound on the take-up bobbin with a quick traverse as is usual when throwing tussah, the pulleys at the foot end of the frame are changed. If the size of the pulley e_6 , Fig. 2 (*a*), is increased, or the size of the pulley e_4 is decreased, the cam will revolve faster. This, of course, will cause the ring rails to move faster, giving the desired cross-wind. When a slow traverse is desired, these operations would be reversed.

The thread is wound on the bobbin, layer upon layer, without the use of a variable motion as found on machines previously described. Due to this fact, the length of traverse must be very carefully adjusted; otherwise, the silk will either be low at each head if the traverse is too short, or high at both heads if too long; or, should the length of traverse be correct but improperly adjusted, the thread will run high at one head and low at the other. Sometimes the machine is fitted with a cam roller that has the hole passing through it, slightly off center. With this construction, each time the cam roller presents a new face to the cam, its eccentric motion will cause the stud to be in a slightly different position than that given by

the previous face of the roller; consequently, the ring rail connected to the stud and roller, as explained, will be moved to a different position and will guide the thread on the bobbin accordingly.

22. Ring Rail.—The ring rail f , Fig. 1, not only supports the spinning rings f_1 so that they will be in one plane, but it is given an up-and-down traverse motion whereby the twisted thread is guided on the revolving take-up bobbin. Thus, the ring rail on this machine corresponds to the traverse bar of the winder or spinner; but instead of guiding the thread on the bobbin in the customary manner, its up-and-down motion guides the thread on the bobbin while it is in a vertical position. The ring rail is constructed of channel steel and in a short frame extends the length of the machine. Each machine has two ring rails, since a row of spindles is located on each side of the machine. The ring rails on both sides should be perfectly level; otherwise, the silk may not be traversed in a like manner on all bobbins. This is especially true where rails are of great length; in such a case, however, to facilitate adjustments, they are customarily made in sections. This construction allows each section of rail to be carefully adjusted, reducing the liability of sagging in the center and also removing any undue strains and stresses.

23. Although one of the purposes of the ring rail is to support the spinning rings, they are not mounted directly on the rail, but are suitably retained in *ring holders*. Briefly, the rings are held firmly in the ring holders, so that they cannot move in any direction. Passing directly through the center of the ring is the spindle, and it is important that the spindle will be exactly in the center of the ring. Adjustments are made by loosening the screws holding the ring holder to the rail and adjusting the ring and the holder as required. The ring really acts as a track for the traveler, which is a small bent wire snapped on the ring, and serves to guide it around the bobbin as it is pulled by the thread.

24. Rings and Travelers.—Of the various rings manufactured, two types are usually employed on machines that

insert the twist in the thread with the aid of a traveler. They are known as flanged, or double-flanged, rings, and flat, or beveled, rings. Both types are illustrated in Fig. 4.

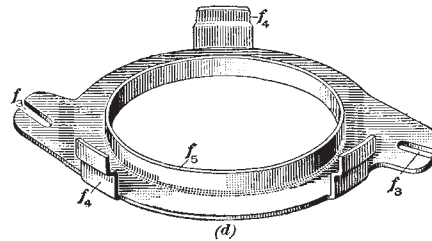
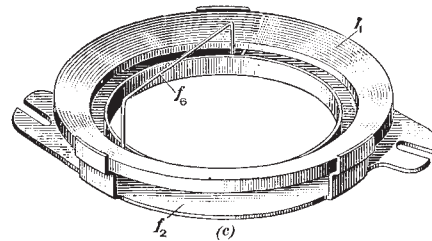
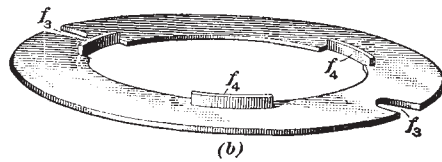
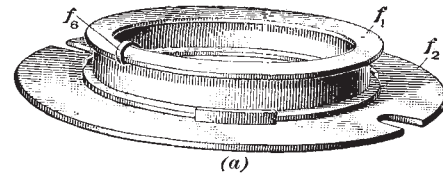


FIG. 4

is shown a double-flanged ring f_1 mounted in its holder, while in (b) is shown a plate type holder suitable for a flanged ring. In (c) is illustrated a flat ring f_1 , in its holder, while in (d) is shown a ring holder suitable for the flat type of ring.

The flanged ring f_1 , view (a), consists of two smooth flanges connected by a thin rib of steel. The entire ring is supported on the ring rail by the plate-type ring holder f_2 , which is a very common type of holder. It is a steel stamping designed to rest on the ring rail, where it is attached by two small screws that pass through the slots f_3 and enter tapped holes in the ring rail. The slots are of sufficient length to allow adjustments to be made, so that all parts of the ring will be equally distant from the spindle. The object of the three small clips, or ears, f_4 is to allow the ring to be removed easily from the holder for replacements, and still be firmly held in its proper position

when the machine is in operation. In (a) the ring is shown with a traveler f_6 in position.

25. The second type of ring that has been referred to is shown at f_1 , Fig. (4) (c). It consists of a single flange that is beveled or cupped, as illustrated. When mounted in the holder f_2 , the outer edge of the ring will be higher than the center. The ring holder is stamped from a piece of steel and contains the slots f_3 , view (d), through which pass the screws that fasten it to the rail. Three clips f_4 are also provided on this holder, but they are larger and are located on the outer edge of the holder. They extend upwards and are offset slightly in order to provide a support for the ring, thus preventing it from being held in the holder in a slanting position. Furthermore, the inner portion f_5 of the ring holder is pressed upwards, so as to form a guard that prevents the traveler from falling out. The relation between this guard and the ring when in position on the holder may be seen in (c), which also shows the traveler f_6 in position.

26. The size of ring to be used on the doubler-spinner depends, to a certain degree, on the size of the silk and the number of ends that are to be doubled and twisted. The size of the bobbin head must also be considered, for it is evident that a ring with an inside diameter smaller than the diameter of the bobbin head cannot be used. Moreover, the equipment of the machine must be known, for machines equipped with rings attached to ring rails and swing spindles require rings at least $\frac{1}{8}$ inch greater in diameter than machines equipped with rigid spindles. The sizes of double-flanged rings vary somewhat, but the sizes customarily employed range from $1\frac{1}{8}$ inches to $2\frac{1}{2}$ inches in diameter, inside. Of these sizes, a double-flanged ring that is used to a large extent measures $2\frac{1}{4}$ inches, inside diameter, and is, of course, specially designed for silk. It has a flange $\frac{5}{8}$ inch wide, commonly known as a No. 2 flange. Of the flat rings, the sizes usually vary from $2\frac{7}{16}$ inches to $2\frac{1}{8}$ inches in diameter, inside.

27. The size of the flange is usually expressed by a number. The width of the flange, in thirty-seconds of an inch, is

first measured, and then the flange number is found by the following rule:

Rule.—*Subtract 3 from the number of thirty-seconds of an inch denoting the width of the flange; the remainder will be the number of the flange.*

EXAMPLE 1.—If a flange is $\frac{5}{8}$ inch wide, what is the flange number?

SOLUTION.—The number of thirty-seconds of an inch of width of the flange is 5. Then, by the rule, the flange number is

$$5-3=2. \text{ Ans.}$$

That is, a No. 2 flange is used.

EXAMPLE 2.—What is the flange number if the width of the flange is $\frac{11}{16}$ inch?

SOLUTION.—As $\frac{11}{16} = \frac{5\frac{1}{2}}{32}$, the number of thirty-seconds is $5\frac{1}{2}$. Hence by the rule, the flange number is

$$5\frac{1}{2}-3=2\frac{1}{2}. \text{ Ans.}$$

That is, a No. $2\frac{1}{2}$ flange is used.

28. If the number of the flange is known, the width may be found by the following rule:

Rule.—*Add 3 to the number of the flange, and the sum will be the number of thirty-seconds of an inch of width of the flange.*

EXAMPLE.—What is the width of a No. 1 flange?

SOLUTION.—The number of the flange is 1. By the rule,

$$3+1=4$$

which is the number of thirty-seconds. Therefore, the width is $\frac{4}{32}$ in. Ans.

29. Many varieties of travelers are manufactured for silk-twisting purposes, but those mostly employed are the round-pointed traveler, the square-pointed traveler, and the bar

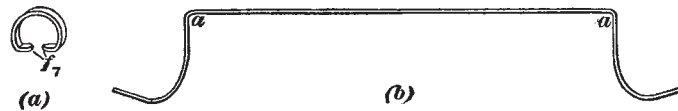


FIG. 5

traveler. An enlarged view of a round-pointed traveler is given in Fig. 5 (a), while its proportionate size may be seen at f_6 on the ring f_1 , Figs. 1 and 4 (a). It is a steel clip

mounted on the spinning ring, around which it is free to move under the pull of the thread, which, when passing from the supply to the receiving bobbin on the spindle, is threaded under the traveler. The objects of the traveler are to guide the yarn to the bobbin and to provide a means of inserting twist in the thread.

As travelers are often run at a speed of 50 miles per hour, day in and day out, they should be carefully made. Travelers are prepared from the highest grade of steel wire drawn to the correct size and gauged to .001 inch. This wire is flattened, rolled, and annealed, after which it is cut and bent to the desired shape on automatic machines. The travelers are then hardened, tempered, scoured, and polished, each process requiring the greatest amount of skill and exactness.

30. The two principal kinds are those having the points rounded, as shown at f_1 , Fig. 5 (*a*), and those having square points. The round-pointed traveler is generally preferred to the square-pointed traveler, which is the older form. Not only do travelers differ in the shape of the points, but also in the extent to which the wire is flattened, giving either a broad or a narrow back; they also differ in the arc of the circle, some having a round back, while others are somewhat flattened. There is also a slight difference in the flange, or the turned-up part of the traveler. Travelers are placed in position by springing them on the rings; consequently, they should be made with the correct size of flange for the ring used and with as small a distance between the points of the flanges as will allow them to go on the rings without unnecessary breakage. The tendency now is toward narrow flanged rings, allowing a stronger traveler without increasing its weight.

31. The weights of travelers are indicated by a scale of numbers, as shown in Table I. No. 1 traveler is taken as the standard, with a weight of approximately 1 grain, and travelers weighing more than 1 grain each are indicated by numbers greater than 1; the higher the number, the heavier the traveler. Travelers lighter than 1 grain are indicated by whole numbers, with 0 added, from 1-0 to 23-0; in this case,

the higher the number, the lighter will be the traveler. The table shows the approximate weight, in grains, of ten travelers from No. 53 to No. 23-0, as made by one firm.

TABLE I
NUMBERS AND WEIGHTS OF TRAVELERS

Number of Traveler	Weight of Ten Travelers Grains	Number of Traveler	Weight of Ten Travelers Grains	Number of Traveler	Weight of Ten Travelers Grains
53	118	26	64	1 -0	9
52	116	25	62	2 -0	8½
51	114	24	60	3 -0	8
50	112	23	58	4 -0	7½
49	110	22	56	5 -0	7
48	108	21	54	6 -0	6½
47	106	20	52	7 -0	6
46	104	19	50	7½-0	5¾
45	102	18	48	8 -0	5½
44	100	17	46	8½-0	5¼
43	98	16	44	9 -0	5
42	96	15	42	9½-0	4¾
41	94	14	39	10 -0	4½
40	92	13	36	10½-0	4¼
39	90	12	33	11 -0	4
38	88	11	30	12 -0	3¾
37	86	10	26	13 -0	3½
36	84	9	23	14 -0	3¼
35	82	8	20	15 -0	3
34	80	7	18	16 -0	2¾
33	78	6	16	17 -0	2½
32	76	5	14	18 -0	2¼
31	74	4	13	19 -0	2
30	72	3	12	20 -0	1¾
29	70	2	11	21 -0	1½
28	68	1	10	22 -0	1¼
27	66			23 -0	1

There are numerous other makes of travelers on the market, and although the same numbers are used for designating the sizes, they do not indicate the same weights in all makes.

32. The bar traveler, or wire traveler, as it is also referred to, is shown at f_6 , Fig. 4 (*b*), while an enlarged view is given in Fig. 5 (*b*). It consists of a piece of tempered-steel wire bent to the shape shown. The ends are turned up slightly and slipped under the edge of the ring. It is prevented from falling from the ring by that part of the ring holder which extends upwards through the center of the ring.

In ordering bar travelers for a doubler-spinner, it is necessary to obtain the inside diameter of the ring, which, of course, will be of the flat type. Using the inside diameter of the ring as a basis, the proper length of traveler to be used may be found from Table II. Besides the proper length of traveler, which is the distance aa , it is necessary to know the proper weight, in order that the correct amount of tension will be applied to the thread. For this reason, the various lengths are made in different weights, known as light, medium,

TABLE II
LENGTHS OF TRAVELERS

Inside Diameter of Ring Inches	Length of Traveler Inches
$2\frac{1}{16}$	$1\frac{5}{8}$
$2\frac{7}{16}$	$1\frac{3}{4}$
$2\frac{11}{16}$	2
$2\frac{15}{16}$	$2\frac{1}{8}$

heavy, and extra heavy. The numbers given to the travelers classed under the foregoing weights range from No. 7 to No. 24, inclusive, while the size of the wire, which is very important in relation to the weight, measures from .018 inch to .055 inch in diameter for the given number of travelers. In addition to this, the length of the leg must be considered, for this also is made in three lengths, governed by the diameter of the wire and other factors.

33. When determining the proper bar travelers to be used, two very important factors must be observed in addition to those just mentioned. In the first place, the speed of the spindle should be considered, for bar travelers are usually run

at a lower speed than ring travelers. Secondly, the type of thread being run should be considered, for a heavy thread composed of many ends will produce a greater tension and drag on the traveler, than will a lighter thread. The weight of the traveler should not be too great, as it increases the tension on the thread and is liable to cause strains and excessive breakage. This may be remedied by substituting a lighter traveler, which reduces the tension, as it is easier for the thread to draw the lighter traveler around its path. Should the traveler be too light for the weight of the thread, it is likely to be bent upwards and fly out; or, by bending, it will guide the thread over the head of the bobbin. Sometimes, this trouble may be overcome by substituting a shorter traveler for one that continually flies out.

When the mill is running one shift, it will be necessary to replace the bar travelers about once each week. Due to the continual running before it is replaced, the traveler sometimes wears to such an extent that it flies off the ring, and at times the worn end of the traveler strikes the silk on the bobbin, thus cutting it and resulting in a slight increase in the amount of waste made in a subsequent operation.

34. It is impossible to give a definite rule by which to find the weight of ring traveler to be used for a certain thread, but the following general principles should be observed:

1. A larger ring, other conditions being alike, requires a lighter traveler.
2. A change to a coarser thread may require a heavier traveler.
3. Putting more twist into the thread may require a heavier traveler.
4. Old rings require heavier travelers than do new ones; frames are usually started with light travelers and run with them until the rings become smooth from wear, after which heavier travelers are required in order to obtain the necessary tension on the thread.
5. During moist, sticky weather travelers run hard and fly off; under these circumstances a lighter traveler should be

used. In case of doubt, the preference should be given to the heavier traveler, if the elasticity of the thread will not be impaired, as a heavier traveler will make a firmer bobbin, which is generally desirable.

35. In order to give a general idea as to the size of the traveler to use, it may be explained that the sizes of round-point ring travelers usually supplied by one manufacturer range from No. 19-0 to No. 1. Probably the sizes ranging from No. 15-0 to No. 5-0 are most frequently used. When bar travelers are employed, the sizes usually range from No. 7 to No. 14. It should be remembered that these sizes are merely given as a guide and the most suitable traveler to be used is best found by experiment with a few different sizes. Care should be taken when changing from one make of ring traveler to another, to determine whether a difference exists between the weights of the two makes. Usually, to detect this variation in weight, the weight of 100 travelers of the new make is compared with the weight of the same number of the old.

BOBBINS AND SPINDLES

36. Take-Up Bobbins.—The take-up bobbins *g*, Fig. 1, usually employed on the doubler-spinner differ only slightly from the bobbins that have already been described. A bobbin of the proper construction for this type of machine consists of a wooden barrel to which a fiber head is attached at the upper end, while a considerably heavier wooden head is located at the bottom. The barrel, usually made of dogwood or other suitable wood used in the manufacture of bobbins, is about 4 inches in length and $1\frac{1}{4}$ inches in diameter. The fiber head, measuring from $\frac{1}{8}$ to $\frac{3}{16}$ inch in thickness, and slightly over 2 inches in diameter, is glued to the upper end of the barrel, and is also held by four or five screws that pass through the head into the barrel. The wooden head glued to the opposite end of the barrel is slightly larger than the fiber head and is about $2\frac{1}{8}$ inches in diameter and $\frac{5}{8}$ inch thick.

37. On the under side of the lower bobbin head is cut a slot about $\frac{1}{8}$ inch wide and 1 inch long, this construction being

necessary, because of the design of the spindle on which the bobbin is placed. Sometimes two small holes are bored in the head and are located in the proximity of the large hole to serve the same purpose as the groove. Bobbins may have either

straight or tapered holes, depending on the succeeding operations that the thread must undergo while on the bobbin. For example, a bobbin that is to be employed on the doubler-spinner only is made with a straight non-tapering hole. But, as the doubler-spinner is frequently employed to insert a preliminary twist in the thread, and the full bobbins are removed and transferred to a second-time spinner or twister, to complete the twisting, bobbins for this type of work are constructed with tapered holes, as twisters are invariably equipped with tapered spindles.

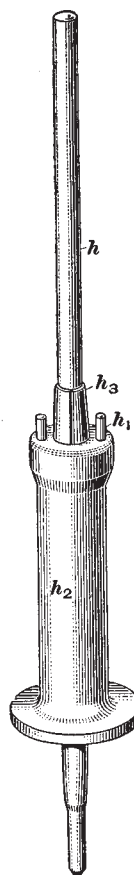


FIG. 6

38. Spindles.—A detailed description of the spindles is unnecessary, as they are of the same construction as the spindles on the spinner or twister. Both rigid and swing spindles are supplied on the doubler-spinner; however, the spindles shown in the various illustrations of the doubler-spinner are of the rigid type. The spindle belt also is held in contact with the spindle whorls by means of stationary idlers.

The blade *h*, Fig. 6, although made of high-carbon steel, is unlike the regular spinner in that it is straight. With a spindle of this type the bobbin rests on the top of the whorl, and all the bobbins resting on whorls of the same height will be in line. The object of this construction is evident. Since the silk is wound on the bobbin while it is in a vertical position, and the traverse of the ring rail is adjusted, so as to place the thread between the heads of the bobbin, any bobbin that is not in its proper position will not be traversed in the correct manner. Thus, should one bobbin be high while another is low, the silk would wind over the

upper head or on the lower head respectively, according to the relative positions of the bobbins on the spindles.

39. As there cannot be as close a fit between a straight spindle and a bobbin as between a tapered spindle and its bobbin, the spindle of the doubler-spinner is constructed as in Fig. 6. Two small pins h_1 protrude from the top of the whorl h_2 and engage the groove or the two small holes in the under side of the bobbin head when it rests on top of the whorl. This prevents slippage between the bobbin and the spindle. The taper-hole bobbin is also used on the doubler-spinner; but, to place such a bobbin on a straight spindle and operate it successfully, a small brass bushing or ferrule h_3 is slipped over the blade and allowed to rest on top of the whorl. The ferrule may be compared to the screw button used on the doubler-spindle, for it causes the apparent size of the lower end of the spindle to be increased so that the large hole of the bobbin will fit snugly on the ferrule, while the small hole, which is at the top of the bobbin, is just about the same size as the spindle at this point. With the ferrule in place, the bobbin may be revolved without wobbling.

40. While the spindles of the doubler-spinner are of the rigid type, they are not mounted directly on the spindle rail but are supported in an eccentric spindle holder of special design, shown partly in cross-section in Fig. 7. The spindle rail a_2 supports the holder i , which rests in a recess in the rail. The upper part of the casting consists of a lip i_1 , the under side of which is in contact with top of the spindle rail. The body of

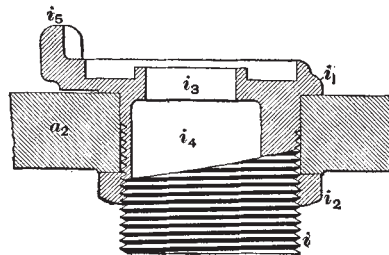


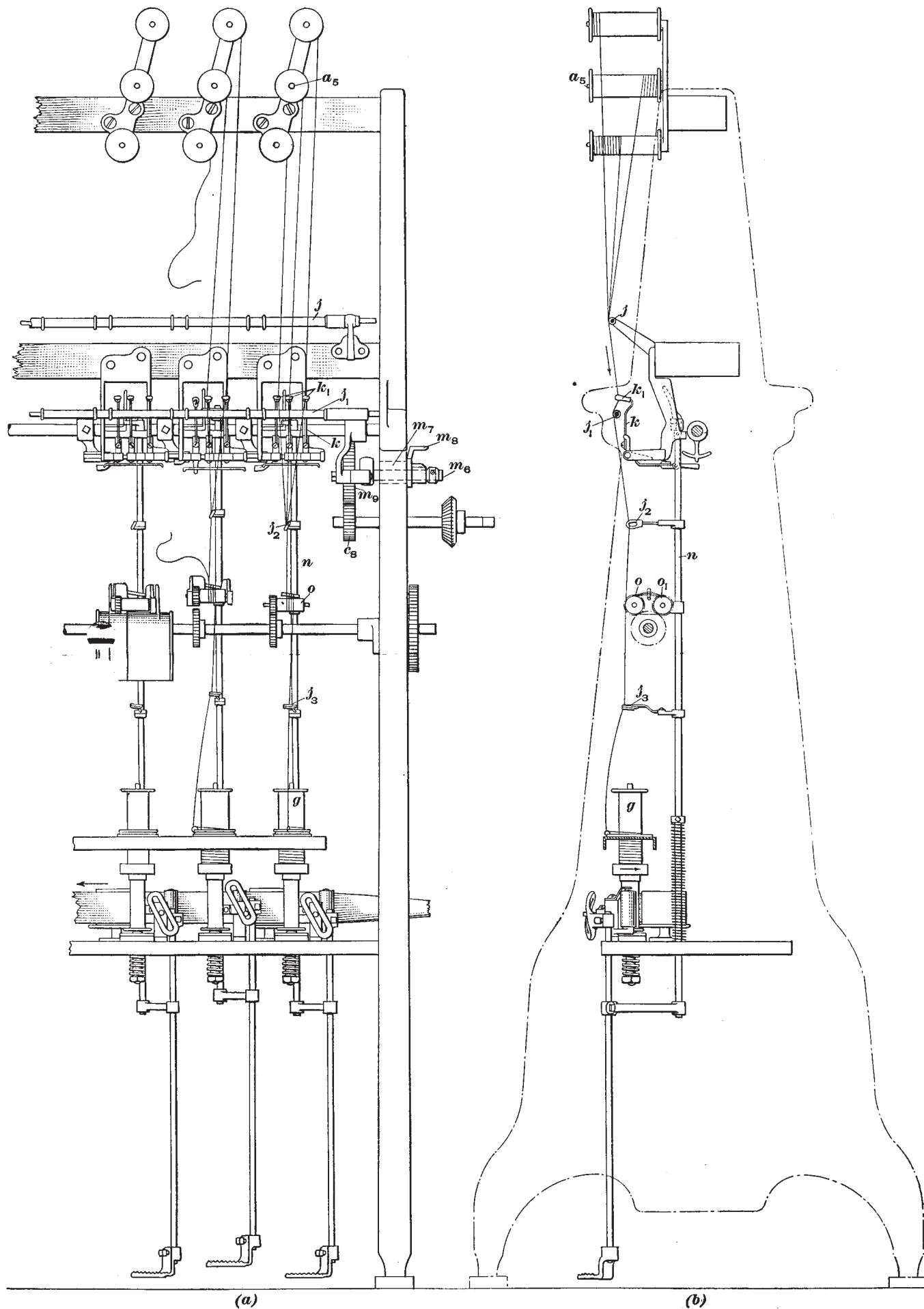
FIG. 7

the holder is threaded to receive a nut i_2 on the part that extends through the spindle rail. When the nut is firmly drawn up against the under side of the rail, the holder will be secured in position. Passing through the lip is a

hole i_3 that is slightly off center and through which the lower part of the spindle socket passes. When the socket is in place, the compression spring and nut are placed on the threaded part of the socket. The nut is tightened sufficiently so that the spindle will be held in place, but still have the very slight wobble characteristic of all spindles. To allow for this wobble, the recess i_4 is made large enough to accommodate easily the compression spring. Moreover, the base of the socket that ordinarily is in contact with the spindle rail, now rests in the recessed portion of the lip i_1 and is prevented from turning by the engagement of a small slot in the socket with extension i_5 .

On account of the eccentric construction of the holder, the spindle it supports may easily be adjusted to the spindle belt. For example, if the spindle is to be moved closer to the belt, it is only necessary to tap the side of the holder that supports the extension i_5 , which causes the entire holder to turn in the rail, and thus shift the spindle. It is well, after moving the eccentric holder in this manner, to tighten the nut i_2 . If this is not done, the nut is likely to loosen gradually and allow the spindle whorl to lose contact with the spindle belt.

41. Doubler-spinners are also equipped with swing spindles instead of rigid spindles. The swing spindle is exactly like that used on spinners and twisters, except that it is made with a straight blade and has the two small pins in the top of the whorl. In mounting this spindle, the rail step of the latter is firmly attached to the spindle rail while the whorl is held in contact with the spindle belt by the action of a coil spring. However, when this type of spindle is employed on the doubler-spinner, the distance the spindle may swing from the belt is limited to approximately $\frac{1}{8}$ inch. This limit is fixed by a stop, in the form of a brake so located that the spindle will come in contact with it and be halted in its swing. The object of limiting the swing of the spindle is thus explained. On an ordinary type of single-process spinner the swing spindle may be pulled away from the belt a quarter-turn when removing bobbins. On a double-spinner using spinning rings, however, the bobbin would come in contact with the ring encircling it and damage the silk.



(a)

(b)

FIG. 8

Double-page spread rotated 90° to fit on page.

STOP-MOTION

42. Like other machines on which the operation of doubling is performed prior to twisting, it is necessary on the doubler-spinner to provide a means that will insure the doubling of the proper number of ends while the thread is being wound on the take-up bobbin. For this reason, a stop-motion is applied, which prevents the twisting and winding of any thread on the take-up bobbin after an end of the ply thread breaks or runs out. The stop-motion is very sensitive, as the parts that are brought into action when a thread breaks function immediately. The method of detecting broken ends is similar to the method in use on the doubler; the threads are led downwards from the bobbins on the jack-pins, thence through the porcelain drop-wire eyes, and to the take-up bobbin on the spindle. Hence, when an end breaks, the tension will be removed from the drop wire, and it will fall backwards, thus bringing the stop-motion into action.

43. The stop-motion automatically performs three functions: The gears on the feed-rolls and on the feed-roll shaft are thrown out of mesh; the spindle drive belt is forced slightly away from the spindle whorl, thus cutting off the power; and a brake is applied to the whorl of the spindle, causing the spindle to stop. These operations are performed each time an end breaks. Each end controls a drop wire; otherwise, the spindle would not be stopped when one end breaks. Also, each spindle is equipped with an individual stop-motion, so that the stoppage of one spindle does not affect any of the remaining spindles on the frame. The complete stop-motion mechanism is illustrated in Fig. 8, (*a*) being a side or front elevation of the frame showing three complete spindles, and (*b*) an end view. The relative positions of the drop wires, feed-rolls, take-up bobbins, and so on, may be clearly seen.

44. The silk, passing downwards from the bobbins on the jack-pins a , Fig. 8, is guided over the roller guide j , through the porcelain hooks k , on the drop wires k , over the roller guide j_1 , and thence through the porcelain hooks j_2 . From this point the

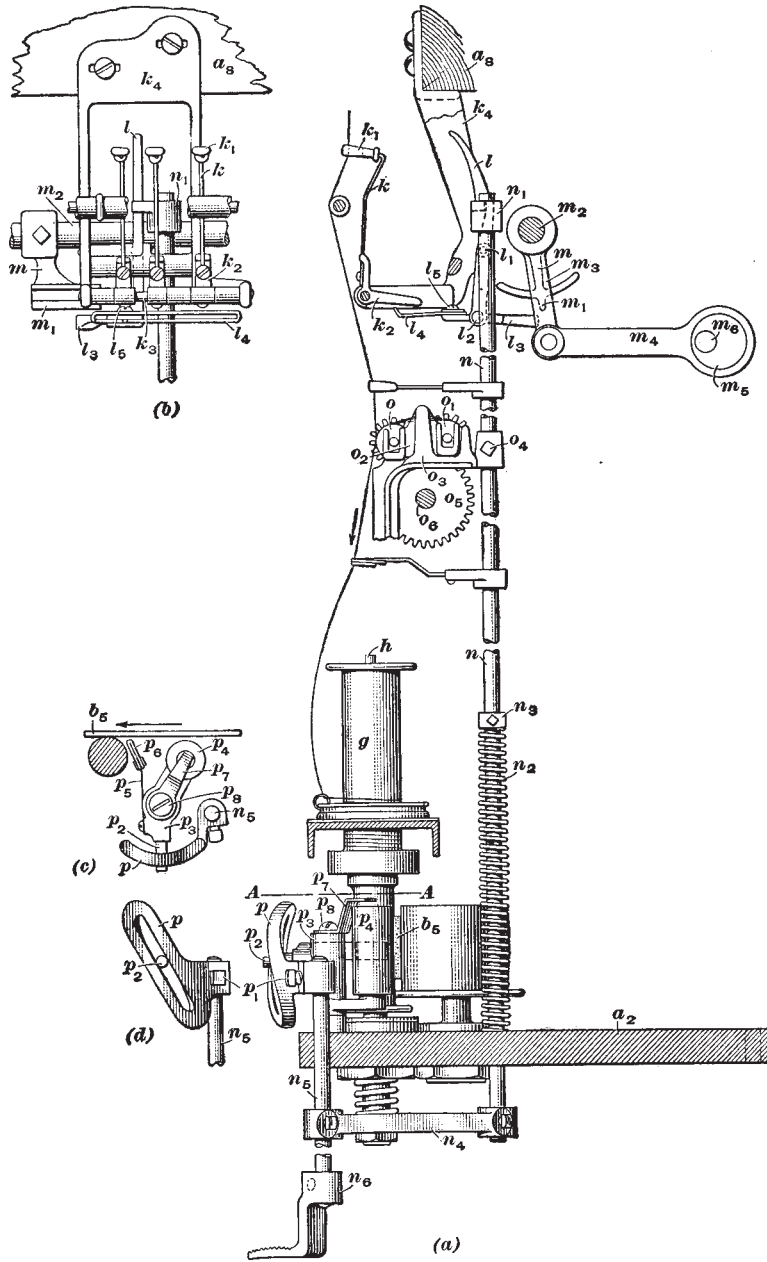


FIG. 9

threads are led to the feed-rolls o and o_1 , which are driven by gears and shafting from the head end of the frame. They draw the silk from the bobbins on the jack-pins, double it so that all individual ends of the ply thread are under the same tension, pass it through the centering eye j_3 , and feed it to the take-up bobbin g at the proper speed to insert the correct twist.

In Fig. 9 (*a*) is shown an end view of the stop-motion mechanism, including the feed-rolls and spindles; in (*b*) is shown a front elevation of the drop-wire assembly; in (*c*) a section along AA in (*a*); and in (*d*) a front view of the stop whorl shipper.

45. Drop Wires.—As shown in Fig. 9 (*a*) and (*b*) the drop wire k supporting the porcelain eye k_1 is attached by a setscrew to the drop-wire foot k_2 mounted on the short rod k_3 , on which it has a certain amount of freedom of motion. The rod k_3 is held in two arms of the bracket k_4 attached to the rail a_8 . The motion of the drop wires is confined to a back-and-forth movement. When a thread is passing through the eye with sufficient tension, the wire will remain upright. Should a thread break, the tension will be removed and the wire will fall back and place the remaining parts of the stop-motion in operation. In this illustration only three drop wires are shown since the frame is equipped for only 3-end doubling. If the frame is equipped to double 6, 8, or 10 ends, it will have a corresponding number of drop wires and jack-pins.

Another part of the stop-motion acting in conjunction with the drop wires is the stop-off lever holder l . It is a small iron lever pivoted on a pin l_1 and, extending downwards, terminating at l_2 , where it supports a similar pin. This pin acts as a pivot for the stop-off lever l_3 and when in the running position it is practically horizontal. While one portion of the stop-off lever l_3 extends toward the center of the machine, the opposite end is toward the drop wires and carries the tripper wire l_4 , which is attached to the stop-off lever by the setscrew l_5 . The wire l_4 acts as a tripper and is balanced so that a falling drop wire will tilt the stop-off lever and cause the stop-motion to operate, or *kick-off*, as it is termed in the mill.

46. Operating in conjunction with the drop wires, stop-off lever holder, and the stop-off lever, are the rocker-arms m , Fig. 9, that disengage the stop-off lever holder so that the various parts of the stop-motion will operate. The rocker-arm m is especially designed so that the lug m_1 forming a part of its under side will come in contact with the stop-off lever l_3 and cause it to kick off. The rocker-arms are located on the rocker-arm shaft m_2 which receives an oscillating motion in the following manner: An arm m_3 secured to the rocker-arm shaft near the head end of the machine is connected to the eccentric strap m_4 , which in turn passes around the eccentric m_5 . The eccentric, being attached to the shaft m_6 , receives its power from the head end of the machine where it is driven by suitable gears. Thus, when the eccentric shaft is revolved, it will transmit an oscillating motion to the rocker-arm shaft. The rocker-arm shaft extends the entire length of the machine and supports as many rocker-arms as there are spindles on one side of the frame, for, by virtue of the design, one rocker-arm serves the stop-motion mechanism for two spindles, one located on each side of the frame.

47. In the actual operation of the frame, the vertical rod n , Fig. 9, which is capable of moving upwards and downwards, is held in its lowest position by the engagement of the stop-off lever holder l and the lug n_1 . At the same time, the threads are guided through the porcelain eyes attached to the drop wires while passing from the bobbins on the jack-pins to the take-up bobbin, and the tension holds the drop wires in an upright position. The rocker-arms, also, are now brought into motion, and swing back and forth, since the gear attached to the end of the eccentric shaft is in mesh with its driving gear. A coil spring n_2 , encircling the rod n , is held in a semi-compressed position by a collar n_3 fastened to the rod by a set-screw. This spring tends to move upwards; however, since the stop-off lever holder l is engaged with the lug on the rod n , it will be retained in this position.

48. Suppose that an end runs out on one of the bobbins on the jack-pins, or that an end breaks. The tension on the

thread will be removed immediately while the drop wire through which the end was threaded will fall backwards. This will cause the end of the drop-wire foot to move downwards and strike the wire l_4 , Fig. 9, which is connected to the stop-off lever and the stop-off lever holder. The stop-off lever will be tilted and its opposite end will be raised into the path of the oscillating rocker arm. On its return swing, the lug m_1 on the rocker-arm m will strike the stop-off lever and carry it along in the same direction. The stop-off lever holder will also be moved in the same direction, but as the holder swings on a pivot l_1 and the lower end is moved in one direction, the upper end will move in the opposite direction. This will result in the disengagement of the stop-off lever holder l and the lug n_1 attached to the rod n . The rod will jump upwards on account of the pressure of the spring n_2 and will stop the feed-rolls and the spindle immediately.

49. Feed-Rolls.—Located slightly lower than the drop wires and supported by the rod n , Fig. 9 (*a*), are the feed-rolls o and o_1 . They are loosely supported in a hanger or holder o_2 that rests on a shield o_3 fastened to the rod n by a setscrew o_4 . When in the running position, that is, when the rod n is depressed, the gears which are integral with the feed-rolls mesh with the larger gear o_5 mounted on the feed-roll shaft o_6 . The feed-roll shaft receives power from the head end of the frame where its speed may be altered by the substitution of various change gears. Such change of speed will have the same effect on the twist inserted in the thread as the alteration of the speed of the take-up or friction rolls on a spinner or twister, since the twist of the thread is governed at this point.

A detailed view of the feed-rolls is given in Fig. 10 (*a*) and (*b*). In (*a*) is shown a front view of the shield and feed-roll hanger, while in (*b*) the method of driving the rolls may be seen. The feed rolls o and o_1 are loosely supported in a hanger o_2 , for a two-fold purpose. First, the rolls may be lifted from the shield o_3 by grasping the hanger at the upright portion o_2 and lifting it, thus removing the complete assembly.

Secondly, the rolls may be removed individually in order to clean any accumulated waste or to polish their surfaces. The hanger and rolls are deposited on the shield o_3 , being held in position by the engagement of a groove in the hanger with a tongue on the shield.

50. The shield o_3 , Fig. 10, projects downwards over the feed-roll shaft, protecting the operative from injury and preventing waste silk from being wound on the feed-roll shaft or driving gears. It is held on the rod by the setscrew o_4 , at which point adjustments may be made should the gears on the

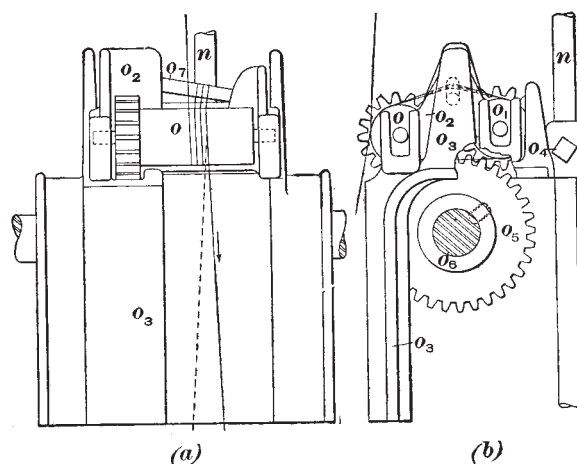


FIG. 10

rolls and the gear o_5 on the feed-roll shaft o_6 mesh improperly. When in the running position the gears of both feed-rolls rest on the gear o_5 with only the slight pressure due to their own weight. Should any object be drawn between the gears, the feed-rolls would immediately rise in the hanger and be disengaged. This, of course, is a protection for the operative.

The threads, shown wrapped around the feed-rolls, pass over a small porcelain bar o_7 located in a slanting position above and between the two feed rolls. The bar causes the silk to be distributed evenly over the rolls and prevent one thread from running over another. It is commonly used in conjunction

with the type of rolls in the illustration, although its use is not essential.

51. Two types of feed-rolls, known as the *plain roll* and the *grooved roll*, are generally used on a doubler-spinner. The plain roll, as the name implies, is merely a roll of suitable size polished smooth; the rolls illustrated in Fig. 8 are of this type. Grooved rolls are similar except that they have three, and sometimes four, shallow grooves turned in them. The grooves are from $\frac{1}{8}$ to $\frac{1}{16}$ inch in width and depth. The object of grooving is to create a guide for the thread while it is running. Often, when plain rolls are employed, the silk becomes crossed, and in running on itself results in breakages. This difficulty is usually overcome when grooved rolls are used, provided each wrap of silk is placed in its individual groove.

52. It is very important that the feed-rolls at all times be kept free from waste that sometimes accumulates when an end breaks and wraps around the roll, as that waste would probably break the remaining ends that are running. If the ends were tied up and the waste still allowed to remain on the rolls, uneven doubling would invariably result; so it is usually removed with the aid of a knife, scissors, or other cutting instrument. Extreme care must be exercised, however, that the grooves of the rolls are not scratched or marred in so doing, as they would scratch or injure the silk causing it to become fuzzy after the boiling-off process. To facilitate the operation of removing the waste, grooved rolls sometimes have a similar groove cut longitudinally on the face of the roll, intersecting the other grooves at right angles. The waste is then very easily removed by passing the cutting instrument along the lengthwise groove. There is also less liability of scratching the roll when removing waste in this manner.

53. Doubler-spinners are sometimes equipped with a single feed-roll for each spindle, in which case the feed-roll is larger than when two rolls are employed, because the friction between the roll and the silk must be sufficient to draw the silk from the bobbins. For this reason, a 2-inch roll is used. The large roll is located in the same relative position as the rolls

previously described, but is supported in a hanger attached to the vertical rod. Moreover, the roll shaft is retained in the hanger in a manner that allows the silk to be wrapped around the roll without removing it from the machine.

In operation, the silk is usually given three wraps around both rolls by lifting the rolls, in their hanger or holder, from the shield and winding the ply thread three times around them, after which they are returned to their position on the shield. If the single roll is employed, removal from the machine will be unnecessary. When the machine is in operation, the rod n , Fig. 10, will be depressed and consequently the shield lowered so that the feed-roll gears will mesh with the gear on the feed-roll shaft. This will cause the rolls to revolve and deliver the silk to the spindles. However, should an end run out or break, causing the rod n to jump upwards, the shield will move in that direction and cause the disengaging of the feed-roll gears and the gear on the feed-roll shaft, thus stopping the rolls. This causes the bobbins on the jack-pins to stop, and also prevents the feeding of thread to the spindle.

54. Spindle Stop.—Because of the method of inserting the twist in the thread, the failure of the feed-rolls to deliver silk to the spindles would cause the number of turns of twist per inch to increase. Should the thread be held at one end while the other is rapidly twirled around, as by a spindle, the thread would be twisted harder and harder, until finally it would break, on account of the strain exerted on it. For this reason, the doubler-spinner is equipped with a spindle stop, which, working in conjunction with the other parts of the stop-motion, effectively stops the spindle when an end breaks. By referring to Fig. 9 (*a*) it will be seen that the rod n extends downwards through the spindle rail a_2 and is connected by a cross-arm n_4 to another rod n_5 that also passes through the spindle rail, but at a point slightly in front of the spindle and to the right of it. This rod extends toward the floor, and at its lower end a pedal n_6 is attached. The pedal is placed in this position so that the operative may start the spindle in operation by treading on the pedal.

55. At the upper end of the rod n_5 , Fig. 9 (*a*), which is slightly above the spindle rail, is the cam, or stop whorl shipper, p , which is a very important part of the spindle stop. The cam is firmly attached to the rod n_5 by the setscrew p_1 at which point necessary adjustments may be made. Engaging with the cam is a pin p_2 that is securely held in the stop whorl step p_3 and clearly shown in (*c*), which is a section along AA in (*a*). Also supported on an arm of the stop whorl step is the stop whorl p_4 and the stop whorl brake p_5 . The stop whorl is about equal in diameter to the spindle whorl and is supported in a suitable bearing. Its purpose is to serve as an idler and press the spindle belt away from the spindle whorl. The stop whorl brake p_5 consists of a flat piece of steel that is held to the stop whorl step by a small screw. The steel extends a sufficient distance to come in contact with the spindle whorl when the stop whorl step is shipped. The brake is also bent slightly, and the part that presses against the spindle is covered with a strip of rawhide p_6 , thus increasing the friction between the parts. The stop whorl is prevented from jumping from its bearing by the spring lock p_7 , which is held to the casting p_3 by a screw p_8 . This lock is stationary and does not move with the stop whorl, but is arranged so that the stop whorl cannot fly off when running; it may, however, be easily removed when this part is to be oiled.

56. In operation, the bobbin g , Fig. 9 (*a*), located on the spindle h , is rotated at the required number of revolutions per minute by contact of the spindle belt b_5 with the spindle whorl. In case a thread that is winding on the bobbin should break while the machine is in motion, the drop wires and feed-rolls will function as described. As the rod n moves upwards, it will impart a similar motion to the rod n_5 , to which it is connected. The stop whorl shipper p will also be moved with it, and will cause the pin p_2 and the stop whorl step p_3 to move to the right. This may be readily seen by referring to view (*d*), which is a front view of the stop whorl shipper p . Since the slot slants down toward the right, raising the shipper p will cause the entire stop whorl step to move to the right. Moving

the pin of the stop whorl step to the right will cause the stop whorl to press against the drive belt b_s , view (c), since the stop whorl step is pivoted at the point p_s . Naturally, as the stop whorl is moved toward the belt, the stop whorl brake p_s , also attached to the stop whorl step, will come in contact with the spindle whorl, thus applying the brake as the belt is moved away and loses driving contact with the spindle whorl.

57. The relative positions of the parts of the stop-motion mechanism are shown in Fig. 8 (a). The illustration shows one spindle with a broken thread between the bobbins on the jack-pins and the drop wires, thus causing a kick-off. The remaining spindles are shown in the running position. In the spindle that is stopped the drop wire has fallen back, causing the rod n to jump upwards, raising the feed-rolls and causing the spindle to cease operating. The pedal is raised slightly higher than the remaining pedals; thus, when starting again, it is necessary to tread on this pedal, and if the threads have been properly tied and placed through their respective drop wires the stop-off lever holder will engage the lug attached to the upper end of the rod n and hold it in position.

58. When the doubler-spinner is equipped with swing spindles, the construction and arrangement of various parts are altered. For instance, the rod n_s , Fig. 9 (a), passes through the spindle rail at a point between the spindle belt and the swing gate of the spindle. It performs the same function as the stop whorl shipper. The side toward the spindle is beveled, so that the top of the rod ends in a point. The slanting portion extends to a point about an inch from the end of the rod. When in place, the rod is adjusted in such a way that the beveled part barely touches the swing gate of the spindle. In rising, when an end breaks, the slanting portion of the rod forces the spindle away from the belt and causes the whorl to come in contact with the brake. The latter acts both as a brake and as a spindle stop, preventing the spindle from swinging excessively, which would cause the bobbin to strike the spinning ring and damage the thread.

59. Eccentric Shipper and Gear.—When stopping the machine, the tension is removed from each thread; for, as the bobbins come to a stop, the drop wires fall backwards and cause the stop-off lever to be moved in the path of the lug on the rocker-arm. This, of course, would occur to every end, and cause every spindle to be stopped, making it necessary for the operative to start each spindle individually when the machine is again set in motion. That difficulty is overcome, however, by so designing the machine that the rocker-arm shaft may be stopped before the operation of the entire machine is halted. In Fig. 8 (*a*) is shown the method of mounting the eccentric shaft m_6 . The bushing m_7 , supported in the end stand of the frame, is so constructed that it may be turned from side to side by the handle m_8 , being bored eccentric to receive the shaft. The shaft does not transmit power, but merely carries the gear m_9 that causes the cam or eccentric to revolve when it is in mesh with its driving gear c_8 .

60. When the handle m_8 , Fig. 8 (*a*), is moved toward the center of the machine, which may be designated as the running position, the eccentric shaft passing through the bushing will be at its lowest position. This will allow the gears m_9 and c_8 to mesh, and motion will then be transmitted by the eccentric strap to the rocker-arm shaft. In stopping the machine, the eccentric shipper latch m_{10} , Fig. 1, is lifted, disengaging the lug on the bearing and allowing the eccentric shipper m_8 to be thrown in the opposite direction, that is, away from the center of the frame. This causes the disengagement of the gears, resulting in the stoppage of the rocker-arm shaft, and allowing the drop wires to fall without causing the stop-motion to operate.

DETAILS OF TWISTING

61. The principles employed when inserting the twist in the thread on the doubler-spinner are not unlike those used on machines previously described; however, the construction of the parts responsible for the twisting is somewhat different. A view of these parts, illustrating in detail the manner of

inserting the twist, is shown in Fig. 11. On leaving the feed-roll *o*, which is revolving at a uniform speed, the ply threads

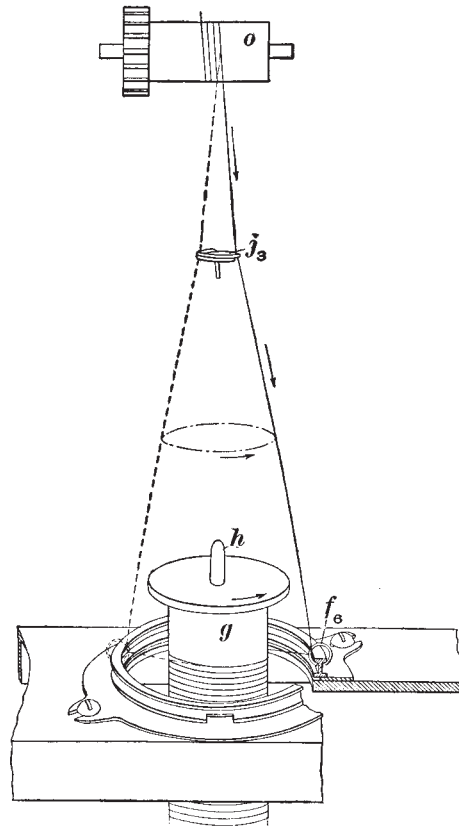


FIG. 11

are guided downwards through the wire centering eye *j_s*. The eye is attached to the rod that supports the feed-rolls and is so adjusted that its center will be directly above the spindle. The ends passing through the centering eye are led downwards and, after being threaded under the traveler *f_s*, are wrapped around the barrel of the bobbin *g* on the spindle *h*. In passing from the feed-rolls to the take-up bobbin, the proper number of turns of twist are inserted in the thread between these points by the aid of the traveler, which is very important when twisting threads

in this manner. The functions it performs are twofold, namely, to guide the thread to the bobbin, and to provide a means of inserting the twist in the thread.

62. To understand how the traveler acts when twist is being inserted in the thread, it should be remembered that the bobbin on which the thread is wound revolves at a high speed that is constant throughout the operation of winding the silk

on the bobbin; also, the feed-rolls deliver a constant length of thread. Suppose, for illustration, that the bobbin is $1\frac{1}{4}$ inches in diameter and makes 5,000 revolutions per minute, and that the feed-rolls are delivering 1,600 inches of thread in one minute. The tendency of the bobbin will be to wind on $1\frac{1}{4} \times 3.1416 \times 5,000 = 19,635$ inches of thread in the same time that only 1,600 inches is delivered, which will necessarily result in breaking the thread between the feed-rolls and the bobbin. However, if the thread is passed through some such device as the traveler that revolves with the bobbin, one of several results will take place: if the traveler makes the same number of revolutions per minute as the bobbin, no thread will be wound on the bobbin; if the traveler makes a number of revolutions equal to the number of revolutions made by the bobbin less the number of revolutions required by the bobbin to take up the thread delivered, the thread will be wound on the bobbin and at the same time twist will be inserted; if the traveler makes a smaller number of revolutions than that cited in the last instance, the yarn will be broken between the feed-rolls and the bobbin.

63. As the bobbin tends to wind on itself more thread than is delivered by the feed-rolls, a tension is maintained in the thread, which tension, being transmitted to the traveler, causes the latter to revolve around the ring on which it is mounted. The traveler is of such weight that the thread must exert a slight pull before the traveler will revolve; but this strain is not great enough to injure the elasticity of the silk or break the thread. If the feed-rolls deliver 1,600 inches per minute and the bobbin is $1\frac{1}{4}$ inches in diameter, $1,600 \div (3.1416 \times 1\frac{1}{4}) = 407.435$ revolutions of the bobbin will be made in winding the thread, and the traveler will make $5,000 - 407.435 = 4,592.565$ revolutions as it is carried around by the thread. This will have exactly the same effect as if 1,600 inches of yarn were held firmly at one end, and the other end twisted 4,592.565 times, and will give $4,592.565 \div 1,600 = 2.87$ turns per inch in the thread. Hence, where a spinning ring and traveler are employed, the bobbin revolves at a much higher

speed than is required to wind on the yarn delivered, and the traveler compensates for the excess speed by revolving the thread at a slightly lower speed than the bobbin.

64. As the bobbin revolves at a uniform rate, its surface speed increases as the diameter increases. The feed-rolls deliver thread at a uniform rate, and so the traveler must have a variable speed as the thread builds up on the bobbin. As the surface speed of the bobbin increases, the traveler speed must also increase, since it lags behind the spindle speed only a sufficient number of turns to allow the yarn delivered by the feed-rolls to be wound on the bobbin. As the turns in the yarn correspond with the speed of the traveler, more twist will be inserted in the yarn when winding on a full bobbin than when winding on an empty bobbin where the traveler speed is not so great. The difference in the amount of twist inserted in the yarn when the bobbin is empty and when it is full is so slight as to be negligible.

CALCULATIONS

65. Speed Calculations.—Speed calculations in connection with the doubler-spinner involve such matters as the size of pulley on the line shaft, the rotative speed of spindles, the speed of the feed-rolls, and the speed of the traveler. The methods to be followed will be illustrated by examples.

EXAMPLE 1.—The 9-inch tight pulley b , Fig. 12, on the crosshead shaft b_2 is to make 420 revolutions per minute and is to be driven from a line shaft that makes 315 revolutions per minute. Find the diameter of the driving pulley on the line shaft.

SOLUTION.—The required diameter of pulley on the line shaft is

$$\frac{9 \times 420}{315} = 12 \text{ in. Ans.}$$

EXAMPLE 2.—The 12-inch spindle-belt pulley b_3 , Fig. 12, makes 420 revolutions per minute. What is the speed of the spindles if they have $\frac{1}{8}$ -inch whorls?

SOLUTION.—The speed of the spindles is

$$\frac{420 \times 12}{\frac{1}{8}} = 6,203.076 \text{ r. p. m. Ans.}$$

EXAMPLE 3.—If the crosshead shaft b_3 , Fig. 12, makes 420 revolutions per minute and carries a 7-inch bottom pulley c that drives, through the belt c_1 , a 5-inch top pulley c_2 , what is the speed of the feed-roll o ,

provided the remaining gears have the numbers of teeth indicated in the illustration?

SOLUTION.—The speed of the feed-roll is

$$\frac{420 \times 7 \times 36 \times 25 \times 54 \times 32}{5 \times 36 \times 45 \times 54 \times 16} = 653.333 \text{ r. p. m. Ans.}$$

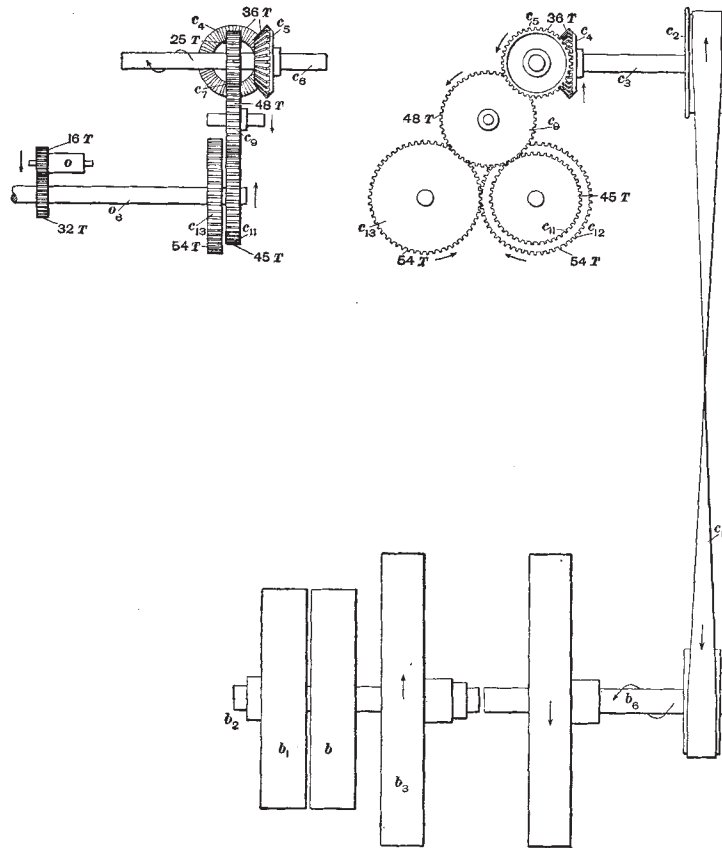


FIG. 12

66. When the speed of the spindle, the speed of the feed-roll, and the diameter of the bobbin are known, the speed of the traveler is found by the following rule:

Rule.—To find the speed of the traveler, from the number of revolutions per minute of the spindle, subtract the number

of revolutions per minute of the bobbin required to take up the yarn delivered per minute by the feed-roll.

EXAMPLE.—If the spindles make 6,203.076 revolutions per minute and the feed-rolls 653.333 revolutions per minute, what is the speed of the traveler when the bobbins are $1\frac{1}{4}$ inches in diameter?

SOLUTION.—The amount of thread delivered from the feed-rolls is
 $3.1416 \times 653.333 = 2,052.51$ in. per min.

To take up this amount of thread, the bobbin must run at a speed of

$$\frac{2,052.514}{3.1416 \times 1\frac{1}{4}} = 522.666 \text{ r. p. m.}$$

Then, the speed of the traveler is $6,203.076 - 522.666 = 5,680.41$ r. p. m.
 Ans.

TWIST CALCULATIONS

67. The principal calculations that may be applied to a doubler-spinner are for the purpose of determining the number of turns of twist that will be inserted in the thread after a certain combination of gears is placed on the machine, the methods used being similar to those employed in previous calculations relative to twist. The method of taking up the thread on the doubler-spinner is different from that on any other machine that has been described. The thread is fed from the feed-rolls to the take-up bobbin, the twist being inserted as the thread winds on the bobbin. In the single-process machine, the twist is inserted as the thread is drawn from the bobbin. Hence, instead of the speed of take-up of the roll in inches, the delivery of the roll in inches is employed.

68. Probably the quickest way to find the proper gears to produce a certain twist is to use the twist chart, or feed gear table, usually supplied with the machine. In doing this, it is very important that the diameter of the spindle whorl and the diameter of the feed-rolls on the machine are the same as those used as a basis for calculating the table. Therefore, spindle whorls $\frac{1}{8}$ inch in diameter are employed on the doubler-spinner. On the machine being described, the feed-rolls are 1 inch in diameter, but some machines are equipped with $\frac{7}{8}$ -inch feed-rolls. It may be readily seen that a frame with 1-inch rolls will deliver more silk, thus inserting less twist in the thread,

than one with $\frac{7}{8}$ -inch rolls, provided, of course, rolls of both sizes make the same number of revolutions per minute. There-

TABLE III
TWIST CHART FOR 1-INCH FEED-ROLLS

Turns of Twist per Inch	Gear c_7 on Shaft c_6	Gear c_{11} on Shaft a_8	Diameter of Pulley c_2 on Shaft c_3	Diameter of Pulley c on Shaft b_6
1	25	22	5	10
$1\frac{1}{2}$	25	32	5	10
2	25	30	5	7
$2\frac{1}{2}$	25	37	5	7
3	25	45	5	7
$3\frac{1}{2}$	25	52	5	7
4	25	60	5	7
$4\frac{1}{2}$	22	42	5	5
5	22	47	5	5
$5\frac{1}{2}$	22	51	5	5
6	22	56	5	5
$6\frac{1}{2}$	19	53	5	5
7	19	57	5	5
$7\frac{1}{2}$	19	61	5	5
8	19	65	5	5
9	22	42	10	5
10	22	47	10	5
11	22	52	10	5
12	22	56	10	5
13	19	53	10	5
14	19	57	10	5
15	19	61	10	5
16	20	48	10	7
17	20	51	10	7
18	20	54	10	7
19	20	57	10	7
20	20	60	10	7

fore, Table III is applicable to a machine equipped with 1-inch feed-rolls and $\frac{1}{8}$ -inch spindle whorls, whereas Table IV

should be used when $\frac{7}{8}$ -inch rolls and $\frac{13}{16}$ -inch whorls are employed.

TABLE IV
TWIST CHART FOR $\frac{7}{8}$ -INCH FEED-ROLLS

Turns of Twist per Inch	Gear c_7 on Shaft c_6	Gear c_{11} on Shaft o_6	Diameter of Pulley c_2 on Shaft c_3	Diameter of Pulley c on Shaft b_6
1	28	21	5	10
$1\frac{1}{2}$	28	31	5	10
2	28	30	5	7
$2\frac{1}{2}$	28	37	5	7
3	28	44	5	7
$3\frac{1}{2}$	28	51	5	7
4	28	59	5	7
$4\frac{1}{2}$	21	50	5	7
5	21	55	5	7
$5\frac{1}{2}$	21	60	5	7
6	16	52	5	7
$6\frac{1}{2}$	21	51	5	5
7	21	55	5	5
$7\frac{1}{2}$	21	59	5	5
8	21	62	5	5
9	25	42	10	5
10	25	47	10	5
11	25	51	10	5
12	25	56	10	5
13	25	60	10	5
14	21	55	10	5
15	21	58	10	5
16	21	62	10	5
17	16	52	10	5
18	16	54	10	5
19	16	57	10	5
20	16	60	10	5

69. In addition to the information given in Tables III and IV, it is necessary to take into account the following:

When inserting twists from 1 to 3 turns and using the change gears in Table III, a 48-tooth gear c_8 , Fig. 12, must be placed on the stud of the movable hanger c_{10} , Fig. 2 (*b*), and adjusted so as to cause it to mesh with both change gears. Should it be desired to insert from 4 to 15 turns of twist, inclusive, a 36-tooth gear should be used on the stud. Twists ranging between 16 and 20 turns, inclusive, will require a compound gear having 24 and 48 teeth, so adjusted that the 48-tooth gear meshes with the gear c_7 , Fig. 12, on the bevel-gear shaft.

Should the machine require the use of Table IV, a 48-tooth gear should be placed on the stud attached to the hanger c_{10} , Fig. 2 (*b*), for twists of 1, $1\frac{1}{2}$, and 2 turns. For twists ranging from $2\frac{1}{2}$ to 20 turns, inclusive, a 36-tooth gear should be placed on the stud.

70. The method of arranging the gears from a twist chart in order to obtain a desired twist, has been explained; hence, the method of calculating the twist may be explained. For all practical purposes, it is considered sufficiently accurate to divide the length of thread delivered by the feed-rolls into the calculated speed of the spindle, making no allowance for slippage, and accept the result as representing the actual turns per inch that may be expected. The following calculations are made on this basis:

Rule I.—*To find the turns of twist being placed in the yarn, when figuring from gears, consider the gear on the end of the feed-roll as the driver; multiply together all the driving gears, the diameters of the driving pulleys, and the diameter of the spindle-belt pulley, and divide that product by the product of all the driven gears, the diameters of the driven pulleys, the diameter of the spindle whorl, and the circumference of the feed-rolls.*

EXAMPLE.—Find the twist per inch that is being inserted in a thread twisted on a machine geared as illustrated in Fig. 12. The diameter of the feed-rolls o is 1 inch, the diameter of the spindle-belt pulley b_1 is 12 inches, and the diameter of the spindle whorl is $\frac{1}{3}$ inch.

SOLUTION.—Apply rule I, and the number of turns per inch is found to be

$$\frac{16 \times 54 \times 45 \times 36 \times 5 \times 12}{32 \times 54 \times 25 \times 36 \times 7 \times \frac{1}{8} \times 3.1416} = 3.022, \text{ or practically } 3. \text{ Ans.}$$

Rule II.—*To find the number of turns of twist per inch, when the speed of the spindles and the number of inches of yarn delivered by the feed-rolls are known, divide the speed of the spindles, without any allowance for slippage, by the inches delivered per minute by the feed-roll.*

EXAMPLE.—What is the twist per inch being inserted in the yarn if the spindles make 6,203.076 revolutions per minute and the feed-rolls deliver 2,052.510 inches per minute?

SOLUTION.—Apply rule II, and the number of turns per twist per inch is found to be

$$6,203.076 \div 2,052.510 = 3.022, \text{ or practically } 3. \text{ Ans.}$$

71. From the feed gear tables, it will be seen that at least one gear must be changed, or both gears and both pulleys must be changed, to alter the twist being inserted in the thread. So, when finding the twist constant, it is necessary to obtain one constant for each change gear and one constant for each change pulley, necessitating the calculation of four constants. However, after the constant has been found, it will only be necessary to divide it into the twist or by the twist in order to obtain the desired result. If the result of the calculation is a constant factor, it will give the desired twist when multiplied by the change gear, or it will give the proper change gear when divided into the twist. If the constant found is a constant dividend, it will give the twist desired when divided by the change gear or it will give the change gear when divided by the twist.

Rule.—*To find the constant for twist, consider the gear on the end of the feed-roll as a driver and the twist gear or twist pulley for which the constant is to be found, as a 1-tooth gear or a 1-inch pulley; multiply together all the driving gears, the diameters of the driving pulleys, and of the spindle drive-belt pulley, and divide that product by the product of all the driven gears, the diameters of the driven pulleys, the diameter of the spindle whorl, and the circumference of the feed-roll.*

EXAMPLE.—In place of the gears on the doubler-spinner illustrated in Fig. 12, substitute the following: A 56-tooth gear c_{11} on the feed-roll shaft o_8 and a 22-tooth gear c_7 on the bevel-gear shaft c_6 . Assume that the 5-inch top pulley c_2 is driven by a 5-inch bottom pulley c . The frame also is equipped with 12-inch spindle-belt pulleys, 1-inch feed-rolls, and $\frac{1}{8}$ -inch spindle whorls. Find (a) the constants for the change gears and change pulleys; and (b) the size of gear or pulley to give 6 turns of twist per inch.

SOLUTION.—Four sets of calculations are required, the foregoing rule being applied in each case.

(a) For the gear c_{11} on the feed-roll shaft o_8 the constant factor is

$$\frac{16 \times 54 \times 1 \times 36 \times 5 \times 12}{32 \times 54 \times 22 \times 36 \times 5 \times \frac{1}{8} \times 3.1416} = .1068. \text{ Ans.}$$

(b) The size of change gear required is

$$6 \div .1068 = 56.1, \text{ or } 56 \text{ teeth. Ans.}$$

(a) For the gear c_7 on the bevel-gear shaft c_6 the constant dividend is

$$\frac{16 \times 54 \times 56 \times 36 \times 5 \times 12}{32 \times 54 \times 1 \times 36 \times 5 \times \frac{1}{8} \times 3.1416} = 131.633. \text{ Ans.}$$

(b) The size of change gear required is

$$131.633 \div 6 = 21.9, \text{ or } 22 \text{ teeth. Ans.}$$

(a) For the pulley c_2 on the shaft c_3 the constant factor is

$$\frac{16 \times 54 \times 56 \times 36 \times 1 \times 12}{32 \times 54 \times 22 \times 36 \times 5 \times \frac{1}{8} \times 3.1416} = 1.196. \text{ Ans.}$$

(b) The diameter of change pulley required is

$$6 \div 1.196 = 5.016, \text{ or } 5 \text{ in. Ans.}$$

(a) For the pulley c on the crosshead shaft b_4 the constant dividend is

$$\frac{16 \times 54 \times 56 \times 36 \times 5 \times 12}{32 \times 54 \times 22 \times 36 \times 1 \times \frac{1}{8} \times 3.1416} = 29.916$$

(b) The diameter of change pulley required is

$$29.916 \div 6 = 4.986, \text{ or } 5 \text{ in. Ans.}$$

72. Production.—The principles employed in calculating the production of spinners, or twistors, may be applied to the doubler-spinner. The theoretical production will probably differ from the actual production, owing to the degree of skill of the various operatives, the change in quality of silk, variations in atmospheric conditions, and so on. The actual production is frequently found in the following manner: When the frame is started in the morning, empty bobbins are placed on all spindles, and as each bobbin is doffed it is marked and placed

in a selected receptacle. At the end of the day all bobbins are removed from the frame, regardless of the amount of yarn they contain, and the entire lot is weighed. In the next process, after all the bobbins are emptied of yarn, they are weighed. By subtracting the weight of the empty bobbins from the weight of the bobbins and the silk, the net weight of the silk will be obtained.

73. The theoretical production in pounds per spindle-hour of a 3-thread, 13/15-denier tram twisted at various spindle speeds, is given in Table V.

TABLE V
PRODUCTION OF 3-THREAD
13/15 DENIER TRAM

Spindle Speed Revolutions per Minute	Turns of Twist per Inch	Production per Spindle- Hour Pounds
5,000	3	.0261
5,000	3½	.0223
5,500	3	.0287
5,500	3½	.0246
6,000	3	.0313
6,000	3½	.0268

From 10 to 20 per cent. should be deducted from the table values to allow for stoppages resulting when tying ends, doffing bobbins, and so on.

Rule.—*To find the production per spindle-hour, divide the product of the number of revolutions per minute of the spindle and the number of minutes in an hour by the product of the*

number of turns of twist per inch, the number of inches in a yard, and the number of yards per pound of the ply thread.

EXAMPLE.—Find the production in pounds per spindle-hour if the spindles make 5,000 revolutions per minute, producing a 5-thread 13/15-denier tram (63,779 yards per pound) having 3 turns of twist per inch.

SOLUTION.—Apply the rule, and the production per spindle-hour is found to be

$$\frac{5,000 \times 60}{3 \times 36 \times 63,779} = .0435 \text{ lb. Ans.}$$

In the foregoing example it will be necessary to know the spindle speed. This may be obtained by calculating from the crosshead shaft or by applying a speed indicator directly to the spindle.

74. The production in the example of the preceding article is the theoretical production of one spindle operating continuously for an hour. To determine the production of the entire frame per hour, it will be necessary to multiply the spindle-hour production by the number of spindles on the frame. Again, multiplying the production per frame per hour by the number of hours in a working day will give the daily production without any consideration for stoppage. From 10 to 20 per cent. should be deducted for stoppage in order that the result will be more nearly correct.

EXAMPLE.—If the production per spindle-hour on a doubler-spinner is .0435 pound, find the daily production of an 80-spindle frame operating 9 hours per day, and allowing 20 per cent. for stoppage.

SOLUTION.—The production per day, allowing for stoppages, is
 $.0435 \times 80 \times 9 \times (1.00 - .20) = 25.056$ lb. Ans.

OPERATION AND CARE

STARTING, STOPPING, AND REVERSING TWIST

75. Detailed Operation.—The machine, if equipped with a crosshead shaft, is set in motion by shifting the driving belt from the loose pulley to the tight pulley; if fitted with an individual motor drive, the frame is started by placing the control handle of the starting switch in the *on* position. As soon as the machine has attained its proper running speed, the eccentric shipper latch is lifted so that the eccentric shipper may be thrown toward the center of the machine, causing the rocker-arms to swing back and forth. With the rocker-arm shaft in action, the stop-motion will be in complete operation, and any broken or run-out ends will immediately cause the spindle to stop. If an end breaks or runs out, the bobbin causing the stoppage is located on the jack-pins and, if empty, is replaced with a full bobbin; if the thread parted because of faulty winding, the end is found and the bobbin is returned to the jack-pin. The end is then led downwards from the bobbin and is threaded through the porcelain hook guide that is attached to the drop wire through which the end had previously passed.

From the drop wires, the faulty end plus the remaining ends in their respective drop wires, are grouped together and passed through a porcelain hook guide fastened to the vertical rod by setscrews; this latter guide properly leads the ends to the feed-rolls. The feed-rolls in their hanger are lifted from the shield with the left hand and the group of ends wrapped three times around the rolls, while a length of the thread is allowed to extend from the rolls. The entire feed-roll assembly is then replaced on the shield.

76. The take-up bobbin is removed from the spindle and a small quantity of thread is pulled from the bobbin. The thread should then be untwisted to determine whether it is the correct ply, and, if found to be incorrect, a sufficient length should be drawn from the bobbin until the proper number of singles are found in the ply yarn. From the take-up bobbin the thread should be slipped under the traveler, in case a ring traveler is employed; if the bar or wire type is used, the thread is passed between the traveler and the ring. Passing upwards, the thread is slipped into the wire centering eye and is then grouped with the length of thread extending from the feed-rolls, where the ends are quickly knotted together. The group of threads, passing over the operative's hand located at a point between the feed-rolls and the centering eye, are drawn away from the machine until they are taut, and, simultaneously, the pedal at the end of the vertical rod is depressed. This starts the spindle in motion, also causing the gears on the feed-rolls to mesh with the rotating gear on the feed-roll shaft, resulting in the delivery of the silk. Furthermore, the silk, as it leaves the feed-rolls, has the proper thread speed with relation to the revolutions per minute of the bobbin, so that the desired number of turns of twist will be inserted in the thread as it is wound on the bobbin. As the thread winds on the bobbin, the operative's hand should be moved gradually toward the machine so that the excess of thread between the feed-rolls and the receiving bobbin will be taken up.

77. In stopping the machine, the preliminary operations described in Art. **75** are merely reversed. For example,

while the frame is still in motion, the eccentric shipper latch is lifted so that the eccentric shipper may be moved in a direction away from the machine, and thus disengage the gear that drives the rocker-arm shaft. After this the belt should be shipped to the loose pulley, or the control handle of the starting switch should be shifted to the off position, causing the motor, and consequently the frame, to stop. While the frame is coming to a stop, the drop wires will fall backwards, as the tension on the thread decreases as the bobbins stop; however, this fact may be disregarded, for the stop-motion will not be affected while the eccentric shipper is thrown into the inoperative position.

78. Reversing Twist.—The direction of twist is not changed very frequently on a doubler-spinner. As it is essentially a tram machine, it is usually employed in the production of tram yarn; and as tram has a right twist, any variation in the turns per inch may be made by changing the twist change gears, which will not affect the direction of twist. At times the doubler-spinner is employed to double the spun threads and insert a slight amount of twist, usually 3 or $3\frac{1}{2}$ turns, in 2-thread organzine, while the remainder of the twist is inserted on a regular twister or second-time spinner. In this case, however, a right twist is given to the yarn.

The reversal of the direction of rotation of various parts of the machine is necessary when changing from a right to a left twist, as in the case of certain crêpes of which one-half of the entire lot to be thrown has a right twist while the remainder has a left twist. Hence, should a doubler-spinner be employed to double the threads and insert several turns of twist, it would be necessary to have several machines for right twist and several machines for left twist.

79. The frame shown in Fig. 1 is arranged to insert a right twist in the thread, as the spindle belt is driven in the proper direction to cause the spindles to revolve in a counter-clockwise direction. The belts and gears driving the feed-rolls are also arranged to feed the thread in the correct manner for this twist. Should it be desired to reverse the twist,

it will be necessary, as on all other spinning machinery, to reverse the direction of rotation of the bobbins, by changing the drive belt from an open to a crossed belt. This will cause the spindles to revolve in the proper direction for that twist; however, the feed-rolls will then take up the thread from the take-up bobbin instead of feeding it. This difficulty is eliminated by removing the belt c_1 , Fig. 2, that transmits motion from the crosshead shaft to the top pulley shaft and changing it from a crossed to an open belt, thus changing the direction of rotation of the feed-rolls. The thread is then fed to the spindles revolving in a clockwise direction, and a left twist will be inserted.

80. Frames equipped with individual motor drive reverse the direction of twist in either of two ways. With a reversible motor, the handle of the starting switch is placed in the reverse position, which reverses the direction of rotation of the motor and also that of the spindles, while the reversing of the feed-roll drive is brought about as previously described. When the frame is equipped with the shifting-pin mechanism, the direction of the motor is left unchanged while the shifting pin in the dog is moved to engage with the opposite spindle pulley. The remaining part of the machine is reversed in the usual manner.

Should the frame be equipped with a chain take-up instead of the belt c_1 , Fig. 2, the direction of the feed-rolls would be reversed, without altering the chain, in the following manner: As shown in (b), the gear c_9 is in mesh with the gear c_{11} on the right feed-roll shaft. This latter gear should be removed from the right-hand shaft and placed on the left feed-roll shaft. When the gear is in place, the idler c_9 on the adjustable stud should be shifted so that it will transmit motion from the gear c_5 to the gear c_{11} on the left feed-roll shaft. The feed-roll shafts will then rotate in the correct manner and feed the thread so that the twist inserted will be correct. The gear c_{11} must always be shifted from one take-up shaft to the other whenever changing the direction of twist on machines equipped with a chain drive, since the chain cannot be crossed like a belt.

DEFECTIVE WORK

81. Hard Twist.—Thrown silks that have been twisted in excess of the number of turns for which the machine is adjusted are known as *hard twist*. That is, should the proper twist gears be located in the train of gears to insert 3 turns of twist, and on testing the thread a portion is found to contain 4 turns or more, the thread is said to contain hard twist. The production of hard twist in the yarn is sometimes caused when the stop-motion is not in proper working order. In this instance the spindle knocks off even though all the ends are intact and are winding on the bobbin. The spindle belt, of course, is immediately pressed away from the belt, but sometimes only an insufficient amount, allowing the spindle belt to turn the spindle gradually, obviously increasing the twist. When the stopped spindle with all ends intact is noted by the operative, it is usually started, with the result that the hard-twisted portion of yarn remains on the bobbin.

Operatives should be instructed to notify the machinist or fixer whenever a spindle knocks off continuously. The trouble would then be eliminated by moving the spindle slightly away from the spindle belt, or adjusting the stop whorl shipper to move the stop whorl idler, so that it will press the belt farther away from the spindle whorl. Care should be taken, however, not to cause the stop whorl idler to press the spindle belt too far away, as this is likely to affect the adjoining spindles.

82. Hard twist may also result when the gear attached to the feed-roll shaft becomes loose and slips. This condition would cause the feed-rolls to revolve slower and consequently increase the twist in the thread. Hard twist may be eliminated by inspecting the gears from time to time, and, should any appear loose, the setscrews holding them should be tightened. Sometimes the adjustment between the driving gear and the gears on the feed-rolls is incorrect, and the rolls run with an uneven, jerky motion.

Wrapping the thread around the feed rolls an insufficient number of times, thus allowing it to slip, results in hard-

twisted threads. The thread is usually wrapped around the rolls three times. Sometimes, when the thread breakages occur at the rolls, only two wraps are given. The thread from these spindles should be frequently tested, however, to detect any hard twist, as this is likely to occur. A single wrap is rarely used, as the slippage is too great.

83. Slack Twist.—The principal causes of slack twist are oily spindle belts and improper setting of the spindles. Oily spindle belts allow the spindles to slip, since the driving surface is not in good condition. The spindle belts, of course, should be cleaned from time to time by applications of chalk or whiting. Slack twist resulting from improper setting of the spindles is caused when a spindle knocks off and the stop whorl idler presses the spindle belt too far away from the spindle whorl, thus affecting the adjoining spindle or spindles. When a spindle operates in this manner, it should be adjusted immediately in order that its proper relation with respect to the spindle belt will be maintained.

84. Singles.—The term *singles* is generally applied to yarns composed of two single ends one of which has broken, leaving the remaining end intact. However, it is also applied to yarns containing fewer ends than the required ply yarn contains. Defects of this nature may be traced to various causes, the most frequent of which is the faulty operation of the stop-motion. For instance, the stop-motion may not be in good working condition and therefore fail to function when an end breaks. The undersized ply thread continues to be wound on the take-up bobbin until it is discovered, when the operative may stop the spindle, replace the broken thread with a sound thread, tie the group of ends from the drop wires to the undersized groups on the bobbin, and start the spindle. This results in a single on the bobbin. Sometimes the spindle operates a long time in this manner, twisting and winding a large amount of undersized thread on the bobbin before it is discovered. The undersized thread on the take-up bobbin should be removed, and the threads should not be tied until the correct ply is found on the bobbin. This, of course, while resulting in a pro-

duct of the required ply, causes a considerable quantity of waste; hence, spindles with stop-motions that operate improperly should be immediately readjusted.

85. The improper operation of the stop-motion is usually caused by sticking drop wires; that is, the drop wire becomes bent or damaged, so that it fails to fall backwards when an end breaks. Sometimes the drop wire becomes bent, allowing the porcelain guide to strike lightly the bar against which the drop wires rest when brought in an upright position. When an end breaks, the drop wire falls backwards slightly, and as the hook guide comes in contact with the bar, the drop wire cannot move farther, thus allowing the spindle to revolve and twist an undersized yarn. Waste and dirt also frequently collect and become wrapped around the pin holding the drop-wire feet, thus hindering their free action, with similar results. Such waste should always be removed when cleaning the machine, and, if necessary, cleanings should be more frequent.

86. Corkscrew Threads.—Corkscrew threads are produced on the doubler-spinner in the same ways as on vertical doubling and single-process twisting. They are invariably produced when coarse and fine ends are twisted together, a condition that is especially noticeable in organzine. This defect is very likely to occur on the doubler-spinner when producing organzine by doubling and twisting two spun singles in a single operation. Ply yarns composed of more than two raw singles do not corkscrew like a 2-thread organzine. Another common cause is the failure to clean the feed-rolls and to keep them free from waste. For instance, at times, an end breaks and the silk wraps around the roll. Later, when the ends are retied and wrapped around the rolls in this condition, one thread may climb the ring of waste on the roll, be stretched, and feed faster than the end that is in contact with the true circumference of the roll. A corkscrew thread will result from twisting threads fed in this manner.

87. Clean feed-rolls will eliminate corkscrew threads caused at the rolls. However, other conditions may affect the ends so that a corkscrew thread will result. Among these may

be mentioned jack-pins that are either dry or covered with waste and dirt, causing the bobbin to turn hard, and stretching the thread before it reaches the feed-rolls. Operating the machine at a high speed will sometimes cause the threads to be stretched, since they are often under uneven tension, which increases the probability of the formation of corkscrew threads. This likelihood may be reduced by operating the machine at a slower speed. The reasons for defects caused by improper doubling apply to this machine. On the whole, the possibilities of producing corkscrew threads are practically eliminated if the supply bobbins used are of equal size, if the jack-pins are kept clean and oiled frequently, and if the feed-rolls are kept free from waste, and the machine is operated at a moderate speed.

ADJUSTMENTS

88. Adjustment of Feed-Rolls.—The feed-rolls, hanger, and shield should always be correctly adjusted, so that the gears of the rolls will mesh properly with the driving gear on the feed-roll shaft. Sometimes, this adjustment is not attended to and the feed-rolls are allowed to mesh with the driving gear without being properly alined. Unnecessary wear of the teeth on the feed-roll gears and the driving gear results. When the feed-roll gears become worn so that they do not function properly, they should be replaced by new rolls. In like manner, a worn driving gear should be removed and a split gear put in its place. Such a gear is made in halves, so that it may be applied to any part of the shaft in sections, and when fastened in place by setscrews it acts like a solid gear.

89. Adjusting Spindles.—The spindles are placed close to each other in order that the capacity of the machine may be as large as possible. This spacing often results in difficulties that may be traced to the adjustment of the spindle in relation to the spindle drive belt. It frequently happens that a spindle is placed so that the whorl presses the spindle belt quite tightly, but not sufficiently to affect the driving of the adjoining spindles. However, should an end break and cause a spindle

to kick off, the stop whorl will press against the belt with such pressure as to cause the belt to be moved away from the spindle whorl. The spindle brake will be applied and the spindle will stop; but the stop whorl may press the belt so far away from the spindle as to cause it to lose contact slightly with the whorl of the adjoining spindle. This condition may be readily discovered by grasping the spindle blade of the spindle located on each side of the spindle that is being adjusted. With the three spindles in operation, the stop-motion of the center spindle should be brought into operation, and any slackening in the speed of the two spindles that are being held between the fingers will be noticed immediately.

90. The trouble just described may be overcome by either of two methods. Sometimes the tardy spindle is moved closer to the spindle belt by tapping the eccentric spindle holder. If, on the other hand, the throw of the stop whorl idler is too great, the screw holding the stop whorl shipper should be loosened and the latter part moved so as to change the length of the throw. When this is properly adjusted, the operation of the stop-motion will cause the spindle belt to be pressed away from the spindle whorl just enough to clear the whorl, and yet not to affect the adjoining spindles.

In connection with the adjustment of spindles, the spindle brake should be kept in proper condition; that is, weakened or cracked springs should be renewed, while old, worn leathers should be replaced. When replacing these parts, the spindle should be carefully observed when it kicks off, in order to determine whether the readjusted brake works properly.

91. Adjusting Rings.—A readjusted spindle will not be in exactly the position it had before its correction. Hence, the spindle will not be exactly in the center of the ring, thus frequently necessitating the adjustment of the latter, which is done as follows: A bobbin is placed on the spindle and the machine is operated until the ring rail is either at its high or low position. The screws holding the ring holder to the rail are loosened and the ring is adjusted very carefully so that the distance between the bobbin head and the ring is the same at

all points. The screws holding the ring holder are then carefully tightened, so that the ring will not move, but will retain the correct position in relation to the bobbin. Besides employing a bobbin to gauge the distance between the bobbin and the ring, an adjusting or centering ring is used. This is placed on the spindle and serves the same purpose as the bobbin.

OILING

92. Machine Oiling.—The doubler-spinner is equipped with suitable oil holes and grease cups for lubricating the various parts. Careful attention should be given to the loose pulley on the crosshead shaft. Very often when the drive belt is shifted to the loose pulley and allowed to run there for a considerable time, the friction causes the bearings to become hot. If the machine be run in this manner, it will be necessary to oil thoroughly the bearings at frequent intervals. In addition to oiling the various parts which are similar to those on the machines already described, the spindles will require oiling about once every 3 months, since the speed at which they operate is not very high. The spindles are of practically the same construction as those employed on the spinner or twister and are oiled in the same manner.

When an individual motor drive is employed, the bearings of the motor are usually lubricated with grease of medium or hard consistency contained in grease cups that are turned from time to time. By employing a lubricant of this nature, the splashing of oil on the spindle belts and the dripping of oil on the floor are eliminated. The life of the spindle belts is prolonged in this way since a mineral oil injures the leather and should be avoided. Moreover, keeping the floor free from oil, which collects dust and waste, gives a cleaner appearance to the spinning room.

93. Ring Oiling.—The various types of rings employed on the doubler-spinner described, should be given the proper care in order that the term of service may be prolonged. For this reason it is always well to oil the rings frequently; in fact, in many mills this is a daily task of the fixer or attendant on

whom is placed the responsibility of maintaining the machines in good running order. The oil used is of the non-fluid variety, vaseline or petroleum jelly being used to a large extent and found very efficient. A clean oil should be used, as care should be taken not to stain the silk unnecessarily.

Oiling the rings may easily be carried out by applying the lubricant with a small piece of wood; however, it is very common to apply the lubricant with the forefinger dipped in the receptacle containing the lubricant, or a small amount may be placed in the palm of the left hand and used as needed.

94. When double-flanged rings are used, a small amount of lubricant should be placed under the upper flange so that the points of the traveler will be well lubricated, since this point receives the most wear. With the bevel ring, however, the lubricant may be placed near the inner edge of the ring, where it will gradually move downwards and thoroughly lubricate the traveler, which, in this case, is of the bar type. Besides being oiled, the rings should be cleaned from time to time, since the constant addition of oil collects fuzz, grit, and waste, hinders the action of the traveler, and causes a greater amount of wear.

SPEED AND HORSEPOWER

95. As is to be expected, the speed at which the doubler-spinner is operated is less than the speed of an ordinary twister, since the method of twisting threads is usually at a reduced speed. When operating at high speed, the travelers frequently fly off, especially when bar travelers are employed. This trouble may be eliminated after the proper operating speed has been attained. In addition, the doubler-spinner is equipped with many complicated parts not found on other machines. Hence, at high speeds various parts are sometimes thrown out of line and fail to function properly, producing defective threads. Because of the various conditions on which the speed of the machine is dependent, it is difficult to give a definite operating speed; however, spindle speeds ranging from 4,500 to 6,500 revolutions per minute are used. A very efficient

speed, found satisfactory for the ordinary work for which this machine is particularly adapted, is about 5,000 revolutions per minute.

96. When the frame is employed for doubling and twisting coarse or fuzzy threads that have a tendency to split, such as tussah and artificial silk, the speed should be reduced. The reduced speed is not so hard on the thread and tends to cause a more uniform product of higher quality. The speeds for this class of work range from 2,100 to 3,500 revolutions per minute, and higher; however, the best speed may be obtained by experiment and careful observation.

The horsepower required to operate the doubler-spinner depends on the construction and size. If the frame is equipped with ball bearings, the power required will be lower than when plain bearings are used. Considering a machine equipped with ball bearings, a 1-horsepower motor will efficiently operate a 120-spindle frame running at 4,000 revolutions per minute. This may be employed as a basis for determining the power required, keeping in mind that an increase in speed and the number of spindles requires a larger motor, the speed being the more important factor.

SIZE OF MACHINE

97. Since the doubler-spinner is designed to double up to 14 ends, and twist these simultaneously, it is built in different spindle spacings in order that it may accommodate on a single row of jack-pins the number of bobbins referred to. If a machine is equipped to double 14 ends, it will be necessary to have the spindles farther apart than when only 6 or 8 ends are processed. For this reason, spacings measuring 4 inches, 5 inches, and 5½ inches are regularly supplied according to the number of jack-pins in a single row. In addition to the various spacings, the machines are built in different spindle capacities according to the number of spindles required and the available floor space. The sizes regularly constructed contain 100 spindles, 80 spindles, and 76 spindles. A 100-spindle frame, with spindles spaced 4 inches apart, is 19 feet 4 inches

long and approximately 15 inches wide; the 80-spindle frame with spindles spaced 5 inches apart, and the 76-spindle frame with spindles spaced $5\frac{1}{4}$ inches apart, have the same dimensions as the 100-spindle frame with 4-inch spacing. The height of the frames from the floor to the top jack-pin varies in accordance with the number of jack-pins that are in one row. Should the frame be equipped with 6 jack-pins in one row its height will be in the vicinity of 70 inches. The feed-rolls on all doubler-spinners, however, are approximately the same height, this being about 36 inches from the floor. The approximate weight of the doubler-spinners boxed and ready for shipment, is about 2,100 pounds.

SILK THROWING

(PART 7)

Serial 5002G

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 would happen if a spindle should continue to revolve after the feed-rolls stop delivering silk?
- (2) Why is it necessary to operate the eccentric shipper when stopping the doubler-spinner?
- (3) Explain how to change the traverse when it is desired to use a bobbin with a longer barrel.
- (4) What are the purposes of the traveler?
- (5) (a) Why are straight-blade spindles employed on doubler-spinners? (b) Explain how the straight spindle may be made to accommodate a taper-hole bobbin.
- (6) How should a doubler-spinner be arranged to wind the silk on the take-up bobbin with a quick traverse?
- (7) What are meant by the terms single-process, two-process, and three-process machines?
- (8) Discuss the important factors that must be considered the correct bar travelers to use.
- (9) Briefly describe the passage of the silk from the supply bobbins to the take-up bobbins.

- (10) (a) What is hard twist? (b) What are singles?
(c) What are the causes of these defects?
- (11) What is the advantage of the grooved type of feed-rolls sometimes used on the doubler-spinner?
- (12) Name the three principal functions of the doubler-spinner?
- (13) Explain how spinning rings are adjusted.
- (14) (a) How often should spinning rings be lubricated?
(b) What kind of lubricant should be employed?
- (15) Why is an eccentric spindle holder used with a rigid spindle?
- (16) State several causes of corkscrew threads.
- (17) What three functions are automatically performed by the stop-motion?
- (18) Why are the feed-rolls of a doubler-spinner supported in hangers?
- (19) What is the flange number if the flange of a ring is $\frac{7}{32}$ inch wide? Ans. 4.
- (20) Find the twist per inch being inserted in the thread if the gear c_{11} , Fig. 12, has 47 teeth, and the gear c_7 has 22 teeth. The top pulley c_2 is 10 inches in diameter, the bottom pulley c is 5 inches and the spindle-belt pulley b_3 is 12 inches in diameter. The feed-rolls are 1 inch in diameter, and the spindle whorl is $1\frac{3}{8}$ inch in diameter.

Ans. 10.043

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