The Project Method of Teaching

SILK THROWING

PART 8

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.

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

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 INTERNATIONAL CORRESPONDENCE SCHOOLS

SILK THROWING
(PART 8)

COMBINATION MACHINES—(Continued)

OTHER FORMS OF MACHINES

DOUBLER-SPINNER

1. Differences of Construction.—Besides the doubler-spinner described in the preceding Section, other machines made by different manufacturers are found in many throwing mills. They all have the same basic construction and operation, but some parts are of different design in order to increase the efficiency and to assist the operative. Therefore, it will only be necessary to describe the variations in construction.

The machine about to be described is also a two-process machine, performing the operations of doubling and twisting; hence it is employed mostly in throwing operations in which single threads are doubled prior to twisting. In performing these operations, it acts much the same as the machine previously described; that is, the threads are drawn from the bobbins on the jack-pins by passing the silk around two positively driven feed-rolls. The rolls in turn deliver the thread at the proper speed to the take-up bobbins in order that the correct number of turns of twist will be inserted in the thread.

2. Probably the most important difference to be found on the machine being described is in the stop-motion and related parts. For instance, when an end breaks on this machine and the stop-motion is brought into operation, the feed-rolls stop turning and the spindle, located on a swing gate, is moved away from the spindle belt. When the spindle is stopped, it is moved away from the belt, allowing the latter to run unhindered, and consequently reducing the power requirements to a minimum. Moreover, the rings around which the traveler is pulled are held on individual supports; therefore, when a spindle is moved away from the spindle belt, the ring will move with it.

3. Details of Driving.—The double-spinner illustrated in Fig. 1 is driven by an individual motor, that type of drive being employed to a large extent because it renders unnecessary the use of driving belts from the drive shaft to the driving pulley on the crosshead shaft. Belt slippage is thus eliminated, and the absence of belts creates a cleaner spinning room. The motor *b* is located near the head end stand *a*, with its driving shaft vertical, and is generally mounted on an iron casting, or bed, that is held to the floor with lag screws. The holes in the bedplate are slots, so that the position of the motor may be easily changed. By this adjustment slackness may be removed from the spindle belt. The vertical shaft of the motor carries the small driving pulley b_1 around which passes the spindle drive pulley b_2. On leaving the driving pulley of the motor, the spindle belt traverses one side of the machine, passes around a pulley located at the foot end of the machine, and returns on the opposite side to the motor driving pulley.

4. Every driving belt has a tight side and a slack side while in motion, the slack side being that which leaves the driving pulley and passes to the driven pulley. On the doubler-spinner shown in Fig. 1, the slack side of the belt is at one side of the machine, between the leaving side of the driving pulley and the spindles. To maintain the spindle belt at the correct tension, the spindle belt tension device is located at this side. An idler *c* rotates on a stud c_1 that is supported in a carriage c_2 designed to slide on two rods c_3 held in a bracket attached to the end stand. A pulley c_4 carries a heavy cord or a chain c_5, one end of which is attached to the carriage c_2 while the other

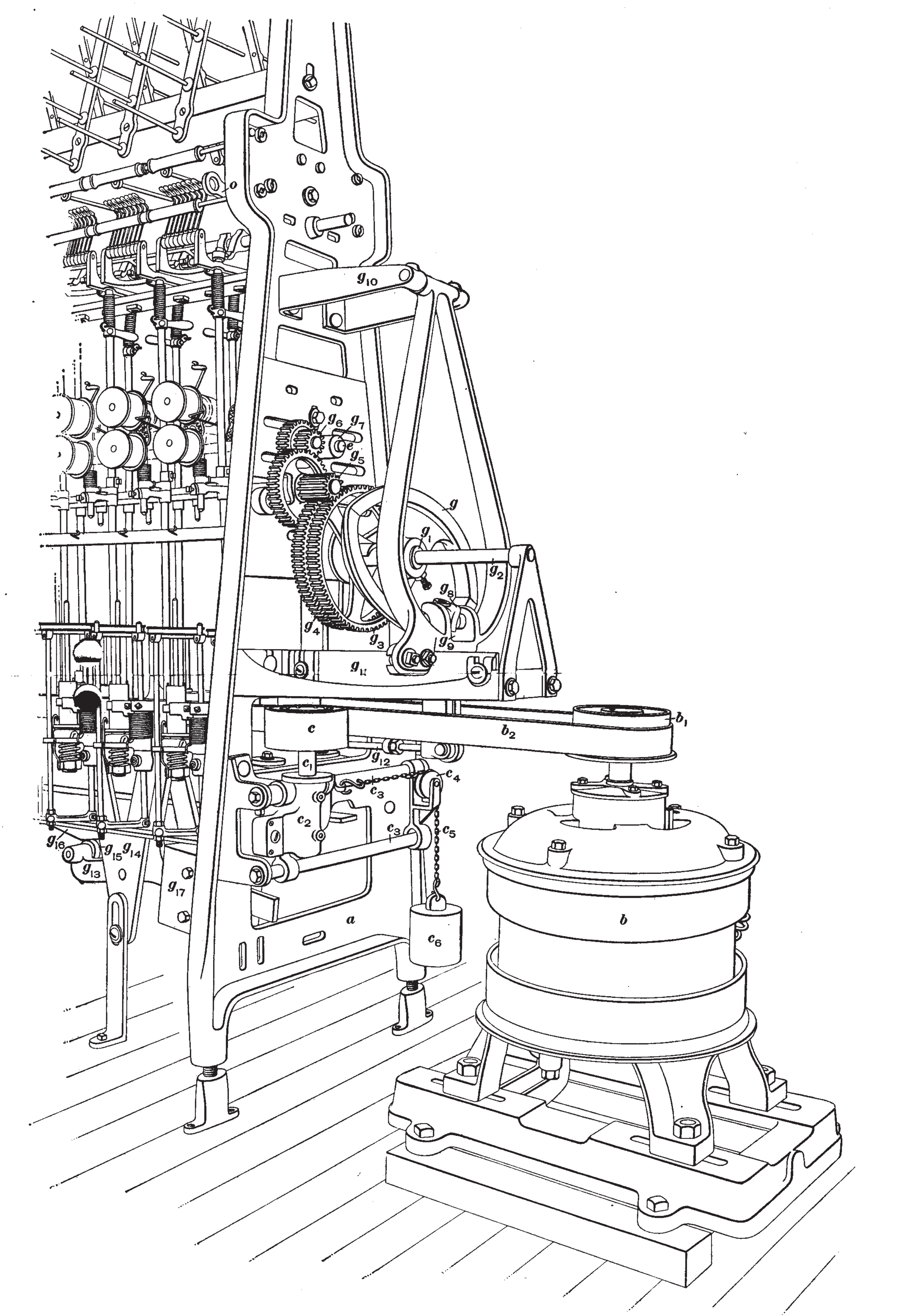

Fig. 1

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end supports a heavy weight c_6. The constant pull of the weight on the carriage presses the idler against the belt, taking up the slack and causing the belt to run taut. With such a tension device the pressure must be applied to the slack side of the belt. If applied to the tight side, the belt would not be tightened effectively. As the stretch of the belt increases its length the idler c moves toward the center of the machine. Should the belt become too long causing the tension device to be ineffective, and permitting the belt to slip while passing around the motor drive pulley, the motor should be moved slightly away from the machine until the tension device again operates effectively. The motor should not be moved too far as the belt will then be too tight and put excessive strain on the bearings.

5. In addition to the individual motor drive, the machine has a crosshead shaft, if it is to be driven by belt from a driving shaft. The crosshead shaft is located at the head end and is of practically the same construction as in the single-process spinner or twister. It consists of the tight and loose drive pulleys of which the tight pulley is a part of the tight spindle-belt drive pulley. This, when in motion, transmits the power to the spindle belt, in turn driving the spindles.

The method of maintaining the tension of the spindle belt when the frame is equipped with a crosshead-shaft drive is identical with that employed on spinners. The spindle belt passes under the machine and around an idler on which a constant pull is exerted by a strong coil spring, thus keeping the belt taut. It is evident, from a comparison of both drives, that a machine with a crosshead-shaft drive subjects the belt to more turns than one that is motor driven. With the crosshead-shaft drive the belt must pass around the loose spindle-belt pulley, then around the movable idler, and back around the tight spindle-belt pulley. With the individual motor drive, however, the belt is directly connected to the pulley on the motor shaft.

6. Feed-Roll Shaft.—While driving the spindles on each side of the machine, Fig. 1, the spindle belt also imparts motion to a vertical shaft at the foot end of the machine and shown at *d,* Fig. 2. The spindle drive belt passes around a pulley d_1

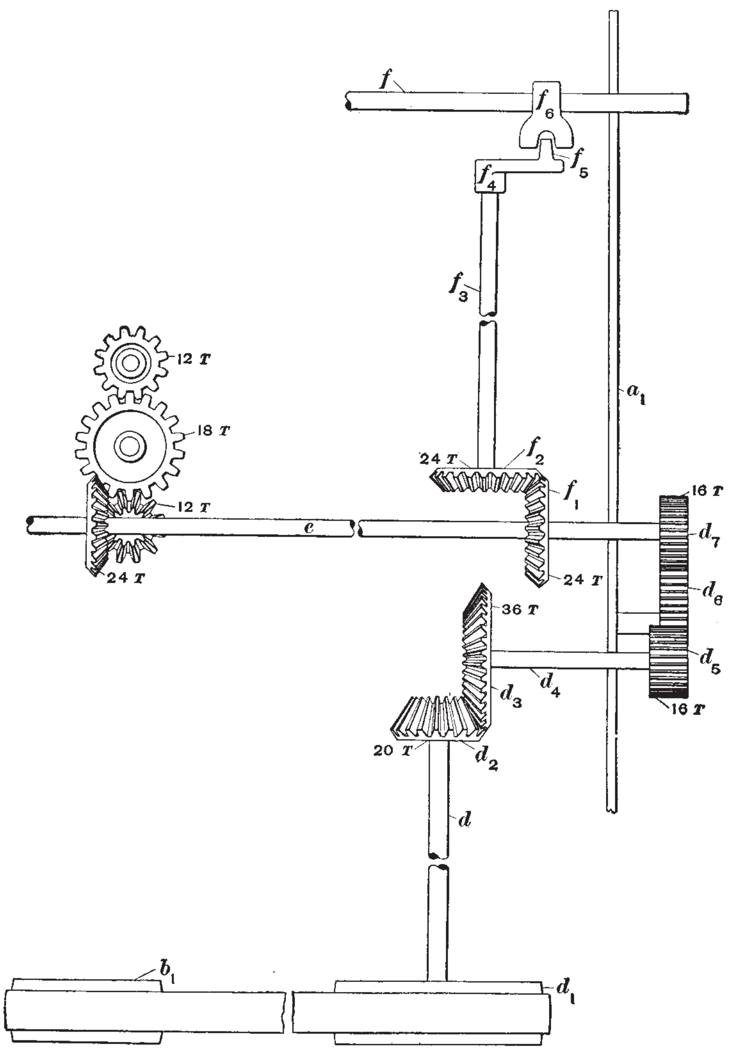


Fig. 2

on the lower end of the vertical shaft, which rotates in ball bearings and is at such a distance from the frame as to allow the removal or replacement of the spindle belt. On the upper end of the vertical shaft is a 20-tooth bevel gear d_2 that meshes with a 36-tooth bevel gear d_3 on the short shaft d_4, the latter passing through the end stand a_1 of the machine. On the opposite end of the shaft d_4 is a 16-tooth spur gear d_5 that transmits motion through the intermediate gear d_6, on an adjustable stud attached to the end stand, to the 16-tooth spur gear d_7. The gear d_7 is fastened to the feed-roll shaft e and may be considered the change gear, as it is changed more frequently than any other gear when the twist must be altered. An iron shield prevents articles that are dropped accidentally from coming in contact with the gears and causing serious damage while the machine is in operation. The shield also protects the operatives, as it prevents their clothing from coming in contact with the revolving gears. The gear cover is so made that it may be easily removed when gears must be changed to alter the twist per inch.

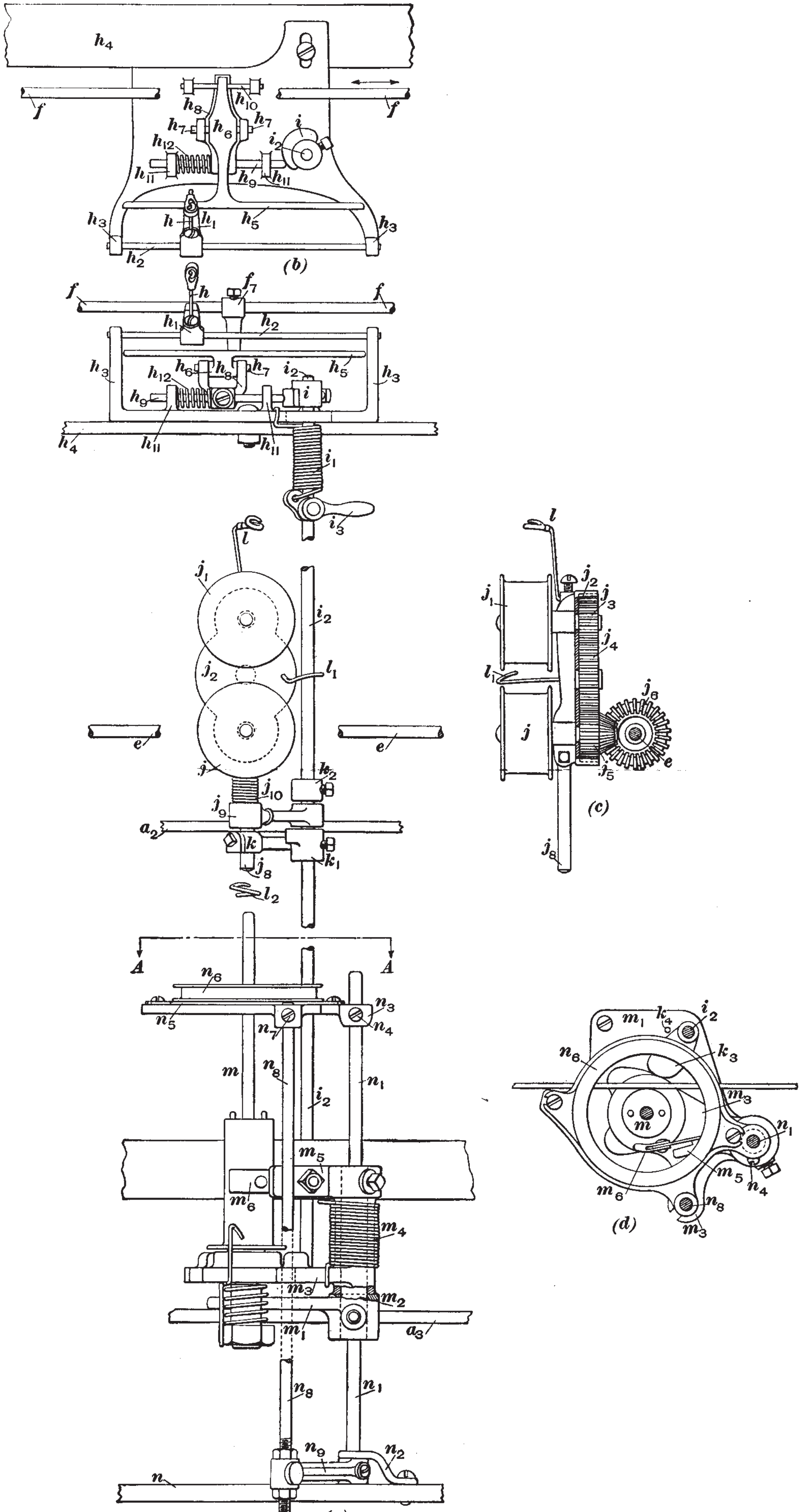
7. Because of the construction of the machine, only one feed-roll shaft is needed, and it is located in the center of the machine so that the feed-rolls on both sides of the machine may be driven from it. The feed-roll shaft e, Fig. 2, also imparts a reciprocating motion to the rod f that operates in conjunction with the stop-motion. The 24-tooth bevel gear f_1 on the feed-roll shaft e meshes with a 24-tooth bevel gear f_2 on the vertical shaft f_3 that rotates in bearings held in hangers attached to the end stands. Passing upwards through the rail that supports the drop wire brackets and the upper bearing, not shown in the illustration, is the vertical shaft f_3, at the upper end of which is a crank f_4 that carries a vertical pin f_5, near its end. The pin engages with a slotted casting f_6 fastened to the knock-off rod f. When the machine is in operation, the vertical shaft f_3 and the crank f_4 will revolve at a constant speed, thus causing the knock-off rod f, to move back and forth.

8. Traverse Mechanism.—The traverse given to the thread while it is winding on the take-up bobbin is imparted to a form of ring rail by the large cam g, Fig. 1, through a series of levers underneath the machine. The cam is very heavy, because of the weight of the ring rails it must lift, and is attached to a sleeve g_1 that rotates on a stud g_2. One end of the stud is attached to the end stand and the other is rigidly supported in a bracket. The two spur gears g_3 and g_4 of different sizes are mounted on the sleeve and stud and are employed to give a slight variable motion to the cam, and consequently to the traverse of the thread as it is wound on the bobbin. Both gears mesh with a small, long-faced spur gear of the compound g_5 mounted on a stud fastened to the end stand. The large gear of the compound meshes with another compound g_6 that is driven by a small spur gear g_7 on the feed-roll shaft *e*.

Resting against the cam is a large cam roller that is held in the swivel bracket g_8 carried by the casting g_9. This casting swings towards and away from the machine as the cam turns as its upper end is pivoted on a short shaft held in the bracket g_{10}. The lower end is prevented from moving sidewise by a blade g_{11} that fits in a slot in the casting. Provision is made for adjustment to take up wear between the blade and the casting.

9. An arm of the casting g_9, Fig. 1, extends downwards between the sides of the spindle belt and is joined to the traverse rod g_{12} that extends the entire length of the machine. The traverse rod is linked to the traverse arms g_{13}, which are suitably distributed along the frame, the number of such arms depending on the length of the machine. The traverse arms work on pivots and are supported in castings g_{14} strengthened by brackets attached to the floor by lag screws. At one end the traverse arm carries the roller g_{15}, which is continually in contact with the arm g_{16} that carries the ring rail on each side of the machine. On the opposite end of the traverse arm is a heavy counterweight g_{17} that tends to balance the weight of the ring rails. The counterweight is held in place by setscrews, and so it may be moved either away from or towards the pivot point, thus increasing or decreasing the weight that must be lifted by the cam.

10. The turning of the cam g, Fig. 1, moves the cam follower and the casting holding it backwards and forwards with



§ 13 Fig. 3 86886

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a slow motion. This motion is transmitted by the long rod g_{12} to the traverse arms, and the horizontal motion of the rod is thus changed to a vertical movement of the cross-arm g_{16}. The roller g_{15} changes sliding contact into rolling contact and thus reduces friction and wear at this point. As the cross-arm g_{16} moves upwards and downwards, both traverse rails will move in the same way, as they are connected to it. Adjustments of the raising or lowering of the traverse of the rails is accomplished by shortening or lengthening the rod g_{12}.

11. Action of Stop-Motion.—The construction and operation of the stop-motion on the double-spinner being considered are similar in certain respects to those employed on the machine previously described. The ends are threaded through the drop wires that are held upright while the threads are intact and running. When an end breaks, the drop wire immediately falls backwards and causes the various parts of the stop-motion to be brought into operation, and at the same time the feed-rolls are thrown out·of action; also, the spindle is shifted from the belt, and by coming in contact with a spindle brake a rapid stoppage of the spindle and the bobbin is assured. A detailed illustration of the stop-motion is given in Fig. 3. In (*a*) is shown a front elevation of the entire stop-motion assembly, including the drop wires, the feed-rolls, and the spindle; in (*b*) is shown a top view of the drop-wire mechanism; (*c*) illustrates a side view of the feed-rolls; and (*d*) is a cross-section on *A-A* in (*a*).

12. Drop Wires.—The drop wires h, Fig. 3 (*a*) and (*b*), are held by setscrews to drop-wire feet h_1 pivoted on the rod h_2. This rod is supported in a horizontal position by a bracket h_3 rigidly bolted to the rail h_4. The ends of the drop-wire feet are directly over the arm h_5 that forms a part of the stop-off lever h_6. When in the running position, the ends of the drop-wire feet are raised away from the arm h_5 and remain in that position until the tension is removed from the drop wire. The stop-off lever is pivoted on the pin h_7, held by the support h_8, and is so carefully adjusted that the weight of a drop-wire foot resting on the arm h_5 will immediately cause it to be depressed while its opposite end will move upwards.

The front end of the stop-off lever support is fastened to the rod h_9, while the opposite end is **U**-shaped, and is held and guided by the rod h_{10}. This construction allows it to move from side to side with a certain amount of freedom when the stop-motion is brought into action. Each end of the rod h_9 extends through one of the bearings h_{11} in order that it will be held in its proper position; but one end is in contact with the eccentric *i*. The rod h_9 is constantly held in contact with the eccentric by the pressure of the spring h_{12} between one of the bearings and the lever support. The eccentric *i* is so formed that its low part acts as a step that comes in contact with the end of the rod h_9. The rod thus holds the eccentric in place and prevents it from turning in the direction in which it is pulled by the spring i_1 acting on the rod i_2.

13. When in operation, several parts of the stop-motion function at the same time. The knock-off rod *f* moves back and forth and carries the knock-off lug f_7. While moving back and forth, the lug will pass the stop-off lever; for, while the threads are intact and running through the drop-wire eyes, a slight clearance exists between the knock-off lug and the stop-off lever, since the latter is balanced so that it will be in an approximately level position. Should an end break, the tension will be removed from the thread and allow the drop wire to fall back, the drop-wire foot will come in contact with the arm h_5 of the stop-off lever and cause that part to be depressed, while the opposite end will be raised and will be in the path of the lug f_7. The lug will then carry with it the stop-off lever and its support. Since the support is fastened to the rod h_9, the rod will be moved against the compression of the spring h_{12}, and the end of the rod will be drawn from the step of the eccentric. This will release the eccentric, which allows the rod i_2 to turn and causes the remaining parts of the stop-motion to function.

14. The bracket h_3, Fig. 3 (*a*) and (*b*), holding the rod h_2 and drop wires *h*, is made wide enough to hold a sufficient number of drop wires on the rod. Thus, to double and twist

12 ends, it would be considered the best practice to provide 12 drop wires for each spindle. Should only 6 threads be twisted on a machine equipped for 12-end work, it is necessary to hold the 6 unused drop wires in an upright position so that the stop-motion will not be brought into action and cause the spindles to stop. Very often the drop wires are tied in an upright position with a piece of string.

Sometimes, when an end breaks, the rod h_9 is drawn so that the cam i is released but does not turn with sufficient force to cause the rod h_9, and consequently the stop-off lever, to move out of the path of the reciprocating lug f_7. This condition should be avoided, as the continual striking of the lug against the stop-off lever may cause a misalinement of some parts. It may be avoided in the following manner: The spring i_1 that turns the rod i_2 should be tightened until the rod will turn with sufficient force to move the rod h_9 far enough toward the left so the lug will not strike the stop-off lever after the cam is released. When adjusting the lug f_7, it is set so that it will strike the stop-off lever with only enough force to cause the rod h_9 to release the cam.

15. Feed-Rolls.—The feed-rolls j and j_1, Fig. 3 (a) and (c), between the drop wires and the spindles supporting the take-up bobbins, draw the thread from the bobbins on the jack-pins and feed it to the take-up bobbins. They are smooth and of fairly large diameter, so that a greater surface may be presented to the silk that is wrapped around them, thus reducing the possibility of slippage. They have small flanges at the ends to prevent the silk from sliding off. Each feed-roll is fixed to a shaft that turns in a larger bearing supported by the housing j_2. The shaft of the upper feed-roll carries the 12-tooth gear j_3, which meshes with an 18-tooth idler j_4 on a stud and through it imparts motion to another 12-tooth gear j_5 on the shaft of the lower feed-roll j. The gear j_5 is a combination spur and bevel gear, the spur gear meshing with the idler j_4 and the bevel gear with the bevel gear j_6 on the feed-roll shaft e. The entire feed-roll assembly is supported on a rod j_8 and uses as a bearing the casting j_9. The latter also acts as a bearing for the rod i_2, and since it is firmly attached to the rail a_2, it prevents vibration of the rod i_2. Fastened to the rod j_8 directly below the casting j_9 is a lever k that extends toward the center of the machine and is so adjusted that it will come in contact with the lower side of a cam or eccentric k_1 on the vertical rod i_2. This rod, passing upwards through the hub of the casting j_9 carries the stop lever k_2. The stop lever also extends toward the center of the machine and is adjusted to come in contact with the casting j_9 when the spindle knocks off.

16. In operation, the ends passing through the drop wires are guided through the pigtail guide l, Fig. 3 (a) and (c), directly above the feed-rolls, and thence wrapped around the rolls. To aid in keeping wiry threads on the rolls and prevent them from jumping off, a wire hook guide l_1 is attached to the housing j_2. From the feed-rolls the threads pass downwards through the centering eye l_2. With the threads in their proper positions as described, the spindle may be started by turning the handle i_3 in the proper direction, causing the vertical rod i_2 to turn also. With all threads intact and running, the feed-rolls will deliver silk at the proper speed for which the machine is set; however, should an end break, the drop wire would fall backwards and cause the disengagement of the rod h_9 and the eccentric i. The rod i_2 would then make about a quarter-turn, carrying the cam k_1 around with it. As the cam k_1 presses against the lever k, the entire feed-roll assembly, which is fastened to the rod j_8, will move with the lever k and cause the disengagement of the gear j_5 on the lower feed-roll and the gear j_6 on the feed-roll shaft, thus stopping the feed-rolls. It may be added that the gears j_5 and j_6 are held in mesh, when in the running position, by the pull of the spring j_{10}, which exerts a constant pressure on the feed-roll housing.

17. Spindles.—The spindles m, Fig. 3 (a), are swing-type spindles of the usual type, but with slight variations in the general construction and the method of mounting, as the spindle support is designed especially for use with the type of stop-motion shown. The spindle rail a_3 extends the entire length of the machine and is bolted to the end stand at each end of the frame. Spaced at regular intervals along the frame are the spindles, securely held to the spindle rail by the rail steps m_1. The latter is designed to extend slightly away from the spindle rail and support, in a vertical postion, a steel bushing m_2 tightly fitted in the rail step, and held by a setscrew. The bushing acts as a pivot on which the swing gate m_3 may swing. The spring m_4 attached to the swing gate and a stationary part of the spindle exerts the necessary pressure to hold the spindle whorl in contact with the spindle drive belt when in the operative position. The socket and spindle of this machine are mounted in the swing gate in exactly the same manner as on other machines; that is, a felt washer is located between the socket and the swing gate so as to absorb a part of the vibration, while the socket is kept in place by a nut drawn up against a compression spring.

18. Mounted directly above the spring m_4, Fig. 3 (*a*), and fastened to the steel bushing, is the stop-whorl brake casting m_5, which supports a thin strip of steel to which a small strip m_6 of leather or raw hide is riveted. The purpose of this strip is to provide a better friction surface to stop the spindle whorl and also to prevent it from becoming marked or scratched by its contact with the spring. The shape of the casting m_5 and the relation of the brake m_6 to the spindle m may be easily seen in (*d*). The rod i_2 extends downwards from the drop wire assembly, past the feed-rolls, and rests in a bearing in the rail step m_1. It carries a peculiarly shaped cam k_3 that is employed to press against the swing gate and force it away from the spindle belt. When the spindle is in operation, the cam rests against the small pin k_4, allowing sufficient clearance for the whorl to be pressed against the spindle belt by the spring, thus causing rotation.

19. In conjunction with the specially designed swing-gate bearing employed in the doubler-spinner are a unique ring holder and a traverse mechanism. The traverse bar *n*, Fig. 3 (*a*), extends the entire length of the machine and supports a slender rod n_1 that extends upwards through the steel bushing m_2. The weight of the rod and the parts attached to it is not great enough to cause it to move downwards with the bar n; therefore, to assure a positive action, a casting n_2 having a **U**-shaped slot is fastened to the bar and holds the rod securely. The upper end of the rod carries the ring-holder bracket n_3 which is held by the setscrew n_4. The bracket is supported in a horizontal position and retains the plate-type ring holder n_5 that holds the spinning ring n_6. Fastened to the bracket by the screw n_7 is a second rod n_8 that passes downwards past the spindle and engages with the connecting-rod n_9. The rod n_8 is threaded and provided with nuts, whereby the height of the ring may be adjusted.

20. In passing from the ring-holder bracket to the traverse bar, the rod n_8, Fig. 3 (a) and (d), engages with a **U**-shaped slot in the swing gate m_3. This construction allows a free up-and-down movement of the rods n_1 and n_8 and yet causes the spinning ring to be moved a distance equal to the movement of the spindle, thus maintaining the proper relation between these parts. When the swing gate and the spindle are pressed away from the spindle belt, the rod n_8 will be carried with them, and as these parts swing on the same center, the spindle will always be located in the exact center of the ring.

The silk to be twisted, after leaving the feed-rolls, is guided through the centering eye, under the traveler supported on the spinning ring, and then wrapped around the barrel of the bobbin. When the machine is in motion, a slow up-and-down movement is given to the traverse bar n, which is transmitted to the spinning ring and causes the guiding of the thread on the barrel of the bobbin. The breakage of an end, however, causes a drop wire to fall, resulting in the turning of the rod i_2, and with it the cam k_3. The turning of the cam moves the swing gate so that the spindle whorl loses contact with the belt and at the same time comes in contact with the stop-whorl brake, effectively stopping the spindle.

21. It is very important, in the proper operation of the stop-motion, for the spindle to stop immediately when an end breaks. Should the spindle continue to rotate, even if only a very slight amount, it is likely that hard twist will be produced.

Therefore, the stop-whorl brakes should be examined and adjusted from time to time, and the leathers renewed whenever this is deemed necessary. In, making adjustments, the steel spring should not be placed so that the leather will rub the whorl while the spindle is in motion. Neither should the brake be too far away from the whorl, as it would not then stop the spindle when applied. In order that the stop-whorl brake will function properly, the brake should be so adjusted that its leather will touch the whorl immediately after the whorl loses contact with the belt.

22. The stop-motion is brought into action immediately after a drop wire falls backwards, which may result when an end breaks or when the tension of the thread is insufficient to support the drop wire in an upright position. When the frame is being stopped, the threads in losing their speed become slack and allow all the drop wires to fall. Each spindle will then be stopped automatically because of the operation of the individual stop-motions. Therefore, to prevent the stoppage of each spindle, which would necessitate individual starting, a device is provided that may be shifted so as to retain the drop wires in an upright position while the frame is being stopped. It consists of a long, flat bar located directly back of the drop wires that is pivoted so it may be swung against the drop wires to hold them upright, or away from them to allow their normal operation. This is accomplished by moving the handle *o*, Fig. 1. The handle is shown in the position to cause the bar to retain the drop wires upright, which is its proper position in stopping the machine, for, when the drop wires are in this position the stop-motions do not operate, consequently the spindles will run until the machine has lost its momentum. When the machine is again brought into operation and the running threads are taut, the handle *o* is pressed away from the operative, allowing the drop wires to assume their natural running position.

23. Twist Calculations.—The calculations that are necessary in connection with the doubler-spinner just described are similar to those given in other Sections and deal mainly with speeds, twist, and production. Twist calculations for determining the constant from which the proper gear to give a desired twist may be found, or for determining the theoretical amount of twist and comparing with the actual twist, are the most important. Twist calculations, however, are practically eliminated by the use of feed gear tables or twist gear charts. Such tables are regularly supplied with machines of this type, from which the proper gears may be found to give approxi-

TABLE I

SIZES OF CHANGE GEARS

Turns of Twist per Inch	Gear d_7 on Shaft e	Intermediate Gear d_6
1	16	Any gear to fit
1½	24	
2	32	
2½	40	
3	48	
3½	56	
4	64	
4½	72	
5	80	

TABLE II

SIZES OF CHANGE GEARS

Turns of Twist per Inch	Gear d_7 on Shaft e	Compound Gear
5½	44	24 and 48
6	48	24 and 48
6½	52	24 and 48
7	56	24 and 48
7½	60	24 and 48
8	64	24 and 48
8½	68	24 and 48
9	72	24 and 48
9½	76	24 and 48
10	80	24 and 48

TABLE III

SIZES OF CHANGE GEARS

Turns of Twist per Inch	Gear d_7 on Shaft e	Compound Gear
10½	42	15 and 60
11	44	15 and 60
11½	46	15 and 60
12	48	15 and 60
12½	50	15 and 60
13	52	15 and 60
13½	54	15 and 60
14	56	15 and 60
14½	58	15 and 60
15	60	15 and 60
15½	62	15 and 60
16	64	15 and 60
16½	66	15 and 60
17	68	15 and 60
17½	70	15 and 60
18	72	15 and 60
18½	74	15 and 60
19	76	15 and 60
19½	78	15 and 60
20	80	15 and 60

mately the twist within the twist range of the machine. The twist range on the machine in Fig. 1 is from 1 to 20 turns, inclusive, increasing by half turns. When from 1 to 5 turns of twist, inclusive, are desired, reference should be made to Table I. It will be seen that any size of intermediate gear d_6, Fig. 2, may be employed, as this gear merely transmits power from the gear d_5 to the gear d_7. It is very important that the proper size of gear d_7 be placed on the shaft e; otherwise, the speed of the feed-rolls will be incorrect and they will fail to deliver the silk at the necessary speed to give the desired twist.

When twists ranging from $5\frac{1}{2}$ to 10 turns, inclusive, are desired, it will be necessary to place a compound gear having 24 teeth and 48 teeth in place of the intermediate gear d_6 and then use Table II. The compound gear should be placed on the stud so that the gear d_5 will mesh with the 48-tooth gear, while the 24-tooth gear should mesh with the gear d_7.

Table III is employed when the desired twist is between $10\frac{1}{2}$ and 20 turns. In this instance a 15-tooth and 60-tooth compound is necessary in order to reduce the speed of the feed-rolls to the proper degree. It should be noted that the 16-tooth gear d_5 on the shaft d_4 is not referred to in the tables. This gear is not changed, but is allowed to remain on the shaft for all twists. It may be added that this type of machine is regularly equipped with spindles having 1-inch whorls. Hence, in the following examples this size is considered when it is necessary to include the diameter of the spindle whorl in the calculation.

EXAMPLE 1.—Find the speed of the spindle, if the whorl is 1 inch in diameter and the spindle belt is driven by a 4-inch pulley b_1, Fig. 2, on the motor shaft making 1,250 revolutions per minute.

SOLUTION.—The speed of the spindle is found to be

$$\frac{4\times 1{,}250}{1}=5{,}000 \text{ r. p. m.} \quad \text{Ans.}$$

EXAMPLE 2.—Find the surface speed of the feed-roll, in inches per minute, when a 4-inch pulley on the motor shaft makes 1,250 revolutions per minute and drives the pulley d_1, Fig. 2, which is 7 inches in diameter. Take the sizes of the remaining gears as marked and the circumference of the feed-roll as 6 inches.

SOLUTION.—The surface speed of the feed-roll is

$$\frac{1{,}250\times 4\times 20\times 16\times 24\times 6}{7\times 36\times 16\times 12}=4{,}761.904 \text{ in. per min. Ans.}$$

EXAMPLE 3.—It is known that the feed-rolls deliver 4,761.904 inches per minute while the spindles make 5,000 revolutions per minute. Find the twist per inch in the thread.

SOLUTION.—The twist in the thread is found to be

$$5{,}000\div 4{,}761.904=1.05, \text{ or approximately 1 turn per in. Ans.}$$

EXAMPLE 4.—Find the twist per inch in the thread if the machine is geared as shown in Fig. 2. The diameter of the pulley d_1 is 7 inches and the circumference of the feed-rolls is 6 inches.

SOLUTION.—The twist per inch in the thread is found to be

$$\frac{12\times 16\times 36\times 7}{24\times 16\times 20\times 1\times 6}=1.05, \text{ or 1 turn per in. Ans.}$$

EXAMPLE. 5.—Find the twist per inch in the thread if a 60-tooth gear is substituted for the gear d_7, Fig. 2, and a 24- and 48-tooth compound gear is used instead of the intermediate d_6, the 24-tooth gear meshing with the gear d_7.

SOLUTION.—The twist per inch in the thread is found to be

$$\frac{12\times 60\times 48\times 36\times 7}{24\times 24\times 16\times 20\times 1\times 6}=7.875, \text{ or approximately } 7\tfrac{1}{2} \text{ turns per in. Ans.}$$

EXAMPLE 6.—Find the twist per inch that is being inserted in a thread if a 60-tooth gear is substituted for the gear d_7, Fig. 2, and a 15- and 60-tooth compound replaces the gear d_6, the 15-tooth gear of the compound meshing with the gear d_7.

SOLUTION.—The twist per inch in the thread is found to be

$$\frac{12\times 60\times 60\times 36\times 7}{24\times 15\times 16\times 20\times 1\times 6}=15.75 \text{ turns per in. Ans.}$$

The answers obtained in many of the twist calculations may not correspond exactly to the twist per inch given in the tables. This may be illustrated by example 6, in which the theoretical twist is $15\frac{3}{4}$ turns, while the actual twist as given in Table III is 15. The difference between the theoretical twist and the actual twist is due to many factors that affect the machine while it is in operation. Therefore, to overcome this, manufacturers frequently give, on the twist chart, gear combinations that produce theoretical twists that are slightly in excess of the actual twist being inserted in the thread. Sometimes, on testing the twisted thread, it will be necessary to substitute a larger or smaller twist change gear to obtain the desired turns per inch.

24. Reversing Twist.—A machine of the type shown in Fig. 1 is usually employed, as far as possible, for the manufacture of one class of yarn; for changes from one class of yarn to another always result in a loss of time. Also, the class of yarns made on this machine usually has a right twist; hence, it will not be necessary to reverse the direction of twist very often. However, should reverse of twist be required, the first operation will be to reverse the direction of rotation of the spindles, which is done by causing the spindle drive belt to move in the opposite direction. The direction of motion of the feed-rolls is reversed as follows: The movable stud on which the intermediate d_6, Fig. 2, is mounted is shifted so that the gears d_5 and d_6 are thrown out of mesh. A special bracket, carrying a stud on which a second intermediate is mounted, is attached to the foot stand of the machine and adjusted until its intermediate is thrown into mesh with the gears d_5 and d_6 and transmit motion from one to the other. The insertion of this second idler will cause the feed-rolls to revolve in the reverse direction and deliver silk correctly to the take-up bobbin.

SPINNER-DOUBLER

25. General Construction.—The spinner-doubler is another type of two-process machine employed to a limited extent in the throwing of silk yarns. Its use is gradually decreasing, as new and improved machines that perform the same operations at a lower cost and with better results are employed at the present time. For this reason, many of the spinner-doublers that were in use some years ago have been converted into single-process machines and are now employed in that capacity. As the name implies, the spinner-doubler is a combination of a first-time machine, or spinner, and a doubler, and it performs these operations simultaneously. From this it is evident that the machine is essentially an organzine machine, as the operations that have been named are always performed in this order when preparing organzine.

The spinner-doubler is very similar to throwing machinery previously described. It has the customary end stands, but they are slightly wider than on the usual spinner or twister. The end stands are held together by pipe ties and support the moving and stationary parts of the machine. The wider construction is necessary because four rows of spindles are located on this machine instead of two. The head end stand supports the vertical shaft on which the tight and loose driving pulleys are mounted. Brackets extending from this end stand carry two idler pulleys that change the direction of the belt so that it may pass around the drive pulleys arranged with their faces vertical. The motion the drive pulleys receive is transmitted upwards through the vertical shaft and imparted to the twist change gears located at the head end of the frame. These gears are arranged to drive both take-up shafts at the same speed, and any variation in speed to change the twist per inch is controlled by different groupings of the twist change gears.

26. Besides imparting motion to the take-up shafts, the vertical shaft imparts motion to the spindles by means of a spindle-belt drive that differs from any that have been described. Fig. 4 shows the arrangement of the spindle drive belts and the method of driving the spindles. The vertical shaft *a*, on which the wide-faced spindle drive pulley *b* is mounted, receives its motion from a line shaft. The machine is equipped with two spindle belts, the upper belt *c* running on one side of the machine and the lower belt c_1 on the opposite side. The spindle belts are guided by a wide-faced idler *d* mounted on a fixed stud near the vertical shaft. The idler causes the upper belt *c* to pass along the inner side of the frame, thence around the movable idler *e*, and back on the outer side of the machine to the drive pulley *b*. The lower belt c_1 passes along the outside of the frame, thence around the movable idler e_1 and back on the inner side of the frame where it is guided over the idler *d* to the drive pulley *b*. Each of the movable idlers *e* and e_1 is fitted with a spring and lever that automatically takes up the slack and retains the belt at a suitable running tension.

27. The spindles *f*, Fig. 4, attached to the spindle rails, are of the swing type and are held against the spindle belt with sufficient pressure to prevent slippage. They are arranged in pairs, so that the thread from the bobbin on the inner spindle and the thread from the bobbin on the outer spindle are wound on the same take-up bobbin at the same time. By locating the spindle belts at different levels, as shown, the spindles f_1 on one

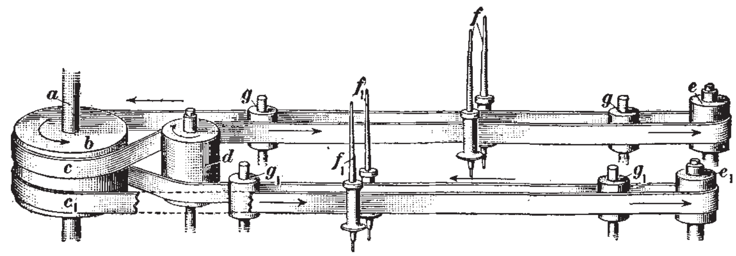


FIG. 4

side of the frame are 2 inches lower than the spindles f on the opposite side. In order to retain the spindle driving belt in the proper position to drive the spindles, fixed idlers are distributed along the spindle belt. The belt c is prevented from sagging by the idlers g, while the belt c_1 is supported by the idlers g_1.

28. Operation of Spinner-Doubler.—Thread that is to be processed on a spinner-doubler, is prepared on an ordinary winding frame. The silk, when delivered to the spinner-doubler, is wound on taper-hole spinner bobbins in the correct manner to permit the insertion of a left hand twist in the thread. As the operation is started, the end of silk on the bobbin of the inner row and the end on the bobbin of the outer row are found and led upwards to the individual guides or drag wires. From the drag wires the silk is led upwards in individual strands and passes over a plush cushion or pad, also known as a plush board, located at this position to give the desired tension to the thread. Passing upwards the ends are slipped through the respective porcelain eyes attached to the drop wires, and then both threads passing over the same guide on the traverse bar are wound on the take-up bobbin. The take-up bobbin that is employed on this machine should have a tapered hole, since the full bobbins are transferred to the second-time spinner where the opposite twist is inserted in the thread.

29. The drop wires are a part of the stop-motion necessary on a machine of this type, delivering as its product a ply thread. The drop wires and related parts of the stop-motion should be inspected from time to time and kept in perfect working order so that the product of the machine will always contain the desired number of threads. Sometimes one end breaks while the spindles are in operation and the drop wire that it supported, fails to fall backwards. The stop-motion, of course, fails to operate and the bobbin continues to take up only one thread. This is known as a *single*. If on the other hand, one end breaks and the stop-motion does function properly, the take-up bobbin will be lifted from contact with the take-up roll and prevent continued winding of a single. The spindles, however, are not stopped, but continue to revolve, resulting in the twisting of the intact end until it also breaks. Both ends must then be located on the take-up bobbin and pulled back until the operative is positive that the doubled ends are found as they were first wound on the take-up bobbin. If this it not done, *short singles* are likely to be produced. Short singles are produced when one end has several turns on the take-up bobbin in excess of the other end and the ends are tied, while in this condition, to the ends brought upwards from the bobbins on the spindle. It is evident that this end will break in second-time spinning; for, when it is being drawn from the bobbin, it will reach a point where the single ends cross or are looped, resulting in a break.

30. Another operation that requires great care and exactness is the adjustment of the tension of the threads. This adjustment is made by changing the position of the plush pad over which the single threads pass. If it is desired to reduce the tension on a thread, the plush pad is lowered. Care must be taken in this operation, for it should always be remembered that the tension on a thread that is being drawn from a full bobbin is less than the tension on a thread that is being drawn from a bobbin that is nearly empty. Hence should a full bobbin and one that is nearly empty be on the spindles, and the threads be wound on the same take-up bobbin, the drop wire through which the thread from the full bobbin is passing is likely to fall backwards under the light tension and cause the take-up bobbin to stop. When the take-up bobbin ceases to revolve and wind the thread, the threads passing from the bobbins on the spindles to the take-up bobbin are still intact, as the stopping of the latter resulted from the release of the drop wire caused by the light tension on the thread. Hence the revolving spindles would continue to twist the threads, finally resulting in the breakage of the singles because of the high twist.

31. Uneven tension on the single ends is detrimental to the production of good work. Should two ends be wound on a bobbin under unequal tension, so that one end is considerably tighter than the other, the one thread, naturally, will be stretched. After this thread is given the second-time twisting, then reeled, and steamed, the contraction of both threads will not be the same, thus resulting in a cockled or corkscrew thread.

It is very important, in the operation of the spinner-doubler to have the idlers exactly plumb, especially the movable idlers around which the spindle belts pass. If they are not plumb, considerable difficulty will be encountered with the spindle belts, for it will be difficult to keep them running smoothly and steadily. Should the idler e or e_1, Fig. 4, be inclined away from the machine, its position would cause the belt to jump; that is, it would rise and fall on the idler, or even jump off the idler if the angle of inclination were sufficient. Conversely, should the idler be inclined toward the machine, the belt would have a tendency to be guided toward the bottom of the idler.

In addition to keeping the idlers plumb, the tension of the spindle belts should be noted and adjusted so that each belt will have, approximately, the same tension. The tension is increased by turning a wing nut, which, moving on a threaded rod attached to the coil spring, increases the length of the spring and also the tension. By the lever arrangement previously described, the pressure on the idler is increased and the belt tightened.

THREE-PROCESS MACHINES

32. Type of Machine.—Among the various combination machines used in silk throwing mills is a three-process machine performing the operations of spinning, doubling, and twisting. Because of the number and sequence of operations, the machine is essentially an organzine machine, for that type of thread is subjected to these operations, in the order named. Before the advent of combination machines, threads in this class of yarn were subjected to the operations referred to on single-process machines, thus requiring more time and a greater number of operations in their preparation. While the product from the single-process machine was satisfactory, an improved machine that would effect a saving in labor was desired. Therefore, the three-process machine was developed and is now used to a large extent for throwing organzine in one operation.

33. When preparing yarns on combination machines of the three-process type, silk of high quality must be employed in order that the production may be high. With a good grade of silk that has been carefully wound, the machine will operate with little trouble and a minimum amount of care. Breakage of ends will occur at times, even on the best grades of silk; however, the poorer grades are more troublesome in this respect and so should be avoided on the spinner-doubler-twister, if possible. Increased breakage of the thread on this type of machine increases the percentage of stoppage a considerable amount, which may be illustrated by comparing the single-process and the three-process machines. In the former, when an end breaks, only one process is affected according to the stage of manufacture of the thread. Thus, should the thread be on the spinner, the doubler, or the twister, only one operation will be affected. When preparing the yarn on a combination machine, however, the breakage of a thread during any one of the three operations will cause the remaining two to become inoperative. Thus, should a thread break while the group of ends is passing over the feed-rolls, the first-time and second-time operations will be affected.

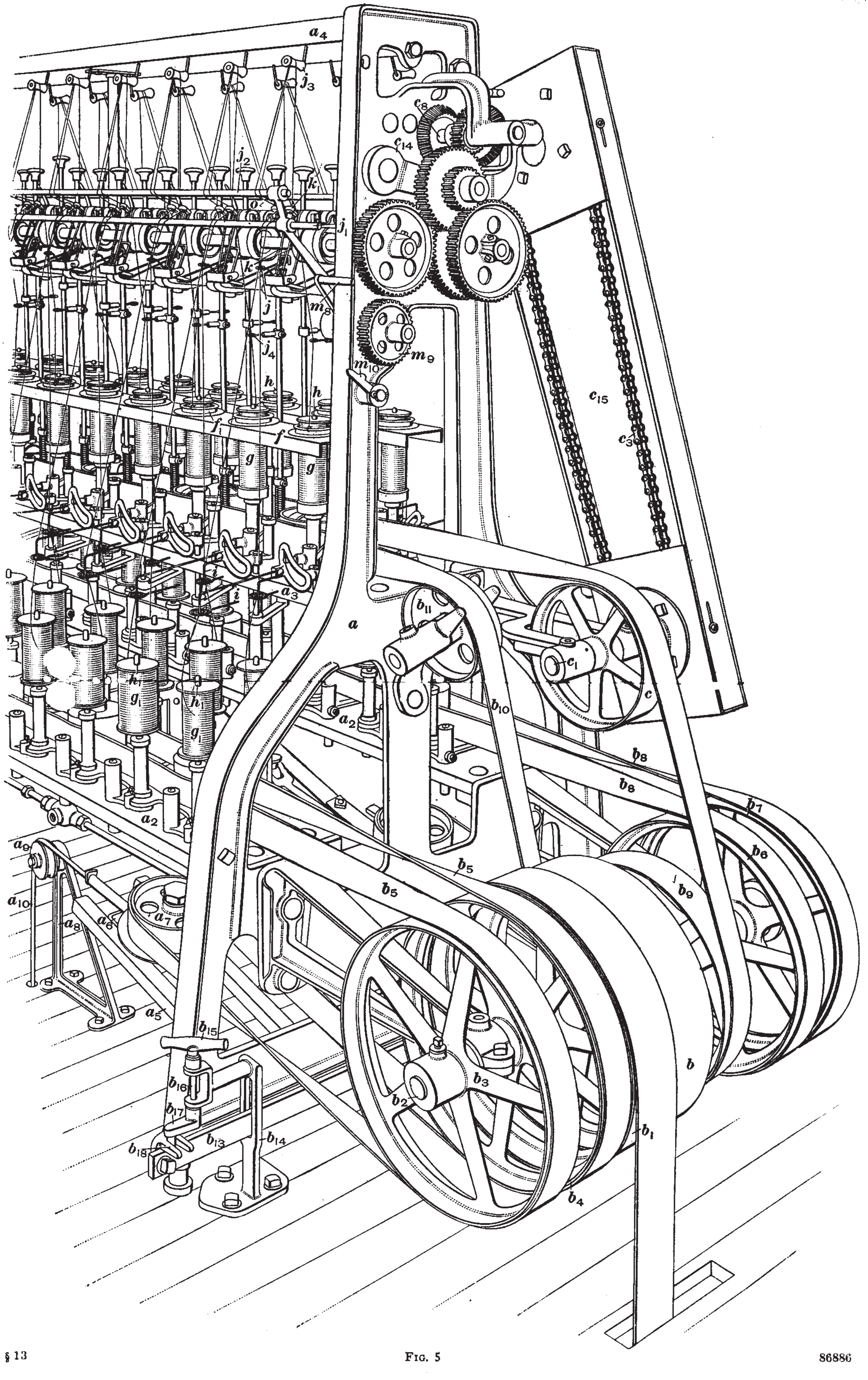
After the breakage of an end the spindle is again brought into action by tying the ends and starting in the proper manner. In tying the ends, however, the operative must be very skilful; for on a machine of this type, three operations must be considered instead of only one. The threads must be found on one set of bobbins, then threaded through the various guides and tied to the end on the take-up bobbin. Furthermore, starting the spindle so that the thread will properly wind on the bobbin without breaking requires considerable skill and experience, and must be done with extreme care.

34. Comparison of Results of Single-Process and Three-Process Methods.—There are certain advantages of three-process machines that are important and worthy of consideration. In the first place, the production of corkscrew threads is greatly reduced because of the method of doubling and feeding or delivering the spun threads to the take-up bobbin. As the thread is drawn from the spinner bobbins and then doubled it is immediately led to the take-up bobbin and twisted under a uniform tension. The uniformity of tension is assured by wrapping the several threads that compose the ply thread around the same feed-rolls. Hence, they are drawn from the first-time bobbin and delivered to the second-time bobbin at the same speed and under the same tension and the production of corkscrew threads is practically eliminated from this source.

In addition, organzine prepared on this machine generally requires no steaming in order to set the twist after the twisted thread has been wound on the reel fly, preparatory to making the skeins, probably because the threads pass through the three operations of spinning, doubling, and twisting without any delays, under uniform tension, and so on, all of which have a direct influence on the smoothness of the finished thread.

35. As is to be expected, the three-process machine has a number of disadvantages. One that must be contended with is the question of labor and the difficulty of obtaining efficient operatives for the machine. It requires a greater amount of skill to operate a three-process machine efficiently than one of the single-process type. An operative of a three-process machine must find and tie up the ends from three bobbins and do this at a sufficient speed so that other broken ends may be properly attended to. The operation of tying the ends, also, must be performed with speed and dexterity; otherwise, the rapidly revolving bobbins will increase the twist of the thread that is drawn from the first-time bobbin until it is twisted hard. This, of course, should be avoided as much as possible, as it alters the uniformity of the twist of the yarn. To prevent this, the silk is gradually drawn, by hand, from the spinning bobbin at the same speed as the feed-rolls would draw it upwards. The end is then quickly tied, and the spindle is started. In this manner the thread is not held stationary long enough to allow an appreciable amount of twist to be added to the thread.

36. Principal Parts.—A perspective view of a three-process combination machine, or a spinner-doubler-twister, is given in Fig. 5. The head stand *a* and a similar end stand at the foot of the machine, support the parts of the machine. The head stand carries the driving mechanism, consisting principally of the tight and loose driving pulleys *b* and b_1 on the crosshead shaft b_2. The crosshead shaft is supported in hangers bolted to the head stand. The motion imparted to the tight pulley is transmitted by another pulley b_9 on the crosshead shaft to the pulley *c*. The latter, located directly above the crosshead shaft, is fastened to a short shaft c_1 that is held in a hanger bolted to the head stand. The motion given to the shaft c_1 is transmitted by the chain c_3 and gears to the bevel-gear shaft c_8 and thence to the various parts of the machine. Motion from the bevel-gear shaft is indirectly transmitted to the cam *e*, located near the foot end of the machine, and the turning of the cam causes an up-and-down motion to be given to the ring rail *f*. Since the ring rail carries the rings f_1, the latter will move with the rail and guide the thread on the bobbins *g* on the spindles *h*. The bobbins *g* and the spindles *h* are known as the second-time bobbins and spindles, while the bobbins g_1 and the spindles h_1 are known as the first-time bobbins and spindles.



§ 13 Fig. 5 86886

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37. Method of Operation.—The principles of operation of a spinner-doubler-twister are similar to those of the machines that have been described. The passage of the thread from the supply bobbins to the take-up bobbins on the three-process machine is similar to that on a single-process up-spinner or on a two-process down-spinner, or doubler-spinner. When the machine is in operation, the motion imparted to the crosshead shaft is distributed to the various parts of the machine, causing the first-time and second-time spindles, feed-rolls, and ring rails to function in the proper manner. The supply bobbins g_1, Fig. 5, on the rapidly revolving first-time spindles h_1 spin the thread as it is drawn upwards, which constitutes the first-time spinning. The spindles are grouped in pairs, which are arranged in that order so that a thread may be drawn from each bobbin composing the singles of the 2-thread organzine. In their upward passage the single ends are wrapped around individual tension wires i of practically the same design as those employed for the first-time spinning on an ordinary up-spinner. On leaving the tension wires i, the threads are guided through the wire eye j over the tension bar j_1, through the porcelain eye k_1 attached to the drop wires k, thence over the tension bar j_2 and around the porcelain roller j_3 attached to the bobbin shelf a_4.

38. The passage of the thread from the supply bobbins and upwards through the tension wires to the porcelain roller j_3, Fig. 5, is as single ends. From the roller guide the threads are grouped as one and are subsequently considered as a doubled thread. The doubled thread, passing from the roller guide j_3, is led downwards to the feed-rolls o, around which the untwisted ply thread is wrapped several times. The revolution of the rolls draws the threads from the rapidly revolving first-time bobbins and delivers it to the second-time bobbins, which are the take-up bobbins. On leaving the feed-rolls the doubled thread is directed through a centering eye j_4 located directly above the bobbin. Thence the doubled end is passed under a traveler supported on a spinning ring and is wound on the revolving take-up bobbin.

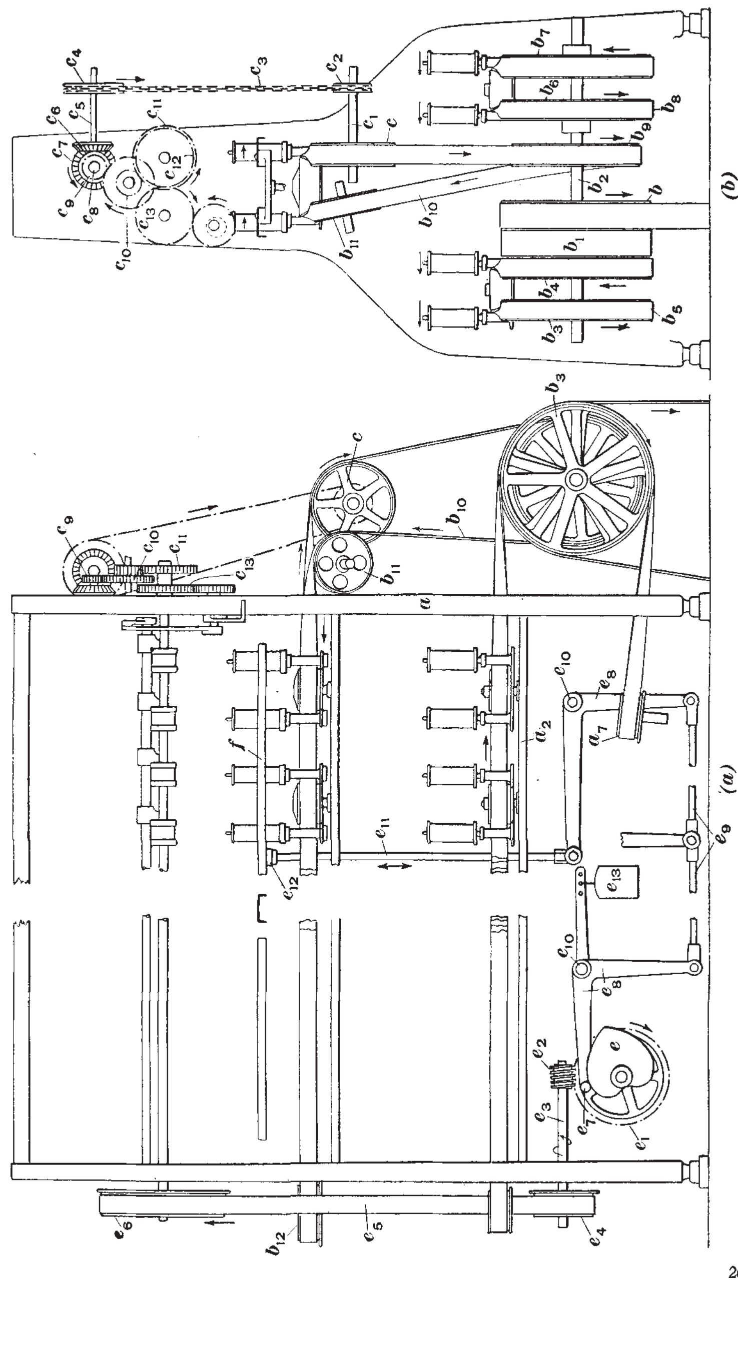


Fig. 6

39 Crosshead-Shaft Drive.—Two views of the crosshead-shaft driving mechanism are shown in Fig. 6, (*a*) being a side elevation and (*b*) an end view showing the various driving pulleys. The main driving belt, carried on the tight pulley b, passes through the floor and is driven from a line shaft below the floor. Adjoining the loose pulley b_1 on the crosshead shaft b_2 are the spindle-belt pulleys b_3 and b_4 that drive the first-time spindles on one side of the machine. Of these pulleys, b_3 is considered the tight pulley and b_4 is the corresponding loose pulley. The spindles are driven by contact with the spindle belt b_5, which extends the length of the machine. It drives the inner row of spindles, passes around the stationary idler at the foot end of the machine, and returns to the crosshead shaft, driving the outer row of spindles. After passing around the tight pulley b_3 it is guided under the machine to the movable idler a_7. Another pair of spindle-belt driving pulleys are located on the opposite end of the crosshead shaft. They are the tight spindle-belt pulley b_6 and the loose spindle-belt pulley b_7, which drive the spindle belt b_8.

40. Since the spindle belts drive the first-time spindles on both sides of the machine in the same manner, similar spindle-belt take-up mechanisms are provided in order that the same tension may be given to both belts. An inclined track a_5, Fig. 5, is securely attached to the end-stand a and extends towards the opposite end of the frame. An iron carriage or spider a_6 so constructed that it may freely slide on the track holds a pin that acts as the bearing for the idler a_7 around which the spindle belt passes. A stationary upright stand a_8, rigidly attached to the floor by lag screws, supports a small pulley a_9, over which passes a rope a_{10} that is attached to the carriage a_6. A heavy weight suspended from the other end of the rope, below the floor, exerts a constant pull on the carriage and idler, thus maintaining an even tension on the belt. Sometimes a heavy coil spring is used, instead of the rope and weight, to put tension on the belt. One end of a short iron rod with hooked ends is attached to the carriage and the coil spring is hooked to the other end. The opposite end of the coil spring is then attached to a support of the machine, or to a threaded rod passing through a middle stand. This construction allows quick adjustment of the tension.

41. Both of the foregoing methods of applying tension to the spindle belt are employed, but the latter is the more desirable. If the machines are located on the first floor of the mill, so that the weight suspended from the end of the rope hangs in an unused portion of the basement, the type of take-up shown in Fig. 5 may be used. But when the machines are situated so that the falling of a suspended weight is liable to cause injury to operatives, or damage to machinery located underneath, a spring take-up should be employed. The parting of the rope a_{10} and consequently the falling of the weight may result if the rope becomes chafed, naturally causing a weak place in the rope and resulting in its breakage. Moreover, should it be desired to rearrange the machines at some future time, it will be necessary to bore new holes in the floor to allow for the passage of the rope. With a spring take-up, no trouble of this nature would be encountered, for the entire machine could be shifted as a unit. With the type shown, increasing the tension of the spindle belt requires either a larger weight or additional weights. If, on the contrary, a spring take-up is employed, it is only necessary to tighten the nut on the threaded rod, thus lengthening the coil spring and increasing the tension of the belt.

42. Besides transmitting motion to the first-time spindles, the crosshead shaft b_2, Fig. 6 (b), carries a pulley b_9 around which passes the spindle belt b_{10} that drives the second-time spindles. The spindle belt b_{10}, on leaving the face of the driving pulley b_9 passes upwards and is guided at approximately a right angle by the idler b_{11}, which changes the plane of the belt. After traversing the length of the machine, the spindle belt passes around the movable idler b_{12} at the foot stand and returns on the opposite side of the machine to the head stand. At this point it is guided downwards toward the driving pulley b_9 by passing over the pulley c. The pulley c not only guides the second-time spindle belt but also transmits motion to other parts of the machine. The tension of the second-time spindle belt is properly maintained at the foot end of the machine by a take-up device.

43. Variation in Crosshead-Shaft Construction.—The construction of the crosshead-shaft driving mechanism is not the same on all spinner-doubler-twisters. For example, the machine shown in Figs. 5 and 6 is equipped with tight and loose pulleys 12 inches in diameter. On the machine equipped with the driving arrangement of which the crosshead shaft and pulleys are illustrated in Fig. 7, several differences may be noted. The main driving pulleys b and b_1 on the crosshead shaft b_2 are of

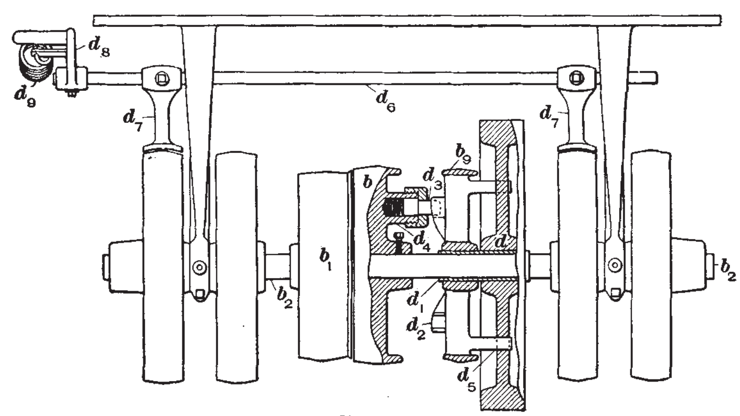


FIG. 7

smaller diameter, the diameter of the tight pulley b being 10 inches and of the loose pulley b_1, $9\frac{1}{2}$ inches. The purpose of making the loose pulley slightly smaller than the tight pulley is to decrease the tension of the belt when it is running on the loose pulley, and, therefore, reduce the strain on the loose pulley bearing. This construction is especially desirable in mills in which the belt is allowed to run on the loose pulley for considerable periods of time. Also, the drive belt is maintained in better condition, as the tension is removed when the frame is at rest. To permit the drive belt to easily be shipped from the smaller to the larger pulley, the edge of the loose pulley b_1 adjoining the tight pulley has a $\frac{1}{4}$-inch bevel.

44. The crosshead shaft b_2, Fig. 7, carries a balance wheel d and a special second-time pulley b_9. The balance wheel, or flywheel, d has a very heavy rim, so that it will retain its momentum a short time after the frame has stopped. It is mounted on a bushing d_1 that also carries the second-time pulley b_9, which has a series of teeth d_2 protruding from its side. These teeth are slanted, so that the spring pin d_3 in the housing d_4 forming a part of the tight pulley b may act upon them. The pulley b_9 has two lugs d_5 that come in contact with a part of the balance wheel and cause it to be turned with the second-time pulley b_9. When motion is imparted to the tight pulley b, the spring pin d_3, probably in contact with the slanting part of a tooth, will be moved and strike the vertical side of a tooth and cause the pulley b_9 to revolve with it. Similarly, the lugs d_5 will cause the balance wheel to revolve. Therefore, the balance wheel, the second-time pulley, and the crosshead shaft will revolve together at the same speed.

45. Should the driving belt be shipped to the loose pulley b_1, Fig. 7, in order to stop the frame, the first-time spindles would soon stop their rotation in a natural manner; however, since the balance wheel has stored up a sufficient amount of energy while in motion, it will continue to revolve, losing its speed gradually. Its continued revolution is possible because the ratchet teeth d_2 are inclined, so that the spring pin is depressed and slides over them, accompanied by a clicking sound. Naturally the second-time spindles will continue to revolve, taking up the silk after the first-time spindles have stopped their revolution. Therefore, the object of the balance wheel is to take up the slack thread between the first-time and second-time bobbins and prevent the formation of kinks or snarls in the thread while the machine is stopping. The period elapsing between the stopping of both sets of spindles varies from 8 to 12 seconds. It is evident that if a heavy balance wheel is employed, this period will be increased, whereas a lighter wheel will reduce the interval. To insure that the period elapsing between the stopping of both sets of spindles is not too short, a brake is usually employed in conjunction with a machine equipped with a balance wheel. By means of the brake, the first-time spindles are quickly stopped while the balance wheel continues to revolve and loses its motion somewhat slower; hence, the thread will be taken up on the second-time bobbins after those on the first-time spindles have stopped. In this way the formation of kinks and snarls will be prevented as the thread is kept under a slight tension.

46. A brake mechanism employed to hasten the stoppage of the first-time spindles is constructed as follows: A shaft d_6, Fig. 7, passing through the brackets that support the crosshead shaft has fastened to it two short brake arms d_7 that are in line with the faces of the first-time spindle-belt driving pulleys. At one end of the shaft d_6 is a handle d_8 extending about 10 inches away from the shaft and at right angles to it. A strong extension spring d_9 is attached to the handle and to the frame and holds the handle firmly against the end stands while the machine is running. The handle is swung away from the machine in order to bring the brake arms in contact with the spindle-belt pulleys. When the handle has been swung beyond the vertical position, the spring will hold the brake arms in contact with the first-time spindle-belt pulleys with the correct pressure. The braking surfaces of the brake arms are faced with leather.

47. Individual Motor Drive.—The spinner-doubler-twister is also driven by individual motors, thus eliminating driving belts, belt shippers, and line shafts. The usual motor drive consists of three individual motors mounted directly to the head stand of the machine. Hence it is necessary to remove the crosshead shaft and brackets from the frame in order that the motors driving the first-time spindle belts may be correctly adjusted. The motors driving these belts are arranged with the driving shafts in a vertical position and carrying small driving pulleys at their ends. Each spindle belt is driven directly by means of the pulley, the belt passing around it without any quarter-turns or sharp bends, thus effecting a saving in power and reducing the number of parts. Moreover, the initial cost of belts will be less, as shorter spindle belts are employed; for, with an installation of this type, the belt does not pass under the machine to a movable idler as when a crosshead shaft is used, but is driven directly from the motor pulley.

48. The motor employed to drive the second-time spindles is located in the center of the end stand and above the two motors that drive the first-time spindles. It has a long shaft that extends from both ends of the motor housing and the upper end carries a small bevel gear. The lower end carries a small driving pulley and a flywheel that acts in the same manner as the flywheel on the crosshead shaft in Fig. 7. The second-time spindle belt passes around the small driving pulley on the lower end of the shaft and drives the spindles.

The small bevel gear on the end of the motor shaft meshes with a larger bevel gear on one feed-roll shaft of the machine. Thus, when the frame is in motion, the motor drives the second-time spindles and also the feed-rolls at the proper speed to cause the insertion of the correct amount of twist. Since the second-time spindles and feed-rolls are driven by the same motor, the relative speeds of these parts will always remain the same, provided that no gears are changed, and a uniform twist in the second-time operation will be assured.

49. A frame with an individual motor drive is started very easily. The flow of electric current to the three motors is governed by a single switch, so that, when the control handle is thrown to the on position, the motors will start simultaneously. The starting mechanism consists of a make-and-break switch fitted with an automatic throw-out device that is brought into action when the voltage of the current delivered to the motors drops below a certain minimum. The switch is also arranged so that the throw-out device will operate when the load is too great, thus automatically breaking the circuit, and protecting the motors from injury.

The machine is stopped by shifting the control handle of the starting switch, to the off position, which breaks the electrical circuit. However, the two motors driving the first-time spindles stop in a short time, while the motor driving the second-time spindles continues to revolve from 8 to 12 seconds longer because of the momentum of the flywheel. In this way the formation of the kinks is prevented.

50. Bevel-Gear Shaft.—The motion of the various gears on the head stand *a*, Fig. 5, is derived from the pulley *c*, which is driven by contact with the second-time spindle belt b_{10}. This pulley is fastened to a short shaft c_1 that turns in a hanger bolted to the end stand. As shown in Fig. 6 (*b*), the shaft c_1 supports a sprocket c_2 at its other end, and imparts motion by means of the chain c_3 to the upper sprocket c_4. The upper sprocket c_4 is fastened to the shaft c_5 which is supported in a hanger attached to the end stand. This hanger retains the bevel gear c_6 in mesh with a similar bevel gear c_7 on the bevel-gear shaft c_8. The rotation of the gear c_7 turns the bevel-gear shaft and also the spur gear c_9 mounted on the shaft, as may be seen by referring to (*a*) and (*b*). The spur gear c_9 meshes with the larger gear of the compound gear c_{10} while the smaller gear of the compound meshes with a spur gear c_{11} on one feed-roll shaft. This feed-roll shaft carries a gear c_{12} that meshes with a gear c_{13} of the same size on the other feed-roll shaft, and thus motion is given to the second feed-roll shaft.

51. Of the gears that have just been described, the gear c_9, Fig. 6, and the gear c_{11} are the change gears, which are altered when twist changes are to be made. The compound gear c_{10} is mounted on an adjustable stud held in a casting c_{14}, Fig. 5, bolted to the end stand. The chain guard c_{15}, shown in place, serves to protect the operative from being caught in the sprocket and chain, and also prevents the chain from catching waste silk. The guard acts as a shield to prevent lubricant thrown from the chain while in rapid motion from coming in contact with silk or other objects. The guard may be removed when the chain is to be cleaned and lubricated. Sometimes that part of the guard surrounding the sprocket is circular in shape and made in two halves so that the outer half may easily be removed. This is necessary when it is desired to examine or inspect the sprockets. The inner half of the guard is firmly supported by the machine.

52. Cam and Ring Rail.—While being wound on the second-time bobbins, the thread is properly distributed between the heads by the motion, transmitted to the ring rail *f*, Fig. 5. The traverse mechanism on this machine is identical with that on the doubler-spinner described in the preceding Section, and so a detailed description here is unnecessary. The cam of these traverse motions is sometimes provided with an automatic oiler that keeps the bearing surface of the cam lubricated at all times. The body of the oiler is located directly under the cam and contains an ample supply of oil. Extending through the top of the body is a spring supporting a wick that rests in the oil container, while its upper end is at such a height as to come in contact with the high part of the cam. The oil absorbed by the wick travels upwards, and at each revolution of the cam the high part strikes the wick. Lubricant is thus deposited on that part of the cam, and the cam roller spreads the lubricant over the entire bearing surface of the cam.

Sometimes an oil well is located under the worm so that it turns in an oil bath. The oil that it carries is lifted and is deposited on the worm-gear, thus lubricating these parts.

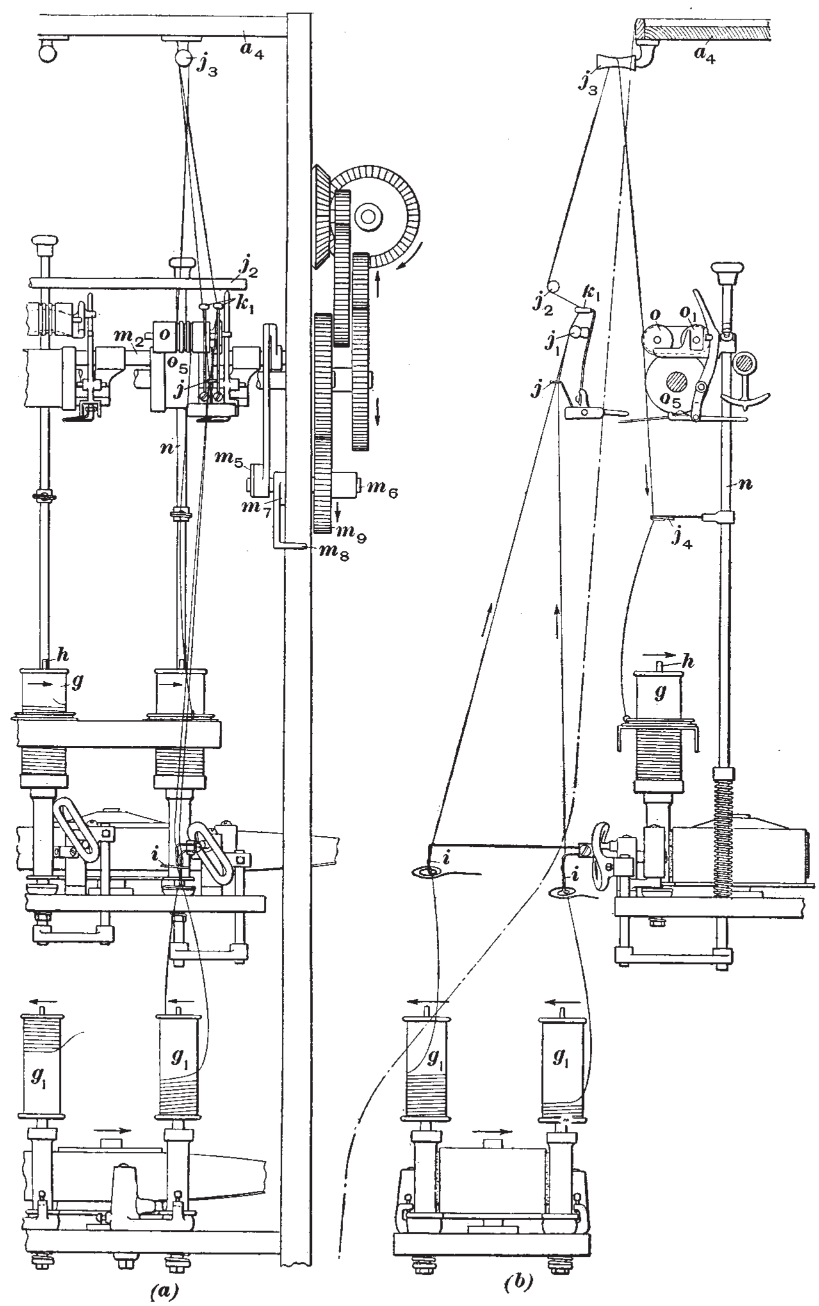
53. Rings and Travelers.—The selection of rings and travelers for the spinner-doubler-twister is governed by practically the same factors as in the selection of rings and travelers for the doubler-spinners, because the method of inserting the twist is the same on both machines. Of the various sizes of rings that are employed on the three-process machine probably the best results are obtained by using rings from $1\frac{13}{16}$ to $2\frac{1}{4}$ inches in diameter. These rings usually have No. 1 flanges, which are about $\frac{4}{32}$ inch in width. Since the product of this machine is 2-thread organzine, changing the weight of the traveler is seldom necessary, for the silk employed is of a standard size and the weight of the finished thread is constant, more or less. Of the various travelers, a No. 15–0 is probably used most frequently, with a variation of a few sizes heavier or lighter, as may be deemed necessary.

54. Spindles and Bobbins.—The first-time spindles h_1, Fig. 5, on the first-time spindle rail a_2 are of the customary swing type. They are so placed that the compression spring and nut extend through an oval or elliptical slot in the spindle rail. The slot is designed with the point of attachment of the rail step as the center, so that when the spindle is pulled away from the spindle belt it will move in the slot. The spindles are equipped with regular tapered spindle blades. The second-time spindles *h* are located on the second-time spindle rail a_3 and are of the rigid type, but adjustments may be made by shifting the eccentric spindle holder that supports the spindle. The construction is identical with the method of supporting the spindles on the doubler-spinner, and detailed description is unnecessary.

55. Sometimes, instead of rigid second-time spindles, swing spindles are used. This type of spindle is mounted on the second-time rail in the same way as the swing-type spindle on the doubler-spinner. With either rigid or swing spindles, the second-time spindles are always equipped with straight spindles and two small pins in the top of the whorl to engage with the bobbin.

The bobbins are identical in size, shape, and construction with those previously described. The bobbins on the first-time spindles are ordinary taper-hole, fiber-head, organzine winder bobbins that are delivered from the winding frame. Similarly, the bobbins on the second-time spindles are identical in construction with those on the doubler-spinner, being constructed with a straight hole. The barrels and heads of the second-time bobbins are frequently of smaller diameter than on the bobbins regularly employed on the doubler-spinner. The diameter of the upper head is usually $1\frac{5}{8}$ inches, the diameter of the bottom head $1\frac{11}{16}$ inches, and the diameter of the barrel $\frac{7}{8}$ inch; the length of traverse is approximately 4 inches.

56. Stop-Motion.—A general view of the stop-motion of the spinner-doubler-twister is given in Fig. 8. In (*a*) is a side view showing the relative position of the various parts, while (*b*) is an end view. In Fig. 9 the details of the stop-motion assembly are clearly shown; (*a*) is a detailed end view of the entire stop-motion mechanism; (*b*) is a front view of


a4
j3
j2
k1
m2
o
o5
j
n
m5
m6
m7
m9
m8
h
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g1
g1
(a)
a4
j3
j2
k1
o
o1
j1
j
o5
n
j4
h
g
i
i
g1
g1
(b)

Fig. 8

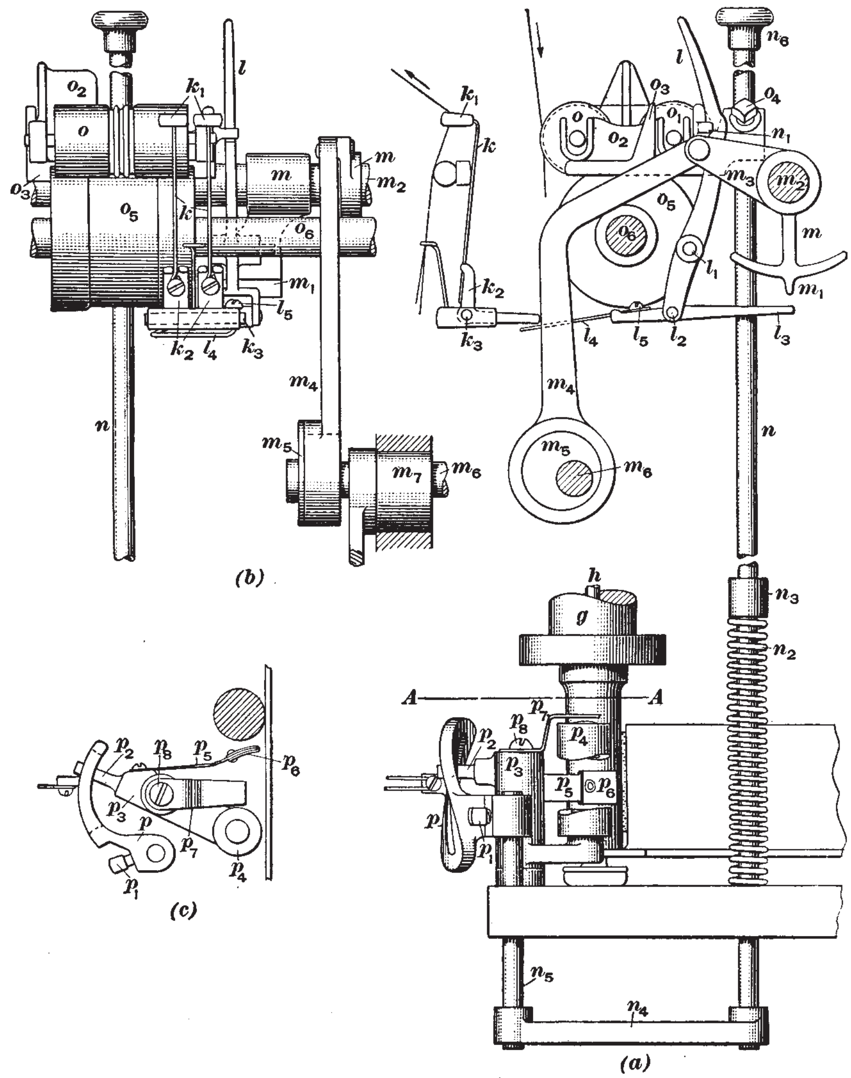

FIG. 9

the feed-rolls and drop-wire assembly; and (*c*) is a section on *A-A* in view (*a*).

Since the principles of operation and general construction of the parts of the stop-motion on the spinner-doubler-twister are similar to those of the doubler-spinner stop-motion, a detailed description will not be given here.

57. Although the general construction is similar, several slight variations may be pointed out. The thread as it leaves the first-time bobbin g_1, Fig. 8, is wrapped around individual tension wires i in order to give it the required tension in the first-time operation. On leaving the tension wire it passes through the eye j, over the bar j_1, then through the drop wire eyes k_1, over another bar j_2, and upwards over the roller j_3 attached to the bobbin shelf a_4. Sometimes an enameled wire hook is substituted in place of the porcelain roll j_3. This hook is of the pigtail variety, of such form that the thread may be easily dropped into place. From the roller guide j_3 the thread passes to the feed-rolls o and o_1 The feed-rolls are of the grooved type, having three grooves cut in their surfaces. In addition, they are friction driven; that is, they rest on the driving drum o_5 and are driven by frictional contact only. Besides this type of roll drive, however, positively driven, or geared, feed-rolls are also employed.

On leaving the feed-rolls, the thread is guided downwards through the wire centering eye j_4 and thence to the second-time bobbin g. The spindle h that carries the bobbin, as previously described, is similar to the spindle employed on the doubler-spinner. The method of stopping the spindle after an end breaks is similar to that previously explained. While the spinner-doubler-twister being described has rigid spindles, swing spindles are also provided. When the latter type is used, the spindle is moved away from the belt when an end breaks. Its movement is intercepted by a small brake that prevents the spindle from swinging too far and also stops its revolution, preventing hard twist.

58. In the operation of the stop-motion, it may be added that the method of starting and stopping the rocker-arm shaft m_2, Fig. 8 (a), is identical with the method employed on the doubler-spinner. For example, before stopping the frame, the eccentric shipper latch m_{10}, Fig. 5, is lifted, whereupon the eccentric shipper m_8, Figs. 5 and 8 (a), may be raised, thus disengaging the gear m_9 from its driving gear on the feed-roll shaft. The eccentric m_5 is carried on the eccentric shaft m_6, which, in turn, rotates in the eccentric bushing m_7. When starting the machine, these operations are reversed. In Fig. 5, the eccentric shipper m_8 is raised, disengaging the gears; hence, it is the off position. In Fig. 8 (a) the position is reversed; that is, the eccentric shipper m_8 is lowered, causing the gear m_9 to engage with its driving gear, and so this is considered the running position.

59. Relation Between First-Time and Second-Time Twists. In the single-process method of throwing, the first-time operation in which the single thread is spun, or twisted, is called first-time spinning, or simply spinning. The second-time operation of twisting the spun threads in an opposite direction to that given in the first-time spinning is called second-time spinning, or twisting. These are the operations that occur on a three-process machine, also, and since the product of spinning is delivered directly to twisting, the speed of the feed-rolls is very important. Ordinarily, when the thread is drawn from a bobbin on a revolving spindle and wound on a take-up bobbin that is driven by a feed, or take-up, roll, an alteration in the speed of the feed-roll will cause an alteration in the twist being inserted in the thread. If the thread is drawn by feed-rolls and then delivered to a take-up bobbin on a revolving spindle the twist will also vary when the speed of the feed-rolls is altered. On the three-process machine one set of feed-rolls draws the threads from the revolving first-time bobbins and delivers them to the revolving second-time bobbin; hence, should the speed of the feed-rolls be changed, the thread would be taken up from the first-time bobbins and delivered to the second-time bobbin at a proportionate speed so that the twist per inch in both operations will be increased or decreased as the case may be. Therefore, if the spindle speed remains constant, increasing the speed of the feed-rolls will cause the twist per inch in both the first-time and second-time operations to be decreased. Conversely, should the speed of the feed-rolls be decreased, the twist per inch inserted in the first-time and second-time operations will be increased.

60. Suppose, for example, that the twist change gears on the end stand are grouped so as to insert 16 turns in the first-time spinning and other adjustments are made to cause 14 turns in the second-time spinning. The speed at which the feed-rolls revolve will then cause the thread to be drawn from the first-time bobbins at the correct speed so that 16 turns will be inserted, while the silk will be delivered to the second-time bobbins and 14 turns will be inserted as the thread winds on them. If it is desired to insert approximately 18 turns in the first-time and 16 turns in the second-time spinning, a twist gear must be changed to alter the speed of the feed-rolls. The change of twist, in this case, is only to insert more twist in both operations, and as the difference between the two twists is proportionate it is only necessary to insert a twist gear that will decrease the speed of the feed-rolls to the correct value. Even though this change is made, and the feed-rolls revolve slower, the ratio between the first-time and second-time twists will remain the same.

In both instances, in the preceding paragraph, the speed of all the spindles remains constant. However, as is to be expected, the first-time spindles must be operated at a somewhat higher speed than the second-time spindles, in order to insert the excess twist of the spinning operation. The speed of the first-time spindles on 16/14 turns organzine is approximately 12 to 14 per cent. higher than the speed of the second-time spindles. Hence, with the spindle speed constant, any alterations to the speed of the feed-rolls will alter the twist per inch in both first-time and second-time spinning.

61. Sometimes, although not frequently, it may be desired to change the difference in the number of turns of twist between the first-time and second-time operations. For example, 21 turns may be desired in the first-time spinning, instead of inserting 16 turns, and 14 turns in the second-time spinning. Since, in this case the change in twist is only in the first-time operation, it is unnecessary to alter the speed of the feed-rolls by substituting another twist change gear. It is required to change the speed of the second-time spindles only. The speed of the latter and consequently that of the feed-rolls is reduced so that the first-time spindles will revolve a sufficient number of times to insert 21 turns in the same time in which the second-time spindles insert 14 turns. This alteration in the speed of the second-time spindles is made by substituting a smaller second-time driving pulley b_9, Fig. 5, for the one on the crosshead shaft that drives the second-time spindles. By decreasing the size of the second-time drive pulley, the spindle belt will run slower, consequently driving the spindles at a reduced speed. Moreover, the spindle belt in passing over the pulley *c* also drives the feed-rolls at a speed which is in proportion to that of the spindles, hence, the correct twist per inch will be inserted in the second-time operation. By decreasing the speed of the second-time spindles and also that of the feed-rolls, the twist inserted in the second-time operation will remain unchanged, while the twist inserted in the first-time operation will be increased because the feed-rolls draw the thread from the first-time bobbins at a slower speed, and allow the spindles to act on the thread for a greater length of time. If, on the other hand the size of the second-time driving pulley is increased, the speed of the second-time spindles and the feed-rolls will be greater; hence, the thread will also be drawn faster from the first-time bobbins which causes less twist to be inserted in the thread.

CALCULATIONS

62. Speed and Twist Calculations.—The speed and twist calculations of the spinner-double-twister relate principally to crosshead-shaft speeds, spindle speeds for both first-time and second-time operations, twists, and twist constants. As the calculations are similar to those of previously described machines, the rules will be omitted. In connection with twists, a feed gear table is employed from which the twist gear for any desired twist within the range may be found. A table applicable to the spinner-doubler-twister is shown in Table IV. In the first column is given the turns of twist per inch inserted in the thread as it winds on the second-time bobbins, the number ranging from 10 to 20 turns, inclusive. The two remaining columns show the proper sizes of gears to be combined in order to produce the twists in the first column. For example, by placing a 21-tooth gear on the bevel-gear shaft and a 58-tooth gear on the feed-roll shaft, the feed-rolls will deliver the silk so that 14 turns will be inserted in the second-time operation.

TABLE IV

CHANGE GEARS FOR SPINNER-DOUBLER-TWISTER

Turns of Twist per Inch Second-Time Spindles	Gear c_9 on Bevel-Gear Shaft c_8	Gear c_{11} on Roll Shaft o_6
10	21	42
11	21	46
12	21	50
13	21	54
14	21	58
15	21	62
16	16	51
17	16	54
18	16	57
19	16	60
20	16	63

TABLE V

INCREASE IN FIRST-TIME TWIST BY CHANGING SECOND-TIME DRIVING PULLEY

Diameter of Pulley b_9 on Crosshead Shaft Inches	Increase in First-Time Twist Per Cent.
10½	14
10	20
9	33
8	50
7½	60

63. Decreasing the size of the second-time driving pulley will cause an increase in the twist that is inserted in the first-time operation, the percentage of increase being as indicated in Table V. In other words, the speed of the second-time spindles is reduced, so that while these spindles are inserting, say, 12 turns in 1 inch of thread the first-time spindles insert a greater number of turns. For example, if 14 turns of twist are being placed in the second-time twist and a

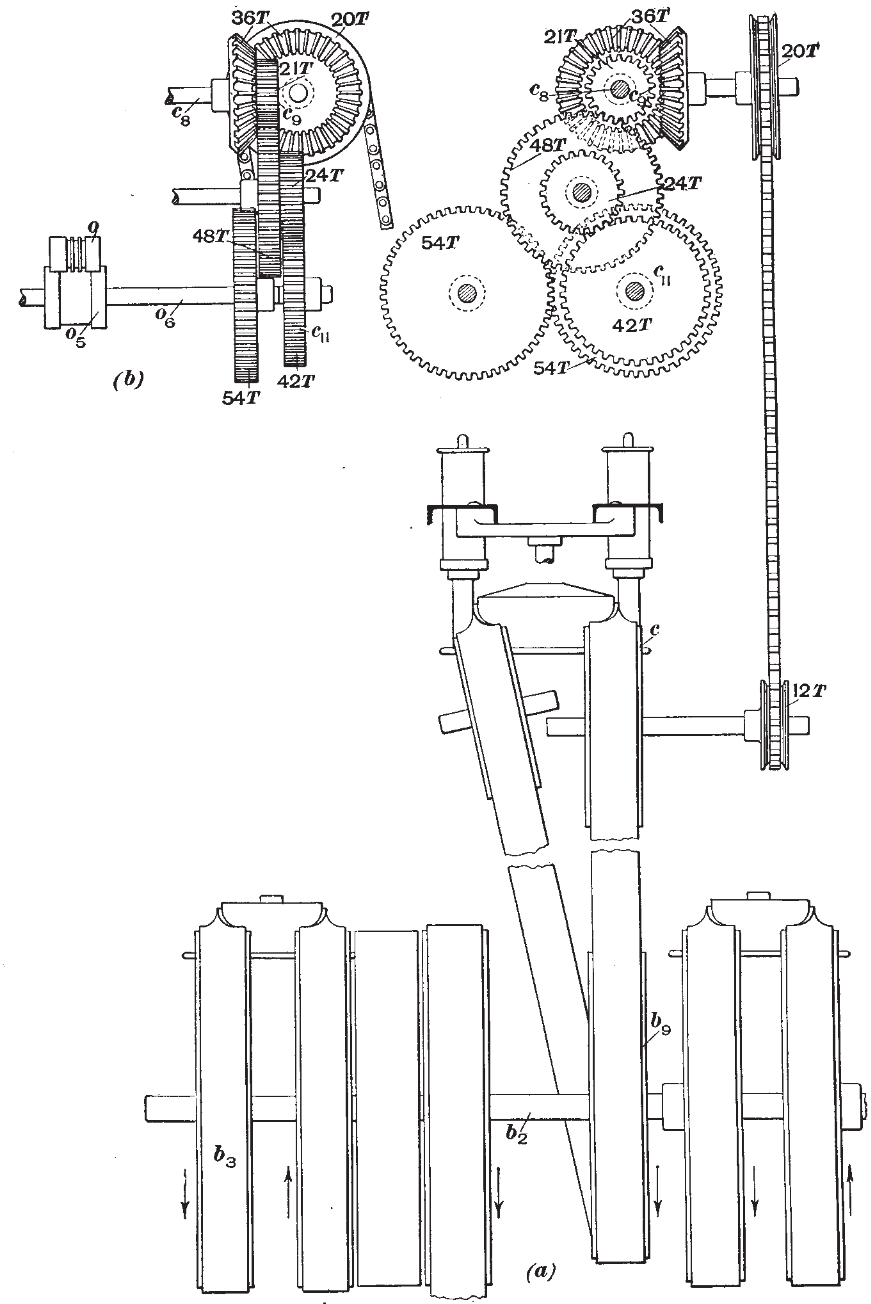
36T
20T
21T
c8
c9
24T
48T
q
o5
o6
c11
54T
42T
(b)
21T
36T
20T
c8
c9
48T
24T
54T
c11
42T
54T
c
12T
b9
b2
b3
(a)

Fig. 10

$10\frac{1}{2}$-inch pulley b_9, Fig. 10, is located on the crosshead shaft, then according to Table V, the first-time will have 14 per cent. more twist than the second-time. Since 14 per cent. of 14 turns is 1.96 turns, the product may be considered a 16/14 turn organzine. Should it be desired to insert a slightly greater amount of twist in the first-time, a 10-inch pulley should be substituted for the $10\frac{1}{2}$-inch pulley. In accordance with the table, this will give 20 per cent. more twist in the first-time. As 20 per cent. of 14 turns is 2.8 turns, the result will be 16.8 turns in the first-time and 14 in the second. This would also be considered a 16/14 turn organzine and is preferred by many throwsters, as slight slippages would not cause the twist to fall under the stipulated amount.

Example 1.—The crosshead shaft b_2, Fig. 10, makes 812.5 revolutions per minute, the first-time driving pulley b_3 is 12 inches in diameter, and the second-time pulley b_9 is 10 inches in diameter. Find (*a*) the speed of the first-time spindles and (*b*) the speed of the second-time spindles, if the spindle whorls are $\frac{13}{16}$ inch in diameter.

Solution.—(*a*) The speed of the first-time spindles is

$$\frac{812.5\times 12}{\frac{13}{16}} = 12{,}000 \text{ r. p. m. Ans.}$$

(*b*) The speed of the second-time spindles is

$$\frac{812.5\times 10}{\frac{13}{16}} = 10{,}000 \text{ r. p. m. Ans.}$$

Example 2.—Find, through the gearing, the twist that is being inserted by the first-time spindles with the gears and pulleys shown in Fig. 10. The diameter of the first-time driving pulley is 12 inches; the diameter of the second-time driving pulley is 10 inches; the diameter of the pulley c is $6\frac{3}{4}$ inches; the diameter of the spindle whorl is $\frac{13}{16}$ inch; the diameter of the feed-roll driving drum o_5 is 2 inches and that of the feed-roll o is 1 inch, but allowing for the grooves in the roll, the diameter of the delivery surface is $\frac{7}{8}$ inch.

Solution.—The number of turns of twist being inserted by the first-time spindles is

$$\frac{1\times 42\times 48\times 36\times 20\times 6\frac{3}{4}\times 12}{2\times 24\times 21\times 36\times 12\times 10\times \frac{7}{8}\times 3.1416\times \frac{13}{16}} = 12.088 \text{ turns per in. Ans.}$$

Example 3.—Find, through the gearing, the number of turns of twist being inserted by the second-time spindles, the gears being the same as in example. 2.

SOLUTION.—The number of turns of twist being inserted by the second-time spindles is

$$\frac{1\times42\times48\times36\times20\times6\tfrac{3}{4}}{2\times24\times21\times36\times12\times\tfrac{7}{8}\times3.1416\times\tfrac{13}{16}}=10.073 \text{ turns per in. Ans.}$$

EXAMPLE 4.—Using the same gearing as in examples 2 and 3, find the inches of thread delivered per minute by the feed-rolls when the cross-head shaft makes 812.5 revolutions per minute.

SOLUTION.—The delivery of the feed-rolls is found to be

$$\frac{812.5\times10\times12\times36\times21\times24\times2\times\tfrac{7}{8}\times3.1416}{6\tfrac{3}{4}\times20\times36\times48\times42\times1}=992.658 \text{ in. per min. Ans.}$$

EXAMPLE 5.—If the feed-rolls take up 992.658 inches of thread per minute from the first-time bobbins revolving 12,000 revolutions per minute and deliver it at the same speed to the second-time bobbins revolving at 10,000 revolutions per minute, find the twist per inch inserted in each.

SOLUTION.—The twist inserted in the first-time operation is

$$12{,}000\div992.658=12.088 \text{ turns per in. Ans.}$$

The twist inserted in the second-time operation is

$$10{,}000\div992.658=10.073 \text{ turns per in. Ans.}$$

EXAMPLE 6.—With the gears and pulleys arranged as shown in Fig. 10, what is the twist constant if the gear c_{11} is considered the twist change gear?

SOLUTION.—The twist constant is

$$\frac{1\times1\times48\times36\times20\times6\tfrac{3}{4}}{2\times24\times21\times36\times12.\times\tfrac{7}{8}\times3.1416\times\tfrac{13}{16}}=.2398. \text{ Ans.}$$

EXAMPLE 7.—Find the correct change gear to produce 14 turns of twist per inch if the twist constant is .2398.

SOLUTION.—

$$14+.2398=58.381$$

Hence, a 58-tooth gear would be used. Ans.

EXAMPLE 8.—Find the twist per inch being inserted in the thread if the twist constant is .2398 and a 42-tooth change gear is used.

SOLUTION.—The twist per inch is found to be

$$.2398\times42=10.071 \text{ turns. Ans.}$$

EXAMPLE 9.—Find the twist constant, considering the gear c_{11}, Fig. 10, on the shaft o_6 as the change gear and the gear on the bevel-gear shaft c_8 a 16-tooth gear.

SOLUTION.—The twist constant is found to be

$$\frac{1\times1\times48\times36\times20\times6\tfrac{3}{4}}{2\times24\times16\times36\times12\times\tfrac{7}{8}\times3.1416\times\tfrac{13}{16}}=.3148. \text{ Ans.}$$

64. Production Calculations.—The production of the spinner-doubler-twister is calculated in the same way as the production of the doubler-spinner. The calculation is based mainly on the revolutions per minute of the second-time spindles, the turns of twist being inserted in the thread, and the yards per pound of the ply thread. The calculation will give the theoretical or 100 per cent., production, but allowance for stoppage may be made by the methods employed on machines previously described, and deducted from the theoretical production found.

EXAMPLE 1.—What is the theoretical production, in pounds per spindle-hour, if the second-time spindles of the spinner-doubler-twister make 8,500 revolutions per minute, producing a 2-thread 13/15-denier organzine (159,448 yards per pound) having 16/14 turns of twist?

SOLUTION.—The theoretical production, in pounds per spindle-hour is

$$\frac{8{,}500\times 60}{14\times 36\times 159{,}448}=.0063 \text{ lb. Ans.}$$

EXAMPLE. 2.—If an 88-spindle second-time machine produces .0063 pound per spindle-hour and operates 10 hours per day, find the daily production.

SOLUTION.—The daily production in this case is.

$$.0063\times 88\times 10=5.544 \text{ lb. Ans.}$$

65. The result found in the solution of example 2 in the preceding article is the theoretical production and could not be maintained in a mill. For this reason it will be necessary to deduct a certain percentage for slippage, stoppage, doffing full bobbins, tying broken ends and so on. The amount to be deducted is variable and depends to a considerable extent on the skill and dexterity of the operative, the speed at which the machine is run, the quality of the raw silk, and so on. In problems of this nature, the speed at which the second-time spindles revolve and the turns of twist in the second-time operation are alone considered, since these are important factors in the take-up of the thread. In addition, the size of the raw silk should be known, together with the number of plies in the finished thread.

66. Details of Operation.—Since the preliminary operations of starting the doubler-spinner and the spinner-doubler-twister are similar it will be unnecessary to repeat the details here. Considering the machine in motion, but with a spindle stopped because of a broken single from one first-time bobbin, tying the ends and restarting the spindle are accomplished in the following manner: The second-time bobbin is first removed from the second-time spindle in order to find the twisted end on the bobbin. After the end is found, a small quantity of silk is pulled from the bobbin and the thread untwisted in order to determine whether it is composed of two twisted singles. If only one twisted single is discovered, more silk is drawn from the bobbin until the correct ply thread is found. After the correct end is found a length of thread capable of extending a short distance past the feed-rolls is pulled from the second-time bobbin, which is then replaced on the second-time spindle. With the bobbin in place, the thread is slipped under the traveler and then passed through the centering eye located directly above the spindle. The hanger supporting the feed-rolls is next lifted from its place and held in the left hand while the thread is wrapped three times around the rolls, which are again replaced in their original position.

67. After the foregoing operations are completed, the first-time bobbins are removed from the first-time spindles, which are in constant motion, and the end is found on each in the same manner as on the second-time bobbins. After the ends are found, a length of thread is pulled from each bobbin and the bobbins are then replaced on the first-time spindles. The spindles will immediately set the bobbins in motion and cause the threads to wrap around the individual tension wires, giving them the correct tension for first-time spinning. As the bobbins on the first-time spindles are constantly revolving, it is necessary to draw the threads upwards gradually, so that an excessive amount of twist will not be inserted in the single. While taking up the thread in this manner, the end of twisted thread extending from the feed-rolls is grouped with the two spun singles and quickly tied in a knot, from which the tails are usually cut by scissors carried in the operative's hand. Next, one finger of the left hand is held against the under side of the drop-wire feet, or back of the drop wires, to keep them erect, while the vertical rod is pressed downwards with the right hand, thus starting the spindle. The thread, passing from a point near the drop wires to the feed-rolls, runs over the right hand, which is now raised in order to deposit the thread on the porcelain roller guide or enameled wire guide attached to the bobbin shelf. With the end properly deposited in the guide, the ends are guided through their respective drop-wire guides, whereupon the left hand may be removed from the drop-wire feet, since the tension of the thread will hold them erect.

68. Although the foregoing is a common method of tying ends slight variations are sometimes made; for, different operatives gradually acquire individual styles, and after constant repetition become very skilful in their methods of tying ends. Speed is essential in operations of this nature, especially in tying the ends after the single ends are found; for, the greater the delay in starting the spindle, the higher will be the twist inserted in the first-time operation.

Sometimes, in stopping the frame, kinks or snarls are formed in the thread between the tension wires and the drop wires. Such snarls, if not removed, would later pass through the second-time operation and form a defect in the finished thread. Hence, if kinks are present in the thread, they should be *rubbed out* before starting the frame. This is accomplished by gently pulling and stroking the thread until the kink has been eliminated. After the snarl is removed, the slack thread is wrapped on the first-time bobbin by turning it backwards. Because of the formation of snarls, the frames are stopped only when absolutely necessary, as at the end of the day. They are usually allowed to run during the lunch hour without any attention; for, as the ends break, the second-time bobbins will automatically stop, and they will be started when the operative returns to work.

69. Changing Second-Time Drive Pulley.—Should it be desired to change the size of the pulley driving the second-time spindles, it will be necessary to loosen the bearings holding the crosshead shaft. The tight and loose first-time spindle-belt pulley on the right side of the shaft should be removed, whereupon the balance wheel and the second-time pulley may be drawn from the shaft. The second-time pulley may then be lifted from the bushing and a pulley of the proper size substituted. This, however, is very seldom done, since the percentage of difference between the twists is about constant and all changes are made to increase or decrease the twists, which is accomplished by alternating the twist change gears, thus increasing or decreasing the speed of the feed-rolls and affecting both operations.

70. Hard Twist.—It is evident that since many parts of the doubler-spinner and the spinner-doubler-twister are of the same construction, and operated in a similar manner, defects of the same nature will be produced on both machines. For this reason it will be advisable to review the defects that resulted when processing yarns on the doubler-spinner for only the defects which are characteristic of the spinner-doubler-twister will be described here.

Hard twist frequently results on a spinner-doubler-twister equipped with friction drive rolls, when oil comes in contact with the feed-roll driving drum. The friction between the driving drum and the feed-rolls is thus reduced causing slippage, which results in the formation of hard twist in both the first-time and second-time operations; for, it allows the feed-rolls to revolve at a slower speed, consequently causing an increase in the twist per inch in the yarn. The slippage between the driving drum and the feed-rolls may be prevented to a certain extent by exercising great care when oiling bearings close to the feed-rolls. Oily rolls should be wiped clean and dry and a small amount of chalk should be sprinkled on the driving surfaces to increase the friction and eliminate slippage. Rosin is also used for this purpose, but it tends to become sticky and often forms small lumps on the roll, causing it to run with a slightly uneven motion.

71. Caterpillars.—Very often, in the manufacture of 2-thread organzine, one thread of the ply breaks and is pushed along the intact thread, thus forming a bunch of silk that is called a caterpillar. Most frequently, this is caused by cut or worn travelers. After a traveler has been in operation for some time, it becomes grooved where the thread passes through it. Then, as the ply thread passes through the groove, one of the ply threads becomes cut and is pushed along the intact thread for a short distance before breaking. Caterpillars can be avoided by changing the travelers when they become worn. Sometimes cracked or broken rings cause this defect; hence, a thorough examination should be given to all parts of the frame and spindles when caterpillars are found.

ADJUSTMENTS

72. Adjustments.—The adjustments most frequently necessary on the spinner-doubler-twister usually relate to the second-time spindles, which are acted on by the stop-motion. At times the operation of the stop-motion, when incorrectly adjusted, causes the spindles to continue revolving even after the feed-rolls have stopped delivering silk. This condition should be remedied in the same manner as described in connection with the doubler-spinner. All gears should be meshed properly, and chains should be given the proper tautness, in order that they will not hum or slap. The humming noise will be noticed when the chain is adjusted too tightly, whereas slaps result when the chain is too loose. The traverse motion and the rings should also be adjusted in proper relation to the bobbins so that the thread will be properly guided and wound on the bobbin.

73. Oiling.—Correct oiling of the spinner-doubler-twister is very important for successful operation. Although the frame varies in construction from other frames previously described, the oiling of the various parts, such as the crosshead shaft, spindles, bearings, and so on, is accomplished in practically the same manner as on the frames already described.

74. Size of Machine.—The spinner-doubler-twister is regularly built with 160 first-time spindles and 80 second-time spindles. A machine of this spindle capacity is about 19 feet 6 inches long, and about 1 foot 11 inches wide, and its height from the floor to the feed-rolls is approximately 3 feet 8 inches. A frame of these dimensions weighs approximately 2,800 pounds when crated and ready for shipment. While this is a common size, machines with other spindle capacities are built according to the needs of the throwster. The weight of a machine, of course, is in proportion to the number of spindles it contains; hence the weight and size given may be employed as a basis for calculating other weights and sizes.

75. Horsepower and Speed.—When arranged for group drive, the standard spinner carrying 160 first-time and 80 second-time spindles requires from $2\frac{1}{2}$ to $2\frac{3}{4}$ horespower in order to operate properly. Group drive refers to the driving arrangement of the frames; for example, when several machines equipped with crosshead shafts are driven from line shafts in turn receiving their motion from a large motor, the term *group drive* is employed. Approximately 3 horsepower is allowed when individual motors are employed, each motor rating about 1 horsepower and all being of one type. The motors are designed to operate at slightly more than 1,700 revolutions per minute, which may be considered a normal operating speed. In order that they shall run with as little friction as possible, the motors should have ball bearings and conveniently located grease cups, by means of which the bearings may be lubricated.

76. The speed at which the machine should be operated depends, to a certain extent, on the quality of silk that is being processed. When constantly running silk of high quality, the speed may be higher than when a poor quality is being thrown; however, a normal operating speed should be determined from which little change will be necessary. Of the various speeds that are employed, it is advisable to operate the first-time spindles at a speed between 9,000 and 10,000 revolutions per minute. The second-time spindles are operated most advantageously between 7,500 and 8,500 revolutions per minute. The slower speed, of course, is explained by the fact that a traveler is employed in the latter operation and also to allow a greater number of turns to be inserted in the first-time operation. It may be added that, although the speeds given are considered the most advantageous working speeds, higher speeds are often employed. When exceptionally good work is being run, the speeds are sometimes increased so that the first-time spindles make more than 10,000 revolutions per minute; however, this practice is not advisable.

SILK THROWING

(PART 8)

Serial 5002 H | 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 aswers are completed, examine them closely and correct all all the errors you can find; then mail your work to us.*

(1) If the stretch in the spindle belt on the spinner illustrated in Fig. 1 becomes so great that the tension device is ineffective, how may it again be made to operate effectively?

(2) How should the stop-whorl brakes, Fig. 3, be adjusted so that they will function properly?

(3) (*a*) If, when an end breaks, the rod h_9, Fig. 3 (*a*), releases the cam *i*, but is not forced, together with the stop-off lever, out of the path of the reciprocating lug *f*, what should be done to prevent the stop-off lever and lug from striking? (*b*) Explain how the lug f_7 should be set in relation to the stop-off lever.

(4) If a spinner-doubler is employed in a throwing mill, from which machine and what type of bobbin is the silk delivered to this machine?

(5) (*a*) Explain how short singles are produced on the spinner-doubler. (*b*) Why do short singles invariably break in second-time spinning?

(6) (*a*) State the class of yarn for which the three-process machine is particularly adapted. (*b*) Name in the proper order the operations performed by the three-process machine.

(7) What is the nature of the defects known as caterpillars, and what causes them to occur?

(8) What is the effect on the twist per inch inserted in both the first-time and second-time operations on the spinner-doubler-twister if the speed of the feed-rolls is increased? Give the reasons for your answer.

(9) (*a*) What defect is caused when friction-driven feed-rolls on the spinner-doubler-twister become oily and slip? (*b*) When friction-driven feed-rolls slip, how may the defect be remedied?

(10) Describe the passage of the thread on the spinner-double-twister

(11) Explain how to change the second-time drive pulley b_9, Fig. 5.

(12) What should be the speeds of the first-time and the second-time spindles?

(13) (*a*) What is the purpose of constructing the loose pulley b_1, Fig. 7, with a smaller diameter than that of the tight pulley b? (*b*) Why is the edge of the loose pulley adjoining that of the tight pulley beveled?

(14) Describe the device employed on the doubler-spinner illustrated in Fig. 1, that retains the drop wires in an upright position while the frame is being stopped.

(15) (*a*) What is the object of the balance wheel on the spinner-doubler-twister? (*b*) Why is the continued revolution of the balance wheel possible after the crosshead shaft has stopped?

(16) (*a*) How is the speed between the first-time and second-time spindles altered? (*b*) Describe, fully, why the

twist inserted in the first-time operation is increased when the size of the second-time pulley b_9, Fig. 5, is decreased.

(17) (*a*) How much time should elapse between the stoping of the first-time and second-time spindles? (*b*) Why is a brake employed on the spinner-doubler-twister and where is the braking effect applied?

(18) If, when stopping the spinner-doubler-twister small kinks or snarls are formed in the thread, what should be done to the thread before starting the machine?

(19) A spinner-doubler-twister has 100 second-time spindles making 8,000 revolutions per minute and operates 10 hours per day. If the product is 2-thread 14/16 denier organzine (148,818 yards per pound) twisted 14/12 turns, and an allowance of 20 per cent. is made for stoppage, what is the daily production in pounds? Ans. 6 lb.

NOTE: Carry production per spindle-hour to nearest fourth decimal place.

(20) Assuming the production per spindle-hour including stoppage to be .005 pound for a certain silk, find the number of second-time spindles required on a spinner-doubler-twister to produce 9 pounds of that silk in 9 hours. Ans. 200.

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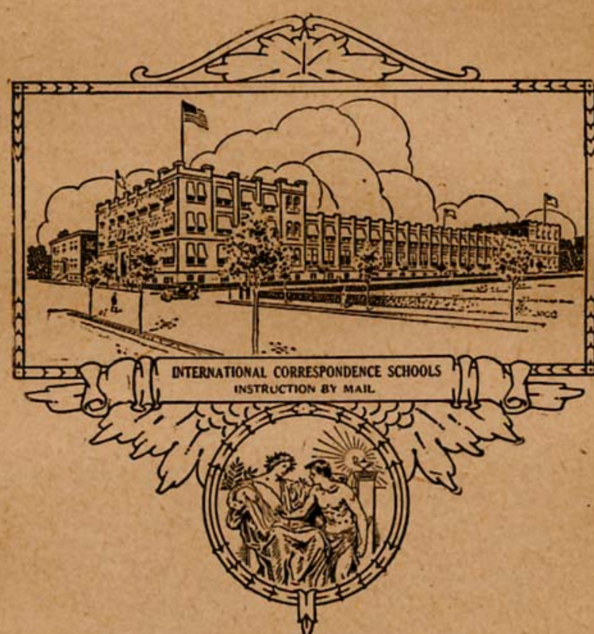
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