

CHAIN WARPING

(PART 2)

Serial 642B

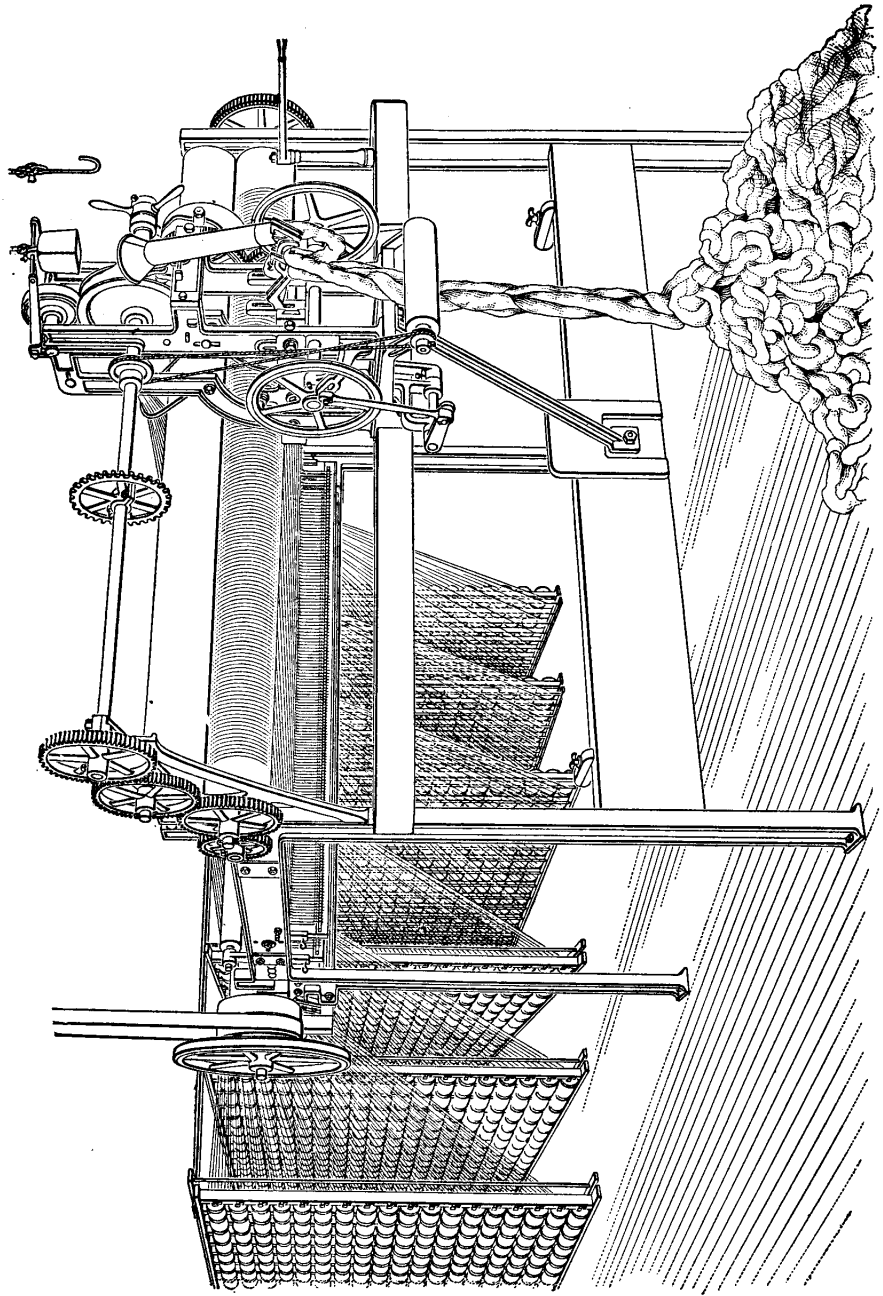
Edition 1

CONSTRUCTION OF CHAIN WARPERS

DENN WARPERS

1. The machine in most common use for making chains is the **Denn warper**. Owing to its adaptability for making either balled or linked chains, with a large number of ends (because of the possibility of using large creels) and of any required length, the advantages of this machine are so evident as to have caused its wide use during recent years. A common type of Denn warper equipped with one linking head is shown in perspective in Fig. 1 and in section in Fig. 2.

2. **Passage of Yarn.**—The spools of yarn are placed in the creels *a*, Fig. 2, and the ends conducted through an eye board *b*, each end passing through a separate eye, thence under a roll *c*, and over another roll *c*₁; each end then passes through a drop wire in the stop-motion *d*, where the mechanical stop-motion is used, after which the ends are all collected in a sheet and passed over the roll *c*₂. They are next threaded through the harnesses *f, g*, which are used only when leases are taken, and then pass around a measuring roll *h*, on which is a presser roll *h*₁, both of which are of cast iron. The sheet of yarn is returned around a roll *j*, up to which time the yarn has been arranged in a wide sheet. From this point, however, the sheet is contracted by means of an arch *k*, until by the time it reaches the guide fork *k*₁ it is in the form of a rope of yarn, which then passes to the linking arrangement *l*.



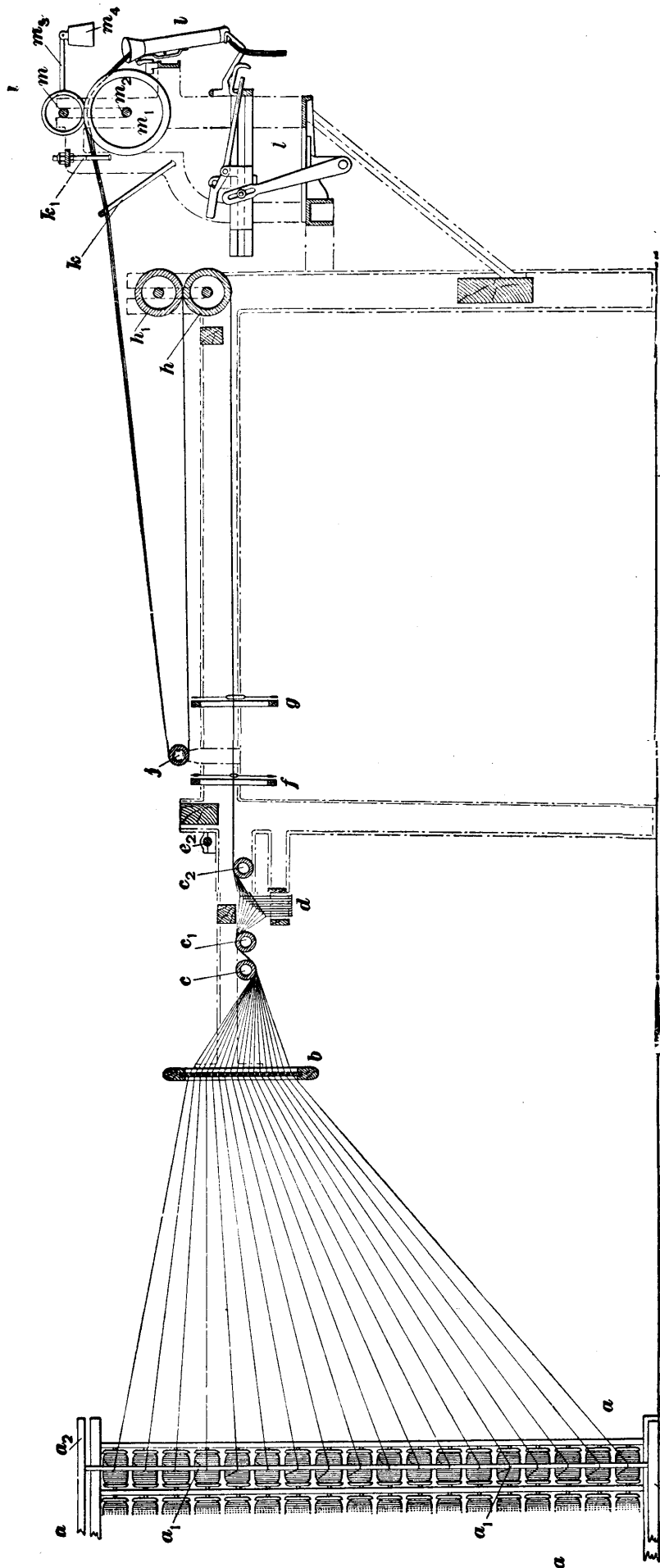


FIG. 2

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The machine under description is equipped with the mechanical stop-motion, the common type of measuring motion, and with one linker only, but different arrangements of Denn warpers are in use. For instance, an electrical stop-motion is now generally used instead of a mechanical one, two linkers may be applied instead of one, or the linker may be disconnected and one or more balling attachments applied. The construction of the warper illustrated will be described, as it contains most of the essential parts of any Denn warper, after which variations in the construction of Denn warpers will be referred to.

3. Creels.—A feature of Denn warpers is the large creel capacity, as compared with other warpers. The most common size of machine is that which provides for 2,250 ends, but they are made for 2,430, 2,520, 2,808, 3,006, or 3,204 ends, as required. In order to provide for this large number of ends a number of separate creels are used, generally six, all similar in construction. They are vertical, constructed of wooden standards connected at the top and bottom by a wooden framework, and adjusted at the required distance to allow a spool to be inserted between each pair of standards. Attached to the standards are iron steps, in which the spool skewers rest, carrying the spools. Immediately in front of the face of the creel from which the yarn is delivered, in case a mechanical stop-motion is used, are a series of vertical iron rods a_1 , Fig. 2, supported at the top and bottom in a framework a_2 , each being placed about opposite the center of each vertical row of spools. This arrangement is better shown in Fig. 3, which is a plan view of the warper and a number of creels, only the ends of the latter being shown, in order to indicate their location. It will be seen that each end of yarn passes from its spool around the vertical guide rod and then at an angle toward the eye board of the warper. In a warper equipped with an electrical stop-motion, the iron rods are not used; a wooden standard carries the electrical connections and the stop-motion wires occupy about the same position as the iron rod.

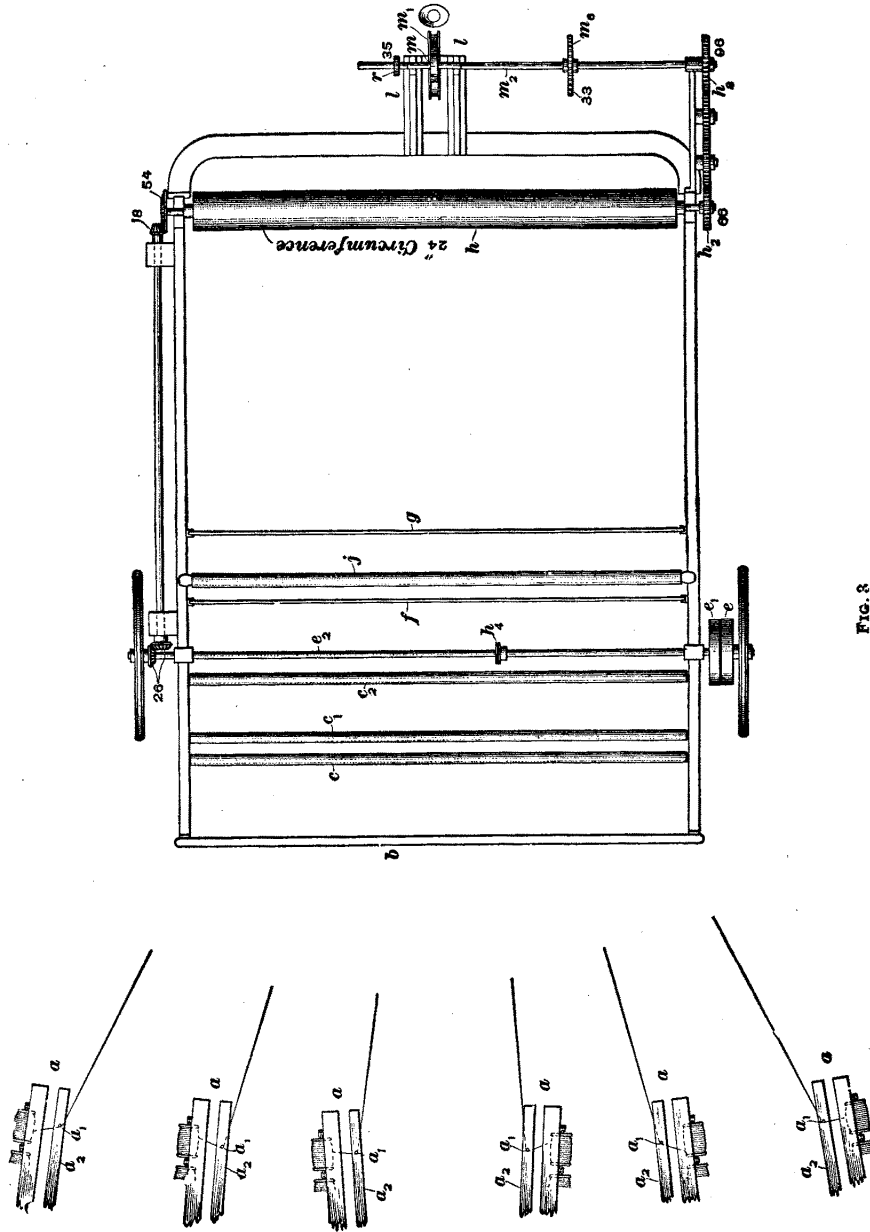


FIG. 8

The size of the creels is determined by the number of ends that it is intended to warp; the creels are generally arranged with spools in vertical rows, there being as many vertical rows and as many separate creels as are necessary to bring up the creel capacity to the total required; for instance, a warper for 2,250 ends has one creel with 20 vertical rows and five creels that each have 21 vertical rows, each row having 18 spools, which gives a total creel capacity of 2,250 ends. One for 2,432 ends has six creels, the two outer ones each having 26 vertical rows of spools and the four inner ones, 25 vertical rows, with 16 spools in each vertical row—in all $(26 + 25 + 25 + 25 + 25 + 26) \times 16 = 2,432$. The creels should be firmly stayed and set such a distance apart as will give a convenient passageway between the creels for access in tying in new spools or connecting broken ends.

4. The eye board *b*, shown in Figs. 2 and 3, is a thin wooden board, enclosed in a wooden frame and pierced with holes, in which are fixed porcelain guide eyes. There are as many vertical rows of eyes as there are vertical rows of spools in all the creels, and as many eyes in each vertical row as there are spools in one vertical row in the creel; that is, for 2,250 ends there would be 18 eyes in each vertical row in the eye board and 125 vertical rows. The eye board is stationary and simply serves as a guide to bring the ends of yarn into proper position and hold them in the same relative position to one another as the spools occupy in the creels, thus in the case of a broken end facilitating the finding of the spool from which the end has been broken. As the vertical rows of holes in the eye board are numbered to correspond to the numbering of the vertical rows of spools in the creel, by a glance at the eye board the number of the creel and the number of the vertical row of that creel in which the end is broken can be readily determined. The eye board is sometimes called the *holeyboard*.

5. **Driving.**—One method of driving the Denn warper is shown in Fig. 3. The shaft *e*, receives the power from the shafting of the room by means of the tight pulley *e*,,

close to which is the loose pulley e . At each of the outer ends of this shaft is a hand wheel for the purpose of turning the warper by hand when necessary. At the end of the shaft e_2 , opposite the driving pulley, is a bevel gear of 26 teeth that drives another bevel gear of 26 teeth on a long side shaft. On the opposite end of this shaft is a bevel gear of 18 teeth that meshes with a 54-tooth gear on the measuring-roll shaft. At the opposite end of the measuring-roll shaft is a train of gears consisting of a 66-tooth gear h_2 that drives, through two carriers, a 96-tooth gear h_3 on the shaft m_2 , which carries the lower grooved calender roll m_1 . On this shaft is also a 35-tooth gear r , used for operating the linker, and a 33-tooth sprocket gear m_3 , used for operating the balling attachment when the linker is not used.

Another method of driving that is being introduced and, in fact, is taking the place of the side shaft and bevel gears is to connect the shaft e_2 with the measuring roll h by means of two sprocket gears and a chain. The gear on e_2 in this case usually contains 10 teeth, and that on h 30 teeth.

MECHANICAL STOP-MOTION

6. After leaving the eye board and passing under the guide roll c and over the roll c_1 , which are smooth iron rolls supported on each side of the frame and constructed so as to revolve easily, the yarn passes through the stop-motion, shown in Figs. 2 and 4, if the **mechanical stop-motion** is used. This consists of a rigid wooden framework d_1 , Fig. 4, at the top and bottom of which are brass plates d_2, d_3 , respectively, each of which is perforated with twice as many holes as there are places for spools in the creels. Through the holes in these plates are passed bent wire staples, or drop wires, d_4 that have a slight turn at their lower ends, so as to prevent their being raised out of the framework. These staples are of different lengths so as to form several tiers when they are all raised; immediately above the top portion of each tier, when the wires are raised, are two small guide

rods d_s . The object of arranging the stop-motion wires in tiers is to provide for inserting the ends of yarn at several heights, so that a large number of ends may pass through the stop-motion without crowding and so as to give facilities for finding broken ends and replacing them through their proper wires in the stop-motion.

When all the wires are threaded with yarn, their lower ends are level, so that in considering the operation of the

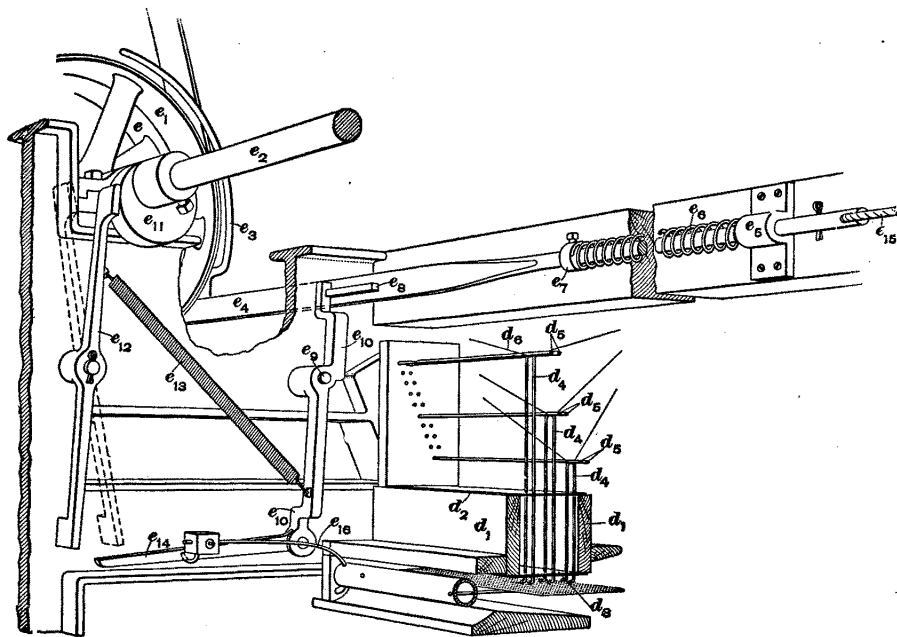


FIG. 4

stop-motion the different heights of the wires may be ignored. After passing the stop-motion, all the ends of yarn are again collected into one wide horizontal sheet over the roll c_2 , Fig. 2. In passing between the two rolls c_1, c_2 , every end is slightly depressed, in consequence of the position of the stop-motion, and every end passes underneath one pair of guide rods similar to d_s , Fig. 4. Each pair of guide rods is spread sufficiently to allow the upper ends of

the stop-motion wires in the row directly below it to stand between its two rods. Thus, when the ends forming the upper sheet d_2 are in position beneath the guide rods d_2 , with each end threaded through a stop-motion wire, there will be one row of stop-motion wires across the machine suspended from this sheet of ends, with the bottom of the wires just projecting through the lower brass plate d_3 ; similar rows of shorter wires are suspended from other sheets of ends. In Fig. 4, only three of the stop-motion wires are shown, the others being omitted for clearness. The wires shown are for three sheets of ends, as indicated.

7. The belt that drives the tight pulley e_1 , Fig. 4, of the warper passes through the guide fork e_2 , which is supported on a horizontal rod e_3 that passes through a bracket e_4 attached to the wooden framework of the machine; on this rod is a spring e_5 , which is held in position by a collar e_6 setscrewed to the rod. On the flat part of the belt-guide rod is a projection e_7 ; and below this, suspended from a stud e_8 , is a lever e_{10} , to the lower end of which is attached a latch e_{11} , supported near its middle by a wire hook. An eccentric e_{12} , fastened on the shaft e_9 , gives a constant reciprocating motion to a vertical lever e_{13} suspended on a stud at its center; the upper end of this lever is constantly drawn against the surface of the eccentric by means of a spring e_{14} , which is also connected to e_{10} . The extreme positions of the lever e_{13} are shown by the solid and the dotted lines, the path of its movement at the lower end being immediately over the end of the latch e_{11} , but out of contact with it unless it should be raised.

The driving belt is drawn from the loose pulley e to the tight pulley e_1 by means of a rope e_{15} secured to the belt-guide rod; this rope passes around part of the machine, so that it may be started from the front or from either side near the shaft e_9 . The pulling of the rope results in compressing the spring e_5 and drawing the shipper rod a sufficient distance to admit of the upper end of the lever e_{10} falling behind the projection e_7 on the rod e_3 , thus holding it and retaining

the belt on the tight pulley until the upper end of the lever e_{10} is moved from the belt-guide rod, when the projection is released and the coil spring throws the belt guide and belt from the tight to the loose pulley.

8. The warper is stopped in the following manner at the breakage of any end passing through the stop-motion. Below the drop wires of the stop-motion is a sheet of brass gauze resting on levers and so accurately balanced that the weight of even one wire falling on it will cause it to depress the arms on which it rests and thus raise the arm e_{10} , Fig. 4. This arm carries the wire hook that supports the latch e_{14} ; and consequently, when e_{10} is raised, e_{14} is also raised, so that its outer end comes in the path of the lower end of the lever e_{12} , which at its next inward movement strikes the end of the latch e_{14} , pressing it back and thus forcing the upper end of the lever e_{10} away from the belt-guide rod, with the result that the belt is shifted to the loose pulley and the machine stopped. The attendant, by noting which wire has dropped on the sheet of brass gauze and the corresponding hole in the eye board, can easily trace the spool from which the end has broken. He should then take hold of the broken end on the spool and carry it forwards to the eye board, through which it is threaded in a manner similar to that of threading a needle. From the eye board, the end is passed under the roll c , Fig. 2, over the roll c_1 , and is then ready to be passed through the drop wire in which it belongs. Before this can be done it is necessary to raise the drop wire so that a small drawing-in hook can be used to draw the end through it. The tender raises the drop wire, either with one of his fingers or by raising the sheet of brass gauze so that it will occupy its proper position, and then passes the hook through it from the front. The end that has been brought forwards is caught on the hook and drawn through the wire, and then passed over the roll c_2 and pieced to the broken end in the machine. The machine is now started slowly and the speed gradually increased until full speed is attained. The distance from the stop-motion to the measuring roll h and back to the return

roll j gives a number of yards of yarn, and as the machine stops promptly, it is seldom that the broken end has passed beyond the return roll, thus always giving an opportunity to piece it up.

LEASING HARNESSES

9. The leasing harnesses f, g are shown in Fig. 2 and, in detail, in Fig. 5 (a) and (b); f is the harness for taking the thread lease and g the harness for the pin lease. Each consists of a rectangular wooden framework with steel rods f_1, g_1 secured to the upper and lower horizontal bars. On these rods, heddles f_2, g_2 are threaded so as to be retained in a vertical position, but with freedom to move laterally.

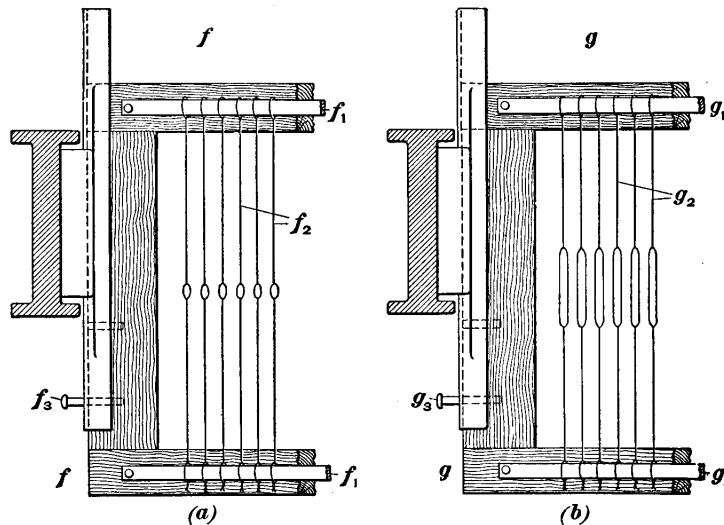


FIG. 5

Each heddle consists of a twisted, tinned, steel wire that has an eye at the center, as well as eyes at the top and bottom through which the rods f_1, g_1 are passed. In the harness for the thread lease, this eye is small; but for the pin lease, it is elongated. These frames are supported at each end by an iron bracket containing a vertical slot; the brackets are attached to the iron beams that form the upper part of the

sides of the machine. The frames may be moved up or down in the vertical slots and when in the position required are held by means of pins similar to f_3 and g_3 , at each end of the frame; these pins project through a hole in the bracket into one of two holes in the frame. The harnesses may therefore be secured in any one of three positions, according to whether the pins are in the upper or lower holes or beneath the frames. When a lease is not being taken the pins are inserted in the lower holes, which raises the harness so that the central eyes in the heddles are directly in the path of the yarn as it passes through the warper, thus offering the least possible resistance.

In the harness for the thread lease, the number of heddles is equal to one-half the number of ends that it is possible to warp on the machine. Each alternate end of warp is passed through one of the eyes; the other ends pass between the heddles. For instance, the first, third, fifth, and all odd-numbered ends, counting from one side of the machine, will pass through separate eyes, while the even-numbered ends—the second, fourth, sixth, etc.—will pass between the heddles. The harness for taking the pin lease does not carry so many heddles, since the yarn must be leased in groups of 2, 3, 4 ends, or more. In case the harness frame is arranged for 4-end pin leasing, the number of heddles will be one-eighth the number of spools that the creels are capable of holding, and the ends will pass through the pin-leasing harness in groups of 4 ends each—the first 4 ends through the first eye, the next 4 ends between the first and second heddles, the third group of 4 ends through the second eye, the fourth group of 4 ends between the second and third heddles, and so on.

10. Thread Lease.—When it is desired to take a **thread lease**, the machine is stopped, the pins in the ends of the harness frame f , Figs. 2 and 5 (a), are withdrawn, and the frame is allowed to drop a couple of inches, when the pins are inserted in the upper holes. The lowering of the harness allows a shed to be formed so that a lease

band can be passed between the two sheets of ends, for which a long, round or oval stick with a slot in each end is generally used. One end of the lease band is attached to the slot in one end of this stick, and the stick and band are passed through the shed, after which the end of the band attached to the stick is removed and the stick withdrawn. The band is longer than the width of the sheet of ends and consequently its ends hang down slightly at each side. The pins at the ends of the harness are now withdrawn, the harness is raised, and the pins inserted beneath it, thus holding it in

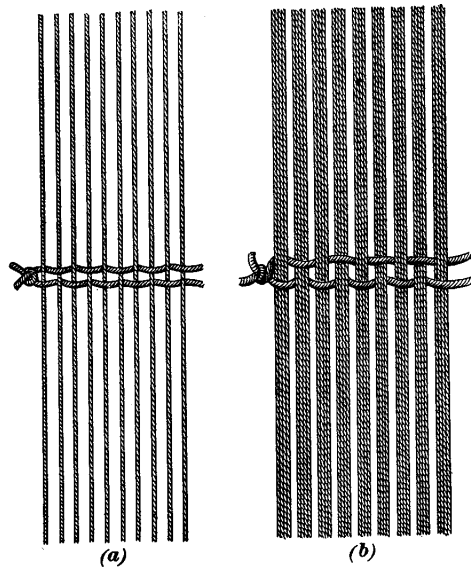


FIG. 6

the required position. Raising the harness raises the set of ends that was previously depressed, and thus another shed is formed and another band inserted in the manner previously described. The harness is then lowered into its original position, so that all the ends form one even sheet, after which the ends of the bands are tied together. This completes the taking of the lease and if it is

not desired to take a pin lease as well as a thread lease, the machine is started again. The lease bands should always be inserted in front of the leasing mechanism; otherwise they cannot pass forwards with the yarn, because they will come in contact with this mechanism. Fig. 6 (a) shows the arrangement of the threads at the lease band when a thread lease is taken.

11. Pin Lease.—The pin lease is taken in the same manner as the thread lease except that the harness *g*, Figs. 2

and 5 (*b*), is used instead of the harness *f*. The arrangement of the threads in a 4-end pin lease is shown in Fig. 6 (*b*).

Another method of taking a pin lease is to adopt the pin-leasing arrangement shown in Fig. 7 (*a*) and (*b*), (*a*) being a perspective view and (*b*) a sectional elevation. This is a rigid, rectangular wooden framework that is attached to the machine and consists of a top rail *a* and a bottom rail *a*,

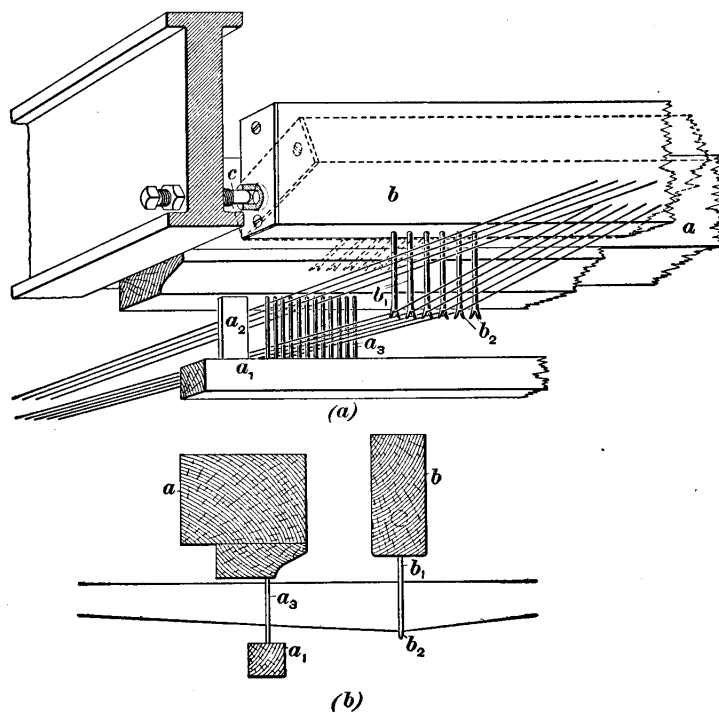


FIG. 7

connected by a wooden bar, similar to *a*₃, at each end. Iron pins *a*, extend from the top rail to the bottom rail, fitting into sockets in each rail; they are placed 3 pins to the inch. Directly in front of the top pin rail is a wooden block *b* that has securely fitted into it pins *b*₁ that are twice as far apart as the pins in the pin rail. The lower ends of these pins, instead of fitting into another block, are flattened and spread

with a notch cut in each, thus forming a fork b . The wooden block b is mounted on a stud, similar to c , at each side of the machine; these studs are below the center of gravity of the block, so that when out of use it automatically falls into the position shown in dotted lines, raising the pins b , out of contact with the yarn. Usually the pin lease must be taken in groups of 4 ends, in which case the yarn is threaded between the pins of the pin rail in groups of 4 ends. In order that all parts may be clearly seen only one end is shown as passing between each two pins in the pin rail in Fig. 7 (*a*). When the correct length has been warped and it is necessary to insert a pin lease, the block b is turned from the position shown in dotted lines to the position shown in full lines, thus moving the forked pins downwards so as to press on those groups of yarn that pass through alternate spaces in the pin rail. By this means alternate groups of 4 ends can be pressed below the normal level of the yarn, thus forming a shed through which the lease band may be passed. The wooden block b is then turned into the position shown by the dotted lines and moved sidewise a distance equal to that between two pins in the pin rail, and again turned down. In this case, it will press down those groups of ends that were left up before and form another shed, through which the lease band is passed and its ends tied to the ends of the band previously inserted, thus giving a means of dividing the warp into groups of 4 ends after it has been passed through succeeding processes.

12. After the lease has been taken, the warper tender starts the machine slowly until the portion of the chain containing the lease bands passes forwards and arrives at the rear of the linker head. The machine is then stopped and the tender raises the weight arms m_s , Figs. 2 and 8, together with the weight m_s , by pulling down the cord m_s far enough to allow the hook at its lower end to be caught under a suitable portion of the framework of the head; this raises the weight and levers high enough to remove the entire pressure of the weight from the top calender roll m . After this

has been accomplished, the linker head is thrown out of gear, so that the chain will not be linked until after the lease band has passed through the guide tube p , by turning the collar w with the handles w_1 in the required direction to relieve the pressure of the collar w_3 against the hub of the gear r . The attendant then starts the machine slowly with one hand and with the other draws the chain through the calender rolls m, m_1 and the guide tube p until the lease band has passed through the guide tube, after which the linker head is put into gear and the machine is allowed to run until another lease is to be taken, when the operation previously described is repeated.

ROLLS

13. The **measuring roll** h , Figs. 2 and 5, is a hollow, cast-iron, cloth-covered roll, 24 inches in circumference. Immediately above it, with its ends revolving between vertical guides, is another cast-iron, cloth-covered roll h_1 of the same size, that presses heavily on the measuring roll so as to grip each warp end and thus draw the yarn at an even rate from the spools in the creels. The upper roll, which is not shown in Fig. 3, is driven by friction from the lower one, and the object of covering both with cloth is to prevent damage to the ends of yarn and yet secure sufficient pressure to draw them evenly. The return roll j is a plain iron roll. The lower flanged **calender roll** m_1 is on the shaft m_2 ; the upper one m is a small leather-covered roll supported in position by suitable vertical guides and weighted by means of levers similar to m_3 , which carry a weight m_4 . When the machine is in operation, the upper roll is held down by means of the weighted levers, so as to secure a sufficient pull on the chain passing between the two rolls; but, when so desired, the weight and levers can be raised by pulling a cord, thus removing any tension on the warp and preventing its being carried forwards. Between the return roll j and the calender rolls m, m_1 is an arched rod k and an inverted fork k_1 to collect the sheet of yarn into a chain immediately before it passes between the calender rolls.

As the yarn leaves the calender rolls, it may be allowed to fall, without being linked, into a bag suspended by hooks; or it may be passed through a linker and put up in linked form, thence falling into a bag or other receptacle, or being deposited in a pile on a piece of burlap on the floor until the chain has been completed, when it is coiled up and tied ready for baling. Besides these forms, the chain may be conducted to a balling attachment and wound in the form of a ball without being linked.

LINKERS

14. A **linker** is an attachment applied to a warper for the purpose of making links in the chain, and may be either a single or a double linker. A single linker makes a link of three thicknesses of the chain, while with a double linker five thicknesses of chain form the link. In other words, in single links the chain is reduced to about one-third its length, and in double links to about one-fifth its length. Single linkers are now seldom used, as the double linkers are considered better.

The linker on the machine under description is of the double-linker type and is shown in perspective in Figs. 1 and 8. It is attached to the front of the warper, as shown in Figs. 1, 2, and 3, and consists mainly of the framework n , Fig. 8, for supporting the various parts, such as the calender rolls m, m_1 , the guide tube p , the necessary hooks, etc., for linking the chain, and the driving mechanism for operating the various parts of the head.

The guide tube p moves in and out around two pairs of hooked arms q, q_1 and hooks q_2, q_3 in the form of a figure 8. Four positions of the tube, arms, and hooks, together with the chain as it is operated on by them, are shown in Fig. 9 (*a*), (*b*), (*c*), and (*d*). In Fig. 9 (*a*), the tube is midway between the hooked arms q, q_1 and is ready to start on its outward movement so that it may pass around the hooked arms q_1 , as shown in Fig. 9 (*b*). Fig. 9 (*c*) shows the tube in position midway between the arms q, q_1 ready to start on

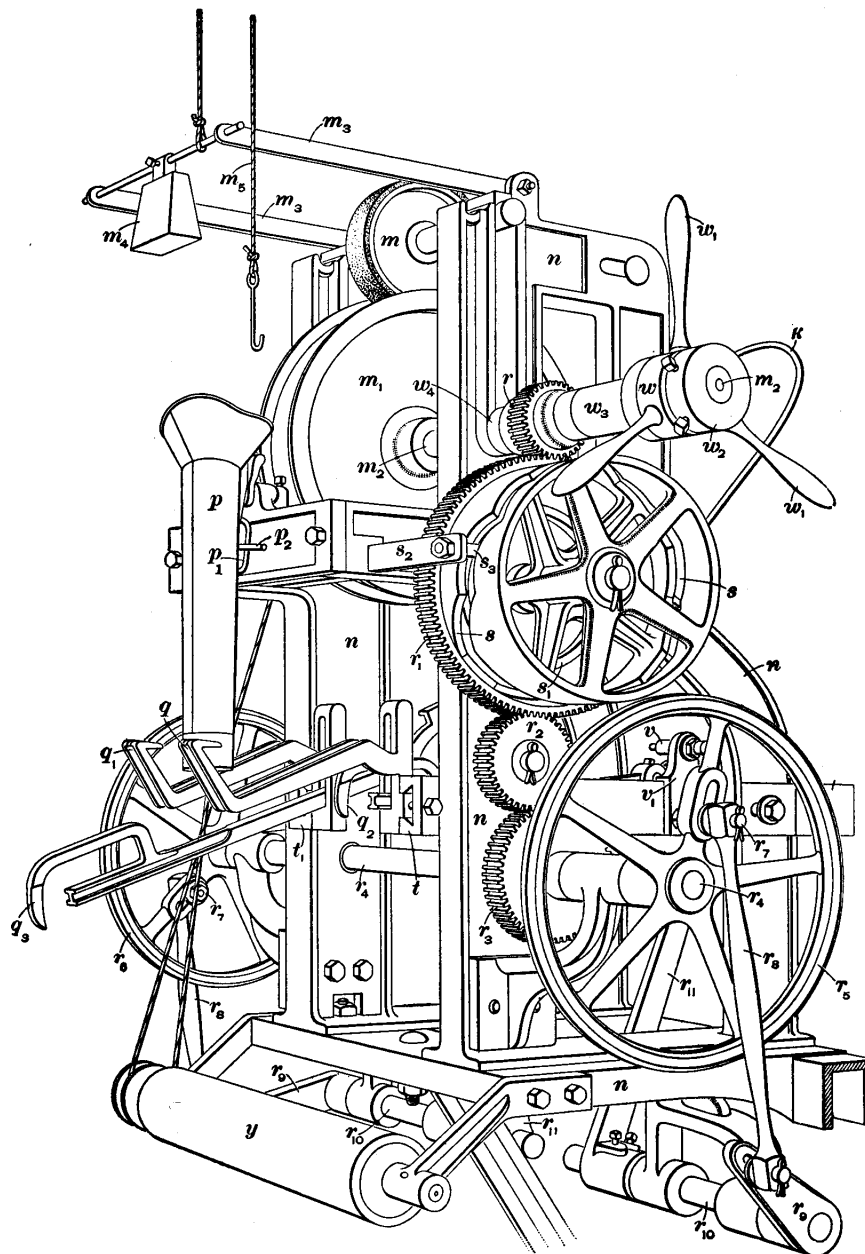
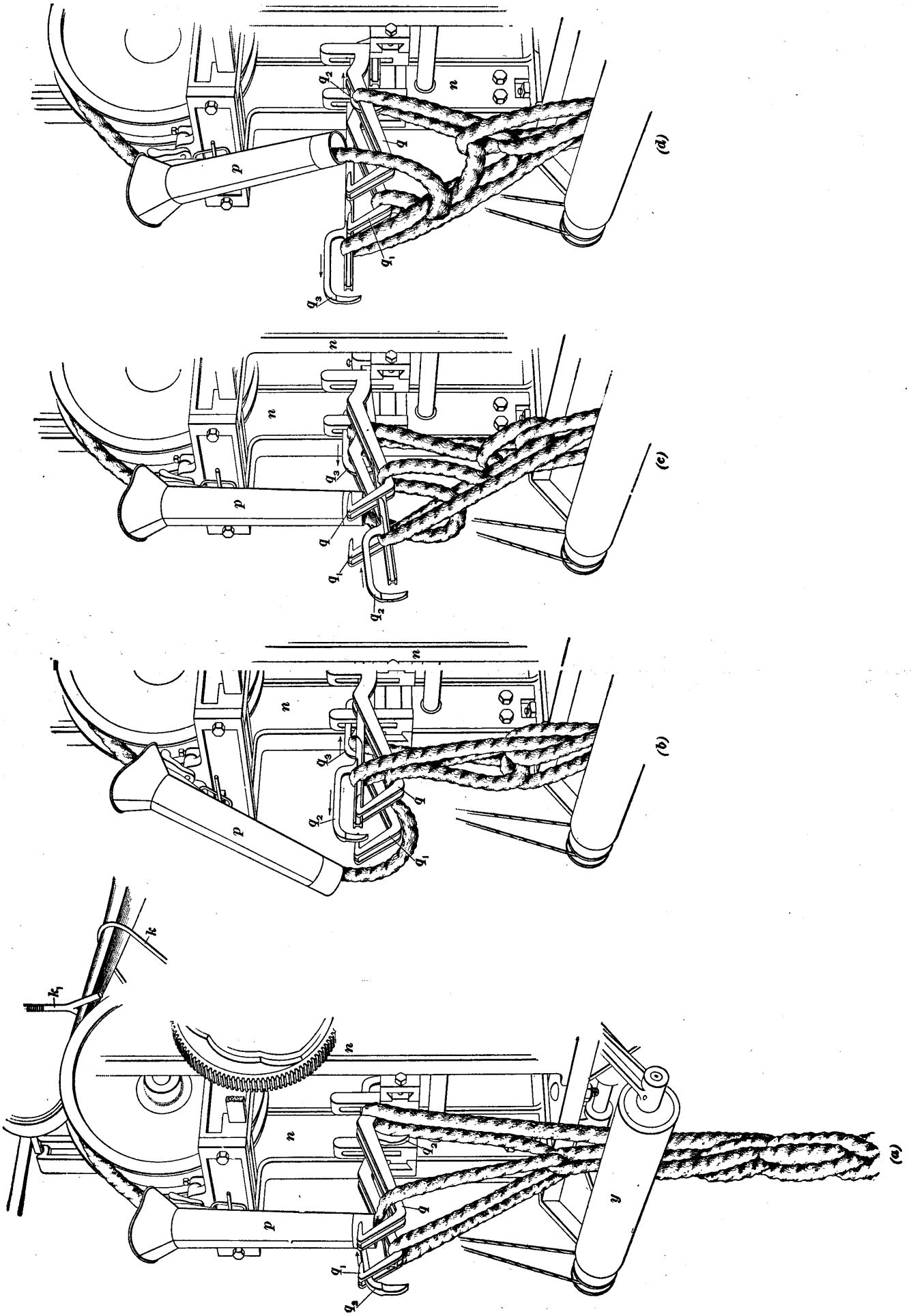


FIG. 8

its outward movement so as to pass out around the arms q , as shown in Fig. 9 (*a*). While the lower end of the guide tube p is moving about in this manner, the chain is being delivered continuously from the calender rolls, so that it is laid around the hooked arms q, q_1 and operated on by the hooks q_2, q_3 , thus linking the chain of ends as shown.

15. The linker head is driven from the gear r , as shown in Fig. 8. This gear drives the gear r_1 and the cams $s, s_1; r_1$ in turn, meshes with the gear r_2 , which meshes with the gear r_3 situated on the shaft r_4 . This shaft passes through the head and carries at each end a hand wheel r_5, r_6 . These wheels serve the purpose of crank-wheels as well, for one of the spokes of each wheel carries an enlargement in which a short stud is placed to form a connection for the connecting-rod r_7 , which is connected at the opposite end by means of a similar stud to the lever r_8 , setscrewed to a short shaft r_{10} . As the wheels revolve, a reciprocating motion is imparted to the shafts r_{10} . At the inner end of each shaft is attached a long lever r_{11} that projects upwards, as shown in Figs. 8 and 10 (*a*) and (*b*); these levers operate the hooks q_2, q_3 . Fig. 10 (*a*) and (*b*) shows interior sectional elevations of the mechanism operating the hook q_2 , and the connection between the latter and the shaft r_{10} . The connections and operations of the hook q_2 , Fig. 8, are similar to those of q_3 , the only difference being that when the hook q_2 is in its extreme outward position the hook q_3 is in its innermost position.

16. Attached to the framework n , Figs. 8 and 10 (*a*) and (*b*), on each side of the linker head are long, slotted, horizontal rails, or beds, t, t_1 . The bed t carries at its front end the pair of hooked arms q , while the other bed t_1 carries the other pair of hooked arms q_1 . The bed t_1 and arms q_1 are shown in Fig. 8. The hook q_2 , Fig. 10, has a long shank running backwards and is pivoted at u_1 to the slide u , which is so shaped that a certain portion of it fits into the groove in the horizontal bed t ; it is moved forwards and backwards along this bed by means of the lever r_{11} , to which it is attached by means of a stud screw u_2 . As the shaft r_{10}



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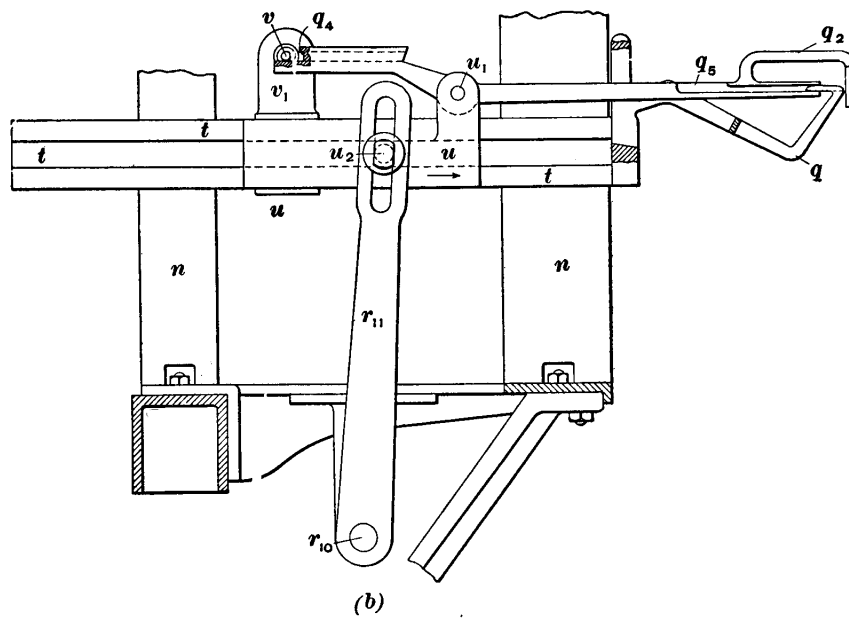
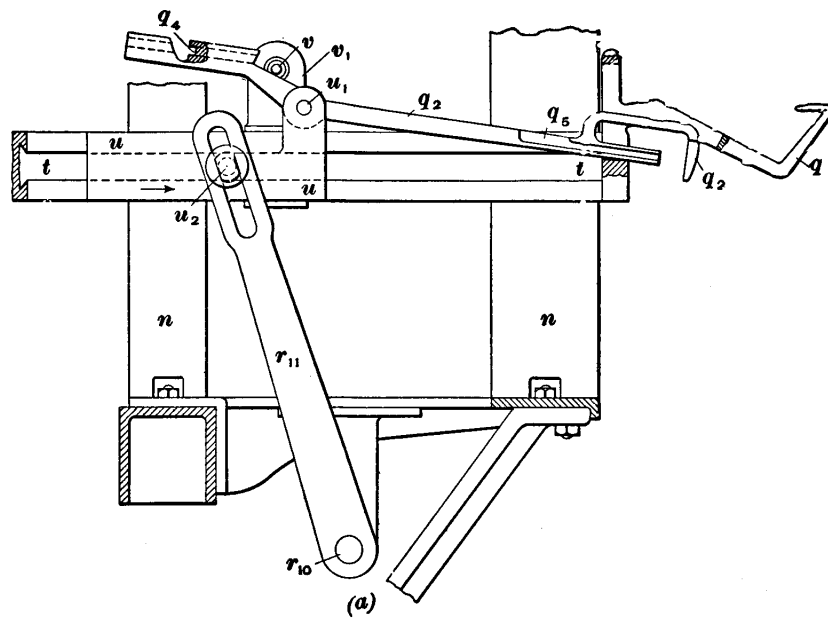


FIG. 10

oscillates, a reciprocating motion is imparted to the slide u . Since the hook q_2 is pivoted to this slide, both move in and out together.

17. In Fig. 10 (*a*), the hook q_2 is shown in approximately the same position as in Fig. 8. When the slide begins to move outwards, the hook must be raised, so that the long straight shank will be in a horizontal position. The raising of the hook is accomplished by means of the pin v , which is supported by the bracket v_1 , coming in contact with the inclined portion of the hook shank near the point at which it is pivoted. As the slide u moves outwards, as shown by the arrow, the pin v gradually forces down the inner end of the hook and consequently raises the outer end until the pin v projects into the horizontal slot q_4 , thus causing the hook, together with its long, straight shank, to occupy a horizontal position while moving outwards. The hook, as it moves outwards, is in the proper position to allow the grooved part, which is shaped as shown in Fig. 8, to pass on to the horizontal prongs of the hooked arms q , as shown in Fig. 10 (*b*). This passage takes place just before the pin v leaves the slot q_4 . With its outer end retained in this manner, the hook will occupy a horizontal position until it has moved outwards a sufficient distance to allow the opening q_5 to pass over the horizontal prongs of the hooked arms q , thus allowing the outer end to drop, as there is nothing to hold it in place. The extreme outward movement of the hook is completed at this point and it now returns and assumes its innermost position. This movement is accomplished by the backward movement of the upper end of the lever r_{11} . As the hook moves inwards, the lower edge of the inclined portion of the shank near the pivot u , comes in contact with the pin v and forces it into its supporting bracket, thus allowing the hook to pass beyond and the pin to protrude from the bracket again. Thus it will be seen that the pin has a slight lateral movement, being caused to project from its supporting bracket by a spring. When the backward movement is completed, the lever r_{11}

starts to move forwards again, carrying with it the hook q_2 , so that the pin v again comes in contact with the upper edge of the short incline of the hook, thus raising it into a horizontal position, when the cycle of operations is again repeated. This movement continues, in order that the chain may be linked as it is delivered by the guide tube.

As the hook q_2 moves inwards, it carries a portion of the chain with it, as shown in the first position, Fig. 9 (*a*); then as the hook starts to move outwards the portion of the chain that was carried back is carried forwards, as shown in the second position, Fig. 9 (*b*), and finally passed over the prongs of the hooked arms q , and drops with the hook q_2 , as shown in the third position, Fig. 9 (*c*). The hook now starts to move backwards, and as it does, the portion of the chain that has thus been acted on comes in contact with the lower front part of the pair of hooked arms q , where it is retained, as the space between these is not large enough to allow it to pass. It remains in this position until the end of the grooved part of the hook has passed and allows it to drop. As the hook continues its inward movement, it catches the portion of the chain that rests over the arms q and carries it backwards, as shown in the fourth position, Fig. 9 (*d*), until it occupies the position of the chain shown in the first position, Fig. 9 (*a*). While this hook has been at work, the hook on the opposite side of the head has been working in a similar manner, except that it reaches its extreme outward position when the first one has reached its innermost position, and vice versa. The guide tube p has also been at work during these operations, laying the chain around the hooked arms q, q_1 , so that it is in the correct position to be acted on by the hooks q_2, q_3 .

18. The guide tube p , Fig. 8, is operated by means of the cams s, s_1 and a combination of slides and levers. It is attached to the framework n near its upper end by a swinging hinge, which is operated by means of the sliding bar s_2 , the cam-bowl s_3 , and the cam s , so that it has a side movement due to the shape of the cam-course. The inward and

outward movement is accomplished by the cam s_1 , which operates, through a combination of levers, the pin p_2 that pushes out the tube and draws it in again. This pin passes through a wire loop p_1 , which is attached to the guide tube. The combined action of the cams s, s_1 , together with their connections with the guide tube p , is such as to cause the lower end of the guide tube to move in a path around the hooked arms q, q_1 corresponding to the shape of a figure 8.

19. The linker head can be thrown in or out of gear while the machine is running by turning the collar w , Fig. 8, by means of the handles w_1 . Throwing the linker out of gear does not stop the delivery of the chain, as the calender rolls continue to revolve as long as the remainder of the machine is in operation; it merely stops the linking mechanism so that the chain is delivered without being linked. The collar w is threaded on the inside and works in a short thread on the shaft m_2 . The outer end of the shaft m_2 , as shown, carries a collar w_2 that is firmly setscrewed to it; the position of this collar governs the extreme outward movement of the threaded collar w . On the same shaft with these two collars is a long collar, or sleeve, w_3 , one end of which is in close proximity to the collar w , and the other to the hub of the gear r when the head is out of gear. Fastened to the shaft on the opposite side of this gear is a small collar w_4 . When it is desired to throw the head into gear, the collar w is turned by means of the handles so that it is moved toward the framework n . Moving the collar in this direction forces the sleeve w_3 toward the gear, and a continued movement forces the gear slightly nearer the framework until it is firmly held between the collar w_4 and the sleeve w_3 , thus causing it to revolve with the shaft m_2 until the pressure is relieved by turning the collar w in the opposite direction. Fig. 8 shows the various parts in their proper positions when the head is in gear.

The roll y , Figs. 8 and 9 (*a*), simply serves as a guide roll to guide the chain as it passes downwards after it has been linked. It is driven by a small band from a grooved pulley

on the shaft m_1 . As the chain passes the guide roll y , it is usually deposited on a piece of burlap spread on the floor for that purpose; after the chain has been completed, it is ready to be coiled and baled, or put up in any other convenient manner. Sometimes it is delivered directly into bags or trucks. Linked chains are not made to such an extent at present as formerly, the tendency being more toward the production of balled chains.

BALLING ATTACHMENT

20. In case it is desired to ball the chain instead of linking it, the yarn after passing through the calender rolls m, m_1 , Fig. 2, is carried downwards at an angle under the warper, through a guide, around a return wheel, and thence forwards to a **balling attachment** fastened to the floor at the front of the machine. The return wheel is usually situated about midway between the upright standards of the machine when only one balling attachment is applied. As is shown in Fig. 11, it consists of the bed a that is securely fastened to the floor, the stand a_1 , fastened to the bed and supporting the return wheel b , and an adjustable guide b_1 .

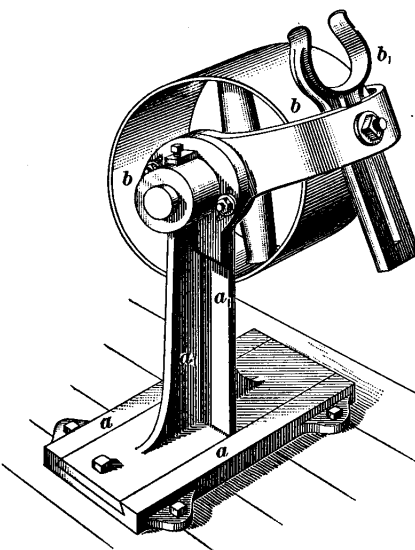


FIG. 11

The balling attachment proper is similar to that used on the ordinary type of balling warper so far as the main mechanism and construction are concerned; the principal difference is in the method of driving. The attachment shown in Fig. 12 is the type generally used in connection with the Denn warper

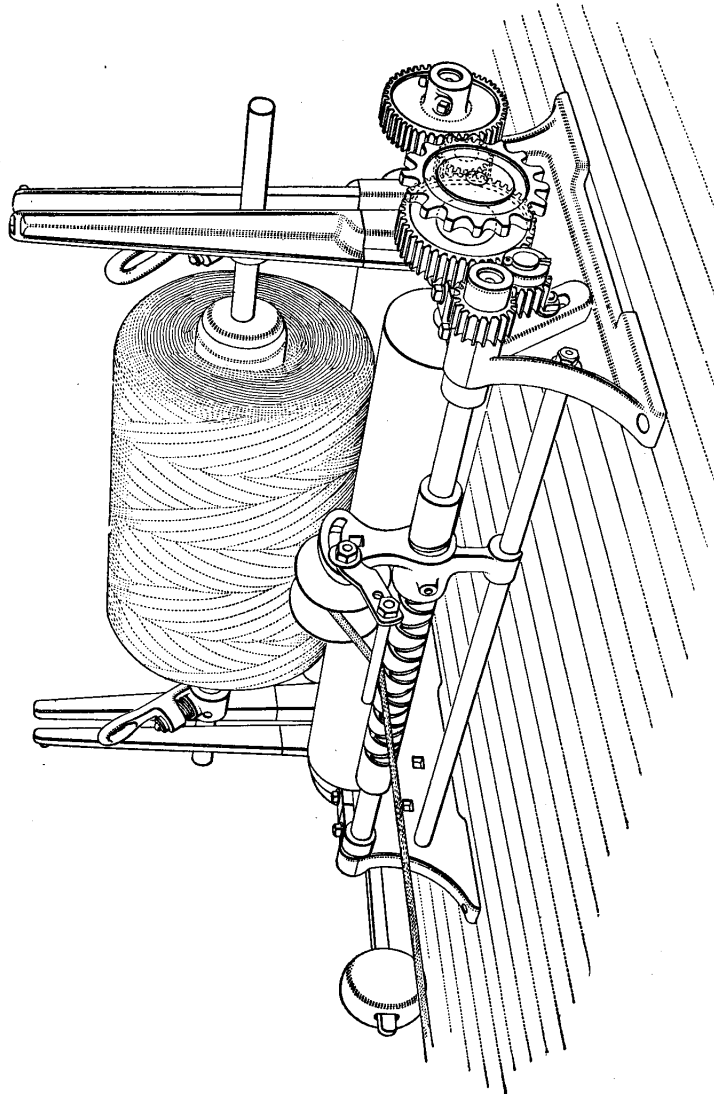


FIG. 12

for making balled chains. It is driven from the large sprocket gear m_6 on the shaft m_2 , Fig. 3, by means of a chain driving a small sprocket gear, as shown in Fig. 12. In this case no slow-motion mechanism is applied, the balling attachment being positively driven at a uniform speed.

MEASURING MOTION

21. As the chains must always be made of a specified length and usually consist of a definite number of cuts, at the completion of some of which lease bands must be inserted, it is necessary to have some arrangement on the Denn warper to indicate when the required length for each cut has been warped, when lease bands should be inserted, and also when the entire chain has been completed. In addition to notifying the operator at these points, it is of advantage to have the machine stop automatically, because of the necessity of inserting lease or cut bands at certain places.

The details of the measuring motion are shown in Figs. 13 and 14; the single-threaded worm h_1 , also shown in Fig. 3, on the cross-shaft e_2 drives the worm-gear h_2 , which in the machine under description has 78 teeth and is on the same shaft with the gear h_3 of 27 teeth; h_2 drives, through a carrier gear, the gear h_4 of 78 teeth, which is fastened on the shaft h_5 known as the *striker shaft*. The gears h_2 , h_3 , h_4 are change gears that must be altered when it is required to measure different lengths between cut marks, between lease bands, and for the entire warp. On the same shaft with the gear h_4 is a collar that carries a pin h_6 , which at a certain point in the revolution of the gear h_4 presses against the end of a wire rod h_{10} carrying a bell h_{11} . This pressure is not removed until the pin is carried around far enough to release the end of the rod h_{10} , which is then pulled back suddenly by means of the spring h_{12} , consequently ringing the bell; the curves in the wire supporting the bell tend to prolong the vibrations and intensify the sounding of the alarm. This takes place at the end of each cut.

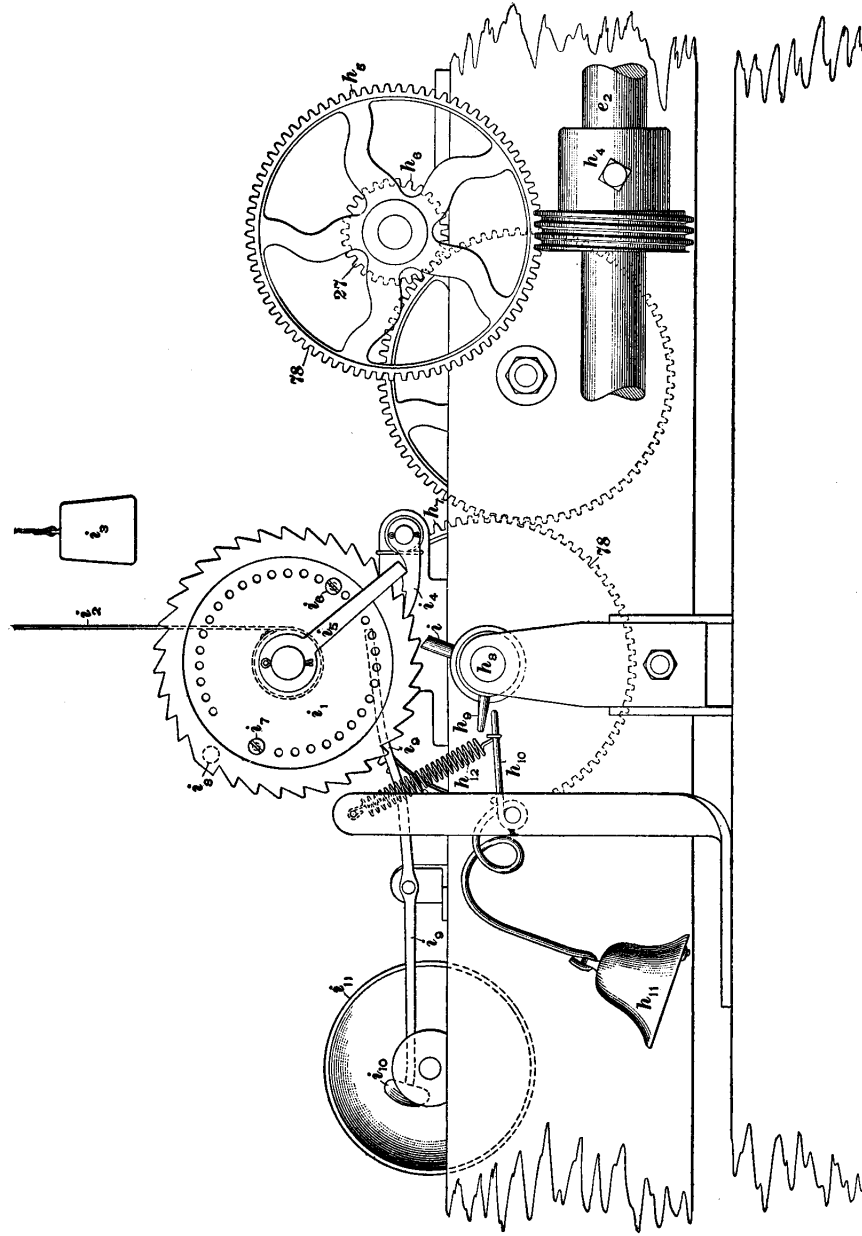


FIG. 13

22. At the same time that the bell is sounded, a pin i that is attached to the striker shaft h , in a similar manner to the pin h , moves the disk i , a distance of 1 tooth. This disk is mounted on a short stud and consists of a plate with ratchet teeth on its outer edge and a series of holes arranged

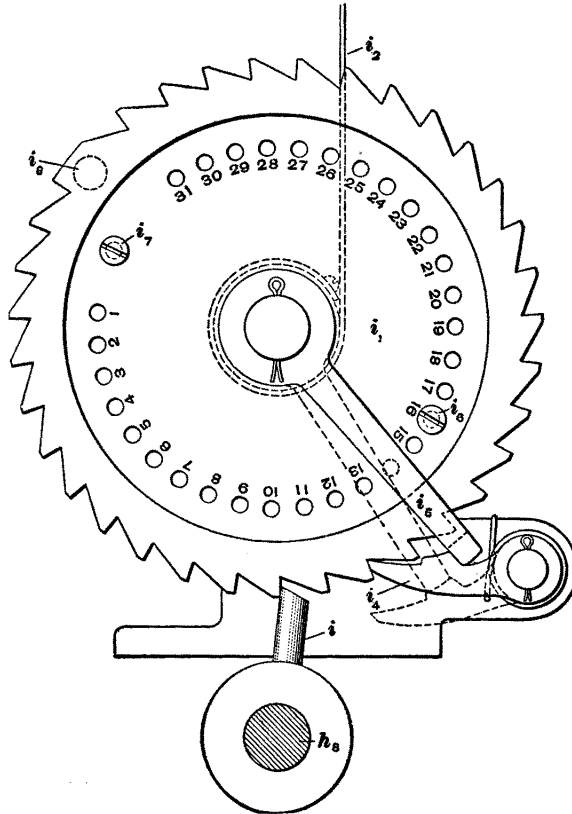


FIG. 14

in a circle in its inner part. Around the hub of the disk is wound a cord, or strap, i_2 that passes upwards over a pulley and carries at its other end a weight i_3 ; the tendency of the disk, therefore, when released, is to revolve in the opposite direction to that in which it is moved by the operation of

the pin, because the pressure, or pull, of the weight tends to unwind the cord z_2 from its hub. The pawl i_4 is held in contact with the teeth of the disk by means of a spring, and holds it in position after the pin moves it forwards 1 tooth at each revolution of the striker shaft h_8 . Hanging from the stud on which the disk i_1 is mounted is a long arm i_5 with its lower end resting loosely on the pawl i_4 . A pin i_6 may be placed in any one of the 31 holes of the disk, its position determining the number of cuts required between lease bands. In case there should be 16 cuts between leases, the pin is placed in hole number 16, as shown in Fig. 14. When the striker shaft has made 16 revolutions, it will have moved the disk 16 teeth and brought this pin in contact with the hanging arm i_5 . This will press down the arm and with it the pawl until they occupy the positions shown in dotted lines in Fig. 14; the arm in this case rests against an enlarged portion of the pawl, thus holding it entirely out of contact with the disk. When this takes place there is nothing to prevent the disk revolving backwards in consequence of the pull of the weight i_3 . It continues its backward movement until the pin i_6 strikes the arm i_5 and removes it from the projection on the pawl i_4 , which allows the pawl to come in contact with one of the teeth of the disk i_1 , thus preventing its turning any farther in this direction. The pawl stops the disk in the proper position for starting another chain. This backward movement of the disk allows the cord z_2 to be unwound from its hub and the pin i_6 to come in contact with one end of the lever i_7 , thus causing the opposite end, which carries a hammer i_{10} , to rise and strike the gong i_{11} . This notifies the operator that the required number of cuts has been warped, when he should stop the machine and insert the lease bands.

23. In the later styles of Denn warpers, which are supplied with electrical stop-motions to stop the machine in case of the breakage of an end, electricity is also applied to the measuring motion, by using a rack in place of the disk. The striker shaft moves the rack 1 tooth at the completion of each

cut, as in the case of the measuring motion with the circular disk; but when the rack has been moved a sufficient distance to bring a projecting rod situated at the end of the rack against another rod attached to a stationary part of the machine, an electric bell is rung to notify the attendant, and the warper is stopped automatically. The advantage of this is that in the event of the attendant being otherwise engaged or inattentive, if the complete length of chain has been made, the machine stops automatically and thus prevents the formation of a longer chain than is required, as happens with the arrangement shown in Fig. 13, which merely rings the gong and does not stop the machine.

CALCULATIONS

24. Calculations for Measuring Motion.—The calculations necessary for the Denn warper are limited as compared with those for other textile machines. The only ones of importance are for the measuring motion and the weight of the chain.

25. To find the number of yards in a cut when the circumference of the measuring roll, the connecting gearing between the measuring roll and the driving shaft, and the sizes of the gears in the measuring motion are known:

Rule.—*Considering the gear on the end of the measuring roll as a driver, multiply the circumference of the measuring roll by the product of the driven gears and divide by the product of the driving gears multiplied by 36 (the number of inches in 1 yard).*

EXAMPLE.—Find the number of yards in a cut for a warper geared as shown in Figs. 3 and 13.

$$\text{SOLUTION.}—\frac{24 \times 18 \times 26 \times 78 \times 78}{54 \times 26 \times 1 \times 27 \times 36} = 50.074 \text{ yd. per cut. Ans.}$$

26. The length of cut desired may sometimes require that only one of the change gears h, h_1, h_2 , Fig. 13, be changed, while in other instances two or even the entire three gears must be changed. To calculate the change gear, a constant may be found for any one of these gears.

To find the constant for finding the length of a cut or the size of the gear required to produce a cut of a given length, the sizes of the various gears being known:

Rule.—*Apply the rule for finding the number of yards in a cut, considering the change gear as having 1 tooth.*

EXAMPLE 1.—Find the constant for the measuring motion according to the gearing in Figs. 3 and 13, considering the gear h_0 as the change gear.

$$\text{SOLUTION.}— \frac{24 \times 18 \times 26 \times 78 \times 78}{54 \times 26 \times 1 \times 1 \times 36} = 1,352, \text{ constant. Ans.}$$

EXAMPLE 2.—Find the constant for the measuring motion according to the gearing in Figs. 3 and 13, considering the gear h_1 as the change gear.

$$\text{SOLUTION.}— \frac{24 \times 18 \times 26 \times 78 \times 1}{54 \times 26 \times 1 \times 27 \times 36} = .6419, \text{ constant. Ans.}$$

In example 1, the constant is a **constant dividend**, while in example 2 it is a **constant factor**.

27. To find the number of yards in a cut when the constant is a constant dividend.

Rule I.—*Divide the constant by the size of the change gear.*

EXAMPLE 1.—Find the number of yards in a cut with a 27-tooth change gear at h_0 when the constant is 1,352.

$$\text{SOLUTION.}— 1,352 \div 27 = 50.074 \text{ yd. per cut. Ans.}$$

To find the number of yards in a cut when the constant is a constant factor.

Rule II.—*Multiply the size of the change gear by the constant.*

EXAMPLE 2.—Find the number of yards in a cut with a 78-tooth change gear at h_1 when the constant is .6419.

$$\text{SOLUTION.}— 78 \times .6419 = 50.068 \text{ yd. per cut. Ans.}$$

To find the size of the change gear required at h_0 when the constant dividend and the number of yards in a cut are known:

Rule III.—*Divide the constant dividend by the number of yards in the cut.*

EXAMPLE 3.—Find the size of the change gear required at h_0 to produce a 50.074-yard cut when the constant is 1,352.

$$\text{SOLUTION.}— 1,352 \div 50.074 = 27\text{-tooth change gear. Ans.}$$

To find the size of the change gear required at h , when the constant factor and the number of yards in a cut are known:

Rule IV.—*Divide the number of yards in a cut by the constant.*

EXAMPLE 4.—Find the size of the change gear required at h , to produce a 50.074-yard cut when the constant is .6419.

SOLUTION.— $50.074 \div .6419 = 78.009$, a 78-tooth change gear. Ans.

28. Calculations for Weight of Chain.—To find the weight of a chain when the total length of the chain, in yards, the number of ends in the chain, and the ply and counts of the yarn are known:

Rule.—*Divide the product of the total length, in yards, the total number of ends in the chain, and the ply of the yarn by the product of the number of yards in a hank and the counts of the single yarn that constitutes the ply yarn.*

EXAMPLE.— Find the weight of a 10,000-yard chain that contains 2,250 ends of 2-ply 20s.

SOLUTION.— $\frac{10,000 \times 2,250 \times 2}{840 \times 20} = 2,678.571$ lb., total weight of the chain. Ans.

ELECTRICAL STOP-MOTIONS AND ANNUNCIATORS

29. Fundamental Principles of Electricity.—A principle that is now frequently applied to warping machines of certain makes is that of automatically stopping the machine through the use of electricity. But before considering **electric stop-motions**, it is necessary to give some attention to certain laws of electricity that make it possible to apply this class of stop-motions to cotton-mill machinery. The electric current must always be generated by some suitable mechanism, which for stop-motions on warpers generally consists of a dynamo placed in some suitable position with relation to the machine. If suitable connections are made, an electric current will flow from the dynamo through the connections back to the dynamo, forming what is known as a *circuit*. In order to have a current of electricity, there must always be a complete route, or

circuit, from the source of the electric current, through the various connections, back to the place from which it started. If there is more than one route that the current can follow, it will divide into two or more currents, but the maximum current will always flow through the path of the least resistance. If for any reason the circuit is broken, the flow of electricity will stop. The two ends, at any place where the circuit is interrupted, are known as *terminals*, one of which is termed *positive* and the other *negative*. The terminal from which the current would flow, if connected with the other terminal, is called **positive**, while the other terminal, into which the current would flow from the positive terminal, is called **negative**.

Substances are divided into two classes according to the resistance they offer to the flow of electricity, known as **conductors** and **non-conductors**; the former consist of those substances through which an electric current can readily pass, such as metals, while the latter comprise substances that offer great resistance to the flow, as, for instance, glass, silk, cotton, etc. When two conductors come in contact, the current readily flows from one to the other. If it is desired to prevent this flow, they must be separated by letting air or some substance that is a non-conductor intervene between them; they are then said to be *insulated*. If, while insulated, it is desired, at times, to establish a connection between them, a device, such as a switch, is interposed between the terminals. As long as the terminals of a circuit, connected with a dynamo in operation, remain insulated, no current will pass through the circuit. The terminals are then said to be *charged*, as they are ready to establish a current the moment a contact is made.

If a piece of soft iron is surrounded by coils of wire through which an electric current passes, the iron becomes magnetized and has the power of attracting certain other metals, such as iron and steel. A piece of iron magnetized in this manner is known as an **electromagnet**. This magnet must be supported by a suitable part of the machine and connected to a dynamo or some other source of electrical energy.

30. Stop-Motions.—In the latest styles of Denn warpers, electrical stop-motions are extensively used in place of the mechanical. Under certain circumstances the electrical motion is simpler and more effective. In case the electric stop-motion is applied to stop the machine when an end breaks, it is usually applied to the creels. The creels used on the machine under description for the electrical stop-motion are different from those used with the mechanical stop-motion. The main parts for supporting the spools are practically the same, but the arrangement in front of each vertical row of spools is like that shown in Fig. 15. In front of the standards *a* that carry the spools is an additional wooden vertical standard *a*₁, to

which are attached two strips, or bars, of copper *b*, *b*₁ that extend from the bottom to the top of the creel. A drop wire *c* is pivoted on a screw in the bar *b*₁, so that it is always in electrical contact with this bar. The bars similar to *b*₁ are con-

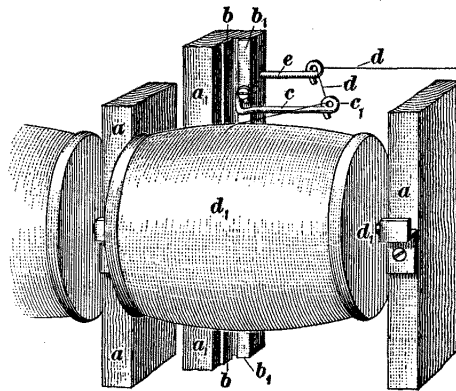


FIG. 15

nected at the top by means of wires, throughout the entire creel, to other bars running along the creel top, so that they form one terminal of an electrical circuit, while all the bars similar to *b*, which do not carry drop wires, are also connected and thus form the other terminal. Both terminals are connected with the dynamo by means of conducting wires, and one of these is so connected with the electromagnet *z*, Fig. 16, that whenever a current is passing between the dynamo and the terminals it will circulate around the electromagnet and energize it.

The end of yarn *d*, Fig. 15, passing from the spool *d*₁ is carried through a loop *e*₁ in the outer end of the drop wire and

thence to a fixed curved guide wire e screwed into the standard a_1 . The yarn supports the outer end of the drop wire c as shown; thus, if the yarn breaks, this end falls and the curved part, or shoulder, of the inner portion is brought in

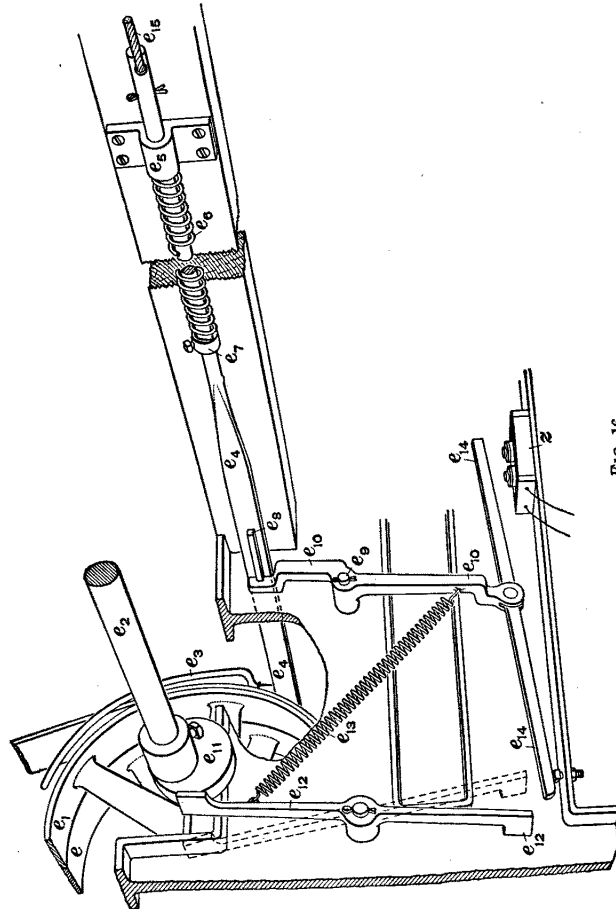


FIG. 16

contact with the vertical strip b , thus connecting the two strips b and b_1 , and allowing the circuit to be completed. With the circuit completed, the electromagnet z , Fig. 16, attracts, or draws down, the end of the lever e_{14} , which is pivoted to

the lever e_{10} , so that the other end rises and comes in the path of the lower end of the lever e_{12} , which results in the belt being shipped from the tight to the loose pulley in the same way as with the mechanical stop-motion. The reference letters in Figs. 4 and 16 are the same for corresponding parts. After the end has been pieced up, the circuit is broken again, because the drop wire is held up in position by means of the yarn; the end of the lever e_{11} , that is directly over the electromagnet is therefore allowed to rise, because the weight of the opposite end is greater, and as no current is flowing through the electromagnet, the latter is inactive and has no power to attract the lever.

31. In electrical stop-motions that are applied to stop the machine at the completion of a cut, when a lease band is to be inserted, and when the chain is complete, the desired result is accomplished by having the measuring motion so constructed that positively and negatively charged parts are brought in contact when the desired length has been run, thus completing the circuit and stopping the machine by means of the magnet in the same way as explained in connection with the breaking of an end.

32. Annunciators.—When chains contain more than 800 ends, an **annunciator** is also used in connection with the stop-motion for broken ends, to indicate the portion of the creel where the operator can find the broken end. The spools in the creels are divided into a number of groups, usually nine, each with a certain number of rows of spools. The groups are numbered to correspond to a similar number of signals in an annunciator, so that when an end breaks the signal indicating the portion of the creel containing the broken end is shown.

WALCOTT WARPERS

33. The **Walcott warper**, Fig. 17, differs from the **Denn warper** mainly in the arrangement by which the ends are brought downwards from the creel and warped at a short distance from the floor, affording ready access to the broken ends. The yarn passes from the creel a , through an eye

board, or holeyboard, *b*, thence over a measuring roll *c*, under a guide roll *d*, and through the lease reeds *e, f* mounted on stands secured to the frame of the warper. The sheet of

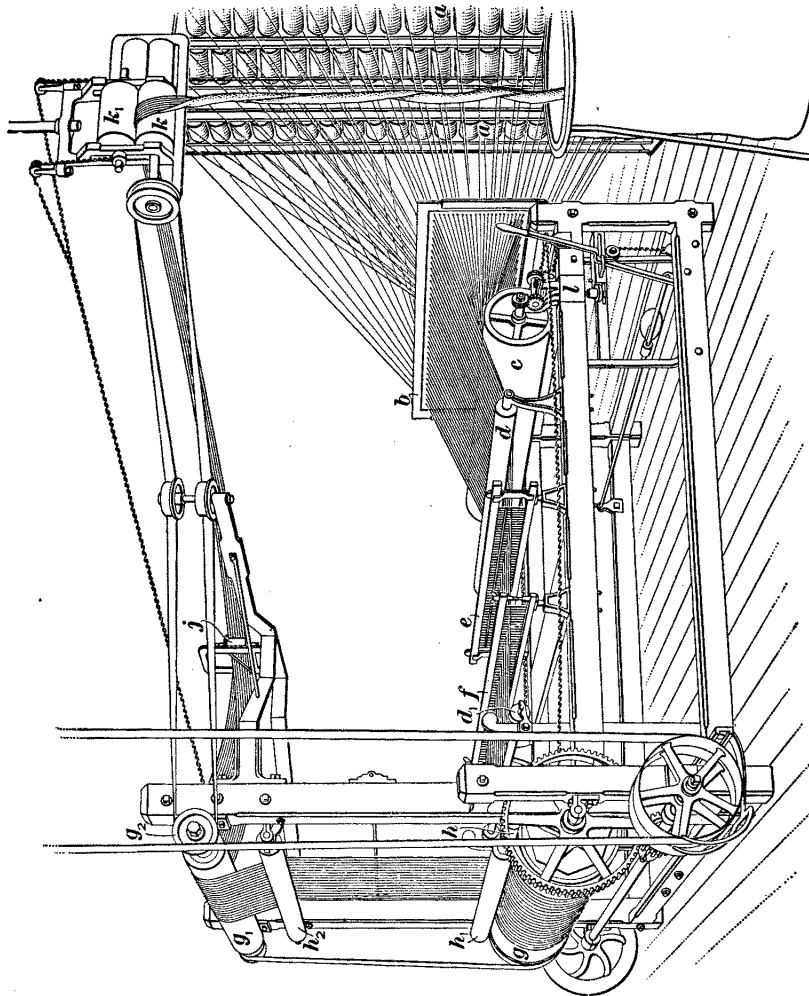


FIG. 17

ends is then conducted over another guide roll *d*₁, to and around almost the entire circumference of a large roll *g*, called a *draft roll*. This is covered with cloth, and, by

rolls h, h_1 being placed in a suitable position, is given so long a contact with the ends of yarn as to provide a steady and even pull on every end, thus insuring that all the ends shall, as nearly as possible, be the same length in the completed chain. Thence the sheet of yarn passes upwards to the roll h_2 and then around the roll g_1 , which has the same circumferential speed as the draft roll g . Up to this point the yarn has been in a wide, evenly laid sheet, but now it is contracted and carried around a guide pulley j and between the condenser, or calender, rolls k, k_1 . The upper roll k_1 is self-weighted, i. e., of sufficient weight in itself to draw the chain between the two rolls; it is driven by friction from the bottom roll k , which is driven positively, by means of a belt, from the pulley g_2 on the end of the roll g_1 , the direction of the belt being changed by means of guide pulleys, as indicated. The upper roll can be raised when necessary by a chain that is attached to a bearing at each end of the roll. From the condenser rolls, the warp drops into a bag, box, or other suitable receptacle. It is then ready to be put in proper form for shipment, or may be taken out and either linked or balled by means of a linker or a balling machine.

Fig. 17 shows a Walcott warper without a stop-motion, but one can be applied if required. A measuring motion is connected with the measuring roll as shown at l . Any of the types of leases described can be taken on this machine as well as on any other machine. They are generally taken by means of reeds similar to e, f , which are constructed especially for this purpose. Walcott warpers are usually constructed so as to make chains containing up to 1,200 ends and are used chiefly for short chains, although long chains can be made if required. The space occupied by a Walcott warper with a creel for 1,200 spools is 13 feet by 32 feet; its height is $8\frac{1}{2}$ feet.

of **beaming**, although it is sometimes called **Yorkshire dressing**, after the name of the English county where it is widely in use.

36. Passage of the Yarn.—The chains, shown in ball form, are placed on the floor and passed upwards between two wooden rolls and over a slotted block of wood, after which they are loosely opened out; if they contain bunch-knot leases or bout leases, they are usually divided accordingly, care being taken to arrange the threads in the same relative positions as they occupied when being warped. At a distance of several feet is placed a framework consisting of two stands, or supports, a, a_1 , Fig. 18, and three or four wooden bars, which are usually either oval or square with the edges rounded off to prevent damaging or cutting the yarn. When more than one chain is used, as shown, each chain is generally opened out into a sheet, so that the various ends will occupy the same relative positions as in the warper; each chain is passed over a separate bar. After each sheet has passed over its respective bar, they all pass downwards and around the roll b and thence forwards to the loom beam c .

37. Driving.—Power is applied to the front section of the machine by a belt from the shafting of the room, which runs to the tight-and-loose pulleys d, d_1 , Fig. 18, being guided by means of a belt fork d_2 . On the same shaft with the tight-and-loose pulleys is a three-speed step pulley e , while directly above it is another three-speed step pulley e_1 on a short shaft. On the same shaft with the latter is the first gear f of a train of three gears by which the beam is driven.

The step pulleys give a ready means of changing the speed at which a beam revolves and consequently the speed at which the warp passes through the machine. The slowest speed is obtained by having the belt connecting the step pulleys on the smallest part of the lower step pulley and the largest part of the upper step pulley; the fastest speed is obtained by putting the belt on the largest part of the lower step pulley and on the smallest part of the upper step pulley; while an intermediate speed is obtained by placing the belt

on the middle section of each step pulley. In case the yarn separates easily and is of good quality, the fast speed is used; where a tangled or tender warp is being beamed, the intermediate or slow speed is used.

38. Operation.—The operator stands between the two sections of the machine and operates a reed with one hand and a brush with the other. The reed is of the ordinary type used in a loom and the ends pass through the dents in the same order as leased. If there are 4 ends to a pin, i. e., if the pin lease separates the chain into sections of 4 ends each, then 4 ends will pass through each dent; if there are 6 ends to a pin, then 6 ends will pass through each dent; and so on. The reed is supported by the sheet of ends and is moved slightly to and fro by the hand of the operator so as to open up the sheet effectually without breakage.

After the power is applied and as the yarn begins to be drawn over the frame downwards and horizontally toward the loom beam, the beamer tender constantly passes the brush over the surface of the warp, between the reed and the loom beam; the individual bristles of the brush project between the ends and thus effectually separate them and destroy any entanglement that may have been caused through the dyeing or bleaching or other converting processes.

The overhead system of beaming is used to some extent in the United States and quite commonly in Europe, but only for short-chain warps.

ENTWISTLE TYPE OF BEAMING MACHINE

39. A more common system, especially for long-chain warps, although it can be used equally well for short chains, is the **Entwistle beaming machine** shown in Fig. 19. This beamer consists of two distinct sections—the *head*, or front section, *a* and the *tension*, or rear, section *b*. Between these two sections are a number of minor parts.

40. Passage of Yarn.—A ball or coil of chain is deposited on the floor between the front and rear sections and one end of it passed up over the guide pulley *c*, which

is supported from the ceiling, downwards at an angle to the lower tension drum *d*, then up between two of the guide rolls of the set *e*, around the upper tension drum *d*₁, down

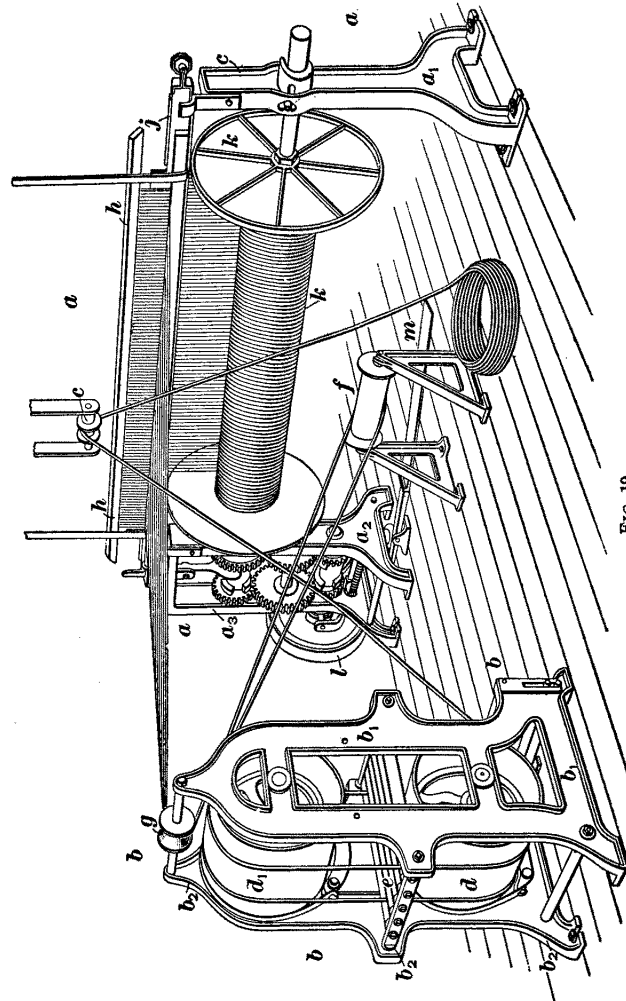


FIG. 19

between two other guide rolls and again around the lower tension drum, then upwards and again around the upper tension drum, from which it passes downwards at an angle

to the return roll *f*, which is supported by two stands attached to the floor. From the return roll *f*, the chain passes back to the rear section *b*, around the return pulley *g*, and thence forwards to the front section *a*. On its way to the front section, the chain is opened into a level sheet of ends and passed through the swinging reed *h* before it reaches the expansion comb *j* and the beam *k*.

41. The **tension**, or rear, section *b* is composed of two upright supports *b*₁, *b*₂, that are connected by the necessary rods and braces. The tension drums *d*, *d*₁ are supported by these standards and serve to give the chain the necessary tension so that it can be opened properly and wound on the beam with the correct amount of firmness. Between the standards and also between the tension drums is a set of five small guide rolls *e*, which guide the chain in its passage from the lower tension drum to the upper one, and vice versa. Directly above the center of the upper surface of the top tension drum is a small grooved return, or guide, wheel *g* from which the yarn passes to the front section.

42. The **head**, or front section, *a* is composed of three upright supports *a*₁, *a*₂, *a*₃, which are securely fastened to the floor and connected in a proper manner. The uprights *a*₁, *a*₂ carry the bearings for the beam on which the yarn is wound and also the expansion comb *j*, which is of the ordinary construction and spreads out the ends in an even sheet so that they will lie properly on the beam. The beam *k* is of the ordinary construction, such as is used in the slasher or loom. The reed *h* is usually suspended from the ceiling by straps, as shown, so that it can be moved back and forth for a short distance. Only one end of yarn passes through each dent of the reed on its passage to the beam. The standards *a*₂, *a*₃ support the necessary driving mechanism.

43. Driving.—The driving of this machine is accomplished through a friction clutch pulley *l* so connected to a treadle *m* that the machine can be stopped instantly, when occasion demands. The friction clutch pulley is connected

to the beam by two trains of clutch gears, so that four different speeds may be obtained.

44. Operation.—After a chain has been placed in position between the front and rear sections and passed through and around the various parts to the beam, the machine is started by the pressure of the foot on the treadle. The operator stands in front of the beam and moves the reed *h* to and fro with his hands in order to effectually separate the threads so that they may pass properly to the beam without breaking or becoming tangled.

45. The floor space occupied by this machine is about 27 feet long by about 8 feet 8 inches wide. The driving pulley is usually about 18 inches in diameter and is driven by means of a $2\frac{1}{2}$ - or 3-inch belt at the rate of about 60 revolutions per minute. Measuring clocks are sometimes applied to indicate the length wound on the beam. Beam compressors are also used on certain occasions so that the yarn may be wound more firmly on the beam. This machine can be used for transferring the yarn to loom beams for use in the loom or to section beams for use in the slasher. A beamer of this type will produce about 670 pounds of number 20s yarn in 1 day of 10 hours with an allowance of about $33\frac{1}{3}$ per cent. for stoppages, etc.

46. The beaming process completes the warp ready for the loom on the short-chain system, except for the attaching of the reed and harnesses. On the long-chain system, the warp remains on a section beam after the beaming process and is then dealt with by the method common to the ordinary cotton-warp-preparation processes—several of these section beams are placed in a slasher and there sized and run on to a loom beam, after which the ends are drawn in through the harnesses and reed, when the warp is ready for the loom. It is this possibility of obtaining a very considerable length of yarn on a section beam that renders the long-chain system more economical, and increases its popularity, especially for colored-goods manufacturing.

QUILLING

CONSTRUCTION OF THE QUILLING MACHINE

47. The last process on the long-chain system for filling yarns is that of **quilling**, in which the yarn forming the chain is wound on filling bobbins, or quills, ready for the

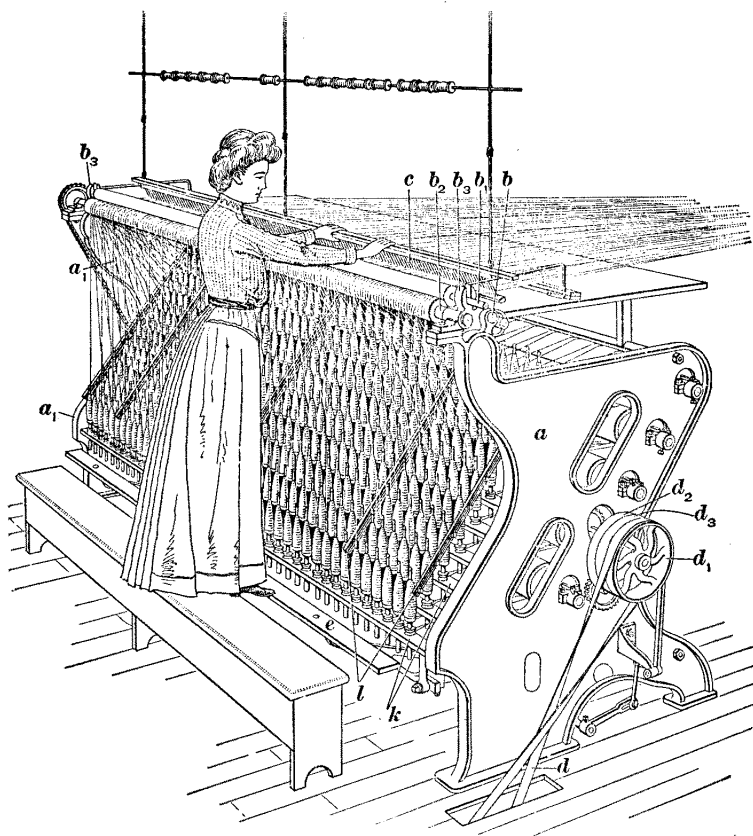


FIG. 20

shuttle. The quilling machine consists of two main sections, the quilling machine proper, shown in Fig. 20, being a substantial framework holding a series of spindle rails, usually

nine in number, arranged in tiers, with 42 spindles in each tier. The other portion of the apparatus is not shown in Fig. 20, but somewhat resembles the rear, or tension, part of the long-chain beaming mechanism shown in Fig. 19, consisting merely of tension rolls by which the yarn is held before passing to the quilling machine proper.

The end standards a, a_1 support three long metal rolls that serve to draw the yarn forwards into the machine. Only two of these rolls are clearly shown, but the extreme end of the third can be seen at b . The rolls b, b_2 are in the same plane and parallel, with only a slight distance between them. They are held securely in bearings at each end, while the roll b_1 rests on top of them, its ends working in vertical slides b_3 . The yarn passes through a reed c that is situated directly behind these rolls; then it passes over the roll b , under the roll b_1 , and over the other roll b_2 . The reed c is suspended so that it can be moved backwards and forwards slightly, in order to properly separate the ends, to prevent breakage, etc.

Power is applied to the machine by means of a belt d , which drives the loose, tight, and slow-motion pulleys d_1, d_2, d_3 , respectively, and is shifted by a belt fork actuated by the treadle e .

48. The **spindles**, of which there are 378 in a frame, are shown in Fig. 21, (*a*) showing a perspective and (*b*) a section through a spindle and bobbin. The spindle proper extends from f to f_1 , the whorl f_2 being rigidly attached to it. Immediately above the whorl is a small pad of woolen felt g , on which rests a cap h , consisting of the lower flange h_1 and the upper flange h_2 , in which is inserted a pin h_3 , the upper part of the cap being extended to form a sleeve h_4 . The **bobbin** j rests on the cap h and is driven either by having a slot cut in its lower portion to fit over the pin h_3 , or having a pin j_1 in its base that comes against the pin h_3 .

The spindles themselves fit into recesses prepared for them in each of the spindle rails k , Fig. 20, and are driven

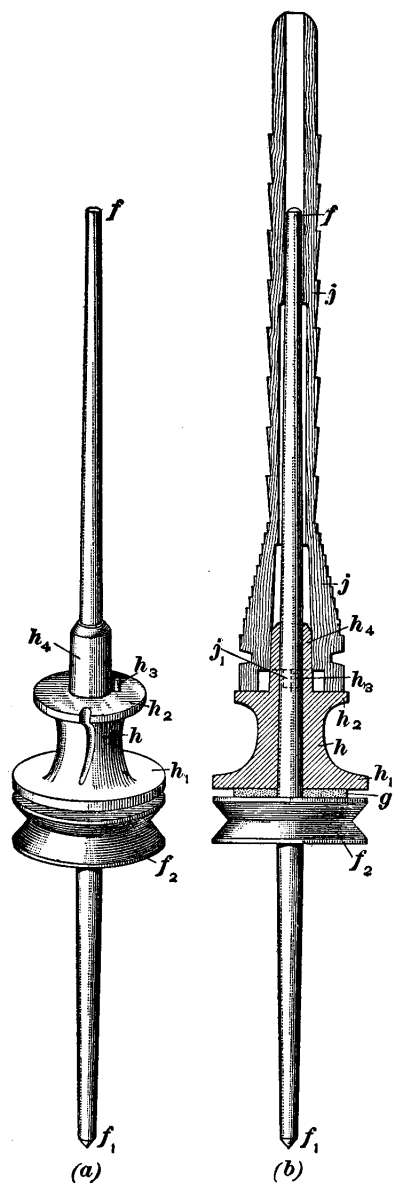


FIG. 21

by spindle bands from a number of cylinders inside the frame that are driven from the main driving shaft. The spindle itself is positively driven, but the bobbin is driven from the cap *h*, Fig. 21, which is supported by the piece of woolen cloth and receives its motion through the friction between it and the upper part of the whorl of the spindle. This friction is sufficient to drive the bobbin at such a speed as to take up all the yarn that is brought forwards from the chain, but in consequence of the drive not being positive, breakage of yarn by excessive tension is prevented.

49. Directly in front of the bobbins are series of guide wires attached to the inclined bars *l*, Fig. 20, which in turn are supported by vertical rods and actuated by a **builder motion** that gives them a vertical reciprocating motion corresponding to the length of traverse required in winding the yarn on the quills. The builder motion used on this machine resembles very closely the filling-wind builder used on

the ring spinning frame. The guide bars *l* are raised a little higher at each traverse, thus building the yarn on the bobbin gradually from the bottom to the top, so that it can be unwound readily from the nose when placed in the shuttle. The builder motion winds slowly in one direction and then returns quickly; thus the return layer of yarn binds firmly to the quill the layer of yarn previously wound and makes a hard bobbin suitable for the weaving process.

The quills commonly used are about 7 inches in length and will contain about 1,900 yards of No. 30s yarn. It will be noticed that the filling does not come in contact with any portion of the machine that tends to burnish it by continual friction.

A quiller of the type described occupies a space of about 4 feet wide by 10 feet 10 inches long without the chain tension head, etc.; with these parts the space required is 10 feet 10 inches by about 30 feet. The main driving shaft of this machine with the belt on the tight pulley should make about 320 revolutions per minute. The driving pulley is usually about 10 inches in diameter and is generally driven by means of a 2-inch belt.

MANAGEMENT

50. Warping and quilling machinery, like all other textile machinery, requires careful attention. In some places high speed and production, as regards quantity, receive the greatest amount of attention, while the quality of the product is ignored. To obtain quality and then quantity should be the aim, and in order to do this to the best advantage, the machinery should be properly cared for. Important points in caring for machinery are oiling, repairing, cleaning, speed, etc. Probably the most important point that is neglected is the proper oiling of the various parts of the machines. All revolving, swinging, and sliding parts should be carefully oiled at stated intervals. The oil should generally be applied in small quantities, as a small quantity of oil in the proper place is far better than a large quantity in the wrong place

and only a part of it in the proper place. The swiftly revolving parts should be oiled twice daily; those parts that move very slowly, once weekly; while those between these extremes should be oiled once daily, every other day, etc.

Repairing is an important point that should always be attended to as thoroughly as possible under the circumstances, no matter what the nature of the breakdown or damage may be. Proper repairing, as well as proper oiling, adds to the quality and quantity of the production.

The cleaning of the machines should be regularly and carefully attended to, especially in regard to removing the lint and oil that collect around or near the parts with which the yarn comes in contact. All other parts should also be kept clean.

The speed of the machine should not be excessive. High speeds can be obtained on almost every machine, but just as soon as the proper working speed is exceeded, the quality of the work will deteriorate.

Piecing-up and doffing should be carefully performed in the manner best suited to the machine under operation. Most tenders have their own ways of performing these operations, yet in the main they are all similar.