

WINDING

TUBE WINDING

INTRODUCTION

1. In the textile industries, yarns are wound, for various purposes, in forms and on machines that differ according to the object desired. A form of winding that of late years has assumed considerable importance and appears to be on the increase is that of winding yarn, thread, and twine on wooden or paper tubes (generally the latter) either of the cylindrical or conical type. The word parallel is used in the textile trades for cylindrical when applied to such tubes. A parallel tube containing yarn is generally spoken of as a *tube*, but sometimes as a *cheese*, while a conical tube filled with yarn is generally called a *cone*, although in some places both the parallel and conical tubes are spoken of as cheeses. The process of winding that produces parallel or conical tubes is spoken of as *tube winding* or *cone winding*, respectively. Owing to the method of guiding the yarn to the tube by means of a rapid traversing motion, which causes the yarn to cross the path of yarn previously wound on the tube, still other names are applied to this method of winding; for example, *cross-winding* and *quick-traverse winding*. From the fact that the yarn is wound by means of contact with a revolving drum, it is sometimes called quick-traverse drum winding, but this name is unsuitable and tends to confuse the process with the ordinary method of drum winding on a double-headed spool, for which machine the name of drum winder should be reserved. Throughout this Section the name tube

For notice of copyright, see page immediately following the title page

winding will be used and should be understood to cover the process of winding yarn, in any machine, on either a parallel or conical tube without heads or flanges.

2. Yarn may be wound on tube winders from either cops, bobbins, skeins, spools, or, sometimes, cheeses. In cases where single yarn that is in the form of a cop or spinning bobbin, ply yarn that is on a twister bobbin, or yarn that has been bleached, dyed, or mercerized and remains in skein form has to be sold and transported a considerable distance, the tube winder is very useful. It is especially advantageous when the yarn has to be used afterwards at a machine or process where it is convenient to take it from a fixed creel or framework capable of holding a considerable supply of yarn. For example, at many knitting machines it is convenient to take a number of ends of yarn from a creel or stand, and the longer the supply of yarn lasts, the better; in such cases the conical-tube formation is frequently used. In some forms of sewing, seaming, edging, or covering machines, it is possible to take the thread from a tube on a fixed stand, as is also the case in the use of twine and small cords; and in these cases also the conical tubes are often used. The parallel-tube form is especially suitable for winding yarn intended for warps, and which is to be transported a considerable distance, since the ends can be warped directly from the parallel tubes placed in an ordinary warper creel, thus saving the transportation and return of wooden warper spools, which is expensive and inconvenient. The largest use of tube winders is for making cones of knitting yarns.

Another object in the use of a tube winder is to perform the duty of a doubler winder. Tube winders are so constructed that one end only may be wound on a tube or, when desired, two or more ends may be wound together side by side, the operation of course being simply one of winding; the ends are not twisted together at this process. The objects of this machine may therefore be said to be: (1) to wind a considerable length of yarn on a tube in such a form that it may be handled without being damaged and unwound

easily at the succeeding process; (2) to wind a number of ends together on one tube and at an even tension, in order to prevent corkscrewing or imperfections when twisting these ends together to form a thread or a ply yarn. Large quantities of yarn intended for covering electric wire are wound in this manner.

3. The principle on which the tube winder is constructed and operated is to give to the end or ends being conducted to the tube a rapid reciprocating traverse motion, so that the end of yarn is first carried from one side of the tube to the other and then rapidly reversed and carried back again. By this means one layer of yarn serves to bind the preceding layers, and as the end of yarn is only allowed the briefest possible dwell at each side of the tube, only a small portion of its length remains at the side at each traverse; therefore, the yarn that forms the edges of the tube is held firmly by the succeeding layers, and thus at each side of the tube firm ends are produced, which allow transportation or handling without the yarn becoming entangled at the ends. By this means, a structure of yarn is built up without the use of heads or flanges at the ends of the tube, and at the same time it will satisfactorily unwind at the next process. Tube winding thus differs in two essential features from the older form of winding yarn in parallel coils by means of a slow traverse along the surface of a double-headed wooden spool, either mounted on a vertical spindle, as in case of a spooler, or resting on a drum, as in case of a drum spool winder.

QUICK-TRAVERSE DRUM WINDERS

4. All types of tube winders have many features in common. The object and result in each case is practically the same, the differences being chiefly in the methods of imparting the traverse to the yarn and in the detailed construction of the machine in the matter of stop-motions, etc. In a large number of machines, the yarn is wound on the tube by contact with a revolving drum; while in another style, the yarn is guided along the surface of a tube

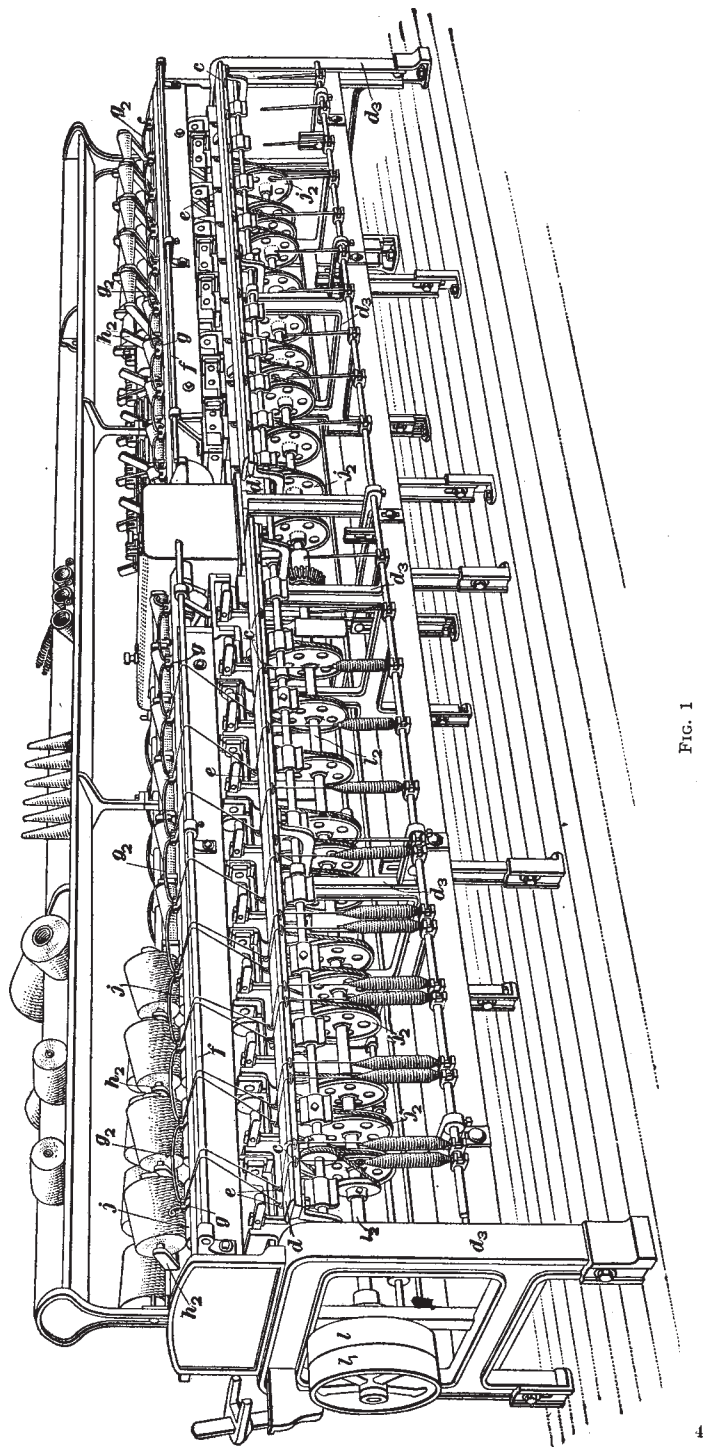
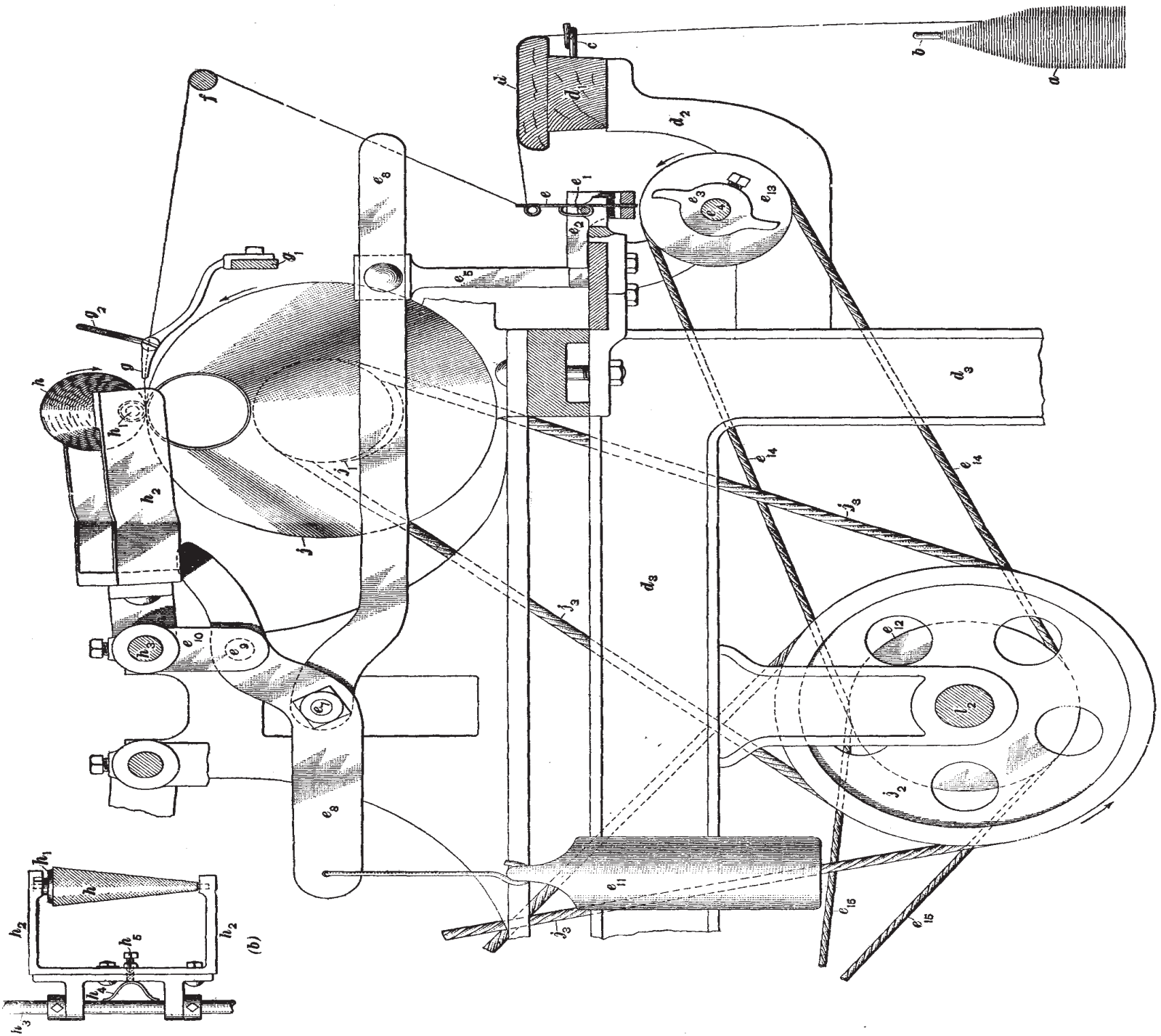


FIG. 1



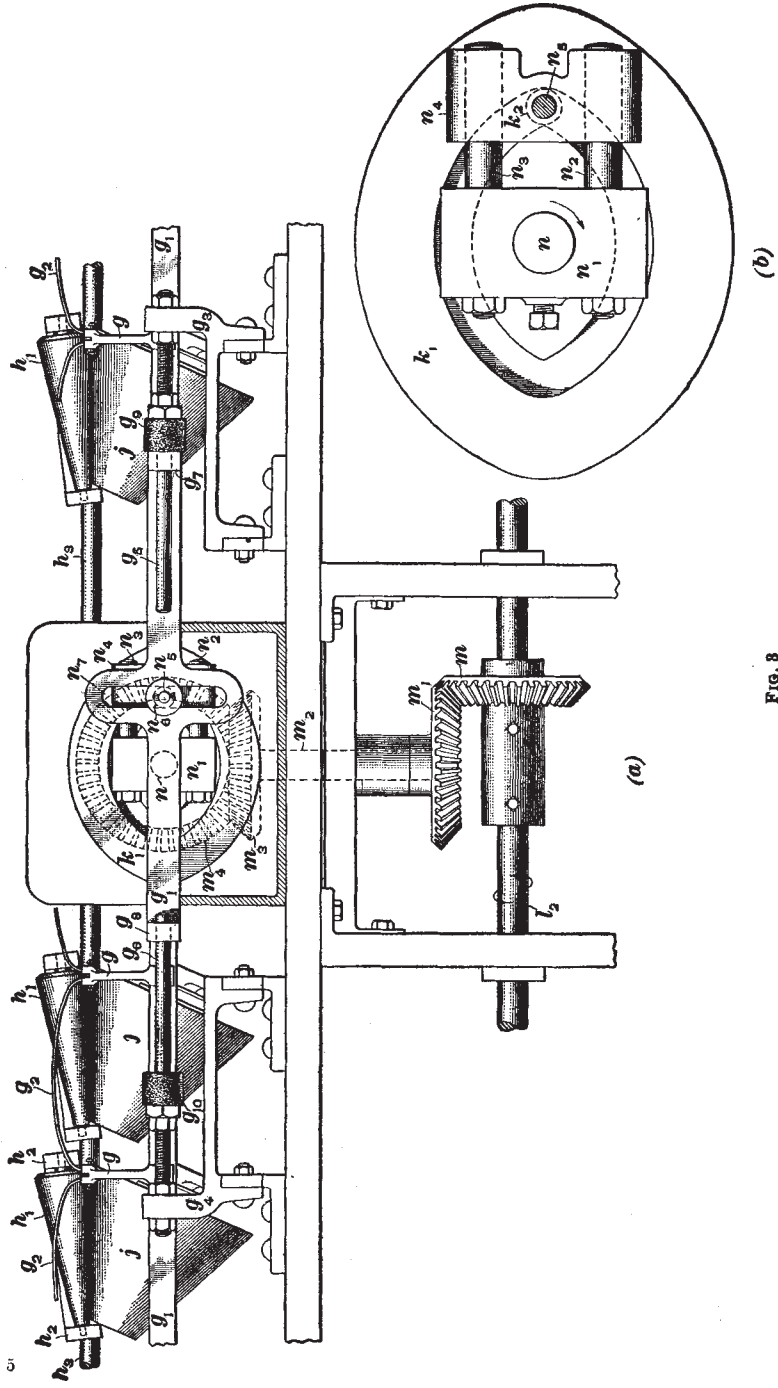


FIG. 8

mounted on a revolving spindle; the latter is known as the *Universal system*.

One form of tube winder in which the winding is performed by means of contact with a revolving drum and which possesses all the typical features of a quick-traverse cross-winding frame is shown in Fig. 1. A section through

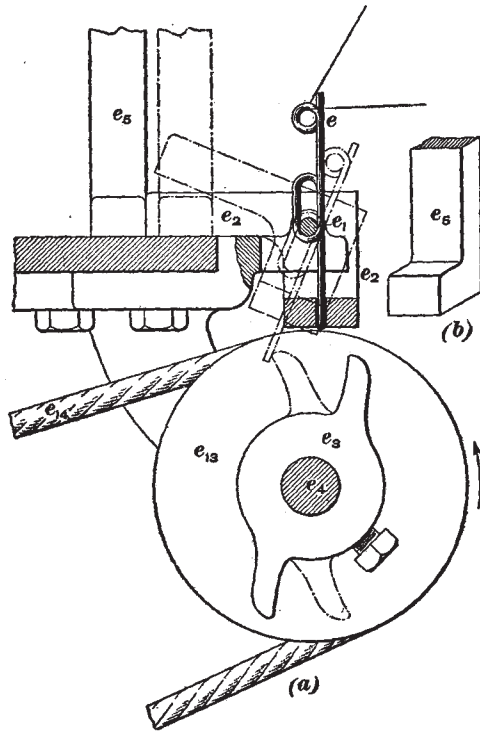


FIG. 4

a portion of the frame is shown in Fig. 2 (a); the mechanism for producing the traverse in Fig. 3 (a) and (b); and the stop-motion and connected parts, in Fig. 4. A plan of the driving of the drums and the knock-off dog-shafts is also shown in Fig. 6. The same reference letters apply to the same parts when represented in different figures, and in considering the construction of the machine it is advisable to

refer to the parts as represented in each of the drawings in which they are shown.

5. Passage of the Yarn.—The material being wound passes from the creel, which is shown in Fig. 2 (*a*) as holding a cop, through the first wire-guide eye *c*, over and into contact with the tension board *d*, through the upper eye of the stop-motion wire *e*, around the guide rod *f*, and thence through a slot in the traverse guide *g* to the tube *h*, on which it is wound and which rests on the winding drum *j*. The arrangement for the passage of the stock is the same at each drum along both sides of the machine, for quick-traverse tube winders are constructed with the two sides of the frame alike so as to economize in floor space and the cost of construction of the machine.

6. The creel, shown in Fig. 1, consists of a round rod to which are setscrewed footsteps carrying skewers, or spindles, on which are mounted cops or bobbins of yarn [both cops and bobbins are shown in the creel in Fig. 1, while one of the cops is also shown at *a* in Fig. 2 (*a*)]. The creels of tube winders may be constructed to receive either cops, bobbins, cheeses, skeins, or spools, depending on the form of the yarn that is to be wound. When used also as doubler winders, the creels are so constructed as to hold a supply from two or more cops, bobbins, etc. for each drum. In Fig. 1, the first four drums are shown as being used for doubler winding, taking ends of yarn from two cops. The next two drums each take one end of yarn only from a cop, while the seventh and eighth drums each take one end of yarn from a ring-spinning bobbin with filling wind. Above the frame and supported at intervals by brackets are two slightly inclined shelves, each of which slopes toward a central vertical partition, thus forming a receptacle for the supply of yarn for the creel and also for empty and filled tubes.

7. Driving of the Winding Drums.—In the application of power to the tube winder two important points must receive consideration—the driving of the winding drums and the method of giving motion to the yarn-traversing apparatus.

Underneath and along the middle of the machine is a driving shaft l_2 , Figs. 1 and 2 (*a*), carrying at one end a tight pulley l and a loose pulley l_1 , Fig. 1. At intervals along the driving shaft are placed double-grooved band pulleys j_2 , Fig. 2 (*a*), each of which drives two winding drums, one on each side of the frame, by means of a band j_1 that passes partly around the pulley j_2 , then around a smaller grooved pulley j_1 attached to the drum j , again around the pulley j_2 , and finally around the pulley j_1 attached to the drum j on the opposite side of the frame. The band is open on one side of the frame and crossed on the other side. In connection with this description, Fig. 6 should be referred to, as this is a top plan view of the banding of one type of a quick-traverse drum winder, which is similar to the one under description except for the mechanism for imparting the traversing motion.

8. Center Traverse Motion.—The traverse motion shown in Fig. 3 is often called the **center traverse motion**, to distinguish it from an older form of traverse motion known as the *end traverse motion*. The winding drum j , Figs. 2 (*a*) and 3, is conical, but as it is mounted so that its center arbor, or spindle, is at an angle, the portion of the drum that happens to be on the upper side is always in a horizontal position. Resting on the upper surface of the drum is a tube h mounted on a mandrel h_1 , which is cone-shaped for conical-tube winding and straight for parallel-tube winding. The tube is, of course, either cone-shaped or cylindrical according to the method of winding desired. The mandrel revolves in bearings carried by the frame h_2 , which can be raised by suitable mechanism and the tube thus lifted from the winding drum. The machine described is shown arranged for winding conical tubes.

Immediately in front of the winding drums is a traverse rod g , having a horizontal reciprocating motion and supporting the traverse guides g . In the upper part of the traverse guide is cut a small slot, through which the yarn passes to the tube when being wound. Curved pieces of wire g_1 are setscrewed to the guides g , as shown in Figs. 1, 2 (*a*), and 3,

thus connecting and steadying the guides by forming bridges between them. The wires g_2 also furnish a means of guiding the yarn into the slot, so that after an end has been broken and pieced by the attendant, it is simply laid across the traverse arrangement approximately in the correct position, when it slides down the curved portion of g_2 , and thus finds its way into the slot in the traverse guide. A reciprocating motion is given to the rod g_1 and consequently to the traverse guides g and to the yarn that passes through the slots in them. In Fig. 3 (*a*), the guides are shown at almost the extreme right-hand side of each mandrel; the next movement of the traverse will be toward the left-hand side, thus carrying the yarn across the face of the tube.

In ordinary forms of reciprocating motions, such as those produced by a revolving crank, the speed is greatest at the center of the traverse and gradually diminishes toward each end, and at the point where the traverse is reversed it is almost impossible to prevent a slight dwell. If such a motion were applied to the quick-traverse tube-winding machine, this dwell, although of very brief duration, would result in winding more yarn at the ends of the tubes than at the center and would thus give an uneven surface to the tube. It is the object in all tube-winding machines to reduce this dwell as much as possible by the use of a traverse motion that gives a constant speed to the traverse guides, in order to wind the yarn evenly along the face of the tube, so that in case of a parallel tube the diameter will be the same at all points, and in case of a conical tube the diameter will increase uniformly. In the frame under description the traverse is obtained as follows.

9. The shaft l , Fig. 3 (*a*), that carries the pulleys for driving the drums also carries at its center the bevel gear m , which drives the bevel gear m_1 on the short vertical shaft m_2 . At its upper end, the vertical shaft carries a bevel gear m_3 driving another bevel gear m_4 situated on the crankshaft n , which extends horizontally across the frame above the vertical shaft m_2 . At each side of the frame is a metal

box that carries the mechanism for imparting a reciprocating motion to the traverse rods g_1 . The shaft n extends into these boxes, a suitable portion of which forms bearings for it. The inner upright portion of each box supports a stationary cam k_1 , shown in Fig. 3 (*a*) and (*b*). In Fig. 3 (*b*), the traverse rod and some of the other parts have been omitted, so that the construction of the parts that give the throw to the traverse rod may be more clearly shown. The shaft n passes through the center portion of the cam k_1 and carries a casting n_1 firmly setscrewed to it. Securely fastened to the casting n_1 are two studs n_2, n_3 that are free to slide in and out of two chambers in the casting n_4 . This latter casting carries a pin, or stud, n_5 on which are situated two cam-bowls k_2, n_6 . The cam-bowl k_2 is located on the inner side of the casting n_4 and runs in the course of the cam k_1 , while the other bowl n_6 is located on the outside of the casting n_4 and runs in a slot n_7 in the center of the traverse rod g_1 , which is enlarged in the center so as to contain the vertical slot n_7 . The entire mechanism forms a crank arrangement that gives a reciprocating motion to the traverse rod g_1 , the shaft n acting as a crank-shaft.

As the shaft n revolves, it carries with it the casting n_1 and the two studs that slide in the cavities in the casting n_4 . Since the studs n_2, n_3 support the casting n_4 , and since it carries the cam-bowl k_2 , it will slide in and out on the studs n_2, n_3 , according to the position of the cam-bowl k_2 in the course of the cam k_1 , because the connection with the studs forces the piece n_4 to revolve around the shaft n . The length of the course in the cam k_1 governs the length of the traverse, or throw of the rod g_1 and the guides g .

As the cam-bowl k_2 travels around the course of the cam k_1 by means of the mechanism just described, the vertical position of the cam-bowl n_6 will be constantly changing in the slot n_7 and the rod will be moved first in one direction and then in the other because the piece n_4 is constantly being moved from right to left and left to right.

Each side of the framework supports two sets of brackets g_3, g_4 , which serve to support the rods g_3, g_4 that

steady and guide the traverse rod g_1 . The traverse rod carries two lugs, or projections, g_7, g_8 that slide on the rods g_5, g_6 , respectively. These rods carry rubber cushions g_9, g_{10} that can be adjusted to the required position on the rods by means of nuts. These cushions prevent jar of the traverse rod and guides carried by it, and also relieve strain on the cam-bowl k_2 and on the cam k_1 , when the bowl is farthest from the center of the cam. The extreme movement of the cam-bowl k_2 in one direction is shown in Fig. 3 (*b*), while in (*a*) the positions of the various parts are shown when the cam-bowl is in this position.

The lower part of the box containing the mechanism is of solid construction and contains a supply of heavy oil, sufficiently deep to allow the casting n_4 to dip into it at each revolution. The whole of the mechanism is tightly cased in, so that the oil may be thrown over all parts of the mechanism without escaping, thus securing perfect lubrication.

10. Stop-motions are applied to tube-winding frames for two reasons. In winding single yarn, if an end broke and there were no stop-motion, the last layers of yarn wound on the tube would remain in constant contact with the winding drum and would gradually become glazed and damaged by the constant polishing effect of the drum. In case two or more ends were being wound together on one tube and one broke, if no stop-motion were applied the strand of yarn wound on the cone would contain only one end instead of two in case of 2-ply winding, two ends instead of three in case of 3-ply winding, etc. It is now customary to apply to tube winders a stop-motion so arranged that it will throw the tube out of contact with the winding drum. Such a mechanism is shown in Figs. 2 and 4.

Immediately behind and slightly below the tension board d are situated the drop, or guide, wires e . There is a group of these wires in front of each winding drum j , the number of wires in each group depending on the number of ends being wound on each tube. The framework supports a number of small swing brackets similar to e_2 , there being

one for each group of drop wires. These brackets swing on a pin, or stud, e_1 that also passes through the lower loop in the drop wires, thus forming a support for them and preventing their falling too far when an end breaks. The yarn passes through the upper loop, or eye, on its passage to the tube and thus holds it in the position shown in full lines in Fig. 4 (*a*). The lower end of the drop wire passes through a hole in the lower part of the bracket e_2 . The inner portion of this bracket rests on a flat portion of the framework and is in contact with the lower part of the arm e_3 . The construction of the lower portion of this arm is shown in Fig. 4 (*b*); at its upper end it is attached to a long lever e_4 , Fig. 2 (*a*), that is fulcrumed at e_7 to the weight lever e_8 . The weight lever is fulcrumed at e_6 to the pendent arm e_{10} and carries at one end, by means of a wire hook, a weight e_{11} , while the other end rests against a part of the under portion of the frame h_2 . The weight e_{11} thus has a constant tendency to pull down the inner end of the lever e_8 and consequently raise the other end, together with the frame h_2 , and also force outwards the lever e_4 and arm e_3 . It is prevented from doing this, however, when the yarn is holding the drop wire or wires in their upright position by the pressure of the arm e_2 against e_3 . The pendent arm e_{10} is setscrewed to a shaft h_3 that extends the length of the frame. There are two of these shafts, one for each side of the machine, and in addition to carrying pendent arms similar to e_{10} , they support frames similar to h_2 .

When an end breaks, the swing bracket e_2 and the drop wire e , together with the arm e_3 , assume the position shown in dot-and-dash lines in Fig. 4 (*a*). This is brought about by the wire e dropping because the tension of the yarn has ceased and there is nothing to hold e in position. As the wire falls, its lower end protrudes through the hole in the lower part of the swinging bracket so that it comes in contact with one of the projections of the revolving dog e_5 ; and as this dog continues its forward movement in the direction shown by the arrow, it carries with it the lower end of the wire and causes the bracket e_2 to turn on the stud e_1 .

There is one of these dogs for each group of drop wires. When the bracket assumes the position shown in dot-and-dash lines, the inner portion is removed from direct contact with the arm e_6 , thereby leaving it free to slide outwards on the framework. This allows the weight e_{11} to move downwards and carry with it the inner end of the arm e_6 , raise the upper end, and force outwards the lever e_6 and arm e_6 . This action of the lever e_6 raises the frame h_2 and thus lifts the tube h from contact with the drum j , so that the winding of the yarn ceases. The extreme outer portion of the lever e_6 terminates in a handle, and when starting up a tube after an end breaks or a new tube is put in place of a full one, the end is properly pieced up and the lever e_6 forced inwards by means of the handle. The lever is held in position again by means of bracket e_2 , which allows the frame h_2 to be lowered into position, so that motion is imparted to the tube by means of the drum on which it rests.

11. Fig. 2 (*a*) and (*b*) shows a side view and a plan view of the frame h , that carries the mandrel h_1 on which the tube h is placed. The frame is composed of two main parts, which are securely bolted together and swing on the shaft h_3 . It is prevented from sliding along the shaft by two collars, one on either side of the two arms that swing on the shaft h_3 . The necessary friction to keep the frame from swinging too freely on the shaft is produced by means of a spring h_4 and an adjusting screw h_5 . This screw passes through the frame, and when more friction is required it is turned so as to force the part of the spring that is in contact with it nearer the shaft h_3 . At the outer ends of the two outward projecting arms are formed two bearings that support the mandrel.

Motion is imparted to the knock-off dog-shaft by means of two grooved pulleys e_{12} , e_{13} , Fig. 2; e_{12} , which is a double-grooved pulley, is on the main driving shaft l_2 of the machine, while e_{13} , which is a single-grooved pulley, is on the dog-shaft e_4 . A similar arrangement is applied to the machine illustrated in Fig. 6. As there are two of these dog-shafts, one for each side of the machine, there are two

single-grooved pulleys, as shown in Fig. 6. One of the dog-shafts is driven by an open band e_{14} , while the other is driven by a crossed band e_{15} .

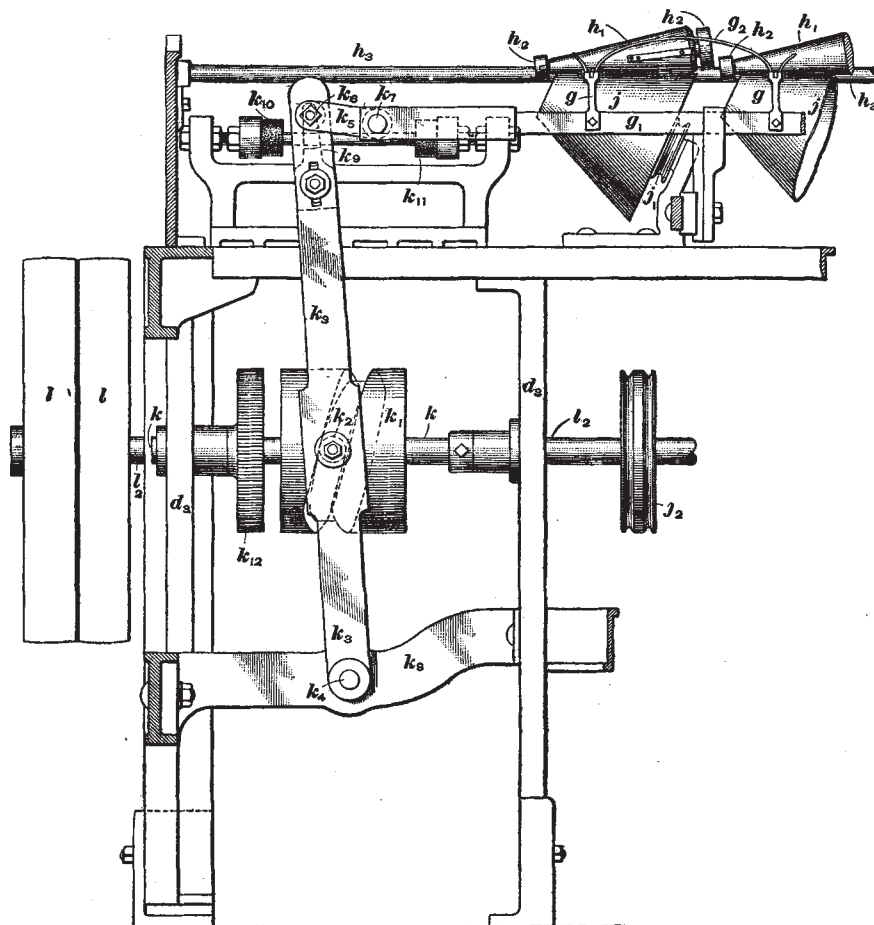


FIG. 5

12. The end traverse motion, Figs. 5 and 6, although an older form than that described, is largely used. The guides and guide rods are similar in both cases; the difference lies principally in the construction of the mechanism

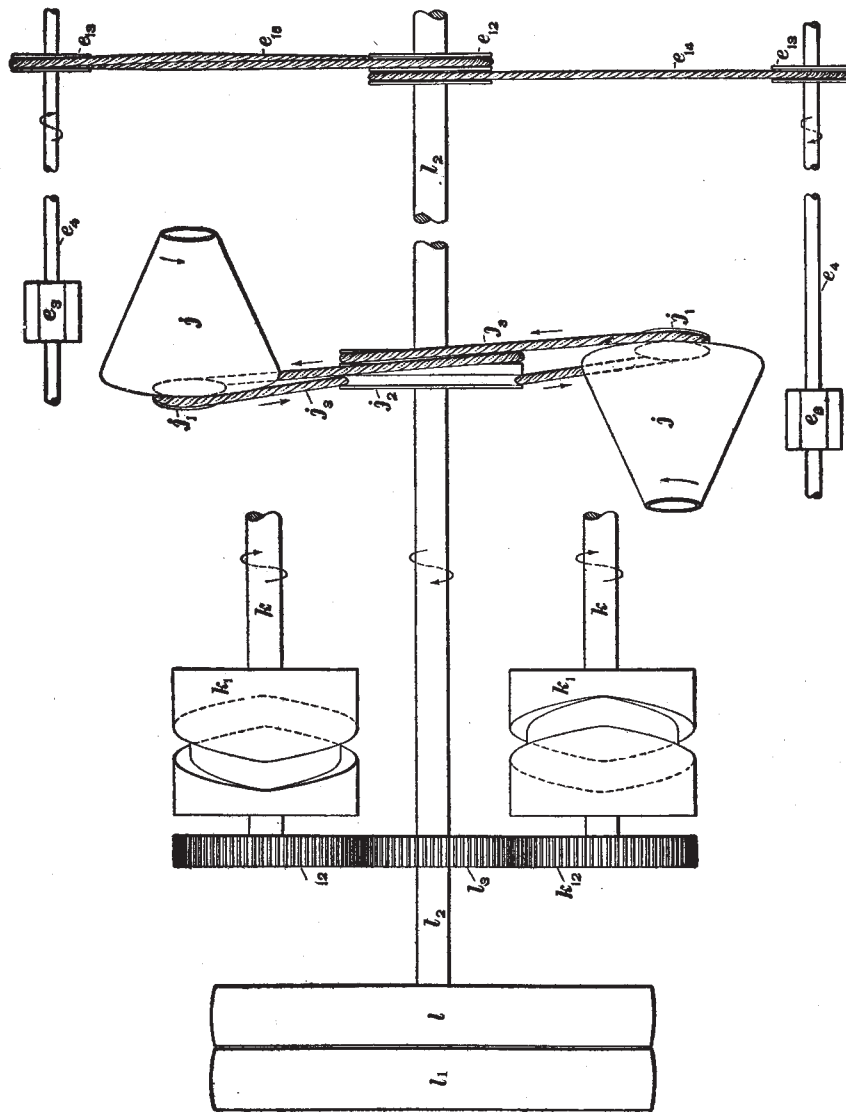


FIG. 6

that imparts a reciprocating motion to the guide rod g_1 . The main shaft l_2 of the machine carries a gear l_1 that drives the gears k_{12}, k_{13} , one on each cam-shaft k . Fig. 6 is a plan view showing the method of driving the cams k_1 , winding drums j , and dog-shafts e_4 , while Fig. 5 is a front elevation and shows the method of driving one of the guide rods g_1 , the other one on the opposite side being driven in a similar manner. The bracket k_8 extends between the two sampsons d_3 and supports the lever k_3 , which is pivoted at k_4 ; at k_5 is attached a link k_6 , which is also attached to the traverse rod g_1 at k_7 . The lever k_3 is steadied at the upper end by means of an arm k_8 , through which passes a small rod that carries the rubber cushions k_{10}, k_{11} . About two-thirds of the way from the top, the lever carries a stud, which in turn supports a cam-bowl k_2 that works in the course of the cam k_1 . The construction of the cam, together with the other parts, is such as to give the upper end of the upright lever k_3 a reciprocating motion, which is communicated to the traverse rod g_1 by the link k_6 , thereby causing the guides g to move quickly to and fro across the drums.

13. This tube winder is often spoken of as the *Broadbent winder* from the fact that it was first built by a firm of this name and is still constructed by them, although similar types of machines are now made by other builders. This name is given to it to distinguish it from the Hill & Brown winder and from the Universal winder. The Hill & Brown winder is an older form, and belongs to the drum-winder type, but the traverse of the yarn is obtained without the use of a separate traverse motion, each drum being constructed with a helical slot running along its circumference, first from one side and then to the other, through which the yarn is conducted to the tube. The Broadbent type of winder is constructed in various sizes, from 20 to 160 drums, 100 drums (50 on each side) being a common size. A machine with 100 drums occupies a space of 31 feet 10 inches by 3 feet 11 inches and requires about 1 horsepower to drive it.

SPINDLE WINDERS

14. A tube winder of the spindle-winding type accomplishes the same purpose as the quick-traverse drum winder, but in a different manner. The revolving drum used in a drum winder is dispensed with and the yarn wound on a tube placed on a positively rotated spindle. One type of spindle winder is that known as the **Universal winder**. It is shown in Fig. 7 and consists of a single-head machine; that is, there is only one winding spindle, and consequently the machine winds only one tube at a time. A more common construction is to place several of these winding heads side by side on a stand-ard, the number of heads usually not exceeding six, which is the most common number. Spindle winders of this type are capable of winding either parallel or conical tubes, and produce a hard, compact structure with the coils wound closely together, for which reason they are sometimes spoken of as *close-traverse* or *close-winding* machines to distinguish them from the open-traverse or open-winding type, to which drum winders belong.

As the construction of each head in a six-head machine is the same and as this construction corresponds to that of a single-head machine, only the latter type will be described. The single-head machine is shown as winding only one end, but the Universal winder can be, and frequently is, arranged to wind several ends, usually not exceeding three. A considerable portion of the mechanism is enclosed within metal covers and is so shown in Fig. 7. Fig. 8 is a front view of the machine showing the positions of the various parts during winding, while in Fig. 9, which is also a front view, the parts are shown in the positions they occupy after the machine has been automatically stopped and winding has ceased; Fig. 10 shows a side view, partly in section.

15. **Passage of Yarn.**—Referring to Fig. 7, the bobbin *a* is placed on a spindle in the center of the plate *b*, and the end passed upwards through the guide wire *c*. From the guide wire, the yarn passes around the tension

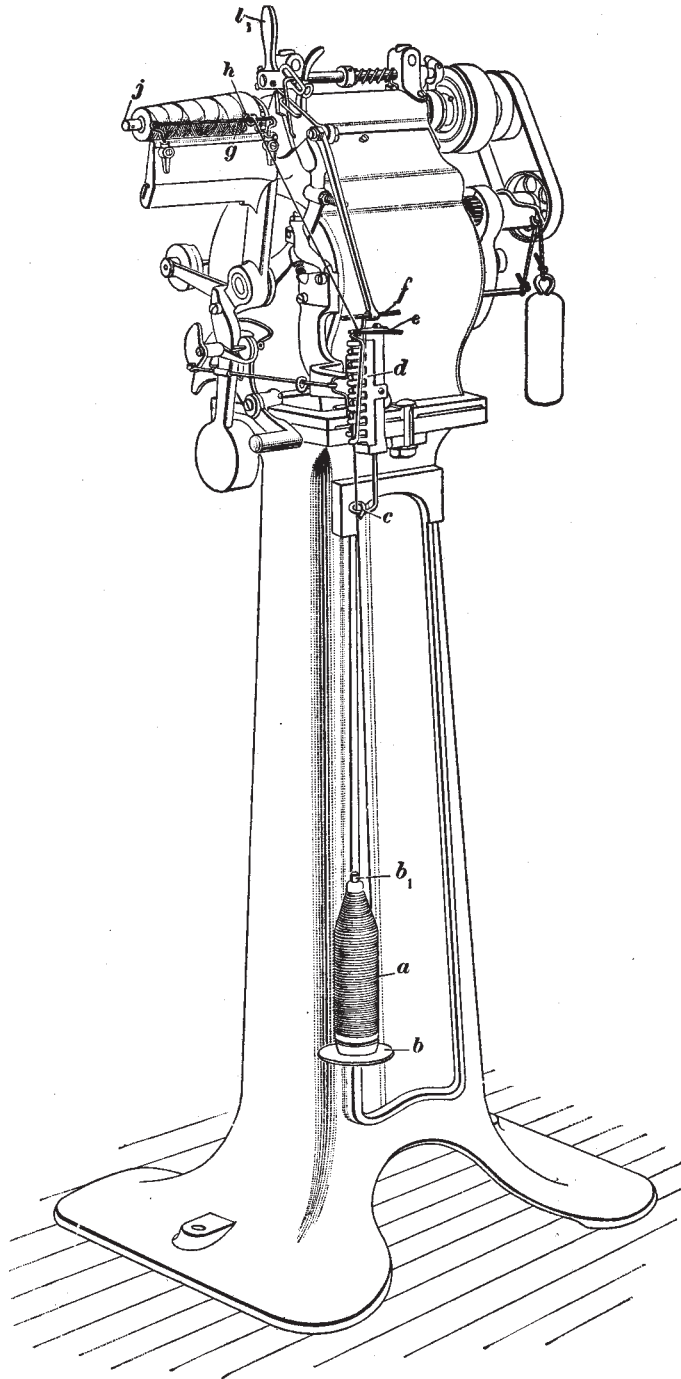


FIG. 7

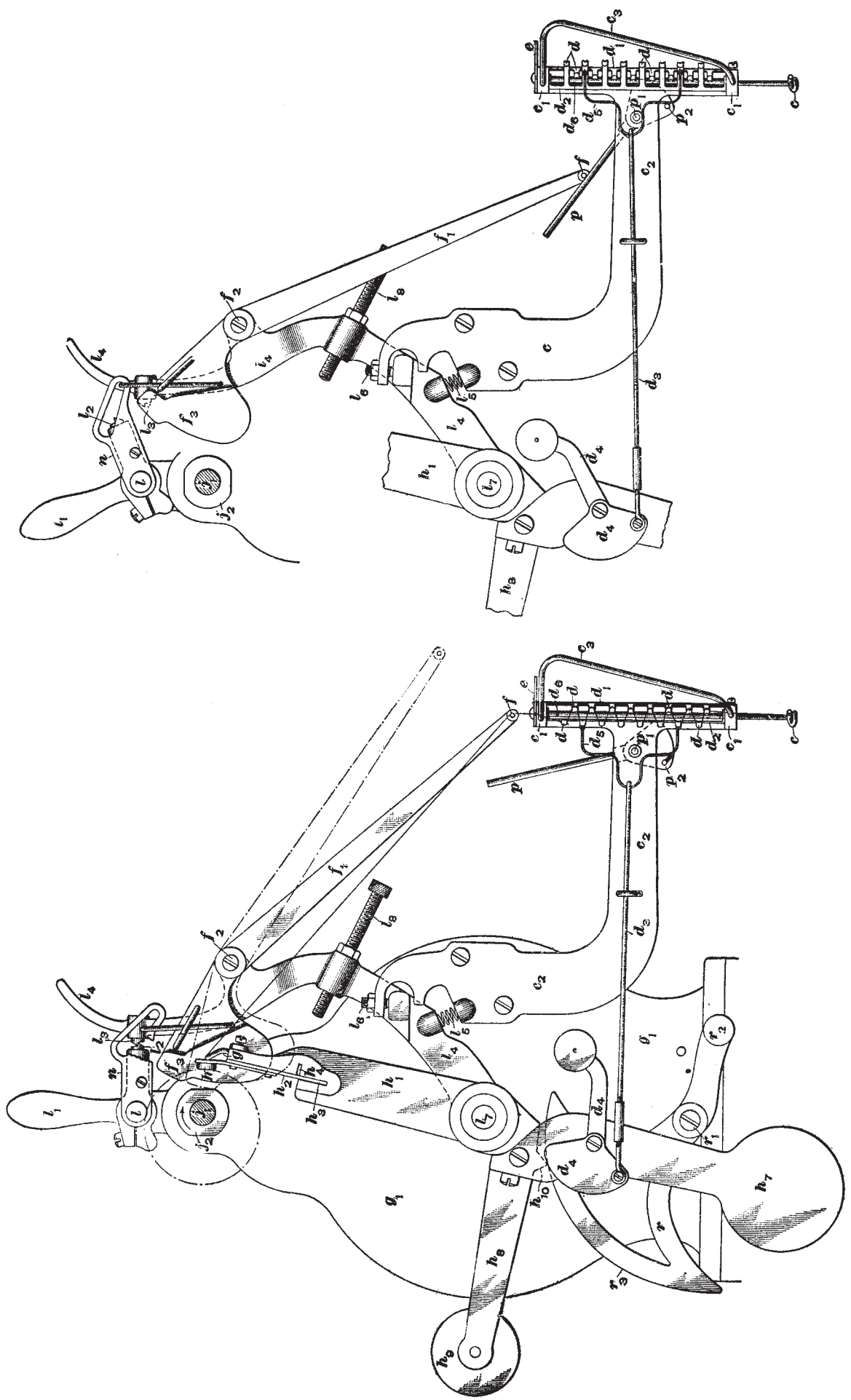


FIG. 9

FIG. 8

Rotated 90° to fit on page.

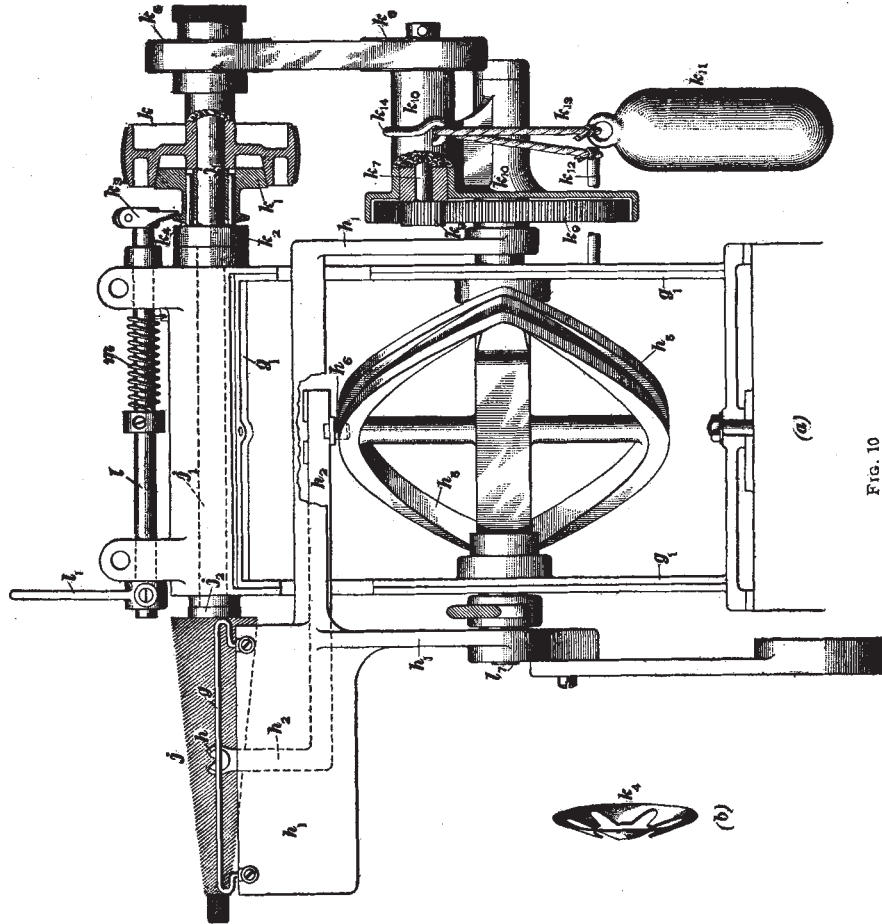


FIG. 10

fingers d , through a slot in the plate e , over the pin f , then at an angle to another guide wire g , through the traverse-guide eye h , and on to the tube or cone shell on the spindle j .

16. The **yarn holder** is a simple device for holding the bobbins, cops, etc., from which the yarn is to be wound. A spindle b_1 supported by a bracket attached to the framework carries the bobbin, which rests on a circular plate b that is passed over the spindle so as to form a flange or table around its base.

17. Yarn Guide and Tension Controller.—The yarn guide, or guide wire, c is a bent wire with a curl, or loop, at one end, as shown in Figs. 7, 8, and 9. The center of the loop of the guide wire should be directly in line with the center of the spindle in the yarn holder. This wire is supported by a bracket c_1 attached to the arm c_2 . The bracket c_1 also carries the tension-finger plates d_1, d_2 , and the kink, or snarl, arrester e . Each plate d_1, d_2 carries eight tension fingers d , which are curved, the face with which the yarn comes in contact being rounded, as shown in Figs. 8 and 9. The plate d_2 is pivoted at each end to a rod d_3 so that it is free to swing on the bracket c_1 , while the plate d_1 is securely attached to the bracket. The swinging plate d_2 is connected by a rod d_3 and wire bracket d_4 to a quadrant weight lever d_4 , which regulates the amount of tension on the yarn. The tension can be increased or decreased by putting more or less weight on the lever d_4 .

The wire c_3 , which is supported by the bracket c_1 , serves as a guide and facilitates passing the yarn between the tension fingers when they are released and occupy the position shown in Fig. 9. The plate e , which is situated at the top of the bracket c_1 and forms a kink, or snarl, arrester, is simply a flat plate with a long, narrow slot through which the yarn passes. Any kinks, snarls, or bunches in the yarn come in contact with the under side of the plate and are thus prevented from passing forwards on to the tube.

18. The **traverse guide** h , shown more clearly in Fig. 10 (*a*), is carried by a flat, steel plate h , that works

in a slot h_2 , Fig. 8, in the frame h_1 , which swings freely on bushings attached to the framework g_1 . The plate h_2 has a number of small lugs that project into the slot h_2 , which serves to guide and steady the plate during its movements to and fro. The plate is given a quick traverse motion by means of the cam h_3 , Fig. 10 (a), and the cam-bowl h_4 , which is supported by a small stud attached to the plate. The frame h_1 carries, in addition to the guide h and plate h_2 , the

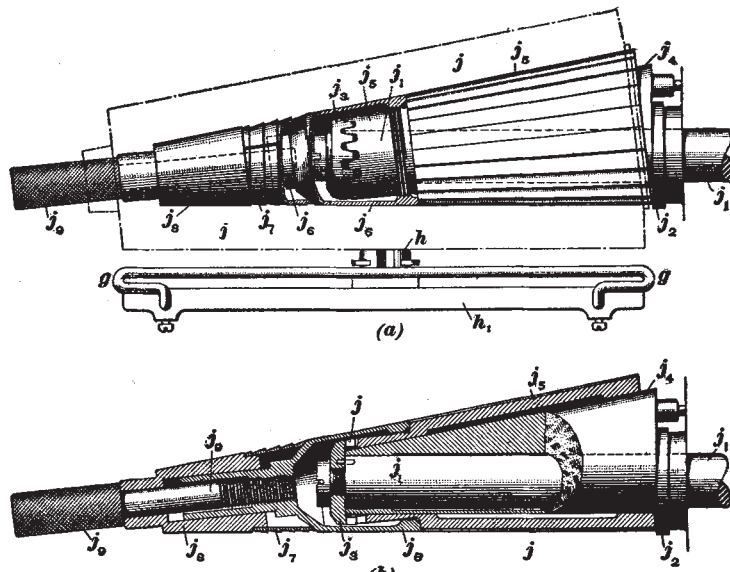


FIG. 11

guide wire g . The quick movement of the traverse guide h causes the yarn to be wound on the tube in long open spirals 2 or 3 inches apart, the next spiral being wound close to the first, the next again close to the previous, etc., thus giving the appearance and effect of a very close wind.

19. The spindle in the machine under consideration is for winding conical cheeses and is composed of a number of parts; a plan view partly broken away is shown in Fig. 11 (a) and a section in Fig. 11 (b). The main part j_1 of the spindle j

is a straight steel rod with a collar j_2 that comes in contact with the outside end of one of the bearings that support the spindle. There are two of these bearings carried by the framework, one at either end of the spindle. The rod j_1 carries a small gear j_3 and also a cone frustum j_4 , which is so mounted that the side nearest the traverse guide h is always parallel to the guide. The frustum j_4 is prevented from revolving with the rod j_1 by a small pin that projects into a hole in the framework. A thin fluted conical shell j_5 that fits over the cone frustum j_4 carries teeth at its small end that mesh with those of the gear j_3 on the rod j_1 . As the rod j_1 revolves, the gear j_3 turns the cone shell j_5 , which is free to revolve on the frustum j_4 . A cap j_6 that fits over this gearing is screwed to the cone shell and consequently revolves with it; about midway of its length the cap has a tapered shoulder so as to open the split ring j_7 , which is fluted spirally. Beyond this split ring is another cap j_8 , the inner end of which comes in contact with the outer end of the split ring. This cap is forced against the split ring by means of a shoulder on the screw j_9 , the head of which is knurled so that it can be turned by hand; the screw passes through the cap j_8 and screws into the straight cylindrical portion of the cap j_6 , thus binding the conical shell j_5 and the parts j_6 , j_7 , j_8 together. A paper cone tube is placed on the spindle and the screw j_9 tightened, which causes the cap j_8 to be forced inwards, thus pushing the split ring up on the shoulder of the cap j_6 and, in consequence, causing the ring to expand. The expanding of the split ring prevents the tube pulling off or getting loose until the screw j_9 is loosened, while the flutes of the conical shell j_5 prevent its turning on the spindle while in position. The position of a cone tube partly filled is shown on the spindle in dot-and-dash lines in Fig. 11 (*a*).

20. Stop-motions are applied to this frame to operate when an end breaks or runs out and when the cheese has attained the desired size. The spindle is the seat, or base, of all the stop-motions and is stopped when any one of the

motions acts. The spindle is driven directly from the pulley k by means of a friction cone, shown in section in Fig. 10 (*a*). When the lever l_1 on the rod l is drawn up to a vertical position, as shown in Fig. 8, the friction cone is thrown in, as explained in Art. 23, and the spindle caused to revolve. The lever l_1 carries a catch l_2 , Figs. 8 and 9, that connects with the catch l_3 on the lever l_4 , which is pivoted on a sleeve of the left-hand bearing of the cam-shaft and held in position by a small spiral spring l_5 , the setscrew l_6 governing the extent of the upward movement of the lever. The catch l_3 coming in contact with the catch l_2 holds the lever l_1 in its upright position, as shown in Fig. 8.

When the yarn is passing from the holder to the tube, the lever f_1 pivoted at f_2 is held in the position shown by the full lines in Fig. 8 by the yarn passing over the pin f_3 , which prevents the heavier end f_4 falling. When, however, an end breaks or runs out, the end f_4 falls until its face comes in contact with the collar j_2 . When this action first takes place, a notch on the face of f_4 bears against that portion of the collar j_2 that is concentric with the rod j_1 . As the collar continues to revolve, a flat face on it comes in contact with the face of the upper portion of f_4 , thus allowing f_4 to fall still farther until it occupies the position shown by the dot-and-dash lines in Fig. 8. Then, as the spindle continues its revolution, the increase in size of the collar will force the lever f_1 to the right, bringing with it the knock-off lever l_4 , which swings on its center l_7 , compressing the spring l_8 , and disconnecting the two catches l_3 , l_2 . This allows the spring m on the rod l , Fig. 10 (*a*), to turn the rod a portion of a revolution, which causes the friction cone to be thrown out, thus stopping the spindle.

Attached to, and swinging with, the lever l_1 is an arm n , Figs. 8 and 9, that has a slot at its outer end connected with the upper end of the lever f_1 by means of a short wire rod. When the two catches unlock and the spring m forces the lever l_1 to the left, looking at the front of the machine, the outer portion of the arm n will be raised, which will lift the upper end of the lever f_1 and cause the lever to turn on its

center f_1 . The lower end of f_1 , being depressed by this action, comes in contact with the upper end of a lever p centered at p_1 . The lower end of this lever carries a pin, or stud, p_2 , which comes in contact with the wire bracket d_1 attached to the swinging tension plate d_2 and also to the rod d_3 through which the tension is regulated; this forces the wire bracket to the right and opens the tension fingers, so that the yarn can be readily passed between them and pieced to the end on the cheese. When the end is pieced up and the lever l_1 drawn toward the right and locked, the lower end of the lever f_1 rises and assumes the position shown in full lines in Fig. 8. This figure shows the various parts of the stop-motion in the positions they occupy during winding, while Fig. 9 shows the positions of the various parts after the stop-motion has acted and stopped the head. After the machine has knocked off and the lever l_1 occupies the position shown in Fig. 9, the spring l_2 expands and forces up the lever l_1 into position, so that the catch l_3 will lock with the catch l_4 when the lever l_1 is drawn to the right in order to throw in the friction cone and start the machine.

21. The stop-motion that operates when the cheese has attained the desired size is as follows: The lever l_4 , Figs. 8 and 9, carries an adjusting screw l_5 , which can be turned so as to project through the lever to a greater or less extent, in order to regulate the size of the cheese to be made. The traverse guide h rests against the surface of the cheese, as shown in Figs. 8 and 11 (a). As the cheese increases in size, the traverse guide h and frame h_1 , Fig. 8, are gradually forced from the center of the spindle until the cheese has become so large that the frame h_1 is forced against the end of the adjusting screw l_5 . A continued increase in the size of the cheese will force the screw l_5 and, consequently, the lever l_4 to the right and unlock the catches l_3, l_2 , thus stopping the head.

22. The frame h_1 is counterbalanced by the weight arm h_7 , while the arm h_8 carries a stud at its outer end on which weights h_9 are placed, so that the frame h_1 will

be held in proper position and exert a slight pressure on the cheese while it is being wound.

The quadrant r , Fig. 8, is used when piecing up a broken end. Pulling the upper end of the frame h_1 to the right, so as to raise the arm h_3 and weight h_5 , removes the pressure of the projection h_{10} on the curved surface of the quadrant and allows the latter to swing on its center r_3 ; as the handle r_2 is heavier than the curved portion r_3 , it swings down and raises the curved portion, which is eccentric in its relation to the center r_1 , the upper part being nearer the center than the lower part. Consequently, when the upper portion of the frame swings on its center, the quadrant turns so that its curved face is always in close contact with the projection h_{10} . When the pressure has been removed from the upper portion of the frame h_1 , the projection h_{10} is allowed to press on the curved surface of the quadrant and thus hold the frame in any desired position. By this means the frame h_1 can be drawn back out of the way to facilitate piecing, after which it can be moved forwards to its proper position by simply raising the handle of the quadrant.

23. Method of Driving.—The main driving pulley of the frame is shown at k , Fig. 10 (*a*). This pulley is loose on the shaft j_1 , but its inner surface is conical to fit a cone k_1 attached to the shaft j_1 by means of two pins firmly fixed in the collar k_2 attached to the shaft. When the lever l_1 is drawn forwards and locked in position, the dog k_3 on the rod l , by reason of its shape, releases the cone k_1 and allows the diaphragm spring k_4 to force it to the right until its conical surface is firmly in contact with the surface of the conical cut-out of the pulley k . This spring is shown in section in position in Fig. 10 (*a*), while a perspective view is given in Fig. 10 (*b*). The pulley k is crowned and is about 4 inches in diameter.

The traverse cam h_6 is driven from the spindle shaft j_1 in the following manner: Attached to the spindle shaft j_1 is a pulley k_5 that drives the pulley k_6 by means of a short belt.

The pulley k_1 is on a short shaft k_7 , the opposite end of which carries a small spur gear k_8 of 20 teeth, which in turn drives a large spur gear k_9 of 120 teeth. The gear k_9 is attached to the cam-shaft and thus imparts motion to the cam k_5 . As the casting k_{10} , forming a casing for the gears k_8 , k_9 , and a support for the short shaft k_7 , swings on the cam-shaft, some means must be adopted to give the necessary tension to the belt on the pulleys k_2 , k_3 , in order that the cam-shaft may be driven properly. This is accomplished by having the weight k_{11} connected to a rod, or pin, k_{12} , by a cord, or band, k_{13} , that passes over the hook k_{14} attached to the casting k_{10} . The pulleys k_2 , k_3 are each about 3 inches in diameter.

24. Spindle-winding machines are not usually operated singly, as shown in Fig. 7, but in groups of six heads, spoken of as a *gang* of six spindles. The floor space occupied by a six-head machine is 4 feet 8 inches by 1 foot 8 inches.

MANAGEMENT

25. The points connected with the proper operation of a room of tube winders are numerous and require careful attention. The instructions given by buyers of the yarn should always be carefully followed. These relate principally to the numbers of the yarn and sizes of tubes or cones. The room should be so operated that each number or kind of yarn is kept separate, and thus the possibility of mixing different kinds or qualities avoided, both before the yarn arrives at the machine and at the winder.

Winders are usually constructed to make tubes with a maximum traverse of 6 inches, although occasionally frames are made for 8-inch traverse. Those made for 6-inch traverse can be changed to 5-inch, 4-inch, or even a smaller traverse; the change is usually made by changing the cam, but on some makes of machines, especially those with the traverse motion at the end, a slight adjustment of about 1 inch can be made by changing the leverage of the lever k_6 ,

Fig. 5, by moving the connection at k , downwards or upwards as required.

Buyers do not often specify the length of traverse; for ordinary knitting yarn, when not specified, a $5\frac{1}{2}$ -inch traverse is used in case of cones. When yarn is to be wound on cones, the diameter of the cone at its larger end is generally given by the buyer as a guide, usually 7 or $7\frac{1}{2}$ inches. Sometimes as small a diameter as $5\frac{1}{2}$ or 6 inches is required, but very seldom. The attendant should be instructed to remove the cones when they attain the desired size and he should be watched to see that this is done. Parallel tubes are often made with a $5\frac{1}{2}$ -inch traverse and a $4\frac{1}{2}$ -inch diameter. These dimensions are for ordinary cotton yarns, and of course are varied for other materials and for special purposes. When making parallel tubes, the end of the yarn last wound on should always be tied so as to avoid its raveling off; it is better to do this on cones also, although this is not always done.

26. Among the points that require attention in the operation of the machine are cleanliness and satisfactory oiling. The newer makes of quick-traverse drum winders are so constructed that the traverse motion is self-oiling, while in the Universal winder the spindle is self-oiling, thus avoiding the necessity of constant attention to these quickly revolving parts. There are, however, on the quick-traverse drum winder a number of other parts that do not revolve so quickly but that require oiling twice a week or oftener. Oiling should be carefully performed, since in case of an excess of oil or oil getting on to parts of the machine with which the yarn comes in contact, the yarn will be stained. For the same reason winders should be kept carefully cleaned, so as to avoid the possibility of lint and dirt passing forwards with the yarn.

The rapid reciprocating motion of the traverse rods of drum winders creates considerable jar and vibration, and although this is counteracted by the strong construction of the machines and of the traverse motions, as well as by rubber cushions so placed as to destroy as much as possible of the

jár, there is a tendency for parts to work loose and adjustments to become slack. The machines should be carefully and periodically examined for such defects, and all wear taken up promptly and loose parts tightened. If such defects are attended to at once, it prevents additional wear and enables the machine to be run with much less vibration.

The full tubes from each machine should be occasionally examined to make sure that the yarn does not overrun at the ends, which produces what are called *cobwebs* or *dropped ends* and makes it difficult to unwind the yarn at the next process, often causing breakage there. In some cases this is caused by faulty construction of the machines and is then difficult to remedy, but more frequently it is on account of parts working loose and wearing, which consequently allow the ends to run over the ends of the tube. A careful study should be made of the best relation between the speed of traverse and the length of the yarn wound. Some classes of yarn, especially smooth, or polished, yarn or ply yarn, require a quicker traverse in proportion to the amount of yarn wound than ordinary yarns or single yarns.

In case of winding more than one end on a tube, the stop-motion should be kept in perfect order so as to act promptly in case an end breaks; otherwise the strand of yarn will pass to the tube with one end short of the required number. When an end breaks it should be carefully tied to the other end with a small knot. In case of winding two ends to one tube, the single broken end should be tied to the other single end and not made into a bunch knot. The tension on the yarn should also be carefully adjusted so that the same amount will be applied to every end. This is of special importance in case of winding several ends together where the object is to wind exactly the same length of each end on the tube. Should there be less tension on one end than another, a slightly different length of yarn would pass from one cop or bobbin than from the others, thus tending to make corkscrewed yarn at the twisting process.

In the case of the Universal winder, care should be taken to have the friction cone fit the conical shell properly, in order

to obtain a positive and even drive when it is necessary to revolve the spindle, and also so that it will be out of contact with the shell when it is necessary to stop the spindle. When the friction cone is out, the driving pulley should revolve freely on its shaft without imparting motion to any other part of the machine.

Before shipping the tubes or cheeses, they should be separately wrapped in paper and packed in wooden cases, which are also lined with paper. These cases are of different sizes according to the requirements of buyers, but a common weight of case with open-wound tubes or cones such as are made on the quick-traverse drum winders is 250 pounds, although sometimes large cases are used with a capacity of 400 pounds. A greater weight of yarn wound on a close-winding spindle winder can be packed in a case and runs as high as 350 pounds for the ordinary sized case. The attendants are usually women, who are paid so much per 100 pounds, a slightly higher rate being paid for winding from ring bobbins than from cops.

27. The production of the various machines depends on the counts and quality of the yarn and the number of ends that are being run, as well as the form into which it is being wound. These factors affect the speed at which it is possible to run the machine, but for all ordinary purposes a well-constructed quick-traverse drum winder can be operated so as to wind 140 or 150 yards per minute, and the net production after allowing for breakages and stoppages for various purposes should be in excess of 100 yards per minute for each drum or spindle.

The makers of spindle winders claim that the production per spindle is approximately three times that of a drum of a quick-traverse drum winder.

Views are shown in Fig. 12 of the various styles of conical and parallel tubes. The conical tubes are shown at (*a*) and (*b*), (*a*) being an open-wind tube such as is made on a quick-traverse drum winder, and (*b*), a close-wind tube as produced on a spindle winder. A parallel tube with an open

wind is shown at (c) and one with a close wind at (d). These are all shown built up on paper tubes. A spool with

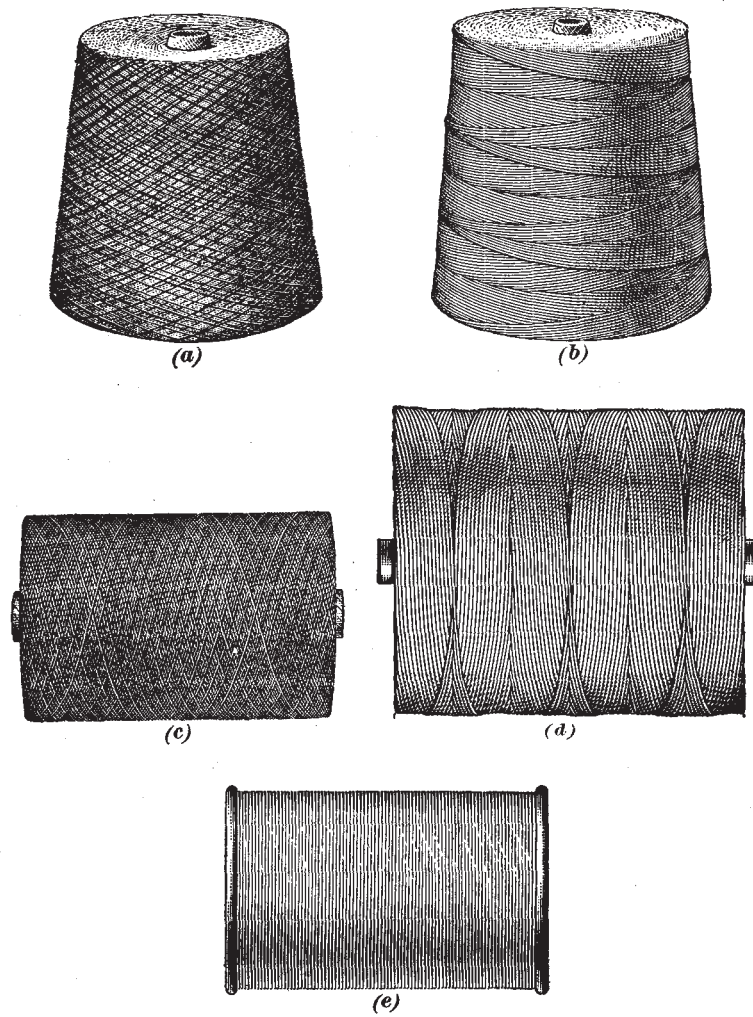


FIG. 12

double heads, such as made on the slow-traverse drum winder, is shown at (e).

BACK WINDING FOR WEAVING YARNS

28. **Back winding** is the term applied to the rewinding of skeined yarns in suitable form for the purpose for which they are intended. Another name for this is *skein winding*. Skeined yarns for weaving may be rewound for use either as filling or as warp, although back winding for filling yarns is much more common than for warp yarns.

29. **Pirn Winder.**—The back winding of filling yarn is performed on a **pirn**, or **quill**, **winding machine** so constructed as to hold the skein on a rice, or swift, constructed of wood with a number of pairs of rods, radiating in different directions, inserted in the center hub, and tied together at their ends. The hubs contain two pins, each of which rests in a suitable bearing. The skein of yarn is stretched over the ends of the rods in a suitable position for unwinding and the end passed to a bobbin placed on a horizontal or vertical spindle, being given a short traverse that builds it up in the form shown in Fig. 13 (b). The empty bobbin is shown in section at (a). Such bobbins are called *quills*, *pirns*, or *shuttle bobbins*.

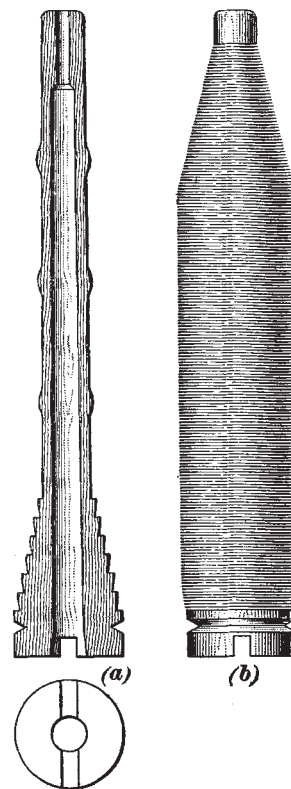


FIG. 13

30. The **slow-traverse drum winder** is the machine used for backwinding skeined yarn that has been bleached,

dyed, mercerized, or otherwise treated, on to double-headed spools, Fig. 12 (*e*), for warping purposes. The skein of yarn is held in the same way as in pirn winding. Motion is imparted to the spool by its resting on a revolving drum of suitable width to fit between the heads of the spool, and a traverse corresponding to the distance between the heads is given to the yarn. This traverse is comparatively slow so as to build up the yarn in a succession of even layers until the spool is filled, and the name slow-traverse winding is therefore given to this process to distinguish it from quick-traverse winding, which forms tubes of yarn built up on a paper or wooden tube without heads.

31. Miscellaneous Winding Machines. — Various other types of winders are used for special purposes in various branches of the textile trade. The number of varieties and the many different styles of construction prevent a detailed description of each, but most of the machines consist merely of a framework for holding in a suitable position the yarn to be unwound and some mechanism for driving the part of the machine that carries the framework on which the yarn is to be wound. One form of such machines is that known as the cop winder, in which the yarn is wound on to a cop to be used in the shuttle of the loom or of a sewing or embroidery machine. Winders are also made to take yarn from imperfectly wound cops, bobbins, or quills, and rewind it in perfect form, thus avoiding the loss that would result if the yarn were cut off and sold as waste.

The construction of the machines is usually of the simplest and their operation and management do not involve any special knowledge beyond that of applying the ordinary methods of cleaning, oiling, and economical operating by reducing the possibilities of making waste, and keeping the machinery in proper repair and running order.

Perhaps the most important matter to look out for in many cases is to have the machinery so oiled and cleaned as to prevent the possibility of black oil coming in contact with the yarn as it passes through the machine.

WINDING

EXAMINATION QUESTIONS

- (1) (a) Explain how a reciprocating motion is imparted to the guide rod g_1 , Fig. 3, by means of its connections with the shaft l_2 . (b) What is the object of this reciprocating motion?
- (2) Explain, fully, how the cone of yarn is removed from contact with the winding drum when the end breaks, referring to Fig. 2.
- (3) Explain the meaning of the following expressions as used in connection with winding: (a) quick-traverse winding; (b) cross-winding; (c) drum winding; (d) slow-traverse drum winding; (e) quick-traverse drum winding; (f) spindle winding; (g) cone winding.
- (4) Explain how the length of the traverse of the tube winder shown in Fig. 5 could be slightly reduced.
- (5) What machine is used to place skeined yarn in a suitable form for use in the shuttle of a loom?
- (6) Summarize the reasons for the increasing use of the tube-winding machine for cotton yarns.
- (7) State, briefly, the important points of difference in the construction of the spindle and the drum winders on the quick-traverse principle.
- (8) Explain, briefly, how the spindle of a spindle winder is caused to stop winding under the following conditions: (a) when an end breaks; (b) when the cone or tube becomes sufficiently large.

- (9) When the tension of the yarn being wound on a spindle winder is insufficient, how can it be increased to the proper amount?
- (10) State how cheeses of yarn are packed for shipment.
- (11) What are the common dimensions of conical tubes of knitting yarn?
- (12) What faults should be avoided in winding conical tubes?
- (13) (a) For what class of work are the slow-traverse drum winders used? (b) In what form and by what means is the yarn wound?
- (14) (a) State, fully, the objects of applying stop-motions to drum winders. (b) Does the entire machine stop when an end breaks, in case two ends are passing to each tube, on a machine of the type shown in Fig. 1?
- (15) Explain, fully, how the traverse guide of the spindle winder shown in Fig. 7 is caused to move to and fro in order to guide the yarn on the tube in the required manner.
- (16) Explain, clearly, the object of the kink, or snarl, arresters used on spindle winders.