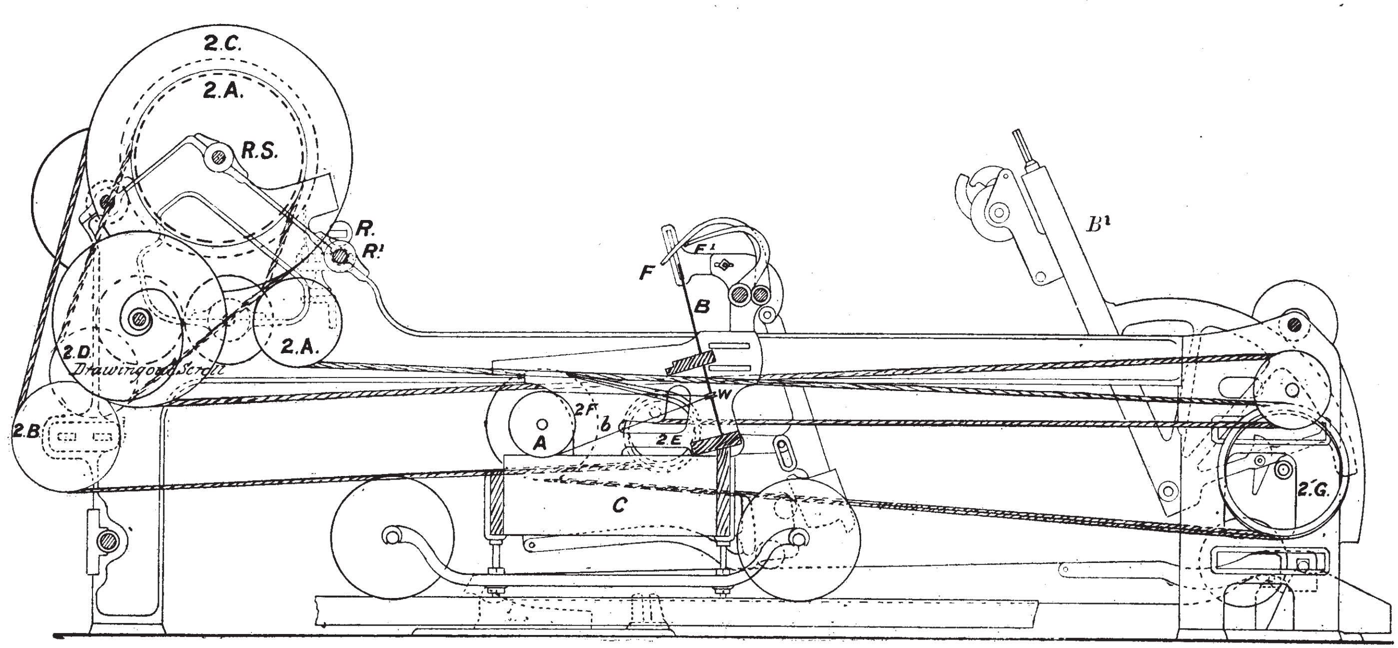



FIG. 83. Self Actor. End Elevation.

First the *drum* of the counter shaft is the main drive, and controls by the strap pulleys, 1A and 1C (Fig. 84), all motions relating to the drawing and spinning, including the outward "run" of the carriage, the operations of the cylinder, A, spindles, B, twist gear, the delivery rollers, R, $R^1$, surface drums, and the slubbing or drafting mechanism —the last three are only in motion during the first half of the outward traverse of the carriage. Second, the *three-grooved pulley* on the same counter or driving shaft actuates the parts for drawing up the carriage, the cam shaft, and the motions for backing off.

The scheme of the various motions and the methods of controlling them may be traced by reference to Fig. 84. Starting with the rim shaft, on one end is fixed the principal change pinion, 7, and inside the framework a second pinion for the twist gear. These may at once be explained. The former, by a chain of wheels, drives the delivery roller shaft, D S (Fig. 84), which carries a set of wheels at each end for imparting motion to the surface drums. The intermittent action of the rollers is determined by the slubbing wheel and clutch, the wheel being numbered for fixing the length of sliver to pass between the rollers at each draw, that is, the alternating periods at which the latter are to revolve and to be out of action. For regulating the amount of twist to be given to the length of sliver delivered, a twist gear, or wheel, begins moving at the same time as the spindles, and is arranged to operate the strap guide catch at the proper moment, changing from the fast to the loose speed pulley and stopping the spindles. It is driven off the rim shaft and consists of a short shaft mounted at one end with a finger for lifting the catch of the strap guide, and at the other with the twist wheel marked to indicate the turns for setting. The rim shaft, R, S (Figs. 83 and 84), carries three strap pulleys, 1A, 1B, and 1C, and two rim pulleys, 2A and 2C. Pulley 1A—the small speed drive —acts in conjunction with 2A; and 1C—the fast speed drive —turns the large rim pulley, 2C. The bands passing round the rim pulleys drive the tin roller, A, of the carriage.

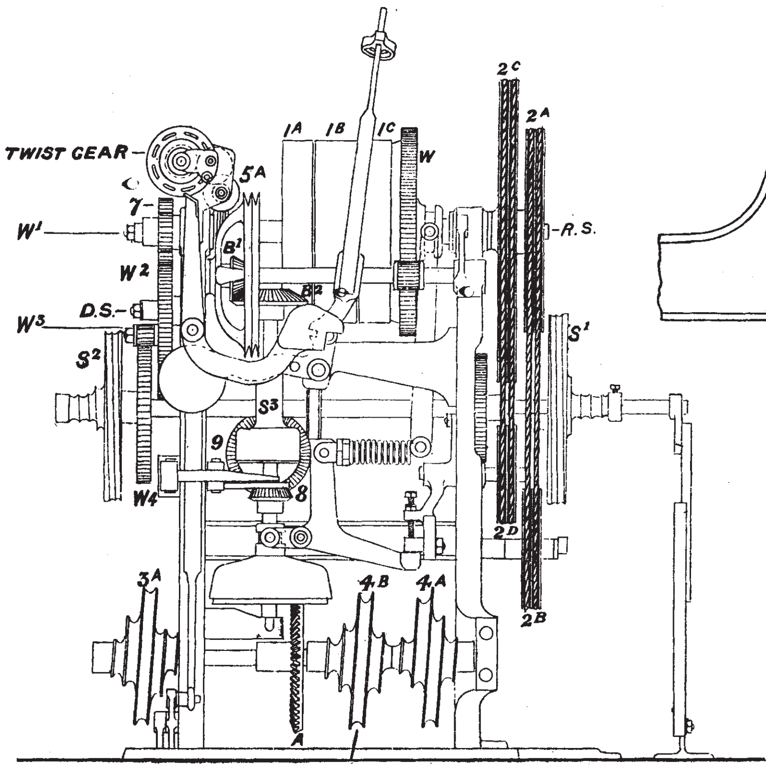



FIG. 84.

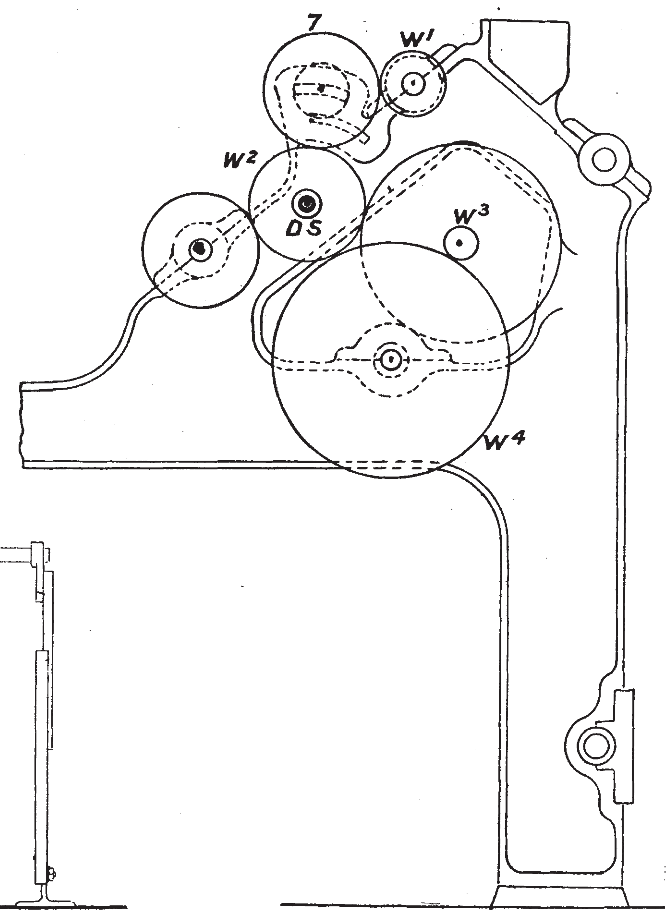



FIG. 84a.

1A. Fast Pulley on Rim Shaft (Slow Speed).
1B. Loose Pulley on Rim Shaft.
1C. Fast Cone armed Pulley for Rim Shaft for Double Speed.
2A. Double Grooved Rim for Single Speed.
2B. Double Grooved Bottom Rim Band Carrier Pulley.
2C. Double Grooved Rim for Double Speed
2D. Double Grooved Top Rim Band Carrier Pulley.
3A. } 4B. } Taking-in Scrolls.
4A. Check Scroll.
A. Taking-in Scroll Bevil.
W. Backing-off Wheel with leather-covered Friction Cone for Backing-off.
5A. Double Grooved Bell-armed Taking-in Pulley for Rope Taking-in and Backing-off.
B1. Taking-in Bevil to fit in Bell-arm Wheel.
B2. Taking-in Bevil for top of Upright.
S3. Sliding Cover for Cam Friction.
8. Bevil for Friction to drive Cam Shaft.
9. Cam Shaft Bevil.
R.S. Rim Shaft.
W1. Change Pinion on end of Rim Shaft.
7. Double Intermediate Wheel.
W2. Intermediate Wheel.
D.S. Stud of Intermediate Wheel.
W3. Drag Wheel and Pinion.
W4. Wheel on Drawing-out Scroll Shaft.
S1. Drawing-out Scroll.
S2. Check Drawing-out Scroll.

Headstock (Platt Bros.) Self Actor.

Pulley 1C is keyed to a bush which runs free on the Rim Shaft through Backing-off Wheel W, to which the Double Speed Rim 2C is attached.

The fast speed pulley is not secured to the rim shaft, but to a long sleeve, or boss, running loosely on the shaft. The large rim pulley is also fixed on the same boss. Hence 1C and 2C may be driven independently of other parts on the rim shaft. To explain—when the carriage is drawing out, and 1A drives 2A, the latter by means of $\frac{7}{16}''$ cotton band, turns the tin roller which, by $\frac{1}{8}''$ cotton band, sets the spindles in motion; but, meanwhile, all other pulleys and connections on the shaft are acting as carriers. When the small rim pulley has accomplished its part of the routine (*i.e.*, operated the rollers and spindles during the first period of the drawing out of the carriage), the belt is changed from 1A to 1C, transmitting movement to the large or fast rim pulley, 2C, which becomes the driver—other pulleys acting as carriers—and augments the speed of the spindles to give the degree of twine necessary. This rim pulley also actuates the jacking-up motion from the tin roller. It is stopped by the action of the twist gear on the completion of the "spin," and just before the backing-off takes place.

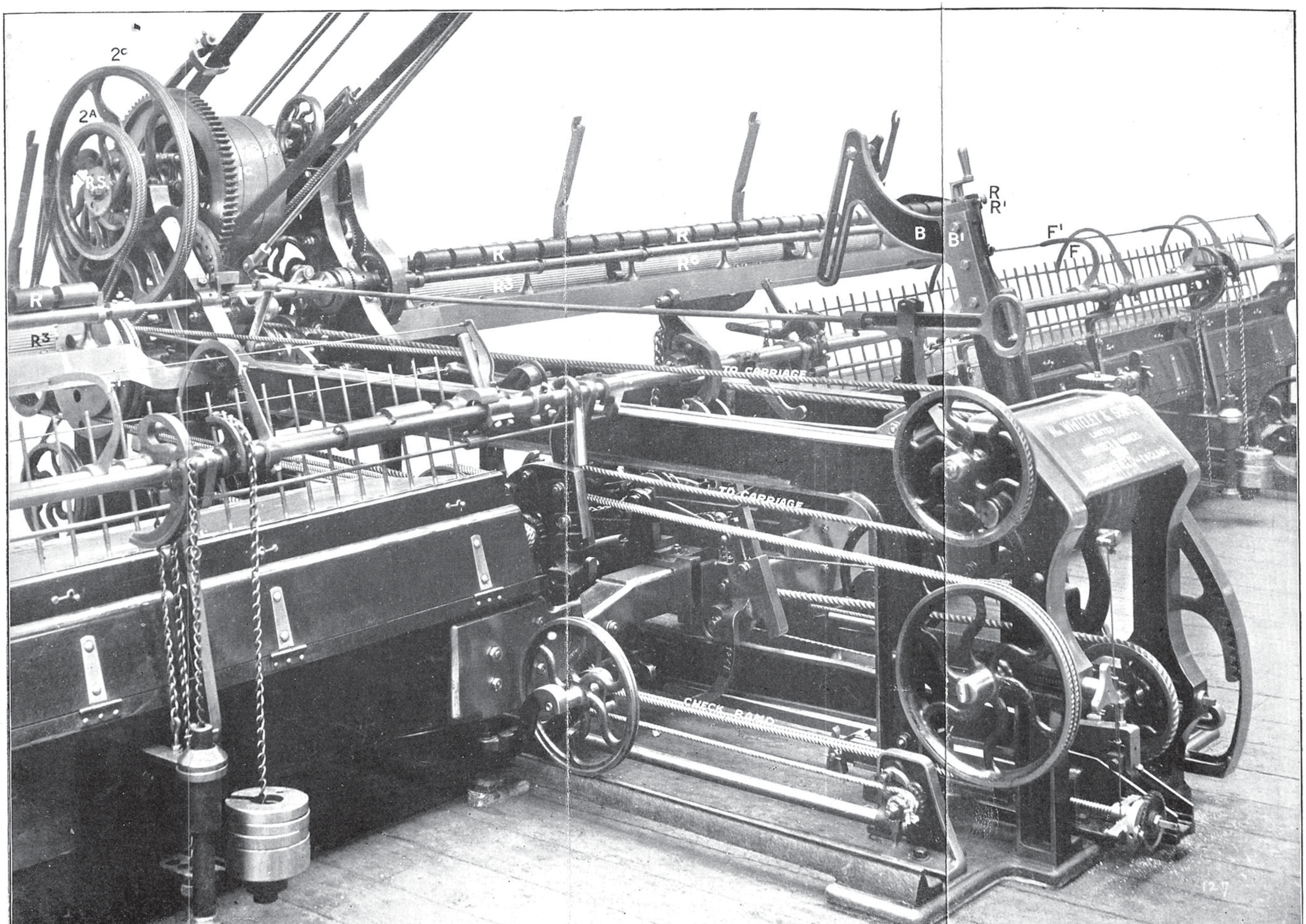
It is now understood how two speeds are given to the spindles, why they are essential, and at what stage in the movement of the carriage the transition is made in the drive of the spindles from band pulley 2A to band pulley 2C.

The course of the bands or cords for this purpose are shown in Fig. 85 and Fig. 86 (in Figs. 85, 86, and 87 the inner rim in all cases is taken as the first in the series), the former is the arrangement in the self-actor for woollen yarns made by Messrs. Platt Bros., and the latter by Messrs. Wm. Whiteley and Sons. Both methods are largely practised.

Starting (Fig. 85) with the large rim, 2nd C, the band passes round the bottom guide, 2nd D, and round 2nd E, 2nd F, 2nd G, 2nd H, to small rim, 1st A, small rim guide, 1st B, returning to the large rim, 1st C, then round 1st D, 1st E, 1st F, 1st G, 1st H, 2nd A, 2nd B, and back to 2nd C.

In Fig. 86, guide B is a four-grooved pulley, the extra guide in Platt's system being substituted by the use of

Plate XXIII




[Messrs. William Whiteley and Sons, Ltd.

View of Self-Actor.

*Fold-out rotated 90° to fit on page.*

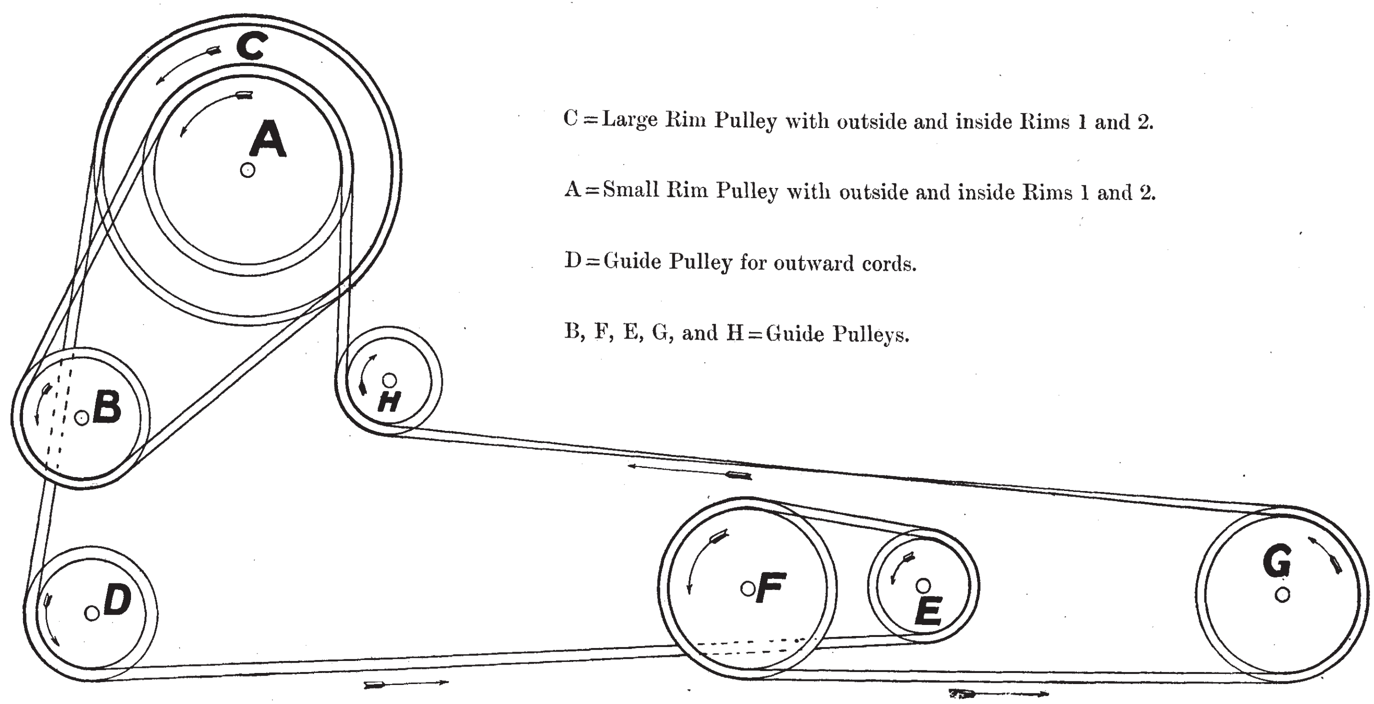



FIG. 85. Scheme of Bands for controlling Carriage (Platt).

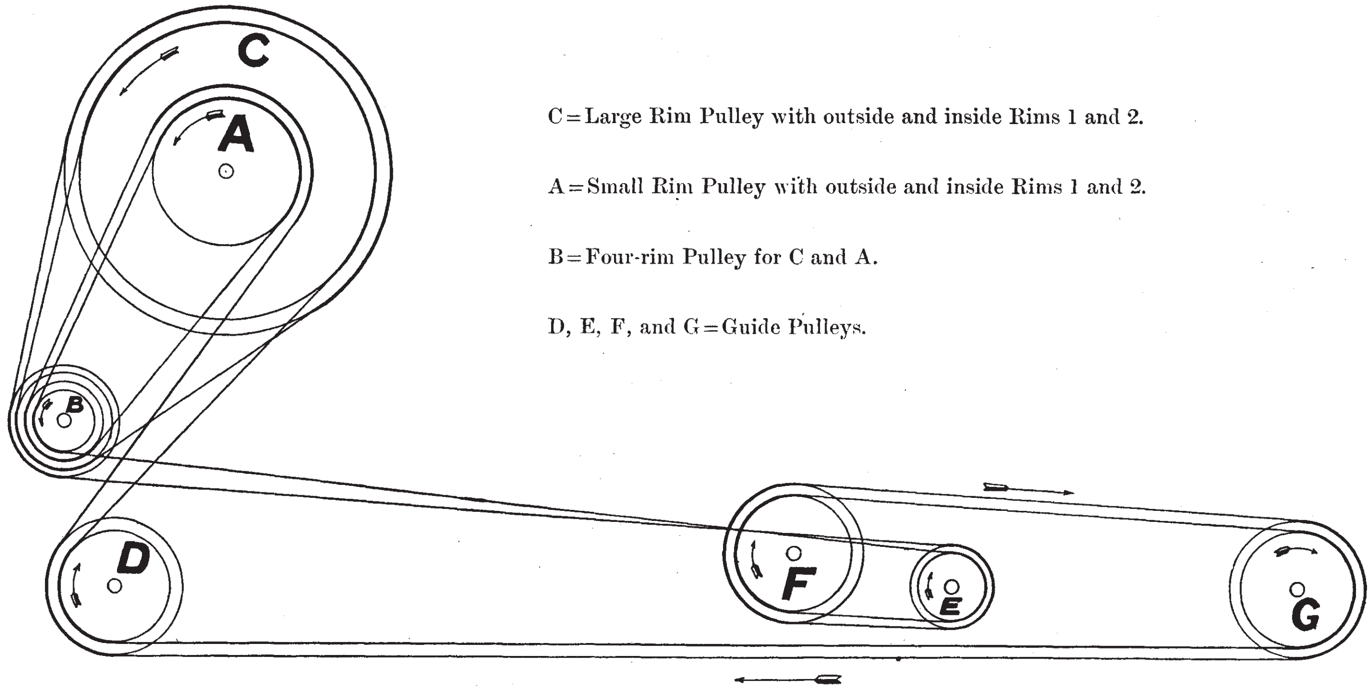



Fig. 86. Scheme of Bands for controlling the Carriage (Whiteley).

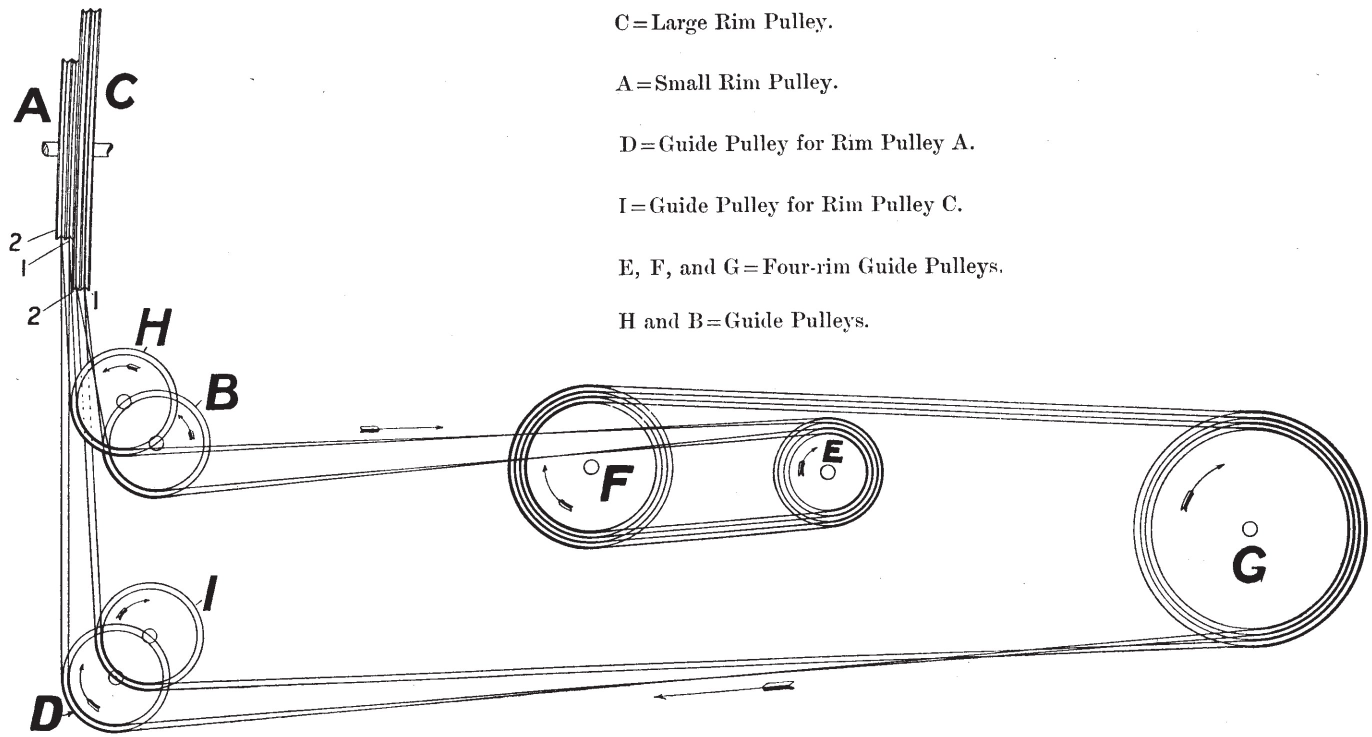



FIG. 87. Scheme of Bands for controlling the Carriage (Asa Lees).

four instead of two grooves in this bottom guide. The course of bands is: 2nd rim of C, 4th B, 2nd E, 2nd F, 2nd G, 2nd D, 2nd A, 2nd B, 1st A, 1st B, 1st E, 1st F, 1st G, 1st D, 1st C, 3rd B, return to 2nd C.

One of the special features in the method practised in Messrs. Asa Lees' cross-driven self-actor (Fig. 87), is the upper and lower guide pulleys are in duplicate and not in a line with each other. The remaining rim pulleys of the series have four grooves instead of two. The course of the bands here (Fig. 87), is as follows: From 1st C to 1st B, 1st E, 1st F, 1st G, 1st D, 1st A, 1st H, 3rd E, 3rd F, 3rd G, 1st I, 2nd C, 2nd B, 2nd E, 2nd F, 2nd G, 2nd D, 2nd A, 2nd H, 4th E, 4th F, 4th G, 2nd I, and return to 1st C.

*Control of the Carriage.*—The traverse of the carriage is complicated, due to its variable speeds. Thus, at the commencement of the draw, the speed is slow, then accelerated, and after the cessation of the delivery rollers, slowed down. This diverse rate of movement is controlled by a pair of scrolls—the drawing out scroll, $S^1$, and the check scroll, $S^2$ (Fig. 84). They are constructed to take different lengths of cotton driving band, namely, 84″, 78″, and 72″, allowing 12″ extra on the draw of the carriage for adjustment of the band on the scroll, whether on the starting or finishing section. It will be seen that the grooves in $S^1$ are put the reverse of the grooves in $S^2$. Beginning with the attachment of the $\frac{1}{2}''$ cotton band, it is wound on from the thick to small part, passed over pulley $A^2$ (Fig. 88), to be fastened to a ratchet wheel in the middle of the carriage. The check scroll, $S^2$ (Fig. 84), is wrapped with a similar band, beginning at the smallest diameter, and coiling to fill the grooves. The free end is then taken and attached direct to the framework of the carriage. The check band winds off as the drawing out scroll winds on, preventing the carriage from over-running.

60. *Continuous Spinning of Woollen Yarns* (*Machines made by Messrs. Platt Bros., and Messrs. John Sykes and Sons*).—As the term denotes, the object is to spin a carded and condensed sliver without the sequence of intermittent

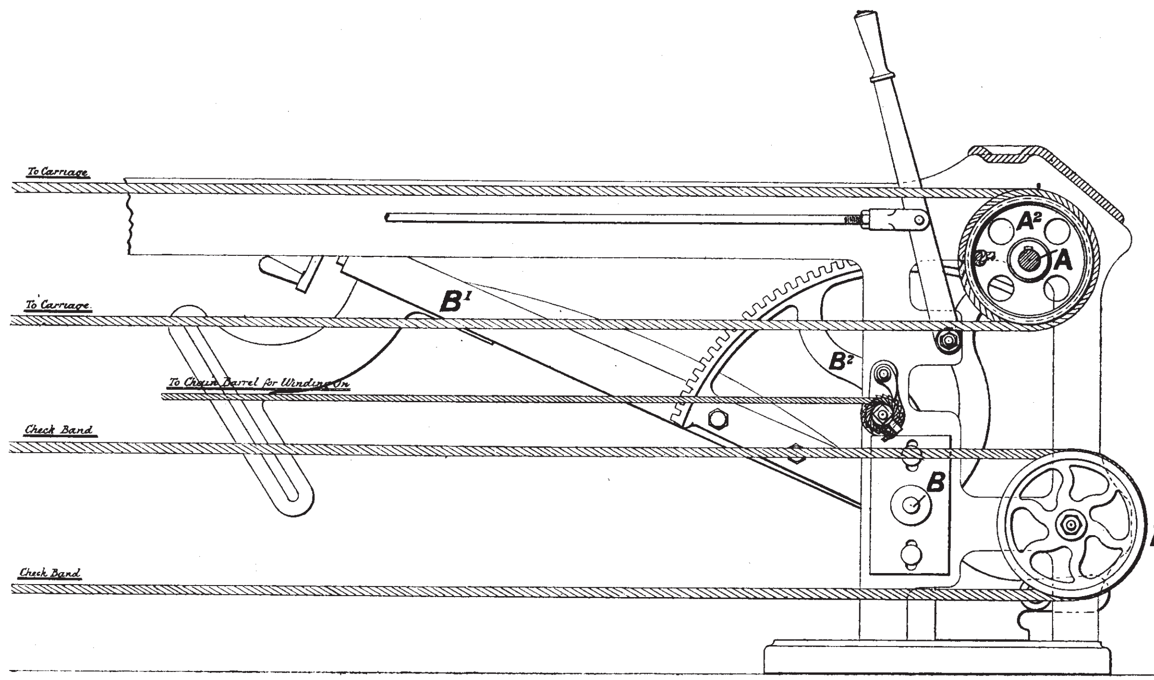



FIG. 88. Section of Self-Actor—Quadrant Motion.

motions on the self-actor, that is, to draft to the required degree a sliver free from twine, then by twisting to convert it into a firm, weavable yarn, the delivery of the sliver and the winding up of the spun thread therefrom being performed continuously. This, it will be observed, is entirely different in nature of routine from the compound process of spinning which takes place on the self-actor. Thus drafting is not accomplished by the spindles, on which the

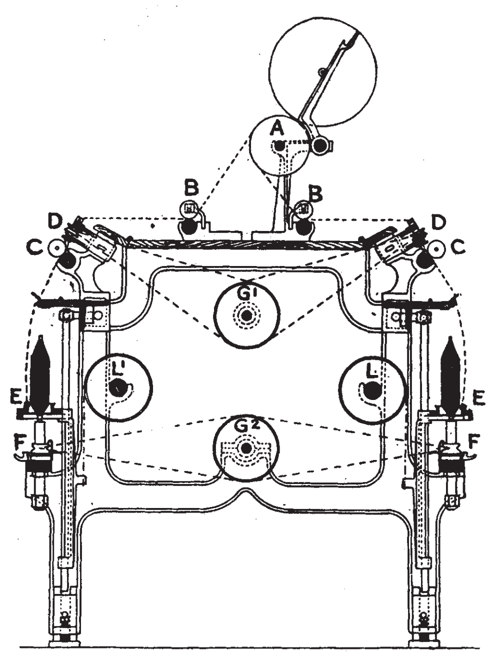



FIG. 89. Sykes' Continuous Woollen Spinning Frame.

$G^1$ = Cylinder for driving the Wharls. $G^2$ = Cylinder for driving the Spindles.

yarn is wound, fixed in a movable carriage; intermittent revolving delivery rollers are not used; and the yarn is not spun and wound up in lengths of a few yards each at a time. As substitutes for these distinguishing mechanical features of mule spinning—the slivers pass between a pair of receiving rollers, between sets of "carriers," to a pair of delivering rollers having a higher circumferential speed, and thereby elongating or drafting the slivers; twist is inserted into the drawn out slivers as they escape from the nip of the delivery rollers, and pass forward to the bobbins;

and a continuous winding up of the yarn is effected by the spindles mounted in a fixed frame (Fig. 89). Mechanically the system possesses some of the features of frame spin-

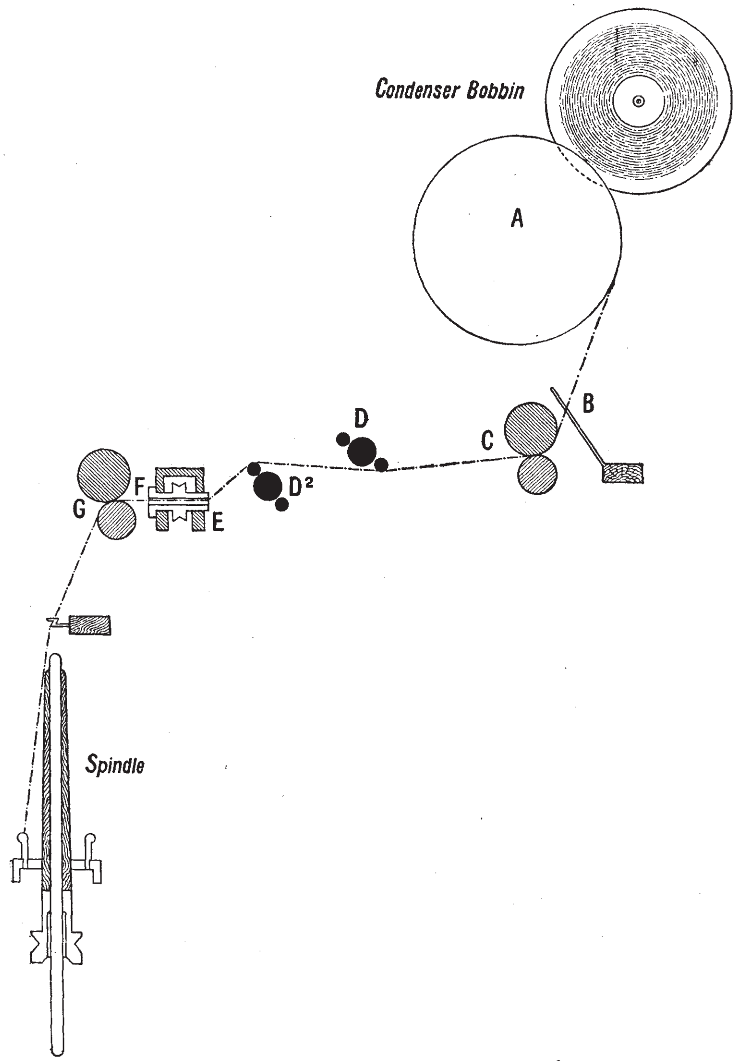



Fig. 90. Sectional Drawing showing the passage of the thread in the Continuous Woollen Frame (Sykes).

ning for worsted and cotton yarns; but here there are several drawing boxes, in each of which doubling and drafting—and maybe a slight degree of twisting—are practised, until a thread of suitable diameter and regularity of structure may be formed in the process of roving. The soft thread, thus obtained, is still further drafted on the spinning frame before the real and final twist is introduced—which makes it a weavable yarn—as it passes from the front pair of rollers to the spindles. An essential difference, therefore, between frame-spun worsted yarn and the continuous-spun woollen yarn, is that the former is a multiple or series of preparatory but similar processes *plus* spinning, and the latter a simple routine of work,

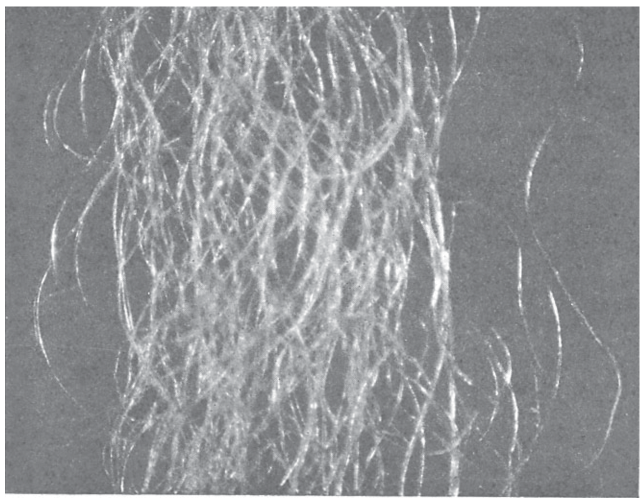


FIG. 91. Sliver from Condenser Bobbin.

converting, at *one* operation, the untwisted condenser sliver into a firm, spun thread.

61. *Comparison between Mule and Frame Spun Yarns.*—That yarns spun on the self-actor and the continuous frame should differ in structure and quality is sufficiently evident from the mechanical treatment to which the condensed slivers are subjected, peculiar to the two systems. The condensed yarns may be identical as to material and method of preparation, but they would receive a different structural formation and character if spun on the mule and frame machine. Comparing such yarns in the first stage of spinning after drawing out or attenuation (Figs. 91 and 79), the elements of dissimilarity are quite marked. The

slivers in these two photomicrographic illustrations are both made of cheviot wool and condensed to a similar counts—the former being frame or roller, and the latter mule or spindle drafted. Both are consistent to a definite arrangement or grouping of filaments, but in Fig. 79 they are more closely adjusted in relation to each other than in Fig. 91. The sliver is not so free from irregularities, the fibres being unequally distributed, and more curly, but the core of the sliver is firmer and more compact than the

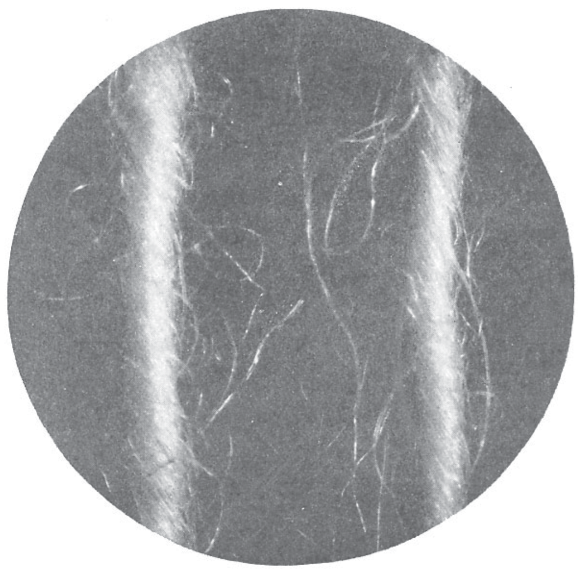


FIG. 92. Frame Spun Woollen Yarn.

sliver in Fig. 91. This is due to the measure of twist applied to the slivers when spinning on the mule prior to the process of drafting. Each twist fixes the order of fibres prepared by the operations of carding and condensing. Roller drafting tends to straighten the fibres and to draw them in a systematic relation to each other, but spindle drafting has the opposite effect, establishing and consolidating the fibrous characteristics of the condensed sliver.

The filaments, after twisting, have not the same facility to glide or pass each other during the process of attenuation of the slivers, as in the untwisted condition. The whirling of the slivers in twisting produces the meshing of fibres seen in Fig. 79. Twisting has given a definite turn or direction to the stronger fibres, the finer and shorter wool being forced into the core or heart of the thread. On the other hand, in the roller-drafted sliver (Fig. 91) the fibres possess an equality of distribution and arrangement approaching parallelism. Drafting is possible in such a sliver with a minimum degree of friction and strain on the individual fibres.

The spun yarns (Figs. 80 and 92) resulting from the two types of sliver, have their characteristics more clearly developed. The smoothness and levelness of surface of the one, and the rough undulated surface of the other, are increasingly pronounced. In twisting a sliver of the construction of Fig. 92, the fibres roll into contact with each other. Being comparatively straight, a level thread is formed in the process, whereas in spinning slivers on the self-actor the longer fibres whirl round the circumference of the yarn—the short filament being utilized in making the core—and impart to it the uneven and undulated surface sketched in Fig. 80.

Each system of spinning has its applications. By far the larger bulk of woollen yarn manufactured is mule spun. Spinning on the self-actor produces a structure of thread of sound felting character, and suitable for a wide range of fabrics diversified in quality, finish, and wearing strength. But if clearness and distinctness of weave design are essentials in the woven texture—the continuous-spun yarn may be advantageously used. Resembling in certain features a worsted thread it is adapted for this purpose. The "frame," however, is chiefly suitable for the spinning of low and medium counts of yarns, owing to the lesser amount of drafting feasible as compared with spindle drafting. For example, yarns of 10, 15, and 20 yards per dram would be condensed to 7, 11, and 15 yards per dram. It is, however, a system of high productive power, economical as to machinery, and one convenient to follow.

The frames (Fig. 89) are built in duplicate. The threads from A pass between rollers, B, thence through the wharl driven off $G^1$. Some drafting takes place between the nip of rollers B and C. The yarn is wound on to bobbins by the thread passing beneath a traveller running round each rim of the bobbin plate (E, Fig. 89), which has an up and down motion for distributing the yarn evenly on the surface of the bobbin.

In a later machine made by Sykes the wharls, F (Fig. 90) are fixed horizontally, and those on each side of the machine are driven independently.

The passage of the thread in this machine is sketched in Fig. 90. Here the slivers from the condenser bobbins pass between guide pins B, between delivering rollers C, under guides D and over $D^2$ to the point E of the wharl F, then between draw rollers G and under the traveller on to the bobbin placed on the spindle. Wharl F inserts a degree of "false twist" (*i.e.* twist which is afterwards taken out between rollers G and the rim traveller) into the sliver or slubbing during drafting, which takes place from rollers G to C. The functions of the revolvers D and $D^2$ are, by being in contact with the slubbing, to prevent the "false twist" from running up tight towards G, and to preserve it in a suitable condition for even drafting.

All real twist, which converts the slubbing into a sound or true thread, is put into the slivers by the spindle and the traveller revolving on the rim of plate E, Fig. 89.

62. *The Twisting Frame.*—For the purpose of constructing folded or twist yarns, which are a combination of separate single yarns twisted into one compound thread, the twisting frame is employed. It consists of the headstock, various sets of rollers, looping and knopping frame, and mechanism for driving the spindles, and the frame for regulating the distribution of the folded yarn on to the bobbin. Twisting is a supplementary operation to spinning and one that is largely practised in both woollen and worsted manufacturing in the production of (*a*) folded yarns—two-, or three-ply—and (*b*) fancy twist yarns in various materials, counts, and structures (Chap. V).

## TABLE IV

### Productive Power of Machinery used in Woollen Yarn Manufacture

The following data form a general guide as to the productive power of the various machines employed in the production of woollen yarns:

(A) Wool Scouring.

*Production*

Varies from 6,000 to 7,000 lb. of greasy or dirty wool per day of 10 hours.

The smaller weight represents greasy Merino wool.

The yield of clean wool will vary from, say, 2,500 lb. to 6,000 lb.

*Controlling Factors*

I. Character of Material.

(*a*) Nature of the impurities.
(*b*) Quantities of impurities.
(*c*) Openness or otherwise of the wool.

II. Available Washing.

(*a*) Length, capacity, and number of bowls.
(*b*) Temperature.
(*c*) Detergents.

(B) Wool Drying.

This operation is necessary for all wools, except when they are to be dyed in the same works, and also long coarse wools for worsted yarns.

Usually, the drying is arranged to keep up to the scouring.

*Production*

Varies according to make and style of machine. One of the best for fine wools is the McNaught Revolving Dryer, 28 feet in length, and will treat 4,000 lb. per day.

*Controlling Factors*

I. Character of Material.
 (*a*) Coarse or fine.
 (*b*) Open nature or otherwise.
 (*c*) Condition from scouring machine.
II. Temperature.
III. Speed.
IV. Degree of Dryness required.
V. Size and construction of machine.

(C) Blending Machines.

*Teazer or Willey*

48 inch machine.

*Production*

Varies, say, from 800 to 1,000 lb. per hour.

*Controlling Factors*

I. Character of the material.
 (*a*) Time the material remains in the machine.
II. Style and construction of the machine.
III. Speed.

*Fearnought*

48 inch machine.

*Production*

Varies up to 1,200 lb. per hour.

*Controlling Factors*

I. Character of materials.
II. Style and construction of machine.
III. Speed.

(D) Sets of Carding Machines.

*Production*

(On ordinary average sets)

280 lb. per day on fine wools for fine counts.
500 lb. per day on coarser wools for medium and low counts.
800 lb. per day on low materials.

Calculations usually based on the surface speed of the last doffer and the weight of the web; or the surface speed of the winding drums, number of threads, and counts of condensed thread.

*Controlling Factors*

I. Quality of material, and the amount of carding it will require. Its suitability for the machine and its condition.

II. Amount of working available.
 (*a*) Number of parts.
 (*b*) Sizes of rollers, etc.

III. Speed of the machine.

IV. Weight of feed, or ratio of feeding.

V. Character and strength of the Card Clothing: also condition.

(E) MULE SPINNING.

*Production*

On coarse counts: say, 10 skns.; 1 lb. per spindle per day.

On medium counts: say, 20 skns.; $\frac{1}{2}$ lb. per spindle per day.

On fine counts: say, 48 skns.; $\frac{1}{4}$ lb. per spindle per day.

*Controlling Factors*

I. Number of draws per minute, depending upon the character of the material.
 (*a*) Amount of twist.
 (*b*) To a slight extent, amount of draft.
 (*c*) Speed of rim shaft.

# CHAPTER IV

## WORSTED YARN CONSTRUCTION



63. *The term "Worsted."*—Wool from the same fleece, or even parts of the same fleece, may be manufactured into either worsted or woollen yarns. Strictly speaking, it is solely the routine of mechanical action through which the wool passes, from the natural condition to the spun thread, which makes the difference in quality, lustre and structure of the two types of all-wool yarns. The distinction is noted in French by using the terms *laine cardée* and *laine peigné* and in German by *wollen-garn* and *kamm-garn*, apparently implying that a worsted yarn is made of wool which at one stage of manufacture has been *combed*, and that a woollen yarn is obtained by carding. As regards the woollen, the definition is essentially correct; but combing is not a necessary operation in the making of certain classes of worsted yarns; and there is no single

process which can be taken to determine the structure of a woollen or worsted thread.

A *woollen* thread is formed by mechanical work and routine—utilizing all classes of fibres in the raw material—which separate filament from filament, and intermingle, and re-arrange the fibres, so that by twisting round and over each other, they are bound together in continuous lengths of yarn of uniform density and structure throughout.

The mechanical treatment and routine in forming a *worsted* thread, also separate filament from filament but re-arrange and re-group them on a system in which the fibres are in a line with each other, so that the continuous rounded lengths of yarn, when twisted or spun, possess a smooth and more or less a bright surface (compare specimens 1, 2, 3, 4, and 5 with specimens 6, 7, 8, and 9, Plates XXIV and XXV).

Another feature to be noted is the greater length of yarn producible from a given quantity of wool prepared by the worsted than the woollen scheme of manufacture. Taking a pound of clean, fine wool it might, by carding and spinning on the self-actor, be made to give from 10,000 to 12,000 yards of yarn; but the same wool, prepared on the worsted principle, would give from 60,000 to 70,000 yards of spun thread.

64. *Systems of Worsted Yarn Manufacture.*—Worsted yarns are made by the following methods:

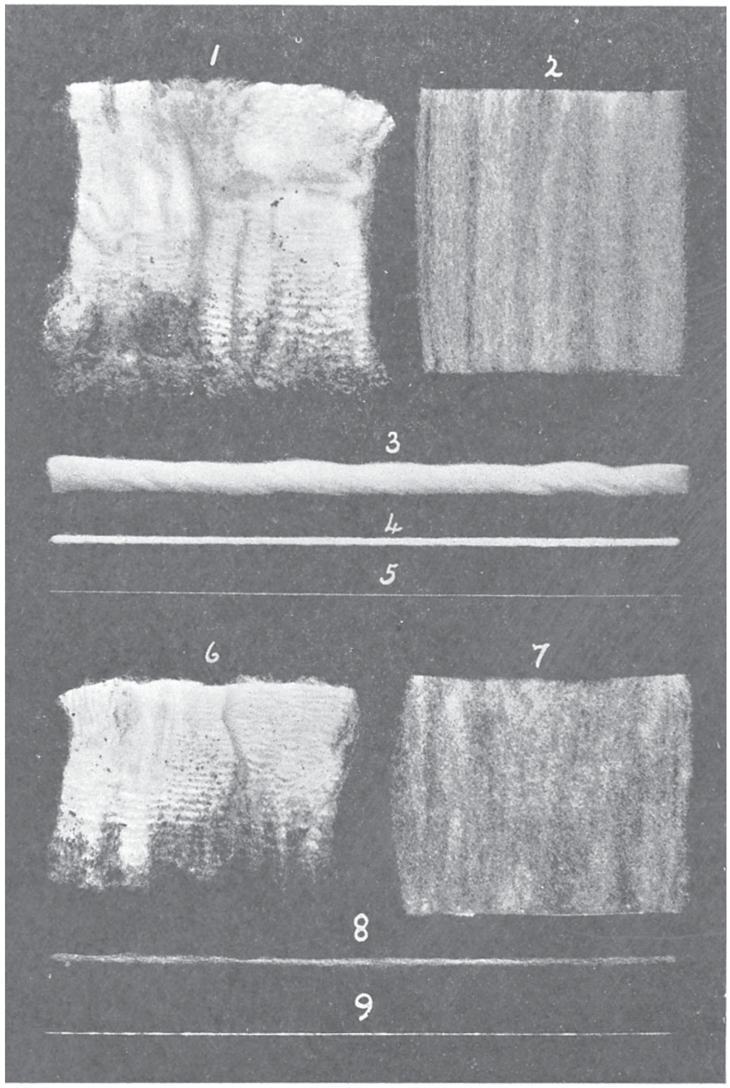
I. Carding, backwashing, drawing, and spinning, *e.g.*, chiefly carpets and hosiery yarns.

II. Carding, backwashing, gilling, combing, drawing, roving, and spinning (cap or flyer frames), *e.g.*, botany and cross-bred yarns made from short and medium-stapled wools.

III. Preparing by gill boxes, combing, drawing, roving, and spinning (flyer frame), *e.g.*, long-stapled wools for lustre yarns.

IV. Continental system A. For short and medium-stapled wools, the processes comprising—carding,

PLATE XXIV.




SPECIMENS OF MERINO WOOL IN THE SEVERAL STAGES OF MANUFACTURE. WORSTED AND WOOLLEN SYSTEMS.

backwashing, combing, drawing, with important and essential differences in the mechanical treatment of the material from the English systems for straightening and levelling the fibres in drawing and also in spinning, which is performed on the self-actor and by roller and not spindle drafting.

V. Continental system B. For the treatment of materials without combing, the operations being—carding, drawing, or levelling (*Bobinoir intermédiare à frotteur à dentelles*), re-carding (*Cardé mélangeuse*), re-drawing, and spinning on the ring frame or self-actor.

Each method produces a yarn of distinct structure and characteristics. By the first and simplest routine a yarn is obtained resembling in appearance a woollen thread: for, on account of the absence of combing from the processes of construction, the short and curly fibres remain in the spun yarn. By the second system, the typical botany and cross-bred yarns for coatings, suitings, dress and costume fabrics are acquired, and should be level, smooth, and of a bright quality. The true lustrous "worsted" is made by the third routine or gill-box preparation. The Continental systems yield a yarn of a full character and soft structure. Whichever system of thread production is practised, the *fundamental principle* is the same, for in all classes of worsted yarns the fibres are straightened and arranged in the order of parallelism.

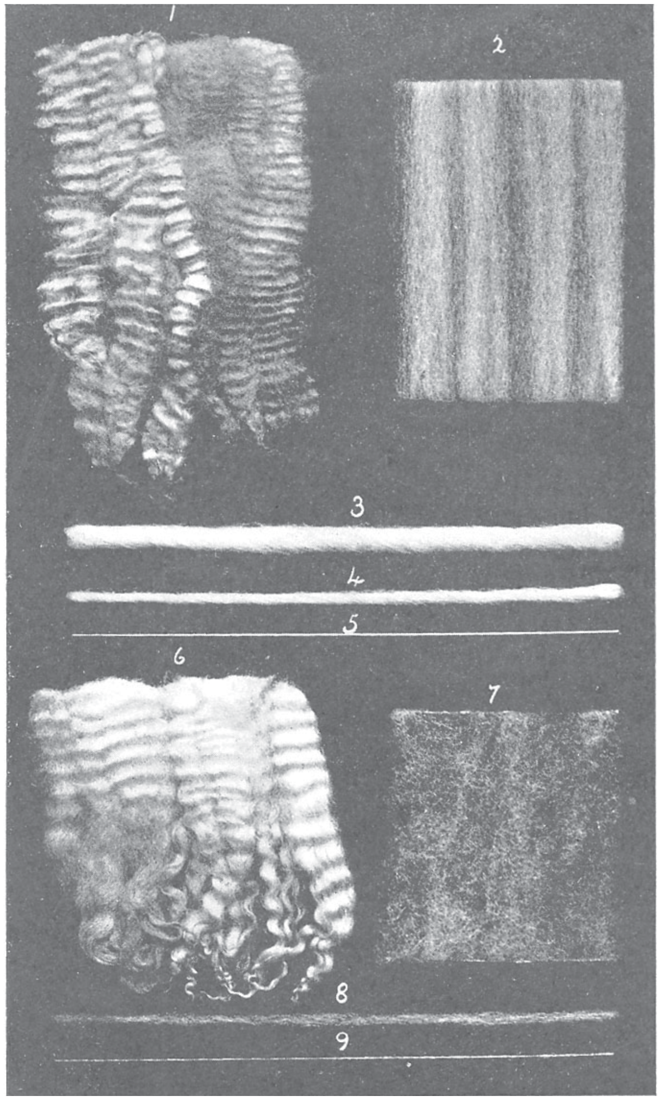
In worsted yarn making, it is not so much a scheme of opening, blending, and crossing of the fibres, as a system of separation, drawing out, and re-arrangement of the fibres of the wool in one common line with each other. A perfect mingling and grouping of the fibres is necessary; but, whereas the distinctive feature of woollen-thread manufacture is that of mixing the fibres thoroughly and of producing a level sliver, yet, as understood, there is no definite system of combination practised, for fibres may lay either across or lengthways of the material; on the other hand, in worsted-yarn construction, in addition to preparing a continuous ribbon or slubbing of uniform size, the fibres must be straightened and brought into parallel line. For example, by System II of worsted-yarn manufacture the treatment of the wool comprises: (*a*) opened and separated but crossed and intermingled in carding; (*b*) the fibres straightened, the staple attenuated and levelled in gilling; (*c*) short and neppy fibres extracted and the straight and longer fibres laid parallel to each other in combing; (*d*) an even stubbing of regular size and composed of straightened fibres formed in drawing; (*e*) a thick thread of soft, open structure produced in roving; and (*f*) a firm, sound, bright yarn of a required counts, made by drafting and twisting in the process of spinning.

65. *Preliminary Processes, Blending.*—The preliminary processes of scouring and carding in Systems I, II, IV, and V are similar in principle and results to those which form part of woollen yarn manufacture, but worsted carding is done in *one* machine, and is but a preliminary opening and levelling of the fibres, and differs in details from the compound operations of scribbling, carding, and condensing.

There are one or two distinctive features of the process of blending for worsted, which require explanation. In woollen-yarn making, blending is done in teazing and carding, after which little further mixing is effected. Condensing simply divides the sheet of filaments into slivers of corresponding length and thickness, and twisting follows without altering the relation of the fibres to each other beyond imparting a degree of lateral displacement of the fibres by drafting in the operation of spinning. But in worsted-yarn construction (English systems) blending is done *after* carding: in the first place, by re-combing the dyed tops; and, in the second place, it is accomplished in gilling, the process of mixing continuing in the several drawing boxes employed. *Mélangeuse* either for tops of different materials or colours, on the Continental system, precedes drawing, in which the work is completed as on the English principle.

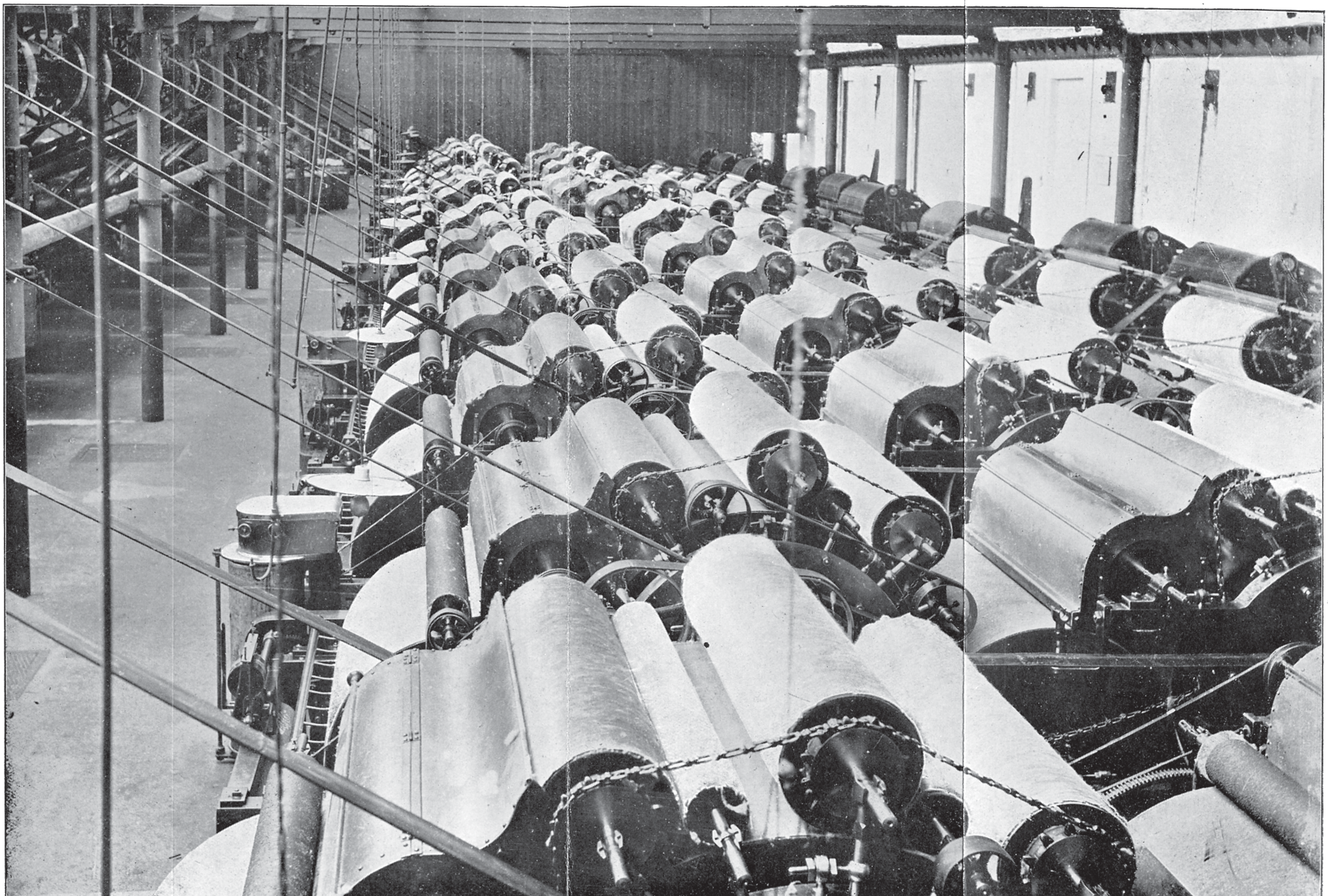
In each of these systems there is one common feature,

PLATE XXV.




SPECIMENS OF CROSS-BRED WOOL IN THE SEVERAL STAGES OF MANUFACTURE. WORSTED AND WOOLLEN SYSTEMS.

PLATE XXVI



[Per Messrs. Taylor Wordsworth and Co., Ltd.

PLANT OF WORSTED CARDING PLANT (MILL VIEW), SHOWING SCHEME OF ARRANGEMENT AND DRIVING.

*Fold-out rotated 90° to fit on page.*

namely, the blending of the fibres occurs when they are in a line with each other, straight and regular in arrangement and grouping, and not when crossed and intermingled as in the carded state.

66. *Worsted Carder, Burring Appliances (Factory View of Plant of Worsted Carding, Plate XXVI and Figs.* 93 *and* 93*a*, *Plates XXVII dnd XXVIII).*—The worsted carder differs in construction and in combination of parts from a woollen carder, but the operation is similar in principle in both types of machine. The object is to separate, as in woollen carding, the fibres of the wool from each other and to re-arrange them, at the same time removing burrs

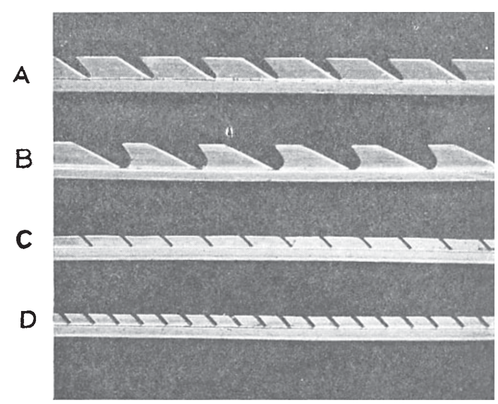



Fig. 94.

and other foreign matter, and delivering the material in one continuous ribbon or sliver of equal thickness, fibrous density, and consistency, and weight, for a fixed length of sliver, throughout the whole operation.

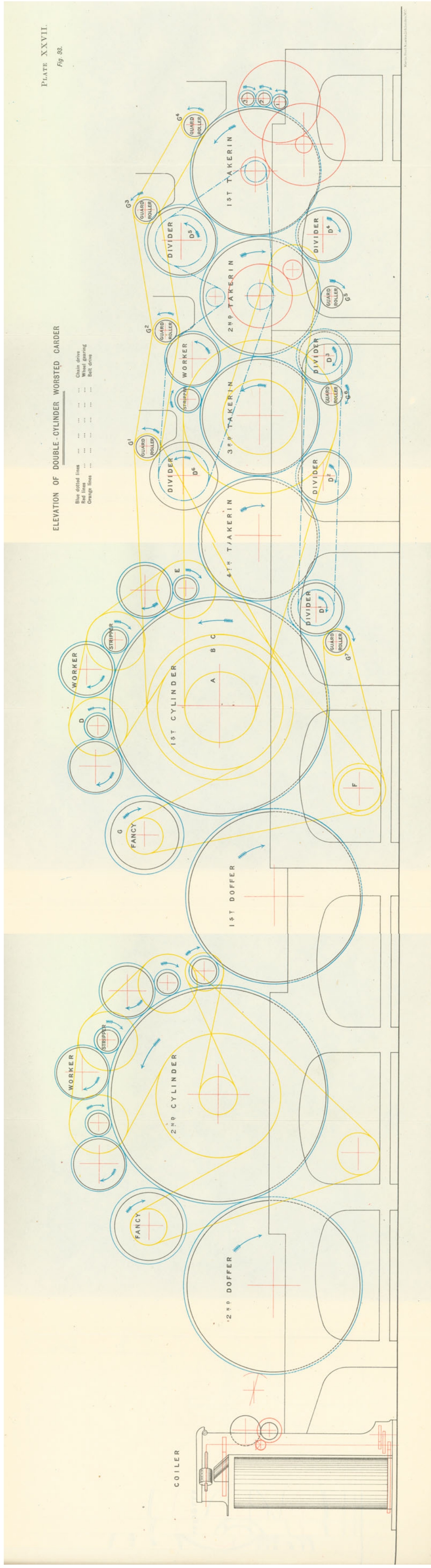
An ordinary worsted carder may be mounted with four takers-in or openers, garnished with strong steel teeth increasing in fineness from one roller to the other. The speed of the rollers also advances from the first to the last in the set. Fixed in close proximity with the first two takers-in are the burring rollers which may be eight or ten in number. These are not covered with card clothing but with Garnett wire (see Fig. 94). Each burr-roller has a separate guard-roller for lashing the burrs, seeds, etc., out of the material. On this system the large burrs are removed by the first guard-roller off the front burring cylinder, the medium-sized burrs by the second, and the broken burrs and seeds by the last guard-roller.

Various mechanical contrivances for burr crushing are also employed. Harmel's mechanism, constructed by Messrs. Platt Bros., consists of three rollers fixed between the first doffer and the second cylinder. The two small fluted steel rollers are mounted over a larger roller with a plain or smooth surface. They are so adjusted that when the wool passes between them, the fluted rollers break and crush the burrs, making them free to drop under the cylinders during the carding operation. Such impurities as escape being removed are extracted in combing. Harmel's calendar-delivery is for a similar function. Here there are two heavy rollers. The upper one fluted and the lower one plain-surfaced, and they extend about one-third the width of the card. By passing the carded fleece of fibres, taken from the last doffer, under a bar, it is diminished to the width of the crushing rollers. In both these appliances, the idea is to crush the burrs, but the object of the burr-roller system, as explained, is to beat them from the wool.

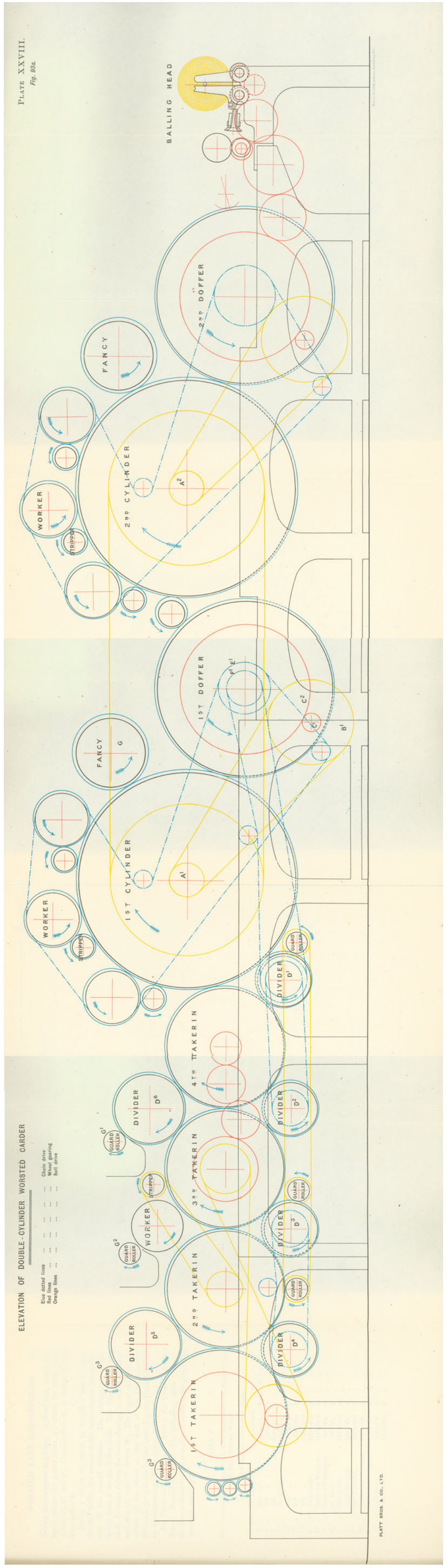
The carded material is delivered from the last doffer (Figs. 93 and 93*a*, Plates XXVII and XXVIII) into a can-coiler, or on to large bobbins. It passes from the doffing comb through a funnel guide, either into the coiler, or on to the bobbin which, having both a lateral and rotary motion, winds the lap of fibres transversely on to its surface.

67. *Worsted Carder, Methods of Driving.*—The method of driving the various parts of a worsted card is indicated in Plates XXVII and XXVIII, Figs. 93 and 93*a*. The initial drive is off pulley A on the main cylinder, the belt from which passes over the pulley on the shaft of the third taker-in, a wheel on the same shaft imparting motion by wheel-gearing to the fourth taker-in, and to the first and second by belt and wheel-gearing.

A second belt passes round pulleys B, D, E, F, and G,




*Fold-out reduced to 28 % and rotated 90º to fit on page.*




*Fold-out reduced to 28 % and rotated 90° to fit on page.*

driving the strippers and fancy. A third belt, round pulley C, drives the guard-roller, $G^1$, which, by other belts, drives $G^2$, $G^3$, and $G^4$. Guard-roller, $G^7$, is driven by belt from pulley F.

Pulley $A^1$ drives $B^1$, which, by wheels $C^1$ and $C^2$, turns the first doffer, the second doffer being driven in a similar way off the second cylinder. The workers are chain-driven from $E^1$ on the doffer shaft. The wheel, $F^1$, on this shaft, by chain drives the *lower* divider, $D^1$, which drives $D^2$ and also $D^3$, and $D^3$ drives $D^4$. The *upper* dividers are driven by the wheel on the shaft of the first taker-in. Motion is given to the balling head (Fig. 93, Plate XXVII) by wheel-gearing off the doffer-shaft.

68. *Particulars of Card Clothing for Cross-bred and Botany Worsted Carders.*—The following table contains the data of three typical sets of card clothing for preparing wools for combing:

TABLE V

SETS OF CARD CLOTHING FOR A, FINE CROSS-BRED; B, BOTANY; AND C, FINE BOTANY WOOLS

*A. Worsted Card for Cross-Bred Wools.*

| | | | | | | |
|---|---|---|---|---|---|---|
| 2″ | fillet | 1st Taker-in | Garnetted. | | | |
| 2″ | ,, | 2nd ,, | 60's/6's | 6 | ply Vul. | I. R. |
| 2″ | ,, | 3rd ,, | 80's/8's | 5 | ,, | ,, |
| 2″ | ,, | 4th ,, | 100's/10's | 4 | ,, | ,, |
| 1½″ | ,, | 1st Divider | 60's/6's | 6 | ,, | ,, |
| 1½″ | ,, | 2nd ,, | 80's/8's | 5 | ,, | ,, |
| 1½″ | ,, | 3rd ,, | 90's/10's | 5 | ,, | ,, |
| 1½″ | ,, | 4th ,, | 105's/10's | 4 | ,, | ,, |
| 2″ | ,, | 1st Cylinder | 110's/10's | 4 | ,, | ,, |
| 1½″ | ,, | Three 1st Workers | 115's/10's | 4 | ,, | ,, |
| 1″ | ,, | Three 1st Strippers | 80's/8's | 4 | ,, | ,, |
| 1½″ | ,, | 1st Fancy | 60's/6's | 4 | ,, | ,, |
| 2″ | ,, | Mid Doffer | 115's/10's | 4 | ,, | ,, |
| 1″ | ,, | Angle Stripper | 100's/9's | 4 | ,, | ,, |
| 2″ | ,, | Last Cylinder | 125's/12's | 4 | ,, | ,, |
| 1½″ | ,, | Three Last Workers | 130's/12's | 4 | ,, | ,, |
| 1″ | ,, | Three Last Strippers | 90's/9's | 4 | ,, | ,, |
| 1½″ | ,, | Last Fancy | 70's/7's | 4 | ,, | ,, |
| 2″ | ,, | Last Doffer | 130's/12's | 4 | ,, | ,, |

*B. Worsted Card for Botany Wools.*

| | | | | | | |
|---|---|---|---|---|---|---|
| 2″ | fillet | 1st Taker-in | Dia. Pt. | 7 | ply Vul. | I. R. Cloth |
| 2″ | ,, | 2nd ,, | 90's/9's | 5 | ,, | ,, |
| 2″ | ,, | 3rd ,, | 100's/10½'s | 4 | ,, | ,, |
| 2″ | ,, | 4th ,, | 115's/10's | 4 | ,, | ,, |
| 1½″ | ,, | 1st Divider | 70's/8's | 6 | ,, | ,, |
| 1½″ | ,, | 2nd ,, | 90's/10's | 5 | ,, | ,, |
| 1½″ | ,, | 3rd ,, | 110's/10's | 4 | ,, | ,, |
| 1½″ | ,, | 4th ,, | 120's/10's | 4 | ,, | ,, |
| 2″ | ,, | 1st Cylinder | 130's/12's | 4 | ,, | ,, |
| 1½″ | ,, | 1st Worker | 135's/12's | 4 | ,, | ,, |
| 1½″ | ,, | 2nd and 3rd Workers | 140's/12's | 4 | ,, | ,, |
| 1″ | ,, | Three 1st Strippers | 110's/10's | 4 | ,, | ,, |
| 1½″ | ,, | 1st Fancy | 70's/7's | 4 | ,, | ,, |
| 2″ | ,, | Mid Doffer | 140's/12's | 4 | ,, | ,, |
| 1″ | ,, | Angle Stripper | 110's/10's | 4 | ,, | ,, |
| 2″ | ,, | Last Cylinder | 145's/13½'s | 4 | ,, | ,, |
| 1½″ | ,, | 4th Worker | 150's/13½'s | 4 | ,, | ,, |
| 1½″ | ,, | 5th and 6th Workers | 155's/14's | 4 | ,, | ,, |
| 1″ | ,, | Three Last Strippers | 115's/10's | 4 | ,, | ,, |
| 1½″ | ,, | Last Fancy | 80's/8's | 4 | ,, | ,, |
| 2″ | ,, | Last Doffer | 155's/14's | [1] 4 | ,, | ,, |

*C. Worsted Card for Fine Botany Wools.*[2]

| | | | | | | |
|---|---|---|---|---|---|---|
| 2″ | fillet | 1st Taker-in | Dia. Pt. | 7 | ply Vul. | Cloth I. R. |
| 2″ | ,, | 2nd ,, | 90's/9's | 5 | ,, | ,, |
| 2″ | ,, | 3rd ,, | 100's/10's | 4 | ,, | ,, |
| 2″ | ,, | 4th ,, | 120's/10's | 4 | ,, | ,, |
| 1½″ | ,, | 1st Divider | 70's/7's | 6 | ,, | ,, |
| 1½″ | ,, | 2nd ,, | 90's/9's | 5 | ,, | ,, |
| 1½″ | ,, | 3rd ,, | 115's/10's | 4 | ,, | ,, |
| 1½″ | ,, | 4th ,, | 120's/10's | 4 | ,, | ,, |
| 2″ | ,, | 1st Cylinder | 130's/12's | 4 | ,, | ,, |
| 1½″ | ,, | 1st Worker | 135's/12's | 4 | ,, | ,, |
| 1½″ | ,, | 2nd and 3rd Workers | 140's/12's | 4 | ,, | ,, |
| 1″ | ,, | Three 1st Strippers | 110's/10's | 4 | ,, | ,, |
| 1½″ | ,, | 1st Fancy | 70's/7's | 4 | ,, | ,, |
| 2″ | ,, | Mid Doffer | 140's/12's | 4 | ,, | ,, |
| 1″ | ,, | Angle Stripper | 120's/10's | 4 | ,, | ,, |
| 2″ | ,, | Last Cylinder | 150's/13½'s | 4 | ,, | ,, |
| 1½″ | ,, | Three Last Workers | 155's/14's | 4 | ,, | ,, |
| 1″ | ,, | Three Last Strippers | 115's/10's | 4 | ,, | ,, |
| 1½″ | ,, | Last Fancy | 80's/8's | 4 | ,, | ,, |
| 2″ | ,, | Last Doffer | 160's/14's | 4 | ,, | ,, |

[1] Three or four ply cloth may be used for 150's and 155's.

[2] In the latter part of the set the "counts" may, if required, be increased by 5.