

Notes.—The “breaker” or scribbler includes breast and one swift; “intermediate” one swift; and “carder” two swifts. The material is delivered by the scribbler on the side roper principle, with “bank” or “ball” feed to the intermediate, and Scotch feed delivery and overhead conveyance to the carder, so that the ribbon of material is delivered with the fibres in the reverse direction to that in which they are collected off the doffer; further to prevent them being laid in the same line on the feed of the carder, the sliver is spread diagonally.

The set comprises the following parts of the diameters indicated:

SCRIBBLER		INTERMEDIATE		CARDER
Feed Rollers	2"	2"		2"
Taker-in Roller	12"	12"		12"
Breast	40"			30"
Breast, Fancy	12"			
Breast, Doffer	30"			
Swift	50"	50"		50"
Swift, Fancy	12"	12"		12"
Swift, Doffer	36"	30"		30"
Workers	9"	8"		8"
Strippers	4 $\frac{3}{4}$ "	4 $\frac{1}{2}$ "		4 $\frac{1}{2}$ "

SECOND EXAMPLE (Figs. 42 and 42*a*, Plates XIII and XIV). A typical set comprising scribbler with Scotch roper delivery and carder with 4 bobbin tape condenser,

Width on the card 60".

Application.—To the carding of Southdown and similar wools for flannels, and also, with suitable counts of wire “clothing,” for medium and fine qualities of fancy woollens.

The set comprises *scribbler* with breast cylinder and three pairs of workers and strippers, two swifts with four pairs of strippers and workers; and *carder* also with two swifts similarly garnished. The diameters of corresponding rollers are the same in each machine, namely, feed rollers, 2 $\frac{1}{2}$ "; taker-in, 9"; angle strippers, 6"; workers 4",

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PLATE XV. XVI AND XVII. Figs. 83, 84 and 85.
 SET OF CARDING MACHINES FOR GROSSBRED AND MEDIUM STAPLE WOOLS FOR MIXTURE YARNS.
 CONSISTING OF SCRIBBLER OR BREAKER, INTERMEDIATE AND CARDE AND TAPE CONDENSER.

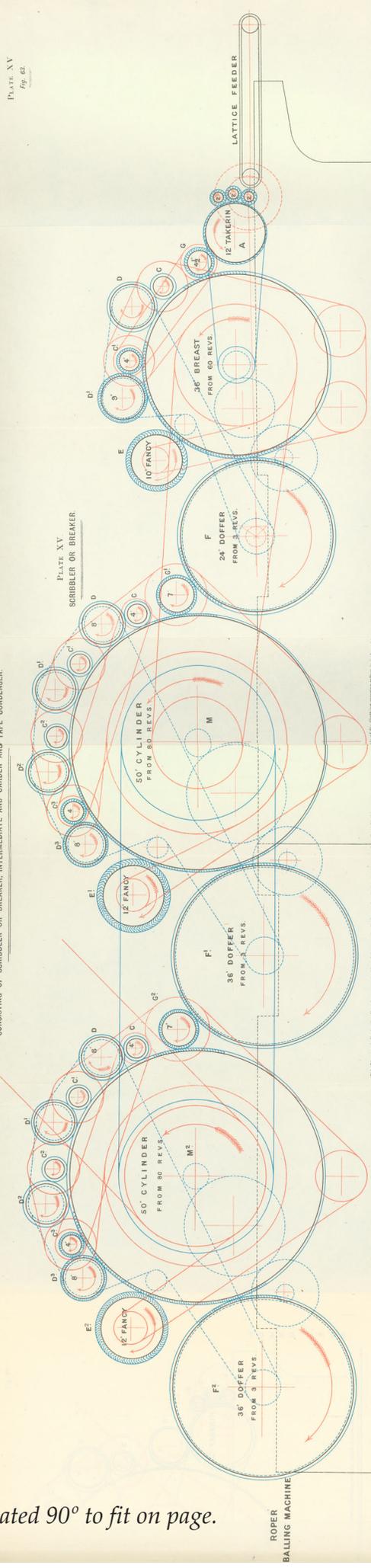


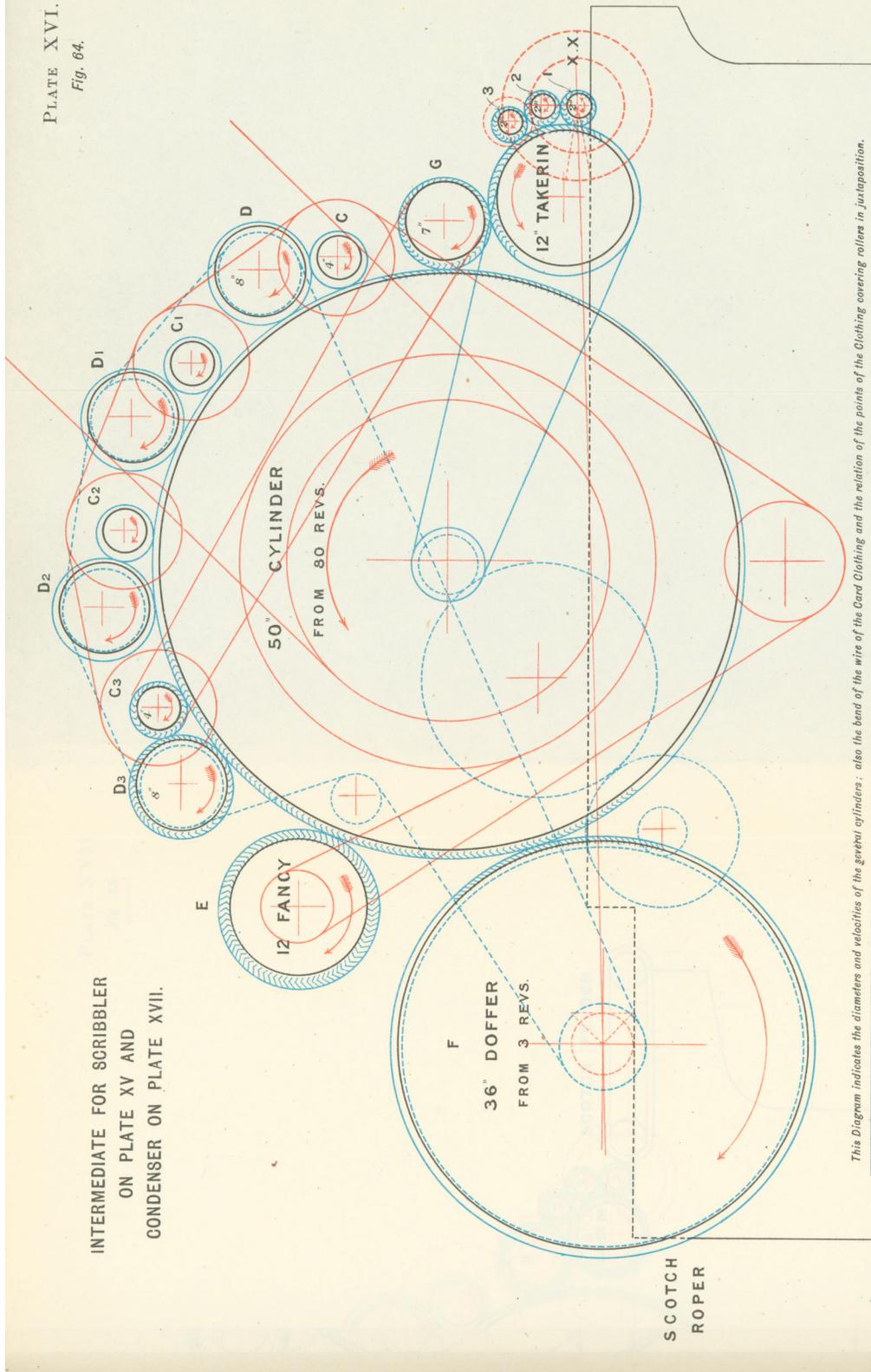
PLATE XV
 Fig. 83

The Diagrams indicate the direction and number of the several rotations, also the kind of the gear (Pinion and the nature of the Gear) of all the working members shown in the Diagrams.

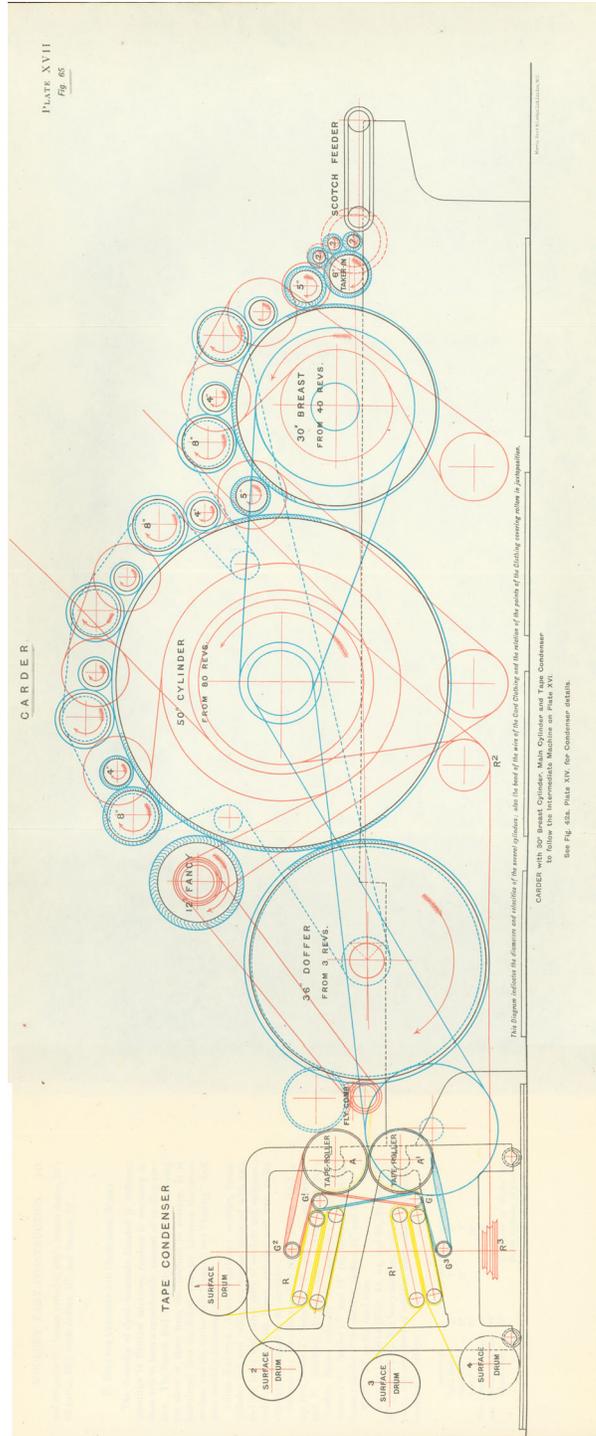
SCRIBBLER or BREAKER: Consists of Breast Cylinder, two Skirts and Roper and Balling Machine delivery. For detailed parts and methods of drive, see Plate XVII.

PLATE XV
 Fig. 84

PLATE XVI.
Fig. 64.



Fold-out reduced to 67 % and rotated 90° to fit on page.



Fold-out reduced to 33 % and rotated 90° to fit on page.

and strippers 9"; breast cylinder, 40½"; breast doffer, 30"; all swifts, 50"; swift doffers, 36", and fancies, 12".

B. SETS FOR CHEVIOTS AND CROSS-BRED WOOLS

The diversity of dyed materials blended in different quantities in Cheviot mixtures, renders it necessary in these sets to have a considerable amount of carding surface. The Scotch feed is usually adopted for conveying the sheet of fibres from one machine to another. It is introduced into the fourth example between the intermediate and the carder with "roper" and "balling" feed from scribbler to intermediate.

THIRD EXAMPLE. A set comprising: *scribbler*, breast cylinder and two swifts, the former mounted with two and the latter with three pairs of workers and strippers; and *carder* also with breast cylinder and two swifts similarly garnished to the scribbler.

Diameters: Two bottom feed rollers 2" and third or top feed roller 4"; taker-in, 12", and angle strippers 4" and 5". *Scribbler*: Breast cylinder 45½"; swift 50"; *Carder*: Breast cylinder 30"; swift 50"; strippers 5"; workers 9"; fancies 12" and 13" (no fancy roller on the breast cylinder of the carder); doffers 34" and 36".

Width: 60" on the card wire.

FOURTH EXAMPLE (Figs. 63, 64, and 65, Plates XV, XVI, and XVII). For fancy mixture, hosiery and knitting yarns, and composed of *scribbler*, *intermediate*, and *carder*, arranged as below:

	SCRIBBLER	INTERMEDIATE	CARDER
	Feed Rollers 2"	2"	2"
	Taker-in 12"	12"	6"
	Breast 36"		30"
Two	(Breast Workers 9"		8"
sets	(Breast Strippers 4"		4"
	Breast Fancy 10"		No Fancy or Doffer on Breast Cylinder of Carder but a 5" Angle Stripper

	SCRIBBLER	INTERMEDIATE	CARDER
	Breast Doffer . . . 24"		
	1st Swift 50"	50"	50"
	2nd Swift 50"		
Four sets {	Swift Workers . . . 8"	Four { 8"	Four { 8"
	Swift Strippers . . 4"	pairs { 4"	pairs { 4"
	Swift Fancy 12"	12"	12"
	Swift Doffers . . . 36"	36"	36"
	Angle Strippers . . 7"	7"	

A feature of this set is the introduction of a breast cylinder or swift into the carder for the purpose of more fully crossing and mixing the materials.

C. BLENDS OF WOOL AND COTTON

In sets of machines for this class of blend there must be ample carding surface in order to (1) get the fibres thoroughly and evenly mixed; and (2), if pulled waste forms a part of the blend, to destroy any ends of threads which may not have been satisfactorily opened in garning.

FIFTH EXAMPLE. A typical set, comprising scribbler with breast and three swifts (all 50" in diameter, and with four sets of workers and strippers over each, 9" and 4½" in diameter respectively); and *carder* with two swifts having the same number of rollers as the swifts of the scribbler. Rope and Scotch feed system applied for transference of the material from the scribbler to the carder.

Either the double-doffer or the tape condenser may be applied to this class of machine.

D. BLENDS OF MUNGO AND LOW CLASS MATERIALS

SIXTH EXAMPLE. A standard set combines *scribbler* (72" on the card wire) and *carder* (60" on the card wire). The former should comprise breast and three swifts with three pairs of rollers over each; and the latter, breast and two swifts similarly mounted.

The Blamire's cross delivery is the most suitable with the three roll bat feed for the carder. Such short fibre as

mungo could not be so satisfactorily treated on the roper system or the Scotch overhead feed. A double doffer condenser with double tandem leather rubbers for shoddy blends, but single rubbers for mungo would be used.

Dimensions: Breast cylinder, 48"; swifts, 52"; doffer 36"; workers, 9"; strippers, $4\frac{3}{4}$ "; fancies, 12" and 14"; taker-in, 12"; and feed rollers, 2".

E. SET FOR WOOLS FOR BLANKET AND SIMILAR QUALITIES OF YARNS

(Figs. 66 and 66a, Plates XVIII and XIX)

SEVENTH EXAMPLE. One type here consists of *scribbler*, breast, and two cylinders with three sets of rollers over each; and *carder*, breast, with two sets of rollers and two swifts with three sets of workers and strippers to each, the diameters of the rollers being: breast scribbler, $45\frac{1}{2}$ "; breast doffer, 30"; swifts, 50"; swift doffers, 36"; all workers, 9"; strippers and angle strippers, 5"; fancies, 13"; two bottom feed rollers, 2"; and top feed roller, 4". Blamire's lap-former from scribbler to carder, and double doffer (20" in diameter) and double rubber condenser.

F. CONTINENTAL SETS

These in some instances closely resemble in parts and method of arrangement sets of machine of English design and construction. Two standard sets may be considered. The former is a typical set of the single-cylinder class; and the latter is used for medium and short materials, for army and similar cloths.

EIGHTH EXAMPLE. Figs. 67, 68, and 69. Comprises *scribbler*, *intermediate*, and *carder*.

Attached to the scribbler is the preparatory motions mentioned in Paragraph 49 (Fig. 54).• Special features of the set are the use of two doffers for each swift, upper and lower, and two fancies with a stripper fixed in front of the former, and a second stripper placed between the two doffers.

The wool from the top doffer travelling over the endless apron passes under a guide roller; and that from the lower doffer over a corresponding apron and under the guide, when the band of fibres is conveyed by the Scotch feed attachment to the intermediate, Fig. 68.

The intermediate has one cylinder and five sets of workers, being in other particulars similar to the scribbler. The carded material passes between a guide roller and lower endless lattice delivery and forward to two supplementary travelling aprons, to be spread on the feed of the carder, with the fibres in the same line as they are removed from the intermediate.

The carder (Fig. 69) is identical in arrangement as the intermediate, with a tape condenser attached, delivering four sets of threads.

NINTH EXAMPLE. This is a two-part machine, both the *scribbler* and *carder* having a breast cylinder and one swift, having four sets of rollers over the former and six sets over the latter.

Between the doffer and the main cylinder two rollers take the place of the angle stripper, the lower one clearing the material off the doffer, and the upper one taking a portion of the wool from the stripper and transferring it to the doffer.

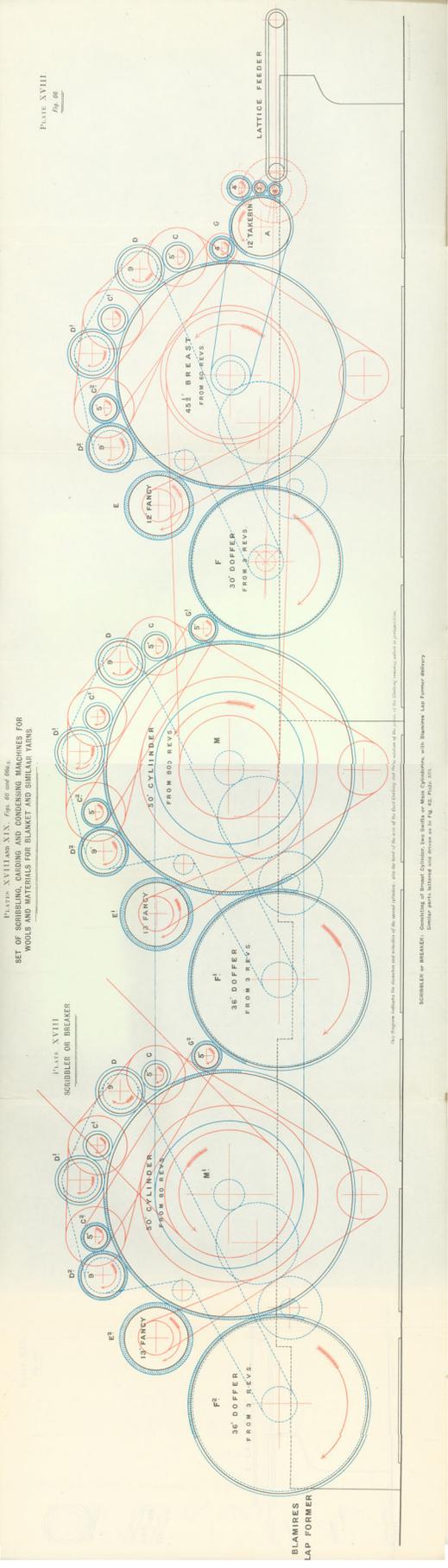
The dimensions of the breast and main cylinders and other rollers are similar to those of English construction.

53. *Methods of Driving Carding Machines.*—Fig. 42, Plate XIII (system practised by Messrs. Platt Bros.) is a sketch of the ordinary system of imparting motion to the various parts of a scribbler or carder. The driving pulley is fixed on the main shaft of the last cylinder, and from this shaft all motions are derived.

(1) **MAIN CYLINDERS and BREAST.** By belt (blue line) the pulley on the shaft of the second swift drives a pulley on the shaft of the first swift; and a similar drive transmits movement to the breast cylinder.

(2) **THE DOFFERS.** By a train of wheels (dotted in blue) the breast doffer is driven off the shaft of the

PLATE XVIII
SET OF SCORBLING, CARDING AND CONDENSING MACHINES FOR
WOOLS AND MATERIALS FOR BLANKET AND SIMILAR YARNS

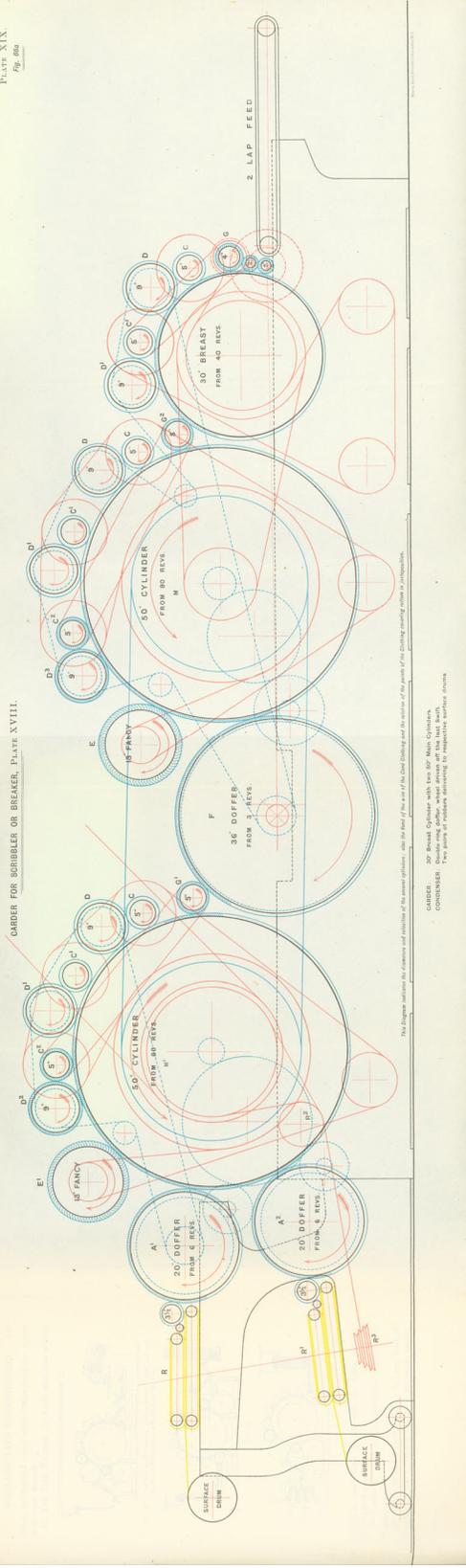


(No. 1) Diagram indicates the direction and rotation of the several rollers, with the hand of the arrow of the 30° Cylinder and 12 Farcy rollers of the drawing machine, with the roller of the 30° Cylinder and 12 Farcy rollers of the drawing machine, with the roller of the 30° Cylinder and 12 Farcy rollers of the drawing machine.

SCORBLING or BREAKER. Consisting of several Cylinders, two Dofters, or Wools, Cylinders, with Blamires Lap Former delivery. Similar parts lettered and driven as in Fig. 67, Plate VII.

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

CARDER FOR SCURBLER OR BREAKER, PLATE XVIII.



This diagram is intended for reference and illustration of the general principle, and is not to be used for the construction of the machine.

NOTE: The diameter of the rollers and cylinders is given in feet and inches.

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

breast, the first and second swift doffers being also driven in the same manner.

(3) THE FEED ROLLERS. By a side shaft (not shown)

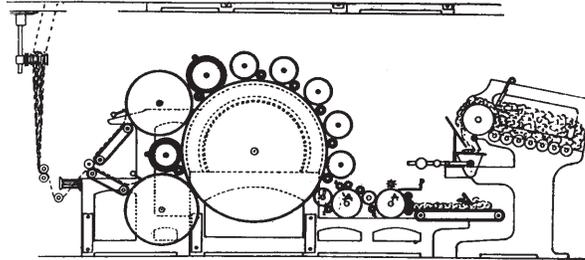


FIG. 67. Over first small Cylinder, A, Burr-Roller is fixed, and over the second Cylinder, A, a Worker and Stripper.

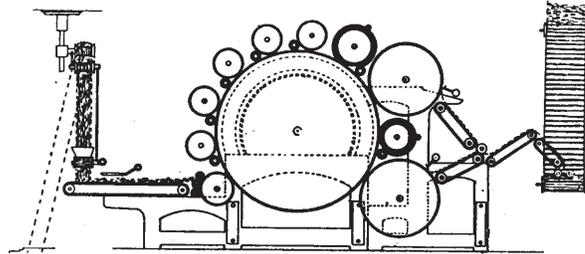


FIG. 68.

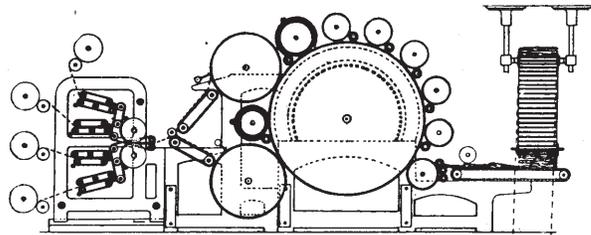


FIG. 69.

which is bevel-wheel geared with the doffer and the bottom feed roller.

(4) **TAKER-IN.** By belt (blue line) off a pulley on the breast shaft.

(5) **STRIPPERS and FANCY.** Also by belt (red line) off the pulley on the breast and on each of the swifts, passing

round pulleys on the strippers and the fancy, and under guide rollers beneath each cylinder.

(6) WORKERS. By chain (dotted in blue) from a wheel on each doffer shaft.

In a complete set of machines the intermediate and carder are also driven on the system described.

54. *Condensing*.—The object of this operation, as its name implies, is to condense or reduce into compact slivers the sheet of fibres delivered by the last main cylinder of the carder. By pressure and friction it divides the material into a series of soft, round, fluffy threads, designated slivers, supplying to them a sufficient degree of uniformity, solidity, and adhesiveness to make them capable of bearing the tension applied to them in the spinning operation.

The counts—*i.e.*, the diameter or size—of the condensed sliver in relation to that of the yarn into which it is drawn and spun is determined (1) by the qualities of the materials used; (2) the counts of the yarn to be produced; and (3) the degree of twine or twist to be inserted.

(1) Wools moderately long in staple admit of more drafting or attenuation in spinning than wools of a shorter staple, a factor which in a degree controls the counts of the condensed sliver, because the less drafting feasible the higher the counts of the sliver requisite to form a given counts of yarn.

(2) In fine-spun yarns it is the practice to condense relatively to higher counts than in coarse-spun yarns, or yarns thick in diameter. For the former, say 30 to 40 yards per dram, the average rule is to condense to two-thirds, but for the latter—5 to 8 yards per dram—condense to about half the counts of the yarn to be spun.

(3) The looser in twine, or the smaller the number of turns per inch to be imparted to the sliver in spinning, the more closely should the size of the sliver approach the actual counts of the yarn.

55. *Types of Condensers*.—These chiefly differ from each other in the system on which they are constructed for

(1) dividing the fleece of carded fibres into narrow widths of equal dimensions; and (2) of forming the flat ribbon, thus removed from the carder, into the thread-like consistency of a sliver. They are as follows:

I. Condensers consisting of single doffer, single stripper, and one pair of rubbers or leathers.

II. Condensers consisting of single doffer, double stripper, and tandem rubbers or leathers.

III. Condensers consisting of double doffer, double stripper, and two pairs of rubbers or leathers.

IV. Condensers consisting of double doffer, double stripper, and double tandem rubbers or leathers.

V. Tape condensers. (*See Plate XXI, Platt's Tape Condenser with description appended thereto; also Factory View of Carding and Condensing Machinery, Plate XX. The Convoy Woollen Co., co. Donegal.*)

I. SINGLE DOFFER, SINGLE STRIPPER, ONE PAIR OF RUBBERS

In this, the simplest construction of condenser, the doffer is covered with rings of card clothing $\frac{13}{16}$ " in width, allowing a space of $\frac{3}{16}$ "ths between each sliver stripped off the cylinder of the carder. So that if the cylinder were 72" wide there would be about $13\frac{1}{2}$ " of its surface that the wire of the doffer would never operate upon. To prevent the accumulation of fibres on the uncleaned parts a two-fold action is applied to the workers on the last swift of the carding machine, for they have both a rotatory and transverse motion, so that any fibres escaping the action of the ringed clothing of the doffer are re-distributed on the surface of the cylinder. This arrangement in time places the fibres in such positions that they cannot fail to be laid hold of by the wire clothing of the condenser. The narrow bands of fibres are taken off the doffer by the stripper (B, Fig. 70) and passed by it on to a pair of rubbers which deliver them up to the bobbins in the creel.

The characteristic feature of roundness the slivers attain in this process is due to the action of the rubbers,

which not only revolve on separate rollers, but oscillate from side to side. The slivers, which are in an extremely soft and pliable condition when leaving the doffer, gradually become rounder and rounder, firmer and firmer, under the continued transverse motion of the rubbers, until they assume the appearance of loose, untwisted threads.

When only one pair of rubbers, *c*, is employed, they should be about 12" in length from centre to centre. The rotatory motion is obtained by wheel gearing off the doffer,

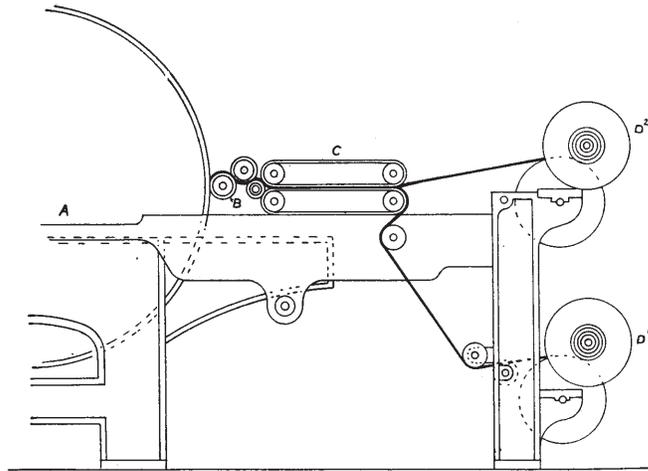


FIG. 70. Single-Rubber Condenser.

but the transverse motion by a vertical shaft driven by rope off the last cylinder of the carder. The upper part of this shaft is mounted with eccentrics, and the lower part with grooved pulleys of different diameters, by which the speeds of the eccentrics controlling the oscillating movement of the leathers may be varied as required. The condenser bobbins are turned by friction, or by the surface drums, D^1 and D^2 .

II. SINGLE DOFFER, SINGLE STRIPPER, AND TANDEM LEATHER

This is similar in construction to Type I, only there are two pairs of rubbers, Fig. 71, R^1 and R^2 , which provide

additional rubbing surface, and render the system suitable for short-fibred materials. Some degree of drafting may be done between r^1 and r^2 .

The method of driving is sketched in Fig. 71. Motion is imparted to the first pair of leathers by the doffer wheel, A, gearing with B, the stud wheel of which turns C. This wheel gears with a 31 wheel on the shaft of lower leather, on which is also fixed a 32 wheel gearing with the upper rubber wheel. The second pair of rubbers is driven off R, through the intermediate wheels, E, F, and G.

The divider, M (a spacing roller for the slivers), is

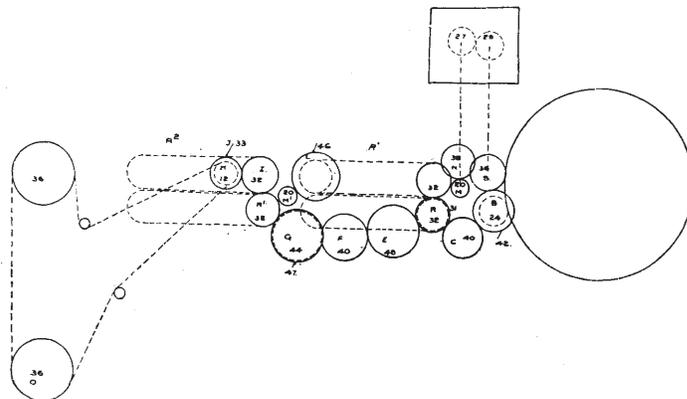


FIG. 71. Driving Mechanism for Single Stripper Tandem Condenser.

turned by a wheel on the opposite end of the stripper shaft to that shown geared into a wheel on the end of shaft, M. The upper stripper or clearer also derives motion from M.

Assuming the teeth in the several sets of wheels are known, the speed of the rubbers, of the dividers, and of the surface drums may readily be ascertained. In Fig. 71 the following are the data required: Doffer wheel, A, = 238 teeth; doffer wheel, B, = 24 teeth; wheel on same stud as B, = 42; C, 40; R, 32 and 31; E, 48; F, 40; G, 44, carrying a 47; H, 32; N (clearer for stripper), 32; first divider, M, 20; second divider, M¹ 20; L, 46; I, 32; J, 33; K, 12;

q, 36; and s, 32. Opposite end of the stripper shaft, s, = 28 wheel geared with a 27 on the shaft of the first divider.

$$\begin{aligned} \therefore \text{Speed of 1st Rubbers} &= \frac{A \times \text{stud wheel } 42 \times \text{revs. of doffer.}}{B \times R} \\ \text{Speed of 2nd Rubbers} &= \frac{A \times B \times J \times \text{revs. of doffer}}{G \times H} \\ \text{Speed of Dividers} &= \frac{A \times B \times s \times \text{revs. of doffer}}{B \times o \times 27 \text{ wheel on shaft of divider}} \\ \text{Speed of Surface Drums} &= \frac{R' \times K \times \text{speed}}{J \times Q} \end{aligned}$$

III AND IV. TYPES

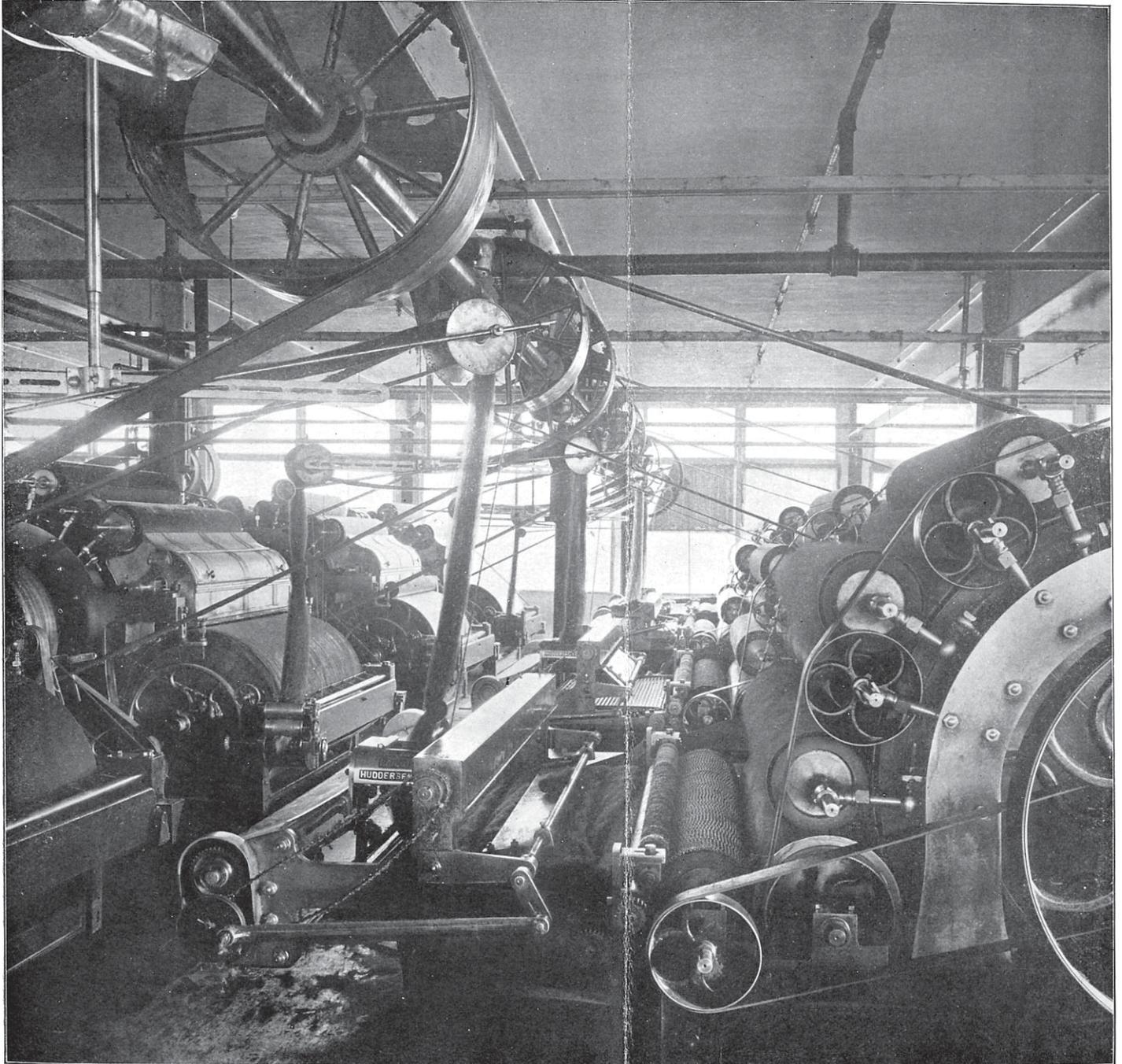
In the former there is one pair of upper rubbers and one pair of lower rubbers, but in the latter two pairs of top and two pairs of bottom rubbers arranged in tandem order, as in Fig. 72. Both the doffers are clothed on the ring principle, with the strips of card clothing of the upper one opposite the spaces in the lower one, and *vice versa*, so that the fibres escaping from the points of one are engaged by those of the other doffer. A defect of this arrangement is that the slivers from the bottom doffer are liable to be thicker than those from the top doffer; but it has the considerable advantage over the first type of machine, in that the card clothing of the two doffers act upon every part of the width of the last cylinder of the carder.

The construction of this condenser (Type IV) is shown in the line drawing, Fig. 72. The slivers from the top doffer pass between the rims of the divider, the two sets of rubbers, and round the surface drums to the condenser bobbins, those from the lower doffer being conveyed in a like manner to the bobbins fixed in the bottom part of the creel.

V. TAPE CONDENSERS. (See Plates XX and XXI)

They are so called on account of the use of narrow strips of leather and steel bands for dividing the fleece of fibres, and delivering them to the rubber in a suitable degree of consistency to be convertible into a condensed

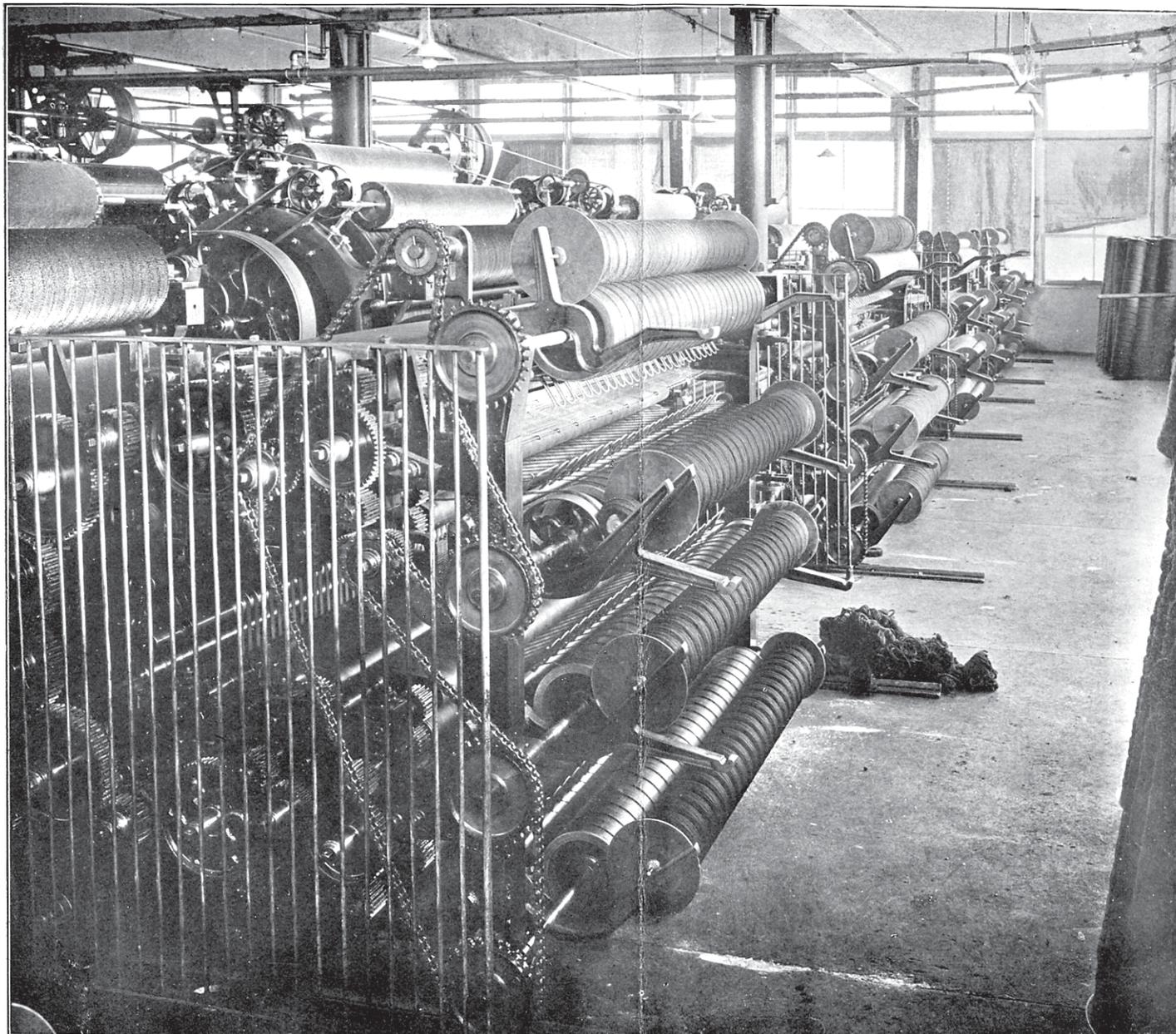
PLATE XX (1)



[The Convoy Woollen Co., Ltd., Convoy, Co. Donegal.]

FACTORY VIEW OF CARDING MACHINERY. SCOTCH-FEED DELIVERY AND CONVEYING MECHANISM.

PLATE XX (2)



[The Convooy Woollen Co., Ltd., Convooy, Co. Donegal.

FACTORY VIEW OF CARDING AND CONDENSING MACHINERY—CONDENSER SECTIONS.

sliver. Thus the sheet of carded material is removed from the doffer by the usual fly comb, and immediately passes between an upper and lower metal roller, A, A^1 , Fig. 65, Plate XVII, divided into as many sections as there are slivers to be condensed. The rollers of a 60" cylinder machine may contain 120 or more divisions. Each alternate section is grooved, the smooth surface of one roller opposing the grooved parts of the other.

The principle of the machine will be understood from the line drawing, Fig. 65, Plate XVII. Here the thick faint yellow line shows the fleece of fibres from the fly comb of the

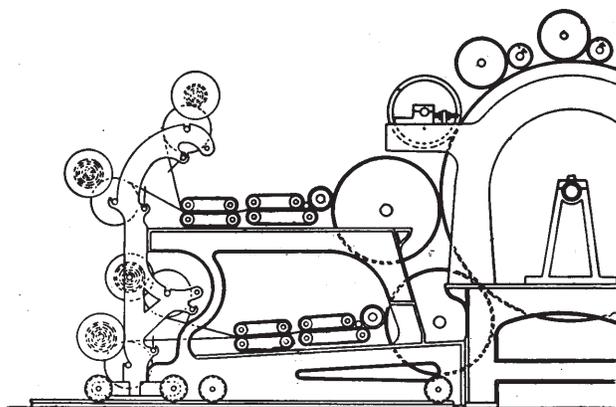


FIG. 72. Double-Rubber Tandem Condenser.

doffer as it passes between the grooved cylinders, A and A^1 , to the rubbers, R and R^1 . The two series of endless bands divide the sheet of material from the doffer into two series of strips or slivers, those coloured red taking the series off A , and those coloured blue the series off A^1 . The slivers of the former are conveyed to rubbers R , and from the latter to rubbers R^1 .

The routine of the red-coloured bands is over the cylinder A , between A and A^1 , under guide G , round G^1 and G^2 , back to A ; and that of the blue-coloured bands under A^1 , guide G^3 , G , over G^1 , and between cylinder A and A^1 . The slivers from the upper rubbers are delivered

by friction drums, 1 and 2, and from the lower rubbers by 3 and 4, to the bobbins in condenser creel.

The driving gear for this type of condenser is sketched in Fig. 73. A pulley, 10½" diameter, on the shaft of the last cylinder of the carder by belt drives a 19" pulley, A, on the condenser, carrying, B, gearing, C¹, which turns pinion, D¹, gearing with the lower rubber wheel.

$$\therefore \text{I.} = \frac{\text{A } 19" \times \text{pulley } (10\frac{1}{2}')} {\text{Revs. per minute of the main cylinder}} = \text{Revs.}$$

of A per minute.

$$\text{II.} = \frac{\text{B } (10 \text{ teeth}) \times \text{large D}^1 (52) \times \text{revs. of A}} {\text{small D}^1 (48) \times \text{R}^1 (23 \text{ teeth, rubber shaft wheel})} = \text{Speed of}$$

rubbers per minute.

$$\text{III.} = \frac{\text{Rubber pinion r}^1 (36) \times \text{E } (12) \times 37 (\text{revs. of rubber})} {\text{J } (40) \times \text{F } (32)} = \text{Revs. of}$$

surface drums per minute.

The doffer (wheel 238), Fig. 73, is not driven direct off the swift, but by wheel gearing, thus B gears with a wheel on shaft C, turning C², which meshes with C³, mounted with the change wheel 75, and this imparts motion to the wheel on the doffer shaft.

The arrangement of the rubbers and bobbins—surface drums chain driven—for four and six parts of rubbers is sketched in Figs. 74 and 75.

In the Bolette system, Fig. 76, the dividing bands partly encircle the cylinder, so that the liability of breakage is diminished, and also of irregular condensing through unsatisfactory joinings of the bands.

In the sectional drawing, Fig. 76, A and B are the cross bars to which the steel blades are secured, C and D the carrying leathers, E and F the pressing rollers for the steel blades, G and H the stripping rollers, I and K the rubbers, and 1 to 4 the surface drums. The steel blades fastened to parts A pass between the two carrying leathers, C and D (passing under pieces L and M), and also between these carrying leathers and the rollers E and F. The steel blades fastened to part B pass between the carrying leathers and between pressing roller, E, and the carrying leather, C.

The dividing of the fleece of fibres is effected at the

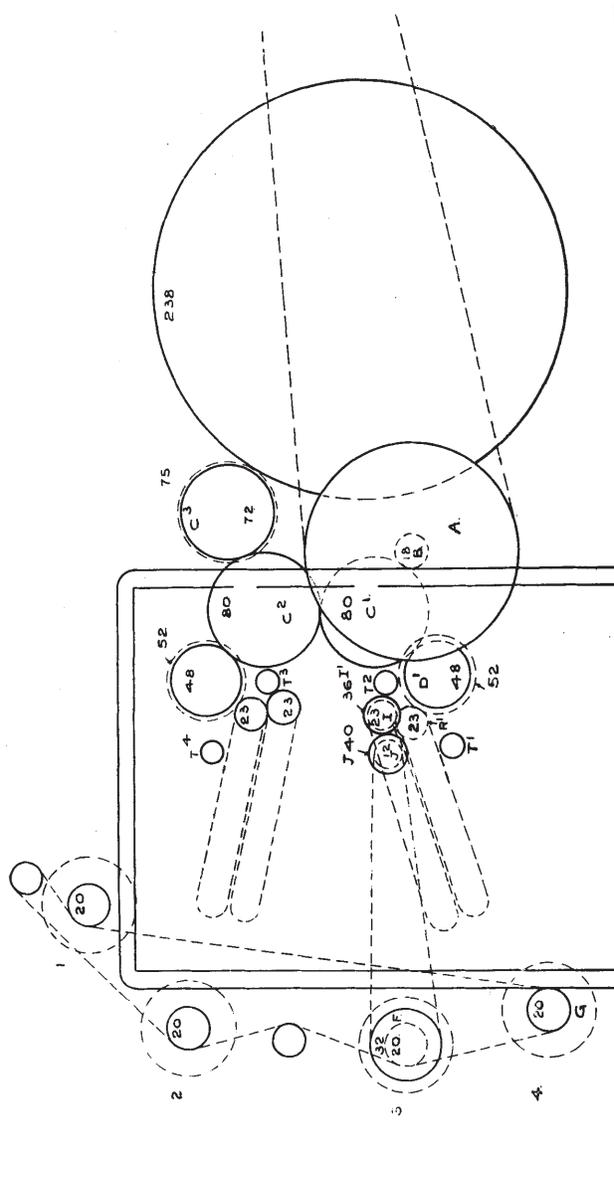


FIG. 73. Driving Mechanism for Double-Rubber Condenser.

point where the steel blades intersect, the course of the material being indicated by grey lines. The following is the routine: The material stripped from the doffer by the fly comb is divided into ribbons or slivers, one series being conveyed by the steel blades, A, and the carrying leather, D, and the other series by the steel blades, B, and the carrying leathers, c. Rollers G and H convey the separate series of threads to the rubbing leathers, I and K, respectively. The steel blades have a slow, vertical and

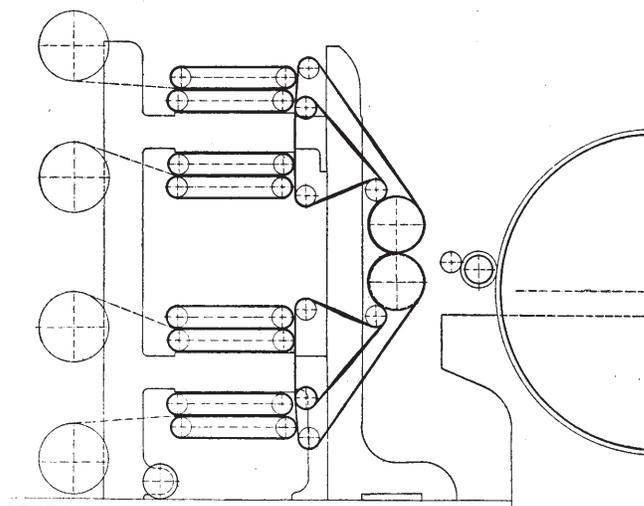


FIG. 74. Four-Bobbin (with four pairs of rubbers) Tape Condenser.

horizontal movement which equalizes the wearing of the blades, and also of the carrying leathers.

There are other types of condensers, such as the Gessner, and modifications of the types of dividers, but those described comprise the main principles of construction.

56. *Spinning (for factory view of a set of self actors see Plate XXII, Conroy Woollen Co., Ltd., co. Donegal).*—The only process, after condensing, through which the wool has to pass before a weavable thread or yarn is obtained, is spinning. The condensed sliver is nothing less than the basis of the spun yarn, for all that is requisite to make it suitable for weaving purposes is the addition of twist. This,

of course, is necessary to impart strength, firmness, and solidity,—three essentials which are not present in the soft thread yielded by the condenser. A sliver is the result of rubbing a number of fibres together, but the yarn produced on the mule or self-actor is obtained by two distinct motions—firstly, that of twisting, compressing, and twining the

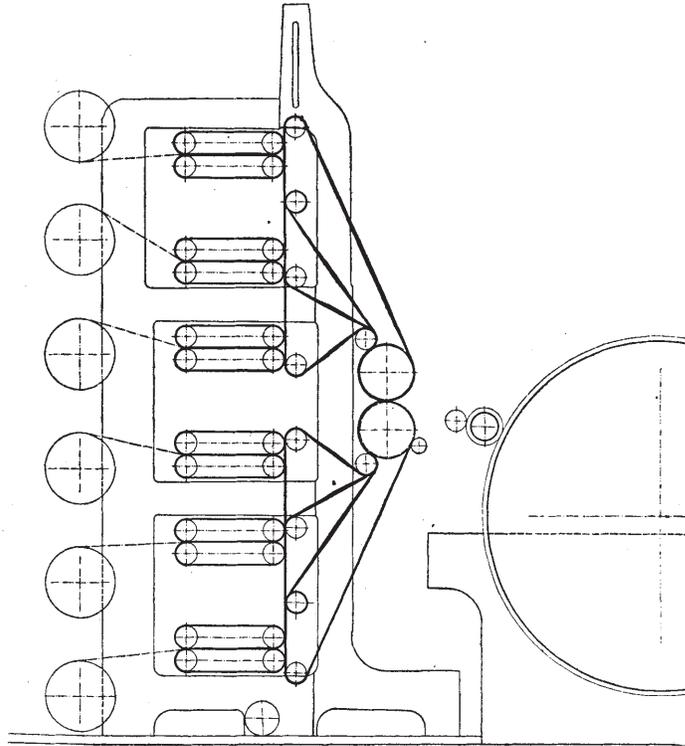


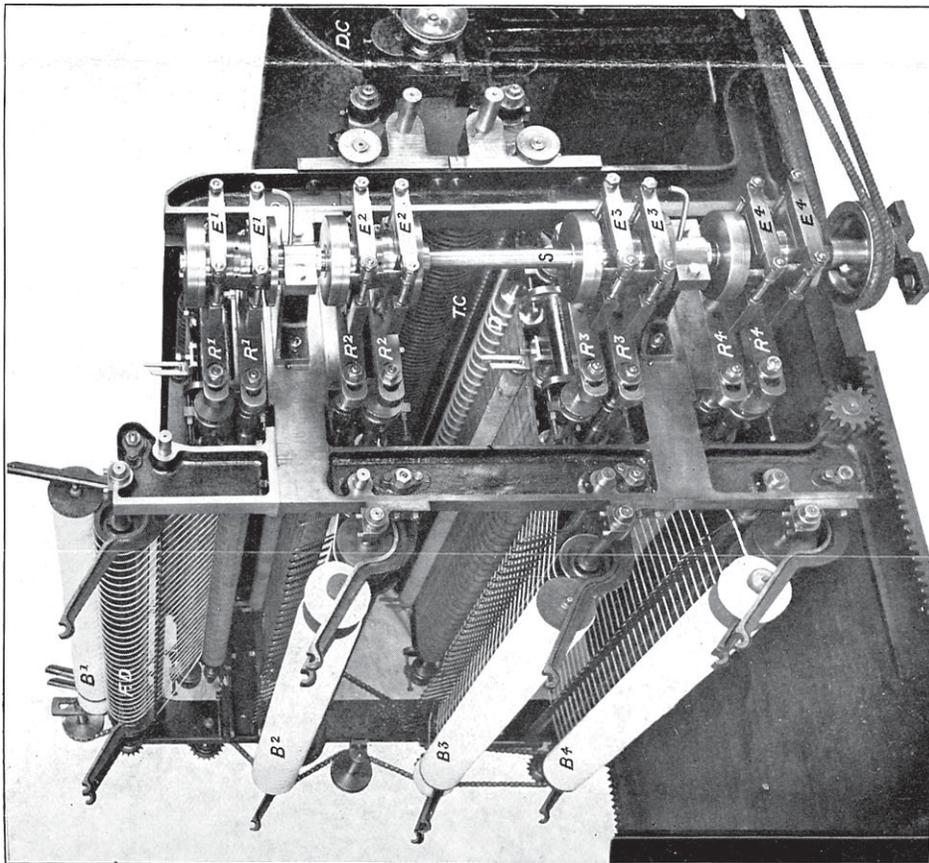
FIG. 75. Six-Bobbin (with six pairs of rubbers) Tape Condenser.

individual fibres of which the sliver is composed, firmly round one another, affording thereby strength, compactness, and tenacity to the thread; and, secondly, that of drawing out (simultaneously imparting additional twist or twine) the sliver, which increases its length in the same ratio as it decreases its thickness or circumference.

The sliver of the condenser possesses but little adhesiveness. It is in the form of a thread, but lacks weaving

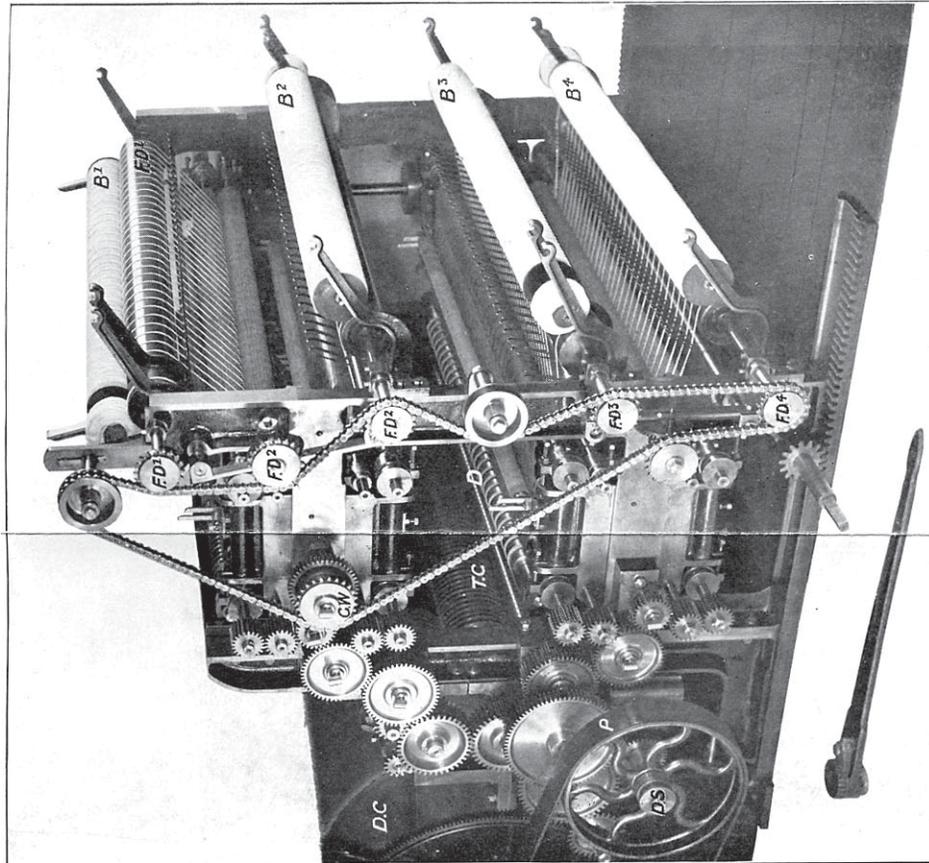
capabilities. When tension is applied it readily breaks. This arises from the relation which the fibres sustain to each other. They are simply rolled one over the other into a continuous circular longitudinal form, without any motion being applied to secure them permanently in this condition. To impart strength and elasticity to the sliver thus formed, and to transform it into a thread or yarn which will bear the friction and strain of the weaving process, a binding affinity or cohesion of the fibres must be brought about. The method of effecting this, as already noted, consists in imparting into the sliver twist, which forces the fibres into closer contact with each other, reducing the thickness of the thread, and substituting solidity, resisting power, and tenacity, for softness, lack of firmness, and lack of elasticity.

The condition and relation of the carded filaments in the condensed sliver are clearly observed in Figs. 77 and 78. The former is a condensed thread made of Cheviot wool, and the latter of pulled waste. Such distinct qualities of materials are evident in the slivers, but this is insufficient to destroy the distinguishing characteristic of each sliver, namely, the clustered groups of entangled filaments. Curly, short, and every variety of fibre which have been carded together, constitute a feature of the slivers. One essential must be noted in both Figs. 77 and 78—the density or degree of cohesion is uniform or equalized—that is to say there are no compact, unopened “neps” of fibres. Necessarily, the sliver in Fig. 78 is more compact or denser in structure than the sliver in Fig. 77, but this is caused by the difference in the quality and fineness of the two classes of materials of which they are respectively manufactured. The absence of twist is another characteristic. The adhesion of the filaments and the consistency of the sliver have been effected by the oscillating or side movement of the pairs of leathers of the condenser, and the continuous length produced by the revolving action of the same. Submit these slivers or lengths of clusters of fibres to the processes of twisting and drafting or attenuation, and



SECTION I.

D.C. = Doffer Cylinder.
 E.¹ to E.⁴ = Eccentrics for Imparting Oscillating Motion to Rubbers R.¹, R.², R.³, and R.⁴.
 T.C. = Upper Tape Cylinder.
 S. = Upright Shaft, Rope Driven, for Driving Eccentric Gearing.
 D. = Divider.
 R.¹ to R.⁴ = Rubbing Leathers.
 B.¹ to B.⁴ = Condenser Bobbins.
 F.D. = Friction Drum for Condenser Bobbin B.¹.



SECTION II.

P. = Strap Pulley driven off Shaft of Carder.
 D.S. = Shaft carrying Driving Wheel for giving motion through Wheel Gearing shown to (1) the Tape Cylinders; (2) the Rubbers (Rotary Movement) and Dividers; and (3) the Friction Drums.
 T.C. = Upper Tape Cylinder.
 D. = Divider.
 D.C. = Doffing Cylinder.
 C.W. = Wheel for Chain Gear.
 F.D.¹ to F.D.⁴ = Friction Drum Wheels.
 B.¹ to B.⁴ = Condenser Bobbins.

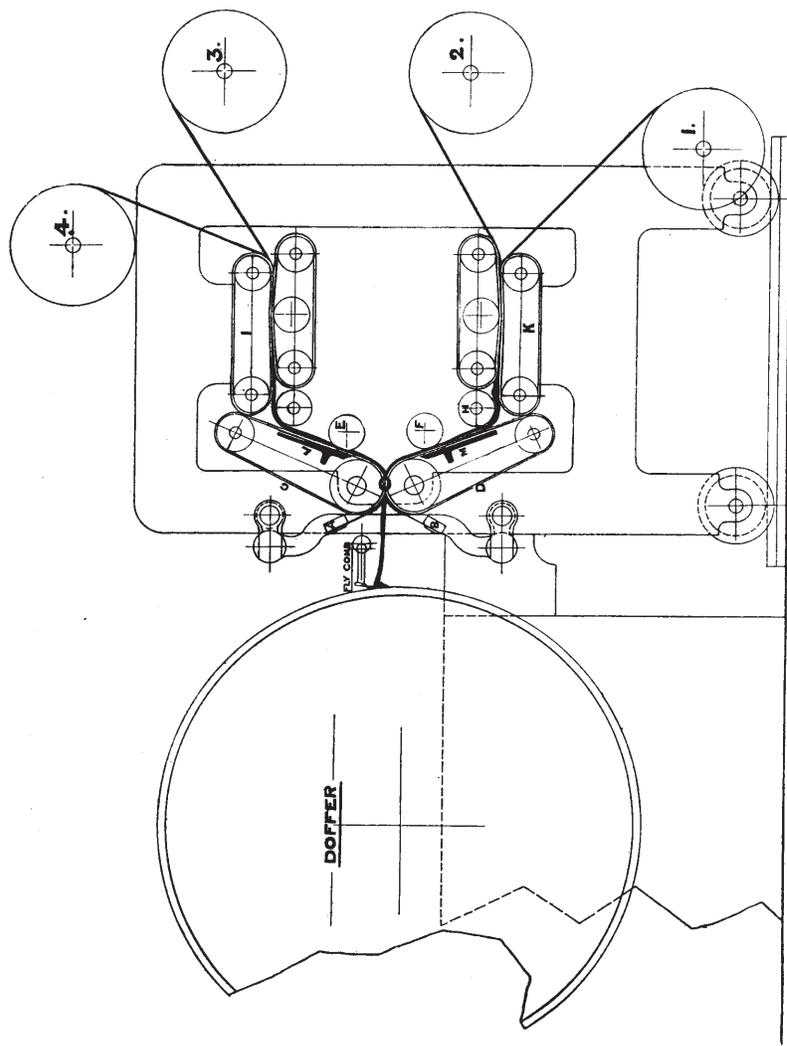


FIG. 76. Bolette's Tape Condenser.

observe what transpires. Fig. 77 is changed to the structure, density, and fineness of Fig. 79; and similarly Fig. 78 is changed to Fig. 81, illustrating the results which have to be attained in the spinning operation. The

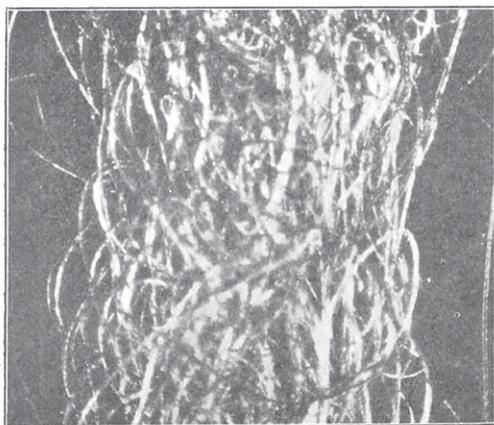


FIG. 77. Condensed Sliver, Cross-bred Wool.



FIG. 78. Condensed Sliver, Pulled Waste.

effect of additional twist is denoted by a still greater contrast (see Figs. 80 and 82).

57. *Compound Nature of Spinning.*—It is now understood that the looseness of consistency of the condensed sliver render it essential before drafting or drawing out is attempted, that some definite amount of twisting of the

fibres together must be done. This is the preliminary part of the process. After a short length of sliver has been delivered by rollers R, R¹ (Fig. 82 and Plate XXIII), simul-



FIG. 79. Condensed Sliver (Cross-bred Wool) after Drafting.



FIG. 80. Spun Yarn (17 Count), Cross-bred Wool.

taneously with the insertion of twist or twine, a spun yarn structure results which may be elongated about one-third without breakage, providing that twisting is concurrently performed with the drawing operation.

There are strictly three distinct stages in the spinning of a woollen yarn on the self-actor:

I. The delivery of a definite length of thread concurrently with the insertion of twine. This is done during

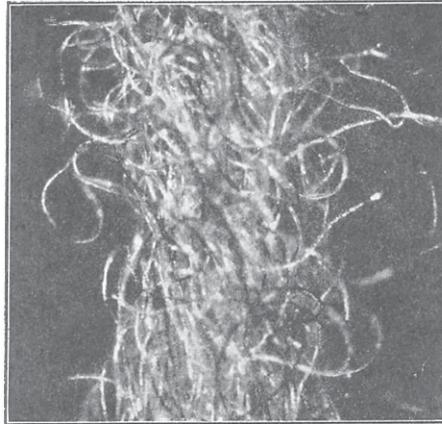


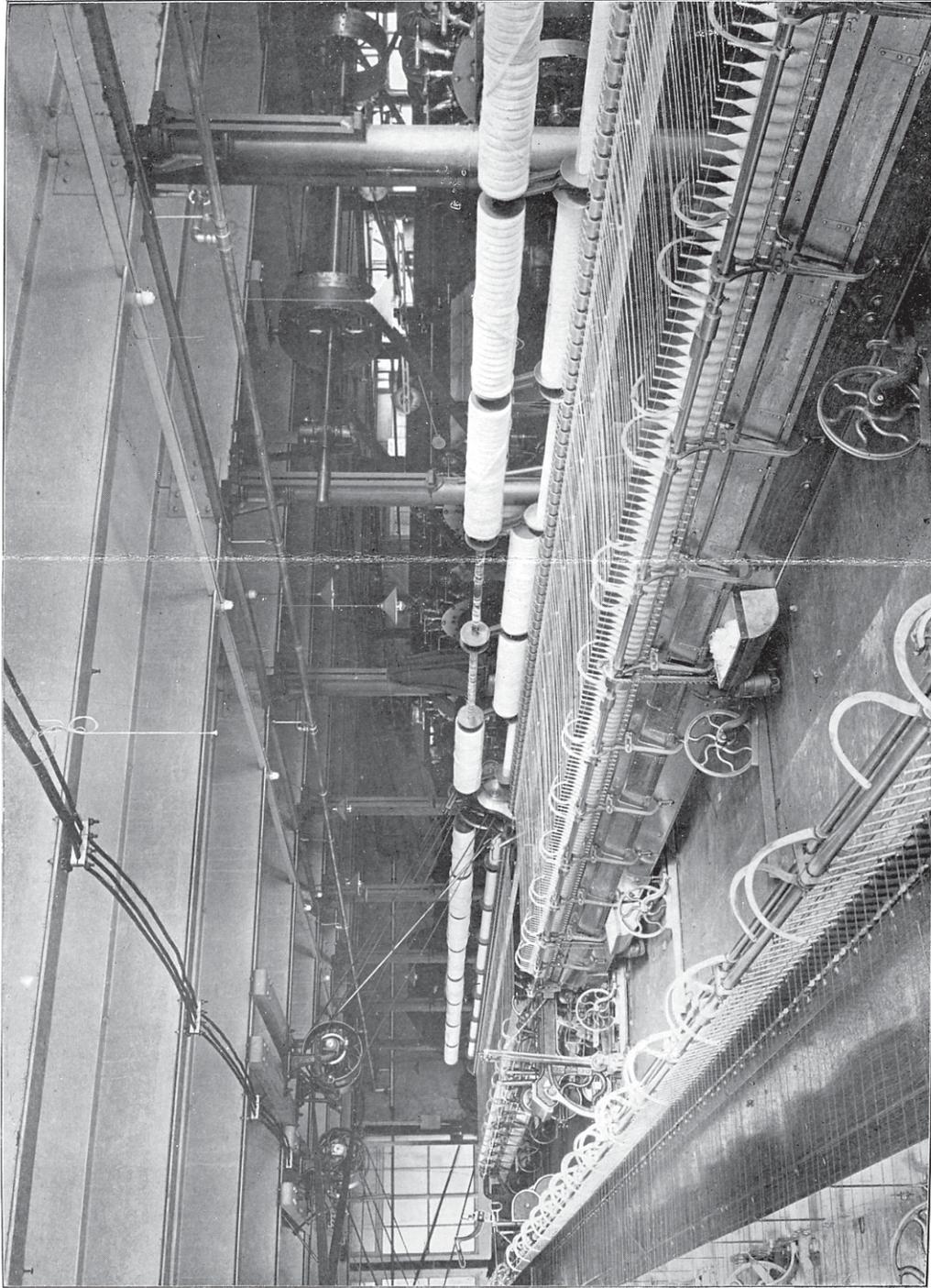
FIG. 81. Condensed Sliver after Drafting, Pulled Waste.



FIG. 82. Spun Yarn (20 skeins), Pulled Waste.

the first period of the outward traverse of the carriage (c, Fig. 83). The spindles then revolve relatively at a higher speed than the delivery rollers R, and the carriage moves at its lower speed. The explanation of this is (a) the rapid action of the spindles—the slivers resting on the top of them—in imparting twist, solidify and strengthen the yarn,

PLATE XXII



VIEW OF SELF-ACTORS (WOOLLEN MILL).

[The Convooy Woollen Co., Ltd., Convooy, Co. Donegal.

Fold-out rotated 90° to fit on page.

filament being twisted round filament; and (*b*) the slow traverse of the carriage provides the necessary period, as the slivers are being given out by the rollers, for insertion of this preliminary twist or twine.

II. DRAFTING AND TWISTING. These are done at one and the same time, and immediately follow the preceding process. First the rotary movement of the rollers, R, R^1 , is suspended, but the carriage continues its outward traverse, reaching the limit of which, it also stops, the speed of the spindles being augmented. The drafting is effected at the stage from the stoppage of the rollers, and increases the length of the yarn by about one-third. If twist were not added during attenuation the threads would break. Figs. 79 and 81 show the structure and quality of the yarn on the stoppage of the carriage, and Figs. 80 and 82, when the final twist has been given, converting a loose fibrous sliver into a firm, weavable yarn.

III. PREPARATION FOR WINDING. The yarn nearest the tip of the spindle is slightly harder in twine than the length approaching the rollers. This has to be rectified before winding on to the cop on the spindle, otherwise an uneven spin—a thread varying in turns per inch—would ensue. To accomplish this the spindles are reversed (turned backing off), the slack being taken up by the action of the faller, F , and the counter faller, F^1 (Fig. 83 and Plate XXIII), bringing the threads into proper relation to the spindles for winding.

58. *Winding the Yarn on to the Spindles.*—The spindles, as the carriage approaches the delivering rollers, wind up the yarn, its distribution being regulated and governed by the quadrant and the cop shaper.

To follow the mechanical routine—the slivers coming from the condenser bobbins fixed in the stands (Plate XXIII) of the frame pass between rollers, R, R^1 , the upper one a pressure roller, and the lower one fluted. The condenser bobbins are turned by the friction rollers R^3 . The spindles, B , and cylinder A (Fig. 83), are fixed in the carriage, C . A band or cord, b , is taken round A , and

the wharfl, w, of each spindle so that the entire series of spindles is driven by the cylinder.

As the carriage recedes, faller F retains the slivers on the level with the tips of the spindles, so, although nearly at right angles with them, twisting is effected without winding. Reaching the end of the traverse, the motion of the spindles is, for an instant, interrupted, and the fallers are so operated that F¹ depresses the threads, the spindles being reversed, and the carriage slightly moving forward. Immediately all the parts are automatically started for winding up, the carriage travelling towards rollers, R, R¹, and the spindles revolving at the slow speed and in the same direction as in twisting, but now resulting in the spun yarn being wound on to the cop or bobbin.

The diversity of mechanical changes involved comprises (a) the delivery rollers revolving and stopping at a definite period in relation to the outward "run" of the carriage; (b) the actuation of the fallers, successively, for twisting and winding; (c) the variation in the speeds of the spindles in twisting, their momentary reversal, and their re-starting for winding; and (d) the drawing up of the carriage and winding of the yarn in a tapering coil on to the cop.

59. *Method of Driving.*—This is more complex than in carding and other machinery, due to the several groups of motions which have to be started and stopped in the sequence of work described. The system ordinarily adopted consists in the employment of a counter-shaft on which are mounted fast and loose pulleys, driven from the motor or main shaft, a drum for driving the rim shaft of the headstock, and a three-grooved rope pulley for driving the intermediate or back shaft 2A (Fig. 83). The strap guide is, during the operations, changed automatically from 1B to 1A or 1C (Fig. 84). When placed on 1B, the loose pulley, all parts of the machine are stopped. The rim shaft in a parallel driven self-actor, is parallel with the carriage, and is termed direct drive as distinct from a cross-driven machine with the rim shaft fixed at right angles to the carriage.