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CATALOGUE OF COTTON SPINNING & WEAVING MACHINERY,

WITH CALCULATIONS, &c.

PLATT BROTHERS & CO. LIMITED,

HARTFORD WORKS,

OLDHAM, ENGLAND.

1906.

A. R. Granley
Supt D. T. Co Ltd
Merchants Branch
1912

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HARTFORD WORKS,
OLDHAM.

IN response to requests from our numerous friends, and to meet a growing demand of the trade, we have pleasure in presenting this book of information, and illustrations of machines made by us for the treatment of cotton in all its processes, from the raw state to the finished cloth.

For those engaged in the trade as managers, carders, &c., we give illustrations, showing in plan and elevation the gearing of the principal machines, with tables of references to wheels, and rules for calculating any changes that may be necessary in the gearing, &c., to meet requirements.

For the assistance of those not so thoroughly acquainted with the technical part of the subject, and with a view to imparting an easy acquaintance with the operations required from the raw cotton to the spun yarn or cloth, we submit a concise description of the modern processes of Cotton Manufacture, and for those interested in the historical aspect of the industry we have added a retrospective account of the progress made in the sequence and construction of the machines employed since the introduction of the Spinning Machine in the year 1738.

In order to give a good general idea of the arrangement of modern mills, we have inserted a few plates, showing complete plants of machinery for opening, preparing, spinning, weaving, and finishing cotton goods.

We further give a list of machines constructed by us for the treatment of various fibrous materials, together with a list of our home and foreign agents.

We shall at all times be pleased to prepare estimates of complete plants of machinery, if furnished with particulars of the class of cotton to be used, the counts of yarn to be spun, and the total production required in any given time.

If weaving be contemplated, we should, if possible, be supplied with small post samples of the cloths to be woven, each sample with at least one selvedge on, and the width to be stated for our guidance in offering suitable machines.

We may add that the quality of the materials used by us, combined with efficient workmanship and neatness of design, have hitherto given eminent satisfaction, ensuring as they do, in a remarkable degree, durability and steadiness at high speeds, together with maximum production and a minimum of trouble and expense in repairs. These qualities it will be our endeavour to maintain as in the past.

PLATT BROTHERS & CO. LTD.

Oldham,
1906.

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CALCULATIONS and PRODUCTIONS will be found under the heading of each Machine.

PLATT BROTHERS & CO. LIMITED,

HARTFORD WORKS, OLDHAM, ENGLAND,

MAKERS OF MACHINERY IN GREAT VARIETY, FOR

OPENING, CARDING, COMBING, PREPARING, SPINNING, DOUBLING, & WEAVING COTTON, WOOL, WORSTED, SILK WASTE, ASBESTOS, &c., ALSO SEED OPENING AND GINNING MACHINERY FOR LONG OR SHORT STAPLED COTTON.

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HOPPER BALE BREAKER or IMPROVED COTTON PULLING MACHINE, with or without Mixing Lattices.

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ROLLERS, SPINDLES, FLYERS, BOBBINS, &c.

MILL ACCESSORIES OF EVERY DESCRIPTION.

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AWARDS.

LONDON, Council Medal, 1851.

PARIS, Grande Médaille d'Honneur, 1855.

LONDON, Prize Medal, 1862.

PARIS, Gold Medal, 1867.

MOSCOW, Gold Medal, 1872.

VIENNA, Diploma of Honour, and Cross of Knight of the Order of Francis Joseph to the Chairman of the Company, S. R. PLATT, Esq., 1873.

CONSTANTINOPLE, Order of Medjidie (for Gins), 1863.

NAPLES, Silver Medal (for Gins), 1864.

PHILADELPHIA, Diploma and Medal (for Gins), 1876.

PARIS, Grand Prix d'Honneur (the only one for Section No. 56), Gold Medal, and the Cross of the Legion of Honour to the Chairman of the Company, S. R. PLATT, Esq., 1878.

CRYSTAL PALACE, LONDON, Gold Medal, 1881.

ATLANTA (U.S.) EXHIBITION, Gold Medal (for Gins), 1881.

CHARLESTON (U.S.) EXHIBITION, Gold Medal (for Gins), 1881.

BRADFORD, 1 Gold and 2 Silver Medals, 1882.

HUDDERSFIELD, 1 Gold and 2 Silver Medals, 1883.

EDINBURGH, Gold Medal, 1886.

BARCELONA, Gold Medal and Diploma, 1888.

CHICAGO, Gold Medal and Diploma, 1893.

ATLANTA (U.S.) Gold Medal (for Gins), 1896.

ROUEN, Diplome de Grand Prix, 1896.

PARIS, Grand Prix, and Gold Medal, 1900.

ST. LOUIS, Grand Prize, 1904.

CRYSTAL PALACE, LONDON, Grand Prize (for Gins), 1905.

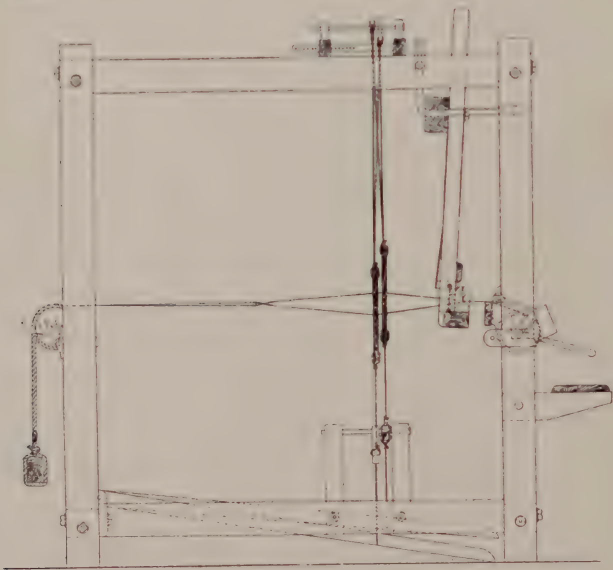
A BRIEF RETROSPECT OF THE PROGRESS MADE IN THE MANUFACTURE OF COTTON,

AND IN THE

CONSTRUCTION OF COTTON MACHINERY SINCE THE INVENTION OF THE SPINNING MACHINE IN 1738.

Amongst the industrial arts which contribute to the welfare of mankind, few have attained a more important position than the modern system of Cotton Manufacture, or have exercised a greater influence upon the progress of civilisation. The most reliable evidence yet obtained points to Egypt or India, or at any rate to the East, as the birthplace of the industry, and at an early period the art became a prevalent domestic occupation in India, being so general, indeed, as to employ at one time almost half the population. Cotton was grown near most villages, and spun and woven on the spot, each little community producing for its own consumption. The coarsest yarns were made upon a heavy, clumsily constructed wheel, evidently the forerunner of the domestic wheel long in use in this country, and the Saxony wheel of a somewhat later date. The finer muslin yarns for which the East has been famous from remote times were, however, spun by means of the spindle that had been in use from time immemorial. A distaff was sometimes employed, though the process was often conducted without. The spindle in the earliest times was composed of a straight piece of wood, weighted at one end with a piece of clay. Subsequently an iron spindle was introduced, though at what precise date cannot be stated, and it is also impossible to say at what period the crude wheel above mentioned was invented, though doubtless it was after the invention of the spindle. It is somewhat strange that the Eastern races never invented anything to supersede these rude appliances, although they attained a high degree of skill in their use. The same barrenness characterised their efforts in dealing with the *machinery* for weaving, and although recent researches have disclosed the fact that in remote times amongst the extinct civilisations of Egypt, the production of cloth, elaborate in texture and artistic in design, was quite common, yet nothing mechanical of these races appears to have advanced in successive stages as, for example, may be traced in almost every branch of industry in the West, from which it would appear that the epoch of mechanical invention was not destined to have its birth in the East. We find that the distaff and spindle and the crude wheel before referred to continued to be the only instruments by which yarn was produced until about the year 1530, when the domestic hand spinning wheel appears to have been invented, and for a long time was the only improvement made.

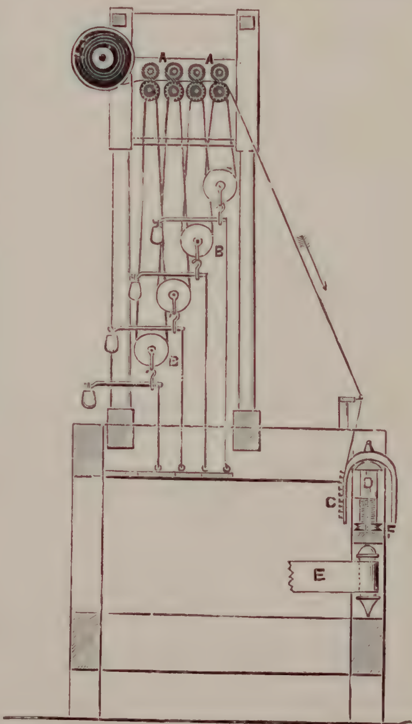
In the early part of the eighteenth century the elder Kay, of Bury, in Lancashire, invented the picking stick for the hand loom, and improved the shuttle, thus enabling one weaver to operate a loom where two were formerly required, and at the same time to produce double the amount of cloth. This may be regarded as the beginning of the modern epoch of invention, and its first practical result. The increased demand for yarn which followed as a natural consequence the general adoption of Kay's improvement greatly stimulated invention, but a considerable time elapsed before any further real progress was made.



Hand Loom.

The credit of the first invention of the Spinning Machine is due to Lewis Paul in 1738, more than a century and a half ago, all spinning having been previously done by hand. In his first machine the raw cotton was passed through a succession of pairs of rollers, each pair running faster than the preceding one, so as to draw out the sliver of cotton longitudinally to any degree of fineness required. The machine thus accomplished only the drawing process, leaving the sliver so formed to be twisted and wound afterwards by hand. The great feature of this invention was that the important principle of drawing by rollers running at different speeds was thus established at the outset, to supersede drawing by the fingers in hand spinning; and this mode of drawing has since been adhered to as the fundamental principle in the preparation of fibrous materials for spinning.

In 1748 Paul further invented a carding machine, for carding or combing the raw cotton in preparation for the drawing rollers. ,It consisted of a number of flat parallel cards fixed upon a table with spaces between them; the teeth of the cards being all bent in the same direction, the cotton was carded by being drawn over them by hand by means of an upper flat carding board set with teeth bent in the opposite direction to those in the lower card. In another arrangement this flat upper card was replaced by a horizontal carding cylinder, made to revolve by hand, whilst the lower carding table was made concave to fit the underside of the cylinder. When the cotton was sufficiently



Arkwright's Spinning Machine. Fig. 1.

carded, it was taken off each card separately by hand by a needle-stick, and then made into one entire roll or lap.

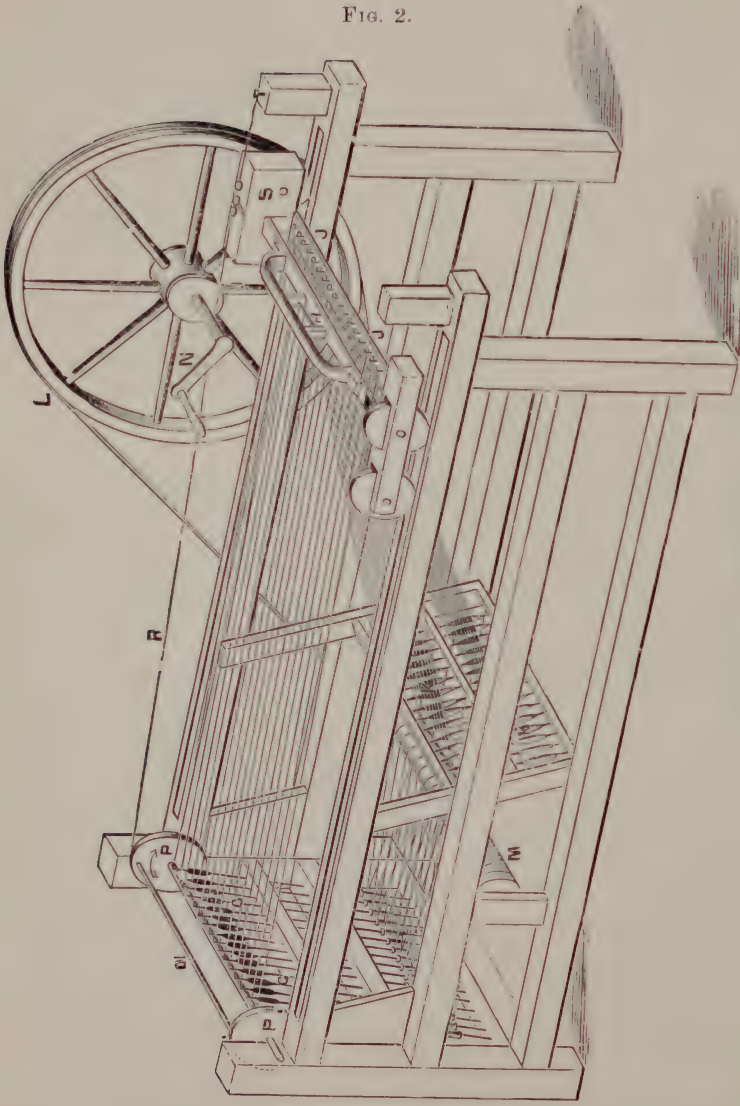
In 1758 Paul further improved his original spinning machine by rendering it capable of performing the two other processes of twisting and winding requisite to complete the operation of spinning by machinery, and he constructed a spinning machine having a circular frame containing fifty spindles. The cotton was drawn by rollers, as in his previous machine, and the sliver was delivered from the rollers to a bobbin upon each spindle, by means of an arm or flyer fixed upon the spindle; the latter being so contrived as to go faster than the bobbin, the sliver was thus twisted into thread by the flyer, and at the same time wound upon the bobbin.

Although the two mechanical devices which have formed the basis of all subsequent spinning machinery—namely the drawing rollers running at different speeds and the differential speed of the bobbin—were thus originated by Paul, it does not appear that his machines were ever practically successful; and Arkwright's spinning machine of 1769, shown in Fig. 1, appears to have the merit of being the first that was brought into successful operation. This machine cannot be called more than an improvement in detail upon Paul's, as the principles of the two are the same; and it is difficult to imagine that Arkwright had not seen Paul's machine. The success of the later machine may be attributed to its superiority both in workmanship and in the material employed, the earlier machine having been composed almost entirely of wood.

The four pairs of drawing rollers A A, Fig. 1, were made of brass and steel, and geared together by pinions; the bottom rollers were covered with wood and fluted, and the top ones were covered with leather, and pressed down upon the bottom rollers by the weighted cords and pulleys B B. The sliver delivered by the rollers was then twisted into a yarn or roving by the flyer C, and wound upon the bobbin D. The differential speed between the bobbin and the spindle, by which the two operations of twisting and winding were effected, was exactly the same as now employed for the same purpose, although the motion was obtained by different means. If the flyer and bobbin both revolved at the same rate and in the same direction, no winding would take place, and the effect would be confined to twisting the sliver into a roving. But if the bobbin rotate slower than the flyer, then winding would be effected at a rate equal to the difference between the two speeds. This was accomplished in Arkwright's machine by the simple means of a friction brake upon the bobbin D, the bobbin being loose upon the spindle and dragged round by the thread, whilst the flyer C was fast upon the spindle and driven direct and at a constant speed by the driving strap E below. The friction brake to retard the bobbin was made by a worsted cord passed round a groove F at the bottom of the bobbin, and tightened by hand to the required tension. The drag put upon the bobbin by this friction brake also put a stretch upon the roving, and caused it to be wound tightly on the bobbin in solid layers instead of in loose coils. In the arm of the flyer C were fixed a number of hooks, under which the roving was passed, and the winding on the bobbin was done in successive steps, by stopping the bobbin and moving the roving successively from one hook to the next on the flyer, as the idea of giving the bobbin a vertical motion upon its spindle so as to traverse the roving regularly had not yet originated.

In 1770 Hargreaves invented the Spinning Jenny, shown in Fig. 2, the principle of which is identical with that of the present spinning machinery. It thus presents a remarkable instance of a correct perception respecting the best mode of working having been attained at so early a stage in the application of machinery to a new purpose. The operation of spinning into threads the rovings produced by the machines already described, or by the modern improved machines similar in principle, comprises the two processes of elongating and twisting the roving to form it into a thread, and then winding the spun thread into the form of a "cop" upon the same spindle by which the spinning or twisting has been performed. With the difference that instead of the elongation of the thread being due entirely to the pull or draft of the cross-bar, it is now—in cotton spinning—chiefly effected by draft rollers incorporated with this machine by Samuel Crompton, about the year 1780; and also that instead of the spindles remaining in a stationary frame, they are now placed in a carriage which traverses backwards and forwards, whilst the draft rollers are arranged on a fixed beam. The two processes above mentioned still continue to be performed in essentially the same manner as in Hargreaves' Spinning Jenny, in which the twisting of the thread is effected by causing the spindles G, Fig. 2, to revolve, as though for winding up the thread, but allowing the last coil of thread to slip off the point of the spindle once in each revolution. For this purpose the thread is led off

Fig. 2.



Hargreaves' Spinning Jenny.

from the end of the spindle at an angle so much greater than a right angle that its tendency to wind in a spiral brings it to the top extremity of the spindle in each revolution, causing the coil at the point of the spindle to slip off the end at each successive revolution; and the top of the spindle is shaped conical to facilitate the slipping off of the thread. The result is that the thread is twisted one turn by each revolution of the spindle, without disturbing or interfering with the portion of spun thread already wound up into a cop on the spindle. The crossbar J, carrying the guiding eyes through which the several threads pass, rests at each end on a carriage that runs along the side framing of the machine; and before the commencement of the spinning by the spindles G, the crossbar is first drawn backwards from the spindles by hand through about one-third the length of the machine, drawing off a supply of roving from the bobbins K below, which are free to turn on their bearings. The clasp H is then pressed down tightly upon the crossbar J, holding the rovings fast, and the spindles G are set in motion, twisting the lengths of thread between the spindles and the crossbar; and during the twisting the crossbar is gradually drawn backwards by hand to the end of the machine, thus producing the required elongation of the threads by tension during the spinning, as was done in the case of hand spinning by the weight of the bobbin or spindle hanging from the twisting thread. The spindles G receive their motion from the drum M driven by the driving pulley L, which is turned with the right hand by the handle N, while the left hand draws back the crossbar J by means of the handle upon the clasp H.

When the crossbar J has been drawn back to the extreme end of the machine and the spinning of the threads has been completed, they are then wound upon the spindles by depressing them all simultaneously to the lower portion of the spindles by means of the "faller wire" O, which is brought down upon the threads by the rotation of the discs P P in the direction of the arrow. The rotation of the discs is effected by tightening the cord R which runs along the side of the machine, and they are turned back again by a counterbalance weight which raises the faller wire when the cord is released; the cord passes round three horizontal pulleys on the top of the carriage S, and is tightened for depressing the faller wire by a transverse sliding movement being given to the middle pulley by means of a hand lever, which is worked by the left hand whilst holding the clasp on the crossbar J. The threads being depressed by the faller wire, the further rotation of the spindles now causes the threads to be wound up in cops upon the spindles, the sliding crossbar J being pushed forwards gradually by hand as the winding proceeds, until it again reaches the spindles, when it is ready for beginning the spinning of a fresh length of rovings. During the winding of the threads already spun between the spindles and the crossbar J, this length of threads is secured and separated from the untwisted rovings beyond the crossbar by the pressure of the clasp H, which is kept pressed down tightly upon the threads.

On the completion of the spinning, however, of each length of threads, and before the change can take place from spinning to winding, it is necessary first to unwind the short spiral of thread extending up from the top of the cop previously wound to the top extremity of the spindle. This spiral is unavoidably formed during the transition from winding to twisting and before the thread can reach the point where it ceases to wind and begins slipping off the end of the spindle at each revolution; but if this portion of thread were not entirely removed before the faller wire O is lowered at each transition from twisting to winding, an irregular accumulation of thread would take place upon the upper end of the spindle, spoiling the form of the cop and interfering with the proper slipping off action in twisting. When the twisting of each stretch of yarn is concluded, the motion of the spindles has therefore to be stopped and reversed for a sufficient number of turns to unwind these few spiral coils; this is done by the spinner stopping the driving wheel L, and then giving it a partial turn backwards by hand, for "backing-off" the thread, before turning the wheel, and consequently the spindles, forward again in the normal direction, in order to wind the thread on the spindles.

This backing-off motion and the faller wire are identical with those now in use in the modern self-acting mule, the only difference being that they are now made automatic in their action. In winding the cop each successive layer of thread is so regulated that a conical form is given to each end of the finished cop, in order to prevent the thread from getting loosened upon it at the ends in subsequent handling; whilst at the same time the crossing of the thread in the alternate spiral layers gives firmness to the cop, and still allows the thread to be afterwards drawn off as in a shuttle. In the spinning jenny this shape of cop was obtained by regulating the winding of the thread by means of the cord R acting upon the discs P P, raising and lowering the faller wire O during the winding so as to guide the thread upon the spindles for producing the desired shape of cop. The same shape of cop and mode of guiding the thread are still retained in the present spinning machines; but the whole of the movements are now effected entirely by self-acting machinery.

Further improvements in the preparatory processes of carding and roving were introduced by Arkwright in 1775, which may be said to include the principal features contained in the carding and roving machines now used. The cotton delivered from the preliminary machine was formed into a roll or lap, for supplying a continuous fleece of cotton to the carding cylinders, the carding operation being repeated until the irregular mass of fibres in the raw material had been combed straight and laid parallel in the fleece of cotton with a sufficient degree of uniformity to allow of proceeding to the subsequent operations. Comb-plates worked backwards and forwards by cranks were also added for combing off the cotton in a continuous fleece from the "doffer" or taking-off cylinder of each of the carding machines. The sliver delivered from the last carding process was passed between a pair of rollers for the purpose of consolidating it by the pressure of the rollers after the loosening action of the doffing comb-plate; and it was then coiled down into a can.

The doubling and drawing processes employed at this stage of the manufacture were also introduced by Arkwright at the same time, the object being to intermingle the fibres more completely in the sliver, and thereby render it more uniform in quality, ready for twisting into a roving. For this purpose two or generally more of the slivers from the carding engine are passed side by side through a series of pairs of drawing rollers, each pair in succession being made to run faster than the preceding one; and the last pair of rollers runs as many times faster than the first pair as there are slivers doubled together, so that the single combined sliver delivered from the rollers is drawn down to the same size or weight per foot as one of the original slivers. The doubling and drawing operations are usually performed three times, and the ultimate sliver so prepared is then ready for the roving frame, at which it is again drawn and twisted and wound upon a bobbin.

In the roving frame Arkwright now effected an important advance upon his previous machine, shown in Fig. 1, by introducing the new principle which has since been adhered to, of driving the bobbin and the spindle independently by separate motions, instead of allowing the bobbin to be simply dragged round by the thread as previously described. At the same time he also introduced the conical regulating drum, for reducing the speed of the bobbin in proportion as its diameter was increased by the thickness of the coils of roving wound upon it, so as to avoid increasing the tension upon the roving, as would be the case if the speed of the bobbin were uniform, since the spindle and flyer are driven always at a constant speed. This method of regulating the speed of the bobbin by a conical drum is the same as the one still employed in modern machinery, with modifications only in the mode of application. There appears reason also to believe that the rising and falling motion of the bobbin upon the spindle, for winding the roving on the bobbin in regular coils by continuous vertical movement of the bobbin, was also introduced by Arkwright at the same time, although no description is given by him of the manner in which this was accomplished; but in the drawing illustrating the series of improvements introduced by him at that period, the flyer upon the spindle is shown with a single eye for delivering the roving upon the bobbin, instead of the succession of hooks fixed on the arm of the flyer in the previous machine (Fig. 1), for winding the roving on in a succession of steps; and a sufficient space is also left in the drawing to allow of the required vertical movement of the bobbin. This principle of lifting and lowering the bobbin upon the spindle during the winding, which is employed in all the present machines, has not been traced to any earlier date than these final improvements introduced by Arkwright in 1775.

By thus making special machines for each process in the preparation of the material for spinning, Arkwright effected a most important division of labour; and the factory system, already introduced in the silk manufacture, became rapidly extended in consequence, as will be seen from the following data:—

Total value of Cotton Yarn produced in Great Britain in 1760, about	£200,000
Total value of Cotton Yarn produced in Great Britain in 1894, about	£90,000,000

or about 450 times greater in the latter year, notwithstanding the enormously reduced cost in production, which may be taken at a little more than one-third the cost of production in 1760, as will be seen from the figures below:—

GREAT BRITAIN.

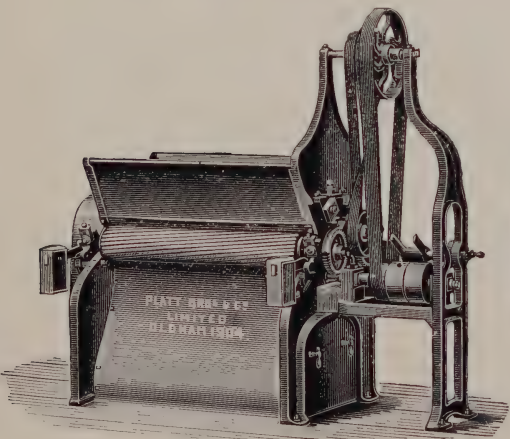
Year	Spindles in Operation.	Operatives up to and including Spinning, not including Twining, Doubling, Reeling, Winding, &c.	Operatives per 1,000 Spindles.	Hours per Week.	Average Wages per Week.	Production per Spindle per Year.	Yarn Spun.
1830	10,000,000	90,000	9	69	11s. 6d.	21·6 lbs.	216,500,000 lbs
1860	30,000,000	120,000	4	60	14s. 0d.	30·3 ,,	910,000,000 ,,
1894	45,000,000	135,000	3	56½	19s. 0d.	32·5 ,,	1,465,000,000 ,,
1901	48,000,000	140,000	2·9	56½	20s. 0d.	33·3 ,,	1,600,000,000 ,,

The production per spindle of 32's twist has increased as follows:—

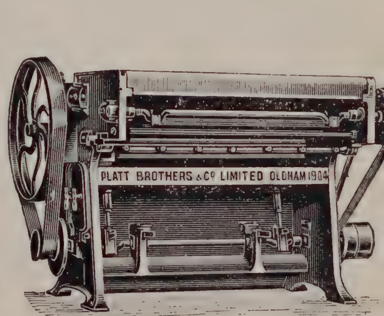
1866, 22½	hanks,	Mule,	in a week of	60 hours.
1885, 28	,,	Mule,	do.	56½ ,,
1893, 31	,,	Mule,	do.	56½ ,,
1893, 44	,,	Ring,	do.	56½ ,,
1904, 31	,,	Mule,	do.	55½ ,,
1904, 44	,,	Ring,	do.	55½ ,,

MODERN COTTON SPINNING.

IN an important sense of the word the manufacture of cotton begins at the plantation and the gin house. Cotton is, in reality, a species of hair or down that grows out of the seed and envelops or wraps it. The seed is somewhat smaller than the common pea, and when the down or lint is pulled away, it shows a black and rather oily husk. The weight of the seed is about thrice that of the enveloping wool. Thus 1,200 lbs. as it comes from the field will be separated by the gin into 300 lbs. of lint and 900 lbs. of seed. The separation of this seed from the cotton is the first process required to prepare it for the market, and is effected by various methods, but chiefly by means of a gin, consisting of a series of saws revolving in the interstices of an iron bed upon which the cotton is placed, the fibre being drawn through the slits in the bed, leaving the seeds behind. The gins first used broke the fibre more or less, and were especially injurious to the long stapled cotton. The Macarthy gin, an American invention, separates the seed from the cotton without occasioning any injury to the staple, the cotton being drawn by a leather covered roller, between a metallic plate fixed tangentially to the roller, and a blade which moves up and down in a plane immediately behind and parallel to the fixed plate, the seeds being forced out by the action of the movable blade.



Double Roller Gin.



Single Action Macarthy Gin

The raw cotton, as taken from the plant, is usually "ginned" in the neighbourhood of the plantation, and is then compressed into bales by hydraulic power or otherwise, and in this form it is received at the mills. The cotton then undergoes a variety of processes preparatory to being spun into yarn or thread.

The first operation is to open the bales and feed the cotton in large pieces to the Hopper Bale Breaker (see sectional elevation) in order that it may be opened and loosened as much as possible before being either made into a mixing or passed direct to the Blowing Machinery where mixings are dispensed with, as is now the case in many mills.

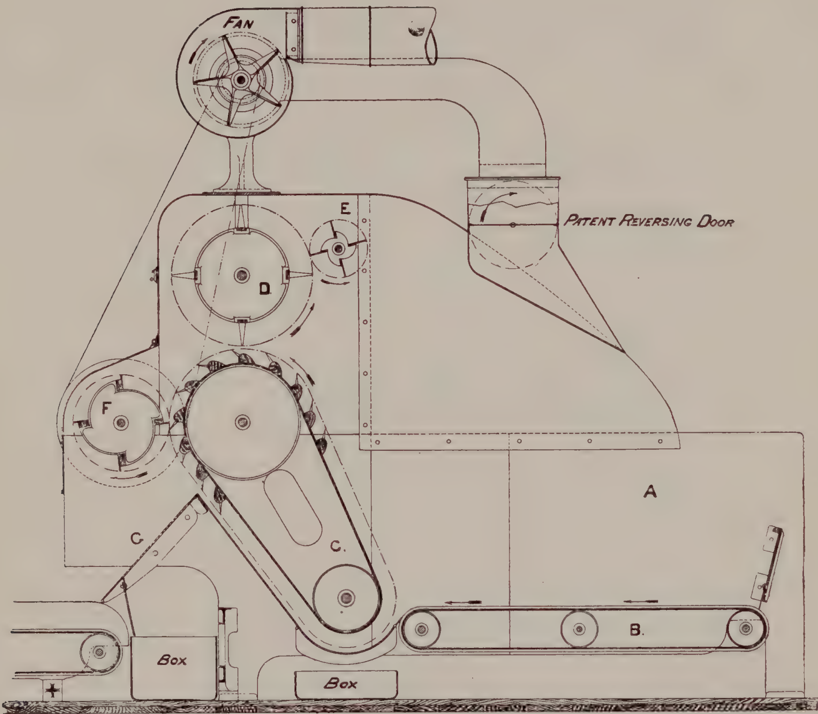
Mixings should, however, be used for long stapled cotton such as Sea Islands, Egyptian, &c., for spinning fine counts of yarn.

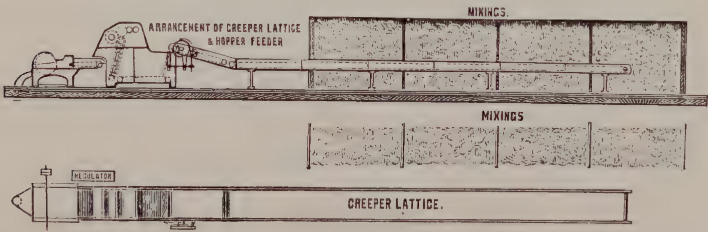
The direct arrangement (without mixings) is used for all classes of cotton with the exception of Sea Islands and fine Egyptian.

Hopper Bale Breaker.—The cotton taken from the bales is put in the hopper A, the horizontal lattice B carrying it forward and pressing it against the spikes of the inclined elevating lattice C, where it is subjected to a sort of combing action, and is then carried upward to the spiked roller D, which further combs the cotton, and throws back into the hopper any large or unopened pieces, thus securing more perfect opening and mixing of the cotton before it leaves the hopper.

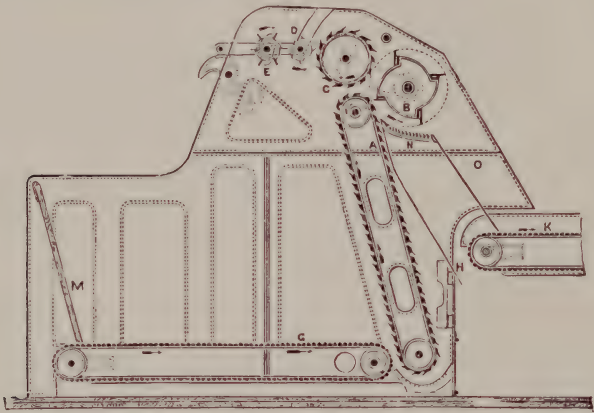
The spiked roller is stripped and kept clean by the stripping roller E, the surplus cotton falling back into the hopper. The cotton after passing the spiked roller is stripped from the inclined lattice by the beater F, and falls on the grid G in the delivery sheet, and is conveyed either to the mixing or to the filling lattice of the Hopper Feeding Machine, which not only dispenses with carrying the cotton long distances, but keeps the hopper regularly charged, the lattice being governed by an automatic arrangement fixed to the end of the hopper.

HOPPER BALE BREAKER.





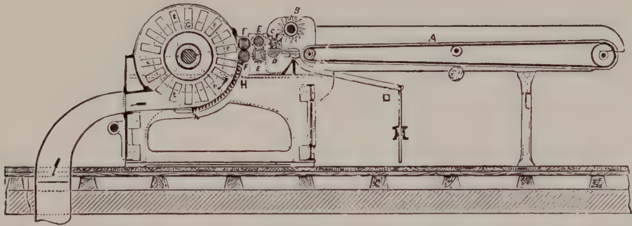
Hopper Feeder, with creeper or filling lattice. In the arrangement shown above, the cotton is taken from the mixings and spread evenly upon the creeper lattice which conveys it to the hopper feeder.



After the cotton is deposited in the hopper it is carried forward by the lattice G against the face of the inclined lattice A, travelling in the direction indicated by the arrows, and thence up to the combing cylinder C (running in the opposite direction), which gives the combing action claimed by us, and allows only small pieces of cotton to pass forward. The cylinder C takes off the surplus of the feed and carries round a charge of small pieces, the large pieces having in the meantime been removed by the action of the strippers D and E, and returned into the hopper (well away from the lifting lattice A), thus the lifting lattice A, and the combing cylinder C, take forward only small pieces of well-combed cotton, which is stripped by the cylinder B, and passed down the shoot O on to the lattice feeder K, all loose refuse passing through the bars at N and out at H.

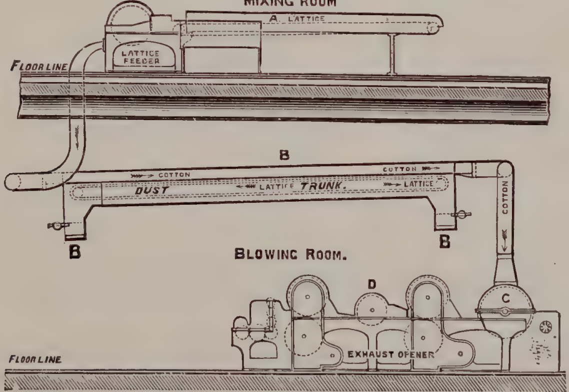
Ample space is provided between the lattice G and the lifting lattice A, thereby allowing any hard substance which the spikes will not take up to pass out through the bottom grid.

Lattice Feeder.—The cotton, after passing through the hopper feeder, is delivered in an even and open state on to the feed lattice A (connected with the exhaust opener), which, with the help of the collecting roller B, carries it to the pedal feed roller C.



The pedals D D regulate the quantity of cotton passing through the machine, and the rollers E E, F F, having an increased velocity, pull the cotton and present it to the cylinder G. The action of the cylinder, which revolves quickly and beats the cotton against the grid bars *h h*, cleans the cotton; the sand and other impurities pass through the spaces between the bars, and are deposited on the floor underneath the machine.

By the action of the large fans in the exhaust opener, the cotton is drawn through the **Dust Trunk,** which is provided with a travelling lattice. The lattice moves in the opposite direction to the cotton, and the cotton in its passage through the dust trunk beats against the ribs which are attached to the lattice cloth, and the impurities falling on the lattice are carried along and emptied on to doors B B at the end of the dust trunk. These doors are provided with levers and weights, so that when the weight of the dirt, &c., overcomes the weight of the lever, it falls into a bag or other receptacle.

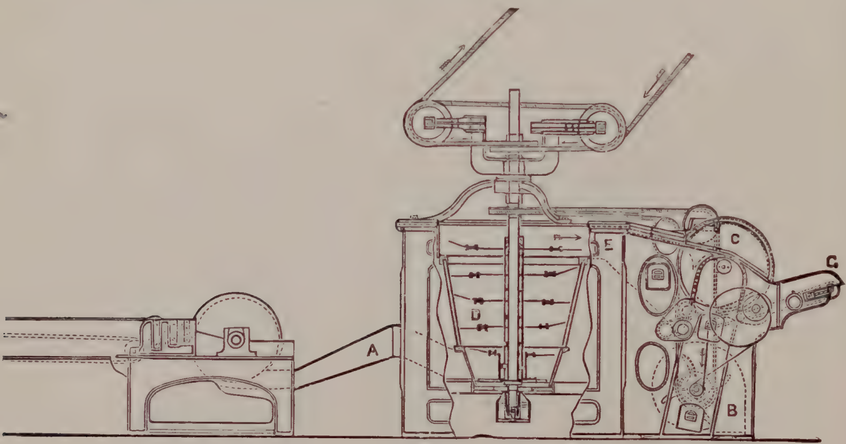


Cotton Waste Opening Machine.—This machine is used for working up clean waste from Carding Engines, Frames, &c., and is now frequently used in combination with the Exhaust Opener. For our special patent arrangements of this machine see full description under this heading.

Crighton Opener.– Before proceeding with the exhaust opener it will, perhaps, be advisable at this point to describe briefly another type of opener, which is frequently adopted with advantage, viz., the Crighton or vertical beater opener.

This machine may be arranged to work in connection with the bale breaker previous to the cotton being mixed, or it may be placed between the lattice feeder and the exhaust opener. The latter arrangement is generally adopted for the reason that the cotton having already passed through the hopper bale breaker, hopper feeder and lattice feeders, is in a fairly loose condition, and is therefore calculated to require less severe treatment than at an earlier stage, thus reducing to a minimum the risk of damaging the fibre, and at the same time opening and cleaning more effectively.

This opener may also be constructed with a lattice feeder and a delivery lattice as in illustration, for adoption in small mills where the outturn required does not warrant putting down an exhaust opener, and may be arranged to deliver into a hopper feeder, the latter to feed a scutcher, the cotton being thus made into a lap without further handling

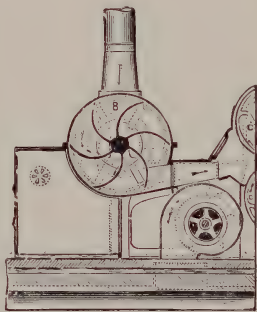


In this opener the cotton is drawn from the feed pipe A by the action of the fan B, which produces a partial vacuum in the cage C, and is brought into contact with the bottom blades of the quickly revolving beater D, which loosen the cotton and, as it rises, the action is repeated by each blade, until the cotton escapes at E in the direction of the arrows to the revolving cage C, and from thence is cleared by the delivery roller and the lattice G.

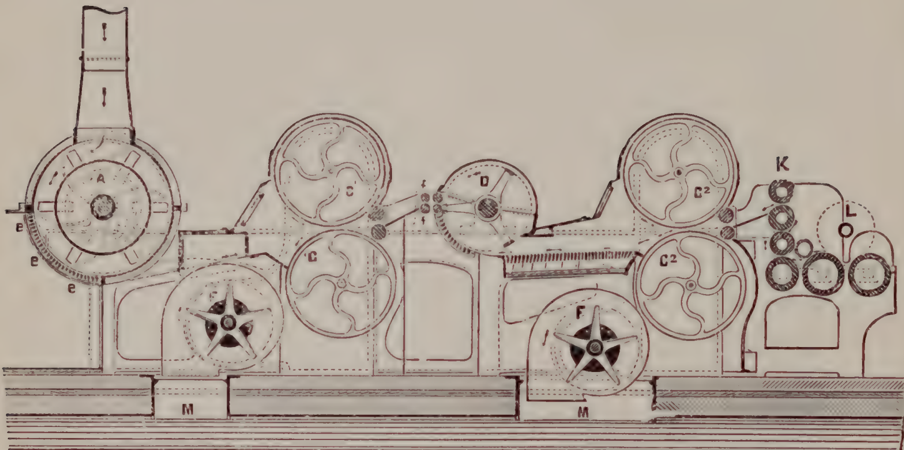
When the machine is placed between the lattice feeder and the exhaust opener, the cylinder part only is used, the lattice feed and delivery parts being dispensed with, and the cotton passing direct into the pipe A, is drawn from thence to the exhaust opener.

When a clean grade of cotton is being worked it may, by an arrangement of valves, miss the crighton cylinder and pass direct to the exhaust opener, or on the other hand, where dirty East Indian cottons are being worked, it is often considered advisable to put down two single crighton cylinders, so arranged that the cotton may pass through one or both cylinders as required.

Below is a section of the **Exhaust Opener** through the large fan casing, and the small arrows indicate the passage of the cotton from the feed pipe to the passage leading to the first pair of dust cages C^1 C^1.



The cotton is drawn from the lattice feeder by the action of the large fan B (see cut), and presented to cylinder A, which passes it over the grid bars *e e e*, the dirt, &c., falling through the spaces between the bars into the box behind the cylinder. The cotton then passes on to the first pair of cages C^1 C^1, through the feed rollers *f f*, and is presented to the action of a beater D passing over the beater bars and dust box, which further clean it; it is then spread quite level on the second pair of dust cages C^2 C^2, and then passes through the calender rollers K as indicated by the arrows, and is made into a roll or lap L. The above-mentioned dust cages (or wire gauze cylinders) serve as fine sieves, their interiors being exhausted by the fans F F, by which means the more minute particles of dust are sifted out of the cotton and discharged by the fans through the apertures M M, and deposited in the dust cellar underneath.

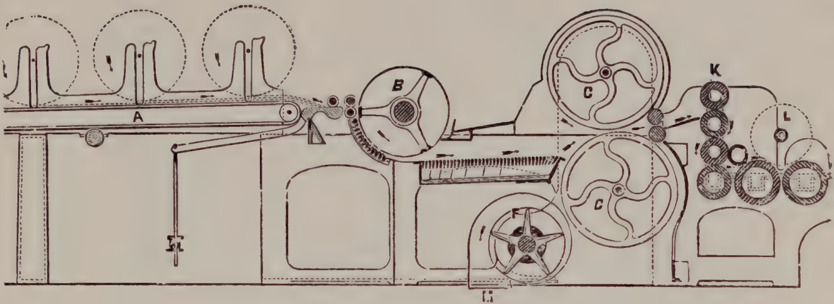


Exhaust Opener and Lap Machine.

It should be observed that at the commencement of each lap, the rollers at the lattice feeder are started a short time before the lap part of the opener, and at the finish the feeder stops the same length of time before the lap part; by this means the trunk and pipes are freed from cotton when the lap part stops; thus the irregularity caused by the cotton falling in the trunk is obviated.

The connection between feeder and opener is automatic in its action, and requires no attention, nor is it necessary for the feeder to be above the blowing room, but may be on the same level, or in the room below.

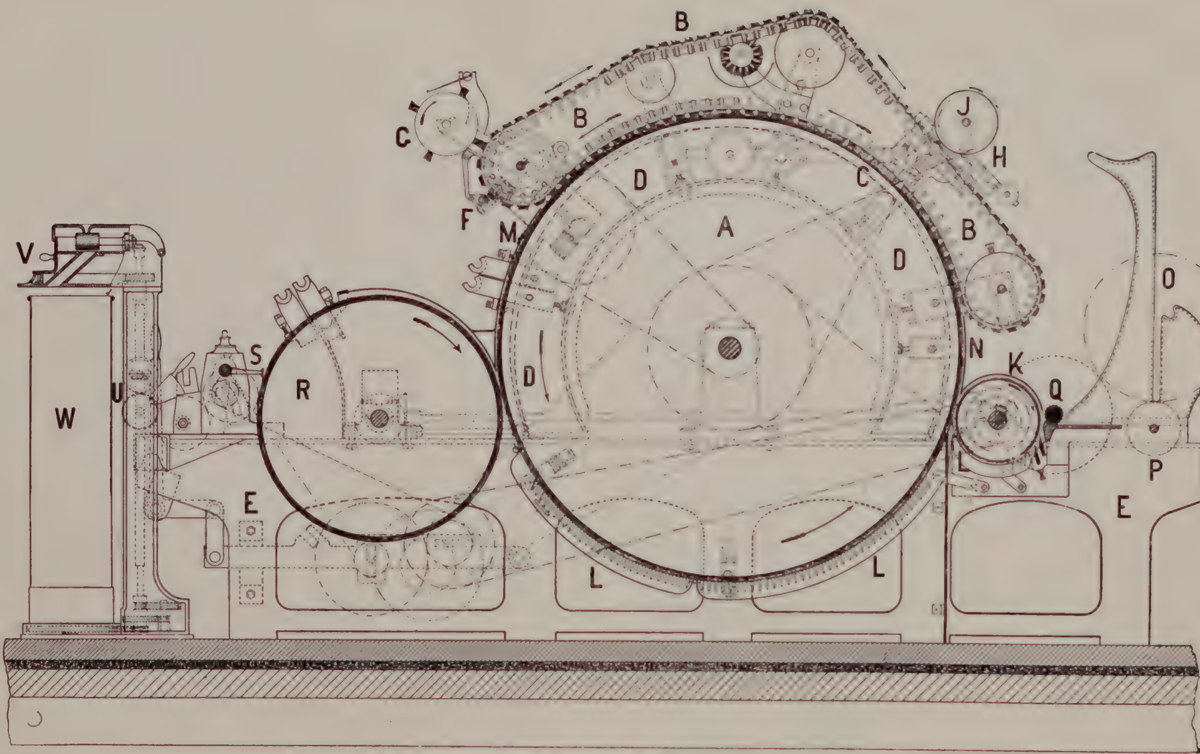
The next operation is to take four of the laps made by the exhaust opener and place them on the feed lattice A of a **Scutcher**. The lattice unrolls the laps and conveys the four layers to the feed rollers, where the material is again regulated by the rollers and pedals, and then passes on to the beater B to be further cleaned and spread evenly on the cages C C, thence through the callender rollers K, as indicated, and made into a lap L, this operation being repeated where necessary.



Single Scutcher and Lap Machine.

By the adoption of our system, consisting of Hopper Bale Breaker, Hopper and Lattice Feeders, Crighton Opener cylinder part, Exhaust Opener and Lap Machine, and Single Scutchers, cotton may be made into finished laps at a **considerable reduction in labour** as compared with the ordinary system. See various arrangements of Blowing Machinery, pages 76 to 79.

Carding.—The carding process which follows the scutching is, in the opinion of many experts, the most important operation through which the cotton passes. It is at this point that the final cleansing takes place by the elimination of the impurities that have not been removed by the opening and scutching machinery, and the fibres, which are at this stage crossed in every conceivable direction, require to be placed in parallel order. The Carding Engine which accomplishes this the most successfully will give the most satisfactory results in the spinning; or, in other words, lead to the production of the best yarn. The premier position has now been unanimously assigned to the present form of the self-stripping revolving flat card. This card is shown in section, and consists of a main carding cylinder A; and on its circumference the flats B B—which are made in the form of cast-iron ribs faced with card clothing—are seen connected, so as to form an endless travelling lattice, those at work resting upon flexible semi-circular rings C, which are accurately fitted upon the fixed bends D D, the whole being carried from the frame sides E E. The flats when out of action—*i.e.*, when quitting the cylinder A—are stripped of any fibres or impurities adhering to them by the action of the patent vibrating comb F and the revolving brush G. The flats then pass over guide rollers to the grinding apparatus H, whereby the faces of all the flats are



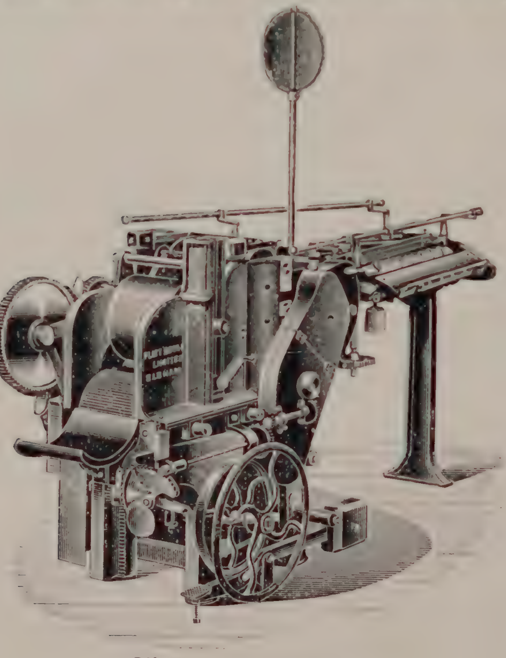
Patent Iron Revolving Flat Carding Engine.

successively ground from their working surfaces by the grinding roller J, and the points of the wire levelled and sharpened while the card is working. The extra cleaning facilities afforded by this type of carding engine have been still further augmented by the arrangement of the casings and knives applied to the cylinder A and the taker-in K respectively. A simple form of adjustment has been devised to give any desired result, and being regulated from the outside of the frame, it makes what was formerly a laborious duty into the simplest that the attendant has to perform. The casings and the covers are adjustable, to allow for any wearing of the wire on the respective parts they enclose, so as to prevent the formation of accumulations, which in older systems were the main cause of inefficient work. The unlapping of the fleece of the lap O is performed by the roller P, on which the lap rests, and it is then drawn forward under the feed roller Q, and delivered to the taker-in roller K, revolving in the direction of the arrow. At this point the carding or combing action commences, the fleece being held by the feed roller Q. The fibrous tufts of cotton are carried round on the underside of the taker-in to the main carding cylinder A. The wire clothing of the carding cylinder sweeps off the cotton from the taker-in K, and carries it forward to the series of flats B B. The wire clothing of the flats is set to face that on the main carding cylinder, and travels forward in the same direction as the surface of the cylinder, but at a very slow rate. The cotton thus undergoes a very thorough carding and straightening in passing the forty flats, which are always in contact with the top of the carding cylinder. The fleece of cotton after its passage through the flats is taken off in a continuous sheet by the doffer R, the wire clothing of which faces that on the cylinder, but runs at a much slower speed. The fleece thus receives a further straightening and stretching on leaving the carding cylinder, and is carried on the underside of the doffer to the vibrating comb S, which describes a short arc of $1\frac{1}{4}$ inches vertical movement, and is driven from a self-oiling oscillating motion which runs at 2,000 revolutions per minute or upwards without the slightest inconvenience. This comb strips the fleece from the face of the doffer in its down stroke and clears itself in rising. The thin fleece of the full width of the machine is then gathered in lateral guides to a width of about 6 inches, and finally into a smooth bell-mouthed funnel having a hole only half-an-inch in diameter, through which the contracted ribbon or sliver is drawn by the calender rollers U U, whence it passes to the coiler V and can W. The sliver is coiled by this arrangement until the can is filled, and then taken to the drawing frame.

The old system of using two sets of cards, generally called "breakers" and "finishers," may be said to be obsolete in this country.

The lap produced on the scutcher, and placed behind the Carding Engine, is made of such a weight per yard as to produce a sliver of the average thickness required, the doffer of the Carding Engine being arranged to run at a suitable speed for the purpose. There is, however, a varying amount of waste in the carding, consequently the thickness of the sliver, as deposited in the coiler can, may vary to a certain extent, and it is the function of the Drawing Frame to make the sliver as uniform in thickness as possible.

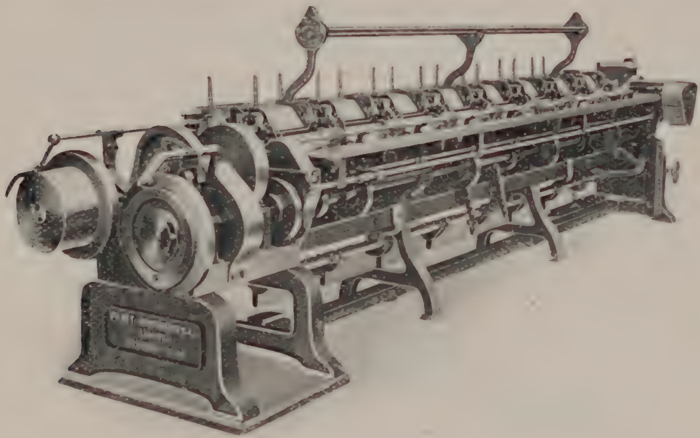
The Sliver Lap Machine. Generally 16 or 20 cans are put to this Machine, 8 or 10 on each side, the slivers passing from the cans over the spoons connected with a stop motion,



Sliver Lap Machine.

thence through three pairs of drawing rollers, and forward to a series of calender rollers which press the slivers into a sheet, and form them into a lap.

We may add that we are also makers of the Ribbon Lap Machine referred to below, if preferred by any of our customers.

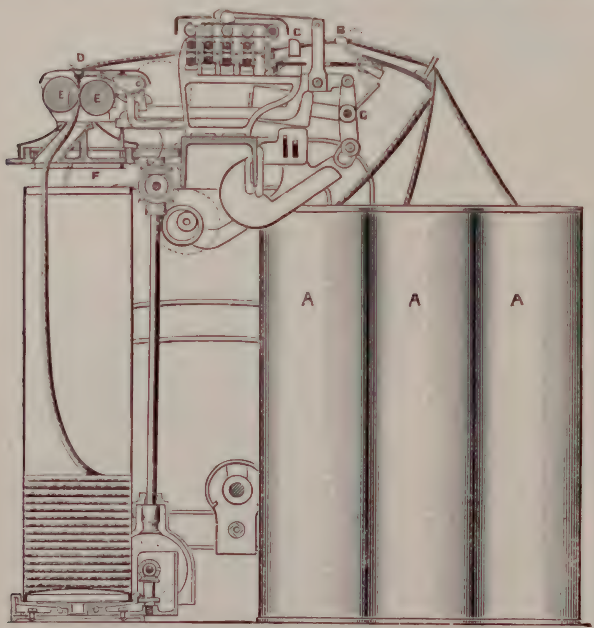


Improved Cotton Combing Machine.
(Heilmann's System.)

Combing.—The better class of yarn, known as fine numbers (say from 80's to 250's or upwards), is, after carding, usually combed on the Combing Machine to eliminate all short fibre, which is an indispensable operation for these higher qualities. In order that the cotton may be in a suitable form and condition for combing, the card sliver is passed through one passage of drawing and made into a lap by the Sliver Lap Machine. Another system is to displace the Drawing Frame at this stage, and insert a Ribbon Lap Machine between the Sliver Lap Machine and the Comber. In the former system the doubling takes place in the sliver, and in the latter in the lap, both systems, however, having the definite object of obtaining a uniform lap, with the fibres of cotton in the greatest possible degree of parallelism, so as to be in the most suitable condition for combing.

After leaving the comber the sliver is passed through three passages of drawing frames for further doubling and drawing, thus rendering the sliver more uniform in density throughout its length.

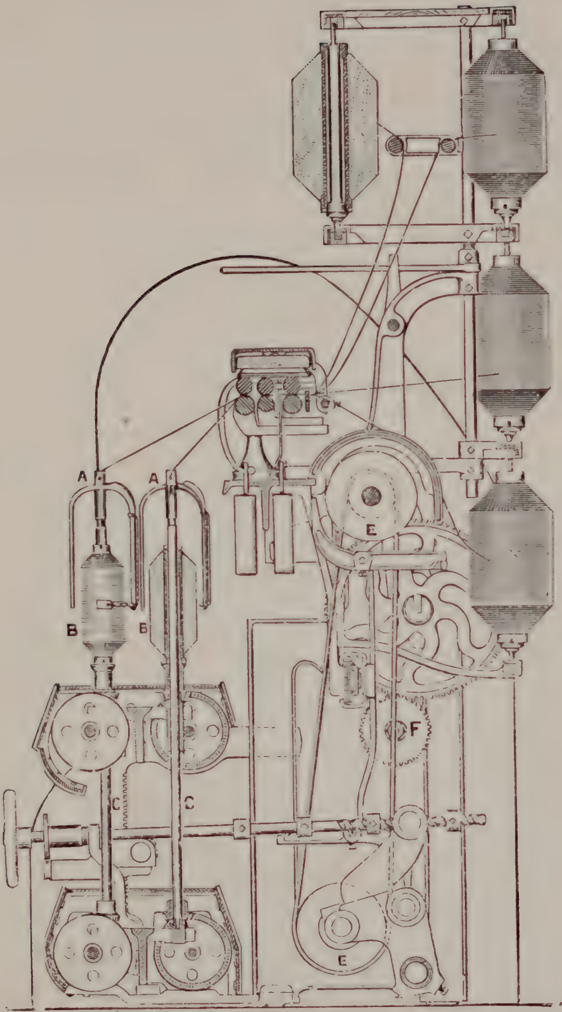
The Drawing Frame is for the purpose of placing the fibres of cotton more parallel, and to render the sliver as uniform as possible in thickness. It is fitted, as a rule, with four rows of top and bottom rollers (sometimes five or six), and to each coiler or delivery six or eight cans are placed at the back, according to circumstances. The slivers as drawn from the cans A A pass over the tumblers B of the back stop motion, through the guides C of the traverse bars behind the rollers, and through the draft rollers to the trumpet D of the front stop motion. The sliver then passes between the calender rollers E E, through the tube of the coiler, and is deposited in the can. Underneath the coiler wheel of one of the cans of each head a loose plate F is so arranged that when the can is full the plate is lifted by the coils of sliver, and being



Drawing Frame.

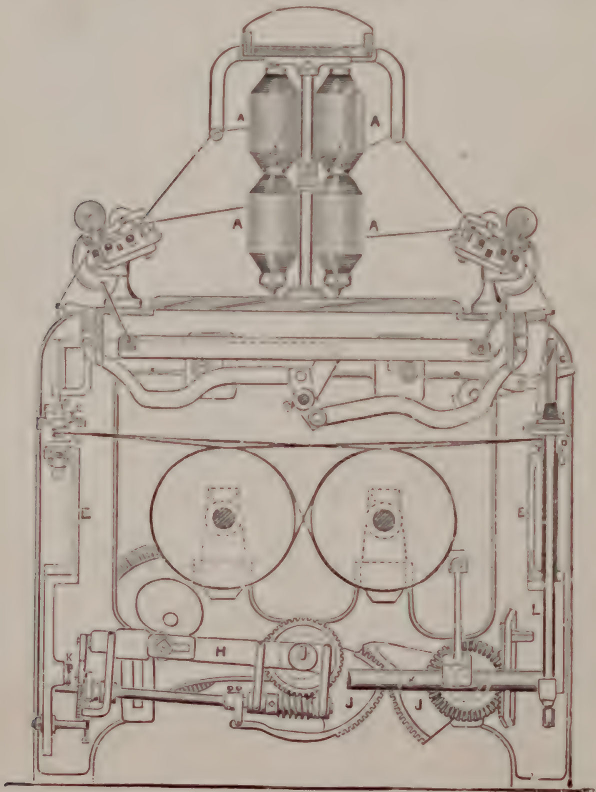
in connection with the rocking shaft G stops the machine. The whole of the cans in this head are then removed, replaced by empty ones, and the machine set to work again. There is one tumbler B to each sliver, and if the sliver breaks or the can becomes empty the tumbler through which it passes over-balances, comes in contact with the oscillating bar on the rocking shaft G, and by simple mechanism stops the machine. The trumpet D of the front stop motion is connected with the same mechanism, its object being to stop the machine when the sliver is light or breaks from any cause, such as roller laps, &c. As the special function of the drawing frame is to lay the fibres of cotton parallel and render the slivers of equal thickness by frequent doublings, &c., the rollers naturally play a very important part; the gearing is arranged at one end of the rollers, which run at gradually increasing speeds from the back to the front lines, to attenuate the sliver or give what is called "draft." To maintain the flutes and the bearings of these rollers in good condition, the front, and sometimes the second, lines of rollers are casehardened. The draft from the front to the back rollers is usually arranged to suit the number of ends run into one, that is to say, when six ends are run into one, a draft of six, and for eight ends a draft of eight. It is customary to have three passages of drawing frames, or four passages for fine yarns, each head or passage having six, seven, or eight coilers, according to the weight of sliver to be produced.

The Slubbing, Intermediate, Roving, and Fine Roving Frames which follow—according to the fineness of the roving required—further elongate and stretch the fibres; but in addition to the drawing process it is necessary at this stage to put in twist to give sufficient strength to the roving, so that it may be put on and drawn off the bobbin without undue stretching. For coarse counts of yarn there are usually two passages of flyer frames, viz., slubbing and roving; for medium counts three passages, viz., slubbing, intermediate, and roving frames; and for very fine counts four passages, viz., slubbing, intermediate, roving and fine roving frames. The Slubbing Frame receives one can per spindle, taken from the third or fourth passage of Drawing Frame, and draws or elongates the sliver by means of three rows of rollers, producing a roving or thread three, four, or five times or thereabouts finer than received from the Drawing Frame. The bobbins from the slubbing spindles are next put in the creel of the intermediate frame, two bobbins to each spindle, and the drawing and twisting processes are repeated; the same being done in the roving and fine roving frames, where the latter are necessary, according to the counts of yarn to be produced. All these flyer frames are similar in general construction, but have graduated sizes of rollers and of bobbins, &c., to suit the counts of roving to be produced, therefore a description of one machine will serve for the whole series. On reference to illustration it will be seen that the cotton passes through the three lines of top and bottom rollers to the spindles. Each spindle has on its upper end a tubular flyer A A, which surrounds the bobbin B B, which fits on a bobbin wheel running on the collar or bolster of the spindle C C. Both the spindles and the bobbins revolve in the same direction, but at different speeds, so as to cause the fibre to be wound on and twisted at the same rate as it is delivered from the rollers. By means of a shortening apparatus the length of traverse is reduced as each layer of roving is placed on the bobbin, and at the same time the strap on the cones E E receives a definite movement, and the variable speed from the bottom cone is then transmitted through the patent winding motion on the driving shaft F to the bobbins B B. In these frames, as well as in spinning machines, it is usual to have at least the front row of fluted rollers case-hardened. The spinning into yarn from the roving bobbin is at present done on either the self-acting mule or the ring spinning frame.



Section of Flyer Frame.

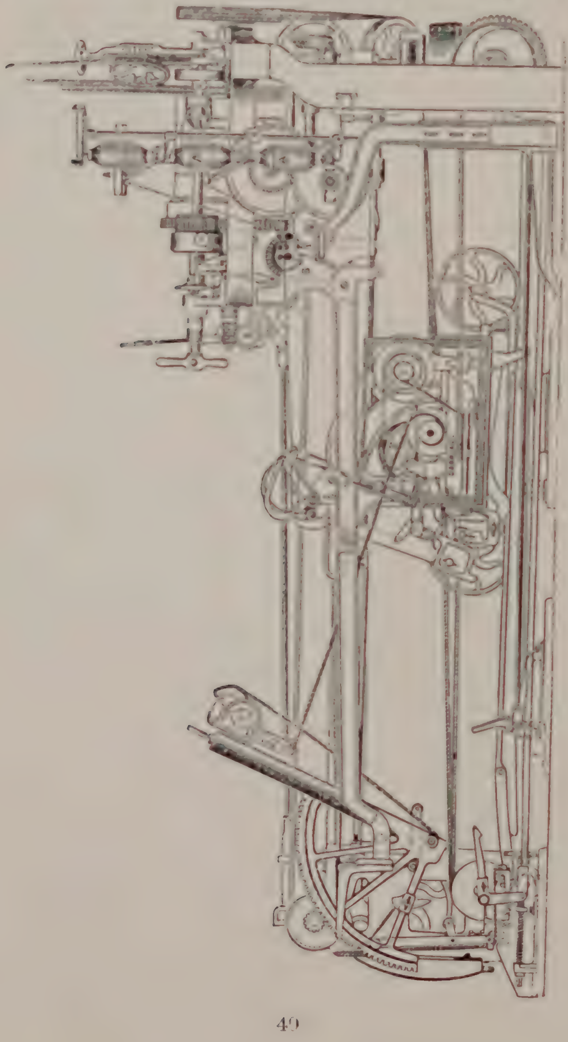
The Ring Spinning Frame has taken the place of the Flyer Throstle for warp yarns, and besides is capable of spinning weft yarns; and although extensively adopted for coarse and medium yarns, the ring frame has in recent years been so improved that fine yarns are now largely spun on this machine with satisfactory results, particularly in countries where skilled labour is not available. The roving from the bobbins A A, taken from the Roving Frame, passes from the creel through three lines of draft rollers B B to the bobbins C, which are placed upon and held firmly by the spindles D D. These spindles are screwed in the double girder rails E E. The



Section of Ring Spinning Frame.

requisite twist is obtained in the yarn by means of the small steel traveller G G, through which the yarn (in its passage from the rollers to the bobbins) is threaded. The revolutions of the spindle are communicated to the yarn through the traveller, thus putting in the twist, and the traveller, combined with the friction of the atmosphere, creates the necessary drag to wind the yarn tightly on the bobbins. The travellers are made of various sizes to suit the strength of yarn being spun. The traverse of the yarn on the bobbins is caused by the copping motion H, which communicates the necessary motion to the ring plates I I through the volute wheels J J, the rocking shaft K K, and the lifting pillars L. The ring frame illustrated shows the machine for spinning warp yarns, and although differing in some respects, will also serve to show the machine for spinning weft on wood pirns, or weft cops on paper tubes. Much time and ingenuity have been spent in endeavouring to make the spindles durable and free from vibration, and to make the bolster holder to contain a good supply of oil. Spindles of our D pattern, with front oil spout and reservoir, require oiling once only in several months, although they run well and steadily at the high speed of about 10,000 revolutions per minute.

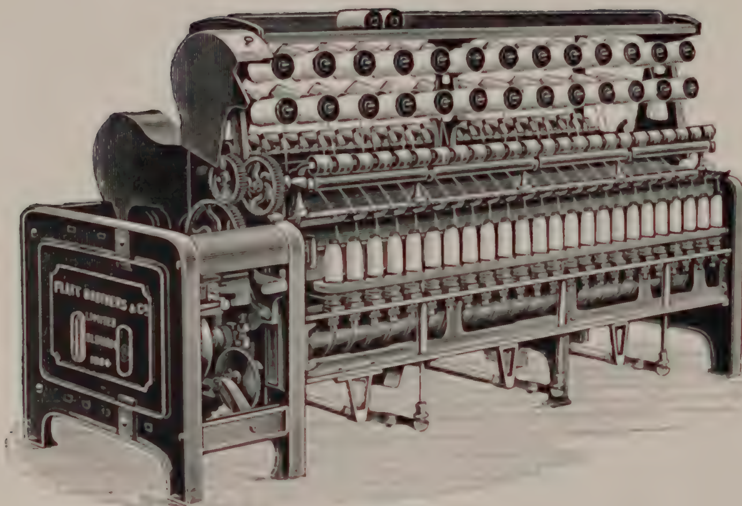
The Self-acting Mule takes up the fibre at the same stage as the ring spinning frame, but works by a different method, in such a manner that it will spin the most varied grades of yarn from the coarsest to the finest qualities and from the shortest to the longest staples. The leading peculiarity of the mule is that while the roller beams and rollers are fixed in one position, the carriage which supports the spindle has a backward and forward motion to and from the roller beams. The illustration shows the headstock containing the gearing for imparting motion to the whole machine, the creel containing the roving bobbins, the draft rollers, the square, viz., that part of the carriage which is underneath the framing of the headstock, and which contains some of the principal mechanism. The carriage D contains the spindles on which the yarn is wound, the fallers, and the tin roller to drive the spindles; and the square contains the winding-on drum, &c. From the bobbins A A, placed in the creel, the roving, either single or double as the case may be, passes through the draft rollers B to the spindles C, and by appropriate mechanism the carriage is made to travel outward from the roller beam, the tin roller being driven by ropes and the spindles by bands. The spindles are placed at an angle to the base line of the carriage, inclining towards the rollers, so that during the drawing out of the carriage when the yarn is receiving the required twist from the rapid revolution of the spindles, the yarn may slip off the



Self-Acting Mule.

point of the spindle, and no winding take place. Towards the completion of the outward run of the carriage certain changes in the gearing are made; the motion of the draft rollers B ceases, but the spindles C continue to revolve, and as the yarn is thus held by the motionless rollers a further stretch, called "after draft" or "jacking," may be given if necessary. This motion is, however, used only for certain classes of fine yarns. The spindles are then, by the mechanism of the headstock, made to revolve in the opposite direction to their first motion, thus unwinding the spiral coils of yarn on the spindles whilst the faller wire is being depressed to the proper position for guiding the thread on the spindle. In the final or third movement the carriage begins its traverse towards the rollers, and as it runs in, the spindles revolve and wind on the spun and twisted length of yarn resulting from the previous cycle of movements. The length of the stretch averages about 64 inches, and according to circumstances up to five stretches per minute are made. As stated above, the mule will spin from the coarsest to the finest counts, and yarn has been spun to the astonishing degree of fineness of No. 400, that is, 400 × 840, or 336,000 yards, or about 190 miles in length, for 1 lb. of cotton. From 300 to 400 hanks to the pound are at times spun from Sea Island cotton. The mule illustrated shows rope taking-in motion, patent nosing motion, and other improvements

Doubling or Twisting of two, three, or more threads is done on either ring or flyer system, according to the purpose for which the yarn is intended. For hosiery, and where a full thread is required, the work is done in a dry state, but for sewings, nettings, &c., the yarn before being twisted is passed through water. The ring doubler or twister is somewhat similar in principle to the ring spinning frame illustrated, but has only one line of delivery rollers instead of draft rollers. We make these machines on the English system, with the water trough behind the rollers, or on the Scotch system, with the rollers revolving in the water troughs, as largely adopted by the thread trade.

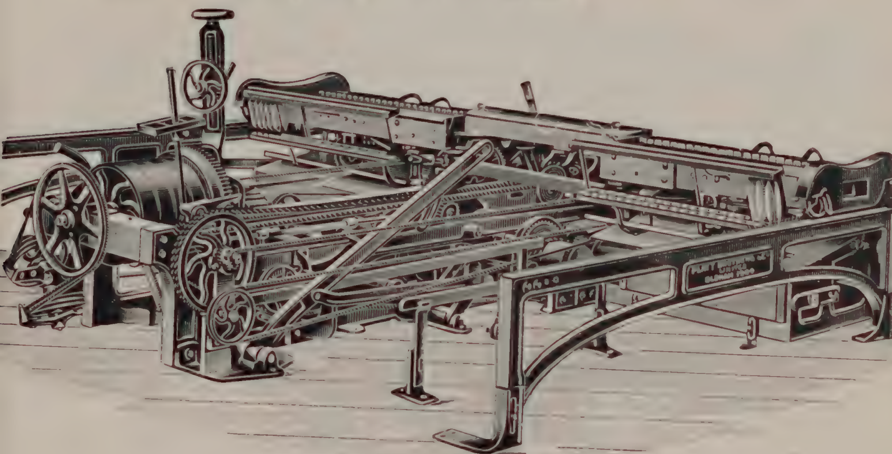


Ring Doubler.

The Self-acting Twiner is another machine used for doubling. It is worked on the same principle as the self-acting mule, but has, instead of the draft rollers, a locking apparatus to hold the threads while the spindles are winding on the doubled yarn as the slide or creel goes in, and to release the threads as the slide or creel draws out. As a rule, the spindles in a twiner are in a stationary frame, in a similar position to that occupied by the roller beam in the mule, whilst the slide or creel containing the cops or bobbins of yarn to be doubled and twisted runs to and from this fixed spindle frame.

Our self-acting twiners are of the most modern type, containing all recent improvements of the self-acting mule that are applicable to twiners, such as rope taking-in motion, backing-off chain tightening motion, and patent nosing motion. The framing of the headstock is exceptionally solid, and the different parts are easy of access.

Various forms of slides can be supplied, including the old wood locking slide, but we recommend our ordinary form as the simplest and most certain in its action, and it leaves the least slack yarn on unlocking. We arrange the slides for dry doubling or with water trough or other arrangements for wet doubling, and with various forms of creels for doubling from cops or bobbins, or from winders' bobbins on which two or more threads have been previously wound. The twiners are made to suit any position of main driving shaft in the building to contain them. We are sole makers of Tetlow's patent clearer plates for cleaning the yarn whilst doubling.



Self-acting Twiner.

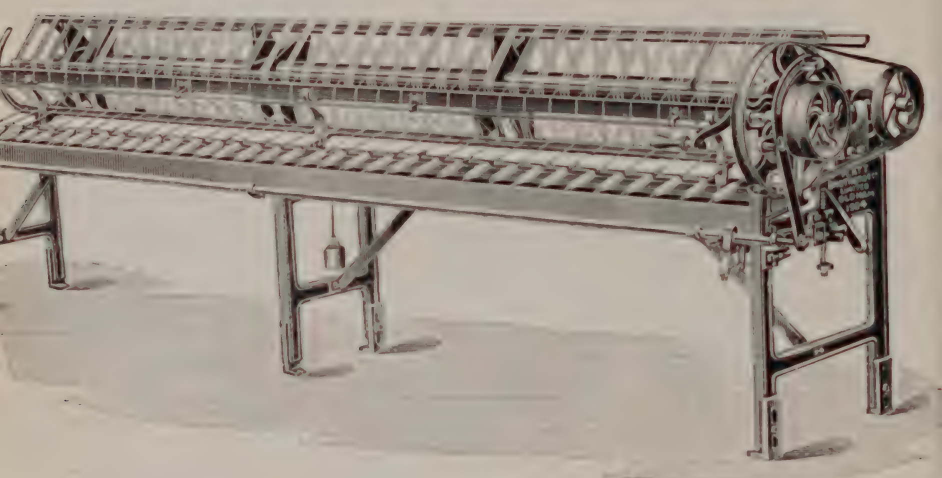
Reeling.—In order to facilitate the dyeing of the yarn, it is necessary that it be in an open condition suitable for receiving the dye, and to achieve this, it is wound from the cop or bobbin on to a swift in the form of a hank, for which purpose reels are constructed in a variety of ways, depending whether the yarn is to be wound from cops or bobbins.

The "swift" is composed of a light iron tube or a tin cylinder, upon which a number of arms are mounted, and on the ends of these arms are fixed wooden laths or bars, around which the yarn is wound into hanks, from cops or bobbins fixed on suitable skewers, pegs, or spindles, as required.

A stop motion is applied, so that when a certain length has been reeled, the strap is transferred from the fast to the loose pulley, and the machine is stopped.

An automatic stop motion when a thread breaks is also applied, when required, for the prevention of short length hanks.

To doff the hanks, the swift is made so that the arms can be drawn together, or closed, thus releasing or slackening the hanks, and enabling the attendant to draw them to the end of the reel, whereby a suitable doffing arrangement the hanks may be removed.

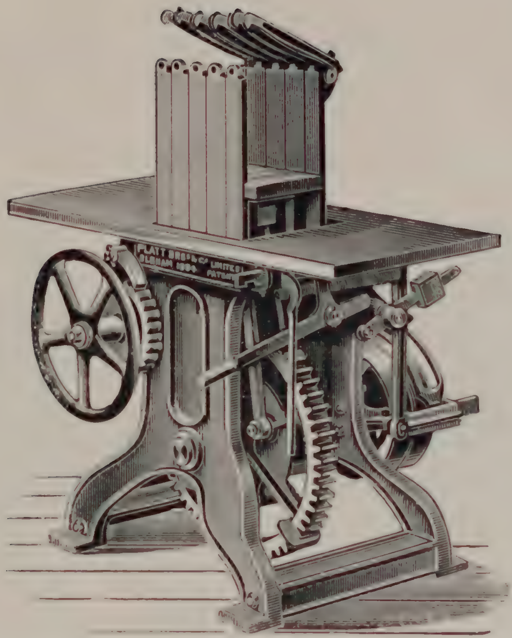


Cop Reel.

(Hand and Power.)

Bundling Press.—If the yarn is intended for export, after being reeled it is made up into bundles of 5lb., 10lb., or 12lb. each in weight.

These bundles are formed by the aid of the bundling press, which contains within a strong frame powerful gearing by which a presser table is moved upwards. Attached to the side framing are two sets of five or more cast steel side bars, slightly separated from each other to allow of the passage of strings. To one of the sets of side bars are hinged bars, which pass across the top and are locked automatically by levers jointed to the opposite set, the whole forming a box to contain the requisite number of knotted hanks to form a bundle of the desired weight.



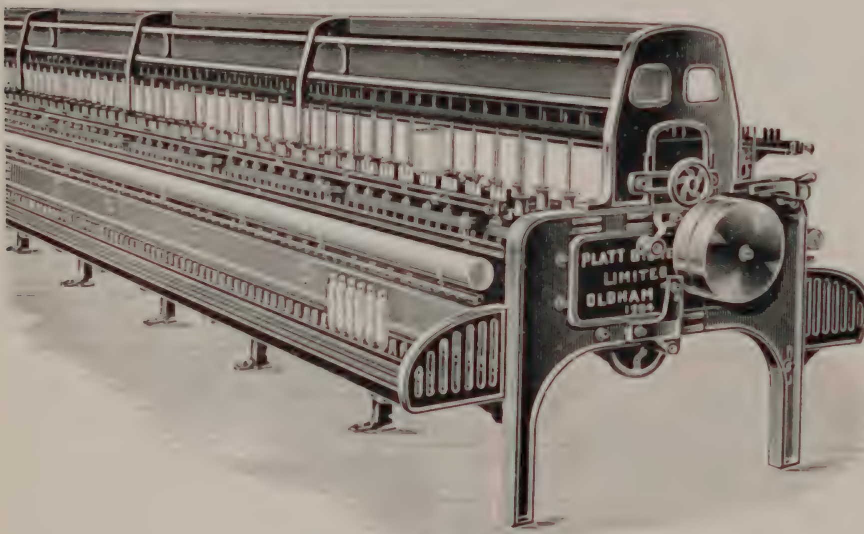
Bundling Press, with Patent Self-closing and Opening Bars.

The action of the press with automatic closing box is as follows:—The knots or hanks having been placed in the box, and the strap moved from the loose to the fast pulley, the top bars descend and are fastened automatically. The table or presser then rises until the bundle is pressed to the proper size, when the knocking-off motion comes into action and the press stops. The attendant then ties the various strings, and releases a catch from the ratchet wheel on flywheel shaft, when the presser sinks by its own weight, and during its descent the top bars are automatically unlocked and turned back, and the bundle then removed by the attendant.

Warp Winding Frame. This machine winds the grey yarn from the mule cop or ring frame bobbin on to larger bobbins called warpers' bobbins, and at the same time clears the yarn of impurities.

The machine has on each side two rows of spindles driven by bands from a tin drum or roller, running through the centre of the machine.

The cops or bobbins to be wound are fixed in front of the machine, and the threads pass over a drag roller covered with



Warp Winding Machine.

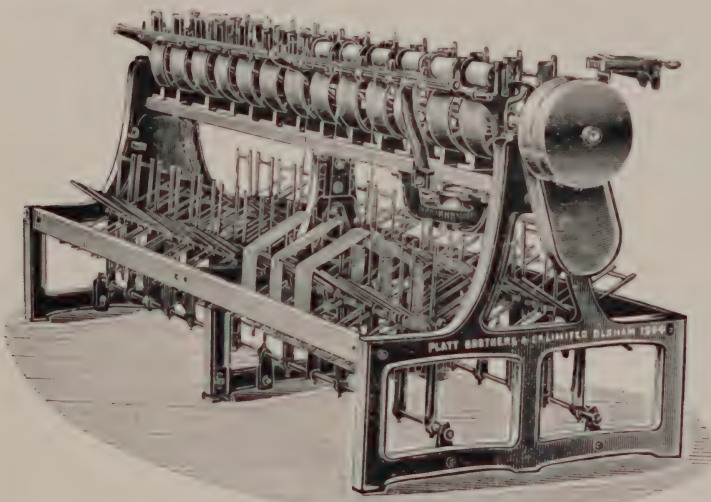
cloth, and thence over a guide rod, through a card wire brush, and over a guide, on to the warpers' bobbin.

On each spindle is fixed a cast-iron disc, covered with a flannel washer, on which the bobbin rests and revolves by frictional contact.

The wire brush and guide traverse upwards and downwards whilst filling the bobbins with yarn.

As the warpers' bobbins fill and get larger in diameter, a gradually increasing rate of winding and tension on the yarn takes place, owing to the greater circumference of the bobbin; and on this account it is therefore usual to run the back row of spindles more slowly than the front row, and as the bobbins on the front row of spindles increase in diameter they are placed on the back row, thus reducing the tension on the yarn. Bobbins up to about half size are therefore produced on the front row of spindles and full size bobbins on the back row, both sets working, however, at the same time.

The Drum Winder is used for winding hanks on to warping bobbins ready for the creel of the warping or beaming machine. The warpers' bobbins are placed on iron



Drum Winder,
To wind from Hanks to Warpers' Bobbins.
Single line of Drums, 2 Bobbins per Drum.

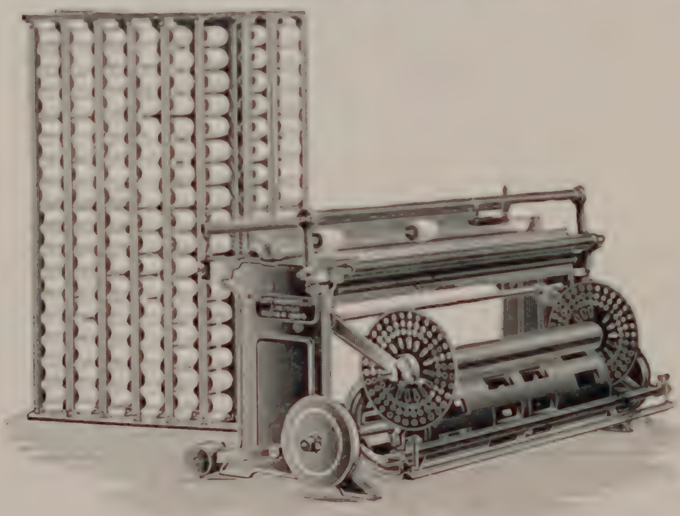
surface drums, and are driven by frictional contact. By this means a **uniform surface velocity** is imparted to the bobbin, and consequently a uniform tension on the thread is obtained, which is an important desideratum in winding hanks the threads of which may have become matted together in the dyeing.

To guide the yarn on to the bobbin, thread guides are fixed to a rod extending the length of the frame, and to which a lateral traverse equal to the lift of the bobbin or the distance between its flanges is given by suitable mechanism.

The drum winder may be constructed with a line of drums on each side of the machine, with one bobbin per drum, or with a single line of drums in the centre, but with two bobbins per drum. The former type is most convenient where the work-people are of very short stature.

Pirn Winder for Weft.—After dyeing the hanks of yarn used for weft in weaving coloured goods, such as checks, it is necessary to re-wind the yarn on the **Pirn Winder** to prepare cops (cannettes) or pirns for the loom shuttle. On each side of this machine are swifts to receive the dyed hanks, the yarn passing from the banks over guide rods, one of which has a radial movement to traverse the yarn on to paper tubes or pirns. The form of the cop is obtained by means of a slit conical cup through which the spindle and the pirn pass. The yarn is guided through the slit in the cup on to the revolving pirn, and as the winding progresses it accumulates and fills the cup, and causes the cop or pirn to be pushed upwards, at the same time imparting to the cop its conical shape. It may be added that the machine may be arranged for hanks above or below.

The Warping or Beaming Machine follows the winding frame, and has a creel, **V** shape in plan, to contain 500 or more warpers' bobbins, the threads from which are passed through a reed, under and over tension rollers, and



Warping Machine.

thence through a guide comb and on to a warpers' beam, consisting of a wood roller about 5" diameter, with iron flanges about 21" diameter. The yarn is now in a suitable condition for being sized, to facilitate weaving, &c.

Sectional Warping is a method largely adopted for dyed or coloured warps, and where the warp yarn is sized in the hank. The machine for this purpose is a diminutive beaming frame, with a creel for 400 to 600 bobbins.

The yarn is warped in sections or cheeses about 5 inches in width, the number depending upon the number of threads to be put on the loom beam.

If the yarn is required in balls for transport the ends from a section are gathered together into a loose rope and coiled in a balling machine.

For warps containing coloured ends, the system of sectional warping presents well known advantages. The yarn can be sized in the hank after reeling (each colour being kept separate), then wound on warpers' bobbins on the Drum Winder already described, and finally placed in the creel of the Sectional Warping machine in the required order to form stripes and other effects as in check and fancy cloths.

Size Mixing.—This is performed in becks or wooden cisterns fitted with revolving dashers to stir the mixture. The mixing of size requires constant care and supervision, as variation in quality of materials used, atmospheric conditions, time of storage, &c., necessitate changes in proportions of ingredients to obtain correct and unvarying weights of size in the yarn and prevent mildew. The ingredients and the proportions used are very variable, each manufacturer having his own particular recipe; experience, therefore, is the only reliable guide in matters of this kind.

The following are the principal ingredients used:—

1st. *Adhesive Substances* which have vegetable origin.—Wheat flour, farina, sago, rice, dextrine or British gum, and Irish moss.

2nd. *Weighting Substances.*—China clay, sulphate of lime, French chalk, silicate of magnesia, sulphate of magnesia or Epsom salts, sulphate of soda or Glauber's salts.

3rd. Fatty Substances or Lubricants—Tallow, bleached palm oil, cocoanut oil, castor oil, olive oil, and paraffin oil.

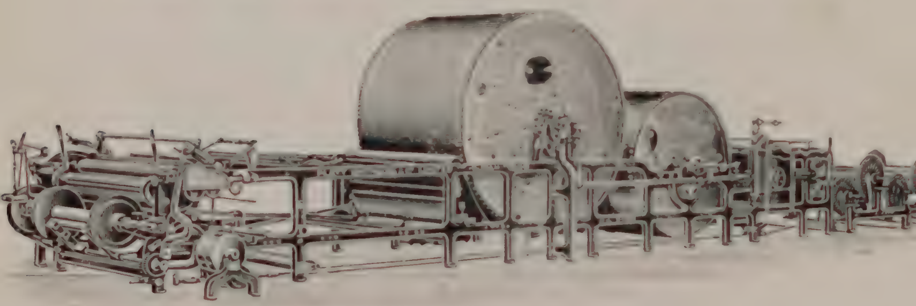
4th. Deliquescents and Softeners.—Chloride of magnesium, chloride of calcium, glycerine and soaps.

5th. Antiseptics.—Chloride of zinc, carbolic acid, cresylic acid and salts of arsenic, &c., including numerous sizing liquors which may be decoctions of chloride of zinc and other antiseptics.

The Slasher Sizing Machine is now almost universally adopted for applying size to the warp yarn. The machine is of considerable length, and consists of a creel for six or eight warpers' beams, a size box with immersion and squeezing rollers, and two copper cylinders for drying, together with the headstock containing the gearing, &c., to wind the sized and dried warp on to the loom beam.

The beams from the warping machine are placed in the creel in two levels, the number of ends on each being such that the total from all the beams make up the required number of ends in the warp. The ends are gathered together in a sheet, those from the first beams passing under and over those which follow alternately, and thence through the sowe box, passing under a skeleton immersion roller, which may be raised or lowered at pleasure, and through a pair of presser rollers, to squeeze out the superfluous size, at the same time pressing the size into the yarn.

The warp then passes forward and is wound round the larger cylinder, thence over carrier rollers, and round the small cylinder, after which it passes to and fro over other carrier



Slasher Sizing Machine.

rollers below the machine, and with the assistance of one or two fans is thus thoroughly cooled and dried before being wound on the yarn beam for the loom.

Ball Sizing is the system of sizing adopted after the process of ball warping. The warps are uncoiled and run into a large vat of size, passing over a number of immersed rollers, and left until thoroughly soaked, after which the superfluous size is expelled by passing between presser rollers, and the warp taken to a drying machine consisting of about 12 cylinders heated by steam, where it is dried, and afterwards again balled and beamed.

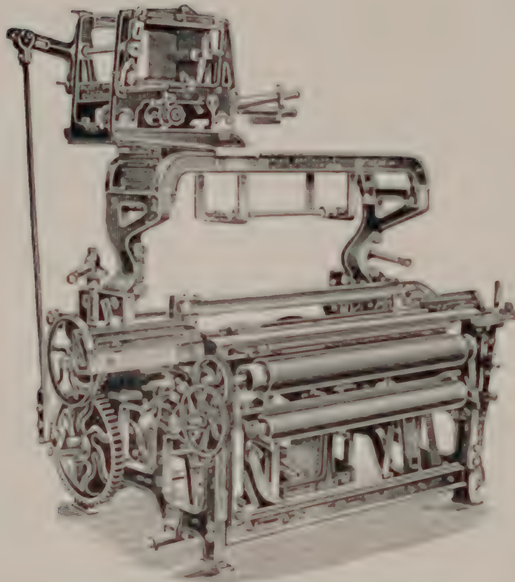
Owing, however, to the extra processes involved, and to several other drawbacks inherent to the system, this method is becoming obsolete, and is being superseded by slasher sizing. For the export of sized warps it is, however, still in vogue.

Drawing-in.—Before the yarn beam is ready for the loom, each end must be drawn through the eyes or mails of the healds and through a dent in the reed; this process is termed drawing-in.

The healds are used in making the shed for the passage of the shuttle, and consist of two staves or rods connected by heald cord, in the centre of which is an eye or mail. A set of healds comprises two or more sets of staves. To separate the warp to form a shed, one or more healds are raised and one or more lowered in the loom, and thus form the desired effect or pattern of cloth.

The reed or comb is an arrangement of dents—pieces of flattened and polished wire about five inches long—fixed between strips of wood by pitched band. The dents are closer or further apart as the reed is finer or coarser in counts. Two ends are generally drawn between each split or dent.

Twisting-in.—Where the healds have been used before with the same counts per inch, &c., the ends from a new beam are pieced by a loomer, or twister-in, to a corresponding end which has been left in the heald from an old beam; this process is termed twisting-in.



Overpick Calico Loom with Dobby.

The Loom interlaces the warp and weft yarns in such a manner as to form a firm texture of plain or fancy cloth according to requirements.

The beam containing the sized warp yarn is placed in suitable beatings at the back of the loom, from whence the yarn passes upwards and over the back rest, through the heald eyes and through the reed or comb; at this point the shuttle containing the weft yarn is caused to pass through the opening—termed a shed—created by the division of the warp into two portions by the lifting of some and lowering of other healds, and the weft thus projected across the warp is immediately beaten up by the reed held by the lathe or slay close to the previous pick or shot of weft; the cloth thus woven then passes over an iron surface roller covered with perforated steel filleting on to the cloth roller.

To keep the warp at a suitable tension, the yarn beam is held by means of chains and weighted levers, the chains passing round the collars of the beams at each end, the threads of yarn from the beam being separated by two lease rods placed across the warp between the back rest and the healds, the alternate ends passing under one rod and over the other to keep them thoroughly separated and independent of each other.

The healds are carried by straps and cords from heald rollers fixed to the cross framing over the top of the loom, and are operated from a tappet shaft below the machine by means of levers, the tappet shaft being driven from the crank shaft by spur gearing outside the loom framing.

The shuttle containing the weft yarn traverses the warp by the action of a cam or picking plate on the tappet shaft, which communicates by a blow a quick movement to the picking-stick, on which is a leather strap connected to the picker—a piece of leather or buffalo hide—against which the shuttle rests in the shuttle box; the motion of the picking-stick is transmitted to the picker, and the shuttle is driven over the slay and across the loom into a similar box on the other side.

A positive take-up motion is applied to the cloth roller to take up the woven cloth at a definite rate, and thus determine the density of cloth by controlling the number of picks or shots of weft in a given space; and a motion is also applied to stop the loom when the weft breaks or when the cop or pirn in the shuttle is empty.

The variety of cloths that may be woven on the loom is almost illimitable, and for the weaving of checks, figured goods, gauze, pile, or other patterns of fancy cloths, special appliances or motions are used, such as additional tappets of various kinds, circular or drop shuttle box motions for 3, 4, or 6 shuttles on one or both sides, and dobbies and jacquards for complicated or figured cloths.

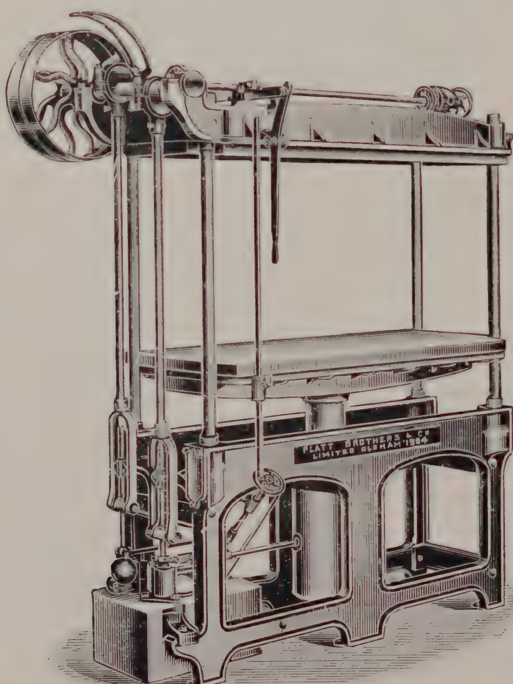
The cloth from the loom is taken to the warehouse where, after being examined, it is folded and made up into bundles of about 10 pieces ready for transport.

Cloth Folding Machine.—This machine, as its name implies, folds the cloth in plaits or layers varying in size from 18″ to 44″, according to requirements.

The cloth is placed on a tray in front of the machine and passes upwards over an inclined table, where by means of reciprocating knives stretching across the machine the cloth is carried backwards and forwards and folded in layers or plaits on a sinking table, convex in shape, to conform to the curve described by the moving knife.

The mechanism of the machine is of a simple character, consisting of a series of levers actuated by a cam driven from the driving shaft, and an apparatus is applied to stop the machine as soon as the end of the cloth passes over it.

The Hydraulic Cloth Press is intended to press the cloth in order to reduce its bulk. The illustration shows the press to work by power only, but when desired it can be constructed to work also by hand, the method of working being readily understood from the illustration. The pump lifts the water from the tank and forces it into the ram cylinder; the pressure of the water then compels the ram to rise, and with it the table on which the cloth has been placed. The table is thus gradually forced against the plate overhead, supported by four pillars, and by means of a rod fixed to one side of the table, the driving strap is changed from the fast to the loose pulley when the desired pressure has been obtained, and by opening the valve the table descends by its own weight and the water in the ram cylinder is returned to the tank.



Hydraulic Cloth Press.

PARTICULARS AND CALCULATIONS

RELATING TO OUR

LATEST MACHINERY

FOR

GINNING, OPENING, CARDING,

COMBING, PREPARING,

SPINNING AND DOUBLING COTTON.

POWER LOOMS AND PREPARING.

PLATT BROTHERS & CO. LIMITED,

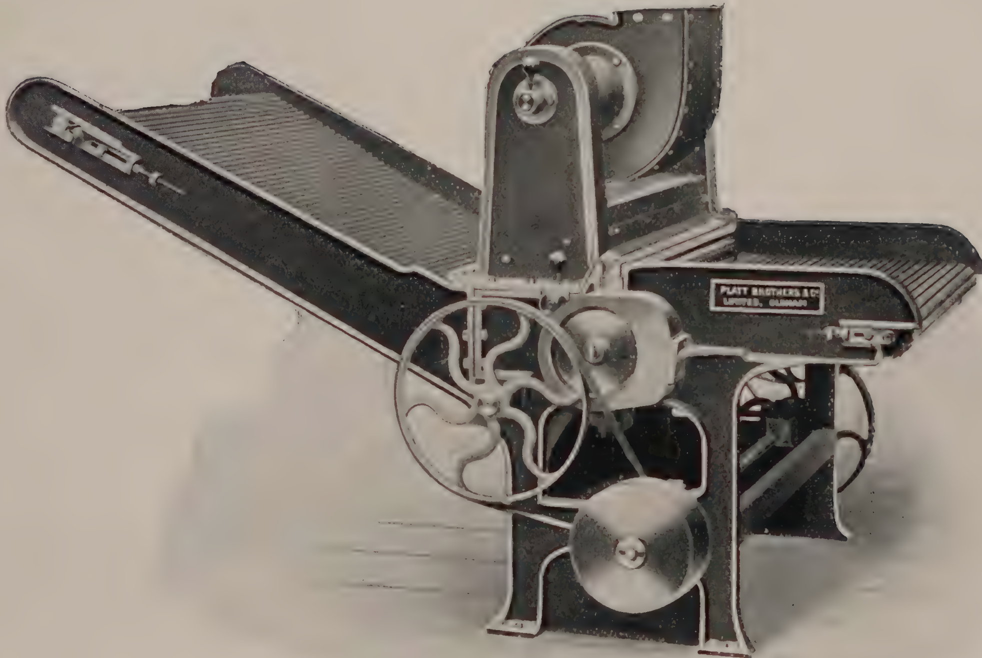
HARTFORD WORKS,

OLDHAM, ENGLAND.

SEED COTTON OPENING

AND

GINNING MACHINERY.



Single Cylinder Seed Cotton Opener, 40″ wide, with Delivery Lattice.

SINGLE CYLINDER SEED COTTON OPENER,

40 INCHES WIDE.

All woolly seed cotton is found to be more or less matted together by the interlacing of the fibres, particularly the shorter stapled varieties, as American Uplands, several varieties of East Indian, and some of the Levant cottons.

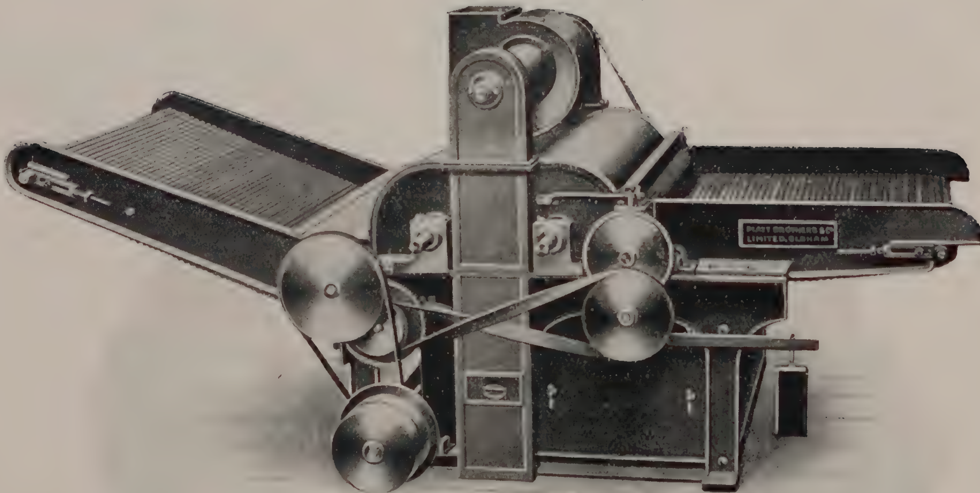
This machine is constructed to disentangle such seed cotton, and in doing so the fibres on each seed are straightened, enabling the gin to take hold of them more readily, thus increasing the production of ginned cotton considerably.

The machine is made with fan for up draft only, and can be supplied either **with** or **without** delivery lattice.

Production.—One opener will serve for ten of our double action, or five of our double roller gins.

Floor space occupied (with delivery), $8' \ 3'' \times 5' \ 7\frac{1}{2}''$.
,, ,, (without delivery), $3' \ 9\frac{1}{2}'' \times 5' \ 7\frac{1}{2}''$.

Driving pulleys, $12'' \times 2\frac{1}{2}'' \times 2\frac{1}{2}''$. Speed about 320 revs. per minute.



Double Cylinder Seed Cotton Opener, 50″ wide, with Delivery Lattice.

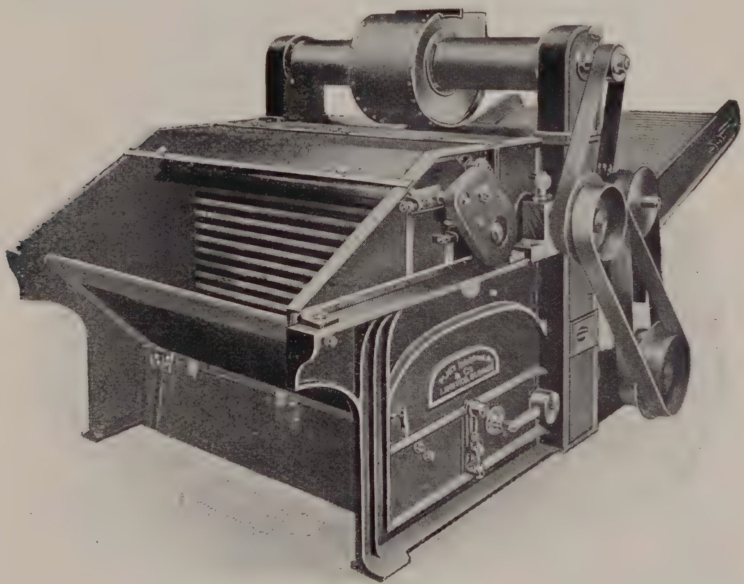
DOUBLE CYLINDER SEED COTTON OPENER,

50 INCHES WIDE.

This machine serves the same purpose as a Single Cylinder Seed Cotton Opener, but is 50 in. wide, has two cylinders, and may be made for either up or down draft.

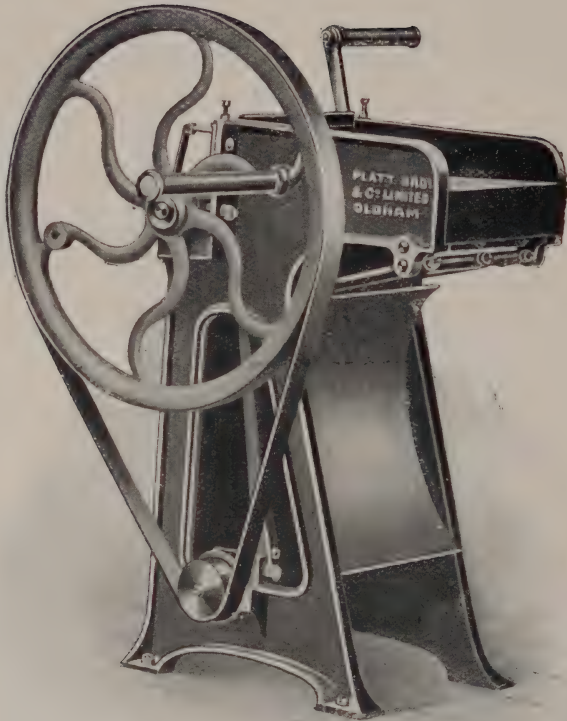
The advantages over the Single Cylinder Machine are:—The extraction of more dirt, sand, &c., and the production about double, say one ton of seed cotton per hour.

The machine is sometimes made with a hopper feed, thus:—



Floor space occupied, 11′ 9″ × 7′ 0″.

Driving pulleys, 12″ × 3½″ × 3½″. Speed about 530 revs. per minute.



PATENT HAND POWER MACARTHY COTTON GIN,

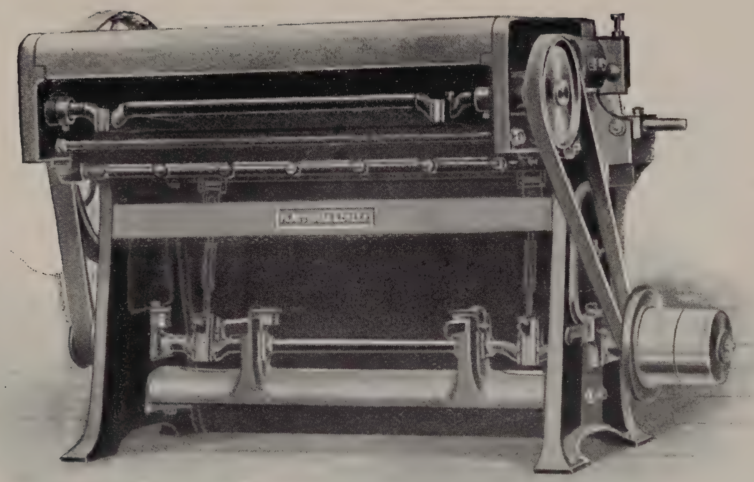
12″ WIDE, WITH MOVING SEED GRID.

This machine is suitable for ginning any kind of seed cotton without injury to the staple. Two persons are required to attend it; one to turn with both hands at the fly wheel, and the other to turn the crank handle with one hand and to feed with the other: the **production** being about 4 to 6 lbs. of *cleaned* cotton per hour according to class.

If the machine is required to work by power, the crank handle is taken off and a 16 in. pulley substituted.

Floor space occupied, 3′ 9″ × 2′ 9″.

Speed of handle shaft, about 40 revs. per minute.



PATENT SELF-FEEDING SINGLE ACTION, SINGLE ROLLER MACARTHY COTTON GIN, FOR POWER.

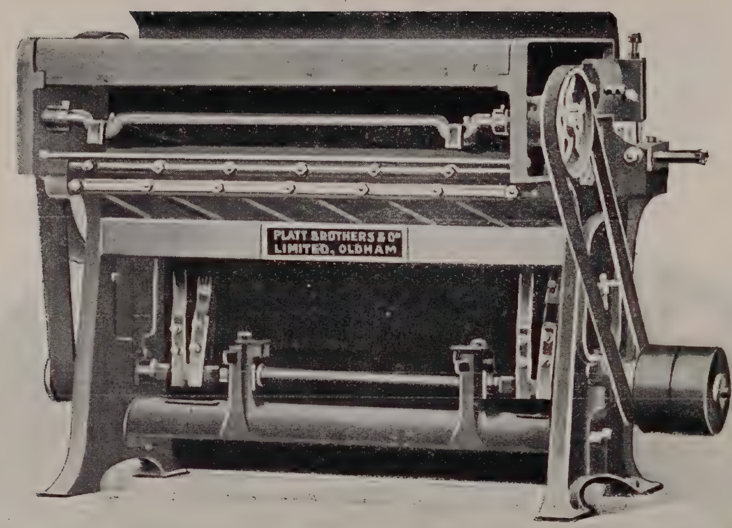
This machine is adapted more particularly for ginning long stapled seed cotton, such as Egyptian, Sea Islands, &c., for which it is specially recommended. It separates the seeds without crushing them, or in any way injuring the fibre.

Production.—This will depend upon circumstances, and the quality of cotton to be ginned; speaking generally, however, the gin will turn off from 50 to 60 lbs. of ginned Egyptian cotton per hour, and from 60 to 80 lbs. of Sea Islands or other long stapled cotton, with pulleys running about 750 revs. per minute, but a much higher production can of course be obtained by running the gin at an increased speed, as it is well known that in Egypt an output of 100 lbs. per hour is obtained by running the gin at 900—1,000 revs. per minute. This speed for Sea Islands cotton would give a production of from 800 to 1,200 lbs. of cleaned cotton per day of 10 hours.

The driving pulleys are now fitted with balance weights, which enable the gin to be run at an increased speed with a minimum of vibration.

Floor space occupied, $4' \ 10\frac{1}{2}'' \times 3' \ 3\frac{1}{2}''$.

Driving pulleys, $6\frac{1}{2}'' \times 3'' \times 3''$. Speed about 700—1,000 revs. per minute.



PATENT SELF-FEEDING DOUBLE ACTION, SINGLE ROLLER MACARTHY COTTON GIN, FOR POWER.

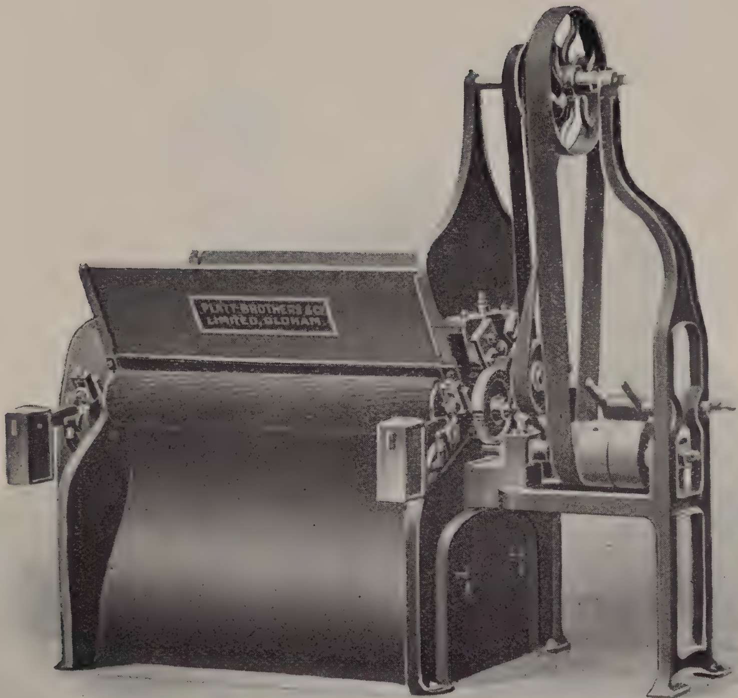
This machine is adapted for ginning almost every description of woolly seed cotton; it separates the seeds without crushing them, or in any way injuring the fibre.

By means of the double knife arrangement, the production of the Macarthy Gin is considerably increased, every revolution of the crank giving two strokes of the knife, and as each knife balances the other while in action, an easy and steady motion is maintained, which, in connection with the lower speed at which the machine works, adds greatly to its durability.

Production about 40 lbs. *cleaned* cotton per hour, of Surat, Smyrna, or similar varieties.

Floor space occupied, $5'\ 1\frac{1}{2}'' \times 3'\ 3\frac{1}{2}''$.

Driving pulleys, $7'' \times 4'' \times 4''$. Speed about 600 revs. per minute.



PATENT DOUBLE ROLLER COTTON GIN (WITH OSCILLATING LEVER),

40 INCHES WIDE.

This machine is well adapted for separating cotton from its seeds, more especially such as have the husk or shell covered with short fibre (technically called woolly seed), of which American Uplands is the chief variety. Of this kind of cotton the production would be about 80 lbs. per hour;

but with cotton that does not adhere so tenaciously to the seed the machine would give a proportionately greater result.

This Gin has been found specially advantageous for those descriptions of short stapled cotton in which it is difficult to separate the fibre from the seed in consequence of the tenacity with which it adheres to the seed, such cotton, for example, as grown in Madras, Bengal, British Burmah, Persia, China, and West Coast of Africa. The outturn of cleaned cotton from these descriptions varies very much, being sometimes not more than 40 lbs. per hour; for other classes, the production may be taken as stated above.

The preceding illustration shows the Gin fitted with Oscillating Lever which we advise, but we also make it with Crank Motion, fitted with a Needle Lubricator, *see opposite.*

The gin may also be fitted with an improved moving grid, similar to that in the single roller gin, with $\frac{1}{4}''$ or $\frac{5}{16}''$ slots, depending on the size of the seeds, and the former system of moving and fixed grids will thus be dispensed with, the mode of setting being as usual.

This grid has found favour among many of our customers, and has met with general satisfaction, the seeds being especially well cleaned, whilst the danger of breakage from stones or other substances found in the cotton is reduced to a minimum.

The Machine possesses many advantages, namely:—

1st.—That it is perfectly self-feeding, as the Cotton, on being thrown into the Hopper passes through the Machine without requiring any further attention.

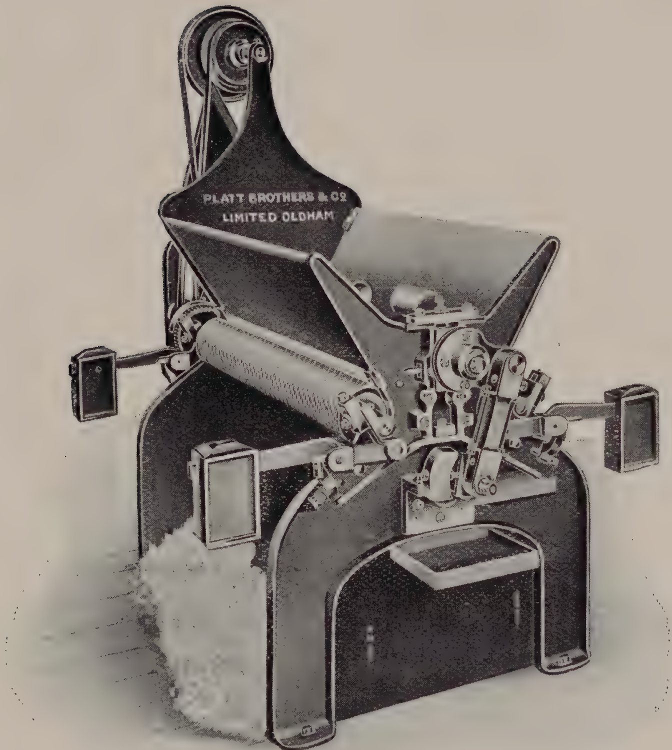
2nd.—It is also self-adjusting, the fixed knives being perfectly rigid, and the rollers being pressed against the knives by weights; an unvarying and uniform pressure is thus obtained, which cannot be tampered with, as in the case of Gins having the knife held up to the roller by means of springs placed at intervals in its length.

3rd.—The Machine can be instantly regulated for various lengths of staples as required.

4th.—The Rollers wear much longer than in the ordinary Gin, and the fixed and moving knives cannot enter into contact on the insertion of any extraneous matter, such as Ginned Cotton, pieces of string, &c., the rollers receding from the knife and allowing the obstruction to pass freely away.

Floor space occupied, $6' \ 3'' \times 4' \ 4''$.

Driving pulleys, $7'' \times 3\frac{1}{2}''$ wide. Speed about 600 revs. per minute

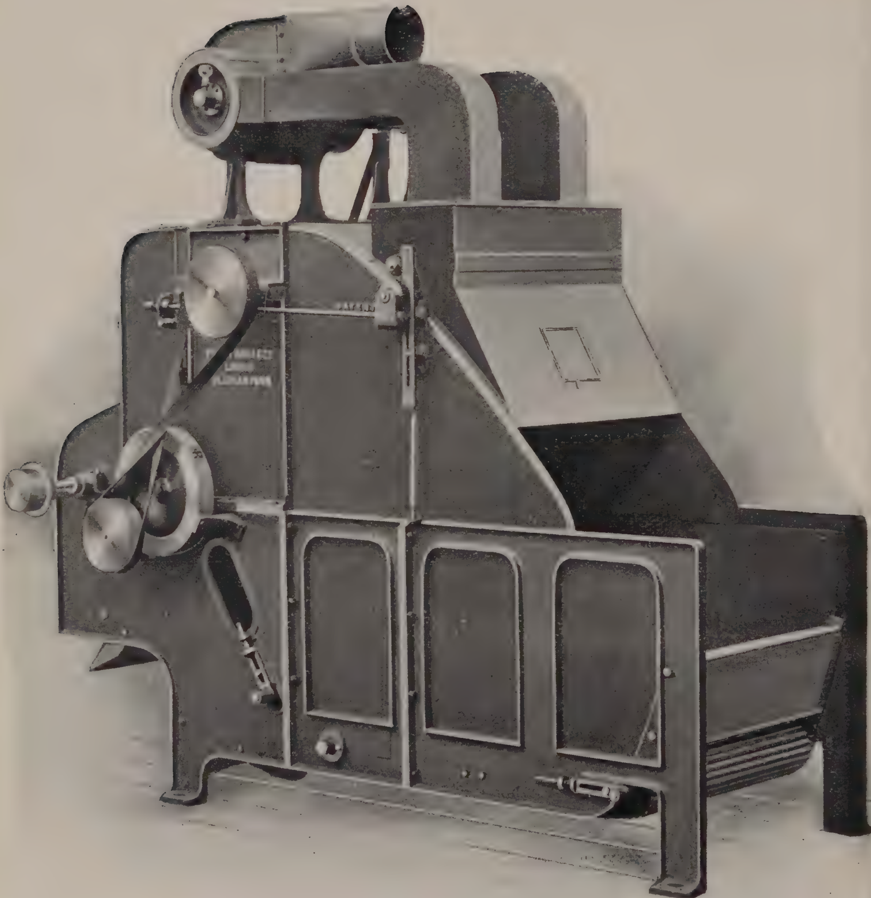


Patent Double Roller Cotton Gin,
with Crank Motion in lieu of Oscillating Lever.

Mixing, Opening,

Carding, Combing, Drawing,

and Flyer Frames.



HOPPER BALE BREAKER,
OR IMPROVED COTTON PULLING MACHINE,

as arranged when the cotton is to be delivered on to lattices and carried forward to mixing bins.

Left hand side of machine when standing at feeder end.

We have pleasure in calling attention to the above machine and its improved methods of dealing with cotton as taken from the bale, as well as to the general advantages over previous Bale Breakers.

1st.—Improved loosening of the cotton and freedom from damage to the fibre, by the substitution of a combing action instead of the roller tearing system.

2nd.—Simplicity in design and construction, combined with a minimum amount of wear and tear in working parts.

3rd.—Reduced liability to fire through friction, &c.

4th.—Large increase in production, the machine being capable of dealing with about eight ordinary bales per hour.

5th.—Greater facility in feeding, and improved automatic treatment of the cotton.

The action of the machine is as follows:—

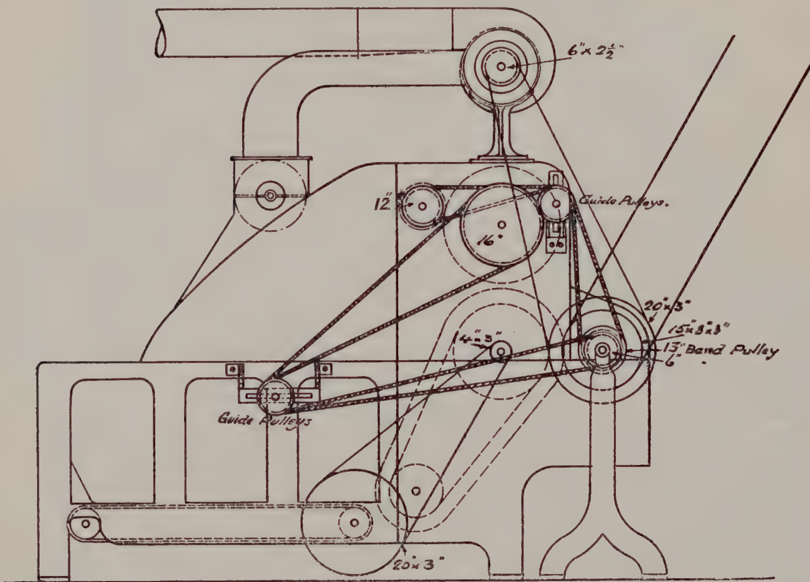
The cotton taken from the bales in pieces as large as possible is put in the hopper, the horizontal lattice carrying it forward and pressing it against the spikes of an inclined elevating lattice, where it is subjected to a sort of combing action, and is then carried upward to a spiked roller which further combs the cotton, and throws back into the hopper any large or unopened pieces, thus securing more perfect opening and mixing of the cotton before it leaves the hopper.

The spiked roller is stripped and kept clean by a stripping roller, the surplus cotton falling back into the hopper. The cotton after passing the spiked roller is stripped from the inclined lattice by a beater, and falls on a grid in the delivery sheet.

There is a grid below the inclined lattice, as well as in the delivery sheet, so that dirt, &c., may fall through.

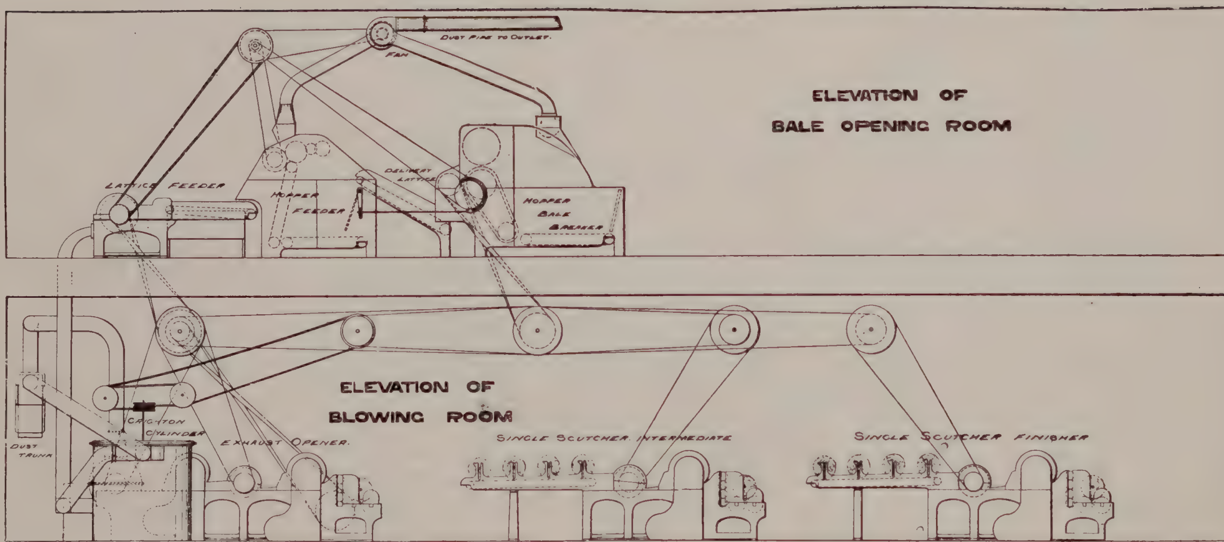
All machines are now fitted with Fan and Hood and with patent reversible grid as shown, the grid or perforated door being intermittently or otherwise rotated so that the faces are alternately directly opposed to the rising dust and dirt and afterwards quickly reversed. Thus, what was at one time the active or opposing face of the grid becomes the non-active or passive face, and *vice versa*.

Under this arrangement, dust and dirt are allowed to accumulate upon the grid for a suitable length of time, whereupon the grid is rapidly reversed, and its layer or coating of dust and dirt is turned face-in to the air suction pipe, the accumulated mass being rapidly withdrawn or sucked away from the grid by the fan. By these means the dust and dirt is wholly withdrawn and permanently removed from the machine at suitable intervals, whilst the regular reversal of the grid renders the action of the fan more uniform and certain.

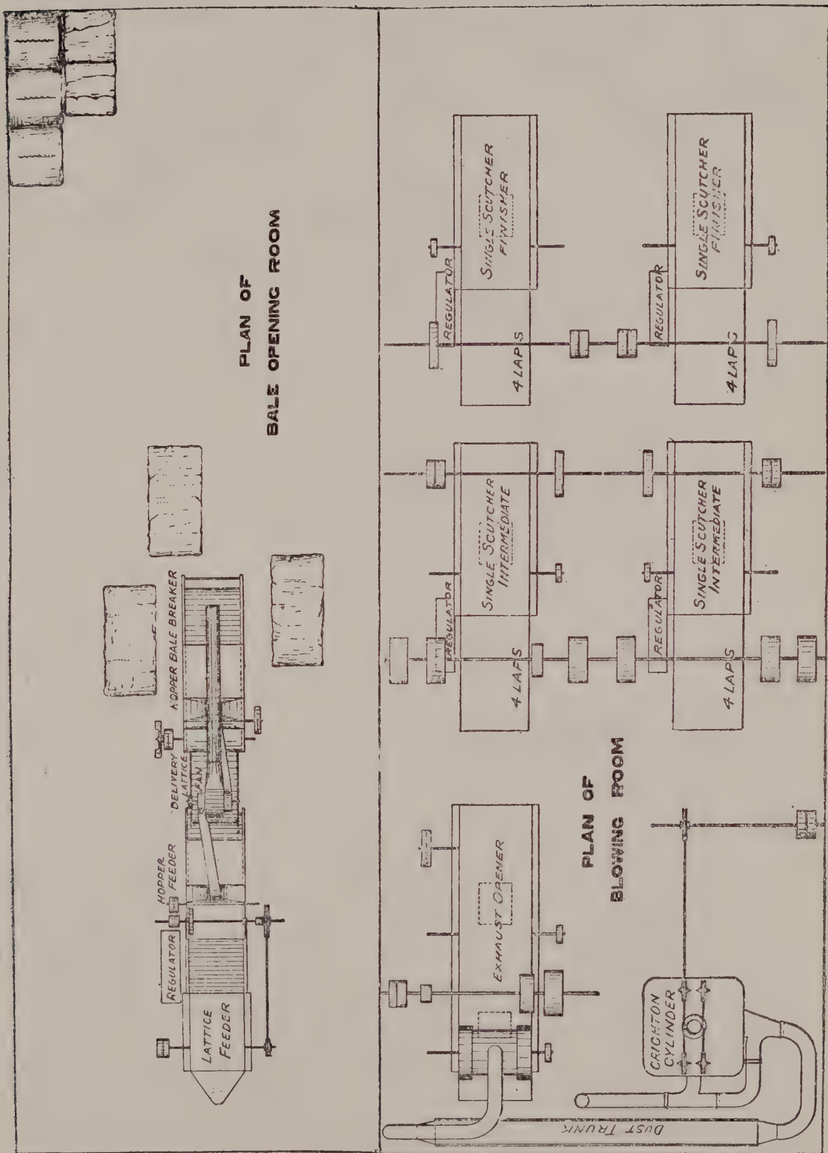


Hopper Bale Breaker. Arrangement of driving.

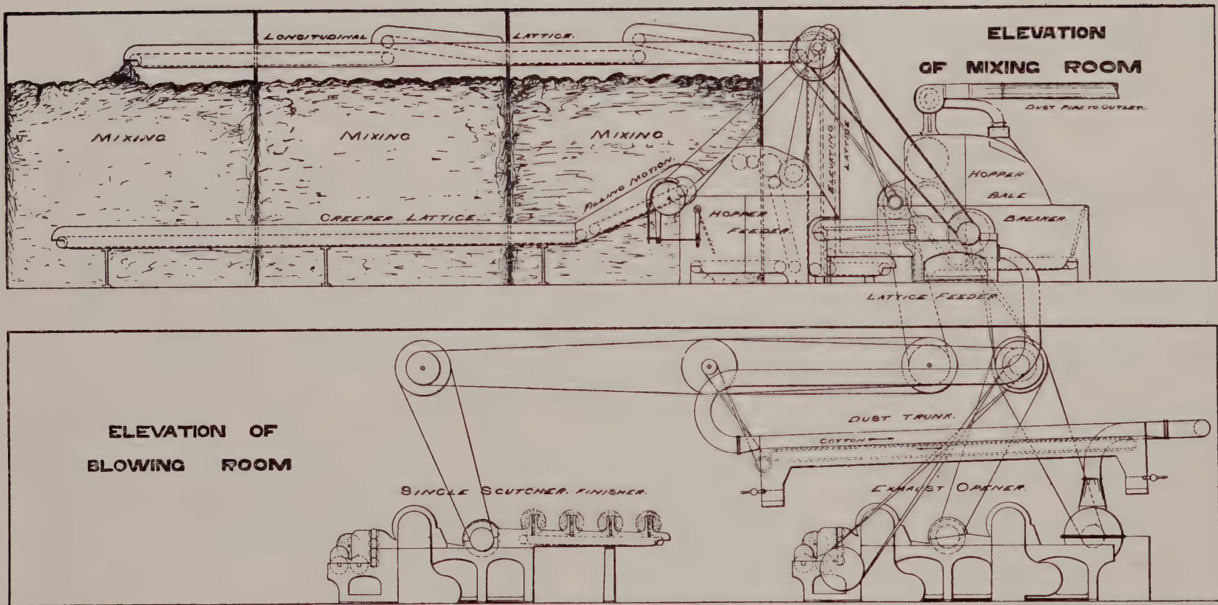
Floor space occupied, 9′ 7½″ × 6′ 7″.
Driving pulleys on beater shaft, 14″ or 15″ × 3″ × 3″, 300 revs.
Band pulley on cylinder shaft, 16″, 112·5 revs.
Band pulley on stripper shaft, 12″, 325 revs.
Fan pulley, 6″, 1,000 revs. per minnte.



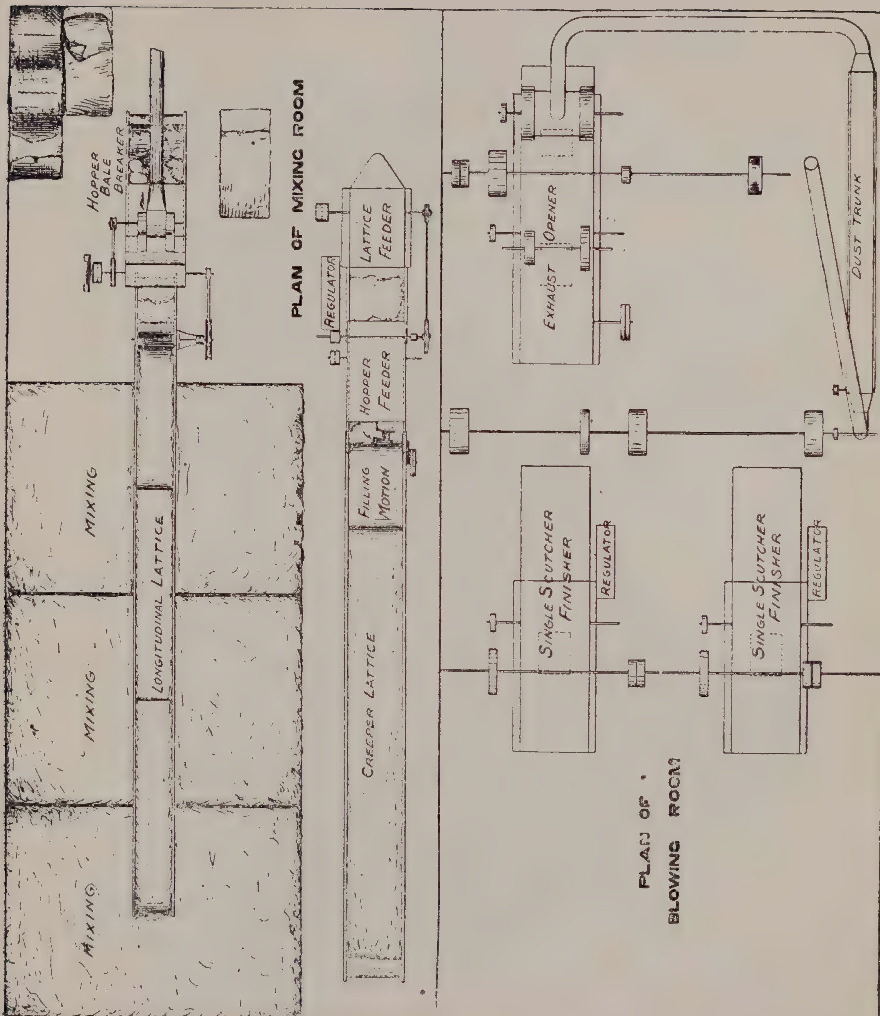
Arrangement of Blowing Room Machinery without Mixings.



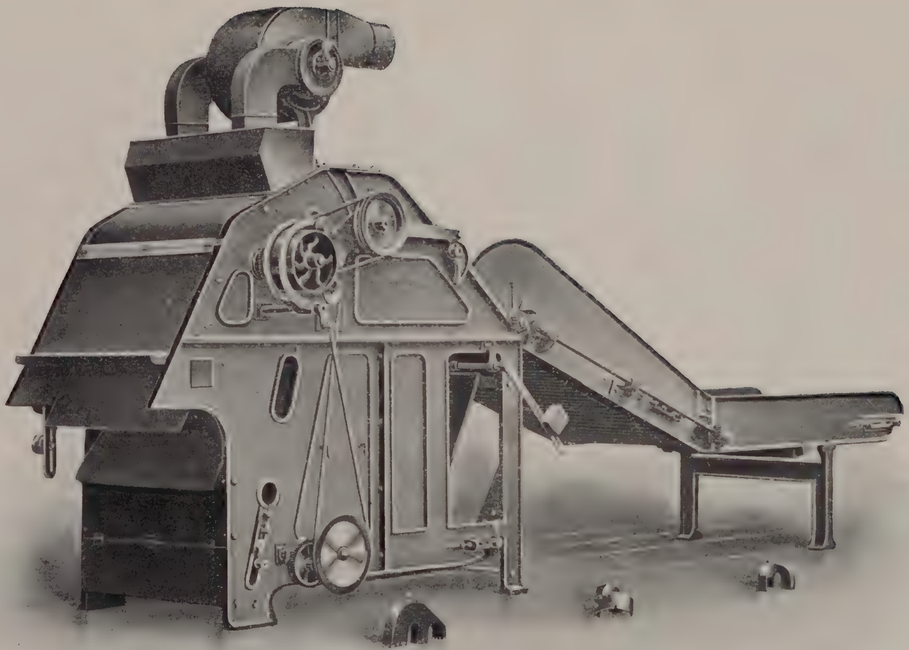
Arrangement of Blowing Room Machinery without Mixings.



Arrangement of Blowing Room Machinery with Mixings.



Arrangement of Blowing Room Machinery with Mixings.



Patent Automatic Hopper Feeding Machine, with Patent Automatic Filling Motion and Fan.

PATENT AUTOMATIC HOPPER FEEDING MACHINE,

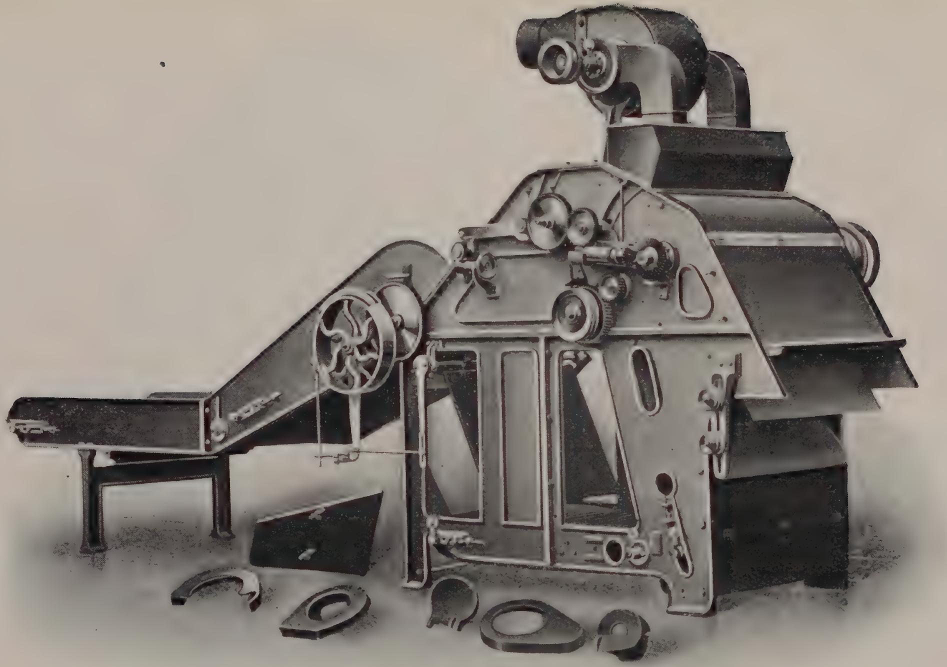
WITH PATENT AUTOMATIC FILLING MOTION AND FAN, FOR COTTON OPENERS AND SCUTCHERS.

Automatic Hopper Feeding Machines have been employed in woollen mills for many years, and have served the purposes of the users mainly from the fact that the small amount of production required from the machine allowed ample time for mechanically weighing the material. It must therefore be observed that, in introducing this principle of machine as part of a cotton mill plant, provision should be made for a large production without the aid of any weighing apparatus. This most important requirement has been amply provided for in our machine, and the difficulties arising from irregularity in feeding, consequent upon the varying height of the cotton in the hopper, most effectively overcome. The main features in this connection consist in our arrangement of the lifting lattice and combing cylinder, which ensure more regular feeding than is possible by hand, and at the same time delivering the cotton on the feed lattice of opener or scutcher well opened and free from the heavier particles of refuse. This machine can be easily attached to the lattice of openers and spreading scutchers, and where the mixings are in the room above, self-acting shoots can be provided for keeping the Hopper Feeders properly charged. Besides the arrangements shown we can adapt the Hopper Feeder, Lattices, &c., to suit the space at disposal in any room, according to circumstances. We also make a No. 2 Hopper Feeding Machine which is simpler in construction than No. 1, and is principally used for feeding Crighton Openers.

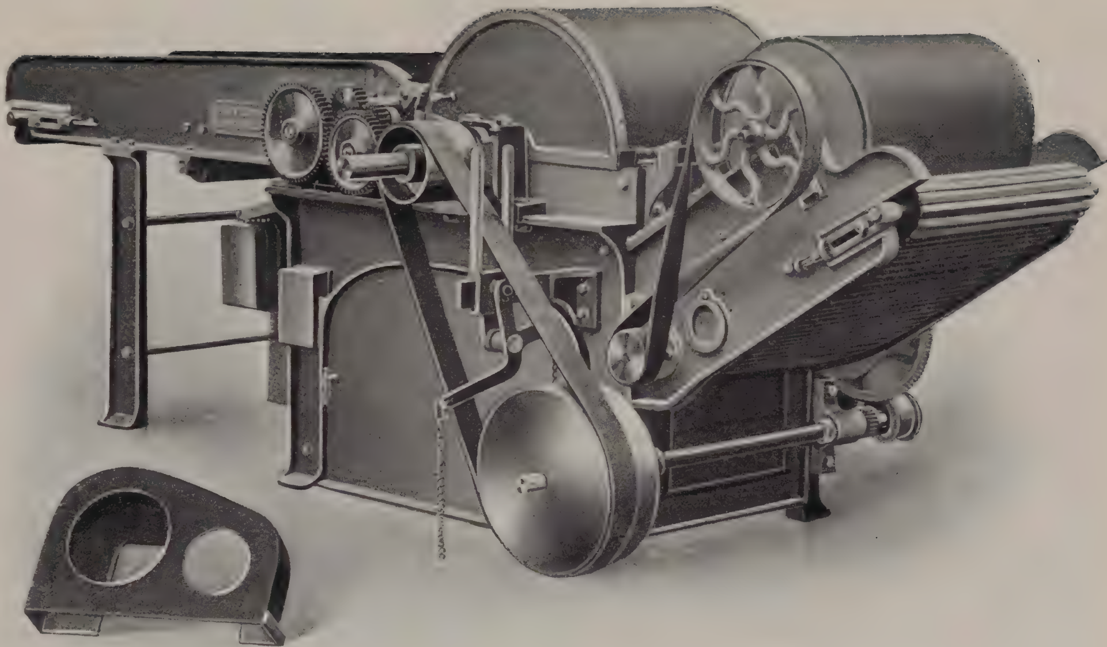
Floor space occupied (Machine 36″ wide), 7′ 3″ × 5′ 1″, without Filling Motion; if with Filling Motion, 4′ 3″ centres, and Creeper Lattice, 6′ centres, 18′ × 5′ 1″.

Driving pulleys, 10″ × 3″ × 3″. Speed about 300 revs. per minute.

Production, 30,000 lbs. per week of 50 hours.



Patent Automatic Hopper Feeding Machine, with Patent Automatic Filling Motion and Fan. Panels taken away to show Swing Door of Filling Motion.



Cotton Waste Opening Machine, for opening clean Waste from Carding Engines, Frames, &c.

COTTON WASTE OPENING MACHINE.

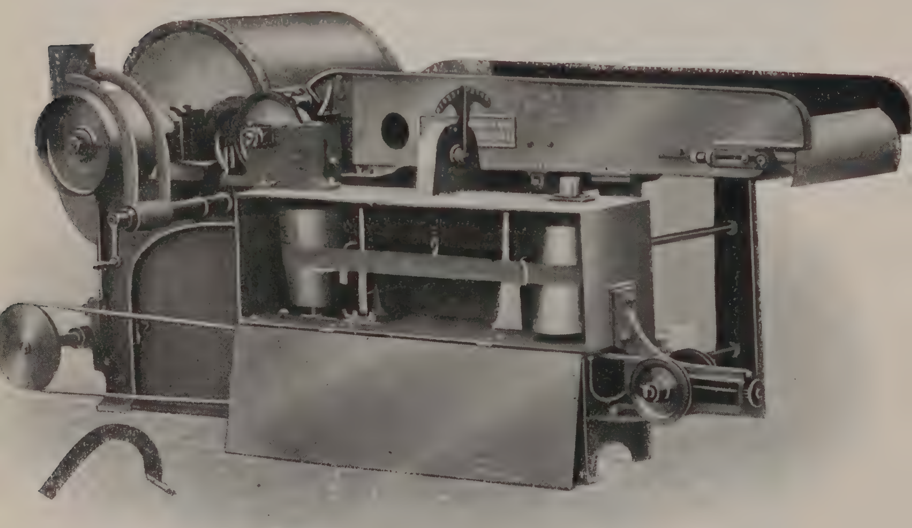
The object of this machine is to reduce the clean waste fibre from Carding Engines, Frames, &c., to an open and fleecy condition so that it can be incorporated more easily with the raw cotton.

Its action will be easily understood on reference to the illustration opposite. The waste fibre is placed on a creeper lattice and carried forward to the collecting and feed rollers. It then comes under the action of a swiftly running spiked cylinder which combs the waste fibre and delivers it on to the lattice and zinc cage in an open and fleecy condition and deposits it on to the floor or into skips ready to be mixed with the raw cotton.

Floor space occupied, 11′ 4″ × 5′ 5″.

Driving Pulleys, 12″ × 4″ × 4″. Speed about 650 revs. per minute.

Production, **70** lbs. per hour.



Cotton Waste Opening and Feeding Machine, with Regulator, to work in patent combination with Exhaust or other Opener.

Patent Improved Arrangements for Mixing worked up clean Waste from Carding Engines, Frames, &c., with Cotton passing through Exhaust or other Opening Machines.

Considerable difficulty has always been experienced in the "Mixing" and "Blowing" rooms of cotton mills in obtaining a thorough blending or incorporation of the worked up waste from the Carding Engines, Frames, &c., with the raw cotton. This difficulty has been accentuated since the introduction and use of the Hopper Bale Breaker and Hopper Feeding Machine, and especially in cases where the use of the "stacking" system has been abandoned.

In present practice two methods are generally used to mix waste with the raw cotton.

Where the old system of "mixing" or "stacking" is employed, the waste is made into laps on a Scutcher, then broken up by hand and put on the mixings to be fed into the Hopper Feeder along with the cotton.

Where there are no "mixings" or "stacks," the waste fibre is put through the Hopper Bale Breaker by the attendant, and there mixed with the mass of cotton under treatment. In this case the feeding of the waste fibre to the Hopper Bale Breaker is left entirely to the discretion of the operator, and it frequently happens that he will feed at one time considerably too much bulk of fibre to compensate for previous neglect.

In both the above cases the great drawback to success lies in the fact that the waste fibre is introduced more or less in the mass. It is found that this mass of waste fibre instead of being broken up and intimately incorporated with the main body of the raw cotton, remains isolated and unmixed, and retains this condition throughout all the process of preparing and spinning and causes defective and weak places in the yarn.

In carrying out our patent improved arrangement, the waste fibre is reduced to an open and fleecy condition and incorporated with the main body of raw cotton whilst in such a favourable condition for being intimately mixed therewith.

A reference to Figs. 1 and 2 will show that we employ as a feeding machine the Roving Waste Opener **A**, and feed the waste thereto on a creeper lattice **a**, the cylinder **b**

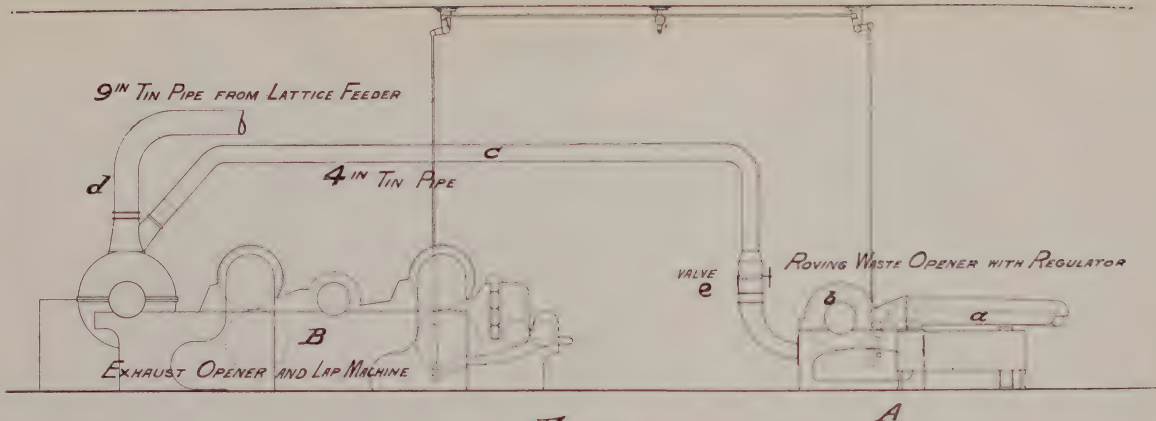

9IN TIN PIPE FROM LATTICE FEEDER
d
c
4IN TIN PIPE
VALVE
e
ROVING WASTE OPENER WITH REGULATOR
b
a
B
EXHAUST OPENER AND LAP MACHINE
A

Fig. 1

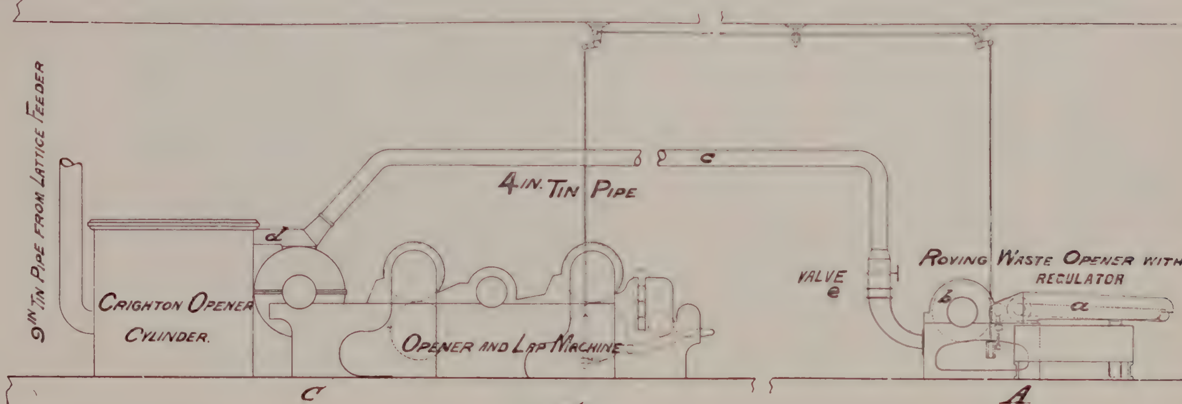

c
4IN. TIN PIPE
9IN TIN PIPE FROM LATTICE FEEDER
d
CRIGHTON OPENER
CYLINDER.
OPENER AND LAP MACHINE
VALVE
e
ROVING WASTE OPENER WITH
REGULATOR
b
a
C
A

Fig. 2

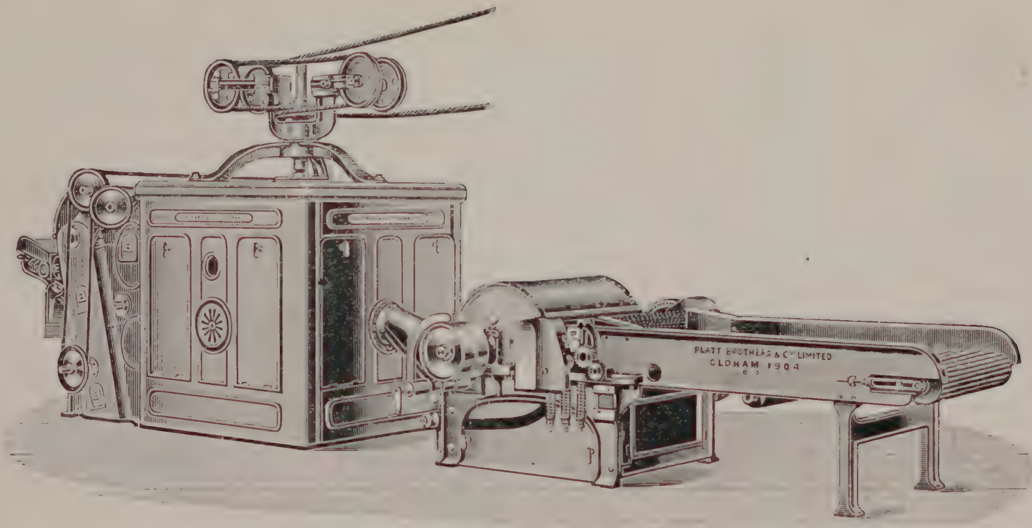
reducing the waste to a very open and fleecy condition. In conjunction with the Roving Waste Opener, there is a tube **c** connected with the exhaust tube **d** of an Exhaust Opener Lap Machine **B.** The waste in its passage is reduced to an open and fleecy condition and drawn into the Exhaust Opener **B,** and there well mixed with the main mass of raw cotton passing through the machine.

The tube **c** is provided with a stop valve **e.**

The machine **A** for feeding the waste fibre is preferably provided with a suitable stopping and starting arrangement, and is connected with the Opener **B** and Lattice Feeder, so as to start and stop the two machines simultaneously; it is also provided with a Regulator so as to ensure a regular feed.

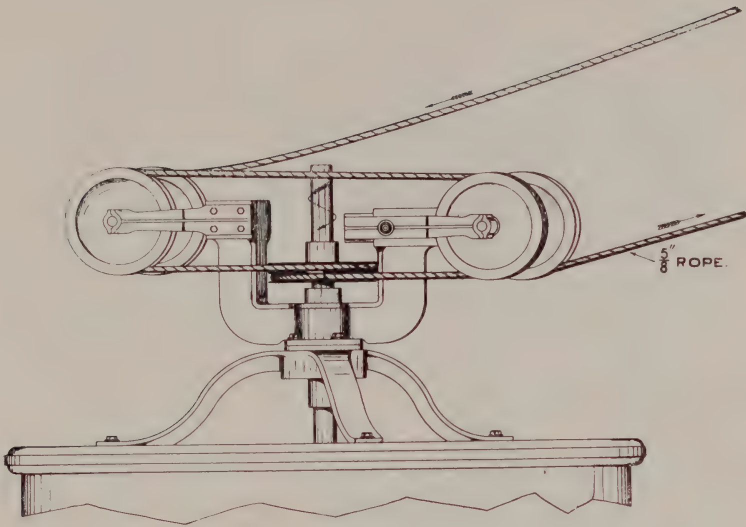
The feed pipe **c** of the Roving Waste Opener may be connected to the exhaust pipe **d** of the Lap Opener at any part of the circuit. Any form of Opener suitable for feeding the waste fibre may be used in lieu of the Waste Opener, and any type of Opener may be employed in lieu of the Exhaust Opener, for instance, a Combined Crighton Opener and Lap Machine, as shown in Fig. 2, the Roving Waste Opener being marked **A,** and the Crighton Opener Lap Machine **C.**

By the above arrangement it will be seen that the waste which is already clean is not passed through the preliminary Machines, thus avoiding damage to the staple, and much loss of clean fibre; the Machine may be placed in either Mixing or Blowing Room.



Crighton Opener with Improved Lattice Feeding Machine 36in. wide, 6ft. centres of creeper, 2 pairs of feed rollers, and disc cylinder 24 in. diar. Feeder driven by strap, and vertical cylinder in opener by rope from countershaft. Fan for down draft, driven by rope from vertical cylinder. The opener can be made to order with or without the feeding machine, and the feeding may be arranged at back or on either side. The cylinder part only of this machine is now extensively used in patent combination with our exhaust opener and lap machine. See pages 76 and 77.

We also make the Lattice Feeding Machine 22″ wide, with disc cylinder 15″ diar.



BALANCED ROPE DRIVING.

The above illustration shows method of driving the cylinder in Crighton Opener, by means of balanced rope driving.

This system is now preferred to the old method of driving by strap, as the pull on the cylinder shaft is equally divided, whereas by the old system it is all on one side.

The balanced rope driving also affords greater facility for the placement of the opener, as its situation is not necessarily governed by the position of the driving shaft, as in the case of strap driving, which system is now obsolete.

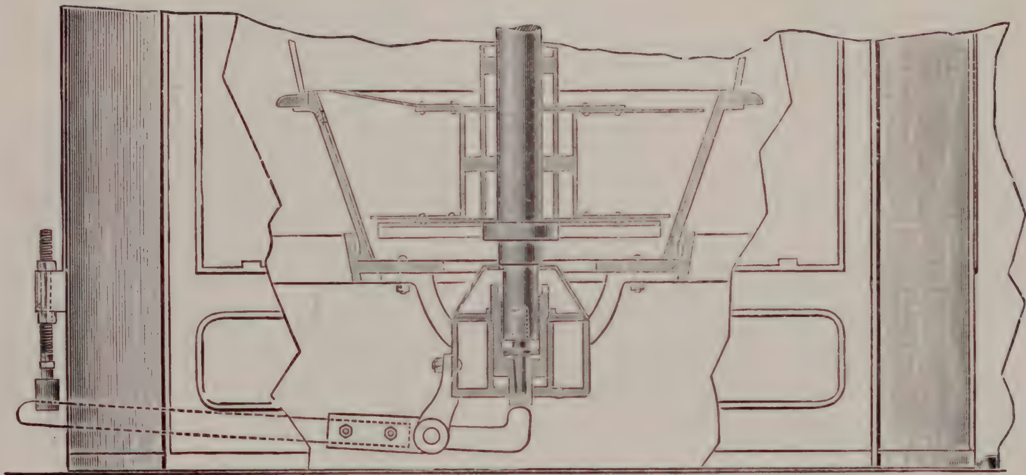
Floor space occupied, $22'\ 10'' \times 7'\ 2\frac{1}{2}''$.

Driving pulleys on Feeding Machine, $12'' \times 4'' \times 4''$. Speed about 900 revs. per minute.

Driving pulley on cylinder of opener, $12''$ diar., grooves for $\frac{5}{8}''$ rope. Speed about 1,100 revs. per minute.

When working in combination with Exhaust Opener, speed about 550 revs. per minute.

Production, 40,000 lbs. per week of 50 hours.

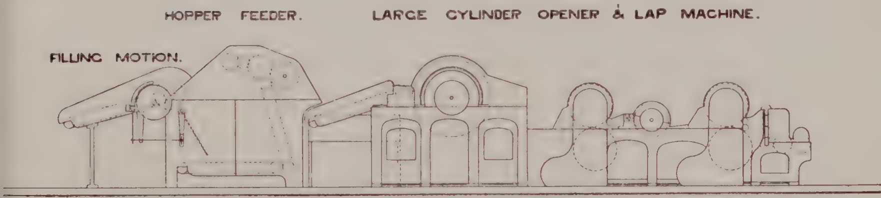


Apparatus for regulating the distance between the cylinder and grid according to the class of cotton used.

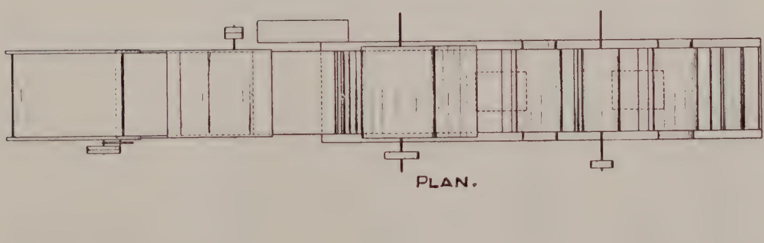
This apparatus has been arranged to dispense with the variation of speeds required in dealing with the different classes of cotton. The cylinder being conical, the action of raising increases the space between it and the cleaning bars, this being equivalent to a diminution in the speed of the cylinder when a better class of cotton is being passed through.

Large Cylinder Opener and Lap Machine with Patent Automatic Hopper Feeder and Filling Motion attached.

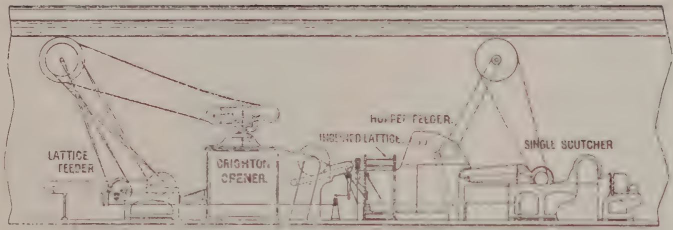
This machine is well adapted for opening, cleaning, and forming into good even laps, the better qualities of American and Egyptian cottons, and is especially suitable for small plants where the production does not exceed say 18,000 lbs. per week of 50 working hours, the laps from this machine then being passed through a Finisher Scutcher.

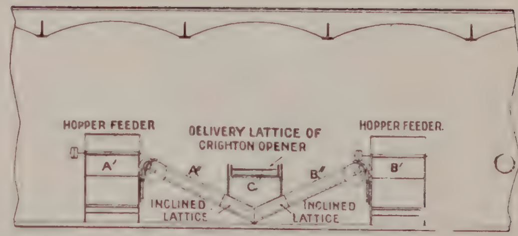


ELEVATION.

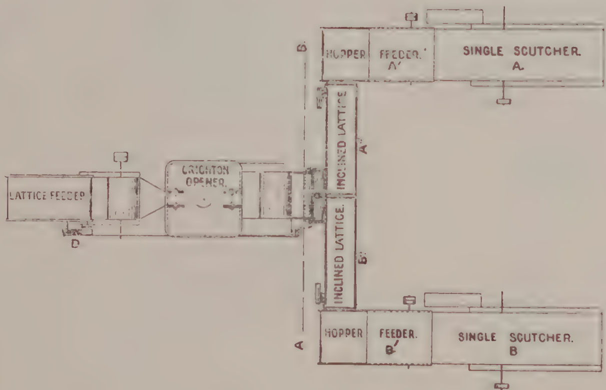


PLAN.





SECTION ON LINE A B



Arrangement showing 2 Scutchers fed automatically by Patent Automatic Hopper Feeding Machine and a special combination of Crighton Opener and Filling Motion.

Arrangement showing 2 Scutchers fed automatically by Patent Automatic Hopper Feeding Machine and a special combination of Crighton Opener and Filling Motion.

This combination is particularly suited for working American cotton, and is so arranged that cotton may be passed through both Scutchers at one and the same time. If, however, the Scutcher A be stopped say when at the completion of a lap, the spiked lattice of the Hopper A^1 will also stop, and the supply of cotton from the Hopper Feeder to the Scutcher A will cease. The supply of cotton from the Filling Motion A^{11} will, however, continue until the weight of cotton upon the swing door in the Hopper causes it to fall downwards, and by an arrangement of levers and strap guide, move the strap driving the Filling Motion on to the loose pulley, thus stopping the Filling Motion lattice A^{11} and the supply of cotton to the Hopper Feeder A^1.

When the Scutcher A restarts, the spiked lattice of the Hopper Feeder A^1 also starts automatically, and the supply of cotton to the Scutcher A continues, the weight of material in the Hopper is thus reduced and the swing door released, setting in motion again the lattice of Filling Motion A^{11}, whereby a fresh supply of cotton is conveyed to the Hopper Feeder A^1.

The above remarks also apply to the Scutcher B, Hopper Feeder B^1, and the Filling Motion B^{11}.

Further, when there is sufficient cotton in the receptacle or box formed by the two inclined lattices A^{11} and B^{11}, the weight of the cotton presses the swing door at C downwards, and the door being connected with the fast and loose pulley at D by rods and levers, moves the driving strap on to the loose pulley, thus stopping the feed lattice of the Lattice Feeder, and discontinuing the supply of cotton to the Crighton Opener; when, however, more cotton is required, the swing door C is released, and the strap is moved on to the fast pulley and the feed lattices set in motion again.

The production of this combination would be about 28,000 lbs. in a week of 50 working hours.

The laps from the Scutchers are then taken to the Finisher Scutchers as usual.

Arrangements of Dust Chamber, Chimney, or Ventilating Tower, for Opening or Blowing Machinery.

This is a subject that receives too little attention compared with its importance in connection with cotton spinning, and a few remarks on the matter will perhaps not be out of place.

We give illustrations of four systems, but the adoption of any one will depend upon the local conditions of the ground on which the mill is built:—

Fig. 1.—Shows the blowing room with cellar underneath the entire area, into which the fans of the exhaust opener and scutcher will blow. This is the best arrangement under which it is possible to work. The depth of the cellar may be anywhere from 6 to 10 feet under the beam, and each fan or mouthpiece should point towards the outlet or chimney, and be provided with a light tin door to prevent back-draught when the machine is not working. In connection with the cellar, there should be a dust chimney or ventilating tower extending somewhat above the highest point of the building, to allow of the free escape of air, the heavier particles of dust settling in the cellar, to be periodically cleared away.

This chimney should have a clear outlet, with an area equivalent to not less than 10 square feet for each fan, and the opening from the dust cellar to the dust chimney should be of a similar area. It may be remarked that the above figures give the best results, anything less than these necessitate excessive fan speeds, which cause the licking of laps, and the fibres of cotton to be covered with dust.

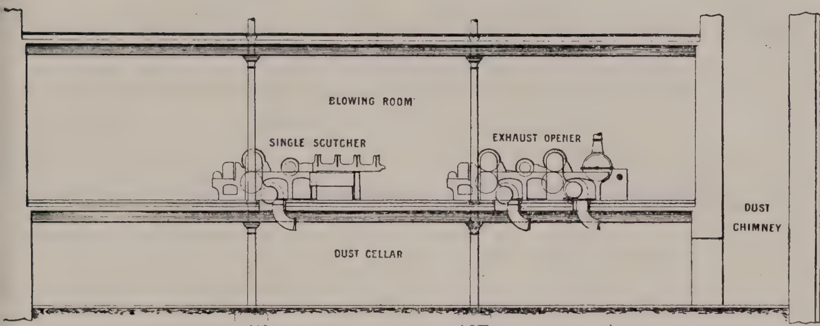
Fig. 2 shows a similar arrangement to Fig. 1, but with a portion only of the cellar used as a dust chamber, into which some of the fans blow direct, whilst others are connected by tin pipes 9″ diar., the mouthpieces of which should point towards the opening into the chimney.

Fig. 3.—Where conditions do not allow the whole of the blowing room to be cellared, then under each lot of openers and scutchers it is customary to have flues of suitable dimensions, say 4′ 6″ deep, by 2′ 6″ wide, leading into a dust chamber, so that a man may enter to remove the accumulation of "fanny" or droppings from time to time.

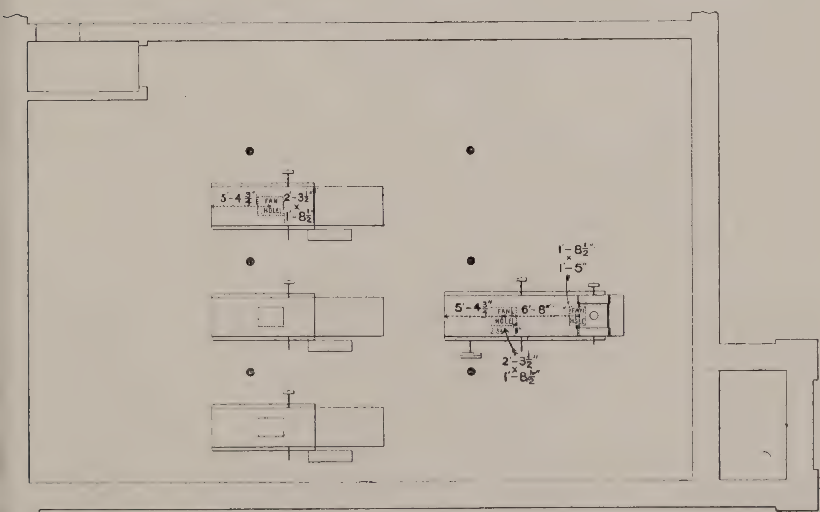
Fig 4 shows a similar arrangement to No. 3, but without dust chamber, the whole of the flues leading directly up to the opening in the dust chimney.

Dust Arrangement for Opening or Blowing Machinery.

Fig. 1.



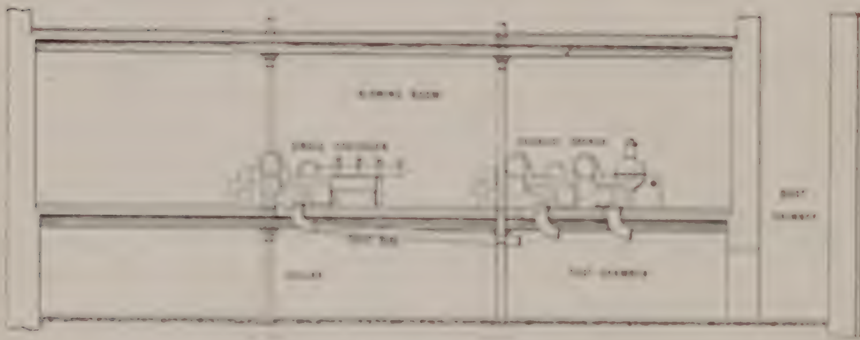
ELEVATION.



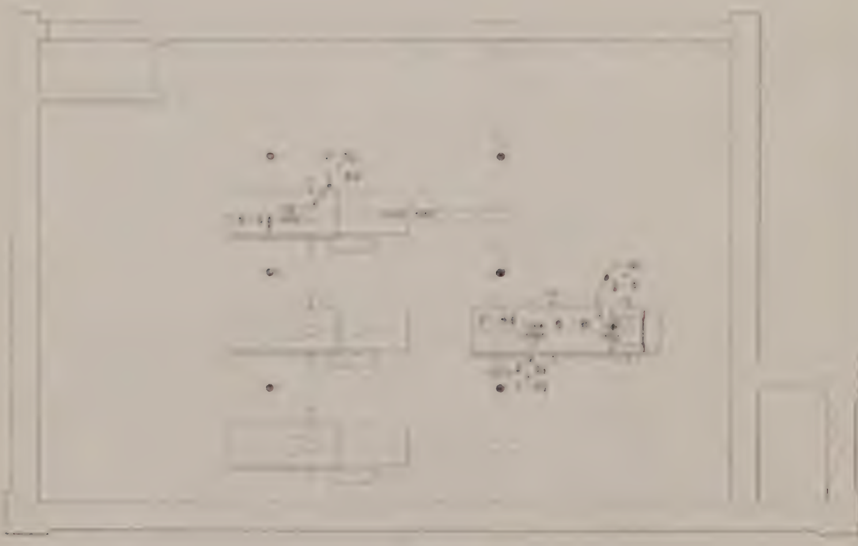
PLAN.

Dust Arrangement for Opening or Blowing Machinery.

FIG. 2.



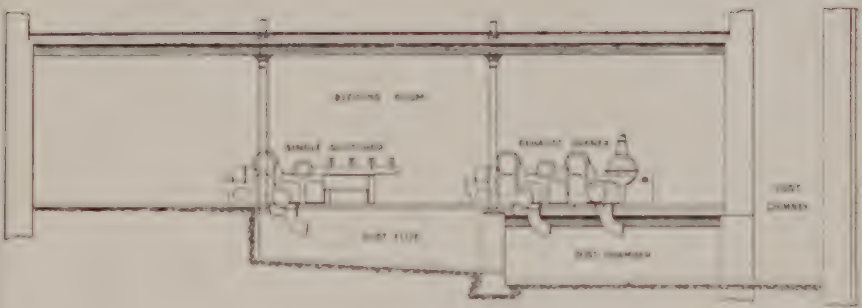
ELEVATION.



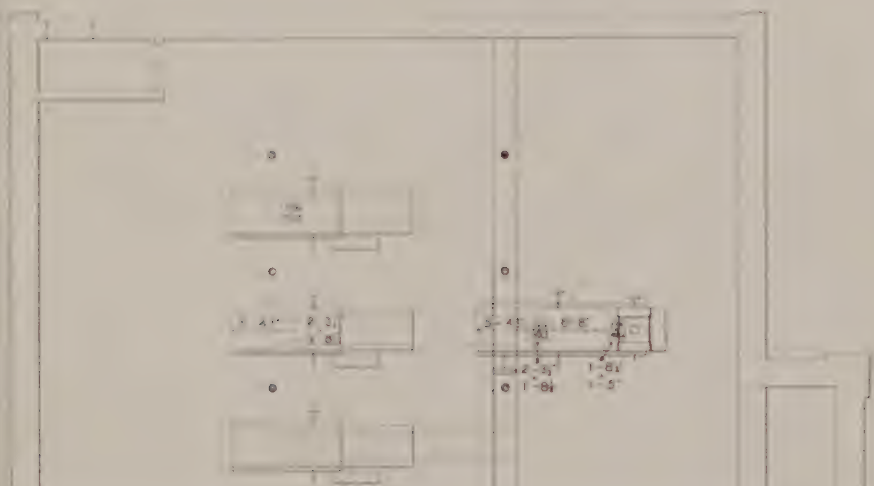
PLAN.

Dust Arrangement for Opening or Blowing Machinery.

FIG. 3.



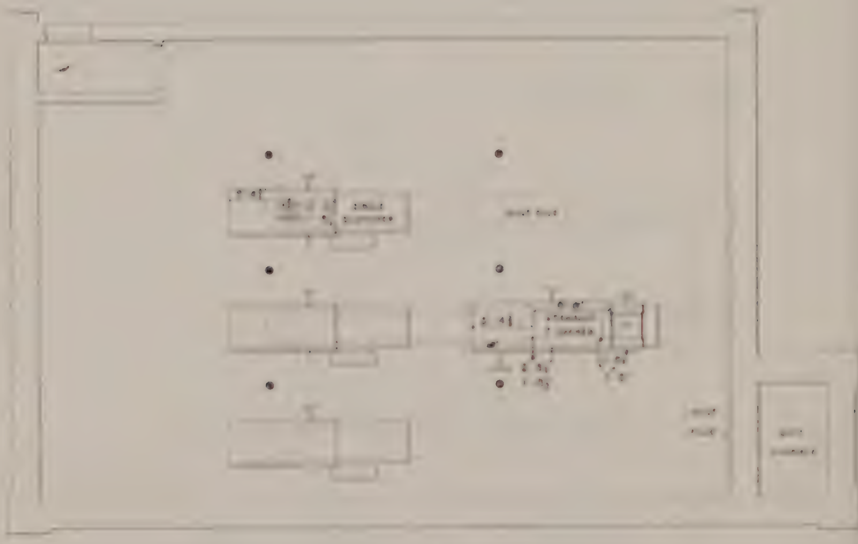
ELEVATION.



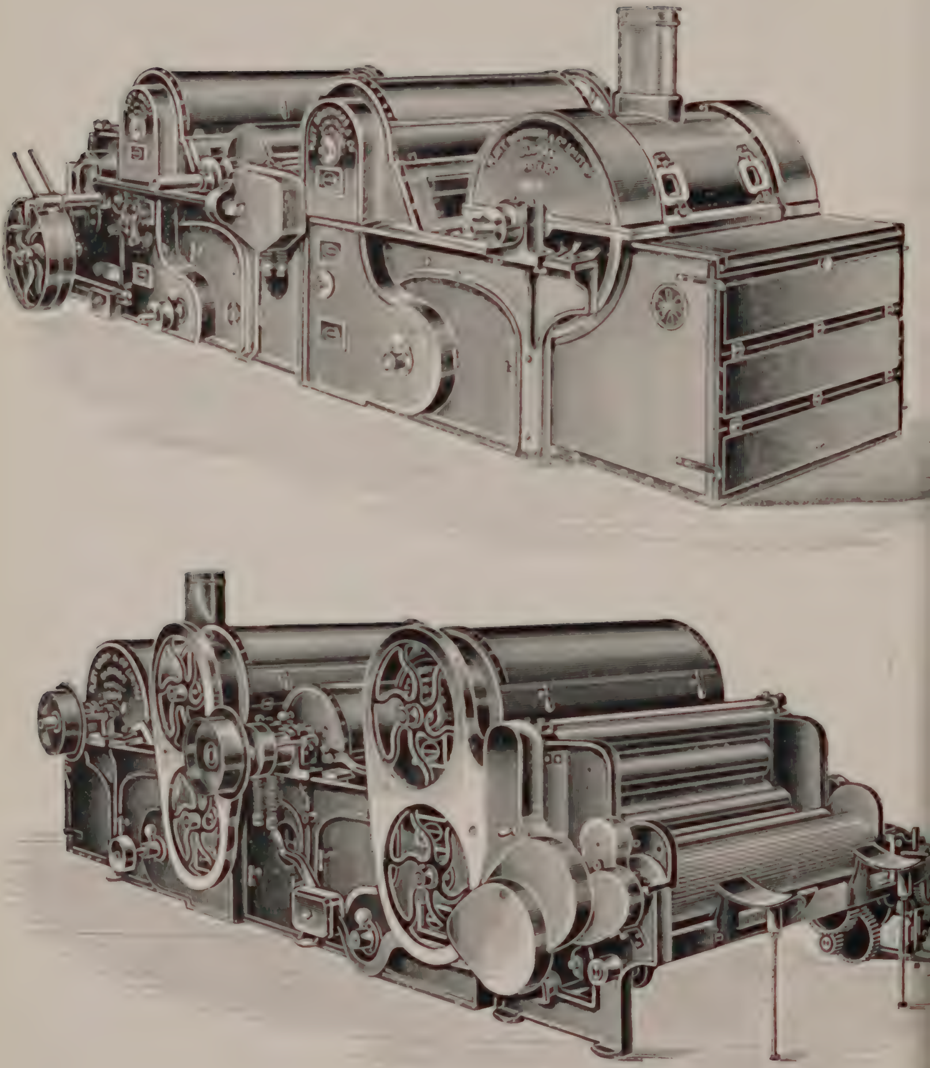
PLAN.

Dust Arrangement for Opening or Blowing Machinery.

Fig. 4.



PLAN



Patent Exhaust Opener and Lap Machine, with Improved Beater Bars and Dust Box.

PATENT
EXHAUST OPENER AND LAP MACHINE,
WITH IMPROVED BEATER BARS AND DUST BOX.

By the adoption of the above machine with its Feeder and Patent Dust Trunk (powerful aids in cleaning) 30,000 lbs. of cotton can be worked into well formed laps in 50 hours.

The working operations of this machine and its accessories may be explained as follows:—

The cotton is served from the mixings and spread on the Creeper Lattice which can be made of any convenient length (see Plan and Section of Blowing Room Machinery with Mixings, Pages 78 and 79) and afterwards passes through the Hopper Feeding Machine, which spreads it evenly upon the lattice of the Lattice Feeder, the cotton passing to the collecting roller, regulating roller and pedals, two pairs of feed or breaker rollers, and cylinder 24 in. diameter (having 27 cleaning bars fixed underneath). From this cylinder the cotton is drawn by the action of the exhaust fans across the Patent Dust Trunk, where a travelling ribbed cloth or grid—moving in the opposite direction to the cotton—is provided for depositing the refuse automatically into a bag at each end, thus rendering it unnecessary to stop the Opener for cleaning the Trunk. The cotton then passes from this Trunk to the Exhaust Opener, when it is again operated on by the cylinder of the Exhaust Opener, 34 in. diameter (having 24 bars fixed under, as a further addition to the cleaning power already exerted). After that, the cotton is thrown off equally on to the dust cages by the action of our patent exhaust fans, and is then presented in a level condition to the beater, being afterwards formed into a sound, level, and regular lap, without the use of dampers in the cages. We also show an arrangement which dispenses with the usual Mixings or Stacks, the cotton being taken from the bale, placed in the hopper of the Hopper Bale Breaker, and carried forward direct to the Hopper Feeding Machine (see Plan and Section of Blowing Room Machinery without Mixings, Pages 76 and 77).

It should be observed that, at the commencement of each lap, the rollers at the Feeder are started a short time before the lap part of the Opener, and at the finish the Feeder stops the same length of time before the lap part; by this means the Trunk and Pipes are freed from cotton when the lap part stops, thus the irregularity caused by the cotton falling in the Trunk is obviated. The connection between Feeder and Opener is automatic in its action and requires no attention. The Feeder need not be in the room over the Blowing Room, but may be on the same level or in the room below, as may be most convenient.

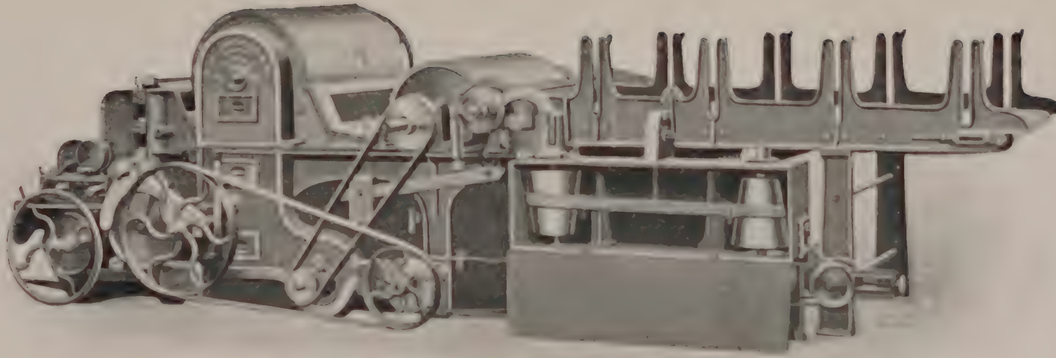
By the adoption of our system, consisting of Hopper Bale Breaker or Improved Cotton Pulling Machine, Hopper Feeding Machine, Lattice Feeder (which can be arranged in a variety of ways according to circumstances), Crighton Opener Cylinder part, Exhaust Opener with Lap Machine, and Single Scutchers, cotton may be made into finished laps at a considerable reduction in labour as compared with the system formerly in vogue.

Floor space occupied (if to be followed by Scutchers making 45″ laps for 45″ cards), 16′ 3″ × 7′ 10″.

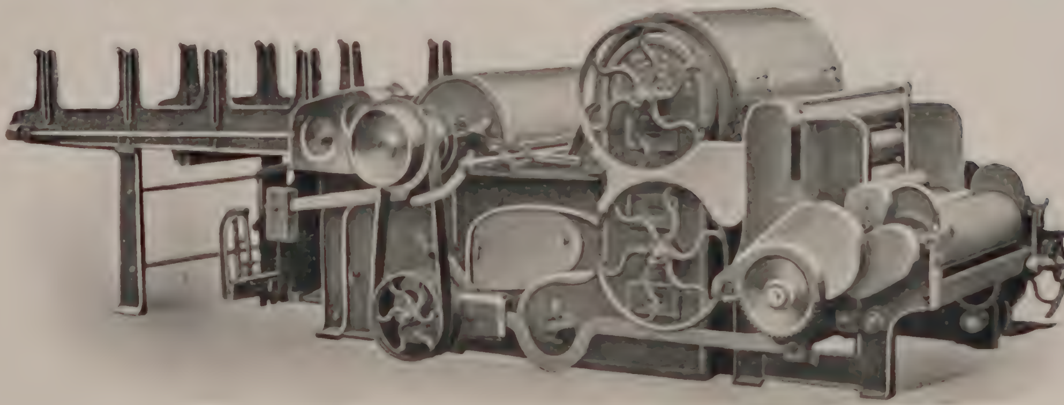
Speed of machine depending on quality and quantity of cotton to be dealt with, and other circumstances, say

Driving pulley on beater, 12″ × 4″. 1,050 revs. per minute.

Driving pulley on cylinder, 13″ × 4″. 970 revs. per minute for ordinary American Cotton.



Single Scutcher and Lap Machine.



Single Scutcher and Lap Machine.

SINGLE SCUTCHER AND LAP MACHINE,

WITH FEED REGULATOR AND IMPROVED PIANO PEDAL ARRANGEMENT.

The simplicity in the construction, and the results obtained from this machine for some time past, left little to be desired, but by the addition of improved bars under the beater, and a dust box with loose bars between beater and cages (fig. 1), an improvement in the cleaning—more especially in the greater amount of leaf extracted—has been obtained.

The results are so satisfactory that we desire it to be known that the improvements can, at a small cost, be easily applied to old machines with equally good results.

The machine is shown with pedal feed regulators attached, which are simple in action, and need little attention; and by the enlargement of the cones, special rope driving, and simplicity in the connection between the pedals and cone strap, the regulating of the feed is all that can be desired.

The arrangement of pedals (fig. 2) is used for long staple cotton both for Scutchers with spreading feeders and those with feeders for doubling laps. By this system the advantage of the use of pedals is obtained for regulating, at the same time retaining the rollers for the beater to strike off.

The arrangement of pedals (fig. 3) is used for medium staple cottons when same has to be spread on the feed lattice of Breaker Scutchers or Openers.

The arrangement of Pedals (fig. 4) is used for low short staple cotton, both for Scutchers with spreading feeders and those with feeders for doubling laps.

This feed regulator can be attached to any make of Opener or Scutcher.

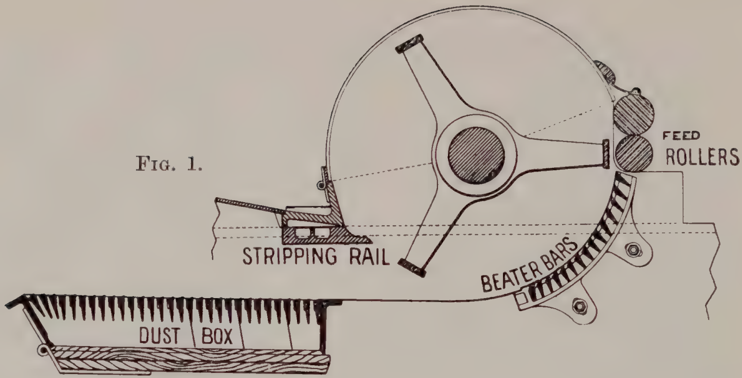
Floor space occupied (if 46″ wide for 45″ laps), 15′ 7″ × 7′ 4″.

Speed according to class of cotton and other circumstances.

Driving pulley on beater, 12″ × 4″. Say 1,080 revs. per minute for average American Cotton.

Production, 12,000 to 15,000 lbs. and upwards of cleaned cotton per week of 50 hours, depending upon quality of work required.

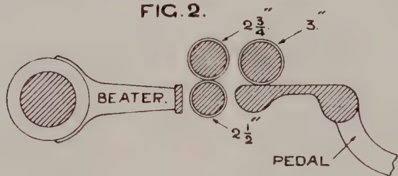
Fig. 1.



Arrangement showing Improved Bars under Beater and Dust Box, with Loose Bars between Beater and Cages. Patent Improved Stripping Rail.

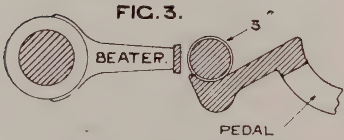
3 ROLLER ARRANGEMENT

FIG. 2.



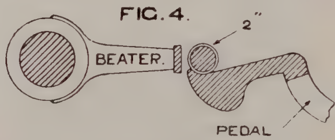
SINGLE 3" ROLLER

FIG. 3.



SINGLE 2" ROLLER

FIG. 4.



It is important that the bars under the beater should be so adjusted as to allow the maximum amount of leaf and dust, and the minimum amount of good cotton, to be thrown out. The bars are numbered 1 to 15, and care should be taken to place them consecutively, the lowest number being at the bottom.

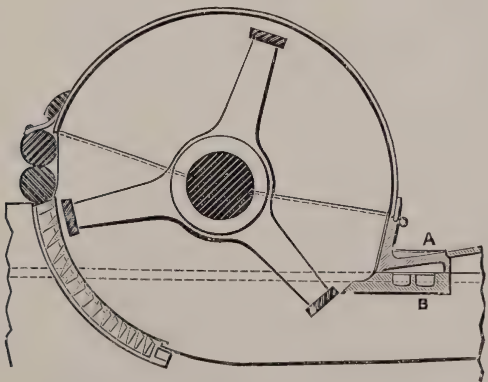
The bars can be adjusted to suit different varieties of cotton, by means of the screws on the end of each bar, and, as will be seen from the illustration, the openings should be narrowest at the bottom, gradually widening as they near the feed rollers, the long face of each bar being uppermost.

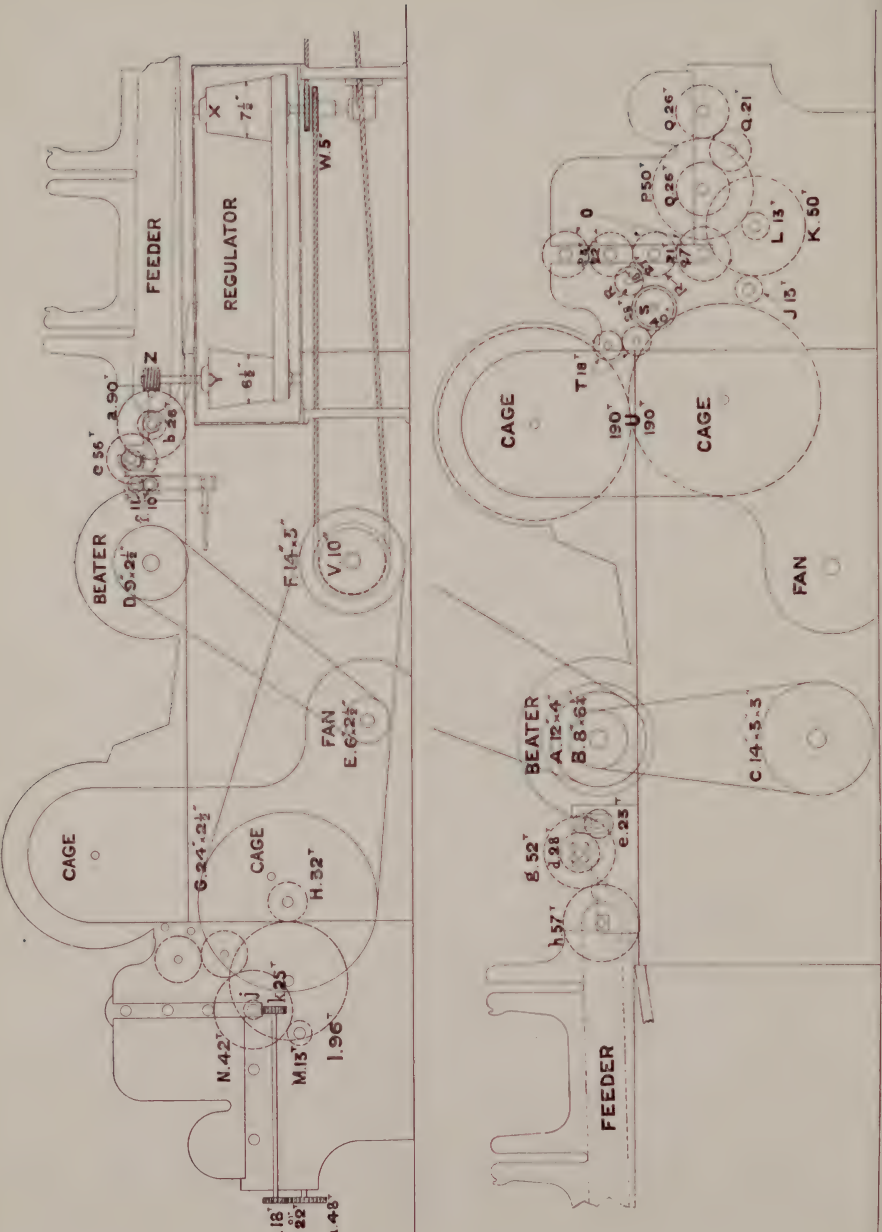
PATENT IMPROVED STRIPPING RAIL FOR OPENERS AND SCUTCHERS.

The construction of these machines has long been deficient in facilities for adjusting the beater and stripping rail otherwise than by moving the whole of the feed part of the machine. This has been a serious inconvenience and the cause of much inferior work, in consequence of the beater carrying the cotton round, thereby producing neps in the lap. The need for an effective and simple method of making this adjustment accurately and expeditiously has long been observed as necessary to satisfactory working conditions, which can only be obtained by the stripping rail and beater being set just so close as to allow the beater to pass the rail. Our "Patent Improved Stripping Rail," as illustrated (Fig. 1), meets all the requirements perfectly, the part **B** being separate from the part **A,** and fixed to the beater pedestal, which allows the stripping rail to be kept at the required distance from the beater by means of screws which can readily be adjusted to meet the wearing of the beater blades.

When the stripping rail is correctly set to the beater, the two can be moved simultaneously and set to or from the feed rollers at such distances as may be desired.

Fig. 1.




FEEDER
REGULATOR
X
Y
Z
W.5ᵀ
BEATER
D.9"×2½"
F.14"×3"
V.10"
FAN
E.6"×2½"
CAGE
CAGE
G.24"×2½"
H.32ᵀ
N.42ᵀ
k.25ᵀ
M.13ᵀ
CAGE
CAGE
T18ᵀ
U
190ᵀ
190ᵀ
FAN
BEATER
A.12"×4"
B.8"×6¼"
C.14"×3"×3
g.52ᵀ
e.25ᵀ
h.57ᵀ
FEEDER
P.50ᵀ
Q.26ᵀ
Q.21ᵀ
L.13ᵀ
K.50ᵀ
J 13ᵀ
R
S
O

Alphabetical References to Diagrams of Single Scutcher and Lap Machine.

A Beater driving pulley 12″ diar., 4″ wide.
B Pulley on beater for driving cross shaft 8″ diar., $6\frac{1}{4}$″ wide.
C Pulleys on cross shaft 14″ diar., 3″ wide, fast and loose.
D Pulley on beater shaft for driving fan 9″ diar., $2\frac{1}{2}$″ wide.
E Pulley on fan 6″ diar., $2\frac{1}{2}$″ wide.
F Pulley on cross shaft for driving slow motion 14″ diar., 3″ wide.
G Slow motion pulley 24″ diar., $2\frac{1}{2}$″ wide.
H Pinion on slow motion stud, 32T.
I Wheel on slow motion shaft, 96T.
J Pinion on slow motion shaft, 13T.
K Large wheel on drop shaft, 50T.
L Pinion on drop shaft driving 9″ fluted lap rollers, 13T.
M Flange or disengaging pinion on drop shaft, 13T.
N Calender wheel on bottom roller, 42T.
O Calender roller coupling wheels, bottom calender, 7″ diar., 27T.
1st, $5\frac{1}{2}$″ calender, 21T. 2nd, $5\frac{1}{2}$″ calender, 22T.
3rd, $5\frac{1}{2}$″ calender, 23T.
P Large wheel on 9″ fluted lap roller, 50T.
Q Coupling wheels for 9″ fluted lap rollers, 26T, carrier 21T.
R Wheel for driving cage and cage rollers, 27T, carrier 18T.
S Compound carrier for driving cages and cage rollers, 40T,–28T.
T Cage roller wheels, 18T, cage rollers $3\frac{1}{4}$″ diar.
U Cage wheels, 190T.
V Band pulley on cross shaft for driving regulator 10″ diar.
W Double grooved band pulley on driving cone 5″ diar.
X Driving cone $7\frac{1}{2}$″ diar. at centre.
Y Driven cone $6\frac{1}{2}$″ diar. at centre.
Z Single worm on driven cone.
a Worm wheel on stud, 90T.
b Pinion on worm wheel stud, 28T.
c Wheel on catch box, 56T, regulating roller 3″ diar.
d Wheel on regulating roller for driving feed rollers, 28T.
e Wheel on bottom feed roller, 23T, bottom feed roller $2\frac{1}{2}$″ diar.
top feed roller, $2\frac{3}{4}$″ diar.
f Feed roller coupling wheels, 10T and 11T.
g Wheel on regulating roller for driving lattice, 52T.
h Wheel on lattice shaft, 57T.
j Single worm on bottom calender driving knocking-off motion.
k Worm wheel on knocking-off motion shaft, 25T.
l Knocking-off change pinion, 18T to 22T.
m Snug or knocking-off wheel, 48T.

CALCULATIONS.

TO FIND DRAFT OF A SCUTCHER.

Rule :—

$$\frac{\text{Surface speed of } 9'' \text{ Fluted Lap Roller}}{\text{Surface speed of Regulating Roller}} = \text{Draft.}$$

Viz. :—

$$\frac{\text{Diar. of Fluted Lap Roller} \times c \times a \times Y \times W \times F \times H \times J \times L}{\text{Diar. of Regulating Roller} \times b \times Z \times X \times V \times G \times I \times K \times P} = \text{Draft.}$$

TO FIND THE PINION REQUIRED TO KNOCK OFF AT A GIVEN LENGTH OF LAP.

$$\frac{m \times k \times N \times L \times \text{Circum. of Fluted Lap Roller in inches}}{\text{Length of Lap in yards} \times j \times M \times P \times 36''} = \text{Number of Teeth required in Pinion l.}$$

TO FIND CONSTANT NUMBER FOR DITTO.

$$\frac{m \times k \times N \times L \times \text{Circum. of Fluted Lap Roller in inches}}{j \times M \times P \times 36''} = \text{Constant Number.}$$

$$\frac{\text{Constant Number}}{\text{Length of Lap in yards}} = \text{Number of Teeth in Change Pinion l.}$$

$$\frac{\text{Constant Number}}{\text{Number of Teeth in Change Pinion l}} = \text{Length of Lap in yards.}$$

TO FIND PERCENTAGE OF WASTE MADE.

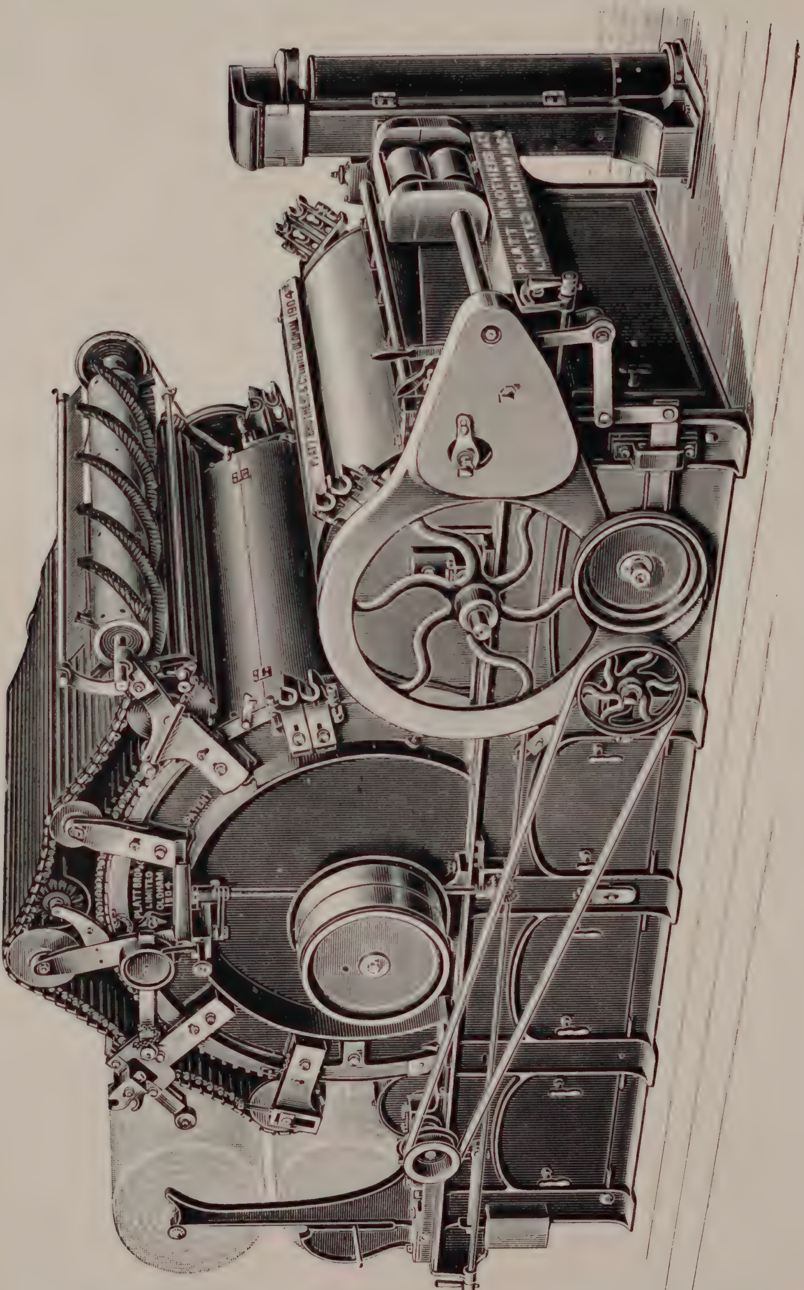
$$\frac{\text{Loss in weight} \times 100}{\text{Weight of cotton put up at feed end}} = \text{Percentage of Waste made.}$$

TO FIND DECIMAL HANK OF LAP.

Divide the weight, in ounces, of any number of yards of finished Lap into the dividend for that length, and the quotient will be the Decimal Hank of Lap.

The following are the dividends, in ounces, for the number of yards stated :—

Yards.		Dividend.	Yards.		Dividend.
1	......	·019047	4	......	·076188
2	......	·038094	5	......	·095235
3	......	·057141	6	......	·114282



Patent Iron Revolving Flat Carding Engine.

PATENT IRON REVOLVING FLAT CARDING ENGINE,

WITH PATENT GRINDING APPARATUS AND PATENT PERFORATED OR SLOTTED FLEXIBLE BENDS ATTACHED.

The principal feature in all Carding Engines of this construction is the position of the fixed bends; these hitherto have been placed as close as practicable to the cylinder edges, the intervening space being filled up with linings or flanges made of wood or iron, or both. None of these methods however have had the desired effect of preventing the long standing evil known as "**side waste**;" this we can now claim to have successfully accomplished by an ingenious contrivance which enables us to place the fixed bends under the ends or inside the cylinder, thus bringing the flexible bends or flat course to the position formerly occupied by the wood linings in our old construction.

The change will be understood by reference to the two following sections, on which all the retained parts are indicated by corresponding letters; thus the changed position of the fixed bends with all that they carry will be apparent.

These new features will naturally lead the observer to associate other and important changes which he finds in a shortened flat, the cylinder ends perfectly enclosed, resulting in improved selvedges and the entire disappearance of "**side waste.**"

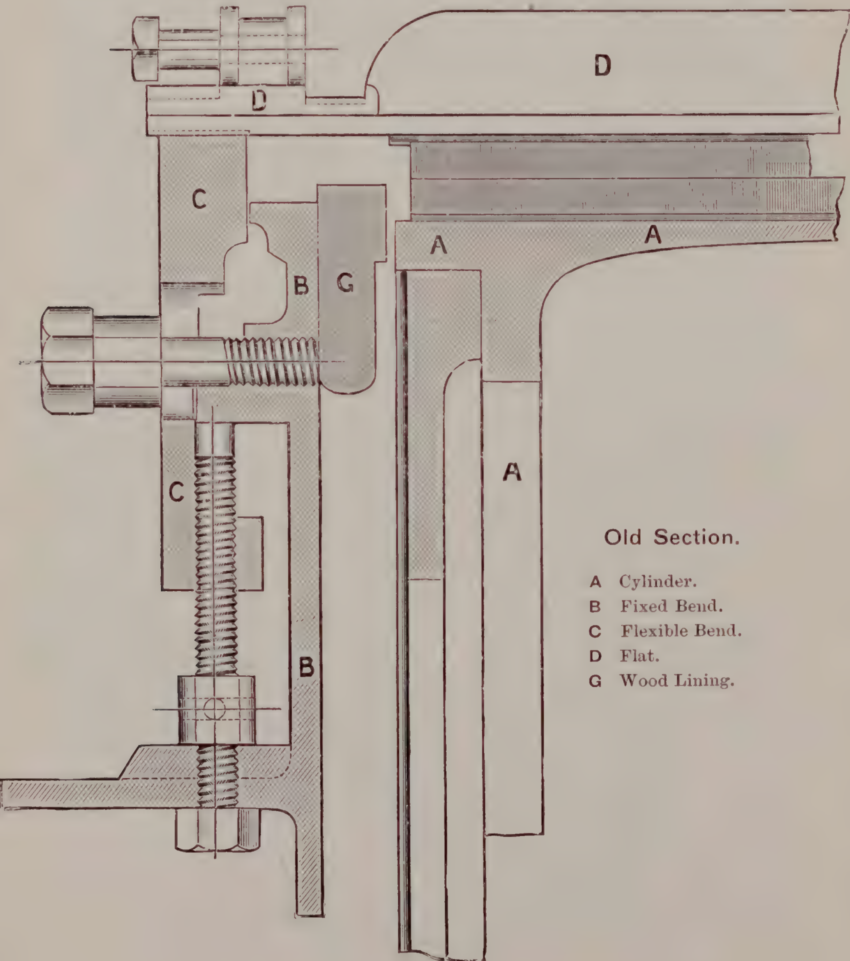
In order that it may be more clearly seen how we have arrived at these long desired results, we direct attention again to the two sections before named, in which it will be noticed that in the old section the fixed bend **(B)** fulfils the dual function of carrying the flexible bend **(C)** brackets, &c., on the outside, and a wood lining inside, to fill up the space between the bend and cylinder, and it may be said here that this method was up to the present time the only alternative for preventing the "**side waste**;" and it could not be said, until this card was introduced, that this defect had been overcome.

The cause of this defect lay undoubtedly in the large and exposed surface of the fixed bends to the action of the cylinder, the current of air created by each revolution became the disturbing influence by reason of being pent up between the bend and the cylinder, thus leading to a condition which cannot be better described than as a whirlwind.

This action is constantly abstracting cotton from the ends of the flats, and especially in modern cards in which full width laps are used, and indeed in all Carding Engines that have been made up to the present time. The evil has been largely increased since the introduction of heavy weights and large productions, for the higher the cylinder speed the stronger is the current of air created and the larger the quantity of side accumulation made.

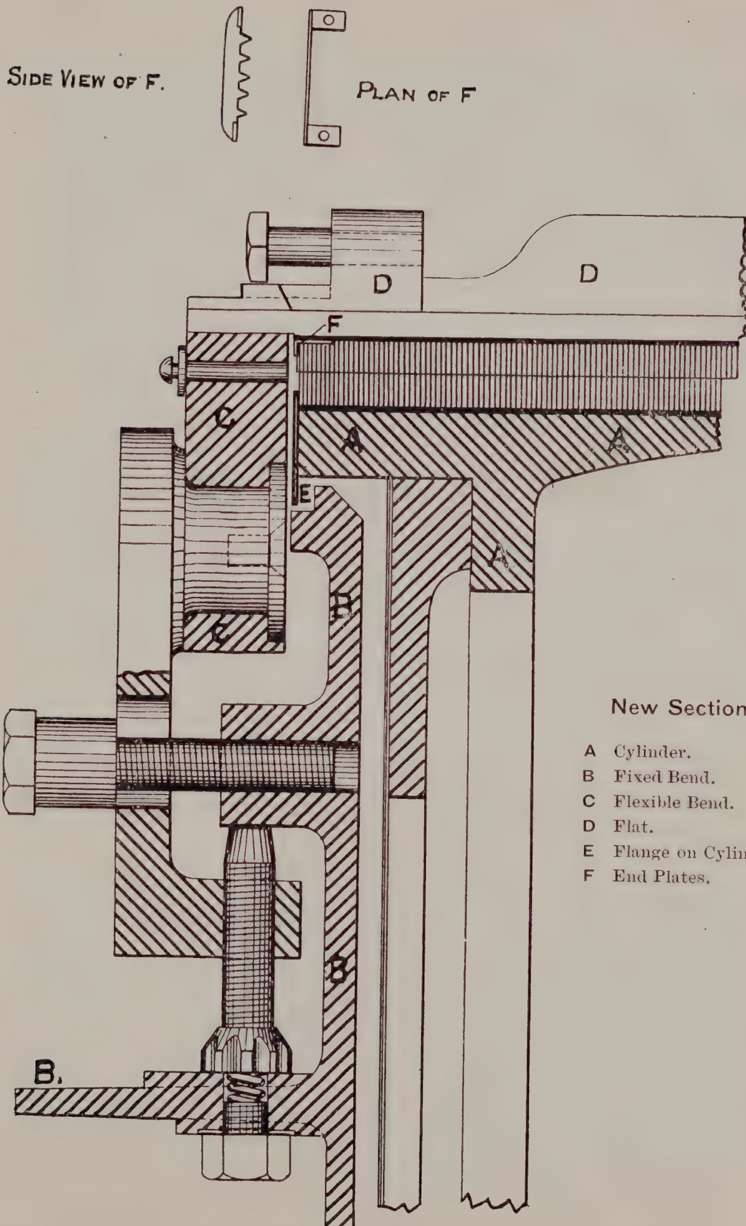
Again, a glance at the new section shows at once the converse of the action just described. The fixed bend **B** is inside the cylinder, consequently the current of air made between it and the cylinder cannot escape so as to abstract any cotton from the flats, this being prevented by the flange **E.**

The flange **E**, 1⅛ in. broad, really takes the position of the fixed bend in the old card, and its surface area exposed to the cylinder being so much less the currents of air generated are so light in volume that they are dispersed into the atmosphere of the room. From the position of the bend **B**, flange **E**, and flexible bend **C**, it will be observed that if any "**side waste**" is made at all, it must pass between the flange **E**, and flexible bend **C** and on to the outside of the bend **B**, and not gather on the inside until it is rolled into lumps as in other constructions where the fixed bends are on the outside of the cylinder.



Old Section.

A Cylinder.
B Fixed Bend.
C Flexible Bend.
D Flat.
G Wood Lining.



New Section.

A Cylinder.
B Fixed Bend.
C Flexible Bend.
D Flat.
E Flange on Cylinder.
F End Plates.

Patented arrangement for setting the taker-in and cylinder undercasings. The advantages we claim are the simplicity of the parts combined with the celerity with which they can be adjusted. **A principal feature** is, that Carders are enabled by this system to set these parts with the greatest accuracy from the outside of the framing with their ordinary gauges, whilst the taker-in undercasing along with the mote knives when once set for a desired result will never require disturbing, any future movement being regulated from the taker-in pedestals, to which they are attached by a novel arrangement. These improvements will of themselves prove a great desideratum to the proper setting of a most important part of the Carding Engine.

The flexible bend is now carried on a fulcrum from its centre, which removes any possibility of side strain. The importance of this step will be fully recognised in the fact that we are now enabled to finish them off entirely by machinery. In adopting the 5 setting points arrangement to our Flexible Bend, we have not departed from the principles which have at all times guided us in its construction, but in our present modification we gain a greater assurance that the setting when once correctly done, will remain so more permanently, and be less liable to be influenced by vibration or interference by any irresponsible person. The setting of the flats by these improvements is made absolutely positive for all stages of the wearing of the wire.

The doffer driving is re-arranged to enable the adoption of an open strap from the taker-in, at the same time permitting driving pulleys to be used on the cylinder up to twenty inches diameter.

A slow driving apparatus for turning the cylinder and doffer slowly when grinding or stripping, is also combined in this re-arrangement.

One of the many advantages we claim for our patent Carding Engine is that it will be the narrowest machine in the market for the respective widths of laps, at the same time obtaining a maximum amount of carding capacity. **We construct it of several widths on wire, say 36 in., 38 in., 40 in. or 45 in. to suit new or old Scutchers as desired with 72-2 in., 90-1$\frac{5}{8}$ in., or 106-1$\frac{3}{8}$ in. flats.**

The 40 in. machines as formerly made occupied a space of 10 ft. by 5 ft. 10$\frac{1}{2}$ in.

Our new engine, 40 in., with 24 in. doffer, now takes up only 10 ft. by 5 ft. $2\frac{1}{2}$ in.; or, with 27 in. doffer, 10 ft. 3 in. by 5 ft. $2\frac{1}{2}$ in.

If 45 in. on wire. 24 in. doffer, 10 ft. 2 in. by 5 ft. $7\frac{1}{2}$ in.; or, with 27 in. doffer, as now generally made, 10 ft. 5 in. by 5 ft. $7\frac{1}{2}$ in.

There is thus a reduction of 8 in. per Carding Engine, amounting in round numbers to a saving of space of one machine in every eight.

We may say that with these important improvements added, our Carding Engine is complete and fully equipped for every change that takes place through grinding or general wear and tear from the ordinary working of card clothing.

It should be mentioned that all the parts can be adjusted from the "outside," and the extreme simplicity of every part renders skilled card room labour quite unnecessary, bringing the machine entirely under the control of ordinary card room labour.

Production.—All practical spinners are well aware that this is a matter always to be determined by the requirements of the trade in which they are engaged, and that the weight per hour must necessarily be in accord with the grades of cotton used and the purposes to which the products have to be applied. We, however, consider the following suitable production for good work from Carding Engines 45″ on wire with the classes of cotton enumerated.

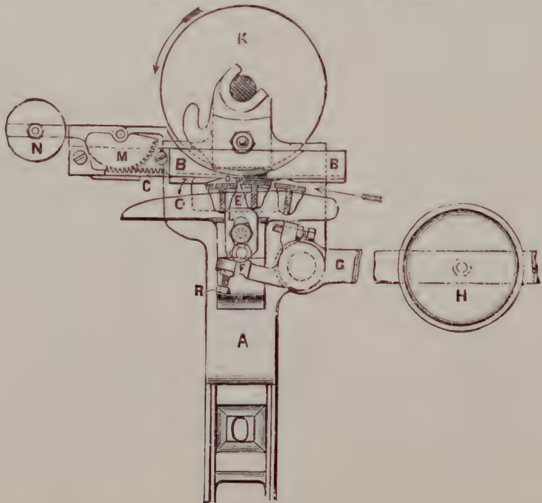
Indian Cotton for Counts	10's to 20's,	15 lbs. to 18 lbs. per hour.
American „ „	20's to 40's,	12 „ 15 „
Egyptian (uncombed)	40's to 60's,	5 „ 7 „
„ (combed)	60's and upwards,	7 lbs. to 8 lbs. per hour.

In dealing with this question the matter of card wire is a most important factor, seeing that the best results so largely depend upon its good quality, finish, and final preparation for carding. Careful deliberation is therefore necessary on the part of the spinner in the selection of this accessory to the Carding Engine, or his confidence placed in us by leaving its selection to ourselves.

Driving pulleys, 12″ to 20″ diar., 3″ wide. Speed about 160 to 170 revs. per minute, according to circumstances.

PLATT'S IMPROVED GRINDING APPARATUS
(McConnel and Higginson's Patents) for
REVOLVING FLATS OF CARDING ENGINES.

The apparatus will be readily understood by reference to the illustration (fig. 1), in which **A** is the grinding fixing; to this is fixed the bridge bracket **B,** in which a rack and bar **C** slide; to this is attached a shoe **D,** the lower surface of which is formed to the required bevel at which it is desired that the card wire shall be ground. The working or carding surfaces of the Flats **E** are supported and regulated by the shoe **D** when grinding by the action of the lifter **L,** and the levers **F** and **G,** the opposite end of the latter being loaded by a weight **H.** Each of the Flats as they travel along seize the "lip" or projecting end of the shoe **D,** and are carried along until the wires have passed under the grinding roller **K,** when the "Flat" drops off the lifter **L,** and releases the shoe **D,** which immediately returns to its original position by means of the positive movement derived from the rack **C,** quadrant **M,** and weight **N.** In case the Flat **E** should not leave the shoe **D** at the right moment it will be carried against the fixed incline or stop **O,** which will at once cause the Flat **E** to release the shoe **D** with certainty. Every Flat in the set is dealt with in the same manner, thus ensuring an uniformity in grinding that cannot be excelled. The attendant should try every Flat as it is lifted in the shoe **D,** and set the lifter **L** with the setting screw **R,** so that every Flat is pressed tightly in the shoe **D.**



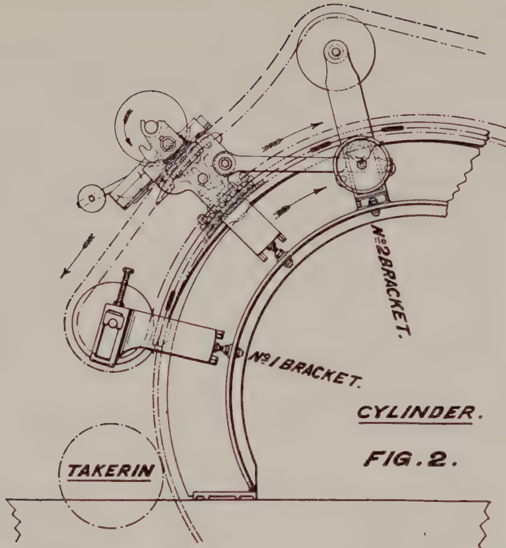


FIG. 2.

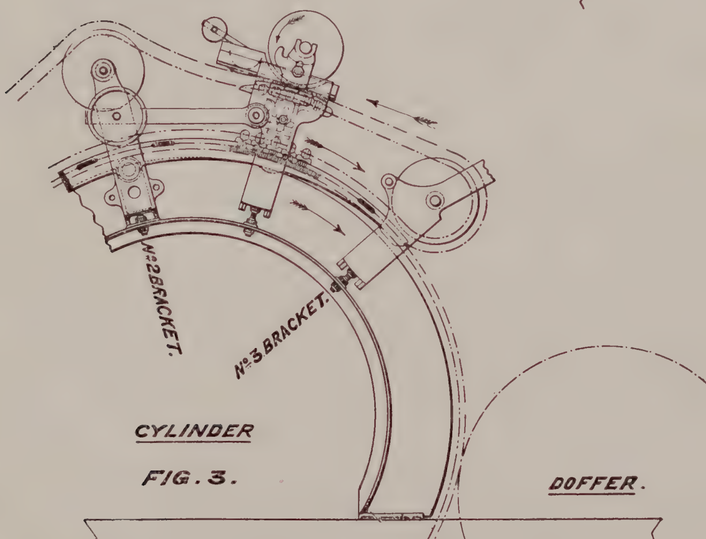
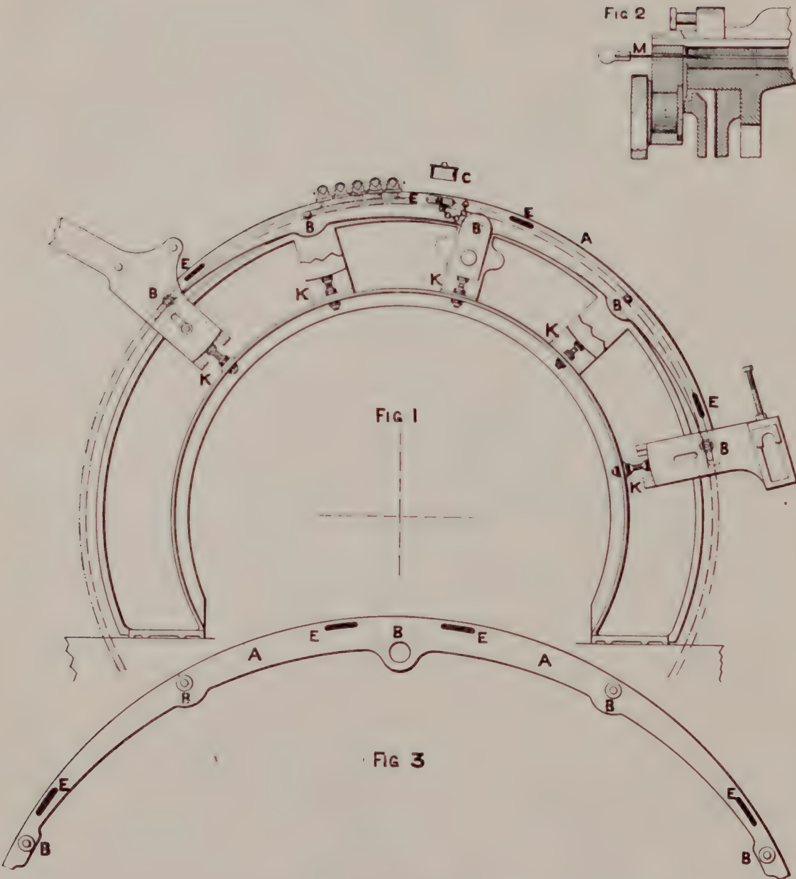


FIG. 3.

Figs. 2 and 3 represent the apparatus in position on the card, and it will be observed that it may be placed either at the back or the front of the Carding Engine, the former position being now mostly preferred on account of its accessibility to the light, and also for the facilities which its more advantageous position offers to the attendant when setting the grinding roller.



Patent Perforated or Slotted Flexible Bends.

PATENT PERFORATED OR SLOTTED FLEXIBLE BENDS,

FOR ASCERTAINING HOW THE WIRE ON THE FLATS IS SET RELATIVELY TO THE WIRE ON THE CYLINDER IN REVOLVING FLAT CARDS.

Fig. 1 of the annexed drawings shows the elevation of those portions of the Carding Engine which are necessary to illustrate this invention.

Fig. 2 is a cross section through one of the perforations.

Fig. 3 shows the Patent Perforated Flexible Bend detached from the card. This bend suffers no diminution in strength, as the slots are cast in them ; thus the natural surface or skin of the metal is unbroken, thereby preserving its rigidity.

The flexible bend **A** is shown with five setting points **B**, and at **E** the perforations or slots are shown. **C** shows one of the solid plugs and chain attachments by which the perforations are closed when the setting is completed.

When the flexible bend **A** requires adjustment it is only necessary to turn the screw **K** with the special screw key, and simultaneously inserting the steel gauge **M** in the slot nearest to it. The gauge **M** will easily pass between the wires on the flat and cylinder, as shown in Fig. 2 in cross section. Starting at the top, or centre, the attendant will in turn proceed to each setting screw and its adjacent perforation, taking care to use a gauge of suitable thickness for the class of cotton and the weight of lap he is carding.

The simplicity of this system now renders what has hitherto been a difficult operation an easy one, and at the same time ensuring the efficiency of the card by the increased confidence given to the operator in the performance of the important operation of setting.

A Comb.
B Stripping Comb Arm.
C Filbow.
D Cam.
E Additional Lever.
F Cam for receding movement.
G Cannon Brackets.

Fig. 1.

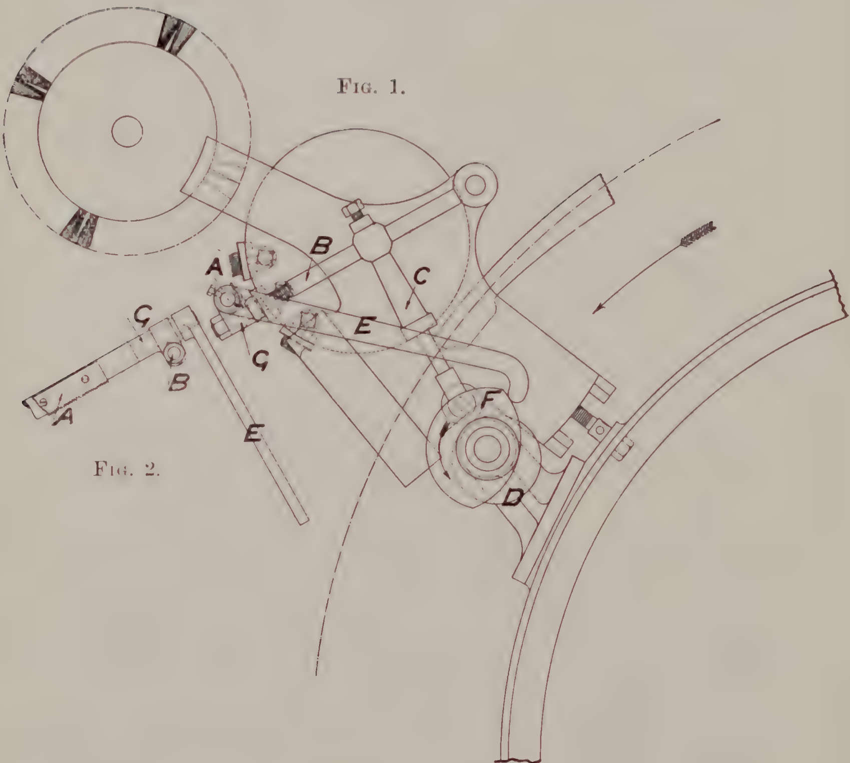


Fig. 2.

Receding Comb.

RECEDING COMB,

FOR STRIPPING THE FLATS EMPLOYED IN SELF-STRIPPING REVOLVING FLAT CARDING ENGINES (BUTTERWORTH'S PATENT).

The construction and action of this Comb will be understood by reference to the illustrations and explanations given thereon, namely,—Figs. 1 and 2 representing that portion of a Revolving Flat Carding Engine to which the Comb is applied; the Comb being shown under letter **A** in front and side view. The teeth of the Comb **A** move in the arc described by the Stripping Comb Arm **B** by its connection **C** with the Cam **D** as usual, but at the end of this downward or stripping stroke, the patent mechanism consisting of the additional Lever **E**, Cam **F**, and Cannon Bracket **G**, come into action as shown in Fig. 1; producing a secondary or receding movement entirely maintaining the Comb at a safe distance from the Card Wire during the upward or return stroke, preventing the possibility of damage being done to the Wire. The auxiliary Cam **F** then passes out of action, leaving the ordinary Cam **D** to complete the down stroke, and so on.

The receding angle of the Comb in relation to the Card Wire can be varied by the Cam **F** if required.

The advantages obtained by the adoption of this Comb are:—

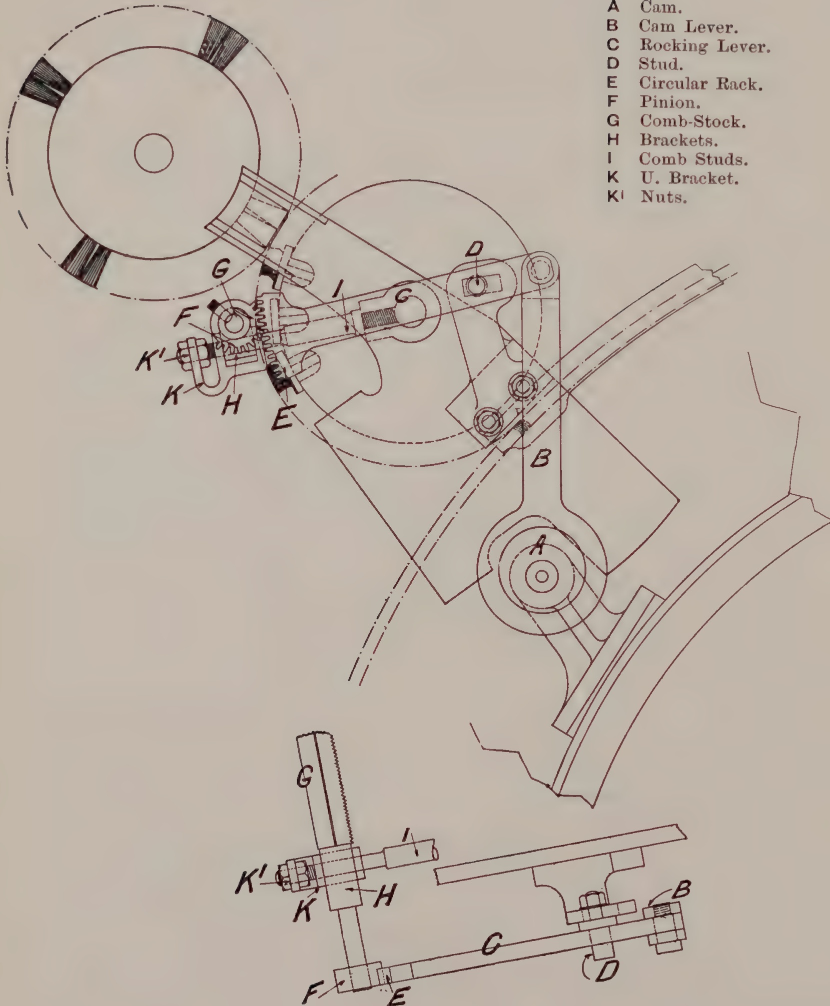
1st.—It permits of closer setting without damage to the Card Wire; for the reason that its secondary or receding motion draws or lifts the strips out of the Flats before making the upward or return stroke.

2nd.—The possibility of angular setting with relation to the Card teeth.

3rd.—By the withdrawing action at the termination of the downward stroke, the strips may be reduced to an extent utterly impossible with the old type of Stripping Comb.

4th.—The economy consequent on such lightened strips.

5th.—All danger of contact with the Card Wire in the return stroke is removed by the receding motion of the Comb; and effectually disposes of any liability of disturbance of the angle of the Wire well known hitherto as the cause of "high wires" on the Flats.



A Cam.
B Cam Lever.
C Rocking Lever.
D Stud.
E Circular Rack.
F Pinion.
G Comb-Stock.
H Brackets.
I Comb Studs.
K U. Bracket.
K' Nuts.

PATENT OSCILLATING COMB

(JONES AND HEAP'S PATENT).

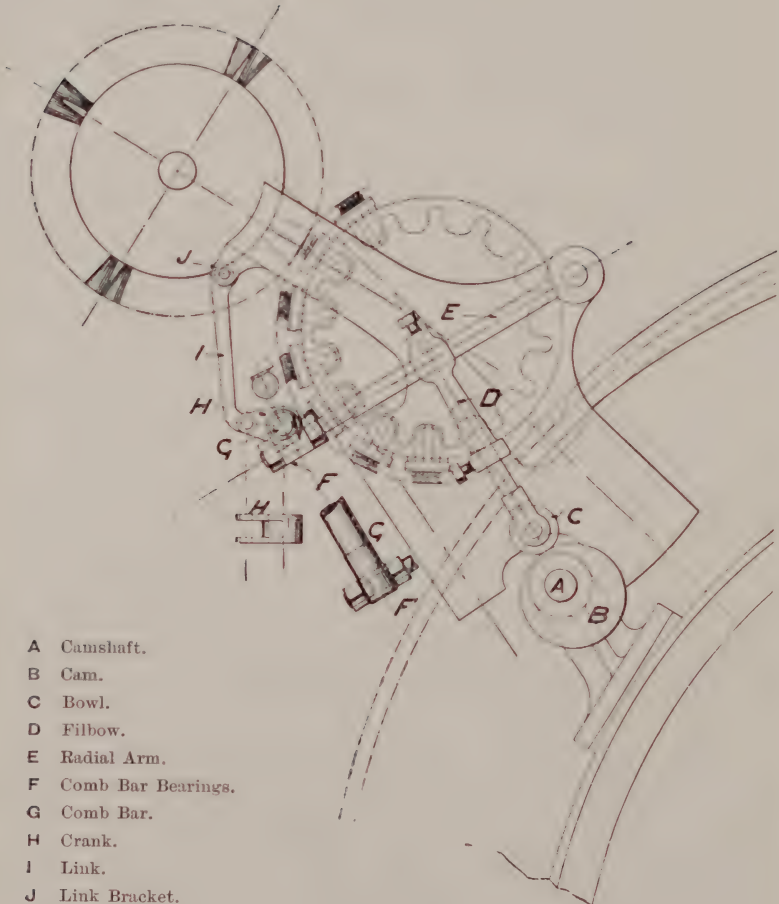
This system of Stripping Comb dispenses with the ordinary and well known up and down movement, and adopts an oscillating motion on its own axis; by this movement it is claimed that the Comb being in contact, or close to the wire on the Flat the least possible moment of time, the danger of spoiling the wire is reduced to a minimum.

It is also claimed that the quick or sharp and direct pull or pluck given by the oscillating motion of the Comb, effectively removes the strips from the wire on the Flat.

The action of the Comb will be easily understood by reference to the illustration.

The Cam **A**, acting on the Cam Lever **B**, causes it to rise and fall, and gives a rocking motion to the Lever **C**, which is pivoted on a Stud **D**. At one end of the Lever **C**, is a Circular Rack **E**, geared into the Pinion **F**, which is fastened to the Comb-Stock **G**, thereby giving an oscillating motion on its own axis, to the Comb.

The Comb-Stock is carried in bearings or brackets **H**, which are themselves carried by the Comb Studs **I**, and are held loosely by the brackets **K**. The latter are fastened firmly to the Comb Studs **I** by means of the Nuts $\mathbf{K}^1$, and can be set to the required distance from the wire on the Flats by means of the Nuts $\mathbf{K}^1$.



A Camshaft.
B Cam.
C Bowl.
D Filbow.
E Radial Arm.
F Comb Bar Bearings.
G Comb Bar.
H Crank.
I Link.
J Link Bracket.

PLATT'S IMPROVED STRIPPING COMB.

This Stripping Comb combines the oscillating motion with the ordinary up and down motion, but in a slower manner than previously obtained, thereby giving a nearer approach to the combing movement essential to the perfect stripping of the Flats.

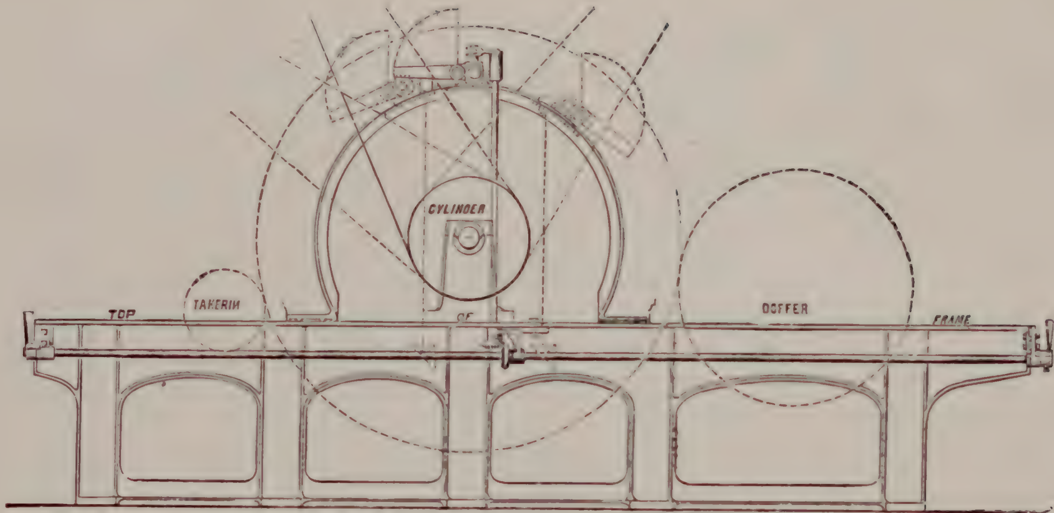
In the construction of this stripping motion special attention has been given to the design, so that the same brackets, levers, &c., used for the New Pattern Card, can be used when the Comb is applied to the Old Pattern Card, thus making its adoption to the Old Cards a very easy and cheap alteration.

In applying this Stripping Comb to the Old Pattern Card nothing is disturbed, the parts F, H, I, and J only being added.

The action of the apparatus will be easily understood by reference to the illustration.

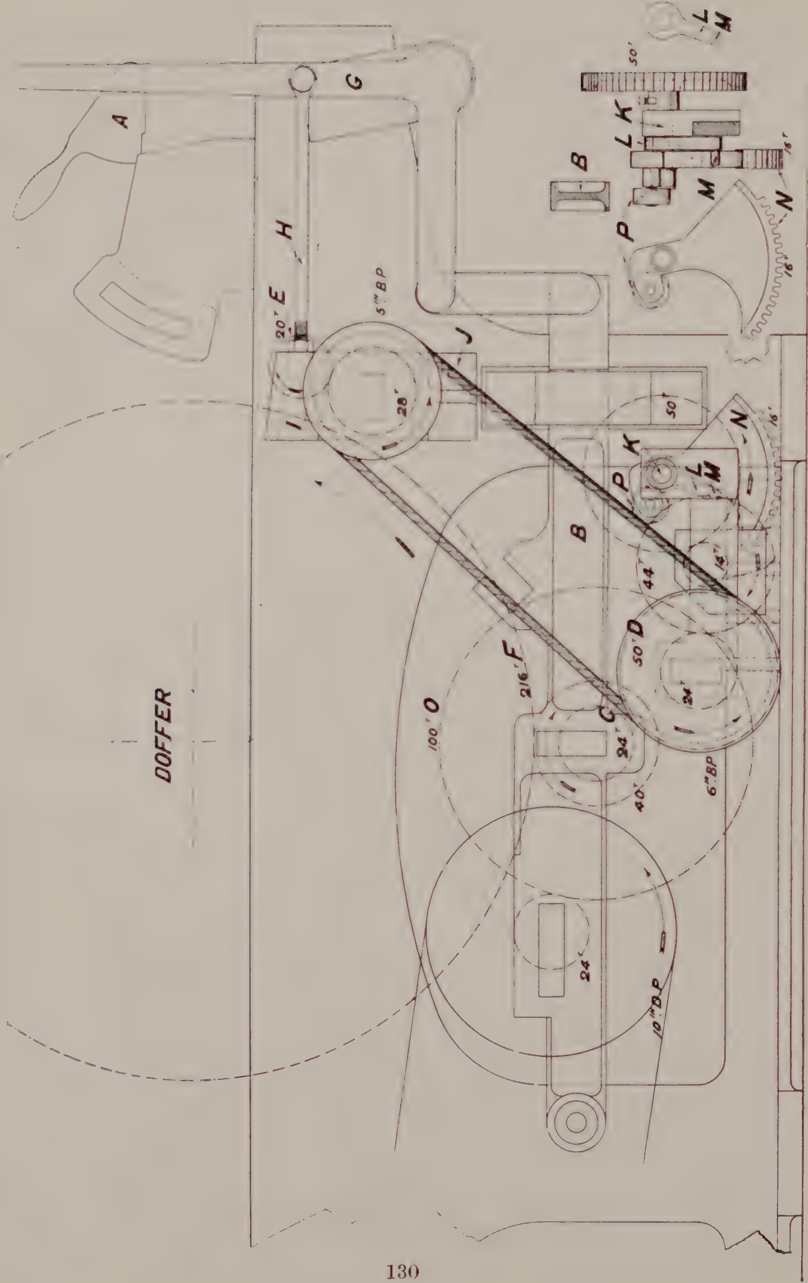
The Cam B, acting on the Radial Arm E, causes it to rise and fall in the ordinary manner, but owing to the action of the Crank H and pivoted connecting Link I, which act on the pivoted Comb Bar G, the Comb Bar, in addition to its up and down movement, receives a rocking motion on its own axis; the path in which the serrated edge of the Comb travels during its up and down motion is therefore diverted, and instead of having its curve or convexity in the same direction as the arc to which the Flats travel, has its curve in the opposite direction, as shown in dotted lines; by these means, the Flats are stripped more effectively than heretofore.

With this arrangement the Stripping Comb can be set further off the wire on the Flats than with the ordinary method of Stripping, thereby ensuring greater safety to the wire.



PATENT STRAP GUIDE.

In some mills the Carding Engines are placed so close to each other that it is somewhat dangerous to the attendant to pass between the cards to start or stop same. To remove this danger, we have applied an arrangement whereby the attendant can start or stop the card from the taker-in or doffer end of the machine, the working of which can be easily understood from the above illustration. This arrangement takes the place of the ordinary strap guide, which is pushed by hand along the stud fastened to the fixed bend or moved by means of a screwed shaft and pin.



Slow Motion Driving of Doffer.

SLOW MOTION DRIVING OF DOFFER.

In consequence of the high speed at which Carding Engines are now worked, the delivery of web or sliver by the doffer of a Carding Engine now takes place at a speed so great that, except by an attendant of more than ordinary dexterity, the piecing or passing of the web or sliver into the bite of the calender rollers of a Carding Engine, after the web or sliver has been broken down, is not effected quickly enough to avoid an accumulation of web or sliver beneath the doffing comb, which is objectionable and wasteful. To meet these objections, the arrangement shewn in the illustration has been designed. Its action is as follows:—As soon as the web or sliver breaks, the attendant releases the catch or hand lever **A**, thereby causing the drop lever **B** to fall out of its ordinary working position into a position that enables the 24 teeth spur wheel **C**, which is carried by the above drop lever, to gear with the 50 teeth wheel **D**, and at the same time brings the 20 teeth slow motion pinion **E** into gear with the 216 teeth doffer wheel **F**; this latter motion is caused by the forward movement of the bell cranked lever **G**, through the connecting rod **H** and slide **I** in the bracket **J**. It will be evident from the illustration that, as soon as the 24 teeth wheel **C** gears with 50 teeth wheel **D**, and the 20 teeth slow motion pinion **E** gears with the 216 teeth doffer wheel **F**, a slow movement of the doffer takes place.

This slow movement continues just long enough to allow the attendant to piece up the web or sliver, then the doffer is brought back automatically to its normal speed in the following manner:—While the slow movement of the doffer is taking place a shaft **K** is caused to revolve slowly by a train of wheels, driven from the 24 teeth wheel **C**; on this shaft **K** is fixed a small lever **L** which carries a pin **M**. This pin **M** during a certain portion of the revolution comes in contact with a quadrant **N**, which is mounted loosely on the shaft **K**. As soon as this contact takes place the quadrant commences to revolve slowly, and continues to do so until it overbalances itself and falls into gear with the 100 teeth wheel **O**. This wheel now takes up the driving of the quadrant and causes it to revolve rapidly, thus bringing a bowl **P** which is attached to the quadrant **N** into sudden contact with the underside of the drop lever **B**. This contact causes the drop lever to be lifted back again into its normal working position.

PLAN.

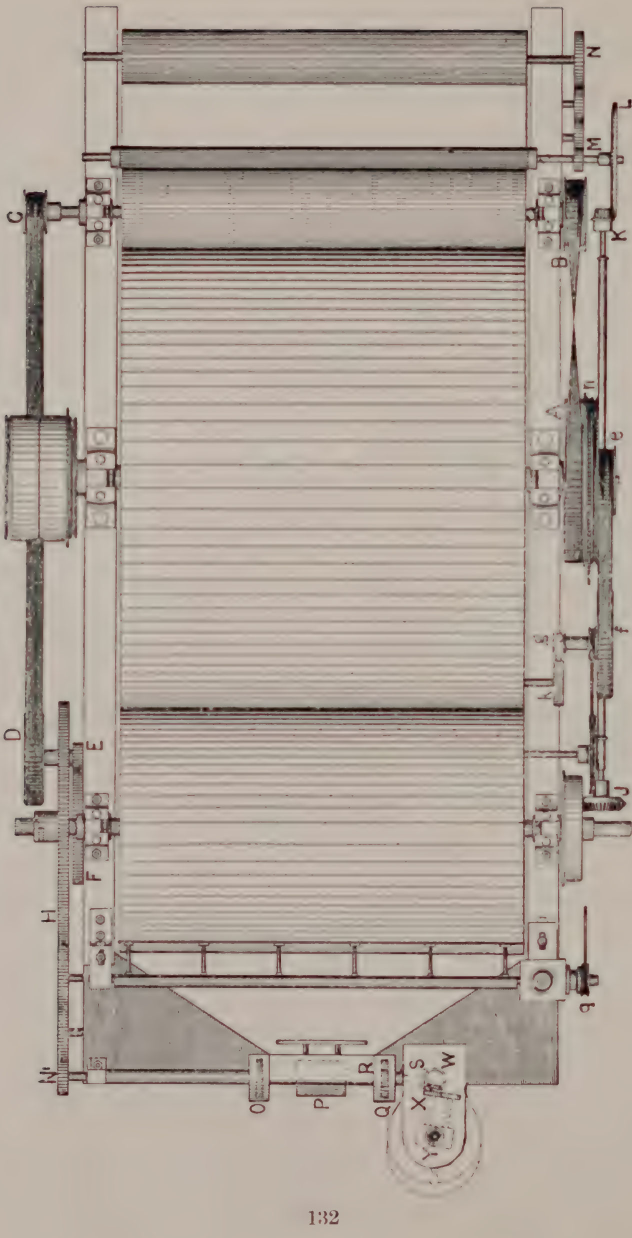


Diagram of Flat Carding Engine.

ELEVATION.

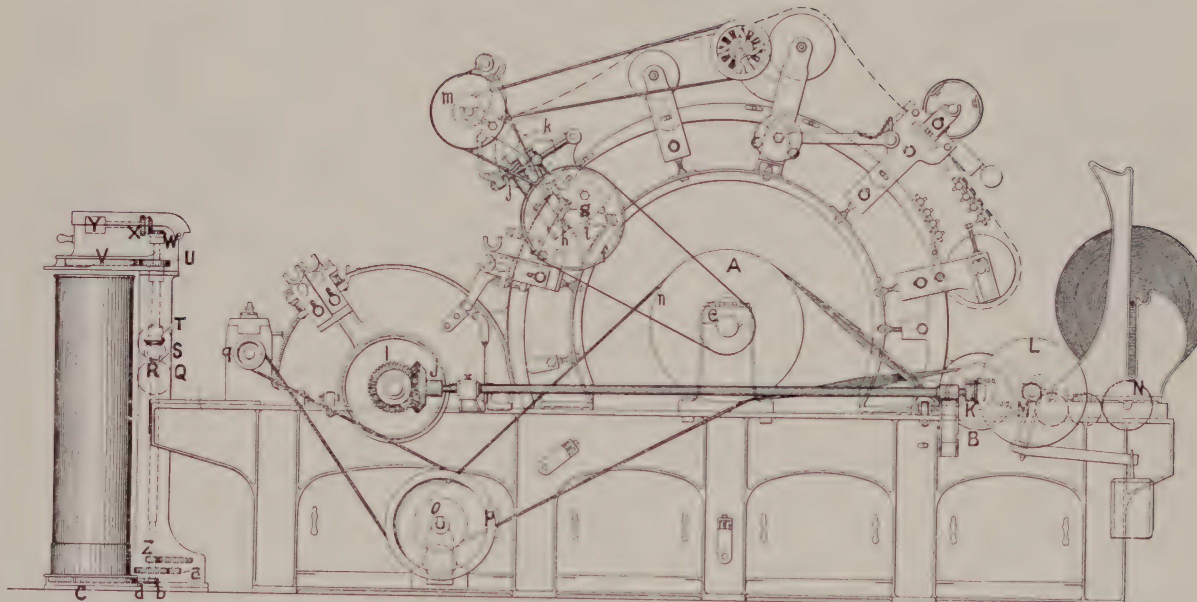


Diagram of Flat Carding Engine.

ELEVATION

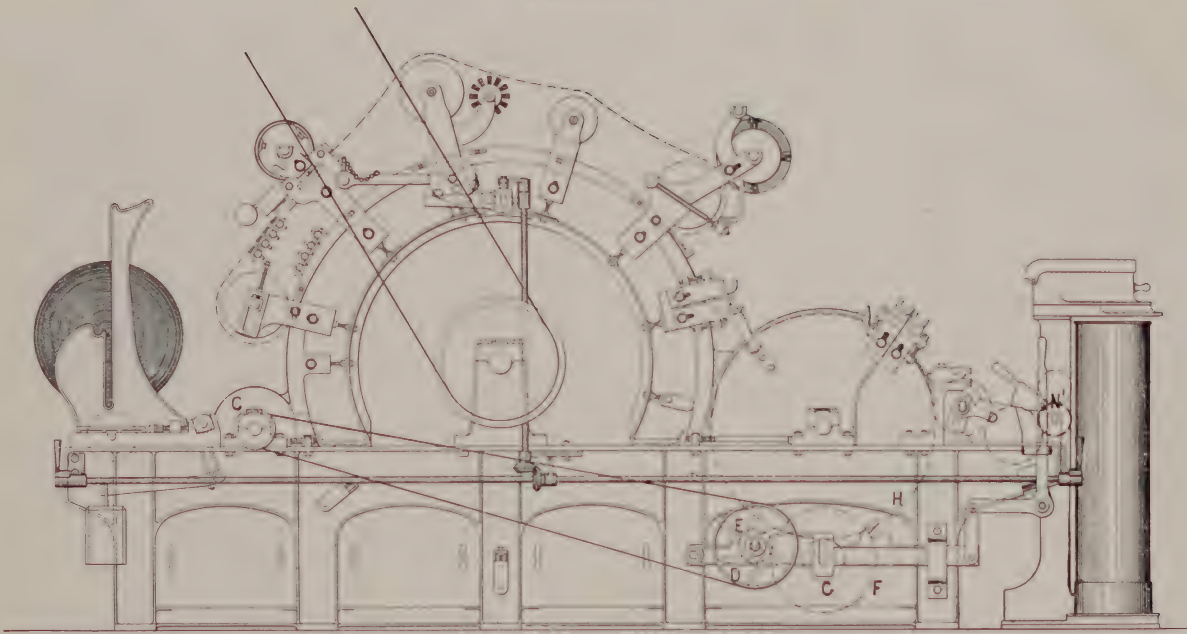
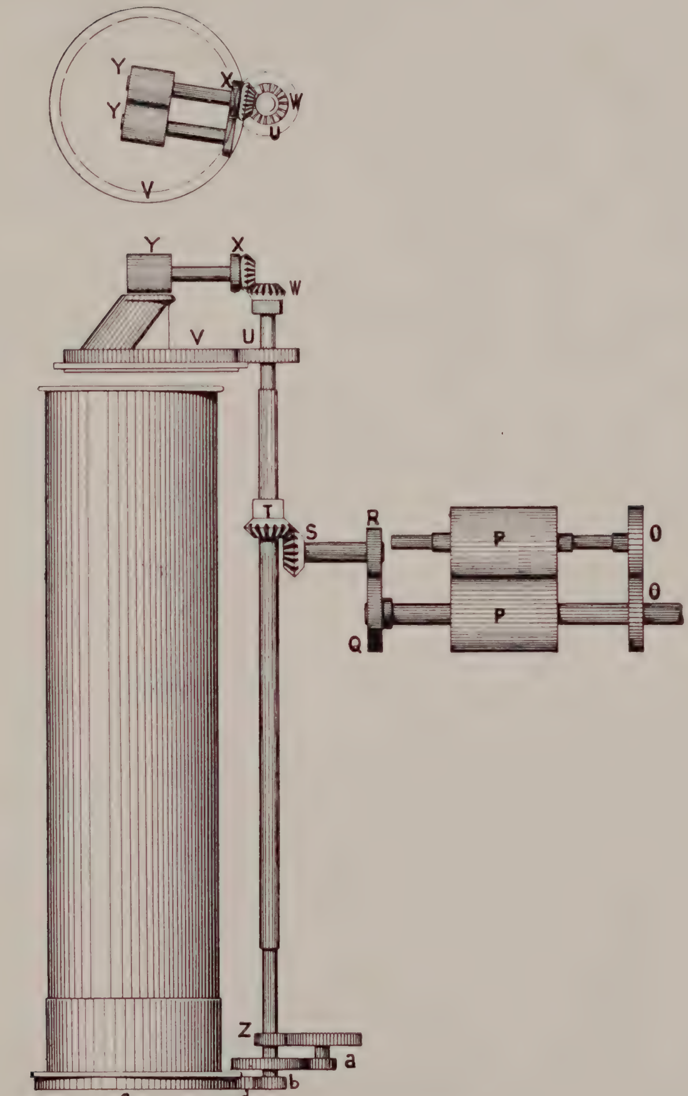


Diagram of Flat Carding Engine.



Coiler Gearing.

References to Letters on Diagrams.

Taker-in and Doffer Driving.

A Taker-in driving pulley, 14″ to 18″ diar.

B Taker-in pulley, 6″, 7″ or 8″ diar.

C Doffer driving pulley on taker-in shaft, 5″ diar. (varies from $3\frac{1}{2}$″ to 6″).

D Dandy pulley, 10″ diar. if 27″ doffer, 12″ diar. for 24″ doffer.

E Change wheel on dandy pulley boss, 18T. to 50T.

F Wheel on 2nd stud, 40T. or 100T.

G Wheel on 2nd stud, 20T. or 40T.

H Doffer wheel, 216T. for 27″ doffer, or 192T. for 24″ doffer.

Diar. of Doffer, 24″ or 27″.

Feeder Driving.

I Doffer bevel wheel, 30T. or 40T.

J Side shaft bevel wheel, 40T.

K Side shaft change bevel wheel, 9T. to 32T.

L Feeder plate bevel wheel, 120T.

M Feed roller pinion, 17T.

N Lap roller wheel, 48T.

Diar. of Lap Roller, 6″.

„ „ Feed Roller, $2\frac{1}{4}$″.

Calender, Coiler and Can Driving.

N[1] Calender pinion, 30T.

O Calender coupling wheels, 32T.

P Calender rollers, 4″ diar.

Q Calender wheel driving coiler, 31T.

R Coiler cannon shaft wheel, 15T.

S Coiler cannon shaft mitre wheel, 20T.

T Coiler upright shaft mitre wheel, 20T.

U Pinion on upright shaft, 38T.

V Coiler tube wheel, 106T.

W Top bevel wheel on coiler upright shaft, 16T.

X Combined bevel and spur wheel on coiler calender, 16T. S.W. 24T

Y Coiler calenders, 2″ diar.

Z Pinion at bottom of coiler upright, 16T.

a Double carrier wheels on stud, 48T. and 16T.

b Double carrier wheels loose on upright shaft, 48T. and 14T.

c Can dish wheel, 82T.

d Carrier wheel on radius bar, 19T.

FLAT DRIVING.

e Driving pulley on cylinder shaft, $6\frac{1}{2}''$ diar.

f Box pulley on stud, 12″ diar.

g Single worm on stud.

h Single worm wheel on inclined shaft, 24T.

j Single or double worm on incline shaft.

k Single or double worm wheel on notch block shaft, 40T.

l Band pulley on stud, $3\frac{1}{2}''$ diar.

m Band pulley on 4 row brush, 8″ diar.

FLY COMB DRIVING.

n Band pulley on cylinder shaft, 18″ diar.

o Band pulley on carrier stud, 6″ diar.

p Band pulley on carrier stud, 12″ diar.

q Band pulley on fly comb spindle, 4″ diar., range $3\frac{1}{2}''$ to 5″.

COUNTS OF WIRE FOR CARD CLOTHING.

The wire is drawn to numbers from one upwards according to a graduated scale, but the counts are not determined by the thickness of the wire, but by the number of staples in a square inch of clothing. Formerly the counts were reckoned by the number of staples in a straight line across a sheet of clothing 4 inches wide. The crown, on the other hand, is the number of wires in 1 inch along the clothing, and is usually 10 per inch. The number of staples per square inch is always $2\frac{1}{2}$ times the counts, thus 100's counts would be 250 staples, and is found as follows :—10 staples along the cloth and 25 across equals 250 staples per square inch, or 500 points.

CALCULATIONS.

To find Total Draft.

$$\frac{\text{Diar. of } Y \times N \times L \times J \times H \times Q}{\text{Diar. of Lap Roller} \times M \times K \times I \times N^{1} \times R} = \text{Total Draft.}$$

Given the Draft, to find Side Shaft Change Bevel.

$$\frac{\text{Diar. of } Y \times N \times L \times J \times H \times Q}{\text{Diar. of Lap Roller} \times M \times \underset{\text{required}}{\text{Draft}} \times I \times N^{1} \times R} = \begin{array}{c}\text{Side Shaft Change}\\ \text{Wheel required.}\end{array}$$

To find Constant Number for Draft.

$$\frac{\text{Diar. of } Y \times N \times L \times J \times H \times Q}{\text{Diar. of Lap Roller} \times M \times I \times N^{1} \times R} = \text{Constant Number.}$$

$$\frac{\text{Constant Number}}{\text{Draft required}} = \text{Side Shaft Change Wheel.}$$

$$\frac{\text{Constant Number}}{\text{Side Shaft Change Wheel}} = \text{Total Draft.}$$

To find Draft between Feed Roller and Doffer.

$$\frac{\text{Diar. of Doffer} \times L \times J}{\text{Diar. of Feed Roller} \times K \times I} = \text{Draft.}$$

To find Calculated Production in a given time.

$$\frac{\begin{array}{c}\text{Number of Working}\\ \text{hours}\end{array} \times \overset{\text{mins.}}{60} \times \begin{array}{c}\text{Revs. of Doffer}\\ \text{per min.}\end{array} \times H \times Q \times \begin{array}{c}\text{Circum.}\\ \text{of } Y\end{array} \times \begin{array}{c}\text{grains}\\ \text{per yard of}\\ \text{deld. sliver}\end{array}}{N^{1} \times R \times 36'' \times 7000 \text{ grains}}$$

$$= \text{Production in lbs.}$$

To find Constant Number for Production.

$$\frac{\overset{\text{mins.}}{60} \times H \times Q \times \text{Circum. of } Y}{N^1 \times R \times 36'' \times 7000 \text{ grains}} = \text{Constant Number.}$$

Constant number × grains per yd. of delivered Sliver × Revs. of Doffer per min. = Production in lbs. per hour.

To find what Hank Sliver is being Produced.

Divide the weight in grains of a certain number of yards of delivered sliver into the dividend for the number of yards taken, and the quotient will be the hank required.

Example :—

$$\text{Dividend for one yard} = \frac{7000}{840} = 8{\cdot}3\dot{3} \text{ grains.}$$

$$\text{Dividend for six yards} = 8{\cdot}33 \times 6 = 50 \text{ grains.}$$

Example : Weight of six yards of Sliver = 13 dwts. 21 grs. or 333 grs.

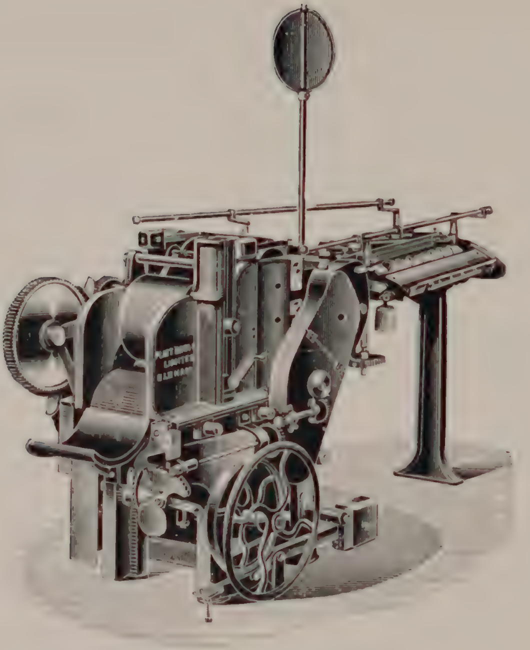
Therefore— $$\frac{50}{333} = 0{\cdot}15 \text{ Hank Sliver.}$$

The following are the "Dividends" in grains for the number of yards stated below :—

Yards.		Dividend.		Yards.		Dividend.
1	=	8·333	......	5	=	41·666
2	=	16·666	......	6	=	50·000
3	=	25·000	......	8	=	66·666
4	=	33·333	......	10	=	83·333

To find Length of Fillet for covering a Cylinder.

$$\frac{\text{Diar. of Cylinder} \times \text{Width of Cylinder} \times 3{\cdot}1416}{\text{Width of Fillet} \times 12''} = \text{Number of feet required.}$$



Sliver Lap Machine.

This machine serves to unite and form into a narrow lap the slivers from the 1st passage of drawing prior to combing.

It is arranged for 14, 16, 18, 20 and 24 cans up, and for laps $7\frac{7}{16}''$, $10\frac{1}{2}''$, $11''$ or $12''$ wide, as desired, and is fitted with tumbler stop motion to each sliver, top and bottom draft rollers, compression and lap rollers, knocking-off motion with signal post or semaphore, &c.

Floor space occupied, with 20 cans up for $12''$ lap, $9'\ 0'' \times 5'\ 0\frac{1}{2}''$.

Driving pulleys $12''$ to $15'' \times 1\frac{3}{4}''$. Speed about 250 to 320 revs. per minute.

Production, one machine for about six combers

[We are also makers of the **Ribbon Lap Machine** with lap former, to double six laps from the Sliver Lap Machine into one lap for the comber, where this system is preferred.]

Heilmann's Cotton Comber.

HEILMANN'S COTTON COMBER.

The increasing demand for this machine during the last few years has led to the introduction of many changes in its construction, which contribute in a high degree to superior work combined with a great increase in production, at the same time giving facilities for adjustment to suit short stapled cotton.

The specialities of our construction are as follows, viz.:—

The Gearing Headstock is built upon a solid cast-iron base plate, and has two frame ends supporting a planed table, which gives great solidity and steadiness to the principal working parts. The base of the machine has also been widened, which ensures steadiness and smoothness of action in the working parts when running at a maximum speed. The detail parts of the machine are shaped, planed and bored by improved machinery, so as to make them interchangeable. The Cam Shaft is made in two lengths with flange couplings and is carried through the whole length of the machine, and improved cut Nipper Cams are applied at both ends, thus preventing torsion and securing a better nip. The cams for giving reciprocating motion are cut by improved machinery, thus securing a smooth motion at an increased speed.

The machine is now made with eight or ten boxes, to take laps $10\frac{1}{2}$ in., 11 in. or 12 in. wide (instead of $7\frac{1}{2}$ in. as formerly), thereby greatly increasing the production of the machine whilst maintaining the quality of the combing.

The wrought-iron Notch Wheel (formerly cast-iron) is now made broad on the face, and casehardened to prevent rapid wear.

The bottom feed and detaching rollers are made of cast steel, and the brass top detaching rollers have wrought-iron casehardened pivots, working in brass levers, with wrought-iron links and studs casehardened.

When desired we apply a Patent Relieving Motion to the weights on the drawbox and detaching rollers.

The Comb Shells, Comb Strips, and Fluted Segments are all interchangeable, any shell, fluted segment or comb strip fitting any barrel.

Moss's Patent Adjustable Guides, fixed to comb barrel, are applied for condensing or narrowing the edges of the sliver, both before and after combing, thus making firmer selvedges.

The Circular Comb Brushes are fitted with Freemantle's Patent Oscillating Motion, for the better cleaning of the Circular Comb.

The driving shaft is provided with special arrangement so that the Circular Brushes may be revolved for cleaning purposes *without* running the other portions of the machine.

We apply Patent Tumbler Stop Motions in sliver plate opposite each box, or all together behind the drawbox, to stop the machine when any of the slivers break.

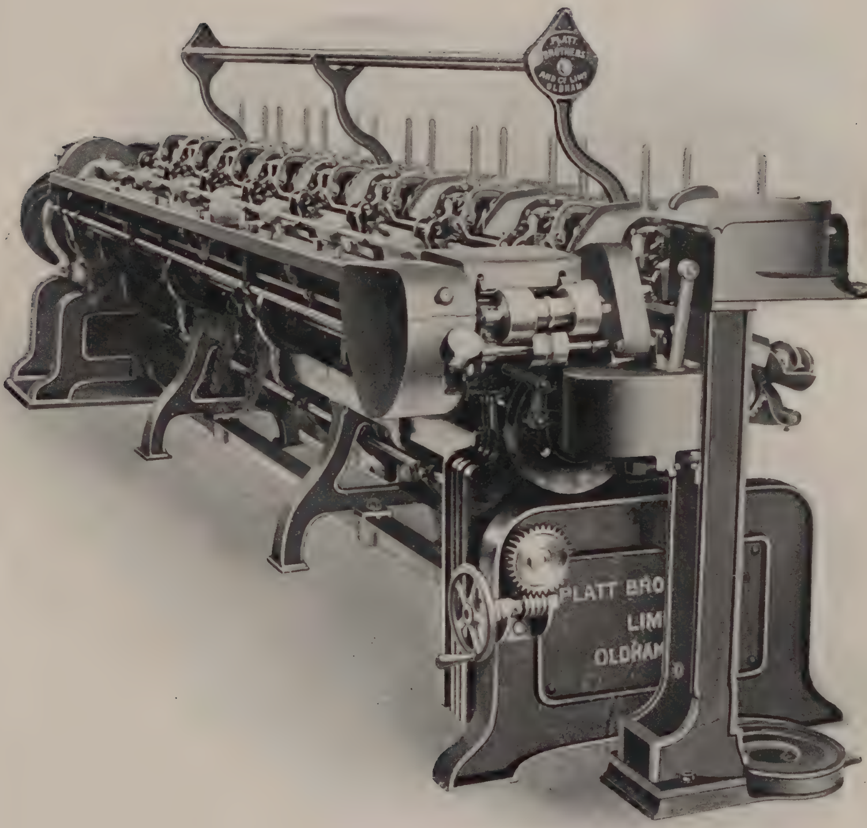
Coiler for Cans, 36 in. by 9 in., 10 in. or 12 in. diar. Stop motion in Coiler Cover, stop motion when can is full. Drawbox with 3, 4, or 5 lines of rollers; Iron Flats with wood linings for stationary cloths; Iron Flats for endless cloth clearers, with or without Ermen's Self-stripping Combs. Indicator to drawbox, showing number and decimal of hanks.

We are prepared to meet the demand of customers who desire to introduce the operation of combing for coarser counts than hitherto customary, or for cotton intended to be mercerised.

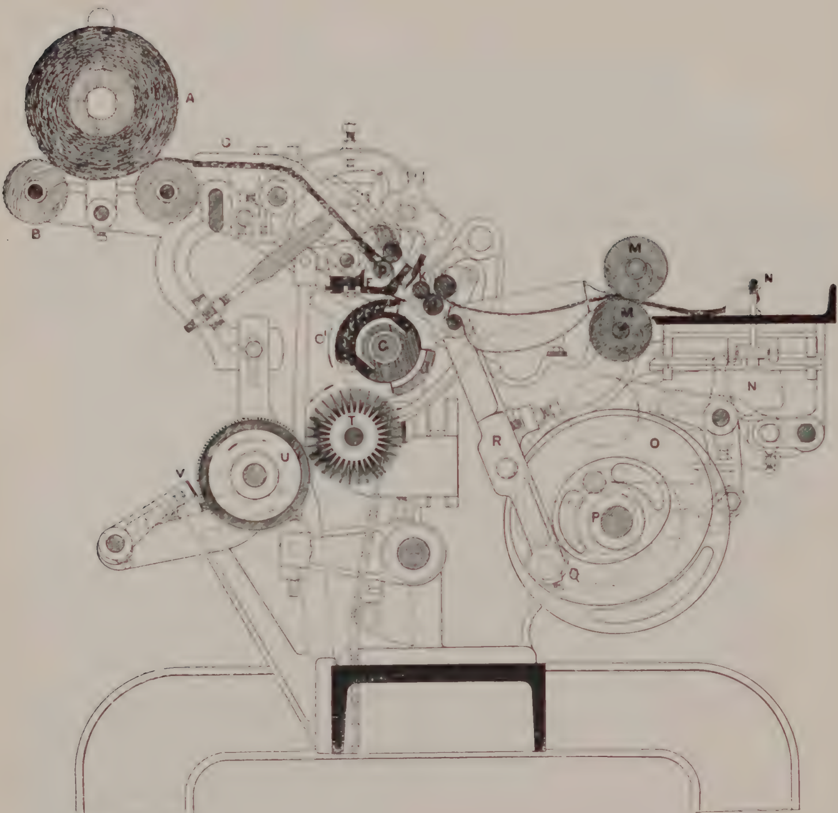
The weight of lap usually combed when the finer counts are required varies from say 9 dwts. to 15 dwts. per lineal yard (depending on the width of lap and the quality of the sliver produced), but where a lower standard of combing is found sufficient to meet requirements, we are in a position to supply machines which will comb laps more than twice the usual weight.

Production, 8 to 13 lbs. per hour of combed cotton, depending on circumstances. Driving pulleys 10 in. to 15 in. diar. × 3 in. wide. Speed, 300 to 360 revs. per minute, to give 80 to 95 nips per minute, according to the class of cotton and quality of combing required.

Floor space occupied (8 boxes, 12″ lap) 17′ 10½″ × 3′ 6″.



Heilmann's Cotton Comber.



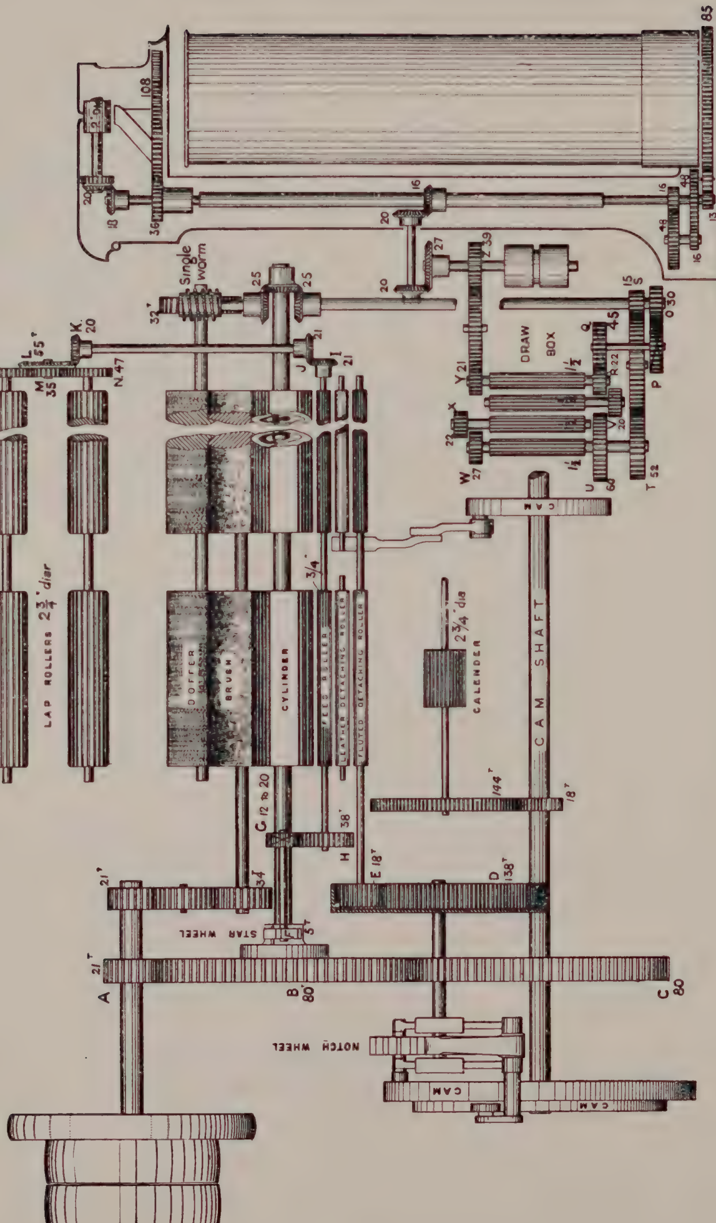
Heilmann's Cotton Comber.

Section shewing Nipper Bar and Cushion Plate in contact; comb cylinder commencing to comb the tuft of cotton and the top comb lifted.

Heilmann's Cotton Comber.

References to Letters on Sectional Elevations.

A	Lap $10\frac{1}{2}''$, $11''$, or $12''$ wide.
B	Wood lap rollers.
C	Lap plate.
D	Feed rollers.
E	Nipper Bars.
F	Cushion plate.
G	Comb cylinder shaft.
G^1	Comb segment.
J	Fluted segment.
H	Top and bottom fluted detaching rollers.
K	Detaching roller covered.
L	Top comb.
M M	Sliver calenders.
N	Patent tumbler stop motion in sliver plate.
P	Cam shaft.
T	Brush.
U	Doffer covered with inserted wire.
V	Noil stripping comb.



Gearing of Cotton Comber.

Heilmann's Cotton Comber.

A Driving shaft wheel 21 T.
B Comb shaft wheel 80 T.
C Cam shaft wheel 80 T.
D Internal wheel 138 T.
E Detaching roller pinion 18 T.
F Star wheel 5 T.
G Feed roller change wheel 12 T. to 20 T.
H Wheel on end of feed roller 38 T or 30 T.
I Bevel on feed roller driving creel side shaft.
J, K Bevels on side shaft connecting feed roller and lap rollers.
L 55 T bevel wheel — cast together.
M 35 T spur „ — cast together.
N N Coupling gearing to lap rollers.
O Change wheel (30 T.) on end of drawbox driving shaft.
P, Q Compound carrier and change wheels.
R Front roller change pinion 22 T.
S Pinion 15 T. on drawbox driving shaft, driving back roller.
T Drawbox back roller change wheel.
U Back roller wheel driving 2nd roller V.
V 2nd roller change pinion.
W Back roller pinion driving 3rd roller X.
X 3rd roller change pinion.
Y change Pinion on end of front roller driving drawbox calender.
Z Wheel on drawbox calender.

Draft represented by percentage of loss in noil, in Comber.

Loss.	Draft.	Loss.	Draft.	Loss.	Draft.
7½ %	1·081	12½ %	1·142	17½ %	1·212
8 %	1·087	13 %	1·15	18 %	1·219
9 %	1·099	14 %	1·162	19 %	1·234
10 %	1·11	15 %	1·176	20 %	1·25
11 %	1·123	16 %	1·19	22½ %	1·29
12 %	1·136	17 %	1·205	25 %	1·33

To alter draft in drawbox change the speed of front roller.

Total Draft in Comber with 8 boxes.

Weight of Comber Lap per yard. dwts. grs.	HANK SLIVER DELIVERED.							
	·13	·14	·15	·16	·17	·18	·19	·20
	Draft.	Draft.	Draft.	Draft.	Draft.	Draft.	Draft.	Draft.
10 0	29·96	32·26	34·57	36·87	39·18	41·48	43·79	46·09
10 12	31·46	33·88	36·30	38·72	41·14	43·56	45·98	48·40
11 0	32·96	35·49	38·03	40·56	43·10	45·63	48·17	50·70
11 12	34·45	37·10	39·75	42·41	45·06	47·71	50·36	53·01
12 0	35·95	38·72	41·48	44·25	47·02	49·78	52·55	55·31
12 12	37·45	40·33	43·21	46·09	48·97	51·86	54·74	57·62
13 0	38·95	41·94	44·94	47·94	50·93	53·93	56·93	59·92
13 12	40·45	43·56	46·67	49·78	52·89	56·00	59·12	62·23
14 0	41·94	45·17	48·40	51·63	54·85	58·08	61·31	64·53
14 12	43·44	46·78	50·13	53·47	56·81	60·15	63·50	66·84
15 0	44·94	48·40	51·86	55·31	58·77	62·23	65·69	69·14

Draft in Machine not including drawbox.

Feed Wheel.	1⅛″ Back Roller.	1¼″ Back Roller.	1½″ Back Roller.
	Draft.	Draft.	Draft.
12	9·140	9·207	9·140
13	8·442	8·503	8·442
14	7·847	7·904	7·847
15	7·307	7·361	7·307
16	6·850	6·900	6·850
17	6·447	6·494	6·447
18	6·089	6·134	6·089
19	5·891	5·934	5·891

Note.—The drafts are the same for 1⅛″ roller as for 1½″ roller, in consequence of using a 39 T. wheel for the 1⅛″ roller, and 52 T. wheel for the 1½″ roller, or in the ratio of 3 to 4.

Cotton Comber; Calculations.

To find total Draft in Comber Drawbox.

$$\frac{\text{Diar. of front roller} \times T. \times O. \times Q.}{\text{Diar. of back roller} \times S. \times P. \times R.} = \text{draft.}$$

Total Draft in Comber from lap roller to coiler calender without allowance for noil.

$$\frac{\overset{N}{47} \times \overset{L}{55} \times \overset{J}{21} \times \overset{H}{38} \times \overset{F}{5} \times 25 \times O. \times \overset{Q}{45} \times Y. \times 27 \times 20 \times 18 \times 2'' \text{ coiler calender.}}{\underset{M}{35} \times \underset{K}{20} \times I \times G \times 1 \times 25 \times P. \times R. \times Z. \times 20 \times 16 \times 20 \times 2\tfrac{3}{4}'' \text{ lap roller.}}$$

Draft between Lap Rollers and Feed Rollers $\dfrac{47 \times 55 \times 3/4''}{11/4'' \times 35 \times 20} = 1{\cdot}007.$

Draft between Feed Rollers and Calenders.

Feed change wheel.	19T.	18T.	17T.	16T.	15T.	14T.	13T.	12T.
Draft	4·58	4·83	5·12	5·44	5·8	6·22	6·7	7·25

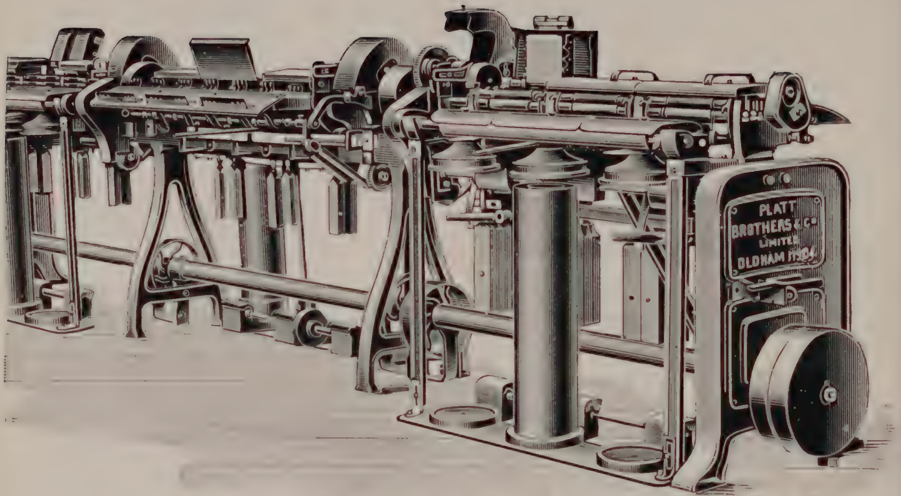
Feed change wheel varies with the length and quality of the fibre; the larger wheel for the longer fibre.

Draft between calender and Drawbox with $1\frac{1}{4}''$ back roller. $\dfrac{144 \times 15 \times 5/4'' \text{ back roller.}}{\underset{\text{calr.}}{11/4''} \times 18 \times 43} = 1{\cdot}268.$

Ditto. with $1\frac{1}{2}''$ back roller $\dfrac{144 \times 15 \times 6/4'' \text{ back roller.}}{11/4'' \times 18 \times 52} = 1{\cdot}260.$

Draft between drawbox and Coiler with $1\frac{1}{4}''$ front roller. $\dfrac{17 \times 27 \times 20 \times 18 \times 2''}{5/4'' \times 39 \times 20 \times 16 \times 20} = 1{\cdot}06.$

Ditto with $1\frac{1}{2}''$ front roller $\dfrac{21 \times 27 \times 20 \times 18 \times 2''}{6/4'' \times 39 \times 20 \times 16 \times 20} = 1{\cdot}09.$



DRAWING FRAME.

This machine can be made of the following staffs, viz.:— 15", $16\frac{1}{8}$", 17", or $18\frac{1}{8}$", the latter being generally preferred, as it allows more space for the rows of cans at the back.

The standard height from floor to top of roller beam is 3′ $5\frac{1}{2}$"—for the usual size of cans, viz., 36" × 9"—but by sinking the can-plates two inches into the floor, the height may be reduced, to order, to 3′ $3\frac{1}{2}$".

Drawing Frames may be arranged in one, two, three, or more heads, as may be most convenient, and can be placed in a variety of ways, according to space at disposal and other circumstances.

Iron flats for stationary cloths are included in the usual price of the machine, but Ermen's Patent Revolving Self-Stripping Clearers are recommended to prevent accumulation of flat waste and spoiled work.

The top rollers may be all common (solid rollers) or with Leigh's Patent Loose Bosses—to one or more rows—or with loose bushes to the ends of the rollers, as may be preferred.

The polished front plates are made either to cover the calenders only, or to go close up to the front roller.

The coilers are usually made of the standard Drawing Frame pattern as shown, but if preferred, we can apply the Carding Engine pattern of coiler.

The tumbler stop motions are generally made to work on pivots, but are also made of the knife edge pattern if desired. These tumblers may also be constructed to move to and fro in connection with the traverse motion.

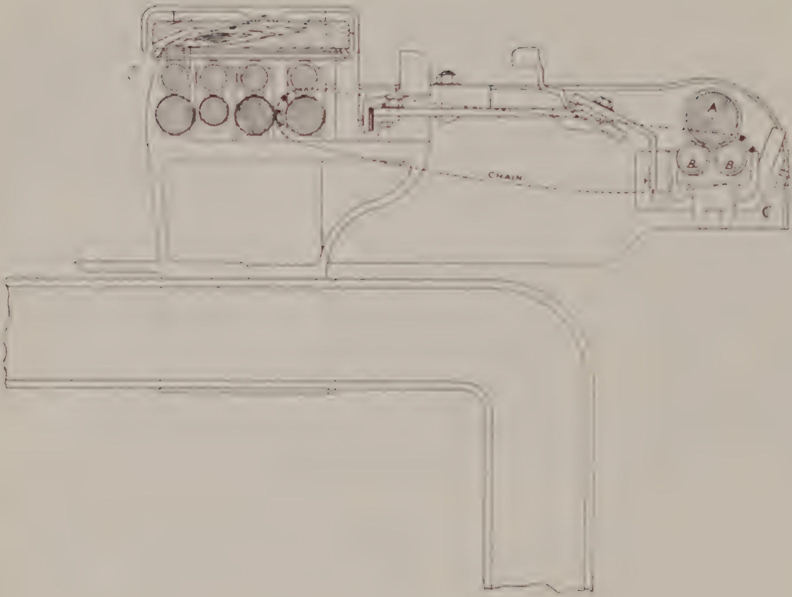
The machine may be fitted with the Dugdale and Haworth's Single Preventer behind the tumblers of the back stop motion (see illustration, page 154).

The traverse motion may be of the standard single pattern, or Tatham's Patent Double Guides.

Instead of unhardened bottom rollers, it is now generally preferred to have the front line or the first and second lines casehardened, end to end, and to harden the necks and squares of the other lines of rollers.

Floor space occupied: A Frame 3 × 7 dels., $18\frac{1}{8}''$ staff, $38'\ 1\frac{1}{8}'' \times 5'\ 1''$.

Driving pulleys, $12''$ to $18''$ diar. × $3''$ or $3\frac{1}{2}''$ wide. Speed about 200 to 300 revs. per minute, according to circumstances.



DUGDALE AND HAWORTH'S

IMPROVED ROLLER ARRANGEMENT. (Single Preventer.)

As will be seen from the illustration, this apparatus consists of two lines of plain bottom rollers **B B,** and a plain top roller **A.** Its function is to assist the sliver out of the can, to cause any breakages there may be, to take place behind the draft rollers, before the sliver reaches the tumbler, also to maintain one uniform tension on the tumbler, thus making the stop motion more positive in its action.

The top roller **A** does not need to be lifted, as there is a top roller to every two slivers, and the sliver when pieced up and placed in the hole of back guide plate, finds its way unassisted under the end of the top roller **A**.

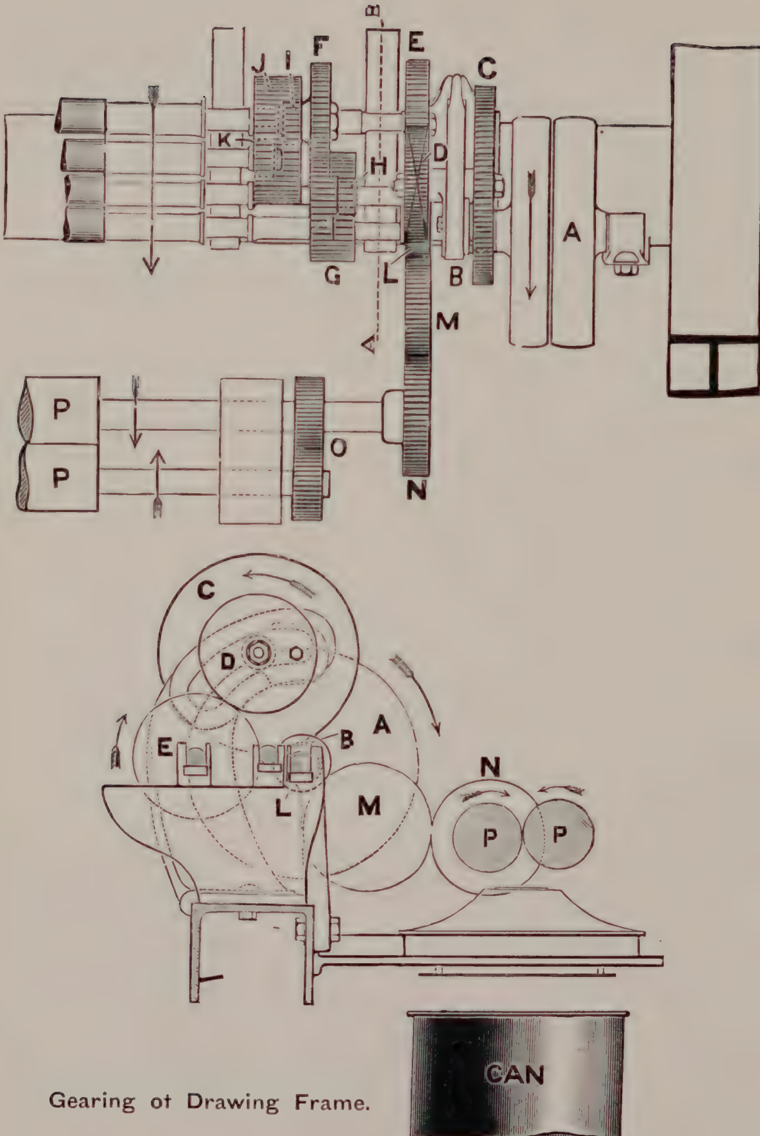
Drawing Frame.

Alphabetical References to Sketches.

A	Front roller pulleys	10″ diameter
B	Front roller pinion	18T
C	Crown wheel	100T
D	Draft change wheel	46T to 56T
E	Back roller wheel	54T 60T or 66T
F	Wheel on back roller for driving 2nd roller	52T to 60T
G	Double carrier wheel	56T
H	2nd roller pinion	20T to 22T
I	Back roller pinion for driving 3rd roller	25T to 28T
J	Double carrier wheel	56T
K	3rd roller pinion	20T to 22T
L	Front roller calender wheel	18T or 20T
M	Carrier wheel	44T
N	Calender wheel	39T
O	Calender roller coupling wheels	30T
P	Calender rollers	3″ diam.

Gearing to coilers from $1\frac{1}{2}''$ front roller .... $\dfrac{20 \times 30 \times 40}{32 \times 30 \times 90}$ coiler wheel

Gearing to cans from front roller ...... $\dfrac{20 \times 20 \times 14 \times 16 \times 13}{32 \times 30 \times 50 \times 16 \times 85}$ can wheel



Gearing of Drawing Frame.

Drawing Frame.—Calculations.

To find Total Draft, viz.:—Between Front and Back Rollers.

$$\frac{\text{Diar. of Front Roller} \times E \times C}{\text{Diar. of Back Roller} \times D \times B} = \text{Total Draft.}$$

To find Draft Change Wheel for any given Draft.

$$\frac{\text{Diar. of Front Roller} \times E \times C}{\text{Diar. of Back Roller} \times \text{Draft required} \times B} = \text{Draft Change Wheel required.}$$

To find Constant Number for Total Draft.

$$\frac{\text{Diar. of Front Roller} \times E \times C}{\text{Diar. of Back Roller} \times B} = \text{Constant Number.}$$

$$\frac{\text{Constant Number}}{\text{Draft Change Wheel}} = \text{Total Draft.} \qquad \frac{\text{Constant Number}}{\text{Total Draft required}} = \text{Draft Change Wheel.}$$

To find Intermediate Drafts.

$$\frac{\text{Diar. of 3rd Roller} \times I}{\text{Diar. of 4th or Back Roller} \times K} = \text{Draft between 3rd and 4th Rollers.}$$

$$\frac{\text{Diar. of 2nd Roller} \times F}{\text{Diar. of Back Roller} \times H} = \text{Draft between 2nd and 4th Rollers.}$$

$$\frac{\text{Diar. of 2nd Roller} \times K \times F}{\text{Diar. of 3rd Roller} \times I \times H} = \text{Draft between 2nd and 3rd Rollers.}$$

Intermediate Drafts multiplied together = Total Draft.

To find Draft Change Wheel when altering the Weight or Hank of Sliver.

$$\frac{\text{Desired Weight} \times \text{Change Wheel on}}{\text{present Weight of Sliver.}} = \text{Draft Change Wheel required.}$$

or

$$\frac{\text{Present Hank} \times \text{Change Wheel on}}{\text{Hank Sliver required.}} = \text{Draft Change Wheel required.}$$

To find the Hank Drawing.

Divide the weight in grains of a certain number of yards of delivered Sliver into the dividend for the number of yards taken, and the quotient will be the hank required.

(*See* Card Calculations for example, also P. 139 for Table of Dividends.)

or

$$\frac{\text{Draft in Drawing Frame} \times \text{Hank Carding}}{\text{Number of Ends put up}} = \text{Hank Drawing.}$$

$$\frac{\text{Number of Ends put up} \times \text{Hank Drawing}}{\text{Hank Carding}} = \text{Draft.}$$

$$\frac{\text{Number of Ends put up} \times \text{Hank Drawing}}{\text{Draft}} = \text{Hank Carding.}$$

$$\frac{\text{Number of Ends put up} \times \text{Weight of Carding}}{\text{Draft}} = \text{Weight of Drawing.}$$

$$\frac{\text{Number of Ends put up} \times \text{Weight of Carding}}{\text{Weight of Drawing}} = \text{Draft.}$$

To find the "Calculated" Production in Hanks per delivery in 10 hours.

$$\frac{\underset{\text{per minute}}{\text{Revs. of Front Roller}} \times \underset{60}{\text{mins.}} \times \underset{10}{\text{hours}} \times \underset{\text{Front Roller}}{\text{Circum. of}}}{840 \text{ yards} \times 36 \text{ inches}} = \text{Hanks per delivery.}$$

$$\frac{\text{Hanks per delivery}}{\text{decimal hank of Sliver}} = \text{Pounds per delivery.}$$

From the "calculated" production, an allowance should be made for stoppages due to breakages of sliver, &c., and although this will vary according to circumstances, such as the speeds of rollers, skill of the workpeople, and the quality of the cotton worked, the following percentages may be taken as a suitable allowance generally. See next page.

Calculated Production per Finishing Delivery per Day of 10 Hours,

Without any Allowance for Loss in Stoppages, &c.

Hank Sliver.	Weight of Sliver per 6 yards.			Revolutions of Front Roller, 1⅜″ diameter.		
				300 Revs.	350 Revs.	400 Revs.
	oz.	dwts.	grains	lbs.	lbs.	lbs.
·100	1	2	14·5	257·14	300·00	342·81
·105	1	1	14·68	244·89	285·72	326·50
·110	1	0	17·04	233·75	272·71	311·69
·115		18	2·78	223·59	260·87	298·11
·120		17	8·66	214·29	250·00	285·72
·125		16	16·00	205·71	240·00	274·27
·130		16	0·6	197·80	230 64	263·74
·135		15	10·37	190·48	222·22	253·97
·140		14	21·0	183·66	214·29	244·89
·145		14	8·82	177·34	206·88	236·44
·150		13	21·33	171·43	200·CO	128·48
·155		13	10·58	165·90	193·54	221·19
·160		13	0·50	160·71	187·39	214·29
·170		12	6·0	151·23	176·46	201·68
·180		11	13·77	142·86	166·67	190·48
·190		10	23·15	135·34	157·89	180·45
·200		10	10·0	128·57	149·98	171·41

If Front Roller 1¼″ diameter, multiply above productions by $\cdot\dot{9}\dot{0}$.

„ „ 1½″ „ „ „ „ „ $1\cdot\dot{0}\dot{9}$.

If 2 deliveries per head, deduct 8% from above productions for loss in stoppages, &c.

3 „ „ „ 12% „ „ „

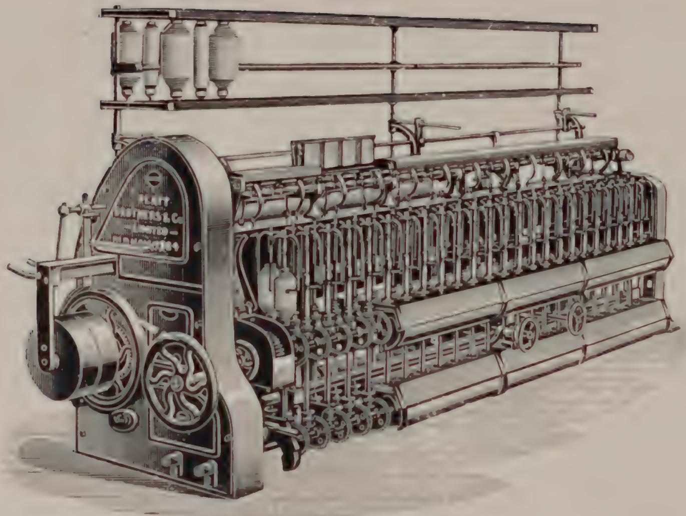
4 „ „ „ 15·5% „ „ „

5 „ „ „ 19% „ „ „

6 „ „ „ 22% „ „ „

7 „ „ „ 25% „ „ „

8 „ „ „ 27·5% „ „ „



Front View.

SLUBBING, INTERMEDIATE, AND ROVING FRAMES.

IMPROVED "J" PATTERNS.

The principal feature of our "J" patterns is the use of a cast-iron bed plate (between the frame end and the first spring piece), having fitting beds, to which the reversing motion and other details are bolted.

The patterns have been so designed that one and the same pattern of bed plate will serve for all Slubbing, Intermediate and Roving Frames of a like "hand," and the advantage obtained from the fewness of parts is of very great importance. Compared with the old style of machine with double back or cross rail, the new machine is more solid and substantial, and more easy of access.

Spur wheel gearing is used in every case between the bottom cone and the winding motion, instead of an upright shaft with bevel wheels, and in connection with this system of spur wheel gearing, there is a convenient arrangement for changing the winding wheel.

Since 1884 we have casehardened the $1\frac{3}{4}$ in. diar. pulley shafts from end to end, and this method has proved to be very durable and satisfactory. The pedestals are of cast-iron, and the whole arrangement works with a minimum amount of friction and wear. We now fix a bracket to the end of our new frames, as an additional support for the pulleys and driving shaft, which greatly increases the power to resist the pull of the strap, and possesses the advantage over other arrangements of leaving the strap as free to be put on or off the pulleys as if the shaft were without the end support.

Winding Motion.—The machines are fitted with the Curtis and Rhodes patent differential or winding motion, of which the principal advantages over the Houldsworth system of "sun and planet" motion (with the combination of four bevel wheels), are in the use of spur wheels instead of bevels, and in the fact that the pulley shaft and the wheels in the differential motion are all running in the same direction, thus minimising the wear and friction, and also reducing the power required to drive the apparatus, consequently increasing the efficiency of the motion and the durability of the various parts.

To reduce to a minimum the inequality in the winding due to the motion of the lifting rail (in connection with the train of wheels between the winding motion and the bobbin shafts), the driving or pulley shaft is placed in the centre of the arc described by the swing lever in the motion from top to bottom of the chase or lift.

An Improved Cone Strap Tightening Apparatus is applied to all the machines of this pattern. The bottom cone is held in a rigid frame, which swings radially on pivots at each end, so as to permit the cone to be raised or lowered, and this obviates the trouble of shortening or relacing the cone strap. The apparatus for regulating the tension of the cone strap, as well as the apparatus for winding back the cone strap when the bobbins are full, are both worked from the front or spindle side of the machine, so that a little tenter can operate both.

We apply **Ashton and Moorhouse's Patent Duplex Cones** when desired. This apparatus consists of two top and two bottom cones—instead of the usual single top and bottom cones—the bottom cones having the Improved Cone Strap Tightening Apparatus so as to tighten both straps together.

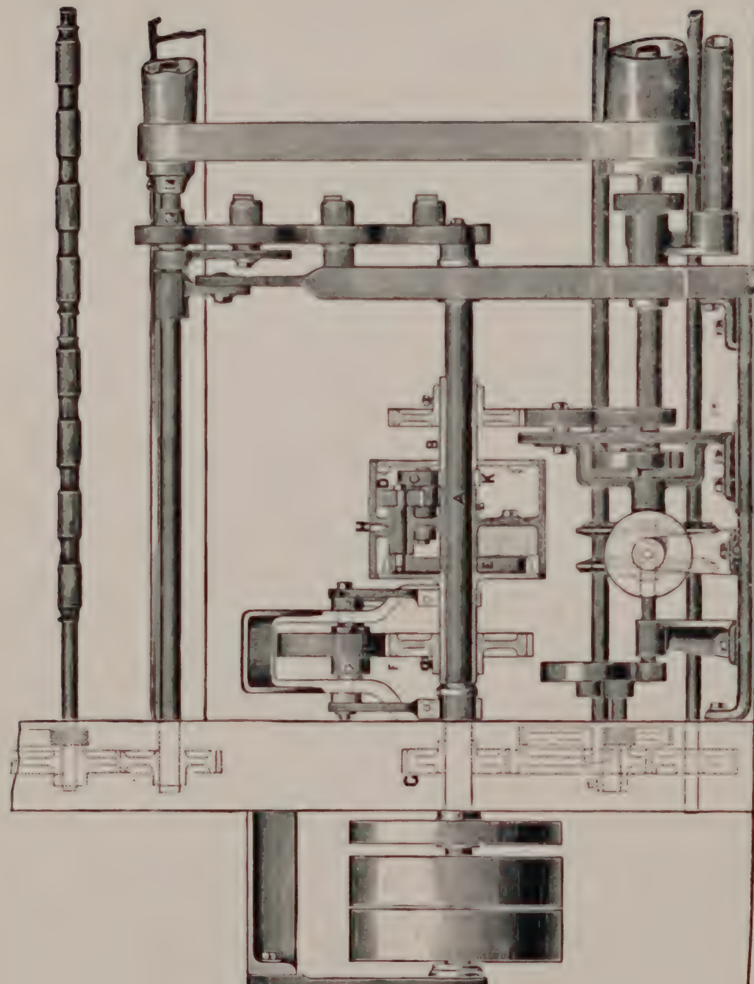
We can balance the lifter rail by dead weight and chain attached behind the rail, such as we have adopted as our standard for many years, or if preferred, we can now supply a Lever Balancing Arrangement underneath the centre of rail.

Our standard Traverse Motion being worked from the Shortening Motion is to a certain extent variable, but we can supply other forms of traverse motions if preferred, viz.:—Dugdale's Variable, Dodd's Variable, Tatham's Duplex, or Heart Traverse Motion, all worked from back roller.

The ordinary Knocking-off Motion stops the frame at the extremity of the traverse, but we have patented the Hilton's Automatic Stop Motion, which is designed to stop the machine automatically at any point in the traverse, when the bobbins have attained the desired diameter.

Where required, a German clock, or Measuring and Knocking-off Motion, can be applied at end of top coneshaft.

Either Long or Short Spindle Collars are applied, as may be preferred, but for the high speeds now in request the long collar system is recommended, and where adopted double pressers are considered unnecessary, as the collar supports the spindle to the fullest possible extent.



Curtis and Rhodes' Patent Winding Motion for Flyer Frames.

CURTIS AND RHODES' PATENT WINDING MOTION FOR FLYER FRAMES.

The Curtis and Rhodes' patent winding motion has been introduced to overcome the objections to the Houldsworth "Jack i'th' Box," or sun and planet motion; it reduces the speed of the internal wheels to a minimum, and is so arranged that all the wheels run in the same direction (and not in the contrary direction to each other as is the case with the Houldsworth "Jack i'th' Box"), thus increasing the durability and requiring less attention in oiling and cleaning.

After a long experience we can recommend this Motion with confidence as being the best system in use at the present time, particularly for bobbin to lead as now almost invariably adopted in modern mills.

The illustration shows the Curtis and Rhodes' patent winding motion applied to our improved ("J" pattern) frames. **A** is the driving shaft, the spindles being driven by wheel **G** and the bobbins by wheel **F**. As usual, the wheel **F** driving the bobbins is loose on the driving shaft, but is fixed to the long bush of the internal wheel **E**. The disc **H** is fixed to, and runs with, the shaft **A**. The connection of the internal wheel **E** with the bottom cone is by means of the train of spur wheels, the long bush **B** on driving shaft with small pinion **K** projecting into the box. This pinion drives the pinions **C** and **D**; the stud carrying the wheel **D** having at its other end a small pinion **L** driving the internal wheel **E**, which is cast to the long collar on which the wheel **F**, which drives the bobbin shafts, is fastened.

AUTOMATIC LOCKING DOORS.

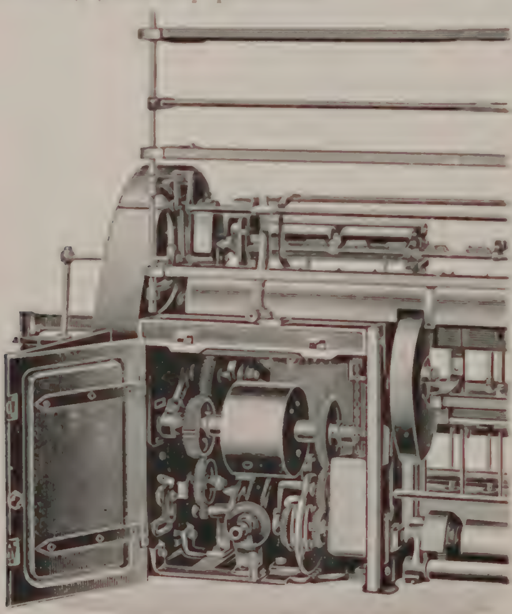
The loose cast-iron guards hitherto usually applied are somewhat liable to be broken, and in some cases the work-people forget to replace these guards after cleaning, &c.

Frames with Automatic Locking Doors (shown in illustration) have no loose guards whatever behind the Headstock.

The doors are made of stamped sheet iron, and are placed at the back of the machine between the frame end and the first spring piece, thus covering effectually the main gearing of the frames, and securing at the same time ready access to all the parts for oiling, cleaning, and the changing of wheels.

The automatic locking apparatus is applied to prevent the frame being set in motion until the doors are closed and fastened, and once closed, and the machine in motion, the doors cannot be opened again until the strap is moved on to the loose pulley, thus preventing the liability to accidents from oiling and cleaning machinery in motion.

We can put the train of twist gearing from end of pulley shaft to top cone *inside or outside* the Automatic Locking Doors, the former being generally preferred.



FLYER FRAMES.

Staffs or standard sizes of rollers (measured from centre to centre of stand), distances of spindles, and diameters of bobbins when full are :—

STAFF.	Distance of Spindles.	Diameter of Full Bobbin.	Spindles in each Box or Staff.
SLUBBING FRAMES.			
$21\frac{7}{8}$ ins.	11 ins.	$5\frac{1}{2}$ ins.	4
$20\frac{1}{2}$ ins.	$10\frac{1}{4}$ ins.	$5\frac{1}{2}$ ins.	4
19 ins.	$9\frac{1}{2}$ ins.	$5\frac{1}{2}$ ins.	4
18 ins.	9 ins.	$5\frac{1}{2}$ ins.	4
17 ins.	$8\frac{1}{2}$ ins.	$5\frac{1}{2}$ ins.	4
16 ins.	8 ins.	$5\frac{1}{4}$ ins.	4
INTERMEDIATE FRAMES.			
STAFF.	Distance of Spindles.	Diameter of Full Bobbin.	Spindles in each Box or Staff.
$26\frac{3}{8}$ ins.	$6\frac{5}{8}$ ins.	$4\frac{3}{4}$ ins.	8
25 ins.	$6\frac{1}{4}$ ins.	$4\frac{1}{2}$ ins.	8
$24\frac{1}{8}$ ins.	8 ins.	$4\frac{3}{4}$ ins.	6
24 ins.	8 ins.	$5\frac{1}{4}$ ins.	6
$19\frac{3}{4}$ ins.	$6\frac{5}{8}$ ins.	$4\frac{3}{4}$ ins.	6
ROVING FRAMES.			
STAFF.	Distance of Spindles.	Diameter of Full Bobbin.	Spindles in each Box or Staff.
24 ins.	6 ins.	4 ins.	8
$21\frac{7}{8}$ ins.	$5\frac{1}{2}$ ins.	$3\frac{3}{4}$ ins.	8
$20\frac{1}{2}$ ins.	$5\frac{1}{8}$ ins.	$3\frac{5}{8}$ ins.	8
19 ins.	$4\frac{3}{4}$ ins.	$3\frac{3}{8}$ ins.	8
18 ins.	$4\frac{1}{2}$ ins.	$3\frac{1}{4}$ ins.	8
$17\frac{1}{2}$ ins.	$4\frac{3}{8}$ ins.	$3\frac{1}{8}$ ins.	8
16 ins.	4 ins.	$2\frac{1}{2}$ ins.	8
22 ins.	$4\frac{3}{8}$ ins.	$3\frac{1}{8}$ in.	10
20 ins.	4 ins.	$2\frac{1}{2}$ in.	10
$21\frac{3}{4}$ ins.	$3\frac{5}{8}$ ins.	$2\frac{1}{2}$ ins.	12

In order to calculate the length of frame multiply the number of boxes by the staff, and add $33\frac{1}{2}$ inches for gearing and driving pulleys 3 inches wide, plus $2\frac{1}{4}$ inches if with $3\frac{1}{2}$ inches wide pulleys and suspended pedestals.

Width of Frames : Slubbing, 4′ 6″ ; Intermediate, 3′ ; Roving, 3′.

Driving pulleys, 9″ to 23″ diar. × 3″ or $3\frac{1}{2}$″ wide.

Speed of spindles according to circumstances, see next page.

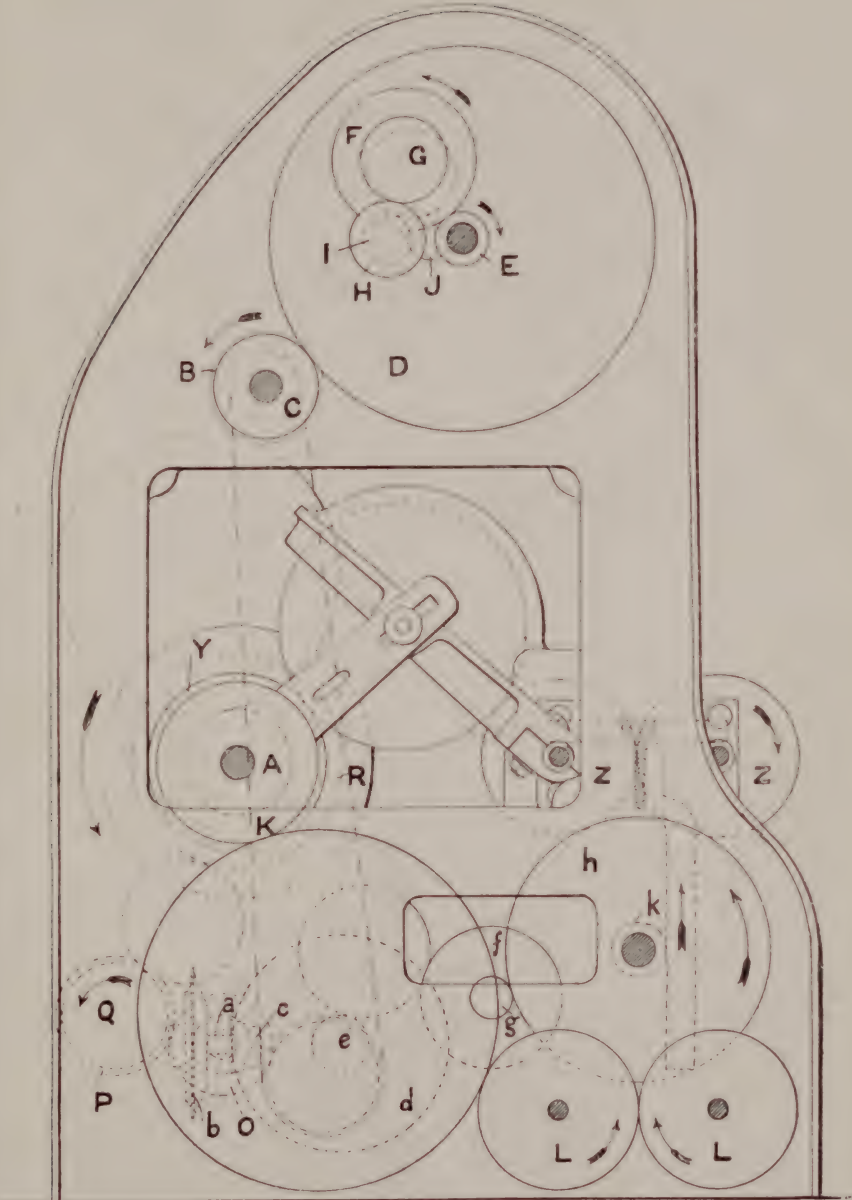
Speeds of Spindles for various sizes of Bobbins.

The approximate speed of spindles for American cotton may be taken as follows:—

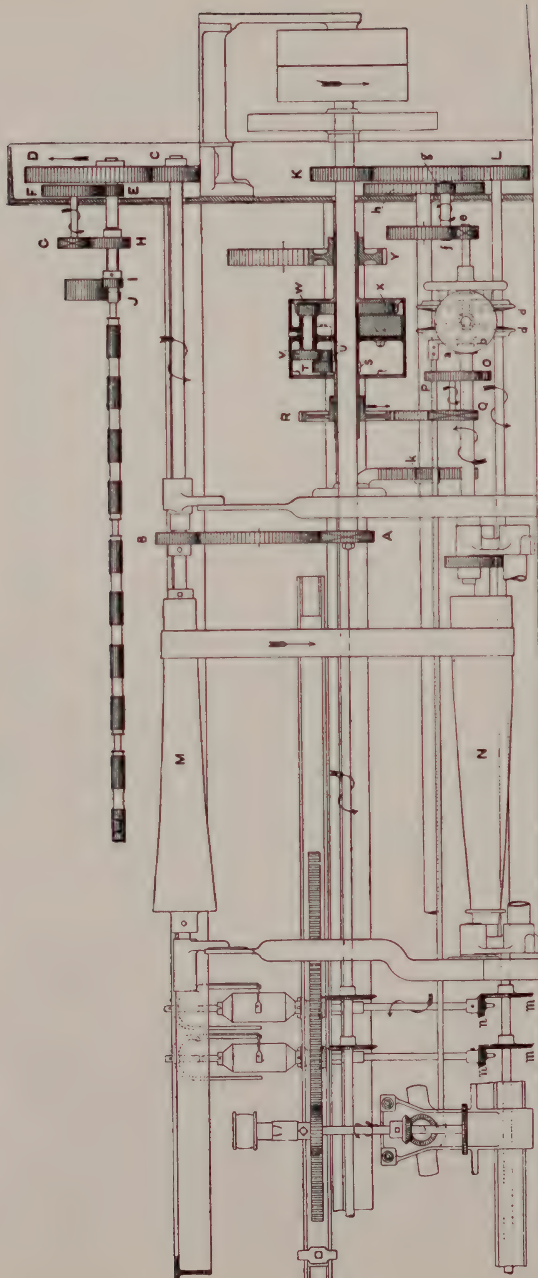
Machine.	Lift.	Diar. of Full Bobbin.	Short Collars.	Long Collars.
Slubbing	12″	6½″	320	450
,,	12″	5½″	350	500
,,	11″	5½″	420	540
,,	10″	5½″	460	600
Intermediate	11″	4¾″	540	700
,,	10″	4½″	600	750
,,	9″	4½″	680	880
,,	8″	4½″	750	890
Coarse Roving	9″	4″	720	936
,,	8″	4″	760	980
Roving	8″	3½″	800	1000
,,	7″	3½″	850	1100
Fine Roving	7″	3½″	1000	1300
,,	6″	3½″	1060	1360
,,	6″	2½″	1260	1500

For short stapled cotton, such as East Indian, the above spindle speeds are sometimes exceeded, but not as a rule recommended, if durability of parts is to be considered.

For long stapled cotton, such as Egyptian, Sea Islands, &c., it is not considered advisable to run Slubbing and Intermediate frames with long collars at a higher speed than stated in the "short collar" list above.



Flyer Frame. End View.



Flyer Frame, "J" Pattern.

Slubbing, Intermediate, and Roving Frames.

Alphabetical References to Sketches.

Twist Arrangement.

		Slub.	Int.	Rov.	Fine Rov.
A	Twist change wheel	—	—	—	
B	Middle top cone shaft wheel	30T	30T	40T	55T
C	Gear end top cone or backshaft wheel	51T	42T	35T	30T
D	Front roller wheel	130T	130T	130T	140T
K	Spindle driving wheel	39T	39T	33T	35T
L	Spindle shaft or bottom coupling wheels	39T	39T	33T	35T
m	Skew gear wheel on spindle shaft	48T	56T	60T	47T
n	Spindle pinion	24T	24T	21T	21T

Draft Arrangement.

		Slub.	Int.	Rov.	Fine Rov.
E	Front roller pinion	24T or 28T	24T or 28T	24T or 28T	24T or 28T
F	Crown wheel	90T	90T	90T	90T or 100T
G	Draft change wheel	—	—	—	—
H	Back roller wheel	48T or 56T	48T or 56T	48T or 56T	48T or 56T
I	Back roller pinion	—	—	—	—
J	Middle roller pinion	—	—	—	—

Bobbin Driving Arrangement.

		Slub.	Int.	Rov.	Fine Rov.
M	Top cone (concave)	—	—	—	—
N	Bottom cone (convex)	—	—	—	—
O	Spur wheel on bottom short cone shaft	45T	45T	45T	45T
P	Stud wheel	50T	50T	50T	50T

		Slub.	Int.	Rov.	Fine Rov.
Q	Taking-up or winding change wheel	— ...	— ...	— ...	—
R	Long socket wheel (outside box)	106T ...	106T ...	106T ...	80T
S	Long socket pinion	30T ...	30T ...	30T ...	30T
T	Compound carrier (inside box)	25T ...	25T ...	25T ...	25T
U		24T ...	24T ...	17T ...	16T
V	Single wheel ,, ,,	24T ...	24T ...	30T ...	32T
W	Stud pinion ,, ,,	14T ...	14T ...	14T ...	14T
X	Internal wheel (for bobbin to lead)	90T ...	90T ...	90T ...	90T
Y	Bobbin driving or box wheel ...	58T ...	58T ...	47T ...	52T
Z	Bobbin shaft or top coupling wheels	47T ...	47T ...	42T ...	35T

Lifting Arrangement.

		Slub.	Int.	Rov.	Fine Rov.
a	Bevel on short cone shaft	13T ...	13T ...	13T ...	13T
b	Plate bevel on short horizontal shaft	50T ...	50T ...	50T ...	60T
c	Small bevel on short horizontal shaft	14T ...	12T ...	10T ...	8T
d d	Reversing bevels	100T ...	100T ...	100T ...	100T
e	Lifter change wheel on reversing shaft	18T ...	16T ...	13T ...	13T
f	Compound carrier	40T ...	40T ...	50T ...	50T
g		28T ...	18T ...	17T ...	14T
h	Lifter shaft wheel...........	90T ...	90T ...	90T ...	90T
k	Lifter rack pinion..................	22T ...	22T ...	22T ...	20T

Slubbing, Intermediate, and Roving Frames.

Calculations.

To find Speed of Spindles.

$$\text{Speed of pulley shaft} \times \frac{K \times m}{L \times n} = \text{Speed of Spindles.}$$

To find Speed of Front Roller.

$$\text{Speed of pulley shaft} \times \frac{A \times C}{B \times D} = \text{Speed of Front Roller.}$$

To find Turns of Spindle for 1 of Front Roller.

$$\frac{D \times B \times K \times m}{C \times A \times L \times n} = \text{Turns of Spindle for 1 of Front Roller.}$$

$$\frac{\text{Turns of Spindle for 1 of Front Roller}}{\text{Circumference of Front Roller.}} = \text{Turns of Twist per inch.}$$

To find Turns of Twist per inch.

$$\frac{\text{Speed of Spindles per min.}}{\text{Length delivered by Front Roller per min.}} = \text{Turns of Twist per inch}$$

Therefore :—

$$\left\{\frac{D \times B \times K \times m}{C \times A \times L \times n}\right\} \text{Divided by Circumference of Front Roller} = \text{Turns of Twist per inch.}$$

To find Constant Number for Twist.

$$\frac{D \times B \times K \times m}{C \times \text{Circum. of Front Roller} \times L \times n} = \text{Constant Number.}$$

$$\frac{\text{Constant Number}}{\text{Twist Wheel}} = \text{Turns of Twist per inch.}$$

$$\frac{\text{Constant Number}}{\text{Turns per inch required}} = \text{Twist Wheel required.}$$

To find Draft.

$$\frac{\text{Hank delivered}}{\text{Hank fed up}} \text{ Total Draft. } \quad or \quad \frac{\text{Diar. of Front Roller} \times H \times F}{\text{Diar. of Back Roller} \times G \times E} \text{ Total Draft.}$$

To find Constant Number for Draft.

$$\frac{\text{Diar. of Front Roller} \times H \times F}{\text{Diar. of Back Roller} \times E} = \text{Constant Number.}$$

$$\frac{\text{Constant Number}}{\text{Draft Wheel}} = \text{Total Draft.}$$

$$\frac{\text{Constant Number}}{\text{Total Draft required}} = \text{Draft Change Wheel.}$$

To find Draft between Middle and Back Rollers or breakage Draft.

$$\frac{\text{Diar. of 2nd Roller} \times I}{\text{Diar. of 3rd Roller} \times J} = \text{Breakage Draft.}$$

To find the Layers per inch of Lift.

$$\frac{h \times f \times d \times b \times N \times C \times \text{Dia. of Front Roller}}{g \times e \times c \times a \times M \times D \times \text{Dia. of Empty Bobbin} \times 6{\cdot}9} = \text{Layers per inch of Lift.}$$

Note.—6·9 inches is the distance travelled by the top rail whilst the lifting shaft makes one revolution.

In this case the diameters of top and bottom cones should be taken at centre of strap when set for empty bobbin.

To find the Layers per inch of Lift when altering the Hank.

$$\frac{\text{Layers per inch being made} \times \sqrt{\text{hank to be made}}}{\sqrt{\text{hank being made}}} = \text{Layers per inch required.}$$

To find Lifter Change Wheel when altering number of Layers per inch.

$$\frac{\text{Layers per inch being made} \times \text{Lifter Wheel on}}{\text{Layers per inch required}} = \text{Lifter Change Wheel required.}$$

To find approximate **Speed of Bobbins.**

1st. To find Speed of Long Socket Wheel R.

$$\text{Speed of Pulley Shaft} \times \frac{A \times M \times O \times Q}{B \times N \times P \times R} = \text{Speed of R.}$$

2nd. To find Speed of Bobbin Driving Wheel Y.

$$\text{Speed of R minus Speed of Pulley Shaft} \times \left(\frac{S \times U \times W}{T \times V \times X}\right) + \text{Speed of Pulley Shaft} = \text{Speed of Bobbin Driving Wheel Y.}$$

$$\text{Speed of Y} \times \frac{Y \times m}{Z \times n} = \text{Speed of Bobbins.}$$

Speed of Bobbins minus the Speed of Spindles = Excess Speed of Bobbins required for winding on the Sliver. (Bobbin to lead.)

Excess revs. of Bobbins × circumference of Bobbin = length of Sliver wound on the Bobbin, which should be about equal to the length delivered by the front roller in the time taken.

Note.—The accuracy of the above calculation depends altogether upon obtaining the exact speed of bottom cone at the particular diar. of bobbin taken.

When altering from one Hank to another to find:—

Draft Wheel.

$$\frac{\text{Hank being made} \times \text{Change Wheel on}}{\text{Hank required}} = \text{Change Wheel required.}$$

Twist Wheel or Lifter Wheel.

$$\sqrt{\frac{\text{Present wheel}^2 \times \text{Hank being made}}{\text{Hank required}}}$$

Ratchet Wheel.

$$\sqrt{\frac{\text{Present wheel}^2 \times \text{Hank required}}{\text{Hank being made}}}$$

To find Calculated Production.

$$\frac{\text{Speed of Spindles per min.} \times 60 \text{ minutes} \times \text{Number of hours taken}}{\text{Turns of Twist per inch} \times 36'' \times 840 \text{ yards}} = \text{Hanks delivered.}$$

or

$$\frac{\text{Inches delivered by Front Roller per minute} \times 60 \text{ minutes} \times \text{Number of hours taken}}{36'' \times 840 \text{ yards}} = \text{Hanks delivered.}$$

$$\frac{\text{Hanks per number of hours taken}}{\text{Hank of Sliver}} = \text{Pounds delivered.}$$

Note.—As will be seen, the above is for "calculated" production only, that is, assuming continuous running for the number of hours taken. To obtain a near estimate of the "actual" production, certain allowances require to be made for loss in piecing, doffing, &c.; this loss will vary according to circumstances, such as speed of spindles, hank roving produced, skill of workpeople, &c., but the following may be taken as a range:—Slubbing, 39 to 22 per cent.; Intermediate, 18 to 8 per cent.; Roving, 17 to 5 per cent.; Fine Roving, $12\frac{1}{2}$ to $4\frac{1}{2}$ per cent., depending on hank roving, &c.

To find Hank of Sliver produced.

$$\text{The dividend for 1 yard} = \frac{7000 \text{ grs.}}{840 \text{ yards}} = 8{\cdot}33.$$

Therefore :—

$$\frac{8{\cdot}33 \times \text{Number of yards taken}}{\text{Weight in grains of the number of yards taken}} = \text{Hank of Sliver.}$$

Slubbing, Intermediate, and Roving Frames.

The following illustration will show how to find the production of Slubbing, Intermediate, or Roving Frames under any given circumstances.

Take for example say 4 hank roving under the conditions laid down, thus :—

$$\frac{1100 \text{ revs.} \times 60 \text{ mins.} \times 10 \text{ hours}}{\underset{\text{turns}}{2{\cdot}3} \times \underset{\text{yds.}}{840} \times \underset{\text{ins.}}{36}} = 9{\cdot}48 - 11\,\% = 8{\cdot}44 \text{ hanks per 10 hours.}$$

Productions of Slubbing, Intermediate, Roving, and Fine Roving Frames.

In calculating these productions we have assumed average weights of bobbins and allowances for doffing, breakages, &c., but have not made any allowance for cleaning time.

Slubbing Frames.

Twist per inch $= \sqrt[2]{\text{counts}} \times 0{\cdot}95$ for American cotton.

,, ,, = ,, × 0·64 ,, Egyptian ,,

Revs. of Spindles per min.	Hank Roving.	Turns of Twist per inch.	Production in 10 hours, after all allowance for loss taken off, not including cleaning time.		Kind of Cotton.	Loss allowed for doffing and breakages.
			Hanks.	lbs.		
600	0·5	0·671	10·8	21·6	American	39 %
600	0·55	0·704	10·6	19·3	,,	37 %
600	0·6	0·736	10·5	17·5	,,	35 %
600	0·65	0·765	10·3	15·9	,,	33½%
600	0·7	0·795	10·18	14·5	,,	32 %
600	0·75	0·822	10·0	13·4	,,	30½%
600	0·8	0·849	9·87	12·3	,,	29½%
600	0·85	0·875	9·7	11·4	,,	28½%
600	0·9	0·901	9·58	10·6	,,	27½%
440	1·0	0·640	10·37	10·37	Egyptian	24 %
440	1·1	0·671	10·0	9·1	,,	23 %
440	1·2	0·701	9·7	8·1	,,	22 %

Intermediate Frames.

Twist per inch $= \sqrt[2]{\text{counts}} \times 1{\cdot}05$ for American cotton.

" " = " $\times$ 0·76 " Egyptian "

Revs. of Spindles per min.	Hank Roving.	Turns of Twist per inch.	Production in 10 hours, after all allowance for loss taken off, not including time for piecing.		Kind of Cotton.	Loss allowed for doffing and breakages.
			Hanks.	lbs.		
750	1·2	1·149	10·61	8·84	American	18 %
750	1·4	1·241	10·07	7·19	"	16 %
750	1·6	1·327	9·64	6·02	"	14 %
750	1·8	1·407	9·24	5·08	"	12½%
750	2·0	1·484	8·91	4·45	"	11 %
750	2·2	1·557	8·59	3·9	"	10 %
650	2·5	1·201	9·66	3·86	Egyptian	10 %
650	3·0	1·316	8·91	2·97	"	9 %
650	3·5	1·421	8·28	2·42	"	8 %

Roving Frames.

Twist per inch $= \sqrt[2]{\text{counts}} \times 1{\cdot}15$ for American cotton.

Revs. of Spindles per min.	Hank Roving.	Turns of Twist per inch.	Production in 10 hours, after all allowance for loss taken off, not including time for piecing.		Kind of Cotton.	Loss allowed for doffing and breakages.
			Hanks.	lbs.		
1100	3·0	1·99	9·10	3·03	American	17 %
1100	3·25	2·072	8·89	2·73	"	15½%
1100	3·5	2·15	8·77	2·5	"	13½%
1100	3·75	2·226	8·57	2·28	"	12½%
1100	4·0	2·3	8·44	2·11	"	11 %
1100	4·25	2·37	8·28	1·94	"	10 %
1100	4·5	2·439	8·14	1·8	"	9 %
1100	4·75	2·505	8·01	1·68	"	8 %
1100	5·0	2·571	7·84	1·56	"	7½%
1100	5·25	2·634	7·7	1·46	"	7 %
1100	5·5	2·696	7·56	1·37	"	6¾%
1100	5·75	2·756	7·42	1·29	"	6¼%
1100	6·0	2·816	7·28	1·21	"	6 %
1100	6·25	2·875	7·15	1·14	"	5¾%
1100	6·5	2·931	7·03	1·08	"	5½%
1100	6·75	2·987	6·92	1·02	"	5¼%
1100	7·0	3·041	6·81	0·97	"	5 %

FINE ROVING FRAMES.

Twist per inch $= \sqrt[2]{\text{counts}} \times 1{\cdot}0$ for Egyptian cotton.

Revs. of Spindles per min.	Hank Roving.	Turns of Twist per inch.	Production in 10 hours, after all allowance for loss taken off, not including time for piecing.		Kind of Cotton.	Loss allowed for doffing and breakages.
			Hanks.	lbs.		
1200	7·0	2·645	7·87	1·125	Egyptian	12½%
1200	7·5	2·738	7·73	1·031	,,	11 %
1200	8·0	2·828	7·57	0·947	,,	10 %
1200	8·5	2·915	7·51	0·883	,,	8 %
1200	9·0	3·0	7·38	0·82	,,	7 %
1200	9·5	3·082	7·26	0·764	,,	6 %
1200	10·0	3·162	7·11	0·71	,,	5½%
1200	10·5	3·24	6·98	0·664	,,	5 %
1200	11·0	3·316	6·82	0·62	,,	5 %
1200	11·5	3·391	6·68	0·581	,,	4¾%
1200	12·0	3·464	6·54	0·545	,,	4¾%
1200	12·5	3·535	6·41	0·513	,,	4¾%
1200	13·0	3·605	6·29	0·483	,,	4¾%
1200	13·5	3·674	6·18	0·458	,,	4½%
1200	14·0	3·741	6·07	0·434	,,	4½%

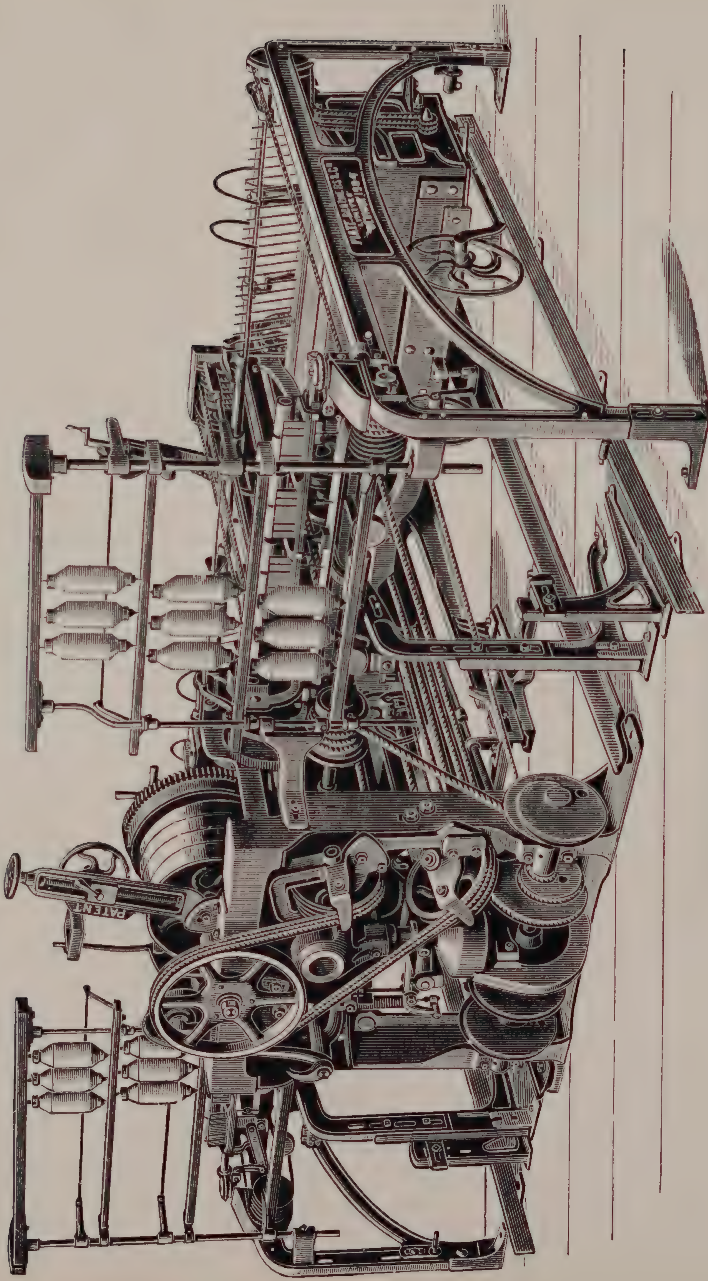
NOTE.—In the headings of productions of Intermediate, Roving, and Fine Roving Frames, read "time for cleaning" instead of time for piecing.

SPINNING MACHINERY.

SELF-ACTING MULES

AND

RING SPINNING FRAMES.



Self-Acting Mule, with Rim at Back.

PATENT SELF-ACTING MULE.

In drawing attention to the many improvements and additions introduced during recent years in our Patent Self-Acting Mule, we desire to mention the substantial construction and state of efficiency to which it has now attained, for coarse, medium, and fine yarns.

As will be seen from the back view of the mule shown by the illustration, the headstock is bolted on strong foundation plates which carry also the main slips and copping motion, and thus facilitate the adjusting of the latter.

The **Rim** can be placed at the **back or side,** as preferred, or as may be best suited for the position of the main driving shaft in the room in which the mule has to be placed, and the gauge or distance between the spindles may be from 1 in. upwards, depending upon the class of work required.

The following motions, &c., may be adopted according to requirements :—

Moorhouse and Ashton's patent Duplex Driving.

Patent rope tightening apparatus to rope taking-in.

Jacking or Stretching and Roller Delivery Motion whilst jacking during the last few inches of the stretch, for the purpose of drawing out any snarls or thick places in the yarn.

Quadrant screw of two diameters.

Anti-friction bowls to front and counter fallers.

Scroll band tightening frame.

Patent holder for fastening check scroll bands.

Patent Automatic Nosing Motion, and quadrant box with 3 catches.

Patent governor or cop regulator for adjusting the winding-on motion to the increasing size of cop, which is automatic in its action.

Patent Backing-off Chain Tightening Motion.

Click locking motion, and motion for holding the winding-on click out of gear during the outward run of the carriage.

Plate Bolsters and Plate Footsteps of various descriptions.

Palmer's and other patent step covers with deep steps.

Tin roller pulley in halves.

Tin roller shaft in square with flanged couplings on each side.

Double carrier wheels at headstock or outend.

Casehardened tin roller arbors. Steel tin roller shafts.

Motion for forcing the strap off the fast pulley before the completion of the outward run of the carriage.

Front faller depressing motion.

Treble-grooved rim band arrangement, with compensating bottom rim band carrier pulley for taking up the slack band at the commencement of the outward run of the carriage.

Handle on side of headstock for stopping the mule without stopping the countershaft; special arrangements in connection with the drawing out and taking in of the carriage, by means of which, in case of obstruction, the carriage can be stopped by the attendant very quickly during the outward run, or suddenly during the taking in; also automatic arrangement for stopping the carriage during its outward run, should the camshaft by accident or otherwise make its change before the proper time; likewise special arrangements for disengaging the taking-in motion by the carriage itself, when terminating its inward run.

These arrangements prevent the breakage of the drawing-out and taking-in bands, and render the mule less liable to derangement and breakage from accidents or mismanagement.

Guards over carriage wheels, rim band carrier pulley, middle drawing-out from floor to scroll and also over scroll, crown wheel, front roller pinion, change pinion and back roller wheel, backing-off wheel on rimshaft, and a sheet-iron guard behind the headstock.

Swivel tin roller bearings, oiled from front of carriage.

Roller delivery motion whilst the carriage is going in, to deliver about 4 in. additional yarn during winding, which tends to increase the production.

Long copping rail with loose front automatic incline for regulating the locking of the fallers.

Double copping plates, which allow the copping rail to be taken out and replaced at any stage of the cop's progress without disturbing its working position.

Improved Construction of Square and Carriage Coupling, by which the square and carriage are more firmly and accurately fastened together, rimshaft casehardened, and general construction such that an easy and accurate adjustment of the various parts of the machine, combined with great steadiness and durability, are obtained.

For long mules we recommend middle drawing-out band arrangements, and an extra taking-in scroll for driving the drawing-out shaft during the going in of the carriage, thus making it into a taking-in shaft, which gives greater steadiness to the carriage whilst going in, and for excessively long mules it is also advisable to have the rollers driven in the middle of each side, as the strain or torsion is then no greater than in short mules.

We are also Makers of Self-acting mules for fine yarns from Egyptian and Sea Islands cottons, say up to 300's, which, in former years, had to be spun on hand mules, owing to the delicate treatment required to prevent stretching or breaking of the thread, but now the Mule as made by us spins the finest counts as easily as 90's could be spun some years ago.

In addition to the motions on the mule for medium counts, the **Fine Spinning Mule** is fitted with patent faller lifting motion, the faller being lifted positively according to the speed of the tin roller or spindles, and lifted at a variable speed to suit the difference in the diar. of spindle, thus enabling the yarn to be coiled on the spindles free from snarls when the faller is unlocked by the patent unlocking motion, which is so arranged that the faller does not commence to unlock until the carriage finishes its inward run; **special slow speed arrangement to run the spindles slowly during the lifting of the winding faller**; patent motion for regulating the position of the counter faller during the rise of the winding faller; roller delivery motions to deliver during jacking, and the going in of the carriage, by which means the rollers are never allowed to stop during the time the mule is at work except during backing-off.

The mule can be made with either **double** or **single** speed. The double speed motion is accomplished without the aid of gearing, making it silent in its action, and the ratio of quick to slow speed or *vice versa* can be altered separately and independently of each other.

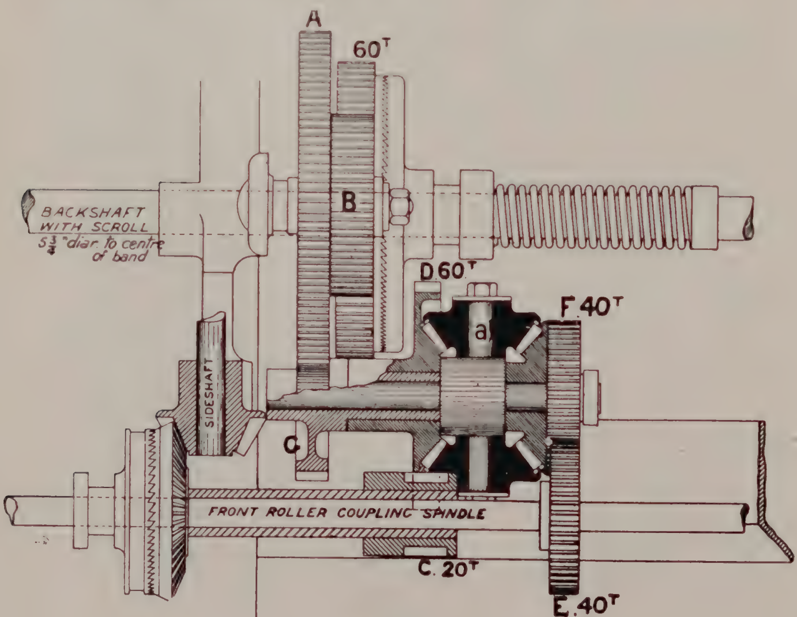
Motion to impart a slow speed to the spindles at the termination of the inward run of carriage and during the unlocking of the fallers, which is applied without faller lifting motion, thereby less time is lost during this operation than with the last named motion.

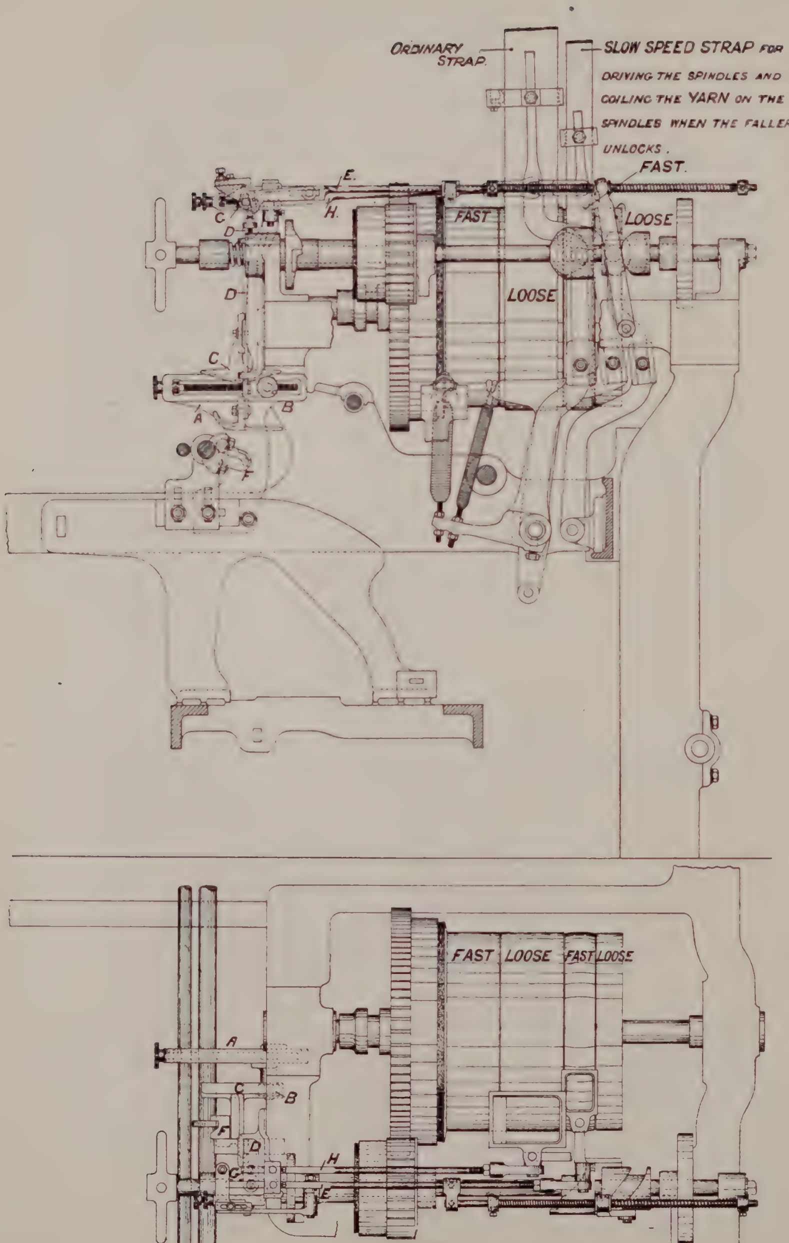
JACKING OR STRETCHING MOTION.

When the Jacking or Stretching Motion is used, the Cam changes before the carriage completes its outward run; the Jacking Motion then draws out the carriage very slowly to the full extent of the draw or stretch. During this time the spindles are revolving at the full speed, and continue to do so until the Twist Motion forces the catch off to allow the strap to go on the loose pulley on the rimshaft.

Our motion is arranged with the backshaft driving wheel connected to the arm of an epicyclic train of wheels as shown in the illustration.

When the front roller catch box is in gear, the wheel **G** makes $\frac{2}{3}$ of 1 revolution, whilst the front roller catch box makes 1 revolution, *i.e.*, $\frac{2}{3}$ revolutions of arm **a**, and wheel **G** for 1 revolution of roller or wheel **C**. When the catch box is opened, and the front roller stops, then the arm **a** (or wheel **G**) runs at $\frac{1}{6}$ speed of the catch box or wheel **C**; or in other words at $\frac{1}{4}$ the normal speed of carriage.




ORDINARY STRAP.
SLOW SPEED STRAP FOR DRIVING THE SPINDLES AND COILING THE YARN ON THE SPINDLES WHEN THE FALLER UNLOCKS.
FAST.
E.
H.
C
D
FAST
LOOSE
LOOSE
D
C
A
B
F
FAST
LOOSE
FAST
LOOSE
A
C
B
F
D
H
G
E

Slow Speed Motion for controlling the Yarn during the rise of the Winding Faller as the carriage finishes its inward run, for S. A. Cotton Mules, Rim at Back.

This motion gives a slow speed to the spindles when the carriage is completing its inward run, and during the rise of the front or winding faller after the unlocking has taken place, its object being to control more effectively the winding of the yarn at the apex of the chase, and to coil a few turns on the spindle blade. By these means a firmer nose or chase of cop is made, and any tendency to produce snarled yarn is obviated; the motion where in use is giving every satisfaction, particularly when spinning 80's counts and upwards. (English Cotton Standard.)

Description of Motion.

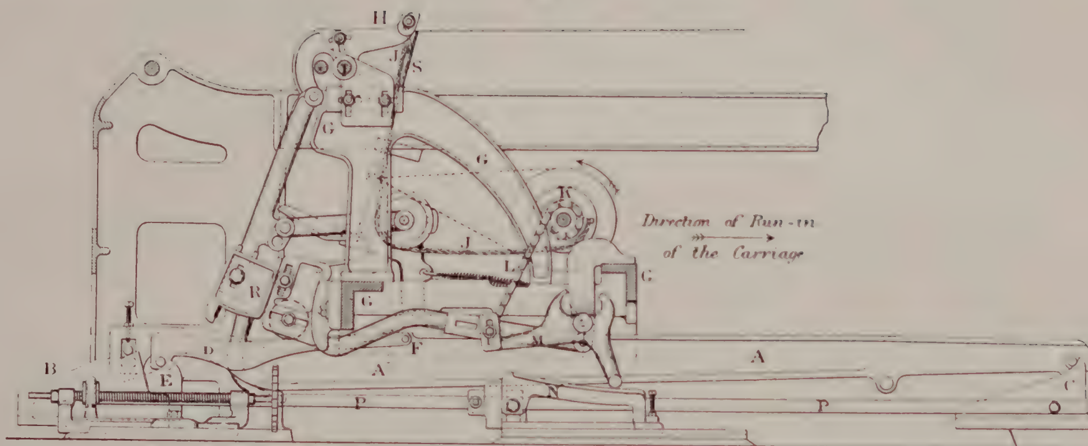
On the rimshaft there are two fast and two loose pulleys, with separate strap guiders and drums on countershaft, the broader fast pulley being for the purpose of driving the mule during drawing out, by a single broad strap in the usual manner, and the other for the slow motion in question.

The taking-in is driven as in the ordinary mule, by a band or rope from the countershaft, and during taking-in each strap is on its own loose pulley, and remains in that position until the carriage is nearing the termination of its inward run, when the slow speed is put into operation.

For the latter motion there is a bracket **A**, fixed to the spur of square with an adjusting screw, which carries a finger and bowl **B**, by which the period it is desired to put on slow speed, can be regulated.

As the carriage is terminating its inward run, the bowl **B** comes in contact with an incline bracket **C**, fixed to a flat slide bar **D**, in front and on right hand side of headstock below the camshaft, and relieves a round slide bar **E**, attached to strap guider (on top of headstock over camshaft), which is holding the strap on loose pulley, thereby allowing the strap to go on the fast pulley belonging to the slow speed motion. On the winding or front faller shaft there is a finger **F**, which, at the completion of the unlocking of fallers, lifts up again the slide bar **D**, liberates a catch **G**, thereby allowing the slow speed strap to pass from fast to loose slow speed pulley. The ordinary broad strap on rimshaft is immediately allowed to pass from the loose to fast pulley by rod **H**, attached to strap guider, being liberated by the slide bar **D**, and then the mule commences its operation under ordinary conditions.

Fig. 1.



Backing-off Chain Tightening Motion.

BACKING-OFF CHAIN TIGHTENING MOTION.

When the carriage is coming out, the winding faller wire is generally about $1\frac{1}{4}''$ above the points of the spindles. During the backing-off, the spindles begin to uncoil the yarn before the faller wire begins to move, because the tin roller must make some little movement before the backing-off click can take hold of the ratchet wheel, and in addition to this, the spindles continue to uncoil the yarn during the time the faller wire is moving from its position above the spindle points, until it touches the yarn. The spindles have thus a considerable start, and at the completion of a set of cops this loss of motion of the faller wire produces very bad results. At the commencement of a set of cops, the conditions are very much more favourable, for, although the space actually passed through by the faller wire before it touches the yarn, remains constant, it bears at the commencement a very much smaller proportion to the entire distance passed through by the wire before the faller locks, than it does at the completion of the set. Consequently, the backing-off chain has to be slack at the beginning of a set of cops, otherwise the speed of the faller wire would force the yarn down the spindles faster than it would uncoil, and would thereby break the thread. Hence, the backing-off chain having been adjusted to the proper length for backing off nicely at the commencement of the set, it is desirable gradually to tighten or shorten it as the cop increases in length, until at the completion of the cop the chain is almost tight.

The requisite shortening or tightening of the chain is effected automatically by our backing-off chain tightening motion. The winding faller shaft **I** (Fig. 1) has keyed upon it the backing-off finger **H** ; the backing-off chain **J** is fastened at one end to the finger **H,** and at the other end to the backing-off snail **K,** which is mounted with a ratchet-clutch upon the tin roller shaft. The backing-off tightening chain **L** has one end fastened to the boss of the snail **K**, and the other end to the bell-crank lever **M,** the tail of which is shown resting on an incline **N.** This incline slides upon a plate fastened to the floor, and an arm on the front end of the incline grips the copping plate connecting-rod **P,** so that by means of two hoops fixed upon the connecting-rod **P,** the incline **N** is caused to move backwards with the backward motion of the rod during the formation of the cop.

Thus, as the copping plates **B** and **C**, with the connecting-rod **P**, gradually travel backwards as the cop progresses, the higher part of the incline **N** is brought under the tail of the lever **M**, causing the latter to turn in the direction of the arrow, and so pulling the chain **L**, which in turn, acting upon the snail **K**, takes up the slack of the backing-off chain **J**. The incline **N** is made so that it can be varied to suit the particular requirements of various kinds of mules. By varying the form of the incline, the action on the chain can be varied to suit any circumstances.

When once set, the apparatus needs no further attention. At the commencement of a set of cops, the copping plates **B E C** are wound forwards again into their initial position, the incline **N** goes with them, and the backing-off chain **J** is restored to its normal slackness.

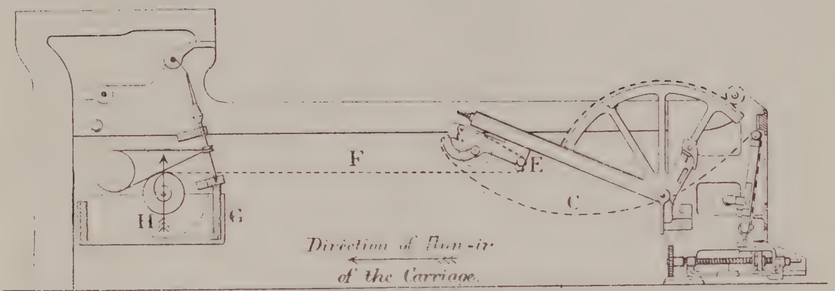
AUTOMATIC NOSING MOTION.

In winding upon the nose or point of the cop, something is wanted which shall continue or supplement the ordinary velocity-accelerating function of the quadrant, so that its action will be suited to the constantly diminishing diameter of the spindle on which the cop-nose is being wound. This object is attained by the application and use of a scroll upon the end of the winding-on drum **H**.

When the cop has attained its full diameter, the scroll drum **H** should be in the position shown in Fig. 2, on the completion of the inward run of the carriage **G**. As the cop becomes gradually built up higher on the taper spindle, more winding chain ought to be uncoiled from the scroll, until, at the completion of the cop, the chain should be wholly uncoiled, as shown in Fig. 3. It will be understood that the velocity of the winding increases in the same ratio as the diameter decreases of the scroll **H**. The amount of acceleration thus given depends on the quantity used of the scroll portion of the winding drum, and the character of the acceleration depends on the form of the scroll end of the winding drum.

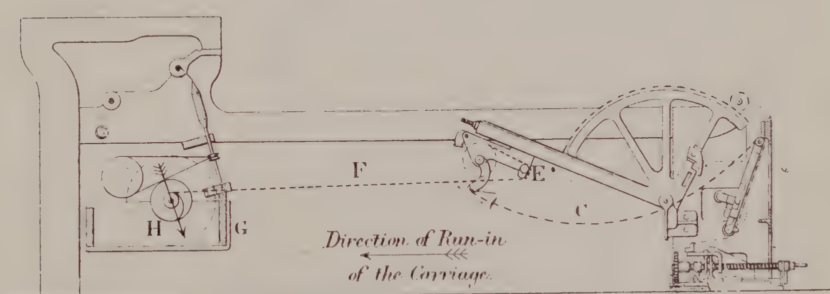
The end of the winding chain **F** (Fig. 4) instead of being merely attached as formerly to the quadrant nut **E**, is now wound upon the body of a ratchet-wheel **A**, on the shaft of which is also fixed a scroll **I**. Another chain **C**, coiling on this scroll,

Fig. 2.



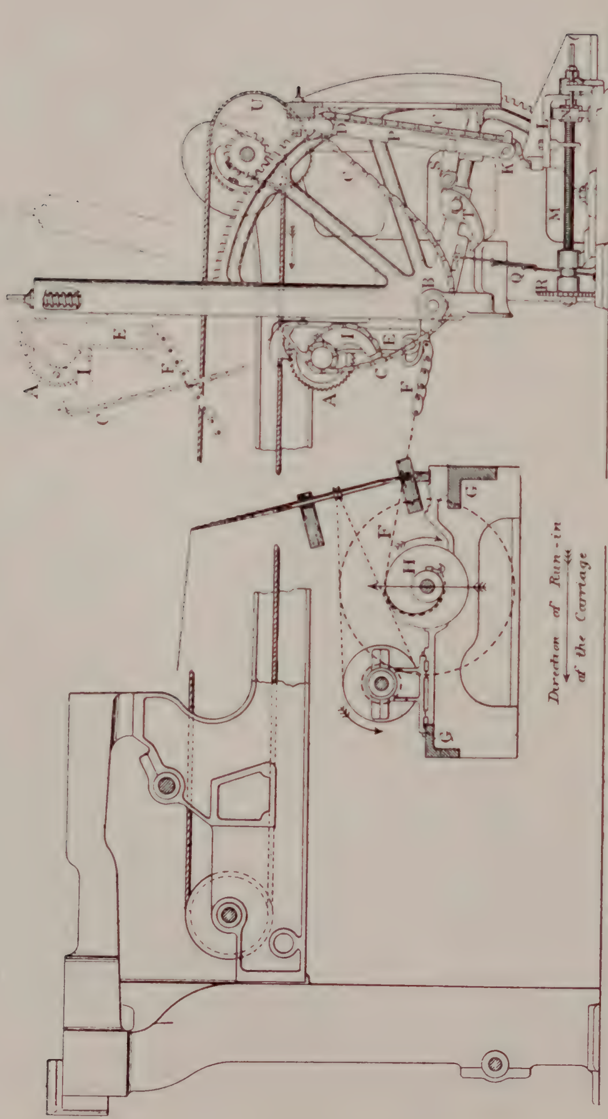
Completion of Cop-bottom.

Fig. 3.



Completion of Cop.

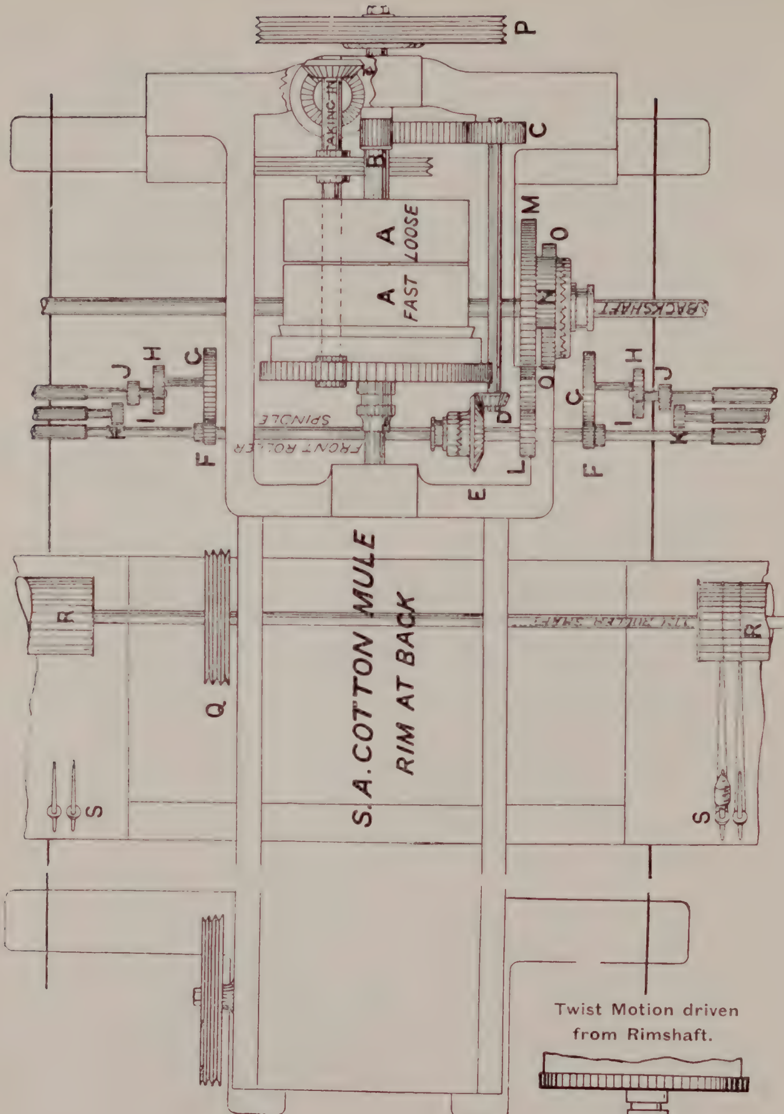
FIG. 4.



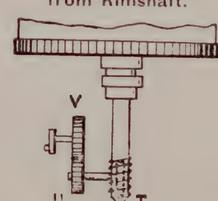
Automatic Nosing Motion.

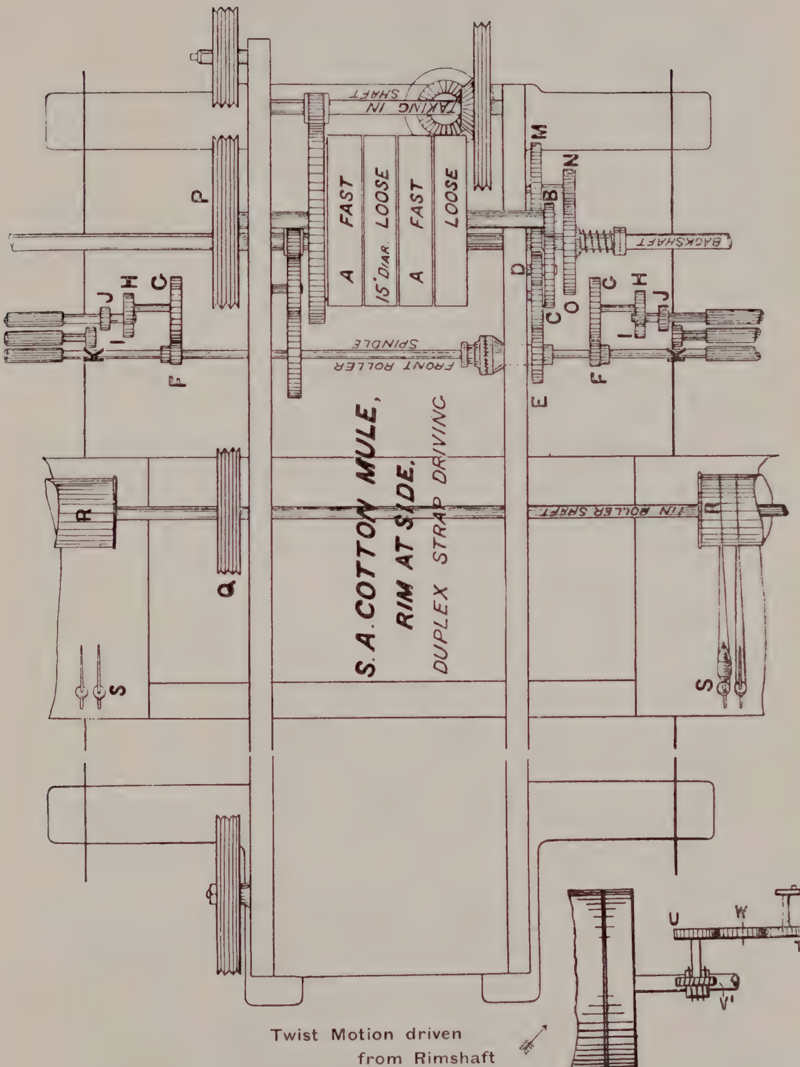
passes thence under and over the stationary pulleys **B** and **D,** and under the swinging pulley **K** ; and its end is fastened to the sliding bracket **L,** which slides on the shaper screw **M** of the copping motion. The pull of the chain **C** causes this sliding bracket **L** to press outwards against the front nug of the shaper frame. The nut **N,** travelling in towards **R** along the shaper screw, comes into contact with an inner arm on the bracket **L,** and causes it to slide inwards with the inward movement of the nut, and so gradually pulls the chain **C** in the same direction. The movement of the quadrant nut **E** further out from the centre of the quadrant, takes up the slack in the chain **C,** and on the further outward movement of the quadrant nut, after the slack is taken up, the tension of the chain **C** brought about by this rise of the quadrant nut, and by the arrangement of lever **P,** bracket **T,** and bracket **L,** causes the scroll **I** to turn and wind upon the ratchet-wheel **A** a length of winding chain **F,** which would otherwise remain coiled on the winding-on drum **H.**

By causing the nut **N** of the shaper screw to act sooner or later on the sliding bracket **L,** a greater or less amount of the scroll on the winding drum **H** may be brought into use. By these arrangements, the winding can be accommodated to any form of spindles. Before beginning a fresh set of cops, the winding chain **F** must be uncoiled from the ratchet-wheel **A** in the quadrant nut.



Twist Motion driven from Rimshaft.





Twist Motion driven from Rimshaft

Self-Acting Mule, with Rim at Back.

Alphabetical References to Diagrams.

A Rimshaft driving pulleys, 14″ diar. and upwards (usually 15″).

B Rim pinion, *21T and upwards (in the mule with rim at side, the rim pinion is the usual change place).

C Back change wheel.

D Bevel on cross shaft, 15T, for mule with rim at back.

E Wheel on front spindle catch box.

F Front roller pinion, single or double, of various sizes.

G Crown wheel, 120T. † Range 80T to 150T.

H	Draft change wheel, 20T to 75T	Interchangeable.
I	Back roller wheel, about 50T	

J	Back roller pinion	of various sizes, according to size of rollers.
K	Middle roller pinion	

L	Wheel on front spindle for driving backshaft (for mule with rim at back)	of various sizes	These are governed by dia. of front roller, and require different brackets when these conditions are altered.
M	Drag or gain wheel		
N	Drag pinion		

O Drawing-out wheel on catch box, 60T.

P Rim or twist pulley, 9″ and upwards.

Q Tin roller pulley. Range 9″ to 13″.

R Tin roller, 5″, $5\frac{1}{2}$″, or 6″.

S Spindle warve, $\frac{5}{8}$″, $\frac{11}{16}$″, $\frac{3}{4}$″, $\frac{13}{16}$″, $\frac{7}{8}$″, or 1″.

			Mule with rim at back.	Mule with rim at side.	
T	Twist change wheel...		20T to 105T	22T to 56T	Twist motion when driven from rimshaft.
U	Pinion...	15T	16T or 20T	25T	
V	Twist motion wheel...	40T	44T or 45T	...	
V[1]	Worm wheel			25T	
W	Carrier wheel			33T	

* The gearing between the rim pinion and the back change wheel is effected by means of an intermediate wheel, arranged on a centre stud carried by a radial bracket. This wheel may be either single or double, thus giving an almost unlimited range of wheels for obtaining the desired speed of rollers.

† Crown wheels require a different radial bracket for each size.

Note.—It is now customary when a wide range of counts are intended to be spun on one Mule to send spare drums of different diameters (in halves) for countershaft, so that the speed of rimshaft can be easily altered, thus obviating the use of very large or small rims.

Self-Acting Mule.

Calculations.

To find Speed of Rimshaft.

$$\text{Speed of Mainshaft} \times \frac{\text{Diar. of Drum on Mainshaft} \times \text{Diar. of Drum on Countershaft}}{\text{Diar of Pulley on Countershaft} \times \text{Diar. of Rimshaft Driving Pulley (A)}} = \text{Speed of Rimshaft.}$$

To find Speed of Front Roller.

$$\text{Speed of Rimshaft} \times \frac{B \times D}{C \times E} = \text{Speed of Front Roller.}$$

Draft.

$$\frac{\text{Counts of Yarn}}{\text{Hank Roving}} = \text{Total Draft.}$$

or

$$\text{Draft in Rollers} \times \text{Draft in Carriage} = \text{Total Draft.}$$

$$\frac{\text{Hank Roving} \times \text{Draft in Rollers} \times \text{Stretch in Inches}}{\text{Length Delivered by Front roller per Draw}} = \text{Counts of Yarn.}$$

To find Draft in Rollers when Counts, Hank Roving, and Gain of Carriage are known.

$$\frac{\text{Counts} \times \text{Length Delivered by Front Roller per Draw}}{\text{Length of Stretch} \times \text{Hank Roving}} = \text{Draft in Rollers.}$$

To find Draft in Rollers.

$$\frac{\text{Diar. of Front Roller} \times I \times G}{\text{Diar. of Back Roller} \times H \times F} = \text{Draft in Rollers.}$$

To find Draft Wheel to give any required Draft.

$$\frac{\text{Dia. of Front Roller} \times I \times G}{\text{Diar. of Back Roller} \times \text{Draft Required} \times F} = \text{Draft Change Wheel Required}$$

To find Constant Number for Draft.

$$\frac{\text{Diar. of Front Roller} \times I \times G}{\text{Dia. of Back Roller} \times F} = \text{Constant Number.}$$

$$\frac{\text{Constant Number}}{\text{Draft required}} = \text{Draft Change Wheel.} \qquad \frac{\text{Constant Number}}{\text{Draft Wheel}} = \text{Draft in Rollers.}$$

To find Speed of Spindles.

$$\text{Revs. of Rimshaft per minute} \times \frac{P \times R \;(+ \tfrac{1}{16}'' \text{ for dia. of banding})}{Q \times S \;(+ \tfrac{1}{16}'' \text{ for dia. of banding})} = \text{Speed of Spindles.}$$

To find Turns of Spindle for 1 of Rim.

$$\frac{P \times R \;(+ \tfrac{1}{16}'' \text{ for dia. of banding})}{Q \times S \;(+ \tfrac{1}{16}'' \text{ for dia. of banding})} = \text{Turns of Spindle for 1 of Rim.}$$

TWIST.

To find Turns of Twist per inch.

$$\frac{\text{Revs. of Spindles per minute or per draw}}{\text{Length delivered by Front Roller per minute or per draw}} = \text{Turns of Twist per inch.}$$

or

$$\frac{E \times C \times P \times R \;(+ \tfrac{1}{16}'' \text{ for banding})}{\text{Circum. of Front Roller} \times D \times B \times Q \times S \;(+ \tfrac{1}{16}'' \text{ for banding})} = \text{Turns of Twist per inch.}$$

To find Constant Number for Twist.

1st. When using the Back Change Wheel **C** as the Changing Place.

$$\frac{\text{Circum. of Front Roller} \times D \times B \times Q \times S \;(+ \tfrac{1}{16}'' \text{ for banding})}{E \times P \times R \;(+ \tfrac{1}{16}'' \text{ for banding})} = \text{Constant Number.}$$

Constant Number (inverted) × Back Change Wheel = Twist per inch.

Constant × Turns of Twist = Back Change Wheel.

2nd. When using the Rim **P** as the Changing Place.

$$\frac{E \times C \times R \;(+ \tfrac{1}{16}'' \text{ for banding})}{\text{Circum. of Front Roller} \times D \times B \times Q \times S \;(+ \tfrac{1}{16}'' \text{ for banding})} = \text{Constant Number.}$$

Constant Number × Diar. of Rim = Turns of Twist per Inch.

Constant Number (inverted) × Turns of Twist = Diar. of Rim required.

To find Twist Wheel when Twist Motion is driven from Rim Shaft.

$$\frac{\begin{matrix}\text{Turns} \\ \text{per inch} \\ \text{required}\end{matrix} \times \begin{matrix}\text{Length} \\ \text{of Stretch} \\ \text{in inches}\end{matrix} \times Q \times S \left(\begin{matrix}+\frac{1}{16}''\text{for} \\ \text{banding}\end{matrix}\right) \times \begin{matrix}\text{Twist} \\ \text{Motion (20T)} \\ \text{Pinion}\end{matrix}}{P \times R\ (+\ \frac{1}{16}''\text{ for banding}) \times \text{Twist Motion Wheel (40T)}} = \begin{matrix}\text{Twist} \\ \text{Wheel} \\ \text{Required.}\end{matrix}$$

If Mules with Roller Delivery Motion whilst carriage is going in, add say from 3″ to 4″ to the length of stretch in the above form of calculation.

Note.—The Twist Motion Wheel and Pinion vary according to circumstances.

The above same rule applies when Twist Motion is driven from Tin Roller Shaft, but P and Q must be omitted.

To find Number of Draws per minute

(allowing 5 secs. for backing-off, running in, &c.).

Stretch × Turns per inch = Revs. of Spindles for 1 stretch.

$$\frac{\text{Revolutions of Spindles per stretch} \times 60 \text{ seconds}}{\text{Speed of Spindles per minute}} = \begin{matrix}\text{Time for} \\ \text{Twisting} \\ \text{in seconds.}\end{matrix}$$

Time for Twisting + 5 secs. = Time for 1 stretch.

$$\frac{60 \text{ seconds}}{\text{Time in seconds for 1 stretch}} = \text{Draws per minute.}$$

Shaper Wheels.

It is somewhat difficult to formulate a rule to determine Shaper Wheel required when starting new Mules, the Pitch of Shaper Screw, diameter of Cop to be made, amount of weight on Fallers—which is governed by the quality of Yarn required, and the number of turns of Twist per inch to be put in the Yarn, &c.,—all having an important effect on the result. The correct wheel should be found by trial, and the following rule can then be used for finding the Shaper Wheel when changing counts. Multiply present wheel by the square root of counts required, and divide by square root of present counts.

Example:—Suppose it is required to change from 36's to 25's counts, and the Shaper Wheel in use has 30 teeth:—

$$\left.\begin{matrix}\text{Square root of } 36 = 6 \\ \text{Square root of } 25 = 5\end{matrix}\right\} \frac{30\text{T} \times 5}{6} = 25 \text{ teeth.}$$

therefore, a 25's wheel should be used.

To find approximate Production of a Mule in Hanks or Lbs. per week.

$$\frac{\text{Number of draws per minute} \times \text{Length of stretch in inches} \times \text{Number of Working hours per week} \times \text{60 minutes}}{\text{840 yards} \times \text{36 inches.}} = \text{Hanks per week.}$$

$$\frac{\text{Hanks per week}}{\text{Counts}} = \text{lbs. per week.}$$

Note.—To obtain working hours allow about 4 % to 7½ % for time required for doffing, breakages, &c., depending on counts of yarn, time taken in doffing, &c.

Table Showing the Turns of Spindles for 1 of Rim.

Diameter of Rim Pulley.	10" Tin Roller Pulleys. 6" Tin Roller.						12" Tin Roller Pulleys. 6" Tin Roller.					
	Diameter of Spindle Warve.						Diameter of Spindle Warve.					
	⅝"	11/16"	¾"	13/16"	⅞"	1"	⅝"	11/16"	¾"	13/16"	⅞"	1"
12"	10·58	9·7	8·95	8·31	7·75	6·84	8·81	8·08	7·46	6·92	6·46	5·70
13"	11·46	10·50	9·70	9·00	8·40	7·41	9·55	8·75	8·08	7·50	7·00	6·18
14"	12·34	11·31	10·44	9·70	9·05	7·98	10·28	9·43	8·70	8·08	7·54	6·65
15"	13·22	12·12	11·19	10·39	9·70	8·55	11·02	10·10	9·32	8·66	8·08	7·13
16"	14·10	12·93	11·93	11·08	10·34	9·12	11·75	10·77	9·94	9·23	8·62	7·60
17"	14·98	13·74	12·68	11·77	10·99	9·70	12·49	11·45	10·57	9·81	9·16	8·08
18"	15·86	14·55	13·43	12·47	11·64	10·27	13·22	12·12	11·19	10·39	9·70	8·55
19"	16·75	15·36	14·17	13·16	12·28	10·84	13·96	12·80	11·81	10·97	10·23	9·03
20"	17·63	16·16	14·92	13·85	12·93	11·41	14·69	13·47	12·43	11·54	10·77	9·50

Table showing the Wheels and Pinions required to give various amounts of Drag or Gain of the Carriage for Self-Acting Cotton Mules with RIM AT THE BACK.

The length of yarn delivered per stretch equals

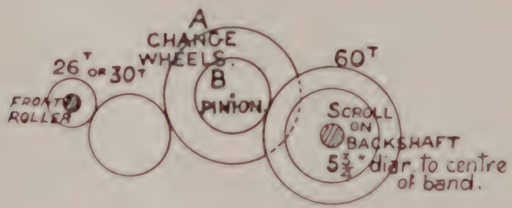
$$\frac{A}{B} \times \frac{60}{26 \text{ or } 30 \times 5\frac{3}{4}''} \times \text{diar. of Front Roller} \times \text{length of stretch.}$$

The Drag or Gain is obtained by subtracting the length of yarn delivered by the roller from the total stretch of the carriage.

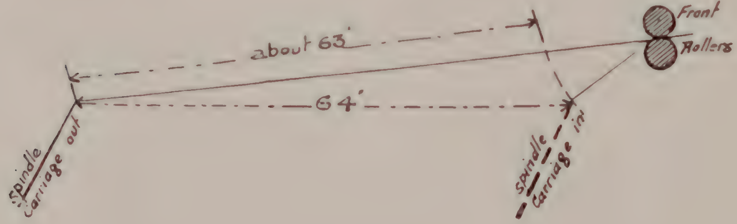
A = number of teeth in change wheel.

B = number of teeth in change pinion.

N.B.—In cases where [illegible], [illegible], [illegible], and 1" diam of rollers are used a 26T wheel is used on same, and for rollers of [illegible] and [illegible] diar., a 30T wheel is used.



In calculating the following drags, we have allowed for a loss of one inch in the stretch, consequent on the change in the angle of the thread from nip of roller to spindle point, at the commencement and completion of the stretch, *see diagram.*



The following results are for a Mule of 64-inch stretch.

Yarn delivered and Drag produced in inches for different diameters of Front Bottom Rollers.												
Change Wheels.	$\frac{13}{16}''$		$\frac{7}{8}''$		$\frac{15}{16}''$		$1''$		$1\frac{1}{16}''$		$1\frac{1}{8}''$	
	Yarn del.	Drag prod.	Yarn del.	Drag prod.	Yarn del.	Drag prod.	Yarn del.	Drag prod.	Yarn del.	Drag prod.	Yarn del.	Drag prod.
86/40	...	...	...	...	...	...	55·2	7·8	...	...	...	...
87/40	...	...	...	...	...	...	55·85	7·15	...	...	...	...
88/40	...	...	...	...	...	...	56·5	6·5	...	...	...	...
86/39	...	...	...	...	...	...	56·55	6·45	...	...	...	...
89/40	...	...	...	...	...	...	57·15	5·85	...	...	...	...
87/39	...	...	...	...	...	...	57·3	5·7	...	...	...	...
90/40	...	...	...	...	...	...	57·8	5·2	...	...	...	...
88/39	...	...	...	...	...	...	57·95	5·05	...	...	...	...
86/38	...	...	...	...	...	...	58·0	5·0	...	...	...	...
91/40	...	...	...	...	...	...	58·45	4·55	...	...	...	...
89/39	...	...	...	...	...	...	58·6	4·4	...	...	...	...
87/38	...	...	...	...	...	...	58·8	4·2	...	...	...	...
92/40	...	...	...	...	...	...	59·1	3·9	...	...	...	...
90/39	...	...	...	...	...	...	59·25	3·75	...	...	...	...
88/38	...	...	...	...	...	...	59·5	3·5	...	...	58·0	5·0
86/37	...	...	...	...	...	...	59·55	3·45	...	...	58·15	4·85
93/40	...	...	...	...	...	...	59·7	3·3	...	...	58·2	4·8
91/39	...	...	...	...	...	...	59·95	3·05	...	...	58·4	4·6
89/38	...	...	...	...	...	...	60·15	2·85	...	...	58·6	4·4
94/40	...	...	...	...	...	...	60·35	2·65	...	...	58·9	4·1
87/37	...	...	...	...	...	...	60·4	2·6	...	...	58·9	4·1
92/39	...	...	...	...	...	...	60·6	2·4	...	...	59·1	3·9
90/38	...	...	...	...	...	...	60·85	2·15	...	...	59·35	3·65
95/40	...	...	...	...	...	...	61·0	2·0	...	...	59·55	3·45
88/37	...	...	...	...	...	...	61·1	1·9	...	...	59·6	3·4
93/39	...	...	...	...	...	...	61·2	1·8	...	...	59·7	3·3
86/36	...	...	...	...	...	...	61·2	1·8	...	...	59·7	3·3
91/38	...	...	...	...	...	...	61·5	1·5	...	...	60·0	3·0
96/40	...	...	...	...	...	...	61·55	1·45	...	...	60·1	2·9
89/37	...	...	...	...	...	...	61·8	1·2	...	...	60·3	2·7
94/39	...	...	...	...	58·0	5·0	61·9	1·1	...	...	60·4	2·6
87/36	...	...	...	...	58·15	4·85	62·1	0·9	...	...	60·65	2·35
92/38	...	...	...	...	58·2	4·8	62·2	0·8	...	...	60·7	2·3
97/40	...	...	...	...	58·3	4·7	62·25	0·75	...	...	60·8	2·2
90/37	...	...	...	...	58·5	4·5	62·5	0·5	...	...	61·0	2·0
95/39	...	...	...	...	58·6	4·4	62·55	0·45	...	...	61·05	1·95
88/36	...	...	...	...	58·7	4·3	62·8	0·2	...	...	61·25	1·75
98/40	...	...	...	...	58·8	4·2	62·85	0·15	...	...	61·3	1·7
93/38	...	...	...	...	58·85	4·15	62·85	0·15	...	...	61·35	1·65
86/35	...	...	...	...	59·15	3·85	63·0	...	57·9	5·1	61·5	1·5
96/39	...	...	...	...	59·2	3·8	...	...	58·0	5·0	61·7	1·3
91/37	...	...	...	...	59·25	3·75	...	...	58·05	4·95	61·7	1·3
89/36	...	...	...	...	59·4	3·6	...	...	58·25	4·75	61·8	1·2
94/38	...	...	...	...	59·5	3·5	...	...	58·3	4·7	62·0	1·0
99/40	...	...	...	...	59·55	3·45	...	...	58·35	4·65	62·05	0·95

The following results are for a Mule of 64-inch stretch.—Continued.

Change Wheels.	Yarn delivered and Drag produced in inches for different diameters of Front Bottom Rollers.											
	13/16"		7/8"		15/16"		1"		1 1/16"		1 1/8"	
	Yarn del.	Drag prod.	Yarn del.	Drag prod.	Yarn del.	Drag prod.	Yarn del.	Drag prod.	Yarn del.	Drag prod.	Yarn del.	Drag prod.
87 35	...	...	...	...	59·8	3·2	...	...	58·5	4·5	62·25	·75
97 39	...	...	...	...	59·85	3·15	...	...	58·6	4·4	62·3	·7
92 37	...	...	...	...	59·85	3·15	...	...	58·6	4·4	62·3	·7
100 40	...	...	...	...	60·15	2·85	...	...	58·95	4·05	62·6	·4
95 38	...	...	...	...	60·15	2·85	...	...	58·95	4·05	62·6	·4
90 36	...	...	...	...	60·15	2·85	...	...	58·95	4·05	62·6	·4
93 37	...	...	...	...	60·4	2·6	...	...	59·25	3·75	62·95	·05
88 35	...	...	...	...	60·5	2·5	...	...	59·3	3·7	63·0	...
98 39	...	...	...	...	60·5	2·5	...	...	59·3	3·7	63·0	...
96 38	...	...	...	...	60·7	2·3	...	...	59·5	3·5	...	...
86 34	...	...	...	...	60·8	2·2	...	...	59·6	3·4	...	...
91 36	...	...	...	...	60·85	2·15	...	...	59·65	3·35	...	...
99 39	...	...	...	...	61·05	1·95	...	...	59·95	3·05	...	...
94 37	...	...	...	...	61·2	1·8	...	...	60·0	3·0	...	...
89 35	...	...	...	...	61·25	1·75	...	...	60·0	3·0	...	...
97 38	...	...	...	...	61·4	1·6	...	...	60·1	2·9	...	...
92 36	...	...	...	...	61·55	1·45	...	...	60·2	2·8	...	...
87 34	...	...	...	...	61·6	1·4	...	...	60·3	2·7	...	...
100 39	...	...	...	...	61·7	1·3	...	...	60·4	2·6	...	...
95 37	...	...	...	...	61·85	1·15	...	...	60·5	2·5	...	...
90 35	...	...	...	...	61·9	1·1	...	...	60·6	2·4	...	...
98 38	...	...	57·8	5·2	62·1	·9	...	...	60·75	2·25	...	...
93 36	...	...	58·0	5·0	62·2	·8	...	...	60·85	2·15	...	...
88 34	...	...	58·1	4·9	62·25	·75	...	...	61·0	2·0	...	...
96 37	...	...	58·2	4·8	62·4	·6	...	...	61·25	1·75	...	...
91 35	...	...	58·3	4·7	62·6	·4	...	...	61·3	1·7	...	...
99 38	...	...	58·5	4·5	62·7	·3	...	...	61·45	1·65	...	...
86 33	...	...	58·5	4·5	62·75	·25	...	...	61·5	1·5	...	...
94 36	...	...	58·5	4·5	62·75	·25	...	...	61·5	1·5	...	...
89 34	...	...	58·7	4·3	62·95	·05	...	...	61·65	1·35	...	...
97 37	...	...	58·8	4·2	...	...	...	...	61·75	1·25	...	...
92 35	...	...	59·0	4·0	...	...	...	...	61·95	1·05	...	...
100 38	...	...	59·05	3·95	...	...	...	...	62·05	·95	...	...
87 33	...	...	59·2	3·8	...	...	...	...	62·2	·8	...	...
95 36	...	...	59·25	3·75	...	...	...	...	62·3	·7	...	...
90 34	...	...	59·4	3·6	...	...	...	...	62·4	·6	...	...
98 37	...	...	59·4	3·6	...	...	...	...	62·4	·6	...	...
93 35	...	...	59·5	3·5	...	...	...	...	62·55	·45	...	...
88 33	...	...	59·8	3·2	...	...	...	...	62·85	·15	...	...
96 36	...	...	59·8	3·2	...	...	...	...	62·85	·15	...	...
99 37	...	...	60·0	3·0	...	...	...	...	...	...	...	...
91 34	...	...	60·15	2·85	...	...	...	...	...	...	...	...
86 32	...	...	60·3	2·7	...	...	...	...	...	...	...	...
94 35	...	...	60·35	2·65	...	...	...	...	...	...	...	...
97 36	...	...	60·4	2·6	...	...	...	...	...	...	...	...

The following results are for a Mule of 64-inch stretch.—Continued.

Yarn delivered and Drag produced in inches for different diameters of Front Bottom Rollers.

Change Wheels.	$\frac{13}{16}''$		$\frac{7}{8}''$		$\frac{15}{16}''$		$1''$		$1\frac{1}{16}''$		$1\frac{1}{8}''$	
	Yarn del.	Drag prod.	Yarn del.	Drag prod.	Yarn del.	Drag prod.	Yarn del.	Drag prod.	Yarn del.	Drag prod.	Yarn del.	Drag prod.
89/33	...	...	60·6	2·4	...	...	...	...	...	...	...	...
100/37	...	...	60·7	2·3	...	...	...	...	...	...	...	...
92/34	...	...	60·8	2·2	...	...	...	...	...	...	...	...
95/35	...	...	61·0	2·0	...	...	...	...	...	...	...	...
87/32	...	...	61·1	1·9	...	...	...	...	...	...	...	...
98/36	...	...	61·2	1·8	...	...	...	...	...	...	...	...
90/33	...	...	61·3	1·7	...	...	...	...	...	...	...	...
93/34	...	...	61·5	1·5	...	...	...	...	...	...	...	...
96/35	...	...	61·5	1·5	...	...	...	...	...	...	...	...
99/36	...	...	61·6	1·4	...	...	...	...	...	...	...	...
88/32	...	...	61·6	1·4	...	...	...	...	...	...	...	...
91/33	...	...	62·0	1·0	...	...	...	...	...	...	...	...
94/34	...	...	62·15	·85	...	...	...	...	...	...	...	...
97/35	...	...	62·2	·8	...	...	...	...	...	...	...	...
100/36	58·0	5·0	62·3	·7	...	...	...	...	...	...	...	...
89/32	58·1	4·9	62·4	·6	...	...	...	...	...	...	...	...
92/33	58·2	4·8	62·65	·35	...	...	...	...	...	...	...	...
95/34	58·2	4·7	62·8	·2	...	...	...	...	...	...	...	...
98/35	58·3	4·7	62·85	·15	...	...	...	...	...	...	...	...
90/32	58·7	4·3	...	...	...	...	...	...	...	...	...	...
93/33	58·8	4·2	...	...	...	...	...	...	...	...	...	...
96/34	58·9	4·1	...	...	...	...	...	...	...	...	...	...
99/35	59·0	4·0	...	...	...	...	...	...	...	...	...	...
91/32	59·3	3·7	...	...	...	...	...	...	...	...	...	...
94/33	59·55	3·45	...	...	...	...	...	...	...	...	...	...
97/34	59·6	3·4	...	...	...	...	...	...	...	...	...	...
100/35	59·65	3·35	...	...	...	...	...	...	...	...	...	...
92/32	60·0	3·0	...	...	...	...	...	...	...	...	...	...
95/33	60·1	2·9	...	...	...	...	...	...	...	...	...	...
98/34	60·2	2·8	...	...	...	...	...	...	...	...	...	...
93/32	60·65	2·35	...	...	...	...	...	...	...	...	...	...
96/33	60·7	2·3	...	...	...	...	...	...	...	...	...	...
99/34	60·7	2·3	...	...	...	...	...	...	...	...	...	...
94/32	61·2	1·8	...	...	...	...	...	...	...	...	...	...
97/33	61·3	1·7	...	...	...	...	...	...	...	...	...	...
100/34	61·3	1·7	...	...	...	...	...	...	...	...	...	...
95/32	61·8	1·2	...	...	...	...	...	...	...	...	...	...
98/33	62·0	1·0	...	...	...	...	...	...	...	...	...	...
96/32	62·6	·4	...	...	...	...	...	...	...	...	...	...
99/33	62·6	·4	...	...	...	...	...	...	...	...	...	...
97/32	...	...	...	...	...	...	...	...	...	...	...	...
100/33	...	...	...	...	...	...	...	...	...	...	...	...
98/32	...	...	...	...	...	...	...	...	...	...	...	...
99/32	...	...	...	...	...	...	...	...	...	...	...	...
100/32	...	...	...	...	...	...	...	...	...	...	...	...

Table showing the Wheels and Pinions required to give various amounts of Drag or Gain of the Carriage for Self-Acting Cotton Mules with RIM AT THE BACK. With Jacking or Stretching Motion, but it is assumed that there is no jacking or drawing out.

The length of yarn delivered per stretch equals

$$\frac{A}{B} \times \frac{60}{45 \times 5\frac{3}{4}'' \times \frac{1}{2}\left(\frac{40}{40} + \frac{20}{60}\right)} \times \text{diar. of Front Roller} \times \text{length of stretch.}$$

The Drag or Gain is obtained by subtracting the length of yarn delivered by the roller, from the total stretch of the carriage.

A = number of teeth in change wheel.
B = number of teeth in change pinion.

See diagram and remarks at foot of page 204.

See also sketch of Jacking or Stretching Motion, page 186.

The following results are for a Mule of 64-inch stretch.

Yarn delivered and Drag produced in inches for different diameters of Front Bottom Rollers.

Change Wheels.	1″		$1\frac{1}{16}$″		$1\frac{1}{8}$″	
	Yarn delivered.	Drag produced.	Yarn delivered.	Drag produced.	Yarn delivered.	Drag produced.
86/40	47·8	15·2	50·75	12·25	53·85	9·15
87/40	48·4	14·6	51·45	11·55	54·45	8·55
88/40	48·95	14·05	52·05	10·95	55·1	7·9
86/39	49·0	14·0	52·1	10·9	55·2	7·8
89/40	49·55	13·45	52·6	10·4	55·7	7·3
87/39	49·65	13·35	52·75	10·25	55·85	7·15
90/40	50·1	12·9	53·2	9·8	56·35	6·65
88/39	50·25	12·75	53·35	9·65	56·5	6·5
86/38	50·4	12·6	53·6	9·4	56·75	6·25
91/40	50·65	12·35	53·8	9·20	56·95	6·05
89/39	50·8	12·2	54·0	9·0	57·15	5·85
87/38	50·95	12·05	54·15	8·85	57·35	5·65
92/40	51·2	11·8	54·4	8·6	57·6	5·4
90/39	51·35	11·65	54·6	8·4	57·8	5·2
88/38	51·55	11·45	54·75	8·25	58·0	5·0
86/37	51·75	11·25	54·95	8·05	58·2	4·8
93/40	51·75	11·25	55·0	8.0	58·25	4·75
91/39	51·95	11·05	55·2	7·8	58·5	4·5
89/38	52·15	10·85	55·4	7·6	58·65	4·35
94/40	52·3	10·7	55·6	7·4	58·85	4·15
87/37	52·35	10·65	55·6	7·4	58·9	4·1
92/39	52·5	10·5	55·8	7·2	59·1	3·9
90/38	52·7	10·3	56·0	7·0	59·3	3·7
95/40	52·85	10·15	56·15	6·85	59·5	3·5
88/37	52·95	10·05	56·25	6·75	59·55	3·45
93/39	53·15	9·85	56·4	6·6	59·7	3·3
86/36	53·2	9·8	56·45	6·55	59·75	3·25
91/38	53·3	9·7	56·65	6·35	59·95	3·05
96/40	53·5	9·5	56·7	6·3	60·05	2·95
89/37	53·55	9·45	56·9	6·1	60·25	2·75
94/39	53·65	9·35	57·0	6·0	60·35	2·65
87/36	53·8	9·2	57·15	5·85	60·5	2·5
92/38	53·9	9·1	57·25	5·75	60·65	2·35
97/40	54·1	8·9	57·3	5·7	60·7	2·3
90/37	54·15	8·85	57·55	5·45	60·9	2·1
95/39	54·25	8·75	57·65	5·35	61·0	2·0
88/36	54·4	8·6	57·8	5·2	61·2	1·8
98/40	54·5	8·5	57·9	5·1	61·3	1·7
93/38	54·5	8·5	57·9	5·1	61·3	1·7
86/35	54·7	8·3	58·1	4·9	61·45	1·55
96/39	54·75	8·25	58·2	4·8	61·55	1·45
91/37	54·75	8·25	58·25	4·75	61·6	1·4
89/36	55·05	7·95	58·45	4·55	61·9	1·1
94/38	55·05	7·95	58·5	4·5	61·95	1·05
99/40	55·15	7·85	58·65	4·35	62·1	·9

The following results are for a Mule of 64-inch stretch.—Continued.

Change Wheels.	Yarn delivered and drag produced in inches for different diameters of Front Bottom Rollers.					
	1″		$1\frac{1}{16}$″		$1\frac{1}{8}$″	
	Yarn delivered.	Drag produced.	Yarn delivered.	Drag produced.	Yarn delivered.	Drag produced.
87/35	55·35	7·65	58·8	4·2	62·25	·75
97/39	55·35	7·65	58·8	4·2	62·25	·75
92/37	55·35	7·65	58·8	4·2	62·25	·75
100/40	55·65	7·35	59·15	3·85	62·6	·4
95/38	55·65	7·35	59·15	3·85	62·6	·4
90/36	55·65	7·35	59·15	3·85	62·6	·4
93/37	55·95	7·05	59·45	3·55	62·95	·05
88/35	55·95	7·05	59·45	3·55	62·95	·05
98/39	56·0	7·0	59·5	3·5	63·0	...
96/38	56·25	6·75	59·75	3·25	...	...
86/34	56·25	6·75	59·75	3·25	...	...
91/36	56·3	6·7	59·8	3·2	...	...
99/39	56·5	6·5	60·05	2·95	...	...
94/37	56·55	6·45	60·1	2·9	...	...
89/35	56·6	6·4	60·15	2·85	...	...
97/38	56·8	6·2	60·4	2·6	...	...
92/36	56·9	6·1	60·45	2·55	...	...
87/34	56·95	6·05	60·5	2·5	...	...
100/39	57·2	5·8	60·7	2·3	...	...
95/37	57·25	5·75	60·75	2·25	...	...
90/35	57·25	5·75	60·8	2·2	...	...
98/38	57·45	5·55	61·0	2·0	...	...
93/36	57·5	5·5	61·1	1·9	...	...
88/34	57·6	5·4	61·2	1·8	...	...
96/37	57·7	5·3	61·3	1·7	...	...
91/35	57·9	5·1	61·5	1·5	...	...
99/38	58·0	5·0	61·6	1·4	...	...
86/33	58·1	4·9	61·7	1·3	...	...
94/36	58·15	4·85	61·75	1·25	...	...
89/34	58·25	4·75	61·9	1·1	...	...
97/37	58·35	4·65	62·0	1·0	...	...
92/35	58·5	4·5	62·15	·85	...	...
100/38	58·6	4·4	62·25	·75	...	...
87/33	58·7	4·3	62·35	·65	...	...
95/36	58·75	4·25	62·4	·6	...	...
90/34	58·95	4·05	62·6	·4	...	...
98/37	59·0	4·0	62·65	·35	...	...
93/35	59·15	3·85	62·85	·15	...	...
88/33	59·35	3·65	...	...	...	...
96/36	59·4	3·6	...	...	...	...
99/37	59·5	3·5	...	...	...	...
91/34	59·6	3·4	...	...	...	...
86/32	59·8	3·2	...	...	...	...
94/35	59·8	3·2	...	...	...	...
97/36	60·0	3·0	...	...	...	...

The following results are for a Mule of 64-inch stretch.—Continued.

Change Wheels.	Yarn delivered and Drag produced in inches for different diameters of Front Bottom Rollers. 1″ Yarn delivered.	1″ Drag produced.	$1\frac{1}{16}$″ Yarn delivered.	$1\frac{1}{16}$″ Drag produced.	$1\frac{1}{8}$″ Yarn delivered.	$1\frac{1}{8}$″ Drag produced.
89/33	60·05	2·95	...	...	...	...
100/37	60·1	2·9	...	...	...	...
92/34	60·25	2·75	...	...	...	...
95/35	60·4	2·6	...	...	...	...
87/32	60·6	2·4	...	...	...	...
98/36	60·7	2·3	...	...	...	...
90/33	60·7	2·3	...	...	...	...
93/34	60·9	2·1	...	...	...	...
96/35	61·1	1·9	...	...	...	...
99/36	61·3	1·7	...	...	...	...
88/32	61·3	1·7	...	...	...	...
91/33	61·4	1·6	...	...	...	...
94/34	61·55	1·45	...	...	...	...
97/35	61·7	1·3	...	...	...	...
100/36	61·8	1·2	...	...	...	...
89/32	61·9	1·1	...	...	...	...
92/33	62·05	·95	...	...	...	...
95/34	62·2	·8	...	...	...	...
98/35	62·3	·7	...	...	...	...
90/32	62·65	·35	...	...	...	...
93/33	62·75	·25	...	...	...	...
96/34	62·9	·1	...	...	...	...
99/35	63·0	...	...	...	...	...
91/32	...	...	...	...	...	...
94/33	...	...	...	...	...	...
97/34	...	...	...	...	...	...
100/35	...	...	...	...	...	...
92/32	...	...	...	...	...	...
95/33	...	...	...	...	...	...
98/34	...	...	...	...	...	...
93/32	...	...	...	...	...	...
96/33	...	...	...	...	...	...
99/34	...	...	...	...	...	...
94/32	...	...	...	...	...	...
97/33	...	...	...	...	...	...
100/34	...	...	...	...	...	...
95/32	...	...	...	...	...	...
98/33	...	...	...	...	...	...
96/32	...	...	...	...	...	...
99/33	...	...	...	...	...	...
97/32	...	...	...	...	...	...
100/33	...	...	...	...	...	...
98/32	...	...	...	...	...	...
99/32	...	...	...	...	...	...
100/32	...	...	...	...	...	...

Table showing the Wheels and Pinions required to give various amounts of Drag or Gain of the Carriage for Self-Acting Cotton Mules with RIM AT SIDE.

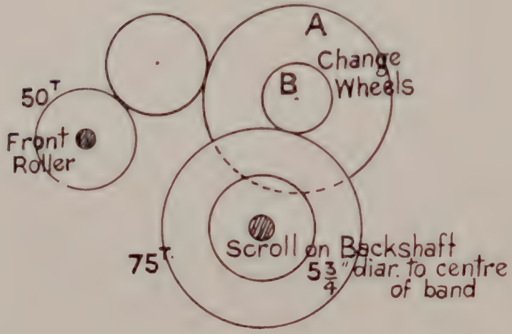
The length of yarn delivered per stretch equals

$$\frac{A}{B} \cdot \frac{75}{50 \times 5\frac{3}{4}''} \times \text{diar. of Front Roller} \times \text{length of stretch.}$$

The Drag or Gain is obtained by subtracting the length of yarn delivered by the roller, from the total stretch of the carriage.

A = number of teeth in change wheel.
B = number of teeth in change pinion.

(See diagram and remarks at foot of page 204.)



The following results are for a Mule of 64-inch stretch.

Yarn delivered and Drag produced in inches for different diameters of Front Bottom Rollers.

Change Wheels	$\frac{13}{16}''$ Yarn del.	$\frac{13}{16}''$ Drag prod.	$\frac{7}{8}''$ Yarn del.	$\frac{7}{8}''$ Drag prod.	$\frac{15}{16}''$ Yarn del.	$\frac{15}{16}''$ Drag prod.	Change Wheels	$1''$ Yarn del.	$1''$ Drag prod.	$1\frac{1}{16}''$ Yarn del.	$1\frac{1}{16}''$ Drag prod.	$1\frac{1}{8}''$ Yarn del.	$1\frac{1}{8}''$ Drag prod.
88/24	...	...	...	...	57·4	5·6	87/28	...	...	55·2	7·8	58·4	4·6
92/25	...	...	...	...	57·6	5·4	88/28	...	...	55·8	7·2	59·1	3·9
89/24	...	...	...	...	58·1	4·9	89/28	...	...	56·4	6·6	59·7	3·3
93/25	...	...	...	...	58·3	4·7	90/28	...	...	57·0	6·0	60·3	2·7
90/24	...	...	...	...	58·8	4·2	87/27	...	...	57·2	5·8	60·6	2·4
94/25	...	...	...	...	58·8	4·2	91/28	...	...	57.6	5·4	61·0	2·0
87/23	...	...	...	...	59·2	3·8	88/27	...	...	57·8	5·2	61·3	1·7
91/24	...	...	...	...	59·4	3·6	92/28	...	...	58·3	4·7	61·7	1·3
95/25	...	...	...	...	59·4	3·6	89/27	...	...	58·5	4·5	62·0	1·0
88/23	...	...	...	...	60·0	3·0	93/28	...	...	59·0	4·0	62·2	·8
92/24	...	...	...	...	60·0	3·0	90/27	...	...	59·2	3·8	62·5	·5
89/23	...	...	...	...	60·6	2·4	87/26	...	...	59·4	3·6	62·9	·1
93/24	...	...	...	...	60·6	2·4	94/28	...	...	59·6	3·4	63·0	...
90/23	...	...	...	...	61·3	1·7	91/27	...	...	59·9	3·1	...	...
94/24	...	...	...	...	61·3	1·7	88/26	...	...	60·0	3·0	...	...
87/22	...	...	57·8	5·2	61·9	1·1	95/28	...	...	60·2	2·8	...	...
91/23	...	...	57·8	5·2	61·9	1·1	92/27	...	...	60·5	2·5	...	...
95/24	...	...	57·9	5·1	62·0	1·0	89/26	...	...	60·8	2·2	...	...
92/23	...	...	58·5	4·5	62·6	·4	93/27	57·5	5·5	61·2	1·8	...	...
88/22	...	...	58·5	4·5	62·6	·4	90/26	57·8	5·2	61·5	1·5	...	...
93/23	...	...	59·0	4·0	...	...	87/25	58·2	4·8	61·7	1·3	...	...
89/22	...	...	59·1	3·9	...	...	94/27	58·2	4·8	61·7	1·3	...	...
94/23	...	...	59·6	3·4	...	...	91/26	58·4	4·6	62·2	·8	...	...
90/22	...	...	59·9	3·1	...	...	95/27	58·9	4·1	62·4	·6	...	...
95/23	...	...	60·4	2·6	...	...	88/25	58·9	4·1	62·5	·5	...	...
91/22	...	...	60·5	2·5	...	...	92/26	59·1	3·9	62·9	·1	...	...
87/21	...	...	60·5	2·5	...	...	89/25	59·5	3·5	...	...	...	...
92/22	...	...	61·1	1·9	...	...	93/26	59·9	3·1	...	...	...	...
88/21	...	...	61·2	1·8	...	...	90/25	60·1	2·9	...	...	...	...
93/22	...	...	61·7	1·3	...	...	94/26	60·5	2·5	...	...	...	...
89/21	...	...	61·9	1·1	...	...	87/24	60·5	2·5	...	...	...	...
94/22	...	...	62·4	·6	...	...	91/25	60·8	2·2	...	...	...	...
90/21	...	...	62·6	·4	...	...	95/26	61·0	2·0	...	...	...	...
95/22	58·7	4·3	63·0	...	...	...	88/24	61·3	1·7	...	...	...	...
91/21	58·8	4·2	...	...	...	...	92/25	61·4	1·6	...	...	...	...
87/20	59·0	4·0	...	...	...	...	89/24	61·9	1·1	...	...	...	...
92/21	59·5	3·5	...	...	...	...	93/25	62·2	·8	...	...	...	...
88/20	59·7	3·3	...	...	...	...	90/24	62·6	·4	...	...	...	...
93/21	60·1	2·9	...	...	...	...	94/25	62·6	·4	...	...	...	...
89/20	60·3	2·7	...	...	...	...	...	...	...	...	...	...	...
94/21	60·8	2·4	...	...	...	...	...	...	...	...	...	...	...
90/20	61·0	2·0	...	...	...	...	...	...	...	...	...	...	...
95/21	61·4	1·6	...	...	...	...	...	...	...	...	...	...	...
91/20	61·6	1·4	...	...	...	...	...	...	...	...	...	...	...
92/20	62·3	·7	...	...	...	...	...	...	...	...	...	...	...
93/20	63·0	...	...	...	...	...	...	...	...	...	...	...	...
94/20	...	...	...	...	...	...	...	...	...	...	...	...	...

SELF-ACTING MULES.

The production obtained from Self-Acting Mules may be taken approximately as given below. In calculating these productions, we have assumed average speeds and allowances for doffing, breakages, &c., **but have not made any allowance for cleaning time.**

All Twist Yarns.

Counts of Yarn.	Turns of Twist per inch.	No. of Draws per min.	Draw or Stretch.	Production in 10 hours, after all allowance for loss taken off, not including cleaning time.		Kind of Cotton.	Loss allowed for doffing and breakages.
				Hanks.	Lbs.		
16's	15·0	5·25	66″	6·26	0·39	American	7½ %
20's	16·77	5·25	66″	6·26	0·31	,,	7½ %
24's	18·37	5·0	66″	6·00	0·25	,,	7 %
30's	20·54	4·85	64″	5·63	0·188	,,	7 %
36's	22·5	4·65	64″	5·43	0·150	,,	6½ %
40's	23·71	4·5	64″	5·26	0·131	,,	6½ %
44's	24·87	4·25	64″	4·99	0·113	,,	6 %
50's	26·51	4·0	64″	4·70	0·094	,,	6 %
56's	27·68	4·0	64″	4·70	0·083	,,	6 %
60's	28·65	4·0	64″	4·70	0·078	,,	6 %
60's	27·88	3·25	63″ + 3″	3·98	0·056	Egyptian	5 %
70's	30·11	3·0	63″ + 3″	3·67	0·052	,,	5 %
80's	32·20	2·75	63″ + 3″	3·37	0·042	,,	5 %
90's	34·15	2·5	63″ + 3″	3·08	0·034	,,	4½ %
100's	36·0	2·5	60″ + 3″	2·94	0·029	,,	4½ %
110's	37·75	2·25	60″ + 3″	2·66	0·024	,,	4 %
120's	39·43	2·15	60″ + 3″	2·54	0·021	,,	4 %

Note.—The productions for 60's to 120's from Egyptian cotton are calculated for Mules with about 3″ of roller delivery motion whilst winding on.

For finer counts from good Egyptian and Sea Islands cottons the productions are not given, as these might prove misleading, owing to the varying conditions as to turns of twist per inch in the yarn, and other circumstances.

Space Occupied.

To calculate the length of a Self-Acting Mule, multiply number of spindles by distance and add :—

5′ $1\frac{1}{4}$″ for $45\frac{1}{4}$″ Coupling Spindle, Double Carriers at Headstock, Rim at back, Oldham Mule.

5′ 9″ for 53″ Coupling Spindle, Double Carriers at Headstock, Rim at back, Jacking Motion, Roller Delivery Motion, &c., Bolton Mule.

8′ 1″ for $44\frac{1}{2}$″ Coupling Spindle, all 3 lines of rollers driven in the middle of each side, flanged coupling, Rim at back, Oldham Mule.

8′ $5\frac{1}{2}$″ for 49″ Coupling Spindle, all 3 lines of rollers driven in the middle of each side, flanged couplings, Rim at back, Jacking Motion, Roller Delivery Motion, &c., Bolton Mule.

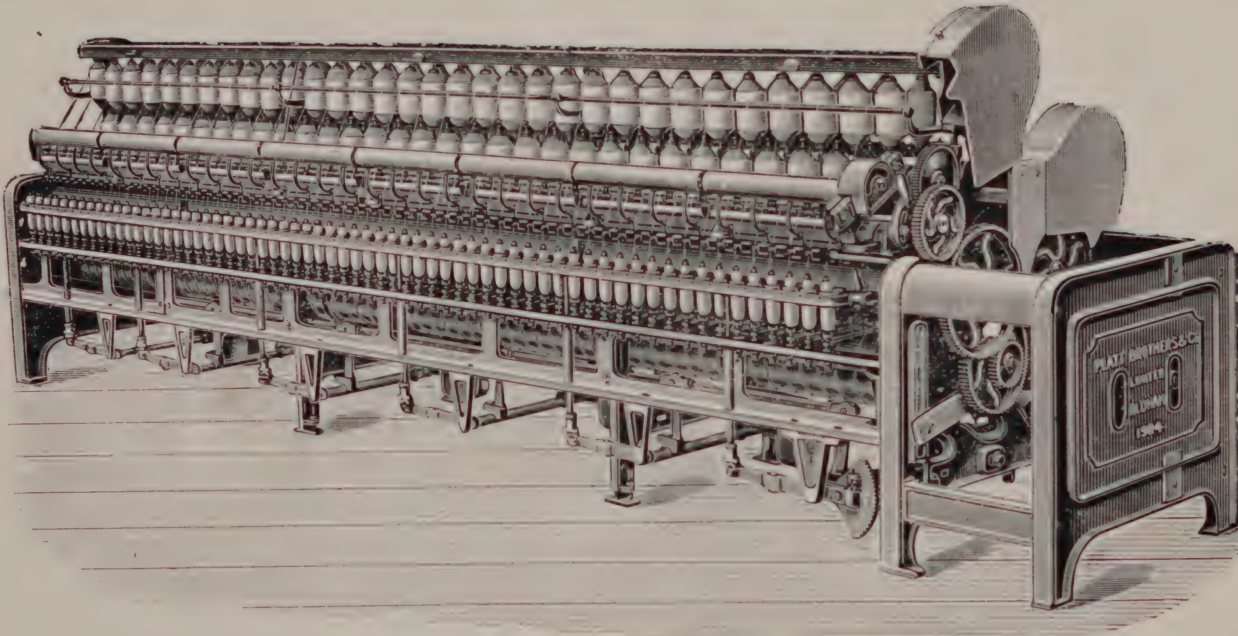
If with Rim at side Mule, Double Carriers at Headstock, $50\frac{1}{2}$″ Coupling Spindle, add 5′ $6\frac{1}{2}$″.

If with Rim at side Mule, Double Carriers at Headstock, $56\frac{1}{2}$″ Coupling Spindle, Jacking Motion, Roller Delivery Motion, &c., add 6′ $0\frac{1}{2}$″.

Width with say 64″ stretch from back of creel with 3 heights of bobbins, single line, to end of stretch, 8′ $0\frac{3}{4}$″. From end of stretch to front of headstock, 1′ 9″. From front of fallers when carriage is in, to back of headstock, 3′ 9″

Rim Pulleys 14″ and upwards, usually 15″. Ordinary Driving 5″ fast, $5\frac{1}{4}$″ loose. Moorhouse & Ashton's Duplex Driving, 2 fast pulleys each 3″ wide; 2 loose pulleys each $3\frac{1}{4}$″ wide.

Speed 600 to 950 revolutions per minute, according to circumstances.



Ring Spinning Frame for Warp Yarns.

No. 3 Pattern.

Birkenhead's Patent Creel.

RING SPINNING FRAMES,

FOR WARP OR WEFT, ON RABBETH BOBBINS, WOOD PIRNS, OR PAPER TUBES.

These Machines are made $2\frac{1}{4}''$, $2\frac{3}{8}''$, $2\frac{1}{2}''$, $2\frac{5}{8}''$, $2\frac{3}{4}''$, $2\frac{7}{8}''$, and $3''$ distance, with Rings $1\frac{1}{8}''$, $1\frac{1}{4}''$, or $1\frac{3}{8}''$ for weft. and $1\frac{3}{8}''$, $1\frac{1}{2}''$, $1\frac{5}{8}''$, $1\frac{3}{4}''$, or $2''$ for warp. The rails which contain the spindles are cast on what is known as the girder principle (double rail and lever lifting motion), with planed fitting beds at the back and solid cast planed ends to joint together and fit to the headstock and out end. The upper flange of the rails, in which the spindles are fixed, is planed on the top, on the underside and on the face. This forms a true fitting bed for the spindle or bolster holders, consequently they can be fixed firmly in the spindle rail, with little fear of their working loose or moving from the position in which they are set. The ring plates are surfaced for reception of the rings, when on the Machine after erection, so as to ensure the proper bedding of the rings.

The **Spindles** are of our **Patent Flexible** Pattern, of which we can supply 3 types, the standard being the Ordinary Flexible Spindle, in which it is necessary to take off the spindle bands so as to remove the running part of spindle for cleaning or oiling purposes. The other patterns referred to above are our "D" and "G" types, which can be oiled without disturbing the spindle bands, viz., the "D" pattern with front oiling spout and Angle Iron Covers, and the "G" pattern with removable brass cartridge oil tube. These spindles are further described in separate circulars. The spindles for Warp Frames can be arranged for Rabbeth Bobbins, *i.e.*, with cast-iron cups as usual; or for Paper Tubes, in which case a wood bush cemented on the spindle, or one secured by cast-iron tip, may be adopted. The spindles for Weft Frames may be made with ordinary blade and cup for Wood Pirns, or with thick blade for thin paper tubes.

The **Rings** are made of steel, casehardened, and on special automatic machinery, to template and gauge. All are thoroughly tested after hardening, both for perfect smoothness on the flange, also for concentricity, and none are allowed to pass into the machine which are not perfect in hardening, perfect on the flange, or concentric, so far as is possible to ensure by careful examination.

We usually make the rings with one flange only; but if preferred, we supply the double flanged reversible rings with split cast-iron holders, or with sheet-iron holders.

The **Roller Stands** are made of various degrees of inclination, according to the quality of yarn required from Indian, American, Egyptian, and other cottons; or with level stands in some cases for **extra hard** warp yarns, or other special qualities. For silk waste or worsted yarns special arrangements of roller stands are required. These are, however, not further alluded to in this circular.

As a rule the front line only of top rollers is prepared for covering and weighting, the position of the weight hook being so arranged as to pull through the line of centres of top and bottom rollers. This arrangement tends to keep the necks of the bottom rollers and the pivots of the top rollers away from the fronts of the stands and cap bars, and thus to reduce the liability to wear, and has proved to be so efficient that we have found the front face of the slots in the stands practically unworn after a number of years' working. All stands and slides are planed and fitted with brass bushes for each of the three lines of rollers.

We also make (where preferred by spinners of East Indian or other short staple cottons) roller stands with a greater inclination, and with this arrangement generally prepare all three lines of top rollers for covering with cloth and leather. The three lines of top rollers in this arrangement being saddled and lever weighted.

Our standard system of **Top Clearer** is in box lengths, with turned malleable-iron pivots at each end, and with adjustable sheet-iron fixing on the cap bar fingers. These clearers are, however, if preferred (and at a small extra cost), made in half-box (say 4 spindle) lengths. In either of the above arrangements **Ч**-shaped adjustable clearer fixings may be applied with considerable advantage in maintaining a steady running top clearer well and evenly felted, and one that will keep the top rollers clean.

Where the draft rollers are likely to be kept at about one width of setting, the top clearers are, if preferred, made in half-box lengths, without pivots, also without adjustable fixings. This arrangement is very satisfactory where the clearers rest on the front and the back top rollers only.

The **Creels** can be made of iron, lined with wood and fitted with porcelain steps, but we usually supply our Birkenhead Patent, which in a two height creel is about 5" lower than the Iron Creel. These properly constructed creels are better for the skewer points and for the easy pulling off of the roving than the common construction with an iron bar, countersunk for reception of the skewer points, adopted by some makers.

Our **Headstocks** (No. 3 Pattern) are constructed with a polished iron turn-over guard over the draft wheels, and in mills where special provision is desired to prevent the tenters being injured, we add a special sheet-iron guard at front of twist and intermediate gearing; also an automatic apparatus to prevent the turn-over guards being lifted whilst the frame is at work, at a small extra cost.

All draft wheels are cut out of solid blanks, the smaller wheels being of steel, casehardened; the twist wheels are all turned and machined inside the teeth, and when at work run with perfect smoothness and without noise.

The two **Tin Rollers** are made of the best tin plate, each cast-iron end is separately turned and balanced before being put in the tin roller, each section of the tin roller being made on special machinery, so that whatever the thickness of the tinned plate, the outside diameter of the tin roller is invariably to template size. After being put together in the required lengths each tin roller is run at a maximum working speed and put in a perfect balance before leaving the works. The tin roller arbors are of Cast-iron, working in Cast-iron Pedestals, and have proved to be a most satisfactory bearing where ordinary care is taken in lubrication; each of the inside bearings is fitted with brass oil tube from the pedestal to the top board, and as a matter of extra precaution each pedestal has a tallow cup to contain a supply of tallow, to come into use if the bearing should become heated through neglect in oiling.

Where required, and at an extra cost, we apply Mohler's Patent Pedestals to the tin rollers at gear and out ends, and inside pedestals, with rings, for special lubrication, instead of our ordinary system. We supply Swivel Tin Roller Pedestals to the middle bearings, and if preferred can apply Loose Steel Oiling Rings for same (the latter being extra).

The loose driving pulley runs on a cast-iron cannon bracket, which is bolted to a bracket fitted outside the frame end for easy removal of the pulleys when required. The loose pulley is fitted with an "ink bottle" lubricator to retain the oil.

When required we apply a rope driving and tightening apparatus to drive the two tin rollers together at *out end*, and thus drive the second or negative tin roller positively. We, however, attach little importance to this apparatus, either as a means of preventing loss in speed in the spindles driven by the negative tin roller when starting the frame, or as an economiser of spindle banding.

The **Lifting Motion** is usually cop build, the formation of the base being done either by means of Patent volute wheels in the swing lever of the building motion, which, by the way, is connected with the rocking shaft by means of gearing, or by means of a Chain and Sector Lifting Motion, whichever is preferred.

Where desired we can supply a Lifting Motion to make a parallel wound bobbin with shortening motion, also double ended bobbins with parallel build. However, either of these systems present several disadvantages in working compared with the standard cop build bobbin, and are not usually adopted except in the case of extra hard twisted yarn (crape yarn), where it may be desirable to wind from a parallel bobbin to prevent the formation of snarls. We have also a Compound Lifting Motion arranged to wind Cop or Parallel Build at will.

The ordinary **Anti-balloon Apparatus** is a wire with semi-automatic tumbler lever, but for soft or weak yarns, or where a more perfect anti-balloon apparatus is required, we supply our special arrangement of "Blinker" Separators between each spindle, fitted to each length of ring plate, so that the plate with the "Blinkers" may be easily lifted off the pillars altogether when necessary for cleaning or other purpose. (See full description, page 227.)

We also supply the Shepherd & Midgeley's Patent Anti-Balloon Plates where desired. These are made with slit at front to entirely surround the ring, or scooped out and hinged to turn back for doffing.

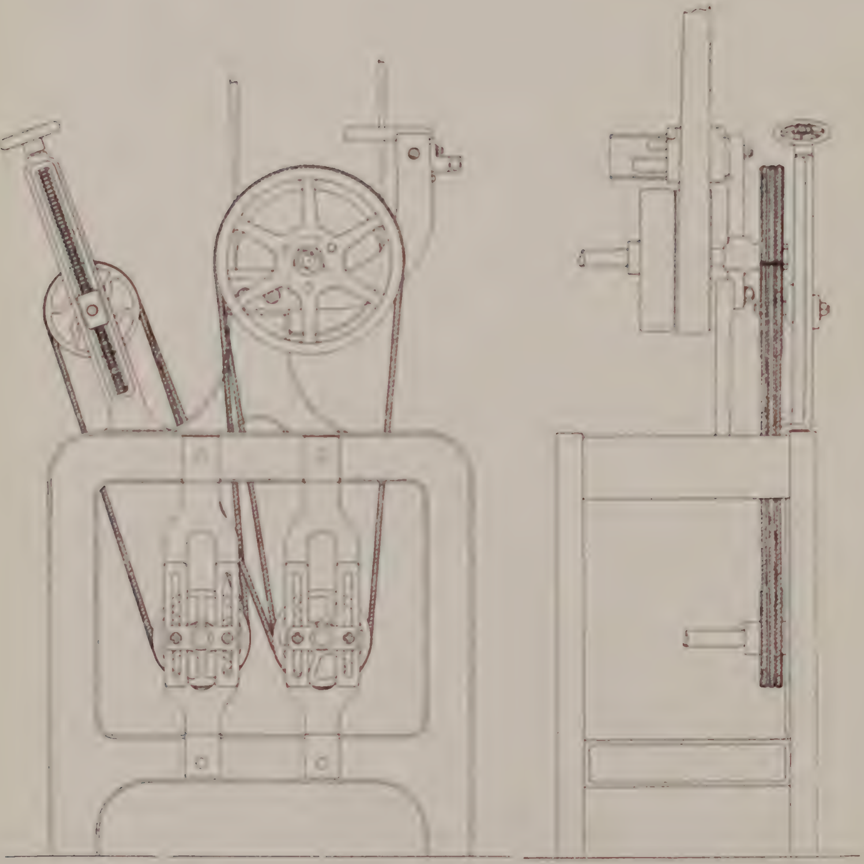
We now frequently apply an adjustable swinging socket to the Lifting pillar feet, which is found useful in obviating re-setting and levelling after taking the pillars out for cleaning.

Our ordinary Thread Lappets are of wood, but we can supply Metallic Lappets on cedar rib or angle iron bar.

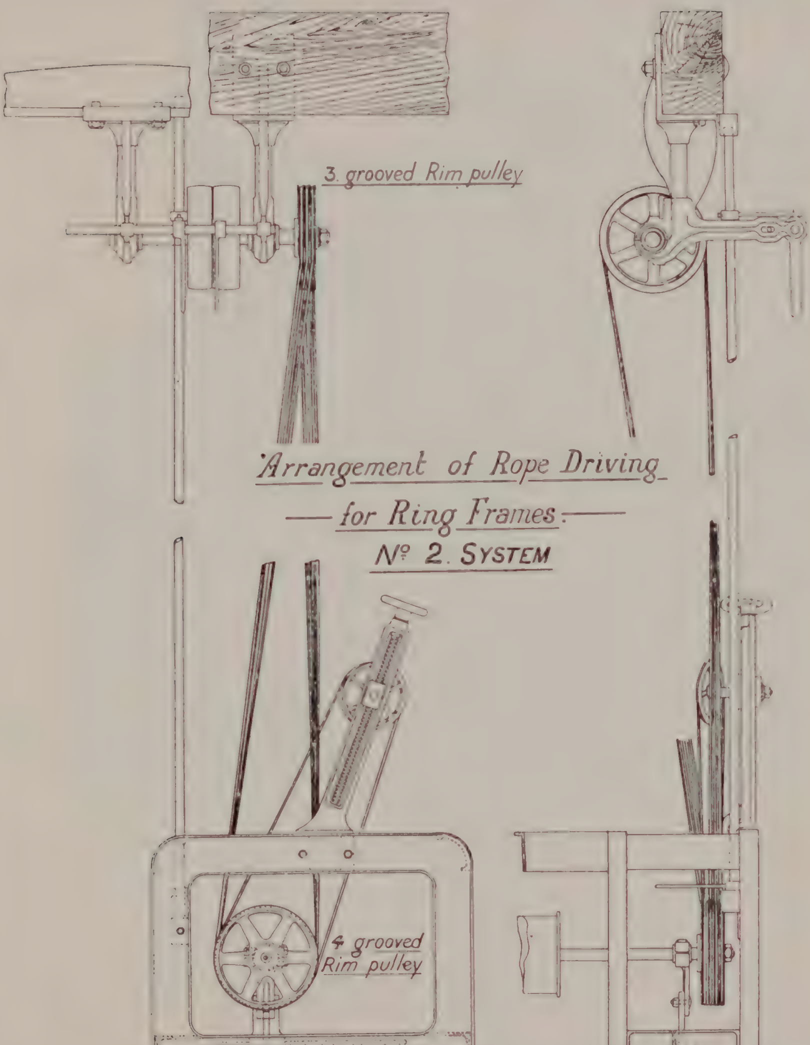
We are Makers of Ring Spinning Frames to spin from Condenser Bobbins or "cheeses" from Waste Carding Engines.

ROPE DRIVING ARRANGEMENT AT HEADSTOCK.—Where a frequent change is desired in the speed of spindles, say for spinning a range of the coarsest counts, or where a medium is desired to obtain a high spindle speed from a slow running driving shaft, we apply Changeable Rim Pulley Driving and Rope Tightening Apparatus at the Headstock (No. 1 System), or Special Counter-driving (No. 2 System) with rims to serve the same purpose. We also supply Fast and Loose Rope Driving Pulleys (No. 3 System) where desired. This system has been adopted with very satisfactory results as regards durability of ropes, and the ropes do not, moreover, interfere with the light. In this arrangement the fast pulley is provided with two grooves so that the rope, in being moved from the loose to the fast pulley, starts the Frame slowly as the first groove in the fast pulley allows the rope to slip slightly; on giving the rope fork a further movement, the rope enters the twitch groove in the fast pulley and puts the Frame up to full speed.

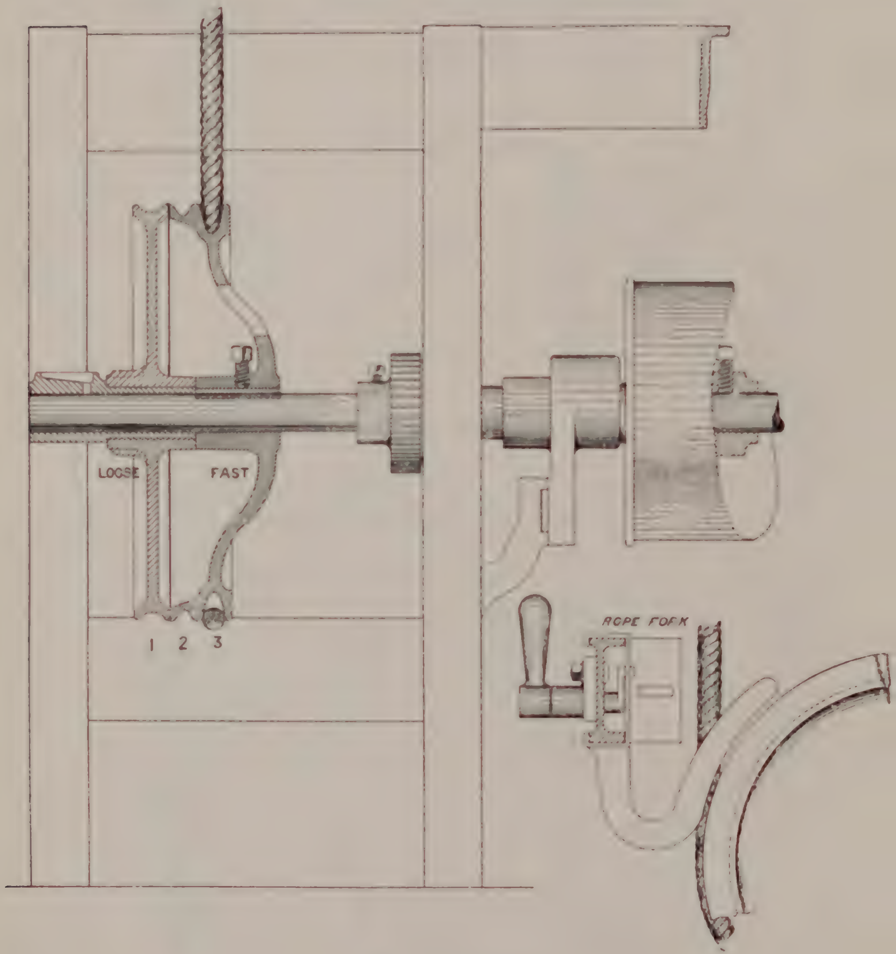
Arrangement of Rope Driving for Ring Frames.



No. 1 System.

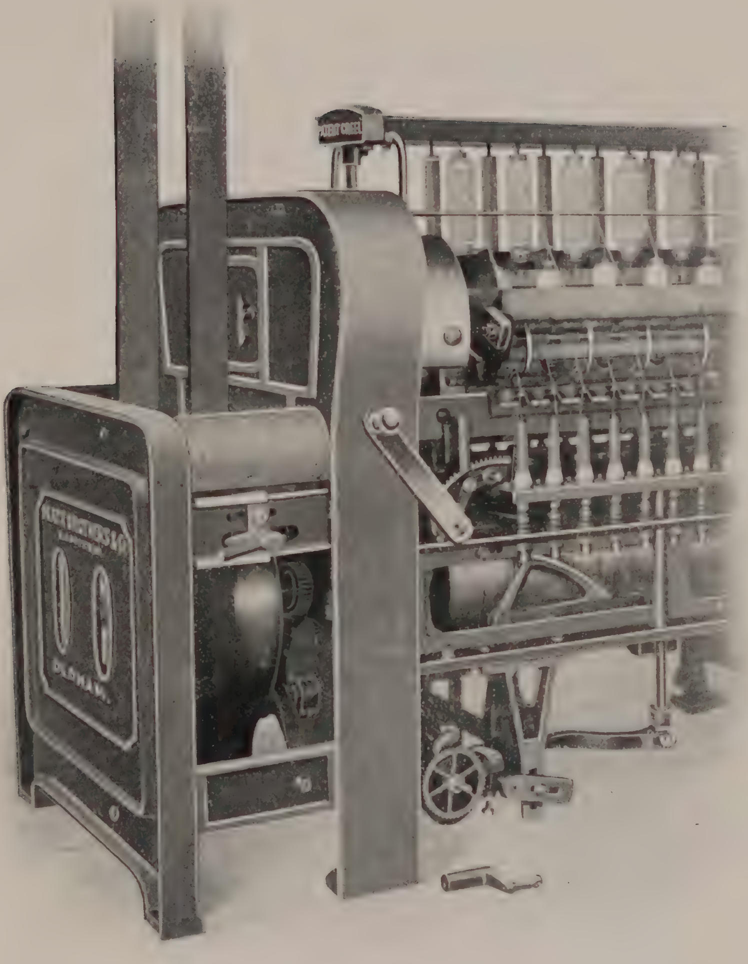

3. grooved Rim pulley
Arrangement of Rope Driving
— for Ring Frames. —
Nº 2. SYSTEM
4 grooved
Rim pulley

Arrangement of Rope Driving for Ring Frames.



No. 3 System.

1 rope, but 2 grooves in fast pulley to start the Frame slowly.



Ring Spinning Frame.
No. 4 Pattern.

If preferred, we are now prepared to supply our No. 4 Pattern of Headstock with Box Frame Ends, as per illustration, in which the whole of the gearing is enclosed; access being provided to the change wheels, for which facilities are given for a large range in the number of teeth.

Blinker Separators.

BLINKER SEPARATORS

ON FLAT BAR FIXINGS, FOR RING SPINNING FRAMES.

These are considered specially suitable where a short staple or low class of cotton is to be spun, also where the lift is long, or where the spindle gauge is limited.

They effectually prevent excessive "ballooning" and lashing of threads, and permit of the use of a light traveller when spinning soft or weak yarns, and it is found that when the Blinker Separators are in operation it is not necessary to change the travellers for a small difference in the counts of yarn being spun.

The adoption of Separators renders a reduction in the gauge or spindle distance quite permissible; for instance, rings $1\frac{5}{8}$ in. diameter may be put in $2\frac{1}{4}$ in. distance only (instead of in $2\frac{5}{8}$ in. distance as usual where the ordinary anti-balloon wires are used), so that floor space is proportionately economised. Of course, this reduction in the spindle gauge makes the space around the rings somewhat limited, and care in cleaning is necessary to keep the ring rails clear of "fly." The bars carrying the Separators are in lengths equal to the ring plates, and are fixed above the surface of the ring plates in the best position to allow of the escape of "fly" or loose fibre. The C. I. Separators are well polished, and are fitted by setscrew on flat bar as shown; thus all Blinkers are in correct alignment, and broken ones may be easily changed without disturbing others.

We have patented an arrangement for putting the Separators into action at the same time as the thread lappets are lowered from headstock, and after the Frame has been doffed. Thus, when the bobbins become full, and the Frame is ready for doffing, the attendants push back each length or section of Separators as they proceed with the doffing (Fig. 1).

When starting the Frame, the "tenter" releases the handle **A** at headstock, in order to drop the thread lappets, and at the same time, by means of the connections **B**, the Separators are also moved forward into the normal working position (Fig. 2).

RING SPINNING FRAMES.

The following are the usual gauges for various counts of yarn, but it will be understood that special circumstances such as weak yarns or a desire for high speeds, large capacity of bobbin, &c., may render divergences from the list below advisable:—

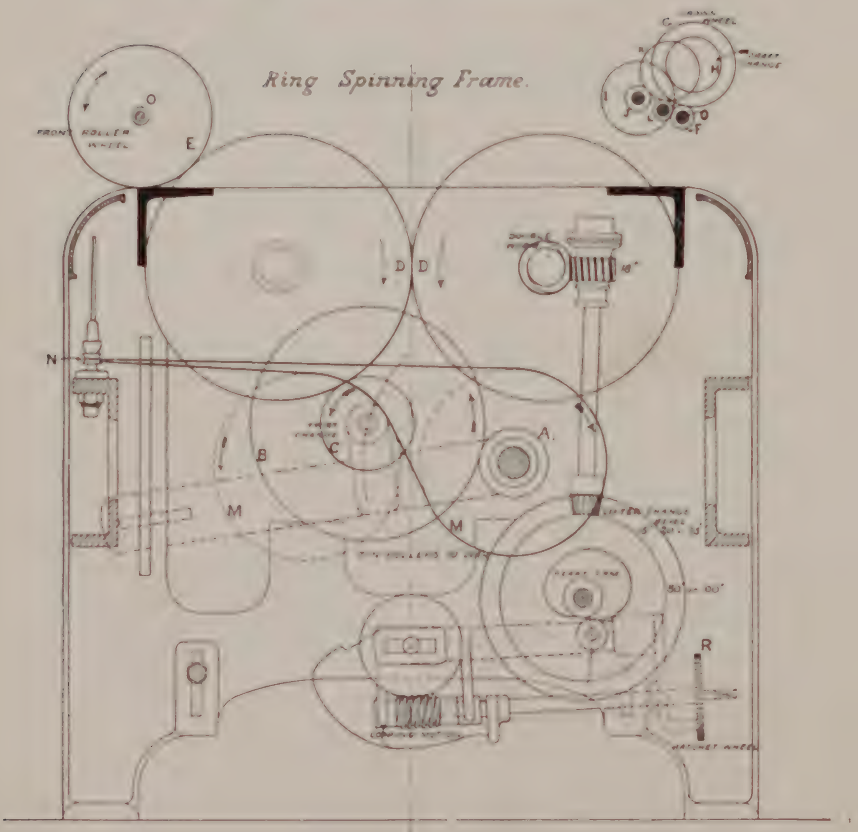
Counts of Yarn.	Diameter of Ring.	Distance of Spindles.	Lift.
6's to 12's	2"	2¾" with Separators	6" to 7"
6's to 12's	2"	3" with or without Separators	6"
10's to 16's	1¾" or 1⅝"	2½" with Separators	6"
15's to 24's	1¾"	2½" with Separators	5½" or 6"
15's to 24's	1¾"	2¾" with or without Separators	5½" or 6"
24's to 40's	1⅝"	2¼" with Separators	5" or 5½"
24's to 40's	1⅝"	2½" with or without Separators	5" or 5½"
40's to 60's	1½"	2⅜" with or without Separators	5"
60's to 80's	1⅜"	2¼" with or without Separators	5"

Traveller Table for Ring Spinning.

We give below a list of Travellers for Ring Spinning. It cannot, however, be said to be absolutely definite under all conditions, as there are many factors which may affect the weight of Traveller to be used, viz.: —class of cotton being worked, speed of spindles, diameter of ring, turns of twist per inch, and the kind of anti-balloon arrangements (Separators or otherwise) in use. It is intended to serve as a general guide or basis only, and may be used for American cottons and high speeds.

Counts of Yarn to be spun.	Size of Traveller.	
90's to 100's	18/0	
81's to 90's	17/0	
76's to 80's	16/0	
71's to 75's	15/0	
66's to 70's	14/0	
61's to 65's	13/0	
56's to 60's	12/0	
51's to 55's	11/0	
46's to 50's	10/0	
42's to 45's	9/0	
39's to 41's	8/0	
36's to 38's	7/0	For Indian cotton about 5 sizes lighter, and for Egyptian and Sea Islands cottons 4 to 5 sizes heavier.
33's to 35's	6/0	
30's to 32's	5/0	
28's to 29's	4/0	
26's to 27's	3/0	
24's to 25's	2/0	
22's to 23's	1/0	
20's to 21's	1's	
18's to 19's	2's	
16's to 17's	3's	
14's to 15's	4's	
12's to 13's	5's	
10's to 11's	6's	
8's to 9's	7's	
6's to 7's	8's	
4's to 5's	9's	
2's to 3's	10's	
1's	11's	

No. 3 Pattern Headstock.



Ring Spinning Frame.

No. 3 Pattern.

Alphabetical References to Sketch.

Twist and Draft Arrangement.

			Range.
A	Tin roller wheel	25T 30T	18T to 40T
B	Twist carrier wheel	100T	60T to 120T
C	Twist change wheel		18T to 80T
D D	Armed Intermediate wheel	114T	
E	Front roller wheel	62T	
F	Front roller pinion	20T or 25T	
G	Crown wheel	100T, 105T, or 120T	
H	Draft change wheels		20T to 50T
I	Back roller wheel	56T	30T to 56T
J	Back roller pinion	18T, 20T, or 25T	
K	Double carrier wheel	66T	
L	Middle roller pinion	14T, 15T, 16T	
M	Tin roller, 10″ diar.		
N	Spindle warves, $\frac{3}{4}$″, $\frac{7}{8}$″ or 1″ diar.		
O	Front bottom rollers	$\frac{13}{16}$″, $\frac{7}{8}$″, $\frac{15}{16}$″, 1″ or $1\frac{1}{16}$″ diar.	
R	Ratchet or shaper change wheel.		

Calculations.

To find Speed of Tin Rollers.

$$\text{Speed of driving shaft} \times \frac{\text{Diar. of Driving Drum}}{\text{Diar. of pulley on Tin Roller}} = \text{Speed of Tin Roller.}$$

To find Speed of Spindles.

$$\text{Speed of Tin Roller} \times \frac{\text{Diar. of Tin Roller } (+ \tfrac{1}{16}'' \text{ for banding})}{\text{Diar. of Spindle Warve } (+ \tfrac{1}{16}'' \text{ for banding})} = \text{Speed of Spindles}$$

To find Turns of Spindle for 1 of Front Roller.

$$\frac{E \times B \times \text{diar. of Tin Roller } (+ \tfrac{1}{16}'' \text{ for banding})}{C \times A \times \text{diar. of Spindle Warve } (+ \tfrac{1}{16}'' \text{ for banding})}$$

$$= \text{Turns of Spindle for 1 of Front Roller.}$$

To find Turns of Twist per inch.

$$\frac{E \times B \times \text{diar. of Tin Roller } (+ \tfrac{1}{16}'' \text{ for banding})}{C \times A \times \text{diar. of Spdl. Warve } (+ \tfrac{1}{16}'' \text{ for banding}) \times \text{circum. of Front Roller}}$$

$$= \text{Turns per inch.}$$

or

$$\frac{\text{Speed of Spindles per minutes}}{\text{Speed of Front Roller} \times \text{circumference (diameter} \times 3{\cdot}14)} = \text{Turns of Twist per inch.}$$

To find Twist Wheel to give any Number of Turns per inch.

$$\frac{E \times B \times \text{diar. of Tin Roller } (+ \tfrac{1}{16}'' \text{ for banding})}{\text{Turns per inch required} \times A \times \text{diar. of Spdl. Warve} + \tfrac{1}{16}'' \text{ for banding} \times \text{circum. of Front Roller}} = \text{Wheel reqd.}$$

Ratchet or Shaper Wheels.

It is somewhat difficult to formulate a rule to determine ratchet wheel required when starting a frame; the conditions of twist, drag, speed, diameter of bobbin, diameter of ring and the speed of lifter, all having an important effect on the result.

The correct wheel should be found by trial, and the following rule can then be used for finding the ratchet wheel when changing counts.

Multiply present wheel by the square root of counts required and divide by square root of present counts.

Example.—Suppose it is required to change from 36's to 25's counts, and the shaper wheel in use has 30 teeth:

$$\left.\begin{array}{l}\text{Square root of } 36 = 6\\ \text{Square root of } 25 = 5\end{array}\right\} \quad \frac{30\text{r} \times 5}{6} = 25 \text{ teeth.}$$

therefore a 25's wheel should be used.

To find Constant Number for Twist.

$$\frac{E \times B \times \text{diar. of Tin Roller } (+ \tfrac{1}{16}'' \text{ for banding})}{A \times \begin{array}{c}\text{diar. of Spindle Warve}\\ (+ \tfrac{1}{16}'' \text{ for banding})\end{array} \times \begin{array}{c}\text{circum. of Front}\\ \text{Roller}\end{array}} = \begin{array}{l}\text{Constant}\\ \text{Number.}\end{array}$$

$$\frac{\text{Constant Number}}{\text{Twist Wheel}} = \text{Turns of Twist per inch.}$$

$$\frac{\text{Constant Number}}{\text{Turns of Twist per inch}} = \text{Twist Wheel.}$$

To find the Total **Draft** $\dfrac{\text{Counts}}{\text{Hank Roving}} = \text{Draft.}$

or $$\frac{\text{Diar. of front roller} \times I \times G}{\text{Diar. of back roller} \times H \times F} = \text{Draft.}$$

To find Draft between Back and Middle Rollers.

$$\frac{\text{Diar. of 2nd roller} \times J}{\text{Diar. of 3rd roller} \times L} = \text{Breakage draft between 2nd and 3rd rollers.}$$

To find Draft Change Wheel for any required Draft.

$$\frac{\text{Diar. of front roller} \times \text{I} \times \text{G}}{\text{Diar. of back roller} \times \text{draft required} \times \text{F}} = \text{Draft Change Wheel.}$$

To find Constant Number for Draft.

$$\frac{\text{Diar. of front roller} \times \text{I} \times \text{G}}{\text{Diar of back roller} \times \text{F}} = \text{Constant Number.}$$

$$\frac{\text{Constant Number}}{\text{Draft Wheel}} = \text{Draft.} \qquad \frac{\text{Constant Number}}{\text{Draft}} = \text{Draft Wheel.}$$

The exact amount of Twist in Yarn spun on the Ring and Traveller System.

Suppose the rollers deliver 300 inches per minute and the spindles make 9,000 revolutions per minute.

Then the number of inches of yarn delivered per minute from rollers, divided by circumference of bobbin at any given point, equals the number of revolutions the traveller must lag behind the spindle to wind the yarn on the bobbin.

Example:—Suppose bobbin 1" diar. × 3·14 = 3·14" circumference.

300 inches of yarn ÷ 3·14 = 95·5 turns of traveller lost in winding.

9,000 revs. of spindles minus 95·5 = 8,904 revs. of traveller.

or 8,904 revs. of traveller ÷ 300 = 29·68, exact number of turns of twist given by traveller to each inch of yarn delivered by roller.

RING SPINNING FRAMES.

The production obtained from Ring Spinning Frames may be taken approximately as given below. In calculating these productions, we have assumed average speeds and allowances for doffing, breakages, &c., **but have not made any allowance for cleaning time.**

All Twist Yarns.

Counts of Yarn.	Speed of Spindles per min.	Turns of Twist per inch.	Production in 10 hours, after all allowance for loss taken off, not including cleaning time.		Kind of Cotton.	Loss allowed for doffing and breakages.
	Revs.		Hanks.	Lbs.		
10's	6,800	12·01	10·119	1·011	American	10 %
14's	7,700	14·21	9·780	0·698	"	9 %
16's	8,300	15·2	9·860	0·616	"	9 %
20's	8,300	16·99	8·912	0·445	"	8 %
24's	9,000	18·61	8·827	0·367	"	8 %
28's	9,000	20·10	8·272	0·295	"	7 %
32's	9,000	21·49	7·728	0·241	"	7 %
36's	9,400	22·8	7·691	0·213	"	6 %
40's	9,700	24·03	7·528	0·188	"	6 %
50's	9,500	25·49	7·024	0·140	Egyptian	5 %
55's	9,500	26·74	6·689	0·121	"	5 %
60's	9,400	27·92	6·346	0·105	"	5 %
65's	9,400	29·07	6·095	0·093	"	5 %
70's	9,200	30·16	5·749	0·082	"	5 %
75's	9,200	31·22	5·554	0·074	"	5 %
80's	9,000	32·25	5·260	0·065	"	5 %

Space Occupied.

To calculate the length of a Ring Spinning Frame No. 3 Pattern, take half the number of spindles, multiply by the spindle distance, and add 28¾″ if with 13″ buffets, and 29¾″ if with 14″ buffets.

A Frame No. 4 Pattern with 10″ buffets, occupies 2″ more than a Frame No. 3 Pattern with 13″ buffets.

If Frame driven in middle and single geared, with 2 pulleys 4″ wide, 16″ buffets, add 42″.

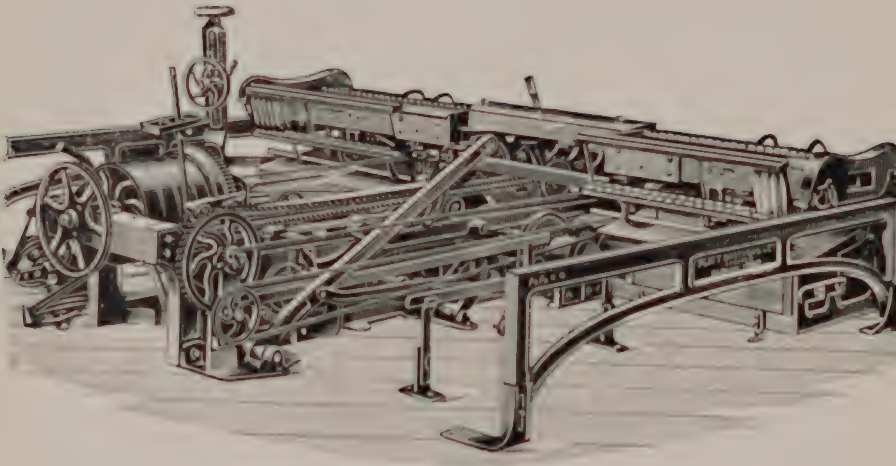
If Frame driven in middle and double geared, with 4 pulleys 5″ × 2½″ × 2½″ × 5″, 28″ buffets, add 55″.

The usual widths of driving pulleys are:—3″ up to 340 spindles; 3½″ for 352 spindles and upwards, with 13″ buffets; 4″ wide for 400 spindles and upwards, with 14″ buffets; 4½″ wide for 450 spindles and upwards, 16″ buffets.

Pulleys, 11″ to 18″ diar. Speed according to circumstances.

Widths of Frames, 2′ 10″, 3′ 0″, 3′ 5″, depending upon circumstances, usually 3′ 0″.

DOUBLING MACHINERY.



Self-Acting Twiner.

We are makers of Self-Acting Twiners of the most modern type, containing all recent improvements of the Self-Acting Mule that are applicable to twiners, including rope taking-in motion, backing-off chain tightening motion, and patent nosing motion. The shaft connecting the tin rollers on each side of the headstock can be disconnected without disturbing any part of the tin rollers, thus facilitating changes of pulleys, &c. The framing of the headstock is exceptionally solid, and all the different parts are easy of access. Various forms of slides can be supplied, including the old wood locking slide, but we recommend our ordinary form as the simplest and most certain in its action, and it leaves the least slack yarn on unlocking. We arrange the slides for dry doubling or with water trough or other arrangements for wet doubling, and with various forms of creels for doubling from cops or bobbins or from winders' bobbins on which two or more threads have been previously wound. The Twiners are made to suit any position of main driving shaft in the building to contain them. We are sole makers of Tetlow's patent clearer plates for cleaning the yarn whilst doubling.

The illustration shews the ordinary Twiner with moving creel, but we also construct the Mule-Twiner with stationary creel and travelling carriage.

SELF-ACTING TWINER.

The productions likely to be obtained from Self-Acting Twiners may be fixed approximately as follows, but these must not be taken as hard and fast figures, as productions depend upon the speed of spindles, twist per inch, skill of the workpeople, quality of the yarn, &c., &c.

Counts of Yarn.	Speed of Spindles.	Turns of Twist per Inch.	Approximate production in 10 hours, after all allowances for loss.	
	Revs.		Hanks.	Lbs.
16's 2 fold	7,500	16	4·1	0·512
20's ,,	8,000	18	4·16	0·416
24's ,,	8,500	20	4·25	0·354
30's ,,	9,000	22	4·5	0·3
36's ,,	10,000	24	4·5	0·25
40's ,,	10,500	25	4·5	0·225
50's ,,	10,500	26	4·5	0·18
60's ,,	10,000	27	4·25	0·141
70's ,,	10,000	28·5	4·16	0·119
80's ,,	10,000	30	4·0	0·10

To calculate the length of a Self-Acting Twiner, multiply the number of spindles by the distance, and add $52\frac{1}{2}''$.

Width of Machine with 70″ stretch; from back of creel to end of stretch, 8′ 10″ with ordinary creel 3 feet wide; from end of stretch to front of headstock, $13\frac{3}{4}''$; from front of fallers to back of Headstock, $10\frac{1}{2}''$.

To calculate the length of a Mule Twiner with 41″ coupling spindle, multiply number of spindles by distance and add 57″.

Width of Machine with 70″ stretch and ordinary creel 3′ wide; from back of creel to end of stretch, 8′ 10″; from end of stretch to front of headstock, 1′ 9″; from back of creel to back of headstock, 9″.

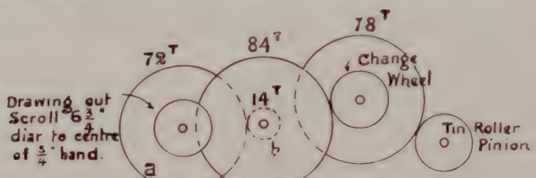
Driving pulleys usually 15″ diar.

Twist Table for S. A. Twiners

With ¾" Spindle Warve. Tin Roller 6" Diameter.

Change Wheels.	Turns of Twist per inch with a 15's Tin Roller Pinion.	Turns of Twist per inch with a 20's Tin Roller Pinion.	Turns of Twist per inch with a 25's Tin Roller Pinion.	Turns of Twist per inch with a 30's Tin Roller Pinion.
20	39·52	29·64	23·71	19·76
21	37·64	28·23	22·58	18·82
22	35·92	26·94	21·56	17·96
23	34·37	25·78	20·62	17·18
24	32·94	24·70	19·76	16·47
25	31·61	23 71	18·97	15·81
26	30·40	22·80	18·24	15·20
27	29·27	21·96	17·56	14·63
28	28·23	21 17	16·94	14·12
29	27·26	20·45	16·36	13·63
30	26·34	19·76	15·81	13·18
31	25·49	19·12	15·29	12·75
32	24·70	18·53	14·82	12·35
33	23·95	17·96	14·37	11·98
34	23·25	17·44	13·95	11·63
35	22·58	16·94	13·55	11·29
36	21·96	16·47	13·18	10·98
37	21·36	16·02	12·82	10·68
38	20·80	15·60	12·48	10·40
39	20·26	15·20	12·16	10·13
40	19·76	14·82	11·86	9·88
41	19·28	14·46	11·57	9·64
42	18·82	14·12	11·29	9·41
43	18·38	13·79	11·03	9·19
44	17·96	13·47	10·78	8·98
45	17·56	13·17	10·54	8·78
46	17·18	12·89	10·31	8·59
47	16·82	12·62	10·09	8·41
48	16·47	12·35	9·88	8·24
49	16·13	12·10	9·68	8·07
50	15·81	11·86	9·49	7·90
51	15·50	11 63	9·30	7·75
52	15·20	11·40	9·12	7·60
53	14·91	11·18	8·95	7·46
54	14·63	10·98	8·78	7·32
55	14·37	10·78	8·62	7·18
56	...	10·58	8·47	7·06
57	...	10·40	8·32	6·94
58	...	...	8·18	6·82
59	...	...	8·04	6·70
60	...	...	7·90	6·59
61	...	...	...	6·48
62	...	..	...	6·37

If wheel a be made with 74 teeth and wheel b with 12 teeth, the turns of twist per inch will be 1·2 times more than the twists given in the above lists; for instance, a 20T change wheel, and 15T tin roller pinion, will be 39·52 × 1·2 = 47·42 turns of twist per inch.

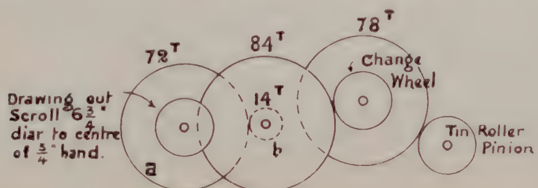


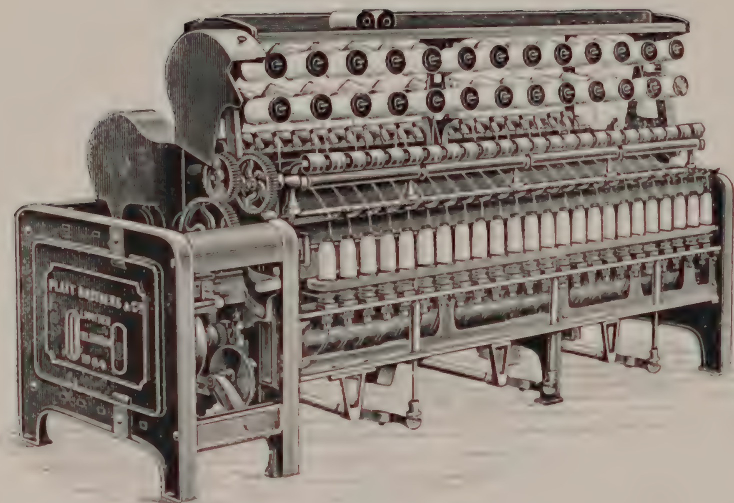
Twist Table for S. A. Twiners

With $\frac{13}{16}''$ Spindle Warve. Tin Roller 6″ Diameter.

Change Wheels.	Turns of Twist per inch with a 15's Tin Roller Pinion.	Turns of Twist per inch with a 20's Tin Roller Pinion.	Turns of Twist per inch with a 25's Tin Roller Pinion.	Turns of Twist per inch with a 30's Tin Roller Pinion.
20	36·70	27·52	22·02	18·35
21	34·95	26·21	20·97	17·48
22	33·36	25·02	20·02	16·68
23	31·92	23·94	19·15	15·96
24	30·58	22·94	18·35	15·29
25	29·36	22·02	17·62	14·68
26	28·23	21·17	16·94	14·11
27	27·18	20·38	16·31	13·59
28	26·21	19·66	15·73	13·10
29	25·31	18·98	15·19	12·65
30	24·46	18·35	14·68	12·23
31	23·68	17·76	14·21	11·84
32	22·94	17·20	13·76	11·47
33	22·24	16·68	13·34	11·12
34	21·59	16·19	12·95	10·79
35	20·97	15·73	12·58	10·48
36	20·39	15·29	12·23	10·19
37	19·84	14·88	11·90	9·92
38	19·31	14·49	11·59	9·66
39	18·82	14·11	11·29	9·41
40	18·35	13·76	11·01	9·18
41	17·90	13·42	10·74	8·95
42	17·48	13·11	10·49	8·74
43	17·07	12·80	10·24	8·54
44	16·68	12·51	10·01	8·34
45	16·31	12·23	9·79	8·15
46	15·96	11·97	9·57	7·98
47	15·62	11·71	9·37	7·81
48	15·30	11·47	9·18	7·65
49	14·98	11·23	8·99	7·49
50	14·68	11·01	8·81	7·34
51	14·39	10·79	8·63	7·19
52	14·11	10·58	8·47	7·06
53	13·85	10·39	8·31	6·93
54	13·59	10·19	8·15	6·80
55	13·35	10·01	8·01	6·68
56	...	9·83	7·87	6·56
57	...	9·66	7·72	6·44
58	...	...	7·60	6·33
59	...	...	7·46	6·22
60	...	...	7·34	6·12
61	...	...	...	6·02
62			...	5·92

If wheel **a** be made with 74 teeth and wheel **b** with 12 teeth, the turns of twist per inch will be 1·2 times more than the twists given in the above lists; for instance, a 20T change wheel, and 15T tin roller pinion, will be 36·7 × 1·2 = 44·04 turns of twist per inch.





Ring Doubling Frame.

These frames are similar in general construction to our Ring Spinning Frames, and possess such well-known features as the double girder spindle rails and strong angle roller beams. They are made for either dry or wet work, and on either the English system or on the Scotch system.

In the **Scotch** System the rollers revolve *in* the copper water troughs, with arrangement at end to lift the rollers out for cleaning. The whole of the brackets in the water troughs are of *brass*, so as to avoid rust and staining of yarn.

In the **English** System the copper troughs are of large section, and are placed *behind* the rollers; there is an arrangement at the end of the frame to lift the glass rods (which immerse the threads in the water) altogether out of the troughs at one movement of a lever, so that cleaning, &c., may be facilitated, the whole arrangement being of the best material and workmanship.

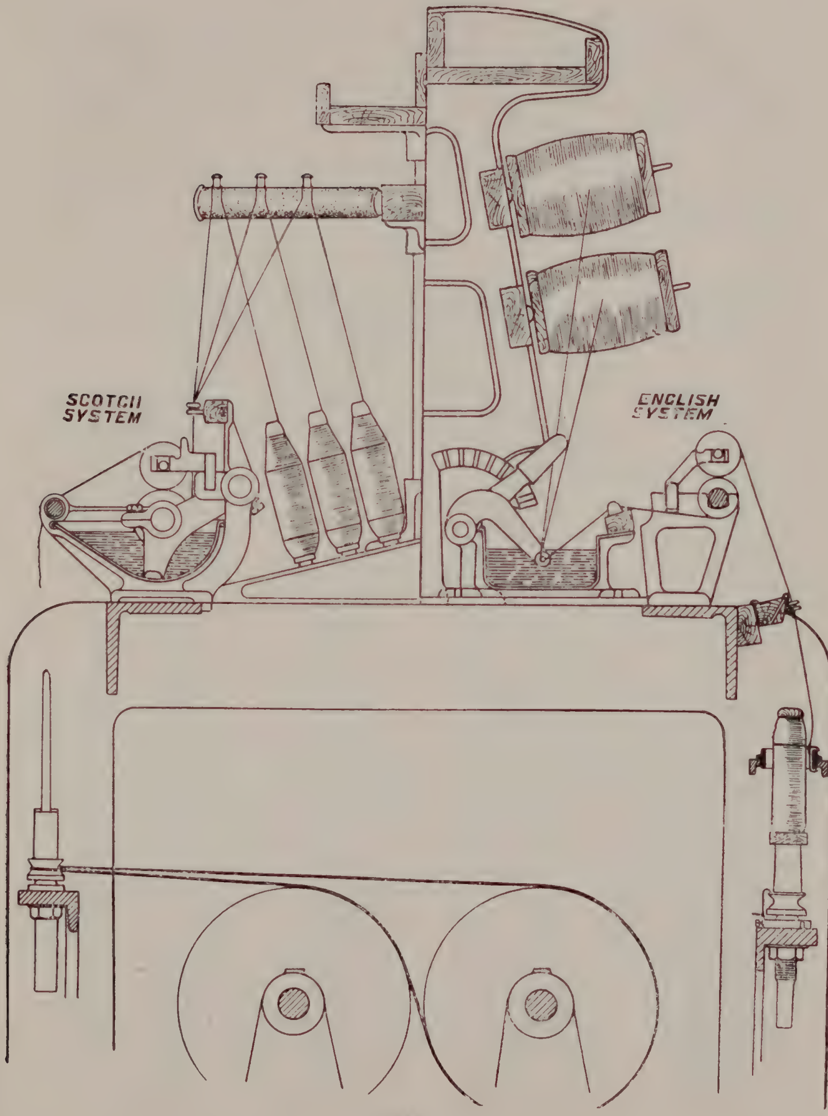
Two tin rollers, 10″ diar., and flexible spindles of the latest description, with knee brakes of various patterns.

Parallel build on double-ended bobbins, cop build on ordinary ring bobbins or paper tubes, or tapering motion for single flanged bobbins.

Creels for cops, ring bobbins or winder bobbins, as desired.

When required, we can apply rope pulley driving arrangement so that speed of spindles may be readily varied, exactly as described and illustrated under the head of Ring Spinning Frames.

Ring Doubler, shewing Two Systems of Water Troughs.



TRAVELLER TABLE FOR DRY DOUBLING.

We give below a list of Travellers for Ring Doubling. It cannot, however, be said to be absolutely definite under all conditions, as there are many factors which may affect the weight of Traveller to be used, viz.:—speed of spindles, diameter of ring, turns of twist per inch, &c.

It is intended to serve as a general guide or basis only, and may be used for dry doubling with $1\frac{3}{4}''$ to $2''$ rings, spinning section thus:—

Counts and Ply of Yarn.	Size of Traveller.	Counts and Ply of Yarn.	Size of Traveller.
s		s	
2/2 fold	14 or 15	70/2 fold	4/0 or 3/0
4/2 ,,	14 or 15	72/2 ,,	4/0 or 3/0
6/2 ,,	13 or 14	74/2 ,,	5/0 or 4/0
8/2 ,,	13 or 14	76/2 ,,	5/0 or 4/0
10/2 ,,	12 or 13	78/2 ,,	6/0 or 5/0
12/2 ,,	12 or 13	80/2 ,,	6/0 or 5/0
14/2 ,,	11 or 12	82/2 ,,	7/0 or 6/0
16/2 ,,	11 or 12	84/2 ,,	7/0 or 6/0
18/2 ,,	10 or 11	86/2 ,,	8/0 or 7/0
20/2 ,,	10 or 11	88/2 ,,	8/0 or 7/0
22/2 ,,	9 or 10	90/2 ,,	9/0 or 8/0
24/2 ,,	9 or 10	92/2 ,,	9/0 or 8/0
26/2 ,,	8 or 9	94/2 ,,	10/0 or 9/0
28/2 ,,	8 or 9	96/2 ,,	10/0 or 9/0
30/2 ,,	7 or 8	98/2 ,,	11/0 or 10/0
32/2 ,,	7 or 8	100/2 ,,	11/0 or 10/0
34/2 ,,	6 or 7	102/2 ,,	12/0 or 11/0
36/2 ,,	6 or 7	104/2 ,,	12/0 or 11/0
38/2 ,,	5 or 6	106/2 ,,	13/0 or 12/0
40/2 ,,	5 or 6	108/2 ,,	13/0 or 12/0
42/2 ,,	4 or 5	110/2 ,,	14/0 or 13/0
44/2 ,,	4 or 5	112/2 ,,	14/0 or 13/0
46/2 ,,	3 or 4	114/2 ,,	15/0 or 14/0
48/2 ,,	3 or 4	116/2 ,,	15/0 or 14/0
50/2 ,,	2 or 3	118/2 ,,	16/0 or 15/0
52/2 ,,	2 or 3	120/2 ,,	16/0 or 15/0
54/2 ,,	1 or 2	122/2 ,,	17/0 or 16/0
56/2 ,,	1 or 2	124/2 ,,	17/0 or 16/0
58/2 ,,	1/0 or 1	126/2 ,,	18/0 or 17/0
60/2 ,,	1/0 or 1	128/2 ,,	18/0 or 17/0
62/2 ,,	2/0 or 1/0	130/2 ,,	19/0 or 18/0
64/2 ,,	2/0 or 1/0	...	...
66/2 ,,	3/0 or 2/0	...	...
68/2 ,,	3/0 or 2/0	...	...

TRAVELLER TABLE FOR WET DOUBLING.

Say with Rings $1\frac{3}{4}''$ to $2''$ diameter. Ear pattern of Traveller, thus :—

A slight deviation from this list may, however, be necessary, depending upon speed of spindles, diameter of ring, turns of twist per inch, &c.

Counts of Yarn.	Fold or Ply.	Size of Traveller for			Counts of Yarn.	Fold or Ply.	Size of Traveller for		
		2 Ply.	3 Ply.	4 Ply.			2 Ply.	3 Ply.	4 Ply.
4's	2–3–4	9	7	5	54's	2–3–4	17½	16½	15
6's	2–3–4	10	8	6	56's	2–3–4	18	16½	15½
8's	2–3–4	10½	8½	6½	58's	2–3–4	18	16½	15½
10's	2–3–4	11	9	7	60's	2–3–4	18½	17	16
12's	2–3–4	11½	9½	7½	62's	2–3–4	18½	17	16
14's	2–3–4	12	10	8	64's	2–3–4	18½	17	16
16's	2–3–4	13	11	9	66's	2–3–4	18½	17½	16½
18's	2–3–4	13½	11½	9½	68's	2–3–4	18½	17½	16½
20's	2–3–4	14	12	10	70's	2–3–4	19	18	17
22's	2–3–4	14½	12½	10½	72's	2–3–4	19	18	17
24's	2–3–4	14½	13	11	74's	2–3–4	19	18	17
26's	2–3–4	15	14	12	76's	2–3–4	19	18	17½
28's	2–3–4	15½	14½	12½	78's	2–3–4	19½	18	17½
30's	2–3–4	15½	14½	12½	80's	2–3–4	19½	18	18
32's	2–3–4	16	14½	13	82's	2–3–4	19½	18	18
34's	2–3–4	16½	14½	13	84's	2–3–4	19½	18	18
36's	2–3–4	17	15	13½	86's	2–3–4	20	18½	18½
38's	2–3–4	17	15	13½	88's	2–3–4	20	18½	18½
40's	2–3–4	17	15½	13½	90's	2–3–4	20	19	19
42's	2–3–4	17	15½	13½	92's	2–3–4	20½	19	19
44's	2–3–4	17	15½	13½	94's	2–3–4	20½	19	19
46's	2–3–4	17	16	14	96's	2–3–4	21	19	19
48's	2–3–4	17	16	14½	98's	2–3–4	21	19	19
50's	2–3–4	17½	16½	15	100's	2–3–4	21	19	19
52's	2–3–4	17½	16½	15	...	...	...	...	...

Traveller Table for Wet Doubling.

Say with Rings $2\frac{1}{4}''$ to $2\frac{1}{2}''$ diameter. Ear pattern of Traveller, thus :—

A slight deviation from this list may, however, be necessary, depending upon speed of spindles, diameter of ring, turns of twist per inch, &c.

Counts of Yarn.	Fold or Ply.	Size of Traveller for			Counts of Yarn.	Fold or Ply.	Size of Traveller for		
		2 Ply.	3 Ply.	4 Ply.			2 Ply.	3 Ply.	4 Ply.
2's	2-3-4	9	7	6	50's	2-3-4	18	17	15½
4's	2-3-4	9½	7½	6½	52's	2-3-4	18	17	15½
6's	2-3-4	10	8	7	54's	2-3-4	18	17	15½
8's	2-3-4	10½	8½	7½	56's	2-3-4	18½	17	16
10's	2-3-4	11	9½	8	58's	2-3-4	18½	17	16
12's	2-3-4	12	10½	8½	60's	2-3-4	19	17½	16½
14's	2-3-4	13	11	9	62's	2-3-4	19	17½	16½
16's	2-3-4	13½	11½	9½	64's	2-3-4	19	17½	16½
18's	2-3-4	14	12	10	66's	2-3-4	19	18	17
20's	2-3-4	14½	12½	10½	68's	2-3-4	19	18	17
22's	2-3-4	15	12½	11	70's	2-3-4	19½	18½	17½
24's	2-3-4	15	13	11½	72's	2-3-4	19½	18½	17½
26's	2-3-4	15½	14½	12½	74's	2-3-4	19½	18½	17½
28's	2-3-4	16	15	13	76's	2-3-4	19½	18½	18
30's	2-3-4	16	15	13	78's	2-3-4	20	18½	18
32's	2-3-4	16½	15	13½	80's	2-3-4	20	18½	18½
34's	2-3-4	17	15	13½	84's	2-3-4	20	18½	18½
36's	2-3-4	17½	15½	14	86's	2-3-4	20½	19	19
38's	2-3-4	17½	15½	14	88's	2-3-4	20½	19	19
40's	2-3-4	17½	16	14	90's	2-3-4	20½	19½	19½
42's	2-3-4	17½	16	14	92's	2-3-4	21	19½	19½
44's	2-3-4	17½	16	14	96's	2-3-4	21½	19½	19½
46's	3-3-4	17½	16	14½	98's	2-3-4	21½	19½	19½
48's	2-3-4	17½	16½	15	100's	2-3-4	21½	19½	19½

Ring Doubling Frame.

The production obtained from Ring Doubling Frames may be taken approximately as given below.

In calculating these productions, we have assumed average speeds and allowances for doffing, breakages, &c., **but have not made any allowance for cleaning time.**

	Counts of Yarn in single.	Number of ends doubled into one.	Turns of Twist per inch.	Diameter of Ring.	Lift.	Speed of Spindles per min.	Production in 10 hours, after all allowance for loss taken off, not including cleaning time.		Loss allowed for doffing and breakages.
						Revs.	Hanks.	Lbs.	
For Nettings.	4's	3	5·4	3″	5½″ or 6″	4,200	12·34	9·26	20 %
	6's	3	6·61	3″	5½″	4,500	11·07	5·53	18 %
	8's	3	7·63	2¾″	5½″	4,500	9·94	3·72	15 %
	10's	4	7·39	2¾″	5½″	4,500	10·26	4·10	15 %
	16's	6	7·6	2¾″	5½″	4,500	9·98	3·74	15 %
	20's	8	7·37	2¾″	5½″	4,500	10·29	4·11	15 %
	12's	4	8·10	2½″	5″	5,000	10·71	3·57	12½ %
	10's	3	8·53	2½″	5″	5,500	11·19	3·35	12½ %
	14's	4	8·75	2½″	5″	5,500	10·91	3·11	12½ %
	14's	3	10·10	2½″	5″	5,500	9·48	2·03	12½ %
	18's	4	9·92	2½″	5″	5,500	9·61	2·13	12½ %
	10's	2	10·11	2¼″	5″	6,000	10·58	2·11	10 %
	15's	3	10·45	2¼″	5″	6,000	10·24	2·04	10 %
	20's	3	12·07	2¼″	5″	6,000	8·87	1·33	10 %
	15's	2	12·39	2¼″	5″	6,000	8·64	1·15	10 %
	25's	3	13·5	2¼″	5″	6,000	7·93	0·95	10 %
	20's	2	14·31	2″ or 2⅛″	5″	7,000	8·92	0·89	8 %
	25's	2	16·0	2″	5″	7,000	7·98	0·63	8 %
	30's	2	17·52	2″	5″	7,000	7·29	0·48	8 %
	35's	2	18·93	1¾″	5″	8,000	7·96	0·45	5 %
	40's	2	20·23	1¾″	5″	8,000	7·45	0·37	5 %
	50's	3	19·09	1¾″	5″	8,000	7·89	0·47	5 %
	60's	3	20·91	1¾″	5″	8,000	7·21	0·36	5 %
	60's	2	24·78	1¾″	5″	8,000	6·08	0·20	5 %
	70's	2	26·77	1¾″	5″	8,000	5·63	0·16	5 %
	80's	2	28·62	1¾″	5″	8,000	5 26	0·13	5 %
For Warps.	20's	2	18·60	2″ or 2⅛″	5″	7,000	6·86	0·68	8 %
	25's	2	20·50	2″	5″	7,000	6·23	0·49	8 %
	30's	2	21·90	2″	5″	7,000	5·83	0·38	8 %
	35's	2	23·66	1¾	5″	8,000	6·37	0·36	5 %
	40's	2	25·29	1¾	5″	8,000	5 96	0·29	5 %
	50's	2	27·57	1¾	5″	8,000	5·46	0·21	5 %
	60's	2	29·43	1¾	5″	8,000	5·12	0·17	5 %
	70's	2	31·79	1¾	5″	8,000	4·74	0·13	5 %
	80's	2	33·98	1¾	5″	8,000	4·43	0·11	5 %

The foregoing list is based upon the yarn in the creel having been previously wound on to large winder bobbins.

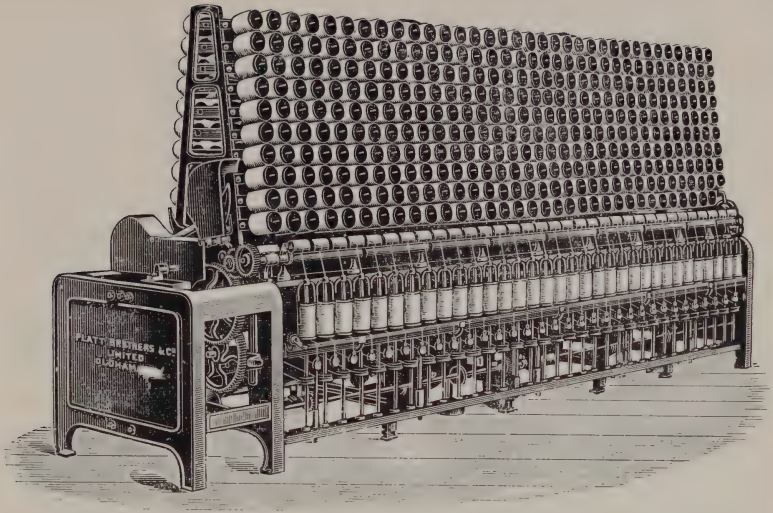
If cops or ring bobbins be placed direct in creel, the productions will be slightly less than given on previous page.

[It will be understood that special circumstances such as a desire for extra large bobbins to reduce knots, high speeds or specially soft twist, &c., may render some deviations from the foregoing list advisable.]

To calculate the length of a Ring Doubling Frame driven at the end is as follows :—Take half the number of spindles, multiply by distance of spindles and add $26\frac{1}{4}''$ if with $13''$ buffets, and pulleys $3''$ or $3\frac{1}{2}''$ wide ; $14''$ buffets, and pulleys, $4''$ wide, add $27\frac{1}{4}''$. If double geared and driven in the middle with 4 pulleys, add $49\frac{3}{4}''$.

Width of Frame, $2'\ 10''$, $3'\ 0''$, $3'\ 5''$, or $4'\ 0''$ depending upon circumstances.

Driving pulleys, $11''$ to $18''$ diar. Speed about 620 revs. per minute.



Flyer Doubler Frame.

We make this machine for dry work or for wet work, on the English or Scotch system of water troughs, for such yarns as heald, netting, knittings, &c.

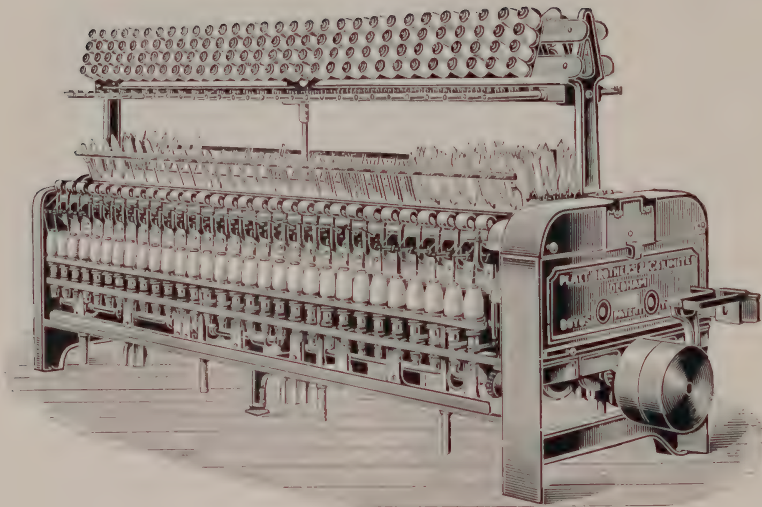
Adjustable drag weight arrangement to each bobbin, spindles driven by bands or tapes, 1 or 2 tin rollers, frame 3′ 5″ wide.

This class of machine is generally preferred for the "cabling" or finishing doubling process of heald, netting, and such yarns, where uniformity of twist is essential.

Counts when doubled.	Lift.	Distance.	Width inside Flyer.	Speed of Spindles.
·25 to 0·50's	5″	5″	4″	1900
·5 to 1's	$4\frac{1}{2}$″	$4\frac{1}{2}$″	$3\frac{1}{2}$″	2700
1's to 3's	4″	4″	$3\frac{1}{4}$″	3000
4's	$3\frac{1}{2}$″	$3\frac{1}{2}$″	$2\frac{3}{4}$″	3200
8's	$3\frac{1}{4}$″	3″	$2\frac{1}{4}$″	3500
12's	3″	3″	$2\frac{1}{4}$″	3900
16's	$2\frac{3}{4}$″	$2\frac{3}{4}$″	$2\frac{1}{8}$″	4100

We also make a **Special Heavy Machine,** 4′ wide, for bobbins 6″ lift, $3\frac{1}{2}$″ to $3\frac{3}{4}$″ flanges, spindles driven by tapes, strong flyers with tube to shoulders, heavy drag discs to engage with bottom flange of bobbin, &c.

This machine is used for the heaviest nettings, sail cloth yarns, shop twine, &c.



BOYD'S STOP MOTION RING TWISTER.

The ordinary process in making twisted yarns from spinning bobbins and mule cops is to wind the yarn, one or more threads, on to warping bobbins, and to place these bobbins in the creel of the twisting or doubling machines. This process tends to clear the yarn and to weed out the weak places, and it reduces the amount of creeling at the doubler.

In cases, however, where it is desired to twist *direct* from cops or spinning bobbins, so as to save the cost and time of winding, the Boyd's Stop Motion Twister has proved successful. Large varieties of yarns, and in small quantities, may thus be conveniently made owing to the cops or spinning bobbins containing a much smaller amount of yarn than the large warping bobbins. The abolition of the winding process saves power, floor space, winders' wages, cost of winding bobbins; but, on the other hand, increases the amount of creeling.

This machine has behind the rollers a case or frame containing 2, 3, or more detectors, according to the number of threads to be twisted together. The threads are passed through the eyelets in the detectors, and when a thread breaks the detector drops and comes in contact with a revolving camshaft which pushes the top roller clear of the bottom roller, and thus stops the delivery of yarn, at the same time slackening and gripping the spindle band, and stopping the spindle, leaving the broken thread behind the roller ready to be pieced up, thus abolishing all bunch knots, singles, and waste.

The twisted threads at the front of the rollers pass through an eyelet in a starting lever and thence on to a bobbin. Should a traveller fly off or a thread balloon to excess, the tension of the thread becomes slack and the lever is allowed to rise and being in communication with the detector frame, the spindle is stopped. A roller lap by the same mechanism will also stop the spindle.

Each spindle is perfectly independent from the others, therefore when a double ended bobbin is full it is necessary to stop only one spindle to replace it with an empty bobbin, and it is when making cop build bobbins only that the entire frame need be stopped for doffing.

The machine has usually one tin roller 10in. diameter, a separate copping or building motion at each side of the frame, and may be fitted with our patent flexible doubler spindles with suitable diameter of rings.

If desired the ring twister may be fitted with parallel build for a double ended bobbin, cop build for paper tubes or wood weft pirns, or conical build for bobbins without heads, for either warp or weft.

We can also apply both copping motion and parallel build motions if desired.

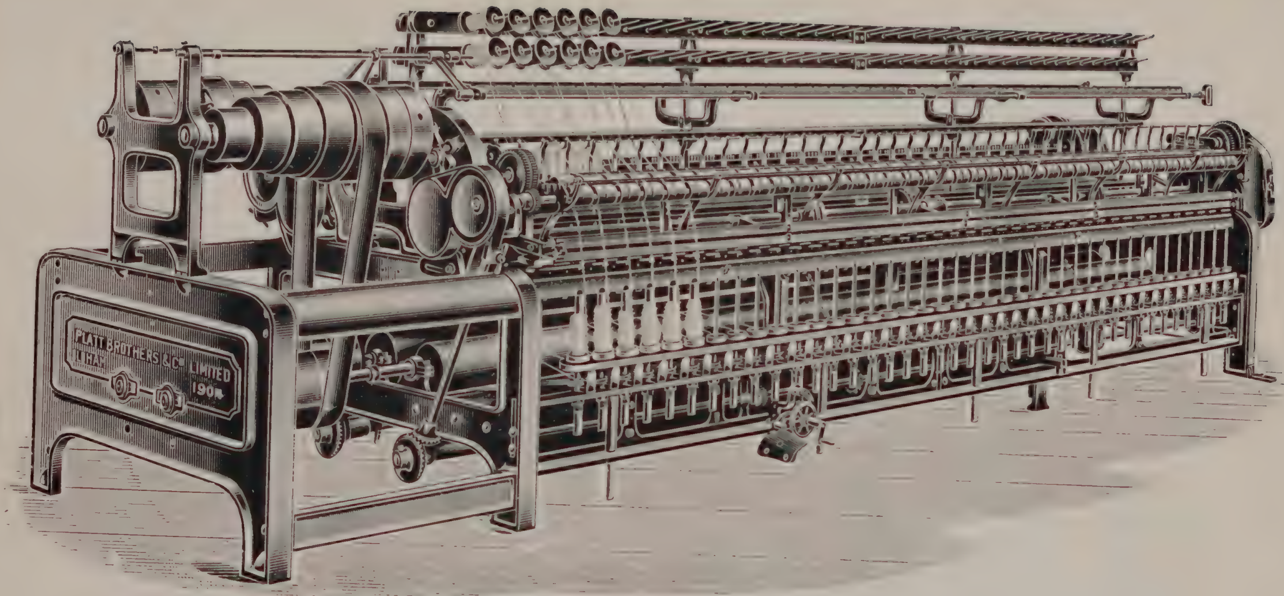
[We make the Stop Motion Twister on the **Flyer** system when desired, for knitting, stocking, and such yarns.]

To calculate length of Boyd's Stop Motion Twister, take 1 less than half the number of spindles, multiply by the distance, and add $29\frac{3}{4}''$ if pulleys 4″ wide.

If fitted with 5 speeded cones, take 1 less than half the number of spindles, multiply by the distance, and add 42″.

Pulleys, 11″ to 18″ diar. Speed depending upon circumstances.

Width of Frame, 3′ 2″, 3′ 5″, or 4′ 2″.



Woollen Ring Doubler. For Plain and Fancy Yarns.

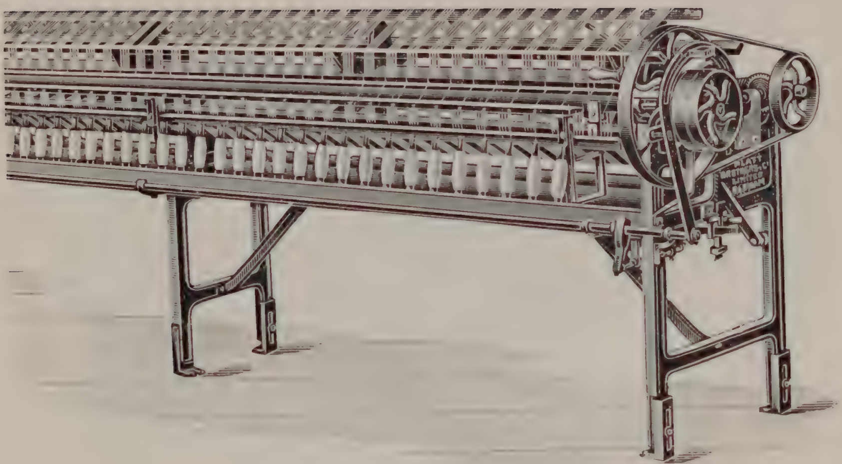
(No. 4 Pattern.)

Fitted with motions for making all kinds of Plain and Fancy Yarns from cotton, wool, worsted, mohair, silk, &c. Double Girder Spindle Rails. Patent Flexible Doubler Spindles with Knee Brake. Each side of machine driven independently of the other, with fast and loose pulleys and 5 speeded cone pulleys to vary speed of spindles as required. Cop or conical building motions for wood bobbins and paper tubes, or parallel build for double ended bobbins. To calculate length, multiply half the number of spindles by the distance, and add 3′ 1!″ if 30½″ buffets; if with 3 or 4 lines of rollers, &c., for fancy yarns, add 4′ 7″ (if extra gearing at outend, 4′ 11″). Width of Frame, 4′ 4″. Pulleys, 9″ to 16″ diar., 3″ wide. Speeds, 600 revs. for plain twisting, 350 for fancy twisting.

REELING, BUNDLING,

AND

WINDING.



Cop Reel. (Hand and Power.)

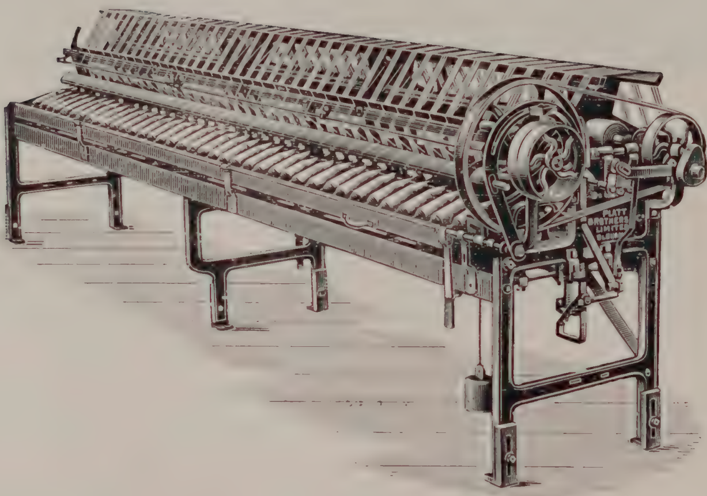
Arranged for Reeling plain and cross hanks from Ring Bobbins on Split Wood Pegs or from Mule Cops. Ordinary Skeining Motion and Spaced Doffing Rim, or Holt's Patent Doffing Gate if preferred.

Production, about 220 Hanks per spindle per week of 60 hours.

[We are also makers of Coleby's Patent Reel with 4 short swifts of 10 hanks each, for which a high production is claimed owing to reduced percentage of time lost in stoppages.]

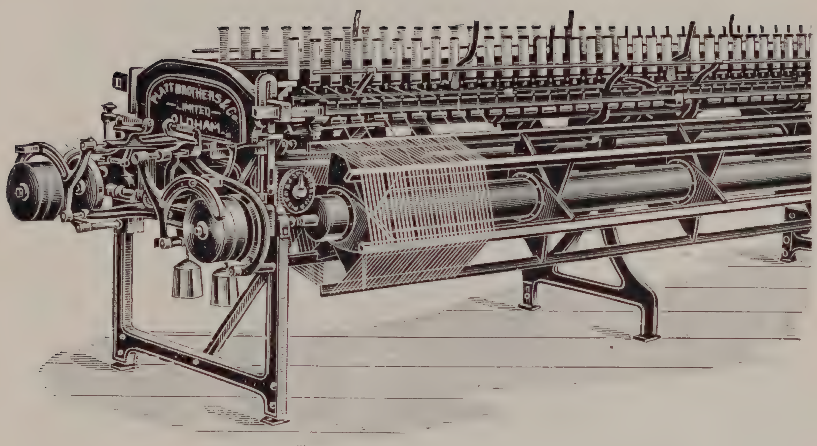
To calculate length of Reel, take 1 less than the total number of hanks, multiply by the distance, and add 25″. Width overall, 3′ 2″.

Pulleys, $8'' \times 1\frac{1}{2}''$, to run about 145 revs. per minute.



Cop Reel. (Hand and Power.)

Arranged for Reeling plain and cross hanks from Mule Cops or from Ring Bobbins. Ordinary Skeining Motion and Spaced Doffing Rim, or Holt's Patent Doffing Gate, as preferred. Movable Cop Tray, and Automatic Stop Motion when a thread breaks, if desired.



Double Bobbin Reel. (Power only.)

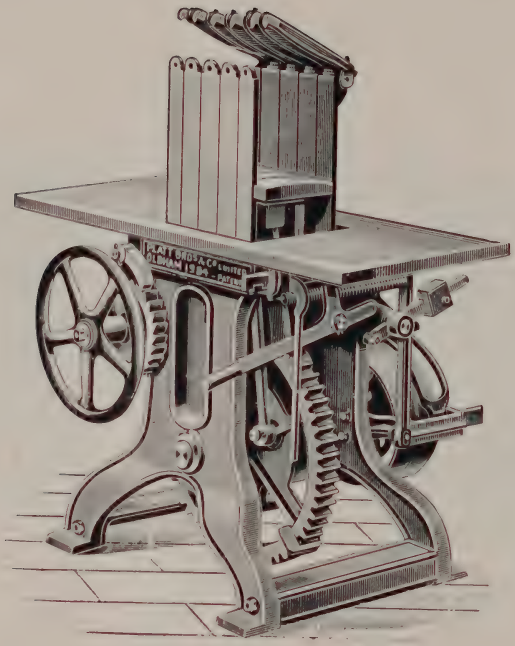
Arranged for Reeling plain and cross hanks from Double-ended Bobbins placed on Revolving Creel Spindles. Ordinary Skeining Motion and Spaced Doffing Rim, or Holt's Patent Doffing Gate.

We also make this Reel with Releasing Motion to slacken the hanks on the swift before doffing.

To calculate length of machine, take 1 less than half the number of hanks, multiply by the distance, and add $26\frac{1}{2}''$. Width overall, $4'\ 2''$.

Pulleys, $8'' \times 1\frac{3}{4}''$, if reeling from bobbins on revolving spindles, 180 revs. per minute. We also make this machine to reel from Mule Cops or from Ring Bobbins on skewers or pegs respectively, in which case the pulleys will run at about 280 revs. per minute.

Production, about 140 to 220 hanks per spindle, per week of 60 hours.



BUNDLING PRESS,

WITH ORDINARY OR WITH

COLEBY'S PATENT SELF-CLOSING AND OPENING BOX.

In the ordinary bundling press it is necessary for the attendant, after filling the box with knots of yarn, to let down the top bars, fasten them with the locking levers, and after the bundle has been pressed and tied, to unfasten and turn back the top bars out of the way, so that the bundle may be taken out.

The Coleby's patent arrangement as shown above *closes and opens the bars mechanically*, and thus reduces the amount of manual labour, and increases the production of bundles.

Our press is well and substantially constructed, all joints being planed.

The Box—which in Coleby's arrangement is specially constructed of cast-steel—is usually made for 10 lbs. bundles (with extra wood block if required for 5 lbs. bundles), and with five bars and four string slits, as illustrated, but the box and bars may be made to any special size or number of strings, according to requirements.

The top board and the presser block are of solid polished birch, and when intended for 5 lbs. bundles, the bars are lined with baywood.

A four-armed lever may readily be attached (in place of the flywheel shown) to drive the press by hand, in case steam power is not available.

In addition to the bundling press to work by hand and power, we also construct an **Extra Strong Press with Compound Gearing,** specially adapted for hard twisted or doubled yarns.

STANDARD DIMENSIONS OF BOX

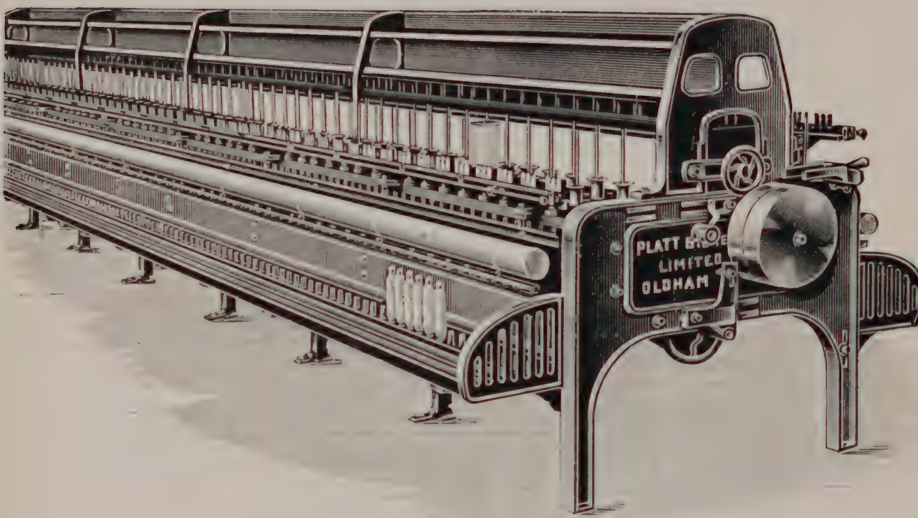
(WHEN RAM IS AT THE LOWEST POINT).

For 10 lbs. bundles,	knotted English hanks, 54″ circum.	12″ long	× 9″ wide	× 13″ high.
For 5 kilos. ,,	knotted French hanks, 56″ circum.	$13\frac{1}{4}$″ ,,	× 9″ ,,	× 13″ ,,
For 10 lbs. ,,	English hanks, long bundles, not knotted.	24″ ,,	× $6\frac{1}{2}$″ ,,	× 14″ ,,
,, ,,	extra strong press for hard-twisted yarns...	12″ ,,	× 9″ ,,	× 16″ ,,
,, ,,	Coleby's patent (ordinary pattern)...	$12\frac{1}{4}$″ ,,	× 9″ ,,	× $14\frac{1}{2}$″ ,,

The total extent of adjustment, viz., total length of fitting bed for vertical bars, for an ordinary 10 lb press is about $14\frac{7}{8}$″. Length of muntins 10″.

Floor space occupied, 2′ 9″ × 2′ 9″. Pulleys, 14″ × 3″ × 3″. Speed, about 60 revs. per minute.

Production, 10,000 lbs. per week of 60 hours.



Warp Winding Frame.

This machine is generally made with two rows of spindles on each side, $4\frac{7}{8}''$ gauge.

When desired we apply *self-contained* winder spindles, and two tin rollers to obtain a long and durable band.

The illustration shows a machine fitted with bobbin box, with shelves for bobbins, endless travelling apron to carry empty bobbins to end of frame, creel for ring bobbins on wood pegs with circular drag roller covered with cloth.

We can arrange the creel for mule cops, ring bobbins or double-ended bobbins on revolving spindles, as may be required.

We generally apply card wire clearer brushes and **T** headed adjustable thread guides, but when preferred, we apply brush boards or steel plate guides with crow foot slits.

When used as a "Clearer" winding frame, we can apply revolving creel spindles to hold doubler or gassing frame bobbins, and patent adjustable clearer guide plates.

The lifting motion is *in the middle of the frame* to reduce torsion in the lifter shafts.

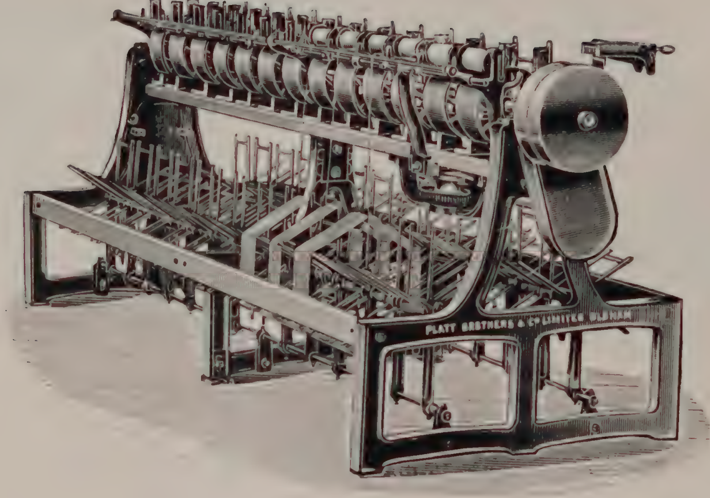
We occasionally make this machine with single line of spindles on each side to wind from hanks, but for dyed hanks particularly, we prefer the drum winder which maintains a uniform speed of hank.

To calculate the length of a Winding Machine with double line of spindles on each end, take $\frac{1}{4}$ the number of spindles, multiply by distance, and add 20″.

Width of machine to wind from rabbeth bobbins,		5′ 6″.
,, ,, ,,	cops	6′ 3″.

Pulleys, $12'' \times 2\frac{1}{2}''$. Speed, about 100 revs. per minute.

Production, about 350 to 450 hanks per spindle, per week of 60 hours.



Drum Winder.

Single line of drums, 2 bobbins per drum.

Swifts or Racers for hanks below. Latch and catch motion and pressure frames to bobbin. Heart traverse motion and adjustable thread guides.

Drums $7\frac{3}{8}''$ distance centre to centre for $5''$ traverse.

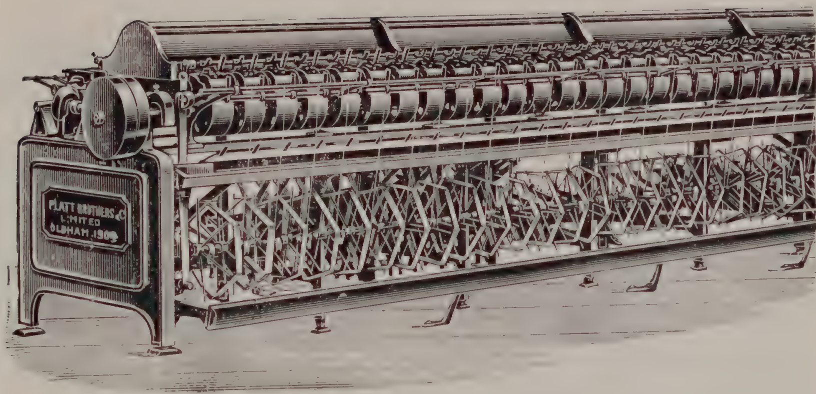
Width of frame, $3'\ 7''$.

To calculate length of machine, multiply the number of drums by the distance, and add $18''$.

Driving Pulleys, $12'' \times 2\frac{1}{2}''$. Speed, about 100 revs. per minute = 100 revs. per minute of drums.

If required, we can apply compound gearing 24T/72T between the pulleys and drums, so that the pulleys may be run at about 300 revs., for 100 revs. per minute of drums.

Production, after allowing say 20% for loss in stoppages, &c., about 284 hanks per bobbin, per week of 60 hours. The allowance for loss will, of course, depend upon circumstances.



Drum Winder

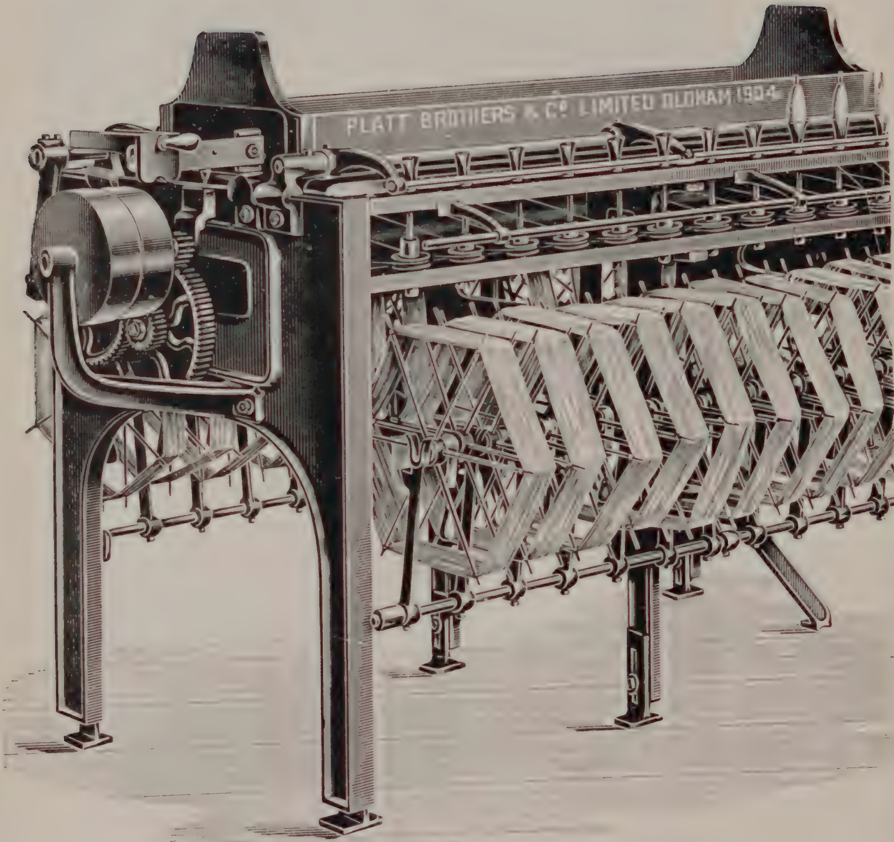
With 2 rows of drums, 1 bobbin per drum.

These machines are generally used for winding dyed or bleached hanks on to warping bobbins, and as the winding is by surface contact, between the bobbin and the surface drum the speed of the hanks is *uniform*.

The machine is fitted with latch and catch motion and pressure frames, to make a hard bobbin. Swifts placed below and bobbin box on top. Heart traverse motion and adjustable "duck bill" thread guides. Drums $7\frac{3}{8}''$ distance centre to centre for $5''$ traverse. Width of frame 4 feet.

To calculate length of machine, take half the number of drums, multiply by distance, and add $27\frac{1}{4}''$.

Driving pulleys, $12'' \times 2\frac{1}{2}''$. Speed, about 100 revs. per minute = 100 revs. per minute of drums.



Weft Pirn Winder.

WEFT PIRN WINDER.

This machine is generally used for winding dyed or bleached hanks into cops or pirns of suitable size for the loom shuttle.

The spindles are arranged vertically, and are driven by warves containing a steel die which engages with a flattened part at the lower end of the spindles.

The cop or pirn is generally formed in a cast-iron conical cup with slit, but where preferred, we apply anti-friction cones of wood or iron to prevent glazing of the yarn whilst being wound.

We have three heights of framing, 2′ 6½″, 3′, and 3′ 6″, whilst the width overall with 54″ swifts is 4′ 4″.

The swifts containing the hanks are arranged above or below the machine as desired, although we generally prefer our tall pattern of machine with swifts below. The brackets supporting the swifts are *bolted* to the underside of the bottom spindle rail and thus keep in perfect alignment.

The lifting or traverse motion is an arrangement of radial levers, and when winding from hanks we prefer to apply a differential motion such as our "table-scroll" pattern to reduce the speed of the spindle when winding on the point of cop, and thus keep the speed of the hanks more uniform and prevent over-running.

We can also arrange for Racers or Birdcages to contain hanks with balance weight arrangement to maintain tension.

The spindles can be arranged with top weights for wood pirns or springs to hold paper tubes.

This machine is occasionally used for re-winding damaged cops.

To calculate length of machine, take half the number of spindles, multiply by the distance, and add 26″.

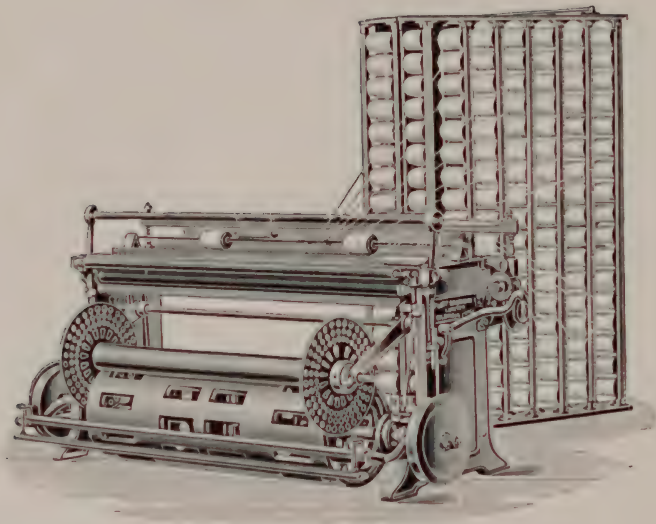
Pulleys, 9″ to 12″ × 2½″. Speed, about 360 revs. per minute.

Production, about 120 to 130 hanks per spindle per week of 60 hours.

WARPING AND SIZING MACHINES,

POWER LOOMS,

CLOTH FOLDING, &c.



Warping Machine,

With Singleton's stop motion, plain or expanding surface drum, knocking-off motion to stop the machine for any required length of warp in yards or metrès. Clock face indicator for short lengths. Creel for 300, 400, 510, 612, or 700 bobbins, with boxwood or glass bushes for creel pegs.

When required we apply an arrangement to lower the full beam to the floor and yarn damping arrangement.

We make any desired width of machine; our standard being for looms up to 52″ reed space, with plain fixed drum 57″ long on body, or if expanding drum from 41″ to 63″.

Driving pulleys $14\frac{1}{2}'' \times 2''$. Speed about 41 revs. per minute.

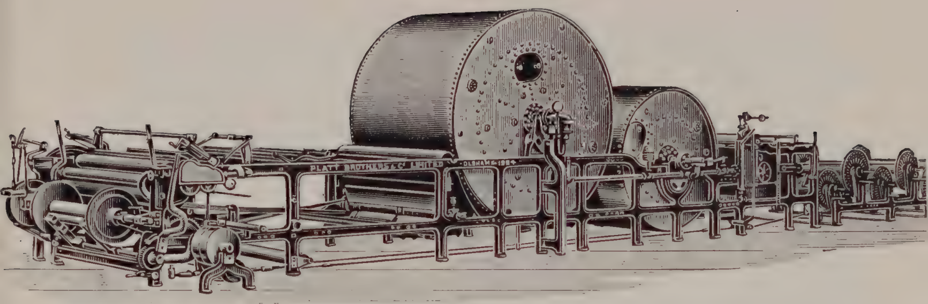
Length overall, about 16′ 0″ to 17′ 0″, including creel for 510 bobbins. Width, 3′ 9″ to 4′ 0″ more than the reed space of the widest Loom.

Production.—1 machine will serve for about 60 to 80 Looms.

WARP SIZING.

In order to prepare warps for the loom, there are in use by manufacturers several varieties of sizing machines of which we are makers, such as the Single Cylinder Dressing Machine used by velvet and fustian manufacturers to size two-fold warp yarns direct from the warpers' bobbin to the beam. These beams are afterwards run, six or eight together, on to a loom beam by means of a beaming machine.

Another system is the Dressing Machine, with steam pipes and steam boxes, above which the yarn is passed (or with a small copper cylinder at each side of the machine, round which the warp is taken) to the loom beam in the centre of the machine. This latter type of machine is, however, now rarely used except for special cloths or where a small production or output only is required.



SLASHER SIZING MACHINE.

The Slasher Sizing Machine as shown by illustration is, however, now adopted for most classes of cotton goods except the finest and most delicate yarns, and it is also used to size some classes of linen warps.

The following are some of the specialities of our machine:—

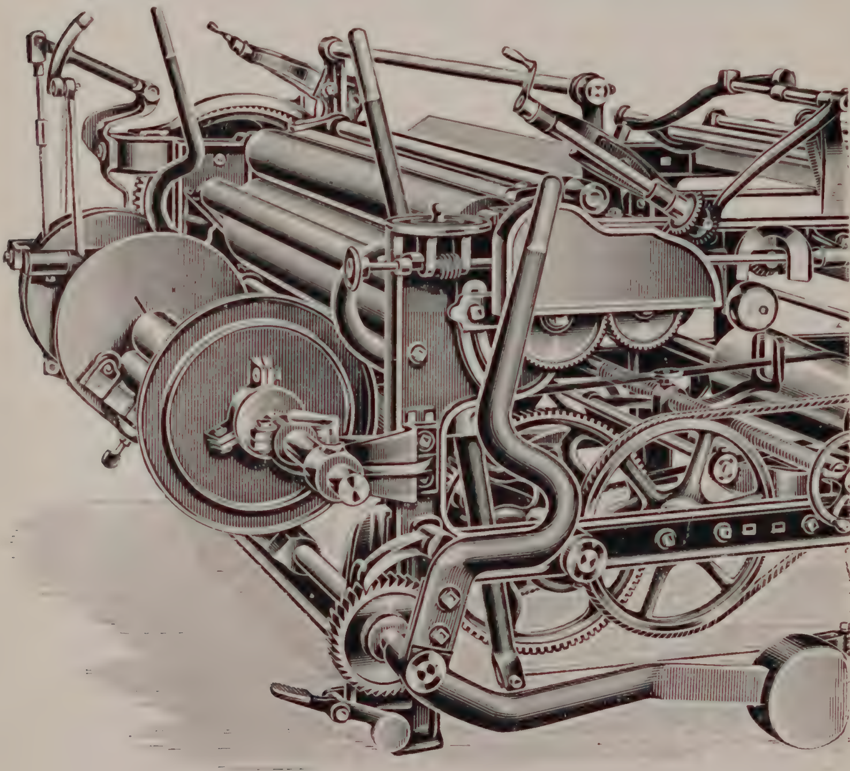
Size or Sowe box.—This is usually made of pine wood painted only, or lined with sheet copper and fastened with copper rivets, or of solid teak wood (not lined with copper), or of cast-iron. The two latter systems are the more lasting, teak wood especially being very durable, and well worth the additional first cost.

Cavity Feed.—Behind the size box is what is known as a **Cavity Feed Box,** fitted with a brass cylindrical float (with air tube to prevent collapse) going the full length of the box. This float opens or closes a feed valve, which connects by pipe with the size mixing apparatus, and thus keeps the size at one uniform level.

The **Cavity Feed** is fitted with steam pipes to keep the size boiling, so that the size may enter the box without reducing the temperature. If required, the slasher may be made with two size boxes, one behind the other or one above the other, to serve for warp of two colours.

The size box is fitted, as a rule, with one **Seamless Drawn Copper Roller** (which runs on anti-friction bowls) and with cast-iron pressure roller; the flanges of the copper roller are usually made of iron, but at a small extra cost may be made of brass. The stuffing box is so arranged that the size cannot, if ordinary care be taken, escape at this point. In all cases one of the ends is fitted with an **Expansion and Contraction Arrangement,** so that it is allowed to slide on the shaft (with its ends outside the size box), and with inlet and outlet for air at the key way. This arrangement prevents the ends becoming loose, and makes it impossible for size to be drawn inside the copper roller. If desired (at an extra cost) the size box may be fitted with two copper and two iron pressure rollers.

The Immersion Roller is made skeleton pattern, 14″ diameter.



Slasher Sizing Machine. Headstock or Delivery End.

Drying Cylinders.—To this detail we draw special attention, because it is very important to reduce the risk of explosions to a minimum, and great care is taken by us in the design and construction. The cylinders are made usually of copper sheets, but, if preferred, the sheets may be of tinned copper (at an extra cost); or, at a slightly cheaper cost, of tinned iron. The latter, however, we do not advise our friends to adopt. The cylinder ends are of steel plates, flanged and turned to correct diameter on the flanges, each end being in one piece without joint or weld. The copper plates are to a heavy gauge with brazed lap-over joints, to give greater strength. The copper plates are thoroughly planished or hammered by hand, and are bent over the edge of the cylinder ends, rivetted with copper rivets, and the space underneath the rivets filled up with solder.

The buckets inside the cylinders are of sheet copper, and are securely fixed to the inside rings and stays, the whole of the work being of the best quality. Each cylinder end is fitted with the necessary pressure and vacuum valves. **The cylinders run on anti-friction bowls,** so as to put the least possible tension on the yarn.

Extra Drying Rollers.—By means of extra rollers (if required) the yarn is made to surround almost completely the large and small cylinders, so as to use the largest possible drying surface.

After leaving the small cylinder the yarn is passed to and fro round carrier rollers placed below the machine, so as to cool it thoroughly before it reaches the beam.

Positive Delivery Motion is of the latest and most improved type, to deliver the yarn at a constant speed. There is the usual change wheel arrangement to make a large change in the speed of the delivery roller, when necessary, **but in addition we apply a pair of cones,** with hand wheel at the side of the machine, by which the attendant can, in a moment, adjust the speed yet more finely, and without stopping the machine.

Automatic Friction Winding On.—This apparatus is made with two frictions, one to each side of the driving wheel, with a direct pressure by a lever on each side. This is a considerable improvement on any arrangement in which there is a pressure on the friction on one side only. As the loom beam fills with yarn the necessary variation in **pressure is put on the two frictions by means of a long wedge** acting upon the extremities of the two levers, this wedge being connected to the levers which carry the pressure rollers of the loom beam. At the top of this wedge is a space into which the two bowls of the friction levers are allowed to drop when the attendant desires to take the pressure off the frictions which drive the loom beam. The full beam may thus be readily removed and an empty beam put in.

Our ordinary arrangement is to apply one **cast-iron pressure roller only to the loom beam,** this roller being of suitable length to just clear between the flanges of the loom beams, but we are prepared to supply, where specially ordered, Hitchon's or other patent pressure rollers.

Marking Motion is arranged so as to give a great variation in the length of the cut by means of change wheels. By the addition of the dhootee marker, each cut may be divided into several parts.

The measuring motion is usually arranged to take the same cut change wheels as are used in the taking-up motion of the looms. A good allowance of change wheels is supplied with each slasher without extra charge. We also apply, where preferred, the "Hitchon" system of measuring motion, by which any length of cut can be obtained without the use of change wheels.

Valves and Steam Taps.—The slasher is complete with gun metal steam taps, reducing valves, and with Cowburn's dead weight safety valves; steam traps to copper cylinders, and large Water Separator to main steam supply.

Fans.—One, two, three, or four fans are supplied, as may be preferred, although two are usual.

Slow Motion, to give one-ninth of the full speed, is applied to all slashers.

Width of Machine.—The standard width of slashers is 60″ wide on cylinder, to prepare beams for looms up to 52″ reed space. We have, however, patterns for machines 44″ to 102″ wide on copper, say for looms 36″ to 94″ reed space.

Diameters of Cylinders.—40″ & 60″; 48″ & 72″; 60″ & 72″; 48″ & 84″; 60″ & 84″; 72″ & 84″; as may be required, 48″ & 72″ and 60″ & 84″ being the most usual sizes.

We also make machines with one large cylinder only, where specially preferred.

The Creel for warpers' beams is of special construction, with screws for the bearings of the pivots of the beam for convenient adjustment where the beams or pivots vary in length.

SLASHER SIZING MACHINE.

CALCULATIONS FOR LENGTH OF MARK OR "CUT," WHEN USING THE **ORDINARY** MARKING MOTION.

[The usual circumference of Measuring Roller is 14·4 ins., but we make rollers $\frac{1}{2}$ yard, $\frac{1}{2}$ mètre or $\frac{1}{2}$ arschine circumference as desired.]

The Bell Wheel has usually 45 teeth, driven by single worm on the same stud as the wheel **X.** Both **X** and **Y** are change wheels, and may be any size up to 120 teeth.

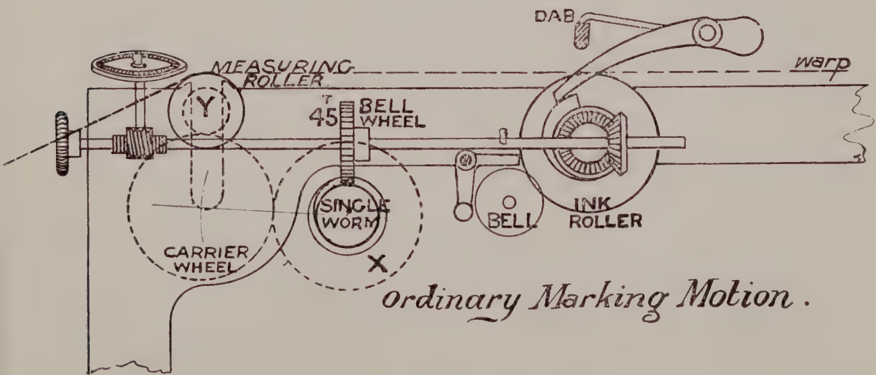
An almost infinite number of *fine changes* in the *length* of cut or mark may thus be obtained.

$$\frac{45 \times X}{1 \times Y} = \frac{\text{Length of cut in inches.}}{\text{Circumference of measuring roller}}$$

Example:—Required a "cut" or mark 36 yds. long.

$$\frac{45 \times X}{1 \times Y} = \frac{36 \text{ yds.} \times 36 \text{ ins.}}{14{\cdot}4 \text{ in.}} \quad or \quad \frac{45\ X}{Y} = \frac{90}{1} \quad \text{or } 45\ X = 90\ Y.$$

Therefore, wheels in the proportion of 45 and 90 represent **Y** and **X,** say 36T and 72T or 18T and 36T, and so on; *i.e.*, any 2 wheels in the proportion of 45 and 90 or 1 : 2 will give the required length of mark.



Ordinary Marking Motion.

Machine with 72″ and 48″ cylinders, 2 fans, 1 copper roller in sowe box, and creel for 6 beams, 38′ $2\frac{1}{4}$″.

Machine with 72″ and 48″ cylinders, 2 fans, 1 copper roller in sowe box, with creel for 8 beams, 40′ $9\frac{3}{4}$″.

Machine with 72″ and 48″ cylinders, 3 fans, 2 sowe boxes, 2 copper rollers, creel for 6 beams, 46′ 1″.

Width = reed space of widest Loom + $49\frac{1}{2}$″.

Pulleys, 12″ × 4″ × $1\frac{3}{4}$″ × 4″. Speed, about 300 revs. for medium counts. Coarse yarns, proportionately slower.

Production.—1 Machine will serve for about 200 to 300 Looms, depending upon counts of yarn, amount of size put in, &c.

POWER LOOMS.

We are makers of a large variety of Looms for calicoes, checks, fustians, velvets, linen goods, lappet and leno goods, tapestry, chenille, Axminster, moquette and other carpeting, &c., &c., but regret that the somewhat limited scope of a book of this kind does not permit of our illustrating and describing more than a few of our more usual types. The general construction is exceptionally strong, and experience shews our Looms to withstand shipping and transport with a minimum of breakages, and to possess great durability in working.

CALICO LOOMS.

In drawing attention to this predominant type of Loom, we may say that all the fitting places on the Loom sides are planed.

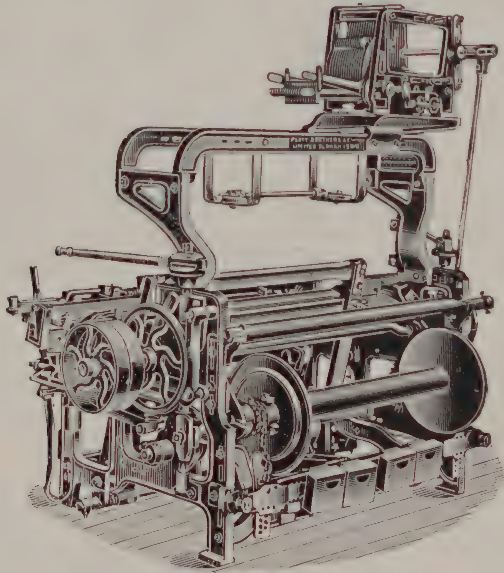
All cross rails have milled joints and are cut to template length, thus making all rails of a given reedspace interchangeable, reducing fitting and levelling to a minimum, besides imparting greater stability and ensuring steady running at the high speeds now in vogue.

The lathe is carefully constructed, and has a birchwood trash or race board.

The cast-iron box bottom plate is planed all over, and the iron box front is also planed.

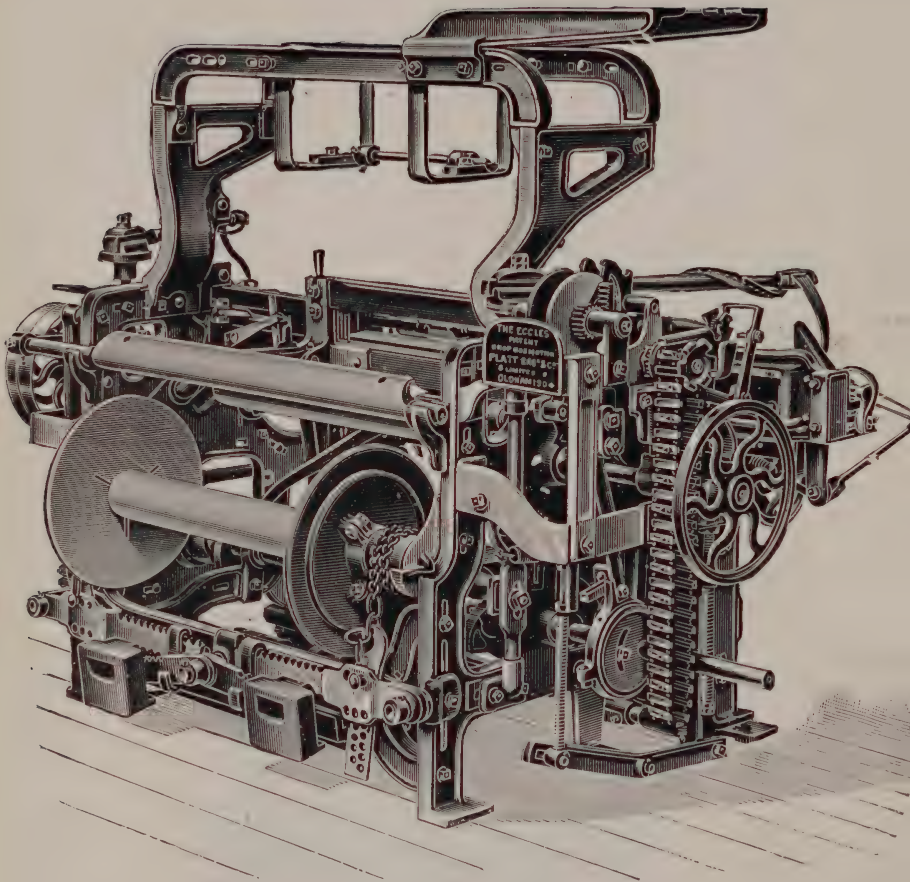
Tappet shaft, $1\frac{1}{2}$ in. diameter, working in cast-iron bush, wrought-iron crankshaft, $1\frac{9}{16}$ in. diameter, in long brass bearings. Under or Overpick Motion as preferred.

Our loose reed arrangement is made with heater and bracket or "duck bill," and the spider is a specially strong wrought-iron shaft



OVERPICK CALICO LOOM,

with Single Needle Dobby and Improved Under Motion to give *uniform* tension on springs during movement of healds.



OVERPICK CALICO LOOM,

fitted with the "ECCLES" PATENT DROP-BOX SHUTTLE MOTION with Governor Chain Motion, for cross-bordered goods. Prepared also for the reception of a Dobby.

In drawing attention to the "Eccles" Drop-Box Motion, we may say that the apparatus presents advantages and features which will be fully appreciated by those acquainted with the requirements of the weaving trade, and which may be briefly stated as follows:—

Simplicity of the working parts, the motion being contained in a single frame, which may be easily fixed to existing looms The drop boxes being balanced and the working parts quite free from strain, a minimum amount of power is required to drive the apparatus.

A Loom, 40″ reed space, with 4 shuttles of the usual small size (No. 3), may be run about 180 picks per minute. Wider looms, or looms with 6 shuttles, proportionately slower. We have recently made new patterns for 6 boxes, which we are prepared to supply if required. Speed about 160 revs. for looms 40″ reed space.

The boxes being actuated by cranks and connecting rods, both the upward and downward movements of the boxes are positive and quite free from bouncing or vibration. The boxes, when at rest, are on a perfect level with the lathe or slay, and at that time are *securely locked in position.* The movements of the boxes are controlled by the usual small steel cards, which are within easy reach of the weaver. The boxes can be adjusted by hand without turning the loom. Any change of boxes can be made with perfect ease, the box *skipping from top to bottom, or vice versa, and any compartment being brought into operation in any desired order of succession.*

The "Eccles" Box Motion can be worked backwards and forwards with the loom.

For cross-bordered goods, such as handkerchiefs, scarves, towels, &c., a governor chain motion is applied to control the box pattern chain, and this affords special facilities for dealing with large checks and long patterns. Its simplicity and the economy it effects in the number of cards used deserves special notice; 100 cards may frequently be made to do the work of 2,000 or 3,000. For short and simple patterns, and for *small* checks, such as ginghams, the governor chain motion may be omitted, with a corresponding reduction in the first cost of the loom.

Many thousands of looms with this motion are at work both at home and abroad, and are giving every satisfaction.

[We are also makers of the Diggle & Wright-Shaw drop box motions, "pick and pick," or on one side only, and looms with Circular Box Motion.]

CALCULATIONS.

ORDINARY POSITIVE TAKING-UP MOTION ON CALICO LOOMS.

$$\frac{\text{Ratchet Wheel} \times \text{Stud Wheel, 140T} \times \text{Surface Roller Wheel}}{\text{12T Small Pinion} \times \text{Circumference of Surface Roller in quarter inches}} = \text{Mathematical Dividend.}$$

Mathematical Dividend + 1½% Contraction = Practical Dividend.

$$\frac{\text{Dividend}}{\text{Picks per quarter inch}} = \text{Change Wheel required.}$$

OUR STANDARD ARRANGEMENT IS:—

$$\frac{\text{20, 30 to 70 or 80T Ratchet} \times \text{140T Stud Wheel} \times \text{64T Surface Roller Wheel}}{\text{12T Pinion} \times \text{16″ Circum.} = 64 \times \tfrac{1}{4}\text{ ins.}}$$

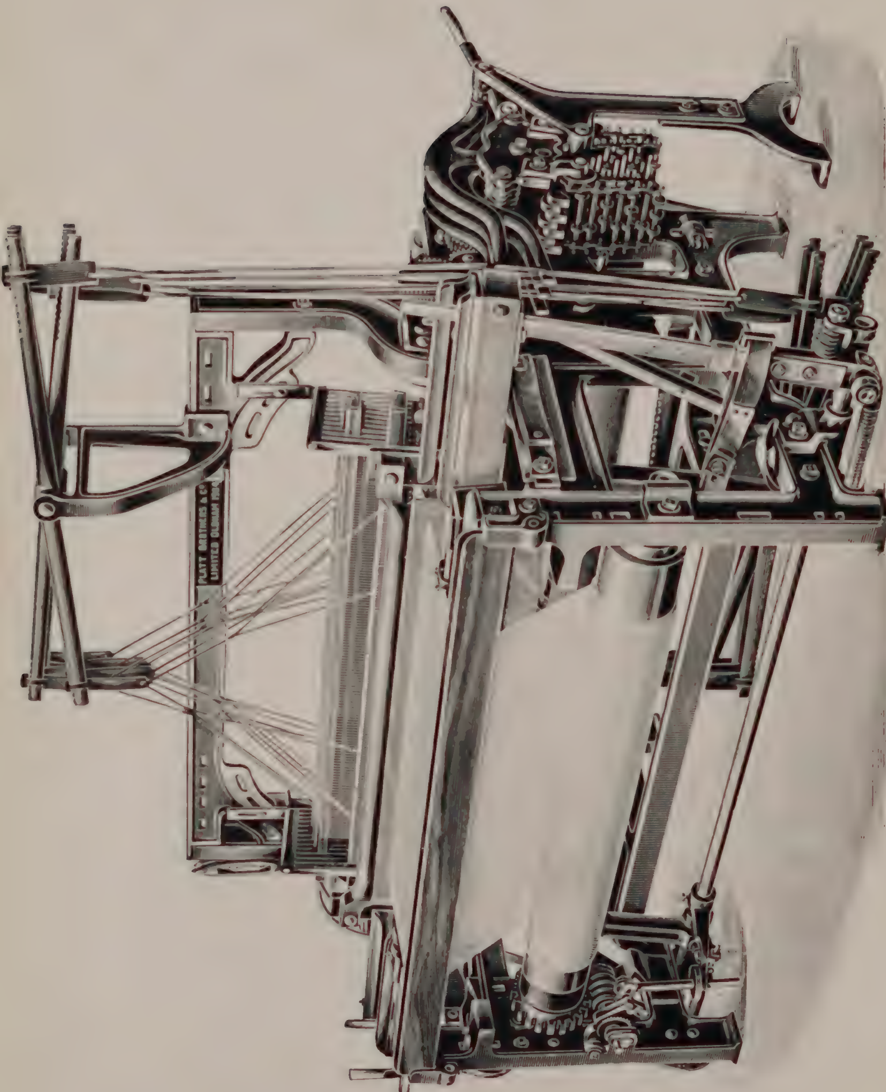
Dividend	with	20	Ratchet.........	236·83
,,	,,	30	,, ...	355·25
,,	,,	40	,, ...	473·66
,,	,,	50	,, ...	592·08
,,	,,	60	,, ...	710·50
,,	,,	70	,, ...	828·91

We are also makers of Pickles' patent taking-up motion, in which the number of teeth in change wheel represents the number of picks per ¼ inch.

To find the length of a Calico Loom, Overpick pattern, No. 3 shuttle, 19¾″ box, add 40½″ to the reed space.

Width overall, with 15″ beam flanges = 4′ 0″

Pulleys, 7″ to 16″ diar. × 2¼″ wide. Speed depending upon reed space of Loom, &c., say a 36″ reed Loom, loose reed, 210 picks per minute.



Fustian or Velvet Loom.

FUSTIAN OR VELVET LOOM.

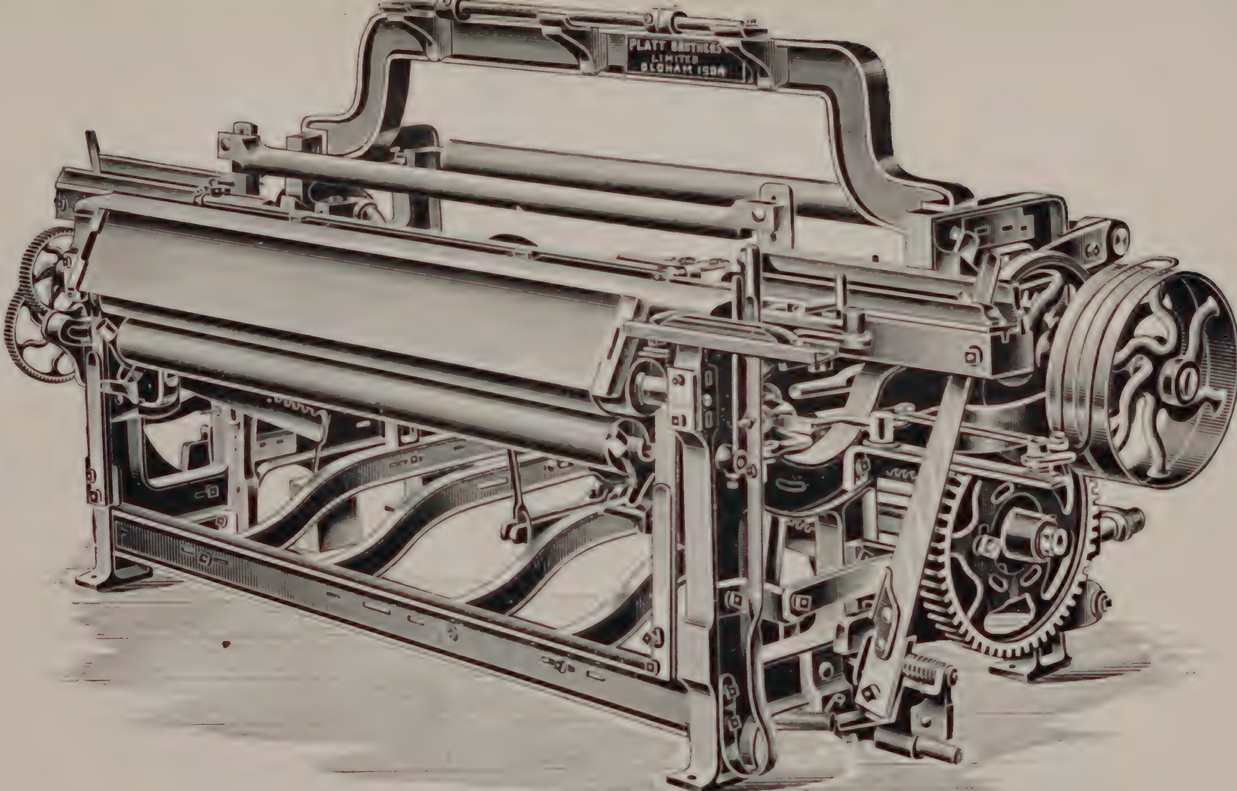
This Loom is of an exceptionally strong pattern, with fitting places on sides planed, and rails cut to template length as in our other Looms.

It is fitted with underpick (Clegg's) motion, iron back roller and iron or wood yarn beam, weft stop motion and balance (worm) taking-up motion and chain weighting for yarn beam, &c. The illustration shows patent Oscillating Tappets which afford facilities for changing the number of picks to the round of pattern, but we can apply plain and twill tappets at end, or Woodcroft's section tappets as preferred.

We also make this Loom with Positive taking-up motion to surface roller up to breast beam, *combined* with Balance taking-up motion to iron cloth roller, which is found advantageous for such goods as light evenly picked velvets, sheetings, &c.

We have many thousands of this type of Loom at work in the Oldham District, in fact it is recognised as the standard Loom for the Fustian, Cord, and Velvet Trade.

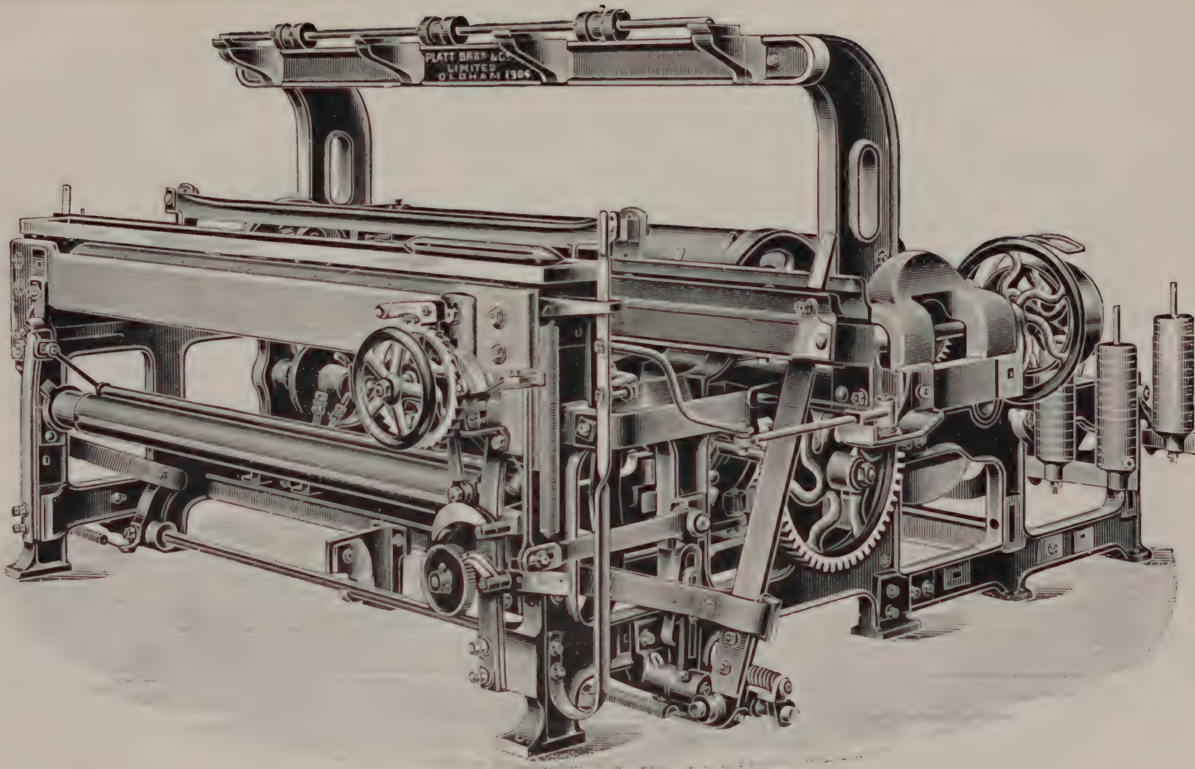
This class of Loom has also been extensively adopted for sheetings, and we have rail patterns for this purpose up to 140″ reed space.



No. 10 Heavy Linen Loom.

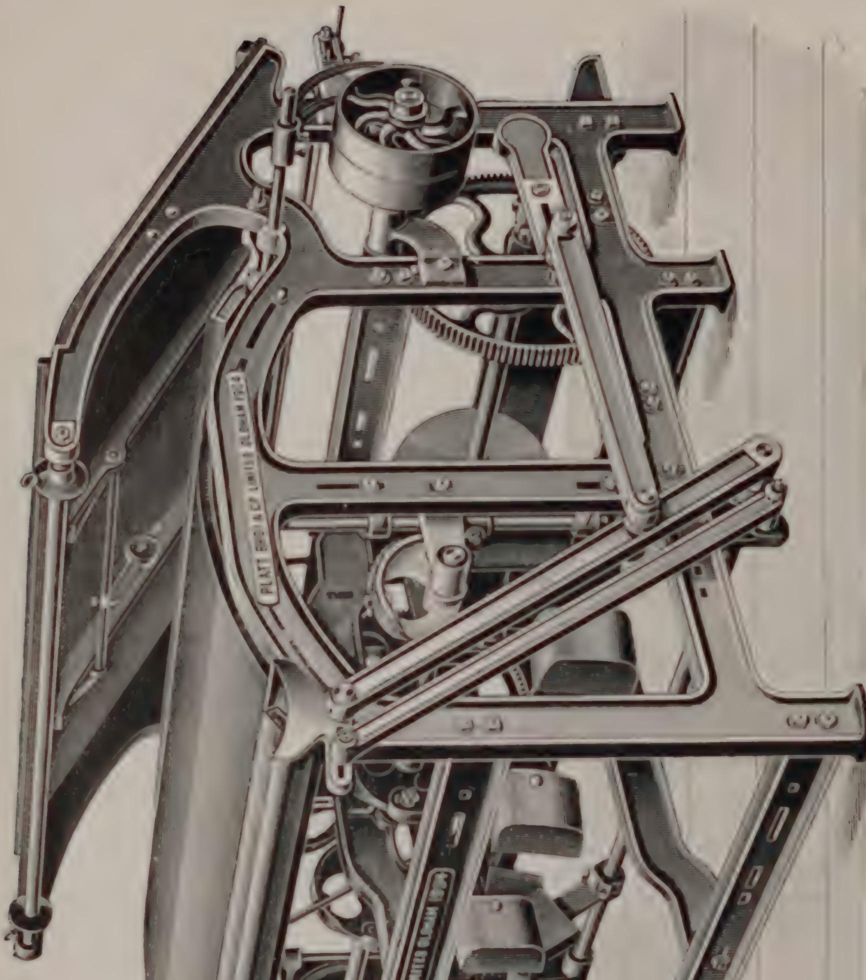
This Loom is specially adapted for strong linen and jute goods, and is fitted with heavy sides and cross rails, extra strong wrought-iron crank and tappet shafts. Heavy Lathe with cast-iron hand top. Underpick side lever motion, strong oval back rest with positive easing motion, &c., &c.

[We have also a lighter pattern of Linen Loom (No. 8) for handkerchiefs and other light linen goods.]



No. 16 Heavy Loom.

This Loom has been specially designed for such goods as ducks, heavy sail cloths, heavy tarpaulin, &c. It is fitted with compound driving to crank shaft, positive take-up motion to iron surface roller which is grooved for inserted brass strips with steel pins. Balance take-up to iron cloth roller. Special underpick motion, extension framing for two yarn beams, geared together "tandem" and fitted with long wrought-iron weight levers as shown.



Cloth Folding Machine.

CLOTH FOLDING MACHINE.

This machine can be made for any width of cloth up to 100in. wide. Our standard pattern is capable of folding plaits 18in. to 44in. long, but, by the addition of special attachments, plaits as short as 10in. can be made. We have also a special pattern of machine for plaits 33in. to 60in. long.

A radial motion is applied to depress the cloth table alternately on each side to relieve the cards as the knife passes under. The grip rails can be lined with card wire or india-rubber, according to the class of fabric to be folded.

The framing and general details are of our well-known substantial construction, and each part is carefully machined and accurately fitted in its proper position. Spur gearing, p. 6, is applied at each end of driving and crank shafts to prevent torsion, and the setting arrangement for different lengths of plaits is of simple design and easily manipulated. We supply gratis, with each machine, a cast-iron slide or setting bar for use when altering the length of plait.

The top of each frame side is marked with a graduated scale to indicate the length of plait being folded. These graduations can be marked either in English inches, or in metrical dimensions, as preferred.

The machine is provided with a stop motion which comes into action when the end of "piece" is reached, and a brake operates to stop the frame quickly.

When desired we can supply an **Unrolling or Batching Machine** to let the cloth off from rollers.

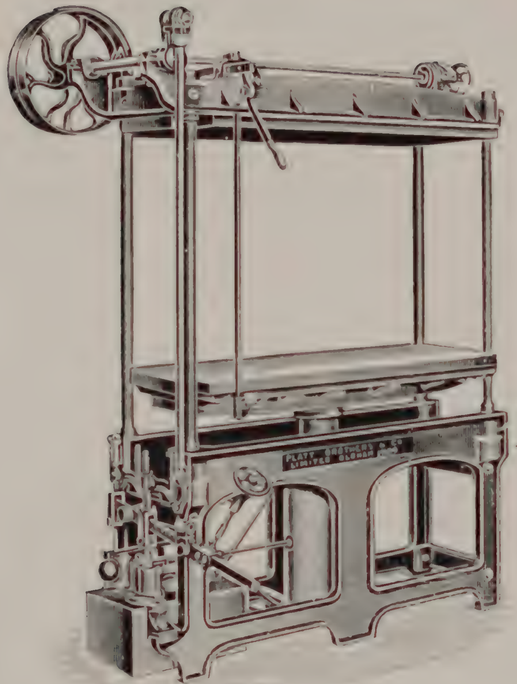
We can supply these machines of any width up to 100 inches, to place behind the Cloth Folding Machine. If instructed we can apply cone driving at end of machine to regulate the speed of cloth delivered.

Length overall for plaits up to 44″ = 7′ 0″.
" " " 60″ = 8′ 4″.

Width overall = width of cloth + 2′ 10″.

Pulleys, 10″ × $2\frac{1}{2}$″ × $2\frac{1}{2}$″. Speed, about 156 to 160 revs. per minute.

Production, 1 machine for about 300 Looms.



HYDRAULIC CLOTH PRESS.

We make this machine with pumps worked by eccentrics, or by crank on top pulley shaft, as shown, the latter being our standard arrangement, and permits of the connecting rods being readily disconnected and the pumps worked by hand. Ram 6″ diar., 18″ stroke. Double pumps 1″ plungers. Press tested to 1 ton per square inch on ram.

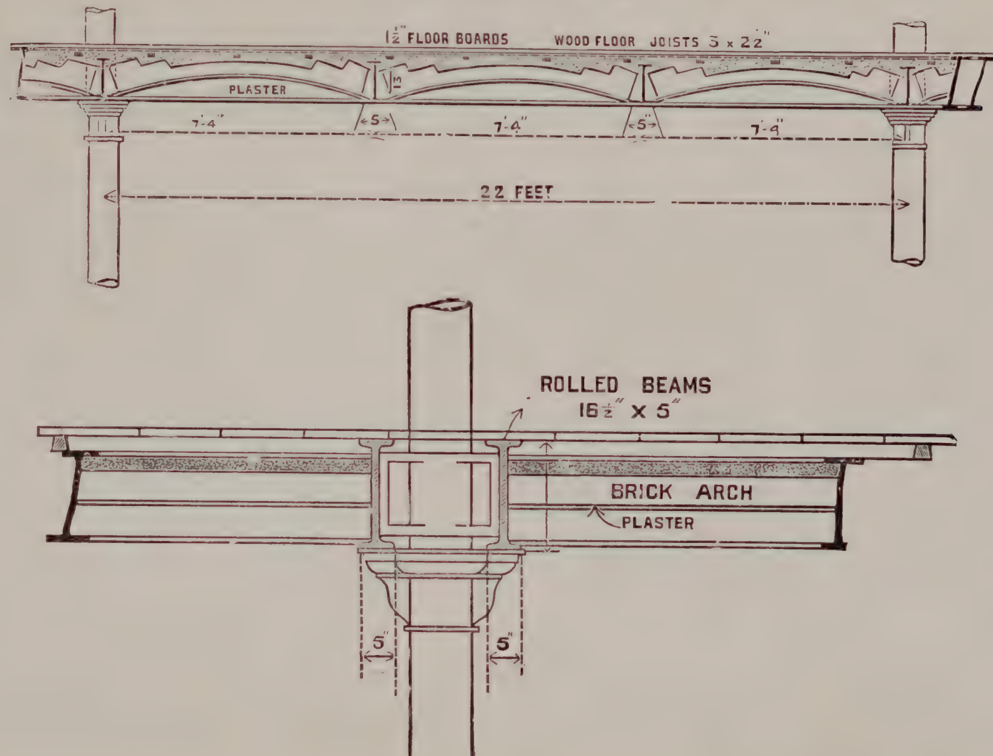
Table	56¾″	long	× 16¼″	wide.	Opening	18″	deep.	Small size.
,,	56¾″	,,	× 24″	,,	,,	26″	,,	Medium size.
,,	56¾″	,,	× 24″	,,	,,	40″	,,	Large ,,

Pulleys 18″ × 3″ × 3″. Speed about 85 revs. per minute.

Length overall, 6′ 6″ × 3′ 9″.

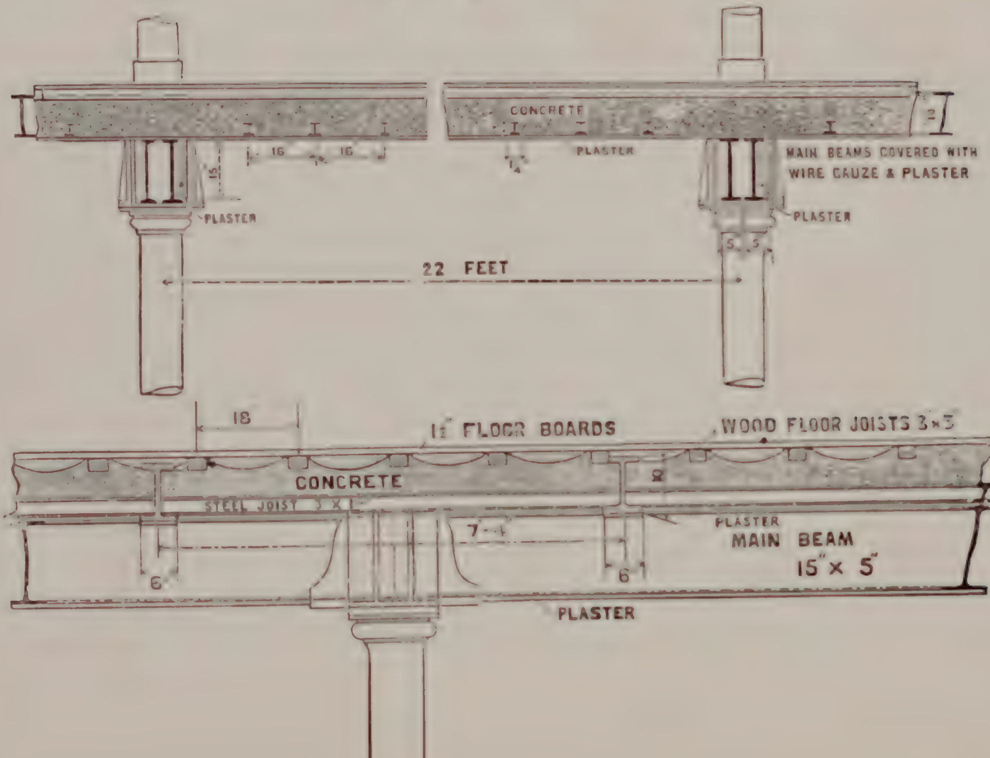
Production, 1 machine for about 500 Looms.

Ceiling, with Steel Double Main Girders, Steel Cross Beams, and Brick Arches.
Bays, 22 feet × 22 feet.



Ceiling, with Steel Girders and Flat Concrete Ceiling, with Small Steel Joists.

Bays, 22 feet × 14 feet.

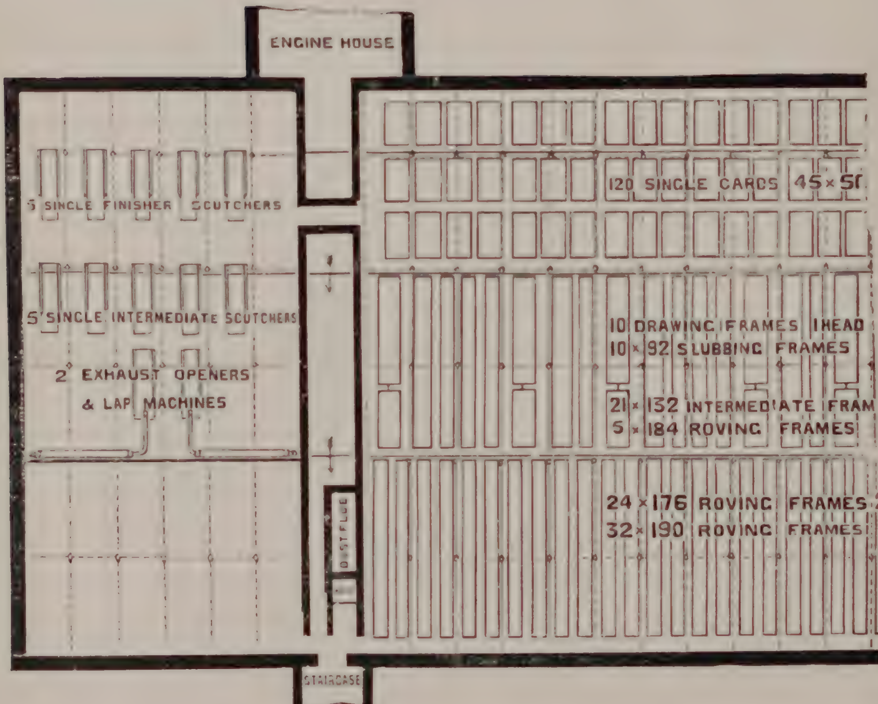


CEILING, WITH CAST-IRON MAIN BEAMS, TRANSVERSE BEAMS, AND BRICK ARCHES.

Ceiling, with Brick Arches, 11′ 0″ Span, Bays 22′ × 11′.

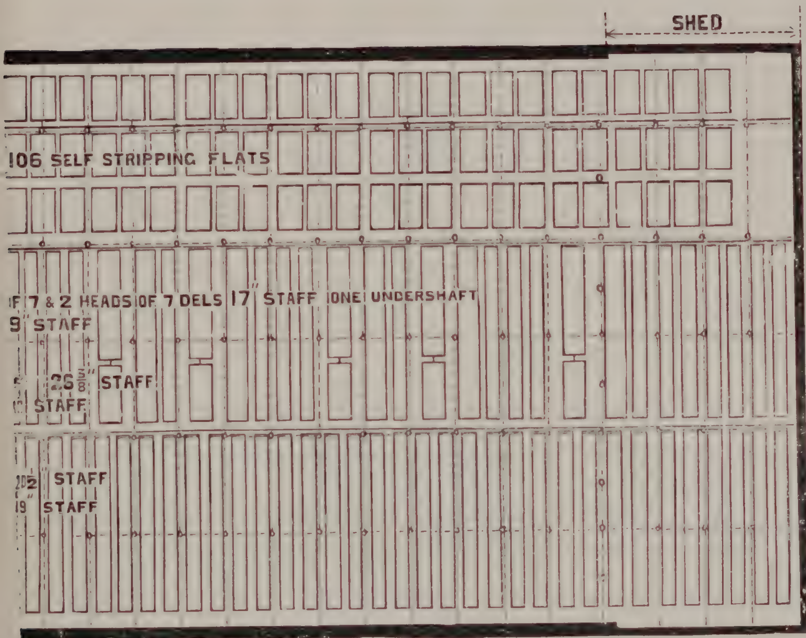
Wrought-iron Beams 15″ × 6″.

OLDHAM MILL, containing 121,540 Mule Spindles and



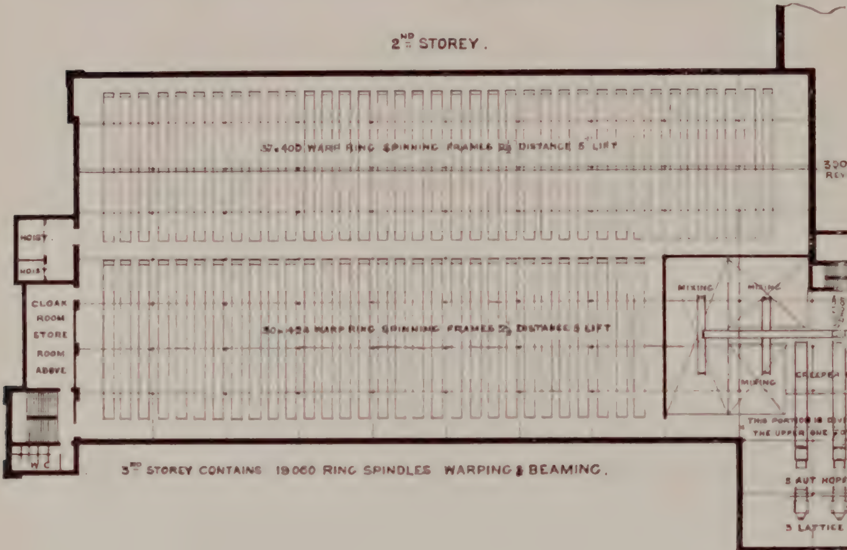
(3 Spinning Rooms above.

PREPARATION FOR COUNTS AVERAGE 45s TWIST AND 66s WEFT.



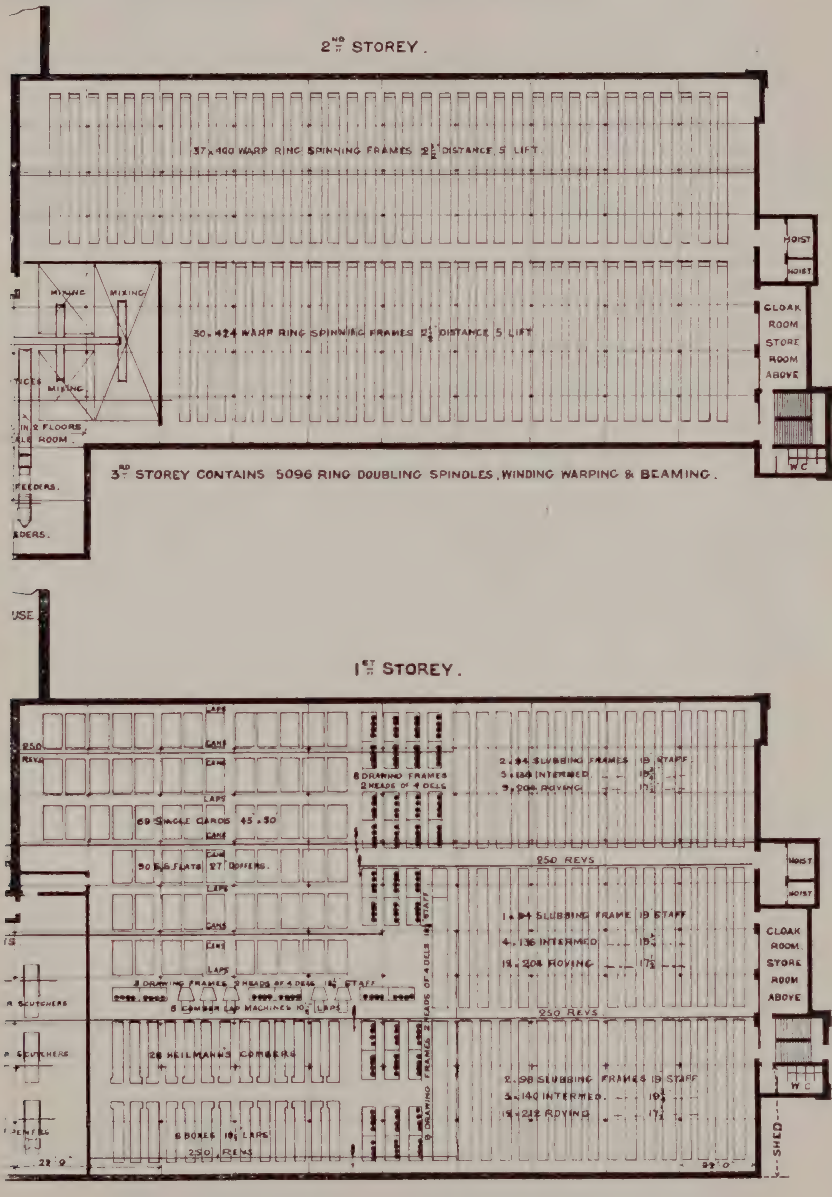
4 STOREYS HIGH.)

MODERN SPINNING MILL, CONTAINING 74,100 RING SPINDLES AND WITH 5,096 DOUBLING SPINDLES,



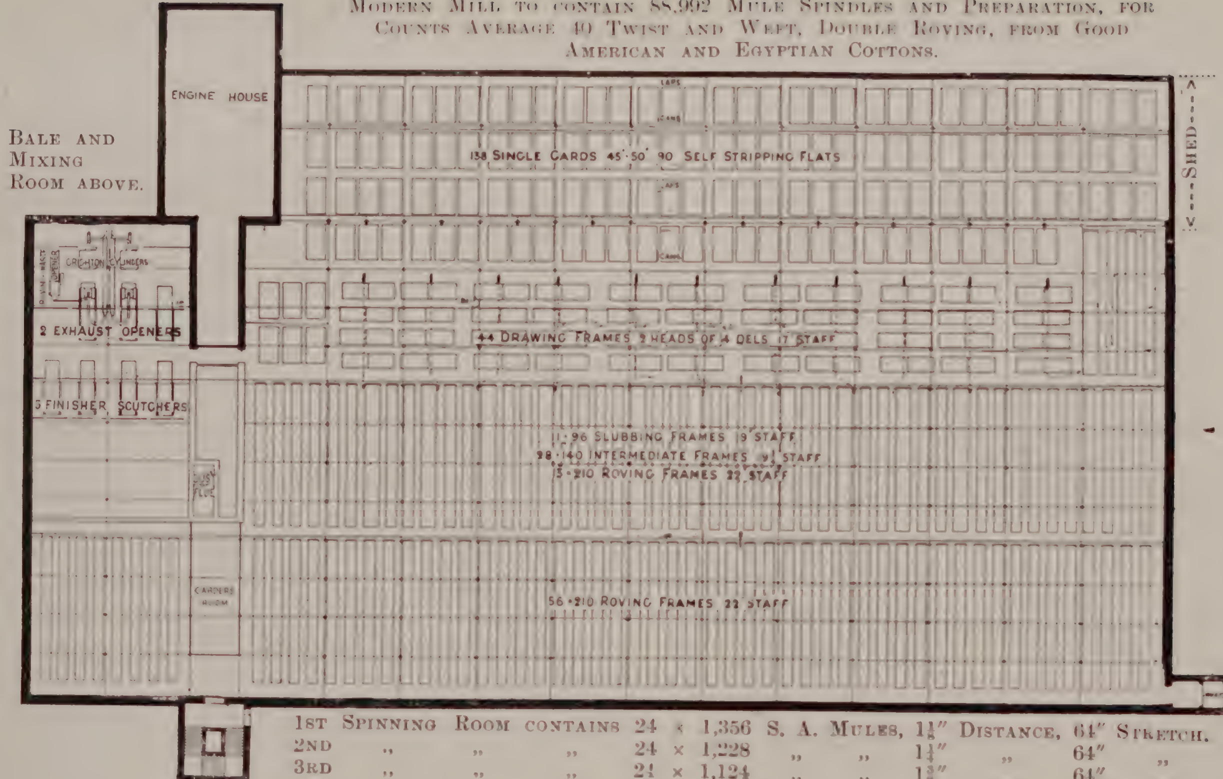
CELLAR OR BASEMENT CONTAINS

Peparation, Counts Average 60s Carded and Carded and Combed Yarns, Reeling, Winding, Warping and Beaming Machines



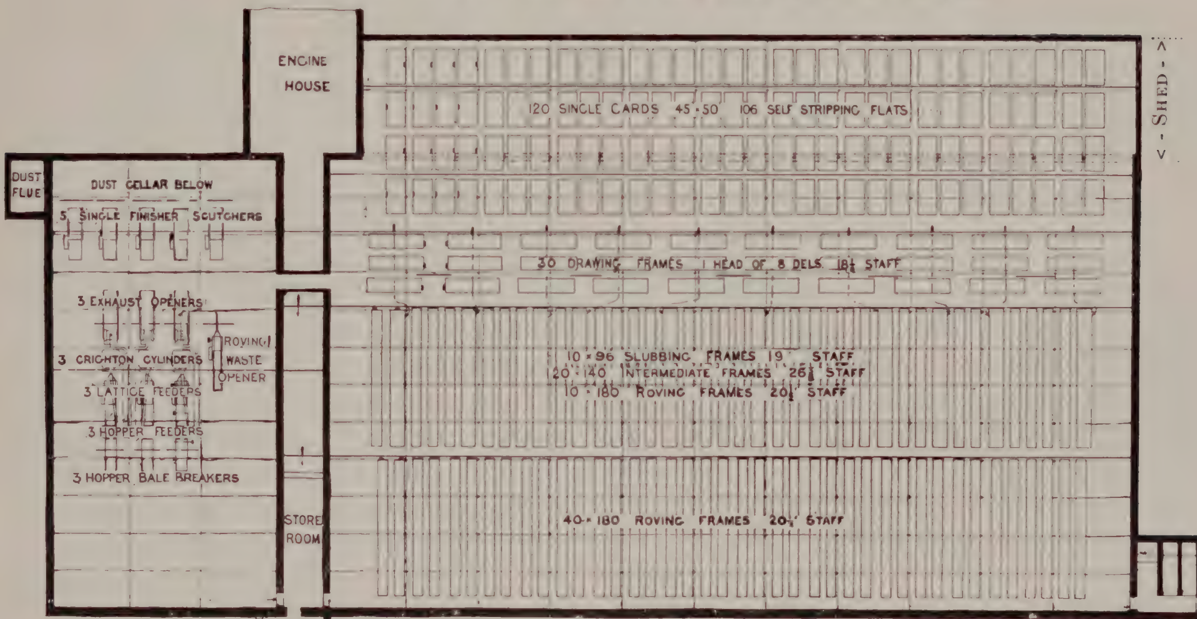
Reeling, Bundling, Yarn Store, &c.

Modern Mill to contain 88,992 Mule Spindles and Preparation, for Counts Average 40 Twist and Weft, Double Roving, from Good American and Egyptian Cottons.



1st Spinning Room contains	24 × 1,356	S. A. Mules,	$1\frac{1}{8}''$	Distance,	64″	Stretch.
2nd ,, ,, ,,	24 × 1,228	,,	$1\frac{1}{4}''$	,,	64″	,,
3rd ,, ,, ,,	24 × 1,124	,,	$1\frac{3}{8}''$	,,	64″	,,

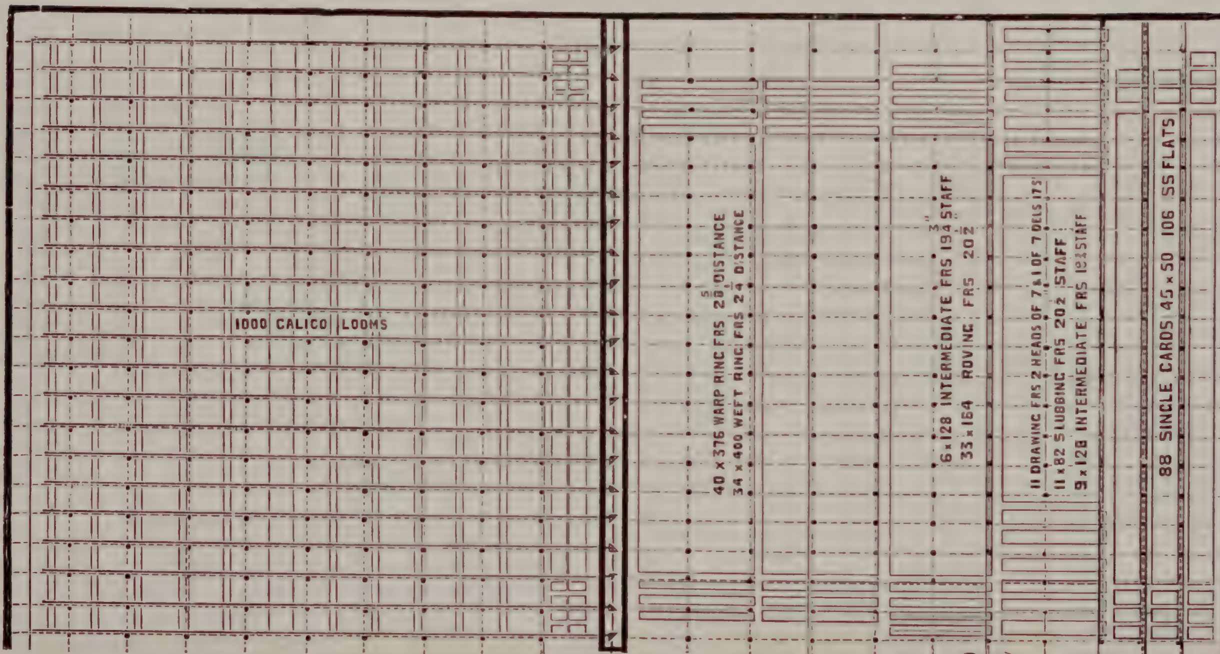
Modern Mill to contain 106,176 Mule Spindles and Preparation, for Counts 30's to 40's Twist and Weft, from American Cotton.

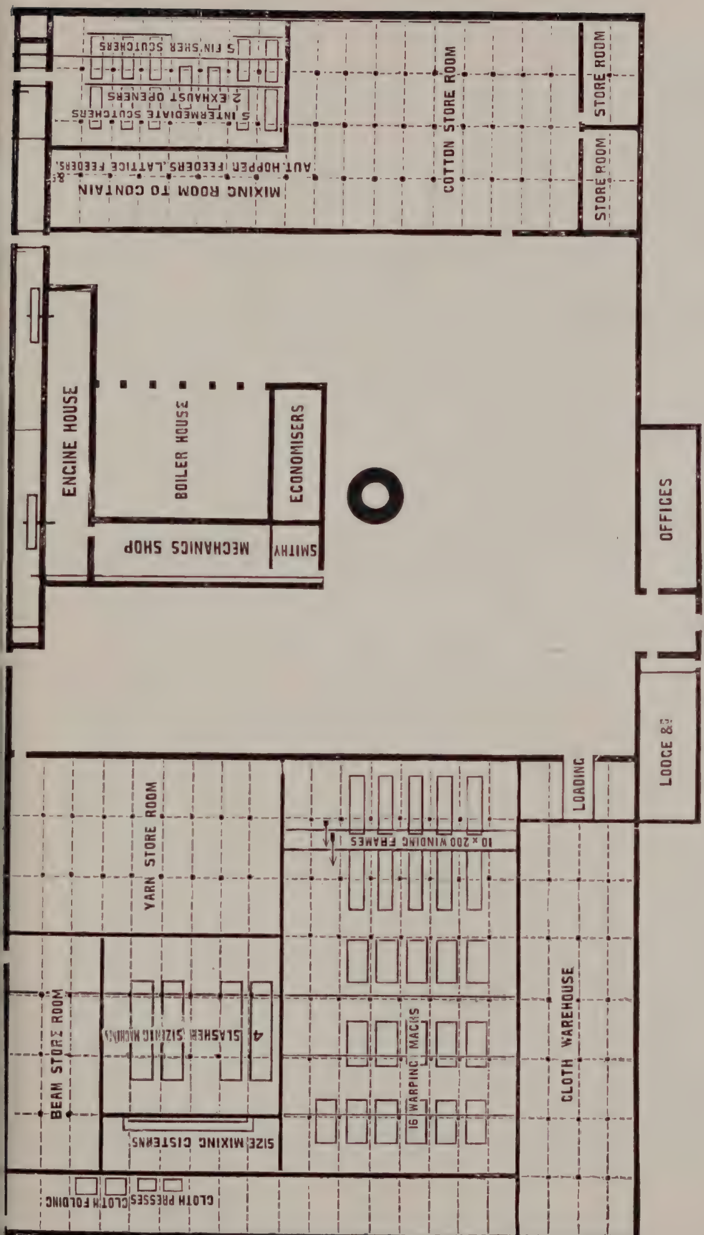


1st Spinning Room contains	28 × 1,344	S. A. Mules,	1⅛″	Distance,	64″	Stretch.
2nd ,, ,, ,,	28 × 1,344	,,	1⅛″	,,	64″	,,
3rd ,, ,, ,,	28 × 1,104	,,	1⅜″	,,	64″	,,

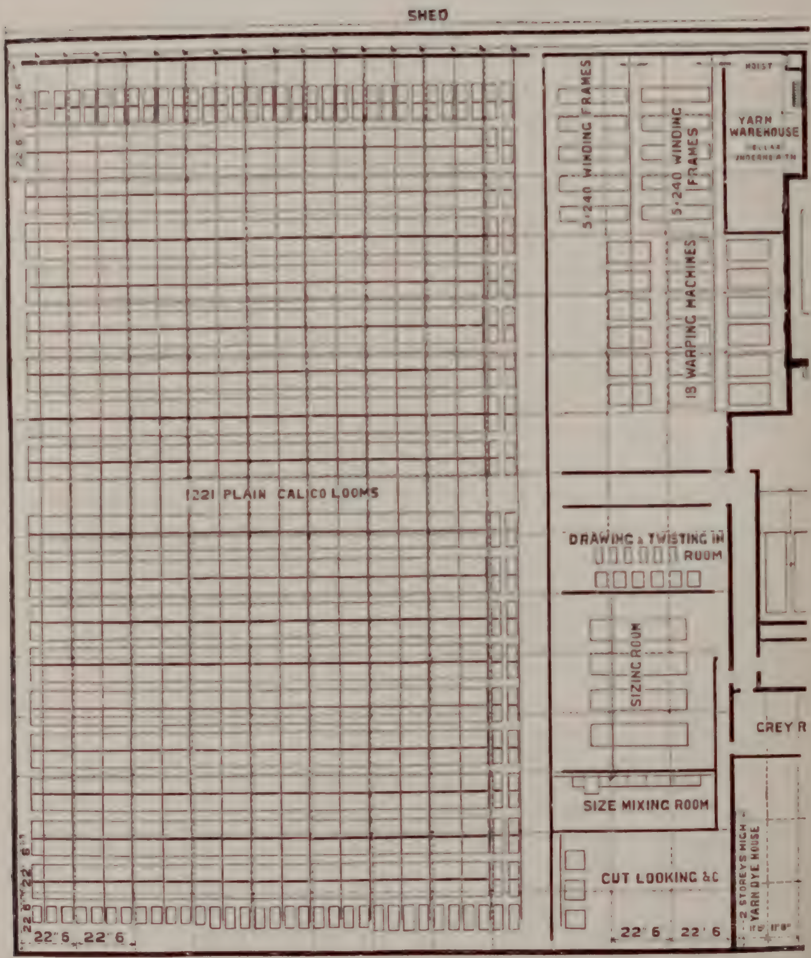
SHED MILL,

Containing 30,000 Ring Spindles and Preparation, Counts Average 18s, and 1,000 Looms.



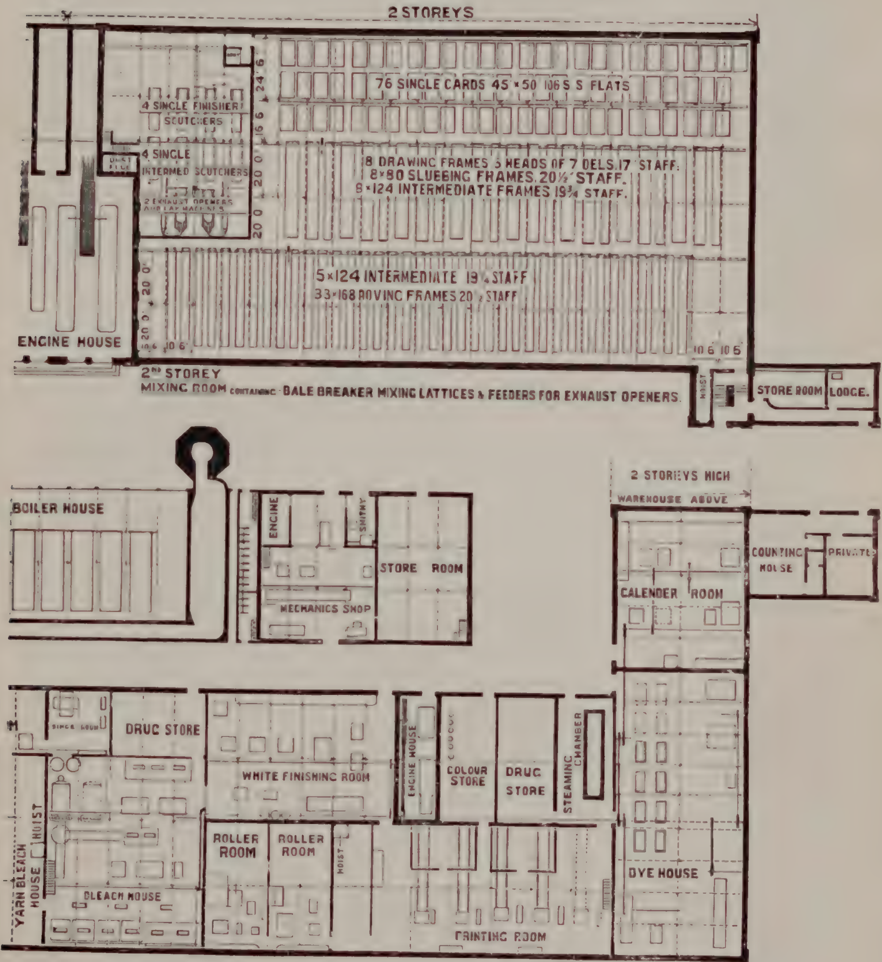

5 FIN'SHER SCUTCHERS
2 EXHAUST OPENERS
5 INTERMEDIATE SCUTCHERS
AUT. HOPPER FEEDERS, LATTICE FEEDERS, &c
MIXING ROOM TO CONTAIN
COTTON STORE ROOM
STORE ROOM
STORE ROOM
ENGINE HOUSE
BOILER HOUSE
ECONOMISERS
MECHANICS SHOP
SMITHY
OFFICES
LODGE &c
LOADING
YARN STORE ROOM
10 × 200 WINDING FRAMES
CLOTH WAREHOUSE
BEAM STORE ROOM
4 SLASHER SIZING MACHINES
16 WARPING MACHS
SIZE MIXING CISTERNS
CLOTH PRESSES
CLOTH FOLDING

MILL IN BRAZIL, containing 37,340 Ring Spindles and Preparation, Cloth Printing and



Counts Average 40s, and 1,220 Looms, with Bleaching, Dyeing, Finishing Plant.

(37,340 Ring Spindles in Room above.)

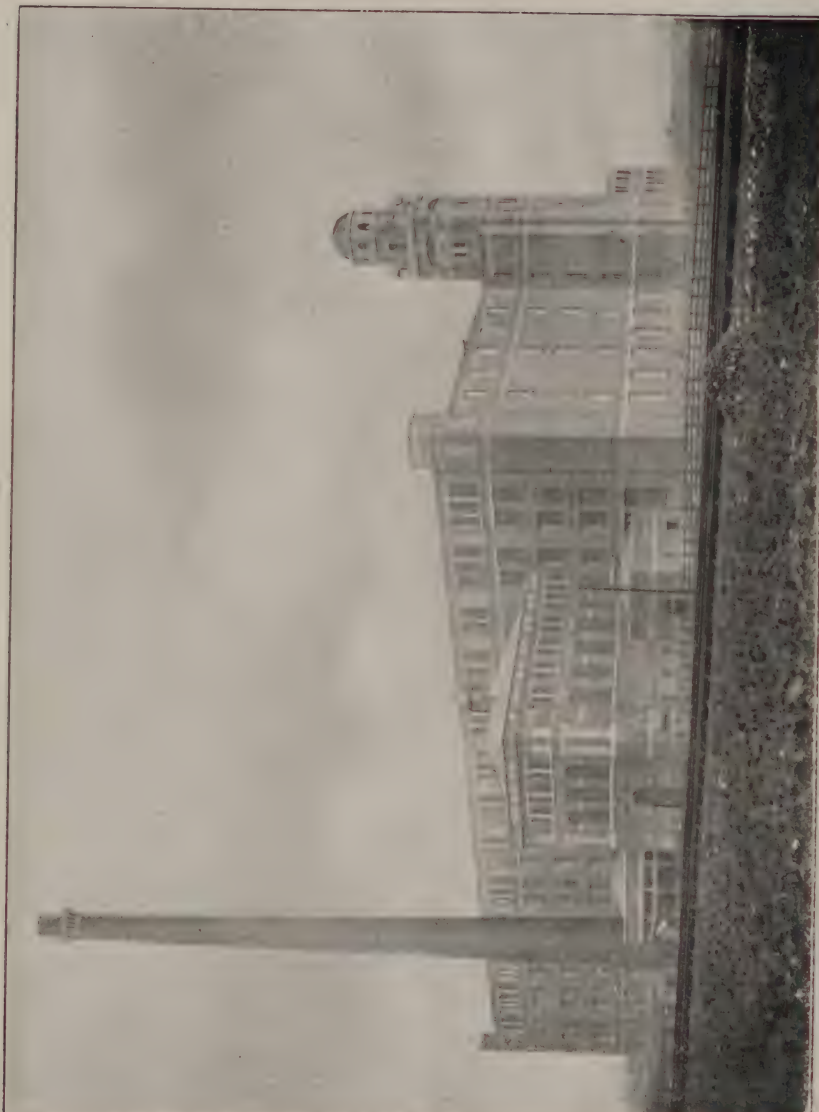


Delta Mill, Royton

Lion Mill.　　ROYTON MILLS.　　Bee Mill.

Parkside Mill. Star Mill. King Mill.

GROUP OF ROYTON MILLS.



Laburnum Mill, Atherton.

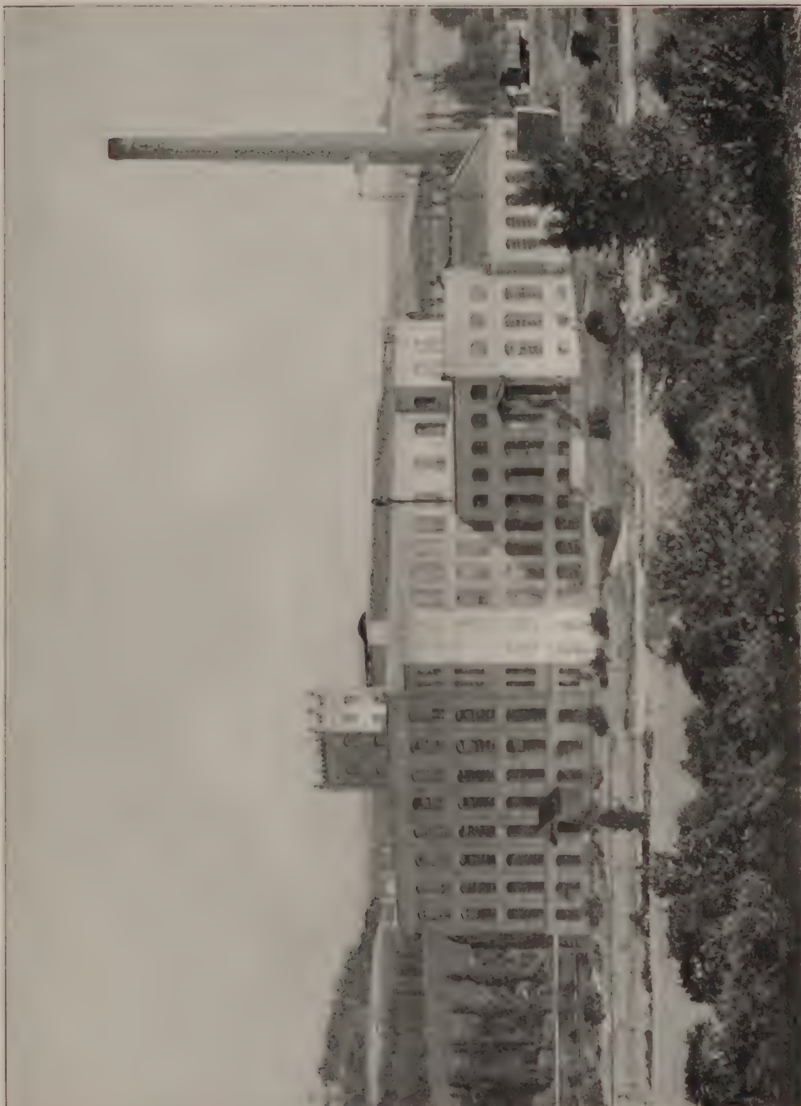
Coppull Ring Mill, Nr. Chorley.

Mill at Tannwald, Bohemia.

La Cotonnière Lilloise, Lille, France.

Mr. Benigno Crespi's Mill at Crespi sull' Adda, near Milan, Italy.

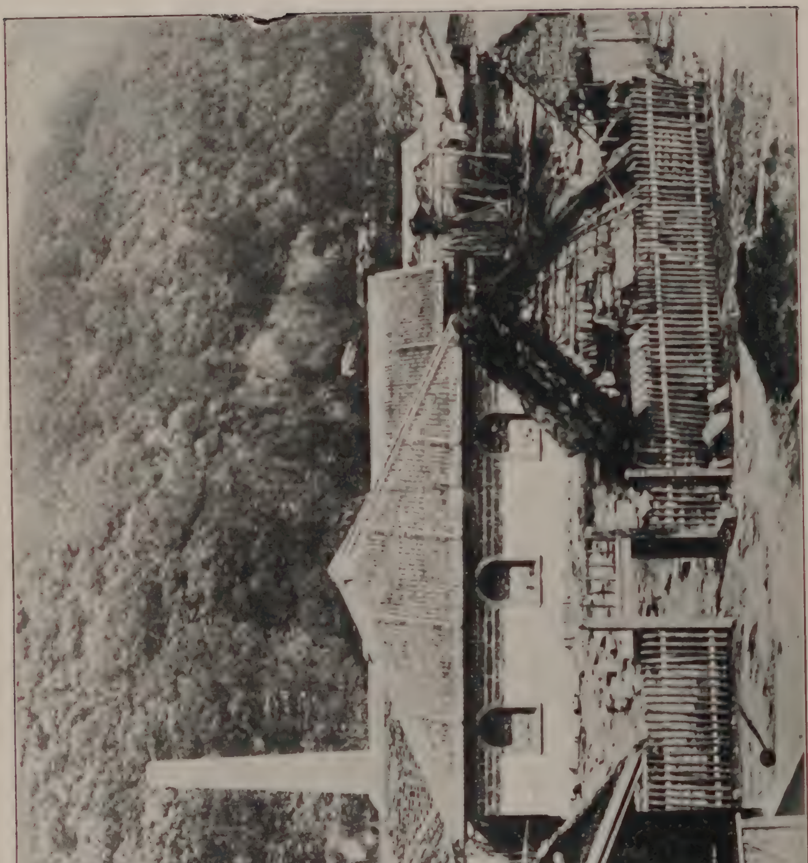
Spinning and Doubling Mill (Baron H. de Liser) at Schlan, Bohemia.



Spinning and Doubling Mill (Baron H. de Liser) at Schlan, Bohemia.

Messrs. Pasquale & F.lli Borghi, Varano, Italy.

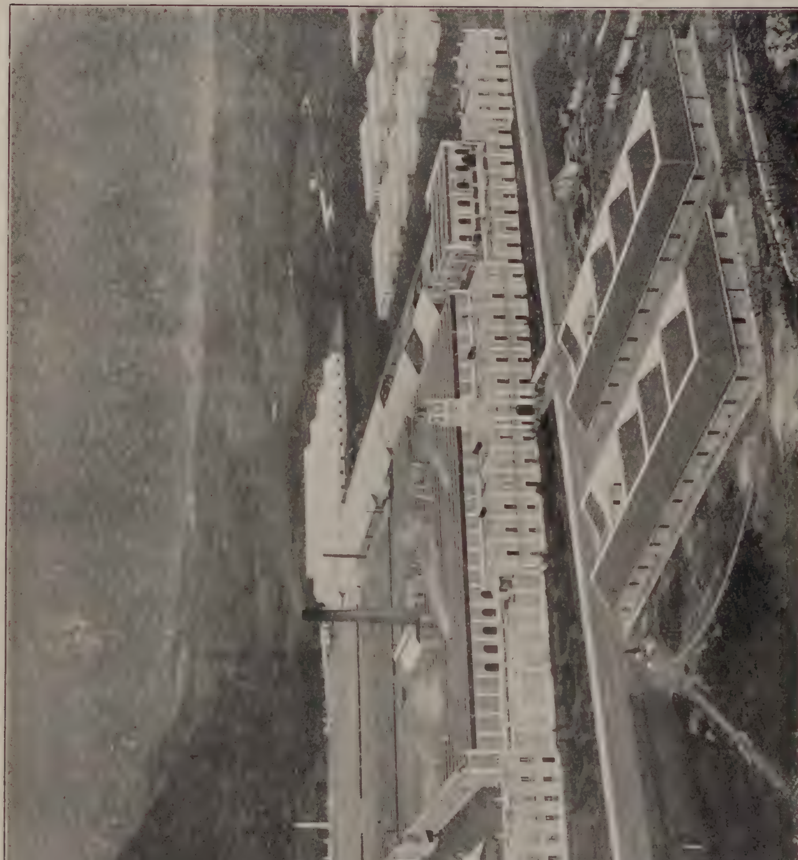
Bangu Mill, Rio de Janiero, Brazil.



Kagoshima Mill, Japan (Built by Prince Satsuma, 1866)
The first Mill in Japan.

Osaka Mill, Japan (1888).

Kohinoor Mill, Bombay.



Rio Blanco Mill, Orizaba, Mexico.