ILLUSTRATED CATALOGUE OF

COTTON SPINNING MACHINERY

John Hetherington & Sons,
LIMITED,
MANCHESTER.

SOLE AGENT FOR U. S. A. AND CANADA

Herbert Harrison

Room 1125 10 High St.

Boston, Mass.

Illustrated Catalogue

OF

TEXTILE MACHINERY

MADE BY

John Hetherington & Sons,
LIMITED

VULCAN AND ANCOATS WORKS,
(Established 1830.)

POLLARD STREET,

MANCHESTER.

Telephone No. 3745 City.
(5 lines.)

Telegraphic Address:
"HETH," MANCHESTER.

Also proprietors of

CURTIS, SONS & CO.,
(Established 1804.)

Phœnix Works, Manchester.

~~John R Moore~~
~~318 Ashley Blvd~~
June 15 1924

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PREFACE.

We have pleasure in submitting to your notice our new Catalogue of Textile Machinery.

Our endeavour has been to produce a book which, while useful generally, may also be instructive to those desirous of closely examining particular points of practice, and we trust the present edition, which has been brought up to date, and gives information respecting new Machines and Improvements made by us since the issue of our last Catalogue in 1911, will meet with your appreciation.

John Hetherington & Sons, Ltd.

February, 1921.

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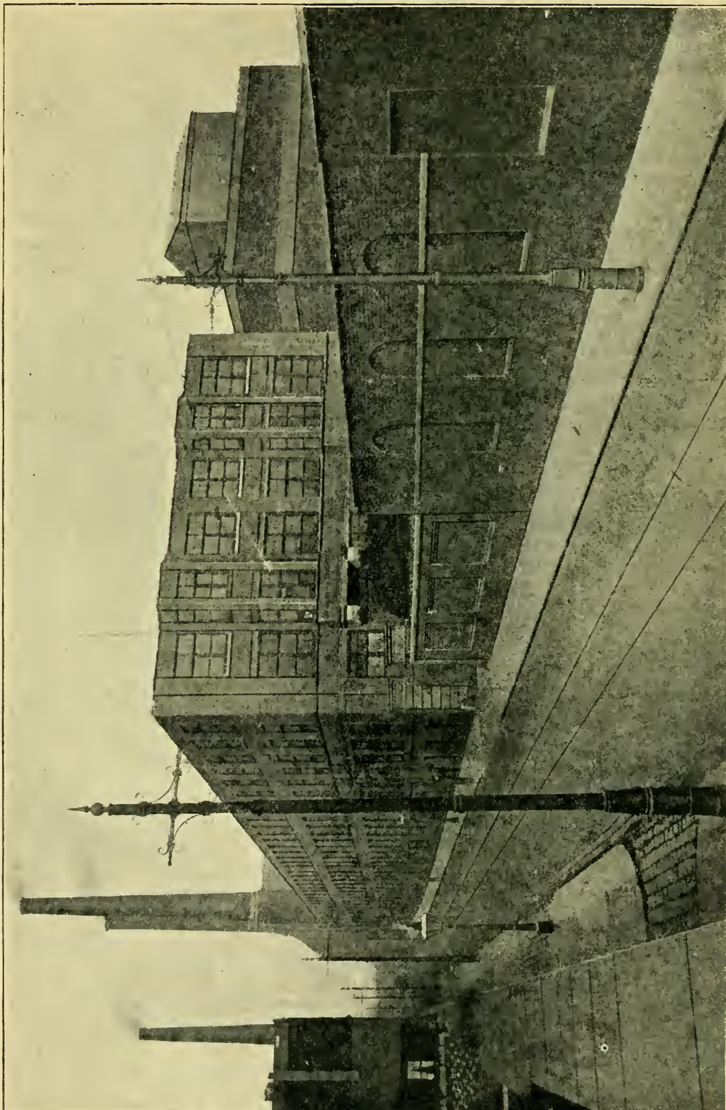
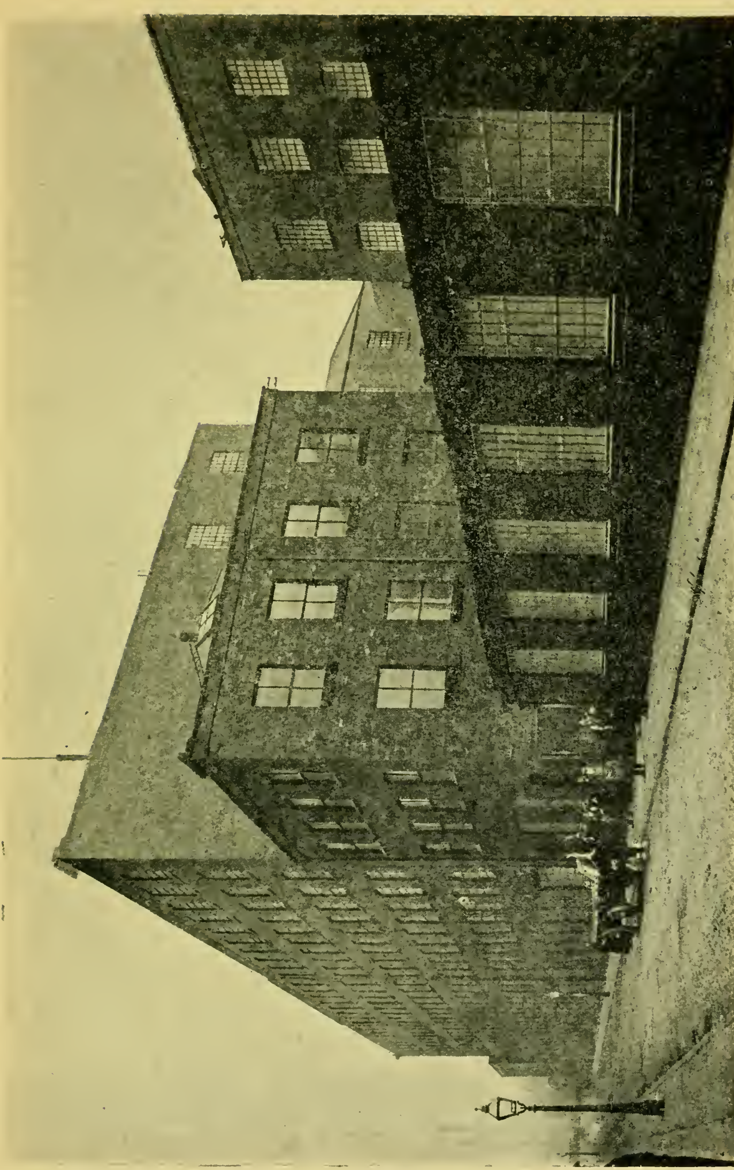


VULCAN WORKS, POLLARD STREET, ANCOATS, MANCHESTER.



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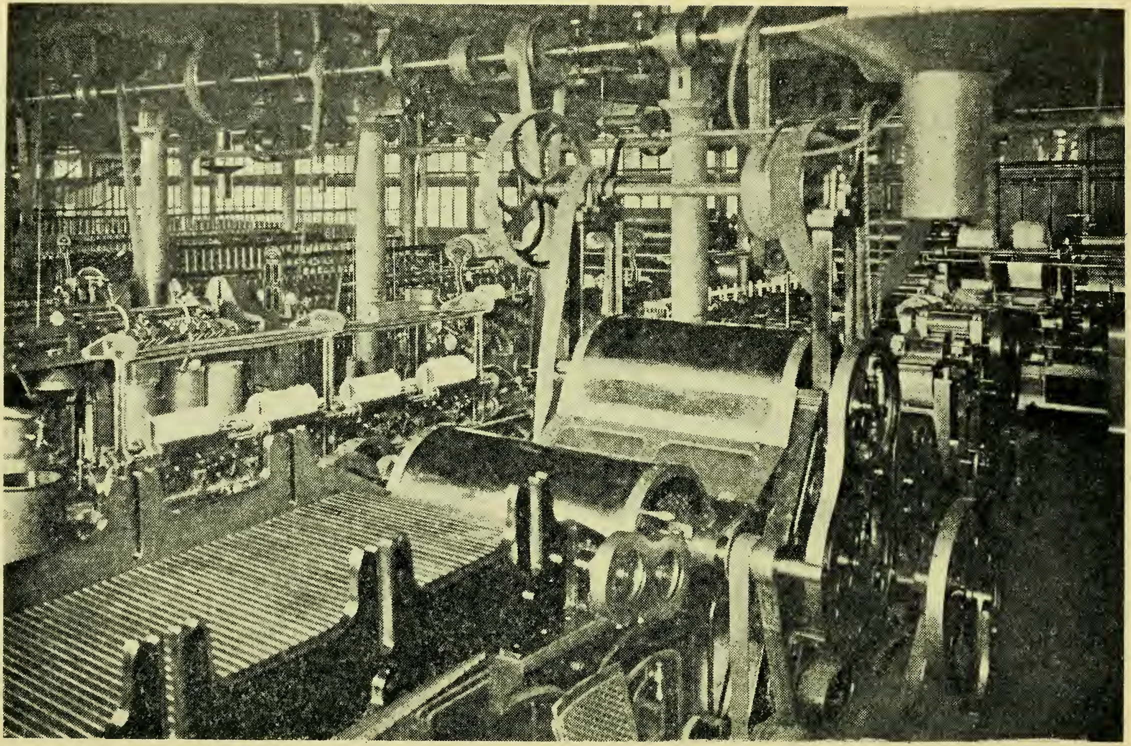
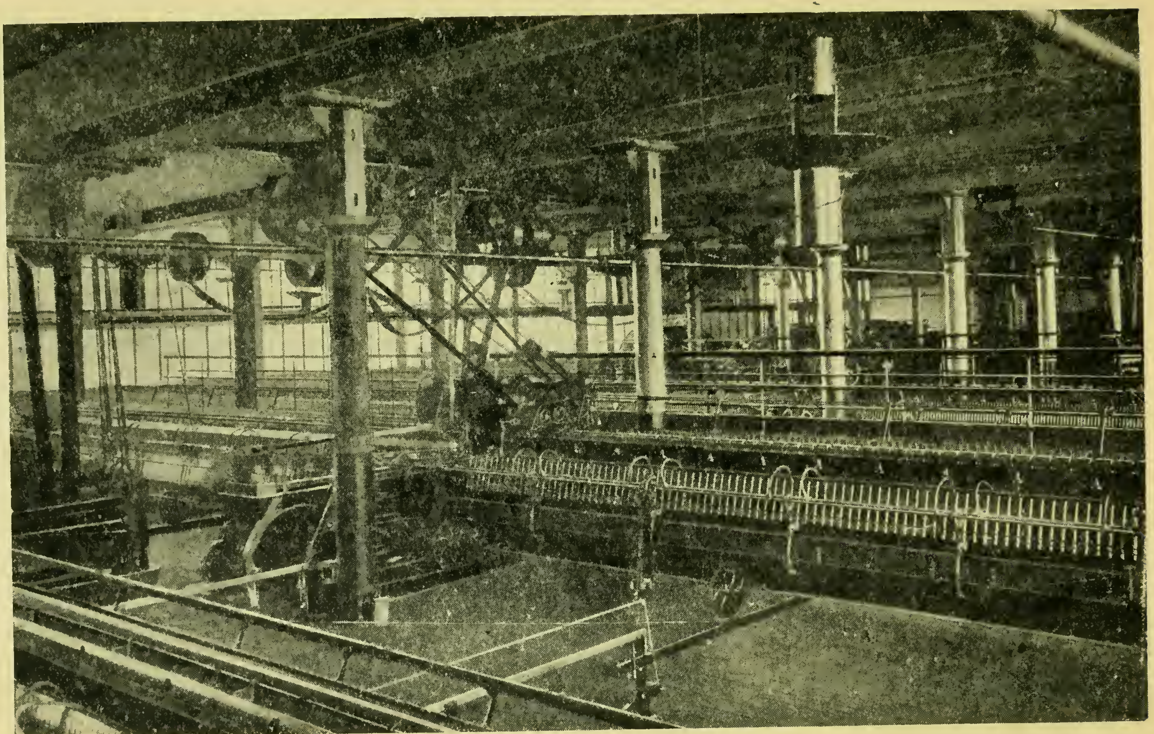


SHOW ROOM, POLLARD STREET, LOOKING EAST, 112 FEET × 60 FEET.



SHOW ROOM, POLLARD STREET, LOOKING SOUTH.

MOULDING SHOP, 290 FEET × 90 FEET.

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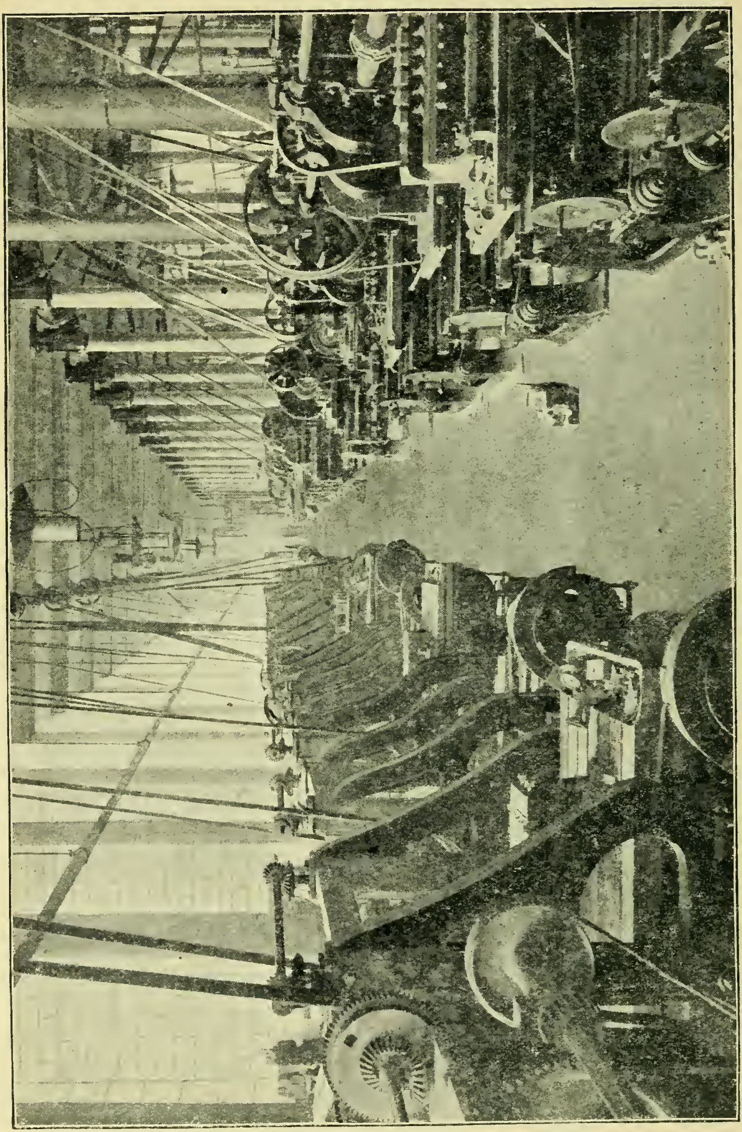
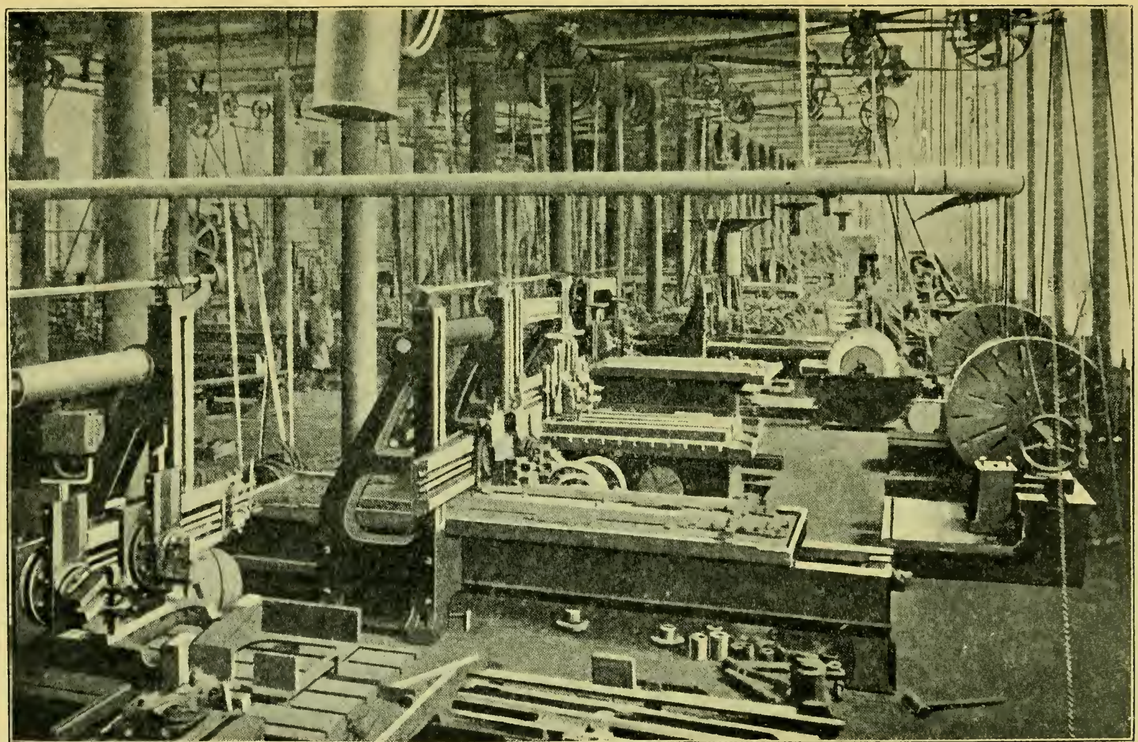


MILLING SHOP.



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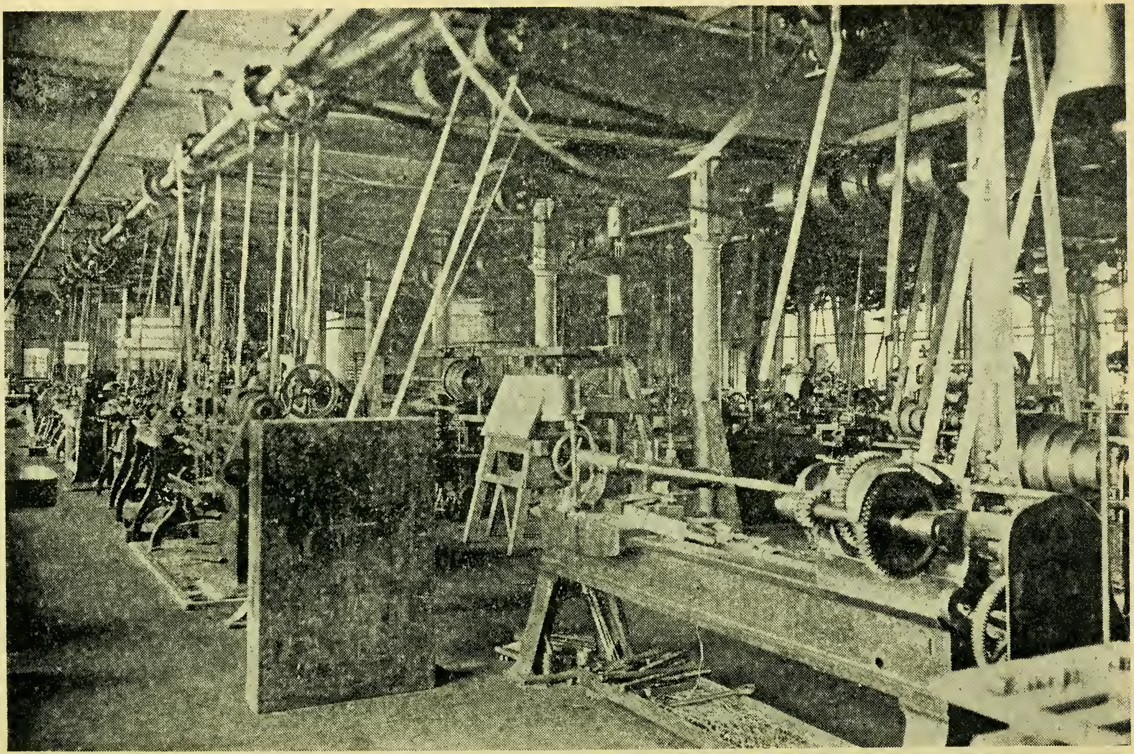
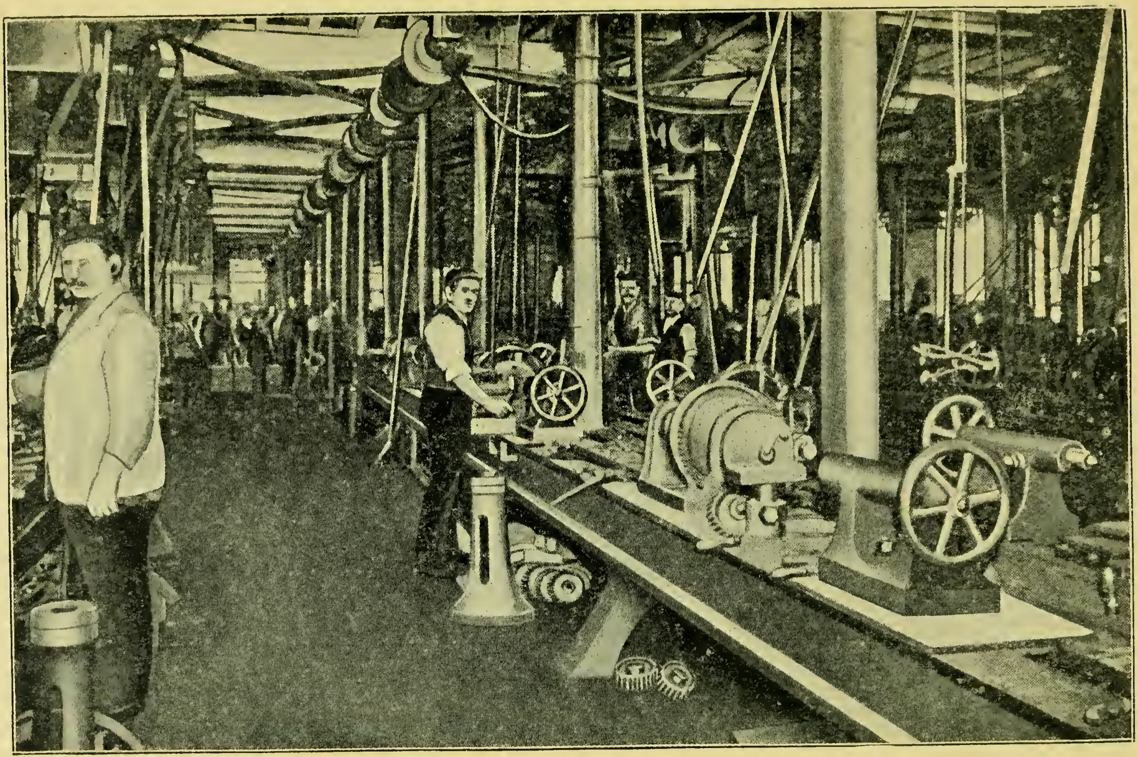
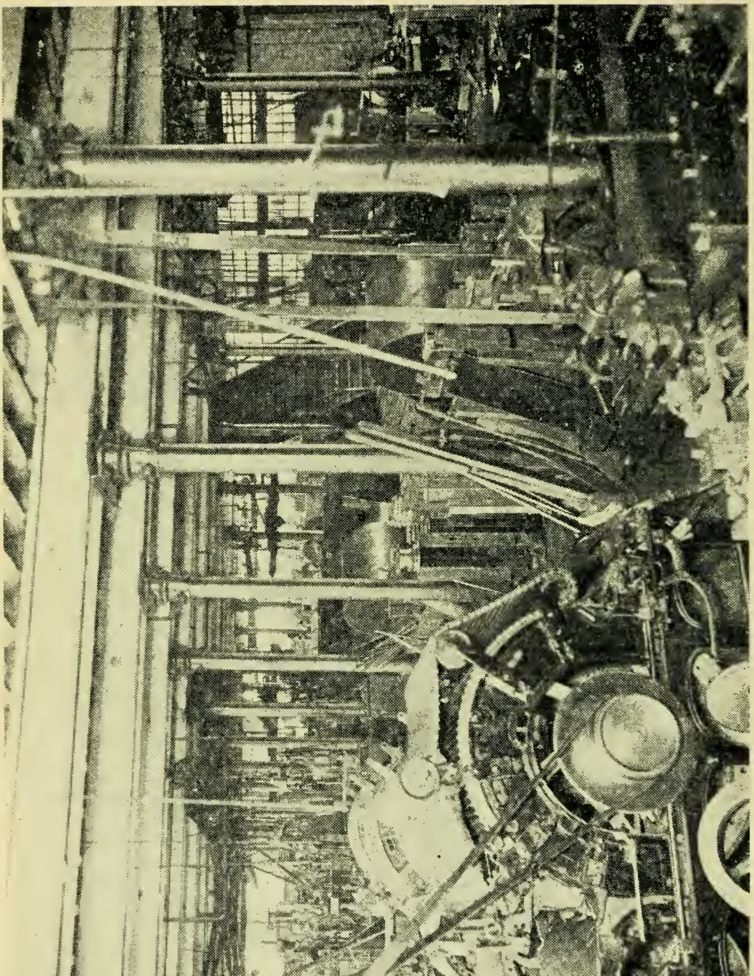


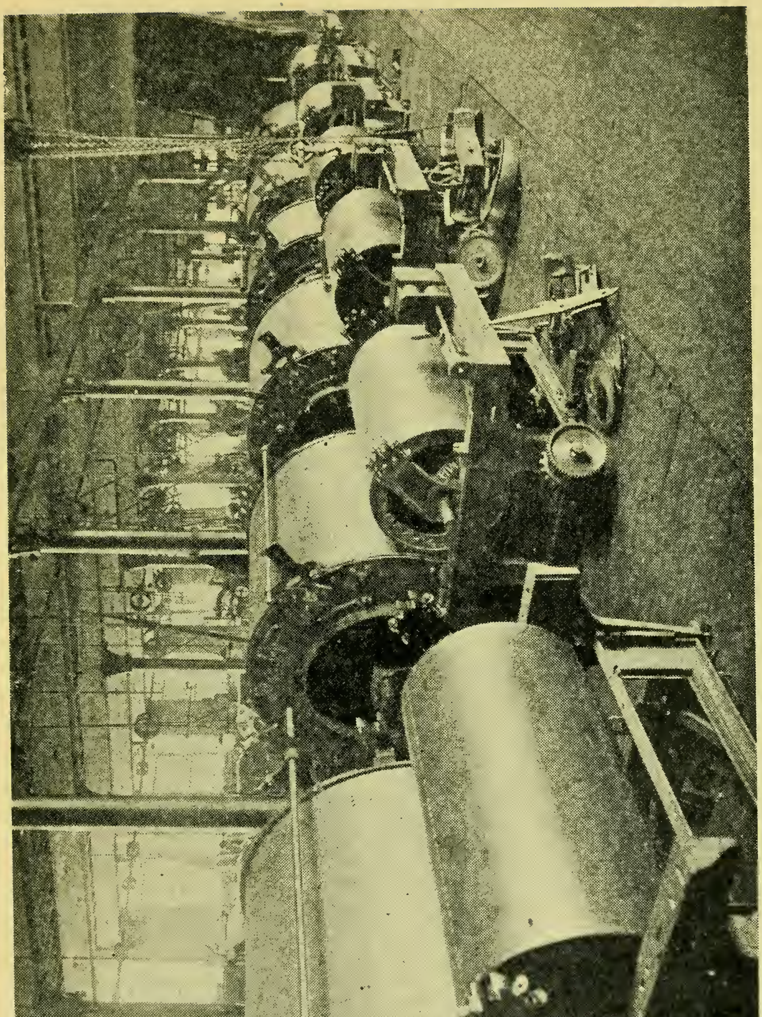
No. 3 TURNING SHOP—NEW BUILDING.



No. 3 TURNING SHOP—OLD BUILDING.



CARD-ERECTING DEPARTMENT.



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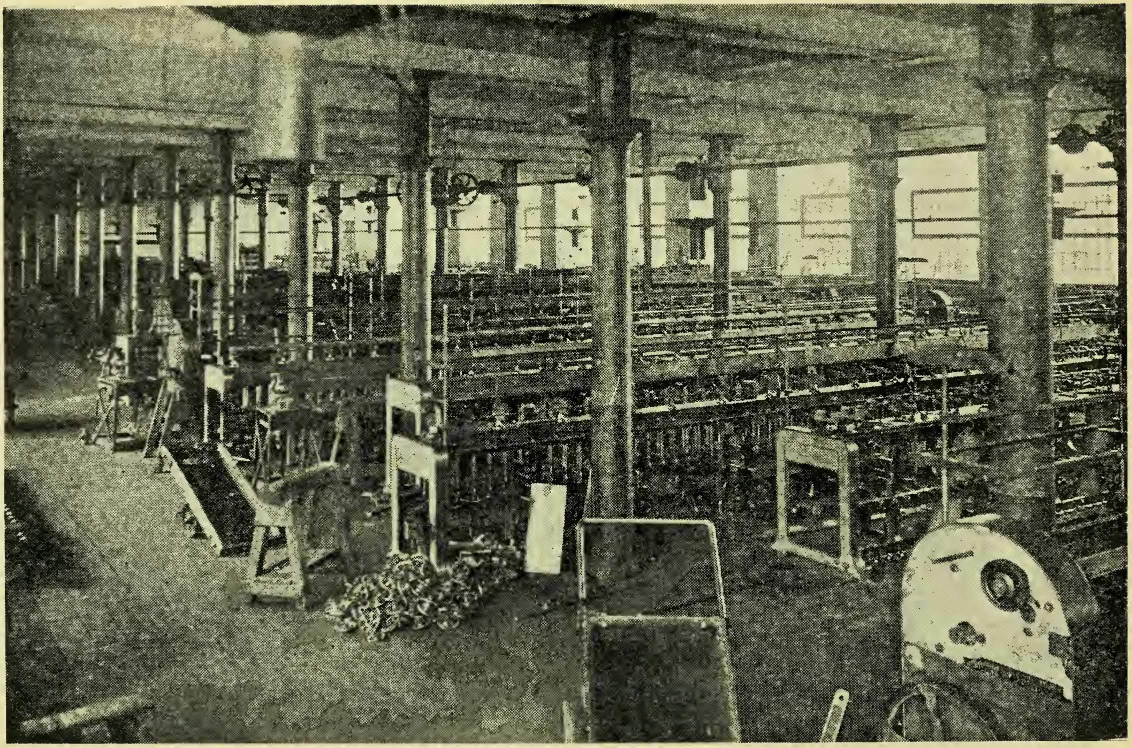

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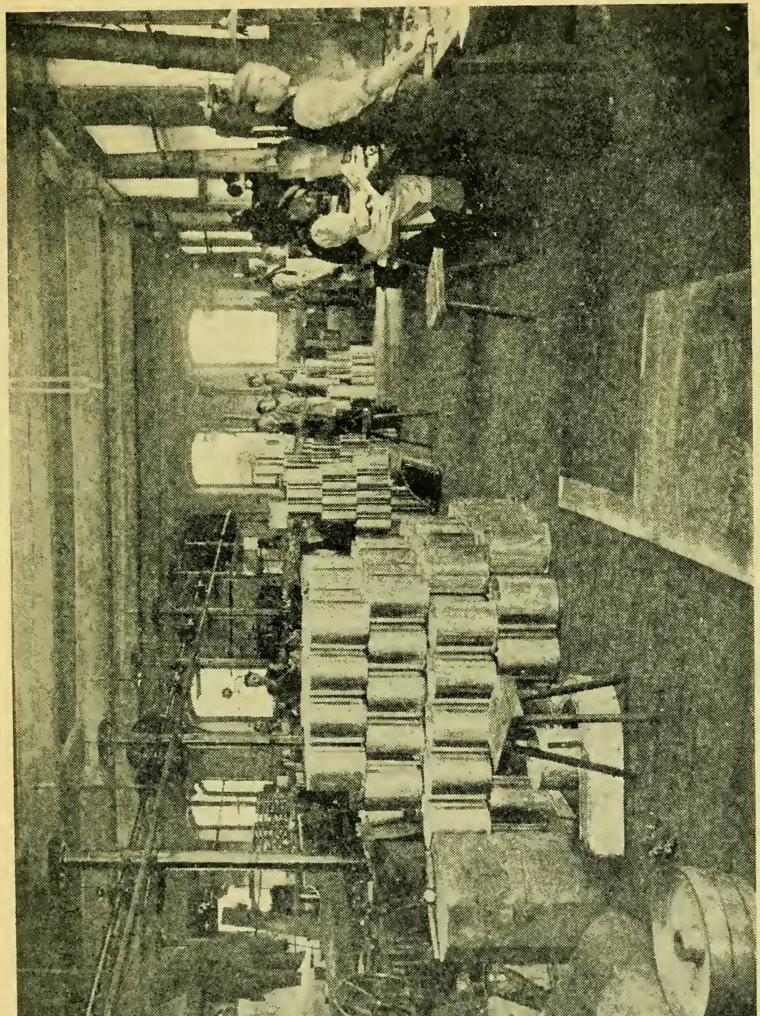

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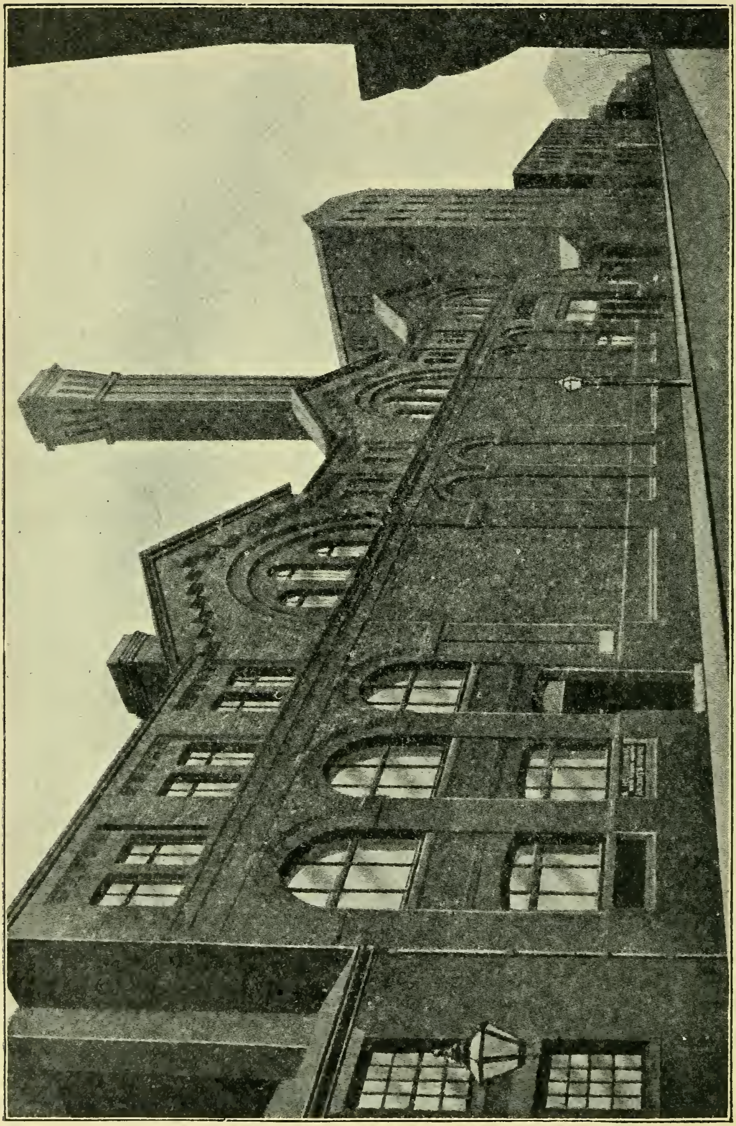

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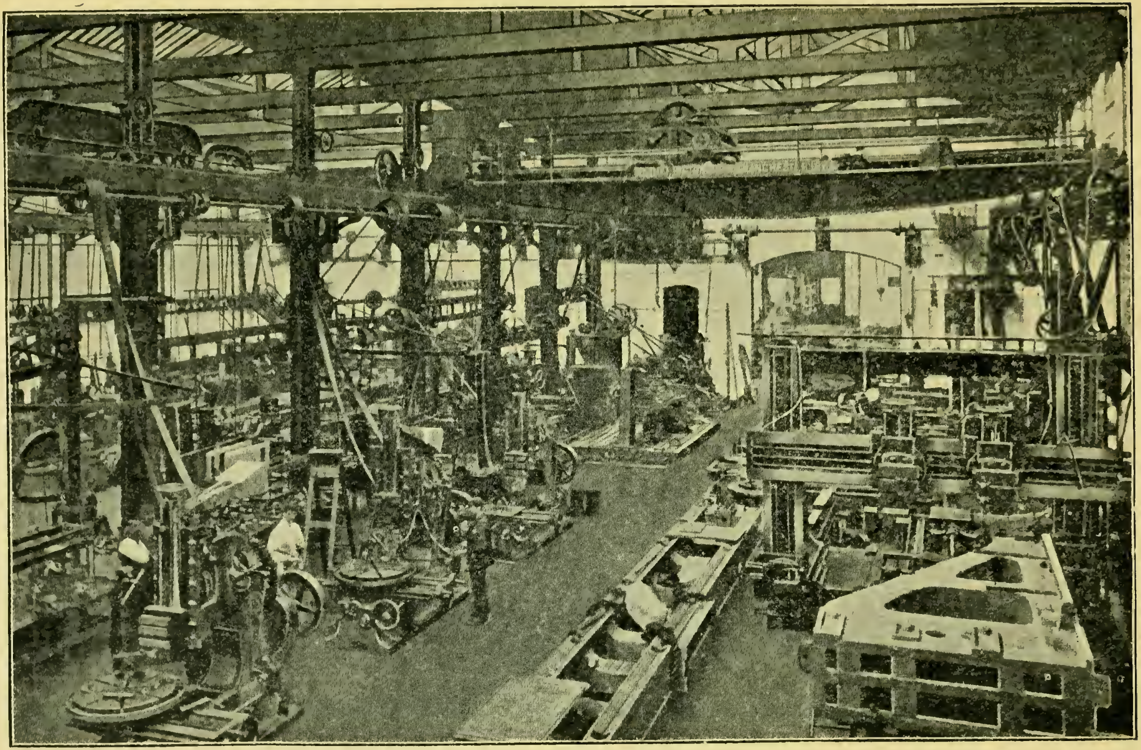

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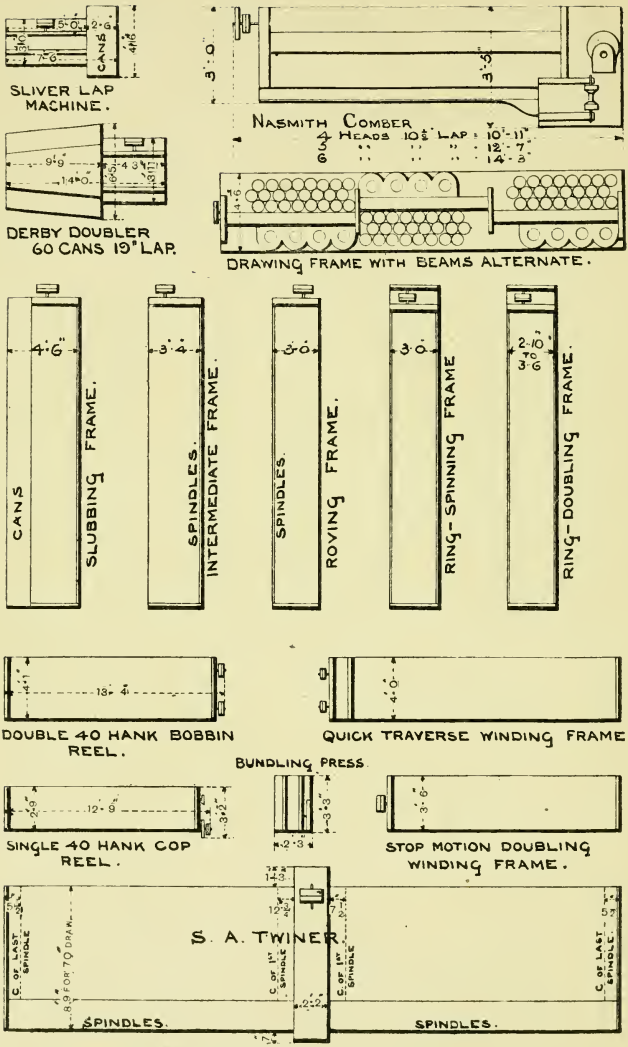

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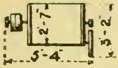

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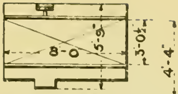
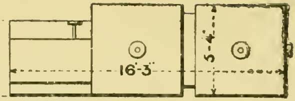
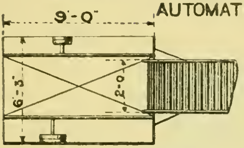


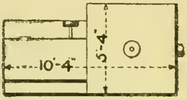
AUTOMATIC FEEDER



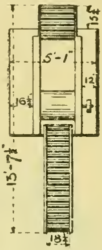
DOUBLE CRIGHTON OPENER



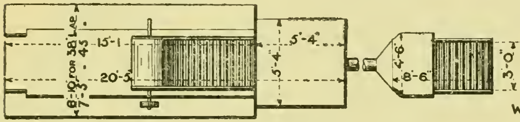
HOPPER BALE OPENER



SINGLE CRIGHTON OPENER



ROVING WASTE OPENER



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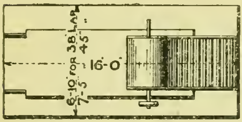
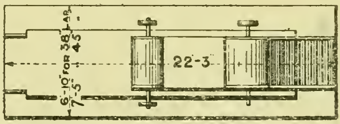


SINGLE LARGE CYLINDER OPENER



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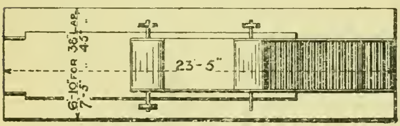

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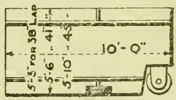

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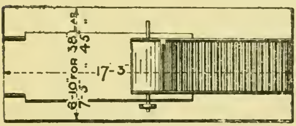
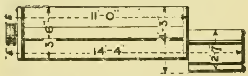
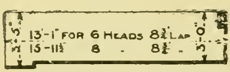


SINGLE BEATER SCUTCHER 4 LAPS UP

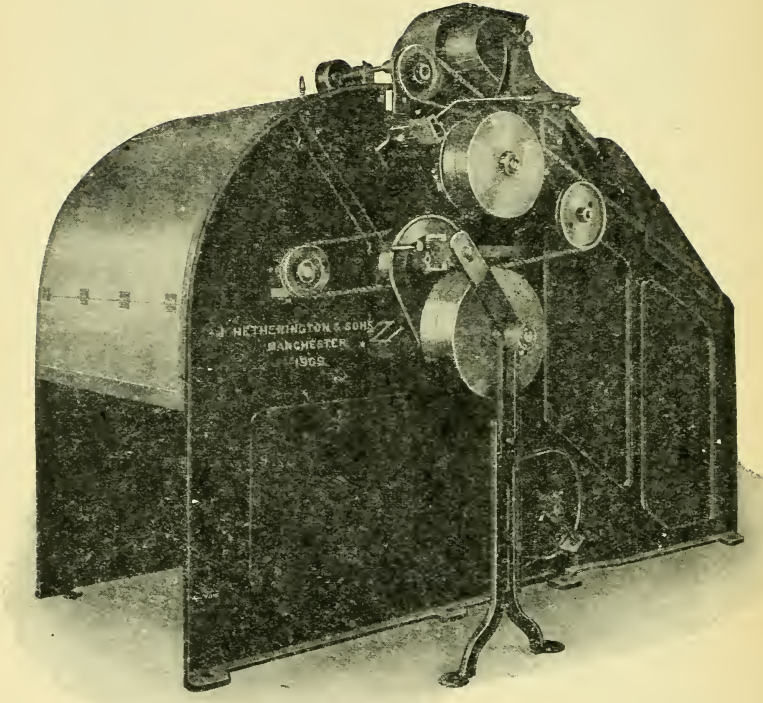


RIBBON LAP MACHINE



HEILMANN COMBER

— DIMENSIONS OF MACHINES —



HOPPER BALE OPENER

Hopper Bale Opener.

Advantages of the bale opener.—The advantage of this machine in the mill cannot well be over-estimated, particularly in large mills. The cotton is opened up better and more evenly than by hand, and with much less labour on the part of the operatives, while a considerable saving in wages is effected. In addition to this, the wear and tear of the machines following is considerably reduced, as the cotton has already lost some of the heavy dirt, and is presented to them in a much more open state than it is possible to get from hand mixing.

Description of machine.—Our new machine, represented in the accompanying illustrations, is arranged to take the cotton direct from the bale, fed either by hand in large quantities, or by a slow-moving lattice. The working parts are so arranged that the cotton is treated to a combing, in place of a tearing or pulling action, as in the case of the majority of the old roller bale breakers. The receiver floor of this machine when not supplied with a slow-moving feed lattice is composed of inclined grids or bars, through which the loose dirt falls, and arrangements are made at the end of the machine so that the waste can easily be removed without stopping the machine. These grids are placed at such an angle that the cotton slides down to the foot of the spiked lattice.

Improved spiked lattice.—In the construction of this machine we have devoted particular attention to the formation of the spiked lattice, which will be seen by referring to the sketch, Fig. 1 giving a section of same. The laths A, carrying the spikes or teeth, are secured to an endless canvas B by fixing them to a strip of wood C on the other side of the canvas sheet B. The whole combination is then fastened to endless leather bands D in such a manner that the canvas sheet B hangs slack between each lath.

Advantages of the new lattice.—The object in making the lattice in the manner described is to prevent the trouble resulting from bits of cotton, grit, dirt, &c., getting between the laths and the canvas, as the sheet, in turning round the drums in the old system, slightly separates from the edges of the laths, and allows this matter to get between the laths and canvas. These bits are compressed when the band straightens itself, and with this constant accumulation of hard pressed matter between the laths and canvas it finally results in a breakage of the lath or splitting of the canvas. With this new arrangement this trouble is impossible. The bending takes place on the leather band D, and the slackness of the canvas B prevents it ever becoming too tight on going round the drums, or the laths becoming separated at the edges any more at this stage than when the lattice is travelling in a straight line; and it will be readily seen that it is impossible for dirt to gather and in time break off the laths. With the canvas never requiring tightening up, there is nothing to cause breaking or splitting of the sheet—a fault in the old arrangement which allows dirt, &c., to get on to the rollers, causing great wear to the same, and preventing a positive drive for the lattice. This lattice as a whole, only requires to be tight enough to get a sufficient grip on the rollers for driving.

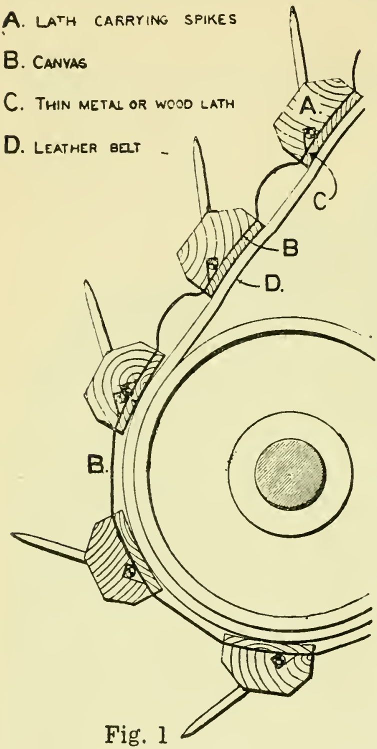


Fig. 1

This method of building up the lattice makes it much stronger, and effectually prevents the spikes from being forced through the laths from the front.

The cotton is taken up the spiked lattice, and operated upon by the "**evener" roller**, revolving in the opposite direction to the lattice, its action being to take off the surplus cotton from the lattice, and throw it back into the hopper. This roller is made adjustable so that it can be easily set at any required distance from the lattice, suitable for the different kinds of cotton being worked. To prevent any cotton being carried round the "evener" roller, it is in turn stripped by a **winged beater** also made adjustable. This treatment has opened the cotton to a considerable degree, and loosened a large amount of dirt, sand, &c. To prevent this from being carried along with the cotton, we introduce an **exhaust fan** over the hopper, with the mouth placed over the centre of the receiver or bin of the machine; this mouth or entrance to the fan we cover with a perforated sheet, through which the dust, &c., is drawn, and carried away by a pipe in the usual manner to the dust chamber or any convenient place. To keep this perforated sheet clear of fluff or any accumulation whatever, we employ a **mechanical stripper or cleaner**, consisting of a light brush, which is slowly passed to and fro over the surface of the perforated sheet at the mouth of the exhaust fan (Fig 2). This device is driven from the lattice shaft, on which we place a worm, working into a worm wheel on a side shaft, with connections and levers as shown, which oscillates the brush on the stud or pivot at its lower extremity, thus keeping the entrance to the exhaust pipe always clear, without any attention from the attendant.

The cotton from the upright lattice, after passing the "evener" roller, is beaten off by means of a **flap roller** on to a set of grid bars. These grids are so arranged that it is impossible for the cotton to miss them before leaving the machine, and they take all the heavy dirt, &c., which has been loosened from the cotton after leaving the front portion of the machine. Underneath the grids we place a box to receive these droppings, which can easily be removed and emptied at any time.

Self adjusting bearings are supplied to spiked lattice and rollers to reduce the wear of the shafts and bearings, and power required for driving the machine.

The arrangement shown in Fig. 2 shows the machine delivering on to a lattice for making mixings, but they can be made to feed direct into Crighton Openers, &c., if required.

The best arrangement when mixings are not required is the combination of the Bale Opener feeding direct to an Automatic Feeder supplied with a filling arrangement, which automatically regulates the supply of cotton from the Bale Opener.

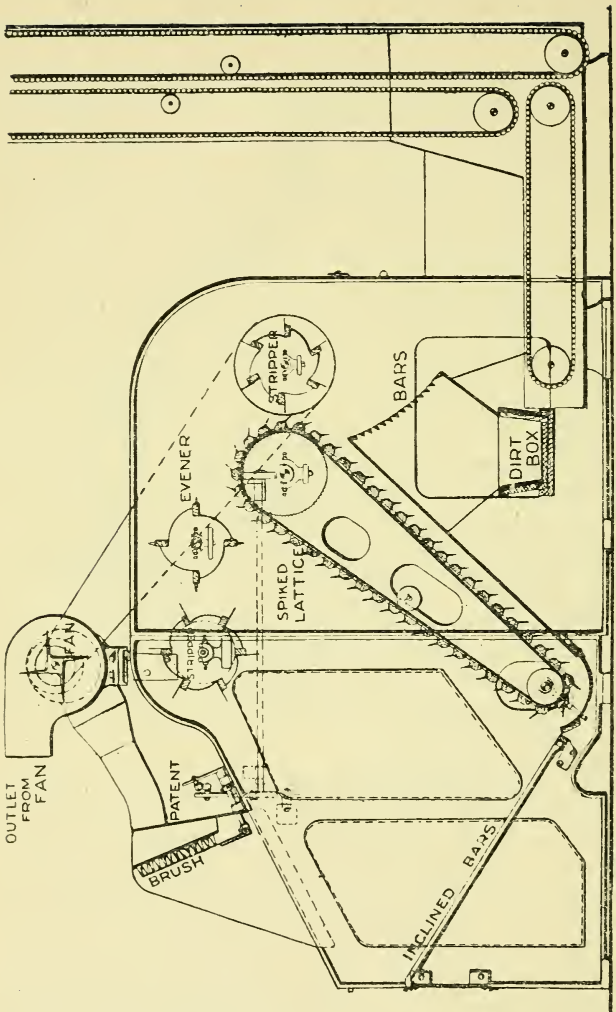


Fig. 2.

SECTION OF "HETH" BALE OPENER.

Position of the machine.—The machine may be placed in the mixing room or in an adjoining room above or below, as may be most suitable, as the lattices can be made in almost any combination. Where a vertical lattice is necessary it is usually connected directly with the machine, and driven from it by a $\frac{5}{8}$in. rope. The distributing lattices are also usually driven from the machine, but in extensive installations they may be driven separately by strap.

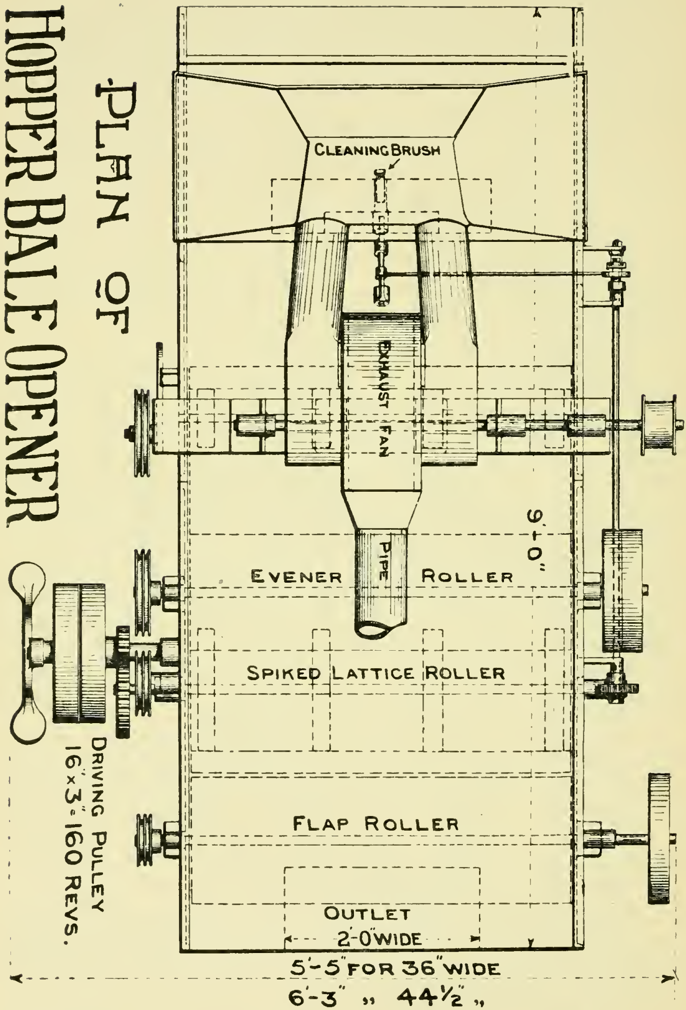
Bale opener combined with Crighton opener.—Where low classes of dirty cotton are used, the Bale Opener can be arranged to drop the cotton on to the feed table of a Creeper Feed or Porcupine Opener feeding a Crighton Opener, the delivery lattice of which is modified, and extended to deliver the cotton on to the distributing lattice. The cotton may be arranged to pass at will either directly to the mixing, or first through the Opener.

Distributing or mixing lattices are supplied to the Hopper Bale Opener, and arranged to make any number of mixings, and carried in any manner most suitable to the shape of the room. They can also be arranged to feed direct into an Automatic Feeder supplied with a device, which stops the Bale Opener when a given quantity of cotton is delivered, and so continually regulating the supply of the cotton to the various machines to follow. When using lattices in connection with the bale opener the cotton is delivered on to a short lattice placed as low as possible, and is in turn taken up by a double elevating lattice usually 2ft. wide, with deep sides, well stayed together. From this double lattice the cotton is delivered on to the distributing or cross lattice making the various mixings.

Lattices are usually driven from the Bale Opener by either rope or belt driving, so that the whole combination is self-contained. Special arrangements of lattices for feeding two or three Automatic Feeders automatically, or for any number of machines, either direct from Bale Opener or Crighton Opener, are made as desired.

Formerly the lattice sides were made of cast-iron, but we now make them in a special manner in sheet-iron, suitably stiffened, the object being to make them as light as possible, and unbreakable.

Means of fixing lattices.—The lattice hangers are made with feet to fit on to small iron beams (of section as below), which must be placed in the proper position in


PLAN OF
HOPPER BALE OPENER
CLEANING BRUSH
EXHAUST FAN
PIPE
EVENER ROLLER
SPIKED LATTICE ROLLER
FLAP ROLLER
OUTLET
2'-0" WIDE
9'-0"
DRIVING PULLEY
16"x3" 160 REVS.
5'-5" FOR 36" WIDE
6'-3" " 44½" "

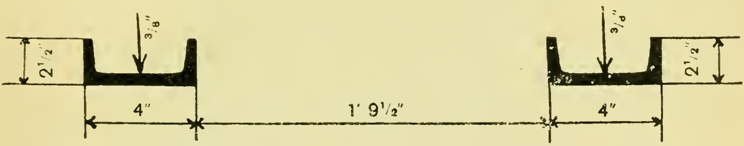
advance. The hangers and lattices are then easily attached by hook-bolts. All the reversing bevels are covered, and the reversing arrangements made as perfect as possible.

Power.—Two H.P. for machine without lattice.

Pulleys and speeds.—Spiked lattice pulley, 16in. to 24in. dia., 160 revs.; Beater pulley, 14in. to 22in. dia., 180 revs.; Distributing lattice pulley, 16in. to 20in. dia., 100 revs. for $\frac{5}{8}$in. dia. rope requiring 25 ft.

Floor space.—9ft. by 5ft. 5in. for 36in. wide machine; 9ft. by 6ft. 3in. for $44\frac{1}{2}$in. wide machine. Width of delivery lattices, 2ft.

Weights of Machines without lattice		Cubic feet
Gross	Net	
$41\frac{1}{2}$ cwts.	34 cwts.	164 for 36in. wide machine
44 ,,	36 ,,	167 for $44\frac{1}{2}$in. ,, ,,



Weight of 12ft. of double vertical lattice and attachments, gross 13 cwts., net $11\frac{1}{4}$ cwts. Weight of 30 feet of distributing lattice, gross $15\frac{3}{4}$ cwts., net $13\frac{1}{2}$ cwts.

Strapping, &c.—Main driving belt, 3in. wide, Beater belt, 2in. wide, length according to position of main shaft. Rope for driving the vertical lattice, 25ft. by $\frac{5}{8}$in. dia. Rope for driving the distributing lattice, 25ft. by $\frac{5}{8}$in. dia., or belt $2\frac{1}{2}$in. wide if driven separately.

Production.—2,500lbs. to 3,000lbs. per hour

Hand of machine.—To determine the hand of the machine face delivery end, and note if the driving pulley must be on the right or left hand side.

BALE OPENER SPECIFICATION.

[If our works are closed by reason of strikes, lock-outs, break-downs, or other unforeseen causes beyond our control, it is hereby understood that a reasonable delay in the time of delivery be allowed to us.]

Details to be given when ordering the Bale Openers.

How many machines?

To be fed by hand   or lattice?

Will you require mixings?   How many?

Do you feed direct into Automatic Feeder with Patent Feeding arrangement   or direct into Opener?

What kind of cotton do you work?

Weight of cotton to be worked per week?

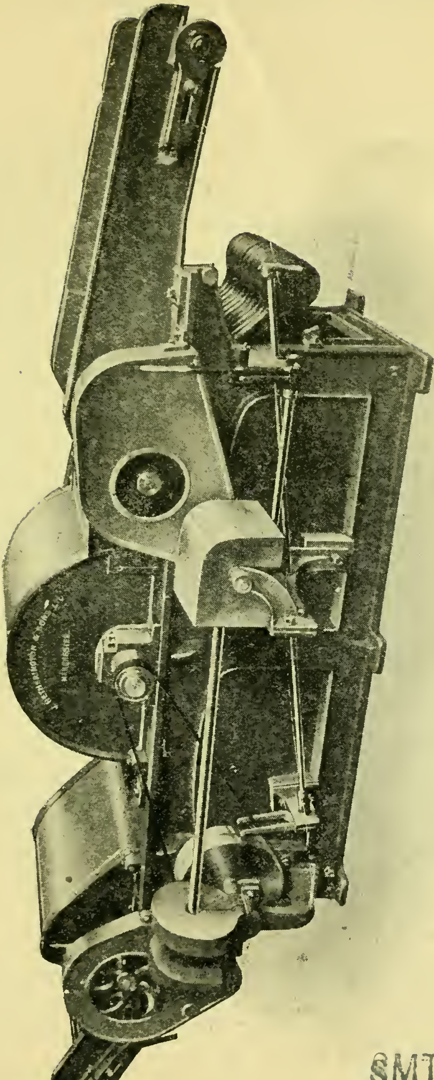
Do you require Fan @   extra Pipes @   per foot?

When facing delivery, pulley to be on the right or left hand?

Speed of Line Shaft?

When must the above be delivered?

Observations and remarks.



ROVING WASTE OPENER.

Roving Waste Opener.

A considerable economy, an important consideration in modern mill management, is effected by the installation of this machine, inasmuch as all roving or soft waste may be passed through it and delivered in such an open, fleecy state as to permit of its being mixed with the raw cotton and so converted into yarn along with the latter. The waste is placed on a lattice and carried to the feed roller, it is then treated to a combing action by a quick-running spiked beater, and it is finally delivered by the assistance of a zinc cage on to a delivery lattice arranged to be worked in connection with the usual mixing or distributing lattices of the mill, or to deposit the fleece into a skip if desired.

The lattice on which the waste is spread is usually 23 inches wide, and may be of any length required. There is also provided **a stopping and reversing motion** to prevent accidents.

The feed roller revolves over self-weighted pedals.

The cylinder or beater of Beechwood, 24ins. dia., is furnished with flat steel pins of fine pitch, which treat the material to a **combing** action. The ends are of sheet-iron made in halves and the shaft is hardened at its bearings.

A zinc cage assists the action of delivery from the cylinder on to a lattice arranged to supply other lattices, or to deliver into skips as required.

A locking device prevents the cylinder cover from being raised whilst the cylinder is running.

Guards are provided wherever necessary.

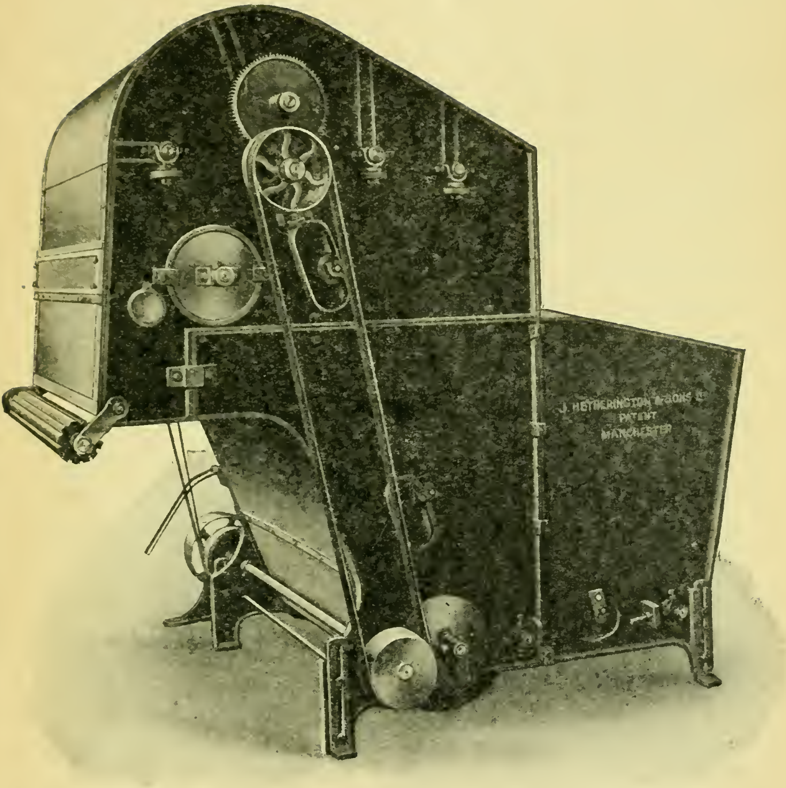
Space occupied.—10ft. × 5ft. 1in. with short lattice, 13ft. 7ins. × 5ft. 1in. with long lattice.

Pulley.—10ins. dia. × 3in. wide.

Speed.—800 to 825 revs. per min. **Power.**—4 I.H.P.

Strapping.—Main belt 3in. wide, length according to position of line shaft, beater to cross shaft 8ft. × 2in. wide.

Production.—30 to 35lbs. per hour according to kind of waste.



IMPROVED AUTOMATIC HOPPER FEEDER.

New Automatic Hopper Feeder.

This machine, first introduced into this country by us, and illustrated in the accompanying views, is designed to replace the hand feeding of openers and scutchers by an automatic process. It spreads the cotton on to the feed tables with much greater regularity than is possible by hand, in addition to opening it considerably, and completely obviates the necessity of weighing, the attendant having only to fill the hoppers from time to time, taking care that the supply does not run low.

It may be applied in several ways. In new installations it is usual to place the feeder before the opener, both feeder and porcupine being placed together in the mixing room. The labour of the attendants is greatly facilitated and a considerable saving in wages effected by the use of these machines, especially in large mills where more than one opener is at work, since one workman can attend to three machines when conveniently placed. The cotton being considerably opened in passing through this machine, is presented to the opener in an open fleecy state, so that the action of the latter is more effective and the cotton better cleaned in its passage than would otherwise be the case.

Summary of advantages.—Of our latest improved pattern machine is unequalled for sensitive regulation, economising labour and subjecting the cotton to a cleaning process, with the result that a cleaner and **more regular yarn** is made, owing to the exceptional regularity of the feed.

Improved framing with *self-adjusting bearings* for lattices and rollers.

Shrouded end-plates for the rollers to prevent dust and dirt from penetrating and so causing friction.

Rope driving is employed all through except as regards the two change wheels for regulating the feed to a nicety, and the fast and loose strap pulleys for the automatic starting and stopping of the machine.

Double rope driving is employed for the levelling roller, its stripper, the beater stripper, and the surplus roller over the reserve box.

Spiked lifting lattice with driving blocks of 10in. diameter, the large size of the blocks preventing slipping of the lattice and consequent irregularities in the feed.

Adjustments for the levelling or evener roller and the stripper, in relation to the vertical lattice.

Reserve box with delivery roller, together with adjustable back plates, scale, and index finger.

Surplus roller over the reserve box, with inspection window to keep the working of the machine under control.

Perforated grids under surplus roller and lifting lattice to allow the loose dirt to fall away.

Regulation.—We advise the use of a **swing door** in the hopper in conjunction with a feed lattice.

This swing door regulates the volume of cotton in the hopper and therefore ensures an even feed to the reserve box. It may control the action of a creeper lattice or a spider for pipe-feeding from above.

The regulator of the succeeding machine acts on the delivery roller of the reserve box, *but not* on any other part of the hopper feeder, thus relieving the strain on the cone strap and permitting extremely sensitive regulation at the final stage.

The repeated regulation of the quantity of material fed, also during its treatment and again on its delivery to the succeeding machine, together with the ample facilities provided for the variation of quantity fed and delivered, must appeal strongly to all who possess any knowledge of the spinning industry, and they will be in a position to appreciate our claim that this machine is the *last word* in Automatic Feeders.

Description.—**Fig. 1** shows in elevation our new machine, constructed from entirely new models with several modifications. It consists of a horizontal bottom feeding lattice **A** on which the cotton rests, and is thereby constantly urged against the spiked vertical lattice **B**. There is also shown a slow running feeding lattice **M** which can be made any length to suit the requirements of the mill. In conjunction with this lattice **M**, we usually employ a swing door **N**, placed about midway in the bin or hopper, and it is so arranged to act on the fast and loose driving pulleys

O, to stop and start the feeding according to the amount of cotton in the bin. The vertical lattice is now driven by 10in. diameter blocks to prevent any slipping, change wheels are supplied for giving a range of speeds. To regulate the thickness of material on the vertical lattice **B** and to prevent any lumps being carried forward, a spiked evener roller **C** revolving in the opposite direction to the lattice is placed near the top of the machine its action being to comb off the surplus cotton from the vertical lattice and throw it back into the hopper. To prevent any cotton being carried round this roller it is in turn stripped by a winged beater **D**. The rollers **C** and **D** can easily be adjusted to the vertical lattice. The vertical lattice is in turn cleared by means of a winged beater **E** the material falling into a reserve box **F**. This box is provided with adjustable boards **G** and **H**, the object being to regulate the space for the cotton; these boards are provided with an index plate. At the lower end of the reserve box is a fluted delivery roller **J** driven from the feed lattice of the machine it supplies, by this means the regulator of the opener or scutcher controls the speed of the delivery without altering the speed of the vertical lattice. Over the reserve box is placed a winged beater **K**, the object of this beater is to regulate the height of the cotton in the box, and to throw the surplus cotton back on to the vertical lattice to be returned to the hopper. At the lower end of the lattice is placed a perforated zinc grid to allow any dirt to fall away.

The machine is supplied with fast and loose pulleys **L** for direct driving, or to be connected up to the drop lever or side shaft of the succeeding machine for automatically stopping and starting of the machine.

All the beaters and stripping rollers are driven by an endless rope from the driving shaft. These beaters and rollers are supplied with swivel bearings and shrouded ends to prevent the cotton from winding round the shaft.

Regulation.—To facilitate the regulation of the supply to the reserve box without speeding up the vertical lattice **B**, the spiked evener roller **C** can be moved within certain limits so as to vary the distance between the spikes of the roller and of the lattice. The greater the distance between them the heavier will be the feed, and vice-versa. This distance depends also to some extent on the kind of cotton being worked.

SECTION OF IMPROVED AUTOMATIC FEEDER,

with balanced door and feeding lattice.

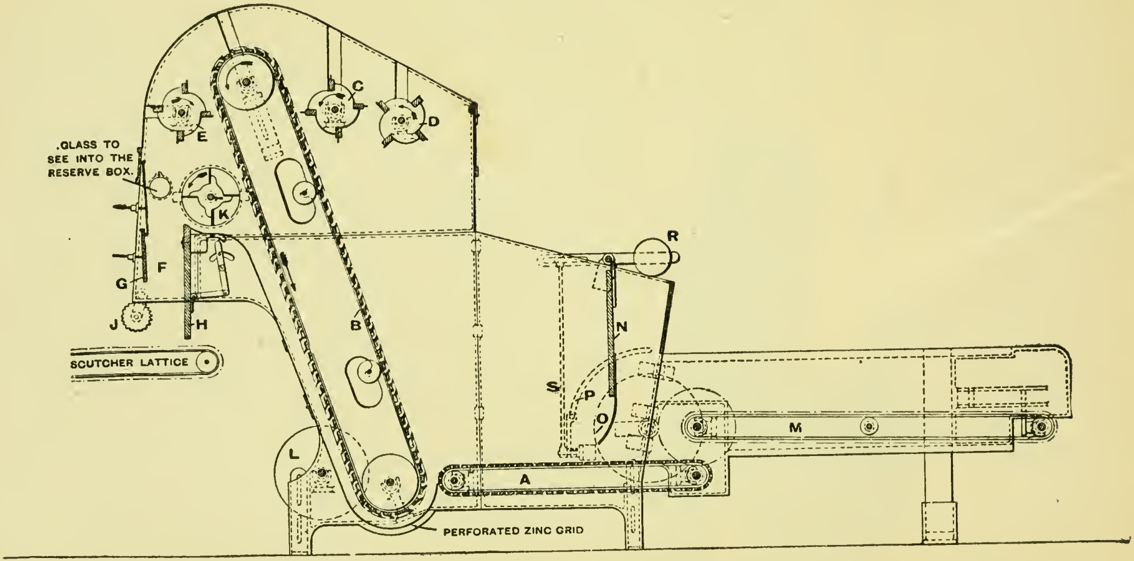


Fig. 1.

Stopping and knocking off arrangements.—The machine is supplied with fast and loose driving pulleys, and may be driven independently from the main shaft or from the machine it feeds. When applied to machines making laps the strap fork is connected up to the drop lever, which stops the machine on completion of the lap. It is also driven sometimes from the side shaft of the opener or scutcher. All the necessary parts and connections are delivered with the machine.

Automatic filling of hoppers.—This device is for regulating and controlling the supply of cotton to the hopper automatically.

At the receiving end of the hopper a swing door **N** (see fig. 1) is placed, hanging midway between the back of the receiver and the vertical lattice **B.** The door is so balanced that the slighest variation of the volume of cotton in the bin acts promptly upon it. The door is connected up to the fast and loose pulley **O** of the feeding lattice **M** if fed in the same room, or to the pulley driving a revolving spider (fig. 2) placed at the foot of a trunk if fed from the room above. Directly a given quantity has been delivered the door is moved, and by the connections **R** and **S** to the strap fork **P** the belt is shifted on to the loose pulley and the feed stopped. When the volume of cotton becomes light the door moves in the opposite direction after passing a given point, the connections to the strap fork again begins to operate and brings the belt on to the fast pulley and the feed is resumed. When connected up to a bale opener this motion can be so arranged to stop and start the delivery directly the required amount has been received in the bin of the hopper.

Application to vertical openers.—In cases where more than one opener is at work, delivering the cotton in an open state and not as a lap, a saving of wages may also be effected by the application of feeders. In such cases the machines are made in different widths to suit feed tables from 24in. upwards, or to feed directly into the opener trumpet.

Application to openers making laps.—Under these conditions we strongly recommend a machine having a swing door, as previously described. This could be worked in connection with a slow running lattice bringing the cotton from the mixings and delivering it into the hopper, or from a bale opener if fed direct.

In cases where the mixing room is above the scutching room it is necessary to introduce a pipe or trunk between the lattice and the hopper, at the bottom of which is a box containing a revolving spider. In order to regulate the supply of cotton from the trunk to the hopper, the swing door in the bin is connected to the strap fork which controls the driving of the spider. If desired, the lattice feeding the trunk could be dispensed with, and the cotton put into the trunk by hand. By a modification of this trunk and spider arrangement two or more openers could be supplied from one feeding lattice. (See Fig. 2).

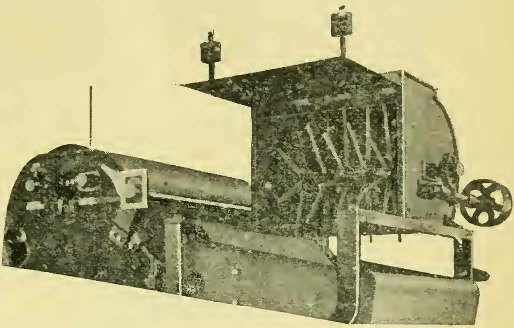


Fig. 2.

Application to scutchers.—In existing installations where the openers deliver the cotton in an open state, and the scutchers are fed by hand, the machine is placed before the scutcher feed table. Should the opener be supplying two scutchers, a reversible lattice is arranged to receive the cotton from the opener and carry it to the hoppers, each end of the lattice being over a hopper, so that the cotton can be dropped into either hopper, the operative being able to reverse the lattice at will by a handle conveniently placed, and keep both hoppers well filled.

Dimensions.—The floor space occupied by the machine varies according to the width of the machine being fed. The length in all cases being 7ft. 9in. The gearing occupies 1ft. 9in. on the driving side and 11in. on the off side, total 2ft. 8in., and to this dimension must be added the width of the hopper, which is usually that of the table on which the machine has to feed.

Pulleys.—These are usually 16in. $\times$ $2\frac{1}{2}$in., but can go up to 24in. dia. **Speed.**—120 revs. per min.

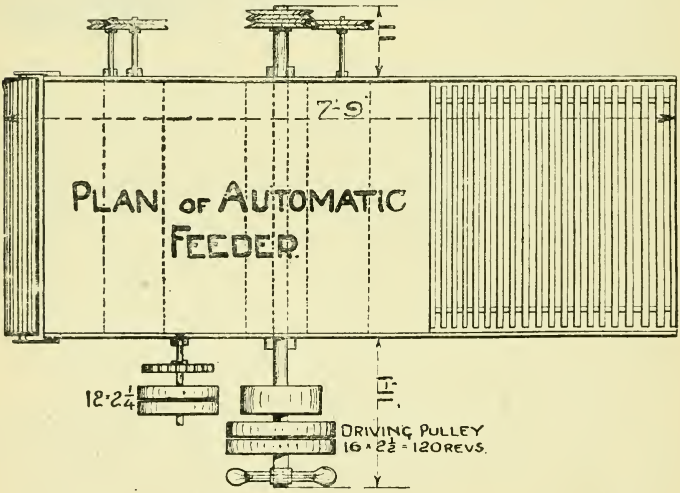
Strapping and ropes.—Main driving strap $2\frac{1}{2}$in. wide, length according to the method of drive. From driving shaft to spiked lattice 15ft. 6in. $\times$ $2\frac{1}{4}$in. Rope for driving the various strippers, beaters, &c., 35ft. $\times$ $\frac{1}{2}$in. dia.

Power.—I.H.P. for machine only, and I.H.P. for every 100ft. of feeding lattice 36in. wide.

Weights of Machines	Gross	Net	
$36\frac{1}{2}$in. wide	$34\frac{1}{4}$ cwts.	$27\frac{1}{3}$ cwts.	Feeding Lattices, 3ft. wide extra.
39in. ,,	$36\frac{1}{8}$,,	$29\frac{1}{2}$,,	
45in. ,,	$38\frac{1}{3}$,,	$31\frac{1}{2}$,,	

Production.—From 30,000 to 60,000 lbs. per week according to the width of feeding lattice.

Hand of Machine.—To determine the hand of the machine face the delivery end, and note if the driving pulley must be on the right or left hand side.



AUTOMATIC FEEDER SPECIFICATION.

Details to be given when ordering feeders.

How many Machines ?

To feed Scutcher. Opener, or Creeper Feed whose make ?

Width of lattice to feed on to ?

Weight of Lap per yard required ?

Time required to make one Lap ?

Speed of main or Countershaft per minute ?

Diameter of Main or Countershaft ?

To knock off from Side Shaft or Drop Lever ?

Is Drop Lever on right hand or left hand side when facing Lapping-up end ?

What class of Cotton ? Does it pass through a Bale Opener ?

Will you have our Automatic filling motion.

Do you require a Feeding Lattice ?

What length of Lattice Width of Lattice ?

Do you require a Feeding Trunk Supplied with a Revolving Spider ?

Diameter of Driving Pulleys (usually 16in. $\times$ 2½in.)

[If our works are closed by reason of strikes, lock-outs, break-downs, or other unforeseen causes beyond our control, it is hereby understood that a reasonable delay in the time of delivery be allowed to us.]

Observations and remarks :

Porcupine Opener or Creeper Feed Table.

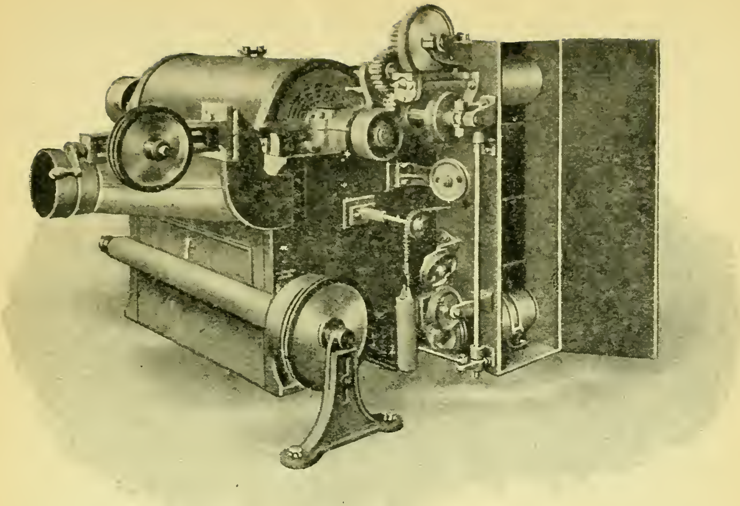
The porcupine opener prepares the cotton for the Crighton Opener to which it is connected by a mouthpiece either direct or through piping. The machine is usually placed in the mixing room in combination with a hopper feeder, but it may be attached directly to the Crighton Opener, and the porcupine driven directly from the vertical beater. If placed in the mixing room it may be driven either directly from the vertical beater by rope, or from a separate countershaft. When used in connection with the combined opener and scutcher the feed is stopped automatically when the lap is completed, or a little before.

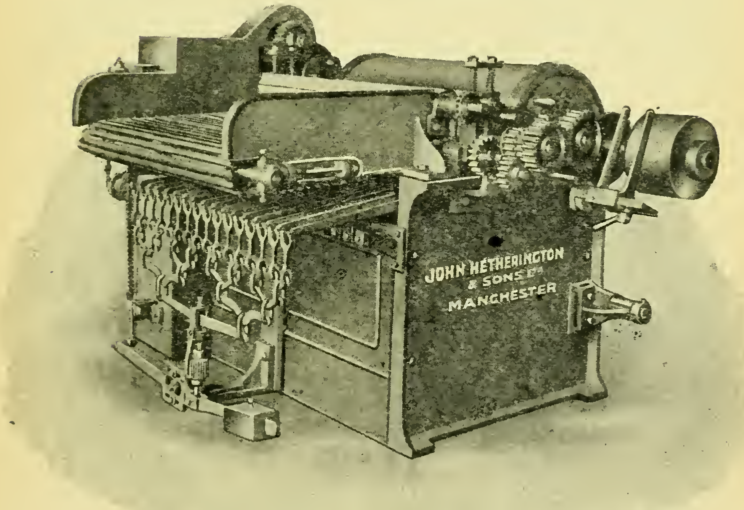
The machine consists of a feed lattice usually 36in. wide, the length depends largely on circumstances. **Two pairs of feed rollers**, one pair $2\frac{1}{2}$in. diameter to collect the cotton from the lattice, and one pair 2in. diameter for the beater to strike from. A porcupine beater, grid bars, with special setting arrangement, and cone feed is also applied if desired.

The porcupine beater or cylinder is $17\frac{1}{2}$in. diameter, and built up of a number of discs, each carrying six steel teeth riveted on. The discs are threaded on the shaft in such a way that the teeth fall in helical lines round the cylinder formed by the discs, thus increasing the steadiness in running and entirely doing away with the noise and diminishing the power required to drive it. The complete porcupine is then balanced when running at the required speed, and revolves in long, carefully-made bearings, of the Mohler self-lubricating type.

The beater bars are carried on circular ribs fixed to the inside of the framing, and having the same centre as the beater. By this arrangement the distance between each, can be regulated at will with the greatest facility to suit any particular class of cotton that may have to be worked.

The greater impurities are thrown out through the grid below the porcupine, and the cleaned and opened cotton is ejected into the outlet pipe.





PORCUPINE OPENER WITH IMPROVED LINK PEDAL MOTION AND REGULATOR ATTACHED.

Cone feed combined with our improved **link pedal motion** can be supplied to this machine if required.

Safety motions applied to the beater cover to prevent same being opened when the machine is in motion.

The lattice feed table may be made any required length. When over 3ft. 6in. long, charged extra.

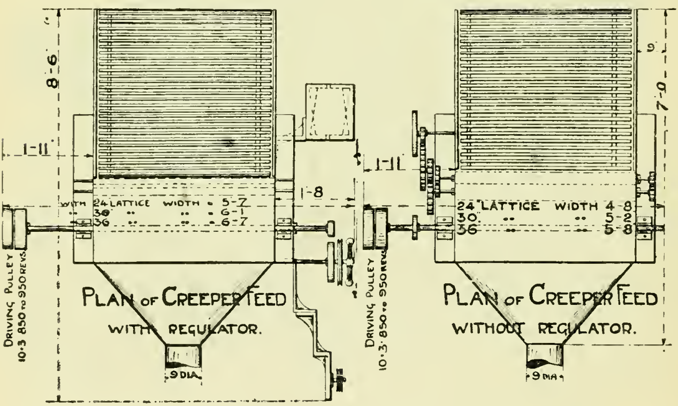
Dimensions.—The machine is made in three sizes, namely, with lattice 24in., 30in. and 36in. wide and 3ft. long, unless otherwise ordered.

24in. lattice	3ft. long	= 7ft. long	× 4ft. 8in. wide.	Without Regulator.
30in. ,,	,,	= 7ft. ,,	× 5ft. 2in. ,,	
36in. ,,	,,	= 7ft. ,,	× 5ft. 8in. ,,	

For machines with regulators, 11ins. must be added to the width, and 18ins. to the lengths given above.

Pulley, speed and power.—If driven from line or countershaft, the pulley on beater is 10in. dia. × 3in. wide, at 850 to 950 revs. The power is 1·5 I.H.P.

Strapping, &c.—If the machine is driven by a rope from the opener, a 20in. pulley for $\frac{3}{4}$in. rope is used and is 15ft. long. Driving belt 3in. wide, length according to position of main shaft. Beater to cross shaft, 8ft. × 2in. wide, Cone belt, 8ft. × $1\frac{1}{4}$in. wide.



Vertical or Crighton Openers.

Our Crighton or vertical opener has long been established as an exceedingly valuable machine for the effective cleaning of most classes of cotton without damage to the staple or undue loss of serviceable fibre.

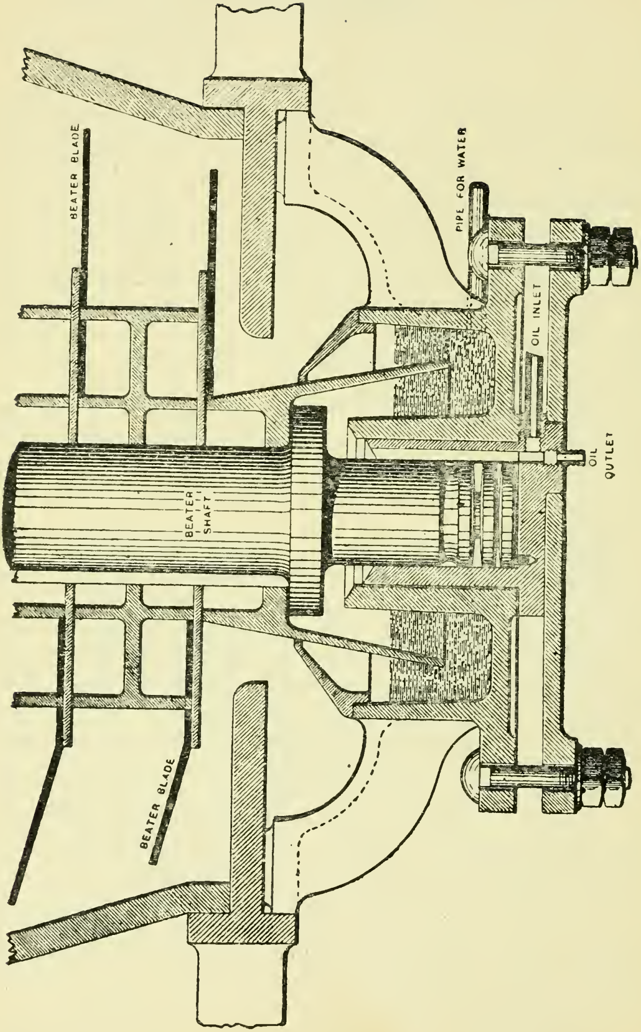
The single opener is generally combined with a hopper feeder placed before it and the cotton is delivered from the opener in an open fleecy state, by a lattice into suitable receptacles, or to another hopper feeder coupled up with a breaker scutcher. In some cases it is combined with the bale opener for treating lower grades of cotton *before it reaches the mixings.*

The double opener is made with two vertical beaters as shown in the illustration. A trap door inside the machine is controlled by an external lever to permit of the cotton being passed through one or both vertical beaters as required. (See page 31).

The vertical beater is built up on a strong shaft, and the upper bearing is 1ft. 7½in. long, so as to ensure great steadiness in running. The beater is composed of seven discs of varying diameter, each carrying steel arms, riveted on, and the whole, as seen in the section of the double machine, presenting the aspect of an inverted cone. They are carefully balanced when running at their normal speed.

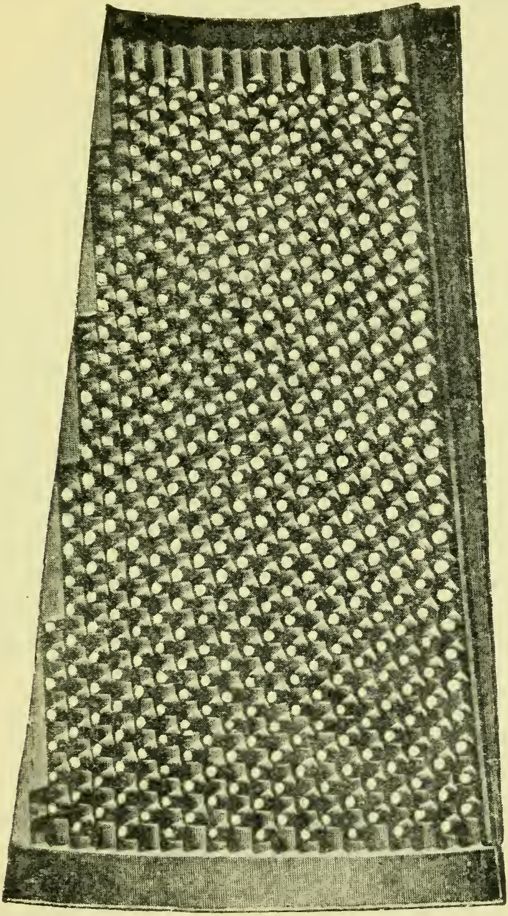
The footsteps.—These are made with special care. The lower end of the shaft contains a hardened steel peg, running on a hardened steel washer, at the bottom of the footstep. The footstep itself is surrounded with a reservoir filled with water, in which runs the lower edge of an inverted dish, carried on the shaft, thus absolutely protecting the footstep against the entrance of dirt or grit, and keeping it cool. The water and oil are supplied to the footstep through pipes having their orifices outside the machine, so that the height of both the oil and the water may been seen and maintained at the correct level.

The grids do not lend themselves to a written description, but the construction may be clearly seen from the



FOOTSTEP FOR VERTICAL BEATER

illustration given. They have been remarkably successful, and throw out the maximum amount of dirt with the least possible loss of serviceable fibre or damage to the cotton. The distance of the grids from the vertical may be regulated within certain limits by set screws. The openings at the bottom of the grid are larger than those at the top, to allow of the seed and heavier dirt getting away more easily; and as the cotton rises the holes are reduced in size, to avoid



OPENER GRID.

undue loss of good fibre. The holes are countersunk from the outside of the grid, so that the dirt, having once passed the hole, falls easily away and cannot be drawn in again. **We can apply these grids** to existing machines on receipt of accurate dimensions.

Delivery.—The cotton passes from the beater to the **perforated cage,** and is taken from this by a stripping roller, no troublesome damper being used, and is delivered open and fleecy, either into baskets or on to a travelling lattice, for distribution to the mixings or to hoppers placed before the succeeding scutchers.

Driving.—The machine is usually built with the countershaft on the machine to drive the vertical beaters and the fans, but these may both be driven from a separate countershaft. In this case the underside of the pulley on the counter driving the beaters should be half an inch higher than the pulley on the beater for every foot of distance.

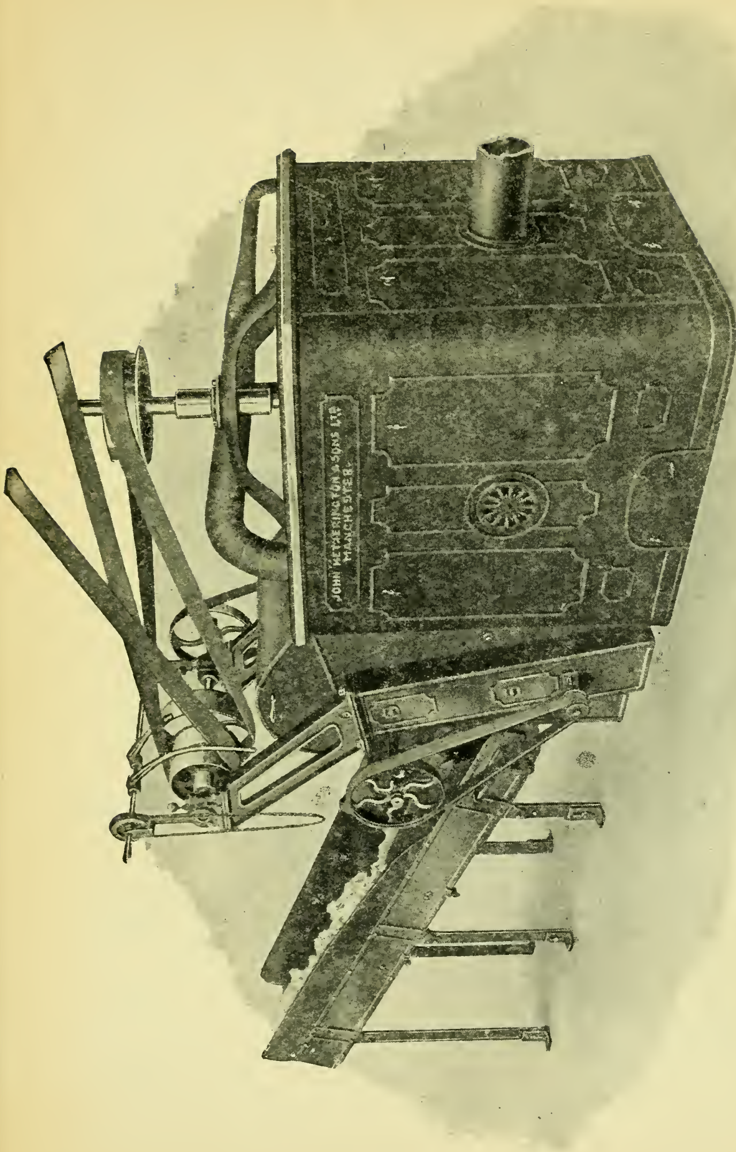
We also make, if desired, a special arrangement of **rope driving** for the beaters with tightening arrangement, the object being to do away with the side pull by passing the rope twice round the beater pulley, so that it pulls in both directions, and the rope is $\frac{3}{4}$in. dia. (See page 31).

Gearing.—All wheels are efficiently guarded, so as to comply with the requirements of the Factory Inspectors. All pulleys are accurately balanced.

Dust trunks are sometimes placed between the Porcupine Opener Feed Table and the Crighton when dirty cotton is being worked. These trunks are built up of a number of grids, which allows the dirt, &c., to fall away as the cotton passes in its loosened state over them on its way to the Crighton Opener. Special attention has been paid to the formation of the grids to get the best results, and means are taken for the easy cleaning of same, and to allow of great space for the collection of dirt.

The trunks are connected to the two machines by galvanised pipes.

Speed and Pulleys.—When the countershaft is delivered with the machine it carries a fast and loose pulley, 16in. × 5in., which should run at 670 revolutions. The other pulleys are then supplied by us to drive the fans at 950 for the single machine and 1,200 for the double machine, and the beaters at 1,000. If the counter be not delivered with the machine, the pulleys are:—Vertical beater pulley,



SINGLE CRIGHTON OPENER WITH SELF-CONTAINED COUNTERSHAFT.

12in. × 5in., or 15in. dia. for ¾in. rope; Fan shaft pulley, 10in. × 3in.; and they should run at the above respective speeds, and if driven by strap care should be taken that the countershaft is placed in such a position to come in line with the pulley on vertical beater shaft, which is 7ft. 3½in. from the floor to the centre of the pulley.

Strapping and ropes.—With countershaft on the machine:—From line shaft to counter 4½in. wide, length according to distance of line shaft. From counter to the vertical, 16ft. 6in. × 4in. wide. From counter to the fan, 22ft. × 2½in. wide.

If the counter be not on the machine the length of these straps will be according to the distance of the countershaft, but in all cases the following are required:—Fan shaft to the cage driving pulley, 5ft. 6in. × 2in. From beater to beater in the double machine, 16ft. × 4in.

Rope for driving the porcupine, is ¾in. dia., and 15ft. long, if the porcupine is attached to the opener direct; otherwise, length according to distance which also applies for the balanced rope drive.

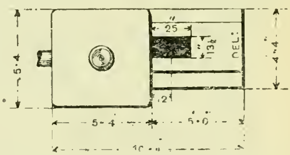
Power required.—Single Crighton Opener, 4 I.H.P. Double Crighton Opener, 8 I.H.P.

Production.—35,000lbs. to 45,000lbs. in 56 hours.

The floor space.

Single opener, 10ft. 4in. × 5ft. 4in.
Double ,, 16ft. 2in. × 5ft. 4in.

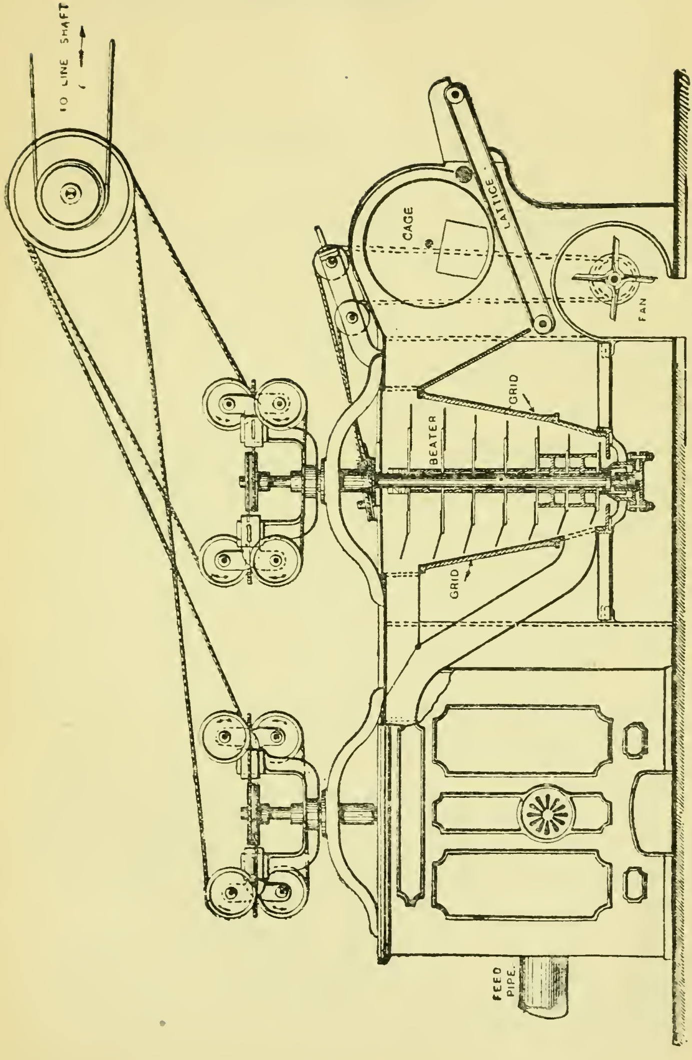
We also make a small-size Opener, the floor space of which is 9ft. 10in. × 4ft., 10in. for a single machine.



SINGLE VERTICAL OPENER.

WEIGHTS OF OPENERS.

Description of Machine	Gross Weight			Nett Weight			Cubic Feet
	Tons	Cwts.	Qrs.	Tons	Cwts.	Qrs.	
Single Crighton Opener, with countershaft	3	16	0	3	2	0	300
Double Crighton Opener, with countershaft	5	10	0	4	10	0	440



DOUBLE VERTICAL OPENER WITH IMPROVED ROPE DRIVING.

CRIGHTON OPENER SPECIFICATION.

Details to be given when ordering Openers.

How many machines?

How fed, by hand? Creeper Feeder or Automatic Feeder.

If extra length of Lattice required? (usually 4 feet).

Patent Grids or Dust Boxes? How many?

Galvanized Iron Trunks or Exhaust Pipes? What length?

When facing the Delivery is the Feed to be opposite, as usual, or on the right or left hand?

Speed of Vertical Beater? revolutions per minute (usually 1,000 revolutions per minute).

Diameter of Vertical Beater Pulley? (usually 12in.)

Will you have a Countershaft on top of Machine?

Is the Opener to be a Single or Double Machine?

Speed of Main Shaft?

Diameter of Drum on same?

All Hangers, Beams, Pulleys, &c., for driving Creeper Feed in room adjoining, extra over price of Machine.

When must the above be delivered?

[If our works are closed by reason of strikes, lock-outs, breakdowns, or other unforeseen causes beyond our control, it is hereby understood that a reasonable delay in the time of delivery be allowed to us.]

Shipping instructions;

Terms of payment:

Observations and remarks:

Combined Opener and Scutcher.

We make the above machines either with a **single or double Crighton opener**, combined with a **single or double scutcher** with lapping-up end.

The cotton is drawn through the opener by a powerful fan, and after passing between the cages is delivered to feed rollers, which present it to the beater, and it is afterwards made into a lap.

The beater is usually made with two blades, but three can be put in if specially asked for. It is reversible, and runs in long Mohler bearings with special continuous oiling arrangement.

The beater bars are carried on circular ribs fixed to the inside of the framing, and having the same centre as the beater. By this arrangement the distance between each, can be regulated at will with the greatest facility to suit any particular class of cotton that may have to be worked.

The cages are of good size and carefully placed, so as to permit as much dirt as possible to fall out of the cotton in its passage from the beater to the cage.

The press rollers are four in number, so as to consolidate the laps as much as possible, and prevent them licking when unrolling on the following machine.

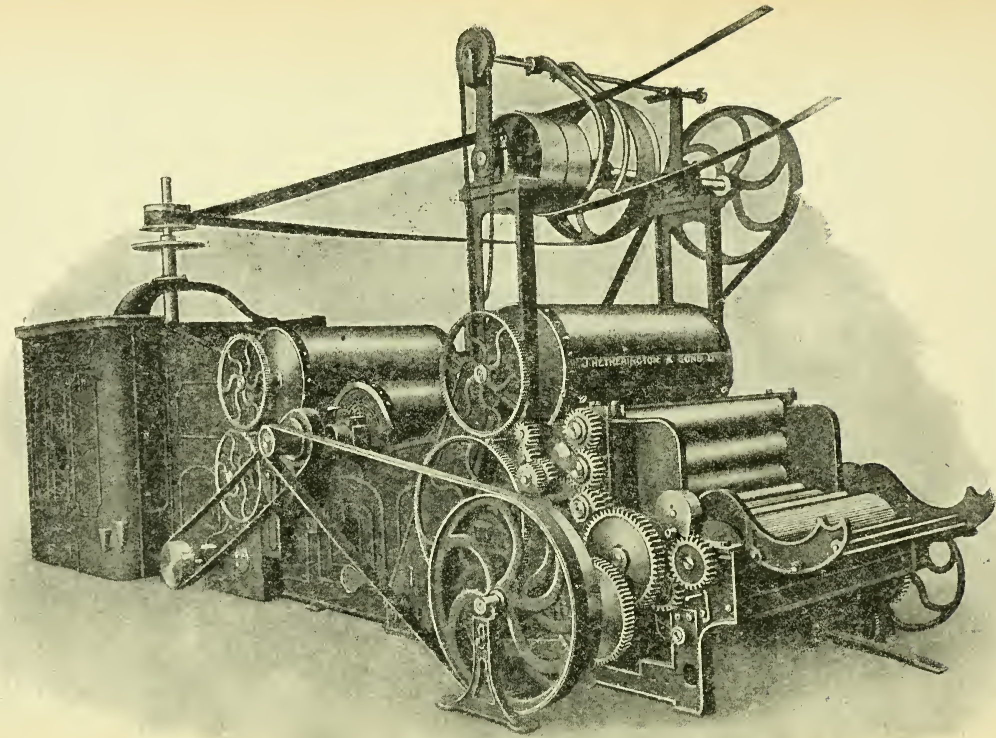
A cradle, conveniently placed, is provided for the reception of the finished laps, and **hollow lap rollers** are supplied with the machines.

The stop motion to regulate the length of the lap is extremely simple, the length can easily be altered by changing a single wheel.

The fans are of careful construction and efficient power, and the shafts run in Mohler bearings with continuous oiling arrangements.

Safety appliances are provided if specially asked for, to prevent the covers being raised whilst the beater is running.

A countershaft is built on the machine if asked for, having fast and loose pulleys of 16in. dia., which should run at 500 revolutions per minute.



COMBINED SINGLE OPENER AND SCUTCHER.

We invariably recommend this machine with countershaft on the machine, as shown in our illustration, but if not, care should be taken that the underside of the driving pulley on the countershaft is half an inch higher than the pulley on the upright beater for every foot of distance.

Gearing.—The driving and gearing are shown in the accompanying diagrams. All wheels are efficiently guarded and all the pulleys are accurately balanced.

Strapping and ropes.—Line shaft to counter, 5in. wide, length according to distance of the line shaft.
Countershaft to vertical beater, length 32ft. 6in. × 4in. wide.
Countershaft to horizontal beater, length 16ft. 6in. × 4in. wide.
Horizontal beater to opener fan, length 12ft. 9in. × 3in. wide.
Horizontal beater to scutcher fan, length 8ft. 9in. × $2\frac{1}{4}$in. wide.
Beater to lapping-up pulley, 16ft. × $2\frac{1}{4}$in. wide.

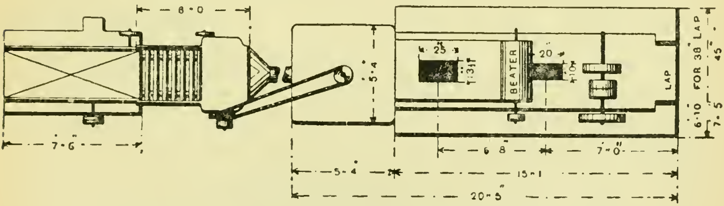
Rope from the vertical beater shaft to the porcupine pulley, length 20ft. 6in. for $\frac{3}{4}$in. rope.

(If the porcupine is not attached to the opener directly, length of rope according to distance, and $\frac{3}{4}$in. rope required to drive the feed rollers of the porcupine from the side shaft of the scutcher).

Power required for the single combination without the porcupine, 9 I.H.P.

Production.—25,000lbs. to 32,000lbs. in 60 hours.

Floor space.—Combined Single Crighton Opener and single scutcher, length 20ft 5in. × 6ft. 10in. for 38in. lap, and 7ft. 5in. for 45in. lap. If with double Crighton Opener the length will be 6ft. 2in. extra.



COMBINED SINGLE OPENER AND SCUTCHER
WITH AUTOMATIC AND CREEPER FEED.

Speeds.—Vertical beater, 1,000 revolutions. Two-bladed horizontal or scutcher beater, 1,500 revolutions for 38in. and 41in. laps. Three-bladed beater, 1,000 revolutions for 45in. lap.

Pulleys.—Scutcher beater pulley, 10in. dia. × 4in. wide. Vertical beater pulley, 12in. dia. × 6in. wide or if rope driven, usually 15in. dia. for $\frac{3}{4}$in. dia. rope.

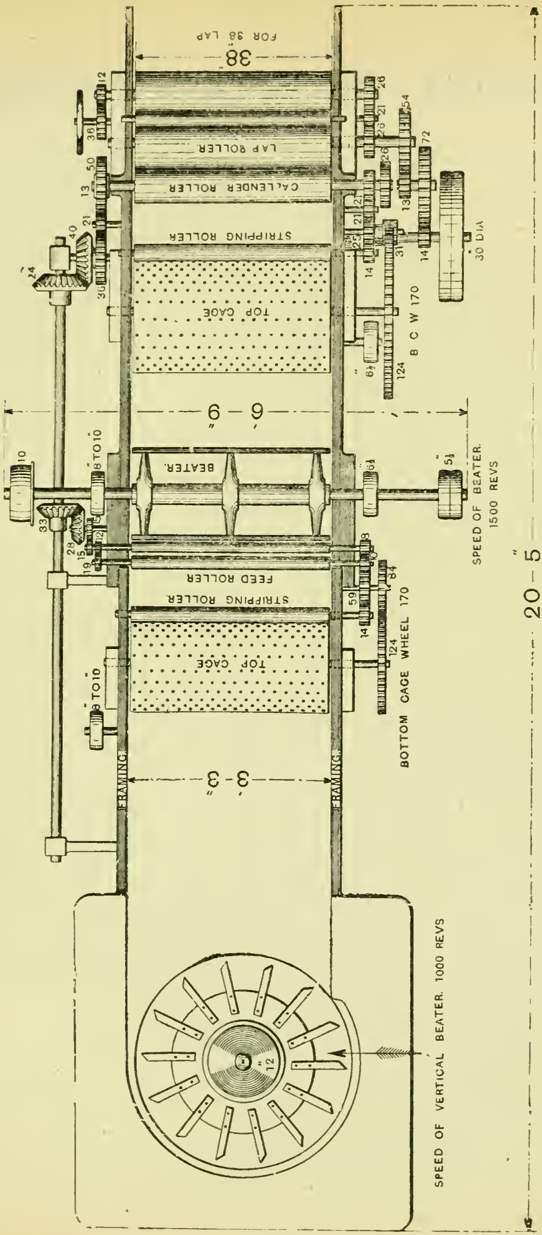
Weights.—A combined single opener and single scutcher for 38in. lap, and with self-contained countershaft, weighs 8 tons 6 cwt. gross, and 6 tons 16 cwt. net.

COMBINED CRIGHTON OPENER AND SCUTCHING MACHINE SPECIFICATION.

Details to be given when ordering Combined Opener and Scutcher.
How many Machines?
What width of lap are they to make? inches.
How fed—by hand? or with Creeper Feed Table 36in. wide, and Porcupine Beater? at per Feeder.
If extra length required? at per foot.
Is Creeper Feed Table attached to Machine or in an adjoining room?
Patent Grids or Dust Boxes? at per box. How many?
Galvanized Iron Trunks or Exhaust Pipes? at per foot, What length?
When facing the Delivery is the Feed to be opposite, as usual, or on the right or left hand?
Speed of Vertical Beater? revolutions per minute (usually 1,000 revolutions per minute).
Diameter of Vertical Beater Pulleys 12 inches.
Will you have a Countershaft on Top of Machine? at per Machine.
Is the Opener to be with a Single or Double Vertical Beater?
How many Scutcher Beaters in each Machine?
Speed of Scutcher Beaters in each Machine? revolutions per minute (usually with two blades about 1,500 revolutions per minute).
Diameter of Scutcher Beater Pulleys? inches (usually 10in. diameter).
When you face the Delivery end of the Machine, must the Scutcher Beater Pulleys be on the right or left hand side of it?
Will you have an up or down draft?
Speed of Main Shaft?
Diameter of Drum on same?
All Hangers, Beams, Pulleys, &c., for driving Creeper Feed in room adjoining, extra over price of Machine.
When must the above be delivered?

[If our works are closed by reason of strikes, lock-outs, break-downs, or other unforeseen causes beyond our control, it is hereby understood that a reasonable delay in the time of delivery be allowed to us.]

Shipping instructions:
Terms of payment:
Observations and remarks:



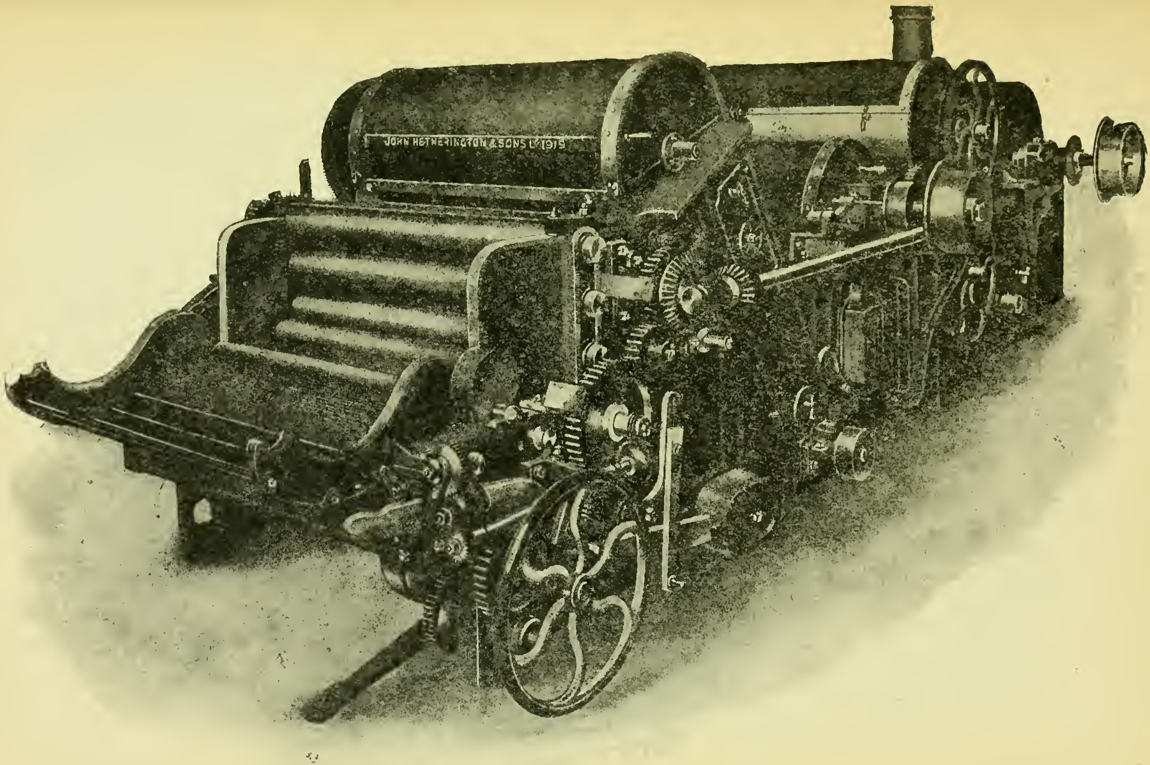
PLAN OF COMBINED SINGLE OPENER AND SCUTCHER.

Exhaust Openers Combined with Scutcher.

These machines are employed when a cleaned grade of cotton is being worked; yet they are sometimes used in conjunction with Single Crighton Openers when dirty Indian cotton is being treated. They are fed through pipes connected up to a Creeper Feed Table, supplied with a Cone feed pedal motion to ensure a regular supply of cotton. In treating the dirty cottons the feed pipes are coupled up to one or two Crighton Openers, and the pipes are then supplied with dampers or valves so that the cotton may pass through or miss these latter machines as required in its passage to the Exhaust Opener. Between the Creeper Feed and the Exhaust Opener dust trunks are supplied if desired.

The exhaust consists of two fans, 30in diameter, and a 24in. diameter cylinder placed on one shaft. The fans placed on each side of the cylinder draw the cotton through the pipes and present it to the cylinder, which is composed of discs carrying strikers of hardened steel. Grid bars are provided under the cylinder through which the impurities fall into a box below provided for their reception, which can be easily removed and emptied at any time. From the cylinder the cotton is drawn by an underneath fan to a pair of dust cages supplied with the usual pair of stripping rollers, and is in turn presented to the two or three-bladed beater through two pairs of feed rollers. **The beater** is 18in. diameter and reversible, and runs in long Mohler self-oiling bearings. **The beater bars** are so arranged that they can be regulated at will to suit any class of cotton. **Dust cages** with stripping rollers instead of the troublesome dampers. **Fans extra large** in order to prevent choking of the cotton between the cylinder or beater and the cages, the fan shaft runs in self-lubricating Mohler bearings.

Four heavy press rollers with clearers to prevent licking, and the **lapping-up apparatus** has the lap roller bored out to take headed lap rods.



ELEVATION OF EXHAUST OPENER AND SCUTCHER.

The measuring and stop motion to regulate the length of the lap is extremely simple, yet effective, and any length of lap can be altered by changing one wheel.

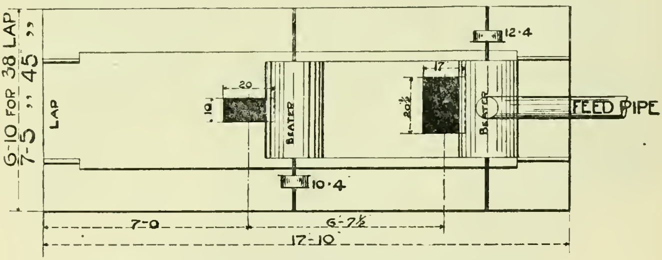
Safety locking motion for automatically locking beater cover and glass door over cages when the machine is running, and all gearing is efficiently guarded.

Pulleys and speeds.—Exhaust cylinder pulley 12in. to 15in. dia. × 4in. wide, at 950 to 980 revs. Scutcher beater pulleys 8in. to 11in. dia (usually 10in.) Speed for two-bladed beater 1,500 revs., and for three-bladed beater 1,000 revs., usual for 45in. wide machines.

Power—Opener and single scutcher 8 to 9 I.H.P.

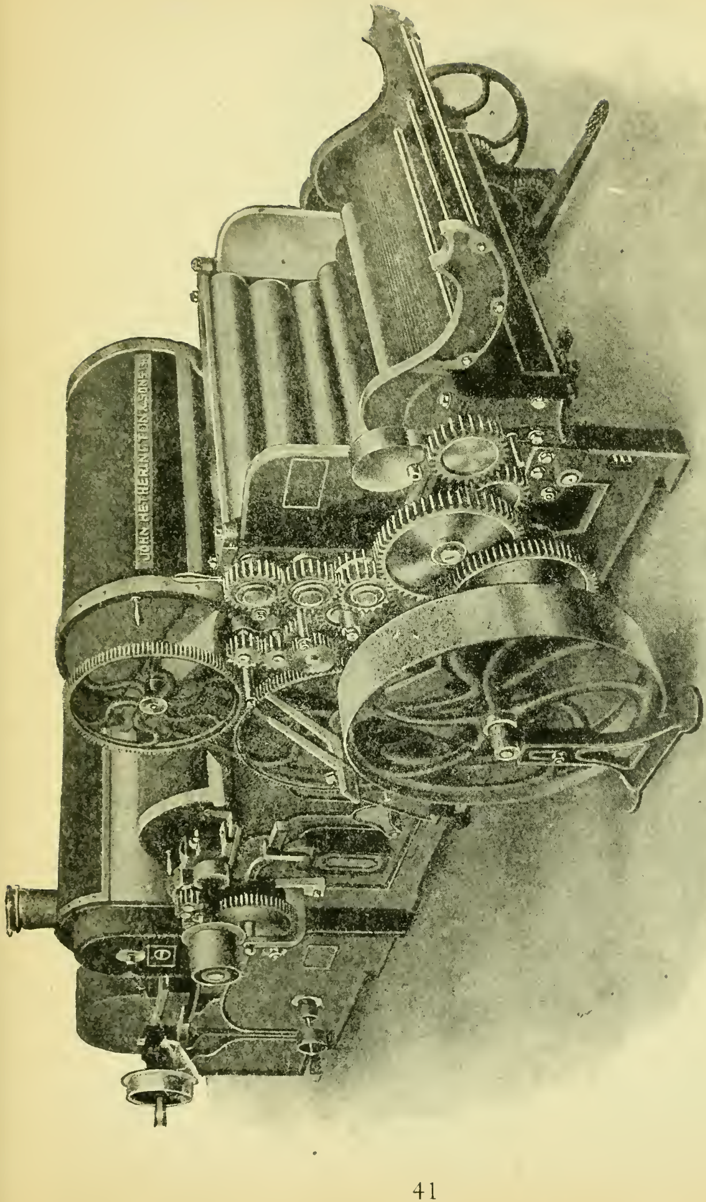
Strapping.—Line shaft to countershaft, 5in. wide belt, length according to position of line shaft. Countershaft to exhaust and horizontal beaters, 4in. wide, length according to distance. With self-contained countershaft, the lengths are 31ft. for the exhaust beater and 16ft. 6in. for horizontal beater. Exhaust beater to fan, 9ft. 6in. × 2½in. wide. Horizontal beater to fan, 8ft. 9in. × 2¼in. wide. Beater to lapping-up pulley, 16ft. × 2¼in. wide.

Floor space.—For opener and single scutcher combined, 17ft. 10in. long; width for 38in. lap, 6ft. 10in. and for 45in. lap, 7ft. 5in. wide.



PLAN OF EXHAUST OPENER & SCUTCHER.

Weights.—Exhaust opener and Scutcher, 41in. wide. 6 tons, 5 cwt., 1 qr., gross. 5 tons, 12 cwt., 14 lb., net.



ELEVATION OF EXHAUST OPENER AND SCUTCHER.

EXHAUST OPENER and LAP MACHINE SPECIFICATION.

Details required when ordering Exhaust Openers.

How many Machines?

Width of lap to be made? inches.

Class of Cotton to be worked?

How fed—by Creeper Feed Table? and Hopper Feeder?

Is a Crighton Opener employed between Creeper Feed and Exhaust?

Do you require Dust Boxes? how many? at per box.

Shall we supply Exhaust Trunks or Pipes? at per foot.

Speed of Cylinder? revolutions per minute.

Diameter of Pulley on Cylinder? (usually 13in.)

Speed of Scutcher Beater 2 blades? revolutions (usually 1,500 revolutions).

Speed of Scutcher Beater, 3 blades? revolutions (usually 1,000 revolutions).

Diameter of Scutcher Beater Pulley? inches (usually 10in. diameter).

Will you have a Countershaft on Machine? at per Machine.

Speed of Main Shaft?

Diameter of Drum on same?

All Hangers, Beams, Pulleys, &c., for driving Creeper Feed in room adjoining, extra over price of Machine.

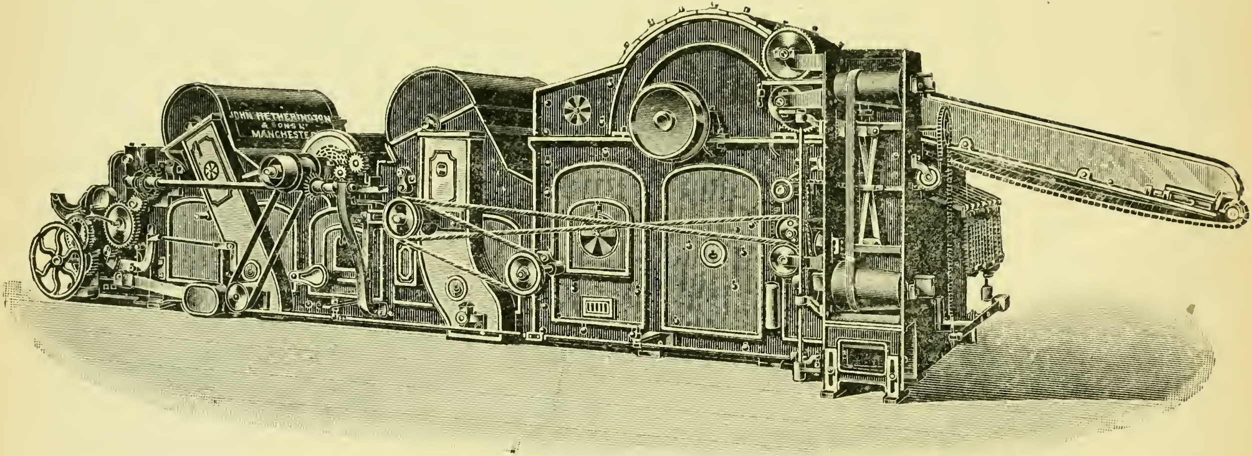
When must the above be delivered?

[If our works are closed by reason of strikes, lock-outs, break-downs, or other unforeseen causes beyond our control, it is hereby understood that a reasonable delay in the time of delivery be allowed to us.]

Shipping instructions:

Terms of payment:

Observations and remarks:



LARGE CYLINDER OPENER.

With one Large Cylinder, one 18in. Beater, and two Sets of Cages and Lapping-up Apparatus.

Large Cylinder Openers.

These machines for many years have been recognised as the correct pattern for good American, Egyptian and Sea Islands cotton.

They are made with **feeding lattice, one cylinder, one set of cages,** and lapping-up apparatus. This is the most common machine for very fine work.

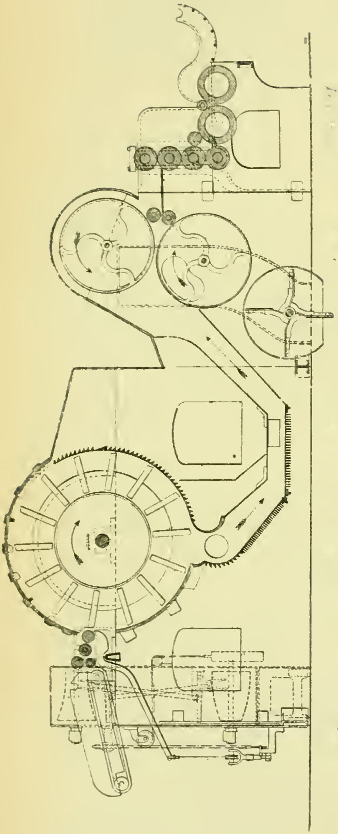
For American and Egyptian Cottons they are made with **feeding lattice, one cylinder, one beater, two sets of cages,** and lapping-up apparatus.

The cylinder, 41in. dia., is built up of wrought-iron discs to which are fastened specially-formed teeth or strikers, mounted on a steel shaft and carefully balanced at working speed. The blades or strikers of the cylinder, strike the cotton upwards against the rounded surface of the roller and not against the pedal nose. This is done to secure the gentle treatment of the staple and to increase the working surface, so that about three-quarters of the circumference of the large cylinder is utilised as an effective opening and cleaning surface, with dust chambers, suitable dampers, &c.

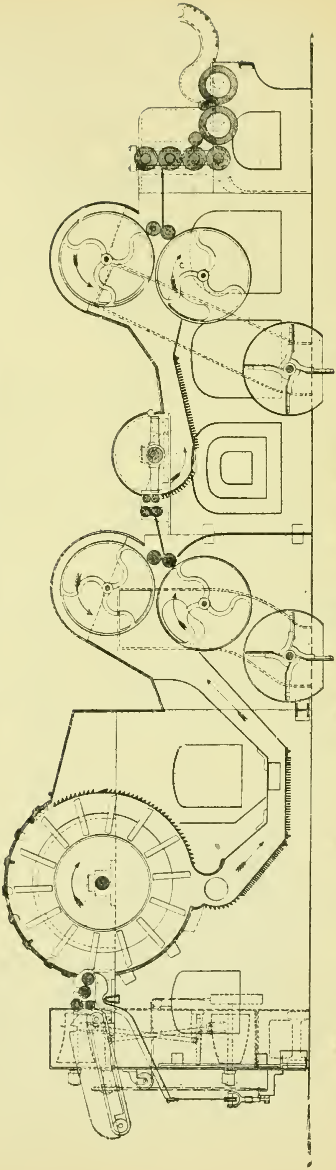
The cover plates are made of cast-iron, and on the underside are projections or teeth, their object being to arrest the progress of the cotton so as to assist the cylinder in the opening of the cotton previous to shaking out the impurities.

Cone feeds and pedal motions are usually supplied with these machines, in connection with our improved regulator. The cone box is vertical, and contains a pair of cones of a large diameter, driven by a long endless rope with a good tightening arrangement, which gives a steady and noiseless drive. The levers carrying the cone strap-fork have been lengthened, and the fulcrums placed at the extremities of the box behind the cones. By this means the strap-fork at any point of its movement is kept close to the cone, the strap is acted on much more quickly, and the action is much more sensitive than in the old arrangement where the levers were short and the strap-forks were necessarily carried some distance from the cones.

Improved link regulator.—In this arrangement we employ the usual pedal levers, to one end of these are



SECTION OF LARGE CYLINDER OPENER.



SECTION OF LARGE CYLINDER OPENER & SCUTCHER.

attached links; two of these links are coupled together by a lever thus forming a series of eight levers. The eight levers are again coupled together by link and lever and reduced to four levers, which are in turn reduced in a like manner to two. These two levers are coupled up to a larger lever pivoted in the centre; this latter lever is connected to a long lever supported from the frame side and the floor, it is provided with an adjustable centre, and one end is coupled up to the cone box, and the other end carries a weight for balancing. The link connecting these two levers is made adjustable for regulating the distance between them. The whole arrangement is very simple and effective, with practically no friction, and it can be easily kept clean and regulated.

Formerly a slight variation in the thickness of the lap did not affect the cone strap, owing to play or flexion in the intermediate levers, but by the above arrangement this defect is avoided. All friction is reduced, and the device has proved to be extremely sensitive to any variation of the lap.

The beater, $17\frac{1}{2}$in. dia., is usually made with two blades, but three can be put in if specially asked for. It is reversible, and runs in long Mohler bearings with special continuous oiling arrangement.

The beater bars are carried on circular ribs fixed to the inside of the framing, and having the same centre as the beater. By this arrangement, the distance between each can be regulated at will with the greatest facility to suit any particular class of cotton that may have to be worked.

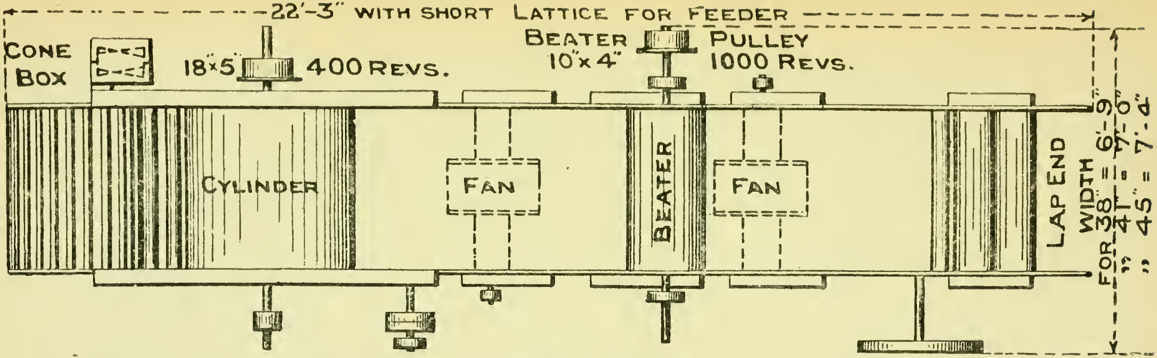
Dust cages are of good size, and supplied with stripping rollers, instead of the troublesome dampers which are usually placed inside the cages.

The fan is of careful construction and efficient power, being made extra large in order to prevent choking between the cylinder and first pair of cages. The shaft runs in Mohler bearings with continuous oiling arrangement.

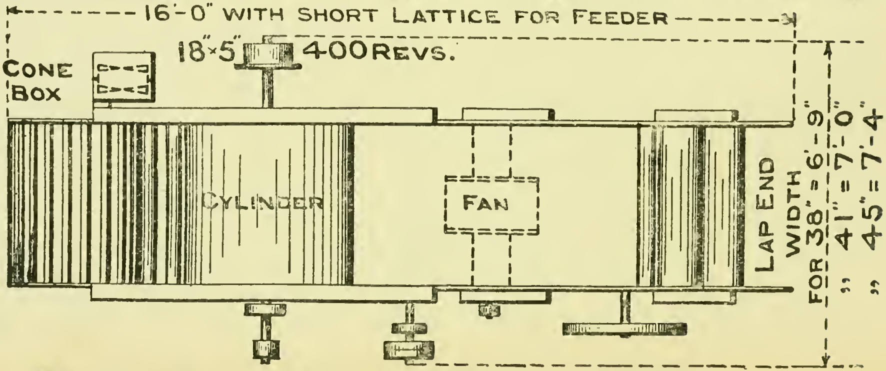
Four heavy press rollers with clearers to prevent licking, and the **lapping-up apparatus** has the lap roller bored out to take headed lap rods, with **lap tray** to take full laps.

Adjustable measuring and stop motion.—To regulate the length of the lap is extremely simple, and the length of lap can be altered by changing one wheel.

A countershaft is built on the machine if specially asked for, having fast and loose pulleys of 18in. to 20in. dia.



PLAN OF LARGE CYLINDER OPENER & SCUTCHER.



PLAN OF LARGE CYLINDER OPENER.

Safety appliances are provided if specially asked for, to prevent the covers being raised whilst the beater is running. **Guards.**—All gearing is efficiently guarded to meet all the requirements of the Factory Act.

The opener is generally fed by a **hopper feeder of our new type** which may be driven from a separate line-shaft and is quite independent of the regulator on the opener. The regulator does not require to control the hopper feeder as in the case of other types of this machine. Our combination is therefore extremely sensitive and answers readily and instantaneously to the slightest irregularities in the feed so that we obtain **laps of great regularity in weight throughout.**

Speeds, &c.—Speed of cylinder, 450 to 500 revolutions for American cotton, 350 to 450 revolutions for Egyptian, and 300 to 350 revolutions for Sea Islands. The pulley on the cylinder shaft is 18in. to 20in. dia. and 5in. wide. Speed of beater, 1,500 revolutions for American cotton, 1,000 revolutions for Egyptian, and 850 revolutions for Sea Islands. The pulley on the beater shaft is 10in. dia. × 4in. wide.

Pulleys.—On cylinder 18in. to 20in. dia. for 5in. belt, and on beater 10in. dia. for 4in. belt.

Straps.—Cylinder to cross shaft, 7ft. 3in. × 2¼in. Cross shaft to lap drum pulley, 15ft. 3in. × 2¼in. Beater to opener fan, 13ft. 6in. × 2¾in. Beater to scutcher fan, 7ft. 9in. × 2¼in. For cones, 8ft. 4in. × 1½in. Rope for driving the regulator is 45ft. long and ⅝in. dia.

Power.—**Single opener** with lapping-up apparatus, 5 I.H.P.; **combined single opener and scutcher** with lapping-up apparatus, 9 I.H.P.

Production.—1,800 to 4,500lbs. per 10 hours, according to the weight of lap per yard being produced.

Floor space.—Single opener with lapping-up end, 18ft. 7in. × 6ft. 10in. for 38in. lap, and 7ft. 5in. for 45in. lap. Single opener and scutcher combined, 24ft. 10in. × 6ft. 10in. for 38in. lap, and 7ft. 5in. for 45in. lap.

If the machine is fed by an automatic feeder the above lengths can be reduced by 31in., as shown on the plans.

Weights.—A large cylinder opener and scutcher, with regulator for 38in. laps, weighs 174 cwt. gross and 142 cwt. net.

LARGE CYLINDER OPENER.

How many Machines?

What width of lap are they to make?

How many Cylinders per Machine?

How many 18in. Beaters per Machine?

How fed—by hand or Automatic Feeder?

Speed of Large Cylinder? revolutions per minute.

Speed of 18in. Beater? revolutions per minute.

Size of Driving Pulleys? (usually 18in. to 20in. diameter).

Speed of Line Shaft? revolutions per minute.

Drum on Line Shaft?

When facing the Delivery must the Driving Pulley be on the right or left hand?

Will you have an up or down draft?

Will you have Lord's Cone Feed Motion attached? at per Machine.

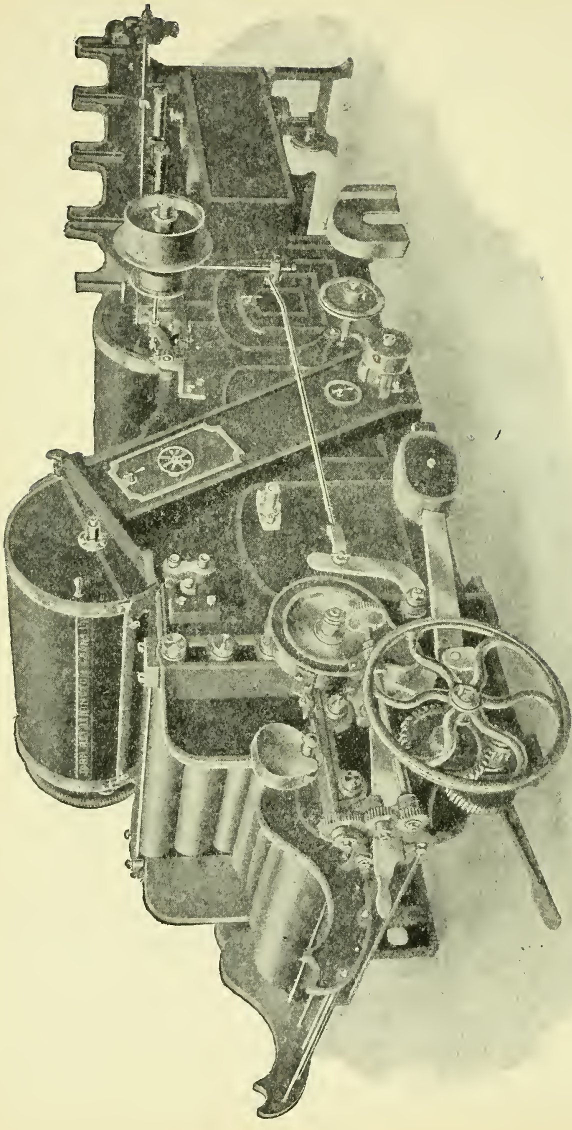
Will you have Lord's Cone Feed with Piano attached? at per Machine.

Or our Improved Link Regulator? at per Machine.

When must the above be delivered?

[If our works are closed by reason of strikes, lock-outs, break-downs, or other unforeseen causes beyond our control, it is hereby understood that a reasonable delay in the time of delivery be allowed to us.]

Remarks:



SINGLE BEATER SCUTCHER, SHOWING CONE BOX.

Improved Scutcher.

We have completely remodelled this machine, so as to combine the best features of both the Hetherington and Curtis machines, and we do not hesitate to say that the result has been an unqualified success. The machine, whilst not detrimentally affecting the strength or elasticity of the fibre, possesses a very high cleaning power, the laps have perfect selvedges and are extremely regular, both as regards the total weight and the weight from yard to yard. Our illustrations give a general view of the single beater machine. The machine may, however, be made with two beaters if desired.

The feeding lattices for machines fed by Automatic Feeders are about 3ft. long, but in the case of finishing scutchers they are made to take four laps up. The cotton is delivered to the beater, when short cottons are being worked through a single roller and pedal arrangement, which allows of a close setting. For the longer grade cottons an extra pair of feed rollers are employed, the cotton in this case is struck round the bottom feed roller, thus minimising any possible damage to the fibre.

Cone feed pedal motions are usually supplied with these machines in connection with our **link regulator** which has been improved in many ways, large cones running at high speed are employed and driven by rope with special tightening arrangement. The levers carrying the cone strap-fork have been lengthened, and the fulcrums placed at the extremities of the box behind the cones. By this means the strap-fork at any point of its movement is kept close to the cone, the strap is acted on much more quickly, and the action is much more sensitive than in the old arrangement, where the levers where short and the strap-forks were necessarily carried some distance from the cones.

Improved link regulator.—In this arrangement we employ the usual pedal levers, to one end of these are attached links, two of these links are coupled together by a lever, thus forming a series of eight levers. These eight levers are again coupled together by link and lever and reduced to four levers, which are in turn reduced in a like manner to two. These two levers are coupled up to a larger lever pivoted in the centre; this latter lever is connected to a long lever supported from the frame side and the floor. This lever is provided with an adjustable centre, and one end is connected up to the cone box, and the other end carries a balance weight. The link connecting these latter levers is made adjustable for regulating the distance between them. The whole arrangement is very simple and effective with practically no friction, and it can be easily kept clean and regulated.

Formerly a slight variation in the thickness of the lap did not affect the cone strap, owing to play or flexion in the intermediate levers, but by the above arrangement this defect is avoided. All friction is reduced, and the device had proved to be extremely sensitive to any variation of the lap.

The beater 17½in. dia. is usually made with two blades, but three can be put in if specially asked for. It is reversible, and runs in long Mohler bearings with special continuous oiling arrangement.

The beater bars are carried on circular ribs fixed to the inside of the framing, and having the same centre as the beater. By this arrangement the distance between each bar can be regulated at will, with the greatest facility to suit any particular class of cotton that may have to be worked.

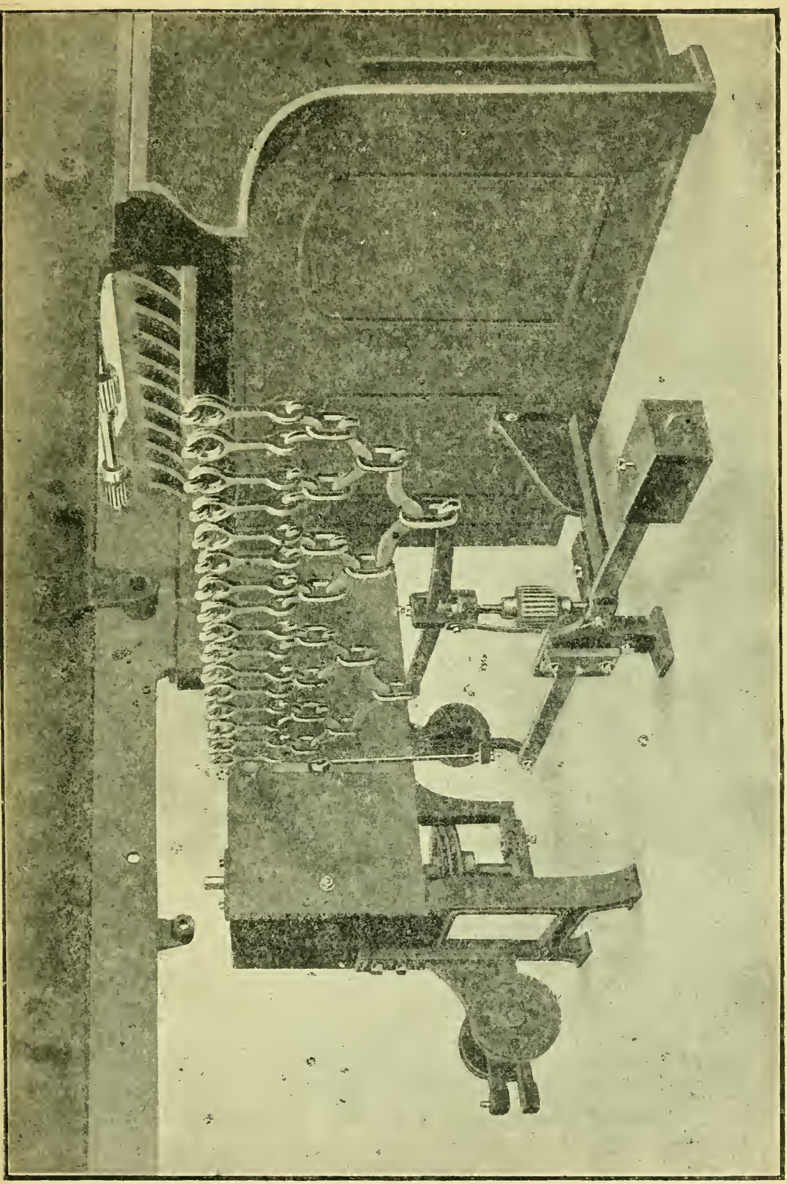
The cages are of good size and carefully placed, so as to permit as much dirt as possible to fall out of the cotton in its passage from the beater to the cage. The cage is stripped by a roller, and a damper with its attendant evils and collection of dirt is dispensed with.

The fan is of careful construction and efficient power and the shaft runs in Mohler bearings and continuous oiling arrangements.

The press rollers are four in number, so as to consolidate the laps as much as possible, and prevent them licking when unrolling on the following machine. **A cradle**, conveniently placed, is provided for the reception of the finished laps, and **hollow lap rollers** are supplied with the machines.

Measuring and stop motion to regulate the length of the lap is extremely simple, and the length of lap can be altered by changing a single wheel.

Safety appliances are provided when required, to prevent the covers being raised whilst the beater is running.



IMPROVED LINK MOTION.

Gearing.—The driving and gearing are shown in the accompanying diagrams. All wheels are efficiently guarded so as to comply with the requirements of the Factory Act. All pulleys are accurately balanced.

A countershaft is built on the machine if specially asked for, having fast and loose pulleys of 16in. dia., which should run at 500 revolutions per minute.

Power required to drive the machine is 4 I.H.P. for the single, and 8 I.H.P. for the double machine.

The production varies from 1,800lbs. to 2,900lbs. in 10 hours, according to the class of work, and may be altered without affecting the draft by changing the pulley on the end of the beater driving the cross shaft.

Strapping and banding.—Main belt for driving the counter, 5in. wide, length according to distance of the main shaft. Belt for driving beater with countershaft on the machine, 16ft. 6in. × 4in. (If driven from separate counter, length according to distance). Beater to cross shaft, 7ft. 3in. × 2¼in. Beater to fan, 7ft. 9in. × 2¼in. Cross shaft to lap drum driving pulley, 15ft. 3in. × 2¼in. Beater to beater in the double machine, 16ft. 4in. × 4in. Second fan belt in the double machine, 8ft. 9in. × 2¼in. Rope for driving the cone, ⅝in. dia., and 14ft. 9in. long. The cone strap is 8ft. × 1¼in.

Pulleys.—8in. to 11in. dia., usually 10in. × 4in. wide. Height of beater shaft, 36in. from floor.

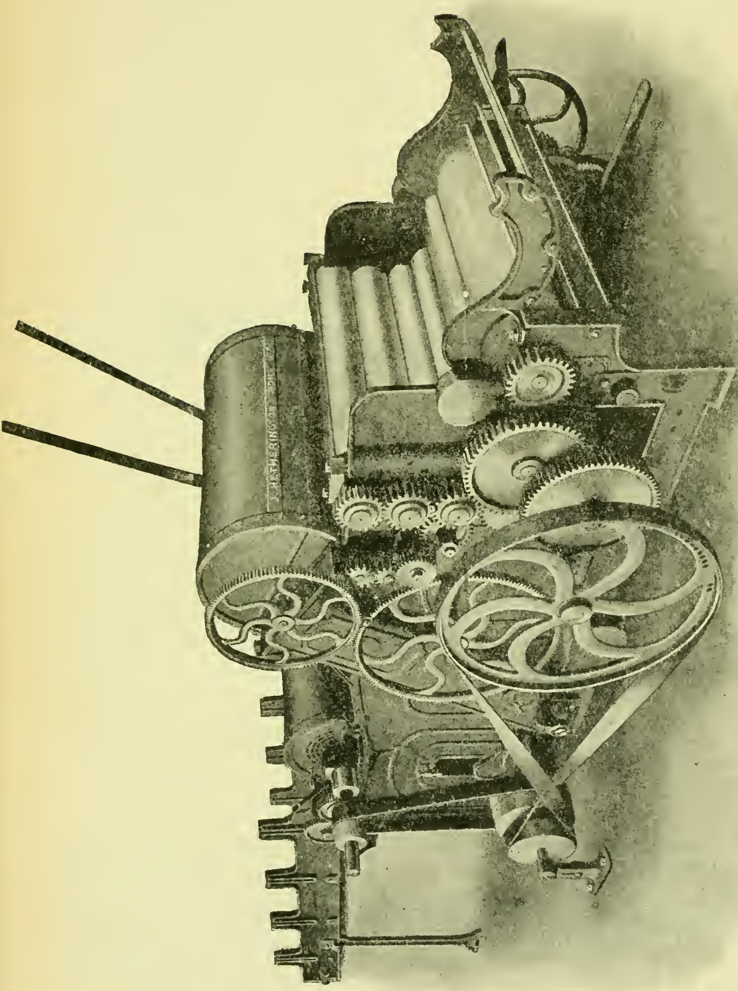
SPEEDS—American cotton.—Two-bladed beater fcr 38in. laps, 1,500 revolutions per minute; three-bladed beater for 45in. laps, 1,000 revolutions per minute.

Egyptian cotton.—Two-bladed beater from 1,000 to 1,200 revolutions per minute.

Sea Islands cotton.—Two-bladed beater from 850 to 1,000 revolutions per minute.

Floor space.—Single machine 17ft. 3in. long × 6ft. 10in. wide for 38in. laps, and 7ft. 5in. wide for 45in. laps. **Double machine** 23ft. 5in. × 6ft. 10in. wide for 38in. laps, and 7ft. 5in. wide for 45in. laps. These lengths are for **feed table to take four laps up.** If to be fed by **automatic feeder,** the length could be reduced 3ft. 3in.

Hand of machine, stand facing the lap end, and note if pulley must be on right or left hand side.

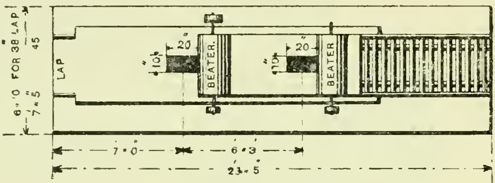


SINGLE BEATER SCUTCHER.

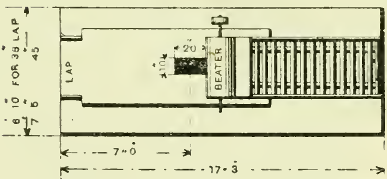
WEIGHTS OF MACHINES.

Width	SINGLE MACHINE					DOUBLE MACHINE				
	Gross		Nett		Cubic Feet	Gross		Nett		Cubic Feet
	Tons	Cwts.	Tons	Cwts.		Tons	Cwts.	Tons	Cwts.	
38in.	4	18	4	1	282	6	17	5	6	414
41in.	5	1	4	4	300	7	1	5	10	444
45in.	5	4	4	8	320	7	6	5	17	466

These weights include the regulator. For machines without regulator, deduct 15 cwt. gross, 13 cwt. nett, and 32 cubic feet.



DOUBLE BEATER SCUTCHER.



SINGLE BEATER SCUTCHER.

DRAFT.

A draft of four means that one yard of lap of given weight fed to the machine must be delivered as four yards having the same weight. If the wheels and pulleys were calculated so that the lap drums should take up just four times the length fed by the feed rollers in a given time, the laps would be too light, owing to loss by waste and slip in the cone and other straps, consequently allowance must be made for this loss and slip. The **percentage of loss** in waste may be found by multiplying the weight loss in the given time by 100, and dividing by the weight of cotton fed to the machine in the same time. In calculating the draft, it is convenient to consider the feed roller as driving the lap drums through the cones. The diameters of the latter may be neglected, being approximately equal when the strap is in the middle. Allowing 12 per cent. for loss, for example, say 7 per cent. for waste and 5 per cent. for slip, the feed roller may be assumed to make 1·12 revolutions, and the lap drums then made to take up only **four** times the length fed by the feed roller for **one turn**. A very exact draft of four (by weight) will then be obtained. The calculation is as follows, and will be understood on reference to the illustration showing the gearing in plan:—

Dia. of the feed roller, 3in. Dia. of lap drums 9in.

Suppose D = the draft; X = the dia. of the rope pulley on the cross shaft driving the cones; Y = the dia. of the pulley driving the lap end.

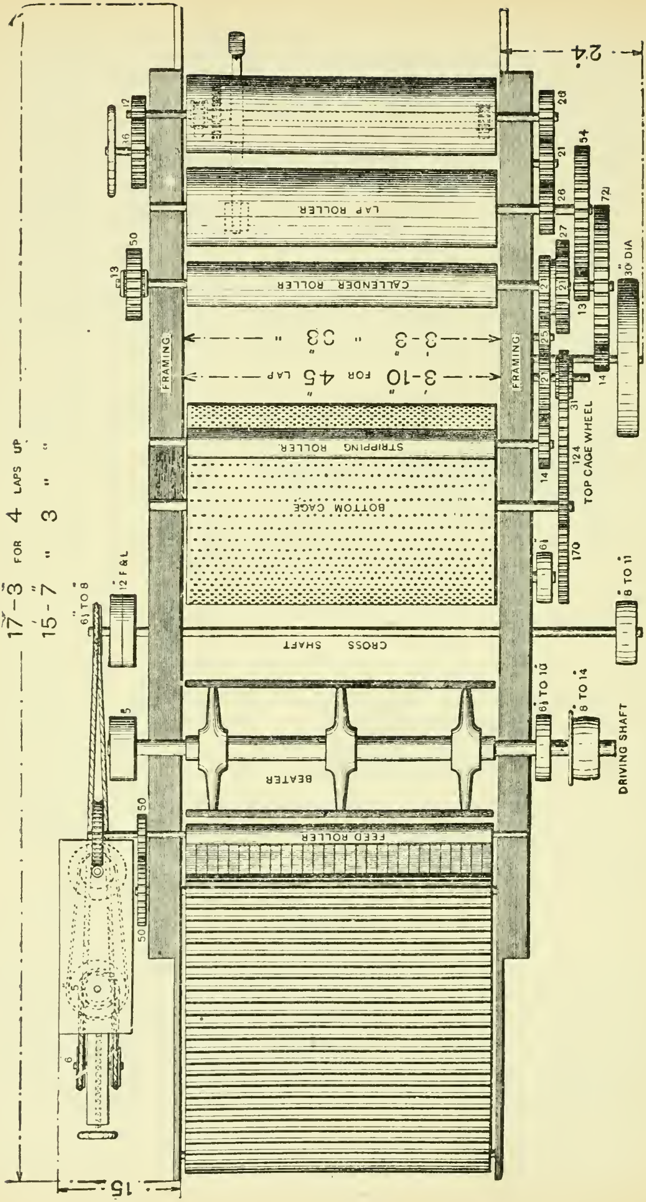
$$\text{Then: } \frac{1{\cdot}12 \times 95 \times 5 \times Y \times 14 \times 13 \times 9}{1 \times X \times 30 \times 72 \times 54 \times 3} = D$$

$$\text{whence: } \frac{Y \times 2{\cdot}49}{X} = D \qquad \text{or } Y = \frac{D \quad X}{2{\cdot}49}$$

So that the required draft being known, it is only necessary to multiply it by any convenient assumed diameter of X, and divide by the constant 2·49 to obtain the suitable diameter of the pulley Y. The constant is dependent on the assumed loss, and if this were greater or less than 12 per cent. the constant would be proportionately greater or less. The suitable diameters of the pulleys for three different drafts are given in the following table:—

Draft = 3	Rope pulley = $7\frac{1}{2}$in.	Strap pulley = 9in.
,, = $3\frac{1}{2}$	,, ,, = $7\frac{1}{2}$in.	,, ,, = $10\frac{1}{2}$in.
,, = 4	,, ,, = $7\frac{1}{2}$in.	,, ,, = 12in.

In our machine the pulleys on either end of the cross shaft may be changed to alter the draft. A change in the rope pulley driving the cones alters both draft and production, but a change in the pulley driving the lap drums only alters the draft. For any given draft the pulleys must bear a fixed ratio to each other.



PLAN OF SINGLE BEATER SCUTCHER.

SCUTCHING MACHINE SPECIFICATION.

Details to be given when ordering Scutchers.

How many machines?

What width of laps are they to make? inches.

Will you have them to be fed by Automatic Feeder or by laps?
If laps, how many? (usually three).

To suit Carding Engines inches on the wire?

How many beaters in each machine?

Will you have self-contained driving? Revolutions per minute (usually 500).

Speed of line shaft?

Distance between line shaft and ceiling?

Largest size of drum? inches (usually 36in.)

Speed of Beater? Revolutions per minute (usually with two blades 1,500 revolutions per minute).

Diameter of Beater Pulleys? inches (usually 10in. diameter).

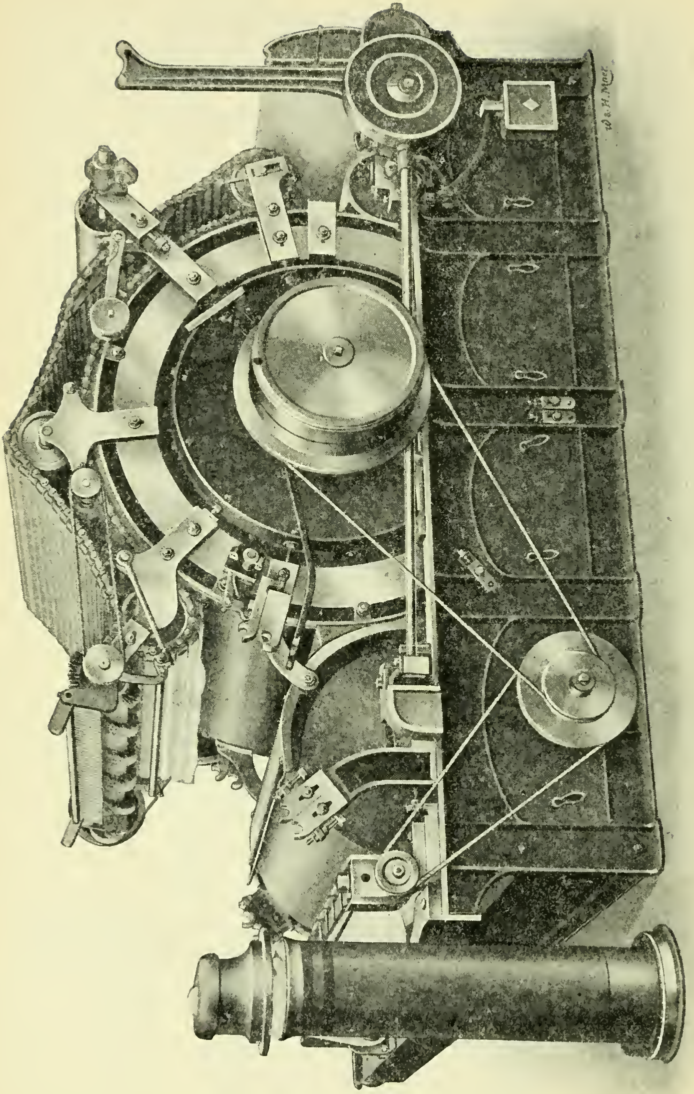
When you face the delivery end of the machine, must the Beater Pulleys be on the right or left hand side of it?

Will you have Cone Feed with Link Motion attached?
at per machine.

When must the above be delivered?

[If our works are closed by reason of strikes, lock-outs, break-downs, or other unforeseen causes beyond our control, it is hereby understood that a reasonable delay in the time of delivery be allowed to us.]

Observations and remarks:



Improved Carding Engine.

The accompanying illustrations show two views of our new **patent carding engine** constructed from entirely new Models, and, while retaining all the good points of the previous cards, several modifications have been introduced which tend to improve the working and the accurate setting of the machine. All the parts have cast on them a well-defined letter or number to facilitate ordering change pieces or parts broken in transit. Each piece is a duplicate of a standard piece, so that all parts bearing the same letter or number are interchangeable, and catalogues are supplied containing illustrations of each part giving the corresponding letter or number, together with the names of same, so that the necessary renewals can be ordered with the assurance that they will come to order, and when to hand, fit in place.

The frame sides are made much stronger, and the lap end is extended to carry the lap plate and carrier; this latter is arranged to carry two laps without coming in contact with each other.

The height of the Card has not been increased notwithstanding that the space between the chain of flats has been greatly increased to facilitate setting and cleaning operations.

The feed roller weighting has been modified, and arranged that after the weights are removed the levers can be unhooked and easily removed for setting purposes, &c. Otherwise we still retain the principle of that used by us for many years.

In our arrangement the feed roller bearings are not controlled by a fork, but are quite free, and held by a simple system of levers and weights, so that any thickness passing under the roller only serves to increase the bite on the point of the plate, and entirely prevents the evil of snatching.

The takers-in are clothed up to the edge and fitted with specially arranged shirts to prevent the exit or collection of fly.

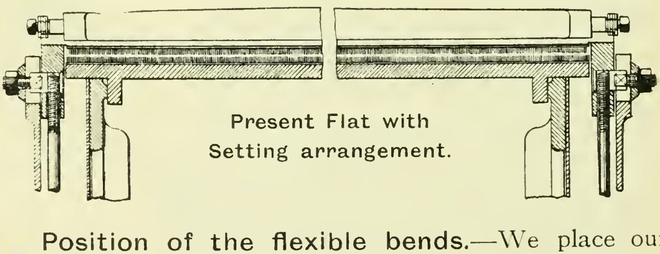
Taker-in pedestal.—This pedestal is capped and made adjustable by means of a tail pin which enables the pedestal to control a plate inside the card side which carries the cylinder and taker-in undercasings together with the mote knives.

The mote knives are so designed that they can be set independently of each other, and when they are at once set for any desired result, any future movements are regulated from the taker-in pedestal. When once set, the undercasings and mote knives require no further adjustment, because the movement of the taker-in governs the whole arrangement.

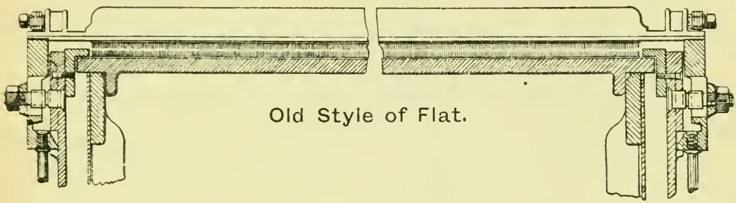
The division and feed plates have also been modified to prevent any good fibre being thrown down, and to separate the heavy dirt and seed from the short fly below the taker-in.

The bend is made of a good deep rigid section, and constructed with a turned and polished section part. Seatings are milled across the turned surface to receive the various brackets, which prevents them getting askew or out of truth.

The flexible bend is supplied with **five setting points** with the simplest possible tail pin adjustment, terminating at the flange of the bend. The flexible is under positive control, and can be set to the finest possible limits. The flexible bends are milled when in position on the card as before, thus ensuring absolute concentricity with the cylinder, which by this new method of setting can be retained at all stages of wear on the wire. We still retain the flexible bend on the inside of the fixed bend and next to the cylinder, thus retaining the present **short flat**. The length of the flat therefore only exceeds the width on the wire by the length of the bearing surfaces, or about two inches, and is consequently the shortest possible for any given width on the wire.



Position of the flexible bends.—We place our flexible bends on the inside of the frame bends, and next to the cylinder, which is clothed quite up to the edge. Two important advantages result from this arrangement. Firstly, the cylinder ends are completely closed in and the escape of fly is prevented, any little that may work out being at liberty to fall away, as may be seen on examining the illustration Fig. 1. In some Cards where the short flat is sought after, this fly cannot freely get away, and by collecting acts as a brake on the cylinder, thus greatly increasing the power required to drive the machine. Secondly, the cylinder end being completely closed in, the lap may be worked the full width of the wire, so that the resulting selvedges are perfect, and there is little or no fly at the ends of the doffing comb. In most Cards there is a certain space between the cylinder ends and the flexible, usually filled up by the framing; but by so much must the flat be longer, and is usually left bare of wire over this space. (Fig 2).



Old Style of Flat.

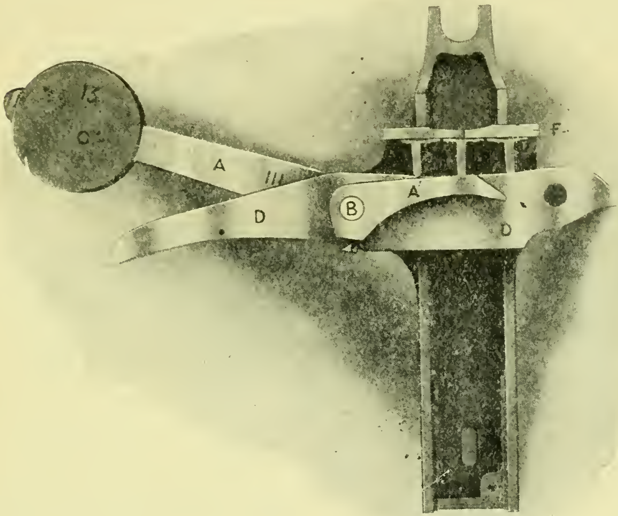
To counteract this disadvantage the cylinder is made narrower than the lap, and the latter is doubled over at the edges. We do not, however, think this advisable, as it puts very heavy carding on the wire at the edges where it is least able to bear it. By making the cylinder the same width as the lap the selvedges are better, as the thinness of the edges of the lap is more than compensated for by the natural tendency to spread in passing through the Card.

Method of trueing the flexibles.—If the flexible bend had to remain always in the same position, it would not be difficult to make it perfectly concentric with the cylinder. Its diameter must, however, be reduced from time to time, according as the wire is ground away on the cylinder and flats. We have exhaustively studied this problem, and claim that our flexible shows no measurable deflection until the diameter has been reduced far beyond the limits necessary in practice. The flexibles are fastened in their places on the Card. While in this position a machine is bolted on the cylinder carrying a milling cutter at each end, which passes over the bends from one end to the other, milling them from the cylinder, so that they are absolutely concentric with it. The milling cutters are both carried on the same shaft, which can be easily set parallel to the cylinder in the direction of its width, so that the surfaces of the two bends are both in the same line, and perfectly parallel with the surface of the cylinder in the direction of its width, and no twist remains in the bends; consequently the bearing surfaces of the flats lie on the full width of the flexibles from end to end. The wearing of both the bends and the flat ends is thus reduced to a minimum and equalised. A further advantage of this system is that if rendered necessary through unusual wear or accident, the operation of trueing up the bends may be repeated at any subsequent time in the mill, and this without removing the clothing from the cylinder. The whole operation only occupies a few hours, and the bends are then as good as new.

The number of flats usually supplied with this card is 106.

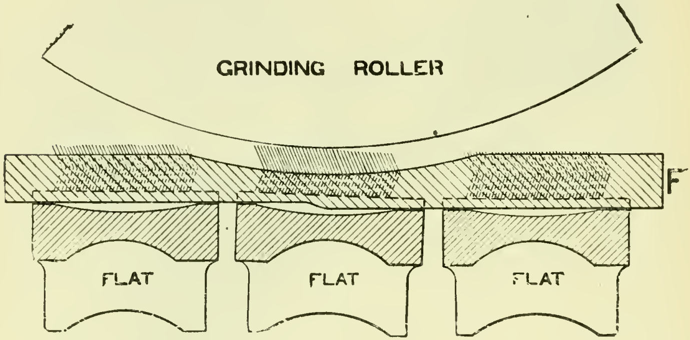
Flat ends.—In order to set the flats to the cylinder with the greatest accuracy, it is necessary after having obtained a perfectly concentric bend, to have each flat exactly alike, and this we ensure by the most elaborate care in their manufacture. It is further necessary that the flat itself be as short as possible and perfectly rigid, otherwise it deflects by its own weight. Any deflection of the flat will cause the wire to touch the cylinder in the middle whilst still some distance away at the ends. We have already shown that our flat is the shortest possible. On comparing Figs. 1 and 2, it will be seen that in the one the beading or rib on the back of the flat is interrupted, and this flat, which is the type of some still made to-day, is inherently weak. When we placed our flexibles inside the frames, we were also able to do away with this break in the back rib of the flat, and to carry the bead right through to the end without any break in its continuity, thus rendering the flat extremely rigid, and practically without deflection. Another fertile cause of deflection in the flats, is the pull of the chain when the point where it is attached to the flat lies inside the flexible. Our flat ends are so made that this point of attachment lies directly over the centre of the flexibles; consequently the pressure or pull of the chain has no tendency to deflect the flat in any way. Resuming, therefore, we are of opinion that our flat is the best that can be made; it is the shortest possible, it is as rigid as possible, and finally, is not affected by the pressure of the chain.

The grinding motion is the one adopted by us some years ago, being simple and efficient and capable of most accurate work. It has been lowered and is now located above the back bowl bracket, so as to be more convenient when putting in the grinding roller.



Flat grinding apparatus.—The result obtained from the revolving flat Card depends on the accuracy with which the various parts, particularly the flats can be set, not only when they are new, but also when the inevitable wear of the ends take place. The object of our grinding apparatus is to grind the flats from their working surfaces, and thus ensure that the height of the wire from that surface is identical in every flat, no matter how the working surface may wear in each flat. This would be easy enough if the surface of the wire were parallel with the working surface, but this is not so, for to ensure the necessary "heel" in the flat, the one side of the working surface is cut lower than the other, and is therefore not parallel with the surface of the wire. In order to grind from the working surface of the flat without destroying the "heel," we employ the following device, being a combination of simplicity and efficiency when such accurate working is demanded.

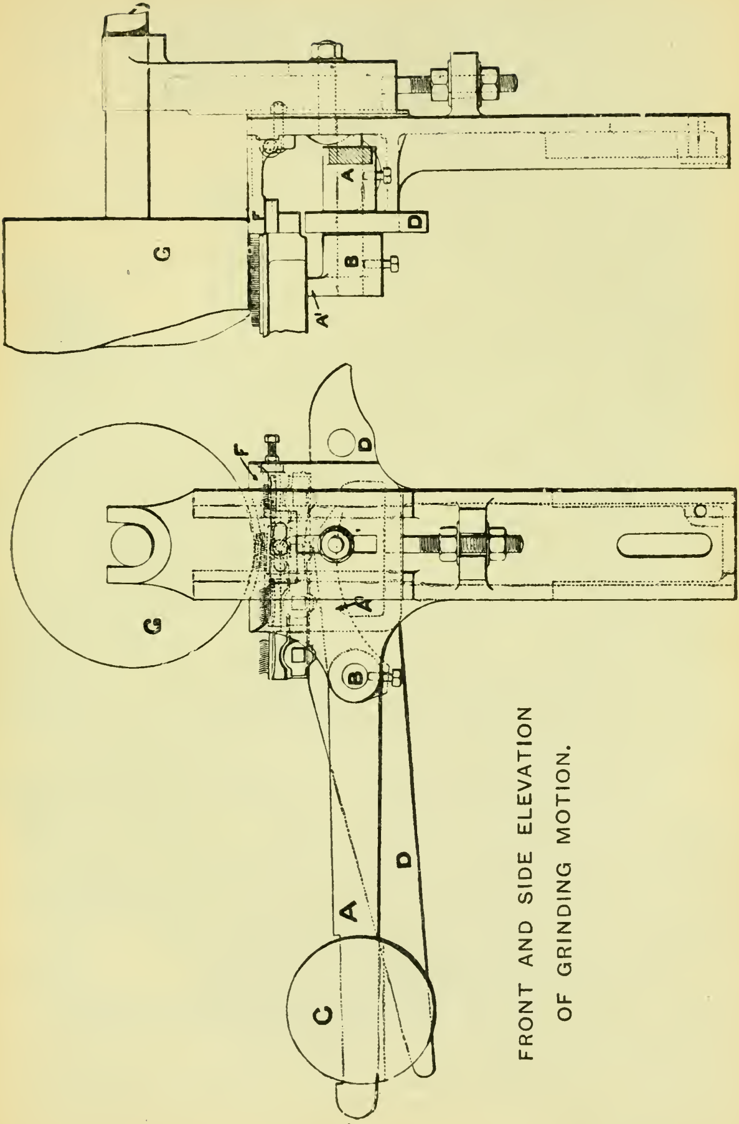
The illustrations show the weighted lever A centred at B on the fixed plate D. When the weight C is placed in position the finger A^1 is raised against the rib of the flat to be ground, pressing it into contact with the controlling plate F, which is firmly fixed in position. The flats ride on the upper surface of the plate D until they come under the influence of the finger A^1. Each half of the



controlling plate F is in a different plane, with a step from one to the other in the centre, so that when one edge of the working surface of the flat end is on the one plane, the second edge is on the other plane (the position when grinding is taking place), and the flat wire is kept in the necessary horizontal position during the grinding process to preserve the "heel."

The controlling plate is marked on the edge to show where the grinding commences, and it will be seen that this is directly after the first edge of the flat end (moving backwards) mounts the step. The process continues until the second edge of the flat end approaches near to the step, at which point the whole flat is clear of the grinding roller G.

In speaking of the front and back edge of the wire or flat end, it should be explained that the former is the one towards which the wire points, and which is first approached by the cotton.



FRONT AND SIDE ELEVATION
OF GRINDING MOTION.

The sprocket for driving the flat chain is placed eccentrically to the flat bowl. By this means the drive is not affected by any wear of the flat chain as very few teeth are in mesh at the same time. The chain itself is tightened at the back bowl bracket.

The flat stripping brush is now made much larger in diameter than hitherto, and runs at about one-third of the former speed. It is so arranged that it is impossible for the comb to injure the wire, and it can be adjusted to any required distance from same.

The top bowl bracket is arranged to carry two tie rods across the card, our object being to make the bends very rigid.

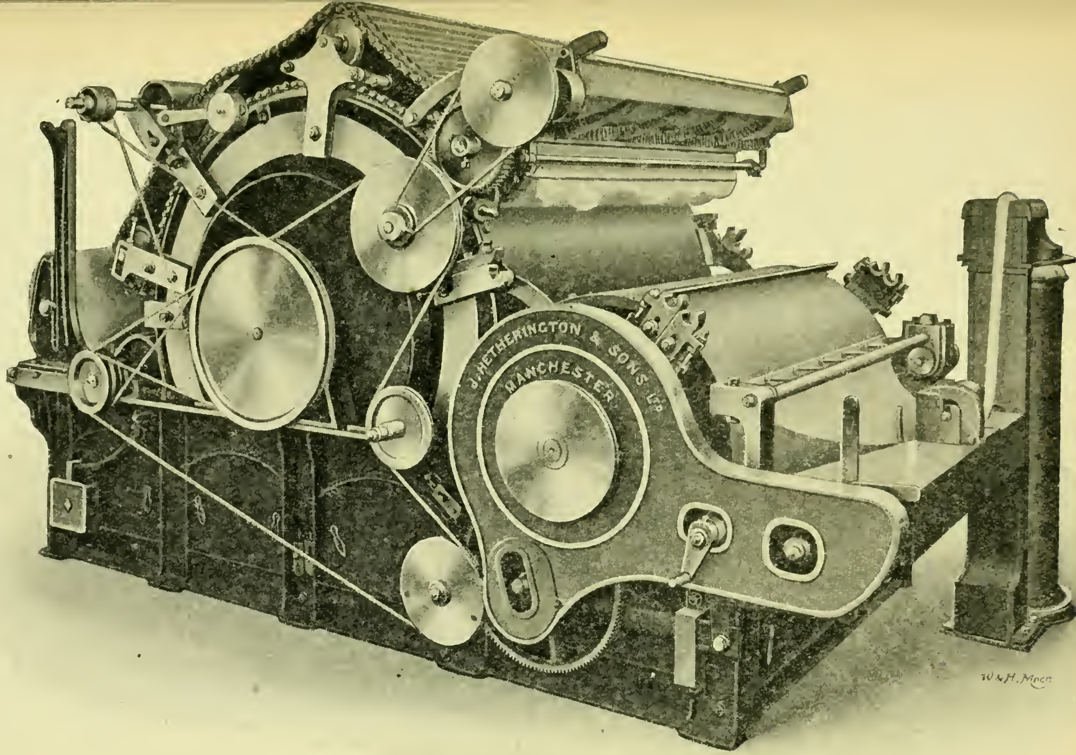
The cylinder pedestal now is provided with a channel for taking away all the surplus oil which prevents it from getting into the inside of the card and thus on to the wire.

Cylinders and doffers are trued up with an emery wheel on their own shafts to give a perfectly smooth and even surface for the clothing to rest on. They are balanced when running at a speed they run at in the mill, so that the effect of the centrifugal force is properly counteracted.

The undercasings have also had special attention with regard to strength and stiffness. They are now made in halves with very strong sides and stiff cross bars. The adjustment for these casings is done from the outside by a very simple device. The back portion is carried from the taker-in pedestal, so that when the taker-in is set the casing will follow.

The front stripping plate and doffer covers are carried by V-shaped brackets and provided with two setting points, one for the top stripping knife and one for the bottom stripping knife or filling-up piece between the cylinder and the doffer. The top knife can be set with great accuracy, so that the strips are always under proper control.

The doffer pedestal is now made with a cap, but still carries the grinding and stripping brackets. Arranged in this manner the whole combination is moved whenever any adjustment of the doffer takes place, so obviating the possibility of any disarrangement and rendering it impossible for the grinding roller to get out of line with the doffer and to grind hollow.



ELEVATION OF NEW CARD WITH **ROPE** DRIVING.
IT CAN, HOWEVER, BE MADE FOR **STRAP** DRIVING IF SO DESIRED.

The drop-lever carrying the barrow change wheel driving the doffer is now carried on a much longer bearing and is therefore very steady. It is provided with a disengaging handle operated from the front of the machine.

Drive for taker-in and doffer can be arranged for either **belt** or **rope** drive. The rope drive as now applied also **drives the flats** in addition to the doffer and taker-in. The rope is endless and a convenient tightening arrangement is provided. The pulleys are now of a much larger diameter than formerly and the ropes are so arranged that there is no rubbing or chafing at the crossings, and as no shifting device is now required, the rope for this new drive should last for years without replacement. For the purpose of disengaging the worm drive to allow the flats to be turned round by hand, the flat driving pulley is mounted on an eccentric bush, and the turning handle is in a position easy of access and offers no obstruction when in use.

If desired, a patented **double speed motion** can be applied to the doffer.

The delivery end is now made much stronger and better in appearance. The shaft driving the calender rollers is placed below the name plate or front stretcher, thus leaving all clear on the top and making it much more convenient and safer for the operatives when cleaning or piecing up.

Top and bottom calender rollers are both 4in. diameter. This allows for a larger wheel at the end of the calender shaft, and therefore a finer change can be obtained for regulating the delivery of the sliver to the coiler.

The comb box is made with the double link and eccentric motion. All bearings being cast-iron to cast-iron, the wear is practically nil. The bearings run in an oil bath, thus allowing a high speed to be maintained without heat, and ensuring silent running.

The comb stock is of large diameter, with six arms for the 38in. wide machine, and seven for the 45in. wide machine, carries the comb.

The coiler top is of the usual neat design, but the can bottom and the pillar have been entirely remodelled.

Guards.—All moving parts are carefully guarded with safety motion for the front cylinder cover when ordered.

Clothing.—Unless otherwise ordered, we put the following counts of wire on our Cards:—

Class of Cotton.		Cylinder.	Doffer.	Tops.
Surat.	Lowest Class ...	80's	90's	70's
	Better ,, ...	90's	100's	80's
American.	Lowest ,, ...	100's	110's	100's
	Better ,, ...	110's	120's	110's
Egyptian.	Ordinary ,, ...	110's	120's	110's
	Better Classes ...	120's	130's	120's

We attach the clothing to the flats at our works by special machinery.

To find the length of 2in. fillet to cover a card cylinder.—Diameter of cylinder × width of cylinder × 3·1416 ÷ width of fillet × 12in. = feet required.

The length of fillet required to clothe the 24in. doffer with $1\frac{1}{2}$in. fillet, and the 50in. cylinders with 2in. fillet for various widths of the Cards, is as follows:—

Width on the Wire.	Doffers.	Cylinders.
38in. (965 m/m)	159ft. 0in.	248ft.
41in. (1^m 04)	171ft. 6in.	268ft.
45in. (1^m 144)	188ft. 6in.	294ft.

To these lengths must be added about 6ft., so that the tail ends may be properly stretched up.

The weight of clothing is as follows:—

Width on the Wire.	Tops.	Cylinder and Doffer.	Total.
Ins.	lbs.	lbs.	lbs.
38	$29\frac{1}{4}$	81	$104\frac{1}{4}$
41	$31\frac{1}{2}$	$87\frac{1}{2}$	119
45	$34\frac{1}{2}$	96	$130\frac{1}{2}$

The Pulleys supplied are usually 16in. dia. × 3in. wide. Other diameters are supplied if required. They should make 160 to 165 revolutions per minute. The height from the floor to centre of driving shaft is 31in. and the dia. is $2\frac{1}{2}$in.

Power.—The power required is $\frac{3}{4}$ I.H.P. per card.

Hands of machines.—To determine the hand of the Card, stand facing the doffer and note if the pulleys must be on the right or left hand side.

Pinions, &c.—Supplied with each Card are two shaft pinions and two barrow wheels in addition to those on the machine.

Strapping.—The length of the main belt is determined by the position of shaft in relation to the machine, but it is usually about 40ft. long by 3in. wide.

Banding.—The banding required per Card is 50ft. of $\frac{1}{2}$in. and 12ft. of $\frac{3}{8}$in.

Dimensions and Weights.

Width on the Wire.	Width.	Length.	Gross.	Nett.	Cubic Feet.
	ft. in.	ft. in.	T. C.	T. C.	
38in.	5 1½	10 0	3 0	2 5	287
41in.	5 4½	10 0	3 3	2 8	296
45in.	5 8½	10 0	3 5	2 10	310

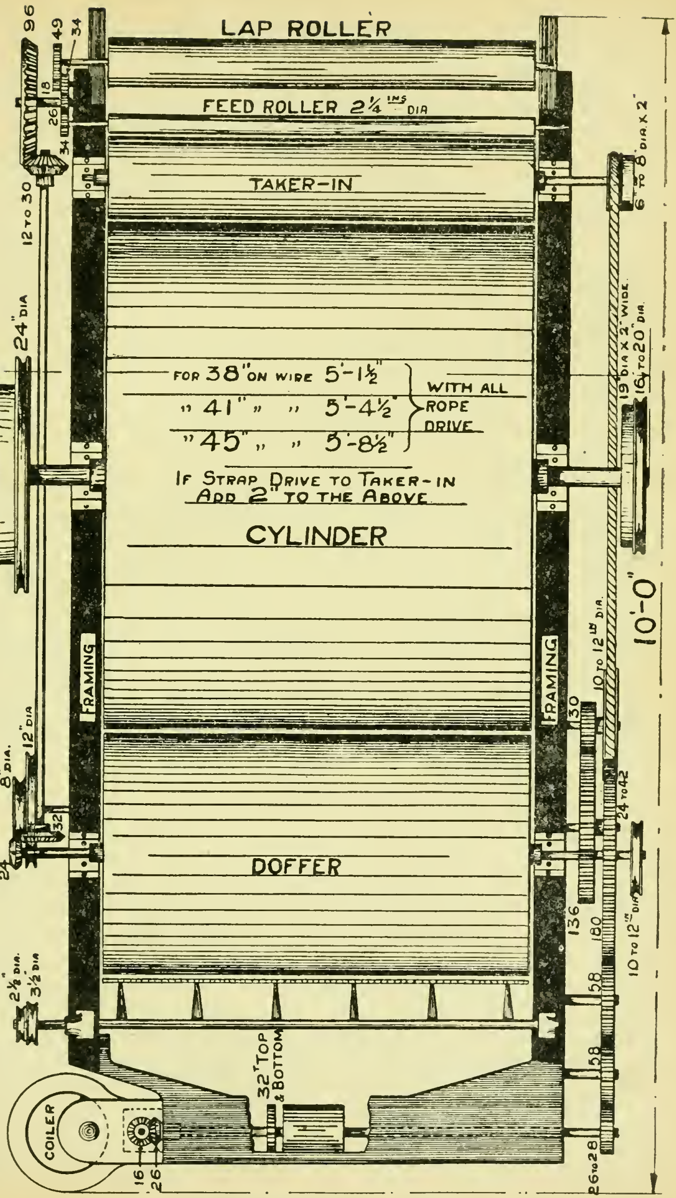
Calculations.

Draft and counts.—The draft that may be required in a Card is determined by dividing the weight in grains of a yard of lap by the weight in grains of a yard of sliver, or by dividing the counts of sliver by the counts of the lap, and to do this as exactly as possible it is well to reduce the actual weight or counts of the laps by about 5 per cent. for waste. Thus, if a yard of lap weigh a pound (7,000 grains) or is 0·00119 hank, the weight should only be taken as 6,650 grains, or the counts as 0·00125, and if a yard of the resulting sliver had to be $55\frac{1}{2}$ grains or 0·15 hank, the required draft would be 120. The draft is altered by changing the side shaft bevel, and the figures given below will be understood on reference to the small plan of the Card annexed:—

$$\frac{34}{26} \times \frac{96}{x} \times \frac{32}{24} \times \frac{180}{26,\ 27,\ 28} \times \frac{4\text{in.}}{2\frac{1}{4}} \ \frac{\text{Cal. R.}}{\text{Feed R.}} = \frac{\text{draft of}}{\text{Card.}}$$

Two factors in the above train vary; the wheel on the end of the calender which depends on the kind of cotton worked, and the diameter of the feed roller, which is **2¼in.** diameter for all widths of our make of Card.

From the fixed elements constants may be determined so that the draft or side shaft bevel may be immediately determined.



PLAN OF LEFT HAND CARD

SHOWING STRAP DRIVE TO TAKER-IN

They are given in the following table:—

Wheel on the end of Calender.	Feed Roller, $2\frac{1}{4}$in. diameter.	
26	2060	These are our usual constants, but the gearing can be altered to increase or decrease them if required.
27	1983	
28	1913	

These numbers divided by the draft will give the side shaft bevel to give that draft, or divided by the number of teeth in the side shaft bevel will show the draft it gives.

To find the draft between feed roller and doffer.—Wheel on side shaft × wheel on feed roller end × diameter of doffer ÷ bevel wheel on end of doffer × change pinion on end of side shaft × by diameter of feed roller = draft required.

Production.—It is impossible to give a standard list of productions, as these vary so very much according to the quality, weight of sliver per yard, and the class of cotton being worked. We, however, give a formula below by which this can be approximately arrived at:—

$$\frac{\frac{\text{minutes}}{\text{per hour.}} \times \frac{\text{revs. of doffer}}{\text{per min.}} \times \frac{\text{diam. of doffer}}{\text{with wire.}} \times 3{\cdot}1416 \times \frac{\text{weight of sliver}}{\text{(grs. per yd.)}}}{36\text{in.} \times 7{,}000 \text{ grs. per yd.}} = \text{lbs. per hour.}$$

If the result is multiplied by the actual working hours per week of the Card, allowing for all stoppages, cleaning, and grinding, the result will give the weekly production.

SPECIFICATION.

Details to be given when ordering Cards.

Diameter of the Cylinder 50in.
Diameter of the Doffer 24in.
Diameter of the Taker-in 9in.
No. of Flats 106, of which 42 are always working.
Speed of the Cylinder from 160 to 165 revolutions per minute.
How many Cards ?
Width of Lap from the Scutchers ?
Diameter of the Driving Pulleys ? Usually 16 inches.
When facing the Doffer how many Cards with Pulleys on the right
,, ,, ,, ,, ,, left ?
Are we to supply our Patent Flat Grinding Apparatus ?
Are we to supply our Patent Double Speed for the Doffer ?
Are we to supply a Mote Knife below the Taker-in ?
Are we to supply an Undercasing below the Taker-in ?
Are we to supply an Undercasing below the Cylinder ? In one or two parts ?
Are we to supply a Strap Fork ?
Are we to supply the Taker--in covered with saw tooth wire ?
Are we to supply the Clothing ?
Are we to supply the Flats with the tops attached ? And by what system ?
Counts of the Clothing Cylinder. Doffer. Flats.
What kind of cotton do you intend to work ?

DIMENSIONS OF THE CANS.

Total height ? Inside diameter ? Outside diameter at bottom ?

DIMENSIONS OF THE GRINDING ROLLERS.

Diameter of the Roller ? Length ? Diameter of the Shafts ?
Weight of one yard of Lap ?
Weight of six yards of Sliver ?

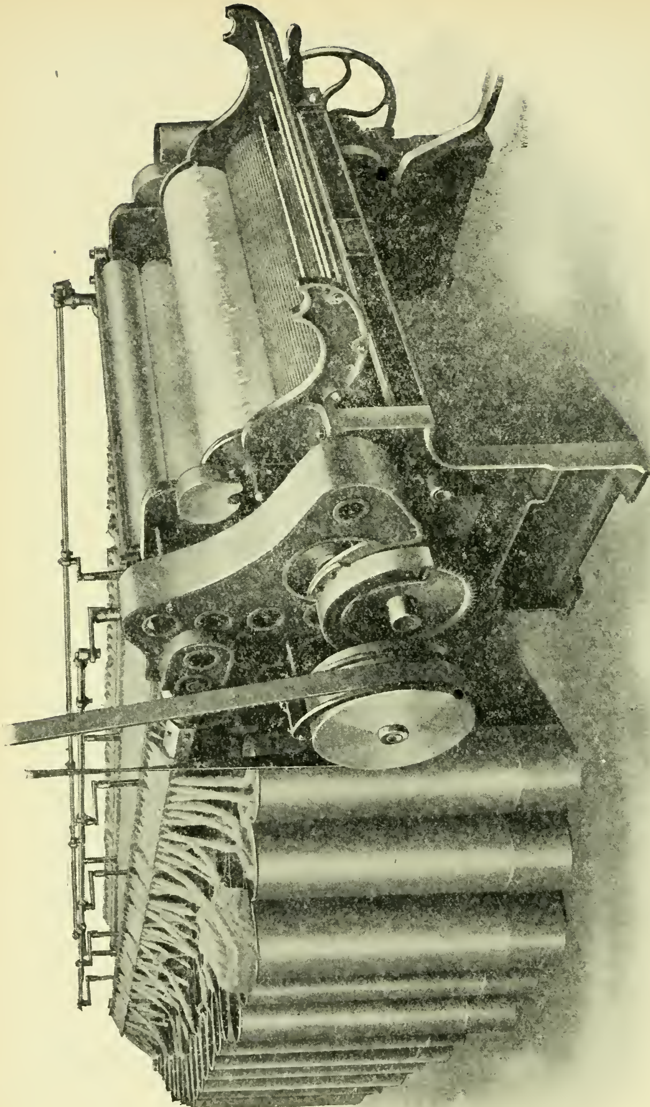
CHANGE WHEELS.

With each Card Two Side Shaft Bevels, and Two Barrow Wheels are delivered gratis in addition to the Wheels on the Machine itself.

Are we to deliver any extra Wheels ?
Side Shaft Bevels ? Barrow Wheels ?
When must delivery commence ? and when be completed ?

[If our works are closed by reason of strikes, lock-outs, breakdowns, or other unforeseen causes beyond our control, it is hereby understood that a reasonable delay in the time of delivery be allowed to us.]

Shipping instructions :
Terms of payment :
Observations and Remarks :



DERBY DOUBLER.

Derby Doubler.

The object of this machine is to unite into a sheet a given number of slivers from the Breaker Card and make them into a lap for the Finisher Card.

As it is necessary that the laps made on this machine should be uniform, there is a **stop motion** to each sliver which stops the machine when an end breaks.

These machines are constructed with four callender rollers, two iron bottom fluted drums and one iron top fluted drum, by which means the laps are made of much greater density and consequently of much greater weight than was possible formerly.

A measuring motion is applied which can easily be adjusted to make any desired length of lap.

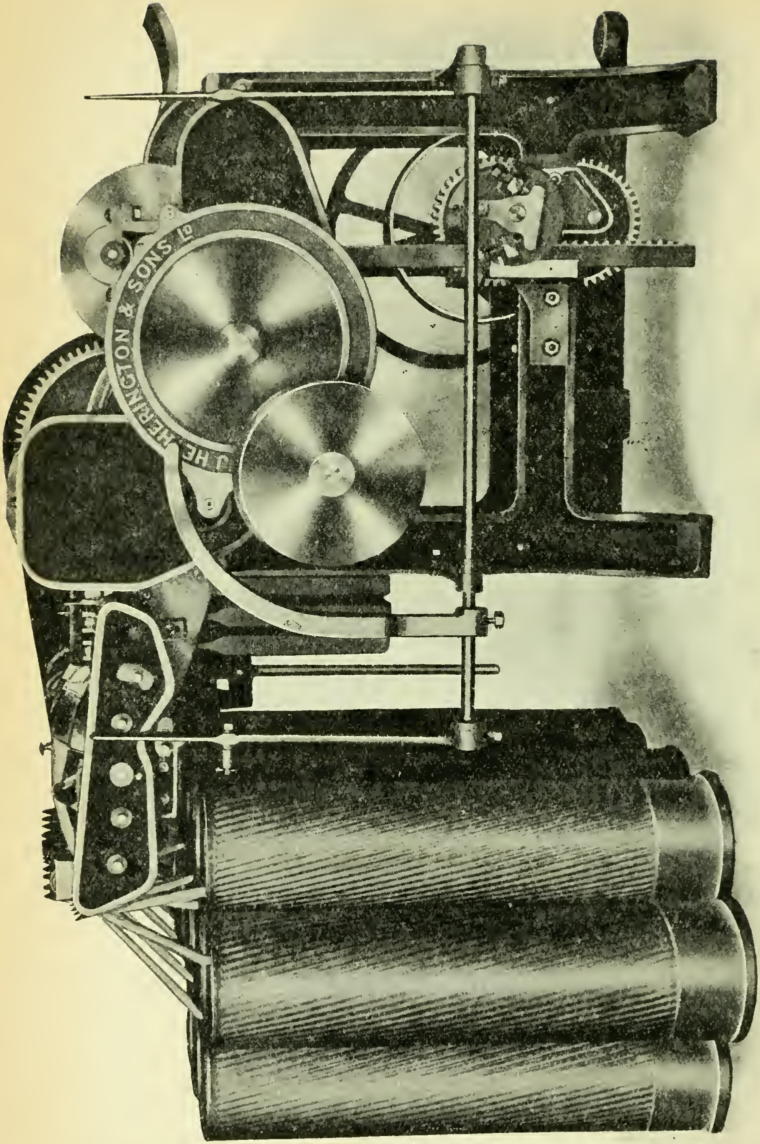
We have patterns with V table patent stop motion to each sliver or can for 22 to 140 cans.

Weights and Dimensions of Derby Doublers.

Cans per Machine	Width of Laps	Space occupied	Weights	
			Gross	Nett
		Ft. In. Ft. In.		
22	10in. to 13in.	9 0 × 6 0	45 cwt.	40 cwt.
36	17in. to 19in.	12 0 × 6 6	50 ,,	42 ,,
60	23-34-37in.	14 0 × 7 8	58 ,,	48 ,,
72 to 96	41in. to 47½in.	17 4 × 8 8	74 ,,	61 ,,
96 to 140	60in. to 66in.	23 1 × 9 8½		

Driving pulleys, 14in. dia., 3in. wide, making 150 to 200 revs. per min. **Power,** 96 cans 1½ I.H.P.

Production from 1,500 to 1,600 lbs. per day.



SLIVER LAP MACHINE WITH SINGLE PREVENTER.

Sliver Lap Machine.

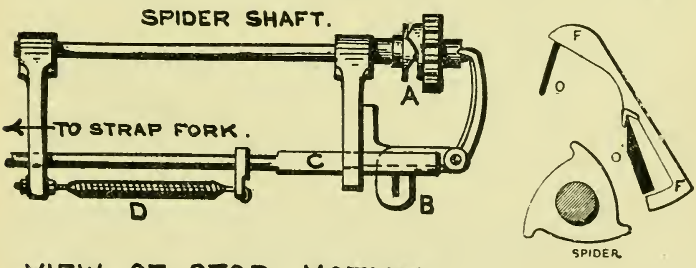
This machine when used in conjunction with the Ribbon Lap Machine is usually provided with three pairs of drawing rollers, but when this latter machine is not available and the laps are taken direct from the Sliver Lap Machine to the Comber four pairs of drawing rollers are recommended.

Callender rollers.—Two pairs of these are provided, and they are so arranged that the sheet of cotton is well consolidated and so made into a lap of the greatest possible density.

The lap spindle is specially constructed to allow of a quick and easy removal of the finished lap and replacement of a fresh bobbin.

Width of lap.—Machines can be supplied suitable for laps of $7\frac{1}{2}$in., $8\frac{3}{4}$in., 9in. and $10\frac{1}{2}$in. in width, composed of any number of slivers from 14 to 20, usually 18 for 9in. laps suitable for $10\frac{1}{2}$in. laps on the Ribbon Lap Machine for the Nasmith Comber.

Sliver stop motion.—Each sliver is provided with an automatic stop motion which brings the machine to a standstill before the broken end enters the rollers. It is on the same principle as that applied to the drawing frame. The spoons or tumblers **F** are pivoted on a fixed bar **O** having a knife edge; below this is a shaft on which are placed a

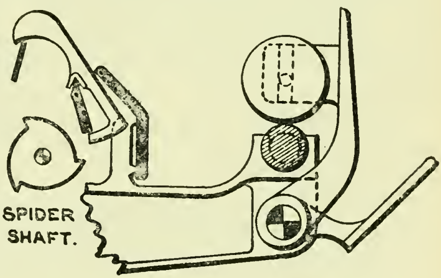


VIEW OF STOP MOTION.

number of spiders, or wings. This shaft is driven by an inclined clutch **A** which, so long as the shaft turns easily, is kept in gear by a counterpoise **B**. When the machine is at work the weight of the sliver keeps the upper end of the tumbler down, but directly the sliver breaks the lower end of the tumbler or spoon falls, and thus offers a solid resistance to the spider shaft. This stops the shaft and throws the clutch **A** forward, and the counterpoise **B** rising lifts the slide bar **C** out of a notch in which it rests and allows the spiral spring **D** to throw the strap on to the loose pulley.

Lap stop motion.—A full lap stop or measuring motion is also applied so that the size and weight of the laps can be regulated at will. The $7\frac{1}{2}$in. laps usually weigh 10 dwts. to the yard, and the $8\frac{3}{4}$in. laps 11·5 dwts. to the yard. In preparing laps for the Nasmith Comber these are from 21 to 24 dwts. per yard, 9in. wide for $10\frac{1}{2}$in. Combers, and are usually 12in. diameter. **The draft** in the machine should not be more than two.

Patent single preventer.—This motion is a very great help both in drawing the sliver from the cans in such a manner as not to break or strain it, and also in preventing the breakage of the sliver at any point between the guide and back pair of rollers. It also makes the sliver stop motion more positive in its action, so that in the event of a sliver breaking there will be no possibility of a "Single" or thin sliver going forward.



Formerly the laps from this machine were put directly on to the comber, but we now introduce an intermediate machine, described later, with a view to making laps in which the fibres are drawn more parallel and of more even section, with the object of getting better combing with less waste.

Pulleys 12in. × $2\frac{1}{2}$in. running usually at 250 revs. per min. The machine driving pulley, running at 250 revs. per min., will produce approximately 2,000 yards of lap per hour. The height from the floor to centre of driving shaft is 2ft. 4in., and the dia. of the shaft is $1\frac{1}{4}$in. **Power.**—Approximately one-third horse-power.

Floor space, including cans, 7ft. 6in. × 4ft. 6in.

Weight.—Approximate gross weight (9in. lap), 21 cwt. Nett weight (9in. lap), 18 cwt.

Production.—One machine will supply laps for six 8-headed Heilmann or six 6-headed Nasmith Combers.

Draft.—The draft in this machine is usually 1·95, and the wheels are as follows:—

$$\frac{64}{\text{B.R.W. } 33} \times \frac{24}{41} \times \frac{26}{50} \times \frac{21}{21} \times \frac{72}{29} \times \frac{12}{72} \times \frac{12\text{in. drum.}}{1\frac{1}{2}\text{in. B.R.}} = 1{\cdot}95.$$

Any alteration to the draft may be got by altering the 33 front roller wheel.

We supply extra with each machine one top roller and two change wheels. We strongly recommend the metallic rollers in this machine.

Hand of machine.—To determine the hand, stand facing the lap end of the machine, and note if the driving pulley must be on the right or left hand side.

SPECIFICATION FOR SLIVER LAP MACHINE.

JOHN HETHERINGTON & SONS, LIMITED, MANCHESTER.

NOTE.—Should these works be closed, wholly or in part, through strikes, lockouts, breakdowns, or any unforeseen causes, a reasonable delay to be granted to the makers.

SLIVER LAP MACHINE.

How many Lap Machines? Width of Lap to be made?

Diameter of the Rollers? First Second Third Fourth

Are we to supply *Metallic* Rollers or ordinary ones?

Draft 4th to 3rd	×	×
,, 3rd to 2nd	×	×
,, 2nd to 1st	×	×
,, 3rd to 5in. Call	×	×

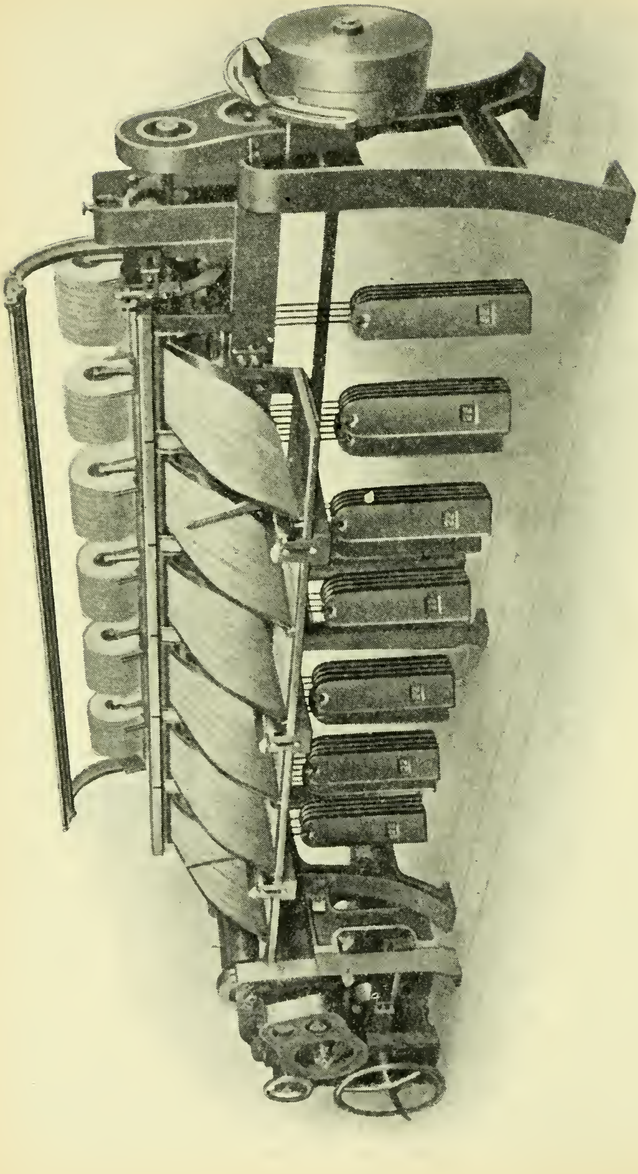
Are we to cover the Top Rollers and Clearers?

Diameter of the Driving Pulleys? Speed per minute?

No. of ends up? Weight per yard of Sliver?

One extra ordinary Top Roller and Three Draft wheels are supplied gratis with each machine.

When must the machine be delivered, and how?



RIBBON LAP MACHINE.

Ribbon Lap Machine.

The purpose of this machine is to draw six laps made by the Sliver Lap Machine into one, and a draft of six is therefore provided for.

The six laps placed in the creel pass through four lines of drawing rollers, each resulting web then being taken over a highly polished curved plate which conducts it on to the front table of the machine, along which it travels at right angles to its path through the rollers. This implies the whole six being laid one upon the other before they reach the end of the table on which are arranged a number of press rollers to ensure an even contact of the six component layers of the new lap, which is then thoroughly consolidated by the two pairs of heavily weighted callender rollers and re-wound on a bobbin by the lap drums.

Advantages.—The drawing process straightens the fibres, the draft usually approaching six, and the superposing of the six webs gives laps of absolutely even section, so that all the fibres are firmly held by the comber nipper, the two causes combining to reduce the comber waste to a minimum, and increasing the production.

The laps from the Sliver Lap Machine are usually made $1\frac{1}{2}$in. narrower than those to be made by the ribbon lap machine to allow for the spreading of the cotton in passing the draw rollers of the latter.

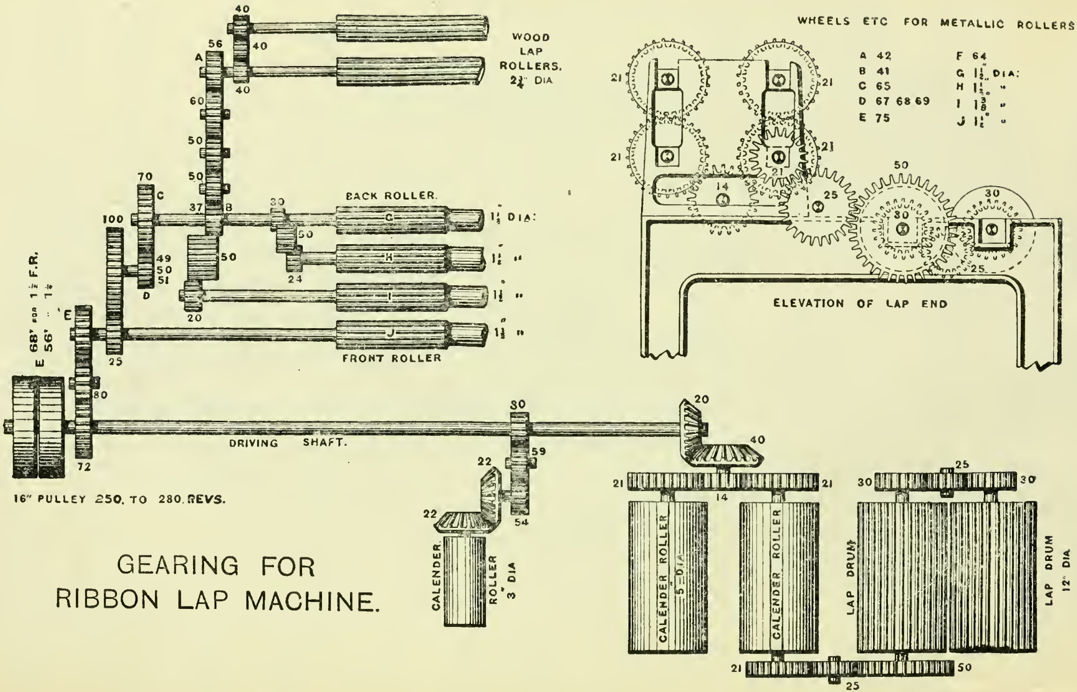
Stop motions are applied to each lap, so that if one runs off, the machine comes to a standstill before the sliver enters the rollers.

A full lap stop or measuring motion is also applied, so that the size of the laps can be regulated at will and all the laps made alike, both in size and length.

Rollers.—We strongly recommend metallic rollers in these machines. If ordinary rollers are used the top rollers should have **loose ends.**

The stands are made on the same principle as those on the drawing frame, that is, each slide can be set separately and is furnished with an easily renewable brass step.

Clearer covers are now made of sheet steel, and we can supply either the Stationary or the Ermen's Clearer.



GEARING FOR RIBBON LAP MACHINE.

The curved web conductors are usually made of sheet steel pressed into shape and nickel plated. We can supply them in highly polished cast iron or at an extra cost cover them with sheet brass.

Our illustrations show the machine in perspective, and a plan is also appended giving the details of the gearing, size of pulleys, speeds, &c.

The theoretical production may be obtained from the following formula:—

$$\frac{\text{Speed of the pulleys} \times \text{weight of yard of lap in grains}}{80}$$

The result will be pounds in 10 hours, and should be reduced by about 10 per cent. to obtain the actual production, the allowance being for stoppage and taking off the laps.

The weight of the laps varies from 10 to 14 dwts. per yard according to the width and the quality of combing required for Heilmann Combers, and from 24 to 27 dwts. for Nasmith Combers. They may be made $7\frac{1}{2}$in., $8\frac{3}{4}$in., or $10\frac{1}{2}$in. wide for Heilmann and $10\frac{1}{2}$in. for Nasmith Combers.

Draft.—The total draft in the machine is:—

$$\frac{56 \times 70 \times 100 \times 68 \times 20 \times 14 \times 21 \times 12\text{in.}}{30 \times \text{change wheel} \times 25 \times 72 \times 40 \times 21 \times 50 \times 2{\cdot}75\text{in.}}$$

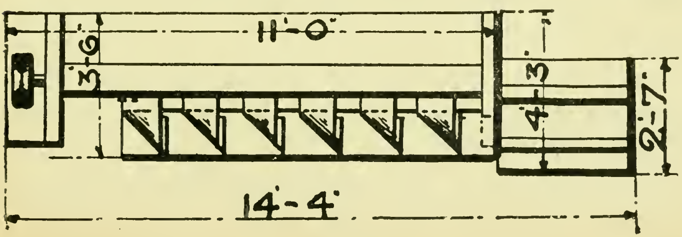
$$= \frac{301{\cdot}7}{\text{change wheel}} = \text{Draft} = \left\{ \begin{array}{l} \text{From the wood} \\ \text{lap roller to the} \\ \text{12in. drum.} \end{array} \right.$$

The draft in the fluted roller is ...... $\left\{ \frac{70}{\text{c. w.}} \times \frac{100}{25} = \frac{280}{\text{change wheel}} \right.$ if both back and front rollers are the same diameter.

Weight of a machine of six heads and for $10\frac{1}{2}$in. laps:

Gross	(machine alone)	46cwt. 3qrs.	(roller weights)	8cwt. 2qrs.
Nett	,, ,,	31 ,,	,, ,,	8 ,,

Cubic feet with weights, 118.



Floor space for 6 heads, 14ft. 4in. × 4ft. 3in.

Production.—One machine to six 8-headed Heilmann Combers; one machine to six 6-headed Nasmith Combers.

Driving pulley, 16in. diameter × 3in. The height of the driving shaft centre from the floor is 24½in. and the diameter of the shaft is 1½in.

Speed, 250 revolutions per minute, for 5 or 6 combers.

Power required approximately, 1 H.P.

Hand of machine.—To determine the hand of the machine stand facing the curved plates, and note if the driving pulley must be on the right or left hand side.

SPECIFICATION FOR RIBBON LAP MACHINE.

JOHN HETHERINGTON & SONS LIMITED, MANCHESTER.

NOTE—Should these works be closed, wholly or in part, through strikes, lockouts, breakdowns, or any unforeseen causes, a reasonable delay to be granted to the makers.

RIBBON LAP MACHINE.

How many Ribbon Lap Machines? Width of Lap to be made?

How many Heads per Machine?

Diameter of the Rollers? First Second Third Fourth

Are we to supply *Metallic* or ordinary Rollers?

If the latter, will you have the Top Rollers with *Loose Ends?*

Are we to cover the Top Rollers and Clearers?

Will you have the Curved Plates covered with Sheet Brass?

Diameter of the Pulleys? Revolutions per minute?

When facing the table how many machines with Pulleys on the right?

" " " " " " " left?

One extra ordinary Top Roller and Three Draft Wheels are supplied gratis with each machine.

When must the machines be delivered, and how?

Draw Frame and Lap Machine Combined.

When the Ribbon Lap Machine is not used the slivers from the Card are usually put through one head of drawing, and afterwards these slivers are made into a lap on the ordinary Sliver Lap Machine.

The Draw Frame and Lap Machine is used in some districts in place of the Sliver and Ribbon Lap machines for making the comber laps direct from the Card Sliver.

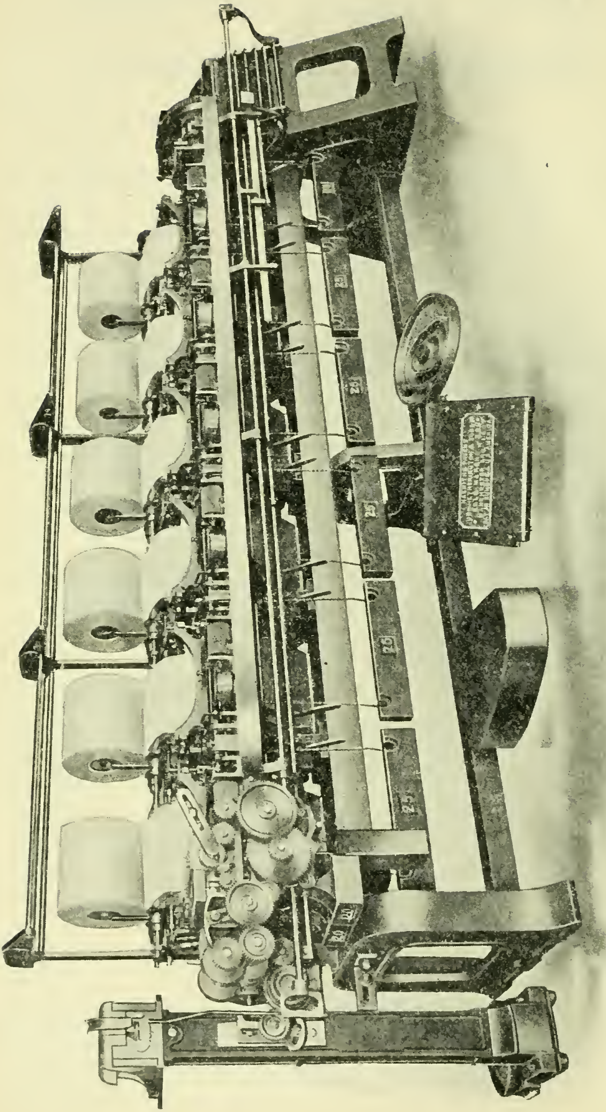
These machines are usually made 3 or 4 deliveries, with about 12 cans per delivery. The slivers pass through 4 pairs of drawing rollers, and are afterwards combined together and made into a lap of a suitable width and weight for the comber as in the case of the Ribbon Lap Machine.

Floor space.—A machine of three deliveries, 21½in. gauge and 36 cans, with lap machine = 12ft. 2in. × 5ft. 3in. wide.

For four deliveries = 14ft. 0in. × 5ft. 3in. wide.

Driving pulley.—16in. to 20in. dia. × 3in. wide. **Speed.**—175 revs. per min.

Power for four deliveries, ¾ H.P.



"NASMITH" COMBER.

Nasmith Comber.

The Heilmann Combing machine was introduced to the cotton trade by JOHN HETHERINGTON & SONS in 1850, and it has since that time until recently remained without a serious rival. All admit the excellence of the work done by it, but it is also acknowledged that its production is small, that the piecing and overlap leave something to be desired, and that it is only effective when treating long cotton. Its use has therefore been restricted to the finer branches of cotton spinning.

An intimate knowledge of the Heilmann and of the Hetherington Lecoeur Combers enabled the designer and patentee of the Nasmith Comber to retain all the best points of the Heilmann whilst obviating its two chief defects, namely, its low production and defective piecing and overlap, greatly simplifying the mechanical detail at the same time, and producing a machine applicable to all lengths of cotton fibre.

The advantages of the Nasmith Comber may be summarised as follows:—

(a) Without increase of speed, twice the production of a Heilmann Comber can be obtained and the quality maintained, thus economising floor space, power, wages, and repairs.

(b) It will deal with all lengths of staple from $\frac{7}{8}$ inch to 2 inches, without abnormal waste on the shorter varieties.

(c) It makes a perfect piecing with long overlap even on the shortest cotton, and the well-known cloudy Heilmann draw-box sliver is entirely obviated.

(d) The quantity of waste is easily controlled and if desired it will work with very low waste, even on short staple, for semi-combed yarns.

(e) All its motions, except those of the detaching rollers, are continuous, so that there is only one cam in the machine, which runs very quietly and with proportionately reduced wear and tear.

(f) **Its mechanism and adjustment are much simpler than those of any other comber; it rarely requires resetting, and all its parts are easily accessible.**

(g) **There is no leather covering required on the nipper, which, once set, cannot be made to touch the cylinder.**

(h) **To change from long to short cotton** takes less than an hour.

In addition to the foregoing advantages, the following details may be noted :—

Dimensions.—It occupies the same space as a Heilmann Comber of the same number of heads and width of lap, but **stands 4 inches lower** for convenience of the tenter.

The headstock is made extra strong and cast in a solid piece to prevent vibration.

The stands for each head are mounted on a beam of a very strong section.

The bearings of the cylinder, nipper shafts and detaching rollers are split bushes of standard size, easily and cheaply renewable when necessary.

The nipper pivots are plain studs in cast-iron bushes renewable at a trifling cost.

The brush and doffer shafts can be lifted straight out without disturbing any other part of the machine.

The front plate extends backward to the detaching rollers, completely covering the callender shaft.

A convenient weight-relieving motion obviates the lifting of the detaching roller weights by hand.

A selvage guide between the detaching rollers insures perfect selvages instead of trailing, ragged ones.

The drawing head is made with four rows of rollers supplied with the ordinary stationary flat clearer or the "**Ermen**" if desired.

Stop motions can be applied to each sliver as it leaves the collecting tin, which stops the machine when the thickness of the sliver becomes too heavy or too light; also a **coiler stop motion** for automatically stopping the machine when an end fails or is not up to the average weight required. **A full can or measuring** motion is sometimes applied which automatically stops the machine when any given length of sliver has been delivered.

SECTION OF NASMITH'S PATENT COMBER.

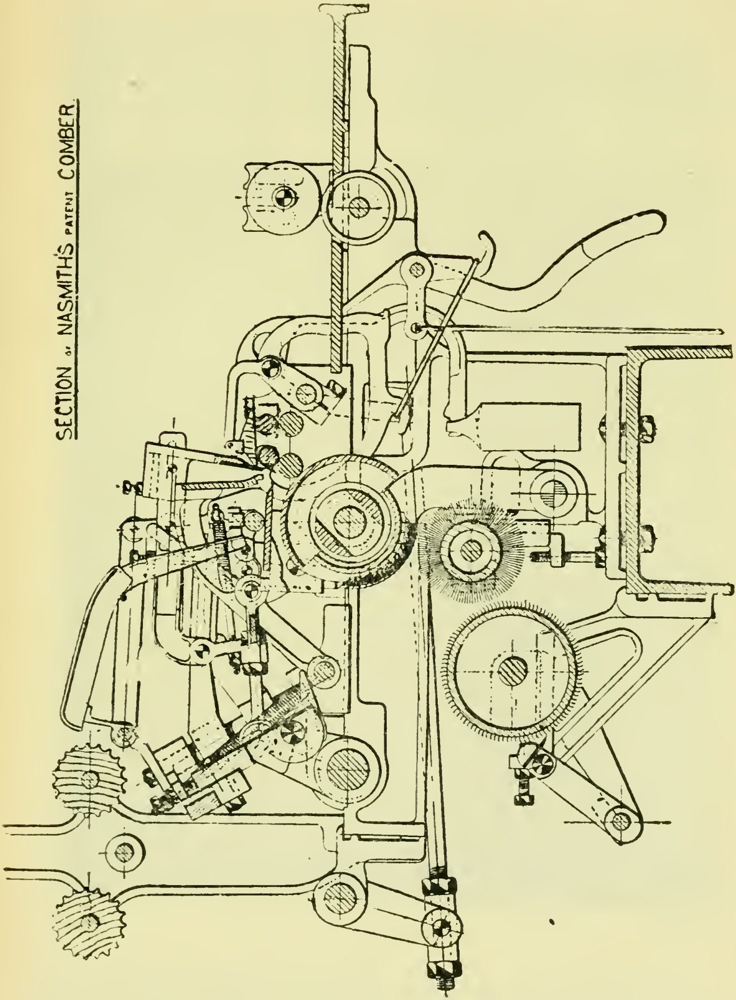
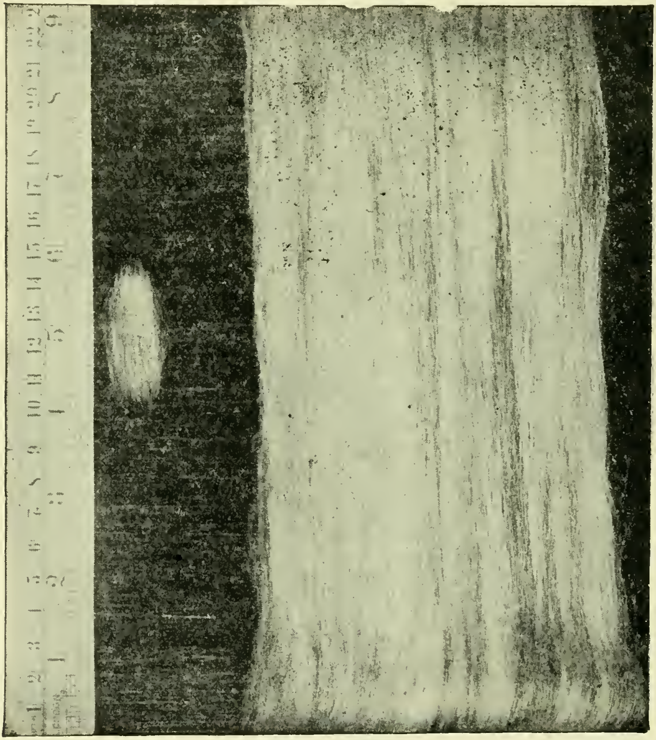


Fig. 1.

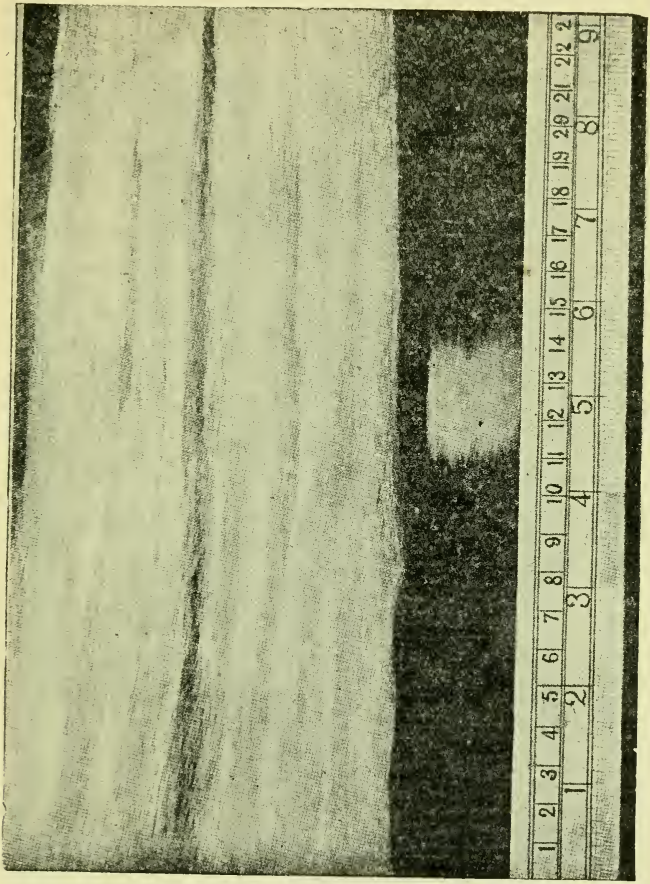
Waste arrangements.—We supply, when ordered, a waste shaft for receiving the waste and forming same into a lap in place of allowing it to drop into the ordinary waste bin. Another method is to have movable bobbins around which the lap is formed, each bobbin receiving the waste from two heads.

Waste tins.—We can, if desired, supply the **circular waste tin** for the lap-forming arrangement, or the **ordinary waste tin** used when the waste is delivered in a loose state.



No. 1.

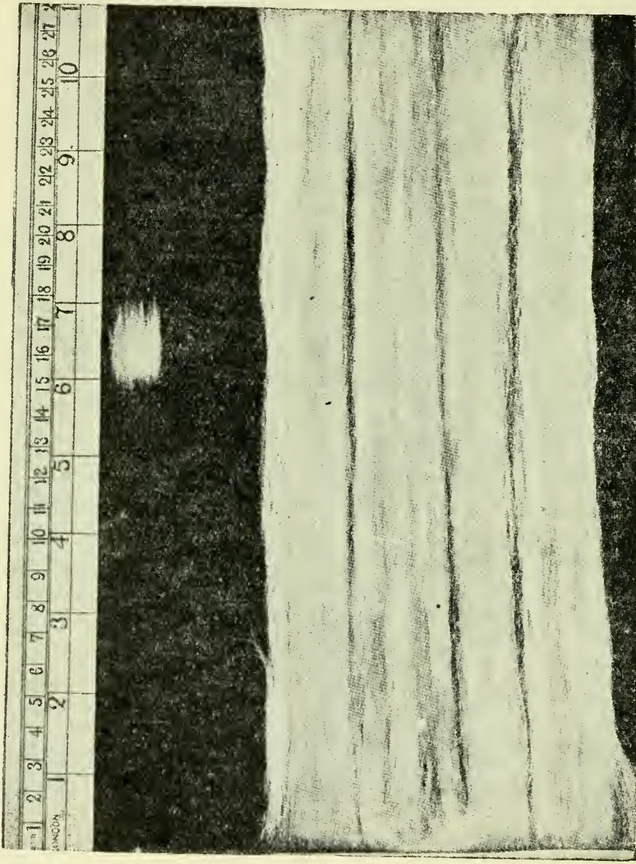
We are also licensees for the **Roth Patent Aspirator,** which, working in conjunction with the brush, replaces the doffers and doffing combs by a perforated tube and damper, acting on the same principle as the scutcher cage. A small fan placed under the headstock, driven from the driving shaft, provides the draft, which is only slight; see illustrations on pages 113 and 117.



No. 2.

The advantage of this apparatus is that it not only collects the waste from the brush but also all the fly from other parts of the comber, and keeps the room clean. So much is this the case that it is never necessary to stop for cleaning except at the week-end to clean the machinery parts. The production of the machine is increased about 8 per cent. by saving cleaning time, and one tenter can take care of an extra machine.

Staple.—The range of staple that can be combed is much more extensive than on the Heilmann machine.



No. 3.

Owing to the manner of making the piecing, cotton with a length of staple of $\frac{7}{8}$-inch can be combed and a uniform fleece produced, so well amalgamated that it can be lifted from the detaching roller and laid over the creel without rupture. Illustrations taken from photographs are shown of three different staples, as the fleece leaves the front roller of the draw box, looking more like a drawing frame sliver than a comber sliver, and this shows the excellent piecing which characterises this machine and makes the yarn so remarkable for evenness and strength, notwithstanding the small percentage of waste taken out.

The work of the Nasmith Comber may be classed under three heads:—

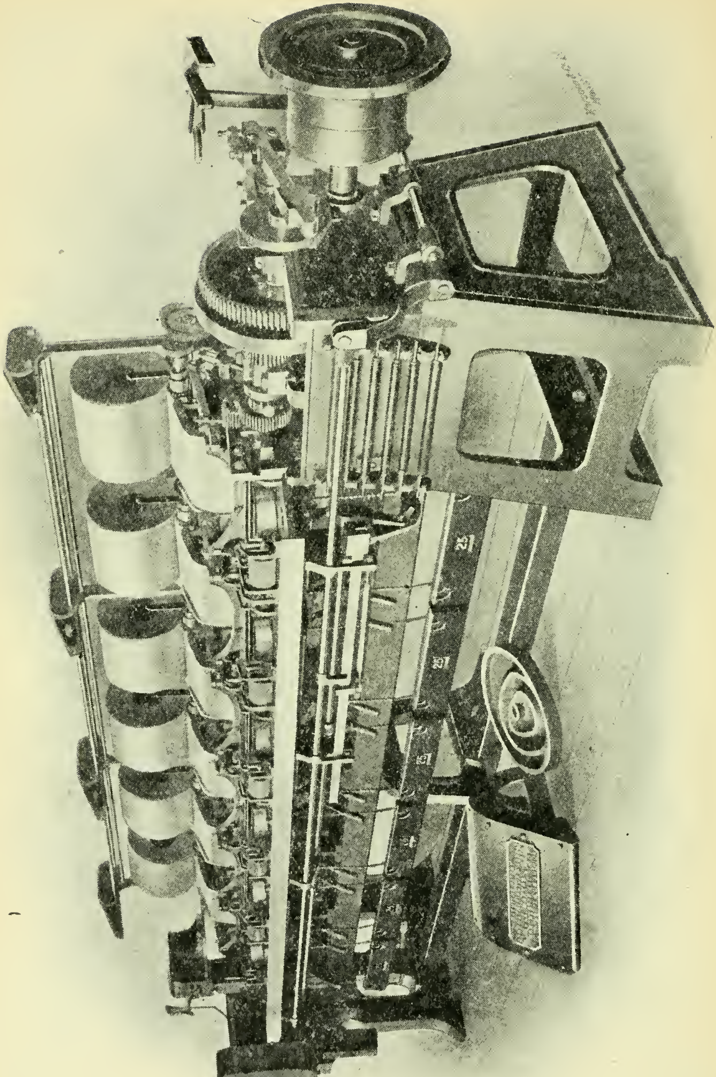
1. **Fine combing proper,** when it does the same work as the Heilmann. In this case not more than twice the production of the Heilmann for the same quality should be attempted, and for Sea Island cotton not more than 75 per cent more.

2. **Medium combing** where high production and low waste may be obtained.

3. **Coarse combing** to take the place of fine carded yarns or ordinary carded yarns. In this case special cylinders and top combs are used and a high production attained with waste from 5 to 8 per cent. The yarn must not be compared with real combed yarns, but is better than any carded yarn, even when, in preparation for this combing, the card production is pushed to its limit and the card waste reduced to $2\frac{1}{2}$ per cent. For this class of work 1,000 pounds may be put through both card and comber weekly. This high production and low waste opens again for spinners the question of combing for ordinary and medium yarns.

The illustration shows a six-head Nasmith Comber, and the sectional views with the following description will make the main details and action of the machine clear to the reader. Fig. 1 shows a complete section through a head. Fig. 2 shows the crank, M, on the end of the cylinder shaft, A, for rocking the nipper shaft, W. The peculiarity of this motion is the slow advance of the nipper towards the detaching rollers, allowing maximum time for the detaching operation and the quick return. The motion of the nipper is continuous, smooth, and quiet.

Figs. 3 and 4 are sections showing the parts at the close of the detaching period and during combing respectively. Fig. 5 shows the details of the top comb, and Figs. A, B, and C of Fig. 6 show the position of the parts at various points of the stroke.



"NASMITH" COMBER.

The combing cylinder has 17 rows of needles, no fluted segment to wear the brushes, plain ends without bosses or set screws, and is completely enclosed.

The nipper, driven by a crank, is silent and self-contained, with fixed lower jaw that cannot touch the cylinder. It has no leather covering, closes gently without hammering, with little tension on the springs when opening, the weight coming on gradually as it closes. It swings on 1-inch studs 3 inches long, rocking in cast-iron bushes, and never requires resetting.

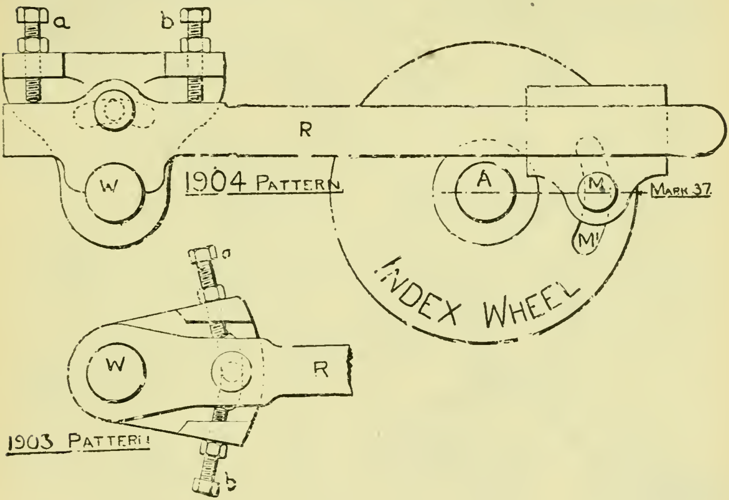


Fig. 2.

The nipper shaft, W, Fig. 3, is rocked to and fro by a crank, Fig. 2, and is connected to the nipper bridge, S, by the arms, W^1, and connecting rods, V (two to each nipper), with adjusting nuts, V^1, so that the nipper jaws may be set parallel to and at the proper distance from the steel detaching roller, D. Once all the nippers are correctly set, their distance from the roller, D, may be altered simultaneously by the screws, *a* and *b*, Fig. 2. The nipper bridge, S, is bolted at each end to an upright, N, secured to a stud, N^1, which rocks in a bush carried in the framing. The top

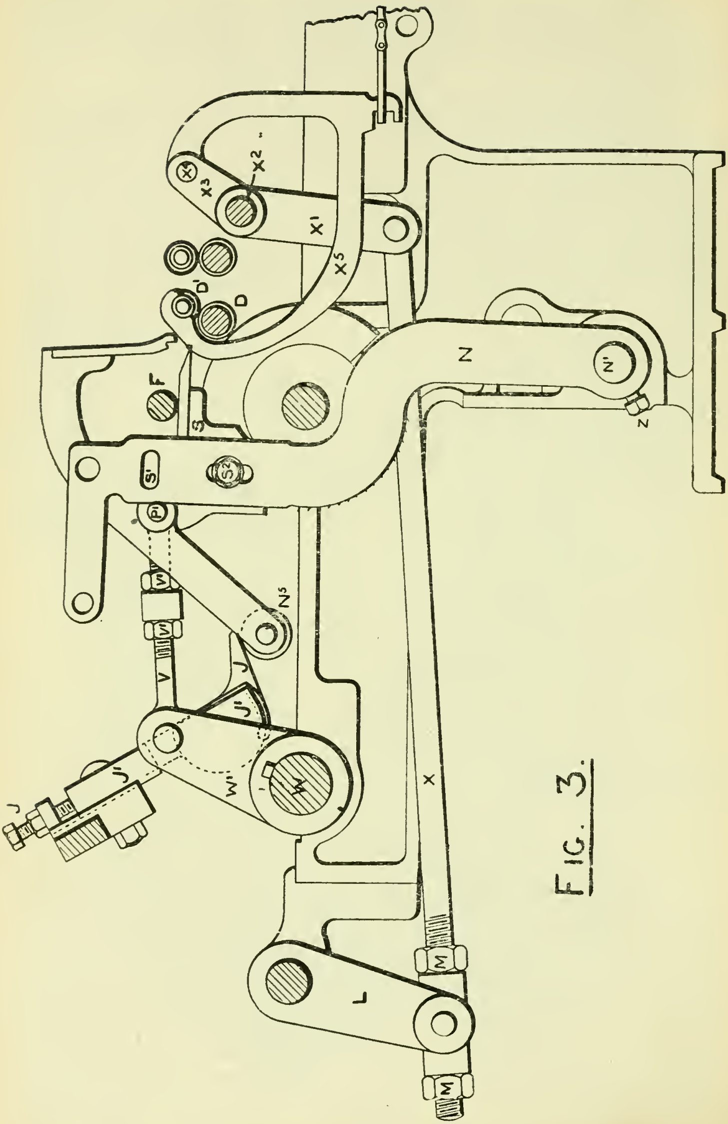


Fig. 3.

nipper arms pivot on studs, P^1, carried in projections cast on the bridge, S. At the lower end of the arm a cross bar carries a bowl, N^5, which comes in contact with the adjustable incline, J, and opens the nipper as it moves forward. When the nipper moves back for combing, Fig. 4, this bowl leaves the incline, J, and the nipper closes under the influence of springs attached to the lower end of the nipper arms. There is little pressure on the springs when the nipper is opening, but a strong pressure when closed during combing. The opening and closing thus takes place gently and without the detrimental hammering blow observable in the Heilmann and other combers. The nipper is adjustable to the needles by set screws, T, Fig. 4, and once set is a fixture and cannot be made to touch the cylinder, as its path if continued in both directions never intersects the circumference of the cylinder.

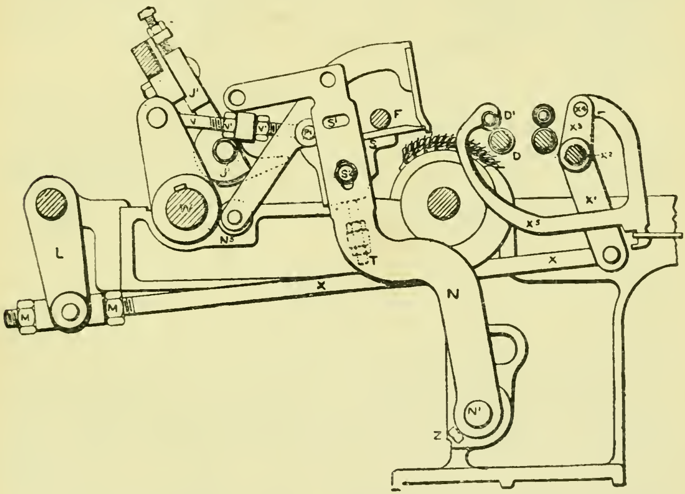


Fig. 4.

The feed roller.—Each nipper carries its own feed roller, F, Fig. 4, which is adjustable on the nipper plate, so that its distance from the jaw of the nipper is easily set to suit the length of the fibre operated on. The roller receives its rotation from the movement of the nipper through a ratchet and pawl. The roller turns inside a stationary bush, and the ratchet lever rocks on the outside of the bush, so there is no contact between the roller and ratchet except through the pawl, the whole being enclosed in a casing to exclude fluff and dust. There are no change wheels, the amount of feed being altered by the simple displacement of a stud.

The top comb.—Fig. 5 shows the disposition of the top comb, C, which is bolted to the slot in the arms, C^1. This slot and set screws, C^5, permit an adjustment of the angle of the comb within the required limits. The arms, C^1, are pivoted on the nipper frame at C^3, and consequently participate exactly in the reciprocating motion of the nipper. During combing the weight of the comb rests on the set screws, C^4, which regulate the depth of penetration of the comb. When the nipper goes back the bowl C^2 comes in contact with the adjustable bar, I, and is gradually raised to keep the comb clean. Thus the height at which the bar, I, is adjusted determines the moment or time when the top comb enters the fleece, and the set screws, C^4, the depth of penetration.

It will be noticed from the foregoing that the opening and closing of the nipper, the raising and lowering of the top comb, and the rotation of the feed roller all result naturally and in the simplest manner from the reciprocating motion of the nipper **driven by a simple crank.**

The detaching rollers.—The position and action of the steel detaching roller, D, Figs. 3, 4, and 5, is identical with that of the Heilmann machine, except that the rotation of the roller continues a much greater time during each stroke in the Nasmith than in the Heilmann. The surface speed of the roller never exceeds that of the Heilmann roller; it only takes a longer time to perform its greater arc of revolution. Again, the surface speed of the Helimann roller must coincide exactly with that of the fluted cylinder, and after backing off it must acquire this speed in the briefest possible fraction of a stroke. The leather roller never coming into contact with the cylinder, no such embarrassing restriction exists in the Nasmith machine and the rollers stop and start gently, the cam being designed to start and stop the sector just as a crank would.

The leather covered detaching roller, D^1, Figs. 3, 4, and 5, never comes in contact with the cylinder, but rests simply on the bottom roller, from which it receives its rotary motion, and in addition to this it receives a bodily movement to and fro, from the position of Fig. 3 to that of Fig. 4. This is obtained from the lever, L, keyed on its shaft, and operated by a simple eccentric on the cylinder shaft (not shown). The connection is made through the rod, X, with adjusting screws, M M, to the lever, X^1, and the weight hook, X^5.

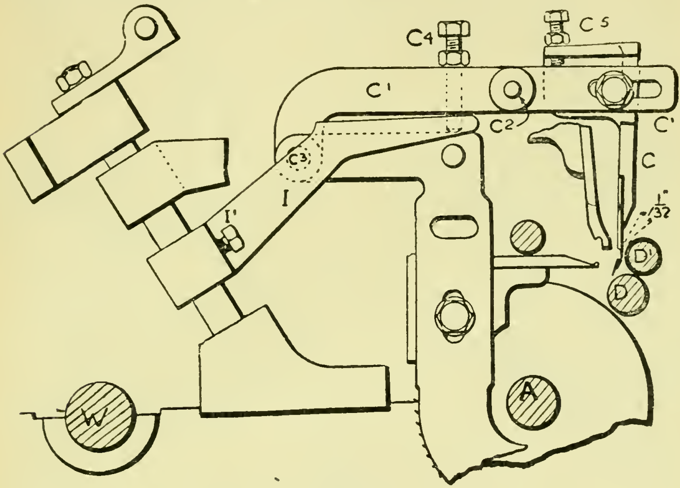


Fig. 5.

Five important advantages result from this disposition:

1. The time available for detaching and drawing through the top comb is greatly prolonged.

2. The top roller is as easily set as a drawing head roller, doing away with any delicate adjustment.

3. No definite and fixed surface speed of the roller is imposed and a smooth cam takes the place of the abrupt notch wheel cam.

4. The shock and deflection of the leather roller dropping on the cylinder under the influence of weights is done away with, and a 25-pound weight easily works a $10\frac{1}{2}$-inch lap of 600 or 700 grains per yard.

5. A long overlap and perfect piecing are obtained even with $\frac{7}{8}$-inch staple.

Action of the machine.—Having described the details of the machine, we may follow it through one cycle of operations. Fig. 6, A, B, C, shows the main organs in three positions. The first, Fig. A, shows the needles passing through the end of the lap, held down by the closed nipper, which is now in its rearward position (the dead point of the crank). Before the fine needles have passed the nipper is already moving forward in the same direction as the cylinder, thus reducing the effective speed at which the needles are passing through the cotton and easing the strain on the fibre. In Fig. B. of Fig. 6 the needles have passed and the nipper is about the middle of its path toward the detaching rollers. As the last row of needles passes under the detaching rollers the latter turn backward, and owing to the top roller leaning toward the cylinder the end of the combed fleece thus delivered backward is projected into the space between the last row of needles and the plain segment, whose front edge strokes the fleece close against and under the bottom roller, so as to present a clean surface to the advancing nipper tuft for piecing. Meantime, the nipper having opened, the lap end rises automatically and points directly towards the nip of the rollers. It would rise higher, but is met by the falling top comb and kept in proper position. The detaching rollers now begin to turn forward and seize the tips of the fibres presented by the advancing nipper and pull the lap end into the top comb. The nipper continues to advance, but with diminishing speed (approaching the dead point of the crank), thrusting the end of the lap gradually into the nip of the rollers, which successively seize fresh fibres and draw them off through the top comb. The top roller moves away before the advancing nipper and top comb, but is eventually overtaken by them as both the nipper and roller arrive at the end of their respective paths; this is best seen in Figs. 5 and 6. The rollers continue their rotary movement an instant longer to commence the separation, which is completed by the withdrawal of the nipper and top comb, leaving a short combed end projecting from the rollers, and the process recommences.

The overlap of the piecing thus obtained is about two inches as compared with about $\frac{5}{8}$ inch on a Heilmann for any staple. Further, the detachment is a comparatively slow and continuous operation, compared with a practically instantaneous snatch in the Heilmann, as both leather roller and fluted segment are moving at full speed when they fall together, whereas the rollers in the Nasmith are only starting up slowly when they seize the nipper tuft. Again, the Heilmann roller drops on the nipper tuft about $\frac{3}{8}$ to $\frac{1}{2}$ inch from the tip, and, so to speak, in the quick of the lap, where it draws with difficulty, whereas the Nasmith rollers seize the lap by the extreme tip, where it draws easily and with-

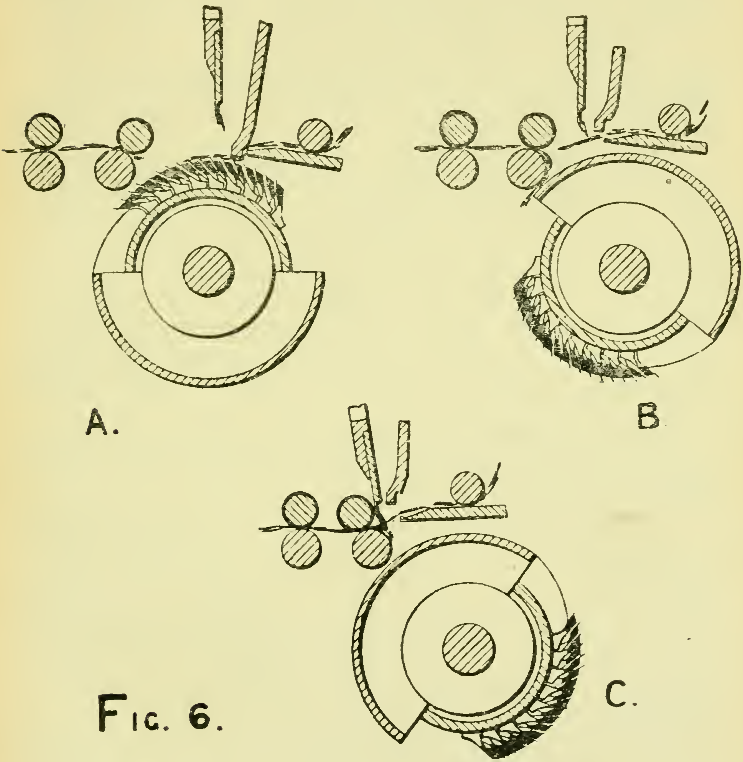


Fig. 6.

out undue strain. The Heilmann rollers have to complete the separation without assistance from the nipper, consequently much of their forward movement is unproductive, while the forward motion in the Nasmith is almost entirely used for producing, the separation being completed by the retirement of the nipper.

Weight of laps.—The $10\frac{1}{2}$in. laps may weigh :—
For superfine work from Sea Island, 13 to 18 dwts. per yard.
For medium work from Florida, 18 to 22 dwts. per yard.
Egyptian and American, 22 to 32 dwts. per yard.
For Sea Island and light laps a fine cylinder is recommended, with 33 top combs, 81 needles to the inch. For Egyptian and Long American the standard cylinder, with 28 top combs, 66 needles to the inch is used. **In all cases the top comb needles should project $\frac{3}{16}$in. from the comb stock.**

Amount of feed.—Four or five teeth of feed may be taken, the former for the finer work, but six teeth are rarely practicable. It is better to work with a heavy lap and light feed than a light lap and heavy feed.

The waste for ordinary work may vary from 12 to 30 per cent., and for semi-combed 5 to 12 per cent., according to the quality required. The quantity is under complete and easy control, and may be altered to any extent in a few minutes. The chief factor in determining the length and consequently the amount of waste is the distance between the nipper and the steel detaching roller when the nipper is at the forward end of its path. This distance, on all the nippers, may be simultaneously altered by screws *a* and *b*, Fig. 2.

Double combing is cheaply done with this machine owing to its high production, and the second combing may take 3 to 8 per cent. of waste.

The production naturally varies as in other combers, according to the quality of work required, and depends largely on the nature of the cotton. Good work with fairly carded Egyptian cotton can be obtained by using a 25 dwt. lap and 5 teeth of feed. At 100 beats per minute, with 15 per cent. of waste, rather over 800lbs. can be got from a six-headed machine in 50 hours. The general production formulæ are as follows :—

P = The pounds produced per head per hour continuous work.
R = The number of teeth of the lap ratchet taken each stroke.
W = The weight in grains of a yard of lap after deducting the waste.
X = The teeth in the change wheel on the lap ratchet. (Usually 42.)

$$P = \frac{100 \times R \times X \times 35 \times 2{\cdot}75 \times 3{\cdot}14 \times 60 \times W}{75 \times 80 \times 47 \times 36 \times 7000} = \frac{R \times X \times W}{3918{\cdot}9}$$

or if X is the usual $42 \dfrac{R \times W}{93{\cdot}307} = P$

Then if R is 4 teeth $\dfrac{W}{23{\cdot}3} = P$ if R is 5 $\dfrac{W}{18{\cdot}66} = P$

THE GEARING AND THE DRAWING HEAD.

Plan on page 109.

To determine the total draft between the lap and the sliver,

If W = the weight of a yard of lap in grains, after deducting the loss in waste,

N = the number of laps up or number of heads,

S = the grains in a yard of sliver,

Then the total draft, $T = \dfrac{W \times N}{S}$

To determine the draft wheel to give any required total draft,

Let R = the number of teeth of the lap ratchet taken every nip,

C = the number of teeth in the cross shaft wheel,

And D = the number of teeth required in the draft wheel.

In calculating the total draft, consider the lap roller as driving through to the coiler top, then for No. 4 drawing heads we have

$$\frac{47 \times 80 \times 75 \times C \times 88 \times 2\tfrac{1}{16}\text{in.}}{35 \times 42 \times R \times D \times 63 \times 2\tfrac{3}{4}\text{in.}} = T \quad \text{The total draft;}$$

thus $\dfrac{201 \times C}{RT} = D$ (The draft wheel).

From this a constant is determined for all values of C and R. The former is 60, 66 or 77, and the latter 4 or 5.

Teeth of Feed.	Cross Shaft Wheels.		
	60	66	77
4	3015	3318	3870
5	2412	2652	3095

The numbers given above divided by the total draft gives **the draft wheel.**

Example: With six laps up weighing 25 dwts. per yard and deducting 15 per cent. for waste with 50 grains per yard in the sliver, the total draft would be

$$T = \frac{510 \times 6}{50} = 61{\cdot}2$$

Then, if 66 be on the cross shaft and 5 teeth of feed are taken each stroke on the feed ratchet, the constant from the table is 2652, and the draft wheel is

$$\frac{2652}{61.2} = 43 \text{ nearly.}$$

In starting a machine put the proper draft wheel on, calculated as above, then get the draft on the table as low as possible by the wheel A. The callender, being fluted, causes this wheel to vary according to the weight of sliver, a lighter sliver requiring a larger wheel. Then adjust the tension in the tin between the detaching roller and the callender by changing the speed wheel B if necessary. At index 8 the fleece should be just tight without stretching. There should be as little draft as possible between the detaching roller and the draw box.

In No. 3 drawing head the cross shaft wheel is always 77, and in altering the draft both the coiler wheel C and the draft wheel D must be changed. Both must have the same number of teeth. The **constants are**:—With 4 teeth of feed, 3234; 5 teeth of feed, 2585.

They are determined as follows for $1\frac{1}{4}$in. front roller, and 42 on the feed ratchet:—

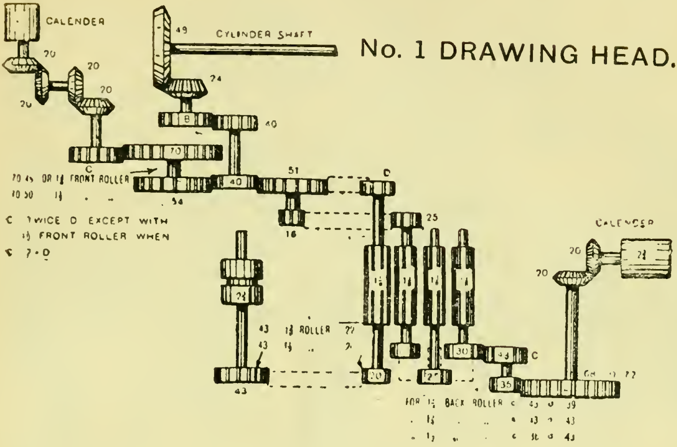
$$\frac{47 \times 80 \times 75 \times 48 \times B \times 70 \times 2\text{in.}}{35 \times 42 \times R \times 24 \times 54 \times C \times 2\frac{3}{4}\text{in.}} = T$$

$$\textbf{thus } \frac{361{\cdot}7 \times B}{R \times T} = C$$

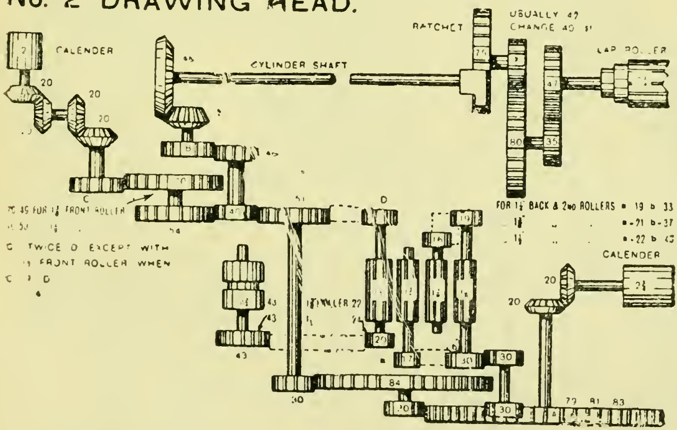
and the draft wheel is **half** the coiler wheel.

Conclusion.—The life of every machine depends on systematic attention to the cleaning, oiling, and adjustment of its parts. All the pivots about the nipper, the steel detaching rollers, the gearing, the cylinder and brush shafts should be systematically oiled weekly. The pivots of the leather covered detaching rollers should be wiped daily and oiled a

No. 1 DRAWING HEAD.

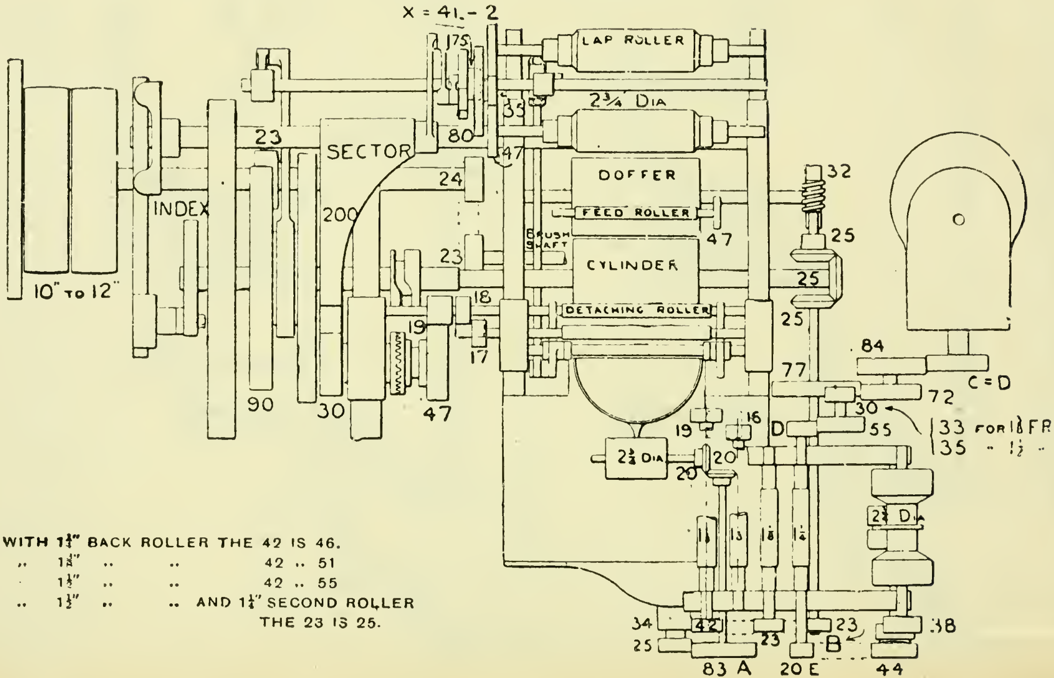


No. 2 DRAWING HEAD.



Full plans of Nos. 3 and 4 drawing heads and plans of Nos. 1 and 2 drawing heads are given, but the constants for the two latter are not so simple as above, owing to the variable wheel B entering as a factor.

No. 3 DRAWING HEAD (1904 Pattern).

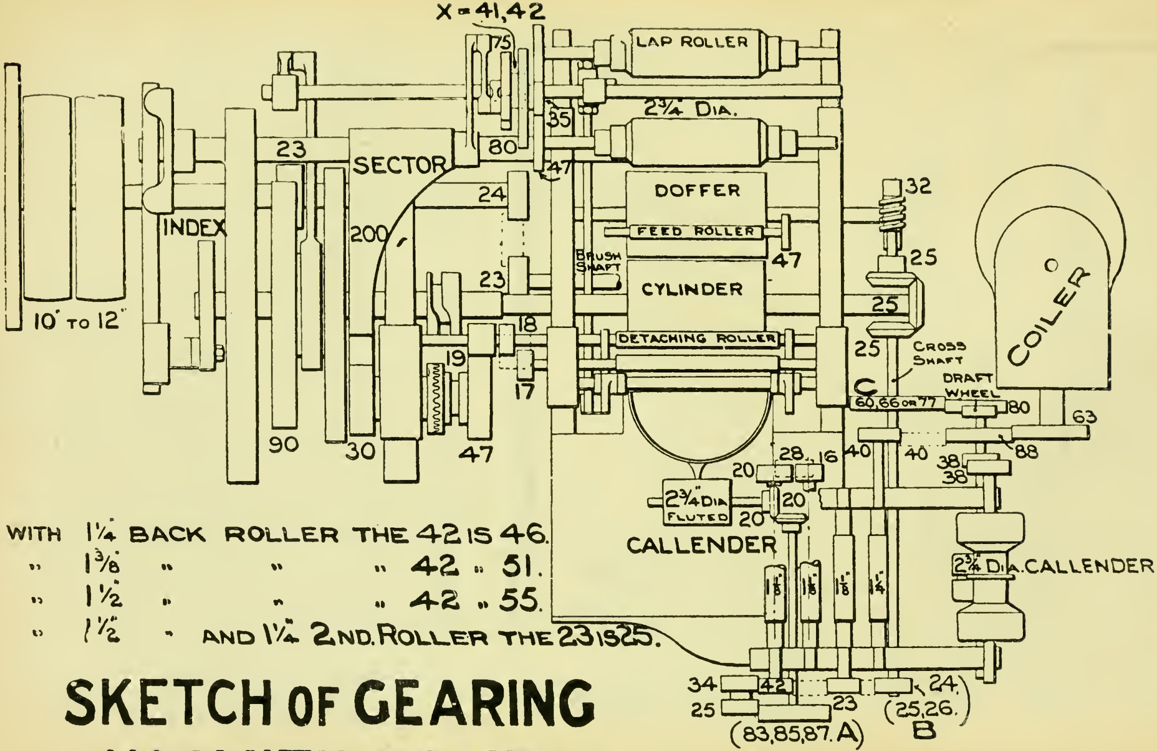


WITH $1\frac{3}{4}$" BACK ROLLER THE 42 IS 46.

" $1\frac{5}{8}$" " " 42 " 51

" $1\frac{1}{2}$" " " 42 " 55

" $1\frac{1}{2}$" " " AND $1\frac{1}{4}$" SECOND ROLLER THE 23 IS 25.



WITH 1¼" BACK ROLLER THE 42 IS 46.
" 1⅜" " " " 42 " 51.
" 1½" " " " 42 " 55.
" 1½" " AND 1¼" 2ND. ROLLER THE 23 IS 25.

SKETCH OF GEARING FOR NASMITH COMBER. No. 4 DRAWING HEAD.

very little by the finger dipped in oil. These rollers have not a higher speed than those of the Heilmann machine, but continue turning as long again each nip.

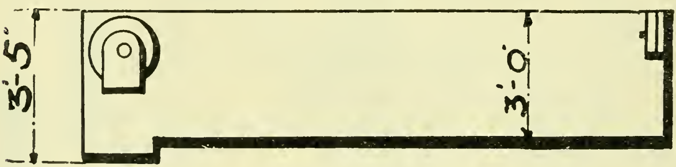
Keep the top combs and detaching rollers in good condition and exactly adjusted and good work will invariably result.

Pulleys.—10in. × 3in. dia. are usually supplied with the machine unless ordered larger. Height of driving shaft from floor is 25in. and the dia. is $1\frac{1}{2}$in.

Speeds	335 Revs.	= (86 nips)	for	Finest Sea Island.
	350 ,,	(90 ,,)	,,	Florida Cottons.
	370 ,,	(95 ,,)	,,	Egyptian and Best American.
	390 ,,	(100 ,,)	,,	Coarse Work.

Power.—Six-head machine, $\frac{3}{4}$ H.P. without aspirator.

Dimensions and Weight.	Length	Width	(Approximate Weight) Gross	Net
4 Heads $10\frac{1}{2}$in. lap	10ft. 11in.	3ft. 6in.	37 cwts.	28 cwts.
5 ,, $10\frac{1}{2}$in. ,,	12ft. 7in.	3ft. 6in.	42 cwts.	$32\frac{1}{2}$ cwts.
6 ,, $10\frac{1}{2}$in. ,,	14ft. 3in.	3ft. 6in.	47 cwts.	37 cwts.



Automatic Roller Truing Machine.

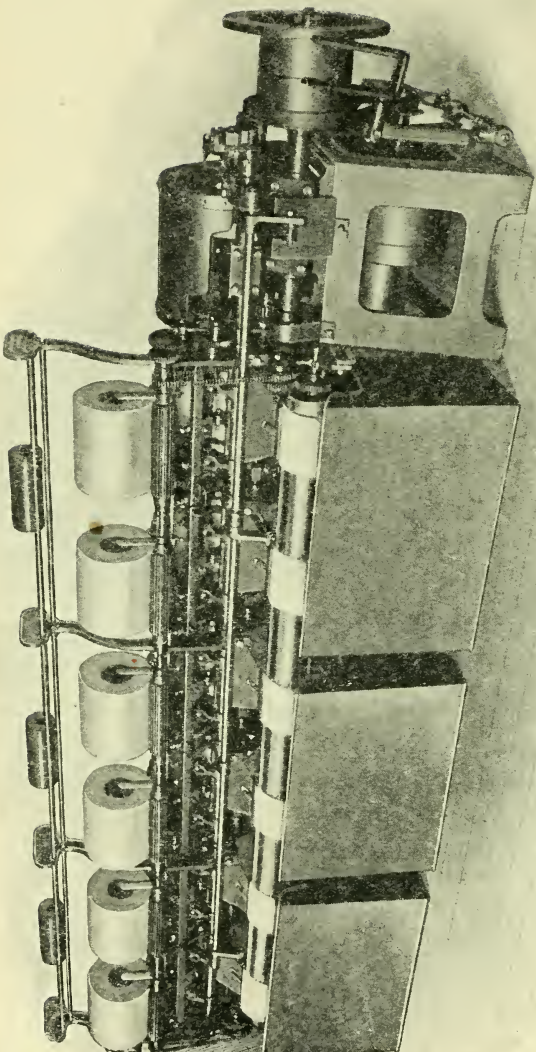
This machine was specially designed for the truing-up of all kinds of damaged, uneven, or worn leather coverings on top rollers, and to produce a perfectly level surface where combing machines are employed this machine is indispensable as it is imperative that the leather covered detaching rollers should be absolutely true from end to end otherwise the piecing of the sliver is bad and much waste is made. This machine produces a perfectly true roller and prolongs the life of the leather covering.

Collecting and Drawing Waste from Combing Machines.

ROTH'S SYSTEM.

Consists in substituting a perforated drum for the doffers, the waste drawn from the revolving brush by suction. A fan placed underneath the comber carries the waste from the revolving brush to the perforated drum. The drum revolves slowly, and the waste is led in the form of a fleece into boxes or may be deposited on to a conveyor and delivered into a coiler.

Advantages.—Increased production, because the comber is kept running all the time. The cleaning of the comber only requires to be done about once a week instead of four or five times per day without this apparatus. The circular combs and brushes are always clean and never get filled up. The waste is of more value as it is not knotty. No dust can fly about the machine nor in the room.



COMBER SUPPLIED WITH ROTH'S SYSTEM.

JOHN HETHERINGTON & SON'S

Patent System of Collecting and Drawing Comber Waste.

The waste is stripped from the doffers in the ordinary way and is deposited in the form of a fleece on to a travelling conveyor, and after being drawn through a series of rollers is deposited in the form of a sliver into a can through a coiling arrangement.

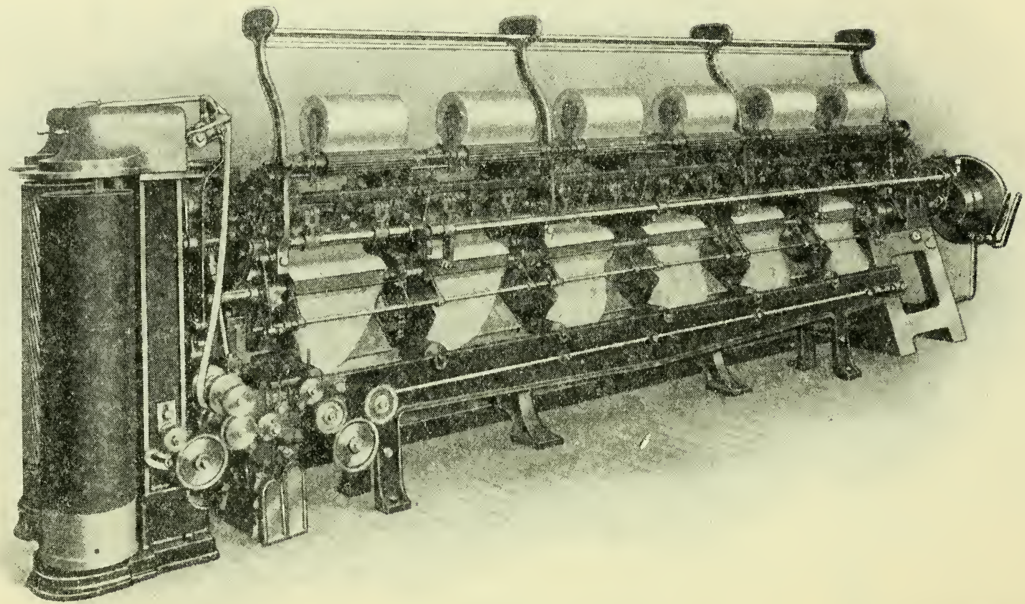
The sliver thus produced may be used for mixing one or more cans with other cotton at the Drawing Frames, or it may be used as a special preparation.

Advantages.—Saving of wages by using the waste as it comes direct from this apparatus.

The waste can be used without having to pass a second time through Openers, Scutchers, and Cards, which process entails a loss of about 15 per cent.

With this apparatus the fibres are not weakened, and can be spun up to 16's, or higher, according to the class of cotton.

No waste boxes nor waste lapping arrangement required, and therefore greater cleanliness is obtained.



HETHERINGTON'S PATENT SYSTEM OF COLLECTING AND DRAWING COMBER WASTE.

JOHN HETHERINGTON & SON'S

Patent Waste Conveyor in conjunction with Roth's Aspirator.

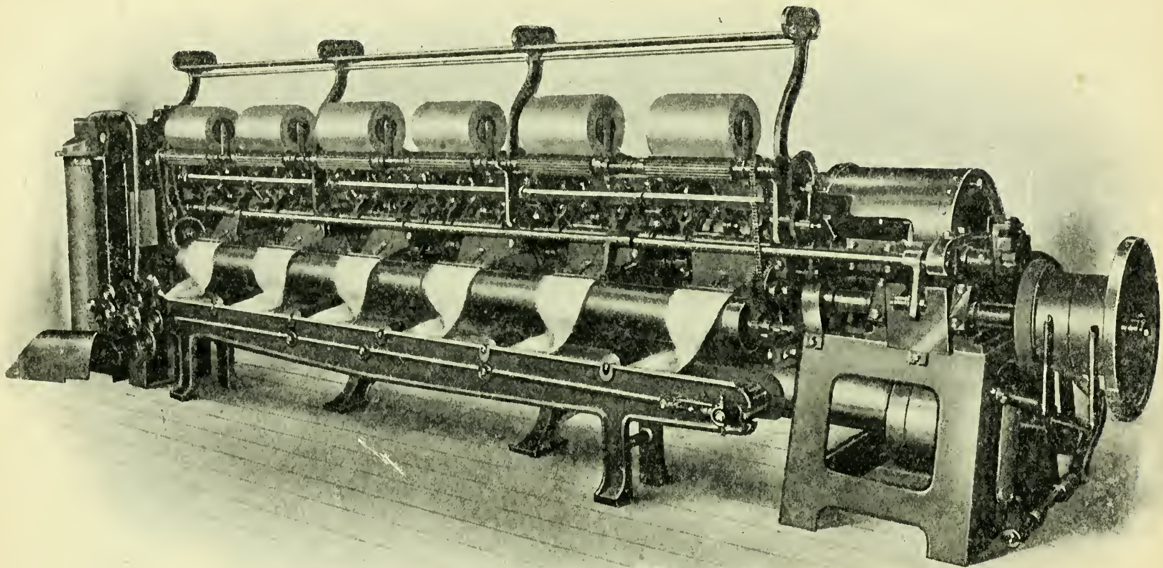
The waste delivered by the rotating cylinder of the Aspirator is carried by a travelling conveyor to a series of consolidating and drawing rollers, where it is condensed into any given weight of sliver and delivered into a can through a coiling arrangement.

Advantages.—Saving of wages by using the waste as it comes direct from this apparatus.

The waste can be used without having to pass a second time through Openers, Scutchers and Cards, which process entails a loss of about 15 per cent.

With this apparatus the fibre is not weakened, and can be spun up to 16's, or higher, according to the class of cotton.

No waste boxes nor waste lapping arrangement required, and therefore greater cleanliness is obtained.



HETHERINGTON'S PATENT WASTE CONVEYOR IN CONJUNCTION WITH ROTH'S ASPIRATOR

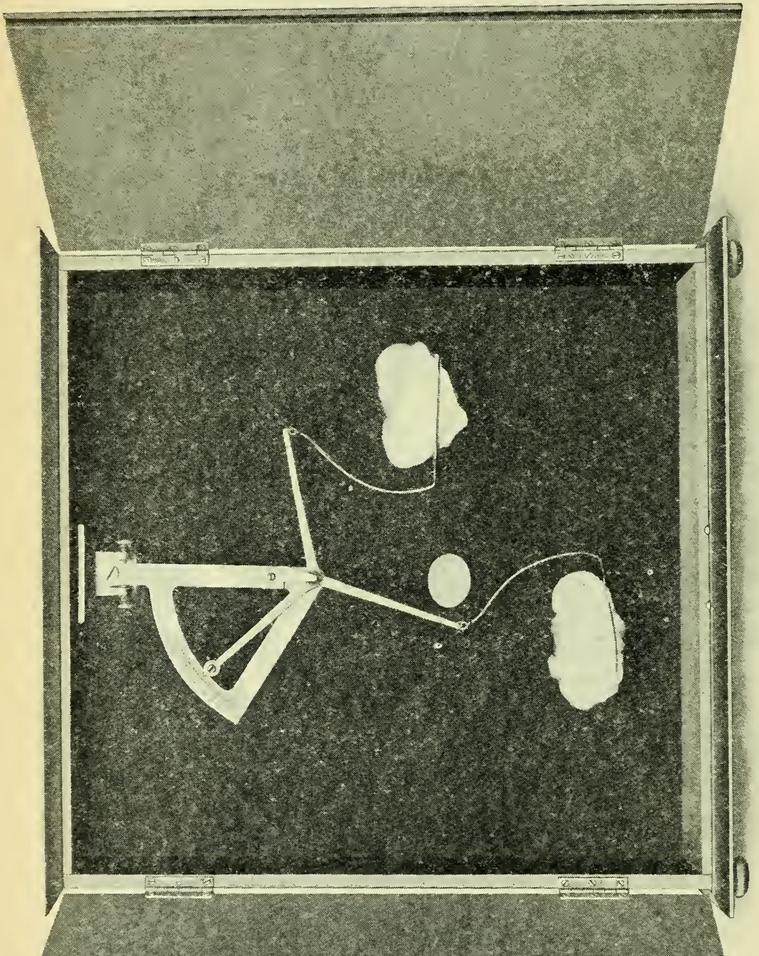
Percentage Balance for Comber Waste.

THIS USEFUL APPLIANCE IS THE ESSENCE OF SIMPLICITY AND ACCURACY.

Any unmeasured length of combed sliver, within the limit that can be accommodated, is placed on the left-hand side of the balance, and the waste resulting from it on the right-hand side; the pointer will then indicate a figure which will be the percentage of waste taken out in the combing process.

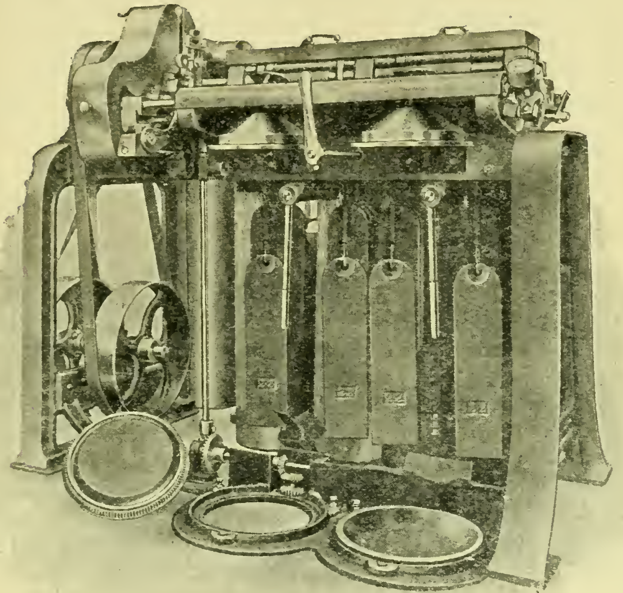
The ease and rapidity with which the weighing can be made by simply placing a length of combed sliver on one side, and its waste on the other, ensures much more frequent tests and a corresponding increase of regularity in production.

The scale is clearly cut in 1 per cent. divisions and the result can be easily read to ¼ per cent. It is advisable to see that the case is set on a level base, and the balance should be carefully regulated by placing a small object or weight on the left-hand side and then adjusting the two top regulating screws until the pointer is opposite the first mark on the index plate. The balance is made of brass with a steel pointer and arms, and is enclosed in a polished baywood case.



PERCENTAGE BALANCE FOR COMBER WASTE.

Improved Drawing Frame.



The accompanying illustrations show two elevations and gearing of the machine, together with sections and details of various improvements. The machine has been **completely overhauled**, and **many improvements** discovered during the course of a long practical experience are embodied in it. **All the parts are made interchangeable**, and each part is provided with a letter or numeral so that in case of breakdown the necessary renewals can be ordered with the assurance that they will be sent according to order and fit in place correctly.

The chief advantages of our Improved Drawing Frame consist of the following:—

Beams are made extra strong, planed on three sides, and supported at the ends with strong frame ends.

The stands carrying the callender rollers, the drawing rollers, and the feed rollers are cast in one piece, and each set is milled at the same time on the same machine, so as to ensure absolute alignment of all the rollers. The steps in the stands are loose brasses which can be easily renewed at any time, and each line of rollers can be set independently of the others. The bearings for the stop motion shafts and for the shaft driving the coiler motions are provided with removable caps, so that the shafts can be lifted out and do not require to be drawn out at the end of the frame.

The gearing is all placed at one end, and only one change wheel is required to be altered in changing the draft. (See gearing, page 132).

Spring weight hooks are supplied for the dead weights on the front line of rollers, enabling us to run the front roller quicker than would otherwise be the case without the roller jumping. The leather covering of the top rollers lasts longer with this arrangement than with ordinary dead weighting.

The fluted rollers are made single boss so that the fleece presents only two selvedges, and fly and waste is thus avoided.

Top rollers with loose ends are also supplied when required, and the weight hooks hang on the loose bush at the end of the roller instead of on the running roller. The advantage of the loose ends over the loose boss roller is that the roller itself is solid and the ends run in loose bushes, each having good surfaces for lubrication, and which can easily be oiled, thus reducing friction to a minimum.

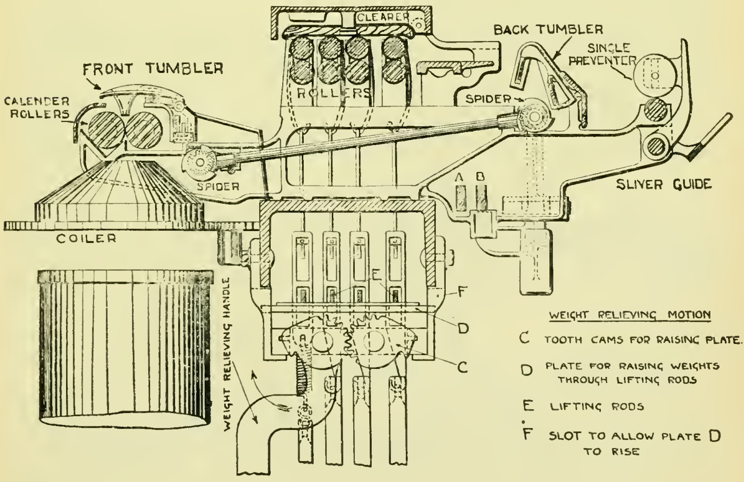
Metallic rollers.—For certain classes of work these rollers have advantages, if special care is taken to find the correct settings for the particular length of staple employed. The result is increased production and elimination of the trouble and expense in connection with leather-covered top rollers.

Diameters of rollers.—In filling up the specification forms for drawing frame rollers care must be taken that the distance between the centres of the first and second rollers just exceeds the length of the staple of the cotton proposed to be used, and suitable diameters arranged to give this distance. A good rule to follow for the second and third roller distances is to allow an extra $\frac{1}{8}$in., and a $\frac{1}{4}$in. for the third and fourth rollers; any variation to the above can easily be arranged for if clearly set down on the specification forms.

The following combination of rollers will give an idea of the diameters of rollers used when working different kinds of cotton :—

Cottons	Bottom Rollers				Top Rollers
China and Indian	$1\frac{1}{8}$	$\frac{7}{8}$	$1\frac{1}{8}$	$1\frac{1}{8}$ dia.	$\frac{7}{8}$ dia. uncovered
	$1\frac{1}{8}$	1	$1\frac{1}{8}$	$1\frac{1}{8}$,,	$\frac{7}{8}$ or $\frac{15}{16}$ dia. uncovered
American	$1\frac{1}{4}$	$1\frac{1}{16}$	$1\frac{1}{4}$	$1\frac{1}{4}$,,	1 ,, $1\frac{1}{16}$,, ,,
	$1\frac{1}{4}$	$1\frac{1}{8}$	$1\frac{1}{8}$	$1\frac{1}{4}$,,	1 ,, $1\frac{1}{16}$,, ,,
	$1\frac{1}{4}$	$1\frac{1}{8}$	$1\frac{1}{4}$	$1\frac{1}{4}$,,	1 to $1\frac{1}{8}$,, ,,
Egyptian and Sea Island ...	$1\frac{3}{8}$	$1\frac{1}{8}$	$1\frac{1}{8}$	$1\frac{3}{8}$,,	$1\frac{1}{16}$ or $1\frac{1}{8}$,, ,,
	$1\frac{3}{8}$	$1\frac{1}{4}$	$1\frac{1}{4}$	$1\frac{3}{8}$,,	$1\frac{1}{8}$,, $1\frac{1}{4}$,, ,,
	$1\frac{3}{8}$	$1\frac{1}{4}$	$1\frac{3}{8}$	$1\frac{3}{8}$,,	$1\frac{1}{4}$ dia. uncovered
	$1\frac{1}{2}$	$1\frac{1}{8}$	$1\frac{1}{2}$	$1\frac{1}{2}$,,	$1\frac{1}{4}$,, ,,
	$1\frac{1}{2}$	$1\frac{3}{8}$	$1\frac{3}{8}$	$1\frac{1}{2}$,,	$1\frac{1}{4}$,, ,,
	$1\frac{1}{2}$	$1\frac{3}{8}$	$1\frac{1}{2}$	$1\frac{1}{2}$,,	$1\frac{1}{4}$ or $1\frac{3}{8}$ dia. uncovered

Rollers weights.—For ordinary rollers we usually supply two weights, each of 22lbs. for F.R. and 17lbs. for 2nd, 3rd, and 4th rollers. For **metallic rollers** we supply 10lbs. for 1st, 2nd, and 3rd rollers and 12lbs. for the 4th roller.



Section of Drawing Frame.

A weight relieving motion is applied to take the weight off the top rollers when the machine is left standing for any length of time, so as to prevent the top rollers being marked or flattened by the flutes of the bottom rollers.

We have recently applied for a patent for a new **weight relieving motion.** The object of this new motion is to lift the weights in as easy and even manner as possible, and it is so arranged that it does not disturb the correct position of the weight hooks or wires when the rollers have to be taken out for cleaning, &c. To prevent this the ordinary oblong nuts on the wires are discarded and a nut is employed having a set screw attached at the side; this screw is to lock the nut on the screwed wires after the correct position is found, and thus making it impossible to accidentally alter the position of the screwed regulating wires when changing the rollers or removing them for cleaning, &c. The weights supplied with this motion are one each of 44lbs. on F.R. and 34lbs. for 2nd, 3rd, and 4th rollers.

Traverse motion with special flexible brass sliver guide, adjustable to the thickness of the sliver, prevents overlapping or too wide separation of the slivers on entering the rollers.

Clearers.—We supply usually the ordinary stationary felt-covered clearer, with polished steel cover to each delivery, hinged to suitable fixings.

Ermen's clearer can also be supplied if required. This is an endless felted cloth driven at a positive speed and automatically stripped by a comb.

The stop motion spider shafts, front and back, are driven by the incline clutch **C**, Fig. 6, which, so long as the shafts turn easily, is kept in gear by the spring **E** attached to counterpoise **D**. When the shafts are stopped by the falling of a tumbler the clutch is thrown forward, and the counterpoise **D** rising lifts the bar **B** out of the notch in which it rests, and allows the spiral spring **F** to throw the strap on to the loose pulley.

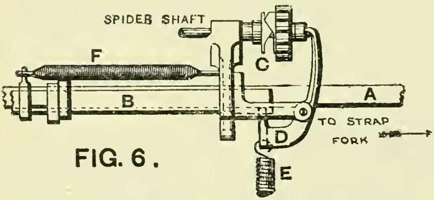
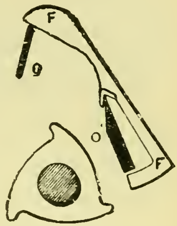


FIG. 6.

SIDE VIEW OF STOP MOTION.

The back stop motion tumbler pivots on the upper knife edge of the bar **O**, Fig. 9, which is a fixture. The lower end of the tumbler just passes under the bar, and when the tumbler falls this offers a solid resistance. When the machine is at work the weight of the sliver keeps the upper end of the tumbler against the bar O, which can be adjusted in the direction of its breadth so that the lower end of the tumbler just clears the revolving spider, and the slightest displacement of the tumbler stops the frame.

Fig. 9.



The front stop motion can be adjusted with great nicety, acting when a sliver is too heavy, as when a piece of clearer waste comes forward, and also when a sliver is too light, as when a roller lap occurs.

The Trumpet E, Figs. 7 and 8, pivots on two pointed projections cast on its underside, and carries a pendant K at the back hanging free. When the machine is working the trumpet E is drawn down at the front till the projection at the end of the pendant K meets the underside of the lever L, which is prevented from rising by the balance weight P, which can be adjusted nearer to or further from the pendant to suit different thicknesses of sliver, but if the trumpet gets stopped by a piece of clearer waste or too heavy a sliver,

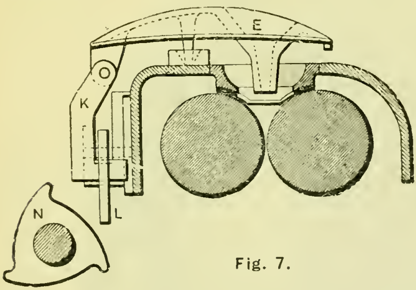


Fig. 7.

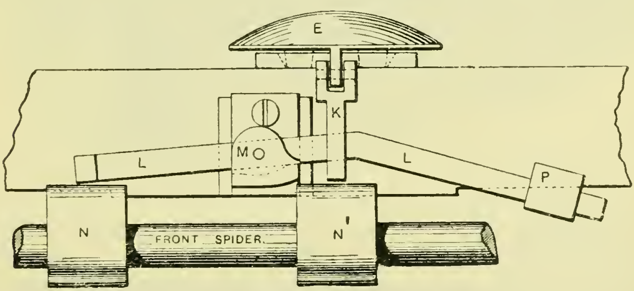
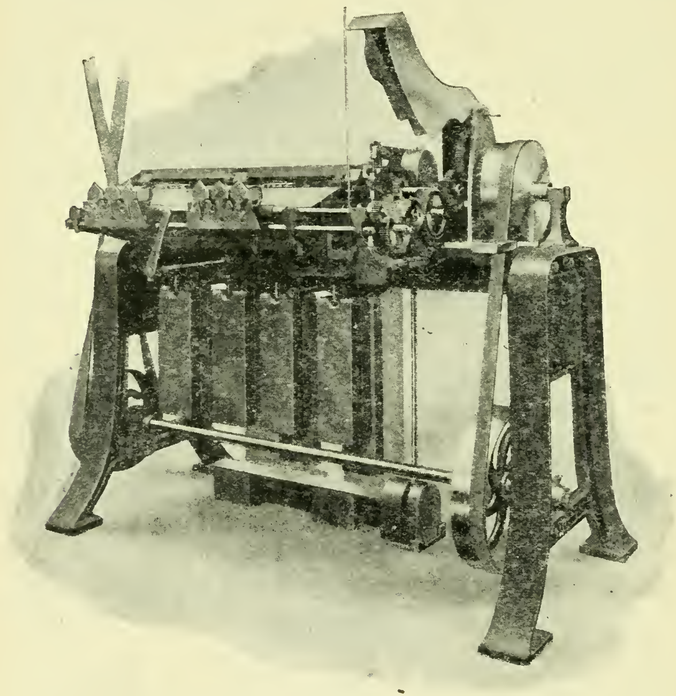


Fig. 8.

from whatever cause arising, the resistance of the weight **P** is overcome, and the left-hand end of the lever **L** is thrown down into the spider **N**, Fig. 8, stopping the machine. On the other hand, if the sliver is too light, the trumpet **E** falls back under the influence of the pendant **K**, which then engages in the right-hand spider N^1, also stopping the frame.

Full can stop motion.—This motion is arranged to stop the machine after any desired length of sliver has been delivered, or when the can is full, and to prevent the re-starting of the machine until the full can is exchanged for an empty one.



Electric stop motion.—The primary object of this patent is to simplify the mechanism when applied to stopping the machine automatically upon the sliver coming through too light or too heavy. This it effects by dispensing with the ordinary split wheels usually employed for transmitting motion from the back to the front callender rollers. We adopt a front callender roller long enough to serve six or more deliveries, which make up one head; and the back roller we make of one diameter throughout. This alteration, with the other parts affected, is clearly illustrated in the two views given herewith, Figs. 1 and 2, which show the

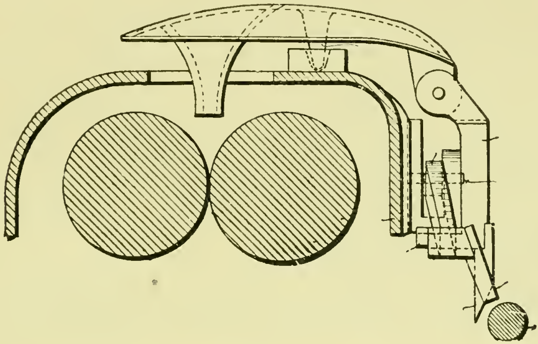


Fig. 1.

callender rollers, the top plate of cover, and the ordinary balanced bell-mouthed trumpet, which is pivoted and forms part of an electric circuit. In connection with the latter is applied a tumbler, which, when the sliver is coming through regularly, rests normally clear of a rod that also forms part of the electric circuit. Should a thin or light part of the sliver present itself to the trumpet, the front end rises and

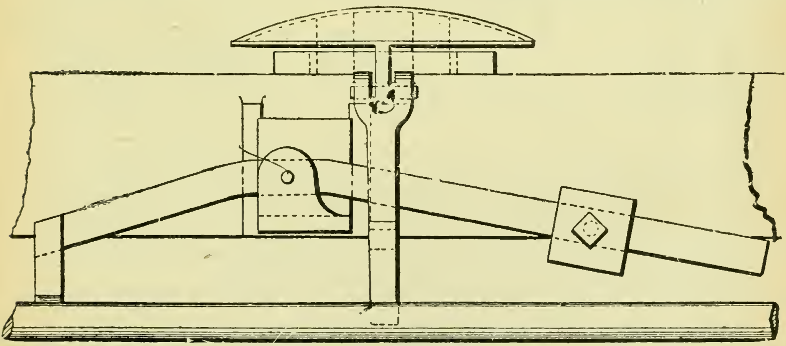


Fig. 2.

causes the tumbler to come into contact with the rod mentioned, and in so doing completes the electric circuit and stops the machine. On the other hand, when the sliver is too thick and heavy, the stop motion is actuated by the aid of a projection formed on the tumbler, which normally rests below a balanced pivoted lever. One end of this lever rests near but normally clear of the rod, and the other end is provided with an adjustable weight. The parts are so arranged that when the trumpet is drawn down by the extra weight of the sliver the tumbler is raised, and the projection thereon comes under and lifts the weighted end of the balanced lever, thus bringing its other end into contact with the rod, which completes the circuit and stops the machine.

Application to existing machines.—We have so designed the parts which constitute the above electric stop motion that it can be applied to existing drawing frames at a comparatively small cost.

Single preventer.—Without this arrangement the back roller must raise the sliver from the bottom of the can and drag it across the stop motion tumblers, so that the

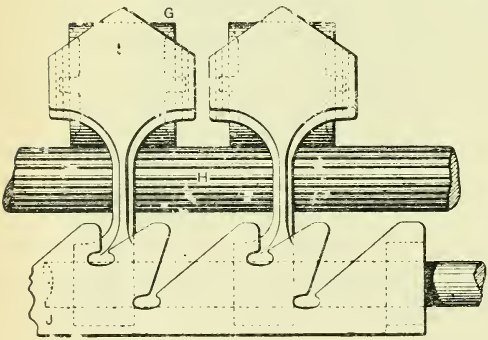


Fig. 1.

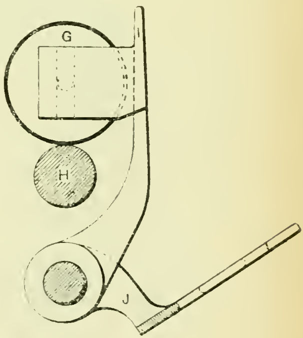


Fig. 2.

rupture of the sliver almost invariably takes place close to the back roller, and the weight of the broken end resting on the tumbler retards, if it does not completely prevent the action of the stop motion, and the other has already passed into the rollers before the machine is stopped.

To obviate this defect we apply an extra feed roller, seen in the above sketch, placed over the centre of the cans and a little above them, thus reducing the danger of stretching delicate slivers. The sliver being thus fed to the back roller over the stop motion, which lies between the two rollers, no rupture can take place unless before the feed roller, consequently the broken end of the sliver never even reaches the tumbler before the machine is at a standstill (it is useless to introduce a roller between the stop motion and the back roller). A great advantage of our system is that the attendant has both hands free when piecing, one to put up the sliver and the other to set on the machine; the top roller never requires to be lifted. Owing to the form given to the bracket I, Fig. 2, which carries the roller, the sliver then passes naturally and of its own accord under the roller.

Coiling motion.—Some time ago, seeing the desirability of introducing a Drawing Frame standing lower than the ordinary one, so that it might be more easily within the reach of the operatives of small stature, we introduced the arrangement as described below; but as this modification may not be generally known to spinners we think the occasion opportune for drawing attention to same, and shall be glad at any time to show frames of this particular design to anyone interested.

The improvement consists of a cast-iron plate fastened to the frame end and spring piece and resting on the floor. This plate is arranged to receive the trays which carry the cans. In order to effect this without cutting the floor away, we dispense with the shaft and bevel wheels previously carried below the coiler tray. By doing this it allows the tray to clear the floor and turn freely. The tray is formed with inclined sides, to get the cans readily in and out of position without injury. On the outside of each tray is a ring of teeth into which works a spur wheel on an upright stud, having above a bevel wheel working into a bevel wheel on a driving shaft placed over the trays. This shaft is driven by an upright shaft receiving motion from a shaft conveniently placed near the beams.

Patent coiling motion.—General Advantages:

1.—The height of the frame is greatly reduced.
2.—The floor requires no cutting to receive the frame for carrying the cans.
3.—A fixed arrangement, supported from the framing, to prevent the can motion from getting out of the correct position to the coiler motion.
4.—Easy adjustment of can to coiler motion.

Dimensions of Drawing Frame.

Heads	Deliveries per head	15in. Gauge Ft.	In.	Metres	16in. Gauge Ft.	In.	Metres	18in. Gauge Ft.	In.	Metres
1 Head	2	5	6½	1·689	5	8½	1·740	6	0½	1·842
	3	6	9½	2·070	7	0½	2·146	7	6½	2·299
	4	8	0½	2·451	8	4½	2·553	9	0½	2·756
	5	9	3½	2·832	9	8½	2·959	10	6½	3·213
	6	10	6½	3·213	11	0½	3·365	12	0½	3·670
	7	11	9½	3·594	12	4½	3·772	13	6½	4·127
	8	13	0½	3·975	13	8½	4·173	15	0½	4·889
2 Heads	2	10	3¼	3·130	10	7¼	3·232	11	3¼	3·435
	3	12	9¼	3·892	13	3¼	4·044	14	3¼	4·349
	4	15	3¼	4·654	15	11¼	4·857	17	3¼	5·263
	5	17	9¼	5·416	18	7¼	5·670	20	3¼	6·177
	6	20	3¼	6·178	21	3¼	6·483	23	3¼	7·091
	7	22	9¼	6·940	23	11¼	7·296	26	3¼	8·005
	8	25	3¼	7·702	26	7¼	8·109	29	3¼	8·919
3 Heads	2	15	0	4·572	15	6	4·724	16	6	5·028
	3	18	9	5·715	19	6	5·943	21	0	6·399
	4	22	6	6·858	23	6	7·162	25	6	7·770
	5	26	3	8·000	27	6	8·381	30	0	9·144
	6	30	0	9·144	31	6	9·600	34	6	10·512
	7	33	9	10·287	35	6	10·819	39	0	11·883
	8	37	6	11·430	39	6	12·038	43	6	13·259
4 Heads	2	19	8¾	6·014	20	4¾	6·217	21	8¾	6·623
	3	24	8¾	7·538	25	8¾	7·842	27	8¾	8·451
	4	29	8¾	9·062	31	0¾	9·467	33	8¾	10·282
	5	34	8¾	10·586	36	4¾	11·092	39	8¾	12·110
	6	39	8¾	12·110	41	8¾	12·717	45	8¾	13·940
	7	44	8¾	13·634	47	0¾	14·342	51	8¾	15·769
	8	49	8¾	15·158	52	4¾	15·967	57	8¾	17·598

The foregoing lengths are for frames all delivering on one side of the frame. If the heads are set alternately (zigzag) 1in. must be added for 2 or 3 heads and 2in. for 4 heads. If alternate and Ermen clearers add 1⅝in. for 2 heads and 3¼in. for 3 heads instead of 1in.

When fast and loose driving pulleys are supplied, 4 inches should be added to the above lengths.

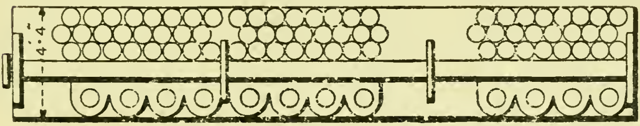
Gearing.

No. of Heads	Cams all on one side	Heads Alternate
1	3ft. $0\frac{1}{2}$in. ($0^{m}927$)	——
2	5ft. $3\frac{1}{4}$in. ($1^{m}508$)	5ft. $4\frac{1}{4}$in. ($1^{m}533$)
3	7ft. 6in. ($2^{m}287$)	7ft. 7in. ($2^{m}312$)
4	9ft. $8\frac{3}{4}$in. ($2^{m}965$)	9ft. $10\frac{3}{4}$in. ($2^{m}990$)

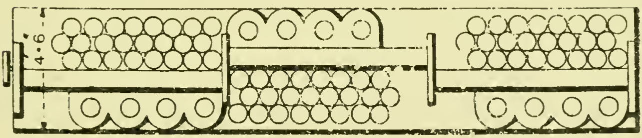
If, in a frame of 3 heads, with a passage of 18in. is required, 2ft. must be added to the total length of the frame to allow for the passage and an extra frame end.

Width, including 3 rows of cans, 4ft. 6in. for 6 ends up.
,, ,, 4 ,, ,, 5ft. 2in. ,, 8 ,,

Power required.—One I.H.P. for every 14 deliveries.



Drawing Frame with Beams straight.



Drawing Frame with Beams alternate.

Strapping.—Main belt, 3in. wide; length according to circumstances. Small belt, 2in. wide to front roller, 11ft. long when crossed; 10ft. 6in. long if open.

Weights.—Below is given the approximate weight of a 16in. gauge frame.

Gearing only	1 head ...	6 cwt.	3 heads ...	$14\frac{1}{2}$ cwt.
	2 heads ...	$10\frac{1}{4}$,,	4 ,, ...	$18\frac{1}{2}$,,

Running part of the frame per delivery ... $3\frac{1}{4}$,,

Weights per delivery ... ... $1\frac{1}{2}$,,

When "Ermen's" clearers are supplied add 17lbs. per delivery to the running part.

When frames are more than 4 deliveries per head add 60lbs. per head for the intermediate spring piece.

Pulleys.—14in. to 22in. dia. × 3in. wide. On the driving shaft an 18in. pulley drives a 12in. on the F.R. The height of the driving shaft from the floor is 12in. and the dia. is $1\frac{1}{2}$in.

Speeds.—For American Cotton. Driving shaft 235 revs. = 350 revs. of front roller usually $1\frac{3}{8}$in. diameter.

For Egyptian Cotton. Driving shaft about 185 revs. = 275 revs. of front roller usually $1\frac{1}{2}$in. diameter.

For Sea Island Cotton, with $1\frac{1}{2}$ F.R. Driving shaft 140 revs. = 210 revs. of front roller.

Calculations, Formulæ, Productions, &c.

Draft.—In calculating the draft it is convenient to consider the back roller as driving the front roller. In our machine there is a slight draft between the $1\frac{1}{4}$in. feed roller and the back roller, as also between the front roller and the 2in. callender. The drawing rollers may be anything from $1\frac{1}{16}$in. to $1\frac{1}{2}$in., and standard wheels are adopted as under for various combinations of rollers.

				Wheel A on feed roller		Wheel B on back roller
$1\frac{1}{4}$in. feed	working with	$1\frac{1}{16}$in.	back roller,	40	...	33
,,	,,	$1\frac{1}{8}$in.	,,	44	...	39
,,	,,	$1\frac{1}{4}$in.	,,	39	...	38
,,	,,	$1\frac{3}{8}$in.	,,	36	...	39
,,	,,	$1\frac{1}{2}$in.	,,	33	...	39

Similarly, the wheels connecting the front rollers and the callender are:—

				Wheel on the front roller	Wheel C on the callender (For Ordinary Fluted Rollers)	Wheel C on the callender (For Patent Metallic Rollers)
2in. callender	working	$1\frac{1}{16}$in.	front	30	56	44
,,	,,	$1\frac{1}{8}$in.	,,	30	52	42
,,	,,	$1\frac{3}{16}$in.	,,	30	50	40
,,	,,	$1\frac{1}{4}$in.	,,	30	47	36
,,	,,	$1\frac{3}{8}$in.	,,	30	43	34
,,	,,	$1\frac{1}{2}$in.	,,	30	39	32

The following table of constants for various combinations of sizes of front and back rollers has been calculated from the above data and that given in Fig 1. Constants are given for the draft in the drawing rollers only, and also for the total draft, and in each case for a 70 and an 80 back roller wheel, one or other of these being put on according to the relation in the diameter of the front and back rollers.

$$\frac{\text{Constant}}{\text{draft}} = \textbf{change wheel}, \text{ or } \frac{\text{Constant}}{\text{change wheel}} = \textbf{draft}$$

The draft between the back roller and the 2nd and 3rd respectively is fixed for any particular machine, and any change made in the pinion only alters the draft between the front roller and the second roller.

Diam. of Rollers.		Constant for draft in the fluted rollers only		Constant for total draft from the 1in. feed roller to the 2in. callender	
		Back Roller Wheels		Back Roller Wheels	
Front	Back	70	80	70	80
In.	In.				
$1\frac{1}{16}$	$1\frac{1}{16}$	280	320	306	350
$1\frac{1}{16}$	$1\frac{1}{8}$	264	302	284	325
$1\frac{1}{8}$	$1\frac{1}{8}$	280	320	304	347·5
$1\frac{1}{8}$	$1\frac{1}{4}$	252	288	276	316
$1\frac{1}{4}$	$1\frac{1}{8}$	311	356	326	373
$1\frac{1}{4}$	$1\frac{1}{4}$	280	320	296	338
$1\frac{1}{4}$	$1\frac{3}{8}$	254·6	291	268	305
$1\frac{3}{8}$	$1\frac{1}{8}$	342	391	357·5	408
$1\frac{3}{8}$	$1\frac{1}{4}$	308	352	328	372
$1\frac{3}{8}$	$1\frac{3}{8}$	280	320	292·5	334
$1\frac{1}{2}$	$1\frac{1}{8}$	373	427	389	445
$1\frac{1}{2}$	$1\frac{1}{4}$	336	384	354·5	405
$1\frac{1}{2}$	$1\frac{3}{8}$	305	349	318	364
$1\frac{1}{2}$	$1\frac{1}{2}$	280	320	292	334

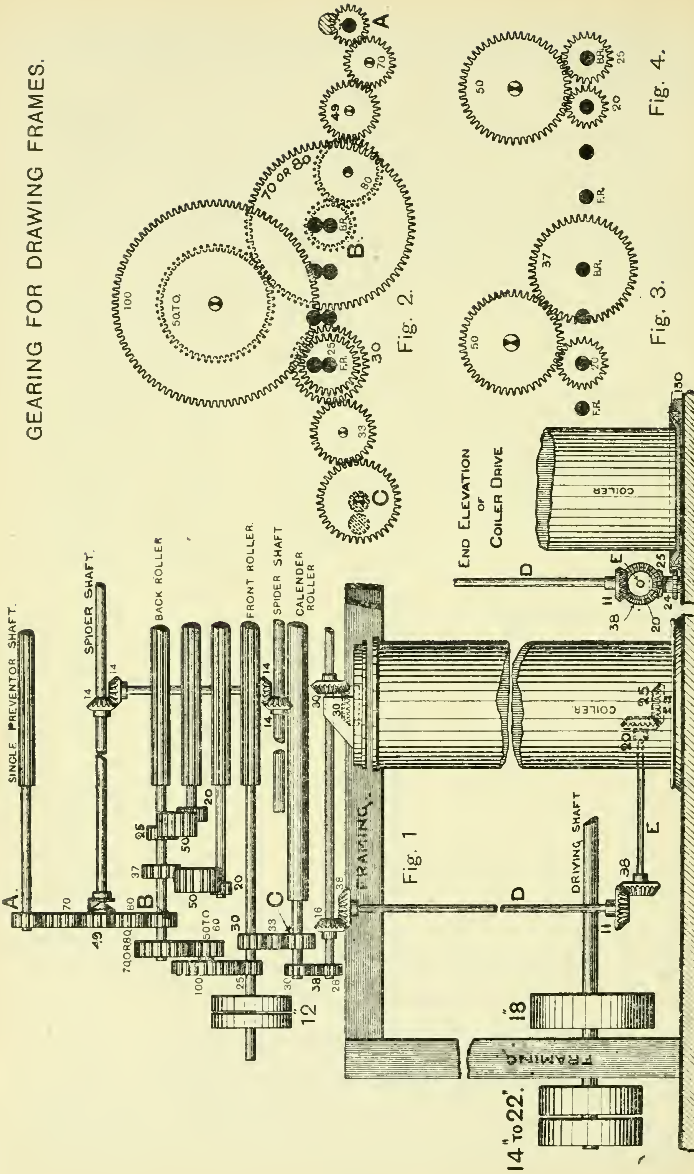
The manner of calculating the draft will be seen from the following, which will be understood on reference to Fig. 1, representing a plan of the gearing.

$$\textbf{Total draft} = \frac{\text{A} \times 70 \text{ or } 80 \times 100 \times \text{C} \times 2\text{in.}}{\text{B} \times \text{X } 25 \times 48 \times 1\frac{1}{4}\text{in.}}$$

$$\textbf{Draft in the 4 rollers} = \frac{70 \text{ or } 80 \times 100 \times \text{f}}{\text{X} \times 25 \times \text{b}}$$

where *f* is the diameter of the front rollers and *b* that of the back roller.

GEARING FOR DRAWING FRAMES.



The following are also useful Formulæ:—

$$\text{Hank drawing} = \frac{\text{Draft} \times \text{hank carding}}{\text{number of ends up}}$$

$$\text{Weight of drawing} = \frac{\text{Weight of carding} \times \text{No. of ends up}}{\text{draft}}$$

$$\text{Draft} = \frac{\text{No. of ends up} \times \text{hank drawing}}{\text{hank carding}}$$

$$\text{Hank carding} = \frac{\text{No. of ends up} \times \text{hank drawing}}{\text{draft}}$$

$$\text{Change wheel} = \frac{\text{Desired weight} \times \text{change wheel on}}{\text{present weight}}$$

$$\text{or} = \frac{\text{Present hank} \times \text{change wheel on}}{\text{desired hank}}$$

$$\text{Speed of front roller} = \frac{\text{Revs. of driving shaft} \times \text{dia. of bottom pulley}}{\text{dia. of pulley on front roller}}$$

Production.—This may be very approximately determined from the table given below, which is based on the assumption that the frame is standing 20% of the engine time. A good tenter will not exceed $17\frac{1}{2}$% of stoppage. The numbers in the table, if divided by the hank of the sliver, will give the actual production in lbs. per 10 hours.

Speed of Front Roller	Diameter of Front Rollers					
	1in.	$1\frac{1}{16}$in.	$1\frac{1}{8}$in.	$1\frac{1}{4}$in.	$1\frac{3}{8}$in.	$1\frac{1}{2}$in.
275	13·7	14·58	15·42	17·13	18·85	20·56
300	14·95	15·88	16·82	18·68	20·55	22·42
325	16·2	17·22	18·22	20·25	22·28	24·3
350	17·45	18·53	19 62	21·8	23·98	26·17
375	18·7	19·86	21·02	23·37	25·7	28·04
400	19·94	21·18	21·42	24·92	27·41	29·9
425	21·18	22·51	23·82	26·48	29 12	31·78
450	22·42	23·83	25·24	28·04	30·85	33·65
475	23·68	25·16	26·63	29·6	32·56	35·52
500	34·92	26·5	28·04	31·16	34 28	37·4

Another method of calculating the production of a drawing frame is as follows:—

$$\frac{\text{Diam.} \times \text{Revs. of front roller per min.} \times 3{\cdot}1416 \times 60\text{min}}{36\text{in.}} = \text{yards per head per hour} = Y$$

$$\frac{Y \times \text{grains per yard of finished sliver}}{7000} = \text{lbs. per head per hour} = W$$

W × Number of working hours per week = lbs. per head per week.

DRAWING FRAME SPECIFICATION.

To M

Please write answers to the questions below, and return the form as soon as possible, retaining the Duplicate one for your own use. *The extras are printed in Italics.*

JOHN HETHERINGTON & SONS LTD., MANCHESTER.

NOTE—Should these works be closed, wholly or in part, through strikes, lock-outs, breakdowns, or any unforeseen causes a reasonable delay to be granted to the makers.

How many Frames? How many Heads to each Frame? How many Deliveries in each Head?

Will you have the Heads to deliver all on one side of the Beam, or set alternately?

To stand in what length including Driving Pulleys? What gauge will you have—14, 15, 16, 17, 18, 20? (usually 16).

Gearing	For Frames to deliver all on one side,	1 Head, 3ft. 0in.;	2 Heads, 5ft. $3\frac{1}{4}$in.
	,, ,, alternately	,, 3ft. 0in.	,, 5ft. $4\frac{1}{4}$in.
	,, ,, all on one side,	3 Heads, 7ft. 6in.:	4 Heads, 9ft. $8\frac{3}{4}$in.
	,, ,, alternately	,, 7ft. 7in.	,, 9ft. $10\frac{3}{4}$in.

Diameter of Fluted Rollers:— Diameter of Top Rollers:—

Is Front Line of Bottom Rollers to be Case-hardened?			Or are the Necks only to be Case-hardened?			
Front	in.	(usually $1\frac{1}{4}$ or $1\frac{3}{8}$)		Front	in.	usually all 1 inch.
Second	,,	(usually $1\frac{1}{8}$)		Second	,,	
Third	,,			Third	,,	
Fourth	,,	(usually $1\frac{1}{4}$ or $1\frac{3}{8}$)		Fourth	,,	

Are we to cover Top Rollers and Clearers?

If Top Rollers for Front Lines to be E. Leigh's Patent Loose Boss? or Loose Ends at per delivery

In all four lines to have loose ends? at per delivery

If Ermen's Clearers? at per delivery. Steel Flat Top Clearers? Will you have Coiling Motion?

Height of Can? inches. Inside diameter of Can? Inches. Outside diameter of Can at the bottom? inches.

Indicators? at each.

Top Roller Dead Weight—	Front? lbs.	Second? lbs.	Third? lbs.	Fourth? lbs.
(Usually for Covered Rollers	22lbs.)	(17lbs.)	(17lbs.)	(17lbs.)
(,, Metallic ,,	10lbs.)	(10lbs.)	(10lbs.)	(10lbs.)

Total Draught of Fluted Rollers? Draught from 1st to 2nd? Draught from 2nd to 3rd? Draught from 3rd to 4th?

Distance from Centre to Centre of Rollers:— Front to Second smallest distance? to open to

If Traverse motion to be applied Second to Third to open to

How many Slivers will you double at each delivery? Third to Fourth to open to

Diameter of Pulleys on Driving Shaft? inches (usually 16in.) Speed of Main Shaft revs. Diam. of Drum inches

Do you require Fast and Loose Driving Pulleys? Do you require a passage? between heads of inches.

Diameter of Pulleys for Driving Front Roller? inches (usually 18in. on Shaft into 12in. on Front Roller).

What hand of Frame when facing Delivering Roller? on right hand on left hand

Will you have a Back Stop Motion? *Will you have an Eccentric Weight Relieving Motion at per delivery.*

Will you have our Patent Front Stopping Motion, which Stops when a Sliver breaks between the Front Fluted Roller and the Callender Roller, and also when a lump or unusually thick Sliver comes forward? at per del.

Will you have a Stopping Motion when the Cans are full? at per del.

Will you have extra Roller placed behind Stop Motion for assisting Cotton out of Cans (Dugdale's Patent Single Preventer) at per delivery.

If with Patent Metallic Rollers at per delivery.

Indicators to each head or to each finishing head only? at each.

If with self-locking guards? at If driving shafts to be cased in? at

NOTE.—The Spare Pinions, &c., supplied without charge with each Drawing Frame of three heads are as follows: Six Draught Pinions and Three Top Rollers.

Is a complete set of Change Wheels wanted for each Frame, or how many?

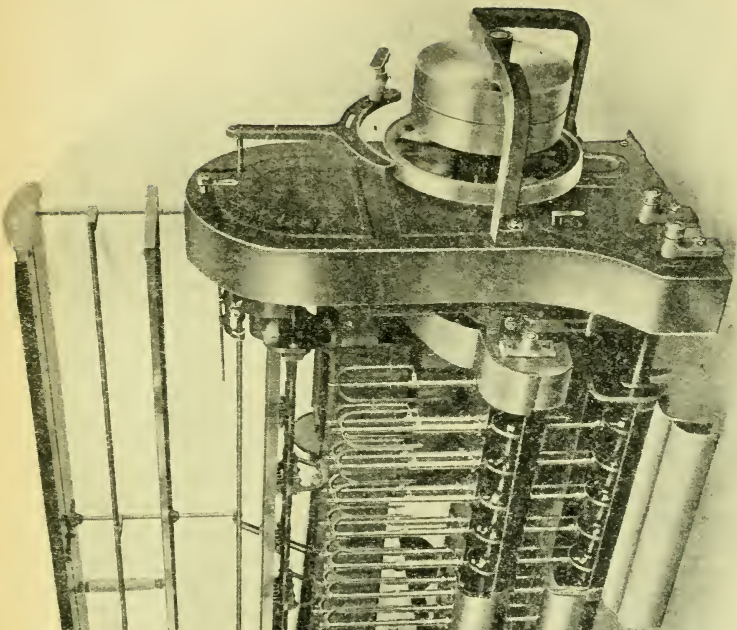
Change Draught Wheels wanted: No. of Teeth to

Are any spare articles to be sent in addition to the above?

When must the Frames be delivered, and how?

REMARKS:—

Date *Signed by*



FRONT VIEW OF ROVING FRAME.

Improved Speed Frames.

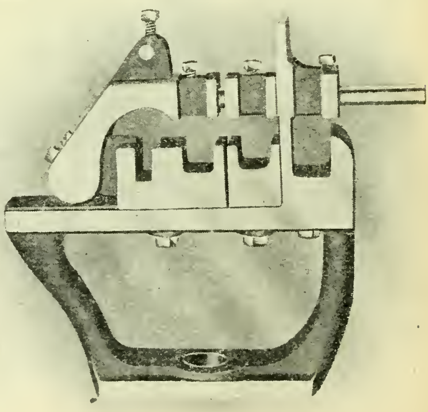
Our illustrations show the front and back views of the frame, also the gearing in diagrams for the various kinds of frame, together with a section of the Curtis-Rhodes differential motion, roller stand, etc.

General construction.—The four varieties of this class of machine in general use, viz.:—**Slubbing, Intermediate, Roving and Fine Jack Frames,** which we construct in a variety of different gauges and lengths, have been recently overhauled and modernized as far as possible, involving the employment of many new patterns.

All parts have a letter or number cast on them and those bearing the same letter or number are interchangeable, whilst the letters or numbers, names and illustrations, will be found in the "*detail*" books we supply, so that renewals may be ordered, and obtained exactly similar to the pieces to be replaced.

The framing is made specially low to facilitate creeling, and extra strong, so that it is possible to run the frames at the highest speeds with a minimum of driving power.

The spring pieces are planed to receive the roller beam, and they are provided with adjustable feet to compensate for any irregularity in the floor level.



The beams are very strong and planed on the top

The roller stands are of unusual width to give a long bearing to the roller necks, and are all carefully milled to template, as are also the **cap-bars.** We make frames if specially desired with an intermediate stand, thus doubling the number of bearings for the rollers. When this is done we usually dispense with the cap-bar, the roller stand itself carrying the top rollers, so that when the bottom rollers are set, the top ones are set along with them, but we can also put in the intermediate stand with the usual arrangement of cap bar.

Diameter of rollers, &c.—Below is given a list of suitable diameters of roller, &c., for various cottons:—

Cottons	Machines	Bottom Rollers			Top Rollers			Usual Weights lbs.		
		1st.	2nd.	3rd.	1st.	2nd.	3rd.	F.R.	M.R.	B.W.
China or Indian	Slubber	$1\frac{1}{16}$	1	$1\frac{1}{16}$	$\frac{7}{8}$	$\frac{7}{8}$	$\frac{7}{8}$	18	22	
	Intermediate	$1\frac{1}{16}$	1	$1\frac{1}{16}$	$\frac{7}{8}$	$\frac{7}{8}$	$\frac{7}{8}$	14	18	
	Roving	1	$\frac{7}{8}$	1	$\frac{13}{16}$	$\frac{13}{16}$	$\frac{13}{16}$	20	24	
American	Slubber	$1\frac{1}{4}$	1	$1\frac{1}{4}$	1	1	1	18–20	22 to 24	
	Intermediate	$1\frac{1}{4}$	1	$1\frac{1}{4}$	1	1	1	14	18	
	Roving	$1\frac{1}{8}$	1	$1\frac{1}{8}$	1	1	1	20	24	
Egyptian and Sea Island	Slubber	$1\frac{3}{8}$	$1\frac{1}{4}$	$1\frac{3}{8}$	$1\frac{3}{16}$	$1\frac{3}{16}$	$1\frac{3}{16}$	14	12	12
	Intermediate	$1\frac{1}{4}$	$1\frac{1}{8}$	$1\frac{1}{4}$	$1\frac{1}{4}$ or $1\frac{1}{8}$	$1\frac{1}{8}$	$2\frac{1}{2}$	12	10	...
	Roving ... Fine Jack	$1\frac{1}{4}$	$1\frac{1}{8}$	$1\frac{1}{4}$	$1\frac{1}{4}$	$1\frac{1}{8}$ $1\frac{1}{8}$	$1\frac{1}{8}$ $2\frac{1}{4}$	12 8	10 ...	10 ...

Division or dividing plates are sometimes applied to slubbing frames; these are made of steel and placed in front of the roller beam between the front roller and the flyer to prevent a broken end lashing.

The wheels of the draft gear are all machine cut. The other wheels in the gearing are unusually broad and strong and are machine moulded and cleaned out by machinery, and this we consider better than cutting the teeth out of the solid, as the wheels thus cast are quite as true as cut ones, with the advantage that the hard scale remains on the working surface of the tooth, thus greatly increasing its durability.

The cones are of unusual length and diameter, and run at a high speed, and their shape is quite perfect, being the result of long experience in spinning very fine counts where absolutely perfect winding is a *sine qua non.* They are placed as far apart as possible, so that a long strap can be used.

Improved motion for raising and lowering the bottom cone.—The bottom cone is carried in a stout swinging frame, and to wind the strap back it is lifted bodily. This is done by a lever conveniently placed on the front of the frame, which is provided with a locking motion, so that when the cone is down it is securely held and the strap is kept tight. It is also provided with a suitable regulating screw.

The long rack for moving the cone belt is carried on two bowls to reduce friction in order that the change will act more freely and quickly.

Balancing of the top rail.—We claim special advantages for our method of doing this. Instead of using the customary chains and weights which throw the rail forward (being necessarily attached to one side of it), causing the guides to bind in the slides and the spindles to run heavily, we introduce a lever lying lengthwise of the frame and pivoted in the spring piece. One end of the lever supports the rail directly under its centre, and the other end carries the balance weight. In this way the rail does not tend to fall forward, and it moves easily in the slides as well as leaving the spindles very free. There is no friction between the lever and the rail, but only a rolling contact, and the two arms of the lever are in constant ratio to one another throughout the full length of the lift, so that there is no variation in the weight applied. The **lifter shaft** does not require to be between the spindles, but is placed behind them so that the bottom rail can easily be kept clean.

The top and bottom rails are covered at the front by polished steel covers curved over at the upper edge with the double object of protecting the wooden middle covers and of preventing the bobbins, when laid on the rail before doffing, from falling off. The back rail covers have the top edge raised to prevent the bobbins falling off behind, and the front and back covers of the bottom rail reach to the floor, so that nothing can get underneath, and the racks are also well protected. Instead of the usual baywood covers on the top of the rails, iron ones can be put in if required, thereby making the whole of the casing fireproof.

Bottom casing plates are arranged to prevent bobbins, brushes, &c., getting under the bottom rail, and forming a complete protection for the gearing.

The spindle and bobbin shafts are stronger than usual to prevent torsion in long frames, and run in brass-bushed bearings well arranged for oiling.

The spindle and bobbin shaft wheels are specially designed to run with the least possible noise, and are all machine-moulded. The arrangement for carrying the swing motion has been modified by the additon of an extra arm and bracket placed at the frame end, thereby reducing the vibration considerably.

The driving shaft, which is of steel and increased in diameter, with cast-iron bushes fastened on it, and these run in cast-iron bearings, being easily renewed if wear takes place. The driving shaft has an additional support outside the pulleys, which also serves as a guard for the strap.

Stop motions.—We apply a positive knocking-off motion for stopping the frames when the bobbins are full, and, if required, we supply an improved **stop and lock motion** arranged to stop the frame when any desired number of layers of cotton has been wound on the bobbin, and to prevent the re-starting of the frame until the cone strap is wound back.

Measuring motion is applied, which stops the frame when any desired length of cotton has been delivered by the front roller.

An electric stop motion is supplied when required, a very effective means of preventing "Single" or knotted rovings.

Spindle oiling.—Special attention has been given to the oiling of the spindle, and the vertical bearings are slightly dished out at their upper ends so as to retain as much of the oil as possible.

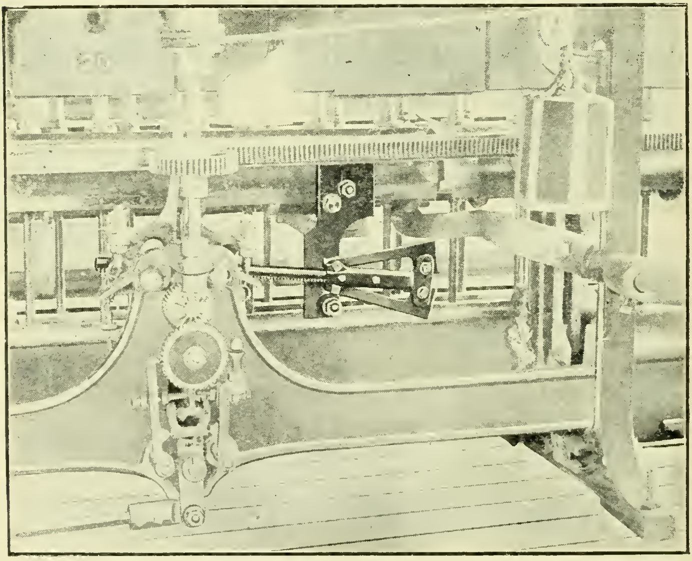
Spindle footsteps, when required, are made on the self-lubricating principle, which is a loose step, arranged with a specially-formed groove making an encased oil chamber, and insuring perfect lubrication.

Either long or short collars are supplied as may be preferred, but long collars we strongly recommend, as the collar supports the spindle to the fullest possible extent.

Ordinary long collars are bored throughout their entire length, so that the inner surface is smooth and does not collect fly and dirt. When desired we can supply long collars made from steel tubes.

The shortening and reversing motions have been much improved. In the reversing motion the two rocking levers are mounted on separate centres instead of on one as was formerly the case; longer bosses can thus be provided, causing steadier working and less wear and tear. Formerly the whole shaft carrying the reversing bevels was moved to and fro, but in our new arrangement only the two reversing bevels are displaced, so that the action is practically instantaneous owing to the absence of friction. The mechanism for the displacement of the cone strap has been the object of a patented improvement, so that a very fine ratchet wheel can be used in place of those formerly used which had only a few teeth. A spur gear is introduced behind the ratchet, which can also be changed if necessary, and the wheels used are the ordinary draft wheels.

Patent shortening or tapering motion.—The essential feature of this motion is the shaper plate, which is secured to the end of the tapering rack. This plate is slightly concave, and is actuated by the studs on the bracket



VIEW OF TAPERING MOTION AS APPLIED TO AN EXISTING FRAME.

fastened to the rail. The tapering rack, which may be described as a lever, has its fulcrum at one fixed distance throughout the building of the bobbins, and the leverage required to make the change is the same throughout, whereas in the old style of slotted plate or two-bar the distance from the centre of the motion to the end of the rack is shortened as the bobbins increase in diameter, and, therefore, greater pressure is required to make the change. By the use of this shaper plate for building the bobbin, we are enabled to make a much shorter taper, which, being convex, prevents any running over or under, and we are able to put considerably more length in the bobbins, in some cases as much as twenty per cent., thus reducing the number of doffings.

ADVANTAGES:—

> **Increased Production.**
> **Better Winding.**
> **Shorter and Convex Taper of Bobbins.**
> **Can be easily applied to existing Machines of any make.**

Clearers.—We usually supply the stationary flat clearer or the revolving top clearer, to which is attached a traverse motion; this latter is mostly used on roving or fine jack frames when fine work is being produced.

Clearer covers.—These are now made from sheet steel unless specially ordered, and are so arranged that when the cover is turned up it does not come in contact with the sliver, and at the same time it gives sufficient space for piecing up the broken end or pulling same through the eye of the traverse.

The winding has been the object of very special study in our frame, and we claim that it is absolutely perfect. In addition to a large, long, quick-running, and perfectly-formed cone, the position of the driving shaft in relation to the rail has been carefully considered, so that the motion of the rail does not cause an independent motion of the bobbins, and the Curtis-Rhodes differential motion is applied to all our frames. An illustration of the motion is given, and the following explanation will be understood on reference to it. The central casing C D, which is carefully balanced when running, is fast to the shaft, and carries the bosses of the two compound wheels. The internal wheel, to which is attached the bobbin wheel, runs loose on the shaft, as does also the cone wheel at the right hand. The latter carries a 23 pinion inside the box, gearing with the 35 of the compound 35/20, the 20 gears with another pinion usually 25 teeth on the same stud as the 14, which gears with the 92 internal wheel fixed to the bobbin driver. If now the cone wheel runs at the same speed as the shaft, the bobbin wheel would make the same number of turns as the shaft and spindle wheel, but if the cone wheel runs a little quicker than the shaft it will cause the bobbin wheel through the intermediate gear also to run a little quicker, and in the following ratio: Suppose **A** = the speed of the shaft, and **n** = that of the cone wheel, **n** being greater than **A**. The excess of speed of **n** over **A** will be represented by the expression (**n**—**A**). Then the number of turns of the bobbin wheel for **A** turns of the shaft will be

$$N = A + \frac{(n - A) \times 23 \times 20 \times 14}{35 \times 25 \times 92} \quad \textbf{thus} \quad N = A + \frac{2\,(n - A)}{25}$$

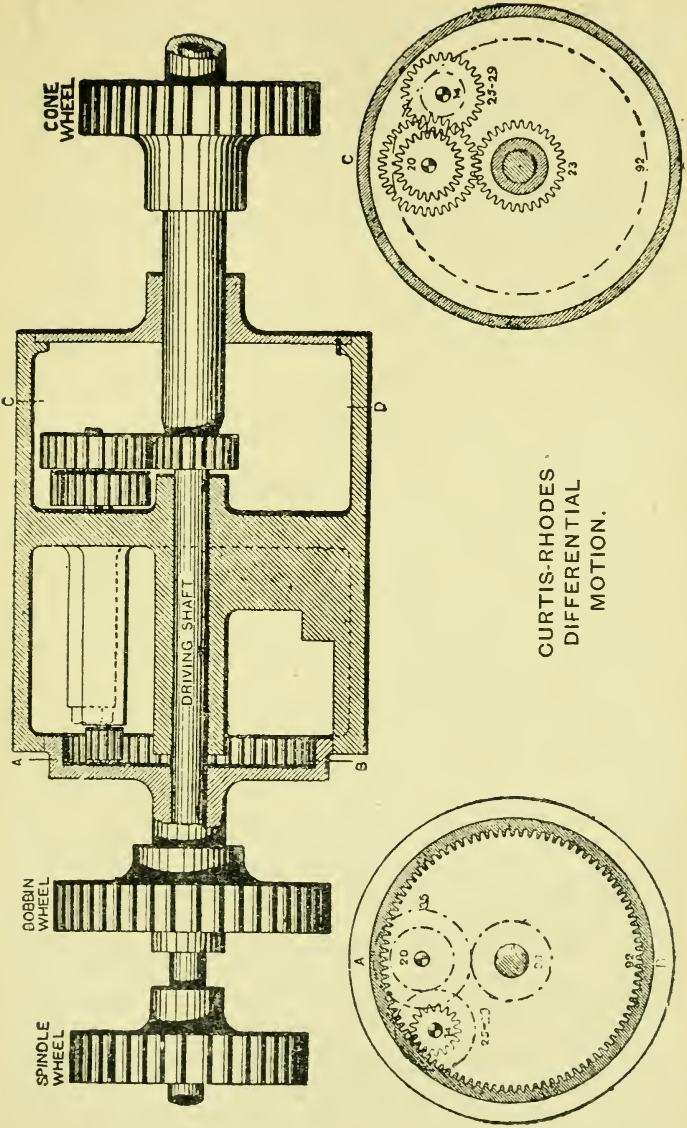
The great advantage of this motion is that all the parts run in the same direction as the shaft, and at only slightly different speed, whilst the inside pinions run very slowly indeed on their axes, so that the wear and tear and the noise are greatly reduced. The bobbins derive the greater part of their speed from the shaft, and only the excess of speed of the bobbin over the flyer is derived from the cone, and that through a very slow-running and consequently powerful mechanism. Through the employment of this arrangement the work of the cone strap is greatly reduced and the winding proportionately better.

It goes without saying that the winding can only be perfect when absolutely true bobbins are used.

"Moraes" differential motion.—This motion is worked by an internally and externally toothed wheel mounted upon an eccentric formed on the sleeve to which the variable motion is imparted. This wheel gears into a wheel fixed on the sleeve of the wheel for driving the bobbins. The whole of the combination is cased in, and the eccentric is formed with a chamber for lubricant.

Disengaging motions are applied to the lifter shafts of all frames when specially desired.

Creels are made of angle iron, lined with wood and supplied with pot footsteps and the usual **top** board to receive the full bobbins.



CURTIS-RHODES DIFFERENTIAL MOTION.

Guards.—In view of the strict regulations of the Employers' Liability Act, we apply guards to all wheels, as well as to all moving parts, so that everything is now completely covered in, and when ordered we supply our **improved self-locking doors,** casing in all the gearing at the back of the frame. These doors also prevent the starting of the machine until closed, or the opening of same while the machine is running.

Brakes to the flywheels are worked from the setting-on rod, so that directly the strap is brought on to the loose pulley the brake is applied.

The usual extras are supplied with the frames if ordered, such as long collars, loose boss top rollers, division plates, special measuring motion, **Paley's** or **Tatham's traverse motion,** brake, rollers and necks and squares case-hardened, indicator, bobbin boxes, self-weighted rollers, extra strong spindles, electric stop motion for intermediates, etc.

We supply gratis with each machine four ordinary and two loose boss top rollers, three twist wheels, three draft wheels, three lifter wheels and three ratchets, including those on the machine. If desired, we can clothe the clearers and cover the top rollers with either sheepskin or calf skin.

Hand of machine.—To determine the hand of the machine face the spindles, and note if the pulleys must be on the right or left hand.

Strapping, etc.—The main driving belt is 3in. wide, and the cone straps 2in. wide and 7ft. 3in. long for 10in. lift, and 6ft. 7in. for 7in. lift frames. Six feet of $\frac{1}{2}$in. rope is required for the shortening motion drag weight. To keep the frames running on ordinary work we usually estimate that it requires 10 tubes per spindle for slubbing frames, 11 for intermediates, and 12·5 for roving frames.

Pulleys.—Slubbing and intermediate, 14in. to 20in. dia. Roving and fine jack frames, 14in. to 18in. dia. × 3in. wide. The centre of driving shaft from floor on 10in. lift. Slubbing and intermediate frames is 21in. and for a 7in. lift. Roving frame 20in.

Speeds.—In the slubbing and intermediate frames the spindles usually make two turns for one of the driving shaft, and in the roving and jack frames 2·51 for the ordinary gauges. Others are indicated in our calculations and the wheels given on the plans of the gearing for the various machines. Below is given a list of speeds of spindles for the various machines working different cottons :—

Cotton	Slubbing F.	Intermediate F.	Roving F.	Fine Jack F.
	Revs.	Revs.	Revs.	Revs.
American ...	600 to 650	750 to 800	1050 to 1100	—
Egyptian ...	450 to 500	650 to 750	1000 to 1050	1050 to 1150
Sea Island	400 to 450	600 to 650	900 to 1000	1000 to 1100

Horse Power.—The approximate power is 1 H.P. to
50 Slubbing spindles. 60 Intermediate spindles.
70 Roving ,, 75 Fine jack ,,

Nett Weight of Speed Frames.

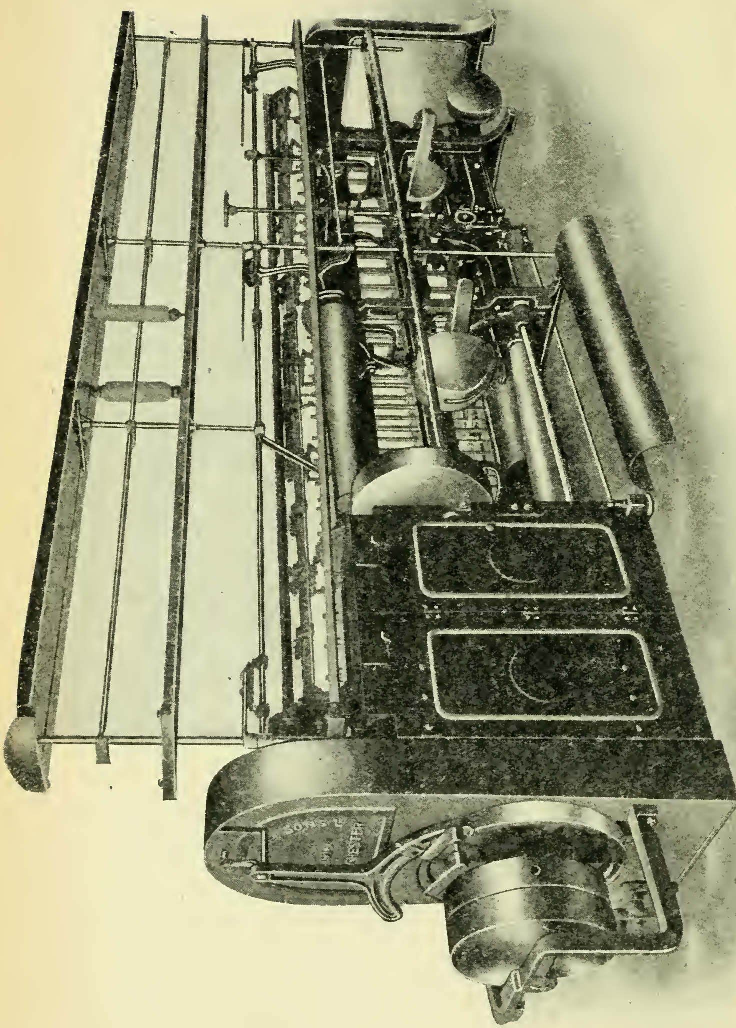
	Slubbing		Int'rmediate		Roving		Jack	
	lbs.	Kilos.	lbs.	Kilos.	lbs.	Kilos.	lbs.	Kilos.
Gearing	2075	945	2075	945	1990	905		
Rest of the Machine in lbs. per spindle without roller and balance weights	$71\frac{3}{4}$	34·6	$54\frac{1}{2}$	24·8	$40\frac{1}{2}$	18·4		
Balance and roller weights per spindle	$27\frac{1}{2}$	12	20	9·1	14	6·4		

To obtain the approximate gross weight add 26 per cent. to the total net weight.

Lengths.—To find the length of a frame multiply the space by half the number of spindles, and add 3ft. $0\frac{1}{2}$in. for single-driven and 5ft. 1in. for double-driven frames. To find the number of spindles that will stand in a given length deduct 3ft. $0\frac{1}{2}$in. or 5ft. 1in. for the gearing from the length, and divide the remainder by the space, the result multiplied by 2 will be the number of spindles required.

Example.—To find the length of a single-driven roving frame of 180 spindles, 20in. gauge :

The table on the following page gives the space for a roving frame gauge 20in. as 5in. ; so multiplying 5in. by 90, which is half the number of spindles, gives 450in. or 37ft. 6in., to which must be added 3ft. $0\frac{1}{2}$in., making 40ft. $6\frac{1}{2}$in. for the total length.



BACK VIEW OF SPEED FRAME.

Similarly, to find the number of 20in. gauge roving spindles to stand in 40ft. 6½in., deduct 3ft. 0½in. for gearing; this leaves 37ft. 6in. for the spindles. 37ft. 6in. divided by 5in. (the space for 20in. gauge) gives 90, and this multiplied by 2 gives 180, which is the number of spindles required.

The following tables give the particulars and sizes of the different frames for which we have patterns, together with the size of bobbins they will produce:—

Frame	Gauge	Space	No. of Spindles per box	Lifts	Diameter of the full bobbin
Slubbers	20½in.	10¼in.	4	10in., 11in. or 12in.	5½in. or 6in.
	20in.	10in.	4	,, ,,	5⅞in.
	19in.	9½in.	4	10in. or 11in.	5¾in.
	18in.	9in.	4	,, ,,	5$\frac{9}{16}$in.
	17in.	8½in.	4	,, ,,	5½in.
	16in.	8in.	4	,, ,,	5⅜in.
Intermediates	21in.	7in.	6	8in., 9in. or 10in.	5⅛in.
	19¾in.	6·58in.	6	,, ,,	4¾in.
	26·33in.	6·58in.	8	,, ,,	4¾in.
	19in.	6·33in.	6	,, ,,	4$\frac{9}{16}$in.
	25·33in.	6·33in.	8	,, ,,	
	18in.	6in.	6	,, ,,	4¼in.
	24in.	6in.	8	,, ,,	
Roving	22in.	5½in.	8	6in., 7in., 8in.	4in.
	21in.	5¼in.	8	,, ,,	3¾in.
	20½in.	5⅛in.	8	,, ,,	3⅝in.
	20in.	5in.	8	,, ,,	3½in.
	19in.	4¾in.	8	6in., 7in.	3$\frac{5}{16}$in.
	18in.	4½in.	8	,, ,,	3$\frac{1}{16}$in.
	17⅝in.	4$\frac{13}{32}$in.	8	,, ,,	3in.
	17$\frac{3}{16}$in.	4$\frac{19}{64}$in.	8	,, ,,	2¾in.
Jacks	24in.	4in.	12	5in. or 6in.	2⅝in.
	15½in.	3⅞in.	8	,, ,,	2⅞in.

Calculations for SLUBBING, INTERMEDIATE, and ROVING FRAMES.

General Formulæ

$$\text{Revs. of Driving Shaft} = \frac{\text{Revs. of main shaft} \times \text{dia. of pulley on same}}{\text{dia. of pulley on frame.}}$$

$$\text{Revs. of Spindles} = \frac{\text{revs. of driving shaft} \times \text{wheel on same} \times 50}{\text{wheel on spindle shaft} \times 25}$$

$$\text{Turns of Spindle for one of Driving Shaft} = \frac{\text{wheel on driving shaft} \times 50}{\text{wheel on spindle shaft} \times 25}$$

$$\text{Turns of spl. for 1 of F.R.} = \frac{\text{F.R. wheel} \times \text{top cone wheel} \times \text{driving shaft W.} \times \text{spl. wheel}}{\text{W. on cone drum shaft} \times \text{twist wheel} \times \text{W. on spl. shaft} \times \text{spindle toe wheel}}$$

$$\text{Revs. of F.R.} = \frac{\text{revs. of driving shaft} \times \text{twist wheel} \times \text{wheel on top cone shaft end}}{\text{top cone wheel} \times \text{wheel on front roller.}}$$

Inches Delivered by Front Roller for One Turn of Driving Shaft

$$= \frac{\text{twist wheel} \times \text{wheel on cone shaft end} \times 3{\cdot}1416 \times \text{dia. of F.R.}}{\text{top cone wheel} \times \text{wheel on F.R.}}$$

$$\text{Turns per Inch} = \frac{\text{revs. per spindle per min.}}{\text{inches delivered per min.}}$$

$$\text{Twist Wheel and Lifter Wheel} = \frac{\text{square root of present counts} \times \text{wheel on}}{\text{square root of required counts}}$$

$$\text{Draft Wheel} = \frac{\text{present counts} \times \text{wheel on}}{\text{required counts}}$$

$$\text{Ratchet Wheel and Rack Wheel} = \frac{\text{square root of required counts} \times \text{wheel on}}{\text{square root of present counts}}$$

$$\text{Counts or Hank Roving} = \frac{8\tfrac{1}{3} \times \text{length wrapped in yards}}{\text{weight of above length in grains}}$$

$$\text{Weight per Yard of Roving in Grains} = \frac{8\tfrac{1}{3}}{\text{hank roving}}$$

$$\text{Revs. of F.R.} = \frac{\text{Revs. of spindles}}{\text{turns per inch}}$$

$$\text{Hanks per Hour} = \frac{\text{revs. of spls. per min.} \times 60\ \text{min.}}{\text{turns per in.} \times 840\ \text{yds.} \times 36\text{in.}}\ \text{less } 12\tfrac{1}{2}\%\ \text{for stoppages}$$

C	SPEED OF SPINDLES = S.															
	550	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250	1300
·8	13·65	14·88	16·12	17·36	18 60	19·85	21·09	22·32	23·56	24·80	26·05	27·30	28·52	29·78	31·00	32·26
·85	12·85	14·00	15·18	16·35	17·50	18·68	19·85	21·00	22·18	23·36	24·52	25:70	26·86	28·02	29·20	30·35
·9	12·13	13·23	14·33	15·43	16·54	17·64	18·75	19·85	20·95	22·06	23·18	24·28	25·38	26·48	27·58	28·68
·95	11·49	12·54	13·57	14·62	15·66	16·70	17·75	18·80	19·85	20·09	21·94	23·00	24·02	25·08	26·12	27·16
1·0	10·92	11·92	12·91	13·89	14·88	15·87	16·87	17·86	18·85	19·85	20·84	21·83	22·82	23·81	24·81	25·80
1·05	10·39	11·34	12·28	13·22	14·16	15·12	16·06	17·00	17·95	18·90	19·85	20·80	21·72	22·68	23·62	24·57
1·1	9·93	10·83	11·73	12·63	13·53	14·44	15·34	16·25	17·15	18·05	18·96	19·86	20·77	21·68	22·58	23·48
1·15	9·49	10·35	11·22	12·08	12·49	13·80	14·67	15·53	16·40	17·26	18·13	19·00	19·95	20·71	21·58	22·42
1·2	9·10	9·93	10·75	11·58	12·40	13·23	14·06	14·89	15·72	16·55	17·37	18·20	19·03	19·85	20·68	21·50
1·25	8·77	9·52	10·32	11·12	11·90	12·70	13·49	14·28	15·08	15 87	16·68	17·47	18·26	19·06	19·85	20·64
1·3	8·40	9·16	9·92	10·68	11·45	12·21	12·97	13·74	14·50	15·26	16·04	16·80	17·56	18·32	19·08	19·85
1·35	8·08	8·82	9·56	10·28	11·02	11·76	12·50	13·23	13·96	14·70	15·44	16·17	16·91	17·65	18·38	19·11

Square Roots.

No.	√	No.	√	No.	√	No.	√
·4	·632	2·4	1·54	4·8	2·19	9·75	3·12
·45	·671	2·5	1·58	4·9	2·21	10	3·16
·5	·707	2·6	1·61	5	2·23	10·25	3·2
·55	·742	2·7	1·64	5·1	2·26	10·5	3·24
·6	·774	2·75	1·658	5·2	2·28	10·75	3·28
·65	·806	2·8	1·07	5·25	2·29	11	3·317
·7	·836	2·9	1·70	5·3	2·30	11·25	3·35
·75	·866	3	1·73	5·4	2·322	11·5	3·39
·8	·894	3·1	1·76	5·5	2·345	11·75	3·43
·85	·922	3·2	1·79	5·6	2·367	12	3·46
·9	·949	3·25	1·802	5·7	2·388	12·5	3·53
·95	·975	3·3	1·816	5·75	2·399	13	3·60
1·0	1	3·4	1·84	5·8	2·401	13·5	3·675
1·1	1·048	3·5	1·87	5·9	2·43	14	3·74
1·2	1·095	3·6	1·897	6	2·45	14·5	3·81
1·25	1·118	3·7	1·92	6·25	2·5	15	3·87
1·3	1·14	3·75	1·936	6·5	2·55	15·5	3·93
1·4	1·184	3·8	1·949	6·75	2·599	16	4
1·5	1·225	3·9	1·975	7	2·647	16·5	4·06
1·6	1·265	4	2	7·25	2·692	17	4·12
1·7	1·304	4·1	2·025	7·5	2·738	17·5	4·18
1·75	1·323	4·2	2·05	7·75	2·784	18	4·24
1·8	1·342	4·25	2·06	8	2·828	18·5	4·3
1·9	1·378	4·3	2·072	8·25	2·872	19	4·36
2	1·415	4·4	2·098	8·5	2·915	19·5	4·41
2·1	1·449	4·5	2·12	8·75	2·957	20	4·47
2·2	1·483	4·6	2·145	9	3		
2·25	1·5	4·7	2·168	9·25	3·04		
2·3	1·517	4·75	2·18	9·5	3·08		

Production.—To cover all the conditions voluminous tables would be required, and we, therefore, think it better to provide a simple formula whereby each may calculate a very approximate production for himself.

The pounds passed through the front roller of a frame in 10 hours' uninterrupted running will be, say, **P** where

$$P = \frac{S}{50{\cdot}4\ C} \times \frac{1}{H\sqrt{H}}$$

where **S** = the speed of the spindles per minute.

C = the number by which the $\sqrt{}$counts is multiplied to give the twists per inch, varying according to the class of cotton.

H = the counts of the roving.

The value of the expression $\frac{S}{50{\cdot}4\ C}$ is given in the table for all likely values for **S** and **C**. Consequently the value of **P** may be at once obtained by dividing the proper number in the table by the counts multiplied by its square root. (A table of square roots is appended).

The actual pounds produced per spindle in 10 hours will then be very approximately :—

$\frac{938\ P}{938 \text{ plus } 16\ P}$ for slubbing frames, with bobbins 10in. × $5\frac{1}{2}$in.

$\frac{825\ P}{825 \text{ plus } 16\ P}$ for intermediate frames, with bobbins 10in. × $4\frac{3}{4}$in.

$\frac{394\ P}{394 \text{ plus } 14\ P}$ for roving frames, with bobbins 7in. × $3\frac{1}{2}$in.

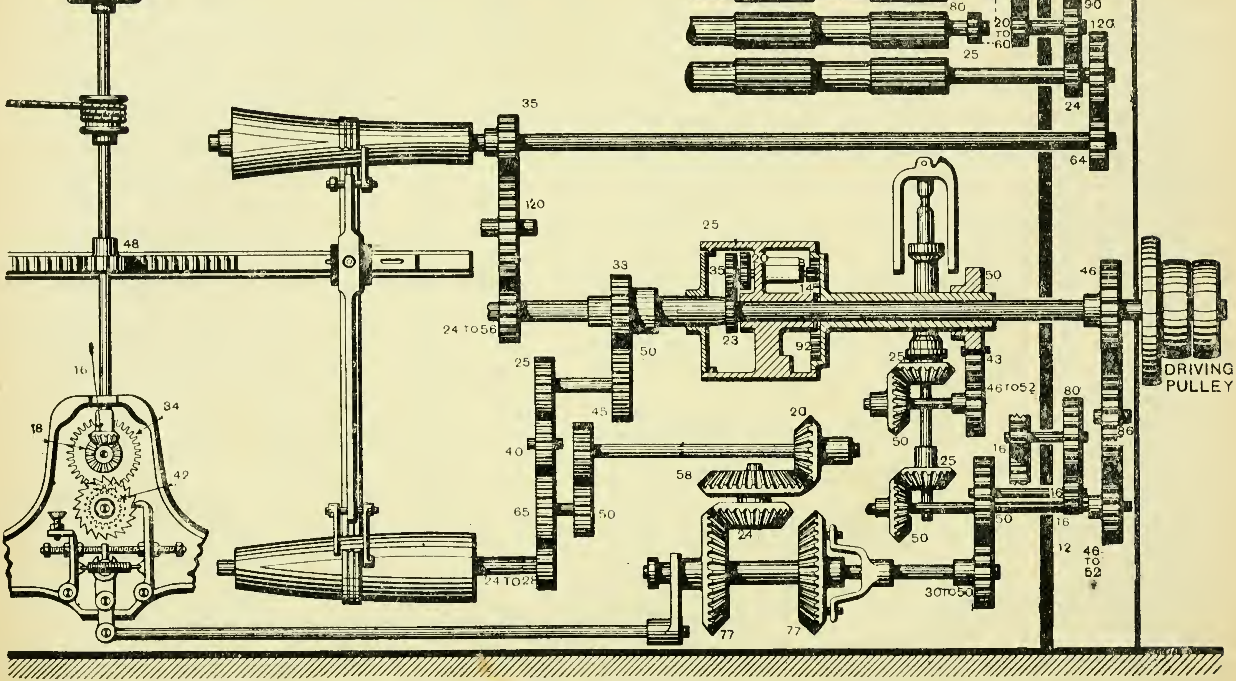
$\frac{300\ P}{300 \text{ plus } 14\ P}$ for jack frames, with bobbins 7in. × $2\frac{3}{4}$in.

$\frac{225\ P}{225 \text{ plus } 14\ P}$ for jack frames, with bobbins 6in. × $2\frac{1}{2}$in.

Example.—Required the actual production of a roving frame spinning 4-hank roving. Speed of spindles 1000. Turns per inch 1·2 $\sqrt{}$counts. In the table opposite 1·2 and under 1000 is found the number 16·55, and dividing this by $4\sqrt{4} = 8$ the result is 2·07 nearly, then

$$\frac{394 \times 2{\cdot}07}{394 + (14 \times 2{\cdot}07)} = \frac{815{\cdot}58}{422{\cdot}98} \quad 1{\cdot}92 \text{ lbs. per spindle.}$$

GEARING OF SLUBBING FRAME



A.—46 for 19″, 20″ and 20½″ gauge, 48 for 17″ and 18″, 50 for 16″, 52 for 20″ gauge, 12″ lift.

Another method of obtaining the production is as follows :—

$$\text{Hanks per hour} = \frac{\text{Revs. of spls. per min.} \times \text{60min.}}{\text{Turns per in.} \times \text{840 yds.} \times \text{36in.}} \text{ less 12\% for stoppages.}$$

f = dia. of front roller. x = the change wheel.

Draft wheel constants.—In all our frames the usual arrangement of draft gearing is shown in the plans of the gearing, namely 24 on the front roller driving 90 on the change wheel stud, and 56 on the back roller.

If f = the dia. of F.R., b = dia. of B.R., and x = the change wheel,

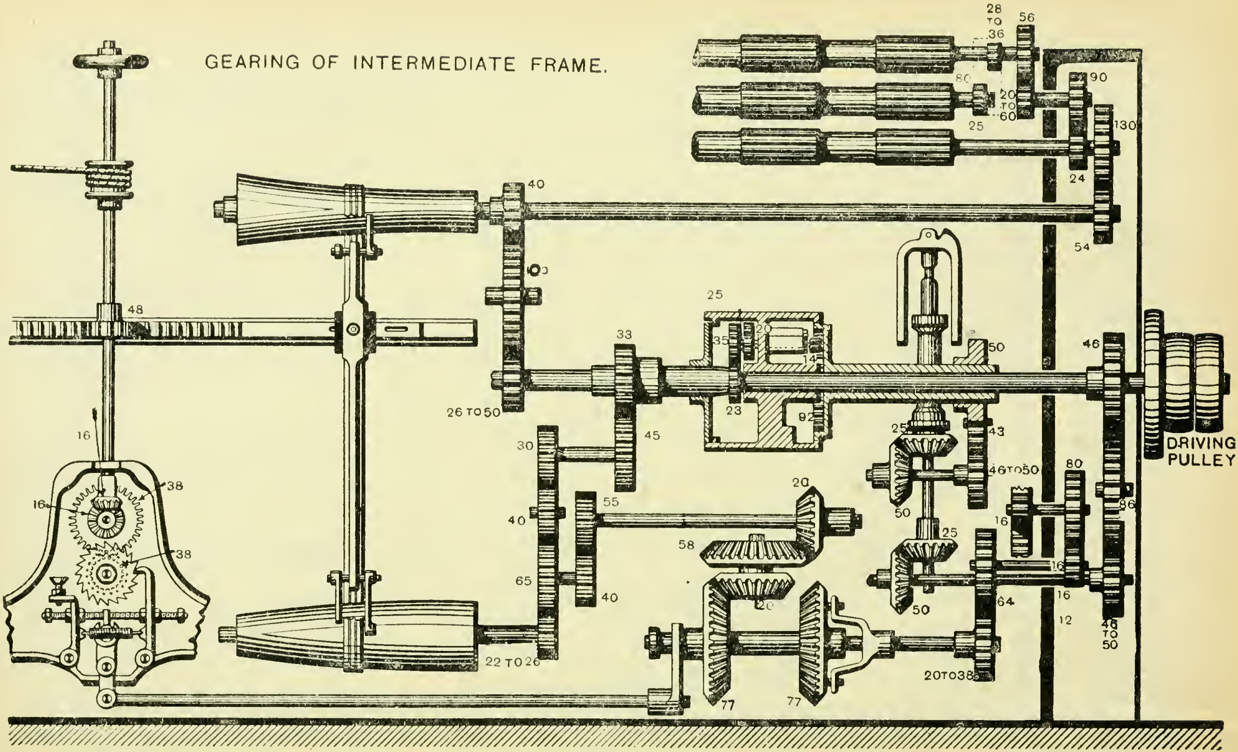
$$\text{then draft} = \frac{56 \times 90 \times f}{x \times 24 \times b} \text{ or } \frac{210 \times f}{x \times b} \text{ and since}$$

for any particular frame f and b have known values, a constant may be determined, which, if divided by the change wheel, will give the draft it gives, or if divided by the draft required will give the change wheel necessary.

In special cases the back roller wheel is a 50, or a 60, and the front roller wheel sometimes 28. The table following gives constants for any of these combinations, and for all usual combination of roller diameters.

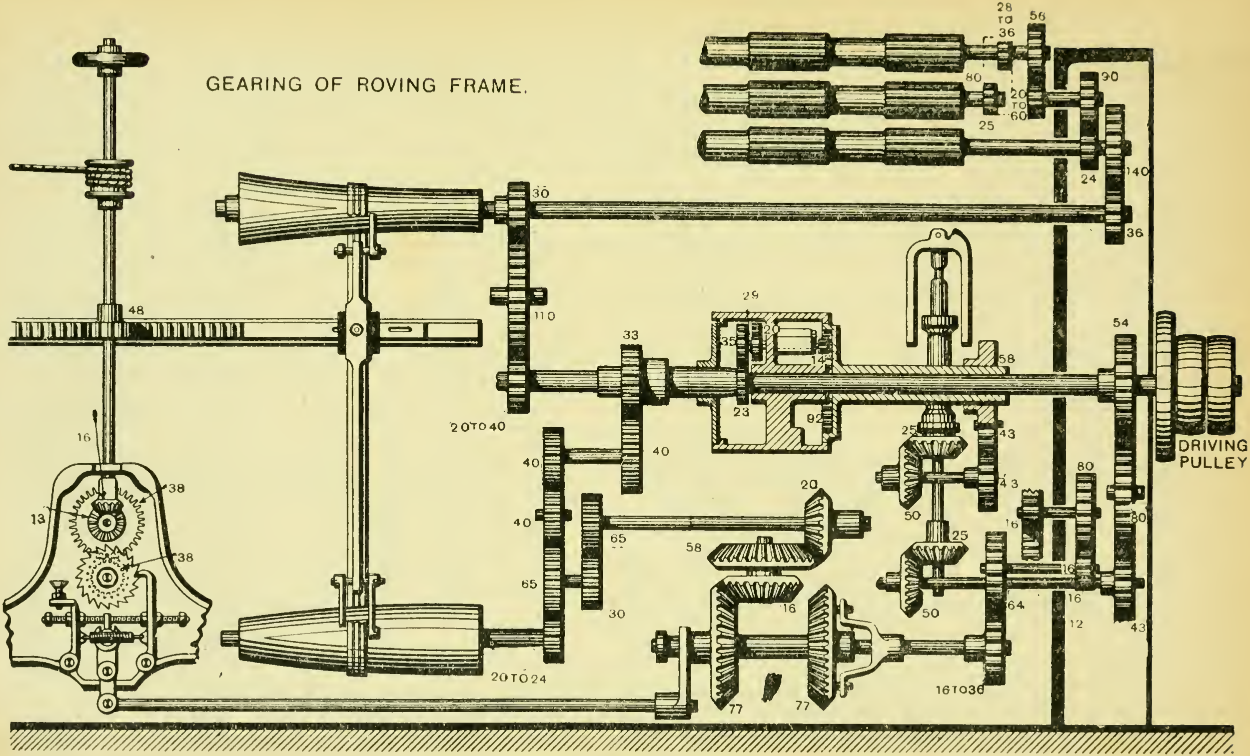
Table of Draft Constants.

Diameter of Rollers		Front and Back Roller Wheels					
Front	Back	Usual	Special				
		24 front 56 back	24 front 50 back	28 front 50 Back	28 front 56 back	24 front 60 back	28 front 60 back
In.	In.						
$\frac{7}{8}$	1	**184**	164	141	157·5	196·8	168·7
$\frac{15}{16}$	1	**197**	175	151	168·6	210·8	180·6
1	1	**210**	187·5	160·8	180	225	192·8
$1\frac{1}{16}$	1	**223**	199	171	191	239	205
$1\frac{1}{16}$	$1\frac{1}{16}$	**210**	187·5	160·8	180	225	192·8
$1\frac{1}{8}$	1	**236**	211	181	202·5	253	217
$1\frac{1}{8}$	$1\frac{1}{8}$	**210**	187·5	160·8	180	225	192·8
$1\frac{1}{4}$	1	**262·5**	234·5	201	225	281	241
$1\frac{1}{4}$	$1\frac{1}{8}$	**233**	208	179	200	250	214
$1\frac{1}{4}$	$1\frac{1}{4}$	**210**	187·5	160·8	180	225	192·8
$1\frac{3}{8}$	$1\frac{1}{8}$	**257**	229	196	220	275	236
$1\frac{3}{8}$	$1\frac{1}{4}$	**231**	206	177	198	247.5	212
$1\frac{3}{8}$	$1\frac{3}{8}$	**210**	187·5	160·8	180	225	192·8
$1\frac{1}{2}$	$1\frac{1}{4}$	**252**	225	193	216	270	231·5
$1\frac{1}{2}$	$1\frac{3}{8}$	**229**	204·5	175·5	196·5	245·5	210·5
$1\frac{1}{2}$	$1\frac{1}{2}$	**210**	187·5	160·8	180	225	192·8



GEARING OF INTERMEDIATE FRAME.

A.—43 for 18″, 44 for 18 and 23″, 46 for 19 and $25\frac{1}{3}$″, 48 for 19 and $25\frac{1}{3}$″, 48 for $19\frac{3}{4}$ and $26\frac{1}{3}$″, 50 for 21″ guage.



A.—42 for $17\frac{3}{16}''$ and $18''$, 43 for $18\frac{1}{2}''$, $20''$ and $21''$ gauges.

Constants for Twist per inch.

SLUBBING FRAMES.

Front roller wheel	Top cone wheel	Wheel on driving shaft	Spindle wheel		
120	35	46	50	1	
64	x	48	25	3·92	= 32 constant
Wheel on cone drum shaft	Twist wheel	Wheel on spindle shaft	Spindle toe wheel	Cir. of F.R. $1\frac{1}{4}$in. dia.	

$$\frac{120}{64} \times \frac{35}{x} \times \frac{46}{48} \times \frac{50}{25} \times \frac{1}{3{\cdot}92} = 32 \text{ constant}$$

INTERMEDIATE FRAMES.

Front roller wheel	Top cone wheel	Wheel on driving shaft	Spindle wheel		
130	40	46	50	1	
54	x	48	25	3·92	= 47 constant
Wheel on cone drum shaft	Twist wheel	Wheel on spindle shaft	Spindle toe wheel	Cir. of F.R. $1\frac{1}{4}$in. dia.	

$$\frac{130}{54} \times \frac{40}{x} \times \frac{46}{48} \times \frac{50}{25} \times \frac{1}{3{\cdot}92} = 47 \text{ constant}$$

ROVING FRAMES.

Front roller wheel	Top cone wheel	Wheel on driving shaft	Spindle wheel		
140	30	54	50	1	
36	x	43	25	3·92	= 74·7 constant
Wheel on cone drum shaft	Twist wheel	Wheel on spindle shaft	Spindle toe wheel	Cir. of F.R. $1\frac{1}{4}$in. dia.	

$$\frac{140}{36} \times \frac{30}{x} \times \frac{54}{43} \times \frac{50}{25} \times \frac{1}{3{\cdot}92} = 74{\cdot}7 \text{ constant}$$

FINE JACK FRAMES.

Front roller wheel	Top cone wheel	Wheel on driving shaft	Spindle wheel		
140	32	54	50	1	
27	x	42	25	3·92	= 108·8 constant
Wheel on cone drum shaft	Twist wheel	Wheel on spindle shaft	Spindle toe wheel	Cir. of F.R. $1\frac{1}{4}$in. dia.	

$$\frac{140}{27} \times \frac{32}{x} \times \frac{54}{42} \times \frac{50}{25} \times \frac{1}{3{\cdot}92} = 108{\cdot}8 \text{ constant}$$

Constant divided by turns per inch = **twist wheel.**

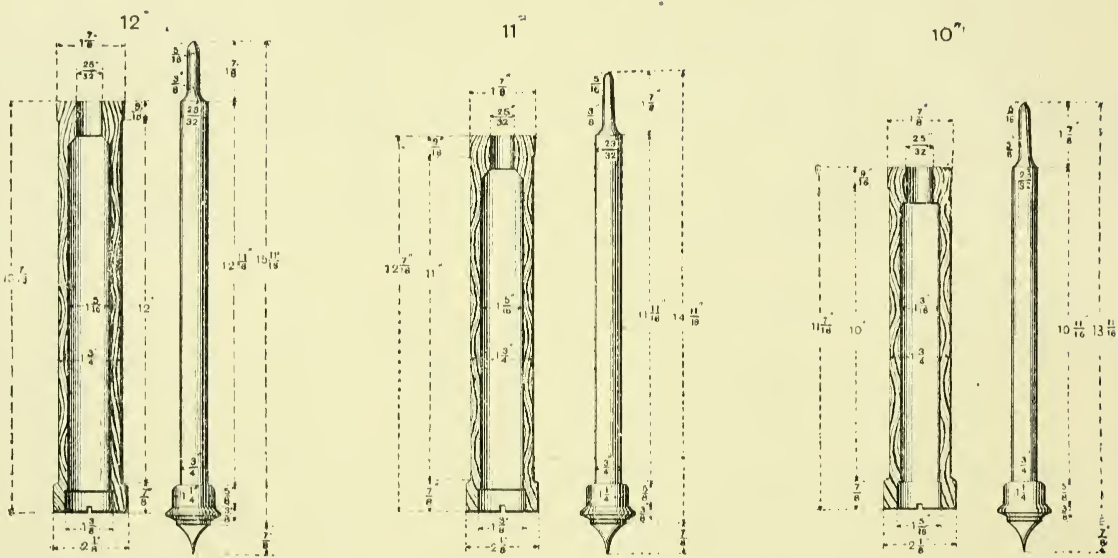
In the following tables constants are given for the different gauges of frames, and for all required diameters of front rollers except $1\frac{3}{16}$in. and $1\frac{5}{16}$in. dia. Should constants for these be required they may be found by dividing the constants given opposite the 1in. roller in the various columns by 1·1875 and 1·3125 respectively.

Slubbing Frames.

Diameter of the front roller	Usual 19in. 20in. 20½in.	17in. 18in.	16in.	20in. for 12in. lift bobbins	Gauge
	46	48	50	52	Wheel on the end of the spindle shaft
	35	35	35	35	Top cone wheel
In.					
$\frac{7}{8}$	47·7	45·8	43·95	43·1	Multipliers for turns per inch
$\frac{15}{16}$	44·6	42·7	41	40·2	Sea Island $\sqrt{\text{counts}} \times {\cdot}7$
1	**41·8**	**40·05**	**38·45**	**37·7**	Egyptian $\sqrt{\text{counts}} \times 0{\cdot}9$
$1\frac{1}{16}$	39·3	37·7	36·18	35·5	American $\sqrt{\text{counts}} \times 1{\cdot}1\text{-}1{\cdot}2$
$1\frac{1}{8}$	37·15	35·6	34·18	33·5	Indian $\sqrt{\text{counts}} \times 1{\cdot}3$
$1\frac{1}{4}$	33·45	32·03	30·76	30·15	*Change Wheel* $= \frac{\text{constant}}{\text{required turns per in.}}$
$1\frac{3}{8}$	30·4	29·12	27·97	27·4	Turns per inch $= \frac{\text{constant}}{\text{twist wheel on}}$
$1\frac{1}{2}$	27·88	26·7	25·62	25·12	

Intermediate Frames.

Diameter of the front roller	18in. 23in.	19in. 25⅓in.	Usual 19¾in. 26⅓in.	21in.	Gauge
	44	46	48	50	Wheel on the end of the spindle shaft
	40	40	40	40	Top cone wheel
In.					
$\frac{7}{8}$	73·45	70·15	66·2	64·55	Multipliers for turns per inch
$\frac{15}{16}$	68·6	65·45	62·5	60·2	Sea Island $\sqrt{\text{counts}} \times {\cdot}78$
1	**64·13**	**61·35**	**58·6**	**56·45**	Egyptian $\sqrt{\text{counts}} \times 0{\cdot}95$
$1\frac{1}{16}$	60·5	57·65	55·15	53·1	American $\sqrt{\text{counts}} \times 1{\cdot}1\text{-}1{\cdot}2$
$1\frac{1}{8}$	57·15	54·55	32·1	50·2	Indian $\sqrt{\text{counts}} \times 1{\cdot}2$
$1\frac{1}{4}$	57·4	49·1	46·9	45·15	*Change Wheel* $= \frac{\text{constant}}{\text{required turns per in.}}$
$1\frac{3}{8}$	46·75	44·6	42·6	41·0	Turns per inch $= \frac{\text{constant}}{\text{twist wheel on}}$
$1\frac{1}{2}$	42·85	40·9	39·08	37·6	



Long Collar Bobbins and Skewers for 12", 11", 10" Lifts.

Roving Frames.

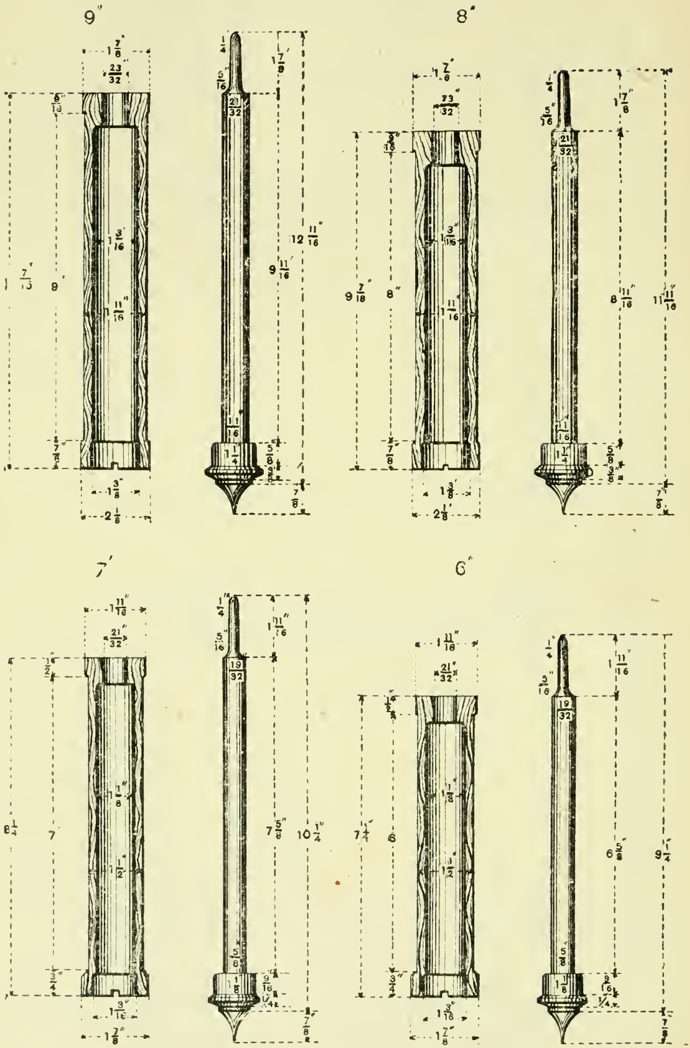
Diameter of the front roller	$17\frac{3}{16}$in. 18in.	$18\frac{1}{2}$in. 20in., 21in.	Gauge
	42	43	Wheel on the end of the spindle shaft
	30	30	Top cone wheel
In. $\frac{7}{8}$	109·3	106·75	Multipliers for turns per inch
$\frac{15}{16}$	97·4	99·6	Sea Island $\sqrt{\text{counts}} \times 1{\cdot}1$
1	95·6	·93·4	Egyptian $\sqrt{\text{counts}} \times 1{\cdot}15$
$1\frac{1}{16}$	89·95	87·9	American $\sqrt{\text{counts}} \times 1{\cdot}2\text{–}1{\cdot}25$
$1\frac{1}{8}$	85	83	Indian $\sqrt{\text{counts}} \times 1{\cdot}5$
$1\frac{1}{4}$	76·5	74·7	$\textit{Change Wheel} = \dfrac{\text{constant}}{\text{required turns per inch}}$
$1\frac{3}{8}$	69·5	67·9	$\text{Turns per inch} = \dfrac{\text{constant}}{\text{twist wheel on}}$
$1\frac{1}{2}$	63·7	62·3	

Fine Jack Frames.—(27 on the end of cone shaft gearing with 140 on the front roller).

Diameter of the front roller	$17\frac{3}{16}$in. 18in., 24in.		Gauge
	42		Wheel on the end of the spindle shaft
	45		Top cone wheel
In. 1	191·3		Multipliers for turns per inch
$1\frac{1}{8}$	170		Sea Island $\sqrt{\text{counts}} \times 0{\cdot}9$
$1\frac{1}{4}$	153		Egyptian $\sqrt{\text{counts}} \times 0{\cdot}95$
$1\frac{3}{8}$	139		American $\sqrt{\text{counts}} \times 1{\cdot}0\text{–}1{\cdot}1$
$1\frac{1}{2}$	127·5		$\textit{Change Wheel} = \dfrac{\text{constant}}{\text{required turns per inch}}$

Multipliers of square root for turns per inch.

	Slubbing	Intermediate	Roving	Fine Jack
Sea Island.........	0·7	0·78	1·1	0·9
Egyptian	0·9	0·95	1·15	0·95
American	1·1—1·2	1·1—1·2	1·2—1·25	1·0—1·1
Indian	1·3	1·2	1·5	...



Long Collar and Bobbins Skewers for
9″, 8″, 7″, 6″ Lifts.

SPECIFICATION.

Details to be given when ordering Speed Frames.

How many Frames? How many Spindles in each Frame?
To stand in what length including driving Pulleys?

NOTE { The gearing occupies 3ft. $0\frac{1}{2}$in. for Single Driven Frames. Width of Frame 3ft. 0in.

Length of Lift? inches
(Usually 10, 9 or 8in.)
For Soft or Press Bobbins? What description of Presser?
Diam. of Bobbin when full? Diam. of Bobbin Barrel?
Flyer or Bobbin to lead?
If with Short Collar? or Mason's Long Collar? extra per Spindle, at
Diam. of Spindle? (Usually $\frac{3}{4}$in.) If with $\frac{13}{16}$in. diam. extra per Spindle, at
Spindles to run Twist or Weft Way? (Usually Twist Way).
If with Patent Footstep extra? at
Which Gauge will you have?

Is the Front Line of Bottom Rollers to be Case-hardened? extra per Spindle at	Diameter of Fluted Rollers		Or are the Necks only to be Hardened extra per Frame at	Diameters of Top Rollers.	
	Front	inch		Front	inch
	Second	,,		Second	,,
	Third	,,		Third	

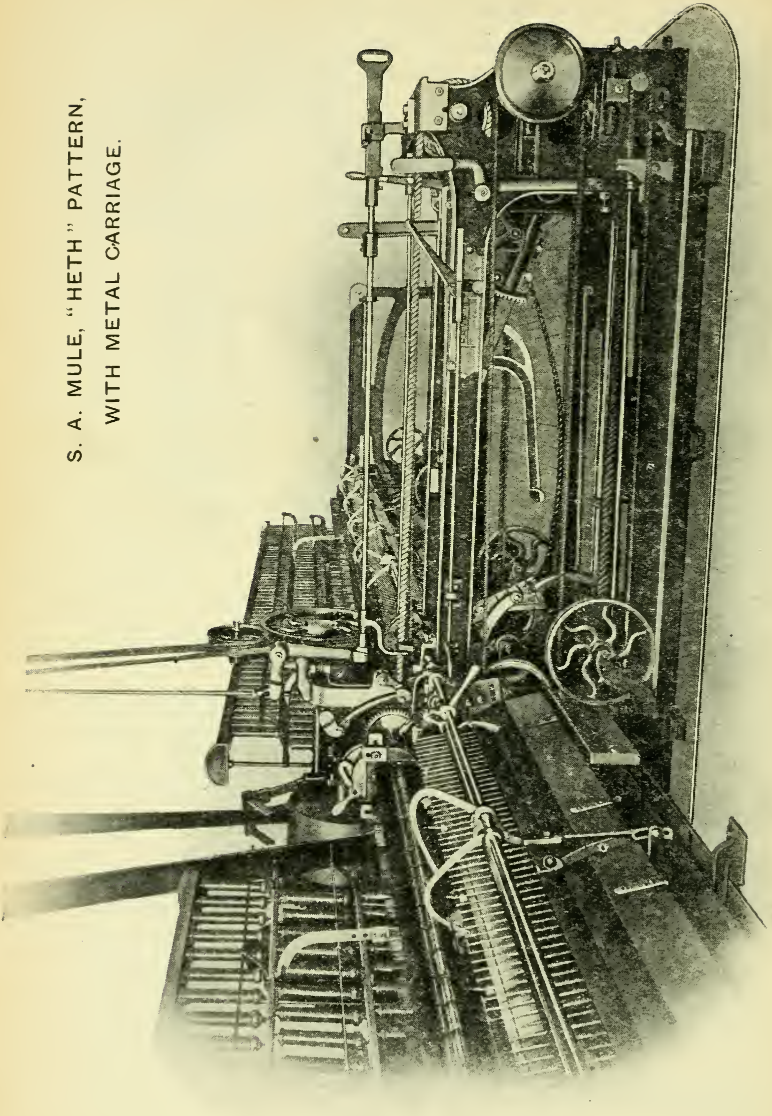
Back Line of Rollers to have corrugated or common Flutes?
If Top Rollers or Front Line to be E. Leigh's Patent Loose Boss?
extra per spindle at
Total Draft of Fluted Rollers? Draft from Front to Second Roller?
Draft from Second to Third Roller?
If Baywood or Iron Flat Top Clearers?
Top Spindle Rail cased with Baywood or Iron?
Distance from centre to centre of Rollers?
Front to Second, smallest distance to open to
Second to Third, smallest distance to open to
Top Roller Dead-weights for three lines of Rollers:—
If Middle and Back Top Rollers Self-weighted?
If three lines of Rollers weighted separately with Dead-weights?
extra per spindle, at
Front lbs. Second lbs. Third lbs.
Number of Hank Roving to be made? Extreme length and diameter of Creel Bobbins?
Creel: If for two Bobbins for each Spindle? or for three B bbins?
at per Spindle?
Height and diameter of Coiler Can?
Speed of Main Shaft per minute? Diameter of Drum on same?
If with Brake, extra at
Speed of Spindle? revs. per minute How many turns of Spindle for one of Front Roller?
Diameter of Driving Pulleys on Frames? in.
Driving Pulleys when facing Spindles on right hand or left hand?
Hank Indicators extra at each. If with separating Plates for ends to run through? extra per Spindle, at

NOTE.—The Spare Pinions, &c., supplied without charge for each Intermediate Frame are as follows:—
2 Draft Pinions, 2 Twist Pinions, 2 Lifter Shaft Pinions, 10 Ratchet Pinions, and 6 Top Rollers.

Is a complete set of Change Wheels wanted for each Frame, or how many?
Change Wheels wanted:—Draft Pinions, Nos. of Teeth to
Twist Nos. of Teeth to
Lifter Shaft Pinions, Nos. of Teeth to
Ratchet, Nos. of Teeth to
Are any spare articles to be sent in addition to the above?
When must the Frames be delivered, and how?

REMARKS:

Date Signed by



S. A. MULE, "HETH" PATTERN,
WITH METAL CARRIAGE.

Patent Self-Acting Mules.

HETHERINGTON AND CURTIS H-PATTERN MULES.

We are makers of the **Hetherington Mule,** the **Curtis H-Pattern Mule,** the **ordinary mule twiners** with stationary creel, and a newly-designed **Yorkshire Twiner** with stationary spindles and travelling creel, as well as of special mules for waste and woollen. All these machines are the outcome of long experience and careful study, and we do not hesitate to say that they lead the way in regard to **production, light running, steady winding,** whilst the upkeep expenses are reduced to a minimum.

All the parts are made on the interchangeable principle, and have cast on them a well-defined letter or number to facilitate ordering change pieces or parts broken in transit, and catalogues are supplied giving illustrations of each part with its corresponding letter or number, so they can be ordered with the assurance that they will come according to order and, when to hand, fit in place.

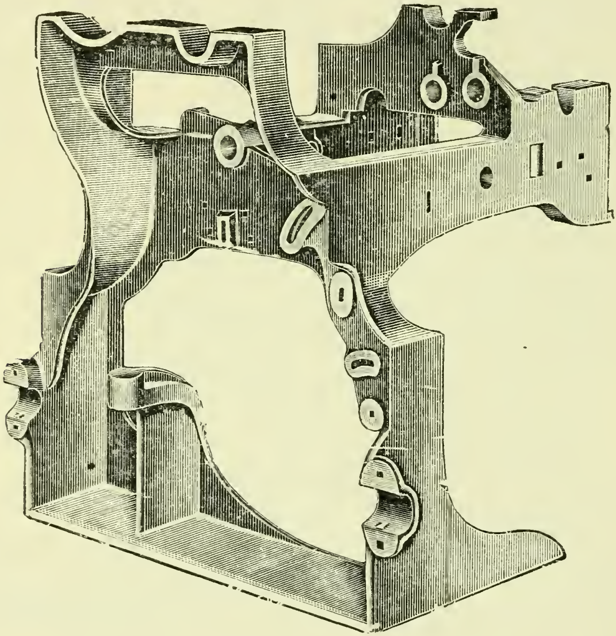
HETHERINGTON PATTERN.

The headstocks, cast in one piece, are spacious and of great strength, and permit of easy access to all parts for the purpose of oiling and regulating, and are so arranged that every part can be easily removed without interfering with any other important part. **The scroll shaft, the rim shaft, and the two backing-off and taking-in shafts** can all be removed in a couple of minutes, as the bearings are so arranged as to come away with the shafts, and being all steady-pinned can be replaced accurately without hesitation. The bearings are all brass-bushed, and the bushes can be easily renewed when worn, and at a most trifling cost.

The illustration shows the mule headstock back, from which it will be seen that it is extra strong and cast all in one piece.

The surfaces on the headstock to receive the various brackets are all milled at one operation by special machinery at one setting, thereby ensuring that all the parts are perfectly square and perpendicular to each other.

The brackets have also milled surfaces so that in every case two perfect facings come together, thus making a solid joint to withstand the vibration which the carriage and different motions produce when the mule is running. All brackets, besides the bolts used for fastening, are steady-pinned, so that if removed they may be replaced in correct position without loss of time.



A special machine is employed for boring holes for back shaft, speed gearing studs, and cam shaft, all at one operation, ensuring correct relation between these parts.

Strong foundation plates receive the headstock and the two first slips with the builder, thus binding the whole into a solid square as the centre of the machine.

The driving belt controls only the turning of the spindles, rollers, and the outward movement of the carriage.

The taking-in and backing-off are driven by separate band from the countershaft, and suitable provision is made for keeping the band tight. The grooved pulley in the headstock is an ordinary rim pulley, and being placed on the outside of the bearing is instantly changed if necessary, and where a large range of counts is to be spun it is a great advantage to be able to alter slightly the speed of the taking-in and backing-off without any trouble.

A special band tightening apparatus is used which comes on the slack side of the band, so that the slack band is taken up as required in a very simple manner.

Strap or independent taking-in and backing-off is applied to mules for spinning counts from 120's to 300's. The motion is driven by a strap in place of ropes (as mentioned above). The arrangement is very simple, and the amount of strap on the drawing-up pulley can be adjusted to give any speed required, this regulation being effected by a stop rod and an adjusting screw. As the strap pulleys are in front of the driving pulleys, the motion takes up no more space than the ordinary drive.

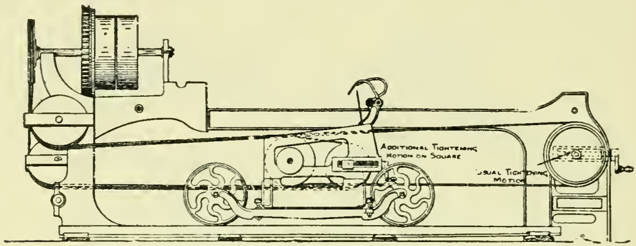
The rim shaft is made of steel, $1\frac{3}{4}$in. dia., with the boss for the rim pulley forged on. We call attention to this, as it allows of the greatest possible speed to be attained, and greatly facilitates the satisfactory working of the mule.

The rim band carrier pulleys are made 13in. dia. This increased size, compared with those ordinarily used, greatly reduces the wear of the rim band, and as they run at a correspondingly much lower speed, and upon steel centres, the lubrication is effected much better, and the risk of fire is greatly reduced, this being one of the most dangerous parts of the mule. We also provide an auxiliary **tightening pulley** on the square for the rim band. By this means we get extra tightening of the band without the front pulley projecting into the wheel-house, and, further, the time is increased before re-splicing of the band is necessary. **Compensating or swing pulley frames** are also applied to take up the slack of the rim band at the commencement of the outward run of the carriage.

The backing-off friction is 19in. in dia., thus giving increased power to this important movement.

The levers for putting the backing-off, taking-in, and cam shaft frictions in and out of gear, as well as those for moving the front roller and backshaft clutches, are all made in the form of a fork, and pass on each side of the shaft so as to grip the friction or clutch on both sides, and thus act squarely on it, preventing twist and torsion and consequent dwell or hesitation.

The taking-in friction is 13in. dia. and thus very powerful. It is so arranged that it may be thrown out from the front of the headstock by a foot lever if required during the inward run.



The back shaft clutch is so arranged that if the carriage meets with any obstruction on the outward run the clutch will be thrown out, and the carriage brought to a standstill.

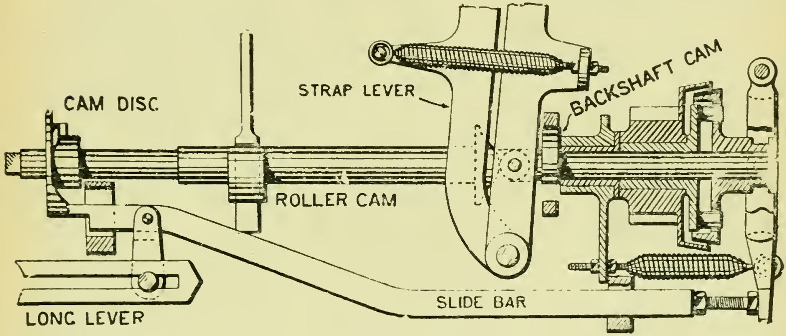
The taking-in scroll bands are in one continuous length, and provision is made for equal tension on both ropes by the introduction of a special tightening apparatus, and a certain length is kept in reserve for re-knotting, thus effecting a saving in banding.

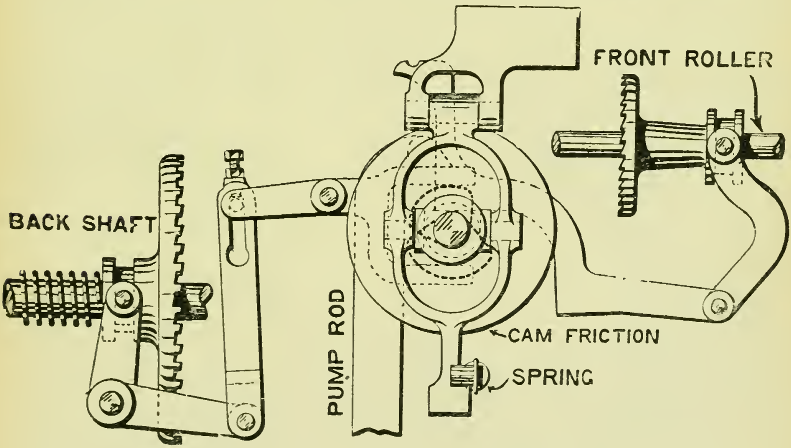
The backing-off cam can be so adjusted that the faller follows the yarn as it uncoils from the spindle.

The backing-off chain tightening motion, which is connected with the builder plates, takes up the slack of the chain automatically, and does not require the slightest attention.

The cam shaft is driven by a friction which is of the simplest construction, being all cast in one piece. Its work is greatly reduced by the independent action of the carriage, which will also make the more important changes, as it will change the strap at both ends of the draw, throw-out the taking-in friction and the backshaft clutch, and all the motions are so arranged that no two that are antagonistic can be in gear at the same time. Thus it is impossible for the taking-in friction to get into gear until the backing-off friction is clear, or the drawing-out clutch to engage whilst the taking-in is in gear.

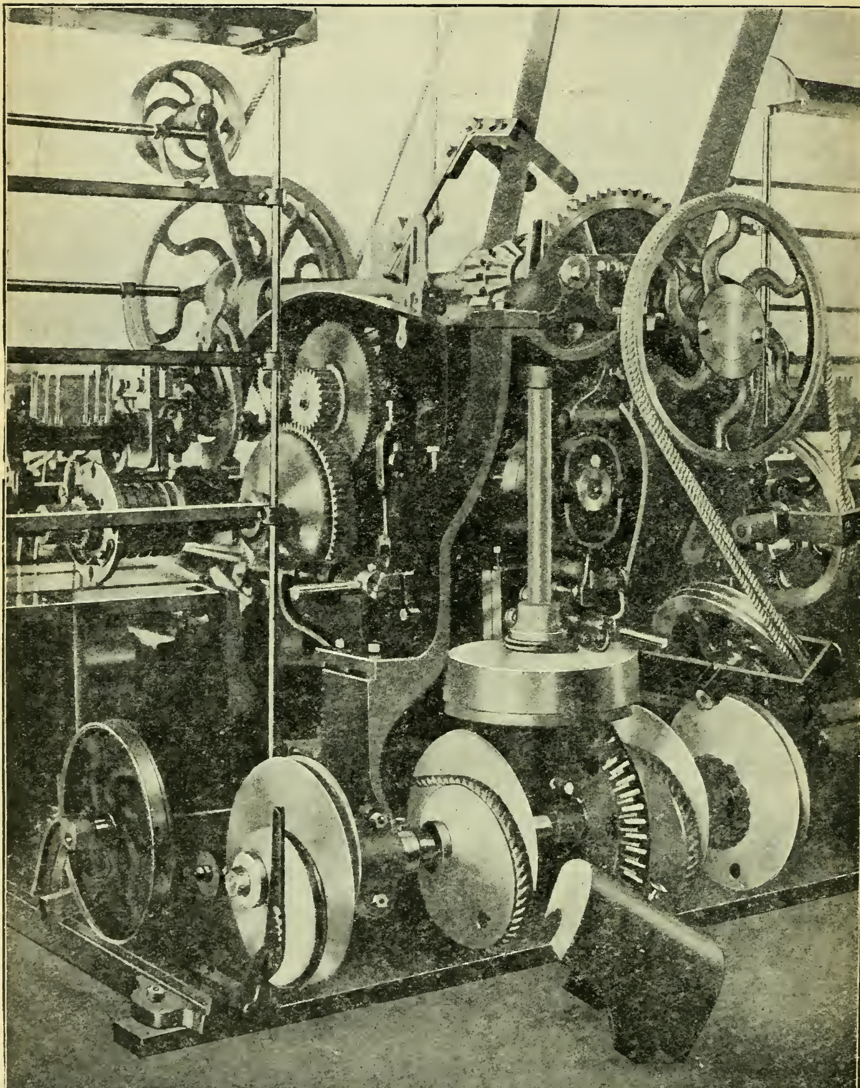
Pulling-off or hastening motion.—This is very simple in construction and easy to adjust. It consists of a lug or finger so arranged that it can be adjusted by the replacing of a peg to get any required movement. This finger or lug





is attached to a rod on the side of the headstock, which is depressed by fallers on the outward run of the carriage, and thus pulls the strap on to the loose pulley.

The tin roller pulley is usually 12in. in dia., but 14in. may be introduced if necessary, and they can be made in halves with two, three, or four grooves, as may be desired.



BACK VIEW OF HEADSTOCK.

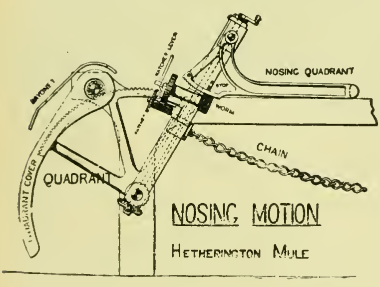
The tin roller shafts are of large diameter, and run in easily lubricated brass bearings, or the bearings can be made on the Mohler principle to swivel and be self-adjusting, if required.

The regulator motion (strapping or governing) is so made that the slightest variation in the position of the fallers makes a corresponding alteration, and a cam again releases the motion without putting any strain on the faller.

A fullcop stop motion is applied to weft mules to ensure all the cops being made the same size.

Faller coupling motion for fine spinning is a preventive of snarls, gives better wound cops, and prevents any undue strain on the yarn. The snail plate that controls the backing-off also coils the yarn on the spindle when the faller rises. The fallers can be more easily and readily adjusted to suit the requirements of the yarn being produced.

The winding has received special attention and may be said to be perfect, no matter whether the carriage runs in slowly or quickly, and a hard cop with an increased length of yarn on it is made. **The builder rails and copping plates** are accurately machined to template so as to give a perfect cop, and must under no consideration be filed at the mill, and the relative positions of the centres of the quadrant and winding drums have been carefully fixed to ensure steady and regular winding. As accessories to the winding, we employ an automatic and perfectly controllable **nosing motion**, mounted on the quadrant, which is clearly shown in the sketch above and the side elevation of the headstock.



The quadrant sector is a separate part and not cast together with the trunk, so that in case of accident it can be replaced at once and at a small cost.

Improved tension motion specially arranged to relieve tension on yarn during backing-off and commencement of winding, by the very gradual increase and decrease of weight applied, permitting the application of heavier weights at the correct moment to ensure firm winding.

Head twist motion is driven from the twist worm on the rim shaft. The motion is so compounded that the twist wheel can be of a reasonable diameter for once round of the motion.

Twist latch.—This device is so arranged that while twisting at the head is taking place the strap is being gradually drawn from the fast pulley, so that when the twist is complete there remains only a small portion of the strap on the fast pulley to be removed. By this arrangement there is a great saving in the backing-off friction, and there is less wear and tear on the rim bands. The device is easily adjusted for drawing off the strap at any given distance.

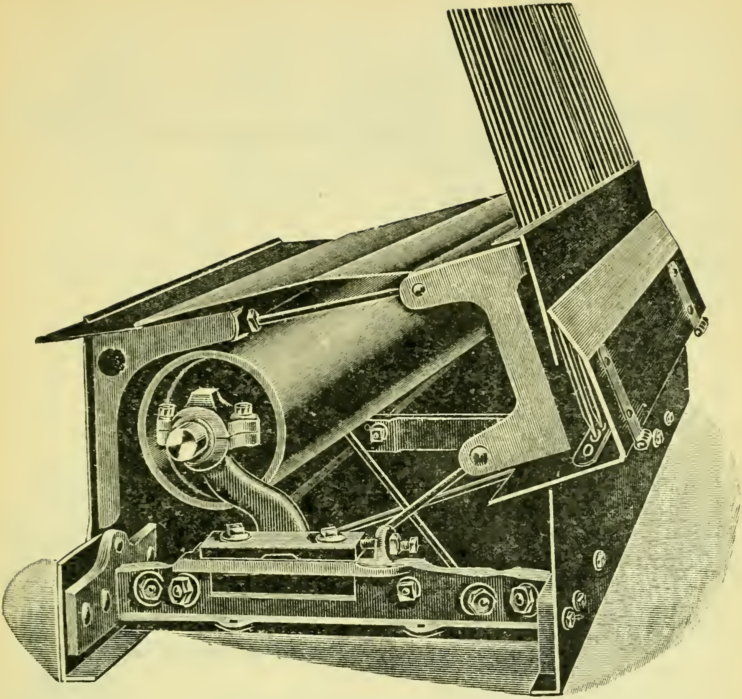
The twist wheels are spur wheels of large diameter so that very small changes may be made, and two change places are provided so as to reduce the number of change wheels required where a large range of counts is to be spun, and they are so arranged that the change can be effected easily and quickly. There is an arrangement in connection with the change wheel which enables us to change on the rim shaft, and also the pinion on the twist lever, thus getting a much larger range than otherwise.

The square is of a very strong section, with the front and back plates cast together. The carriage is built to go inside the square, and is bolted to the front and back plates and steadied with $\frac{3}{4}$in. dia. diagonal rods.

Patent metal carriage.—This carriage is constructed entirely of metal. The whole framework is built up of rails and sheet metal, bound together in such a manner as to present the greatest resistance with a minimum amount of deflection, to meet all strains developed in the carriage when the mule is working, and for rigidity and firmness is superior to anything at present in existence.

The homogeneity of the material distributes the expansion and contraction equally so that each part is affected by it in equal ratio.

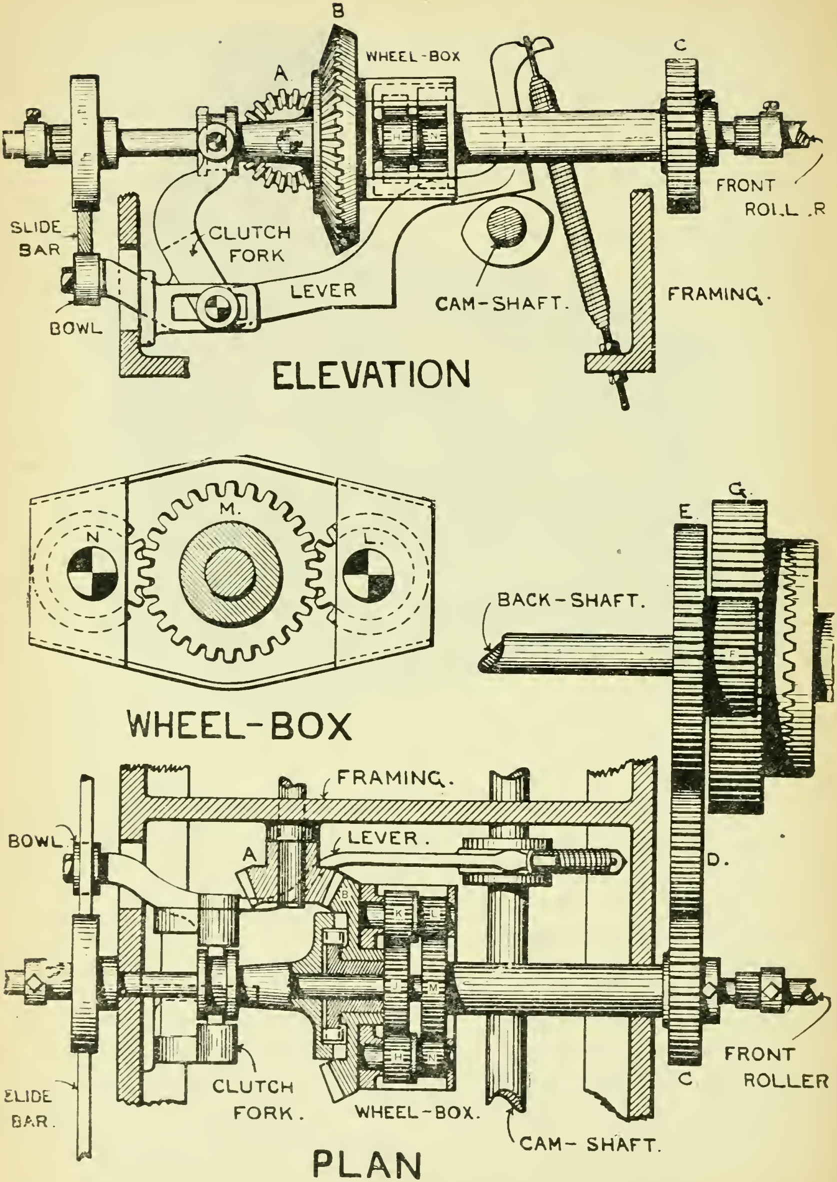
It is much superior to wood, inasmuch as it is not inflammable, runs lighter, is more rigid, is not so liable to get out of square, and produces better work and more length. The wood carriage, after working some years, becomes so saturated with oil that its weight increases very considerably and requires more power to drive, and it becomes more inflammable and requires frequent squaring up in consequence of the shrinking nature of the timber.



SECTION OF METAL CARRIAGE.

Advantages of the Metal Carriage.

1.—Non-inflammable and practically indestructible.
2.—Considerably lighter and stronger.
3.—Less power required to drive the mule.
4.—Steadier, and practically no vibration.
5.—No swinging motion of the carriage.
6.—Less breakage of ends, hence less waste.
7.—More even winding.
8.—Greater production, and higher speeds obtainable.
9.—More sensitive to the changes.
10.—Works with less noise than the ordinary one.
11.—No strain on the rollers, spindle rail, tin rollers, and faller shafts, and when once set correctly remains so.



IMPROVED STRETCHING OR JACK MOTION.

12.—Made in uniform long lengths, affording maximum strength and rigidity, it requires few joints and no special couplings.

13.—Tin roller bearings of swivel type, and supported on firm stretchers directly above carriage bearers.

14.—All metal, hence no trouble through unequal expansion.

The wood carriages are light and very strong and rigid, and are boarded underneath with stout boards so that they are very stiff. The parts are put together by tongues and grooves all cut by special machinery, and are wedged up, by hardwood wedges dipped in glue before they are driven up, and thus making as strong a job as possible. The carriage stays are also strengthened by wrought-iron cross stays bolted from each of the hardwood stays, thus preventing any bending movement, and a **carriage stop motion** is applied so that the carriage can be brought to a standstill at the beam without putting the strap off.

Slips and carriage wheels.—In order to ensure perfect and steady running of the moving parts, we employ at the headstock end of the carriage a much wider slip and carriage wheel than usual. The life of the slip is thus prolonged, and this reducing of the wear of the slip ensures perfect coping for a much longer period than if an ordinary width of the slip was used.

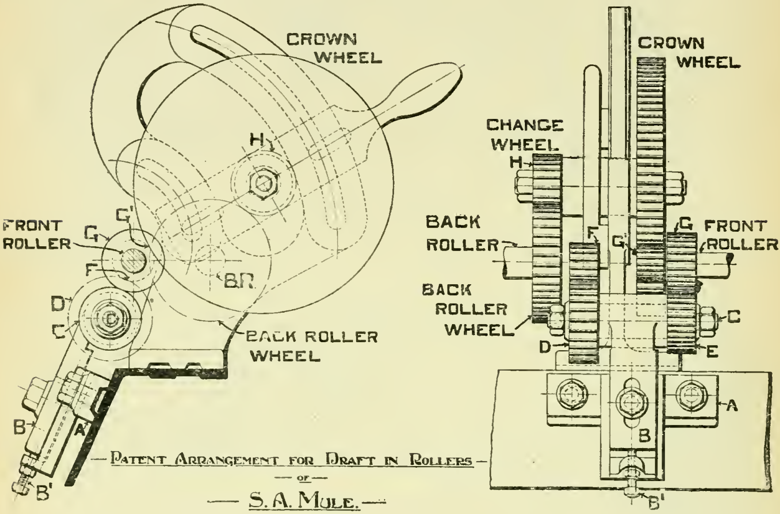
Stretching or jacking motion.—In this arrangement as the carriage is being drawn out from the roller beam before the stretching commences, the front roller spindle, the large bevel, and the whole of the wheel box revolve. The rollers can be disengaged at any time during outward run of the carriage; after they are disengaged the stretching commences, through the wheels A, B, and the wheel box, the wheel C on the long boss, and then through the train of wheels on to the back shaft.

Roller motion whilst winding.—This motion is driven from the back shaft direct on to the front roller.

Roller delivery motion whilst twisting is worked from the worm on the rim shaft through a train of wheels on to the front roller.

Patent draft gearing.—The object of this device is to get unlimited and accurate drafts, at the same time using large change wheels.

The device consists of a compound bracket A, B, secured to the roller beam carrying a stud C, on which are mounted wheels D and E, gearing into F, which is secured to the front roller, and G running loose on the the front roller. F being a driver, gives motion through D and E to the wheels G and G[1] to the crown wheel, change wheel H, and to the back roller.

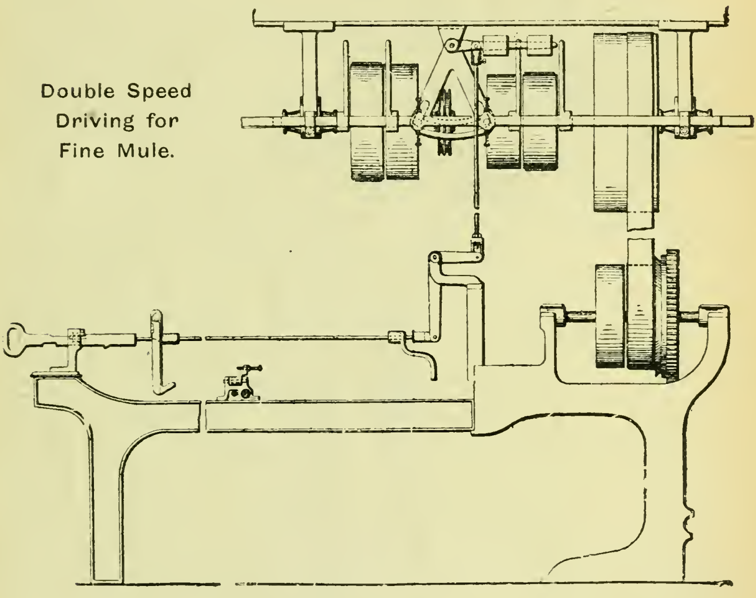


— Patent Arrangement for Draft in Rollers —
— of —
— S. A. Mule. —

For applying to existing machines.—When it is required to change from a low to a high draft, say from 8 to 16, in existing mules by the addition of this arrangement the original front roller wheel must be made to run loose. The motion is then put into gear with this latter wheel and into a new driving wheel which must be fastened to the front roller, and thereby getting the increased draft without changing any of the exisiting wheels or fixings. When it is required to go back to the low draft, the bracket B and the wheels D and E are taken out of gear by means of the adjusting screw B[1], and the original front roller wheel G is again fastened to the front roller, and the original draft remains.

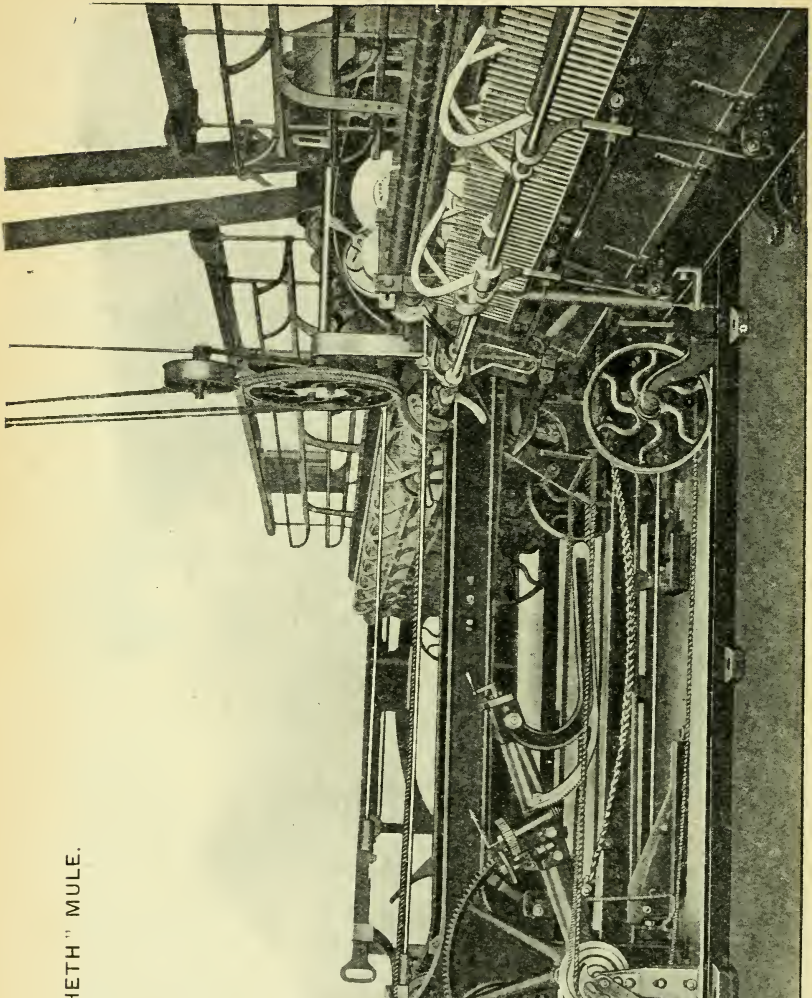
Double speed driving.—The illustration shows the mechanism for driving mules at two speeds for fine counts. We employ two pairs of fast and loose pulleys, and two independent slide bars, each of which carries one of the belt forks for the two driving belts. On a stud above the driving pulleys we pivot a quadrant which has a slot concentric with its arc, but terminating into two radial portions: in these latter, work a stud and bowl fixed to each of the slide bars. When the change takes place, say to the quick speed, the quadrant is moved forward and approximately horizontally, and carries with it the bowl on the slide bar for slow speed, after moving it the required distance on to the loose pulley it comes into the concentric slot and thus leaves the bowl, and in turn comes in contact with the bowl on the bar for the

Double Speed Driving for Fine Mule.



quick speed, thus taking the strap over the loose on to the fast pulley. One great advantage is that it is impossible for the straps to be on the two fast pulleys at the same time, and it is considerably neater than the two sets of three pulleys for obtaining the motion.

Duplex driving can be supplied if desired, consisting of two pairs of fast and loose pulleys on the rim shaft. Owing to these pulleys being narrower than the usual ones the straps have to be moved a smaller distance at each change.



"HETH" MULE.

The pulleys are usually 16in. dia., but may be made larger if desired, our headstocks being capable of taking pulleys up to 20in. dia. and $5\frac{1}{4}$in. wide for 5in. belt if required.

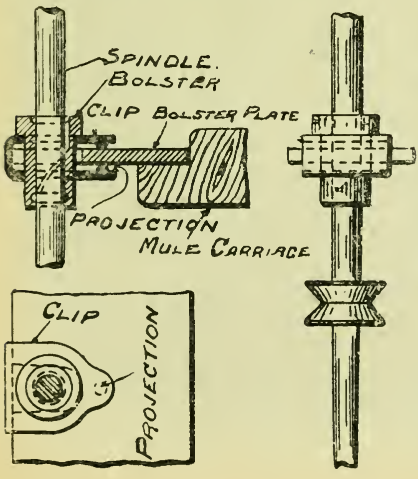
Scavengers.—When required we can supply scavengers or cleaners for clearing the carriage from fluff or loose fibres, either the **curtain or stationary scavenger**, or the **travelling scavenger**, which automatically traverses the length of the roller beam by means of an endless band.

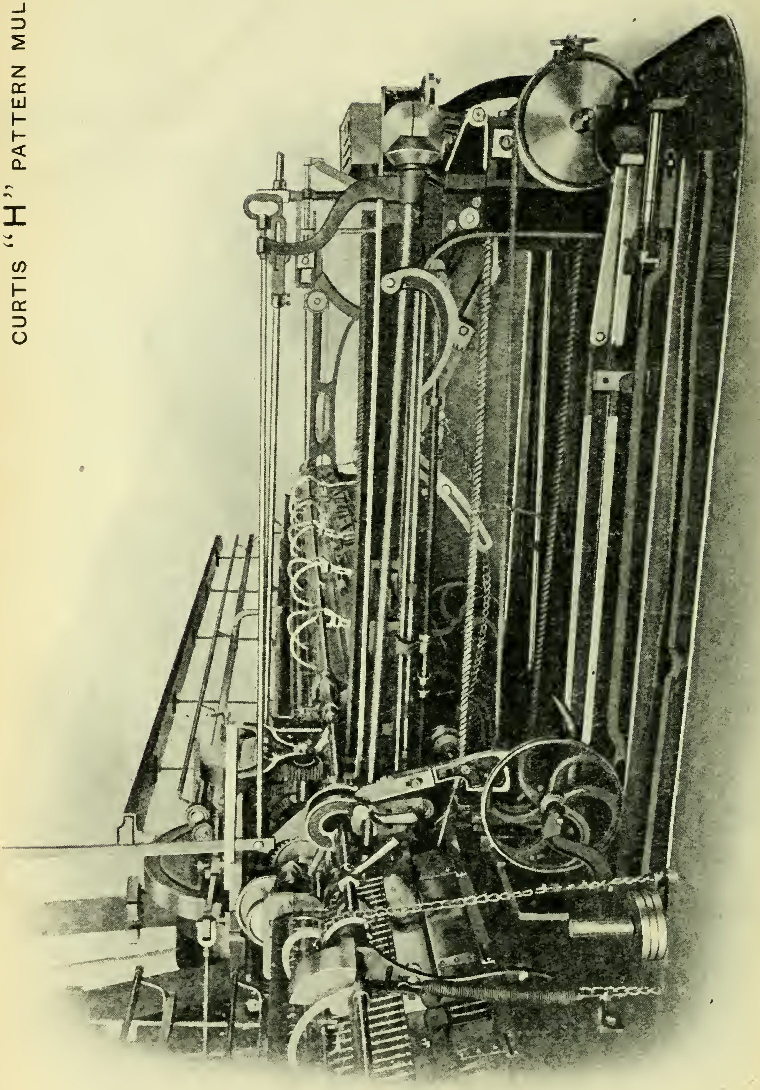
Snicking motion used in fine spinning is driven from a pair of narrow pulleys placed on the rim shaft, its object being to give an increased speed to the spindle a given time before the carriage finishes the inward run, to wind on the slack yarn caused by the lifting of the counter faller. Snarls and cut yarn are thus avoided. The motion can be set to come into operation at any required distance up to 9 inches before the finishing of the stretch.

Fallers.—The counter faller shaft is carried on anti-friction bowls of large diameter, thereby ensuring a free movement of the shaft.

Thread guides for mules with two or three threads per boss are usually supplied with the ordinary slotted traverse guide, and for single boss mules for spinning fine counts from double roving we usually supply back traverse guides with brass eyelet holes, together with spaced middle guides to suit.

Patent loose bolster.—It is generally acknowledged that the spindles absorb a large proportion of the power required to drive mules and twiners. This is mostly due to the rigid manner in which the spindles are held in the bolster. In order to overcome this we have introduced a simple loose gravity bolster for each spindle, whereby less power to drive and less frequent oiling are required. From the sketch it will be seen that we use an ordinary bolster and bolster plate. The





CURTIS "H" PATTERN MULE.

plate is provided with open slots for each bolster, and the bolster itself is carried by a sheet metal clip doubled, to leave a space wider than the thickness of the bolster plate, and the clip itself is a little wider than the slot in the bolster plate.

When the bolster is pulled into position by the band the front portion of the clip abuts against the edge of the bolster plate. At the end of the clip are two projections, with rounded heads, which rest on the bolster plate and allow the bolster to rock freely in every direction, whereby a flexible bearing is obtained for the spindle.

Speeds.—The usual speed of the countershaft is from 480 to 500 revs., and the rim shaft 850 revs. for spindle speed of 8,000 to 11,000 revs. per min., with 6in. dia. tin rollers and $\frac{3}{4}$in. dia. spindle wharve for twist, and 5in. dia. tin roller and $\frac{5}{8}$in. dia. of spindle wharve for weft.

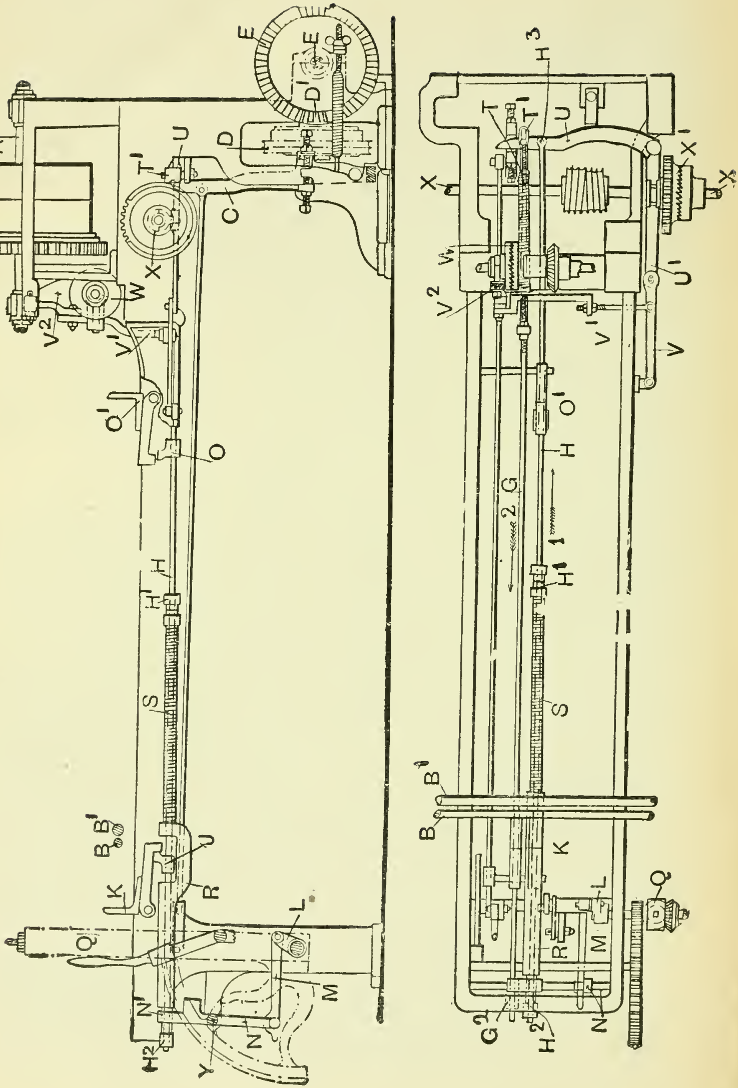
Space.—The gearing occupied by **rim-at-back** mules is 5ft. 5$\frac{1}{2}$in., and with stretching motion 5ft. 6$\frac{1}{2}$in. The **rim-at-side** mule occupies 5ft. 11$\frac{1}{4}$in., and with stretching motion 5ft. 11$\frac{7}{8}$in.

CURTIS H-PATTERN MULE.

This mule is different in many details from the Hetherington Pattern, and is made either on the **spring and lever principle** without a cam shaft, or can be made with a **cam shaft** if desired. Many of the details described in the Hetherington mule are applicable to both mules. In mules made without a cam shaft the changes are performed by springs, rods, and levers, a device creating force holding same in reserve until required, and releasing same at will.

The headstock, of which we give two views, has been completely overhauled and constructed from entirely new models. In doing this, special regard has been given to the general strength of the headstock as a whole, together with the individual parts that go towards the making of what can be safely said to be the strongest mule headstock ever constructed. This enables it to deal more effectively with the spinning of all classes of yarn.

All the parts are made on the interchangeable principle, a now well-recognised method in the building up of all classes of machinery, and each part is provided with a letter or numeral, so that in case of breakdown the necessary renewals can be ordered with the assurance that they will come according to order and, when to hand, fit in place.



H-Pattern Mule.—Spring Change Motion.

The motions are entirely separate from each other, and so arranged that no two antagonistic motions can be in operation together.

Spring change motion.—The cam shaft is replaced by a trip motion which works very satisfactorily, and is illustrated on another page. The motion of the quadrant is utilised to charge a spring during both the outward and inward run of the carriage, and the faller shafts release the trip at both ends of the draw. The attack being one of direct contact, the motion is capable of very accurate adjustment. The quadrant shaft carries a small crank, and its partial revolution acting on a system of levers charges the spring that makes the changes.

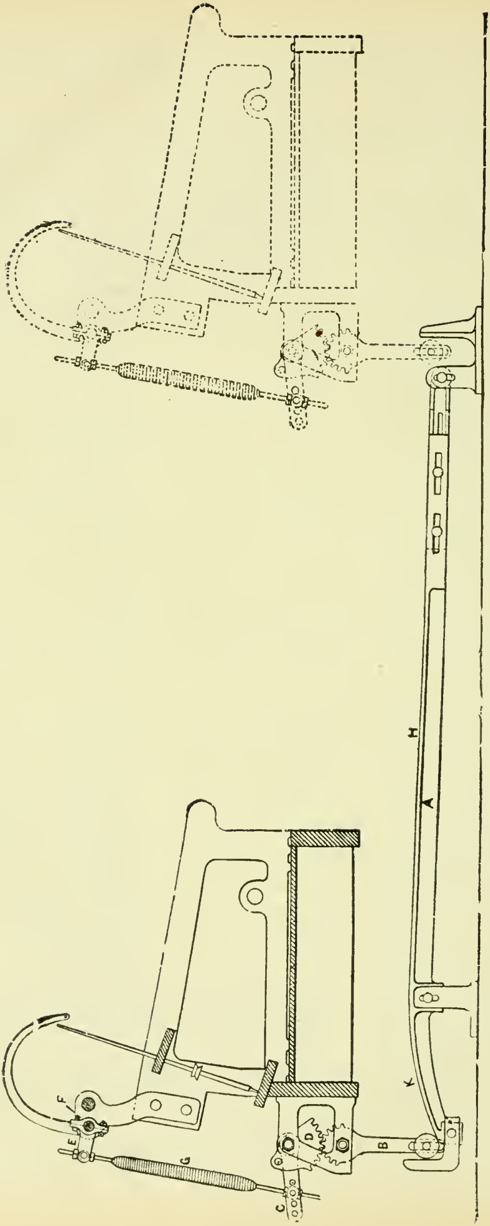
Cam motion.—Only one lever engages with the cam, this being the angle lever which controls the back shaft clutch box, front roller clutch, the taking-in friction, and the engaging of the backing-off friction. This arrangement gives absolute correct timing of the various changes, as the movement of the one cam actuates them all.

Strap motion.—The outward movement of the carriage is utilised to bring the belt on the loose pulley, and the levers are so arranged that the carriage can begin to control this movement in any position within 12in. of the termination of its outward run. When a twist motion is used this, of course, is not required.

The inward run of the carriage immediately before arriving at its termination is in a similar way arranged to put the belt from the loose to the fast pulley, and great care has been taken in the arrangement of the various motions that no antagonistic movements shall or can be brought into operation at the same time, as the changes are so arranged and connected that one must go out of gear before the other is capable of acting, such as the backing-off, which cannot get into gear while the carriage is on its outward run, and the taking-in cannot be in gear at the same time as the drawing-out. Neither can the taking-in get into gear at the same time as the backing-off, as in the action of putting into gear one relieves the other.

The displacement of the strap by the carriage is thoroughly under the control of the minder, who can instantly alter the time to suit requirements.

Driving pulleys.—These are usually made 16in. to 18in. dia., and 5in. wide.



TENSION MOTION, "CURTIS" H. MULE.

Patent strap motion.—By this arrangement the movement of the strap is controlled by a weight instead of a spring, and so arranged that the strap is both taken off the fast pulley and brought on to the loose pulley, or *vice versa*, by the pull of the weight only; this ensures an even and steady movement of the strap, and with using a dead weight in place of a spring there is no possibility of any loss of movement.

Patent backing-off motion.—The backing-off is charged shortly after the carriage leaves the roller beam. The rod is then latched into position, so that there is no strain on the carriage, also little pressure on the levers connected with the fallers at the termination of the draw. The charging of the spring being completed, it then only remains for the rod to be unlatched, which is done by the action of the fallers locking, ready for winding.

The twist motion is driven by a worm on the tin roller shaft, ensuring the correct twist, whether the rim band be tight or slack.

The tin roller shafts are of large diameter, and run in easily-lubricated brass bearings, or the bearings can be made on the Mohler principle to swivel and be self-adjusting if required.

We have patterns for the **rim-at-side** and **rim-at-back** arrangements, and all the foregoing details are applicable to both kinds.

All the usual details can be supplied such as **squaring band pulleys, duplex driving, fallers on bowl, anti-friction carriage bearers, stretching motion, roller motion whilst winding and whilst twisting, travelling scavenger, double speed motion, faller easing motion, strap taking-in and backing-off, wood or all-metal fireproof carriage.**

Tension motion, of which we give an illustration, is worth attention. The rail **A** having a shoulder or rise at the front end can be regulated in height. During the inward run of the carriage the bowl at the end of the lever **B** must run over the shoulder of the rail, and in doing so puts tensions on the yarn through the spring **D**; the greatest tension being whilst winding on the shoulder of the cop. As the carriage runs in and the faller rises the tension is diminished until it ceases altogether when the carriage is near the beam.

Speeds.—The rim shaft may run any speed from 700 to 900 revs. per min., according to the speed of spindles required. The tin rollers are 6in. dia., and the spindle wharves $\frac{3}{4}$in. dia. for both twist and weft. The countershaft usually runs from 425 revs. to 525 revs. per min.

Pulleys.—16in. to 20in. dia. × $5\frac{1}{4}$in. wide for 5in. belt.

Power.—110 twist spindles or 120 weft spindles = 1 H.P.

Length of mules.—Multiply the number of spindles by the gauge and add the following dimensions for the gearing of the different kinds of mules.

Type of Mule	With Roller Motion	With Stretching Motion
Hetherington	5ft. $5\frac{1}{2}$in.	5ft. $6\frac{5}{8}$in.
H-Pattern (Curtis)........	4ft. 11in.	5ft. $2\frac{1}{2}$in.
Hetherington rim at side	5ft. $11\frac{1}{4}$in.	5ft. $11\frac{7}{8}$in.
H-Pattern rim at side....	5ft. 0in.	5ft. $3\frac{1}{2}$in.

To find the number of spindles that will stand in a given length deduct the above lengths from the space available, multiply the remainder by 12 and divide by the gauge. The number of spindles must be divisible—

by 2 for single bossed rollers.

by 4 for rollers with 2 threads per boss.

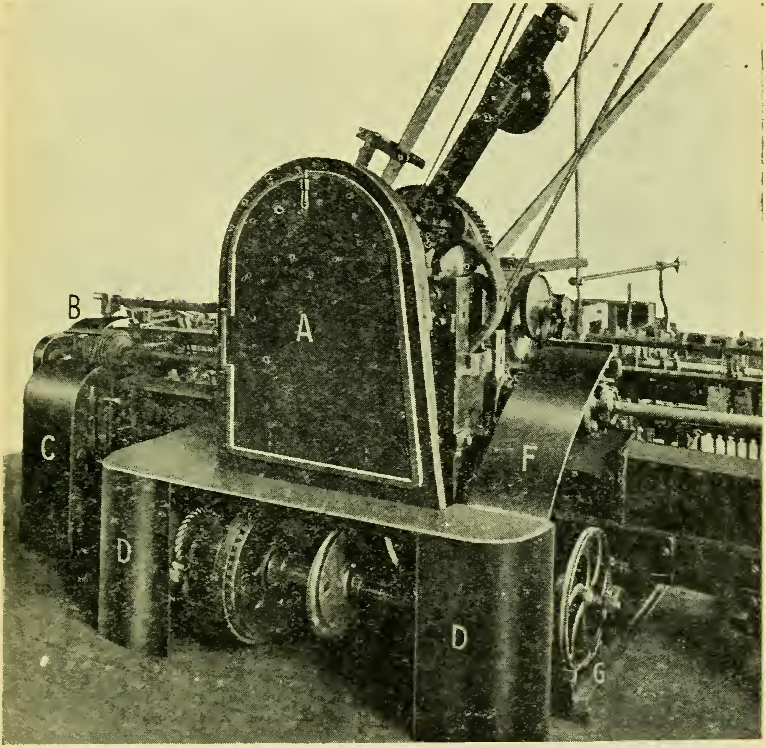
by 6 for rollers with 3 threads per boss.

by 8 for rollers with 4 threads per boss.

The distance from centre to centre of front rollers in a pair of mules for **64in. stretch** for a new mill must not be less than 15ft. 3in. to meet the Factory Act. Centre of front roller to back of headstock is 3ft. 2in., and from the centre of front roller to back of creel is 1ft. 6in. for single creel, 1ft. $8\frac{1}{2}$in. for twist 4-height double roving creel, and 1ft. $10\frac{1}{2}$in. for weft 4-height double roving creel. The distance from centre of front roller to outside of fallers is 6ft. 4in. for 64in. draw.

Stretch.—Mules made for 56in., 58in., 60in., 62in., 64in. and 66in. draw, according to the Nos. to be spun.

Guards.—In view of the strict regulations of the Employers' Liability Act, we apply guards to all wheels as well as to all moving parts, so that everything is now completely covered in, and it is impossible for any serious accidents to occur. The illustrations given herewith, together with the back view of Curtis Headstock shown below, gives an idea of how the different parts are guarded.



BACK VIEW OF H. MULE HEADSTOCK WITH GUARDS.

A—Rim Pulley Guard.

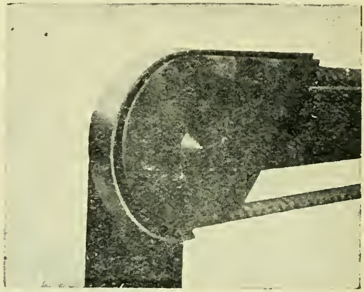
B—End Scroll on Back Shaft.

C—Middle Drawing-out Band.

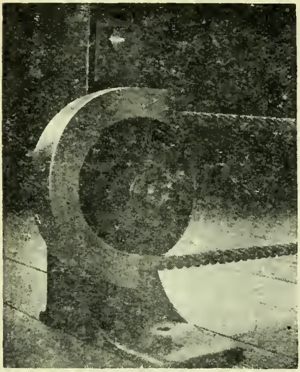
D—Scroll Shaft Guard.

G—Carriage Wheel Guard.

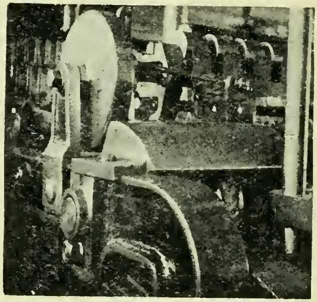
The following illustrations show two methods of guarding the band pulley on the outer frame ends; either kind is adopted according to the position of the pulley, if placed on the top of framing or carried from the floor.



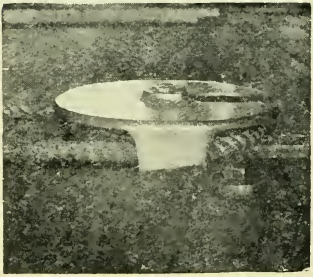
The guard for the **back shaft scroll** is



carried from the outer frame end, completely encircling the scroll and making it impossible to be caught by the band.

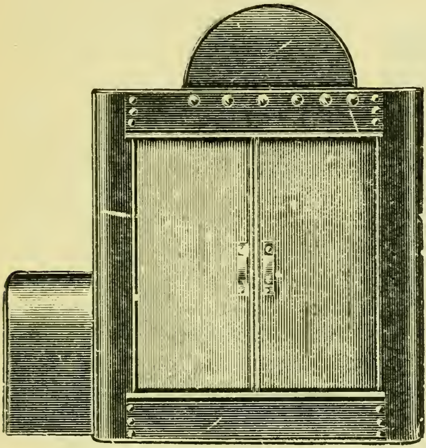


When specially ordered we can supply guards of strong blue planished steel which entirely cover in the scrolls, yet so arranged that no time is lost when replacing a band.

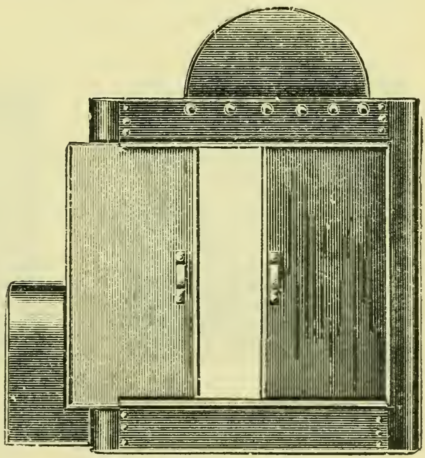


We also make floor brackets and guards for **middle drawing-out band,** on the flat (as shown), or upright pattern which completely case in the pulley, and are firmly secured to the floor, making them impossible to be moved by the passing of skips, &c.

End scroll, frame end pulley, and faller-stop.— These are all guarded, together with the **quadrant,** in such a manner that they have all been passed by H.M. Inspector of Factories and Workshops. All the above can be applied to any make of mule.



The accompanying illustrations show one method of guarding the back part of the headstock. The guard is made of sheet steel riveted together, making a solid guard. It will be seen from the illustrations that it is fitted with sliding doors to enable any change to be made without removing the guard. The guard can be easily cleaned, and there is no fear of fluff gathering, which would be dangerous in case of fire. Sometimes we supply this shape made of wire netting.

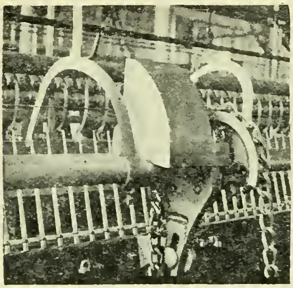


The headstock guard for the **Curtis mule** is formed of a cast-iron frame supported by the headstock back, and filled in with a detachable sheet-iron panel. Below this is a platform and end guards for the taking-in scroll shaft, which may be thus entirely cased in. A view of this arrangement is shown on page 186.

This illustration shows one method of guarding the fallers by means of a cast-iron stationary cover.

We also supply covers for **taking-in bevels, scroll bevels and quadrant, &c.**

Fixed carriage wheel guards.—We have many different patterns of this guard, which is carried from the carriage front in place of running loose on the rail.



Patent faller stop guard.—Upon the faller bracket we form a projection or stud, and this passes through a curved slot formed in the guard. The guard rests normally upon and extends below the counter faller shaft, so that when the winding faller shaft turns, taking the bracket forward and downwards, the projection on the bracket passes along the slot in the guard, which remains stationary, and so effectually protects the operative from injury by the stop on the bracket as it returns sharply upon the counter faller shaft.

This can be applied to existing mules of any make.

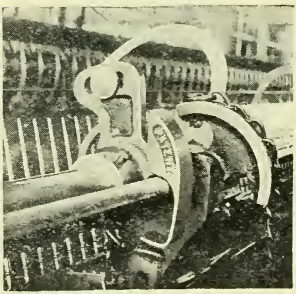


Fig. 1.

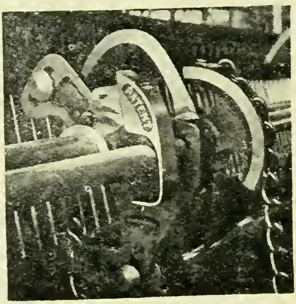


Fig. 2.

Fig. 1 shows the guard in position during the outward run of the carriage.

Fig. 2 the position during the inward run.

Various kinds of Creels used on the "Heth" and "Curtis" Pattern Mules.

The illustrations herewith show a few of the different kinds of creels used for single or double rovings.

For **ordinary twist mules** it is usual to supply a 3-height single creel, which with $1\frac{3}{8}$in. gauge mules allows all full bobbins to be used.

If the height of the room will allow of a single creel when using either single or double roving we strongly recommend them, as it is better for creeling, and much more convenient for the operative when piecing up broken ends.

For **Egyptian and Sea Island Yarn** it is a common practice to use double roving in order to get a better quality of yarn and a more uniform thread.

The creels for these yarns are made in various styles, the single 4-height creel using full and half bobbins being the most common for $1\frac{3}{8}$ gauge or twist mules.

The 3-height double creel, with broad board to take two sets of bobbins, is the one used most for weft or fine gauge mules.

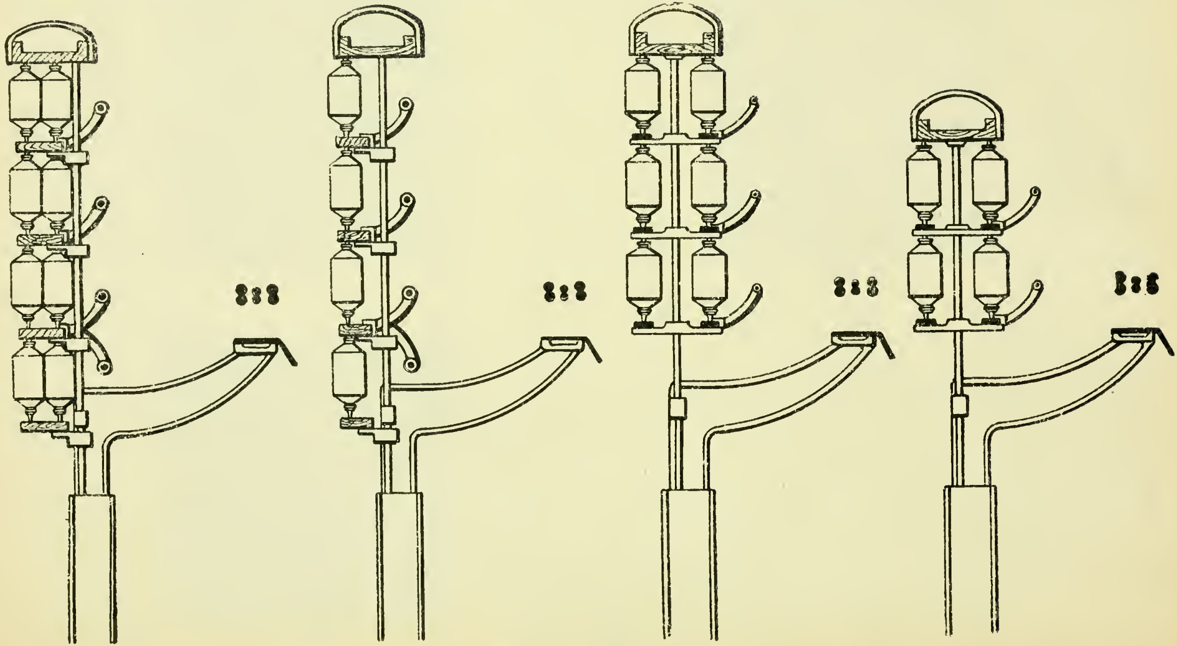
Single or double creels are made with iron or wood supports or rails for carrying the skewers supporting the roving frame bobbins.

All the creels are supported by strong upright rods, carried from the spring pieces, and supplied with top boards to carry the roving frame bobbins ready for putting in the creels.

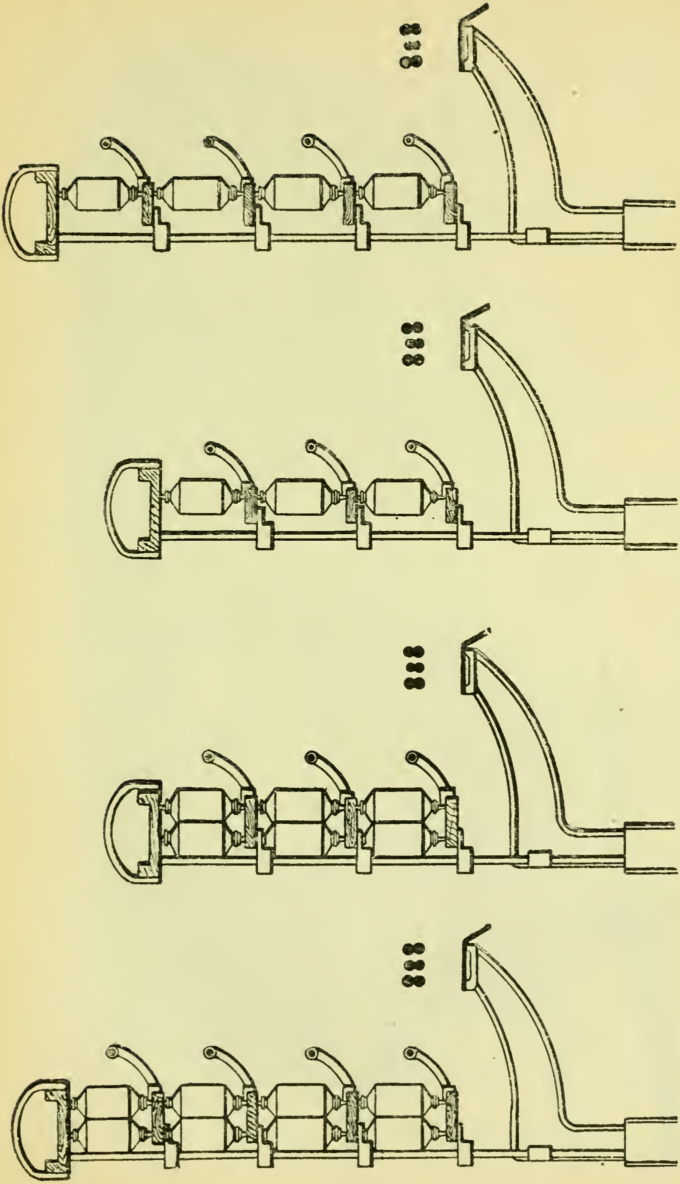
Table creels.—Besides the creels shown in the illustrations, we sometimes employ a table or gallery creel. This is used mostly in attics where the sloping roof does not give sufficient head room for the ordinary creel, or in such places where the light is bad. In this creel the bobbins are placed in a kind of gallery, behind each other, with each row a little higher than the preceding one.

We do not, however, recommend this kind of creel, as they are not convenient to creel or piece up the broken ends. There is also no top board to keep the full bobbins on, and they take up more space than the ordinary creel, and should not be adopted unless for the reasons given above.

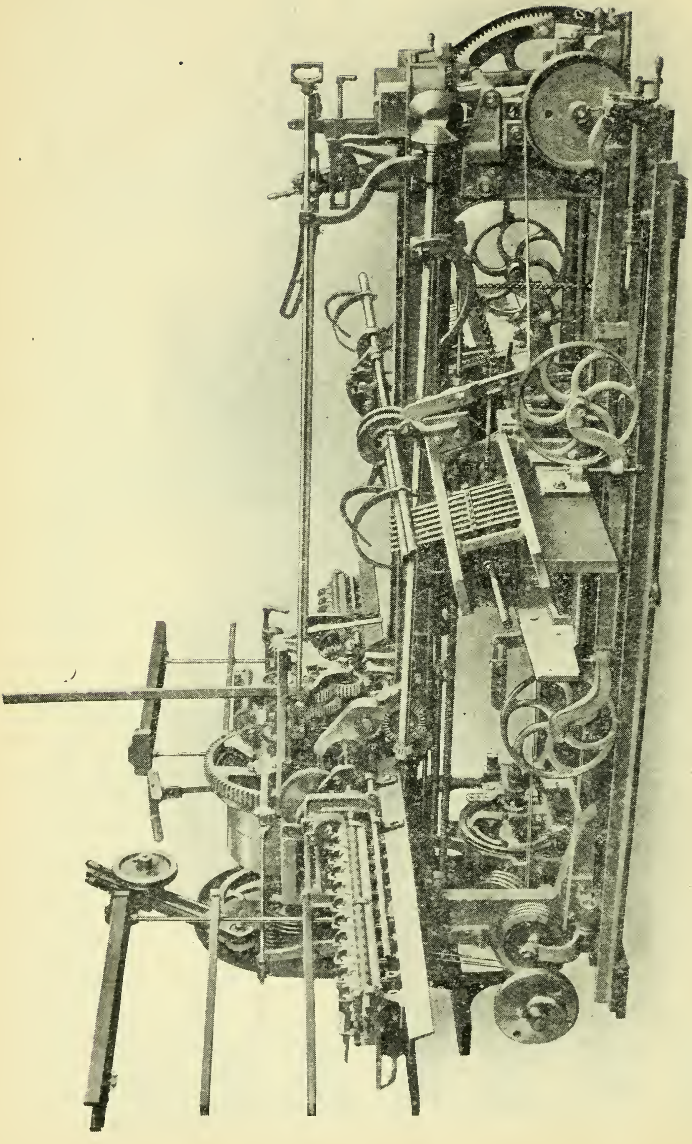
Various kinds of CREELS used on the "HETH" and "CURTIS" PATTERN MULES.



MULE CREELS.



MULE CREELS.



SELF-ACTING MULE FOR WORSTED.

SELF-ACTING MULE for WORSTED.

In designing this mule we have introduced a number of most important improvements, and have succeeded in making a mule easy to manipulate and capable of a good production of yarn of the highest quality.

The Headstock is strong and well braced on two foundation plates, and is made for either the **spring change motion** or **cam shaft.** The **front roller catch box** is controlled by a sliding cam plate. Either wood or our patent metal carriage can be supplied.

Strap motion.—The outward movement of the carriage is utilised to bring the belt on the loose pulley, and the levers are so arranged that the carriage can begin to control this movement in any position within 12 inches of the termination of its outward run. When a twist motion is used this, of course, is not required.

Rollers.—Three, four, or five lines of rollers are used according to requirements, all adjustable, independent of each other, or the two or three front lines fixed and cnly the back line adjustable.

SELF-ACTING MULE for Wool, Shoddy, and Cotton Waste Yarns.

This mule is supplied with **double** or **treble speeds,** which can be applied at any part of the outward run of the carriage, **the rollers** are driven independently of the carriage with separate change wheels for each, the toothed segment of the quadrant and the pinion are made of malleable iron. Wood or our patent metal carriages can be supplied, also **backing-off chain tightening motion, twist motion and backing-off retarding motion, slubbing motion, spindle stop motion, rim band tightening motion, carriage pushing-in motion.** We usually supply one row of plain bottom rollers 1½in dia. and 2¼in. dia. top rollers, but two rows of plain or fluted bottom rollers and one row of top rollers can be supplied if desired. Strong spindles capable of producing cops up to 10½in. long.

For other particulars see small books for Waste or Woollen Machinery.

Pulleys.—16in. to 20in. dia. × $5\frac{1}{4}$in. wide for 5in. belt.

Speeds.—For ordinary counts, 850 revolutions.

Horse Power.—For coarse gauges, 100 spindles; medium gauges, 110 spindles; fine gauges, 120 spindles to 1 H.P.

Length of mules.—Multiply the number of spindles by the gauge and add the following dimensions for the gearing of the different kinds of mules.

Type of Mule	With Roller Motion	With Stretching Motion
Hetherington	5ft. $5\frac{1}{2}$in.	5ft. $6\frac{3}{8}$in,
H-Pattern	4ft. 11in.	5ft. $2\frac{1}{2}$in.
Hetherington rim at side	5ft. $11\frac{1}{4}$in.	5ft. $11\frac{1}{8}$in.
H-Pattern rim at side ...	5ft. 0in.	5ft. $3\frac{1}{2}$in.

To find the number of spindles that will stand in a given length, deduct the above lengths from the space available, multiply the remainder by 12 and divide by the gauge. The number of spindles must be divisible—

by 2 for single bossed rollers,
by 4 for rollers with 2 threads per boss,
by 6 „ „ 3 „ „
by 8 „ „ 4 „ „

Net weight for mules.—Hetherington Pattern, 64in. stretch:—

Headstock, square and end ... ... 3,640 lbs.
Remainder of Machine ... $1\frac{1}{8}$in. gauge, $14\frac{1}{2}$lbs. per spindle.
„ „ ... $1\frac{1}{4}$in. „ $15\frac{3}{4}$lbs. „
„ „ ... $1\frac{3}{8}$in. „ $17\frac{1}{2}$lbs. „

To obtain the approximate gross weight, add 26 per cent.

Strapping required for Mules.

From main shaft to counter usually about 50ft. of 5in. or 6in. strapping.

Down strap usually about 22ft. of $4\frac{1}{2}$in. or 5in. strapping.

Banding.—Hetherington Mule.

2 scroll drawing-up bands ...	$\frac{7}{8}$in. dia.,	10ft.	each.
1 check band	$\frac{7}{8}$in. ,,	21ft.	,,
1 auxiliary scroll band	$\frac{7}{8}$in. ,,	10ft. 6in.	,,
1 long quadrant band	$\frac{7}{8}$in. ,,	21ft.	,,
1 short ,, ,, ...	$\frac{7}{8}$in. ,,	12ft.	,,
5 back shaft scroll bands ...	$\frac{5}{8}$in. ,,	21ft.	,,
5 ,, ,, ,, ...	$\frac{5}{8}$in. ,,	12ft.	,,
4 squaring bands	$\frac{5}{8}$in. ,,	9ft.	,,
Rim band	$\frac{9}{16}$in. ,,	62ft.	,,
Taking-up band	$\frac{9}{16}$in. ,,	36ft.	,,
Strapping motion band	$\frac{1}{2}$in. ,,	19ft. 6in.	,,
Return band	$\frac{1}{2}$in. ,,	18ft.	,,
Spindle banding	$\frac{1}{8}$in. ,,	4ft. per spdle.	

Banding.—H-Pattern Mule.

2 scroll drawing-up bands ...	1in. dia.,	10ft.	each.
1 check scroll band	1in. ,,	19ft.	,,
1 auxiliary scroll band	$\frac{7}{8}$in. ,,	9ft.	,,
2 off end draw bands	$\frac{5}{8}$in. ,,	16ft.	,,
2 short ,, ...	$\frac{5}{8}$in. ,,	10ft.	,,
2 middle ,, ...	$\frac{5}{8}$in. ,,	19ft.	,,
2 short ,, ...	$\frac{5}{8}$in. ,,	12ft.	,,
1 headstock band	$\frac{5}{8}$in. ,,	16ft.	,,
1 short band	$\frac{5}{8}$in. ,,	10ft.	,,
1 return	$\frac{9}{16}$in. ,,	11ft.	,,
Rim band	$\frac{9}{16}$in. ,,	65ft.	,,
Top taking-up band	$\frac{9}{16}$in. ,,	69ft.	,,
8 squaring bands under carriage	$\frac{9}{16}$in. ,,	12ft.	,,

CALCULATIONS AND FORMULÆ.

Mule Twist Formulæ.

$$\text{Turns per inch} = \frac{\text{Turns of spindle in a given time}}{\text{ins. delivered by front roller in same time}}$$

Turns of spindle for one of the rim.—The tin roller pulleys may be any diameter from 8in. to 14in. inclusive. Tin rollers are 6in. and 5in. dia. Spindle wharves are $\frac{5}{8}$in. to 1in. Supposing a mule to have a 12in. tin roller pulley, 6in. tin roller ($=\frac{96}{16}$in.) and $\frac{3}{4}$in. spindle wharves ($\frac{12}{16}$), and D to be the diameter of the rim, then adding $\frac{1}{16}$in. (diameter of band) to the diameters of the tin roller and wharve, the number of turns of the spindle for one of the rim is

$$\frac{D \times 97}{12 \times 13} = D \times \cdot 622$$

The following table gives the multipliers for various sizes of tin roller pulleys and spindle wharves, and for both 6in. and 5in. tin rollers. These numbers multiplied by any diameter of rim will give the number of turns of the spindle for one of that rim.

Diameter of tin rollers	Diameter of spindle wharves	Diameters of Tin Roller Pulleys.						
		8in.	9in.	10in.	11in.	12in.	13in.	14in.
6in.	$\frac{5}{8}$in.	1·1025	·980	·870	·802	·735	·678	·630
	$\frac{3}{4}$in.	·936	·832	·746	·668	·622	·574	·533
	$\frac{7}{8}$in.	·808	·718	·646	·585	·539	·4975	·462
	1in.	·712	·633	·570	·518	·475	·4385	·407
5in.	$\frac{5}{8}$in.	·921	·818	·736	·670	·614	·567	·486
	$\frac{3}{4}$in.	·778	·682	·622	·566	·519	·479	·445
	$\frac{7}{8}$in.	·675	·600	·540	·491	·450	·4155	·389
	1in.	·595	·529	·476	·433	·397	·3665	·340

Mule Draft Formulæ.—On the front roller of the "Heth" mule is a compound wheel with 18 and 22 teeth, either of which may be used as required. The back roller wheel is usually 54, but may be any number from 40 to 60.

If f is the diameter of front, and b that of the back roller, and x the draft wheel

$$\textbf{draft} = \frac{54 \times 120 \times f}{x \times 22 \times b} \text{ or } \frac{54 \times 120 \times f}{x \times 18 \times b} \text{ according}$$

to the front roller wheel in gear, and when f and b are the same (as is usually the case), these expressions reduce to

$\frac{294 \cdot 5}{x}$ and $\frac{360}{x}$ respectively. The following table gives

constants for various combinations of rollers, and with either 18 or 20 in gear:—

TABLE I.

Hetherington Pattern.

Diameter: Front roller	In. $\frac{13}{16}$	In. $\frac{13}{16}$	In. $\frac{13}{16}$	In. $\frac{13}{16}$	In. $\frac{7}{8}$	In. $\frac{7}{8}$	In. $\frac{7}{8}$	In. $\frac{15}{16}$	In. $\frac{15}{16}$	In. 1	In. $1\frac{1}{16}$	In. $1\frac{1}{8}$
Back roller	$\frac{13}{16}$	$\frac{7}{8}$	$\frac{15}{16}$	1	$\frac{7}{8}$	$\frac{15}{16}$	1	$\frac{15}{16}$	1	1	1	1
Constant with 54 back and 22 front roller wheel ...	294·5	273	255	239	294·5	275	258	294·5	276	294·5	313	331
Constant with 54 back and 18 front roller wheel ...	360	334	312	292	360	336	315	360	337	360	382	405

If the back roller wheel be not 54, a new constant may be found by multiplying the foregoing by 54, and dividing by the other back roller wheel on.

H-Pattern.

(Back roller wheel 50, Compound front roller wheel, $\frac{16}{20}$).

Diameter Front roller...	In. $\frac{13}{16}$	In. $\frac{13}{16}$	In. $\frac{13}{16}$	In. $\frac{13}{16}$	In. $\frac{7}{8}$	In. $\frac{7}{8}$	In. $\frac{7}{8}$	In. $\frac{15}{16}$	In. $\frac{15}{16}$	In. 1	In. $1\frac{1}{16}$	In. $1\frac{1}{8}$
Back roller ...	$\frac{13}{16}$	$\frac{7}{8}$	$\frac{15}{16}$	1	$\frac{7}{8}$	$\frac{15}{16}$	1	$\frac{15}{16}$	1	1	1	1
Constant with 54 back and 20 front roller wheel ...	300	278	260	244	300	280	262	300	281	300	319	337
Constant with 50 back and 16 front roller wheel ...	375	348	325	305	375	350	328	375	351	375	399	422

Inches delivered by front roller for one turn of the rim.—In the Hetherington mule there is a 17 or a 20 bevel driving the front roller bevel, and two change places are provided for the twist pinions, the one (x) on one end of the rim shaft, and the other (Y) the wheel that gears with x. Then if f be the diameter of the front roller

Inches delivered for one turn of the rim for a 17 bevel =

$$\frac{x \times 28 \times 17 \times 3{\cdot}14f}{Y \times 35 \times 38} = \frac{x \times f \times 1{\cdot}124}{Y}$$

$$\text{and for a } 20 = \frac{x \times f \times 1{\cdot}322}{Y}$$

Taking the first of these expressions and the example given above for the turns of the spindle, we get

$$\textbf{Turns per inch} = D \times {\cdot}622 \div \frac{x \times f \times 1{\cdot}124}{Y}$$

For any particular mule f is fixed suppose $\frac{7}{8}$ or ·875, and fixing suitable values for the rim and twist wheel on the end of rim shaft, say 16in. and 24 teeth, and supposing the turns per inch required to be 22, we have

$$22 = \frac{16 \times {\cdot}622 \times Y}{24 \times 875 \times 1{\cdot}124} \text{ or, which is the same thing,}$$

$$\frac{22 \times 24 \times {\cdot}875 \times 1{\cdot}124}{16 \times {\cdot}622} = Y\text{, and from this we find}$$

$Y = 51{\cdot}2$, that is a 51 change wheel.

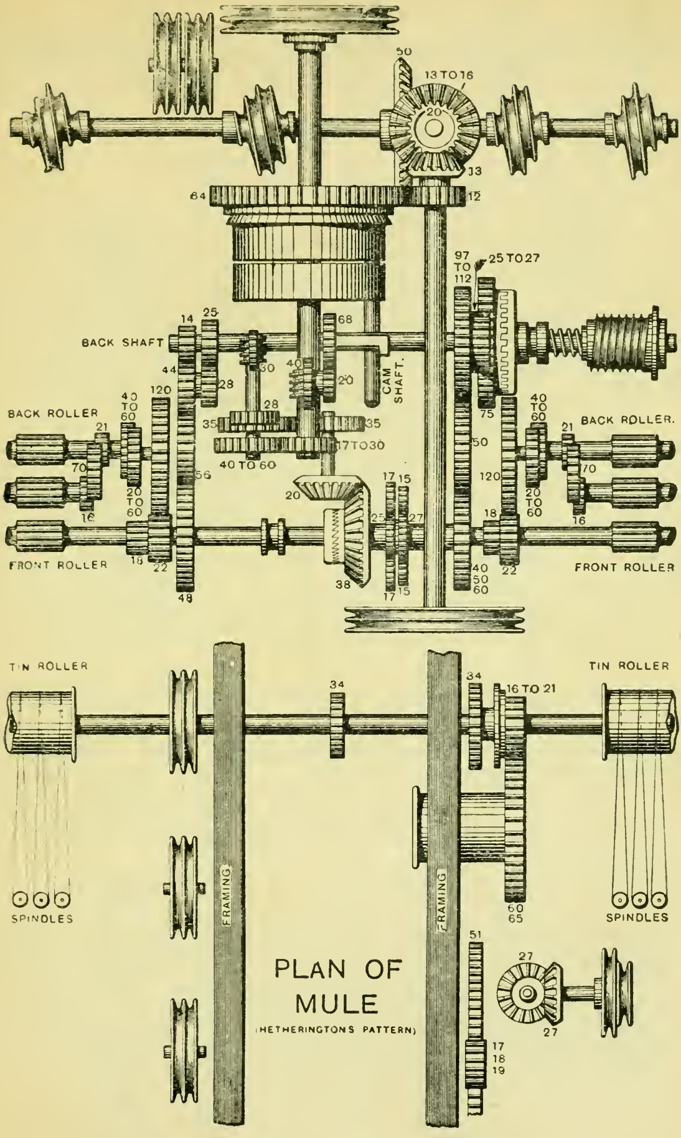
The following tables give constants for a 17 and a 20 driving bevel in conjunction with various diameters of front roller and various sizes of the wheel x on the end of the rim shaft. These constants divided by the wheel Y would give the inches delivered by the roller for one turn of the rim shaft.

These numbers divided by the wheel Y would give the inches delivered by the front roller for one turn of the rim. If we designate the constant in Table II. by **B**, and that obtained by multiplying the constant in Table I. by the diameter of the rim by **A**,

$$\textbf{then the turns per inch} = A \div \frac{B}{Y} = \frac{A \times Y}{B}$$

$$\textbf{or } \frac{\text{turns per inch} \times B}{A} = \textbf{change wheel, Y.}$$

Put into words the rule for the use of the two tables is as follows:—Fix suitable diameter of rim to give desired speed of spindles and convenient size of twist wheel **X**. Then change wheel Y will be found by multiplying the proper constant in Table II. by the required terms per inch, and dividing by the diameter of the rim multiplied by the proper constant in Table I.



GEARING OF "HETH" MULE.

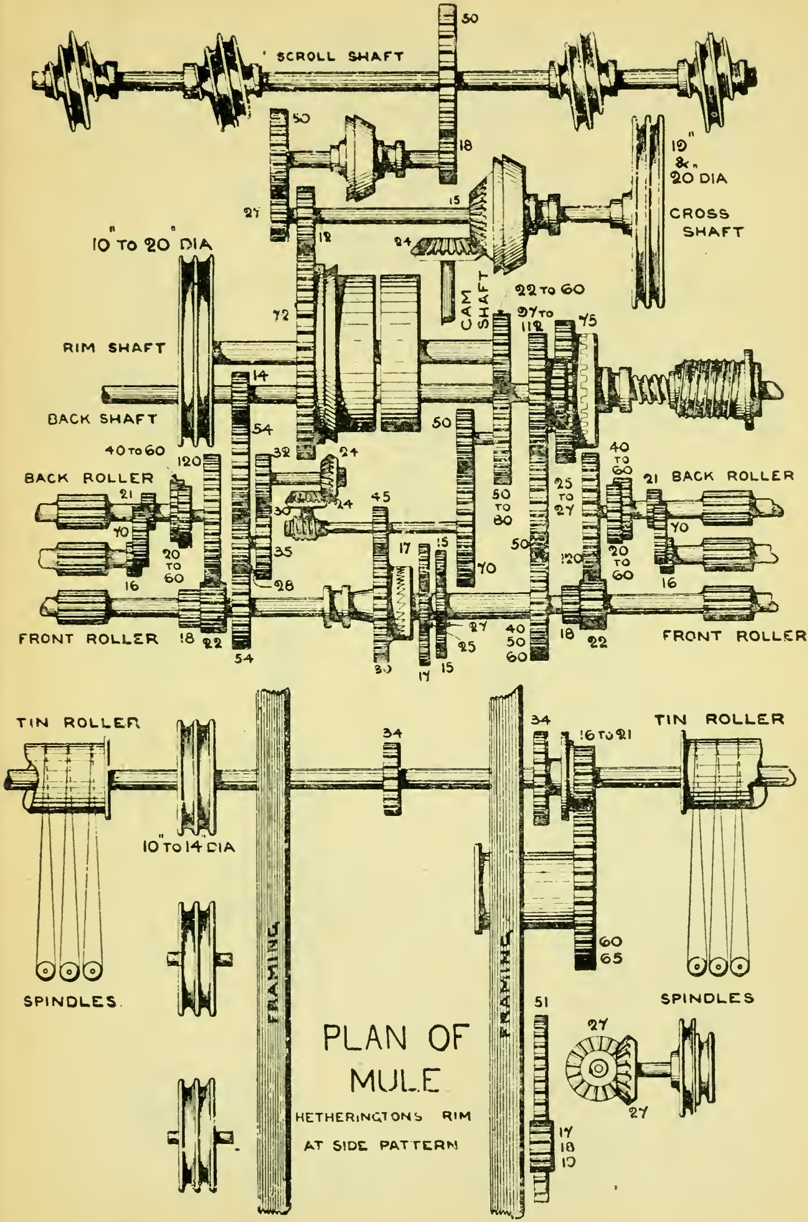
TABLE II.

Driving Bevel	Dia. of the front roller	Wheels on the end of Rim Shaft (X)								
		18	20	22	24	26	28	30	32	34
17 Bevel	$\frac{3}{4}$	15·22	16·92	18·61	20·3	22·0	23·68	25·38	27·08	28·77
	$\frac{13}{16}$	16·5	18·33	20·18	22	23·82	25·68	27·5	29·32	31·18
	$\frac{7}{8}$	17·76	19·74	21·81	23·7	25·66	27·62	29·61	31·58	33·56
	$\frac{15}{16}$	18·97	21·08	23·19	25·3	27·4	29·5	31·6	33·72	35·82
	1	20·22	22·48	24·72	26·98	29·22	31·47	33·72	35·97	38·22
	$1\frac{1}{16}$	21·6	24	26·4	28·8	31·2	33·6	36	38·4	40·8
	$1\frac{1}{8}$	22·86	25·4	27·94	30·48	33·02	35·56	38·1	40·64	43·18
20 Bevel	$\frac{3}{4}$	17·84	19·82	21·8	23·78	25·77	27·74	29·72	31·7	33·7
	$\frac{13}{16}$	19·32	21·48	23·62	25·78	27·91	30·07	32·2	34·36	36·5
	$\frac{7}{8}$	20·8	23·12	25·43	27·75	30·06	32·38	34·68	37	39·3
	$\frac{15}{16}$	22·3	24·78	27·27	29·72	32·21	34·7	37·17	39·65	42·12
	1	23·8	26·43	29·08	31·72	31·38	37	39·66	42·3	44·94
	$1\frac{1}{16}$	25·3	28·10	30·9	33·72	36·52	39·33	42·15	44·95	47·78
	$1\frac{1}{8}$	26·78	29·75	32·72	35·7	38·68	41·64	44·62	47·6	50·56

Example:—Suppose the front roller is $\frac{7}{8}$in. and the driving bevel 17, and that we choose a 24 wheel on the end of the rim shaft; then in the upper half of Table II., opposite $\frac{7}{8}$in. and under 24, we find the number 23·7, and multiplying this by 22 turns, say, for 32's yarn, we get 510·8. If the tin roller be 6in., and the pulley 12in., and spindle wharve $\frac{3}{4}$in., and it be decided to use a 16in. rim, then in the upper half of Table I., opposite $\frac{3}{4}$in. and under 12in., we find the constant ·622, and multiplying this by the rim (16in.) we get 9·952; then

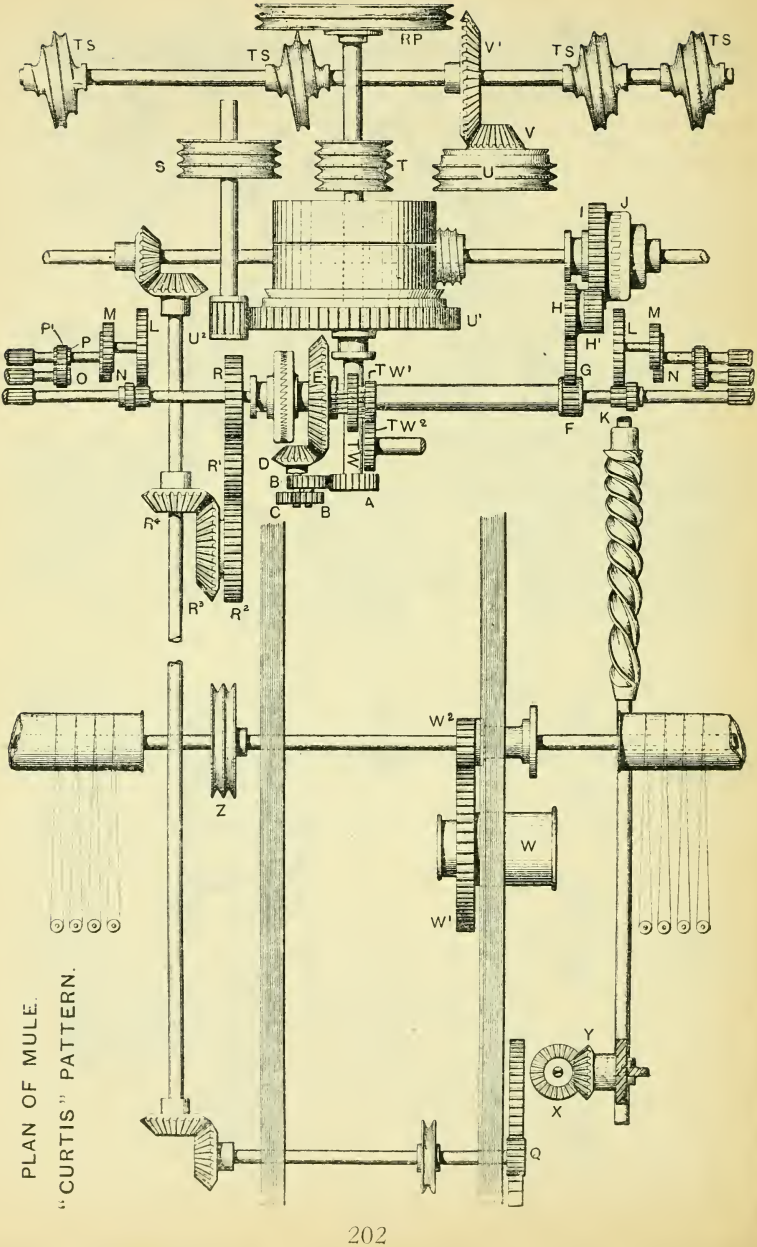
510·0÷9·952=51·2, that is a 51's **change wheel.**

In our "Curtis" **H**-pattern headstock both the change wheels are driving wheels, namely, the wheel on the head of the rim shaft (**X**) and the bevel (**Y**) gearing with the bevel on the front roller. Table I. remains the same, but Table II. assumes a slightly different form, as also the formulæ for obtaining the change wheel from the tables.



PLAN OF MULE

HETHERINGTONS RIM AT SIDE PATTERN



PLAN OF MULE.
"CURTIS" PATTERN.

TABLE II. FOR THE H-PATTERN MULE.

Dia. of the front roller	Bevel gearing with the front roller bevel									
	15	16	17	18	19	20	21	22	23	24
$\frac{3}{4}$	74·8	70·0	66·0	62·2	59·0	56·0	53·4	51·0	48·75	46·7
$\frac{13}{16}$	69·0	64·7	60·9	57·5	54·2	51·8	49·2	47·0	45·0	43·1
$\frac{7}{8}$	63·7	60·0	56·5	53·2	50·5	48·0	45·75	43·7	41·9	40·0
$\frac{15}{16}$	59·7	56·0	52·8	49·85	47·25	44·85	42·7	40·8	39·0	37·4
1	56·0	52·6	49·45	46·7	44·25	42·0	40·0	38·2	36·6	35·0
$1\frac{1}{16}$	52·7	49·5	46·45	43·9	41·6	39·6	37·6	35·95	34·4	33·0
$1\frac{1}{8}$	49·8	46·7	44·0	41·5	39·3	37·4	35·6	34·0	32·5	31·15

A being a constant obtained by the use of Table I., and **B** that from Table II., **X** the change wheel on the end of the rim shaft in the **H**-pattern mule, may be obtained by multiplying **A** by **B** and dividing the result by the twist per inch required.

The following formulæ are useful in changing from one count to another :—

$$\left.\begin{array}{l}\textbf{Twist wheel required}\\ \textbf{(if a driving wheel)}\end{array}\right\} = \frac{\text{sq. root of counts} \times \text{wheel on}}{\text{sq. root of counts required.}}$$

$$\left.\begin{array}{l}\textbf{Twist wheel required}\\ \textbf{(if a driven wheel)}\end{array}\right\} = \frac{\text{sq. root of counts required} \times \text{wheel on}}{\text{square root of present counts}}$$

$$\left.\begin{array}{l}\textbf{Builder ratchet}\\ \textbf{required}\end{array}\right\} = \frac{\text{sq. root of required counts} \times \text{wheel on}}{\text{square root of present counts}}$$

Gain in the carriage.—Since the length of scroll band unrolled in a draw is 64in., and the yarn delivered by the front roller is 64in. less the amount of gain required, we may consider the back shaft scroll as a roller taking up what the roller delivers with a small draft.

1in. of gain in the carriage is equal to a draft of 1·016, and corresponding values for gains up to 5in. are given below :—

Gain ...	1in.	$1\frac{1}{2}$in.	2in.	$2\frac{1}{2}$in.	3in.	$3\frac{1}{2}$in.	4in.	$4\frac{1}{2}$in.	5in.
Draft...	1·016	1·024	1·032	1·041	1·049	1·058	1·066	1.075	1·085

The scrolls on the back shaft are made 5in. diameter, and for $\frac{5}{8}$in. scroll band. Their diameter to the centre of the band is, therefore, $5\frac{5}{8}$in. or 5·625.

The driving wheel on the front roller is either 40, 50, or 60, and three tables of constants for each are given below.

The spur on the gain wheel gearing with the wheel on the back shaft is 25, 26, or 27, and in each table a line of constants for various sizes of front rollers is given opposite each of these wheels.

These constants divided by the draft between the carriage and the roller (that is the gain) will give the gain wheel.

Table I. 40 Front Roller Wheel.

Spur on the Gain Wheel	Diameters of the Front Roller				
	$\frac{7}{8}$in.	$\frac{15}{16}$in.	1in.	$1\frac{1}{16}$in.	$1\frac{1}{8}$in.
25	86·75	80	75	70·6	66·7
26	89·2	83·2	78	73·4	69·35
27	92·6	91·75	81	76·2	72.

Table II. 50 Front Roller Wheel.

Spur on the Gain Wheel	Diameters of the Front Roller				
	$\frac{7}{8}$in.	$\frac{15}{16}$in.	1in.	$1\frac{1}{16}$in.	$1\frac{1}{8}$in.
25	107·2	100	93·75	88·25	83·4
26	111·4	104	97·5	91·7	86·6
27	115·3	107·8	101	95	89·8

Table III. 60 Front Roller Wheel.

Spur on the Gain Wheel	Diameters of the Front Roller				
	$\frac{7}{8}$in.	$\frac{15}{16}$in.	1in.	$1\frac{1}{16}$in.	$1\frac{1}{8}$in.
25	128·7	120	112·5	105·8	100
26	133·8	124·8	117	110	104
27	138·9	129·5	121·5	114	108

Example:—Suppose we require 3in. of gain in the carriage, that is, 1·049 of a draft. We have 60 on the front roller, which is 1in. in diameter, and we choose a gain wheel to have a 26 spur gearing with the back shaft wheel. In

Table III., opposite 26 and below 1in., we find the constant 117, and dividing this by the required draft, 1·049, we get 112 nearly, that is a 112/26 gain wheel, for

$$\frac{60}{112} \times \frac{26}{75} \times \frac{5{\cdot}625\text{in.}}{1\text{in.}} = 1{\cdot}045,$$ or very nearly the draft required.

In our H-pattern the front roller wheel is always 45, and the gain wheel spur 18. The constants are, therefore, as follows:—

Diameters of the Front Rollers.

$\frac{7}{8}$in.		$\frac{15}{16}$in.		1in.		$1\frac{1}{16}$in.		$1\frac{1}{8}$in.
103	...	96·2	...	90·2	...	84·9	...	80·2

These constants divided by the draft (gain) required will give the gain wheel.

A Table of Turns per inch.

To Spin Weft and Twist from 10's to 132's.

Weft Yarns $\sqrt{\text{counts}} \times 3{\cdot}25$		Weft Yarns $\sqrt{\text{counts}} \times 3{\cdot}25$		Twist Yarns $\sqrt{\text{counts}} \times 3{\cdot}75$		Twist Yarns $\sqrt{\text{counts}} \times 3{\cdot}75$	
Counts	Turns	Counts	Turns	Counts	Turns	Counts	Turns
10	10·27	72	27·57	10	11·85	72	31·81
12	11·25	74	27·96	12	12·95	74	32·25
14	12·16	76	28·33	14	14·03	76	32·68
16	13·00	78	28·70	16	15·00	78	33·11
18	13·76	80	29·07	18	15·91	80	33·54
20	14·53	82	29·43	20	16·77	82	33·95
22	15·24	84	29·79	22	17·59	84	34·36
24	15·92	86	30·14	24	18·37	86	34·77
26	16·57	88	30·49	26	19·12	88	35·17
28	17·20	90	30·83	28	19·84	90	35·57
30	17·80	92	31·17	30	20·54	92	35·96
32	18·38	94	31·51	32	21·21	94	36·35
34	18·95	96	31·84	34	21·87	96	36·74
36	19·50	98	32·17	36	22·50	98	37·12
38	20·03	100	32·50	38	23·12	100	37·49
40	20·55	102	32·82	40	23·72	102	37·87
42	21·06	104	33·14	42	24·30	104	38·24
44	21·56	106	33·46	44	24·87	106	38·60
46	22·04	108	33·77	46	25·43	108	38·97
48	22·52	110	34·08	48	25·98	110	39·33
50	22·98	112	34·39	50	26·52	112	39·68
52	23·44	114	34·70	52	27·04	114	40·03
54	23·88	116	35·00	54	27·56	116	40·38
56	24·32	118	35·30	56	28·06	118	40·73
58	24·75	120	35·60	58	28·56	120	41·07
60	25·17	122	35·89	60	29·05	122	41·42
62	25·59	124	36·19	62	29·52	124	41·75
64	26·00	126	36·48	64	30·00	126	42·08
66	26·40	128	36·77	66	30·46	128	42·42
68	26·80	130	37·05	68	30·92	130	42·75
70	27·19	132	37·34	70	31·37	132	43·08

The above table is for American and Indian cottons, for Egyptian and Sea Islands the multipliers for twist and weft are 3·606 and 3·183 respectively.

For Table of Square Roots see page 229.

Useful Formulæ.

$$\text{Twist wheel required (if a driving wheel)} = \frac{\text{sq. root of counts} \times \text{wheel on}}{\text{sq. root of counts required}}$$

$$\text{Twist wheel required (if a driven wheel)} = \frac{\text{sq. root of counts required} \times \text{wheel on}}{\text{sq. root of present counts}}$$

$$\text{Builder ratchet required} = \frac{\text{sq. root of required counts} \times \text{wheel on}}{\text{sq. root of present counts}}$$

$$\text{Turns per inch} = \frac{\text{turns of spindle in a given time}}{\text{inches delivered by front roller in same time}}$$

$$\text{Turns per inch} \doteq \frac{\text{revs. of spindles}}{\text{revs. of F.R.} \times \text{cir. of F.R.}}$$

$$\text{Revs. of F.R.} = \frac{\text{revs. of rim} \times 17 \text{ to } 20 \times 28 \times 17 \text{ or } 20}{40 \text{ to } 60 \times 35 \times 38}$$

$$\text{Draft wheel} = \frac{\text{dia. of F.R.} \times \text{B.R. wheel} \times \text{crown wheel}}{\text{dia. of B.R.} \times \text{draft} \times \text{F.R. wheel}}$$

$$\text{Draft} = \frac{\text{counts} \times \text{length of stretch}}{\text{length delivered in inches} \times \text{hank roving}}$$

$$\text{Counts} = \frac{\text{draft} \times \text{hank roving} \times \text{length of stretch}}{\text{length delivered in inches}}$$

$$\text{Change pinion} = \frac{\text{counts being spun} \times \text{present whee}}{\text{counts wanted}}$$

$$\text{Speed of spindles} = \frac{\text{revs. of rim} \times \text{dia. of rim P.} \times \text{dia. of tin roller}}{\text{pulley on tin roller shaft} \times \text{dia. of spl. wharve}}$$

To find Approximate Production of a Mule in Hanks or Lbs. per Week.

$$\frac{\text{No. of draws per minute} \times \text{Length of stretch in inches} \times \text{No. of working hours per week} \times 60 \text{ minutes}}{840 \text{ yards} \times 36 \text{ inches}} = \text{Hanks per week.}$$

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

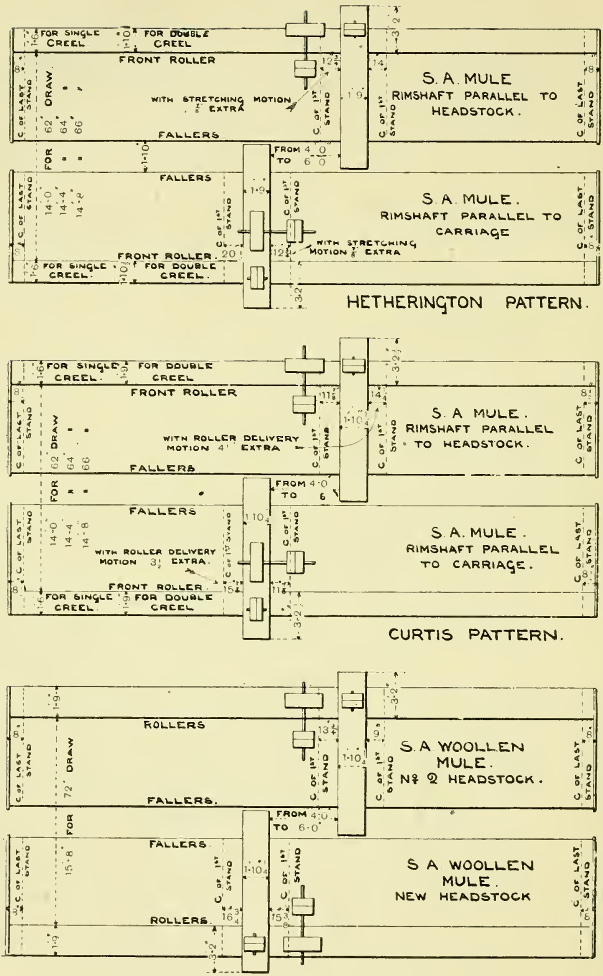
NOTE.—To obtain working hours allow about 5% to 7½% for time required for cleaning, doffing, breakages, &c., depending on counts of yarn, time taken in doffing, &c.

Production of Mules from the Draws per Minute.

(CALCULATED.)

Seconds for 4 draws	Draws per minute	Hanks in 10 hours	Seconds for 4 draws	Draws per minute	Hanks in 10 hours	Seconds for 4 draws	Draws per minute	Hanks in 10 hours
41	5·85	7·42	61	3·9	4·99	81	2·96	3·76
42	5·7	7·26	62	3·87	4·91	82	2·93	3·71
43	5·6	7·08	63	3·81	4·84	83	2·89	3·67
44	5·45	6·93	64	3·72	4·76	84	2·86	3·63
45	5·3	6·77	65	3·69	4·69	85	2·82	3·58
46	5·2	6·62	66	3·64	4·62	86	2·79	3·54
47	5·1	6·48	67	3·58	4·55	87	2·76	3·5
48	5	6·34	68	3·53	4·48	88	2·73	3·46
49	4·9	6·22	69	3·48	4·42	89	2·7	3·42
50	4·8	6·09	70	3·43	4·35	90	2·67	3·38
51	4·7	5·97	71	3·38	4·29	91	2·64	3·35
52	4·6	5·86	72	3·33	4·23	92	2·61	3·31
53	4·5	5·75	73	3·28	4·17	93	2·58	3·28
54	4·45	5·64	74	3·24	4·12	94	2·55	3·24
55	4·36	5·54	75	3·2	4·06	95	2·53	3·21
56	4·28	5·44	76	3·16	4·10	96	2·5	3·18
57	4·2	5·34	77	3·12	3·96	97	2·47	3·14
58	4·14	5·25	78	3·08	3·91	98	2·45	3·11
59	4·07	5·16	79	3·04	3·86	99	2·42	3·08
60	4	5·08	80	3	3·82	100	2·4	3·05

Deduct 7½% for doffing, waste and cleaning, up to 16's yarn }
5% ,, ,, ,, above ,, } to get
the approximate real production. Hanks ÷ counts = lbs.



DIMENSIONS OF MACHINES

SELF-ACTING MULE SPECIFICATION.

How many Mules? To stand in what length?
Number of Spindles in each Mule? For Twist or Weft?
Speed of Spindles per minute?
Gauge of Spindles? inch.
Length of Spindle out of Bolster? ins. Length of Spindle? ins.
Diameter of Wharve on Spindle? inch.
Spindle Blade any particular sort? If tinned. at
If to a Pattern Spindle? Is the floor tiled or boarded?
Description of Headstock—Ordinary? or with rim at side.
Counts to be spun? No. of Hank Roving?
Diameter of Tin Roller? (Usually 6in. for Twist or 5in. for Weft).

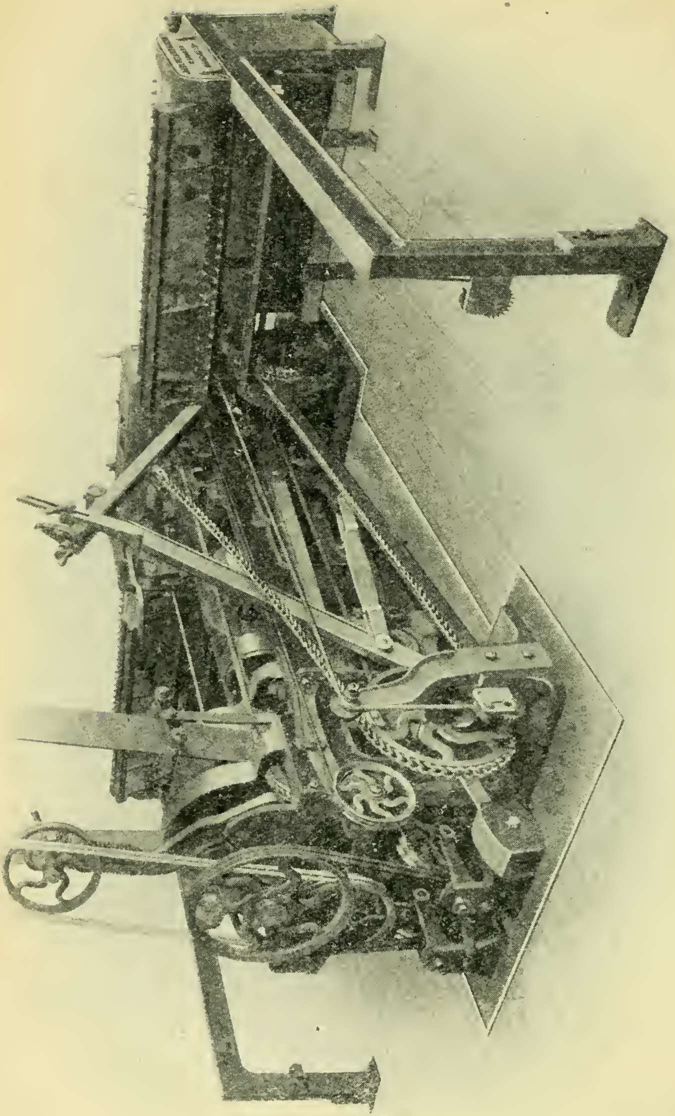
Is the front line of bottom Rollers to be case-hardened?	Diameters of the Fluted Rollers.		Or are the Necks only to be hardened?	Diameters of Top Rollers.	
	Front	inch.		Front	inch.
	Second	,,		Second	,,
	Third	,,		Third	,,

If Top Rollers for front line to be E. Leigh's Patent Loose Boss?
extra per Spindle, at
Top Rollers for three or two threads to a Boss?
or one thread to a Boss? at extra per Spindle?
Draft, front to back? Draft, middle to back?
Distance between front and middle Rollers? inch.
,, ,, middle and back Rollers? inch.
Top Rollers to be weighted by Lever or Dead Weights?
If Lever Weights. fixed or movable?
Weight on Top Rollers? to be lbs. If Dead Weights, state weight of each? lbs.
Diameter of Top Clearers? ins. Top Clearers to work over or between the Saddles?
Curtain Scavengers for Carriages? or Wood Roller Scavengers for
Wood or Steel Carriages? Carriages? at per Spindle.
Shaft for soft ends, under the fluted Rollers?
Shaft for hard ends, at front of Roller Beam? at per Spindle.
Under Clearers with Springs or Weights?
Iron Rods and Tin Traverse Guides? or Steel Traverse Guides?
Wood Creel? or Iron Creel for Roving? at per Spindle.
Upright or Gallery? For two, three, or four heights of bobbins.
Indicators? at each.
Full Cop Stop Motion (for Weft Mules)? at per Mule.
Size of Creel Bobbins? Boarding Bottom of Carriage? at per Spindle.
Plate Footsteps? at per Spindle. Length of Stretch? ins
Gain of Carriage? ins. If driven direct or by a Countershaft?
Speed of Line Shaft? revolutions per minute.
Diameter of Drum on Line Shaft? ins.
Is the Driving Shaft parallel with the Carriage or Headstock?
Direct Driving from Line Shaft? at per Mule.
Bottom Driving Apparatus through the floor? at per Mule.
Top Driving Apparatus? at per Mule.
Patent Regulator? at per Mule. Stretching Motion? at per Mule.
Roller Motion whilst Winding? at per Mule. Back Shaft and Scrolls?
Squaring Band Pulleys and Tightening Apparatus? at per Mule.
Patent Nosing Motion? at per Mule. Zinc Drippers? at per Mule.
Roller Motion whilst Twisting? at per Mule.
Assistant Taking-in Scroll and Ratchet Drum? at per Mule.

Note.—The Spare Pinions, &c., supplied without charge with each Self-Acting Mule, are as follows:—2 Twist Pinions, 4 Draft Pinions. 2 Builder Pinions, and 6 Top Rollers.

Is a complete set of Change Wheels wanted for each Mule, or how many?
Change Wheels wanted:—
Pinions, Nos. of Teeth to Twist, Nos. of Teeth to
Builder to
Are any spare articles to be sent in addition to the above?
When must the Mules be delivered, and how?
Remarks:—

Date Signed by



SELF-ACTING TWINER.

Self-Acting Twiners with Travelling Creel.

"YORKSHIRE" TWINER.

We have recently constructed an entirely new headstock for this machine so as to embody our past experience better than could be done by modifying an existing machine. It is built on substantially the same lines as our mule headstocks. The rim shaft can run at a high speed, and a very large variation in the twist is obtainable. Large pulleys are employed throughout, and all the working parts are solid and substantial, as well as carefully made.

The headstock rests upon planed bedplates which carry the radial arm, cop builder, and other bearings, combining the whole in a very rigid manner.

The position of the drawing-out scroll has been altered so as to bring the band into a perfectly horizontal position in place of the usual inclined one.

An improved tightening motion has been introduced for quickly getting the proper tension of the taking-in bands.

The tin roller pulley and the winding and backing-off ratchets are made in two halves.

The creels are made in various forms for doubling from cops or ring frame bobbins; we also make one to take the bobbins from winding frames, where two or three ends are wound together. Any kind of **water trough** can be applied, with proper arrangements for regulating the drag, and a suitable locking motion for the thread is also provided when necessary.

The **faller stands** are made with anti-friction bowls for the shafts to run on.

Stretch.—The mules for cotton can be made with 60in., 62in., 64in., or 66in. stretch. Those for woollen and waste are usually made for 72in. stretch.

Gauges.—We have patterns for the following gauges, in addition to the ordinary gauges advancing by eights:—

$1\frac{1}{16}$in., $1\frac{1}{12}$in., $1\frac{3}{16}$in., $1\frac{5}{16}$in.

Gearing.—The space occupied by the gearing is 4ft. $9\frac{1}{4}$in. less twice the gauge.

Banding for "Yorkshire" Twiner.

Taking-in scroll band ...	...	$\frac{7}{8}$in. dia., 15ft. 6in. long.
Long drawing-out band ...	...	$\frac{5}{8}$in. ,, 17ft. ,,

Short ,, ,, ...	$\frac{5}{8}$in. dia.,	15ft.	long.
Check band	$\frac{9}{16}$in. ,,	15ft. 6in.	,,
Rim band	$\frac{9}{16}$in. ,,	56ft.	,,
Taking-in bands...	$\frac{9}{16}$in. ,,	46ft.	,,
Band for the governor motion ...	$\frac{7}{16}$in. ,,	15ft.	,,
Squaring bands:—3 required ...	$\frac{7}{16}$in. ,,	9ft.	,,
,, ,, 3 ,, ...	$\frac{7}{16}$in. ,,	11ft.	,,

Nett weight of twiners.—"Yorkshire" Twiners, 72in. stretch:—

Headstock, square and off ends ... ... 3,888lbs.

Remainder of the machine, $1\frac{5}{8}$in. gauge, $9\frac{1}{2}$lbs. per spindle.

Top driving not included in above weights.

To obtain approximate gross weight, add 26 per cent.

Pulleys, usually 16in. dia. × 5in. wide with a speed from 850 to 1,000 revs. per min., according to the class of yarn being produced.

Power.—120 to 160 spindles per 1 I.H.P.

SELF-ACTING "FRENCH" TWINER.

We make twiners on the French principle, *i.e.*, similar to mules with a **stationary creel** for 2 or more cops or bobbins per spindle, and have adapted for same our "Curtis" H-pattern headstock with **spring and lever** or **cam change motion,** fitted with our latest improvements, including patent **backing-off motion, positive twist motion** driven from the tin roller shaft, etc. The **troughs** are usually of wood, and may be zinc lined if desired. We also make zinc troughs to rest on a cast-iron beam as used for the mule roller stands. The **drag** is put on the yarn by means of lead bobbins or porcelain blocks (various other arrangements for regulating the drag may be applied), and we provide a brass locking motion when desired. For other details *re* construction and the various motions and guards see description of mules.

Pulleys.—16in. to 18in. dia. × 5in. wide. **Speed.**—900 to 1,000 revs. per min., and **the gearing** occupies 4ft. $4\frac{1}{2}$in. **Power.**—Similar to the S.A. Mule.

SELF-ACTING TWINER SPECIFICATION.

No. of Twiners? No. of Spindles in each? Distance of Spindles?

Revolutions of Main Shaft per minute? Diameter of Drums on do.?

Diameter of Fast and Loose Pulleys on Countershaft?

Diameter of Drum on do.?

Length of Countershaft? feet inches.

Driven from above or underneath Headstock?

Length of Draw or Stretch? inches.

Length of Spindles? Diameter of Wharve?

Length of Spindle to stand out of Bolster? Speed of Spindles? Twist per inch?

Zinc or Brass Guides?

Covering-in Boards over Tin Rollers to be hinged or in one piece?

Width of List Boards? Are Plummet Weights required?

Nos. to be doubled? From what counts is the Twiner to be started?

Creels? Length of Skewer?

With or without Water Trough?

Price per Spindle? Terms of Payment?

If Driving Apparatus extra?

If Water Troughs extra?

If Patent Tightening Apparatus for Rope Taking-in extra

If Brass Guides instead of Zinc extra?

If to be fixed on stone floor?

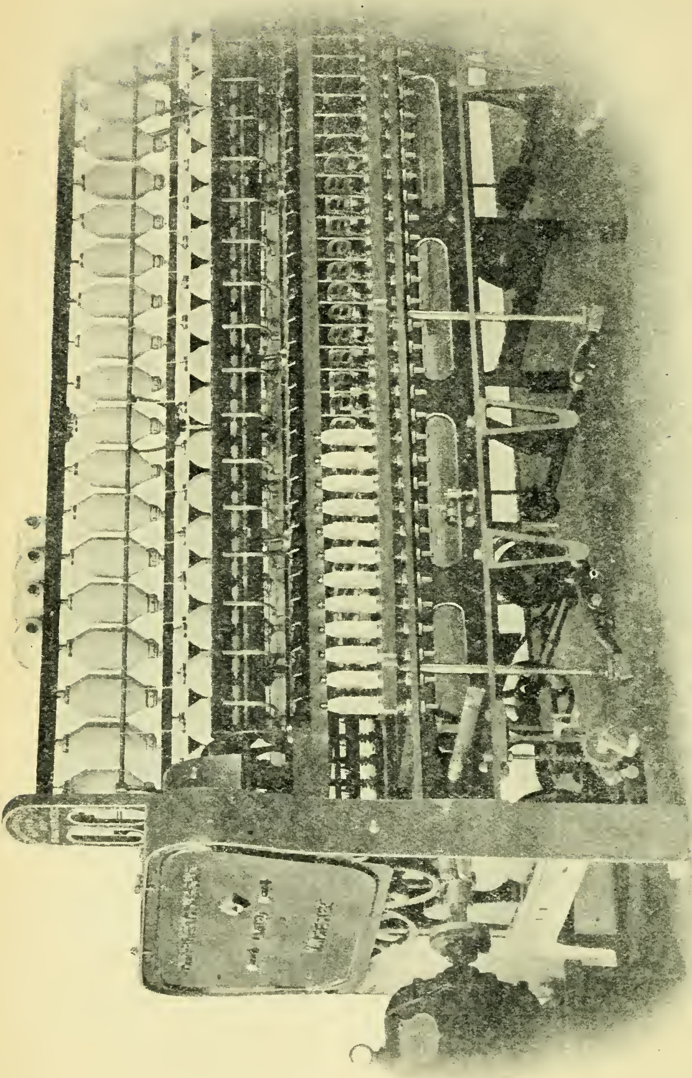
Plate Bolster? Wood or Steel Carriages?

Hardcastle's Patent Continuous Creel?

When must the Machines be delivered, and how?

Remarks:—

Date Signed by



RING SPINNING FRAME.

Ring Spinning Frame.

This machine has just been thoroughly overhauled and brought up to date in every possible way, and we have the utmost confidence in stating that it cannot be surpassed by anything else on the market, both in respect of its finish, solidity, and durability, and in the quality and quantity of its production. Special attention has been paid to facility in making the necessary changes of wheels, etc., in providing a strong foundation for gearing, and to the self-adjustment and automatic lubrication of all high-speed bearings.

Replacement of broken or worn parts.—To facilitate the ordering of these each part is provided with a letter or number, to facilitate ordering change pieces or parts broken in transit.

Gearing ends.—These are specially designed to allow the necessary changes to be made easily, and no material or workmanship is spared to make a strong and perfect foundation for the driving.

Wheels are machine-moulded and the teeth machine-cleaned, with the exception of the draft wheels, which are machine-cut; but if desired cut wheels can be used throuhgout.

Pedestals are self-adjusting and self-lubricating, and rests on broad planed ledges, every convenience being provided for oiling, and all such oil holes as cannot be readily got at are furnished with tubes having the orifice placed in a convenient and conspicuous position.

The tin rollers are strong and well made in short lengths, coupled by stout cast-iron shafts which run in Mohler self-adjusting and self-lubricating bearings, this arrangement of a cast-iron shaft running in a cast-iron flexible bearing being the most satisfactory for the purpose.

Double tin rollers are generally employed in the spinning frames, and they are, when ordered, connected by **rope driving**, with a tension screw arrangement at the off-end. This ensures the same speed in both tin rollers and a considerable saving in the spindle banding.

Panels enclose the gearing and off-ends of the frame and form a guard against accident. All joints and fitting surfaces are planed or milled.

The girder or spindle rails are of a deep and strong section, and machined all over. The top flange forms a true surface for carrying the spindle, and the lower flange carries the rocking shaft brackets for the lifter motion. The back surface of the rail is bolted and pinned to the spring piece, thus making the whole frame very rigid and allows of a high speed being attained.

Ring rails are made broad and strong with an exceptionally deep flange, are milled on the top and front and left squarley into the poker top, where they are also joined, thus avoiding all possibility of accidental displacement.

Lifting motion.—The lifting of the ring rail can be worked by means of chains and bowls; but our usual practice is by L levers, well balanced, connected with the builder motion lever by a chain, which cannot lock as it is always under the necessary tension. The lower arm of the lever carries a bowl, on which rides the poker foot supporting the ring rail. The upright arm of these levers are connected with the levers running the full length of the frame by means of stout adjustable rods. After doffing, the heart lever can be rapidly raised and lowered to take up the slack yarn by application of the foot to a pedal, whilst putting the strap on a fast pulley.

The rocking lever employed for lifting the pokers is made in halves, and so arranged that the level of the ring plates can easily be adjusted. The lifting pokers are carried in long cast-iron tubes to prevent binding at the top or bottom of the lift.

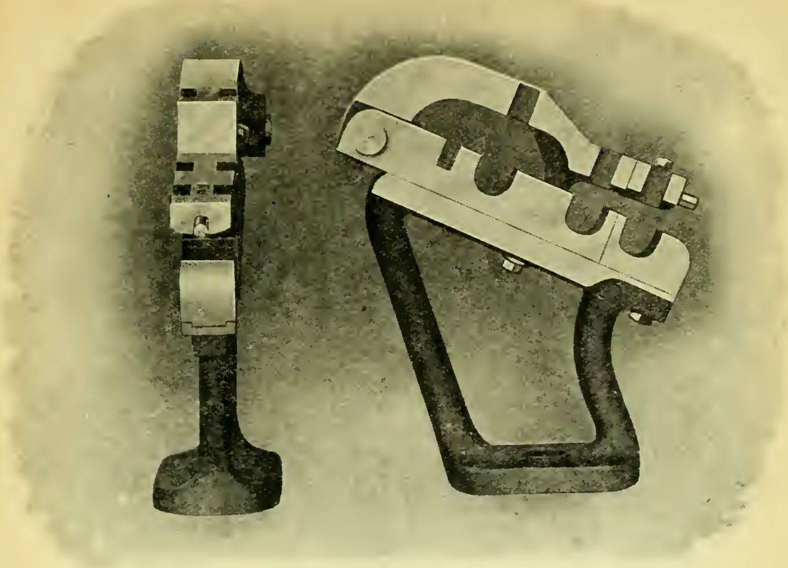
Building or copping motion.—We can supply the straight lift with shortening motion or the ordinary cop building motion which is usual for twist or weft yarns.

The front roller runs in broad stands to reduce wear on the necks, and is placed higher than usual and more to the front, so as to facilitate piecing and cleaning.

The roller stands are of our improved pattern, the bearings for the front roller are bushed with brass and the slides are milled all over to standard sizes. The front bearing is a separate piece so that in case of accident it can be easily replaced without in any way disturbing the stand.

The stands are made with an incline at various angles, **25° for twist** and **35° for weft** being the usual ones. We also supply if desired a **30°** low stand.

The cap bar fingers are made separate and carried on turned bars supported from the stand, the bearings for



the top rollers are all milled, and the front roller nib is separate, thus affording easy adjustment. With all parts being standard sizes, all are interchangeable.

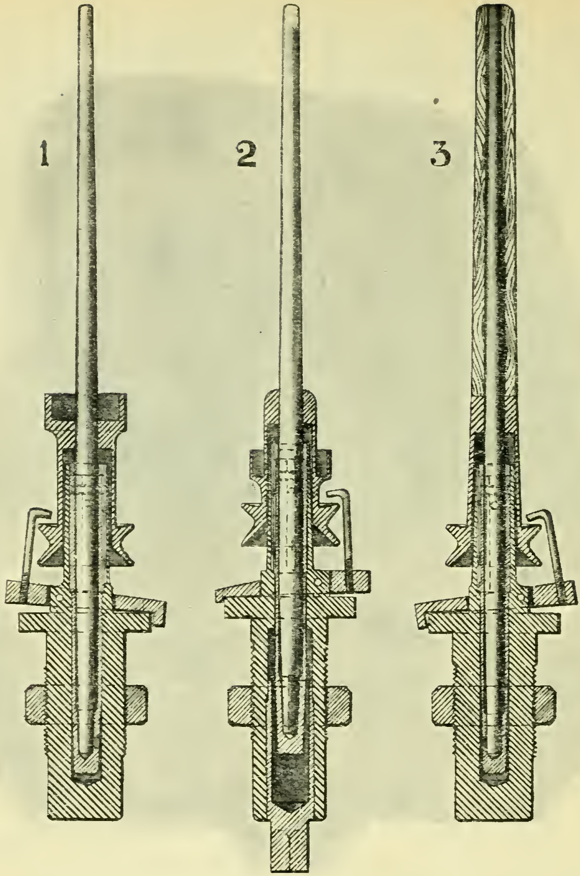
Weighting of the top rollers may be either all three lines weighted by lever and saddle, or the front line only weighted by dead weights and the other two self-weighted, the latter arrangement being specially suitable on the inclined stands with our specially-made cap bars.

The traverse motion on the spinning frames is arranged to reverse quickly at each end, and thus prevent dwell, which is always a great evil.

All our rings are punched from the solid steel bar, turned by specially designed machinery and highly polished after being thoroughly case-hardened. All are carefully examined before leaving our works for smoothness, concentricity and perfect hardening.

Our standard ring is made with one flange, but we also make the double-flanged **reversible ring** with split cast-iron or sheet-iron holders.

Changeable rim pulley driving.—When a frame is required to spin a range of counts from low to medium, or where only a slow-running line shaft is used for driving the



Ring Frame Spindles.

(1) **For weft** with solid bottom, also made with multiple screw oil cup.

(2) **For twist** with multiple screw oil cap, also made with solid bottom instead of oil cup.

(3) **For paper tubes** with wood plug on spindle blade.

NOTE.—Much trouble is frequently caused by the use of **unsuitable oils** and **imperfect bobbins**, and also by neglecting to keep spindles reasonably clean.

frame, we sometimes employ a changeable rim pulley with tightening apparatus at the headstock. This device consists of a shaft with the usual pair of fast and loose driving pulleys, carried from the frame ends, with a plate on the boss of the fast pulley to carry the rim or rope pulley. From this rope pulley the rope passes over suitable guide pulleys on to the tin roller shaft, thus giving motion to the frame, the speed of which is readily changed by changing the rim pulley.

Doffing motion.—By means of this arrangement half a turn of a conveniently-placed handle enables the ring plates to be lowered by the attendant sufficiently to wind a few coils of yarn below the bobbin. These are left on the spindle when the bobbin is withdrawn, and the new bobbin secures the thread ready for re-starting.

Lappets or thread boards have their proper working position determined by an adjustable stop, so that the distance from the thread wire to the top of the bobbin can be regulated by a single screw to suit various counts of yarn; and for doffing they are lifted by a lever conveniently placed at the gearing end of the machine.

Metal lappets or thread guide plates can be supplied if desired. These are fixed on angle irons, hinged to the roller beams, to each of the angle irons we supply 2in. adjusting screws for regulating the angle of the lappet.

Improved "Phœnix" type spindles.—After countless experiments and tests with many types of flexible spindles, we have now succeeded in so improving our well-known "Phœnix" Spindle and adapting it to the longer lifts and higher speeds at present in vogue that we have decided to retain it as our standard. It is made either for twist or weft, with or without detachable oil cup of the multiple screw variety. Each spindle is carefully set, balanced and tested, at a greater speed than under the usual working conditions, before leaving the works.

The spindles are made with or without bobbin cup, and, if required, with a wooden plug the whole length of the blade for use with paper tubes. The oiling of the spindle is perfect, the foot being always immersed in oil with suitable provision for circulation of same, and when the spindle is provided with an oil cup the removal of the dirty oil preparatory to re-oiling is greatly simplified.

We illustrate on page 218 in section three of the principal spindles which we recommend.

The holding-down catch for the spindles is so designed and balanced that no matter how it is moved aside it returns to its original position, and ensures the spindle always being in its bearing.

Separators.—We usually supply the "Blinker" type carried on the ring rail and so arranged that they can easily be turned back for piecing-up or for doffing.

These separators are attached to short angle iron bars; having fixed to each end a pivot and cast with it another projecting lug. The pivot rests in a small bracket secured to the ring rail with the projecting lug on the outside. When the cop is building the separator is upright (see fig. 1), and the lug is then at the top part of the small bracket to prevent the separator falling forward. When the cop is finished the separators are pushed back by hand (see fig. 2), this brings the lug in contact with the bracket at a lower point and thus prevents it from falling too far back; when by the slighest touch with the fingers replaces it again in working position.

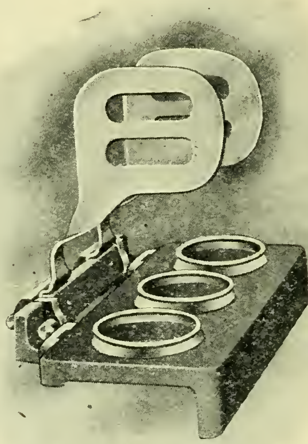


Fig. 1.

Fig 2.

Advantages of the separators.—The

diameter of the ring can be increased by $\frac{1}{8}$in. representing 16 per cent. less doffings, the spindle speed can be increased at least 5 per cent. for the higher counts, and up to 10 per cent. for the lower counts, making a total worthy of consideration. A lighter traveller can be used, and the spinning of soft yarn is facilitated, the quality improved, the yarn being smooth and more elastic.

In the present apparatus we have endeavoured to remove all defects and have no hesitation in stating that it is undoubtedly the most satisfactory for the purpose yet introduced. It is simplicity itself and cannot possibly get out of order, and it does not in any way interfere with the work of the piecers and doffers.

We also supply, when specially ordered, separators or fingers attached to angle iron placed midway in the lift and so arranged that when the ring rail reaches a certain height the whole arrangement falls automatically out of action. After doffing it is replaced by hand.

Other ballooning arrangements.—We can if desired supply the well-known "**Shepherd & Midgley's**" Motion, or the **half-circle steel plate**, which automatically falls out of action at any given portion of the lift.

Rollers.—We supply loose boss top rollers to front line if required. Bottom rollers case-hardened all over, or in the necks and squares only if desired.

Creels can be made in any of the usual forms for double or single rovings. The supports for the skewers carrying the roving bobbins are made of strong angle iron, lined with wood. These are carried by strong upright rods supporting the usual top board for holding the roving bobbins not in use. For double roving we sometimes use a special cast-iron flat creel. By employing this creel two rows of roving bobbins can be used, and the necessity of high creels is dispensed with.

Fig. 1 shows a "Birkenhead" creel for double roving, fig. 2 "Birkenhead" creel for single roving; this gives a lower creel than the ordinary vertical type, fig. 3. Fig. 4 is a vertical creel for double roving.

Strap fork for starting and stopping the frame is so arranged that the machine can be set in motion or stopped from either side.

The machine can be arranged for either **rope or belt driving.** When rope driving is adopted we use specially-designed fast and loose rope pulleys, the fast pulley having

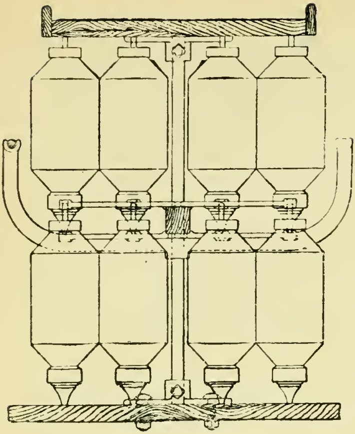


Fig. 1.

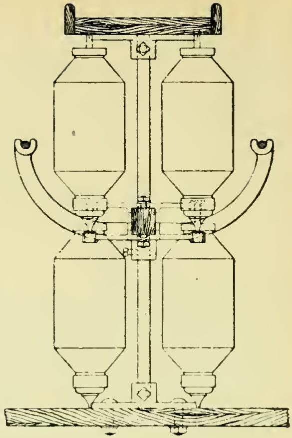


Fig. 2.

Elevation of various
Creels.

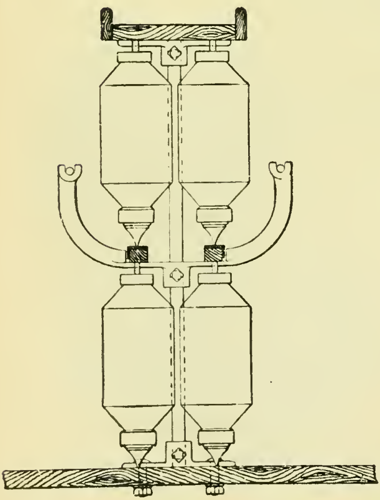


Fig. 3.

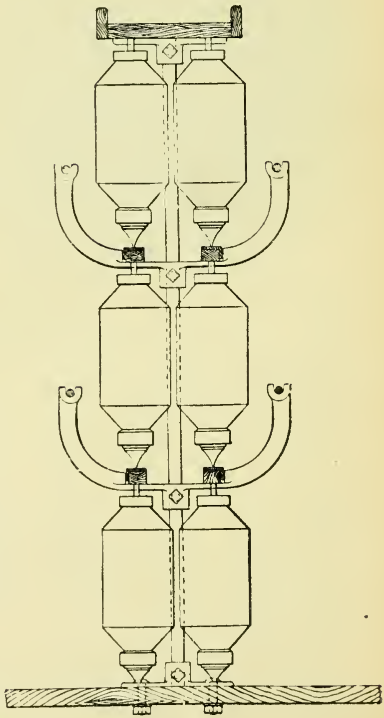
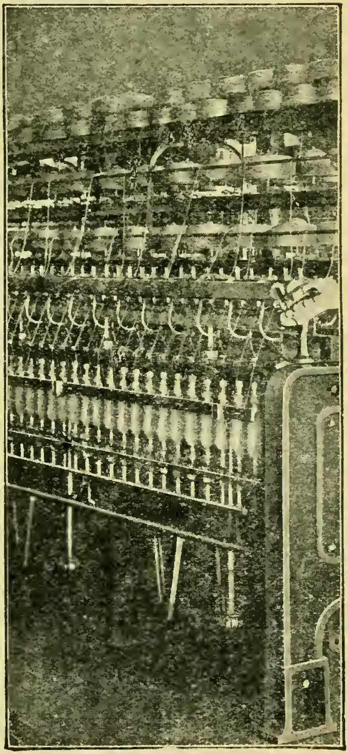


Fig. 4.

two grooves, one of which is shallow and allows the frame to start gradually.

In very long frames the driving pulleys may be placed in the middle of the frame, and in this case the front rollers are usually made to run through from end to end. This arrangement is quite convenient in all respects where the frames must be very long to fill up the room.

Waste ring spinning frames.—We make ring frames for spinning waste, arranged with surface drums to receive the condenser bobbins, or with creels to take cheeses direct from the Carding Engine. The Illustration shows an upright creel to take the small cheeses of bobbins which are usually carried on small tin tubes with a large head.



Length of ring frames. To find the number of spindles that will stand in a given length, deduct the space for the gearing as given below, and divide the remainder by the gauge. The result multiplied by two will be the number of spindles. The number of spindles in spinning frames must be divisible by four.

To find the length of a ring frame of a given number of spindles multiply half the number of spindles by the gauge and add:—Frames with ordinary driving, 2ft. 7in. Frame rollers driven in the middle, 3ft. $5\frac{1}{4}$in. Frames driven at both ends, 4ft. 2in.

Spinning Frame Gauges, etc.

	In.	In.	In.	In.	In.	In.
Gauge	$2\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{5}{8}$	$2\frac{3}{4}$	$2\frac{7}{8}$	3
Diameter of Ring	$1\frac{1}{8}$ or $1\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{5}{8}$	$1\frac{3}{4}$	$1\frac{7}{8}$	2
Diam of Spindle Wharve...	$\frac{3}{4}$	$\frac{7}{8}$	$\frac{7}{8}$	$\frac{7}{8}$	$\frac{7}{8}$	1

When Separators or anti-ballooning plates are employed the gauges may be $\frac{1}{8}$in. less, whilst the ring remains the same diameter.

Lift, usually 4in. to 6in. for weft, and 5in., $5\frac{1}{2}$in., 6in. and 7in. for twist, and coarse counts up to 8in.

Width of frames.—We have patterns for frames 2ft. 9in. and 3ft. wide. The usual width is 3ft.

Hand of frame.—To determine the hand of the frame stand facing the gearing end and state which hand the driving pulleys must be placed.

Horse power.—Medium counts 90 spindles to I.H.P.

Driving pulleys,—10in. to 18in. dia. for $3\frac{1}{2}$in. or 4in. belt. The height of driving shaft from floor is 1ft. 6in. for 5in. lift, and 1ft. $5\frac{1}{2}$in. for 6in. lift, and the dia. is $1\frac{1}{2}$in.

Speeds.—5,500 to 7,500 revs. of spls. for 10's to 15's
7,500 to 9,000 ,, ,, 15's to 20's
9,000 to 9,500 ,, ,, 24's upwards

Strapping, etc.—$3\frac{1}{2}$in. is the usual width for main driving belt, but we sometimes use a 4in. for long frames. If the frame is supplied with a tin roller rope drive, 10ft. of $\frac{1}{2}$in. dia. rope will be required. **Spindle band.**—70in. long per spindle.

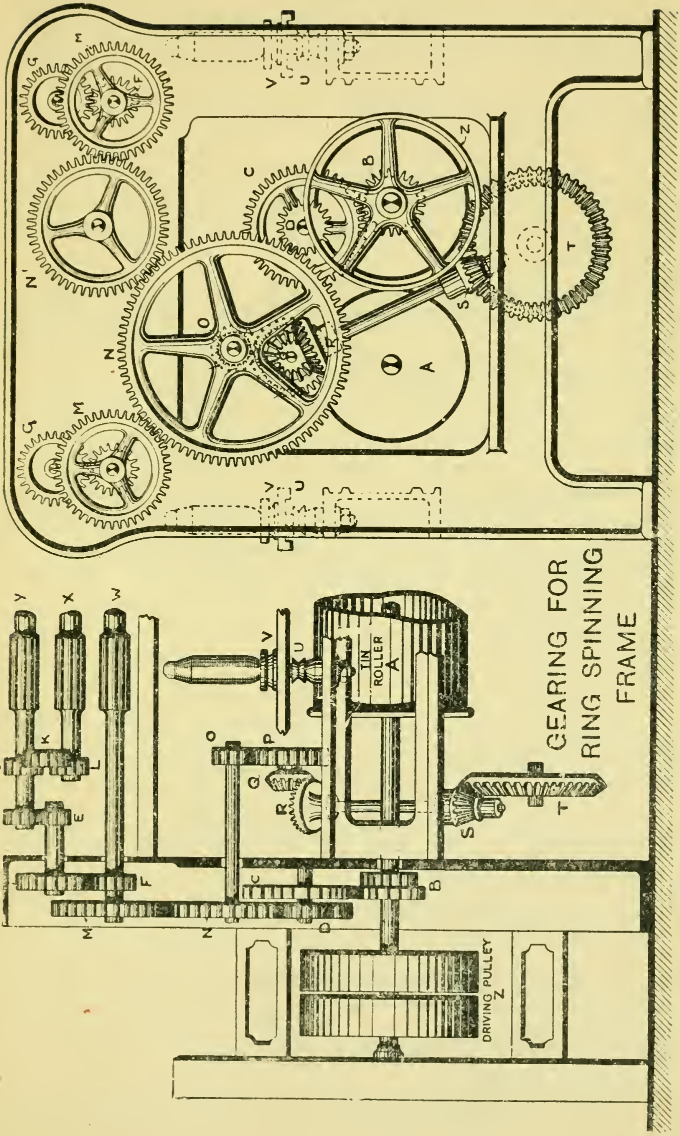
Weights.—Gearing 1,300 lbs., to which must be added the remainder of frame per spindle, as follows:—

$2\frac{5}{8}$in. gauge, 17 lbs.	Roller and balance
$2\frac{3}{4}$in. gauge, 17·2 lbs.	weight, 5·77 lbs.

For gross weight add 32 per cent.

Description of Gearing, etc.

A	Tin roller	N¹	Carrier to F.R. 70T
B	Compound tin roller W., 25T and 40T	O	Lifter wheel 35T
C	Wheel on twist wheel stud gearing with B .. 60T or 75T	P Q	Compound spur and bevel lifter wheel, spur 50T, bevel 17T
D	Twist wheel ... ...20T to 60T	R	Lifter bevel 40T
E	Draught wheel ... ...30T to 60T	S	,, ,, ... 18T
F	Front roller pinion 20T	T	,, ,, ... 120T
G	Crown W. on draught W. stud 100T	U	Spindle wharve
H	Back roller wheel...54T or can change	V	Ring
J	,, driving middle roller ... 30T	W	Front roller
K	,, to middle roller carrier... 50T	X	Middle roller
L	Middle roller wheel 23T	Y	Back roller
M	Front roller end wheel 70T	Z	Driving pulleys
N	Large carrier or lifter driving W135T		



GEARING FOR RING SPINNING FRAME

Calculations.

$$\text{Production in Hanks per hour} \left\{ \frac{\text{Revs. of spls. per min.} \times 60 \text{ mins.}}{\text{Turns per inch} \times 840 \text{ yds.}} \right. = \text{hanks.}$$

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

The table on pages 230 and 231 gives the theoretical production of ring frames in 10 hours' continuous working. The corresponding loss of time for doffing, cleaning, etc., must be deducted.

Spindle speed.—In calculating the speed of spindles, add the thickness of the spindle band to the diameters of the tin roller and spindle wharves, the result will be very approximately the actual speed of the spindles.

$$\text{Speed of Spindles} \left\} = \frac{\text{Speed of line shaft} \times \text{drum} \times \text{dia. of tin roller} + \text{band}}{\text{Pulley on the frame} \times \text{dia. of wharve} + \text{band}} \right.$$

Draft constant.—Our usual arrangement is shown on the plan of gearing, namely, 20 on front roller, driving 100 on change wheel stud, and 54 on the back roller. If f = diameter of front roller, and b = that of back roller, and x = the change wheel, then

$$\text{Draft } \frac{54 \times 100 \times f}{x \times 20 \times b} = \frac{270 \times f}{x \times b} = 270 \text{ draft constant.}$$

270 is therefore the draft constant if the front and back rollers are the same diameter, and the following table gives the constants for other combinations of rollers :—

	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
Dia. front roller ...	$\frac{13}{16}$	$\frac{13}{16}$	$\frac{13}{16}$	$\frac{13}{16}$	$\frac{7}{8}$	$\frac{7}{8}$	$\frac{7}{8}$	$\frac{15}{16}$	$\frac{15}{16}$	1	$1\frac{1}{16}$	$1\frac{1}{8}$	$1\frac{1}{8}$
,, back ,, ...	$\frac{13}{16}$	$\frac{7}{8}$	$\frac{15}{16}$	1	$\frac{7}{8}$	$\frac{15}{16}$	1	$\frac{15}{16}$	1	1	1	1	$1\frac{1}{8}$
Constant with 54 back roller wheel	270	251	234	219	270	252	236	270	253	270	287	304	270

Divide the constants by draft required to get necessary change wheel.

$$\text{Also } \frac{\text{constant}}{\text{change wheel on}} = \textbf{draft} \text{ that wheel gives.}$$

Twist constants.—On the tin roller shaft is a compound driving wheel with 25 and 40 teeth, which gear respectively with 75 and 60 on the twist wheel stud. Either of these pairs may be used as desired.

$$\underset{\text{Twist wheel.}}{\overset{\text{Front roller wheel.}}{\frac{70}{x}}} \times \underset{\text{Driving wheel.}}{\overset{\text{Twist carrier wheel.}}{\frac{75}{25}}} \times \underset{\text{Dia. of wharve in }\frac{1}{8}\text{th} + \text{band.}}{\overset{\text{Dia. of tin roller in }\frac{1}{8}\text{th} + \text{band.}}{\frac{81}{8}}} \times \underset{\text{Circumference of 1in. F. roller.}}{\frac{1}{3{\cdot}1416}} = 676{\cdot}8 \text{ constant}$$

Constant divided by turns per inch = twist wheel.

„ „ **twist wheel** = turns per inch.

The following table gives constants for both combinations with $\frac{3}{4}$ inch, $\frac{7}{8}$ inch, and 1 inch spindle wharves and various diameters of rollers :—

Diameter of Spindle Wharve	Compound Combination Wheel	Diameter of Front Rollers					
		$\frac{13}{16}$ In.	$\frac{7}{8}$ in.	$\frac{15}{16}$ in.	1 in.	$1\frac{1}{16}$ in.	$1\frac{1}{8}$ in.
$\frac{3}{4}$ inch	25/75	953	884	826	774	728	688
	40/60	476·5	442	413	387	364	344
$\frac{7}{8}$ inch	25/75	834	775	723	676·8	638	602
	40/60	417	387·5	361·5	339	319	301
1 inch	25/75	741	688	642	602	566	535
	40/60	370·5	344	321	301	283	267·5

Turns per inch for ring twist = $\sqrt{\text{counts}} \times 4$. ring weft = $\sqrt{\text{counts}} \times 3{\cdot}5$. Square root table on page 229.

Twist wheel $= \dfrac{\text{constant}}{\text{turns per inch required.}}$

$\dfrac{\text{constant}}{\text{twist wheel on}}$ = turns per inch given by that wheel.

Twist per inch $= \dfrac{\text{Dia. of tin roller plus band} \times C \times M.}{D \times B \times \text{Cir of F R} \times \text{dia. of wharve plus band.}}$

D = Twist change wheel.

Twist constant $= \dfrac{\text{Dia. of tin roller plus band} \times C \times M.}{B \times \text{Cir of F R} \times \text{dia. of wharve plus band.}}$

To find the draft.—Counts ÷ hank roving = draft.

To find the hank roving.—Counts ÷ draft = hank roving.

To find the counts.—Length of yarn ÷ weight in grains = counts, or 8·333 ÷ the grains per yard.

Revolutions of front roller $\dfrac{\text{Revs. of } Z \times B \times D.}{C \times M.}$

Travellers.

Below we give an approximate list of travellers for various counts of yarn. It will be understood that it is impossible to fix these definitely as the conditions vary considerably, and the list herewith is only given as a guide :—

Counts of Yarn	Diameter of Ring	Traveller No.	Counts of Yarn	Diameter of Ring	Traveller No.
	In.			In.	
6	2	8	30	$1\frac{5}{8}$	5/0
8	2	7	32	$1\frac{5}{8}$	6/0
10	2	6	34	$1\frac{5}{8}$	7/0
12	$1\frac{3}{4}$	5	36	$1\frac{5}{8}$	8/0
14	$1\frac{3}{4}$	4	38	$1\frac{1}{2}$	9/0
16	$1\frac{3}{4}$	3	40	$1\frac{1}{2}$	10/0
18	$1\frac{3}{4}$	2	42	$1\frac{1}{2}$	11/0
20	$1\frac{5}{8}$	1	45	$1\frac{1}{2}$	12/0
22	$1\frac{5}{8}$	1/0	50	$1\frac{1}{2}$	13/0
24	$1\frac{5}{8}$	2/0	55	$1\frac{1}{2}$—$1\frac{3}{8}$	14/0
26	$1\frac{5}{8}$	3/0	60	$1\frac{1}{2}$—$1\frac{3}{8}$	15/0
28	$1\frac{5}{8}$	4/0	70	$1\frac{1}{2}$—$1\frac{3}{8}$	16/0

The above list is given for American cotton. Indian cotton requires 4 to 5 sizes lighter, and Egyptian and Sea Islands cotton 4 to 5 sizes heavier.

Square Roots.

No.	√	No.	√	No.	√	No.	√
1	1	51	7·141	101	10·049	151	12·288
2	1·414	52	7·211	102	10·099	152	12·328
3	1·732	53	7·280	103	10·148	153	12·369
4	2·0	54	7·348	104	10·198	154	12 409
5	2·236	55	7·416	105	10·246	155	12·449
6	2·449	56	7·483	106	10·295	156	12·490
7	2·645	57	7·549	107	10·344	157	12·529
8	2·828	58	7·615	108	10·392	158	12·569
9	3·0	59	7·681	109	10·440	159	12·609
10	3·162	60	7·745	110	10·488	160	12·649
11	3·316	61	7·810	111	10·535	161	12·688
12	3·464	62	7.874	112	10·583	162	12·727
13	3·605	63	7·937	113	10·630	163	12·767
14	3·741	64	8·0	114	10·677	164	12·806
15	3·872	65	8·062	115	10·723	165	12·845
16	4·0	66	8·124	116	10·770	166	12·884
17	4·123	67	8·185	117	10·816	167	12·922
18	4·242	68	8·246	118	10·862	168	12·961
19	4·358	69	8·306	119	10·908	169	13·0
20	4·472	70	8·366	120	10·954	170	13·038
21	4·582	71	8·426	121	11·0	171	13·076
22	4·690	72	8·485	122	11·045	172	13·114
23	4·795	73	8·544	123	11·090	173	13·152
24	4·898	74	8·602	124	11·135	174	13·190
25	5·0	75	8·660	125	11·180	175	13·228
26	5·099	76	8·717	126	11·224	176	13·266
27	5·196	77	8·774	127	11·269	177	13·304
28	5·291	78	8·831	128	11·313	178	13·341
29	5·385	79	8·888	129	11·357	179	13·379
30	5·477	80	8·944	130	11·401	180	13·416
31	5·567	81	9·0	131	11·445	181	13·453
32	5·656	82	9·055	132	11·489	182	13·490
33	5·744	83	9·110	133	11·532	183	13·527
34	5·830	84	9·165	134	11·575	184	13·564
35	5·916	85	9·219	135	11·618	185	13·601
36	6·0	86	9·273	136	11·661	186	13·638
37	6·082	87	9·327	137	11·704	187	13·674
38	6·164	88	9·380	138	11·747	188	13·711
39	6·245	89	9·433	139	11·789	189	13·747
40	6·324	90	9·486	140	11·832	190	13·784
41	6·403	91	9·539	141	11·874	191	13 820
42	6·48	92	9·591	142	11·916	192	13·856
43	6·557	93	9·643	143	11·958	193	13·892
44	6·633	94	9·695	144	12·0	194	13·928
45	6·708	95	9·746	145	12·041	195	13·964
46	6·782	96	9·797	146	12·083	196	14·0
47	6·855	97	9·848	147	12·124	197	14·035
48	6·928	98	9·899	148	12·165	198	14·071
49	7·0	99	9·949	149	12·206	199	14·106
50	7·071	100	10 0	150	12·247	200	14·142

Calculated Production for 10 Actual

TWIST (turns = $\sqrt{\text{counts}} \times 4$).

Nos.	Diam. of Ring.	Gauge.	Turns per inch.	Diam. of F.R.	Revs. of F.R.	Inches delivered per Min.	Revs. of Spindles per Min.	Hanks per Spl. per 10 Hours.	Lbs. per Spl. per 10 Hours.	French Nos.
	In.			In.						
5	2	3	8'94	7/8	203'5	559'29	5,000	11'09	2'21	4'23
	2	3		7/8	244'2	671'14	6,000	13'31	2'66	
7	2	3	10'58	7/8	189'16	519'83	5,500	10'31	1'472	5'92
	2	3		7/8	206'37	567'107	6,000	11'252	1'607	
	2	3		7/8	223'5	614'36	6,500	12'18	1'74	
10	1¾	2¾	12'64	7/8	172'74	474'7	6,000	9'418	'9418	8'47
	1¾	2¾		7/8	194'32	534'01	6,750	10'59	1'059	
	1¾	2¾		7/8	215'92	593'35	7,500	11'77	1'177	
12	1¾	2¾	13'85	7/8	157'64	433'21	6,000	8'595	'716	10'16
	1¾	2¾		7/8	183'9	505'41	7,000	10'02	'835	
	1¾	2¾		1	183'7	577'61	8,000	11'46	'955	
14	1¾	2¾	14'96	7/8	145'95	401'07	6,000	7'957	'568	11'86
	1¾	2¾		1	148'8	467'91	7,000	9'283	'663	
	1¾	2¾		1	170'1	534'75	8,000	10'61	'758	
16	1¾	2¾	16	1	129'26	406'25	6,500	8'06	'503	13'55
	1¾	2¾		1	149'1	468'75	7,500	9 3	'581	
	1⅝	2⅝		1	169	531'25	8,500	10'54	'658	
18	1¾	2¾	16'96	1	121'8	383'25	6,500	7'604	'422	15'25
	1⅝	2⅝		1	140'7	442'21	7,500	8'77	'487	
	1⅝	2⅝		1	159'4	501'18	8,500	9'944	'552	
20	1⅝	2⅝	17'88	1	124'5	391'49	7,000	7'765	'388	16'94
	1⅝	2⅝		1	142'35	447'42	8,000	8'877	'443	
	1⅝	2⅝		1	160'15	503'35	9,000	9'985	'499	
22	1⅝	2⅝	18'76	1	118'72	373'13	7,000	7'403	'336	18'63
	1⅝	2⅝		1	135'6	426'43	8,000	8'46	'384	
	1⅝	2⅝		1	152'64	479'74	9,000	9'518	'432	
24	1⅝	2⅝	19'59	1	113'69	357'32	7,000	7'09	'295	20'33
	1⅝	2⅝		1	129 92	408 37	8,000	8'102	'337	
	1⅝	2⅝		1	146'16	459'41	9,000	9'115	'379	

WEFT (turns = $\sqrt{\text{counts}} \times 3'5$).

Nos.	Diam. of Ring.	Gauge.	Turns per inch.	Diam. of F.R.	Revs. of F.R.	Inches delivered per Min.	Revs. of Spindles per Min.	Hanks per Spl. per 10 Hours.	Lbs. per Spl. per 10 Hours.	French Nos.
5	1⅝" or 1¼" Ring when using Wood Bobbins = 2¼" gauge.	1" Ring when using Paper Tubes = 2" gauge.	7'826	7/8	232'49	638'89	5,000	12'67	2'53	4'23
				7/8	278'9	766'67	6,000	15'2	3'04	
7			9'257	7/8	216'2	594'14	5,500	11'788	1'68	5'92
				7/8	235'86	648'15	6.000	12'86	1'837	
				7/8	255'5	702'17	6,500	13'931	1'99	
10			11'06	7/8	189'18	519 89	5,750	10'31	1'03	8'47
				7/8	213'86	587'7	6,500	11'66	1'16	
				7/8	238'52	655'5	7,250	13'0	1 3	
12			12'12	7/8	173	474'42	5,750	9'41	'78	10'16
				7/8	202'6	556 93	6.750	11'05	'92	
				1	203'52	639'43	7.750	12'68	1'05	
14			13'09	7/8	159'84	439'26	5,750	8'715	'622	11'86
				1	164'13	515'66	6,750	10'13	'73	
				1	188'45	592'05	7,750	11'74	'838	
16			14	1	136'36	428'57	6,000	8'503	'53	13'55
				1	159'15	500	7,000	9'92	'62	
				1	181'88	571'42	8,000	11'337	'708	
18			14'84	1	128'69	404'31	6,000	8'022	'445	15'25
				1	150'14	471'7	7,000	9'359	'519	
				1	171'59	539'08	8.000	10'69	'593	
20			15'65	1	132'25	415'33	6,500	8'24	'412	16'94
				1	152'54	479.23	7,500	9'508	'475	
				1	172'88	543'13	8'500	10'776	'538	
22			16'41	1	126'08	396'1	6.500	7'859	'357	18'63
				1	145'46	457	7,500	9'067	'412	
				1	164'87	517'97	8.500	10'27	'466	
24			17'14	1	120 7	379'22	6,500	7'524	'313	20'33
				1	139'28	437'57	7.500	8'681	'361	
				1	157'84	495'9	8,500	9'839	'409	

Working Hours of Frame.

TWIST.

Nos.	Diam. of Ring.	Gauge.	Turns per inch.	Diam. of F.R.	Revs. of F.R.	Inches delivered per Min.	Revs. of Spindle per Min.	Hanks per Spl. per 10 Hours.	Lbs. per Spl. per 10 Hours.	French Nos.
	In.			In.						
26	$1\frac{5}{8}$	$2\frac{5}{8}$	20·39	1	117	367·82	7,500	7·289	·28	22·02
	$1\frac{5}{8}$	$2\frac{5}{8}$		1	132·7	416·87	8,500	8·271	·318	
	$1\frac{5}{8}$	$2\frac{5}{8}$		1	148·3	465·91	9,500	9·244	·3554	
28	$1\frac{5}{8}$	$2\frac{5}{8}$	21·16	1	112·7	354·44	7,500	7·032	·251	23·72
	$1\frac{5}{8}$	$2\frac{5}{8}$		1	127·6	401·7	8,500	7·97	·284	
	$1\frac{5}{8}$	$2\frac{5}{8}$		1	142·9	448·96	9,500	8·9	·317	
30	$1\frac{5}{8}$	$2\frac{5}{8}$	21·9	1	116·2	365·3	8,000	7·248	·2416	25·41
	$1\frac{5}{8}$	$2\frac{5}{8}$		1	130·8	410·9	9,000	8·15	·271	
	$1\frac{1}{2}$	$2\frac{1}{2}$		1	145·2	456·62	10,000	9·06	·302	
32	$1\frac{5}{8}$	$2\frac{5}{8}$	22·62	1	112·5	353·67	8,000	7·017	·219	27·10
	$1\frac{5}{8}$	$2\frac{5}{8}$		1	126·6	397·87	9,000	7·894	·246	
	$1\frac{1}{2}$	$2\frac{1}{2}$		1	140·6	442·08	10,000	8·771	·274	
36	$1\frac{5}{8}$	$2\frac{5}{8}$	24	1	106·1	333·33	8,000	6·61	·183	30·49
	$1\frac{5}{8}$	$2\frac{5}{8}$		1	119·3	375	9,000	7·44	·206	
	$1\frac{1}{2}$	$2\frac{1}{2}$		1	132·5	416·66	10,000	8·26	·229	
40	$1\frac{1}{2}$	$2\frac{1}{2}$	25·29	1	100·6	316·33	8,000	6·276	·1569	33·88
	$1\frac{1}{2}$	$2\frac{1}{2}$		1	113·2	355·87	9,000	7·06	·1764	
	$1\frac{1}{2}$	$2\frac{1}{2}$		1	125·9	395·4	10,000	7·845	·1961	
44	$1\frac{1}{2}$	$2\frac{1}{2}$	26·53	1	89·98	282·7	7,500	5·609	·127	37·27
	$1\frac{1}{2}$	$2\frac{1}{2}$		1	102	320·39	8,500	6·359	·144	
	$1\frac{1}{2}$	$2\frac{1}{2}$		$1\frac{1}{16}$	107·31	358·08	9,500	7·104	·1615	
	$1\frac{1}{2}$	$2\frac{1}{2}$		$1\frac{1}{16}$	112·9	377	10,000	7·48	·17	
48	$1\frac{1}{2}$	$2\frac{1}{2}$	27·71	1	86·1	270·66	7,500	5·37	·1118	40·66
	$1\frac{1}{2}$	$2\frac{1}{2}$		1	97·59	396·74	8,500	6·086	·1268	
	$1\frac{1}{2}$	$2\frac{1}{2}$		$1\frac{1}{16}$	102·7	342·83	9,500	6·802	·1416	
	$1\frac{1}{2}$	$2\frac{1}{2}$		$1\frac{1}{16}$	108·1	360·89	10,000	7·16	·1491	
50	$1\frac{1}{2}$	$2\frac{1}{2}$	28·28	1	78·7	247·52	7,000	4·911	·098	42·35
	$1\frac{1}{2}$	$2\frac{1}{2}$		$1\frac{1}{16}$	84·7	282·88	8,000	5·612	·1122	
	$1\frac{1}{2}$	$2\frac{1}{2}$		$1\frac{1}{16}$	95·3	318·24	9,000	6·314	·1262	
	$1\frac{1}{2}$	$2\frac{1}{2}$		$1\frac{1}{16}$	105·9	353·6	10,000	7·016	·1403	

WEFT.

Nos.	Diam. of Ring.	Gauge.	Turns per inch.	Diam. of F.R.	Revs. of F.R.	Inches delivered per Min.	Revs. of Spindle per Min.	Hanks per Spl. per 10 Hours.	Lbs. per Spl. per 10 Hours.	French Nos.
26	1″ or $1\frac{1}{4}$″ Ring when using Wood Bobbins = $2\frac{1}{4}$″ gauge.	1″ Ring when using Paper Tubes = 2″ gauge.	17·84	1	120·4	378·36	6,750	7·507	·288	22·02
				1	138·2	434·41	7,750	8·619	·331	
				1	156·1	490·47	8,750	9·731	·374	
28			18·51	1	116	364·66	6,750	7·235	·258	23·72
				1	133·2	418·69	7,750	8·307	·296	
				1	150·4	472·71	8,750	9·379	·334	
30			19·15	1	120·4	378·59	7,250	7·511	·25	25·41
				1	137	430·8	8,250	8·547	·285	
				1	153·7	483·02	9,250	9·583	·317	
32			19·79	1	116·5	366·34	7,250	7·268	·227	27·10
				1	132·6	416·87	8,250	8·271	·258	
				1	148·7	467·4	9,250	9·273	·289	
36			21	1	109·8	345·23	7,250	6·85	·19	30·49
				1	125	392·85	8,250	7·794	·216	
				1	140·2	440·47	9,250	8·739	·242	
40			22·13	1	104·2	327·6	7,250	6·5	·162	33·88
				1	118·6	372·79	8,250	7·396	·1849	
				1	133	417·98	9,250	8·293	·2073	
44			23·21	1	92·57	290·82	6,750	5·77	·131	37·27
				1	106	333·9	7,750	6·624	·15	
				$1\frac{1}{16}$	112·9	377	8,750	7·48	·17	
				$1\frac{1}{16}$	118·7	396·38	9,200	7·864	·178	
48			24·24	1	88·6	278·46	6,750	5·525	·115	40·66
				1	101·7	319·72	7,750	6·343	·132	
				$1\frac{1}{16}$	108·1	360·97	8,750	7·162	·149	
				$1\frac{1}{16}$	113·5	379·53	9,200	7·538	·157	
50			24·74	1	83·6	262·73	6,500	5·212	·104	42·35
				$1\frac{1}{16}$	90·8	303·15	7,500	6·014	·120	
				$1\frac{1}{16}$	102·9	343·57	8,500	6·817	·136	
				$1\frac{1}{16}$	111·4	371·86	9,200	7·378	·1475	

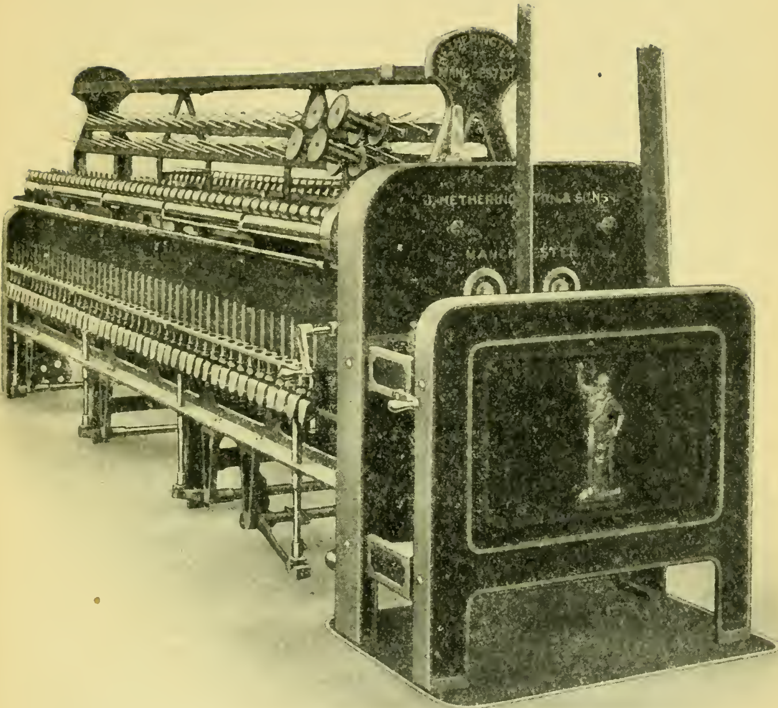
RING SPINNING FRAME QUERIES.

To be Answered when Ordering Machines.

How many frames ?
Facing gearing end, must Pulley be on right or left hand ?
Length overall ? (Gearing occupies 2ft. 7in.)
Width of frame ? (usually 3ft.)
Number of spindles ?
Gauge or distance between spindles ?
Length of lift ?
Inside diameter of ring ?
Improved " Phœnix " spindle to run twist or weft way ?
Diameter of spindle wharve ? For bobbins or paper tubes ?
Spindles to have solid bottom or detachable oil cup ?
Speed of spindles ?
Diameter of tin rollers (usually 10in.) Single or double tin rollers ?
Counts to be spun ? Class of cotton used ?
Hank roving to be used ? Single or double ?
Direction in which roving comes off creel bobbin ?
How many revs. of spindle to one of front roller ? Or turns per inch ?
Creel one height ? Or two heights ? (See illustrations.)
Separators ?
Diameters of top rollers : Front..................Second..................Third..........
Diameters of bottom rollers : Front ....Second..................Third..........
Draft from front to second..................Second to third..................Total.
Shortest distance front to second......................To open to.. ....
Front line bottom rollers case-hardened ?
Necks and squares of second and third lines case-hardened ?
Or necks and squares only of all three lines case-hardened ?
Loose boss front top rollers ? Ordinary or self-lubricating ?
Front rollers dead-weighted ? Second and third lines self-weighted ?
Or all three lines weighted by saddles, levers, and weights ?
Angle or incline of roller stands ?
Total length of skewer ?
Length and diameter of roving bobbin ?
Rope driving and tightening pulleys for tin rollers ?
Speed of line shaft ? Height from floor ?
Diameter of drum on line shaft ?
Diameter of pulley on frame ?
Driven from above or below ?
Are guide pulleys to be supplied ? If by half-crossed strap give sketch.
Is hank indicator to be supplied ?
Are top rollers to be covered ?
Are clearers to be covered ?
Additional change wheels, &c., supplied free of charge :—
4 draft wheels, 2 twist wheels, and 6 top rollers per frame.
If more required, particulars of same to be given.

EXTRAS :—

Loose boss rollers ?
Lubricating arrangement for do. ?
Case-hardened rollers or necks and squares ?
Heth's patent separators ?
Full cop stop motion for weft frames ?
Detachable oil cup to spindle ?
Wood plugs or sleeves for paper tubes ?
Creel for double roving ?
Birkenhead type of creel ?
Rope driving and tightening pulleys ?
Hank indicators ?
Guide pulleys ?
Covering rollers and clearers ?
Above $5\frac{1}{2}$in. lift ?
Patent metal thread lappets ?



GENERAL VIEW OF WET DOUBLER.

Doubling Frames.

Doubling frames are usually made on the **ring** principle, but if desired we still make the **flyer doubler**.

The accompanying illustrations show elevations of the machine and gearing, with sections through the roller beam for the different systems of doubling, etc.

The machine has been carefully overhauled, and many improvements are embodied in it.

All parts are made on the interchangeable principle as in the ring spinning frame, and each part is provided with a letter or numeral so that in case of breakdown the necessary renewals can be ordered with the assurance that they will be sent according to order and fit in place correctly.

The gearing ends are designed to facilitate the necessary changes required for any kinds of doubling.

The wheels are all machine moulded, and the teeth are cleaned by machinery; cut wheels can be supplied if desired.

The pedestals for the driving shaft rest on broad ledges, and every convenience is provided for oiling. Long oil tubes are used, placed in convenient and conspicuous places for such holes as are not readily accessible.

Panels enclose the gearing and off-ends of the frames, and these form a guard against accidents.

Tin rollers.—We make frames with either **single** or **double tin rollers**, as desired. Double tin rollers are sometimes used for dry doubling, but single rollers are always preferred for wet doubling. We strongly advise single rollers in all cases, because with the spindles all being driven from one cylinder, there is not the same liability of slipping, and the result is that a more uniform twist is obtained. The rollers are made in short lengths of very strong material, coupled by stout cast-iron shafts.

The roller bearings.—The tin roller shafts run in "Mohler" self-adjusting and self-lubricating bearings, which are cast-iron on cast-iron.

Girder rails are of a deep and very strong section, with planed surfaces for carrying the spindles, etc.

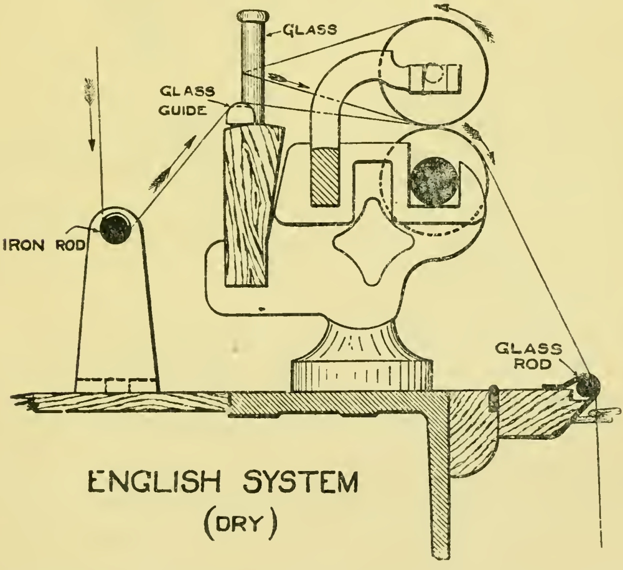
Ring rails are made of wrought-iron planed on the top and let into the poker top where they are also joined, so that they cannot be accidentally displaced; they are consequently very firm.

Splash boards are usually supplied with the wet doubling frames to prevent the water from getting on to the bands and tin rollers.

The lifting of the ring rail is operated by a lever arrangement, with adjustable balance weights. The chain and bowl system can be supplied if preferred.

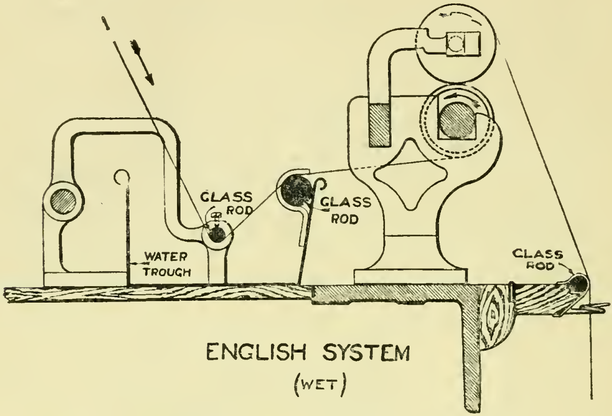
The rocking levers for lifting the pokers are made in halves, so that the ring rails can easily be set dead level.

Frames are made suitable for all classes of doubling. The principal systems are known as the English dry, English wet, and the Scotch system, this latter being also a wet system. A description of each system, with illustration, is given below.



ENGLISH SYSTEM
(DRY)

English system dry doubling.—In this system the yarn comes from bobbins, and passes under an iron rod, and over a glass slit guide through the rollers and round the top roller, afterwards encircling a small glass pillar, and again passing through the rollers, and on to the spindles. The bottom rollers are made of polished steel $1\frac{3}{4}$in. dia. for fine counts and 2in. dia. for coarse work, and the top rollers are of polished cast-iron 2in. dia., but for fine work $1\frac{3}{4}$in. dia. is more suitable.



ENGLISH SYSTEM (WET)

English system wet doubling.—In this system the yarn from the bobbins passes under a glass rod in water and on to the roller, and direct to the spindles. The water troughs are placed behind and independent of the rollers, and may be in short lengths of copper, wood, zinc, or porcelain. We can, however, make the metal and wood troughs in one continuous length, with taps at the ends for filling and running the water off.

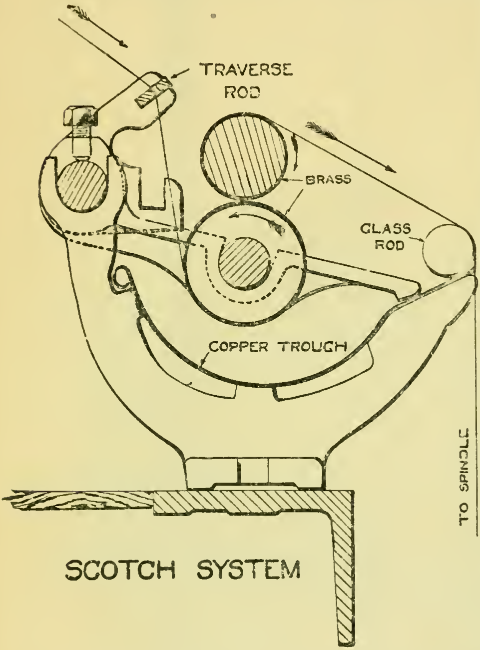
There is an arrangement at the end of the frame to lift the glass rod out of the trough for cleaning, etc.

The rollers are brass covered, $1\frac{3}{4}$in. or 2in. dia. according to the counts of yarn and number of ends up being doubled.

Scotch doubling.—In the Scotch system the water trough is continuous, and is carried on a beam with frequent supports. Inside the trough and in the water runs a $2\frac{1}{2}$in. hollow brass roller which can be raised out of the water by means of a handle and worm gear placed at the end of the frame. The top rollers are solid and brass covered, and $1\frac{3}{4}$in. in diameter. Copper troughs are usually made in long lengths and supplied with a tap or other means for drawing off the water for cleaning, etc. **A traverse motion** is also provided for these frames.

We recommend that the bottom rollers run inwards except for dry doubling and fine work; when we then arrange for them to run outwards, if not specified otherwise.

Thread boards can be made on the **single flap board** principle, one flap to each spindle for **dry work.** For **wet work** the flap board is usually hinged in half boxes, with glass rods and brass thread guides; or made in one continuous length fixed to the beam, and is slightly tilted to allow the bobbins to be lifted clear when doffing. In the **Scotch system** the yarn usually passes over a glass rod which is grooved for each spindle, and this groove acts as a guide, seeing that it comes directly over the centre of the spindle, **and therefore no thread boards are required.**

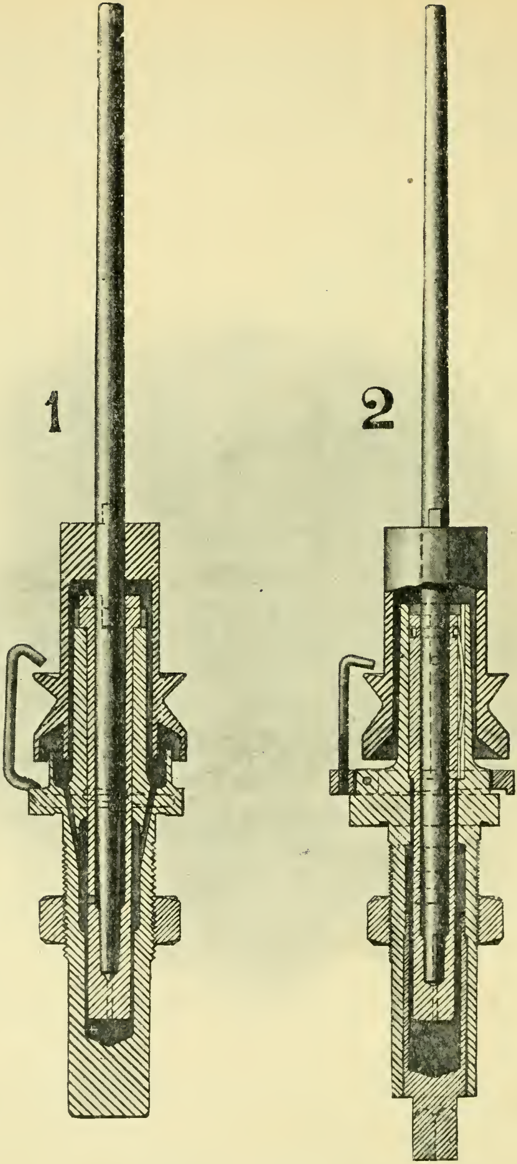


SCOTCH SYSTEM

Spindles.—Sections are shown of the "**Improved Phœnix**" and also of the "**Acme**" **doubling spindles.**

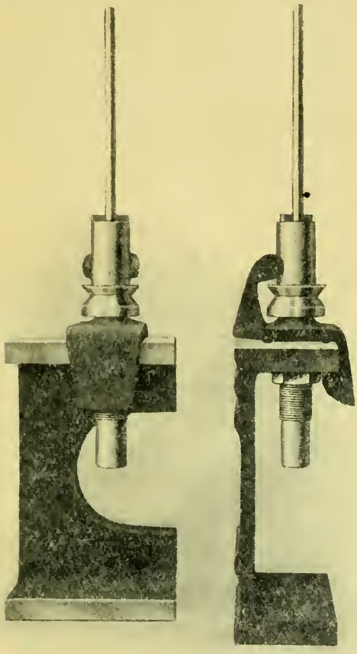
No. 1 shows in section our "**Acme**" spindle with oil chamber under the wharve. **No. 2** is the "**Improved Phœnix**" elastic spindle fitted with a multiple screw oil cup. This spindle can be made with or without oil cup if desired.

Both the spindles are strongly made. They can be supplied either with or without detachable oil cup, and they will run at any reasonable speed. Special care has been taken to make them suitable for all the varied requirements of the doubling trade.



DOUBLING SPINDLES.

Knee brake.—An exceedingly simple and convenient brake, which also acts as a holding down catch, can be supplied when required. When large heavy spindles are



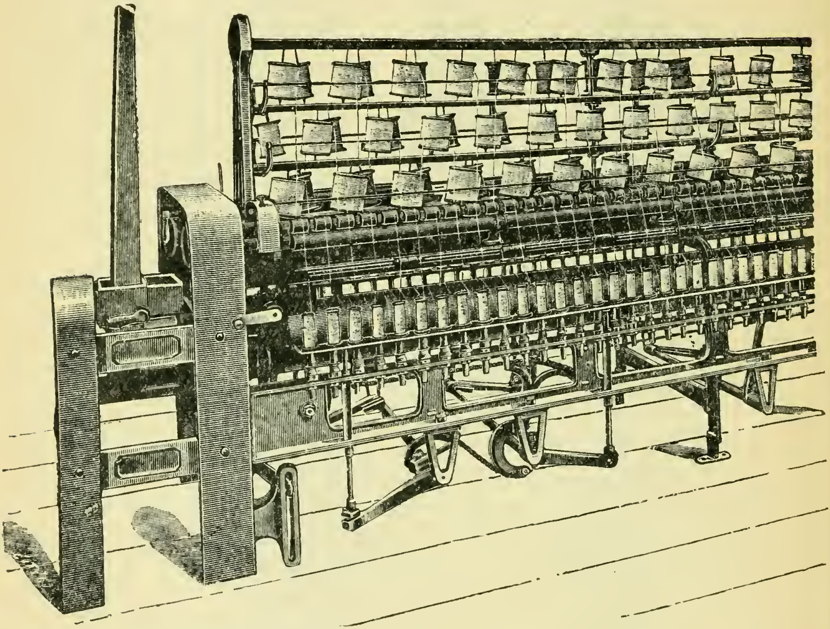
used it greatly assists the operative by keeping the spindles from revolving while piecing up. By simply tilting the casting (which rests loose on the spindle rail) the spindle can be removed, and when used as a brake it is worked by pressing the knee against the projecting part in front of the beam.

Building or copping motions.—Various kinds of lifts or copping motions are applied to doublers. With **flanged bobbins** the ring rail traverses continually from one end of the bobbin to the other. If the bobbin be made **without flanges** the ring rail commences by travelling the full length and gradually shortens so as to give taper ends By this means each layer of yarn is quickly covered up, does not get dirty, and is easily reeled or wound off. Finally the cop may be built exactly like the spinning frame bobbin by the application of a special builder motion.

For hard twisted or wet yarn double-flanged bobbins are used, and the straight lift motion is usually adopted; this prevents waste in the handling of the bobbins, and lends itself to a very easy system of doffing.

Creels are made to receive cops, ring frame bobbins, or bobbins with double flanges, or spools or cheeses made on the Winding Frame.

The creel we recommend for coarse or medium counts is the one known as the **porcupine creel.** This consists of wooden rails running lengthway of the frame, to which are secured steel skewers slightly tilted to carry flanged bobbins or Winding frame cheeses. When required, we can arrange the creel so that the yarn is drawn vertically from the mule or ring cop. For the finer yarns we can supply a 2-height **vertical creel**, so that the bobbins can be carried on revolving skewers. By this arrangement there is less strain on the yarn than if carried by the stationary skewers of the Porcupine creel.



Doubling Frame with 3-Height Vertical Creel.

For economical doubling of two or more ends into one, we strongly advise winding the yarn with the required number of ends together, and then twist them on the doubler. By this arrangement a more even and perfect twist is produced, and there is considerably less waste.

Creels for winding frame bobbins or cheeses, say 5in. dia. per spindle requires a 2-height creel, and for every additional bobbin per spindle 2-heights of creel extra will be required.

Guards.—We supply guards to all wheels and moving parts, and all dangerous parts are cased to meet the views of the Factory Inspector.

Length of machine.—To find the number of spindles that will stand in a given length, deduct the proper amount for the gearing as given below, and divide the remainder by the gauge, The result multiplied by two will be the number of spindles. The number of spindles must be divisible by two.

Gearing.	Scotch System with ordinary driving	...	2ft. $8\frac{1}{4}$in.
	,, rollers driven in the middle		3ft. $4\frac{1}{2}$in.
	,, driven at both ends	...	4ft. 11in.
	English System with ordinary driving	...	2ft. $5\frac{1}{4}$in.
	,, driven in the middle	...	3ft. 10in.
	,, driven at both ends	...	4ft. $7\frac{1}{2}$in.

Width of frames are 3ft. 0in. wide for double tin rollers, and 3ft. 6in. for single tin roller frames.

Counts, Gauge and Diameter of Rings, etc.

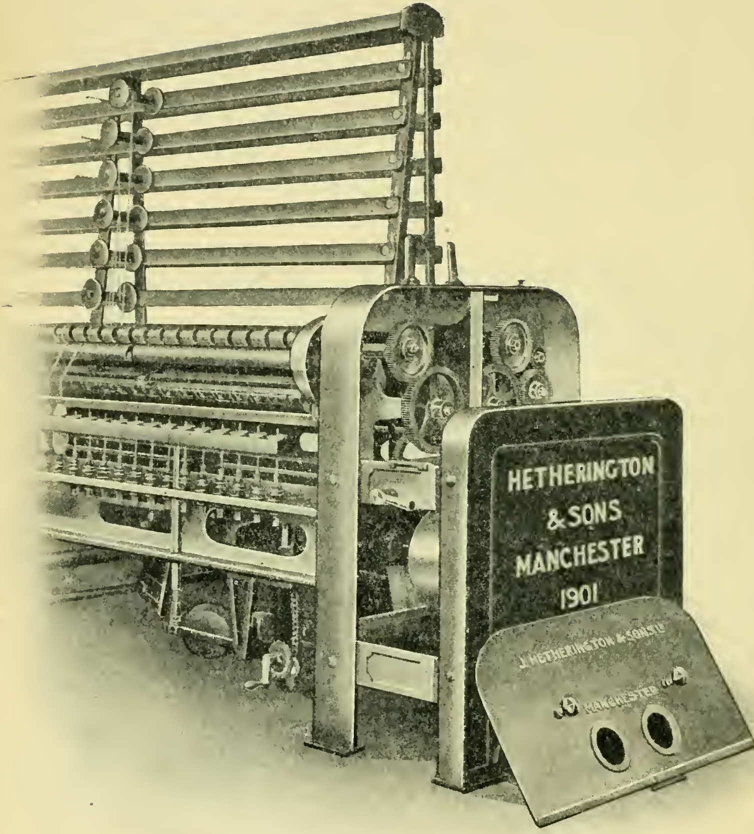
Gauge	$2\frac{1}{4}''$	$2\frac{1}{2}''$	$2\frac{3}{4}''$	3″	$3\frac{1}{4}''$	$3\frac{1}{2}''$	4″
Dia. of Ring	$1\frac{1}{2}''$	$1\frac{3}{4}''$	2″	$2\frac{1}{4}''$	$2\frac{1}{2}''$	$2\frac{3}{4}''$	3″
,, Spindle Wharve... ...	1″	1″	$1\frac{1}{8}''$	$1\frac{1}{8}''$	$1\frac{1}{8}''$	$1\frac{1}{8}''$	$1\frac{1}{4}''$
Counts When Doubled ...	30s to 60s	16s to 30s	10s to 20s	5s to 10s	3s to 6s	2s to 3s	

Lift ... ... 4in., $4\frac{1}{2}$in., 5in. or 6in.

Hand of machine.—To determine the hand of the machine (for doublers with double cylinders) stand facing the gearing and note if the pulleys must be on the right or left hand.

Strapping.—The main driving belt is usually $3\frac{1}{2}$in. wide, but for long or heavy frames we sometimes use a 4in. belt.

Driving pulleys.—These are usually 12in. dia., but we can supply up to 16in. if required. Width $3\frac{1}{2}$in. or 4in. wide according to the length, gauge and lift of frame.



DRY DOUBLING FRAME WITH PORCUPINE CREEL.

Height of driving shaft.—From the floor is 1ft. $4\frac{3}{4}$in. for double tin rollers, and 1ft. $10\frac{3}{4}$in. for sinlge tin rollers. The diameter of the shaft is $1\frac{1}{2}$in.

Below is a list of approximate speeds of spindles for the various finished counts produced on Doubling Frames:—

Revs. of Spindles	Counts when Double	Revs. of Spindles	Counts when Double
4,000	2s to 3s	6,000 to 7,000	10s to 20s
4,500	3s to 6s	7,000 to 7,500	16s to 30s
5,000	5s to 10s	7,500 to 8,000	30s to 60s

Power.—Spindles per I.H.P. on Counts when doubled:—

75 Spindles for Counts	60s	50 Spindles for Counts	10s
65 ,, ,,	40s	45 ,, ,,	5s
55 ,, ,,	20s	40 ,, ,,	2s

Weight of doublers.—Net weight of the gearing is 1,176lbs., to which must be added the remainder of the frame in lbs. per spindle as follows:—

Gauge $2\frac{1}{2}$in.	...	$20\frac{3}{4}$lbs.	Balance weights included.
,, $2\frac{3}{4}$in.	...	$22\frac{1}{4}$lbs.	
,, 3in.	...	$23\frac{3}{4}$lbs.	

To obtain the approximate gross weight add 33 per cent. to the total weight obtained from the above data.

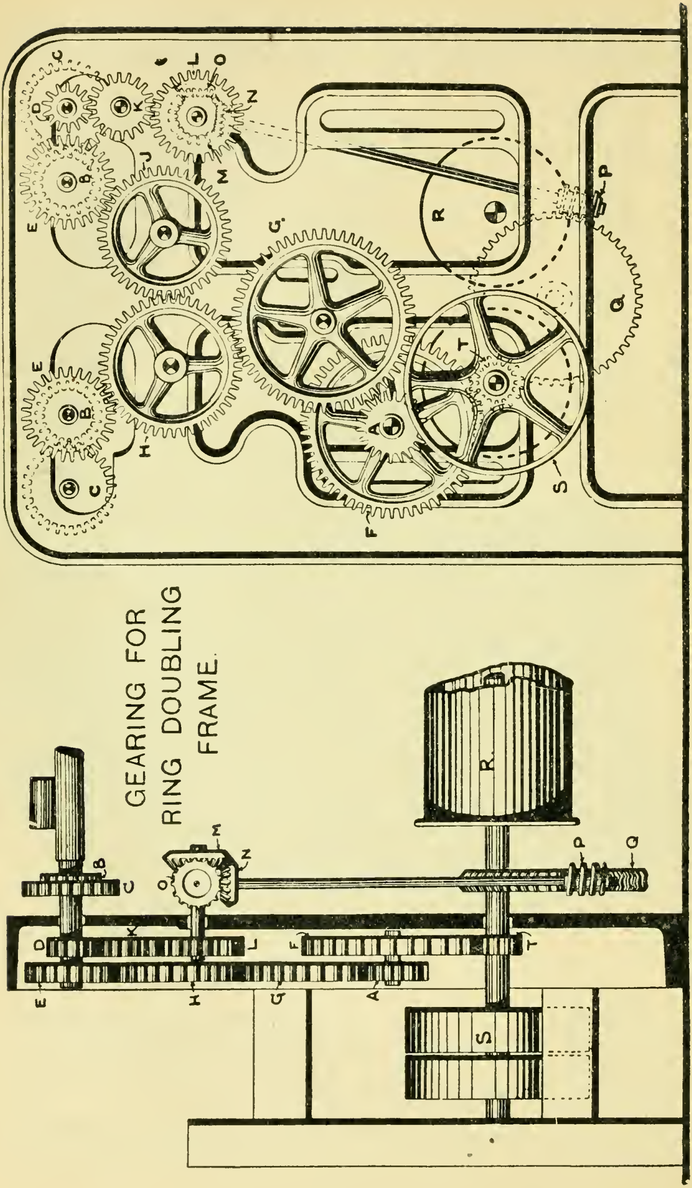
Reference to Gearing.

A Bottom change wheel 20 to 50 teeth
B Top ,, ,, 20 to 50 ,,
C Roller wheel ... ... 50 ,,
D Wheel on end of F.R. driving lifter motion ... 20 ,,
E Large wheel on top change stud ... ... 50 ,,
F Large wheel on bottom change stud ... ... 90 ,,
G Carrier wheel to rollers .. ,,
H ,, ,, ... 70 ,,
J Carrier wheel to rollers, 70 teeth
K L M N Lifter motion wheels driven from D.
O Bevel for hand winding of lifter
P Worm on lifter motion
Q ,, wheel of ,,
R Tin roller
S Driving Pulleys
T Single tin roller wheel, 20 teeth
U Diameter of bottom rollers
V ,, spindle wharve

Calculations.

Spindle speed.—In calculating the speed of spindles, add the thickness of the spindle band to the diameters of the tin roller and spindle wharves, the result will be very approximately the actual speed.

$$\text{Speed of Spindles} = \frac{\text{speed of line shaft} \times \text{drum} \times \text{dia. of tin roller plus band}}{\text{pulley on the frame} \times \text{dia. of wharve plus band}}$$



GEARING FOR RING DOUBLING FRAME.

Constant for Twist for Ring Doubler.

(Scotch System).

$$\frac{\overset{\text{Bottom roller wheel}}{50}}{\underset{\substack{\text{Twist wheel}\\\text{(Top change)}}}{20}} \times \frac{\overset{\text{Compound wheel}}{50}}{\underset{\substack{\text{Twist wheel}\\\text{(Bottom change)}}}{x}} \times \frac{\overset{\text{Twist carrier wheel}}{90}}{\underset{\text{Driving wheel}}{20}} \times \frac{\overset{\substack{\text{Dia. of tin roller}\\\text{in }\frac{1}{8}\text{th + band}}}{81}}{\underset{\substack{\text{Dia of spl. wharve}\\\text{in }\frac{1}{8}\text{th + band}}}{10}} \times \frac{1}{\underset{\substack{\text{Cir. of } 2\frac{1}{2}\text{in.}\\\text{delivery roller}}}{3{\cdot}1416 \times 2\frac{1}{2}\text{in.}}} = \mathbf{580}$$

In all our make of ring doublers we have two change places, by means of which we can get any twist required. The above constant is taken with 20s twist wheel on top change. 10in. tin roller + $1\frac{1}{8}$ spindle wharve.

Constant with 50s twist wheel on top change, with all conditions the same = 232.

Constant divided by turns per inch = twist wheel.

The two change places for the twist mentioned above are one on the wheel gearing with the tin roller wheel and the other one gearing with the wheel on the delivery roller.

Calling the first X and the second Y—

$$\text{Turns per inch} = \frac{\text{Constant}}{\text{X multiplied by Y}}$$

$$\text{X} = \frac{\text{Constant}}{\text{Y multiplied by the required turns per inch}}$$

$$\text{Y} = \frac{\text{Constant}}{\text{X multiplied by the required turns per inch}}$$

Or, in words, assuming any suitable value for one wheel and multiplying it by the required turns per inch, the constant divided by the product thus obtained will give the other wheel.

The result will be more exact if 5 to 10 per cent. be added to the required turns to allow for slip as the constants below are based on the calculated speed of the spindle.

Constants for different diameters of Spindle Wharves and Bottom Rollers.

Diameter of Spindle Wharve	Diameter of Roller				
	$1\frac{1}{2}$in.	$1\frac{3}{4}$in.	2in.	$2\frac{1}{4}$in.	$2\frac{1}{2}$in.
In.					
$\frac{7}{8}$	24150	20700	18100	16150	14500
1	21500	18400	16100	14320	12670
$1\frac{1}{8}$	19350	16600	14520	12900	11600
$1\frac{1}{4}$	17600	15100	13200	11720	10550

$$\text{Production } \frac{\text{Speed of Spindles}}{\sqrt{\text{of counts when doubled}} \times \text{twist constant}} = \text{Inches delivered per minute}$$

$$\frac{\text{Inches delivered per minute} \times 60 \text{ min.} \times \text{actual working hours of frame}}{36\text{in.} \times 840 \text{ yards}} = \text{hanks per week}$$

Constant numbers of twist.—This varies according to the class of work being produced. It would be impossible to give a definite list of constants. We give below a list that could be taken as a guide:—

2 and 3 fold Sewing yarns	$\sqrt{\text{counts}}$	× 8
6, 9 fold Sewing yarns, preparing ...	,,	× 4·5
6, 9 ,, ,, finishing ...	,,	× 8
Hosiery (very soft)	,,	× 4
Ordinary Knitting cotton	,,	× 7
,, Bradford	,,	× $6\frac{1}{2}$
,, Coarse yarn	,,	× $6\frac{1}{2}$
Nottingham Lace yarn	,,	× 5
Crochet preparing	,,	× 7
,, finishing	,,	× 5·6

Travellers for Wet Doubling.—Counts when doubled.

1·75s ...	No. 9s traveller	15s ...	No. 17s traveller
3·5s ..	,, 10s ,,	20s-25s	,, 18s ,,
5s ...	,, 11s ,,	30s ...	,, 19s ,,
5·5s ...	,, 12s ,,	40s ...	,, 20s ,,
6s ...	,, 13s ,,	50s ...	,, 22s ,,
7s ...	,, 14s ,,	60s ...	,, 23s ,,
8s ...	,, 15s ,,	70s ...	,, 24s ,,
10s ...	,, 16s ,,	80s ...	,, 25s ,,

For Dry Doubling.—Counts when doubled.

8s ...	No. 12s traveller	15s ...	No. 8s traveller
10s ...	,, 10s ,,	20s ...	,, 6s ,,

There is no fixed rule for travellers required for any given Counts, as they vary according to the speed of spindles, diameter of ring used, twist, put in number of ends up, and the class of yarn being doubled. Therefore the list given herewith must only be taken as a guide for arriving at the number of the traveller required.

RING DOUBLERS QUERIES.

To be answered when ordering Machines.

How many Frames?
For Dry or Wet Doubling?
Scotch or English System?
Facing gearing end, must pulley be on right or left; show direction of rotation.
Driven from above or below?
Driven over gallows pulleys or by half-twisted strap?
If half-twisted strap, give height cf line shaft from floor and direction of rotation.
Diameter of pulley on frame?
Diameter of pulley on line shaft? Speed of line shaft?
Length of frame overall?
Width of frame? Standard 3ft. 6in. with single and 3ft. with double tin rollers.
Number of spindles?
Gauge?
Length of lift?
Inside diameter of rings? If spinning or doubling pattern?
Bobbins with or without heads? If tapering or copping motion?
Diameter of Bobbin heads? Diameter of hole in bobbin?
Improved "Phœnix" or "Acme" spindles?
Diameter of spindle wharve?
With or without detachable oil cup?
Knee brake to each spindle or not?
Speed of spindles? To run twist or weft way?
Diameter of tin roller?
Single or double tin roller?
Rollers to run outwards or inwards?
Diameter of bottom roller? Solid or hollow?
Diameter of top roller? Solid or hollow?
Must rollers be brass covered or not?
Revs. of spindle for one of front roller?
Turns per inch?
Counts to be doubled, single yarn? double yarn?
Number of ends into one?
From winding frame spools with..................ends on one spool.
From cops or bobbins?
Extreme length and diameter of full creel bobbins?
If from bobbins, must creel be upright or porcupine or for horizontal skewers? How many heights?
Sketch of creel to be given unless left to us?
Thread boards, single flap or half boxes?
Thread boards with glass rod and brass guide?
Thread boards slightly tilted and fixed to beam?
Troughs to be of zinc or copper, in long or short lengths?
Rope driving and tightening motions for tin rollers?
Hank Indicators? Specify change wheels required.

EXTRAS:—

Detachable oil cup to spindles?
Knee brake to each spindle?
Above 5in. lift?
Creels for more than two ends into one?
Builder motion for cops?
Rope driving and tightening motion for connecting tin rollers
Indicators?

Flyer Doublers.

These machines are mostly used for doubling very coarse yarns; such as heald, netting, etc.

They are usually made on the English system with the water troughs behind the rollers, but can be made on the dry system if desired.

The **gearing ends, pedestals,** and the **tin roller bearings** are similar in design and construction to those used on the ring doubler or spinning frames.

The rollers for dry work are usually 2in. dia., the bottom roller is made of polished steel and the tops of polished cast-iron. For Wet doubling these rollers are brass covered.

Troughs are made of copper in one length with a tap at one end for drawing off the water for cleaning, etc. We also supply an arrangement at the end of the frame for raising the glass rods out of the trough.

Creels are made suitable for 2-headed bobbins, similar in design to those of the ring doubler.

Single tin rollers are mostly employed on these frames, and arranged for either band or tape drive for the spindles. Double tin rollers can be supplied if desired. They are made in short lengths of strong material, coupled by stout cast-iron shafts, running in self-adjusting and self-lubricating bearings of the "Mohler" type.

Spindles.—The ordinary **flyer** or the **self-contained** spindles are used on these frames, and can be either driven by bands or tapes as desired. The spindles, when doubling fine counts and of a small lift, the self-contained are often adopted on account of the higher speed obtainable, steady running, and reduced power required.

The ordinary flyer spindles are fitted with footsteps, made on self-lubricating principle with loose covers to facilitate oiling, and for keeping out dirt, fluff, etc.

Rails.—The travelling rails are of a good section and fitted with brass bolsters.

Drag.—Suitable arrangements are employed for getting any amount of drag that may be required.

Threadboards are made of polished hard wood fitted with brass guides and the usual glass rod.

Building motion.—The usual motion employed on the heavy doublers is the chain and bowl lifting motion, with heart and levers for giving motion to the rails. By this arrangement each spindle rail assists in balancing the rail on the opposite side.

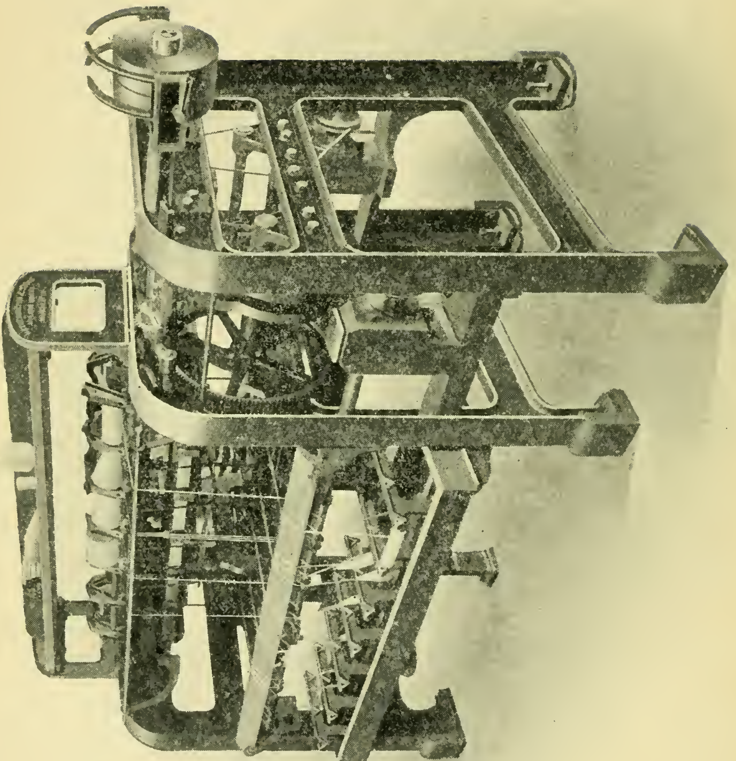
The bobbins usually employed on those frames are the straight 2-headed kind.

Driving pulleys are usually 12in. to 16in. dia. × 3½in. to 4in wide, according to length of frame.

Power varies considerably according to the kind of spindle used, lift, the actual finished counts, and the amount of twist put in. Approximate power is:—

3½in.	gauge	frame,	3,500	revs.	of spl.,	50 to 55	spls.	for I.H.P.
4in.	,,	,,	3,200	,,	,,	42 to 46	,,	,,
4½in.	,,	,,	2,800	,,	,,	38 to 41	,,	,,
5in.	,,	,,	2,250	,,	,,	33 to 36	,,	,,
6in.	,,	,,	1,750	,,	,,	26 to 30	,,	,,

Gearing occupies 2ft. 6½in. and width of the machine is 3ft. 6in. if single tin rollers, and 3ft. 0in. for double tin rollers.



WINDING FRAME

Winding Frames.

Knowles' winding frames.—We are the sole makers of this quick traverse winding frame, for winding either **single** or up to **6 ends**, upon paper or wood tubes of small diameter without heads; **parallel** or **conical** bobbins can be made on the same machine without any alteration.

The traverse motion is actuated by a cam at one end of the machine, and a motion can be supplied that will give any length of traverse from $1\frac{3}{4}$in to 5in. The usual length of traverse is 5in.

We supply when desired a **shortening motion** for making bobbins with tapered ends.

The bobbins are driven by friction by means of an iron roller $1\frac{1}{2}$in. dia., usually running at 700 revolutions per minute, placed on each side of the frame; for **single winding** this drives the bobbin.

Stop motions.—Where several ends are to be wound upon one bobbin there is a self-acting stop motion to each end. On the $1\frac{1}{2}$in. roller an intermediate roller of cast-iron is introduced, usually covered with leather, and when one end breaks this intermediate roller is at once lifted out of contact, and by pressing the bobbin against a brake instantly stops the winding, and at the same time lifts the remaining threads out of the guide on the traverse, thus preventing waste.

Creels are made to order suitable for the required class of winding and the requirements of the trade. They are made for either Mule Cops, Ring Frame Bobbins, Double-headed Bobbins, or spools from Winding Frames to wind off lengthways, or when flanged bobbins are to be used we supply an adjustable rail to receive revolving spindles. For **hank winding** we supply brackets for supporting the swifts on which the hanks are placed. When winding from cops we can, if desired, supply a clearing arrangement.

Pressure roller.—These frames are usually supplied with an automatic pressure roller. This roller is the heaviest at the beginning of the bobbin, and gradually decreases in weight as the diameter of the bobbin increases. By this device a much firmer bobbin, with perfect ends, is produced.

The drag board runs the whole length of the frame, covered with cloth, and is so arranged that it can be put in a suitable position to give the required amount of drag or tension for the class of yarn being wound.

Space.—Width of frame 4ft. Space occupied by gearing 4ft. (but if driven over gallows pulleys 3ft. 8in.), with shortening motion for 5in. traverse. Distance from centre to centre of drum is 7in.

Length overall (with or without stop motions):—

No. of Drums	2½in. Traverse ft.	in.	5in. Traverse ft.	in.
40—20 each side	10	0	15	8
50—25 ,,	11	8	18	7
60—30 ,,	13	4	21	6
70—35 ,,	15	0	24	5
80—40 ,,	16	8	27	4
95—45 each side	18	4	30	3
100—50 ,,	20	0	33	2
110—55 ,,	21	8	36	1
120—60 ,,	23	4	39	0

Power.—120 drums to I.H.P. **Pulleys.**—Usually 8in dia. × 2in. wide. **Speeds.**—700 revs. per min.

Weights and Measurements.

(Approximate).

	Gross	Net	Cubic ft.
60 drums 2in. traverse	40 cwt.	32 cwt.	126
100 ,, 2in. ,, ...	56 ,,	45 ,,	165
70 ,, 5in. ,, ...	53 ,,	44 ,,	165
70 ,, 5in. ,, (stop motion)	57 ,,	45 ,,	179
100 ,, 5in. ,, ...	72 ,,	60 ,,	191

KNOWLES' PATENT WINDING FRAME SPECIFICATION.

How many Frames? How many Drums in each Frame?

Diameter of Driving Pulleys? (Usually 8in.)

Speed of Driving Pulleys? (Usually 700 revs. per minute).

How many ends to wind into one? (Usually three).

Extra if with four ends, five ends, or six ends into one.

We apply a Self-acting Stop Motion to each end when more than one is wound.

If to have shortening motion? Length of traverse?

Creel to wind from cops or *bobbins*

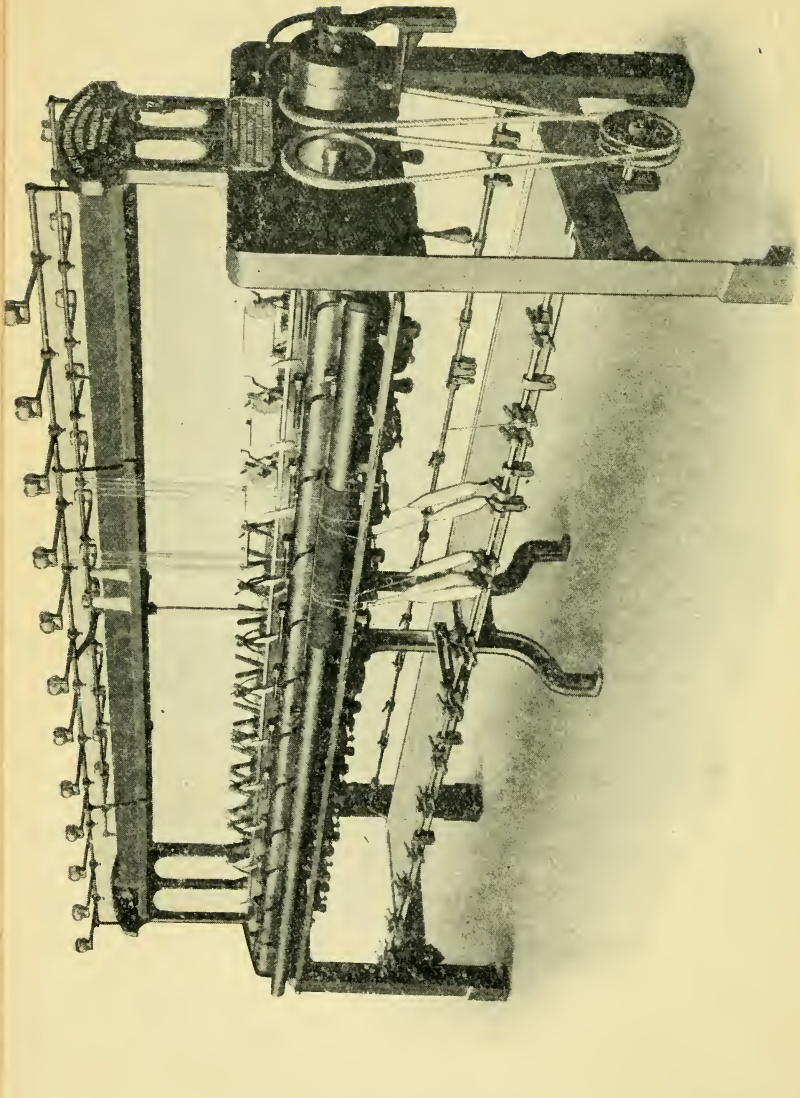
Description of bobbins? On Spindle or Skewer?

We make these Frames to wind on paper tubes $\frac{3}{8}$in. or $\frac{3}{4}$in. diameter, or on plain wooden tubes $1\frac{1}{4}$in. diameter, which will you have?

Stop Motion with plain rod or knuckle joint?

When must the Frame be delivered?

Please state whether the Machine will stand at right angles to the Driving Shaft, or parallel to it?



CAMLESS QUICK-TRAVERSE WINDING FRAME.

The Camless Quick-traverse Cross Winding Frame.

This machine is the only Cross Winding frame made **without cam**, eccentric, split drum, or other cam substitute. There is no reciprocating thread, guide or rail employed.

Cotton, wool, worsted, mohair, jute, silk, or any other material, can be wound, and the enormous production in single winding either on cones and cheeses will recommend it strongly to the **hosiery yarn industry.**

The adjustment from cones to parallel cheeses, or vice-versa, is simply and quickly made.

Solid, firmly wound spools for doubling purposes, transport, etc., are produced, but if intended for **dyeing in the spool,** they can be wound as soft as desired, and particularly so at the extremities (which is not possible in machines actuated by cams) in order to permit the easy access of the dyeing liquor to all parts of the spool.

Traverse motion.—The movement of every part of the traverse motion is **continuously circular, smooth and silent,** and there is no **strain or friction** beyond the drag required on the yarn.

An illustration of the traverse motion is given, from which may be seen that it consists essentially of two projecting fingers suitably shaped, revolving in one direction and driving two similarly shaped fingers in the opposite direction, by means of small pinions in the centre of each pair. The yarn is carried by one finger along a stationary guide rail and brought back again by a finger revolving in the opposite direction. The second finger of each pair merely repeats the action of the first one, so that the four traverses of the yarn are obtained by one revolution of the fingers, which admits of the latter being run at a comparatively low speed, thus making wear and tear in the perfectly balanced traverse motion practically non-existent.

The driving pairs of fingers are driven by means of bevels from a shaft running the whole length of the machine, through clutches which are disengaged when the spool stops, so that the fingers stop at the same time. They are restarted simultaneously with the spools, by means of a slight pressure on the handle of the stop lever.

The absence of vibration or strain on any portion of this machine means a life far in excess of that attainable in any machine in which cams or reciprocating motions are employed.

Stop motion.—The improved instantaneous stop motion ensures the stopping of the spool well before the broken end runs on, provided the break occurs, as it generally does, somewhere in the neighbourhood of the detector wire. The ends are laid in the form of a perfect ribbon without twisting or overlapping.

Creels are made to order suitable for the required class of winding and requirements of the trade. They are made for either Mule Cops, Ring Frame Bobbins, Double-headed Bobbins, or spools from Winding Frames to wind off lengthways, or when flanged bobbins are to be used we supply a rail to receive revolving spindles. For **hank winding** we supply brackets for supporting the swifts on which the hanks are placed. When winding from cops we can, if desired, supply a clearing arrangement.

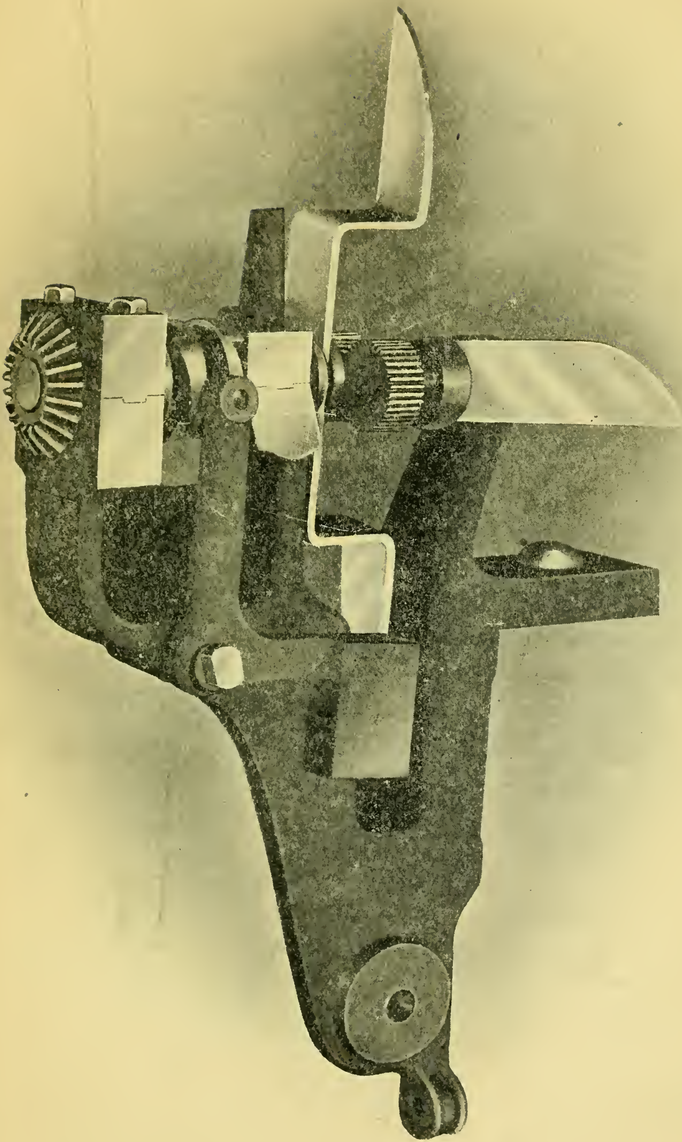
The drag board runs the whole length of the frame, covered with cloth, and is so arranged that it can be put in a suitable position to give the required amount of drag or tension for the class of yarn being wound.

Pulleys.—Usually 8in. dia. × 2in. wide. **Speed.**—1,000 revs. per min.

Power—120 drums to I.H.P. **Space.**—Width of frame 3ft. 6in. Space occupied by gearing 1ft. 6¾in. Centre to centre of drums 10½in.

Production.—For **multiple winding**, with instantaneous stop motion to each end, 10,000 to 12,000 inches per minute (1,000 to 1,200 hanks per week, allowing ample time for cleaning, etc.), can be easily wound.

For **single winding** a production of 12,000 to 15,000 inches or even more, per minute (1,200 to 1,500 hanks per week) can be achieved without difficulty.



QUERY SHEET.
PATENT CAMLESS CROSS WINDER.

How many machines?

Number of drums per machine?

or Extreme length?

Parallel bobbins?

or Conical bobbins? Cone spindles extra

Traverse?

Diameter of full bobbin?

To wind on paper or wood tubes? Special spindles extra

To wind cotton, wool, worsted, mohair, or what?

Counts in creel? Scale?

To be arranged for doubling winding?

How many ends? 5 or 6 ends per spool extra

Automatic stop motion to each end?

Automatic stop motion for full bobbins?

Creel for cops, ring bobbins, or what? from hanks extra

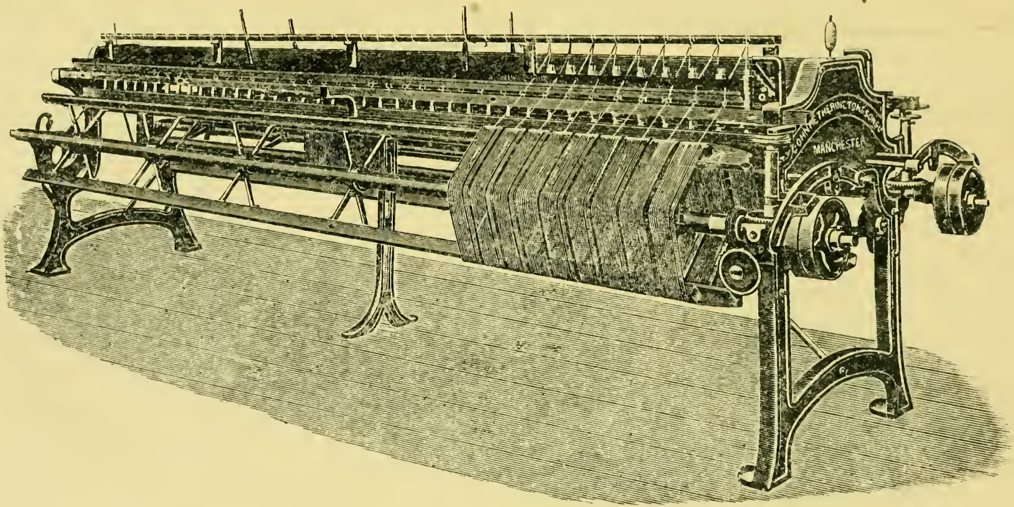
Special requirements regarding the creel?

Special requirements regarding drag on yarn?

Observations:—

Where special paper or wooden tubes are to be used, or special cop-skewers, samples must be sent, so that we can supply suitable spindles and skewer-brackets (we do not supply skewers).

Date Signature



IMPROVED BOBBIN FRAME.

Cop and Bobbin Reels.

We have patterns for the **single cop reels** for hand or power and the **double bobbin reel** for power only. These machines are very simple, well made, and very light running, and are arranged for reeling plain or cross hanks from ring spinning, ring doubler, or flyer doubler bobbins, or from mule cops on either the **English** or **French** system of reeling.

Bobbin reels are usually made double 40 hank, $3\frac{1}{2}$in. gauge, and fitted with 7-lea, **crossing** and **patent "bridge" doffing motion.** Double 30 hank reels can be supplied if desired.

Cop reels are made single, that is, with one swift only, and fitted with 7-lea or measuring motion, which automatically stops the machine on the completion of the hank or given length delivered.

The swifts are built up of tin rollers and wood swivels for the cop reels or machines for very light work, and for the heavier work steel tubes are substituted for the tin rollers, and the swivels are made of iron in place of wood.

A swift brake is applied to the single cop reel; it consists of a leather brake carried on the strap fork rod, which comes in contact with the fast pulley as the driving strap moves on to the loose pulley, thus automatically stopping the machine in half a revolution when running at the highest speed. A brake can be applied to the double reel if specially ordered.

Drop motions.—For the purpose of doffing on the cop or light reels we arrange that the swift can be closed up, but for reels working the heavier or hard twisted yarns we supply a drop motion to two of the swivels. This consists of a hinge with special locking or fastening arrangement, which when unlocked allows the swivel to drop and thus release the hank, which can then be easily removed.

Doffing.—We usually supply the **bridge** motion, the simplest yet invented. There is nothing to get out of order, and it is impossible for the hanks to get soiled when doffing. The end of swift shaft is enclosed in a lubricating loose bush; this bush when the swift is running rests on a ledge cast on the frame end; on the other arm is placed a bracket so shaped to overlap this ledge. When the swift is dropped it is pushed on to the bracket (clearly shown in Fig. 1). The hanks are then pulled off and placed in the recess between the two arms, the swift is then put back into its working position, and the hanks can be lifted out.

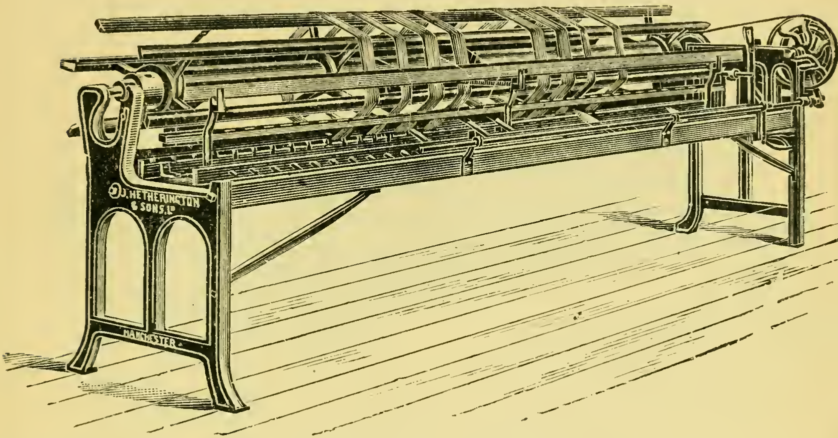


Fig. 1.—SINGLE COP REEL.

We can supply the **gate** or the **wheel** doffing motion if desired.

Traverse motion.—By a simple arrangement this machine can be changed from **7-lea** to **cross reeling** or vice-versa.

The **7-lea** motion is worked from the swift by means of a worm and wheel giving motion to a cross shaft on which is a projection working into a step-down rack.

Cross winding motion is also worked from the swift shaft by a pair of bevel wheels giving motion to a shaft; on the end of this shaft is placed a disc to which is secured an adjustable bracket and stud connected up to the traverse rail, clearly seen in Fig. 2.

Creels for the single cop reel consist of a wood rail placed in front of the swift, and arranged to take either skewers for mule cops or split plugs for ring frame bobbins. For the double reel the creels are provided for split plugs for cop-built bobbins, or for revolving steel spindles for double-flanged bobbins. The spindles are carried in cast-iron rails with a suitable drag motion provided to prevent the bobbins over-running the swift.

We supply also a self-acting **knocking-off motion** which automatically stops the machine on the completion of the hank. A **skeining motion** can also be supplied when desired.

The back of the machine is supplied with pegs, sockets, back laps, etc., to enable any classes of cops, pirns, or bobbins to be reeled, and the machine is in every way made adaptable for a wide range of work.

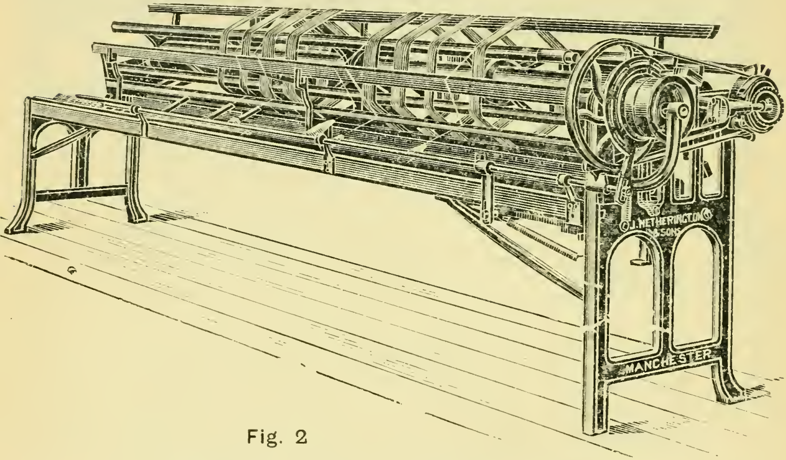


Fig. 2

Dimensions and Weights of Reels.

	Length		Width		Gross			Net	Cubic Feet
	Ft.	in.	Ft.	in.	Cwts.	qrs.	lbs.	Cwts.	
Double 40 Hank Reel ...	13	4	4	0	9	1	12	6	95
Single 40 Hank Reel ...	12	9	3	2	8	1	8	5	78

Speed.—Double bobbin reel ... ... 150 revs.
Single cop reel ... ... 90 ,,

Pulleys.—Double reel ... ... 8in. × $1\frac{1}{2}$in.
Single reel ... ... 6in. × $1\frac{1}{2}$in.

Power.—10 double bobbin reels ... ... = 1 H.P.
20 single cop reels ... ... = 1 H.P.

COP AND BOTTOM REEL SPECIFICATION.

No. of Machines? Single or Double? No. of Hanks?

Gauge? in. Circumference of Swift?

Swifts to be of Steel or Tin? Wood or Iron Swivels?

Crossing Motion? Seven-Lea Motion?

Kind of Doffing Motion required? Drop Motion?

Skeining Motion? Reel to be fitted with Brushes?

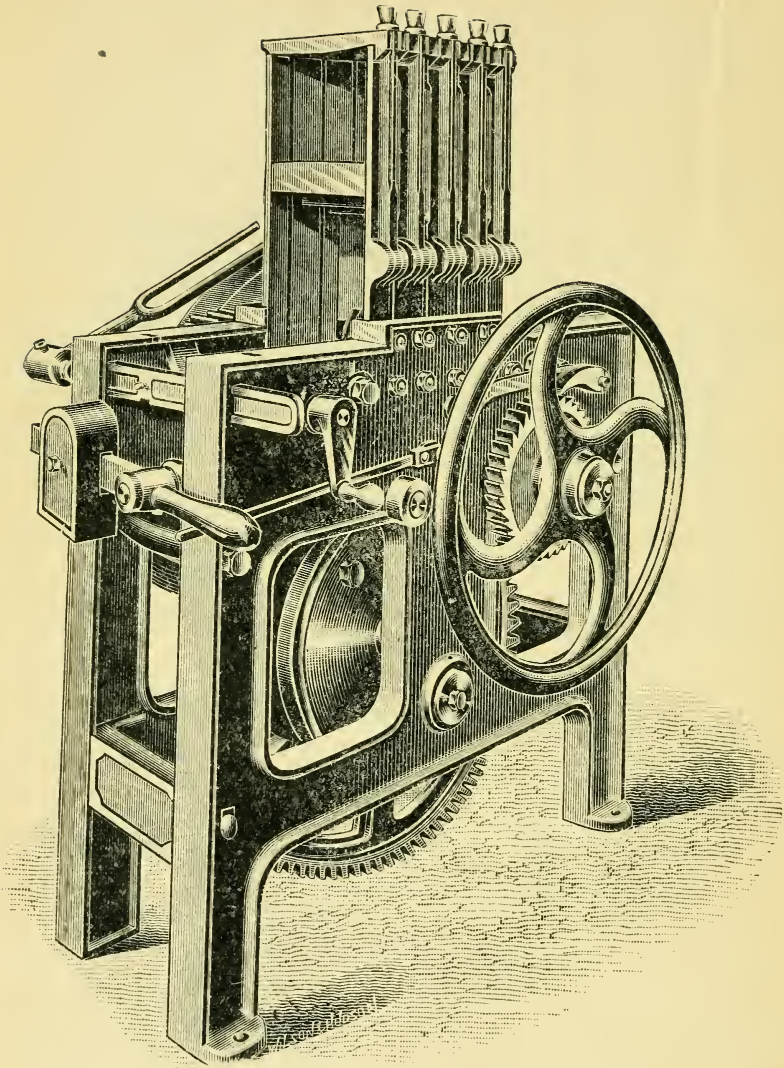
Diameter of Driving Pulleys? in.

Speed of Driving Pulley? revs.

Kind of Creel? Split Plugs, Skewers, or Spindles?

EXTRAS:—

Cross Motion, Drop Motion, Skeining Motion, Brushes, Automatic Brake for Swifts.



IMPROVED BUNDLING PRESS.

Yarn Bundling Press.

These machines are made exceptionally strong, with all facings for stretches and yarn box machined.

The yarn box is 12in. long and 8½in. wide for 10lb. bundles, and usually made for four or five strings. The box, however, can be made any special size and for any number of strings. Loose wood linings and block are supplied when required to make 5lb. bundles. Special attention has been given to the **top bars** and **locking levers** to ensure perfect-fitting hinges and joints.

Knocking-off motion.—A self-acting and adjustable knocking-off motion is applied, which brings a **brake** into action directly the machine is stopped.

Lifting motion.—The pressure on the yarn is got by two eccentrics placed on either side of the lifting wheel; an arm from each of these is connected to the underside of the box, thus giving a very uniform pressure. The press can be worked by hand by removing the hand wheel (seen in the illustration) and putting thereon a specially-formed hand wheel.

Diameter of pulleys	24in. × 3in.
Speed	60 revs. per min.
Power	½ to ¾ H.P.

Weights and Dimensions.

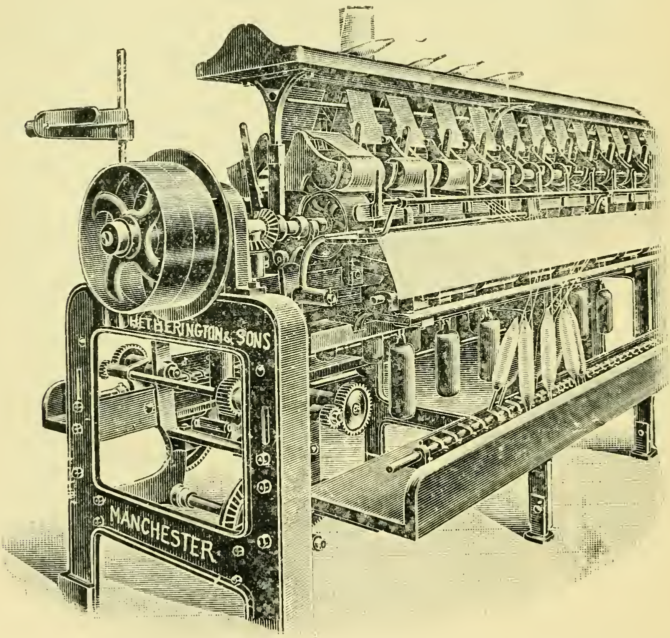
Floor space required	3ft. 0. × 2ft. 0in.
Gross weight	13 cwts. 0 qrs. 12 lbs.
Net weight	10 ,, 3 ,, 19 ,,
Cubic measurement	... 45 cubic feet.

Production.—9,000lbs. to 10,000lbs. per week in 10lb. bundles, and 8,000lbs. to 9,000lbs. when working 5lb. bundles.

Winding and Twisting Machinery.

For Cotton, Silk, Hemp, Jute, Flax, Worsted, Woollen, China-Grass, Twines, &c.

We also make a **positive stop motion winding doubling machine.**—This machine is made to wind up to 20 threads on a bobbin, with postive stop motion to each, it has double drums, and there is no friction when thread stops—all levers are done away with. The simplest machine on the market to work.



The "B" machine is built very strong, making 8in. by 5in. bobbins for jute, hemp and twine.

Twine laying machine.—This is the only machine that will lay hemp, jute and flax twine to advantage, and it does the work perfectly at a very small cost. One girl can mind two machines, and of one lea laid twine in 56 hours she turns out 2,400 lbs. per week. This machine is a strong and heavy 8in. lift, or can be made 6in. lift for medium and light twines.

Cable thread and crochet cotton machine.—This machine puts in the right and left hand twist at one operation, thus saving a second machine in making cable threads or cords, and also saves the re-winding between the ordinary two-twistings. It is in use for six cord sewings, crochet cottons, fishing net twines, etc.

Up twisting machine.—This machine is used for Hemp, Jute, Cotton, Worsted, Woollen, Knittings, and all classes of Dry Twistings.

The advantages are:—

1st.—Half the space saved.

2nd.—A large bobbin is used, consequently a long length without a knot.

3rd.—A great speed is got with this large bobbin.

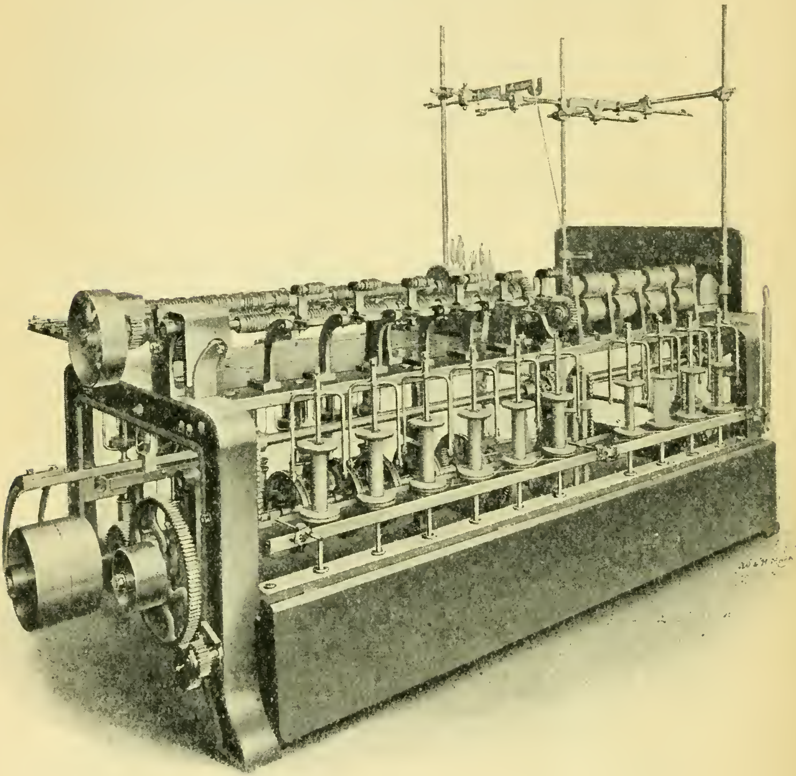
4th.—The warp winding is done by this machine in twisting, thus saving the warp winding machine.

5th.—The twist is more perfect and rounder.

6th—Production very great.

Spindle Banding Machines.

These machines are used for making spindle banding from spoiled cops, or perfect cops, by which a great saving is made, as the banding can be made for $\frac{3}{4}$d. per lb. from

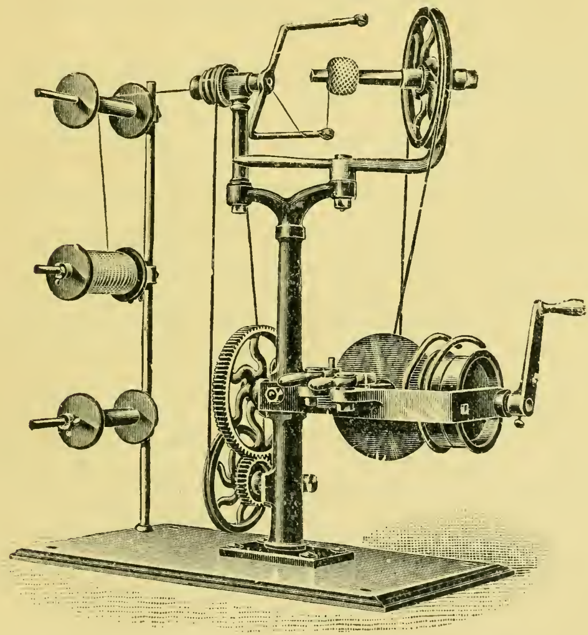


the cops, and it is well **stretched** in the process of making, both in the strands and the complete cord, consequently it does not get slack in working.

These machines are in work in almost every country in Europe and in America, and give great satisfaction.

Balling Machine.

Below we give a view of this machine. The bobbins from the spindle banding machine are placed in a creel or stand, and the banding passes through an eyelet and flyer on to a spindle. This spindle, having a horizontal radial movement, makes the balls any desired shape and size up



to 8in. dia. There is an arrangement to run the spindle at various speeds to suit the different shapes of balls being wound.

This machine can be worked by hand or power.

The machines are built upon a table as shown, and stands can be supplied to carry same if required.

MACHINES MOST ADAPTED FOR

SPINNING YARNS FROM WASTE OR SHORT STAPLE COTTONS.

HARD WASTE, COP BOTTOMS, etc.

For Fine Shoddy Yarns.

Hard waste breaking machine, made with any number of cylinders, for breaking up cop bottoms and other hard waste.

Automatic feeder arranged to feed on to the lattice of a **single scutcher**, fitted with fans for down-draft, Lord's pedal feed motion with cone regulator, and lap arrangement for making laps for 48in. cards.

Breaker carding engine, 48in. on the wire, with extended lattice feed table for two scutcher laps, with two 2in. feed rollers covered with inserted wire, one 2in. roller over same covered with leather fillet, 9in. taker-in with inserted wire, 50in. cylinder, seven rollers, six clearers, and one clearer over taker-in, one wood fancy with draft or bright roller under same, with 30in. doffer. Supplied with draw box and coiler delivery.

Derby doublers, with **V** table for 96 cans for 48in. cards, provided with stop motion and arranged to make laps from sliver of breaker card. Two or three of these laps are placed on the feed table of the finisher card.

Finishing carding engine, which is usually made 48in. on the wire, with extended lattice for two Derby doubler laps placed one behind the other, two feed rollers covered with inserted wire, one roller for leather fillet, 9in. taker-in covered with inserted wire, 50in. cylinder, seven rollers, six clearers, and one clearer over taker-in, one wood fancy with draft or bright roller under same, 24in. ring doffer fitted with single rubber wood divider, fly-comb condenser to take off from 18 to 36 ends on the one bobbin, according to the counts to be spun. Sometimes a tape condenser is used to take off from 36 to 80 ends.

The bobbins made on the condensers are afterwards put into the stands of the self-acting mule or ring frame.

Self-acting mules, for spinning all kinds of waste, made with rim shaft parallel to carriage or headstock, as desired, and the creels can be arranged for either condenser or roving bobbins.

Ring spinning frames arranged with surface drums to receive the condenser bobbins or creels to take cheeses direct from the carding engine or roving frame bobbins.

MACHINES FOR SOFT WASTE

OR

Bump Yarn Strippings, Roller Waste, Scutcher Droppings, etc.

Self-acting willow or cotton opening and cleaning machine, supplied with feeding and delivery lattice and intermittent motion feed rollers.

Waste shaker, for cleaning opener and scutcher droppings.

Single Crighton opener, with vertical beater, arranged for hand feeding and with delivery lattice. A small sized machine is sometimes used with a 30in. vertical beater, which produces about 35,000lbs. per week.

A self-acting willow may be used for very dirty cotton waste instead of a Crighton opener.

Automatic feeder, arranged to feed on the lattice of a **single scutcher**, fitted with fans for down draft, Lord's pedal feed motion with cone regulator, and lap arrangement for making laps for 48in cards.

Breaker carding engine, 48in. on the wire, with extended lattice feed table for two scutcher laps, two 2in. feed rollers covered with inserted wire, one 2in. roller over same covered with leather fillet, 9in. taker-in with inserted wire, 50in. cylinder, seven rollers, six clearers, and one clearer over taker-in, one wood fancy with draft or bright roller under same, with 30in doffer, fitted with side drawing for Scotch feed.

Finishing carding engine, which is usually made 48in. on the wire, with Scotch feed, two feed rollers covered with inserted wire, one roller for leather fillet, 9in. taker-in covered with inserted wire, 50in. cylinder, seven rollers, six clearers, and one clearer over taker-in, one wood fancy with ring draft or bright roller under same, 24in. ring doffer fitted with single rubber wood divider, fly-comb condenser to take off from 14 to 22 ends on to one bobbin, according to the counts to be spun.

The bobbins made on the condensers are afterwards put into the stands of the self-acting mule or ring frame.

Self-acting mules, for spinning all kinds of waste, made with rim shaft parallel to carriage or headstock, as desired, and the creels can be arranged for either condenser or roving bobbins.

Ring spinning frames, arranged with surface drums to receive the condenser bobbins or with creels to take cheeses direct from the carding engine or roving frame bobbins.

ALSO MAKERS OF ALL KINDS

OF

Woollen Machinery, Scribblers and Carders (Wood or Iron) with STEEL SHAFTS and CASE-HARDENED Necks. Blamire's and Scotch Feeds. Single Doffer, Double Doffer and Tape Condensers with Two, Four, or Six Tiers of Single or Tandem Rubbers. Grinding Frames, Patent Self-acting Mules for Woollen, Worsted, Silk, and Cotton Waste. Worsted Carding Engines. Burr Crushers.